Radiative transfer modeling of the hyperspectral and polarized reflectances for aerosol and ocean color remote sensing

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Traditionally ocean color remote sensing relies on spaceborne spectrometers that view an image pixel with discrete spectral bands in only one viewing direction. A list of current ocean color sensors of this type include the Moderate Resolution Imaging Spectroradiometer (MODIS), Visible Infrared Imaging Radiometer Suite (VIIRS), Second Generation Global Imager (SGLI), and Geostationary Ocean Color Imager (GOCI), to name just a few. In order to further enrich the information content and characterize ocean biology and physiology better, the new generation of ocean sensors has evolved to include hyperspectral radiometers. In addition, co-located polarimeters have been proposed to better characterize aerosols and help atmospheric correction of ocean color sensors. One great example is the Ocean Color Instrument (OCI) that is planned to fly onboard NASA's Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission. The OCI is an advanced spectrometer that makes radiometric measurements with continuous spectral coverage from the ultraviolet (350 nm) to the near-infrared (890 nm), plus a set of discrete shortwave infrared bands (940, 1038, 1250, 1378, 1615, 2130, and 2260 nm). In addition, the PACE mission plans to include two multi-angle polarimeters: the UMBC Hyper Angular Rainbow Polarimeter (HARP-2) and the SRON Spectro-polarimeter for Planetary Exploration (SPEXone).

Radiative transfer modeling is an important tool for interpreting the advanced hyperspectral images and polarization measurements. In this talk we will present a vector radiative transfer package for coupled atmosphere and ocean systems that can be used for the aerosol and ocean color retrieval using co-located spectroradiometer and polarimeter data. The package is flexible in both atmospheric and ocean compositions, includes both elastic and inelastic scattering, and incorporates atmospheric gas absorptions. The radiative transfer code has been used to study the sensitivity of the hyperspectral measurements in response to different atmospheric and ocean configurations. It is particularly interesting to study the different contributions of hyperspectral water leaving signals to the top-of-atmosphere measurements for different ocean water types, phytoplankton fluorescence strength, and most interestingly, non-photochemical quenching effects. Moreover, we will also present our current effort of retrieving aerosol and ocean color information simultaneously using polarimeter data, and use that information in assisting the atmospheric correction of hyperspectral ocean color observations. We will present the properties of aerosols and water leaving radiances retrieved from the airborne Research Scanning Polarimeter data and share the lessons that we have learned from this retrieval activity.