Toward the inter-comparison of radiation transfert model for plant modelling application

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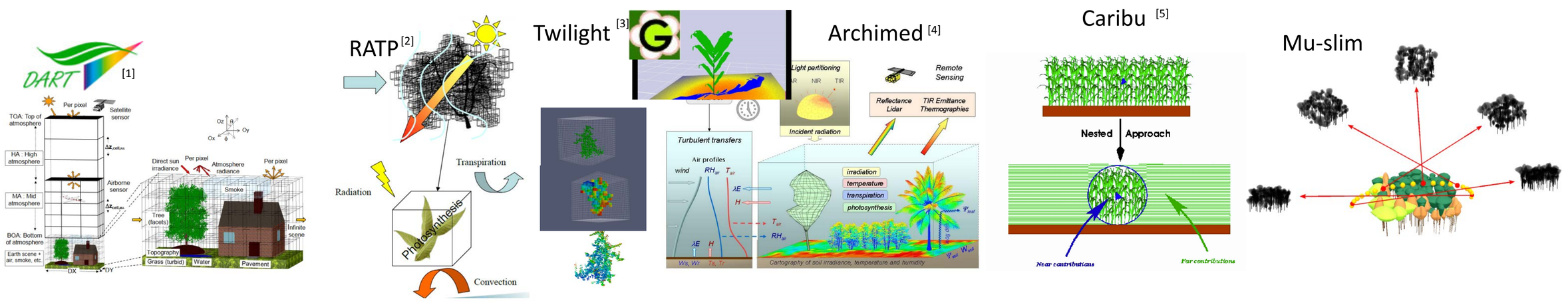
Context

RT models and FSPM

The simulation of radiation transfer (RT) is used in many FSPM models and applications. This preeminence is explained by the central role of light in plant growth and development, light being both the energetic source of photosynthesis and an important mediator for the adaptation of plant development to their environment (photomorphogenesis). Radiation is also a key component of the energy budget of plant organs and a factor driving stomata. Thus RT models are required to simulate organ temperature, leaf photosynthesis, transpiration and water fluxes within plants. At a larger scale, radiation transfer models allow to quantify the light interception efficiency of complex tree crowns or of a canopy, which are important traits for breeding or crop modeling. They also makes it possible to determine the sharing of light between different individuals and species within natural and artificial plant communities; both in field or controlled conditions

A large variety of RT models and approaches



Parallel to this variety of applications, different RT models were developed or adapted for use in the FSPM community. Developed in different context and for different objectives, they differ both in their objectives, in terms of spatial and time scales resolved and, as a consequence, on the way they apprehend plant geometry (volumic vs surfacic objects) and on the way they approximate the physics of radiation transfers and light-plant interactions. Their inter-comparison may be useful to choose and optimize a modeling strategy. Still this task is difficult due to difference in interfaces and in specific parameterization protocols.

How to ease the inter-comparison of RT models ?

Method

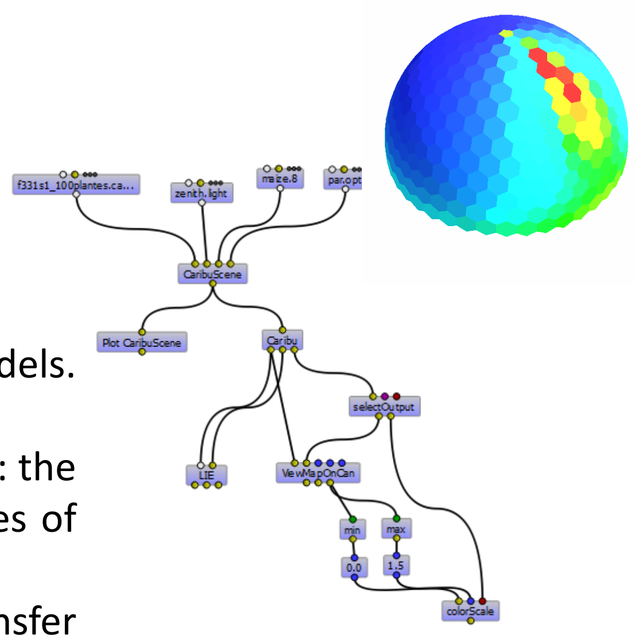
We set-up a software package on the OpenAlea platform, dedicated to the inter-comparison of radiation transfer models. Three light models available on OpenAlea Platform (Caribu, Ratp, Fractalysis) were interfaced with the package.

Standardization of model interfaces

A unique interface was designed for the three models. Two standardization directions were addressed:

- A standardization of the radiative model inputs : the scene, the light sources, the radiative properties of object in the scene
- A standardization of the call to radiative transfer models

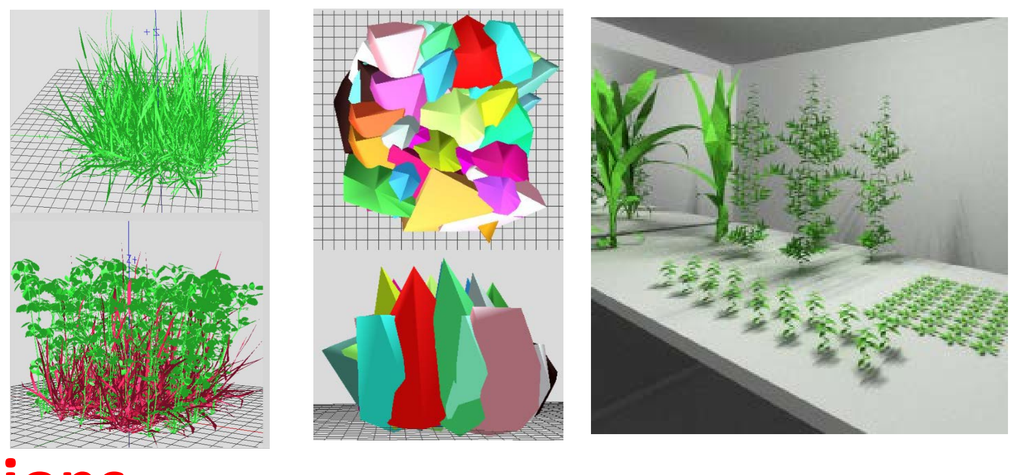
Share parameterization and post-processing tools



Using RT models requires an advanced expertise for a correct parameterization. The definition of standardized interfaces allow to ease this task by providing shared parameterization tools. We concentrate our effort on light sources by allowing parameterization of natural light condition from meteorological data. This tool implements the weather sky model of Perez et al. and offers a flexible 3D discretization of the sky.

Define and publish simulation scenario

The package can be used to simulate RT on virtual scenes with the three light models that are available in the OpenAlea platform. This include measured or simulated trees and crops simulated with L-Py or with GroImp. We currently work at the identification and definition of inter-comparison synthetic scenario representative of these applications. We are also working on metrics to ease the intercomparisons.



Future directions

This work is a first initiative towards a benchmark proposal, open to the whole FSPM community, similar to the RAMI initiative for the inter-comparison of radiation transfer model for remote sensing application (RAdiation transfer Model Intercomparison http://rami-benchmark.jrc.ec.europa.eu/HTML)

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