



# **EUropean CLimate and weather Events: Interpretation and Attribution**

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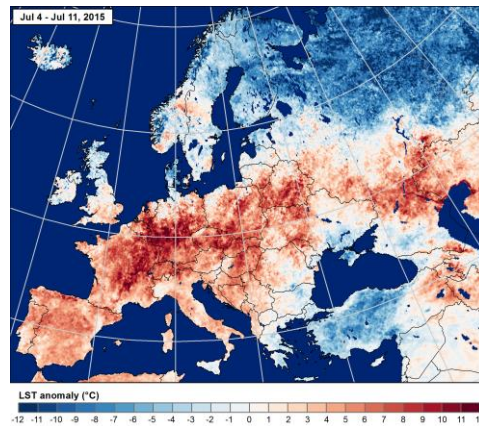
Brussels, Thursday 29 September 2016



- What is the link between recent extreme weather events and anthropogenic climate change and natural climate variability?
- Do we need to adapt to a greater frequency of such events in future or not?



**Cold winters, 2009, 2010**



**Heatwave, Summer 2015**

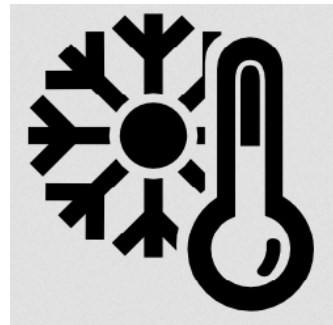


**Floods, Summer 2016**

- 3 year project under the FP7-SPACE Call, started January 2014.
- Brings together 11 European partners.
- Demonstrate the potential for operational attribution systems.
- Evaluate their potential via a set of test cases prototyped with targeted users.

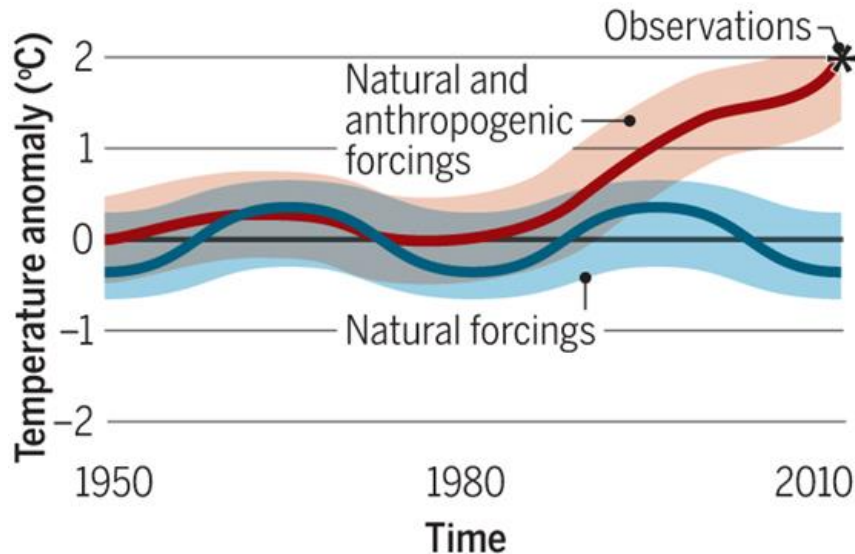
## TEST CASES:

- ☐ Heat waves
- ☐ Cold spells
- ☐ Droughts
- ☐ Floods
- ☐ Storm surges



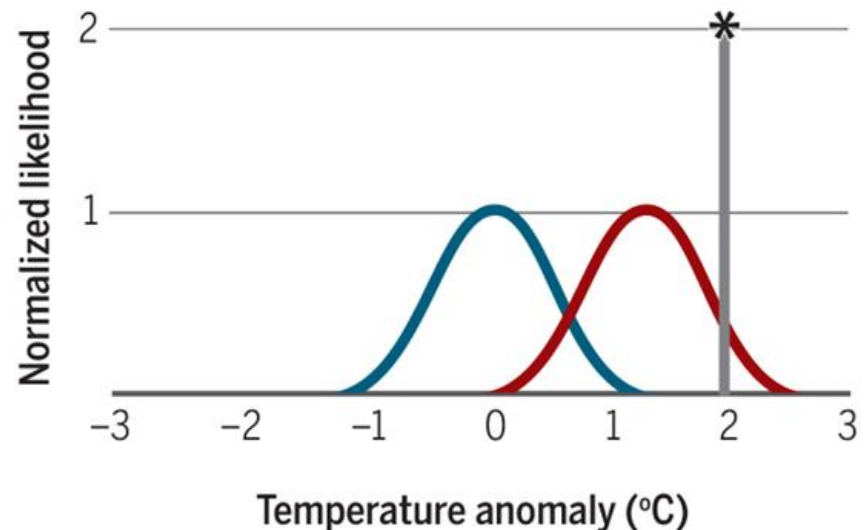
## Observed and modeled temperature changes

Scientists compare changes in observed temperatures to modeled temperatures with or without human influence on climate.

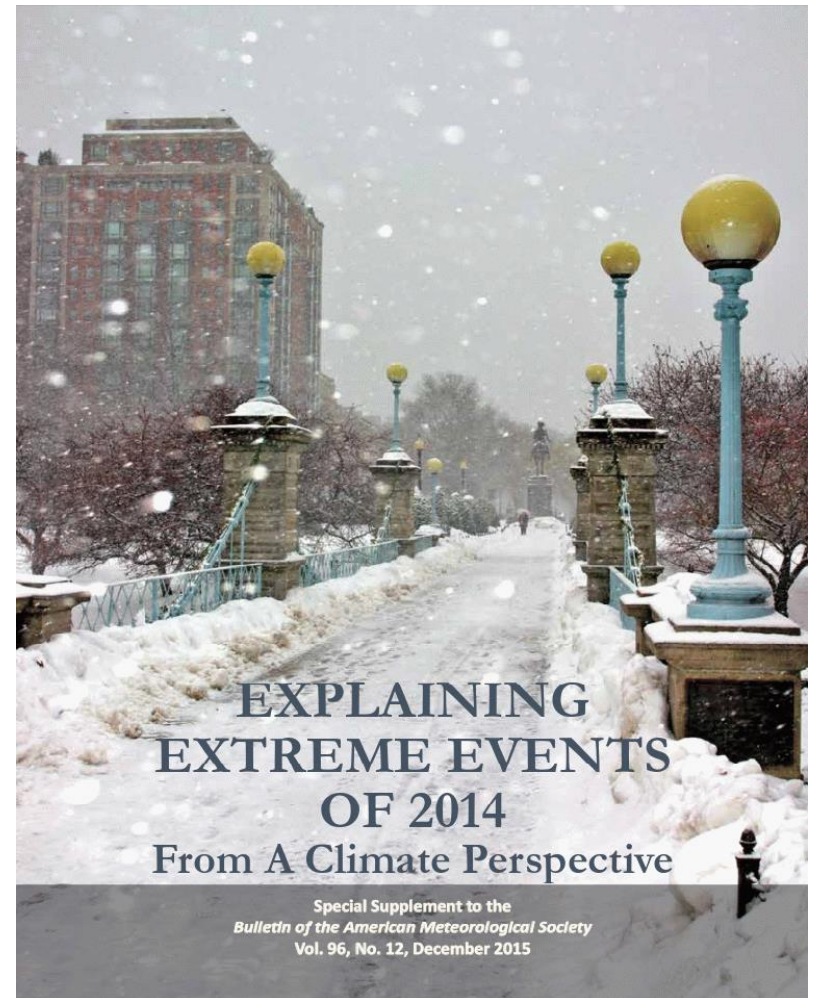


## Distribution of possible temperatures

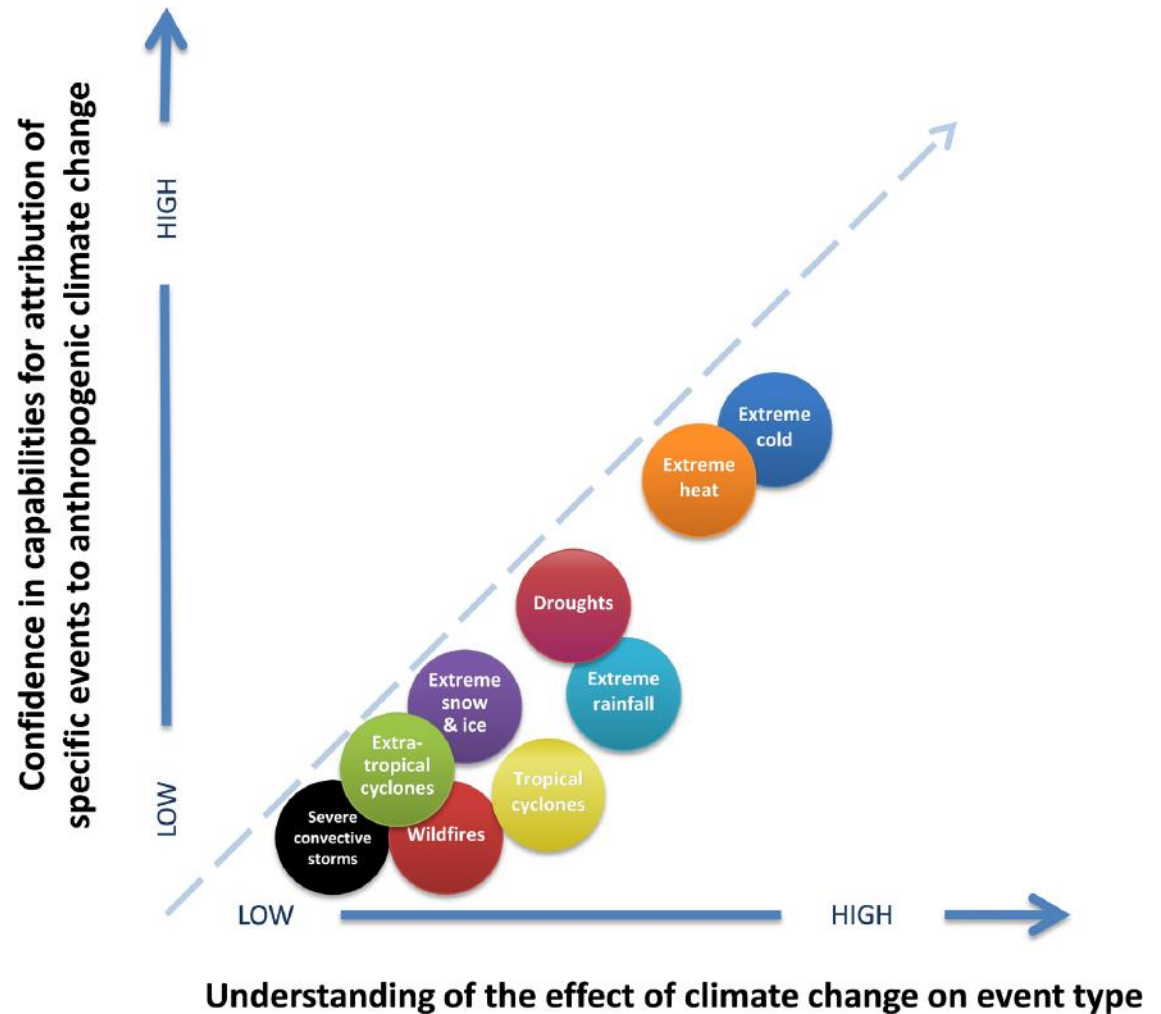
They use this comparison to assess how likely the observed temperatures are with and without human-induced climate change.



- Substantial input to BAMS annual reports explaining extreme events of previous year from a climate perspective



- Substantial input to National Academy of Sciences report on event attribution



## WMO statement on the status of the global climate in 2014



World  
Meteorological  
Organization  
Weather · Climate · Water

WMU-No. 1152

## Event attribution: an application to the global and United Kingdom record temperatures of 2014

*Reference: Christidis, N., P.A. Stott and F.W. Zwiers, Fast-track attribution assessments based on pre-computed estimates of changes in the odds of warm extremes. Climate Dynamics, 2015 (online early-view). Authors: Nikos Christidis, Peter Stott*

Detection and attribution studies have demonstrated that human influence on the climate has been a main driver of the unequivocal warming of the global climate system observed since the 1950s, according to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Human influence has also led to significant regional temperature increases at the

continental and subcontinental scales. The temperature distribution of the UK record of 2014 lies within both distributions, albeit more to the extreme warm tail of the green distribution (Figure 15 (b)). The UK distributions are broader and overlap to a greater extent because natural variability is higher relative to the attributed anthropogenic changes at this smaller scale. At a

may have changed the chances of events in a general case, that is, irrespective of the specific conditions at the time of the event under consideration, until more thorough slow-track investigations become available. A fast-track attribution methodology was published last year by scientists of the Met Office Hadley Centre in the United Kingdom based on pre-computed tables of the change in the likelihood of temperature extremes. Tables can be constructed for any region of the world and are available for the study of both annual and seasonal temperature extremes.

The methodology comprises three steps. First,

global scale, the relative contribution of the anthropogenic component is much larger, and thus the distributions overlap hardly at all. It is estimated that human influence has increased the likelihood of the observed record-breaking temperatures in the United Kingdom by a factor of ten.

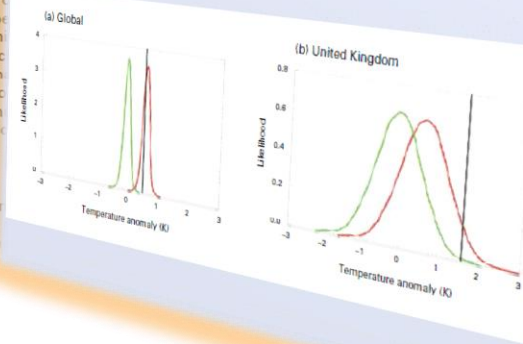
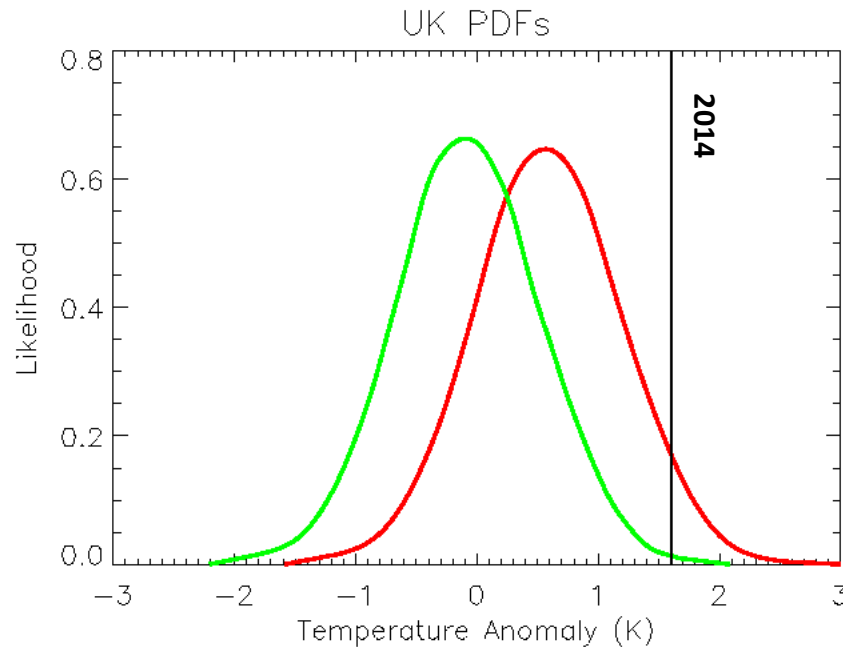


Figure 15. Distributions of (a) global mean and (b) UK mean annual temperature anomalies relative to 1961–1990 from the fast-track attribution methodology with (red line) and without (green line) the effect of human influence on the climate; the temperature records of 2014 are represented by the black vertical lines.

## Application: The record UK temperatures of 2014



Human influence on climate has made breaking the current UK temperature record about ten times more likely

Met Office press release, January 2015

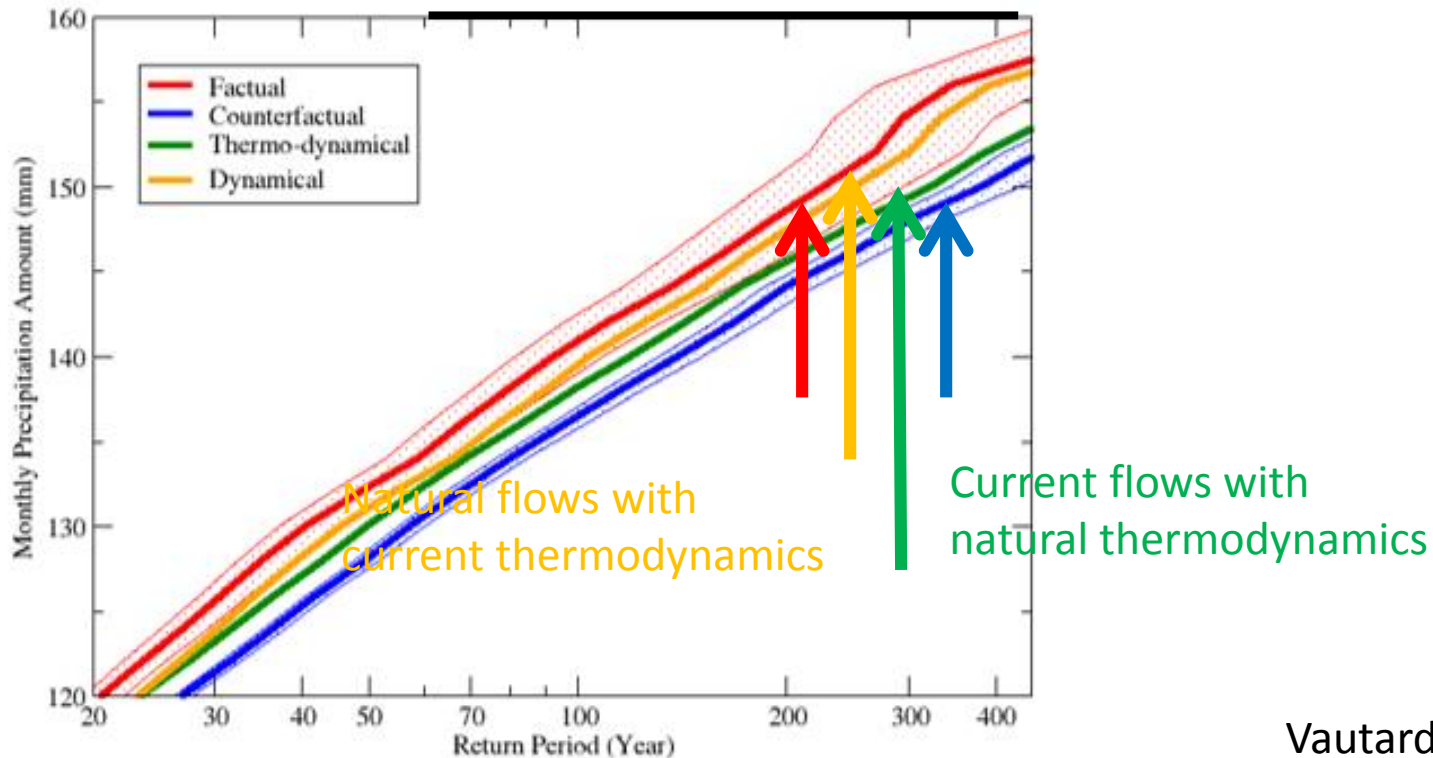
WMO Annual Statement, No 1152, March 2015





# On-going research to develop new methods

## Flooding UK January 2014



Vautard et al., 2016, ERL

## Which aspects have become operational or quasi-operational?

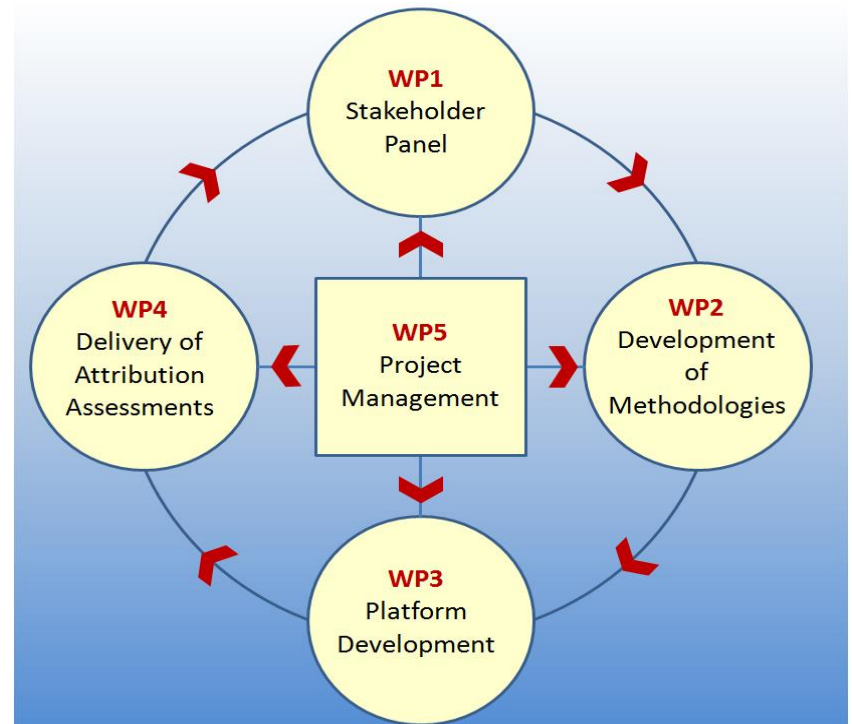
- “Quasi-operational” event attribution capability for extreme temperature events
  - KNMI fast track operational analyses envisaged by end of year
  - Met Office seasonal analyses using coupled and atmosphere only models



# Which products/services still require development work?

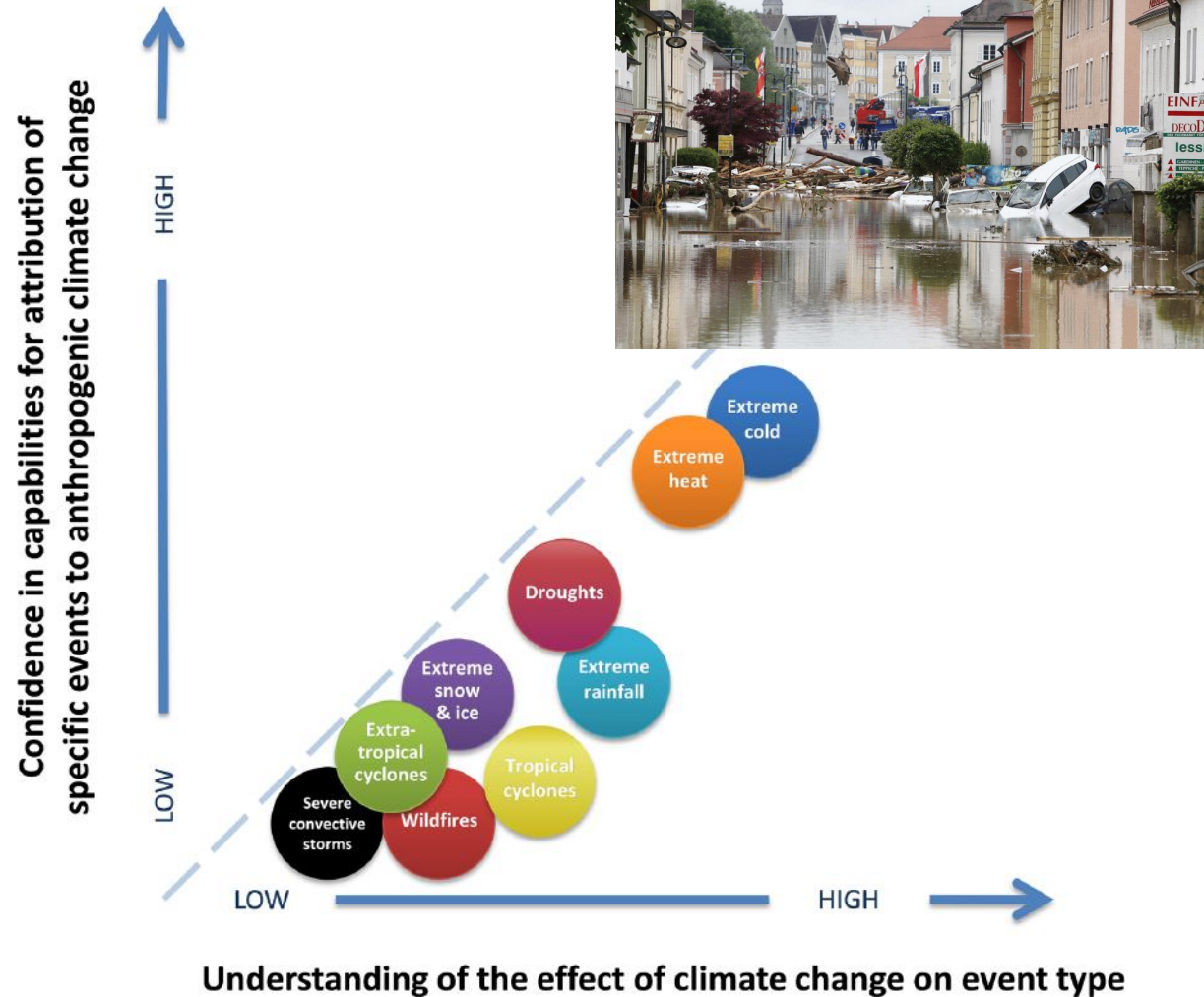
- Event attribution capability for a wider variety of weather and climate events
  - Fast track analysis of extreme rainfall events
  - Seasonal analyses of unusually dry/wet seasons
  - Impacts including flooding, drought

- EUPHEME
- Proposal under ERA4CS
- Multiple methods
- Develop scientific platform to allow user-oriented synthesis of assessments



# Further research needs

- Develop capability to attribute wider variety of events including windstorms, extreme rainfall events etc
- Develop capability to attribute impacts including floods, economic effects, health, etc
- Better understand user applications



- ❖ **WP1,2 (Peter Stott, Met Office)**  
Management and scientific coordination
- ❖ **WP3 (Pete Walton, Oxford)**  
Stakeholder User Panel
- ❖ **WP4 (Hans von Storch, HZG)**  
Stakeholder Engagement
- ❖ **WP5 (Myles Allen, Oxford)**  
Methodologies / Framing Issues
- ❖ **WP6 (Robert Vautard, CNRS CEA)**  
Evaluation & Diagnostics
- ❖ **WP7 (Geert Jan van Oldenborgh, KNMI)**  
Targeted Test Cases
- ❖ **WP8 (Nikos Christidis, Met Office)**  
Near-real time attribution service



# Highlights of progress

- Substantial input to BAMS annual reports explaining extreme events of previous year from a climate perspective
- Substantial input to National Academy of Sciences report on Extreme Weather Event attribution
- Development of methods
  - Statistical based on observations
  - Pre-computed assessments using coupled model runs
  - Seasonally updated assessments using state of the art climate model forced with observed SSTs
  - Analogue methods that partition changes between dynamic and thermodynamic drivers
- Development of systems
  - Fast track
  - Seasonal timescale
- Better understanding of user needs

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# Lessons learned

- Transparency
  - It should be possible to trace route from press release to source material that allows user to understand how the result was obtained
  - This is particularly important when multiple methods have been synthesised
- Layering
  - Tailoring to different decision frameworks requires bi-directional communication between providers and users
  - For event attribution for Europe need to develop a (back office) scientific platform which will enable cross European coordination and synthesis and will allow the delivery of user-oriented assessments (shop window)
  - EUPHEME proposal under ERA4CS call
- Disclosure
  - Emphasise what we understand (qualitative)
  - Be open with uncertainties (which we may not fully quantify)
  - Communicate carefully how further research might affect current results

1. Derive requirements from targeted user groups
2. Develop methods for event attribution including development of experimental designs and clear ways of framing
3. Identify key processes driving extreme events and develop methodologies for representing level of confidence in attribution results
4. Demonstrate the utility of the attribution system on a set of test cases of European weather and climate extremes
5. Deliver quasi-operational attribution assessments on a range of timescales in the aftermath of extreme events

