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Multi-Angle Remote Sensing of Aerosols Over Ocean

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This talk explores the ability of Multi-angle, multi-spectral remote sensing observations anticipated from the EOS MISR instrument, to retrieve aerosol optical depth, size, shape, and composition, globally.

Multi-angle, multi-spectral remote sensing observations, such as those anticipated from the Earth Observing System (EOS) Multi-angle Imaging SpectroRadiometer (MISR), provide a type of information about the characteristics of aerosols never before obtained from satellites. We plan to retrieve aerosol optical depth and aerosol "type," which represents a combination of index of refraction, size distribution, and shape constraints, at 17.6 km spatial resolution. The instrument is scheduled for launch into a 10:30 AM, sun-synchronous polar orbit in June, 1998.

MISR will measure the upwelling visible radiance from Earth in 4 spectral bands centered at 443, 550, 670, and 865 nm, at each of 9 emission angles spread out in the forward and aft directions along the flight path at $\pm 70.5°, \pm 60.0°, \pm 45.6°$, *26.1", and nadir. The spatial sampling rate is 275 meters in the cross-track direction at all angles. Over a period of 7 minutes, a 360 km wide swath of Earth comes into the view of the cameras at each of the 9 emission angles, providing a wide range of scattering angle coverage for each surface location. The data will be used to characterize aerosol optical depth, aerosol type, surface albedo and hi-directional reflectance, and cloud properties. Global coverage will be acquired about once in 9 days at the equator; the nominal mission lifetime is 6 years.

According to theoretical simulations, we will retrieve column aerosol optical depth over calm ocean surfaces to an accuracy of at least 0.05 or 10%, whichever is larger, for natural ranges of aerosol type and amount. In addition, three to four distinct size groups between 0.1 and 2.0 microns effective radius can be identified at most latitudes. We can also distinguish spherical from non-spherical particles under similar conditions, according to these studies (Kahn et al., *J. Geophys. Res.*, in press 1996).

Our retrieval approach involves separating the data into cases where the surface is dark water, dense dark vegetation (DDV), heterogeneous land, or "other" (Diner et al., Level 2 *Aerosol Retrieval Algorithm Theoretical Basis,* JPL D-1 1400, Rev. B, August 15, 1996). Aerosol retrievals will be performed on data in the first 3 categories. For dark water retrievals, we use the red and near-infrared bands only, where the surface is darkest, and we model surface glitter and whitecap effects as a function of estimated surface wind speed, using standard models.

We use the formalism of statistical chi-squared tests to compare the data with simulated instrument radiances to perform the retrieval. Simulations are done for a variety of natural conditions, based on climatological expectations about atmospheric and surface properties. We are currently performing sensitivity studies to determine in detail what differences, over the broad range of natural variability in particle properties, can be detected by MISR. The most recent results of this continuing work will be presented at the conference.