European Space Agency's *Fluorescence Explorer* Mission: Concept and Applications

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The *Fluorescence Explorer* (FLEX) is a dedicated satellite for the detection and measurement of solar-induced fluorescence (SIF). It is one of two candidate missions currently under evaluation by ESA for deployment in its Earth Explorer 8 program, with Phase A/B1 assessments now underway. FLEX is planned as a tandem mission with ESA's core mission Sentinel-3, and would carry an instrument, *FLORIS*, optimized for discrimination of the fluorescence signal in terrestrial vegetation. The FLEX mission would be the first to be focussed upon optimization of SIF detection in terrestrial vegetation, and using finer spatial resolution than is available with current satellites. It would open up a novel avenue for monitoring photosynthetic function from space, with diverse potential applications.

Plant photosynthetic tissues absorbing sunlight in the wavebands of photosynthetically active radiation (400 to 700 nm) emit fluorescence in the form of red and far-red light. This signal confers a small but measurable contribution to apparent reflectance spectra, and with appropriate analysis it may be detected and quantified. Over the last 15-20 years, techniques for SIF detection have progressed from contact or near-contact methods using single leaves to remote techniques using airborne sensors and towers over plant canopies. Ongoing developments in instrumentation, atmospheric correction procedures, signal extraction techniques, and utilization of the SIF signal itself are all critical aspects of progress in this area.

The FLEX mission would crystallize developments to date into a state-of-the-art pioneering mission targeting actual photosynthetic function. This compares to existing methods which address only potential function. Thus, FLEX could serve to provide real-time data on vegetation health and stress status, and inputs for parameterization of photosynthetic models (e.g. with measures of light-use efficiency). SIF might be correlated or modelled to photosynthetic rates or gross primary production — an important topic of research.

An overview of the FLEX mission concept, applications of SIF, scientific challenges and opportunities will be presented.

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