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Crop insurance evaluation in response to extreme events

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Crop yield insurance has been indicated as a tool to manage the uncertainties of crop yields (Sherrick et al., 2004) but the changes in crop yield variability as expected in the near future should be carefully considered for a better quantitative assessment of farmer's revenue risk and insurance values in a climatic change regime (Moriondo et al., 2011).
Under this point of view, mechanistic crop growth models coupled to the output of General/Regional Circulation Models (GCMs, RCMs) offer a valuable tool to evaluate crop responses to climatic change and this approach has been extensively used to describe crop yield distribution in response to climatic change considering changes in both mean climate and variability.
In this work, we studied the effect of a warmer climate on crop yield distribution of durum wheat (Triticum turgidum L. subsp durum) in order to assess the economic significance of climatic change in a risk decision context. Specifically, the outputs of 6 RCMs (Tmin, Tmax, Rainfall, Global Radiation) (van der Linden and Mitchell 2009) have been statistically downscaled by a stochastic weather generator over eight sites across the Mediterranean basin and used to feed the crop growth model Sirius Quality. Three time slices were considered i) the present period PP (average of the period 1975-1990, [CO_2]=350 ppm), 2020 (average of the period 2010-2030, SRES scenario A1b, [CO_2]=415 ppm) and 2040 (average of the period 2030-2050, SRES scenario A1b, [CO_2]=480 ppm). The effect of extreme climate events (i.e. heat stress at anthesis stage) was also considered. The outputs of these simulations were used to estimate the expected payout per hectare from insurance triggered when yields fall below a specific threshold defined as "the insured yield". For each site, the threshold was calculated as a fraction (70%) of the median of yield distribution under PP that represents the percentage of median yield above which indemnity payments are triggered.
The results indicated that when the effect of extreme events was not considered, climate change had a low or no impact on crop yield distribution in 2020 and 2040. This resulted into an expected payout close to what observed in the present period. Conversely, the simulation of the effect of extreme events highly affected the PDFs by reducing the expected yield. This highlights that insured yield in future projections may be overestimated when not considering the impact of extremes, leading to distortions in the risk management of crop insurance companies.

References

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