Storm Interrogation

AWOC Severe Track

IC3-II-E

Estimating updraft intensity with satellite: part 2

Storm Interrogation: Estimating Updraft Intensity with Satellite – Part 2

This session is a followup to part 1 of estimating updraft intensity with satellite data. It is short with 11 slides and should take 15 minutes to complete.

Estimating updraft intensity with satellite: part 2

- Objective
  - Utilize the following satellite signatures to assist radar in estimating updraft strength and severe storm potential
    - overshooting top characteristics,
    - presence of an enhanced-V,
    - anvil shape vs. storm-relative anvil-layer flow,
    - and anvil top temperatures.

This objective uses a case to highlight how the following signatures can be used to assist radar in estimating updraft strength and severe storm potential. We will mention:

•Overshooting top characteristics,

•enhanced-V signatures,

•anvil shape vs. storm-relative anvil-layer flow,

•and Anvil top temperatures.

We will also look at the radar presentation of this storm and some near storm environmental information.

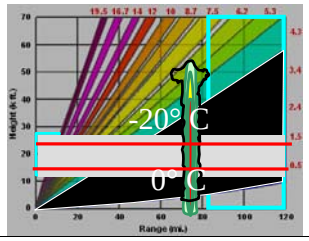
Estimating updraft intensity with satellite: part 2

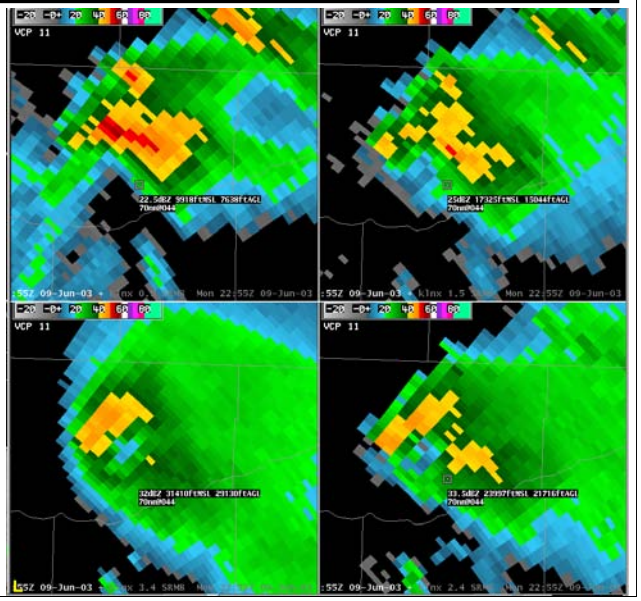
- Suggested prerequisite
  - Part 1 of Estimating updraft intensity with satellite

This is a followup to part 1 of estimating satellite updraft intensity. Because of this, many satellite-based signatures will be mentioned but not explained in any detail. If there is anything that confuses you, refer to part 1 of this session.

Example case

- Northern Nebraska
- Is this updraft severe enough to put out a warning?
- If so, what kind of weather do you expect?





This is a developing storm in northern Nebraska on 09 June 2003. It just recently formed ahead of a dryline bulge near or just south of a warm front. A fairly significant 500mb short-wave trough is coming in from the west and SPC has a MDT risk out for the area.

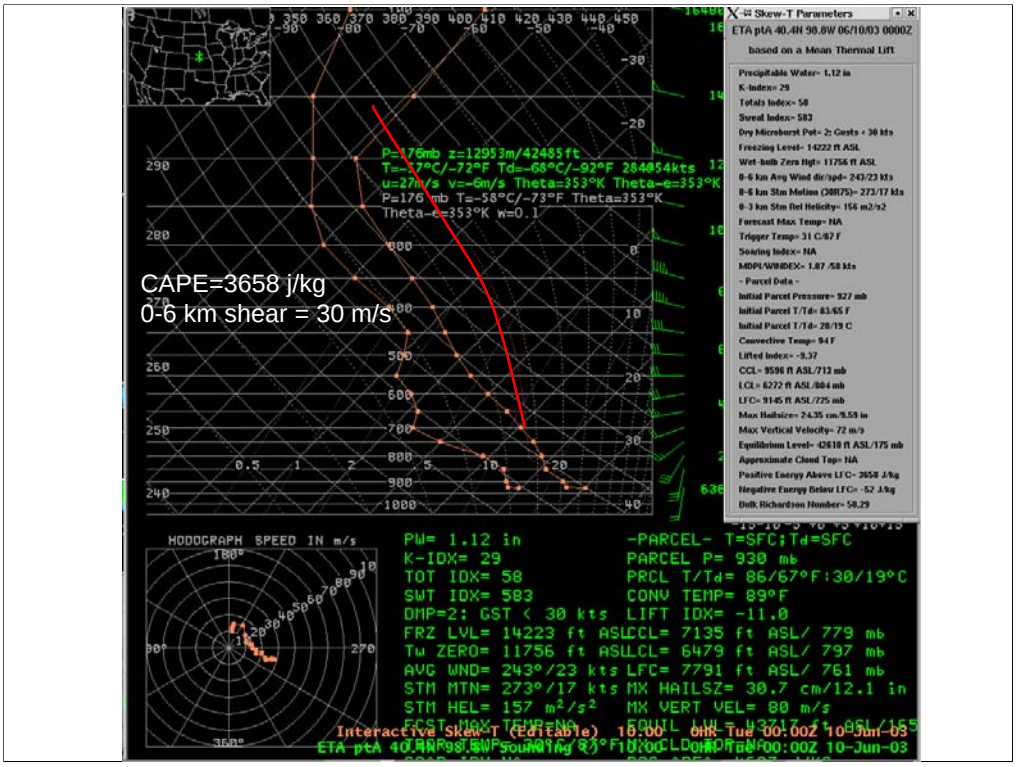
The three frames of this loop show what appears to be a supercell structure with a low-level sharp concave reflectivity gradient, and what appears to be a BWER at 2.4° and 3.4° in elevation, or 21 to 25 kft AGL. However, the surrounding reflectivity is extremely weak at high altitudes. The only reflectivities > 60 dBZ are located at the lowest slice, well below the freezing level.

Is this echo hole a true BWER, one with intense updraft or is it a gap between two cells?

What is this cell capable of doing?

Would you issue a warning based on this data alone?

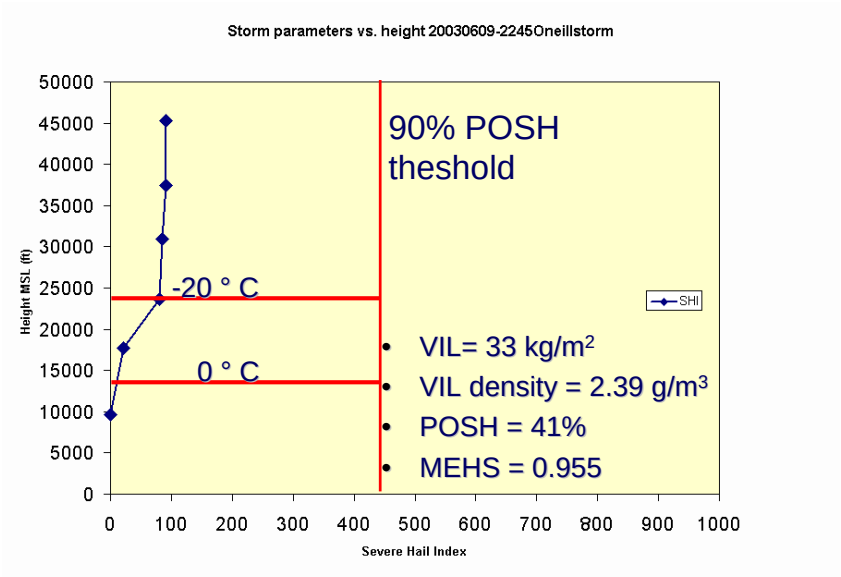
Let's take a look at some more information.



Since this storm is not near any RAOB sounding, I chose to pick an ETA analysis sounding at 00 UTC. During the actual event, this would've been impossible but a RUC or LAPS sounding showed a similar sounding profile to this one. This sounding shows strong 0-6 km shear of 30 m/s, more than enough for supercells. Steep lapse rates and high CAPE means any storm could go severe quickly and be supercellular in nature.

The environments support the radar structure to be more supercellular than two components of a multicell. But what about the low reflectivities?

Vertical storm profile 2245Z

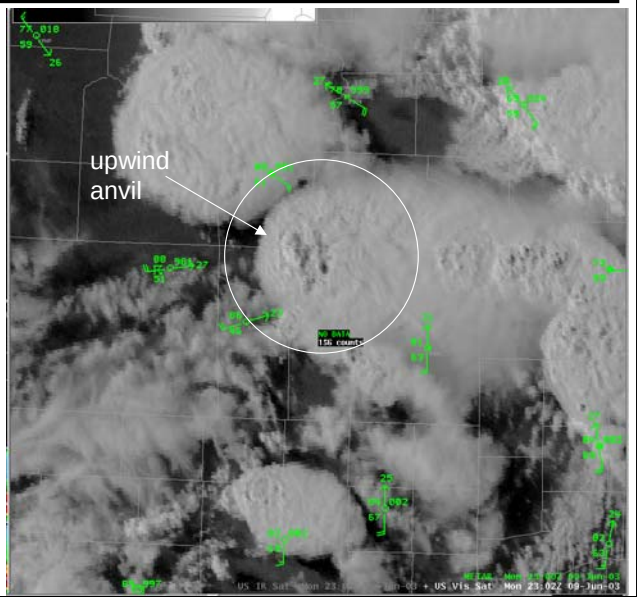


If I take the vertical reflectivity profile for this event, and apply the HDA/VIL tool discussed in the lesson on updraft intensity and reflectivity core heights, I see a slowly decreasing profile of reflectivities, especially where it is needed to increase the Severe Hail Index (SHI). VIL reaches only 33 kg/m^2, VIL density is only 2.39 g/m^3, and SHI is far less than what's needed for a Probability Of Severe Hail (POSH) of 90% (it is only 41%). The Maximum Expected Hail Size (MEHS) seems a bit high given this profile but it is barely over severe limits.

The reflectivity profile does not support any warning, and hasn't in all three volume scans.

Visible images 2245&2300 UTC

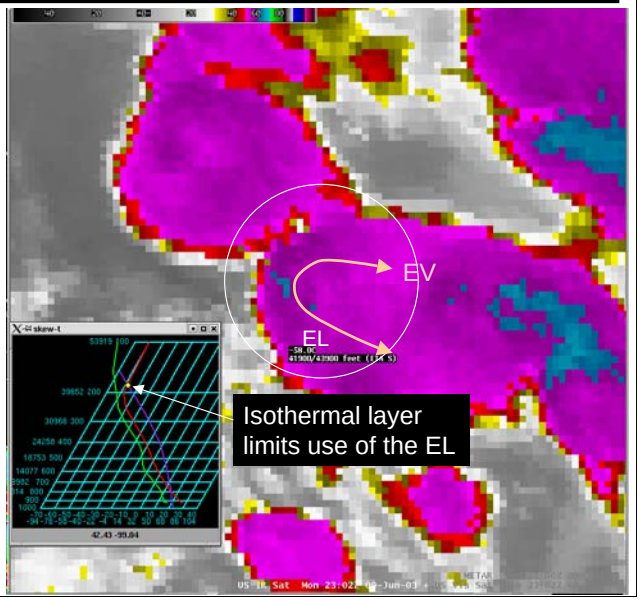
- Strong overshooting top clearly visible
- SR anvil layer flow ~ 20 m/s
- But upwind anvil growth evident



The GOES-12 visible imagery shows a well defined overshooting top with a long anvil downwind and yet, significant upwind anvil growth. The Storm Relative anvil layer flow is about 20 m/s which is in the range to support classic supercells according to Rasmussen and Blanchard (1998). The presence of upwind anvil growth and the classic oval shaped anvil in the face of 20 m/s SR anvil layer flow supports the shape and morphology of the radar structure implying a severe updraft.

Visible images 2245&2300 UTC

- IR shows a weak enhanced-V
- T_{eql} indicates boundary layer moisture being accessed
  - However the layer is isothermal
  - A lower equilibrium level still gives the same T_{eql}



The GOES-12 IR imagery indicates that the brightness temperature EL based on the AWIPS cloud height tool is about where the ETA analysis expects it to be. However, note that there is an isothermal lapse rate across the EL. This means that a fairly broad range anvil EL heights may give similar brightness temperatures. We will not use the EL method here. However, the presence of a weak Enhanced-V and a cold overshooting top supports the visible imagery and the radar reflectivity shape that this storm is a supercell.

Summary of this case

- Radar
  - Weak reflectivities
  - evidence of BWER and WER but no marginal echo overhang reflectivities
- Satellite
  - Evidence of Enhanced-V
  - Strong overshooting top
  - Upwind anvil growth against 20 m/s SR anvil layer flow
- Decision?

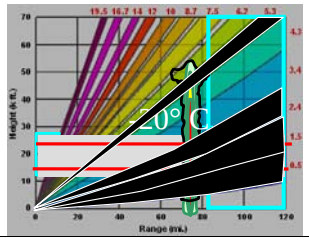
To summarize, the radar showed weak overall reflectivities. The HDA and techniques using the vertical reflectivitiy profile of this storm fail to indicate the potential for severe weather. The presence of a WER is suggested but the classic definition of a WER is one that is overlaid by an intense echo overhang. This is not a classic WER and the same logic applies to the BWER presented here.

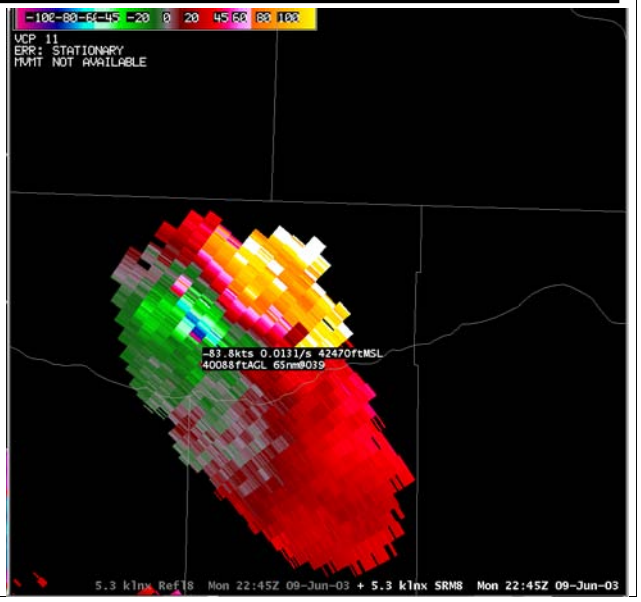
The GOES 12 IR/VIS data support the argument that the WER and BWER are legitimate indicators of a severe updraft, even if they are not surrounded by high reflectivities aloft. The enhanced-V indicates the presence of a strong, persistent updraft in a sheared environment. Evidence of an overshooting top and upwind anvil growth against 40 kts of SR anvil layer flow both add additional support for a severe updraft.

The storm appears to be a supercell with a strong updraft. This is not a high end updraft capable of creating baseball hail but it appears at least strong enough to support golfball hail. The lack of intense reflectivities suggest an LP supercell in appearance and probably has difficulty in developing any kind of severe downdraft. I will go for golfballs in this storm and they are likely to be widely scattered otherwise high reflectivities would show up throughout the storm.

Example case

- This velocity all-tilts scan should help
- What is your decision?





I purposely kept the velocity from entering into our analysis until now. But upon showing it, this storm clearly has a classic midlevel mesocyclone and intense updraft summit divergence of nearly 160 kts. This only adds evidence and confidence that this updraft is significantly strong.

At 2300 UTC, golfball hail was observed by storm chasers from a supercell with visually LP appearance.

Summary

- Low Precipitation supercell
- Severe hail potential higher than weak reflectivities suggest
- Structure analysis along with impressive satellite appearance suggests greater severe potential than the hail algorithm suggests
- Golfball hail reported at 2300 UTC

This is a low precipitation supercell that has a higher severe hail potential than any VIL or HDA products can estimate. There is a BWER and the proper shape of a supercell but the criteria that the BWER must be surrounded and capped by high reflectivities not being met might cast a bit of doubt about the structure indicating a severe updraft. However, the presence of an enhanced-V, large overshooting top, and the velocity structure showing a strong mesocyclone and storm top divergence adds credibility to the fact that this storm's updraft is very strong.

Golfball hail was reported by storm chasers at 2300 UTC.