
Stochastic generators for spatial fields of ecoclimatic agricultural indicators in France

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Abstract

The timing, concomitance and succession of weather events during the life cycle of a plant determines whether they can have adverse impacts on the development of the plant. For example, wheat yield may be reduced when plants are exposed to unusually high heat or drought stress during their growing season in spring or during their grain-filling season in summer. Ecoclimatic indicators are climatic variables calculated at an annual scale and designed to summarize certain weather conditions during a specific phenological phase of a cultivar in agriculture. In this work, we describe an approach to provide stochastic and spatially coherent generators for assessing the spatial extent and aggregation of extreme events in ecoclimatic indicators for wheat. An application is illustrated with training data from climate model simulations for impact studies in France (DRIAS, at 8km resolution). First, we estimate local coefficients from excursion sets to characterize the local extent of relatively large anomalies in ecoclimatic indicators. To allow for space-varying correlation range in the stochastic generator, we use these local coefficients estimates as a covariate to construct a nonstationary covariance on relatively large domains, such as continental France. The spatial model is implemented using the INLA-SPDE approach and allows for simulation of indicator fields conditional to very large values of its spatial average.

This work is based on local range coefficients developed with Ryan Cotsakis (UNIL) and Elena di Bernardino (Université Côte d’Azur) and is joint with Maël Aubry and Carina Furusho-Percot (Agroclim-INRAE).

Keywords: nonstationary correlation, Gaussian copula, INLA, SPDE, regional climate model

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