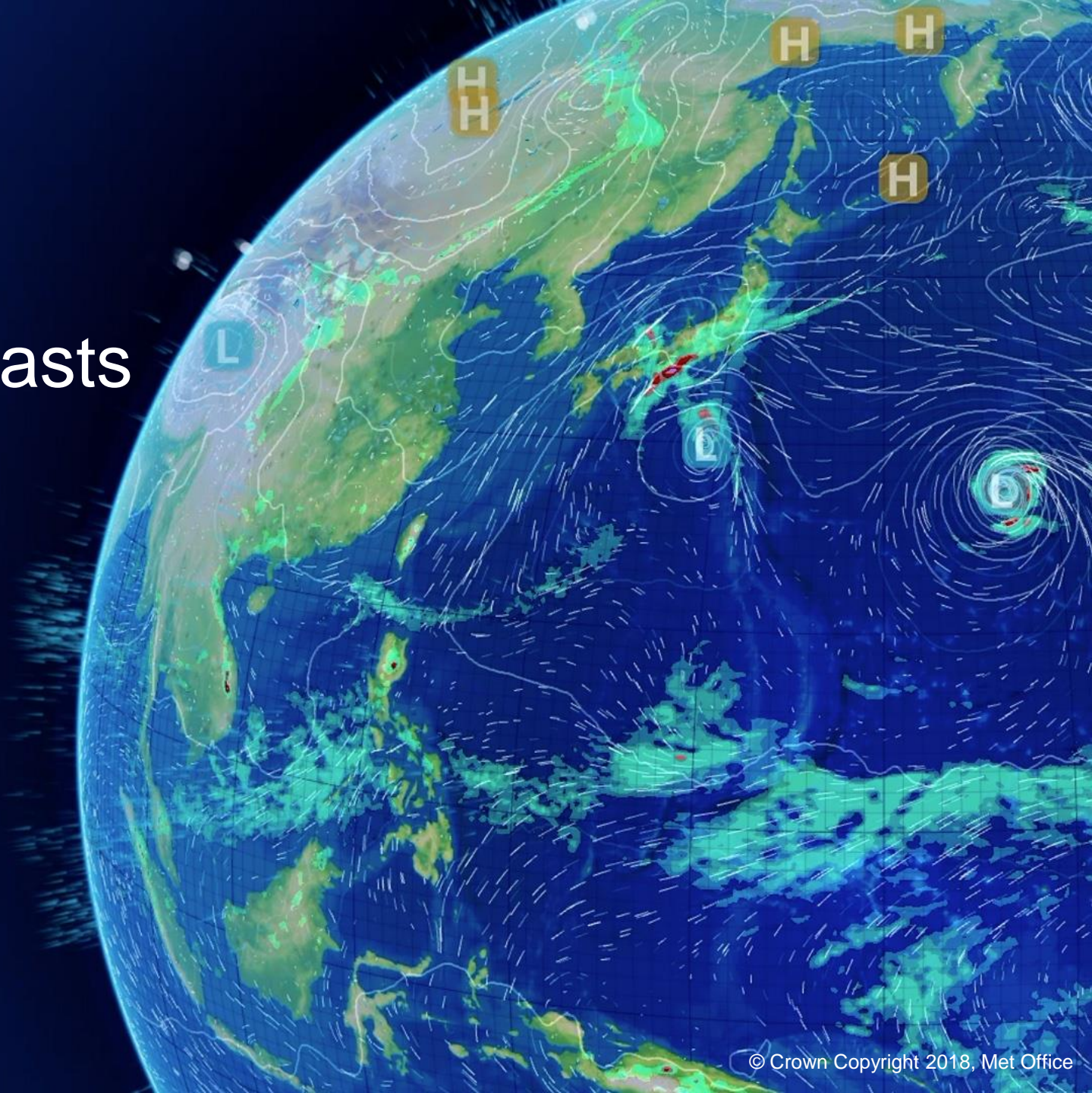


Decision Guidance with Probabilistic Road Forecasts

Henry Odbert & James Shapland



Winter weather risks



Safety



Disruption

Risk mitigation

Freezing?

Yes

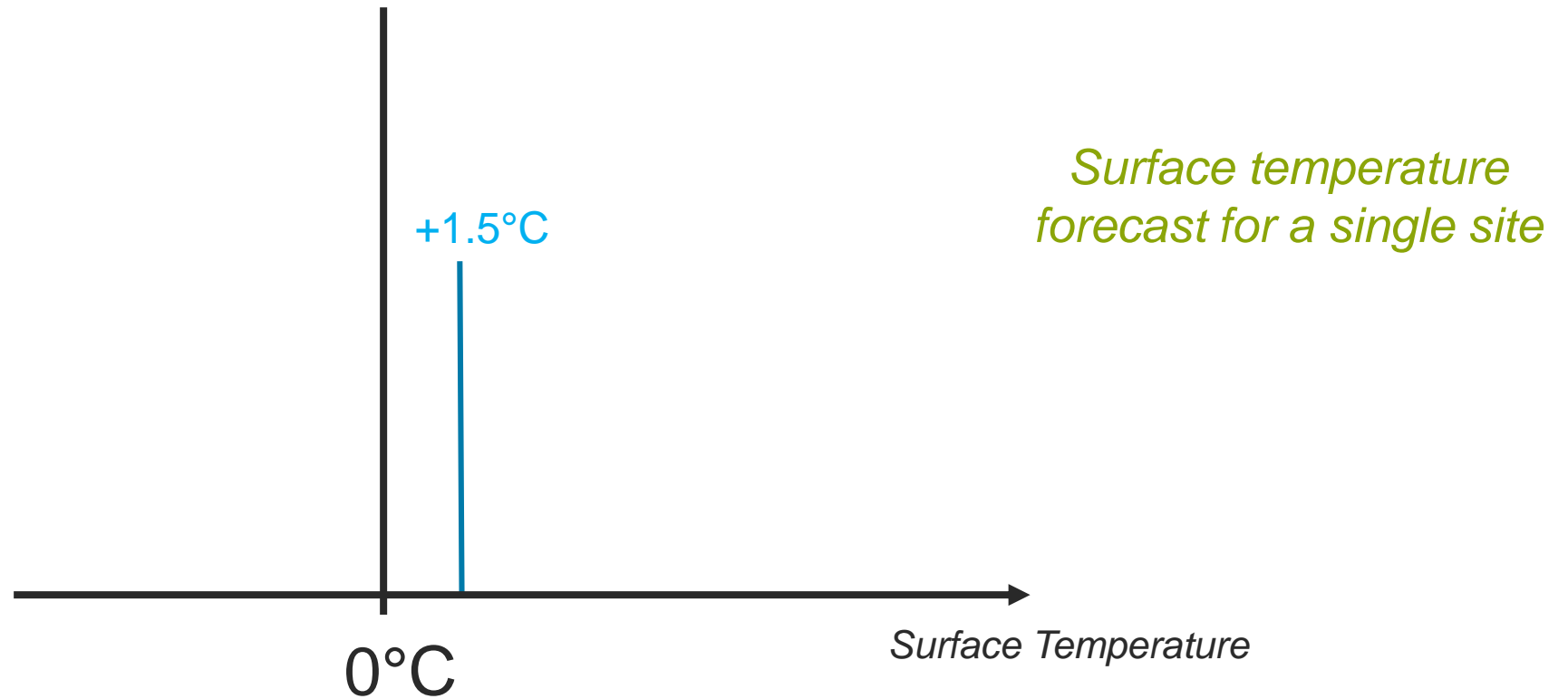
No

Mitigation:

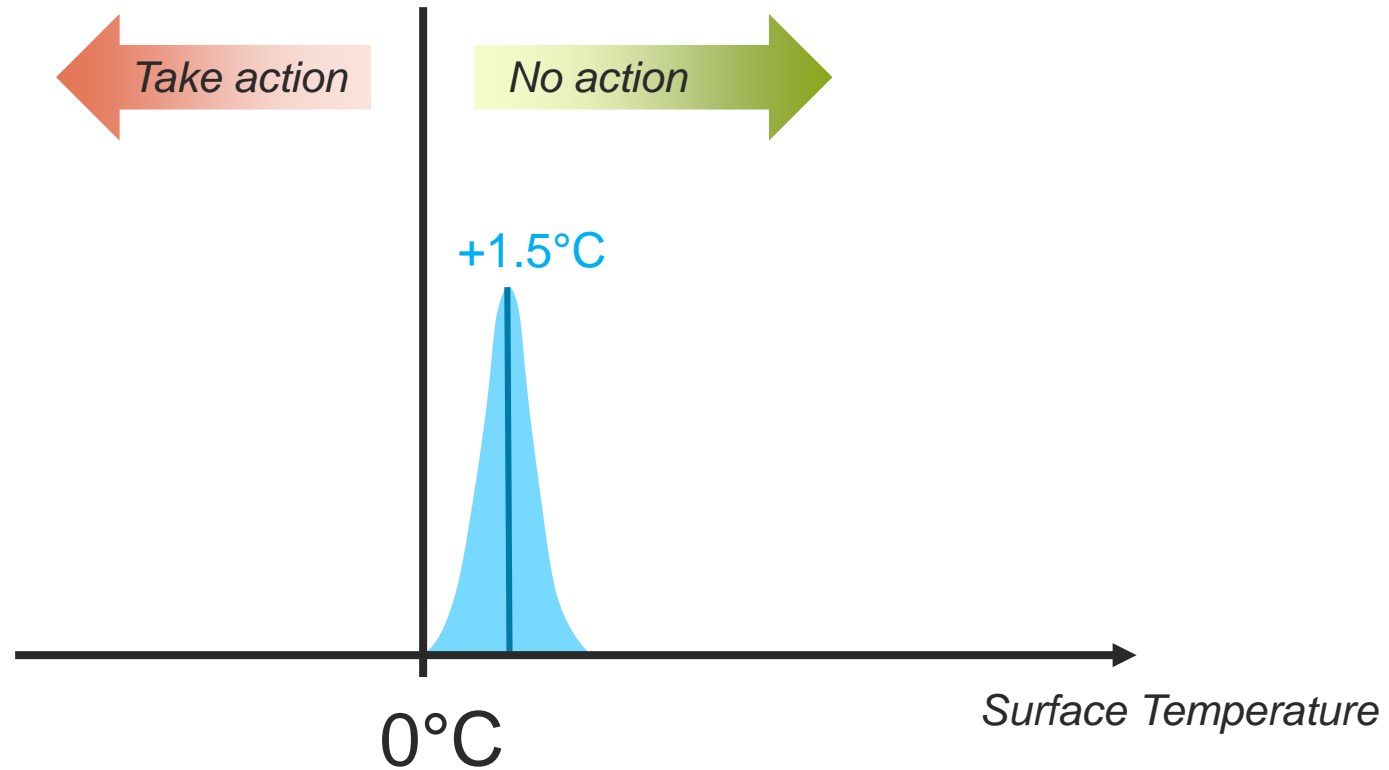
Treat

None

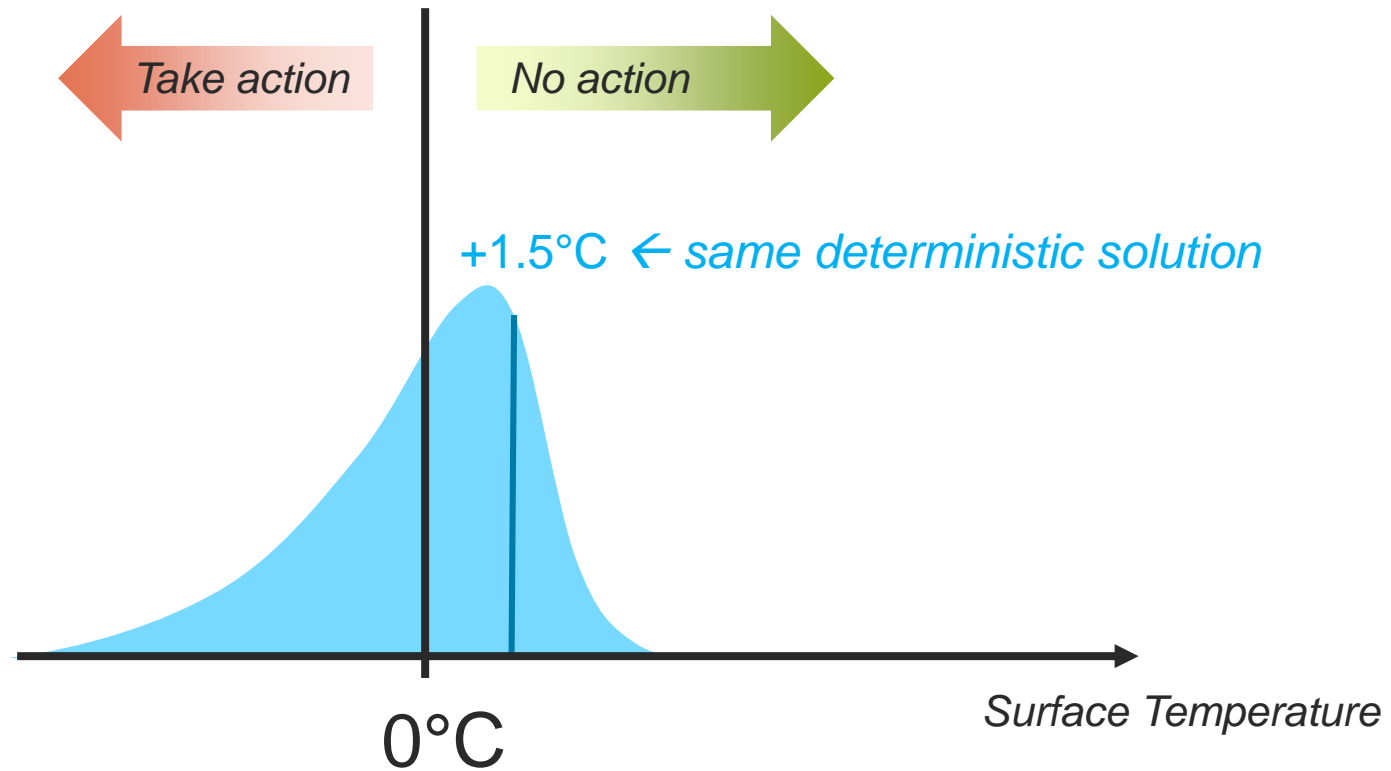
Forecast Uncertainty



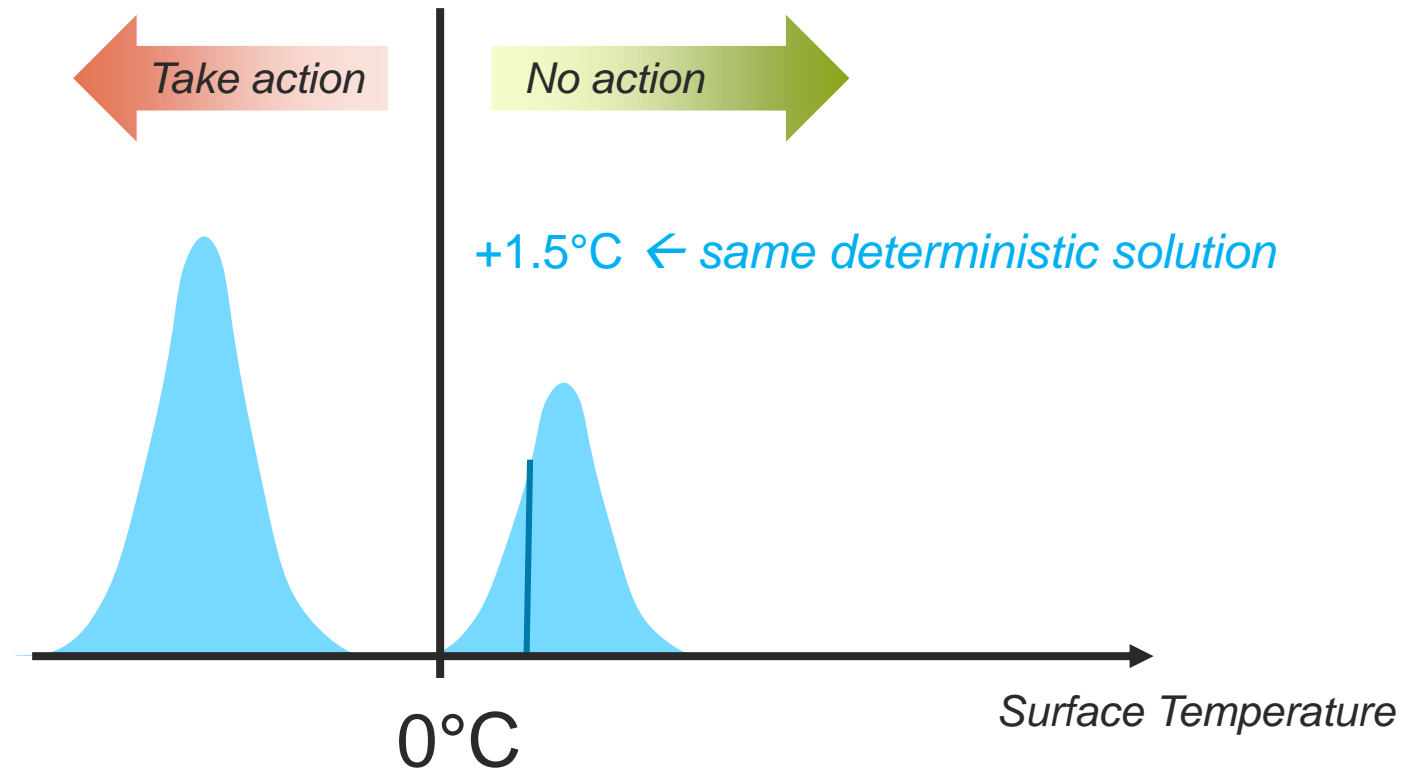
Forecast Uncertainty



Forecast Uncertainty



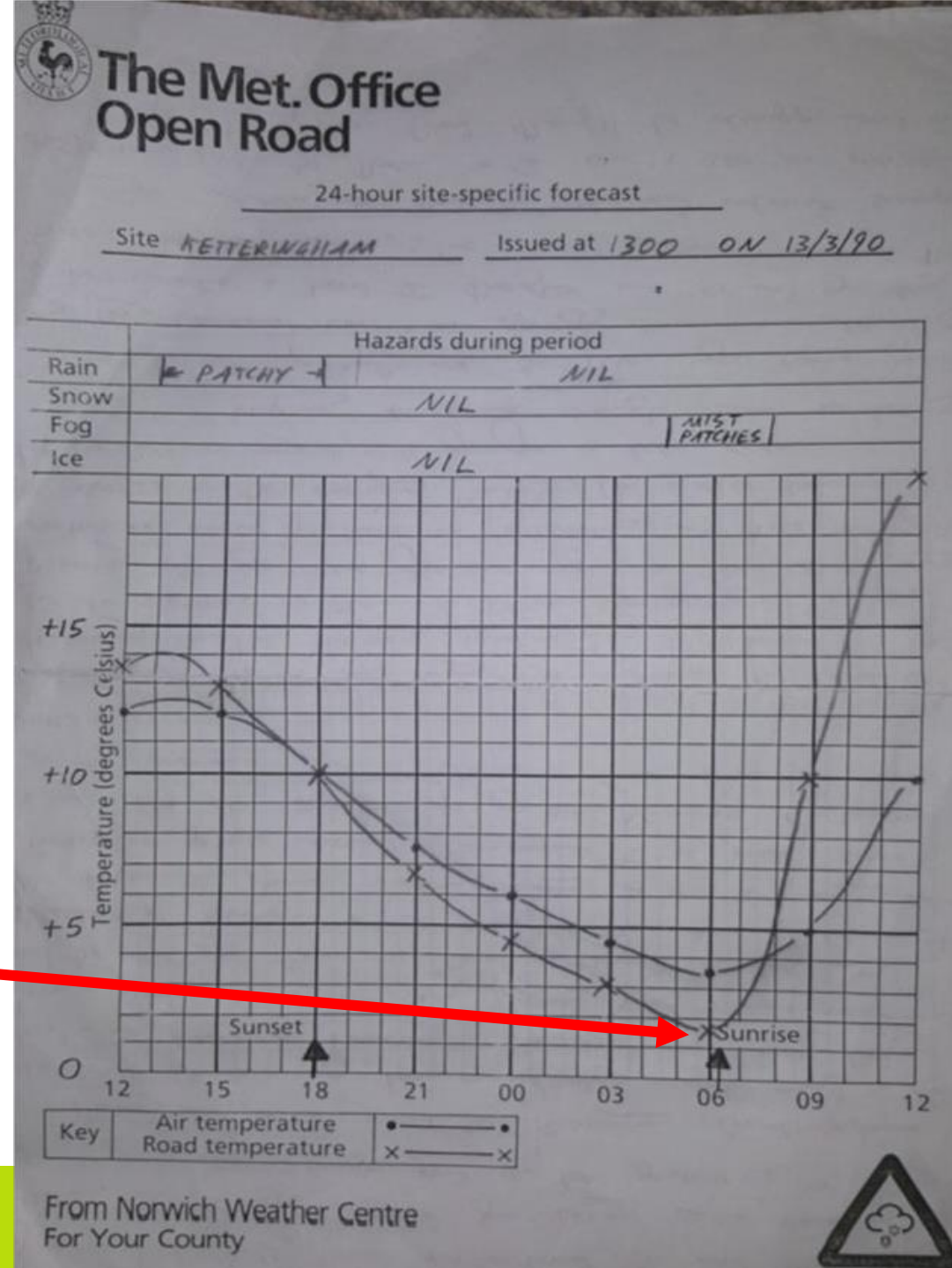
Forecast Uncertainty



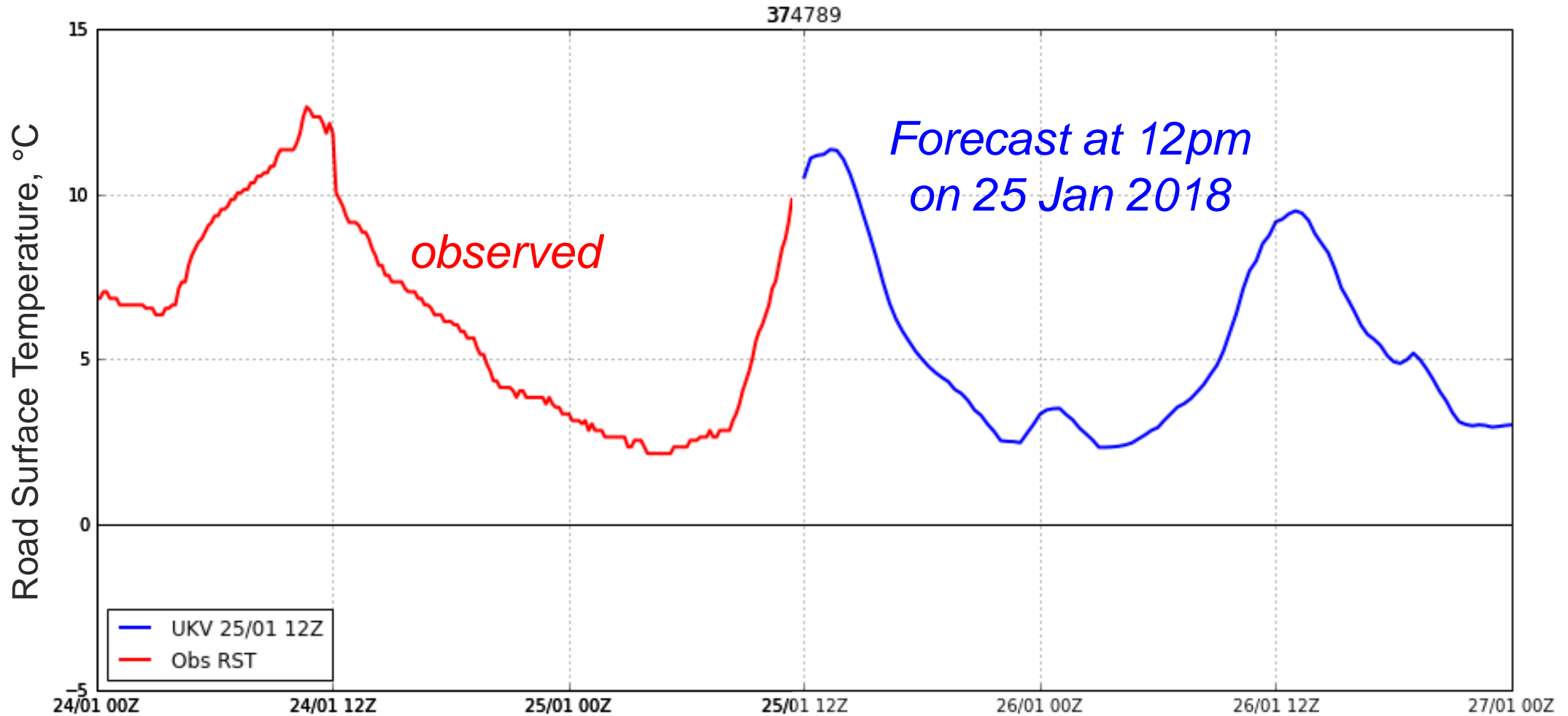
A Cold Night in Norfolk (13-14 Mar 1990)

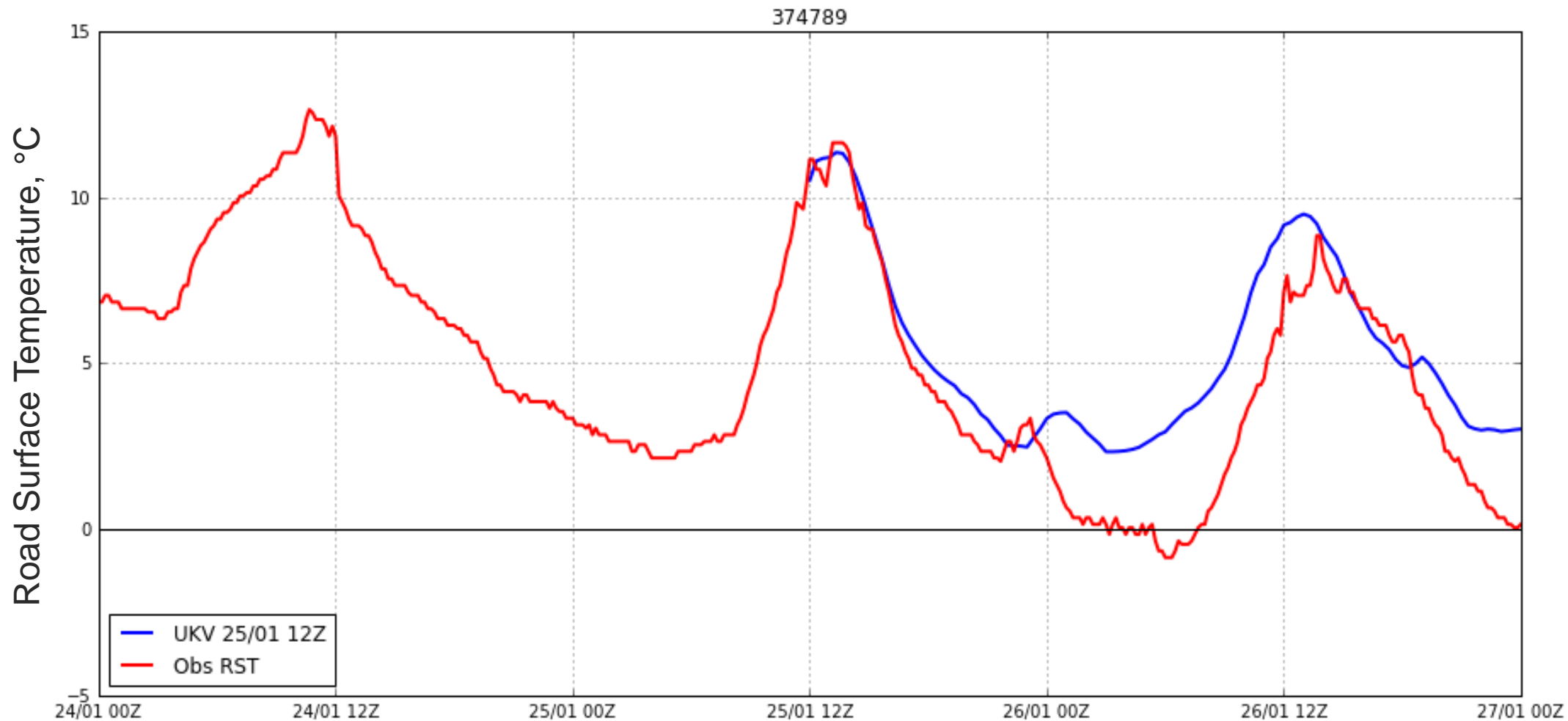
- Deterministic forecast
- Site specific
- No indication of uncertainty

Min RST = +1.5°C



28 Years Later...





NEWS



England

Norfolk

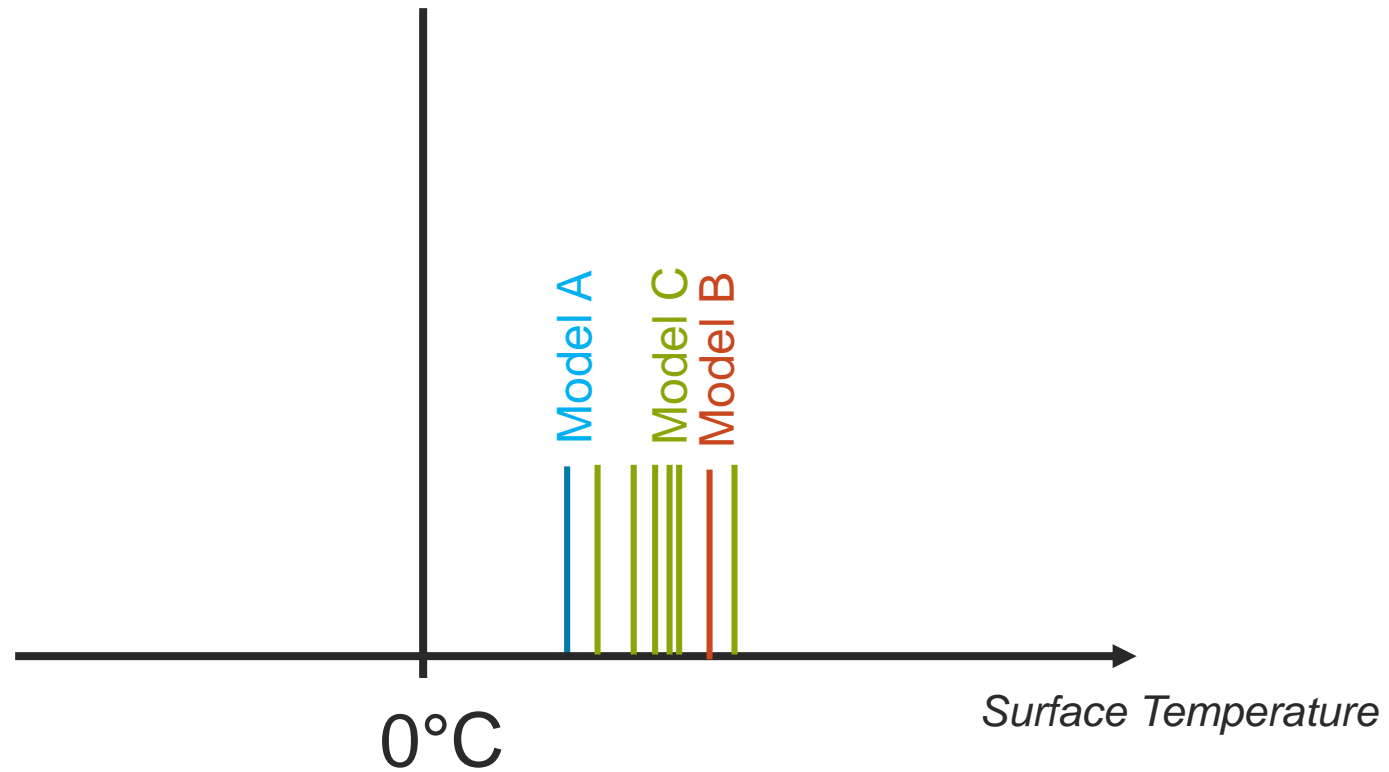
Norfolk County Council's 'gleeful' no-gritting tweet

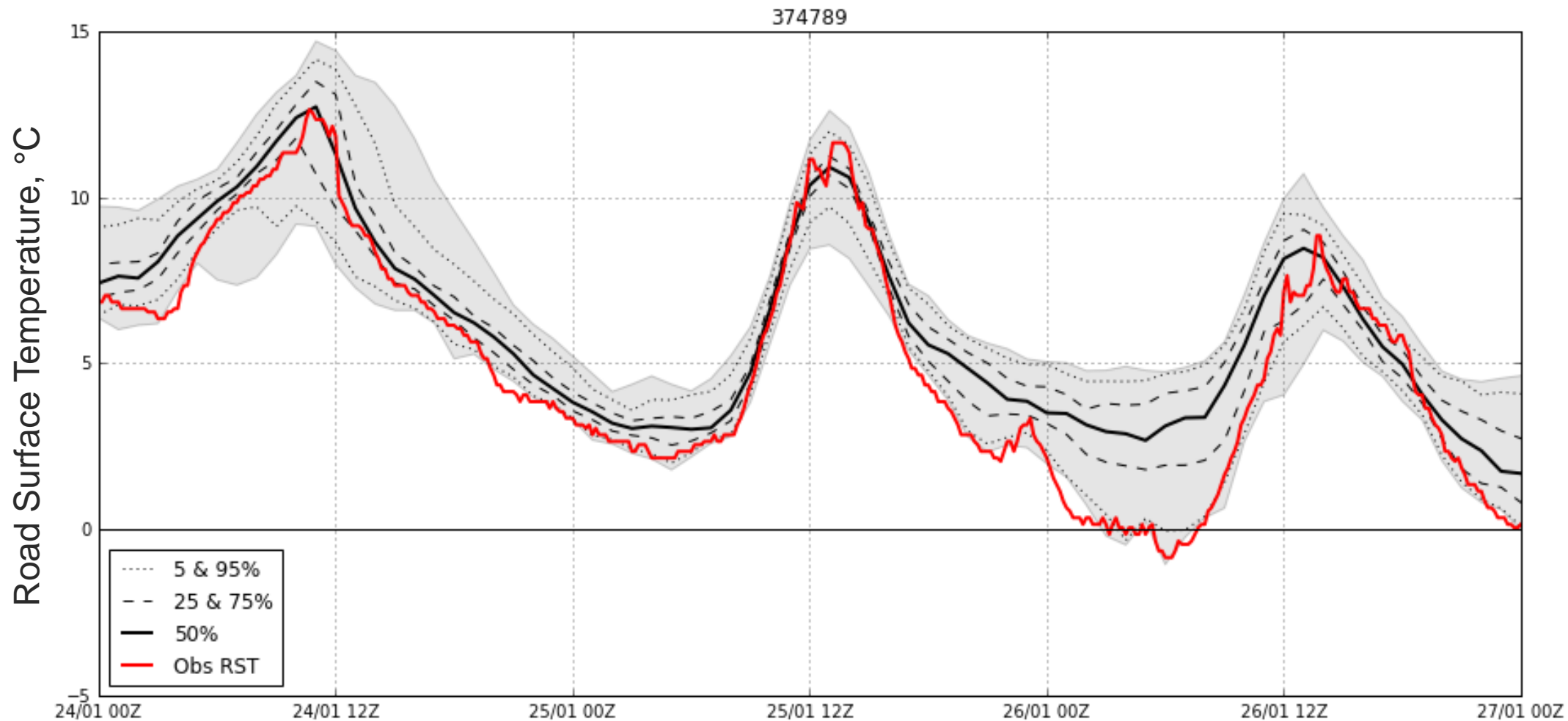
 26 January 2018

A council is facing a backlash for its "gleeful" tweet about not gritting Norfolk's roads, hours before a spate of crashes in icy conditions.

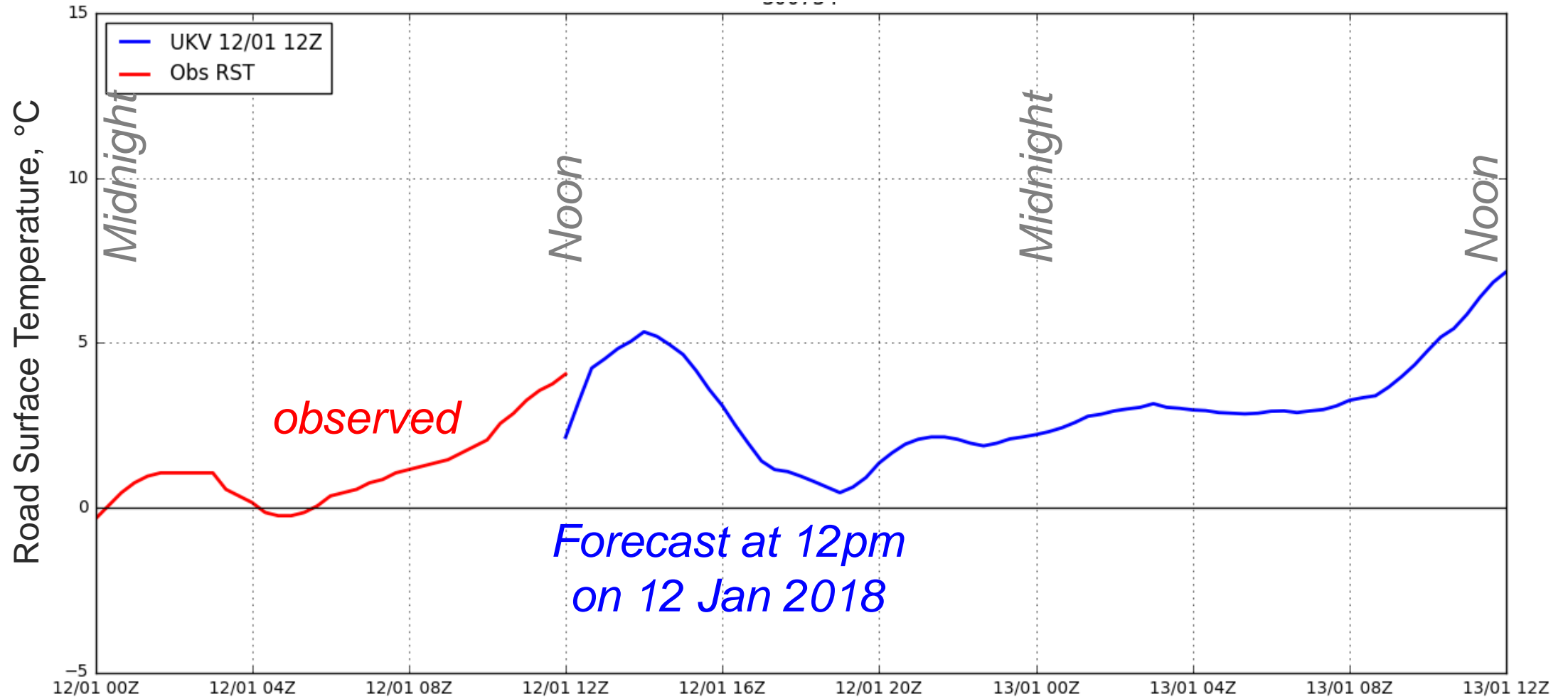
On Thursday, the county council's social media account said: "The sun has got it's [sic] hat on and there's no gritting tonight #NorfolkWinter".

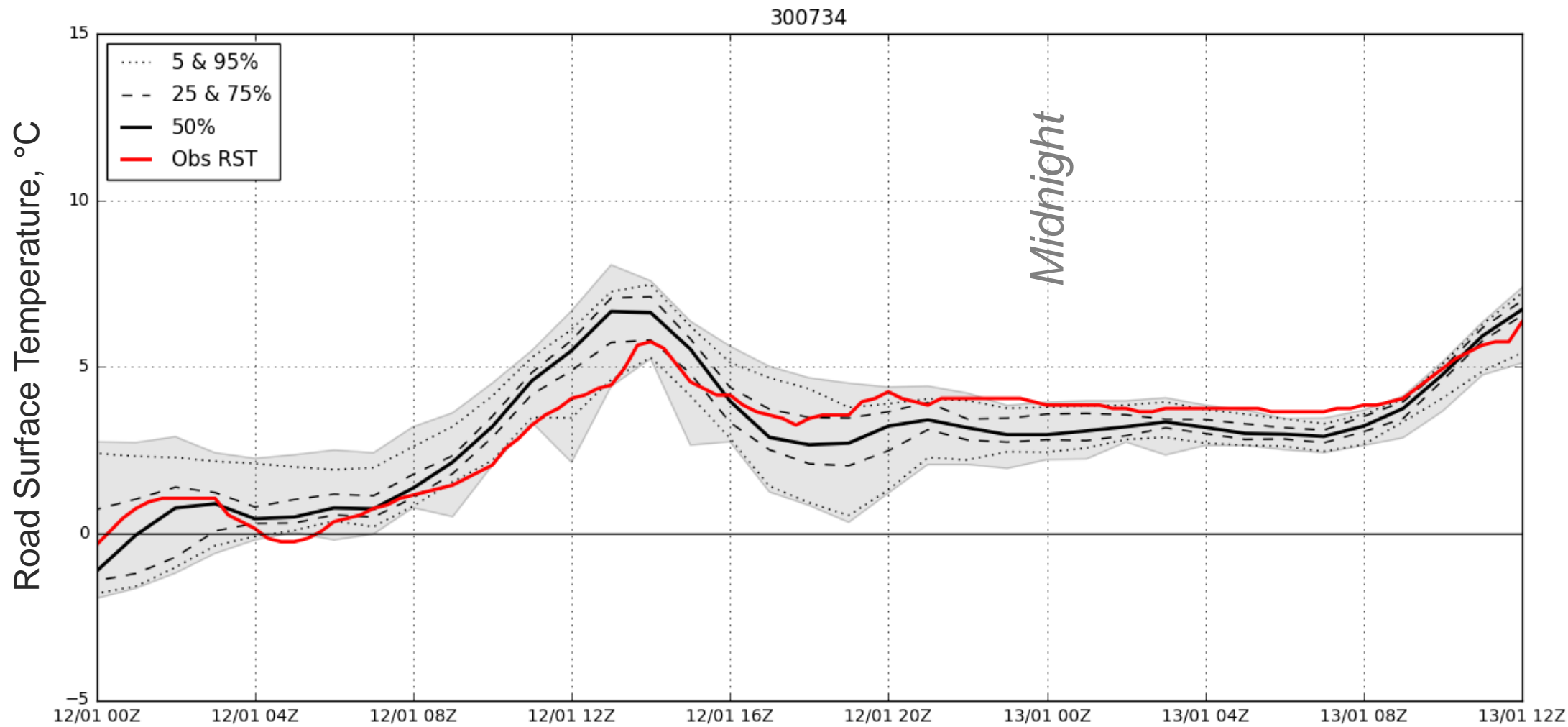
Probabilistic Forecasting





Another example: Herefordshire





Decision guidance case studies

Norfolk

Herefordshire

Deterministic min(RST)

3°C → No action 

0.5°C → Treat? 

Prob (RST < 0°C)

10% → Be ready

0% → No treatment?

... at what Pr(freeze) should action be taken?



*“The probability of incurring
loss due to a hazard.”*
e.g. a road incident due to ice

$$\text{Risk} = \text{Pr}(\text{hazard}) \times \text{Pr}(\text{loss} \mid \text{hazard})$$



mitigation decisions



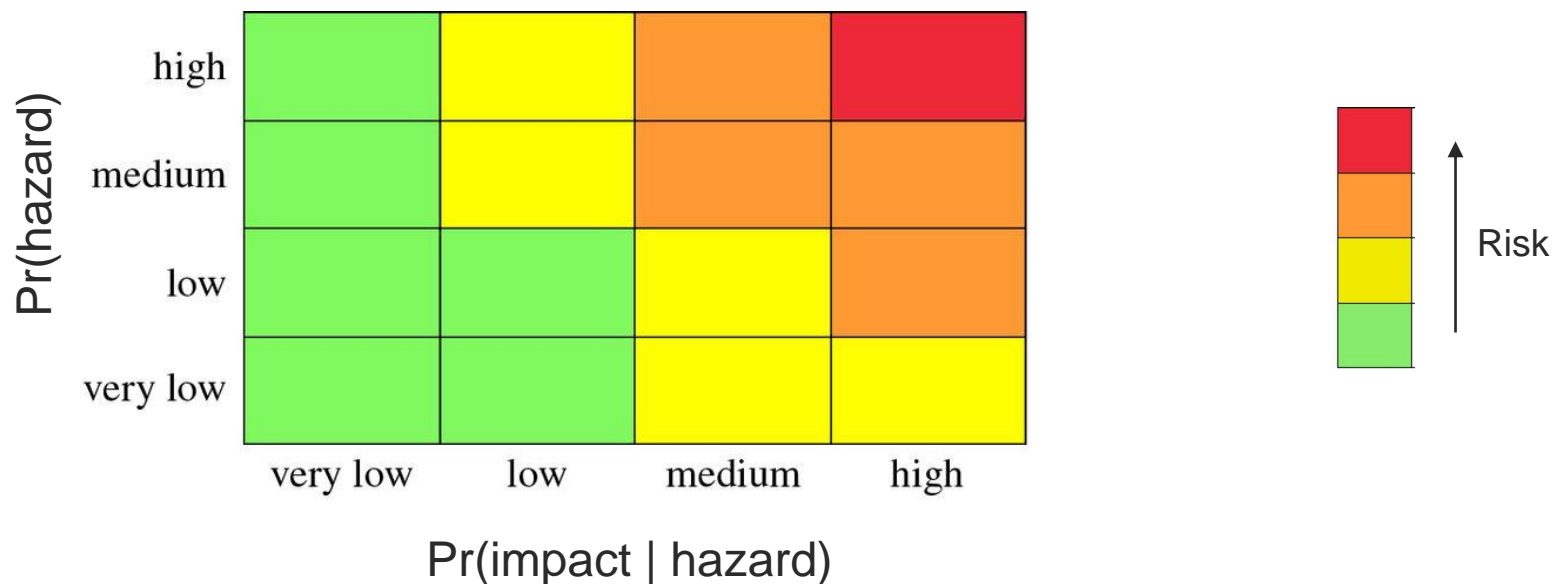
weather forecast



depends on location and time

Better Decision Support

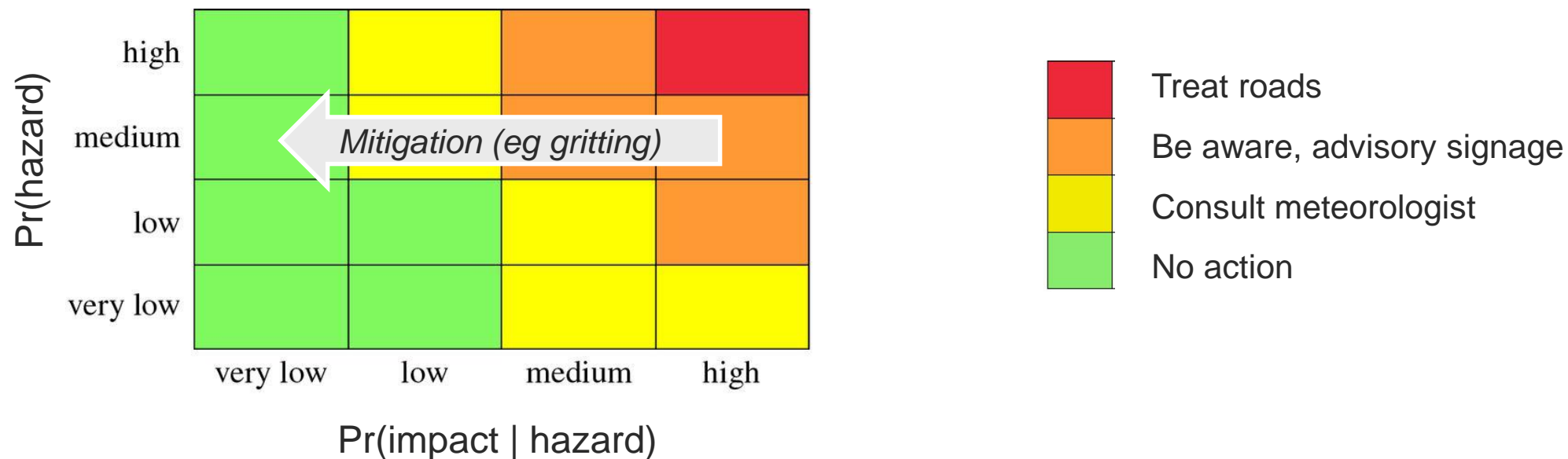
$$\text{Risk} = \text{Pr}(\text{hazard}) \times \text{Pr}(\text{impact} \mid \text{hazard})$$



after Economou *et al.* (2016)

Risk Mitigation

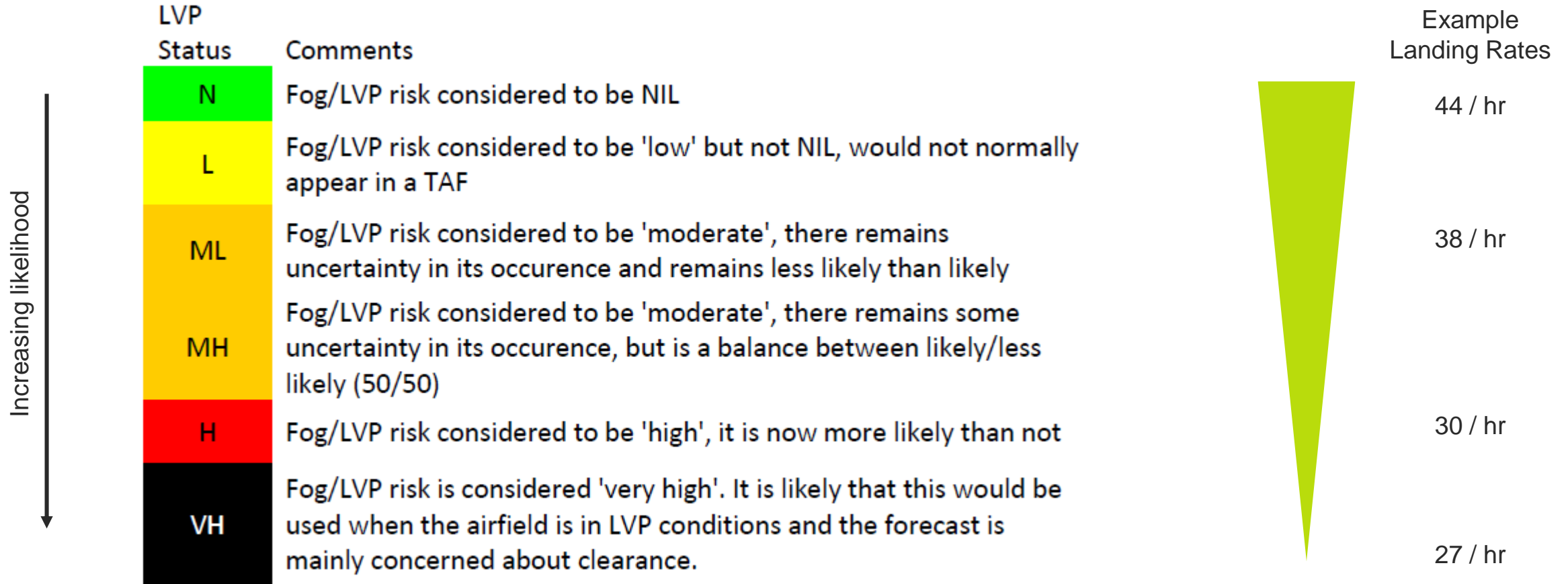
Reduce risk to as low as reasonably practicable (ALARP)



Case Study: Fog at Heathrow

Fog Forecast?	Example Landing Rates
No	44 / hr
Yes	27 / hr

Case Study: Fog at Heathrow



Summary

Issues

Binary, deterministic forecasts ignore useful information about uncertainty

Risk-based decisions are being driven by *hazard* forecasts

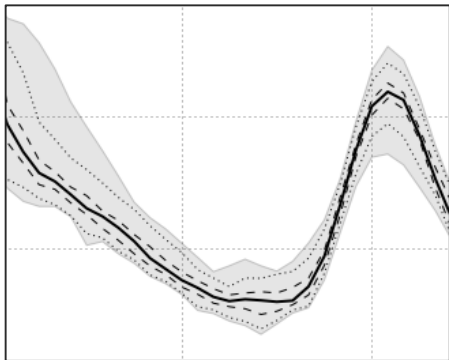
Goal

Driving more accurate and efficient decisions from forecast data

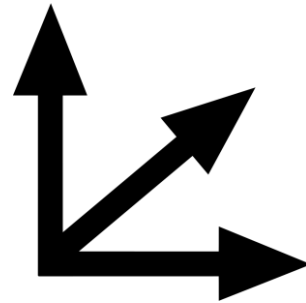
Challenge

Develop a decision support framework using probabilistic hazard and risk forecasting

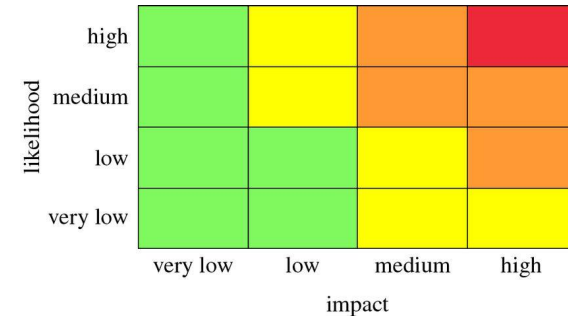
Future Forecasting Services



Probabilistic



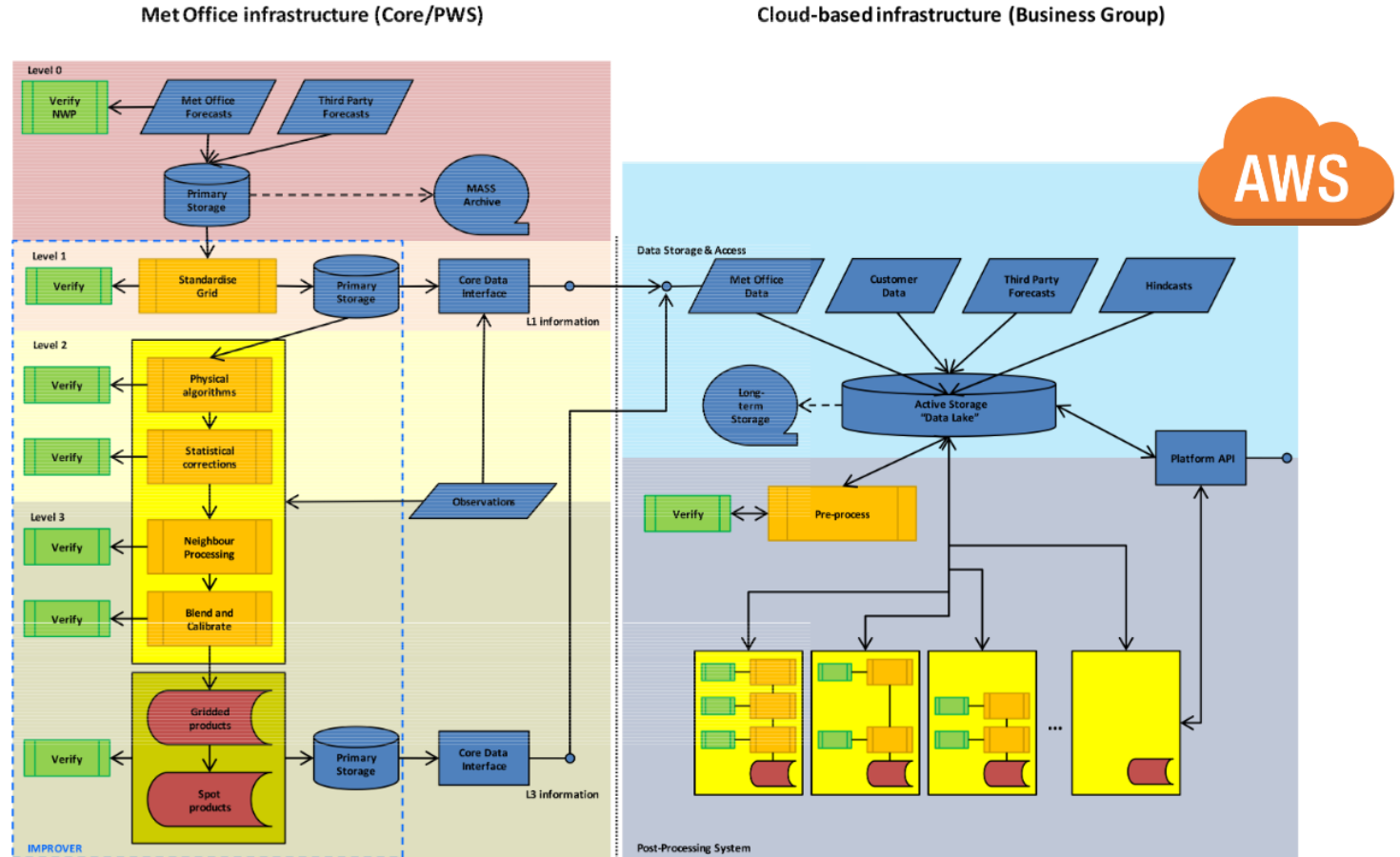
Multi-parametric



Risk-based
Decision Support

Met Office Cloud Platform

- Modular
- Scalable
- Flexible
- On-demand
- Accessible



The NWSRG Task

“To provide best practice guidance for the whole of the UK on the use of Weather Forecasting and RWIS to aid winter service decision making, using risk-based approach where appropriate”

Publication due October 2018

Task Briefing Note	NWSRG17/001
Objective	
To provide best practice guidance for the whole of the UK on the use of Weather Forecasting and Road Weather Information Systems to aid winter service decision making, using a risk-based approach where appropriate. This will form part of the NWSRG national guidance, which is linked to “Well-managed Highway Infrastructure”.	
Background	
The NWSRG are responsible for providing national guidance on winter service for use by highway authorities in the UK. A number of sections of the guidance have already been produced, including planning and decision making, de-icer types, spread rates, salt storage, treatment methods and gritter calibration.	
Guidance should be practical, based on current good practice and research, and scientifically sound. It should be easy for small and large authorities to afford, understand and implement. It is likely to be used in court.	
Well-managed Highway Infrastructure encourages the use of a risk-based approach, and this should be applied to this area wherever appropriate. Reference should also be made of the IHE Risk Liability Guidance.	
Scope	
The guidance should cover the following areas:	
Road weather forecasting:	Road weather information systems:
<ul style="list-style-type: none">- Short-range (up to 36 hours)- Medium range forecasts (2-10+ days)- Long range forecasts (15-30 days)- Seasonal forecasting- Site specific forecasting- Domain-based forecasting- Route-based forecasting (RBF) and thermal mapping	<ul style="list-style-type: none">- Road weather stations (forecast/non-forecast, sensor options, low cost IoT sensors, residual salt measurement)- Weather radar- Weather satellite- Pressure charts- Precipitation- Other useful weather information
The guidance should address the following questions:	
<ul style="list-style-type: none">- What infrastructure and data considerations are required from a highways authority to enable a forecaster to provide forecast information that supports the most effective decision making? (eg location and number of weather stations, information for RBF etc)- What are the advantages and disadvantages of text forecasts, site forecast, domain forecasts, thermal mapping and route-based forecasts in aiding effective decision-making and monitoring changes in weather forecasting?- What is the value of the range of weather station sensors to winter decision makers?- How should weather systems be effectively monitored for changes in the forecast that may require a change of action?- How can weather forecasts support a risk-based approach to winter decision making?	

Thank you



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