Aerosol Forecasting and Data Assimilation at GMAO

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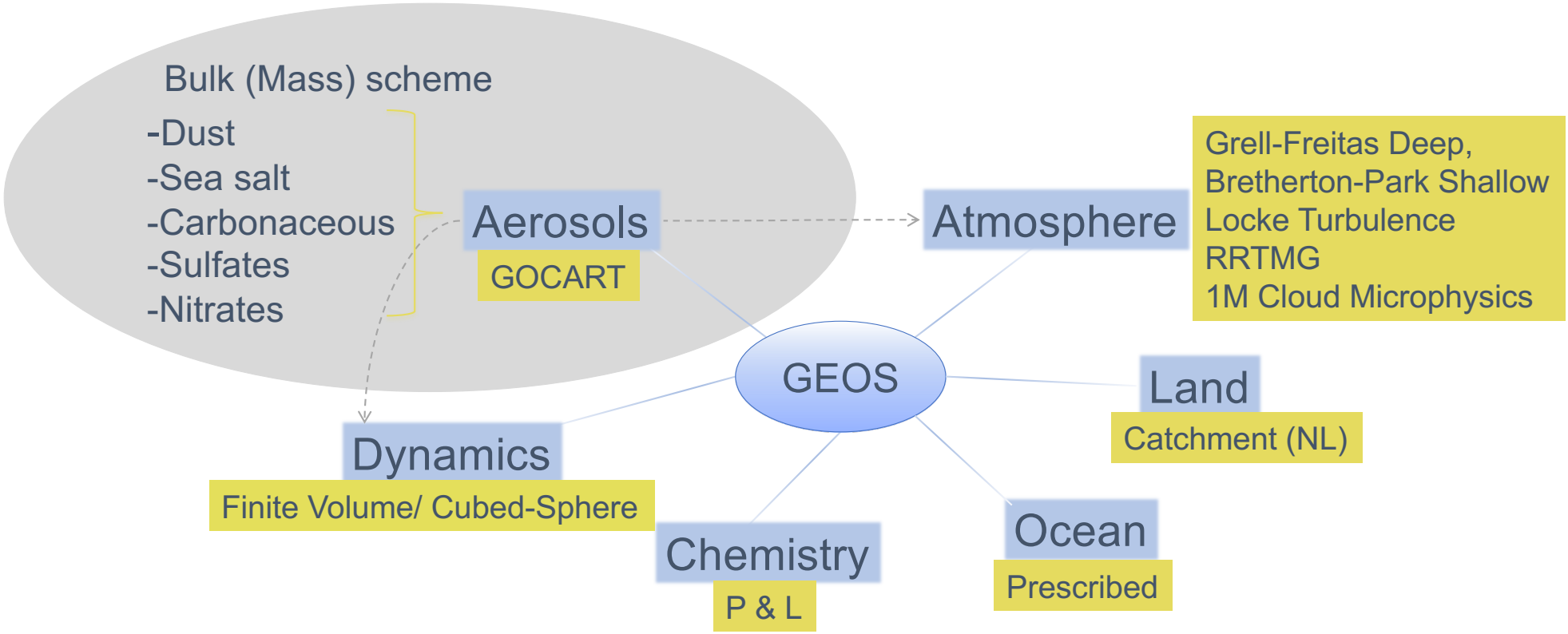
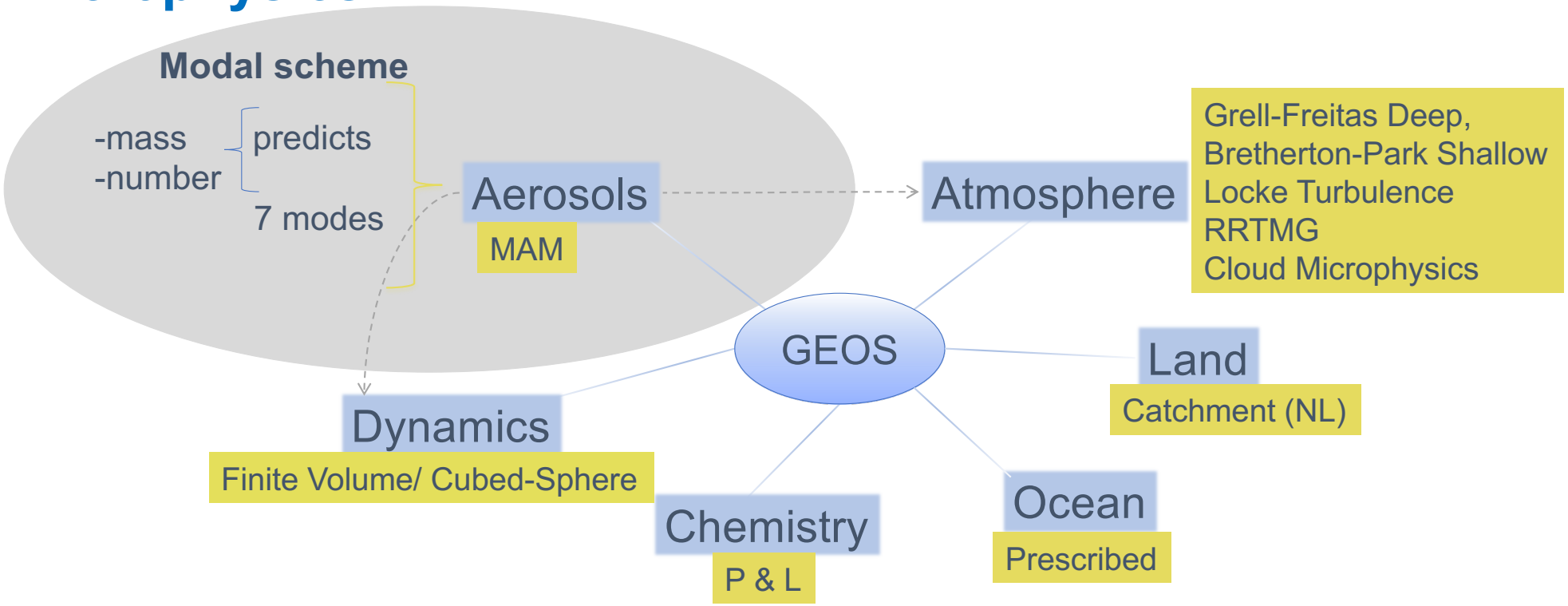
Current GEOS forecasting and Data Assimilation System



Global, 12.5 km , 72 Levels, top at 0.01 hPa

GEOS Aerosol Development: Aerosols & Clouds Microphysics



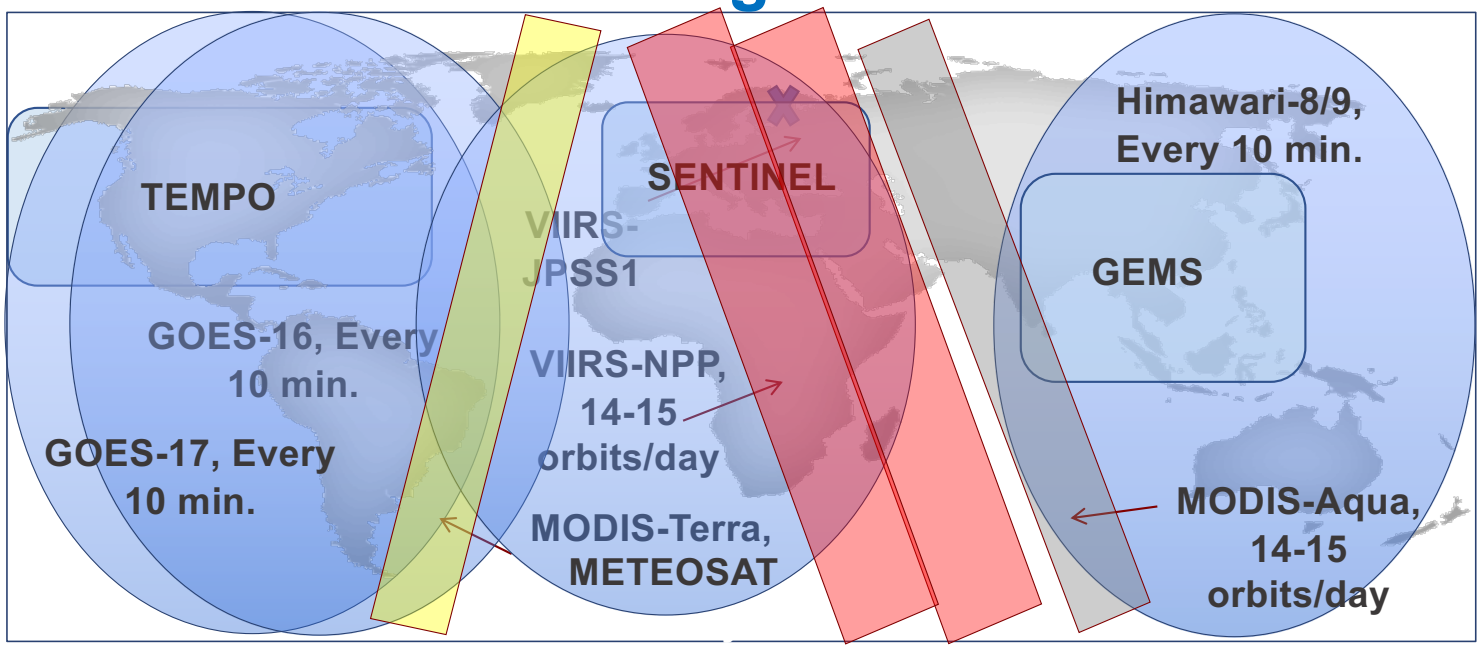
Global, 12.5 km , 72 Levels, top at 0.01 hPa

Aerosol Data Assimilation

- *Current system for Aerosol Analysis: Splitting*
  - 2D-PSAS aerosol analysis with Local Displacement Ensembles **AOD observation at 550nm**.
    - single-wavelength AOD measurements primarily constrain the amount of aerosol in a column, with the vertical structure and speciation primarily determined by the specified emissions and the vertical (and horizontal) transport provided by the model.

- *Future Aerosol Analysis:*
  - *JCSDA –JEDI* hybrid ensemble-variational scheme
    - Multi-wavelength AOD, radiances
    - Lidar observables: vertical profiles of extinction, backscatter at multiple wavelengths
    - Aerosol optical centroid height

Target Aerosol Observing System in GEOS: LEO & GEO Program of Record

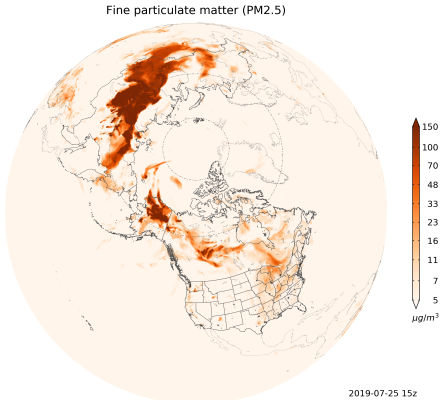


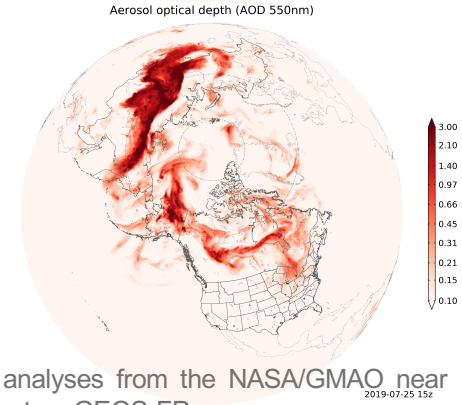
- Current GEOS-FP system assimilates MODIS and AERONET observations
- Assimilation of geostationary GOES and Himawari data are in implementation and testing phases
- Assimilation of VIIRS planned after geostationary data have been implemented.

Summary of GEOS Aerosol Activities (1)

Name	Nominal Resolut-ion	Period	Aerosol Data	Products (among others)	
MERRAero	50 km	2002-2015	MODIS C5	replaced by MERRA-2	REANALYSIS
MERRA-2	50 km	1979-present	AVHRR, MODIS C5/C6, MISR,AERONET	AOD, 3D aerosol profiles of mass, surface PM2.5,…	
GEOS-FP	12.5 km (Output 25km)	on-going	MODIS C6, AERONET	AOD, 3D aerosol profiles of mass, surface PM2.5,… 5 days forecast	NRT

2019 Boreal Forest Fires





Example for July 25, 2019, using analyses from the NASA/GMAO near real-time atmospheric assimilation system GEOS-FP

https://gmao.gsfc.nasa.gov/research/science_snapshots/2021/n_hemi_fires_2020.php

Summary of GEOS Aerosol Activities (2)

- GEOS products are used as ancillary data for several EOS instrument teams, including CALIPSO, CERES, MODIS, etc.
  - GEOS aerosol analyses and short-term forecasts can provide valuable priors to constrain ACCP Level 2 retrievals
  - By assimilating ACCP measurements, GEOS aerosol data assimilation system can also be used to generated ACCP space-time continuous Level 4 data products
- GEOS aerosol forecast have supported an increasing number of NASA, NOAA and DoE airborne campaigns
- GEOS aerosol forecasts are included in ICAP ensemble and WMO SDS services
- Interests from the CDC and John-Hopkins epidemiologists on using GEOS surface $PM_{2.5}$ gridded fields
- Research and applications communities, academia, ….