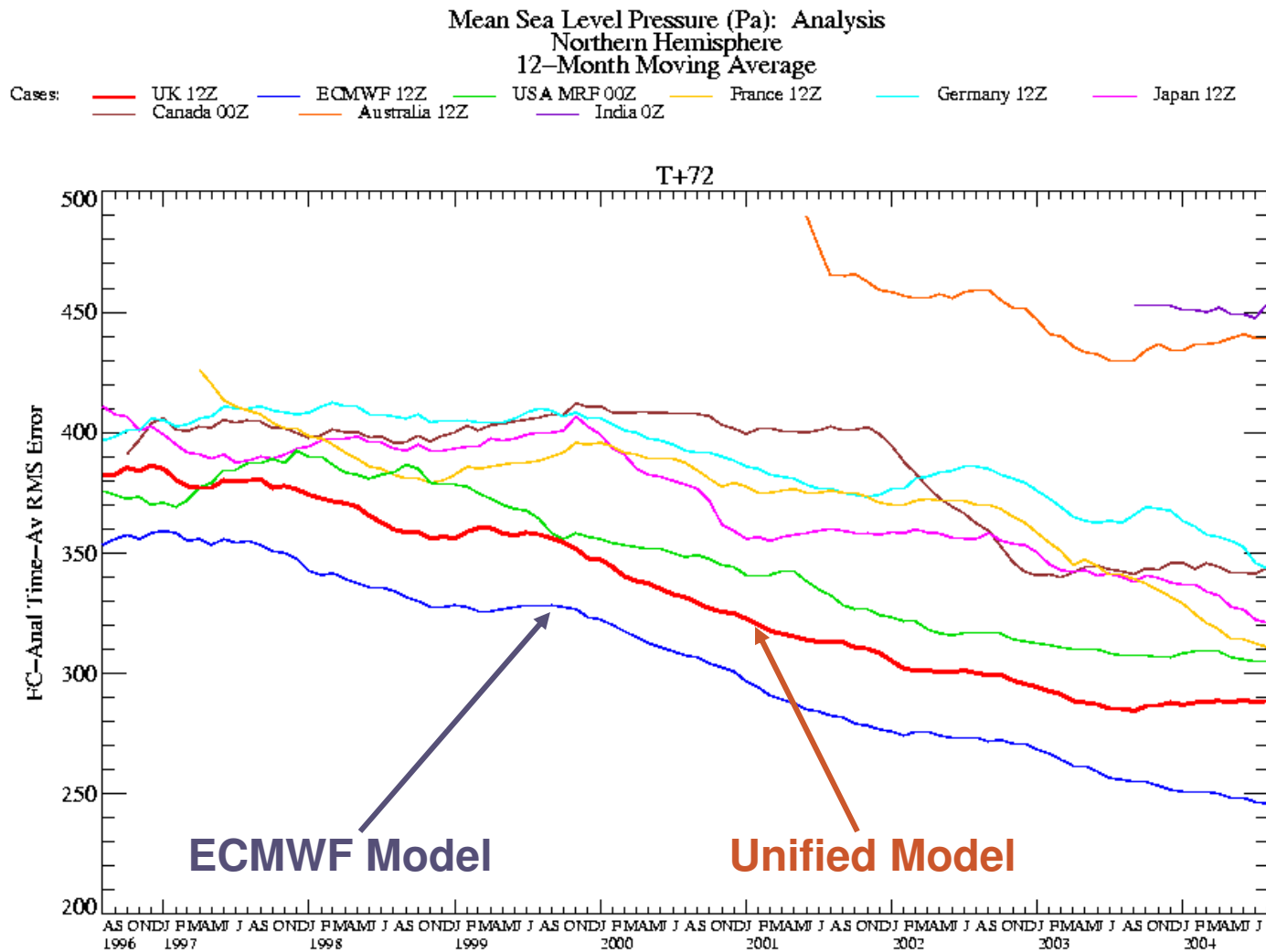




# Numerical Weather Prediction in SAWS: The Unified Model

Eugene Poolman  
South African Weather Service

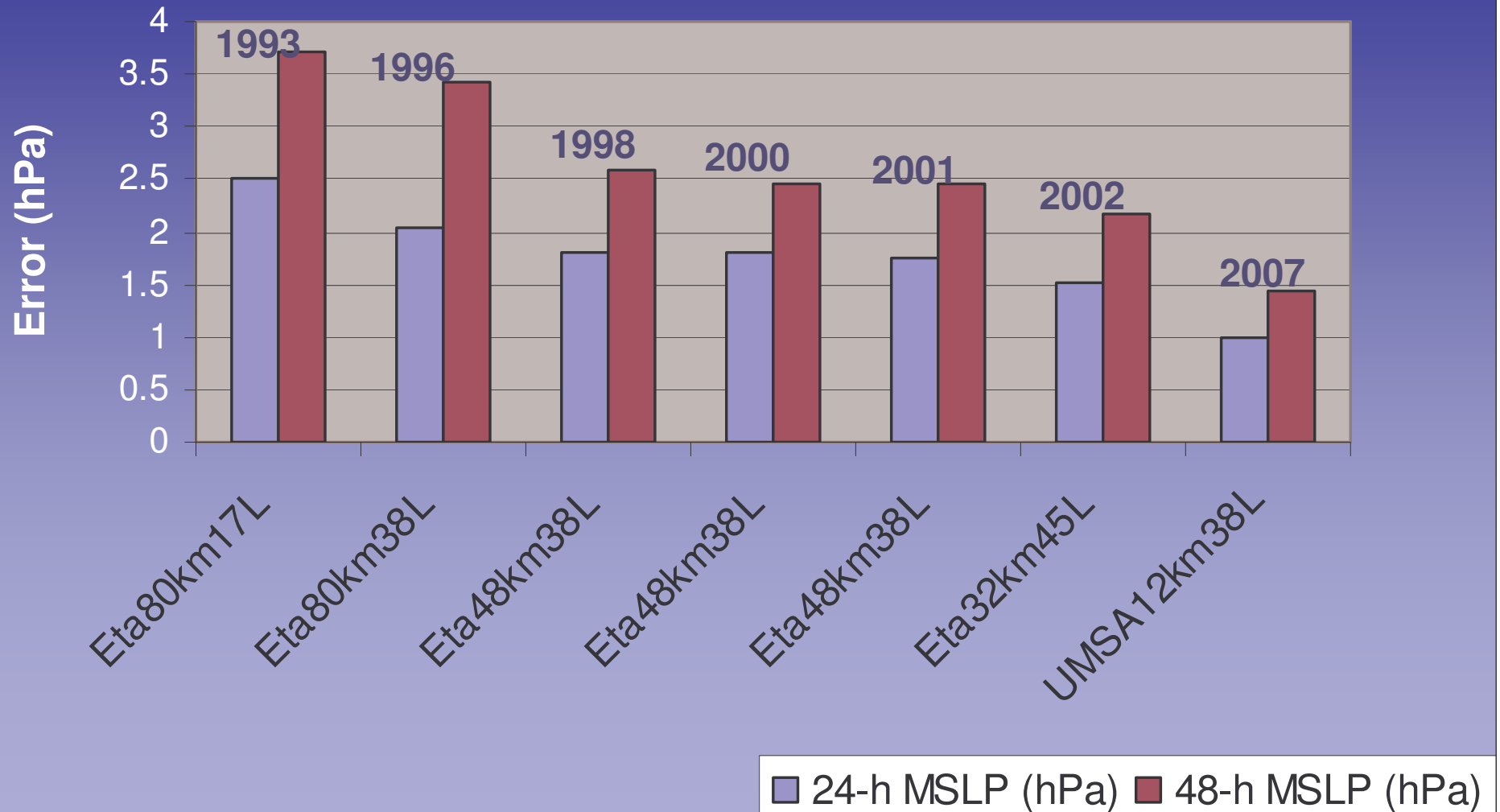
# Unified Model Skill compared to other Major Numerical Weather Prediction Models: progress from 1994 to 2004 (lower values is higher skill)



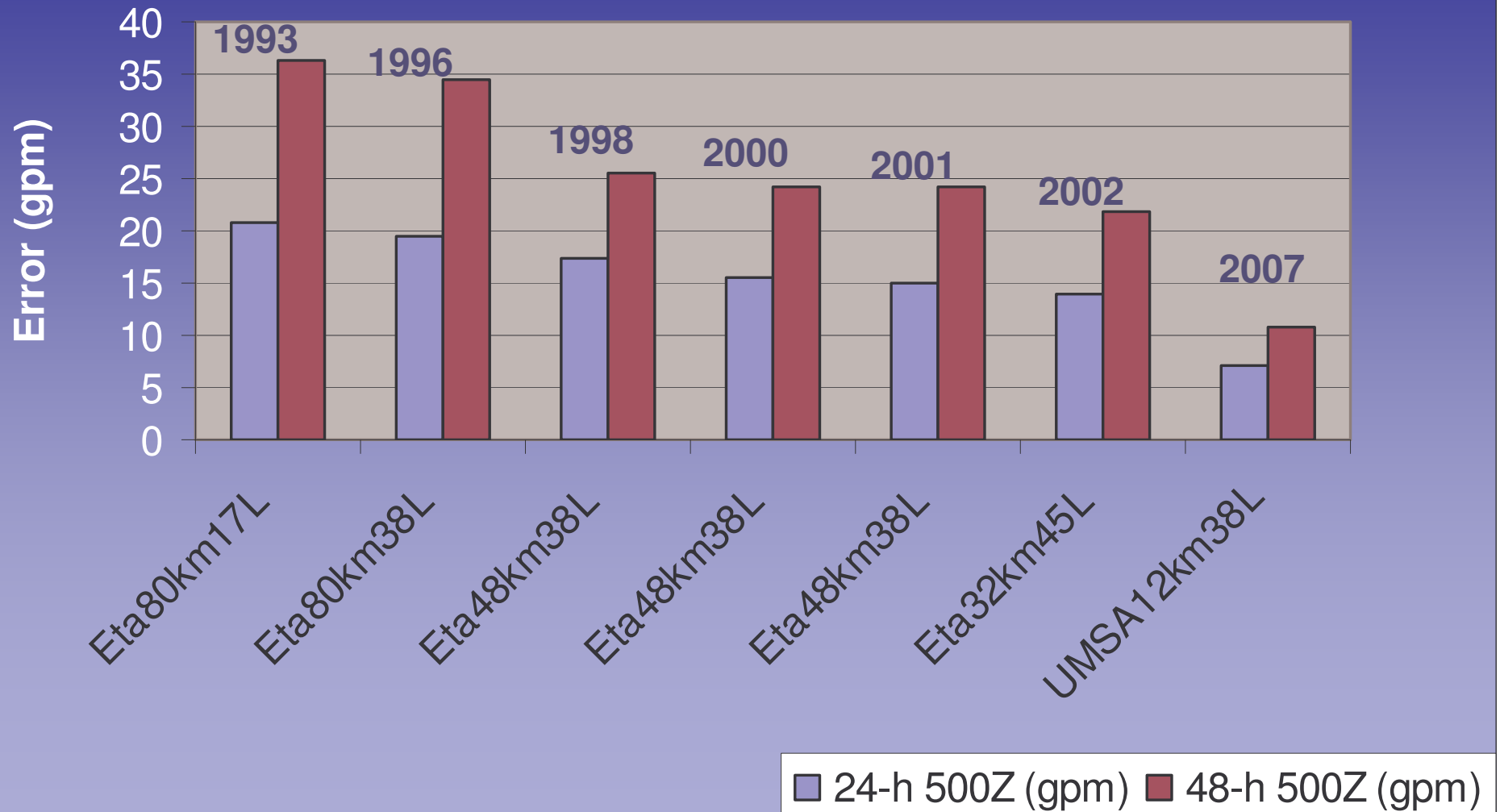
# SAWS NWP Root Mean Square Error

Model version	24 hour		48 hour	
	MSLP	500 hPa	MSLP	500 hPa
Eta80km17L (1993)	2.51	2.08	3.72	3.63
Eta80km38L (1996)	2.04	1.96	3.43	3.44
Eta48km38L (1998)	1.81	1.75	2.58	2.55
Eta48km38L (2000)	1.81	1.55	2.47	2.43
Eta48km38L (2001)	1.75	1.49	2.47	2.41
Eta32km45L (2002)	1.52	1.39	2.18	2.18
UMSA12km38L (2007)	0.99	0.71	1.45	1.08

# SAWS NWP MSLP RMSE



# SAWS NWP 500Z RMSE



# Unified Model at the SAWS

- Replaces Eta3245 at end 2006
- Version 6.1 (installed from Sept 2006), will upgrade in sync with Met Office
- **Operational** licence with Met Office:
  - May use the model for operational forecasting responsibilities
  - Real-time feed of observations, LBCs and initial dump
  - Software support from Met Office scientists, visits
- Regional model centred over Southern Africa
  - **UM SA12**: 12km, 648x480, 38 levels
- Multiple nesting facility
  - Larger domain writes out LBCs for nest

# Unified Model Computing

- **Workstation**

- Pentium-4 running Linux Centos 4.1 OS
- 2GB memory, 240GB disk-space
- Speed: 150 mins/ 24 hr forecast for SA15 :: 148x110L38

- **Supercomputer**

- NEC sx8 single node (8 CPUs) running Super-UX OS
- 128GB memory, 1.2TB disk-space
- Speed: 42 mins/ 24 hr forecast for SA12 :: 648x480L38
- Speed: 2 mins/ 24 hr forecast for SA15 :: 148x110L38

# Unified Model Schedule

- **Input files**

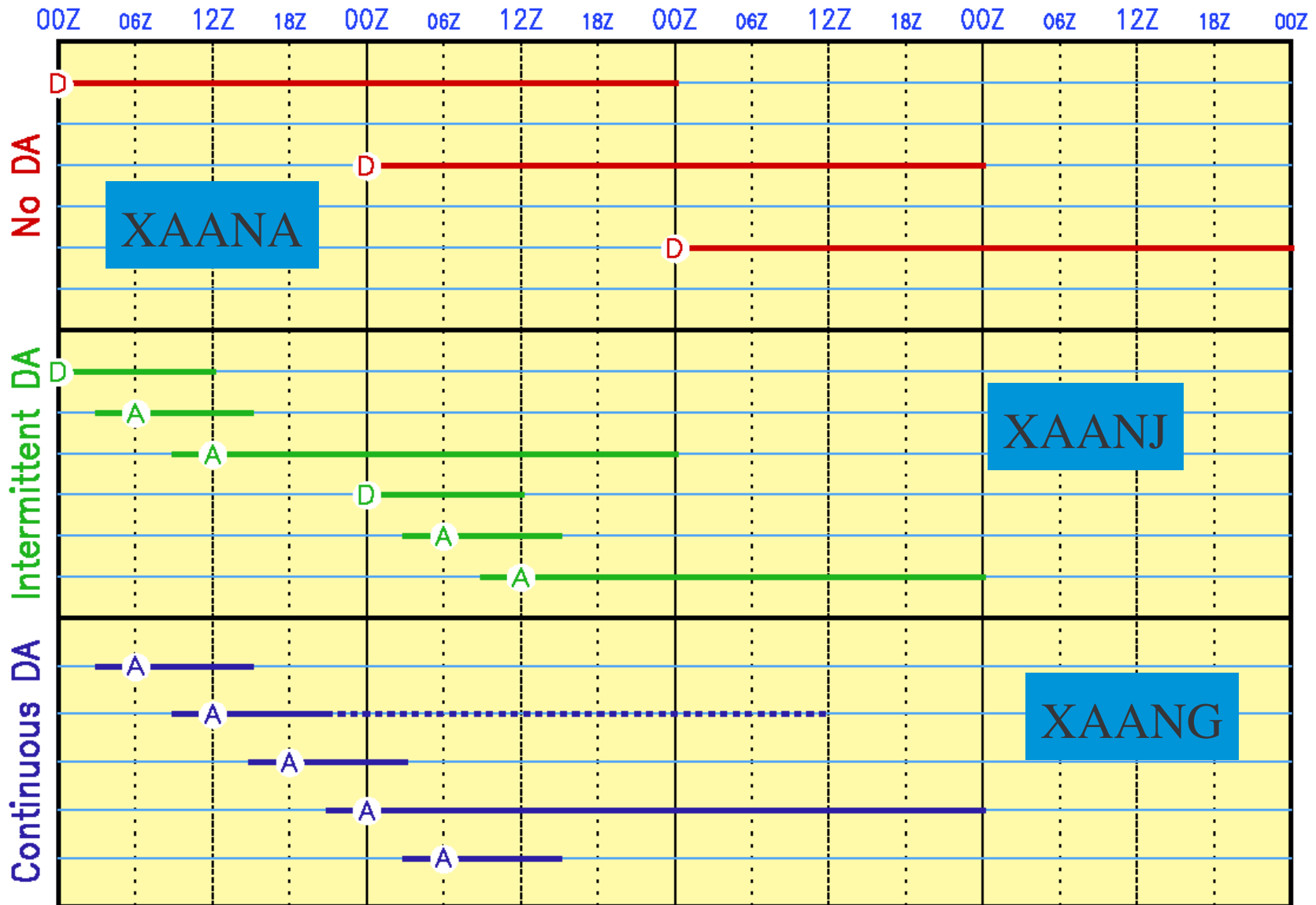
- Dump: initial start file (global model resolution)
- Lateral Boundary Conditions (LBCs) every 3 hours
- Observations: every 6 hours (includes satellites)
- Ancillary files (reconfigure topography etc to high res)

- **Data Assimilation**

- Continuous DA: only input from observations
- Intermittent DA: use Met Office dump, spin-up 12 hours using observations and then make forecast (Eta)
- No DA: Use Met Office dump, reconfigure, do forecast



# Unified Model SA12 Schedule



# Unified Model Output

Output into 64-bit UM fields-file:

- 32bit
- Met Office GRIB
- NCEP GRIB for *PCGRIDDS*
- GRIB/Binary for NINJO
- IEEE binary for GrADS (to populate website)

# Unified Model Output

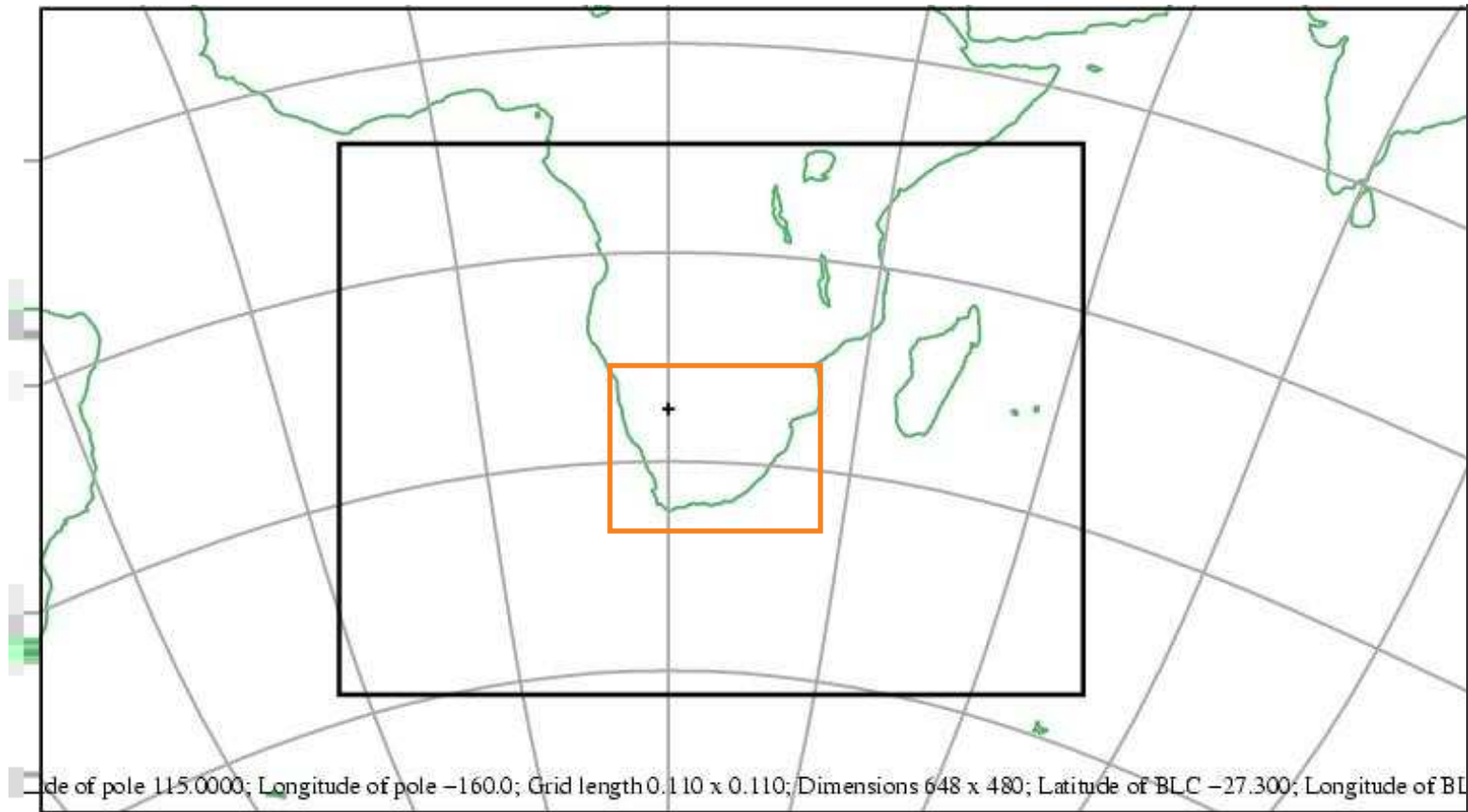
## ❖ Output field formats:

- Regular lat/lon at 0.11x0.11 degrees
- Pressure levels from 1000, 950, ..., 150, 100hPa
- Model levels up to ~300hPa
- Hourly time resolution
- 00Z runs to 48 hours, 12Z runs to 36 hours

## ❖ Output fields:

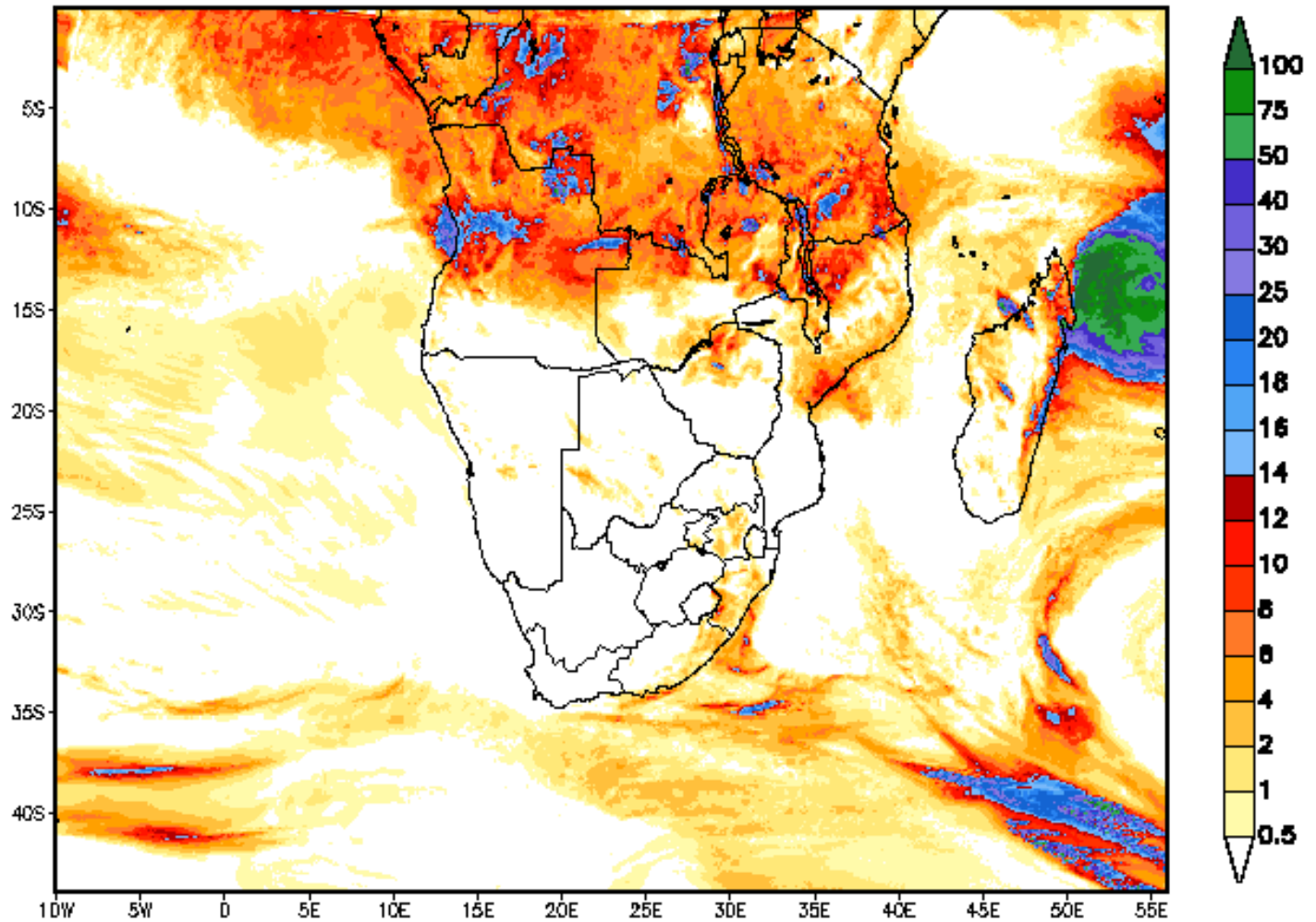
- T, U, V, omega, humidity, Pres, Precip, cloud, vis, trop, tx, tn, thetaw, convection indicator, CLW, PV

# UM SA12 & SA4 Domains



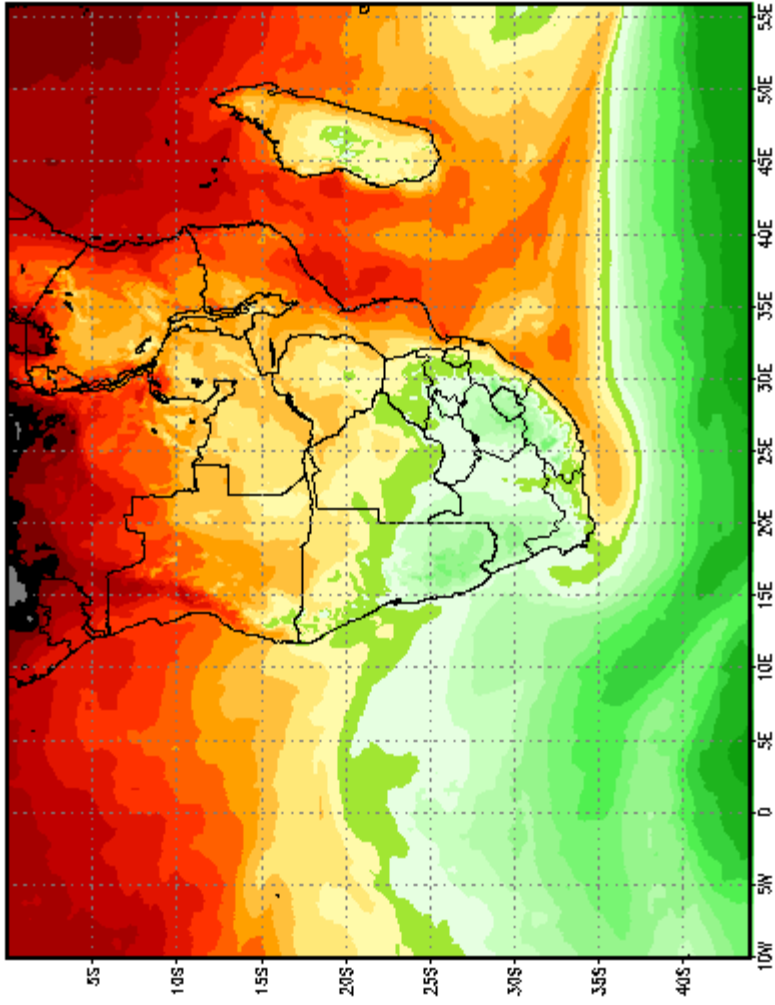
# UM model.....

UM 12km horizontal resolution – xaana Run:  
Accumulating Precipitation for past 24 hours (mm)



Total precipitation of 24Z to 48Z, 13 MAR – Initiated 00Z 12 MAR 2007

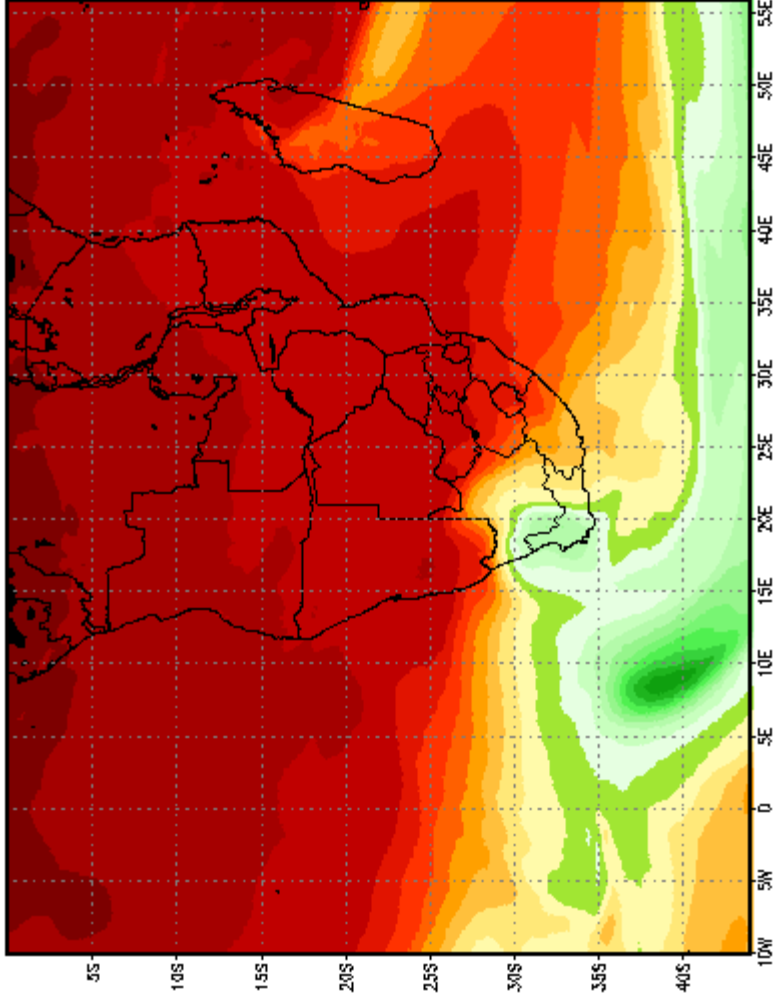
Wet Bulb Potential Temp (1000hPa):: 00Z Friday 14 July 2006



SIADS: COLA/IGES

2006-07-16-11:34

Wet Bulb Potential Temp (500hPa):: 00Z Friday 14 July 2006



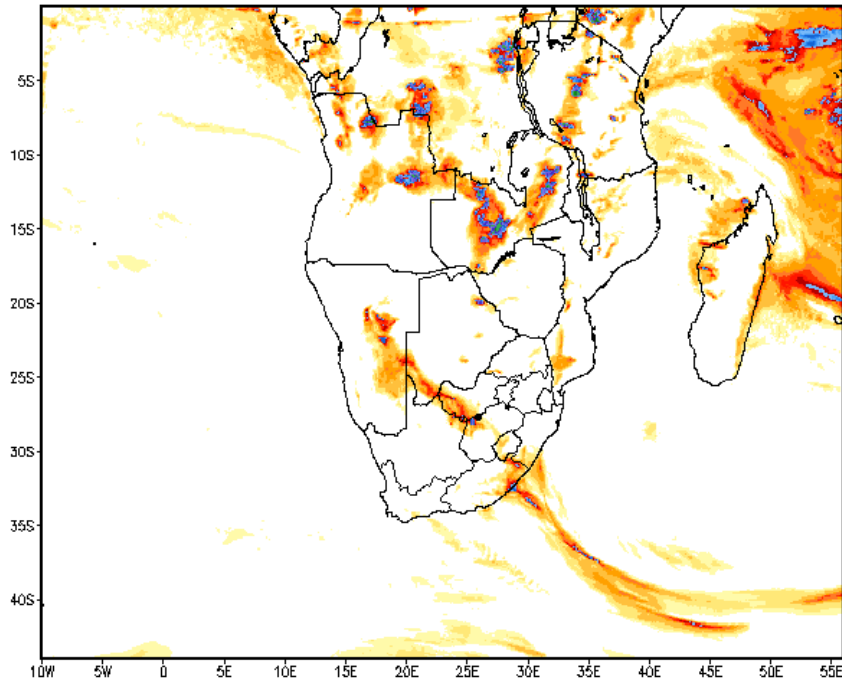
SIADIS: COLA/IGES

2006-07-16-11:46

# Unified Model Forecasts: example of prediction of visibility

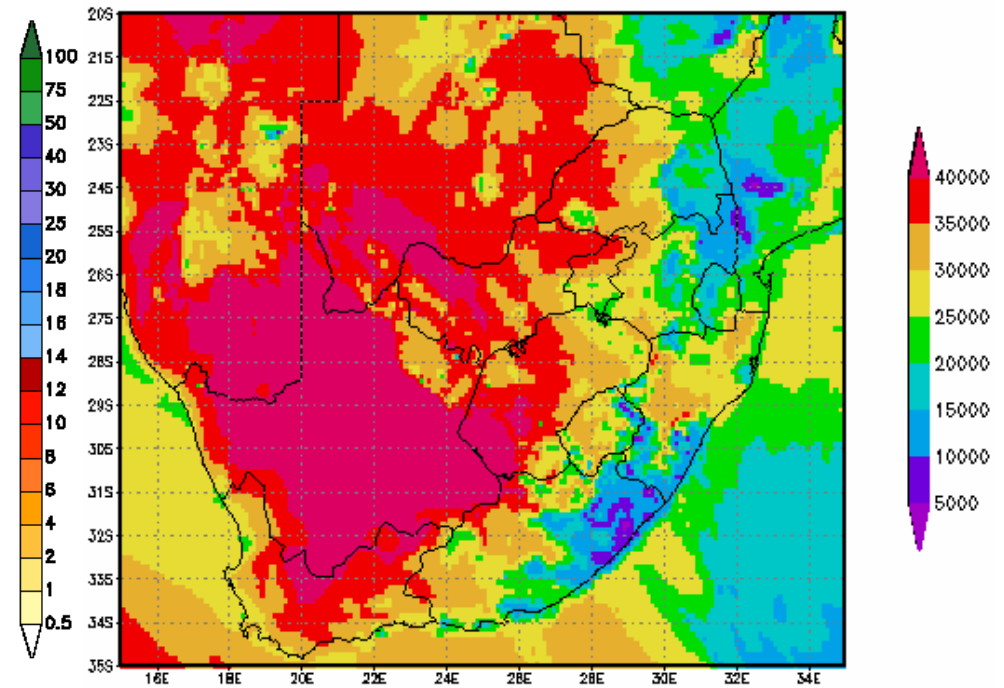
## Predicted Rainfall

UM 12km horizontal resolution – xaana Run:  
Total Precipitation for past 6 hours (mm)



Total precipitation of 18Z to 24Z, 16 NOV – Initiated 00Z 15 NOV 2006

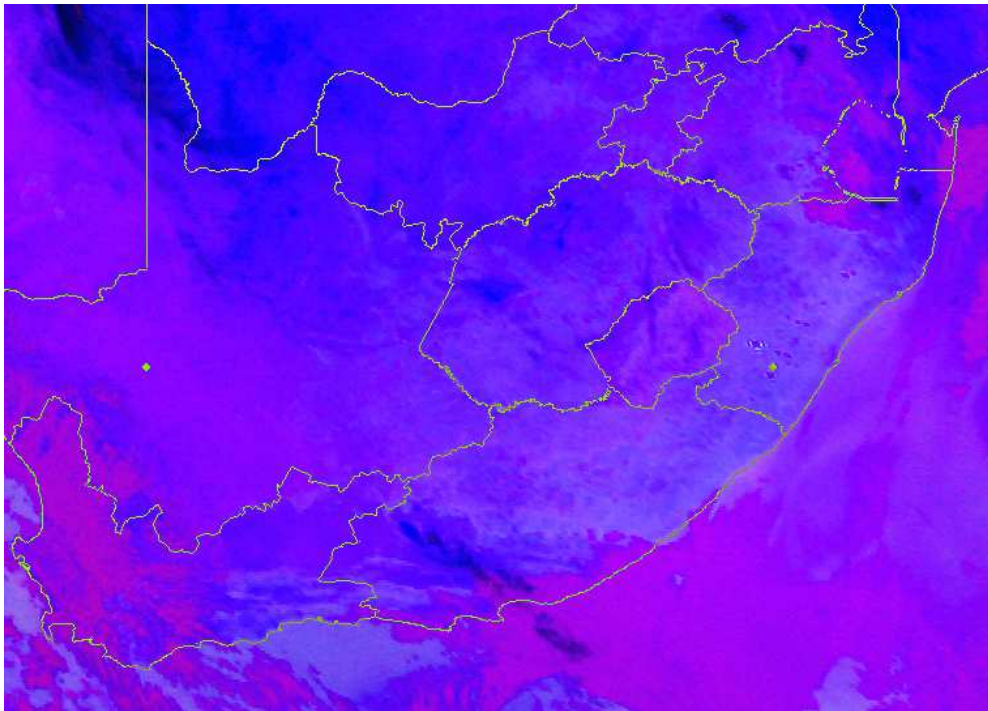
## Predicted Visibility in meters





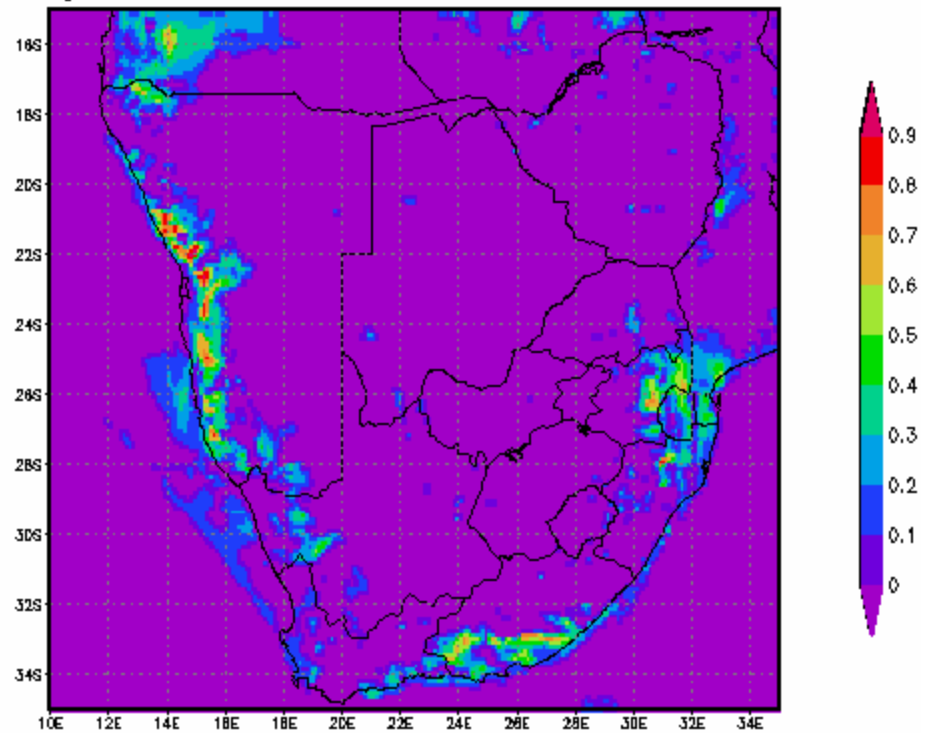
# Unified Model Forecasts: example of prediction of fog

## Satellite view fog

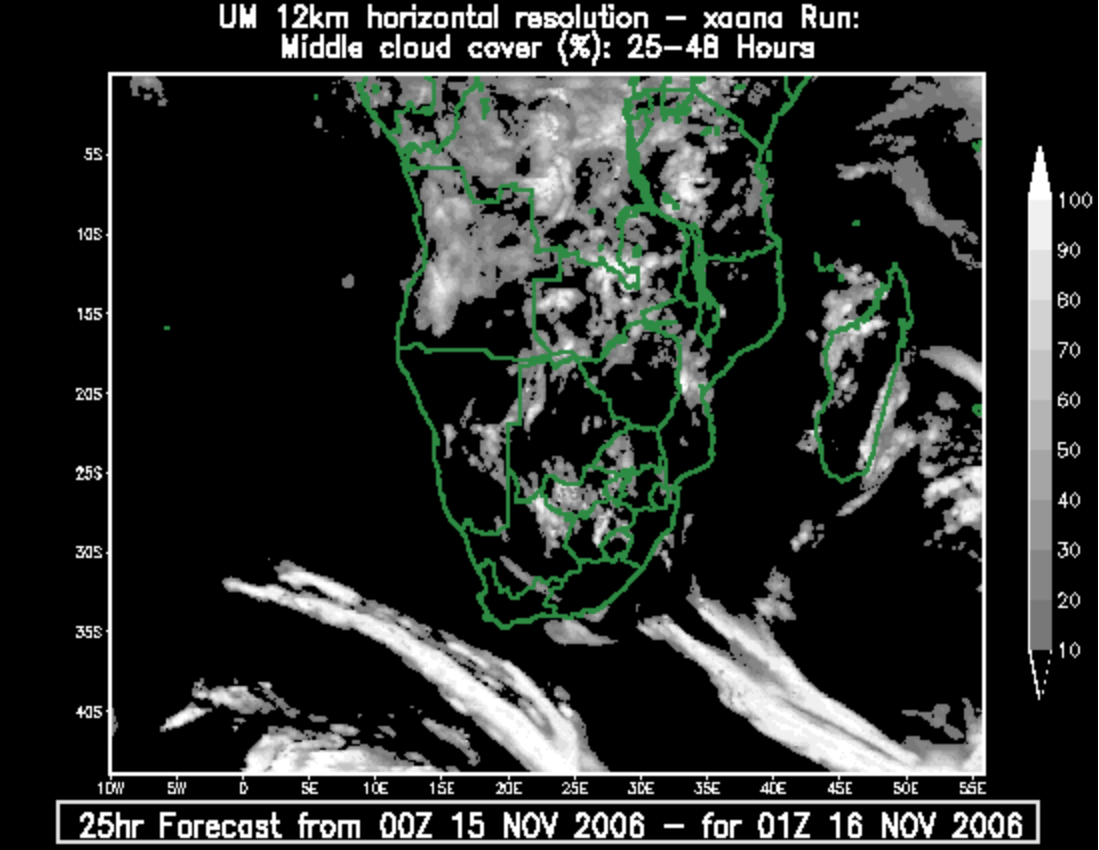
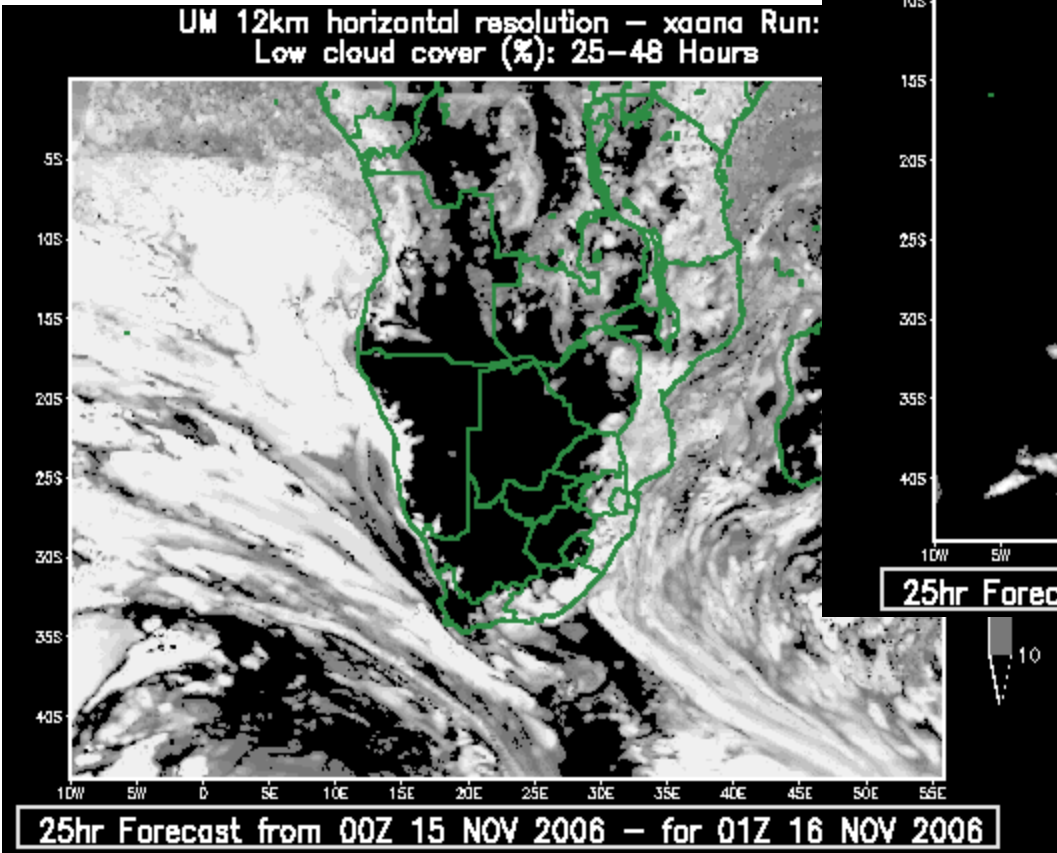


## Model predicted fog

Fog % Forecast at 06:00 SAST on 15 Nov 2006

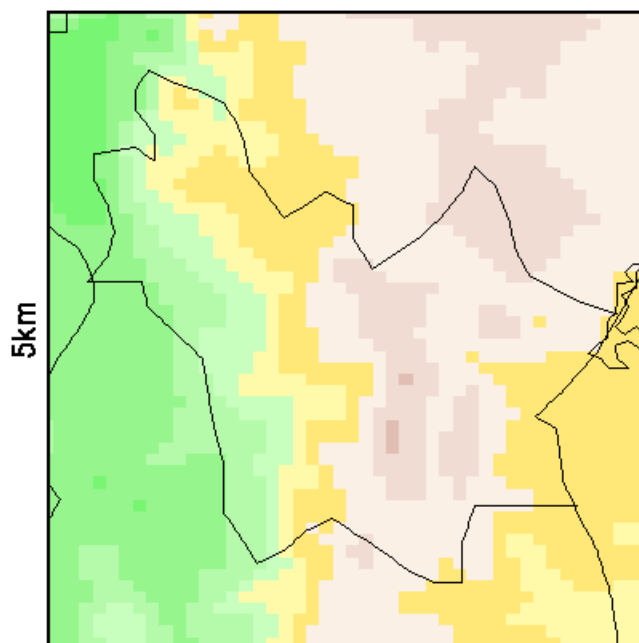
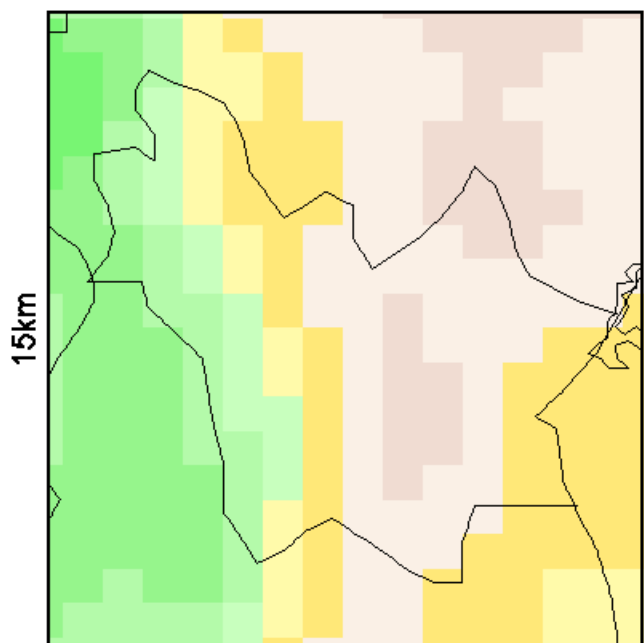
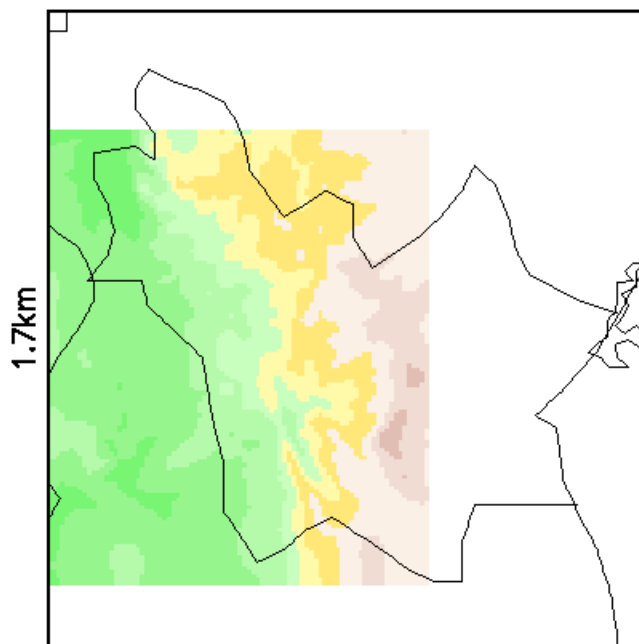
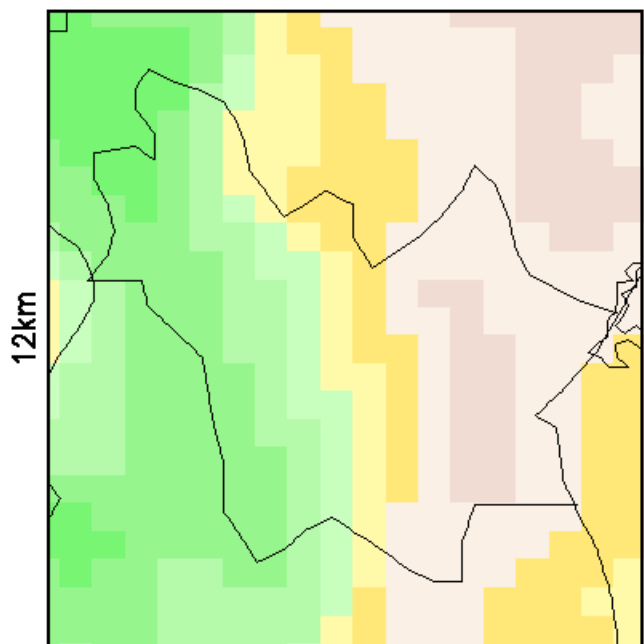


# Unified Model Forecasts: example of prediction of low and middle level cloud (hourly animation)

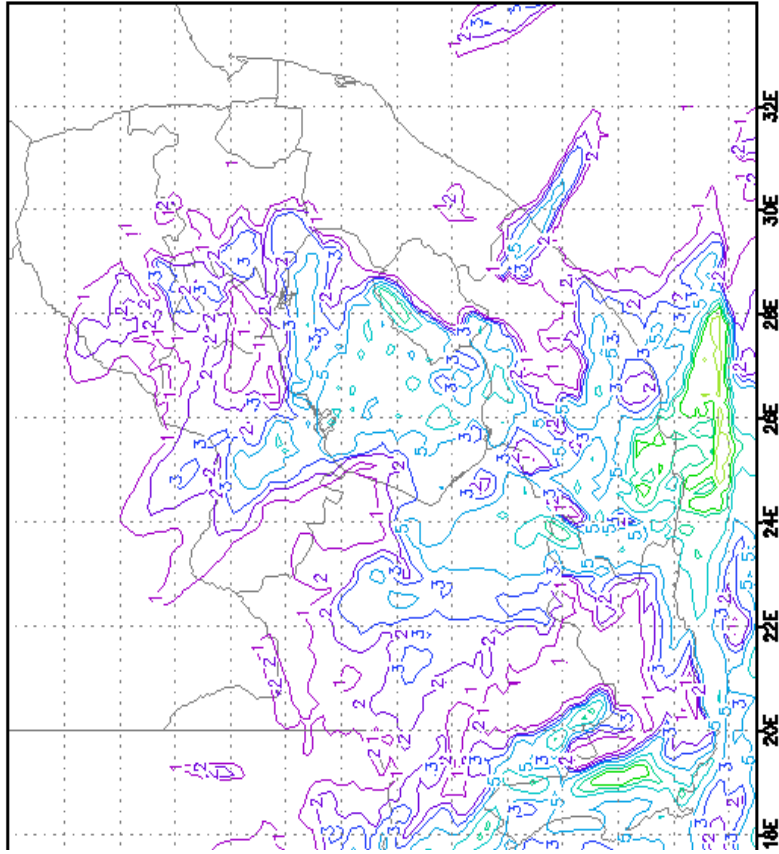


# Mesoscale Modelling

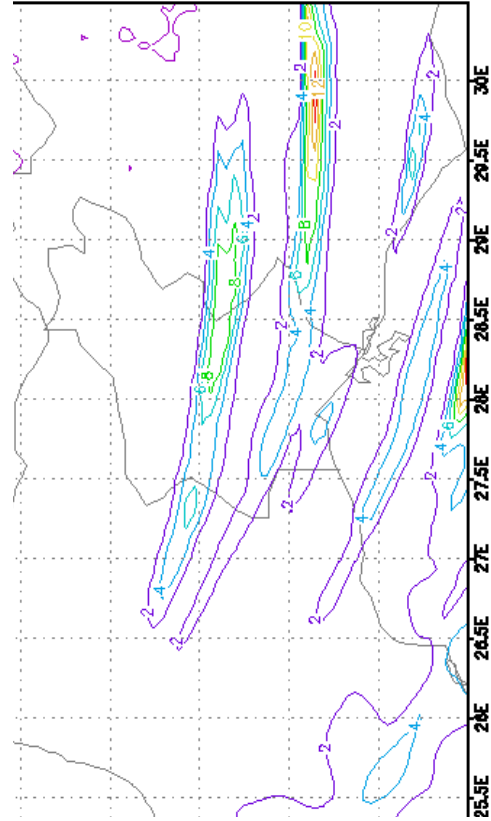
- Nest UM within each domain
  - Have tested: 15km, 5km, 1.7km to investigate spatial detail in rainfall patterns
- Applications
  - High resolution forecasting over airports, cities, regions with strong topographical changes
  - Air quality modelling (high-res winds)
  - Trajectory (forward/backward)
  - Diagnostic studies (e.g. coastal lows)
  - In-shore wave modelling



Total Rainfall :: 20060422

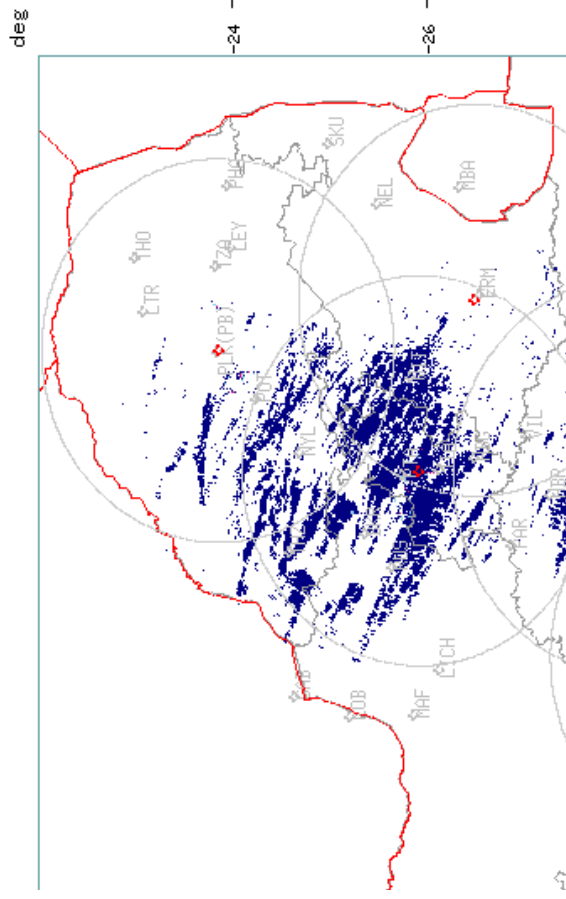


UM6.1 15km

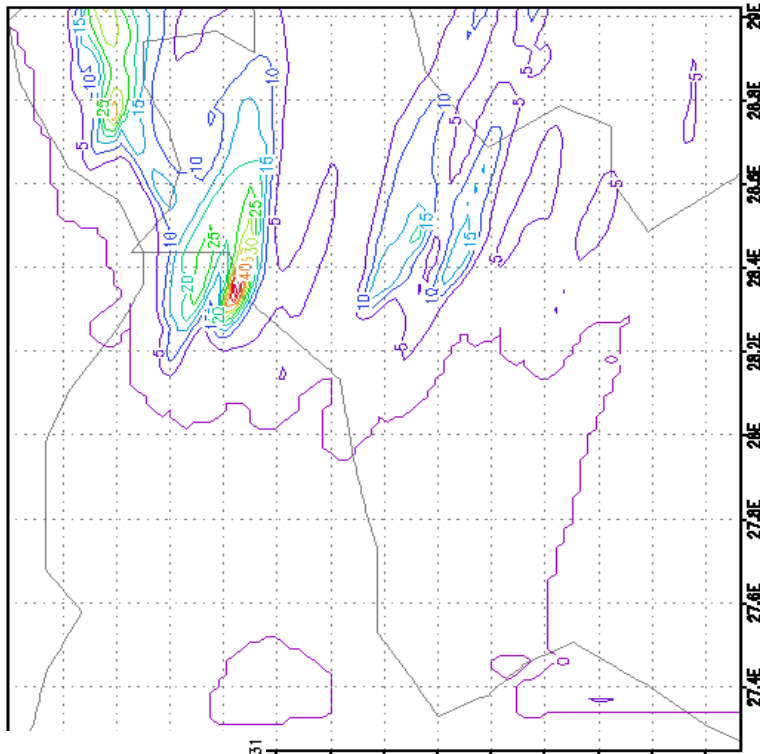


UM6.1 5km

2006-1



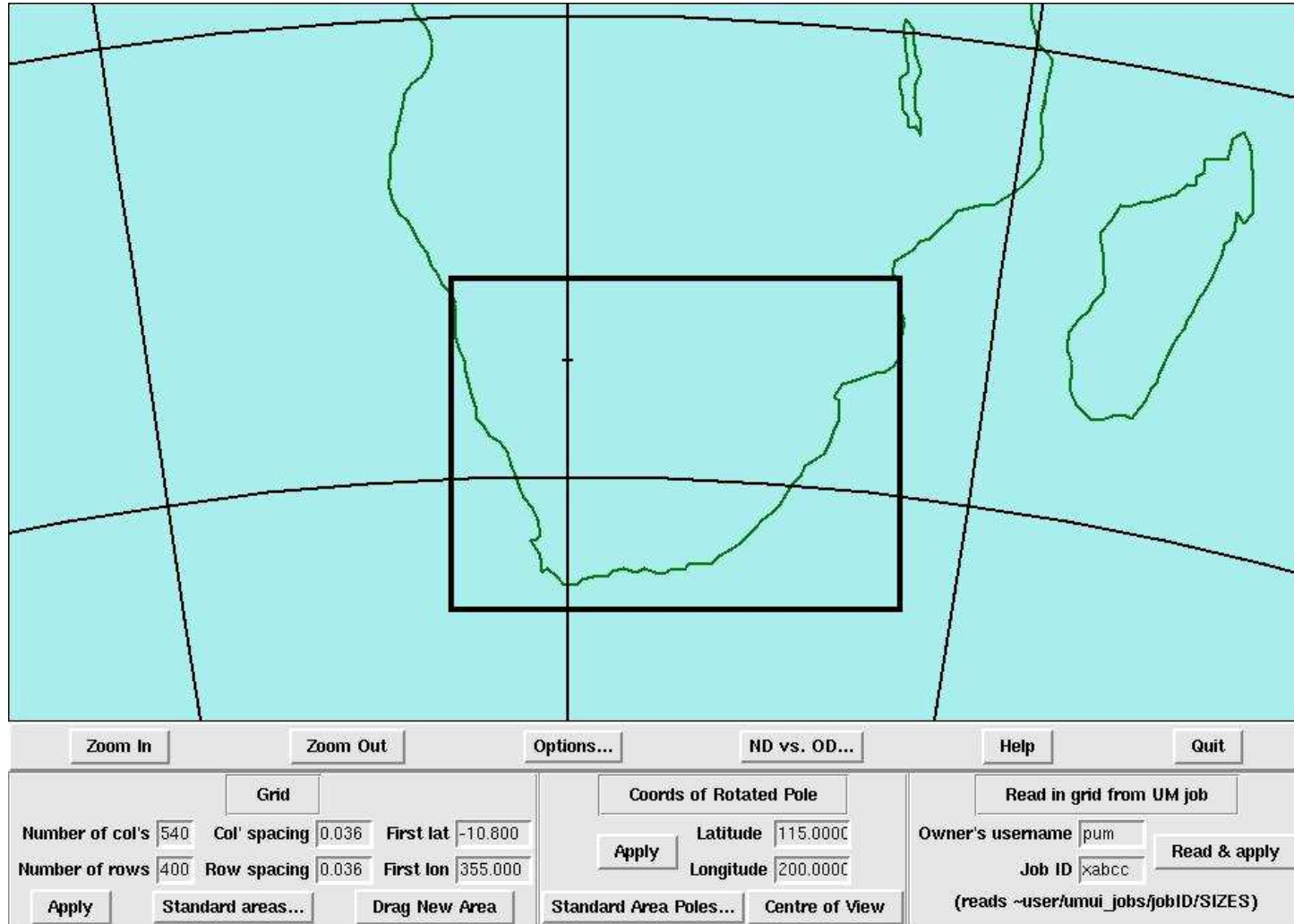
Rainfall (Large-scale rain only) :: 20060422



UM6.1 1.7km

2006-10-02-12:31

# SA4km model :: for 24hr fcsts ...in development phase...



**Thank you**