

Atmospheric rivers and British winter floods

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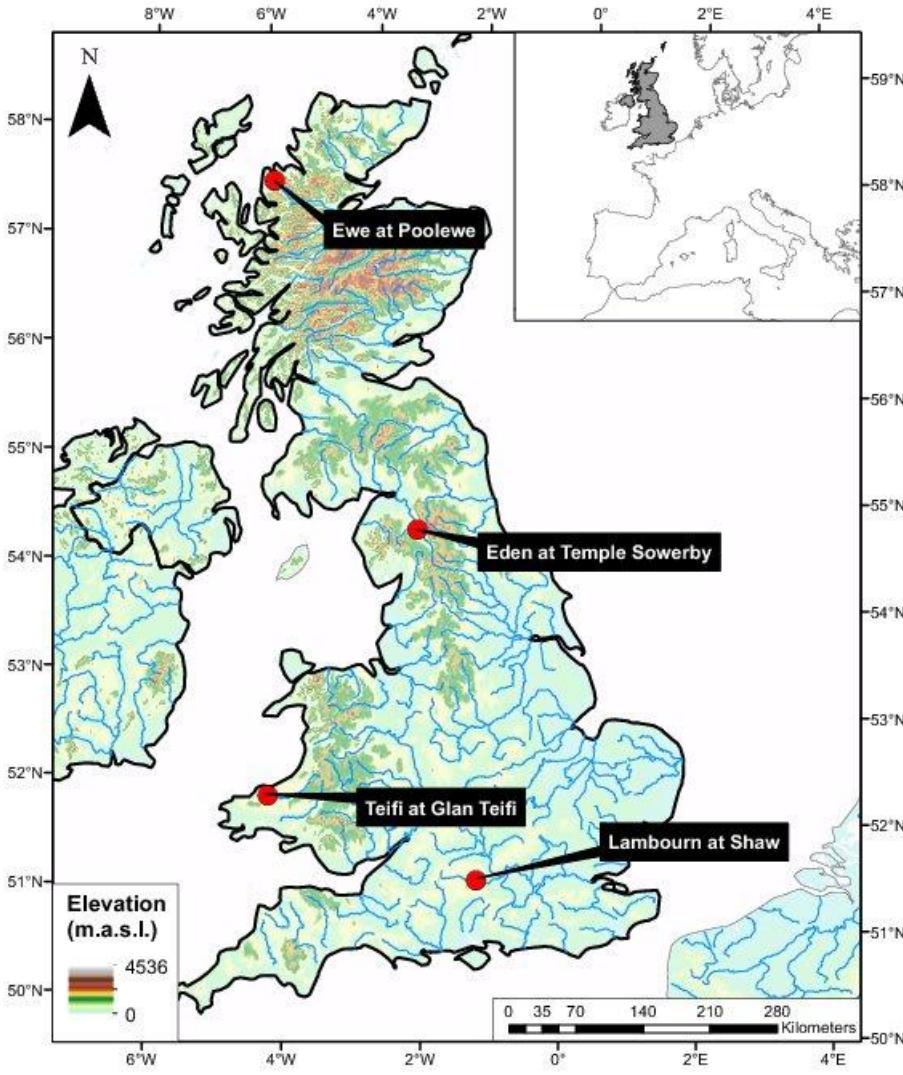
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Atmospheric Rivers (ARs)



- ARs are regions where moisture travels from the subtropics to the mid-latitudes.
- Located within warm sector of extra-tropical cyclones.
- *Tropical Moisture Exports, moisture (or warm) conveyor belts.*
- Most AR-flood research undertaken in western North America (e.g. Ralph et al., 2006; Neiman et al., 2008, 2011).

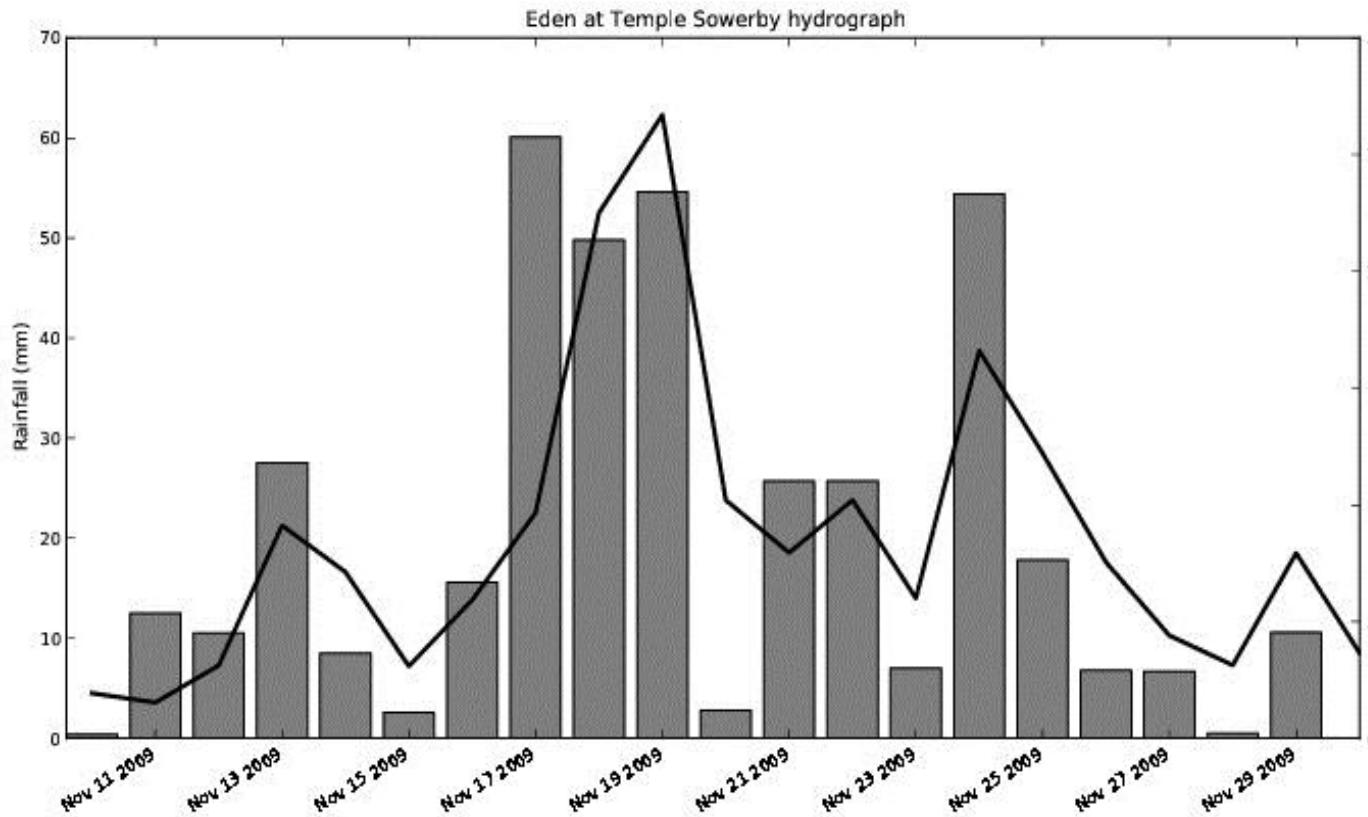


Methods

- 1). Floods identified using a winter maximum series (WMS) over 1970-2010.
- 2). For three days up to flood event the 900 hPa specific humidity and wind fields analysed; satellite data also retrieved.

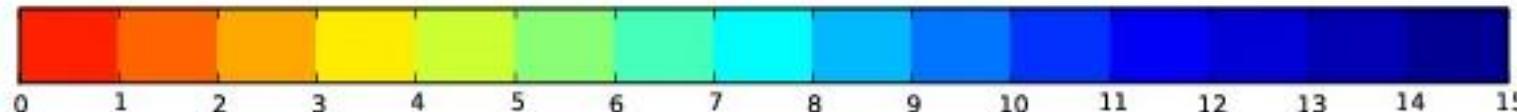
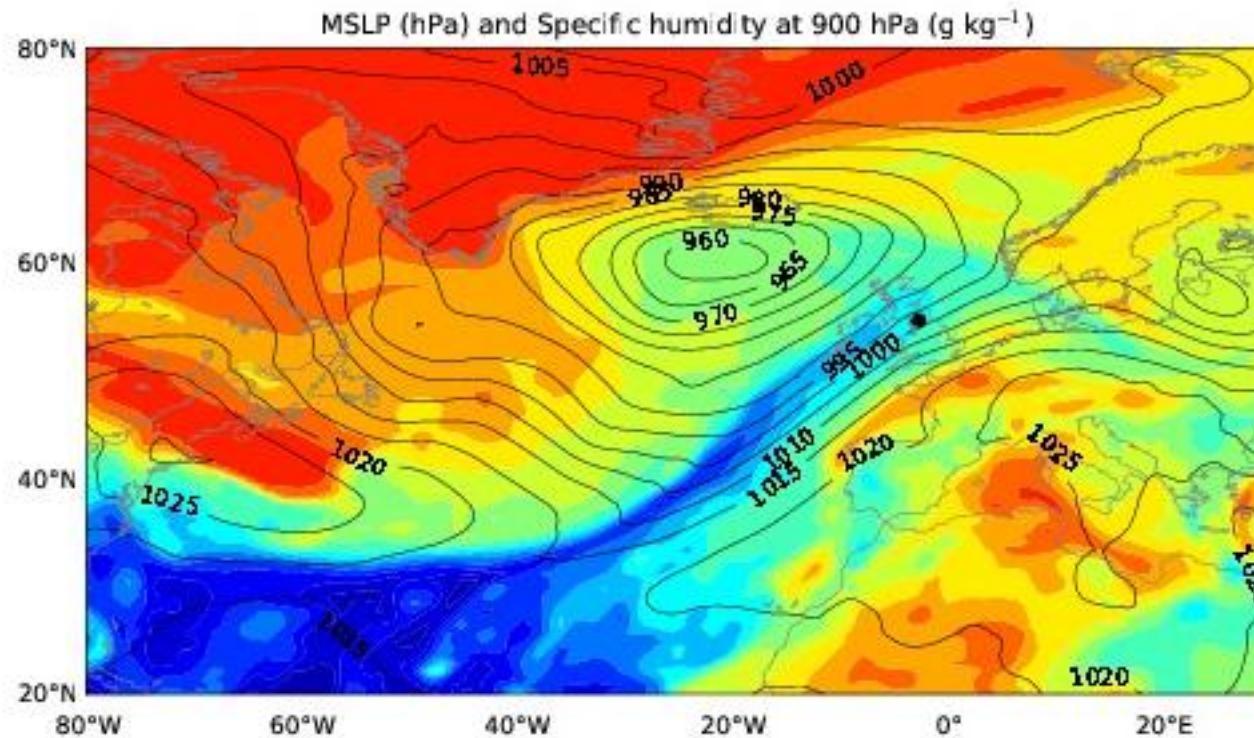
November 2009 Cumbrian flood

- Peak flow at Eden at Temple Sowerby ($267\text{m}^3/\text{s}$) on 19th Nov 2009; 3 day rainfall total of 164.5mm near gauging station.
- Other areas in Cumbria received $>300\text{mm}$ in 24 hours.



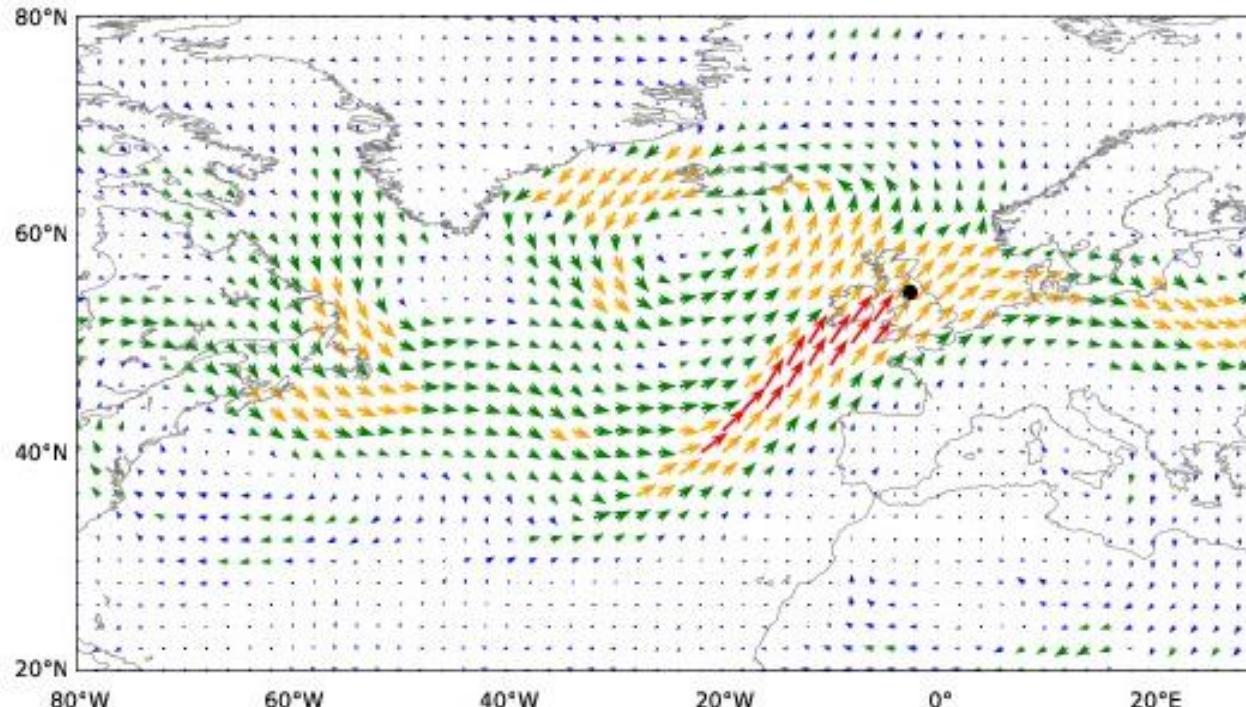
Data source:
UK National
River Flow
Archive /
UKMO
MIDAS.

Fields at 0600 UTC 19th Nov 2009



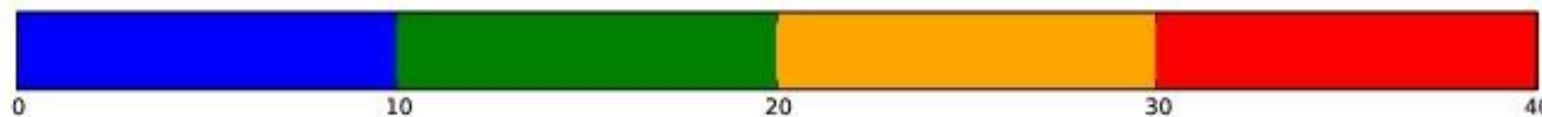
units: ms^{-1}

Fields at 0600 UTC 19th Nov 2009



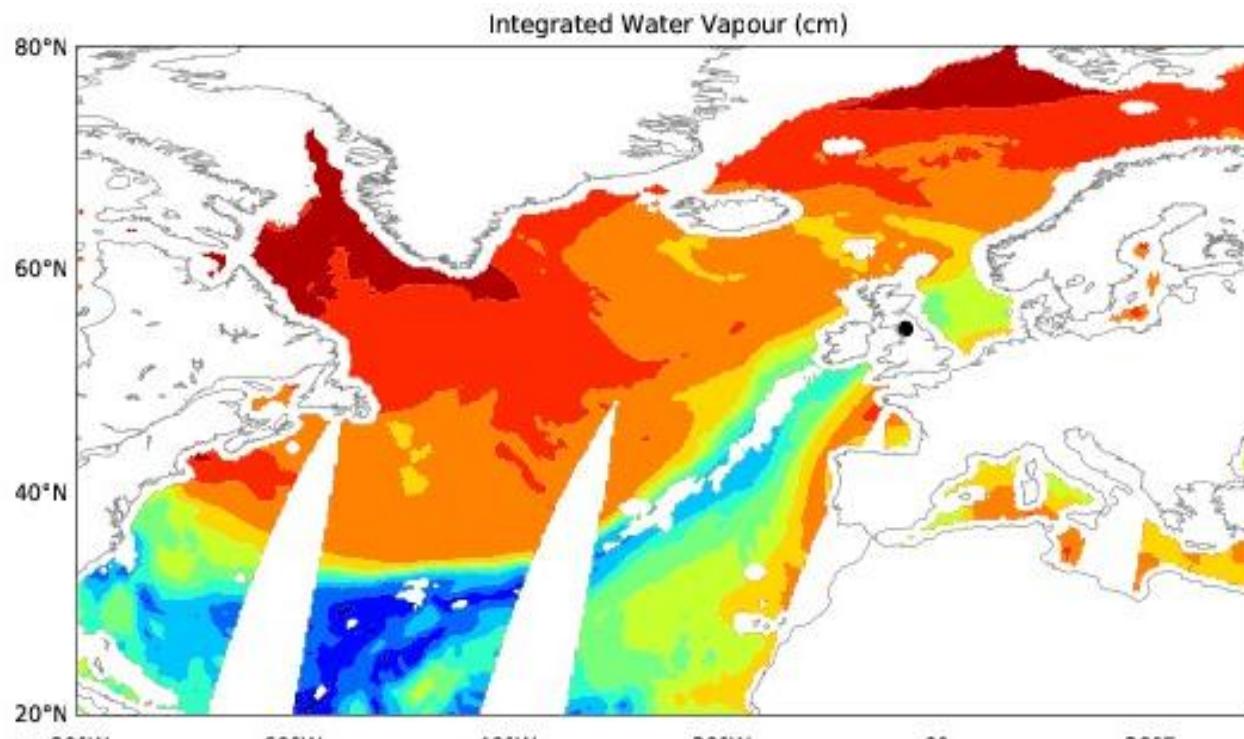
Data source:
ECMWF ERA-
Interim
reanalysis.

SSMI F16
retrieval of
column
IWV



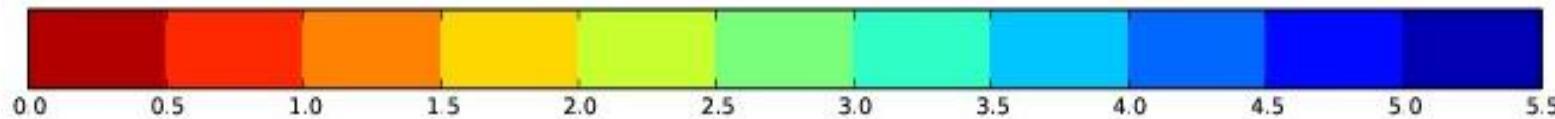
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Fields at 0600 UTC 19th Nov 2009



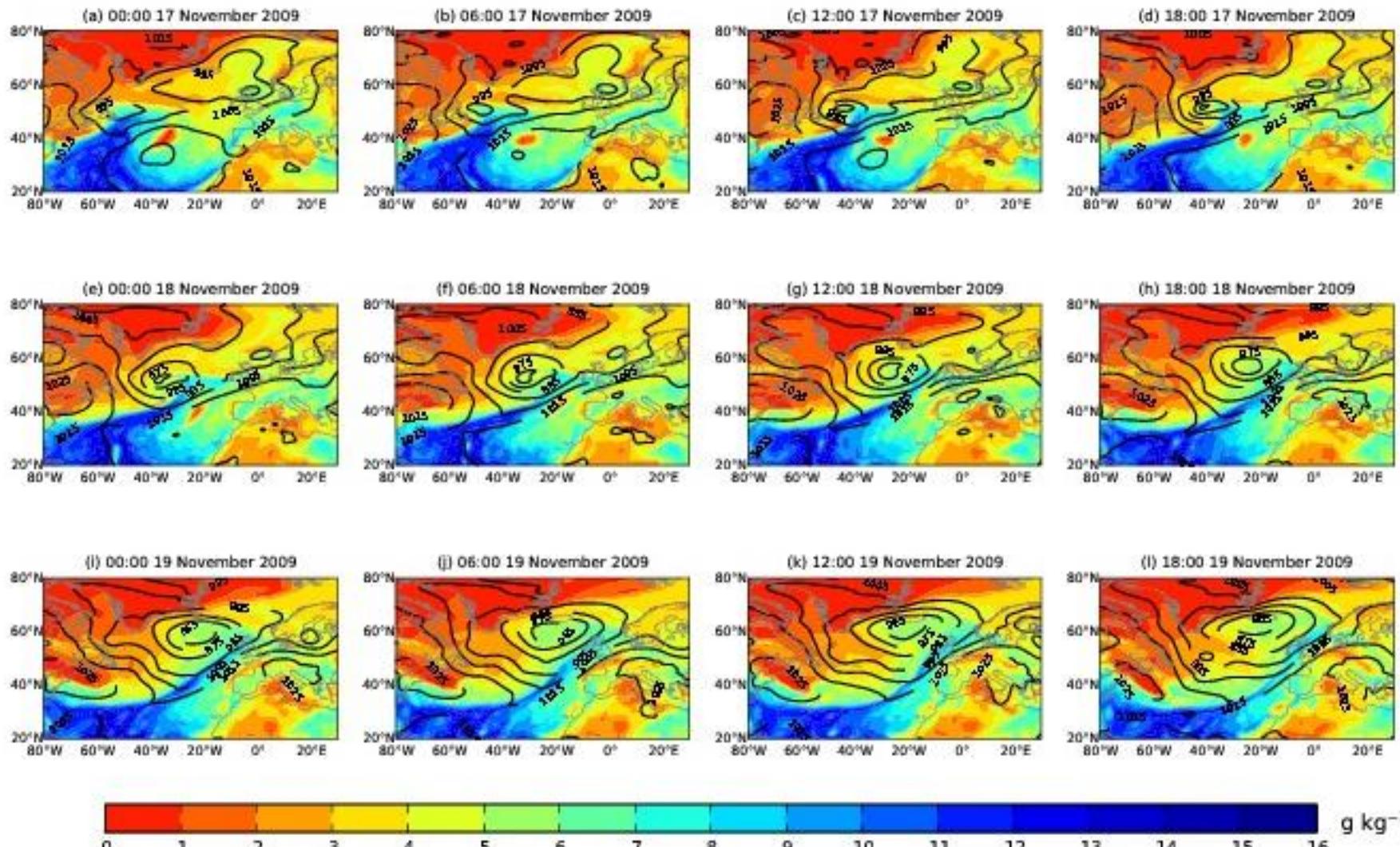
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SSMI F16
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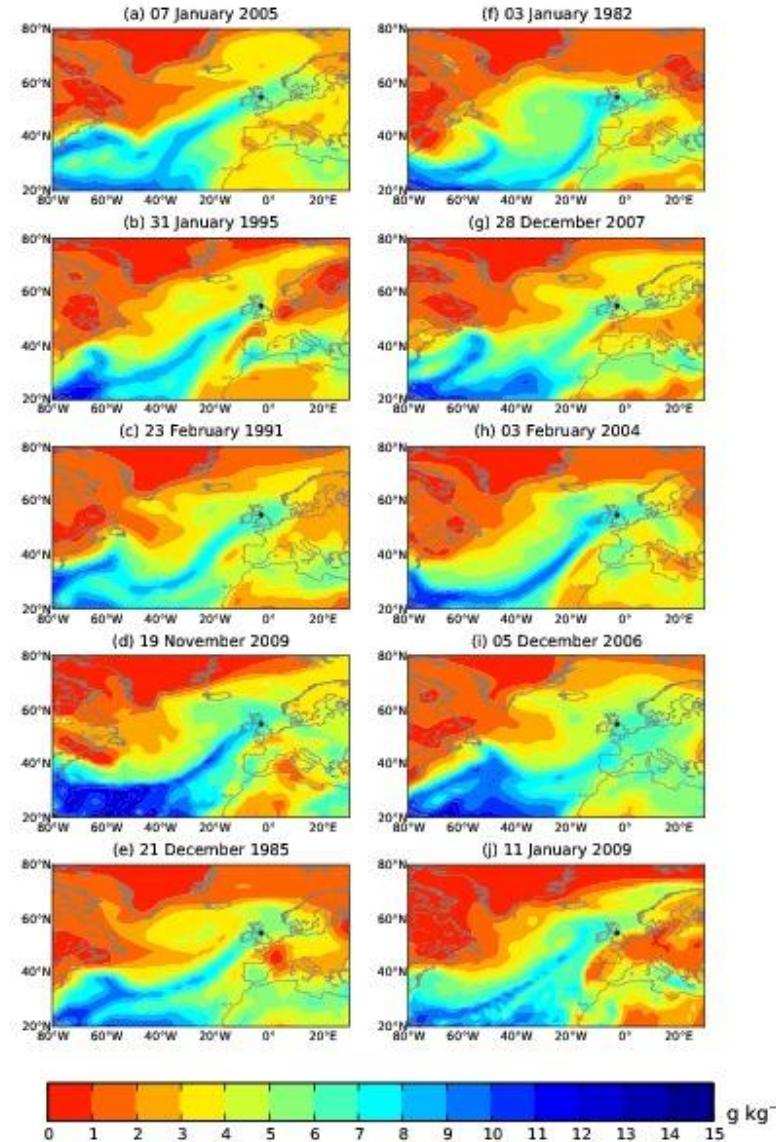
units: ms^{-1}

Evolution of 900 hPa specific humidity and MSLP



Data source: ECMWF ERA-Interim reanalysis.

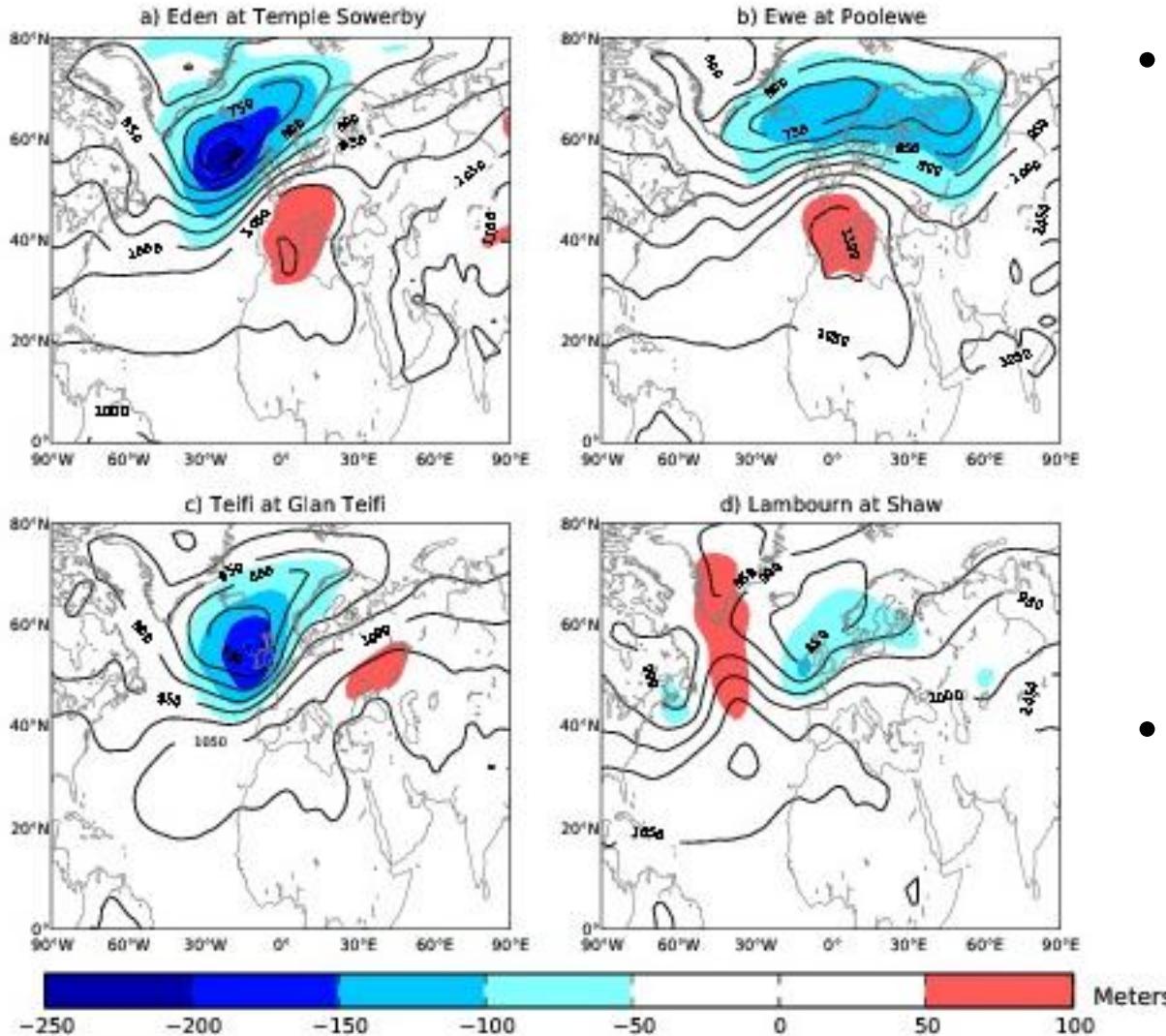
Top 10 winter floods (in WMS) in Eden



- Persistent ARs located over basin in these floods.
- ARs have consistent location and orientation.

Data source: 20th Century / ECMWF ERA-Interim reanalyses.

Atmospheric Circulation



- Tilt in 900 hPa geopotential field leads to poleward and upward movement of moisture-laden air in warm sector of extra-tropical cyclones.
- Most recognisable in fast-responding river basins (west Britain).

Data source: 20th Century / ECMWF ERA-Interim reanalyses.

Conclusions

- Damaging UK flood (November 2009) linked to persistent AR event.
- Ten largest winter floods in a range of UK river basins were connected to ARs.
- ARs were particularly recognisable during winter floods in fast-responding basins; permeable basins require a series of storms to produce floods.
- Findings broadly applicable to NW Europe.

Thank you for listening

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