Geophysical Research Abstracts
Vol. 15, EGU2013-1421, 2013
EGU General Assembly 2013

Ecoclimatic indicators to study crop suitability in present and future climatic conditions

Julie Caubel (1), Inaki Garcia de Cortazar Atauri (1), Frédéric Huard (1), Marie Launay (1), Dominique Ripoche (1), David Gouache (2), Marie-Odile Bancal (3), Anne-Isabelle Graux (4), and Nathalie De Noblet (5)

(1) INRA, AgroClim, Avignon, France, (2) ARVALIS - Institut du Végétal, Service Génétique Physiologie et Protection des Plantes, Orsay, France, (3) INRA, Environnement et Grandes Cultures, Thiverval-Grignon, France, (4) INRA, Ecosystème Prairial, Clermont-Ferrand, France, (5) LSCE, Gif-sur-Yvette, France

Climate change is expected to affect both regional and global food production through changes in overall agroclimatic conditions. It is therefore necessary to develop simple tools of crop suitability diagnosis in a given area so that stakeholders can envisage land use adaptations under climate change conditions. The most common way to investigate potential impacts of climate on the evolution of agrosystems is to make use of an array of agroclimatic indicators, which provide synthetic information derived from climatic variables and calculated within fixed periods (i.e. January first – 31th July). However, the information obtained during these periods does not enable to take account of the plant response to climate. In this work, we present some results of the research program ORACLE (Opportunities and Risks of Agrosystems & forests in response to CLimate, socio-economic and policy changEs in France (and Europe).

We proposed a suite of relevant ecoclimatic indicators, based on temperature and rainfall, in order to evaluate crop suitability for both present and new climatic conditions. Ecoclimatic indicators are agroclimatic indicators (e.g., grain heat stress) calculated during specific phenological phases so as to take account of the plant response to climate (e.g., the grain filling period, flowering- harvest). These indicators are linked with the ecophysiological processes they characterize (for e.g., the grain filling).

To represent this methodology, we studied the suitability of winter wheat in future climatic conditions through three distinct French sites, Toulouse, Dijon and Versailles. Indicators have been calculated using climatic data from 1950 to 2100 simulated by the global climate model ARPEGE forced by a greenhouse effect corresponding to the SRES A1B scenario. The Quantile-Quantile downscaling method was applied to obtain data for the three locations. Phenological stages (emergence, ear 1 cm, flowering, beginning of grain filling and harvest) have been simulated by the STICS, CERES and PANORAMIX crop models with the same input climatic data. Results showed that phenological stages tend to be reached earlier in the future. Significant differences were noted between indicators calculated for invariable calendar periods and indicators calculated during phenological phases. Therefore, ecoclimatic indicators are relevant to provide accurate information about crop suitability in the context of climate change. Whereas most of the indicators do not indicate any significant changes in the future, plant mortality due to frost risks from emergence to ear 1 cm tends to decrease and water supply tends to be more limiting in the future.

These indicators do not replace models but represent additional tools for understanding and spatializing some results obtained by models. Their use can provide a spatial distribution of crops according to their suitability in present or future climatic conditions and enable us to minimize the risk of crop failure. It would be interesting to consider the response uncertainties according to the uncertainties we have in future climatic predictions by using different greenhouse emission scenarios and downscaling methods.