Satellite and model based Severe Weather Index

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Background

- Aim to have a lead time of 2-3 hours of severe weather in the form of damaging hail events
- Radar will remain the best way to issue early warnings of such systems
- Most African countries do not have radar systems available and in SA we still have areas where radar systems do not provide coverage



Slide courtesy Jochen Kerkmann, EUMETSAT





Data and Methodology

- A a satellite and model based indicator of the probability for convection based on was developed in SA which combines satellite based instability indices (LI, KI and TT) as well we satellite based moisture (PW) and height above sea level (orography)
- This Combined Instability Index (CII) gives the probability of seeing lightning with a 3-9 hour lead time in the form of a probability map (published in Met Applications 2010)
- As all other satellite instability indicators can only be calculated in clear air (cloud free conditions)
- For severe convection (excluding tornadic events) we also need all of the above as well as:
 - Deep layer wind shear (not shallow layer, which is more for tornadoes)
 - A surface lifting mechanism



Bulk wind shear

- Thomas Pucik (2010) from Czech Hydrometeorological Institute
 - As a rule of thumb, 15 m/s bulk wind shear in 0-6 km layer, with moderate instability, is a marginal value for supercells.
 - Most works show the range of 20-25 m/s as median values for supercells.
- Laflin and Schumacher, (2006 AMS conference on severe weather):
 - Bulk shear less than 17 m/s = non supercell thunderstorms
 - Bulk shear more than 18 m/s = supercell thunderstorms
- Use 10m and 450 hPa (6km) wind field from local version of UM data to calculate
 BWS

Orographic component of vertical motion (Ralph Petersen, NOAA)

- 10m wind advected with surface pressure:
- U10m(dsfcp/dx) + V10m(dsfcp/dy)
- Get orographic component of the vertical motion (negative values)
- Use local version of Unified Model 10m wind fields (terrain following) with Surface Pressure





Evaluation method

- Damage reports:
 - Report of hail etc. so few towns/areas (lat/ lon)!?
 - Add pixel surrounding this centre point (above/below/left/right)
 - Calculate distance between SWI and damage reports in surrounding 5 pixel box (Barbara Brown)
- Visually Occurrence of lightning (not shown)



Examples

- 24 October 2010 large hail in NE parts of SA damaging crops
- 5 Nov 2010 hail damage in NE part of SA











Distance from SWI pixels

24 Oct 2010 1000 UTC



Case 2: HRV on 5 Nov 2010 14:30 UTC



Slide courtesy Melissa Lazenby





Distance from SWI pixels

5 Nov 2010 1200 UTC



Summary and Conclusion

- Using satellite and model data as a severe weather indicator is an effort to have information in areas where there is no radar coverage (between radars in SA and lack of radars in southern Africa)
- 90% of the damage reports (for these cases) were <80km from the SWI with 2-3 hours lead time
- SWI can thus give a forecaster a "heads-up" on the area where a hail storm can be expected in the next 2-3 hours
- Advantage is that this type of map will be available and updated every 15 minutes and it is independent of radar



Future work

- Examples of the past summer (SH) were used thus far. More cases with detailed damage reports are needed in coming/ current (2011/12) summer (work in progress)
- To have an observation of a severe weather event, to evaluate against is the biggest challenge.
- To expand this product to neighbouring countries is desirable, but needs testing (and observations?!)





Lightning between 1100 and 1400 UTC



Lightning between 1100 and 1400 UTC

Lightning between 1100 and 1400 UTC

Damage reports

In this example the SWI in the centre pixel was associated with 9 damage report pixels in the 60km radius Also calculated the distance between the SWI pixel and the damage report

Case 3: MSG IR108 colour enhanced 13:30 UTC

Distance from SWI pixels

22 Dec 2010 1000 UTC

