#### Meteorological Modeling and Data Assimilation

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This presentation will address

- Current Status
- Overview / Role in FLAGG-MD
- Objectives
- Year 3 Research Focus



NIST-UMD Meeting February 13, 2017





#### Journal article

- Shou Y., et al., 2016: Ensemble simulation of a northerly low-level jet and its impact on air quality over Indianapolis, submitted to J. Geophys. Res. Atmos.
- Shou Y. et al., 2017: Impact of meteorological uncertainties on regional GHG predictions through physics-based ensemble, to be submitted

#### Presentations

 Soupy., et al., 2016: Investigating the impact of a northerly low-level jet on GHG flux estimates for Indianapolis using WRF-LETKF, AGU Fall meeting.











## Role of Meto. Modeling and Data Assimilation in FLAGG-MD





Synthetic (estimated) reality



### Role of Meto. Modeling and Data Assimilation in FLAGG-MD



## Role of Meto. Modeling and Data Assimilation in FLAGG-MD



1. For GHGs flux estimation of NEC Balt-Wash area, provide

- Meteorological fields, as accurately as possible
- Associated uncertainty by ensemble methods through
- Careful physical process study based on WRF-ARW model
- Development of an advanced data assimilation system based on LETKF
- 2. Participate in the episodic studies
- 3. Collaborate and interact with
  - NIST scientists
  - Other NIST groups

to advance our understanding & technology





- Modeling: To advance existing expertise
  - Technical approach
    - Nested domain approach for multiscale processes while achieving high computational efficiency (resolution: from 12km to 500m)
    - Process studies specific to the area
  - References
    - Zhang, D.-L., Y. Shou, and R. Dickerson, 2009
    - Zhang, D.-L., Y. Shou, R. Dickerson, F. Chen, 2011
- LETKF DA system: Implementation after modeling
  - Moving the system from Indiana
  - Validation against observations
  - Uncertainty estimate



2007-07-09-1745UTC



Zhang etal (2011)

- For flux estimates
  - Readily available: Wind fields in the domain(s)
  - Easily incorporated: WRF-CHEM for ensemble simulation of trace gases given ICs.
- Observations
  - Routine NWP DA observations
  - Additional FLAGG-MD observations for modeling and DA systems
    - (Quasi)-permanent: tower, profiler, radiosonde
    - Case study: flight data, low-cost sensors & sondes





# Collaboration with NIST Scientists

- Bridging the gap between the real atmosphere and NIST LES CFD simulation by providing BCs(including uncertainty) of meteorological fields at
  - meaningfully highest resolution possible for WRF-ARW
  - Hopefully useful for NIST LES CFD simulations & analysis
- Comparative study
  - High-resolution NIST LES CFD simulation embedded in WRF-LETKF for comparable spatial/temporal scales.
  - Model simulations vs. FLAGG-MD observations





- In contact with the PSU group (Ken Davis)
  - Learn from each other's experience
  - Exchange ideas/products as appropriate
- Challenge: meto and tracer fields are area specific.
  - $\rightarrow$ Unless we run over similar area, direct comparison is infeasible.





## Summary

- Moving to this area, focus on
  - Modeling
  - Data assimilation
- Looking forward to
  - Collaboration with the NIST scientists
  - Interaction with the other NIST CF groups

Thank you & questions?





#### <u>Indiana</u>

Journal article

Shou Y., D.L. Zhang, K. Ide, R.R. Dickerson, X.R. Ren, P.B. Shepson., 2016: Ensemble simulation of a northerly low-level jet and its impact on air quality over Indianapolis, submitted to *J. Geophys. Res. Atmos*.

Shou Y. et al., 2017: Impact of meteorological uncertainties on regional GHG predictions through physics-based ensemble, *In Prep* 

Presentations

Shou, Y., et al., 2016: Investigating the impact of a northerly low-level jet on GHG flux estimates for Indianapolis using WRF-LETKF, AGU Fall meeting.

Shou, Y., et al., 2017: Evaluation of the errors and uncertainties resulting from urban canopy models and PBL schemes with physics-based ensemble, AMS Annual Meeting.

#### NEC Reference

Zhang, D.-L., Y. Shou, and R. Dickerson, 2009: Impact of upstream urbanization on the urban heat island effects over the Washington-Baltimore metropolitan region. *Geophys. Res. Lett.*, 36, L24401

Zhang, D.-L., Y. Shou, R. Dickerson, and F. Chen, 2011: Impact of upstream The stream on the urban heat island effects over the Washing A-Burner Thetropolitan region. J. Appl. Meteor. Climat., **50**, 2012-2029.

