Satellite Continuity and Synergy Panel

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What do we really need from our satellite aerosol products, globally?

- Observational Estimates of **Direct Aerosol Radiative Forcing** w/Uncertainty
- Observational Estimates of **Indirect Aerosol-Cloud Forcing** w/Uncertainty
- Constraints on **Aerosol Source Strength** for Climate/Air Quality ***Model Initialization***
- Constraints on **Aerosol Injection Height** for Climate/Air Quality ***Model Initialization***
- Constraints on **Aerosol Removal Processes** for ***Model Parameterizations***
- Global, 4-D Distribution of **Aerosol Amount (AOD)** for ***Model Constraint & Validation****
- Global, 4-D Distribution of **Aerosol Type** for ***Model Constraint & Validation****

And to be useful, there are *quantitative* requirements on each of these…

* *Also needed for Observational Direct & Indirect Forcing Estimates*

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(Some of) what we need *in addition to* typical satellite aerosol products

- Aerosol Amount & ***Type*** **Diurnal Coverage** Globally (geostationary + …)
- Aerosol ***Amount & Type*** **Below Cloud** Globally (active sensors + …)
- Aerosol ***Amount & Type*** **at High Latitudes** (active sensors + …)
- **CCN and IN** Amount & Type
- Aerosol **Hygroscopicity** (per type)
- Aerosol **Mass Extinction Efficiency** (per type)
- Aerosol **Light-Absorption (SSA; AAOD)** (per type)
- Constraints on ***Aerosol-Cloud Interaction*** **Processes**
- Constraints on ***Particle Formation*** **Processes**
- **Also**: Very high-quality ***Rel. & Abs.*** ***Radiometric Calibration***

frequent, global *snapshots*; aerosol amount & aerosol type maps, plume & layer heights

Remote-sensing Analysis
- Retrieval Validation
- Assumption Refinement

Regional Context

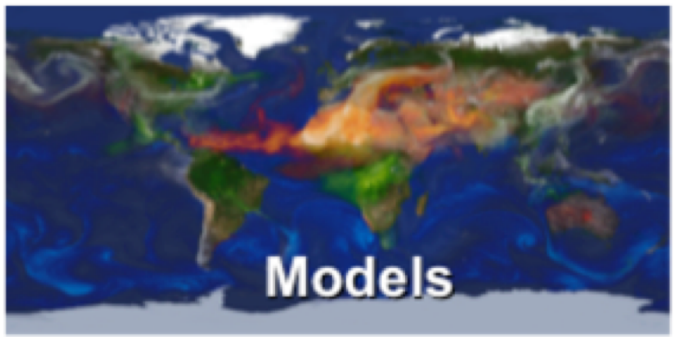
targeted chemical & microphysical detail

point-location time series

CURRENT STATE
- Initial Conditions
- Assimilation

Aerosol-type Predictions; Meteorology; Data integration

Model Validation
- Parameterizations
- Climate Sensitivity
- Underlying mechanisms



space-time interpolation,
Aerosol Direct & Indirect Effects
calculation and prediction

Must ***stratify*** the global satellite data to treat appropriately situations where **different physical mechanisms** apply

Adapted from: Kahn, Survy. Geophys. 2012

SAM-CAAM *Concept*

[Systematic Aircraft Measurements to Characterize Aerosol Air Masses]

[This is currently a ***concept-development effort***, not yet a project]

Primary Goals:

- Interpret and *enhance 18+ years of satellite aerosol retrieval* products
- *Characterize statistically particle properties* for major aerosol types globally, to provide detail unobtainable from space, adding value to all satellite aerosol data:

-- Improved aerosol property assumptions/initialization in satellite *retrieval algorithms*

-- More robust *translation between satellite-retrieved aerosol optical properties and* species-specific aerosol mass and size tracked in *aerosol transport & climate models*

Kahn et al., BAMS 2017

SAM-CAAM *Objective*

[Systematic Aircraft Measurements to Characterize Aerosol Air Masses]

Obtain ***aerosol intensive property PDFs*** required for key aerosol science objectives, but cannot be retrieved with adequate precision, or are ***entirely unobtainable from remote sensing****

- ***Hygroscopicity**** – Particle ambient hydration, aerosol-cloud interactions
- ***Mass Extinction Efficiency**** – Translate between retrieved optical properties from remote sensing & aerosol mass book-kept in models
- ***Spectral Light-Absorption*** – Aerosol direct & semi-direct forcing, atmospheric stability structure & circulation
- ***CCN Properties**** – At least part of the CCN size spectrum is too small to be retrieved by remote-sensing

SAM-CAAM is feasible because:
Unlike aerosol amount, ***aerosol microphysical properties tend to be repeatable*** from year to year, for a given source in a given season

Kahn et al., BAMS 2017

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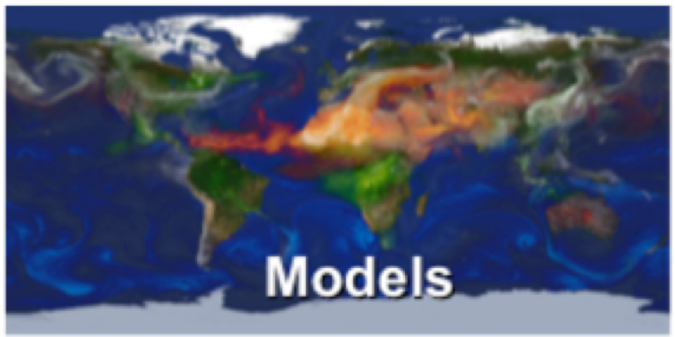

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