



A Summary of the UCAR Google.org Weather and Meningitis Project

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Presented by: Mary Hayden, Tom Hopson, Jeff Lazo, Raj Pandya

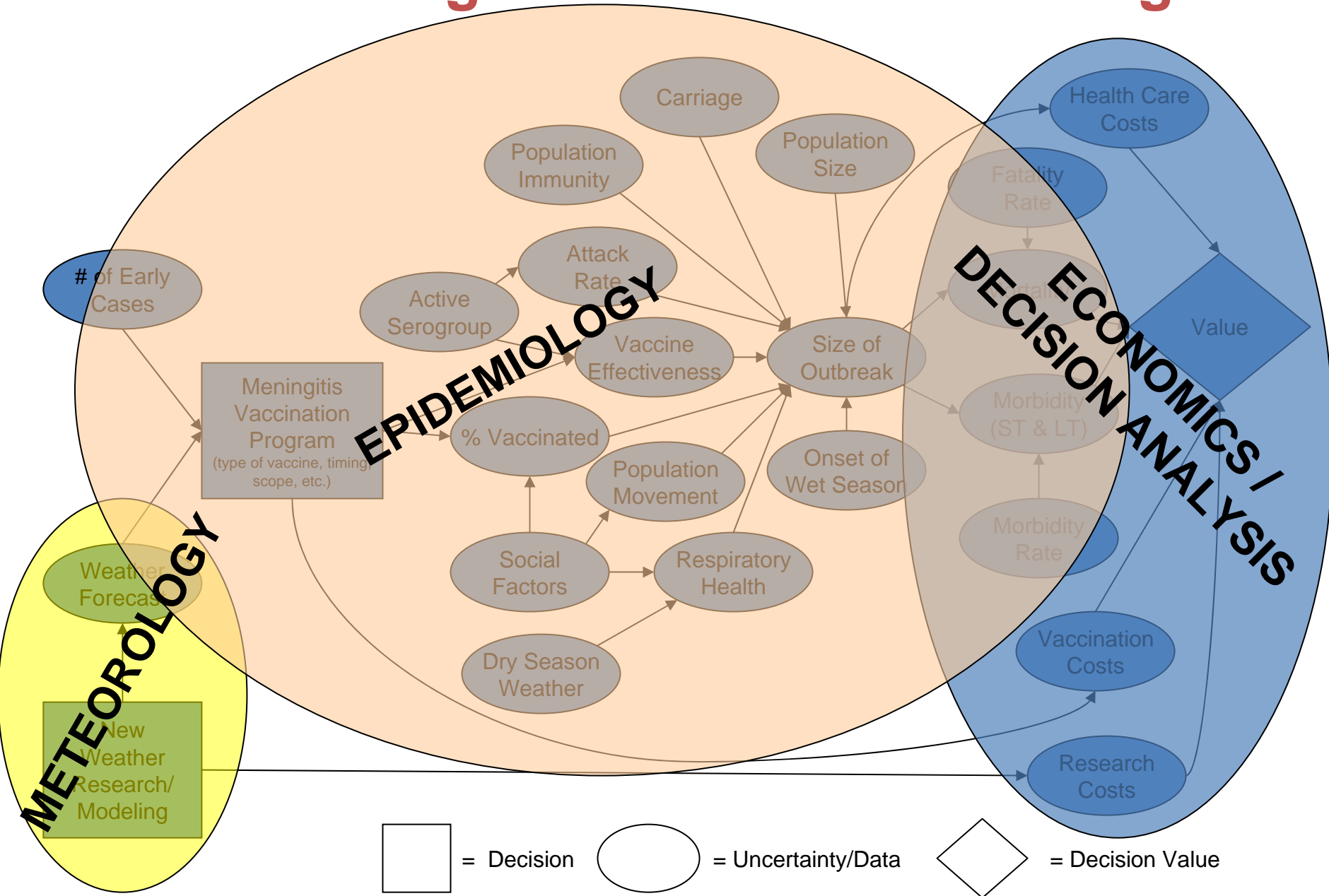
UCAR Board of Trustees Meeting, February 11, 2009



Project Personnel (Clockwise from top left): Abudulai Adams-Forgor, Madeline Thomson, Benjamin Lamptey, Fred Semazzi, Raj Pandya, Jeff Lazo, Mary Hayden, Thomas Hopson, Abraham Hodgson, Jennie Rice, Tom Yoksas, Sylwia Trzaska, Tom Warner



Influence Diagram of Vaccination Program

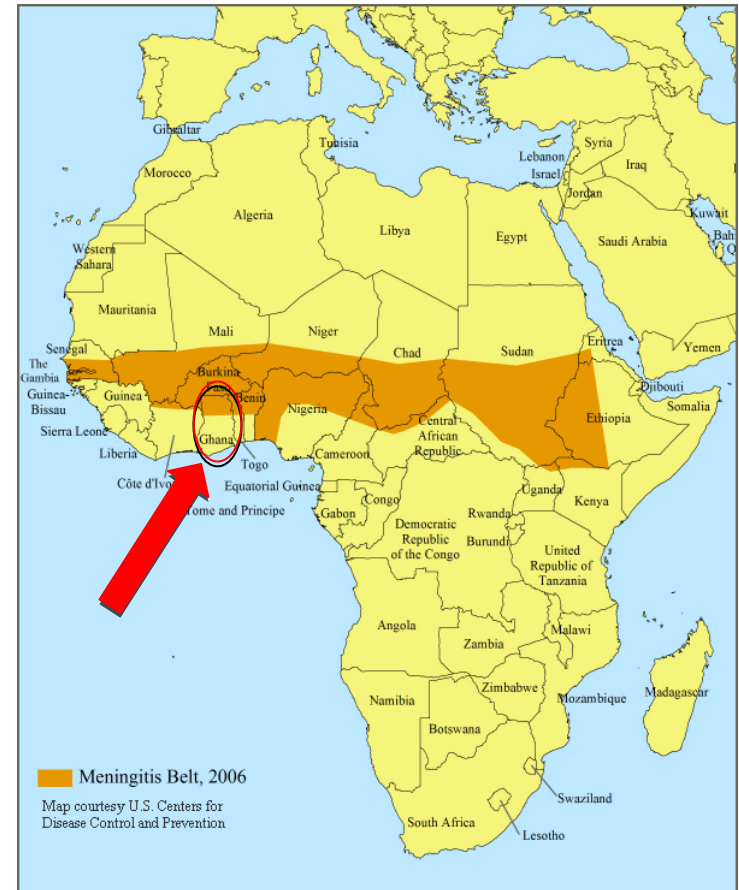


Applying Meteorology to Help Manage Meningitis

- Context:
 - Meningitis epidemiology, risk factors, and vaccination strategies
 - Ghana focus
- Project goal:
 - Minimize meningitis incidence by providing 1-14 day weather forecasts to target dissemination of scarce vaccine
- Project objectives:
 - Objective 1: Investigate utility of meteorological forecasts to inform vaccination campaigns
 - Objective 2: Identify and analyze myriad meningitis risk factors

Context: Managing Meningitis in the Sahel

- Meningitis is endemic in the Sahel in countries with a distinct wet-dry season
- Infectious disease due to bacterium – *Neisseria meningitidis*
- Epidemic in 1996-1997 resulted in 250,000 cases and 25,000 fatalities
- Person-to-person transmission through respiratory and throat secretions – between 10-25% of population may carry bacteria at any time; higher during epidemics
- A **reactive** vaccine strategy is currently used to manage epidemics
 - *Doesn't prevent transmission of the disease by the individual vaccinated*
 - *Only lasts one-to-two years*
 - *Doesn't produce an immune response in children under two*



Our Project Focuses on Ghana

- Available Epidemiological Data
 - Navrongo, in northern Ghana, has excellent meningitis surveillance data going back 10+ years
- Local Expertise
 - Drs. Abudulai Adams-Forgor and Abraham Hodgson, at the Navrongo Health Research Centre, have published on weather-meningitis links in Ghana
 - Former NCAR post-doc, Benjamin Lamptey, provides ties to the operational weather community in Ghana; this will help with data access and sustainability (ultimately, the goal is for the Ghana weather service will provide forecasts)



Navrongo Health Research Centre Main Entrance (above) and Region of surveillance (below)

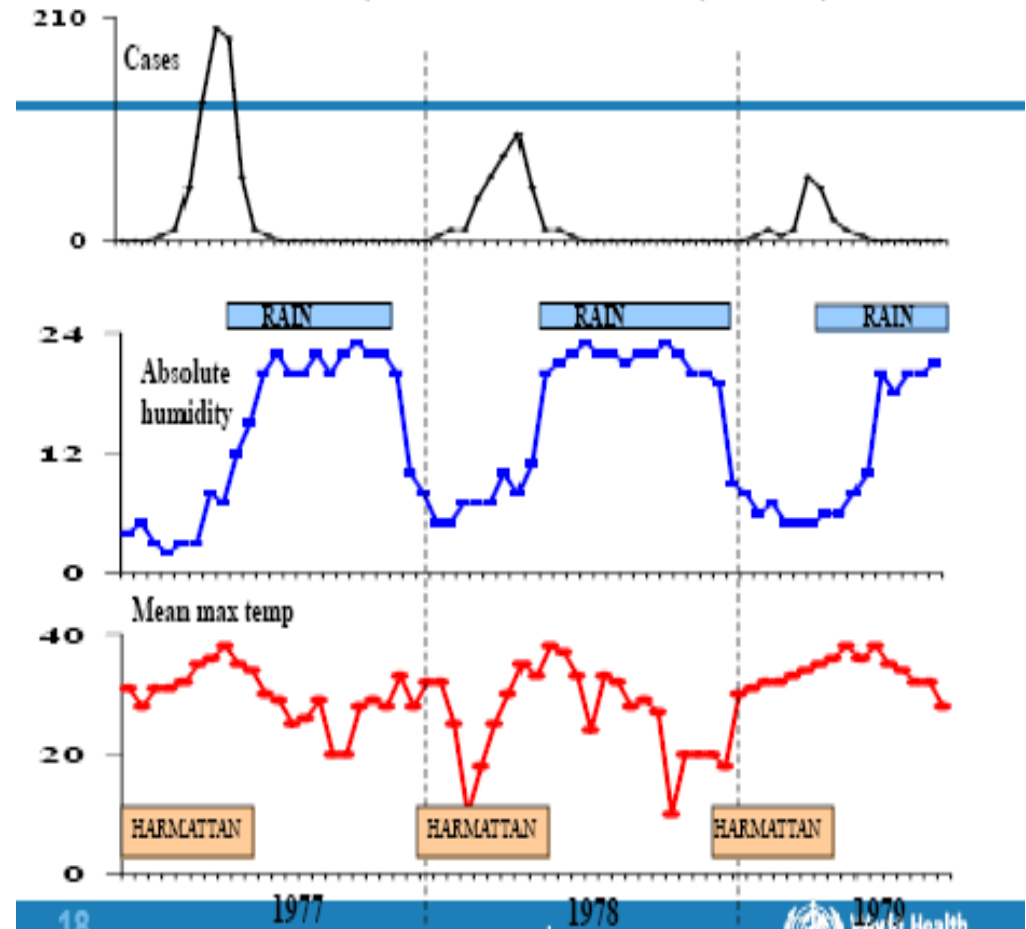


Weather Affects Meningitis Transmission

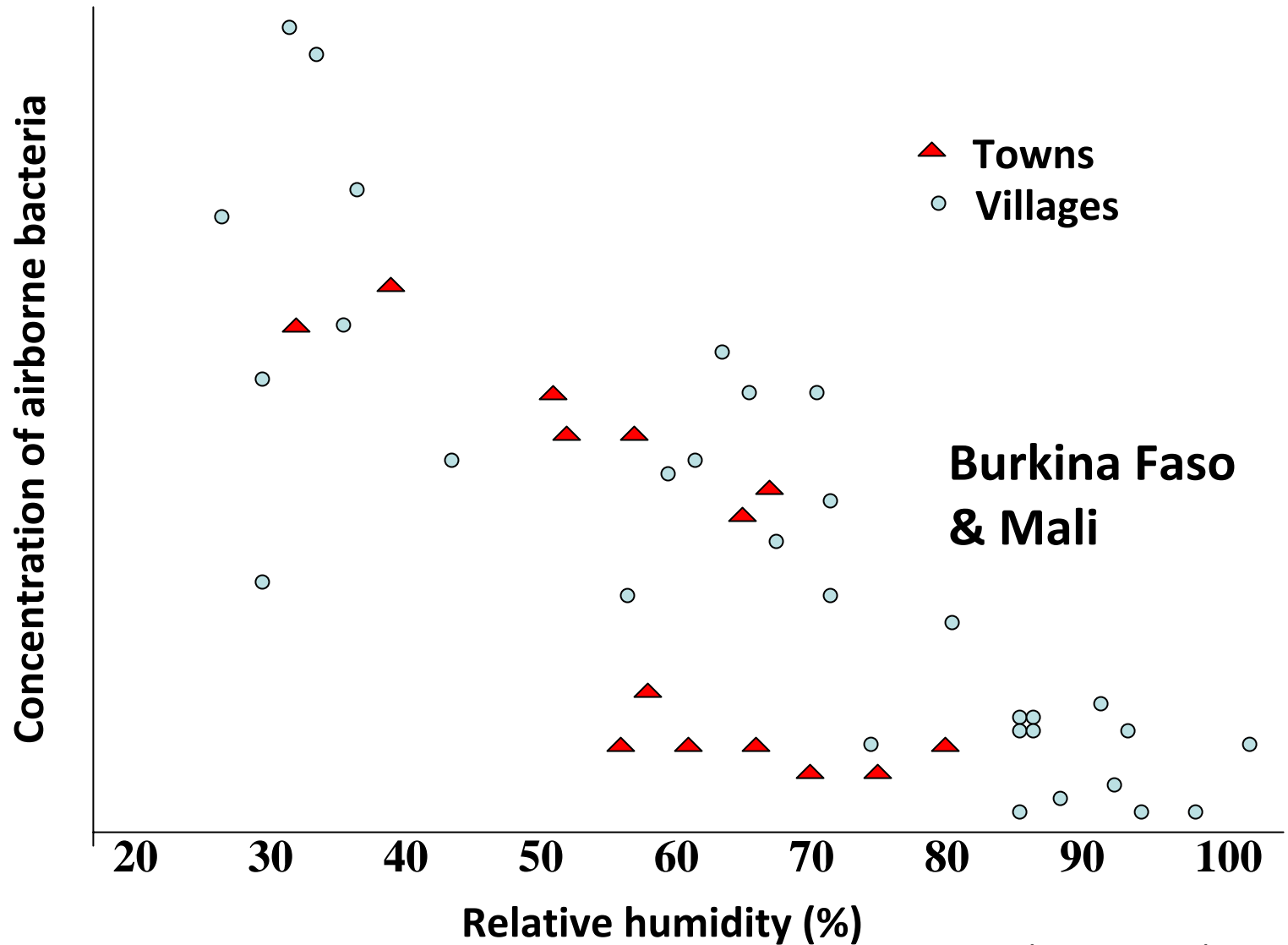
Season and Meningococcal Epidemics

(Greenwood et al. Lancet 1979; 73:557-62)

- *Nm. meningitidis* epidemics need three factors to happen
 - A population susceptible to the emerging serogroup
 - A hyperinvasive/hypervirulent strain
 - **Risk factors (environmental factors/social factors)**
- *Nm. meningitidis* epidemics are observed to occur in the dust season and end with the onset of the rainy season
 - Can humidity forecasts help identify regions where the epidemic will end naturally, so that scarce vaccines can be moved elsewhere?
- What other risk factors can we identify, to comparatively assess the value of the weather forecasts and offer other management strategies

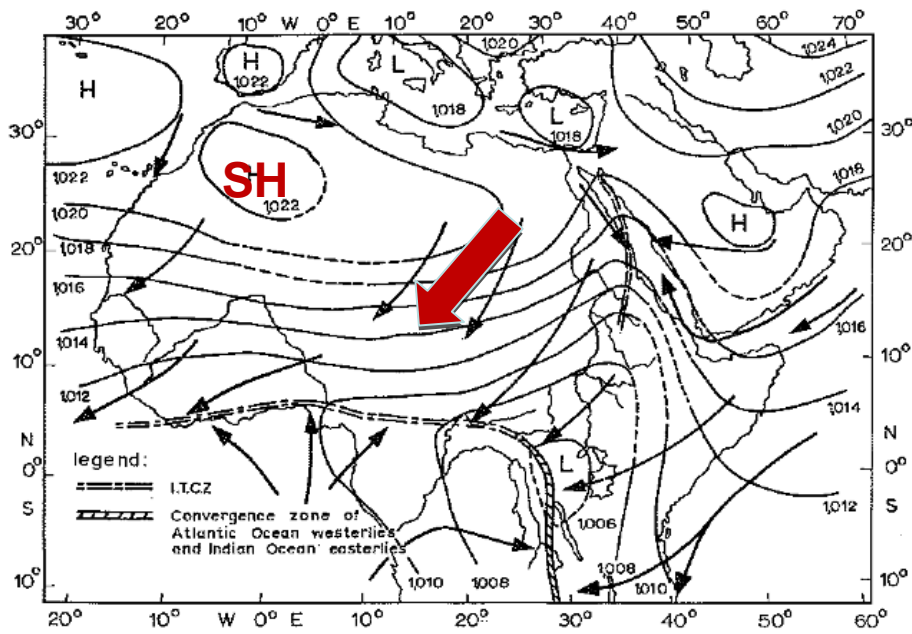


Humidity and Meningococcal Concentration

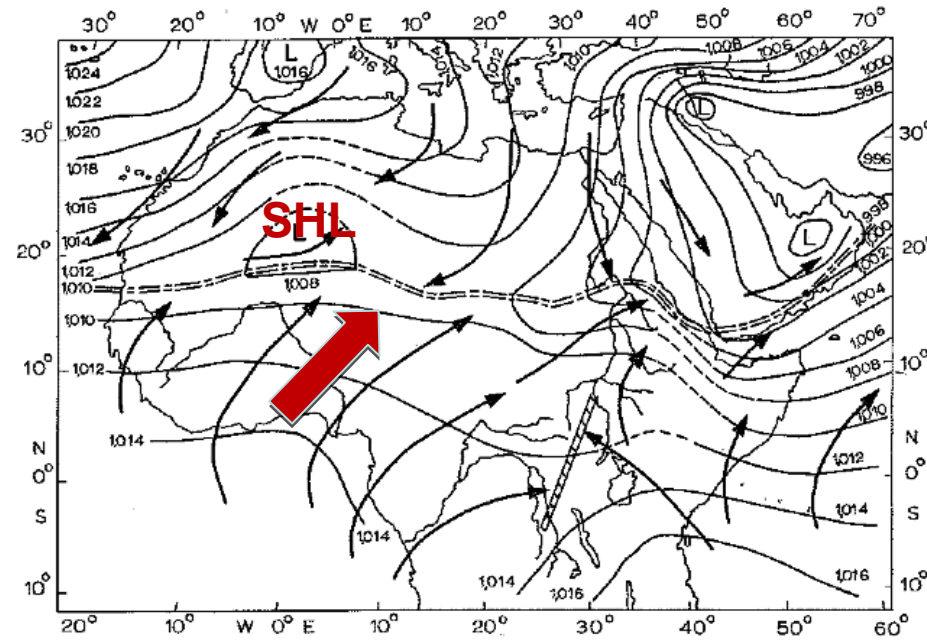


Ghipponi et al. 1971

Climatology of West Africa

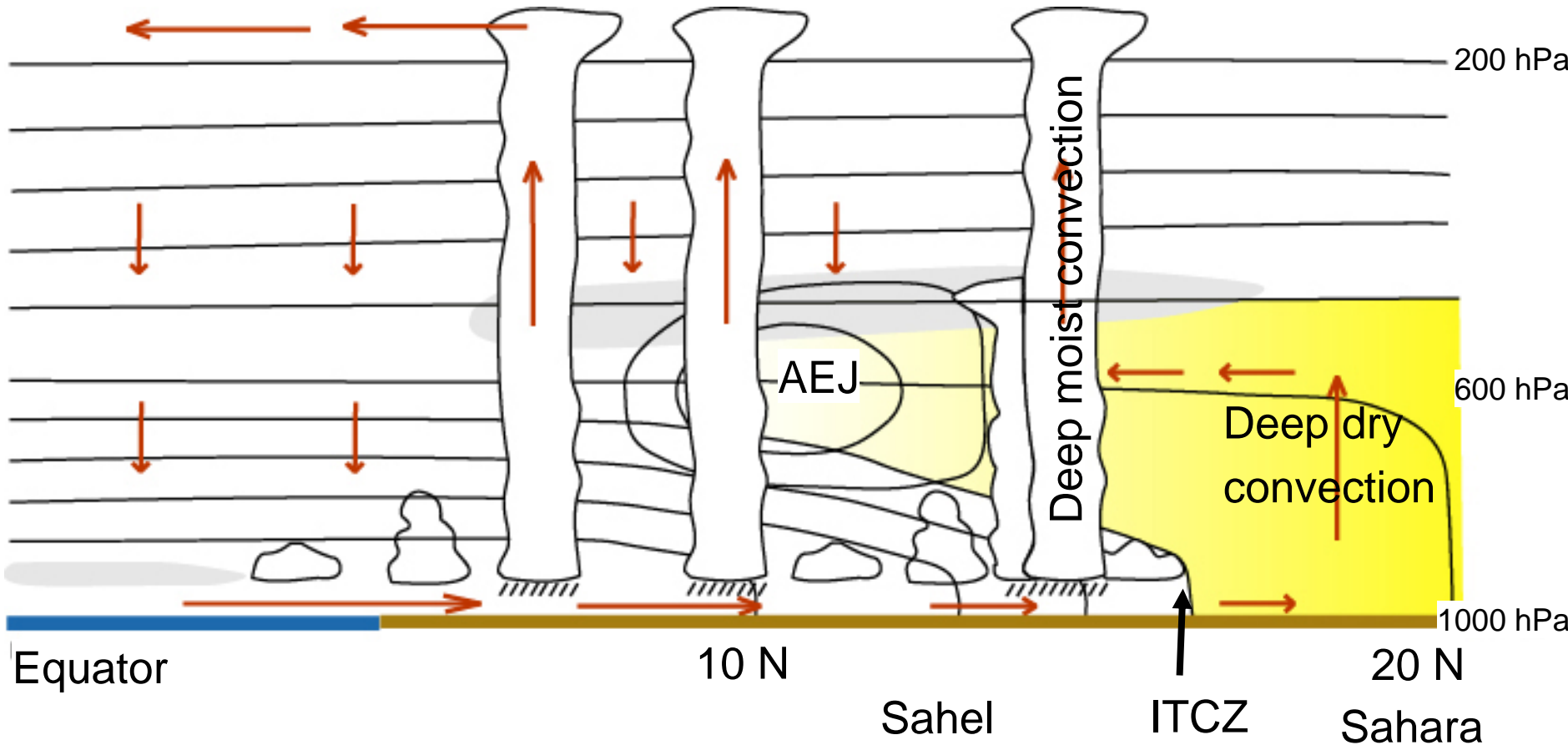


January



July

Schematic Cross Section of the West African Monsoon



- There is a strong diurnal cycle in the monsoon flow
- The monsoon tends to advance northwards during the night (Parker et al, 2005)

Activities: Further Quantify the Weather-meningitis Link on 1-2 Week Time Scales

- Research Collaborators: Benjamin Lamptey (ACCRA), Fred Semazzi (NCSU) and Sylwia Trzaska (IRI)
- Previous studies focused on seasonal time scales over larger geographical regions -- Our focus:
 - medium-range time scale (1 to 2 weeks)
 - finer spatial resolution (Ghanaian district-level)
- Data Partners
 - Epidemiological data: archived 10 years Navrongo district epidemiological records
 - Weather analyses:
 - NCEP and ECMWF Re-analyses
 - NCAR's African Initiative WRF analyses
- Quantifying the connection through
 - statistical models that incorporate impact of weather on meningitis
 - significance and uncertainties in the weather connection

Activities (cont.): Prediction of the End of the Dry Season

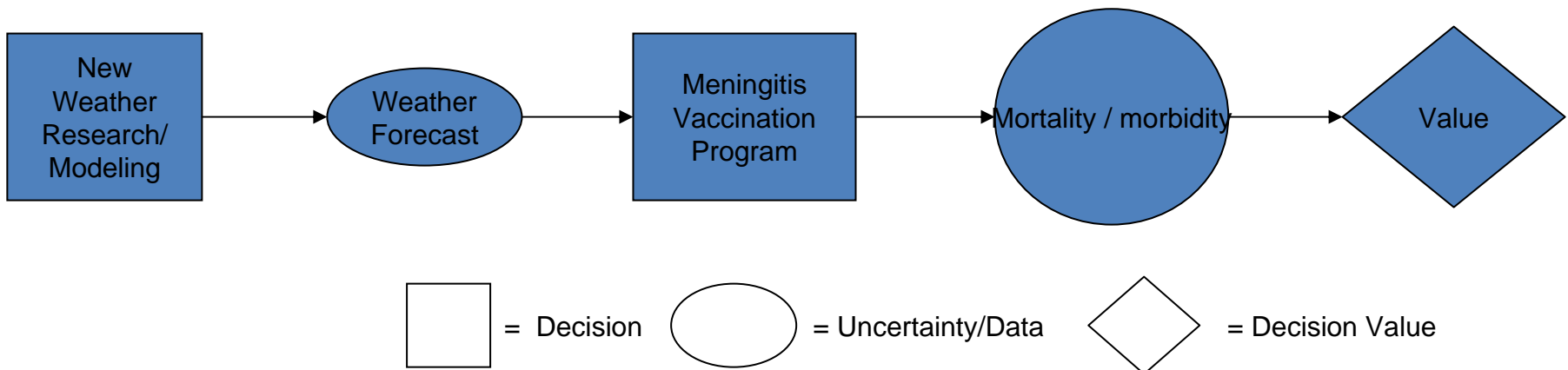
- Weather forecasts
 - WMO THORPEX TIGGE Weather Ensembles (focus: NCEP and ECMWF), 1 to 14 days
 - optimally-combine into probabilistic forecast for humidity, 1-15 days out, over Northern Ghana
 - verify forecast skill
- Dual probabilistic impact of both the weather variables on meningitis outbreaks and the probabilistic forecasting skill - how much utility we can provide?

Conceptual Representation and Quantification of Societal Impacts

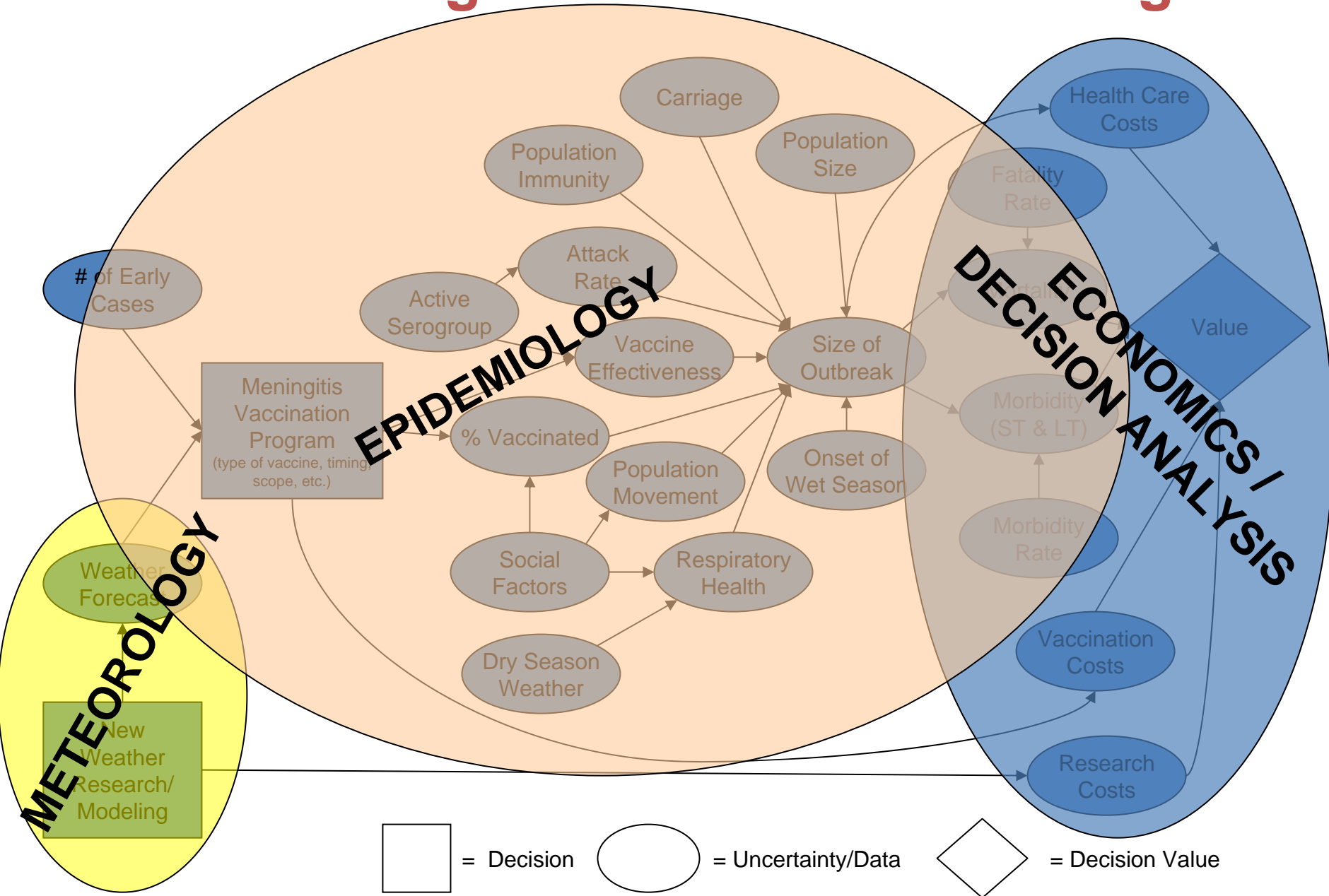
- Approach – economics and decision analysis
 - decision model incorporating relevant aspects of the entire decision process
 - Google.org's vision of Earth-gauging network that integrates environmental, social, and economic data to help communities respond to environmental influences

Influence Diagrams

- Graphical representation of the decision situation and the pathways of information
- Conceptually tying all the components together
- Helping everyone to speak the same language
- Identifying knowledge gaps
- Identifying and setting priorities for data collection
- Used for evaluating uncertainty
- Could be fully developed into a decision analysis model with sufficient quantitative data



Influence Diagram of Vaccination Program



Valuing Health Outcomes

- Ultimate function of the model will be to develop estimates of the value of the improved forecast information and its use in health decision making
- Alternative health outcome measures will be explored based on both theoretical considerations and availability or collection of reliable applied measures including
 - disability adjusted life years (DALYs) – common in health literature
 - quality adjusted life years (QALYs) – relatively new in economics
 - willingness to pay (WTP) – preferred economic approach
- Joint field work to include data collection on economic/socio-behavioral components
 - exposure
 - risk behavior
 - household level impacts
 - benefits and values – WTP?

New Strategies to Engage Diverse and International Communities?

- In addition to people, this project brought together ideas and strategies from across the organization, including:
 - Community-based participatory research: Partnering with communities to develop a shared agenda integrating research, education, and capacity-building
 - Solutions-oriented research: Linking multiple disciplines and local expertise in an end-to-end process from basic understanding to socio-economic and human impact
 - Embedded atmospheric research: Working to contribute our expertise in broader contexts can open doors to new opportunities, including funding.
- *Can this combination provide a strategy for further engagement with diverse and international communities?*
- *What organizational changes would facilitate this? (e.g., employee hiring and evaluation, grant administration, etc.)*

A satellite view of the Earth centered on the African continent. The continent is highlighted in shades of green and brown, while the surrounding oceans and other landmasses are in natural colors. The text "UCAR Africa Initiative" is overlaid in white on the top half of the image.

UCAR Africa Initiative

<http://www.africa.ucar.edu>