On the surface apparent reflectance exploitation: Entangled Solar Induced Fluorescence emission and aerosol scattering effects at oxygen absorption regions

Neus Sabater¹,², Pekka Kolmonen¹, Luis Alonso², Jorge Vicent³, José Moreno², and Antti Arola¹

¹Finnish Meteorological Institute, Helsinki, Finland (neus.sabater@fmi.fi)
²Laboratory for Earth Observation, Valencia, Spain
³Magellium, Toulouse, France

Monitoring vegetation photosynthetic activity and its link with the carbon cycle at a global scale is a leading breakthrough that the scientific community has been seeking in recent years. Pursuing this goal, one of the most important advances in the last decade has been the measurement of the Solar Induced Fluorescence (SIF) at a satellite scale. Current satellite-derived SIF estimations provide SIF measured at certain specific wavelengths depending on the retrieval strategy and the instrument capabilities. However, for the time being, no global observations of the total spectrally resolved and integrated SIF signal have been yet achieved. In a near-future context, spectrally resolved SIF estimations will be provided by missions such as the FLuorescence EXplorer (FLEX) from the European Space Agency.

When disentangling the total SIF contribution, emitted between 650-800 nm, from the acquired satellite signal, molecular and aerosol absorption and scattering effects must be carefully accounted for. Particularly, within the oxygen absorption features, the characterization of the aerosol scattering effects represents the most critical step prior to the SIF estimation.

In the context of the FLEX/Sentinel-3 tandem mission concept, this work presents a novel technique that refines any a priori aerosol characterization process through the exploitation of the high spectral resolution surface apparent reflectance signal at the oxygen absorption regions. Within the absorption features, SIF contribution on satellite-derived surface apparent reflectance generates a characteristic peaky spectrum. However, the shape of these peaks can be simultaneously distorted through the atmospheric correction process due to inaccuracies in the aerosol characterization among other secondary sources. Inaccuracies in the estimation of aerosol optical thickness, Angstrom exponent, asymmetry of the scattering or single scattering albedo translate into characteristic distortions in the shape of the peaks in the apparent reflectance. This particular behaviour allows inferring the magnitude of the errors and correcting them. The presented technique improves the accuracy of any a priori aerosol retrieval.

Authors expect this study to be also of interest to other hyperspectral missions when exploiting, at high spectral resolution, information from oxygen absorption regions.