M2 SOAC-DC : Fiche de stage

Titre du stage :

Modeling terrestrial and satellite chlorophyll solar induced fluorescence signal with DART

- Comparison with NASA in-situ measurements and extension to large landscapes -

Nom et statut du (des) responsable (s) de stage :

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- NASA: Morton D., Cook B., Middleton B.
- Netherlands: Van der Tol, Verhoef W.

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Internship proposal:

The potential of chlorophyll solar induced fluorescence (SIF) in monitoring plant carbon assimilation (primary production), phenology and health has attracted considerable attention in the terrestrial plant ecology, and global climate change modelling research communities. It explains that ESA and NASA space agencies are being preparing satellite missions for observing SIF from space: Fluorescence Explorer (ESA-FLEX) satellite and geostationary SIF satellite (NASA). The preparation of these missions requires models that simulate SIF of vegetation canopies, including its observation from space. Most present models are 1-D: they neglect the strong influence of the 3-D architecture of vegetation canopies (crops, forests, etc.) on the SIF signal of these canopies. In addition, they usually neglect essential features such as topography and atmosphere interaction. These strong limitations explain that the scientific community aims to develop 3-D models. DART (http://www.cesbio.ups-tlse.fr/dart) is usually assumed to be the most complete 3-D radiative transfer model. It simulates the radiative budget and remote sensing (in-situ, airborne, satellite) observations of LiDARs and spectro-radiometers (ultraviolet to thermal infrared), for any natural / urban landscape, and any experimental / instrumental configuration. Recently, DART team in CESBIO implemented fluorescence modeling into DART. Present results are very encouraging. In collaboration with DART team and collaborators, this internship aims to:

- To further study DART simulated SIF, through the comparison with 1-D models (*e.g.*, SCOPE) and in-situ measurements in a NASA study area (USA).
- To study the adaptation of DART to large landscapes (crops, forests,..), with atmosphere and topography). For this adaptation, it will be necessary to develop SIF modeling for the case of landscapes that are simulated with the so-called "facet - turbid" approach.
- To simulate the observations of SIF from the next ESA and NASA satellites and to analyze the experimental (*e.g.*, spectral resolution, SNR, etc.) and environment (*e.g.*, atmosphere, etc.) constraints.

Expected skill of the student: good level in radiation physics and data processing, if possible with a sound knowledge in programming language (if possible: Python).

Language of the internship: French or English

Internship financing: ESA (European Space Agency)