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The Tropical Carbon Mission (TCM): quantifying tropical carbon fluxes from space

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The tropics and sub-tropics are regions of key importance for the global carbon cycle. These diverse and productive ecosystems are subject to rapid environmental change due to extensive deforestation and urbanisation, with consequent changes in hydrology and regional carbon balance. However, greenhouse gas (GHG) fluxes in the tropics and southern-hemispheric sub-tropics are poorly constrained by the existing network of surface measurements. Observations of CO2 and CH4 over the tropics with the precision and frequency that are required by scientists, policy makers and carbon markets is an unmet technical challenge and without such observations we cannot obtain the required step-wise change in current understanding of the tropical and global carbon cycle as needed for improved predictions of the future climate and it will be impossible to move far forward with establishing a robust emission verification scheme that is critical in reducing global GHG emissions.

The Tropical Carbon Mission (TCM) is a proposed bilateral Earth Observation mission between the UK and US space agencies for launch in 2015/2016. TCM will measure columns of CO2, CH4 and CO over the tropics to a precision sufficient to infer the underlying emission and uptake of CO2 from natural and anthropogenic activities. TCM will be launched in a low Earth orbit at an inclination of 35o to enhance coverage over the tropics. TCM will carry two mature instruments: (1) a copy of the visible/short-wave IR (SWIR) spectrometer that the NASA/Jet Propulsion Laboratory has developed for the Orbiting Carbon Observatory (OCO) missions; and (2) a version of the SWIR instrument developed in the UK by Surrey Space Technologies Limited (SSTL) for the ESA Sentinel-5 precursor, the Carbon Monoxide and Methane Spectrometer (CMS), which will be co-boresighted with the OCO instrument.

The primary objectives of TCM are to reduce overall uncertainties in the magnitude and distribution of tropical CO2 fluxes, and to improve our understanding of the tropical carbon cycle. These will result in more reliable climate change forecasts and contribute to the verification of anthropogenic emissions as part of international treaty agreements. Additional objectives of TCM are to reduce the uncertainties in the magnitude and distribution of CO and CH4; and to use concurrent measurements of CO and CH4 to improve source attribution of observed variations in CO2. Finally, TCM will also complement global survey CO2 measurements from OCO-2 (and other potential polar LEO missions e.g. CarbonSat).

In this paper, we will present an overview over the proposed mission, its science objective and its science payload. We also show the results of observation system simulation experiment (OSSE) studies that have been carried out to demonstrate the impact of TCM on tropical carbon fluxes.