ST1.3 ATMOSPHERIC PRECURSORS

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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

Allan et al. (2015)
Summer Events

Annual Composites

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)

\[
\theta_e \approx (T + 2.46 \times 10^3 q / p)^{0.285}
\]

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

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

Extreme event? ↔ Atmospheric precursor?
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:**

• Allan R.P. (2015) Scientific Knowledge of Meteorological Drivers of Widespread Flooding, report to JBA/Environment Agency