What Question, Which Data and Why it Matters to Ask

Bradfield Lyon
School of Earth and Climate Sciences and Climate Change Institute, University of Maine
Adjunct Research Scientist, IRI, Columbia University

Health and Climate Colloquium 2016
June 8, 2016
Columbia University
What Question?

The Telegraph  India Heat Wave
May 2016

Effects of Climate on Variability in Lyme Disease Incidence in the Northeastern United States
Subak, 2003

The Link Between Zika and Climate Change

“Changes in temperature, precipitation, and humidity can alter how long the mosquitoes live, how often they bite, how many offspring they have.”
Which Data? Example 1

Hot topic or hot air? Climate change and malaria resurgence in East African highlands

Simon I. Hay, David J. Rogers, Sarah E. Randolph, David I. Stem, Jonathan Cox, G. Dennis Shanks and Robert W. Snow
Simple Questions with Difficult Answers

But not simpler

Albert Einstein
Climate Scientist
Epidemiologist
Rap Artist
Which Data?

Temperature JULY 1998

Publically Available Stations
Adjusted Data

Trend = +1.71 °C/30 yrs.

Adjusted Data

Trend = +0.65 °C/30 yrs.

Kericho Station Observations
Maximum Temperature

Omumbo et al., 2012
“Temperature” is Not a Single Variable...

Differing values when using mean temp., maximum temp. and minimum temperature.

Example for Nov. 2008 at Kericho, Kenya

**Correlations:**
- $r(\text{Tmax, Tmin}) = -0.44$
- $r(\text{Tmean, Tmin}) = +0.70$
- $r(\text{Tmean, Tmax}) = +0.32$
Which Data?

Dinku, T. et al., 2011
Global Changes in Local Places

What Scale(s)?

Land and ocean temperature departures from average, February 1998

Omumbo et al. (2012)
What is Now Feasible

Malaria Degree Days in ENACTS
($T_{mean} - 15.4$)

Average Monthly MDD, Elevation > 1500m

Annual MDD, Elevation > 1500m
“Here’s a list of 100,000 warehouses full of data. I’d like you to condense them down to one meaningful warehouse.”
Example 2 -- An East African “Climate Paradox”

A Wetter East Africa Due to Climate Change?

Figure 1. (Left) Projected change in annual precipitation 2080-2099 relative to the observed climate 1980-1999. From IPCC Fourth Assessment Report Working Group I Figure 11.2. (Right) Observed percent change in long rains precipitation (March to June) in the Greater Horn 1979-2009 relative to 1950-1979. From Williams and Funk (2011).
East African “Climate Paradox”
East African “Climate Paradox”

Lyon, 2014

Lyon and Vigaud, in press
Example 3: Data for Modeling...

**Figure 2** Malaria-model ensemble simulation outputs. Monthly *P. falciparum* malaria incidence observed in Kericho over the period spanning January, 1979 to October, 2004 (x-axes) versus the 50% percentile of the distributions of monthly *P. falciparum* malaria prevalence (y-axes) simulated by the MAC (upper left panel), AM (upper right), WCT (lower left), and ABP (lower right) models, for the actual climatic conditions, for the period spanning January, 1979 to December, 2009, and for 1-, 1-, 2-, and 0-month time lags, respectively. Red and blue solid lines represent the adjusted linear trends (see $R^2$-values on each panel) for each model and for the four-malaria-model ensemble (MME), respectively. Dashed black line in the upper-right panel depicts the adjusted linear trend for the MME when non-linear changes in the mean duration of host's infectivity to vectors are considered.

Ruiz et al., 2014
Many climate models struggle to capture average rainfall conditions in E. Africa

→ Are some models better suited to the question being addressed than others?

→ Be careful in blindly taking model data directly off the shelf…

→ There are other methods available to address uncertainty in future climate conditions, particularly in the next 10-30 years.
Conclusions

• Know thy data: If it involves climate, involve a climate scientist
  → An enormous amount of weather and climate data is available
  → This provides many new opportunities for research and “operations”
  → The challenge is selecting which data is most appropriate….

• Need to match climate data to the specific question be addressed
  → Spatial scale (local, regional, global)
  → Time scale (“weather”, sub-seasonal, interannual, decadal, CC)

• Current monitoring and prediction capabilities of global weather and climate are unprecedented. This includes an increasing amount of data available in near “real-time.”
  → Linking available weather and climate data to useable information in the health community (and other fields) is an unprecedented opportunity. Collaboration across disciplines is the necessary mechanism to overcome the attendant challenges.