EVALUATION OF SEVERE WEATHER GUIDANCE MAPS ISSUED BY THE SOUTH AFRICAN WEATHER SERVICE

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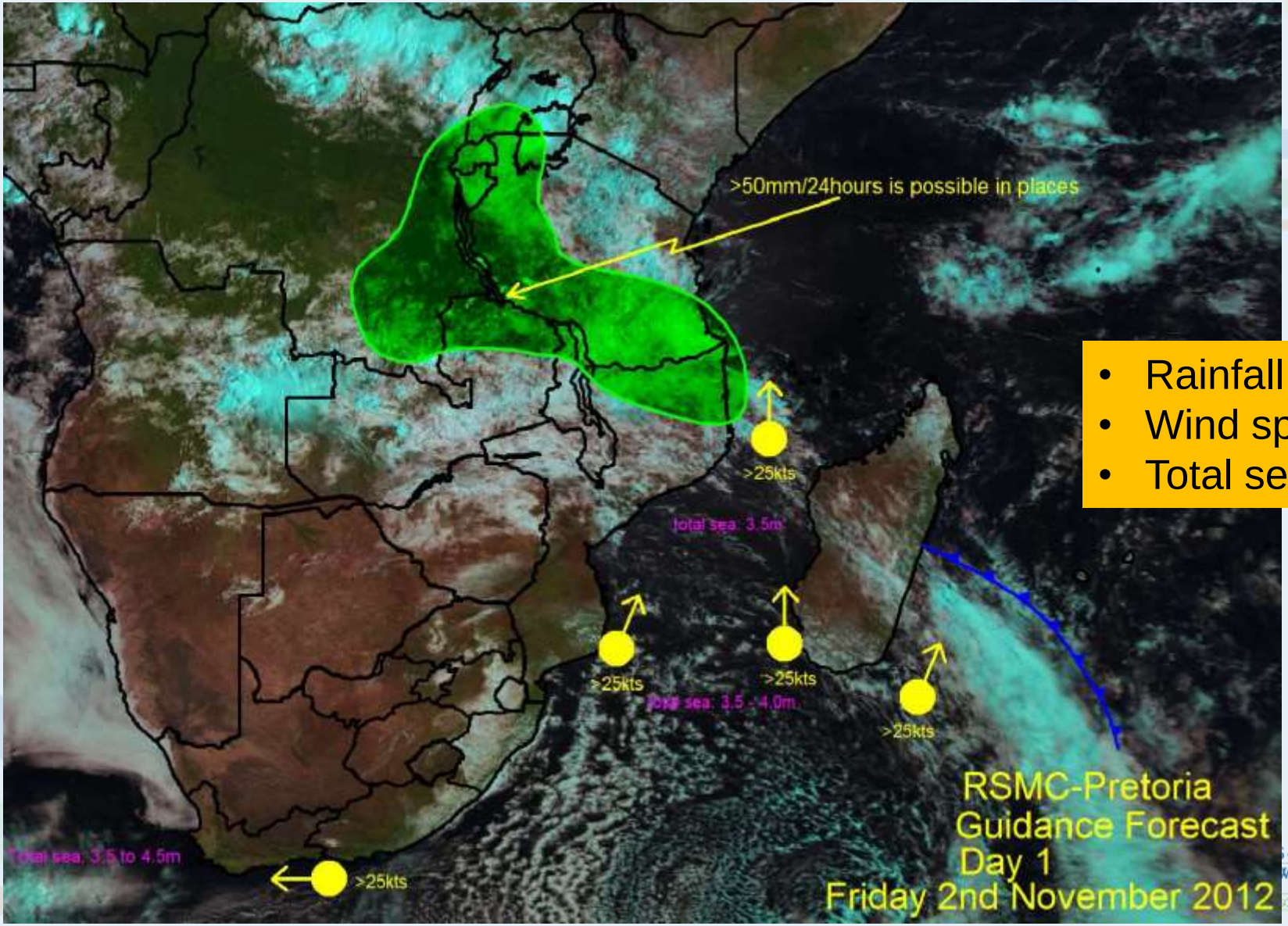
SEVERE WEATHER GUIDANCE MAPS



- Rainfall
- Wind speed
- Total sea

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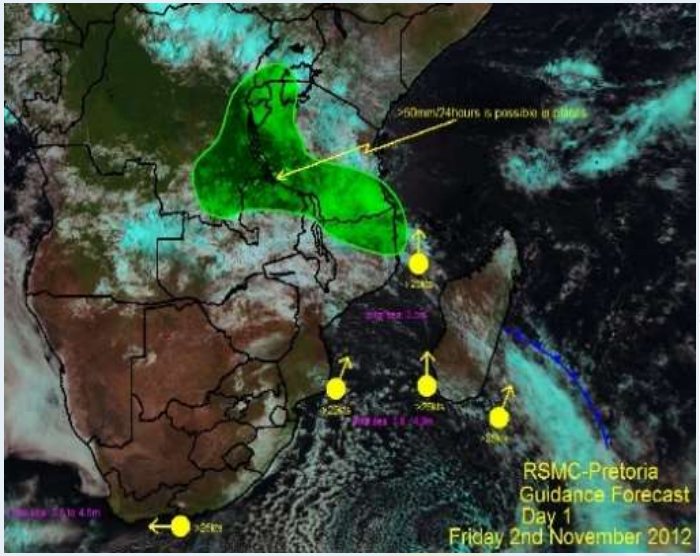
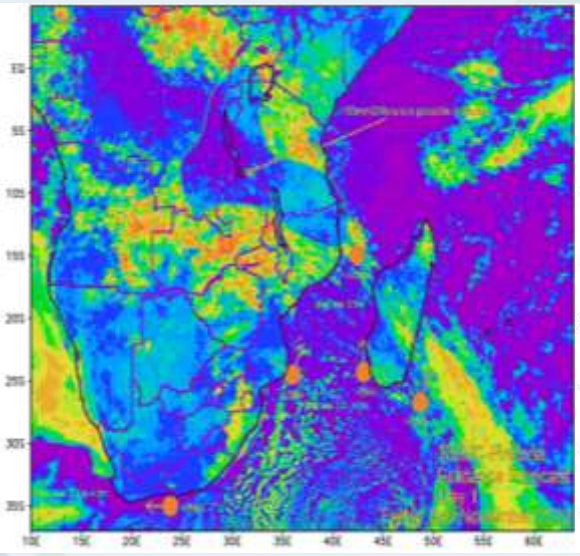
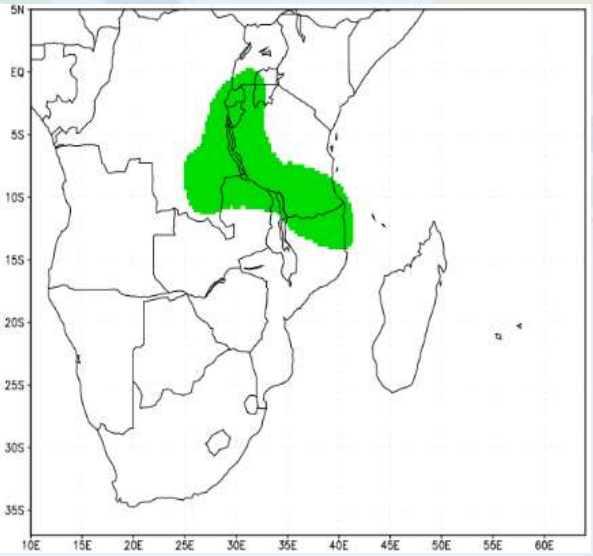
JPEG TO GRIDDED BINARY DATA







JPEG format image created by forecasters

Gridded binary geographical referenced maps

Region of severe weather identified and dichotomous field created

1. R,G and B values respectively extracted
2. SW corner coordinates known
3. *nx* and *ny* extracted from RGB fields (# pixel cols and rows)
4. Exported to geographical map

1. Combination of RGB values created
2. Grid boxes exceeding threshold value = 1
3. All other values = 0

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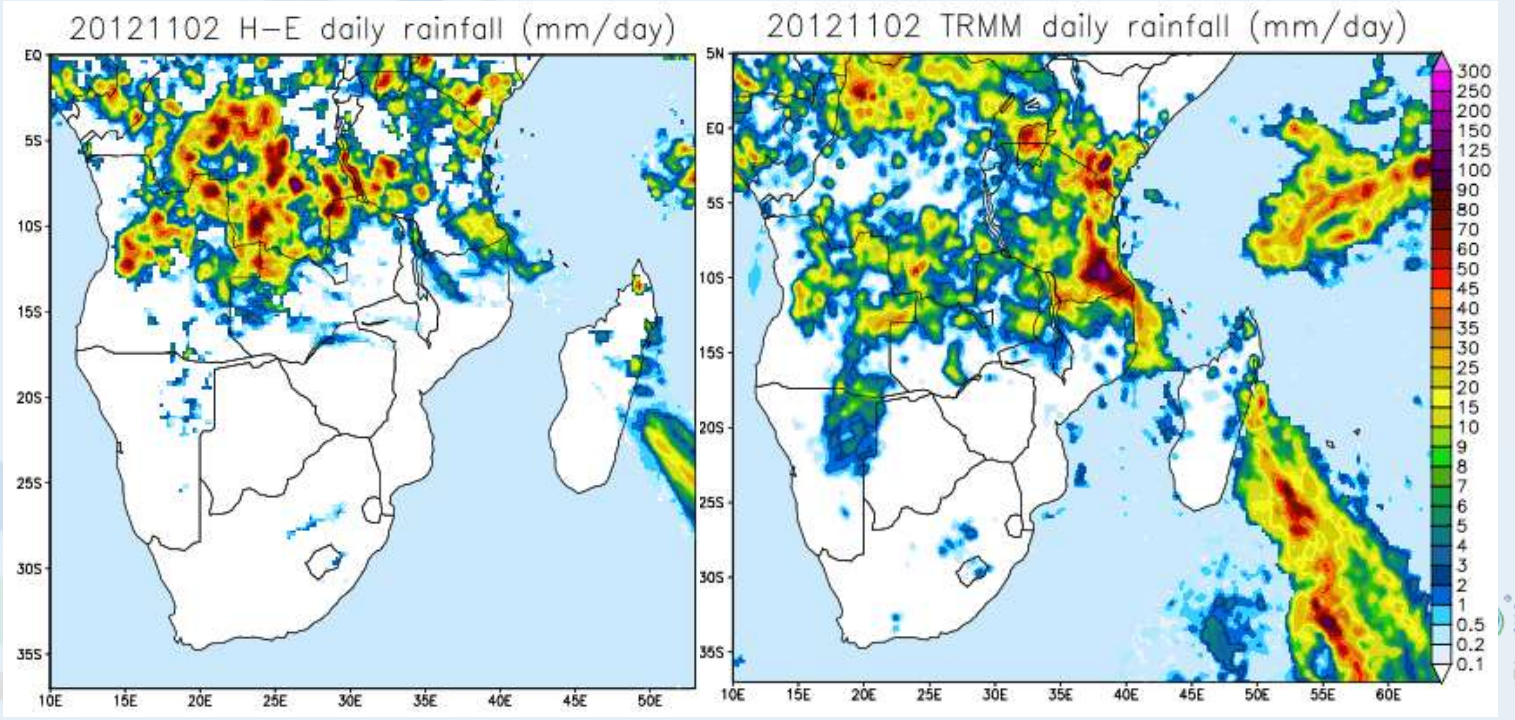
HYDRO-ESTIMATOR AND TRMM

- Used as ground truth data (both satellite based precipitation estimated rainfall fields)
- HE limited to 10-53°E and 0-37°S but higher resolution (12 km)
- TRMM covers whole of SWFDP domain (including Mauritius and Reunion) but lower resolution (~25 km)



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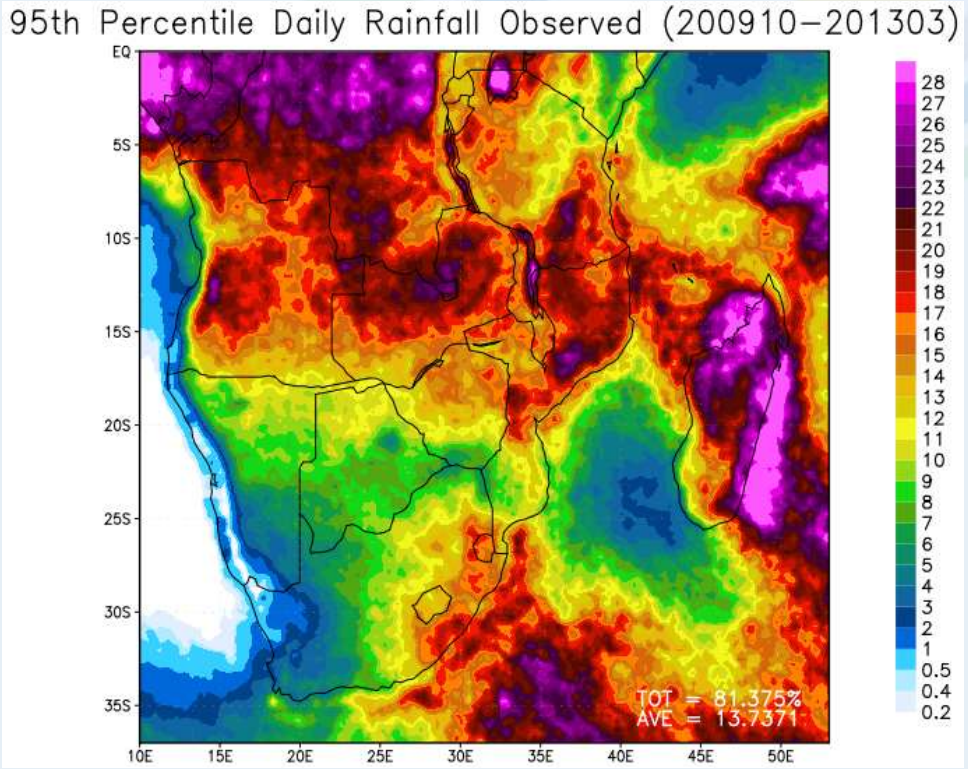
VERIFICATION PROCESS

- All fields are rescaled to IPWG's standard 0.25° resolution.
- SWFDP fields are created for both HE and TRMM domains.
- HE and TRMM fields are converted to dichotomous fields for both 25 and 50 mm/day threshold values.
- 25 mm/day is used together with 50 mm/day since 25 mm/day for a 0.25° is considered extreme and falls within the 95th percentile value.
- Statistics are calculated per season as well as for whole period.
- Daily verification is also done.

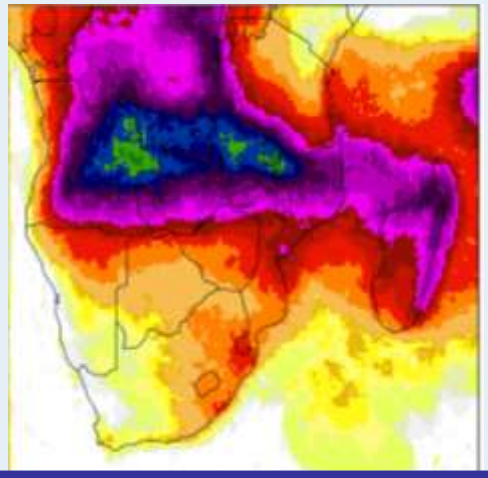


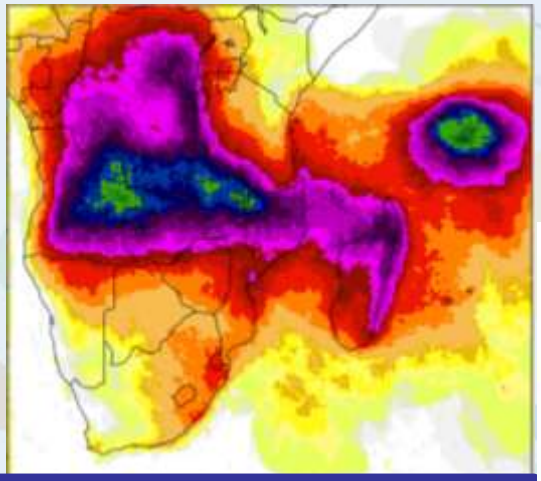
DJF, MAM, JJA, SON
1 October 2009 to 31 March 2103

NUMBER OF EVENTS PER THRESHOLD FOR 200910 TO 201303

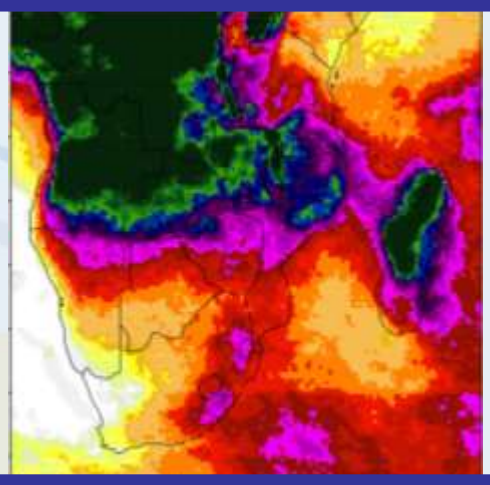
SWFDP EVENTS FOR HYDRO-ESTIMATOR DOMAIN

SWFDP EVENTS FOR TRMM DOMAIN

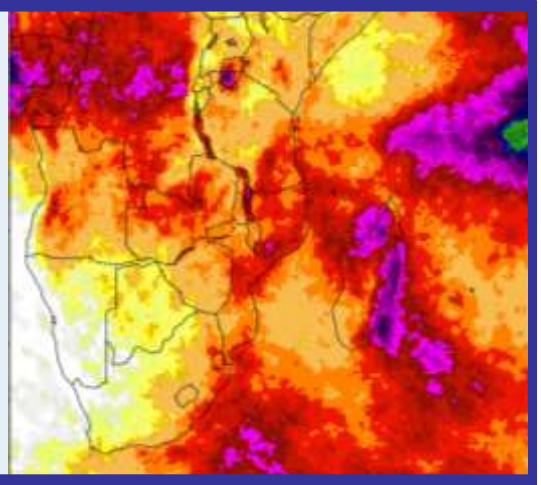


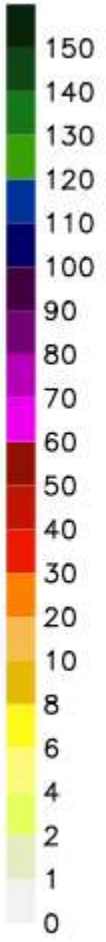


HE 25 MM/DAY EVENTS

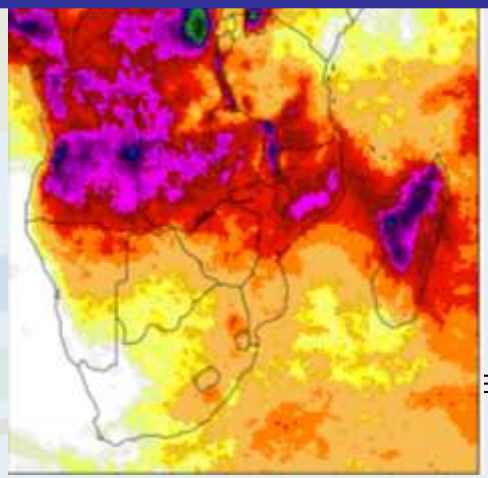


TRMM 25 MM/DAY EVENTS

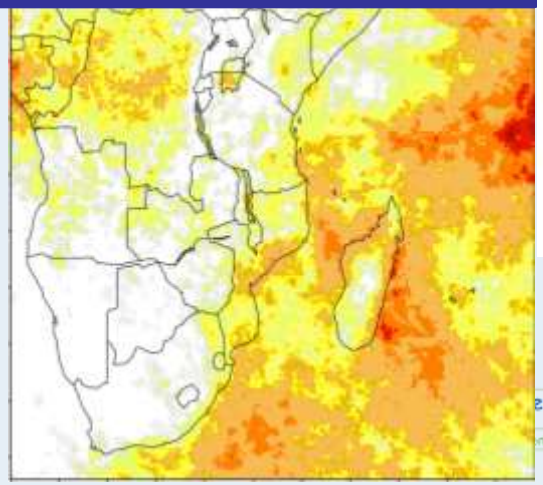




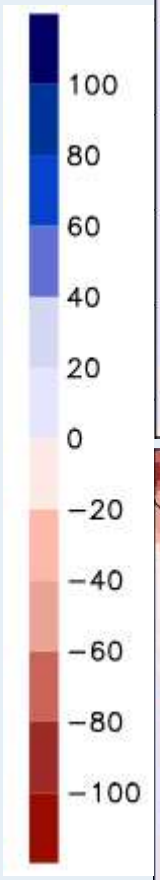
HE 50 MM/DAY EVENTS

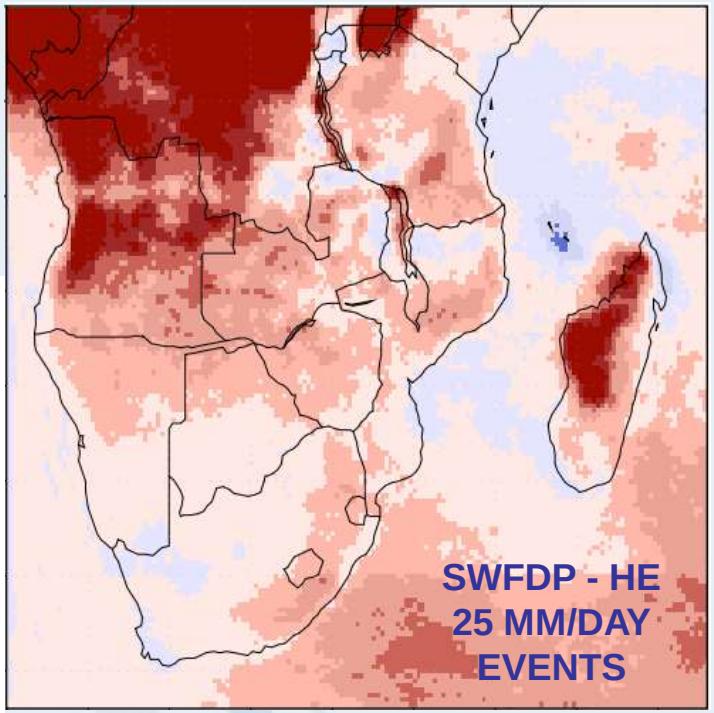


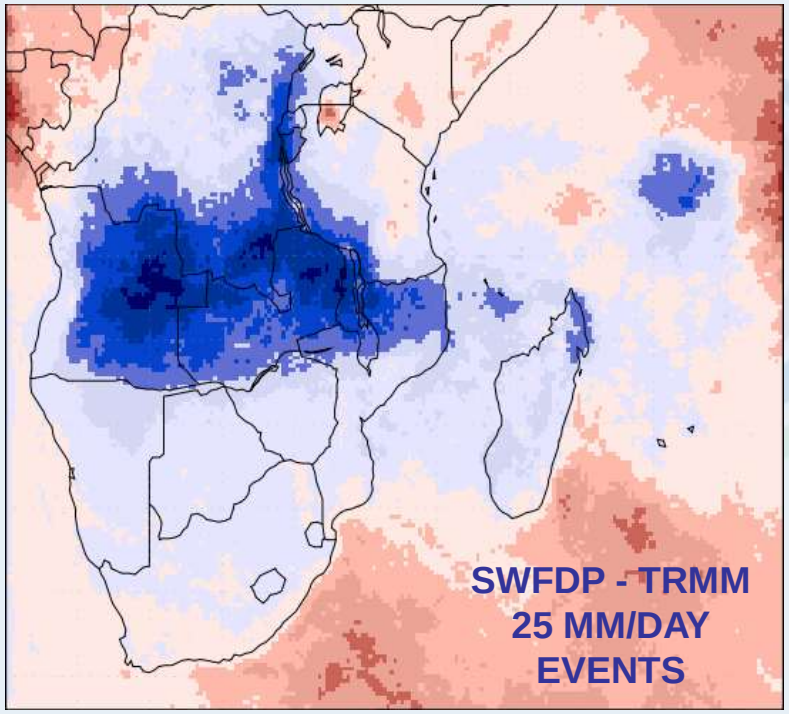
TRMM 50 MM/DAY EVENTS

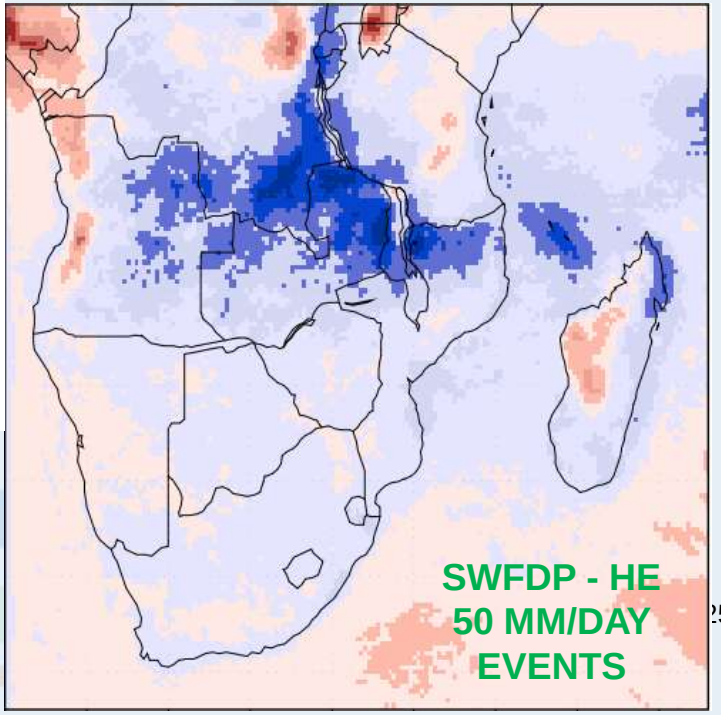


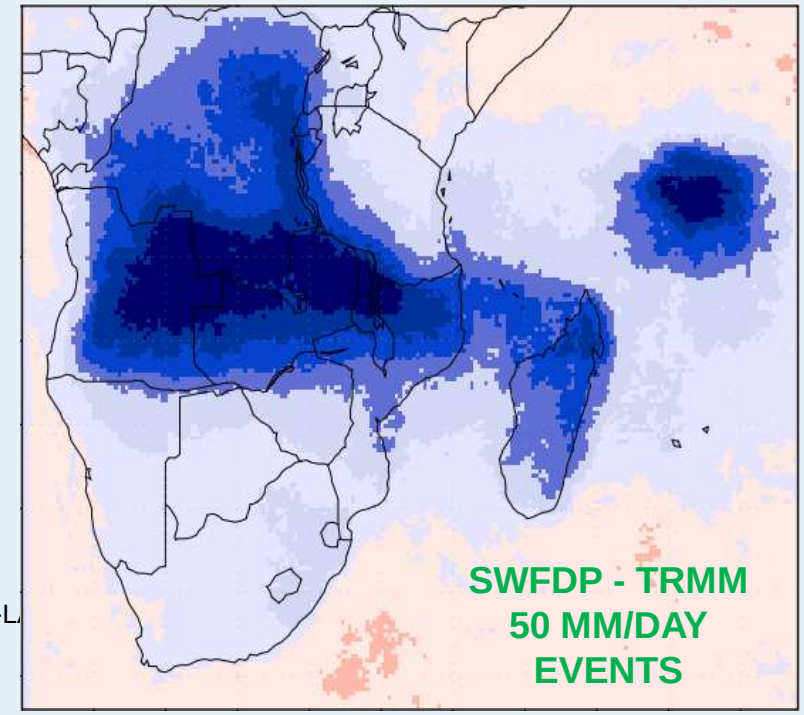
DIFFERENCE MAPS IN NUMBER OF EVENTS FOR 200910 TO 201303











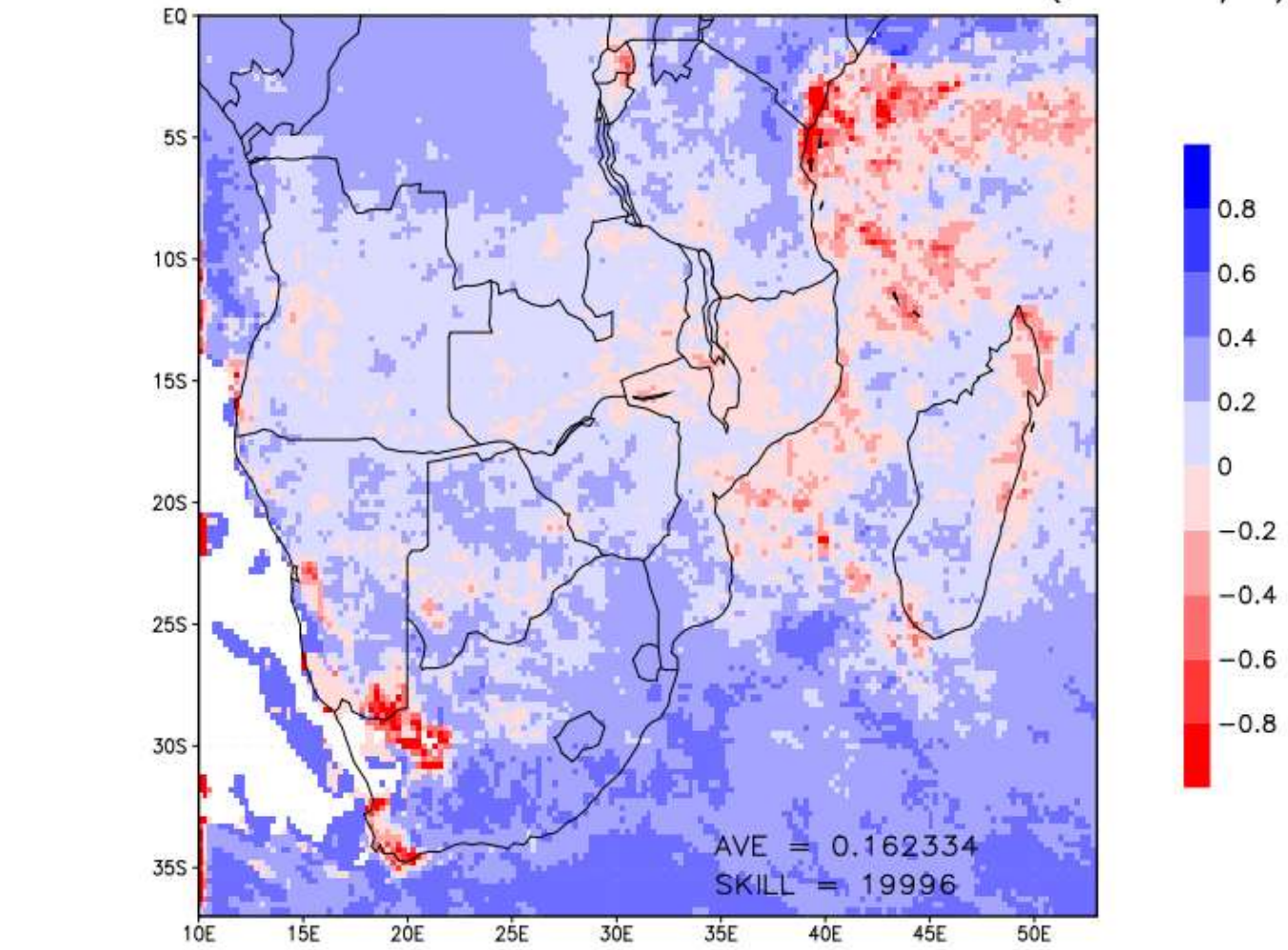
VERIFICATION STATISTICS

- Statistics from contingency tables
- Brier skill score
- Due to the extreme/severity of the events being verified, extremal scores were also calculated:

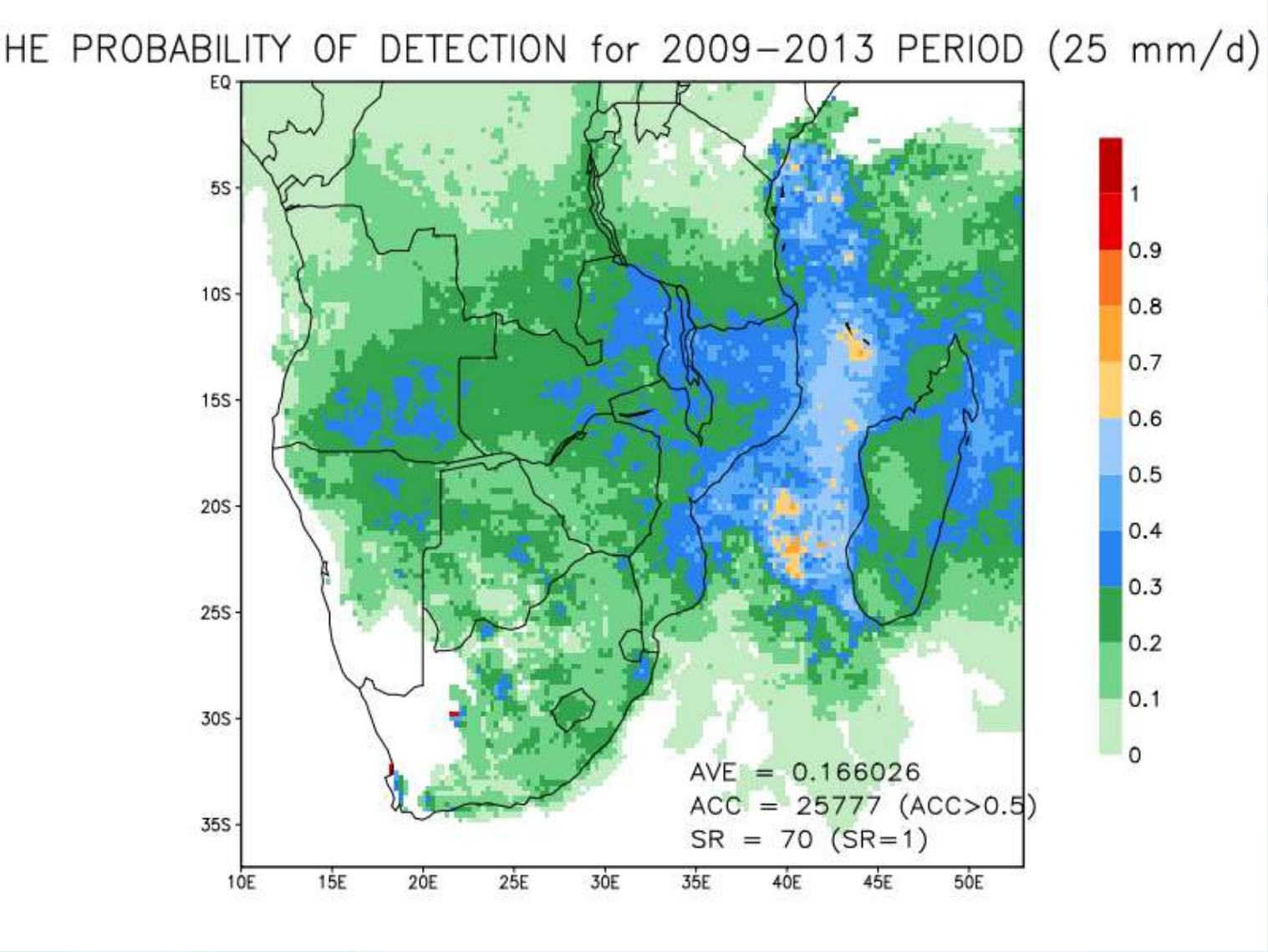
Extremal Dependence Index : $EDI = \frac{\log(FR)-\log(HR)}{\log(FR)+\log(HR)}$

Symmetric EDI: $SEDI = \frac{\log(FR)-\log(HR)-\log(1-FR)+\log(1-HR)}{\log(FR)+\log(HR)+\log(1-FR)+\log(1-HR)}$

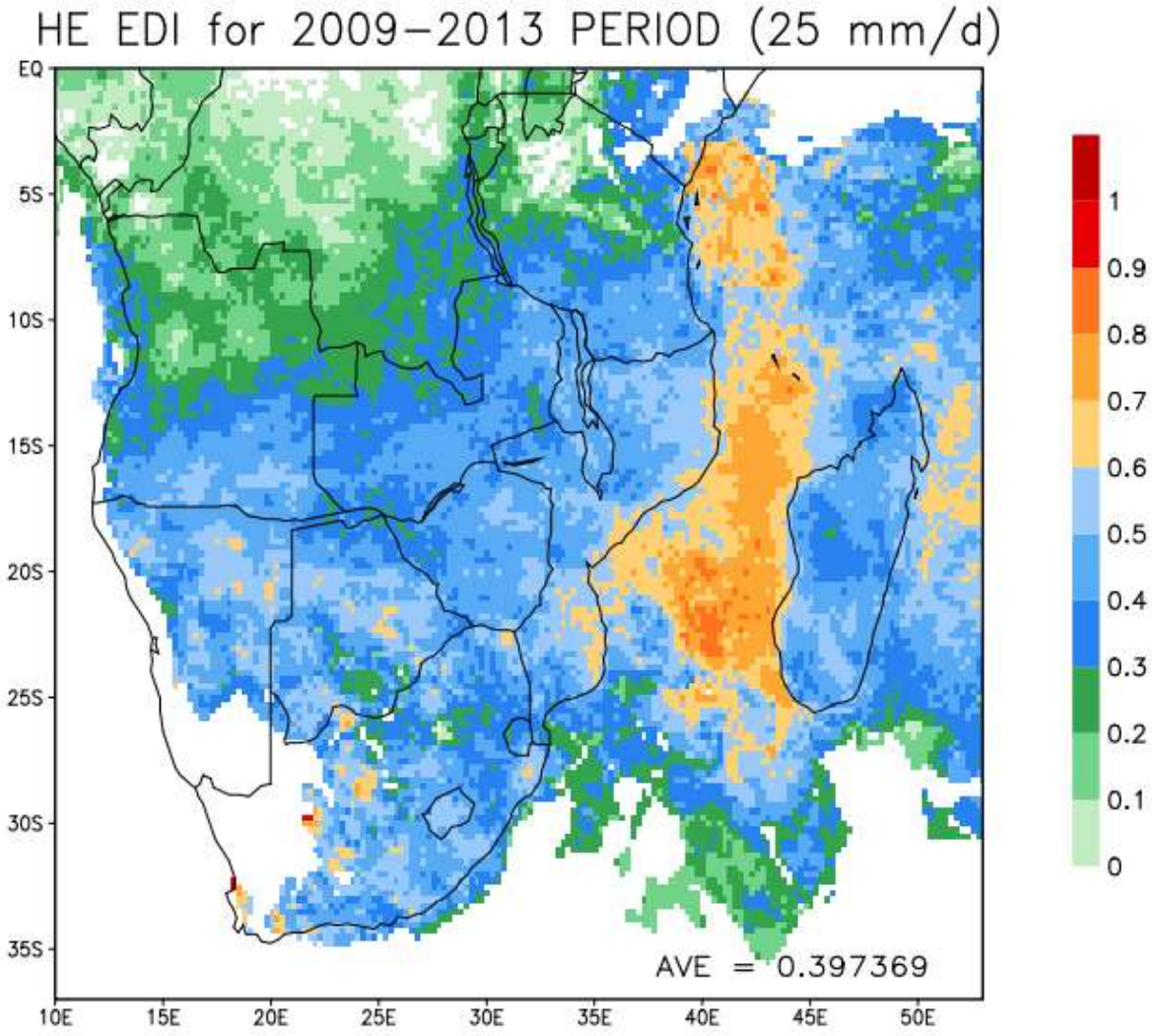
VERIFICATION RESULTS



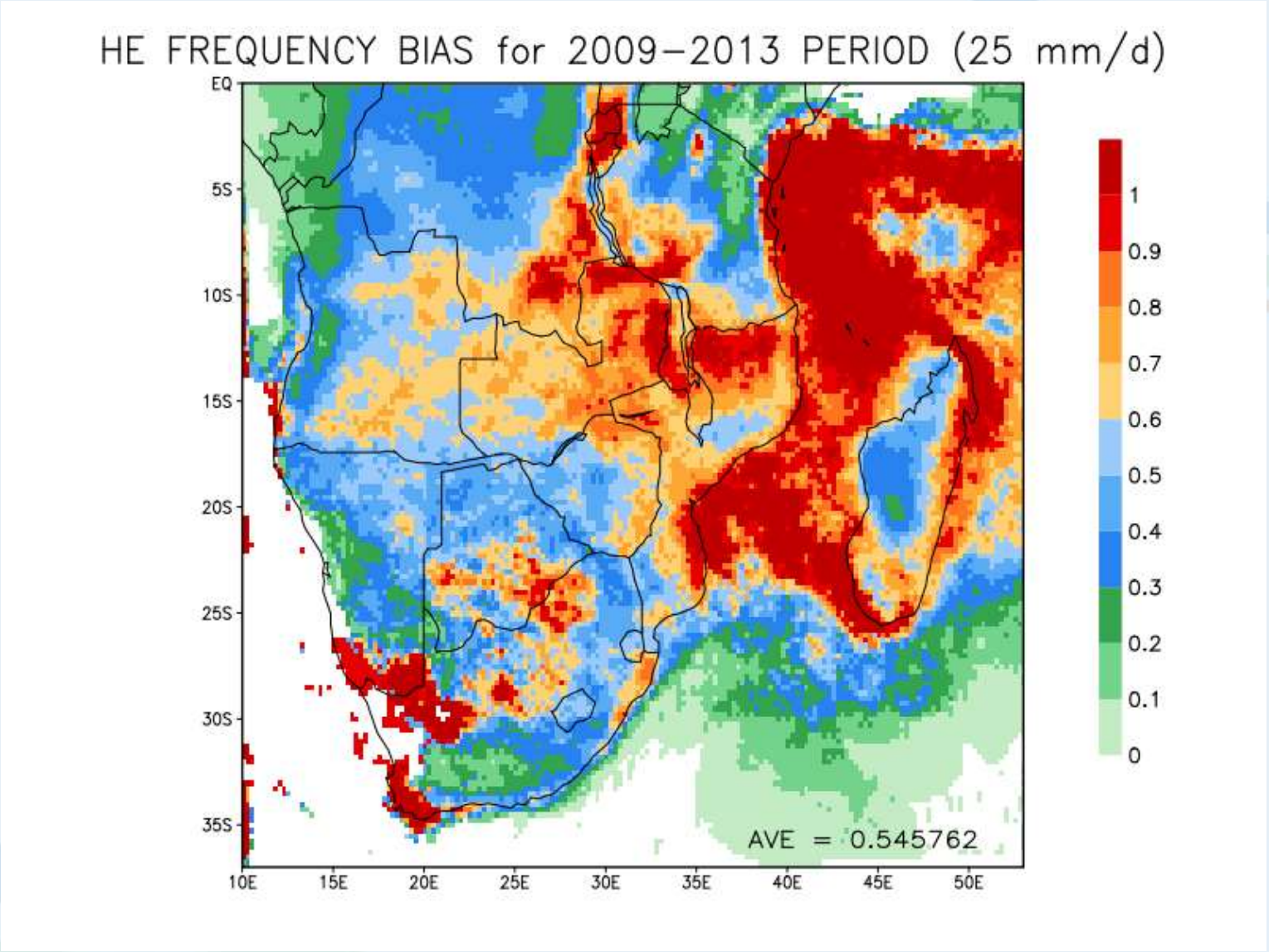
VERIFICATION RESULTS



VERIFICATION RESULTS



VERIFICATION RESULTS



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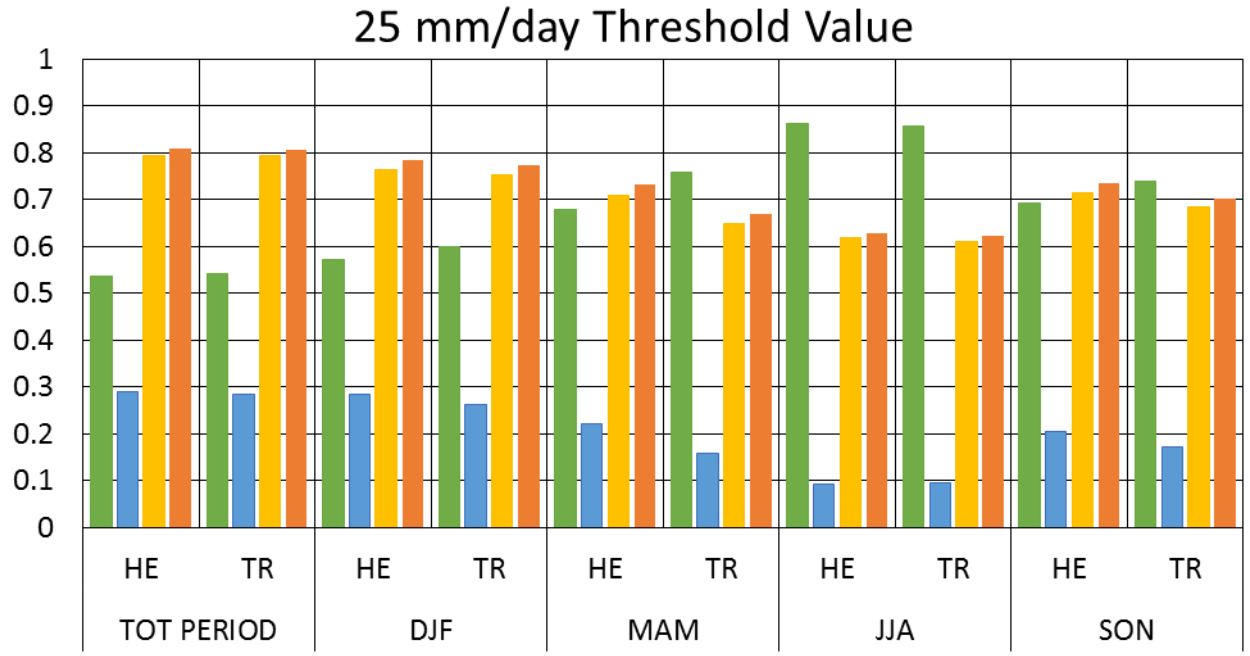
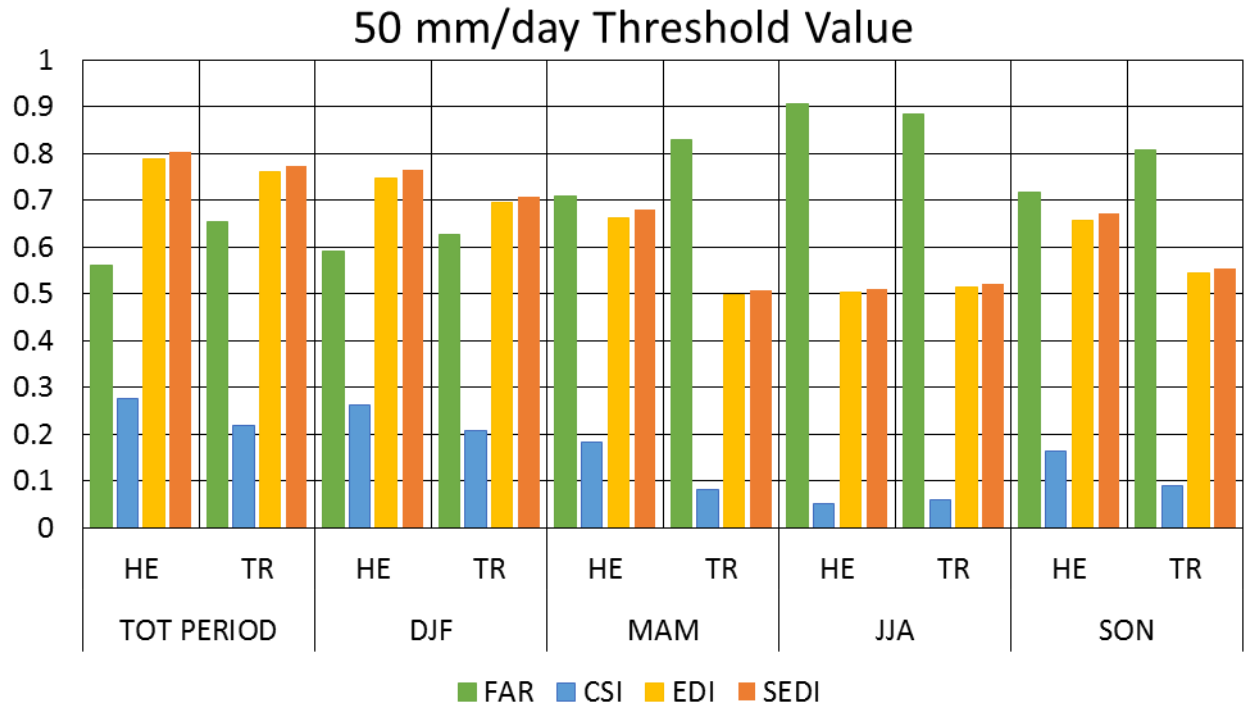
VERIFICATION RESULTS





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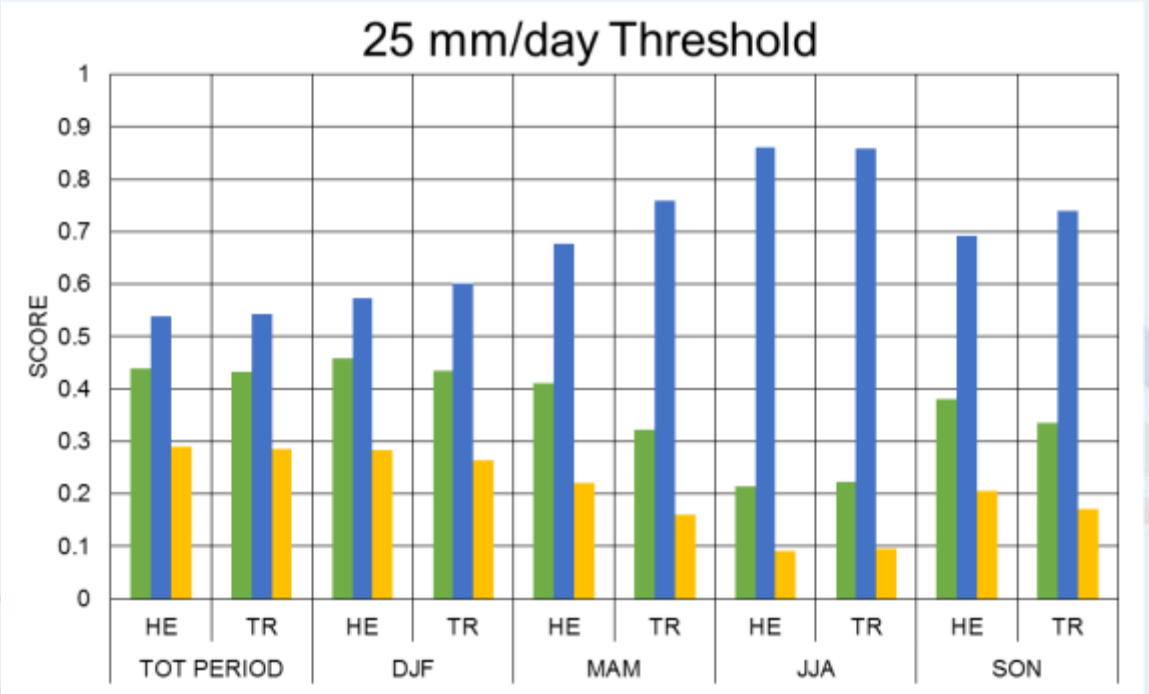
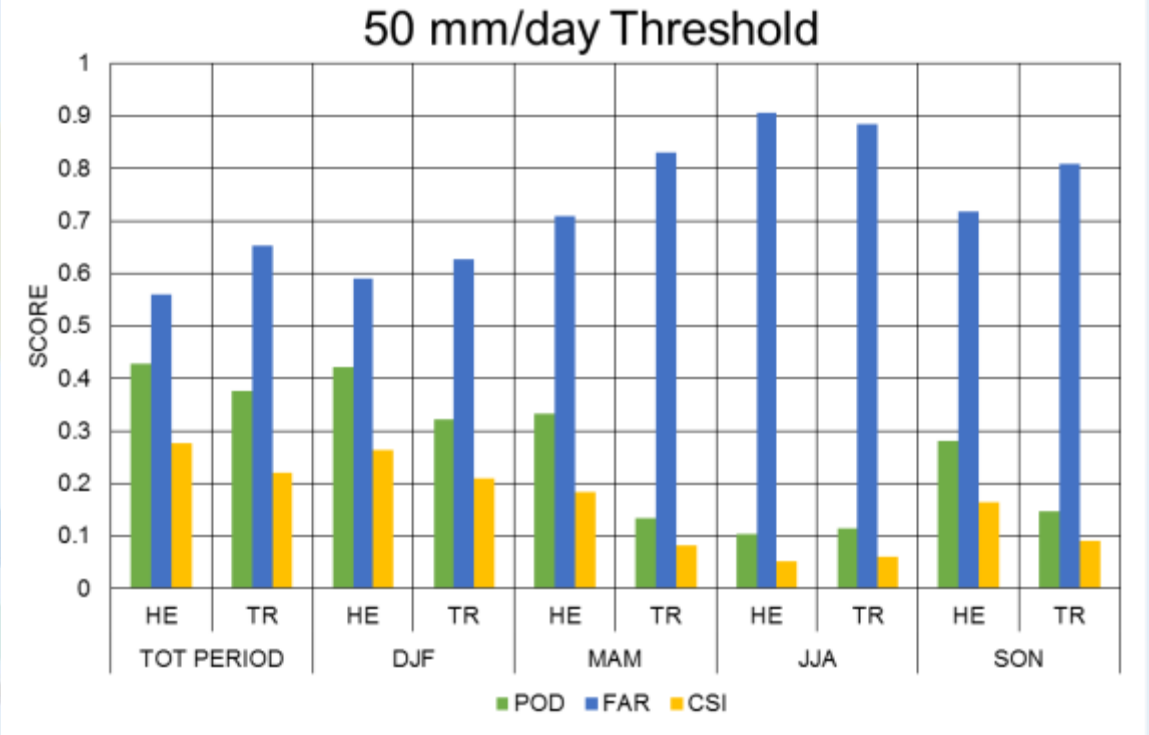
VERIFICATION RESULTS





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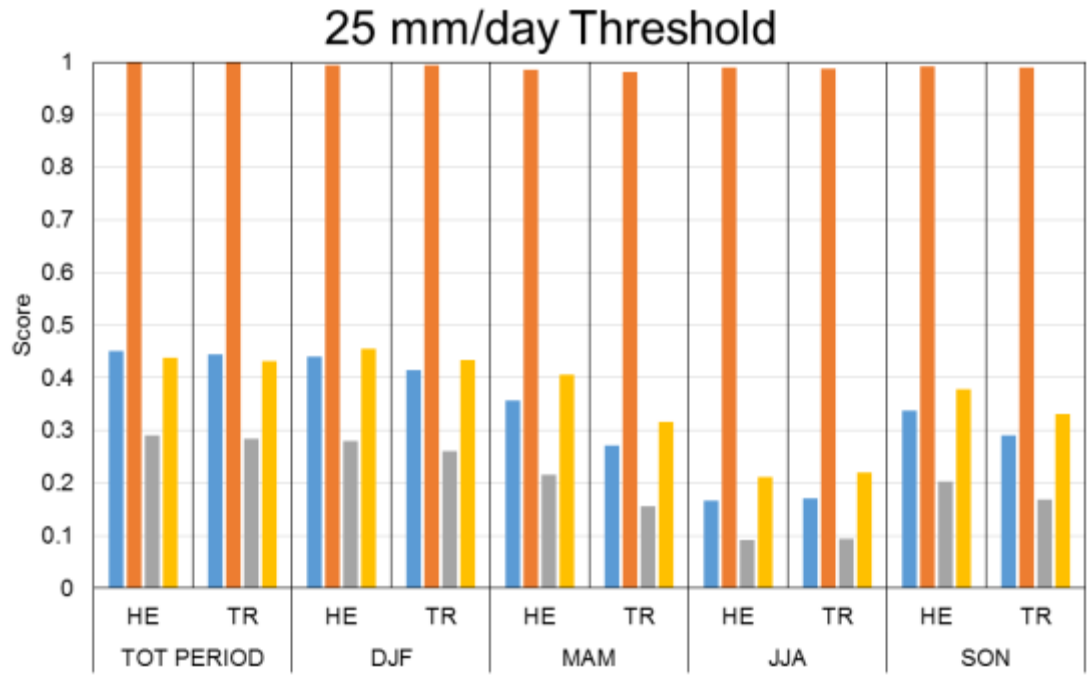
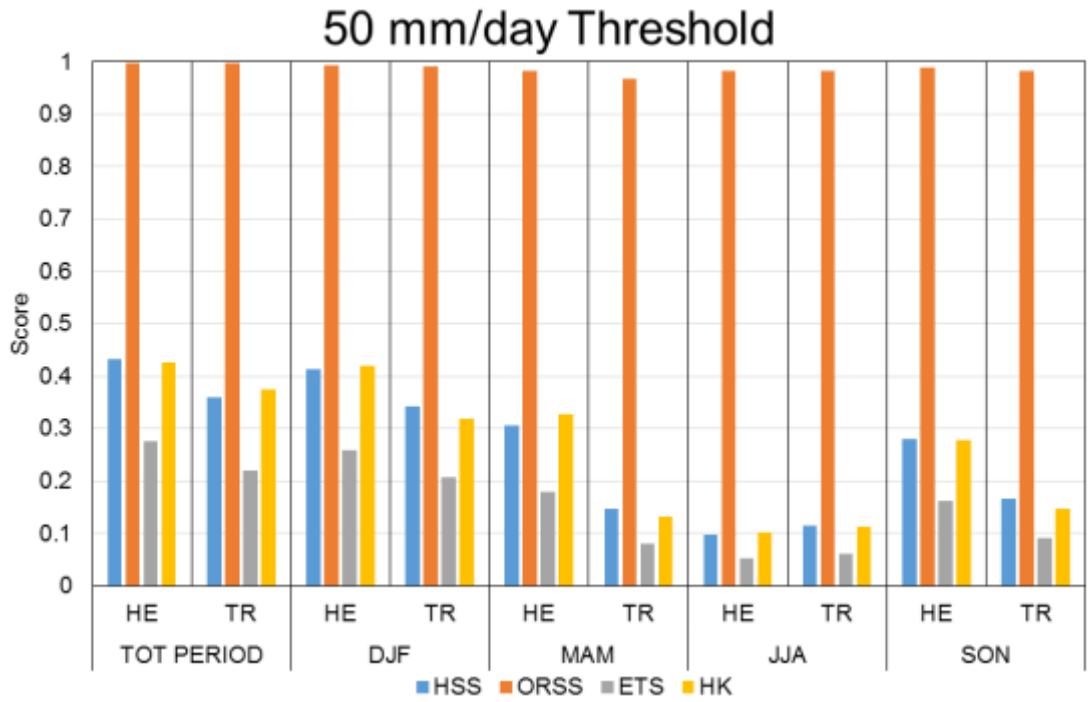
VERIFICATION RESULTS





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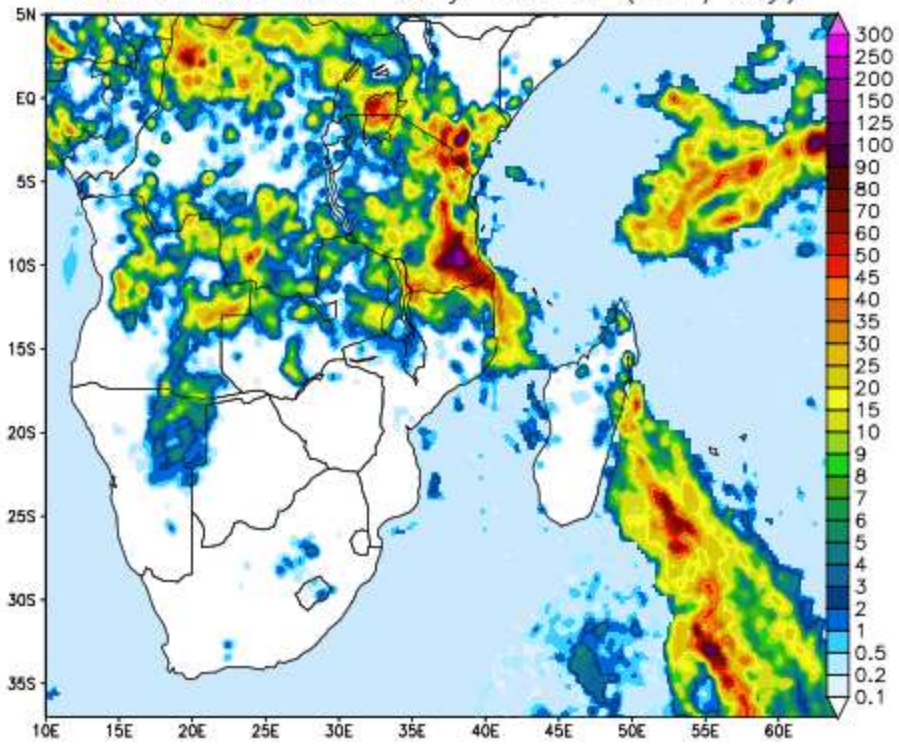
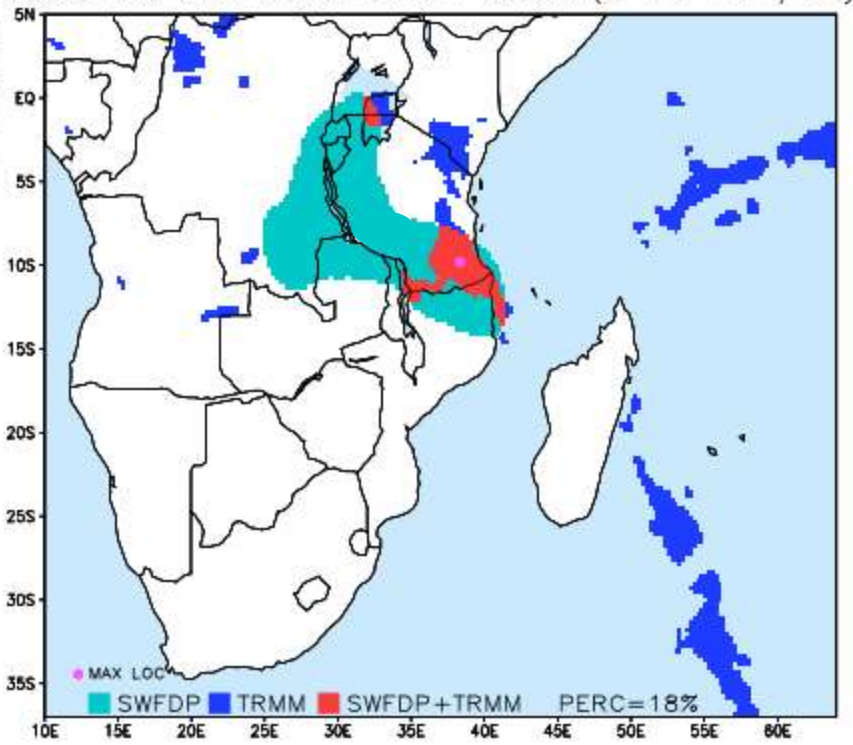
20121102 TRMM daily rainfall (mm/day)



Guidance and Observation fields (> 25 mm/day)



Verification statistics for 20121102 : Grid Size = 0.25° : Units = mm/day : n = 36673

	Guidance	TRMM
Number of gridpoints >= 25 mm	1790	1545
Average Rain over domain	~	3.29297
>= 25 mm Rain Area (km²*10⁶)	1.11875	0.965625
Maximum Rainfall Observed (mm)	~	184.584

Categorical Forecasts	
Frequency Bias	1.15858
Probability of Detection	0.179935
False Alarm Ratio	0.844693
Hansen & Kuipers Score	0.136893
Equitable threat score	0.0679466
Spatial Correlation	0.212297

GUIDANCE \ OBSERVATION	>=25	<25
>=25	278	1512
<25	1267	33616

Extreme Events Verification	
Extreme Dependency Score	0.29738
Symmetric Extreme Dependency Score	0.267231
Extremal Dependency Index	0.294278
Symmetric Extremal Dependency Index	0.310553
(**Ferro and Stephenson, 2011***)	

http://rsmc.weathersa.co.za/RSMC/index.php
Format based on IPWG verification output

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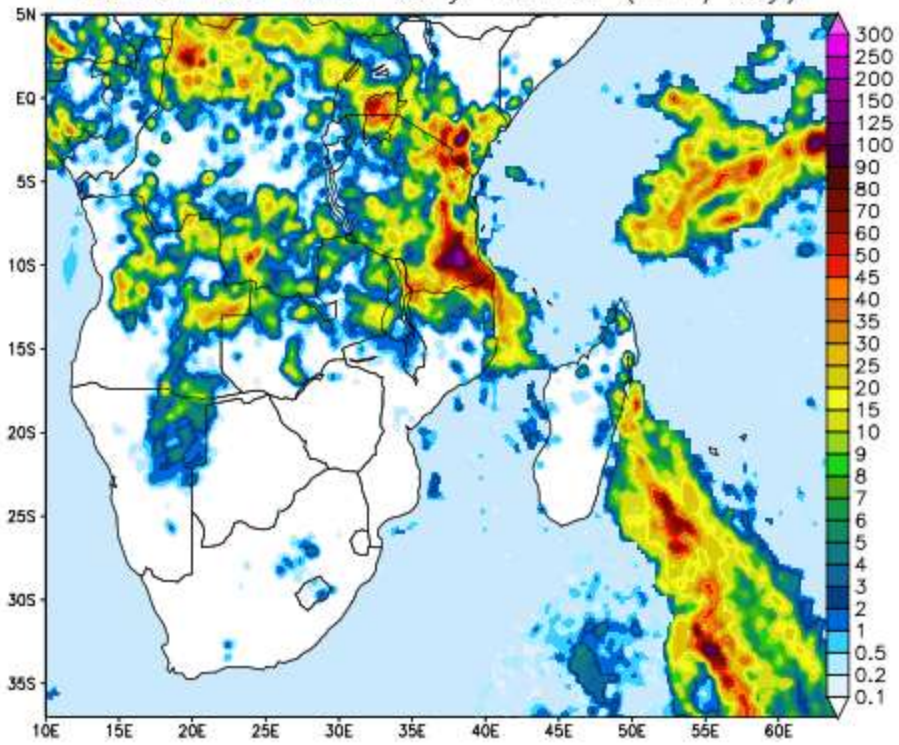
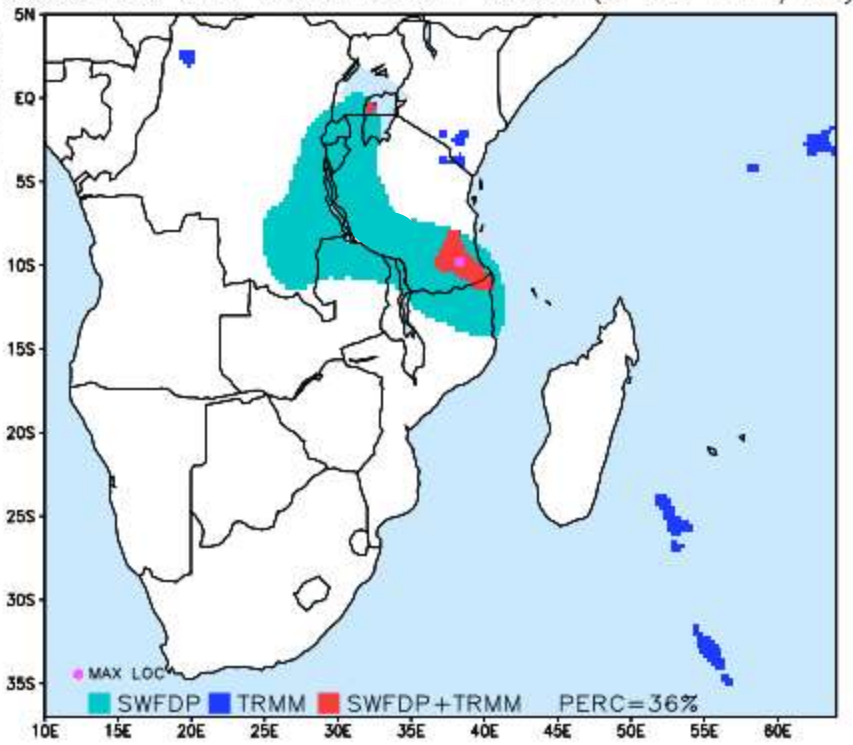
20121102 TRMM daily rainfall (mm/day)



Guidance and Observation fields (> 50 mm/day)



Verification statistics for 20121102 : Grid Size = 0.25° : Units = mm/day : n = 36673

	Guidance	TRMM
Number of gridpoints >= 50 mm	1790	317
Average Rain over domain	~	3.29297
>= 50 mm Rain Area (km²*10⁶)	1.11875	0.198125
Maximum Rainfall Observed (mm)	~	184.584

Categorical Forecasts	
Frequency Bias	5.64669
Probability of Detection	0.362776
False Alarm Ratio	0.935754
Hansen & Kuipers Score	0.316704
Equitable threat score	0.0503546
Spatial Correlation	0.184536

		OBSERVATION >=50	OBSERVATION <50
GUIDANCE	>=50	115	1675
GUIDANCE	<50	202	34681

Extreme Events Verification	
Extreme Dependency Score	0.648224
Symmetric Extreme Dependency Score	0.347945
Extremal Dependency Index	0.504355
Symmetric Extremal Dependency Index	0.537562

(**Ferro and Stephenson, 2011***)

http://rsmc.weathersa.co.za/RSMC/index.php
Format based on IPWG verification output

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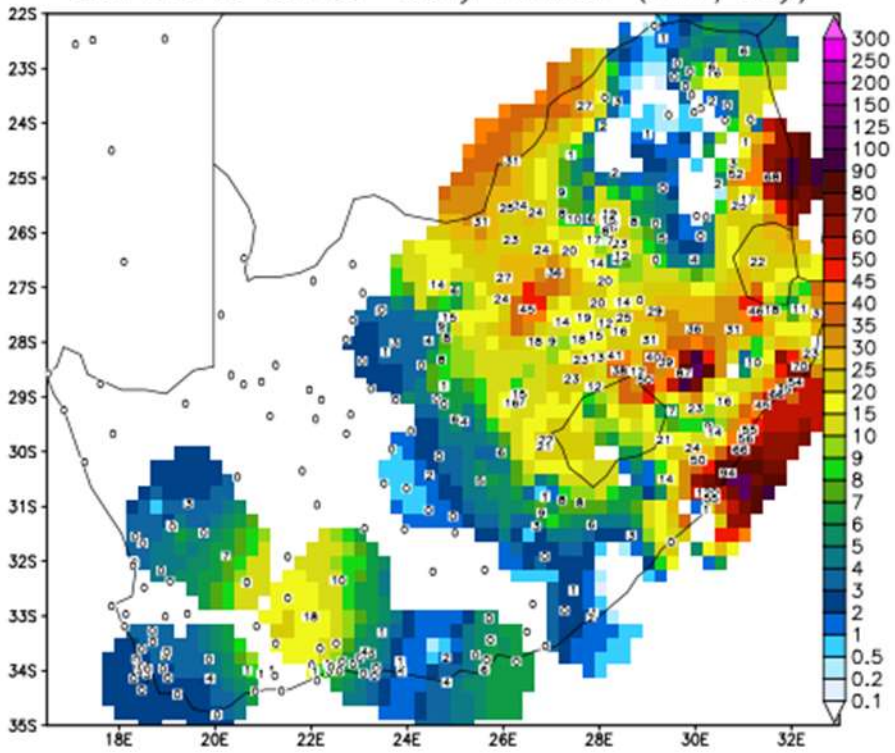
CONCLUSIONS

- The most skilful months are during the austral summer rainfall season.
- It is also found that useful categorical statistics and some spatial information can be obtained on a case study or daily basis of evaluation.
- Good indications to rather apply a 25 mm/day threshold as opposed to the extreme value of 50 mm/day due to the decrease in the false alarms and increase in hits.

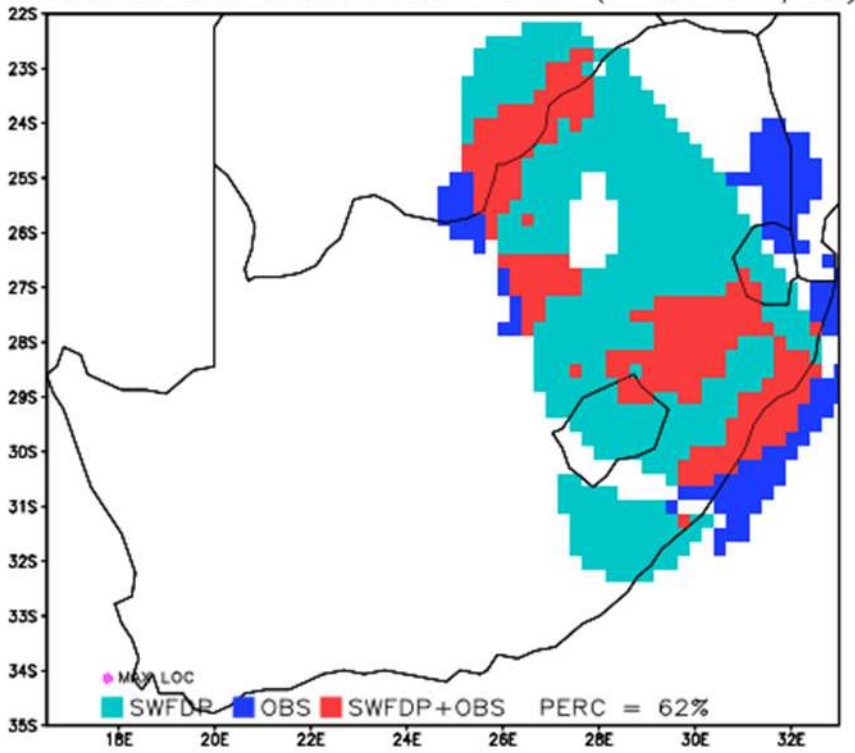
FUTURE WORK

- Include wind speed verification.
- Include number of guidance regions per month/season.
- Increase lead-time verification
- More spatial dependent verification techniques (i.e. exclude oceans from calculations).
- Address issues regarding using subjective area forecasts with objective gridded observations.

20121210 SYNOP daily rainfall (mm/day)



Guidance and Observation fields (> 25 mm/day)



Verification statistics for 20121210 : Grid Size = 0.25° : Units = mm/day : n = 333

	Guidance	H-E
Number of gridpoints >= 25 mm	1086	333
Average Rain over domain	~	15.4409
>= 25 mm Rain Area (km²*10⁴)	0.67875	0.208125
Maximum Rainfall Observed (mm)	~	110.007

Categorical Forecasts	
Frequency Bias	0.624625
Probability of Detection	0.624625
False Alarm Ratio	0
Hansen & Kuipers Score	0.624625
Equitable threat score	0
Spatial Correlation	-9.99e+08

GUIDANCE \ OBSERVATION	>=25	<25
>=25	208	0
<25	125	24566

Extreme Events Verification	
Extreme Dependency Score	-1
Symmetric Extreme Dependency Score	0
Extremal Dependency Index	Data
Symmetric Extremal Dependency Index	Data
(**Ferro and Stephenson, 2011***)	

http://rsmc.weathersa.co.za/RSMC/index.php
Format based on IPWG verification output

WMO

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