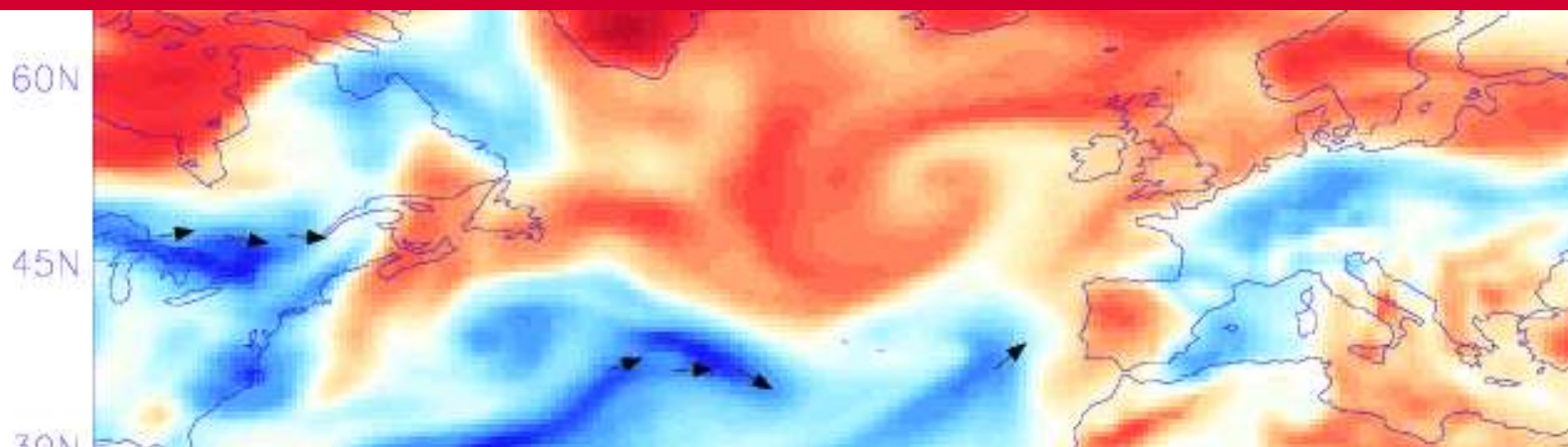


ST1.3 ATMOSPHERIC PRECURSORS



Richard Allan, Adrian Champion (University of Reading)

Hayley Fowler, Stephen Blenkinsop (Newcastle University)

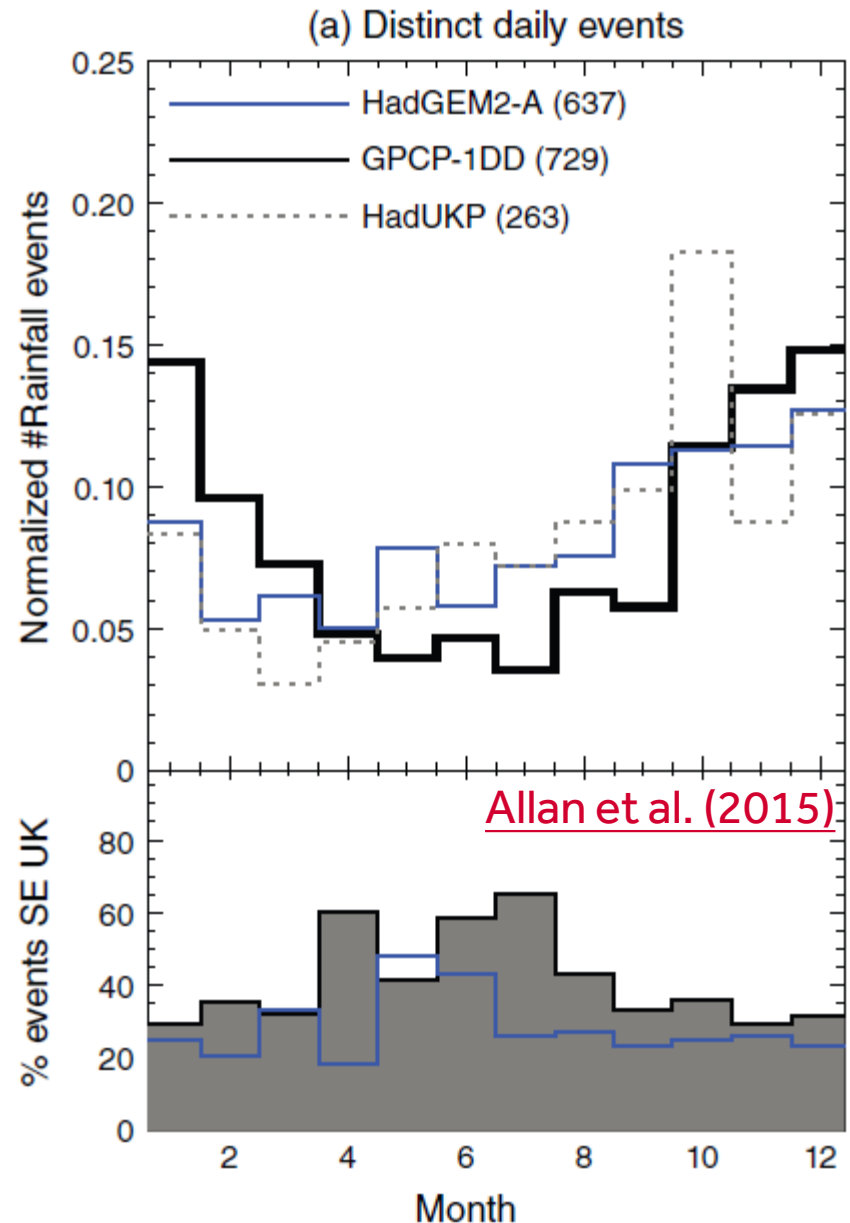
ST1.3 OBJECTIVES

ATMOSPHERIC PRECURSORS

- Assess the influence of moisture transport in FFIR summer events using reanalysis data
- Evaluate the time/space scales associated with FFIR events using daily and hourly rain gauge data
- Characterise atmospheric conditions preceding FFIR impacts using historical and rain gauge data
- Contribute toward case study inter-comparisons and write up publications

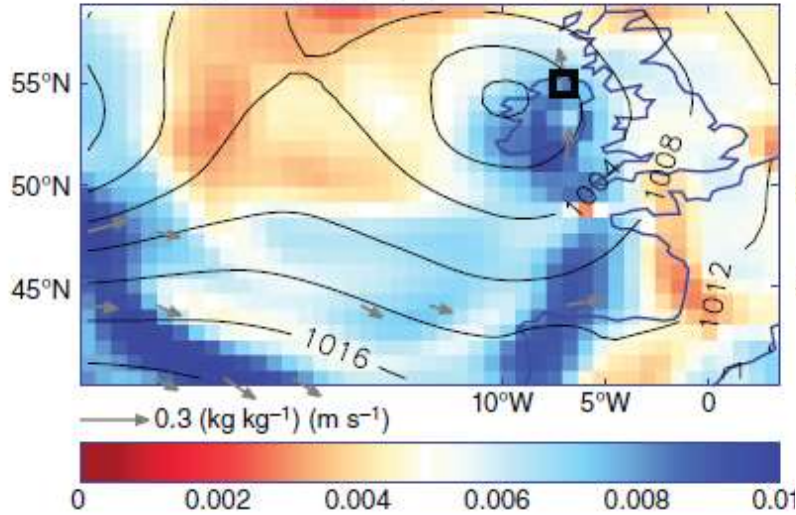
FREQUENCY OF HEAVY RAINFALL BY MONTH (1997-2008)

- Frequency of top 1% daily rainfall by month across UK
- Fewer summer daily extreme events
- But up to 60% of summer events for South East region
- Highly sensitive to time/space scales
- What are moisture characteristics associated with heavy rainfall?
- Use satellite or gauge-based rainfall observations and simulations
- Is intense moisture transport (e.g. Atmospheric Rivers) associated with intense summer rainfall

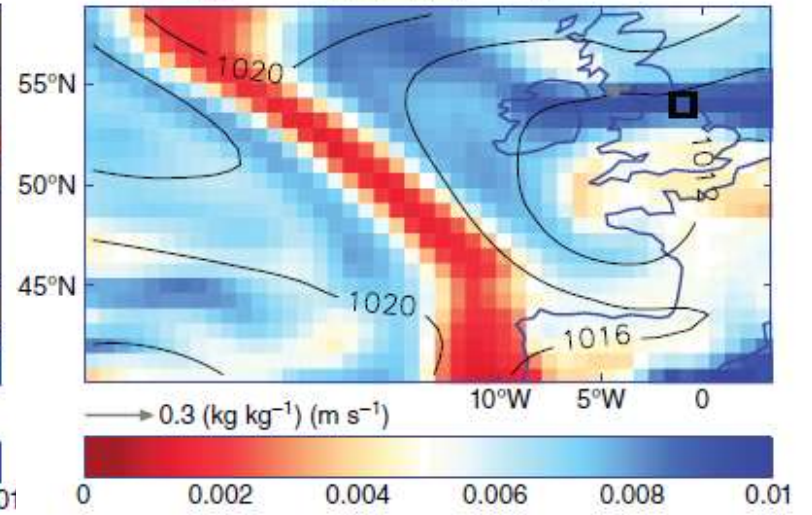


Summer Events

(a) NIP q (kg kg^{-1}), 16 August 2008

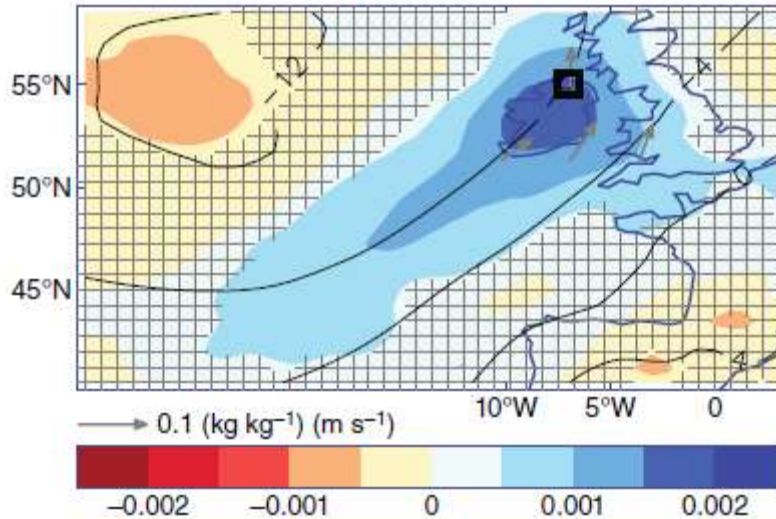


(d) NEEP q (kg kg^{-1}), 1 August 2002

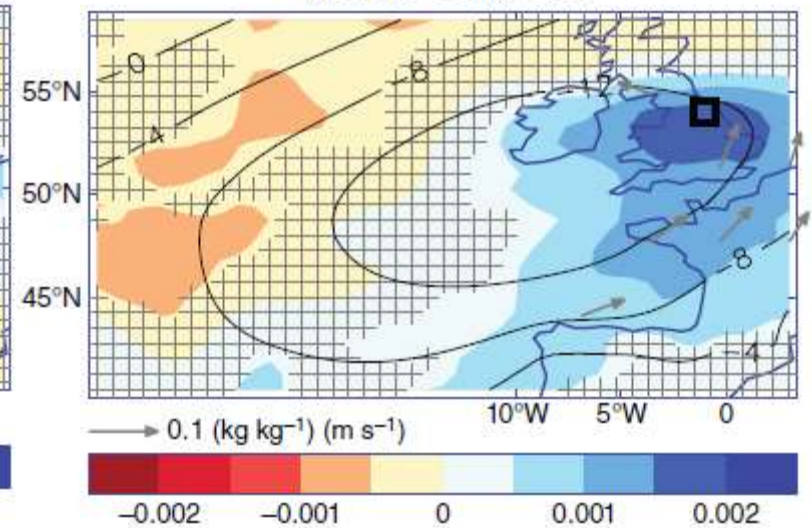


Annual Composites

(a) NIP Composite



(d) NEEP Composite



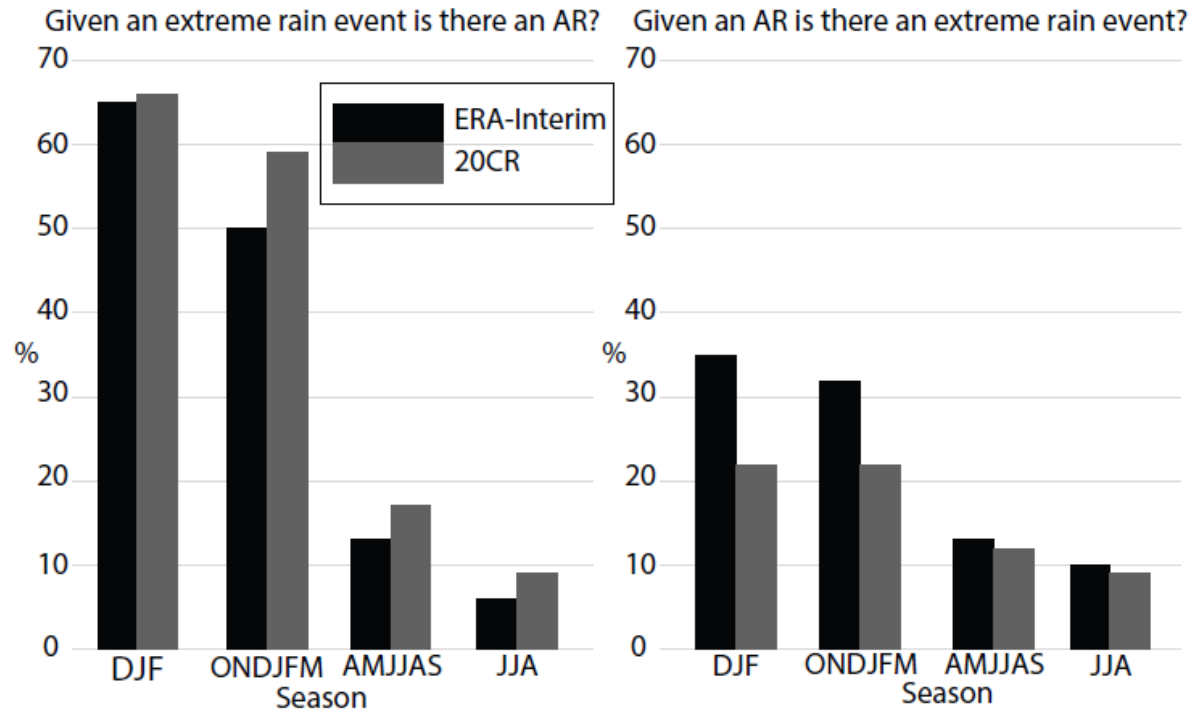
HadUKP gauge record

[Allan et al. \(2015\) IJOC](#)

ROLE OF ATMOSPHERIC RIVERS?



- Daily raingauge data from MIDAS
- 90% threshold of UK daily rain
- ERA-Interim (1979 - 2013) & 20CR (1900 - 2012) reanalyses
- Summer results:
 - <20% of extreme rain events identified had an associated AR.
 - <10% of ARs produce extreme rain event.

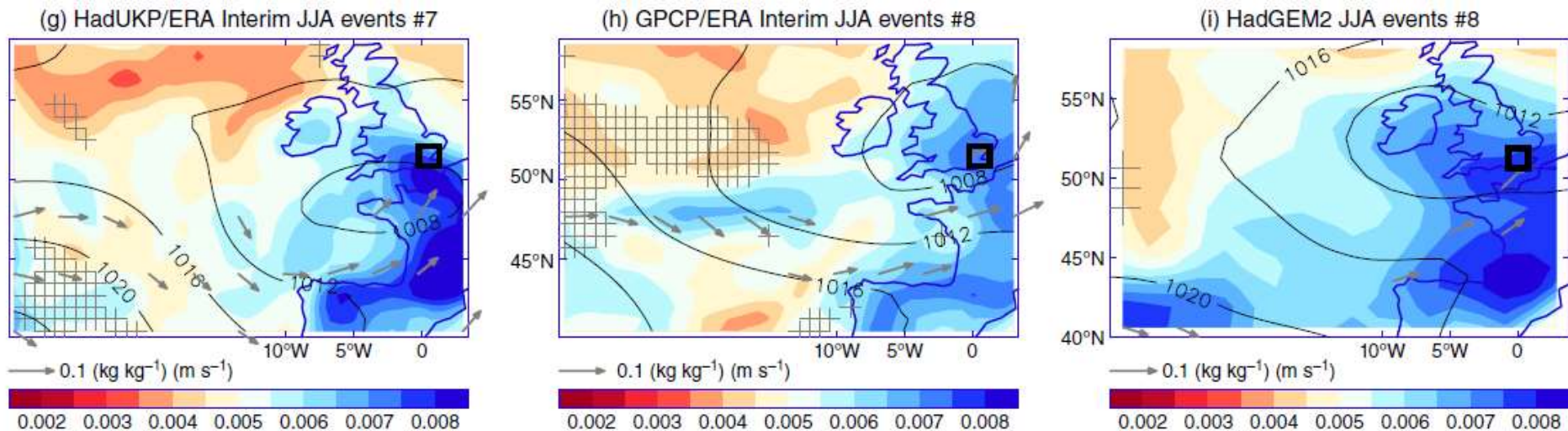


[Champion et al. \(2015\) JGR](#)

MOISTURE CHARACTERISTICS



- What moisture characteristics are associated with heavy summer rainfall?
- Gauge/satellite-based rainfall + reanalysis vs simulation
- Composites for SE: Cyclonic flow, high continental moisture



[Allan et al. \(2015\) IJOC](#) see also [Lavers et al. 2014 Nature Comm](#)

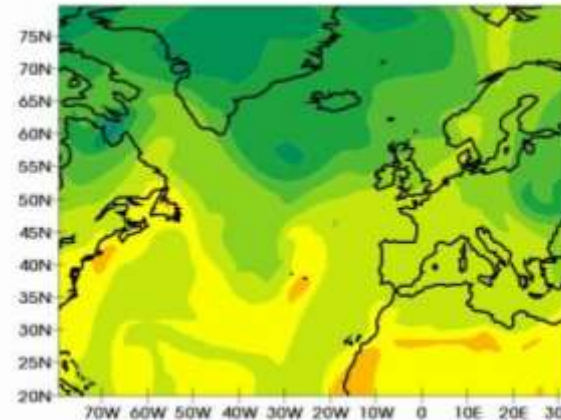
ST1.3 ONGOING WORK

- Progressing to 3-hourly gauge data
- Considering range of additional precursor diagnostics including stability-based metrics (e.g. wet bulb potential temperature)

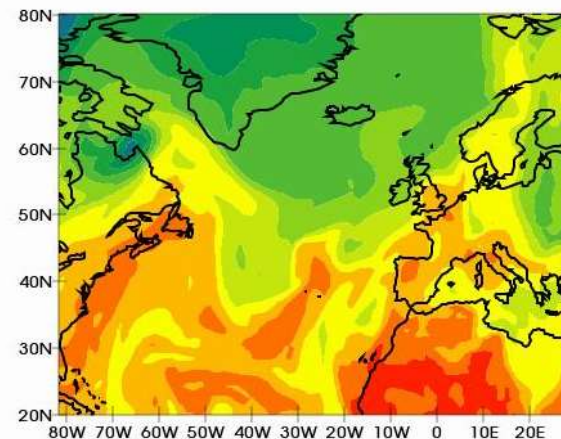
$$\theta_e \approx (T + 2.46 \times 10^3 q) \left(\frac{1000}{p} \right)^{0.285}$$

$$\theta_w \approx 5.114 - 51.489 \left(\frac{\theta_e}{C} \right)^{-1/K_d}$$

- What is the dependence on region/season/catchment type?
- Can we use historical events data?



500 hPa



700 hPa

θ_w surrogate



DIAGNOSTICS UNDER INVESTIGATION

- Integrated Water Vapour (IWV) - when the maximum exceeds the 85% threshold over the UK
- Integrated Vapour Transport (IVT) - when the maximum exceeds the 85% threshold over the UK, no other relevance to ARs
- Theta-e, Theta-w surrogates - the difference between 700hPa and 500hPa as a stability proxy
- Warm moist ascents with a horizontal wind shear at upper levels (500hPa) - exactly how this will be defined is being worked out.
- Reanalysis convective rainfall diagnostic as proxy of large-scale instability?



PLANS

- Complications with AR study and in acquiring 3-hourly rain-gauge data have delayed work – *sorry!*
- Progressing to 3-hourly rain gauge data & additional precursor diagnostics (e.g. dew point & wet bulb potential temperature)
- Finalise and apply set of precursor diagnostics and case studies for initial analysis of atmospheric precursors to extreme rainfall/flooding events using reanalysis datasets and hourly/3-hourly rain gauge data in collaboration with Newcastle → paper
- Plan for further study assessing regional/temporal /catchment characteristic dependence of atmospheric precursors
- Continue to work with Newcastle & partners to collaborate on datasets (hourly rain-gauge data and potentially flooding impacts information), precursor diagnostics and assessing spatiotemporal clustering of events



OUTPUTS/DELIVERABLES

- **Dissemination:** Various talks on SINATRA work (e.g. EMS conference)
- **Outreach:** schools events, talks to general public, development of online courses, twitter, media interviews
- **Additional Activities:**
 - Meetings with FFC, Nigel Roberts and Newcastle to discuss diagnostics
 - 2 MSc projects: daily/hourly rain gauge datasets (inc. link to XL Catlin)

Publications/Reports:

- Champion, A.J., R.P. Allan and D.A. Lavers, (2015) Atmospheric Rivers don't explain UK Summer Extreme Rainfall, Journal of Geophysical Research, 120, 6731-6741, [doi: 10.1002/2014JD022863](https://doi.org/10.1002/2014JD022863)
- Allan, R. P., D. A. Lavers and A. J. Champion (2015), Diagnosing links between atmospheric moisture and extreme daily precipitation over the UK, Int. J. Climatol., in press, [doi: 10.1002/joc.4547](https://doi.org/10.1002/joc.4547).
- Allan R.P. (2015) Scientific Knowledge of Meteorological Drivers of Widespread Flooding, report to JBA/Environment Agency