Air Quality Breakout Session Report

Inputs from: L. E. Flynn, H.-C. Huang, S. Kondragunta, C. Long, S. Lu, M. Newchurch, R. B. Pierce, E.-S. Yang, J. Zhang, S. Zhou,

Scientific Development in Air Quality

- Fully or partially funded by JCSDA
  - Improving Global Forecasting System (GFS) ozone forecasts PI: Long, NWS/CPC)
    - OMI, MLS, and HRDLS ozone assimilation. MLS assimilation reduces ozone forecast errors, improves ozone hole forecasts, positively impacts SH 500 mb heights
  - Global aerosol model capability using NEMS/GFS-GOCART (PI: Lu, EMC)
    - Impact of aerosols on surface UV flux, temperature
    - Testing generalized tracer transport in GFS-GOCART
  - Offline GFS-GOCART (PI: Davidson/McQueen)
    - WMO dust warning system
    - Support National Air Quality Forecast System (NAQFS)
  - Aerosol data assimilation using operational MODIS aerosol products (PI: Reid, NRL)
    - Developed NAVDAS-AOD assimilation package is in transition to FNMOC operations
    - Developed QA/QC procedures for assimilating MODIS AOD data
    - Tested aerosol data fusion from multiple sensors using assimilation[2]

Scientific Development in Air Quality

- Unfunded by JCSDA (Leveraged Funding)
  - Satellite AOD assimilation to improve CMAQ PM2.5 Predictions (PI: Kondragunta, NESDIS)
    - Positive impact for GOES and MODIS AOD assimilation. Impact (positive or negative) depends on quality of satellite data and knowledge of vertical distribution of aerosols
  - RAQMS TES/OMI/MLS/OSIRIS/MODIS data denial studies: Impacts of satellite measurements on tropospheric ozone (PI: Brad Pierce, NESDIS)
    - Bias corrections are necessary for satellite O3 to have a positive impact on tropospheric ozone.
    - Assimilation of OSIRIS Limb scattering and TES IR retrievals builds capabilities for assimilation of OMPS and CrIS measurements on NPP and NPOESS
    - Assimilation of MODIS AOD retrievals builds capabilities for assimilation of VIIRS measurements on NPP and NPOESS
  - OMI ozone, MODIS AOD, CALIPSO, RAQMS boundary conditions improve CMAQ forecasts (PI: Newchurch, UAH)
    - Impact on updating IC/BC using ozone profiles in CMAQ improved surface ozone predictions
    - Enhancements to CMAQ by adding lightning produced NOx
    - Develop capabilities to investigate regional air quality issues in southeast
  - Development of GOME-2 NO2 and HCHO products (PI: Kondragunta, NESDIS)
    - Verify and improve NOx and isoprene emissions in CMAQ

Scientific Direction and Progress

- Relevance to JCSDA priorities
  - Operational air quality forecast improvements with focus on aerosols (PM2.5).
    - Model development (GFS-GOCART) is a major near-term activity
    - Satellite trace gas and aerosol assimilation in a regional model (CMAQ) and global models (GFS, RAQMS, NAAPS)
- Development of code/products capable of being integrated into JCSDA supported systems
  - QA/QC tests developed for MODIS near real time AOD data
  - Updated GSI code to assimilate high vertical resolution ozone profiles
  - NESDIS was funded by NWS OST to deliver GOES smoke concentration product for air quality forecast verification
  - NESDIS is being funded by NWS OST to deliver MODIS dust detection product in support of GFS dust modeling activities
  - NESDIS working closely with NWS air quality group in facilitating transfer of operational NASA and NOAA satellite data for assimilation/verification activities
- Likely to lead to a positive impact of forecast skill or other tangible positive impact on JCSDA systems
  - Goal is to contribute to the improvement of surface ozone and PM2.5 forecasts by improving the model initial and boundary conditions using satellite data
  - Improve radiance assimilation through inclusion of trace gases and aerosols for improving weather and visibility forecasts

Future Plans

- Future direction of group effort
  - Sustain research that supports GFS ozone assimilation work
    - Current sensors (GOME-2, OMI, SBUV/2, IASI,MLS)
    - Future sensors (OMPS, CrIS,)
  - Develop/improve capabilities that utilize satellite data to improve air quality forecasts
    - Aerosol forecasting and AOD assimilation using (current sensors :MODIS, GOES, SEVIRI,OMI; future sensors: VIIRS, OMPS, GOES-R)
    - Trace gas forecasting and assimilation (current sensors:SEVIRI,GOME-2, OMI, IASI,MLS, TES, `OSIRIS; future sensors: OMPS, CrIS, GOES-R, GOSAT)
    - Fires/emissions (MODIS, GOES, AVHRR)
- Unfunded areas of high priority that need JCSDA attention
  - Development of satellite-derived near real time biomass burning emissions for GFS. Note: JCSDA supported the development of GOES biomass burning emissions product
    - Support 1-day workshop to evaluate existing products and plan for development of new products. Expected participants are NASA, NOAA, NRL, USFS, and EPA
  - Intercomparison and validation studies of global model aerosol simulations: GFS-GOCART vs RAQMS vs NAAPS and satellite data
  - Using RAQMS, WRF-CHEM, and CMAQ aerosol simulations to generate synthetic GOES-R ABI radiances. Need CRTM generated look-up tables (Funded by GOES-R AWG)
  - Develop parameterized chemistry for GFS using RAQMS

Outstanding Issues

- How do we demonstrate the impact of trace gas and aerosol satellite data on air quality forecast in an operational system?
  - GSI requires inline trace gas and aerosols
    - Neither GFS nor NAM has inline chemistry
    - Operational regional air quality model is offline
  - GSI requires additional development for generalized tracers
- Recommendation to JCSDA Executive Board
  - Increase support for trace gas and aerosol capabilities within GSI and CRTM
  - Support research to operations activities related to trace gas and aerosol data assimilation using current research models and sensors