17:00   How precisely do maize crop models simulate the impact of climate change variables on yields and water use?

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AgMIP is an international program bringing together research projects on climate, crop modelling and regional agriculture adaptation to climate change. One objective is to better assess the projections of global food availability depending on different staple crops (wheat, rice and maize), taking into account the projections of climate change for the end of century and the uncertainty attached to them. The need for robust estimates, *i.e.* good crop models for yields and use of natural resources is a prerequisite to benchmark the various cropping systems and local solutions that will ultimately be explored in order to cope with climate change, without bringing about any negative side effects on the environment. Modelers hence work together internationally in order to compare and improve process-based crop simulation models. Maize is a strategic crop, exhibiting high potential radiation and water use efficiencies and is cultivated worldwide. In a first phase, the impacts of CO_2 and temperature on the maize yields and water use were studied using 23 crop models on 4 sites with contrasted cool or hot climate conditions, under no water limitation (Lusignan in France, Ames in the United States, Morogoro in Tanzania and Rio Verde in Brasil). Models were run using local soil conditions and climate variables for 30 years (1980-2010) after adjusting the cultivar parameters to the ones used in one experiment in each site. At the four sites studied, the average values across models of simulated yields were closer to the observed local experimental results than the simulation of any individual model. This indicated that ensemble modelling could be a relevant way to approach the impact of climate change on maize yields. There was also a broad agreement between models to simulate a reduction in maize yield in response to temperature, roughly - 0.5 Mg ha^{-1} per °C increase, with no significant impact on water use, although the latter variable was estimated with a large variability between models. Plant phenology was the mostly altered process with increasing temperature. Shortening of the duration from flowering to maturity in particular reduced the gain in grain weight during that phase. This suggests that genetics could hence play a key role in adapting maize production to climate change, at least under high water availability. Doubling [CO_2] from 360 to 720 µmole mole^{-1} increased grain yield by 7.5% on average across models and sites, with a slight decrease of water use, bringing about an increase in water use efficiency. However, the variability of the response to [CO_2] was very high, bringing about the need to better simulate the role of CO_2, especially on plant transpiration. In a second phase, models are therefore now being tested against Free Air CO_2 Enrichment experimental data, so that variability can be reduced and the actual impact of global change on water use can be assessed with a relevant precision to adaptating agricultural practices.