A 13-YEAR GLOBAL GRIDDED DATASET OF SURFACE BIDIRECTIONAL REFLECTANCE AND AEROSOL OPTICAL DEPTHS FROM ATSR-2 AND AATSR MEASUREMENTS

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It is becoming accepted that remote sensing can provide the spatial resolution and coverage and, increasingly, the temporal length of observations required to constrain and validate climate models, and to identify seasonal and interannual change on a global scale. Surface reflectance and aerosol optical depth (AOD) are both important parameters in climate modelling. Bidirectional surface reflectance measurements can be used to help constrain estimates of surface albedo, and spectral indices based on surface reflectance also correlate with various vegetation properties such as leaf area and fractional coverage. Aerosol optical depths are an important component of radiative transfer modelling and can be used to track pollution and biogenic atmospheric aerosol.

In order to retrieve surface reflectance values and AODs from satellite top-of-atmosphere (TOA) radiance measurements the contributions from land-surface scattering and atmospheric scattering must be separated. We are now generating a 13-year global gridded dataset of surface bidirectional reflectances and AOD values from TOA radiances measured by the Along Track Scanning Radiometer-2 (ATSR-2) and the Advanced Along Track Scanning Radiometer (AATSR) instruments onboard the ERS-2 and Envisat satellites. The algorithm used to separate the contributions from surface and atmospheric scattering to TOA radiances utilises both the dual-angle and multispectral capability of the (A)ATSR instruments, is based on a physical model of light scattering, and requires no a-priori knowledge of the land surface [1, 2].

A global comparison with surface-based Aeronet sun photometer measurements of AOD will be presented to demonstrate that the retrieval method performs well over a variety of land surfaces. Global retrievals of monthly AOD based on the AATSR data (2003-2008) will be presented and discussed. The discussion will consider temporal changes in global-mean and regional-mean AODs, and changes according to aerosol size as indicated by Angstrom coefficient. A case-study of AOD over the Amazon based on the full ATSR-2 and AATSR dataset will also be presented.

From a global analysis of the 6 years from 2003 to 2008 we can show that in addition to strong seasonal cycles global-mean AOD shows considerable interannual variation. This interannual variation must be considered in the context of apparent small but significant linear long-term negative trends [3]. For example, trend analysis shows a dip in global-mean AOD during 2006 followed by an increase in 2007. Inspection of the data on a regional basis shows that the largest contributor to this global signal is northern Africa. Analysis on the basis of Angstrom coefficient suggests that this variability is caused by variations in the amount of desert dust suspended in the atmosphere. It is known that the Sahara desert is the single largest producer of atmospheric dust on Earth [4] with direct and indirect radiative effects of the dust affecting regional and global climate. It is therefore important to identify and understand variations in this globally important aerosol source. This example illustrates the problems associated with identifying long-term trends in a parameter that has a short life time and localised source regions.

Another region where the climatic effects of atmospheric aerosols are likely to be significant is the Amazon region of South America. It is becoming increasingly apparent that the future of the Amazon rainforest is under threat from both climate change and agricultural practices such as deforestation and biomass burning [5]. Atmospheric aerosols are likely to play an important role in the interaction between deforestation, fire and climate change. Here we use our 13-year time series of AOD measurements to examine the role of aerosols in biosphere-climate interactions over the Amazon. The seasonal cycle of AOD shows peaks in March and September. The September peak is caused by local dry-season biomass burning. The March peak has not been identified previously but is coincident with more remote fires located in northern South America. A decreasing trend in dry-season AOD between 1995 and 2000 and a subsequent increase from 2000 to 2004 can be explained by deforestation practices driven by economic forces, whereas even higher AOD levels in 2005 were probably caused more by the exceptional drought of that year. Throughout the time series dry-season AODs are inversely correlated with dry-season precipitation suggesting a positive feedback between aerosols and drought that may contribute to enhanced drought under climate change [6].

The complete time series of AATSR data has been processed using the European Space Agency's (ESA) Grid Processing On Demand (GPOD) facility and it is planned that these datasets will be made available to users via the ESA EOLI catalogue. The ATSR-2 data are being processed at Swansea University. The combined dataset will constitute the longest available time series of remotely sensed AODs and atmospherically corrected surface reflectances.

1. REFERENCES

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