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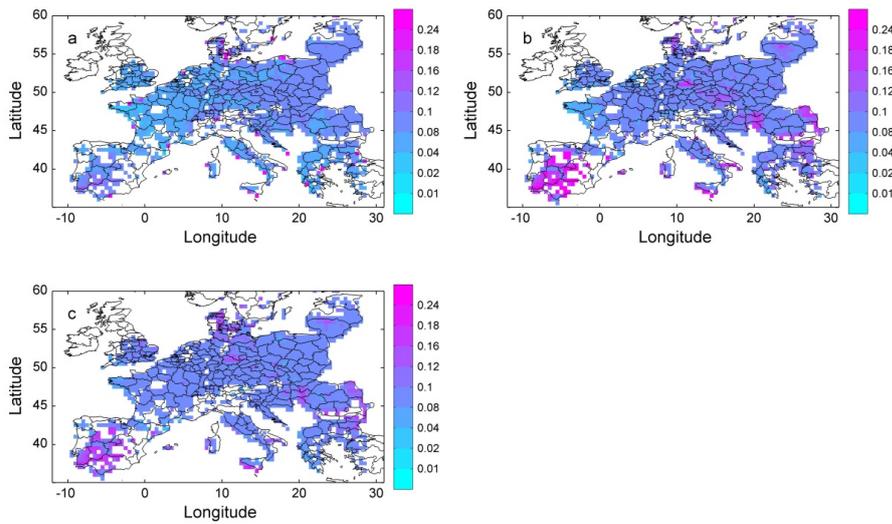
Supplement of

Climate-mediated spatiotemporal variability in terrestrial productivity across Europe

X. Wu et al.

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Figure S1



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Figure S1. Spatial patterns of the coefficients of variation (CV) of the detrended March-June summed NDVI (a), GPP (b), and FAPAR (c) during 1982-2008. Blank region indicates that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low (< 5%) fraction of croplands in those pixels.

Figure S2

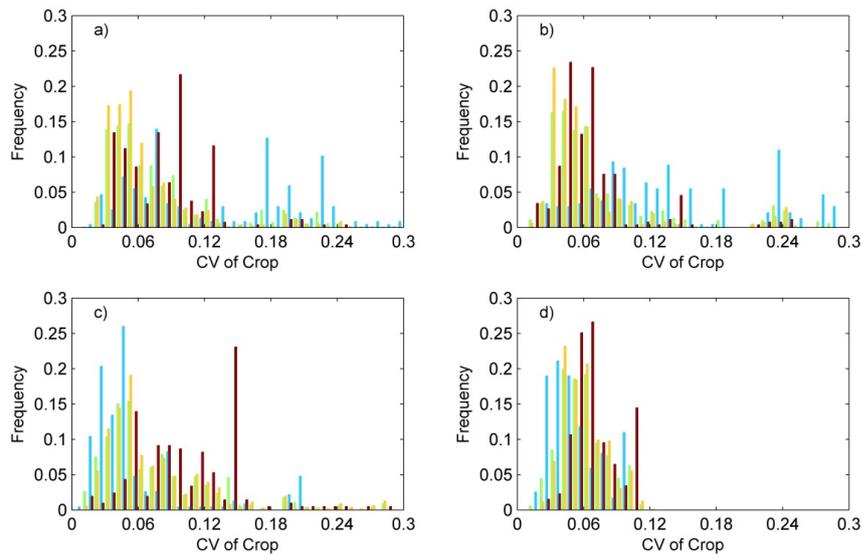


Figure S2. Frequency distribution of coefficients of variation (CV) of the detrended crop yield data in Europe (green bars), and climate zones of Cf (orange bars), Cs (blue bars) and Df (brown bars), which are derived from Köppen-Geiger climate classification, for barley (a), wheat (b), grain maize (c) and potatoes (d) during 1975-2009.

Figure S3.

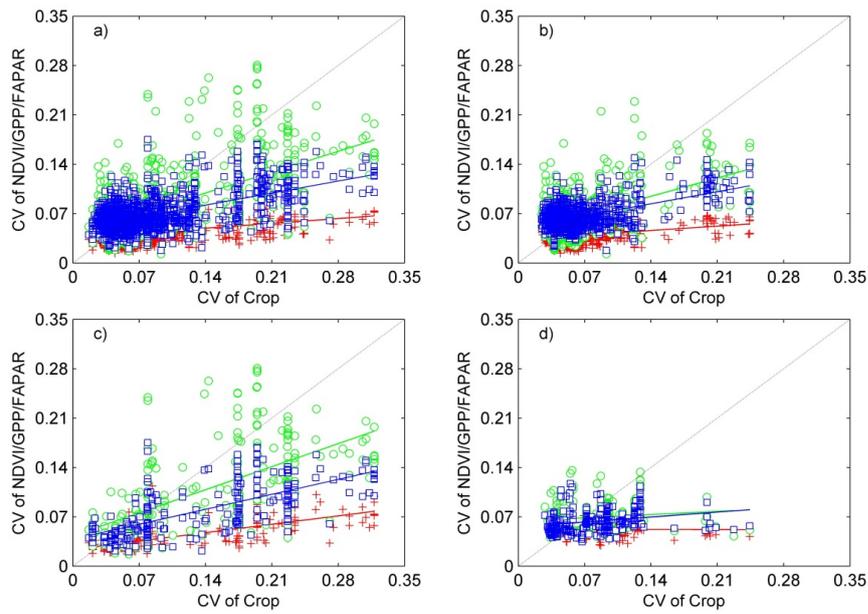
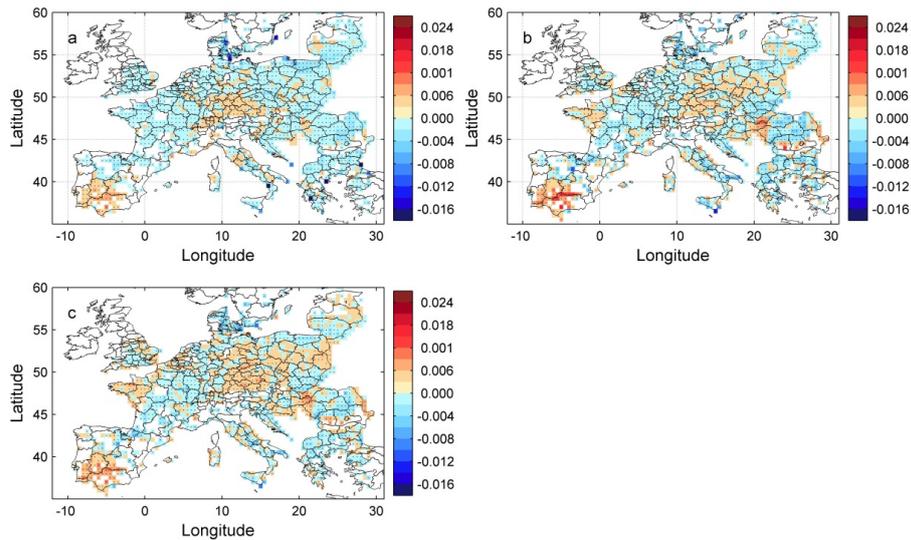


Figure S3. Comparisons of coefficients of variation of barley yield with coefficients of variation of March-June summed NDVI (red crosses), GPP (green circles), and FAPAR (blue squares) in Europe (a) and climate zones of Cf (b), Cs (c) and Df (d), respectively.

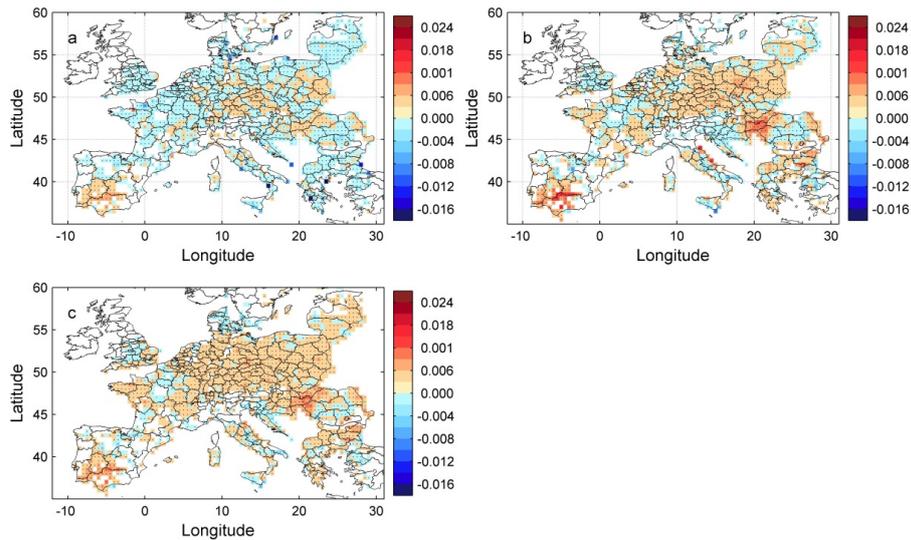
Figure S4.



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Figure S4. Spatial patterns of the estimated trends in the moving coefficients of variation (CV) of the detrended March-June summed NDVI (a), GPP (b) and FAPAR (c) calculated using a 10-yr sliding window with 1-yr lag during 1982-2008. The trends in the moving CV are estimated by the Theil-Sen slope method (Yue *et al.*, 2002). Significant trends were marked by black points. Blank region indicates that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low (< 5%) fraction of croplands in those pixels.

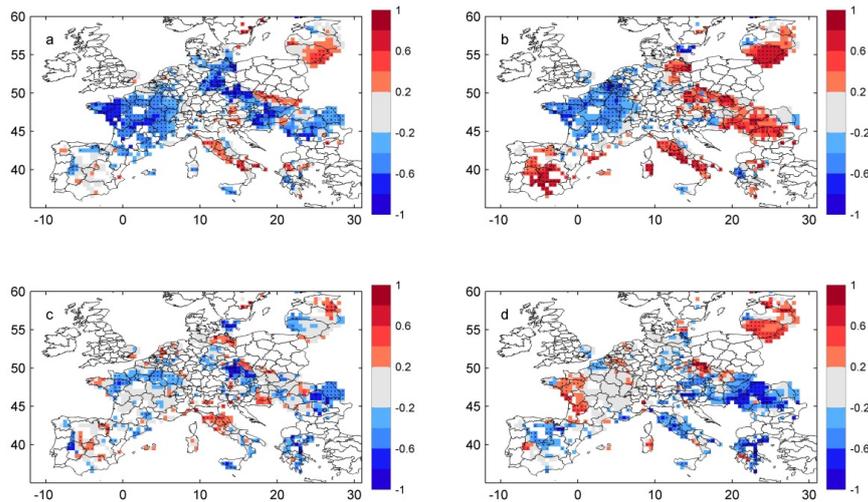
Figure S5



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Figure S5. Spatial patterns of the estimated trends in the moving coefficients of variation (CV) of the detrended March-September summed NDVI (a), GPP (b) and FAPAR (c) calculated using a 10-yr sliding window with 1-yr lag during 1982-2008. The trends in the moving CV are estimated by the Theil-Sen slope method (Yue *et al.*, 2002). Significant trends were marked by black points. Blank region indicates that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low (< 5%) fraction of croplands in those pixels.

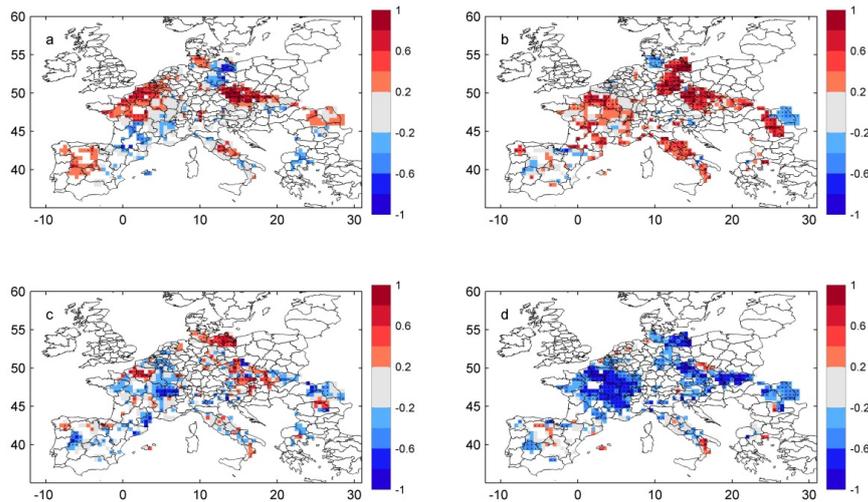
Figure S6



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Figure S6. Response function coefficients between wheat yield and mean growing season temperature (TMP_a), total growing season water availability index (WAI_b) and consecutive frost days (CFD_c) and mean growing season maximum of daily maximum mean temperature (MMT_d). Significant response function coefficients between wheat yield and climate are marked by black points. Blank regions indicate that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low ($< 5\%$) fraction of croplands in those pixels.

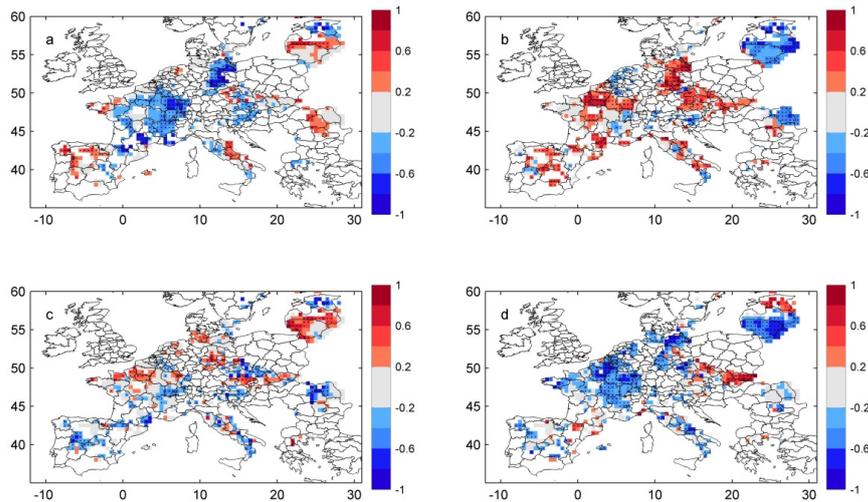
Figure S7



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Figure S7. Response function coefficients between grain maize yield and mean growing season temperature (TMP_a), total growing season water availability index (WAb) and consecutive frost days (CFD_c) and mean growing season maximum of daily maximum mean temperature ($MMFd$). Significant response function coefficients between grain maize yield and climate are marked by black points. Blank regions indicate that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low ($< 5\%$) fraction of croplands in those pixels.

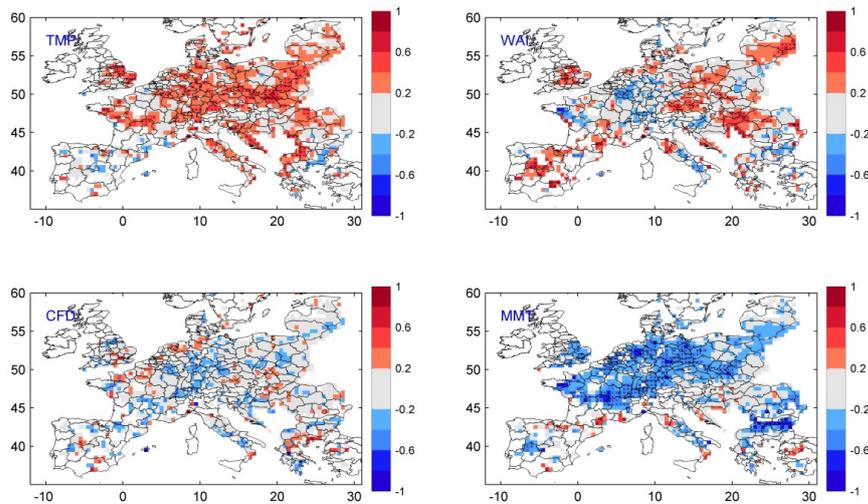
Figure S8



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Figure S8. Response function coefficients between potato yield and mean growing season temperature (TMP_a), total growing season water availability index (WAI_b) and consecutive frost days (CFD_c) and mean growing season maximum of daily maximum mean temperature (MMT_d). Significant response function coefficients between potato yield and climate are marked by black points. Blank regions indicate that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low (< 5%) fraction of croplands in those pixels.

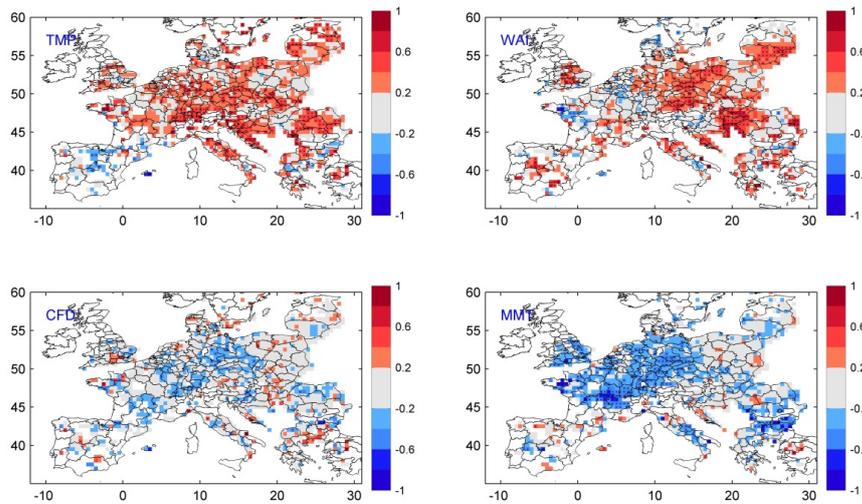
Figure S9



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Figure S9. Response function coefficients between March-September summed NDVI and mean March-September temperature (TMP), total March-September water availability index (WAI) and consecutive frost days (CFD) and mean March-September maximum of daily maximum mean temperature (MMT). Significant response function coefficients between NDVI and climate are marked by black points. Blank regions indicate that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low ($< 5\%$) fraction of croplands in those pixels.

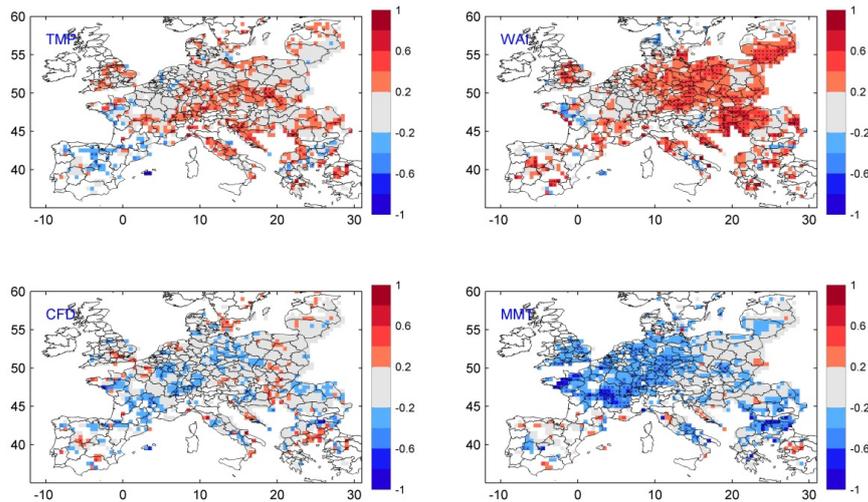
Figure S10



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Figure S10. Response function coefficients between March-September summed GPP and mean March-September temperature (TMP), total March-September water availability index (WAI) and consecutive frost days (CFD) and mean March-September maximum of daily maximum mean temperature (MMT). Significant response function coefficients between GPP and climate are marked by black points. Blank regions indicate that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low (< 5%) fraction of croplands in those pixels.

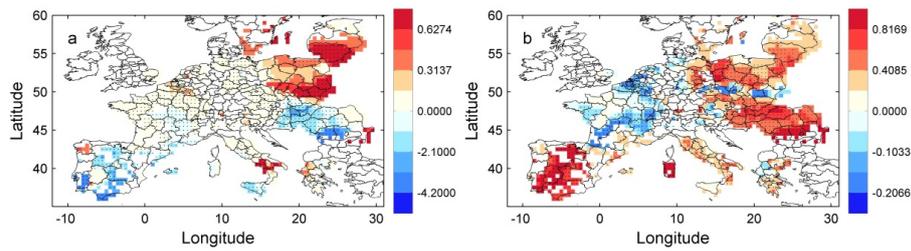
Figure S11



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Figure S11. Response function coefficients between March-September summed FAPAR and mean March-September temperature (TMP), total March-September water availability index (WAI) and consecutive frost days (CFD) and mean March-September maximum of daily maximum mean temperature (MMT). Significant response function coefficients between FAPAR and climate are marked by black points. Blank regions indicate that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low ($< 5\%$) fraction of croplands in those pixels.

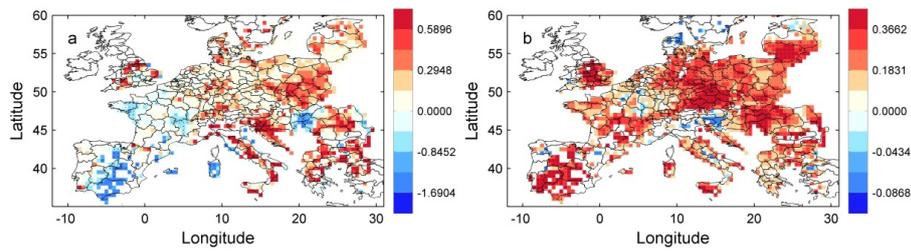
Figure S12



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Figure S12. Spatial patterns of the climate sensitivity of wheat yield to the mean growing-season temperature (a) and total growing season water availability index (b) estimated by the slope of linear regression during 1975-2009. Significant slopes were marked by black points. Blank regions indicate that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low ($< 5\%$) fraction of croplands in those pixels.

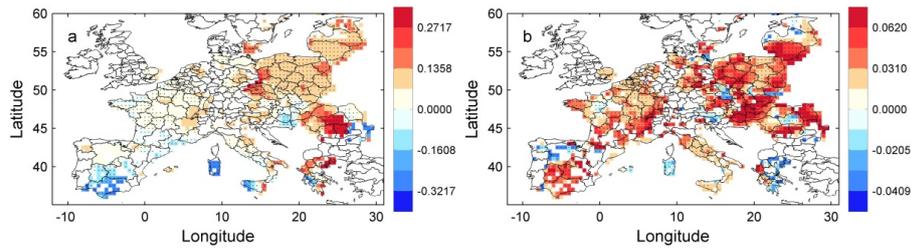
Figure S13



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Figure S13. Spatial patterns of the climate sensitivity of March-September summed FAPAR to the mean March-September temperature (a) and total March-September water availability index (b) estimated by the slope of linear regression during 1982-2008. Significant slopes were marked by black points. Blank regions indicate that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low ($< 5\%$) fraction of croplands in those pixels. Consistent patterns are also observed for March-September summed NDVI and GPP (data are not shown here).

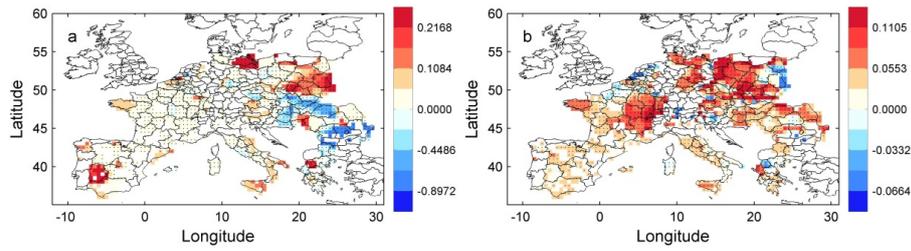
Figure S14



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Figure S14. Spatial patterns of the linear trends in moving climate sensitivities of wheat yield to the mean growing-season temperature (a) and total growing season water availability index (b) estimated by the Theil-Sen slope method using a 10-yr sliding window with 1-yr lag during 1975-2009. Significant trends were marked by black points. Blank regions indicate that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low ($< 5\%$) fraction of croplands in those pixels.

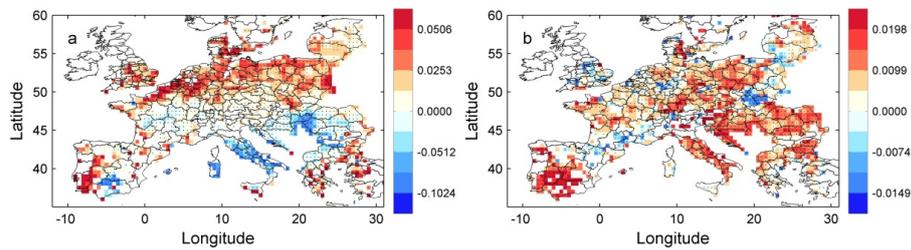
Figure S15



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Figure S15. Spatial patterns of the linear trends in moving climate sensitivities of grain maize yield to the mean growing-season temperature (a) and total growing season water availability index (b) estimated by the Theil-Sen slope method using a 10-yr sliding window with 1-yr lag during 1975-2009. Significant trends were marked by black points. Blank regions indicate that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low ($< 5\%$) fraction of croplands in those pixels.

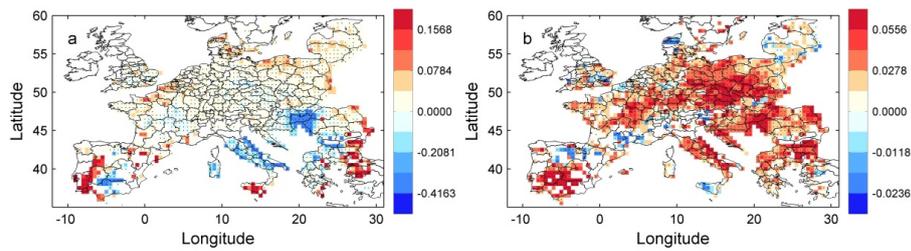
Figure S16



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Figure S16. Spatial patterns of the linear trends in moving climate sensitivities of March-September summed NDVI to mean March-September temperature (a) and total March-September water availability index (b) estimated by the Theil-Sen slope method using a 10-yr sliding window with 1-yr lag during 1982-2008. Significant trends were marked by black points. Blank regions indicate that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low ($< 5\%$) fraction of croplands in those pixels.

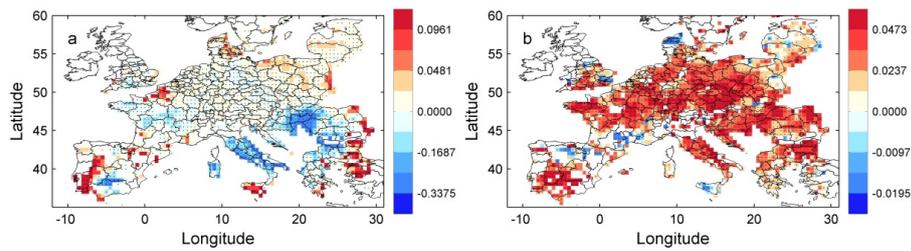
Figure S17



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Figure S17. Spatial patterns of the linear trends in moving climate sensitivities of March-September summed GPP to mean March-September temperature (a) and total March-September water availability index (b) estimated by the Theil-Sen slope method using a 10-yr sliding window with 1-yr lag during 1982-2008. Significant trends were marked by black points. Blank regions indicate that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low ($< 5\%$) fraction of croplands in those pixels.

Figure S18



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Figure S18. Spatial patterns of the linear trends in moving climate sensitivities of March-September summed FAPAR to mean March-September temperature (a) and total March-September water availability index (b) estimated by the Theil-Sen slope method using a 10-yr sliding window with 1-yr lag during 1982-2008. Significant trends were marked by black points. Blank regions indicate that there is [intensive irrigation \(with irrigated area fraction \$\geq 15\%\$ \)](#), no crop yield records or with very low ($< 5\%$) fraction of croplands in those pixels.

Figure S19

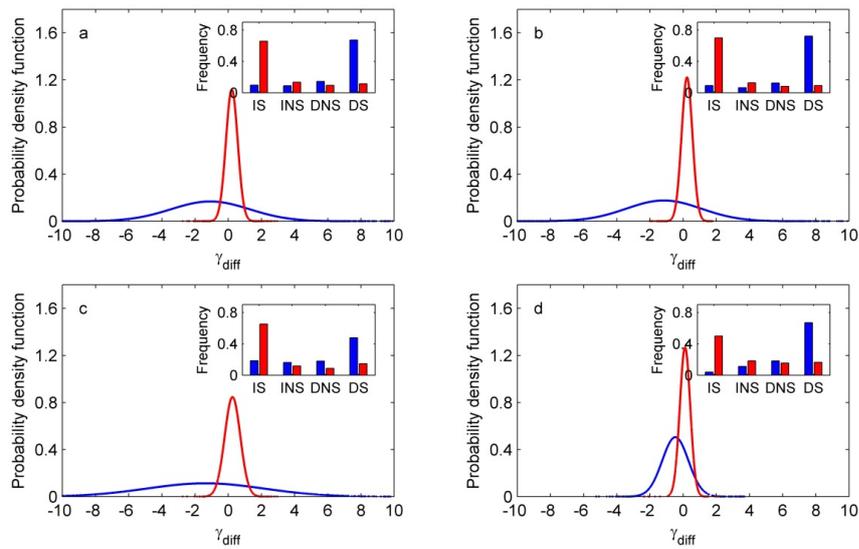


Figure S19. Probability density function for the differences of moving climate sensitivities of March-September summed GPP to mean March-September temperature (blue line) and total March-September water availability index (red line) between 1995-2008 and 1982-1995 for Europe (a), and climate zones Cf (b), Cs (c), and Df (d). The inset shows the percentages of pixels suffering the four different trend types (significantly increasing, IS; increasing but not significant, INS; decreasing but not significant, DNS; significantly decreasing, DS) for climate sensitivities of GPP to mean March-September temperature (blue bars) and total March-September water availability index (red bars). Consistent patterns are also observed from the perspectives of NDVI and FAPAR (data are not shown).

Figure S20.

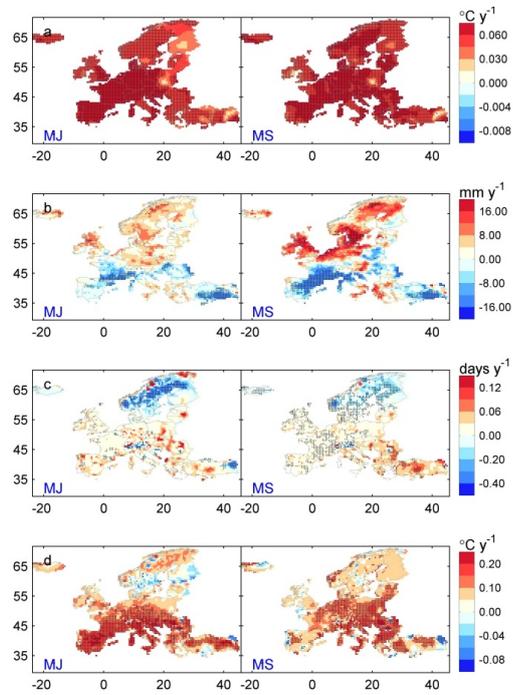


Figure S20. Linear trends in seasonal (MJ: March-June and MS: March-September) temperature (a), water availability index (b), consecutive frost days (c) and maximum of daily maximum mean temperature (d) during 1975-2009, as estimated by the linear regression. Significant ($p < 0.05$) trends were marked by black points.

Figure S21.

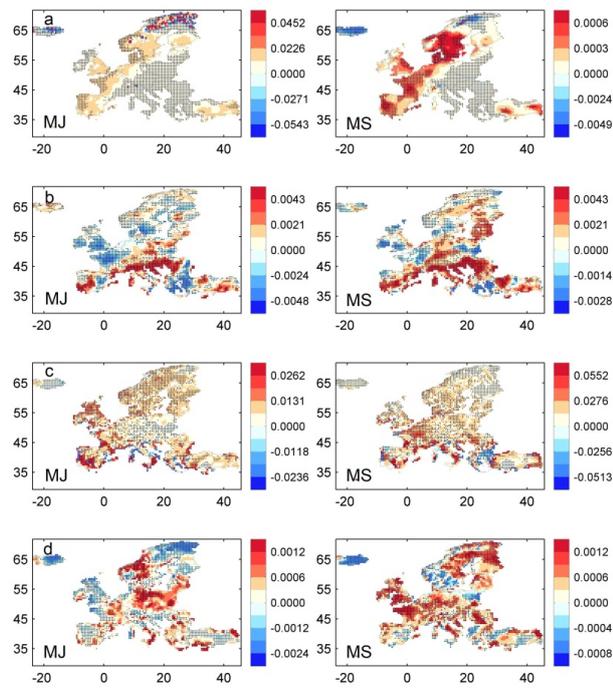


Figure S21. Linear trends in the moving coefficients of variation (CV) of the seasonal (MJ: March-June and MS: March-September) temperature (a), water availability index (b), consecutive frost days (c) and maximum of daily maximum mean temperature (d), as estimated by the Theil-Sen slope method using a 10-yr sliding window with 1-yr lag during 1975-2009. Significant ($p < 0.05$) trends were marked by black points.

References

Yue S, Pilon P, Phinney B, Cavadias G (2002) The influence of autocorrelation on the ability to detect trend in hydrological series. *Hydrological Processes*, 16, 1807-1829.