Traceable Radiometry Underpinning Terrestrial- and Helio-Studies (TRUTHS): Enabling a Space-based Climate and Calibration Observatory – A proposed ESA Earth Watch mission

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Abstract

TRUTHS was recently proposed, by UKSA for implementation as part of the ESA Earth Watch program. Subject to subscription at Space19+ in November it will start formal Phase A/B1 in spring 2020 with a target launch in 2026.

In the context of this workshop, TRUTHS will enable a new epoch in optical remote sensing. The mission will provide the means to establish robust SI traceability in space at unprecedented accuracies. Flying in a 90 degree, pre-cessing orbit, TRUTHS' hyperspectral imager will have regular simultaneous nadir observations with all satellites at different locations on the Earth, as well as existing CEOS calibration infrastructure such as RadCalNet and Pseudo Invariant Calibration Sites (PICS). As an agile platform it will be able to match observation angles of other satellites and also undertake BRDF characterisation of specific targets. Not only will this enable cross-comparison with mainstream sensors such as Sentinel 2/3 and Landsat 8+ but also the 'Newspace' constellations, not only facilitating traceability but also in many cases an upgrade in calibration accuracy. TRUTHS hyperspectral imager allows the spectral bands of other sensors to be matched and its spatial resolution is sufficient to correlate with other sensors. A core output from the mission will be a calibration service (ToA spectral radiance/reflectance and also BoA surface reflectance) for many of the worlds EO sensors, potentially implemented under the auspices of CEOS/GSICS and in essence will become a 'metrology laboratory in space'. TRUTHS is mission designed explicitly to meet the exacting needs of climate. Its primary goal is to establish a benchmark dataset of the radiation state of the planet, spectrally and spatially resolved with sufficient accuracy that trends can be detected limited only by natural variability, immune from biases and ambiguities of sensor performance and degradation. It measures incoming and reflected solar radiation from ~320 nm to 2450 nm with an uncertainty of 0.3% (k=2) (a factor ten improvement over existing sensors), globally sampled at 50 m spatial resolution. This allows it not only to quantify radiation balance but also to attribute effects to key climate feedbacks such as Cloud and Albedo as well as account for potential variations in energy inputs total and spectral solar irradiance - facilitating testing of climate forecast models in the shortest time possible. TRUTHS will be the scientific forerunner of a paradigm shift in how the Earth is observed, delivering data not constrained to a single discipline but deliberately specified to allow it to be configured to support applications in and at the boundaries of Land, Ocean and

Atmosphere and meet the exacting needs of ECVs e.g. Land and Ocean Carbon cycle, TRUTHS will be an enabling element of the internationally requested 'space-based climate and calibration observatory', ideally in conjunction with other benchmark sensors such as CLARREO.

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