

Reducing costs and improving efficiency using Route Based Forecasting

P. Sachon
Met Office, UK.
patrick.sachon@metoffice.gov.uk

RÉSUMÉ

Réduire les coûts et efficacité en utilisant les prévision Météo-routes (RBF)

Le Met Office est un leader mondial dans la fourniture de services météorologiques et climatiques avec plus de 150 ans d'expérience. Nous travaillons en étroite collaboration avec notre clientèle routière pour lui permettre de prendre des décisions en toute confiance pour réduire les effets des conditions météorologiques en assurant une libre circulation en toute sécurité tout au long de l'année.

Météo-routes (RBF)

Les température de surface de la route et les conditions météorologiques peuvent varier considérablement sur différents tronçons créant des aléas quant au coûts de sablage et de salage d'hiver. RBF est un outil prévisionnel pour la route conçu pour aider à réduire les dépenses et améliorer l'efficacité opérationnelle en permettant aux clients (DiRIF, DRIEA, DRE et autres) de sélectionner les tronçons individuels plutôt que de traiter une route sur son ensemble. Ceci permet de réduire les dépenses de fonctionnement et les impacts environnementaux et permet de varier les traitements en fonction de l'exposition climatique de chaque tronçon de route. Les réserves de sel ou de sable peuvent être maintenues de manière plus efficace en utilisant RBF dans les opérations de traitements ou d'entretien des routes en hiver. Le Met Office fournit actuellement des prévisions pour plus de 350 routes au Royaume-Uni pendant l'hiver. Ceci permet aux services d'exploitation des routes d'améliorer leur efficacité, de réduire leurs coûts et a mieux gérer les activités hivernales, tout en réduisant l'impact du froid sur leurs réseaux routiers.

Le «Route Optimisation» ou RO est un service complémentaire qui optimise les données de températures des routes. Le «Route Optimisation» permet aux services d'entretien des routes d'optimiser le salage, de réduire les dépenses de carburant et éventuellement de réduire le parc de camions. Le comté du Devon a entrepris une optimisation de son réseau routier afin de réduire son budget annuel de €300.000 sans compromettre la sécurité routière. L'objectif était de réduire le kilométrage, le carburant, la flotte et les coûts de main-d'œuvre sans compromettre la sécurité. A ce jour, la direction de l'équipement du comté a réduit son budget €250.000 en réduisant le nombre de lignes de sablage en utilisant le RO.

Le «RBF» et le «Route Optimisation» fournissent une solution qui permet d'améliorer l'efficacité et de réduire les coûts des opérations de salage hivernal sans compromettre la sécurité routière.

Ce résumé explique brièvement les avantages budgétaires de l'utilisation des prévisions RBF et RO comparés aux services de prévision météorologiques routières classiques et démontre les avantages qu'offrent ces technologies à l'avenir.

ABSTRACT

Reducing costs while improving efficiency using Route Based Forecasting

The Met Office is a world leader in providing weather and climate services and we've been forecasting the weather for more than 150 years. We work closely with our road customers to enable them to make informed decisions with confidence that reduce the impacts of weather by ensuring roads flow freely and safely all year round.

Route Based Forecasting (RBF)

Road surface temperature and weather conditions can vary greatly on different routes creating uncertainty in the amount of the route that requires winter maintenance. RBF is a road weather forecasting development designed to help reduce expenditure and improve operational efficiency by enabling road customers to

selectively grit individual routes rather than an entire domain. This makes it possible to reduce operational expenditure and environmental impacts and gives the option of applying variable treatments to routes. Salt reserves can be maintained more effectively by using RBF within winter road maintenance operations. The Met Office provided forecasts for over 350 routes in the UK throughout the winter period of 2011 to 2012, helping customers improve efficiency, reduce costs to streamline winter maintenance activities and reduce the impact of cold weather on their road networks.

Route Optimisation can be used to further improve the efficiency of winter maintenance operations and build on the cost benefits achieved by using RBF. Route Optimisation ensures winter maintenance services are delivered in the most efficient way possible, reducing fuel expenditure and potentially enabling fleets to be reduced. Route Optimisation using climatology provides an additional level of benefit over traditional Route Optimisation techniques. Devon County Council (DCC) undertook a climatologically enhanced Route Optimisation of its network. DCC wanted to save £250k from its annual winter maintenance budget. With road safety and efficiency in mind, the aim was to reduce mileage, fuel, fleet and labour costs without compromising safety. So far DCC has saved £200k by reducing the number of gritting routes through a climatologically enhanced Route Optimisation.

RBF and Route Optimisation provide a solution to help improve the efficient and cost-effectiveness of winter maintenance operations without compromising road safety.

This paper highlights the cost benefits of using Route Based Forecasting and Route Optimisation when compared with classic road weather forecasting services and looks at the opportunities these technologies offer for the future.

1. BACKGROUND

Route Based Forecasting (RBF) is a road weather forecasting development designed to enable treating of road surfaces on a route by route basis. Whereas traditional Domain Based Forecasting techniques only allows an “all or nothing” approach to treating the routes within the domain.

The forecast model is run for a string of locations approximately every 500m along a route. This information is then summarised into a segment (consisting of ~5 forecast locations) and then a route (consisting of ~10 segments). Each forecast location takes into account factors such as, orography, shading by buildings or trees, skyview, traffic speed, traffic volume and road construction.

The concept of RBF is becoming increasingly popular among winter maintenance authorities and is seen as having the potential to reduce the overall operational cost of winter service by enabling people to grit on a route by route basis. The level of interest in the RBF system can be measured by the increase in the number of individual routes that the Met Office has been asked to provide forecasts for over the last few winters: from around 50 forecasts in 2008/09 to over 250 forecasts during the winter of 2010/11. Through the winter of 2011/12 the Met Office provided forecasts for over 350 routes in the UK. This helped customers to improve efficiency, reduce costs to streamline winter maintenance activities and reduce the impact of cold weather on their road networks.

As well as having the potential to improve operational efficiency on a day-to-day basis, RBF can also be used as a powerful tool in the route optimisation process. This is not only as an aid to the process itself but also as a basis for the provision of forecast information following optimisation in order to make the most of the optimisation process.

Gritting particular routes instead of all routes within a domain is considered to generate significant savings for the customer as costs are reduced from selective gritting. With tightening winter maintenance budgets and ongoing austerity measures, proving actual

cost savings from using RBF over Domain Based Forecasting is more essential than ever and is a key requirement for those considering RBF.

2. AIM

The aim of the study, carried out by the Met Office, was to investigate whether RBF may offer increased savings to the customer on marginal nights*, due to the reduction of gritting treatments required, in comparison to following domain based forecasting guidance.

*Marginal nights are defined as a night when the road temperature is expected to be very close to freezing (normally within 2 °C).

2.2. Objectives

There were two objectives for this study:

Objective 1: To focus the analysis on marginal nights where Domain Based Forecasts recommend gritting all routes while, in contrast, RBF recommends gritting selected routes to indicate the cost savings and reduced environmental impact in gritting selectively by route on marginal nights

Objective 2: To examine forecast examples for several Met Office customers including customers from different segments, such as local authorities and contractors, and if possible by representing different regions within the UK to give a fair representation across a range of geographical area.

3. METHODOLOGY

To demonstrate the value of RBF; an analysis of Domain Forecasts verses Route Based Forecasts was carried out on marginal nights to recognise variations between the two forecasts.

The evidence was collected in the form of Domain and RBF text forecasts that are available to the customer within Met Office's OpenRoad platform*.

Five customer organisations segments from across the UK were selected for analysis, these were as follows:

- Lancashire County Council (North England, UK)
- Balfour Beatty Mott Macdonald Highways Agency Area 10 (North England, UK)

*OpenRoad is a weather forecasting package specifically designed by the Met Office for the road sector to help minimise the effects of weather on the roads. Forecasts can be received in a range of delivery channels including text summaries or via an interactive website.

- Lincolnshire County Council (Midlands, UK)
- Wiltshire County Council (South West England, UK)
- Enterprise Mouchel Ltd. Highways Agency Area 1 (South West England, UK)

3.1. Study period

This analysis took place during periods during the winter with significant numbers of marginal nights in the United Kingdom during January to March 2013.

Figure 1. Examples of Met Office Domain and Route Based Forecast output used for the study. In this example all of the Domain Forecasts have an 'Amber' readiness status. This leaves the customer with a difficult decision about which routes to grit within the domains.

The Route Based Forecast output indicates that several routes within the domains actually have 'Green' readiness which indicates that these routes do not require treatments.



24 Hour Domain Forecast Update for Lincolnshire

Valid from noon on Sunday 27 Jan 2013 to noon on Monday 28 Jan 2013

Update Headline: Freezing times brought forward across Trent Valley, Wolds, Coastal and Grantham. Update to wind detail. Otherwise no changes to previously issued forecast.

Forecaster Commentary: Assessment of RBF and Site-Specific Data

Good guidance given by the graphical forecast information today. Slight uncertainty regarding extent of showers this evening, although timings of showers from graphs should not be taken literally.

Minimum Temperature and Hazard Summary

Domain	Readiness Colour	Min RST	Time Below Zero	% Prob Ice	% Prob Hoar Frost	% Prob Snow (cm)	Fog	Strong Wind	% Prob Rain
Trent Valley	AMBER	MS01	0100-0900	60	30	0	N/H	Y/H	30
Lincoln Ridge	AMBER	MS01	0100-0900	60	30	0	N/H	Y/H	30
Wolds	AMBER	MS02	2300-0900	60	40	0	N/H	Y/H	20
Coastal	AMBER	MS01	0100-0900	60	40	0	N/H	N/H	20
Grantham	AMBER	MS01	0100-0900	60	30	0	N/H	N/H	30
Fenland	AMBER	MS01	0200-0900	60	40	0	N/H	N/H	30
Wisbech	AMBER	MS01	0300-0900	40	30	0	N/H	Y/H	20

4. RESULTS

Results were calculated by measuring route lengths and the amount of road to be gritted for each Domain and for each individual route using RBF. The total savings per km were then calculated for RBF over a period of marginal nights.

Figure 2. Results of the study comparing the distance that would have been treated using a Domain forecast compared with using an RBF forecast.

Customer	Km saving from using RBF	Average saving from using RBF per day on marginal nights	Average % of network
Lancashire County Council	5,222 km (eight day period)	652.7 km	26.41%
Balfour Beatty Area 10	1,913 km (seven day period)	273.3 km	22.73%
Lincolnshire County Council	2,057 km (five day period)	411.3 km	13.91%
Wiltshire County Council	123.2 km (two day period)	61.6 km	27.01%
Enterprise Mouchel Ltd. Area 1	54.29 km (one day period)	54.29 km	8.87%
Total average % of network			19.7%

5. DISCUSSION

Findings concluded that all five customers that were studied made significant savings by using RBF instead of Domain Forecasting. As route lengths and road conditions vary, some customers experienced higher savings from using RBF, as shown in the results table.

Enterprise Mouchel Ltd. Area 1 and Wiltshire County Council's average savings from using RBF appear to be relatively low in comparison to other customer routes. It is expected that this is due to limited data collection and it is expected that these savings would increase if there was more available marginal night data.

As the forecasts were collected between January and March 2013 there are limitations in the time period with the results covering one day to eight day periods. Using a larger set of data over a longer period of time, with all customers having consistent days, would provide a clearer indication of average savings per marginal night. The average number of

marginal nights per winter is 1:3 (equivalent to circa 70 nights per winter). This study used a maximum of an eight day period so is unrepresentative of an entire season.

Findings suggest that, on average, 20% of the total network does not require treatment when use RBF instead of Domain Based Forecasts.

In addition to using RBF there are several ways that customers could further enhance the efficiency of their winter maintenance operations. One option is Route Optimisation which is a solution that can further improve the efficiency of RBF. Route Optimisation involves a review of winter maintenance operations and regional climatology to optimise the use of resources without reducing the number of treated routes. Route Optimisation ensures winter maintenance services are delivered in the most efficient way possible, reducing fuel expenditure and potentially enabling fleets to be reduced. Devon County Council (DCC) undertook route optimisation on its network in order to save £250k from its annual winter maintenance budget. DCC has saved £294k by reducing the number of gritting routes through a climatologically enhanced route optimisation, a saving of 8% of their total budget.

A further innovation that could yield additional savings for customers is selective treatment or dynamic routing using segment level RBF data. When RBF is set up for customers each route is broken down into sections of road with similar meteorological characteristics. A forecast is produced for each 'segment' of the route and this data is aggregated to produce a forecast for the whole route. This segment level data could be used to further enhance winter maintenance operations by treating sections of routes differently or dynamically routing winter maintenance vehicles to treat the sections of each route that require treatment. Early work on this by the Met Office and Exactrack in the UK has suggested that substantial savings could be made by harnessing the RBF segment level data together with innovative equipment in winter maintenance vehicles. Further work in this area is required to fully understand the potential impacts of this new technology.

6. CONCLUSIONS

- From the pilot study it is estimated that Route Based Forecasting has a 10% saving on expendables i.e Fuel, Labour, Deicing chemical
- From the Devon County Council Route Optimisation achieved an 8% saving on expendables and assets.
- A longer time period time is needed to improve the calculated savings due to RBF.