Prediction, Prevention, and Preparedness: Using Climate Information for Public Health Policy and Decision Support

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“Whoever would study medicine aright must learn of the following subjects:

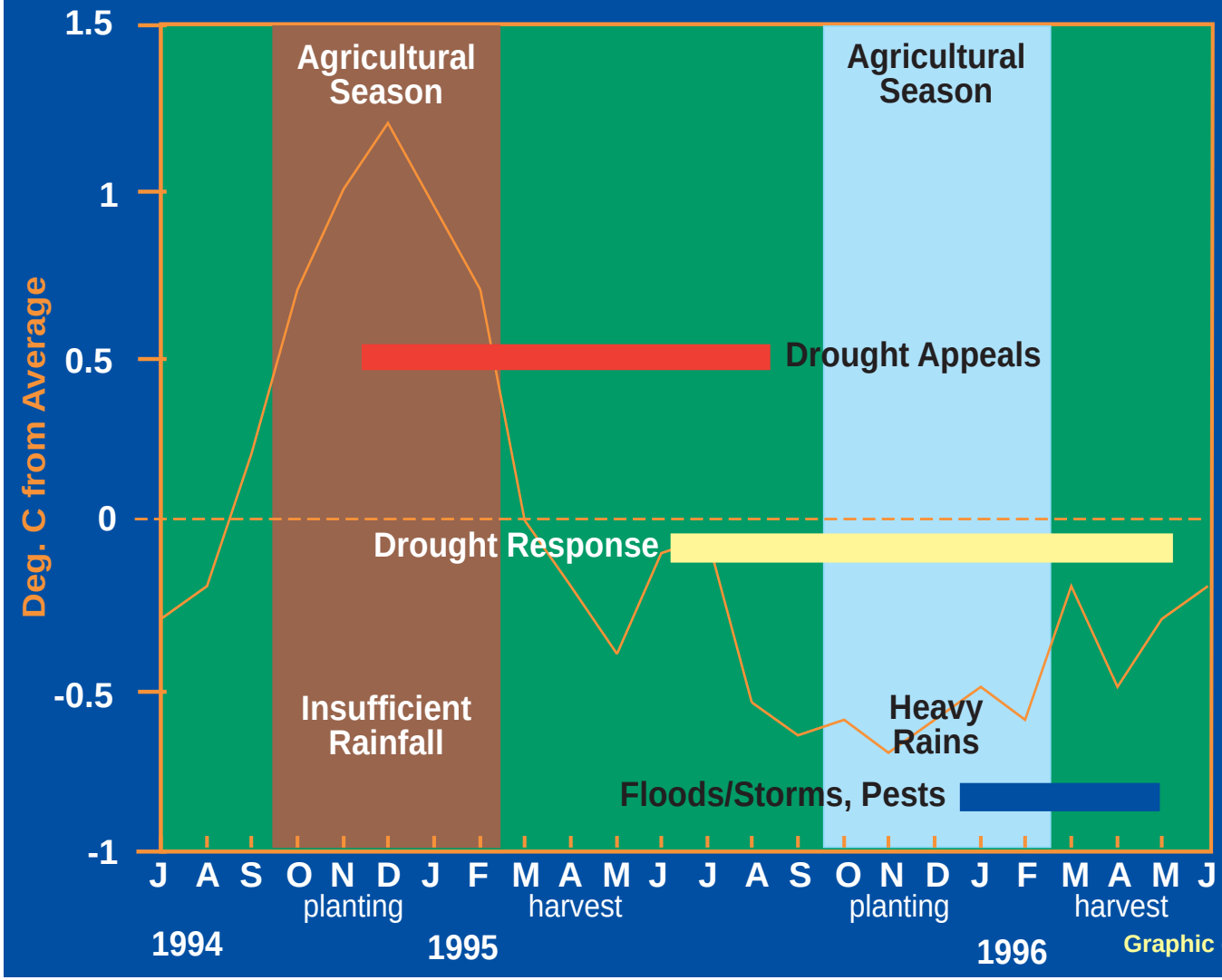
First he must consider the seasons of the year and the differences between them. Secondly he must study the warm and the cold winds, both those which are common to every country and those peculiar to a particular locality…”

Hippocrates 4th-5th century B.C.

A Brief History--The Context

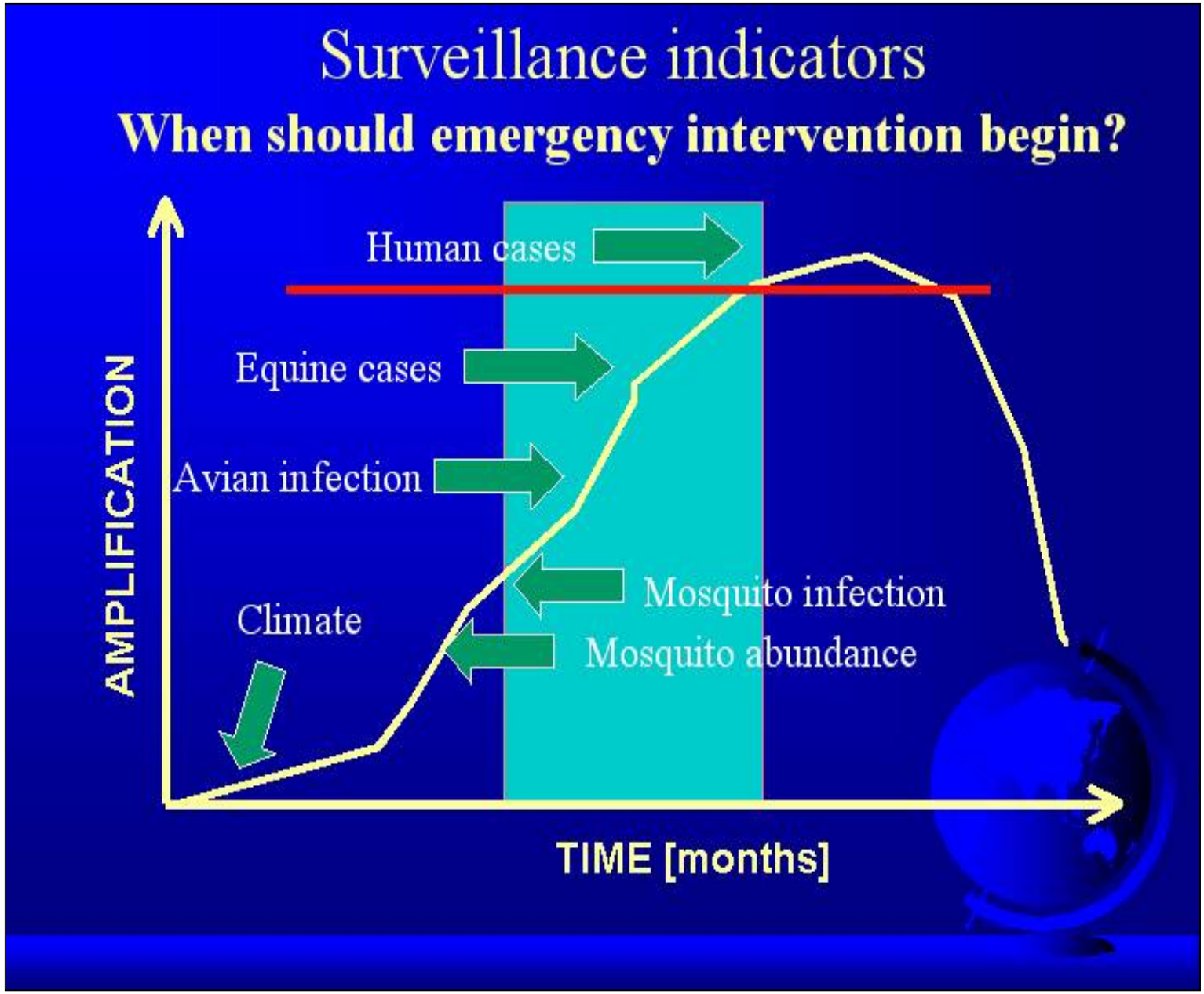
- El Nino not yet a household name
- A rapidly evolving capacity for seasonal to interannual prediction
- A need to understand what information was needed, how it was or was not used, and the implications of that use
- The public health issues needed some special attention

Emergency and Response: Behind the Curve



NINO3 SST Anomaly is an index of sea-surface temperatures in the tropical Pacific ocean. Elevated NINO3 values are associated with reduced southern Africa rainfall.

Graphic developed by Maxx Dilley, IRI


Surveillance indicators
When should emergency intervention begin?
Human cases
Equine cases
Avian infection
Climate
Mosquito infection
Mosquito abundance
AMPLIFICATION
TIME [months]

CVHP Drivers

- National Research Council(NRC) "**Under the Weather: Climate, Ecosystems and Infectious Disease**"
- NRC "**Global Environmental Change: Research Pathways for the Next Decade**"
- NRC **"From Monsoons to Microbes: The Role of the Oceans in Human Health**"
- American Society for Microbiology Colloquium "**Climate Variability and Human Health: An Interdisciplinary Perspective"**
- Washington Advisory Group/EPRI "**Climate Change and Vector-Borne and other Infectious Disease: A Research Agenda**"
- **US Global Change Research Program**
- **Climate Change Science Program**

Climate Variability and Health Program

- Part of OGP/Climate and Societal Interactions (CSI)
- Roots in Human Dimensions and Research Applications
- Filling a gap in the Federal system
- Societal Problem-Requirements Questions
- Partnerships

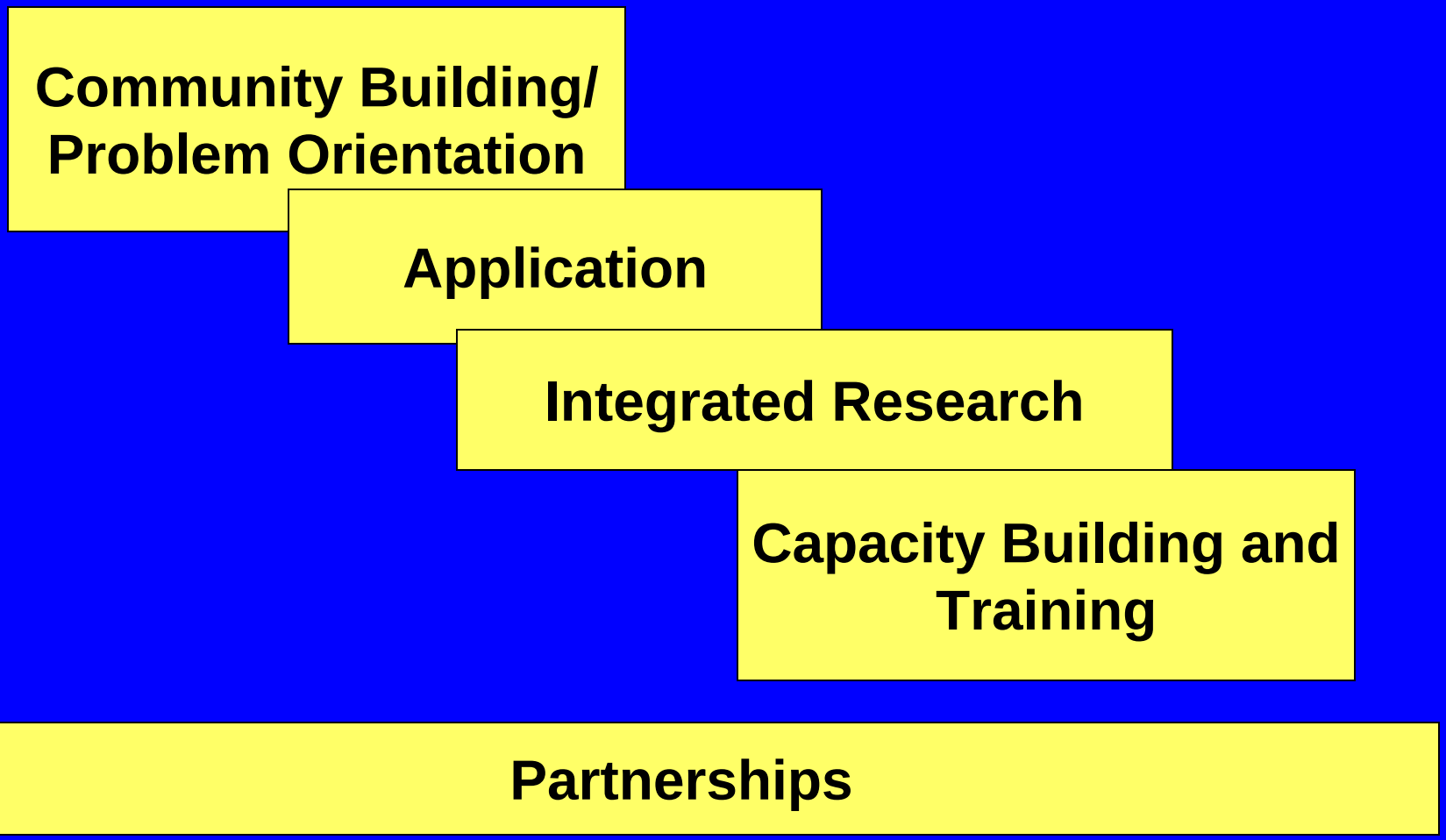
Climate Variability and Health Program: Goal

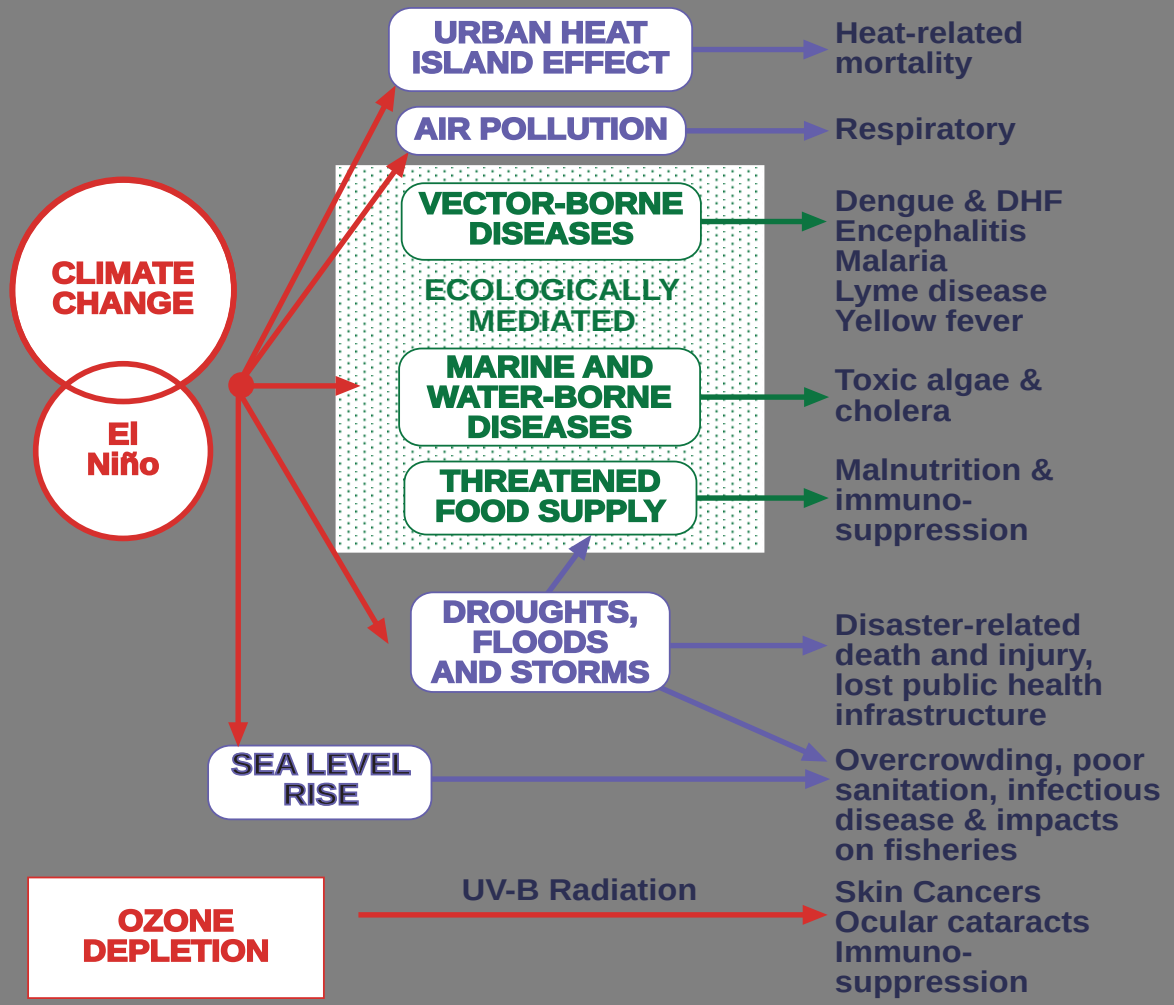
To improve public health and well being through the integration of useful climate information into public health policy and decisionmaking at the appropriate scale.

Climate Variability and Health Program: Objectives

1. Framing-Understand and define the problem and the **appropriate role** for climate information;
2. Develop a **solid scientific foundation** to support public health policy and decision-making;
3. Build a robust and highly **integrated climate and health research and application community**; and
4. **Build capacity** within regions to research and apply climate information toward the goals of public health.

Climate Variability and Health Program Components





Anticipated causal pathways of public health impacts from climate change. Adapted from: Patz & Balbus. Methods for assessing public health vulnerability toclimate change. Climate Research 1996;6: 113-125..

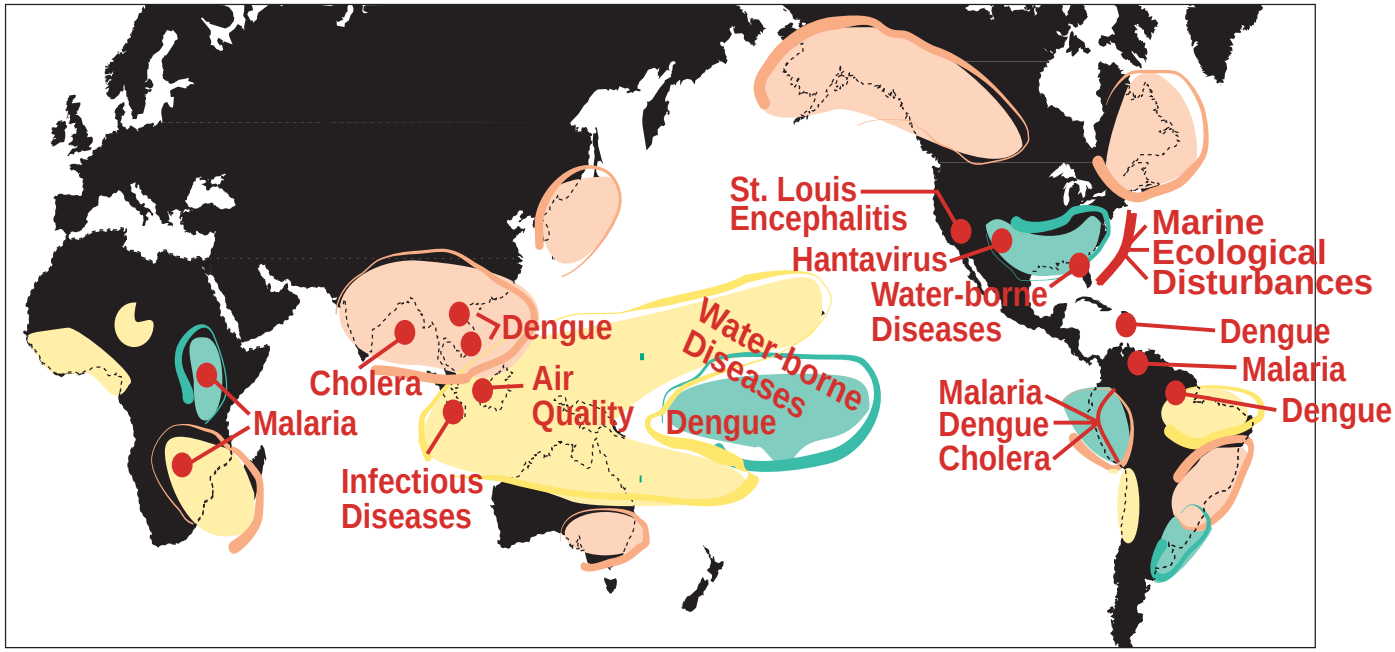
Community Building/Problem Orientation

- Workshops and Presentations
- Interagency Working Groups-West Nile, IDIWC
- International Organizations-World Health Organization
- Regional partners, workshops, pilot projects

Application

- Regional Climate and Health Training workshops-Samoa, Niger, Barbados
- Malaria Early Warning System-Southern Africa
- Meningitis Early Warning-Niger
- West Nile Virus-CIP
- California Application Project/mosquito control-RISA
- Health in the Pacific Islands-Asia/HD
- Energy Modeling Forum-HD
- Mosquito Control -CIP/RCCs/RISA/SCO

The ENSO Experiment
Research Activities



Generalized El Niño-Southern Oscillation (ENSO) Impacts

= dry
= wet
= warm
= dry & warm
= wet & warm
= wet & cool

Public Health Benefits of Advanced Planning in Pohnpei

Integrated Research: Joint Announcement on Climate Variability and Human Health

- NOAA, NSF, EPA, and EPRI with NASA
- Requires public health, climate and ecology expertise on proposal team
- End goal is improved public health
- Domestic and International
- Approx $1.5 million
- Moving into fourth year of partnership

Joint Announcement on Climate Variability and Human Health: Goal

To stimulate the formation of interdisciplinary teams to:

- Illuminate the pathways through which climate affects human health, and
- Explore the potential for incorporating useful climate information for public health policy and decision making

Research Funded

- Rift Valley Fever--Zimbabwe
- Cholera in Bangladesh
- Bartonellosis in Peru
- Diarrheal Diseases in Lima, Peru
- Dengue at the US/Mexico Border
- Climate and WEE, SLE in California
- Asthma and Aeroallergens in the Northeastern United States
- Mosquito Dynamics in Mid Atlantic
- Influenza
- Methods Research

Climate Variability and Health Program: Research Findings

- Malaria--Applying climate information in Southern Africa and Colombia
- Malaria Early Warning System
- Dengue--Developing predictive models for dengue in the Asia-Pacific region
- Rift Valley Fever--Developing predictive model
- Meningitis--Determining severity of dry season and onset of rains

The Role of Climate in Predicting Infectious Disease Risk

Kenya 1997-98: Severe El Niño-related Flooding-- Rift Valley Fever Outbreak

•The Public Health Question

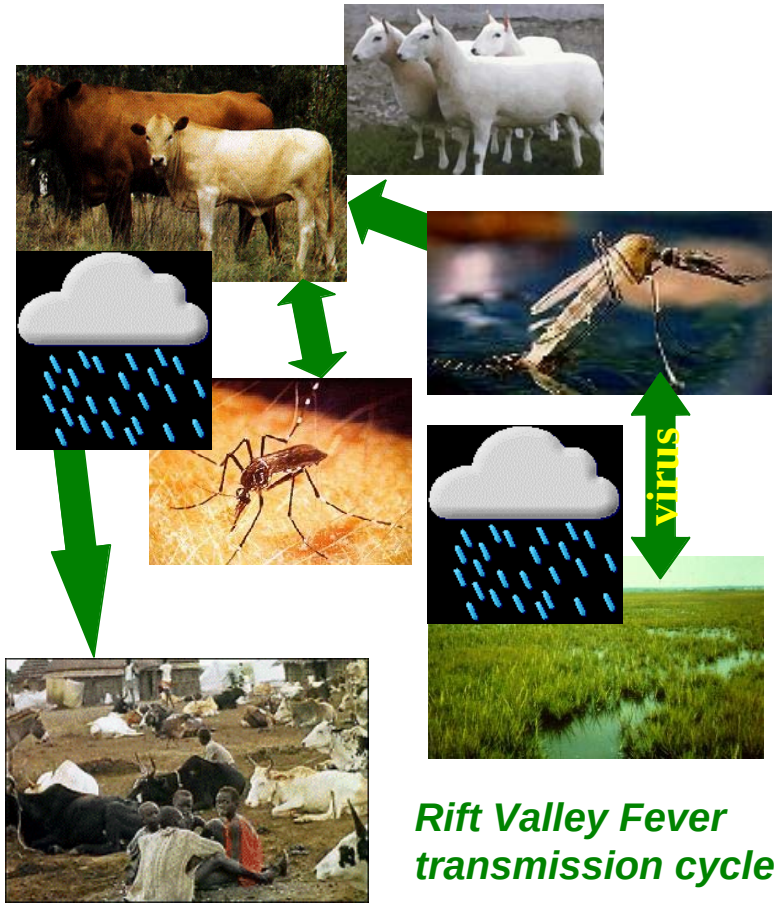
Can we use climate information to help predict RVF and begin vaccination?

•The Integrated Research Approach

Climate, Ecology, Public Health, Modeling, Field/Process Study

•Integrated Spatial Spread Model Developed

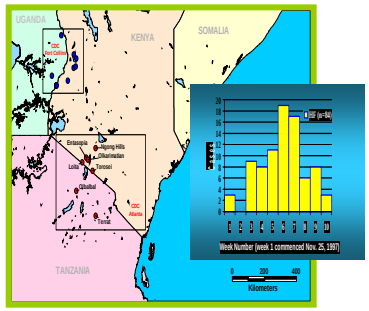
Being applied to Plague and other issues of Homeland Security



Rift Valley Fever transmission cycle

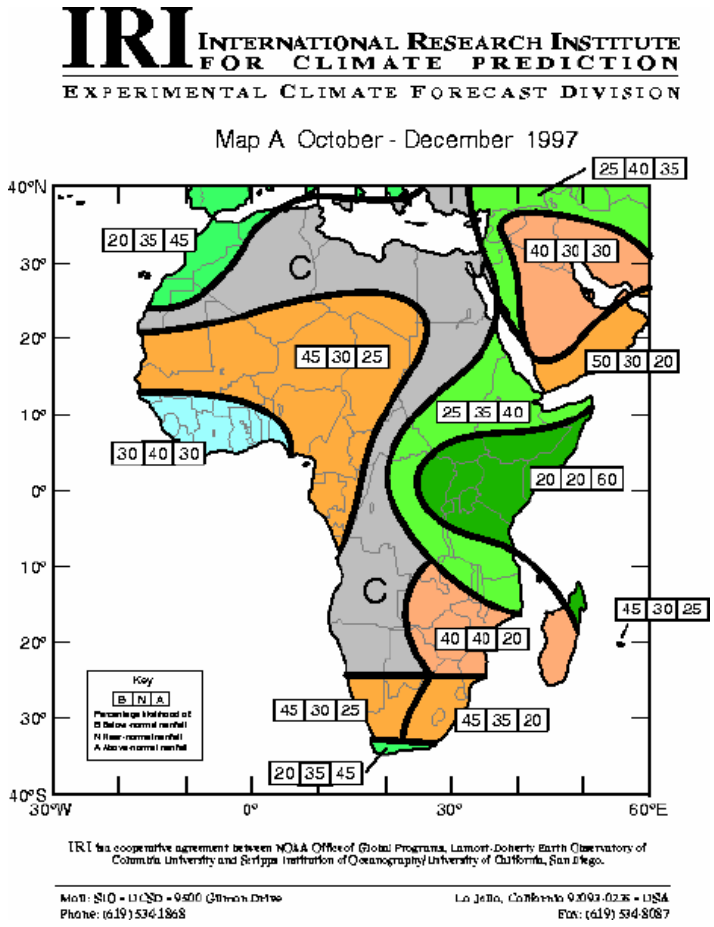
Kenya RVF Outbreak 1997-1998

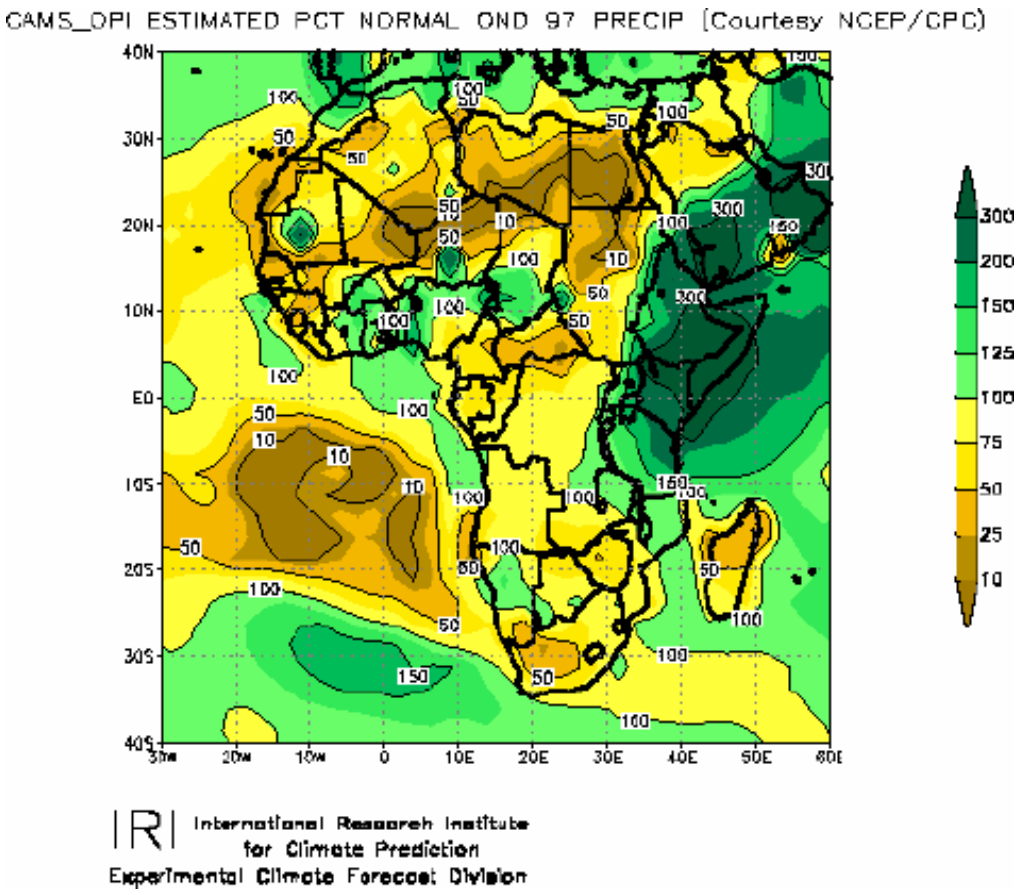
- Heavy rains between October 1997 and April 1998
- Dramatic regional epidemic of multiple diseases: Nov 1997 - Apr 1998
- Feb 98: Kenyan government requested U.S. medical aid & support
  - Ground specimen collections made in representative locations



Climate Forecast

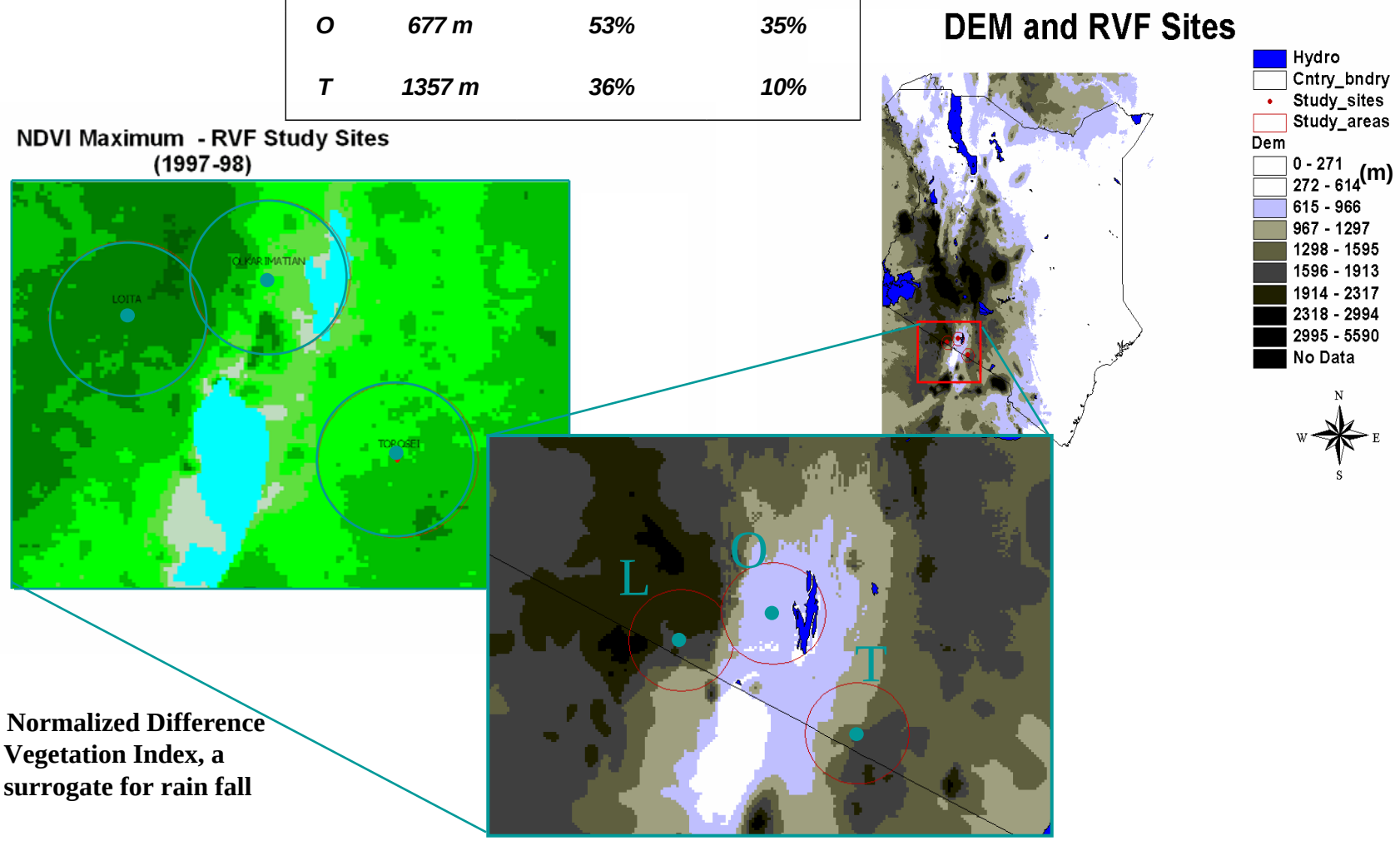
- NOAA/IRI 3-month forecast, issued in October 1997, for October-December (plus validation)
- Successful prediction of above-normal precipitation





Kenya Sites Landscape Characteristics

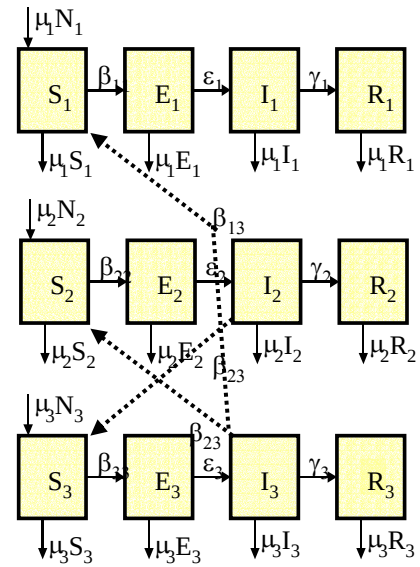
Site	Elevation	Livestock pos.	Human pos.
L	*1796 m*	*4%*	*0%*
O	*677 m*	*53%*	*35%*
T	*1357 m*	*36%*	*10%*



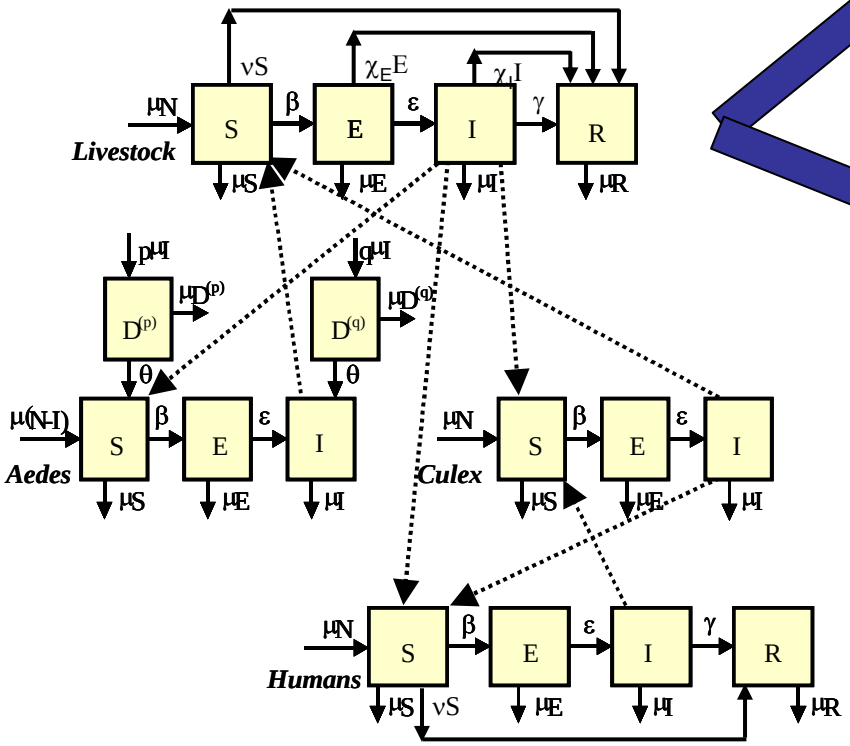
NDVI = Normalized Difference Vegetation Index, a surrogate for rain fall

Development of Disease Epidemic Model

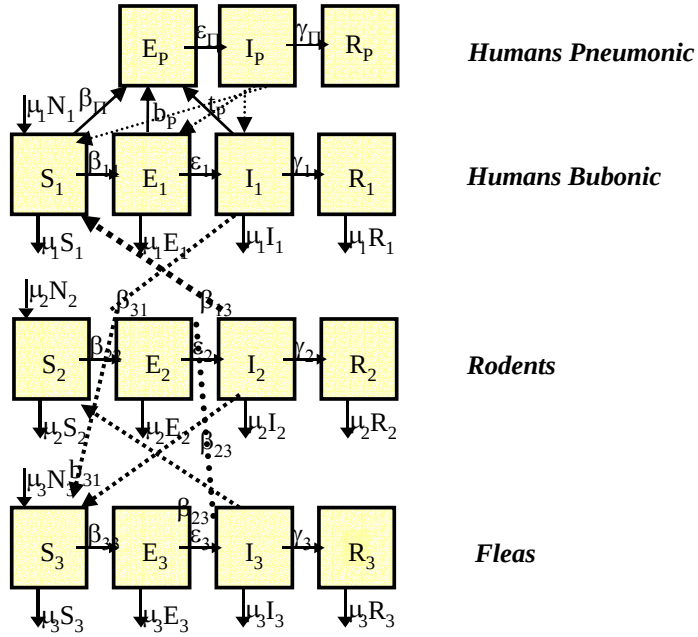
West Nile Virus

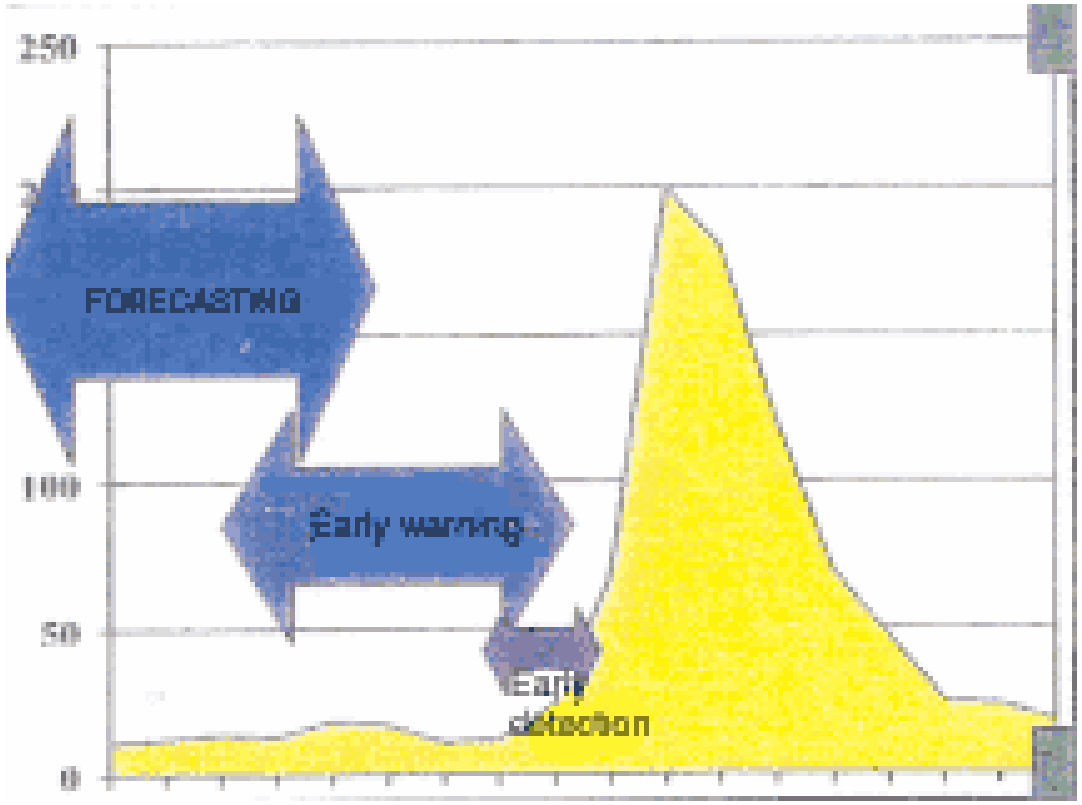


Rift Valley Fever

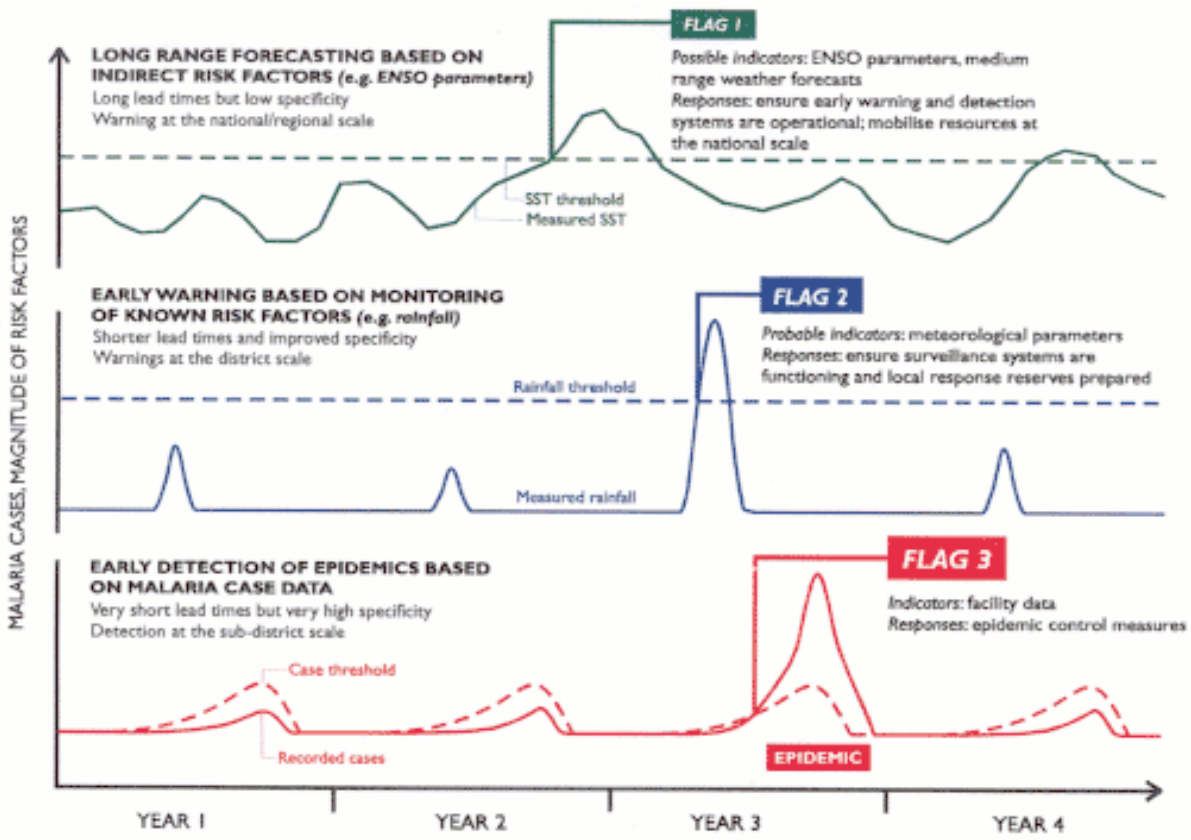


Plague





Building a cost-effective monitoring system including forecasting, early warning and early detection systems leads to (i) either very early recognition of the emergency and immediate control measures or (ii) leads to the implementation of preventive control measures before epidemic starts. The last option is strongly correlated to the accuracy (probability above 90% ?) of the integrated forecasting system in place to predict epidemics. ***Source: World Health Organization***

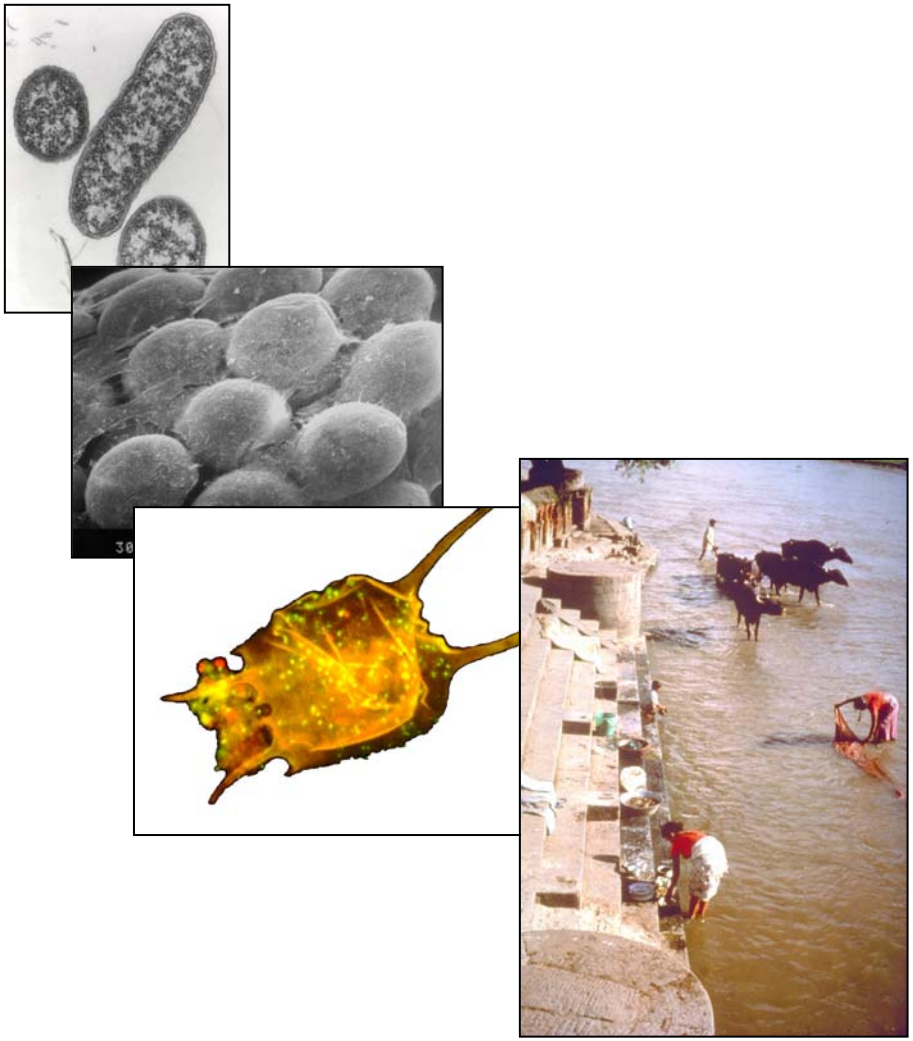


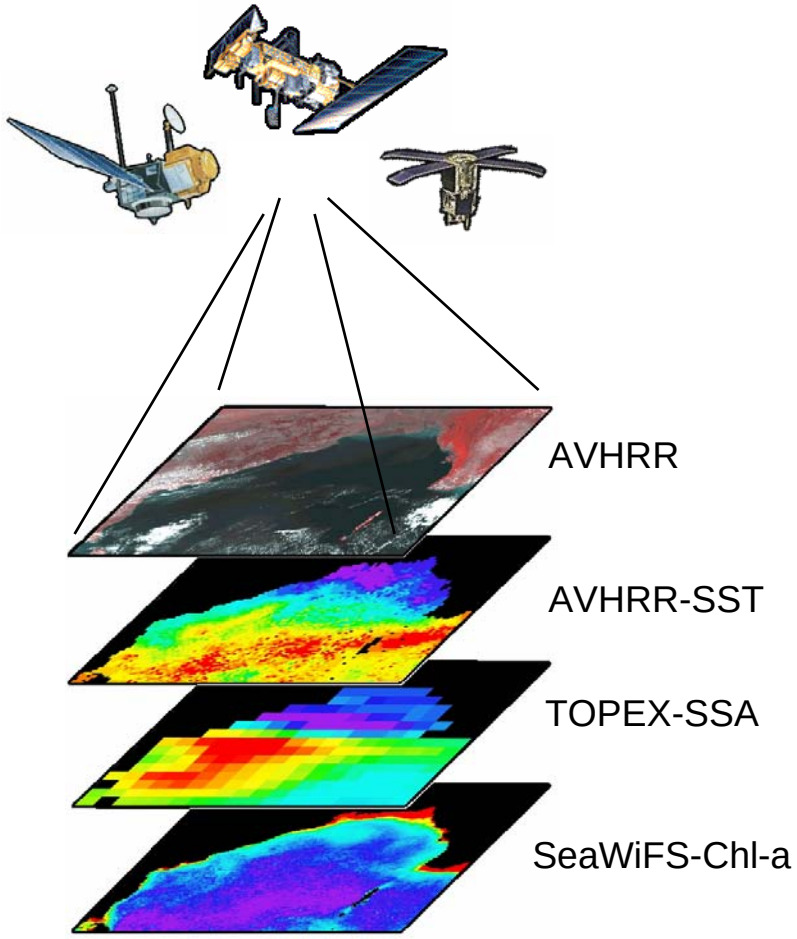
A three-tiered approach for epidemic forecasting, early warning and detection. Each tier is associated with specific indicators and responses. In this simplified example a first warning flag is raised at the regional level after sea-surface temperature (SST) anomolies suggest an impending El Nino event Subsequent excess rainfall is monitored directly as part of an early warning system and Flag 2 is raised. Malaria cases are monitored at the individual facility level and an epidemic declared once a defined threshold has been exceeded. (http://www.rbm.who.int/cmc_upload/0/000/011/636/cdc_epidemics.htm)

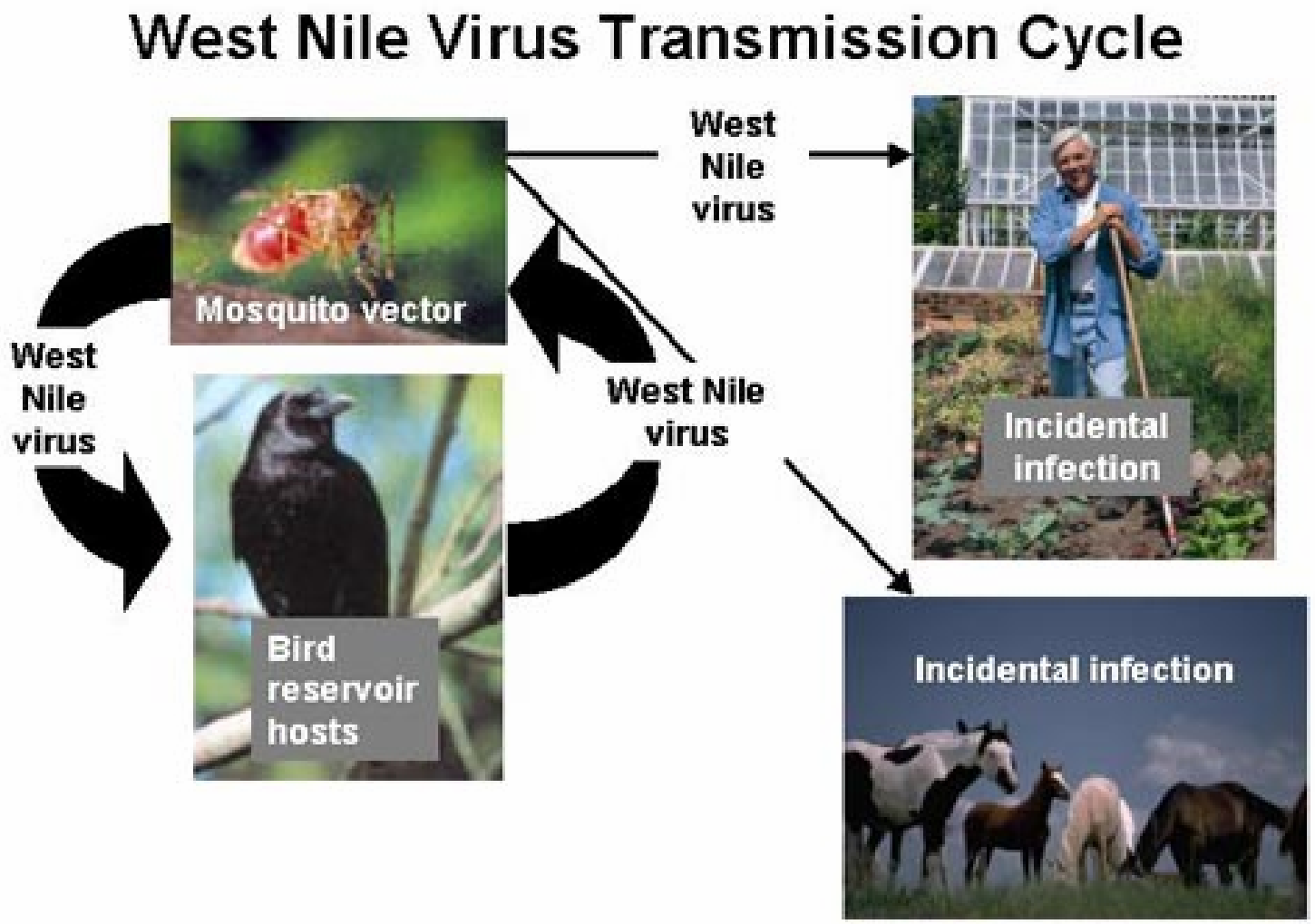
Climate Variability and Health Program: Research Findings

- **Cholera--Research supports the propogation of cholera along with elevated sea surface temperatures in coastal Peru and Bangladesh**
- **Diarrheal Diseases--Increased hospital admissions in Lima, Peru and reduced incidence in Federated States of Micronesia**
- **Shellfish poisoning--contaminated runoff and coastal environment**

Monitoring the Temporal Patterns of Cholera Transmission Risk







Source: Centers for Disease Control and Prevention

Measures of Success??

- Peer Reviewed Articles
- Integrated Teams
- RISA/scientific partnerships
- International Partnerships/agendas
- Similar and higher level programs in other agencies
- Leveraging work--other parts of NOAA, Centers for Disease Control, Private Sector
- Better Mosquito Control...

“Increase the use of novel surveillance systems and modeling techniques to help predict, detect, or monitor disease trends, environmental and climatic conditions or genetic shifts that suggest disease outbreaks and facilitate epidemiological investigations.”

National Academy of Science, Institute of Medicine
Public Health Systems and Emerging Infections, 2000

Challenges and Opportunities

- Move from surveillance and response to prediction and prevention
- Use new tools and technologies to meet climate-related health threats head-on
- Build regional capacity for more integrated health early warning systems
- Climate Information as an adaptation tool

Climate and Environmental Information for Public Health: A Partnership

- Understanding the problem and the contextual factors
- Identification, production, and development of useful information
- Application, intervention and feedback- a mix of research and use

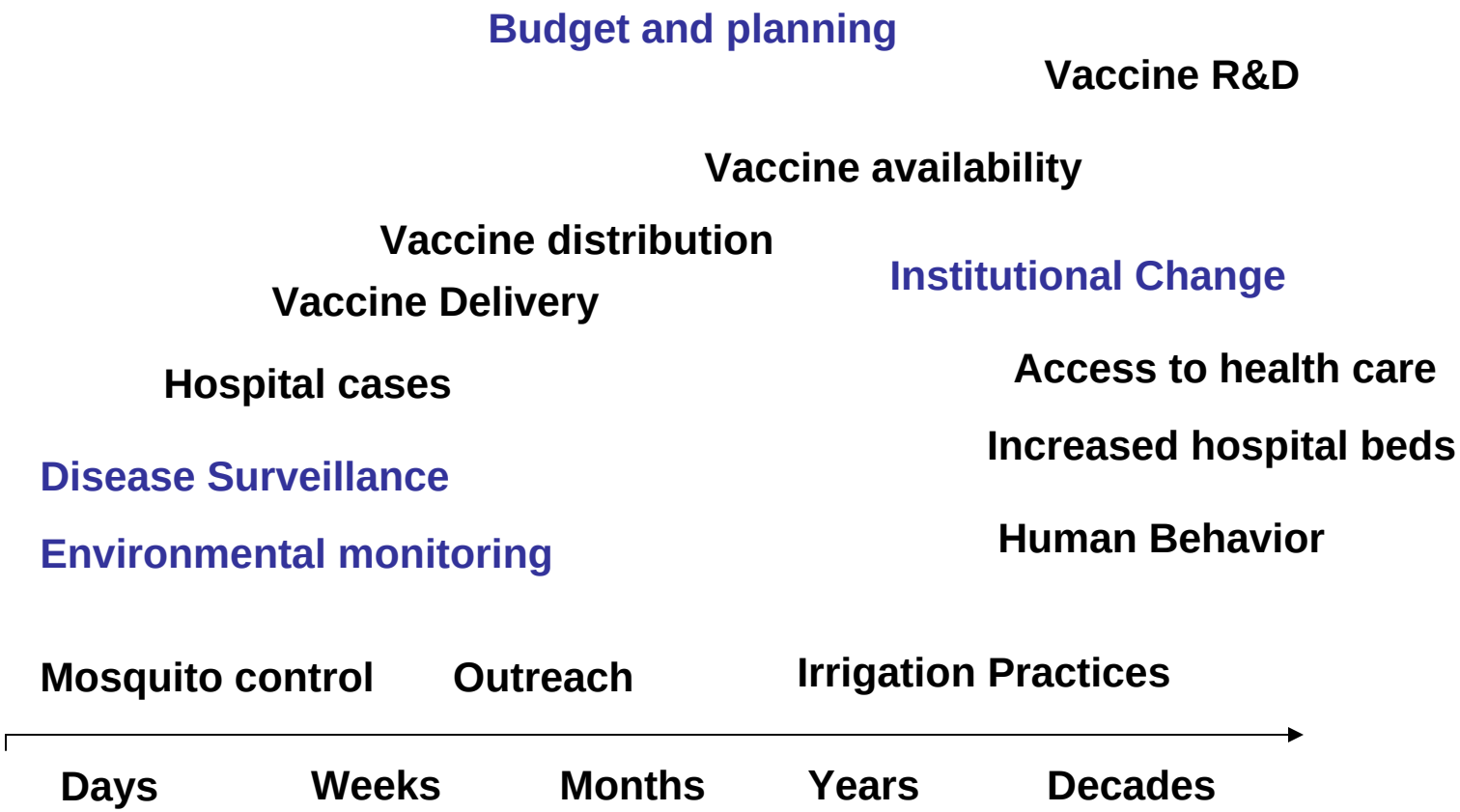
Methods

- Intellectual framing, problem orientation, practical approach
- Development of sustainable information systems
- Assessment as a process-facilitates institutional flexibility, sustainability, human capital and useful solutions

Using climate information as part of the adaptation process

- **Looking at climate across time scales**
- **Enhancing resilience without creating new vulnerabilities**
- **Building institutional, human, and scientific capacity for flexible and responsive action**

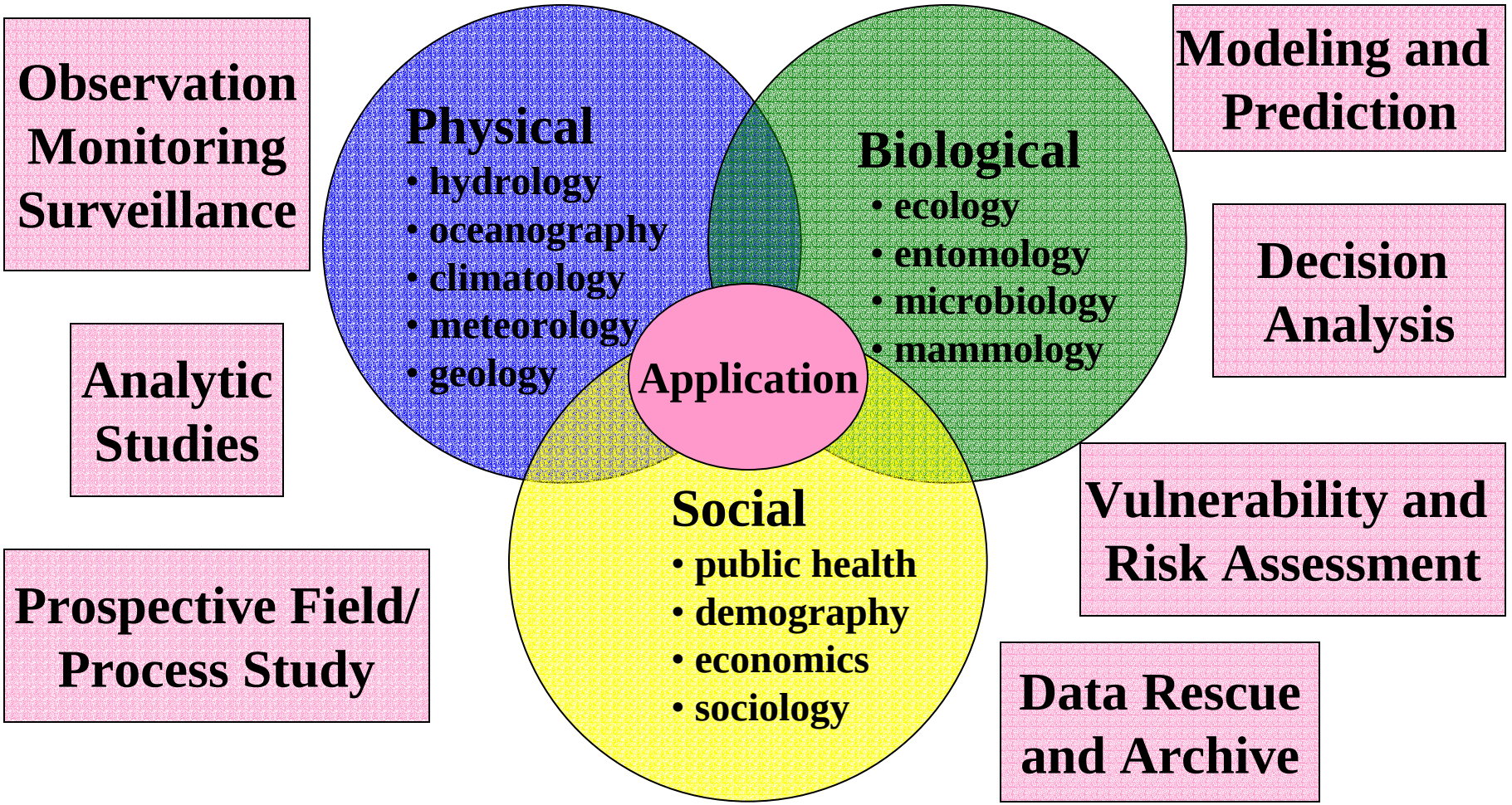
Conceptual timeline for public health adaptation to climate



Looking Forward

- **Sustaining and expanding current partnerships- NOAA, Interagency, private sector**
- **USGCRP/CCRI Deliverables**
- **Defining and feedback to Requirements Process**
- **Implement Research Agendas**
- **Management of Interagency and Interdisciplinary research**
- **Informing Adaptation efforts**
- **Health RISA**
- **Mosquito Control Activity, West Nile Task Force**

Multidisciplinary Community Integrated Approach



Components of a Health Early Warning System

Oceans and Health Initiative

- FY03 Appropriation
- Develop NOAA expertise in Oceans and Health
- Intra-NOAA and Inter-Agency
- NOAA Centers of Excellence
- External Peer-Reviewed Grants
- Visiting Scholars
- Workshop--September