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Remote sensing of chlorophyll fluorescence with GOSAT

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Sun-induced chlorophyll fluorescence (F_s) emitted by plants as a by-product during photosynthesis carries information about their photosynthetic activity. It is possible to exploit space-based remote sensing measurements to retrieve the fluorescence signal and thus indirectly study carbon fluxes on a global scale.

We implement a fluorescence retrieval based on the method pioneered by Frankenberg et al. (2011) into the framework of the University of Leicester Full-Physics GOSAT CO_2 retrieval (UoL-FP). This physically-based approach is applied to high-resolution spectra at the edges of the O_2 A-Band in the red to NIR range, that feature strong solar as well as a few weak O_2 absorption lines. The fluorescence signal, which acts as an additional source, results in an in-filling of the measured solar absorption lines that are used to distinguish F_s from reflectance effects.

By analysing GOSAT soundings from 2009 onwards, we examine global and regional long-term trends of F_s and compare them with parameters related to plant physiology, such as spectral vegetation indices and MODIS-derived model GPP values. Following Guanter et al. (2012) and Frankenberg et al. (2011), different regions and biomes are considered and we find that seasonal trends of both model GPP data as well as greenness indicators are well reproduced by our GOSAT-retrieved F_s.