Assessing Convective Influence by Utilizing Cloud to Ground Lightning Data and High Resolution Kinematic Trajectories

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**Goals**

- Quantity the convective influence of parcels sampled during INTEX-A by using National Lightning Detection Network cloud to ground flash counts as a convective indicator.
- Perform “lightning tracing” along backward air trajectories created by a mesoscale meteorological model, expanding upon the work of Jeker et al., JGR, 2000.
- Construct a post-convective vertical profile of lightning NOx from INTEX-A observations.

**Methodology**

- This initial analysis was performed on Flight 7 (lower left), once it was influenced by widespread deep convection on several previous days.
- Back trajectories from the flight were made using output from the Rapid Update Cycle (RUC) model which has spatial and temporal resolutions of 20 km and 3 hours, respectively.
- For each hour back along a trajectory, a flash is said to have influenced the trajectory if it fell within a spatial threshold of the trajectory up to an hour before or half an hour after trajectory arrival.
- The spatial threshold was increased 2 km every hour back from the flight to account for increasing trajectory uncertainty with time.

**Convective Age**

- Convectively fresh parcels, ones that have recently encountered convection, have a higher ratio of reactive NOx to HNO\textsubscript{3}, HNO\textsubscript{2}, and PAN than do older encounters.
- The change in the ratio of NOx to HNO\textsubscript{3} is more noticeable between fresh and stale parcels than in the change in the NOx to HNO\textsubscript{3} ratio.
- HNO\textsubscript{3} is a more significant component of a stale parcel's NOx than a fresh parcel's NOx.
- Some grouping of points is noticeable, but there is indication of multiple convective origins along the 4 flight legs.

**Case Study:**

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- Diurnal heating generated afternoon thunderstorms across the Midwest and Southeast for several days prior to the flight.
- A large high pressure system covered the Southeast, producing stagnation and clockwise windward circulation.
- Strong cold front with associated thunderstorms moved through the northern Great Plains.

**Summary**

- By using high resolution trajectories to perform lightning tracing, a procedure has been created to analyze the convective influences on INTEX-A observations.
- Tested on the chemical data from Flight 7, this method provided results which seem reasonable statistically and theoretically.
- The calculated age since convection agrees with expected trends in the temporal evolution of NOx products.
- It is important to note that assessing a parcel's cumulative lightning influence is more advantageous in potential lightning NOx calculations.
- When this model is applied to the full INTEX-A dataset, it will optimally allow the development of a post-convective vertical lightning NOx profile.
- Potential omissions of this research include addressing NO per flash production estimates, comparing the usefulness of lightning with other convection indicators, and quantifying trajectory uncertainties with chemical observations (NOx).