INTRODUCTION

The diffusing path lengths of AATSR’s forward and nadir views are used to separate the contributions from aerosol scattering and surface reflectance in the observed top-of-atmosphere (TOA) radiance. This poster presents an effort to extend the Oxford-RAL retrieval of Aerosols and Clouds (ORAC) scheme used by the GRAPE and GlobAEROSOL projects (Thomas et al., 2007), which currently uses data from the nadir viewing geometry only, to take advantage of the dual-view capabilities AATSR offers.

The new algorithm uses optimal estimation to retrieve aerosol optical depth at 550 nm, effective radius and surface albedo at 550 nm for both forward and nadir viewing geometries (with the spectral shape of the surface constrained by a model based on Cox and Munk (1954a,b) statistics for the sea, and MODIS data (Scatterfield et al., 2004) for the land). At present the 4 channels in the visible region of the spectrum are used; future work will incorporate the infrared channels to improve characterization of effective radius and provide information on aerosol layer height.

INSTRUMENTAL DETAILS

The Advanced Along-Track Scanning Radiometer (AATSR) is aboard Envisat (launched March 2002), and is the successor of the earlier similar instruments ATSR and ATSR-2, on ERS-1 and ERS-2 respectively. Instrumental design is shown in Figure 1, below.

![AATSR schematic diagram](image)

A special feature of the instrument is its two viewing geometries, shown in Figure 2. AATSR has a circular scan pattern, and obtains forward-view measurements at a zenith angle of 53°-55°. Around 100 seconds later, the same region is sampled at a nadir viewing zenith angle of 0°-2°. These near-simultaneous views provide an excellent opportunity for aerosol characterization given their different path lengths. Global coverage is achieved every 3 days.

The visible channels view an on-board calibration target once per orbit. Infrared channels are monitored through use of hot and cold black body targets once per scan. Data is provided with nadir and forward views geolocated as 1 km by 1 km pixels; the retrieval may be performed at this resolution or ‘superpixelled’ to a lower forward views geolocated as 1 km by 1 km pixels; the retrieval may be performed at this resolution or ‘superpixelled’ to a lower.

FUTURE WORK

1. Replace the assumption of a Lambertian surface with a full bidirectional reflection distribution function (BRDF).
2. Incorporate the IR channels into the retrieval scheme.
3. The purpose of the forward model is to predict TOA radiance given atmospheric and surface conditions. The aerosol models are used with the DISORT radiative transfer code (Stamnes et al., 1998) and MODTRAN gas absorption database (Brown et al., 2004) to generate lookup tables (LUTs) of atmospheric transmission and reflectance over a range of geometry (varying solar zenith, satellite zenith and relative azimuth angles) and aerosol (varying optical depth and effective radius) conditions.

AEROSOL MODEL

Aerosol microphysical properties from the OPAC database (Hess et al., 1998) have been used to generate aerosol class models corresponding to typical continental, maritime, dust, urban and Antarctic aerosol. Each class consists of up to 4 aerosol components, represented by lognormal distributions with differing modal radius and spread. Size distributions with different effective radii are obtained by altering the mixing ratio of these components. These models are then fed into the atmospheric forward model.

ATMOSPHERIC FORWARD MODEL

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Starting from a first guess at the atmospheric state \( x_0 \), the retrieval is performed using a standard dual-view optimal estimation retrieval scheme for AATSR (Rodgers, 2000).

ITERATION AND QUALITY CONTROL

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SAMPLE RESULTS

CONTINENTAL EUROPE

A comparative study with other satellite retrievals and AERONET data over continental Europe has been performed (Kokhanovsky et al., 2007). A false-colour composite image (Figure 4) and results of the AATSR retrieval (Figure 5) for October 13th 2005 are presented here.

The scene was largely cloud-free, as seen in Figure 4. Retrieved optical depth compared well to values retrieved by other satellites, and had a slight positive bias over AERONET data. Effective radius is a data product not provided by many other satellite retrievals and was reasonably uniform over the area. The nadir view tended to show a higher surface albedo than the forward, this suggests using a surface bidirectional reflectance distribution function (BRDF) model instead of the Lambertian assumption may improve results. Finally, retrieval cost was generally low. It should be noted that cost is divided by the number of channels used before output, hence values are 1/8 of those from Equation 4.

SAHARAN DUST

Quantification of Saharan dust is of importance to better estimate its radiative forcing, and quantify the mass transported across the Atlantic ocean. The transported dust is thought to be an important source of iron to oceanic plankton and the Amazon rainforests. The retrieval of dust from space is particularly challenging because:

1. Desert surfaces are particularly bright. Consequently it is harder to estimate the atmospheric component of TOA radiance. AATSR’s dual views help alleviate this problem.
2. Dust particles are often non-spherical. The assumption of sphericity used in the calculations leads to an error in the determination of the phase function.

REFERENCES

1. Thomas, G. E. and A. M. Sayer, 1. Desert surfaces are particularly bright. Consequently it is harder to estimate the atmospheric component of TOA radiance. AATSR’s dual views help alleviate this problem. 2. Dust particles are often non-spherical. The assumption of sphericity used in the calculations leads to an error in the determination of the phase function.