Reducing uncertainty in prediction of wheat performance under climate change

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Goals

- ✓ **To quantify the uncertainty of large wheat multi-model ensembles, create simulation capacity to assist the assessment of impacts of climate change.**
- ✓ **To improve identification of climate change hotspots, promising regional-specific wheat breeding traits and crop management and quantification of adaptation options across the globe.**
- ✓ **Step-wise strategy to improve model accuracy through addressing physiological crop growth processes in increasing order of complexity.**

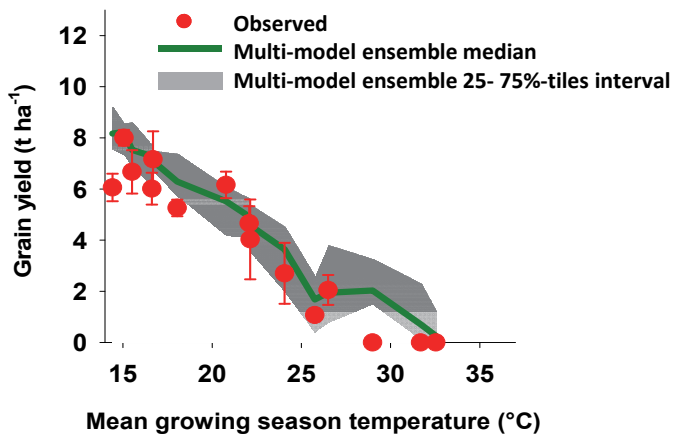

Figure 1 | Observed and multi-model simulation (*n* = 30 models) of wheat grain yield in a blind test[1].

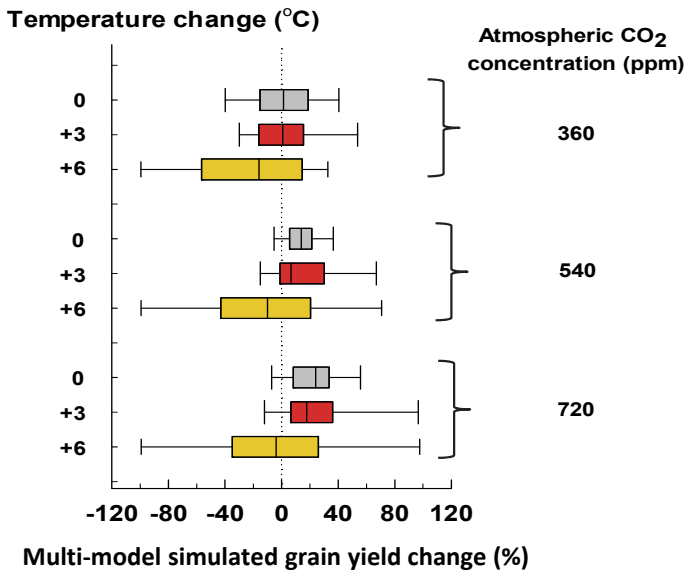

Figure 2 | Simulated wheat yield change with 26 models in response to temperature and atmospheric [CO_2][3].

Findings

- ✓ **The model ensemble median is consistently more accurate in simulating the crop temperature response than any single model[1,2] (Fig. 1).**
- ✓ **Simulated impacts of elevated atmospheric [CO_2] on grain yields vary relatively little across models (50% of model results were within ±20% of the median response) (Fig. 2). Uncertainty in simulated grain yield shows a strong dependency on temperature[3].**
- ✓ **Extrapolating the model ensemble temperature response (at current atmospheric [CO_2]) indicates that warming is already slowing yield gains at a majority of wheat-growing locations. Global wheat production is estimated to fall by 6% for each °C of further temperature increase and to become more variable over space and time[1] (Fig. 3).**

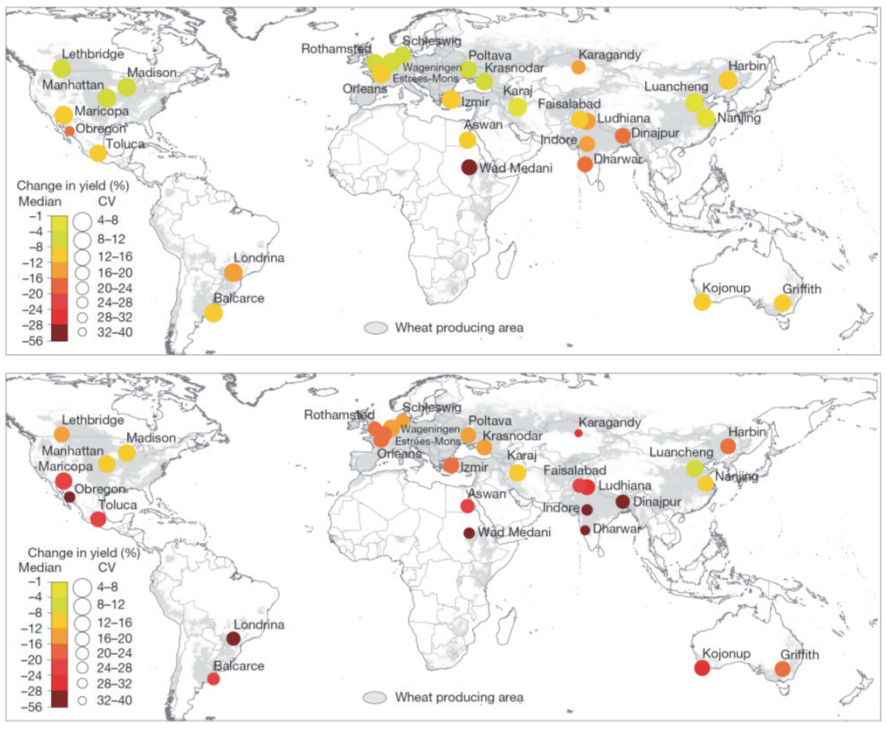

Figure 3 | Multi-model ensemble (*n* = 29 models) simulation of the percent change and the coefficient of variation (CV) in median grain yield for +2 °C (upper map) and +4 °C (lower map) temperature increase imposed on the 1981-2010 period[1].

Expected Impact

- ✓ **Enhanced wheat modeling capacity and precision for impact and adaption assessments of breeding goals, crop management and climate change for targeted yield improvements.**

References

[1] Asseng S, Ewert F, Martre P, *et al. Rising temperatures reduce global wheat production. Nature Clim Change 2015, 5: 143-147.*

[2] Martre P, Wallach D, Asseng S, *et al. Multimodel ensembles of wheat growth: many models are better than one. Glob Chang Biol 2015, 21: 911-925.*

[3] Asseng S, Ewert F, Rosenzweig C, *et al. Uncertainty in simulating wheat yields under climate change. Nature Clim Change 2013, 3: 827-832.*