Role of AirMISR in radiometric calibration and geophysical product validation of Multiangle Imaging SpectroRadiometer (MISR)

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AirMISR is the aircraft simulator for the EOS MISR instrument. MISR, scheduled for launch on the Terra Platform in December, 1999, is a unique instrument consisting of a bank of nine cameras viewing all areas of the Earth's surface nearly simultaneously at nine view angles: nadir, 26.1°, 45.6°, 60.0 °, and 70.5 ° fore and aft along the spacecraft ground track., and in four narrow spectral bands at 446, 558, 672, and 866 nm. The ground resolution of MISR is 250 m at nadir with a swath width of 360 km. MISR will be in a descending orbit of inclination ~ 98° with an equator crossing time of about 10:30 AM LSTThe principal missions of MISR are to estimate amount and composition of tropospheric aerosols, the surface reflectance of land surfaces, cloud-free and diffuse sky surface albedo and albedo of cloud fields, with a view to improving knowledge of the Earth's radiation balance. AirMISR was fashioned from a single spare MISR camera, attached to a computer-controlled rotating gimbal, and mounted in the nose cone of the ER-2 aircraft. For straight, level, constant altitude, constant air speed flight conditions, AirMISR duplicates the angles of view achieved by MISR for a single target area with pixel size of about 7 m at nadir and cross-track field of view of 25 km.

AirMISR has been the principal tool for validation of MISR aerosol, surface bidirectional reflectance factor (BRF), and cloud height and radiation retrieval algorithms, and for study of questions arising with the vicarious calibration of MISR. As part of field validation exercises, the ER-2 with AirMISR passes over selected target areas at the expected MISR overpass time, and executes a rosette crossing pattern of back and forth lines involving six geographic azimuths, two parallel to the MISR ground track (whose heading is about 190° at northern midlatitudes), two in the principal plane of the Sun, and two approximately orthogonal to the principal plane. Simultaneously with overflights, ground observations of direct solar and diffuse sky radiation are carried out by surface instruments. From these, estimates are made of aerosol column effective optical depth and single scattering albedo and column effective single scattering phase function. The aerosol model produced is "closed" in the sense that it generates downwelling radiances (and irradiance) consistent with the surface-measured radiation quantities. A sphere-scanning radiometer termed PARABOLA III, provides measurements required to generate the BRF. A radiative transfer code is used calculate from the field measured data, the upwelling radiance at AirMISR (or MISR), thus generating a consistent basis for independent radiometric calibration of AirMISR(or MISR), this being termed a *vicarious* calibration.On other occasions of aerosol or BRF retrievals, these ground-based parameters generate TOA radiances that can also be compared to the AirMISR or MISR observed radiances. AirMISR and MISR algorithms are used to generate MISR-based parameters, which are then compared with ground-based numbers.

The multiangle and flexible time and azimuth views afforded by AirMISR allow determination of directional radiation reflected by clouds, leading to estimates of cloud field albedo. The multiangle geometry also gives simply, according to traditional stereoscopic techniques, estimates of cloud top height (or bottoms where visible).

Results from field campaigns at Barrow, Alaska(cloud measurements), Rogers Lake, CA (vicarious calibration), Konza Prairie, Kansas (aerosol and grassland BRF retrieval), Marina, CA (aerosol over ocean water), and Lake Tahoe, CA (aerosol over shallow and deep lake water). Algorithm validation and vicarious calibration activities are planned to continue into the post-launch period.

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