Land Surface Albedo from MSG Geostationary Satellite: method for retrieval, validation, and application for weather forecast

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Abstract

The European Meteorological Satellite Organization (EUMETSAT) maintains a number of decentralized processing centers dedicated to different scientific themes. The Satellite Application Facility on Land Surface Analysis (LSA-SAF) is hosted by the Portuguese Meteorological Institute. Its objective is to provide value added products for the meteorological and environmental science communities with main applications in the fields of climate modeling, environmental management, natural hazards management, and climate change detection. Since 2005 data from Meteosat Second Generation (MSG) satellite are routinely processed in near real time by the Land-SAF operational system located in Lisbon. The operational products include land surface albedo and temperature, short-wave and long-wave downwelling radiation fluxes, and snow cover. They have a spatial resolution of 3 km at the sub-satellite point and around 5 km over Europe. The product files are generated in HDF5 format with projection and spatial resolution corresponding to the characteristics of MSG/SEVIRI instrument. Products are distributed in near-real time by Eumetcast via satellite and can be ordered from the project website (http://landsaf.meteo.pt).

After 10 years (1999-2009) of research, development, and progressive operational activities, a summary of the surface albedo product characteristics, status and performances are presented. The albedo product is delivered on a daily basis in order to capture rapid changes such as ones caused by snowfalls. The basic algorithm concept comprises an atmospheric correction scheme, the inversion of a linear semi-empirical model of the bidirectional reflectance distribution function, the angular integration of the bidirectional reflectance distribution function to obtain spectral albedo, and the application of suitable conversion relations to derive broadband albedo estimates. These latter were evaluated against similar MODIS albedo fields and ground networks over Europe and North Africa regions. The results indicate a relative accuracy of 10% compared to MODIS products with the exception of the visible broadband albedo. The main objective of LSA-SAF project is to provide value added products for meteorological community with application in field of numerical weather prediction. A surface analysis system based on the use of Kalman filter was developed, and the use of LSA-SAF surface albedo was evaluated on the weather forecast model ALADIN. Results clearly show a positive impact on the 12 hour forecast of 2m temperature. Moreover, an operational MSG aerosol product is under development that will allow a near real time atmospheric correction of the MSG radiance. Results show a significant enhancement of the consistency of the surface albedo.

The outline of the next phase (the Continuous Development and Operational Phase, 2007-2012) is presented: to provide a new product generation by means of merging data between the polar satellite MetOp (Meteorological Operational, launched in October 2006) and the MSG-2 geostationary satellite data. The additional information will be particularly beneficial for high latitudes in winter. The LSA SAF program provides a great opportunity to monitor and identify human-induced climate change as a consistent production of data sets guaranteed until at least 2019 with the forthcoming MSG-3 mission.