Geophysical Research Abstracts
Vol. 13, EGU2011-2876-1, 2011
EGU General Assembly 2011

Analysis of MISR 10-year aerosol products in dust-laden conditions

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Multiangle remote sensing, in particular from the Multi-angle Imaging SpectroRadiometer (MISR) instrument on the Terra satellite, provides a unique source of data for studying dust emission and transport. MISR's multiple view angles allow the retrieval of aerosol properties over bright surfaces and such retrievals have been shown to be sensitive to the non-sphericity of dust aerosols over both land and water. In addition, MISR provides stereographic views of thick aerosol plumes, allowing heights and instantaneous winds to be derived at spatial resolutions on the order of 1 km.

We use the 10+ year aerosol data record of aerosol optical depth (AOD), aerosol optical properties, and dust plume heights and wind speeds in and downwind of large dust source regions to demonstrate MISR's unique strengths and assess potential biases in the current retrievals under dust-laden conditions, in the context of a satellite-based dust climatology.

Consistent with previous studies, MISR retrievals both near dust sources and in mid-range dust transport regions tend to overestimate instantaneous AOD in the low AOD range and underestimate it in the high AOD range compared to ground-based AERONET sunphotometer retrievals. Even so, the MISR inter-annual and seasonal AOD patterns reproduce those at AERONET stations near Saharan and Asian dust sources, and are in agreement with independent meteorological surface observations. As such, MISR provides a useful record of such temporal patterns that is often temporally and spatially more extensive than those available from ground-based observations. Comparisons of MISR with MODIS Deep Blue and OMI data demonstrate similar anomalies, seasonal cycles, and AOT multi-year spatial patterns in dust source regions, although some discrepancies, especially under heavy dust loading, are observed and factors likely to contribute to this issue will be discussed.

MISR non-spherical aerosol fraction shows seasonal peaks consistent with the annual dust climatology in Asia. The seasonal cycle of MISR absorbing-particle AOD also agrees well with OMI aerosol index (AI) downwind of source regions. This suggests that MISR small and non-spherical fractions can be used to separate dust from pollution aerosols, particularly in the long-range transport regions.

Finally, we will demonstrate MISR's capabilities to simultaneously retrieve dust plume heights and winds over deserts using the MISR iNteractive eXplorer (MINX) software tool. These retrievals have been used to derive dust plume climatologies for both the Bodélé region in northern Africa and the Taklamakan dust source region in Asia.