CLIMATE CHANGE: an Impact-based Severe Weather Warning System

South African Weather Service

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KIMBERLEY

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CLIMATE CHANGE: Why impact based forecasting

- According to **studies and observations**, south Africa is experiencing some of the harsh realities of climate change: shifting of precipitation patterns as well as the rising temperatures.
- These changes in meteorological parameters lead to frequent and severe meteorological hazards.
- The impacts of severe meteorological hazards give rise to multiple causalities and significant damage to property and infrastructure, with adverse socio economic consequences for communities that can persist for years.

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CLIMATE CHANGE: Why impact based forecasting

- With all these changes it is no longer enough to provide a just a weather forecast or warning: According to WMO, the meteorological centers should provide warnings in support of safety of life and mitigation of damage to property and infrastructure.
- Impact based forecasting was conceived.

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SAWS: Legislation framework

- South African Weather Service Act (2001) as amended in 2013:
  - Mandates SAWS to issue severe weather warnings
  - Defines the role of SAWS as the *single authoritative voice of severe weather-related warnings* in SA
  - Mandates SAWS to be the custodian of climate data information

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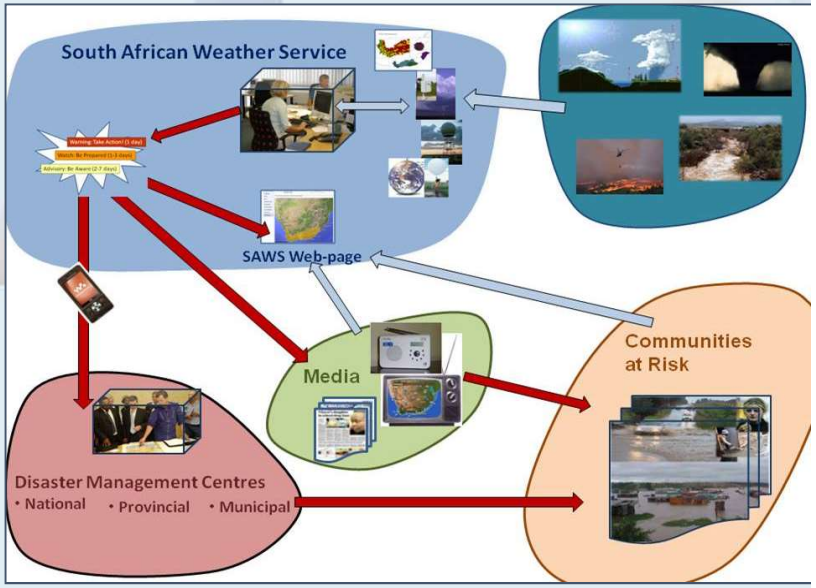
Severe Weather Warning Service

- Forecasters
  - *Monitor* weather hazards using radar, satellite, observations and numerical weather prediction models
  - Provide *weather outlooks* in DRR advisory forums and as requested
  - *Issue warnings* for severe weather hazards to DRR structures and the general public (through media)
  - Participate in *JOCs prior* and *during* events, providing specialised weather information
  - *Monitor progression* of severe weather events, *update* warnings and *share* information with DRR structures
- Continuously enhance the SWWS in collaboration with DRR structures

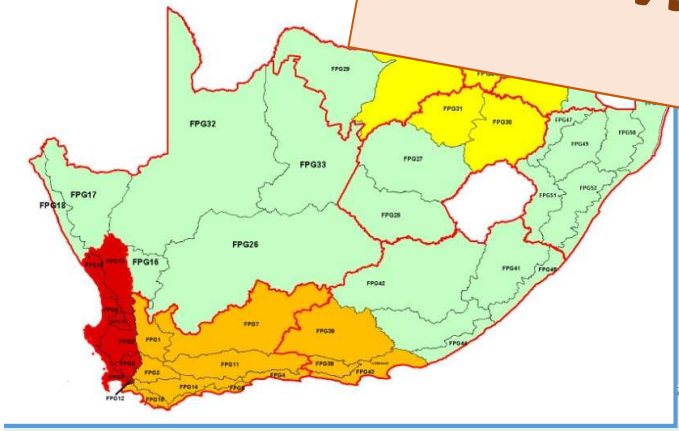


History: Public Warning Hazards: (up to 2012)

	HAZARD	DEFINITION
1	Extremely heat	Maximum temperature forecast 40°C and above
2	Very cold	Maximum temperatures 10°C and below and/or Minimum -10°C below
3	High discomfort	Discomfort Index (D.I.), meeting or exceeding 38°C (or 100 °F)
4	Heat wave	3 consecutive days with maximum temperature to be more or equal to 5°C higher than the average maximum of the hottest month for the particular station in the FPG region/s
5	Gale force winds and stronger	Average wind speed of more than 34knots (62 km/h) or gusts in excess of 44knots for land based regions
6	Fire Danger Rating	If the fire danger rating is high or extreme according to the NFDRS work instruction
7	Heavy rain	50 mm or more within 24 hours
8	Flash Flood	Flash flood as defined by SAFFG work instruction Warning : Within three hours from time of forecast Watch : 3 to 6 hours from time of forecast Advisory: Beyond 6 hours from the time of forecast
9	Snow	Sufficient snow to cause significant traffic danger and/or disruptions in mountain passes, major roads and/or highways and/or populated areas
10	Severe thunderstorms	Severe Thunderstorm in line with the USA NSSL definition with one or any combination of the following: - Hail of greater than 19mm diameter or large amounts of small hail - Tornadoes (any), - Wind gusts 50kts or more, in association with a thunderstorm

Severe Weather Warning Levels (from 2013): Reduced number of hazards to 7

No Alert	***Special Weather Advisory***	***Weather Watch***	***Weather Warning***
	Be Aware!	Be Prepared!	Take Action!
No hazardous weather expected	Early warning of *potential* hazardous weather	Weather conditions are *likely to* become hazardous	Hazard is *already occurring* or is *imminent*
	2 to 6 days	1 to 3 days	Next 24 hours
	Heat Waves Strong winds High discomfort	Flooding Veldfire conditions	Heavy rain Disruptive snow Veldfire conditions



Still weather threshold based

International Developments?

WMO: Disconnect between *warning* of hydromet events, and the understanding of their *impacts*

'Weather warnings need to be more tailored towards the end-user' (KNMI)

'Weather warnings should only be issued if severe weather is expected to have an impact' (UK)

IMPACT-BASED WARNINGS

- UK implemented in 2011
- WMO Guidelines (latest version 2015)
- Europe, USA, Australia in various versions
- Pilot projects by WMO in Myanmar, Mauritius, Mozambique, Malaysia, etc.

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What is Impact-Based forecasting?

Moving from:

What the weather will ***be***:
(Meteorological thresholds)
- 50mm in 24 hours
- 35 knot winds

To:

What the weather will ***do***:
(Impact Warnings)
- Roads flooded
- Communities cut off

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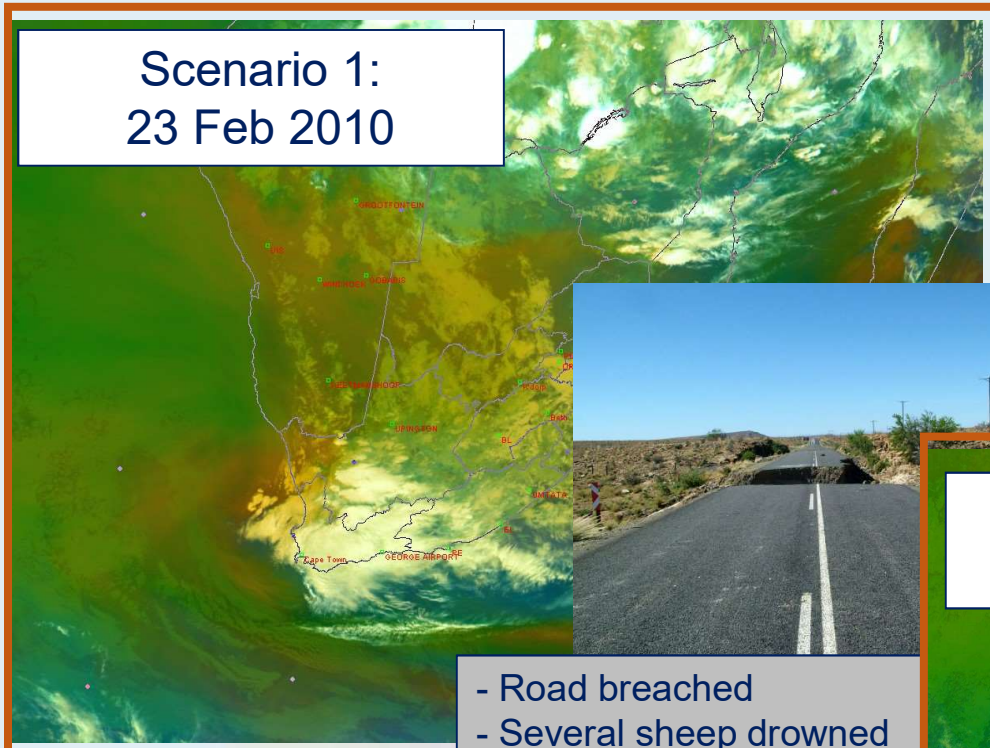
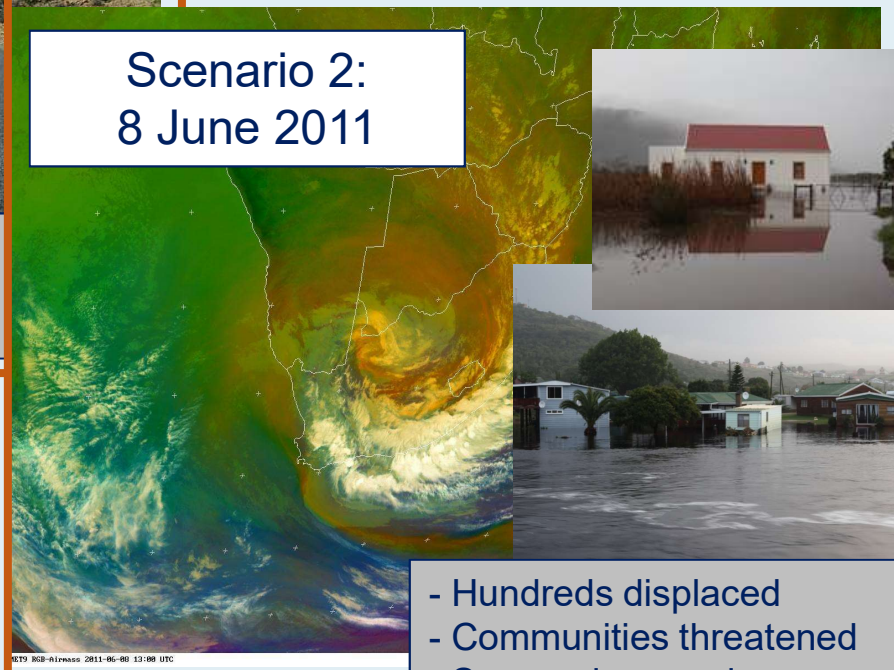
Impact-based Severe Weather Warning System

Scenario 1:
23 Feb 2010



- Road breached
- Several sheep drowned

Scenario 2:
8 June 2011



- Hundreds displaced
- Communities threatened
- Severe damaged

Why Impact-based Severe Weather Warning System

Why Impact-based forecasting in South Africa?

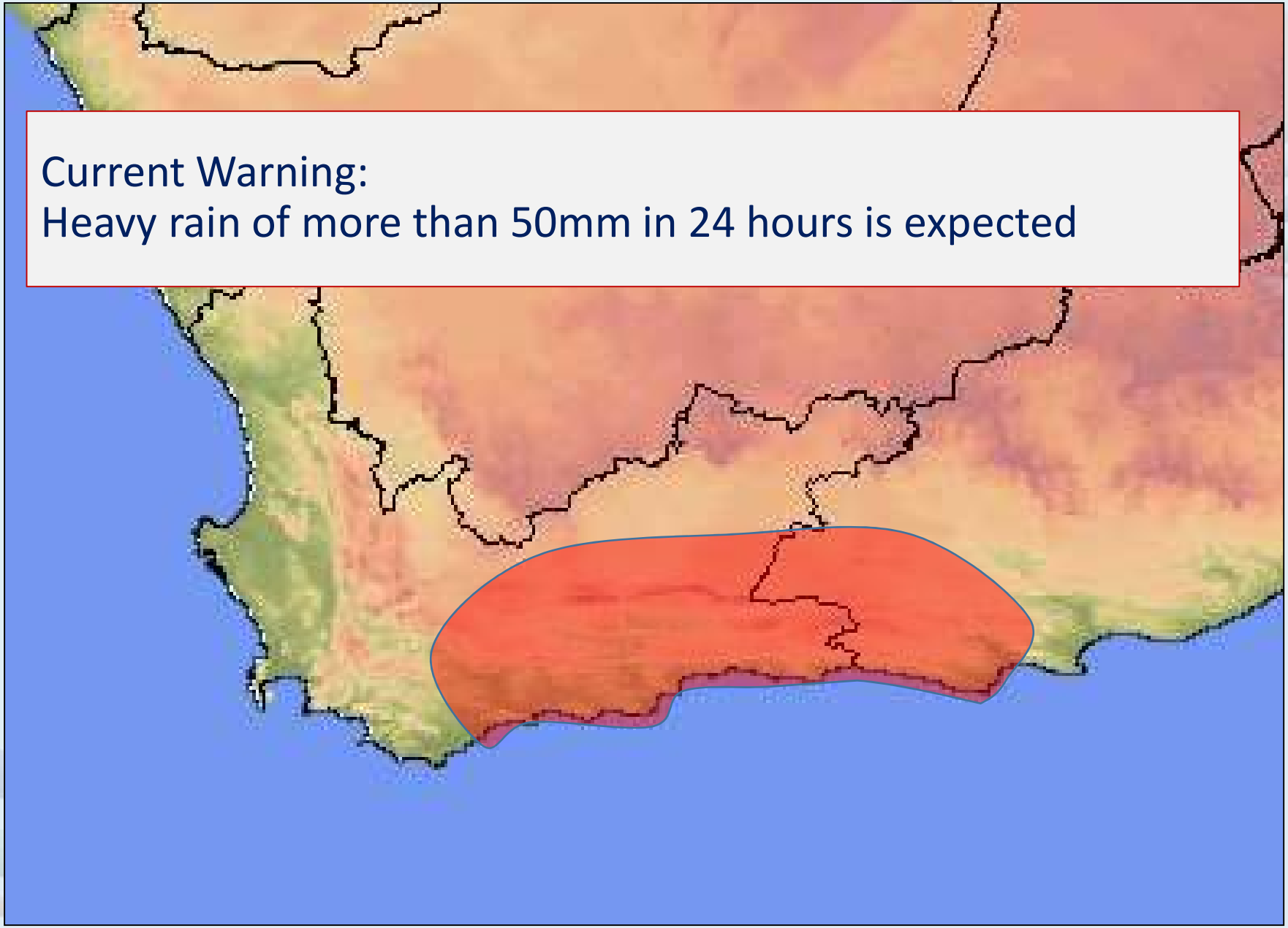
- Huge variation in vulnerability of communities across country (from densely populated cities, vast rural communities, extensive agricultural areas, varied infrastructure distribution)
- Severe weather conditions leading to serious impacts in many places and limited impacts elsewhere

Forecast needs to evolve from
*what weather will **be**,* to
*what weather will **do**…*

Requires a paradigm shift:

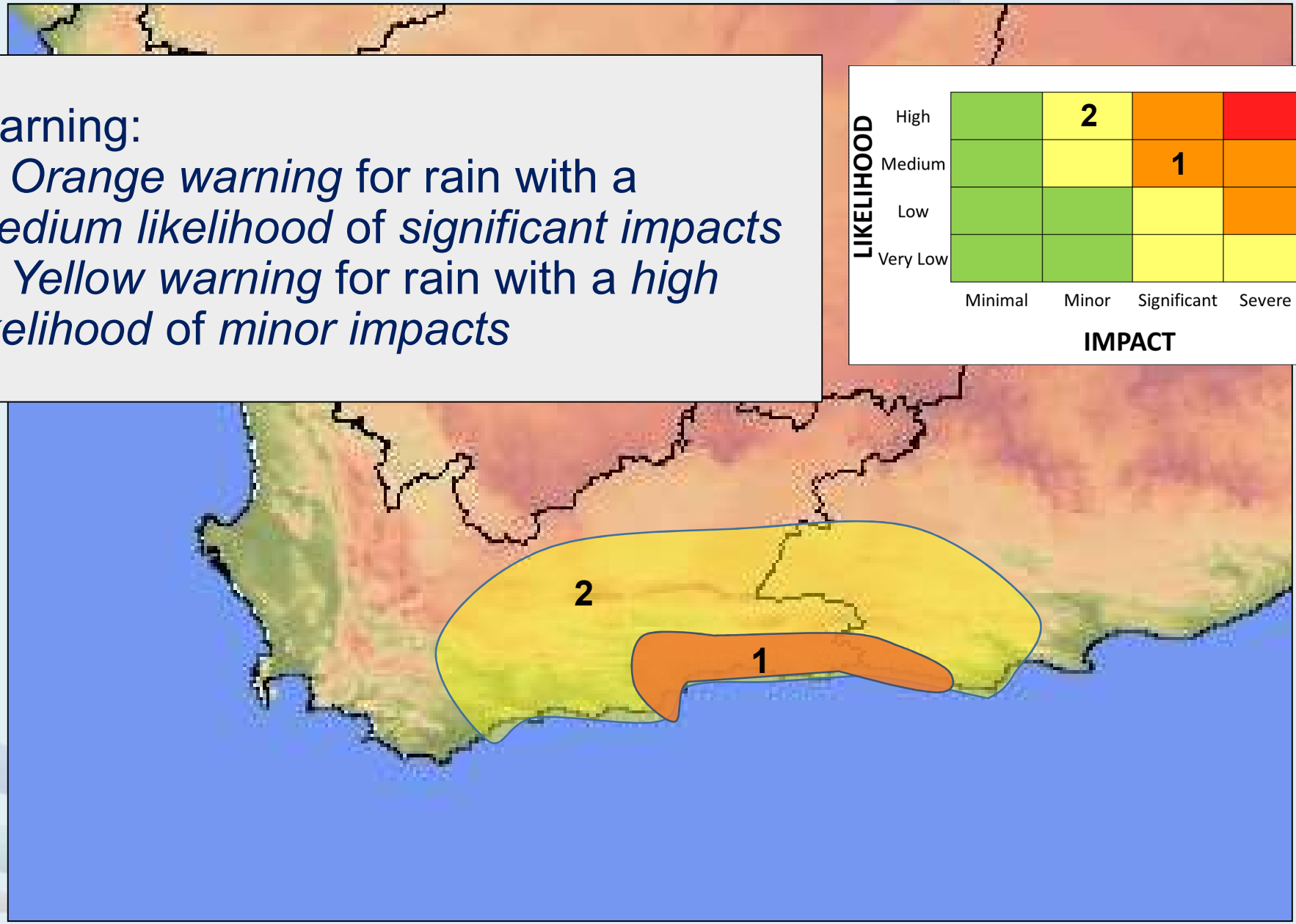
- From warnings based on *weather thresholds* (50mm in 24hrs)
- To warnings based on variations in vulnerability - *impact levels* (minimal, minor, significant, severe)

We need to change from this to….



An impact-based Early Warning System

Warning:
1. *Orange warning* for rain with a *medium likelihood* of *significant impacts*
2. *Yellow warning* for rain with a *high likelihood* of *minor impacts*



4 Year Project: Developing an Impact-Based Severe Weather Warning Service

- **Aim:** Based on WMO recommendations, to develop, test and implement an Impact-based forecasting and warning service in South Africa, through close collaboration between forecasters and disaster managers

- Associated projects and sponsors:
  - SAWS and NDMC (Developing Impact-based SWWS)
    UK Newton Fund WP 4 (High Impact Weather)
    USAID/NOAA (Advancing IDSS in SA)

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So, how does it work?

- Impact tables helps with high-level distinguishing between less severe and more severe impact levels
- Impact level depends on vulnerability in local area to impacts
- Content determined by collective disaster management input

Generic description of different impact levels

Minimal	Minor	Significant	Severe
Day to day activities not affected but some ***small scale*** impacts occur	Some ***local*** incidents, minor disruptions, 'business as usual' for emergency responders	Disruption to day to day routines and activities, mostly ***localised***. ***Short-term*** strain on emergency responder organisations	***Widespread,*** Prolonged disruption to day to day routines and activities ***Prolonged*** strain on emergency responders organisations.

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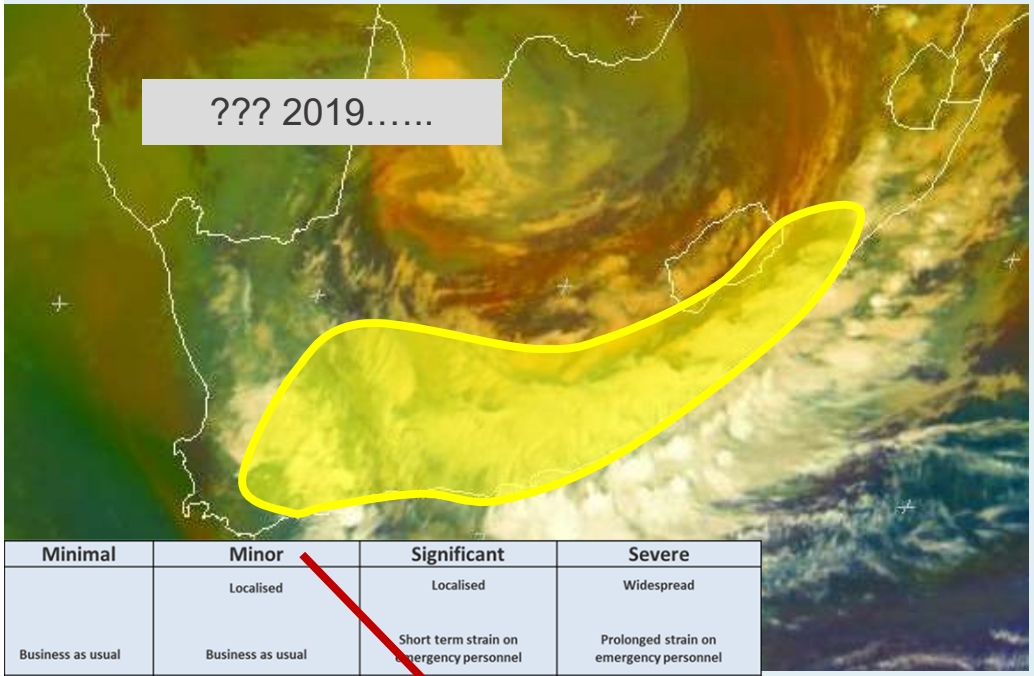
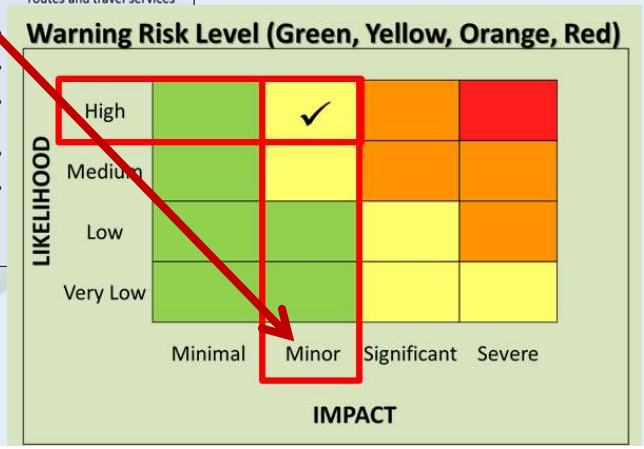
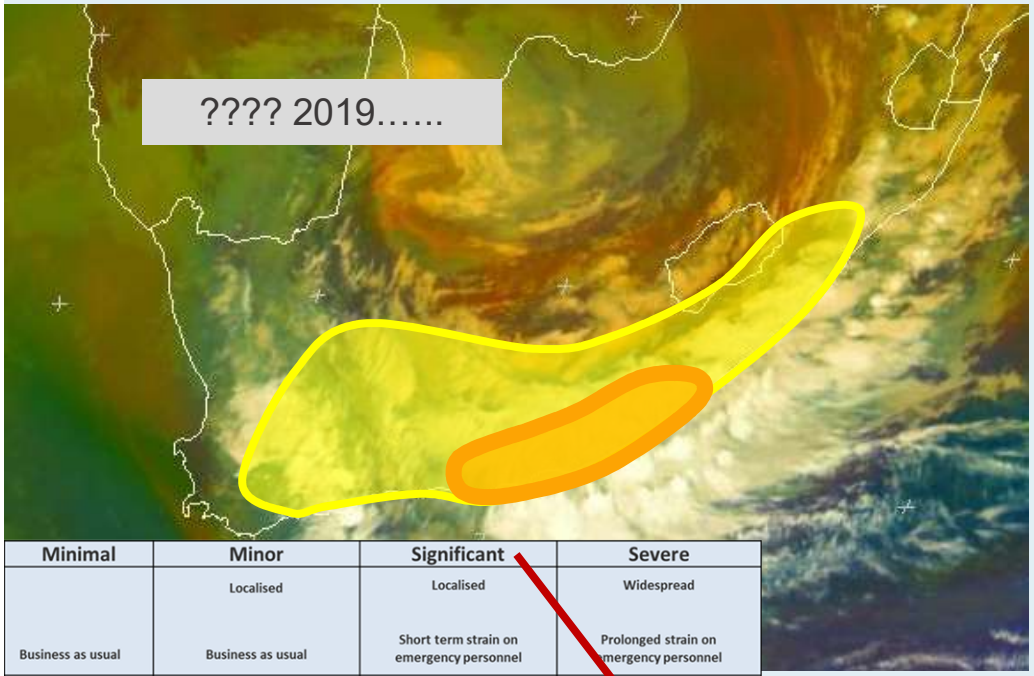


Minimal	Minor	Significant	Severe
	Localised	Localised	Widespread
Business as usual	Business as usual	Short term strain on emergency personnel	Prolonged strain on emergency personnel
• Some **Pooling** of water on roads • Day to day activities not disturbed • Wet roads • Minimal traffic congestion	• **Localised flooding** of susceptible roads, low-lying areas and bridges • Localised and short term disruption to municipal services (water, electricity) • Major roads affected but can be used, increased travel times • Minor motor vehicle accidents due to slippery roads • Closure of roads crossing low water bridges	• **Flooding** of roads and settlements *(formal and informal)* • Disruption to municipal services (water, electricity) • Major disruption of traffic flow due to major roads being flooded or closed • Possible damage to roads and bridges • Danger to life (fast flowing streams / deep water) • Some communities temporarily not accessible/cut-off • Displacement of affected communities • Damage to property, infrastructure and loss of livelihood	• **Widespread flooding** of roads and settlements • Widespread, prolonged disruption to municipal services (water, electricity) • Widespread transport routes and travel services



- Forecasters identify a region where rainfall could result in adverse impacts
- Based on the *Impact tables*, the most appropriate *impact level* is identified for an area
- The expected *likelihood* of these impacts to occur is determined
- Then the appropriate *warning risk level* is established

So, how does it work?



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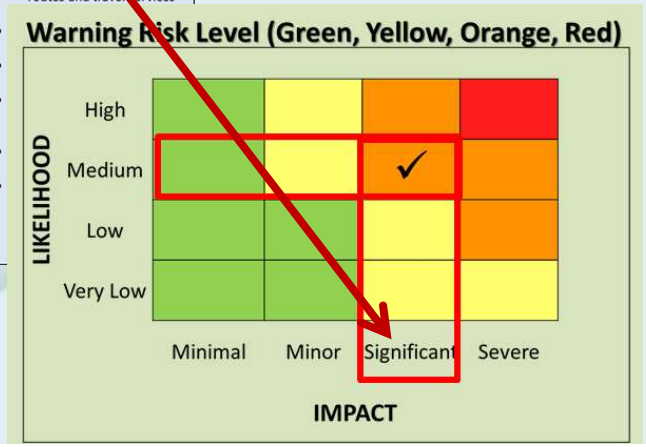

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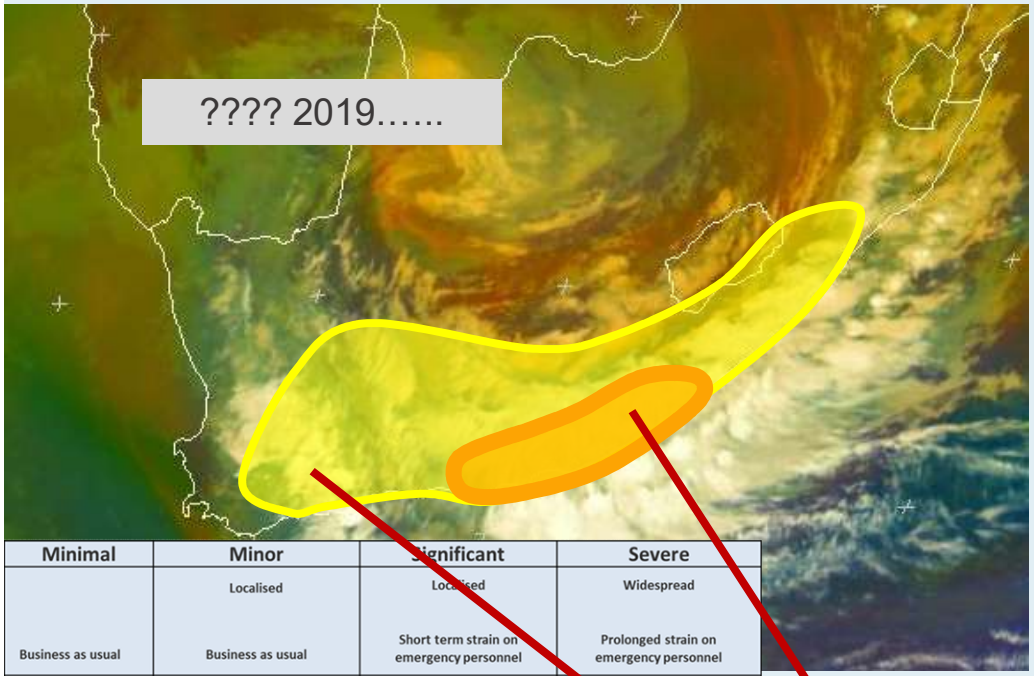
- Based on the *Impact tables*, the most appropriate *impact level* is identified for an area
- The expected *likelihood* of these impacts to occur is determined
- Then the appropriate *warning risk level* is established
- The same is done for areas with higher vulnerability

So, how does it work?



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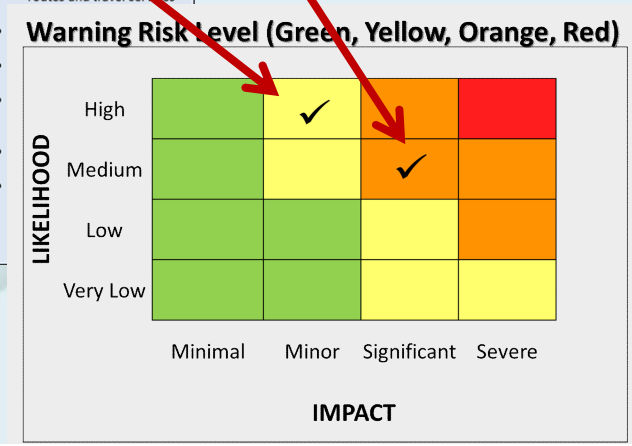

- Coordination with disaster management is important for *orange* and *red* warnings
- Important to note the difference in impact and likelihood of the yellow and orange warnings
- These warnings require a different response from disaster management depending on its *impact* and *likelihood* levels

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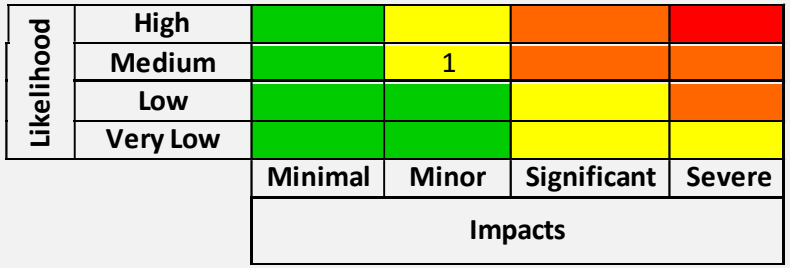
Example of Impact-based warning

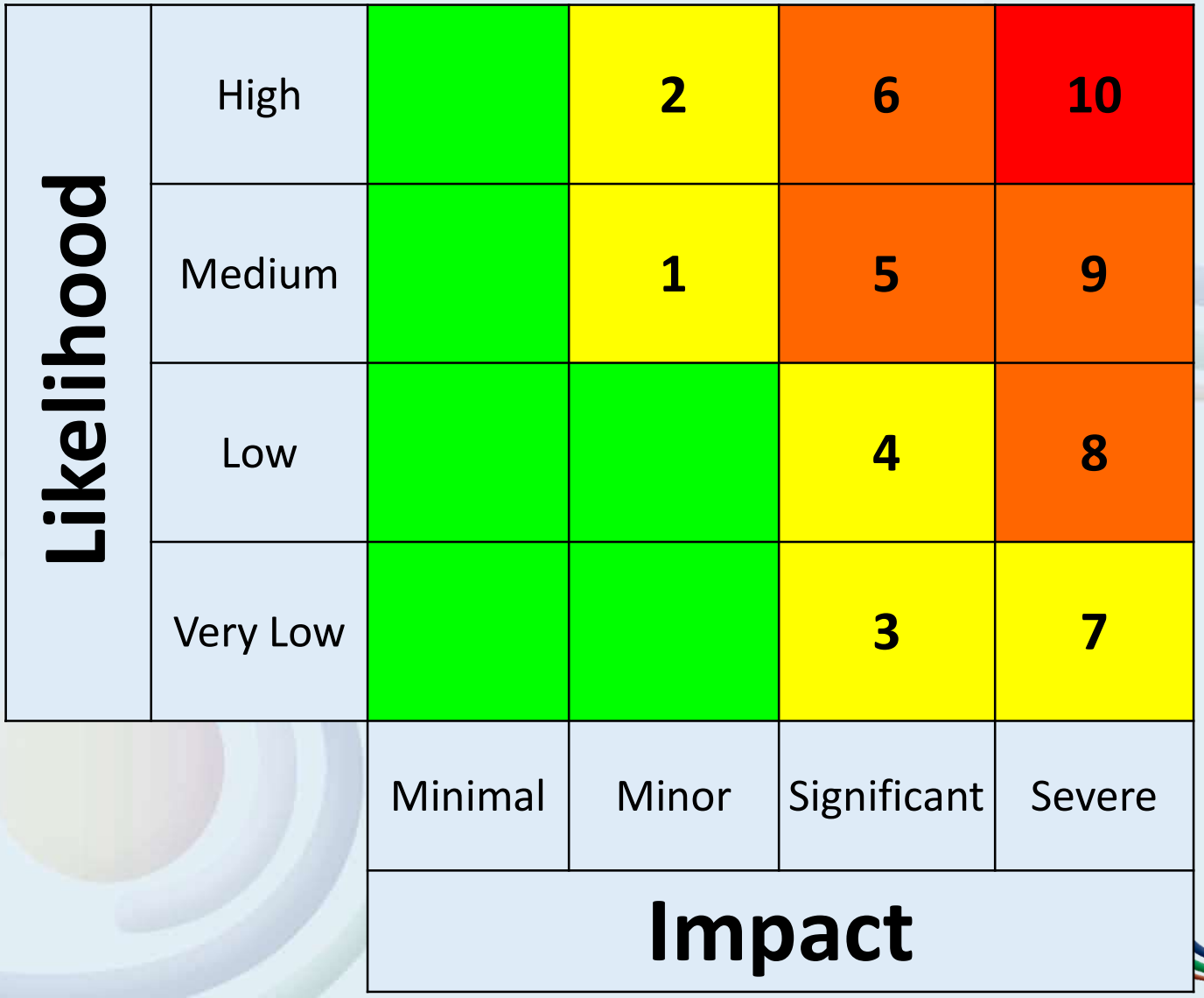
Forecast for Wednesday 22 February to Thursday 23 February 2017

Date Issued:	22-Feb-17
Date Valid:	22 Feb 2017 to 23 Feb 2017
Time Valid:	11h00 22 Feb to 23h00 23 Feb
Warning (SMS)	YELLOW WARNING OF RAIN
	1. Be aware that some low level disruption l occur over Gauteng
Discussion (Email and Website)	High rainfall amounts have already been rec Gauteng and therefore the ground should be due to these high amounts. The areas that ar flooding have already reported flooding and rainfall (even amounts that are not particula could cause those same areas to flood again **higher** likelihood of minor impacts occurring **City of Tshwane** due to the bulk of the rain e occur over this area. Please be aware that localised flooding of su roads and settlements, low-lying areas and b is possible. Major roads will be affected, but used with an increase in travel times. Roads water bridges could possibly need to be clos



Forecast for Monday 20 February to Wednesday 22 February 2017

Date Issued:	20-Feb-17
Date Valid:	20 Feb 2017 to 22 Feb 2017
Time Valid:	08h00 20 Feb to 23h00 22 Feb
Warning (SMS)	ORANGE WARNING OF RAIN
	5. Be prepared for some moderate level disruption to normal daily life in Gauteng.
Discussion (Email and Website)	Rainfall already occurring across Gauteng with decent rainfall amounts already measured in places, however models are indicating rainfall to subside slightly for the remainder of the today with the bulk of rain coming in overnight and especially tomorrow during peak hour morning traffic. There is an indication that more than 100 mm is possible in places tomorrow (Tue). Heavy rainfall could persist over Gauteng on Wednesday, especially over the northern parts (COT). Areas that are prone to flooding need to be closely monitored over this period. Please be aware that flooding of roads and settlements (formal and informal) are possible, disruption of municipal services, major traffic flow problems (disruptions) because of flooded roads and significant reduced visibility due to rainfall, possible damages to roads and bridges due to flooding, possible danger to life (due to fast flowing streams and rivers), some communities could be displaced.



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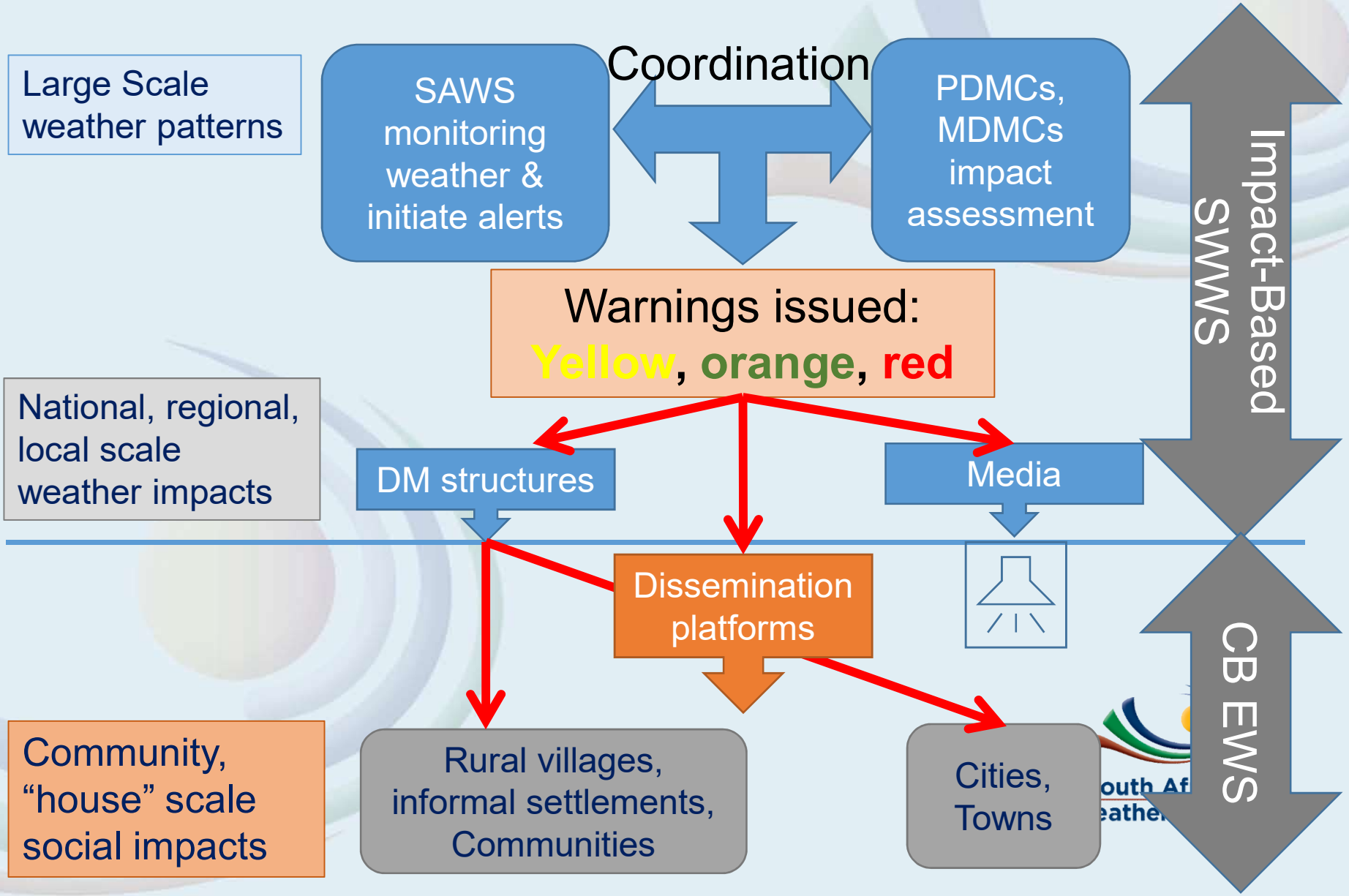
Integrated “end-to-end” EWS



Summary

- It is a user oriented, easy to understand, risk-based Early Warning System, adapted for South African conditions.
- It will result in a joint ownership of warnings (system involves participation of DM before issuance of Orange and Red warnings)
- This concept has been introduced in DRR, can be extended to other spheres like energy, agriculture, retail etc.Multi-disciplinary cooperative and interconnected.
- These warnings will replace the current warning system soon.
- Future developments will include the use of GIS-based vulnerability data to pin-point areas at highest risk.
- Warning verification methods to be developed.
- Effective Early warnings System – an important part of adapting to the changing climate – SAWS working hard on this

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SAWS Dissemination

- In order to reach 55 million South Africans on a daily basis, SAWS has embarked on a drive to increase the number of channels that are used to disseminate information to the general public and other stakeholders.
- Some of the channels that are used include:
    - Traditional media such as print, radio and TV
    - Mobile Apps
    - Web Portals
    - API
    - Social Media

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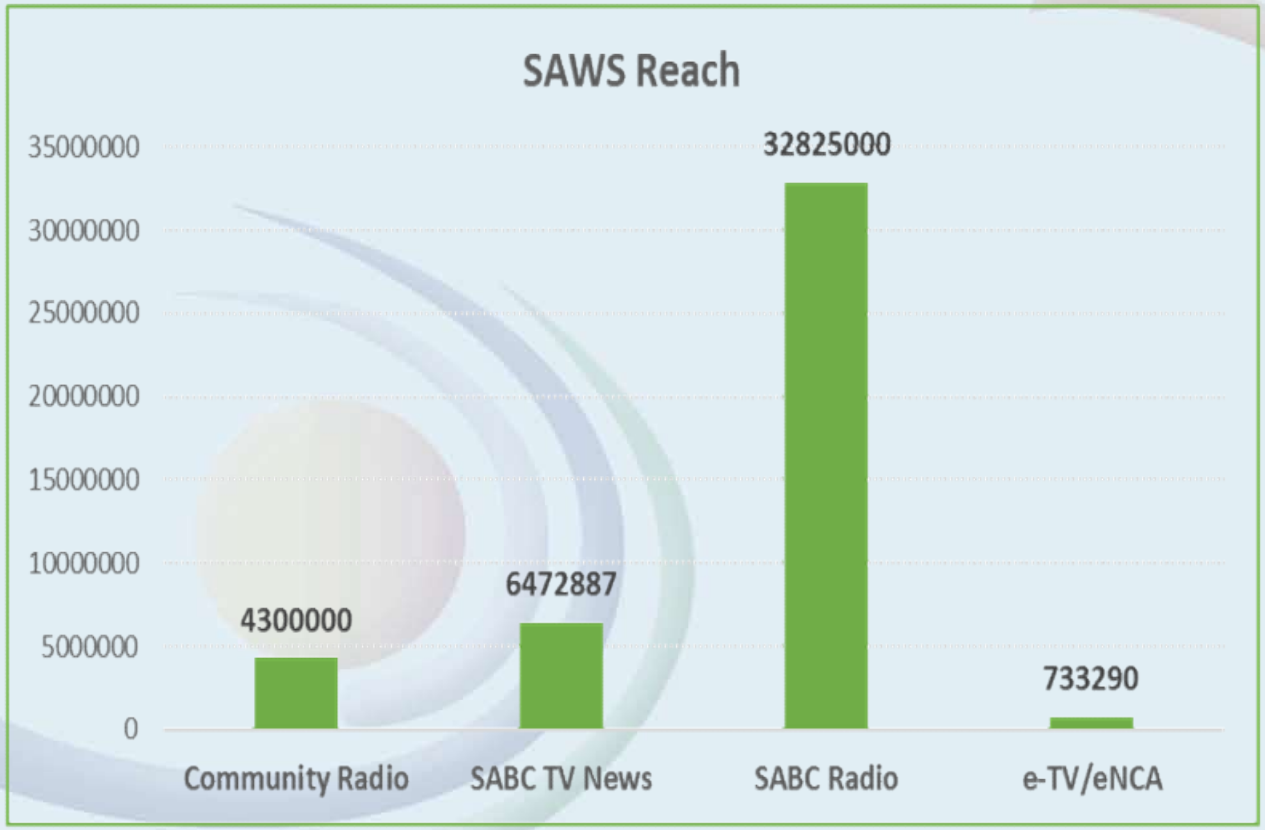
SAWS Dissemination Channels



Number of people reached daily

	Reach as % of SApopulation
eTV/eNCA	1,3%
Community Radio	7,8%
SABC TV News	11,8%
SABC Radio	**59,7%**

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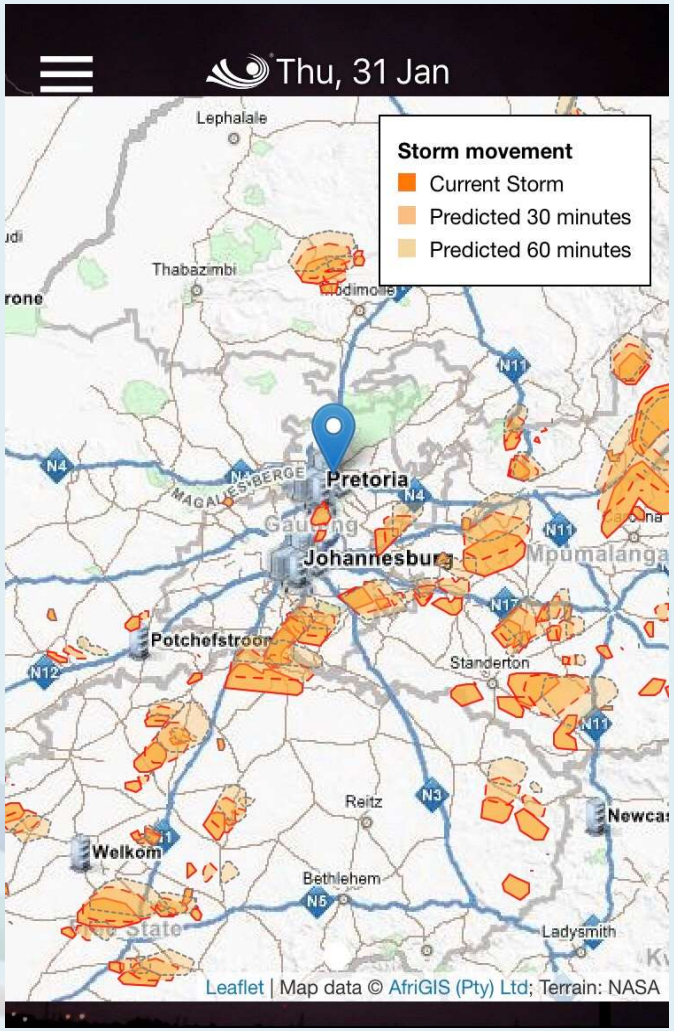
WeatherSMART App

With Live Storm Tracking



Track Storm Movement Based on Your Location

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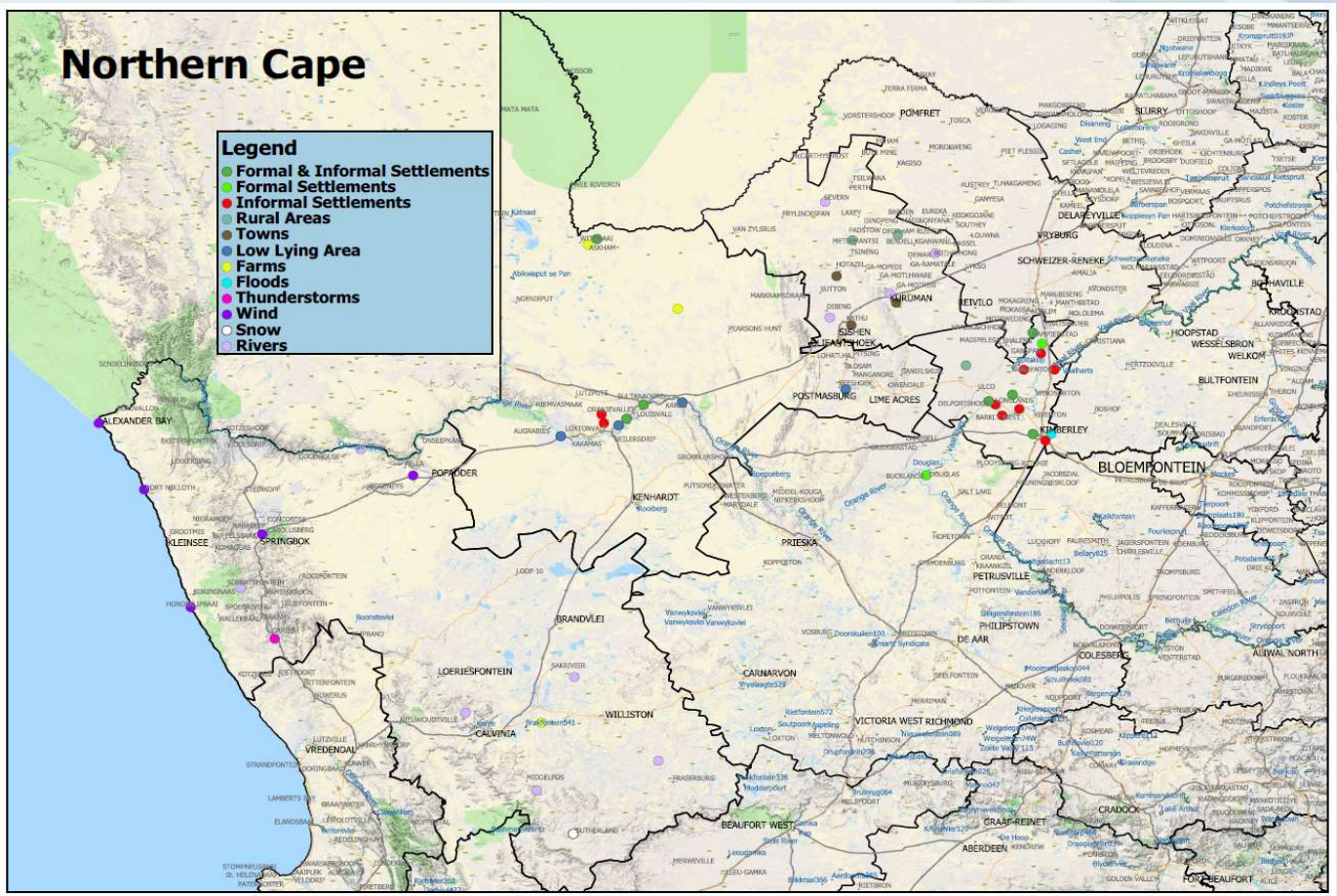
What has been done so far?



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Thank You

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