Development of the MetOp Scene Generator Module (MSGM) for the ESA FORUM End-to-End Simulator

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ABSTRACT

In this work we present the fundamental elements of the MetOp-SG Module (MSGM) of the FORUM End-To-End Simulator (FEES) developed for the European Space Agency, in preparation for FORUM, ESA's 9th Earth Explorer (launch 2027), for flying in formation with MetOp-SG. This work constitutes also a basis for further, future applications to other sensors. The goal of the MetOp-SG Module (MSGM) is to simulate IASI-NG (Infrared Atmospheric Sounder Interferometer Next Generation) L1C data, following the format specified by EUMETSAT. This module slots into the existing Phase A/B1 FORUM end-to-end simulator (FEES A/B1), and for this reason, its structure is coherent with the interfaces already defined in FEES A/B1.

The MSGM provides a set of functionalities which aim at calculating IASI-NG radiances corresponding to those observations taken in coincidence with FORUM. The synergy between the two instruments is in fact of fundamental importance to obtain full coverage of the Earth outgoing longwave spectrum in the whole infrared range, including the Far Infrared, which will be observed by FORUM for the very first time from satellite remote sensing. To achieve this, the MSGM is composed of three submodules: 1) the MetOp-SG Matching Module (MSGM-MM), which is responsible of the collocation of the IASI-NG fields of view with the FORUM observation; 2) the MetOp-SG Scene Generator (MSGM-SG), which has the task of producing the high spectral resolution radiances that reach the IASI-NG sensor; 3) the MetOp-SG Observation System Simulator (MSGM-OSS), which ingests the high-resolution spectra and applies the simulation of the Level 1 processor to get the L1C synthetic products. The software is developed in Matlab, C and Fortran 2003.

The current version of the software, which relies on LBLRTM and LBLDIS radiative transfer models, includes several ancillary databases of optical properties of clouds and aerosols as well as a full emissivity database for the Mediterranean and Northern European region which is built upon the Huang emissivity global database. Special emphasis was placed on harmonising these databases to apply them across the full spectral range of FORUM+IASI-NG, in order to make them easily adaptable for further applications. In this work we present the full scheme of the software and its functionalities, showing how each submodule works and showcasing some sample results.