

Weather Research and Forecast (WRF) Modeling in AFRICA: The Ghana Example

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Overall Goal

Model-based computer weather forecasting performed

- in Africa
- by Africans
- for Africa's needs

Motivation

- **Capacity building**
 - **Operational forecasting** - for public safety, agriculture, water resources, energy, health
 - **Training** - numerical weather modeling, computer-system management.
 - **Education** - model output will be used for university instruction and research
 - This is an inclusive effort not exclusive. Will work with existing modeling and training centers in Africa
- A tool for cooperation among local universities, government agencies and the private sector regarding weather information.

A Two-phase Development Plan

- Phase – I
 - Establish an operational mesoscale forecasting system at NCAR (using modest computer), and provide web-based products to African weather services. Focus first on West Africa **Internally funded, DONE.**
 - Improve model (forecast quality) and graphical interface based on feedback from African forecasters. **Internally funded, ONGOING.**
 - Conduct a workshop for forecasters, in Accra, on “effective use of high-resolution meteorological-model products” **(UNFUNDED).**

Current Operational Forecast System:

Computational Grids

Three nested
domains

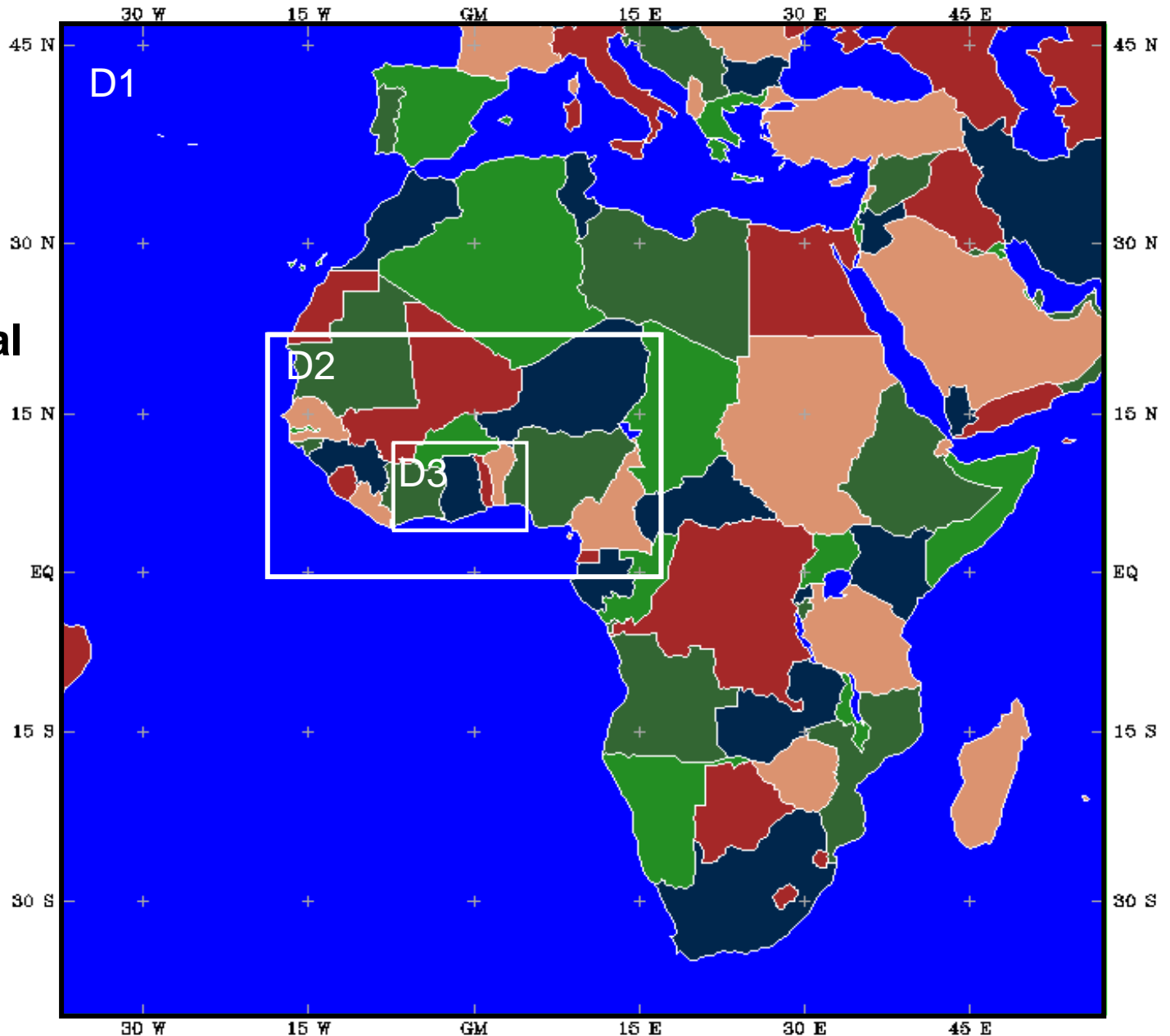
$DX =$
40.5/13.5/4.5 km

Dimensions

D1: 261x261x36

D2: 184x295x36

D3: 208x301x36



- **Phase – II**

- **Expand area coverage of model high-resolution weather products using larger computer.**
- **Expand educational component – Work with African universities and meteorological services to improve knowledge of numerical weather prediction and mesoscale meteorology.**
- **Develop capacity for operating and maintaining operational computing and communication system to support NWP**
- **Develop partnerships with African stakeholders (agriculture, water, etc.) to adapt weather products to special needs – e.g., coupled weather/agricultural models, dust-storm models, etc.**
- **External Funding will be needed**

Early Partners and Interested Organizations

- **Ghana Meteorological Agency**
- **Nigeria Meteorological Agency (through Ernest Afesimama)**
- **University of Ghana – Legon, Ghana**
- **Kwame Nkrumah University of Science and Technology - Kumasi, Ghana**
- **Federal University of Technology, Akure, Nigeria (through Adebayo)**
- **Private sector (ZedX Inc., coupling weather models with agricultural models, etc.)**
- **African Centre for Meteorological Applications and Development (ACMAD)**
- **Kofi Annan Centre of Excellence (KACE), Ghana**

Model Web sites

- **Real-Time Demonstration home page**
<http://www.ral.ucar.edu/projects/wafrica>

A satellite image of the Earth, centered on the African continent. The image shows the blue oceans, white clouds, and green and brown landmasses. The text is overlaid on the image.

Weather Research in Africa: Science for Society

Arlene Laing and Mitch Moncrieff
(NCAR/MMM)

Motivation & Research Needs

- African societies need better precipitation forecasts (for economy, health, water resource management, ...).
- Seasonal forecasts miss some critical information
(e.g., onset and duration of dry periods and heavy precipitation events)
- **Dire need to quantify Africa's convective weather systems and precipitation regimes** (satellite, radar, field observations)
- **Conduct diagnostic studies of different types of extreme weather** (e.g., severe weather, flash floods, dust storms)
- **Improve representation of physical processes in numerical weather prediction models**

Geographic Distribution & Diurnal Cycle

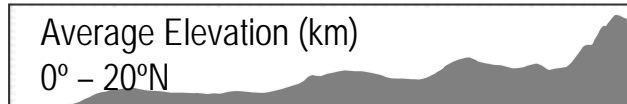
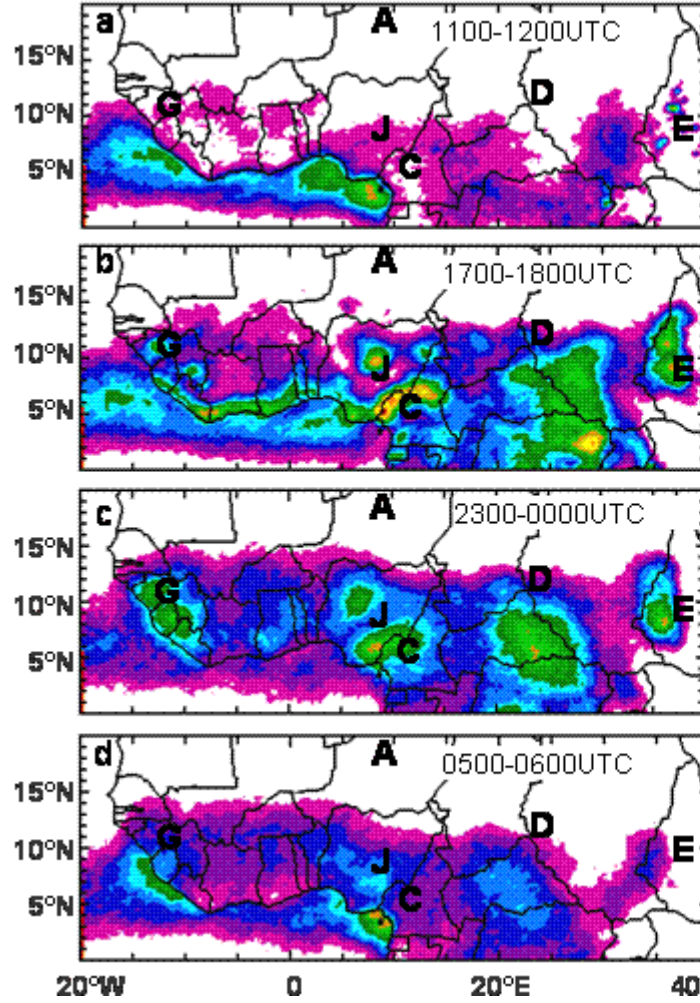
Precipitating convective systems identified by satellite IR

Convection triggered daily in lee of high terrain

Propagation to WSW => delay in time of daily max precipitation

Pre-monsoon

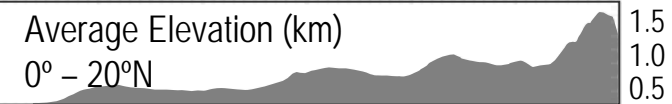
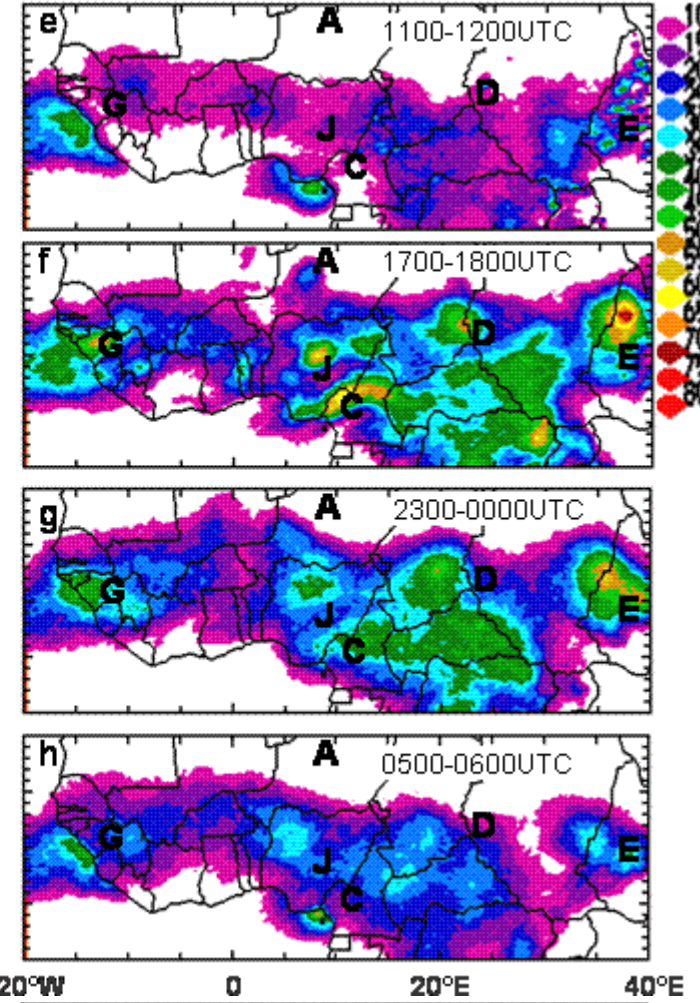
15 May – 30 June 1999 to 2003



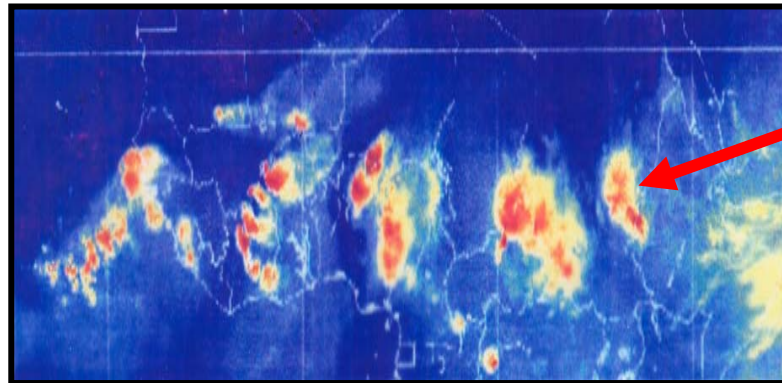
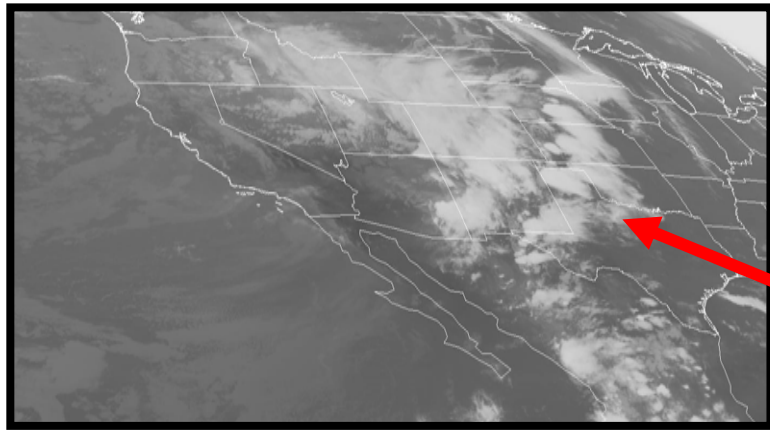
Letters mark mountain peaks

Peak monsoon

1 July – 15 Aug 1999 to 2003



Patterns of convective precipitation over N. Africa resemble those in specific regions around the World



... specifically, environmental shear controls convective organization (c.f., US continent during summer - Moncrieff and Liu, 2006)

What is best way to apply what has been learnt in the US to weather prediction in Africa?