Document d'offre de thèse destiné aux candidats (Anglais)

Title: Metrics to assess the spatialisation of crop models for Precision Agriculture: application to a vine water status model.

Supervision Team
Dr James Taylor (Irstea) Precision Agriculture
Prof Bruno Tisseyre (SupAgro) Precision Viticulture
Dr Sebastien Roux (Inra) Biometry

The thesis will be performed in the DeMo (Decision and Modelisation) team of UMP ITAP (Information, Technologies, Analyse environmental, Procédés agricoles) and based in Montpellier

Abstract:

This proposal address a gap in knowledge about how next generation spatial crop models can be assessed for performance. The wide variety of high resolution agriculture data now available is shifting perspectives on how crop models can be altered and used for tactical, short-term predictions and in-season management. Updating and spatialising existing crop models will fundamental change the nature of the model and interactions between intermediary model parameters and model inputs. These will now be spatial in nature and exhibit some level of spatial autocorrelation. Similarly, outputs of the model will be spatially autocorrelated. Under these conditions, classical approaches to assess model performance will be sub optimal. This work will propose, test and validate new statistical approaches to assess spatial crop model performance. The basic model will be a spatialised model of vinewater stress applied to Mediterranean vineyard systems. The project will draw on academic modelling and (geo-)statistical expertise within UMRs ITAP and MISTEA and industry support from ITK, ICV and Terranis.

Candidate:

This project would suit either a trained biometrician who was interested in working in applied geo-statistics in the agriculture domain or it would suit a viticulturists/agronomist who was interested in precision agriculture and developing geo-statistical expertise

Further details:

There exists enormous knowledge gaps in how to best manipulate crop models to accept and to be updated with spatial (and temporal) high-resolution ancillary data, the implications that changing the model has on predictive power (and subsequent management options), and how to properly assess

model performance at varying scales. Agricultural scientists need metrics and protocols to help achieve this and this thesis will develop these decision tools.

Objective:

The crux of this thesis will be method development to generate metrics to assess the effect of incorporating multi-temporal spatial crop and environmental observations into existing crop models. The intent will be to incorporate aspects of *spatial* variance decomposition into a Sobol-based sensitivity analysis. The intent is to improve understanding of how to spatialize model predictions for enhanced spatial management. It will not and cannot address all issues, but will start to provide tools to achieve this. The intent is not to arrive at the best spatialize model, but to develop tools that will help all models arrive at this point.

Spatial crop (agri-environmental) models will generate outputs with a change in extend, coverage and/or support from traditional crop model applications. The need for correct methods of sensitivity analysis has been previously discussed and some methods proposed. However, these have been typically proposed for large scale, regional applications, and not for very high resolution, sub-field, agronomic applications. It is an area of sensitivity analysis that requires further work.

Proposed Workplan: (This is flexible and will be adapted to the candidates goals)

A) Build better understanding

- Conduct a review of existing approaches to assessing spatial models in the agri-environmental sciences and suitability for application to spatial crop models. (Months 1-6) (Journal article – Agsystems journal)
- Generate a discussion paper on spatial and spatialized crop models in an environment of increasing spatio-temporal data streams. A SWOT analysis of the concept. (Months 3-9) (Discussion article – Journal (precision ag?))

B) Build the science

- Spatialise the crop model (WSM) – beta version (Months 3-15). (Conference paper). Based on Mas Numerique database.
- Develop metrics for assessing spatial model performance (at various scales). Sensitivity analysis of spatial inputs on model performance (Months 12-30) (Conference paper leading to Journal (statistical/modelling domain) paper)

C) Demonstrate outcomes

- Demonstrate application of metrics to assess the ITK-WSM (Months 18-32) (Viticulture Journal); Use Mas Numerique and Tavel region as case studies

- Update the spatialized model based on experiences within the project. (Months 20-30) (Industry outcome – translational activity)

D) *Completion*

- Synthesis of existing publications and final write-up into thesis. Soutenance.(Months 30-36)

Contact for more information: james.taylor@irstea.fr