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# Use of polarization to retrieve aerosol parameters in coupled atmosphere-surface systems

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Simultaneous retrieval of aerosol and surface properties by means of inverse techniques based on coupled atmosphere-surface radiative transfer modeling and optimal estimation can yield a considerable improvement in retrieval accuracy based on radiances measured by MERIS, MODIS, and similar instruments compared with traditional methods. However, there are uniqueness problems associated with photometric remote sensing measurements that ignore polarization effects, and rely on measuring only the radiance. For example, it has been shown that if only one wavelength is available, accurate aerosol information over an open ocean scene requires a sensor that measures the Stokes parameters Q and U in addition to the total radiance I. Use of polarization measurements is particularly important for absorbing aerosols over coastal waters as well as over bright targets such as snow and ice, where it has proved difficult to retrieve aerosol single-scattering albedo from radiance-only spectrometers such as MERIS and MODIS. We use a vector radiative transfer model for the coupled atmosphere-surface system in conjunction with an optimal estimation method to quantify how polarization measurements can be used to overcome the uniqueness problems associated with radiance-only retrieval of aerosol parameters. In particular, we discuss how future instruments, which unlike MERIS and MODIS measure the Stokes parameters Q and U in addition to the total radiance I, can be used to enhance our ability to retrieve accurate aerosol parameters over turbid coastal waters and bright targets like snow and ice.