Modeling Urban Impacts on Regional Weather of the Central U.S

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Motivation

- Urbanization and regional weather
- Urban Canopy Model (UCM)
Data and Methods

- Cities along the Ohio River
  - Evansville, IN
  - Louisville, KY
  - Cincinnati, OH
- Summer Precipitation Events
  - 11 June 2006
  - 17 June 2006
  - 23 June 2006
  - 29 August 2008
Parameterizations

Microphysics
- WSM 6-class

Cumulus
- Kain-Fritsch

Radiation
- RRTM Long Wave
- Goddard Shortwave

Land Surface
- Noah

Boundary Layer
- YSU

Domain Sizes and Resolutions

Domain 1 – 116 x 98  9 km
Domain 2 – 208 x 160  3 km
Domain 3 – 301 x 160  1 km
Domain 4 – 190 x 190  1 km
Land Use Categories, Domain 3
Land Use Categories, Domain 4
Analysis

Model Output

- 1-km spatial resolution
- 54 hour run time
  - Began at 18 Z, previous day
- 1-hourly output

Comparison Data

- NARR data
  - 32-km resolution
  - 3- or 6- hourly outputs
- CPC unified precipitation
  - 0.25° lat (~28-km) resolution
  - 12 and 24 hour totals
Analysis

Root-Mean-Square Error – Planetary Boundary Layer Height (m)

Domain 3

Domain 4

Simulation Time, 3 hr Intervals

11-Jun-06  17-Jun-06  23-Jun-06  29-Aug-08
Analysis

Root-Mean-Square Error – Latent Heat Flux (W m⁻²)

Domain 3

Simulation Time, 3 hr Intervals

-10 -8 -6 -4 -2 0 2 4 6 8

11-Jun-06 17-Jun-06

Domain 4

Simulation Time, 3 hr Intervals

-20 -15 -10 -5 0 5 10 15 20

23-Jun-06 29-Aug-08
Analysis

Root-Mean-Square Error – Sensible Heat Flux (W m⁻²)

Domain 3

Simulation Time, 3 hr Intervals

11-Jun-06, 17-Jun-06

Domain 4

Simulation Time, 3 hr Intervals

23-Jun-06, 29-Aug-08
Analysis

Bias by Case for Inner Domains

11-Jun-06

17-Jun-06

23-Jun-06

29-Aug-08
Analysis

Bias and ETS for Two Cases

**Bias 11-Jun-06**

**ETS - 11-Jun-06**

**Bias 23-Jun-06**

**ETS - 23-Jun-06**
Analysis

23-Jun-06 D03 OBS

23-Jun-06 D03 CTRL
Analysis

23-Jun-06 D03 OBS

23-Jun-06 D03 EXP
Conclusions

- Greatest improvement:
  - Daytime sensible heat flux
- Also improved:
  - Daytime latent heat flux
  - Precipitation reliability (for low precipitation thresholds)
- Tendency to overestimate precipitation
Future Work

• Simulations with more recent (2001) USGS NLCD could improve model accuracy overall

• Higher resolution observational data

• More cases
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