Royal Netherlands
Meteorological Institute
Ministry of Infrastructure and the Environment

Extreme future central European summer droughts in a high-resolution global climate model

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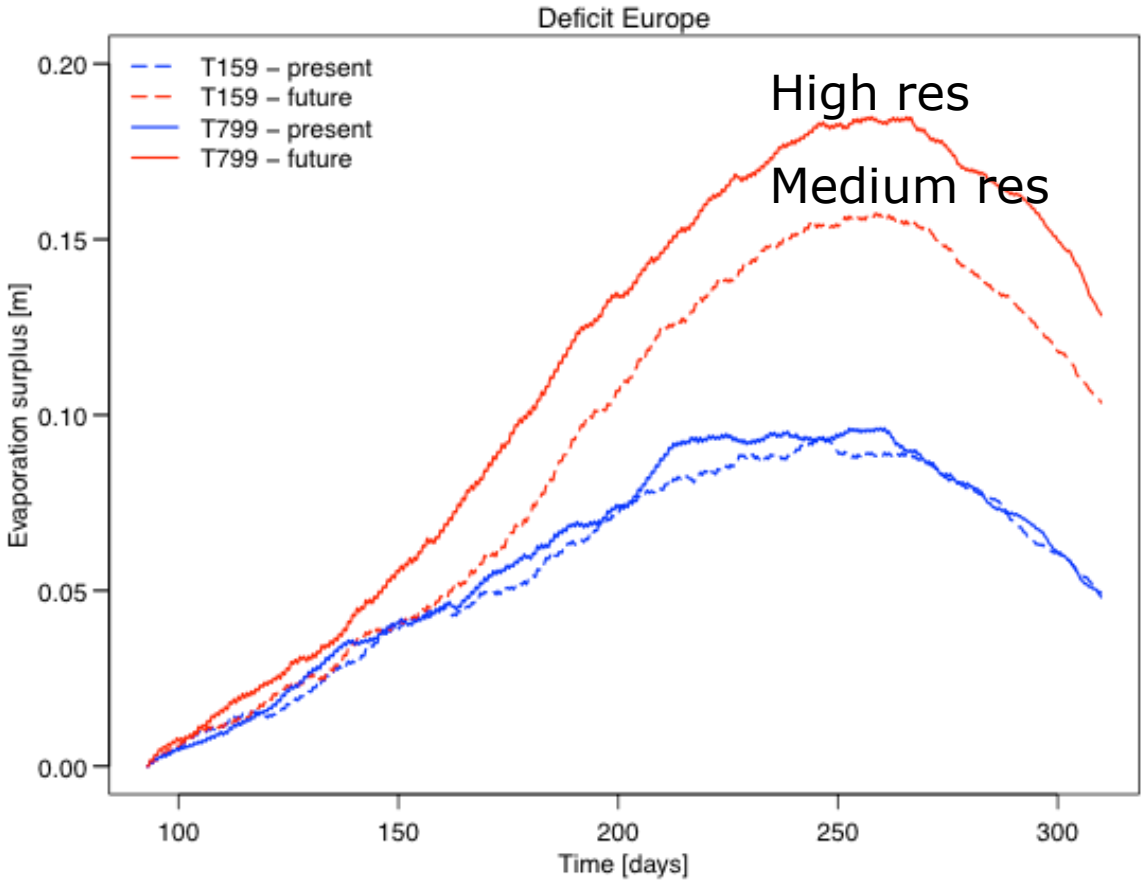
PRIMAVERA

Intensification of central European summer droughts in high-resolution simulations



Model set-up

EC-Earth High Resolution
T799/L91 (~25 km)

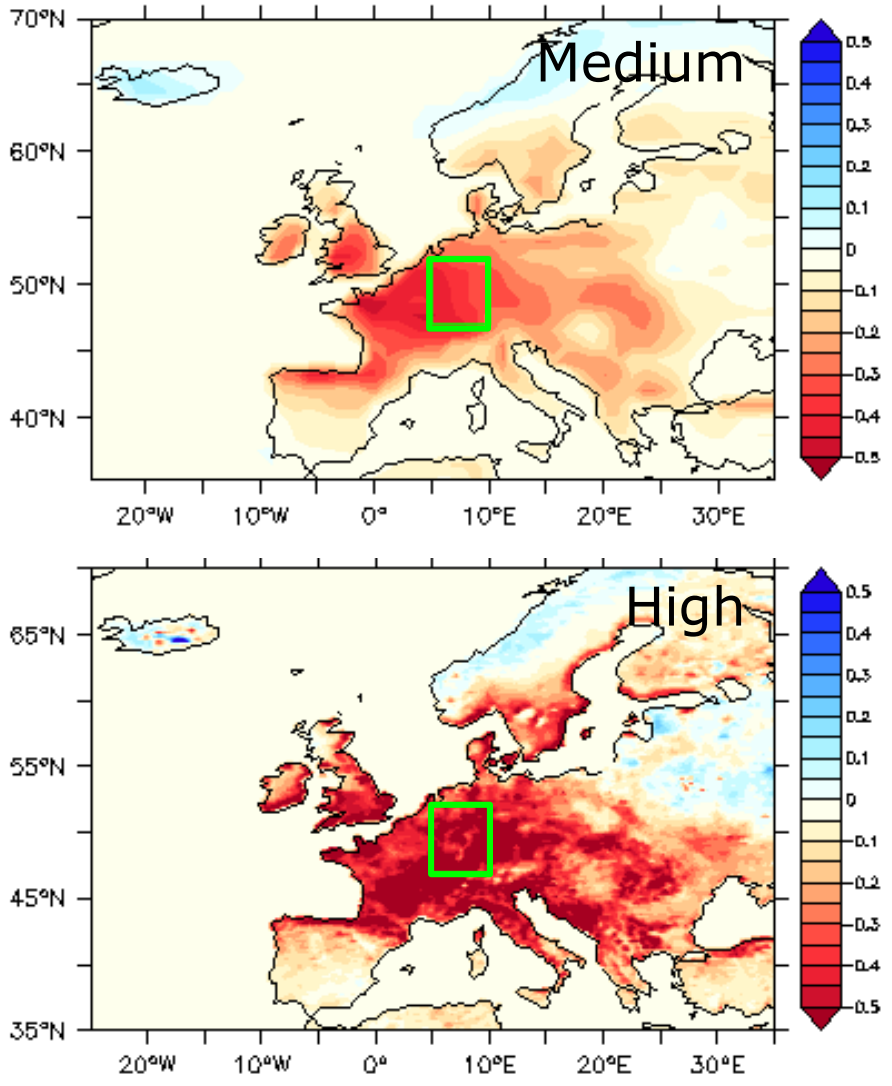
Present period: 2002-2006
Future period: 2094-2098

AMIP runs, RCP4.5 forcing

Ensemble size: 6 (total 30 years per period)

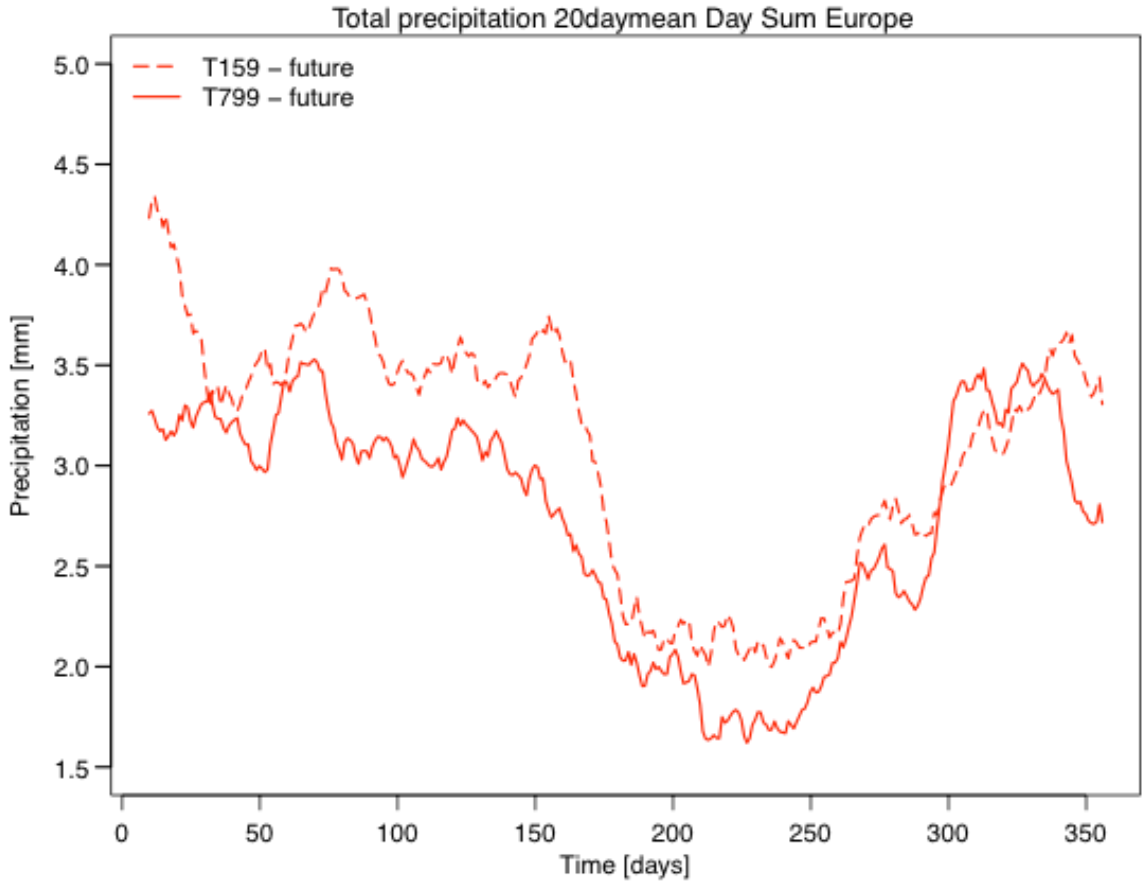
Same experiments are repeated with medium resolution
(T159 ~150km)

Anomalous soil moisture in top layer in late summer (JAS)



Why is future drying larger in high resolution?

Less precipitation in high resolution simulations



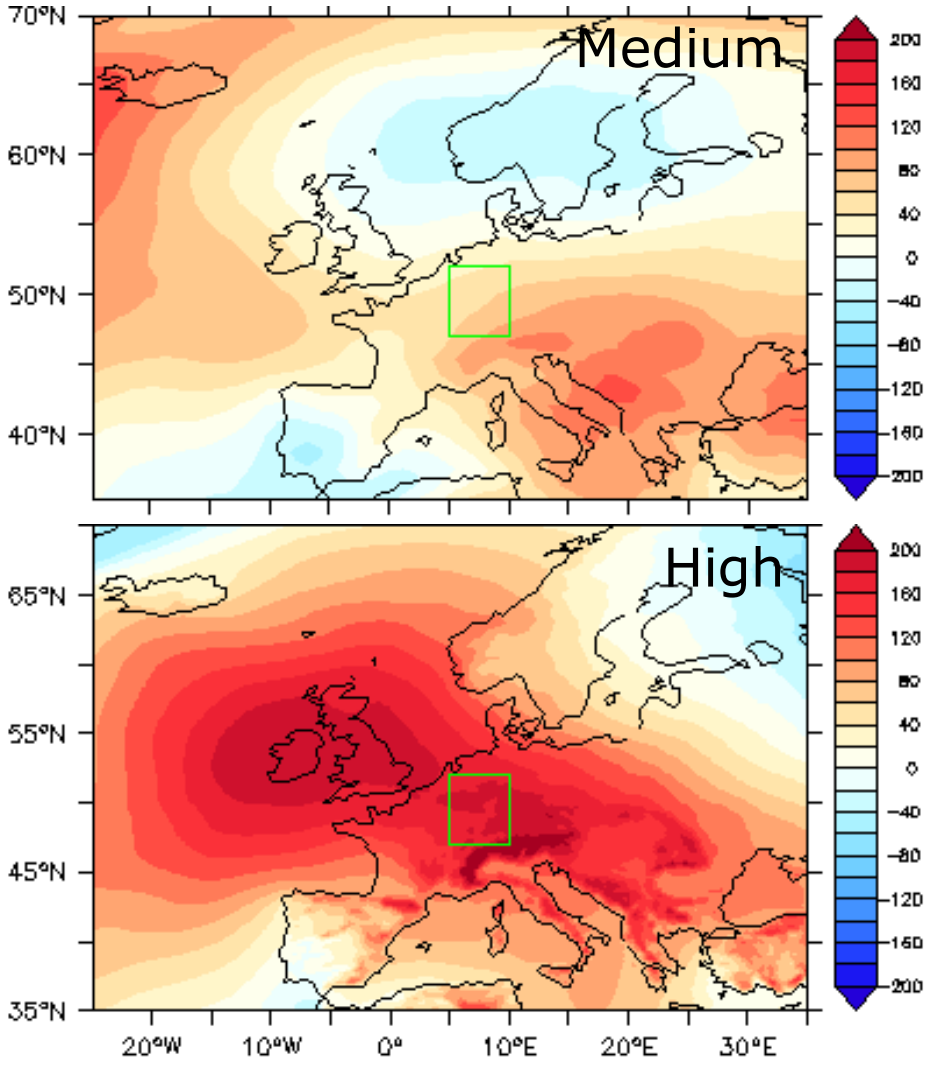
Dynamical cause: Anomalous high over UK in spring

Subsidence

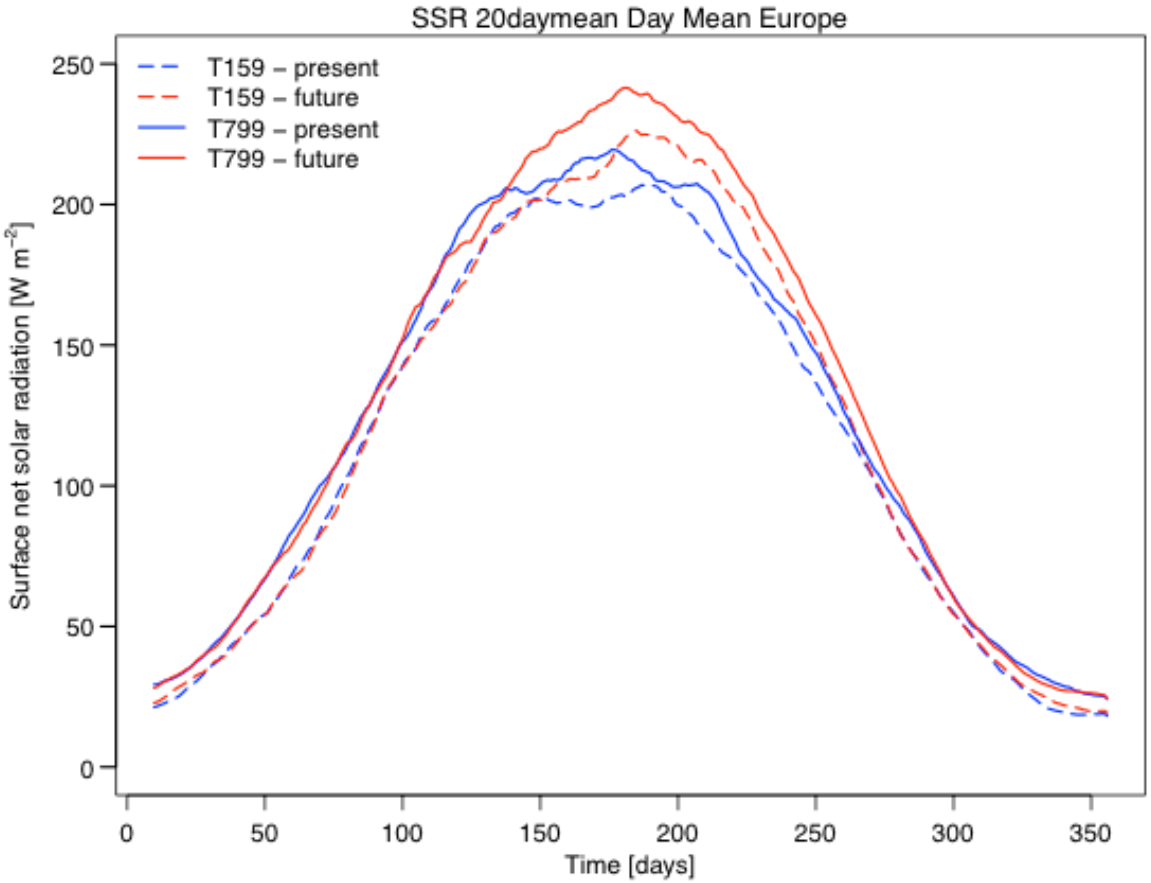
→ reduced precipitation

→ less clouds (more solar radiation)

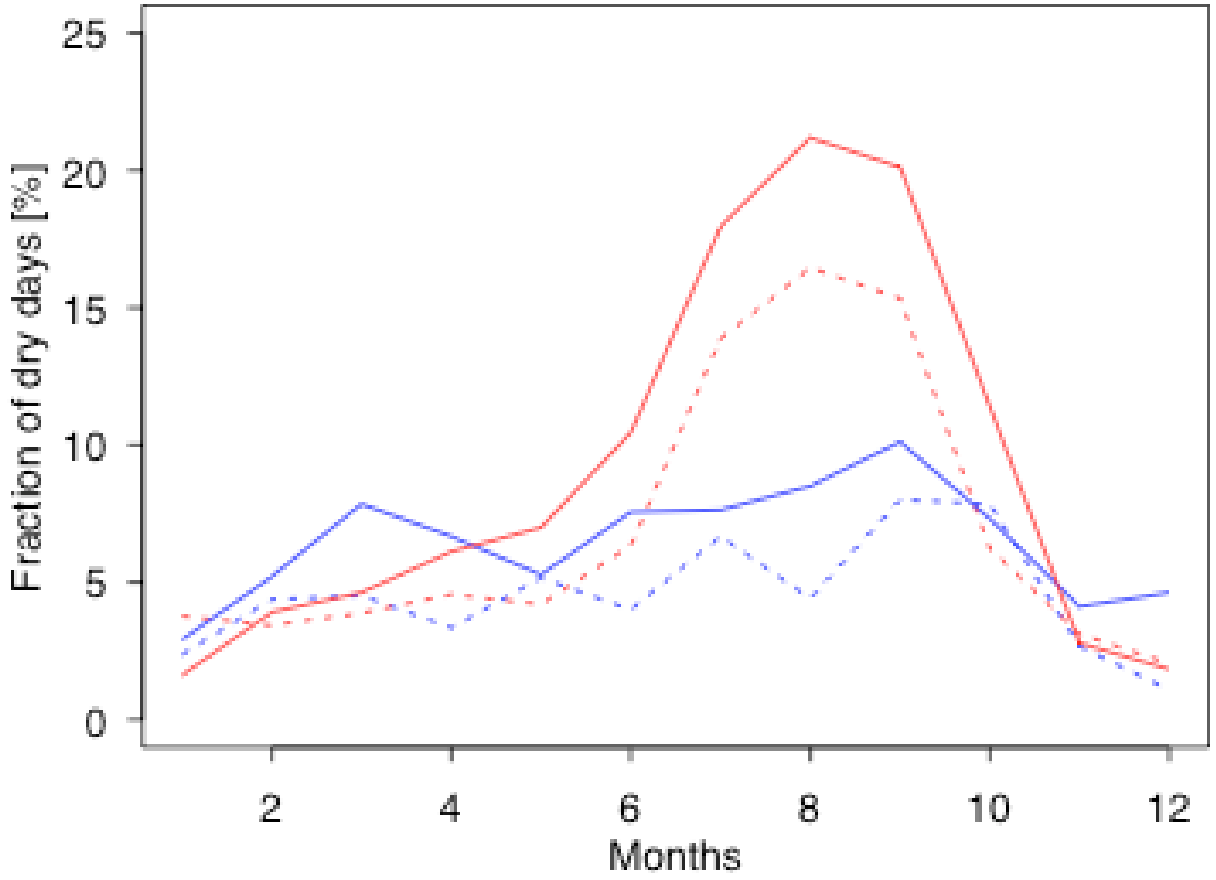
Climate change signal (future – present) of SLP over April-June



More solar radiation reaches surface in high res

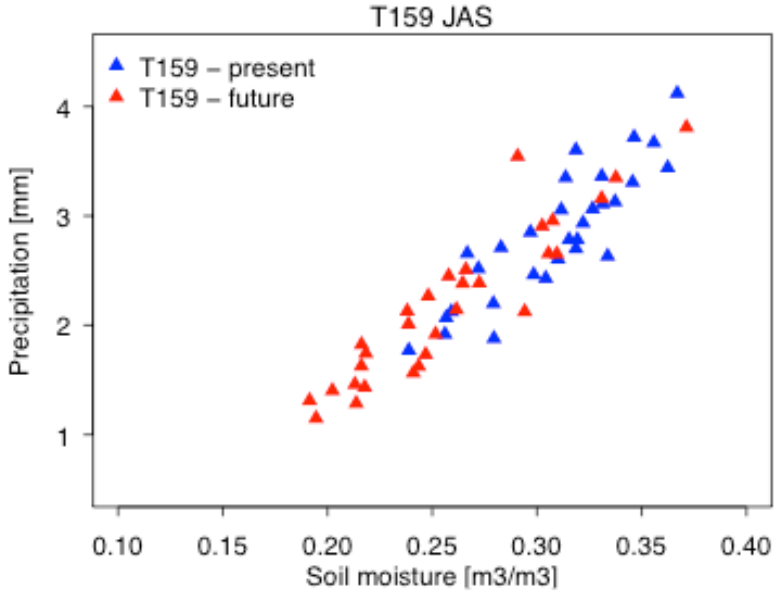


Increase in number of dry days (<0.1 mm) in late summer

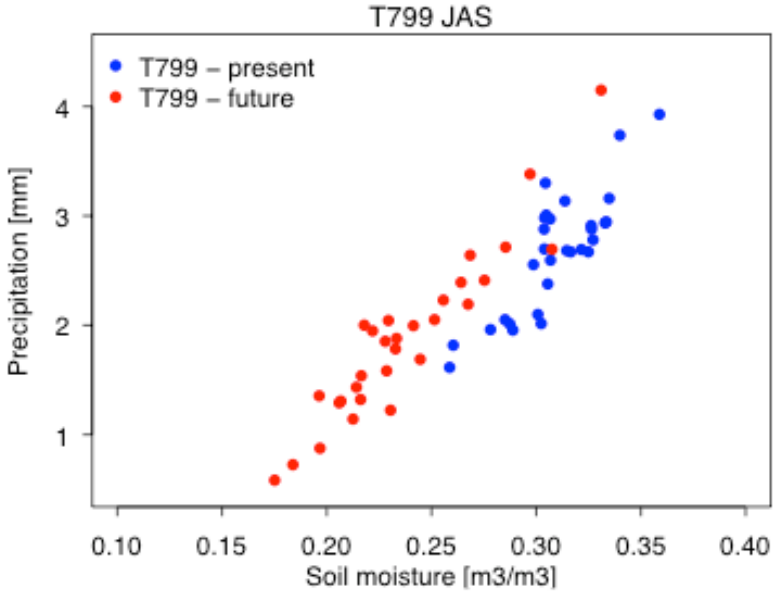


Soil moisture-precipitation feedback

Medium resolution

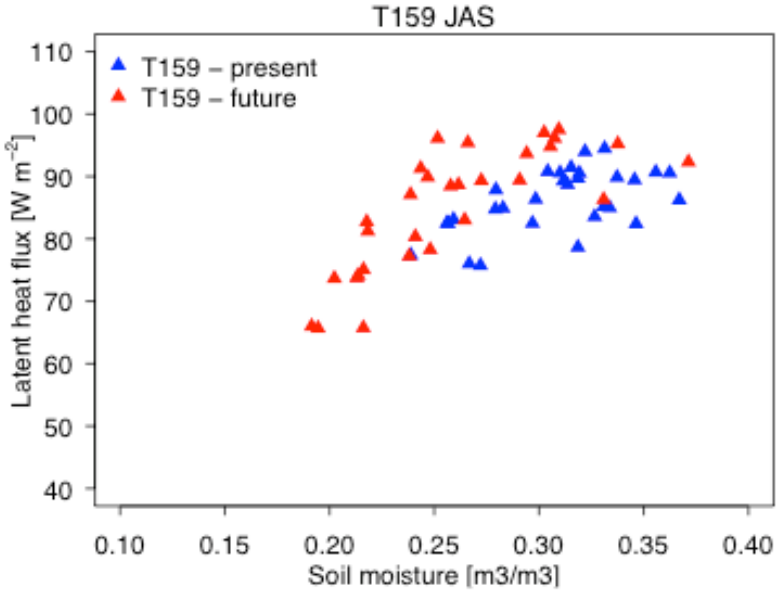


High resolution

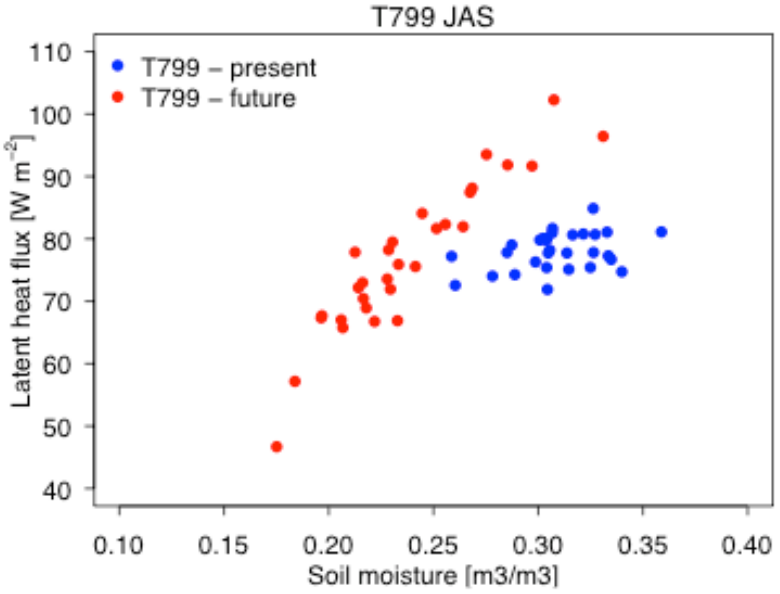


Soil moisture controls evaporation/latent heat flux in future summer (JAS)

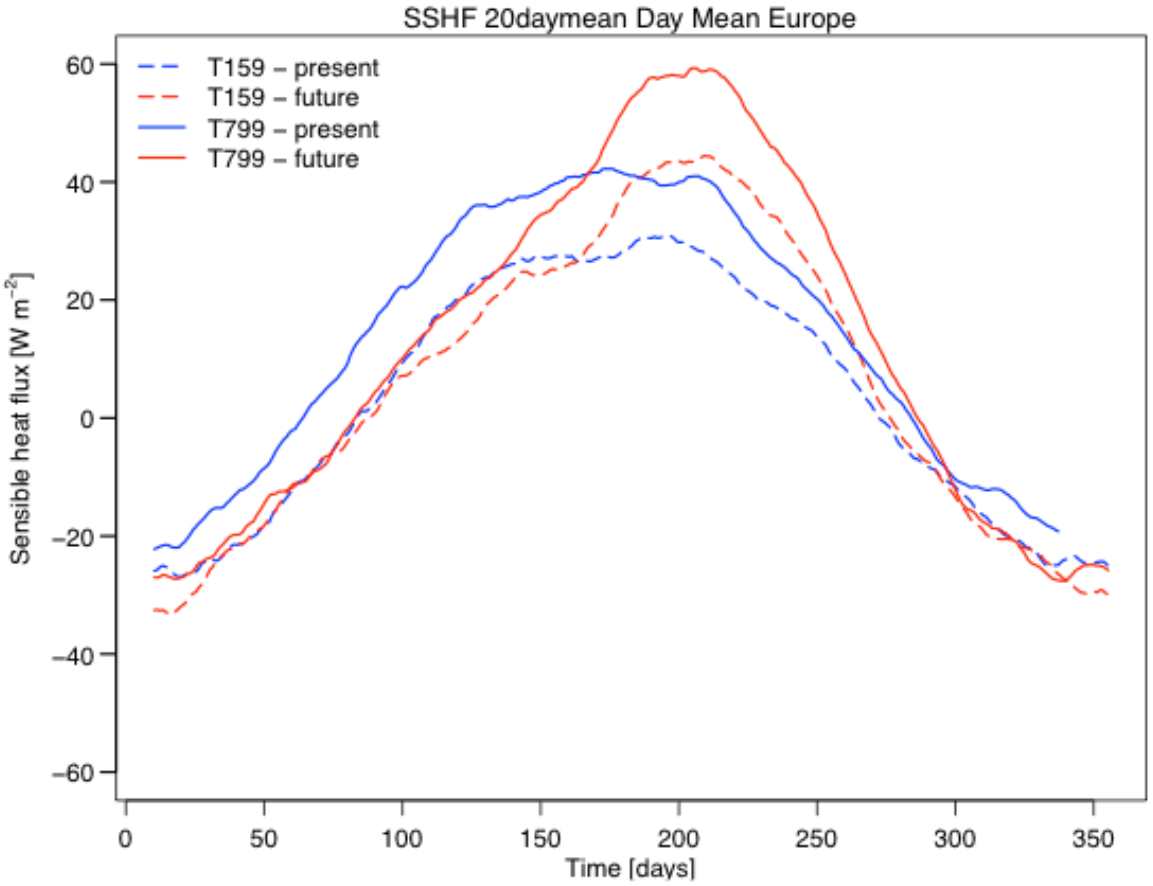
Medium resolution



High resolution

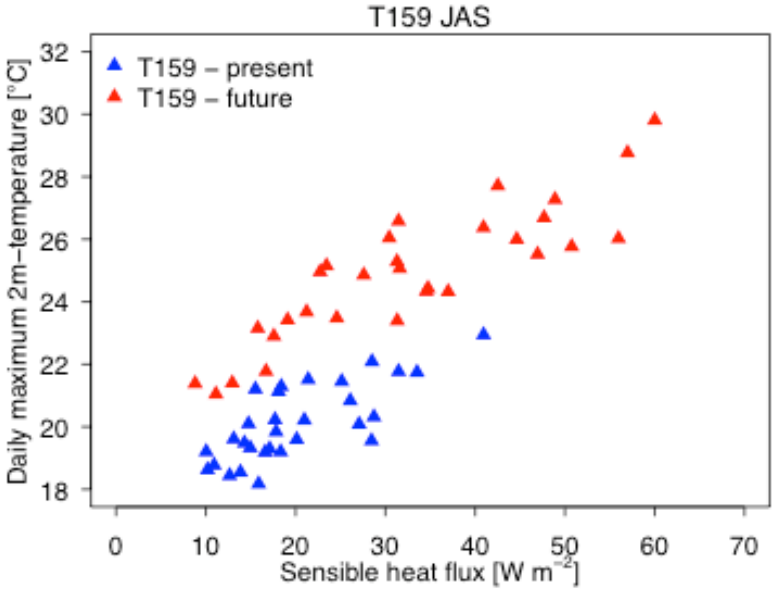


Soil drying reduces evaporative fraction → more energy available for sensible heating

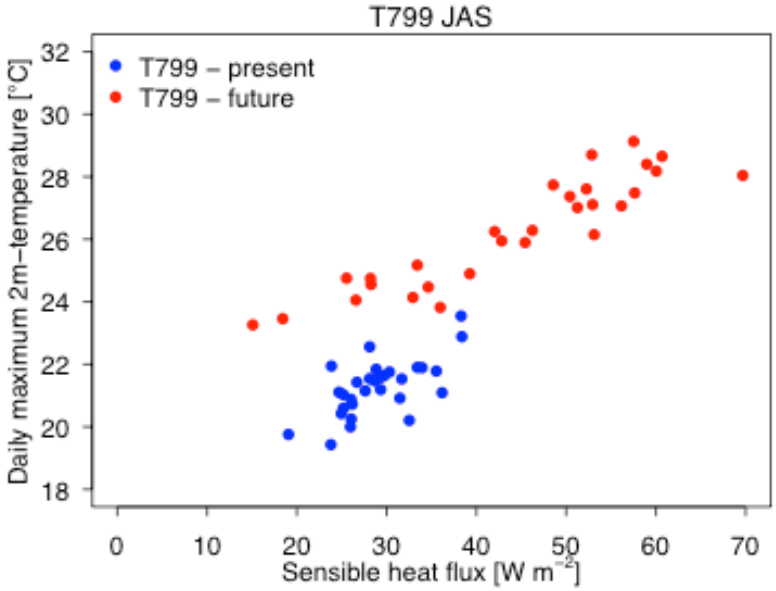


Enhanced sensible heat flux induces increase of near-surface temperature

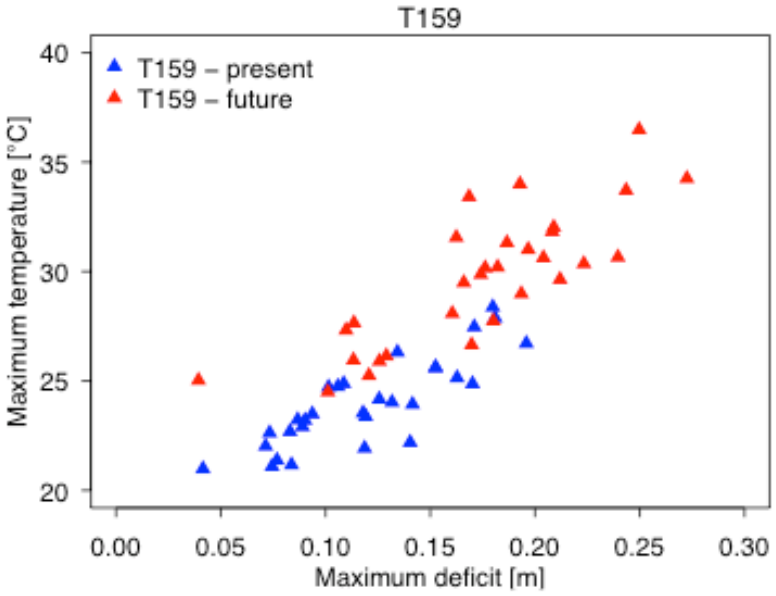
Medium resolution

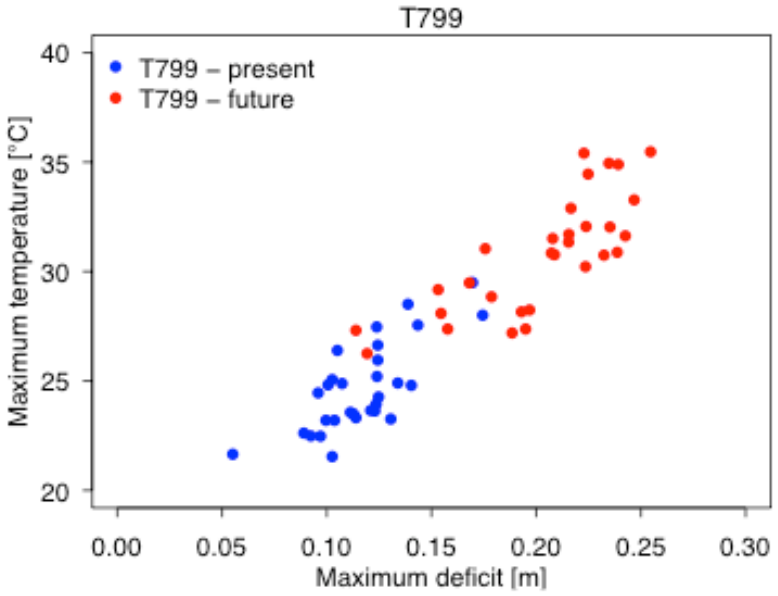


High resolution

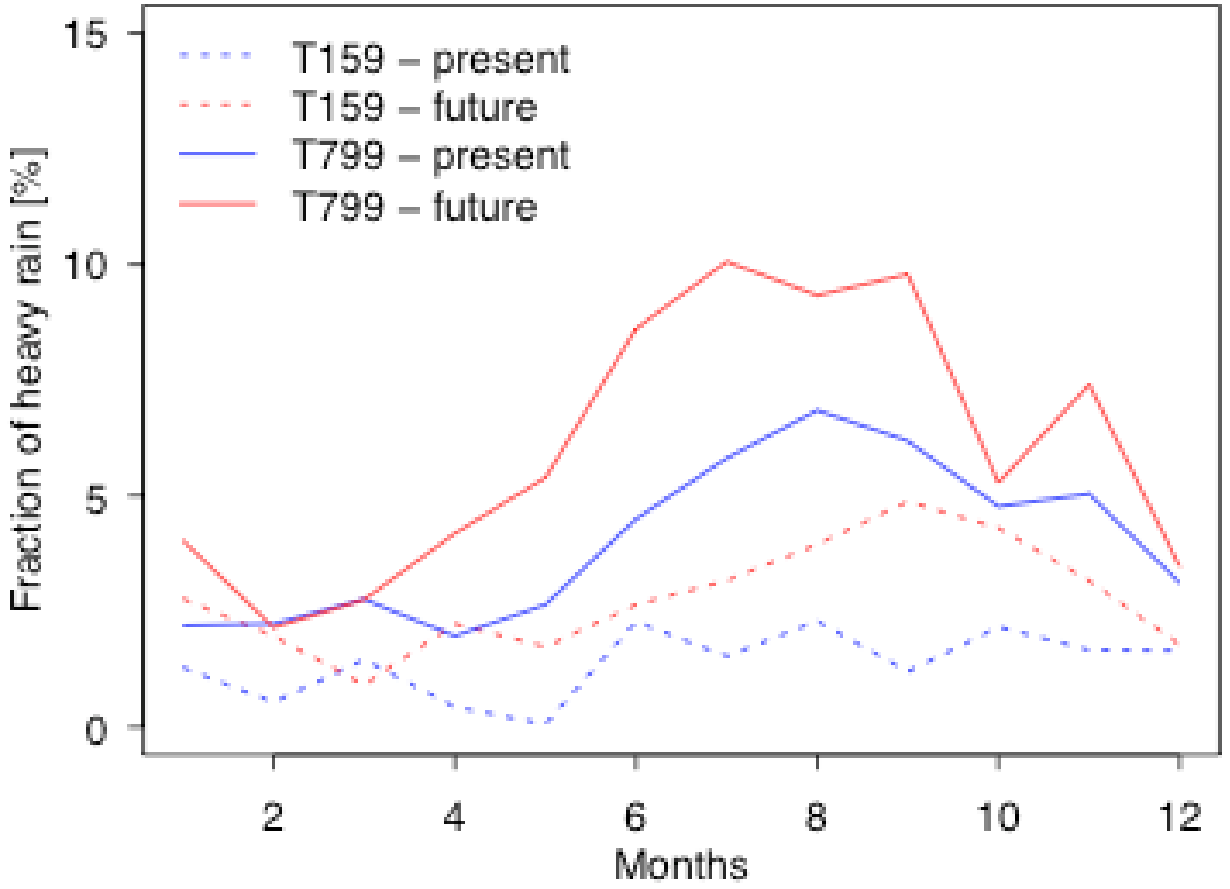


Concurrent driest years and hottest days: drought-induced increase of summer temperatures





Due to enhanced warming larger fraction of precipitation falls as heavy rain (>30 mm/day)



Conclusions

- Enhanced summer drying in high resolution simulations

- Causes and feedbacks:
  - Stronger anti-cyclone response over UK
  - Enhanced solar radiation
  - Reduced evaporative fraction
  - More dry days

- Robustness of enhanced drying in higher resolution will be investigated with PRIMAVERA simulations

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