An Application of the Aerosol Modeling Testbed Toolkit: Investigating Sensitivity of Aerosols to Grid Cell Size

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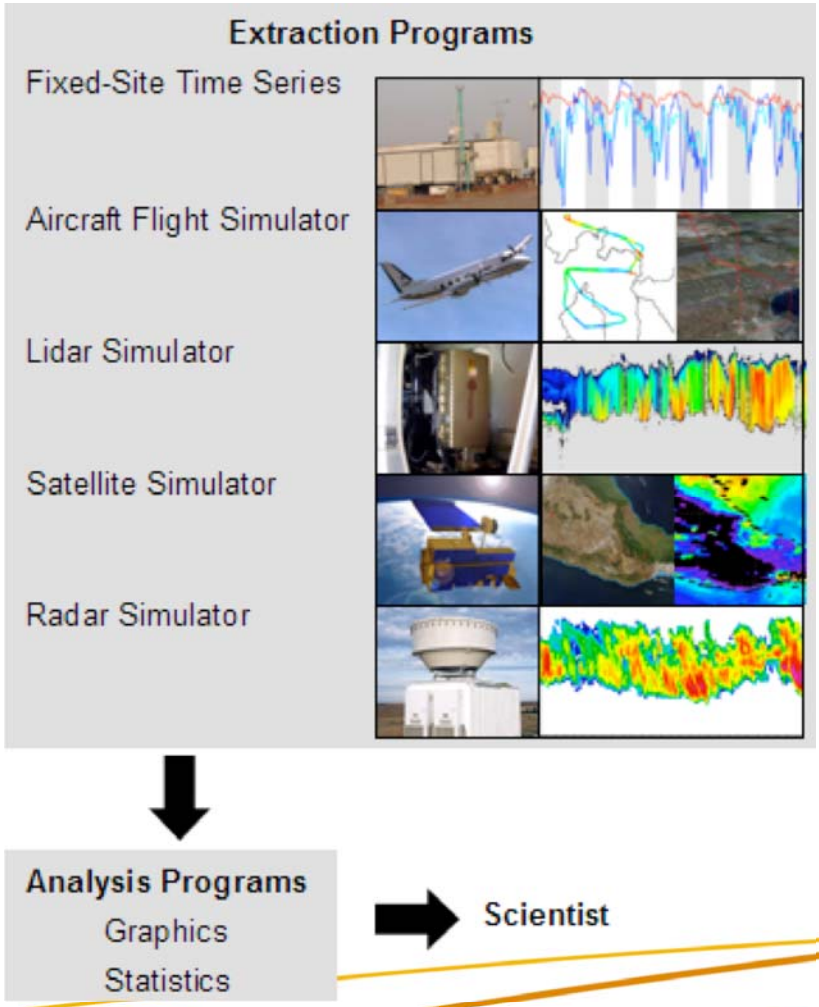
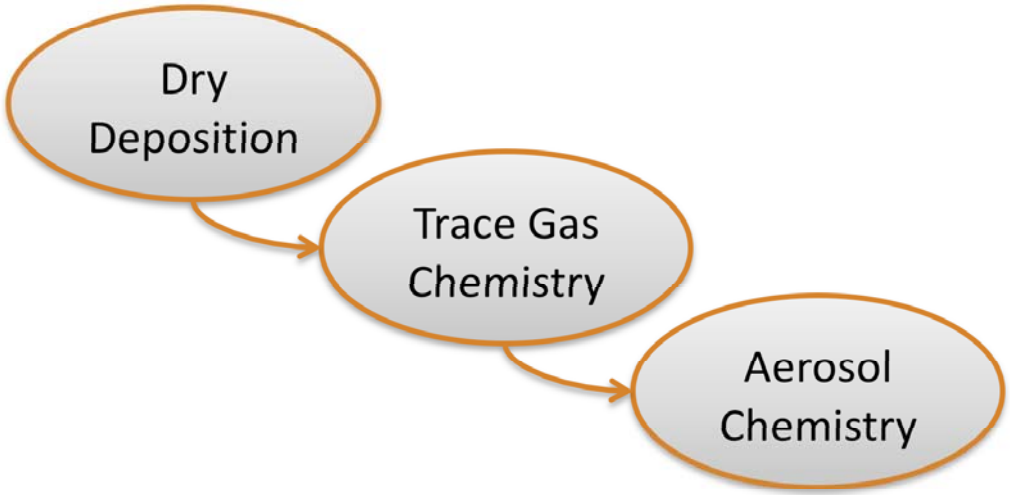
Presentation Goals

- Introduce you to the Analysis Toolkit within the Aerosol Modeling Testbed (AMT)
- Use an analysis of sub-GCM-grid variability as an example project



The Aerosol Modeling Testbed (AMT)

- A framework targeted for developing aerosol modules
  - Primary purpose is aerosols
  - Not limited to aerosols—useful for much more
- Three primary components
  - Modularization of aerosol related WRF-Chem components
  - Statistics and plotting routines for comparing model output with observations (the "Analysis Toolkit")
  - Long-term archive of WRF-Chem simulations documenting model improvements over time



The AMT Analysis Toolkit

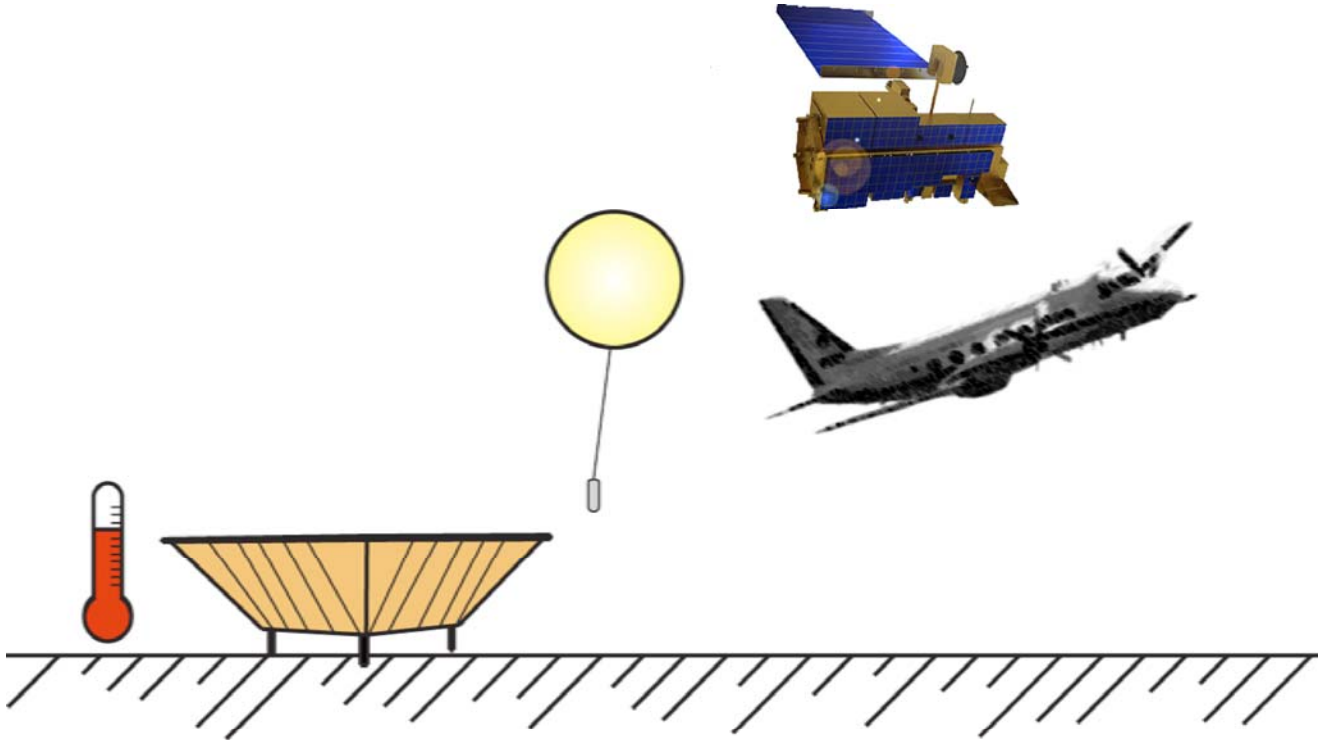
- A framework for quickly quantifying affects of model changes
  - Observation datasets for selected field campaigns
  - Statistical comparisons
  - Overview plots
- Meant to be a tool for scientists developing code to ease their burden comparing with observations
  - Pre-compiled field campaign datasets encompassing all available and valid data
  - Data is pre-formatted from raw investigator formats into a uniform fixed-width ASCII format (netCDF for satellite data)

Complimentary to MET

AMT Analysis Toolkit	MET
Oriented towards field campaigns	Oriented towards operational data
Chemistry data require extensive pre-processing for both obs and model	Designed for use with traditional meteorology data
ASCII and some netCDF	Grib and some netCDF
Basic statistics for “continuous” variables	Basic plus advanced techniques, e.g. “categorical” variables, wavelets, MODE

What kind of observations?

- Can be used with almost any observed time series converted to the simple ASCII file format
- Capable of handling most major instrument types
  - Surface (stationary), aircraft (mobile), profiles, satellite
  - Not yet able to handle volumes, e.g. scanning radar



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The MILAGRO Dataset

- The Megacity Initiative: Local and Global Research Observations (MILAGRO)
- Mexico City during March 2006
- DOE, NSF, NASA, USDA Forest Service, & Mexican agencies
  - Full dataset consists of 20,000 files, 65 GB
  - Consistently formatted with some quality control

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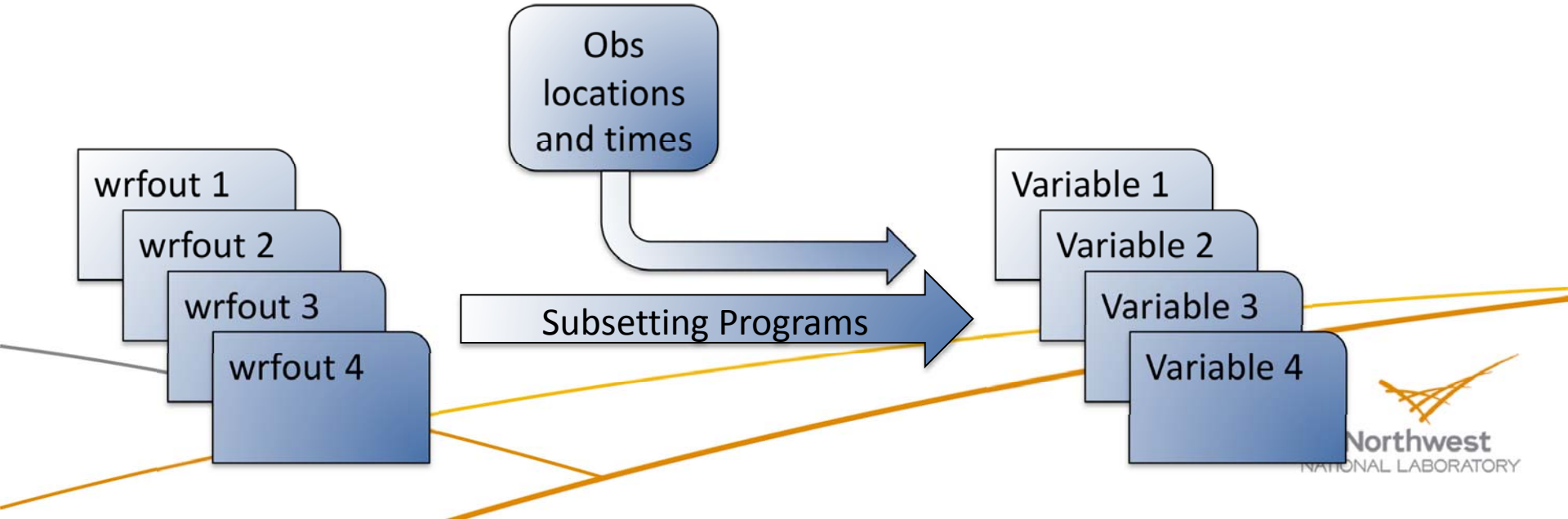
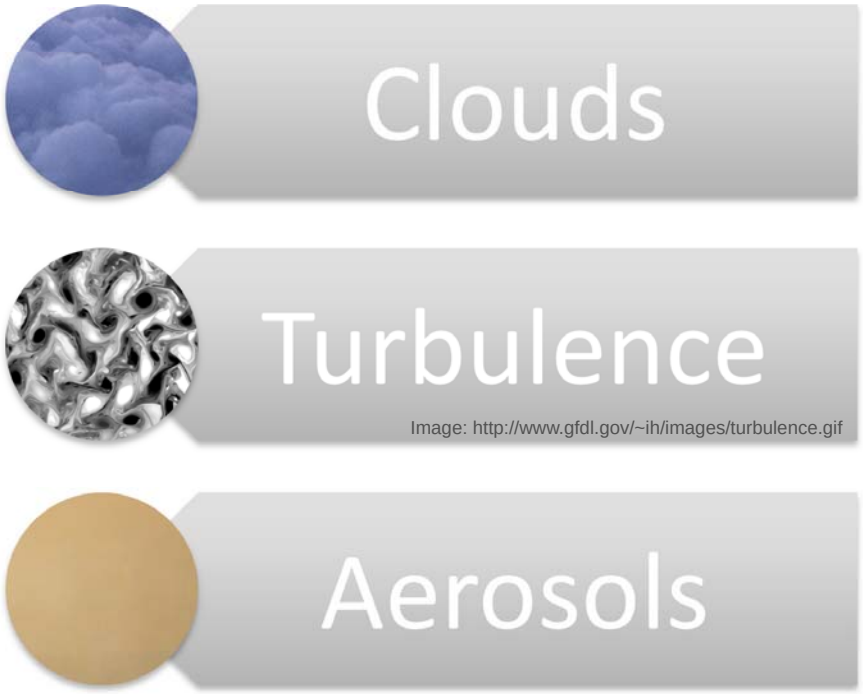
Toolkit Extraction Philosophy

- Extract WRF output corresponding to each obs location
- For aircraft and profiles, WRF is interpolated in space and time to match each observation (typically every 10 or 60 seconds)
- For surface, WRF is extracted at each output time, with time "matching" occurring during analysis
- For satellites, the user has a range of options depending on the particular type of variable and need



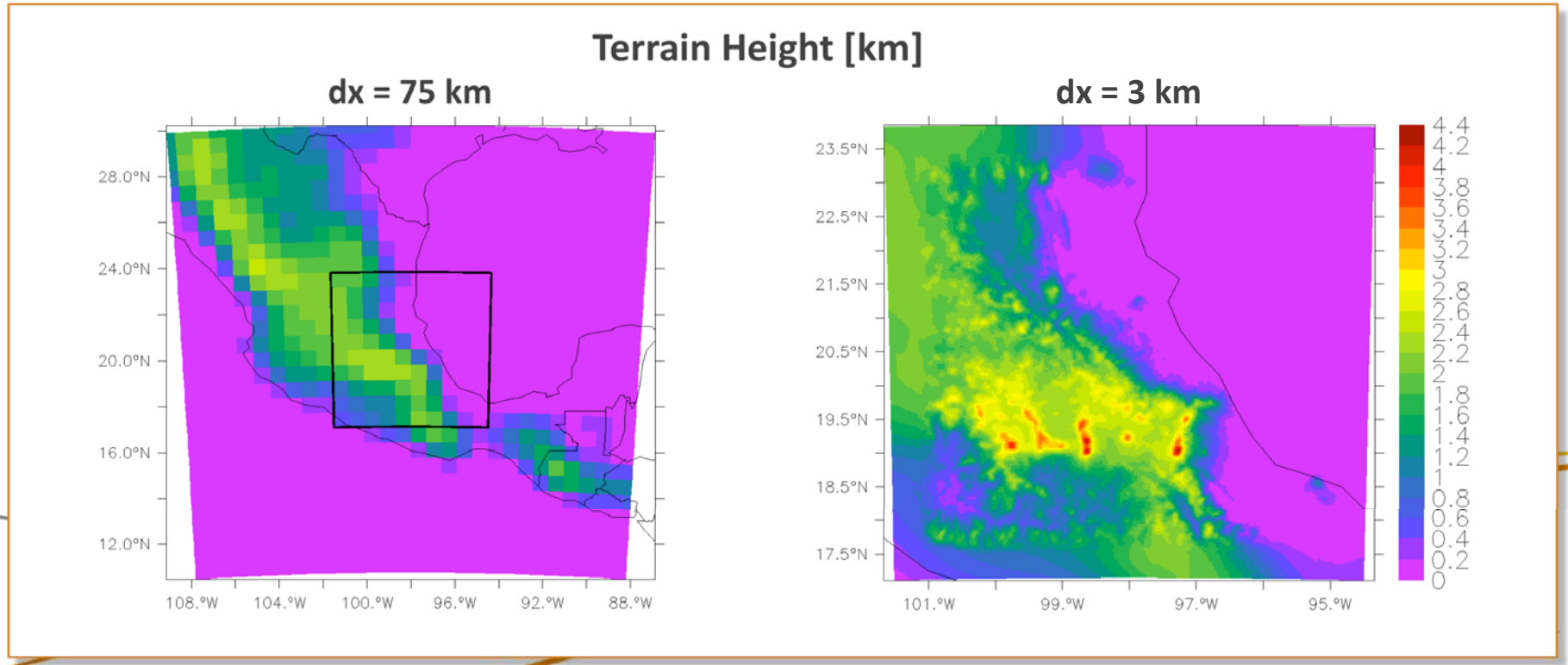
Example Application: Sub-GCM-Grid Cell Variability



- Sub-grid processes affect aerosol climate forcing
- Current sub-grid parameterizations generally neglect aerosols
- Realistic, accurate simulations of local climate will require sub-grid aerosol parameterizations

Methodology

- Use a multi-scale approach with WRF-Chem to replicate grid spacings from GCM to cloud-scale resolving resolutions
- Provide identical boundary conditions for central Mexico
- Configure domains as similarly as possible



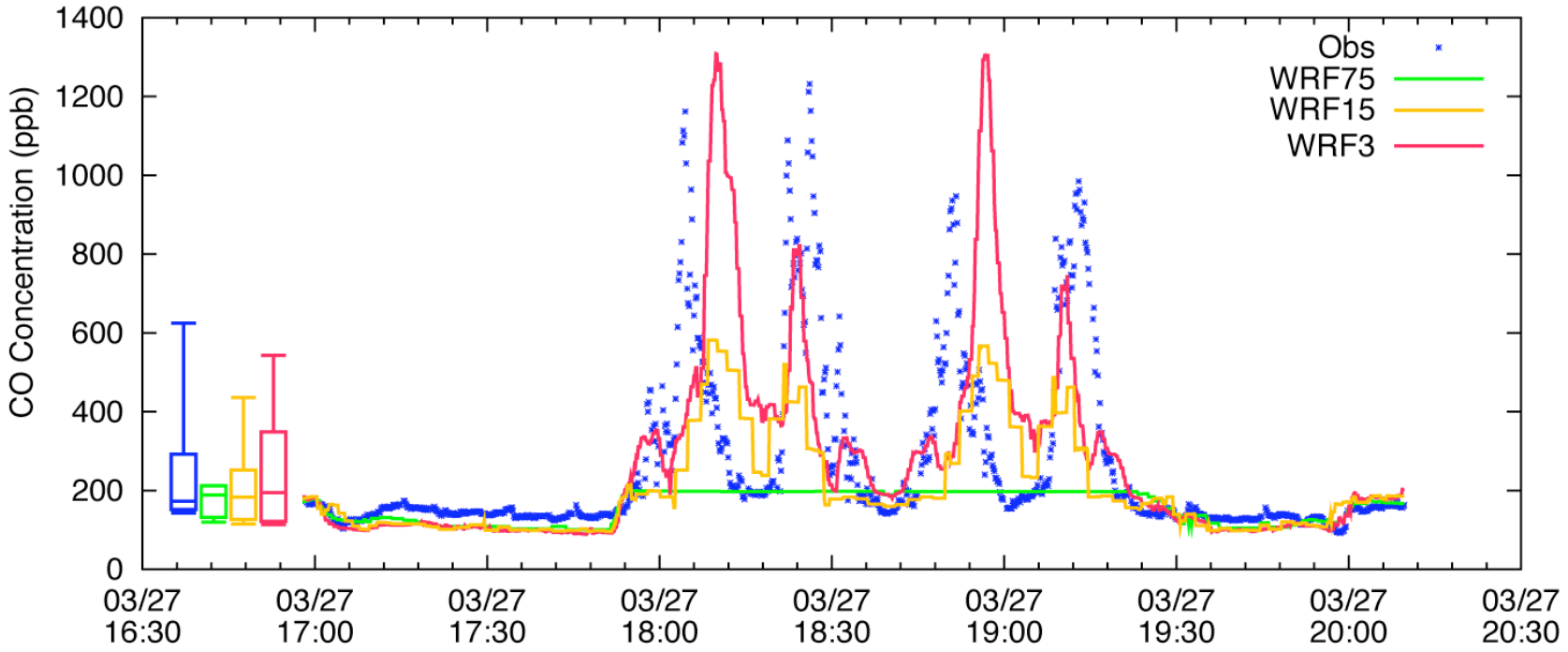
Apply the AMT Toolkit

- Use the Toolkit as a first step to evaluate the model

- Run the “location” programs to get I/J/K info
- Run the “pullvar” programs to subset the WRF simulations
- Run the various statistics and plotting routines

    - What do we get…

CO Comparison: Native Resolution
G-1 Aircraft, 27-Mar-2006



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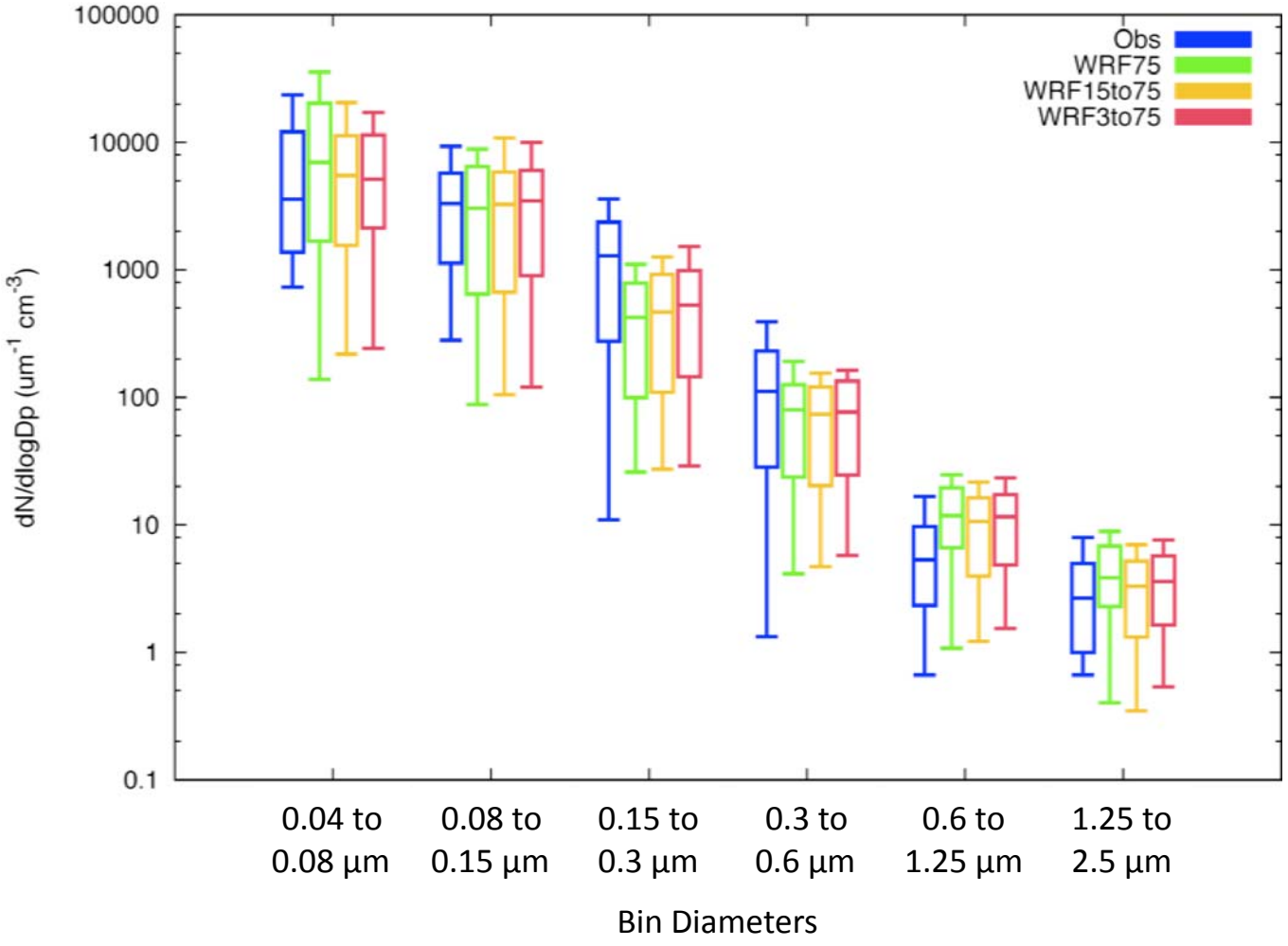
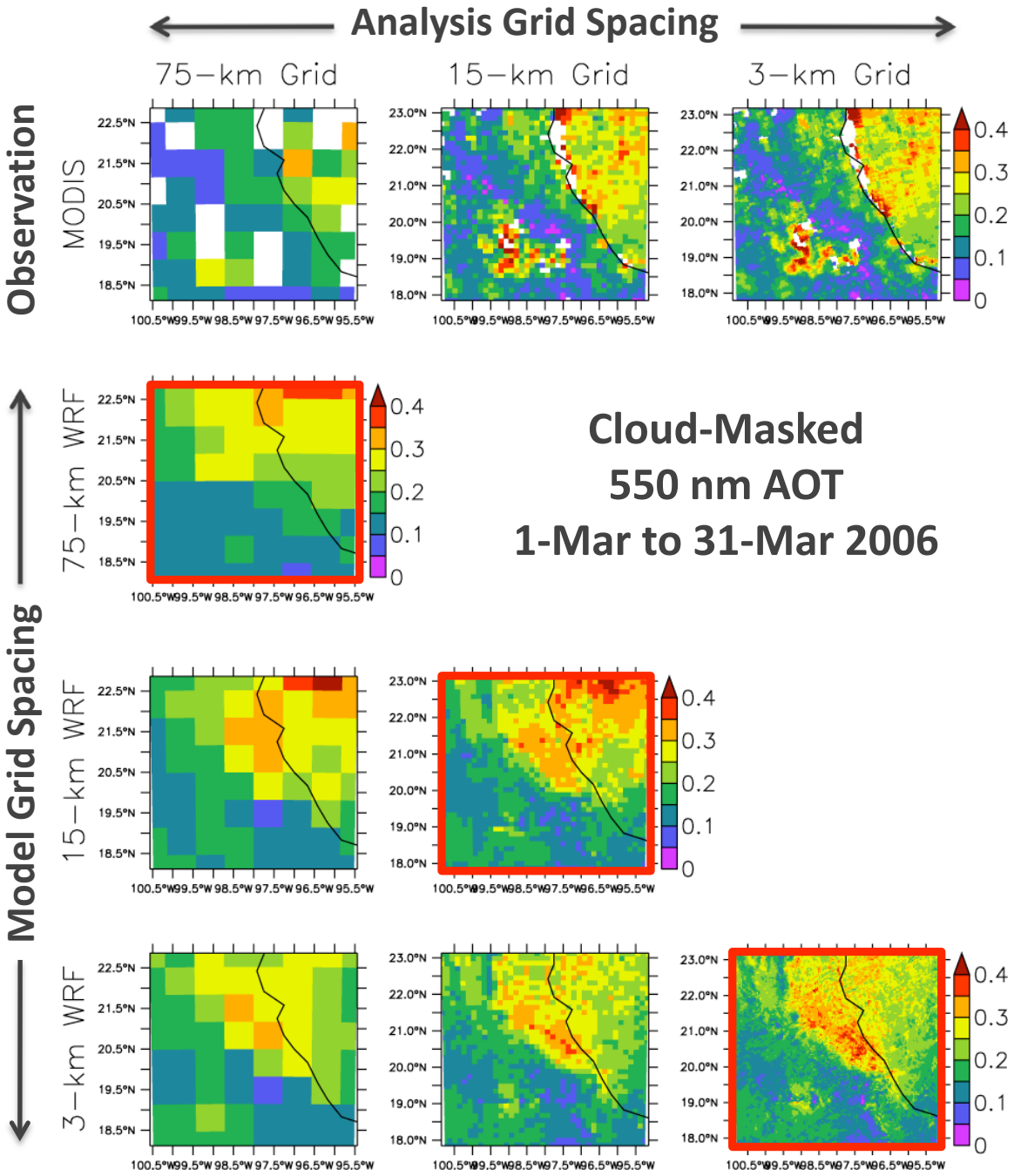
Particle Number Concentration for G-1 Flights: 10, 25, 50, 75, & 90th Percentiles, 75-km Grid

- Under prediction of optically important 3rd & 4th bins



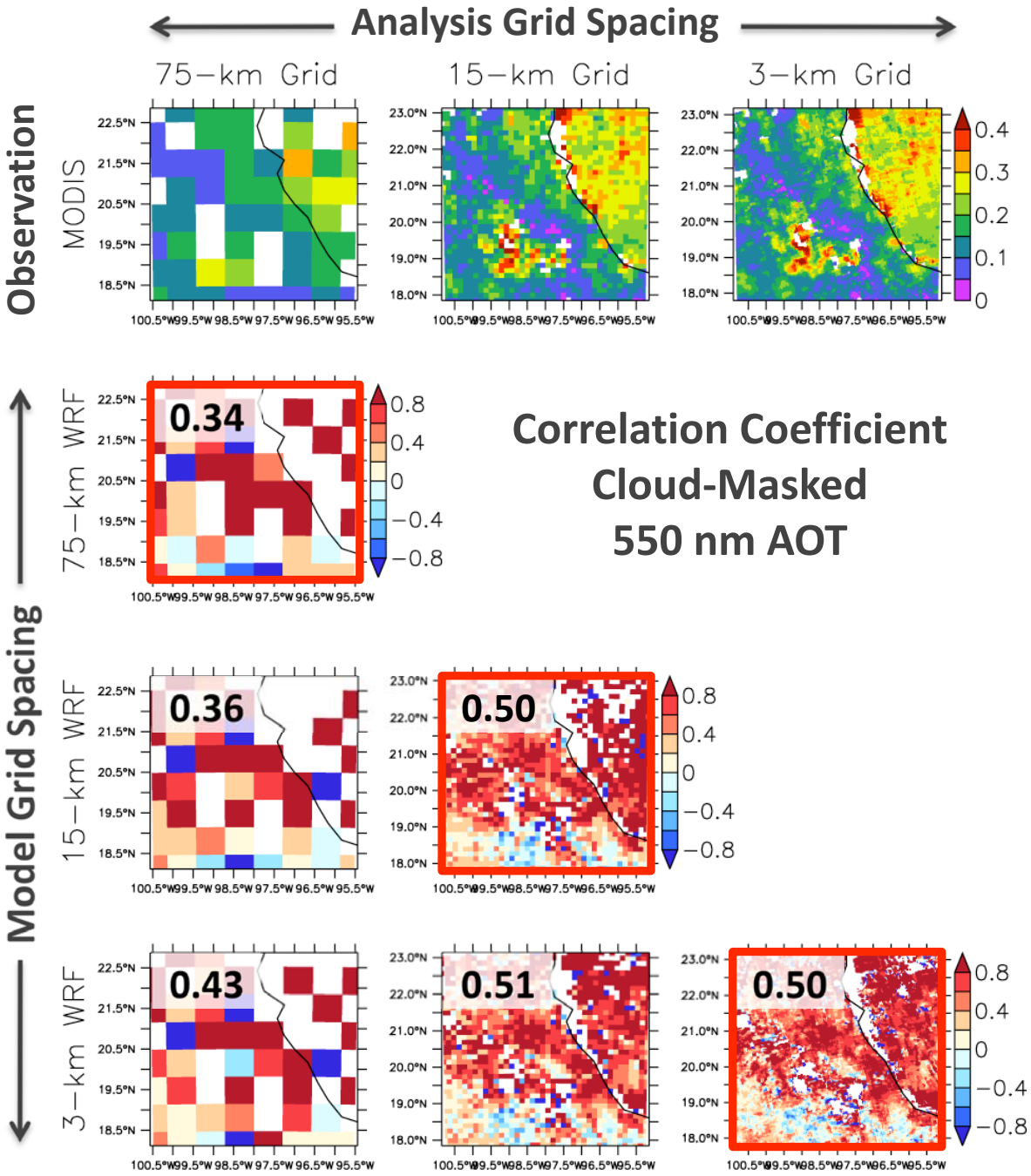
AOT Comparison: MODIS on Aqua

- Recently added a MODIS satellite simulator to the Toolkit
- Satellite comparisons on user defined grids
  - WRF domains
  - Cylindrical equidistant (lat-lon) grids



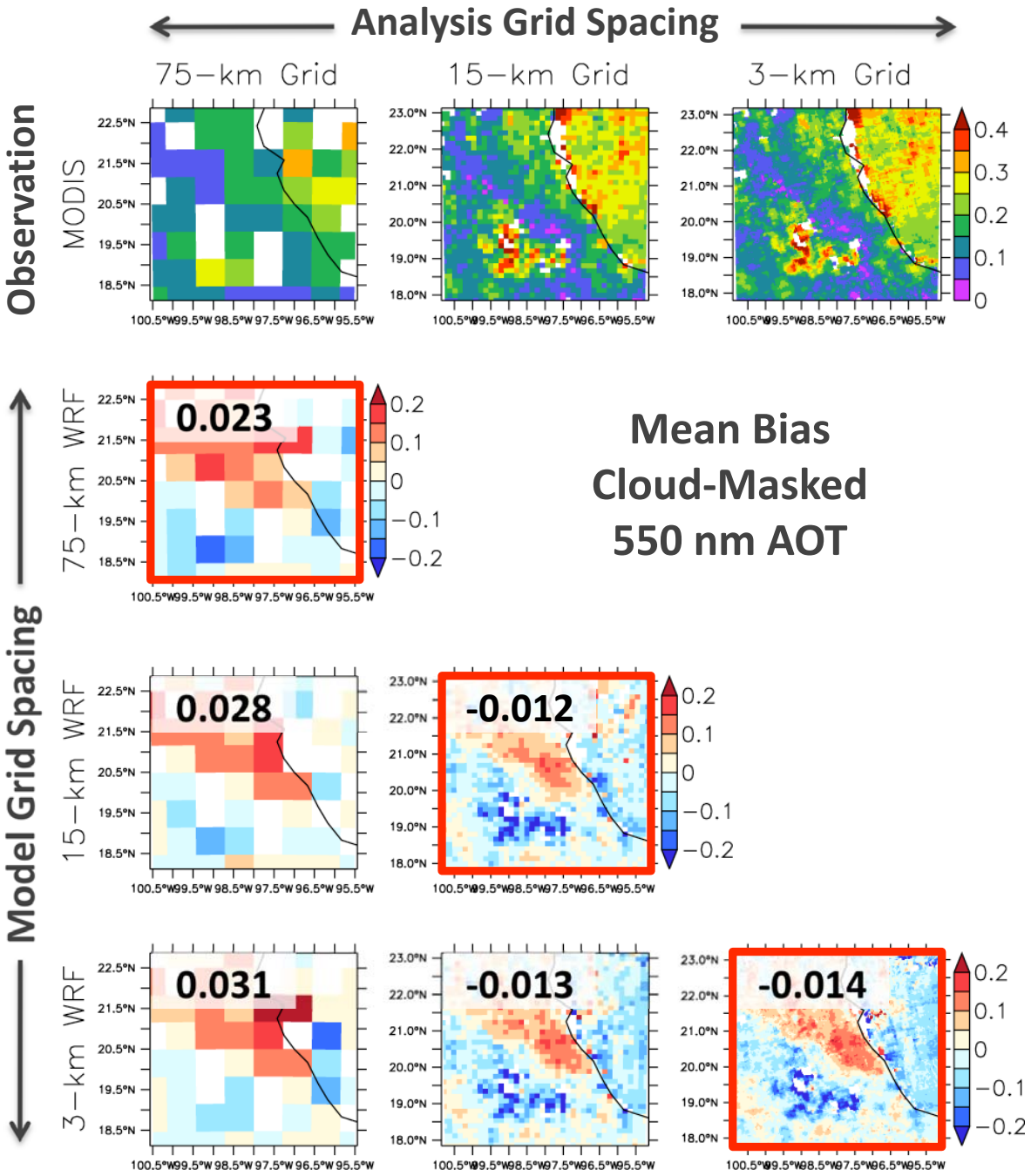
AOT Comparison: MODIS on Aqua

- Increasing model resolution improves time correlation at coarse scale
- Fine scales are similar



AOT Comparison: MODIS on Aqua

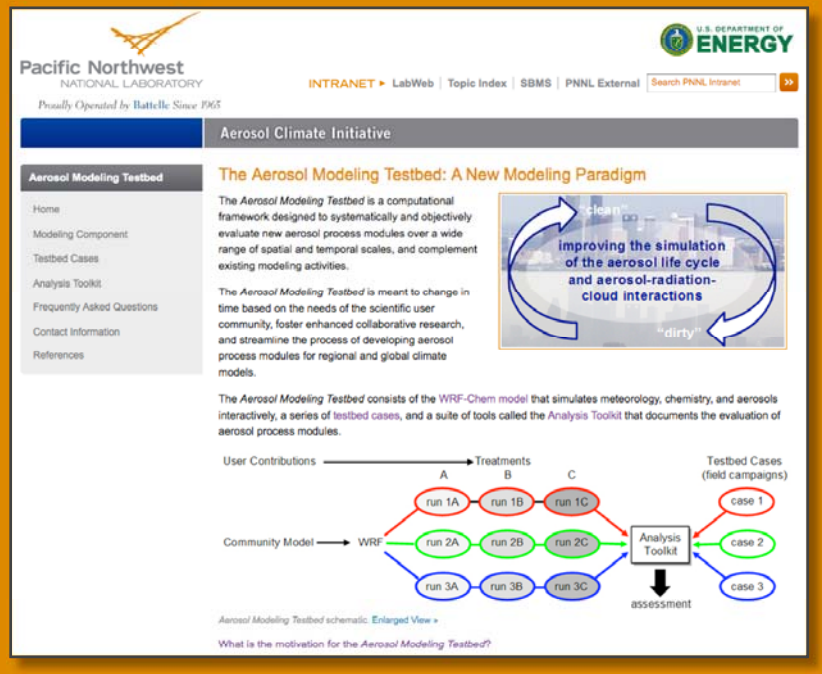
- Fine scales simulate an overall underestimate
- Regionally dependent
- Slight worsening with scale for mean bias
- Statistics of AOT sensitive to cloud-masking technique



For more information about the AMT…

Later this summer more information will be available at:

http://www.pnl.gov/atmospheric/research/aci/aci_proj_testbed.stm



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