The GEOS Neural Network Retrieval (NNR) for Multi-spectral AOD

Patricia Castellanos, Arlindo da Silva

GMAO
Global Modeling & Assimilation Office

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Background

Aerosols have a significant impact on the Earth system through direct and indirect radiative effects. The spatio-temporal distribution of aerosols and their properties are crucial to representing fundamental Earth System processes in global circulation models such as the Goddard Earth Observing System (GEOS).

Aerosol data assimilation synthesizes the observations from various platforms that make up the Earth observing system. Many satellite instruments have capabilities to measure aerosol properties, and various algorithms have been developed to retrieve AOD from the measurements. This has led to a number of independent datasets of AOD observations with different resolutions, biases and uncertainties.

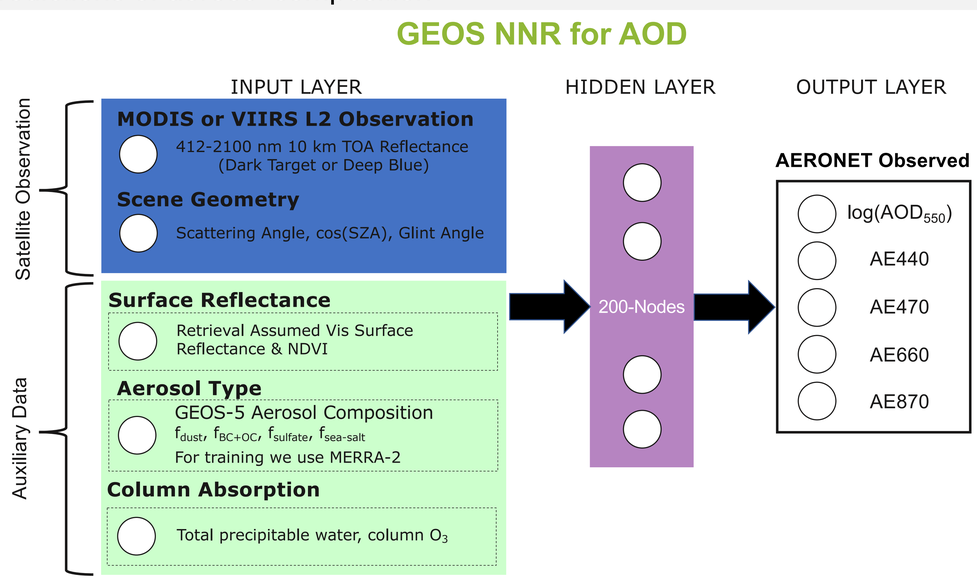
When the various AOD datasets are assimilated, any biases in the data can propagate in the model simulation and lead to artificial spatial and temporal variability.

Goal

The goal of this project is to homogenize the aerosol observing system by means of a neural network scheme that translates satellite observed top-of-the-atmosphere (TOA) reflectance into AERONET observed AOD

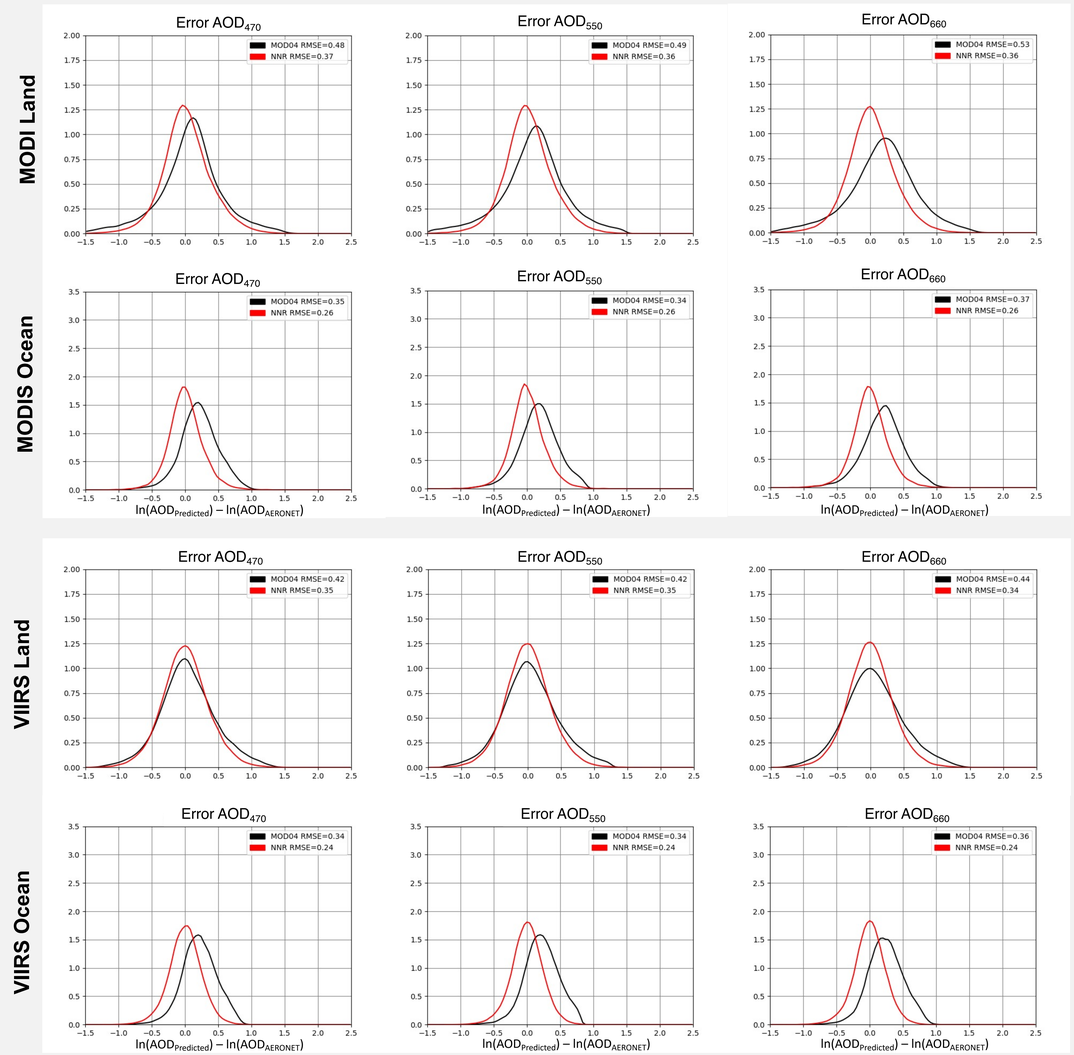
Approach

- A dataset of contemporaneous satellite (MODIS & VIIRS) and AERONET observations from the full data record was created
- The satellite TOA reflectance values are inputs to a back propagation neural network that predicts observed AERONET spectral AOD
- Other ancillary data that provide *a priori* information about the viewing scene are also used as inputs to the neural network to constrain the relationship, including GEOS predictions of aerosol composition



Cross Validation

The figures below show the errors at 3 representative wavelengths between observed AOD by AERONET and AOD predicted from MODIS & VIIRS TOA reflectance observations by the standard Dark Target or Deep Blue algorithms and the NNR algorithm. AERONET observations not used in the neural network training are used for cross-validation.



Conclusions and Future Work

The NNR approach has been applied to both MODIS and VIIRS observations of TOA reflectance and can bias correct and homogenize the observing system for aerosol assimilation in the GEOS global circulation model. Future work will require extending the NNR approach to geostationary observations of UV-VIS reflectance, such as from the GOES satellite series.

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E-mail: patricia.castellanos@nasa.gov | *Web:* gmao.gsfc.nasa.gov

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