Development toward global aerosol DA system at NCEP

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EMC GSI-EnKF group
Aerosol data assimilation development in NCEP

- NCEP started the efforts to develop global aerosol forecasting and assimilation capabilities in 2010.
- NCEP aerosol data assimilation project was suspended in May 2012 due to budgetary constraints.
- NGAC, with the potential benefits to improve weather/climate forecasts, was implemented in Sept 2012.
MODELS
Implement a new unified global coupled data assimilation and modeling suite.
4.13
4.13.1 Couple the atmosphere to the ionosphere, ocean, sea ice, waves, land, and chemistry.
4.13.2 Develop scale-aware physics to enable unified approach to modeling.
4.13.3 Implement Next Generation Global Prediction System dynamic core.
NGGPS Prediction Model Components

- NGGPS implementation plan development includes an aerosol team
- Development of dust/aerosol capabilities is underway by universities and federal labs

Atmospheric Components
- Atm Dycore (TBD)
- Atm Physics (GFS)
- Aerosols (GOCART)
- Atm DA (GSI)

Ocean
- Ocean (HYCOM) (MOM)
- Wave (WW3) (SWAN)
- Sea Ice (CICE/KISS)

Land Surface (NOAH)

NEMS/ESMF

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NCEP Coupled Hybrid-EnKF Data Assimilation System

Coupled Model Ensemble Forecast

NEMS
- OCEAN
- SEA-ICE
- WAVE
- LAND
- AERO
- ATMOS

Ensemble Analysis (N Members)

Input

OUTPUT

Suranjana Saha
ICAP WG Meeting, 15-19 Jun 2015
NGGPS Dust/Aerosol Development in Progress

Prognostic aerosols (GOCART) in candidate dynamic core
- Implementation and Testing of Regional and Global Dust Forecasting (Ginoux, GFDL)
- Using Advanced Photochemical and Aerosol Modules to Verify the Applicability of GOCART Aerosol Modules within Global Weather Prediction Models (Grell, ESRL)

Aerosols and weather/precipitation
- Investigation of Aerosol Effects on Weather Forecast using NCEP Global Forecast System (Lu, SUNYA)
- Evaluating the Impact of Cloud-Aerosol-Precipitation Interaction (CAPI) Schemes on Rainfall Forecast in the NGGPS (Li, U Md)

Upgraded to modal aerosol model
- Improving Cloud Microphysics and Their Interactions with Aerosols in the NCEP Global Models (Lu, SUNYA)

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Aerosol data assimilation development in NCEP

- NGAC aerosol data assimilation using VIIRS AOD is funded by JCSDA from 2015-2016

- NCEP Aerosol data assimilation is build upon the NCEP(w/SUNYA) – GSFC - STAR collaborations. We will leverage expertise in NOAA laboratories (e.g. OAR ERSL) and research communities (e.g. NCAR) under NGGPS program.
The global aerosol analysis system at NCEP will be implemented with incremental updates:

- The first phase is based on GSI framework using VIIRS AOD as input observations and the NGAC output as first guess.
- The system will be extended to use multi-sensor and multi-platform aerosol observations and evolve to an EnKF system.

The primary outcomes include:

- Improved operational global real-time aerosol forecasts. JPSS aerosol information will be assimilated in the NWS operational data assimilation system for the first time.
- A prototype global coupled system with aerosol modeling and data assimilation capabilities.
NGAC Data Assimilation flow chart

NGAC background (converted to 2D) → Aerosol DA → New 2D AOD fields → 2D AOD to 3D mass fields → Run NGAC → Next Cycle

- VIIRS AOD retrievals (2D)
- New NGAC background
Milestone and deliverables

- **Activity 1: VIIRS Quality Assurance and Bias Correction**
  - Conduct VIIRS AOD error analysis
  - Establish VIIRS data screening procedure
  - Prototype data assimilation grade VIIRS AOD product

- **Activity 2: Global Aerosol Analysis**
  - Estimate VIIRS observation errors
  - Determine NGAC background errors and conduct base-line NGAC experiments in non-assimilation runs
  - Modify GSI to include AOD as analysis variable and adopt GSFC’s local Displacement technique
  - Conduct AOD assimilation experiments using VIIRS as observation inputs and NGAC as first guess and conduct benchmark study
  - Prototype global aerosol data assimilation system

- **Activity 3: Synergistic activities**
  - GDAS run scripts are modified to use NGAC as prediction model (NWS R2O project) and VIIRS Cal/Val activities (JPSS program)
  - GAC upgraded to multi-species prediction system (EMC base funding activities)
  - Evaluation of retro-NGAC forecasts (CPO MAPP-CTB project)
Future plan

- Aerosol data assimilation will be evolving into an EnKF system.

- The observations will be extended to include multi-sensor and multi-platform aerosol observations.
Thank You