

Remote sensing to predict yields and analyse the impact of climate scenarios on agricultural production

A broad range of data, knowledge, tools and methods involving many scientific disciplines—meteorology, climatology (global and regional climate models), remote sensing, modelling and agricultural statistics—are required to characterize the impact of climate change and differentiate it from the effects of climate variability. The problem is that these different types of information concern very different spatiotemporal scales, e.g. plot to region, day to year, etc. However, at the operational scale, spatiotemporal variability and parametering have very substantial impacts on the predictive quality of climate models. For instance, in Senegal, mean interannual yields simulated by the SARRA-H (Système d'Analyse Régionale des Risques Agroclimatologiques, Version H) crop model, using data generated by nine regional climate models, showed significant bias (from 200 to 700 kg/ha).

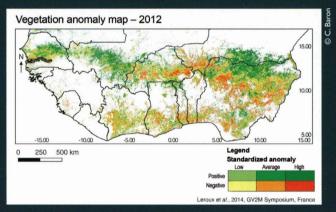
These data may be compared to the mean 600 kg/ha yield obtained using data from the ground station network. However, the SARRA-H model clearly identified major trends concerning the impact of increased temperatures on crop yields. Regarding the Sudanian-Sahelian area, it thus seems that, beyond a 2°C increase in temperature, increased rainfall would not prevent a decline in crop yield, as photoperiodic varieties have a better capacity of adaptation to such change.

UMR TETIS (see page 21) researchers are striving to enhance documentation of these variabilities through a better combination of spatiotemporal scales by seeking consistencies between satellite imagery and modelling indicators. For instance, they are developing national and regional maps that characterize cropping systems and identify crop production anomolies associated with stresses affecting crops. Based on objective, repetitive and comprehensive satellite images, the aim of these studies is to characterize spatiotemporal

variabilities (cultivated area, cropping system, phenology, biomass, etc.) in order to generate descriptors to parameter the models used for predicting yields, while analysing the impact of climate scenarios on agricultural production. These studies are supported by several projects (Programme National de Télédétection Spatiale; Analyse Multidisciplinaire de la Mousson Africaine; Agricultural Model Intercomparison and Improvement Project) along with many institutes and partners (CIRAD, CNRS, INRA, IRD, CNES, AGRHYMET, EMBRAPA, etc.).

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▲ Satellite data providing large-scale information on land cover and temporal variations relative to reference periods.

Sustainable annual crop intensification in stressed tropical environments

The research unit Agro-ecology and Sustainable Intensification of Annual Crops (UR AIDA – CIRAD) conducts research on the sustainable intensification of annual crop production in tropical environments. Its research adresses effective uses of available resources for crop production. The focus is on optimising agro-ecological processes within agrosystems through e.g. integrated management of trophic resources, integrated control of pests and diseases and sustainable use of genetic diversity of crops.

The unit develops a broad range of methods and tools (e.g. crop growth modelling and spatial information analysis) for assessment of crop production systems at different spatial and temporal scales.

In collaboration with producers and local stakeholders AIDA seeks to co-design innovative crop production systems and technologies that are tailored to the farming context and production orientations of smallholder farmers in developing countries (e.g.conservation agriculture based cropping systems, pest control techniques for cotton and sugarcane).

AIDA also aims to document major societal issues and fuel debates on global food security, trade-offs between agricultural production and environmental quality, reduction of greenhouse gas emissions, conservation of water resources and on interactions between agroecosystems, biodiversity and climate change.

See an example of a project conducted by UR AIDA on page 18.



▲ A cotton producer in Burkina Faso.

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