

# Ensemble Exploitation Strategic Action

Rose Jones<sup>1</sup>, Rosa Barciela<sup>2</sup>, Paul Davies<sup>3</sup> and Jon Petch<sup>4</sup>

<sup>1</sup>Services Research and Innovation Manager (Services)

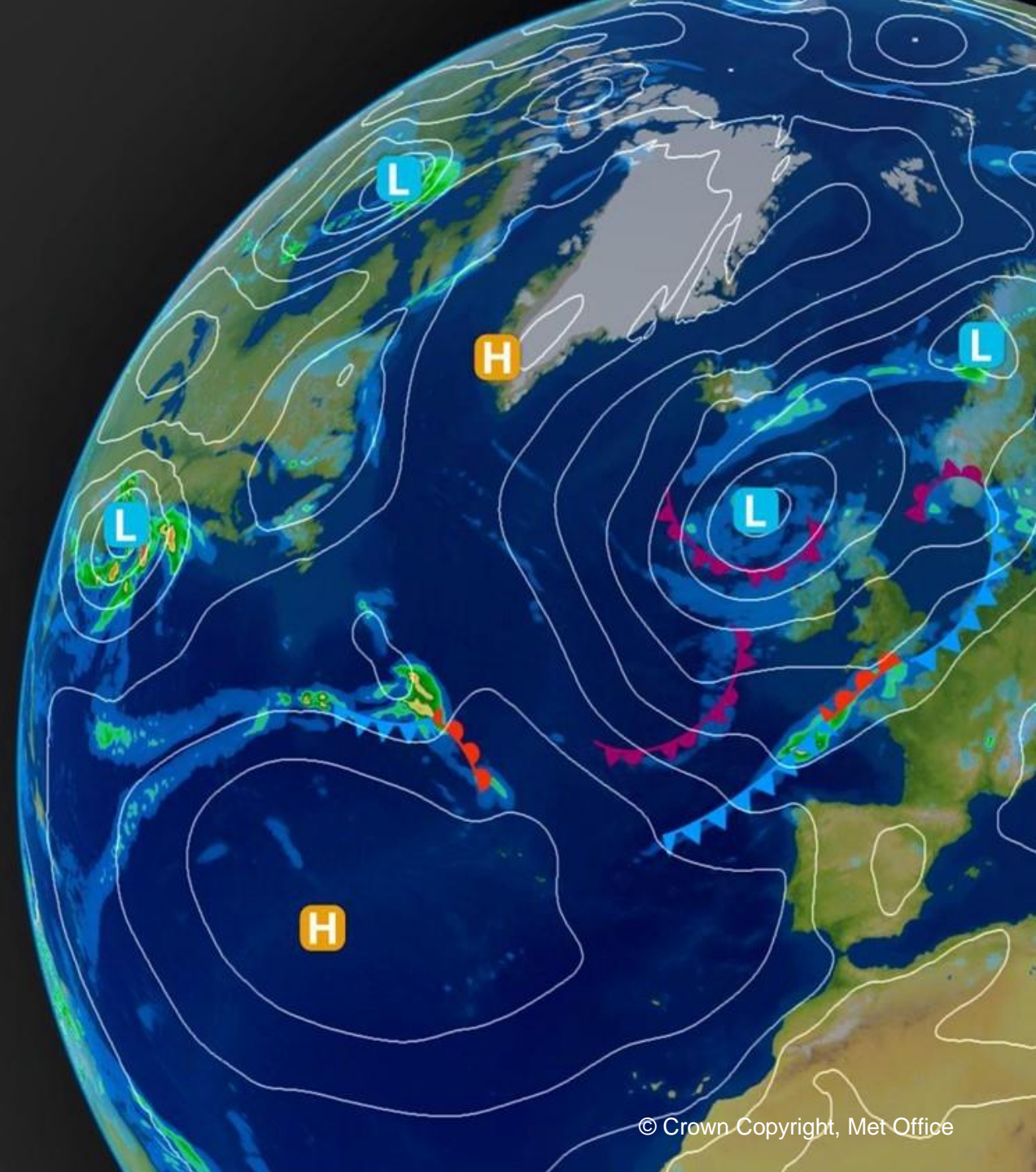
<sup>2</sup>Head of Ensemble Exploitation (joint post in Services and Science)

<sup>3</sup>Principal Fellow Weather & Climate Extremes Unit (Services)

<sup>4</sup>Associate Director of Weather Science

Mike Gray, Teil Howard, Ken Mylne, Chiara Piccolo, Nigel Roberts,  
Patrick Sachon, David Walters, Oak Wells, Keith Williams, Steve  
Willington and teams across MO Science and Services

MOSAC paper 27.14, 18<sup>th</sup> January 2023

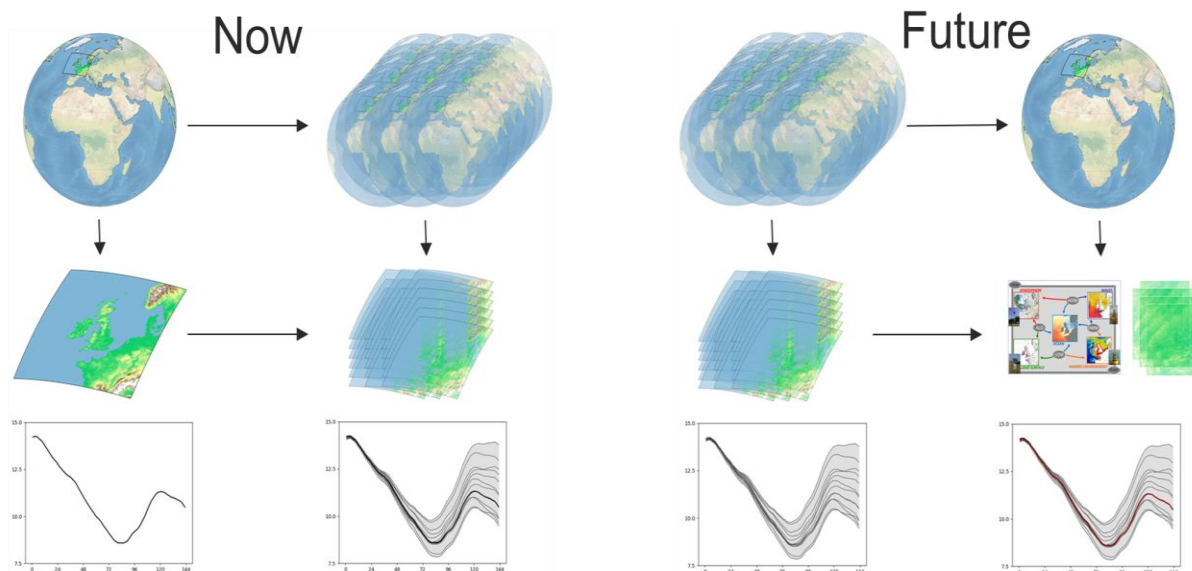


# Overview

- Vision
- Rationale
- Goals and plans
- Progress so far
- Summary

*We are **already** using ensembles but want to **fully exploit and extract maximum value** from our **NWP-based ensemble systems**, for underpinning all our **services**, in order to support users and customers in their **decision-making**, particularly in terms of **risk** of high **impact** weather events by ...*

## Ensembles at the heart of what we do



1. *Increasing the number of forecasts products and services exploiting ensembles.*
2. *Engaging with customers to exploit, and make more use of, our ensembles.*
3. *Developing our models to recognise user requirements and how ensembles are being used .*
4. *Provide a common language.*
5. *Changing the culture.*

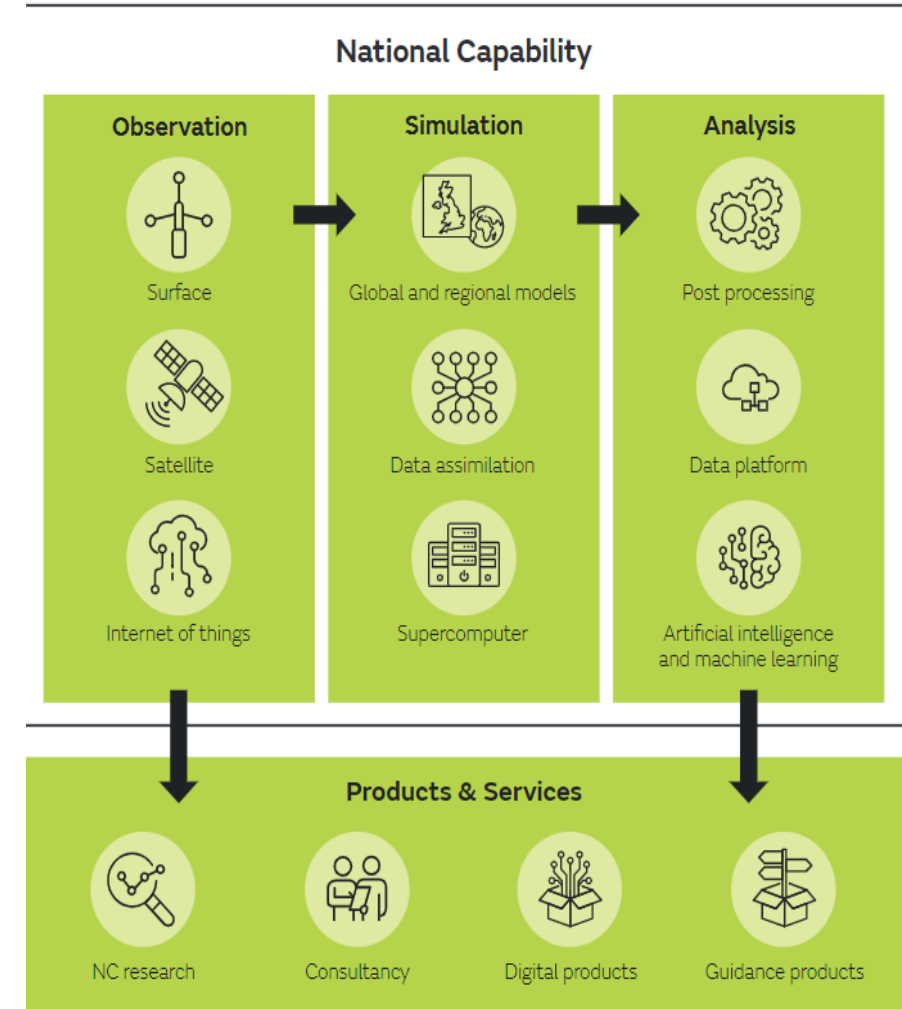
## What are we thinking about here

### We want to move away from deterministic first solutions because:

- It's complex and costly to develop deterministic forecasts as the basis for creating an ensemble.
- There is untapped value in our ensembles (<5% of automated products use them).

### Benefits of using ensembles include:

- Increased predictability, reduced costs and complexities.
- Releasing the value of probability and risk to capture more extreme outcomes.
- Products and services fully exploit the value of our National Capability.



## The current things that need to be better

### All automated products

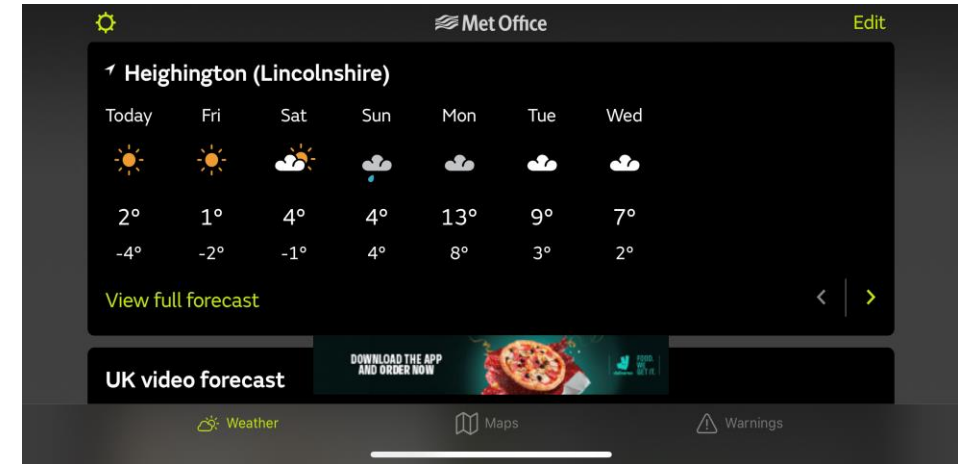
- Only 5% of our automated products use ensemble data, there is untapped benefit!
- The **Web and app** currently displays deterministic symbol, even when we know uncertainty is high. This symbol changes run-run and reduces user confidence, we need to harness the value of probability.

### National Severe Weather Warning Service (NSWWS)

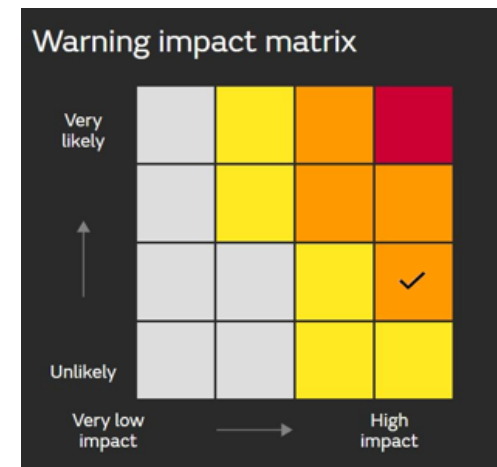
- NSWWS is a likelihood vs impact matrix, and it's our main route to communicate national safety, currently developed from a deterministic-first process.
- An amazing tool to showcase the value of ensembles, using automation in first guess outputs, alerts and data recommendations.

### Our process for making a forecast

- Change our meteorologists' processes from deterministic first, to ensemble first.



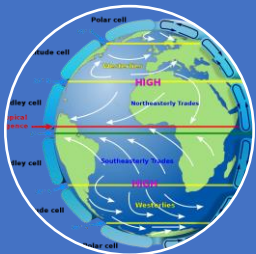
Met Office App Screenshot



NSWWS Matrix

## Areas of work

### 5. Communicating our work and thought leadership



2. Ensemble  
Development



3. Developing our tools,  
processes and people



4. Engaging and  
supporting our users

### 1. Underpinning research

**WP1:** Nigel Roberts & Steve Willington

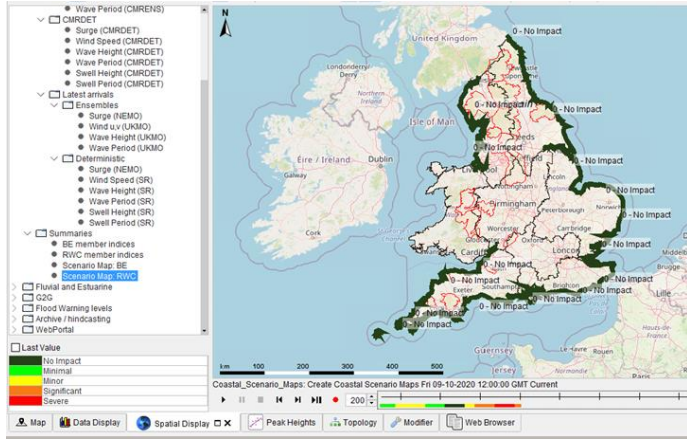
**WP2:** Chiara Piccolo & Keith Williams

**WP3:** Mike Gray & Ken Mylne

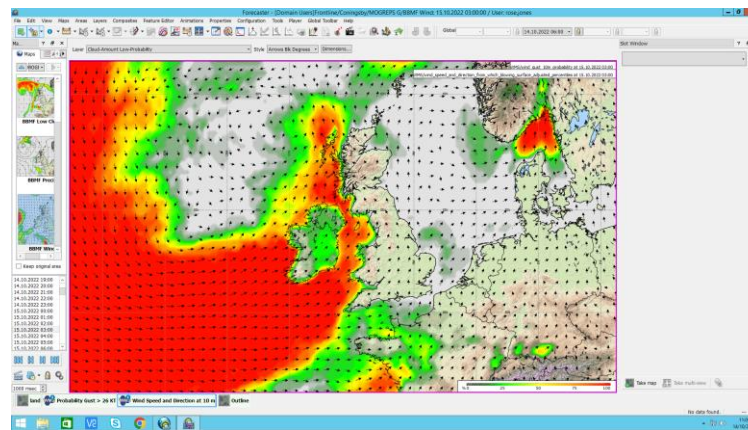
**WP4:** Teil Howard & Patrick Sachon

**WP5:** Oak Wells & David Walters

- Some early success

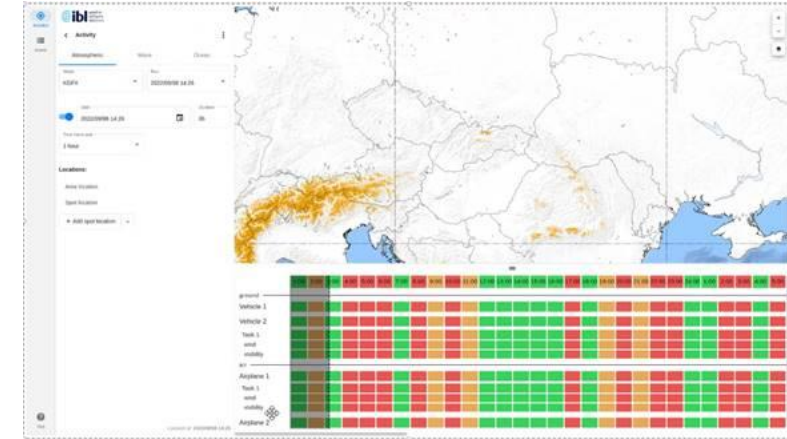


**Ensemble-driven flood decision tools.** This example shows the Realistic Worst Case forecast of coastal conditions in the Bristol channel from Storm Eunice in Feb 2022. This showed a very low likelihood of severe coastal flood impacts from four days ahead, giving responders time to plan and prepare. In the end, the strongest winds narrowly missed the time of high tide and impacts were avoided.



**Met Office issued planning products.**

The Met Office issues planning forecasts for a wide range of users, typically 1-2 weeks ahead (civil aviation, military, roads etc). These planning products often display a risk of a significant threshold occurring, which is generated from meteorologist insight. Some initial planning products have been re-developed to exploit ensemble data, with huge success in the integrity of the data delivered, and in our resulting ability to free our meteorologists to add value and impact guidance to the meteorology.



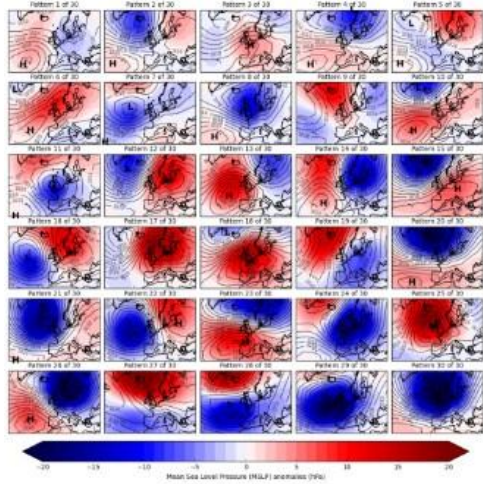
**Newly developed tools to exploit our ensembles.**

The Military MetOc Visualisation Hub (MMVH) is a web-based tool developed for the British military to ensure access to meteorological data, even with bandwidth limitations. We have been able to use our ensemble data stored in the cloud, to generate probabilistic planning matrices, risk matrices, and probabilistic route-planning guidance available for any location at the click of a button. This was developed in collaboration with our military users, to ensure the output met their requirements.

- Some early success

## The value of Decider in anticipating changes in regimes

Met Office



Predominantly high-pressure dominating types throughout July with no sudden transitions in large-scale regime

Day	Month	Weather pattern	Day	Month	Weather pattern
1	July	1	1	August	2
2	July	10	2	August	2
3	July	10	3	August	4
4	July	13	4	August	13
5	July	13	5	August	13
6	July	13	6	August	18
7	July	13	7	August	6
8	July	18	8	August	6
9	July	18	9	August	12
10	July	6	10	August	10
11	July	12	11	August	6
12	July	10	12	August	6
13	July	10	13	August	5
14	July	13	14	August	11
15	July	3	15	August	11
16	July	3	16	August	1
17	July	12	17	August	10
18	July	3	18	August	2
19	July	2	19	August	2
20	July	3	20	August	2
21	July	6	21	August	4
22	July	9	22	August	2
23	July	5	23	August	5
24	July	7	24	August	7
25	July	14	25	August	6
26	July	1	26	August	6
27	July	3	27	August	9
28	July	5	28	August	27
29	July	12	29	August	27
30	July	10	30	August	17
31	July	10	31	August	17

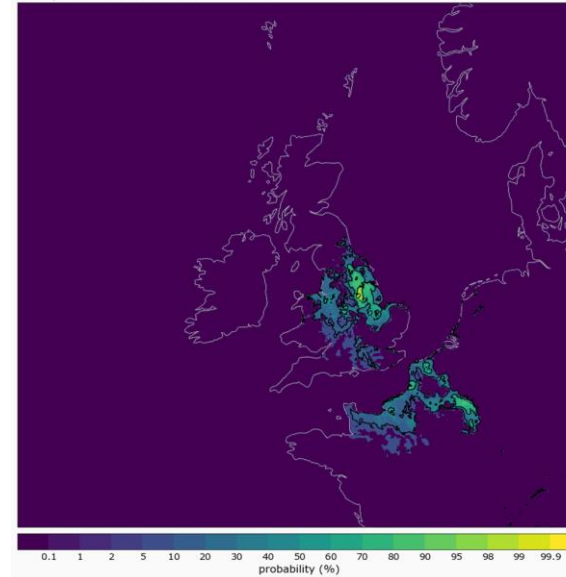
Temporary transition to more unsettled types in mid-August

Easterly dominating high-pressure types at the end of August

Observed weather patterns in July and August (Based on the 1200 UTC Met Office Global Model analysis)

## Extreme Heat Summer 2022 – IMPROVER vs NSWWS

Probability of Temperature at Screen Level Daytime Max > 40 °C 12 hr  
Valid at 2100 UTC on Tue 19/07/2022  
IMPROVER Multi-Model Blend  
Last Updated at 0715 UTC on Sun 17/07/2022



**Amber warning Extreme Heat**

Impact: Medium likelihood of medium impacts

**Red warning Extreme Heat**

Between 00:00 Mon 18 Jul 2022 and 23:59 Tue 19 Jul 2022

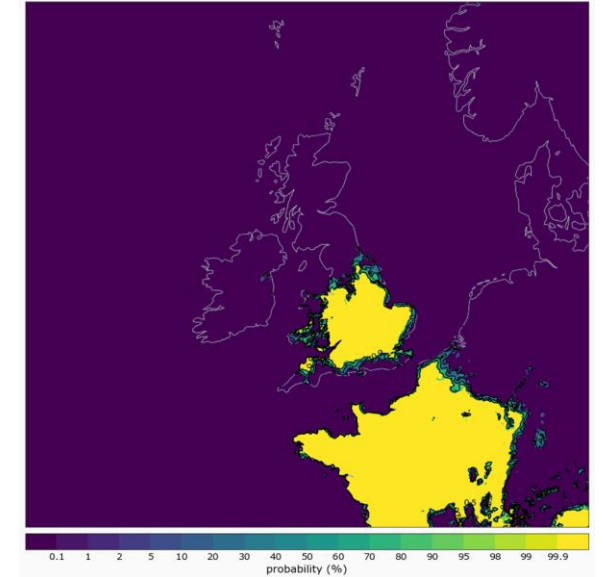
An exceptional hot spell on Monday and Tuesday leading to widespread impacts on people and infrastructure.

What to expect

- Population-wide adverse health effects experienced, not limited to those most vulnerable to extreme heat, leading to serious illness or danger to life. Government advice is that 999 services should be used in emergencies only; seek advice from 111 if you need non-emergency health advice.
- Substantial changes in working practices and daily routines will be required.
- High risk of failure of heat-sensitive systems and equipment, potentially leading to localised loss of power and other essential services, such as water or mobile phone services.
- Significantly more people are likely to visit coastal areas, lakes and rivers, leading to an increased risk of water safety incidents.
- Delays on roads and road closures, along with delays and cancellations to rail and air travel, with significant welfare issues for those who experience even moderate delays.

Impact: High likelihood of high impacts

Probability of Temperature at Screen Level Daytime Max > 34 °C 12 hr  
Valid at 2100 UTC on Mon 18/07/2022  
IMPROVER Multi-Model Blend  
Last Updated at 0600 UTC on Mon 18/07/2022



**Amber warning Extreme Heat**

Impact: Medium likelihood of high impacts

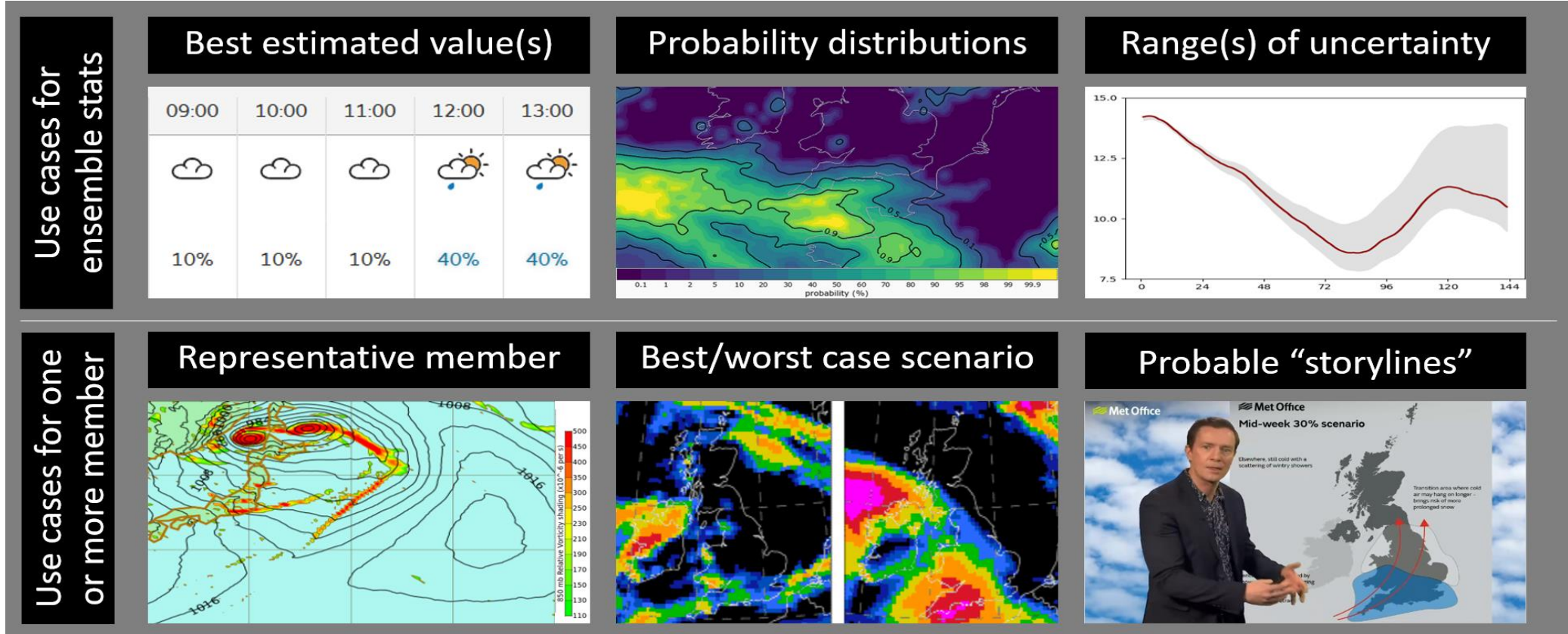
Between 00:00 Sun 17 Jul 2022 and 23:59 Sun 17 Jul 2022

Some exceptionally high temperatures are possible during Sunday and could lead to widespread impacts on people and infrastructure.

What to expect

- Population-wide adverse health effects are likely to be experienced, not limited to those most vulnerable to extreme heat, leading to potential serious illness or danger to life. Government advice is that 999 services should be used in emergencies only; seek advice from 111 if you need non-emergency health advice.
- Substantial changes in working practices and daily routines likely to be required.
- Significantly more people are likely to visit coastal areas, lakes and rivers leading to increased risk of water safety incidents.
- Delays on roads and road closures are possible, along with delays and cancellations to rail and air travel, with potential for significant welfare issues for those who experience even moderate delays.



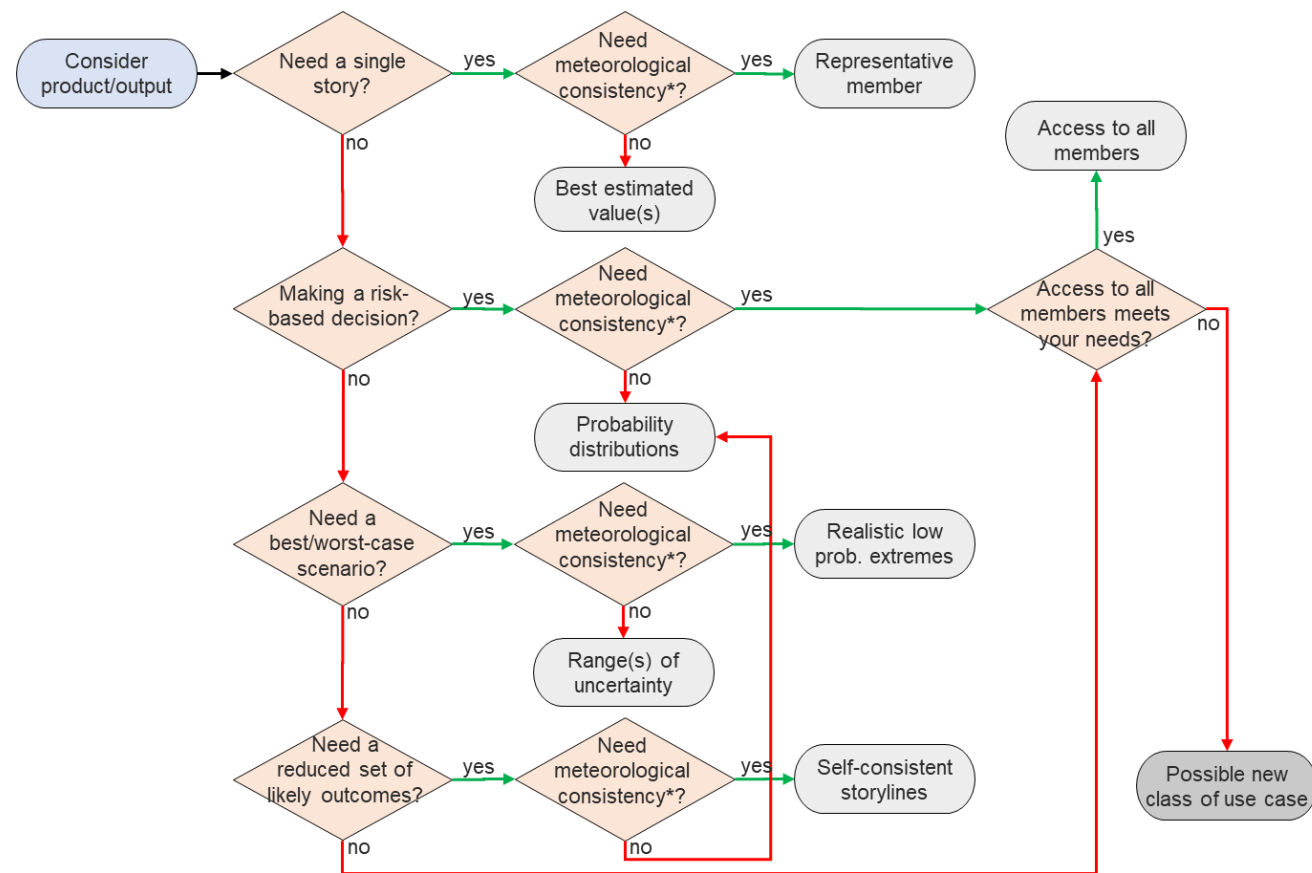


**Other use cases require access to all individual ensemble members**

Here is an excellent example of making good use of ensembles to present an interesting but uncertain 10-day forecast: <https://www.youtube.com/watch?v=n4AftPNhBe4>

## • Collaborative opportunities

- International engagement with other NMSs on exploitation of ensembles.
- National engagement with academia:
  - Reading University (e.g. MOAP RAP on ensembles exploitation theme)
  - Leeds University (e.g. test beds)
- Joint academia - user engagement (e.g. Newcastle University)
- Customer engagement



# Discussion

