Clustering Forecast System for Southern Africa SWFDP

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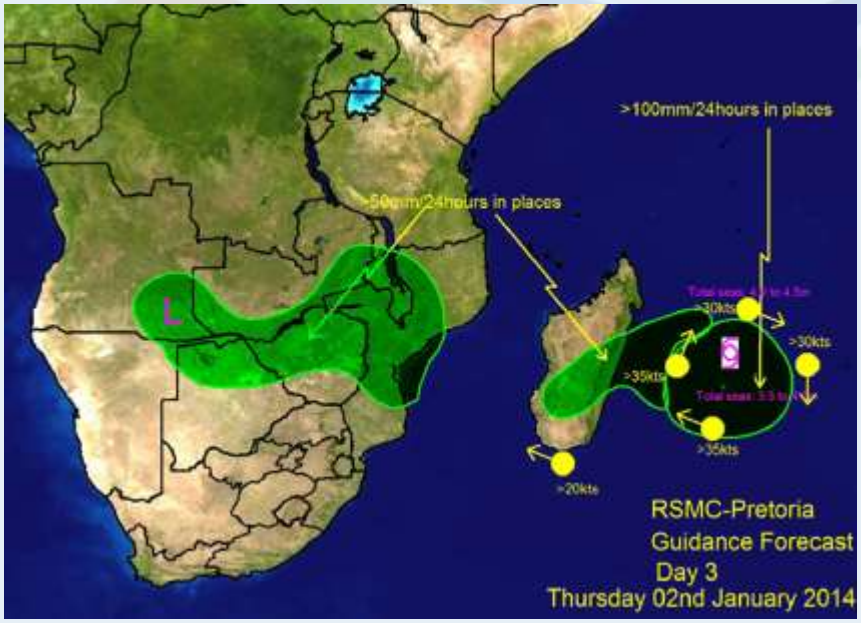
Introduction

- The southern Africa SWFDP is reliant on objective forecast data for days 1 to 5 for issuing guidance maps.
- Forecasters at SAWS already have access to global centre forecasts through the SWFDP initiative where after they use the information to provide subjective guidance to the SWFDP region.
- The TIGGE data represents the ideal forecast in which most of the forecasts from the global forecast centres are contained.
- In order to represent this large ensemble forecast data in a manner which does not overwhelm forecasters, a clustering method was proposed.



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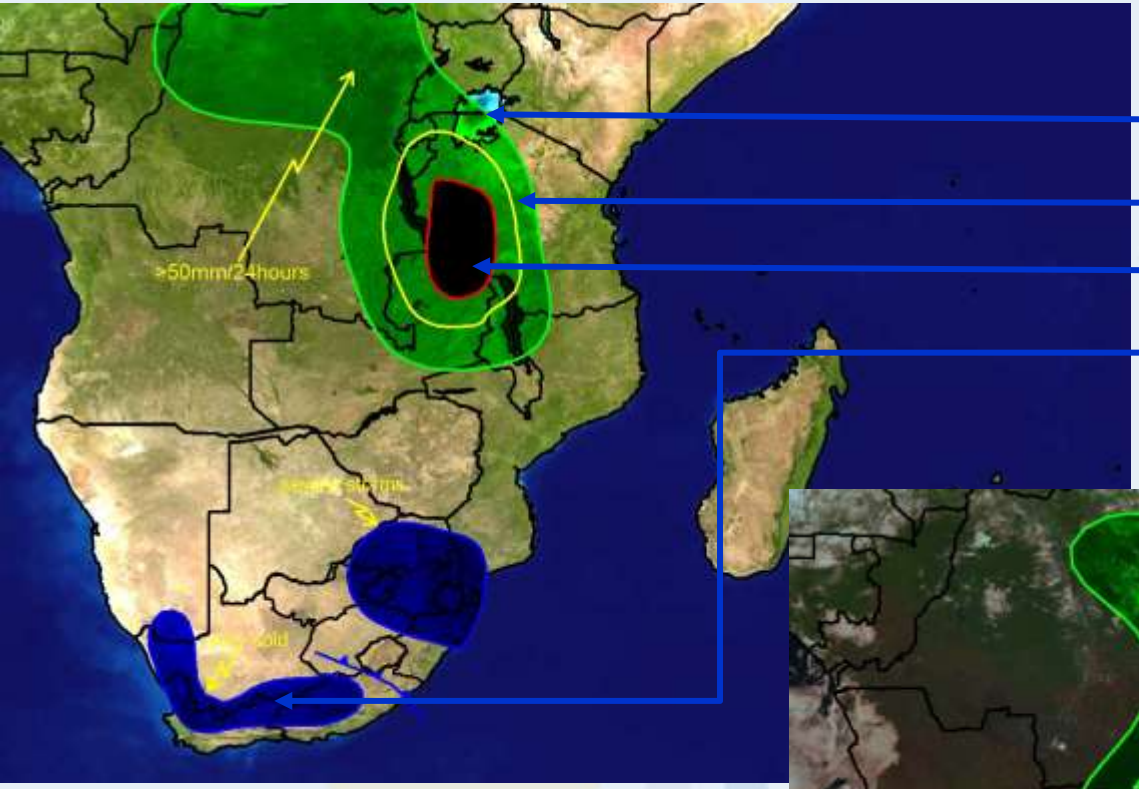
Introduction

- The TIGGE archive consists of nine global producing centres medium-range ensemble forecasts.
- This multi-model/multi-analysis forecast system addresses the issue of model uncertainty and observational error.
- Extensive studies on the TIGGE data have been done and shown to improve warning and guidance on high impact and severe weather.
- This pilot study was done to show that the TIGGE data are useful for guidance for severe weather for the RSMC.
- Furthermore, the forecasters are proposing a more detailed and probabilistic guidance maps and hence an objective probability forecast will be advantageous to this process.

Introduction

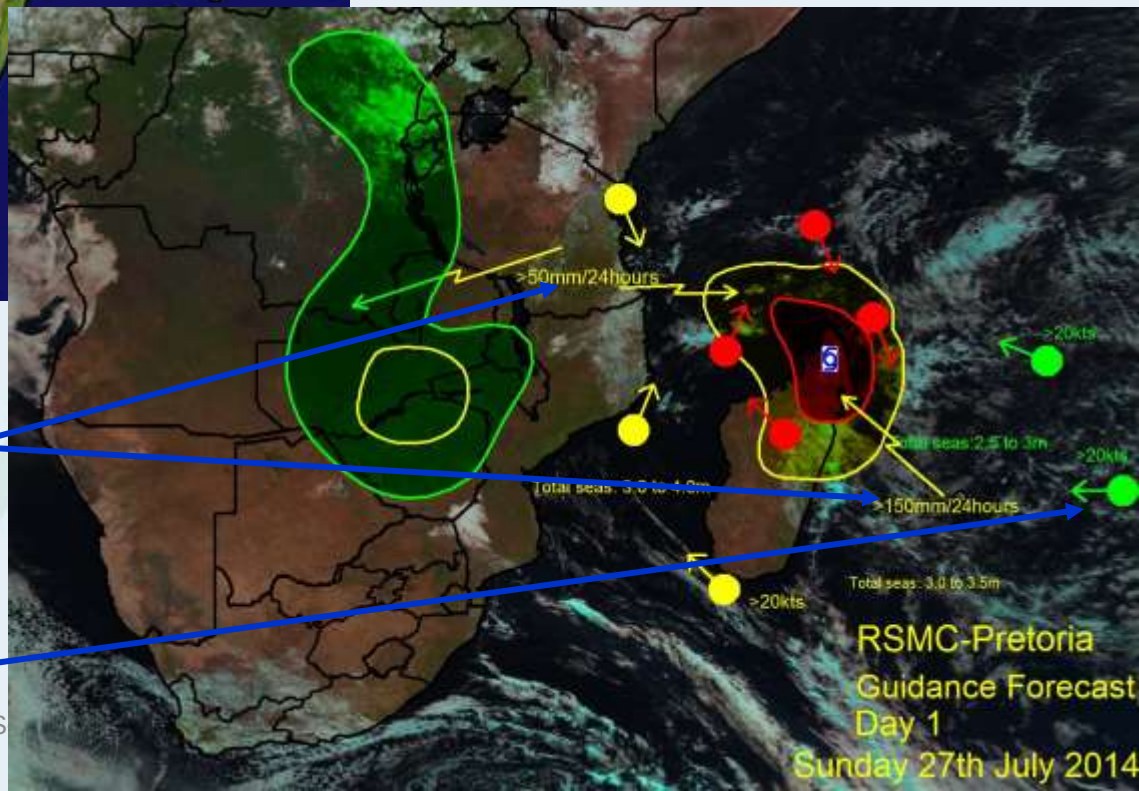


30 %

60%

80%

Also to include severe cold conditions



Distinguish between severe rainfall events

Distinguish between three levels of warning: watch, advisory and warning

Data

- 00 UTC analysis ensemble forecasts from four centres were used and consist of a total of 117 ensemble members.
- European Centre for Medium-Range Weather Forecasts (ECMWF) with **51** members,
- United Kingdoms' MetOffice (UKMO) with **24** members,
- National Centres for Environmental Prediction (NCEP) with **21** members, and
- Canadian Meteorological Centre (CMC) with **24** members.
- The surface variables investigated were 10 m wind speeds, maximum 2 metre temperature and 24-hour rainfall totals (accumulated 06 to 06 UTC).
- The domain covered is 20W to 70E and 10N to 45S.
- 1 December 2013 to 28 February 2014 (DJF 2013/14), adding to a total of 90 x 5 = 450 days.

Center	Analysis Time (UTC)	Ensemble Members	Horizontal Resolution Archived	Forecast Length	Perturbation Method*	Model Uncertainty*
CMC	00/12	20+1	1° x 1°	16 days	EnKf	PTP+SKEB
ECMWF	00/12	50+1	~0.25° x ~0.56°	10 days	EDA-SVINI	SPPT+SPBS
NCEP	00/06/12/18	20+1	1° x 1°	16 days	BV-ETR	STTP
UKMO	00/12	23+1	0.83° x 0.56°	15 days	ETKF	RP+SKEB

Methodology

- To test for current operational applicability, lead times 48- to 150-hours were used to correspond with the 5-day SWFDP guidance time due to the 2-day lag time of TIGGE availability.
- All members were rescaled to a compatible 1° x 1° grid.
- The SOM was set-up to create a 2 x 2 matrix.
- In this study 850 hPa geopotential heights (gpm) at 12 UTC for each of the forecast lead times was used to develop the SOM.
- It was found that SOMs larger than a 4 node matrix in classifying 850 gpm circulations more often than not result with at least one node being empty, possibly due to only one time step being used on the 117 members.
- The 850 gpm were chosen to develop the SOM as the circulation is influential in rainfall and 2 m temperatures over the higher altitudes of the sub-continent.

Methodology

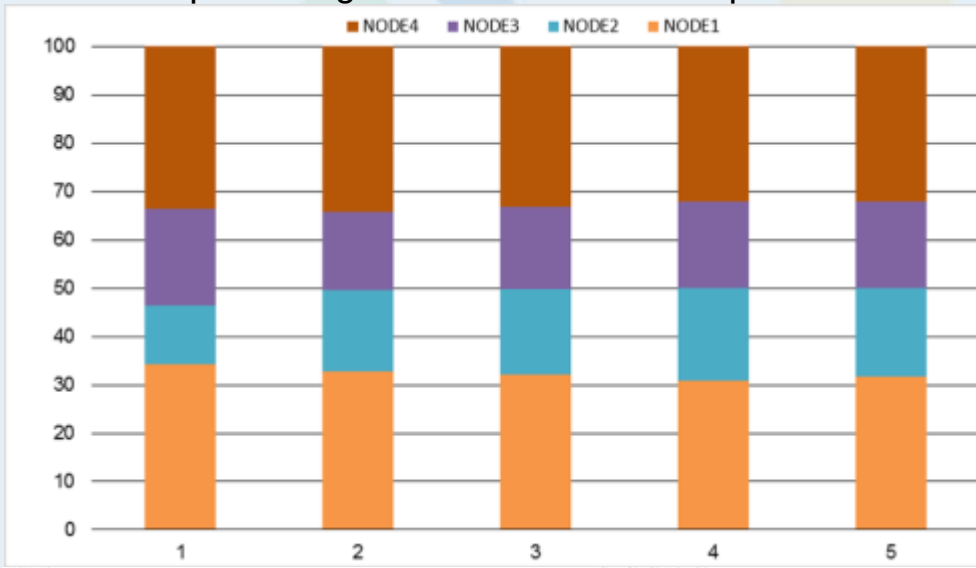
- Forecasts were compared to ECMWF ERA-Interim data.
- It is however acknowledged that this dataset is not completely independent of the forecasts, but since the different scenarios or nodes were verified and not the whole forecast dataset, it was decided that the dependency might be negligent.
- However, for this reason, as an alternative the 06 to 06 UTC accumulated daily rainfall totals were also compared to the FEWS estimated rainfall data.
- The daily 2 m maximum temperature and 10 m wind speeds were evaluated against ERA-Interim data only.
- For this pilot study only spatial and area average bias were calculated for forecasts days 1-5 of the DJF period.

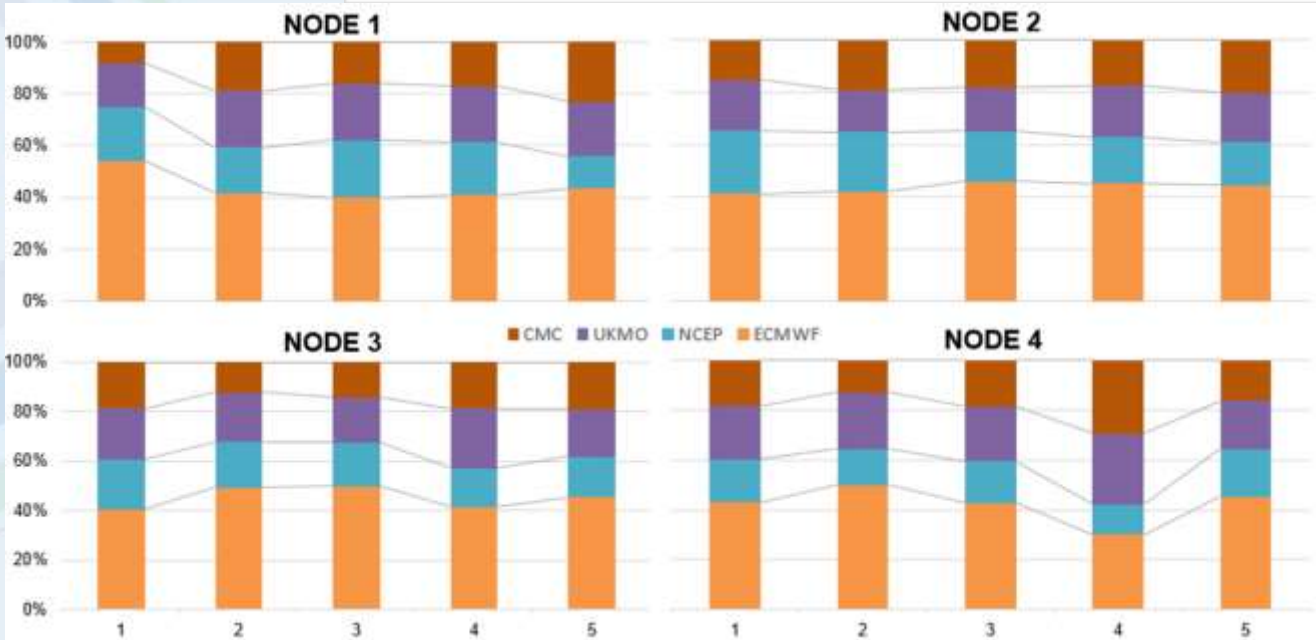
Results

- It is seen that node 1 and node 4 generally have the most members and it was also found that the standard deviation for nodes 1 and node 4 tend to be smaller in comparison with the standard deviation of nodes 2 and 3 respectively due to the larger number of members.

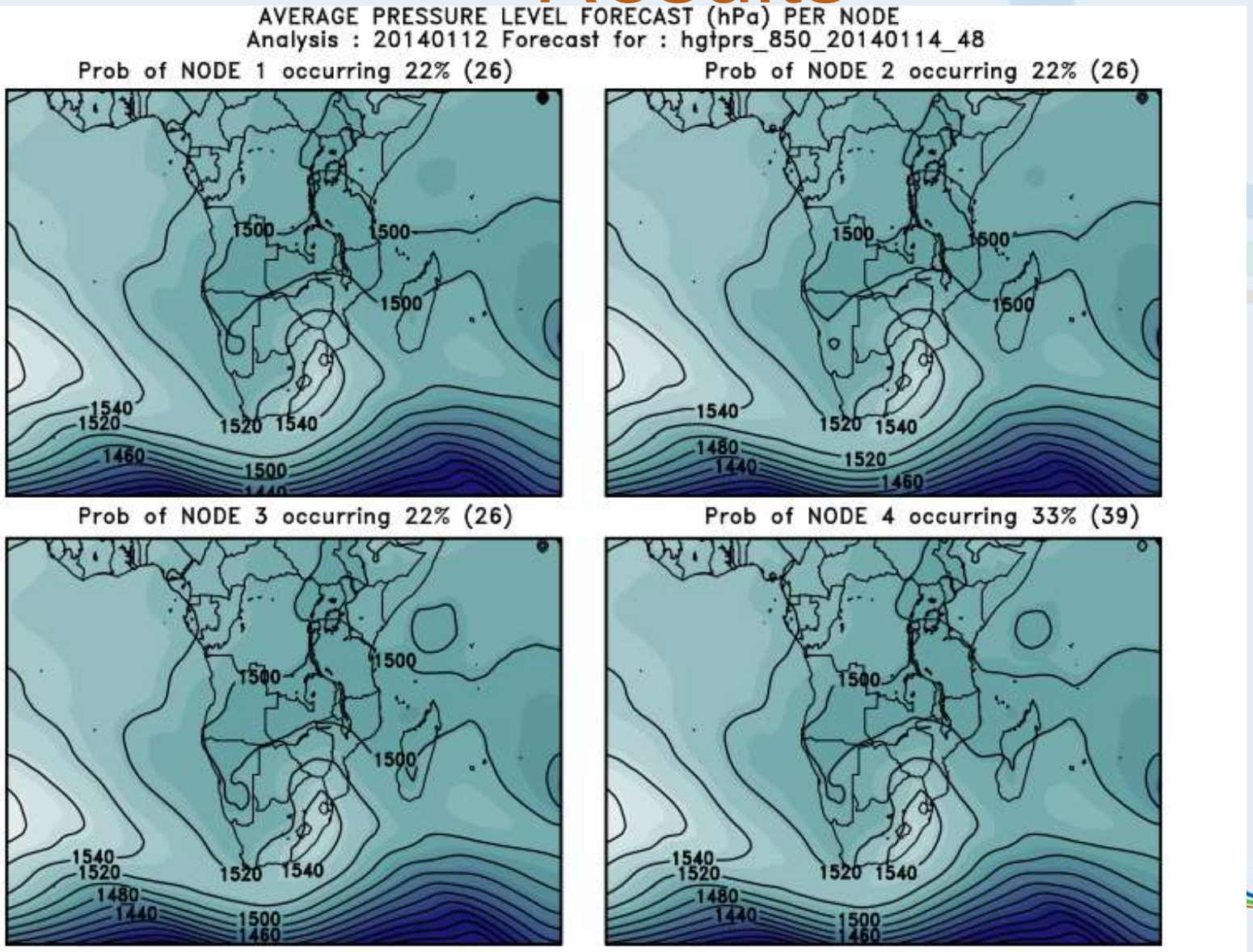
- Due to ECMWF having the largest ensemble size, it is seen that per node per lead time, ECMWF contributes the most members to each forecast.

The percentage number of members per node.





Results



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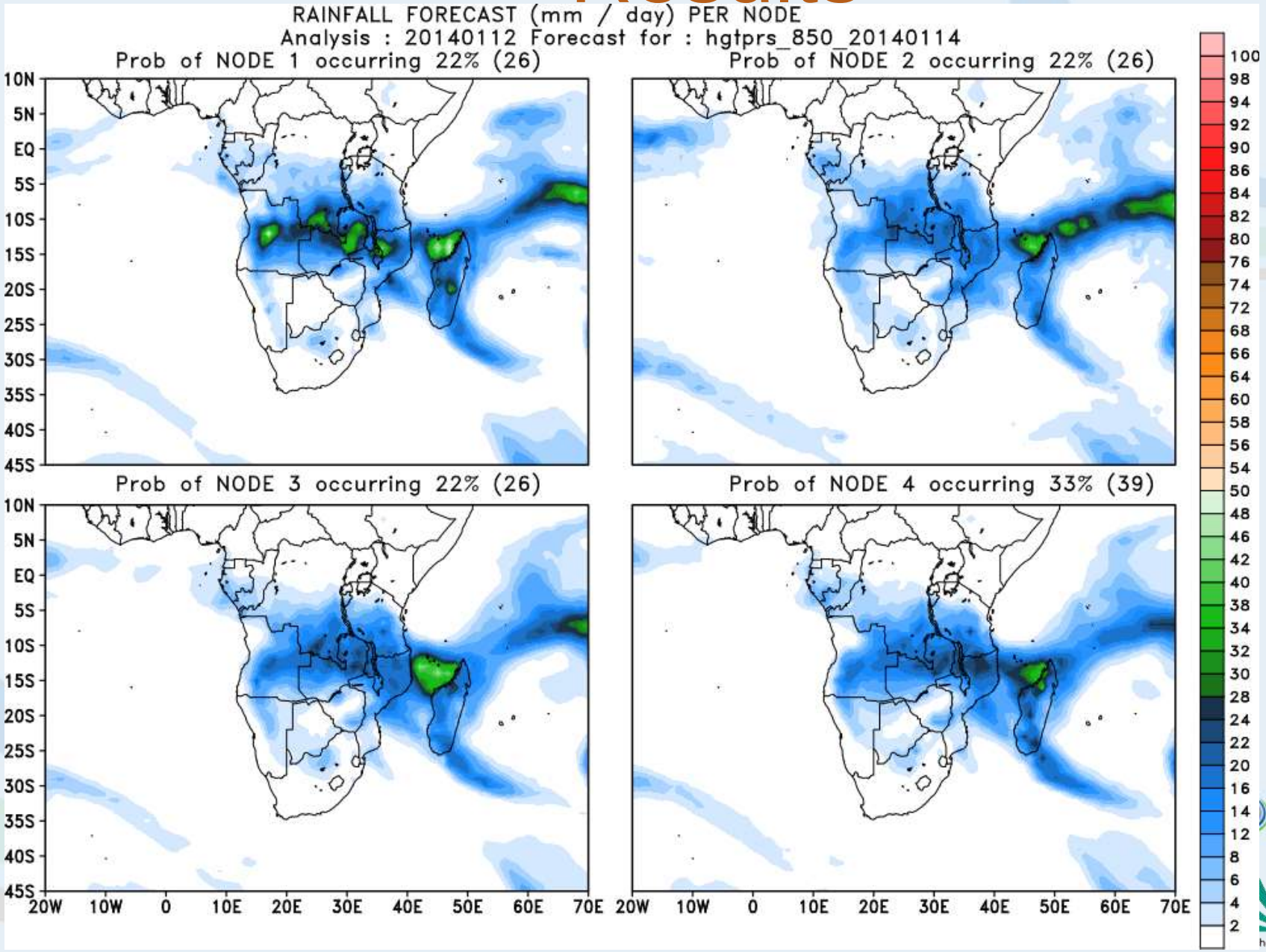
Results



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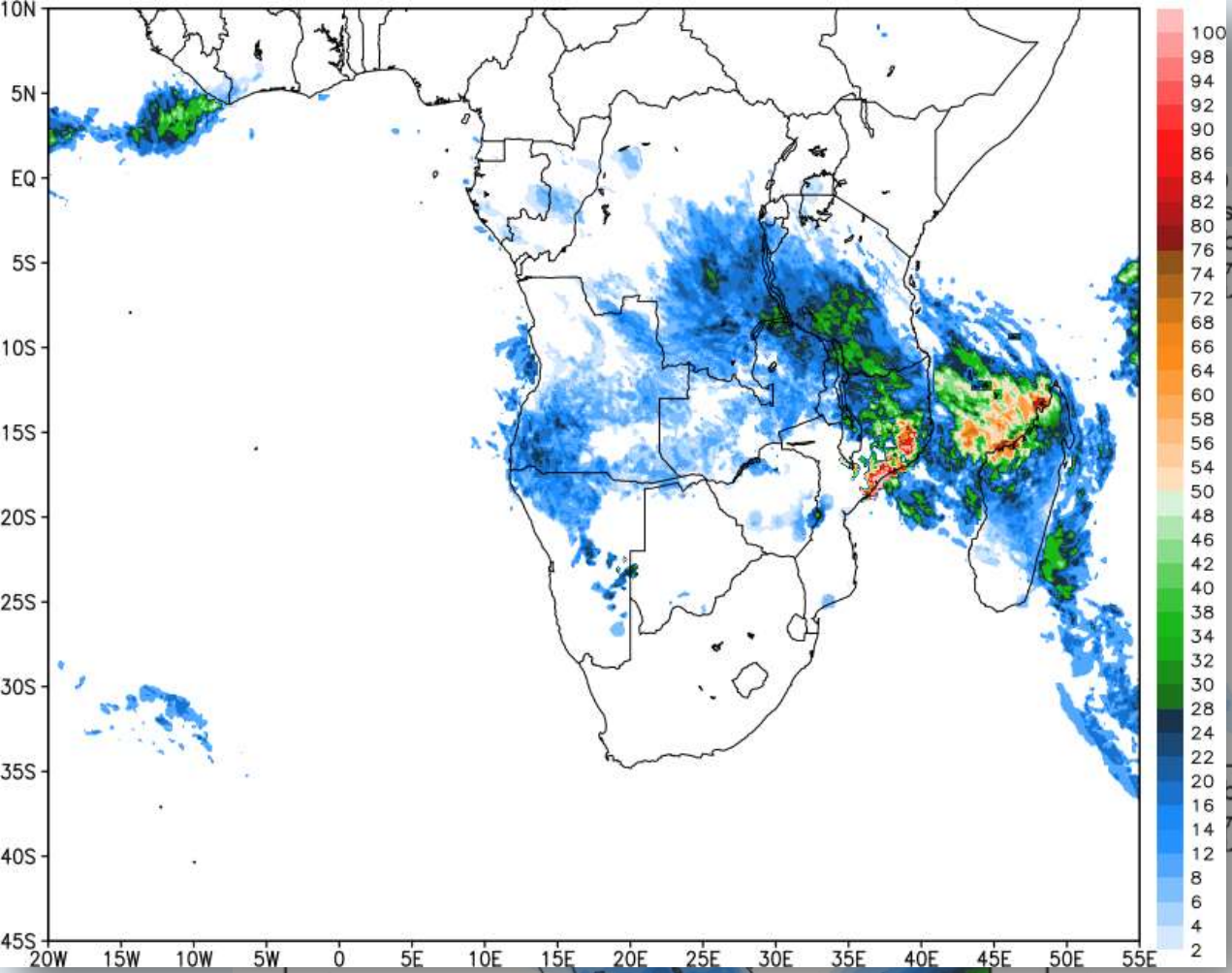
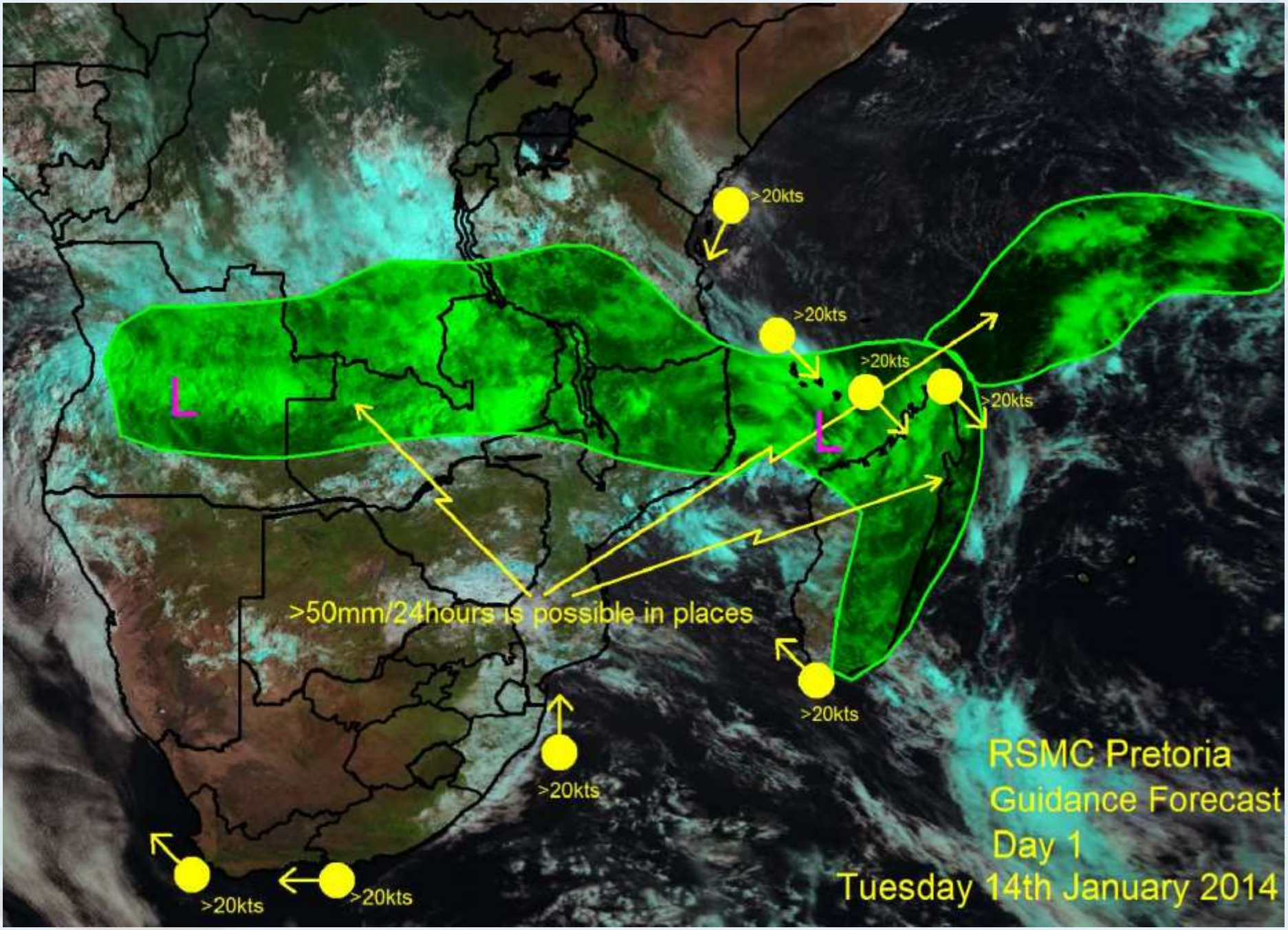
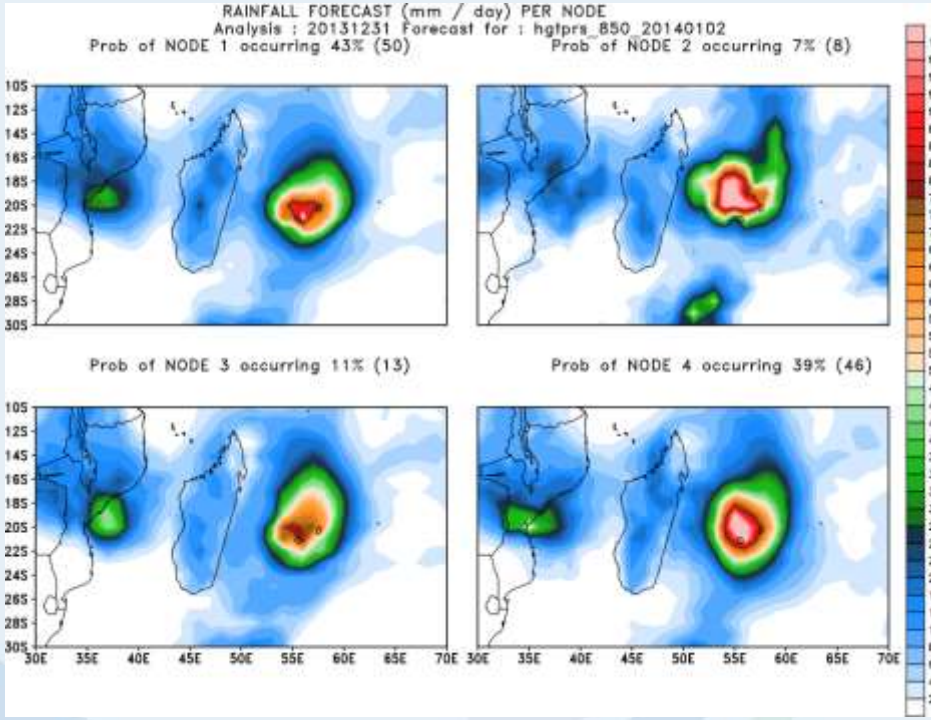
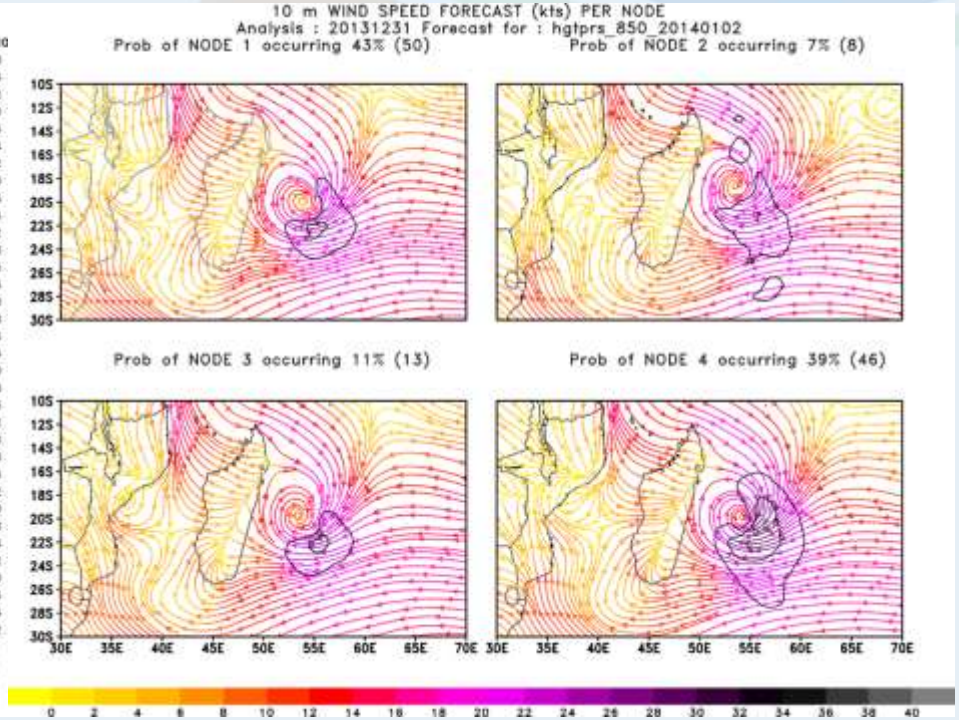

10N
5N
EQ
5S
10S
15S
20S
25S
30S
35S
40S
45S
20W 15W 10W 5W 0 5E 10E 15E 20E 25E 30E 35E 40E 45E 50E 55E
100 98 94 92 90 86 84 82 80 76 74 72 68 66 64 60 58 56 54 50 48 46 42 40 38 34 32 30 28 24 22 20 16 14 12 8 6 4 2

DE
s_850_20140114
of NODE 2 occurring 22% (26)
of NODE 4 occurring 33% (39)
10S
15S
20S
25S
30S
35S
40S
45S
20W 10W 0 10E 20E 30E 40E 50E 60E 70E
100 98 94 92 90 86 84 82 80 76 74 72 68 66 64 60 58 56 54 50 48 46 42 40 38 34 32 30 28 24 22 20 16 14 12 8 6 4 2



Results





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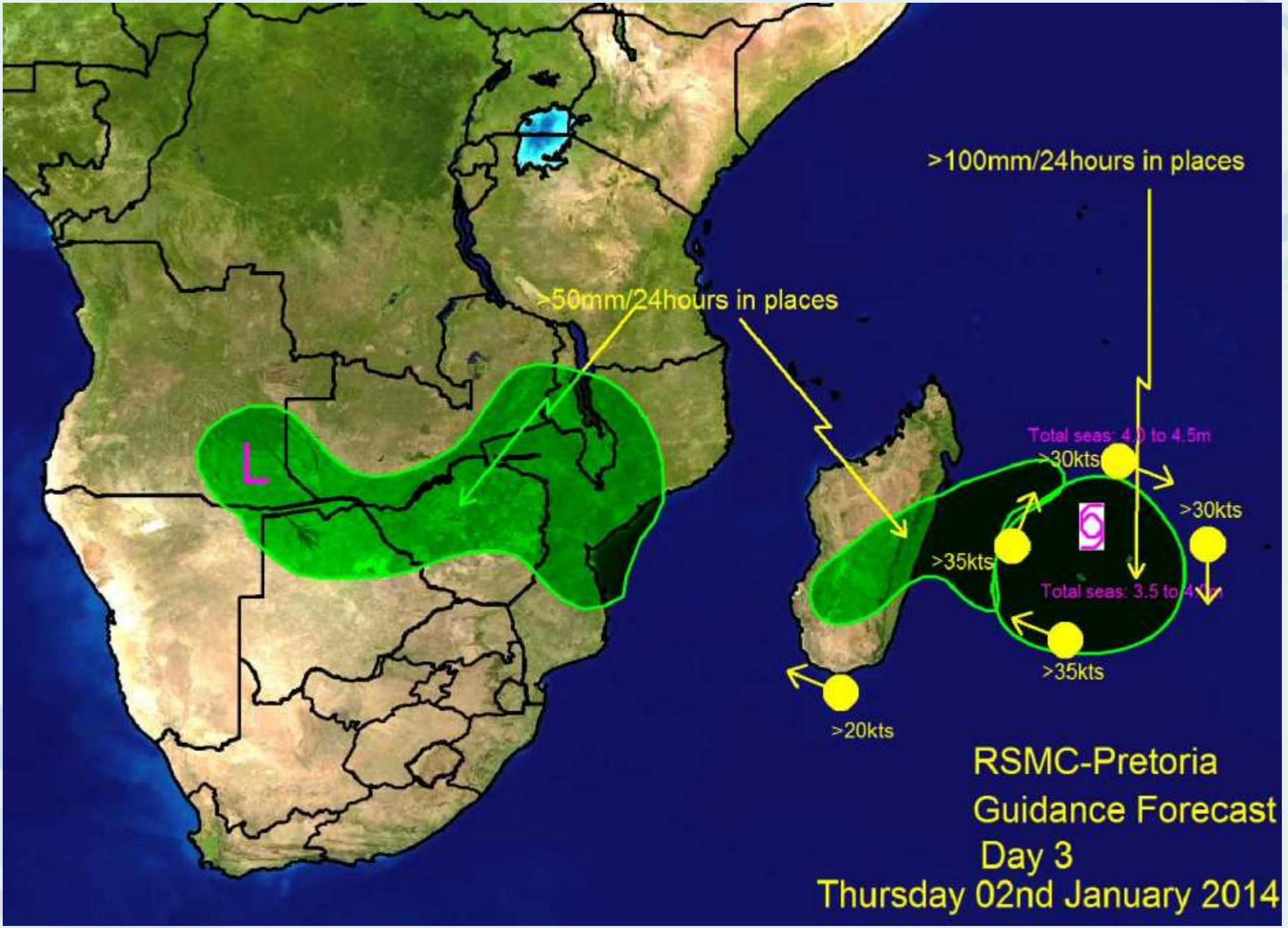
>100mm/24hours in places
>50mm/24hours in places
L
Total seas: 4.0 to 4.5m
>30kts
>30kts
>35kts
Total seas: 3.5 to 4.5m
>35kts
>20kts
RSMC-Pretoria
Guidance Forecast
Day 3
Thursday 02nd January 2014

Conclusion

- The TIGGE archive is a great source of ensemble forecasts.
- The cluster system proposed is primarily a deterministic guidance product whereby the user can still gain explicit spatial daily forecast values for various parameters, but with an uncertainty assigned to each scenario forecast.
- The system is a very simplistic albeit effective manner to view a large data set since an optimized amount of information of expected severe weather conditions for the next couple of days are made available this way.
- However, additional research is required into the sensitivity of SOM on the data set as well as other possible clustering techniques (EOF).