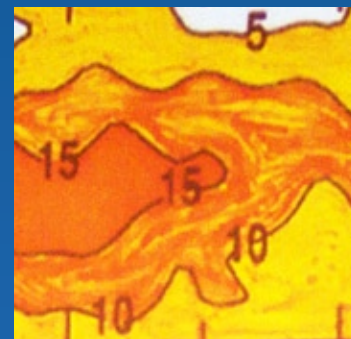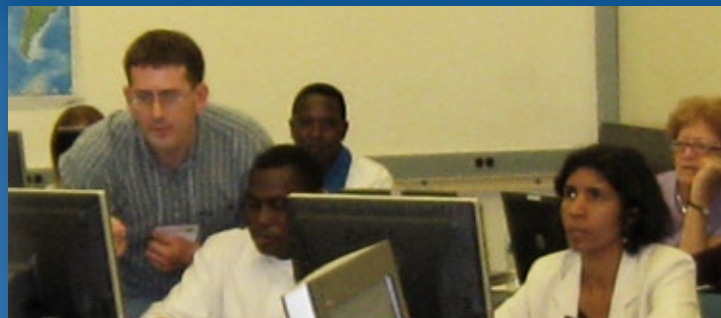# CLIMATE INFORMATION FOR PUBLIC HEALTH

SUMMER INSTITUTE 2009

Summary of the Climate Information for Public Health Training Course

Palisades, New York

June 1-12, 2009

The International Research Institute for Climate and Society

Columbia University MAILMAN SCHOOL OF PUBLIC HEALTH

CIESIN
Columbia University

2009 Summer Institute on Climate Information for Public Health

Summary of the Climate Information for Public Health Training Course
Palisades, New York
June 1-12, 2009

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Organized in partnership with:
Mailman School of Public Health, Columbia University
Center for International Earth Science Information Network (CIESIN), Columbia University

With the participation of:
World Health Organization (WHO)
Centers for Disease Control and Prevention (CDC)

Sponsored by:
Centro de Modelado Científico
Health and Climate Foundation
Meteorological Office Hadley Centre
Public Health Agency of Canada
Tulane University
University Corporation for Atmospheric Research (UCAR)
World Meteorological Organization (WMO)
Google.org
Red Cross/Red Crescent Climate Center

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Executive Summary

As the world's attention is increasingly focused on the effects of climate change, it is essential to better understand the role that climate plays in community health and disease. Equally important is the need for decisive, coordinated interaction between climate experts and health workers to decide how best to respond to the variations in climate that in part drive the burden of disease in communities of developing countries.

The 2009 Summer Institute on Climate Information for Public Health (SI 09) was designed to engage professionals who play a key role in the operational decision-making for climate-sensitive diseases in identifying and evaluating appropriate use of climate information.

The International Research Institute for Climate and Society (IRI) designed and implemented the second annual Summer Institute (SI), in partnership with the Center for International Earth Science Information Network (CIESIN) and the Mailman School of Public Health (MSPH) at Columbia University. The IRI is a premier global research and capacity-building institution focused on the use of climate information in key areas of development. It is a collaborating centre with the World Health Organization–Pan-American Health Organization (WHO–PAHO) on climate-sensitive diseases. The IRI, CIESIN, and MSPH are partner institutions of The Earth Institute at Columbia University. Together these institutes combine extensive experience in environmental health, population mapping and modeling with climate prediction and the study of climate variability and change.

SI 09 was held at Columbia University's Lamont-Doherty Campus in Palisades, New York, between June 1st and June 12th, 2009. A panel discussion was held at the MSPH on June 3rd, 2009.

The course curriculum was designed to help participants (i) enhance their knowledge of climate-sensitive diseases, such as malaria, influenza and meningococcal meningitis, and (ii) foster the use of climate information in the management of climate-sensitive disease programs. Over the course of two weeks, participants were exposed to methodologies and tools developed by IRI

Participants, facilitators gather near Lamont Hall; David Gottlieb

and partner institutions, such as the IRI Data Library. SI 09 comprised four components: core lectures, practical sessions, public talks, and short reports based on individual projects.

These elements combined aimed to:

+ 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

+ Analyze the relationship between climate and public health data in space and time using basic statistics

+ Comprehend the use of climate information in public health decision making

+ Synthesize and apply the course material to the trainees own area of interest

Financial support was provided by the Centro de Modelado Científico, the Health and Climate Foundation, the Meteorological Office Hadley Centre, the Public Health Agency of Canada, Tulane University, the University Corporation for Atmospheric Research, the World Meteorological Organization, Google.org and the Red Cross/Red Crescent Climate Centre.

Participant Selection

Twelve professionals from ten countries in the Americas, Europe and Africa were selected out of the 43 applicants to participate in SI 09. Participants hailed from Ethiopia (3), Kenya (1), Madagascar (1), Mali (1), Ghana (1), the United Kingdom (1), Sweden (1), Ecuador (1), Canada (1) and the United States (1). 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.

Although most of their experience was related to vector-borne diseases, such as malaria or dengue where the link with climate is well established, one third of the trainees were involved in meningitis surveillance and control, an area where research on public health applications for climate information is growing. One participant's area of expertise was in responding to climatic threats to public health, in the broad sense of the term (*e.g.,* probability of flooding).

Selection by the organizing committee was highly competitive and was based on the following criteria:

+ Grasp of the central issues, expressed on the applicant's statement of interest

+ Vision and strategy for applying concepts within a significant follow-up project

+ Home institution's relevance, capacity or connection to key health and climate stakeholders, and ability to sponsor the course

+ The participant's level of influence within their institution in the operational decision-making for climate-sensitive diseases

+ Potential for long-term impact and partnership

Core lectures and practical sessions

The training curriculum provided a balance of relevant concepts and methods from the health and climate communities. In total, 29 facilitators (including the lecturers and organizers), supported by 13 information technology (IT), administrative and communication professionals, led the participants through the following modules:

+ **Module I:** Basic Concepts in Public Health and Climate (Days 1, 2)

+ **Module II:** Sources and Tools for Analyzing Climate and Public Health Data (Days 3, 4, 5, 6)

+ **Module III:** Use of Climate Information in Decision-Making for Climate-Sensitive Diseases (Days 7, 8, 9, 10)

The curriculum was heavily oriented toward methodology, gathering and using evidence for decision-making in order for the trainees to acquire in-depth knowledge and skills in decision-making for health-care planning of climate-sensitive diseases. Hands-on exercises in the afternoon sessions reinforced concepts presented during the morning lectures.

Public talks

Throughout SI 09, four researchers and policy-makers from IRI partner institutions were invited to give lunch-time talks on specific climate-sensitive health issues in order to strengthen the knowledge and provide with field and concrete applications. A panel discussion on meningitis and climate with international key note speakers was also held at the MSPH.

Short reports of personal projects

The final part of the course consisted in the writing of short reports based on the personal projects SI 09 trainees developed throughout the training. This exercise gave the opportunity to embed the concepts and approaches learned within the trainees home institutions and areas of interest. The reports were presented by the trainees to fellow SI 09 participants and facilitators after they completed the course. The short reports addressed issues as varied as new methods to comprehend the relationship between dengue/malaria and climate, a decision tool for malaria prevention in the Kenya Highlands where it has been suggested that the disease is re-emerging, the use of the probability of flooding for launching humanitarian response by the International Federation of Red Cross and Red Crescent Societies (IFRC), capacity building in climate and health in Mali or the development of training courses in Ethiopia and Madagascar.

Climate Information for Public Health Action Newsletter

Building upon the community developed during SI 09, the trainees will contribute news items and participate in the dissemination of the newsletter 'Climate Information for Public Health Action' (CIPHA) that provides updates on the latest developments within the CIPHA network including alumni activities, brief meeting reports, news from the health and climate community as well as opportunities for collaboration and funding.

Course Evaluation

The evaluation of the course highlighted the existing gap in providing climate information to the public health community and the need to lead the public health community to the relevant sources and uses of climate information. The SI 09 evaluation also indicated that this training was perceived as a comprehensive experience by all the participants (trainees, facilitators, organizers and support staff), who showed consistent enthusiasm and a high degree of commitment throughout the course.

This report summarizes Summer Institute 2009 on Climate Information for Public Health. It describes the content and the evaluation of the course with summaries of each training module. It also introduces the participants – organizers, trainees, lecturers, facilitators and support staff – who contributed to the success of SI 09.

'I never thought I could gain so much from this course'

'Very interactive and informative institute, please keep it up'

'This was an excellent course. I think it is essential to combine people from different fields, in-country decision makers and young scientists from all disciplines who will carry the developing field of climate and health forward'

'I appreciate all the effort and assistance from the entire IRI team and all the facilitators who worked so hard to ensure we understood the course content. I look forward to more collaboration with IRI as an institution and also with the individuals in it'

'This was a great and highly relevant course that I hope would be held again next year'

'Thank you for [everything]. Excellent Job'

'Stunning – the team should be very proud'

Participants and facilitators of the Summer Institute 2009; David Gottlieb

Acknowledgements

The authors of this report are most grateful to:

Judy Omumbo and Madeleine Thomson from the IRI, Mark Becker from CIESIN, and Patrick Kinney from the MSPH for their invaluable comments on this report

Cathy Vaughan from the IRI for assiduously reviewing the writing of the document

Jason Rodriguez and Francesco Fiondella from the IRI for their careful editing and design of this report

Besides the current report, the organizers would like to acknowledge the following persons for the truly dedicated support during SI 09:

Mike Dervin for his highly efficient technical support throughout the course

John Del Corral for tirelessly building the SI 09 Web Page, including uploading the data and documents, before and during the Summer Institute

Sandy Vitelli for her excellent logistical support

And all the sponsors, facilitators, support staff and trainees of SI 09 for contributing to the success of the course.

Team Members

Within each institution, the members of the team are presented by alphabetical order.

Organizers

Madeleine Thomson, from the IRI, Mark Becker, from CIESIN and Patrick Kinney, from the MSPH, were responsible for the organization of SI 09.

Curriculum group:

The team was led by Judy Omumbo, from the IRI. Gilma Mantilla, also from the IRI, oversaw the curriculum development.

Logistic team:

The following persons led the logistics of SI 09: Ann Binder, Francesco Fiondella, Leo Ostwald, Jeffrey Turmelle and Sandy Vitelli, from the IRI.

Evaluation group:

The following persons were responsible for developing and overseeing the course evaluation: Laurence Cibrelus, Gilma Mantilla and Megan Sheremata, from the IRI.

Authors of this report:

Laurence Cibrelus was a SI 09 facilitator and conducted the course evaluation. Gilma Mantilla was the general coordinator of the Summer Institute 09 on Climate Information for Public Health.

Detailed biographies of the facilitators, support staff and trainees are provided at the end of this document

Acronyms

APOC	African Program for Onchocerciasis
CDC	Centers for Disease Control and Prevention
CERMES	Centre de Recherche Médicale et Sanitaire
CIESIN	Center for International Earth Science Information Network
CIIFEN	Centro International para la Investigacíon del Fenómeno del Niño
CIPHA	Climate Information for Public Health Action
CLS	Collecte Localisation Satellite
CPT	Climate Predictability Tool
CRM	Climate Risk Management
CSSR	Center for the Study of Science and Religion
DARPA	Defense Advanced Research Projects Agency
D(H)F	Dengue (Hemorrhagic) Fever
DFID	UK Department for International Development
DHMT	District Health Management Team
ENSO	El Niño-Southern Oscillation
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
ICPAC	IGAD Climate Prediction and Applications Centre
IGAD	Intergovernmental Authority on Development
IFRC	International Federation of the Red Cross and Red Crescent Societies
INAMHI	Instituto Nacional de Meteorología en Hidrología
IRD	Institut de Recherche pour le Développement
IRI	International Research Institute for Climate and Society
IT	Information Technology
JPL	Jet Propulsion Laboratory
MCQ	Multiple Choice Questions
MERIT	Meningitis Environmental Risk Information Technologies
MEWS	Malaria Early Warning System
MRTC	Malaria Research Training Centre
MSPH	Mailman School of Public Health
NCAR	National Center for Atmospheric Research
NIH	National Institutes of Health
ORAU	Oak Ridge Associated Universities
ProMED	Program to Monitor Emerging Diseases
SI	Summer Institute on Climate Information for Public Health
SPC	Science Policy Council
UCAR	University Corporation for Atmospheric Research
WHO	World Health Organization
WHO-PAHO	World Health Organization-Pan-American Health Organization
WMO	World Meteorological Organization
WNV	West Nile Virus

Course Overview

The course curriculum was designed to help participants not only to enhance their knowledge of climate-sensitive diseases, such as malaria, influenza, kala-azar (visceral leishmaniasis), meningo-coccal meningitis and Rift Valley Fever , but also to foster and develop the use of climate informa-tion in the management of climate-sensitive disease programs (see Appendix 1). Over the course of two weeks, participants were exposed to methodologies and tools developed by IRI and partner institutions. Learning opportunities included presentations, seminars, small group discussions, case studies and hands-on exercises, including the use of the IRI Data Library, were offered to partici-pants in an integrated work environment facilitated by leaders in their respective fields of research. Facilitators led the participants through the following modules:

> **Module I:** Basic Concepts in Public Health and Climate
> (Days 1, 2)

> **Module II:** Sources and Tools for Analyzing Climate and Public Health Data
> (Days 3, 4, 5, 6)

> **Module III:** Use of Climate Information in Decision-Making for Climate-Sensitive Diseases
> (Days 7, 8, 9, 10)

Classes were held in Lamont Hall and practical sessions in the CIESIN Laboratory. As part of module II, a panel discussion was hosted by the MSPH in the Columbia University Medical Campus with international keynote speakers from the World Health Organization (WHO), the Centers for Disease Control and Prevention (CDC) and the Ministry of Health of Ethiopia (see Appendix 2).

Details on the sponsors are provided in Appendix 3; course agenda on following pages

Week One:	MONDAY, JUNE 1	TUESDAY, JUNE 2	WEDNESDAY, JUNE 3	THURSDAY, JUNE 4	FRIDAY, JUNE 5
MODULE	**Basic Concepts in Public Health and Climate**	**Basic Concepts in Public Health and Climate**	**Sources and Tools for Analyzing Climate and Public Health Data**	**Sources and Tools for Analyzing Climate and Public Health Data**	**Sources and Tools for Analyzing Climate and Public Health Data**
MORNING 9:00AM-12:00PM	*Welcome* Stephen Zebiak	*Climate and Weather Information* Sylwia Trzaska	*Principles of Time Series Analysis* Andy Robertson	*Remote Sensing as a Tool to Manage Environmental Data* Pietro Ceccato	*GIS Applications in Public Health* Mark Becker
	Introduction to Summer Institute 2009 Madeleine Thomson, Patrick Kinney & Mark Becker		*Climate and Vector-Borne Disease Dynamics* Dia-Eldin A. Elnaiem		*Understanding Population Data Sets and their Use in Health Studies* Mark Becker
	Influenza and Climate Stephen Morse	Coffee Break	Coffee Break	Coffee Break	Coffee Break
	ENSO: Linking Climate and Society Stephen Zebiak	*Concepts in Public Health and Epidemiology* Judy Omumbo	*Malaria Vector Distribution and Rainfall* Judy Omumbo	*Climate and Malaria Mapping* Judy Omumbo	*Making Sense of Associations* Tony Barnston
	Climate Risk Management (CRM) in Public Health Madeleine Thomson		*The Climate Suitability for Malaria Transmission Tool in the Health Map Room* Judy Omumbo & Remi Cousin		
LUNCH					
LUNCH-TIME SEMINAR	*Participant Introduction* Madeleine Thomson			*Nature Walk* Barbara Platzer	*The Environmental Protection Agency's Role in Coordinating National and International Efforts on Climate and Heath* Pai-Yei Whung
AFTERNOON 2:00PM-5:00PM	*Methodology of the Course* Judy Omumbo	*Summarizing Climate and Health Data using Descriptive Statistics and Map Tools* Michael Bell	*Panel Discussion: Epidemics and Environment-the Meningitis Challenge in Africa* Patrick Kinney	*Remote Sensing Tools in the Health Map Room: Part I* Pietro Ceccato	*Lagged Correlation of Rainfall with Malaria Incidence* Michael Bell
	Evaluation System Megan Sheremata & Laurence Cibrelus				
	Overview of the IRI Data Library Michael Bell				
	Coffee Break			Coffee Break	
	Introduction to the Map Room Remi Cousin			*Remote Sensing Tools in the Health Map Room: Part II* Pietro Ceccato	
EVENING	Welcome reception		Reception		

Week Two:	MONDAY, JUNE 8	TUESDAY, JUNE 9	WEDNESDAY, JUNE 10	THURSDAY, JUNE 11	FRIDAY, JUNE 12
MODULE	*Sources and Tools for Analyzing Climate and Public Health Data*	*Use of Climate Information in Decision-Making for Climate-Sensitive Diseases*	*Use of Climate Information in Decision-Making for Climate-Sensitive Diseases*	*Use of Climate Information in Decision-Making for Climate-Sensitive Diseases*	*Use of Climate Information in Decision-Making for Climate-Sensitive Diseases*
MORNING 9:00AM-12:00PM	*Cluster Analysis using K-Means* Andy Robertson	*Understanding Predictions and Projections in Climate* Sylwia Trzaska	*Case study - Drought in the Sahel: Natural Variability or Anthropogenic Climate Change* Alessandra Giannini	*Climate Change Impacts on Public Health* Patrick Kinney & Kim Knowlton	*Decision-Making Under Uncertainty* Peter Diggle
	Analyzing Trends Tony Barnston	*Malaria Early Warning and Early Response* Stephen Connor	*Overview of Decision Analysis* Jennie Rice		
	Coffee Break	Coffee Break	Coffee Break		Coffee Break
	Epidemic Detection Patricia Graves	*Analyzing Temperature Trends in the East African Highlands* Bradfield Lyon	*Tools for Decision Making* Jennie Rice		Preparation of Country Short Report
			Country Short Report Guidelines Madeleine Thomson		
LUNCH					
LUNCH-TIME SEMINAR	*Policy Changes Associated with Elimination and Eradication of Malaria* Bernard Nahlen	*Nature Walk* Cathy Vaughan	*A Dynamical Model of Malaria Transmission* Daniel Ruiz	*Open Health Tools* Knut Staring	
AFTERNOON 2:00PM-5:00PM	*K-means Cluster Analysis Exercise: Malaria Seasonality in Eritrea* Pietro Ceccato	*Seasonal Forecasting of Malaria in Botswana* Tony Barnston	Preparation of Country Short Report	*Probabilistic Seasonal Forecasting and its Applications* Simon Mason	Presentation of Participants Reports
	Coffee Break				Evaluation of the Summer Institute 2009
	Monitoring Epidemics Using Thresholds Patricia Graves				
EVENING				Farewell party	Closing

Curriculum

Learning Goals

Module I: Basic Concepts in Public Health and Climate (Days 1, 2)

To equip trainees to (i) understand how climate, in various temporal and spatial scales, drives the transmission of many diseases and, in particular, the role of climate in driving the transmission of vector-borne diseases, meningitis and influenza; (ii) to understand the terms: weather *versus* climate, climatology, climate variability *versus* climate change, climate anomalies, and climate data *versus* climate information (forecast products, monitoring products); (iii) to understand routine epidemiological measurements and their spatial and temporal resolution in the framework of Public Health investigation; (iv) to understand the methodology behind designing a problem-focused map room for addressing a climate risk issue and (v) to understand the capabilities of the IRI Data Library.

Module II: Sources and Tools for Analyzing Climate and Public Health Data (Days 3, 4, 5, 6)

To equip trainees to (i) understand time scales and spatial resolution, the benefits and limitations of different climate, health and environmental data sources including remotely sensed data, meteorological data, climate predictions and epidemiological data; (ii) use new tools for accessing climate and epidemiological data, for analysis and mapping through the IRI Data Library and Excel spreadsheet tools; (iii) select the appropriate type of health data required for different health/climate analyses; (iv) introduce basic concepts of the dynamics climatic drivers of transmission of vector-borne diseases ; (v) define, interpret and understand when to use different statistical methods and (vi) understand the power of maps to display data and as a tool for decision making in Public Health.

Module III: Use of Climate Information in Decision-Making for Climate-Sensitive Diseases (Days 7, 8, 9, 10)

To equip trainees to (i) understand the rationale behind different types of predictions and projections with an emphasis on the interpretation and limitations of the available predictive methods; (ii) introduce the process and techniques for decision analysis, including the benefits of influence diagrams for communicating complex decisions, such as those involving climate and public health; (iii)understand how researchers can help decision makers to understand the sources of uncertainty in forecasts and predictions and what might be done to reduce it; (iv) explore scenario-based integrated risk assessment for climate change and heat-related health impacts and (v) demonstrate how to analyze, create and replicate the simulation outputs of several malaria dynamical models using a case study from Colombia.

Details on the daily classes and associated materials per module are provided on next page(s)

Lectures, Readings, Exercises and Public Talks

Module I: Basic Concepts of Public Health and Climate

Day 1: Monday, June 1, 2009

Morning Session

Influenza and Climate *by Prof. Stephen Morse*

Many infectious diseases have long been considered "seasonal", that is, these infections seem to occur predominantly or exclusively during certain times of year. Influenza, a common respiratory viral infection, is often cited as a prime example. In temperate zones, human influenza infections are thought to occur almost entirely during the winter (the "flu season"), approximately from October through March in the Northern hemisphere. Although explanations have been suggested, such as increased stability of the virus in cold dry conditions, the drivers of seasonality are poorly understood. In tropical and sub-tropical regions (at least in the Old World), by contrast, influenza shows a very different pattern of seasonality, with peaks in both October through March and in the summer (approximately May-July). This pattern has been well documented in a number of locations, including Hong Kong and Bangkok. Evidence of seasonality in temperate and sub-tropical regions was presented and compared. In addition, evidence for seasonality (or at least periodicity) of human infections with H5N1 (avian) influenza was discussed.

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 (1918-1919, 1957, and 1968), and most virologists believe that future pandemics are virtually inevitable. However, these have been notoriously difficult to predict in advance. Interestingly, in the United States, pandemics may appear late in the normal influenza season or even during the summer (the 1957 pandemic appears to have begun in the United States in July).

The lecture reviewed current knowledge about influenza seasonality, and discuss current knowledge gaps.

Recommend Readings

Shamana J and Kohnb M. (2009). Absolute humidity modulates influenza survival, transmission, and seasonality. *Proceedings of the National Academy of Sciences*, **106**. doi_10.1073_pnas.0806852106

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

ENSO: Linking Climate and Society *by Dr. Stephen Zebiak*

El Niño and the Southern Oscillation (ENSO) is the most prominent mode of variability of the Earth's climate on the time scale of seasons to years. Aspects of this phenomenon have been known for centuries; particularly the periodic warming episodes in the eastern tropical Pacific Ocean, with concomitant disruptions of the marine ecosystems. Only much more recently was it first appreciated that extreme weather events from South America, to Australia, and beyond, were intricately connected with oceanic El Niño events. The recent scientific study of this phenomenon has led to the new sub-discipline of tropical atmosphere-ocean dynamics. Hand in hand with increased understanding of ENSO, has been the development of models that could simulate, and later, predict ENSO. Major ENSO events in the years 1982 and 1997 wreaked havoc worldwide, playing a role in far-reaching droughts, flooding, disruptions in fisheries, and many other impacts. The global reach, as well as diverse impacts that have been associated with ENSO have caused increasing focus on this phenomenon across scientific disciplines, as well as a growing public awareness.

The first successes in prediction of ENSO created great excitement about the possibilities of utilizing prediction information for societal benefit a precursor to the activities emerging today in Climate Risk Management and climate change adaptation. Indeed, the IRI was founded upon the promise of applying climate prediction information to benefit societies globally - information that initially revolved closely around ENSO. Even as new endeavors for climate information for society have taken hold, important scientific, institutional and policy challenges remain to be confronted in realizing effective climate services for societies.

Recommended Reading

McPhaden MJ, Zebiak SE, Glantz MH (2006).ENSO as an integrating concept in Earth Science. *Science*, **315**: 1740-1745.

Climate Risk Management in Health *by Dr. Madeleine Thomson*

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 UN Declaration on the Millennium Development Goals, Roll Back Malaria and the Global Fund for Aids TB and Malaria. 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." This was formalized in May 2008 when 193 member states represented at the World Health Assembly adopted a new resolution on health protection from climate change - signaling a high level of engagement from the health sector in this new global agenda.

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. (2009). Health and climate change: a roadmap for applied research. In Protecting Health from Climate Change. *The Lancet,* **373**: 1663-1665.

Afternoon Session

Practical Exercise Summaries

Overview of the IRI Data Library *by Michael Bell*

This session serves as an introduction to the IRI Data Library. It included a presentation of what the Data Library is and how its capabilities make it a unique resource for accessing, displaying, analyzing, and downloading climate, environmental, and epidemiological data. Participants learned how the Data Library is organized, how to find and select data, how to perform simple arithmetic analyses, how to create customized maps and graphs, and how to download data and images. How the Data Library is related to the IRI Map Rooms was also discussed. At the end of the session participants completed a set of group exercises that demonstrate how to perform common tasks and simple analyses.

Introduction to the Map Rooms *by Remi Cousin*

Floods are a major concern in vulnerable areas. The IFRC uses a disaster management information system aimed at preventing and responding to disasters that may affect vulnerable populations, such as floods. There are different types of flood that are characterized by long, short or no warning events. The potential effects are many; including loss of infrastructure, health issues (*e.g.,* cholera), destruction of harvest, or population movements. Besides flood control (*e.g.,* levees) or land use regulations, climate information may help prevent disasters caused by floods by the use of forecasting, monitoring and warning systems.

The analysis of historical climate data and of model forecasts is used to improve the understanding of the risk of heavier rainfall than usual and as a consequence a higher risk of floods. Anomalies, percentiles and climate science bring in complementary information that allows, if understood and interpreted correctly, improved global mapping of risk areas. Contextual information such as vulnerability indicators also contributes to the evaluation of risk areas, along with the climate information.

The aim of this exercise was to illustrate the methodology for the design of an informative early warning system tool (Map Room) based on problem-focused climate information. Participants were expected to learn how climate relates to floods; understand how climate information can help reduce risk related to a priori non climate issues, as well as the nature, or the sense of this information; understand the need of interaction between multi-disciplinary fields in order to address climate risk related problems.

Day 2: Tuesday, June 2, 2009

Morning Session

Introduction to Climate and Climate information *by Dr. Sylwia Trzaska*

This lecture provided an overview of basic concepts in climate and a common understanding of what climate information is as well as its limitations. It defined weather, climate and climate change and introduced the concepts of different time and space scales. It then focused on what defines climate at a given scale, starting from the global (planetary) scale and ending at a given location or point. The terms climatology and climate variability were introduced and the concept of remote influences on climate, or teleconnections, were discussed using the example of ENSO. Following a review of data sources and different types of datasets, a brief overview of the most common analyses used to extract climate information was given.

Concepts in Public Health and Epidemiology *by Dr. Judy Omumbo*

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 described how time and space are used as an epidemiological framework to measure and monitor variability in disease risk. Trainees learned 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 was discussed.

Afternoon Session

Exercise Summary

Statistical Analysis of Climate and Health Data *by Michael Bell*

This session included a set of practical exercises in the Data Library that demonstrate how to use the library as a tool to conduct some simple exploratory data analyses on health and climate data. The structure of epidemiological data in the Data Library was discussed, and

participants learned how to visualize time series. A number of exercises demonstrated how to produce histograms of data distributions and how to calculate several descriptive statistics of central tendency and dispersion. A final exercise demonstrated how to calculate district averages of gridded climate data.

Module II: Sources and Tools for Analyzing Climate and Public Health Data

Day 3: Wednesday, June 3, 2009

Morning Session

Principles of Time Series Analysis *by Dr. Andrew Robertson*

Climate and epidemiological data are often recorded as time series of a measurement at some location. Historical records of weather data began with surface observations on land and from ships, followed by the advent of upper-air soundings and then satellites (since about 1980). These records have lead to much of our understanding of weather and climate, in terms of daily weather fluctuations, seasonality, inter-annual "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 goal of this lecture was to illustrate simple exploratory analyses of univariate time series. We illustrated how simple averaging can be used to highlight different aspects of a climate time series, such as weather, the seasonal cycle, interannual variability, and longer-term variability and trends. We illustrated 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. Simple averaging and plotting were used to show how exploratory analysis of time series can be used as a starting point for more complex statistical analysis to be covered in later lectures and course units, such as multivariate data analyses and identification of associations between climate and epidemiological data.

Climate and Vector Borne Disease Dynamics *by Dr. Dia-Eldin A. Elnaiem*

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, filariasis, onchocerciasis and leishmaniasis infecting 270, 200, 90, 18 and 12 million people, respectively. In addition to insecticide and drug resistance, failure in control of these diseases is attributed to inadequate knowledge of the ecology of their transmission cycles and lack of properly designed surveillance and control programs. In the past two decades, it has become clear that proper planning

of surveillance and control of vector-borne disease should make use of the climatic factors that are known to affect the population dynamics and behavior of disease vectors as well as the transmission of disease pathogens.

The goal of this lecture was to introduce some basic concepts of transmission of vector-borne diseases, with an attempt to answer why climatic factors are essential determinants of their transmission. This session discussed the main effects of climate conditions on vector abundance and the dynamics of transmission of vector-borne diseases; using malaria and West Nile Virus (WNV) as examples. In the final part of the lecture, we addressed the risk mapping of Visceral Leishmaniasis in Sudan as an example of a study where climate and other environmental factors were successfully used to map both the vector and the disease in an ecological and a logistic set up that defied traditional methods of disease surveillance. We concluded that climatic factors exert profound effects on the abundance of disease vectors and the transmission of vector-borne pathogens. These effects should be utilized not only in the spatial and temporal mapping of vectors and vector-borne diseases, but also in the design and evaluation of short-term and long-term disease control programs.

Recommended Readings

Gage Kenneth L, Burkot TR, Eisen RJ, Hayes EB. (2008) Climate and Vector Borne Diseases. *American Journal of Preventive Medicine*, **35**: 436-450

Elnaiem Dia-Eldin A, Schorscher J, Bendall A, Obsomer V, Osman Maha E, Mekkawi IA, Connor S, Ashford R, Thomson MC. (2003).Risk mapping of visceral leishmaniasis: The role of local variation in rainfall and altitude on the presences and incidence of Kala-azar in Easter Sudan. *American Journal of Tropical. Medicine and. Hygiene*, **68**: 10–17

Thomson MC, Elnaiem Dia-Eldin A, Ashford R, Connor S. (1999). 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*, **4**: 105-113.

Exercise Summaries

Malaria Vector Distribution and Rainfall *Dr. Judy Omumbo*

Observations of patterns and associations are key outputs of descriptive epidemiology. Public health practitioners are often faced with the challenge of making decisions based on quick assessments of health-related situations with limited background information. This exercise uses a map tool to describe the distribution of malaria vectors in the context of space. Given the limitations of funds faced by most control programs and the range of available options for malaria control, a decision has to be made on what would work best.

The trainees used observational skills and prior knowledge of vector behavior to make a decision on the most appropriate control intervention

Recommended reading

Coetzee M, Craig M Le Sueur D. (2000). Distribution of African Malaria Mosquitoes Belonging to the *Anopheles gambiae* Complex**. *Parasitology Today*, **16**: 74-77.

The Climate Suitability for Malaria Transmission Tool in the Health Map Room
by Dr. Judy Omumbo

This exercise presented a clickable map interface that describes where, when and for how long the combination of climatic conditions (rainfall, temperature and humidity) may be suitable for malaria transmission on the African continent. The tool presented has applications in intervention targeting (when and where to administer interventions) and also in impact evaluation. Trainees learned how to navigate the tool and review descriptive outputs. They will also use it to discuss the effects of climate on malaria transmission and the effects of this on the assessment of the impact of an intervention.

Afternoon Session

Panel discussion: Epidemics and Environment-the Meningitis Challenge in Africa
chaired by Dr. Patrick Kinney

A panel discussion was hosted by the Mailman School of Public Health in the Columbia University Medical Campus with international keynote speakers from the World Health Organization (WHO), the Centers for Disease Prevention and Control (CDC) and the Ministry of Health of Ethiopia. (See Appendix 2)

Meningococcal meningitis is one of the most feared epidemic diseases in Africa because of its rapid onset, high fatality rates and long-term disabilities, such as brain-damage and deafness, affecting many survivors. In 1996-1997 devastating epidemics in the Sahel affected more than 250,000 people with over 25,000 fatalities.

Current control strategies based on reactive vaccination have not been fully satisfactory in reducing the burden of the disease within the 'Meningitis Belt' – an area in Sub-Saharan Africa str*etc*hing from Senegal in the west to Ethiopia in the east.

New efforts are underway to provide long-term protection to at-risk populations of around 350 million, establishing the means to avoid devastating regional epidemics involving hundreds of thousands of cases and tens of thousands of deaths. This will be possible in large part due to the work of the Meningitis Vaccine Project and the development of an effective long-lasting conjugate vaccine which targets the dominant strain (Group A) of the bacteria which causes meningococcal meningitis and is associated with epidemics.

A further development is that of a multi-disciplinary effort to integrate climate and environmental information into current and future control strategies under the umbrella of the MERIT (Meningitis Environmental Risk Information Technologies) project.

Following a welcome address by Dean Linda Fried, from the MSPH, the event comprised presentations by a panel of speakers as well as open discussion as follows.

Presentations:

Meningococcal Vaccine for Africa: Surveillance and Opportunities for Prevention, Dr. Tom Clark, Meningitis and Vaccine Preventable Diseases Branch, Center for Diseases Control and Prevention (CDC), Atlanta

Creating a 'Community of Practice' for Health-Climate Collaboration: The MERIT project, Dr Eric Bertherat, Epidemic and Pandemic Alert and Response, World Health Organization (WHO), Geneva

What role for Climate/environmental information? Dr. Madeleine Thomson, Chair, Africa Regional Program, IRI, Columbia University

Panel Discussion

1. Climate and meningitis: from physiology to invasive disease - Dr. Patrick Kinney, Mailman School of Public Health, Columbia University

2. Climate science contributions - Dr. Sylwia Trzaska, Climate Scientist, IRI, Columbia University

3. The country perspective - Dr. Yonas Asfaw, Surveillance Officer, Disease Prevention and Control Department, Federal Ministry of Health, Ethiopia and Coordinator of MERIT in Ethiopia.

Open Discussion

Day 4: Thursday, June 4, 2009

Morning Session

Introduction to remote sensing *by Dr. Pietro Ceccato*

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 which 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 range. By measuring the electro-magnetic waves in domains from Gamma rays to Microwaves, we can retrieve information on objects we want to study. This lecture introduced the concepts of remote sensing and showed how to use satellite images to monitor rainfall, air temperature, vegetation status and water bodies.

Recommended Readings

Ceccato P, Dinku T. *Introduction to Remote Sensing for Monitoring: Rainfall, Temperature, Vegetation and Water Bodies*. Notes.

Ceccato P, Connor SJ, Jeanne I, Thomson MC. (2005). Application of Geo-graphical Information Systems and Remote Sensing technologies for assess-ing and monitoring malaria risk. *Parasitology,* **47**: 81-96.

Climate and Malaria Mapping *by Dr. Judy Omumbo*

Judy Omumbo delivers lecture in CIESIN lab; David Gottlieb

Malaria transmission occurs under defined conditions of precipitation, humidity and tem-perature. This knowledge has been applied to the cartography of malaria for almost a cen-tury. Historical malaria maps have used climate information in combination with expert opinion to define the geographical limits of malaria transmission. The widening range of applications for disease maps and need for improved estimates of disease burden as has fuelled an increasing interest in using maps as a key tool for decision-making in disease control.

Today's disease control programs need dynamic maps that track the variability of disease transmission in space and in time. Today's maps are also potentially powerful analysis tools for charting the effects of interventions, policy changes, societal influences on dis-ease and trends. Cartographers over the years have recognized that to understand disease transmission, one must understand the climate. This lecture described, using examples, the evolution of malaria maps for sub-Saharan Africa from historical times to present day

initiatives and the role of climate information in the development of malaria maps.

Recommended Readings

Craig MH, Snow RW, le Sueur D. (1999). A Climate-based Distribution Model of Malaria Transmission in Sub-Saharan Africa. *Parasitology Today,* **15**: 105-111.

Omumbo JA, Hay SI, Snow RW, Rogers DJ. (2005). Modelling malaria risk in East Africa at high spatial resolution. *Tropical Medicine and International Health*, **10**: 557-566.

Feachem, R.G.A., with A.A. Phillips, G.A. Targett (eds).(2009). *Shrinking the Malaria Map: A Prospectus on Malaria Elimination*. Chapter 1 and 6. San Francisco: The Global Health Group, Global Health Sciences, University of California, San Francisco.

Afternoon Session

Exercise Summary

Health Map Room *by Dr. Pietro Ceccato*

In this exercise, trainees learned how to use the Map Room to visualize data on rainfall, temperature, vegetation and water bodies; to extract time series; to extract anomalies ant to download data, images and integrate those into Arc View.

Day 5: Friday, June 5, 2009

Morning Session

GIS Applications in Public Health *by Mark Becker*

This lecture looked at the use of spatial analysis techniques unique to raster based data with a particular focus on gridded socioeconomic data and health information. We covered the fundamental structure of raster or "gridded" data and basic processing operations. The discussion drew from examples of CIESIN collections on gridded data to illustrate how these data can be used in a variety of global health related research applications.

This section also included a hands-on exercise using a number of gridded data sets to analyze the percent of people living in extreme poverty who are also at high risk of exposure to natural hazards. Earthquakes, floods, droughts, and other natural hazards are increasingly causing tens of thousands of deaths, hundreds of thousands of injuries, and billions of dollars in economic losses each year around the world (World Bank, 2005, Natural Disaster Hotspots). It is often stated that the poor are more vulnerable to hazards because they are

often living in the most dangerous geographic locations and environments (*e.g.* coastal flood plains, near active volcanoes, seismic faults, drought prone areas, and in the over-crowded urban periphery).

Using CIESIN's global poverty data (http://sedac.ciesin.columbia.edu/povmap/) in conjunction with multi hazard mortality risk data developed by Columbia University's Center for Hazard and Risk Research (http://www.ldeo.columbia.edu/chrr/) and the World Bank, this exercise used spatially referenced data to explore the poor's exposure to risk of dying from natural hazards. Specifically the exercise used ArcGIS's spatial analyst tools to produce summaries of mortality risk of one or more hazards for different poverty classifications.

Making Sense of Associations *by Dr. Tony Barnston*

In this lecture, "associations" referred to relationships between two variables, such as rainfall and malaria incidence. Once we identify the two variables of interest, we introduced a lag time between them. For rainfall and malaria in Botswana, for example, due to the dynamics of the mosquito life cycle and malaria transmission, we find that the peak of the rainfall season precedes the peak of malaria incidence by about 2 to 3 months. Therefore, in studying the association between rainfall and malaria we consistently used rainfall data occurring 2 to 3 months earlier than the malaria incidence data, building a data set covering many years.

The next step was to evaluate the strength of the association; *i.e.,* to determine how closely related the malaria incidence is to the rainfall. While there are several methods to quantify the strength of the association, here we focus mainly on the linear correlation coefficient. Once the correlation coefficient was obtained, consideration was given to its statistical significance – *i.e.*, the likelihood that the coefficient could have occurred only by chance, given the size of the data sample analyzed. We also discussed the implication of a strong (or statistically significant) correlation regarding a causal relationship between the two variables.

Finally, we showed how the association could be used to make predictions for one of the variables when the value of the other variable was available. For example, when the amount of rainfall has been observed (or forecasted), the correlation coefficient could be used to predict the malaria incidence in advance of its occurrence.

Common complicating issues in the use of correlation to describe the strength of association and for prediction are discussed, such as skewness in one or both variables, the presence of outliers, and non-linear relationships between the variables.

Recommended Readings

Wilks DS, 2006: *Statistical Methods in the Atmospheric Sciences.* Second Edition. Edition. Academic Press, 648 pp.

Wonnacott TH and Wonnacott RJ, 1990: *Introductory Statistics.* Fifth Edition. Chapters 15, 17. John Wiley & Sons, 711 pp.

Afternoon Session

Environmental Protection Agency's Role in Coordinating National and International Efforts on Climate and Health *by Dr. Pai-Yei Whung*

The EPA's science portfolio includes research, applied science, technology, and the use of scientific results for applications and decision making. EPA's Office of the Science Advisor (OSA) is a relatively new office at EPA that provides leadership in science and science policy to ensure the best use of science at the Agency. OSA promotes science integration through several cross-agency bodies, including the Science Policy Council (SPC). Recently, the SPC, a council of senior managers from all of EPA's offices and regions initiated an activity on EPA's science priorities. This initiative seeks cross-EPA consensus on emerging environmental problems that are complex, multifaceted, cross-cutting in their implications, and would benefit from greater collective attention.

The past several months have seen a flurry of activity on Capitol Hill and at the EPA to develop new policies and approaches to address climate change. This activity is consistent with EPA's science priorities. A Black Carbon Bill (S.849) would direct the EPA to do a four-phase study that: (i) develops a universal definition of black carbon; (ii) identifies global black carbon sources and reduction technologies; (iii) identifies current and possible international funding opportunities to mitigate black carbon emissions; and (iv) identifies opportunities for future research and development. The American Clean Energy and Security (ACES) Act (HR.2454), previously known as the Waxman-Markey draft, has four goals: (i) Clean energy – promotes renewable sources of energy, carbon capture and sequestration, low carbon fuels, clean electric vehicles, a smart grid; (ii) Energy efficiency – increases energy efficiency for buildings, appliances, transportation, and industry; (iii) Global warming – limits emissions of heat-trapping pollutants; (iv) Transitioning to a clean energy economy – protects U.S. consumers and industry while promoting green jobs during the upcoming transition period. EPA made a proposal for the National Reporting of Greenhouse Gas (GHG) Emissions. Under the Clean Air Act, this proposal would establish the first comprehensive national system for reporting GHG emissions produced by major sources. In addition, EPA made a proposed Endangerment Finding for GHG. Also under the Clean Air Act, this proposal has two findings: (i) The current and projected concentrations of six key GHG – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) – in the atmosphere threaten the public health and welfare of current and future generations. (ii) The combined emissions of CO_2, CH_4, N_2O, and HFCs from motor vehicles and engines contribute to their atmospheric concentrations and threaten climate change.

Recommended Readings

Climate change Science Program (CCSP).(2008). *Analyses of the effects of global change on human health and welfare and human systems*. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. [Gamble, J.L. (ed.), K.L. Ebi, F.G. Sussman, T.J. Wilbanks, (Authors)]. U.S. Environmental Protection Agency, Washington, DC, USA.

EPA (2009). *Overview of EPA's Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases under the Clean Air Act.*

Exercise Summary

Lagged Correlation of Rainfall and Malaria Incidence *by Michael Bell*

The goal of this exercise was for trainees to learn how to use the Data Library to calculate lagged correlations in time (correlations with a time offset) between climate and health data. The session included a short discussion on sources, quality, and representativeness of weather and climate data. Group exercises demonstrate how to use the Data Library to calculate anomalies of health and climate data, how to map variables by district, how to display time series of climate and health data in the same graph, and how to calculate and map lagged correlations between precipitation anomalies and malaria incidence anomalies.

Day 6: Monday, June 8, 2009

Morning Session

Introduction to Cluster Analysis *by Dr. Andrew Robertson*

In *multivariate* data analysis, identifying any shared behavior between locations or variables is a key simplifying step. The goal of this lecture was to illustrate how multivariate data can be stratified into groups using cluster analysis, to identify patterns of behavior. The resulting clusters or patterns may in turn lead to an improved understanding of the processes that generated the data. Clusters may also provide a concise representation of the large-dimensional data sets to facilitate the identification of associations between climate and health data.

We illustrated how cluster analysis partitions a set of observations into mutually exclusive groupings of similar elements, based on their similarity according to some "distance" measure. We understood how the K-means method works to minimize the scatter within each cluster, its practical implementation, including how to choose the appropriate number of clusters, and how to interpret the results. Examples included July temperatures at US cities, and malaria data gathered for Eritrea. We considered such questions as the following: 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?

Analyzing Trends *by Dr. Tony Barnston*

Trends are worthy of analysis not only in their own right, but also in cases where they get in the way of the main object of study. In this talk we presented several ways to define a trend in a data set, and then to separate it from the other variations in the data.

A typical example of a trend is seen in the number of malaria cases each year in Colombia. The number increases from 1960 to the late 1990s, and then begins decreasing until the late 2000s. These long-term trends are likely associated with gradually increasing drug resistance or change in intervention policy. Embedded within both trends there are year-to-year ups and downs, likely due to variations in the rainfall and/or temperature conditions. We probably want to characterize the effects of resistance and policy changes without the effects of climate mixed in, or the effects of the climate by themselves without the trends getting in the way.

We isolated the variations due to trends using (i) linear regression, and (ii) a moving average. In linear regression, a trend line (or more than one line) was defined, representing the trend(s), and the deviations of the original data from the trend line(s) represented the remaining year-to-year variations. When using a moving average, a more flexible (non-straight) line was defined from several consecutive data points, and again the year-to-year variations could be separated from the background variations defined by the moving average line.

A third approach to the separation of "slow" versus "fast" variations was multiple linear regression, based on external predictor variables that are thought to influence the variable of interest. For example, if the variable of interest is malaria, multiple regression can be applied with rainfall serving as the predictor for the year-to-year variations, and time (*e.g.,* the year) acting as the predictor for trends. Additional predictors (*e.g.,* a dummy variable: 0 or 1) can be used for changes in intervention policy.

Problems specific to each method to isolate trends were discussed. For example, in moving averages, the length of the average (number of points) and a possible weighting scheme needed to be established; in multiple regression, overfitting may become a concern.

Recommended Reading

Wilks DS, 2006: *Statistical Methods in the Atmospheric Sciences.* Second Edition. Academic Press, 648 pp.

Wonnacott TH and Wonnacott RJ, 1990: *Introductory Statistics.* Fifth Edition. Chapters 11-14. John Wiley & Sons, 711 pp.

Epidemic Detection *by Dr. Patricia Graves*

This lecture discussed the need for detailed empirical data on malaria cases in space and time in order to define the normal situation of malaria in a given area ('malariality' as the disease equivalent of 'climatology'). Malaria epidemics can only be defined against this background. Epidemics must be clearly defined in space, time and with a clear case definition. The geographical units chosen should correspond to planning units to facilitate response and future prevention. The pros and cons of proposed epidemic indicators for assessing the success of control programs were discussed. The distinction was made between epidemic and pandemic, and some examples from influenza surveillance in the USA were noted for comparison with malaria. Examples of malaria epidemics were 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 were given: third quartile, the mean plus 1 or 2 standard deviations, the moving average and the C-Sum method. It was emphasized that an epidemic definition is a practical and planning decision, with no objective standard. The issue of whether or not to include 'epidemic years' in the threshold calculations was discussed. Graphs illustrated the different thresholds estimated for particular subzones and the implication for quantifying epidemics as an indicator of malaria control or for relating to climate factors. The number of epidemics occurring (according to one threshold) in Eritrea subzones in particular months in 1997-2003 were shown.

Recommended readings

Hay SI, Simba M, Busolo M, Noor AM , Guyatt HL, Ochola SA, Snow RW. (2002). Defining and Detecting Malaria Epidemics in the Highlands of Western Kenya. *Emerging Infectious Diseases*, **8**: 555-562.

Teklehaimanot Hailay D, Schwartz J , Teklehaimanot Awash and Lipsitc M. (2004). Alert Threshold Algorithms and Malaria Epidemic Detection. *Emerging Infectious Diseases* , **10**: 1220-1226.

Cullen JR, Chitprarop U, Doberstyn EB and Sombatwattanangkul K. (1984). An epidemiological early warning system for malaria control in northern Thailand. *Bulletin of the World Health Organization*. **62**: 107-114.

Afternoon Session

Recent Policy Changes Associated with Elimination and Eradication of Malaria *by Dr. Bernard Nahlen*

Over a half century ago, an international campaign to eradicate malaria using chloroquine for treatment and DDT for vector control made substantial progress in many areas, mainly outside Africa, which was largely excluded from this "global" strategy. Despite initial success, with the emergence and spread of chloroquine-resistant *Plasmodium falciparum* parasites and DDT-resistant *Anopheles* mosquitoes, political and financial commitments soon

began to wane. This resulted in a global resurgence of malaria, including in areas where it had been eliminated. In October, 2007, Bill and Melinda Gates issued a renewed call for complete eradication to be adopted as the long-term global goal in the fight against malaria, a vision which was immediately echoed by the Director Geneva of WHO.

Although this resulted in immediate debate over the wisdom of this call for eradication, recent successes in reducing malaria morbidity and mortality in some countries and progress in development of new tools has provided new impetus for this vision. During the past five years, there have been enormous changes in financing to support scaling-up of effective preventive and treatment to reach those most at risk, with an emphasis this time on highly-endemic regions of Africa. Experience from the age-old fight against malaria indicates that the most effective control programs deliver a combination of tools and that the efficacy of the current tools will continue to be challenged by changes in the parasite and the mosquito. Therefore, although it will be possible to eliminate malaria from many areas with the tools available now, major investments in research to both improve existing tools and to develop new tools will be required to eradicate malaria. To achieve the ambitious goal of eradication key groups—including endemic countries, technical agencies, donors and the scientific community—must align policies and resources behind a common approach. This talk provided an overview of recent efforts to align partners around agreed upon strategies and plans to intensify malaria control efforts as we move towards the longer term goal of malaria elimination/eradication.

Recommended Readings

Feachem, R. & Sabot, O. (2008). A New Global Malaria Eradication Strategy. *The Lancet* **371**: 1633-1635.

The Roll Back Malaria Partnership. (2008) *A Global Malaria Action Plan*. Geneva, Switzerland: The World Health Organization.

Exercise Summaries

K-means Cluster Analysis: Malaria Seasonality in Eritrea *by Dr. Pietro Ceccato*

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. In this exercise, we analyzed malaria patterns in Eritrea and Madagascar. We clustered malaria data collected at district levels over a long time period. The results allowed us to understand the spatial and temporal distribution of malaria in Eritrea and Madagascar. The results helped us in: 1) taking decisions about control strategies and 2) understanding the relationship between malaria and environmental factors.

Recommended Readings

Ceccato P, Ghebremeskel, T, Jaiteh M, Graves PM, Levy M, Ghebreselassie S,Ogbamariam A, Barnston AG, Bell M, del Corral J, Connor SJ, Fesseha I, Brantly EP, Thomson MC. (2007). Malaria Stratification, Climate, and Epidemic Early Warning in Eritrea. *American Journal of Tropical Medicine and Hygiene*, **77:** 61–68.

Morse SS. (2007). The US pandemic influenza implementation plan at six months. *Nature Medicine*, **13**: 681-684.

Monitoring Epidemics using Thresholds *by Dr. Patricia Graves*

Using a dataset of malaria reported outpatient cases by subzone and month for the years 1996 through 2003 in Eritrea, participants estimated the number of epidemics (by subzone-month) that occurred in 2003. Subzones were randomly assigned to groups so that all subzones were covered. An Excel spreadsheet was provided in order to do the calculations and charts efficiently. The trainees defined epidemics using a number of different possible epidemic thresholds (third quartile, mean plus 1 or 2 standard deviations, moving average, cumulative sum). The calculations were done both with and without inclusion of 'epidemic years' in the threshold estimation. At the end of the exercise the trainees pooled their results and discussed the use of different thresholds and base years for defining epidemics.

Module III: Use of Climate Information in Decision-Making for Climate-Sensitive Diseases

Day 7: Tuesday, June 9, 2009

Morning Session

Understanding Predictions and Projections in Climate *by Dr. Sylwia Trzaska*

The objective of this lecture was to provide the participants with an understanding of the rationale behind different types of predictions and projections with an emphasis on the interpretation and limitations of the available information. We started by reviewing the concepts of different time and space scales and related uncertainties. The main factors behind the predictions/projections were then introduced and the main tool, numerical models, briefly presented. The ensemble technique and probabilistic approach to climate prediction was then introduced. The necessity of bias correction, downscaling and verification procedures was discussed and finally, we interpreted and discussed examples of climate predictions and projections.

Malaria Early Warning and Response System (MEWS) *by Dr. Stephen Connor*

Climate informed MEWS have been of interest for many years – at least since the beginning of the 20th century. To prevent epidemics it is necessary to understand where and when

epidemics are likely to occur. 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. There is clearly a trade off between lead-time and accuracy. The most accurate information would be derived from the numbers of confirmed malaria cases occurring, but this currently has the least realizable value for epidemic prevention in less developed countries. The least accurate may be long-range epidemic predictions based on global circulation models.

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. This lecture provided an overview of the rationale, development, and testing of MEWS over the past decade. With a primary focus on malaria in Africa the approach has come to be seen as relevant to other climate-sensitive epidemic diseases in Africa and elsewhere.

Recommended Readings

Thomson MC, Doblas-Reyes FJ, Mason SJ, Hagedorn R, Connor SJ, Phindela T, Morse AP, Palmer TN. (2006). Malaria early warnings based on seasonal climate forecasts from multi-model ensembles. *Nature*, **439**: 576-579.

Connor SJ and Thomson MC. (2005). Epidemic malaria: preparing for the unexpected. SciDevNet Dossier on Malaria. Policy Brief. www.scidev.net

Thomson MC, Mason SJ, Phindela T, Connor SJ. (2005). Use of rainfall and sea surface temperature monitoring for malaria early warning in Botswana. American Journal of Tropical Medicine and Hygiene, 73: 214-221.

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

Trends in Surface Air Temperature in the Highlands of Kenya: Data Constraints
by Dr. Bradfield Lyon

The main goal of this lecture was to present trainees with an interesting example of potential climate change - temperature trends in eastern Africa - that has implications for health (specifically, malaria). Results of previous research have been mixed with some studies suggesting there is an upward trend in temperature, while other studies conclude there is not a significant (in the statistical sense) trend.   The lecture described work that is currently underway at the IRI to investigate temperature trends in the Kenyan highlands, which first examined the methodologies, data and assumptions used in previous studies.

Recommended Readings

Hay SI. *et al*. (2002). Climate change and the resurgence of malaria in the East African highlands. *Nature*, **415**: 905-909.

Patz JA. *et al*. (2002). Regional warming and malaria resurgence. *Nature*, **420**: 627-628.

Pascual M. *et al*. (2006). Malaria resurgence in the East African highlands: Temperature trends revisited. *PNAS*, **103**: 5829-5834.

Afternoon Session

Seasonal Forecasting of Malaria in Botswana *by Dr. Tony Barnston*

Botswana straddles what is termed the "fringe area" of malaria transmission in southern Africa. This is an area, at the geographical margins of stable malaria transmission, that is mostly arid but experiences seasonal epidemics of malaria associated with increased precipitation. Unlike many regions of sub-Saharan Africa, Botswana has a very effective malaria surveillance system where malaria is notifiable and records of incidence are up to date. The national malaria control program has developed a climate-based MEWS modeled according to WHO recommendations. The MEWS has been in place since 1998 and integrates confirmed case monitoring with monitoring of climate variables.

This exercise analyzed the relationship between malaria incidence and rainfall and discussed the application of forecasts in disease prediction and control. The malaria incidence time series was also used to discuss the long term trends in disease and vulnerability changes that may have effects on the trends.

Day 8: Wednesday, June 10, 2009

Morning Session

Drought in the Sahel: Natural Variability or Anthropogenic Climate Change?
by Dr. Alessandra Giannini

The Sahel, the semi-arid southern margin of the Saharan desert, witnessed the most outstanding climatic shift during the second half of the 20th century, from above-normal rainfall conditions to persistent drought, with a partial recovery in most recent times. This lecture illustrated the evidence for this characterization, and discussed hypotheses put forth to explain this phenomenon, paying special attention to the debate around attribution to natural or anthropogenic causes, and consequences for our understanding of the impact of future climate change on this region.

Recommended Readings

Biasutti M, Giannini A. (2006). Robust Sahel drying in response to late 20th century forcings. *Geophys. Research Letters*, **11**: doi:10.1029/2006GL026067.

Giannini A, R Saravanan, P Chang. (2003). Oceanic forcing of Sahel rainfall at interannual to interdecadal time scales. *Science*, **302**:1027-1030, doi:10.1126/science.1089357.

Held IM, Delworth TL, Lu J, Findell K, Knutson TR.(2005). Simulation of Sahel drought in the 20th and 21st centuries. *Proceedings of the National Academy of Science,* **102**: 17891-17896 doi:10.1073/pnas.0509057102.

Decision Analysis Tools for Decision Making *by Jennie Rice*

This lecture provided an introduction to the process and techniques of decision analysis, including the benefits of influence diagrams for communicating complex decisions, such as those involving climate and public health. The lecture used a simplified vaccination decision complicated by a weather uncertainty to illustrate the process and techniques. Trainees learned to construct decision trees and influence diagrams and be exposed to expected value calculations, decision tree rollback, value of information and value of control calculations. The lecture concluded with a presentation of the complex influence diagram under development for meningitis vaccination decisions in sub-Saharan Africa as part of the National Center for Atmospheric Research (NCAR)'s project for Google.org.

Recommended readings

Owens D, Shachter R, Nease R.(1997). Representation and Analysis of Medical Decision Problems with Influence Diagrams. *Medical Decision Making,* **17:** 241-262.

Afternoon Session

Multi-Member Ensemble Approach to Malaria Modeling *by Daniel Ruiz*

Dynamical models have played a significant role in understanding the complexity of malaria transmission dynamics. In this lecture we explained how we have analyzed, created and replicated the simulation outputs of several malaria dynamical models and how we linked all their shared exogenous and endogenous variables in order to create an ensemble framework of malaria conceptual models. The first part of the presentation highlighted the importance of conceptual models in the general context of environmental health and public health; explained the significance of the use of a system dynamics approach for understanding malaria transmission dynamics; described our experiences in creating and implementing the ensemble framework; discussed the main objectives of using malaria conceptual models; and, finally, explored our current and potential capabilities. In the second part of

the lecture the group was able to implement the multi-member ensemble to explore the role that both climatic and non-climatic factors play in fluctuations and trends in malaria incidence, as well as to compare the simulation outputs of some of these models with actual malaria morbidity profiles observed in specific malaria-prone regions with different eco-epidemiological settings. The trainees had access to detailed climatic, non-climatic, ento-mological, and epidemiological datasets of at least three experimental sites. Also, they were able to explore the ongoing efforts of the Colombian Integrated Surveillance and Control System project.

Recommended readings:

Ruiz D, Connor S, Thomson M. (2008). A multimodel framework in support of malaria surveillance and control. *Seasonal Forecasts, Climatic Change, and Human Health – Health and Climate / Advances in Global Change Research Vol. 30*; Madeleine C. Thomson, Ricardo Garcia Herrera and Martin Beniston (ed.), Springer Science, Business Media, Dordrecht; Publisher: Springer Netherlands, ISBN 978-1-4020-6876-8, Chapter VII, pp 101-125.

Pascual M, Cazelles B, Bouma MJ, Chaves LF, Koelle K. (2008). Shifting patterns: malaria dynamics and rainfall variability in an African highland. *Proceedings of the Royal Society B*, **275**:123–132. doi:10.1098/rspb.2007.1068.

Zhou G, Minakawa N, Githeko AK, and Yan G. (2004). Association between climate variability and malaria epidemics in the East African highlands. *Proceedings of the National Academy of Science*. **101**: 2375–2380. doi:10.1073/pnas.0308714100.

Day 9: Thursday, June 11, 2009

Morning Session

Climate Change Impacts on Public Health *by Dr. Patrick Kinney and Dr. Kim Knowlton*

This lecture began with a broad overview of public health impacts of climate change. We discussed the range of health outcomes likely to be influenced by climate change. As a case study, we then examined in greater detail the effects of heat on human health. We discussed research methods for analyzing temperature effects on mortality, and reviewed the main findings from the literature from the perspective of the insights they offer regarding potential climate change impacts. Methodological challenges were highlighted, including confounding variables, mortality displacement, and acclimatization. Sources of data on weather variables and health outcomes were reviewed. We also covered scenario-based integrated risk assessment approaches for looking at potential future impacts, and identi-fied the steps and input requirements for risk assessments. The challenge of downscaling climate predictions to relevant local geographic scales was noted.

Recommended Readings

Kim Knowlton, Barry Lynn, Richard A. Goldberg, Cynthia Rosenzweig, Christian Hogrefe, Joyce Klein Rosenthal, Projecting MPH, Patrick L. Kinney. (2007). Heat-Related Mortality Impacts under a Changing Climate in the New York City Region. *American Journal of Public Health.* **97**:2028–2034.

"Climate change and human health: risk and responses: revised summary 2008". Washington, D.C.: PAHO, © 2008.

Confalonieri, U. B. Menne, R. Akhtar, K.L. Ebi, M. Hauengue, R.S. Kovats, B. Revich, A. Woodward. (2007). Human health. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 391-431.

Afternoon Session

Open Health Tools *by Dr. Knut Staring*

The OpenHealth platform is a collaborative effort from the World Health Organization (WHO) to create an interoperable suite of tools that covers the whole spectrum of public health information needs. At the core of the platform are standards for data exchange and functional integration around a modern service-oriented architecture. Spatial data and GIS is central to the integration of public health data spanning many levels from community and clinic up to national and global, and great emphasis is being put on enabling the pooling of data from various sources such as population census, administrative boundaries, environmental data and animal welfare to enable analysis of factors relevant to public health and relate to information on the burden of disease and availability of health services in various areas.

Probabilistic Seasonal Forecasting and its applications *by Dr. Simon Mason*

Although it is impossible to forecast the weather more than a few days in advance, the science of seasonal climate forecasting is premised upon an ability to predict the general weather conditions over a prolonged period of time, without trying to predict the precise weather at any specific time during that period. The forecasting is possible only because sometimes, and primarily within tropical latitudes, the atmosphere is sensitive to unusual conditions at the earth's surface, and especially at the sea surface. Unusual sea temperatures can result in changes to the heat and moisture supplied to the atmosphere that in turn can disrupt weather conditions in many parts of the globe. However, all seasonal climate forecasts involve a great deal of uncertainty, and a key aspect of forecasting at such time scales is to estimate the uncertainty in the prediction reliably. In this lecture different ways of producing seasonal forecasts with associated estimates of uncertainty were discussed. A

practical exercise, in which a set of seasonal forecasts for Botswana are constructed, was conducted.

Recommended readings

Mason SJ. (2008). Chapter 2: "Flowering Walnuts in the Wood" and Other Bases for Seasonal climate Forecasting. In: Thomson M.C. *et al.,* eds. *Seasonal Forecasts, Climatic change and Human Health.* Springer Science + Business Media B.V. 2008. pp. 13-29.

Day 10: Friday, June 12, 2009

Morning Session

Decision-Making Under Uncertainty *by Prof. Peter Diggle*

Public health professionals are often faced with the dilemma between making a timely decision based on limited information, or delaying until more information is available. Statistical reasoning offers one way out of this dilemma.

This lecture described how statisticians use probability as a metaphor for ignorance, comparing and contrasting traditional ideas of significance testing with more modern approaches based on predictive inference.

I used as a running example an application to the estimation of spatial variation in the prevalence of Loa Loa (eye-worm) in Africa (Thomson *et al*, 2007; Crainiceanu, Diggle and Rowlingson, 2008). The goal was to ascertain whether prevalence at any location within the study region (equatorial west Africa) does or does not exceed 20%, this being the level set by the WHO to trigger a particular public health intervention. The obvious answer of estimating prevalence and applying the intervention where the estimate exceeds 20% is far from optimal. The approach that I advocated in the talk was to build a statistical model for the spatial variation in prevalence using all available data, and use the model to map the probability that prevalence exceeds 20%. I also argued that the statistician's job is not to make the decision on whether or not to apply the intervention, but to give public health professionals the best possible evidence to contribute to their decision making.

Recommended Readings

Crainiceanu C, Diggle PJ and Rowlingson BS. (2008). Bivariate modeling and prediction of spatial variation in Loa Loa prevalence in tropical Africa (with Discussion). *Journal of the American Statistical Association,* **103**: 21–43.

Thomson MC., Christensen OF, Obsomer V, Rowlingson B, Gardon J, Wani S, Takougang I, Enyong P, Kamgno J, Remme H, Boussinesq M, Molyneux

DH, Diggle PJ. (2007). Spatial modeling and prediction of Loa Loa risk: decision-making under uncertainty. *Annals of Tropical Medicine and Parasitology*, **101**: 499–509.

Si2009 participants gather at Lamont Hall to hear a lecture on transmission cycles of disease in Sudan ; David Gottlieb

Afternoon Session

Final Country Short Report

The guidelines for the trainees to prepare the short reports were as follows:

In order to ensure and capture the opportunity for individual participants to explore their own ideas through the course seminars, exercises and discussions we would like you to begin, from the first day, to plan and follow through on a mini project that you define (either individually or in a small group) that uses what you have learned and applies it aspects of your own work/interest – now or in the future.

Short reports on these mini-projects – indicating data sources, analysis tools and results – and framed in the context of practical health decision-making – will be made on the final day of the Institute and used to share the learning experience with co-participants, faculty and future learners. Students should aim for about a 5 page report and a 5-10 minute talk. If students decide to form teams, then an additional 5 minute per team member will be allocated.

Some specific time will be allocated in the second week for furthering the short reports – otherwise participants may use any other free time they find available.

Course Evaluation

All the participants of the course were given the opportunity to evaluate and give their feedback on SI 09: the organizers, the lecturers, the support staff and the trainees. The entire evaluation process was anonymous and relied on on-line open-ended and numeric questions addressing the design and delivery of SI 09, as well as the opportunities that could arise from the course. Such evaluation should allow the organizing committee to improve the planning and delivery of the next releases of this international health and climate training course at Columbia University or in partner institutions across the world.

Methods

At registration, each of the 12 trainees was asked to fill out a pre-course questionnaire in order to elucidate their expectations for the course, their background and prior knowledge of public health and climate (see Appendix 4). During the SI itself, the trainees were asked to fill out individual, anonymous online daily evaluations of the content and format of the day; weekly evaluations were also distributed on the last day of week one and week two. On the final day of the course, participants were asked to provide their overall feedback on the class (*e.g.,* content and delivery; see Appendix 5). The daily evaluations were used to provide the organizing committee with immediate feedback, allowing the organizers to make adjustments for the next day. The result of the daily evaluations will therefore not be detailed in this report, which focuses on the pre-course questionnaire, and the weekly and overall evaluations; the report will also address evaluations of the panel discussion on meningitis and climate and those which referred to the short reports.

After the delivery of the SI, the organizers, lecturers, and support staff were asked to fill out a survey that focused on the planning, objectives, content, delivery, and workload associated with the course; this survey also covered issues related to collaboration opportunities and research insights that might arise from such an international training (see Appendix 6-8).

Questions were open-ended, yes/no, or multiple choice. Performance and satisfaction were assessed using numeric (one to five, with five being the highest) or nominal scales (from very ineffective (1) to highly effective (5); from strong disagreement (1) to strong agreement (5)). This course evaluation report summarizes the descriptive statistics of the yes/no and multiple choice questions (MCQ) as well as the thematic analysis of the respondents' quotes.

Results

Trainees

Pre-Course Questionnaire

The 12 trainees who attended SI 09 had varied profiles. Out of the nine public health professionals (67% of the trainees), five were field practitioners, three were involved in research, and

one mixed practice and research activity. Although most of their experience was related to vector-borne diseases such as malaria or dengue where the link with climate is more established, three (33% of the public health practitioners) were involved in meningitis surveillance and control, an area where research on public health applications of climate information is growing. On the other hand, one participant was confronted with responding to climatic threats to public health, in the broad sense of the term (*e.g.,* probability of flooding). Four of the public health professionals self-identified as also being involved in the climate sector. However, all these nine trainees emphasized their need and interest in gaining further knowledge on climate and the use of climate methodologies and tools to be integrated in their public health practice and/or research (*e.g.,* early warning, risk assessment, disease forecasting, modeling).

The trainees from the climate community (33%) also had either a field or a research occupation. Neither of the two climate trainees who filled the questionnaire declared being involved in the management of public health issues. However, they consistently reported great eagerness to provide the public health community with tools and/or information that could improve decision-making and disease surveillance.

The differences in profile between and within trainees from the health and climate communities were consistent with the differences observed in prior knowledge on health and/or climate. Interestingly, 44% of the public health professionals declared seeking climate knowledge primarily from personal readings, while university coursework and/or scholarly research and/or workshops and trainings were the source of climate knowledge for the remaining public health trainees. None of the climate professionals based their climate knowledge on personal interest/ reading. This finding highlights the existing gap in providing climate information to the public health community and the need to lead the public health community to the relevant sources and uses of climate information.

Despite little knowledge on climate and the tangible public health applications that can be made of climate information, some public health professionals deemed climate information as playing a more important role in decision-making than factors that are traditionally used by the public health community such as, for instance, availability of funding, organizational capacity, previous experience, national economy, health policy and governmental response.

Besides coming from different backgrounds, seven of the 11 trainees who completed the questionnaire (64%) ranked 'learning more about the IRI and/or meeting IRI research staff in order to build further collaboration or gain new insights as one of their highest areas of interest.

Weekly Evaluation

The trainees gave a very positive feedback on the course. Four of them commented that SI 09 was 'an excellent course', and another one 'wish[ed he/she] had taken this course earlier in [his/ her] career'.
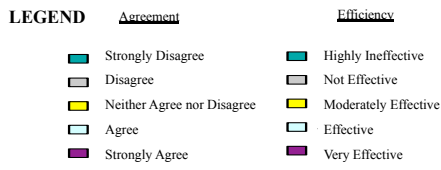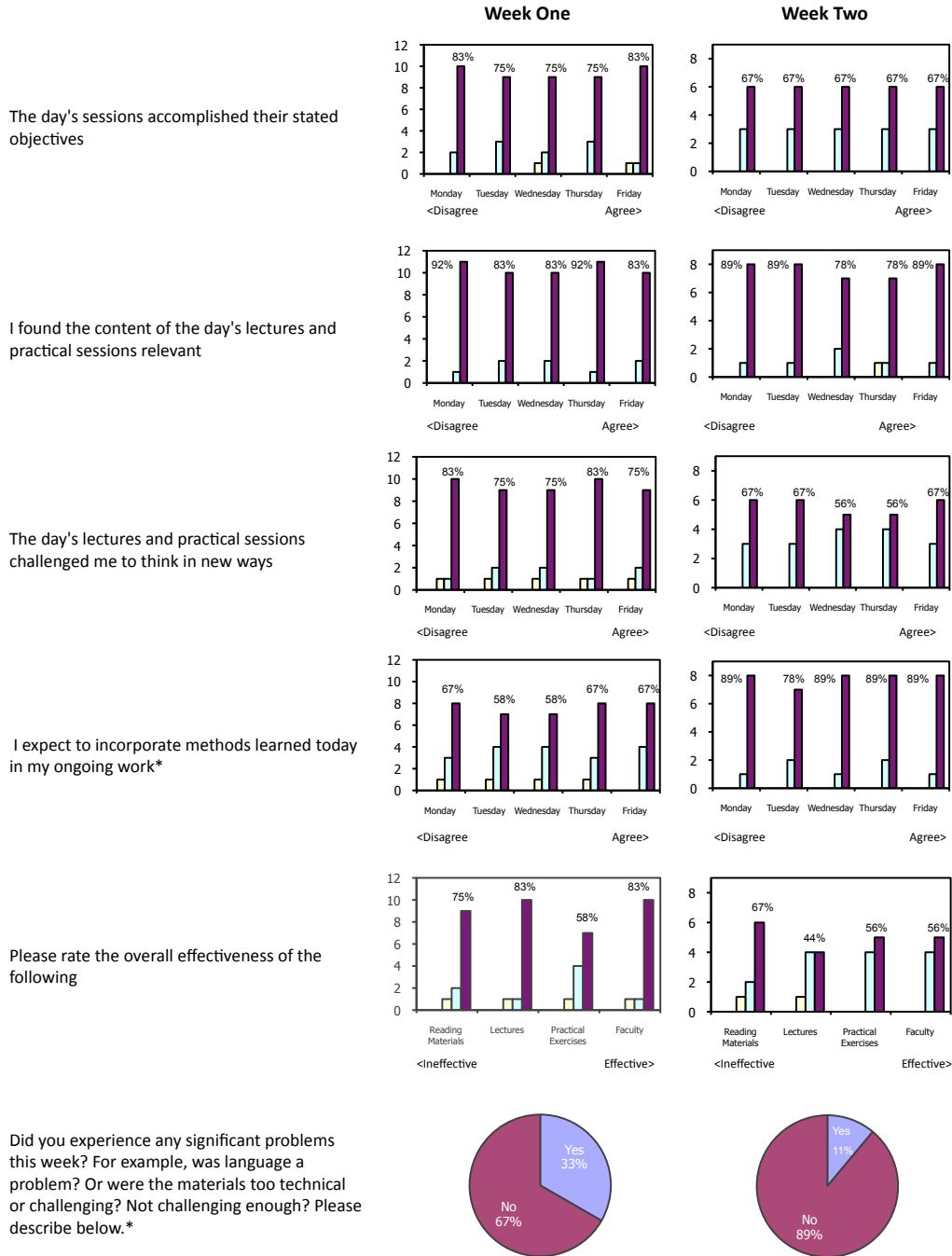
On the whole, results from Week One and Week Two are slightly different, with moderate within-week variations. The overall satisfaction and impact of the course were greater for the first week despite the trainees reporting more challenges at this time (*e.g.,* language and technical difficulties). More information is provided in Figure 1 where the one to five scales reflect either on the efficiency of an item or on the respondent's agreement with a statement. Trainees reported that the course accomplished its stated objectives, with relevant lectures and practical sessions and effective and supportive faculty staff.

The adaptation and knowledge assimilation processes are worth pointing out: even though the trainees reported being challenged to think in new ways during the entire course (on average, 78% strongly agreed with this statement in Week One, 84% in Week Two), they markedly described being able to incorporate the methods learned during the course in their on-going work from Week Two (87% during Week Two *versus* 63% during Week One). This phenomenon is clearly illustrated by the following quote: 'I hope that next week will mean that I reinforce what I have learned and really see how I can use this in my work' or 'I could see what is the best materials could be used in my country'. Such practical applications may include, for instance, 'generating [a]malaria early warning [system]'.

As part of the adaptation process, fewer challenges were experienced by the trainees during Week Two (11% *versus* 33% during Week One). Initial ordeals included linguistic difficulties that slowed down the comprehension process and challenges in mastering the computer- and Internet-based practical session and to 'internalize interactions between climate information associations with public health during analysis'. These were expected challenges because the group of trainees comprised international professionals, with different backgrounds and coming from countries with different languages and varied levels of IT equipment and thus, proficiency. For instance, one trainee found 'the Data Library sessions [...] a little slow for [him/her] but still informative' while they were 'too quick' for two others. However, as a trainee pointed out, 'there were some sessions that were review for me but it was still good to refresh my memory on things'.

Finally, with open-ended comments, the trainees reflected on public talks (*i.e.,* lunch-time seminars), lectures and practical sessions, in addition to confirming their overall excellent rating of the week. They wished there was more public talks with committed speakers on Week One (there was only one lunch seminar that week) and acknowledged that Week Two was a 'build up on the first weeks session [that] helped to deepen the understanding of the course contents. It was more interesting and informative to run practical models for disease prediction and weather during the week' and to be introduced to the 'use [of] the decision-making tools [...] to communicate with academics or meteorology staff'. In terms of practical sessions, the trainees asked for more practical sessions which could be improved, the trainees suggested, by 'doing exercises for each country' (in addition to Africa, on which all the exercises focused), by 'explaining where we can obtain data that do not exist in Data Library' currently.

Figure1: Weekly Evaluation

Week One   **Week Two**

The day's sessions accomplished their stated objectives

I found the content of the day's lectures and practical sessions relevant

The day's lectures and practical sessions challenged me to think in new ways

I expect to incorporate methods learned today in my ongoing work*

Please rate the overall effectiveness of the following

Did you experience any significant problems this week? For example, was language a problem? Or were the materials too technical or challenging? Not challenging enough? Please describe below.*

LEGEND <u>Agreement</u> <u>Efficiency</u>

Strongly Disagree   Highly Ineffective

Disagree   Not Effective

Neither Agree nor Disagree   Moderately Effective

Agree   Effective

Strongly Agree   Very Effective

Overall Evaluation

On the whole, the Summer Institute 2009 was a great success and was very well-received by the trainees, as one of them pointed out: 'I never thought I could gain so much from this course'. The course achieved its objectives, which were on average seen as clearly stated by the trainees and matched their expectations. 'The curricula of the summer institute and the ultimate hands on exercises by far fulfill my expectations', said a trainee. 'I feel more confident about climate and health data and interactions […] and I am better at evaluating papers having learned the analytical techniques' said another one.

However, it seems that the course would gain in comprehensiveness by 'broadening the scope of the diseases [it covers], especially those with different processes (like water borne)', although the trainee acknowledged 'the benefits of focusing on the methods using one disease'. This builds on one of the findings of the weekly evaluation, where a trainee asked for the exercises to cover continents other than Africa. The trainees also suggested that 'using the reading materials more and discussing the methodology in different papers during sessions' would be an interesting improvement for the next SI. However, as emphasized by a SI 09 trainee, 'it was very difficult to do [the readings] with finishing at 5 [pm], having time to eat and network with the other participants, exercise, *etc*. I hope to do them when I get home, and it is nice to know which reading goes with which lecture, but it is not always realistic to read in some cases 40 pages each day. For the participants with not-so-good English it would have been very difficult!' Group work by different disciplines' could also improve the learning process by targeting and being adapted to the interests and prior knowledge of the health and the climate communities.

The course content consistently fulfilled the trainees' expectations. The pre-existing differences in prior climate and/or health knowledge were consistent with the findings that some trainees would have liked the course to have a more appropriate level of depth or to be more clear and easy to understand (for further details, see Figure 2).

More precisely, even though, as one trainee pointed out, 'it is difficult to pick out a single topic', the following topics were deemed most instructive to them : the Map Room, the Data Library, GIS, CPT, regression and disease modeling tools using climate, knowledge of existing data, time series and detrending data, the K-means and cluster analysis, decision tools (from a professional perspective), remote sensing, forecasting using local precipitation, the interaction between malaria and climatic information that were covered during practical and lecture sessions. Using 'free software' was 'very useful' according to the trainees. The opportunity for the trainees to use the Map Room as a tool for decision-making was emphasized several times.

In terms of the global transferability of the course, the trainees acknowledged that 'the materials [could] be used in [their] country', with a greater transferability being achieved if the content was extended to regions other than Africa, health issues different from vector-borne diseases (*e.g.,* cholera, drought), and less 'research focused'. Unfortunately, these limitations were predictable given the newness of the integration of climate factors into public health decision making. Additionally, one trainee pointed out that preparing 'simpler training materials

that can be used by countries' and 'provid[ing them] with simple tools' would be useful.

The following parts of the course were identified by the trainees as the most relevant to their work: early warning systems and forecasting, statistics for disease modeling, mapping and estimation of disease risk using both climate and epidemiological data, the Data Library, decision-making tools, calculation of epidemic thresholds and the WHO databases (Open Health). When asked about the least relevant part of the course, 67% of them perceived the entire course as relevant either to their work or to their areas of interest. The climate in the Sahel and meteorological parts were found least important by one public health and one climate professionals, while another public health professional emphasized that it may not be relevant for field or decision-making public health staff to 'be trained in analytical methods'.

As it emerged from previous answers, the SI learning experience could be enhanced by, for instance, extending the scope of the lectures and/or practical sessions to regions other than Africa and other diseases than those predominantly covered by the SI (*e.g.,* malaria). Such change could create the opportunity to 'learn how to transfer techniques between geographical locations (*e.g.,* Africa/the Americas) and diseases' as a trainee suggested.

'Increasing the practical time for the exploration of web based products using library information', such as 'analytical' or 'decision making' tools, as well as increasing the time allotted to 'the readings' and the 'discussion' would also be a great step forward, according to the trainees. Such modification could be integrated to the revision of the 'sequence of lectures and combination of participants' a trainee asked for.

While reflecting on any additional course content they would recommend to be developed in the future, the trainees pointed out that, in addition to the aspects mentioned above, it would be useful to further: the teaching on modeling using free software, communication of products developed to target users in a simplified way oriented towards decision making, integration to socio-economic components on the proper/improper use of climate information and the involvement of the trainees in the delivery of the

> ## *'Stunning – the team should be very proud'*

SI. For instance, one of them suggested that there could be more 'group work' and that each day a couple of trainees would provide the rest of the group with a 'brief summary about the previous day'. Such interactivity would be a very interesting way to share knowledge and gain from the international and truly diverse expertise of the course trainees. Some trainees also suggested that 'the practical session [use] actual data from each of the participant countries (participants would need to bring some real data with them). So, [by] the time the participants finish the course, they would have different maps and graphs for their country'. This would be easily feasible if, as a trainee proposed, the 'calendar for the course [was sent] to participants before they arrived' and 'the relevant materials [were distributed] ahead of time'. Thinking of the delivery of the SI in advance may also help the trainees to get better expectations of the course and identify more clearly the gaps in knowledge and/or skills they hope to fill by undergoing the training.

Finally, all the trainees were positive about reproducing the course for their home institutions, either as such (56%) or with slight differences in terms of its duration ('more fast') or content. In particular, the trainees asked for the course to be less 'analytical' and more 'decision-making oriented' with a scope covering various health issues. Such new orientation would greatly benefit from an enhanced training on 'mapping and GIS'. The two trainees who had already taken training courses like this reported that this course was 'better' than the other ones. Yet it could be enhanced if the 'the time and variety of participants' were improved. Reflecting on another issue, a trainee also underlined how important it is to 'think of the combination of participants for training'.

In terms of the logistics, some trainees suggested that the meals could be more varied ('Food was great except that it was far too much pizza!' 'We ate the same twice a week. And the breakfast every day was cold'). Trainees also evoked that , although 'it is likely hard to organize, it would have been great to have the option to get to the hotel ourselves as it was sometimes hard to organize meetings with IRI staff, and doing that at 4.30pm or 5pm and heading back later would have been ideal'.

We shall leave the concluding words to the trainees themselves:

'Very interactive and informative institute, please keep it up'

'This was an excellent course. I think it is essential to combine people from different fields, in-country decision makers and young scientists from all disciplines who will carry the developing field of climate and health forward'

'I appreciate all the effort and assistance from the entire IRI team and all the facilitators who worked so hard to ensure we understood the course content. I look forward to more collaboration with IRI as an institution and also with the individuals in it'

Figure 2: Overall Evaluation

Objectives

The objectives f the course were stated clearly

- Agree 22%
- Strongly Agree 78%

The objectives of the course matched my expectations of the course

- Agree 44%
- Strongly Agree 56%

My expectations of the course were met o exceeded (please explain your answer below)*

- Agree 44%
- Strongly Agree 56%
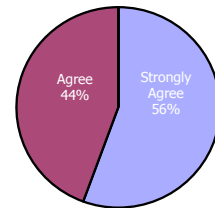
Course Content

The content of the course fulfilled my expectations
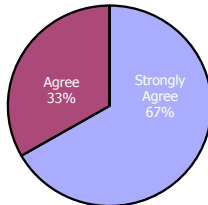
- Agree 33%
- Strongly Agree 67%

The course content covered an appropriate level of depth

- Neither Agree nor Disagree 11.1%
- Agree 33%
- Strongly Agree 56%

The content was delivered in way that wa clear and easy to understand

- Neither Agree nor Disagree 11%
- Agree 22%
- Strongly Agree 67%

The content was coherent with the objectives of the course

- Agree 22%
- Strongly Agree 78%

The course content was engaging

- Neither Agree nor Disagree 11%
- Agree 11%
- Strongly Agree 78%

There was coherence between course lectures and the course objectives

- Agree 22%
- Strongly Agree 78%

There was coherence between lunchtime seminars and the course objectives

- Agree 44%
- Strongly Agree 56%

There was coherence between practical sessions and the course objectives

- Agree 22%
- Strongly Agree 78%

There was coherence between assigned work (i.e. short report) and the course objectives

- Strongly Agree 56%
- Agree 44%
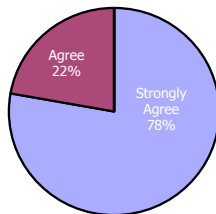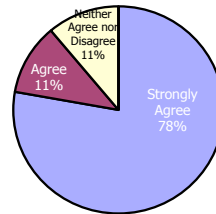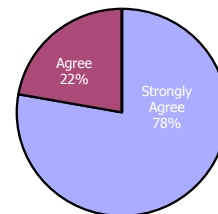
Figure 2 (con't):

Global Transferability of Course Content

Was the content of the course relevant to you geographical region and organization?

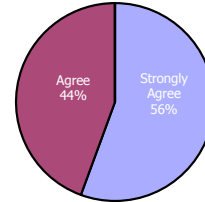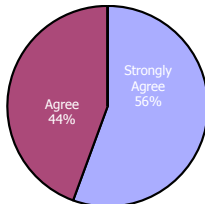*Neither Agree nor Disagree 11%*
Strongly Agree 45%
Agree 44%
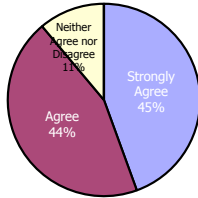
Course design

The course was easy to navigate
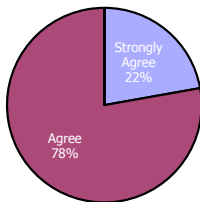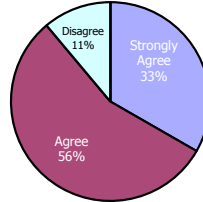
Strongly Agree 22%
Agree 78%

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

Disagree 11%
Strongly Agree 33%
Agree 56%

The course design helped to reinforce my understanding of the content

Agree 44%
Strongly Agree 56%

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

Agree 44%
Strongly Agree 56%

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

Strongly Agree 11%
Disagree 22%
Agree 22%
Neither Agree nor Disagree 45%
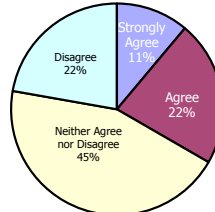
Course Delivery

Have you taken training courses like this before?
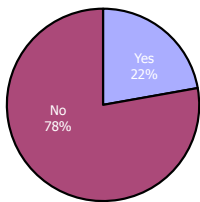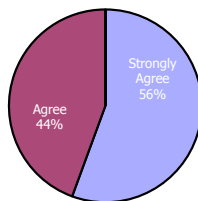
Yes 22%
No 78%

All the activities began on time

Strongly Agree 56%
Agree 44%

Course materials (i.e. readings) were appropriate and helped me to learn the course content

Disagree 11%
Strongly Agree 45%
Agree 44%

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

Agree 11%
Strongly Agree 89%

Course facilitators were available to answer the questions I had about the course content

Agree 11%
Strongly Agree 89%

IRI researchers and staff were available for networking and discussion

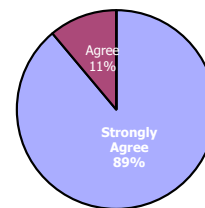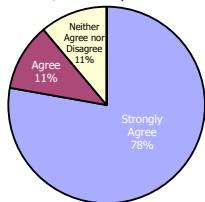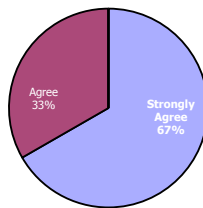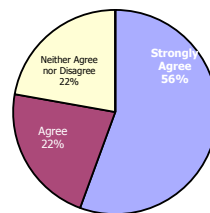*Agree 11%*
Strongly Agree 89%
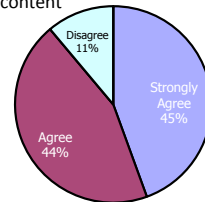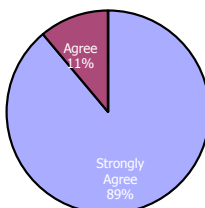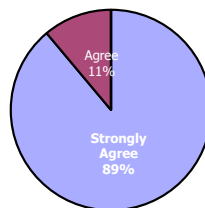
Figure 2 (con't):

Course delivery (continued)

IRI staff was helpful in addressing my questions regarding travel, accommodations, or other personal matters
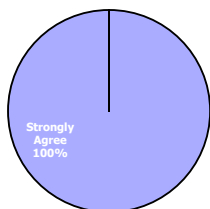
- Neither Agree nor Disagree 11%
- Agree 11%
- Strongly Agree 78%

I enjoyed to hotel accommodations

- Agree 33%
- Strongly Agree 67%

I enjoyed the food

- Neither Agree nor Disagree 22%
- Agree 22%
- Strongly Agree 56%

I enjoyed the special events/dinners

- Strongly Agree 100%

The ultimate part of the course was the short reports based on personal projects that gave the opportunity to embed the concepts and approaches within the trainees' home institutions and projects and present them to SI 09 participants and facilitators after they completed the course.

Trainees consistently reflected on the interest of the 'further value added' of undergoing such assignment (see Figure 3).
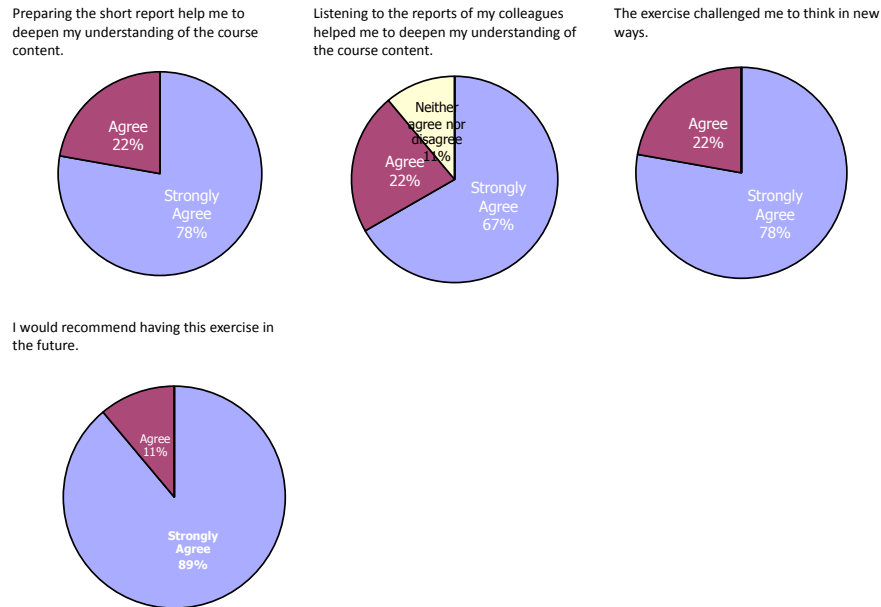
Because 'different [trainees] used different approaches to prepare the short report', it may be useful to provide the participants with more guidelines on the completion of the reports and with instances of the work done by previous cohorts of trainees. 'I was unclear about whether the short report was saying how we would use this in our work, or whether it was to do analysis based on what we had learned. Either is useful and I guess that it is up to everyone what they find most useful to do!'

The trainees pointed out that it would be useful to have 'advanced discussion on the short report writing at the beginning of the institute [in order to] allow participants to explore ideas as the curriculum unveils'. This would be possible if 'more time [was allocated during the day] to prepare the [reports for there is] not enough time in the evening'- which is also the time when the trainees have to do the readings for the next day (see 'Figure 2: Overall Evaluation').

However, given the intensity of the entire course schedule and 'the time available', an alternative to this further work may be, as proposed a trainee, to keep the personal work and opportunity to apply the methods learned during the SI to a 'presentation rather than a report' or, as suggested another trainee, to prepare a 'the report [of] only 3 pages'.

The summaries of the trainees' short reports are available later on in this report.

Figure 3: Evaluation of the Short Reports

Preparing the short report help me to deepen my understanding of the course content.

Agree 22%
Strongly Agree 78%

Listening to the reports of my colleagues helped me to deepen my understanding of the course content.

Neither agree nor disagree 11%
Agree 22%
Strongly Agree 67%

The exercise challenged me to think in new ways.

Agree 22%
Strongly Agree 78%

I would recommend having this exercise in the future.

Agree 11%
Strongly Agree 89%

A panel discussion on meningitis and climate with international key note speakers was held at the MSPH (see Appendix 2: Invitation to the Panel Discussion). The feedback was extremely positive. The seven trainees who answered this question strongly agreed (6) or agreed (1) with the statement that this public talk was clear and easy to understand. All of them deemed this discussion engaging and acknowledged that it challenged them to think in new ways. They would all recommend holding similar talks in the future. Additionally, the logistic was very well-planned.

Organizers and Curriculum Group

The survey was sent to the five persons who organized and designed the curriculum of the SI. Four of them were also responsible for giving a lecture and/or a practical session.

The involvement of the four respondents (response rate=80%) in the development and delivery of the SI varied according to their specific roles (from very important, 75%, to moderate, 25%), and resulted in different levels of work load associated with either the planning or the delivery of the SI. For the organizers, the planning of the course was more demanding (work load was enormous for 50%, heavy for 25% and regular for 25%) than its effective delivery (work load was enormous for 25%, heavy for 25% and regular for 50%).

The organizers gave an overall excellent feedback on the preparation and delivery of SI 09, which was considered 'a significant step forward in all respects' compared to the first edition (see Figure 4).

A major strength of the SI was that it was developed and implemented as a comprehensive experience for the entire participants, whether trainees or facilitators: SI 09 arose from an 'end to end thinking from partnership through curriculum through tools'. 'It not only [brought] in partner participants but also facilitators that we want to partner with'. For this reason, 'the SI act[ed] as a showcase for why we matter to those that come to teach on the course' and 'laid the foundation for future collaboration.' As a result, the SI provided new project insights and opportunities for collaboration to all the organizers, who also acknowledged that the interaction with the participants and lecturers challenged them to think in new ways, including the 'scaling up and long term sustainability' of such course.

The 'hands-on, focused, and intensive' curriculum was an important strength of the SI. According to the organizers, the lectures/practical sessions/talks matched the objectives of the course. Classes were deemed 'of very high quality', with 'good coherence between lectures and practical sessions'. The organizers felt that, 'with little exception', the classes fulfilled the expectations of the students (2/3) who were 'aware of the constraints of different perspectives - depth *versus* breadth - multidisciplinary *versus* same expertise *etc.*' The organizers also perceived that 'some students with a high profile in statistics' 'may have wanted more challenging statistics sessions as this was their field of expertise'.

This point confirms the 'need to be careful in the selection of the participants [(*i.e.,* 'target population')], so we can make sure their profiles are similar', as a trainee also suggested (see 'Overall evaluation'). For that reason, 'it may help to design a pre-selection questionnaire that would let us know the skill levels of participants beforehand. Another alternative [may be] to make the training in basics available online to potential applicants and ask them to complete a pre-course questionnaire to make sure that they have understood the necessary background stats and epidemiology before they come to the course'. Assessing the 'English comprehension skills' of the applicants during the selection process would probably be of great help to ensure greater homogeneity within the group of trainees, for 'a participant [or so] may have language difficulties' in understanding the course. Such limitation could be overcome if some similar courses were developed in languages other than English (*e.g.,* Spanish or French), some people may be 'more familiar' with.

The organizers of the SI also felt that the time and resources dedicated to 'practical exercises' would deserve to be furthered, maybe with 'edited text (*i.e.,* the papers are too long for people to read but perhaps each exercise could have some more text along side)', as suggested an organizer. 'Practical and useful tools related to emerging technologies are of greatest interest, rather than general lecture material'. An organizer proposed that the SI should focus on 'basic concept on climate, weather, forecast, prediction, [and] projections [, in addition to] cluster analysis [which may be taught] as a method to do disease stratification'.

Therefore, a revision of the course curriculum may include, for instance, to 'have two statistics sessions run concurrently; one for basic stats and a another, more advanced one'. The organizers also suggested the course's curriculum should 'encompass more decision-making examples, [us-

ing the] practicals [as] case studies', with 'examples [...] of diseases and situations that are relative to participants'. An organizer suggested these country specific case studies to be followed-up during the entire delivery of the course, 'beginning with the simplest descriptive [statistics] and working through to more complex spatial analyzes'.

Besides offering the course in different languages and in a way that would match the 'need of the different countries', some organizers also suggested to offer 'a shorter, ['more intensive'], version of this [training] for busy professionals, with more intense focus on the data tools, and less on general lectures'. Would the course be 'shortened to one week', the scope of the participants may be extended to 'other faculty' involved for instance in environmental health sciences. Such modification may be eased by the 'development of online training materials on [background] concepts so that these do not need to be covered during the course'.

Finally, '[having] a general coordinator responsible to follow up all the tasks around the organization of the course' was deemed an additional critical strength of the course even though the organizers 'need to work more as team'.

Figure 4: Evaluation by the Organizers and the Curriculum Group
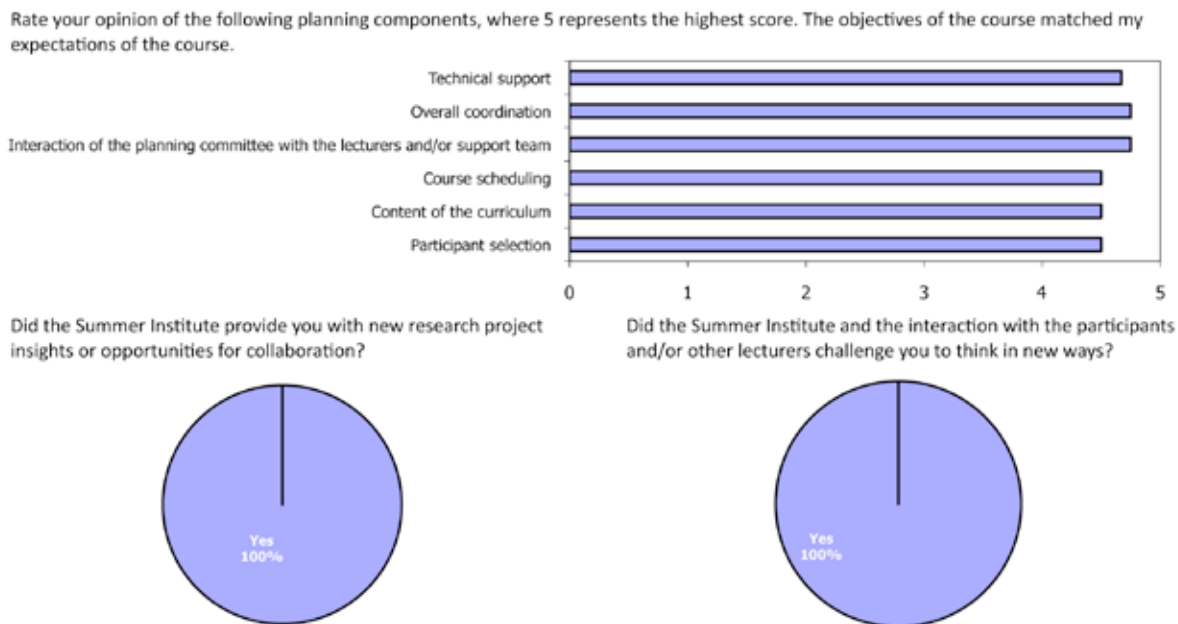
Lecturers

IRI Director-General Stephen Zebiak addresses the SI2009 attendees upon their arrival ; David Gottlieb

The survey was sent to 23 lecturers, responsible for a core lecture, a practical session or a lunch seminar. Seventy-four percent were affiliated to Columbia University, while 26% (n=6) came either from international or governmental institutions such as the WHO, the US Environmental Protection Agency (EPA), the National Institutes of Health (NIH), CDC, or from Universities such as the Lancaster University School of Health and Medicine.

Out of ten lecturers who answered the survey (response rate=43%), five were responsible for a core lecture (and an additional practical session for two of them), one was responsible for a practical session and one for a lunch seminar.

As per the 'good group dynamics', the lecturers acknowledged the 'appropriate selection' of the participants, which 'cover[ed] a good representation of different fields related to climate and health and included both United States participants as well international fellows from countries where climate health issues are highly relevant'.

All of the lecturers felt that the course matched the objectives of the SI and addressed the expectations of the students. 'The content of the curriculum was highly relevant and adequate for the two weeks course' with 'better coordination', although 'the order of all the courses and practicals' may be optimized. The lecturers also emphasized the need for the SI to be a 'more continuous experience' for the trainees, with, for instance, more material provided to the trainees ahead of time, including through 'the Data Library'. 'This is work in progress [, said a lecturer,] and slowly the curriculum and format will get refined', in order to match the 'different background education' of the participants and the different 'relevance […] to their work'. More specifically, a lecturer proposed 'having the "cluster analysis" lecture and practical sessions earlier in the SI, before the analysis on relationship between diseases and climate/environmental factors [to] introduce nicely the necessity to understand the data before searching for relationships with climate and environmental factors'.

Opinions regarding the scheduling of the course varied from 'adequate for the two weeks' course to 'too busy'. However, as the trainees and organizers also did, the lecturers acknowledged that more time should be allocated to the practical sessions.

The guidelines the lecturers received for their presentations 'were sufficient and easy to follow', which was considered a 'very good improvement compared to last year SI'. However, some lecturers experienced 'difficult[ies] to get the sense of what the overall expectations [were] from the whole SI' (*e.g.,* 'practical skills *versus* general understanding of principles') besides their presentations. Such situation could be easily overcome if, as most of the lecturers suggested (90%), the learning goals for their talks were set interactively with the 'organizers rather than being entirely set by one or the other'.

Figure 5: Evaluation by the Lecturers
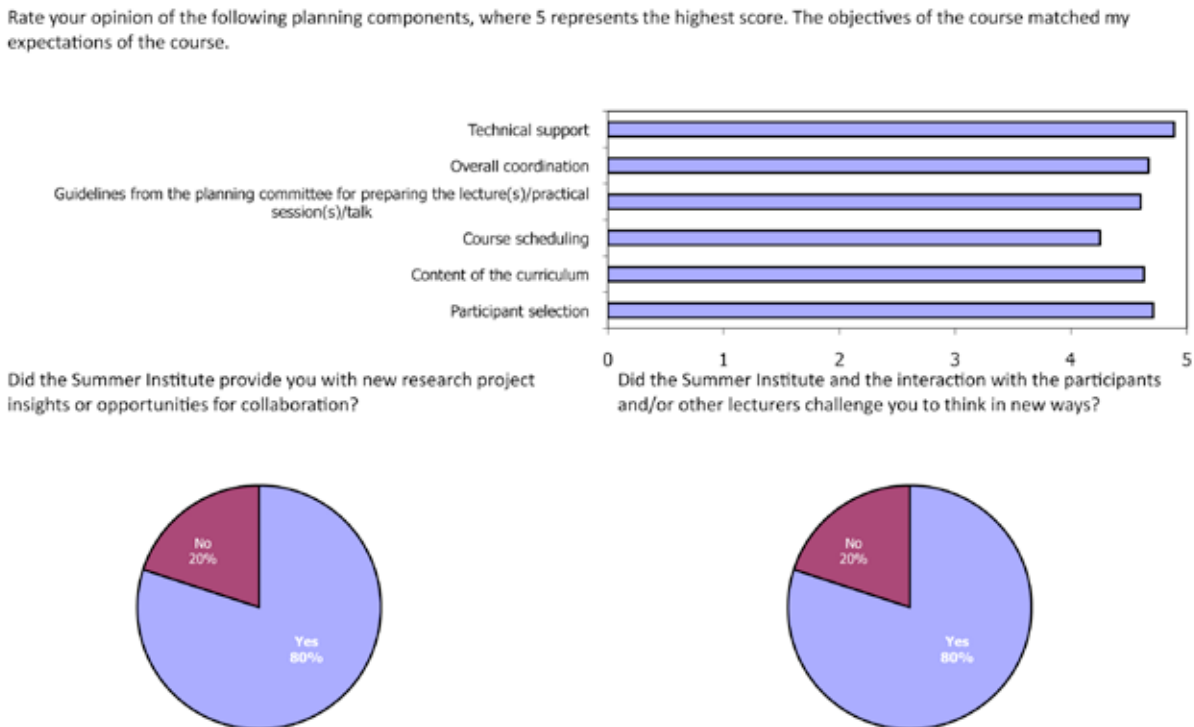
In order to match the expectations of the trainees who asked for some background documents to be sent in advance, 70% of the lecturers agreed to prepare such material ahead of time (*i.e.,* one or two months), as long as they would be notified far in advance. They pointed out that such modification would mean 'having [...] interactive session[s] with students during SI', with some time 'devoted [to] a questions and answers session with trainers regarding reading materials' in an 'already tight schedule', in addition to considerably increasing the work load associated with the preparation of the course, which was so far deemed 'regular' (as was the one associated with the delivery of the SI).

The SI provided 80% of the lecturers with new research project insights or opportunities for new or 'consolidated' collaboration with the institutions of trainees or of the other lecturers. Such experience may be improved, suggested the lecturers, if more time was allocated to 'interact with students' (*e.g.,* '1-2 days for free interactions').

Eighty percent of the lecturers were challenged to think in new ways by the interaction with the participants and/or other lecturers because of the variety of their profiles, interests and skills and the need for the lecturers to respond to the trainees' demand and feedback expressed either during the classes or through the daily evaluations. Some lecturers did not feel challenged by these interactions either because they had 'already been exposed to non-specialists before' or because there was no sufficient time to generate intense communication.

As the organizers had also pointed out, the 'coordination was excellent' and resulted in a smoother and improved delivery of the SI than the first edition of the course. The 'great technical support' also appeared as a strength of SI 09.

Support staff

IRI Support Staff aids Stephen Morse of the Mailman School in prepping his presentation; David Gottlieb

The survey was sent to ten IRI professionals, responsible for administrative, IT or communication support. The response rate was 50%.

SI 09 was perceived as 'professional', 'well planned and executed' and 'better focused than last year' (see Figure 6 on following page). The course 'appeared to be a very successful (weather not included). The coordination and follow through were exemplary' and resulted in everybody's 'role [to go] smoothly', despite some issues with the delivery of logistical services such as the catering.

However, this success may be furthered if the support staff were more 'involved in the agenda planning' in order to maximize their contribution. 'I would rate it highly and an important way to raise awareness of the IRI, both within Columbia University and in the regions of the world in which we work'.

Figure 6: Evaluation by the Support Team

Rate your opinion of the following planning components, where 5 represents the highest score. The objectives of the course expectations of the course.
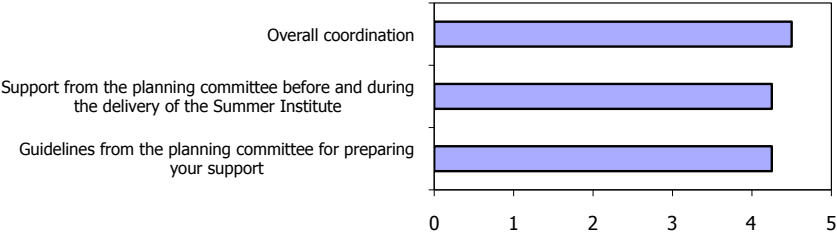
How would you rate the work load associated with the preparation of the Summer Institute (i.e. before it started)?
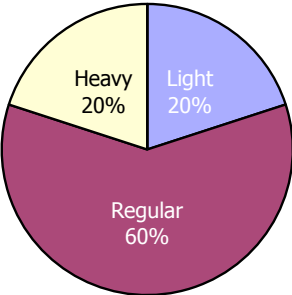
How would you rate the work load associated wit Summer Institute (i.e. during the SI)?
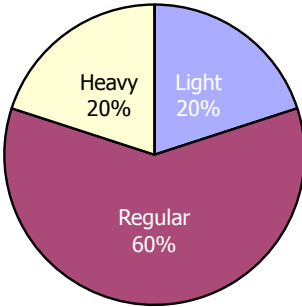
Short Reports Summaries

Dengue and Climate: A Short Report and Lessons Learned
Mary Hayden, Manon Fleury and Rachel Lowe

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 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 introduced some dengue data for Brazil from 2001 to 2008 obtained from SINAN DATASUS, Ministry of Health Brazil 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 highlighted the analyses we have learned to assess the relationship between dengue and climate variables in 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.

Risk Estimation for Epidemic Malaria in the Western Kenya Highlands: A Decision Tool for Rapid Deployment of Elaborate Preventive Interventions
James Sang

The decision to undertake Indoor Residual spraying in the epidemic prone western highlands to prevent malaria epidemics has been a long-standing challenge. Malaria control program has always been faced with the challenge of a prediction model that would allow decisions on spraying. These has always necessitated carrying out routine IRS and avoid taking chances with serious epidemic events because there are not proper prediction model that would provide the appropriate epidemic risk estimation in good lead time before it occurs. This proposed concept attempts to generate ideas around simple modeling using climate parameters, precipitation and temperature (mainly) to develop a risk estimation tool that will facilitate effec-

tive decision-making in response to threats of malaria epidemics. The model will be supported by weekly sentinel facility threshold monitoring at district level currently being implemented to detect increase case incidence at different districts within the epidemic prone highland areas.

Currently there is a good working relationship between the meteorological services and International Climate Prediction and Application Centre (ICPAC). These institutions will be the main resource points together with IRI for providing both technical and data support to this system. The epidemiological data will be sourced from the internal surveillance system within the Ministry of Public Health i.e., disease surveillance and Response, Health Management Information System and districts health management teams (DHMT). The analysis of data and provision of Risk forecast will be done with expertise from the Malaria control program and Meteorological services and in consultation with the disease surveillance and response unit of the Ministry of Public health and Sanitation. The detailed model development and analysis will be worked out with experts from the climate forecasting from the meteorological services, biostatisticians, entomologists and statisticians from the Ministry of public health once the both climate and public health technical departments have accepted the concept.

Training of Professionals on Climate and Health in Ethiopia
Daddi Jima Wayessa, Diriba Korecha and Yonas Asfaw

Climate variability and climate change are some of the factors that have significant effect on the pattern of climate related health issues such as vector-borne diseases, meningitis, malnutrition *etc*. in Ethiopia. To strengthen the prediction, prevention and control of such health issues, it is critically important that the information related to climate factors be well utilized. In order to make use of this available meteorological information for the purpose of evidence based decision-making for the health sector, the meteorological and the health sector has to come together and find a way to accomplish this intended goal, building the capacity of the professionals who are working in the two sectors and other collaborators is important.

The general objective of the training course in Ethiopia is to build the national capacity in order to utilize climate information for decision-making in the health sector at national, regional state and district levels. The time table and the methodology of the training will be adopted from the IRI summer institute course to the Ethiopian context. Accordingly, there will be presentations and practical sessions. All presentations and practical sessions will focus only on practically applicable issues. As, in most cases, the internet connections are slow, practical sessions in Ethiopian context will not be web based. However, the data received from MOH, NMA and IRI will be put on computers and made ready for hands on exercise.

This training would then provide the right knowledge base for developing an epidemic forecast warning system for several diseases such as malaria, meningitis etc. in Ethiopia.

Use of Decision Analysis Tools in IFRC
Lina Nerlander

The International Federation of Red Cross and Red Crescent Societies (IFRC) is one of best known disaster response organizations in the world. However, most of the time a response is initiated only when a disaster has already occurred. As part of a global effort to use climate information to better manage risk in many areas, the RC is attempting to use rainfall forecasts at different time-scales to be better prepared for disasters through for example pre-positioning stocks. This was successfully done in West Africa in 2008, when a seasonal forecast of a >50% probability of extreme precipitation enabled the IFRC West and Central Africa Zone office to appeal for funding and purchase and pre-position stocks. The heavy rainfall and floods did materialize and the Red Cross was better prepared.

The objective of my project is to explore the use of decision analysis tools – influence diagram and decision trees- to think about how the IFRC can scale up the use of probabilistic forecasts as decision-making tools. It must be stressed that this is an analysis that should be done at local level (Red Cross zonal or regional offices, or at country level as relevant – with real numbers!). It should always start with a general discussion and outline of all the factors that contribute to a decision, through using an influence diagram. The opportunity cost (financial and human resources) of responding is clearly one such vital piece of information and will vary greatly from region to region and situation to situation and we need a dynamic way to incorporate this into the analysis. Analyses such as looking at the value of information of waiting for a more precise short term forecast should be done. 'Precise' could here be taken to mean both more certain as well as more geographically precise.

Capacity Building in Climate and Public Health in Mali
Ousmane Toure

The Malaria Research and Training Centre (MRTC), University of Bamako, Mali, is one of the primary resources in Africa for malaria research and other vector-borne diseases. All the work at the MRTC is aimed at developing and testing appropriate strategies for the control of malaria and the reduction of the burden of disease in the people of Mali, the region, and Africa as a whole.

Training of African research and health professionals in Climate and Public Health is required to collect, forward, automate and store data (data management, disease surveillance) that is complete and accurate according to NIH standards. Training in the retrieval and analysis of climate and health data is required. These skills are required across a varietiy of research studies and a solid responsive training effort will enhance the capability of local and regional professionals to train widely and well.

The capacity building in Climate and Public Health in Mali project will impact on MRTC by building on the skills being developed through the NIH informatics grant .Through research capacity building workshops and distance learning opportunities supported by web-based training platform enabling, knowledge transfer through carefully designed training modules, data access,

management and analysis through the IRI Data Library and innovative ICT infrastructure and systems development; we will be able to support the current and future engagement of MRTC in climate and health research.

This proposed project will support the creation of evidence for policy-making.. Ongoing interaction between MRTC staff and IRI staff – along with other partners will occur throughout the 2 year period and will include support to African scientists in project identification and proposal development.

Training Program in Climate and Health in Madagascar
Marie Clemence Rakotoarivony

Malaria is the second cause of morbidity and the first cause of hospital mortality in Madagascar especially among the vulnerable populations. Reinforcement of the Early Warning System by using Climate Information in Madagascar is a goal particularly in this moment when policy makers choose the challenge to eliminate malaria in 2012. For the purpose of evidence based decision-making for the health sector, the meteorological and the health sector had to come together and decided to run a training course on Climate and Health on October 2009. The course will focus on three climate-sensitive diseases malaria, plague and rift valley fever .

 The goals and target of this training are to use climate information on health sector and to involve the capacity building of the membership of the Health and Climate working group. The training is previewed on October 2009 for 20 participants from the health sector and climate sector. The methodology of the training will be adapted from the IRI summer institute course to the Madagascar context. The data needs and the topics for this training are quite identified during the Summer Institute. We will like to work on cluster analysis and in the design and implementation of climate-sensitive disease map rooms.

Experimental Forecast on Malaria and Dengue in Ecuador, Colombia and Venezuela
Cristina Recalde

The key objective is to study the predictability of dengue and malaria incidence for Ecuador, Colombia and Venezuela using regional climatic models and a multi-model ensemble approach for the vector borne diseases. The methodology involves the use of deterministic models for malaria and dengue, which make use of epidemiological and socioeconomic information of each region as well as the use of climate forecasts to provide the necessary environmental variables.

The time window is from January 2000 to December 2008, because of data availability for the period. The spatial resolution of this experiment is 45 km. With the seasonal temperature forecast and the epidemiological and socio economic information it is possible to obtain maps for spatiotemporal incidence rate and basic reproduction rate (R0) for the period referenced above

Conclusions

The Summer Institute 2009 on Climate Information for Public Health brought together high-level participants of various profiles from ten countries. The course was perceived by all the participants (trainees, facilitators, organizers) as a comprehensive experience that provided:

+ A better understanding of the relationship between health and climate, and of the importance and complexity of using climate information in public health decision-making

+ New skills to help apply this knowledge, including for instance the downscaling of climate models for regional and local health risk management

+ New or deeper opportunities for international and multidisciplinary research and collaboration on climate-sensitive diseases

The course also provided an excellent opportunity to address the need for a more coordinated interaction between climate experts and health workers to improve decision-making processes in the public health sector.

The SI was well-planned and successfully fulfilled the trainees' expectations who acknowledged that the materials, either as provided or after minimal targeted adaptations, could be used in their countries and institutions of origin. For instance, this year, similar training courses will be held in French and English in Madagascar and Ethiopia. Both of them will be conducted by the local Health and Climate Working Groups developed in collaboration with the IRI; both will use materials adapted from the SI.

The short reports provided the trainees with the opportunity to apply their newly acquired skills; they also provided organizers and lecturers with further insight on the topics the trainees were interested in. The short reports addressed various public health issues, ranging from new methods to explore the relationship between health and climate, to decision tools that integrate climate information, to capacity building and the development of training.

It is hoped that the public health efforts in participants' home countries will benefit from this course in terms of improved planning and implementation of climate-sensitive disease prevention and control programs. It is also hoped that participants will be able to contribute to a network of trainers, delivering future training initiatives in their home countries or regions. Such progress will be followed up in the *Climate Information for Public Health Action* newsletter.

Recommendations

Based on the above course evaluations and conclusions, the evaluation committee offers a number of recommendations to improve the planning and delivery of further offerings of this international health and climate training course either at Columbia University or in partner institutions across the world. The recommendations are as follows:

Preparation of the course:

+ Send the course schedule and background documents to the trainees and/or post some material online in advance of the course, so that trainees will have clearer expectations of the course and will more clearly identify the gaps in knowledge and/or skills they hope to fill by undergoing the training.

+ Make the training in basic health and climate knowledge available online to potential applicants and ask them to complete a pre-course questionnaire to make sure that they have understood the necessary background statistics and epidemiology before they come to the course. This would also make the SI a more continuous experience

+ Include an English assessment in the pre-selection process, in order to ensure the trainees are fully able to understand and participate in the course. Another option is to deliver the course in other languages

+ Encourage participants to bring some data with them to enable either a spatial or temporal analysis depending on the length of the time series available. A description of what types of data are suitable for this would be sent beforehand

Content of the course:

+ Broaden the scope of the course to include different diseases, especially those with different processes (for instance, water borne), and regions other than Africa

+ Make country-specific case studies that could be developed throughout the entire course, so that the trainees would be able to produce some maps and graphs for their country

+ Make the course more oriented toward decision-making rather than research

+ Run two statistics sessions concurrently depending on the level of statistics of the trainees

+ Set the learning goals for talks interactively with the organizers and the lecturers

Delivery of the course:

+ Involve the trainees more by building more on their knowledge and experiences (*e.g.,* begin the class by a presentation of their work, ask a couple of trainees to summarize the take-home messages that were taught the day before, *etc.*).

+ Further interdisciplinary group work in order to improve the learning process based on prior knowledge of the health and the climate communities.

+ Discuss the methodology detailed in different papers during class and include a questions and answers session with trainers regarding reading materials

+ Continue using free software for data management or analysis

+ Provide the participants with more guidelines on the completion of the reports and with examples of work done by previous cohorts of trainees

Scheduling of the course:

+ Increase the time allocated to hands-on exercises and to the exploration of web-based products using Data Library information

+ Increase the time allotted during the day to the reading and the mini-project

+ Increase the time allotted to interaction with the facilitators (*e.g.,* 1-2 days for free interactions)

+ Develop a shorter, more intensive, version of this course for busy professionals, with more intense focus on the data tools and less on general lectures.

Logistics:

+ Increase the variety of food.

+ Ensure that the trainees may be able to get to the hotel on their own in order to have meetings with the facilitators after the classes are over.

Participants

Trainees

Forgor Abudulai Adams | Navrongo Health Research Centre | Navrongo, Ghana

Forgor is currently a Clinical Research Fellow and Head of the Meningitis Project at the Navrongo Health Research Centre. His work has included using climate and epidemiological data to forecast meningitis outbreaks. He also currently works as Senior Medical Officer at the War Memorial Hospital in Navrongo. His education includes an MD from the State Medical Institute Vitebsk, Belarus, a Master of Public Health degree from the University of Ghana, a Diploma in Tropical Medicine and Hygiene from the University of London, and a PhD in Epidemiology from the University of Basel, Switzerland.

Yonas Asfaw | Ministry of Health | Addis Ababa, Ethiopia

Yonas is a Surveillance Officer in the Disease Prevention and Control Department in the Federal Ministry of Health in Ethiopia. He is directly involved in disease preventive and control activities. He also prepares disease specific appeals and proposals, analyzes national ISDR data, and investigates epidemics and implements control interventions, among other duties. Yonas is also the director of the MERIT-Ethiopia case study. He holds a Masters degree in Public Health from Addis Ababa University and Doctorate of Medicine from Jimma University.

Maron Fleury | Public Health Agency of Canada | Guelph, Ontario, Canada

Maron currently works as a biostatistician and an epidemiologist in the Environmental Issues Division of the Centre for Food-borne, Environment and Zoonotic Infectious Diseases at the Public Health Agency of Canada. As part of her duties, Maron plans and manages collaborative research activities with multiple stakeholders and international partners. Her research has focused on waterborne and food borne diseases. Maron is part of a new effort at the Public Health Agency of Canada studying how climate change will affect the health risks of vector- and waterborne diseases in Canada. She received her Masters of Science degree in Biostatistics from the University of Guelph, Ontario with a focus in epidemiology and statistics.

Mary Hayden | NCAR | Colorado Springs, Colorado, USA

Mary is a postdoctoral fellow and visiting scientist at NCAR's Institute for the Study of Society and Environment and a Guest Researcher with the Centers for Disease Control and Prevention. Her research interests are societal impacts and climate change, particularly climate and health related links, community participatory research, and social mobilization. Currently, Mary is working on projects related to dengue fever transmission – an environmental health pilot investigating the role of waste tires in the potential for dengue fever transmission at the Texas-

Mexico border, a study in San Juan, Puerto Rico focusing on anomalous dry season transmission of dengue fever, and a pilot in Guayaquil, Ecuador investigating environmental determinants of dengue transmission. Additionally, she is investigating patterns of societal risk and vulnerability to extreme heat. Hayden holds a BA in Islamic Studies from the University of Kiel, Germany and a BA from Metropolitan State College, Denver in German and Meteorology. She earned an MA in Geography (Climatology) at the University of Colorado, Boulder and completed her Ph.D. in Health and Behavioral Sciences at the University of Colorado, Denver.

Diriba Korecha Dadi | National Meteorological Agency of Ethiopia | Addis Ababa, Ethiopia

Diriba has served as Team Leader of the Weather Forecast and Early Warning Team at NMA since 2000. In this role, he leads research and operational efforts for forecasting of short, mid, and long-range climate and weather patterns. He is currently the National Focal Person for several WMO activities (Climate Information and Prediction Services, Pilot Project on World City Forecast, and Dynamical Climate Modeling, IGAD Climate Prediction and Application Center). Diriba is currently pursuing his PhD in Climate Variability and Prediction (Meteorology) with the University of Bergen in Norway. He holds a Bsc in Statistics from Addis Ababa University, a Post Graduate Diploma in Advanced General Meteorology from the India Meteorological Department, and a MA in Climate and Society from Columbia University.

Rachel Lowe | University of Exeter | London, UK

Rachel Lowe has been a PhD student at the University of Exeter since October 2007 and is based in the School of Engineering, Computing and Mathematics. Her current research focuses on assessing the viability of using seasonal climate forecasts to predict disease risk in Brazil, funded by the Leverhulme network project EUROBRISA. She is supervised by Professor David Stephenson, Met Office Chair in Statistical Analysis of Weather and Climate. Rachel graduated from the University of East Anglia with a First Class Honors BSc in Meteorology and Oceanography with a year in Europe. She spent one year at the University of Granada in Spain reading Environmental Science. In 2006-07 she completed an MSc with distinction in Geophysical Hazards at University College London where she received a Graduate Masters Award.

Lina Nerlander | Red Cross / Red Crescent Climate Centre | The Hague, The Netherlands

Lina is the health specialist at the RC/RC Climate Centre, working to address the effects of climate change and climate variability on health. This includes for example health emergencies related to disasters and changing patterns of infectious diseases. Lina did her medical training at Oxford University, worked a couple of years as a doctor in the UK and completed a Master's degree at the Harvard School of Public Health. She co-authored a forthcoming World Health Organization report on the links between climate change, water and health. Lina has experience of field research in Kenya and clinical work in Jordan, Egypt and South Africa. She also worked in Sri Lanka after the tsunami.

Cristina Recalde | INAMHI-CIIFEN-UNDP | Guayaquil, Ecuador

Cristina currently works with climatological numerical forecasts in the National Weather and Hydrological Service of Ecuador - Coast Agency (INAMHI). Among her other duties, she is responsible for the monthly Climatological Bulletin, a tool used to produce early alert warnings, risk management and risk maps for the government and other institutions. Before INAMHI, she worked for CIIFEN (International Research Center for El Niño Research). Her research interests include validation and verification of forecasts, generation of downscaling multi-parametric and multi-model ensembles and the application of Model Output Statistics for the Ecuadorian Coast.

Marie Clemence Rakotoarivony | Ministry of Health | Antananarivo, Madagascar

Marie currently works for Madagascar's National Malaria Control Program as Head of the Malaria Epidemic Surveillance unit. She is also currently working towards her Master of Public Health degree from the National Institute of Public Health and Community, Madagascar. She holds a State Doctor Degree from the University of Mahajanga. Marie has previously worked in the National Family Planning Program and as head of a primary health center.

James Sang | Division of Malaria Control, Department of Public Health | Nairobi, Kenya

Within the Division of Malaria Control, James is responsible for malaria epidemic preparedness and response planning and supervision. He is also the focal point officer in the division for connecting climate issues with malaria control. He is also the Chairperson of the Climate and Health Working Group of Kenya. He earned his Post Graduate Certificate in Health Service Management from Birmingham University in the UK, and more recently his Master of Public Health degree from Kenyatta University in Nairobi with a concentration in health services management and policy.

Ousmane Boubacar Touré | Malaria Research and Training Center | Bamako, Mali

Ousmane works as a data and network manager at the Malaria Research and Training Center (MRTC) /Department of Epidemiology and Parasitic Diseases at the University of Bamako in Mali. Since 2004, he has also served as Head of the Bioinformatics Unit. He earned his Masters of Science in Public Health in Biostatistics & Informatics at the Tulane University School of Public Health and Tropical Medicine in 2003. He has conducted research on the use of GIS for malaria information, informatics in genetics, and the interaction between climate and health. He and his colleagues at MRTC work to develop and test strategies to help control malaria and reduce the disease burden of the disease.

Daddi Jima Wayessa | Ministry of Health | Addis Ababa, Ethiopia

Daddi is currently Head of the Malaria and Other Vector-borne Diseases Prevention and Control Team in the Ministry of Health, where his responsibilities include coordination of the overall activities. He is also Chairman of the National Climate and Health Working Group. He also works as Coordinator in the National Onchocerciasis Control program. He has partnered with the World Health Organization and the African Program for Onchocerciasis (APOC) on several projects. Daddi earned his MD for Jimma University in Ethiopia and his Master of Public Health degree from the National University of Ireland.

Facilitators

Tony Barnston | Director, Forecasting Climate, Prediction, Outreach | IRI

Prior to arriving to the IRI at the end of June 2000, Barnston was an operational seasonal climate forecaster and developmental researcher in empirical prediction methodology at the Climate Prediction Center of NOAA for 17 years. He has authored atlases, reports and journal papers on weather and climate, the best known of which were on statistical diagnosis of large-scale circulation patterns and on empirical climate prediction. With his forecast staff, Barnston ensures the production and routinely scheduled issuance of a range of IRI forecast products, including monthly forecasts of sea surface temperatures (including an ENSO outlook) and global precipitation and temperature. His goals are improvement of the accuracy of IRI's real-time forecasts, streamlining and automating the forecast process, facilitating development and delivery of versions of the forecast tailored to the needs and requests of partners and the user community, and training and capacity building in probabilistic climate prediction and implications for decision making.

Mark Becker | Associate Director, Geospatial Applications Division | CIESIN

Mark Becker leads the Geospatial Applications Division at CIESIN, and is an adjunct faculty member at the Mailman School of Public Health. His primary interests are the development of GIS applications for public health programs, and improving urban and regional planning through geospatial technologies. At CIESIN he has partnered with numerous departments and programs at Columbia University to assist in the use of geospatial technologies: with the Columbia Center for Children's Environmental Health, looking at the effects of air pollution on children's health; with the Columbia Superfund Basic Research Program, developing GIS training programs in Bangladesh; and working with the Research Translation Core of the program to bring the findings and techniques of the project to a wider audience. He holds an M.A. in Geography from Hunter College of the City University of New York.

Michael Bell | Senior Staff Associate, Climate Monitoring and Dissemination | IRI

Michael Bell studied meteorology at the University of Oklahoma and graduated with bachelor's and master's degrees in 1994 and 2001, respectively. His master's work involved the study of the decadal and interannual variability of West African rainfall disturbance lines. He joined the IRI in 2001. His research interests include rainfall variability in West Africa, and, more generally, the contributions of weather variability to climate. Bell's responsibilities include contributing to the monthly publication of the IRI Climate Information Digest, support of the IRI Data Library and Map Room, and data acquisition and analysis in support of regional programs and projects.

Pietro Ceccato | Associate Research Scientist, Environmental Monitoring | IRI

Pietro Ceccato trained originally as an agronomist and soil science scientist. He spent two years in Central African Republic working with local communities to improve agricultural practices. He obtained a Master in Environmental Management using decision-support systems and worked as a research scientist at the Natural Resources Institute in United Kingdom. He developed remote sensing products to monitor active fires and vegetation status for assessing the risk of fire occurrence. He worked at the European Commission Joint Research Centre (Ispra, Italy) on the use of remote sensing to monitor vegetation status and used this work to obtain his PhD in Remote Sensing (2001, University of Greenwich, UK). Pietro then joined the UN Food and Agriculture Organization (Rome, Italy) to develop an early warning system for Desert Locust monitoring. He developed remote sensing products and Geographical Information Systems to be used operationally by the Ministries of Agriculture in 21 countries in Africa and Asia. Pietro joined the International Research Institute for Climate and Society in 2004. His current research activities include the development and integration of environmental remote sensing products into early warning systems for human health, pest management and fire risk.

Laurence Cibrelus | Staff Associate, Public Health | IRI

After finishing her medical training in infectious diseases and public health in France, in Spain and in Switzerland at the headquarters of the World Health Organization (WHO), Laurence Cibrelus furthered her commitment to international health and infectious diseases prevention and control by pursuing a Master of Public Health in the Department of Epidemiology and the Global Health Track of the Mailman School of Public Health, Columbia University. Laurence completed her master's practicum in Niger on the drivers for meningitis outbreaks. This project was conducted in collaboration with the International Research Institute for Climate and Society /Earth Institute (IRI) at Columbia University, the WHO and the CERMES (Centre de Recherche Médicale et Sanitaire, affiliated to the Pasteur Institute), within the Meningitis Environmental Risk Information Technologies (MERIT) initiative which supports meningitis prevention and control in the African Meningitis Belt.

Stephen Connor | Director, Environmental Monitoring Program & PAHO/WHO Collaborating Centre on Climate-sensitive Diseases | IRI

Stephen Connor joined the International Research Institute for Climate and Society at Columbia University, New York in May 2002. Previously he was based at the Liverpool School of Tropical Medicine and worked extensively in sub-Saharan Africa for the UK Medical Research Council and the UK Department for International Development's (DFID) Malaria Knowledge Programs. He has a background in Development Studies/ Natural Resource Economics, has specialized in the geography of infectious disease, and has a PhD from the Faculty of Medicine at Liverpool University. Stephen has worked closely with the World Health Organization in Geneva and WHO-AFRO's Inter-Country Programs on Malaria Control, providing technical support to Ministries of Health. He has been a frequent advisor to WHO's Roll Back Malaria Technical Resource Network on Epidemic Prevention and Control. Former Study Group Coordinator, Health Issues in Development, for the UK Development Studies Association. He is currently serving as a member of the World Meteorological Organization Task Force on Socio-Economic Applications of Weather, Climate and Water Services. He is the Director of the Pan-American Health Organization/World Health Organization Collaborating Centre on Early Warning Sytems for Malaria and other Climate-sensitive Diseases.

Rémi Cousin | Staff Associate, Data Library | IRI

Rémi Cousin received his degree from l'Ecole Nationale Supérieure des Mines de Nancy (equivalent to Master degree) in engineering with majors in geo-sciences, in 2005. After specializing in physical oceanography through internships in l'Institut de Recherche pour le Développement (IRD) and Mercator-Océan, Toulouse, France, and Universidad de Concepción in Chile, he worked for CLS (Collecte Localisation Satellite), a subsidiary of CNES, as a consultant at Mercator-Océan to develop user friendly tools to run and post-process Mercator ocean models dedicated to operational oceanography. Rémi then worked at the Jet Propulsion Laboratory (JPL), Pasadena, California, to develop a public outreach and education website on ocean salinity in the context of the co-developed NASA satellite mission Aquarius, and to conduct research to support the activities of the OurOcean group, focusing on regional ocean models. Since 2008, Rémi has been a member of IRI Data Library to develop new functionalities and enable climate information communication and dissemination to end users.

John del Corral | Senior Staff Associate, Database, GIS | IRI

John is interested in the role of computers and computational science in the multi-disciplinary areas of geophysical research. This includes high performance computing, graphical techniques, geographical information systems, database technology, and learning the basic science in the areas of research. John is currently in the Climate Monitoring and Dissemination Division at the IRI. He is actively involved in the establishment and maintenance of a mirror site of the IRI Data Library in Taiwan. He has also built a geographical gazetteer database for IRI institute-wide use. This database incorporates OpenGIS geometries for representing political and geographic objects. John also participates in the current and future design and content delivery of the IRI website. He received his computer science degree from the University of Colorado.

Peter Diggle | Professor of Statistics| Lancaster University School of Health and Medicine

Peter Diggle is Distinguished University Professor of Statistics in the School of Health and Medicine, Lancaster University and Adjunct Professor in the Department of Biostatistics, Johns Hopkins University School of Public Health. Peter's research interests are in the development of statistical methods for spatial and longitudinal data analysis, motivated by applications in the biomedical, health and environmental sciences. He has published 8 books and around 170 articles on these topics in the open literature. Peter is founding co-editor, with Prof Scott Zeger, of the journal "Biostatistics," now in its tenth year of publication. He is also a Trustee of the Biometrika Trust. Peter was awarded the Royal Statistical Society's Guy Medal in Silver in 1997 and is a former editor of the Society's Journal, Series B. He is also a Fellow of the American Statistical Association.

Dia-Eldin A. Elnaiem | Research Specialist | National Institutes of Health

Dia-Eldin is currently working in the Oak Ridge Associated Universities (ORAU) at the National Institute of Health (NIH), where he is conducting research on biology of phlebotomine sand flies and transmission and epidemiology of leishmaniasis. He spent fifteen years as a professor at the University of Khartoum in Sudan, where he taught courses on medical entomology, parasitology and basic zoology and conducted research on the epidemiology of leishmaniasis and malaria. He received his Ph.D. in Medical Entomology from the Liverpool School of Tropical Medicine.

Patricia Graves | Epidemiologist | Carter Center, Malaria Control Program

Dr. Graves joined The Carter Center in January 2007. As program epidemiologist, Dr. Graves provides scientific support to the Center's Malaria Control Program. An epidemiologist and entomologist, Dr. Graves has 25 years experience in applied research and project management in vector-borne disease epidemiology and control, including 11 years advising aid agencies and national governments in Asia, the Pacific, and Africa. She contributed key knowledge to malaria transmission dynamics during a large malaria entomological research project in Papua New Guinea, which she directed. Her recent significant contributions, particularly in Solomon Islands and Eritrea, include the use of evidence and information to assess and improve the effectiveness of control measures for malaria and filariasis, especially indoor residual spraying and impregnated nets. Dr. Graves received her Bachelor of Arts degree from Cambridge University, her doctorate in science from the London School of Hygiene and Tropical Medicine and her master's degree in public health from the University of Colorado Health Sciences Center.

Alessandra Giannini | Associate Research Scientist, Climate Dynamics | IRI

After completing a Physics degree from the University of Milan, Alessandra Giannini moved to New York and Columbia University in 1995 to pursue studies in tropical climate dynamics, with the double intent of learning more about the workings of the climate system, and, by focusing on tropical climate, of learning how to do science that would be of potential use to society. She has researched the dynamics of the impact of the El Niño-Southern Oscillation on tropical Atlantic variability, working on two regions particularly vulnerable to climate variability and change; the Brazilian Nordeste,

and the islands of the Caribbean. The focus of her research now is Sahel drought. A paper that she co-authored and was published in Science in 2003 conclusively attributed the persistence of drought in this region of Africa in the 1970s and 1980s to a warming of the global tropical oceans. She continues to work on climate science, specifically on issues related to African climate change, and to be extremely interested in the policy implications of scientific findings, and in the role of science and scientists in our global society.

Patrick Kinney | Associate Professor of Environmental Health Sciences
Columbia University, Mailman School of Public Health

Dr. Patrick Kinney's teaching and research address issues at the intersection of global environmental change, human health, and policy, with an emphasis on the public health impacts of climate change and air pollution. Dr. Kinney has carried out numerous studies examining the human health effects of air pollution, including studies of the effects of ozone and/or particulate matter on lung health and on daily mortality in large cities. More recently, he developed a new interdisciplinary research and teaching program at Columbia examining the potential impacts of climate change on human health. Dr. Kinney was the first to show that climate change could worsen urban smog problems in the U.S., with attendant adverse health impacts. He also has projected future health impacts related to heat waves in the NYC metropolitan area. In a new research initiative, Dr. Kinney is working with clinicians at Columbia University Medical Center and New York-Presbyterian Hospital to understand how past and future climate may affect pollen-related allergic airway diseases. Dr. Kinney earned his doctorate at the Harvard School of Public Health.

Kim Knowlton | Assistant Clinical Professor of Environmental Health Sciences
Columbia University, Mailman School of Public Health

Kim Knowlton is Senior Scientist on NRDC's Global Warming and Health Project. She works with the Health and Environment Program on communicating the health impacts of global warming, and also on advocating for public health strategies to prepare for and prevent these impacts. Her research has looked at heat- and ozone-related mortality and illnesses as well as possible connections between climate, pollen, allergies and asthma. She attended Cornell University and Hunter College/CUNY, and received a doctorate in public health from Columbia University, where she was a postdoctoral research scientist before joining NRDC, and where she is currently Assistant Clinical Professor in the Department of Environmental Health Sciences.

Bradfield Lyon | Research Scientist, Climate Diagnostics, Drought | IRI

Lyon received his Ph.D. in meteorology from MIT and joined the IRI in 1999. His research activities are focused on observational and modeling diagnostic studies of climate variability, primarily on time scales associated with seasonal to interannual variability but also including climate change. He is particularly interested in investigating causal mechanisms, regional manifestations, prediction, and impacts of drought. While active in climate diagnostic research, Lyon also serves as a liaison and coordinator for collaborative climate research studies in the Philippines and Vietnam. With a focus on observational studies of climate variations he regularly participates in monthly updates of "real time" climate variations around the globe including the status and evolution of ENSO, both within the IRI and with its partner institutions. He is involved in a number of IRI's climate risk management proj-

ects and contributes to training and capacity building activities conducted both at the IRI and in countries of IRI regional partners.

Gilma Mantilla | Senior Staff Associate, Public Health | IRI

Dr. Gilma Mantilla is a Senior Staff Associate at the International Research Institute for Climate and Society (IRI). Her scholarly work has been mainly on Public Health. She is a graduate of Columbia University (Climate and Society MA, 2008), Rosario University, Colombia (Epidemiology 1998), Javeriana University, Colombia (Master in Health Management, 1993) and Escuela Colombiana de Medicina (Physician Surgeon, 1988). Before joining IRI, she was a Colombia's Public Health Surveillance and Control Deputy Manager at the National Health Institute where she worked mainly to establish policies, plans, programs and projects in public health associated with the surveillance and control of infectious diseases; to redesign the National Infectious Diseases Surveillance System and to support operational research on issues like epidemics, outbreaks and disasters. In the IRI she is working on establish tools and protocols for creation, integration and dissemination of knowledge and information related with climate and public health

Simon Mason | Research Scientist, Forecasting, Prediction Research | IRI

Mason has been involved in seasonal climate forecasting research and operations since the early 1990s. He has published numerous papers on seasonal climate forecasting and verification, climate change, and southern African climate variability. He has extensive experience in the production of seasonal climate forecasts in contexts such as the Regional Climate Outlook Forums, and works closely with the World Meteorological Organization (WMO) to promote the definition and adoption of forecasting and verification standards through engagement in the relevant WMO Expert Teams and through the WMO CLIPS Capacity Building Workshops. Mason's primary areas of research include development of methods for diagnosing the quality of forecasts ("forecast verification"), and for recalibrating ensemble predictions. As part of the IRI's outreach and collaboration with other partners, Mason has been heavily involved in capacity building activities, including leading the development and support of the Climate Predictability Tool (CPT).

Stephen Morse | Professor of Clinical Epidemiology/Founding Director & Senior Res. Scientist, Center for Public Health Preparedness | Columbia University Mailman School of Public Health

Dr. Stephen Morse's interests focus on epidemiology of infectious diseases, and improving disease early warning systems. In 2000, he returned to Columbia after 4 years in government as program manager for Biodefense at the Defense Advanced Research Projects Agency (DARPA), Department of Defense, where he co-directed the Pathogen Countermeasures program and subsequently directed the Advanced Diagnostics program. His book, Emerging Viruses (Oxford University Press) was selected by "American Scientist" for its list of "100 Top Science Books of the 20th Century". He currently serves on the Steering Committee of the Institute of Medicine's Forum on Microbial Threats, and the National Academy of Sciences' Committee on Future Biowarfare Threats; and has served as an adviser to numerous government and international organizations. He was the founding chair of ProMED (the nonprofit international Program to Monitor Emerging Diseases) and was one of the originators of ProMED-mail, an international network inaugurated by ProMED in 1994 for outbreak reporting and disease monitoring using the Internet.

Bernard Nahlen | Deputy Director | U.S. President's Malaria Initiative

Bernard Nahlen is the PMI's deputy coordinator tasked with providing guidance on technical issues, program interventions, assisting in-country programs, program facilitation, policy coordination, coherence and implementation. He works in consonance with different government agencies and funding recipients of malaria prevention and treatment. Nahlen graduated from medical school after completing undergraduate studies at the University of Notre Dame. In 1986, he completed his residency in Family Medicine at the University of California, San Francisco, before joining the US Centers for Disease Control and Prevention as an Epidemic Intelligence Service Officer in its Malaria branch. In 1989, he finished a second residency in preventive medicine and later served as Deputy Director of the Los Angeles County AIDS Epidemiology Program. He worked extensively on malaria-related campaigns as the World Health Organization's senior technical advisor since 2000, before taking on his role as PMI's deputy coordinator in May 2007.

Judy Omumbo | Associate Research Scientist, Epidemiology, Disease Risk Modeling | IRI

Dr. Judy Omumbo is an Associate Research Scientist at the International Research Institute for Climate and Society (IRI). Her scholarly work has been mainly on GIS-based mapping of malaria in East Africa using climate data and empirical malariometric data. Her current work is on developing risk maps of climate-sensitive diseases in Africa including Rift Valley fever, meningitis and malaria. She is a graduate of Oxford University (PhD, 2004), Hebrew University, Jerusalem (Master in Public Health 1993) and the University of Nairobi (Bachelor of Dental Surgery 1987).

Jennie Rice | Independent Consultant | Decision Sciences and Economics

Jennie Rice has twenty years of strategic planning consulting experience focusing on decisions complicated by risk, uncertainty, and multiple objectives. She has an M.S. in Management Science and Engineering from Stanford University and is an expert in the application of decision analysis methods. She has developed decision support frameworks and risk management tools for public health decisions, natural resource management, waste management, sustainability, and climate change adaptation. Her work experience includes ten years with Decision Focus Incorporated, a strategic planning consulting firm, developing decision analytic risk management tools, three years as a Senior Economist and Managing Director at ECO Northwest focusing on natural resource preservation, sustainability planning, and climate change policy, and seven years as an independent consultant applying her skills to climate change and natural resource decisions, including teaching clients the theory and practice of decision analysis.

Andy Robertson | Research Scientist, Predictability, Downscaling | IRI

After graduating from the University of Leeds, U.K., with a B.Sc. in mathematics and geography, Robertson received an M.Sc. from Imperial College, London in atmospheric physics and dynamics, and a Ph.D. in atmospheric dynamics from the University of Reading in 1984. Robertson's research interests include regional climate variability, predictability and change, probabilistic daily rainfall modeling, predictability of weather-within-climate, climate downscaling methodologies, and tailoring of climate information for use in conjunction with sectoral models for climate risk management.

Robertson currently leads the downscaling division within IRI's Climate Program, and is the climate nodal person for IRI's Asia-Pacific regional program. His work is focused on bringing climate information into regional projects that seek to demonstrate the value of "climate risk management," through targeted research, tool development, and training/outreach.

Daniel Ruiz Carrascal | Graduate Research Assistant, PhD student | IRI

Daniel is participating in the development of one of the components of the National Integrated Dengue and Malaria Surveillance and Control System, an initiative that has been proposed to mitigate the possible adverse effects of climate change on human health in his home country of Colombia. The Integrated Surveillance and Control System involves the creation of a Malaria Early Warning System. The thought is to use several mathematical models to simulate the complex dynamics of dengue and malaria transmission in endemic-prone areas, to estimate the time of occurrence of unexpected outbreaks, and to evaluate the possible magnitude of the concomitant sharp rises in the incidence of these tropical diseases. He is also interested in the potential impacts of climate change on high mountain ecosystems. He is a graduate of Columbia University (M.A., Climate and Society, 2007) and the National University of Colombia (M.S., Water Resources, 2002, and B.S., Civil Engineering, 1997.)

Megan Sheremata | Staff Associate, Pedagogical Planning, Educational Technology | IRI

Megan joined IRI in the Spring of 2008, after working with the New York State Department of Environmental Conservation, where she coordinated the Lands and Forests Downstate Education Program from 2003 to 2007, with an emphasis on urban climate and invasive species early detection programs. She currently attends Columbia University's Teachers College, where she is completing graduate work in science education. At the IRI, Megan's work focuses on educational technology, coordination of the development of a climate risk management knowledge system, and coordination of educational training activities.

Knut Staring | University of Oslo

Knut Staring holds an MBA and an MA in Economics, and worked on systems development and project management at TietoEnator, before returning to the University of Oslo to do a PhD in Information Systems with a focus on the public health sector in developing countries. He is currently in the Information, Evidence and Research Cluster at the World Health Organization in Geneva, coordinating the development of an interoperable suite of tools for Country Health System Strengthening.

Madeleine Thomson | Senior Research Scientist, Climate Information for Public Health | IRI

Madeleine Thomson is a Senior Research Scientist at the IRI where she chairs the Africa Regional Program, directs Impacts Research and supports the IRI-PAHO-WHO collaborating centre activities. She trained originally as a field entomologist and has spent much of her career engaged in operational research in support of large-scale health interventions, mostly in Africa. Her research focuses on the development of new tools for improving climate-sensitive health interventions (*e.g.,* risk mapping

and early warning systems for malaria, onchocerciasis, kala azar, *etc*). This work has expanded into airborne infections and she is currently developing a substantive program for meningitis environmental risk assessment in anticipation of the new conjugate A vaccine. In recent years she has become increasingly interested in improving institutional and human capacity for incorporating climate information into health planning. To help achieve the latter she is working to create a 'health and climate' disciplinary interface.

Sylwia Trzaska | Associate Research Scientist, Climate Variability, Atlantic | IRI

Sylwia has been with the IRI since 2002. Her research interests include climate variability in the tropical Atlantic on regional scale including Southern America and Africa with special focus on tropical areas, including the Nordeste, Sahel and Southern Africa. She is also interested in observed, reanalyzed and model data analysis on seasonal to decadal time-scales model sensitivity studies to boundary condition modifications, as well as decadal modifications of the major teleconnections in the tropical Atlantic region. She received her doctoral degree from Université de Bourgogne.

Pai-Yei Whung | Chief Scientist, Office of the Science Advisor
U.S. Environmental Protection Agency

As Chief Scientist, Dr. Pai-Yei Whung shares fully with the EPA Science Advisor in planning and developing cross-Agency scientific efforts. This includes providing program management and technical support to the Science Advisor by independent scientific opinions and through leading OSA staff and its multiple science-policy functions. Dr. Whung has a doctoral degree in climate change, marine and atmospheric chemistry, a masters degree in oceanography and marine chemistry, and a bachelors degree in oceanography and geology. Prior to joining EPA, Dr. Whung worked in the Agricultural Research Service at U.S. Department of Agriculture and for at the National Oceanic and Atmospheric Administration where she had a detail to the World Meteorological Organization. Through these positions, Dr. Whung has cultivated a broad perspective on science and technology in the federal government and our partners.

Stephen Zebiak | Director General | Modeling, Prediction, Dynamics | IRI

Dr. Zebiak, IRI Director-General, has worked in the area of ocean-atmosphere interaction and climate variability since completing his Ph.D. at the Massachusetts Institute of Technology in 1984. He and Dr. Mark Cane were the authors of the first dynamical model used to predict El Niño successfully. He has served on numerous advisory committees, including those for the US TOGA Program, the Atlantic Climate Change Program, the Pan American Climate Studies Program, the AMS Committee on Climate Variations, and the Center for the Study of Science and Religion (CSSR). Dr. Zebiak coordinates IRI coupled model efforts, data assimilation/forecast system development, predictability, and climate dynamics research for seasonal-to-interannual time scales. He also helps to foster active collaboration between IRI and other national and international centers engaged in climate modeling and prediction.

Support Staff

Ann Binder| Manager, Staff and Operations | IRI

Binder prepares budgets and sub-contracts in support of IRI and its projects. She assembles and consolidates all income streams and affiliated program budgets into a coherent single financial plan to serve the IRI, its funding agencies, and collaborative business resources. She coordinates human resources for the IRI and assembles information, documents, and hiring plans in coordination with appropriate divisions of Lamont-Doherty Earth Observatory and Columbia. She also works with governmental organizations that facilitate visitor and post-doctoral programs.

Alice Capozzi | Administrative Coordinator | Columbia University, Mailman School of Public Health
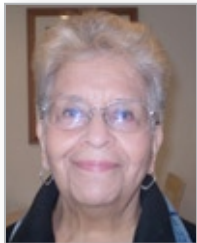
Alice has been with Columbia University for 32 years. She has assisted Dr. Kinney for the past 10 years, utilizing her wide range of skills while working on various projects. Most of her work has been at the Administrative unit of the Heilbrunn Department of Population and Family Health.

John-Michael Cross | Climate and Society Graduate Student | Columbia University

John-Michael has worked at IRI for the past year as part of a work-study program. In that time, he has been enrolled in Columbia's M.A. Program in Climate and Society. His work with IRI has included creation and management of a database of climate and health professionals, preparation of the Climate Information for Public Health newsletter, and helped prepare materials for the Summer Institute. John-Michael is currently interning for the summer in Washington, DC with the Climate Institute and Climate Lab. He earned his B.A. in Public Health from Johns Hopkins University, and before attending Columbia he was a high school math and science teacher through the Teach for America program.

Michael Dervin | System Analyst, Systems Administration | IRI

Michael has been working at the IRI for about two years. He has been a member of the Computing Support team at the IRI and he is responsible for many of the computer operational services at the IRI. He also provides guidance for data storage systems and software tools.

Francesco Fiondella | Communications Officer, Office of the Director-General | IRI

Before coming to the IRI, Francesco worked as an editor in the Wall Street Journal's news graphics department and moonlighted as a science/health reporter for the paper as well. He has also freelanced for a variety of publications, including Discover, The Scientist and Reuters Health. Francesco earned his undergraduate degree in environmental science at Brown University, and his masters degrees in earth and environmental science and in journalism from Columbia. As communications officer, Francesco promotes the IRI's innovative work primarily by writing features for the Institute's home page and engaging with journalists, partner organizations and members of the general public. He designs and edits institutional reports, presentations, and flyers. He also maintains the Institute's media page and news-related email list.

Thea Murillo | Administrative Assistant | IRI

Thea has been with the IRI since July 2007. She provides daily administrative support for the IRI staff. This work includes events coordination, arranging travel accommodations, and the handling of various projects. Her degree is in early childhood education.

Leo Ostwald | Computing Systems Manager, Systems Administration | IRI

Leo Ostwald has held systems engineering/administration positions for various organizations, including Bank of America, Naval Atlantic Meteorology and Oceanography Center, and Computer Sciences Corporation. He holds Master's degrees in Physical Oceanography and Engineering Acoustics from the Naval Postgraduate School. Leo administers and ensures maximum ongoing system performance and availability for the IRI's full-time operational activities. He has lead responsibility for IRI systems, including high performance computing platforms, mass storage facilities, UNIX/LINUX workstations, PC's, remote site communications and scientific visualization.

Barbara Platzer | Africa Regional Program Coordinator | IRI

Born in Nairobi, a UN kid, Barbara has a long standing interest in Africa. Prior to joining the IRI, Barbara served as Assistant Director for the Risk Analysis Group of the Columbia Business School and has been working at Columbia University since 2004. She holds a Masters of International Affairs from the University of Chicago and a Bachelor of Arts in International Relations from Brown University. Barbara serves as coordinator of the Africa Regional Program at the IRI, contributing to the operational and strategic objectives of the Africa Regional Program, its Committee members and more broadly the institute. Supporting international collaborations and partnerships, reporting on program activities, developing grant proposals and helping to manage project timelines, contracts and budgets, Barbara serves as a point of contact for Africa regional activities within the IRI, to Earth Institute and Columbia University officials, as well as to external partners.

## Jason Rodriguez | Communications/Graphic Design | IRI

Jason Rodriguez is a graphic designer specializing in web layout, visual design, HTML, CSS, and traditional print design. His past experience includes his work as a Production Assistant for JTP Creative in NYC organizing photo shoots and creating casting websites. He also was owner director of Residue Gallery, a contemporary arts space in Jersey City, NJ. Jason earned his BA in Computer Arts and Design from Oneonta University (SUNY). Jason is responsible for assisting communications officer, Francesco Fiondella, with layout, design, and production on a variety of print and web features promoting the IRI's innovative work.

Jeffery Turmelle | Senior System Analyst/Network Programmer/Systems Administration | IRI
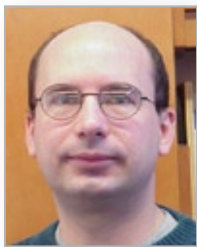
Jeffrey Turmelle received his B.S. degree in Computer Science from the University of Lowell, MA in 1987 and a Masters of Technology Management from Columbia University in 2007. Jeffrey worked in graphics research for the University of Lowell's Graphics Research Laboratory before getting involved in Image Processing at a small startup: Paragon Imaging. He then became involved in large scale development working on medical applications for Sony Electronics. In 1996 he joined Lamont-Doherty Earth Observatory to become the Data Reduction Manager on the R/V Maurice Ewing (Columbia University's Research Vessel) where he managed the computer systems and data processing on board and at the Marine Office. Since 2001, Jeffrey has been a member of the Computing Support team at the IRI and is responsible for many of the computer services at the IRI, including email, directory services and web services.

Cathy Vaughan | Project Coordinator | IRI

Cathy Vaughan is a project coordinator at the IRI. She holds master's degrees in International Relations (Yale 2007) and Climate and Society (Columbia 2008). Cathy has worked for organizations including the Global Roundtable on Climate Change, the Mission of Dominica to the United Nations, and the Austin Chronicle; from 2003 until 2005, Cathy served with the US Peace Corps in Zambia. She is the author of Climate Change: A Reference Handbook, published earlier this year.

Sandy Vitelli | Administrative Assistant, Administrative Support | IRI
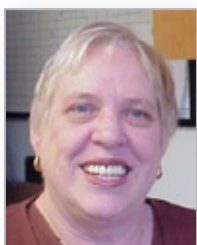
Sandy provides day-to-day administrative support for the organization. She handles special projects with staff and visitors, organizing professional conferences and meetings. She coordinates events, arranges travel accommodations, manages reimbursements related to expenses and the dissemination of reports. She also ensures overall effectiveness and efficiency, while interacting with diversified groups within and outside the IRI.

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Appendix

Appendix 1:SI09 Promotional flyer

Appendix 2: Invitation to the Panel Discussion on Meningitis and Climate

The Mailman School of Public Health, in partnership with the International Research Institute for Climate and Society (IRI) and the Center for International Earth Science Information Network (CIESIN), is pleased to invite you to the panel discussion:

**'Epidemics and Environment –
the Meningitis Challenge in Africa'**

**Mailman School of Public Health,
The Allan Rosenfield Building
Hess Commons
June 3rd, 4-5.30pm followed by Reception**

Meningococcal meningitis is one of the most feared epidemic diseases in Africa because of its rapid onset, high fatality rates and long-term disabilities, such as brain-damage and deafness, affecting many survivors. In 1996-1997 devastating epidemics in the Sahel affected more than 250,000 people with over 25,000 fatalities.

Current control strategies based on reactive vaccination have not been fully satisfactory in reducing the burden of the disease within the 'Meningitis Belt' – an area in Sub-Saharan Africa stretching from Senegal in the west to Ethiopia in the east.

New efforts are underway to provide long-term protection to at-risk populations of around 350 million, establishing the means to avoid devastating regional epidemics involving hundreds of thousands of cases and tens of thousands of deaths. This will be possible in large part due to the work of the Meningitis Vaccine Project and the development of an effective long-lasting conjugate vaccine which targets the dominant strain (Group A) of the bacteria which causes meningococcal meningitis and is associated with epidemics.

A further development is that of a multi-disciplinary effort to integrate climate and environmental information into current and future control strategies under the umbrella of the MERIT (Meningitis Environmental Risk Information Technologies) project.

AGENDA

Chair – Dr. Patrick Kinney, Professor of Environmental Health Sciences and Director of the Columbia Climate and Health Program at the Mailman School of Public Health, Columbia University

4:00 - 4:10 pm: Welcome from the Mailman School of Public Health - Dean Linda Fried

4:10 - 4:40 pm: Presentations:

1. **Meningococcal Vaccine for Africa: Surveillance and Opportunities for Prevention -** Dr. Tom Clark, Meningitis and Vaccine Preventable Diseases Branch, Center for Diseases Control and Prevention (CDC), Atlanta

2. **Creating a 'Community of Practice' for health-climate collaboration: The MERIT project -** Dr Eric Bertherat, Epidemic and Pandemic Alert and Response, World Health Organization (WHO), Geneva

3. **What role for Climate/environmental information? –** Dr. Madeleine Thomson, Chair, Africa Regional Program, IRI, Columbia University

4:40 – 5:00 pm: Panel Discussion

1. **Climate and meningitis: from physiology to invasive disease -** Dr. Patrick Kinney, Mailman School of Public Health, Columbia University

2. **Climate science contributions -** Dr. Sylwia Trzaska, Climate Scientist, IRI, Columbia University

3. **The country perspective -** Dr. Yonas Asfaw, Surveillance Officer, Disease Prevention and Control Department, Federal Ministry of Health, Ethiopia and Coordinator of MERIT in Ethiopia.

5:00 – 5:30 pm: Open Discussion

5:30 – 7:00 pm: Reception

This event is integrated to the Summer Institute 2009 course on 'Climate Information for Public Health', which offers public health decision makers and their partners the opportunity to learn practical methods for integrating climate knowledge and information into decision making processes.

Please, RSVP on-line at:
http://www.surveymonkey.com/s.aspx?sm=7AUAgpY3pP2s0y_2fGtxsxpA_3d_3d

We look forward to seeing you on June 3rd,
With best regards,

The organizers

Appendix 3: List and Description of the Sponsors

Google.org In 2004, when Google founders Larry Page and Sergey Brin wrote to prospective shareholders about their vision for the company, they outlined a commitment to contribute significant resources, including 1% of Google's equity and profits in some form, as well as employee time, to address some of the world's most urgent problems. That commitment became Google.org. Google.org is an integral part of Google Inc., and works closely with a broad range of "Googlers" on projects that make the most of Google's strengths in technology and information; examples of this approach include Flu Trends, RechargeIT, Clean Energy 2030, and PowerMeter.

Public Health Agency of Canada PHAC's primary goal is to strengthen Canada's capacity to protect and improve the health of Canadians and to help reduce pressures on the health-care system.

Tulane University Founded in 1834, Tulane is one of the most highly regarded and selective independent research universities in the United States. A member of the prestigious Association of American Universities, we take pride in being a part of this select group of 62 universities with "pre-eminent programs of graduate and professional education and scholarly research." Our schools and colleges offer undergraduate, graduate and professional degrees in the liberal arts, science and engineering, architecture, business, law, social work, medicine and public health and tropical medicine.

The University Corporation for Atmospheric Research promotes partnership in a collaborative community dedicated to understanding the atmosphere—the air around us—and the interconnected processes that make up the Earth system, from the ocean floor to the Sun's core.

The World Meteorological Organization (WMO) is a specialized agency of the United Nations. It is the UN system's authoritative voice on the state and behavior of the Earth's atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources.

The Climate Centre supports the Red Cross and Red Crescent Movement and its partners in reducing the impacts of climate change and extreme weather events on vulnerable people. The Climate Centre is based in the Netherlands but serves the whole Red Cross / Red Crescent Movement, in particular in developing countries. There is a close co-operation with the secretariat of the International Federation of Red Cross and Red Crescent Societies in Geneva' (from the Red Cross/ Red Crescent Climate Centre Web-page).

The Health and Climate Foundation's mission is to bridge the health and climate communities in order to catalyze new opportunities to reduce the impact of climate sensitive diseases. The organization focuses on practical outcomes and it achieves its mission through leveraging public and private partnerships, facilitating dialogue and building capacity in stakeholder communities to deliver solutions on the ground.

The **Met Office Hadley Centre** is the UK's foremost climate change research centre. We produce world-class guidance on the science of climate change and provide a focus in the UK for the scientific issues associated with climate change.

Centro de Modelado Cientifico - La consolidación de un centro vinculado a las necesidades científicas y tecnológicas de los sectores académicos, social, industrial y de servicios del país es una necesidad para disminuir los niveles de dependencia tecnológica y a su vez generar soluciones endógenas, que conllevan a la resolución de problemas regionales y nacionales que nos mantienen subordinados a los centros de conocimiento mundial. De esta manera, actualmente el C.M.C pretende enfocar sus esfuerzos al estudio primario de las siguientes áreas: Ciencias computacionales, ciencias de la tierra, ciencias urbanas, ciencias del espacio, nanociencia, ciencias de la vida.

Please answer the following questions and return this questionnaire to the registration desk. All responses will be kept confidential.

Participant Information

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

Years in current profession:

Sector: _____
Climate: _____
Public Health: _____
Other: _____

1. Please tell us about your expectations for this course. What do you hope to learn about climate information and public health?

2. Do you currently use climate information in your work? (Circle one)

Yes/No
If yes, please describe how:

3. Please rank the statements below (1 = highest level of interest; 4 = lowest level of interest)

Rank area of Interest

_____I am interested in acquiring skills that will help apply the use climate information to decision-making

_____I am interested in expanding my professional network with participants and organizers of the course

_____I am interested in learning more about the IRI and/or meeting IRI research staff

_____Other (please specify) _____

4. How would you rate your own climate knowledge?

(low climate knowledge)   1   2   3   4   5   (high climate knowledge)

5. What is your primary source of climate knowledge?

a. university coursework
b. scholarly research
c. Workshops/trainings
d. personal interest/reading
e. other: (please specify):_____

Prior Knowledge

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.

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, ailability 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:

Appendix 5: Final Questionnaire to the Trainees (Includes a Daily, Weekly and Overall Course Evaluation)

Thank you for participating in IRI's Summer Institute: Climate Information for Public Health, 2009. Your input regarding this course will greatly improve future planning and course improvements. Please let us know your perceptions about the course content, design, delivery, staring with today's activities. You responses will remain anonymous. We greatly appreciate your time and input.

1. Please select your major area of professional activity:

   Climate / Public Health

Daily Evaluation - Lectures

Please answer the following questions about today's lectures.

2. The lecture speakers were clear and easy to understand

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

3. Today's lectures challenged me to think in new ways

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

4. The lectures fulfilled my expectations

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

5. The scheduling and sequence of the lectures made sense

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

6. The resources, references and other materials were appropriate and helped me understand the content
   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

7. The visual aids used in the lecture were appropriate and helpful
   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

8. Please provide any additional comments today's lectures

Presentations of Short Reports

   Please comments on today's exercise in presenting of the short reports.

9. Preparing the short report help me to deepen my understanding of the course content

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

10. Listening to the reports of my colleagues helped me to deepen my understanding of the course content

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

11. The exercise challenged me to think in new ways

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

12. I would recommend having this exercise in the future

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

13. Please provide us with any additional comments on the short reports

Week In Review
Now, please look back on the week and respond to the questions below.

14. The day's sessions accomplished their stated objectives

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Mon					
Tue					
Wed					
Thr					
Fri					

15. I found the content of the day's lectures and other activities (i.e. practical sessions, short report preparation, etc...) relevant

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Mon					
Tue					
Wed					
Thr					
Fri					

16. The day's lectures and other activities (i.e. practical sessions, short report preparation, etc...) challenged me to think in new ways

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Mon					
Tue					
Wed					
Thr					
Fri					

17. I expect to incorporate methods learned today in my ongoing work (please comment on how in the field below)

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Mon					
Tue					
Wed					
Thr					
Fri					

18. Please rate the overall effectiveness of the following over the past week:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Mon					
Tue					
Wed					
Thr					
Fri					

Comments:

Overall Course Evaluation: Objectives
Now, please share with us your thought on the course overall.

19. The objectives of the course were stated clearly

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

20. The objectives of the course matched my expectations of the course

Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

21. My expectations of the course were met or exceeded (please explain your answer below)

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree
   Please explain your answer:

Overall Course Evaluation: Course Content

22. The content of the course fulfilled my expectations

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

23. The course content covered an appropriate level of depth

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

24. The content was delivered in way that was clear and easy to understand

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

25. The content was coherent with the objectives of the course

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

26. The course content was engaging

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

27. There was coherence between course lectures and the course objectives

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

28. There was coherence between lunchtime seminars and the course objectives

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

29. There was coherence between practical sessions and the course objectives

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

30. There was coherence between assigned work (i.e. short report) and the course objectives

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

31. What topics of the course were most instructive to you? What did you learn that was most valuable?

Overall Course Evaluation: Global Transferability of Course Content

32. Was the content of the course relevant to you geographical region and organization?
(Please provide details about what or was not relevant.)

33. What part of the course was the MOST relevant to your work?

34. What part of the course was the LEAST relevant to your work?

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

36. Keeping in mind the diverse interests among the course participants, what additional course content would recommend be developed in the future?

37. Do you think this course could be reproduced for your organization?

Overall Evaluation: Course Design

38. The course was easy to navigate

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

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

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

40. The course design helped to reinforce my understanding of the content

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

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

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

42. There was enough time and opportunity to engage in practical, hands-on work

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

43. Please provide us with any other comments you have on the course design

Overall Course Evaluation: Course Delivery

44. Have you taken training courses like this before?

       Yes/ No
       If yes, how does this course compare?

45. All the activities began on time

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

46. Course materials (i.e. readings) were appropriate and helped me to learn the course content

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

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

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

48. Course facilitators were available to answer the questions I had about the course content

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

49. IRI researchers and staff were available for networking and discussion

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

50. IRI staff was helpful in addressing my questions regarding travel, accommodations, or other personal matters

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

51. I enjoyed to hotel accommodations

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

52. I enjoyed the food

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

53. I enjoyed the special events/dinners

   Strongly agree / Agree / Neither Agree nor Disagree / Disagree / Strongly Disagree

54. Please provide us with any other comments you have on the course delivery. Please provide any other comments you may have on today's activities, or the overall course.

55. Did you experience any significant problems this week? For example, was language a problem? Or were the materials too technical or challenging? Not challenging enough? Please describe below.

   Yes / No
   Comments:

56. Thank you for your responses, and for your participation in IRI's Summer Institute 2009. If you have any other comments on the course lectures, practical sessions, public talks, logistics, please provide them below.

Appendix 6: Questionnaire to the Organizers

Thank you so very much for organizing the 'Summer Institute 2009' and contributing to its success. Please take the time to anonymously share your experience with us by answering the following questions. The entire survey should not last more than 15 minutes. Your input can truly make a difference. We thank you very much for your time.

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

	1	2	3	4	5	N/A
Participant selection						
Content of the curriculum						
Course scheduling						
Interaction of the planning committee with the lecturers and/or support team						
Overall coordination						
Technical support						

Explain:

1. Do you feel that your lecture(s)/practical session(s)/talk matched the objectives of the SI? Please, explain below.

    Yes / No
    Explain:

2. Do you think that your lecture(s)/practical session(s)/talk addressed the expectations of the students? Please, explain below.

    Yes / No
    Explain:

3. Some participants particularly liked the lectures and/or exercises related to the Map Room, the K-means and cluster analysis and basic training in climate sciences. On your side, which topics do you think the Summer Institute should focus on?

4. Would you be willing to revise the course curriculum and set the learning goals for the lecturers? Please, explain below.

5. Please, identify the strengths of the Summer Institute.

6. In your opinion, which areas need to be improved and which gaps need to be filled. Please, detail (e.g. logistics, design of the curriculum, objectives, choice of participants, ability to improve field decision-making).

7. How would you describe your involvement in the Summer Institute? Please, explain below.

    a. Moderate
    b. Moderate - And you expect it to remain as such next year
    c. important
    d. Important - And you expect it to remain as such next year
    e. Very Important
    f. Very important - And you expect it to remain as such next year

8. How would you rate the work load associated with the preparation of the Summer Institute (i.e. before it started)?

    Light / Regular / Heavy / Enormous

9. How would you rate the work load associated with the delivery of the Summer Institute (i.e. during the SI)?

    Light / Regular / Heavy / Enormous

10. Did the Summer Institute provide you with new research project insights or opportunities for collaboration? Please, explain below.

    Yes / No
    Explain:

11. Did the Summer Institute and the interaction with the participants and/or other lecturers challenge you to think in new ways? Please, explain.

    Yes / No
    Explain:

12. How would you rate the overall of the Summer Institute 2009? Please, provide with any comments and/or suggestions that you think would be useful to better prepare and implement the Summer Institute next year.

Thank you so very much for participating in the 'Summer Institute 2009' and contributing to its success. Please take the time to anonymously share your experience with us by answering the following questions. The entire survey should not last more than 15 minutes. Your input can truly make a difference. We thank you very much for your time.

1. Were you responsible for: (check as much boxes as appropriate)

A core lecture / A practical session / A lunch seminar

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

	1	2	3	4	5	N/A
Participant selection						
Content of the curriculum						
Course scheduling						
Guidelines from the planning committee for preparing thelecture(s)/practical session(s)/talk						
Overall coordination						
Technical support						

Explain:

3. Do you feel that your lecture(s)/practical session(s)/talk matched the objectives of the SI? Please, explain below.

Yes / No
Explain:

4. Do you think that your lecture(s)/practical session(s)/talk addressed the expectations of the students? Please, explain below.

Yes / No
Explain:

5. For your lecture(s)/practical session(s)/talk, you were asked to provide with learning goals. Would have you preferred that the organizers set the learning goals for you? Please, explain below.

Yes / No
Explain:

6. Some participants asked for background documents to be sent in advance. Would you be willing to prepare and send such material two months in advance? Please, explain below.

    Yes / No
    Explain:

7. How would you rate the work load associated with the preparation of the Summer Institute (i.e. before it started)?

    Light / Regular / Heavy / Enormous

8. How would you rate the work load associated with the delivery of the Summer Institute (i.e. during the SI)?

    Light / Regular / Heavy / Enormous

9. Did the Summer Institute provide you with new research project insights or opportunities for collaboration? Please, explain below.

    Yes / No
    Explain:

10. Did the Summer Institute and the interaction with the participants and/or other lecturers challenge you to think in new ways? Please, explain.

    Yes / No
    Explain:

11. How would you rate the overall of the Summer Institute 2009? Please, provide with any comments and/or suggestions that you think would be useful to better prepare and implement the Summer Institute next year.

8: Questionnaire to the Support Team

Thank you so very much for participating in the 'Summer Institute 2009' and contributing to its success. Please take the time to anonymously share your experience with us by answering the following questions. The entire survey should not last more than 10 minutes. Your input can truly make a difference. Thank you very much for your time.

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

	1	2	3	4	5	N/A
Guidelines from the planning committee for preparing your support						
Support from the planning committee before and during the delivery of the Summer Institute						
Overall coordination						

Explain:

2. How would you rate the work load associated with the preparation of the Summer Institute (i.e. before it started)?

Light / Regular / Heavy / Enormous

3. How would you rate the work load associated with the delivery of the Summer Institute (i.e. during the SI)?

Light / Regular / Heavy / Enormous

4. How would you rate the overall of the Summer Institute 2009? Please, provide with any comments and/or suggestions that you think would be useful to better prepare and implement the Summer Institute next year.

The IRI's mission is to enhance society's capability to understand, anticipate and manage the impacts of seasonal climate fluctuations 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.

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