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ESA MISSION SCIENTIFIC VALIDATION BY MEANS OF END-TO-END PERFORMANCE SIMULATORS

Abstract

This paper will present the process, methods and tools developed at ESA to predict and validate the scientific performance of a mission. Performance estimations are required at all stages of a project to assess compliance to mission and system requirements, to support engineering decisions and to prepare for the mission data exploitation by the user. This is done in ESA by mean of End-2-End mission performance Simulators (E2ES).

E2ES are tools which allow to estimate scientific performance by simulating the end-to-end mission chain , i.e. from the observed earth or space scene to the retrieved physical parameters. This includes modelling of platform orbit and attitude and observation geometry, input signal to the instrument based on physical scene and atmospheric parameters, instrument signal acquisition in the spectral and spatial domains, instrument raw data generation, Level-1 products processing and Level-2 Retrievals.

E2ES are used during phase A to support activities like mission performance requirements consolidation and quantification of trade-offs impact on the mission product. Once a mission is approved for implementation, such simulators evolve to become supporting tools for the development and validation of the ground data processing and for CalVal preparation. E2ES are common tools for scientists, payload and system engineers and force better synergy and coordination between these groups .

ESA has defined, as a result of several RD activities, process, methods and tools to reduce the re-engineering effort and to promote reuse in the development of E2E performance simulators. This includes a E2ES reference architecture, a common simulation framework (OpenSF) and a library of generic EO models (BIBLOS). Successful use of E2ES in projects relies also on an appropriate procurement approach and engineering process throughout the project lifecycle.

A number of EO end-to-end simulators have been developed and are currently being developed for the Earth Explorers and Sentinel Missions following this methodology. E2ES are developed and used in EO programs, strongly driven by the fact that ESA is responsible also for the instrument data processing. Although for space science missions this is often done external to ESA by the scientific community, there can also be a use for E2ES in space science and the process, method and tools defined in EO can be reused to a large extent.

This paper will explain the E2ES concept and architecture, will present the current and future RD activities and will describe in detail some E2ES (for BIOMASS, FLEX and EUCLID missions).