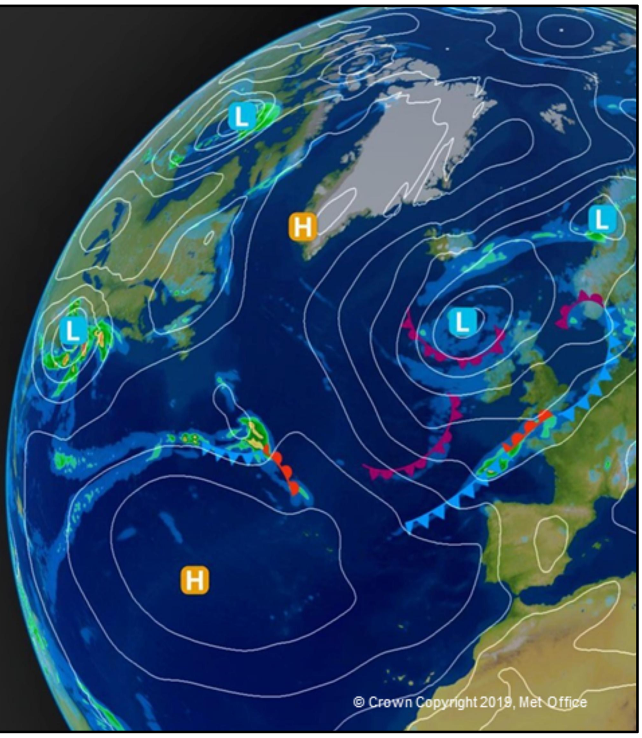
Met Office

Precipitation scenarios for hydrology

ENC April 2019, Madrid

Stephen Moseley, Caroline Sandford

Thanks to: Nigel Roberts



www.metoffice.gov.uk

Met Office

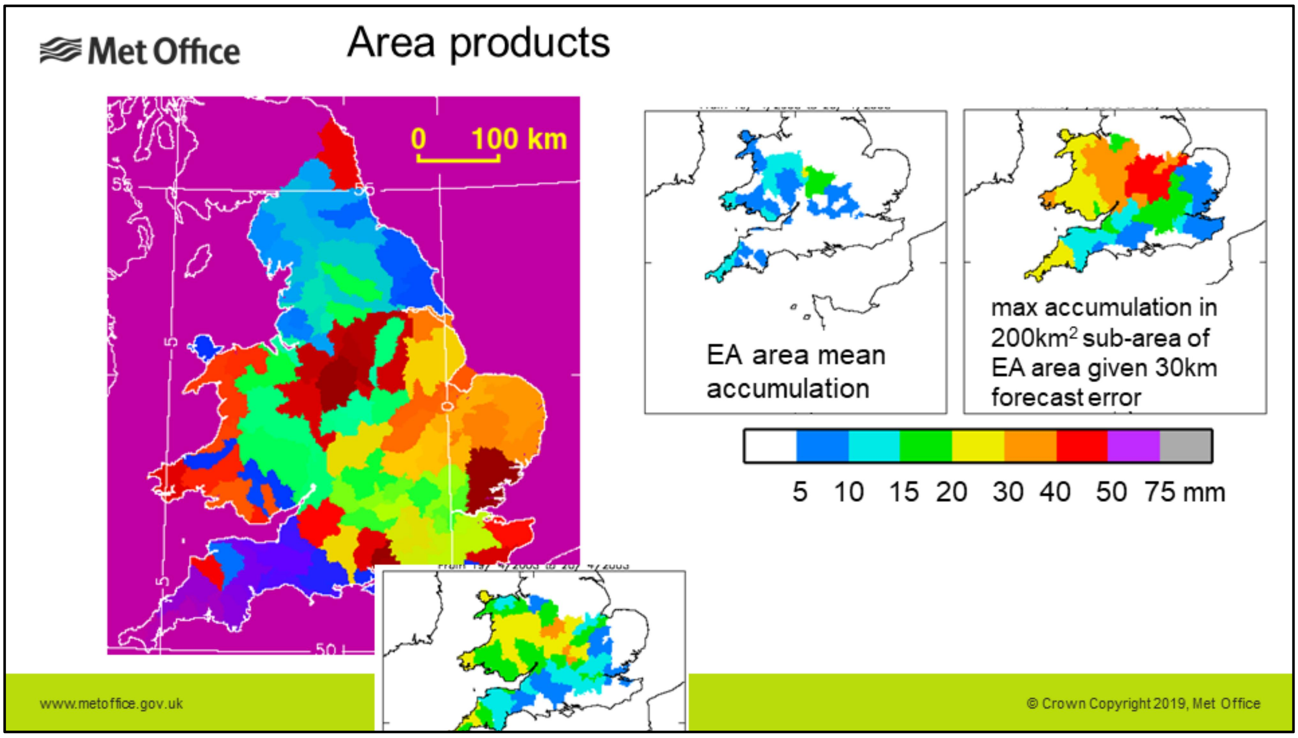
BACKGROUND –
What are we trying to achieve?

Hourly-cycling NWP with 4D-VAR has taken away the need for a complex nowcast system. Verification scores beat nowcast by 45 to 90 minutes (depending on weather type).

We are working to replace our complex nowcast (STEPS) using a simple advection-only deterministic nowcast.

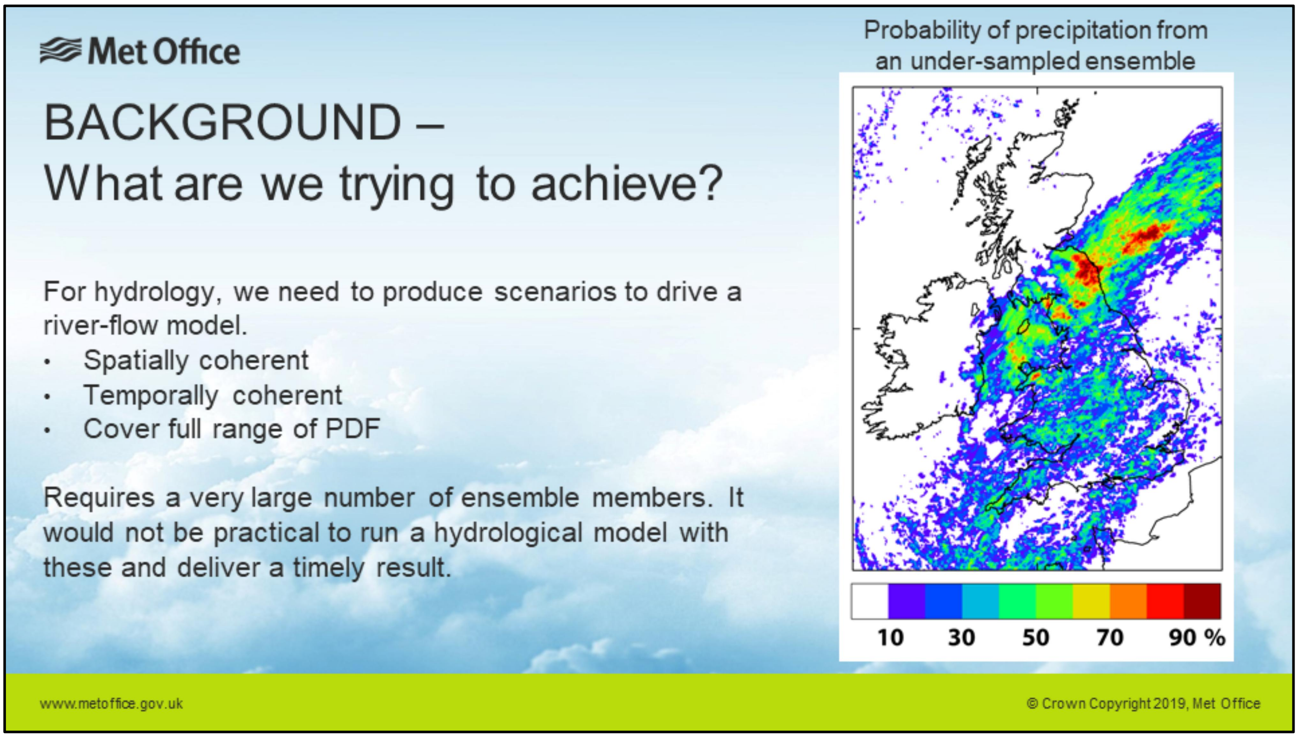
We have adopted an approach that will output all forecasts as probabilities or percentiles as this allows us to blend multiple ensemble and deterministic forecasts into a skilful automated product.

Precipitation nowcast features do not evolve in shape, intensity or advection velocity.



Left: Potential product highlighting small areas at risk of an event, such as flood-inducing rain where the threshold may be different for each area.

Right: Mean and Max precipitation accumulations in a certain time period within pre-defined areas. EA: Environment Agency.



Precipitation nowcast features do not evolve in shape, intensity or advection velocity.

Insufficient members would result in undersampling leading to erroneous results.

Met Office

Finding a reasonable worst case

The Flood Forecasting Centre have asked for scenarios that cover

- Most likely
- Reasonable worst case

- Computationally fast
- Explainable

Needs to be computationally cheap so that we can produce these on nowcast time-scales.

Needs to be a method that can be explained and demonstrated to trained hydrometeorologists as we need them to trust and use it.

Met Office

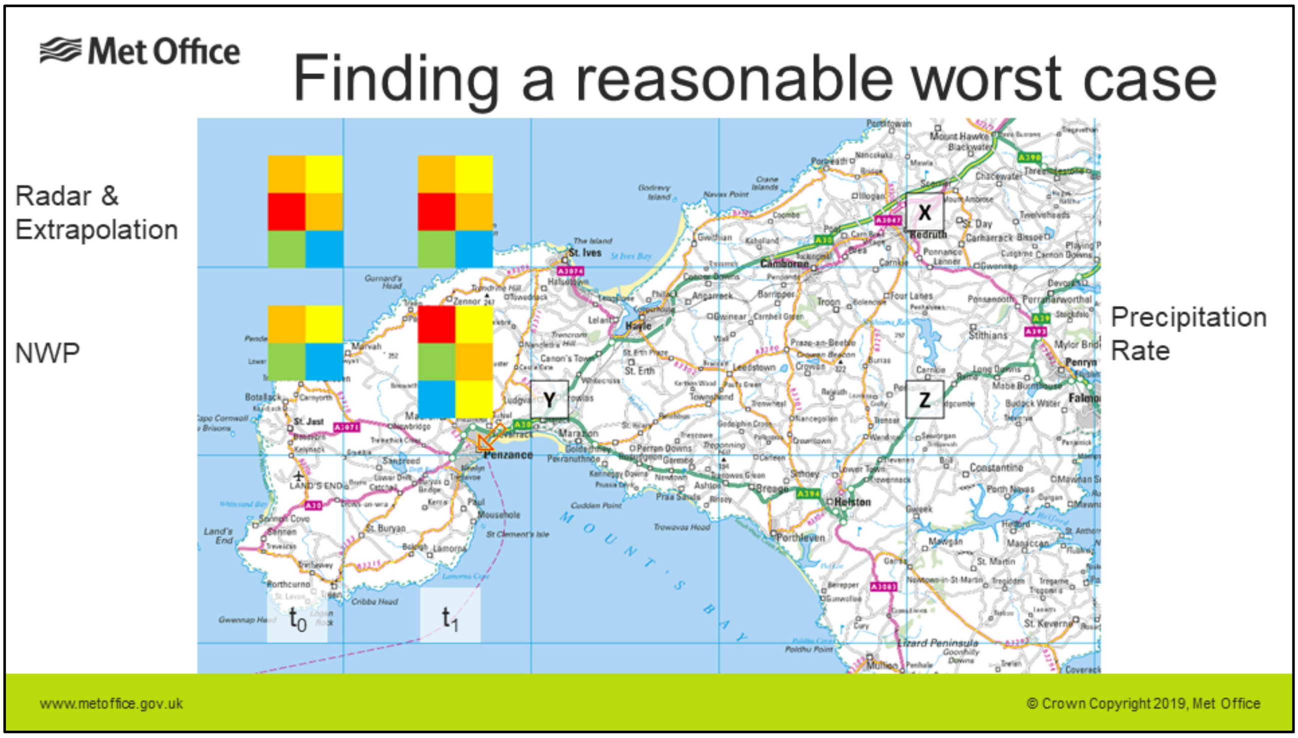
Finding a reasonable worst case

Radar

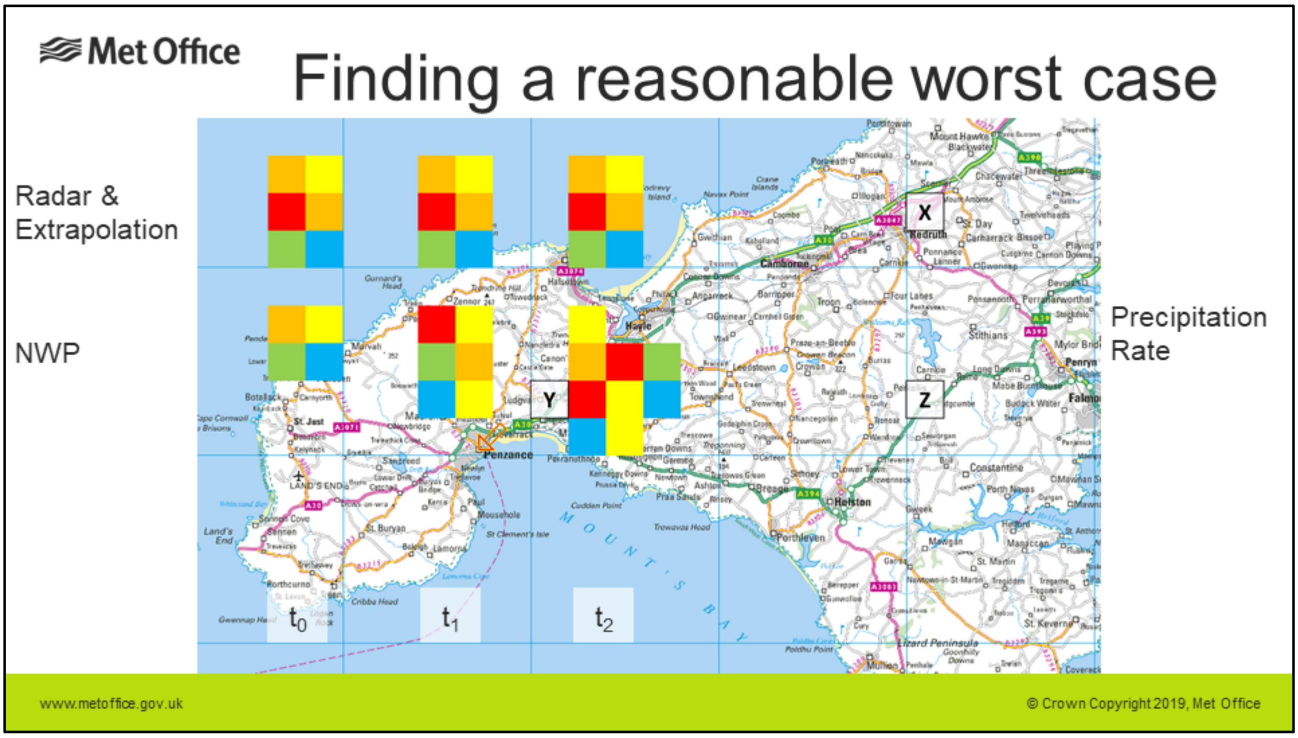
Precipitation Rate

Imagine a case where we have three sensitive locations, X, Y and Z.
We have a radar observation of a precipitation rate cell.

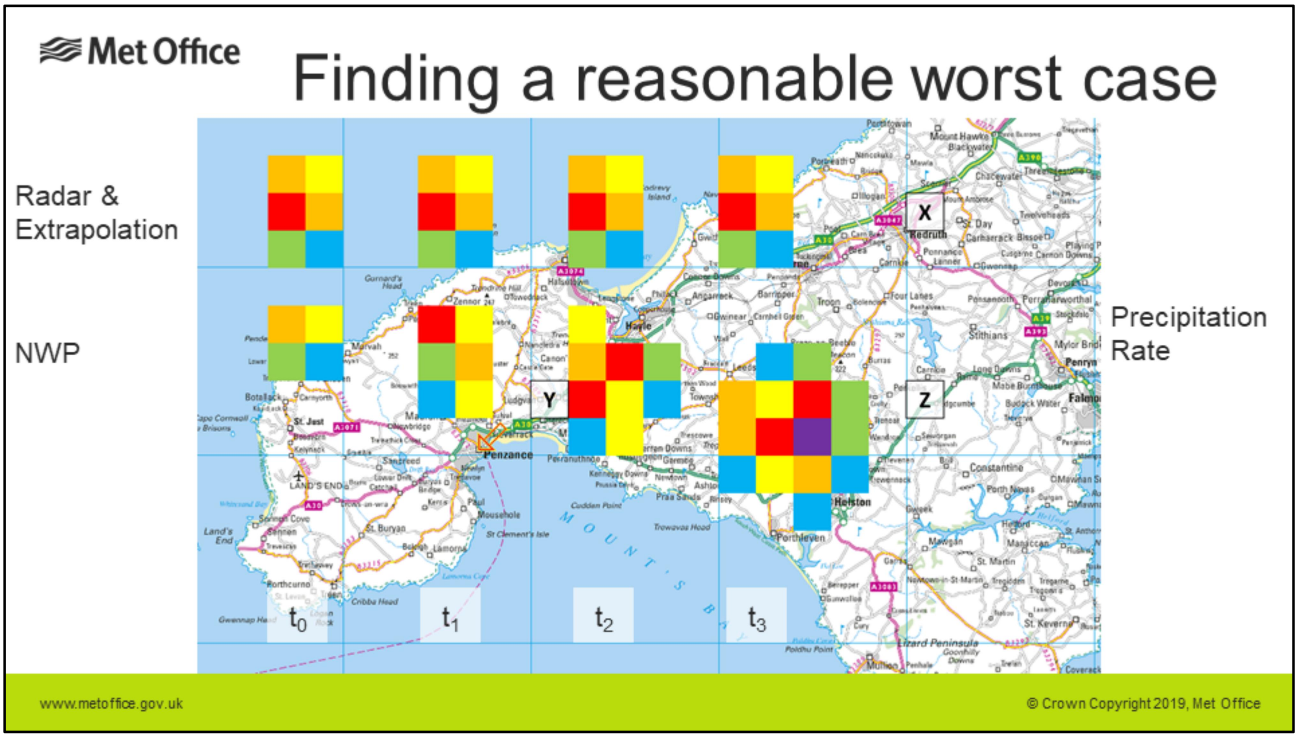
… we also have an NWP forecast valid at the same time with a similar cell in a slightly different position.



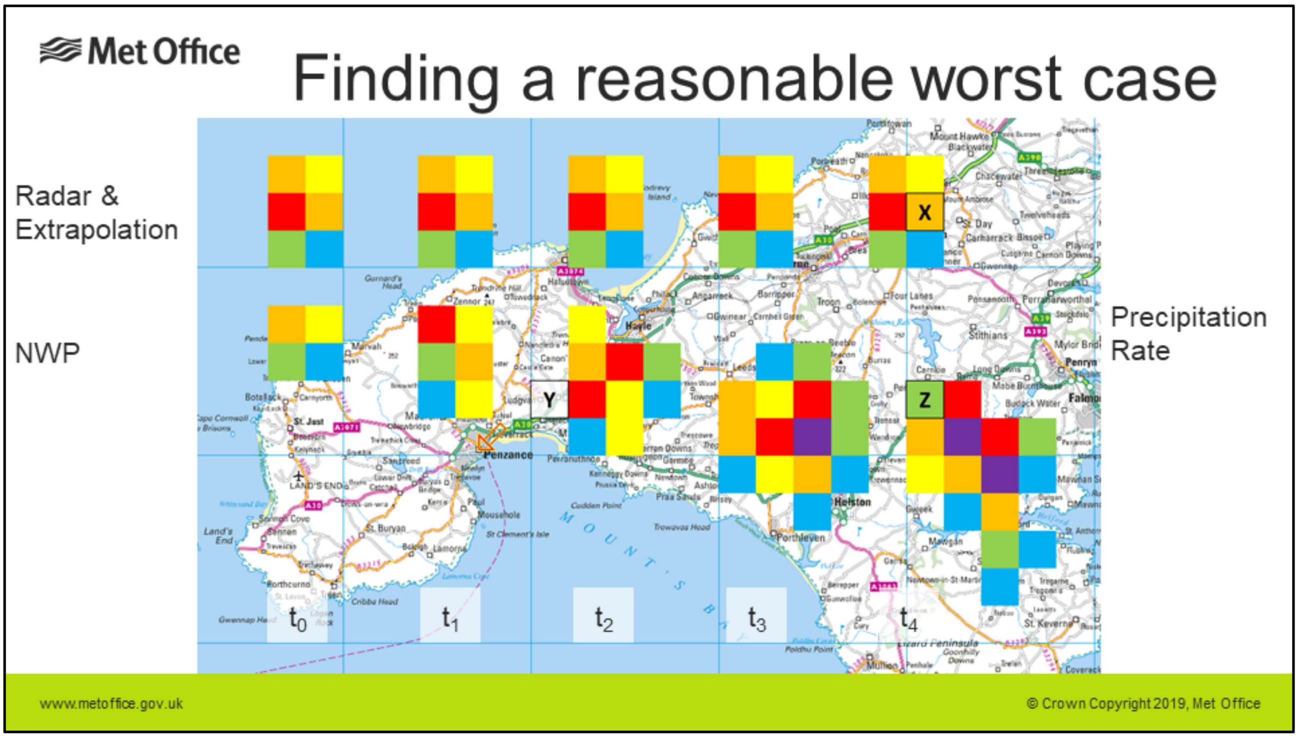
We can advect our radar image forward to produce an extrapolation nowcast and we can take the next time-step from the NWP simulation.



Repeat to get time 2.



Repeat to get time 3.



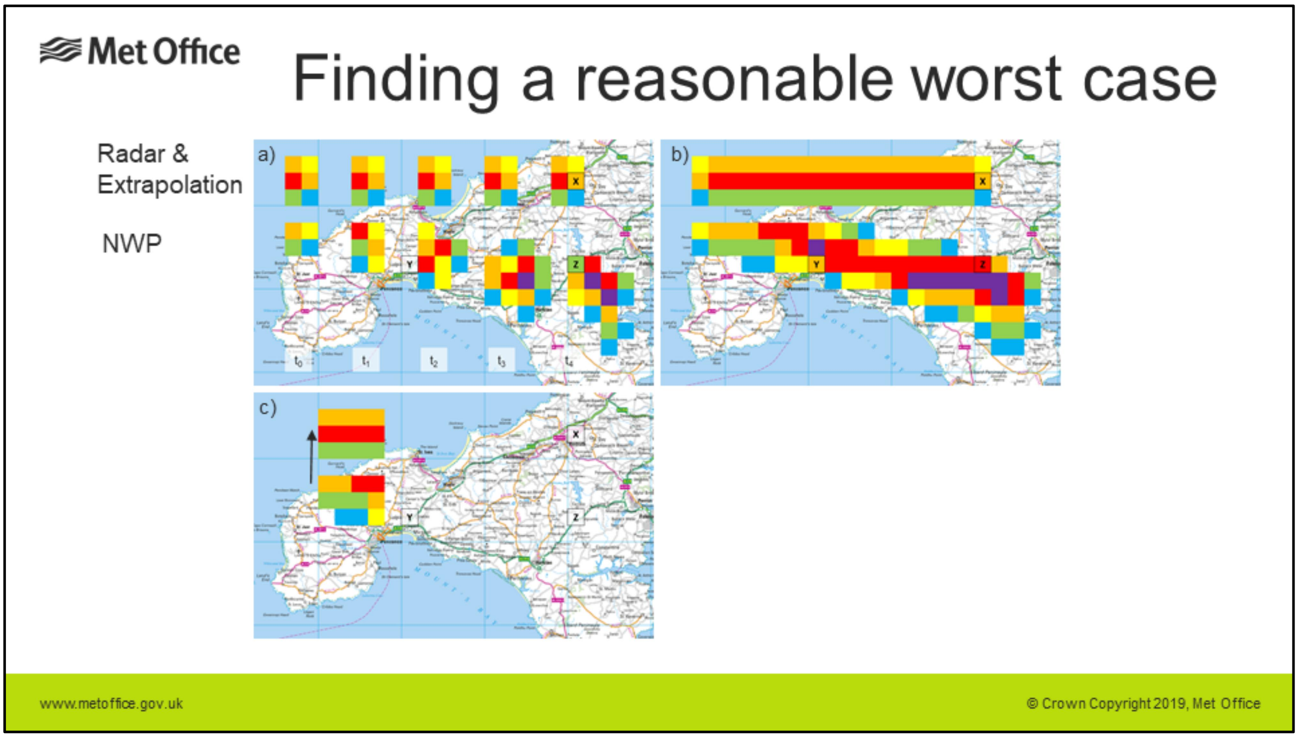
Repeat to get time 4.

We can see that we have predicted some precipitation at X, a little bit at Z and none at Y.

It is clear to a human interpreting this that heavy precipitation is possible at all three, but these two scenarios do not capture it.

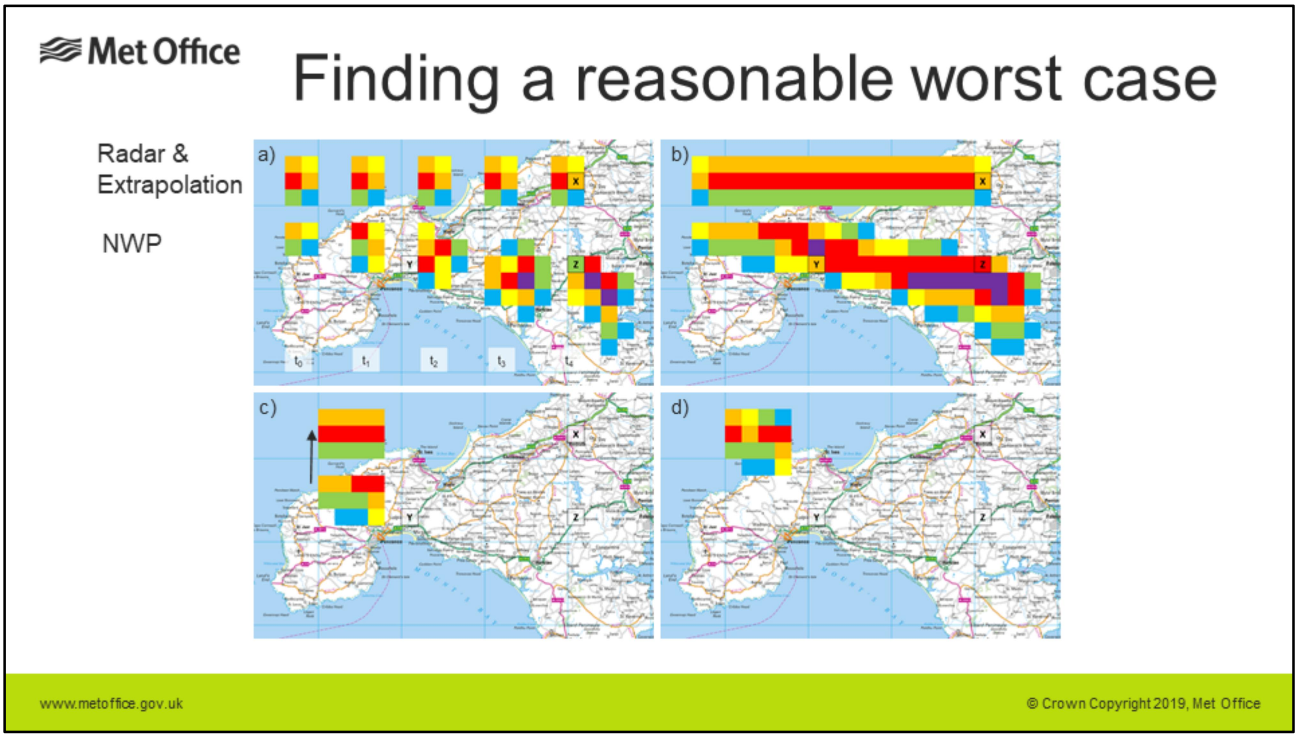
We can easily use precipitation accumulation instead to avoid the jumps seen in precipitation rate data.

This now gives precipitation at all three locations, but still the heaviest precipitation misses them.

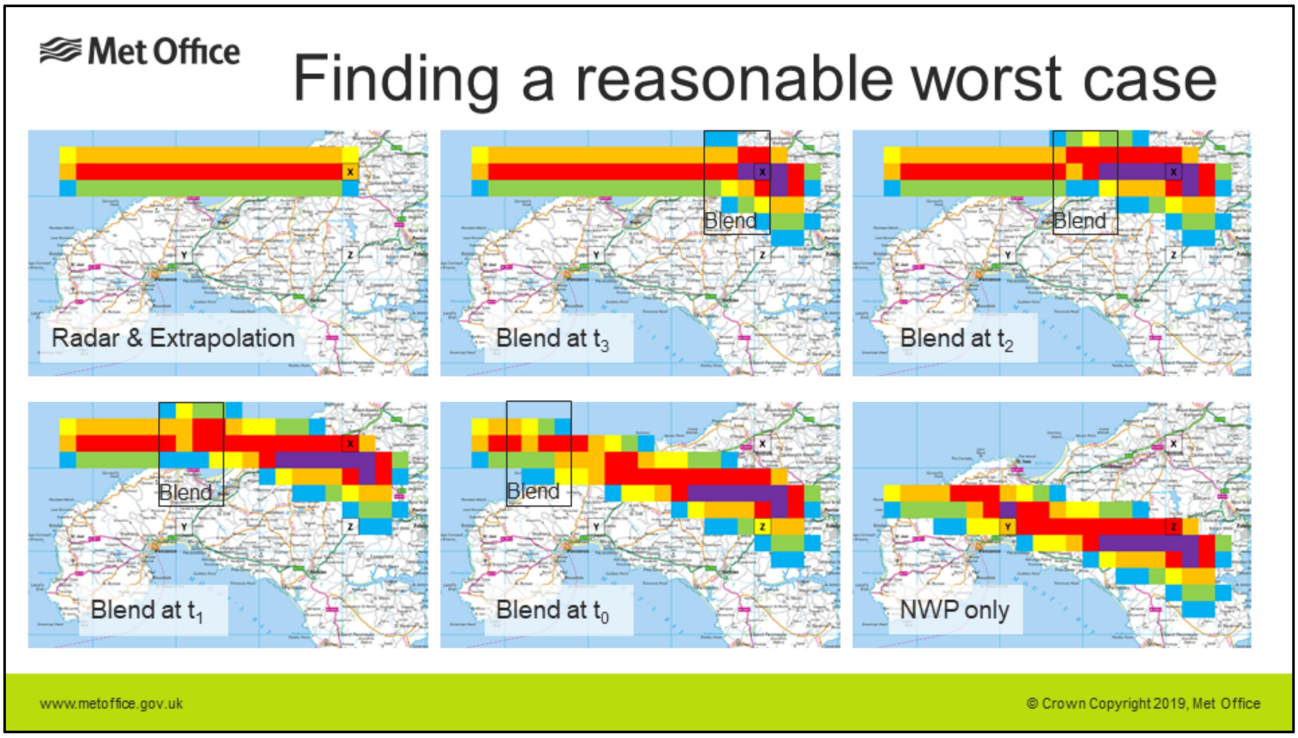


a) Already described.
b) Already described.
c) A realistic scenario can be generated by shifting the NWP (UKV) simulation to the position of the extrapolated location for a small time-slice of the accumulation data. In this case shifting the NWP data 3 grid-squares to the north.

If we select the most intense cell in the extrapolation and in the UKV and line them up, this would simulate a reasonable worst case.



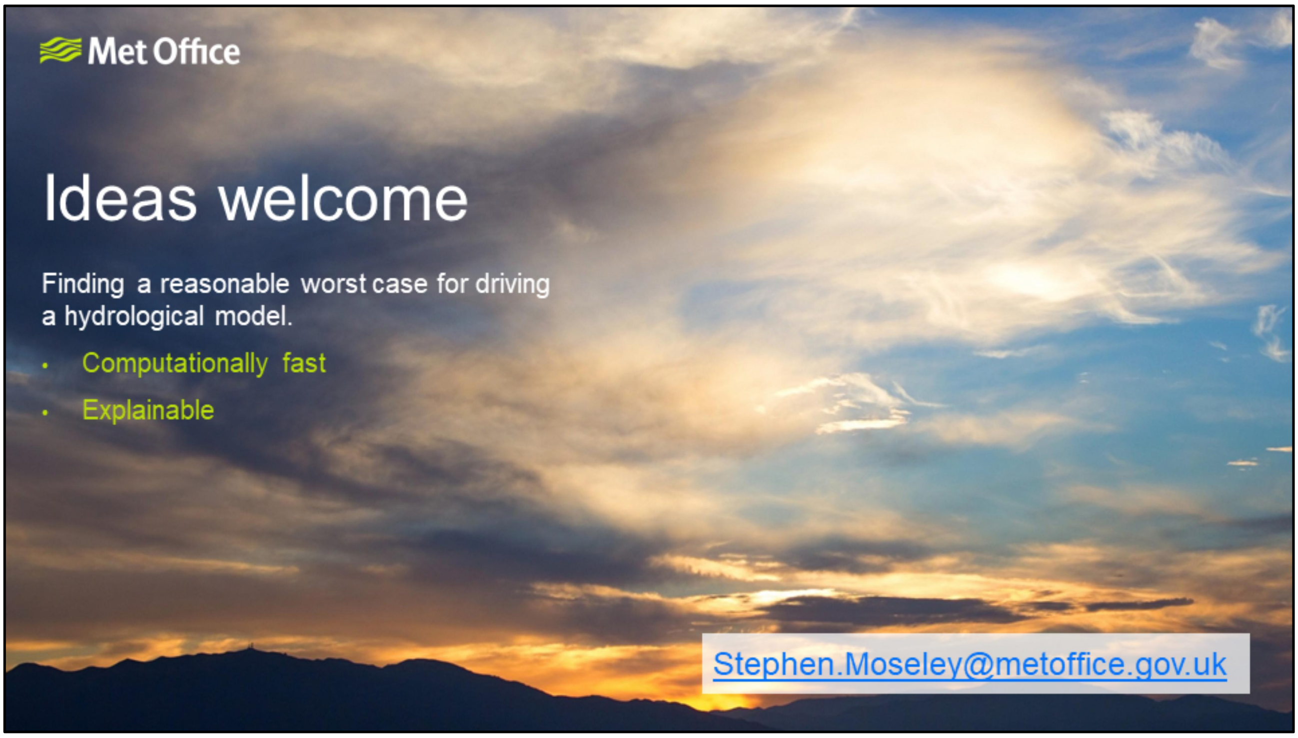
a) Already described.
b) Already described.
c) Already described.
d) Blend the two sources together. On next slide, this is scenario (e) (bottom-centre)



By repeating this blend for each time step we can create six scenarios:

a) Extrapolation only (affects X)
b) Blend with NWP (UKV) at timestep t3 (Bigger impact at X). Timestep t4 is NWP with a grid-shift.
c) Blend at t2
d) Blend at t1
e) Blend at t0 (Impacts Z)
f) NWP (UKV) only (Impacts Y and Z)

We can pick a reasonable worst case for X (c; top-right), and for Y (f; bottom-right), but there isn’t a case where the most intense precipitation intersects Z, although we have cases either side. We could use whole-domain shifting to achieve this.


Met Office
Ideas welcome
Finding a reasonable worst case for driving a hydrological model.
• Computationally fast
• Explainable
Stephen.Moseley@metoffice.gov.uk