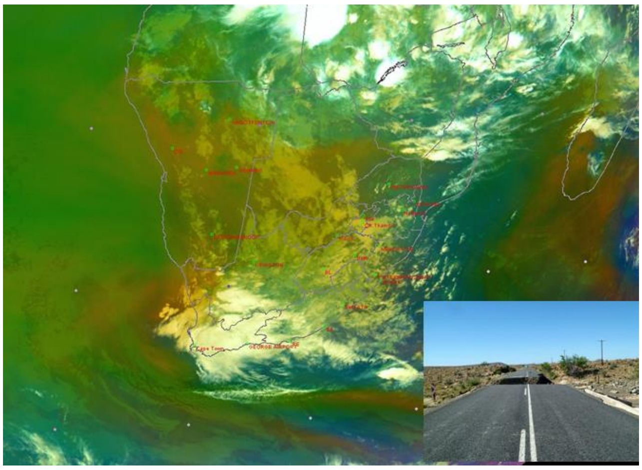
SUMMARY OF THE IMPACT-BASED SEVERE WEATHER WARNING SYSTEM: October 2020

1. Why Impact-based Weather Warnings?

Severe weather-related hazards occur regularly over South Africa, but it is when they impact negatively on humans and their livelihoods, infrastructure or the environment that they can become disastrous. The magnitude of the impact, though, varies between different places depending on the specific vulnerability of the area, as can be seen in the examples in Figure 1.

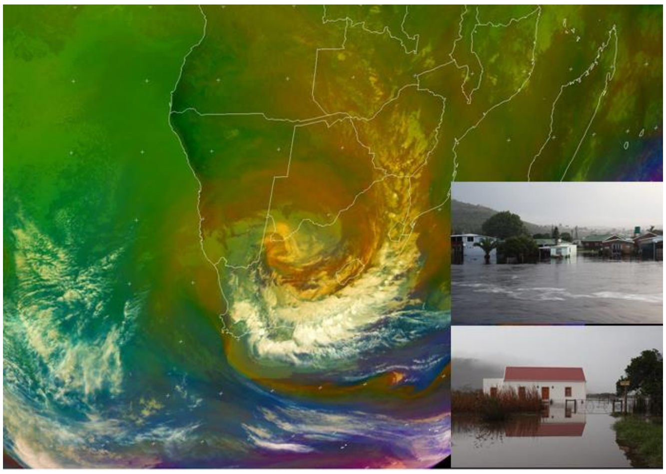
23 February 2010 Cut-off Low



Lead to flash flooding in the Karoo:

- Some roads breached (1 person died)
- Several sheep drowned
- No further reports of significant impact

8 June 2011 Cut-off Low



Resulted in severe flooding on the Cape South Coast

- Hundreds of people displaced
- Severe damage in populated areas
- Communities threatened

Figure 1: Two examples of similar weather systems with contrasting impacts in different parts of the country.

Forecasting severe weather hazards has improved significantly over the last few decades, due to scientific developments in this field. Despite this improvement, accurate and timely warnings of an approaching severe weather hazard do not imply a good response leading to safety of lives or prevent major economic disruption. A severe weather warning needs to provide useful, timely and relevant information to the users (disaster managers and the general public) on the expected severity and the associated likely level of adverse impact due to the hazard to support their decision-making on the most appropriate actions. In short: forecasts need to evolve from ***what the weather will be*** to ***what the weather will do***. This is what impact-based forecasting attempts to do.

2. What is Impact-based Forecasting?

The traditional Severe Weather Warning System (SWWS) in South Africa issued warnings based on weather-related thresholds. Typically, such warnings could be of "heavy rain with more than 50 mm in 24 hours". This warning has no real meaning in a local area where only 30 mm, or another area where more than 100 mm, is required to cause flash flooding that could close bridges or flood properties. An *Impact-based Early Warning System* (EWS) is not based on **weather thresholds**, but rather on increasing severity **levels of impact**, taking into account the localised socio-economic vulnerability to distinguish between *less severe* and *more severe* events.

3. Forecasting Weather Impacts – an Alternative Forecasting Paradigm

In an Impact-based (ImpB) SWWS, instead of assessing potential exceeding of weather thresholds, forecasters identify a region where hazardous weather could occur, no matter the severity of the weather. This could for example be where rainfall could result in adverse impacts.

- Based on the Impact Tables (see Figure 2 right panel for rainfall), the most appropriate ***impact level*** is identified for the region;
- Meteorological systems will aid the forecaster to determine the expected ***likelihood*** that these impacts could occur;
- From this, the appropriate ***warning risk level*** is established (Figure 2 left panel);
- The same is done for areas with a higher vulnerability as in the example in Figure 3.
- Co-ordination with disaster management is very important to decide on orange and red warnings.

Likelihood					
	High		2	6	10
	Medium		1	5	9
	Low			4	8
	Very Low			3	7
		Minimal	Minor	Significant	Severe
		Impact			

Impact-Based Forecasting: RAINFALL Impact Table

Minimal	Minor	Significant	Severe
Business as usual	Localised Business as usual	Localised Short term strain on emergency personnel	Widespread Prolonged strain on emergency personnel
• Some pooling of water on roads or in formal/informal settlements • Day to day activities not disturbed • Wet roads and reduced visibility • Minimal traffic congestion • Isolated mudslides and rockfalls	• **Localised flooding of** susceptible formal/informal settlements or roads, low-lying areas and bridges • Major roads affected but can be used, increased travel times • Difficult driving conditions on dirt roads • Minor motor vehicle accidents due to slippery roads and/ reduced visibility • Closure of roads crossing low water bridges	• **Flooding** of roads and settlements *(formal and informal)* • Danger to life (fast flowing streams / deep water) • Displacement of affected communities • Some communities temporarily not accessible/cut-off • Damage to property, infrastructure, loss of livelihood and livestock • Major disruption of traffic flow due to major	• **Widespread flooding** of roads and settlements • Danger to life (fast flowing streams / deep water) • Large communities not accessible/cut-off for a prolonged period • Widespread displacement of affected communities • Widespread damage to property, buildings and loss of livelihoods and livestock • Widespread transport routes and travel services severely affected

Figure 2: Warning risk level matrix (left) and part of Impact Table for rain (right).

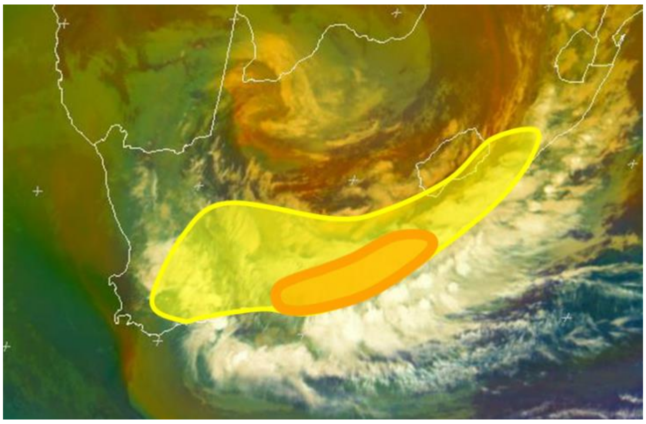


Figure 3: Example of a graphical impact-based warning as discussed in the text.

It is important to note the difference in impact and likelihood between different warning levels. Typically, warnings for hazards a few days in advance could probably be assigned a significant impact level, but a lower likelihood initially. As lead time decreases, increased likelihood could turn the yellow warning into an orange warning, still for the same impact level. Alternatively, the impact level could change as more information about the expected severity of the weather hazard.