Vicarious Calibration

Vicarious calibration is an independent pathway for monitoring instrument radiometric performance, including error assessment with reflectance standards, field instruments and atmospheric reference measurements. In general, the experiment follows a reflectance-based approach with ground measurements of the atmospheric optical depth and surface reflectance over a bright natural target. In this experiment, spectral ground truth data was measured using an AOS FieldSpec Pro FR spectroradiometer in situ surface photometer data from all four dates of MERIS data taken were available. However, extensive wildfires in California and Oregon led to spatially varying atmospheric conditions. As a consequence, large variations in the atmospheric optical depth must be assumed within small regional extents, depending on whether smoke or light smoke were in the line of sight of both the sun photometer and MERIS. Only the sun photometer data of August 22, 2002 could be used to determine aerosol model and horizontal visibility, subsequently applied for radiative transfer calculation. For the other three dates, large offsets between measured and modelled TOA radiances indicate an inadequate atmospheric characterization. In these cases, a best-fitting atmosphere was applied for vicarious calibration, without the use of any sun photometer data.

MODTRAN4, a radiative transfer code (RTC), is used, constrained by field data, to calculate the top-of-atmosphere radiance at the sensor. Input parameters include ground measurements of the surface reflectance, sun-target-sensor geometries and atmospheric properties (aerosol model, horizontal visibility).

Results and Conclusions

- The first band at 412.5 nm (aerosol type sensitive), band 11 (oxygen at 700 nm), and band 18 (water vapour absorption region at 900 nm) are critical for vicarious calibration.
- Apart from these bands, the relative differences between MERIS measured and radiative-transfer modelled TOA radiances do not exceed 0.6% (except for band 2 on October 21, 2002).
- The mean relative differences between MERIS and ME are consistent TOA radiances do not exceed 4.1% for any of the dates under investigation. Exclusion of band 11 and band 15 results in mean differences between 1.8-2.3% for all data sets.
- The absolute uncertainty of this study's VC activities estimated around 3.5%, given reliable sun photometer data is available. Under the absence of such data, the absolute uncertainty of the methodology exceeds 5% (see Table B).
- An incorrect assumption about aerosol absorption can strongly affect the VC accuracies of the shorter wavelengths bands (influence of North American wildfires in summer 2002).
- Based on the uncertainties of the vicarious calibration method and the calibration accuracies of MERIS, no recommendation to update the MERIS calibration is given.

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