Method for generating multi-spectral surface albedo data consistent between AVHRR, VEGETATION and MODIS sensors

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Multi-spectral surface albedo is important for climate modeling and environmental monitoring. Continuous long-term satellite observations with consistent characteristics are also essential for climate change studies. There are significant differences related to spectral coverage and calibration uncertainties between various historical satellite sensors and data records that must be addressed when they are used in climate research. The longest records are available from the historical AVHRR satellite observations since early 80's. The AVHRR has only 3 spectral channels in solar spectral range. Another source of global scale satellite information available since 1998 is the VEGETATION (VGT) sensor onboard of SPOT platform. New source of rich spectral information is available from the MODIS sensor which started operations in 2000 onboard Terra platform. The MODIS has 36 spectral channels including 7 spectral channels specifically designed for surface albedo mapping and other land applications. The MODIS data are of superior quality relative its predecessors. They are calibrated to an absolute scale by means of onboard calibration. In addition, the MODIS surface products are atmospherically corrected using the state-of-the-art techniques, with atmospheric inputs retrieved from the ensemble of MODIS 36 channels.

In this project we propose a method to derive multi-spectral information from historical AVHRR and VGT data that is compatible with MODIS spectral coverage. Method uses a land cover based non-linear regression model, which also accounts for seasonal variations of surface spectral albedo. It employs strong relationship between the surface albedo spectra and the surface land cover type, and the biomass state and amount, and the soil conditions. Model uses 4 VGT channels or 3 AVHRR channels to replicate each of the 7 MODIS land channels. The model parameters are derived for the Atmospheric Radiation Measurement (ARM) Program over the US Southern Great Plains (SGP) region. Data for one specific year that simultaneously involves multiple sensors were used as training set to derive model parameters. Parameter values were found to be robust and independent on the sampling method. When applying the model for time periods beyond the baseline interval, very good level of consistency in data series of albedo derived from different sensors was found. Model successfully reduces the systematic biases and scattering (from up to 15% to less than 5%).

The consistent spectral albedo for 7 MODIS equivalent bands over ARM SGP area was generated continuously for 10-year period from 1995 to 2005. It is available at ftp://ftp.ccrs.nrcan.gc.ca/ad/CCRS_ARM/. Method has been also successfully tested over temperate and polar regions of Canada and Northern US.