APPLIED REMOTE SENSING CLUSTER

Towards High Quality Energy-Specific Solar Radiation Data from MSG - First experiences within the HELIOSAT-3 project

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Introduction

HELIOSAT-3 (EU FP5, ENK5-CT-2000-00332) aims at providing the solar energy community with improved and high-quality solar radiation data products from Meteosat Second Generation (MSG) in combination with ENVISAT measurements. A successful integration of solar energy into the existing energy production depends to a large extent on a detailed knowledge of the highly variable solar resource. To describe the atmospheric extinction, cloud parameters and total column densities of water vapour, aerosols and ozone have to be known as a prerequisite. This poster presents first results on clouds and aerosols. Within HELIOSAT-3 the retrieval of total water vapour columns using MSG SEVIRI data and of ozone using ERS-2 and ENVISAT data is foreseen.

MSG SEVIRI cloud retrieval

The AVHRR Processing scheme Over cLouds Land and Ocean (APOLLO) has been adapted towards MSG SEVIRI data. It discretizes all pixels into four different groups called cloud-free, fully cloudy, partially cloudy, and snow/ice, before deriving physical properties (Saunders and Kriebel 1988, Kriebel et al. 1989, Gesell 1989). Clouds are categorized into three layers according to their top temperature. Each fully cloudy pixel is checked to see whether it is a thick or a thin cloud. Thin clouds are taken as ice clouds, i.e. cirrus, whereas thick clouds are treated as water clouds. Cloud cover is derived for each cloud type separately. For partially cloudy pixels cloud cover is derived from reflectances and temperatures of their cloud-free and cloudy parts. These quantities are taken from the nearest fully cloudy and cloud-free pixels, assuming horizontal homogeneity. The cloud type of the partially cloudy pixels is assigned to the most frequent cloud type in a 50x50 pixels environment.

In each fully cloudy pixel, cloud optical depth, liquid/ice water path, and emissivity are derived during daytime by means of parameterization schemes based on the 600 nm reflectance. For water clouds the dependence of the cloud optical depth on the directional hemispherical cloud top reflectance is used. For ice clouds the scheme is different because they have higher reflectance than water clouds for the same optical thickness (Kriebel et al. 1989). The directional hemispherical cloud top reflectance is obtained from the (measured) bidirectional top of atmosphere reflectance by applying an anisotropy correction, by a correction due to ozone absorption, and by subtracting the surface part of the reflectance transmitted through the cloud (see also Kriebel et al. 1989).

References:
Saunders, R.W. and K.T. Kriebel, 1988, Int. J. Rem. Sens., 9, 123-150
Kriebel, K.T., R.W. Saunders, and G. Gesell, 1989, Beiträge zur Physik der Atmosphäre, Vol. 62, No. 3, pp. 165-171, August 1989
Gesell, G., 1989, Int. J. Rem. Sens., Vol. 10, Nos. 4 and 5, pp. 897-905

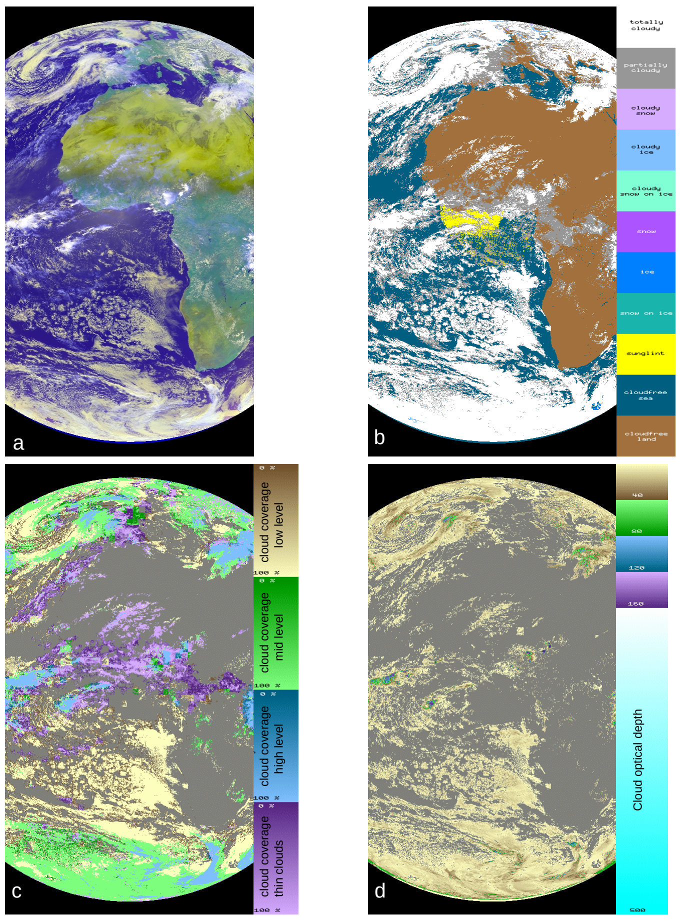

Fig. 1: First MSG APOLLO cloud results for 24. April 2003, 11:57 UTC:
(a) colour composite ch 1,2,10 as RGB, (b) cloud mask,
(c) cloud coverage, (d) cloud optical depth

Aerosol climatology for MSG field of view

Aerosol parameters are retrieved with the new method SYNAER [SYNergetic Aerosol Retrieval; *Holzer-Popp et al.*, 2002a, 2002b] from a combination of simultaneous ERS-2 ATSR-2 and GOME measurements. SYNAER retrieves the boundary layer aerosol optical thickness and differentiates the type of aerosols between continental, maritime, polluted, desert outbreak, and biomass burning / heavily polluted air masses as mixtures of 4 basic aerosol components (sulfate/nitrate, mineral dust, sea salt, soot).

Data from 7/1997 - 3/1998 covering Europe/Africa were received through the ESA AO project SENECA (AO ID-106). Unfortunately, GOME measures “small” pixels of 80x40 km^2 only for 3 days every month, and 320x40 km^2 pixels throughout the rest of the month. For producing the aerosol climatology only “small” pixels are meaningful. Due to the limited data base for this climatology the reasonable temporal-spatial sampling needs to be optimized. The final aim is a 4 seasonal climatology with a 5 degree horizontal grid.

References:
Holzer-Popp, T., M. Schroedter, and G., Gesell, *JGR*, 107, D21, AAC16-1 – 16-17, 2002a.
Holzer-Popp, T., M. Schroedter, and G., Gesell, *JGR*, 107, D24, AAC 10-1 – 10-8, 2002b.

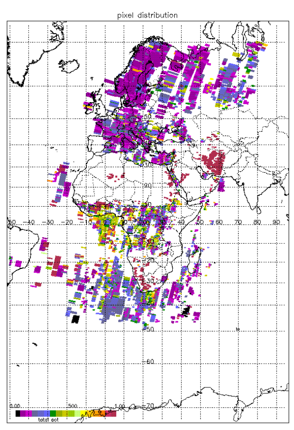

Figure 2: Distribution of exploited GOME pixels for the mean optical thickness (0 – 1) climatology. A total number of 7921 GOME pixels from 7/97 - 3/98 was used.

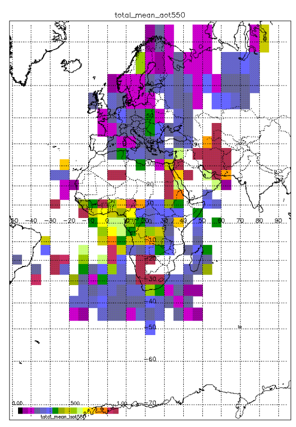

Figure 3: Total mean aerosol optical thickness (0 – 1) at 550 nm in 5x5 degrees boxes.

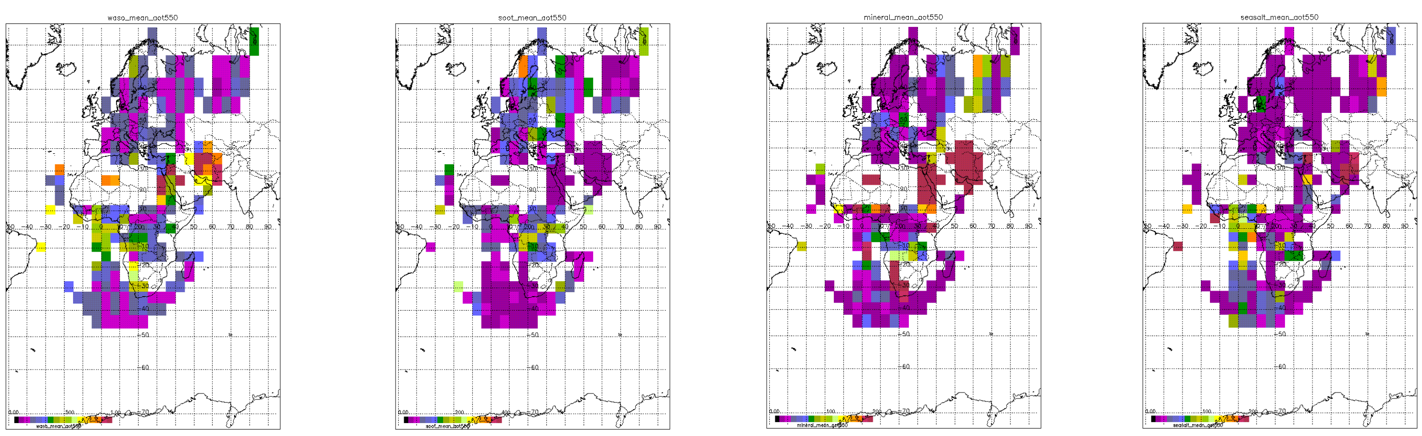

Figure 4: Mean optical thickness at 550 nm of basic aerosol components (from left to right: sulfate/nitrate: 0 - 1, soot: 0 – 0.4, minerals: 0 –0.2, sea salt: 0 – 0.2)