RADIATION TRANSFER MODELS AND QA4EO: CURRENT AND FUTURE EFFORTS FOR TRACEABILITY AND VALIDATION

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Physically-based radiative transfer (RT) models are capable of predicting the reflectance signatures of terrestrial environments. They can simulate the data gathered by space-borne sensors for any viewing and illumination conditions, spatial resolutions, and spectral band locations in the visible and near-infrared (VNIR) domain. As such these models are increasingly contributing to operational retrieval algorithms of essential climate variables, like the Leaf Area Index (LAI) and the Fraction of Absorbed Photosynthetically Active Radiation (FAPAR). Of particular relevance here are the 3-D Monte Carlo (MC) models that represent arbitrary complex three-dimensional structures by combining large numbers of appropriately transformed geometric primitives that are tagged with object-specific scattering properties. In this manner the interactions of light and matter can be simulated in the VNIR domain for both natural and artificial objects/environments, and this over spatial scales that range from the cell structure of individual leaves to entire landscapes with thousands of trees. Once the “scene creation” process has been accomplished it becomes possible to simulate – for any given spectral band and illumination conditions – the radiative transfer within and above the canopy target, for example, to mimic the response of *in-situ* or space-borne instruments.

In principle, 3-D MC RT models may thus serve as ‘virtual laboratories’ where new or existing calibration and validation techniques of remotely sensed quantities and products can be evaluated in a consistent and traceable manner. In practice, such a model-based quality assurance (QA) scheme requires, first, to confirm the fidelity of the RT model - preferably by comparing its simulations to some traceable reference standard – and second, to provide the RT model with a set of (ideally) deterministic descriptions of the structural and spectral properties of all the objects which make up the “scene” (that contributes to the signal gathered by a remote sensor). The purpose of this work is thus to present a coherent overview of existing projects, new achievements and future activities that all aim at enabling a RT model-based QA scheme along the guidelines laid out by QA4EO framework of CEOS. As such, we will first present the on-going fourth phase of the RAdiative transfer Model Intercomparison (RAMI) exercise together with its “community” BRF standard that allows to benchmark RT models in relative terms. Next, we will show how the quality of 3-D MC RT models can be assessed by comparing model simulations to actual measurements carried out with certified instruments under precisely controlled laboratory conditions. Having thus established a traceable quality indicator link we will outline a strategy for using 3-D MC RT models in multi-mission vicarious calibration activities, as well as validation activities of higher level products, like LAI and FAPAR.