Quantifying the indirect impacts of climate on agriculture: An inter-method comparison

Objective

Measure the importance of socio-economic feedbacks to a comprehensive assessment of the impacts of climate change on agriculture.

Approach

- Conducts an inter-method comparison between process models, statistical models, and integrated assessment model (IAMs)
- Incorporates direct impact on yields from a statistical study (ACP) and a process model study (AgMIP) into two IAMs—GCAM and IMPLAN.
- Decomposes total impact on yields into direct effects and feedback (substitution) effects.

Impact

IAMs show fewer negative effects than process-based and statistical crop models due to the inclusion of factors such as technological change, input substitution, and crop switching. The effect of these additional factors can be large, with the additional impact on yields ranging from 20%–40%.

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Decomposition of yields for grains (left) and fruit and vegetables (right) using both the ACP (top) and AgMIP (bottom) impacts estimates in the GCAM and IMPLAN models. All lines are indexes with 2010 equal to 1.

The difference between "Reference Change" and "Total Change" is much larger than the original impacts (reflected in the "Pure Climate" curve), which tells us that these indirect interaction effects (reflected in the "Substitution effect" curve) are more significant than the direct pure climate effects.

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