Atmospheric Properties and Effects Section (Code 7544)

Modeling aerosol and atmopsheric transmission processes, while fusing together satellite remote sensing measurements and products for Warfighter applications

U.S. NAVAL RESEARCH LABORATORY

AT A GLANCE

Who are we?

A member of the Marine Meteorology Division (Code 7500), consisting of 10 civil servants and 15 total employees. Our team is a mixture of meteorologists, physicists, mathematicians, and physical scientists. Our primary focus is on the mechanics of atmospheric aerosol particles, monitoring their movement from space, synthesizing satellite remote sensing and numerical weather prediction products, and recognizing visibility hazards of consequence to Fleet operations.

What do we do?

Our primary operational assets include the Navy Aerosol Analysis and Prediction System (NAAPS), the world's first-ever global aerosol transport prediction system, and Geospatial Information Processing System (GeoIPS), a state-of-the-art toolkit for integrating satellite measurements and products with numerical weather prediction fields.

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Photo from inside the high-altitude exhaust of a pyrocumulonimbus cloud (pyroCb) over the Williams Flats fire in Washington State on August 8, 2019, taken by Dr. David Peterson of the NRL Atmospheric Properties and Effects Section during the FIREX-AQ field campaign from the NASA DC-8 Flying Laboratory.

The Atmospheric Properties and Effects Section studies applied physical mechanisms impacting battlespace environmental maneuvers. Its coordinating principles are rooted in:

- End-to-end atmospheric R&D from basic in situ measurements to remote sensing to data assimilation to model verification to reanalysis and climatology

- Vigorous collaborations across NRL, DoD, federal and university groups

- Direct coordination with operational partners across the Fleet enterprise

From aerosol transport modeling and physical process study, to cloud and radiative microphysical parameterization and climate study, Code 7544 is focused on a broad spectrum of atmotspheric phenomenon impacting electro-optical energy propagation. By integrating satellite remote sensing, product fusion with numerical weather prediction modeling, and advanced imaging development, the group is focused on developing real-time and predictive capabilities supporting Warfighter operations.

Navy Aerosol Analysis and Prediction System (NAAPS) and Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS)
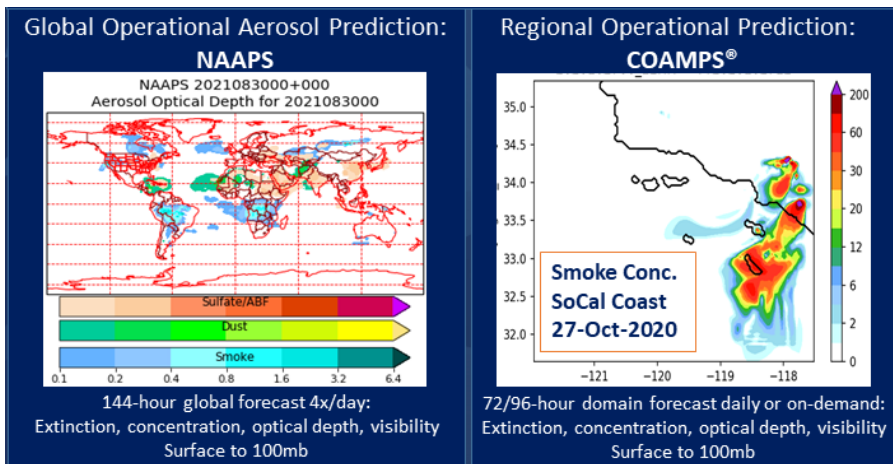
Research & Development Priorities for Code 7544

Convectively-driven aerosol events
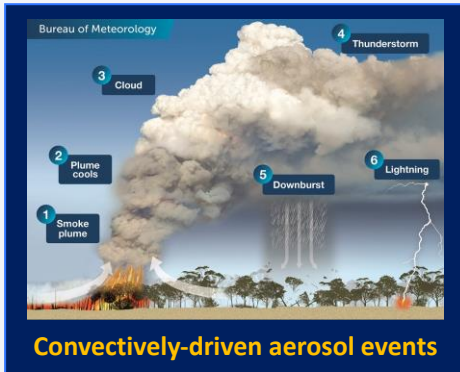
Our team is leading research into the physical mechanisms driving high-impact dust and smoke aerosol plumes initiated by non-precipitating "dry" thunderstorms to facilitate prediction in next-generation Navy environmental monitoring systems.

**Reanalysis and prediction across the EO/IR spectrum**
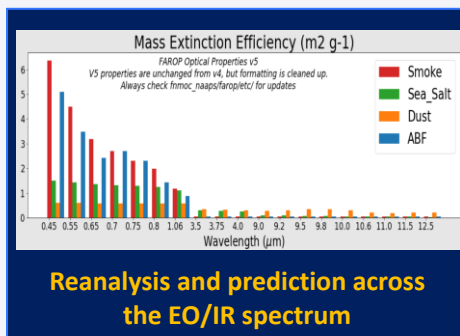
NRL supports atmospheric forecast modeling to predict visibility and atmospheric transmission, as well as reanalysis datasets to support scientific research and improved climatology. Our focus is on quantitative simulation of the effects of scattering and absorbing particles across the spectrum from the ultraviolet to the infrared.

**Decision support for EO propagation performance surfaces**

Real-world applications demand timely information packaged to support complex decision-making. NRL supports numerous development efforts to integrate atmospheric conditions into decision support tools used operationally.

Geolocated Information Processing System (GeoIPS®)
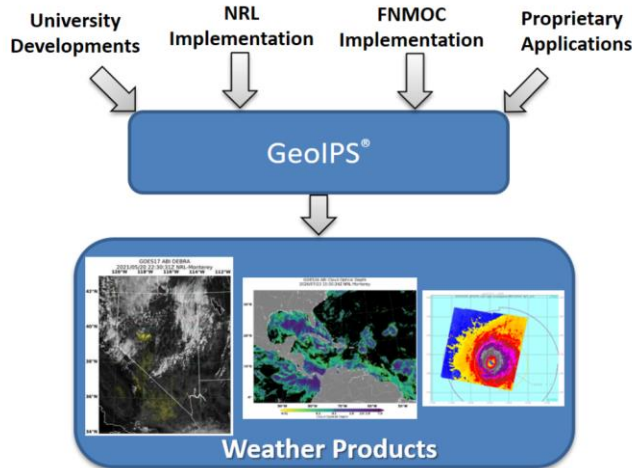
The modular nature of GeoIPS® provides a flexible platform that can be leveraged from research and development all the way through operations. Institutions can create new plugins that seamlessly integrate in the main code base. GeoIPS® is open-source, with the main code base available on github: www.github.com/NRLMMD-GEOIPS
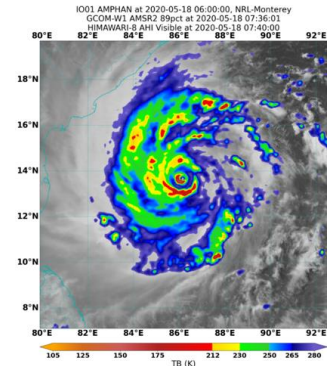
Example tropical cyclone (TC) product of AMSR2 brightness temperatures overlaid on Himawari-8 visible imagery. GeoIPS® provides all the tools for ingesting, sectoring, interpolating, and visualizing geolocated data.

Naval Research Laboratory Marine Meteorology Division Code 7544 leads the Geolocated Information Processing System (GeoIPS®) development effort. GeoIPS® is a collaborative research and development platform for combining disparate datasets into unique meteorological products specifically designed to meet Navy operational needs. This shared development infrastructure used across the weather community facilitates rapid transitions of new technologies both between research organizations, as well as to operational centers.

Atmospheric Transmission Modeling for Laser-Based Applications

Code 7544 is a world-leader in solutions to battlespace environmental problems in atmospheric laser propagation. Navy and DoD applications are increasingly reliant on near real-time and forecast performance surfaces for laser-based systems. Cloud and aerosol transmission and absorption modeling, combined with parameterized solutions to atmospheric refractivity, are primary inputs to decision aids used by the warfighter. Code 7544 is developing both model and in-situ based tools to better enable operational decisions.