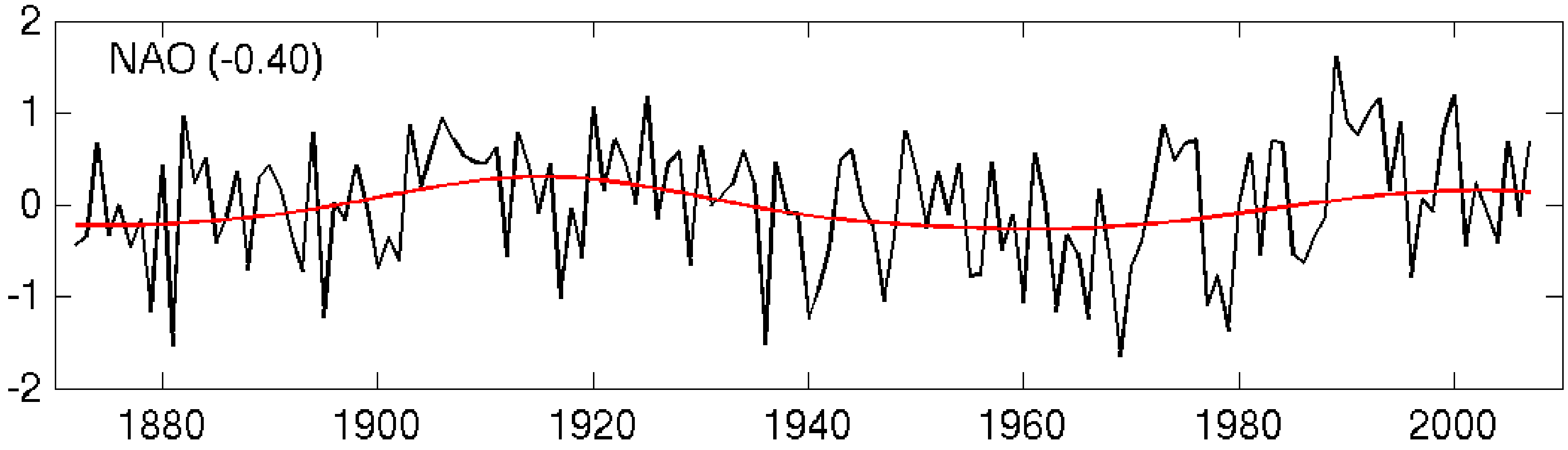
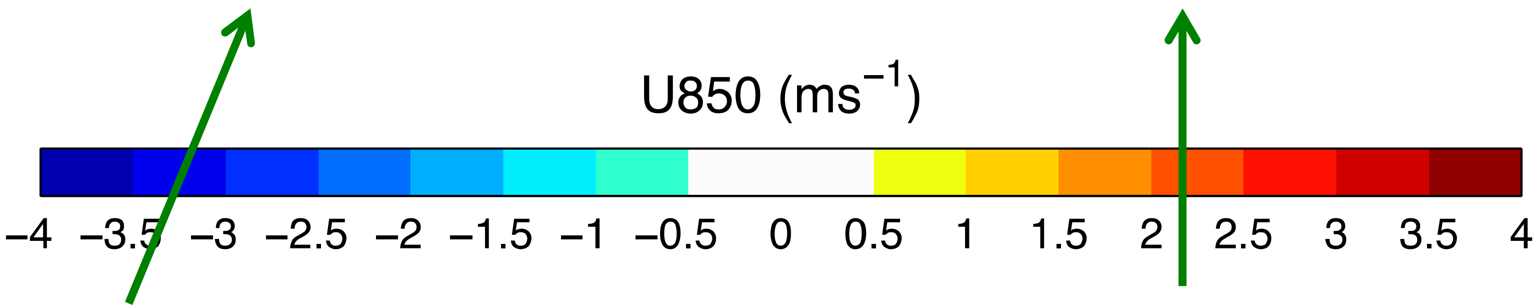
# What's so special about decadal NAO variability?

**Tim Woollings**

With Christian Franzke, Dan Hodson, Buwen Dong, Libby Barnes, Christoph Raible and Joaquim Pinto



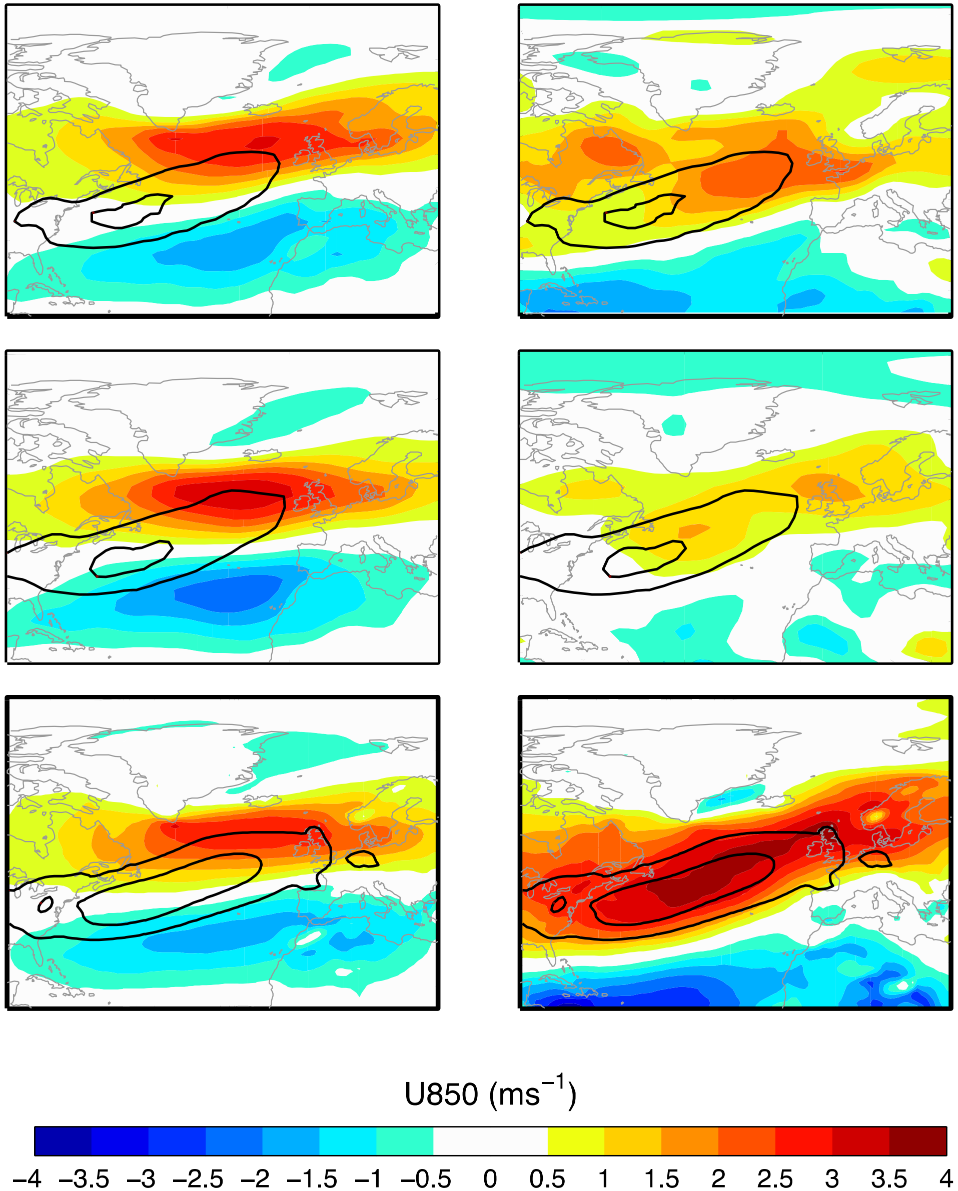



**Short timescale:**
**A jet shift**

**Long timescale:**
**A change in jet speed**

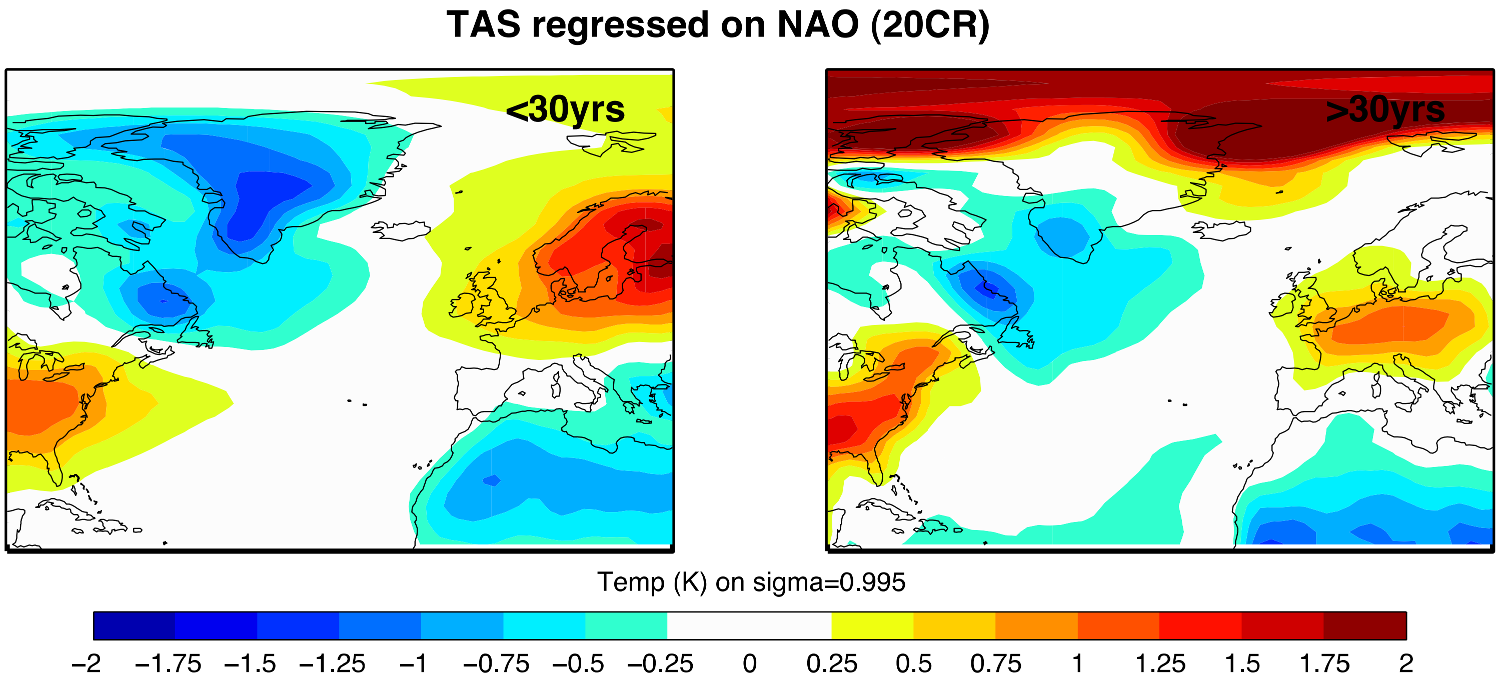
Method:

Linear regression analysis separating short (periods < 30 years) and long (> 30 years) timescales. Use 20th Century reanalysis (1871-2008)

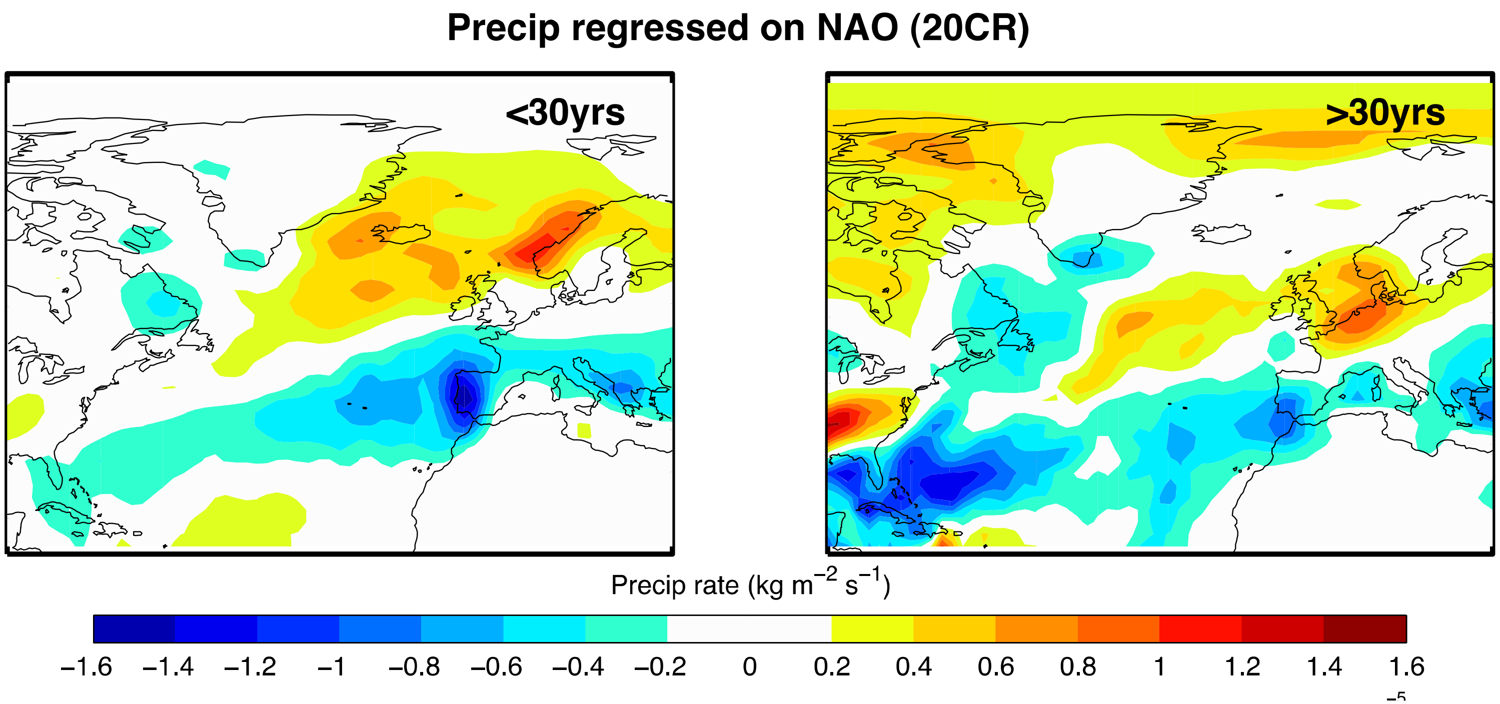



Seen in 20CR, NCEP-NCAR and HiGEM control run.

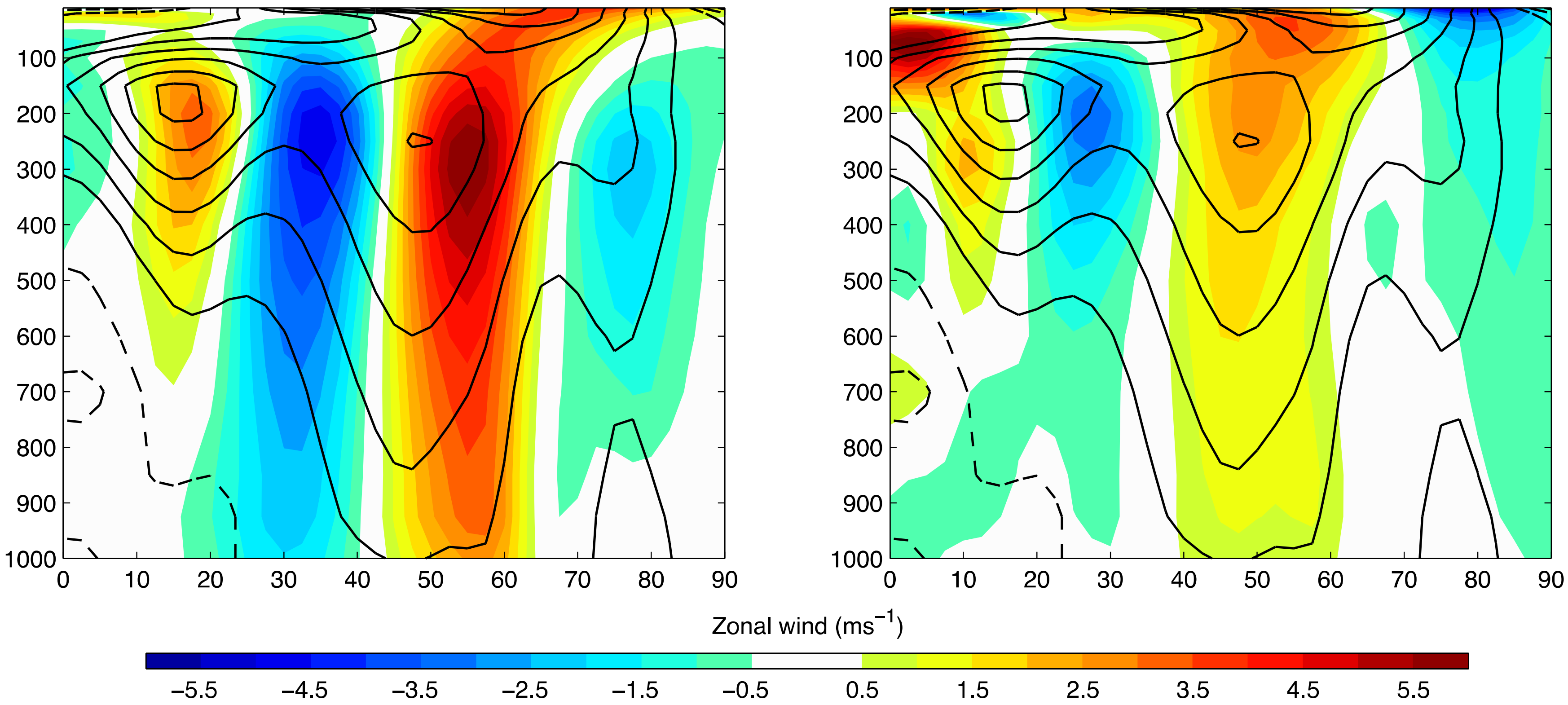
Temperature impacts

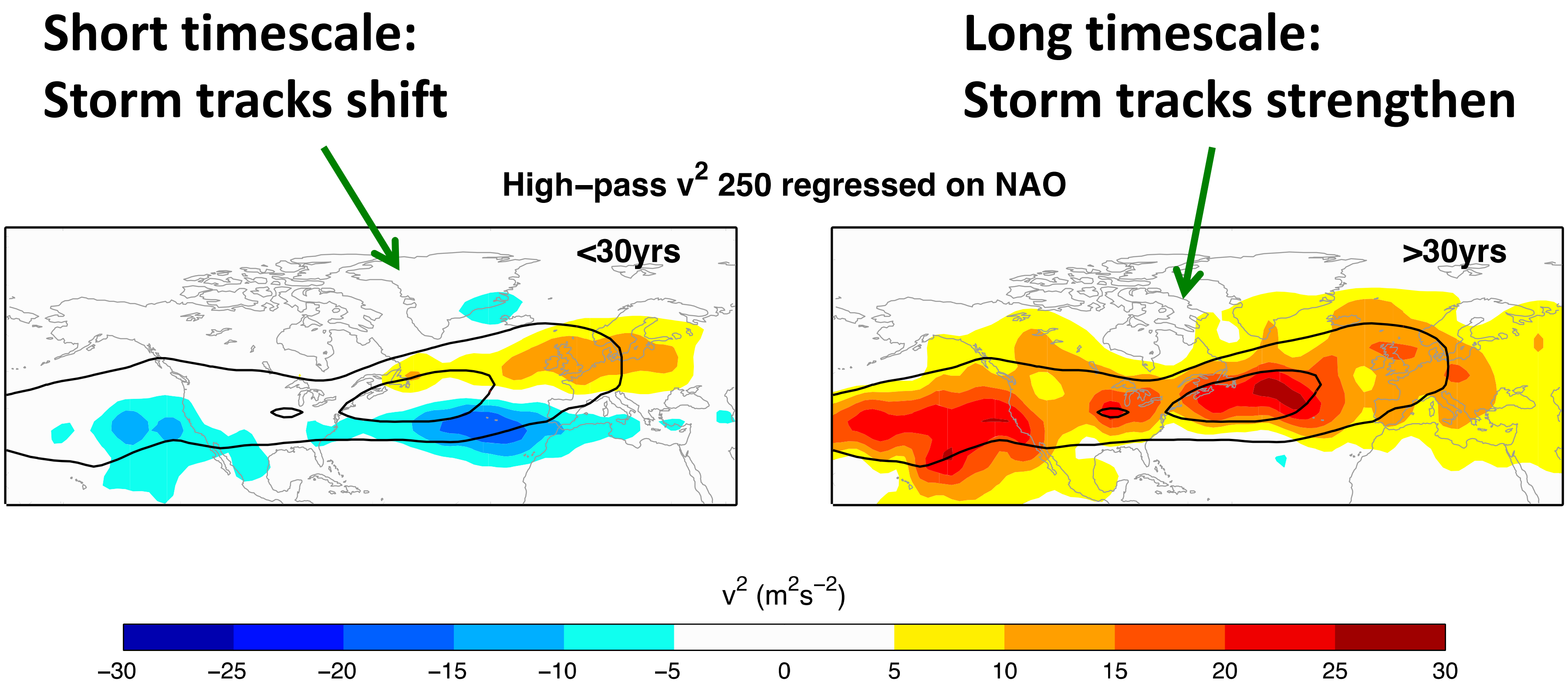



Precipitation impacts

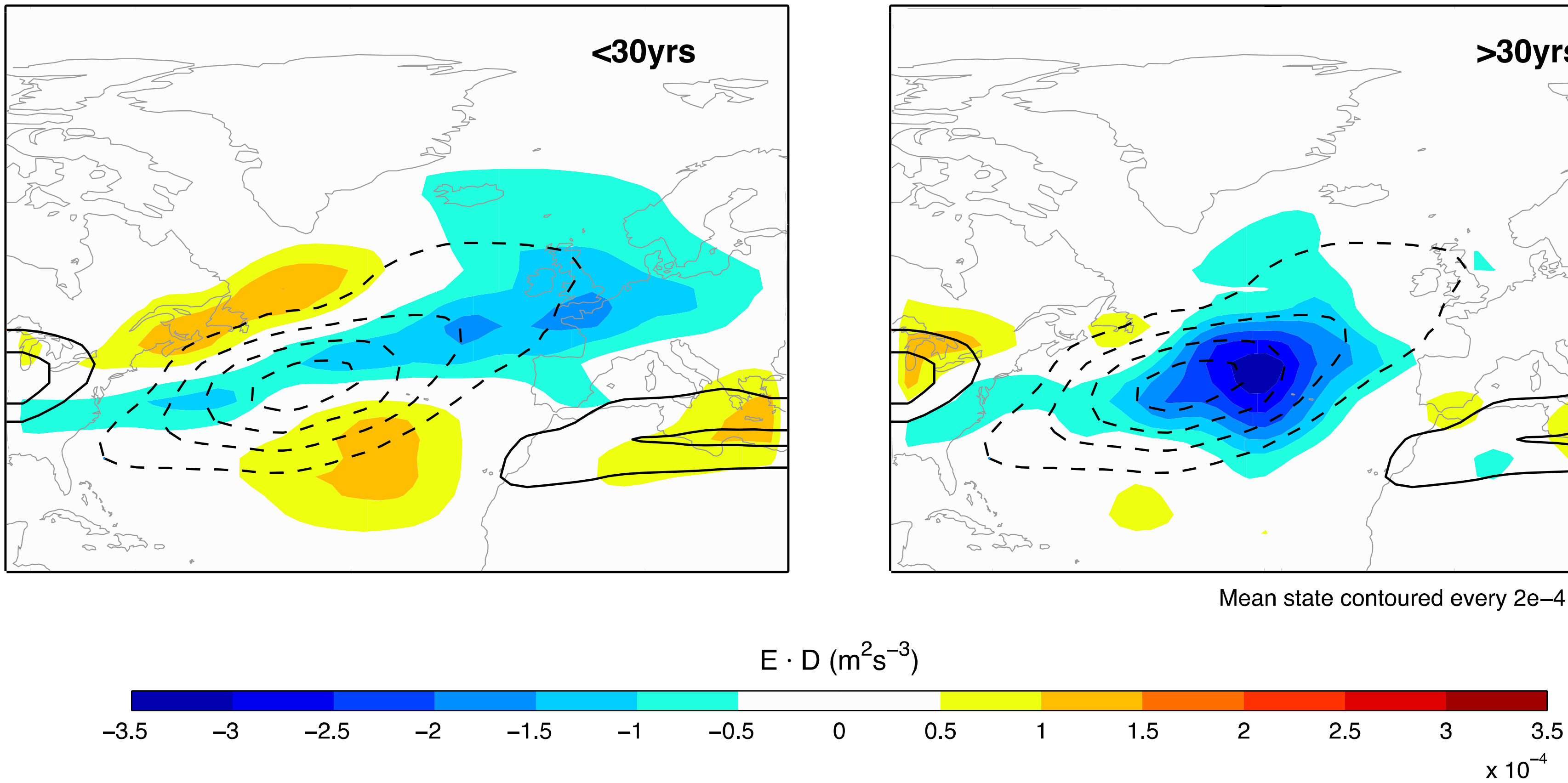


# Variability is deep, equivalent barotropic => eddy-driven




Short timescale:
Storm tracks shift
Long timescale:
Storm tracks strengthen
High–pass $v^2$ 250 regressed on NAO
<30yrs
>30yrs
$v^2$ ($m^2s^{-2}$)
–30
–25
–20
–15
–10
–5
0
5
10
15
20
25
30

## 2–6 day eddy forcing regressed on NAO

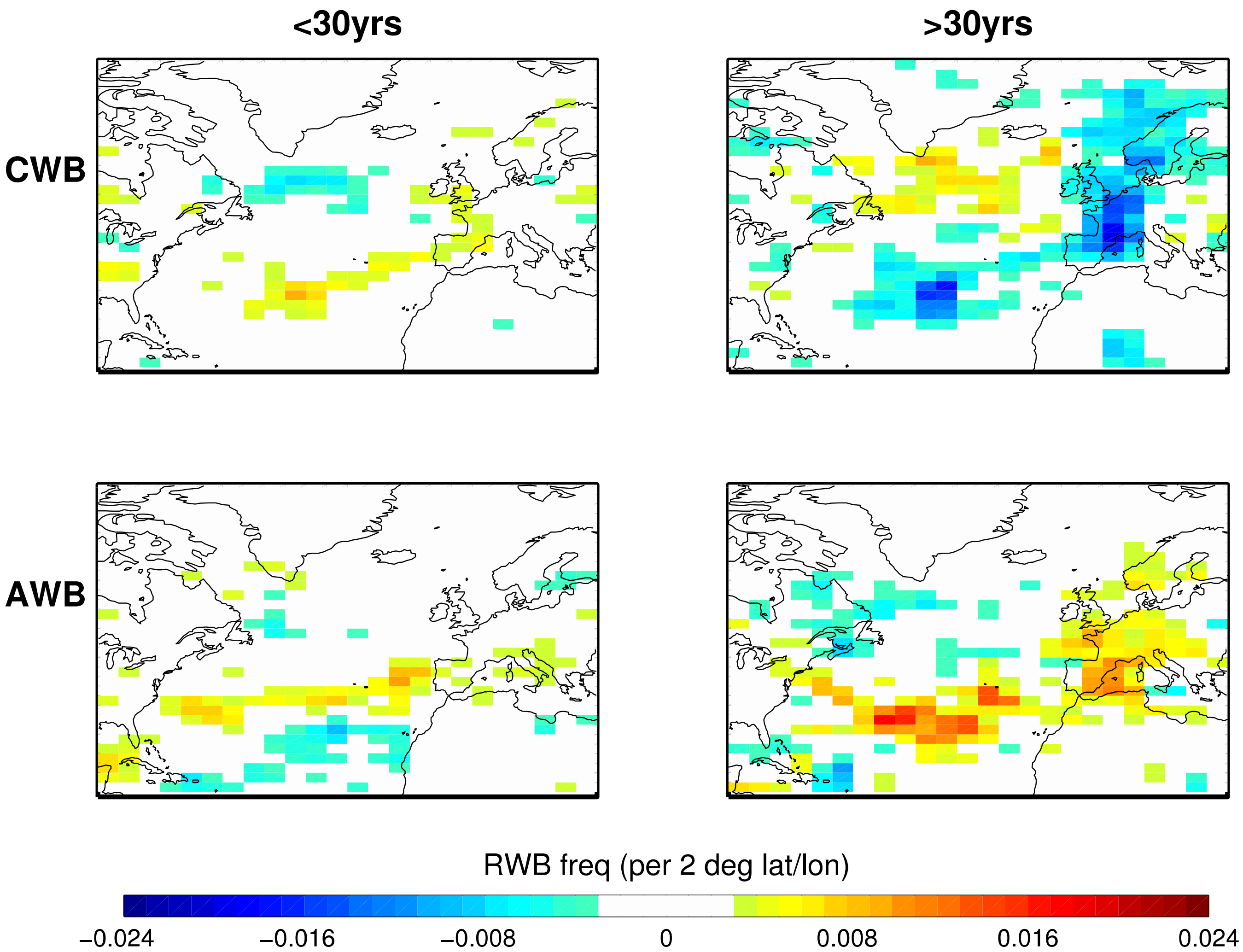


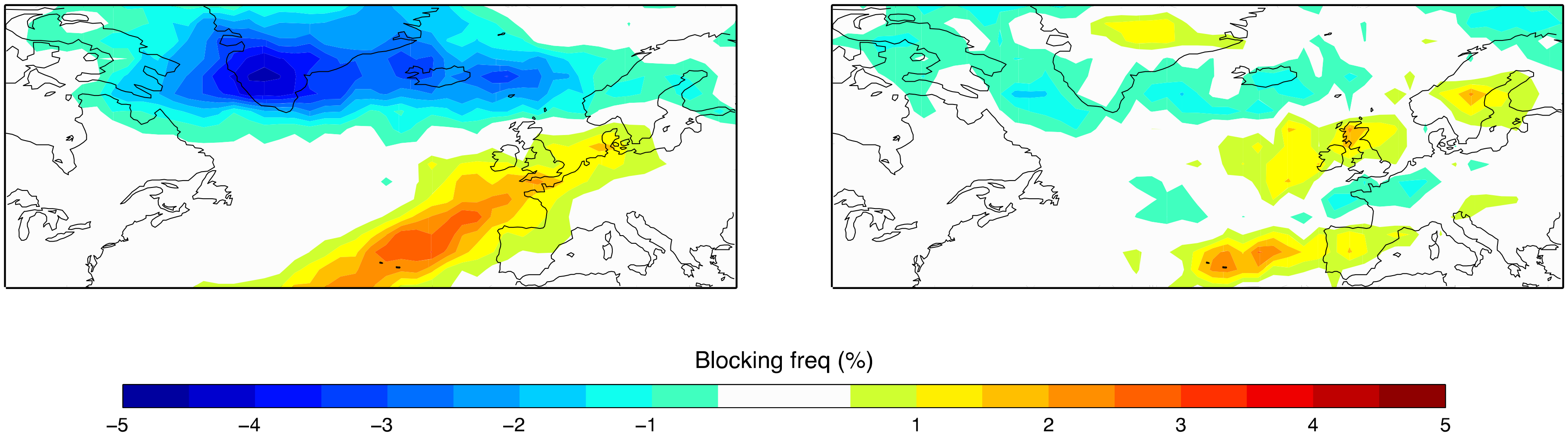

$$\mathbf{E} = ((v'^2 - u'^2)/2, -u'v')$$

$$\mathbf{D} = (U_x - V_y, V_x + U_y)$$

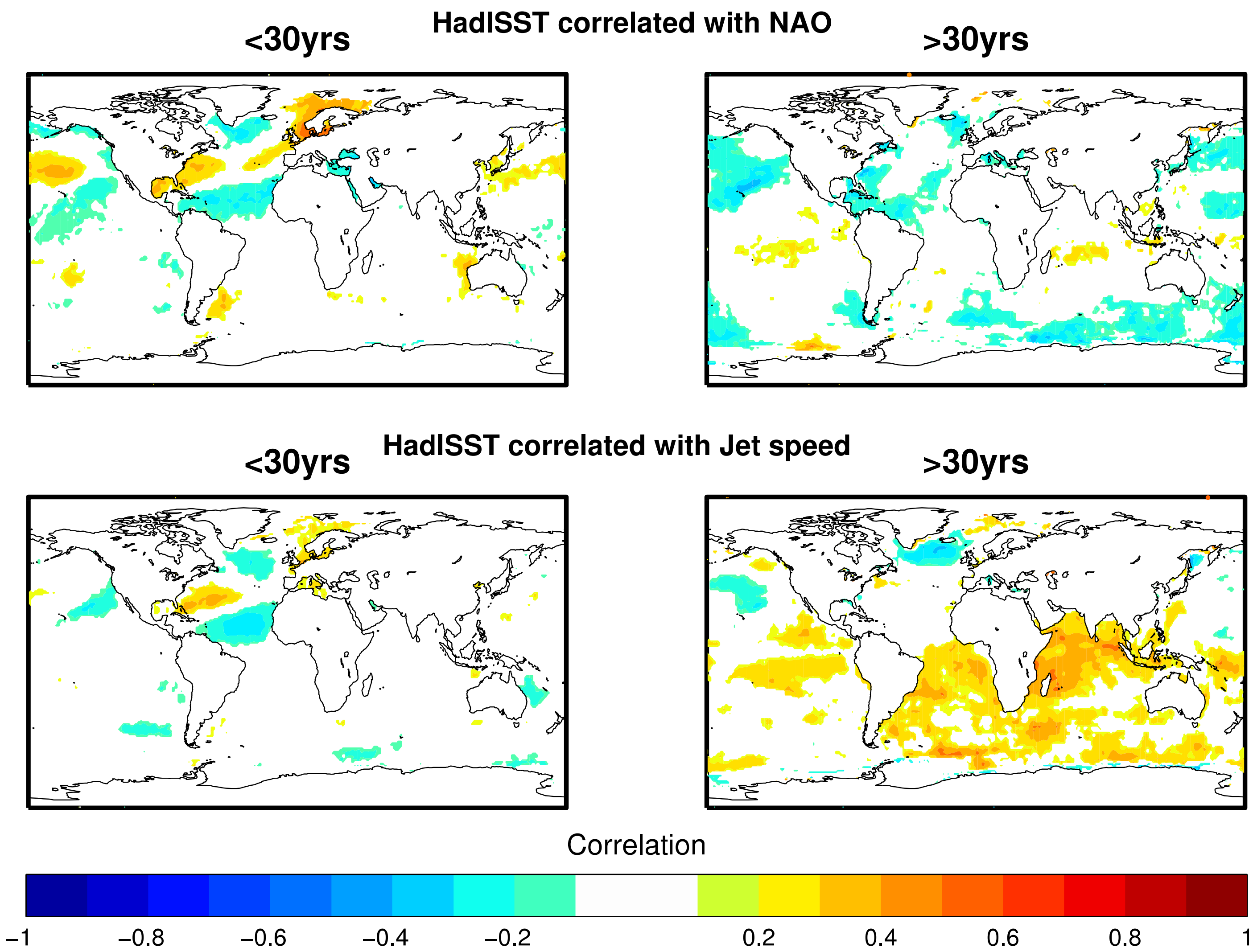
Negative =>
eddies losing KE
to basic state

Transient wave-breaking (Barnes vorticity-based method)
– relatively stronger links to slower timescale.






In contrast, blocking has stronger links to fast timescale


HadISST correlated with NAO
<30yrs
>30yrs
HadISST correlated with Jet speed
<30yrs
>30yrs
Correlation
–1
–0.8
–0.6
–0.4
–0.2
0.2
0.4
0.6
0.8
1

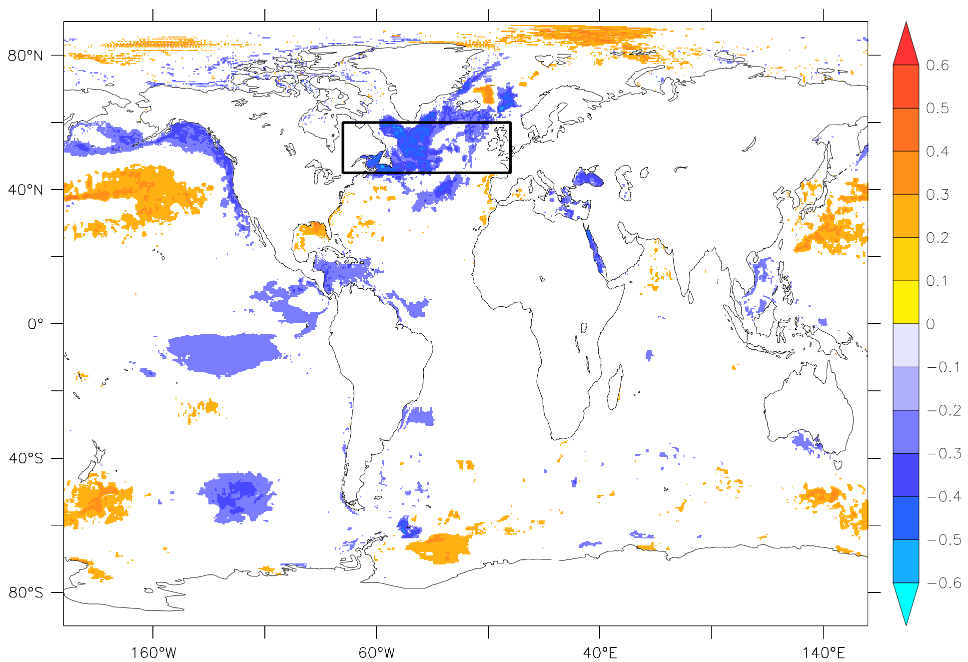
# Causality clear in high-resolution HiGEM model

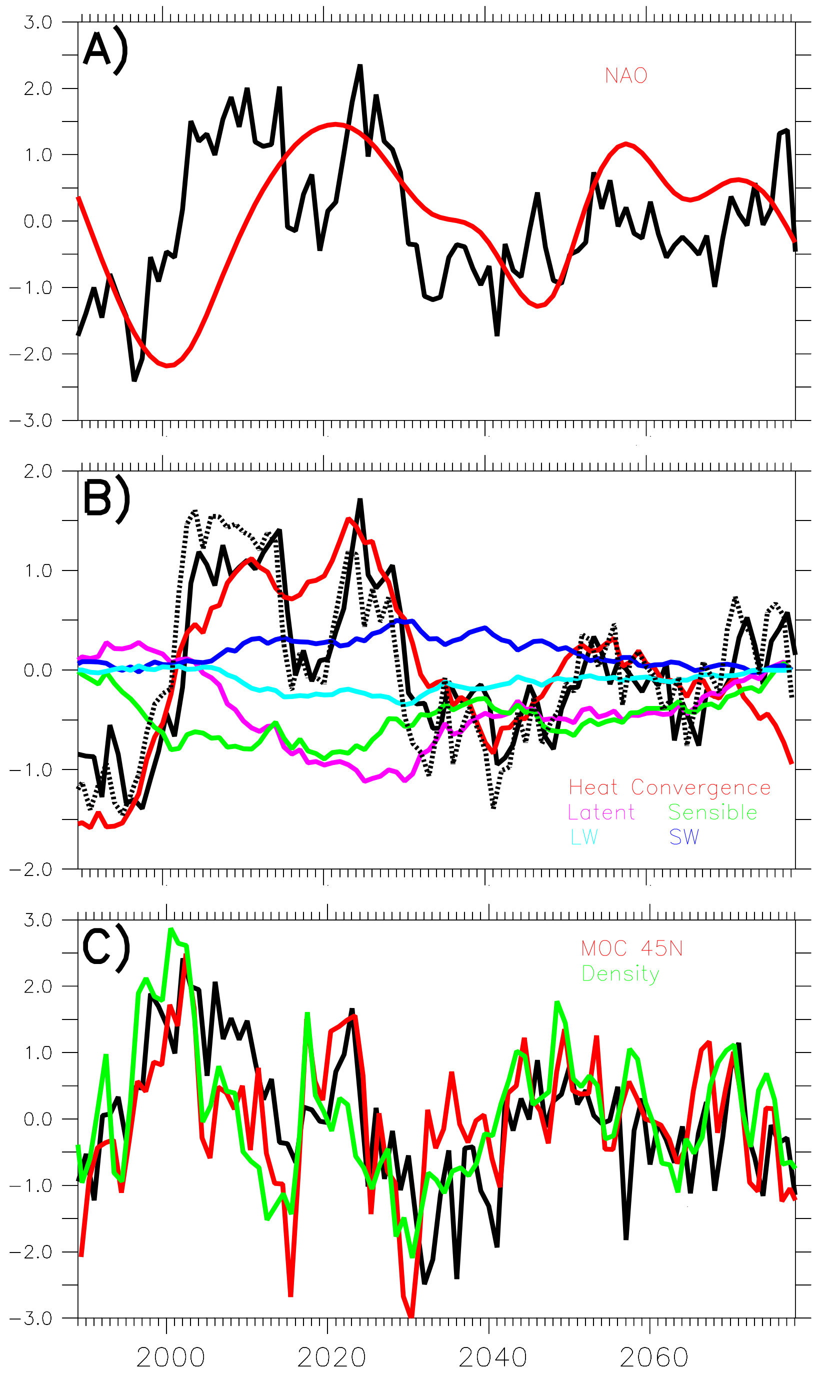
Ocean-atmosphere coupling in the model:

Decrease in ocean heat flux convergence

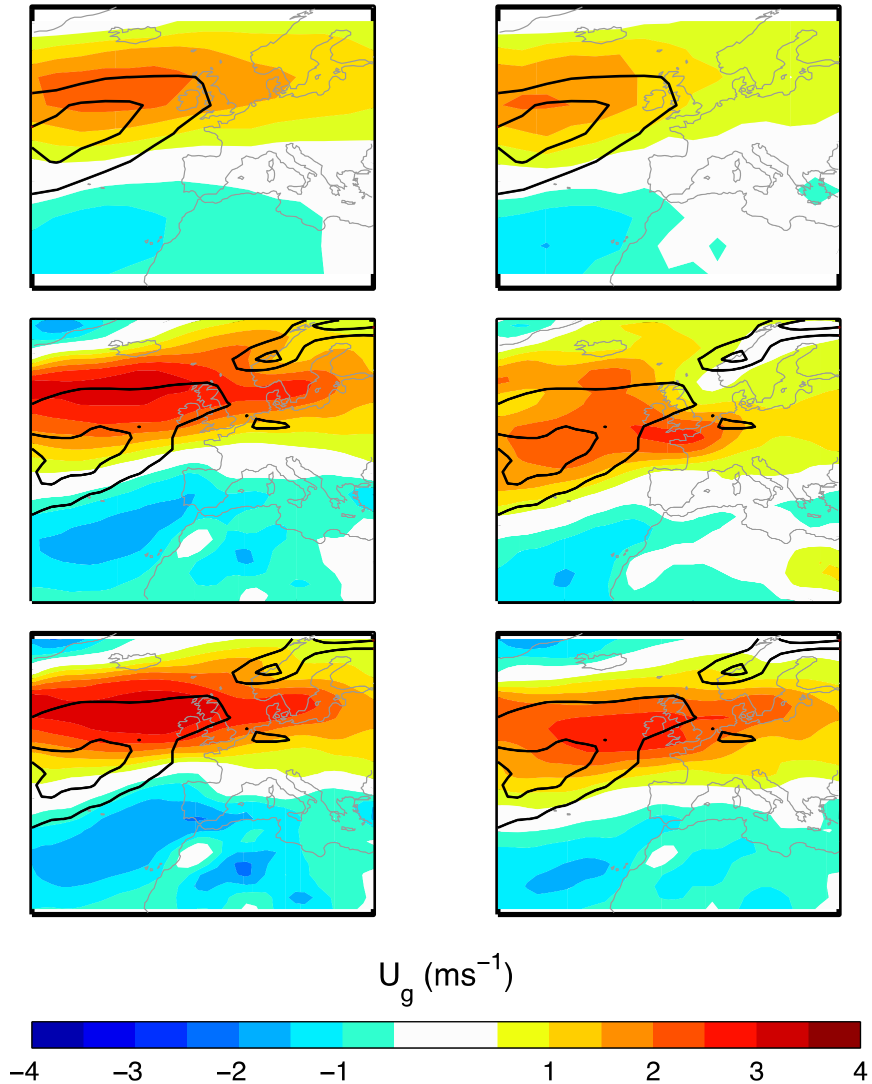
-> Colder subpolar gyre

-> Stronger atmospheric jet



Reconstructions assume stationarity…



# Conclusions

- There **is** something physically different about multidecadal NAO variability (jet strengthening rather than shift)
- This implies potential for predictive skill
- Ocean suggested as influence on long timescale
- Further evidence that assumptions of stationarity are not valid