

# Reservoir Management using Seasonal Forecasts in Lake Kariba and Lake Kahora Bassa: *Initial results and plans*

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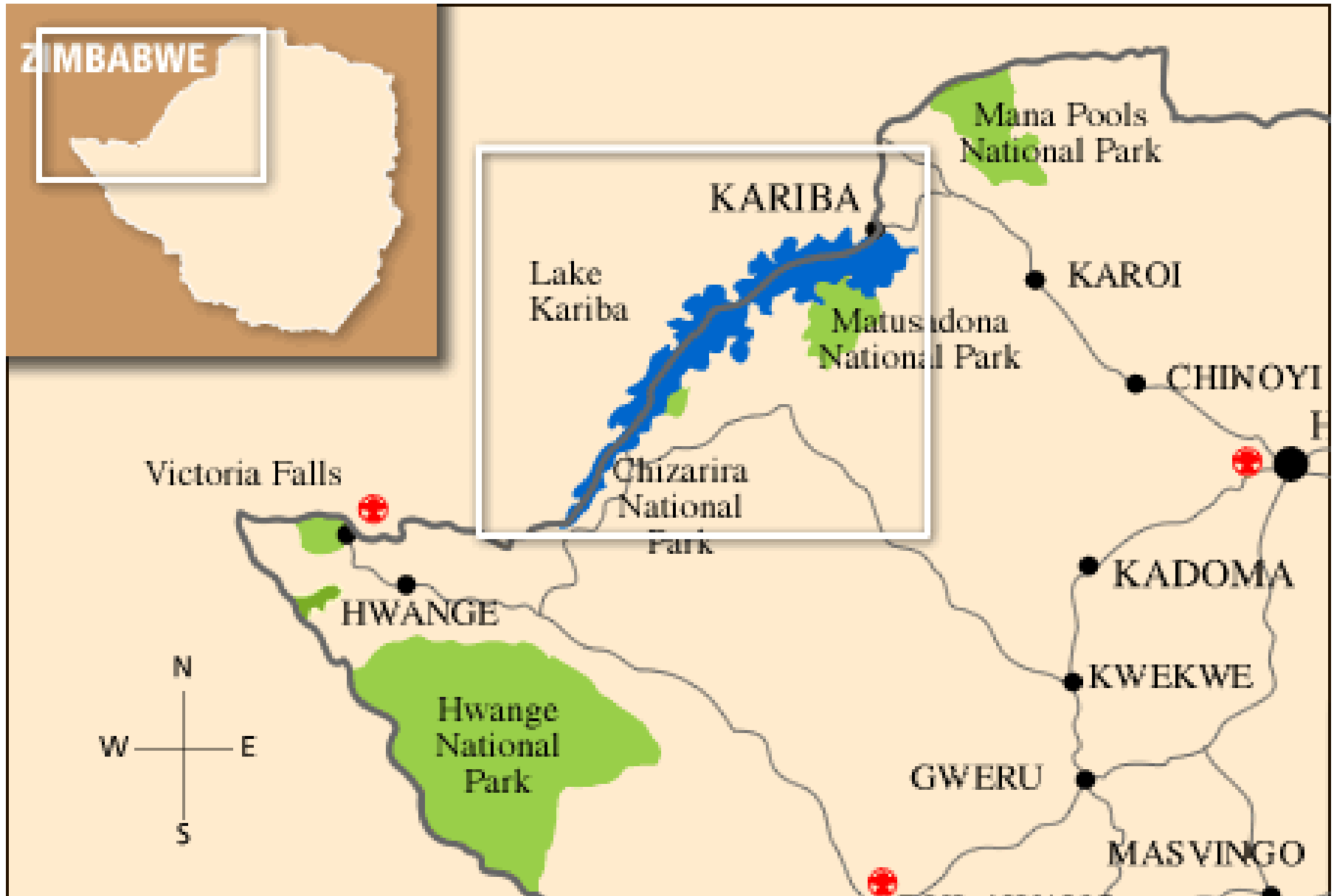
## ACCESS

APPLIED CENTER FOR CLIMATE  
& EARTH SYSTEMS SCIENCE

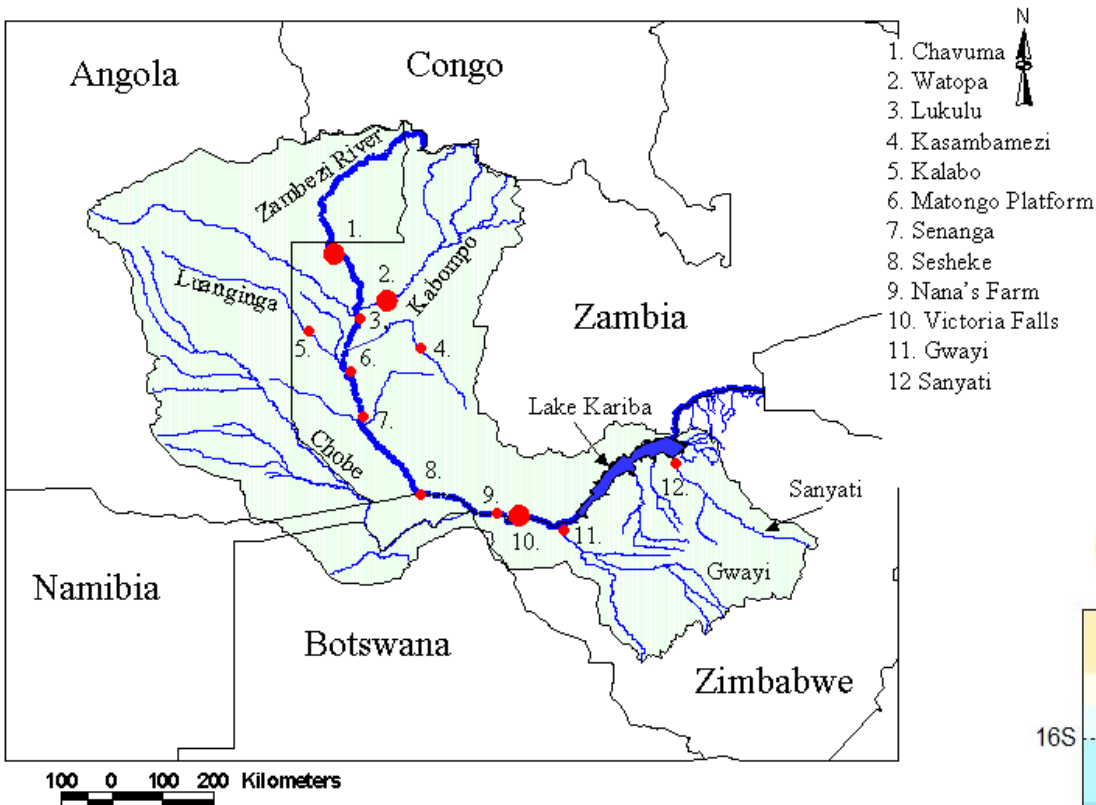
## CSIR

*our future through science*

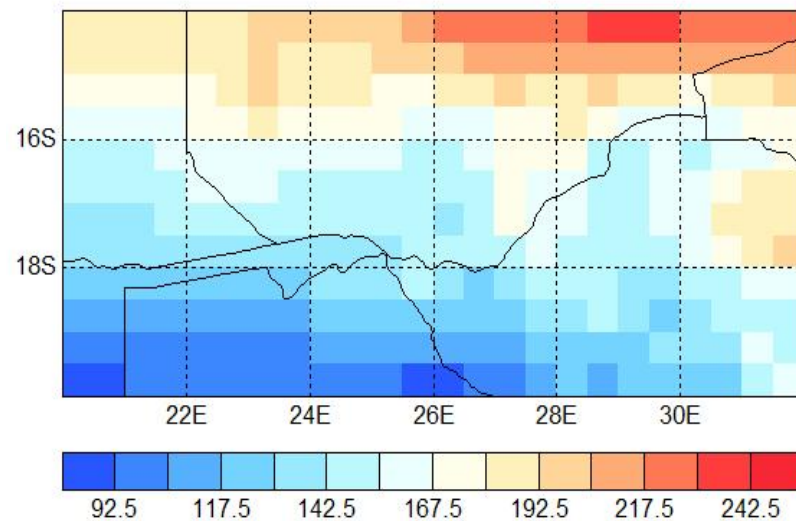
## Focus area for this presentation:



# KARIBA RESERVOIR BASIN



December-January-February Averaged Rainfall (mm)



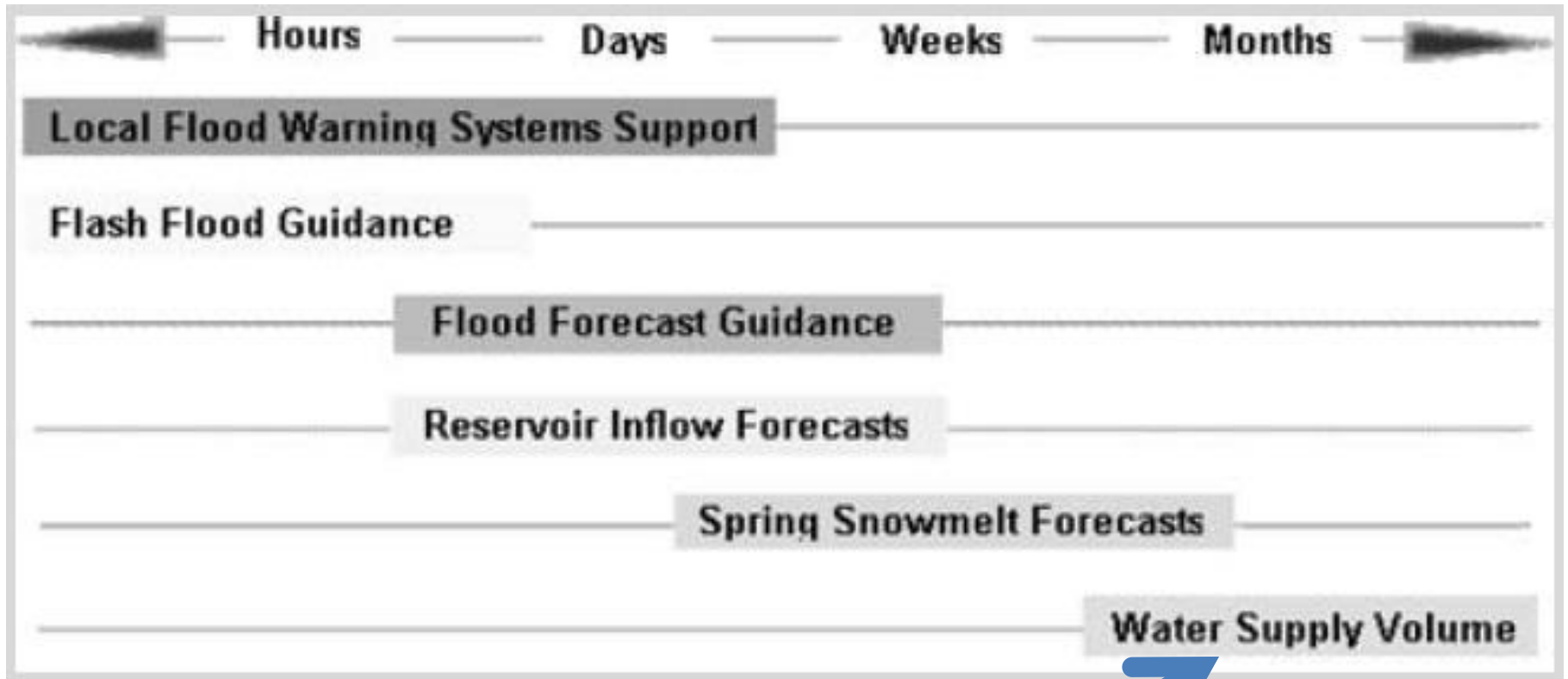
# Importance of Seasonal Forecasts in Reservoir Management

Improved and informed decisions by Dam Managers in

- Timely water releases
- Improved energy production
- Flood control especially downstream
- Water-use efficiency

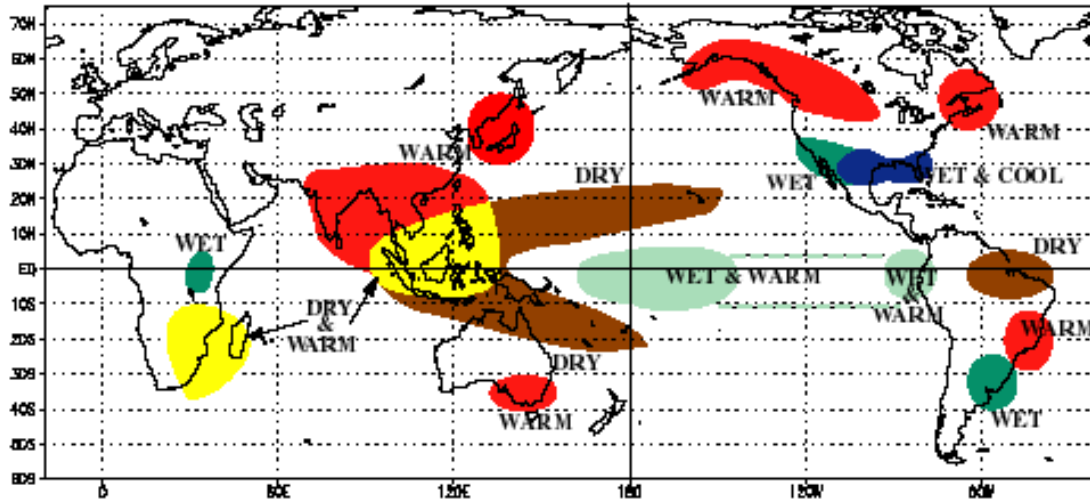
Reservoirs are designed to hold significant amounts of seasonal runoff to mitigate the effects of upriver rainfall variability. The Aswan dam in Egypt provided irrigation through 10 years of drought and sub-normal rainfall over Ethiopia in the 1980s. Very often, however, there are conflicting demands on reservoir managers to provide water for hydropower, irrigation and to manage flood and base flows for the health of lower river communities and ecosystems. Without knowledge of future rainfall, reservoir managers inevitably tend to be conservative. With reliable indicators of future rainfall quantities, reservoir managers are in a better position to make best use of the limited stored water available. Such decisions involve risk, and managing risk is an essential component of making the best of a scarce and highly variable resource such as water.

# What guidance we are aiming to provide

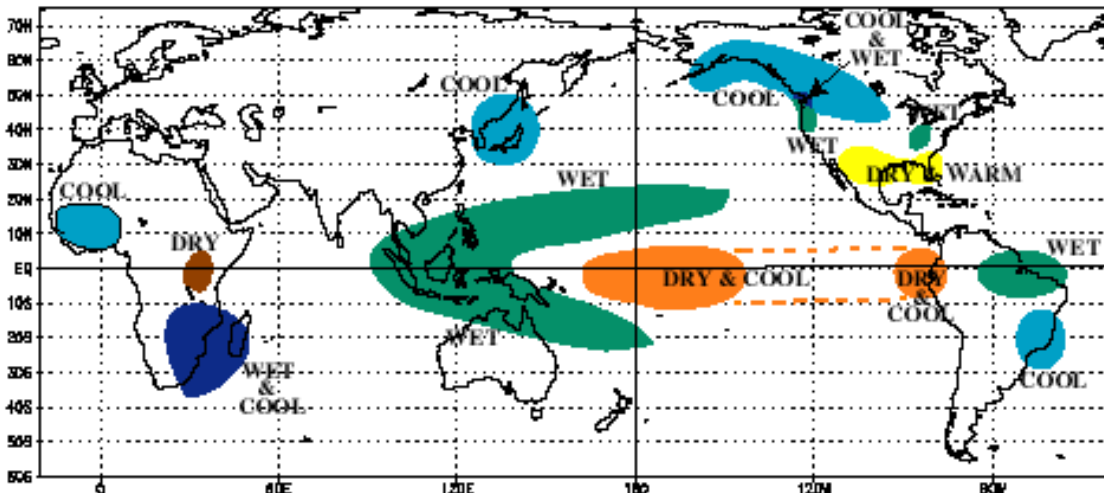


# El Nino and La Nina impacts

## WARM EPISODE RELATIONSHIPS DECEMBER - FEBRUARY

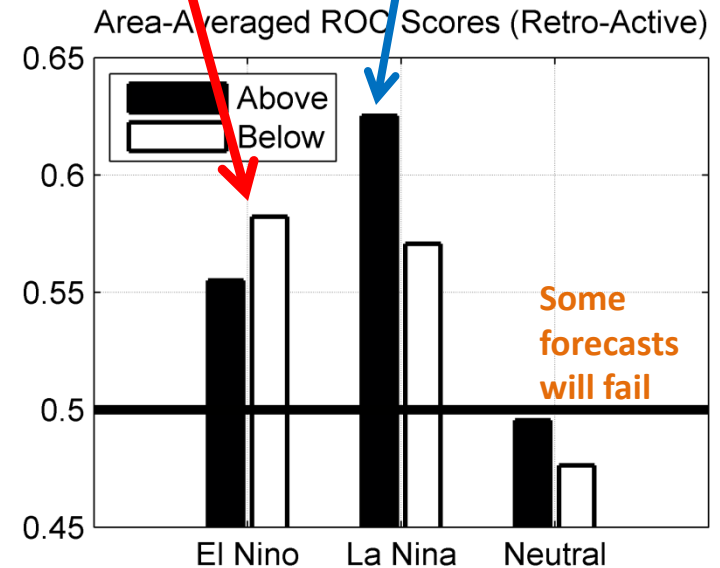


## COLD EPISODE RELATIONSHIPS DECEMBER - FEBRUARY



Skill in predicting dry  
El Niño seasons

Skill in predicting wet  
La Niña seasons



Skill assessment over SADC  
[Landman & Beraki (2012)]

# Prediction Method

State-of-the-art  
global climate  
model

ECHAM4.5-GML-CFSST CGCM

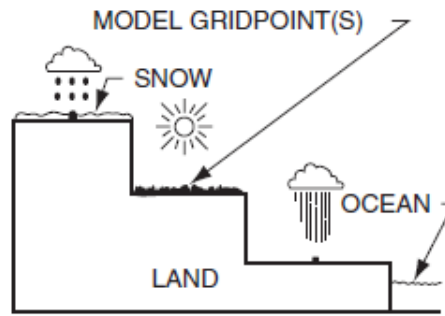
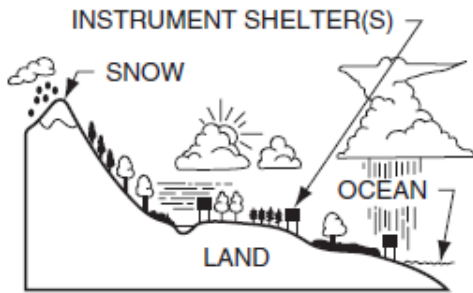
Statistical post-processing



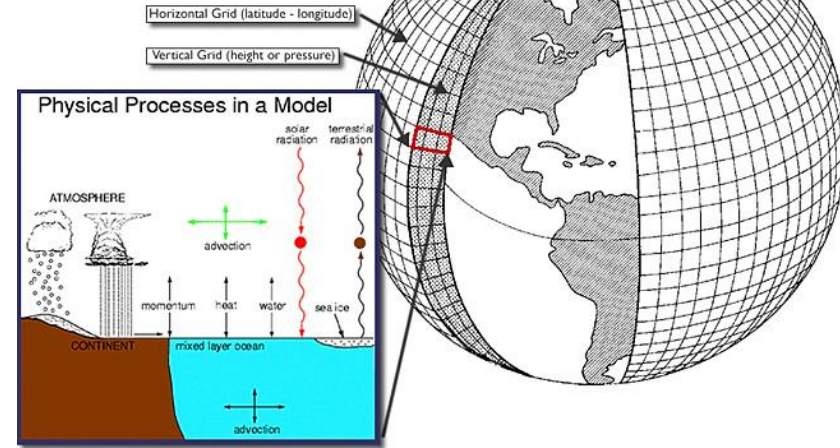
REAL WORLD

Vs.

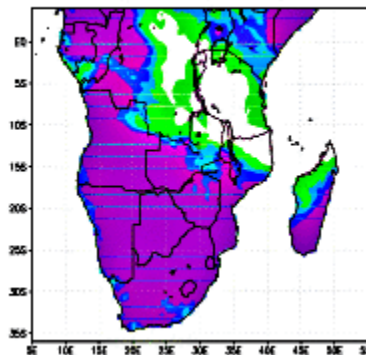
MODEL WORLD



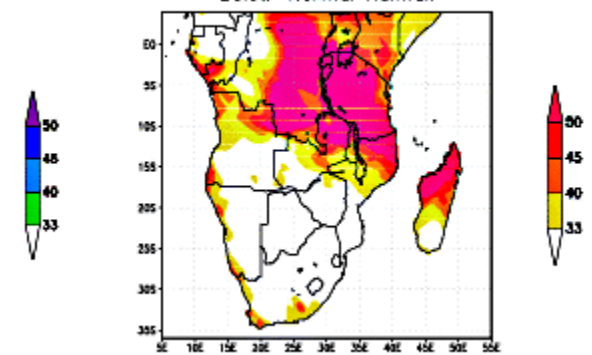
Schematic for Global Atmospheric Model



DECEMBER-JANUARY-FEBRUARY 2010/11  
Above-Normal Rainfall



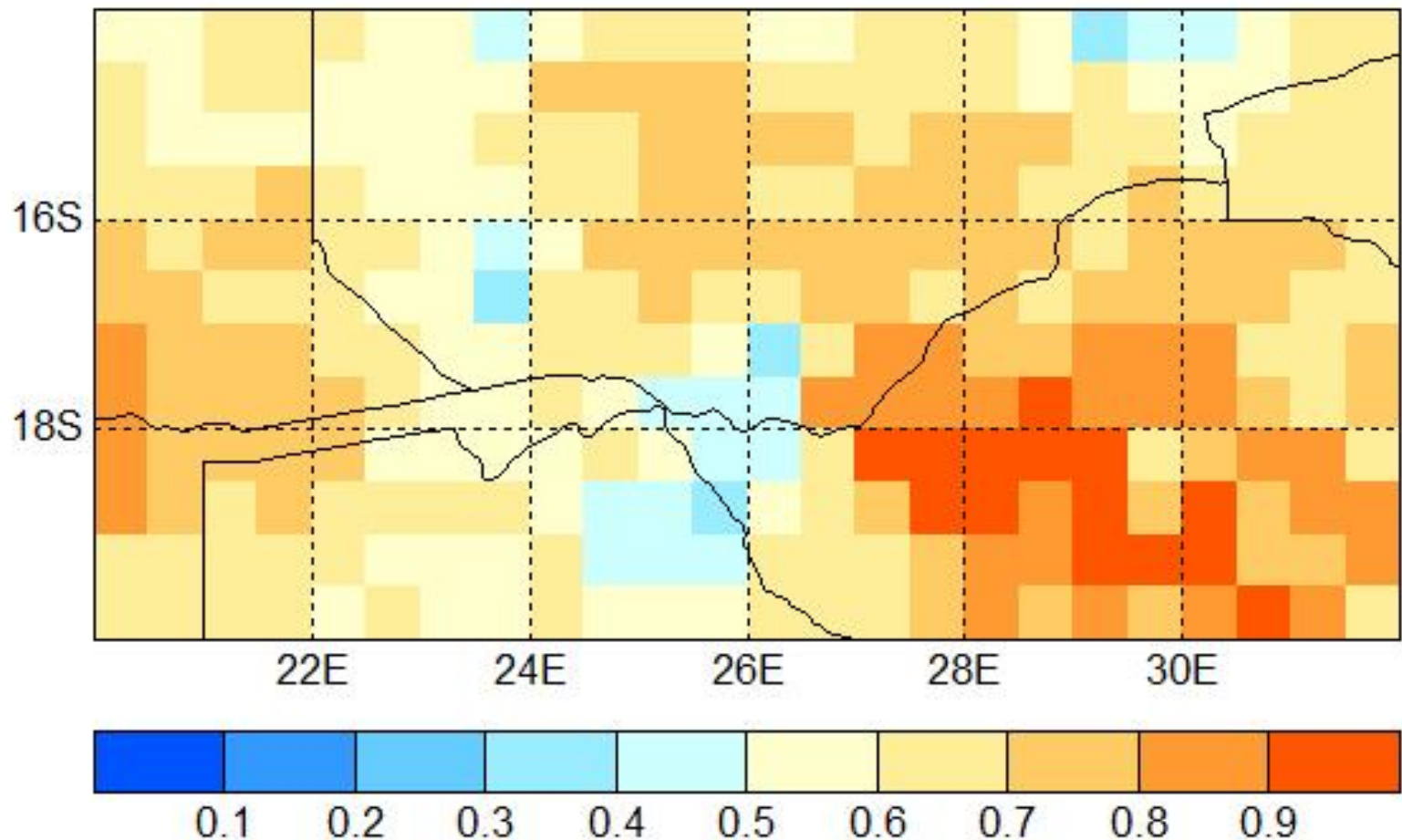
DECEMBER-JANUARY-FEBRUARY 2010/11  
Below-Normal Rainfall



Operational forecast production

# Can we predict seasonal extremes?

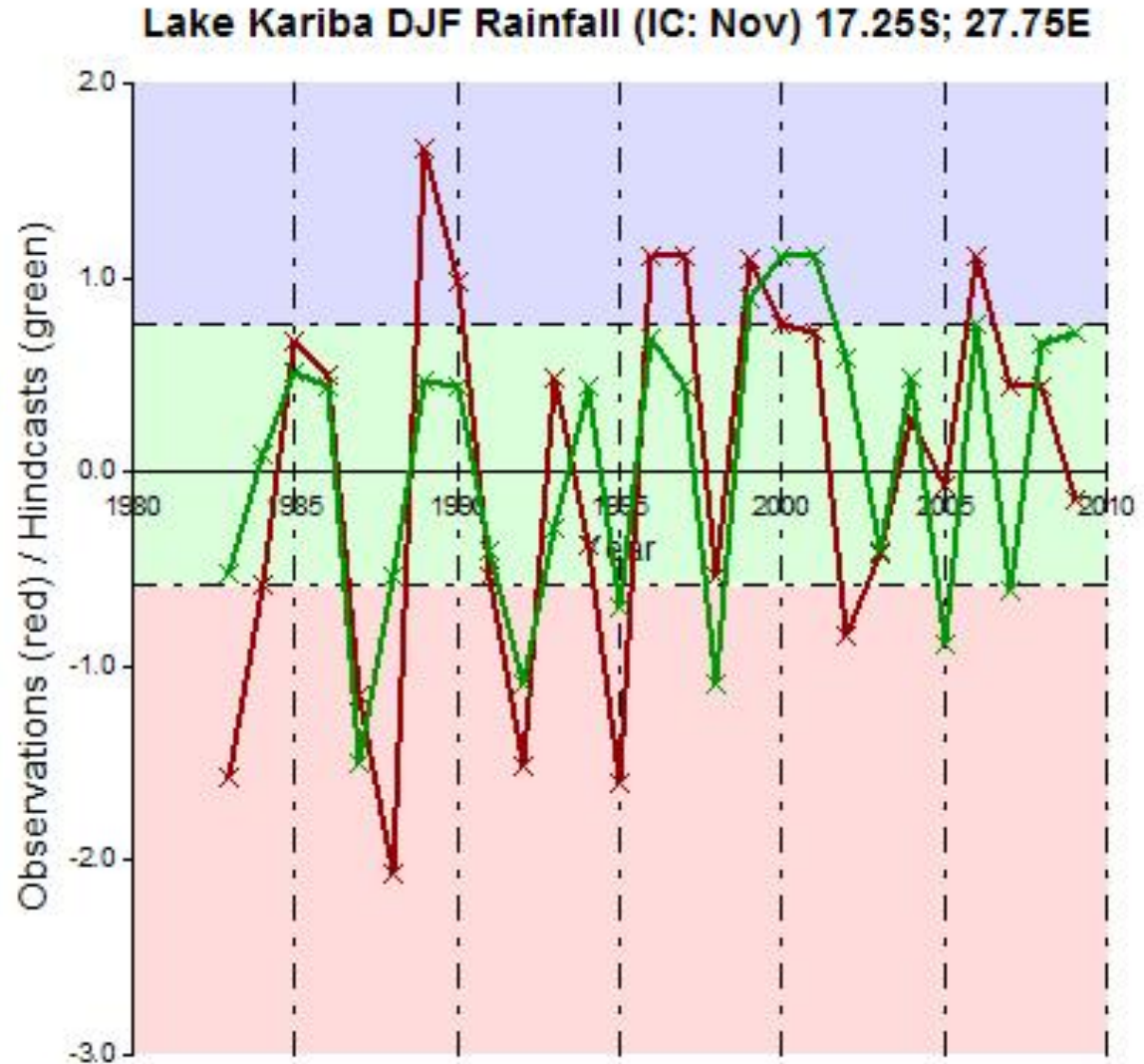
Ability to Predict High DJF Pcp Totals (>75%tile)



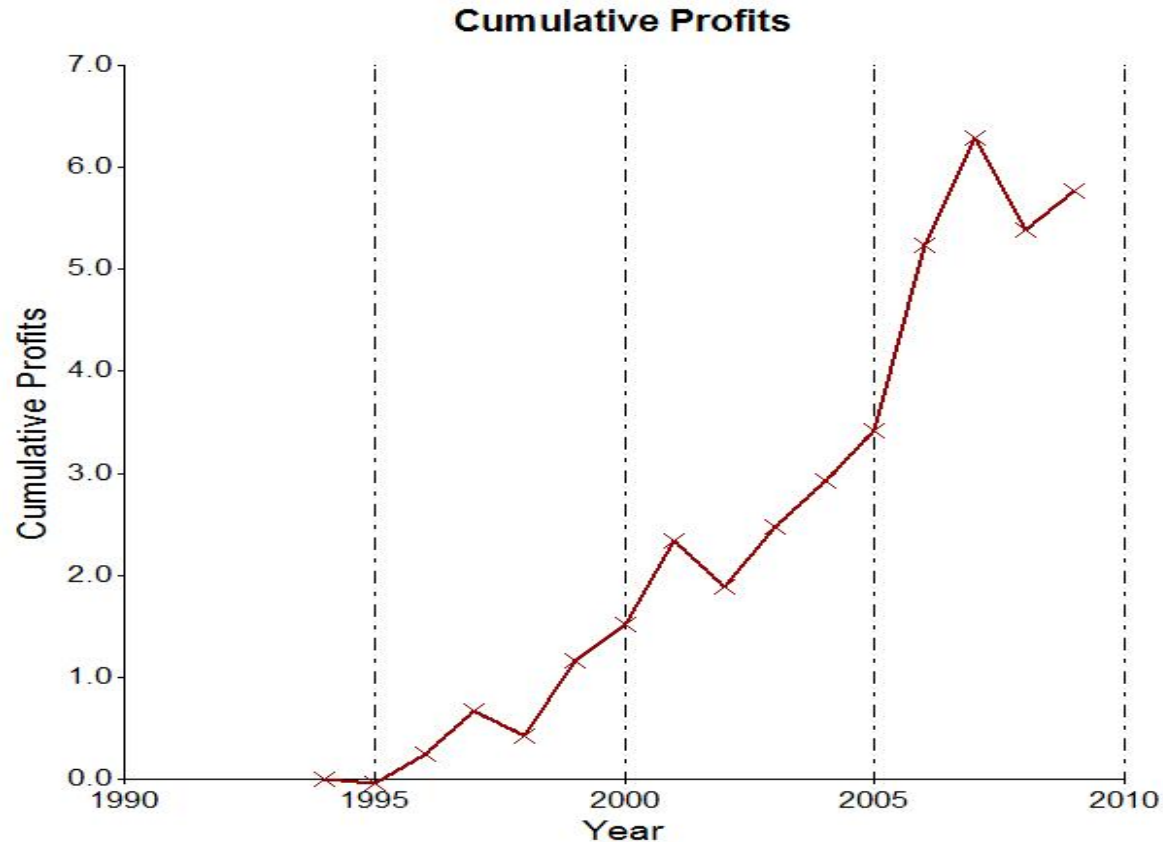
# DJF rainfall (past) forecasts

**Corr = 0.69**

**Hit score = 63%**



# Economic value of (past) forecasts



**Cumulative profits (CP) diagram - it indicates how an initial investment would change in value over time if it were invested on the forecasts and was paid fair odds on the outcome. For example, if the CP is 0.40 it means that an initial investment of \$100 would now be worth \$140. One then invests all \$140 on the next forecast, and make a small profit, so you now have about \$150. The next year you lose a bit etc.**

**This result shows an increase in profit if the forecasts would have been used over the 15 years**

# Forecast example

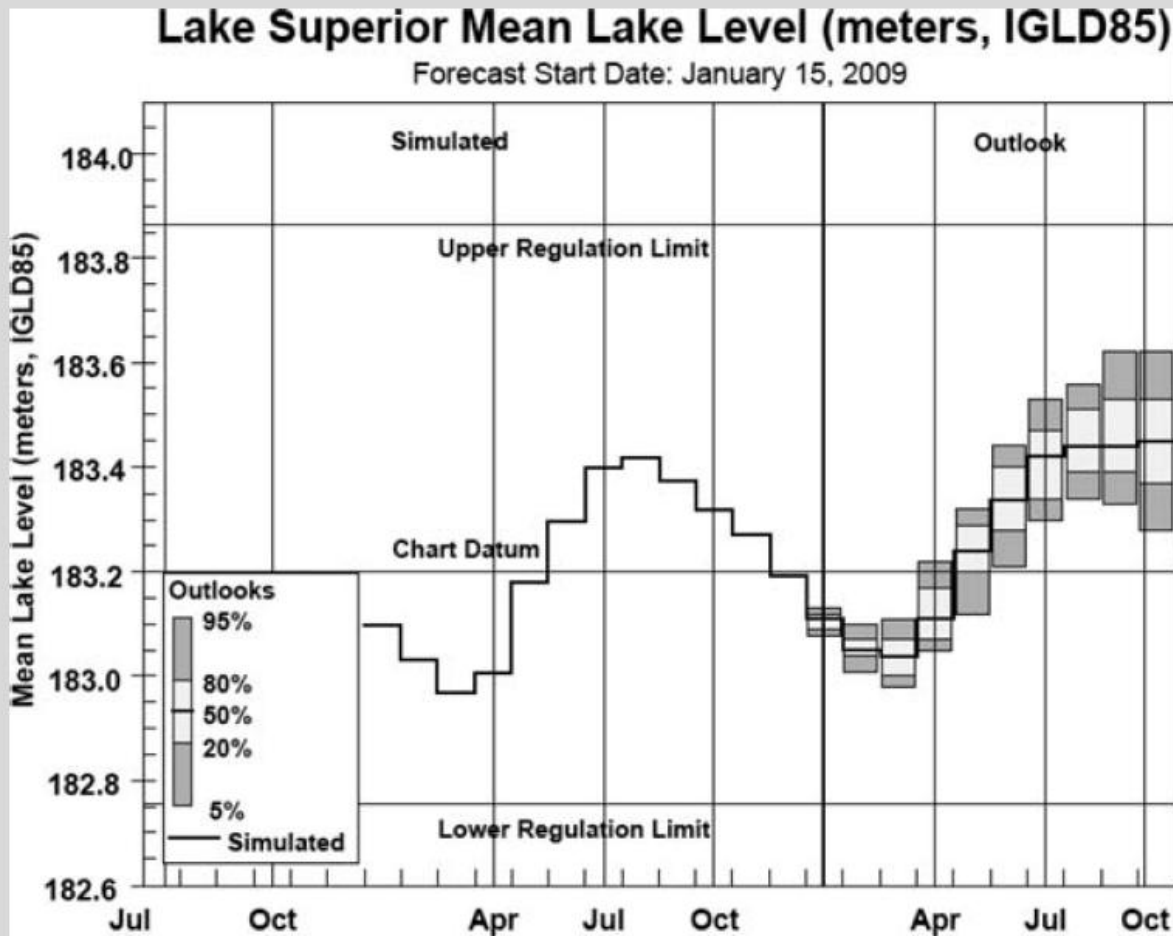


Fig. 10.5 Example of a seasonal water level outlook for Lake Superior (NOAA 2009, courtesy of NOAA, Great Lakes Environmental Research Laboratory)

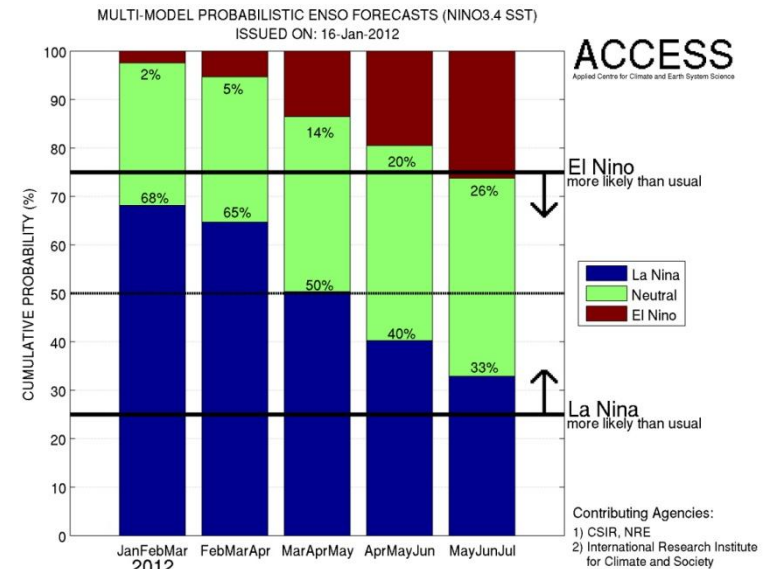
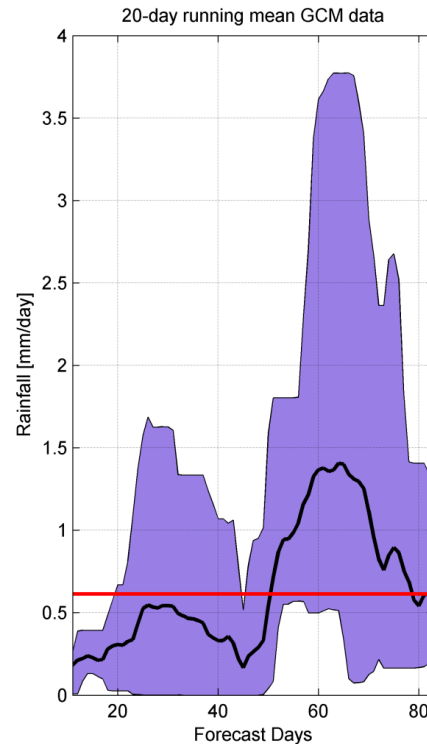
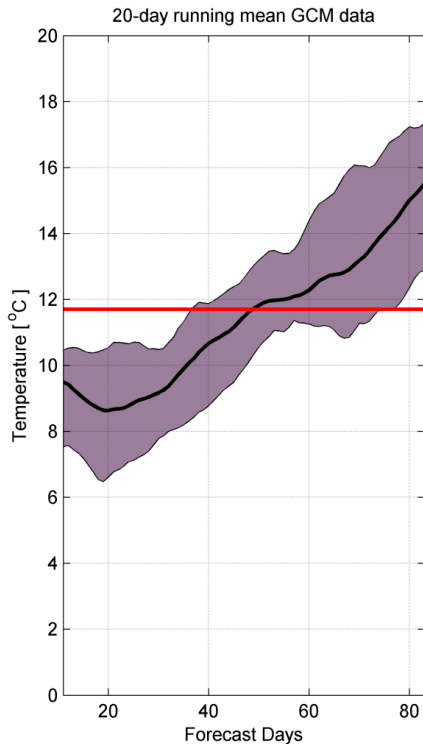
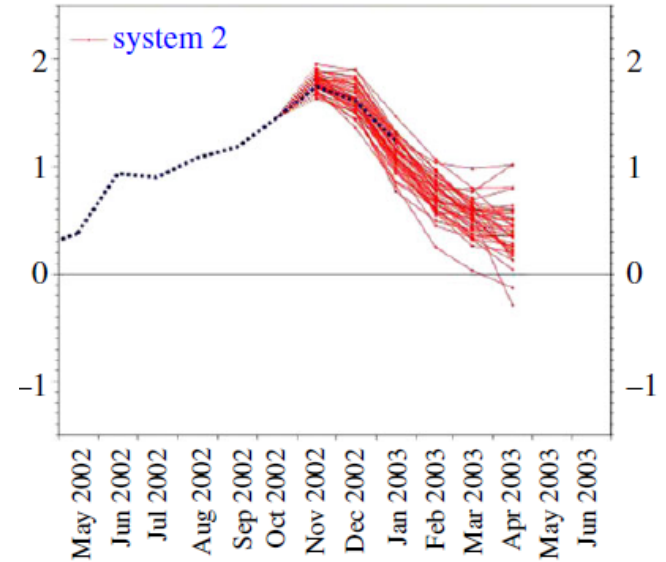
# What we need for our modelling

- Daily data
  - Rainfall
  - Temperatures
  - Inflow
  - Outflow
- >20 years
- Quality controlled, minimal missing values
- **Channels of communication between forecast providers and dam managers**

# How would you like the product to look like?

- Probabilities?
- Lead-time?
- Frequency of issuance?
- Plumes?

NINO3.4 SST anomaly plume  
ECMWF forecast from 1 November 2002



To find out how ENSO may affect the rainfall over southern Africa during the months ahead, please refer to the forecasts for SADC: [http://rava.qsns.net/themes/climate\\_template/](http://rava.qsns.net/themes/climate_template/)

# THANK YOU

For More Information Contact

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