HydEF Research Progress

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• Improve process understanding of atmospheric drivers of UK flooding.
• This better informs GCM downscaling for hydrological applications / future flood projections.
• Atmospheric Rivers (ARs).
• UK floods and links with ARs.
• November 2009 Cumbrian flood.
• Top 10 floods in four British basins.
• Screening for ARs in climate model datasets.
• Preliminary CMIP5 model results.
• Conclusions.
Atmospheric Rivers (ARs)

- ARs are regions where moisture travels from the subtropics to the mid-latitudes.
- Located within warm sector of extra-tropical cyclones.
- Most AR-flood research undertaken in western North America.
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

- Mean daily flow in Eden (Temple Sowerby) was 267m$^3$/s on 19Nov 2009; 3 day rainfall total of 164.5mm near gauging station.
- Other areas in Cumbria received >300mm in 24 hours.

Data source: UK National River Flow Archive / UKMO MIDAS.
Fields at 0600 UTC 19th Nov 2009

Data source: ECMWF ERA-Interim reanalysis.
SSMI F16 retrieval of column IWV

units: $\text{ms}^{-1}$
Evolution of 900 hPa specific humidity and MSLP

Data source: ECMWF ERA-Interim reanalysis.
Top 10 winter floods (in WMS) in Eden

- 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.
Future work

• Screen for ARs in future climate projections to determine change in AR frequency/intensity.
• Finalise index for UCL downscaling.
• Summer floods.
Any Questions?

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