Seasonal Forecasting Review
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Flooding events during summer 2008 / 2009:

There has been a noticeable increase in the frequency of "blocking" patterns since autumn 2007 in the vicinity of Western Europe. These have been identified by an increase in the prevalence of semi-permanent high pressures and a substantial change in the prevailing tropical maritime winds. A change from the usual air-stream has led to some extreme and unusual weather patterns in Western Europe. This is because low pressure systems have been significantly diverted along their paths upon approach to the UK. An increase in blocking patterns is related to both anthropogenic climate change, but particularly activity in the number of sun-spots observed on the surface corona of the Sun[1]. Both external forcing factors influence the strength and position of the mid-latitude jet-stream.

An elongated Azores high pressure system in the North Atlantic Ocean at times substantially reduced the north-easterly advection of warm and moist air from the Atlantic. During other periods the blocking high diverted Atlantic lows from the south, combined with a strong south-westerly flow and rapid release of high concentrations of water vapour into the atmosphere. The blocking feature therefore resulted in wild swings in temperature, as water vapour is the major greenhouse gas in our atmosphere. During the summers of 2008 and 2009 major flooding events affected parts of the UK. During these periods the mid-latitude jet stream, a ribbon of fast moving air located at and altitude around 5km, was deflected further south than usual in the vicinity of the United Kingdom. The deflection resulted in an intensification of low pressure systems, as they gathered heat and moisture along their trajectory. Blocking features significantly affect the skill of seasonal forecasts, but are often poorly predicted in long-term forecasting models.

Winter weather 2009/2010:

In general larger-scale features dominate the longer-term weather patterns. A large-scale anomaly contributed to the extremes of cold during the last two weeks of December 2009. The link between this feature and our weather demonstrated the potential for some clear forecasting skill at much longer time-scales. The weather that is experienced by the public, such as cloudiness and precipitation occurs within the lower portion of atmosphere known as the troposphere. Above the layer of cloud and moist air lies a layer known as the stratosphere at an altitude of ~30km. At high latitudes a circulating region of ozone and cold air usually rotates around the pole within the stratosphere during the winter. This is known as the polar vortex, and dominates the upper level weather of the winter pole due to a contrasting N-S temperature gradient aloft. During late December, the polar vortex was "severed" into two separate vortexes. A vortex split off and became established over America, whilst another elongated vortex was “stretched” across much of Siberia.

Cold weather during December 2009 initially affected the east-coast of the USA, during the onset of the polar vortex split. The extremes of cold affected the UK and Western Europe around two weeks later. A similar stratospheric pattern dominated the weather during February 2009, and was [2]noted by a team at NASA to cause strong easterly winds. During winter 2008/2009 a polar vortex splitting event resulted in heavy snowfall, which crippled London's transport networks. There are clear links between the upper and lower portions of atmosphere, e.g. see potential vorticity and action at a distance ([3]Sir Brian Hoskins etc).

Stratospheric anomalies cause an effect felt in the troposphere and at the surface. Splitting events are commonly associated with a reversal in the usual westerly atmospheric circulation at the surface. During December 2009, an easterly flow extended from West-Siberia into Western Europe. These continental winds herald a change in regime to much colder conditions. Following the stratospheric vortex splitting, a series of additional splitting events occurred causing winter storms and cold in both the east coast of the USA and in the UK. One major event resulted in unprecedented snowfall for the American city of Washington DC during February 2010. The entire northern hemisphere circulation patterns at the surface are severely disrupted by the events in the stratosphere.

[1]Are cold winters in Europe associated with low solar activity? M Lockwood *et al* 2010 *Environ. Res. Lett.* **5** 024001

[2] Holli Riebeek and Paul Newman, Stratosphere Influences Winter Weather, Goddard Modeling and Assimilation Office, 07/02/2009
http://earthobservatory.nasa.gov/IOTD/view.php?id=36972

[3]Hoskins, B.J., McIntyre, M.E. and Robertson, A.W., 1985. On the use and significance of isentropic potential vorticity maps, Quarterly Journal of the Royal Meteorological Society, 111, 877-946.
http://www.rmets.org/pdf/qj_hoskins58_1.pdf

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[Date: 18/06/2010]

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