Development, Application, and Transition of Aerosol and Trace Gas Products Derived from Next-Generation Satellite Observations to Operations

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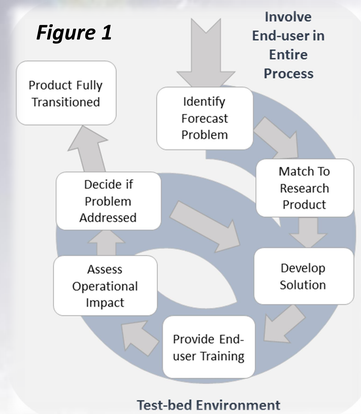
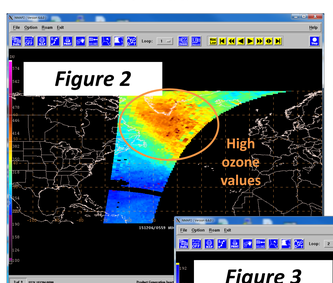
Introduction

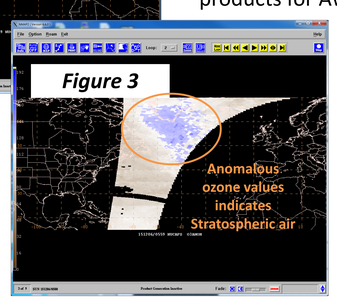
- NASA SPoRT has a history of successfully transitioning unique observations and research capabilities to the operational weather community to improve short-term forecasts.
- SPoRT strives to bridge the gap between research and operations by maintaining interactive partnerships with end users to develop products that match specific forecast challenges, provide training, and assess the products in the operational environment (***Fig. 1***).
- This presentation focuses on recent product development, application, and transition of aerosol and trace gas products to operations for specific forecasting applications.
- Recent activities relating to the SPoRT ozone products, aerosol optical depth composite product, sulfur dioxide, and aerosol index products are discussed.

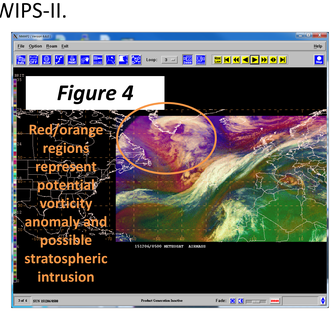


CrIS/ATMS Ozone Products

- Over the past several years, SPoRT has worked closely with the GOES-R and JPSS Proving Grounds to transition ozone products derived from AIRS to National Centers, such as the Ocean Prediction Center and Weather Prediction Center, to aid forecasting explosive cyclogenesis and hurricane-force wind events.
- Since CrIS/ATMS retrievals processed through the NUCAPS algorithm are available near-realtime, the SPoRT ozone products were expanded include the NUCAPS retrievals to provide additional overpasses for forecasters to analyze.
- NUCAPS Total column ozone (***Fig. 2***) and Ozone anomaly (***Fig. 3***) are provided in NAWIPS format.
  - Forecasters use AIRS, IASI, and NUCAPS ozone products in conjunction with the SEVIRI Air Mass RGB (***Fig. 4***) to identify stratospheric air intrusions.
  - Forecasters have given feedback the ozone products compliment the Air Mass RGB and give them confidence in interpreting the RGB.
  - Future work includes formatting the ozone products for AWIPS-II.

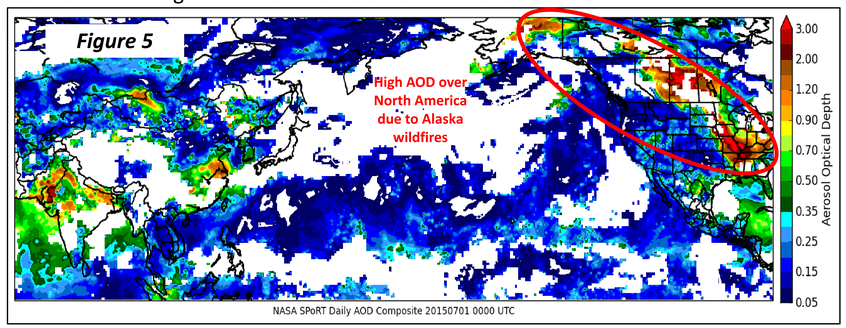




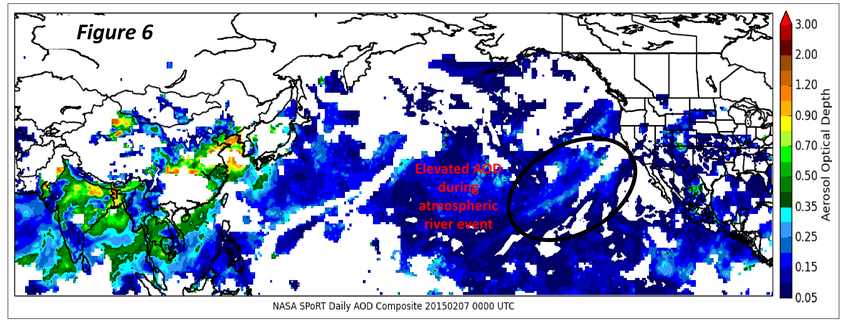


Multi-Satellite Aerosol Optical Depth Composite

- The AOD composite product fuses polar-orbiting and geostationary satellite observations from the MODIS, VIIRS, GOES-15, and MTSAT-2.
- Near-real time AOD retrieval products for MODIS and VIIRS are downloaded through the Land, Atmosphere Near real-time Capability for EOS (LANCE) system and NOAA Comprehensive Large Array-Data Stewardship System (CLASS), respectively.
- We develop our own AOD retrieval algorithms for GOES and MTSAT based on their visible channels and a lookup table of top-of-atmosphere reflectances that were generated from a radiative transfer model.
- To prevent anomalously high AOD from highly reflective clouds, a stringent cloud clearing procedure is used to reject cloud contaminated pixels.
- Cloud-free AOD retrievals for each satellite overpass are used to generate a 6-hourly and daily AOD Composite product on a 0.5° x 0.5° grid.
- The product was designed to track aerosols across the Pacific basin but can be used for fire weather applications. ***Fig. 5*** highlights high AOD and smoke over North America during the Alaska wildfire outbreak of 2015.



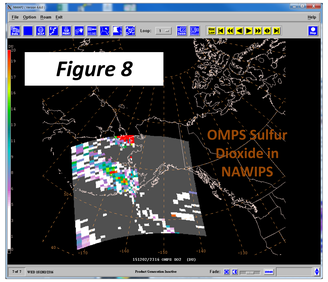
- Forecasters involved in the CalWater 2 field campaign in winter 2015 used the product to anticipate the presence of aerosols in the vicinity of atmospheric rivers.
- The composite product revealed areas of elevated AOD of 0.3 across the eastern Atlantic during a landfalling atmospheric river event from 6-7 February (**Fig. 6**).

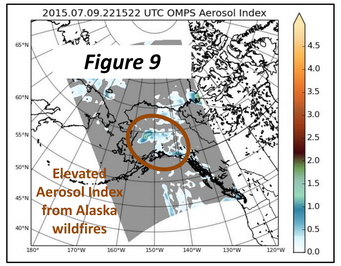


- With the launch of Himawari-8 in October 2014 and the recent decommissioning of MTSAT, SPoRT is currently developing a Himawari-8 AOD retrieval algorithm to incorporate in the composite product.
- The increased spatial and temporal resolution of Himawari-8 along with the additional channels will help generate a more robust AOD composite product.

OMPS Products

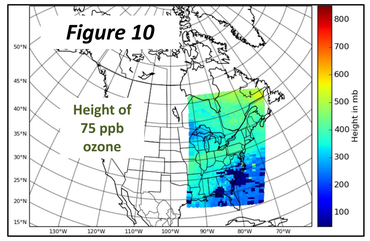
- More recently, SPoRT has worked closely with the GOES-R and JPSS Proving Grounds and forecasters at NOAA/NESDIS Satellite Analysis Branch (SAB) to develop and transition S-NPP OMPS Sulfur Dioxide and Aerosol Index products for monitoring fire, smoke, and volcanic activity.
- With the availability of near-real time, next-generation OMPS at the Alaska and Finland direct readout sites, SPoRT has been able to provide Sulfur Dioxide and Aerosol Index products to SAB in NAWIPS format with reduced latency (***Fig. 8***) .
- The products from the Alaska direct broadcast site (***Fig. 9***) were available during the active 2015 fire season and provided SAB with additional observations.
- SPoRT plans to provide products from the Finland Direct broadcast site to SAB before the 2016 fire season.

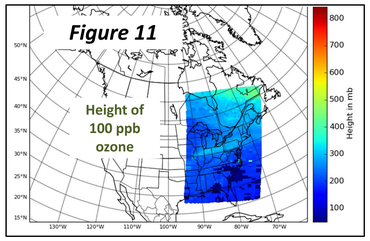




New Product Development

- Areas of high ozone along flight routes can impact crew and passenger health.
- The Federal Aviation Administration employs an individual at the Air Traffic Control System Command Center to forecast and monitor ozone levels
- Current SPoRT ozone products could be used to identify high ozone along flight routes but it is difficult to estimate an exact altitude at which the ozone is worst.
- SPoRT is currently developing a NUCAPS product in conjunction with the Aviation Weather Center for this application.
- The FAA recommends passenger cabins should not exceed 100 ppb for flights exceeding 4 hours; however the surface air quality standard is 75 ppb over 8 hours
- Example plots show the height of 75 ppb ozone (***Fig. 10***) and 100 ppb ozone (***Fig. 11***)





More Information

- http://weather.msfc.nasa.gov/sport/
- https://nasasport.wordpress.com/

Acknowledgment

Thank you to the Satellite Liaisons and the forecasters who have provided valuable feedback to guide product development