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Topic : Applications of remote sensing (crop and forest monitoring and classification)

Assimilation of shortwave remote sensing observations within an agrometeorological model - Crop production estimation.

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The link between an agrometeorological model and shortwave satellite data allows the consistency of the modelling of some remotely observable variables' time profiles to be controlled. Mechanistic crop models provide a good description of matter and energy exchanges between vegetation, soil and atmosphere. This study deals with the modelling of the time profile of satellite reflectances, and then the use of remotely sensed observations in order to constrain the modelling. The study was performed over a 40km by 40km french agricultural region, where environmental factors and initial conditions are controlled.

The time profile of high spatial resolution satellite signal (SPOT HRV, 20x20m²) was predicted at field scale through the link between a crop model (AFRCWHEAT2, Porter, 1993) and a reflectance model (SAIL, Verhoef, 1984). This allowed to check our ability to reproduce the temporal profile of radiometric signal that can be observed from satellite. Both net primary productivity (NPP) and yield were predicted by the crop model. Simulated field yields were compared to farmer's estimated values.

Then satellite observations are used to constrain the crop model, using the 'assimilation' technique. We assume that correction of the initial state can be obtained by the minimization of the differences between observed and simulated reflectances. In optimal conditions, i.e. when the radiometric signal is well simulated in direct way, and when at least one acquisition is available during the growth period, SPOT HRV data assimilation gives satisfactory result. An initial condition, like the sowing date, is retrieved with a correct accuracy.

In a third part, we integrate synthetic observations into the coupled crop growth/radiative transfer model. Tests are performed to point out which acquisition dates are most interesting, the optimized number of satellite data and the consequence of an error in 'observed' reflectances on the accuracy of the retrieved parameters. We noticed for example that the more pertinent acquisition dates are the ones which occur during the growth period.

The linked crop/reflectance models are able to predict SPOT HRV high spatial resolution radiometric signals with given initial conditions. When satellite observations are used to constrain the crop model, the adjusted parameter is retrieved with a satisfactory accuracy. Synthetic data assimilation tests have shown that acquisition frequency and dates can be optimized.