



MODIS albedo validation with higher spatial resolution estimates from FORMOSAT-2

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MODIS ALBEDO VALIDATION WITH HIGHER SPATIAL RESOLUTION ESTIMATES FROM FORMOSAT-2

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Land surface albedo is among the main radiative uncertainties in current climate modeling. The NASA Earth Observing System program provides series of high-level land surface products including albedo at 1-km spatial resolution on a 16-day cycle derived from Moderate Resolution Imaging Spectroradiometer (MODIS) reflectances. Validation of such products still remains problematic because ground point-based measurements are not suitable for direct comparisons with coarse or middle spatial resolution satellite data over heterogeneous landscapes. The objective of this study is to validate the MODIS albedo product with high spatial and temporal resolution data provided by FORMOSAT-2. To overcome the difficulty of the scaling problem, high-resolution images were aggregated by accounting for the Point Spread Function (*PSF*) of MODIS. The study area is a flat region called La Crau, covered by a specific dry grass ecosystem located in the lower Rhône Valley, South-Eastern France. We considered twenty-seven cloud free FORMOSAT-2 images (8-m spatial resolution) acquired from March to October 2006 with a constant viewing angle. The albedo was estimated as a linear combination of waveband reflectances. It was previously validated against ground measurements over different surfaces from the same area presenting a $RMSE_A=0.015$ and no bias (Bsaiibes et al., 2009). About 12×24 equivalent MODIS pixels were finally considered for albedo comparison after aggregation and geometric fittings. Actual albedo MODIS was estimated from directional hemispherical albedo (black-sky albedo) and bi-hemispherical albedo (white-sky albedo), both included into the 1-km spatial resolution MCD43B3 product (Strahler and Muller, 1999). This standard product (which combines data from sensors onboard Terra and Aqua satellites) is a 16-days composite produced every 8 days. An estimate of the fraction of diffuse skylight (*FDS*) was also necessary to calculate the actual albedo. *FDS* changes with solar zenith angle, optical depth, bands and aerosol model types. It was calculated through a lookup table generated with the 6S code for MODIS bands. We obtained values ranging from 0.048 to 0.313 for the optical depth at 550 nm (estimated using data from the Aerosol Robotic NETwork), and from 0.129 to 0.225 for the *FDS*. The *PSF*, modeled as a Gaussian-like shape, was characterized by the value of its Full Width at Half Maximum (*FWHM*), both in the cross-track (*x*) and along-track (*y*) coordinates in the object space. The best performances were for *PSFs* with $FWHM_x$ varying from 1640 m to 2240 m, and with $FWHM_y$ from 920 to 1440 m. The cross-track size of the MODIS *PSF* is much higher than in the along-track direction, as expected, because MODIS is a whiskbroom scanner. The large variability of values obtained for $FWHM_x$ and $FWHM_y$ could be explained by different factors, such as the large homogeneity of the area or the complexity of the 16-days anisotropy model

used to create albedo MODIS by combining data from Terra and Aqua satellites (i.e., it considers data from different days, bands and viewing angles). The comparison between the 1-km FORMOSAT-2 aggregated map through the *PSF* and the albedo MODIS showed a $RMSE_A < 0.013$ ($RMSE_R < 8\%$) and a relative bias $\leq 5\%$. According to the Global Climate Observing System, the accuracy requirement for albedo is 5%, by considering the term accuracy as the bias of the data. Therefore, over our study area and atmospheric conditions, the accuracy of albedo MODIS fulfills the requirements for global monitoring of climate.

References :

Keywords :

albedo, MODIS, FORMOSAT-2, point spread function, La Crau

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