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

TAS regressed on NAO (20CR)

Precip rate (kg m\(^{-2}\) s\(^{-1}\))

Temp (K) on sigma=0.995
Variability is deep, equivalent barotropic $\Rightarrow$ eddy-driven
Short timescale: Storm tracks shift
Long timescale: Storm tracks strengthen

High-pass $v^2$ 250 regressed on NAO

$v^2$ ($m^2s^{-2}$)
2–6 day eddy forcing regressed on NAO

Negative =>
eddies losing KE
to basic state

\[ E = \left( \frac{u'^2 - \bar{u}^2}{2}, -u'u' \right) \]

\[ D = (U_x - V_y, V_x + U_y) \]
Transient wave-breaking (Barnes vorticity-based method)
– relatively stronger links to slower timescale.
In contrast, blocking has stronger links to fast timescale.
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