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Global Hazard Map: Socio-economic Impact Evaluation

UEF2016, 6th-9th June, ECMWF

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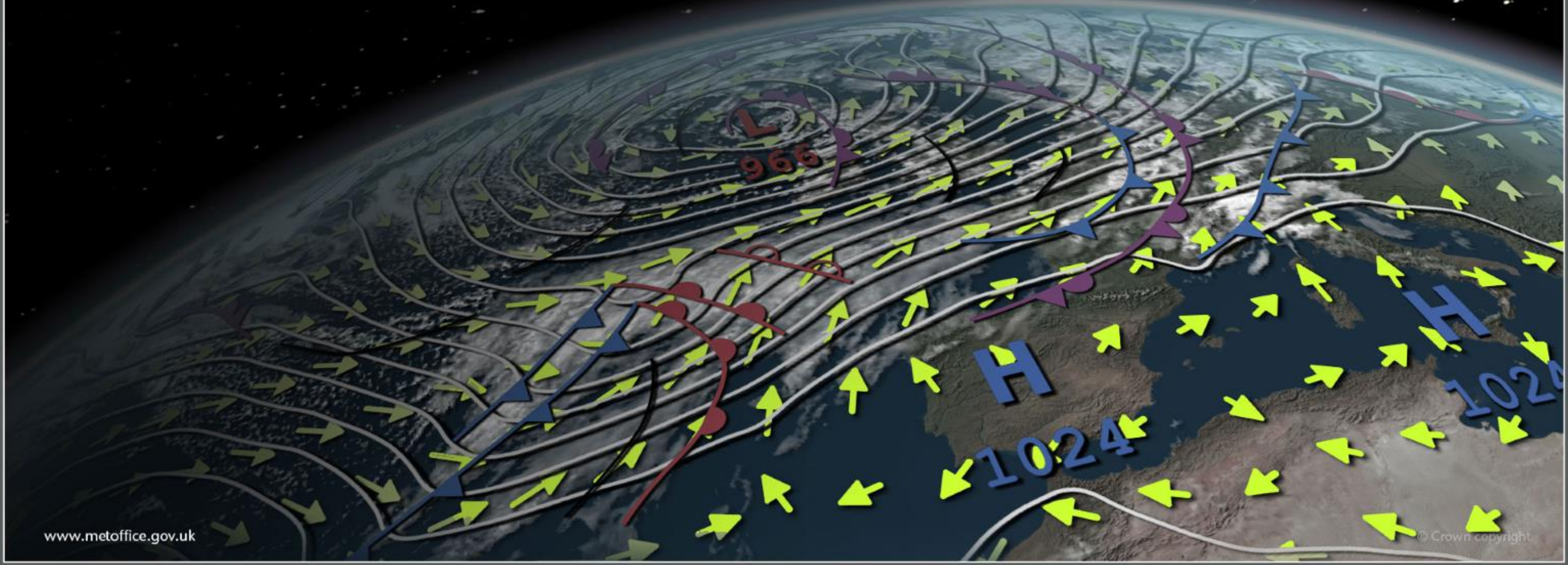
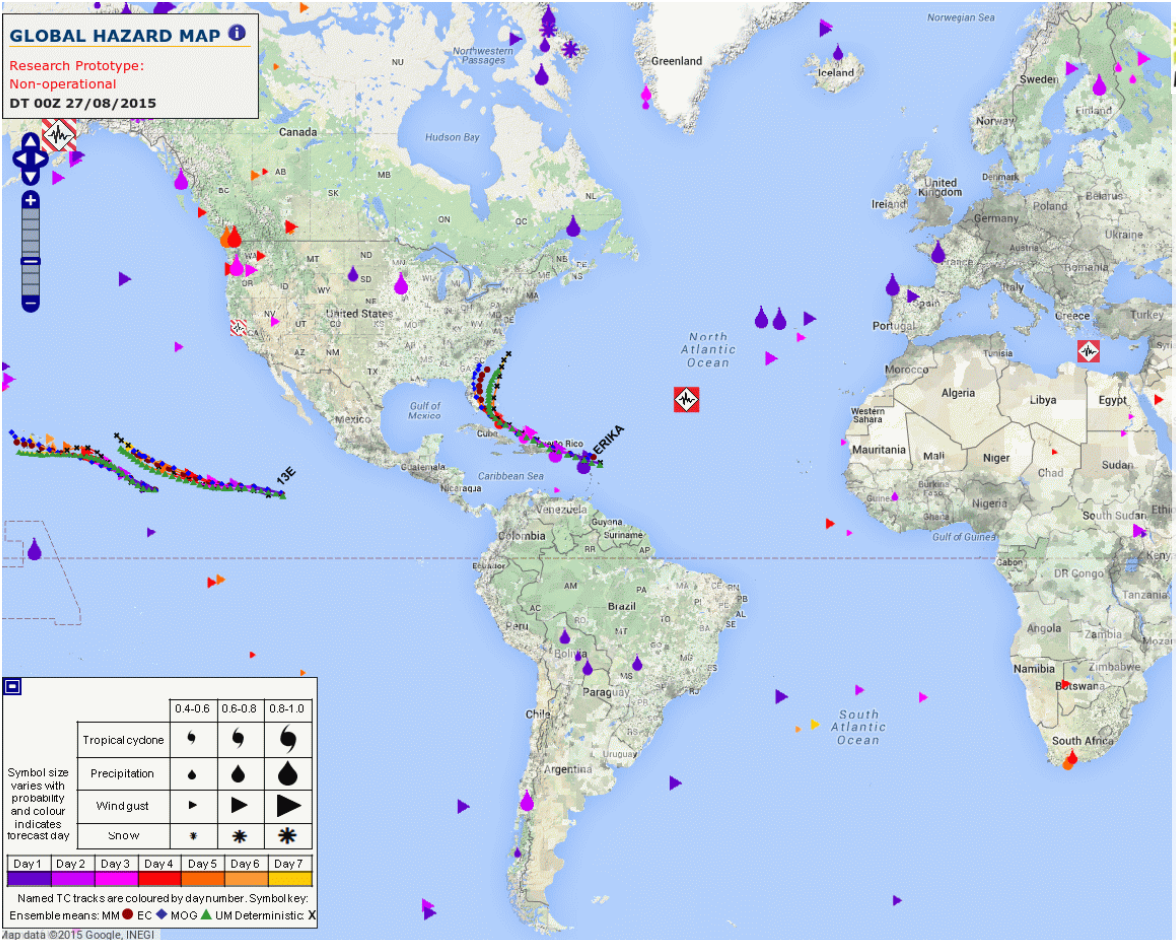


Contents

- What is the Global Hazard Map (GHM)?
- Evaluating GHM performance with relation to socio-economic impact records
    - Forecast layers and high-impact weather events
    - Impact database construction and compilation
    - Dealing with impact database uncertainty
    - Results and future work



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Global Hazard Map

- The "Global Hazard Map" (GHM) aims to summarise the probability of high-impact weather across the globe in the next 7 days
- Web Map Service – easy to overlay info, zoom/pan, flexible format for data layers
- Based on global ensemble forecasts (currently ECMWF ENS and MOGREPS-G)
- Symbol-based summary map, coloured by lead time, gives ‘at a glance’ view of all hazards
- Can then drill down to particular variables / days / models / areas of interest
- For gridded fields forecasts the probability of exceeding the 99th centile of forecast climatology
- Can overlay vulnerability and exposure layers to give information on likely impact
- Includes TC tracks and recent earthquakes

Does GHM capture weather events that lead to socio-economic impact

Aim: assess performance of GHM summary forecast fields in identifying events which resulted in impacts upon communities, infrastructure and businesses

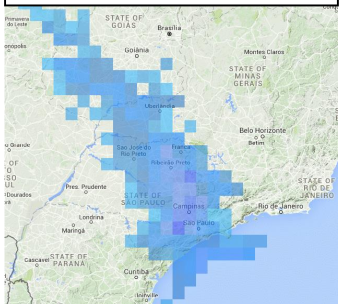
Case study method: comparing single event in space and time against forecasts for the same event

New method: semi-automatic approach for conducting spatial and temporal comparisons between GHM summary forecasts (polygon features) and recorded socio-economic impacts over a historical reference period.

GHM forecast layers and identifying high-impact weather events

ECMWF ENS; MOGREPS-UK; Multi-Model

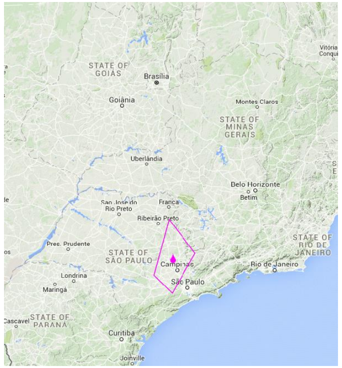
Day 3 forecast from 00Z 09/03/2016



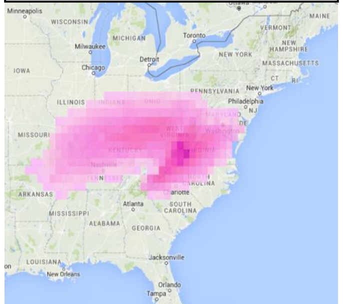
24hr Precipitation Accum.

Probability of 24hr precipitation accumulation exceeding 99th centile of forecast climatology

0.05 0.1 0.2 0.4 0.6 0.8 0.9 0.95



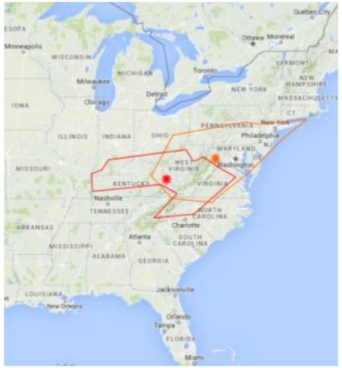
Day 4 forecast from 00Z 19/01/2016



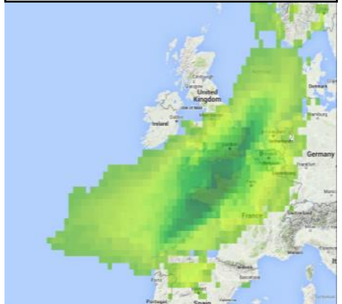
24hr Snowfall Accum.

Probability of 24hr snowfall accumulation exceeding 99th centile of forecast climatology

0.05 0.1 0.2 0.4 0.6 0.8 0.9 0.95



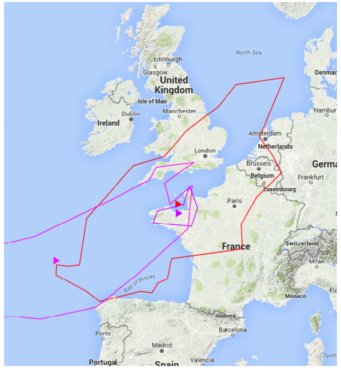
Day 4 forecast from 00Z 25/03/2016



24hr Max. Wind Gust

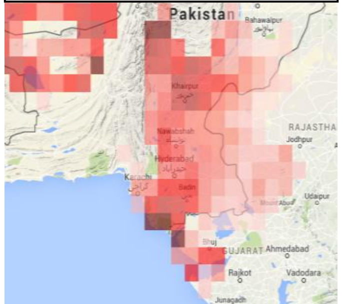
Probability of maximum wind gust exceeding 99th centile of forecast climatology

0.05 0.1 0.2 0.4 0.6 0.8 0.9 0.95



ECMWF ENS only

Day 5 forecast from 12Z 15/06/2015

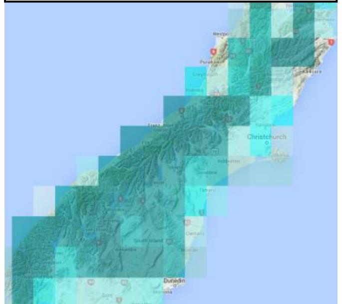


Excess Heat Factor (EHF)

Probability of a heatwave (as defined by the EHF (Excess Heat Factor) methodology)

0.05 0.1 0.2 0.4 0.6 0.8 0.9 0.95

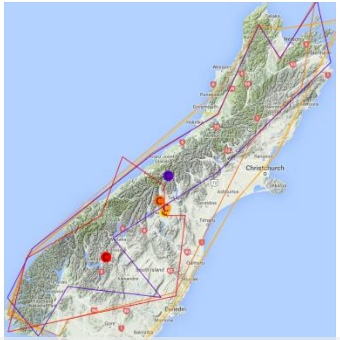
Day 6 forecast from 00Z 15/06/2015



Excess Cold Factor (EHF)

Probability of a coldwave (as defined by the ECF (Excess Cold Factor) methodology)

0.05 0.1 0.2 0.4 0.6 0.8 0.9 0.95



Currently only available in 'Test' version

Method for comparing forecasts with socio-economic impacts

1) Generate historical archive of forecast weather events for specific hazards
   - Archive of all multi-model generated summary polygons for all forecast runs since previous GHM system upgrade
   - Focus on precipitation
2) Construct a database of historical socio-economic impact records for the same reference period and hazard, including geo-spatial reference
3) Assess and capture impact database uncertainty
4) Run comparison between forecast weather events and recorded socio-economic impacts

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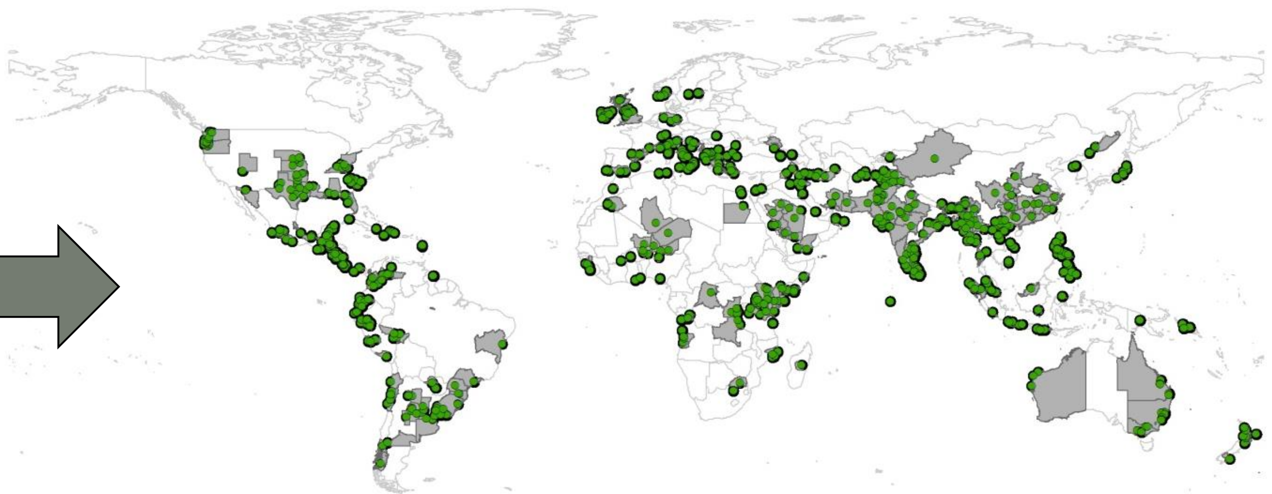
Socio-economic Impact Databases

Heavy Rainfall Database
Spatial_ID (entry ID)
Event_ID (hazard event ID)
Record Date
Start Date
End Date
Hazard Type ('Heavy rainfall')
Trigger/Cause
Secondary Hazards
Hazard Notes
Country Name
Region/State/Province Name
Region/State/Province Latitude
Region/State/Province Longitude
Settlement Name
Settlement Latitude
Settlement Longitude
Impact Information
Impact Categorisation
References

Location of heavy rainfall impacts (February – December 2015)



Between February 8th and December 31st 2015 a total of 261 heavy rainfall events were recorded, resulting in 853 database entries

Public Health England

Global hazards weekly bulletin

Swiss Re

chrome

FloodList

reliefweb

EM-DAT

The International Disaster Database

Centre for Research on the Epidemiology of Disasters - CRED

Impact databases: challenges

- Identifying appropriate data sources for impact information
- Construction with appropriate temporal and spatial information
- Maintenance (real-time v’s retrospective)
- Capturing uncertainty associated with impact records
- Ensuring consistency across a database
- Clear focus on types of impacts being collected (primary hazard impacts v’s impacts associated with primary & secondary hazards; general impact information v’s asset specific impacts)
- Impact categorisation

Method for comparing forecasts with socio-economic impacts

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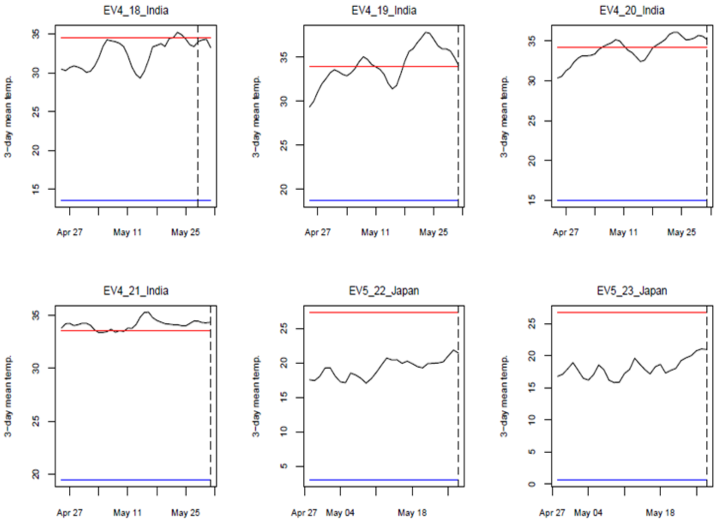
Impact database uncertainty

Options and approaches

Meteorological cross-referencing



Spatial and temporal variability

- Assess spatial uncertainty of the record by categorising the detail of location information available
- Converting impact point locations to areas using Global Administrative Areas (GADM) data – however important to consider which Admin level should be used
- Rules applied to determine heavy rainfall occurrence dates

Can be used to produce an ‘impact-recording uncertainty metric’

Method for comparing forecasts with socio-economic impacts

1) Generate historical archive of forecast weather events for specific hazards

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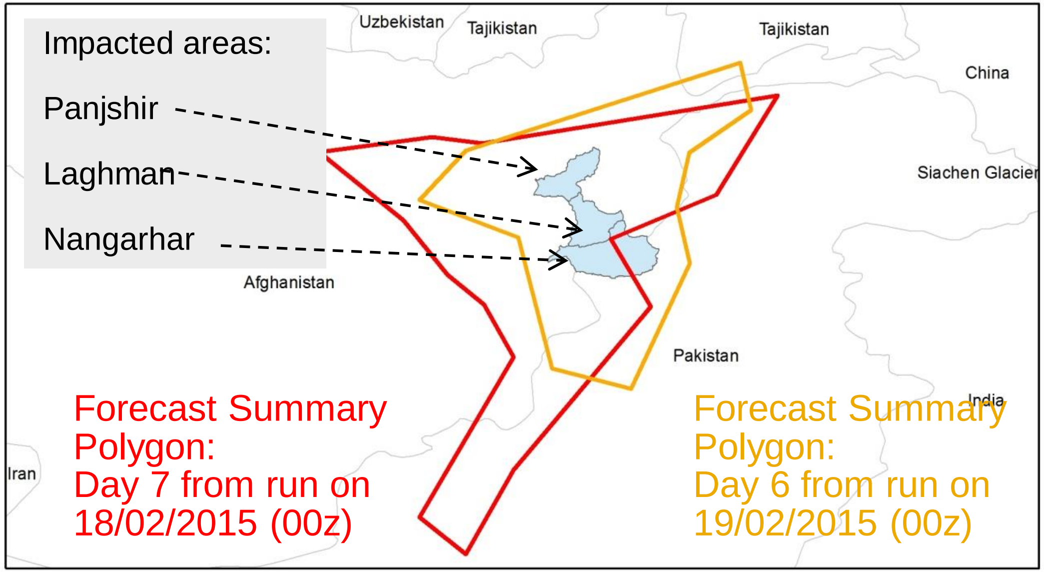
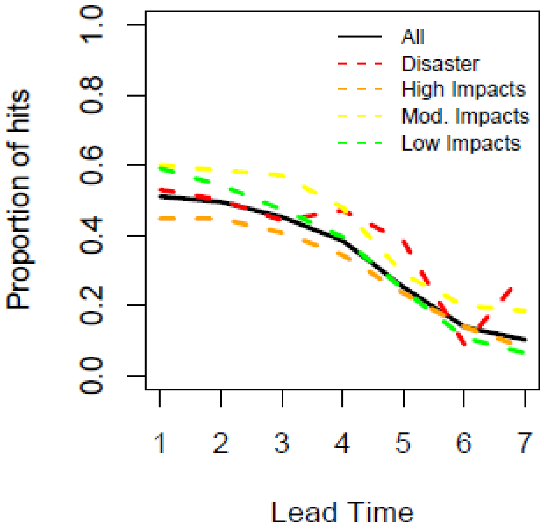
3) Assess and capture impact database uncertainty

4) Run comparison between forecast weather events and recorded socio-economic impacts

Evaluation Results



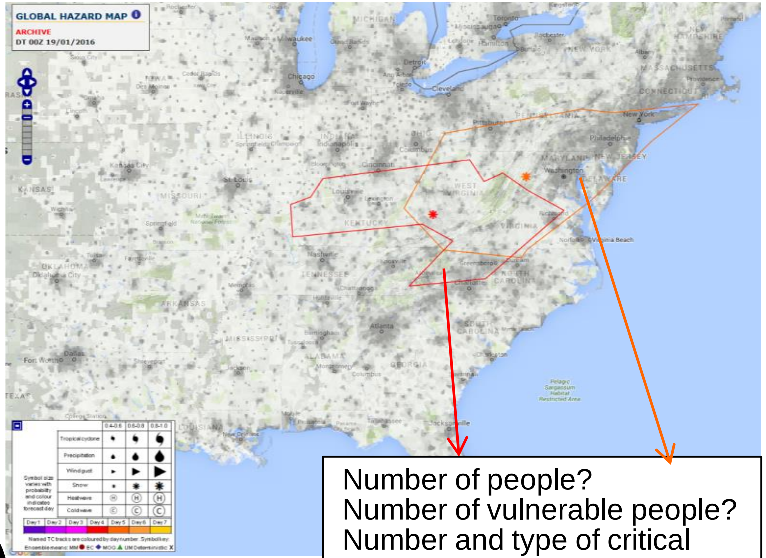
Compare intersects between heavy rainfall impact polygons and GHM forecast precipitation summary polygons, for matching occurrence ('observed') and validity ('forecast') dates



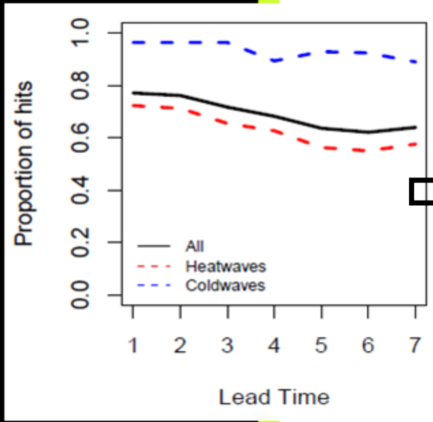
- forecasting climatological extremes is challenging, with uncertainly quickly growing with lead time
- impacts triggered by convective rainfall may not be captured
- heavy rainfall impacts are largely associated with secondary impacts
- 24hr precipitation is only one component contributing to observed impacts

Ongoing/Future work

1. Alter probability thresholds used to generate summary polygons
2. Look at methods to assess false alarms
3. Apply methodology to other hazards (e.g. heatwaves and coldwaves)



Number of people?
Number of vulnerable people?
Number and type of critical infrastructure?
Estimated losses?



comparing intersects between heatwave and coldwave impact polygons and GHM forecast heatwave and coldwave summary polygons, for matching occurrence ('observed') and validity ('forecast') dates.

4. Review drivers of high-impact events both meteorologically and socially
5. Investigate application of social media for impact database generation in real-time

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Questions?