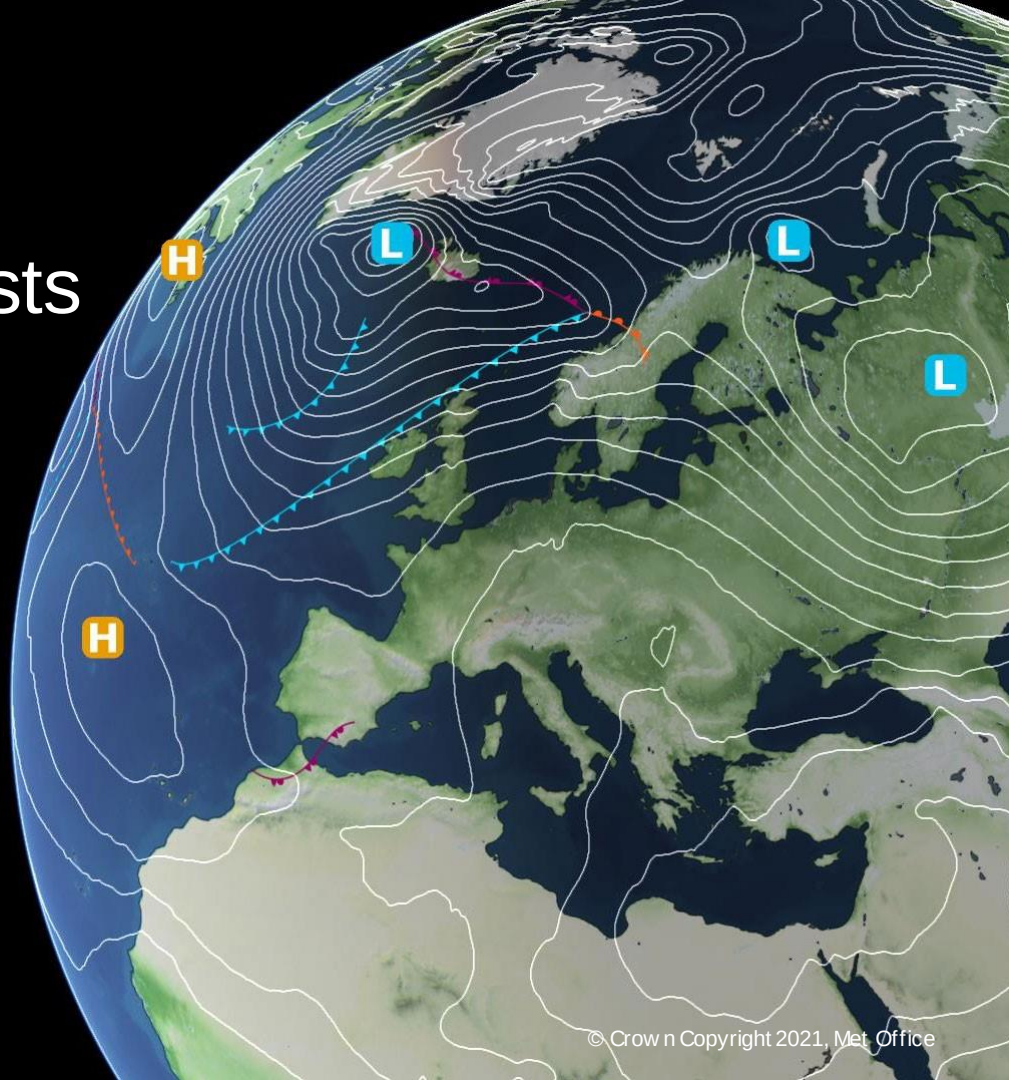
Developing probabilistic surface transport forecasts at the Met Office

Joe Eyles

SIRWEC 2022



© Crown Copyright 2021, Met Office

Introduction

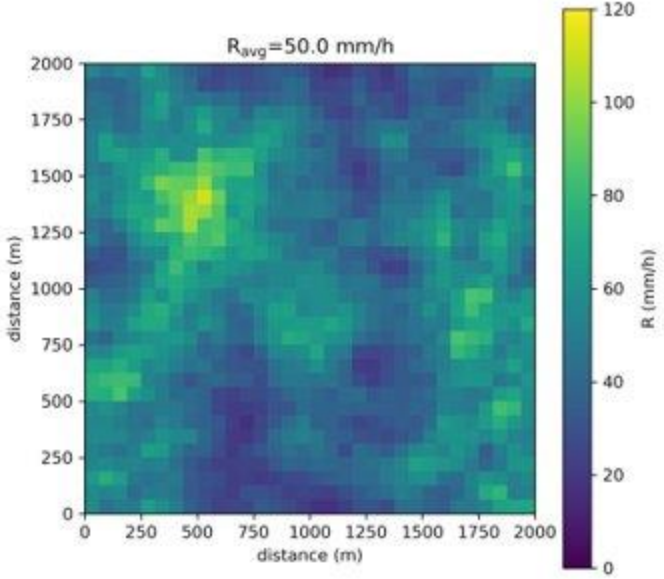
- The Met Office is the UK's national meteorological service
- Part of UK government, also a trading fund
- We provide commercial weather and climate services to business and industry
  - One of these is Surface Transport Forecasting, giving data to key decision makers, ranging from national highways to independent gritting.

Met Office

Weather is hard to forecast

Patchy cloud

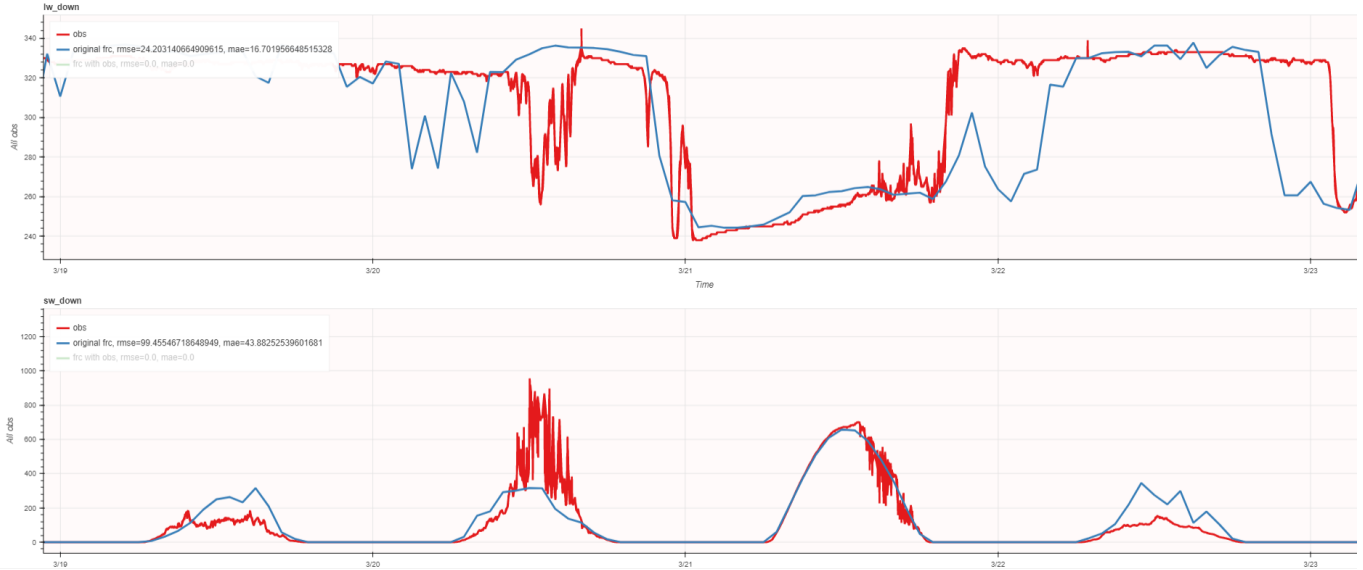
Timing of fronts



Rain intensity/duration

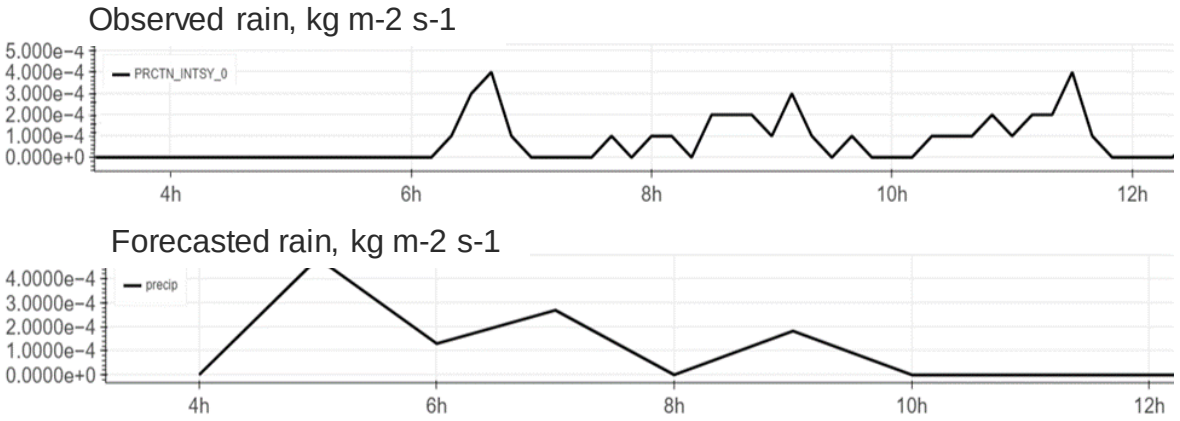
Weather is hard to forecast

This can lead to incorrect forecasts for shortwave (SW) and longwave (LW) down.



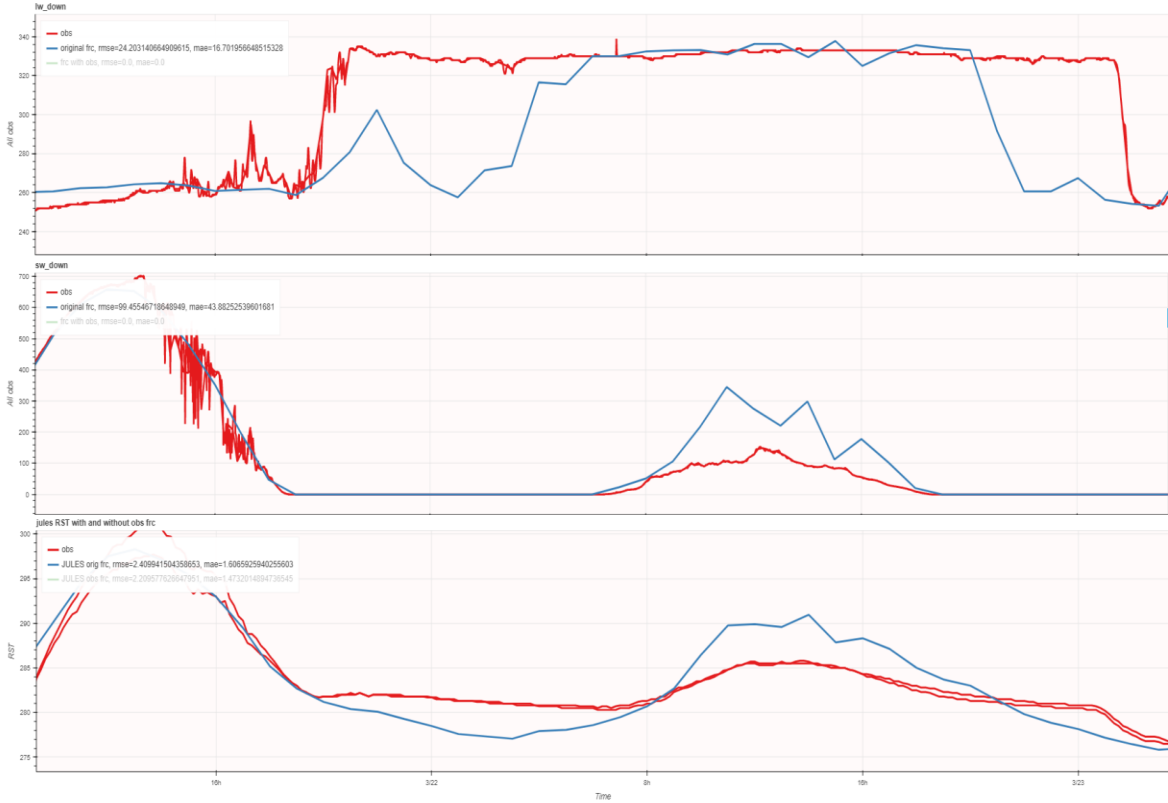
Weather is hard to forecast

Or precipitation forecasts with incorrect timings that do not capture the variability in the rainfall.



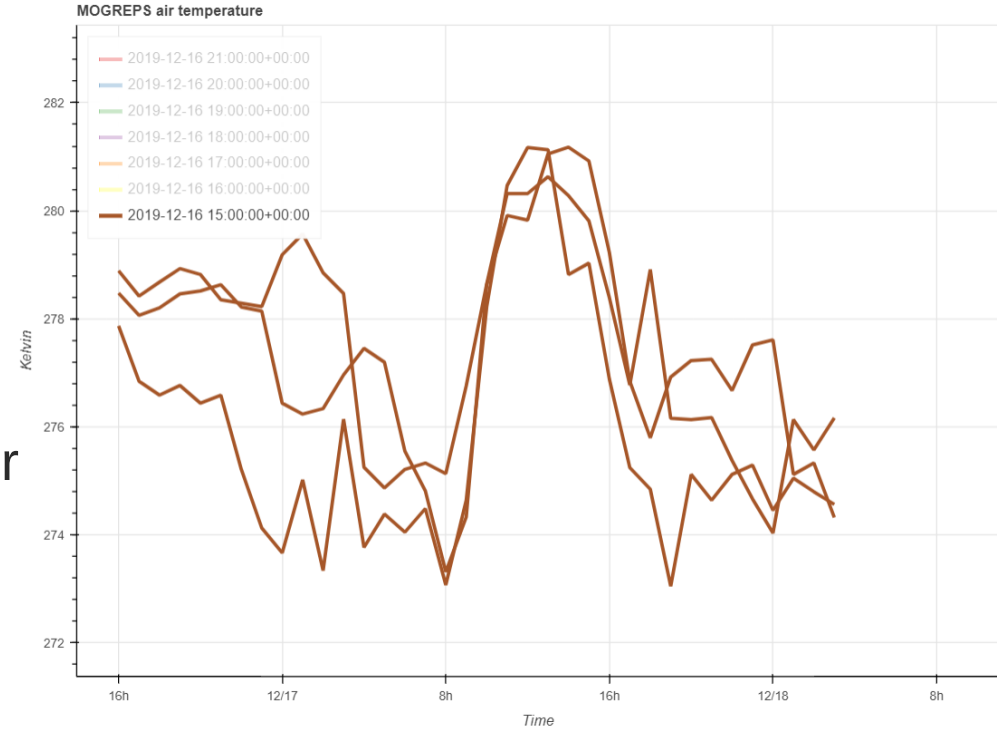
The problem with deterministic road forecasts

Since this data drives the physics, the road forecast can be negatively impacted.



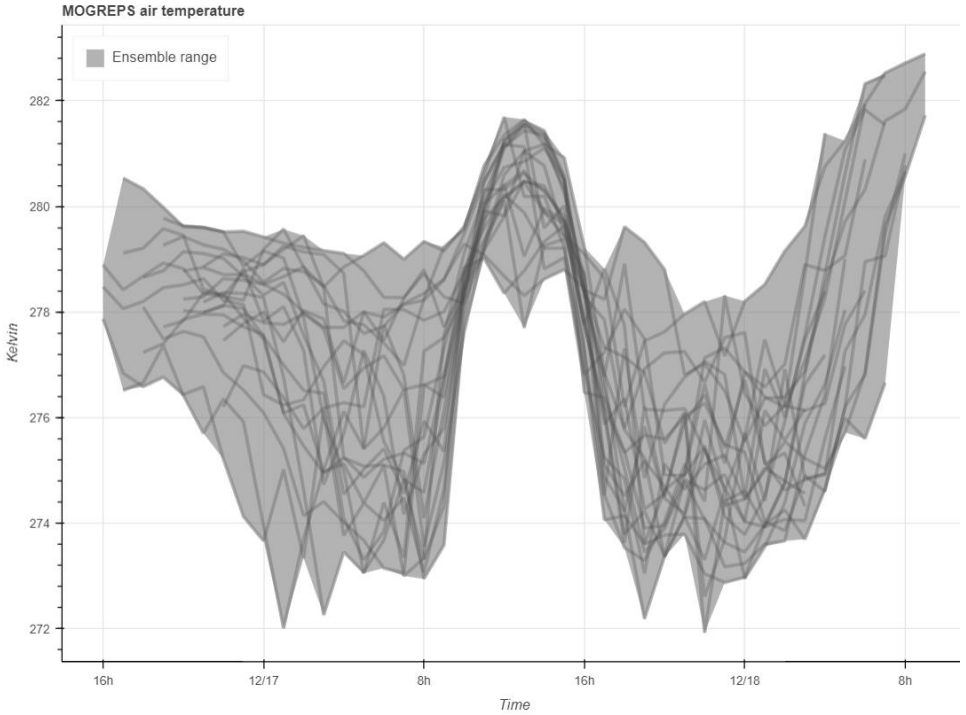
The solution? An ensemble of forecasts

- We initially use MOGREPS-UK
- Varied by perturbing initial conditions
- Each forecast is an equally likely possible future
- 3 forecasts generated each hour



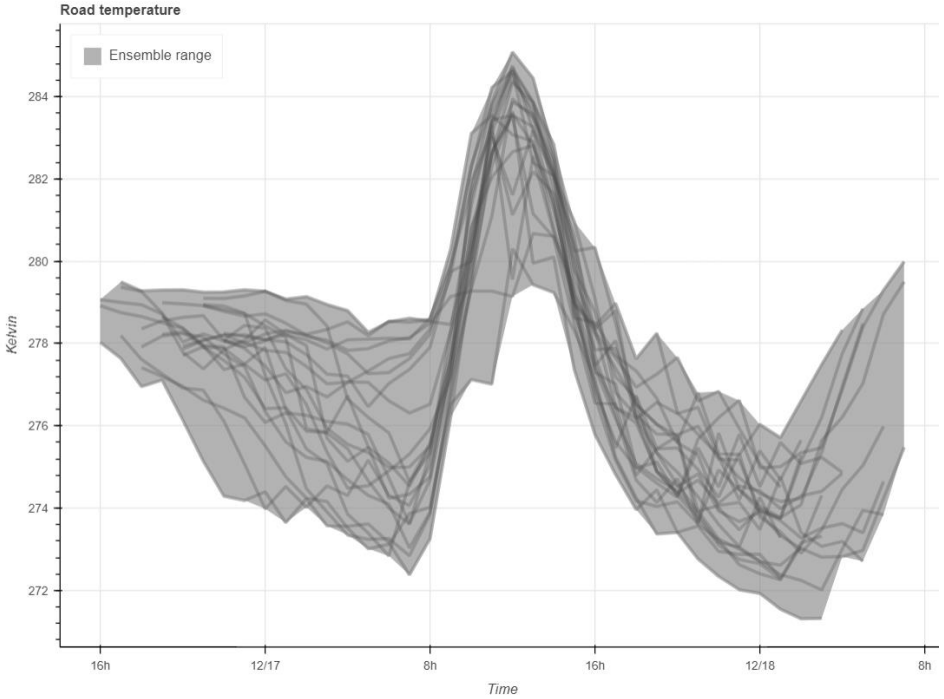
The solution? An ensemble of forecasts

- We initially use MOGREPS-UK
- Varied by perturbing initial conditions
- Each forecast is an equally likely possible future
- 3 forecasts generated each hour
- 18 member lagged ensemble



The solution? An ensemble of forecasts

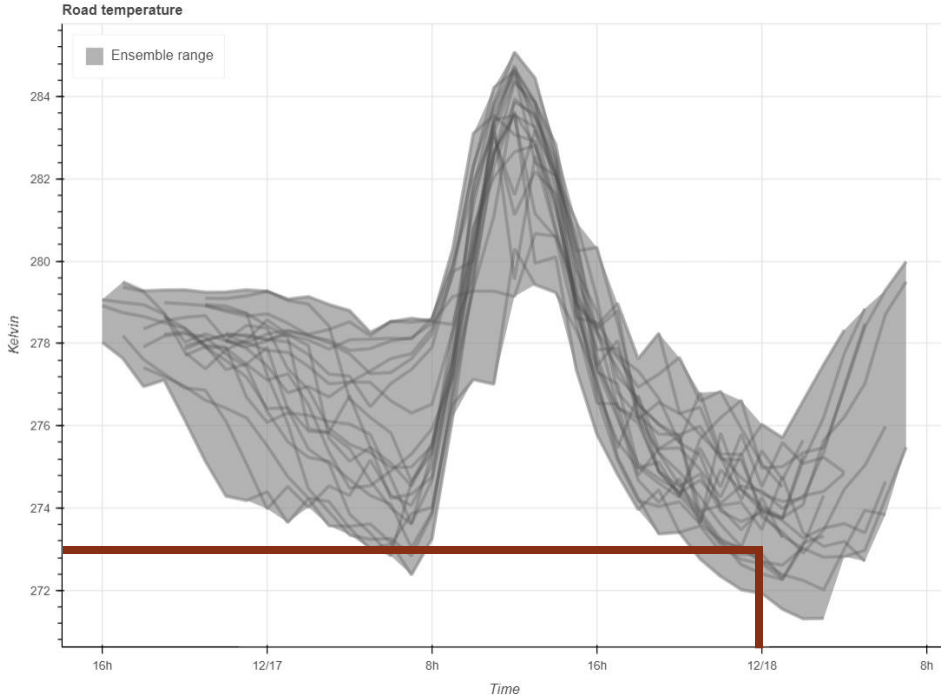
- We use these ensemble forecasts as inputs to our STF model
- One STF forecast per ensemble member
- More on this later



Generating probabilities through ensembles

Simple event (temp):

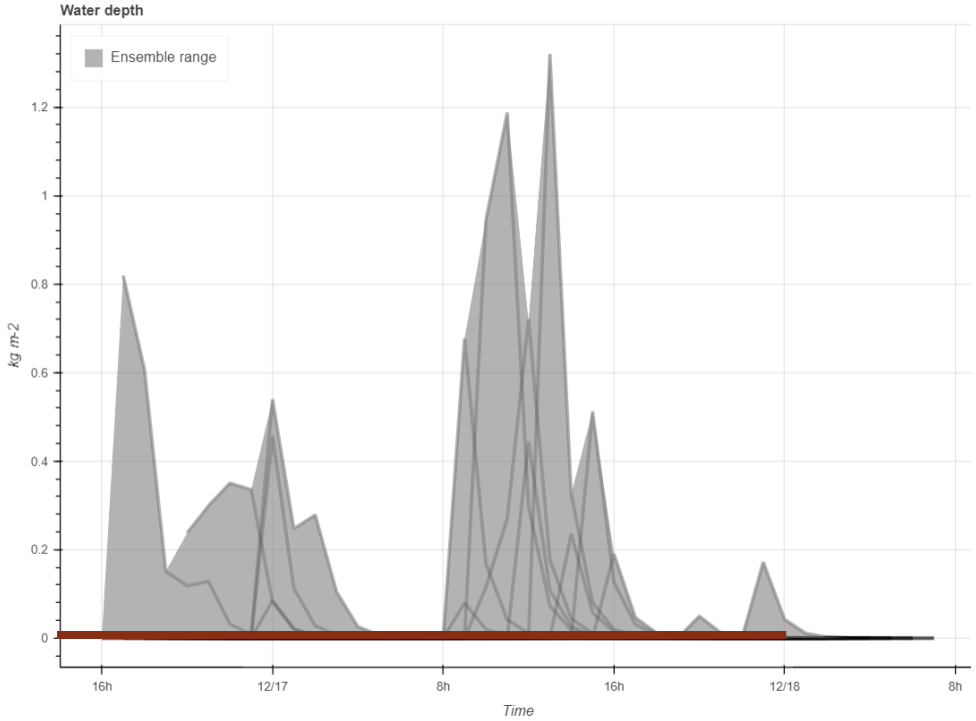
- Prob(RST < 273K) at midnight.
- 5 members are < 274K, 18 members in total
- 5/18, so approximately 27% chance



Generating probabilities through ensembles

Simple event (water):

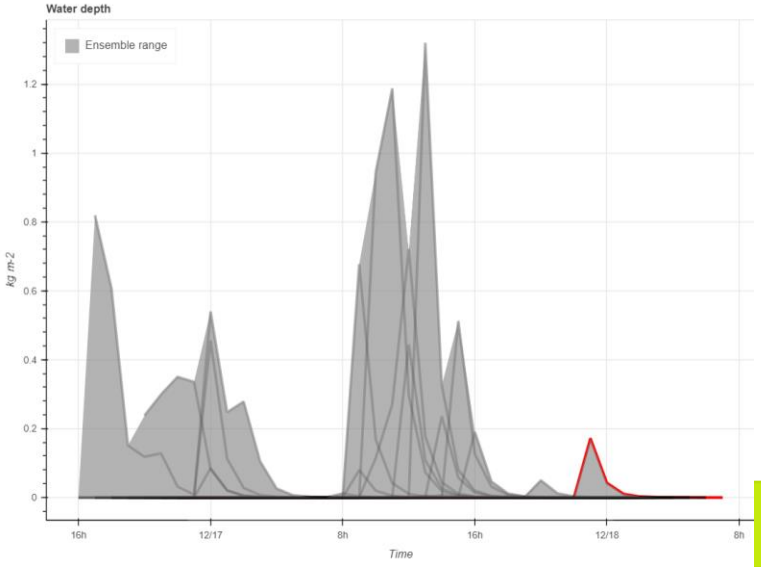
- Prob(water > 0mm) at midnight.
- 1 member has > 0mm, 18 members in total
- 1/18, so approximately 6% chance

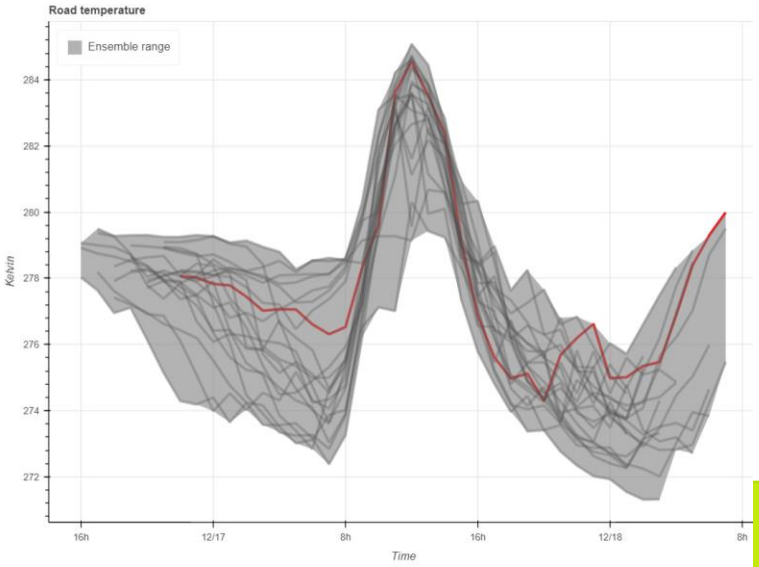


Generating probabilities through ensembles

Ice event:

- Prob(water > 0mm and RST < 273K) at midnight.
- Naively 27% and 6% gives 2% chance.
- Considering ensemble members we arrive at 0% chance.





Met Office

Coherence across parameters, locations and time

- **Parameters:** Is an ice event at a given time/place possible?

“Do I need to grit this location tonight?”

- **Locations:** Are an ice events at multiple locations possible?

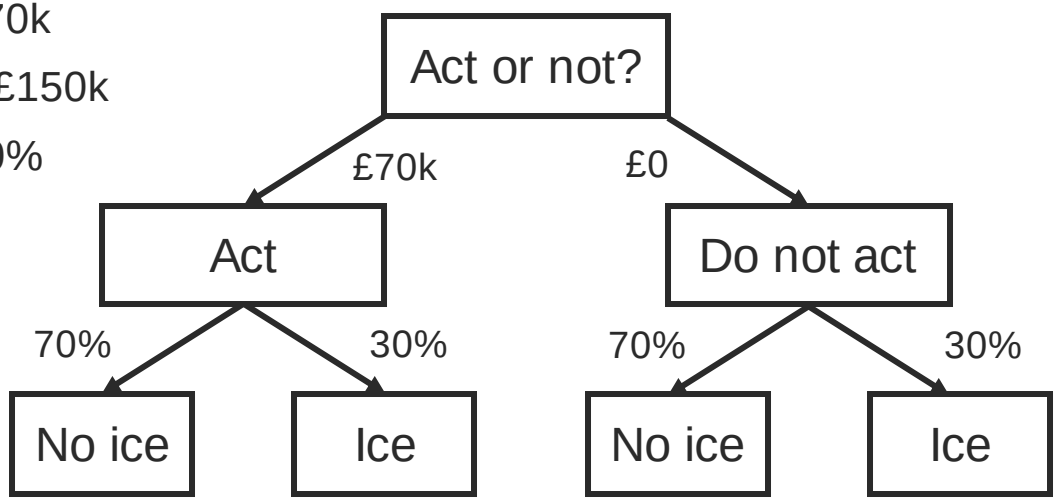
“Do I need to grit all locations?”

- **Time:** Are ice events are multiple times possible?

“Do I need to grit today and tomorrow?”

How to use a probabilistic forecast?

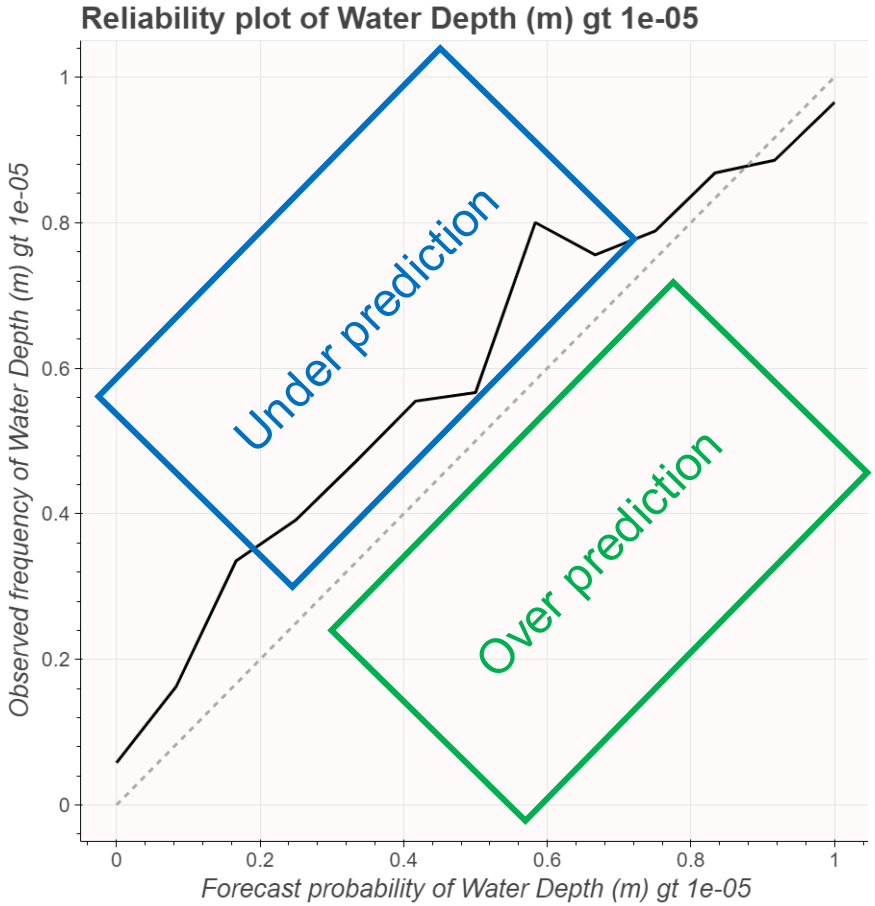
- Cost of action: £70k
- Cost of inaction: £150k
- Chance of ice: 30%



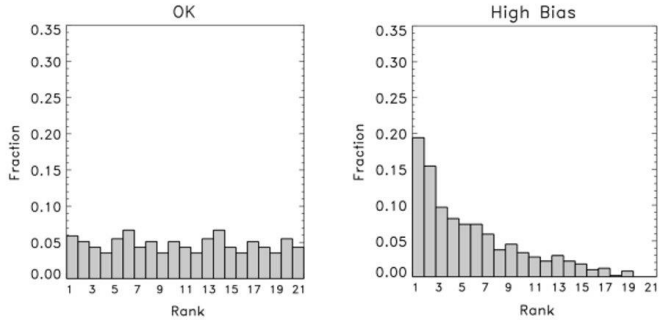
Expected cost:	£70k	£70k	£0	£21k

For more, see: Using metocean forecast verification information to effectively enhance operational decision-making, Steele et al, 2021

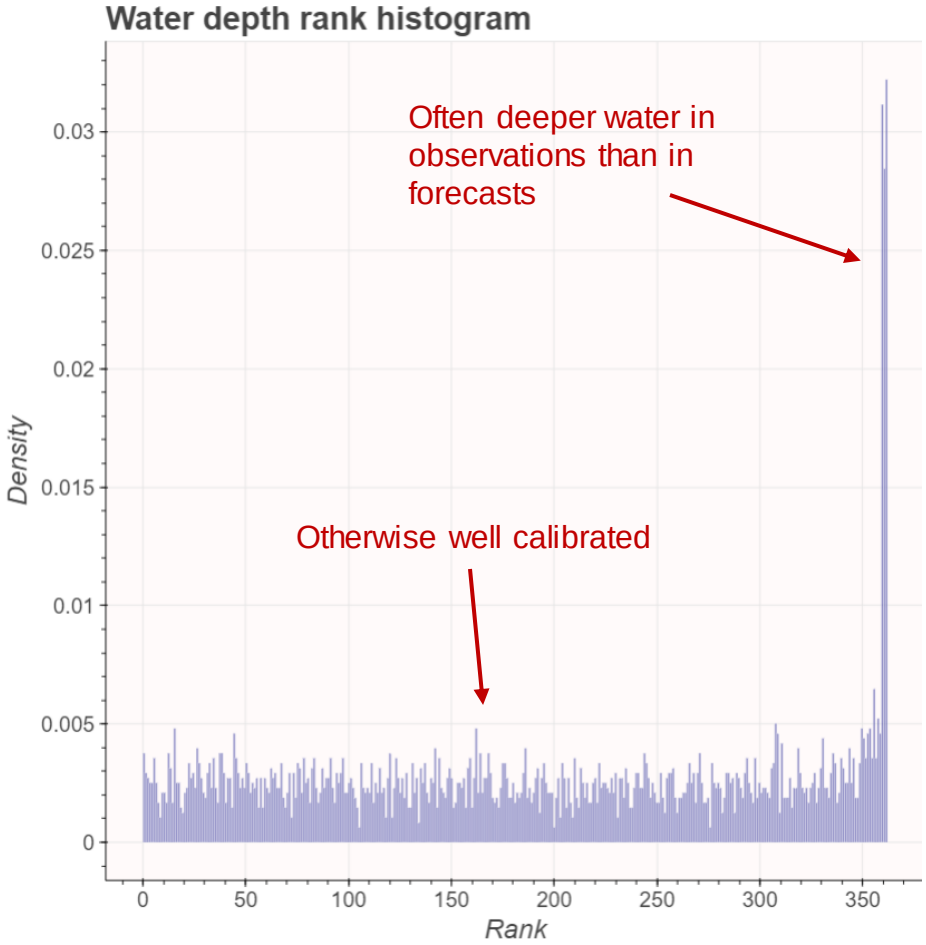
Verification – reliability plot



Verification – rank histogram



Figures borrowed from NOAA presentation on 'Verification and visualization of ensemble forecasts' by Tom Hamill



Met Office

Conclusion

- Deterministic weather forecasts have challenges
- These cause problems in deterministic road forecasts
- We can manage these problems with an ensemble based forecast
- This gives other advantages, such as information about the certainty of an event

Questions?

joe.eyles@metoffice.gov.uk