Follette-Cook et al. (2015) quantified the variability seen in the Maryland/DC DISCOVER-AQ P-3B trace gas data and found it compared well with our WRF/Chem simulation. Is the resolvable variability sufficient to answer the relevant science questions? Lok Lamsal, personal communication (campaign? (i.e. one month)

TEMPO is the first NASA mission to make atmospheric composition observations from geostationary orbit and partially fulfills the goals of the Geostationary Coastal and Air Pollution Study (GCCAPS) mission. The Tropospheric Emissions: Monitoring of Pollution (TEMPO) instrument will be able to observe O3, CO, NO2, and HCHO tropospheric column amounts relative to satellite precision requirements, similar to Follette-Cook et al. (2015).

### Maryland Analysis Highlights – Follette-Cook et al. (2015)

Follette-Cook et al. (2015) quantified the variability seen in the Maryland/DC DISCOVER-AQ P-3B trace gas data and found it compared well with our WRF/Chem simulation. Questions addressed in that analysis:

- How much does each species vary spatially and temporally throughout the campaign? (i.e. one month)
- How much of that variability would a TEMPO-like instrument see?
- Is the resolvable variability sufficient to answer the relevant science questions?

#### Structure Functions

Structure functions are a useful way to quantify variability in both space and time

\[ f(Z, y_x) = \frac{1}{Z(x) - Z(x) - Z(y)} \]

\[ < s > \text{ the average of data pairs separated by distance } y \]

\[ Z \text{ variable of interest at given location } x \]

\[ q \text{ scaling exponent (here } q = 1) \]

Calculate structure functions using data from DISCOVER-AQ P-3B in-situ aircraft (14 flights for MD)

- Both points must be below 2 km (ASL)
- The points must lie in < 2 hrs apart (1.75 hrs for MD)
- The median value of the difference is used for the analysis

Model output was sampled along the P-3B flight track.

### DISCOVER-AQ observations and simulations

#### Inter-Campaign Variability

The results from the MD analysis suggest that the PRs for TEMPO and GEO-CAPE are sufficient for addressing the science questions they are tasked to answer.

#### How does the variability seen in the other three deployments compare to that seen in MD?

- CO variability in CA was much higher than in the other regions; HCHO variability in CA and CO was much lower; MD showed the lowest variability in all species.
- CALifornia – W. Appel
- TX: MD, TX, and CA show comparable differences to MD.
- MD – TX, CO, and MD show comparable differences to MD.

### Conclusions

- Results from an in-depth analysis of trace gas variability in MD indicated that the variability in this region was large enough to be observable by TEMPO.
- The variability observed in MD is relatively similar to the other three campaigns with a few exceptions:
  - CO variability in CA was much higher than in the other regions; HCHO variability in CO was much lower; MD showed the lowest variability in all species.
  - Both model simulations do a reasonable job simulating O3 variability. For CO, the CA/CO simulations largely under/overestimate the variability in the Maryland DISCOVER-AQ observations and simulations

Criteria:

- Both points must be below 2 km (ASL)
- The points must lie in < 2 hrs apart (1.75 hrs for MD)
- The 1-second merge data was used for this analysis
- Model output was sampled along the P-3B flight track