



Two-year scientific position in computational landscape epidemiology at INRA (France), near Paris

Project title: Numerical simulation and computer experimentation for plant epidemiology models on spatially explicit landscapes

Funding project: “GESTion TERritoriale des résistances aux maladies en réponse aux nouvelles contraintes d'utilisation des pesticides en grande culture”. GESTER is a four-year project (2012-2015) supported by the French National Research Agency (ANR). It involves teams from several disciplines, including epidemiology, agronomy, social sciences and mathematical sciences.

Supervisors: Hervé Monod (INRA, UR MIA-Jouy) and Christian Lannou (INRA, UMR Bioger-CPP)

Start date: September 2012

Details

The GESTER project aims at limiting the impacts of crop diseases, while using less pesticide. The objective is to provide efficient and realistic scenarios of crop variety allocations at the scale of a cultivated landscape, in order to increase resistance durability. Mathematical modelling and simulation will play a key role to study the dynamics of plant disease propagation and devise optimal control strategies.

In this context, two INRA units propose a two-year position for an applied mathematician motivated by agro-ecology applications or an agro-ecologist highly skilled in applied mathematics and numerical programming. The aim is to develop innovative methodology and software in C, C++ and R, in order to simulate disease propagation over explicit landscapes and optimize control strategies by computer experimentation.

In a first stage, the objective will be to compare and improve the numerical methods that are used presently to generate agricultural landscapes and to calculate spore dispersal in those landscapes. It will involve devising efficient meshing schemes to perform the integro-differential computations described in Bouvier et al. (2009). It will also involve improving the stochastic methods developed at MIA-Jouy to generate partially controlled landscapes for simulation studies (Le Ber et al, 2009). The second stage will be dedicated to finding scenarios of variety allocations that are optimal with respect to resistance sustainability. This work will be based on mathematical analysis and will require innovative approaches on computer experimentation and simulation-based optimization.

The priority will be to provide and implement methods that are directly useful to the GESTER agro-ecological objectives. The work will also give rise to original methodological research to be published in journals at the interface of agro-ecology and applied mathematics.

Recent related publications of the teams :

- Bouvier A., Kiéu K., Adamczyk K. et H. Monod, 2009. Computation of the integrated flow of particles between polygons. *Environmental Modelling & Software* 24, 843-849.
- Lamboni M., Monod H., Makowski D. 2011. Multivariate sensitivity analysis to measure global contribution of input factors in dynamic models. *Reliability Engineering and System Safety* 96, 450-459.
- Le Ber F., Lavigne C., Adamczyk K., Angevin F. , Colbach N., Mari J.F. et Monod H., 2009. Neutral modelling of agricultural landscape by tessellation methods ; application for gene flow modelling. *Ecological Modelling* 220, 3536-3545.

Papaix J., 2011. Structure du paysage agricole et risque épidémique, une approche demo-génétique. Thèse de Doctorat (Ph.D.). AgroParisTech, Paris.

http://www.inra.fr/miaj/public/nosdoc/these2011julien_papaix.pdf

Papaix J., Goyeau H., du Cheyron Ph., Monod H., Lannou C. 2011. Influence of cultivated landscape composition on variety resistance : an assesment based on the wheat leaf rust epidemics. *New Phytologist* 191, 1095-1107.

Papaix J., David O., Lannou C., Monod H. 2012. Selection for specialist or generalist pathogens in spatially heterogeneous environments. *Submitted*.

Qualifications required

- engineer diploma or Ph.D. in applied mathematics (numerical simulation, scientific computing, probability/statistics). Diploma in agronomy or ecology will be considered provided they are completed by high skills and experience in applied mathematics and programming.
- basic knowledge and interest in plant science and agro-ecology
- experience in programming and simulation
- good oral and written communication skills in French and/or English
- autonomy and aptitude for working in a team and collaborating with different disciplines

Duration : 24 months, starting preferably in September 2012

Position details : Two-year contract as an « Ingénieur de Recherche », salary : about 2100 €/month (netto)

Location :

- INRA, Unité de Mathématique et Informatique Appliquées (UR 341 MIA-J), Jouy en Josas, France
<http://www.jouy.inra.fr/mia>
- INRA, UMR Bioger-CPP BIOlogie et GEstion des Risques en agriculture – Champignons Pathogènes des Plantes, Grignon, France
<http://www4.versailles-grignon.inra.fr/bioger>

Both units are situated 20-25 km south-west of Paris

Contacts and application :

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Informal enquiries can be sent by email to both supervisors. To apply, please send a cover letter of motivation and a detailed CV including the list of publications.

The call is open from 1 June to 1 November 2012, at the latest.