Application of Multiangle Imaging SpectroRadiometer (MISR) to Study of Regional Haze Problems in Conjunction with California Regional PM10/PM2.5 Air Quality Study (CRPAQS) and SAFARI-2000 Dry Season Campaign

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The Multiangle Imaging SpectroRadiometer (MISR) was launched in polar orbit December 18, 1999, aboard the EOS platform Terra. The mission of MISR is to study globally, column abundances of tropospheric aerosols over both land and ocean surfaces, cloud distributions and heights, and provide estimates of surface bidirectional reflectance and spectral albedo under both clear sky and cloudy conditions. The mission goal is to provide improved assessment of these factors for the study of terrestrial radiation balance and impact on climate change.

MISR is a new type of orbital sensor providing from orbit with repeat time of 16 days, multi-angular views of the surface at nine discreet view angles, from nadir to 70.5° relative to local vertical, and in four spectral bands at 446, 558, 672, and 866 nm. MISR exploits its multiangle and multispectral capability through a new algorithm (heterogeneous land) that allows separation of path radiance and surface-leaving radiance components. The path radiance component is compared to radiances generated by a radiative transfer model of the atmosphere and together with multiple aerosol models assembled from search of the literature and climatologically likely presence, to arrive at estimates of aerosol optical depth and particle properties. The MISR retrieval of aerosol optical depth is carried out at scale of 17.6 km over oceanic and land regions.

MISR has sought validation of the new approaches by cooperative field experiments with: (1) the California Regional Particulate PM10/PM2.5 Air Quality Study (CRPAQS) in which particle models of size distribution and refractive index were sought in the California Central Valley, (2) comparisons with measurements of optical depth and particle properties of the AERONET solar radiometer network in the southwest United States and southern Africa. Examples of comparisons between MISR, CRPAQS, and AERONET results for both aerosol optical depth, will be described. For example: (1) MISR employs a present finite number of aerosol particle models globally subdivided between oceanic and land regions in a lookup table mode to provide best matches between model predicted multiangle observed TOA radiances, and those from a radiative transfer code. The best match in a least square sense is chosen as the most likely aerosol model for the scene. (2) The AERONET retrievals employ multispectral measurements of almucantar and principal plane sky radiances under cloud-free circumstances, plus direct sky irradiance measurements. Inversions of these measurements are used to derive atmospheric optical depth plus homogeneous column aerosol models, namely size distributions and refractive index, together with other quantities calculable from Mie theory under homogeneous spherical particle assumptions, (3) The CRPAQS particle model determinations involve directly from measurements of multiple

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atmospheric chemical components plus speciation according to aerodynamic mass distribution functions derived from cascade impactors (MOUDI)

The African and SW US observations from AERONET are confined to the AERONET-based inversions themselves, and with the available MISR models, hence are lacking comparisons with direct chemical or size measurements.

The results for particle optical depth retrievals via AERONET conventional retrievals, in general show favorable agreement with scatter arising as expected from the variable state of aerosol load in the atmosphere at the 20 km scale of MISR retrievals, and by the restricted nature of the physical range of aerosol models used for comparison. A progress report on particle model comparisons provided by the CRPAQS measurements will be reported.

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