



Establishing a Daily Weather Forecasting Station in Africa

Using the GISS Regional Climate
Model to Forecast the Weather in
the African Sahel

The African Sahel



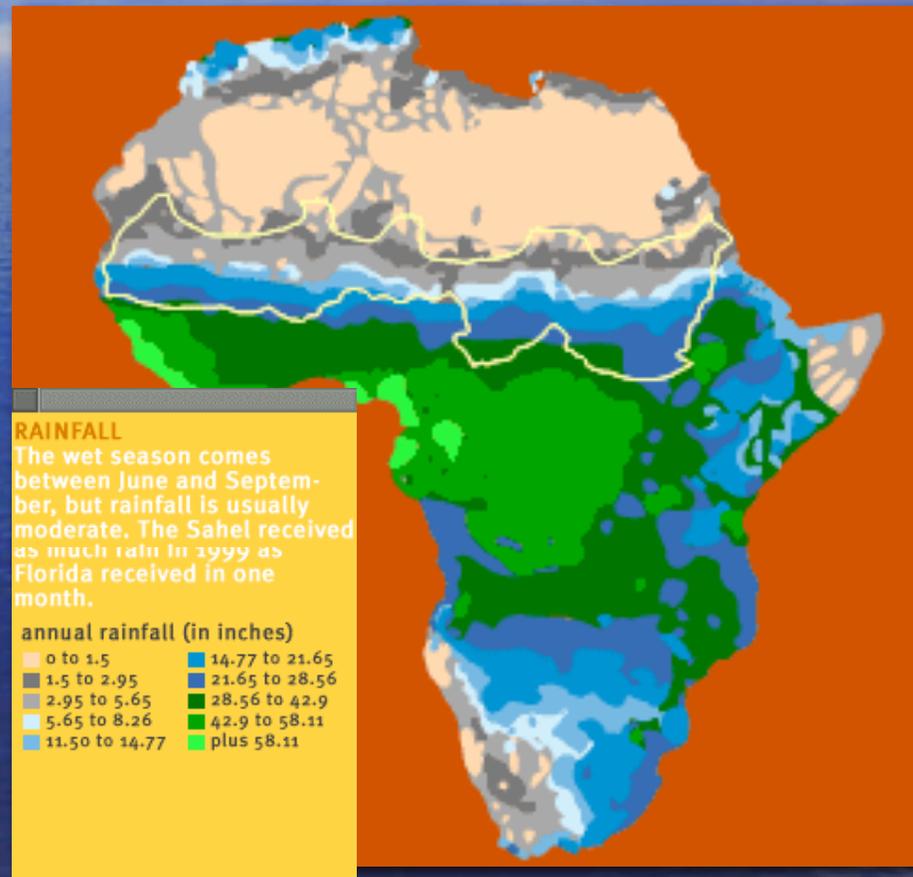
- The Sahel (Arabic for border or shore) is a transition zone between the Sahara desert to the north and the tropical rainforest region to the south.

The African Sahel

The region is predominantly sparse savanna vegetation which receives its rain from the summer monsoons occurring between the months of June and September.

Rainfall in the Sahel

The climate is typically arid and unstable, subject to devastating fluctuations and the steady encroachment of the Sahara desert,



Climate change in the Sahel

- “Climate change in the Burkina Faso does not necessarily mean there is less rain, it means that rainfall has gotten less predictable”.
- “People cannot predict when rain will come, and when it comes, it comes in buckets”.
- “The alternative to floods is basically no rainfall... and either way it is a crisis for some of the world’s poorest people.”

Jan Egeland UN Secretary General's Special Advisor on Conflict

UNEP

African Centre of Meteorological Application for Development



- Established in 1987 by the Conference of Ministers of the United Nations Economic Commission for Africa.
- To provide weather and climate information and to promote sustainable development of Africa in the fields of water resources, health, public safety, and renewable energy.
- <http://www.acmad.org>

African Centre of Meteorological Application for Development



- Weather Prediction
- Climate, Environment, and Development
- Development and Tools Transfer to National Meteorological Services, Telecommunication, and Data Visualization
- Information, Communication, and Meteorological Applications
- On the Job Training
- Applied Meteorological Research

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Our Collaboration with ACMAD began in 2005 With a grant from CCSR to furnish them with a computer to do their own weather forecasting using the GISS RM3 regional climate model. Until this time they relied on European Sources for their weather forecasts.



<http://www.acmad.org>

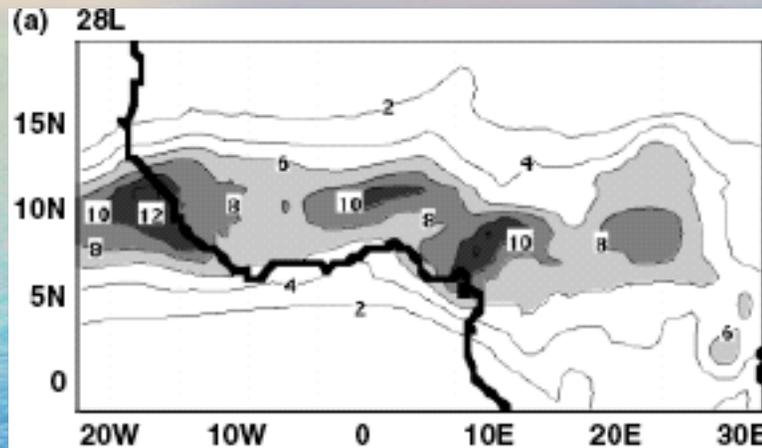
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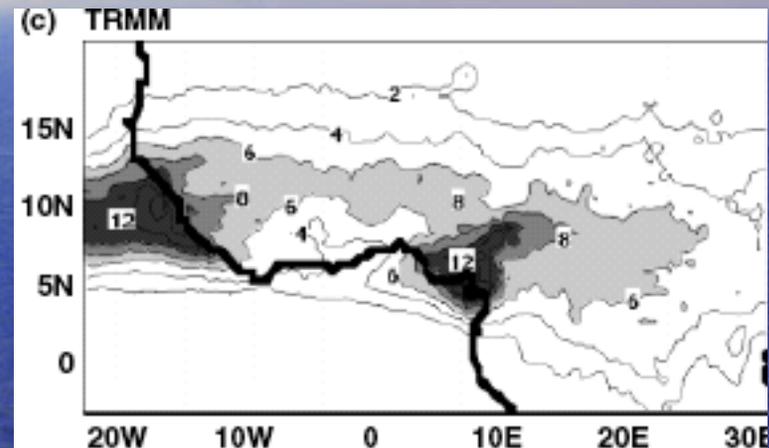
The GISS Regional Climate Model (RM3) has a domain covering West Africa, the eastern North Atlantic, and the Gulf of Guinea. The grid spacing is 0.5 degrees in both longitude and latitude. It is forced over the domain by lateral boundary conditions obtained from the GFS input data for that domain. It uses a semi-Lagrangian advection scheme and semi-implicit time differencing at 28 vertical levels. The RM3 has been updated by the inclusion of the Yao - DelGenio convection and the Abramopoulos-Rosenzweig ground hydrology.

<http://www.acmad.org>

Comparison of RM3 with TRMM for Jun-Jul-Aug-Sep 1998-2003



Average rainfall from RM3
forced with NCEP2 (mm/day)



Average rainfall from TRMM
data (mm/day)

Problems Encountered Setting up Weather Forecasting System

- 50% Voltage fluctuations in the dry Season
- Very slow rate of data transmission
- GFS Input data was changed to [GrIB2](#)
- Data transmission susceptible to interruption
- Need to interface bash scripts with csh scripts
- 12Z output data produced after midnight WAT

Crontab file:

```
11 00 * * * $HOME/GFSdata/clean_yesterdays_files00a
12 00 * * * $HOME/GFSdata/clean_yesterdays_IC00g
13 00 * * * $HOME/GFSdata/testdate00
14 00 * * * $HOME/GFSdata/ftp_grabandgrib_this00
11 06 * * * $HOME/GFSdata/clean_yesterdays_files06a
.
.
.
14 18 * * * $HOME/GFSdata/ftp_grabandgrib_this18
```

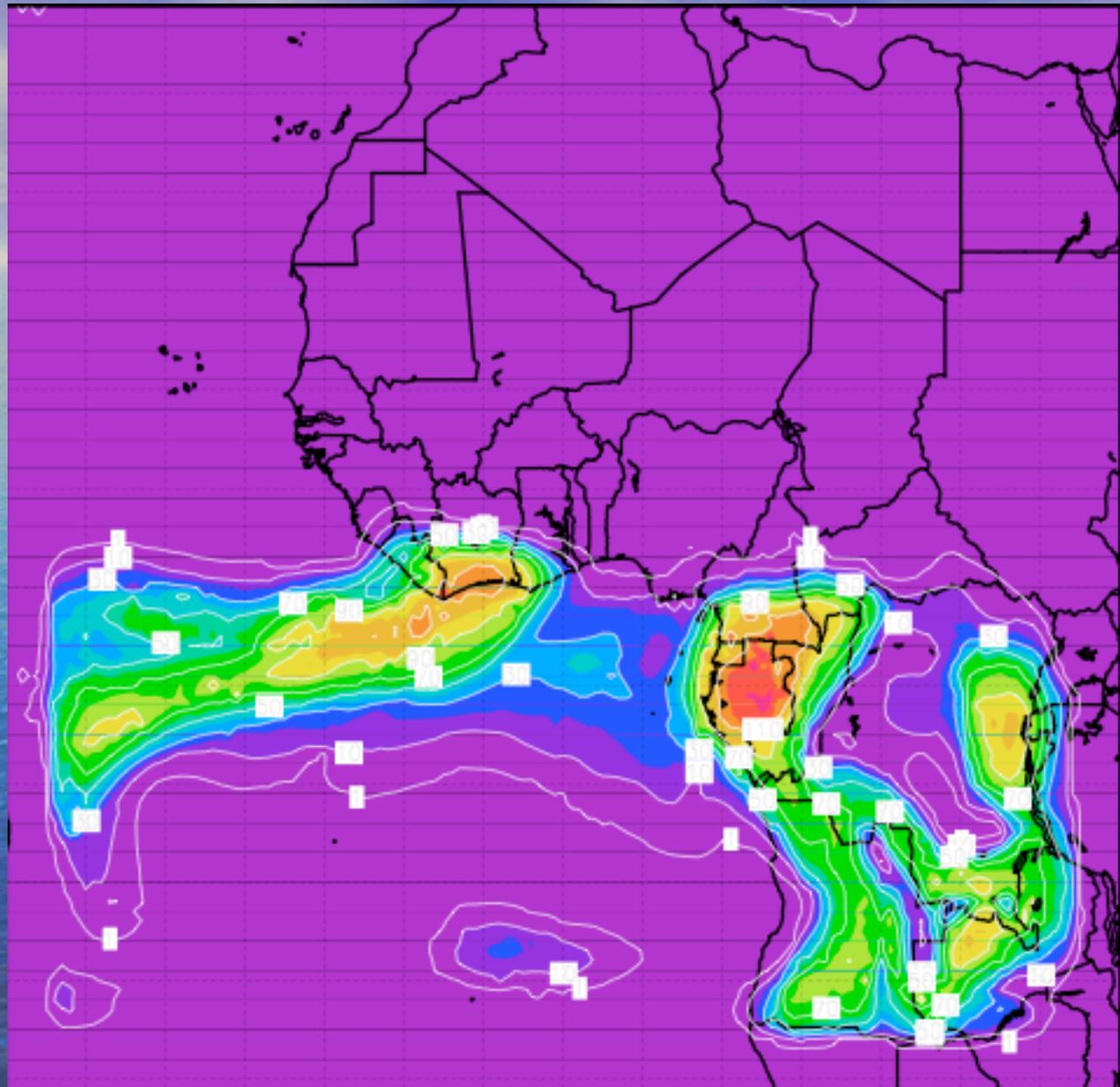
Download data from GFS site:

```
# script to download files from NCEP GFS
echo "Downloading RD.<yyyy><mm><dd> at <hh> hours"
echo Downloading RD.$1$2$3/fh.$5_tl... at $4 hours
#
ftp -n tgftp.nws.noaa.gov << eof
user anonymous cdpgl@giss.nasa.gov
epsv4
binary
prompt
cd SL.us008001/ST.opnl/MT.gfs_CY.$4
cd RD.$1$2$3/PT.grid_DF.gr2
get fh.$5_tl.press_gr.1p0deg
quit
eof
```

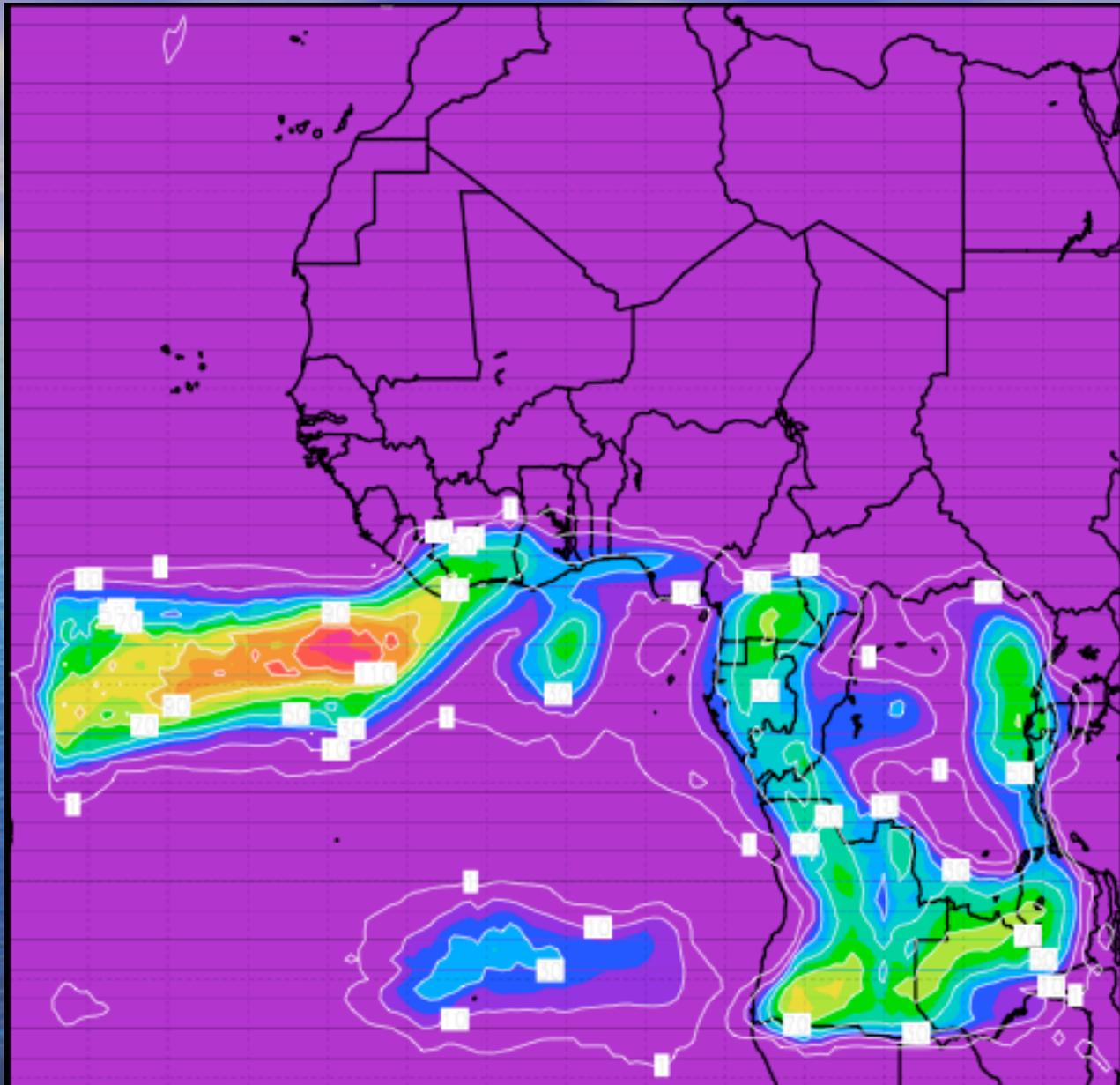
Call GrADS routines:

```
# changes directory to OUTPUTS00 and runs GrADS scripts  
# from there  
#  
cd $HOME/OUTPUTS00  
  csh $HOME/OUTPUTS00/mdkplotrm3n2  
cd $HOME/GFSdata
```

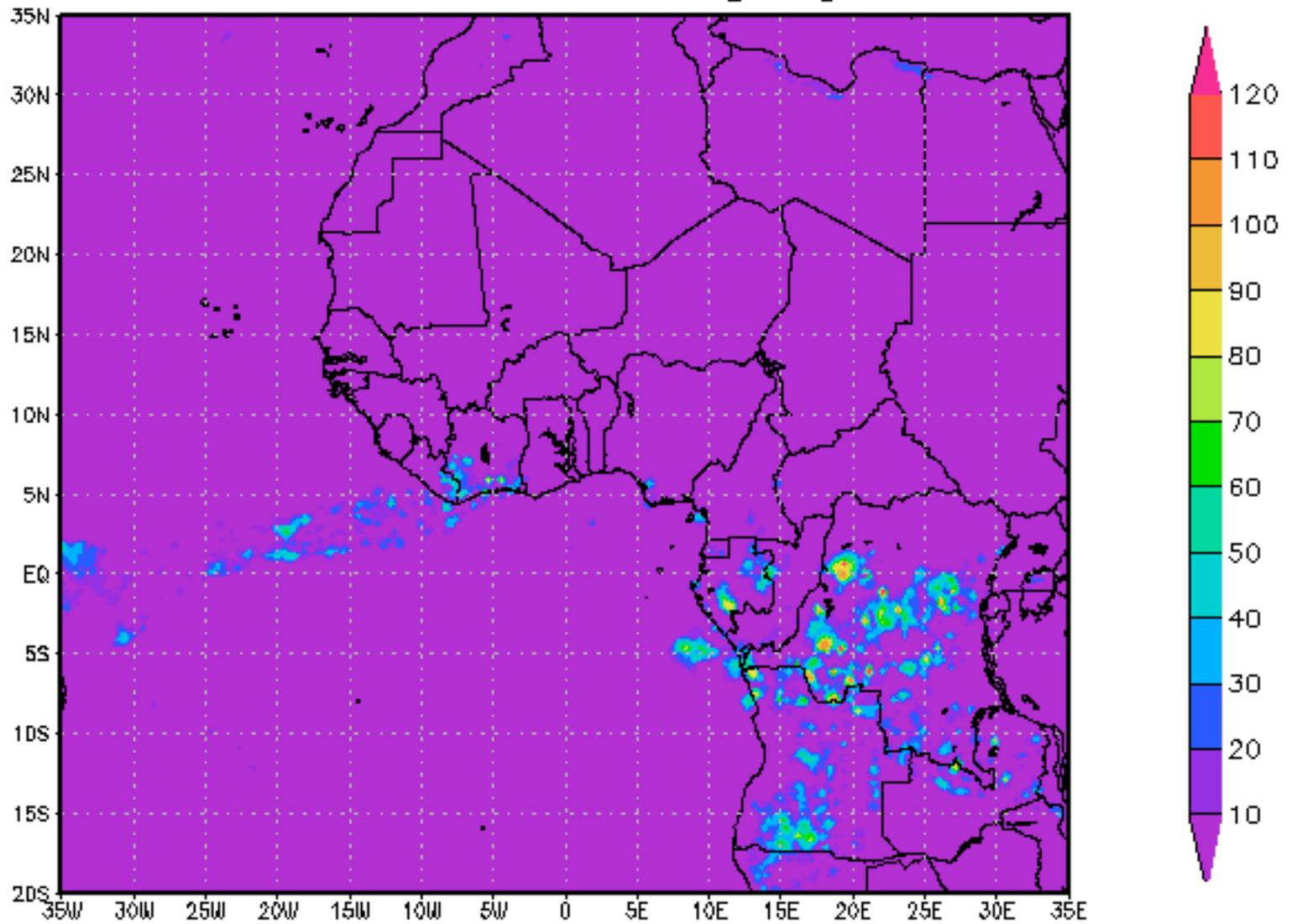
ACMAD RM3 24h rainfall; valid T+24h; from 12Z on Thu Feb12 2009



ACMAD RM3 24h rainfall; valid T+24h; form 00Z on Fri Feb 13, 2009



TRMM TMPA-RT Daily 13Feb2009 Accumulated Rainfall [mm]



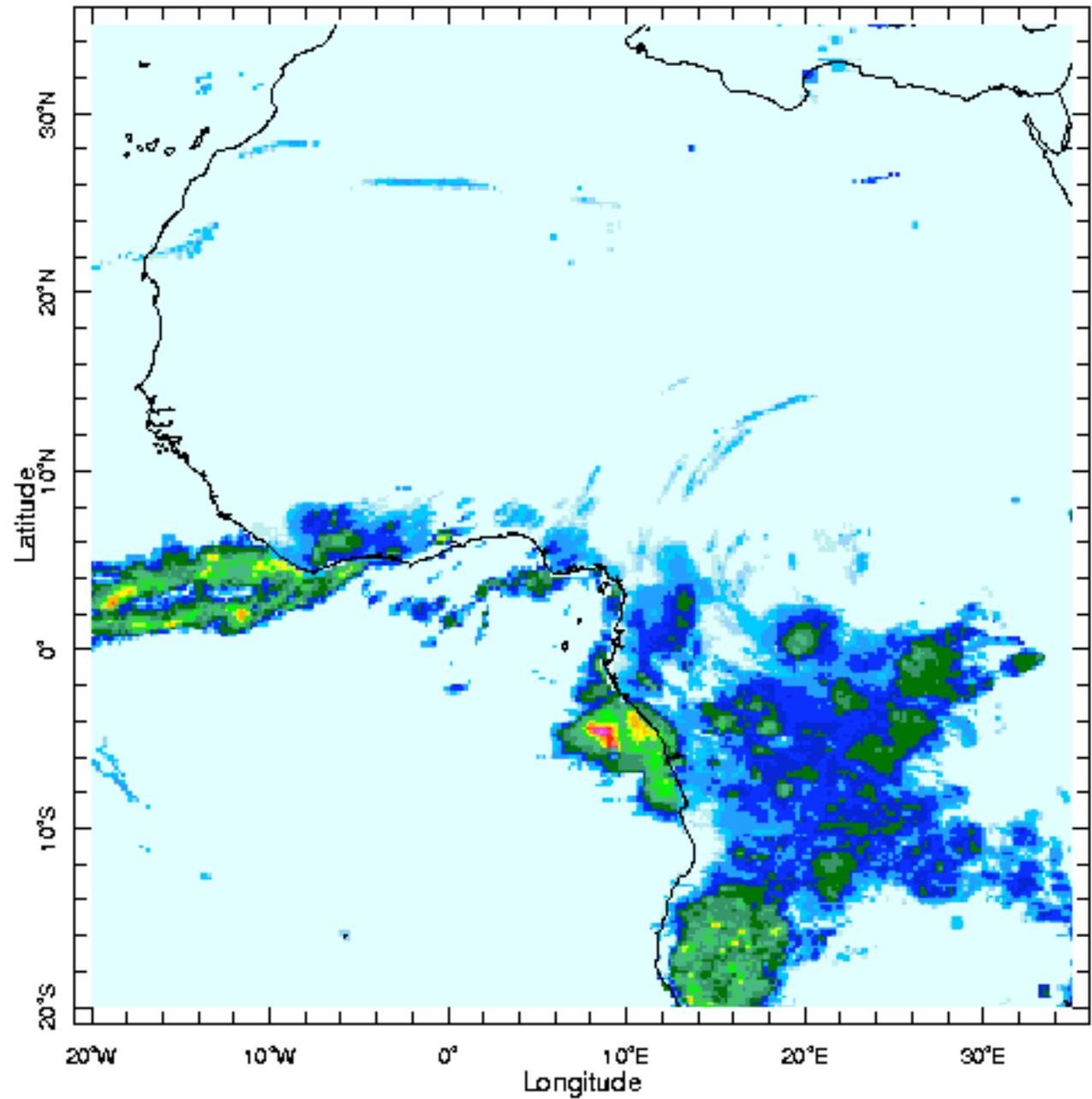
GrADS: GOLA/IGES

2009-02-17-15:49

Generated by NASA's Giovanni (giovanni.gsfc.nasa.gov)

Feb 13
2009
Daily
Rainfall

FEWS Africa
DAILY



13 Feb 2009



Ongoing Tasks:

- Run RM3 on larger domain (-40deg to +40deg lon and -25deg to +40deg lat) and crop output down to original domain.
- Solve “spreading” of high rainfall areas in forecasts
- Explore faster means of downloading [GFS](#) input data
- Set up and run RM3 on additional domain covering southern Africa.

References:

- Druyan, L.M., M. Fulakeza, and P. Lonergan, 2008: The impact of vertical resolution on regional model simulation of the west African summer monsoon. *Intl. J. Climatol.*, 28, 1293-1314
- <http://www.acmad.org>
- <http://lake.nascom.nasa.gov/Giovanni/tovas>
- <http://iridl.ldeo.columbia.edu/SOURCES/.NOAA/.NCEP/.CPC/.FEWS/.Africa/.DAILY/.RFEv2>
- <ftp://tgftp.nws.noaa.gov>
- <http://www.cpc.ncep.noaa.gov/products/wesley/wgrib2>

Reference scripts:

- [crontab script](#)
- [file and directory management](#)
- [main driver script](#)
- [downloader script](#)
- [GrIB2 to ASCII](#)
- [Quality control](#)
- [extract forecasts](#)
- [GrADS interface](#)