Assessing Impulses and Decay of Overshooting Tops relative to Supercell Collapse using Lightning and Phased Array Radar Data

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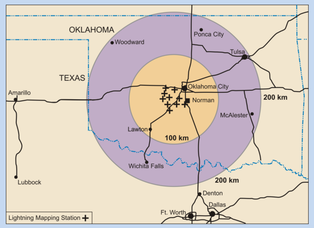
Hypothesis

The impulse and decay patterns of the lightning signatures of a supercell thunderstorm's overshooting top are expected to correspond to similar patterns of the radar signature, which could correspond the cycling of the supercell and updraft strength.

Dataset

Date	Time (UTC)	Location
25 April 2006	0000-0050	El Reno
07 May 2007	0200-0240	Seminole Co.
31 March 2008	0600-0655	Edmond
24 May 2008	1900-2005	Lacey
10 May 2010	2130-2155	Yukon
10 May 2010	2155-2240	Moore
10 May 2010	2225-2305	Norman



Above Study area limited to inner circle representing the 3D range of OK-LMA

Radars used: PAR, KTLX, KFDR, KINX, KSRX, KVNX

Patterns During Tornadogenesis

- In 12 of 14 tornadoes, noticeable impulses in the lightning signature of the overshooting top preceded tornadogenesis by 3-25 minutes.
- In 11 of 14 tornadoes, tornadogenesis coincided with a drop in radar top height and a decrease in either the height or occurrence of lightning in the overshooting top.

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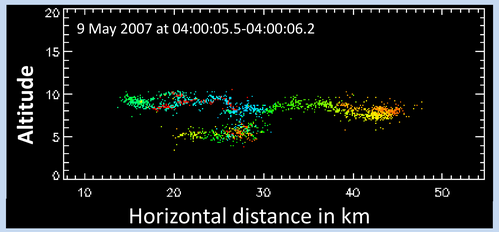
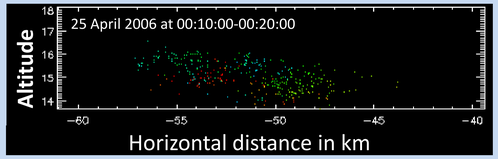
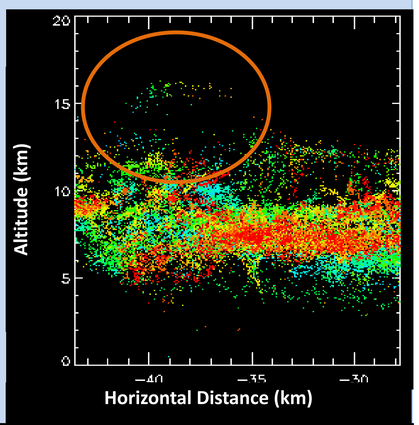
VHF Source Points within an Overshooting Top



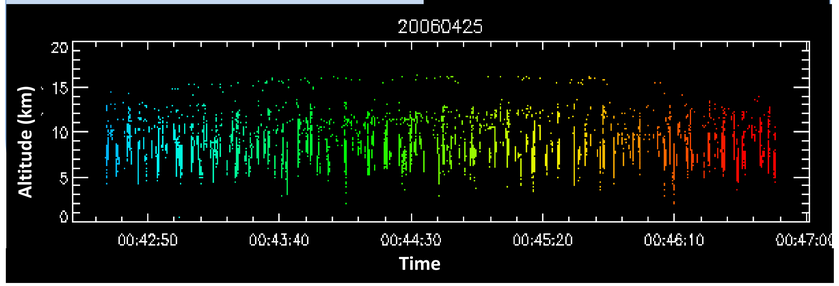


Typical comparison of intracloud flash imaged in 1 sec (**above left**) to activity in an overshooting top over a 10 min period (**below left**) with each dot representing one VHF source point, with blue points occurring before red points (from 25 April 2006).

- A much smaller rate of VHF sources seen in the region of the overshooting top than elsewhere in the storm.
- These points are usually independent of lower flashes.
- This region occasionally contains larger flashes up to 10 VHF source points in size.

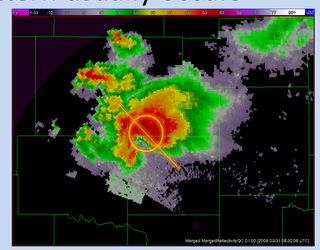


Imaging of an isolated impulse in the vertical (**right**) and by time (**below**) (from 25 April 2006 from 0042 to 0047 UTC).

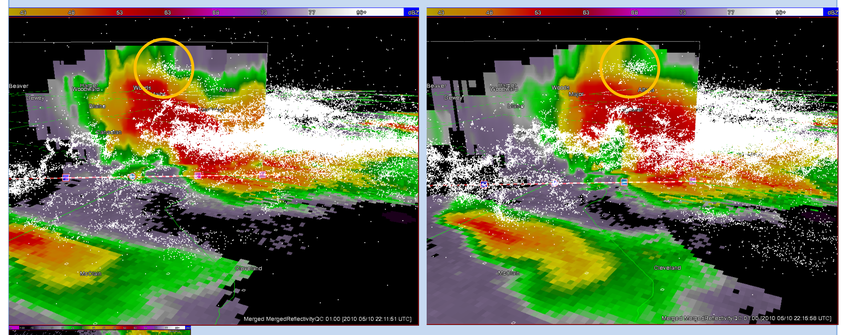


Lightning Activity Compared to Radar

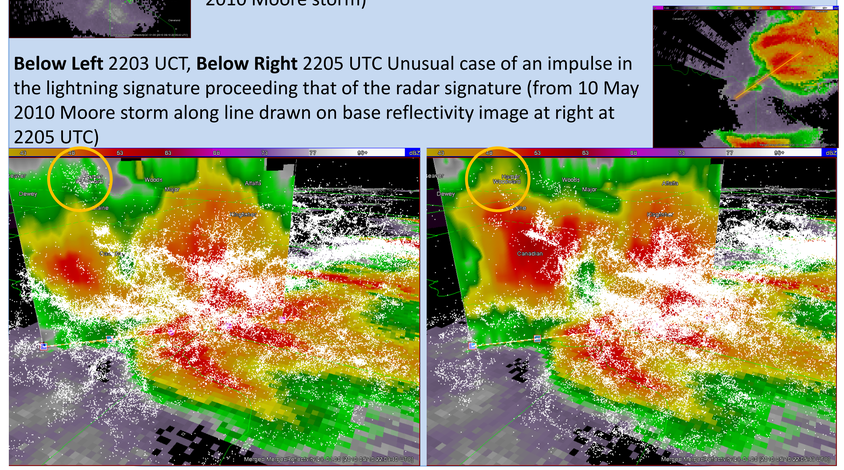
- VHF source points generally most concentrated within and downstream of the overshooting top at 20-40 dBZ .
- An impulse seen in the lightning pattern usually occurs within minutes of a radar impulse.



Right The most concentrated area of VHF source points seen in the overshooting top with respect to base reflectivity (from 31 March 2008 at 0630 UTC)



Above Left 2211 UTC, **Above Right** 2214 UTC Radar cross section (along line drawn on base reflectivity image on left at 2214 UTC) overlaid with 3-demensional VHF source points showing typical locations (from 10 May 2010 Moore storm)



Below Left 2203 UCT, **Below Right** 2205 UTC Unusual case of an impulse in the lightning signature proceeding that of the radar signature (from 10 May 2010 Moore storm along line drawn on base reflectivity image at right at 2205 UTC)