

Probabilistic Road Weather Forecasting



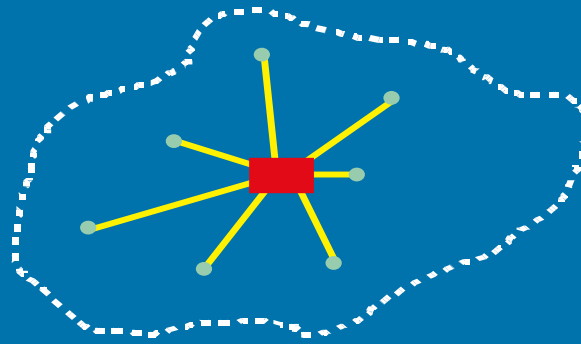
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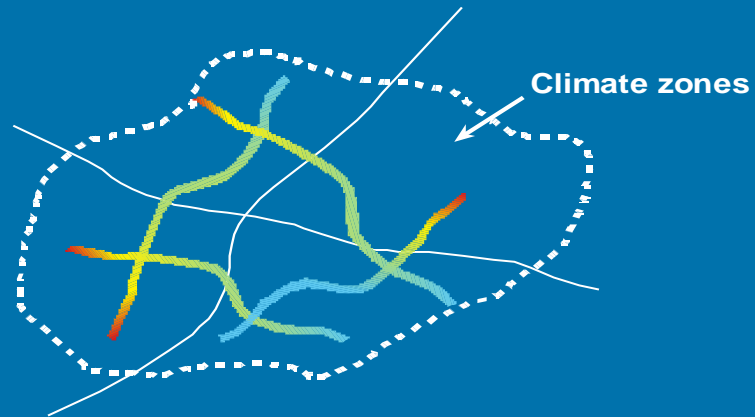
(A)

1984 ICE DETECTION



- outstations
- instation

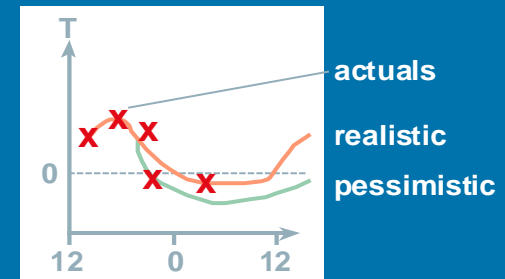
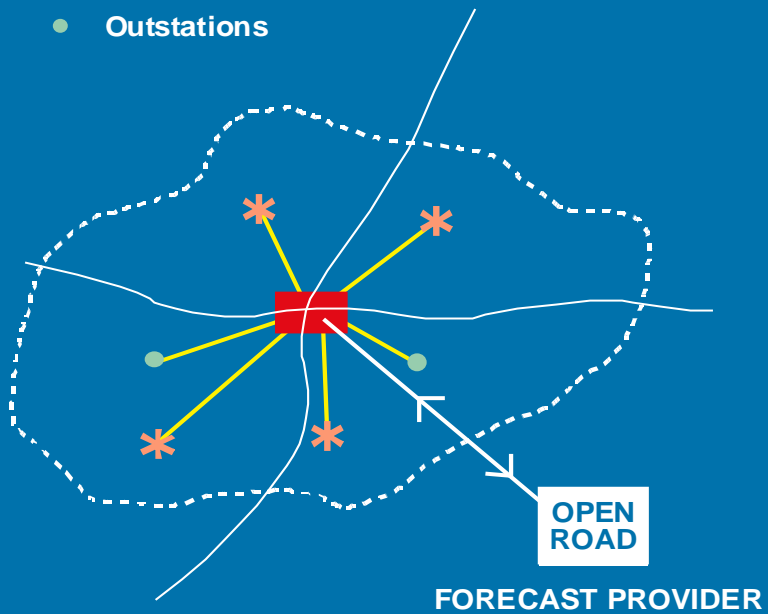
THERMAL MAPPING



First Thermal Map in UK - A9 Scotland April 1984

Ⓑ 1986 ICE PREDICTION

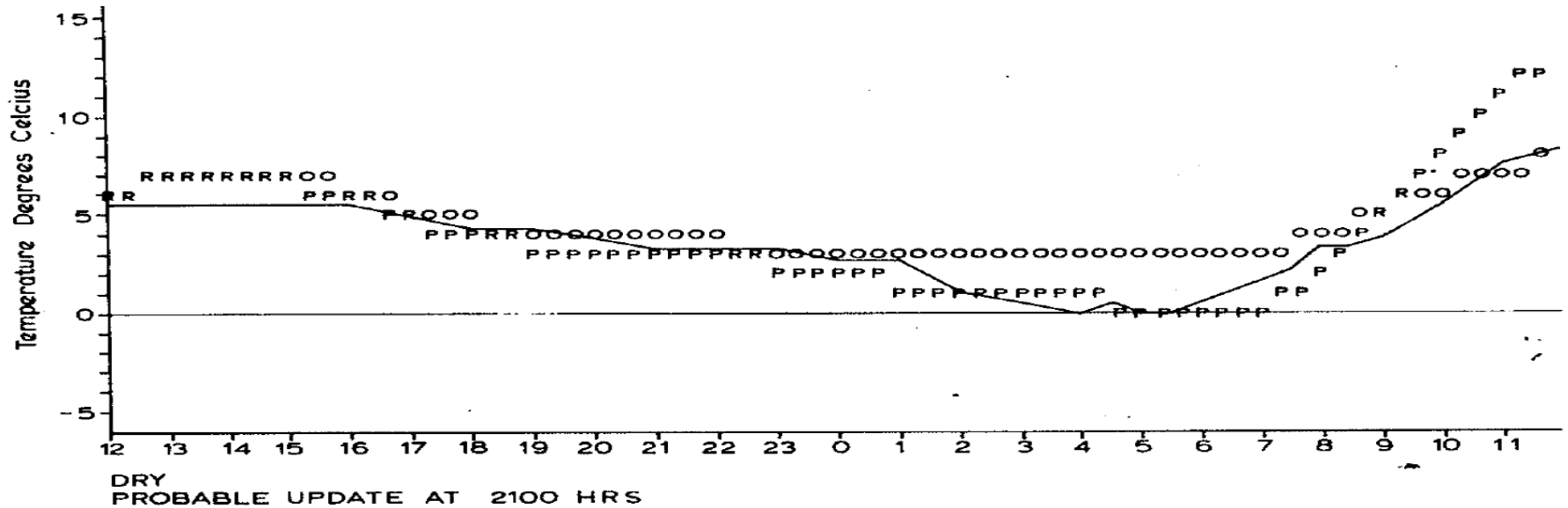
- * Forecast sites
- Outstations



Forecast Thermal Maps

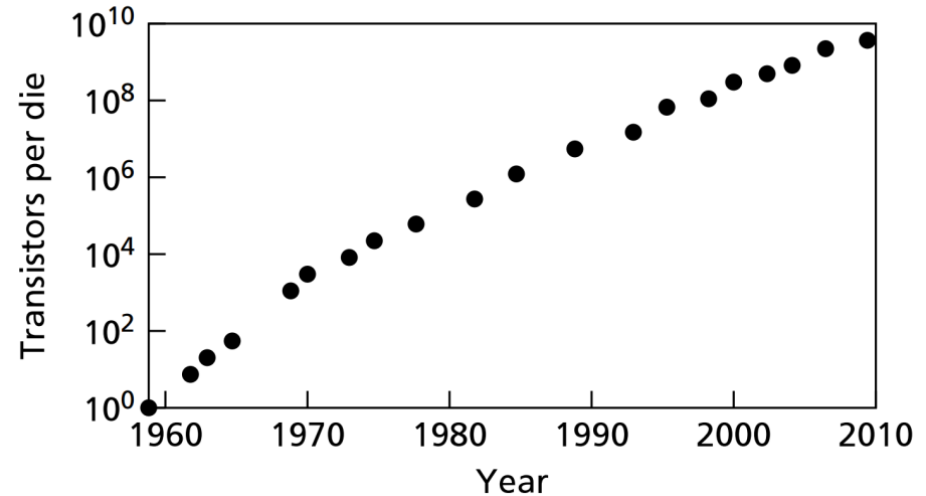
Probabilistic Forecasting (1980s style)

FORECAST GRAPH ISSUED DURING THE AFTERNOON OF 28th FEBRUARY 1984



Deterministic Forecasts

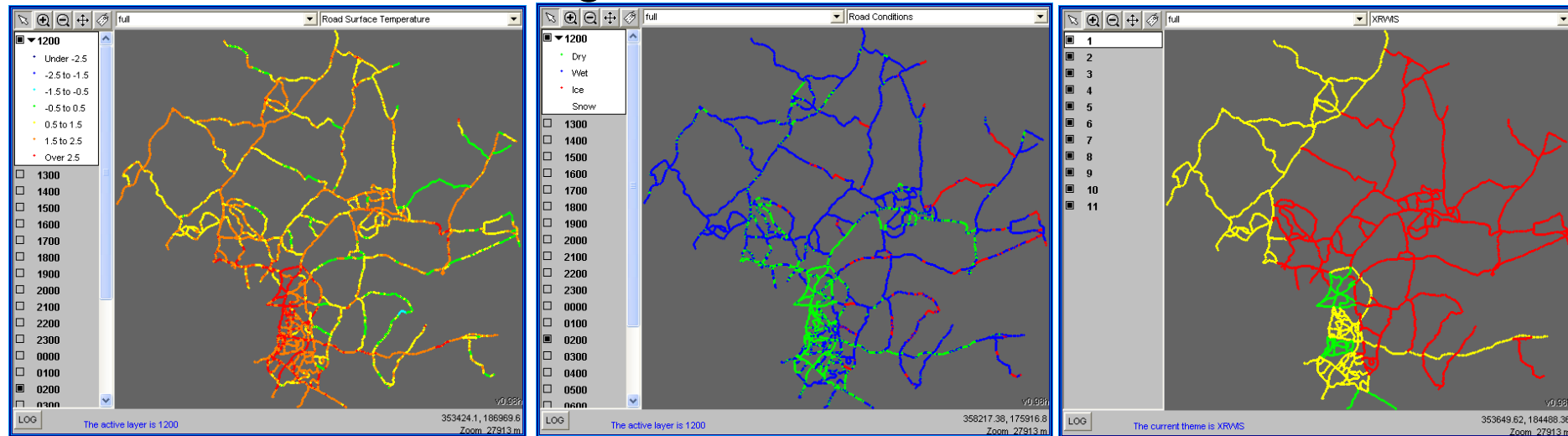
- ❑ Despite increasing computer power, road weather forecasts have remained deterministic in nature but...
- ❑ ...large advances in mesoscale models which drive the downscaling



- ❑ Increasing computer power has instead been used by the winter road maintenance community in other ways:
 - ❑ Salting Route Optimisation
 - ❑ Decision Support Systems
 - ❑ Route Based Forecasting

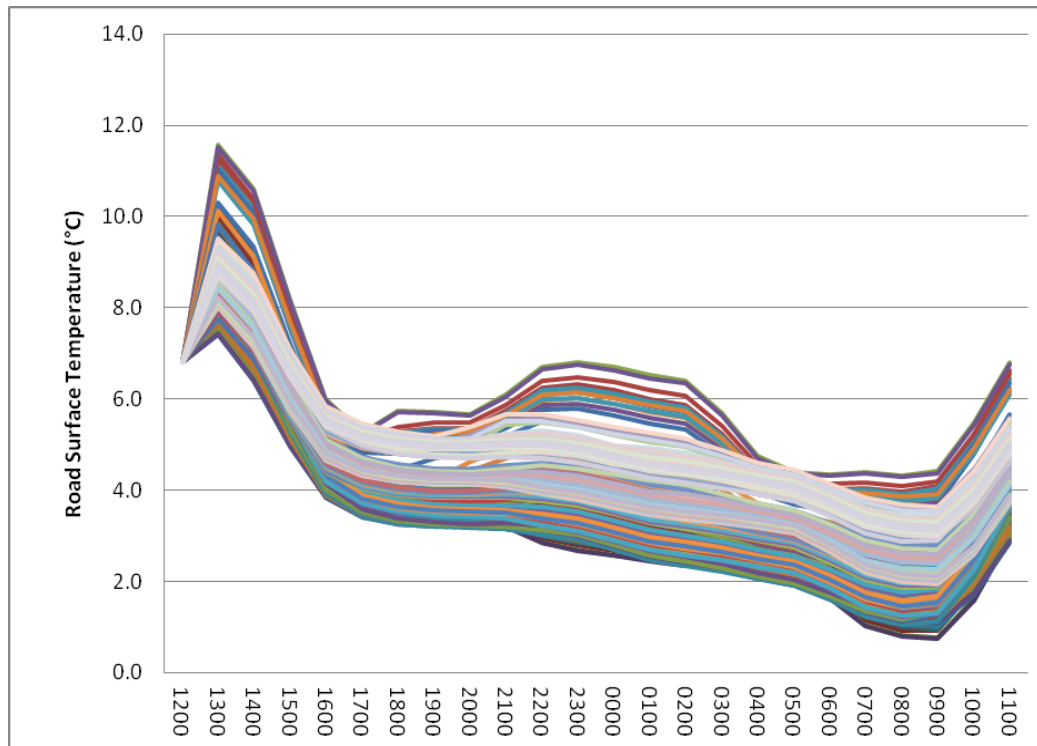
Route-based forecasting

- ❑ A new paradigm in winter road maintenance
- ❑ Spatial interpolations between 'point' outstations no longer reliant on thermal mapping
- ❑ Instead, interpolations are made by modelling the influence of geography on the road surface at 1000s of points around the road network.
- ❑ Essentially running the forecast model 1000s of times with little changes (perturbations) with respect to local geography
- ❑ Still deterministic though in nature...



Probabilistic forecasting

- ❑ Not difficult to scale up from route based forecasting...
- ❑ **Geographical Perturbations:** At the simplest level, each 'point' can be considered to be an ensemble member. This will capture the variation around the salting route on a single graph
- ❑ **Meteorological Perturbations:** If computational resources permit, the model can be run hundreds of times for each site



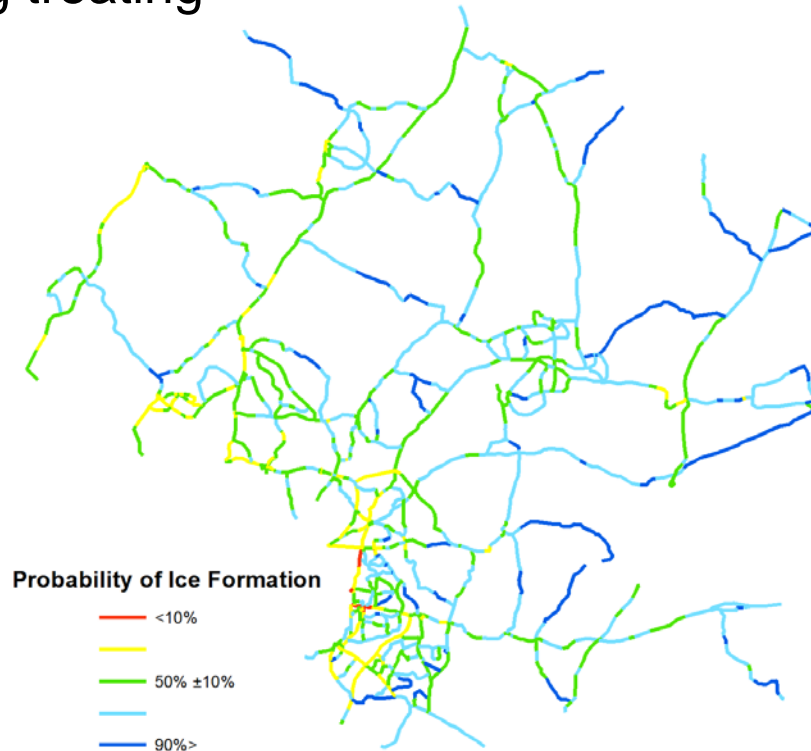
Emulators



- ❑ Route based forecasts can still take several minutes to run for an average size road network.
- ❑ Adding a probabilistic component will slow this down further.
- ❑ A statistical emulator can help here based on a Gaussian process approximation
- ❑ This would be very quick to run, but ultimately challenging to produce
- ❑ Computer power will eventually catch up...
- ❑ ...but is all this really needed by the winter maintenance community anyway?

Visualisation

- ❑ The original pessimistic and optimistic forecast didn't work, so why should this?
- ❑ How can the information be conveyed to the decision maker?
- ❑ Route based forecasting / decision support systems provide the ideal framework:
 - ❑ Probability of route needing treating
 - ❑ Probability maps



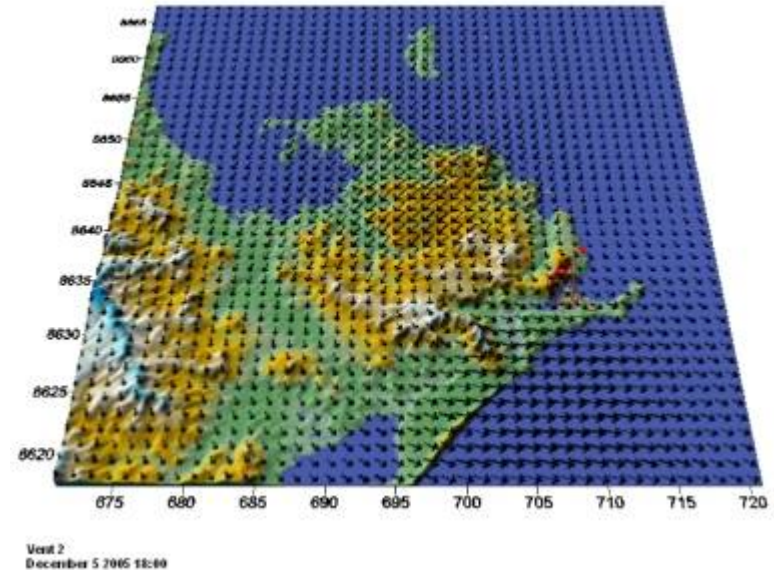
Usage

- ❑ The general public are comfortable with probabilistic forecasts, so the winter maintenance community should be...
- ❑ ...but, the consequences of a 50% chance of road ice (road traffic accident) is far less forgiving than a 50% chance of rainfall (not taking your umbrella to work)
- ❑ There will always be caution in the winter maintenance community.
- ❑ Can a standard probability be agreed on where uniform action is taken? (use of probabilistic forecasts to produce deterministic forecasts!)

- ❑ As computer power increases (or emulators developed), models can be run much further ahead...
 - ❑ Link with weather generators to project future winter road maintenance budgets.
 - ❑ Use to demonstrate to policy makers the likelihood of 'bad winters' before budgets are cut

Conclusion

- ❑ Route based forecasts and decision support systems are perfect frameworks for probabilistic forecasting.
- ❑ 'Sharp' forecasts still need work to make probabilistic forecasting usable (e.g. Bayesian Theory)
- ❑ Does the sector need it?
- ❑ Would the sector use it properly?
- ❑ Worth a trial, but the biggest long-term wins will probably come from further increasing the resolution of mesoscale models.



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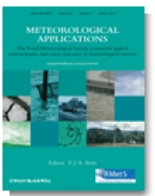
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