**MOTIVATION**

- Interest in modeling urban air quality
  - San Francisco Department of Public Health
  - Bay Area Air Quality Management District
  - City of San Francisco
- Proposed affordable housing development
  - Located downwind from interstate 280
  - 250,000+ vehicles per day
- Modeling using IBM-WRF
  - Complex terrain
  - Building-resolving
  - Mesoscale to microscale nesting
  - Realistic meteorological input

**DOMIAN**

- Semi-idealized domain setup for preliminary testing
  - Outer domain
    - Flat plate
    - Periodic boundary conditions
    - Run for 2 hours to develop turbulence
  - Inner domain
    - Includes buildings from a San Francisco Department of Public Health dataset
    - 1-way nested configuration

**IBM-WRF**

- Lundquist et al., 2010, 2012
- Weather Research and Forecasting model (WRF) modified to use an immersed boundary method (IBM)
  - Allows representation of urban geometries in WRF
  - Cartesian rather than terrain following vertical coordinate
  - Terrain intersects grid, resulting in “cut cells”
  - Computational nodes in solid domain & adjacent to cut cells are “ghost-points” (black circle)
- Ghost-point values establish appropriate boundary conditions through addition of body force term to conservation equations for momentum & scalars (equations #1a & #1b)

**RESULTS**

**Vertical east-west slice through domain midpoint**

- log10 Scalar Concentration
- WRF terrain-following grid
- IBM-WRF Cartesian grid
- One meter resolution
- Three meter resolution
- Ten meter resolution

**WRF TO IBM-WRF NESTING**

- Concurrent one-way nesting from WRF domain to IBM-WRF domain
- Currently in development
- Enables transfer of meteorological information from mesoscale to microscale
- Issue of illresolved terrain features on middle resolution nests
- Virtual buildings / addition of drag to nodes within poorly resolved terrain features

**CONCLUSIONS**

- Preliminary testing shows that IBM-WRF performs well when simulating flow through complex urban terrain
- With continued modification, IBM-WRF will be well equipped for high resolution urban air quality modeling

**REFERENCES**


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