Climate Information for Public Health

Curriculum for Best Practices

by

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Climate Information for Public Health: A Curriculum for Best Practices

Putting Principles to Work

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About the Public Health Initiative at the IRI

The International Research Institute for Climate and Society (IRI)/Earth Institute at Columbia University is the premier global research and capacity building institution focused on the use of climate information for improved risk management in public health. In 2004 the IRI was designated a Pan-American Health Organization - World Health Organization (PAHO-WHO) Collaborating Centre for climate-sensitive diseases and has active international partnerships for malaria, meningococcal meningitis, Rift Valley Fever and health conditions associated with flood, drought and disasters.

The mission of the IRI is to enhance society's capability to understand, anticipate and manage the impacts of climate in order to improve human welfare and the environment, especially in developing countries. The IRI conducts this mission through strategic and applied research, education, capacity building, and by providing forecasts and information products with an emphasis on practical and verifiable utility and partnership.

In particular, the public health commitment of the IRI aims to promote awareness and understanding the linkages between climate and public health, in addition to developing a set of prototypes to address and communicate these. This initiative involves developing, with partners, a knowledge system based on three main components: (i) Understanding the community of practice, identifying the research and information needs, and collaborating with Ministries of Health to work at the local to regional levels; (ii) Developing tools to monitor, survey and predict disease epidemics based on climate data, patterns and trends; and (iii) Building capacity through the education and training of public health professionals on the relationship between climate and public health in order to better manage climate risk.

The Summer Institute course on Climate Information for Public Health (SI) and its associated courses grew out of the recognition of major gaps in the knowledge, methodologies, tools, data and resources available to the public health community in their quest to better manage climate-related risks to improving public health outcomes. The gaps indentified include a deficit in educational and practitioner texts, tools, methodologies and data that can be used to build an appropriate evidence-based of the value of climate information to the public health sector. To meet this need, the SI team started building curricula and learning networks that participants can use, refine and deliver in their own communities. The Summer Institute on Climate Information for Public Health and its associated in-country courses have been run for three years. We learned a lot from the invaluable feedback provided by the courses' participants and facilitators, recognizing the need to develop a standardized community of practice in the use of climate information for public health. In response to these needs, we are pleased to present here the Climate Information for Public Health - A Curriculum for Best Practices.

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Acknowledgements

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Acronyms

ACMAD	African Centre of Meteorological Application for Development
AFRO-WHO	World Health Organization Regional Office for Africa
AMS	American Meteorological Society
CDC	Centers for Disease Control and Prevention
CHWG	Climate and Health Working Group
CIESIN	Center for International Earth Science Information Network
CIPH	Climate Information for Public Health
CIPHA	Climate Information for Public Health Action, newsletter
CIPHAN	Climate Information for Public Health Action Network
CPT	Climate Predictability Tool
CRED	Center for Research on Environmental Decision Making
CRM	Climate Risk Management
ENSO	El Niño-Southern Oscillation
EPA	U.S. Environmental Protection Agency
FAQ	Frequently Asked Question
FETP	Field Epidemiology Training Program
FELTP	Field Epidemiology and Laboratory Training Program
GIS	Geographic Information System
GPS	Geographic Position System
IFRC	International Federation of Red Cross and Red Crescent Societies
IGAD	Intergovernmental Authority on Development
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute for Climate and Society
IT	Information Technology
LSHTM	London School of Hygiene and Tropical Medicine
MDG	Millennium Development Goal
MERIT	Meningitis Environmental Risk Information Technologies
MEWS	Malaria Early Warning System
MSPH	Mailman School of Public Health
NCAR	The National Center for Atmospheric Research
NOAA	National Oceanic and Atmospheric Administration
NGO	Non Governmental Organization
NRDC	Natural Resources Defense Council
PAHO-WHO	Pan-American Health Organization - World Health Organization
PMI	President's Malaria Initiative
SI	Summer Institute on Climate Information for Public Health
UK	United Kingdom
USAID	United States Agency for International Development
WCC-3	World Climate Conference - 3
WHO	World Health Organization
WMO	World Meteorological Organization

The Development of a Curriculum on Climate Information for Public Health

History and Rationale

Public health professionals, field epidemiologists, health management workers and health policymakers are increasingly concerned about the potential impact that climate can have on public health. Climate not only determines the spatial and seasonal distribution of many public health events, such as infectious diseases, but also is a key determinant of inter-annual variability in disease incidence, including epidemics and medium-term trends.

However, many public health professionals are not yet aware of the ways in which climate information can help them manage the impacts of climate on their disease surveillance and control activities, as well as program implementation and evaluation. Similarly, climate scientists are not aware of how they can contribute to the information needs of the public health sector. Despite the challenges inherent to the multidisciplinary nature of the field of climate and public health, interdisciplinary work and dialogue is necessary to bridge this gap.

Public health is a broad effort organized by society to protect, promote and restore the people's health. It is the combination of sciences, skills and beliefs directed to the maintenance and improvement of health through collective or social actions. Many significant contributions to public health stem from activities outside the formal health sector (e.g., water resources management and food security). In this context, climate researchers should be considered a part of the public health community.

Protecting public health from the vagaries of climate will requires new working relationships between the public health sector and the providers of climate data and information. It will also demand a wide variety of strategies and must occur at multiple levels. One of these strategies is to increase the public health community's capacity to understand, use, and demand the appropriate climate information to mitigate the public health impacts of climate. However, good information is not enough. The public health community must also be able to distinguish between different kinds of data to determine what is relevant, at what time and space scale, to their population. Consider, for instance, the many ways that temperature affects human health. Rising average temperatures are predicted to increase the incidence and duration of heat waves, which are known to be a major hazard to particular segments of the population including those with heart problems, respiratory diseases such as asthma, the elderly, the very young, and the homeless. Rising temperatures may also increase the incidence of infectious diseases and contribute to air quality problems. Determining which of these issues are most pressing will require public health professionals to interpret various kinds of information and that is why it is so important to train them. It is also important the courses are tailored to the local context and resources, for developed and developing countries have different abilities to cope with stresses from the climate.

The climate community will also gain in partnering with the public health community on training courses and resulting joint projects, including the development of demand-driven climate products. The importance of such type of initiative was underlined during the World Climate Conference-3 (WCC-3) held in Geneva in September 2009, where the Global Framework for Climate Services was established to "enhance climate observations and monitoring, transform that information into sector-specific products and applications, and disseminate those products widely," said the President of the World Meteorological Organization (WMO), Alexander Bedritsky[2].

Unfortunately, at present there are very few courses on climate information and public health to attend, few academic texts, and – perhaps most importantly – few valued professional qualification in this interdisciplinary field.

In order to fill the gaps existing in climate and public health knowledge and practice, the International Research Institute for Climate and Society (IRI) has developed a Curriculum for Best Practices in Climate Information for Public Health (CIPH) that offers public health decision makers and their partners the opportunity to learn practical methods for integrating climate knowledge into decision-making processes through expert lectures, focused discussions and practical exercises. Relying on real demonstrations and applications, this Curriculum builds on the experience of the 2008, 2009 and 2010 Summer Institute courses on 'Climate Information for Public Health' (SI) the IRI developed in partnership with the Center for International Earth Science Information Network (CIESIN) and the Mailman School of Public Health (MSPH), also from Columbia University [1, 2]. This curriculum also captures lessons and experiences from the three tailored trainings on CIPH that have been implemented in Madagascar and Ethiopia thanks to joint initiatives by the IRI, national Ministries of Health and Meteorological Offices and relevant partners such as the WMO and the World Health Organization (WHO)[3, 4].

We believe this Curriculum for Best Practices aligns with that of Field Epidemiology Training Programs (FETPs) and Field Epidemiology and Laboratory Training Programs (FELTPs) such as these implemented by several Ministries of Health and or local universities across the globe [5]. As developed through Public Health Schools, these in-country FETPs often received initial support from the US Centers for Disease Control and Prevention (CDC) and some of them are members of the Training Programs in Epidemiology and Public Health Interventions Network (TEPHINET)[3]. This Curriculum for Best Practices also aligns with courses or programs developed by Public Health, Environmental or Sustainable Departments of numerous Universities worldwide, relying either on Web-based or off-line training tools [6-8]. This curriculum has been designed to address the interdisciplinary nature of the field of climate information and public health, both at the conceptual level, as well as at the level of methodologies and data analysis techniques.

Much remains to be developed in the area of climate information and public health and the field efficiency of the innovative approaches illustrated in this curriculum is yet to be assessed. For these reasons, including a CIPH module into FETPs and other public health curricula would not only enhance our understanding and operational use of the relationship between climate and health outcomes, but it would also allow to monitor and evaluate how climate information improves public health activities and decision-making. For this effort to be sustained and scaled-up, it is critical that "climate-proficient" public health professionals train and mentor their peers.

This tremendously important initiative must be undertaken jointly by the climate and public health communities, with the common goal of improving public health outcomes across the globe in order to meet the people's most basic needs.

This curriculum on Climate Information for Public Health captures the core concepts of CIPH, which are transfer-

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2 Adapted from WMO Press Release n°86. Available from: http://www.wmo.int/pages/mediacentre/press_releases/pr_861_en.html

3 Created in 1997, Training Programs in Epidemiology and Public Health Interventions Network (TEPHINET) is a professional network of field epidemiology training programs (FETPs) located in 43 countries around the world.

able and adaptable to other curricula, in addition to offering a sample CIPH course based on tangible demonstrations and practical applications. This curriculum for building best practices and the associated sample course presented here cover a two-week training, of 90 hours total. However, when used to implement CIPH courses, it is important this curriculum is tailored to the needs of its users and to the topics relevant to them, resulting in the design of CIPH courses of various lengths – either condensed to shorter courses or extended greatly.

A support to the Courses: The IRI Data Library

The IRI Data Library4 was used in support of all the CIPH training courses conducted so far. It is a powerful open-source computational engine that offers, at no cost to the user, the opportunity to:

- Access and manipulate over 400 datasets from a variety of climate-related topics, including public health;
- Analyze climate and public health data;
- Monitor past and present climate conditions with maps and analyses;
- Create multi-dimensional visual representations of climate and public health data, including animations;
- Customize and download plots and maps in a variety of image and data formats, including compatible with R, GIS or other software for data visualization.

The Data Library overcomes the limitations imposed by GIS platforms by being based on a much more general multi-dimensional data model. It also forms the basis for the IRI Map Rooms, which offer a collection of maps and analyses used to monitor current global and regional climate, as well as historical data. From the maps, it is possible to access and download the publicly available datasets being viewed, including station, atmospheric and oceanic observations and analyses, model-based analyses and forecasts, as well as land surface and vegetation information. In particular, the Health Map Room provides analyses that explore and inform users about the relationship between climate and health.

These operators can be applied to real-time datasets, creating results that are also updated in near-real time meaning that researchers and practitioners can follow environmental and climatic changes as they occur and analyze them against locally evolving health events. This infrastructure simplifies the process of analyzing spatial-temporal datasets greatly.

The Data Library and Map Rooms are most powerfully used on-line. However, off-line versions of both are being implemented to support trainings in developing settings where access to the Internet may be inconsistent. They may be accessed off-line with appropriate application DVD-ROMs that can be made available upon request.

Target Audience and Goals

Target Audience

This Curriculum for Best Practices on Climate information for Public Health is primarily dedicated to Public

4 *For more information on the IRI Data Library, refer to:* iridl.ldeo.columbia.edu

Health Field Epidemiologists, Practitioners or Researchers working in developed or developing countries. However, given the novel nature of the field of climate information and public health and the need to develop tailored, demand-driven CIPH tools and products, it is crucial that CIPH courses also involve professionals working in the climate or meteorological sector to foster mutual understanding around a common set of practices.

The trainees are anticipated to be professionals involved in public health decision-making related to the surveillance, prevention and control of climate-sensitive diseases. Although we are aware that most of their experience will likely be related to vector-borne diseases, such as malaria or dengue where the link with climate is well understood, we also expect the trainees to be involved in the management of other climate-sensitive diseases, such as meningococcal meningitis, an area where research on public health applications for climate information is growing, or in responding to climatic threats to public health, such as flooding and other disasters [1-4].

Goals

This Curriculum for Best Practices in CIPH was designed to help trainees (i) enhancing their knowledge of climate-sensitive diseases and climatic threats to public health, and (ii) fostering the use of climate information in the management of climate-sensitive diseases and disasters programs. The overall objective of this curriculum is to foster efforts aiming to build a community of practice for the use of climate information to enhance public health activities [1-4].

Curriculum Design Glossary

This glossary defines and gives instances of the educational terms in use in this document [5].

Table 1: Description of the educational terms used in a CIPH Curriculum

TERM	PURPOSE	DEFINITION	EXAMPLE
Competency	Describes the expectations for performance and for evaluation of the individual	An integrated set of knowledge, skills, and attitudes that supports successful performance in climate-sensitive public health service context	Use climate information to conduct studies that improve public health actions
Domain	Describes the different components of a competency statement	An identification label summarizing the different contents to be delivered	Basic concepts in public health and climate
Competency Statement	Describes the different learning outcomes	A broad statement of intent of a formal instructional plan that describes learning outcomes	Analyze in space and time the relationship between climate and public health data using appropriate methods and tools
Instructional Goal	Guides the development of an instructional activity and provides the starting point for subsequent planning	A broad statement of intent of a formal instructional plan that describes learning outcomes	Design and conduct analytic studies using climate and non climate variables
Learning Objectives	Frames specific lessons within an instructional goal and provides guidelines for content development, delivery method and evaluation	A specific statement of what a learner will be able to accomplish on completion of a lesson or instruction activity	Construct a time series chart, plot the occurrence of disease and climate anomalies

Climate Information for Public Health Competencies

Which competencies shall be acquired through a Climate Information for Public Health Training?

To achieve its goals, a CIPH course should enable participants to understand the distinctiveness of this field, for instance regarding the importance of spatial and temporal variations in climate for infectious diseases transmission, as well as the exciting opportunities and challenges inherent to working at the intersection of climate and public health, in an interdisciplinary context.

By the end of the course, trainees should understand the basic frameworks for public health analyses, the factors that drive the climate system and the range of methods used to capture public health and climate information.

CIPH trainees should also be able to appropriately analyze this information in order to recognize the relationship existing between climate patterns and climate-sensitive diseases or public health issues, and the resulting opportunities for enhanced public health decision-making, planning and intervention.

New computer and information technology skills will also be gained throughout the course in order to enable the trainees accounting for the specificity of spatial and temporal analysis and properly applying climate information to public health activities.

Once relevant information on climate and public health has been produced, it is important applicable and pertinent messages are provided to the targeted user(s) of this information. Trainees will therefore learn how to develop effective communication means and tools for public health and climate information.

Additionally, considerable efforts are required to further the understanding and use of climate information for enhanced public health decision-making, as well as to build a sustained community of collaboration and practice in this area. This pressing need urges CIPH trainees and their climate and public health partners to develop continued mechanisms and platforms to collaborate, provide feedback, mentor and train their peers on the growing field of climate information for public health. Principles to implement relevant platforms, mechanisms and partnerships to advise, train and collaborate with public health and climate and weather professionals using shall also be taught during CIPH courses.

The competency statements of CIPH training courses are summarized by domain in the following table.

Table 2: Description of the domains addressed in a CIPH Training and their associated competency statements

Domain	Competency Statement
1. Basic Concepts in Public Health and Climate	Understand the basic frameworks for public health analyses, the factors that drive the climate system and the range of methods used to capture public health and climate information
2. Methods and Tools for Analyzing Climate and Public Health Data	Analyze in space and time the relationship between climate and public health data using appropriate statistics, methods and tools
3. Use of Climate Information in Decision-Making for Climate-Sensitive Diseases	Apply climate information to enhance public health surveillance, early warning, prevention and control of climate-sensitive public health issues
4. Computer and Information Technology	Use computers and relevant software for applications in climate information for public health
5. Communication in Public Health and Climate	Develop effective communication means and tools for public health and climate information
6. Collaborating, Mentoring and Training on Climate Information for Public Health	Advise, train and collaborate with public health and climate and weather professionals using relevant platforms, mechanisms and partnerships

How are trainees expected to demonstrate competency in CIPH?

Trainees will demonstrate their newly acquired knowledge and ability to conduct CIPH activities by answering daily quiz questions and by developing a personal project on climate and health.

Daily Quiz

We highly recommend that, everyday with effect from the second day of the training, CIPH trainees answer quiz questions related to the lectures, practical sessions or talks they participated in on the previous day. To promote personal reasoning and thinking, we suggest this exercise is not open books/open notes. The key aims of the quiz are to:

- Help the trainees assess their gain in knowledge and understanding of the key concepts taught;
- Motivate the trainees to quickly assimilate and appropriate key concepts of CIPH; and
- Reinforce learning by providing the trainees with an idea of what topics they should further concentrate on.

Administrating daily quizzes may also help the course organizers understanding how successfully the materials have been delivered and presented.

CIPH projects

It is critical CIPH trainees explore their own ideas and reflect on the course lectures, seminars, exercises and discussions.

Therefore, we strongly encourage conducting, from the beginning of the training, a personal project that may be followed through either individually or in a small group with trainees of both the public health and climate communities. Trainees should build up their project throughout the entire course, applying what they have learned and linking these results to the aspects of their own work or interest relevant to public health decision-making.

We recommend the trainees develop their project using the results and figures obtained during the practical sessions of the training- using either their own data, when applicable, or some datasets made available for the CIPH course.

At the end of the course, trainees shall give a poster, written or oral presentation of their projects, enabling them the opportunity to share the learning experience with co-participants, facilitators, instructors and distance learners. Depending on the profile of the trainees, these projects may or may not be graded, but we suggest implementing a "Best Presentation Prize Committee" to award outstanding presentations.

In addition to the presentations, trainees are required to write a 300-word summary of their CIPH project which would include the following: title, author(s)' name(s), author(s)' affiliation(s), background, objectives, hypothesis and methods, results, interpretation and conclusion.

Climate Information for Public Health Course Delivery and Evaluation

What should be the baseline profile of the participants to Climate Information for Public Health Trainings?

This Curriculum for Best Practices is primarily targeted at public health field epidemiologists, practitioners, policymakers or researchers working in developed or developing countries, as well as to professionals working in the climate or meteorological sectors.

The trainees are expected to be professionals who play a key role in public health decision-making related to the surveillance, prevention or control of climate-sensitive diseases. Although we are aware that most of their experience will likely be related to vector-borne diseases, such as malaria or dengue where the link with climate is well established, we also expect the trainees to be involved in the management of other climate-sensitive diseases, such as meningococcal meningitis, an area where research on public health applications for climate information is growing, or in responding to climatic threats to public health, such as flooding and other disasters.

What should be the profile and role of the course facilitators?

CIPH facilitators would ideally be both climate and public health practitioners with strong knowledge and experience in their own field of expertise, in addition to previous experiences, and/or will to engage, in multi-disciplinary activities related to climate and public health. They could also be alumni from previous CIPH courses.

All together, the facilitators should be a good representation of different fields related to climate and public health if relevant. They could work at universities, international, governmental or non-governmental institutions, as well as research centers – among others.

Regardless of their climate or public health background, it is important the team of facilitators promotes a group-based approach relying on multi-disciplinary interaction and thinking that builds on the prior knowledge and experiences of the trainees.

What are the selection criteria for participating in Climate Information for Public Health Trainings?

Trainees in CIPH are expected to demonstrate the following:

- Understanding of the central issues related to climate and health
- Vision and strategy for applying CIPH concepts in significant operational research project(s)
- Strategic opportunity for engagement with key partner organization(s)
- Potential for near and long-term impact and partnership in CIPH.

These qualifications are important because it is anticipated that CIPH trainees will train and mentor their peers or partners in the use of climate information for enhanced public health decision-making. Such interaction would enable to build up a community of practice within the growing climate and public health.

We encourage assessing these credentials in a pre-course questionnaire set at the time of the selection of the participants. This survey should elucidate the expectations of the trainees for the course, as well as their background and prior knowledge of public health and climate (see Appendix 5).

To reinforce the concepts learned, we also recommend the trainees bring their own data to the training and use them for the practical sessions and the development of their project.

Which training methods may be used?

We suggest CIPH trainings comprise five components:

- Core lectures,
- Practical sessions, such as hands-on exercises and applications, and field practice,

- Public talks and group discussions,
- Daily summary of key messages by a trainee, and
- Trainees' project presentations, which may be oral, poster or written.

It is very important to balance lectures, hands-on practice and interaction between the public health and climate trainees as well as with the facilitators to enhance the trainees' learning experience, appropriation of the course materials and, subsequently, integration into practice of these newly acquired skills. The recapitulation of the key CIPH messages of the previous day by a trainee also furthers the appropriation of the topics by the trainees and their empowerment, turning CIPH courses into a more comprehensive and interactive learning experience.

We also strongly encourage the users of the Curriculum on Climate Information for Public Health to implement special seminars, lectures or exercises adapted to the local context (e.g., history of climate and malaria, influenza and climate: seasonality and early warning, climate change, war and disease, case study on heat waves).

How many trainees may participate in a CIPH course?

Because a CIPH course relies significantly on computer-based hands-on exercises and applications, as well as on the interaction between the trainees and with the facilitators, the number of trainees shall be limited.

Consequently, a CIPH training would ideally involve around 15-20 trainees, which is the optimal number to promote and sustain group discussions, interaction and learning. Although this number may be adapted to the needs of the institution implementing the training and to its computer facilities, we recommend that rather than involving large groups in the course, repeated smaller scale trainings are implemented.

How may a CIPH training be evaluated?

We recommend giving participants to CIPH courses the opportunity to evaluate and give their feedback on the training they were involved in, in different ways: organizers, lecturers, support staff and trainees.

The evaluation process must anonymously address the performance and satisfaction associated with the design and delivery of CIPH trainings, as well as the opportunities that could arise from these courses using open-ended, yes/no, or multiple choice questions. The evaluation surveys may be filled on-line as well as on questionnaires' printouts.

We recommend the following evaluation structure:

- Daily evaluation by the trainees, to assess the content and format of the day, provide the organizing committee and the lecturers with immediate feedback.
- Partial evaluation(s) by the trainees, to identify the key points and challenges associated with the processes of adaptation to the course and knowledge assimilation. The frequency of the partial evaluation(s) shall be adjusted to the total duration of the course (e.g. weekly for a two-week course).

- Overall evaluation of the course by the trainees, to assess whether the goals of the course were met, as well as the value of the course content, its transferability, design and delivery. This survey should also address the collaboration climate and health opportunities and insights arising from the course.
- Immediate post-course evaluation by the organizers, the facilitators and the support staff, to ascertain their impressions of the course planning, goals, content, delivery, and associated workload. Similarly to the trainees overall evaluation, this survey should address the collaboration climate and health opportunities and insights arising from the course.
- At distance post-course survey by the trainees and the facilitators, to assess the impact and usefulness of the CIPH training and its associated trainees-facilitators interaction and mentoring. This survey shall be conducted six to twelve months after the completion of the training.
- Attributing CIPH Training Course Awards is also strongly recommended to acknowledge and reward outstanding facilitators, organizers and support staff, as well as trainees' projects and innovations related to the development or implementation of the course itself.

What is the expected structure of a CIPH course?

The following table details how a typical day of CIPH training may be scheduled.

Table 3: Recommended structure of a typical CIPH Training day

TYPICAL DAY OF CIPH TRAINING	
Morning Session	Daily quiz Summary of the previous day by a participant Open discussion with the lecturers of the previous day Selection of the rapporteur for the following day
	Lecture Open discussion on the lecture, including questions and answers
Lunch Time	Lunch-break or Lunch-time seminar
Afternoon Session	Practical session Open discussion on the practical session, including questions and answers
	Open space for practice, work on personal project, or meeting with the facilitators
	Daily evaluation of the course

Further components of a typical training day may include, but are not limited to: panel discussions, side meetings, presentation of participants' projects and social activities to improve the relationship with the course participants.

What is the optimal duration of a CIPH course?

The standard Curriculum for Best Practices and the associated sample course presented here in cover a two-week training program, of 90 hours total.

However, we are aware that not all topics are relevant to all institutions or programs. Although this document presents the full range of knowledge and skills currently related to the best possible use of climate information for public health, this CIPH curriculum may be tailored to the needs of its users and to the local context. As a result, emphasis may be put on the topics relevant to the users, while those less appropriate to the context of the course shall be condensed if not removed.

Tailored CIPH training course may therefore last from a few days, as done in Ethiopia in December 2009, to an entire semester should CIPH courses be included into Master's programs for instance [4, 8]. It also is possible to design a two-week training where the two weeks are separated by an interim period. This intermission would enable the trainees to assimilate the information they learnt, in addition to developing small CIPH projects that would in turn guide the development of the second part of the training. This strategy was implemented in Madagascar in October 2009 and March 2010 [3].

What is the minimum computer specification to conduct CIPH trainings?

We recommend all trainees be provided with a computer capable of running the software used for the CIPH course: on or off-line versions of the IRI Data Library, ArcView and Microsoft Office (Word, Excel, Power-Point).

CIPH trainees should be familiar with the use of a computer, with the use of Microsoft Office to manipulate and save files, as well as, for trainings using the on-line version of the Data Library, with the use of the Internet [7].

The computer should have the following minimum requirements:

- Processor: Intel dual or quad core, 2GHz or faster
- OS: Linux (Fedora or RedHat); Mac; Windows XP or later
- Database: PostGres/PostGIS
- RAM memory: 4GB
- Hard disk space: 100GB
- Graphics: graphics card with Level2 cache
- The computers must be fitted with USB ports and connected to an inkjet or laser printer. They also may be all connected through an internal network.
- Regular Web-access is preferred but not mandatory to perform a CIPH training.

- For training facilities with access to Internet:
- The minimum Internet connection is:
- Email access must also be provided for the course evaluations.

For training facilities without access to Internet:

The computer must be fitted with a DVD-ROM drive or a local network with a server computer.

Curriculum at a Glance

The following table provides an overview of the Curriculum for Best Practices in CIPH as developed by the IRI [5]. However, it is critical this curriculum is tailored to the needs and expectations of the countries and institutions that will use this document as a reference to develop their own trainings.

Besides translating this material into a relevant language, we strongly encourage the users of the Curriculum for Best Practices in Climate Information for Public Health to implement special seminars adapted to the local context (e.g., history of climate and malaria, influenza and climate: seasonality and early warning, climate change, war and disease, case study on heat waves) [1-4].

We recommend the competency domains be delivered in the order indicated in this "Curriculum at a Glance" (see next page). However, this order may be adapted to the context of the development and implementation of the CIPH training, in particular for topics related to "Computer and Information Technology".

Table 4 . Curriculum at a Glance

BASIC CONCEPTS IN PUBLIC HEALTH AND CLIMATE	DATA, METHODS AND TOOLS FOR ANALYZING CLIMATE AND PUBLIC HEALTH DATA	USE OF CLIMATE INFORMATION IN DECISION-MAKING FOR CLIMATE-SENSITIVE DISEASES	COMPUTER AND INFORMATION TECHNOLOGY	COMMUNICATION IN PUBLIC HEALTH AND CLIMATE	COLLABORATING, MENTORING AND TRAINING ON CLIMATE INFORMATION FOR PUBLIC HEALTH
Introduction to Climate and Climate Information	Understanding Data and Data Quality Control	Useful and Useable Climate Products	Overview and Manipulation of the IRI Data Library	Creating a "Climate-Smart" Public Health Community: How do we Communicate?	Building Sustainable Partnerships to Improve Climate-Sensitive Surveillance and Response
Understanding Predictions and Projections in Climate	Data Constraints and Limitations	Climate Prediction for Weather Forecast Skeptics	Controlling the Quality of the Trainees' Dataset	Communicating and Motivating Action in Climate and Health	Implementing Network and Interaction Platforms
Introduction to Climate-Sensitive Diseases	Remote Sensing as a Source and a Tool to Manage Environmental Data	How to Make Decisions given Probabilistic Forecasts	Data Upload to the IRI Data Library	How to Use Maps as a Tool to Communicate Climate Risk	Developing Climate and Health Proposals
Core Concepts in Public Health and Epidemiology applied to Climate-Sensitive Diseases	Summarizing Climate and Health Data using Descriptive Statistics and Map Tools	Vector Distribution and Rainfall	Extracting Data from the IRI Data Library	Designing Efficient and Tailored Communication Supports	Implementing Training Courses
Climate, Vulnerability and Health: International and National perspectives	Principles of Trends and Time Series Analysis	Early Warning and Early Response to Climate-Sensitive Disease	Applications using the Trainees' Datasets	Writing an Abstract	

Table 4 . Curriculum at a Glance (cont'd)

BASIC CONCEPTS IN PUBLIC HEALTH AND CLIMATE	DATA, METHODS AND TOOLS FOR ANALYZING CLIMATE AND PUBLIC HEALTH DATA	USE OF CLIMATE INFORMATION IN DECISION-MAKING FOR CLIMATE-SENSITIVE DISEASES	COMPUTER AND INFORMATION TECHNOLOGY	COMMUNICATION IN PUBLIC HEALTH AND CLIMATE	COLLABORATING, MENTORING AND TRAINING ON CLIMATE INFORMATION FOR PUBLIC HEALTH
Climate Adaptation in Public Health	Principles and Applications of Cluster Analysis	Integrated Surveillance and Control Systems for Climate-Sensitive Diseases		Presenting a Project on Climate and Public Health	
Climate Risk Management in Public Health	Lagged Correlation of Climate Variables and Disease Incidence	Epidemic Detection and Monitoring using Geo-Referenced Data and Mapping Tools			
Climate Risk Management and Development	Disease Spatio-Temporal Modeling	Environmental Risk Information Technology to Improve the Surveillance and Control of Climate-Sensitive Diseases			
ENSO and Society	Climate Suitability Mapping Tools for Climate-Sensitive Diseases				
Climate and Vector-Borne Disease Dynamics	Using Geographic Position and Information Systems for Public Health				

Table 4 . Curriculum at a Glance (cont'd)

BASIC CONCEPTS IN PUBLIC HEALTH AND CLIMATE	DATA, METHODS AND TOOLS FOR ANALYZING CLIMATE AND PUBLIC HEALTH DATA	USE OF CLIMATE INFORMATION IN DECISION-MAKING FOR CLIMATE-SENSITIVE DISEASES	COMPUTER AND INFORMATION TECHNOLOGY	COMMUNICATION IN PUBLIC HEALTH AND CLIMATE	COLLABORATING, MENTORING AND TRAINING ON CLIMATE INFORMATION FOR PUBLIC HEALTH
Climate Change and Human Health: Current Impacts and Future Risk					
Public Health Surveillance and Opportunities to use Climate Information					

Competencies by Domain

The following tables describe the learning objectives, instructional goals and topics associated with each of the six CIPH competency statements addressed in this curriculum:

- Basic Concepts in Public Health and Climate (Table 5)
- Data Methods and Tools for Analyzing Climate and Public Health Data (Table 6)
- Use of Climate Information in Decision-Making for Climate-Sensitive Diseases (Table 7)
- Computer and Information Technology (Table 8)
- Communication in Public Health and Climate (Table 9), and
- Collaborating, Mentoring and Training on Climate Information for Public Health (Table 10).

Basic Concepts in Public Health and Climate

Table 5. Basic Concepts in Public Health and Climate

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
Understand the basic frameworks for public health analyses, the factors that drive the climate system and the range of methods used to capture public health and climate information	Understand the basic concepts in climate, climate information and its limitations	Understand the notions of weather vs. climate, climatology, climate variability vs. climate change, climate anomalies, climate data vs. climate information (forecast products, monitoring products) Understand the time and space scales of the different climate phenomena Understand the different data sources and approaches to transform climate data into climate information	Introduction to Climate and Climate Information
	Understand the different predictions and projections in climate	Understand and interpret the different types of climate predictions and projections with emphasis on their interpretation and limitations Introduce trainees to the ensemble technique and probabilistic approach to climate prediction as well as the downscaling and verification procedures	Understanding Predictions and Projections in Climate
	Understand the concept of climate sensitive disease	Understand the different categories of climate sensitive diseases Understand how climate sensitive disease are related with different spatial and temporal patterns Identifies gaps and assesses the role of climate information in improving health system performance	Introduction to Climate-Sensitive Diseases

Table 5. Basic Concepts in Public Health and Climate (cont'd)

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
	Understand the variability in space and time of climate-sensitive disease risk	Understand disease risk Use space and time as a framework for measuring variability in disease risk Understand the main measures of disease occurrence in epidemiology as applied to space and time, and their robustness in measuring risk	Core Concepts in Public Health and Epidemiology applied to climate-Sensitive Diseases
Understand the basic frameworks for public health analyses, the factors that drive the climate system and the range of methods used to capture public health and climate information	Understand how climate impacts public health through increased hazards and vulnerability, resulting in increased risk	Describe instances of public health impacts of unexpected climate events and climate-sensitive outbreak-prone diseases at the national and international level Describe the pathways through which climate affects public health Understand the concepts of vulnerability	Climate, Vulnerability, and Health: International and National Perspectives
	Understand the concepts and methods of vulnerability analysis and adaptation to climate change in public health	Understand the characteristics and determinants of system vulnerability Understand the characteristics of adaptation effectiveness (e.g. resilience, critical thresholds and coping mechanisms) Describe the adaptation strategies for public health Understand how science and research can advance the adaptation agenda	Climate Change Adaptation in Public Health

Table 5. Basic Concepts in Public Health and Climate (cont'd)

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
	Understand and broaden the concept of climate risk management to development	Understand the impact of climate variability at different temporal scales on development Illustrate climate risk management in development	Climate Risk Management and Development
Understand the basic frameworks for public health analyses, the factors that drive the climate system and the range of methods used to capture public health and climate information (Continued)	Understand the relevance of ENSO to human activities and welfare	Understand how El Nino and La Nina affect climate throughout the world Understand how an ENSO-modified seasonal climate can affect society, and public health in particular	ENSO and Society
	Understand the basic concepts of the dynamics of transmission of vector-borne diseases and their relationship with climatic factors	Understand how climate impacts vector abundance, species distribution, physiology, synchrony and relationships with hosts. Understand how climate impacts transmission dynamics of vector-borne diseases Understand how climate information can optimize the spatial and temporal mapping of vectors and vector-borne diseases, as well as the design and evaluation of short-term and long-term disease control programs	Climate and Vector-Borne Diseases Dynamics

Table 5. Basic Concepts in Public Health and Climate (cont'd)

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
Understand the basic frameworks for public health analyses, the factors that drive the climate system and the range of methods used to capture public health and climate information (Continued)	Appreciate the multiple ways in which climate change could adversely affect public health	Gain a basic understanding of public health impacts of climate change Understand the range of health outcomes likely to be influenced by climate change Appreciate the ways in which scientific knowledge of climate and health associations are determined Confront the challenges of projecting future health impacts of climate change	Climate Change and Human Health: Current Impacts and Future Risks
	Understand the value of applied climate information in public health surveillance	Understand and describe different types of surveillance Understand how surveillance data can incorporate climate data Identify opportunities were climate data can enhance rveillance quality	Public Health Surveillance and Opportunities to use Climate Information

Data Methods and Tools for Analyzing Climate and Public Health Data

Table 6 Data, Methods and Tools for Analyzing Climate and Public Health Data

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
Analyze in space and time the relationship between climate and public health data using appropriate statistics	Understand the difference between a collection of numbers and data	Control and correct the consistency and uniformity of data Prepare data in the context of multi-disciplinary analysis Illustrate the issues related to data analysis over long time periods and broad regions	Understanding Data and Data Quality Control
	Understand the limitations of climatological datasets before performing data analysis	Understand the source and intended use of climate data in order to avoid placing an excessive burden on these data when conducting analyses Provide examples of regional variations in climate variability and trends Understand the importance of data quality control Gain an appreciation of some of the challenges in assessing temporal trends	Data Constraints and Limitations
	Introduce the concepts of remote sensing and provide information on how to retrieve environmental factors using remotely-sensed products	Become familiar with the remote sensing products available to monitor environment information Understand the methodology to retrieve rainfall, air temperature, vegetation and water bodies Visualize and map data on rainfall, temperature, vegetation and water bodies, extract time series and anomalies, download data and images, integrate images into GIS software	Remote Sensing as a Source and a Tool to Manage Environmental Data

Table 6 Data, Methods and Tools for Analyzing Climate and Public Health Data (cont'd)

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
	Calculate and visualize exploratory and descriptive statistics of climate and public health data	Display time series and histograms of epidemiological and climate data Calculate a monthly climatology Calculate and plot statistical measures of epidemiological and climate variables (e.g., mean, median, standard deviation, root mean squared error, range) Calculate and plot spatial averages of gridded climate and environmental data (e.g., over districts)	Summarizing Climate and Health Data Using Descriptive Statistics and Map Tools
Analyze in space and time the relationship between climate and public health data using appropriate statistics	Learn simple techniques for exploratory analysis of univariate time series of climate and health data	Understand the nature of climate variability on daily to inter-annual time scales in terms of rainfall and temperature at a particular location Learn how simple averaging and time-series plots can be used to separate different time scales of variability, namely weather variability, seasonal cycle, inter-annual variability, inter-decadal variability and long-term trends Identify the direction and strength of a long-term trend in a time series, evaluate the probability that a trend in a data set occurred only by chance, and learn two methods to remove a trend in a data set Learn how several time series can be used in conjunction to identify and quantify associations between them	Principles of Trends and Time Series Analysis

Table 6 Data, Methods and Tools for Analyzing Climate and Public Health Data (cont'd)

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
	Learn how cluster analysis allows identifying patterns in multivariate data and its implication for decision-making in public health	Understand what cluster analysis is Learn how the K-means method works Implement K-means, choose the appropriate number of clusters over specific time periods and spatial resolutions, interpret the results Apply cluster analysis to: Understand the spatial and temporal distribution of climate-sensitive diseases Understand the relationship between climate-sensitive diseases and environmental factors Take decisions about control strategies	Principles and Applications of Cluster Analysis
Analyze in space and time the relationship between climate and public health data using appropriate statistics (Continued)	Learn how to map and correlate climate and health data	Calculate anomalies of epidemiological and climate data Review the calculation of geographically-averaged values of gridded climate data Create maps of epidemiological data aggregated at a given spatial scale Calculate and visualize the Pearson Product Moment Correlation between two variables Learn how to lag two datasets and calculate the lagged correlation	Lagged Correlation of Climate Variables with and Disease Incidence
	Understand how sophisticated statistical modeling ideas can contribute to the solution of real-world public health problems.	Understand the concepts of dynamic regression, spatio-temporal correlation and probabilistic prediction Apply these concepts to climate-sensitive diseases	Disease Spatio-Temporal Modeling

Table 6 Data, Methods and Tools for Analyzing Climate and Public Health Data (cont'd)

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
Analyze in space and time the relationship between climate and public health data using appropriate statistics (Continued)	Understand the utility of climate information for dynamic climate-sensitive disease mapping	Describe where, when and for how long the combination of climatic conditions may be suitable for the occurrence of a climate-sensitive disease using the Climate Suitability tool Understand the tool's graph, table and map outputs, to target the implementation of interventions and evaluate their impact Apprehend the importance of considering climate variability and unusual climate events when selecting a baseline year for assessing the impact of interventions against climate-sensitive diseases	Climate Suitability Mapping of Climate-Sensitive Diseases
	Collect and map data using, respectively, the Geographic Position System and the Geographic Information System to quantify the relationship between environmental and public health data	Understand the underlying fundamentals of how Geographic Position Systems work Apply these basics to plan out and implement the most accurate possible Geographic Position System data collection survey Perform basic spatial analysis techniques of overlays and intersections to create tables, charts and maps of relevant public health and environmental data	Using Geographic Position and Information Systems for Public Health

Use of Climate Information in Decision-Making for Climate-Sensitive Diseases

Table 7. Use of Climate Information in Decision-Making for Climate-Sensitive Diseases

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
Apply climate information to enhance public health surveillance, early warning, prevention and control	Understand which climate products are useful and useable by targeted users	Differentiate truly demand-driven products from those driven by research interest Understand how to characterize which product will be relevant to a particular user Understand why and how to identify the key stakeholder(s) for a given public health and climate issue	Useful and Usable Climate Products
	Understand why it is theoretically possible to forecast beyond the limit at which weather forecasts become useless	Understand why the weather cannot be predicted beyond a few days, but climate can be Gain practical experience in making seasonal forecasts of climate and of climate-sensitive diseases, when possible	Climate Prediction for Weather Forecast Skeptics
	Understand how to make decisions given probabilistic forecasts	Understand and illustrate that using probabilistic forecasts to manage climate-sensitive diseases may result in gain or loss-making decisions	How to Make Decisions given Probabilistic Forecasts
	Make a decision on the most appropriate control intervention for vector-borne diseases using information on rainfall distribution and variability	Map and describe possible associations between the distribution of vector-borne disease and environmental factors, such as the distribution and variability of rainfall Use observational skills and prior knowledge of mosquito vector behavior and rainfall variability and distribution to make a decision on the most appropriate control intervention	Vector Distribution and Rainfall
	Gain an understanding of the rationale, development, and testing of early warning systems for climate-sensitive diseases	Understand why climate information needs to be coupled with public health information to inform public health decisions Illustrate how climate and weather information could be used in the early warning and early response systems of climate-sensitive diseases of public health significance	Early Warning and Early Response to Climate-Sensitive Diseases

Table 7. Use of Climate Information in Decision-Making for Climate-Sensitive Diseases (cont'd)

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
Apply climate information to enhance public health surveillance, early warning, prevention and control (Continued)	Apprehend the role dynamical models play in understanding the complexity of climate-sensitive diseases and their application for integrated disease surveillance and control	Highlight the importance of conceptual models in the context of environmental and public health Understand the structure of dynamical models for climate-sensitive diseases Explore the role dynamical models play in disease risk assessment and control interventions Implement various dynamical models for exploring how climatic and non-climatic factors drive fluctuations and trends in the incidence of climate-sensitive diseases Compare the simulation outputs of some mathematical models with actual diseases morbidity profiles	Integrated Surveillance and Control System for Climate-Sensitive Diseases
	Identify epidemics using a tool for visualizing and mapping climate and health data spatially and temporally referenced	Define and map epidemics of climate-sensitive diseases in relation to known areas and time periods, for situations of different levels of endemicity Understand the need for sufficient past data on cases in order to detect and define epidemics, and the influence of 'base years' chosen on the resulting epidemic threshold Understand and demonstrate the concept of epidemic threshold as defined by various methods (third quartile, mean plus two standard deviations, moving average etc.) Understand the implications for each method on the sensitivity and specificity of epidemic definitions and for early detection of epidemics	Epidemic Detection and Monitoring using Geo-Referenced Data and Mapping Tools
	Understand to the potential for climate and environmental risk information technologies to play a role in the prevention and control of climate-sensitive diseases	Present historical evidence of the role of climate and other factors in epidemic occurrence for known or suspected climate-sensitive diseases Present current questions that remain to be answered for these diseases and how information technologies may help solving these issues	Environmental Risk Information Technologies to Improve the Surveillance and Control of Climate-Sensitive Diseases

Computer and Information Technology

Table 8. Computer and Information Technology

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
	Understand the contents, structure, and capabilities of the IRI Data Library, and how it may be applied as a powerful tool for analyzing climate and health data	Become familiar with the structure of the IRI Data Library and its climate and epidemiological datasets Find data sets, select spatial and temporal domains and visualize the data Perform descriptive to advanced analyses in the IRI Data Library using filters and functions of the expert mode Create customized maps and graphs Download data and images Learn how the Data Library is related to the IRI Map Rooms	Overview and Manipulation of the Data Library
Use computers and relevant software for applications in climate information for public health	Obtain reliable data referenced in space and time with a minimum of errors that are suitable for analysis using appropriate gridding notation	Identify and correct typos, duplicates and other data consistency issues within a dataset Ensure climate and health variables are appropriately defined and data correctly entered in the space and time dimensions Validate the quality of the dataset by performing preliminary analysis using appropriate gridding notation in the IRI Data Library	Controlling the Quality of the Trainees' Datasets
	Upload public health and other datasets from one's computer to the IRI Data Library in order to analyze these datasets against other databases existing in the Data Library	Ensure the data file has the appropriate Ensure the data set has the appropriate spatial and temporal format Ensure the data is characterized by metadata, which has the appropriate format Upload the data Upload the metadata	Data Upload into the Data Library

Table 8. Computer and Information Technology (cont'd)

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
	Download a dataset from the IRI Data Library into one's computer, and open that dataset in a different application	Select a subset of a particular dataset of the IRI Data Library based on time and location, or other independent variables Perform filtering to apply a new grid resolution to the data Learn how to average the data over time using the Data Library Expert Mode when needed Save the dataset to the desktop in appropriate format (e.g., compatible with Microsoft Excel, R, GIS ArcView)	Extracting Data from the Data Library
Use computers and relevant software for applications in climate information for public health	Gain proficiency in the use of the IRI Data Library to analyze climate and health data	Perform independently the following: - Perform exploratory and descriptive data analysis - Calculate and analyze anomalies - Display and analyze time series - Calculate epidemic thresholds - Perform cluster analysis of data - Perform correlation and lagged correlation - Retrieve, analyze, calculate anomalies and visualize data using remote sensing tools in the Data Library - Visualize and analyze data using the climate suitability and mapping tools of the Data Library - Use the Climate Predictability Tool	Applications using the Trainees' Datasets

Communication in Public Health and Climate

Table 9. Communication in Public Health and Climate

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
	Understand the means and challenges to communicate on the use of climate information for public health decision-making and operational research	Increase the public health community's capacity to understand, use, and demand the appropriate climate information Ensure the public health community can distinguish between different kinds of data to determine what is relevant, at what time scale, to their population	Creating a "Climate-Smart" Public Health Community: How do we Communicate?
Develop effective communication means and tools on climate and health	Understand the importance of effective and targeted communication in the dialogue between the climate - meteorological and the public health communities	Apprehend the framework that can help better to communicate climate information to public health practitioners Understand the eight principles of communicating climate information: know your audience, get your audience's attention, translate scientific data into concrete experience, beware of the overuse of emotional appeals, address scientific and climate uncertainties, tap into social identities and affiliations, encourage group participation, make behavior change easier Understand how forecasts and other kinds of maps can succeed or fail in providing relevant and actionable information to users outside of the climate community	Communicating and Motivating Action How to Use maps as a Tool to Communicate Climate Risk

Table 9. Communication in Public Health and Climate (cont'd)

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
Develop effective communication means and tools on climate and health (Continued)	Apply the principles of visual communication to develop and deliver presentation on public health and climate	Design presentation appropriate for the target audience Apply appropriate persuasive techniques Design effective oral, written or poster scientific presentations	Designing Efficient and Tailored Communication Supports
	Create a scientific report	Write an abstract containing the five required sections: background, objectives, hypothesis and methods, results, interpretation and conclusion Write an abstract based on climate and public health data analysis and outcomes	Writing an Abstract
	Publicize the outcomes of climate and health projects	Understand the strengths and weaknesses of specific scientific projects on climate and health (what) Understand the strengths and weaknesses of communication supports (how)	Presenting a Project on Climate and Public Health

Collaborating, Mentoring and Training on Climate Information for Public Health

Table 10. Collaborating, Mentoring and Training on Climate Information for Public Health

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
Advise, train and collaborate with public health and climate and weather professionals using relevant platforms, mechanisms and partnerships	Understand the rationale for implementing climate and health partnerships and the inherent associated challenges	Understand and illustrate the principles of integrated multi-disciplinary climate and health partnerships Understand how sustained projects and user-oriented public health outcomes arise from these partnerships	Building Sustainable Partnerships to Improve Climate-Sensitive Diseases Surveillance and Response
	Implement and/or support platforms for sharing knowledge, field experience and opportunities for collaboration in the area of climate and health	Develop, edit and disseminate paper or electronic-based networking platforms using data and information from the field (e.g., newsletter, bulletin, on-line learning platform) Tailor climate and health networking supports to relevant audience and language (e.g., in-country or regional climate and health working groups, network of CIPH alumni)	Implementing Networking and Interaction Platforms

Table 10. Collaborating, Mentoring and Training on Climate Information for Public Health (cont'd)

COMPETENCY STATEMENT	INSTRUCTIONAL GOAL	LEARNING OBJECTIVES	TOPIC
Advise, train and collaborate with public health and climate and weather professionals using relevant platforms, mechanisms and partnerships	Implement joint climate and public health interventions or operational research projects	Understand the advantages and constraints of implementing multi-disciplinary joint projects Be familiar with the range of potential partners in the area of climate and health (e.g., stakeholders, donors) Understand the principles of writing and submitting a proposal, in particular in the area of climate and health	Developing Climate and Health Proposals
	Advise and train public health and climate and weather professionals	Understand how to set the objectives, methods, materials and evaluation of a course Develop the relevant support for the course materials (e.g., binder, open-source tool for learning) Understand the logistics inherent to a course	Implementing Training Courses

Climate Information for Public Health Course Sample

To illustrate the transferability and adaptability of the frame captured by the Curriculum for Best Practices in Climate Information for Public Health, details on a sample CIPH course are provided in Appendix 2. This sample is based on the Summer Institute Training Course on Climate Information for Public Health implemented at Columbia University since 2008 by the IRI, in partnership with CIESIN and the MSPH [1, 2]. In this course, some elements of the standard Curriculum for Best Practices have been deepened, while some others were condensed. Special seminars based on tangible demonstrations and practical applications developed by members of the local climate and public health network were further implemented.

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7) Postgraduate Study by Distance Learning in Clinical Trials, Epidemiology, Infectious Diseases and Public Health. 2010, London School of Hygiene and Tropical Medicine, University of London: London, UK. p. 44.

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Appendix

Appendix 1: Name and affiliations of the professionals who provided the foundation for the CIPH courses

The professionals who shared their knowledge and experience and provided the foundation for the 2008-2010 training courses on Climate information for Public Health:

The lecturers of the 2008-2010 Summer Institutes:

Walter Baethgen, IRI

Tony Barnston, IRI

Eric Bertherat, WHO

Mark Becker, CIESIN

Michael Bell, IRI

Benno Blumenthal, IRI

Menno Bouma, LSHTM

Pietro Ceccato, IRI

Thomas Clark, CDC

Ulisses Confalonieri, Oswaldo Cruz Foundation

Stephen Connor, IRI

Remi Cousin, IRI

Ashley Curtis, IRI

John del Corral, IRI

Peter Diggle, Lancaster School of Health and Medicine

Tufa Dinku, IRI

Dia El Naiem, University of Maryland

Wayne Elliot, UK Meteorological Office

Francesco Fiondella, IRI

Alessandra Giannini, IRI

Patricia Graves, the Carter Center

Patrick Kinney, MSPH

Kim Knowlton, MSPH and NRDC

Marc Levy, CIESIN

Richard Luce, CDC

Bradfield Lyon, IRI

Stephen Morse, MSPH and USAID

Bernard Nahlen, PMI

Ousmane Ndiaye, IRI

Gilma Mantilla, IRI

Sabine Marx, CRED

Simon Mason, IRI

Judy Omumbo, IRI

Carlos Perez, IRI

Jennie Rice, Independent Consultant

Andrew Robertson, IRI

Daniel Ruiz, IRI

Knut Staring, WHO

Madeleine Thomson, IRI

Sylwia Trzaska, IRI

Pai-Yei Whung, EPA

Pascal Yaka, Burkina Faso Meteorological Office

Greg Yetman, CIESIN

Steve Zebiak, IRI

The CIPH alumni from SI2008 to SI2010:

Betty Abang, CDC, Office of Uganda

Forgor Abudulai Adams, Navrongo Health Research Center, Ghana

Wakgari Amente, Addis Ababa University

Yonas Asfaw, Ministry of Health of Ethiopia

Ayansina Ayanlade, Nigeria University of Obafemi Awolowo

Yilma Bekele, Addis Ababa University

Ali Bouattour, Tunisia Pasteur Institute

Ramesh Chand Dhiman, Indian Council of Medical Research

Viviana Ceron, Colombia National Institute of Health

Laurence Cibrelus, MSPH

Joaquim Da Silva, AFRO-WHO

Maron Fleury, Public Health Agency of Canada

Abenet Girma Dessalegn, CHWG of Ethiopia

Joy Guillemot, John Hopkins Bloomberg School of Public Health

Mary Hayden, NCAR

Seydou Tinni Halidou, ACMAD

Stephanie Kay Moore, NOAA

Louise Kelly-Hope, Liverpool School of Tropical Medicine

Diriba Korecha Dadi, Ethiopia Meteorological Office

Tiantian Li, CDC of China

Rachel Lowe, University of Exeter

Ayub Shisia Manya, Ministry of Public Health and Sanitation of Kenya

Mouhaimouni Moussa, Niger Meteorological Office

Hiwot Namaga, USAID, Office of Ethiopia

Lina Nerlander, Red Cross/Red Crescent Climate Centre

Peter Omeny, Kenya IGAD Climate Prediction and Applications Centre

Andrew Oniarah, Nigeria Meteorological Office

Mesho Radithupa, Botswana Meteorological Office

Marie Clemence Rakotoarivony, Ministry of Health of Madagascar

Cristina Recalde, National Weather and Hydrological Service of Ecuador

James Sang, Ministry of Public Health and Sanitation of Kenya

Michelle Stanton, Lancaster School of Health and Medicine

Wendy Marie Thomas, AMS

Ousmane Boubacar Touré, Malaria Research and Training Center of Mali

Jari Vaino, IFRC

Daddi Jima Wayessa, Ministry of Health of Ethiopia

Adugna Woyessa, Ethiopian Health and Nutrition Research Institute

Pascal Yaka, Burkina Faso Meteorological Office.

The CIPH alumni, lecturers and professionals who developed the Madagascar 2009 and 2010 trainings:

Nivoarimanana Andriamampianina, Madagascar Ministry of Health

Solonomenjanahary Andrianjafinirina, Madagascar Meteorological Office

Pietro Ceccato, IRI

Laurence Cibrelus, IRI

Remi Cousin, IRI

Gilma Mantilla, IRI

Judy Omumbo, IRI

Sabas Rabesahala Lalao, Madagascar Ministry of Health

Herizo Rajaonary, Madagascar National Institute of Public Health

Marie Clémence Rakoarivony, Madagascar Ministry of Health

Alain Rakotoarisoa, Madagascar National Institute of Public Health

Norohasina Rakotoarison, Madagascar Ministry of Health

Fanjasoa Rakotomanana, Madagascar Pasteur Institute

Herinjanahary Ralaiarinoro, Madagascar Meteorological Office

Huguette Ramiakajato Mavoarisoa, Madagascar Ministry of Health

Anne Marie Pierrette Ramiandrisoa Voahanginirina, Madagascar Meteorological Office

Sahondra Vololoniaina Ranivoarisoa, Madagascar Meteorological Office

Yolande Nirina Raoelina, Madagascar Ministry of Health

Nirivololona Raholijao, Madagascar Meteorological Office

Leon Guy Razafindrakoto, Madagascar Meteorological Office

Madeleine Razafindramavo Lalao, Madagascar Ministry of Health

Luciano Tuseo, WHO

Manuela Christophère Vololoniaina Nivoarisoa, Madagascar Ministry of Health.

The CIPH alumni, lecturers and professionals who developed the 2009 Ethiopia training:

Zekarias Adamu, Benishangul-Gumuz, Regional Health Bureau

Abdulhamid Ahmed, Harari Regional Health

Basazinew Alemu, Amhara Regional Health Bureau

Yonas Asfaw, Ministry of Health of Ethiopia

Meshesha Balkew, Aklilu Lemma Institute of Pathobiology, Addis Ababa University

Tony Barnston, IRI

Zayeda Beyene, Ethiopia FELTP

Fikre Bulti, Oromiya Regional Health Bureau

Remi Cousin, IRI

Mekdes Demisse, Southern Nations and Nationalities Peoples Regional Health Bureau

Tufa Dinku, IRI

Gole Ejeta, Ministry of Health of Ethiopia

Fikre Enquselassie, Department of Community Health,Addis Ababa University, and Ethiopia FELTP

Ato Ferede Mosisa, Gambela Regional Health Bureau

Asefaw Getachew, Malaria Control and Evaluation Partnership in Africa/Program for Appropriate Technology in Health (MACEAP-PATH)

Girmaw Gezahegn, Ethiopia Meteorological Office

Daddi Jima, Ethiopian Health and Nutrition Research Institute

Tsehaynesh Lema, All African Leprosy, Tuberculosis, Rehabilitation and Training Center/Armauer Hansen Research Institute (ALERT/AHRI)

Melesse Lemma, Ethiopia Meteorological Office

Gilma Mantilla, IRI

Hiwot Namaga , CHWG Ethiopia

Ousmane Ndiaye, IRI

Nebiyu Negussu, Somali Regional Health Bureau

Hailu Sebagades, Tigray Regional HIV/AIDS Secretariat Office

Haftom Taame, Ambo University

Tadele Tsehaye, School of Public Health, Addis Ababa University

Milliyon Wendabeku, Ethiopia FELTP

Negusu Worku, WHO Ethiopia Country Office

Tessema Worku, Dire Dawa Administrative Council Health Bureau

Adugna Woyessa Gemeda, School of Public Health, Addis Ababa University.

Appendix 2: Climate Information for Public Health Course Sample

Overview of the Course Sample

This two-week full-time course of 90 hours total was conducted in English and trained thirteen professionals from ten countries in the Americas, Asia and Africa in 2010[2]. Three trainees worked in the climate or meteorological sector, and the remaining nine worked either in the public health sector or in health research fields. All trainees were professionals who play a key role in decision-making for health-care planning, evaluation or control of climate-sensitive diseases.

The structure of the course provided a balance of concepts and methods from the health and climate communities using an approach deeply oriented toward methodology, gathering and using evidence for decision-making in order for the trainees to get in-depth knowledge and skills in decision-making for health-care planning of climate-sensitive diseases. The concepts presented during the morning lectures were reinforced by lunch seminars, the panel discussion, afternoon hands-on exercises using the on-line version of the IRI Data Library and Map Room, the daily quiz, the summaries of the key messages discussed on the previous day given by the trainees as well as the group discussion following the summary.

Lectures and practical sessions were held in the Lamont Doherty Campus of Columbia University, where the IRI and CIESIN are located. A panel discussion was hosted by the MSPH at the Columbia University Medical Campus with international keynote speakers from the CDC and the United Kingdom (UK) Meteorological Office.

The final part of the course consisted in a poster session where the trainees had the opportunity to present their personal projects and share their learning experience with co-participants, facilitators, alumni from previous Summer Institutes and the Climate Information for Public Health Network. In addition to the poster, trainees were assigned to write a 300-word summary of their projects. This exercise gave the opportunity to embed the concepts and approaches learned within the trainees' home institutions and areas of interest.

The individual projects the trainees conducted addressed issues as varied as: Temperature and Mortality in Beijing; Relationship between Rainfall and Dengue in Delhi; Mapping of Sand Flies in Tunisia; Mortality and Climate Variability at the National Hospital of Niamey, Niger; Analysis of the 1996-2007 Malaria Morbidity Data from the Kenyan Health Management Information System; Distribution of Plasmodium vivax and Plasmodium falciparum in Lume District, Ethiopia; Typhoid Fever and Climate in Uganda: Is there a Link?; Relationships between Climate and Year-to-year Variability in Meningitis Outbreaks: a Case Study of Burkina Faso and Niger ; Malaria Risk Mapping in Oromia, Ethiopia; Trends of Malaria in Relation to Rainfall at the Alamata Hospital in Northern Ethiopia ; Blooms of Toxin-producing Harmful Algal Blooms on the Washington State Coast, USA ; Climatological Patterns, Long Term Trend and Relationship to Environmental Parameter and Understanding Seasonality and Climate Variability as a tool for Disease Attenuation in Nigeria.

Several awards acknowledged the following outstanding performances: Best Poster, Excellence in Teaching, Involvement, active interaction and timeliness of a course facilitator during the pre course development, Best Information Technology (IT) Innovation, Best Logistic Support, Originality in the development of the course curriculum.

The course evaluation process was designed to highlight any gaps in the contents and delivery of the course material. Overall, the evaluation indicated that the trainees found the training to be very valuable, and provided them with knowledge that could be incorporated into their future work.

Description of the Sample Course

For each of the topics of the six CIPH competency domains, the following information is provided: name and affiliation of the lecturer, method of teaching, summary of the session and recommended reading(s). In this section, the titles of the topics are indicated as delivered during the sample course, and the instructional goals and learning objectives are stated only if they refer to a seminar or lecture that was developed, within a given competency statement, in addition to the standard frame because of its relevance to the context where this sample course was implemented.

In the sample CIPH course provided below, most of the practical sessions involved being familiar with the manipulation of the IRI Data Library. Consequently, the sessions related to "Computer and Information Technology" were delivered very early in the training, after trainees got introduced to the "Basic Concepts in Public Health and Climate", and the session related to "Applications using the Trainees' Datasets" was integrated into varied practical exercises. For the sake of consistency with the overall curriculum, this adaptation of the curriculum is not reflected in the chapter below.

Basic Concepts in Public Health and Climate

Introduction to Climate and Climate Information

Sylwia Trzaska, IRI

Lecture Summary:

One of the main issues of multidisciplinary research is that each discipline has its own approaches, methods and terminology, shaped during the development period of the discipline. Those are most often dictated by availability of the data and data acquisition methods, which led the discipline in given direction, sometime influenced by personal choices of people having contributed to the discipline. This lecture introduces the basic concepts in climatology to enable the participants from the Public Health Sector to efficiently interact with the Climate and Meteorological Community. For example, the notion of scale (spatial and temporal) is central to understanding climate and climate analyses and leads automatically to the distinction between climate variability and climate change (e.g., ENSO). Understanding climate/meteorological data acquisition methods and sources, and related constraints on available information as well as the basic distinction between data and information are also necessary steps to build a common understanding of what is possible. The most common analysis methods used in climate sciences will be introduced with emphasis on the importance of scale adequacy for the problem at stake.

Recommended reading:

IPCC 4th Assessment FAQs; FAQ 1.1, 1.2,1.3,2.1, 6.1, 6.2, 10.1. Available from:

» http://www.ipcc.ch/publications_and_data/ar4/wg1/en/faqs.html

Understanding Predictions and Projections in Climate

Sylwia Trzaska, IRI

Lecture Summary:

Climate forecasts or projections are often misinterpreted due to their probabilistic format, often omitted in sectorial applications. There is more and more interest in health impact of the future climate so it is important that the current generation of Public Health professionals understands what the projections can or cannot tell us. The lecture is aimed at explaining why forecasts/projections can only be produced in a probabilistic format, which, in fact, attempts to quantify the uncertainty attached to the forecast output. Sources of uncertainty as well as the main forecasting methods will be presented. We will devote some time to a practical interpretation of two examples of forecasts: the seasonal forecast and the Climate Change scenario. An important element for the decision process, forecast verification, will also be briefly introduced.

Recommended readings:

IRI Tutorials on forecasting. Available from: http://iri.columbia.edu/climate/forecast/tutorial and http://iri.columbia.edu/climate/forecast/tutorial2

IPCC 4th Assessment. Chapter 11. Introduction to Regional Projections. Available from: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch11s11-1-2.html

IPCC 4th Assessment. FAQs. Available from: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/faqs.html

Introduction to Climate-Sensitive Diseases

Gilma Mantilla, IRI

Lecture Summary:

Twenty major diseases responsible for considerable morbidity and mortality worldwide have currently been identified as influenced by climatic factors, and, as such, qualified as climate-sensitive diseases. The climate sensitive diseases are grouped may be parasitic, viral and bacterial and include those with both short and long development periods. Their sensitivities to climate differ; those with a short development period tend to be highly seasonal or epidemic in nature, with clinical manifestations readily identified and usually the basis of epidemiological research.

Malaria and dengue are the most researched of the climate-sensitive diseases, with a variety of studies conducted on different continents at different times. Studies on chronic diseases are more focused on spatial patterns, with regard to climatic factors, while acute diseases tended to be studied with respect to seasonality and inter-annual variability.

The lecture highlights what has been done to date, identifies gaps and assesses the role of climate information in improving health system performance, especially in developing countries.

Recommended reading:

Kelly-Hope L, Thomson MC. Climate and infectious diseases. In: Thomson MC, Garcia Herrera R, Beniston M, editors. Seasonal Forecasts, Climatic Change and Human Health: Springer Netherlands; 2008. p. 31-70.

Core Concepts in Public Health and Epidemiology

Judy Omumbo, IRI

Lecture Summary:

Epidemiologists are concerned with the analysis of disease risk within population groups. Disease risk waxes and wanes between populations, geographical areas and in time. This variation is driven by environmental and social change. In the case of climate sensitive diseases, variations in disease risk are also driven by climate variability on a seasonal, annual, inter-annual or even decadal time scale. This seminar describes how time and space are used as an epidemiological framework to measure and monitor variability in disease risk. Trainees will learn how to capture and store spatial and temporal information and what aspects of space and time need to be measured and monitored for disease risk management. The rationale for organizing information, within a time and space framework and identifying patterns and associations, with the aim of providing insight to epidemiological processes is discussed.

Recommended readings:

Lafferty KD. The ecology of climate change and infectious diseases. Ecology 2009;90(4):888-900.

Climate, Vulnerability, and Health: International and National Perspectives

Ulisses Confalonieri, Oswaldo Cruz Foundation

Lecture Summary:

Human health can be affected by global climate change in several ways, mediated by the environment and the social characteristics, which includes the health systems. The Intergovernmental Panel on Climate Change (IPCC), in its Fourth Assessment Report, has identified a few observed effects of the changed climate on health, mostly in Europe, but several others are projected for the next decades, such as the spatial redistribution of vector-borne diseases, increase in under nutrition, diarrhea in tropical countries as well as accidents caused by weather extremes and respiratory ailments an many parts of the world. The major task for the health sector is to develop adequate adaptation strategies, which means to reduce the vulnerability of societies. This should be made by public policies oriented by quantitative and comparative assessments of vulnerability that take into account epidemiological, environmental, social and climatic information.

Recommended readings:

Confalonieri U, Menne B, Akhtar R, Ebi KL, Hauengue M, Kovats RS, et al. Human health. In: Parry ML, Canziani OF, Palutikof JP, Linden PJvd, Hanson CE, editors. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press; 2007. p. 391-431.

Confalonieri UEC, Marinho DP, Rodriguez RE. Public health vulnerability to climate change in Brazil. Clim Res 2009;40:175-186.

Climate Adaptation in Public Health

Carlos Perez, IRI

Lecture Summary:

Adaptation to the beneficial and deleterious impacts of climate change is a priority, and there is growing attention to integrate adaptation and mitigation as key components of a vision of and a strategy for sustainable development. It is important to identify, develop and implement effective responses to enhance adaptive capacity and reduce vulnerability of populations, regions and economic sectors. The presentation and discussions among participants will focus on themes related to promoting planned and autonomous adaptation in order to improve resilience in a changing climate. The presentation will also point out the important role that the scientific community may play in advancing the information and knowledge base that would help in adaptation.

Recommended readings:

Heltberg R, Siegel PB, Jorgensen SL. Addressing human vulnerability to climate change: Toward a 'no-regrets' approach. Global Environmental Change 2009;19(1):89-99.

Patwardhan A, Downing T, Leary N, Wilbanks T. Towards an integrated agenda for adaptation research: theory, practice and policy: Strategy paper. Current Opinion in Environmental Sustainability 2009;1(2):219-225.

Climate Risk Management in Public Health

Madeleine Thomson, IRI

Lecture Summary:

During the past decade, the global health community has advocated for, planned and began resourcing global health initiatives focused on the needs of the poor - as indicated by the United Nations Declaration on the Millennium Development Goals (MDGs). The arrival of climate change on the global health centre stage, was marked by the address on climate change and global public health in November 2007 by Margaret Chan Director-General of the WHO - “Climate change will affect, in profoundly adverse ways, some of the most fundamental determinants of health: food, air, water.”

As societies in general and the health community in particular, start to adapt to climate change, will this new agenda detract from, or support the pro-poor global health agenda that has been so long in the making? Climate knowledge and information can form a bridge between these two agendas - managing the climate related risks of today while improving our understanding of the risks of tomorrow.

Recommended readings:

Campbell-Lendrum D, Bertollini R, Neira M, Ebi K, McMichael A. Health and climate change: a roadmap for applied research. The Lancet 2009;373(9676):1663-1665.

Connor S, Omumbo J, Green C, DaSilva J, Mantilla G, Delacollette C, et al. WS-1 Climate and human health: Health and Climate - Needs. In: World Climate Conference 3; 2009; Geneva, Switzerland; 2009 (in press).

Kelly-Hope L, Thomson MC. Climate and infectious diseases. In: Thomson MC, Garcia Herrera R, Beniston M, editors. Seasonal Forecasts, Climatic Change and Human Health: Springer Netherlands; 2008. p. 31-70.

Climate Risk Management and Development

Walter Baethgen, IRI

Lecture Summary:

Introducing and improving climate risk management in the health sector requires full cooperation of climate scientists, climate information providers and agents acting at different levels of the health sector. Such cooperation must be oriented to establish interdisciplinary activities that create climate products, information and tools that effectively inform planning and decision making in the health sector. Adequate interaction between these communities enhances knowledge exchange, ensures adequate identification of problems/demands, and helps to tailor climate related information and products that effectively assist the health community. The history of the first fifteen years of the IRI has taught valuable lessons on the balance needed to maintain scientific excellence and ensure socioeconomic relevance.

Recommended readings:

Baethgen WE. Climate Risk Management for Adaptation to Climate Variability and Change. Crop Science 2010;50(Supplement 1).

Pielke R, Prins G, Rayner S, Sarewitz D. Climate change 2007: lifting the taboo on adaptation. Nature 2007;445(7128):597.

Linking ENSO and Society

Tony Barnston, IRI

Lecture Summary:

ENSO (La Niña and El Niño) refers to the year-to-year variation of sea surface temperature in the central and eastern tropical Pacific relative to its long-term average. The state of ENSO is important because it is known to influence the climate throughout various parts of the world, depending on the season, making possible advance warning of above or below average precipitation and/or temperature. Such variations of seasonal climate, in turn, may affect society in many ways. Some of these impacts are obvious, such as a negative impact of below-average rainfall on agricultural yield and on water reservoirs, or of above-average rainfall on malaria incidence in regions of epidemic malaria. Other impacts may be positive, such as reduction in heating requirements for extra tropical regions having a warmer-than-normal winter related to the ENSO state. Here we discuss these and other ways in which ENSO matters to human society, and how its effects can be anticipated and managed both to minimize negative effects and exploit positive ones.

Recommended readings:

McPhaden MJ, Zebiak SE, Glantz MH. ENSO as an integrating concept in earth science. Science 2006;314(5806):1740.

Thomson MC, Mason SJ, Phindela T, Connor SJ. Use of rainfall and sea surface temperature monitoring for malaria early warning in Botswana. The American journal of tropical medicine and hygiene 2005;73(1):214.

Climate and Vector-Borne Diseases Dynamics

Madeleine Thomson, IRI

Lecture Summary:

Vector-borne diseases present serious problems to human health and welfare around the world, especially in tropical and subtropical regions. According to recent reports of the World Health Organization nearly half of the world's human population is affected by vector-borne diseases; with malaria, schistosomiasis, onchocerciasis and leishmaniasis infecting 270, 200, 90, eighteen and twelve million people, respectively.

The role of climate in the transmission dynamics of vector-borne diseases in the context of replication of disease agents in their vectors and breeding, survival, distribution, abundance and longevity of vectors will be discussed. Due attention will also be given to the impact of climate change on the pattern of disease transmission and the geographical distribution of some diseases.

Recommended reading:

Gage KL, Burkot TR, Eisen RJ, Hayes EB. Climate and vector-borne diseases. American journal of preventive medicine 2008;35(5):436-450.

History of Climate and Malaria – Does Causality Matter?

Menno Bouma, London School of Hygiene and Tropical Medicine

Lecture Instructional Goal:

Obtain a historical and contextual perspective of malaria cycles and epidemic predictability in relation to climate cycles (El Nino Southern Oscillation) and non-climatic drivers.

Learning Objectives:

Appreciate causality attribution problems between climate (and co-linear climate weather parameters), immunity and socio-economic factors.

Summary:

The empirical association between weather-climate and diseases goes back a few thousand years. However, the attribution of causality has been, as illustrated by the origin of the word "malaria" - and still is, a major challenge. Supra-annual "cycles" observed in parts of the malarial world, offer, if predictable, the possibility to be forewarned and forearmed. Sea surface temperatures and air pressure anomalies in the Pacific related to El Nino, and other climate-weather anomalies, show such promise for malaria and some other diseases. The deterministic mechanisms however are not always obvious, and some have even questioned the need to consider climate at all. An overview is given of periodic malaria epidemics on a global scale, and the possible climatic and non-climatic explanations, with some methodological pitfalls and the difficulties in some cases to attribute causality. Understanding the precise mechanisms and the contextual determinants are important for malaria early warning system (MEWS) to become operationally relevant.

Recommended readings:

Bouma MJ, Sondorp HE, Van der Kaay HJ. Climate change and periodic epidemic malaria. The Lancet 1994;343(8910):1440.

Zurbrigg S. Re-thinking the" human factor" in malaria mortality: the case of Punjab, 1868-1940. Parassitologia 1994;36:121-121.

Climate Change and Human Health: Current Impacts and Future Risks

Patrick Kinney, MSPH

Lecture Summary:

One of today's greatest public health challenges is to enhance population health in the face of emerging risks related to climate change. Scientists predict that climate change may lead to:

- Increasing heat-related deaths;
- Diverse health impacts of more intense storms and flood events;
- Risks to water quality, agricultural productivity, and regional peace due to shifting water resources;
- Worsening air quality and asthma;
- Changing patterns of vector-borne and other infectious diseases.

However, the scientific knowledge base upon which to build strategies to reduce health impacts of climate change is surprisingly sparse. By partnering with climate scientists, health scientists have the ability to make significant scientific advances to understand, anticipate, and prevent adverse health consequences. This lecture will provide an introduction to this topic and discuss challenges and opportunities for new research.

Recommended readings:

Knowlton K, Lynn B, Goldberg RA, Rosenzweig C, Hogrefe C, Rosenthal JK, et al. Projecting heat-related mortality impacts under a changing climate in the New York City region. American journal of public health 2007;97(11):2028-2034.

Pan American Health Organization. Climate change and human health: risk and responses: revised summary 2008. Washington DC; 2008.

Climate Change, War and Disease,

Dia El Naiem, University of Maryland

Lecture Instructional Goal:

Discuss the eco-epidemiology of Visceral Leishmaniasis in Sudan in relation to climate change and the possible impact of drought and civil War in Darfur on Recent Epidemics of kala azar in eastern Sudan.

Learning Objectives:

Be introduced to the basic environmental factors affecting the epidemiology of kala azar in Sudan and other areas in East Africa

Understand how GIS and environmental mapping can help in risk-mapping and control of leishmaniasis.

Understand how Sahelian drought and Darfur War have surprisingly influenced kala azar epidemiology in areas that are located far away from the conflict zone.

Summary:

The Epidemiology of vector-borne diseases is influenced by climatic factors that affect the ecology of the vectors and the exposure of human populations to the pathogens. This lecture addresses the eco-epidemiology of visceral leishmaniasis (VL, kala azar), a neglected tropical disease that occurs within a defined climate space and affects some of the poorest communities in the world. One of the notable features of the epidemiology of kala azar in East Africa is that it remains silent for many years and then erupts in severe epidemics that affect the lives of thousands of people. Although environmental information models allowed the prediction of the transmission areas of the VL in Sudan, studies have overlooked the importance of climate-related socioeconomic factors that lead to Darfur War and migration of susceptible populations into kala azar transmission foci. Discussion will include possible effects of these factors on the future epidemiology of the disease.

Recommended readings:

Elnaiem DA, Schorscher J, Bendall A, Obsomer V, Osman ME, Mekkawi AM, et al. Risk mapping of visceral leishmaniasis: the role of local variation in rainfall and altitude on the presence and incidence of kala-azar in eastern Sudan. The American journal of tropical medicine and hygiene 2003;68(1):10.

Thomson MC, Elnaiem DA, Ashford RW, Connor SJ. Towards a kala azar risk map for Sudan: mapping the potential distribution of Phlebotomus orientalis using digital data of environmental variables. Tropical medicine and international health 1999;4(2):105-113.

Public Health Surveillance and Opportunities to use Climate Information

Richard Luce, CDC

Lecture Summary:

The main purpose of surveillance is to control a disease or health condition. Therefore, surveillance is the critical foundation of knowledge upon which public health response, programs, and policy depend. Surveillance is the obligatory first step that is required to objectively identify a health problem. Once identified it is possible to investigate underlying contributing factors. Quality surveillance ensures appropriate and targeted interventions, more effective use of resources as well as meaningful monitoring and evaluation of control and prevention programs. Collection of surveillance data should be interpreted, analyzed and disseminated and linked to public health action. The use of climate data in surveillance is under developed, but has the potential to enhance the usefulness of surveillance by adding predictive and explanatory power.

Recommended readings:

Nsubuga P, White ME, Thacke SB, Anderson MA, Blount SB, Broome CV, et al. Public Health Surveillance: A Tool for Targeting and Monitoring Interventions. In: Disease Control Priorities in Developing Countries, 2nd edition; 2006. p. 997-1015.

Centers for Disease Control and Prevention, Department Of Health And Human Services. Malaria Surveillance — United States, 2007. Morbidity and Mortality Weekly Report 2009;58(SS-2):1-17.

Data, Methods and Tools for Analyzing Climate and Public Health Data

Understanding Data and Data Quality Control

John del Corral, IRI

Lecture Summary:

Precisely describing the time and locale of the data is a major step in the data analysis process. This is particularly true in the instance of geo-referenced climate and health data, that we want to analyze temporally and spatially.

Ensuring good data quality includes: 1) ensuring self-consistency, 2) ensuring geographical consistency, and 3) providing with useful and useable metadata.

Although this process may appear as quite demanding and time-consuming, it shall not be neglected because it: 1) simplifies subsequent analysis, 2) allows more sophisticated functions to be applied, and 3) allows ready comparison with other datasets.

This lecture will lead the trainees through the different steps required to control the quality of their datasets.

Data Constraints and Limitations: the Instance of the Temperature Trends in the Highlands of Kenya

Bradfield Lyon, IRI

Lecture Summary:

Several studies have considered the impact of climate change, and temperature in particular, on the distribution and incidence of malaria in the highland regions of East Africa. The results, however, often led to different conclusions. This was in part related to the fact that they typically used different climate datasets, which were either interpolated analyses based on station observations or an insufficient set of station observations, or length of record, for the specific areas of interest.

It is indeed a critical issue to understand the climate (or health) data being used in any study, including limitations in using such data before conducting any analysis. This includes the issue of data quality but also using the appropriate time scale of information (e.g., daily versus monthly rainfall data) for the health question being considered. One needs to take into account the caveats to using gridded data derived from point observations, for example, to avoid drawing potentially inappropriate conclusions from the analysis. Indeed, any analysis should begin with a simple, exploratory step that can subsequently be followed by more sophisticated methods. It is recommended that when undertaking interdisciplinary studies experts from across disciplines are involved to help minimize misinterpretation of the datasets being used.

This lecture illustrates these points through considering the analysis of the relation between malaria and temperature in the highlands of Kenya.

Recommended readings:

Hay SI, Cox J, Rogers DJ, Randolph SE, Stern DI, Shanks GD, et al. Climate change and the resurgence of malaria in the East African highlands. Nature 2002;415(6874):905-909.

Patz JA, Hulme M, Rosenzweig C, Mitchell TD, Goldberg RA, Githeko AK, et al. Climate change (Communication arising) Regional warming and malaria resurgence. Nature 2002;420(6916):627-628.

Remote Sensing as a Source and a Tool to Manage Environmental Data

Pietro Ceccato, IRI

Lecture and Practical Session

Summary:

Remote sensing is the science of obtaining information about an object through the analysis of data acquired by a device (sensor) that is not in contact with the object (remote). As you read these words, you are employing remote sensing. Your eyes are acting as sensors that analyze the electromagnetic waves (visible light) reflected from this page. The light your eyes acquire is analyzed in your mental computer to enable you to explain the words. Apart from the eyes, more sophisticated sensors have been developed to measure the electromagnetic waves in domains outside the visible. By measuring the electromagnetic waves in domains from Gamma rays to Microwaves, we can retrieve information on objects we want to study.

Recommended readings:

Ceccato P, Dinku T. Introduction to Remote Sensing for Monitoring Rainfall, Temperature, Vegetation and Water Bodies. IRI Technical Report. Available at: http://iri.columbia.edu/publications/id=986

Ceccato P, Connor SJ, Jeanne I, Thomson MC. Application of Geographical Information Systems and Remote Sensing technologies for assessing and monitoring malaria risk. Parassitologia 2005;47(1):81-96.

Summarizing Climate and Health Data Using Descriptive Statistics and Map Tools,

Michael Bell, IRI

Lecture and Practical Session

Summary:

As a first step to understanding or summarizing a data set of observations, whether of climate or health information, it is often useful to calculate exploratory or descriptive statistics of the data. The IRI Data Library includes functions and options useful for calculating and displaying such statistics. This session presents fundamentals of using Expert Mode in the Data Library and practical exercises to calculate measures of central tendency and spread and spatial averages of gridded data.

Recommended reading:

Statistical Techniques in the Data Library: A Tutorial:

http://iridl.ldeo.columbia.edu/dochelp/StatTutorial/

Principles of Trends and Time Series Analysis

Andrew W. Robertson, IRI

Lecture Summary:

Climate and epidemiological data are often recorded as time series of a measurement at some location. Historical records of weather data have lead to much of our understanding of weather and climate, in terms of daily weather fluctuations, seasonality, interannual "climate" variations, and longer term trends. Epidemiological time-series data may show similar and contrasting features, and exploratory analysis of (univariate) time series forms the starting point for more complex statistical analysis, to identify associations between health and climate data, for example.

The lecture will illustrate simple exploratory analyses of univariate time series, including how time-averaging can be used to separate different aspects of a climate time series, such as weather, the seasonal cycle, interannual variability, and longer-term variability and trends. We will illustrate the differing characteristics of temperature, rainfall, and malaria count data using an example from Colombia, and consider the implications for defining "normal" and "unusual" features in time series, and identification of associations between climate and epidemiological data.

Recommended readings:

Tian L, Bi Y, Ho SC, Liu W, Liang S, Goggins WB, et al. One-year delayed effect of fog on malaria transmission: a time-series analysis in the rain forest area of Mengla County, south-west China. Malaria Journal 2008;7(1):110.

Briët OJT, Vounatsou P, Gunawardena DM, Galappaththy GNL, Amerasinghe PH. Temporal correlation between malaria and rainfall in Sri Lanka. Malaria Journal 2008;7(1):77.

Introduction to Cluster Analysis

Andrew Robertson, IRI

Lecture Summary:

In multivariate data analysis, identifying any shared behavior between locations or variables is a key simplifying step. This lecture will teach how such data can be stratified into groups using cluster analysis, in order to identify patterns, and to facilitate the identification of associations between climate and health data.

We will learn how the K-means method partitions a set of observations into sub-groups, based on their similarity according to a measure of the "distance" between them, and so as to minimize the scatter within each cluster. Examples will include July temperatures at US cities, and malaria data gathered for Eritrea. We will try to answer the following questions: Do the patterns identified by cluster analysis always correspond to "real" underlying processes, or could they result from random data? When is cluster analysis a good choice for analyzing health and climate data?

Recommended readings:

Ceccato P, Ghebremeskel T, Jaiteh M, Graves PM, Levy M, Ghebreselassie S, et al. Malaria stratification, climate, and epidemic early warning in Eritrea. The American journal of tropical medicine and hygiene 2007;77(6 Suppl):61.

Wikipedia: http://en.wikipedia.org/wiki/K-means_clustering

Exercises on K-means and Cluster Analysis: Malaria Seasonality

Pietro Ceccato, IRI

Exercise Summary:

Cluster analysis or clustering is the assignment of objects into groups (called clusters) so that objects from the same cluster are more similar to each other than objects from different clusters. Often similarity is assessed according to a distance measure. Clustering is a common technique for statistical data analysis, which is used in many fields, including machine learning, data mining, pattern recognition, image analysis and bioinformatics.

Lagged Correlation of Rainfall with Malaria Incidence

Michael Bell, IRI

Lecture and Practical Session Summary:

One challenge of relating climate conditions to epidemiological conditions is to re-express these data in the same spatial and temporal framework. For example, while epidemiological data may be collected by health district, climate data are often available by station or in a gridded format. This session shows how to use the Data Library to put climate and health data into a common spatial and temporal framework, map data by district, and calculate correlations and lagged correlations by district.

Recommended reading:

Statistical Techniques in the Data Library: A Tutorial: http://iridl.ldeo.columbia.edu/dochelp/StatTutorial/

Disease Spatio-temporal Modeling: the Instance of Meningococcal Meningitis

Peter Diggle, Lancaster School of Health and Medicine

Lecture Summary:

Meningitis incidence across the "meningitis belt" of sub-Saharan Africa shows an irregular cyclic pattern, with large year-to-year variations. In the affected countries, incidence data are typically collected weekly at district level, and a local epidemic declared in any district for which incidence exceeds a fixed threshold. Three limitations of this approach are:

1. It is reactive rather than anticipatory;
2. It does not draw on relevant information from incidence in neighboring districts;
3. Nor does it make use of patterns of association between incidence and environmental predictors.

In this lecture, I will use data from Ethiopia to show how recently developed statistical methodology for spatio-temporally indexed data can be used to develop a predictive approach to meningitis incidence that attempts to overcome the above limitations.

Recommended reading:

Fanshawe TR, Diggle PJ, Rushton S, Sanderson R, Lurz PWW, Glinianaia SV, et al. Modelling spatio-temporal variation in exposure to particulate matter: a two-stage approach. Environmetrics 2007;19(6):549-566.

Malaria Mapping and the Climate Suitability for Malaria Transmission Tool in the Health Map Room

Judy Omumbo, IRI

Lecture and Practical Session Summary:

Disease maps are an important epidemiological tool for understanding the variability of disease distribution in time and in space, which is in part determined by climate. Maps of the suitability of climatic conditions for malaria transmission in a region have been applied widely in areas where empirical disease data are sparse, including for malaria control programs. The development of the malaria parasite and the mosquito vectors is sensitive to temperature, rainfall and humidity. Rainfall plays an important role in the distribution and maintenance of vector breeding sites. Temperature regulates the development rate of both the mosquito larvae and the malaria parasite, Plasmodium falciparum, within the mosquito. Relative humidity and temperature play an important role in the survival and longevity of the mosquito. Using historical data under laboratory conditions, Climate Suitability for Malaria Transmission is defined as the coincidence of precipitation accumulation greater than 80 mm, mean temperature between 18˚C and 32˚C, and relative humidity greater than 60 percent.

Recommended readings:

Craig MH, Snow RW, Le Sueur D. A climate-based distribution model of malaria transmission in sub-Saharan Africa. Parasitology today 1999;15(3):105-110.

Grover-Kopec EK, Blumenthal MB, Ceccato P, Dinku T, Omumbo JA, Connor SJ. Web-based climate information resources for malaria control in Africa. Malaria Journal 2006;5(1):38

Using GPS, GIS and Google Maps for Public Health

Mark Becker, CIESIN

Lecture Summary:

GPS is an increasingly popular way of collecting location information related to health studies. With GPS we can easily create highly accurate spatial data files to indicate the location of health clinics, schools, transportation routes and patient's home locations or village location. In this exercise students will learn the proper use of a standard GPS data collection unit and gain an understanding of procedures to insure data accuracy and integrity. Students will also learn what tools are available for downloading their GPS data and converting it into formats accepted by, Google Earth®/Google Maps® and ArcGIS®.

Recommended reading:

Montana L, Spencer J. Incorporating Geographic Information into MEASURE Surveys: A Field Guide to GPS Data Collection and Demographic and Health Survey GPS Cluster Position Form. Calverton; 2005.

Using GIS to Exploring the Links between Poverty and Natural Hazards

Mark Becker, CIESIN

Practical Session Instructional Goal:

Explore how to use GIS to analyze and quantify the relationship between a population's level of poverty and their exposure to natural hazards.

Learning Objectives:

Use ArcGIS® to learn basic spatial analysis techniques of overlays and intersections to create tables, charts and maps showing the ratio of people living in extreme poverty and their relative exposure to natural hazards

Summary:

This hands-on GIS exercise has students learning to use the analysis tools in ArcGIS® to explore the relationship of poverty levels and exposure to natural hazards. Students will become familiar with the primary spatial data sets used to illustrate poverty and natural hazards across the globe. Students will produce a series of final products including maps and charts to show the results of their analysis.

Recommended reading:

Warner K, Erhart C, de Sherbinin A, Adamo SB, Chai-Onn TC. "In search of Shelter: Mapping the effects of climate change on human migration and displacement." A policy paper prepared for the 2009 Climate Negotiations. Bonn: United Nations University Institute for Environment and Human Security, CARE International, and Center for International Earth Science Information Network at the Earth Institute of Columbia University; 2009.

Use of Climate Information in Decision-making for Climate-Sensitive Diseases

Useful and Usable Climate Products

Ousmane Ndiaye, IRI

Lecture Summary:

As climate science becomes increasingly sophisticated, more sophisticated climate products are developed. Although these state-of-the-art climate products may look very appealing, they will be useless unless their design and implementation are driven by the end users' demands and tailored to their needs and expectations. The consideration of users' demands is extremely important, as the development of climate products is both time-consuming and resource-intensive; wasting scarce human and computational resources is not satisfactory.

This presentation will detail how to tailor a product to the end user, focusing both on what we want to achieve and on what is achievable. It will also emphasize the critical importance of continually considering the rationale and objectives of the project during implementation in order to ensure the project's usefulness and usability.

Recommended readings:

Visit the 'Climate Predictability Tool' Web-page at:

» http://portal.iri.columbia.edu/portal/server.pt?open=514&objID=7264&qid=75549868&rank=1&parentname=SearchResult&parentid=1&mode=2&in_hi_userid=2&cached=true

Visit the following Web page: World Meteorological Organization, World Climate Application and Service Program (WCASP). Regional Climate Outlook Products. Available from:

» http://www.wmo.ch/pages/prog/wcp/wcasp/clips/outlooks/climate_forecasts.html

Climate Prediction for Weather Forecast Skeptics

Simon Mason, IRI

Lecture Summary:

In order to predict the weather we need to know (a) what the weather is like now, and (b) how the current weather is likely to evolve. Our lack of knowledge of the exact weather conditions right now is the primary reason why weather forecasts become inaccurate after only a few days, because small errors in that knowledge rapidly grow into large errors in the predicted weather. Although it is impossible to forecast the exact weather at any given moment beyond a few days into the future, it is possible to predict whether wet, or dry conditions, for example, are likely to be unusually frequent and/or intense. These predictions are possible at seasonal scales because in some parts of the world, and at some times of the year, the atmosphere can be affected by unusual conditions at the earth's surface, especially the surface of the sea.

Recommended reading:

Mason SJ. "Flowering Walnuts in the Wood" and Other Bases for Seasonal Climate Forecasting. In: Thomson MC, Garcia Herrera R, Beniston M, editors. Seasonal Forecasts, Climatic Change and Human Health: Springer Netherlands; 2008. p. 13-29.

The Weather Roulette Game: How to Make Decisions given Probabilistic Forecasts

Simon Mason and Ashley Curtis, IRI

Practical Session Summary:

A series of ten seasonal forecasts will be issued, and the delegates will be required to make investment choices based on the forecasts. The forecasts are presented in standard format, with three probabilities indicating the chances of "below-normal", "normal" and "above-normal" rainfall. The forecasts and observations are drawn from a real operational set of forecasts and observations, but the location and years are not revealed so that the participants cannot cheat using any prior knowledge. The participants will make profits or losses depending upon the amount invested on the category that occurs. Their profits and losses will be accumulated over a ten-year period. The delegates will work in pairs, and the team that accumulates the largest profit wins.

Malaria Vector Distribution and Rainfall

Judy Omumbo, IRI

Lecture Summary:

Public health practitioners must make decisions based on quick assessments relying on limited information. This exercise uses a map tool to spatially describe the distribution of malaria vectors, enabling decision making on what would work best.

Key determinants of Anopheles mosquito distribution (the malaria vector) are their feeding, resting and habitat preferences, classifying them anthropophilic, exophilic, endophilic or zoophilic (refer to glossary for definitions).

Some studies have shown that where there are cattle around a homestead and malaria vectors are predominantly zoophilic, the human population tends to have less malaria infection. Most mosquitoes prefer to breed in stagnant fresh water but there are a few species that are salt water breeders. These behavior traits, however, are not absolute and a zoophilic vector may feed on humans if animal hosts are not readily available. The behavioral differences displayed by malaria vectors are exploited for targeting interventions for controlling malaria.

Recommended reading:

Coetzee M, Craig M, Le Sueur D. Distribution of African malaria mosquitoes belonging to the Anopheles gambiae complex. Parasitology today 2000;16(2):74-77.

Malaria Early Warning and Early Response

Stephen Connor, IRI

Lecture Summary:

Climate informed Malaria Early Warning Systems have been of interest for many years – at least since the beginning of the 20th century. The rationale behind MEWS is simply the pursuit of reliable and timely information on any changes in epidemic potential occurring that may be taking place. The information needs to be focal, i.e. applicable to specific geographic regions prone to epidemics; and timely, i.e. able to offer sufficient lead-time for health services to be able to mobilize effective prevention and control interventions.

The integrated MEWS approach developed since the inception of Roll Back Malaria in 1998 aims to assemble a set of available indicators from the spectrum between these two extremes, and to use these indicators to build up incremental evidence to stimulate and guide more timely and focal prevention and control of malaria epidemics.

Recommended readings:

Thomson MC, Doblas-Reyes FJ, Mason SJ, Hagedorn R, Connor SJ, Phindela T, et al. Malaria early warnings based on seasonal climate forecasts from multi-model ensembles. Nature 2006;439(7076):576-579.

DaSilva J, Garanganga B, Teveredzi V, Marx SM, Mason SJ, Connor SJ. Improving epidemic malaria planning, preparedness and response in Southern Africa. Malaria Journal 2004;3(1):37.

Integrated Malaria Surveillance and Control System for Malaria in Colombia

Daniel Ruiz, IRI

Lecture Summary:

Dynamical models have played a significant role in understanding the complexity of malaria transmission dynamics. In the first part of this lecture we will study several malaria process-based models. In the second part, we will implement some of these tools to: (a) explore the role that both climatic and non-climatic factors play in fluctuations and trends in malaria incidence; (b) compare their simulation outputs with actual malaria morbidity profiles observed in a specific malaria-prone region; (c) simulate the impact of intervention campaigns; and (d) assess several changing climate and future scenarios. Finally, the group will explore the ongoing efforts of the Colombian Integrated Surveillance and Control System project.

Recommended reading:

Ruiz D, Connor SJ, Thomson MC. A Multimodel Framework in Support of Malaria Surveillance and Control. In: Thomson MC, Garcia Herrera R, Beniston M, editors. Seasonal Forecasts, Climatic Change, and Human Health: Springer Netherlands; 2008. p. 101-125.

Malaria Epidemic Detection and Monitoring using Thresholds in the IRI Data Library

Patricia Graves, the Carter Center and Michael Bell, IRI

Lecture and Practical Session Summary:

Detailed empirical data on malaria cases in space and time is needed in order to define the normal situation of malaria in a given area and to define epidemics. The geographical units used in the definition should correspond to planning units to facilitate response and prevention. Examples of malaria epidemics are illustrated with reference to a dataset of cases by subzone and month from Eritrea, 1997 to 2003. Several different proposed methods for estimating malaria epidemic thresholds are given, including third quartile, the mean plus 1 or 2 standard deviations, the moving average and the C-Sum method. It is emphasized that an epidemic definition is a practical and planning decision, with no objective standard. The participants will produce graphs that illustrate the different thresholds estimated for particular subzones and will quantify epidemics that occurred in particular time periods as an indicator of malaria control or for relating to climate factors.

Recommended readings:

Hay SI, Simba M, Busolo M, Noor AM, Guyatt HL, Ochola SA, et al. Defining and detecting malaria epidemics in the highlands of western Kenya. Emerging Infectious Diseases 2002;8(6):555-562.

Cullen JR, Chitprarop U, Doberstyn EB, Sombatwattanangkul K: An epidemiological early warning system for malaria control in northern Thailand. Bull World Health Organ 1984, 62:107-114.

Influenza Seasonality and Early Warning

Stephen Morse, MSPH and USAID

Lecture Instructional Goal:

Better understand the seasonality of infectious diseases, using influenza as an example, opportunities for disease early warning.

Learning Objectives:

- Review current knowledge of influenza seasonality, and discuss current knowledge gaps to be addressed to implement an influenza early warning system
- Present and compare evidence of seasonality in temperate and sub-tropical regions
- Introduce concepts of 'emerging infections", and their ecological and environmental drivers
- Discuss evidence for seasonality (or at least periodicity) of human infections with H5N1 (avian) influenza

Summary:

Many infectious diseases show well-known seasonality. Influenza, a common respiratory viral infection, is often cited as a prime example of "seasonal" disease, occurring mostly during the winter in temperate regions. In tropical and sub-tropical regions however, influenza shows a very different pattern of seasonality, with peaks in both October through March and in the summer. Understanding these patterns may serve to implement an influenza early warning system using, in particular, climate information.

In addition to the "seasonal" influenza, pandemics occur from time to time. Pandemics are caused by novel subtypes, and may spread rapidly throughout the world. There were three well-documented pandemics in the 20th Century and another in 2009. Most virologists believe that pandemics are virtually inevitable. However, these have been notoriously difficult to predict in advance. Interestingly, in the two United States, several pandemics appeared at unusual times, even during the summer (the 1957 pandemic appears to have begun in the United States in July, the H1N1-2009 in April and through the spring and summer).

Recommended readings:

Shaman J, Kohn M. Absolute humidity modulates influenza survival, transmission, and seasonality. Proceedings of the National Academy of Sciences 2009;106(9):3243.

Altizer S, Dobson A, Hosseini P, Hudson P, Pascual M, Rohani P. Seasonality and the dynamics of infectious diseases. Ecology Letters 2006;9(4):467-484.

Meningitis Environmental Risk Information Technologies (MERIT)

Madeleine Thomson, IRI

Lecture Summary:

Meningococcal meningitis is an environmental disease whose spatial and seasonal distribution is readily described by climatic and environmental characteristics. Epidemics of meningococcal meningitis occur throughout sub-Saharan Africa, most frequently in an area, known as the 'Meningitis Belt' that stretches from the Sahelian zone of West Africa to the Horn of Africa. This region is a major source of atmospheric dust over most of north and western Africa and has epidemics and seasonal upsurges in endemic disease in the latter part of the dry season, characterized between November and May by low absolute humidity and the dust-laden Harmattan trade winds. Given the association of the epidemics with a dry and dusty environment and their higher incidence in the 'Meningitis Belt', recent research has focused on developing maps that identify the populations at high risk of epidemics and climate-driven early warning systems that could provide longer lead-times for initiating response. The relevance of this work and the associated development in information technologies to the implementation of current and future epidemic meningitis control strategies in Africa are discussed in this lecture.

Recommended readings:

Cuevas LE, Jeanne I, Molesworth A, Bell M, Savory EC, Connor SJ, et al. Risk mapping and early warning systems for the control of meningitis in Africa. Vaccine 2007;25:A12-A17.

Roberts L. Infectious disease: an ill wind, bringing meningitis. Science 2008;320(5884):1710-1715.

Additional resources:

Video: The International Research Institute for Climate and Society at the Earth Institute CU. Climate and Health in Africa. Google Tour; 2009. Available from: http://www.google.com/landing/cop15/

Web link: Visit the Web-page of the MERIT initiative at http://Merit.hc-foundation.org

Heat Waves in the USA from the Climate Perspective,

Bradfield Lyon, IRI

Lecture Instructional Goal:

Gain an increased awareness of some important characteristics of heat waves from a climate perspective.

Learning Objectives:

Provide a general overview of the large-scale view of heat waves.

Emphasize the local-scale aspects of heat waves, including examples of behavior in a warming climate

Summary:

Reasons for studying heat waves will be briefly discussed followed by some of the difficulties in defining a heat wave. The concept of a heat index will then be introduced. The 1995 heat wave in the US will be considered by examining the large-scale atmospheric circulation associated with the heat wave as well as important local-scale features of the heat wave using Chicago as an example. The final segment of the lecture will briefly examine how all warming is not "equal" when considering climate change.

Recommended readings:

Kunkel KE, Changnon SA, Reinke BC, Arritt RW. The July 1995 heat wave in the Midwest: A climatic perspective and critical weather factors. Bulletin of the American Meteorological Society 1996;77(7):1507-1518.

Lebassi B, González J, Fabris D, Maurer E, Miller N, Milesi C, et al. Observed 1970–2005 Cooling of Summer Daytime Temperatures in Coastal California. Journal of Climate 2009;22:13.

Heat Waves and Public Health: a USA Case Study

Kim Knowlton, NRDC and MSPH

Lecture Instructional Goal:

Discuss the effects of heat waves on public health, and help participants identify potential local strategies for reducing vulnerability to heat waves' harmful health effects.

Learning Objectives:

Describe heat vulnerability factors- different categories and some specific examples

Discuss a case study that evaluated morbidity from a US heat wave

Identify strategies for enhancing heat wave preparedness to help prevent heat-related illness and death

Summary:

Heat waves have substantial acute effects on local populations. A large heat-mortality literature has evolved over the years, yet few studies of heat morbidity have been done. Recent work suggests that a single heat wave can have widespread effects. We will discuss a US Case Study of morbidity during a 2006 California heat wave (Knowlton et al., 2009). Heat vulnerability factors include biomedical, demographic, housing, and community geographic characteristics. We can use this information to identify the most at-risk communities for climate sensitive health outcomes. Climate models project that the frequency, intensity, and duration of heat waves will increase in the future as climate change continues. Climate-health preparedness will be enhanced by developing strategies that identify vulnerabilities, establish tracking systems, apply climate-smart design, and employ public education to protect the most climate-vulnerable among us today, thereby learning how to provide better climate-health protection for all of us in the future.

Recommended readings:

Knowlton K, Rotkin-Ellman M, King G, Margolis HG, Smith D, Solomon G, et al. The 2006 California heat wave: impacts on hospitalizations and emergency department visits. Environmental health perspectives 2009;117(1):61.

Harlan SL, Brazel AJ, Prashad L, Stefanov WL, Larsen L. Neighborhood microclimates and vulnerability to heat stress. Social Science & Medicine 2006;63(11):2847-2863.

Computer and Information Technology

Overview and Manipulation of the IRI Data Library

Michael Bell, IRI

Lecture and Practical Session Summary:

The IRI Data Library is a powerful online resource for accessing, analyzing, visualizing, and downloading climate-related data sets. It is capable of relating different types of data sets (e.g. gridded data, station data, geographic shapes) in a common data model such that relationships between gridded climate data and health data collected by geographic region, for example, can be analyzed. Specialized map and analysis tools in the IRI Map Rooms have been developed using Data Library functionality to meet specific needs in the health community and other sectors. This session provides an introduction to the IRI Data Library.

Recommended reading:

The IRI Data Library: A Tutorial. Available from: http://iridl.ldeo.columbia.edu/dochelp/Tutorial/

Controlling the Quality of Trainees' Datasets

John del Corral, IRI

Practical Session Summary:

To obtain the most accurate information out of the data, it is critical to ensure that the data used has the best quality possible before completing any analysis, even the simplest one,

Ensuring good data quality includes: 1) ensuring self-consistency, 2) ensuring geographical consistency, and 3) providing with useful and useable metadata. Although this process may appear as quite demanding and time-consuming, it shall not be neglected because it: 1) simplifies subsequent analysis, 2) allows more sophisticated functions to be applied, and 3) allows ready comparison with other datasets.

This practical session will lead the trainees through controlling the quality of their datasets and ensure the format of the datasets is compatible with use in the IRI Data Library.

Data Upload into the IRI Data Library

John del Corral, IRI

Practical Session Summary:

Many users of the Data Library from public sector professions (health, agriculture, and water management) have sector-related data from their own region or country. They would like to correlate this data with the climate and environmental data available in the IRI Data Library. An Internet accessible data upload facility is used to bring user data into the IRI Data Library. As long as this data contains spatial and temporal reference information, it can be correlated with the datasets in the Data Library.

Extracting Data from the IRI Data Library

John del Corral, IRI

Practical Session Summary:

It is possible in the Data Library to extract a subset of a particular dataset, based on time and location, or other independent variables. There can be a number of reasons to do this. One may wish to use his/her own analytical software on the subset or may only have intermittent access to the Internet. The extracted data can be delivered in several formats. This reference will describe the process of selecting and downloading data into a spreadsheet application.

Recommended reading:

Manipulating, Visualizing, and Downloading Data in the IRI Data Library: A Tutorial. Available from: http://iridl.ldeo.columbia.edu/dochelp/Tutorial/MVD/

Communication in Public Health and Climate

Creating a "Climate-Smart" Public Health Community: How do we Communicate? Who do we Train?

Panel Discussion at the MSPH, Columbia University

Opening speech: Linda Fried, MSPH

Facilitator: Madeleine Thomson, IRI

Panelists:

Wayne Elliot, UK Meteorological Office

Richard Luce, CDC, Ethiopia, FETP Resident Advisor

Patrick Kinney, Columbia Climate and Health Program, MSPH

Summary:

Increasing the health community's capacity to understand, use, and demand the appropriate climate information is of primary importance to efforts to diminish the health impacts of climate change and climate variability. However, good information is not enough. The health community must also be able to distinguish between different kinds of data to determine what is relevant, at what time scale, to their population.

To fill the current gaps, we must develop research and professional training in the use of climate information for public health decision-making that can be launched in centers of learning throughout the globe. Here, an expert panel discusses the opportunities and challenges we face in the creation of a Climate Smart health community.

How to Efficiently Use Maps as a Tool to Communicate Climate Risks and Information: Communicating and Motivating Action: Insights from Cognitive & Social Psychology and the Decision Sciences

Sabine Marx, CRED

Effective Visual Communication

Francesco Fiondella, IRI

Joint Lecture Summary:

Maps and other visual representations of data are integral forms of communication used by the climate- and meteorological-services communities. Examples include forecast maps of differing spatial and time scales, and environmental-monitoring data maps for humidity, dust and wind. Maps are powerful tools to bring out spatial distributions and relationships and make it possible to visualize and conceptualize patterns and processes that operate through space. However, in many instances, these visualizations fail at communicating valuable, usable, actionable information because they don't take into account the needs and intents of the users (health, water, agricultural, etc.). This lecture discusses some of the ways in which climate information can be communicated more effectively to different audiences. And as a group, we'll analyze an existing map product (the Federation Map room) for its effectiveness or lack thereof in communicating usable information to a target audience.

Recommended readings:

Shome D, Marx S. The Psychology of Climate Change Communication: A Guide for Scientists, Journalists, Educators, Political Aides, and the Interested Public. NY: Center for Research on Environmental Decisions, Columbia University; 2009.

Ishikawa T, Barnston AG, Kastens KA, Louchouarn P. Understanding, evaluation, and use of climate forecast data by environmental policy students. Qualitative Inquiry in Geoscience Education Research 2010.

Writing an Abstract and Presenting a Project on Climate and Public Health

Laurence Cibrelus and Gilma Mantilla, IRI

Guidelines Summary:

To demonstrate their newly acquired competency, trainees are required to write an abstract and make poster presentations of the individual CIPH projects they develop throughout the course, either individually or in a small group with trainees of both the public health and climate communities. Trainees should apply what they have learned and linking these results to the aspects of their own work or interest relevant to public health decision-making. Guidelines are provided on how to develop their projects and write a 300-word summary.

Recommended readings:

Advice on Designing Scientific Posters, by Colin Purrington, Department of Biology, Swarthmore College, Pennsylvania, available from: http://www.swarthmore.edu/NatSci/cpurrin1/posteradvice.htm

Scientific Poster Design, Cornell Center for Materials Research, Cornell University, Ithaca, NY, available from: http://sciencetalk.posterous.com/toward-a-better-scientific-poster

Instances of projects conducted by participants to previous Summer Institutes Poster Clinic: Designing Efficient and Tailored Posters

Francesco Fiondella and Jason Rodriguez, IRI

Practical Session Summary:

Trainees are required to make poster presentations of their individual CIPH projects on the final day of the course. Guidelines are provided on how to develop the content of their posters (what). However, it is as important that their presentations and visualizations reach the audience efficiently and communicate valuable, usable, actionable information (how). During this 'Poster Clinic" session, communication professionals review the trainees' materials.

Collaborating, Mentoring and Training on Climate Information for Public Health

Building Sustainable Partnerships to Improve Climate-Sensitive Diseases Surveillance and Response: the Development of Climate and Health Working Groups

IRI Lecture Summary:

Climate and Health Working Groups (CHWGs) currently operating in Ethiopia, Kenya, and Madagascar, are functional entities that involve government agencies including ministries of health, meteorological services, and other relevant partners. The groups create a framework to reinforce and further collaborations between climate and health communities at the country level. To date, these collaborations have ranged from research to communications to information feedback loops that use climate information to improve public health decision-making. The groups also organize and conduct trainings on issues at the nexus of climate and health.

Encouragingly, all three CHWGs held their first joint working session in early November 2009 at the fifth annual meeting of the Multidisciplinary Initiative for Malaria (MIM) in Nairobi, Kenya. One output of the session was a joint presentation on their achievements and planned activities which was delivered to the MIM Research Capacity Strengthening Symposium: "Building Capacity to Use Climate and Environmental Information for Improving Health Outcomes."

Building Sustainable Partnerships to Improve Meningitis Surveillance and Response: the MERIT Initiative

Eric Bertherat, WHO

Lecture Instructional Goal:

Understand the rationale and means to implement sustainable multi-disciplinary partnerships to improve the surveillance and control of meningococcal meningitis in the African Meningitis Belt

Learning Objectives:

- Illustrate the burden of meningococcal meningitis and the current knowledge on the potential links between meningitis and the environment
- Understand the challenges posed by the current meningitis surveillance and control strategies and the opportunities to use climate information to anticipate the occurrence of meningitis outbreaks
- Illustrate how multi-disciplinary and multi-country partnerships were subsequently developed to better understand the relationship between meningitis and the environment and turn this research into improved public health interventions

Summary:

The current WHO strategy for the control of meningitis outbreaks relies on standard treatment and reactive mass vaccination. Although this 'crisis management' and reactive strategy has saved and will continue to save many lives, it has strong limitations. Improving our understanding of the natural history of the disease and its relation to the environment would help detecting meningitis outbreaks earlier or anticipating their occurrence. This gain in knowledge would in turn result in a significant optimization of the control strategies of the disease. This desire urged the health and climate communities to sit at the same table and work together on solving this issue, resulting in the creation of the Meningitis Environmental Risks Information Technologies (MERIT) project. Ethiopia and Niger are used as case studies, various models are being produced, and decision tools are being developed with the aim of applying these findings as soon as possible.

Recommended reading:

Web link: Visit the Web-page of the MERIT initiative at http://Merit.hc-foundation.org

Implementing Networks and Interaction Platforms: Introduction to the CIPHAN Web site, the CIPH Alumni Network and the CIPHA Newsletter

Gilma Mantilla, IRI

Lecture Summary:

A lot of knowledge remains to be built in the area of climate and public health and the field efficiency of the new approaches implemented is yet to be assessed. For these reasons, it is critical that platforms enabling climate and public health professionals to communicate and share their knowledge and experience exist. To respond to this need, the Climate Information for Public Health Action Network (CIPHAN) has been developed to provide public health professionals with knowledge, methodologies, tools, and data to better manage climate sensitive diseases toward improving health outcomes. It acts as a web portal to guide the learner towards other sources of information, as well as a source of learning resources, such as educational modules and exercises. This site's library also contains a directory of published material to give the reader opportunity for further investigation. Similarly the Climate Information for Public Health Action (CIPHA) newsletter was created to provide updates on the latest developments within the CIPHA network, including the activities of alumni and facilitators, brief meeting reports, news from the health and climate community, and opportunities for collaboration.

Recommended readings:

- Visit the Web-page of the Climate Information for Public Health Action Network (CIPHAN) at: http://ciphan.iri.columbia.edu/
- Moodle.org: Open-source Community-based Tools for Learning
- CIPHA Newsletter, May 2010, Vol.2 Issue 3. International Research Institute for Climate and Society, The Earth Institute at Columbia University, Palisades, NY. Available from: http://iri.columbia.edu/education/ciphnews

Developing Climate and Public Health Projects

Luciano Tuseo, WHO

Lecture Summary:

A lot of knowledge and experience remain to be built in the area of climate and public health. It is therefore critical that the climate and public health/field epidemiology communities, involved in government or international agencies, Non-Governmental Organizations (NGOs), research institutions etc. collaborate to jointly fill this gap, with the common goal of improving public health outcomes across the globe. This collaboration may take the form of climate and public health integrated interventions or operational research projects. Despite the challenges associated with the development of connecting proposals, these projects must be developed with clear and realistic objectives, quality indicators measuring the projects long-term benefits, as well as consistency with and contribution to broader climate and public health policy principles.

Recommended reading:

European Commission. Aid Delivery Methods. Project Cycle Management Guidelines. March 2004. Available from: http://www.europa.eu.int/comm/europeaid/qsm/index_en.htm.

Implementing CIPH Training Courses: The Instance of the 2010 Summer Institute on Climate Information for Public Health

Madeleine Thomson, IRI

Summary:

In 2008 and 2009, Summer Institutes on Climate Information for Public Health were conducted at the Lamont Doherty Campus of Columbia University to engage professionals from around the world who play a key role in the operational decision-making for climate-sensitive diseases in identifying and evaluating appropriate use of climate information. The 2010 Summer Institute builds on this experience and that of our partners and alumni who have been testing in their own institutions the tools, methodologies and approaches developed in this training. This lecture details the frame and the steps that enabled the implementation of such training, to be used a reference to develop similar CIPH courses in partner institutions across the globe.

Recommended reading:

Cibrelus L, Mantilla G. Executive Summary. In: Summary of the Climate Information for Public Health Training Course. Palisades, NY: International Research Institute for Climate and Society at the Earth Institute, Columbia University; 2009. p. 1-5.

Sample Quiz Questions and Answers: Key Take Home Messages on Climate Information for Public Health

- The sample questions and answers indicated below are part of the fulfillment to demonstrate competency in the areas addressed during the CIPH training. They complement the development of a personal project on climate and public health.
- On a daily basis, trainees were assigned to answer quiz questions addressing the key "take home messages" related to the lectures, practical sessions or talks they participated to on the previous day, except when they were directly related to the development of their CIPH project, i.e., to the other requirement to demonstrate competency, or to a panel discussion.

Basic Concepts in Public Health and Climate

Introduction to Climate and Climate Information

Sylwia Trzaska, IRI

What is ENSO and how can you explain its worldwide impacts?

ENSO (El Nino-Southern Oscillation) is a mode of interannual variability in climate. It manifests itself in Sea Surface Temperature anomalies in equatorial Pacific and alteration of the mean atmospheric general circulation structures, mostly the Walker (zonal) cell. During the El Nino phase waters are warmer than usual in the eastern equatorial Pacific and the Walker cell reduced with weaker trade winds over eastern equatorial Pacific and weaker subsidence, leading eventually to rainfall in the usually dry areas centered on the coast of Peru. In western Pacific the usually abundant precipitations are reduced. The situation is reversed in the La Nina phase with colder waters, enhanced trade wind and subsidence and expanded dry areas in the East and enhanced precipitation in the West.

Because atmospheric (and oceanic) circulations are organized in well-defined patterns due to differences in Energy the surface receives, availability of moisture and land-ocean thermal gradients, any perturbation in one of the organized cells affects other cells. Thus changes in the large scale circulation patterns over the Pacific affect atmospheric circulations elsewhere which in turn affects temperature, moisture advection and conditions favorable for rainfall in some areas.

For more info on ENSO check IRI's ENSO Web at:
http://portal.iri.columbia.edu/portal/server.pt?open=512&objID=491&PageID=0&cached=true&mode=2&userID=3794

What is the difference between climate data and climate information?

Cite three most common procedures to extract climate information. Climate data is a collection of numbers relative to climate variables recorded in a given location over a given period of time. Climate information is extracted from those data with a given goal in mind – it can be a climatology, departures from a given value/threshold, correlation between health variable and climate variable etc. Most common procedures include time and space averages, anomalies from the mean or another threshold, differences in means between locations, estimations of amplitude of variations (such as standard deviations), frequency related measures (pdf etc).

Understanding Predictions and Projections in Climate

Sylwia Trzaska, IRI

Describe, interpret and comment the slide entitled 'ENSO Forecast'.

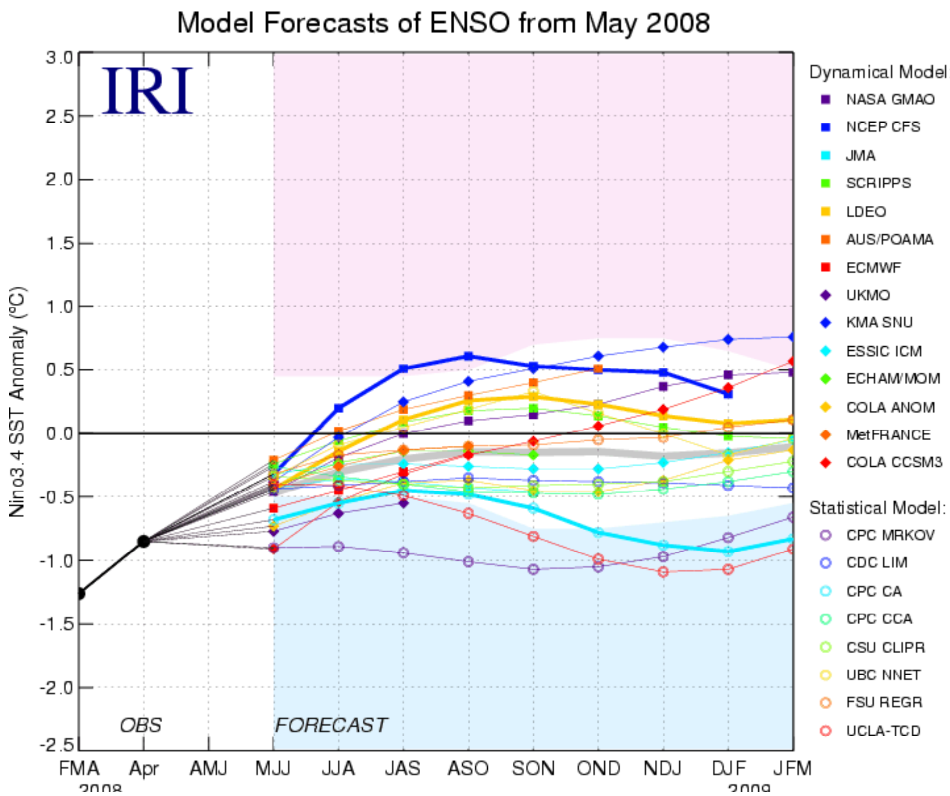


Figure 1: ENSO Forecast, from Understanding Predictions and Projections in Climate by Sylwia Trzaska

Although there is no comment and not much of a legend on the figure, here are the main elements allowing to read and interpret it: the figure shows multiple lines, color areas, seasonal labels on the X axis, SST Nino3.4 anomalies on the Y axis, a list of dynamical and statistical models and the title indicates 'Model Forecast of ENSO from May 2008'.

The multiple lines and multiple models listed tell us that this is a multi-model forecast, a so-called 'plume', showing forecasts from all the models participating in the exercise.

The forecasted variables are the SST in the Nino3.4 region (cf. http://iri.columbia.edu/climate/ENSO/background/monitoring.html#sst check 'The Nino regions'.)

The forecast was made in May i.e. using observed SST from April (hence the single line from FMA to Apr and the dot in Apr) for the following 10 3-months seasons.

Fourteen dynamical models (lines with filled symbols) and 8 statistical models (lines with empty symbols) are represented. The grey line is the multimodel average.

The three different colors areas represent the different climatological terciles for the Nino3.4 index and are given as reference to help interpret the plume. Note that the boundaries of the terciles change with seasons showing a larger amplitude of the middle category in winter, when ENSO reaches its highest amplitude.

The multimodel mean and most of the model outputs in the plume lie within the 'normal' category for the following seasons, giving high confidence that the Nino3.4 SST (and ENSO more generally) are going to be in close to average conditions.

It is important to look at the whole plume to see how close the forecasts from different models are to each other to assess the confidence in the forecast (the larger the spread the less agreement there is among different models, the less confidence we can have that the mean of the forecasts or any of the forecasted scenarios is going to happen; if all the lines are close together we can have high confidence that the actual conditions will be close to those forecasted).

For more info on climate forecasting refer to http://iri.columbia.edu/climate/forecast/tutorial2/

Describe, interpret and comment the slide entitled 'Temperature, precipitation, consensus map'.

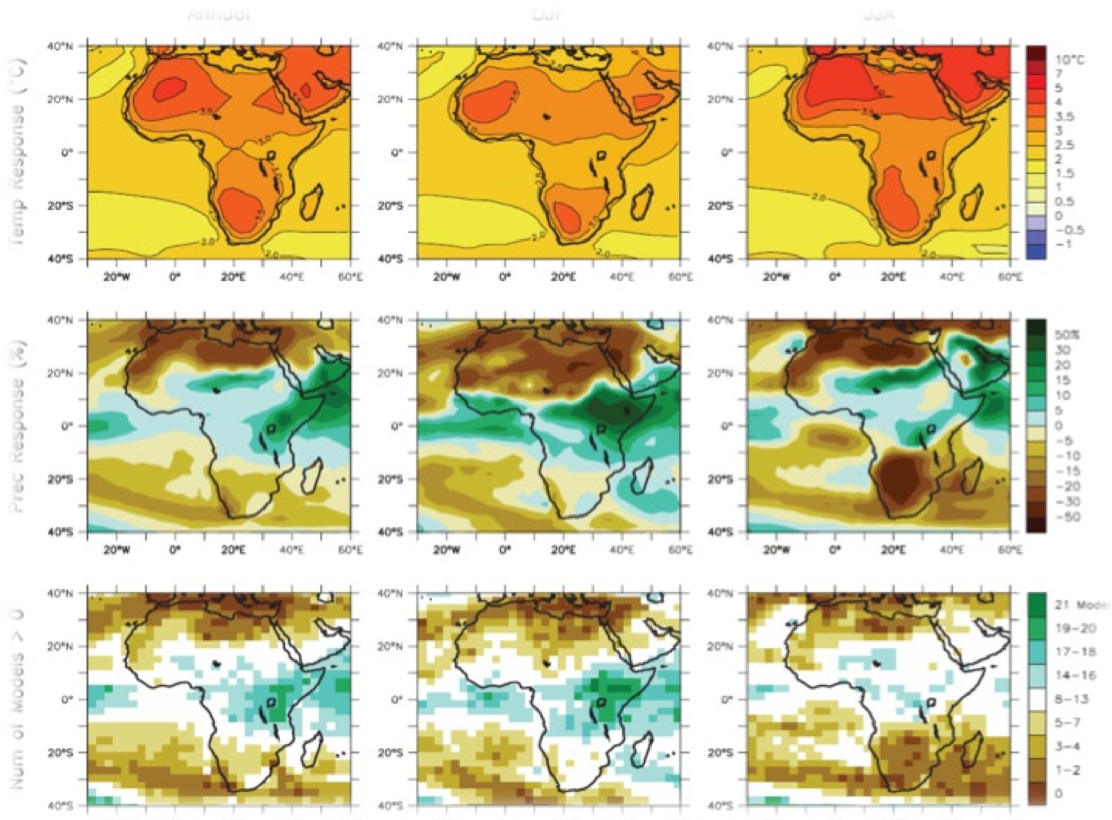


Figure 2: Temperature, precipitation, consensus map, from Understanding Predictions and Projections in Climate by Sylwia Trzaska

The series of maps presents projections of temperature and rainfall in Africa for the 2080-2100 period relative to 1980-2000 period (i.e. in terms of departures from the end of 20th century conditions). The simulations are for the SRES A1B scenario.

The top 3 maps present departures in temperature for annual mean and DJF and JJA seasons. All of temperature projections show increase in temperature of more than 3C over the continent and over 3.5 C in the arid and semi-arid areas. The increase is projected to be stronger in JJA.

The middle row shows projected departures from 'current' state for rainfall. The picture is more contrasted than for temperature with some areas being projected to get more rainfall ('equatorial' areas) and some less rainfall (arid areas).

The 3rd row presents the number of models, out of 21 models, projecting increase in rainfall: greenish colors indicate that the majority is projecting increased rainfall in the given area, brownish colors indicate that only a minority is projecting increased rainfall (i.e. majority is projecting reduced rainfall). White areas show that similar number of models project reduction and increase in rainfall.

It is important to pay attention to the 3rd series of map as they indicate the agreement between models in producing given outcome. Note how wide the white areas are (where approx half of the models project one outcome and half the other), especially during the rainy seasons in the Sahel (JJA) or Southern Africa (DJF). This tells us that we should take the results for rainfall with a lot of caution. This also tells us that we cannot rely on one single model for the projections because there is no evidence that its projection is more likely to happen that others…

Introduction to Climate-Sensitive Diseases

Gilma Mantilla, IRI

List four climate-sensitive diseases.

Answer: The correct answer may include but not be limited to: malaria, dengue, cholera, leishmaniasis (kala-azar), meningitis, and leptospirosis.

Which of the following is/are temperature dependent stages in malaria transmission?

a) Sporogonic cycle (duration of parasite development)

b) Gonotrophic cycle (duration of larval development)

c) Daily vector survival

d) Vector survival after period required for sporogony

e) All of the above

Answer: a) b)

Core Concepts in Public Health and Epidemiology

Judy Omumbo, IRI

True or false?

__The malaria parasite ratio is a commonly used measure of the risk of malaria in a defined population.
__Climate sensitive diseases co-vary in the same time and space scales as climate.
__ENSO is a feature of climate variability that may affect climate sensitive diseases in the same time scale.

Answer: False, True, True

Climate, Vulnerability, and Health: International and National Perspectives

Ulisses Confalonieri, Oswaldo Cruz Foundation

Which of the following elements may influence the way climate impacts public health?

a) Environmental conditions

b) Social conditions

c) Collapse of the public health system

d) Change in health policyi

e) All of the above

f) Only a and b

Answer: e)

Define the following terms:

Adaptation to climate change.

The "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC, 2007).

Mitigation to climate change.

Measures implemented to decrease the intensity of radiative forcing in order to reduce climate change (e.g.: reducing the sources or sinks of greenhouse gases).

Climate Adaptation in Public Health

Carlos Perez, IRI

Define hazard and risk.

Hazard is a possible source of danger (the potential to cause harm), while risk is the likelihood of harm (probability that the hazard or its consequences will take place). In the context of climate change, hazard refers specifically to physical manifestations of climatic variability or change, such as droughts, floods, storms, episodes of heavy rainfall, long-term changes in the mean values of climatic variables, potential future shifts in climatic regimes and so on. Climate hazards may be defined in terms of absolute values or departures from the mean of variables such as rainfall, temperature, wind speed, or water level, perhaps combined with factors such as speed of onset, duration and spatial extent. Hazards are also referred to as climate events.

Risk is defined as either: (i) the probability of occurrence of a hazard that acts to trigger a disaster or series of events *with an undesirable outcome, or (ii) the probability of a disaster or outcome, combining the probability of the hazard event with a consideration of the likely consequences of the hazard.*

Define the difference between biophysical vulnerability and social vulnerability, and explain the role of hazards and adaptive capacity under both definitions.

Biophysical vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Biophysical vulnerability focuses on physical factors, and is as a function of hazard, exposure and sensitivity. Social vulnerability, on the other hand, is all inherent properties of a system, independent of the hazard to which it is exposed, that mediate the outcome of a hazard event. Social vulnerability is one of the determinants of biophysical vulnerability. Under the biophysical vulnerability definition, hazard is assumed to cause an outcome (generally a damage). The adaptive capacity of a system tends to be ignored as a factor that mediates (buffers or magnifies) the outcomes of a hazard. Under the social vulnerability definition, hazards may or may not cause an outcome depending on the inherent capacities of a system, including its adaptive capacity.

Define adaptive capacity and adaptation.

Adaptive capacity is the ability or capacity of a system to modify or change its characteristics or behavior so as to cope better with existing or anticipated external stresses. Adaptive capacity represents potential rather than actual adaptation. Adaptation is adjustments in a system's behavior and characteristics that enhance its ability to cope with external stresses. Adaptation is not automatic. The direct effect of adaptation is to reduce social vulnerability.

Explain why development planning should incorporate climate concerns, and why a precautionary approach is needed when integrating adaptation into development programs?

Development planning efforts typically do not pay explicit attention to climate change, often not even to climate variability. Climate changes, however, are accelerating and their impacts are increasingly evident. Poorer social groups are the most at risk. Development planners need information at the local level that climate models cannot provide due to their coarse spatial resolution. They also need better understanding of the risks and potential direct and indirect impacts facing poor communities and households, and strategies to effectively lower vulnerability. Given these uncertainties, a careful, precautionary and no-regrets approach is needed. No regret interventions are those that that yield benefits regardless of future trends in greenhouse gas emissions and climate scenarios. Planners must avoid rushing to adopt interventions that may be of little value or may result in maladaptations and increased vulnerability.

Climate Risk Management in Public Health

Madeleine Thomson, IRI

What is climate risk management?

Climate Risk Management is a term referring to how do you approach a climate-sensitive decision, making it increasingly seen as the way of dealing with climate variability on the one hand, and climate change on the other.

How might a climate change health agenda detract from a pro-poor global health agenda?

By focusing attention on longer term challenges while ignoring immediate problems

How does climate change differ from climate variability?

Focus is on long term trends rather than near term variability

What is the decision-time frame for national malaria control planners?

Mostly one year – Maximum four.

Climate Risk Management and Development

Walter Baethgen, IRI

Describe two key lessons learned in the history of the IRI and link them to your own institution's activities (in other words, are they relevant for your work?)

Examples:

- *In order to have societal impact research must be demand-driven and problem-focused.*
- *Work must engage stakeholders from the very beginning (to ensure relevance, uptake, ownership, continuity, etc)*
- *The main niche for the IRI is in scientific research, but must ensure that some of that research is oriented to "translating" climate information and products into information and products tat are relevant for the different sectors (health, water, agro)*
- *The most successful work is achieved when we use existing "chains of information" (if chains are not present we need to help to develop and strengthen them)*
- *Using climate information and products in the different sectors, needs that sectorial experts have a minimum understanding of climate. It also needs researchers working in the interface of climate and sectors.*

What is wrong with the following statements?

(a) "The next season will be dry and therefore we do not expect major outbreaks of infectious diseases", (b) "Based on the best available climate models, precipitation in my country in the year 2080 will be 25% higher than in the present".

Key issues are missing in both statements. In (a) they need to add "probabilities". In (b) they need to add "uncertainty"

Linking ENSO and Society

Tony Barnston, IRI

Which of the following are typical seasonal climate effects that occur during El Niño?

a) *Above-average rainfall from October to December in Indonesia*
b) *Below-average rainfall in southern Africa from November to March*
c) *Below-average rainfall from October to December in eastern equatorial Africa (e.g., Kenya)*
d) *Below-average rainfall in the Sahel during July to September*
e) *Above-average monsoon rainfall in India from July to September.*

Answer: b) d)

Which of the following are likely impacts of a moderate to strong El Niño on society?

a) *Greater stress on the anchovy fishing industry in Peru*
b) *Increased risk of forest fire outbreaks in Indonesia*
c) *Likelihood of increased malaria epidemic severity in Botswana and northeastern South Africa*
d) *Heightened risk of poor summer crop yields in central and northern Ethiopia*
e) *Increased bleaching of corals in the tropical Pacific and other tropical oceans*
f) *Reduced snowpack and reservoir water in the southwestern U.S.*
g) *Tendency for more tropical cyclone damage to the Caribbean islands, Mexico, and the U.S.*

Answer: a) b) d) e)

Climate and Vector-Borne Diseases Dynamics

Madeleine Thomson, IRI

Ambient temperature affects:

a) *Parasite development rates in vectors*
b) *Parasite development rates in humans*

Answer: a)

History of Climate and Malaria – Does Causality Matter?

Menno Bouma, London School of Hygiene and Tropical Medicine

Do climate variability and recently identified climate change cause malaria epidemics?

> *The empirical association between weather-climate and diseases goes back a few thousand years. However, the attribution of causality has been and still is a major challenge and several non-climatic factors need to be considered in this relationship.*
>
> *Regardless of any potential causal relationship, how may understanding climate variability impact the preparedness for malaria epidemics?*
>
> *Knowing and forecasting the year-to-year variability of climate may help identifying and predicting the temporal and spatial risk of malaria epidemics. Such anticipation may result in improved outbreak preparedness and control. Which, in turn, reduces the morbidity of malaria epidemics and improves the cost effectiveness of the control measures.*

Climate Change and Human Health: Current Impacts and Future Risks

Patrick Kinney, MSPH

In its 2007 report, the IPCC stated that climate change would have negative impacts on which of the following health outcomes, with high confidence? (Choose one)

- *a) Dengue hemorrhagic fever*
- *b) Asthma*
- *c) Undernutrition*
- *d) Diabetes*

Answer: c)

Historically in the U.S., which of the following weather factors has been responsible for the most fatalities?

- *a) Cold*
- *b) Hurricanes*
- *c) Winter storms*
- *d) Heat*

Answer: d)

Climate Change, War and Disease

Dia El Naiem, University of Maryland

Climate change is expected to influence the epidemiology of kala azar by affecting:

a) *The vector populations*
b) *Leishmania strains*
c) *Socioeconomic status of human populations and their exposure to the disease*
d) *All of the above is correct*
e) *Only a) and c) are correct*

Answer: d)

Within the study areas covered in the lecture, climate change is expected to result in:

a) *An overall increase in the incidence of kala azar*
b) *An overall decrease in the incidence of kala azar*
c) *Either an increase or a decrease in the incidence of kala azar, depending on a complex interaction of environmental and socio-economic factors.*
d) *No effects on kala azar*
e) *Unknown effects on kala azar incidence*

Answer: e)

Public Health Surveillance and Opportunities to use Climate Information

Richard Luce, CDC

Among the common uses and applications public health surveillance are:

a) *Detecting changes in infectious agent*
b) *Evaluating prevention and control measures*
c) *Monitoring long-term trends*
d) *Planning future resource needs for prevention*
e) *All of the above*

Answer: e)

Routine analysis of surveillance data would likely include which of the following (Circle all that apply):

a) The number of cases of a disease reported this week and during the previous 5 weeks.

b) The number of cases of a disease reported this week and the number reported during the comparable week from each of the previous five years.

c) Person-time incidence rates among reported cases.

d) The number of cases by age and sex.

e) The number of cases by district.

Answer: a) b) d) e)

Data, Methods and Tools for Analyzing Climate and Public Health Data

Understanding Data and Data Quality Control

John del Corral, IRI

What are the 2 independent variables needed to correlate Health data with climate data?

Time and location.

What is the difference between a collection of numbers and data?

A collection of numbers can be interpreted or misinterpreted in many ways. Data should be ordered, consistent, and described in such a way as to be interpreted in only one way(the way that the data provider intended).

Data Constraints and Limitations: the Instance of the Temperature Trends in the Highlands of Kenya

Bradfield Lyon, IRI

Consider a gridded analysis of temperature derived from irregularly spaced station observations. From the list below, select all that should be a concern to someone considering using data from a single grid point in analyzing temperature variability at that location:

a) If the spatial resolution of the grid may be less than the distance between some stations, thus the grid point values may be based solely on interpolation.

b) If over the time period covered by gridded data set there may have been a different number of stations used in its construction.

c) If the latitude of the grid point selected is between 30 deg. N and 40 deg. N.

d) If the data set has no documentation available on how it was constructed.

Answer: a) b) d)

When looking at a time history of surface air temperature data it is important to know when an observing station was moved just 100 m from its original location because:

a) The station name may have changed as well

b) The weather instruments may have been damaged during the move

c) Even seemingly slight changes in location can affect temperature readings

d) All of the above

Answer: d)

Remote Sensing as a Source and a Tool to Manage Environmental Data

Pietro Ceccato, IRI

Assignment:

You are responsible for providing relevant information to the Kenyan Ministries of Health and Agriculture on Rift Valley Fever risk in Kenya in the latter half of 2006.You will consider information that would have been available to you during the latter half of 2006 (available monitored climate/environmental information).

Prepare one summary that you would have provided to the Ministries to assess the situation in terms of risk for the Rift Valley Fever in North Kenya during the rainy season (in the beginning of December 2006). Summary should be about half a page text and should include graphics/maps on NDVI and Rainfall

Answer: The answer might vary but in general would like to have the following answer (with one figure on NDVI and one figure on rainfall)

The past 2.5 months have been anomalously wet for Kenya this year. This is seen in the Normalized Difference Vegetation Index (NDVI), comparing October (figure 3) with December (figure 4). Recent rains have caused a dramatic increase in vegetation, particularly in the eastern part of the country. Increased vegetation is associated with higher soil moisture, leading to more suitable habitat for mosquito breeding sites. This is validated by the figure5, which compare rainfall patterns and amounts between 2005 and 2006. Due to the high level of rainfall that has occurred over the country – particularly in the eastern part of the country home to a large percentage of pastoralists – vigilant monitoring of possible outbreaks is advised.

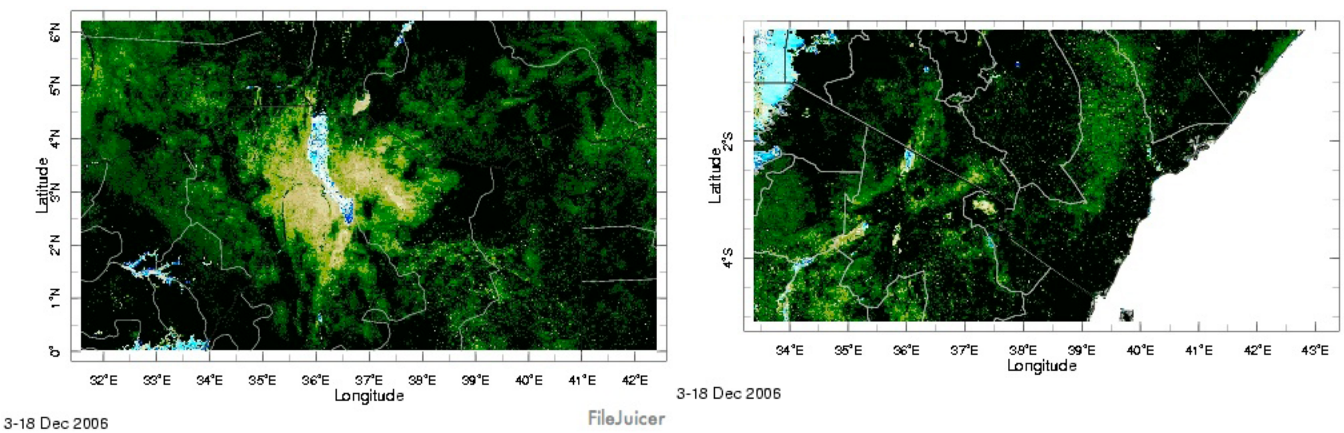


Figure 3: Normalized Difference Vegetation Index in Northern Kenya, October 2006

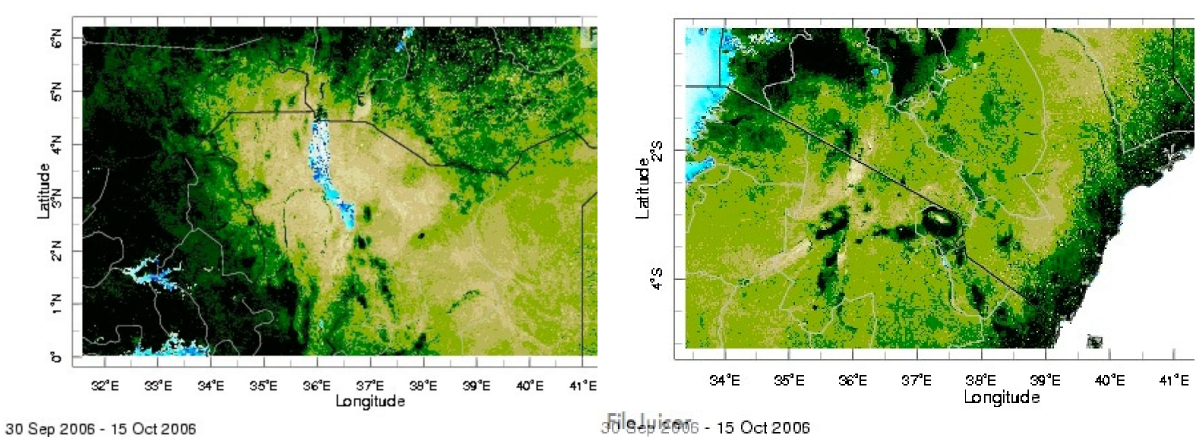


Figure 4: Normalized Difference Vegetation Index in Northern Kenya, December 2006

The use of the NDVI and rainfall products would have led the relevant authorities to take certain precautionary measures to prepare for this large outbreak of Rift Valley Fever in late December. Forecasts showed above normal rainfall creating the ideal conditions for mosquito breeding and disease transmission. If this potential threat of an outbreak was realized, then many decisions could have been made to protect the population and lessen the devastating effects. Specifically, authorities could have sprayed breeding areas and the insides of homes and public buildings, and provided bed nets. Additionally, the livestock could have been vaccinated.

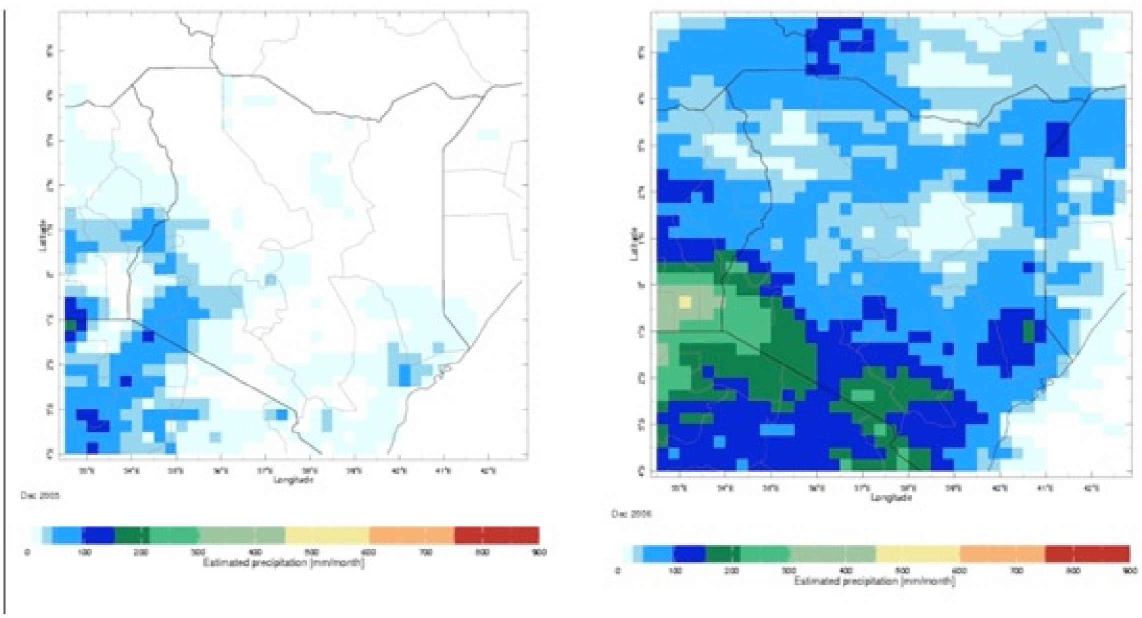


Figure 5: Monthly Rainfall Estimate in Northern Kenya, in December 2005 (left) and December 2006 (right)

Summarizing Climate and Health Data Using Descriptive Statistics and Map Tools

Michael Bell, IRI

Of the following choices, what does an "M" in the Data Library Expert Mode grid matching notation tell you?

a) That two variables match along a grid

b) That two variables do not match along a grid

c) That two variables are offset along a grid

d) That you have multiplied two variables together

Answer: a)

Name some types of statistics that would be useful for describing the distribution of a variable.

Mean, median, range, standard deviation, root mean square anomaly etc.

Principles of Trends and Time Series Analysis

Andrew Robertson, IRI

Describe in words what is meant in a climatic time series by an "anomaly" and how could it be calculated.

An anomaly is a deviation of the quantity from its long-term average. One needs to (calculate long-term average and) subtract it from the values in question.

Describe in words what is meant by a trend in a climatic time series and 2 ways in which it could it be defined and calculated.

A trend is a long-term systematic increase or decrease in a time series, which can be obtained thanks to: (1) linear regression "straight line fit", (2) low-pass filter, such as a moving average.

Introduction to Cluster Analysis

Andrew Robertson, IRI

What is meant by a "cluster" in cluster analysis? A group of relatively homogeneous cases or observations.

The K-means method finds K means, where K is the number of clusters that needs to be chosen in advance. What do these "means" refer to? The average of the cases or observations in the group.

Exercises on K-means and Cluster Analysis: Malaria Seasonality

Pietro Ceccato, IRI

What is the aim of this analysis?

The aim of this analysis is to understand the spatial and temporal distribution of malaria in Eritrea and Madagascar in order to understand the relationship between malaria and environmental factors and to take decisions about control strategies.

Can these results help you target your interventions? How?

Open question leading to open answers.

Lagged correlation of Rainfall with Malaria Incidence

Michael Bell, IRI

Which of the following is an appropriate reason for calculating monthly anomalies of a time series of monthly precipitation data using a 1971-2000 climatological base period?

a) To remove a possibly confounding multi-year linear trend from the time series

b) To remove a possibly confounding mean annual cycle from the time series

c) To correct for changes in variance (heteroscedasticity) in the time series

Answer: b)

Why is it sometimes useful to calculate lagged correlations between climate data and epidemiological data?

There may be a cause-effect relationship between a climate variable and an increase in the occurrence of a disease, such as between an increase in rainfall and an increase in malaria incidence. But while the climate variable may be a triggering mechanism, it may take time for other processes to occur (such as in the life cycle of the disease vector, or pathogen, or in transmission) that ultimately lead to an increase in disease incidence. A lagged correlation may be able to reveal this kind of relationship.

Disease Spatio-temporal Modeling: the Instance of Meningococcal Meningitis

Peter Diggle, Lancaster School of Health and Medicine

What is the difference between a static and a dynamic regression model?

In a static regression model, the regression coefficients have fixed, but unknown values, i.e. they are PARAMETERS. In a dynamic regression model, the regression coefficients are generated by stochastic processes and their values therefore change over time.

Example: A static harmonic regression model for a seasonal phenomenon, Y(t) say, might take the form Y(t) = A + B cos(wt) + C sin(wt) +Z(t) where w is such that the sine-cosine terms show an annual cycle, and Z(t) is a time-sequence of independent residuals. A dynamic version this model would replace some or all of A, B and C by stochastic processes; for example a model with a constant mean but dynamically varying amplitude and phase for the seasonal variation *might specify $B(t) = B(t-1) + U(t)$, $C(t) = C(t-1) + V(t)$, where $U(t)$ and $V(t)$ are time-sequences of independent residuals.*

What determines whether prediction of disease incidence in one district can be improved by knowledge of disease incidence in other districts?

If the incidences from all districts in any given week are independent random variables, prediction of disease incidence in one district cannot be improved by knowledge of disease incidence in other districts. If the incidences from all districts in any given week are dependent, it may be possible to obtain better predictions in any one district by taking account of incidences in neighboring districts. The extent to which this is achievable in practice depends on the nature of the spatio-temporal correlation in the incidence process and the investigator's ability to model the correlation structure accurately.

Malaria Mapping and the Climate Suitability for Malaria Transmission Tool in the Health Map Room

Judy Omumbo, IRI

How is the year to year variability of rainfall likely to affect malaria transmission?

(Consider an anti-malarial intervention that is delivered in Tanzania over a 12-month period beginning in January 1986. The success of this intervention is to be determined after 2 years).

Discuss the possible implications of the variability of precipitation for assessing the impact of the intervention?

These questions are a discussion so there are no right or wrong answers.

Using GPS, GIS and Google Maps for Public Health

Mark Becker, CIESIN

Name three basic considerations when planning a GPS data collection survey

Answer:

- *Level of Accuracy required*
- *Knowing what Datum and Projection system to set the unit*
- *Schedule data collection time for optimal arrangement of satellites (DOP values)*

What program will let you easily download your GPS data from the receiver and save it in formats in which it can easily be loaded into Google Maps/ Google Earth of ArcGIS?

Answer: DNRGarmin.

Using GIS to Exploring the Links between Poverty and Natural Hazards

Mark Becker, IRI

Are people living in extreme poverty more exposed to natural hazards?

Yes, this analysis shows that people living in extreme poverty have an increased exposure to natural hazards.

Name one of the ways that we can create a consistent and comparable map of poverty across the globe?

We have used infant mortality as a proxy measure for levels of poverty.

Use of Climate Information in Decision-Making for Climate-Sensitive Diseases

Useful and Usable Climate Products

Ousmane Ndiaye, IRI

In order to develop useable products should it be 'science driven' or 'demand driven'? Why, what are the pros and cons? (Designing the product).

This is an open discussion. Science driven is for example you got good results (it can be results found at another place) or has an 'interesting' scientific question and want to address it through a project or working group.

The other approach demand driven is to ask first the question what and where are the users' needs and try to address through interaction and iteration. Coming at the end with a product that the users recognize themselves with and will take it.

Which approach works better from your experience a bottom up approach or a top down approach?

What are the advantages and disadvantages for each approach? (Implementing the product). This a follow up question *similar to the first one but instead of looking at the product you deal with the approach/implementation : the best way to make change to happen. In other words if we want to make a change where to start. For the top down approach you assume the best way to change things is by acting/intervening at the upper level of the ladder. By approaching the administration at the higher level (ministry level, services). The decision is always taken at the management level down to the executive and the user. The bottom up implementation is to say an actual change should always start from the end-users end. The starting point or the level to work is always at the user level. Going to the field facing the reality of the terrain and making change. You have to build first a trust with the user: they know you, they believe in you, in your product and they are ready to take action.*

Climate Prediction for Weather Forecast Skeptics

Simon Mason, IRI

What would you consider the most important information if you had to make a forecast for the following timescales:

a) Tomorrow

b) Next 3 months

c) Next 10 years

d) Next century

Answer:

a) The weather now

b) Sea-surface temperatures

c) Sub-surface ocean temperatures

d) Atmospheric composition

Why can we not forecast the weather accurately beyond a few days?

The basic principle is that we don't know the weather exactly right now so the small errors in our knowledge grow rapidly into large errors over time. Initially, over a short time range, we see errors in predicted timing and intensity of weather events and going forward into the future the errors become greater and greater. After about two weeks the forecast and observed weather have nothing more in common than an accidental resemblance.

The Weather Roulette Game: How to Make Decisions given Probabilistic Forecasts

Simon Mason and Ashley Curtis, IRI

Describe a sensible strategy for investment allocations in a "weather roulette"-type scenario.

> ***If we can assume the forecast is reliable (e.g. a category forecast for 40% likelihood actually occurs 40% of the time) you can maximize growth in profits by using the Kelly strategy. The Kelly strategy involves allocating investments directly proportional to the forecast categories (e.g. putting 40% of your investment to category forecast with 40% likelihood, etc). This strategy has been mathematically demonstrated to give you the maximum GROWTH of profits but not maximum EXPECTED profit. The maximum expected profit could be reached by betting 100% on the category with the highest probability. The problem with this strategy is that even though you have a very small chance of making a huge profit, you have a very high chance of going bankrupt. If the forecast is NOT reliable than we need to hedge our investment. In the game it is not difficult to see the forecasts are hedged, but then you need to guess how it has been hedged to adjust your allocation accordingly.***

Malaria Vector Distribution and Rainfall

Judy Omumbo, IRI

How would you describe mean rainfall across Africa?

> ***It varies over space and in time. Some areas have more rainfall on average and others are always drier on average, i.e. trainee should be able to point to variability in average conditions over space and variations in time (seasonality) within those average conditions.***

What do you notice about the distribution of different species?

> ***Their distribution varies in space.***

How would you describe the relationship between annual precipitation and vector distribution by species?

> ***An. gambiae prefers wetter habitats, An. arabiensis is distributed in arid areas.***

What did you notice about the habitat preference of An. melas and An. merus?

> ***An. merus and An. melas are limited to coastlines of West and East Africa respectively.***

How would this information help you to select an anti-malaria intervention?

> ***Vector control program in arid areas can use climate information to time interventions to coincide with the seasons of maximum vector abundance. Resting preferences of the vectors (inside vs. outside) are also important considerations.***

How frequently should measurements of disease be taken?

In general more observations give more information. However, very frequent measurement taking is not practical for most disease control programs. Measurements should be able to at least capture the level of variability of interest to the disease control program. e.g. if the seasonal time scale is relevant for malaria control decisions, then observations of malaria need to be taken at each season.

Malaria Early Warning and Early Response

Stephen Connor, IRI

The major advantage of seasonal climate forecasting over case surveillance in malaria early warning system is due to its:

a) Timeliness

b) Accuracy

c) Cost effectiveness

d) None of the above

Answer: a)

If seasonal forecasts can warn of increased risk of malaria epidemics several months in advance – what is the advantage of environmental/meteorological monitoring?

a) Accuracy

b) Cost effectiveness

c) Confirmation of forecast warning

d) None of the above

Answer: c)

Integrated Malaria Surveillance and Control System for Malaria in Colombia

Daniel Ruiz, IRI

What is the main purpose of system dynamics?

The main purpose of the field of System Dynamics (SD) is to understand the behavior of dynamic systems in which feedback mechanisms and time delays play a significant role. The field of SD provides techniques and tools to investigate (and improve) current decision-making processes and to help decision-makers learn. The aim is to help people make *better decisions when confronted with complex dynamic systems (SD helps to understand what is otherwise perceived to be complex and advanced). The modeling language (stocks, flows, and feedback loops) is intuitive and it is common for all kinds of applications.*

Why malaria process-based models are useful?

Malaria process-based models are useful because they: (a) provide insights into the complexity of malaria transmission; (b) allow us to estimate the timing and severity of malaria outbreaks; (c) help us to analyze the key variables/ confounders behind the onset of malaria outbreaks; (d) allow us to pose and answer "what if" questions; (e) help us to investigate current decision-making processes and provide quantitative goals for effective interventions; and (f) help decision-makers learn.

Malaria Epidemic Detection and Monitoring using Thresholds in the IRI Data Library

Patricia Graves, the Carter Center and Michael Bell, IRI

What are the advantages and disadvantages of the third quartile as an epidemic threshold?

Advantages:

- *Simple to estimate; can be easily done without a computer*
- *Sensitive – will give an alert in 25% of years on average (epidemics will not be missed)*

Disadvantages:

- *Not specific – may overestimate the number of epidemics and give false alerts*
- *Needs five years of past data by month for area under consideration.*

Using the threshold of a) third quartile 2) mean plus two standard deviations, quantify how many districts of Eritrea experienced malaria epidemics by month during 2003. Answer depends on which years are picked as the baseline "non-epidemic" years. So multiple answers are possible as long as they are justified.

Influenza Seasonality and Early Warning

Stephen Morse, MSPH and USAID

All of these infectious diseases show strong seasonal or climate effects, EXCEPT:

a) *Influenza*
b) *Cholera*
c) *Malaria*
d) *HIV*
e) *Meningococcal (bacterial) meningitis*

Answer: d) HIV (the exception; all the others are seasonal or climate-related)

In temperate climates (like New York City), influenza is thought of as being a disease that occurs primarily:

a) *In summer*
b) *In winter*
c) *Year-round*
d) *When it rains*
e) *Influenza never occurs in New York City*

Answer: b) In winter in temperate zones

Meningitis Environmental Risk Information Technologies (MERIT)

Madeleine Thomson, IRI

When does meningococcal meningitis transmission occur in the Sahel?

a) *In the rainy season*
b) *In the dry season*
c) *Throughout the year*

Answer: c) endemic cases occur throughout the year; but outbreaks occur only during the dry season

How might dust contribute to the occurrence of meningococcal meningitis epidemics (choose one)?

a) By transporting the bacteria from one person to another

b) By aggravating the nose and throat and allowing the bacteria to cross into the blood stream

c) Through its impact on temperature.

Answer: b)

Heat Waves in the USA from the Climate Perspective

Bradfield Lyon, IRI

It is difficult to come up with a single definition of a heat wave because (circle all that apply):

a) Average temperature conditions can vary greatly from one region to another making it difficult to select an absolute temperature threshold (e.g., 35C) as a criterion.

b) It is not clear how many consecutive days temperatures need to remain above a given level to be considered a heat wave.

c) Heat waves are not of interest to some people.

d) The ability of the body to cool depends on humidity as well as temperature.

Answer: a) b) d)

Local factors that can influence the physical characteristics of heat waves include the following (circle all that apply):

a) The urban "heat island".

b) Proximity to a large water body.

c) Types of building materials and land surface condition at the location (e.g., cement structures, pavement, bare soil, etc.)

d) Proximity to a restaurant serving very spicy food.

Answer: a) b) c)

Heat Waves and Public Health: a USA Case-Study

Kim Knowlton, NRDC and MSPH

What were some of the key findings of the California heat wave morbidity study?

Any answer that indicates people were really thoughtfully engaged is valid. But, the three following findings deserve to be highlighted:

The Central Coast region, which has cooler absolute temperatures relative to other parts of the state, had by far the highest Rate Ratios of Emergency Room visits;

Very young kids 0-4 years old, as well as the elderly, had high Rate Ratios of ED visits for some causes;

There were a large number of excess Emergency Department visits - over 16,000 – across the state, and almost 1,200 additional hospitalizations; there have been very few prior morbidity studies during such large-scale heat waves, so this was useful information.

Name three of the four elements of Heat Wave Preparedness/Adaptation plans. Three of these four answers:

- *Indentifying vulnerabilities (or Assessment);*
- *Tracking (or Surveillance);*
- *(Climate-smart) Design;*
- *(Public) Education.*

Computer and Information Technology

Overview and Manipulation of the Data Library

Michael Bell, IRI

Name two image file formats in which maps or graphs can be downloaded from the IRI Data Library.

A correct answer would include two of the following: Gif, jpeg, PostScript, PDF, PNG.

Name one difference between the appearance or structure of a gridded data set compared to a station data set in the Data Library.

Station data sets will include a map of station locations, a grid will index the stations using an identifier, and any station latitude/longitude information will appear as dependent variables. In gridded data sets, there is no station map and latitude and longitude are typically grids, or independent variables.

Data Upload into the IRI Data Library

John del Corral, IRI

What are the acceptable tabular file formats to upload data into the IRI Data Library?

Excel (.xls, not .xlsx), Tab separated (.tsv) and Comma separated (.csv).

What are the pre-upload requirements related to the source of the data?

The source of the data needs to be identified and acknowledged. One shall specify any restrictions on use of the data, and any authorization procedures that are needed for accessing the data.

Extracting Data from the IRI Data Library

John del Corral, IRI

Is its possible to "graphically" select the dataset of interest?

Explain. Yes, it is possible. The Data Library provides a 'data viewer' for users to graphically view the dataset they are interested in. In the data viewer, a user can use the computer mouse to select a region of interest, or specify a latitude and longitude range. On the dataset page, one can also restrict the time range by clicking on the 'Data Selection' link, and specifying a time range.

Can the data be extracted as in an Excel format?

Explain. Yes, it is possible, but the data will be downloaded as tabular first, and then transposed into Excel.

Communication in Climate and Health

How to Use Maps as a Tool to Communicate Climate Risks

Sabine Marx, CRED and Francesco Fiondella, IRI

Which of the following isn't a principle outlined in Psychology of Climate Change Communication?

a) Know your audience!

b) Translate data into concrete experience!

c) The more colors, the better!

d) Address uncertainties!

Answer: c)

Explain how the concept of "less is more" can help you make a map that successfully communicates your information.

It forces you to consider simplifying your design so that only the most essential elements are left on the map. The map user should be able to find the key information easily. Include too much information, and the user will get distracted, confused. To effectively implement "less is more" you need to first understand what the goal of your map is (what questions is it meant to answer), and who it's meant for.

Collaborating, Mentoring and Training on Climate Information for Public Health

Building Sustainable Partnerships to Improve Climate-Sensitive Diseases Surveillance and Response: the Development of Climate and Health Working Groups

IRI

Which institutions are likely to be involved in national CHWGs?

Government agencies including ministries of health, meteorological services, and other relevant partners.

What does a CHWG aim to?

The groups create a framework to reinforce and further collaborations between climate and health communities at the country level.

Building Sustainable Partnerships to Improve Meningitis Surveillance and Response: the MERIT Initiative

Eric Bertherat, WHO

What does the multi-disciplinary MERIT initiative aim for?

MERIT aims to: (i) Improve the application of climate and environmental information, (ii) Enhance national and regional surveillance capabilities and (iii) Strengthen decision-making and public health policy development, including capacity building.

Which partners are currently involved in MERIT?

As of 2010, MERIT gathers key institutional partners such as the WHO, the WMO, the Group for Global Earth Observations, the Health and Climate Foundation (HCF), the IRI or AEMET (Agencia Estatal de Meteorologia), as well as scientists, researchers and experts from the following areas: Climate, Anthropology, Biology, Dust, Epidemiology, Modeling and Economy.

Implementing Networks and Interaction Platforms: Introduction to the CIPHAN Web site, the CIPH Alumni Network and the CIPHA Newsletter

Gilma Mantilla, IRI

What does the Climate Information for Public Health Action (CIPHA) newsletter aim for?

This newsletter provides updates on the latest developments within the CIPHA network, including the activities of alumni and facilitators, brief meeting reports, news from the health and climate community, and opportunities for collaboration. As such, it supports networking and capacity building activities within the climate and public health community.

What does the Climate Information for Public Health Action Network (CIPHA) Web site support?

THE CIPHAN Web site has been developed to provide public health professionals with knowledge, methodologies, tools, and data to better manage climate sensitive diseases toward improving health outcomes. It acts as a web portal to guide the learner towards other sources of information, as well as a source of learning resources, such as educational modules and exercises. This site's library also contains a directory of published material to give the reader opportunity for further investigation.

Developing Climate and Public Health Projects

Luciano Tuseo, WHO

What are the components of the Project Cycle Management?

There five components: programming, identification, formulation, implementation and evaluation.

Which phases does the Logical Framework Approach reconcile?

The analysis and the planning phases, i.e., respectively the analysis of stakeholder, problem, objective and strategy, combined to developing the logical framework matrix, scheduling the activity and the resource.

Implementing CIPH Training Course: the Instance of the 2010 Summer Institute on Climate

Information for Public Health

Madeleine Thomson, IRI

What is the expected profile of CIPH trainees?

The trainees are anticipated to be professionals who play a key role in public health decision-making related to the surveillance, prevention or control of climate-sensitive diseases. They may belong to both the broad public health and the broad climate communities.

What are the five components of a CIPH training course?

CIPH trainings comprise five components: core lectures, practical sessions, public talks and discussions, daily summary of key messages by a trainee and presentations of individual projects.

How may a CIPH training be evaluated?

There should be five pillars to the evaluation process: (i) Daily evaluation by the trainees, (ii) Half-course and End-of-course evaluations by the trainees, (iii) Overall evaluation of the course by the trainees, (iv) Immediate post-course evaluation by the organizers, the facilitators and the support staff and (v) At distance post-course survey by the trainees and the facilitators.

Appendix 3: Glossary on Climate Information for Public Health

Disclaimer: The glossary presented below is similar to this used for the 2010 SI. Should this curriculum be used by officers of FETP, the terms related to field epidemiology and public health may be replaced by those habitually used by the program, and only those related to climate sciences or to climate and health activities may be retained.

ABSOLUTE HUMIDITY: the quantity of water vapor expressed as grams per cubic meter of air. Absolute humidity, also expressed as dew point, is a measure of the amount of water in the air independent of temperature. So while relative humidity drops when temperature goes up in a data centre, absolute humidity stays the same.

AGE SPECIFIC RATE: a rate, which applies to a specific age cohort of a population.

AIRBORNE TRANSMISSION: refers to the passage of microorganisms from a source to a person through aerosols, resulting in infection of the person with or without consequent disease.

ALERT THRESHOLD: case number or incidence rate, which, if reached during a specified time period, results in an epidemic alert being declared.

ANOMALY: deviations of a variable from the long-term average. Anomalies are created by subtracting climatological values from observed data and so the values can be positive (greater than the long-term average or negative (less than the long-term average). For example: The average September to December rainfall for Entebbe over the period 1961 to 1990 was 490mm. In 1961, the rainfall during this season was 1000mm, which is a positive anomaly of 510mm. In 1985, only 202mm fell during the season, which is a negative anomaly of 288mm.

ANTHROPOPHILIC: see Vector.

ASSOCIATION: the degree of statistical dependence between two or more events or variables. Events are said to be associated when they occur more frequently together than one would expect by chance. Association does not necessarily imply a causal relationship.

ATTRIBUTABLE RISK: the rate of a disease or other outcome in exposed individuals that can be attributed to the exposure.

BIMODAL RAINFALL DISTRIBUTION: an annual cycle of rainfall that has two rainy seasons and two dry seasons.

CASE-FATALITY RATE: the proportion of people contracting a disease who die of that disease during a specified period of time.

Cause, Necessary: a variable which must always precede an effect. This effect need not be a sole result of one variable.

CLIMATE: the average values and frequencies of the weather including its extremes (e.g., rainfall, air temperature, relative humidity, solar radiation and wind speed) over periods longer than a month (e.g., a season, a year, a decade, 30 years, and so on). For example: The average September to December rainfall at Entebbe from 1902 to 1992 is 438mm.

CLIMATE CHANGE: long-term changes in the climate. Climate change can be natural (e.g., ice ages were caused by changes in the distance between the Earth and the sun), or anthropogenic i.e. caused by changes people have made to the land and atmosphere (e.g., urbanization, pollution).

CLIMATE INFORMATION: Information about historically observed climate (e.g., the average and typical range of variability of the rainfall total for a given location for a given month or season), or a forecast of the climate for a future time (whether for an immediately forthcoming season, or on a much longer time-scale such as 30 years into the future). An important part of climate information is its probabilistic aspect, which pertains to what is most likely, what is relatively less likely, and what would be considered rare (extremely unlikely).

CLIMATE RISK MANAGEMENT: the use of climate information in a multidisciplinary scientific context to cope with climate's impacts on development and resource-management problems. Climate risk management covers a broad range of potential actions, including: early-response systems, strategic diversification, dynamic resource-allocation rules, financial instruments, infrastructure design and capacity building.

CLIMATE VARIABILITY: the range of values the climate at a particular location can take over time. For example: Although the average September to December rainfall in Entebbe from 1902 to 1992 was 438mm, the actual amounts each year were somewhere in between 200mm and 1000mm, which is a large range of values.

CLIMATOLOGY: the long-term average of a given variable, often over time periods of 20-30 years.

CLIMATE NORMALS: long-term climate averages, usually monthly, derived from a standard 30 year period.

CLUSTER: a group of relatively homogeneous cases or observations.

CLUSTER ANALYSIS: statistical techniques that can be applied to data (including spatial data) that exhibit "natural" groupings. Cluster analysis sorts through the raw data and groups them into clusters. Objects in a cluster are similar to each other and are also dissimilar to objects outside the cluster, particularly objects in other clusters.

COMMUNITY: a social grouping with common characteristics, interests or identity – in this document most commonly considered sharing geographical space (come from same village, town, district etc).

CONCEPTUAL MODEL: a representation of a system or process, usually in diagrammatic form, which shows important relationships among the different elements (see also Mathematical Model).

CONFOUNDING FACTOR: a variable which is distributed non-randomly with respect to the independent (exposure) variable and is associated with the dependent (outcome) variable being studied. The association with the dependent variable is usually established from results of previous studies.

CORRELATION COEFFICIENT: a measure of association that indicates the degree to which two or more sets of observations fit a linear relationship. This coefficient, represented by the letter "r", can vary between +1 and -1. If "r" is +1, there is a perfect linear relationship in which one variable varies directly with the other. If "r" = -1, there is again a perfect linear association but one variable varies inversely with the other.

COST-BENEFIT RATIO: the ratio of the net present values (usually monetary values) of measurable benefits to costs. Used to determine the economic feasibility, or probability of success, of a time-bound project or program.

CROSS-SECTIONAL STUDY: a study carried out on a representative sample of a population that examines the relationship between a disease, or other health-re l a t e d characteristic, and other variables of interest, as they exist in a defined population at one particular time.

DATA RECORDS: facts of any kind. (Data are plural, datum is singular).

DATABASE: a systemized collection of information, commonly on electronic media about a specific subject such as disease.

DECISION ANALYSIS: application of probability theory with the aim of calculating the optimal strategy from a series of alternative decisions, which are often expressed graphically in the form of a decision tree. Decision analysis is a tool to help decision-makers choose from several options which is the optimal choice for treatment or control of a disease.

DEPENDENT VARIABLE: a variable or factor, the value of which depends on or is hypothesized to depend on the effect of other [causal] variable(s) in the study (outcome/response variable).

DE-TRENDING: to remove the general long-time drift, tendency, or bent of a set of statistical data in relation to time. Regression and other statistical techniques are used to remove the effects of a long term trend in order to show only the absolute changes in values and to allow potential cyclical patterns to be identified. An example would be to subtract a moving average (e.g., for five years) from the value of the variable.

DETERMINANT: any factor, event or characteristic that when modified can bring about change in a health condition or other defined characteristic. For example disease determinant = any variable (factor) associated with a disease which if removed or altered results in a change in the incidence of disease in a population.

DETERMINISTIC FORECAST: forecast type, which predicts a specific outcome, e.g., 20mm of rainfall, temperatures of 22oC (but gives no indication of reliability).

DETERMINISTIC MODEL: a mathematical model in which all the relationships are fixed and the concept of probability is not involved, so that a given input produces one exact prediction as an output. See also: Stochastic Model.

DISCRIMINANT ANALYSIS: a statistical technique similar to regression analysis but where the dependent variable is dichotomous. Alternatively - a statistical method used to allocate an individual to one or more distinct groups.

DROPLET NUCLEUS: is the airborne residue of a potentially infectious (microorganism bearing) aerosol from which most of the liquid has evaporated (Wells, 1934).

DROUGHT: defined as a prolonged period of poor rainfall distribution resulting in deterioration of natural resources.

EL NIÑO: the periodic appearance of warmer than usual sea surface water in the central and eastern tropical Pacific Ocean, spanning from off the coast of Peru westward to the International Date Line. The phenomenon is associated with increased probability of drought in some regions of the world and excess rainfall in others. El Niño represents the warm phase of ENSO the El Niño Southern Oscillation (see also La Niña). Recent El Niño events occurred in 2009, 2002, 1997, 1994, 1991, 1987, and 1982. Typically, El Niño events last into the beginning of the following calendar year.

ENDEMIC DISEASE: the perennial or seasonal presence of a disease, or infectious agent, within a given geographic area, or population group. It also implies a prevalence that is usual in the area or in the population. When applied to meningitis—there is a constant measurable incidence both of cases of the disease and of its natural transmission in an area over a succession of years.

ENDOPHILIC : see Vector.

ENSEMBLE FORECASTS: An ensemble is simply a group of model forecasts that are valid over an identical time period. These forecasts provide information on the different ways in which the atmosphere may evolve over the next few hours or longer. Ensembles are needed because we do not have enough information to accurately depict the present state of the atmosphere. Even with all the information we obtain from satellites, radars, weather balloons, surface instruments, and other data sources we are unable to provide a perfect three-dimensional picture of the atmosphere at any given time. This means that the information we use to start a numerical weather forecast model, called an initial condition, is imperfect. By analyzing different scenarios, we can determine the most likely evolution of the atmosphere and determine the odds that certain weather events will occur. Numerous studies have shown that ensembles are more accurate than providing a single forecast from the best initial condition, and we also know that ensembles provide more useful information to decision makers.

ENSO: Stands for El Niño Southern Oscillation. ENSO refers to an irregular cycle of warming and cooling of the sea surface temperatures (see definition) of tropical Pacific Ocean. The cycle has an average length of about 4 years, and is a natural part of the Earth's climate system. The oceanic warming and cooling is accompanied by changes in air pressure above the tropical Pacific Ocean (the "Southern Oscillation"). These changes in the Pacific Ocean's temperatures and the atmosphere above it affect the global climate system, and therefore can affect the climate in regions that are far away from the Pacific (like Africa).

EPIDEMIC: the occurrence in a population or region of cases of disease clearly in excess of normal expectancy for that area and time period. When applied to malaria this includes the occurrence of malaria among a population in which the disease was unknown or an unusual seasonal rise or other unusual increase of clinical malaria cases in an area with low or moderately endemic malaria (based on an epidemic thresholds derived from historic data).

EPIDEMIC CURVE: a histogram in which the X-axis represents the time of occurrence of disease cases and the Y-axis represents the number of disease cases. It is a useful tool to determine the epidemiology of disease occurrence in an outbreak investigation.

EPIDEMIC THRESHOLD: case number or incidence rate, which, if reached during a specified time period, results in an epidemic being declared.

EPIDEMIOLOGY: the study of the distribution and determinants of health related states and events in populations.

ERROR, SAMPLING: after testing a sample from a large population, the mean or any other statistic calculated from the sample will have a different value from the true value if the whole population was measured. The difference between the value for the whole population and its estimate calculated from the sample is called the sampling error.

ERROR, SYSTEMATIC: due to factors other than chance, such as faulty measuring instruments.

EVAPOTRANSPIRATION RATE: of actual loss of water from soil through a combination of evaporation and transpiration by plants over a given area with time.

EXOPHILIC: see Vector.

FACTOR: an event or characteristic that brings about a change in health condition - a causal role is often implied.

GEO-REFERENCE: record of data's location in a known mapping co-ordinate system (such as degrees Latitude and Longitude) or projection.

GEOGRAPHIC INFORMATION SYSTEM: a computer-based database designed to store, manage, analyze and System (GIS) visualize geo-referenced data in locational relation to each other. Grid uniform matrix of discreet values – used in some GIS (grid-based) to represent continuous data surfaces such as mean temperature or rainfall estimates or other attributes associated with mapped entities. Some GIS use the term "raster" in place of grid (see also Vector-GIS).

GEOSTATISTICS: the part of spatial statistics relevant to situations in which data relating to a spatially continuous phenomenon are collected from a discrete set of locations

HYPOTHESIS: a proposition that can be tested by facts that are known or can be obtained, e.g., the assertion that an association between two, or more variables or a difference between two or more groups, exists in the larger population of interest.

IMMUNITY: the resistance of an individual to infection, or disease, due to a particular agent. Immunity may be innate (natural), passive (e.g., maternal or through administration of immune serum), or active (acquired from previous exposure or vaccination).

INCIDENCE: the number of new cases of disease or other condition, which occur in a specified population during a given period of time.

INDEPENDENT VARIABLE: the characteristic being observed or measured that is hypothesized to influence an event. An independent variable is not influenced by the event or manifestation but may cause it or contribute to its variation.

INFECTIVITY: the ability of an agent to enter, survive and multiply in a susceptible host. Epidemiologically, it is measured as the proportion of the individuals exposed to an agent who become infected.

INFERENCE: the process of passing from observation to generalization.

INTERPOLATION: process of determining intermediary values among a network, series or range of known values.

LA NIÑA: the cold phase of the El Niño Southern Oscillation. Like its brother El Niño it is associated with periodic variability in regional climatic processes (See also El Niño). Recent La Niña events occurred in 2007, 2000, 1999, 1998, 1996, and 1988. Typically, La Niña events last into the beginning of the following year.

LAG TIME: An interval of time between two related phenomena (such as a cause and its effect).

LAPSE RATE: the rate of change of temperature in the atmosphere with height. It has a mean value of 6.5 degrees Celsius per 1000m.

LINEAR REGRESSION: statistical method used to study the relationship between independent and dependent variables when the dependent variable consists of continuous data.

MATHEMATICAL MODEL: a representation of a system or process in mathematical form in which equations are used to simulate the behavior of the system or process under study (see also Conceptual Model).

MAXIMUM TEMPERATURE: the highest (maximum) temperature recorded during a fixed time period (e.g., 24-hour period for daily maximum temperature).

MICROCLIMATE: the mean values and frequencies of the weather including its extremes (e.g., air temperature, relative humidity, solar radiation and wind speed) in a small geographic area.

MODEL: a representation or simulation of an actual situation or process.

MONITORING OBSERVATION: aimed at measuring change, e.g., in the distribution of weather variables or the prevalence or incidence of disease. Often used to chart the progress of a disease control program, or in assessing its effectiveness (see also Surveillance).

MULTIPLE REGRESSION: an analytical method to determine a linear relationship between a dependent variable and two or more independent variables.

MULTIVARIATE ANALYSIS: a set of techniques used when the variation in several variables has to be studied simultaneously. In statistics it is any analytic method that allows the simultaneous study of two or more dependent variables.

NORMALIZED DIFFERENCE VEGETATION INDEX (NDVI): a commonly used proxy for vegetation condition. NDVI is derived from a manipulation of data from two satellite wave bands presented as a ratio [NDVI = (near infrared—red)/(near infrared + red)]. NDVI is often used in routine monitoring of seasonal vegetation development in response to regional rainfall distribution.

NUMERICAL WEATHER PREDICTIONS (NWP): The primary method of weather forecasting undertaken by solving a set of equations based on initial observed values.

OCCURRENCE: indicating the presence of disease without signifying the frequency. This definition describes the use of the word in international disease reports.

OUTBREAK: occurrence of disease in a population, at a level greater than normally expected where the epidemic is limited in terms of population and geographic area affected.

OUTLIERS: observations differing so widely from the rest of the data as to lead one to suspect that a gross error in recording may have been committed, or suggesting that these values came from a different population.

PARAMETER: a summary descriptive characteristic of a population (cf. statistic—which is a sample-based measure of a variable).

POPULATION (HERD) IMMUNITY: the resistance of a group of subjects to invasion and spread of an infectious agent based on the resistance to infection of a high proportion (but not all) members of the group. Also called "herd" or "population" immunity.

POTENTIAL EVAPOTRANSPIRATION (PET): may be used as a proxy measure for soil moisture budget. It describes the amount of evapotranspiration that could occur if a limitless supply of water were available in the soil. It is based on weather conditions such as wind and temperature and biological factors such as vegetation cover.

POWER PROBABILITY: of finding a difference between two or more groups given that a difference exists. Power = 1-Beta = 1-Probability of a type II error.

PRECIPITATION: Technical term for rainfall and snowfall. In East Africa, precipitation is the same thing as rainfall—except on the top of mountains such as Mt. Kilimanjaro, where it can snow.

PRECISION: the quality of being distinctly defined or stated. Refers to the ability of a test or measuring device to give consistent results when applied repeatedly. Sometimes called "repeatability" (see also Validity). A good test is both precise and valid which are the two components of accuracy.

PREDICTABILITY: A technical term that describes how well we can predict the future weather or climate in a particular region. Predictability varies depending upon how far into the future the forecast extends. In a region with high seasonal predictability (mainly in the tropics) we can make good forecasts of what the climate will be in the next few months given what is happening now. There is no place on Earth that has perfect predictability. There are also some places that have no seasonal predictability at all.

PREDICTIVE VALUE: in screening or diagnostic tests, the predictive value of a positive test is the proportion of test positive subjects who actually have the disease. The predictive value of a negative test is the probability that a subject with a negative test does not have the disease. The predictive value of a test is determined by the sensitivity and specificity of the test, and by the prevalence of the condition at the time the test is used.

PREVALENCE: the proportion of cases of a disease or other condition present in a population at a point in time without any distinction between old and new cases. When used without qualification the term usually refers to the number of cases as a proportion of the population at risk at a specified point in time (point prevalence).

PREVALENCE STUDY: see cross-sectional study.

PROBABILITY: The chance or degree of likelihood that an event will occur. For example: In Entebbe, below normal rainfall in the September to December season has occurred in 10 out of 30 years. If we assume that September to December rainfall in Entebbe in the future will have the characteristics as in the past, then there is a 10 in 30 chance (or 33%) that rainfall will be below normal in the coming season.

PROBABILISTIC FORECAST: measure of the degree of likelihood that a given event will occur. A probabilistic forecast type includes an objective measure of certainty. This type of prediction may be more reliable than a deterministic forecast that gives no indication of certainty.

P**UBLIC HEALTH SURVEILLANCE**: the ongoing, systematic collection, analysis, interpretation and dissemination of health data used by public health authorities to monitor the health of their communities. Its purpose is to provide a factual basis from which health authorities can appropriately set priorities, plan programs, and take action to promote and protect the public's health. See also: Surveillance.

RAINFALL: the quantity of rainfall measured by a rain gauge during a fixed period of time (e.g., 24-hour period for daily rainfall). The term "precipitation" may be used which is inclusive of water as snow, sleet, hail, etc.

RAINFALL ESTIMATES (RFE): estimates of rainfall derived from satellite data combined with ground station data and model outputs.

REGRESSION ANALYSIS: a statistical technique used to examine the relationship between two continuous variables (see also Linear Regression).

RELATIVE HUMIDITY: (%) is the amount of water vapor in a sample of air, divided by the amount that the sample could hold if it were saturated, multiplied by 100.

RELATIVE RISK: the ratio of the disease incidence in individuals exposed to a hypothesized factor to the incidence in individuals not exposed.

RELIABILITY: (for probabilistic forecast system). "If the system forecast is 30% above, 10% normal and 60% below normal rainfall then in 100 years, 30 years should be above normal, 10 years should be normal and 60 years should be below normal in order to be thought of as being perfectly reliable".

REMOTE SENSING: observation of the earth's surface and its physical, biological, hydrological and atmospheric processes from a distance. Usually means data collected from airborne sensors on aircraft or satellites.

RETROSPECTIVE STUDY: a study that collects and utilizes historical data. A case-control study is retrospective because it looks back from the point of known effects to determine causative factors.

RISK: the probability that an event will occur within a fixed time period e.g., that an individual will become infected, become seriously ill or die within a set period, or by certain age.

RISK FACTOR: an attribute, or exposure that increases the probability of occurrence of the specific risk outcome.

RISK INDICATOR: a risk factor that can be monitored routinely for use in an early warning system.

SATELLITE PROXIES: satellite-derived estimates of environmental variables.

SATURATION DEFICIT: the pressure exerted by water vapor that could exist in saturated air (saturation vapor pressure) minus the actual vapor pressure (the actual pressure exerted by the water vapor present).

SATURATION VAPOR PRESSURE: The partial pressure exerted by water molecules in a parcel of air if saturated at a given temperature (may be calculated from wet and dry bulb temperatures).

SEA SURFACE TEMPERATURE: is the temperature of water at the ocean surface—often derived as a proxy from thermal satellite channels. SSTs are an important influence on seasonal rainfall and temperature over land.

SEASON: A division of the year based on some recurring phenomena, usually climatic; e.g., rainy season, dry season, winter, spring etc

SEASONAL CLIMATE FORECAST: A forecast for how rainfall or temperature in a coming season is likely to be different from climatology (see definition). Seasonal climate forecasts can be made in several different ways (for example, using statistical or dynamical method). Because the climate system is so complex, it is almost impossible to take all the factors that determine the future seasonal climate into account. Therefore, climate forecasts are generally given in terms of the probability (see definition) that rainfall or temperature will be either below normal, near normal, or above normal (see terciles).

SEASONALITY: Changes in patterns (of a disease, for instance) which occur predictably at given times of the year.

SECULAR TREND: a long-term trend in the occurrence of disease or other condition.

SENSITIVITY: a statistical measure of how well a binary classification test correctly identifies a condition, e.g., how well a medical screening tests identifies a disease compared to some absolute (Gold standard); for example, for a medical test to determine if a person has a certain disease, the sensitivity to the disease is the probability that if the person has the disease, the test will be positive. The sensitivity is the proportion of true positives of all diseased cases in the population.

SENTINEL SITE: a location or facility that can be used to monitor and assess the level of stability or changes in disease cases on a routine basis – usually selected as best representation of a larger population than that actually sampled.

SKILL: forecast skill refers to the relative accuracy of a set of forecasts, with respect to some set of standard control or reference forecasts.

SIGNIFICANCE: see Statistical Significance.

SPATIAL DISTRIBUTION: the relationship of disease events to location of individual subjects or clusters of subjects.

SPATIAL STATISTICS: statistical methods which take account of location, distance and proximity of observations in relation to each other and additional variables of interest.

SPECIFICITY: in diagnostic tests, the proportion of people that tested negative of all the negative people tested (true negatives); that is (1-false positives).

SPECIFIC HUMIDITY: the quantity of water vapor expressed as grams per kilogram of air.

SPORADIC: a disease occurring irregularly and generally infrequently and without any apparent underlying pattern.

STANDARD ERROR: measure of variability of a sample statistic attempting to specifically relate an observed mean to the true mean of the population. Summary value calculated from a sample of observations usually to estimate a population parameter.

STATISTICAL FORECASTING: Forecasting based on historical patterns in climate.

STATISTICAL SIGNIFICANCE: statistical methods allow an estimate to be made of the probability of the observed degree of association between independent and dependent variables being exceeded under a null hypothesis. From this estimate the statistical "significance" of a result can be stated. Usually the level of statistical significance is stated by the "P" value or critical value. A result is said statistically significant if it is unlikely to have occurred by chance.

STOCHASTIC MODEL: a mathematical model founded on the properties of probability so that a given input produces a range of possible outcomes due to chance alone c.f. deterministic model.

STRATIFIED SAMPLE: involves dividing the population into distinct subgroups according to some important characteristic, e.g., village/compound size, and selecting a random sample out of each subgroup.

SUB-ZOBA: a district in Eritrea (See Zoba).

SURVEILLANCE: observation of a susceptible (uninfected) population aimed at the early detection of cases of a particular disease so that control action can be quickly instituted (see also monitoring). Surveillance is often subdivided into two categories, passive and active: passive surveillance is the secondary use of routinely collected data, which was generated for some other purpose such a diagnostic service; active surveillance is the routine collection of data whose primary purpose is for surveillance. See also Public Health Surveillance.

SURVEY: an investigation in which information is systematically collected.

SYSTEMATIC SAMPLE: the procedure of selecting according to some simple systematic rule, such as every 5th patient entering a health facility. A systematic sample may lead the errors that invalidate generalizations.

TELECONNECTIONS: The effects of changes in Sea Surface Temperatures (see definition) in the Pacific Ocean on temperature and rainfall patterns in regions that are far away from the Pacific. For example: Above average September to December rainfall in the Greater Horn of Africa region is a result of a teleconnection of warmer than normal sea surface temperatures in the Pacific Ocean (see El Niño).

TEMPORAL DISTRIBUTION: the relationship of disease events to time.

TERCILES: One way of dividing rainfall into three categories: below normal, near normal, and above normal. Terciles divide rainfall into three categories that have the same chance of occurring. In a 30-year climatology (see definition), the 10 driest years belong in the below normal tercile, the 10 wettest years belong in the above-normal tercile, and the other 10 years belong in the near-normal tercile. These numbers translate to a 33.3% chance of rainfall being in the below-normal tercile, 33.3% chance of rainfall being in the near-normal tercile, and 33.3% chance of rainfall being in the above-normal tercile. Seasonal climate forecasts (see definition) are often given in terms of the chances of rainfall being in one of the tercile categories. For example: In the 30 years from 1961 to 1990 of September to December rainfall at Entebbe, 10 years had rainfall in the range 200–445mm (below-normal tercile), 10 years had rainfall in the range 445–512mm (near-normal tercile), and 10 years had rainfall in the range 512–1000mm (above-normal tercile). Note that the range of the below-normal tercile is much smaller than the range of the above-normal tercile.

TRANSMISSION OF INFECTION: the carriage of an infectious agent from an infective to a susceptible individual within an infected population or subdivision of a population.

TREND (SEE DE-TRENDING): a long-time movement in an ordered series (e.g., a time series). An essential feature is that the movement, whilst possibly irregular in the short term, shows movement consistently in the same direction over a long term.

TYPE I ERROR: an error, which occurs when using data from a sample that demonstrates a statistically significant association when no such association is present in the population. The probability of a Type 1 error equals the level of significance or alpha.

TYPE II ERROR: an error that occurs from failure to demonstrate a statistically significant association when one exists in a population.

VAPOR PRESSURE: the pressure exerted in a fixed parcel of air by the molecules of water vapor contained within it.

VECTOR: arthropods that transmit disease pathogens following a multiplication and a maturation cycle occurring in their bodies; e.g., mosquitoes, sand flies, ticks. Key determinants of vector distribution are their feeding, resting and habitat preferences. Vectors that prefer to feed on humans are referred to as anthropophilic. In general, the vectors of African malaria bite at night and after feeding, some will rest in shady areas outside houses. Such vectors are termed exophilic i.e. they prefer to rest outdoors after feeding. Others are endophilic and rest indoors on walls and in hidden corners after feeding. These vectors are dominant around human settlements. Other vectors may bite humans and thus transmit malaria but they prefer to bite animals (i.e. they are zoophilic). Such vectors are often most abundant where livestock is kept.

VECTOR-BORNE DISEASE: disease caused by pathogens that are transmitted by insects or other arthropods.

VIRULENCE: the degree of severity of disease produced by an agent in a given host. Epidemiologically, it is measured as the proportion of individuals with disease who become seriously ill or die. The case-fatality rate is a measure of virulence (see also Infectivity and Virulence).

VULNERABILITY: refers to the full range of factors that place an individual at risk of becoming infected, ill or dying from malaria. The degree of vulnerability for an individual, household or group of persons is determined by their exposure to the risk factors and their susceptibility to illness or death if infected with malaria (see Receptivity).

WEATHER: the short-term variations of the atmosphere in terms of pressure, wind temperature, moisture, cloudiness, precipitation and visibility. It is a phenomenon that varies very much from day to day, even hour to hour and we experience it as wet or dry, warm or cold, windy or calm.

ZOBA: Second level administrative unit (zone, region) in Eritrea.

ZOOPHILIC: see Vector.

Appendix 4: Participants' Project Guidelines

It is critical to ensure and capture the opportunity for participants of the Summer Institute to explore their own ideas through the course lectures, seminars, exercises and discussions and to demonstrate their newly acquired competency. Therefore, we would like you to begin, from the beginning of the training, to follow through on a personal project that you decide either individually or in a small group with individuals of both the health and climate communities. We are asking you to define your project and (when applicable) form your working group on the second day of the training and to provide this information to the Summer Institute Team during the first session of the third day of the training.

You will build up your project throughout the entire course, applying what you have learned - using either your own data, when applicable, or some datasets made available to you by the IRI - and linking these results to aspects of your own work or interest. For instance, the projects may explore the relationship between malaria and rainfall in the Kenya Highlands, or between dengue and temperature in Bogota.

We are asking you to develop your project using the results and figures obtained with your data (either personal or provided by the IRI) during the daily practical sessions. A pen drive will be provided to each participant to save these results on a daily basis. Some additional time will also be allocated everyday for you to work on your own projects.

Poster presentations of these projects will be made by the participants on the final day of the course, allowing participants the opportunity to share the learning experience with co-participants, facilitators, distance learners and the climate information for public health network. The poster should include (but not be limited to) the following items: brief overview of the project's targeted country, objectives, project's targeted audience/users, hypothesis, methods, results, interpretation (including new hypothesis that arose), tables and figures (when applicable). We are also asking you to frame your project in the context of public health decision-making.

These projects will not be graded but they will be used to share with co-participants, facilitators, instructors and distance learners. There will also be a "Best Poster Prize Committee" awarding outstanding poster presentations.

During the Summer Institute, you will participate in 1) a special seminar on communication in the area of climate and health, which will, in particular, help you on how to communicate climate and health information using different communication tools, and in 2) a 'Poster Clinic" session, during which communication professionals will review your materials. The links and project's examples indicated at the bottom of this document may help you with the design of your poster and the development of your project.

In addition to the poster, participants will need to write up a 300-word summary which would include the following: title, author(s)' name(s), author(s)' affiliation(s), background, objectives, hypothesis and methods, results, interpretation and conclusion. This summary needs to be written on a Word document and emailed to si2010@iri.columbia.edu before 5pm on Friday May 28, 2010.

Good luck!

Useful resources:

The Psychology of Climate Change Communication: A Guide for Scientists, Journalists, Educators, Political Aides, and the Interested Public, by Debika Shome and Sabine Marx, Center for Research on Environmental Decisions, Columbia University, NY, available from: http://www.csc.noaa.gov/digitalcoast/inundation/pdf/CRED_Psychology_Climate_Change_Communication.pdf

Advice on Designing Scientific Posters, by Colin Purrington, Department of Biology, Swarthmore College, Pennsylvania, available from: http://www.swarthmore.edu/NatSci/cpurrin1/posteradvice.htm

Scientific Poster Design, Cornell Center for Materials Research, Cornell University, Ithaca, NY, available from: http://sciencetalk.posterous.com/toward-a-better-scientific-poster

Instances of projects conducted by participants to previous Summer Institutes (see next page). Please note that on previous years the assignment slightly different.

Dengue and Climate: A short report and lessons learned

12 June 2009

Mary Hayden (National Center for Atmospheric Research), Manon Fleury (Public Health Agency of Canada) and Rachel Lowe (University of Exeter)

Introduction

Dengue is the most important arthropod-borne virus, and its global resurgence has made it a major public health problem in the tropics and subtropics (Gubler 2002). Dengue fever (DF) and dengue hemorrhagic fever (DHF) are diseases that are endemic in the tropical world, caused by four closely related viruses of the genus Flavivirus. Dengue viruses are transmitted by the bite of infected Aedes females, in particular Aedes aegypti, an urban mosquito with widespread distribution in tropical cities. Increasing case numbers in both the Americas and Asia necessitate an examination of changing human and vector ecology in order to better understand the dynamics of dengue transmission. Field survivability of Aedes aegypti and patterns of dengue transmission are influenced by many factors including, but not limited to, climate which influences mosquito biology and interactions between the mosquito vector and dengue virus (Kuno 1995; Scott et al. 2000; Sanchez et al. 2006). In many regions, epidemic dengue transmission is seasonal in response to variability in temperature and rainfall. Although the relative influence of climatic factors is not well understood, in many tropical and subtropical regions there is typically an ebb during the dry season, and greater rates of transmission are seen during the rainy season.

In this report we have created an influence diagram to account for the components involved in dengue transmission to better understand the dynamics of an outbreak. We then introduce some dengue data for Brazil from 2001 to 2008 obtained from SINAN DATASUS, Ministry of Health Brazil[5] which could be used to investigate the relationship between the monthly occurrence of dengue cases and the short-term variations in temperature and precipitation in Brazil. We highlight the analyses we have learned to assess the relationship between dengue and climate variables in

5 *http://dtr2004.saude.gov.br/sinanweb/novo/*

space and time and present a method of downscaling coarse resolution gridded forecast precipitation data for North East Brazil; an area known to demonstrate relatively good forecast skill, to several station locations, which may be more meaningful in terms of relating forecast data to district level disease data.

Material and Methods

An influence diagram (Figure 1) was first created to investigate the different components involved in dengue transmission; it would eventually be used to help make decisions on how to intervene to minimize the impact of a dengue outbreak or epidemic. The diagram demonstrates a decision node for the intervention and the impacts of the intervention on the size of the outbreak. Multiple influences on the size of the outbreak such as the population at risk and mosquito abundance can also be seen. The costs to health care from the outbreak and the costs of intervention can also help to minimize the total number of cases and costs of dengue control in this region. Overall this diagram focuses on identifying what interventions would have the most impact on reducing the number of cases and the costs of intervention versus taking no action. Also since dengue outbreaks seem to be somewhat weather dependent, the exploration of ways to predict future events using early warning systems of weather and climate would be of interest in predicting future outbreaks.

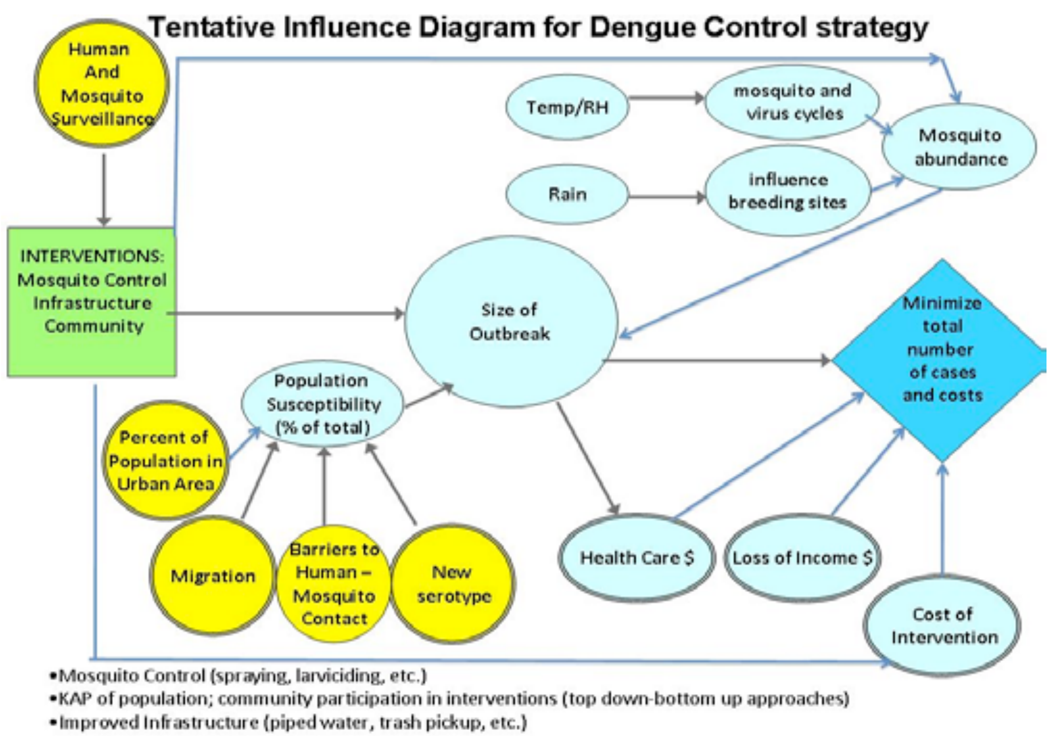


Figure 1: Influence diagram for a dengue control strategy.

The data we have available to explore the monthly relationship between climate and dengue cases are from the data library at IRI for the climate data and the SINAN DATASUS, Ministry of Health Brazil for the health data(Figure 2). The analysis would first consist of descriptive analysis of the data for North East (NE) Brazil to explore the data and to indentify any missing data. Since there are many weather stations and regions in NE Brazil a cluster analysis, using K-means, would first be used to identify clusters of regions with similar dengue cases, temperature and precipitation.

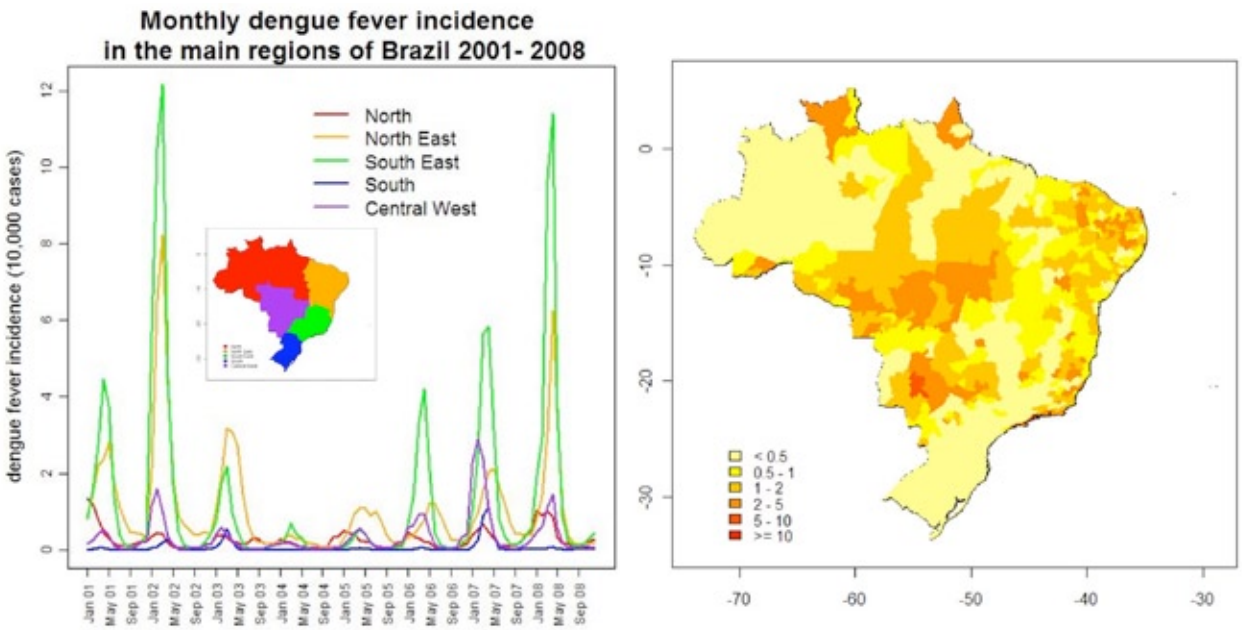


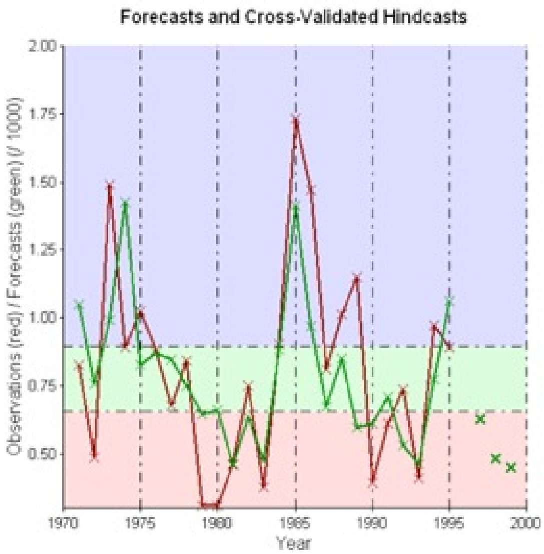
Figure 2: Monthly dengue incidence in the 5 main regions of Brazil (left) and the Standardised Morbidity Ratio (SMR) for the microregions of Brazil (558) for the period 2001- 2008. An SMR greater than 1 indicates areas at risk from dengue.

To explore the relationship between dengue cases and climate we would first do an exploratory time series analysis to look at the distribution and seasonal trends in dengue cases, precipitation and temperature in NE Brazil using the data library on the IRI website. The methods would include using a moving average to better identify the seasonal trend in noisy data. To further explore the seasonal variation in the data an overall average of the monthly data will be plotted and compared to the observed data to see if there are deviations between the average monthly data and the observed data. The second step, if the data show a distinct seasonal pattern in precipitation, temperature and dengue cases, would be to use a lag correlation to explore the relationship between the peaks of temperature and precipitation with dengue cases. Further statistical analysis using generalized linear models will be used to identify the relationship between temperature, precipitation and dengue human cases. Once a relationship is identified we can then use the Climate Prediction Tool (CPT) to forecast the future rainfall and temperature in NE Brazil and the chance of having a dengue outbreak.

The Climate Prediction Tool

The Climate Predictability Tool (CPT) provides a Windows package for the construction of seasonal climate forecasts using model output statistic (MOS) corrections to climate predictions from general circulation model (GCM) or producing forecasts from field data such as sea-surface temperature. For example, the tool can take precipitation forecast from a climate model, and calibrate the forecast to become a more accurate one based on the model's typical biases as detected in a long history of its forecasts as compared with the corresponding actual observations. The software can also be used for principle components regression and canonical correlation analysis on any data.

For this example we use rainfall data from 1 station in NE Brazil. Figure 3 demonstrates a plot of the forecasts with a contingency table for the fit of the mode. The figure shows the observed rainfall for the station in red and hindcast precipitation determined by a statistical adjustment in green with a rainfall forecast for the years 1997-1999. The model contingency table demonstrates the percentage of times rainfall was forecasted correctly in each tercile with below average rainfall being forecasted correctly 80% of the time.



Contingency table:

		Forecast			
		B	N	A	All
Observed	A	10%	44%	50%	32%
	N	10%	44%	50%	32%
	B	80%	11%	0%	36%
	All	40%	36%	24%	100%

Figure 3: Observed rainfall for 1 station in North East Brazil (red line) and hindcast precipitation determined by a statistical adjustment from gridded hindcast data. The green crosses show forecasts rainfall for 1997-1999. The contingency table shows the percentage of times rainfall was forecast correctly in each tercile category. For example, below average rainfall was forecast correctly 80% of the time.

Once we have a proper model fit we can create a probability forecast for future events. Figure 4 shows the probability forecast issued in January for the period of February, March and April (FMA) for each station in NE Brazil. The majority of stations in NE Brazil show that there was a 70-90% chance of rainfall in the below normal category. From these results we can then decide if the control of dengue is required for this region during these months.

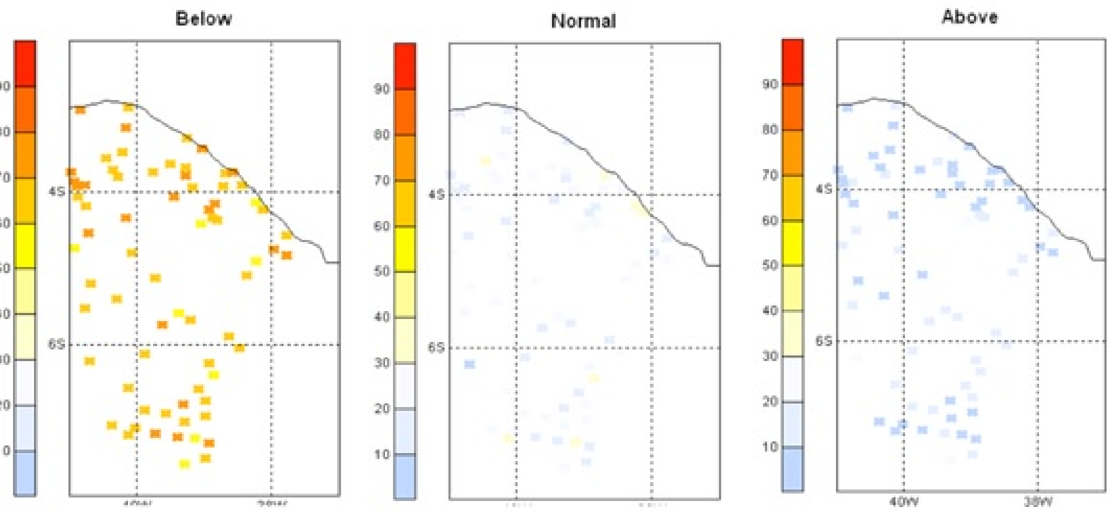


Figure 4: A probability forecast issued in January for the period February – March – April (FMA). For the majority of stations in NE Brazil, there was a 70-90 % chance of rainfall in the below normal category. Intuitively there was a 10-30% chance of rainfall in the above normal category. The probability at each station in the 3 maps add up to 1.

Conclusion

Overall, we have found the course extremely interesting, and we have learned many excellent new tools that we will be able to use in future research of weather, climate and health. We look forward to sharing these tools with our colleagues.

References

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Kuno G. (1995) Review of the factors modulating dengue transmission. Epidemiol Rev 17: 321-335.

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Scott TW, Morrison AC, Lorenz LH, Clark GG, Strickman D, Kittayapong P, Zhou H and Edman J. (2000) Longitudinal studies of Aedes aegypti (Diptera: Culicidae) in Thailand and Puerto Rico: Population Dynamics. Journal of Medical Entomology 37(1): 77-88.

Louise Kelly-Hope

Short Report for IRI Workshop – June 2008

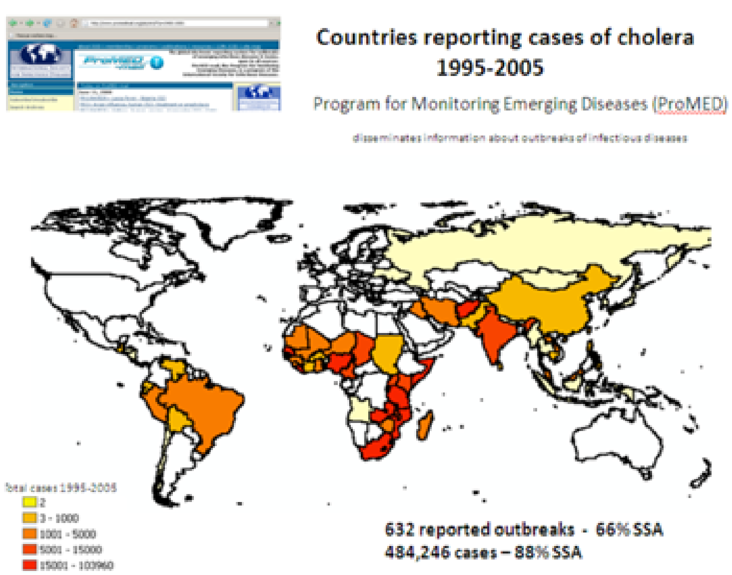
Exploring the Relationship Between Climate and Reported Cholra Outbreaks

1995-2005

This report is based on a compiled a database of cholera outbreak reports from the Program for Monitoring Emerging Diseases (ProMED) from 1995 to 2005 (Griffith et al. 2006). In total 632 reports of cholera outbreaks were identified (meeting a specific criteria), 66% originated in Sub-Saharan Africa, followed by 16.8% from Southeast Asia. Reported outbreaks in Africa tended to be larger in size. The most common risk factors were water source contamination, heavy rainfall and flooding, and population dislocation. While cholera reporting is sub-optimal, this review provided a detailed sub-national quantification of cholera, foci of endemicity in Africa and describes risk factors by region. The group at Fogarty International Center have started analysing this cholera data in relation to climate. The initial analyses have been quite broad i.e. continental, national, provincial. This workshop provides the opportunity to explore a wider range of climate variables in selected cities, regions and countries.

Due to time restrictions and glitches in the DL interface, I am submitting my presentation (cut & paste below) as the short report with additional notes on the activities carried out.

Slide 1.



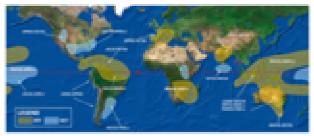
This slide shows the number of cases and specific countries which experienced cholera outbreak s between 1995-2005.

There was great difficulty in interpreting the data as there was, and still is, no standard method of reporting. The exact location/district is often tricky to pinpoint, estimating the population at risk almost impossible and risk factor descriptions are extremely varied

Slide 2.

Many possible ways to use IRI data library to explore the relationship between climate and cholera outbreaks

1. Examine outbreaks
   - occurring in define ENSO regions/periods
   - reporting ENSO as a risk factor



2. Compare
   - 'climate-driven' (e.g. high rainfall) vs. 'non-climate-driven' (e.g. conflict) outbreaks
   - in an outbreak region with a nearby non-outbreak region
   - outbreak years with non-outbreak years
3. In a specific country
   - define the spatial and temporal patterns of disease i.e. when & where outbreaks occurs
   - compare with other diseases (e.g. malaria, meningitis) - identify any overlaps
   - distinguish climate drivers of the different diseases

This slide highlights that there are many different ways to analyse cholera outbreaks.

Even though the data are imperfect, there can still be a lot gained from some sort of analysis. Some sort of climate analyses will help to define ecological parameters.

Slide 3.

Cholera - range of risk factors

Studies have shown associations of *Vibrio cholerae* with climate, including rainfall, flooding, water temperature and depth, sea surface temperatures, and the El Niño Southern Oscillation (ENSO)
(Huq et al. 2005; Koelle et al. 2005b; Lipp et al. 2002; Lobitz et al. 2000; Pascual et al. 2000; Rodo et al. 2002).

ProMed list of reported risk factors

Risk Factor	Cause
Rainfall flooding	Heavy rains and floods disrupt water systems and spread cholera
Water Source Contamination	A specific water source, such as lakes, rivers, or domestic water pipes, is contaminated with cholera
Poor Sanitation	general term used in many reports to refer to a lack of adequate latrines
Lack of potable water	Limited water availability forces people to use contaminated water for domestic purposes
Refugee Camp	Camps for refugees or internally displaced peoples are over-crowded with limited resources, such as water and latrines
Food	Contaminated shellfish or unwashed raw vegetables
Imported Travelers	Travelers with cholera carry the disease to a new area
Conflict Zone	War zones can increase the risk of outbreaks because infrastructure is damaged and people do not have access to proper sanitation or medical care
Urban/dense populations	In cities and slums, people living in extremely close proximity increases the burden on sanitation and facilitates transmission
Seasonal	In some endemic areas, cholera reoccurs during certain seasons
Funeral Feast	Some traditional funeral rites include the washing of the deceased and preparation of a large meal. This situation, combined with the fact that

This slide shows a summary of the putative risk factors reported for cholera outbreaks (Griffith et al. 2006).

Climate is clearly an important risk factor, however, it is also important that the transmission of this disease (like other diseases) is complex, and driven by a combination of climate and non-climate factors.

Slide 4

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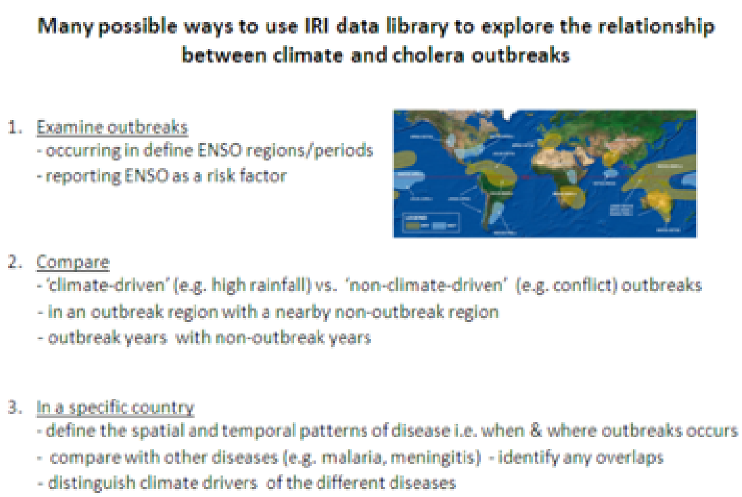
Even though the data are imperfect, there can still be a lot gained from some sort of analysis. Some sort of climate analyses will help to define ecological parameters.

Slide 5



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Slide 6

Many possible ways to use IRI data library to explore the relationship between climate and cholera outbreaks

1. Examine outbreaks
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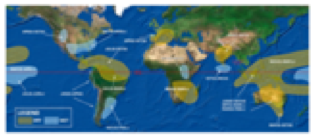
   - reporting ENSO as a risk factor



2. Compare
   - 'climate-driven' (e.g. high rainfall) vs. 'non-climate-driven' (e.g. conflict) outbreaks
   - in an outbreak region with a nearby non-outbreak region
   - outbreak years with non-outbreak years
3. In a specific country
   - define the spatial and temporal patterns of disease i.e. when & where outbreaks occurs
   - compare with other diseases (e.g. malaria, meningitis) - identify any overlaps
   - distinguish climate drivers of the different diseases

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Slide 7

Many possible ways to use IRI data library to explore the relationship between climate and cholera outbreaks

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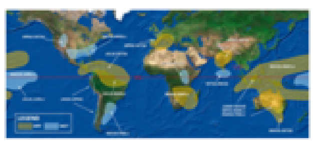

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Slide 8

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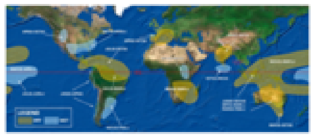

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3. In a specific country
   - define the spatial and temporal patterns of disease i.e. when & where outbreaks occurs
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   - distinguish climate drivers of the different diseases

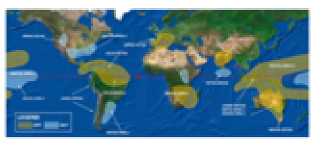
This slide highlights that there are many different ways to analyse cholera outbreaks.

Even though the data are imperfect, there can still be a lot gained from some sort of analysis. Some sort of climate analyses will help to define ecological parameters.

Slide 9

Many possible ways to use IRI data library to explore the relationship between climate and cholera outbreaks

1. Examine outbreaks
   - occurring in define ENSO regions/periods
   - reporting ENSO as a risk factor



2. Compare
   - 'climate-driven' (e.g. high rainfall) vs. 'non-climate-driven' (e.g. conflict) outbreaks
   - in an outbreak region with a nearby non-outbreak region
   - outbreak years with non-outbreak years

3. In a specific country
   - define the spatial and temporal patterns of disease i.e. when & where outbreaks occurs
   - compare with other diseases (e.g. malaria, meningitis) - identify any overlaps
   - distinguish climate drivers of the different diseases

This slide highlights that there are many different ways to analyse cholera outbreaks.

Even though the data are imperfect, there can still be a lot gained from some sort of analysis. Some sort of climate analyses will help to define ecological parameters.

End of report.

Thank you to all for this workshop – it has been very helpful.

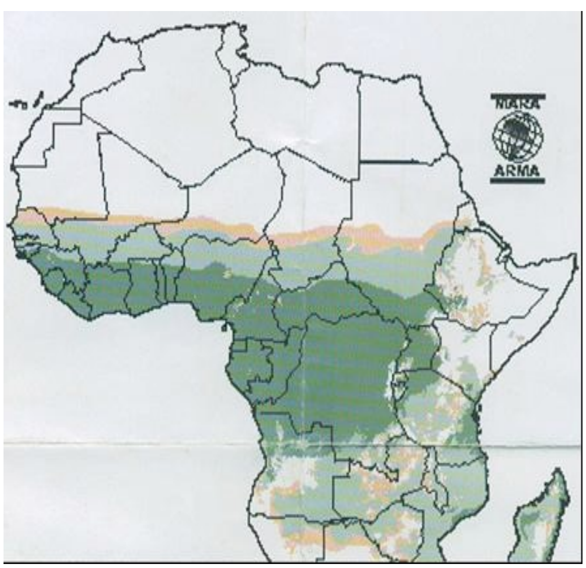
Relationship between Malaria Epidemic and Rainfall in Eritrea

By Omeny Peter

Introduction

Malaria is ranked among the top killer diseases in Africa. It is endemic especially in the lowland areas with warm and humid climates (Fig1a and b). Temperature, rainfall and humidity are the most important climatic parameters that affect malaria transmission (Fig 2a, b and c). Seasonality in the occurrence of malaria is dependent upon the seasonal rainfall pattern with a lag of 2 to 3 months. Malaria epidemics occur after extreme wet seasons such as the 1997/98 El Nino. Epidemics associated with global warming are also emerged in highlands areas making temperature an important climate parameter for malaria transmission in the highland regions.

Extreme rainfall anomalies in the tropics have been associated with El Nino Southern Oscillation (ENSO), which is the main mode of interannual variability at seasonal time scales. Establishing the degree of association between the rainfall and malaria cases may provide a tool in developing models for predicting malaria epidemics. Therefore this study aims at establishing the degree of association between malaria epidemic and rainfall.



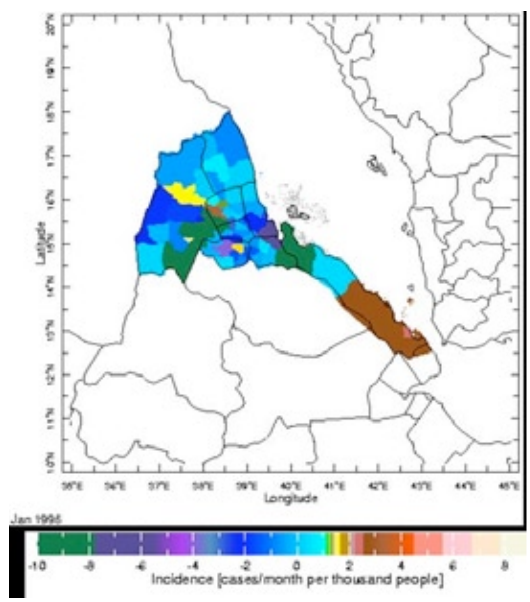


Fig1a: Malaria endemic zones in Africa; Fig1b: Malaria Suitability in Eritrea

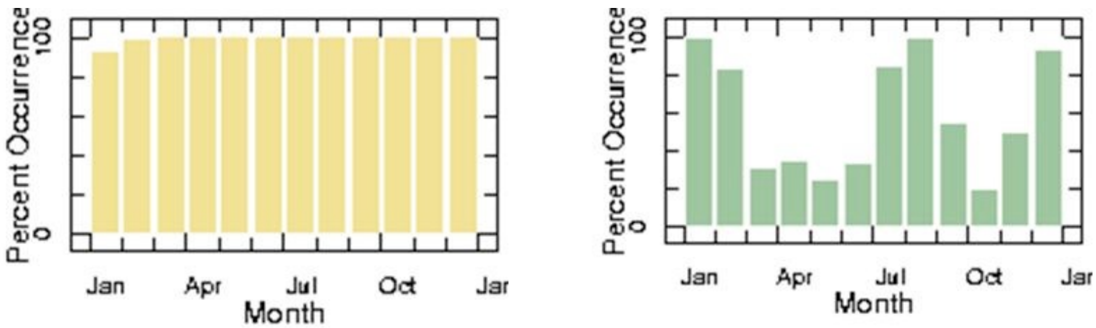


Fig2a: % occurrences in temp. (18oC<T<32oC); Fig2b: % occurrence in RH

Methods

Detrending

Seasonality in both rainfall and malaria incidences was removed by calculating the malaria incidences and rainfall anomalies. The method involved subtracting long-term means from the actual data values.

Time series analysis

This method was used to investigate the epidemic years and Asses the occurrences of malaria epidemics with peak rainfall season. The malaria incidences and rainfall anomalies were plotted for the same period of time (1996-2003).

Correlation analysis

The method involved correlating the rainfall and malaria incidence anomalies to asses the degree of association between the two variables.

Results and Discussions

Epidemic years

Time series results show that the epidemic years were 1998 and 1999 (Fig3). High incidence of malaria occurred in early 1998 and late 1999. The occurrences followed high precipitation anomalies that in 1997 and late 1999 (Fig4). These occurrences could be linked to 1997/98 ENSPO events.

Seasonality in Malaria epidemics

Time series results show that the malaria epidemics follow after the occurrence of extreme rainfall anomalies of

1997/98 El Nino (Fig5) events indicating that ENSO events influence malaria epidemics. High temperatures associated with prolonged drought of 1996 might also have contributed to malaria transmission.

Correlation results

Most stations revealed positive correlation between malaria and rainfall (fig6). Highest positive correlation coefficient of about 0.5 was obtained indicating that some degree of association exists between malaria and rainfall. This result provides an opportunity for developing a model for malaria epidemics prediction. However, lag relationship with rainfall and other climatic parameters needs to be established for a realistic model to be developed.

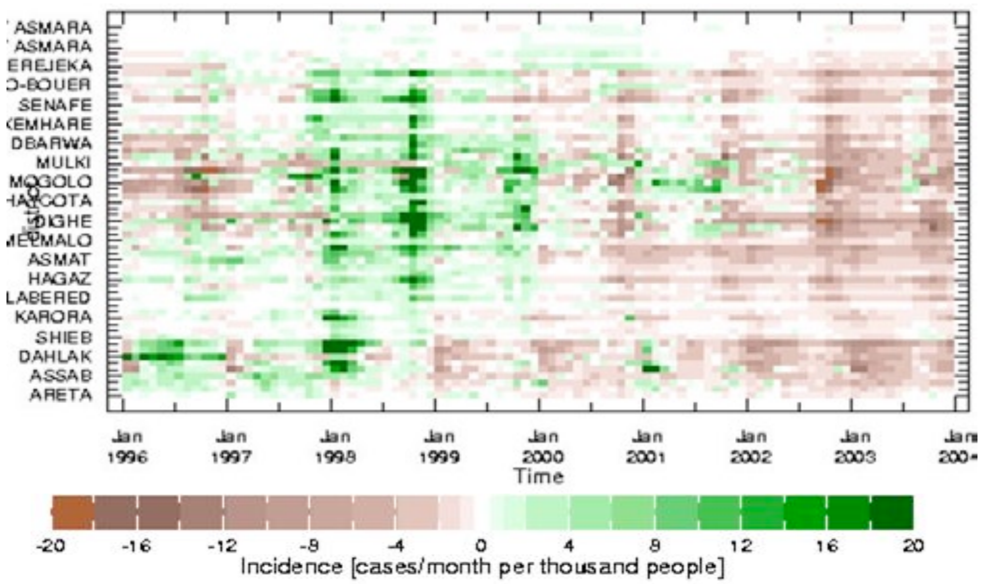


Fig3: Monthly malaria incidences in Eritrea

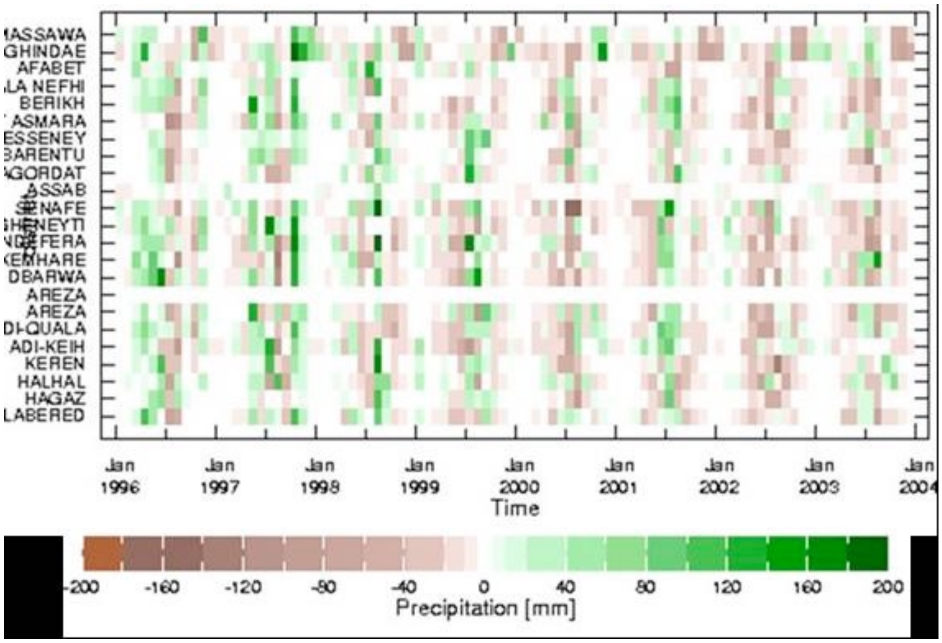


Fig4: Monthly Precipitation anomalies in Eritrea

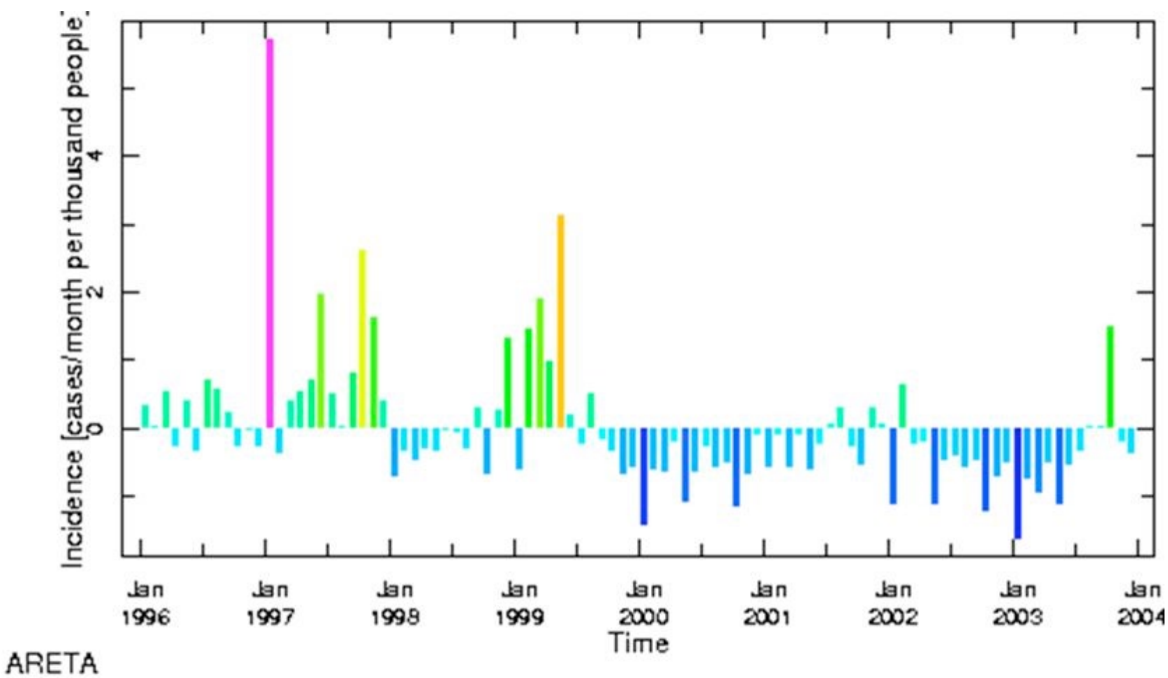


Fig5: Malaria incidences at Areta in Eritrea

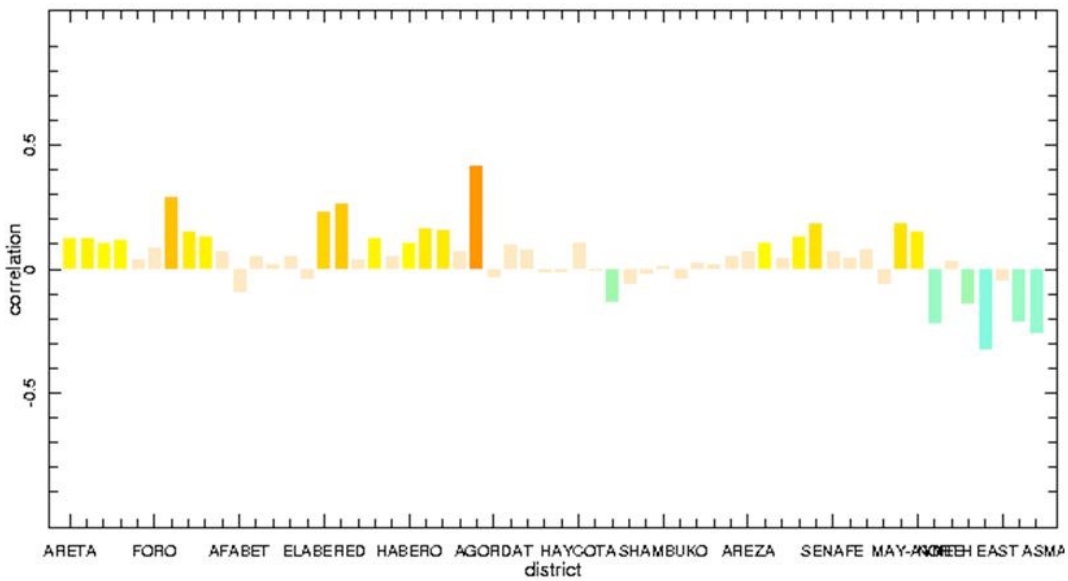


Fig6: Correlation between rainfall and malaria incidence

Conclusions and Recommendations

This study showed that rainfall and malaria are significantly associated. Further analysis should be carried to establish the association between malaria epidemics and other climate variables such as temperature and relative humidity with a view to develop a relationship for predicting malaria epidemics. The study also reveals that malaria epidemics occur after strong ENSO years. Monitoring of ENSO signal should used as an early warning tool to malaria epidemics.

Appendix 5: Course Evaluation Forms

Pre-Course Questionnaire

Please answer the following questions regarding your prior knowledge to the best of your ability. If you do not know an answer to a question, move on to the next question. Your responses will be used to help us evaluate your learning. All responses will be kept confidential.

YOUR INFORMATION

Profession (e.g. Government official, researcher, etc…):

Years in current profession: _

Sector: Climate________, Public Health______, Other _______

QUESTIONS

1. List any climate-sensitive problems you are aware of: *(You may include details about the issues you deal with in your country)*

2. Describe the following terms in one sentence each:

a) weather:

b) climate:

c) climate forecast:

d) probability:

e) seasonality:

3. Describe the difference between climate change and climate variability.

4. There are various methods used in predicting the effect of climate on disease. Please describe those you are familiar with in the space below.

5. The study of climate-sensitive diseases requires analysis of data across space and across time. List those geographic features you are aware of that are used to characterize information across space. In other words, what features are characteristic of spatial data/information?

6. Climate data is described using a variety of units of measure. How is rainfall measured?

a) Millimeters / day
b) Millimeters / month
c) Millimeters / every six days
d) Millimeters / ten days
e) all of the above
f) none of the above

7. How are climate forecasts produced? (i.e. What methods and tools are used?)

8. How are climate forecasts used? (i.e. by non-climate professionals, such as public health experts)

9. Besides climate, what other factors play a role in your decision making? (e.g. National economy, availability of funding, etc…) Please list four primary factors (which may include the examples given) in your decision-making and rank your answers as MORE important, LESS important, or EQUAL in importance than climatic factors.

FACTORS	IMPORTANCE		
a. ____________________	MORE	EQUAL	LESS
b. ____________________	MORE	EQUAL	LESS
c. ____________________	MORE	EQUAL	LESS
d. ____________________	MORE	EQUAL	LESS

Comments:

Final Questionnaire to the Trainee

(includes a Daily, Weekly and Overall Course Evaluation)

DAILY EVALUATION

What is your major area of expertise/professional Activity

☐ Climate ☐ Public Health

The lecture speakers were clear and easy to understand

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Today's lecture challenged me to think in new ways

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

The lectures fulfilled my expectations

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

The scheduling and sequence of the lectures made sense

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

The resources, references and other materials were appropriate and helped me understand the content

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

The visual aids used in the lecture were appropriate and helpful

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Please provide any additional comments on today's lectures:

WEEKLY EVALUATION

Overall, the sessions have accomplished their stated objectives throughout the week

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Over the past week I have found the contents of the lectures and other activities relevant

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

The lectures and activities of the past week have challenged me to think in new ways

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

I expect to incorporate methods learned over the past week in my ongoing work

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

If applicable, please comment on how you intend to incorporate methods learned in your ongoing work

Please rate the overall effectiveness of each of the following over the past week:

Reading materials:

	1	2	3	4	5	
Effective	☐	☐	☐	☐	☐	Ineffective

Lectures:

	1	2	3	4	5	
Effective	☐	☐	☐	☐	☐	Ineffective

Practical Exercises:

	1	2	3	4	5	
Effective	☐	☐	☐	☐	☐	Ineffective

Daily summary by participant:

	1	2	3	4	5	
Effective	☐	☐	☐	☐	☐	Ineffective

Daily quiz:

	1	2	3	4	5	
Effective	☐	☐	☐	☐	☐	Ineffective

Facilitators and Instructors:

	1	2	3	4	5	
Effective	☐	☐	☐	☐	☐	Ineffective

Any additional comments

Please add any additional comments you may have relating to the course over the past week below:

END OF COURSE EVALUATION

Course objectives

The objectives of the course were stated clearly

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

My expectations, with respect to the objectives of the course were met or exceeded
Please comment below

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Please comment

COURSE CONTENTS

The contents of the course fulfilled my expectations

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

The course went into a sufficient amount of depth

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

The course was delivered in a way that was easy to understand

	1	2	3	4	5	
Disagree						Agree

The contents of the course agreed with the objectives of the course

	1	2	3	4	5	
Disagree						Agree

I found the contents of the course engaging

	1	2	3	4	5	
Disagree						Agree

There was an agreement between the course objectives and the course contents

	1	2	3	4	5	
Disagree						Agree

What topics do you think were not covered fully enough?

Please add any additional comments you may have relating to the course contents below:

ADDITIONAL COURSE ACTIVITIES

I found the course was enhanced by the additional activities (such as lunchtime seminars, panel session at Mailman School of Public Health, Weather roulette)

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Comments on additional course activities:

PRACTICAL SESSIONS

I found the course was enhanced by the practical sessions

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

I thought there was a good balance between lectures and practical sessions

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

I found the Data Library easy to use

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

I found the practical sessions engaging

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Please add any additional comments you may have relating to the practical sessions below:

THE PROJECT

I found the option to use my own data for the project valuable

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Prior to starting the course you were given the Project Guidelines. How useful did you find these guidelines?

	1	2	3	4	5	
Not useful at all	☐	☐	☐	☐	☐	Very useful

During the course you were given a template for the poster. How useful did you find this template?

	1	2	3	4	5	
Not useful at all	☐	☐	☐	☐	☐	Very useful

Adequate time was given to work on the project

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Producing a poster was a valuable exercise

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Producing a 300-word summary was a valuable exercise

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Please provide any comments relating to the project below:

Global transferability of the course contents

Which topics of the course did you find most instructive to you?

Was the content of the course valuable to your geographical region and your organization?

Please provide details on what was and was not relevant

What part of the course was MOST valuable to your work?

What part of the course was LEAST valuable to your work?

What would you change about the course to enhance your learning experience?

Bearing in mind the diversity of the course participants, what additional course content would you recommend to be developed for this course for the future?

Do you think these aspects of this course could be incorporated into the training program of your organization?

☐ Yes ☐ No

Please explain your answer:

Do you think you will change any of your working practices as a result of this course?

☐ Yes ☐ No ☐ Don't know

If yes, please comment further

I think I have increased my network within the climate and health community by attending this course

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Please provide further comments:

COURSE DESIGN

The course was well structured

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

The design of the course allowed me to learn at my own pace

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

What is your opinion of the length of the course?

	1	2	3	4	5	
Too Short	☐	☐	☐	☐	☐	Too Long

During the course I was given the opportunity to reinforce my understanding of the content

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

The scheduling of lectures, lunchtime seminars and practical sessions was intuitive and made sense

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

There was enough time to engage in practical hands-on work

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Did you have enough time to read the reading materials provided in the manual

☐ Yes, I read most of the material ☐ Yes, I read some of the material ☐ No, I did not have enough time

If you answered 'Yes' above do you agree with the following statement: The reading materials added value to the presentations

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

If you answered 'Yes' above do you agree with the following statement: I would recommend the reading materials to others

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

The morning review sessions (presented by a selected participant) were useful in helping me to understand the content of the course

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

The morning quizzes were useful in helping me to understand the content of the course

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

The morning discussions (lead by a facilitator from the previous day) were useful in helping me to understand the content of the course

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

The course evaluation process was suitably designed

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Additional comments on the course design:

COURSE DELIVERY

Have you taken a course like this before?

☐ Yes ☐ No

If yes, how does this course compare?

All activities began/finished on time

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Course materials were appropriate and helped me to learn the course contents

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Course facilities (i.e. computers, meeting spaces) were appropriate for the course

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Course facilitators were available to answer questions when needed

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

IRI researchers and staff were available for networking and discussion

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

IRI staff/facilitators were helpful in addressing my questions regarding travel, accommodation and other personal matters

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Please provide us with any additional comments you may have regarding the course delivery

GENERAL

I enjoyed the food that was provided throughout the course

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Additional comments

Suitable accommodation was provided for the course (i.e. the hotel facilities, location etc.)

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Additional comments

The extra activities undertaken during the course (nature walk, celebrity walk, tour of Manhattan etc) were successful

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

Did you experience any significant problems during the course? i.e. was language a problem, was the course content/materials too challenging or not challenging enough?

☐ Yes ☐ No

If yes, please elaborate in the space below:

If you have any additional comments on the course please provide them below.

Thank you for your response, and we hope you enjoyed being a part of the Summer Institute 2010, and we hope you enjoy being part of our Climate and Health community. Keep in touch!

Questionnaire to the Organizers

Rate your opinion of the following planning components, where '5' represents the highest score.

Participant selection

1	2	3	4	5
☐	☐	☐	☐	☐

Content of the curriculum

1	2	3	4	5
☐	☐	☐	☐	☐

Course Scheduling

1	2	3	4	5
☐	☐	☐	☐	☐

Interaction of the planning committee with the lecturers and/or support team

1	2	3	4	5
☐	☐	☐	☐	☐

Overall Coordination

1	2	3	4	5
☐	☐	☐	☐	☐

Technical Support

1	2	3	4	5
☐	☐	☐	☐	☐

Please comment on the ratings given above

Please identify the strengths of the Summer Institute

In your opinion, which areas need to be improved and which gaps need to be filled?

Please provide detail (e.g. logistics, design of the curriculum, objectives, choice of participants, ability to improve field decision-making).

How would you describe your involvement in the Summer Institute?

	1	2	3	4	5	
Light involvement	☐	☐	☐	☐	☐	Heavy involvement

Did you have the opportunity to view the participants' projects/posters

☐ Yes ☐ No

If 'yes', how useful do you think the use of their own data was with respect to how well the participants engaged in their projects

	1	2	3	4	5	
Not at all useful	☐	☐	☐	☐	☐	Very useful

Any further comments with respect to the projects:

Were you present for, or involved in any of the morning sessions of the course, during which a summary and discussion of the previous day's events were held?

☐ Yes ☐ No

If 'yes', please rate how useful these sessions were in relation to improving participants' involvement in the course

	1	2	3	4	5	
Not important	☐	☐	☐	☐	☐	Very important

Any further comments on the morning sessions:

Did you participate in any of the social activities that were arranged during the course (i.e. nature walk, celebrity walk etc.)

Yes No

If 'yes', how useful were these activities in improving your relationship with the course participants?

	1	2	3	4	5	
Not at all useful						Very useful

Do you anticipate being involved in the Summer Institute next year?

Yes No Don't know

How would you rate the workload associated with the preparation of the Summer Institute (i.e. before it started)?

	1	2	3	4	5	
Light						Heavy

How would you rate the workload associated with the delivery of the Summer Institute (i.e. during the SI)?

	1	2	3	4	5	
Light						Heavy

Did the Summer Institute provide you with new research project insights or opportunities for collaboration?

Yes No

Please comment further

Did the Summer Institute and the interaction with the participants and/or other lecturers challenge you to think in new ways?

☐ Yes ☐ No

Please comment further

How would you rate the overall Summer Institute 2010?

	1	2	3	4	5	
Excellent	☐	☐	☐	☐	☐	Poor

Please, provide any comments and/or suggestions that you think would be useful to better prepare and implement the next Summer Institute below.

Questionnaire to the Facilitators

Were you responsible for: Please tick all applicable answers

☐ A core lecture ☐ A practical session

☐ A lunchtime seminar ☐ Other:

Rate your opinion of the following planning components, where '5' represents the highest score.

Participant selection

1	2	3	4	5
☐	☐	☐	☐	☐

Content of the curriculum

1	2	3	4	5
☐	☐	☐	☐	☐

Course Scheduling

1	2	3	4	5
☐	☐	☐	☐	☐

Interaction of the planning committee with the lecturers and/or support team

1	2	3	4	5
☐	☐	☐	☐	☐

Overall Coordination

1	2	3	4	5
☐	☐	☐	☐	☐

Technical Support

1	2	3	4	5
☐	☐	☐	☐	☐

Please comment on the ratings given above

Do you feel that your lecture(s)/practical session(s)/talk matched the objectives of the Summer Institute?

☐ Yes ☐ No

Please explain your answer

Do you think that your lecture(s)/practical session(s)/talk addressed the expectations of the students?

☐ Yes ☐ No

Please explain your answer

Were you involved in the question and answer sessions which were conducted each morning?

☐ Yes ☐ No

Were you present for any of daily summary presentations which were prepared by a course participant each morning?

☐ Yes ☐ No

If you answered 'yes' to at least one of the two questions above, please rate how useful you think these activities were in relation to improving the participants' involvement in the course

	1	2	3	4	5	
Not at all useful	☐	☐	☐	☐	☐	Very useful

Any further comments

Were you involved in the participants' projects or, did you have the opportunity to view their posters?

☐ Yes ☐ No

If 'yes', how useful do you think the use of their own data was with respect to the way in which the participants engaged in their projects?

	1	2	3	4	5	
Not at all useful	☐	☐	☐	☐	☐	Very useful

Any further comments

Did you participate in any of the social activities that were arranged during the course (i.e. nature walk, celebrity walk etc)?

☐ Yes ☐ No

If 'yes' , how useful were these events in improving your relationship with the course participants?

	1	2	3	4	5	
Not at all useful	☐	☐	☐	☐	☐	Very useful

How would you rate the workload associated with the preparation of the Summer Institute (i.e. before it started)?

	1	2	3	4	5	
Light	☐	☐	☐	☐	☐	Heavy

I received sufficient information regarding my role in the Summer Institute prior to the start of the course

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

The amount of information regarding your role in the Summer Institute prior to the start of the course was sufficient

	1	2	3	4	5	
Disagree	☐	☐	☐	☐	☐	Agree

How would you rate the workload associated with the delivery of the Summer Institute (i.e. during the SI)?

	1	2	3	4	5	
Light	☐	☐	☐	☐	☐	Heavy

Did the Summer Institute provide you with new research project insights or opportunities for collaboration?

☐ Yes ☐ No

Please comment further

Did the Summer Institute and the interaction with the participants and/or other lecturers challenge you to think in new ways?

☐ Yes ☐ No

Please comment further

How would you rate the overall Summer Institute 2010?

	1	2	3	4	5	
Excellent	☐	☐	☐	☐	☐	Poor

Please, provide any comments and/or suggestions that you think would be useful to better prepare and implement the next Summer Institute below.

Questionnaire to the Support Staff

Rate your opinion of the following planning components, where '5' represents the highest score.

Participant selection

1	2	3	4	5
☐	☐	☐	☐	☐

Content of the curriculum

1	2	3	4	5
☐	☐	☐	☐	☐

Course Scheduling

1	2	3	4	5
☐	☐	☐	☐	☐

Interaction of the planning committee with the lecturers and/or support team

1	2	3	4	5
☐	☐	☐	☐	☐

Overall Coordination

1	2	3	4	5
☐	☐	☐	☐	☐

Technical Support

1	2	3	4	5
☐	☐	☐	☐	☐

Please comment on the ratings given above

Please identify the strengths of the Summer Institute

In your opinion, which areas need to be improved and which gaps need to be filled. Please provide detail (e.g. logistics, design of the curriculum, objectives, choice of participants, ability to improve field decision-making).

How would you describe your involvement in the Summer Institute?

	1	2	3	4	5	
Light involvement	☐	☐	☐	☐	☐	Heavy involvement

Did you have the opportunity to view the participants' projects/posters

☐ Yes ☒ No

If 'yes', how useful do you think the use of their own data was with respect to how well the participants engaged in their projects?

	1	2	3	4	5	
Not at all useful	☐	☐	☐	☐	☐	Very useful

Any further comments with respect to the projects:

Were you present for, or involved in any of the morning sessions of the course, during which a summary and discussion of the previous day's events were held?

☐ Yes ☐ No

If 'yes', please rate how useful these sessions were in relation to improving participants' involvement in the course

	1	2	3	4	5	
Not important	☐	☐	☐	☐	☐	Very important

Any further comments on the morning sessions:

Did you participate in any of the social activities that were arranged during the course (i.e. nature walk, celebrity walk etc.)

☐ Yes ☐ No

If 'yes', how useful were these activities in improving your relationship with the course participants?

	1	2	3	4	5	
Not at all useful	☐	☐	☐	☐	☐	Very useful

Do you anticipate being involved in the Summer Institute next year?

☒ Yes ☐ No ☐ Don't know

How would you rate the workload associated with the preparation of the Summer Institute (i.e. before it started)?

	1	2	3	4	5	
Light	☐	☐	☐	☐	☐	Heavy

How would you rate the workload associated with the delivery of the Summer Institute (i.e. during the SI)?

	1	2	3	4	5	
Light	☐	☐	☐	☐	☐	Heavy

Did the Summer Institute provide you with new research project insights or opportunities for collaboration?

☐ Yes ☐ No

Please comment further

Did the Summer Institute and the interaction with the participants and/or other lecturers challenge you to think in new ways?

☐ Yes ☐ No

Please comment further

How would you rate the overall Summer Institute 2010?

	1	2	3	4	5	
Excellent	☐	☐	☐	☐	☐	Poor

Please, provide any comments and/or suggestions that you think would be useful to better prepare and implement the next Summer Institute below.

The mission of the IRI is to enhance society's capability to understand, anticipate and manage the impacts of climate in order to improve human welfare and the environment, especially in developing countries. The IRI conducts this mission through strategic and applied research, education, capacity building, and by providing forecasts and information products with an emphasis on practical and verifiable utility and partnership.