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

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Land surface broadband albedo is among the main radiative uncertainties in current climate modeling. The objective of this study is to validate the MODIS albedo product with high spatial and temporal resolution data provided by FORMOSAT-2. Attention is paid on the aggregation of high spatial resolution images by accounting for the MODIS Point Spread Function (PSF).

The study area is a flat region called La Crau, covered by a specific dry grass ecosystem, irrigated grassland and other crops, located in the lower Rhône Valley, South-Eastern France. For MODIS albedo, we used the weekly MCD43B3 16-day composite product at 1-km spatial resolution. The high spatial resolution albedo was assessed thanks to thirty-one cloud free FORMOSAT-2 images (8-m spatial resolution) acquired from March to October 2006 with a constant viewing angle.

Actual MODIS albedo was estimated by a weighted sum of the directional hemispherical albedo (black-sky albedo) and bi-hemispherical albedo (white-sky albedo). The weights were computed from the fraction of diffuse skylight (FDS). FDS varies with solar zenith angle, optical depth, spectral bands and aerosol model types. It was calculated through a lookup table generated with the 6S code for MODIS bands. We used AERONET data and MOD04_L2 and MYD04_L2 aerosol standard products (when AERONET failed) to estimate the aerosol optical thickness for the considered dates and location. We finally obtained FDS ranging from 0.094 to 0.295.

FORMOSAT albedo was estimated as a linear combination of spectral reflectances. The fitting regression was obtained by selecting ground values of albedo acquired at 12:00 UTC (instead of 10:30 UTC, the FORMOSAT overpass time), to temporally match MODIS data. It was previously validated against ground measurements over different surface type within the same area resulting in an RMSEA=0.015 and almost no bias. The resulting albedo was then aggregated at MODIS resolution by accounting for the PSF. This latter was modeled by a Gaussian 2D function, characterized by the value of its Full Width at Half Maximum (FWHM), both in the cross-track (x) and along-track (y). The PSF was estimated by selecting the best correlation coefficient between the aggregated FORMOSAT and MODIS albedo. Depending on the date, the best performances were for FWHMx varying from 1400 m to 2000 m, and with FWHMy from 840 to 1240 m. The cross-track size of the MODIS PSF was much higher than in the along-track direction (1.6 times higher, in average), as expected, because MODIS is a whiskbroom scanner. The large variability of FWHMx and FWHMy values 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, footprints, bands and viewing angles). About 12x25 equivalent MODIS pixels were finally considered for albedo comparison after aggregation and geometric fittings.

The comparison between the 1-km FORMOSAT-2 PSF-aggregated maps and the MODIS albedo showed a RMSEA<0.012 (RMSER<8%) and a relative bias≤6%. 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 fairly fulfills the requirements for global monitoring of climate.

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