Atmospheric Correction of ENMAP Data Over Land and Water

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ABSTRACT

EnMAP is a hyperspectral imager covering the 400 – 2450 nm region with about 200 spectral channels. The spatial resolution is 30 m and the nadir swath width is 30 km with an off-nadir across-track tilt capability of 30°. The instrument consists of two spectrometer units (VNIR and SWIR). Due to the prism design the channel sampling distance varies from about 5 nm (blue region) to 12 nm (SWIR). EnMAP data will be acquired over land and coastal regions.

Different approaches to atmospheric correction will be used. For land scenes the ATCOR model is taken which is based on look-up tables of radiative transfer calculations with the MODTRAN code. For water scenes the MIP (Modular Inversion Program) code is taken. Both codes will account for cirrus detection and correction, and will calculate a map of the cirrus optical thickness.

Selected examples on the retrieval of simulated EnMAP top-of-atmosphere (TOA) radiance scenes will be presented.

1. INTRODUCTION

Hyperspectral imagery of the earth provides a rich source of information that can only fully be exploited if the pre-processing includes an atmospheric correction (AC). Then, the TOA radiance spectrum is converted into a surface reflectance spectrum revealing characteristic surface properties. A number of codes exist to calculate the radiative transfer (RT) through the earth's atmosphere, e.g. MODTRAN, 6S, and libRadtran [1 - 3]. Since the execution time of these codes is too high to be performed on a per-pixel basis, a common technique calculates look-up tables (LUTs) of RT terms (transmittance, path radiance, fluxes) and stores these in a comprehensive database accounting for a large range of weather conditions as well as solar and view geometries.

The atmospheric correction of imagery can then be conducted with suitable software, and we selected the ATCOR [4] and MIP [5] programs for the surface reflectance retrieval of EnMAP data. Both packages account for multiple scattering in a multi-layer atmosphere. The ATCOR database generated with MODTRAN uses the correlated k algorithm in atmospheric absorption regions to achieve a high accuracy. For in-land or coastal water applications the MIP model is employed, a processing tool for the retrieval of hydro-biological parameters. The RT is simulated in MIP for a multilayer atmosphere-water-surface system using the finite element method. MIP can also calculate a map of sun glitter and provides an option to remove this glitter.

Both approaches (ATCOR/MIP) calculate a map of aerosol optical thickness (at 550 nm), account for the adjacency effect, and include a cirrus detection and removal module. In addition, the land module also computes the columnar water vapor map which is required for the surface reflectance retrieval, and allows a combinded atmospheric / topographic correction based on orthorectified imagery and a corresponding DEM. The water module (MIP) essentially uses only channels in atmospheric window regions, therefore, no water vapor map has to be calculated. A map of cirrus optical thickness will be provided for cirrus-affected scenes. There is an extensive literature on ATCOR and MIP, so no further details are given here with the exception of the new algorithm to retrieve the cirrus optical thickness (section 2). Then, retrieval results for selected synthetic scenes are discussed (section 3).

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