

Broader Impacts of the Application of the Combined Use of Data-Driven Methodology and Physics-Based Weather and Climate Prediction Models

Professor Fredrick Semazzi

North Carolina State University

Department of Marine, Earth, and Atmospheric Sciences

North Carolina State University

<http://climlab.meas.ncsu.edu>

Photograph by George Steinmetz

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Views of Africa
National Geographic magazine, September 2005

Outline

Broader Impacts

- **Hurricane forecasting**
- **Climate Projection Research**
- **Seasonal Climate Prediction**

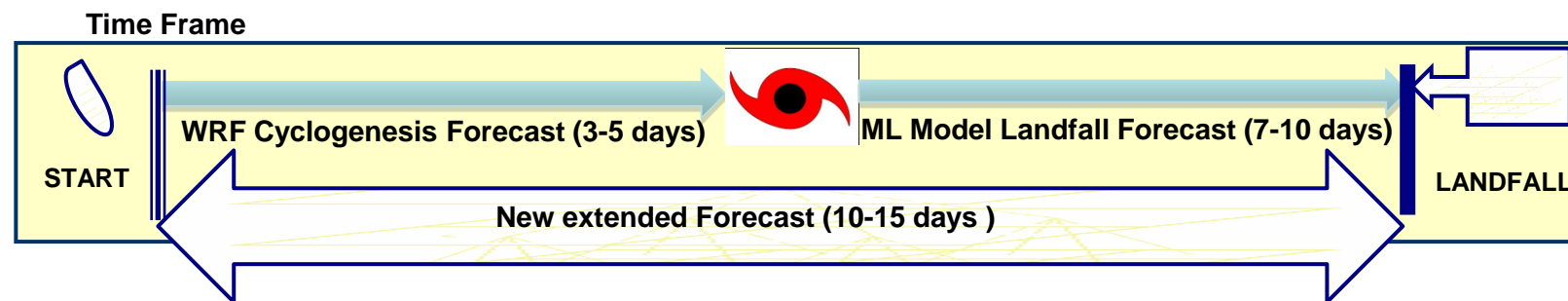
Hurricane Forecasting

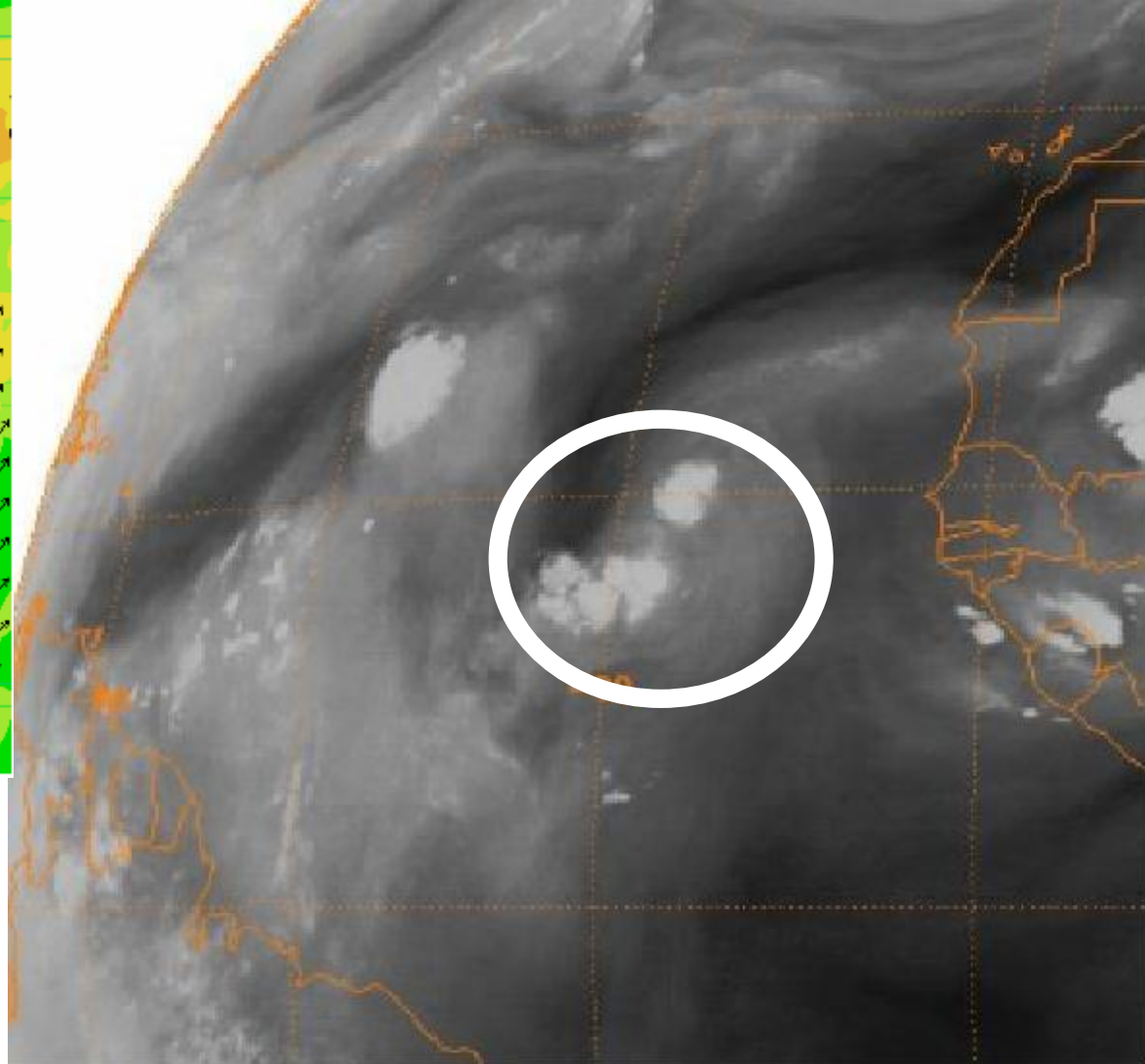
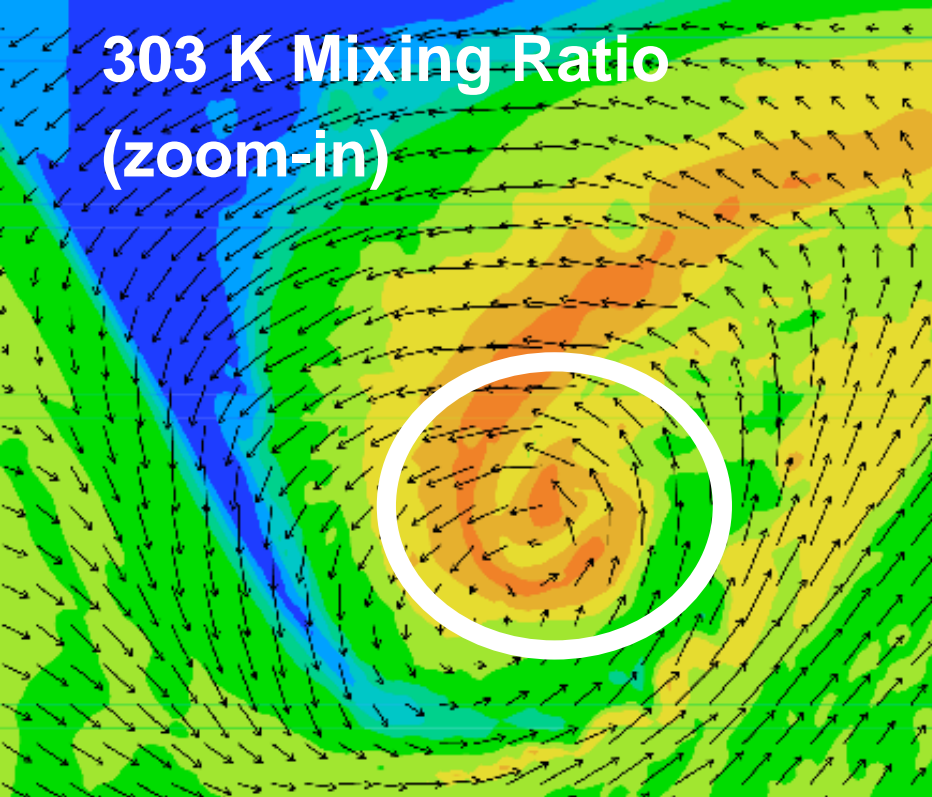
Katrina Hurricane



Development of Hybrid Methodology for Hurricane Forecasting Based on Data-Driven and Physics-Based Models

Pascal Waniha (NC State – CLM)





06Z August 27, 2003

Meteosat-7 WV

303 K Mixing Ratio

Rain Rate

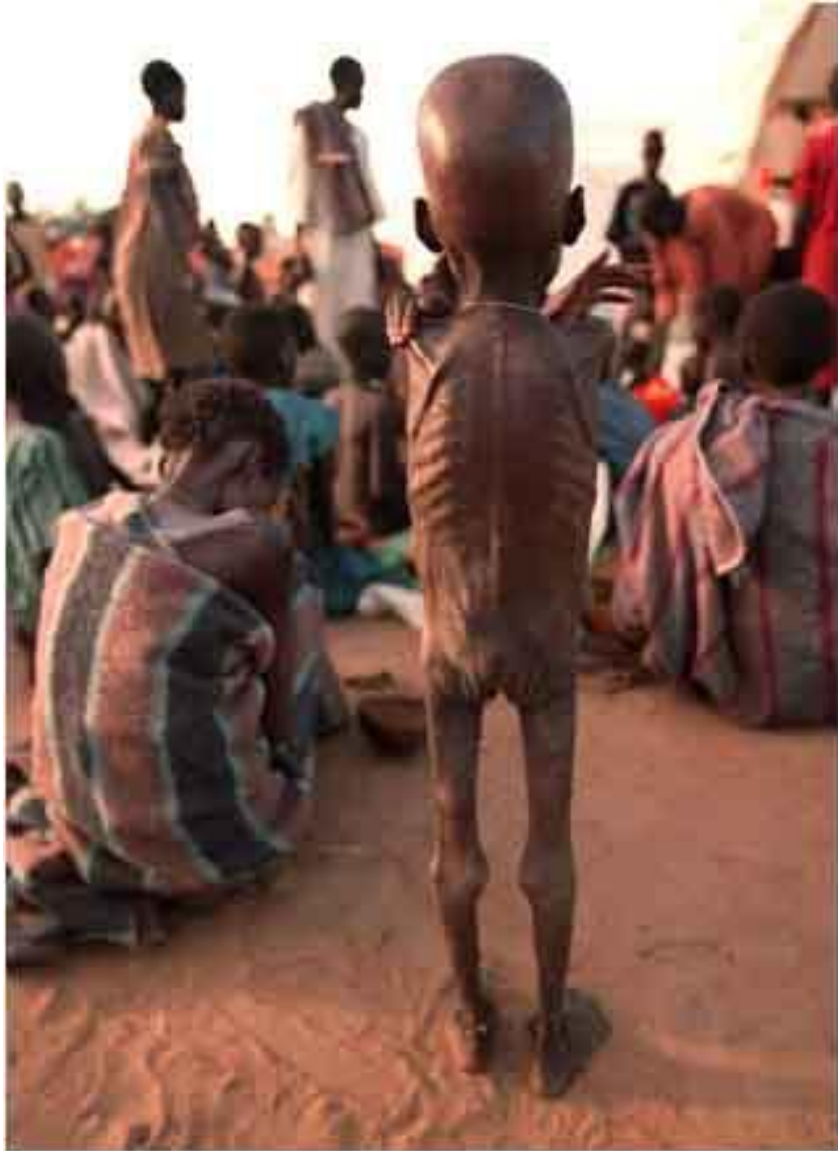
Broader Impacts (Hurricane Forecasting)

- (1) Operationalization of the new research via collaboration with the National Hurricane Centre (NHC) and Regional Hurricane Centres (RHCs) in Indian and eastern Pacific ocean region where the expedition project is developing prediction tools
- (2) Promote the new area of research to study the physics of the inception of Atlantic hurricanes in the Eastern Atlantic via NSF, NOAA & other funding agencies



Climate Change Projections

‘UN calls Somalia drought world’s ‘worst humanitarian disaster’

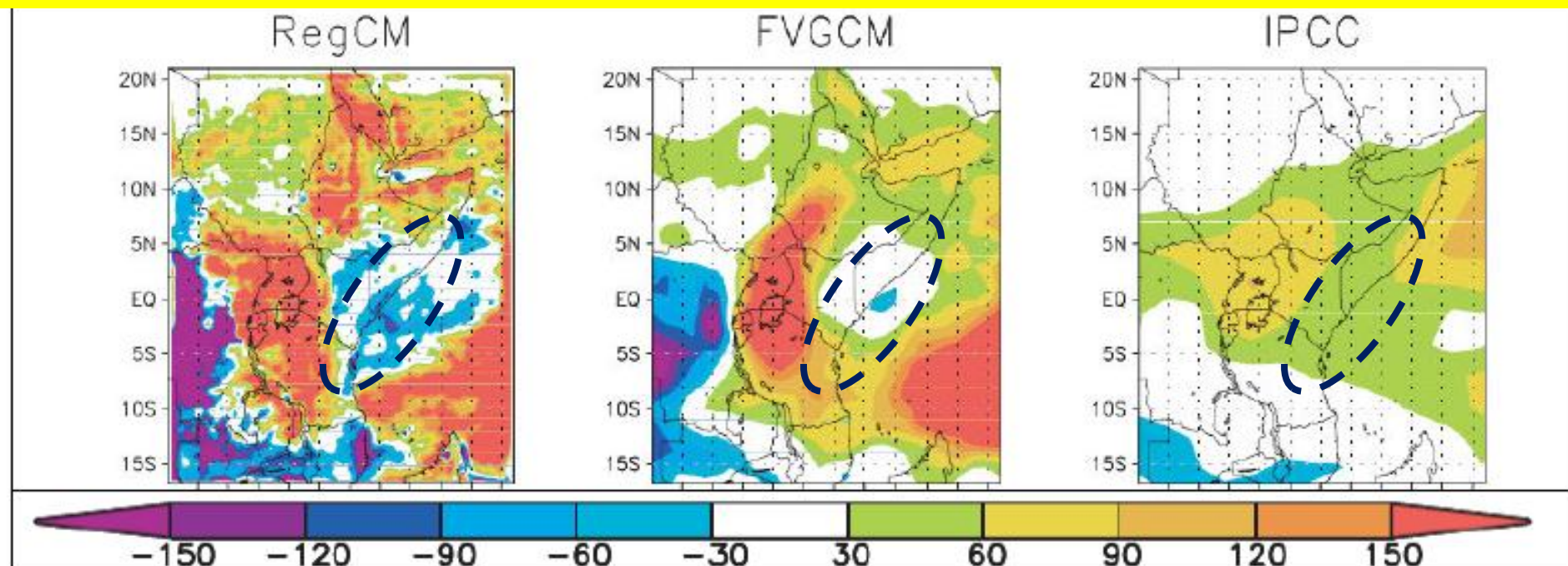


Regional Climate Projections

(Somalia Drought)

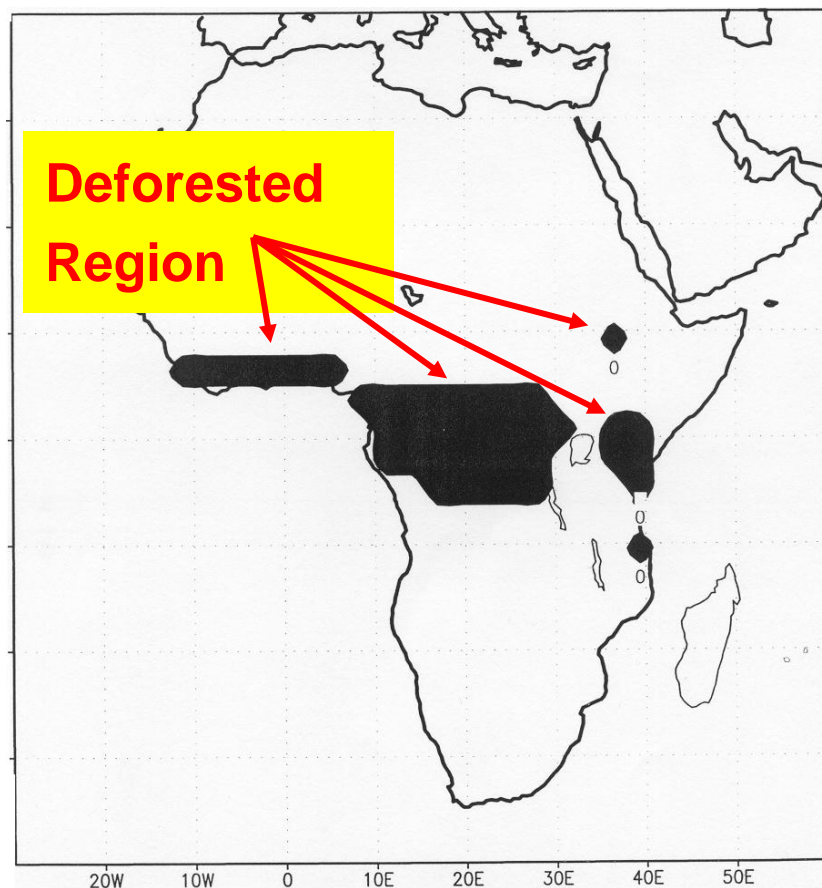
Report to Report to British Department for International Development; 2008

Somalia rainfall deficit cleared evident in RCM projection-Need geographical detail at district level where most decisions are made

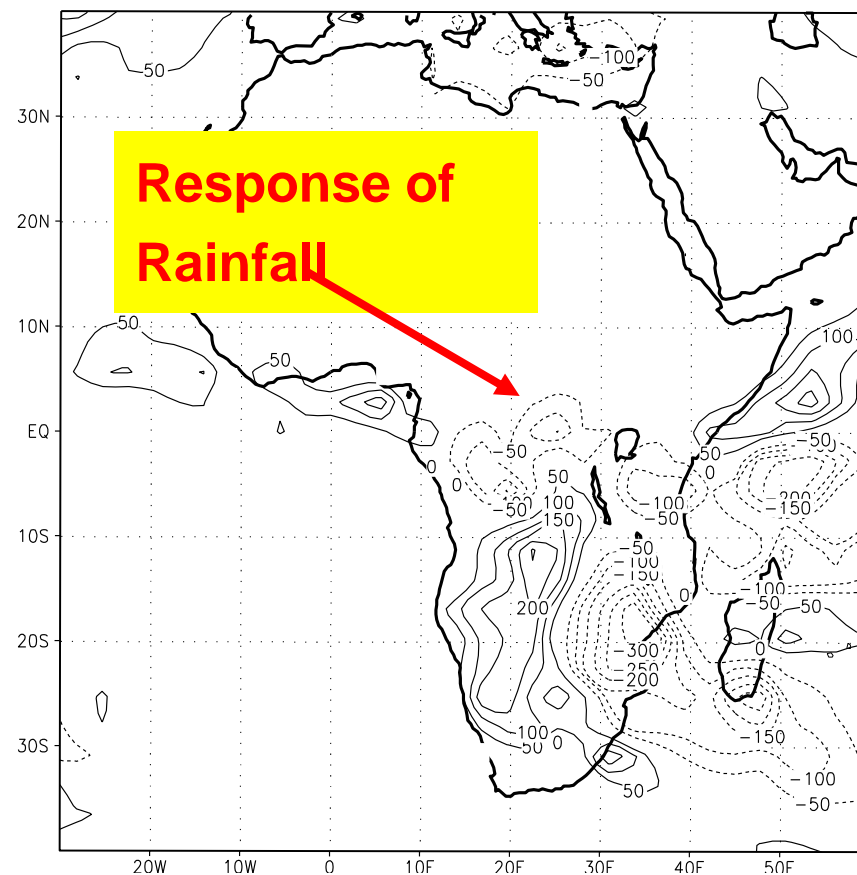


Rainfall projections (A2: 2071-2100 average) minus (RF: 1961-1990 average) for the Oct-Dec short rains: (left) RegCM3 (40 km grid); (centre) 2-member FvGCM ensemble average; (right) eight IPCC GCM super ensemble average. Units, mm.

Large-scale Effects of Deforestation



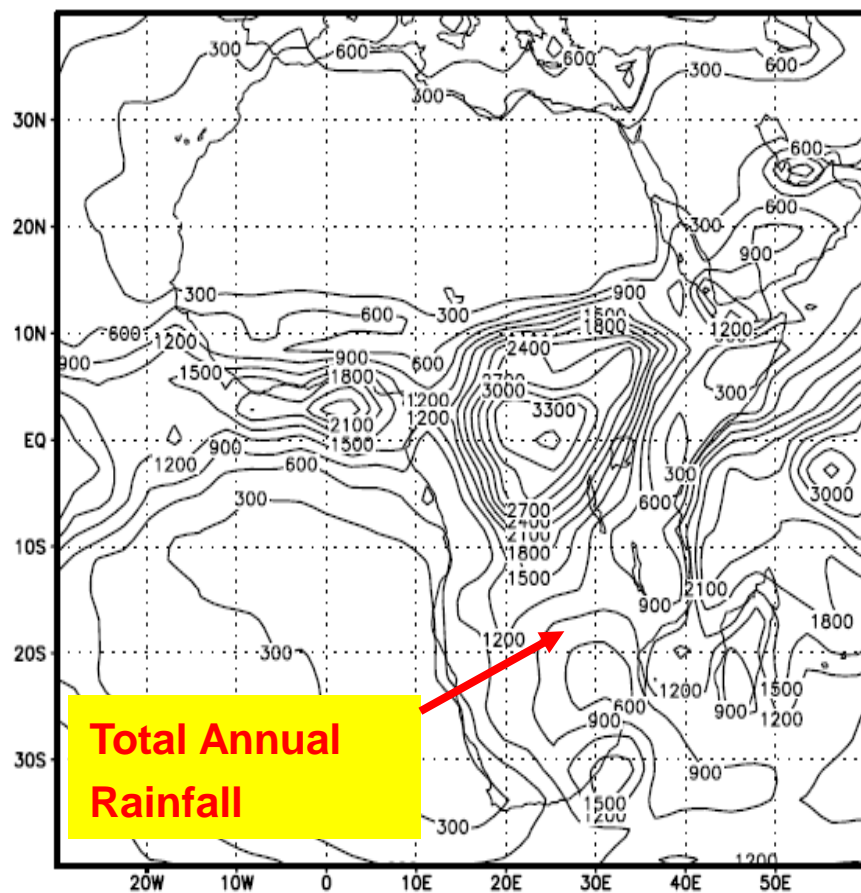
RAINFALL [DEF-CON T]-DJF



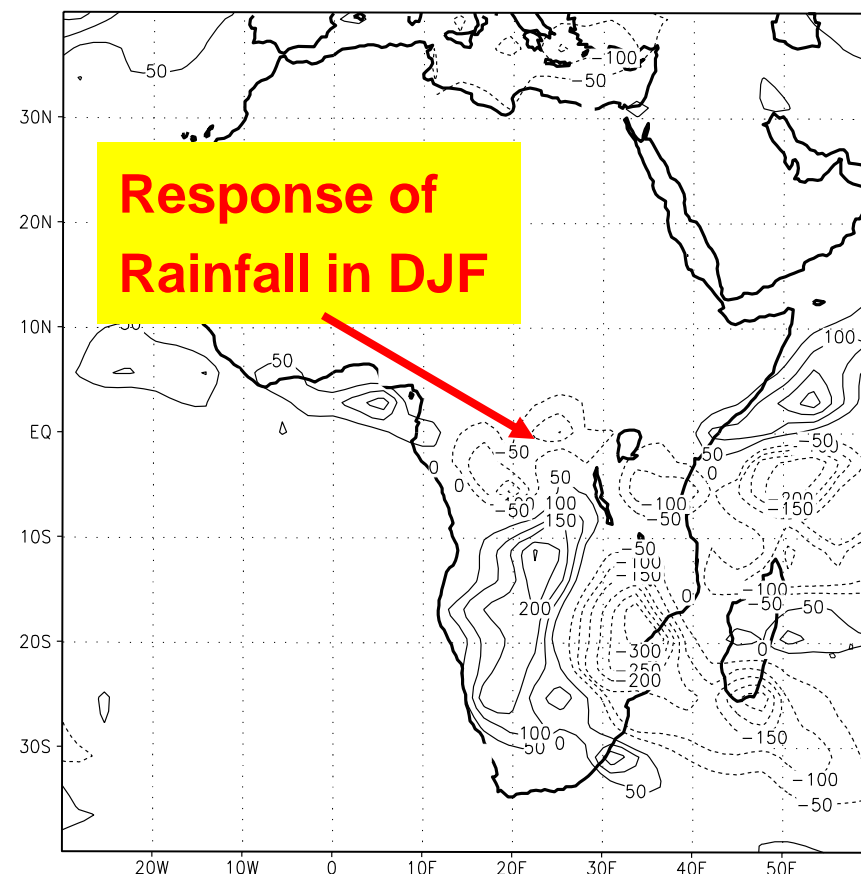
Significance of the equatorial forests may be appreciated by replacing the tropical rain forest with reduced vegetation – Rossby Wave train affecting the southern Africa Monsoon Region

Large-scale Effects of Deforestation

ANNUAL TOTAL (mm) – CONTROL



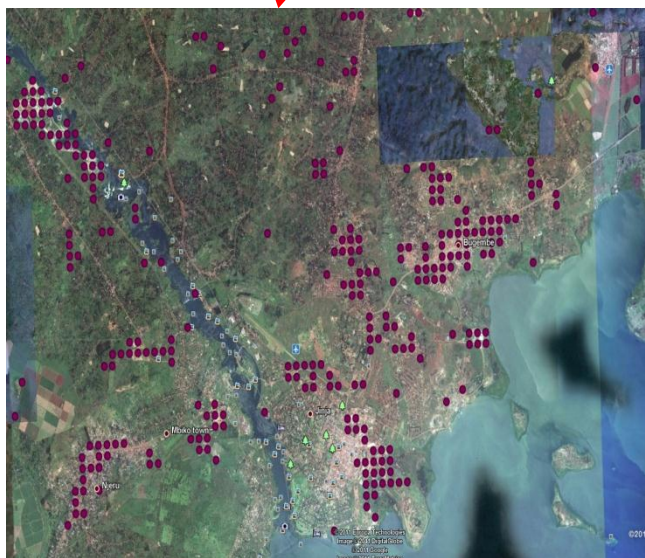
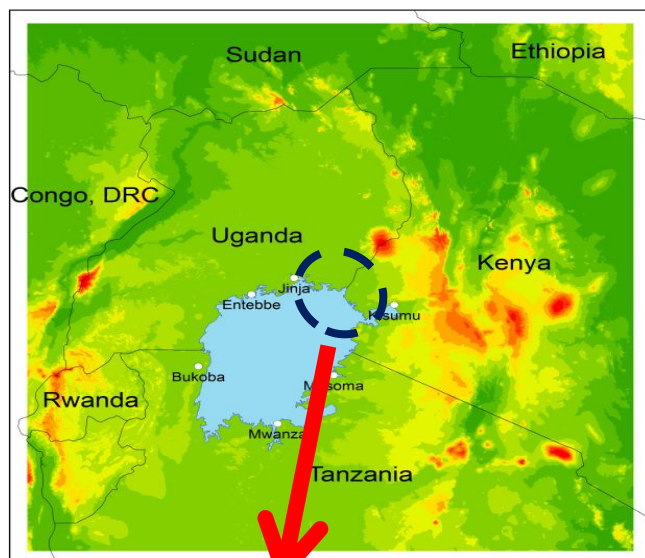
RAINFALL [DEF-CON T]-DJF



Significance of the equatorial forests may be appreciated by replacing the tropical rain forest with reduced vegetation – Rossby Wave train affecting the southern Africa Monsoon Region

Application of computer science detection methods to investigate the impacts of land cover changes on the regional climate over Lake Victoria basin in East Africa

Kara A. Smith (NC State, CLM)



Detection: Changes in land surface cover can be detected from MODIS satellite data Enhanced Vegetation Index (EVI) data-driven classifier University of Minnesota that detects land cover changes.

Specification of model lower boundary condition: Apply University of Minnesota data-driven algorithm to infer & prescribe realistic future land surface cover changes in our climate model projection simulations.

Model projections: Perform WRF regional climate model projection simulations using more realistic land surface cover

Figure: Land cover change in and around Jinja, Uganda as calculated by Expeditions group from University of Minnesota. Red dots are locations of land cover change.

Broader Impacts

(Climate Projection Research)

**Improved climate
projections for climate
adaptation via IPCC Process**

Seasonal Climate Prediction

Meningitis Application

(reinforce google.org project)

- Meningitis is a serious infectious disease affecting 21 countries; Kills 100s of thousands in one year
- 300 million people at risk
- 700,000 cases in the past 10 years
- 10-50 % case fatality rates

African Meningitis Belt



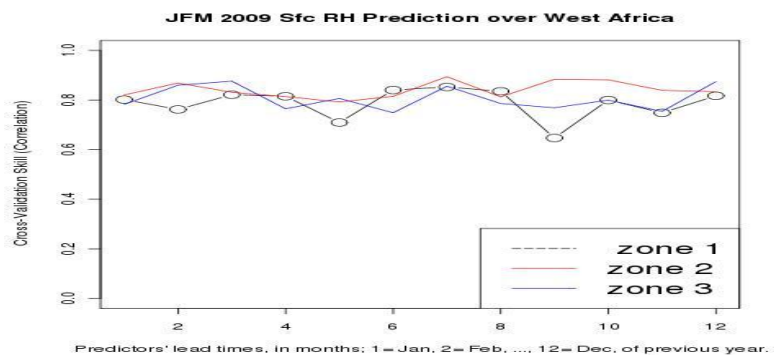
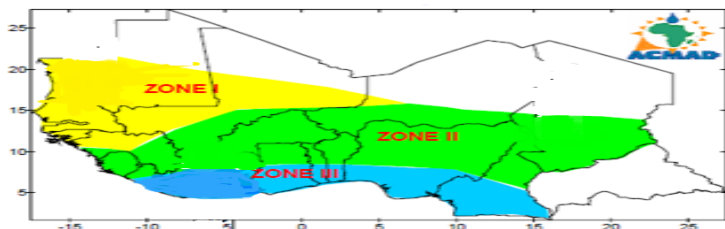
An Application of a Newly Developed Machine Learning Technique for Predicting Climate-Meningitis Seasonal Outlook over West Africa

Isaac Tetteh (NC State – CLM)



Climate Modeling Laboratory

Predictability: JFM 2009 sfc RH over West Africa based on JAS 2009 ACMAD Consensus Seasonal Rainfall Forecast Zones



Conclusions

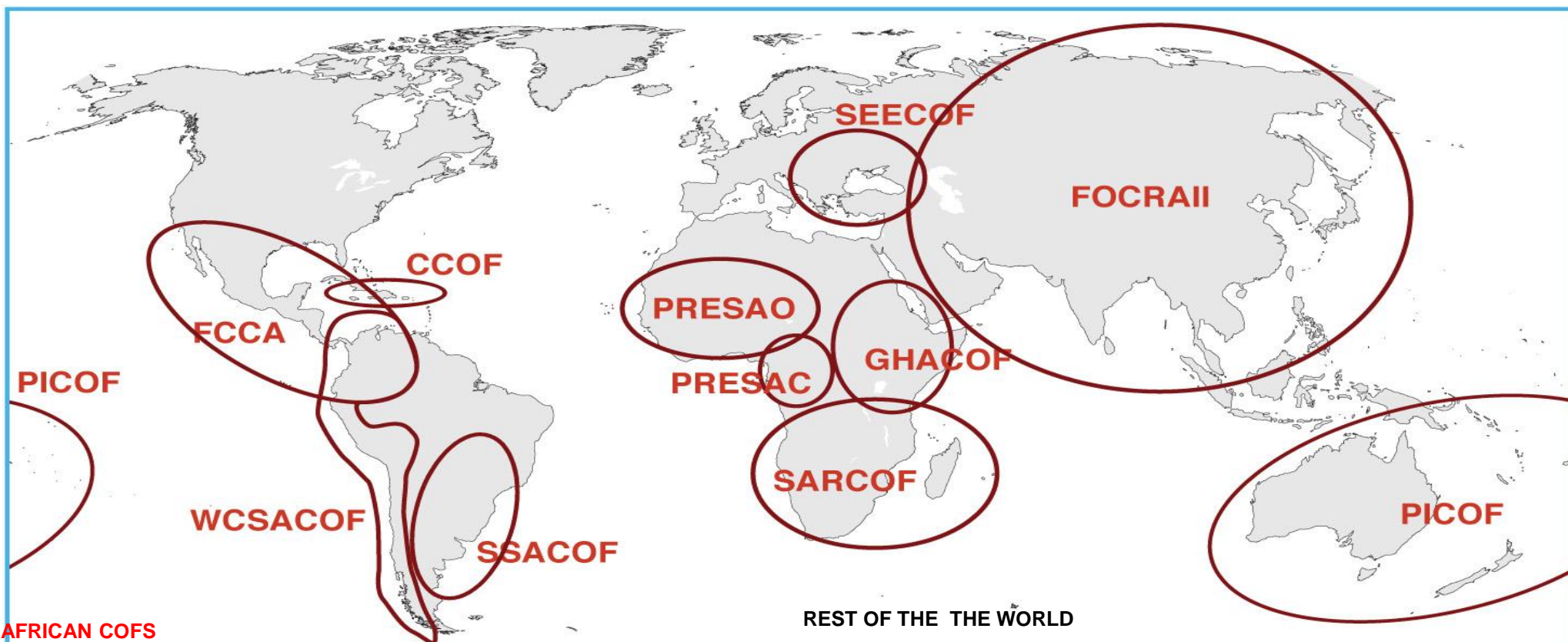
- July predictors; global SST, U & V winds achieved the highest prediction skill of $r = 0.85$ at 5 months lead time for JFM RH over zone 1.
- Similarly, July predictors, in addition to PW, achieved the highest prediction skill of $r = 0.89$ at 5 months lead time over zone 2.
- March predictors, as in zone 2, achieved the highest prediction skill of $r = 0.88$ at the longest lead time of 9 months for zone 3..
- Finally, this research will engage the African Centre of Meteorological Application for Development (ACMAD) seasonal climate prediction centre in West Africa to transfer the new technology to the operational environment. This will maximize broader impacts of the research to benefit over 2 billion people in Africa.

Global Climate Outlook

Regional Prediction Centers

Broader Impact: Operationalization of prediction tools via WA RCC with meningitis as test application sector

Broader Impact: Globalization of prediction tools via WMO GFCS and extend to other climate sensitive sectors



1. **GHACOF:** Greater Horn of Africa COF

2. **SARCOF:** Southern Africa COF

3. **PRESAO:** Western Africa

4. **COFPRESAC:** Central Africa CO

1. **FOCRAII:** Forum On regional Climate monitoring, assessment and prediction for Regional Association II (Asia)

2. **SSACOF:** Southeast of South America COF

3. **WCSACOF:** Western Coast of South America COF

4. **CCOF:** Caribbean COF

5. **FCCA:** Foro Regional del Clima de América Central

6. **PICOF:** Pacific Islands COF

7. **SEECOF:** SouthEastern Europe COF

Perhaps we can put a smile on this man's face



THANK YOU