New techniques for route-based forecasting

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Contents

This presentation covers the following areas

• Introduction
  • Producing a road forecast

• Adding local detail to road model
  • Correcting meteorology for the effects of small-scale hills and valleys
  • Representation of the effects of shading and skyview
Producing a road forecast

Meteorological models
(Global, high resolution regional, ensembles)

Road model
(Cold air pooling, shading, sky-view, construction, traffic etc)

Forecasters
(Modifications and consultancy)

• Other approaches may differ in detail (e.g. role for forecaster before road model; details of statistical correction methods etc)

• RBF needs both
  • accurate, detailed meteorology AND
  • local detail in road model
• Route-based meteorology needs both
  • Accurate, detailed meteorology
    • Use of state-of-the-art kilometre-scale NWP systems – paper 16
  • Local detail in road model
    • New techniques to represent the effects of hills and valleys not seen by the NWP model
    • Improved representation of shading and sky view effects
Representing the effects of small-scale hills and valleys
The best way to capture the effects of hills and valleys is to use an NWP model of high enough resolution to represent them explicitly.

- Hence moves to higher resolution (4km, 1.5km)

In practice, there will still be smaller features that have a significant impact on temperatures in reality:

- Need to represent their effects
  - Altitude-based correction
  - Valley correction
Altitude-based correction

- Temperature correction = (height real – height model) * (lapse rate)

- Lapse rate from model T-height relationship in area surrounding the point of interest
Valley pooling

• Air temperature observations from 3 stable nights
• All tend to show cold spots in valleys
• However, amount of cooling in different valleys varies from case to case
Development of observed cold pools

- Cold pools usually largely established by late evening

- Consistent with Gustavsson et al (1998) observations, and arguments that in-situ cooling rather than drainage is key
Idealized simulations

- Idealized research model simulations (Vosper and Brown, BLM, 2008) to understand cooling in valleys as function of
  - Wind
  - Cloudiness
  - Depth
  - Width
- Test against car survey data
Development of modelled cold pools

- Rapid development (as in observations)
- No sign of significant drainage effects
Sensitivity to valley depth

- Cold pooling increases up to a critical valley depth
- No further increases for deeper valley (turbulence already cut-off)
- Critical valley depth depends on stability (less deep valley required to cut-off turbulence on more stable night)
- Valley temperature correction predicted as a function of non-dimensional measure of stability (Froude number)
Shading and sky view
Shading and sky view

- Science well understood and easily represented in principle in an energy balance model
  - Shading reduces incoming short-wave radiation by day
  - Restricted sky view reducing net outgoing long-wave radiation by night
- Main challenge is correctly predicting when and where shading occurs, and where sky view is restricted
Comparison of GIS shading predictions with car RST measurements

• Excellent correlation between stretches of GIS-predicted shading and reduced RST

⇒ Use GIS to obtain shading and sky-view parameters to input in road model
Summary

• Key developments for route-based forecasting
  • High resolution NWP
  • New techniques for correcting effects of small-scale hills and valleys
  • Shading and sky view parameters
• End-to-end system being tested and refined
Questions