Economic impacts of climate change on agriculture: a comparison of process-based and statistical yield models

Objective

There is a general perception that empirical studies give more pessimistic estimates of crop response to warming than do process-based models. This paper quantifies this difference at the global scale and puts it in the context of other uncertainties in future climate change impacts, such as how quickly farmers are able to adapt to climate change.

Approach

We use a database of yield impact studies compiled for the IPCC Fifth Assessment Report to systematically compare results from process-based and empirical studies.

Impact

This paper confirms the importance of CO2 fertilization in determining the average global impacts of changing temperature over the 21st century. Our results show the question of whether or not CO2 effects are included is more important than either the inclusion of adaptation or the type of study used to estimate the temperature response.

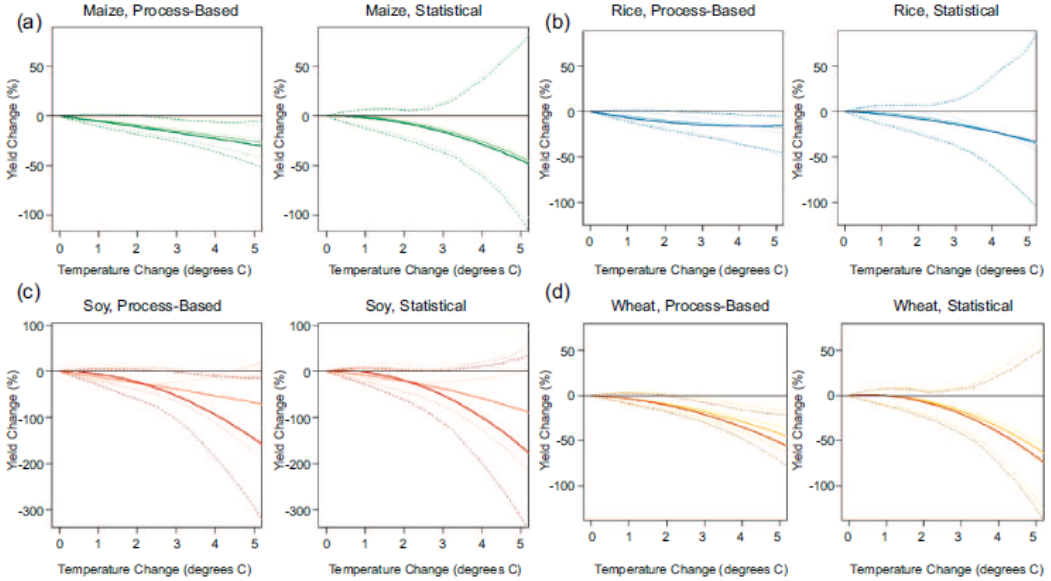

Figure 2. Yield-temperature response functions derived from process-based and statistical models for maize (*a*), rice (*b*), soybeans (*c*) and wheat (*d*) estimated using equation (1). Response curves are plotted for three baseline growing season temperatures based on the 25th, 50th and 75th percentile of temperatures for regions represented in the yield impacts database. In each graph the lightest color corresponds to the coolest baseline temperature and the darkest color to the warmest. Dashed lines show the 95% confidence intervals based on 750 block bootstraps, blocking at the study level. For the GTAP analysis, any grid cell with more than 99% yield loss was set to 99% yield loss. Temperature changes are relative to a 1995–2005 baseline.

Controlling for CO2 fertilization, differences between empirical and process-based responses may be smaller than generally believed.

This publication is supported by the US Department of Energy, Office of Science through the Program on Integrated Assessment Model Development Diagnostics and Intercomparison (PIAMDDI) under DOE Grant No. DE-SC005171

Moore, FC, UL Baldos and T Hertel (2017): Economic impacts of climate change on agriculture: a comparison of process-based and statistical yield models, Environmental Research Letters, 12(6), 065008, DOI: 10.1088/1748-9326/aa6eb2