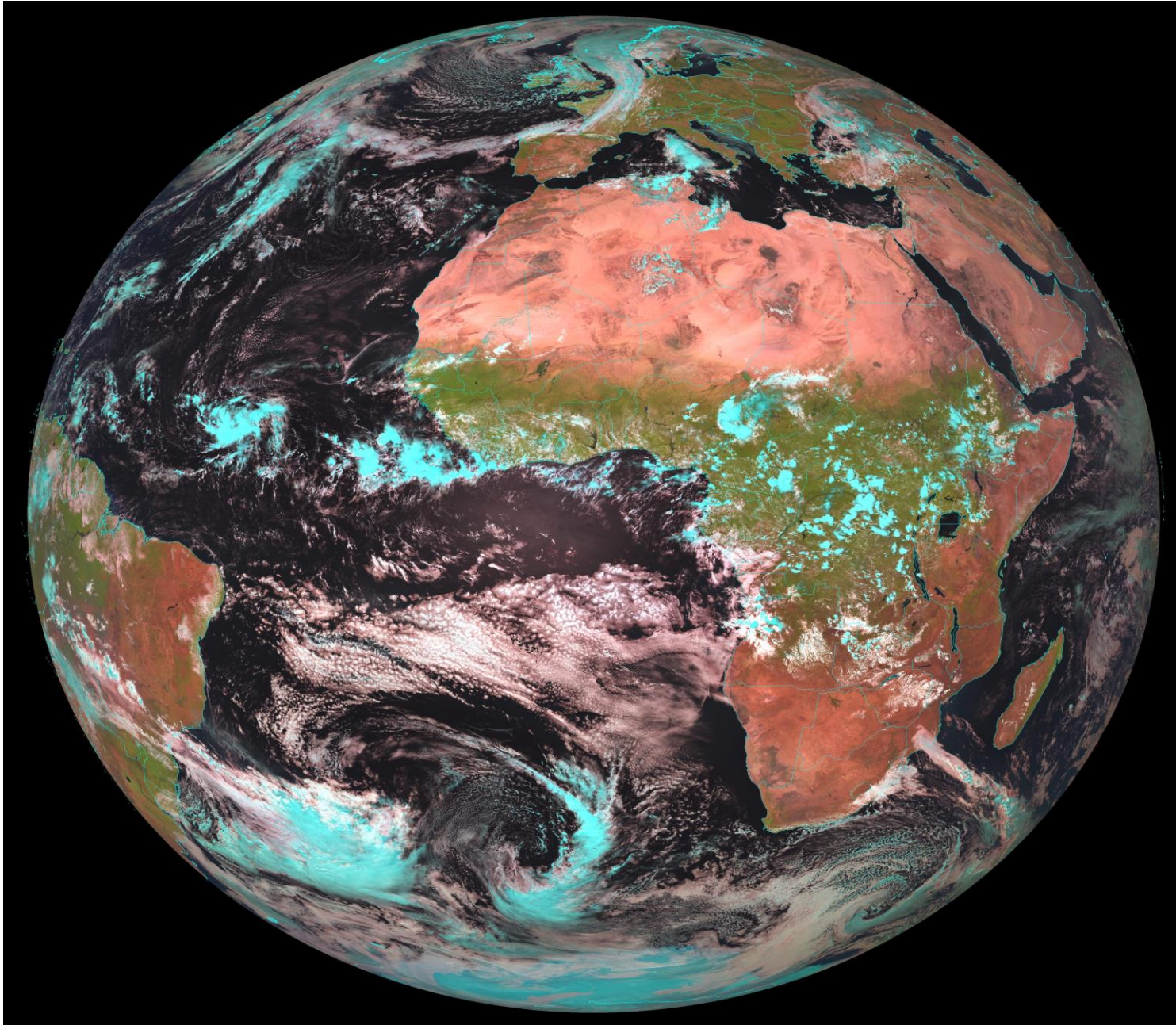


Downscaling seasonal forecasts over South Africa



Chris
Lennard

Seasonal forecasting at CSAG

Implemented new forecast system on a new computational platform...lots of blood, still bleeding

United Kingdom Meteorological Office Atmospheric General Circulation Model - HadAM3P

Resolution: ~190x125km

Run:

10 member ensemble - initialized with previous month start dump

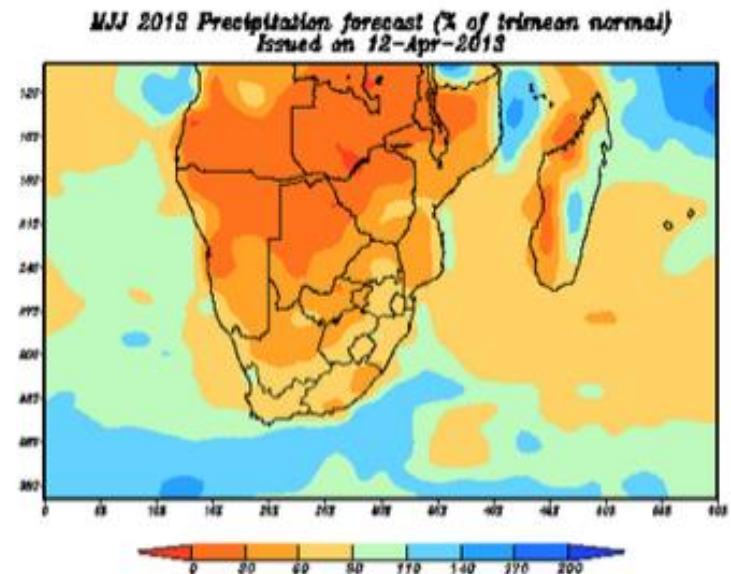
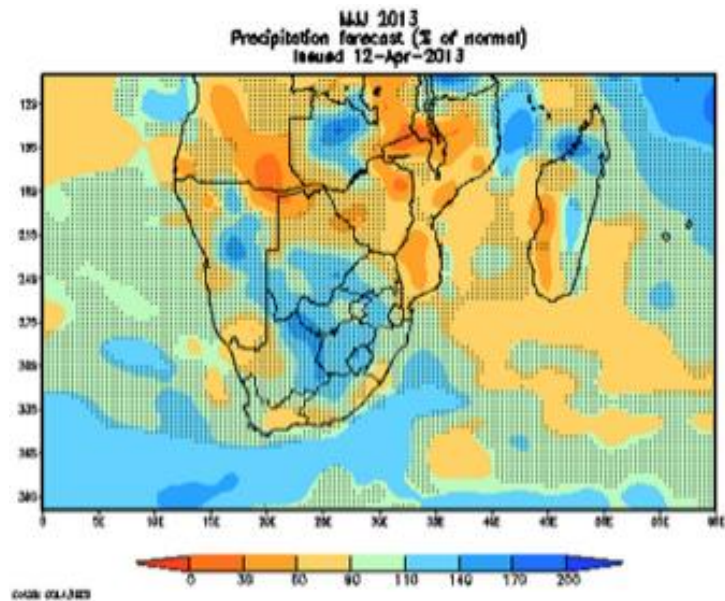
Persisted Reynolds SST anomalies....three month forecast

Produced in the middle of the month

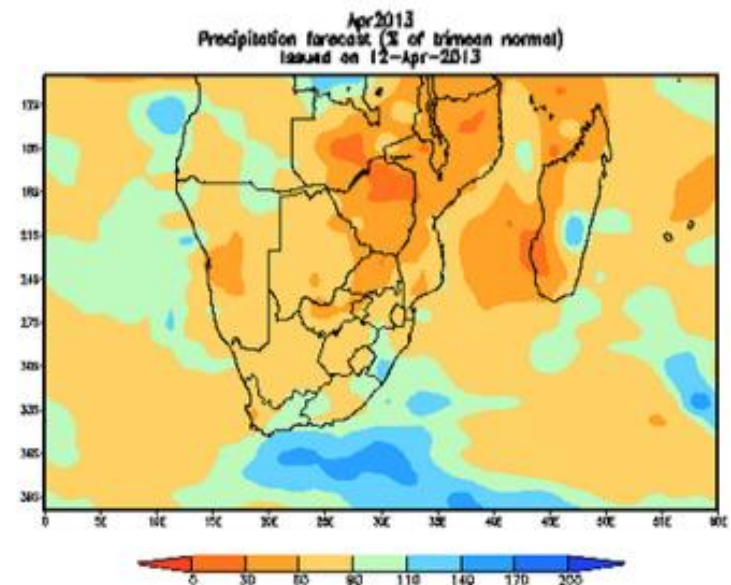
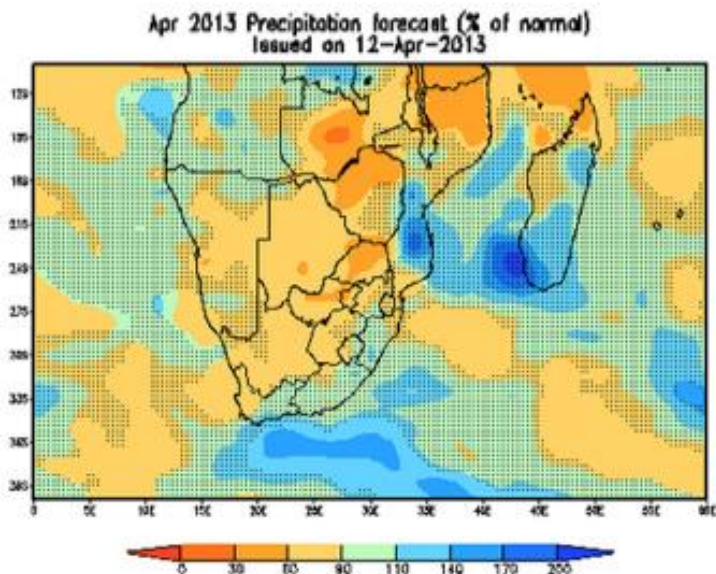
Published online...

www.gfcsa.net/csag.html

Seasonal forecasting at CSAG



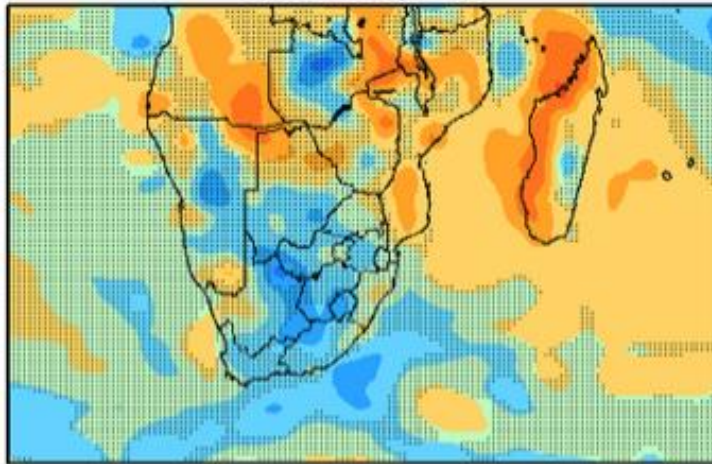
Monthly forecast



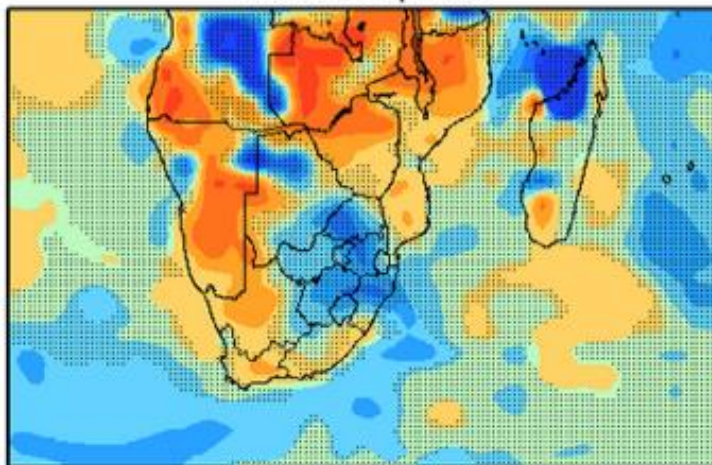
www.gfcsa.net/csag.html

Seasonal forecasting at CSAG

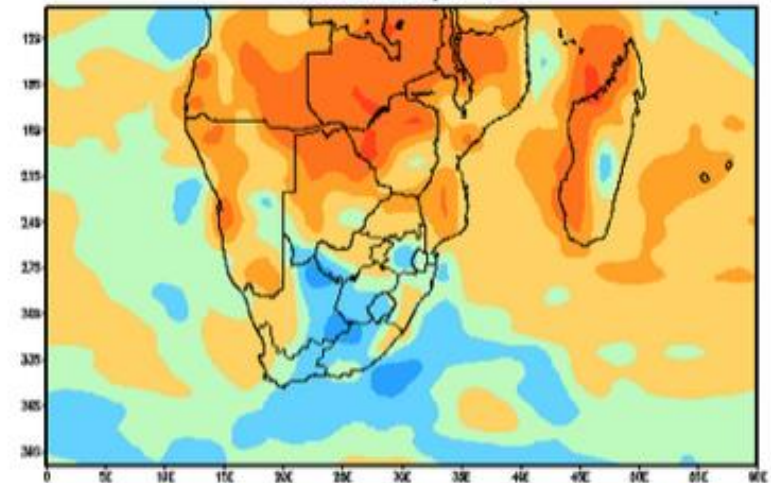
May 2013 Precipitation forecast (% of normal)
Issued on 12-Apr-2013



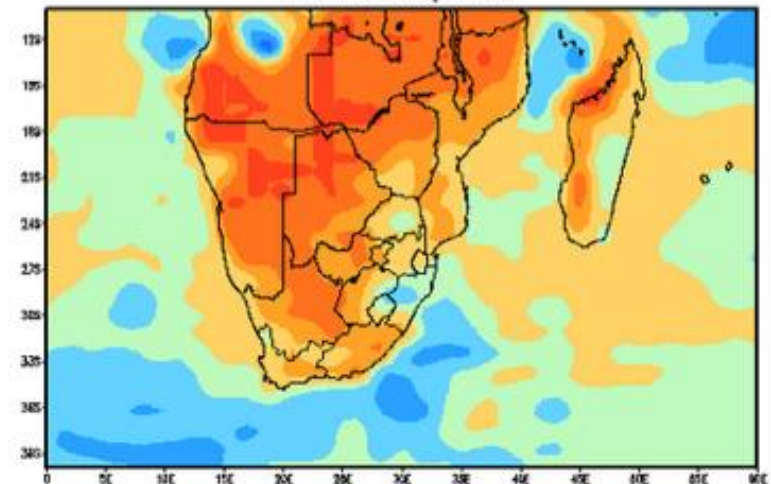
Jun 2013 Precipitation forecast (% of normal)
Issued on 12-Apr-2013



May 2013
Precipitation forecast (% of trimean normal)
Issued on 12-Apr-2013

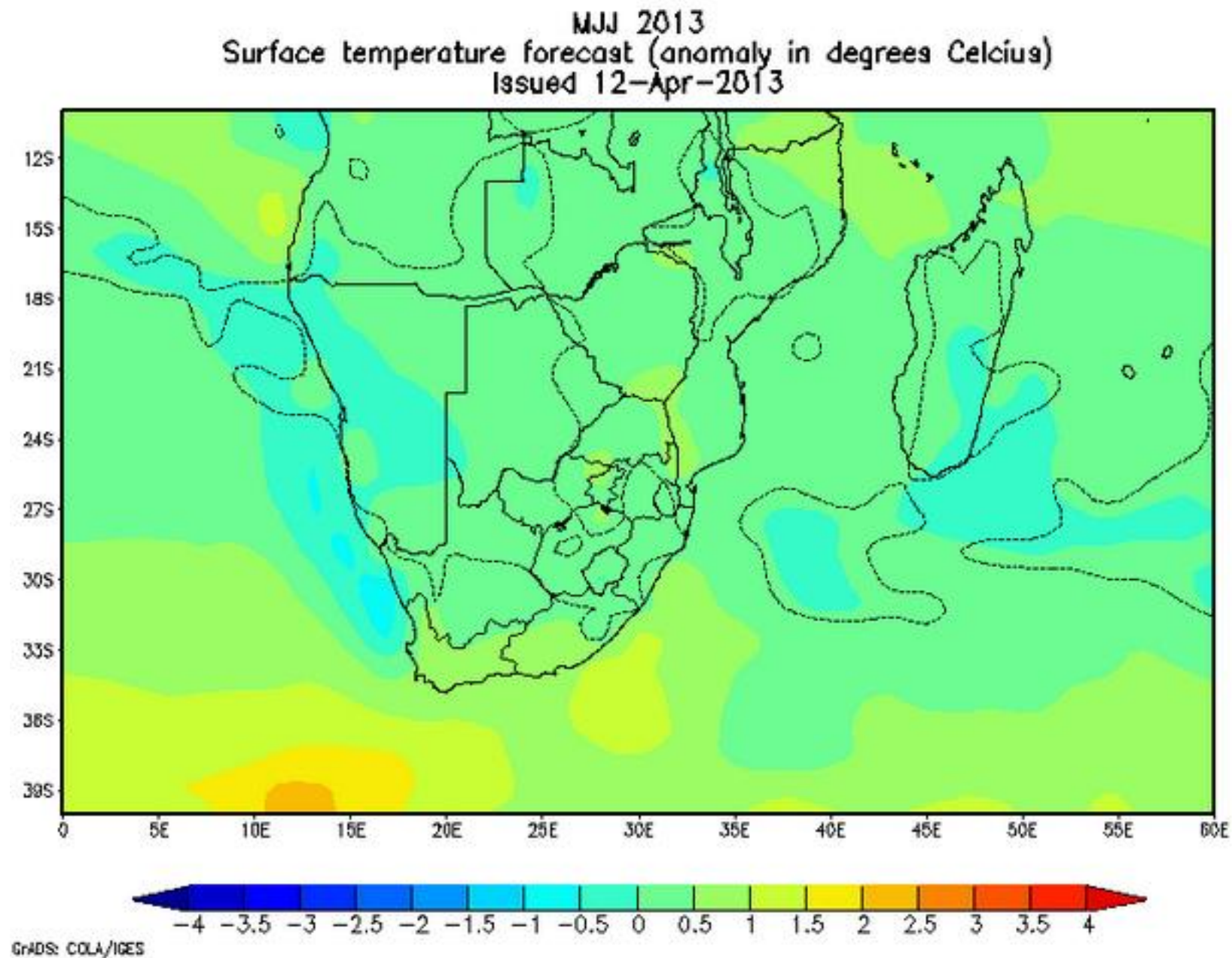


Jun 2013
Precipitation forecast (% of trimean normal)
Issued on 12-Apr-2013



www.gfcsa.net/csag.html

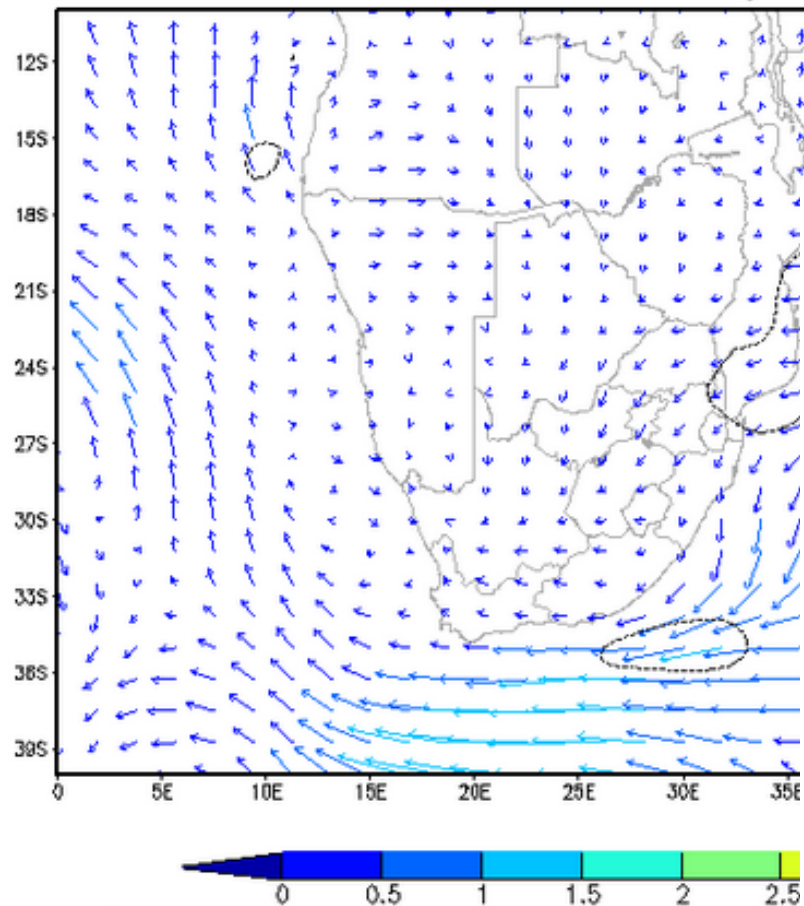
Seasonal forecasting at CSAG



www.gfcsa.net/csag.html

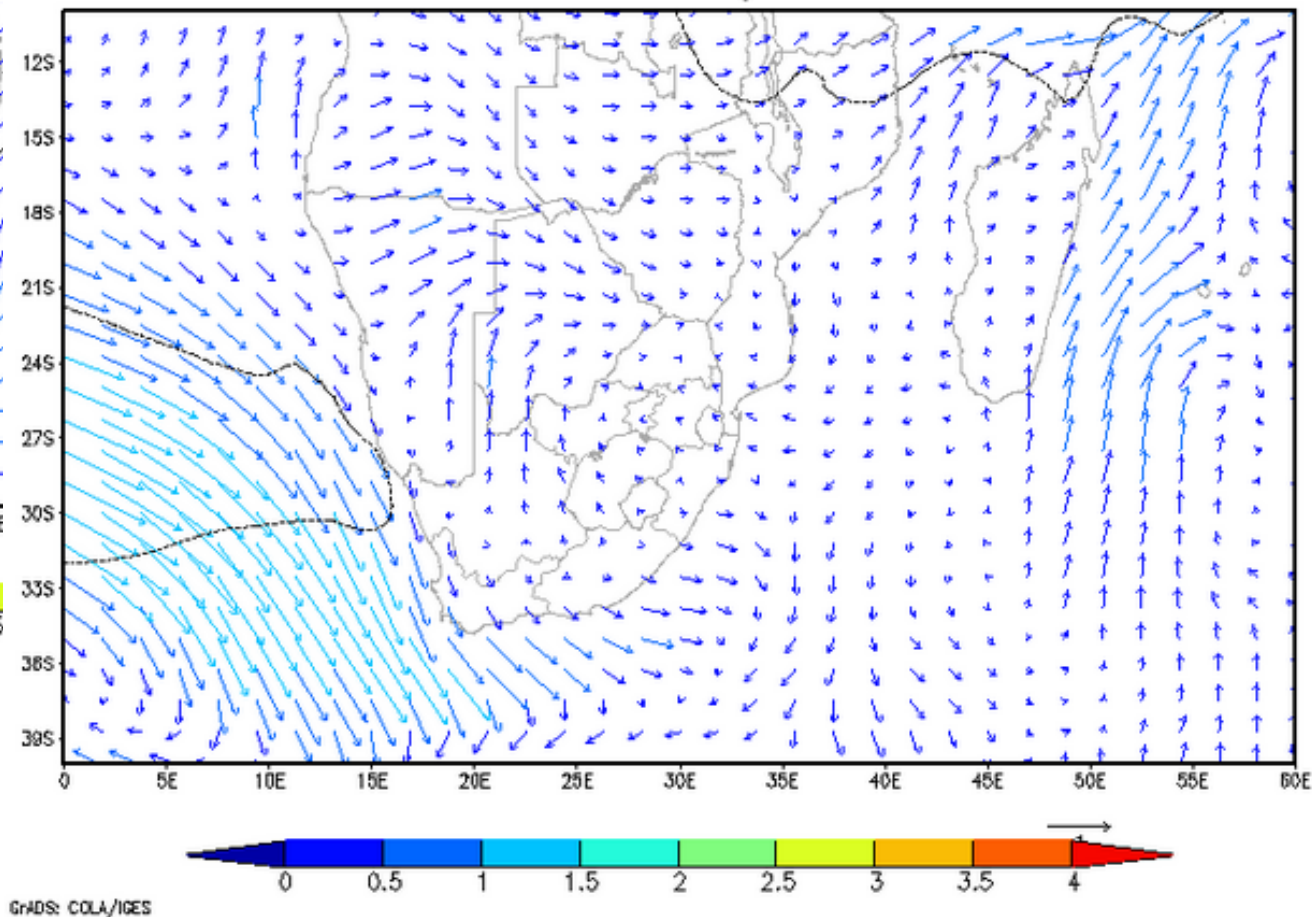
Seasonal forecasting at CSAG

May 2013 Wind vector anomaly forecast (anomaly in ms⁻¹)
Issued on 12-Apr-2013



GrADS: COLA/IGES

Jun 2013 Wind vector anomaly forecast (anomaly in ms⁻¹)
Issued on 12-Apr-2013



GrADS: COLA/IGES

www.gfcsa.net/csag.html

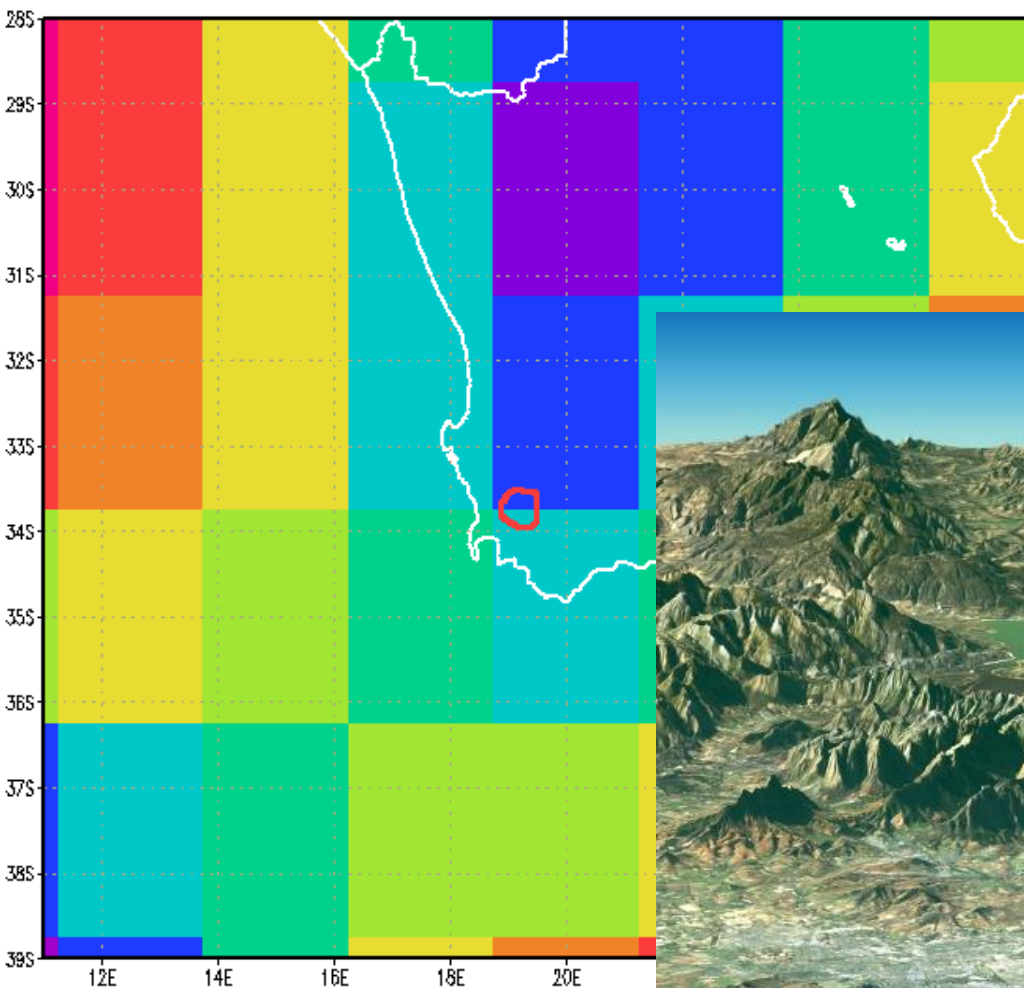
Why downscale?



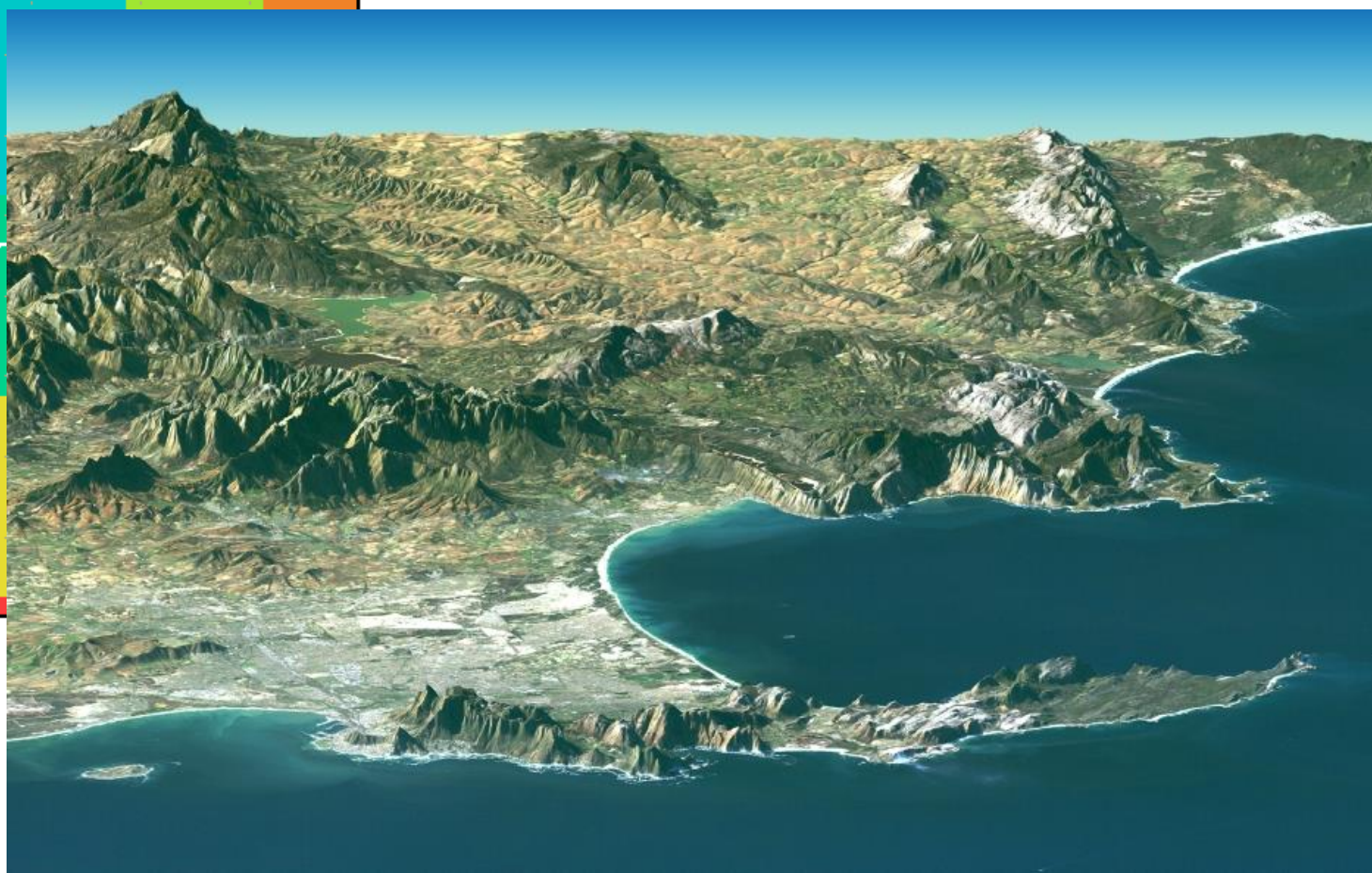
Society operates at the regional scale

Why downscale?

Global Climate Model resolution



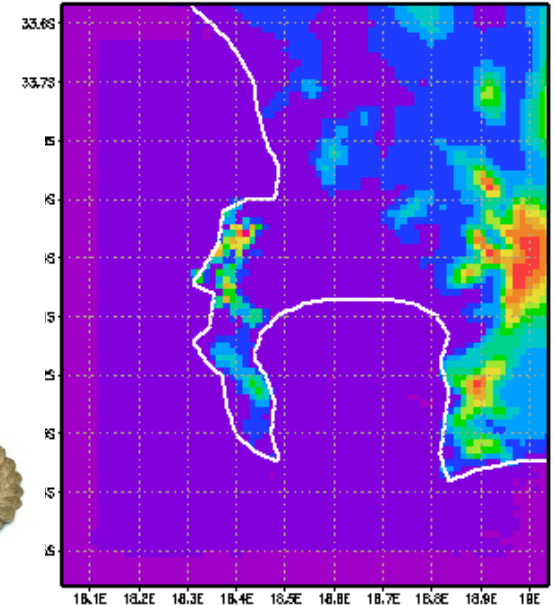
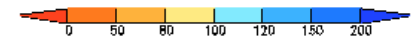
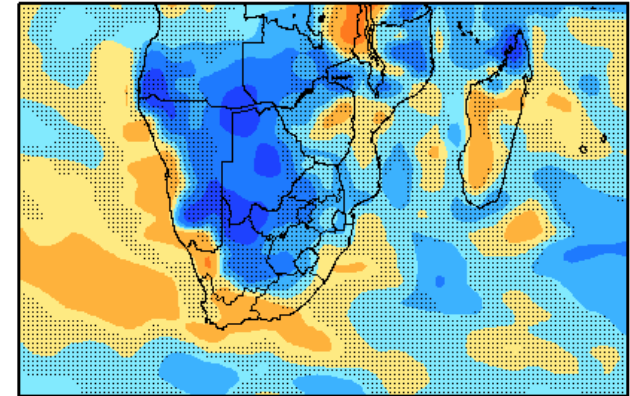
**Dynamical
Downscaling using
WRF**



How do we make a seasonal forecast?

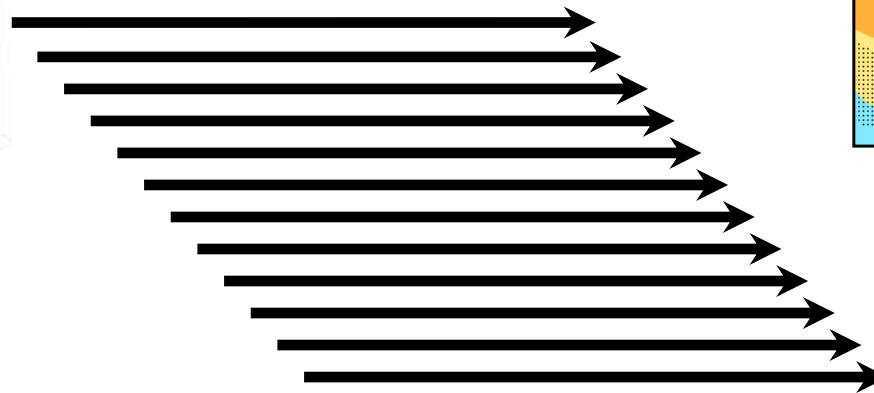
Ensemble Seasonal Forecast

Sep 2011 Precipitation forecast (% of normal)
Issued on 15-Aug-2011



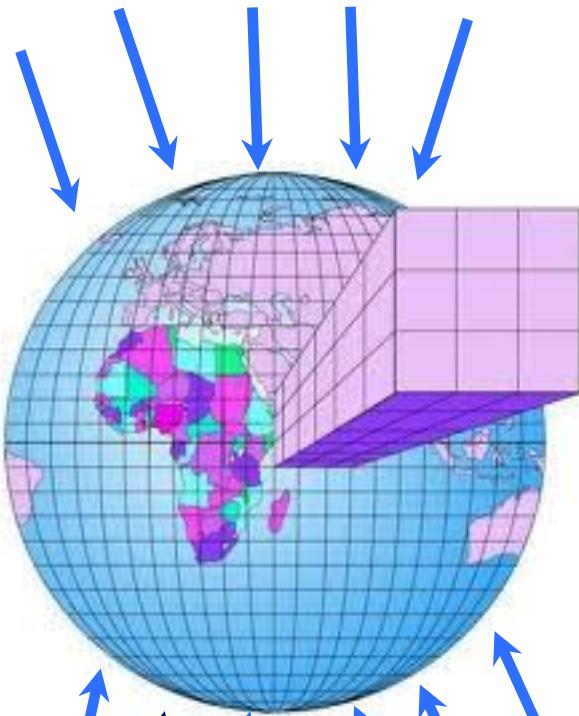
ensive - 1 week, 64 cores

3-6 month into future



Perturb the field to accc for SST vari

Sea Surface Temperatures



Dynamical downscaling

Weather and Research Forecast Model (WRF v3.4.1)

Test run:

- ◆5 member ensemble produced by HadAM3P for testing
- ◆Downscale Jan 2007 - Nov 2008; discard 1st 3 months
- ◆ERA-Interim as a reference for the same period

Resolution: 30km

Domain: Southern Africa.....No nudging

Parameterizations:

Cumulus - Kain-Fritsch

PBL - YSU

Micro-physics - Goddard (ice, snow and graupel)

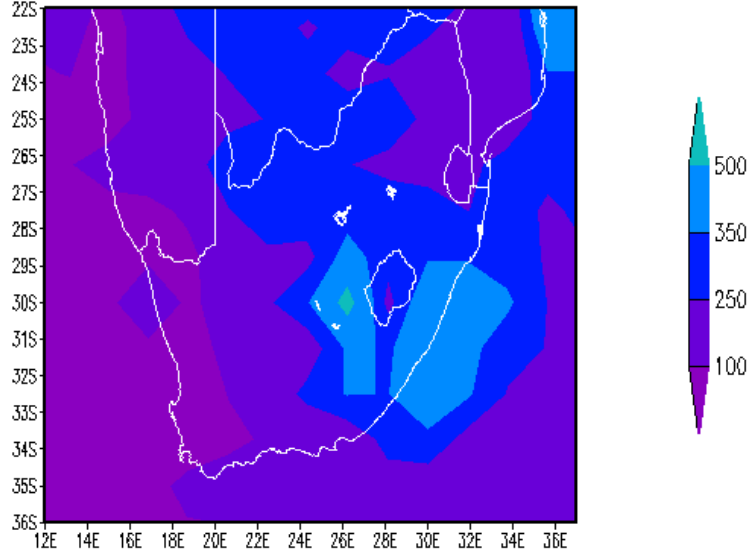
Land surface - Noah LSM

Largest problem.....HadCM3P pp format to WRF grib format

Rainfall

GCM accumulated rainfall

Ensemble mean total rainfall DJF 2009 (mm)

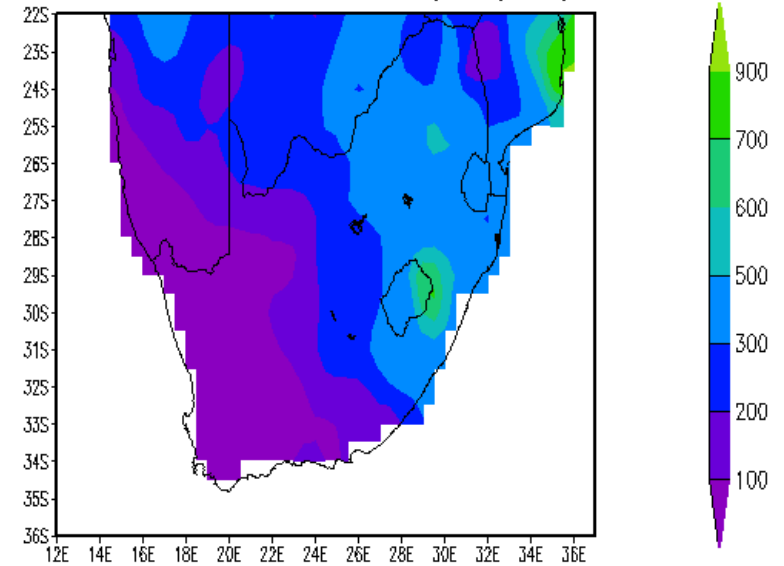


Summer

DJF 08/09

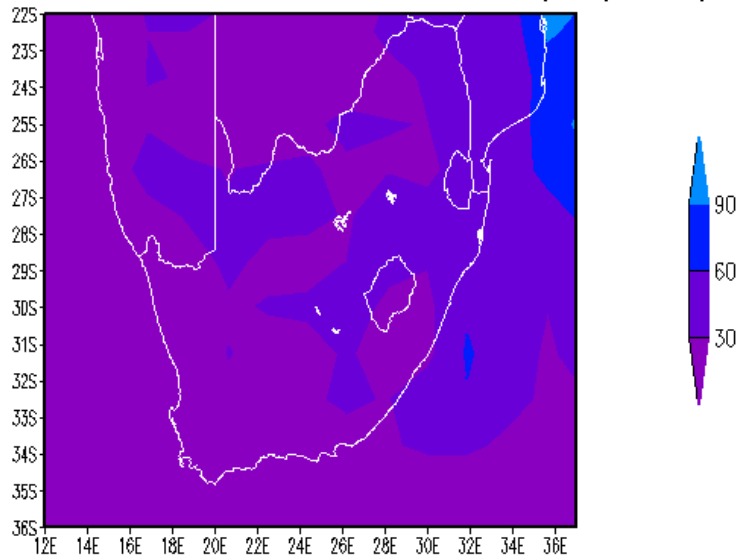
GPCC accumulated rainfall

GPCC rainfall DJF 2008/9 (mm)



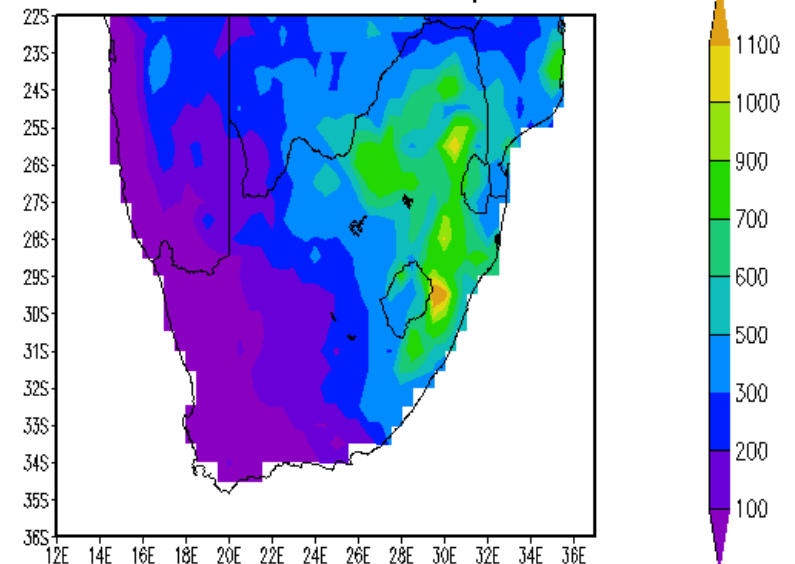
SD between ensemble members

Ensemble mean SD of rainfall DJF 2009 (mm/mnth)



DS ERA accumulated rainfall

ERA rainfall DJF 2008/9

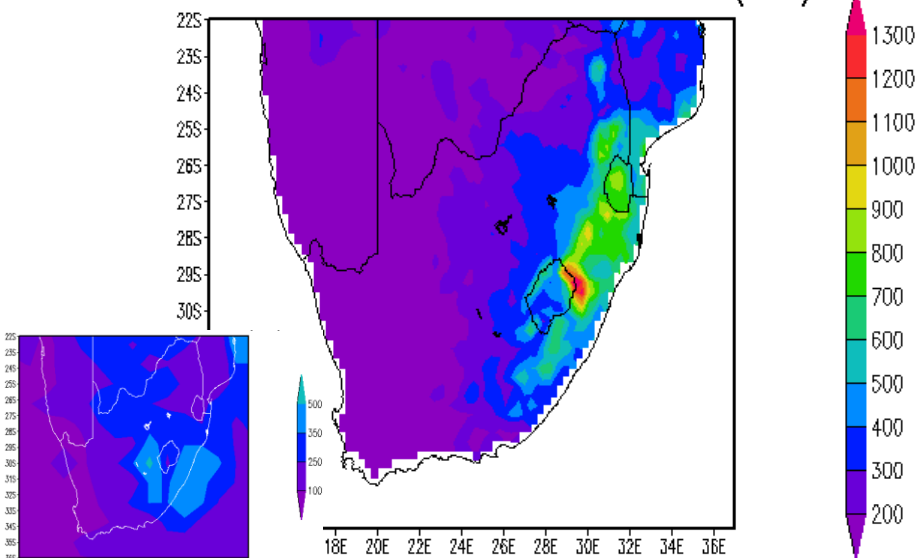


Rainfall

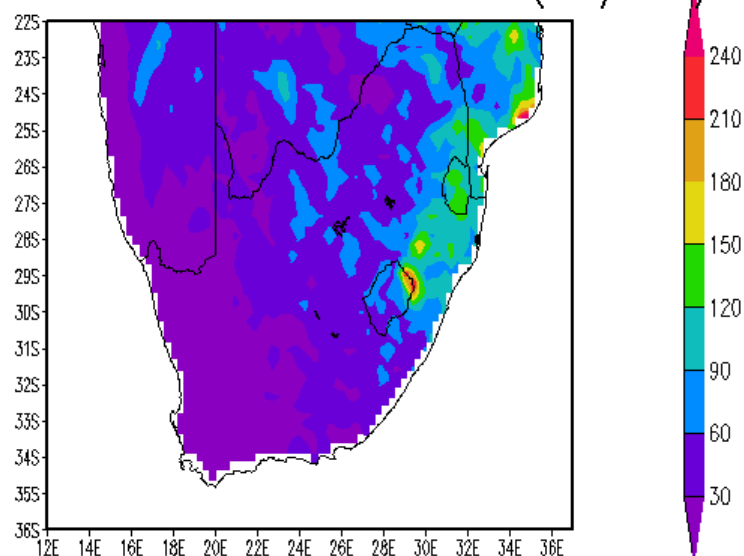
Downscaled....

Anomalies....

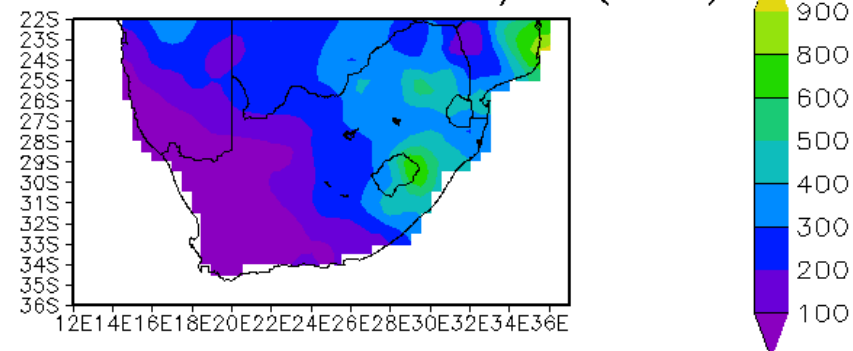
Ensemble mean total rainfall DJF 2009 (mm)



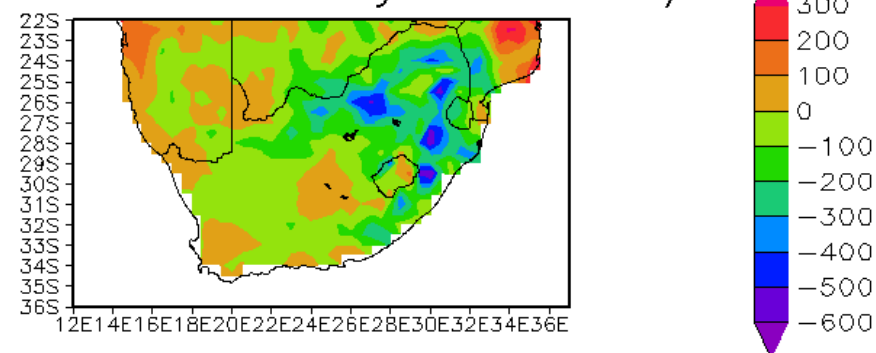
Ensemble mean SD of rainfall DJF 2009 (mm/mnth)



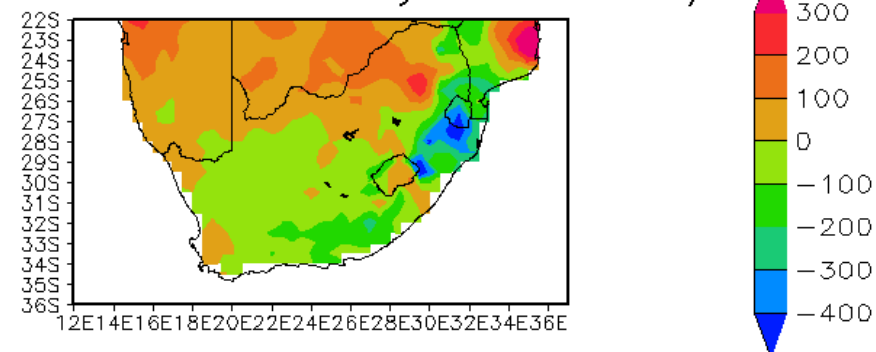
GPCC rainfall DJF 2008/9 (mm)



GPCC-ERA anomaly DJF 2008/9



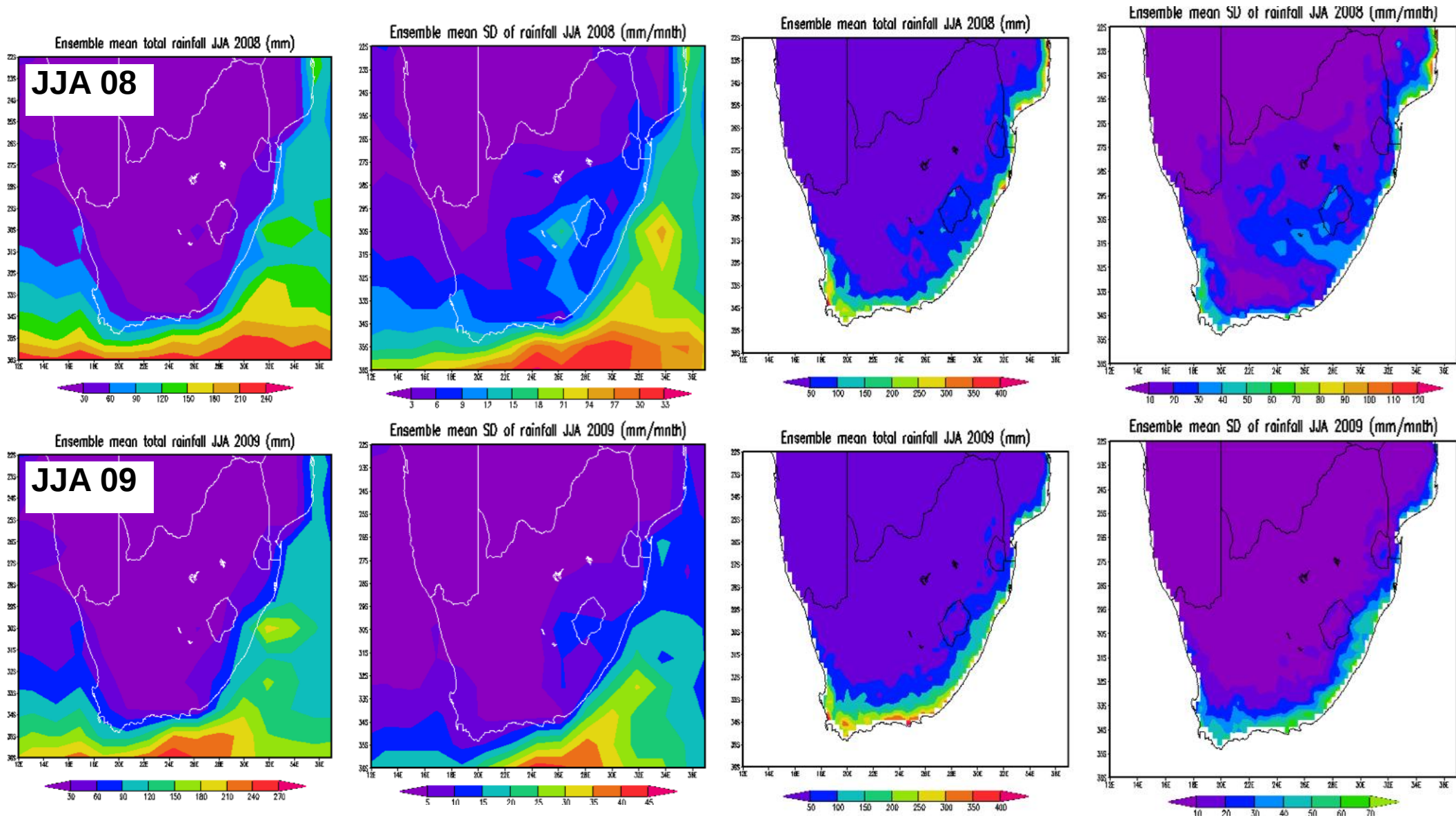
GPCC-Model anomaly DJF 2008/9



Rainfall

GCM mean..... and SD

Downscaled mean and SD



Rainfall

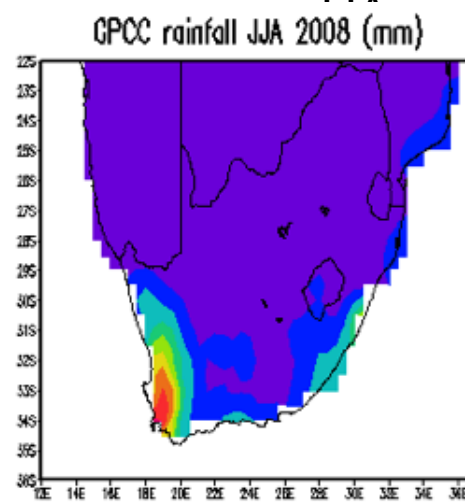
Seasonal
variability

ERA downscaling
has a generally
wetter bias

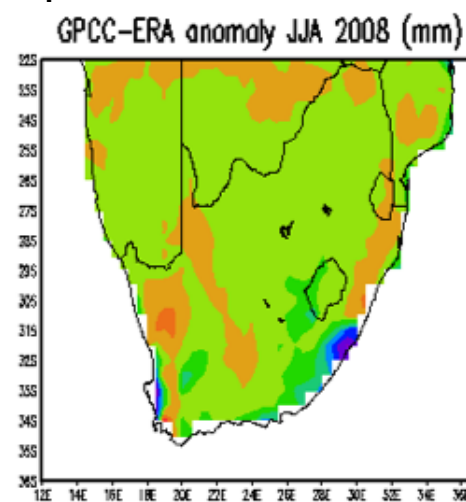
Smaller
magnitude of the
bias than in ERA
downscaling...
probably
cancellation

General wet bias
over south coast

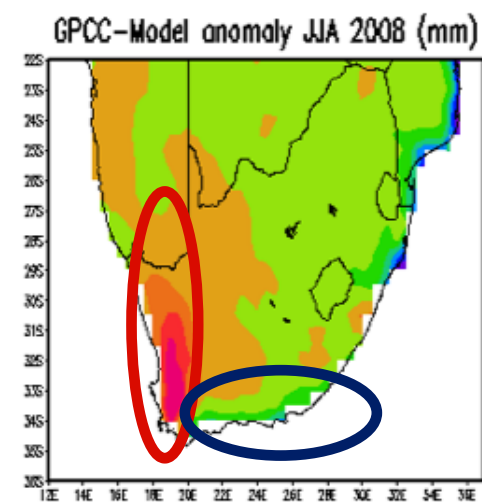
Dry bias over
west coast &
mountains?



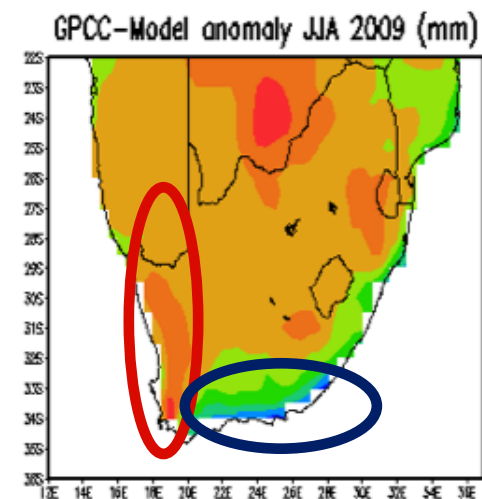
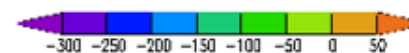
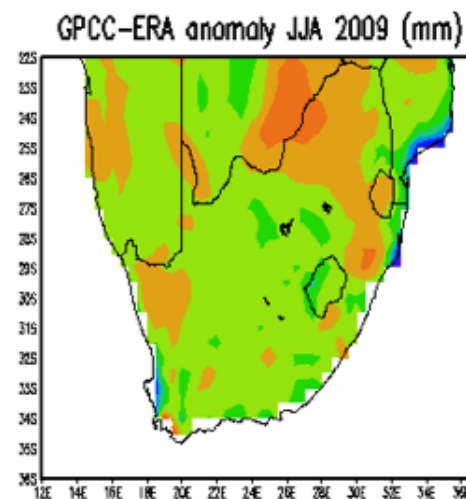
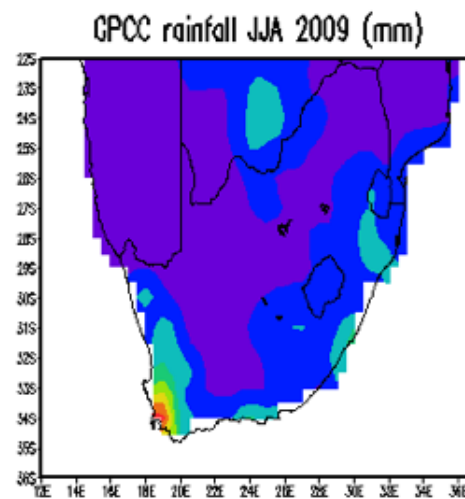
Observed



Anomaly - ERA



Anomaly - Ens



Rainfall

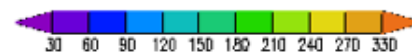
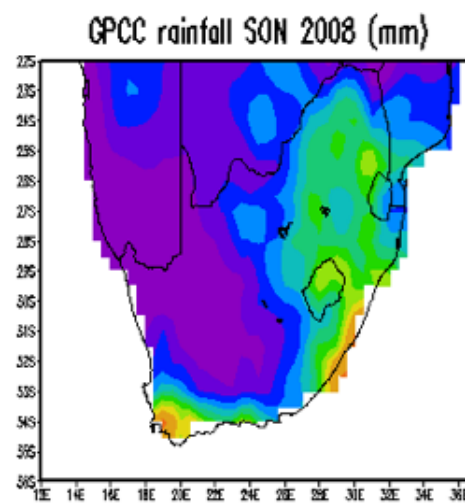
Larger biases in SON

ERA downscaling has a generally wetter bias

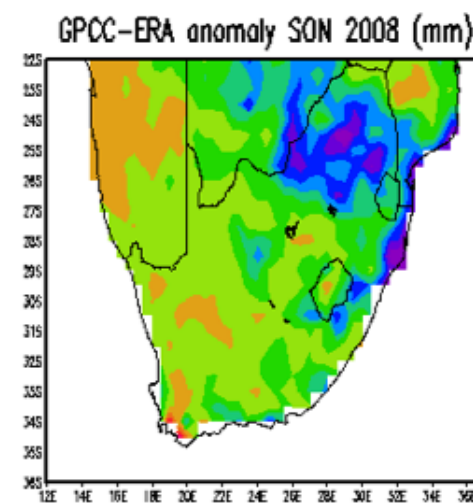
Dry bias over western parts and Cape Town

East coast wet bias in SON

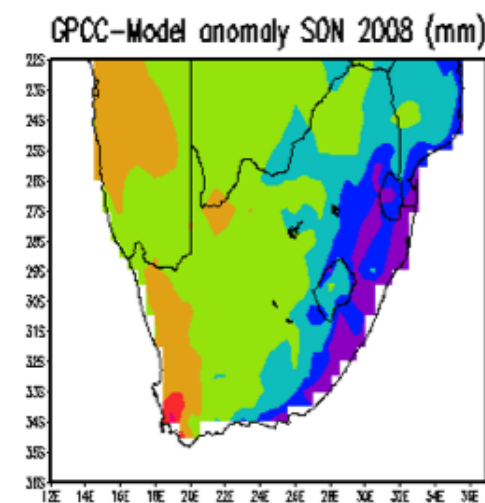
General wet bias over south coast



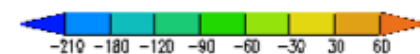
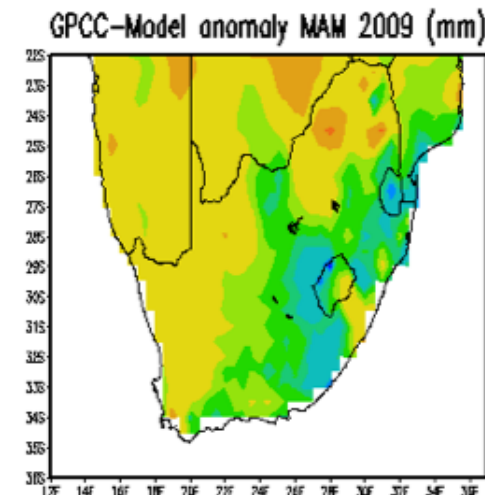
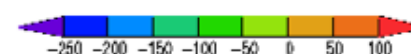
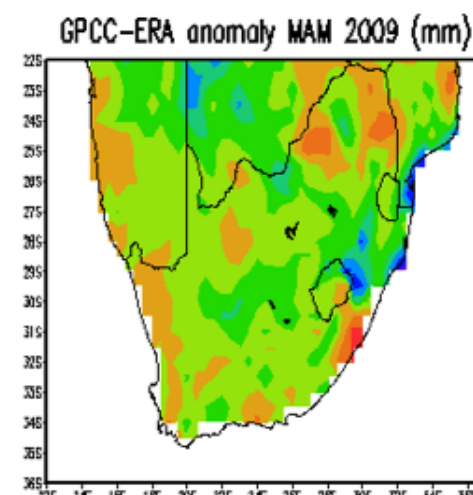
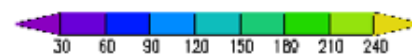
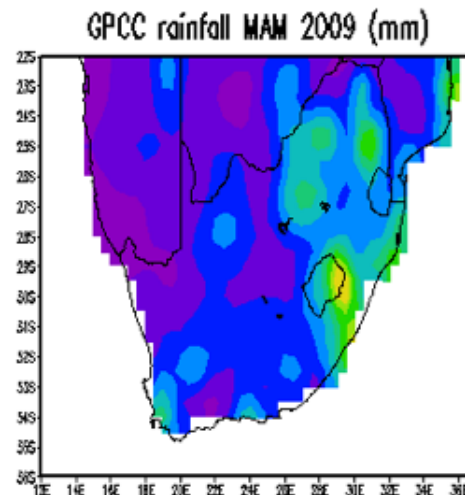
Observed



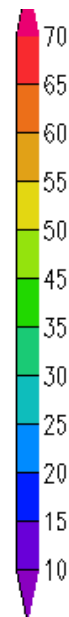
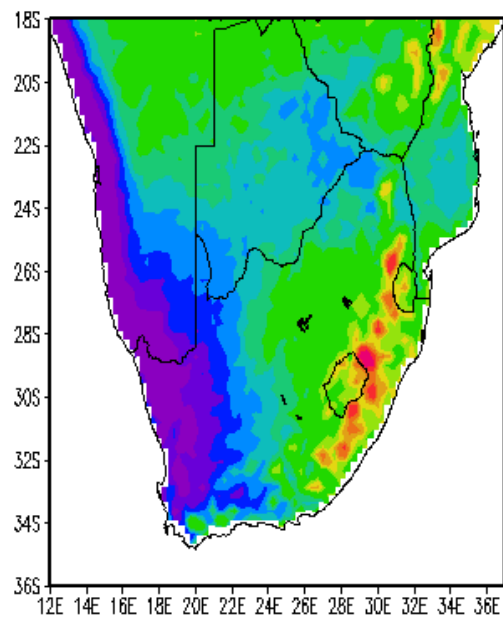
Anomaly - ERA



Anomaly - Ens



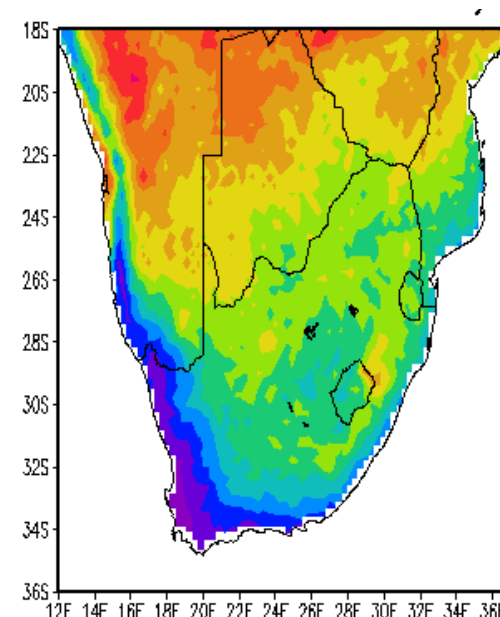
Number of rain days - DJF 09



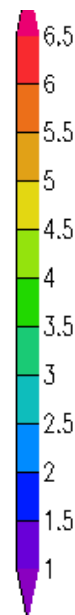
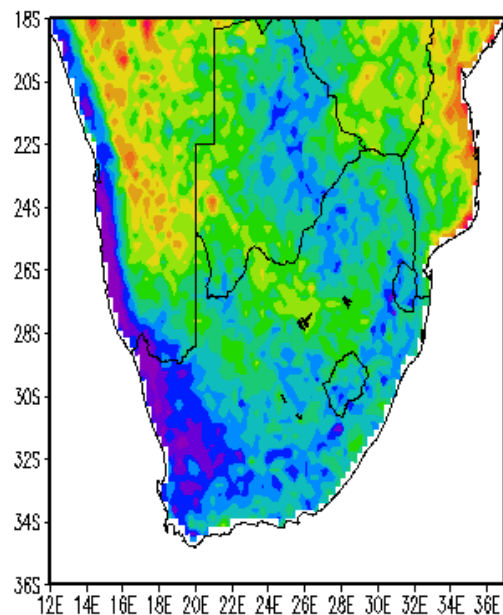
Rainfall metrics

Highest number of rain days over the Drakensberg escarpment with relatively low variability - so most of the downscaled ensembles simulate this

Number of extreme rain days - DJF 09

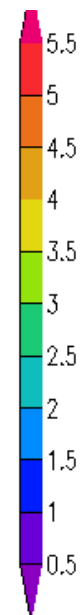
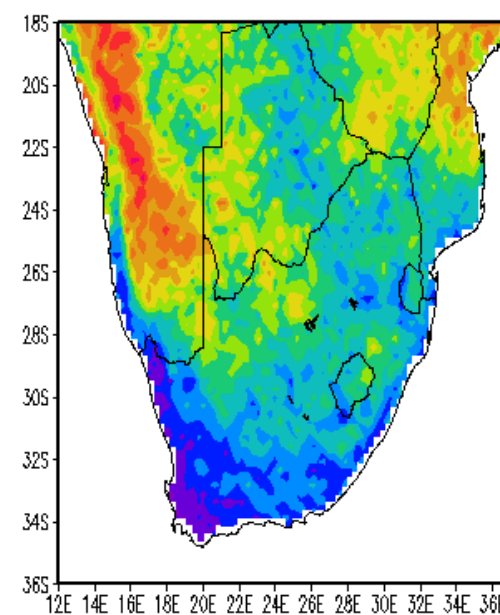


Standard deviation



Greatest variability generally and extreme rain days over Namib desert and Mozambique coast

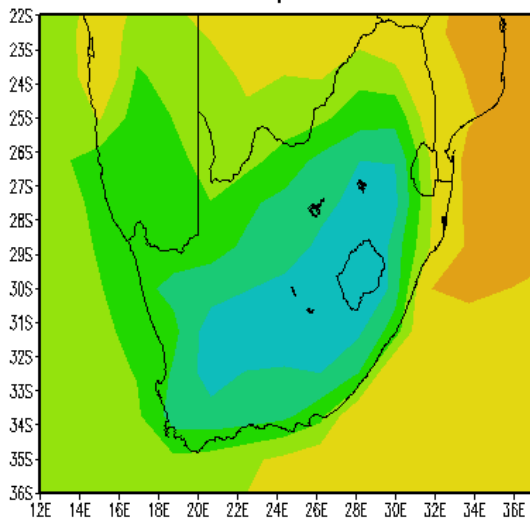
Standard deviation



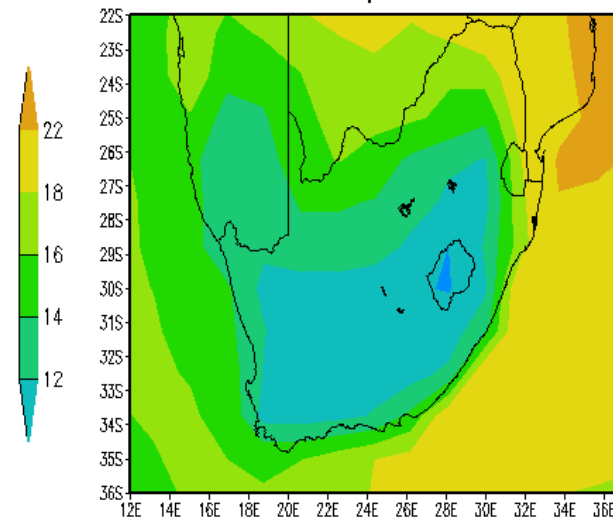
Temperature

GCM

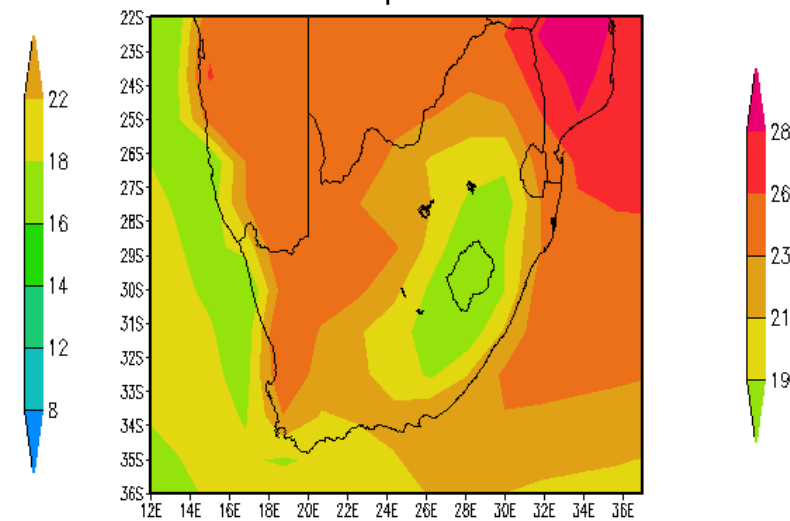
Mean Temp JJA 2008



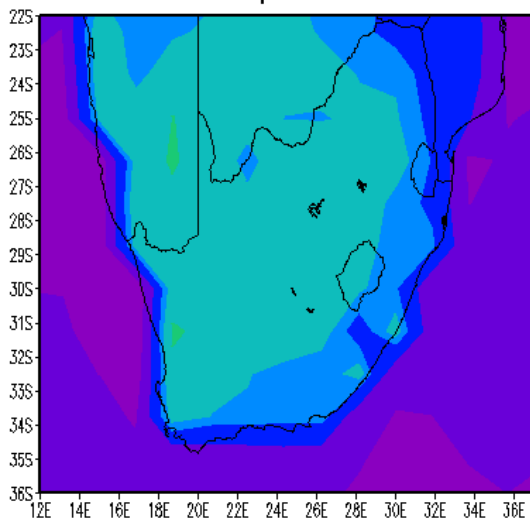
Mean Temp JJA 2009



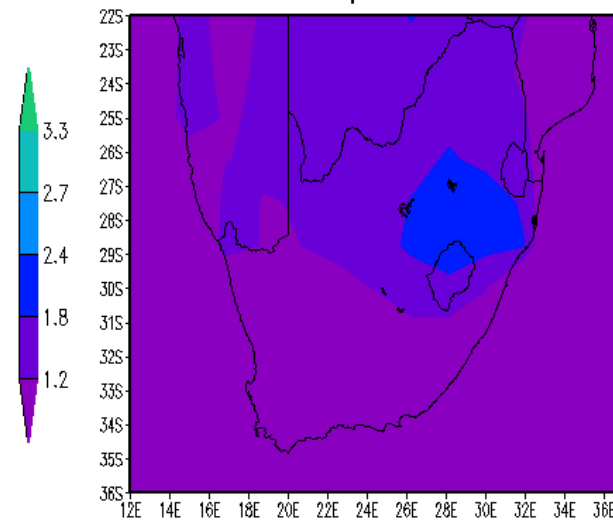
Mean Temp DJF 2008



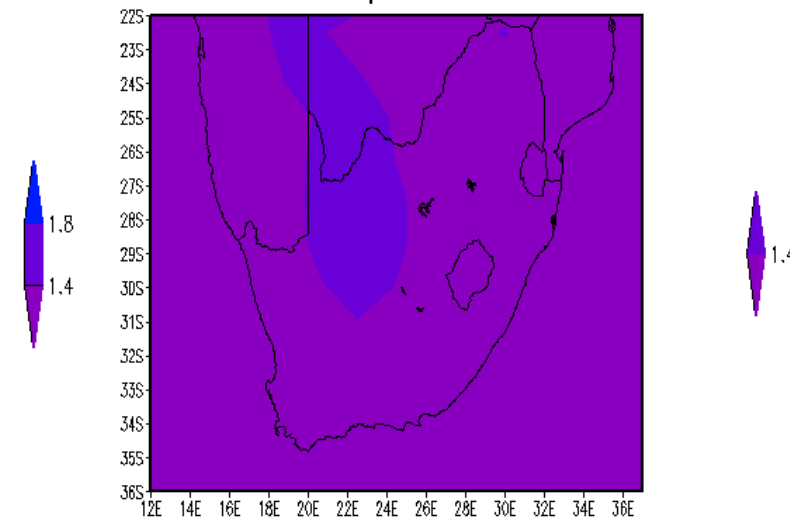
SD Temp JJA 2008



SD Temp JJA 2009



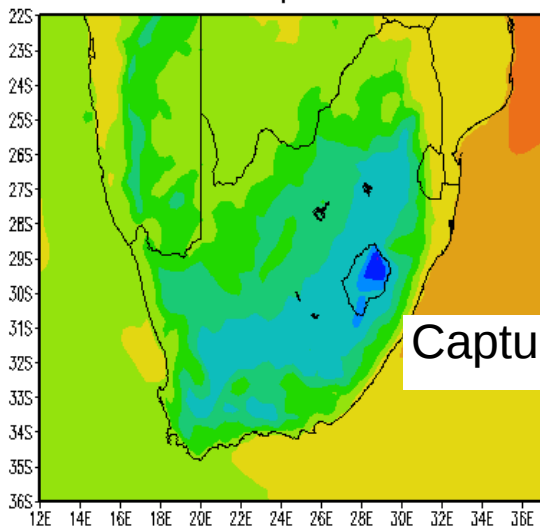
SD Temp DJF 2009



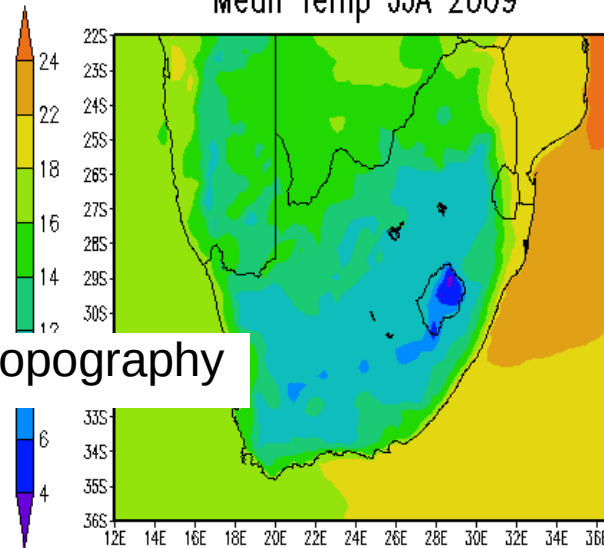
Temperature

Downscaled

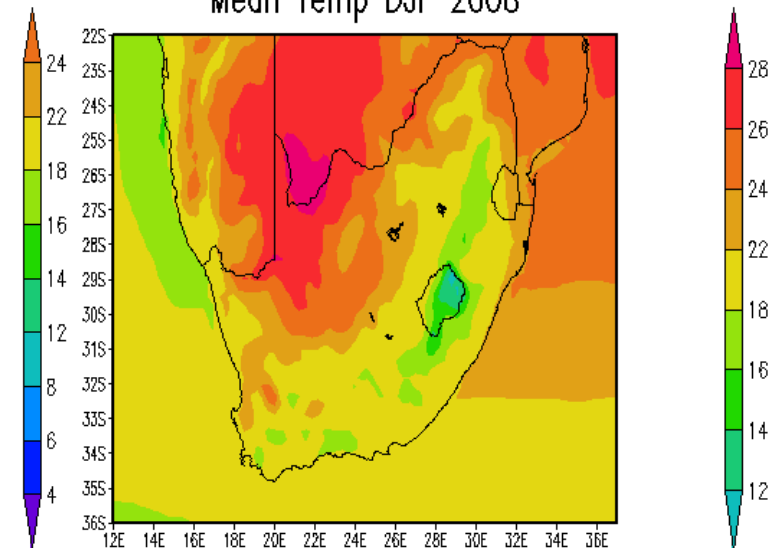
Mean Temp JJA 2008



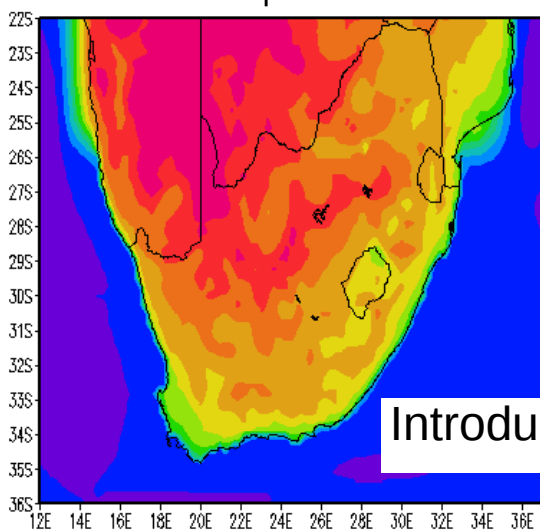
Mean Temp JJA 2009



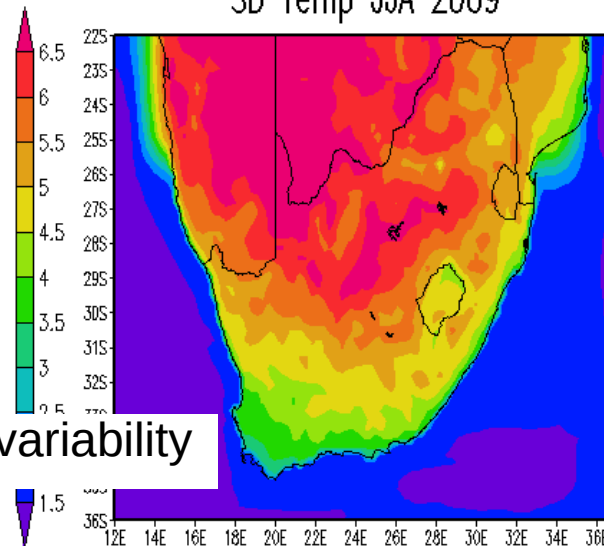
Mean Temp DJF 2008



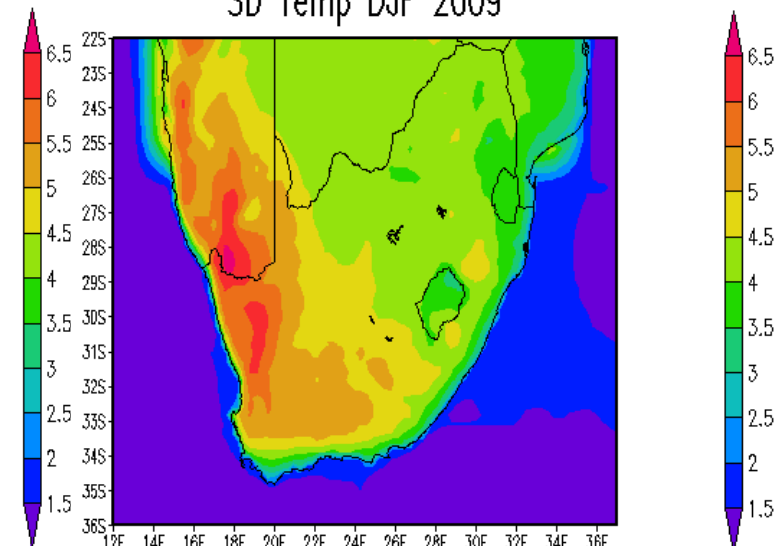
SD Temp JJA 2008



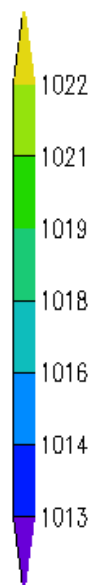
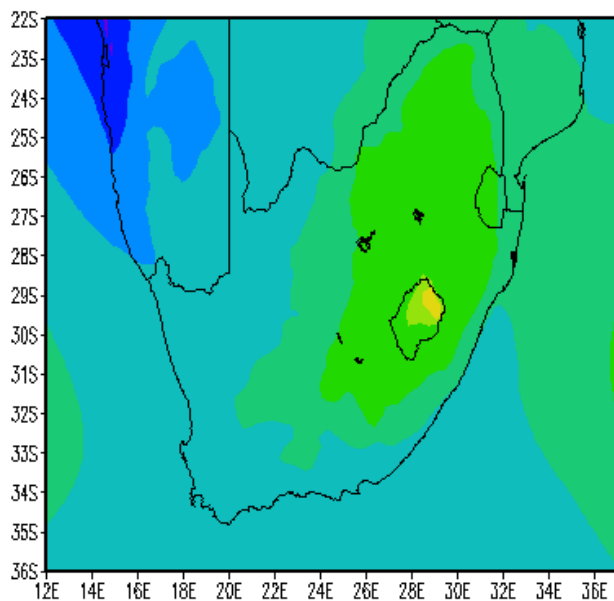
SD Temp JJA 2009



SD Temp DJF 2009



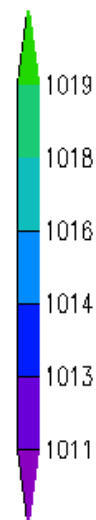
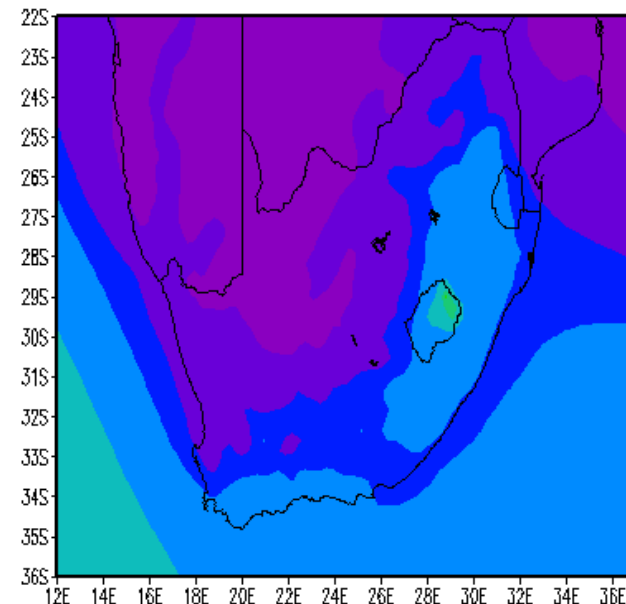
Mean SLP JJA 2008



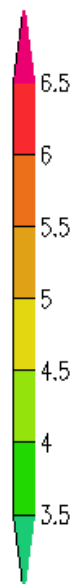
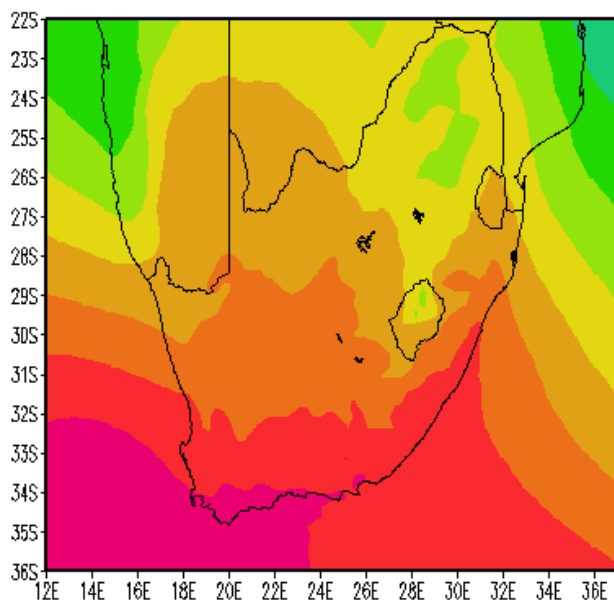
Sea level pressure

Downscaled

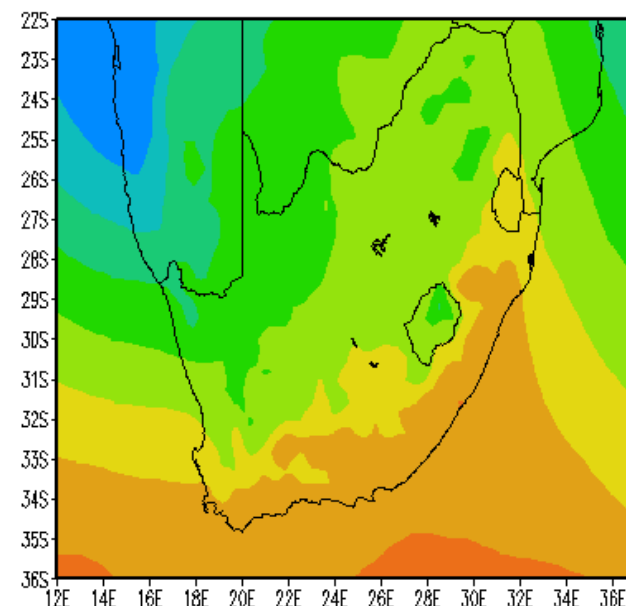
Mean SLP DJF 2008



SD SLP JJA 2008



SD SLP DJF 2009



Summary

1. Downscaled ensemble rainfall at times has lower bias than downscaled ERA-Interim.....error cancellation?
2. Downscaling captures local effects like topography and provides some higher spatial resolution
3. Systematic biases in the GCM propagate through to the RCM, especially when GCM ensemble members are similar over the region
4. Downscaling generally increases the amplitude of GCM patterns

We know:

5. WRF is a wet model...
6. Most of the region' s predictability lies in ENSO

Ongoing...

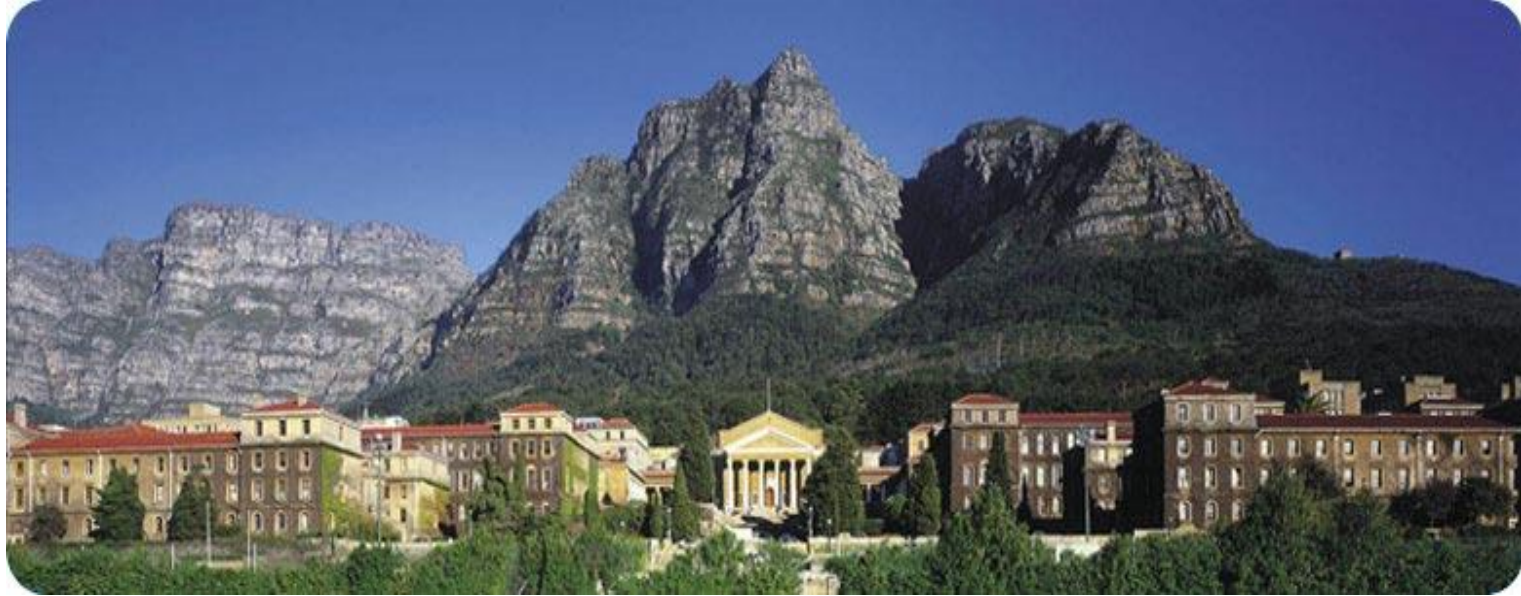
1. Development of a downscaled climatology (which period to use?)
 - GCM hindcast running
 - Downscale this, but WRF needs a lot of data from the GCM
2. Proper skill assessment of forecasts (GCM and DS)
3. Bias correction techniques? Nudging?
4. Statistical downscaling vs dynamical downscaling
5. WRF 3.5.....coupled hydrology model
6. Why?
Measuring “added value”...metrics in a seasonal forecast context

ADVERT:

Come spend a year or two in Cape Town with us...



Thank
you....



What's the question we are trying to address?

"Would you tell me, please, which way I ought to go from here?"

"That depends a good deal on where you want to get to," said the Cat.

"I don't much care where--" said Alice.

"Then it doesn't matter which way you go," said the Cat.

"--so long as I get SOMEWHERE," Alice added as an explanation.

"Oh, you're sure to do that," said the Cat, "if you only walk long enough."



Cordex Web Presence

The official WCRP CORDEX page

<http://wcrp-cordex.ipsl.jussieu.fr/>

CORDEX Africa

<http://www.csag.uct.ac.za/cordex>

[CORDEX Europe](http://www.eurocordex.com)

<http://www.eurocordex.com>

DMI Archive

<http://cordex.dmi.dk/joomla/>

