Nat. Hazards Earth Syst. Sci. Discuss.,
doi:10.5194/nhess-2016-71-RC2, 2016

Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Spatial-Temporal Clustering of Tornadoes" *by* Bruce D. Malamud and Donald L. Turcotte

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Received and published: 31 March 2016

The technique may have some value in some application, but the physical interpretation is fundamentally wrong. The 26 April storms were characterized by quasi-linear structure and the 27 April storms were predominantly discrete supercells. The 4 April case used as proof of "supercell" is actually a derecho. The authors lean on the reverse of that being true. The use of a single supercell as an exemplar is oversimplistic and misleading. If, instead, multiple parallel supercells are assumed, the linear relationship between lag-d and lag-t breaks down. In fact, for the three cases shown, the linear relationship on the plot is indicative of tornadoes associated with linear convective modes, not supercells.

1. p. 1, last paragraph: It's not obvious to me that there's a great physical similarity

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Discussion paper

between the earthquake/aftershock distribution in time and space and tornado outbreaks. Can you offer insight into why one phenomenon (earthquake sequences) that don't seem to me to have a lot of sense of direction provides a model for one (tornado outbreaks) that has a strong sense of direction?

2. p. 2, line 20: Given that these tornadoes all occurred during the Enhanced Fujita scale era, they should be labelled "EF", not "F". Also, the highest value on the scale is EF5, not EF6.

3. p. 4, lines 25-27 and p. 5, lines 8-10: The "potential conclusion" on p. 5 is not consistent with the radar presentation. If you had said that the generation of tornadoes by several separately defined supercells is absent on 26 April, I'd believe it. In the Knupp et al. (2013) reference, they talk about tornadoes associated with a quasi-linear convective system (QLCS) for the early morning tornadoes in Alabama on 27 April (prior to 12 UTC, so associated with the 26 April convective day) and discrete supercell tornado formation for the afternoon/evening of 27 April. The 26th April storms are much less likely to be supercellular than the 27th April storms. This is reflected in the damage ratings associated with the >10 km path tornadoes for the two days.

EF 26th 27th

EF0 4 3

EF1 20 19

EF2 17 12

EF3 5 15

EF4 0 11

EF5 0 4

The 1240 UTC 27 April tornado in Georgia is associated with the end of 26 April outbreak. There are 4 tornadoes in Alabama (1 EF0, 3 EF1) between 16 and 17 UTC

on the 27th that Knupp et al. associate with a small QLCS. The heart of the 27 April outbreak begins after 18 UTC and is unequivocally from supercells, mostly discrete, as opposed to the QLCSs of the 26th (Knupp et al. 2013). The radar loops are available at http://www.srh.noaa.gov/bmx/?n=event_04272011

4. p. 5, lines 23-29: The 4 April 2011 event was not supercellular. It was a derecho event with some embedded tornadoes (http://www.spc.noaa.gov/misc/AbtDerechos/casepages/apr042011page.htm). It appears that the technique proposed here with straight lines on the spatial/temporal lag chart is identifying tornado events associated with linear convection, not supercells.

5. Figure 5: A single supercell is not an appropriate model for a tornado outbreak such as 27 April 2011 where multiple supercells were producing tornadoes. I've done a simple exercise with 4 supercells on parallel paths. Each produces a tornado once per hour 100 units to the east and 10 units to the north of the previous tornado. The 2nd (3rd) [4th] supercell is 50 (100) [150] units north of the first. When I calculate the lag d and lag t, rather than getting a straight line, I get the plot below. I'm confident that if I made a slightly more sophisticated model with the tornadoes not occurring at the exact same time and not due north of each other, and with not identical forward speeds, the plot would fill in much like Figure 4b.

It's probable that, if you created this plot and looked at tornadoes associated with a single supercell separately, you'd see a series of lines. This requires identifying the individual supercell (radar loops would help) or cases such as Palm Sunday 1965, the Superoutbreak in 1974, and May 3 1999 have already had that done. For 27 April, a plot of the tornadoes from Mississippi to northeast Georgia associated with the storm that produced the Tuscaloosa tornado would be illustrative.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., doi:10.5194/nhess-2016-71, 2016.

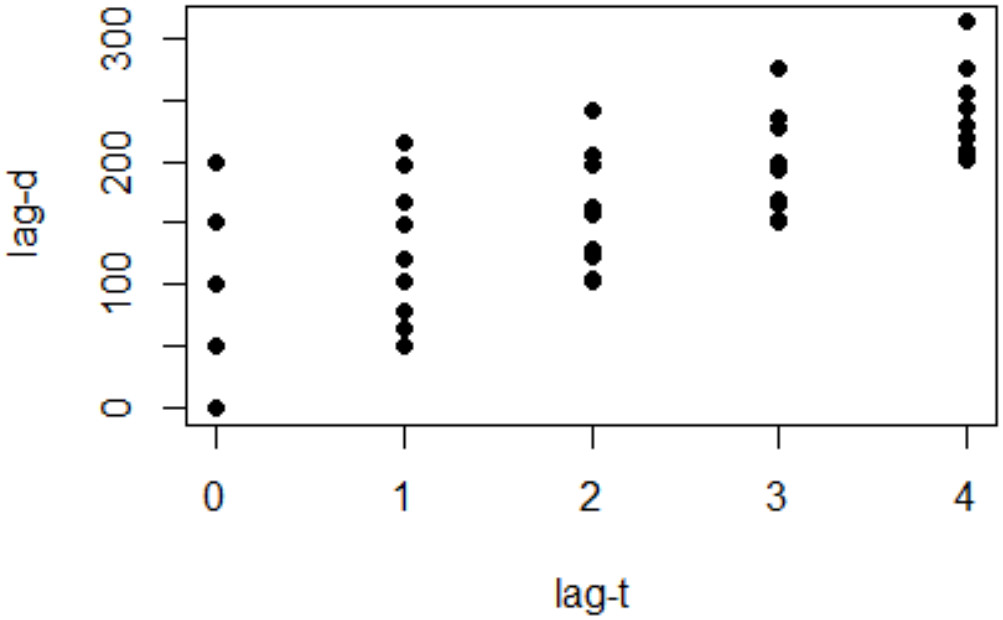

Fig. 1. Simple model-4 supercells