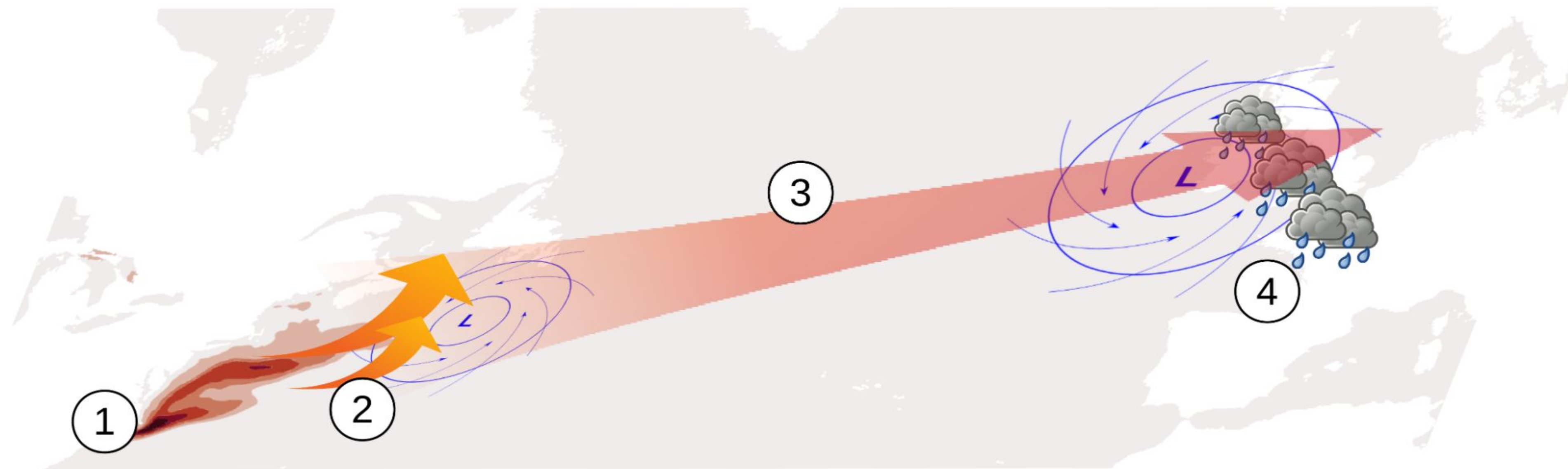


Linking future Gulf Stream warming and increased European winter precipitation in eddy-rich global models

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Different future changes in the Gulf Stream in the eddy-rich global model HadGEM3-GC31 with consequences for European precipitation



Schematic of the chain of events linking the Gulf Stream warming (1) and the precipitation increase over Europe (4) in the eddy-rich global model HadGEM3-GC31. A northward shift and strong local warming of the Gulf Stream destabilizes the atmosphere and favors the formation of winter extratropical cyclones (2). These continue to grow over the North Atlantic (3), aided by intensified diabatic heating and upper-troposphere jet, and eventually bring more rainfall to NW Europe.

Projected changes, especially in the Gulf Stream, are different at lower resolutions. Does this also happen for other models?

HadGEM3-GC31 model version

HH
~50 km atmosphere
~8 km ocean
1 historical simulation
1 SSP5-8.5 scenario
*Stippling on plots: anomalies outside the range of projected changes at all lower resolutions

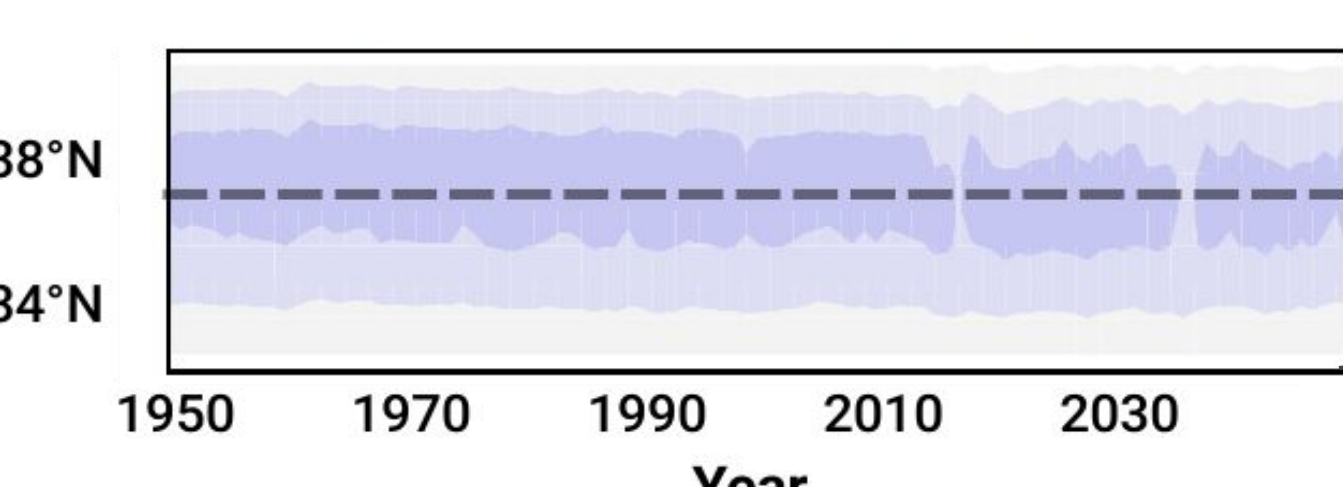
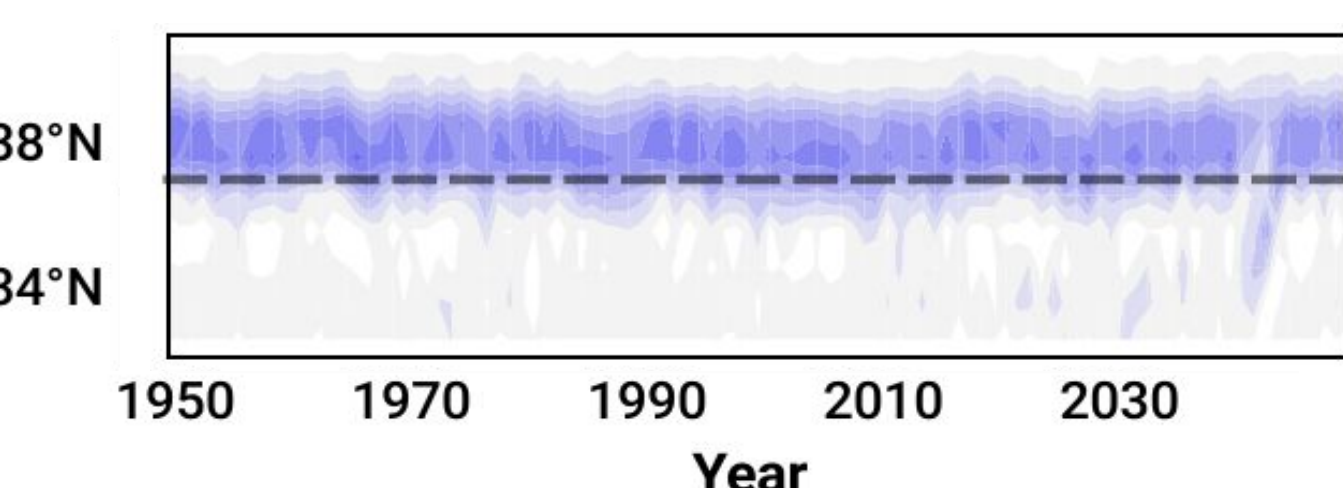
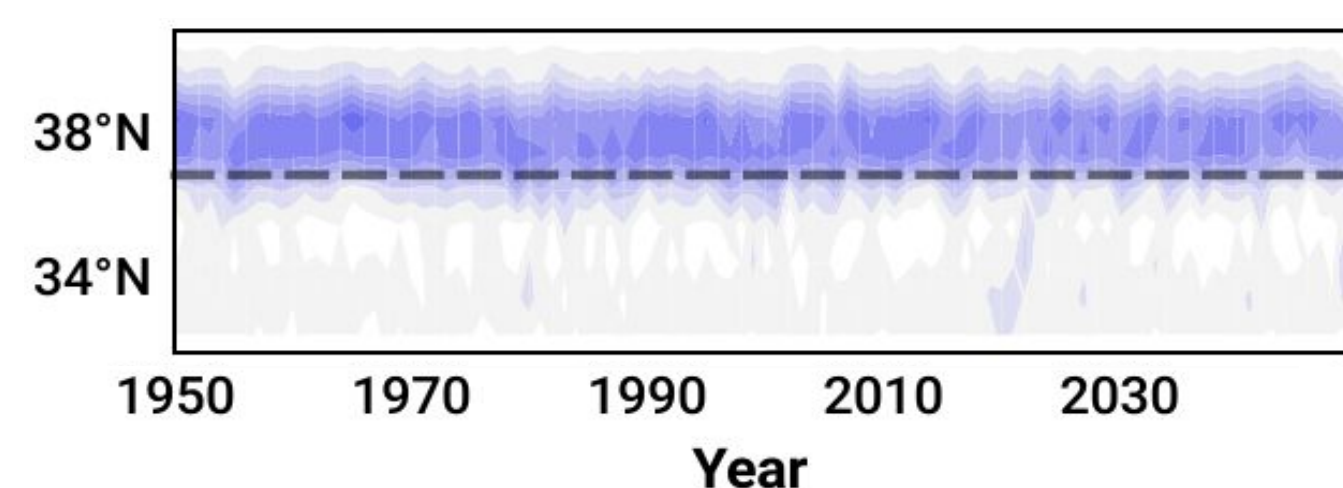
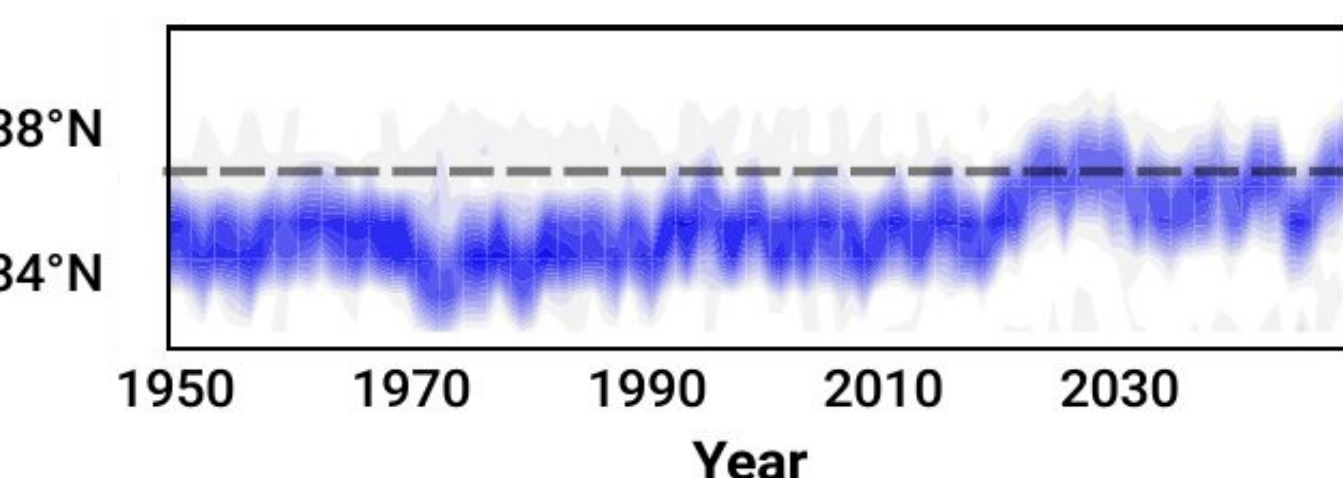
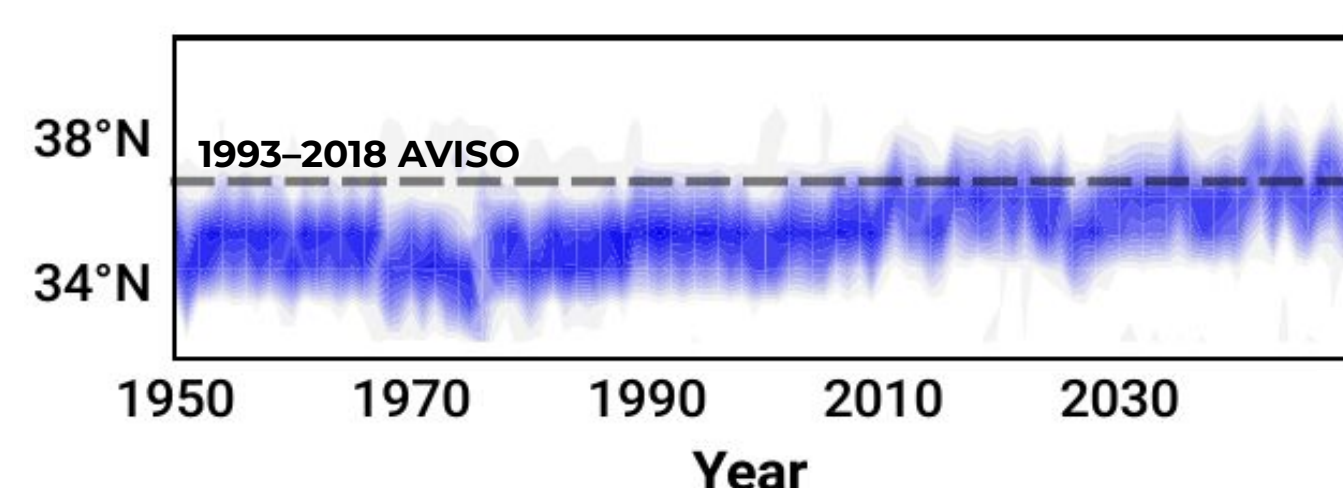
MH
~100 km atmosphere
~8 km ocean
1 historical simulation
1 SSP5-8.5 scenario

HM
~50 km atmosphere
~25 km ocean
3 historical simulations
3 SSP5-8.5 scenarios

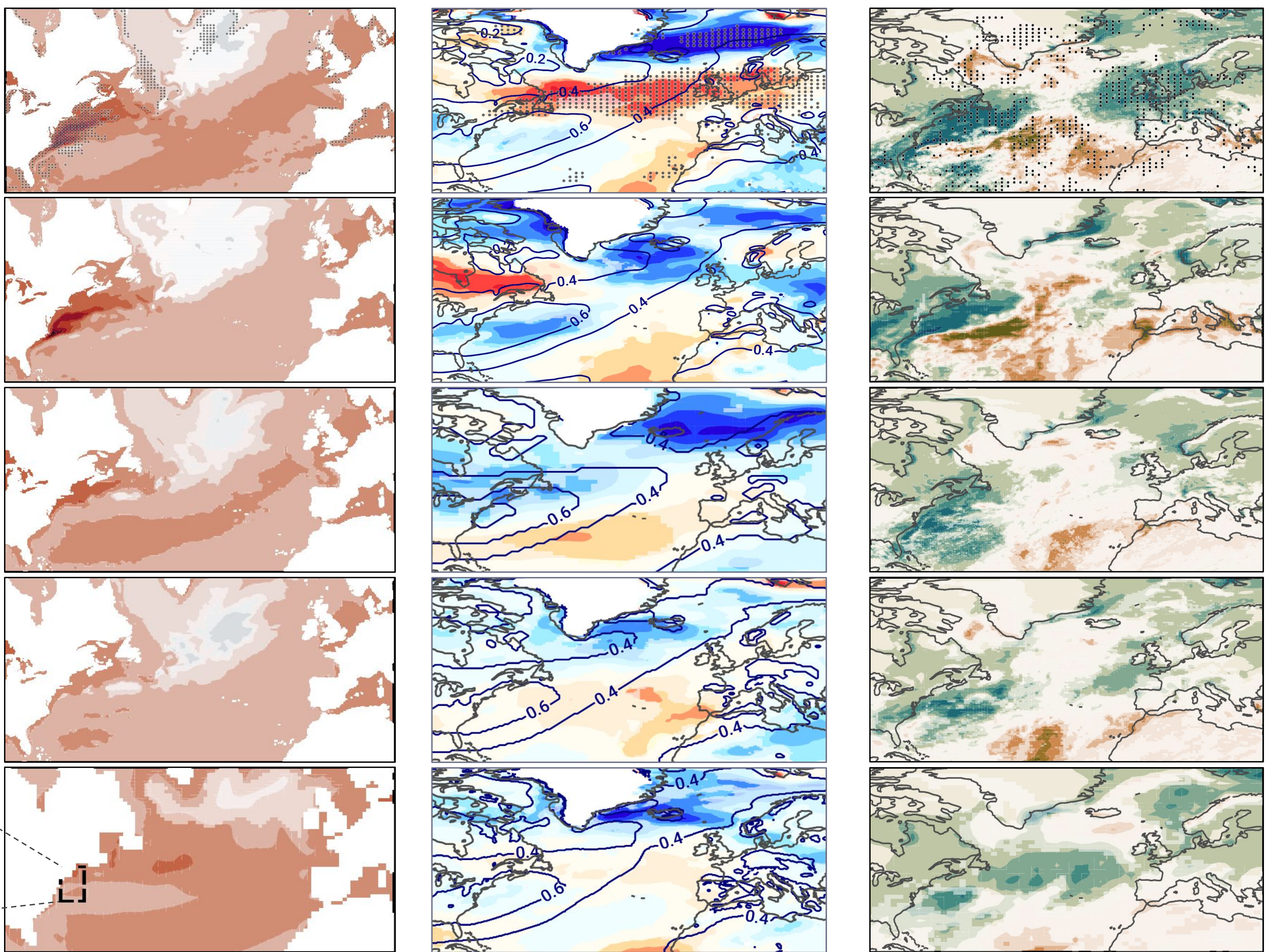
MM
~100 km atmosphere
~25 km ocean
3 historical simulations
3 SSP5-8.5 scenarios

LL
~250 km atmosphere
~100 km ocean
8 historical simulations
4 SSP5-8.5 scenarios

Sea-surface height meridional gradient in the Gulf Stream over time (10^{-6} m/m)



2030-2050 vs 1960-1980 change in SST (K, left), DJF max. Eady growth rate (d^{-1} , center), and DJF precipitation (mm/d, right)



The eddy-rich EC-Earth global model: first results of the HighResMIP historical simulation

EC-Earth model resolutions:

- VHR: Very-high resolution
IFS T1279-ORCA12
~15 km atmosphere, ~8 km ocean
- HR: High resolution
IFS T511-ORCA025
~40 km atmosphere, ~25 km ocean
- SR: Standard resolution
IFS T255-ORCA1
~80 km atmosphere, ~100 km ocean

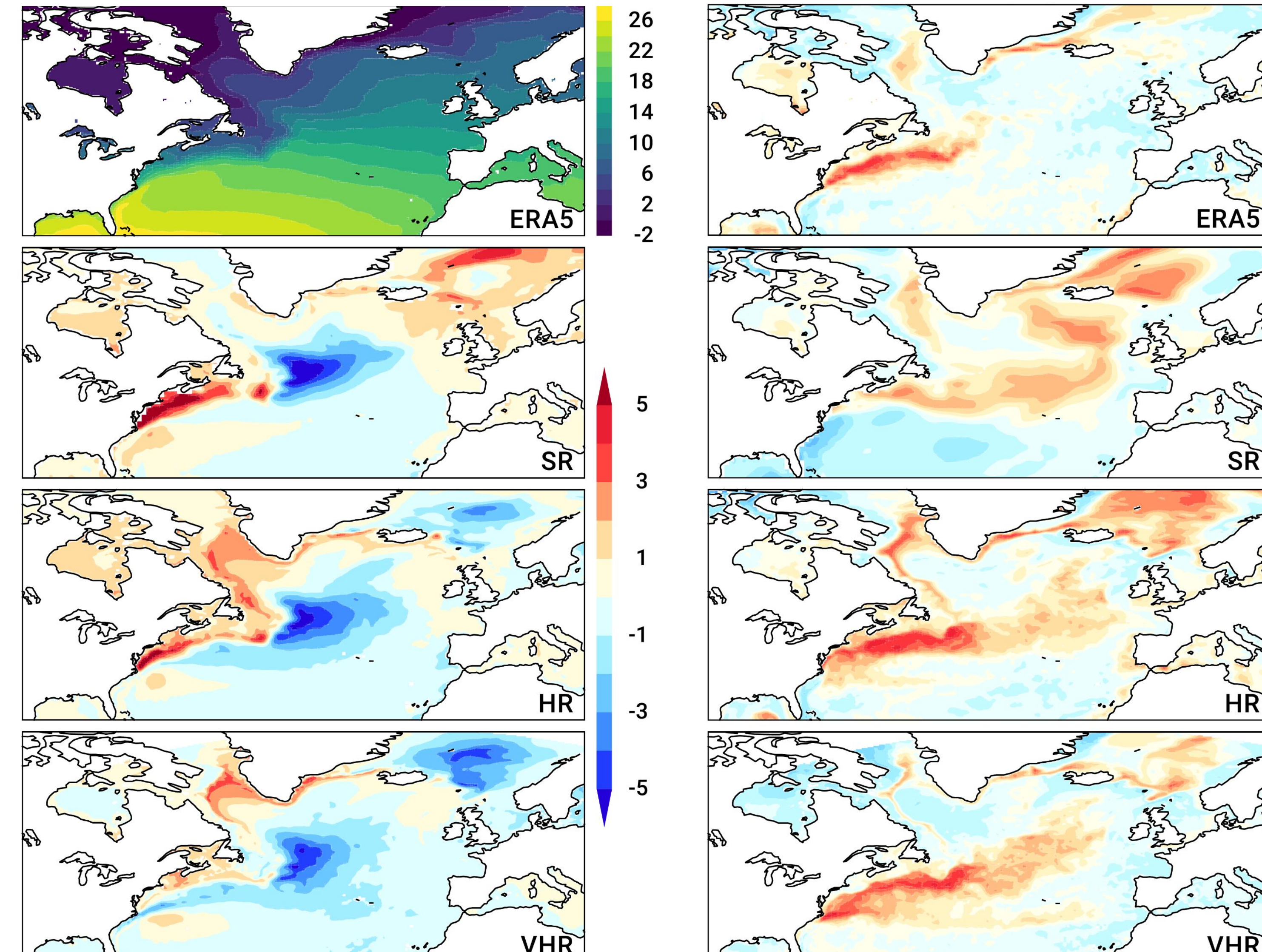
VHR HighResMIP experiments

- hist-1950 (1950-2014): complete
- future-highres (2014-2050): ongoing
- 1950-control: ongoing (~65 years)

Future plans

- Verify the Gulf Stream warming-European precipitation increase mechanism in EC-Earth-VHR
- Investigate the influence of the ocean mesoscale on the meridional and gyre Atlantic circulation in various eddy-rich models (e.g., EC-Earth, HadGEM3, MPI-ESM, CESM)

1980-2014 SST bias (K; left) and monthly SST-surface energy flux correlation (right)



1993-2014 SSH meridional gradient (10^{-6} m/m)

