Satellite based nowcasting products in the pre-convective phase for southern Africa

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Content

- From GII to RII
- CII
  - Basic principles
  - Compared to lightning occurrence
  - Compared to rainfall over southern Africa
- Satellite based hail index
- Conclusions

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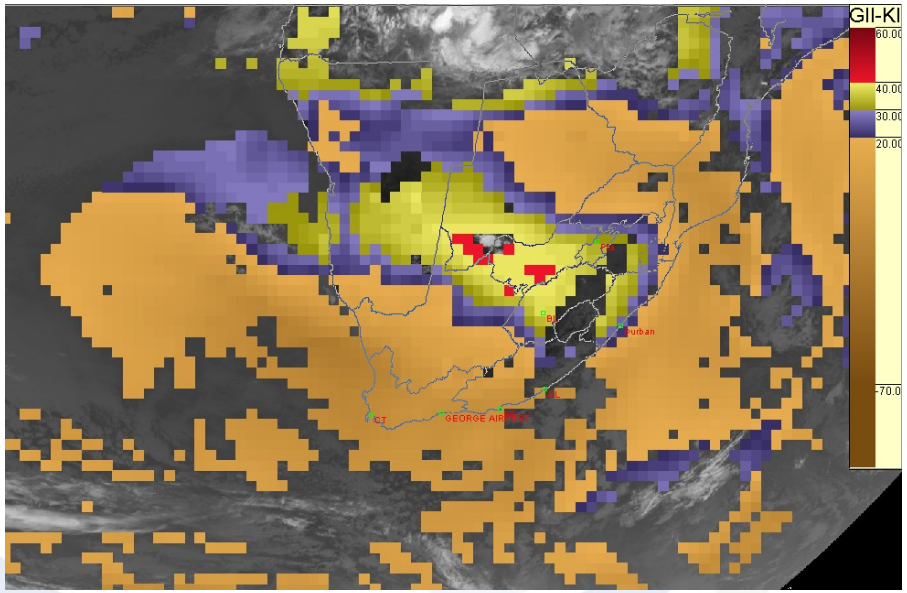
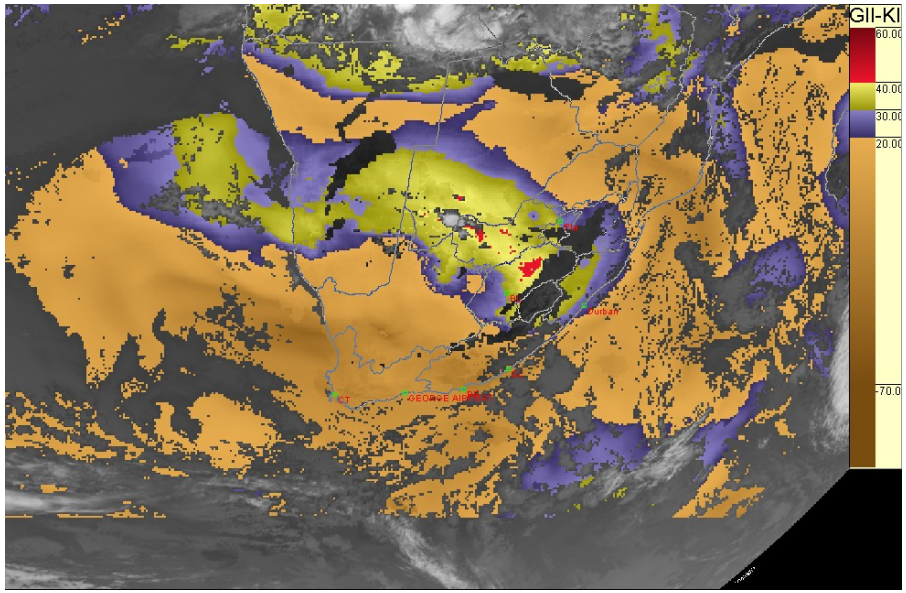
Local progress and improvements to GII

- Using local version of Unified Model (0.1° resolution) instead of ECMWF (1° resolution)
- Calculation of Lifted Index improved, Total Totals added
- Evaluation method using lightning



GII - ECMWF



RII – Unified Model

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Combined Instability Index (CII)

- Goal: to get one map, one parameter, in easy terms for a forecaster to use for very short range forecasting of thunderstorms

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The combined index – Step 1

- Use KI, PW, LI and TT and for each of them:
  - Compare the value of the parameters in the early morning against the occurrence of lightning later in the day with cumulative frequency tables
- Compile a “look-up” table… where a value of the index corresponds to a percentage chance that lightning occurs at that value

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Lookup tables…

- Example for Lifted Index:

	Feb Ave	Mrch Ave	Jan Ave	Nov Ave	Dec Ave	Ave
>=2	1.58	4.65	1.23	3.70	2.93	2.7
<2	4.20	11.20	2.53	11.43	6.13	7.2
<1	10.82	19.95	8.03	22.20	11.40	14.8
<0	19.80	30.30	18.77	34.52	21.88	25.5
<-1	30.44	44.50	31.43	52.67	35.68	39.7
<-2	41.60	59.80	44.87	65.45	49.80	52.7
<-3	62.42	76.55	61.10	76.72	59.30	67.3
<-4	80.78	90.85	74.80	86.10	68.93	80.1
<-5	92.00	98.15	85.97	90.82	78.20	88.6
<-6	97.08	99.80	92.87	95.53	86.70	94.2
<-7	99.02	100.00	96.67	97.97	93.98	97.4
<-8	99.74	100.00	98.87	99.38	98.58	99.3
<-9	99.94	100.00	99.83	99.87	100.00	99.9
<-10	99.94	100.00	99.97	99.97	100.00	100.0
<-11	100.00	100.00	100.00	100.00	100.00	100.0

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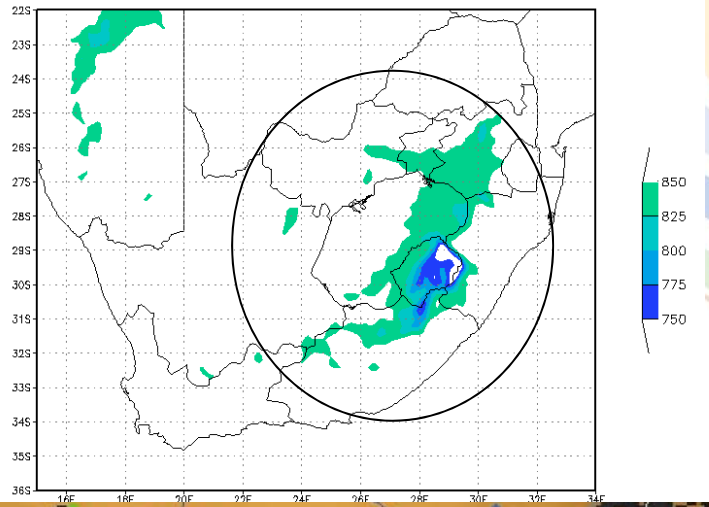
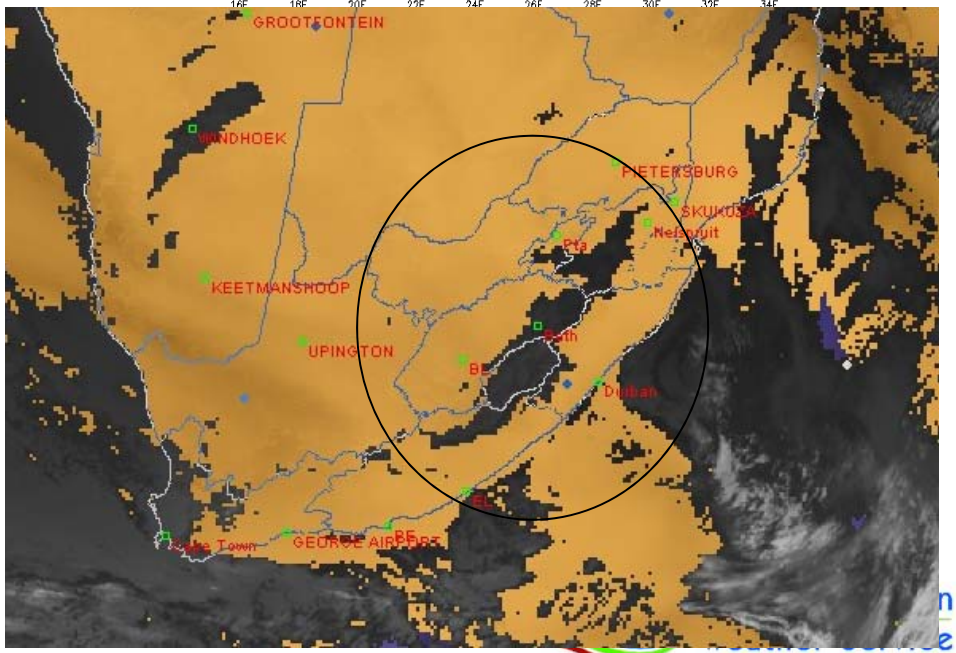
Step 2 – making provision for higher altitudes

- The areas where KI and TT are not available due to the elevation (<850 hPa) still remained a problem. Since KI and TT depend on T and Td values at 850 hPa…





Modified K-Index

$$Mod - K = T_e^* - T_e(500) + T_d^* - \left[T_e(700) - T_d(700)\right],$$

$$where\ T_e^* = \left[T_e(sfc) + T_e(850)\right]/2$$

$$T_d^* = \left[T_d(sfc) + T_d(850)\right]/2$$

We used 825 hPa for SA circumstances

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Modified Total Totals

$$TotalTotals = T_e(850) - T_d(850) - 2[T_e(500)]$$

$$Mod - TT = T_e* - T_d* - 2\left[T_e(500)\right]$$

$$where\ \mathrm{T_e}* = \left[\mathrm{T_e(sfc)} + \mathrm{T_e(850)}\right]/2$$

$$\mathrm{T_d}* = \left[\mathrm{T_d(sfc)} + \mathrm{T_d(850)}\right]/2$$

We used 825 hPa for SA circumstances

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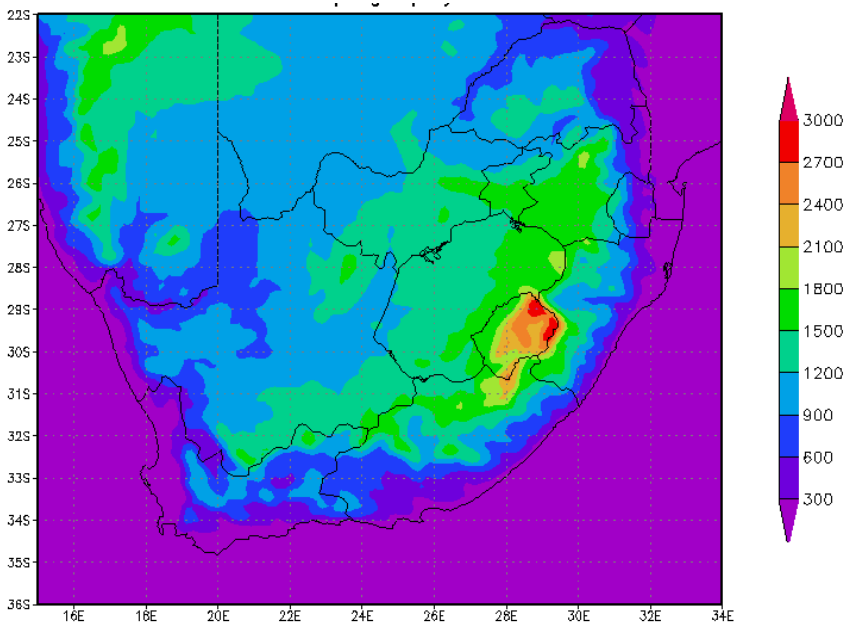
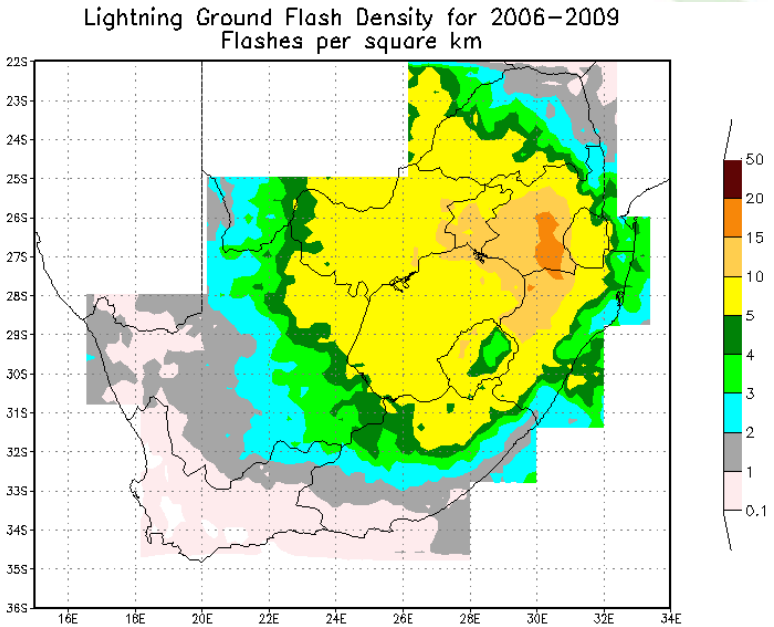
Step 3 – adding height above sea level

- Added topography as another parameter since lightning occurrence (and convection) is related to topography





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Final CII definition…..

- MT, MK, LI and PW:
  - Percentage chance of seeing lightning from look up tables
  - Weighted with HK/TSS
  - And normalized and adding up to 80% of CII
- Topography:
  - Percentage change of seeing lightning from topography the other 20%
- CII = 80% from instability and atmospheric moisture and 20% from trigger due to topography
- Publication on GII in AMS bulletin Feb 2009.
- Publication on RII and CII submitted to Met Applications in Feb 2010

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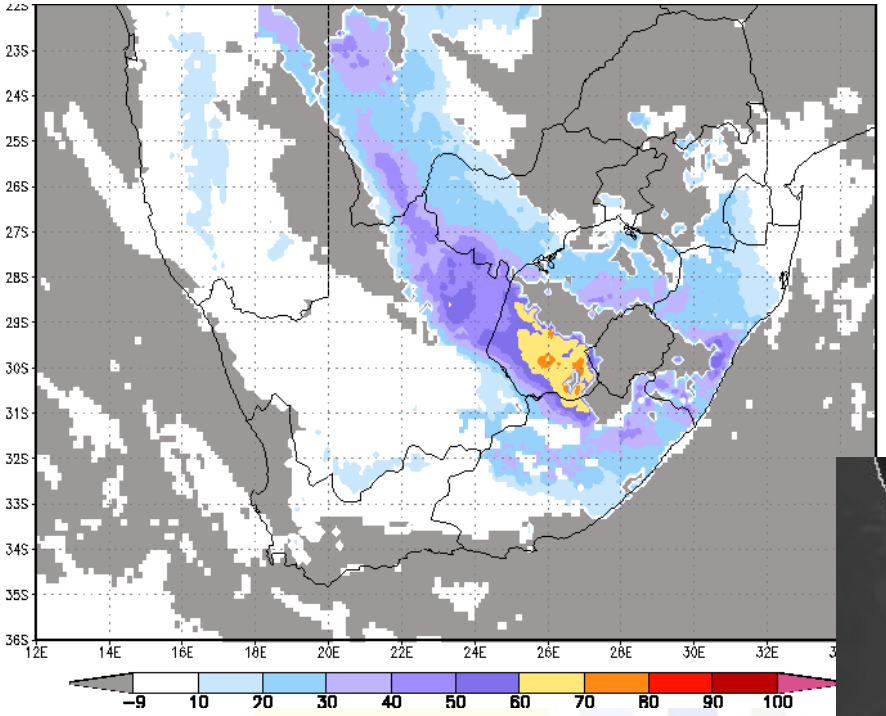
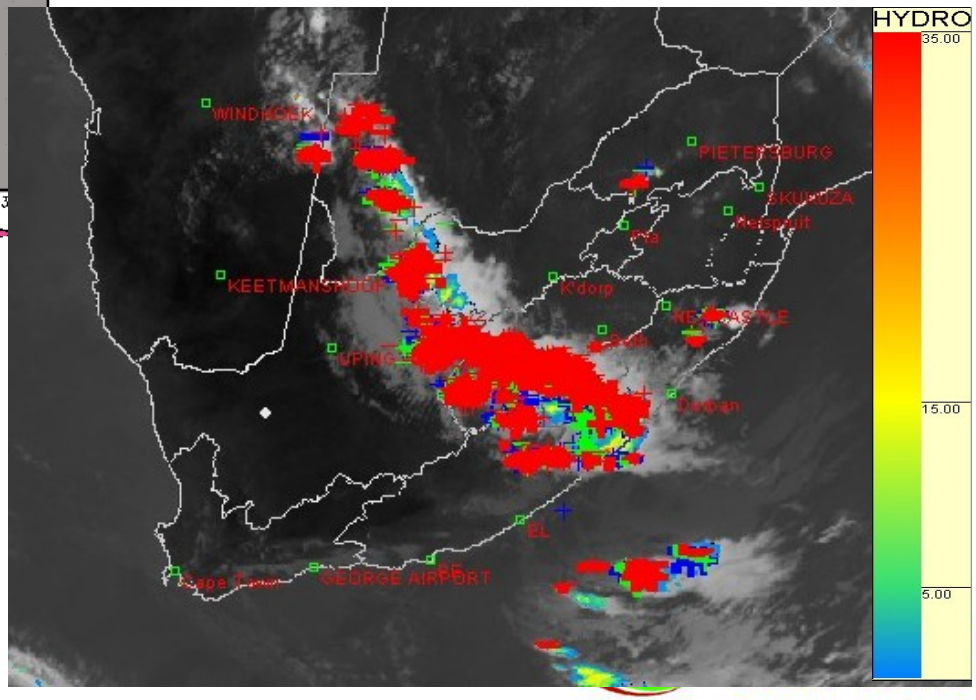
31 Jan 2010

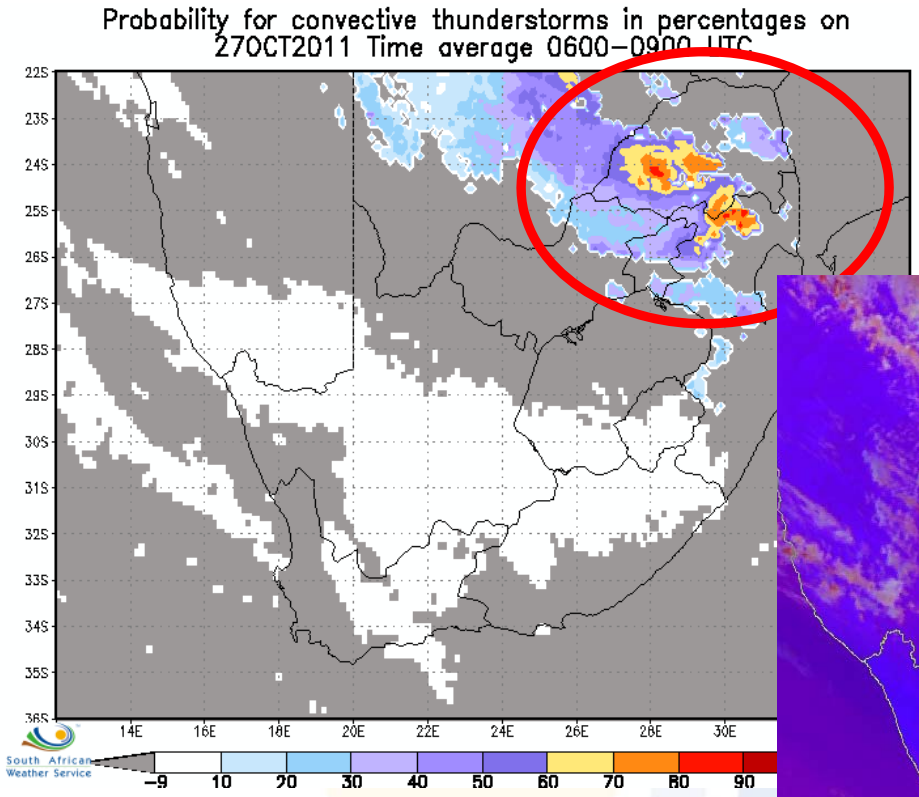


CII 06:00-0900 UTC

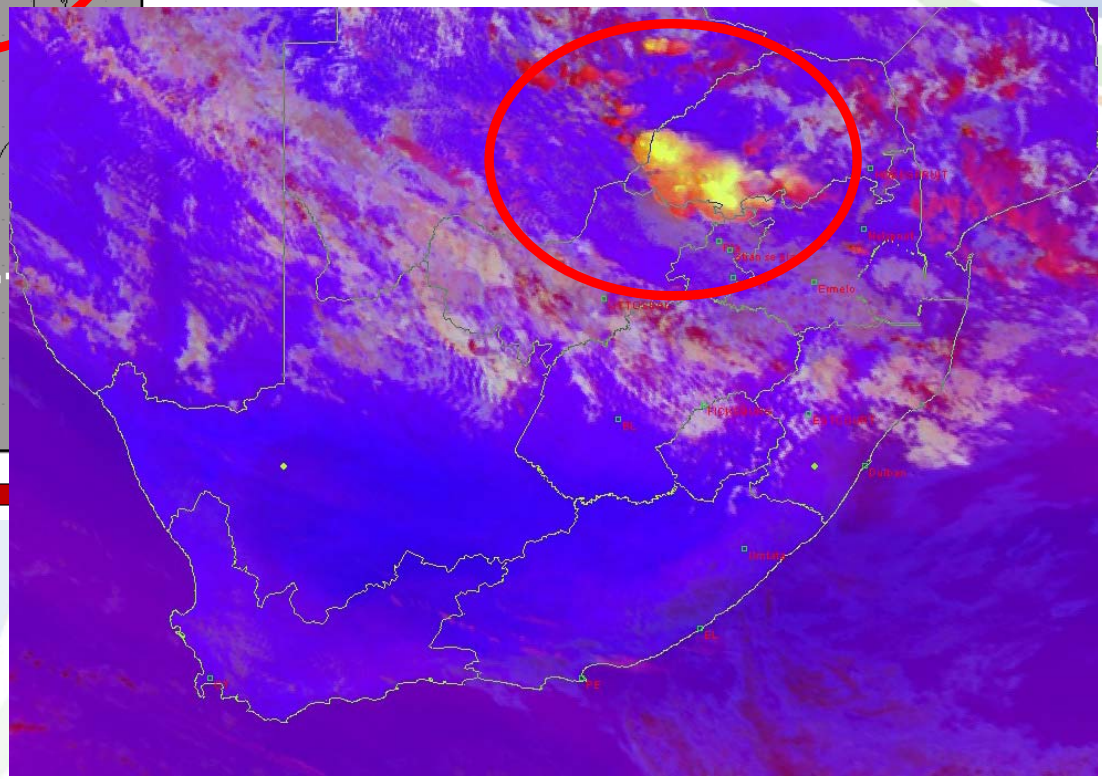
1500 UTC



Example 27 Oct 2011



Conv RGB 1330 UTC



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CII compared to Hydroestimator rainfall for southern Africa

- Compared CII to Hydro-estimator's rainfall for rest of southern Africa to show that they can also use this

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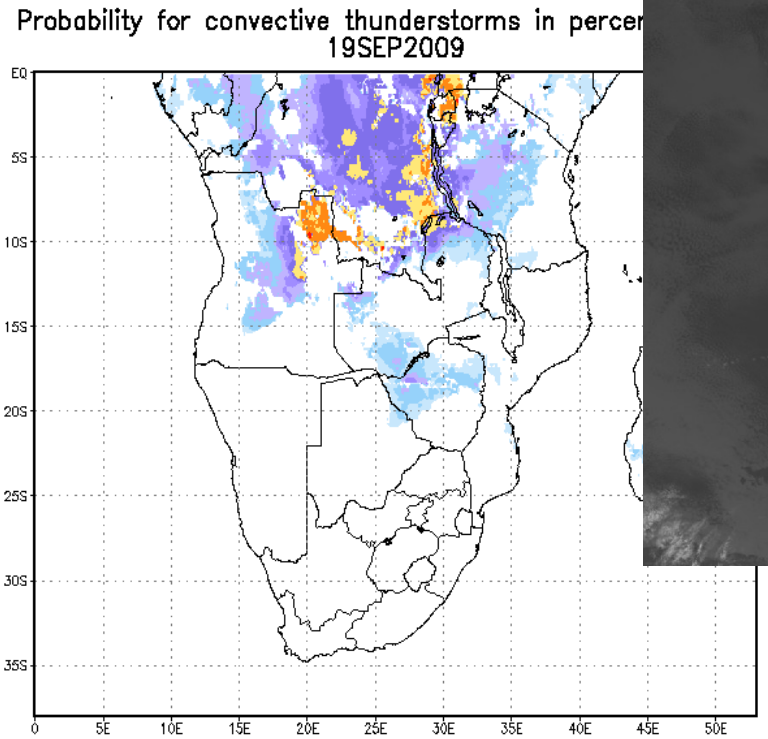
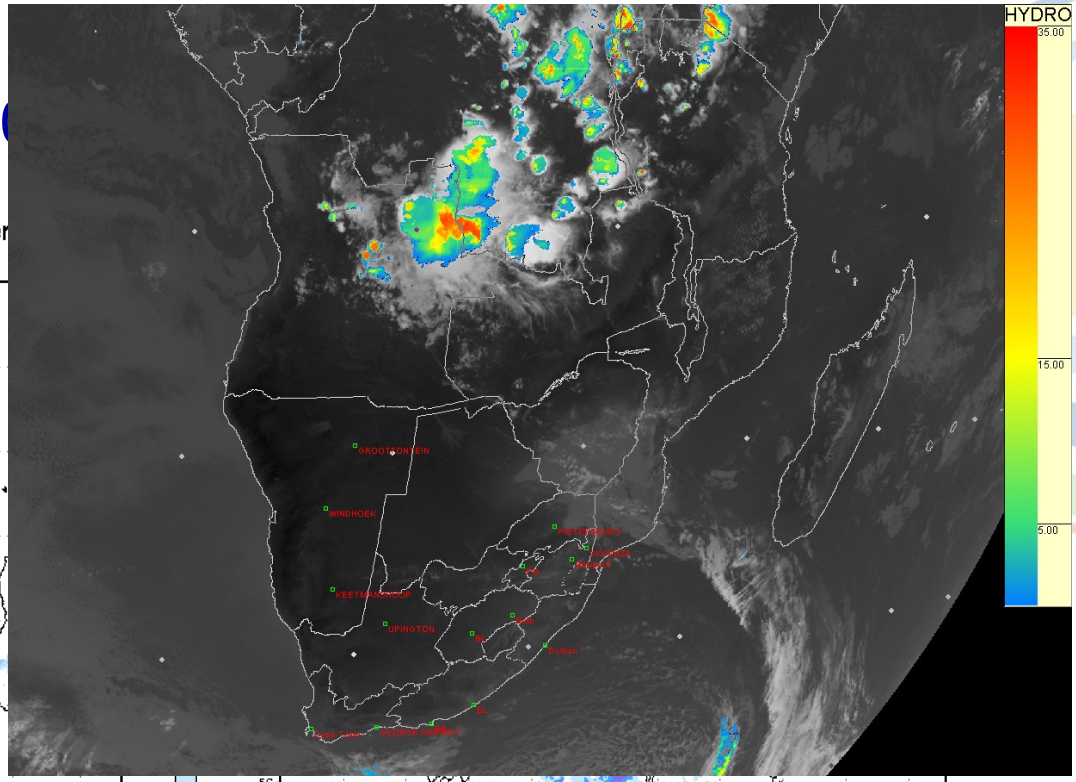
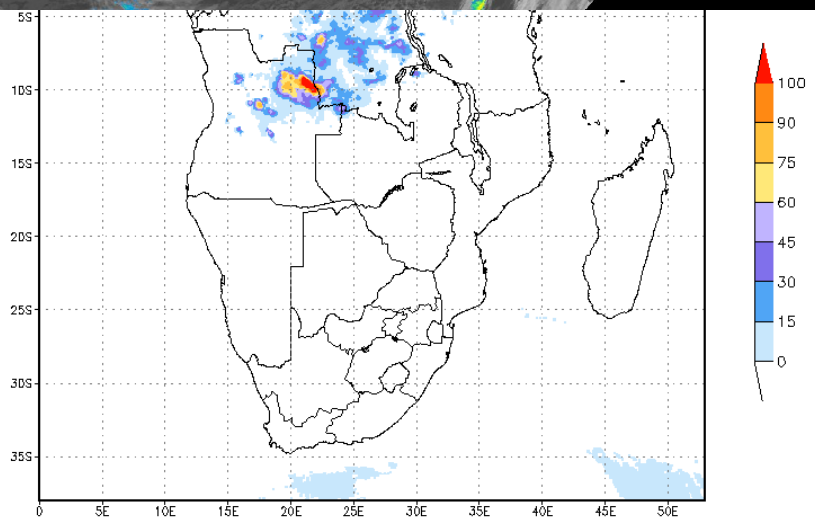
CII vs HE for 19 Sep 20







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GrADS: COLA/IGES

2009-09-20-07:02

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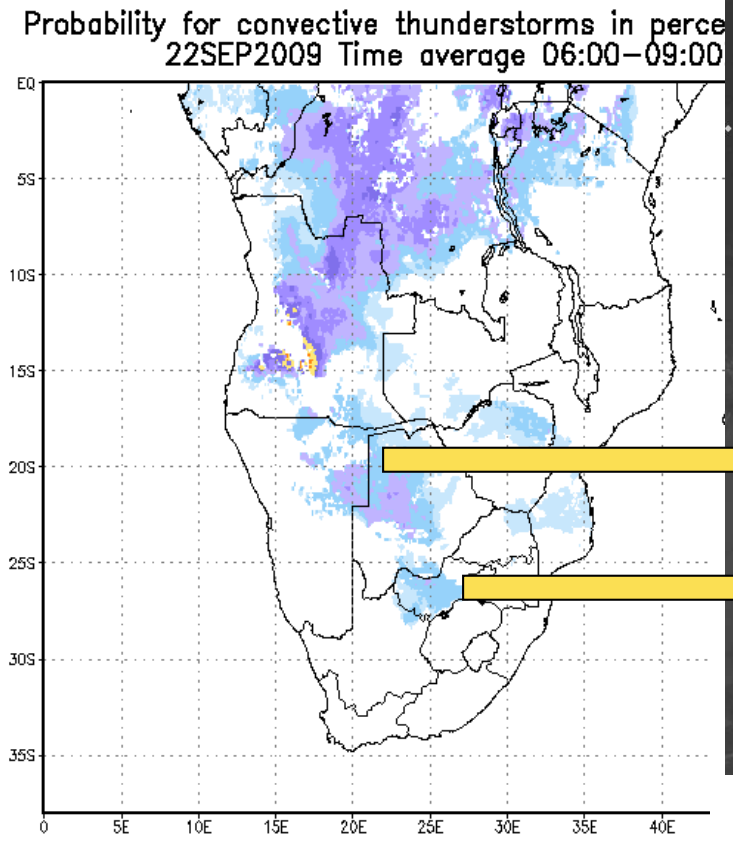
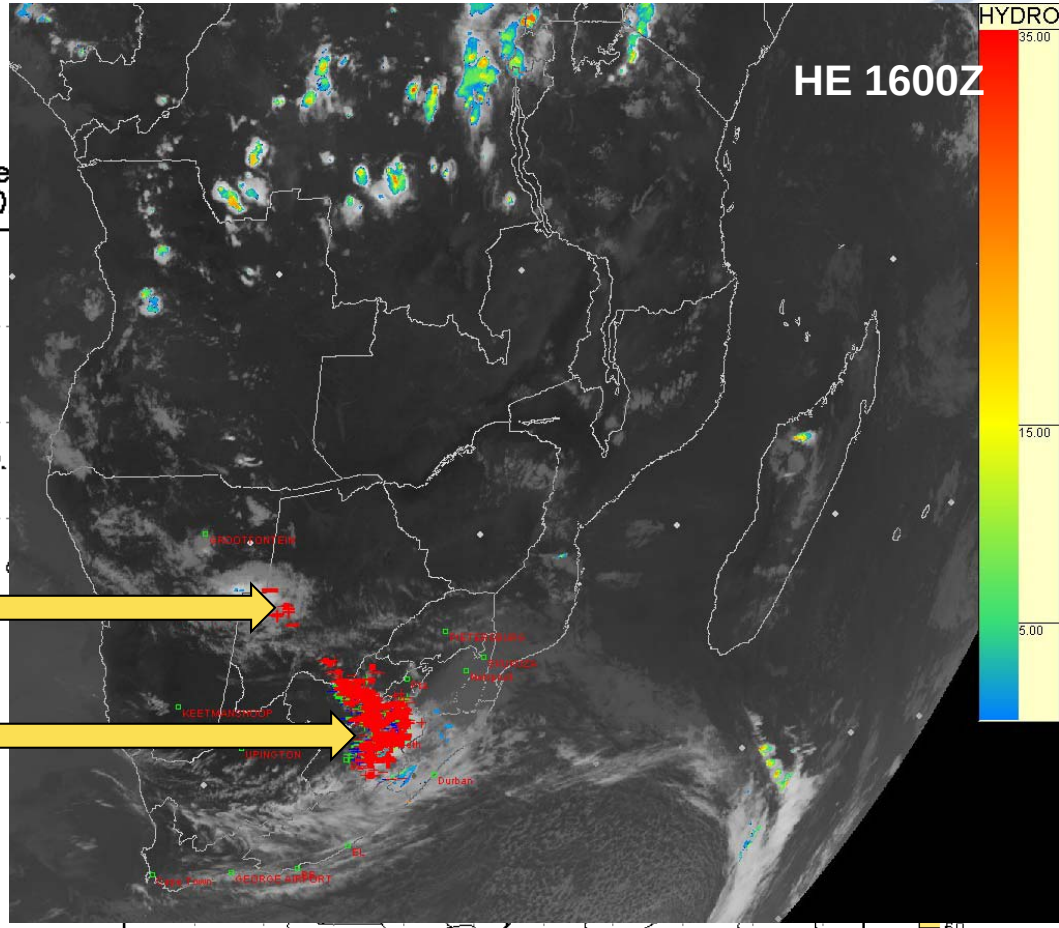
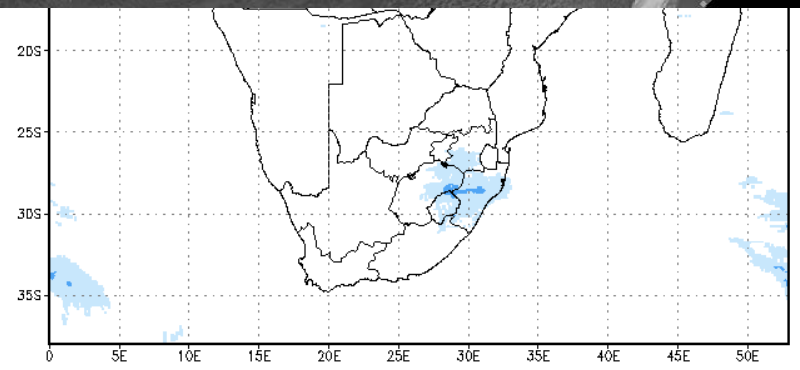
Example 22 Sep 2009







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GrADS: COLA/IGES

2009-09-23-07:02

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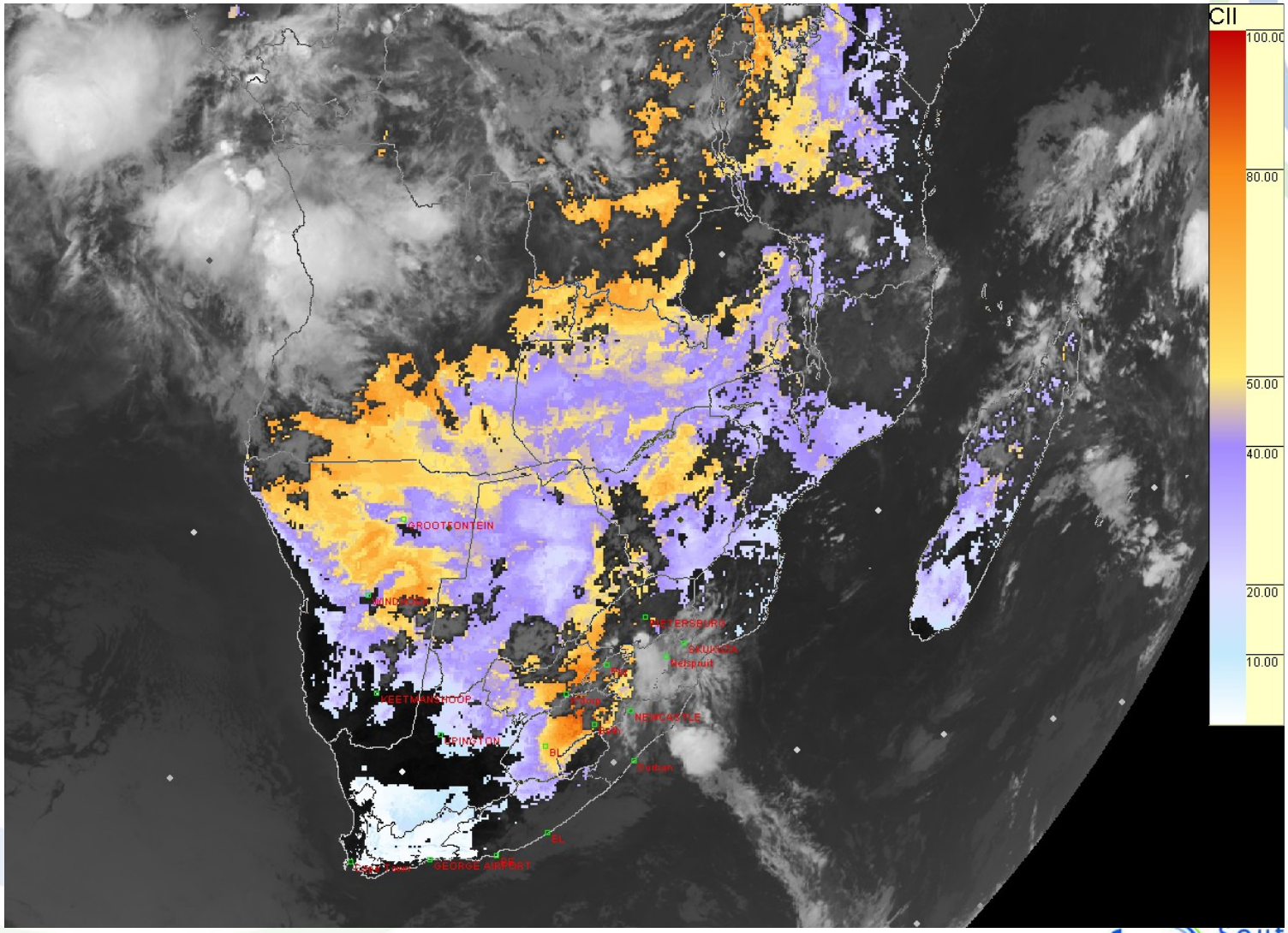
CII in SUMO, every 15 minutes:



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World Meteorological Organization

Regional Specialised Meteorological Center (RSMC) Pretoria

Designated to South African Weather Service

Guidance Products

NWP & EPS Products

Regional Models

- UM SA12
- UM Africa LAM
- Aladin La Reunion

Global Products

- NOAA: GFS
- ECMWF: EPS
- Met Office: EPS
- NOAA: EPS
- SAWS: EPS (SAWS)

Training Website

- Met-eLearning

RSMC Guidance Archive

Contact RSMC

Logout

Guidance Products

Short-range (1-2 Days)

- Map Day 1
- Map Day 2
- Risk Tables
- Discussion

Medium-range (3-5 Days)

- Map Day 3
- Map Day 4
- Map Day 5
- Prob Tables
- Discussion

SWFDP Evaluation Form

- Click Here

Satellite-based 0-12 Hour Products

Satellite-Based Rainfall

Hydro-Estimator Rainfall Totals

- 1hr • 3hr • 6hr • 24hr

Hydro-Estimator Rainfall Totals In Days

- 10 Days • 30 Days
- Description of Product

Convective Thunderstorm Forecasts

Probability of Convective Thunderstorms

- CII
- Description of Product

Regional and International Centers

- ECMWF
- NCEP
- UK Met Office
- WMO
- RSMC - Reunion
- ACMAD

SADC Countries

- SADC Countries National Meteorological Services

Other Services and Products

- Short-range
- Long-range (Seasonal)

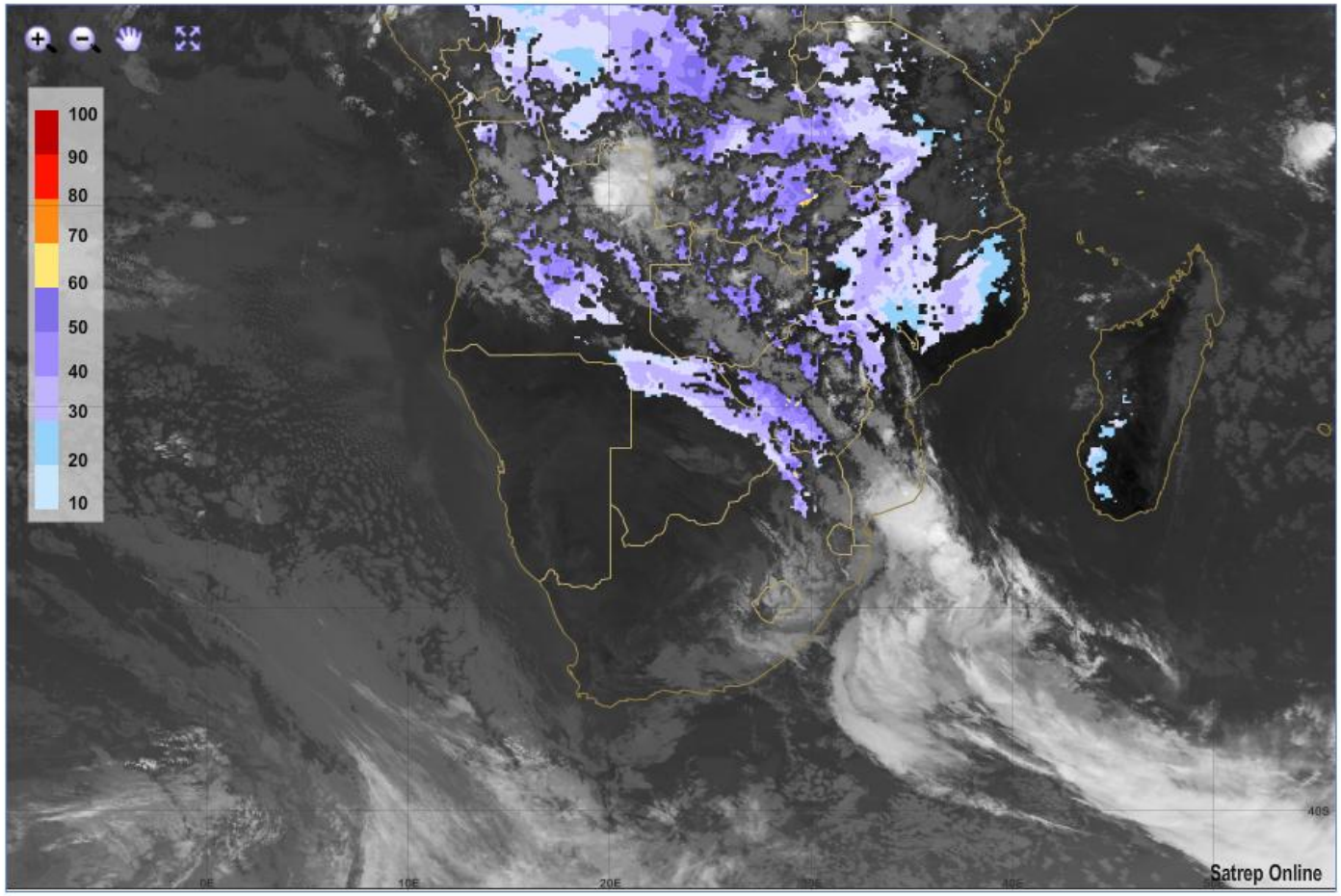
frican
Service

Satrep Online

Todays images 10 November 2010: 0600 UTC

1800 UTC | 0000 UTC | 0600 UTC | 1200 UTC

- UKMO NWP
  - MSLP
  - Temp.
  - Dewpoint Temp.
  - 10m. Windspeed
  - Temp. Ave. 500
  - Equiv. Thickness
  - ThetaW 850
  - H850
  - H700
  - H500
  - H300
  - T500
  - Wind700
  - Wind300
  - RH700
  - Omega 700
  - Omega 500
  - Divergence 850
  - Divergence 300
  - Total Totals
  - Lifted Index
  - Lapse Rate
  - K-index
  - CAPE
  - Fog



- Meteosat Second Generation
  - IR10.8
- Products
  - SYNOP
  - CII

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Recent development: Satellite based hail index

- Development of a satellite and model based nowcasting tool for hail occurrence in test phase – also for use in Africa where very few radars exist.
- In the process a new way of evaluation is generated using satellite and lightning data as well as hail claims for insurance and media reports.

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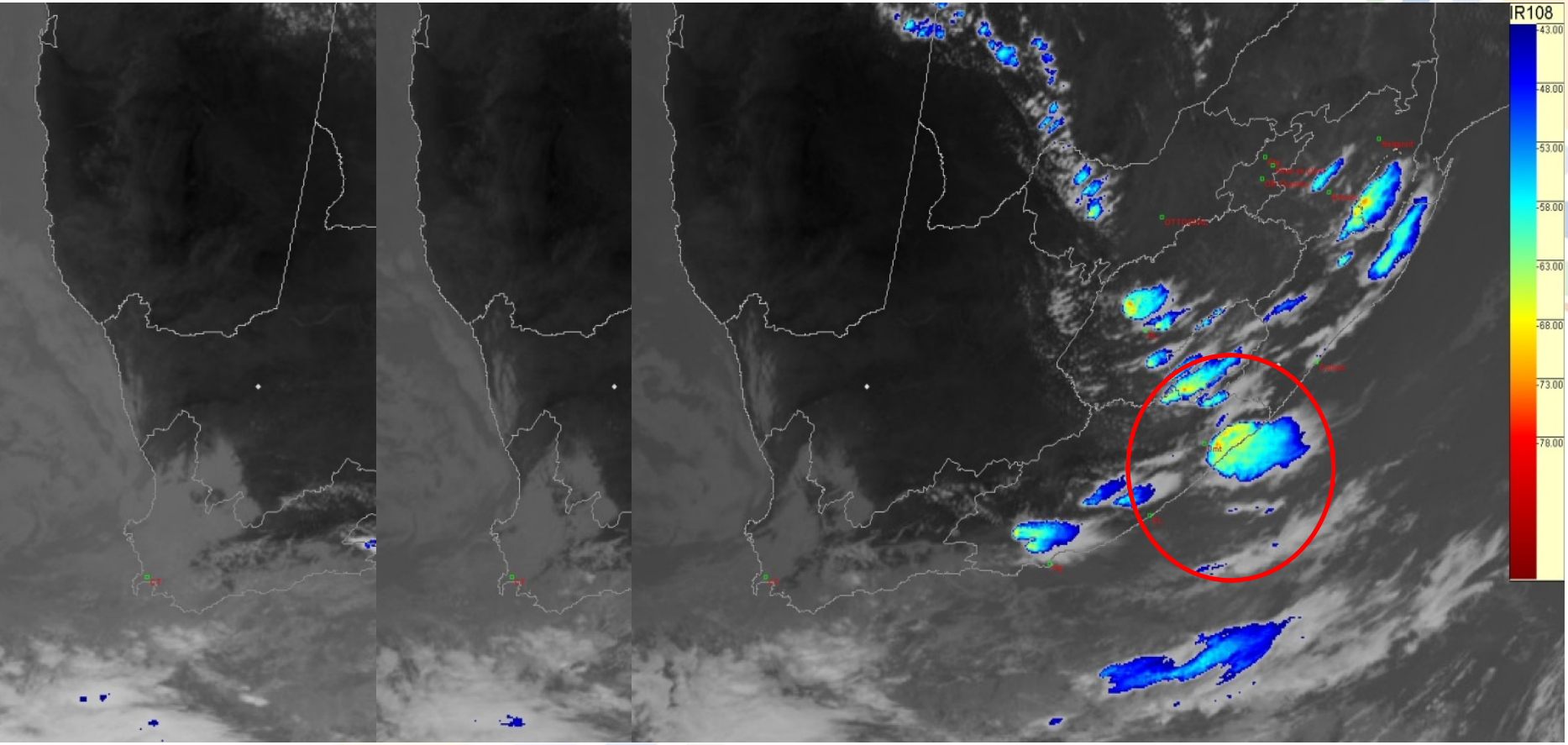
22 Dec 2010 MSG IR 108 colour enhanced 12:30, 13:30 and 14:30



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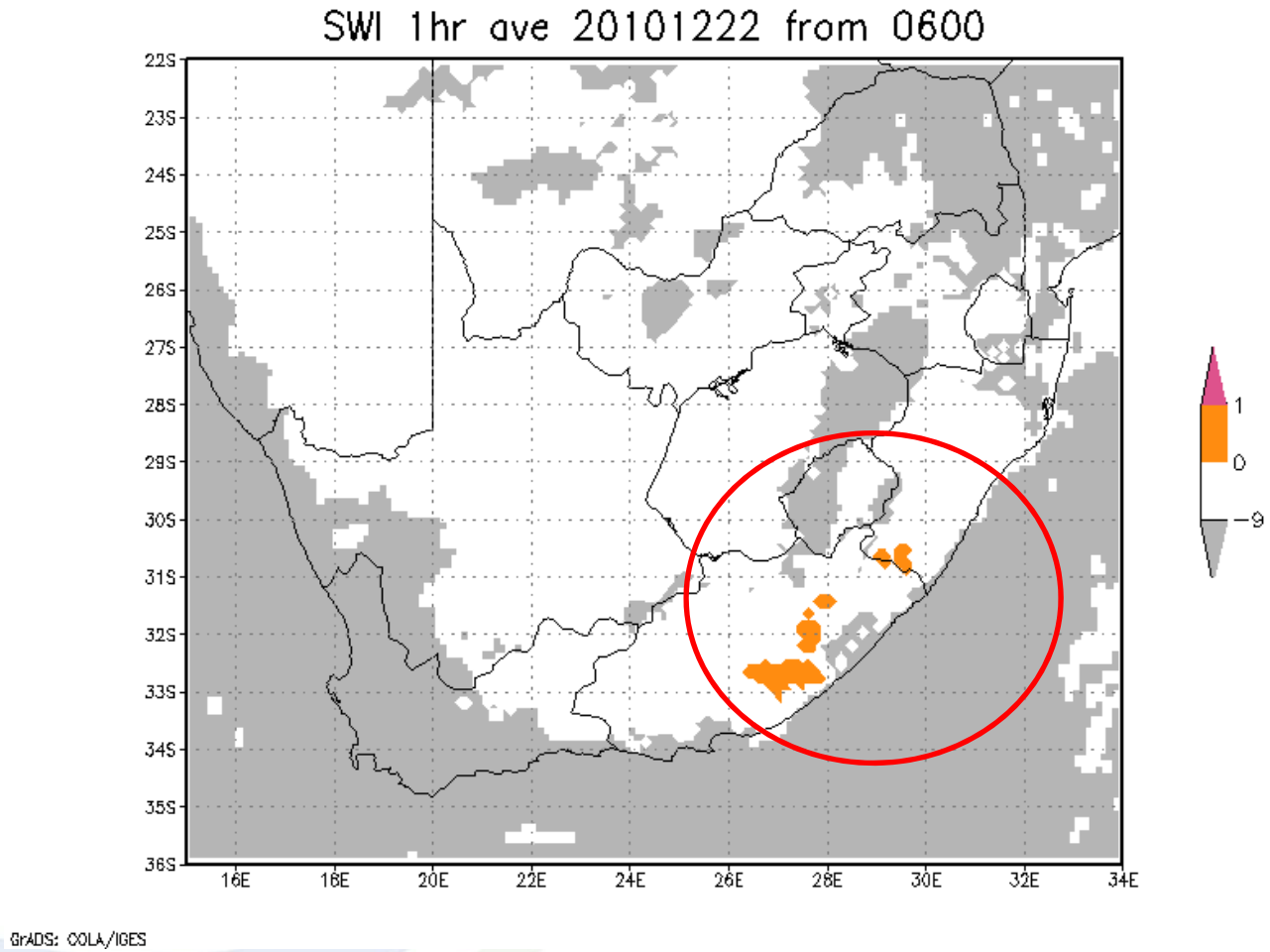
Hail index in hourly averages from 0600 UTC



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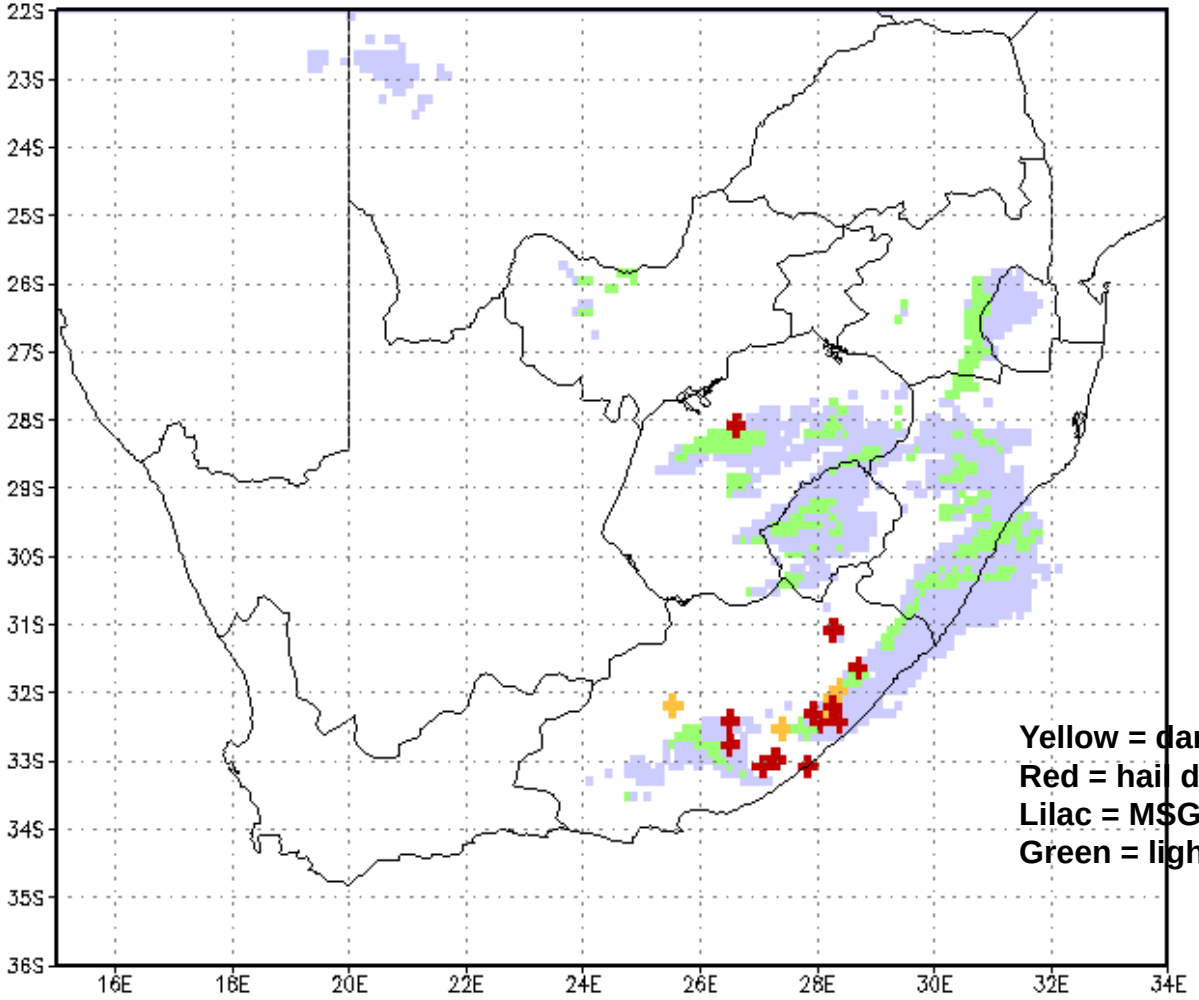
Damage reports on 20101222 from 1200 to 2000 UTC with 210K



Yellow = damage reports
Red = hail damage claims
Lilac = MSG colder than 210K
Green = lightning > 150 strokes

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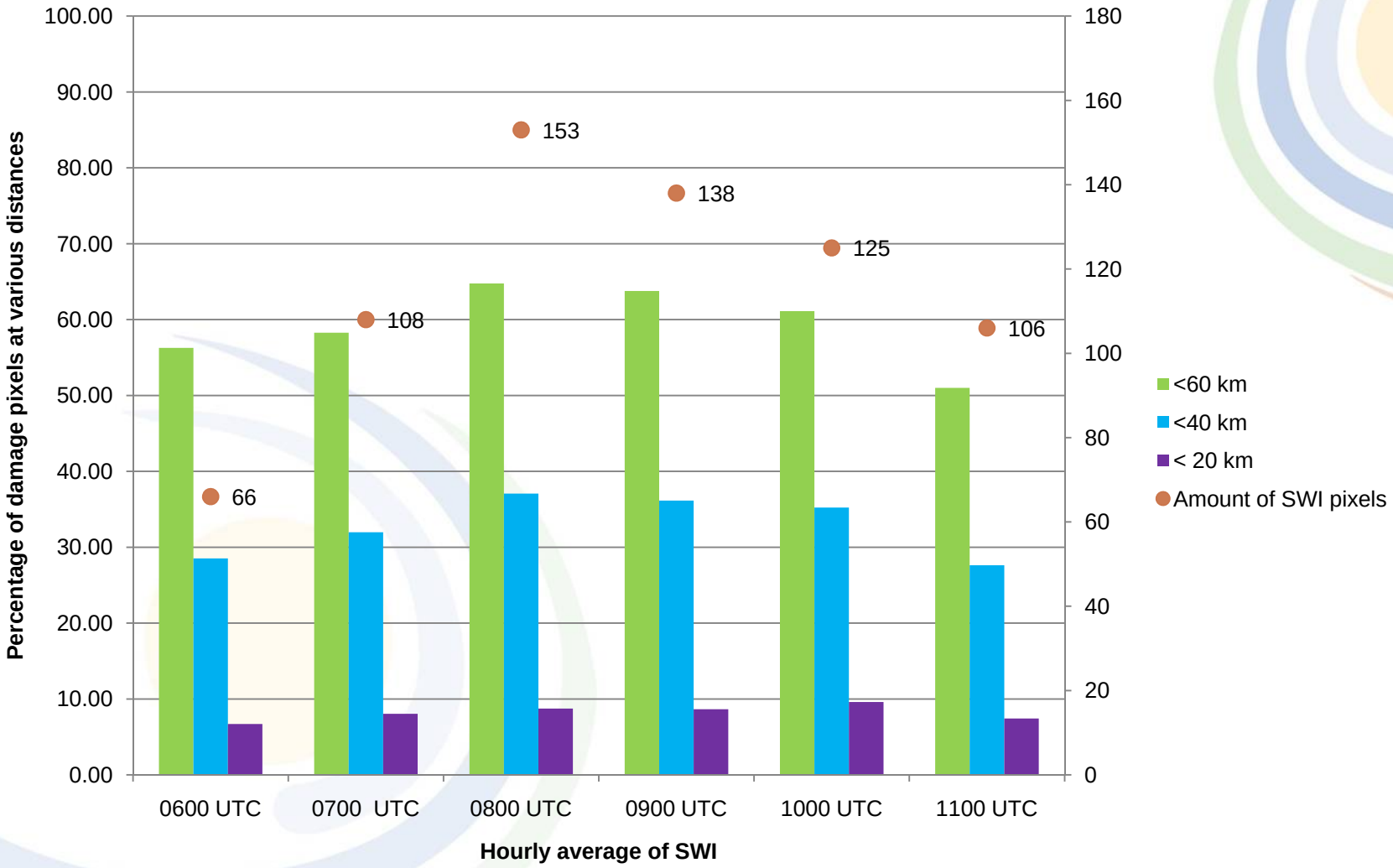
22-Dec-10 – event 1300 to 1400 UTC



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Conclusion

- A lot of work is still ahead to test hail index on more cases
- LIS data for southern Africa?
- MTG – a whole new world awaits us (with lightning imager)
- Collaboration is vital

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