



Met Office



Developments in Weather Forecasting

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A Bit About Me

Steven Wallace Joined Met Office in 2012

- Account Manger – Road
- Account Manager – Rail
- Integration specialist
- I.T Background
- Business improvement program co-ordinator


The forecasting process




Observations from space



Upper-air observations



Surface observations

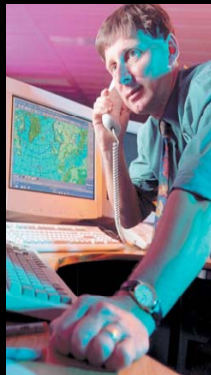


Weather radar

Supercomputer processes and produces information

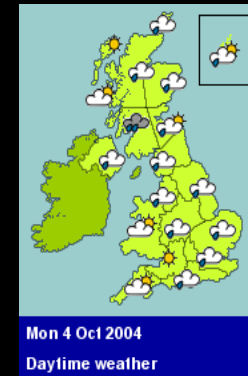


Filter out 'dodgy' data



Forecaster uses this information to produce

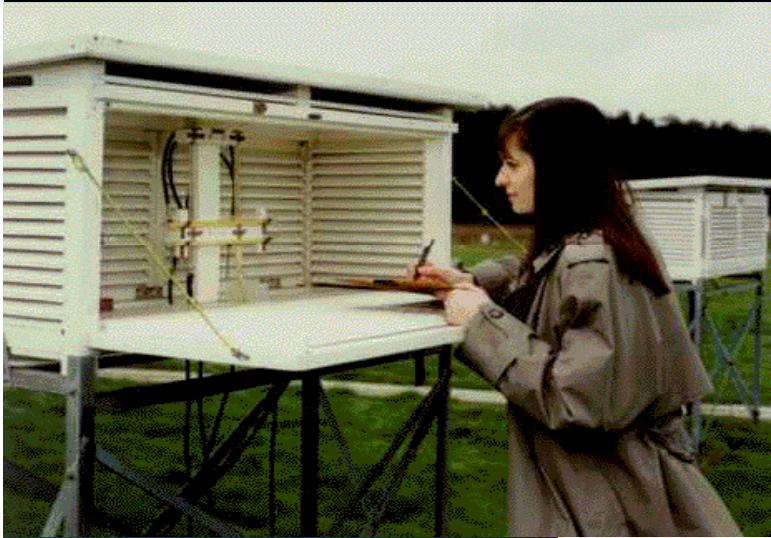
A weather forecast!





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Sourcing weather observations





Ground-based Weather instruments





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Supercomputer

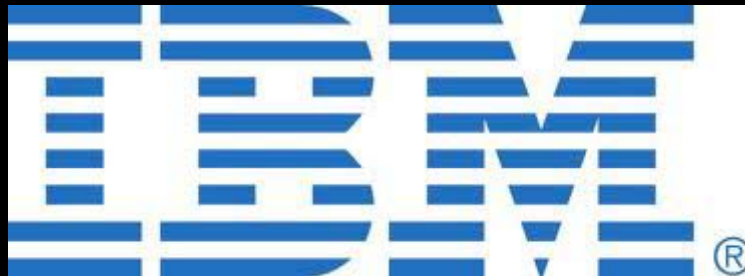
- IBM, 400 trillion calculations per second
- Equivalent to 400,000 PCs





IBM Supercomputer

- New Power 7 installed summer 2012
- Four times faster than previous computer
- Better climate and weather forecasts





Met Office Numerical Weather Prediction (NWP) Models

Previously
40km
Upgrade 2010

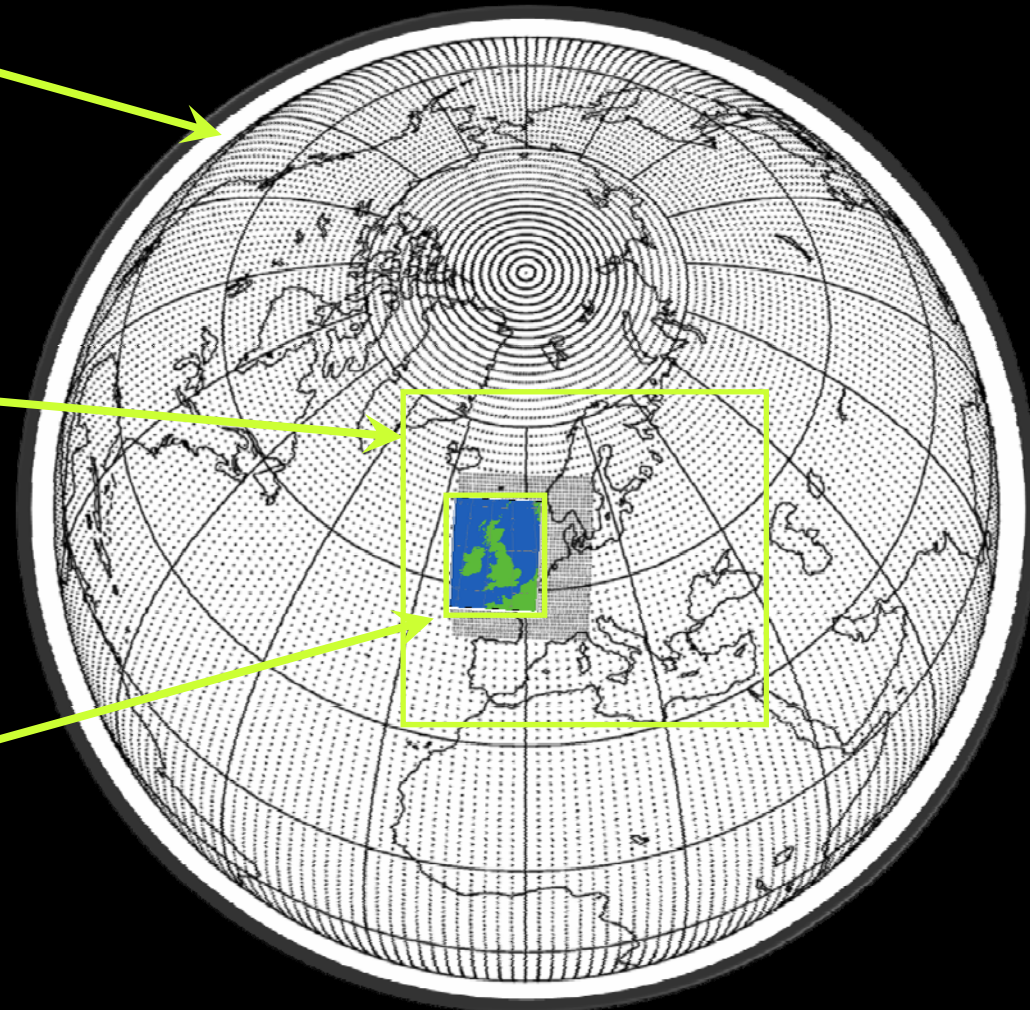
Global
➤25km

Previously
12km
Upgrade 2013

Euro4
➤4.4km

Previously
12km
Upgrade 2006
4 KM
Upgrade 2012

UKV
➤1.5km





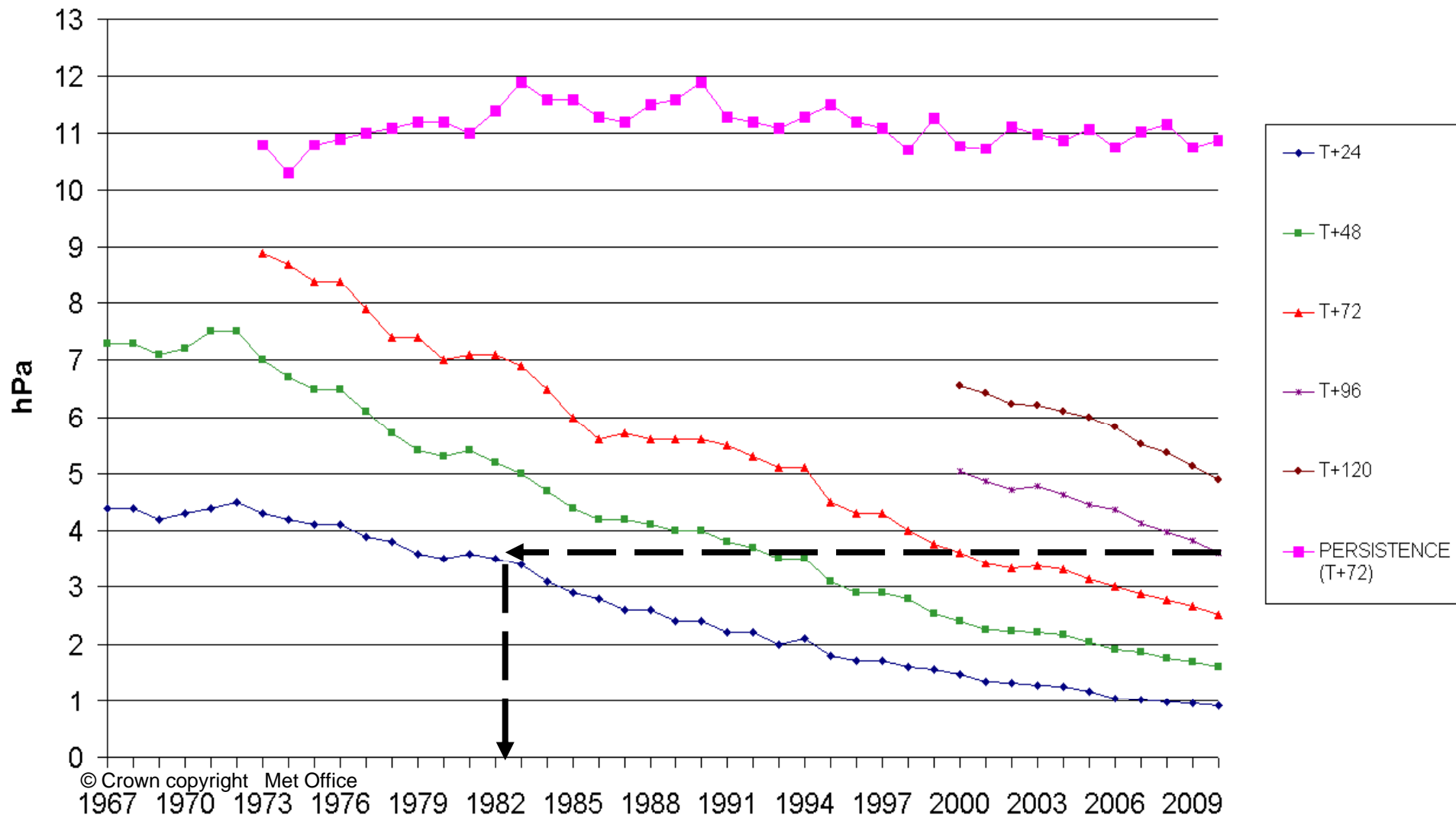
Forecast Accuracy

- Decades of research have tried to find the best ways of representing atmospheric processes in a computer model
- Getting the starting conditions correct is critical
- Errors in the starting conditions are most likely where observations are sparse (e.g. over the Atlantic Ocean)
- The Met Office's Global forecast model takes 95 minutes to produce a forecast for the whole world out to 6 days
- It is run 4 times a day (00, 06, 12, 18 GMT)
- The forecast generally becomes less reliable the further ahead you look



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Improving accuracy



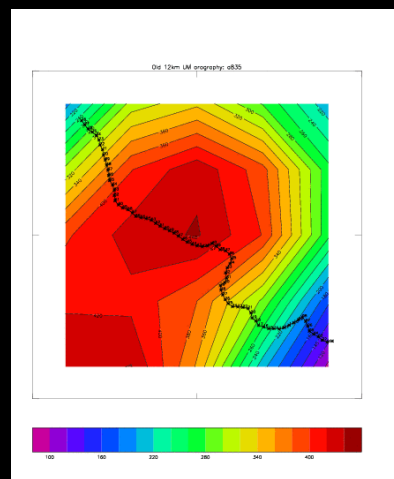
© Crown copyright Met Office



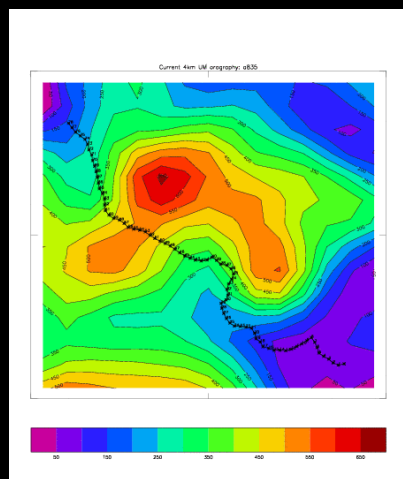
The importance of a high resolution driving model

- Black line represents a road, the A835 in Scotland.
- **Red** colours represent increasing height, **green** then **blue** colours indicate low level terrain.

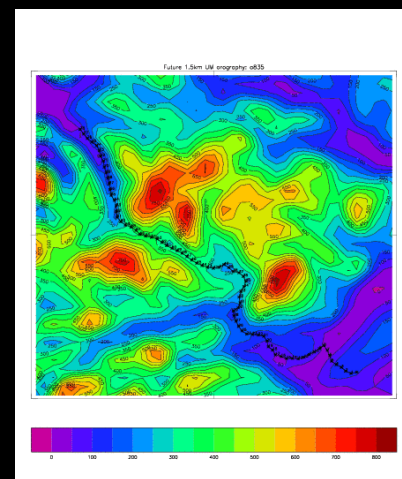
12Km



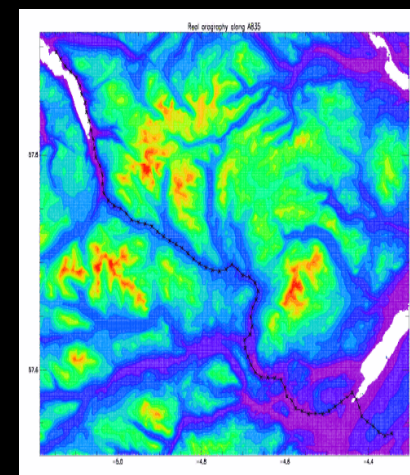
4km



1.5km



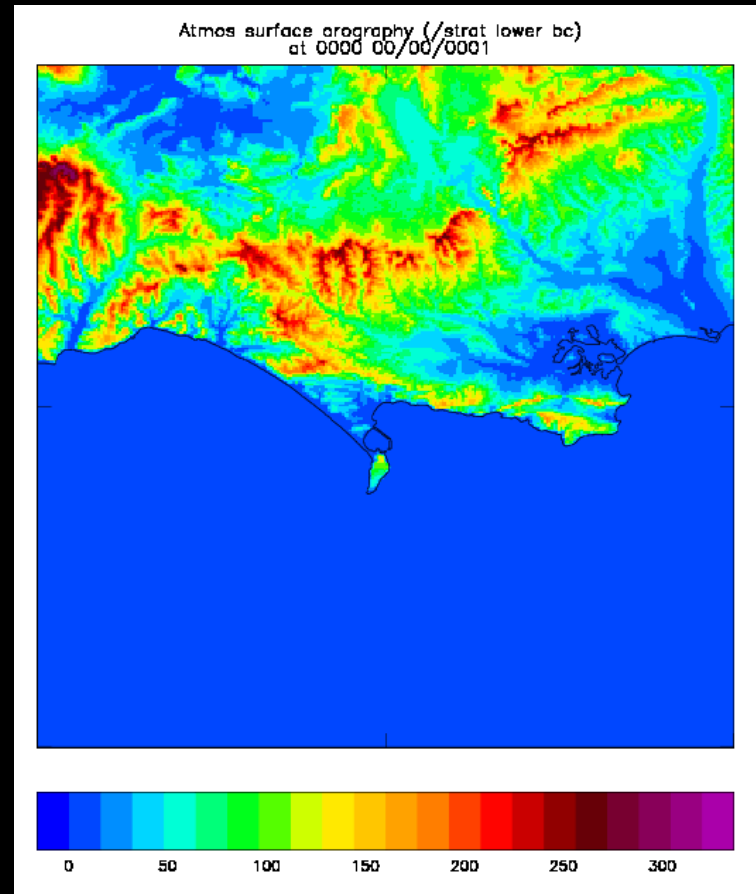
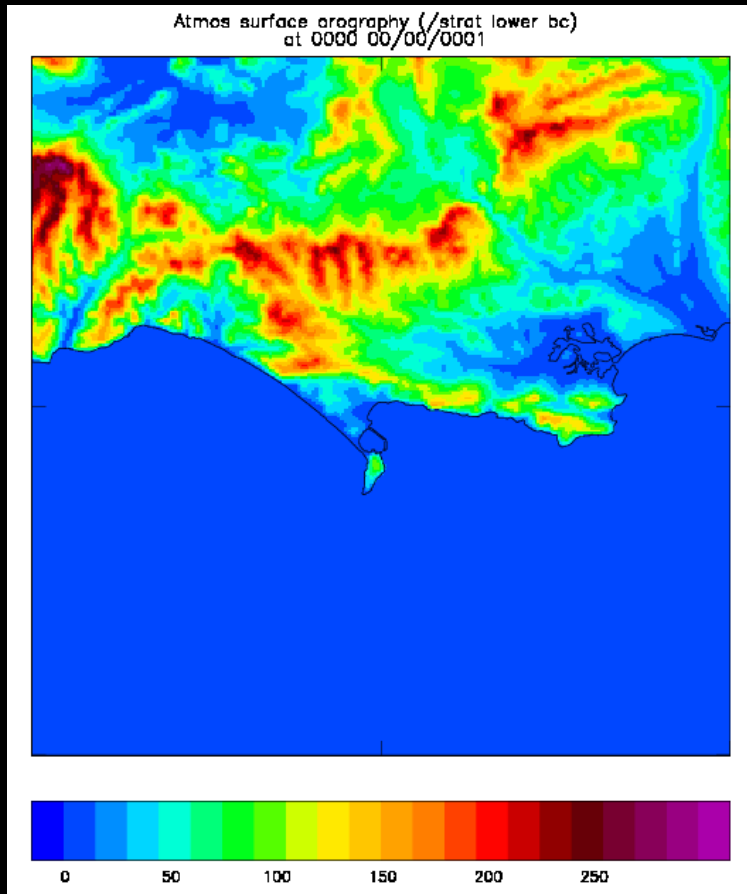
Actual Terrain





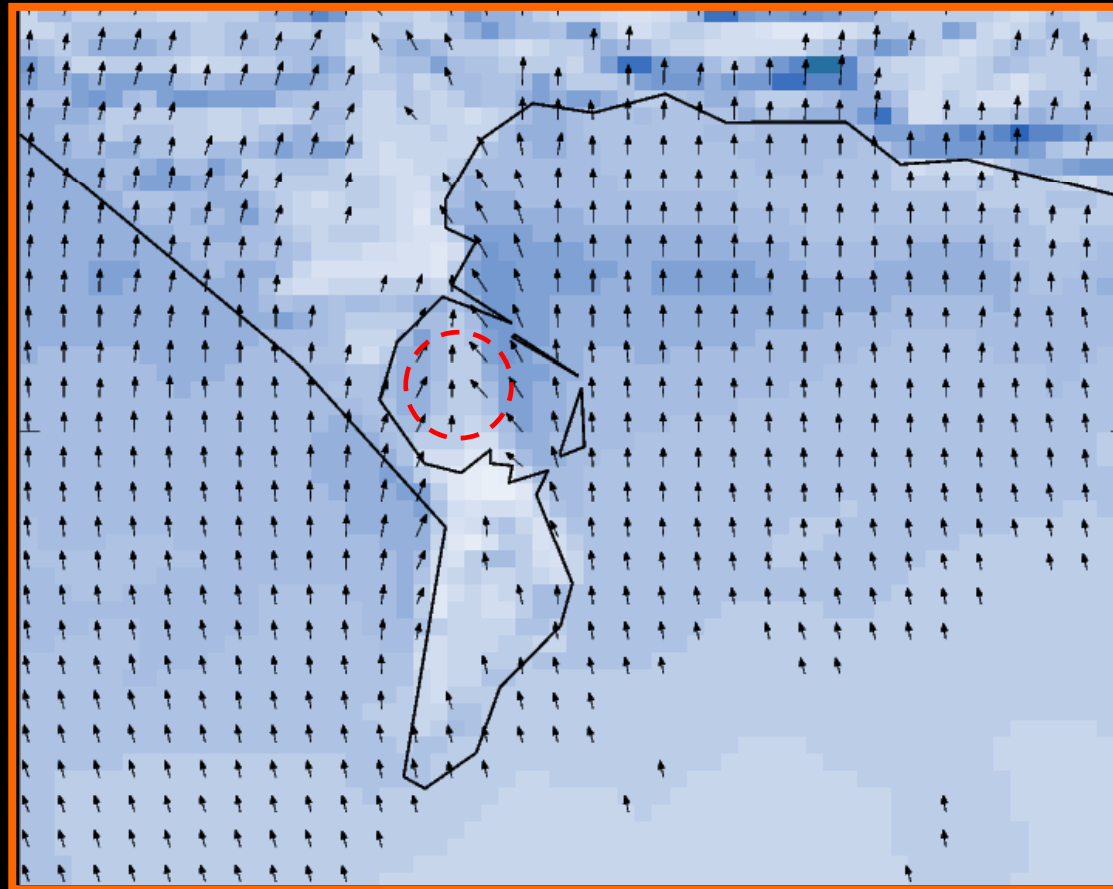
The Future

- Olympic Weymouth Model - 300m resolution
- In 2014, Global model will be upgraded to between 15 -20km

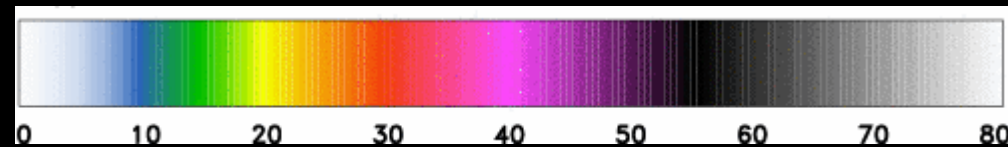


300m model at Paralympics 2012 sailing Winds forecast (knots)

1230 Thursday

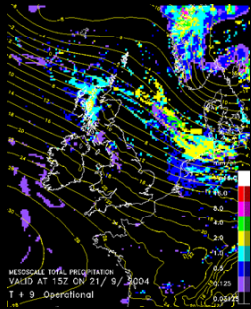


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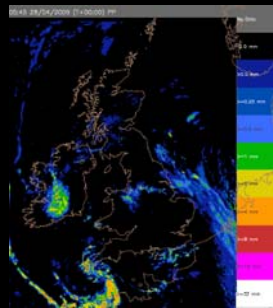




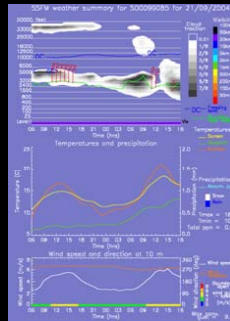
How does this feed into your forecast



UKV
(**UK** Variable
Resolution:
NWP model)



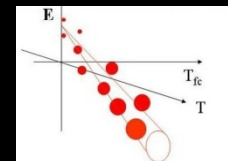
UKPP
(**UK**
Post
Processed)



SSPS
(**S**ite
Specific
Processing
System)



MORST
(**M**et
Office
Road/Rail/Runway
Surface
Temperature
model)



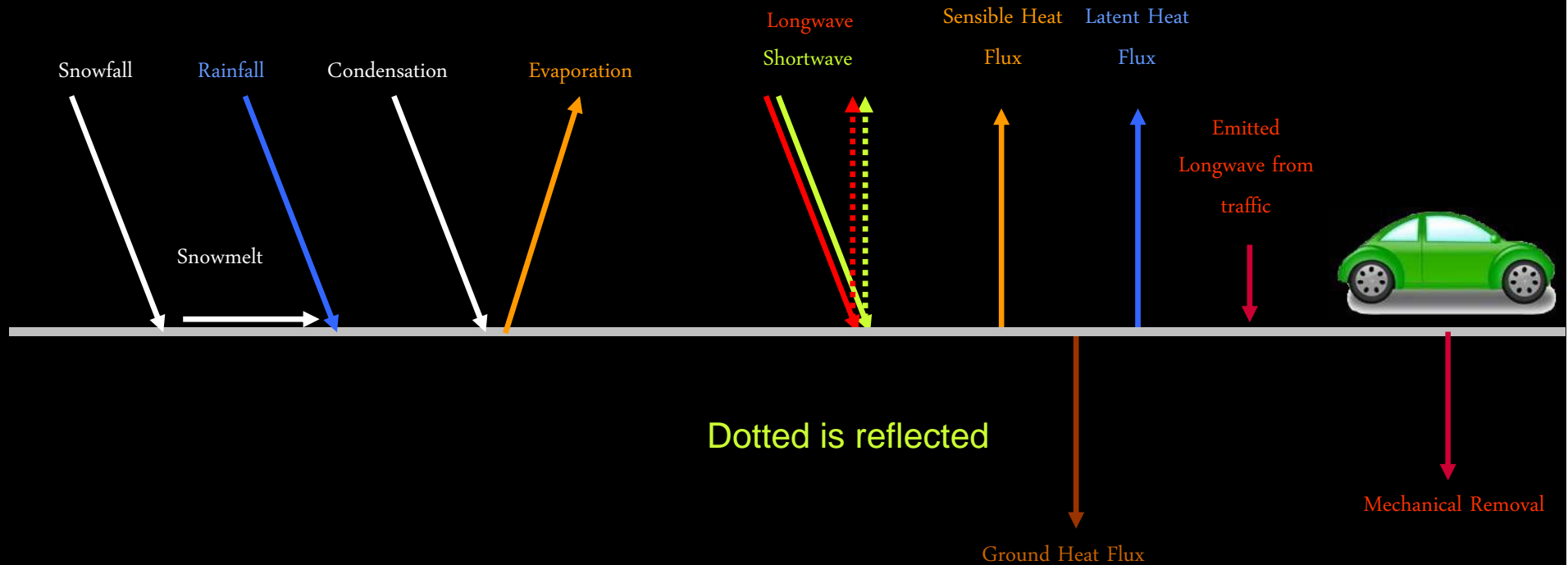
3D Kalman
Filter
(A Statistical
correction
scheme)

Optimal Blend
(Lagging and
blending)

Data flow



MORST - Surface Water & Energy Balance





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Meteorological Input to MORST

Solar radiation
Terrestrial radiation
Air temperature
Humidity / dew-point
Wind speed
Precipitation



UKV + UKPP +
SSPS

Geographical (From GIS)

Shading
Sky-view factor
Landuse/turbulent
mixing



MORST

(Met Office Road Surface Temperature model)

Road Construction and Traffic (GIS)

Road construction
Traffic speed
Traffic volume





Why use RBF?

The screenshot shows the Met Office OpenRoad interface. At the top, there is a navigation bar with icons for Summary, Graph, Observations, Text, Warnings, Verification, and Notices (0). Below this, a banner indicates "Forecaster commentary issued at 12:29 on 06/02" and provides links for "1-5 day UK forecast" and "6-30 day UK forecast".

The main content area features a map of the Shetland Islands. Several question marks are overlaid on the map, specifically on the islands of Unst, Harray, West Mainland, East Mainland, Kirkwall, Stromness, and the Orkney Islands. A red dot is visible on the East Mainland. The map includes labels for "Loch of Harray", "Loch of Stenness", "Stromness", "Kirkwall", and "North Sea".

On the left side, there is a "Sites and routes" panel. It includes a "Sites show forecast data" section with a time bar set to "21:00 on 06/02". Below this is a "Road surface temperature" legend with color-coded boxes: purple for <math>< -3.0</math>, blue for <math>< -1.0</math>, red for <math><= 1.0</math>, yellow for <math><= 3.0</math>, and green for > 3.0. A black box represents "Missing data". There are also checkboxes for "Labels", "Timebar", and "Worst conditions".

On the right side, there is an "Observations" panel with checkboxes for "Infrared Satellite", "Radar", and "Lightning".

At the bottom of the map, there is a scale bar (5 mi / 5 km) and a "No regions saved" message. The footer contains links for "About us", "Terms and conditions", "Privacy policy", "Feedback", and "Contact us", along with the website URL "www.metoffice.gov.uk" and "© Crown copyright".



Why use RBF?

The screenshot displays the Met Office OpenRoad interface. At the top, there is a navigation bar with icons for Summary, Graph, Observations, Text, Warnings, Verification, and Notices (0). Below this, a status bar indicates "Forecaster commentary issued at 12:29 on 06/02" and "1-5 day UK forecast 6-30 day UK forecast".

The main content area features a map of the Orkney Islands with a network of roads highlighted in yellow and red. A sidebar on the left, titled "Sites and routes", provides options for "Sites show forecast data" (set to "21:00 on 06/02") and "Road surface temperature". A color-coded legend for road surface temperature is shown, with categories: <math>< -3.0</math> (purple), <math>< -1.0</math> (blue), ≤ 1.0 (red), ≤ 3.0 (yellow), > 3.0 (green), and "Missing data" (black). Below the legend, there are checkboxes for "Labels", "Timebar", and "Worst conditions", and a "Deselect all routes" button. A list of routes is shown with checkboxes: East Mainland, West Mainland, Kirkwall, and Stromness.

On the right side, an "Observations" panel is visible, with checkboxes for "Infrared Satellite", "Radar", and "Lightning".

At the bottom of the map, there is a scale bar (5 mi / 5 km) and a footer with links for "About us", "Terms and conditions", "Privacy policy", "Feedback", and "Contact us". The footer also includes "Map data ©2013 Google", "www.metoffice.gov.uk", and "© Crown copyright".



Why use RBF?



24 Hour Area Forecast for Orkney Islands Council Valid from noon on Thursday 06 Dec 2012 to noon on Friday 07 Dec 2012

Forecaster Commentary: Assessment of RBF and Site-Specific Data
Good guidance given by the graphical forecast information today. Slight uncertainty regarding distribution of rain and showers.

Readiness Colour	Amber
------------------	-------

Hazard Summary			
Element	Y/N	Conf	Details
Ice	Y	L	A low risk of icy patches if any roads dip below freezing overnight.
Hoar Frost	N	H	Nil
Snow	N	L	Nil
Fog	N	H	See 24 hour weather summary below.
Strong Wind	Y	H	W or SW 10, veering N this evening. Increasing 20 gusts 35 overnight.
Rain	Y	H	See 24 hour weather summary below.

Rain	>=2mm/hr for any hours over the 24 hours.
Strong Wind	>=25mph gusts.
Fog	Visibility less than 200 metres.

Minimum Temperature Summary		
	Temp (C)	Time Below Zero
Air	PS01	N/A
All Roads	MS01	2100-1000
Urban Roads	PS01	N/A

24 Hour Weather Summary	
Showers affecting the area throughout the period, with some hail or sleet at times. A low risk of RSTs dipping below freezing overnight under any clear spells.	

24 Hour RBF Forecast for Orkney Islands Council

Issued At 10:57 UTC, Thursday 06 December 2012
Valid from 12:00 UTC, Thursday 06 December 2012 to 12:00 UTC, Friday 07 December 2012

Forecaster Commentary: Assessment of RBF and Site-Specific Data
Good guidance given by the graphical forecast information today. Slight uncertainty regarding distribution of rain and showers.

Domain	Route	Segment	Min RST	Time Below Zero	Ice	Hoar Frost	Rain	Snow
Orkney Islands	Forecast Text:		Showers affecting the area throughout the period, with some hail or sleet at times. A low risk of RSTs dipping below freezing overnight under any clear spells.					
	East Mainland	01	PS01.3	X	X	X	Y	X
		02	PS01.3	X	X	X	Y	X
		03	PS01.4	X	X	X	Y	X
		04	PS01.5	X	X	X	Y	X
		05	PS02.3	X	X	X	Y	X
		06	PS02.5	X	X	X	Y	X
		07	PS01.9	X	X	X	Y	X
		08	PS01.4	X	X	X	Y	X
		09	PS01.3	X	X	X	Y	X
		10	PS02.4	X	X	X	Y	X
		11	PS02.2	X	X	X	Y	X
		12	PS02.4	X	X	X	Y	X
		13	PS02.3	X	X	X	Y	X
		14	PS02.3	X	X	X	Y	X
		15	PS02.6	X	X	X	Y	X
	West Mainland	01	PS01.2	X	X	X	Y	X
		02	PS01.1	X	X	X	Y	X
		03	PS00.5	X	X	X	Y	X
		04	PS00.1	X	X	X	Y	X
		05	MS00.2	21-08	X	X	Y	X
		06	MS00.5	21-09	X	X	Y	X
		07	MS00.6	07-09	X	X	Y	X
		08	ZERO	X	X	X	Y	X
		09	PS00.3	X	X	X	Y	X
		10	MS00.1	07-08	X	X	Y	X
		11	MS00.6	15-09	X	Y	Y	X
		12	MS01.0	14-09	X	Y	Y	X
		13	MS00.8	15-09	X	Y	Y	X
		14	MS00.1	21-22	X	X	Y	X
		15	ZERO	X	X	X	Y	X
		16	MS00.2	17-18	X	Y	Y	X
		17	MS00.2	17-18	X	X	Y	X
		18	MS00.3	15-17	X	X	Y	X
		19	ZERO	X	X	X	Y	X
	Kirkwall	01	PS01.6	X	X	X	Y	X
		02	PS01.9	X	X	X	Y	X
		03	PS01.6	X	X	X	Y	X
		04	PS02.0	X	X	X	Y	X
	Stromness	01	PS00.8	X	X	X	Y	X
		02	PS00.7	X	X	X	Y	X
	Eday	01	PS02.8	X	X	X	Y	X
		02	PS02.6	X	X	X	Y	X
		03	PS02.6	X	X	X	Y	X
		04	PS02.8	X	X	X	Y	X
	Fiotta	01	PS01.9	X	X	X	Y	X
		01	PS01.0	X	X	X	Y	X
		02	PS00.7	X	X	X	Y	X
	Hoy	03	PS01.2	X	X	X	Y	X
		04	PS01.4	X	X	X	Y	X
		05	PS01.6	X	X	X	Y	X
		01	PS01.1	X	X	X	Y	X
		02	PS00.8	X	X	X	Y	X
	Rousay	03	PS01.3	X	X	X	Y	X
		04	PS00.8	X	X	X	Y	X
		05	PS00.6	X	X	X	Y	X
		01	PS02.8	X	X	X	Y	X
		02	PS02.8	X	X	X	Y	X
	Sanday	03	PS02.8	X	X	X	Y	X
		04	PS03.2	X	X	X	Y	X
		05	PS02.7	X	X	X	Y	X
		01	PS02.0	X	X	X	Y	X
		02	PS01.9	X	X	X	Y	X
	Shapinsay	01	PS02.7	X	X	X	Y	X
		02	PS02.8	X	X	X	Y	X
	Stronsay	03	PS02.9	X	X	X	Y	X
		01	PS02.0	X	X	X	Y	X
		02	PS01.9	X	X	X	Y	X
	Westray	02	PS01.9	X	X	X	Y	X
		03	PS02.4	X	X	X	Y	X



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Localised Variation Along a Route

High Resolution Data Sets from GIS

- Sky-view Factor
- Shading
- Traffic Flow
- Roughness Length





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Route Optimisation

For Devon County Council

Objective: To deliver an effective winter service, with minimal reduction to service, whilst delivering a saving of £250,000 on a typical (not extreme) winter.

- **Step 1** – Operational efficiency.

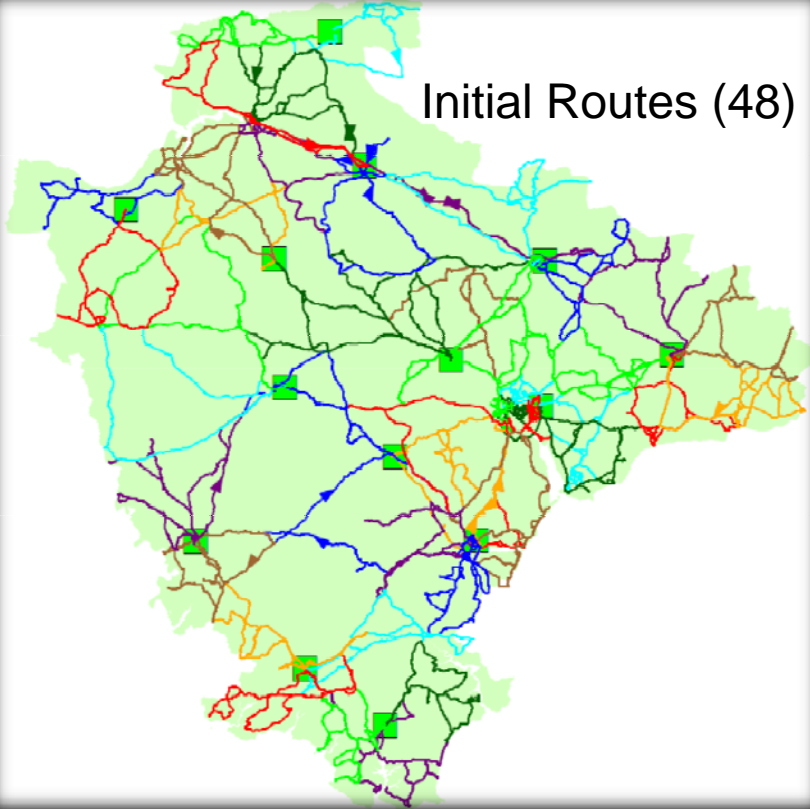
How to deliver the same service for less
>>> mileage, fuel, fleet, labour

- **Step 2** - Climatological Optimisation.

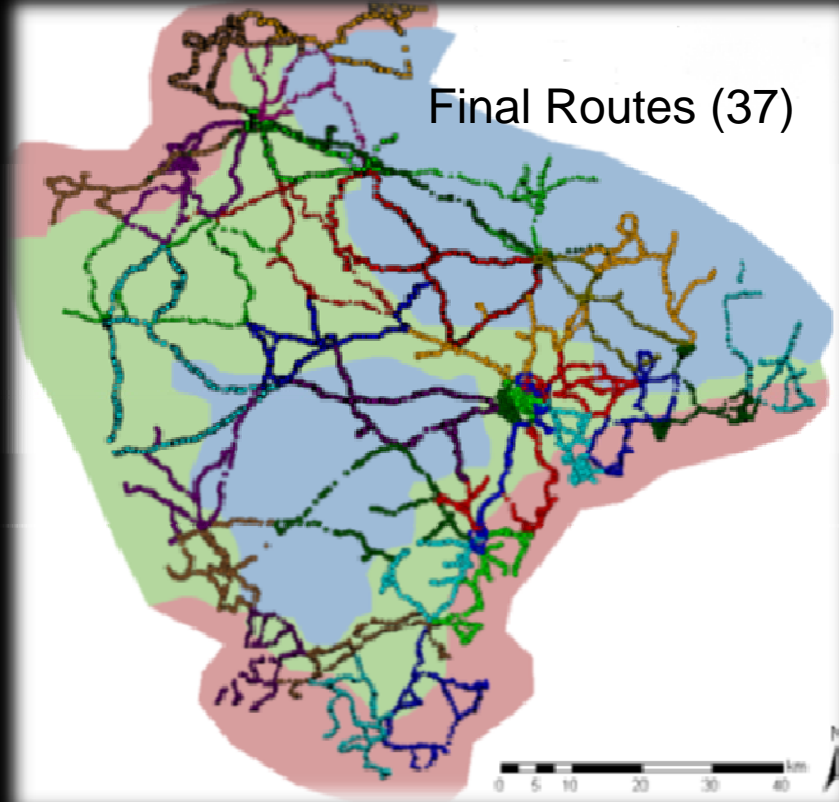
How to deliver the same for **even** less
than above
>>> Selective Domain / route treatment.



Initial Routes (48)

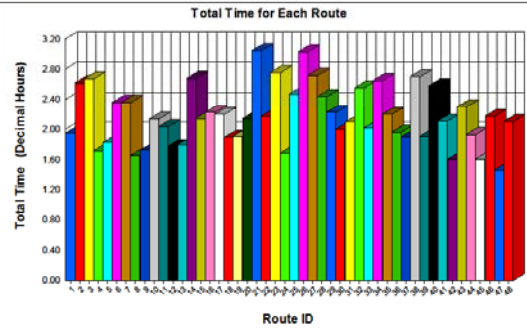


Final Routes (37)



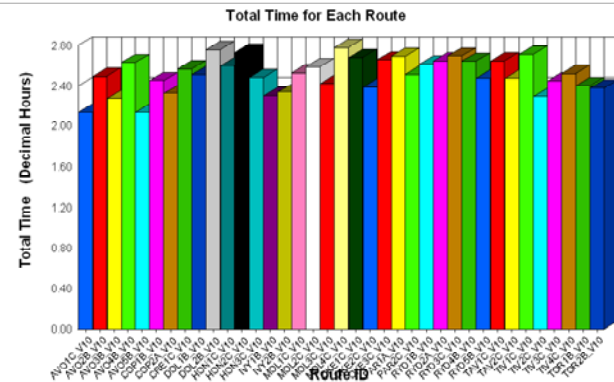
Route Summary Chart

Solution Name: cactive scenario
 Solution Label:
 Report Date: 24/3/2011
 Report Time: 4:21PM



Route Summary Chart

Solution Name: cactive scenario
 Solution Label:
 Report Date: 23/11/2011
 Report Time: 12:44PM





Current and Future Work

- Ongoing accuracy improvements
- Improved quantification of the probability of high impact road hazards.
- Selective Spreading
- Dynamic route optimisation
- Improved capability for modelling Tunnels and Bridges