

Reply to Gonsamo and Chen: Yield findings independent of cause of climate trends

Gonsamo and Chen (1) point out that phases of the North Atlantic Oscillation (NAO) and Scandinavia Pattern (SCA) can affect growing-season climate in Europe and therefore crop productivity. However, it is unclear how this observation relates to our paper, which connects the observed long-term trends in climate with changes in yield (2). We state repeatedly in the paper (pp. 2672 and 2674) that attribution of long-term climate trends in Europe to greenhouse gas emissions is beyond the scope of the analysis. The long-term warming over Europe, wetting over northern Europe, and drying over southern Europe that we use to identify impacts on crop yields may be consistent either with anthropogenic climate change or multidecadal patterns of natural climate variability. A formal analysis to attrib-

bute long-term climate trends to greenhouse gas emissions requires the use of climate model output to characterize both the distinctive signal of anthropogenic climate change and the magnitude of internal variability (3, 4). Such an analysis is beyond the scope of our paper, and therefore we make no claims regarding the cause of the observed long-term climate trends in Europe, which is the focus of the letter by Gonsamo and Chen.

Frances C. Moore^{a,b,1} and David B. Lobell^{b,c}

^aEmmett Interdisciplinary Program in Environment and Resources, ^bCenter for Food Security and the Environment, and ^cDepartment of Environmental Earth System

Science, Stanford University, Stanford, CA 94305

1 Gonsamo A, Chen JM (2015) Winter teleconnections can predict the ensuing summer European crop productivity. *Proc Natl Acad Sci USA* 112:E2265–E2266.

2 Moore FC, Lobell DB (2015) The fingerprint of climate trends on European crop yields. *Proc Natl Acad Sci USA* 112(9):2670–2675.

3 Min SK, Zhang X, Zwiers FW, Hegerl GC (2011) Human contribution to more-intense precipitation extremes. *Nature* 470(7334):378–381.

4 Santer BD, et al. (2013) Identifying human influences on atmospheric temperature. *Proc Natl Acad Sci USA* 110(1):26–33.

Author contributions: F.C.M. and D.B.L. wrote the paper.

The authors declare no conflict of interest.

¹To whom correspondence should be addressed. Email: fcmoore@stanford.edu.