AirMISR HOWLAND_2003 Quality Summary

AirMISR Radiometric Data Quality

The science flights made by AirMISR over the Howland Forest, Maine, target on August 28, 2003 were successful. The camera successfully slewed to all nine angle positions for two runs. The radiometric accuracy and signal-to-noise during this mission was as good as the Science Team has reported in the literature. Individual product files contain metadata identifying dropped/corrupt lines, saturated pixels and related image quality parameters.

The radiometric calibration of AirMISR was done using the same procedures as used to calibrate the MISR cameras; the reported radiometric calibration uncertainties are therefore the same as reported for MISR. (The exception is the camera-to-camera uncertainty, which is believed to be smaller for AirMISR, as the aircraft instrument consists of one gimballed camera). Thus, it is believed that the radiometric uncertainties are small, and the camera signal-to-noise is high.

The values quoted for the systematic component of the radiometric uncertainty, based on vicarious calibration of the instrument, in fractional units, are:

abs_sys_error 0.030
cam_sys_error 0.000
band_sys_error 0.010
pixel_sys_error 0.005

That is, the systematic component of the absolute, camera-to-camera, band-to-band, and pixel-to-pixel are given above. The pixel-to-pixel uncertainty is large enough to cause some visible striping in the imagery where the scene contrast is low and the image display is stretched to highlight small radiometric differences. These systematic components are combined with signal-to-noise (SNR), to determine the total error uncertainties. As SNR is signal dependent, the uncertainties are likewise signal dependent. SNR, at two radiance input levels, are as follows:

SNR(equivalent-reflectance=1.0) ~ 1000
SNR(equivalent-reflectance=0.05) ~ 200

Using these, the total radiometric uncertainties can be determined:

abs_total_error=sqrt(abs_sys_error2+(1/SNR)2)
cam_total_error=sqrt(2)/SNR
band_total_error=sqrt(2)*sqrt(band_sys_error2+(1/SNR)2)
pixel_total_error=sqrt(2)*sqrt(pixel_sys_error2+(1/SNR)2)

AirMISR Georectified Radiance Data Quality

Geometric calibration is performed prior to orthorectification to the UTM map projection grid. The orthorectified Landsat TM scenes (path 011 row 029) obtained through ESE Scientific Data Purchase are used to collect a set of ground control points in order to remove static errors in the camera pointing and airplane position and assure absolute geolocation accuracy in particular for nadir images from both runs. An automated tie points identification and bundle adjustment is used to improve coregistration accuracy between off-nadir and nadir imagery. Using calibration results, geolocation and coregistration errors of about 1000 meters for nadir view to up to 6000 meters for the most oblique views are reduced down to an average of about 60 meters regarding both absolute geolocation and coregistration out of nine view angles. Errors associated with the D camera view angles are somewhat larger, on average of about 150 meters, due to the inability to identify sufficient number of reliable ground control points in the imagery acquired at those oblique angles.

AirMISR Land Surface Data Quality

AEROSOL DEPENDENCY

The land surface product relies on the quality of the aerosol properties used in the atmospheric correction procedure. This aerosol information (optical depth, aerosol type, mixture file, scale height, base altitude, top altitude) is reported in the AirMISR Metadata and is derived from multi-band sunphotometer data taken during the AirMISR overflight of the target.

RELIABILITY OF LAND SURFACE REFLECTANCE VALUES

Because the two AirMISR datasets at the extreme view angles (~70 degrees) can be very difficult to adequately co-register routinely to

datasets at the less extreme AirMISR view angles, only the seven images with view angles between ~60 forward and aftward are used to create the land surface product. For low surface albedo areas, the atmospheric correction scheme should be considered most reliable when the aerosol optical depth is small (< 0.3). For higher albedo areas, good results are obtained for larger optical depths (< 0.4). Thus, it is recommended that users examine the aerosol optical depth field in the Metadata as part of their assessment of the surface parameters. For most AirMISR data, the aerosol amount is not the limiting factor affecting the quality of the retrievals. More important factors are multi-angle pixel co-registration accuracy and possible 3-dimensional (adjacency) effects affecting high contrast areas.

FILL VALUES IN LAND SURFACE REFLECTANCES

Land surface reflectances are computed separately for each AirMISR pixel and for each spectral band. For some pixels, the AirMISR radiances can be of sufficiently low quality (e.g., noise contamination) to prevent a retrieval. In this case a fill value for the land product is archived.

References

References on the radiometric calibration of AirMISR and MISR include the following. Additional references are available from the MISR web site.

1. Bruegge, Carol J., Wedad A. Abdou, Nadine L. Chrien, Barbara J. Gaitley (1998). AirMISR spectral and radiometric performance studies. In Earth Observing System III, Proc. SPIE 3439, San Diego, CA, 19-21 July.
2. Bruegge, C. J., N. L. Chrien, R. A. Kahn, J. V. Martonchik, David Diner (1998). MISR radiometric uncertainty analyses and their utilization within geophysical retrievals. Conference issue: New Developments and Applications in Optical Radiometry (NEWRAD '97), Metrologia., 35, 571-579.
3. Bruegge, C. J., V. G. Duval, N. L. Chrien, R. P. Korechoff, B. J. Gaitley, and E. B. Hochberg (1998). MISR prelaunch instrument calibration and characterization results. IEEE Trans. Geosci. Rem. Sens., Vol. 36, pp. 1186-1198.
4. Chrien, Nadine L., Carol J. Bruegge, Barbara J. Gaitley (2000). AirMISR laboratory calibration and in-flight performance results. Submitted to Remote Sens. Environment, December 1998.
5. Diner, David J., et al. (1998). The Airborne Multi-Angle Imaging SpectroRadiometer (AirMISR): Instrument Description and First Results. IEEE Trans. Geosci. Rem. Sens., Vol. 36, No. 4.

Feedback:

For questions or comments on the AirMISR products, contact the NASA Langley Atmospheric Science Data Center User Services Office.

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