Disentangling vegetation fluorescence signal from space-based measurements of reflected solar radiation

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Abstract

Photosynthesis is one of the most important mechanisms that enable life on Earth. It is a process where sunlight is converted to chemical energy by synthesizing sugars using water from the soil and carbon dioxide from the air. Thus understanding this mechanism is crucial to have a better grasp of our climate system and the Earth's carbon cycle.

One commonly used proxy value to measure photosynthetic activity of plants is solar-induced fluorescence (SIF), which is a subtle light emission signal emitted around the red and the near-infrared wavelengths of the electromagnetic spectrum.

Current methods to retrieve SIF with satellite remote sensing are statistically-based and usually utilize solar Fraunhofer lines to disentangle the SIF signal from the atmospheric and surface contribution of the satellite measured radiance. This disentanglement process is a highly ill-posed problem due to many absorption and scattering events present in the atmosphere and since the SIF signal is relatively small.

In this work, we investigate the SIF retrieval problem using simulated datasets. The simulated satellite instrument is the TROPOspheric Monitoring Instrument (TROPOMI) on board the Copernicus Sentinel-5 satellite. TROPOMI has a good spectral resolution making it a suitable candidate for accurate global SIF retrievals. The results of this study are used to develop a physically-based SIF retrieval with real TROPOMI measured data.