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## **Atmospheric teleconnections, the North Atlantic Oscillation and long range forecasts of European winters**

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We present an update on long range predictability of the winter NAO and hence European winters. Recent years continue to support hindcast results that the winter NAO is predictable at seasonal lead times and here we investigate mechanisms for this predictability from the tropics and the stratosphere.

High predictability of tropical rainfall is first demonstrated for current prediction systems and this is shown to lead to predictable changes in vorticity sources. These are associated with clear stationary Rossby waves that propagate into the extratropics and the Atlantic sector. We estimate that this mechanism can explain around half of the forecast variance in the NAO.

Secondly, we show that initial atmospheric conditions are also important for seasonal prediction of the NAO. Initial anomalies in stratospheric winds at the start of winter propagate downwards into the troposphere on subseasonal timescales where they lead to anomalies in the winter mean surface conditions. Together, these mechanisms appear to explain the majority of forecast variance in the winter NAO. Finally, we discuss some of the remaining errors in forecasts of tropical rainfall and the unresolved signal-to-noise paradox in ensemble forecasts.

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