# Small-scale road surface temperature and condition variations

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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

❑Potential exists to leave the warmer routes untreated or eventually utilise selective salting practices such as dynamic routing
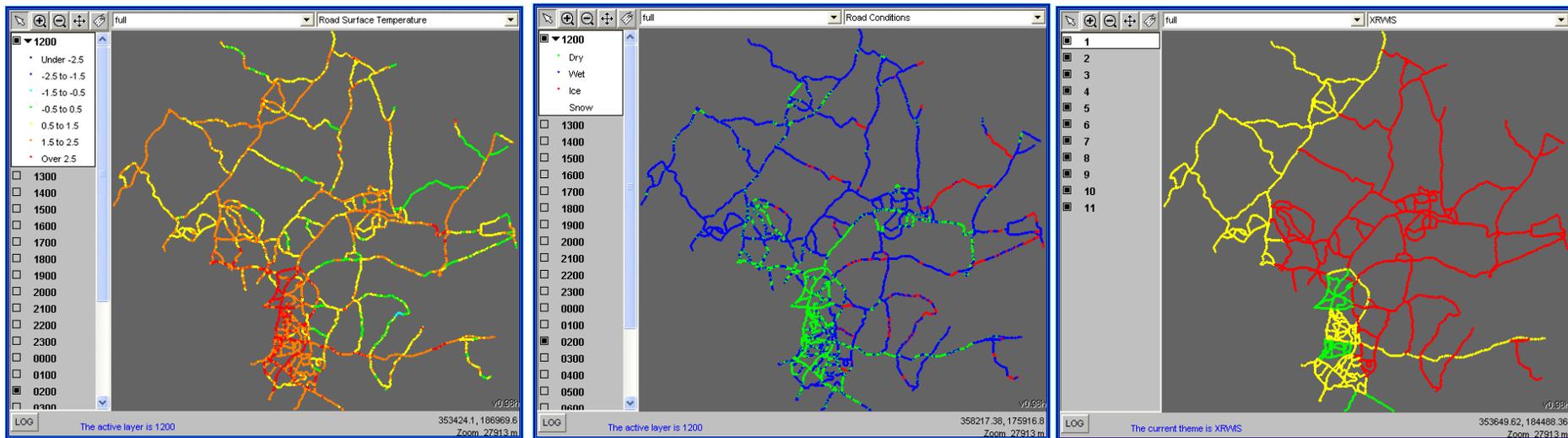
What resolution is required?

❑Forecasts typically provided for every 50m section of road

❑Is this too much information!?

❑Alternatively, is a 50m resolution sufficient to cover all the variations in geographical parameters?

Meteorological	Geographical Parameters	Road Parameters
Solar radiation	Latitude	Depth of construction
Terrestrial radiation	Altitude	Thermal conductivity
Air temperature	Topography	Thermal diffusivity
Cloud cover and type	*Screening*	Emissivity
Wind speed	*Sky-View Factor*	Albedo
Humidity / dew-point	Landuse	*Traffic*
Precipitation	Topographic exposure	

❑What about thermal singularities?
   ❑Bridge decks
   ❑Katabatic drainage

❑This presentation highlights this issue by looking at the cross road profile.

For the cross road profile, most of these parameters can be assumed constant. The exceptions are the sky-view factor and traffic.
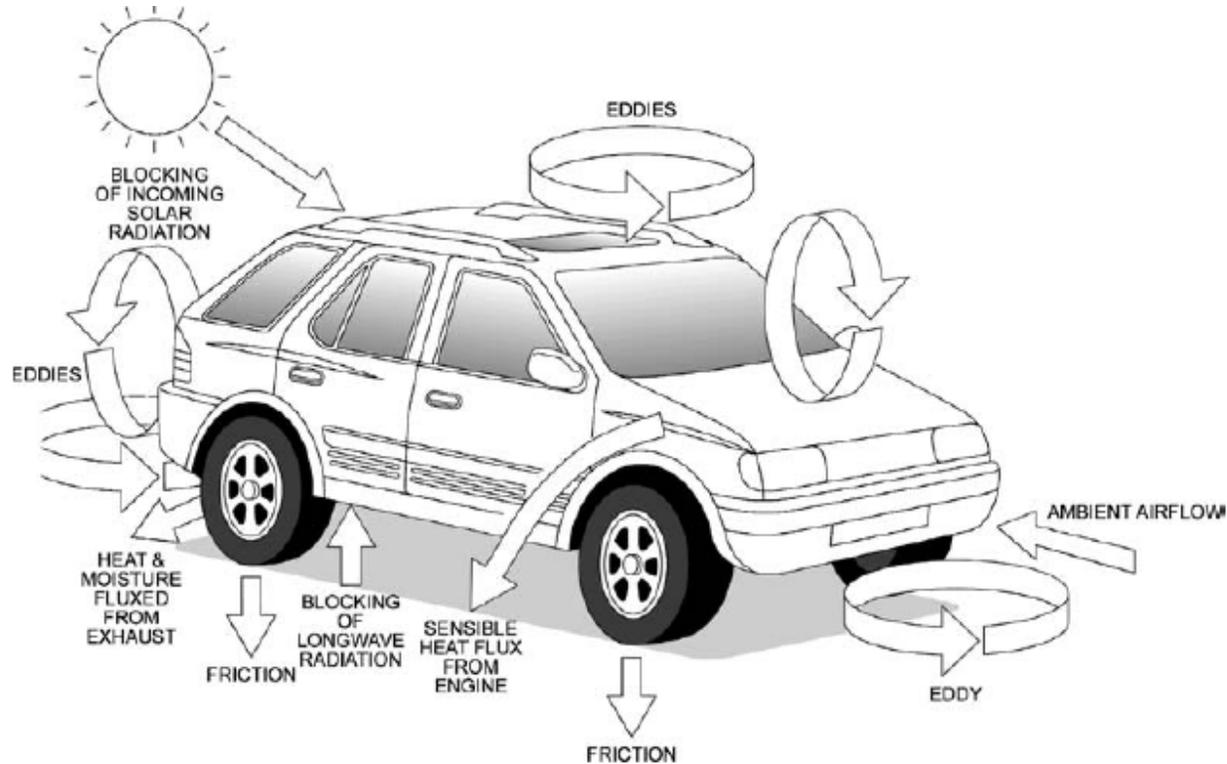
Sky-view factors & Screening

❑ A quantification of the amount of visible sky at a location.
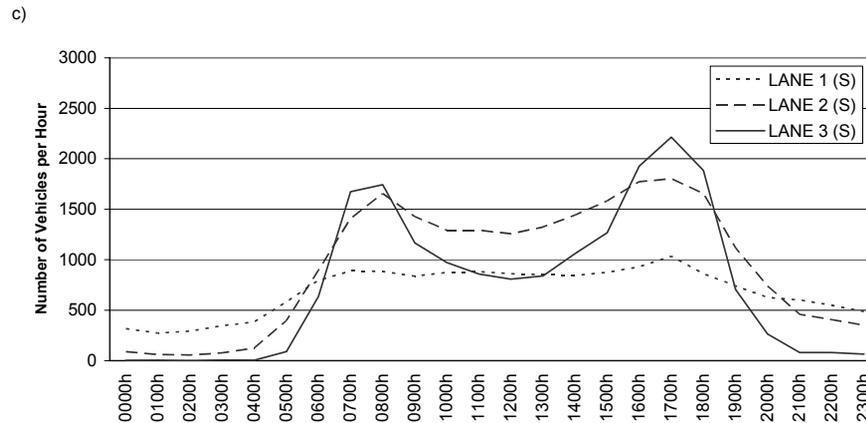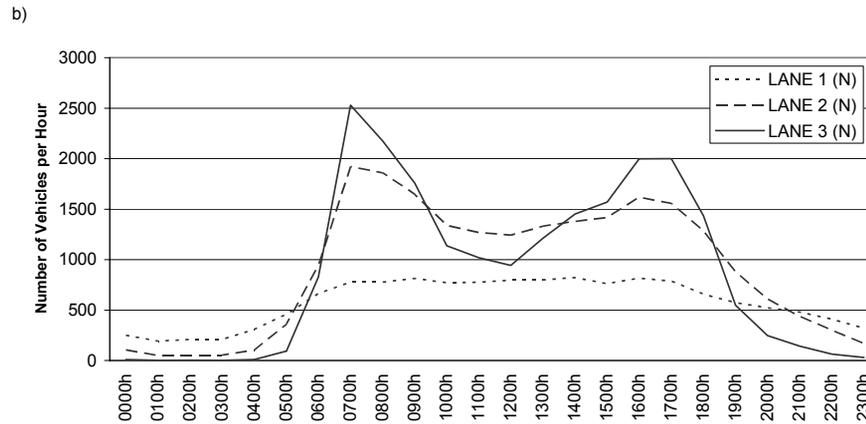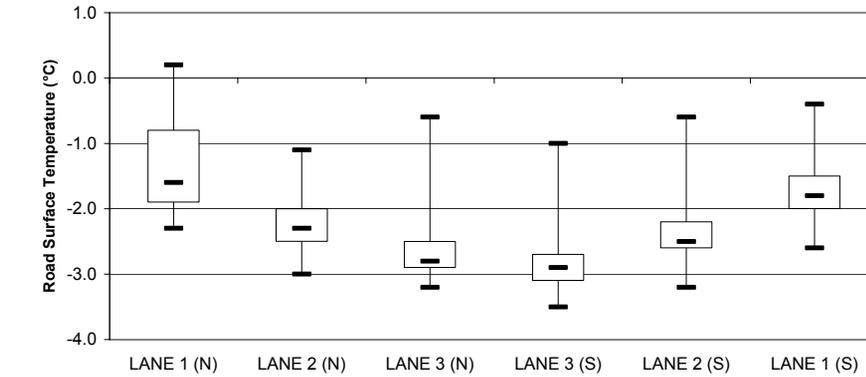❑ The dominant control on road surface temperature.

a)

b)

c)
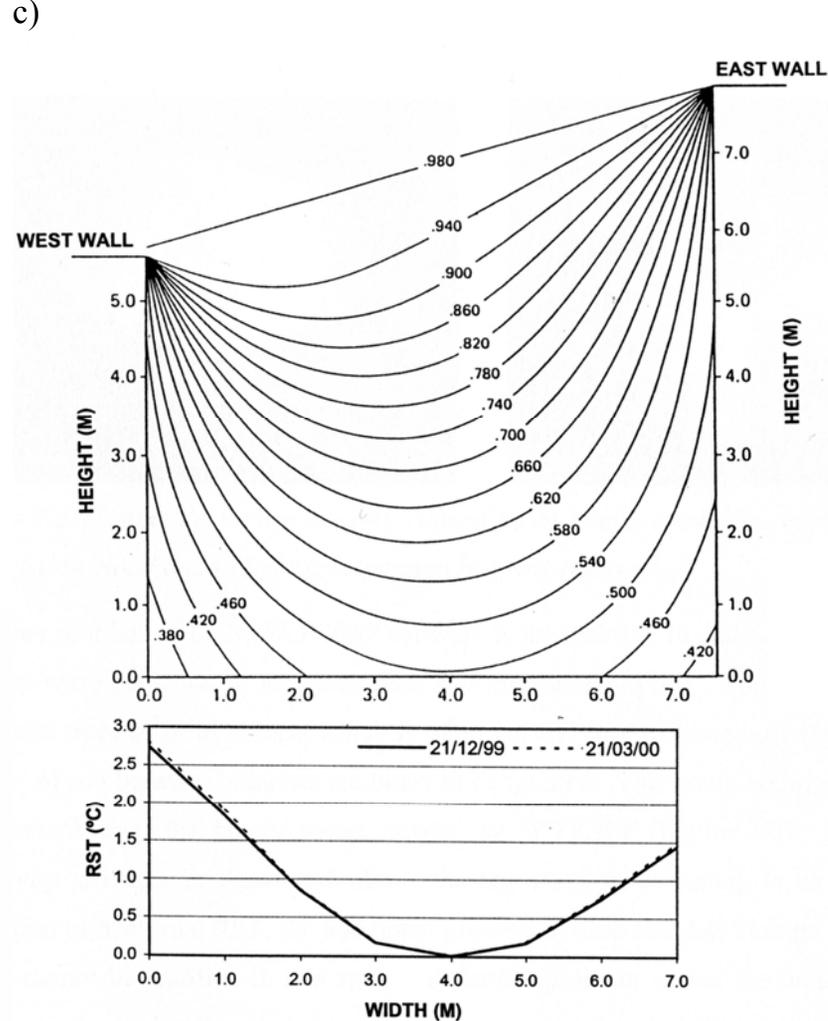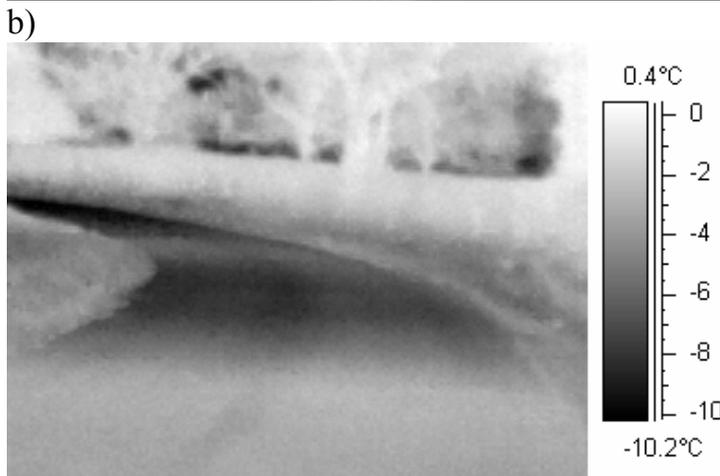
Traffic

❑A major control on road surface temperature and condition.
❑Responsible for a large number of processes:

❑Lead to a general increase in road surface temperatures of the order of 2ºC

❑Very difficult to model. Most studies are just based on measurements.

Effects of traffic on temperature

Effects of traffic on temperature

❑Previous studies are limited as they are reliant on 'point' data (even thermal mapping).

❑The result is that sampling will have been completed in the centre of each lane. This omits crucial data from the analysis:

❑The influence of tyre-tracks

❑Lesser trafficked areas to the edge of the profile.

❑This can be overcome by using thermal imaging techniques:

a)

b)

	No of Pixels	Minimum	Maximum	Difference
AR01	3750	-2.2°C	-0.1°C	2.1°C
AR02	3480	-1.4°C	-0.1°C	1.3°C

Effects of traffic on condition

❑What does this mean for variations in road condition across the road profile?

a)   b)

2006/12/07 11:21   2008/02/22 11:44

❑The effects are similar to temperature.

❑Increased temperature in the more heavily trafficked sections of the road promotes drying

❑Seepage is a further problem which results in the opposite effect

What resolution *is* required?

❑ 50m is probably sufficient resolution for route-based forecasting to cover most thermal singularities.

❑ There is plenty of capability in the systems to increase the resolution if needed.

❑ Variations in the cross profile introduce a new dimension!

❑ Where does it all end?

Variation in temperature in AR01 (approx 5cm by 20cm) =1.6°C!

-2.8°C
-3
-4
-5
-5.8°C

AR01
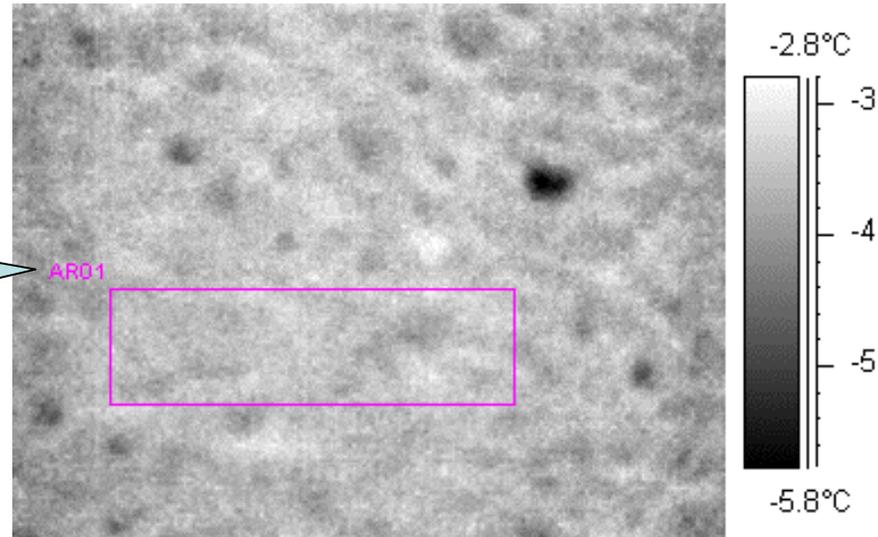
❑ Common sense has to prevail!

❑ But how can we account for all the variations when route based forecasts and thermal mapping techniques rely on 'point' data?

❑ Can thermal imaging be used in the new paradigm?

Some final thoughts…
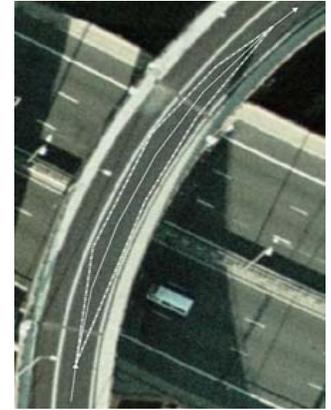
❑No driver (thermal mapper, surveyer or general motorist) takes exactly the same route.

❑Each driver will therefore experience different slipperiness caused by varying road surface temperature and condition.

❑Consider a marginal night:

    ❑*The forecast indicates that the main carriageway remains above freezing*

    ❑*The decision is made not to treat the network*

    ❑*The heavily trafficked lanes are above freezing, but just two metres away on the hard shoulder, the road has fallen below freezing and is now slippery.*

    ❑*Under these circumstances, the driver of a vehicle that deviates onto the hard shoulder is being put at risk and could be subject to an accident.*

    ❑*Does the engineer have a duty of care to protect that motorist?*

    ❑*In an environment of increasing litigation, the answer is yes.*

    ❑*The disadvantage is the financial and environmental burden of overtreating the network.*

❑Hence, can a case be made where we do not include traffic in route based forecasting models?

❑This then accounts for the worst case scenario encountered on the cross road profile.

❑All justified by increasing numbers of lawsuits?