define cloud properties over the simulated surface, which allows evaluating the possible effects of stray light to the instrument.

The L2R contains the necessary retrieval algorithms that will be applied for the atmospheric correction and the fluorescence retrieval. The retrieval scheme process is essentially based on three subsequent steps. The first step involves the atmospheric correction. It characterizes the aerosols optical properties and the columnar water vapour of the image by means of an inversion process that makes use of MODTRAN-based atmospheric Look-Up-Tables (LUTs). It eventually leads to an apparent reflectance product; i.e. reflectance modified by the presence of the fluorescence. This, together with the total irradiance at canopy level, will be the inputs needed in the second step to estimate the fluorescence radiance. Finally, the third step verifies if the fluorescence and the chlorophyll obtained are in agreement by using the correlation between these two variables. In case the retrieval process appears to be incompatible, a parallel process adjusting the atmospheric functions until obtaining a coherent retrieval will be executed. In addition, it is important to be remarked that thanks to the high level of detail simulated in the upward process, errors derived from simplifications assumed in the inversion process will be tested and quantified in the subsequent PEM evaluation module.

FLEX/E2ES is currently in Phase A/B1, however the scientific modules are already in an advanced stage of development. It is foreseen that the FLEX/E2ES will play a pivotal role in the development of the FLEX mission, and will become a benchmark in the construction of future passive optic E2ES.

S2.2 Potential of Current and Future Copernicus Satellite Missions for Low Spatial Resolution Fluorescence Monitoring?

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The Sentinel-4 and Sentinel-5 missions are dedicated to monitoring the composition of the atmosphere for Copernicus Atmosphere Services. Both missions will be carried on meteorological satellites operated by EUMETSAT. In the meantime, a Sentinel-5 Precursor mission is being developed to reduce data gaps between Envisat, in particular the Sciamachy instrument, OMI on the Aura satellite and the launch of Sentinel-5. These missions are part of dedicated Copernicus satellite developments. In addition, within the Meteorological Operational satellite programme (MetOp) a series of three satellites has been realised, which are Copernicus contributing missions. The MetOp satellites, starting in 2006 with the launch of MetOp-A, carry on board the GOME-2 instrument.

These missions have in common that they provide O_2-A band measurements with sufficient spectral resolution for retrieving terrestrial chlorophyll fluorescence information following methods outlined by Frankenberg et al. [GRL, 2011a; GRL, 2011b; AMT, 2012] and Joiner et al. [AMT, 2013]. While the primary products of these missions are related to atmospheric composition, they can provide, serendipitously, fluorescence information on a (near) global scale starting with a temporal frequency of a few days and at a spatial scale of 40×80 km^2 (GOME-2). In the future these observations will be provided by the Sentinel missions on spatial scales of (as good as) 8×8 km^2 and with hourly frequency over Europe (Sentinel-4). As these missions are part of the Copernicus programme, a time series of more than three decades can be expected.

In this presentation mission details will be outlined. Furthermore, interaction with the community will be triggered for exploring the potential of this product and defining requirements.

S2.3 A-SCOPE: Automating Fluorescence Modeling in Support of FLEX

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As part of ESA's FLEX/Sentinel-3 Tandem Mission Photosynthesis Study, a dynamic vegetation model has been developed for canopy fluorescence modelling. This model will eventually facilitate fluorescence retrievals from space, e.g. through assimilation approaches or through inversion against FLEX observations.

For this purpose, the SCOPE (Soil-Canopy Observation, Photosynthesis and Energy Balance) model was chosen as baseline model. SCOPE allows the combined simulation of radiative transfer including fluorescence, photochemistry, and the energy balance at canopy level (Van der Tol et al. 2009). The model links visible to thermal infrared radiance spectra (0.4 to 50 µm) as observed above the canopy to the fluxes of water, heat and carbon dioxide, as a function of vegetation structure, and the vertical profiles of temperature. Within ESA's Photosynthesis Study the SCOPE model has been expanded with a new biochemistry model, namely MD12 (Magnani & Dayyoub, 2013).

To facilitate the usability of SCOPE, and to automate the generation of multiple simulations, the model has been integrated into the ARTMO (Automated Radiative Transfer Models Operator) framework. ARTMO is a graphical user interface (GUI) software package that provides all necessary tools for running a suite of plant radiative transfer models, both at the leaf and at the canopy level. This integrated software package is hereafter referred as Automated SCOPE, shortened to A-SCOPE. Essentially, A SCOPE allows the user: (1) to configure and run SCOPE in a user-friendly way with options to insert single values, ranges, or imported external input datasets; (2) to simulate and store a massive quantity of spectra based on a look-up table (LUT) approach in a relational database; (3) to plot groups of simulated spectra in the same plotting window with color gradients as a function of input parameters; (4) to export simulated spectra and associated meta-data to a text file for further processing. The whole processing chain has been successfully verified on consistency and robustness.

A subsequent requirement is to consolidate SCOPE into an operational, invertible model that enables to retrieve the full fluorescence signal from FLEX observations. Because SCOPE is essentially designed as an energy budget model, however, its large number of input variables makes it currently less suitable to be implemented into an operational processing scheme. A strategy to simplify SCOPE has to be developed. Therefore, a global sensitivity analysis has been conducted to identify of how the impacts of the output data would change in response to variations in key parameters and how they interact. We applied the method of Saltelli et al., (2010), which is a variance-based method that uses a Monte Carlo method to look at the full parameter space. The sensitivity analysis will quantify the relative importance of each input parameter to model outputs, and can help set safe default values for those less influential input parameters in driving the fluorescence signal. This work will close with recommendations regarding how to proceed to modify SCOPE in order to enable developing an invertible model for FLEX fluorescence retrievals.

S2.4 Impact of Instrumental Characteristics on Vegetation Fluorescence Retrieval from Spaceborne Simulated Images

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Non homogeneous physical characteristics of optical detectors, as well as their imperfect calibration and/or the temperature drift of their characteristics along time, may considerably impact on the performances of push-broom imaging spectrometers as those envisaged for the FLEX/FLORIS mission. In CCD 2D arrays the sensitivity of each single detector in the across-track direction can in fact differ from each other, thus inducing the well-known 'vertical striping' effect that is typical of most satellite imagers. Although this problem could be in principle overcome by a reliable flat-field calibration, such a calibration is rarely available and any variation of the instrumental characteristics occurred after its launch is never accounted for. Other detrimental effects on the quality of satellite images can be also caused by uncertainty affecting the spectral calibration, random noise and so forth.

In this paper we present an analysis of the main artifacts introduced by the non-uniformity of the instrumental characteristics in a simulated image dataset of the sensor, with particular reference to