U.S. NAVAL RESEARCH LABORATORY

Upper Atmospheric Data Assimilation

AT A GLANCE

Who are we?

We are a group of scientists and researchers specialized in advanced data assimilation techniques and their application to the upper neutral atmosphere and ionosphere.

What do we do?

Our group researches, designs and builds operational data assimilation and coupled data assimilation systems for the mesosphere, thermosphere and ionosphere.

What will it accomplish?

The goal of our group, and the DOD, is enhanced space environment forecasting.

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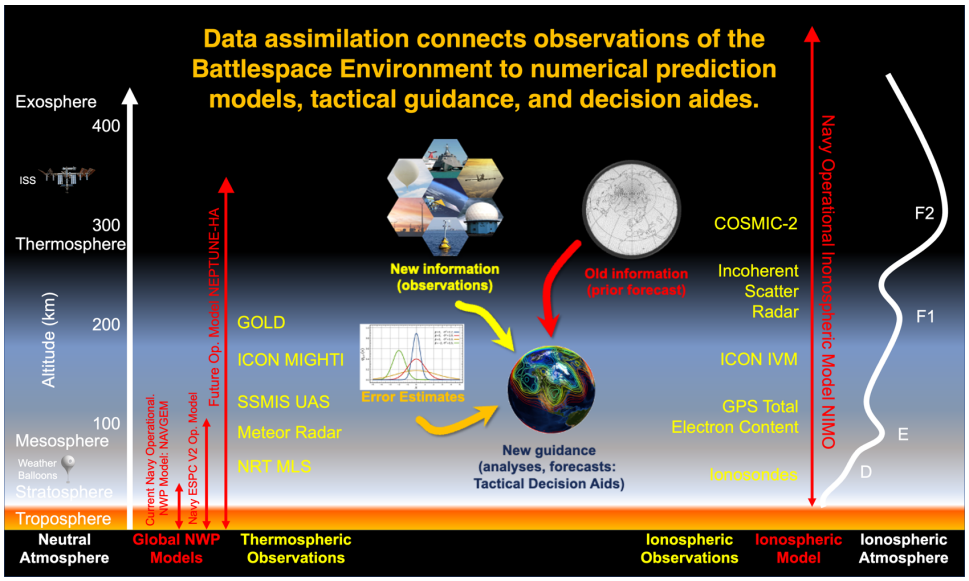

Operationalizing a Navy Coupled Upper Atmosphere Data Assimilation System

From the dearth of observations to the relative immaturity of the numerical modeling, there are many challenges to data assimilation in the upper atmospheric region. Our group is focused on researching, designing, building, maintaining and then improving upon an operational data assimilation system for the mesosphere, thermosphere and ionosphere. We focused on four main components: 1) operational mesospheric/thermospheric data assimilation, 2) operational ionospheric data assimilation, 3) operational observation processing for the mesosphere, thermosphere and ionosphere and 4) coupled neutral-atmospheric and ionospheric assimilation.

The model of the thermosphere that we are primarily working with is a based on the Navy's soon-to-be operational NEPTUNE global forecasting system. NEPTUNE is fundamentally a tropospheric Numerical Weather Prediction (NWP) system. NRL added upper atmospheric physics and raised the NEPTUNE top to reach the thermosphere. The model of the ionosphere that we are primarily working with is the Navy's soon-to-be operational NIMO forecasting system. The current data assimilation system of NIMO is IDA-4D, a 3D-Var solver. We are now working on the next generation of ionospheric data assimilation solvers.

There are very few observations made in the thermosphere and lower mesosphere. Even less are available at latencies short enough for operational processing and ingestion. There are more ionospheric observations in this region, but the covariances between the measured variables and the model state variables is poorly studied. To setup a fully coupled data assimilation system, we are researching the coupling between these physical systems and what that coupling implies about the observations and models. All of this work is aimed at enhancing our understanding of the upper atmosphere, as well as furthering the DoD's capability to predict the space environment.