Use of ATOVS data for operational atmospheric correction

M. Schroedter-Homscheidt, T. Holzer-Popp, P. Tungalagsaikhan, C. Weiss,
German Aerospace Center (DLR), German Remote Sensing Data Center (DFD)
correspondance: marion.schroedter-homscheidt@dlr.de

Abstract

The German Remote Sensing Data Center (DFD) processes TOVS and ATOVS temperature and water vapour profiles on an operational basis for all NOAA passes in the field of view of its receiving facilities in Oberpfaffenhofen. Currently, NOAA 14 and 16 satellites are used. TOVS profiles are retrieved with ITPP 5.21 and ATOVS profiles with a combination of AAPP3.0 and IAPP 2.0. All data sets are made available within the frame of the ICSU World Data Center for Remote Sensing o the Atmosphere (WDC-RSAT, http://wdc.dlr.de).

From these level 2 profile information, value added products like gridded water vapour vertical column maps over Europe are generated. These are used mainly for atmospheric correction of remote sensing sensors measuring in the VIS and NIR range like NOAA-AVHRR, IRS-LISS; Landsat7-ETM, and MODIS.

For atmospheric correction water vapour column information is used together with ozone, cloud, and aerosol observations from satellite.

Additionally, total water vapour column is used in the HELIOSAT-3 project (EU FP5, ENK5-CT-2000-00332). HELIOSAT-3 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. 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 mainly results from our operational processing chain for NOAA-AVHRR and our experimental chain for MODIS.

Pre-Operational atmospheric correction chain

The pre-operational atmospheric correction chain for NOAA-16 AVHRR combines (a) the fast parameterized correction procedure SMAC (b) cloud detection performed with the APOLLO scheme (Saunders and Kriebel 1988, Kriebel et al. 1989, Gesell 1989), (c) ERS-2 GOME ozone measurements, (d) NOAA-ATOVS derived water vapour columns and (e) the GLOBE digital elevation model. Aerosol optical thickness is set to a climatological background value.

References: SMAC: H. Rahman, G. Dedieu, Int. J. Remote Sensing, Vol 15, No 1, 123-143; APOLLO: 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
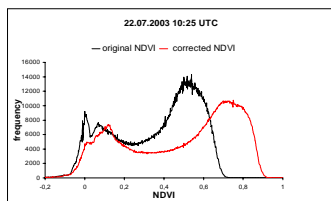

Fig. 1: NOAA-16 AVHRR 22 July 2003, 10:25 UTC
Due to the reduction of atmospheric noise by the correction, the frequency distribution of NDVI looks much smoother and the range of NDVI values is increased significantly (better contrast).
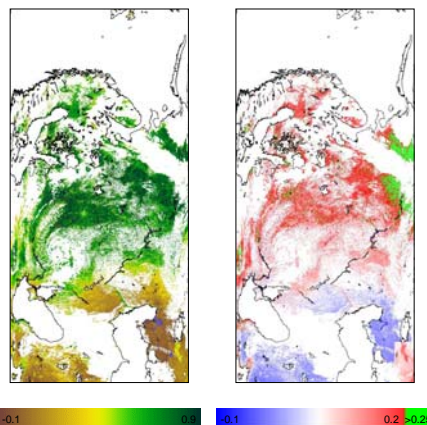

Fig. 2: NOAA-16 AVHRR 22 July 2003, 10:25 UTC
left: corrected NDVI image, right: NDVI difference (correction - original)

Automatic atmospheric correction chain ClearView

A prototype automatic atmospheric correction chain has been built for NOAA-AVHRR, IRS-LISS; Landsat7-ETM, and MODIS. It has 3 steps:
(a) a preprocessor which applies an evidence-based classification of raw data to provide a cloud/shadow mask, turbid areas, and primary land cover classes,
(b) a radiative transfer module which estimates aerosol optical thickness and type over automatically selected dark fields and inverts the satellite signal to surface reflectance values. This module accounts for bidirectional reflectance distribution (based on the primary land cover classification),
(c) an operational interface to assimilated auxiliary data. These include ozone columns (from GOME, SCIAMACHY, GOME-2), and water vapor columns (from ATOVS, MODIS, MSG) and a digital elevation map.

References: Holzer-Popp, T., Bittner, M., Borg, E., Dech, S., Erbertseder, T., et al.: Das automatische Atmospärenkorrekturverfahren Durchblick. Fernerkundung und GIS: neue Sensoren - innovative Methoden, H. Wichmann, Heidelberg, (2001)
US patent No. US 6,484,099 B1 granted Nov. 19, 2002, European and Canadian patents pending
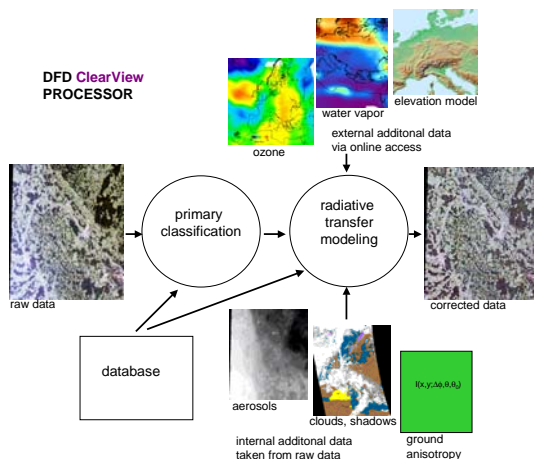

Fig. 3: ClearView scheme

Fig. 4: Terra-1 MODIS 05.06.2000 RGB=143 1km
top: uncorrected image, down: image corrected with ClearView

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