Contribution ID: **77** Type: **Talk**

SOLSTICE, a constellation of cubesat-borne solar occultation limb sounders for atmospheric composition profiling –mission simulator and processing algorithms

In tandem with the SOLSTICE instrument development (see related abstract 'instrument development and qualification') a mission simulator has been developed to evaluate the performance of the SOLSTICE system. The simulator includes production of synthetic Level 0 data raw from the instruments, the processing of calibrated atmospheric transmission as Level 1 data, and the 'retrieval'processor generating the Level 2 vertical profiles of atmospheric constituents.

The sounding geometry is simulated from orbital dynamics using the Orekit package, implemented for constellation of limb solar occultation sounders by GOM Space Luxemburg. For each occultation event, the thermal infrared and visible radiance fields in the instruments'line of sights are calculated from the transmittance produced by the line-by-line Reference Forward Model (RFM) [1]. Two physical models of the two scientific instruments, HIROS and HSDI have been developed to produce synthetical instrument data and their associated noise, from which the Level 0 data is packaged.

The synthetic Level 0 granules are then available for input to the data processor. The Level 1 data processor includes three functions: 1) the HSDI images are processed to reconstruct the accurate knowledge of the line of sight pointing. 2) the HSDI images are processed into calibrated channel transmittance registered as function of altitude. 3) The HIROS high-resolution spectra are calibrated into transmittance on the absolute frequency grid. For performance assessment, an option to fully bypass the platform and instrument simulator has been added so that reference ideal Level 1 data can be produced.

The retrieval algorithm, producing the level 2 dataset, is based on the Multispectral Orbital Retrieval using Sequential Estimation (MORSE) developed at the University of Oxford. The sequential aspect, as implemented in MORSE, is not to solve the equation using all available measurements simultaneously but to divide the measurements into correlated subsets and solve for each in turn, updating the a priori estimate. The vertical profiles are retrieved between 6 and 50 km, on a 1 km grid. MORSE is first run on HSDI data to produce temperature, pressure, water vapour, and pointing correction vertical profiles. HIROS data are then ingested to produce and/or update profiles of temperature, pressure, pointing correction, water vapour, methane, nitrous oxide and ozone profiles. Retrieval errors, averaging kernels, and other optimal estimation diagnostic metrics are also determined.

We will present the simulator architecture and give an overview of its working, as well as a first performance assessment of the SOLSTICE products.

[1] Dudhia, A. (2017). The Reference Forward Model (RFM). Journal of Quantitative Spectroscopy and Radiative Transfer, 186, 243–253. https://doi.org/10.1016/j.jqsrt.2016.06.018

Topic

Upcoming Earth observation limb and occultation instruments

Author: WEIDMANN, Damien (Rutherford Appleton Laboratory)

Co-authors: Dr DUDHIA, Anu (University of Oxford); Dr MACLEOD, Neil (Rutherford Appleton Laboratory); Dr BROWNSWORD, Richard (Rutherford Appleton Laboratory); Dr DONIKI, Stamatia (Rutherford Appleton Laboratory)

Presenter: WEIDMANN, Damien (Rutherford Appleton Laboratory)