Anticipated Insights from GOAmazon to Better Model the Aerosol Lifecycle

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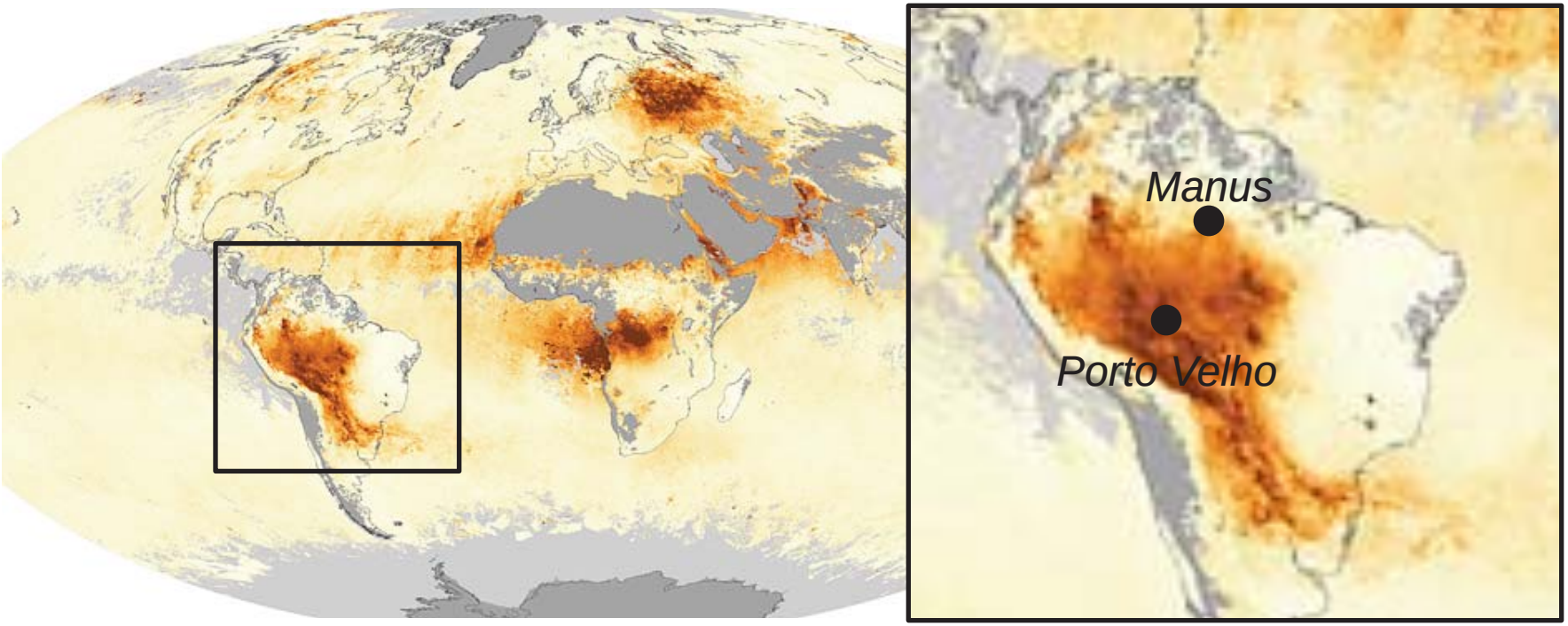
GOAmazon Breakout Session



August 2010 AOD from NASA MODIS

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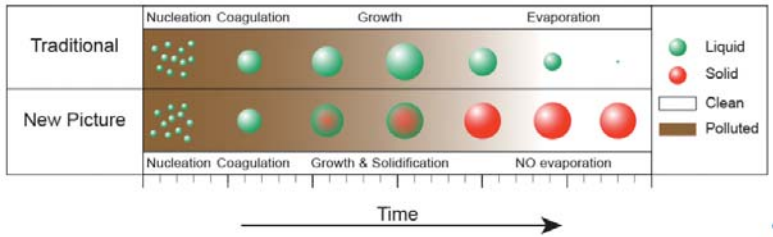
Issues Relevant to Modelers

Major Uncertainties in Model Predictions that Require Additional Data for Evaluation and Parameterization Development

Secondary Organic Aerosols:

- Anthropogenic-biogenic interactions
- Biomass burning SOA

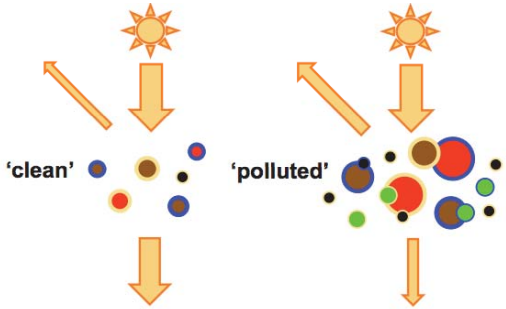


Carbonaceous Aerosols:

- Chemical transformation and mixing of soot and organics

Aerosol Optical Properties:

- Differences in optical properties between aerosols between pristine and anthropogenically influenced air masses
- Aerosol direct and semi-direct effects of aerosols on local meteorology, which consequently could change biogenic emissions of aerosol precursors



CCN Properties:

- Differences in hygroscopic and CCN properties between between pristine and anthropogenically influenced air masses

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Regional Modeling Challenges: Manageable

Regional Modeling for GOAmazon Will be More Challenging than for Other Locations

Meteorology:

- Larger forecast errors in simulated winds during weak synoptic forcing that will affect transport
- Larger forecast errors for clouds during weak synoptic forcing that will affect were when convection occurs, and consequently in-cloud vertical transport and precipitation that affects wet removal

Land Use:

- Default land-use dataset unlikely to include most recent manmade changes in vegetation type
- Incorrectly specifying land-use type can lead to errors in surface heat and moisture fluxes, and consequently boundary layer and cloud processes

up-to-date maps available for Manaus region, but eventually need all of the Amazon for large scale modeling studies

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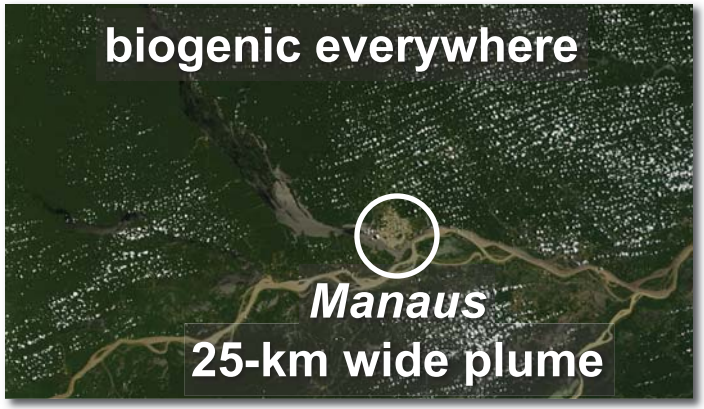
Regional Modeling Challenges: Problematic

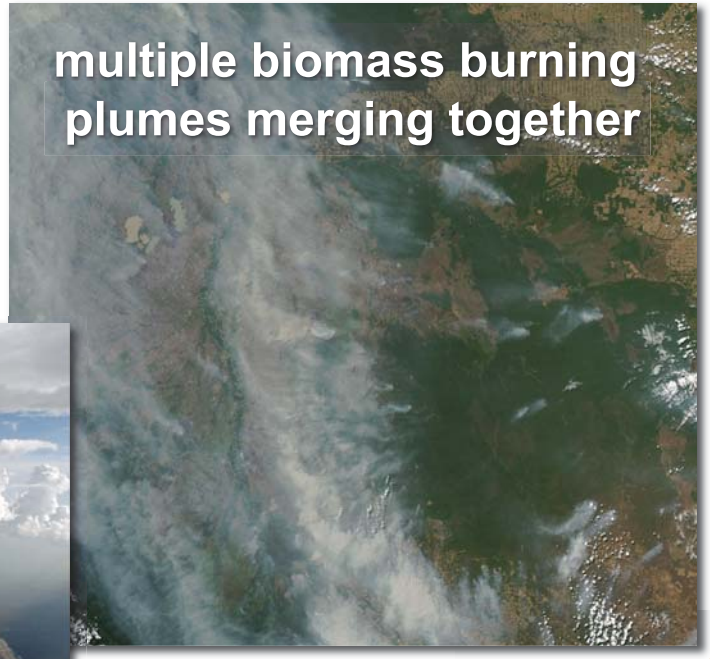
Emissions:

- No anthropogenic inventory, what about mobile, industrial, petrochemical sources?
- Analysis of aircraft transects coupled with other sampling can be used to infer emissions and compare with inventories
- Iterative process likely needed between data and model predictions to assess emission inventories
- On-line biogenic emissions requires meteorology to be simulated well
- MODIS will miss small fires and fires of short duration

Plume Injection Heights:

- Need temperatures of fires
- Impossible to document injection heights of all fires, but some should be estimated





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Regional Modeling Challenges (3)

All of these issues will need to be addressed for 3-D models to **test, evaluate, and improve parameterizations** of aerosol processes and properties, such as SOA evolution, optical properties, and CCN properties

Global Modeling Challenges

Additional Challenges for Representing the Aerosol Lifecycle on Top of Regional Modeling Challenges

- Global model grid cells employ Δx ~ 50 to 200 km, so large fraction of measurements are likely to fall within one or a few grid cells
- What is the best way to compare point measurements with global model grid cell averages?
  - *Use aircraft transects to estimate spatial representativeness of surface measurements*
- How will global model represent over time the mixing of anthropogenic and biogenic sources that are in close proximity with one another?
  - *Nonlinear chemistry of evolving anthropogenic plume downwind*
- Will mixing of point emissions affect chemistry and gas-to-particle partitioning associated with biomass burning plumes?
  - *Chemistry of single plume versus lumping many biomass plumes together*
- While biogenic emissions may be ~homogeneous in undisturbed areas, what is the best way to handle biogenic emissions in deforested areas?
  - *Adjust average biogenic emissions in a grid cell*

Data Issues of Interest to Modelers

New Particle Formation

- Will there be sufficient information to help explain reasons for NPF?

Coarse Aerosols

- Composition and number, but maybe this is not important in the Amazon?

Organic Components

- Analysis of AMS is needed (not trivial activity), but can be done after campaign
- Sufficient precursors trace gas measurements to improve understanding of SOA formation?

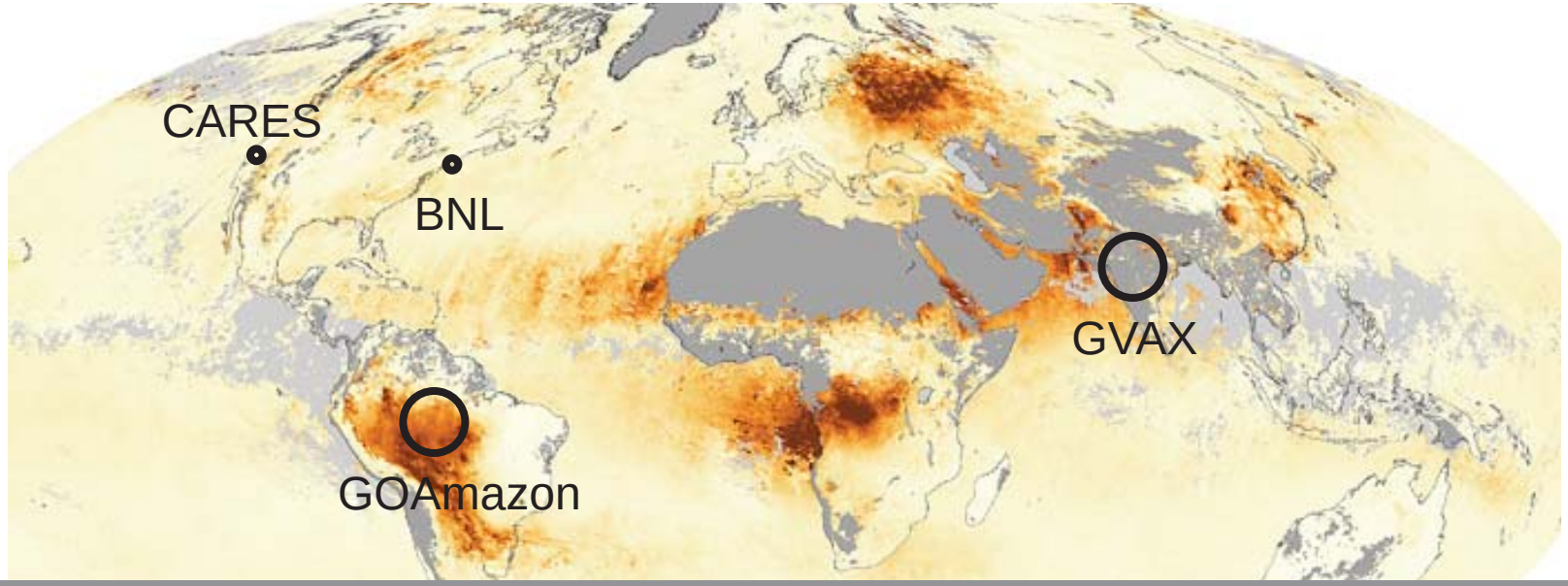
Aerosol Mixing state

- Missing measurements? Will this affect understanding of how soot ages?

Coupling GoAmazon to Other Locales

- Need to evaluate performance of aerosol models and parameterizations not just over the Amazon, but **for other locations** as well
- For climate models, parameterizations should be applicable to **a wide range** meteorological conditions and emission sources

Recent ARM campaigns with similar science objectives on the aerosol lifecycle



There will be modeling activities associated with each, but additional scientific benefits and outcomes to ASR could be attained by a more coordinated activity

Aerosol Modeling Testbed

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