

Nowcasting systems for Developing countries

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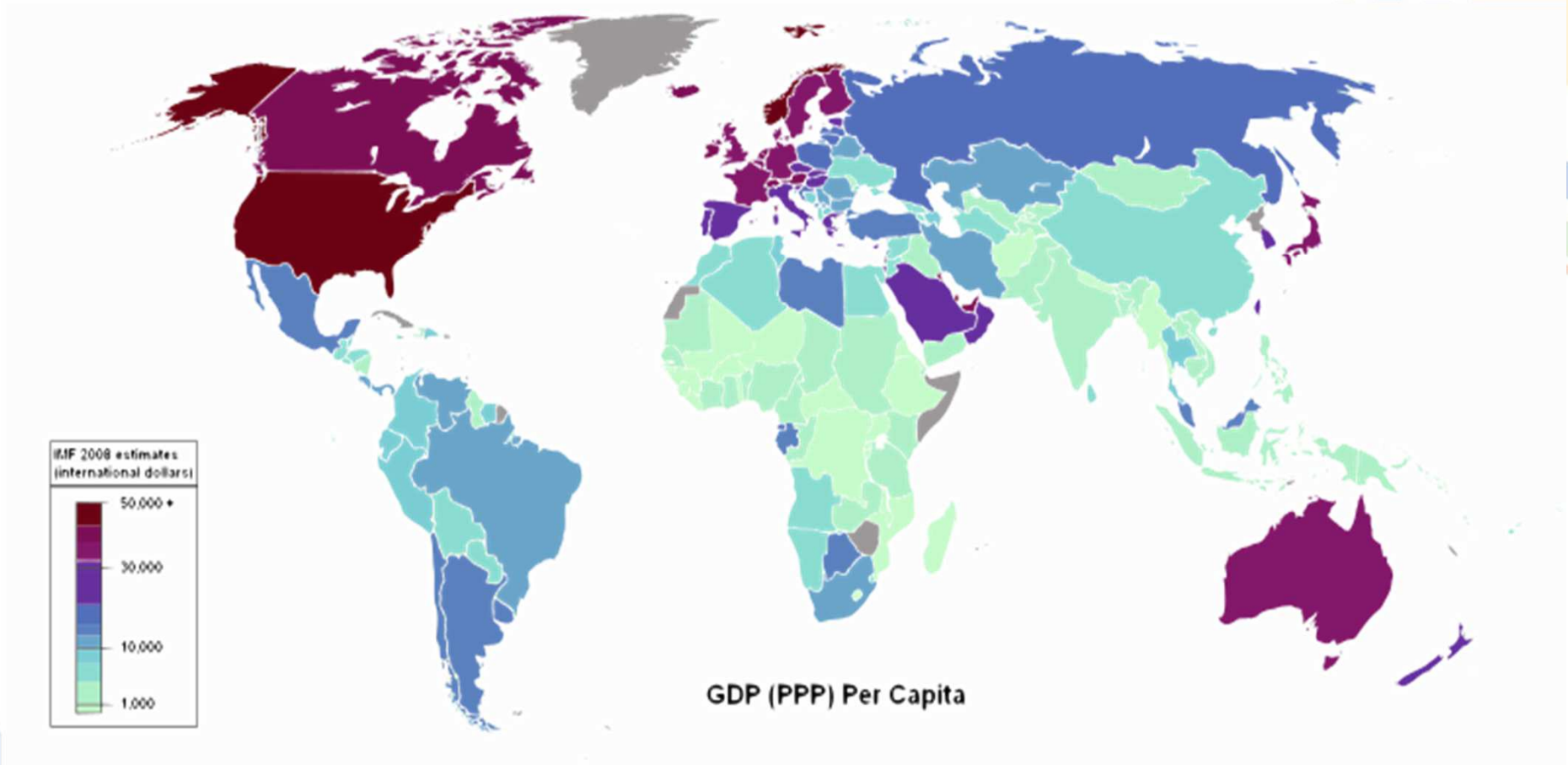
1. Introduction

- **Strength of nowcasting** - location-specific forecasts of the initiation, growth, movement and dissipation of weather phenomenon
- **Ideal world - radar systems**
- Reality, however, is that **many developing countries (DC) and even more so Least Developed Countries (LDC) do not have operational radar systems** at all, and the countries which are fortunate enough to have radar systems, are struggling to maintain and sustain these powerful data sources.

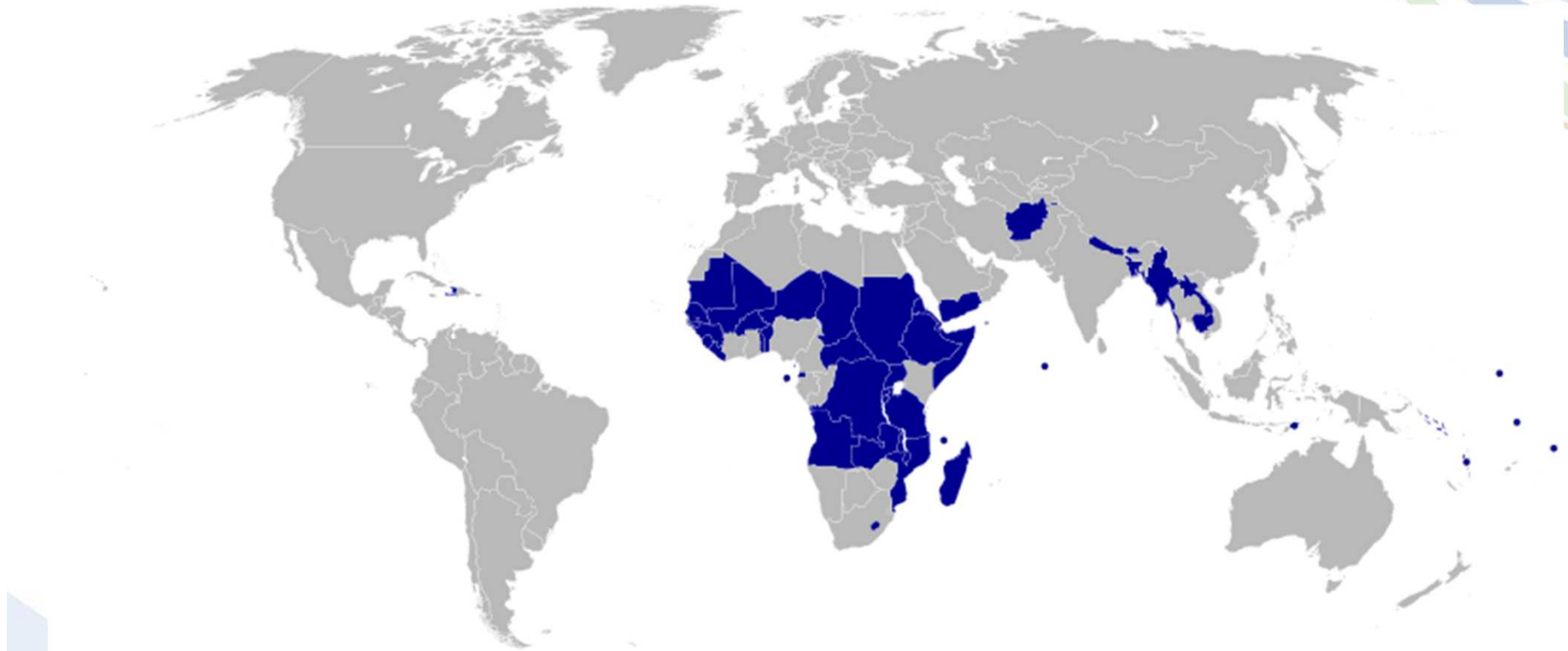
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- The Global Humanitarian Forum states:
 - “Developing countries, which are most likely to suffer the brunt of climate change impacts, have the least number of ground-level weather data observation systems, the critical basis for efficient delivery of weather information.
 - Despite covering a fifth of the world's total land area, Africa has the least developed land-based weather observation system of all continents, and one that is in a deteriorating state.
 - Many existing weather stations do not operate properly, or do not operate at all.
 - WMO estimates that in an ideal scenario, 10 000 weather stations should be operating in Africa. Currently, there are only around 744 stations operational, less than a quarter of which provide observations that meet WMO requirements for standard and frequency of data.”

Global Humanitarian Forum (2008). *Weather information for all initiatives 2008-12* available at http://info.publicintelligence.net/WIFA_Project_Outline_Executive_Summary.pdf.

More than 152 DC world wide in 2008




LDC – 33 in Africa, 14 in Asia Pacific (2011)



Radar networks in DCs

- China, Romania, Brazil, Vietnam, Cuba, Ukraine, UAE, Saudia Arabia, Thailand, Turkey, Philippines, Mali, Kenya, Rwanda (is purchasing a new one), Burkina Faso, Mozambique, Botswana, South Africa (not all operational)
- **Cuba** has several very old Russian radars that are kept functional through the efforts of one dedicated radar engineer and these limited radars are very important for their basic operational detection of storms.
- The World Bank, UN, USAID, national science foundations and national weather services assist in financial support to extend radar coverage.

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- *“The **East African nations** recognize the power of weather radars and have plans to incorporate them into their weather observation networks around Lake Victoria.”*
 - *In **Kenya**, there are radars in place in Nairobi and Mombasa. While these two radars are no longer operational, the Kenya Meteorological Department is hopeful to bring them back online in the near future.”*
 - *With regards to the Lake Victoria region, the **Kenyans** have plans to place a S-band scanning weather radar at the Eldoret International Airport, located approximately 100 km northeast of the lake.”*
 - *The **Tanzanian** Meteorological Agency is currently running one scanning weather radar in Dar es Salaam, and is in the procurement stage of putting a weather radar in Mwanza, located directly on the south-central shore of Lake Victoria. They have an excellent site already selected which would provide coverage over much of Lake Victoria.”*

*(**Atmospheric Observations Feasibility Study report** by Burleyson, Yuter and Rose, 2011)*

WMO Nowcasting symposium (Whistler, 2009)

- **Challenges** surrounding the support of nowcasting efforts in developing countries:
 - observational **data availability**,
 - IT infrastructure and maintenance,
 - tools for processing and visualization,
 - training of operational staff in nowcasting concepts,
 - **end-to-end product dissemination**,
 - **building and maintaining regional radar networks**,
 - access to satellite data and local/regional Numerical Weather Prediction (NWP) model output.

Practical advice

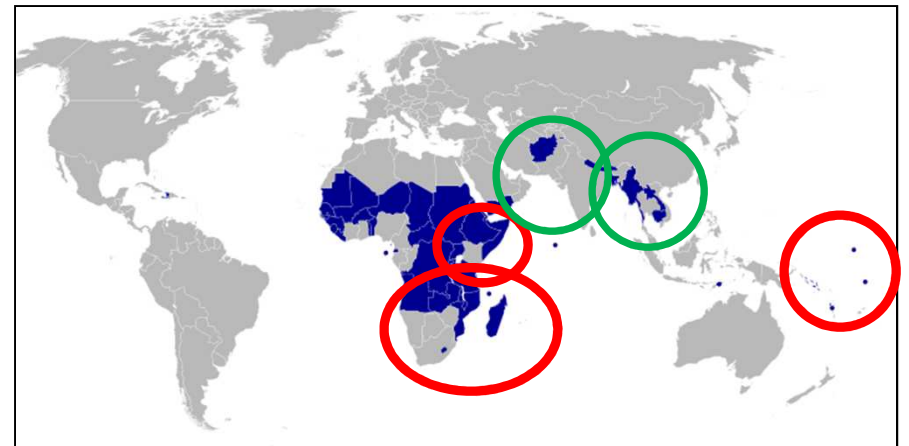
1. Plan purchasing of expensive system in order to be sustainable
2. Plan the dissemination of datasets **via the internet**, GEONETCAST etc.
3. **Start by getting access to satellite data... "it is an efficient poor man's nowcasting system"**.
4. Plan how to develop the expertise and technical support staff in your service necessary to keep these systems operational.
5. Develop and document a sustainable plan for incorporating very short term forecasting in the operational setting.
6. Provide and document end-to-end training taking into account end-user requirements and needs.
7. Regional/international sustainable cooperation is crucial.

2. Severe Weather Forecasting Demonstration Projects (WMO CBS SWFDP)

- The SWFDPs aims:
 - to improve severe weather forecasting in DC and LDC by providing access to current forecasting information (e.g. **NWP and EPS**).
 - Improve lead time of warnings
 - Improve interaction between NMHS and media as well as disaster managers and civil protection authorities
 - Identify areas to improve upon through regular feedback

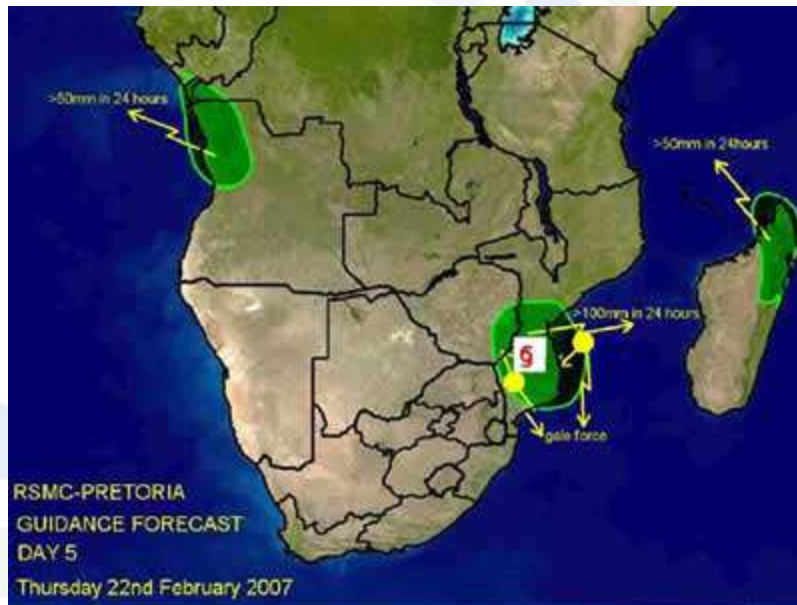
2. Severe Weather Forecasting Demonstration Projects (WMO CBS SWFDP)

- Current status of SWFDPs around the world –
 1. Southern Africa
 - South Eastern Africa 2006-2007 (5 countries involved)
 - Southern Africa expansion 2008-2011 (16 countries involved)
 - RSMC established in Pretoria, South Africa
 2. South Pacific islands
 - Pilot project 2009-2010
 - Full demonstration 2011
 - RSMC established in Wellington
 3. Eastern Africa initiated
 4. Under development – Southeastern Asia and Bay of Bengal



2. Southern Africa SWFDP

- Feedback from the participating NMHSs in the Southern African SWFDP:
 - improved warning services in many countries and
 - contributed to the improvement of relations between NMHSs and disaster management authorities.
- The SWFDP has thus contributed significantly to an end-to-end process of warning dissemination.



World Meteorological Organization

Regional Specialised Meteorological Center (RSMC) Pretoria

Designated to South African Weather Service

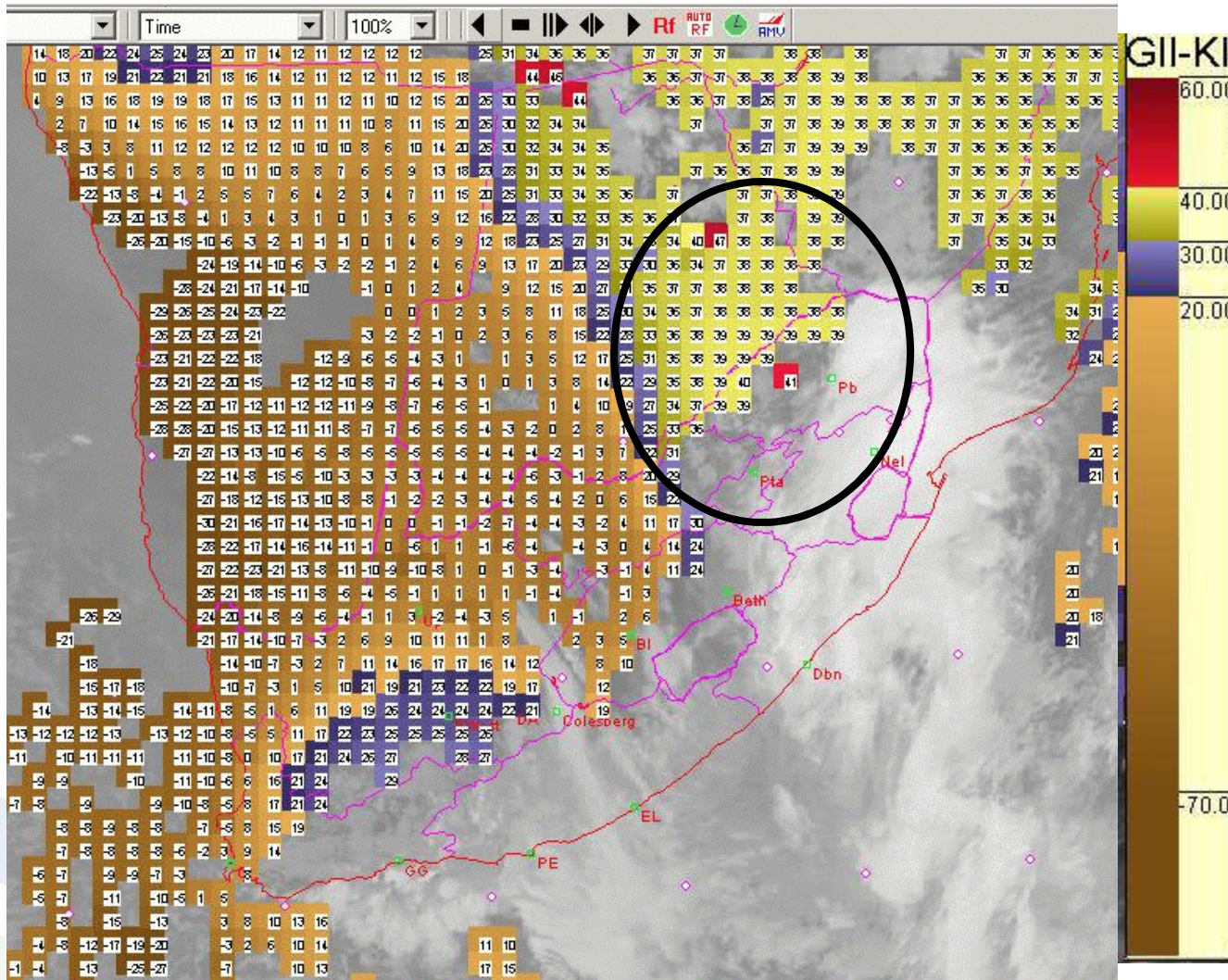
<p>Guidance Products</p> <p>NWP & EPS Products</p> <p>Regional Models</p> <ul style="list-style-type: none"> • UM_R012 • UM_Zone_L0M • Meteo Va Raymo <p>Global Products</p> <ul style="list-style-type: none"> • NMA_G05 • R05G01_E05 • NMA_G01 • R05G01_G05W01 <p>Training Website</p> <ul style="list-style-type: none"> • Met-weather <p>RSMC Guidance Archive</p> <p>Contact RSMC</p> <p>Logout</p>	<p>Guidance Products</p> <p>Short-range (1-2 Days)</p> <ul style="list-style-type: none"> • Hrs Day 1 • Hrs Day 2 • Hrs Tables • Raincast <p>Medium-range (3-5 Days)</p> <ul style="list-style-type: none"> • Hrs Day 3 • Hrs Day 4 • Hrs Day 5 • Hrs Tables • Raincast <p>SWFDP Evaluation Form</p> <ul style="list-style-type: none"> • Click here <p>Satellite-based 0-12 Hour Products</p> <p>Satellite-Based Rainfall</p> <p>Hydro-Estimator Rainfall Totals</p> <ul style="list-style-type: none"> • 1hr • 2hr • 6hr • 24hr <p>Hydro-Estimator Rainfall Totals In Days</p> <ul style="list-style-type: none"> • 10 Days • 20 Days <p>Probability of Convective Thunderstorms</p> <ul style="list-style-type: none"> • 01 • Description of Product <p>• Description of Product</p>	<p>Regional and International Centers</p> <ul style="list-style-type: none"> • RSMC • RSMC • Met. Dept. • WMO • WMO - Mauritius • WMO <p>SADC Countries</p> <ul style="list-style-type: none"> • SADC Countries Regional Meteorological Centres <p>Other Services and Products</p> <ul style="list-style-type: none"> • Short-range • Long-range (Regional)
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2. Severe Weather Forecasting Demonstration Projects (WMO CBS SWFDP)

- Fourth meeting of the CBS-SWFDP Steering Group in Geneva, February 2012:
 - **Challenge for the SWFDP:** “the need for very short-range forecasting tools, to address especially the rapid onset of localized severe thunderstorms which can produce heavy precipitation and strong wind, given the absence of adequate real-time observational networks, especially weather radar coverage.”
 - The usefulness of EUMETSAT satellite based instability products, such as the Global Instability Index, for nowcasting purposes was recognized
 - Also agreed that real time satellite rainfall estimates have proven particularly useful in regions where rain gauges and radar coverage is sparse.
- Surface-based precipitation measurement systems in DC and LDC still needed to accurately measure and monitor precipitation amounts on the ground, to be incorporated into hydrological runoff models as well as aid in validation of other (satellite and model based) methodologies.

3. Satellite based instability products

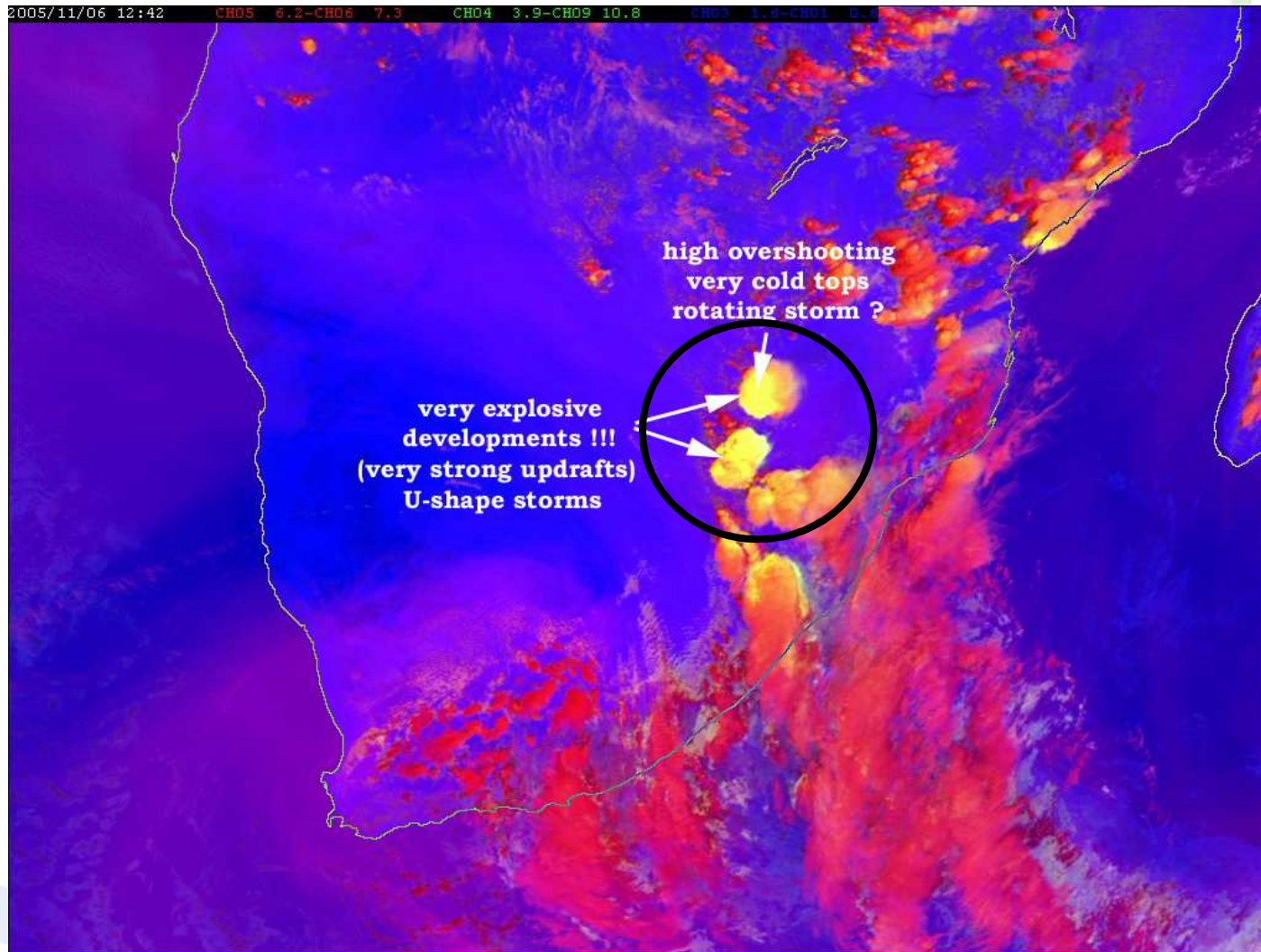
3.1 MSG MPEF Product: Global Instability Index GII



**MSG – 6 channels
and ECMWF as
NWP input**

**K Index for 08:45
on 6 Nov 2005
from GII product**

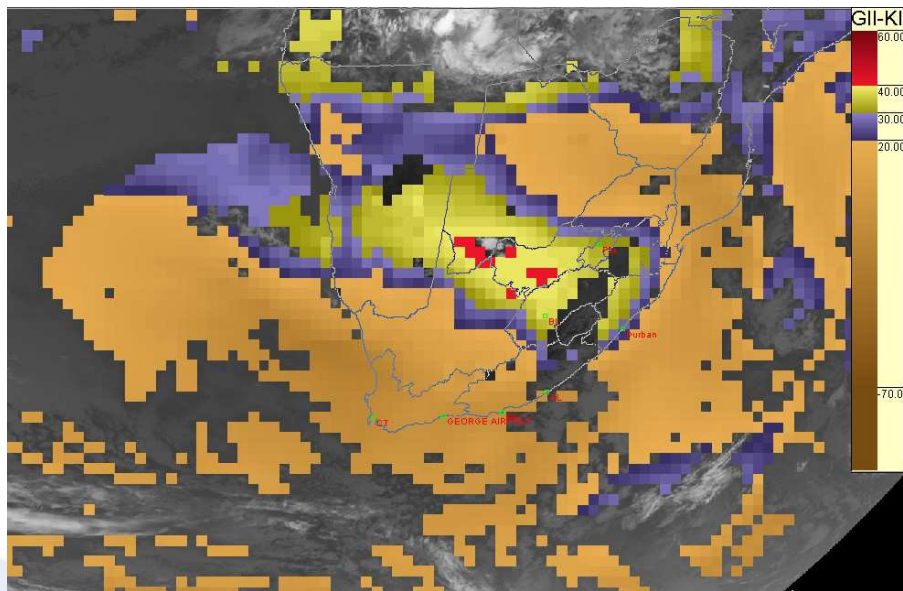
MSG Convection RGB (Ch5-6,Ch4-9,Ch3-1) at 14:42 on 6 Nov 2005



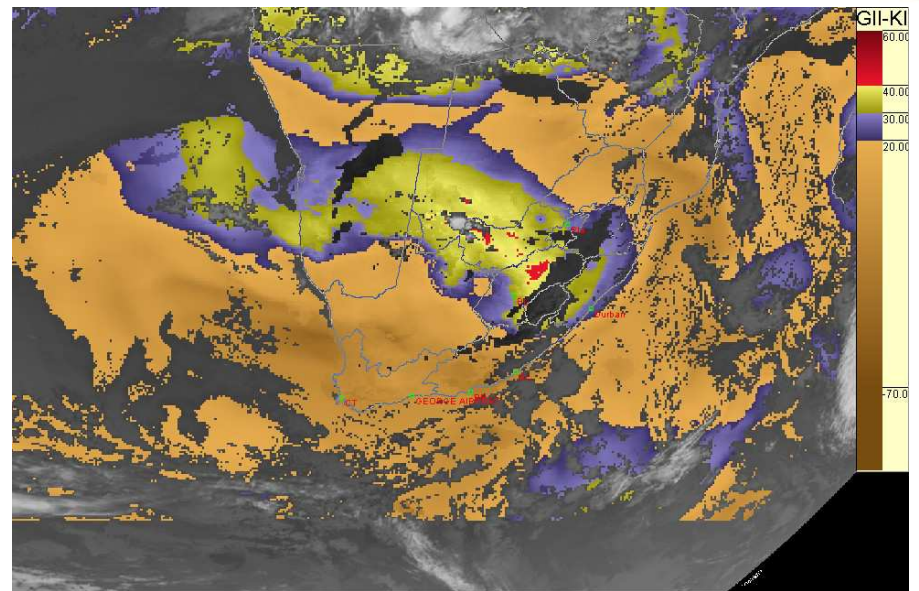
Koenig M, and E De Coning: Feb 2009. The MSG Global Instability Indices Product and its use as a nowcasting tool. *Wea. Forecasting*, 24, 272-285.

3.2 Regionalized satellite based instability indices (RII)

- Since 2007: Using local version of **Unified Model** (0.1 resolution) instead of ECMWF (1° resolution) south of equator
- Running in South Africa on 3x3 pixel resolution instead of 15x15

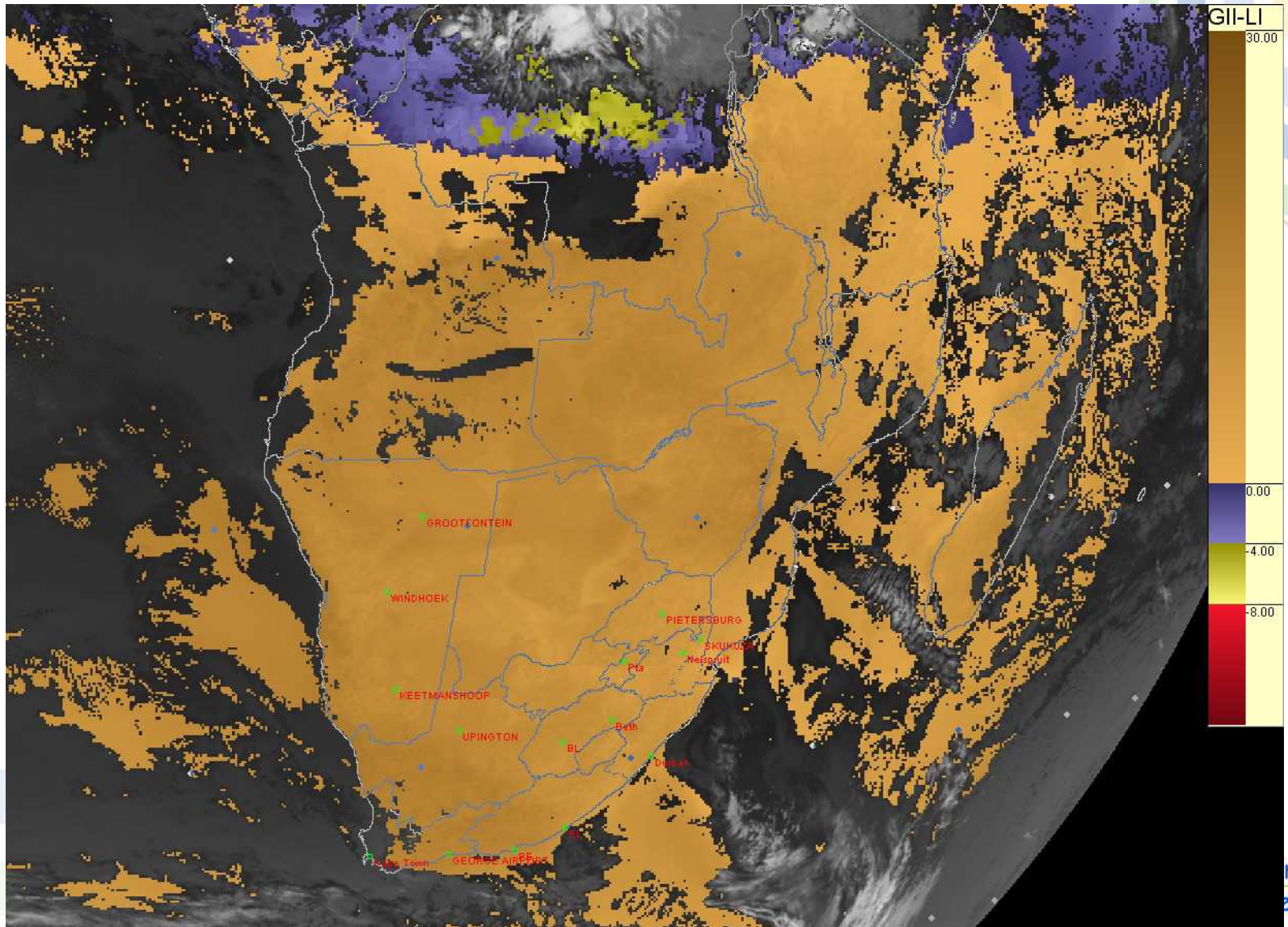


GII - ECMWF



RII - Unified Model

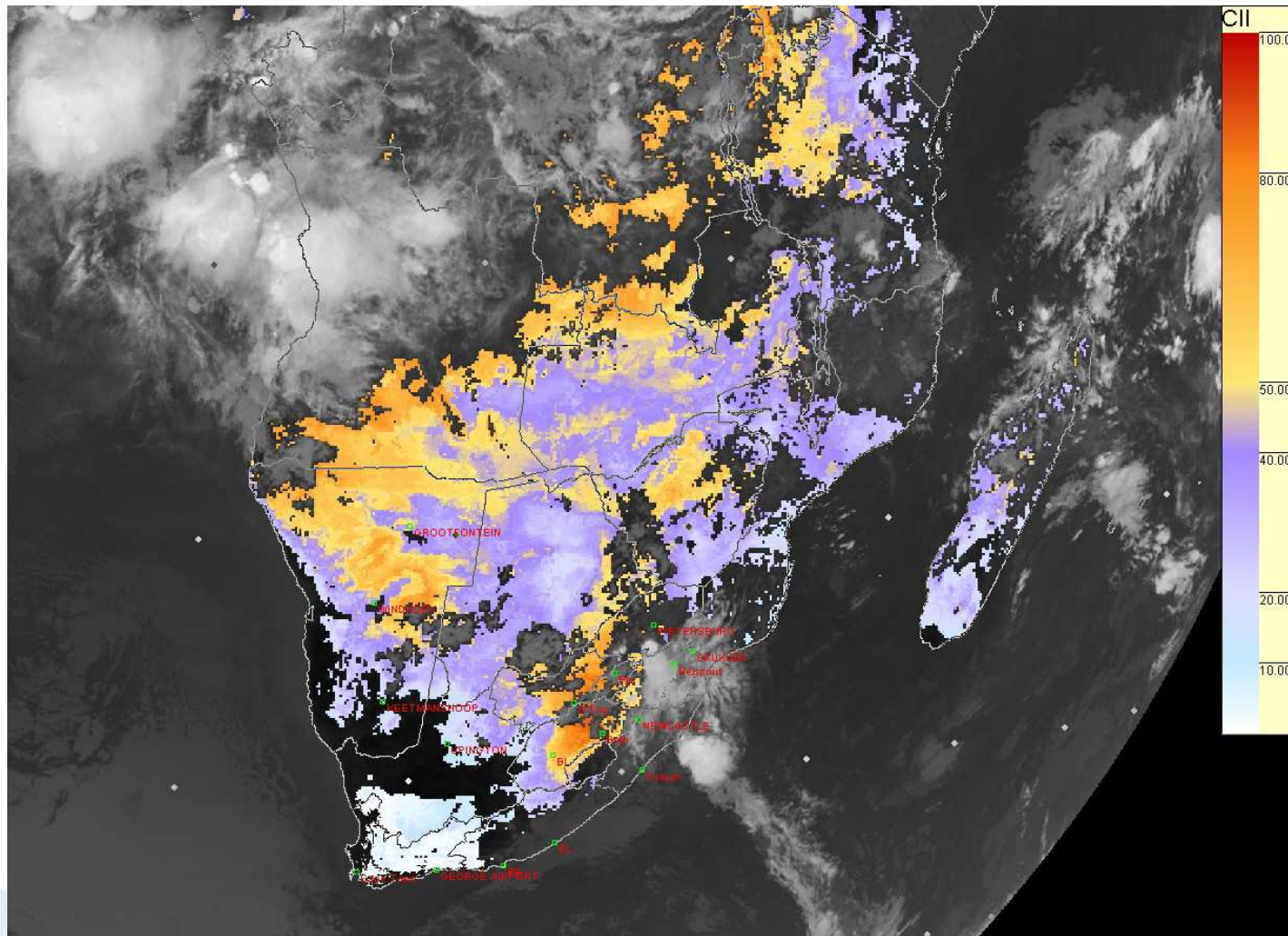
Example of satellite based instability indices over southern Africa: Lifted Index over southern Africa on 3 August 2009



3.3 A probability map for convection

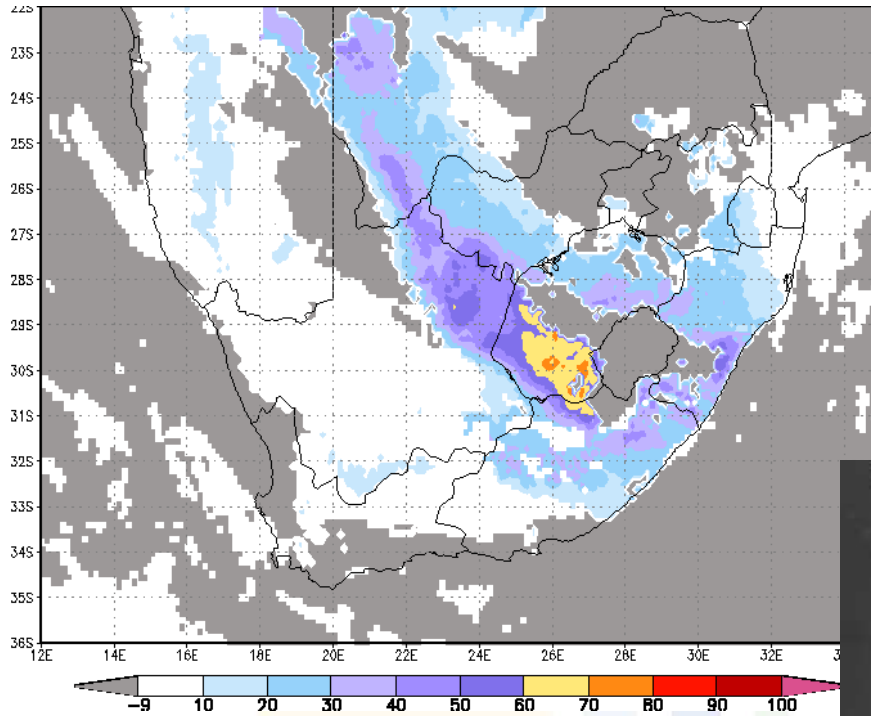
- A combination of satellite based parameters as well as topography was created to give a probability map for seeing lightning later in the day
- For a forecaster this is one easy step to get an indication for where to expect convective development later in the day in probabilistic fashion
- Similar to GII/RII - Calculation only possible in cloud free areas, thus early morning values are used when it is as cloud free as possible.

CII together with IR108 available every 15 minutes:



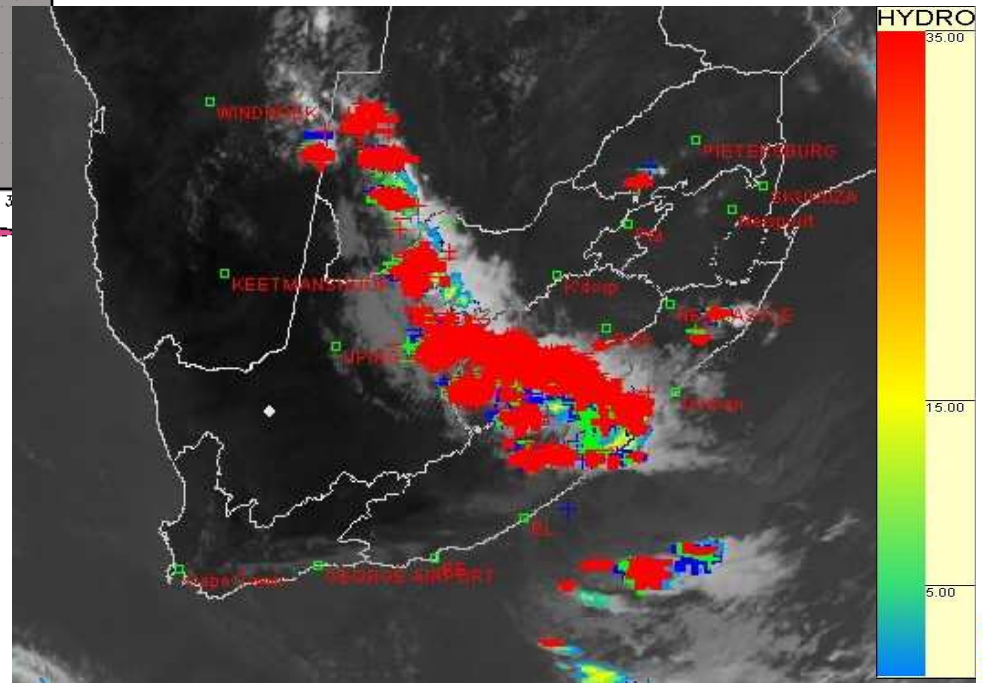
De Coning, E, Koenig, M and J Olivier. December 2011. The Combined Instability Index: A new very-short range convection forecasting technique for southern Africa. *Meteorological Applications*, 18, 421-439.

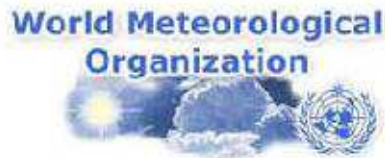
Example: 31 Jan 2010



CII 06:00-0900 UTC

IR108 and lightning at 1500 UTC





Regional Specialised Meteorological Center (RSMC) Pretoria

Designated to



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](#)

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 \(Seasonal\)](#)

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](#)

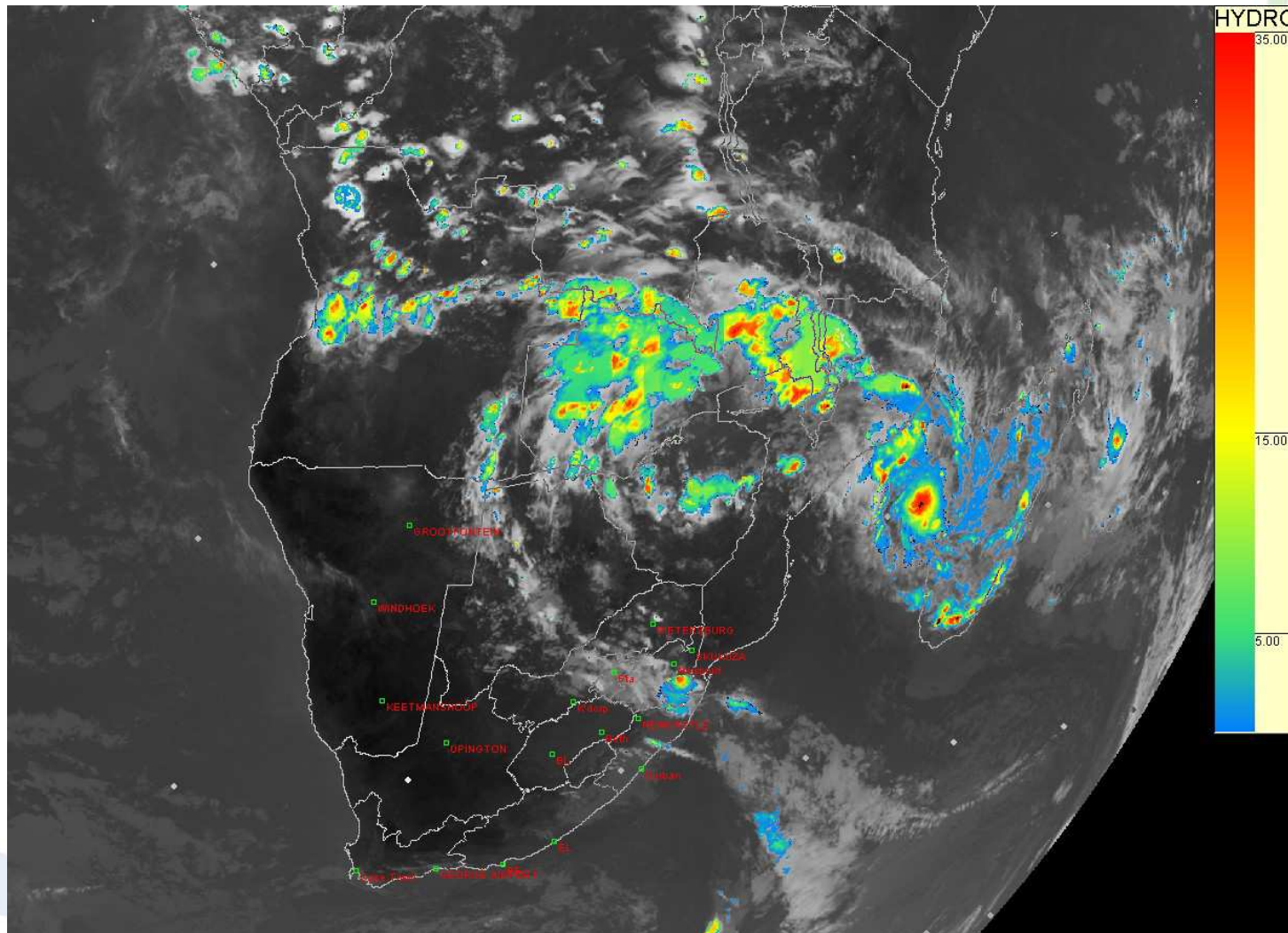


4. Satellite based precipitation estimation

4.1 Hydroestimator

- Hydroestimator (HE) using IR108 and NWP input - **used outside of regions of radar coverage without compromising too much accuracy.**
- HE is operational in SA since October 2007, available every 15 minutes, using MSG IR108 as well as Unified Model input

Example: Hydroestimator – operationally available every 15 minutes





Guidance Products

NWP & EPS Products

Regional Models

- [UM SA12](#)
- [UM Africa LAM](#)
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Global Products

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Satellite-based 0-12 Hour Products

<p>Satellite-Based Rainfall</p> <p>Hydro-Estimator Rainfall Totals</p> <ul style="list-style-type: none"> • 1hr • 3hr • 6hr • 24hr <p>Hydro-Estimator Rainfall Totals In Days</p> <ul style="list-style-type: none"> • 10 Days • 30 Days <ul style="list-style-type: none"> • Description of Product 	<p>Convective Thunderstorm Forecasts</p> <p>Probability of Convective Thunderstorms</p> <ul style="list-style-type: none"> • CII • Description of Product
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Accumulations

4.2. WMO Flash Flood Guidance System

- WMO is attempting to address operational prediction of flash floods in the 1-6 hour time-range by introducing Flash Flood Guidance System¹ (FFGS) projects in various developing regions of the world.
- FFGS :
 - hydrometeorological modelling system
 - predicts the potential for flash floods for each small river basin (averaged 150-200 km²)
 - calculates the amount of rain needed over the basin that will lead to bankfull at the outlet of the river, i.e. start of flooding on a 6 hourly basis
 - Uses real time (hourly) satellite precipitation estimation to model soil moisture and potential flash flooding and rain gauges where possible

1. The Flash Flood Guidance System (FFGS) is the intellectual property of the Hydrologic Research Center (HRC), a non-profit public-benefit corporation based in San Diego, USA. SARFFG was developed and implemented by HRC.

SARFFG

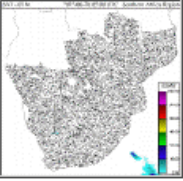
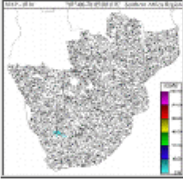
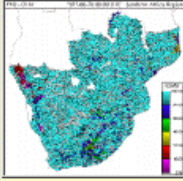
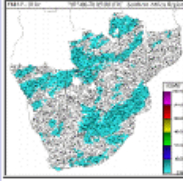
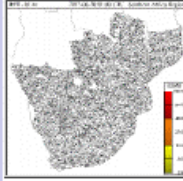
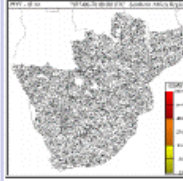
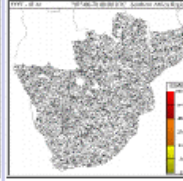
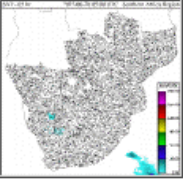
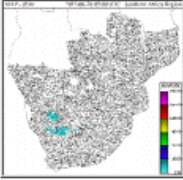
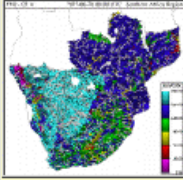
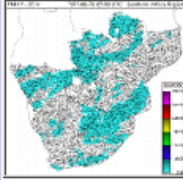
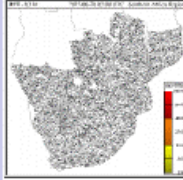
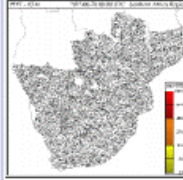
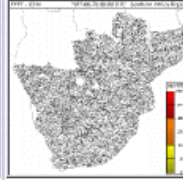
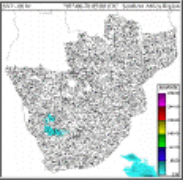
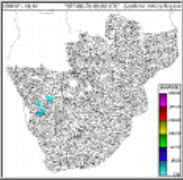
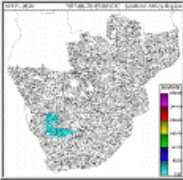
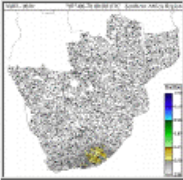
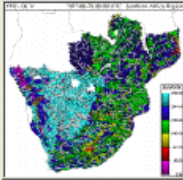
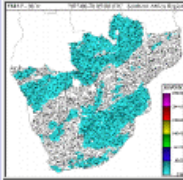
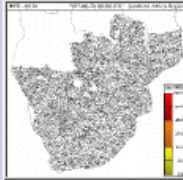
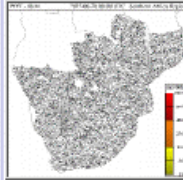
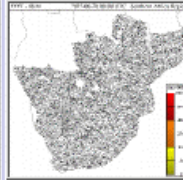
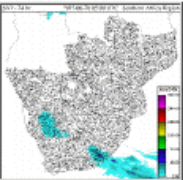
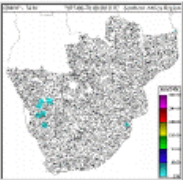
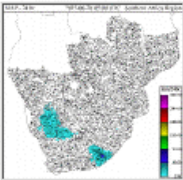
- The Southern African Regional Flash Flood Guidance (SARFFG) project is one of the sub-regional projects of the WMO's global FFGS programme.
- Seven countries in Southern Africa namely Namibia, Botswana, Mozambique, Zimbabwe, Zambia, Malawi and South Africa will participate in the SARFFG.
- SARFFG depends **primarily on satellite QPE as well as gauge data (where possible)** as precipitation input for modelling soil moisture and flash flood guidance over large parts of southern Africa.

SARFFG - Southern Africa Regional Flash Flood Guidance System

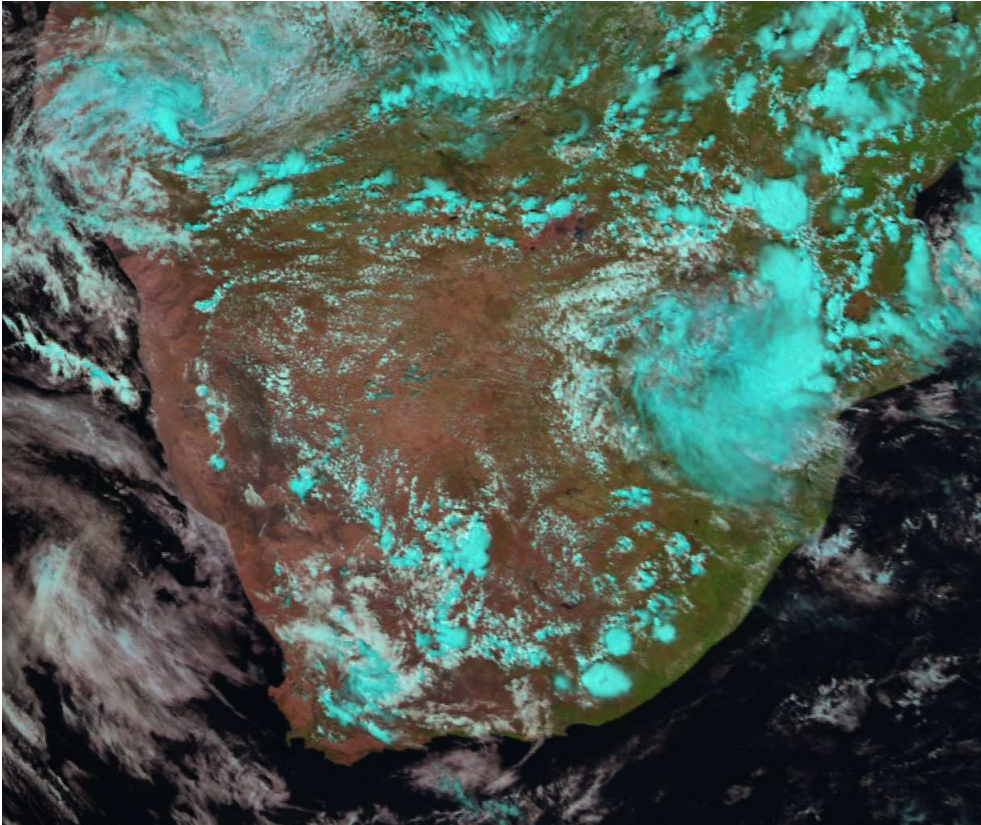
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Nav Date: 2012-06-20 05:00 UTC

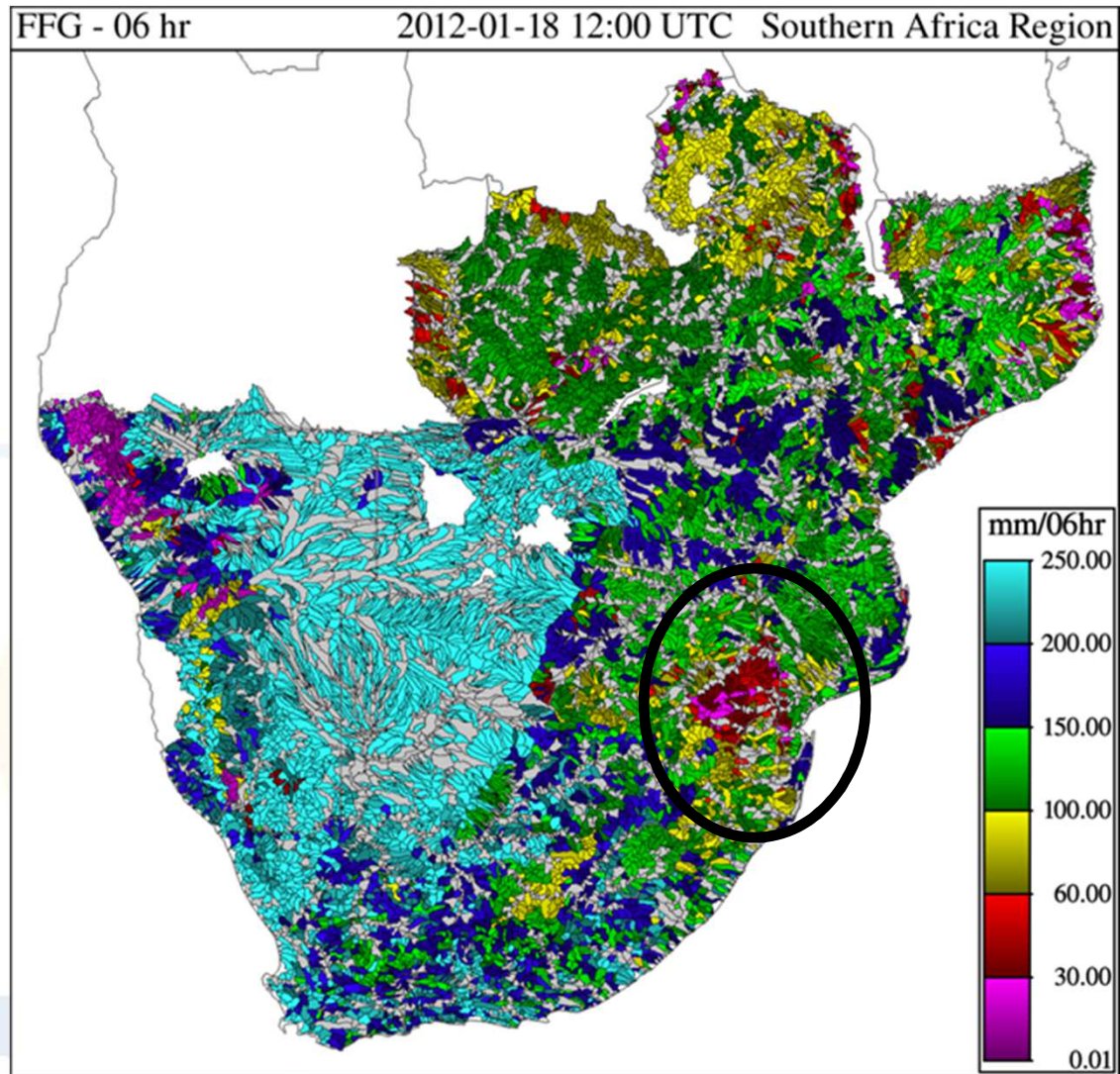
Year: 2012 Month: 06 Day: 20 Hour: 05 REGION: REGIONAL

DT	Satellite	GMAP	Merged MAP	ASM	FFG	FMAP	IFFT	PFFT	FFFT
01-hr	 2012-06-20 05:00 UTC		 2012-06-20 05:00 UTC Text: view		 2012-06-20 00:00 UTC Text: view	 2012-06-20 05:00 UTC Text: view	 2012-06-20 01:00 UTC Text: view	 2012-06-20 00:00 UTC Text: view	 2012-06-20 00:00 UTC Text: view
03-hr	 2012-06-20 05:00 UTC		 2012-06-20 05:00 UTC Text: view		 2012-06-20 00:00 UTC Text: view	 2012-06-20 05:00 UTC Text: view	 2012-06-20 03:00 UTC Text: view	 2012-06-20 00:00 UTC Text: view	 2012-06-20 00:00 UTC Text: view
06-hr	 2012-06-20 05:00 UTC	 2012-06-20 00:00 UTC Text: view	 2012-06-20 05:00 UTC Text: view	 2012-06-20 00:00 UTC Text: view	 2012-06-20 00:00 UTC Text: view	 2012-06-20 05:00 UTC Text: view	 2012-06-20 00:00 UTC Text: view	 2012-06-20 00:00 UTC Text: view	 2012-06-20 00:00 UTC Text: view
24-hr	 2012-06-20 05:00 UTC	 2012-06-20 00:00 UTC Text: view	 2012-06-20 05:00 UTC Text: view						

Example Tropical Cyclone Dando 18 January 2012



Example: SARFFG 18 January 2012 during tropical cyclone Dando



5. Summary

- In the absence of or with limited radar systems and extensive observation networks **NWP and satellite based products** can go a long way to help forecasters in DC and LDC to do nowcasts
- Systems such as **SWFDP and SARFFG are web based** and thus easy to access by forecasters in NMHSs to use the information received from the global and regional centers to issue nowcast information on probability of convection and potential flooding to the disaster management structures in their countries. These systems rely on NWP and satellite data to produce maps of potential high risk events.
- The importance of developing an excellent **collaboration** between weather forecasters and hydrologists, and between weather forecasters and disaster managers, in each country for the successful implementation of the SWFDP and SARFFG is and will remain, of course, fundamental.

6. Conclusion

- Where radar systems are in place - best option for nowcasting systems, complemented by NWP and satellite information.
- Without the luxury of expensive radar systems and/or software display systems - use NWP satellite and global lightning data sources and internet based systems for display.
- Ground based data sources (such as gauge networks and radar systems) – remain crucial/ideal not only for observation but for verification of effectiveness of other data sources.
- SWFDP / FFGS systems are driven by experts and provide funding, but it also serves as very practical ways to get the needed information to NMHCs and thereafter to the media and disaster managers to warn the public on pending hazardous weather events (focus on **people/warnings/actions!**)