PREDICTING THE WEST AFRICAN MONSOON SURFACE WEATHER VARIABILITY AS IT IMPACTS LIVESTOCK AND HUMAN HEALTH

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OUTLINE

Forecasting of surface climate variables is useful for health applications



Disease / Climate Linkages in West Africa



Variability and predictability of West African Monsoon climate attributes



Modeling meningitis incidence





MOTIVATION



Limited public health infrastructure in West Africa

Environmental factors have an outsized influence on health



Longer-lead forecasting could provide warnings through existing decision-making structure



Understanding relationships and potential future prevalence can inform policy decisions

Study Region

Sahel

MENINGOCOCCAL MENINGITIS

- Bacterial disease causing long lasting effects and death
- Greatest risk in semi-arid region south of the Sahara Desert

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Physiological mechanisms controlling climate linkages still unresolved



Study Region

From Molesworth et. al. 2003

RH METRIC WITH MM



Risk of epidemic (10 cases / 100,000) inversely linked to RH



Climatological threshold the inherent background risk of epidemic



Risk drops below threshold at around 40% RH









Humidity is high during the rainy season June - September



Low during the dry season November - March

Background & Motivation Meningitis Climate Predictability Men. Modeling Heat Stress



SEASONAL CYCLE





Meningitis incidence peak during dry season – low RH



Incidence drop to ~0 as RH increases



Lag between drop in RH and increase in incidence

WEST AFRICAN MONSOON



Map Shows: Surface Temperature 850 hPa Winds



Pressure gradient driven low-level onshore winds



Advects moisture inland from Gulf of Guinea



Produces a largely N-S moisture gradient



Monsoon onsets from mid-May retreats from mid-September

WEST AFRICAN MONSOON

Weather Station Clusters by Seasonal RH



Calculated seasonal mean **RH** values: -Onset: 15 May – 20 June -Peak: 20 June – 15 Sep. -Retreat: 15 Sep. – 15 Oct.

Clustered values to see spatial patterns

Used cluster averages for each season for modeling



WEST AFRICAN MONSOON

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PREDICTABILITY

Onset South Cluster Contemp. Correlations



Correlation with climate variables identified predictors

Utilize teleconnections with persistence for predictability

PREDICTABILITY

Onset South Cluster Contemp. Correlations



Average over regions of high correlation to obtain predictors

Correlation done at 1-4 month lead-times

RH MODEL RESULTS



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MENINGITIS MODEL RESULTS





MENINGITIS MODEL RESULTS

Togo + Benin Meningitis Case Counts 8wk Lead Forecast



Background & Motivation Meningitis Climate Predictability

Men. Modeling



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MENINGITIS MODEL RESULTS

Togo + Benin Meningitis Case Counts





Good predictability of incidence at 4, 8, 12 weeks



Limited dataset – weekly 2005-2011



Aggregated by country or multicountry



Currently modeling counts – want to model threshold exceedance



LIVESTOCK AND CLIMATE



Livestock grazing near a resting point on a transhumance corridor. (Photo by Matthew Turner)



Pastoral livestock largely impacted by environment



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good pasture and water Changes in fodder and water availability named greatest

Seasonal N-S migration following

barriers to improving livelihood



Livestock disease third – This includes heat-related illness

Figure 3. "Impacts of perceived climate change" surveys in the Ferlo Region, Senegal



HEAT STRESS

Thermal Humidity Index: THI = 0.8 X T_a + $\frac{\text{RH}}{100}$ X (T_a - 14.4) + 46.4

• Largely pastoral smallholding agriculture systems

High environmental exposure rates – often food and water limited



Pastoralist and his herd in Senegal. (Photo by Peter Shapland)

THI INDEX RESULTS





Threshold levels calculated at each grid point



Number of days at or exceeding threshold during JJA



Thresholds can be altered for species / breed of interest



Modeling Temperature and Relative Humidity to forecast THI

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-Monthly forecasts -Future projections



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Skillful forecasts of disease incidence with right set of climate attributes



Climate attributes are predictable from largescale climate features



Models can be used for risk forecasting or for future projections

THANK YOU

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SEASONAL CYCLE







SEASONAL CYCLE



Increases in THI during temp. peaks



Increase and decrease moderated by relative humidity



