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ASIMUT on line radiative transfer code

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Abstract

The CROSS DRIVE project aims to develop an innovative collaborative workspace infrastructure for space missions that will allow distributed scientific and engineering teams to collectively analyse and interpret scientific data as well as execute operations of planetary spacecraft. ASIMUT will be one of the tools that will be made available to the users. Here we describe this radiative transfer code and how it will be integrated into the virtual environment developed within CROSS DRIVE.

1. Introduction

The concept of CROSS DRIVE is to join research on space engineering and science analysis. The development of the collaborative workspace will be implemented to support the following scientific data analysis:

- Share and correlate atmospheric data sets, analysis, models and simulations based on payloads of the two main Mars' satellites MEX and MRO, and future ExoMars;
- Compare and correlate satellites data for geology and geodesy;
- Benchmark satellite and ground based Mars atmospheric measurements.

The above scientific objectives will help the team to understand and develop necessary scientific algorithms and data management strategy necessary for exploiting Mars satellite and ground based data, Mars science analysis, execute Mars global circulation studies and benchmarking Mars data.

One of the key components in CROSS DRIVE is the creation of a collaborative workspace platform that provides access to remote scientists and engineers, from different disciplines, to collaborate in analysing and exploring space data in order to make scientific discoveries as well as contributing to ongoing space missions. One of the tools that will be made available to the users is a on line radiative transfer code which will be used to simulate the Martian atmosphere and to analyse Level 1 spectra of selected experiments.

2. ASIMUT on line

The IASB-BIRA ASIMUT Radiative Transfer model developed in 2006 was initially used for Earth observation missions (IASI and ACE-FTS) [2]. The code was then adapted for planetary atmospheres, in particular those of Venus [3] and Mars [1]. This code has been developed with the objective to be as general as possible, accepting different instrument types. The algorithm can simulate absorption due to molecular species but also extinction due to Rayleigh and aerosols scattering. Recently ASIMUT has been extended in order to include all scattering effects due to aerosols. ASIMUT has been chosen as the reference code for the NOMAD instrument selected to be on-board the ExoMars TGO.

ASIMUT is a modular program for radiative transfer calculations in planetary atmospheres (Figure 1). The ASIMUT software has been developed to exploit the synergy existing between the growing number of different instruments working under different geometries. The main particularities of the software are:

(i.) The possibility to retrieve columns and/or profiles of atmospheric constituents simultaneously from different spectra, which may have been recorded by different instruments or obtained under different geometries. This allows the possibility to perform combined retrieval, e.g., of a ground based measurement and a satellite-based one probing the same air mass, or from spectra recorded by different instruments on the same platform;
(ii.) The analytical derivation of the Jacobians;
(iii.) The use of the Optimal Estimation method (OEM), using diagonal or full covariance matrices;
(iv.) Its portability;

(v.) Its modularity, hence the ease to add future features.

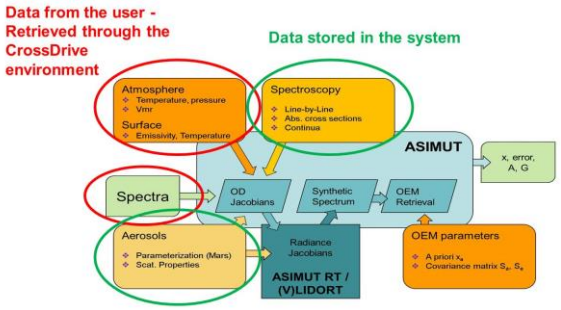

Figure 1: ASIMUT structure

Through the CROSS DRIVE Virtual environment, the user will be offered the possibility to:

- Choose a spectrum or series of spectra corresponding to given geo-temporal locations; Make use of the hi-res images available through the CROSS DRIVE Virtual environment to select the most interesting sites;
- Use the topography information available through the VO of CROSS DRIVE and corresponding to the selected area;
- Prepare the ancillary data needed for the analysis by choosing physical quantities already provided by the system: for example, the surface characteristics (albedo), the initial aerosol/dust/clouds characteristics (physical properties, loading), typical temperature and pressure profiles, initial vertical profiles of atmospheric species, etc.;
- Visualise the spectra, including change of units, saving under recognised file formats;
- Define some parameters for the analysis itself (spectral regions fitted, species to be fitted, etc.);
- Ask the system to perform the analysis;
- View the results of the analysis;
- Compare the results with existing data sets.

ASIMUT is now available on http://asimut.aeronomie.be/ to be tested before being integrated into the Virtual environment of CROSS DRIVE. For the moment data needed for the runs (simulations and retrieval) are typical values saved in the project. The next step will be to allow the user to select a location of the Martian surface through a virtual environment tool, select appropriate data and link those to ASIMUT. It is also foreseen that the retrieved atmospheric parameters will in turn be used for the radiometric correction of imaging data.

We will present the web interface and illustrate the use of ASIMUT through this on line access.

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