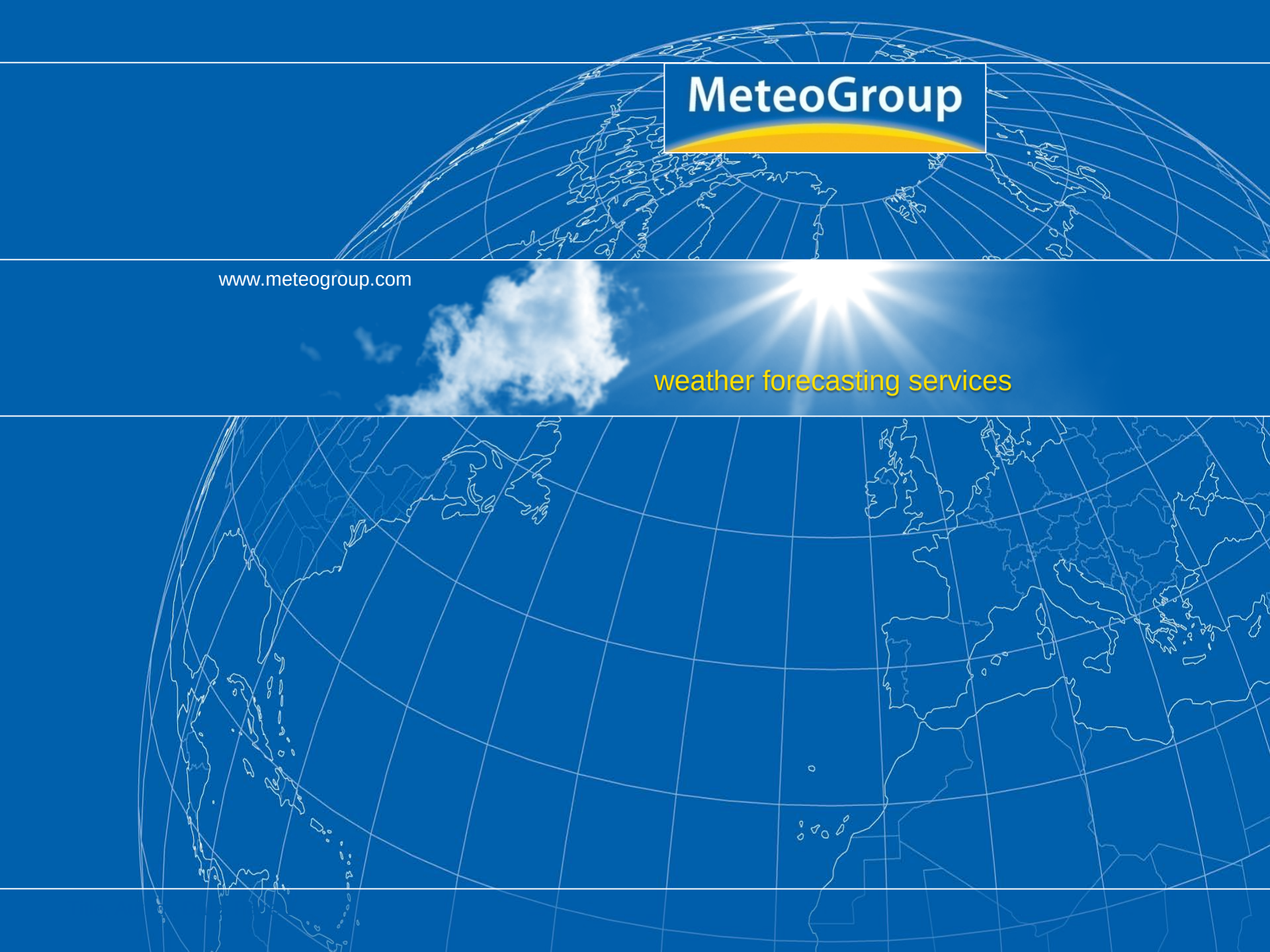
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Use a route based forecast for dynamic gritting

I.W. Smeding, M.J.J.Wokke, J.S.P Wisse,
M.F Jonker, M. Noort, M. Mimpen, M. Dukes, D. Adamson

Ingeborg Smeding
Teamleader Weather & Transport, Meteorological Researcher

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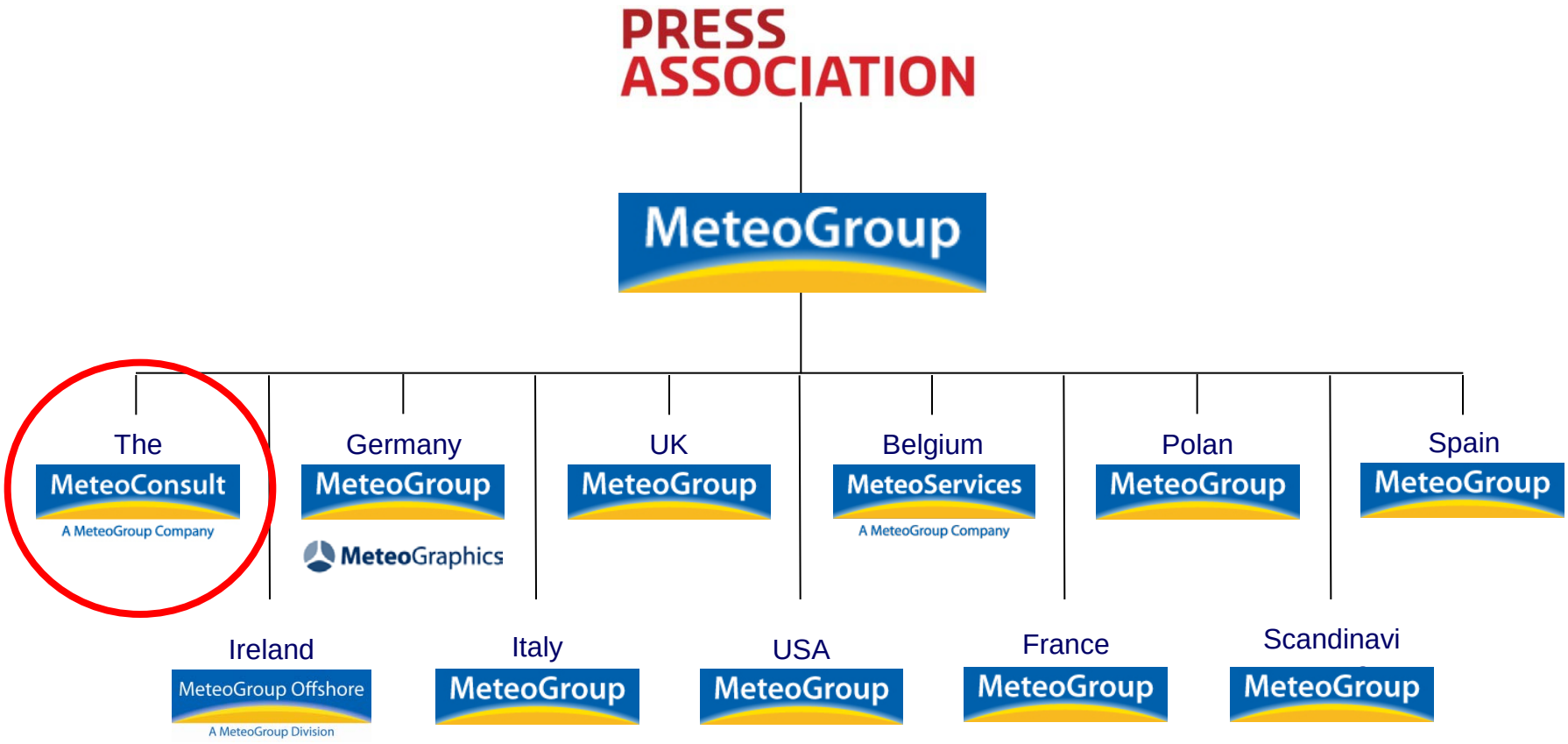
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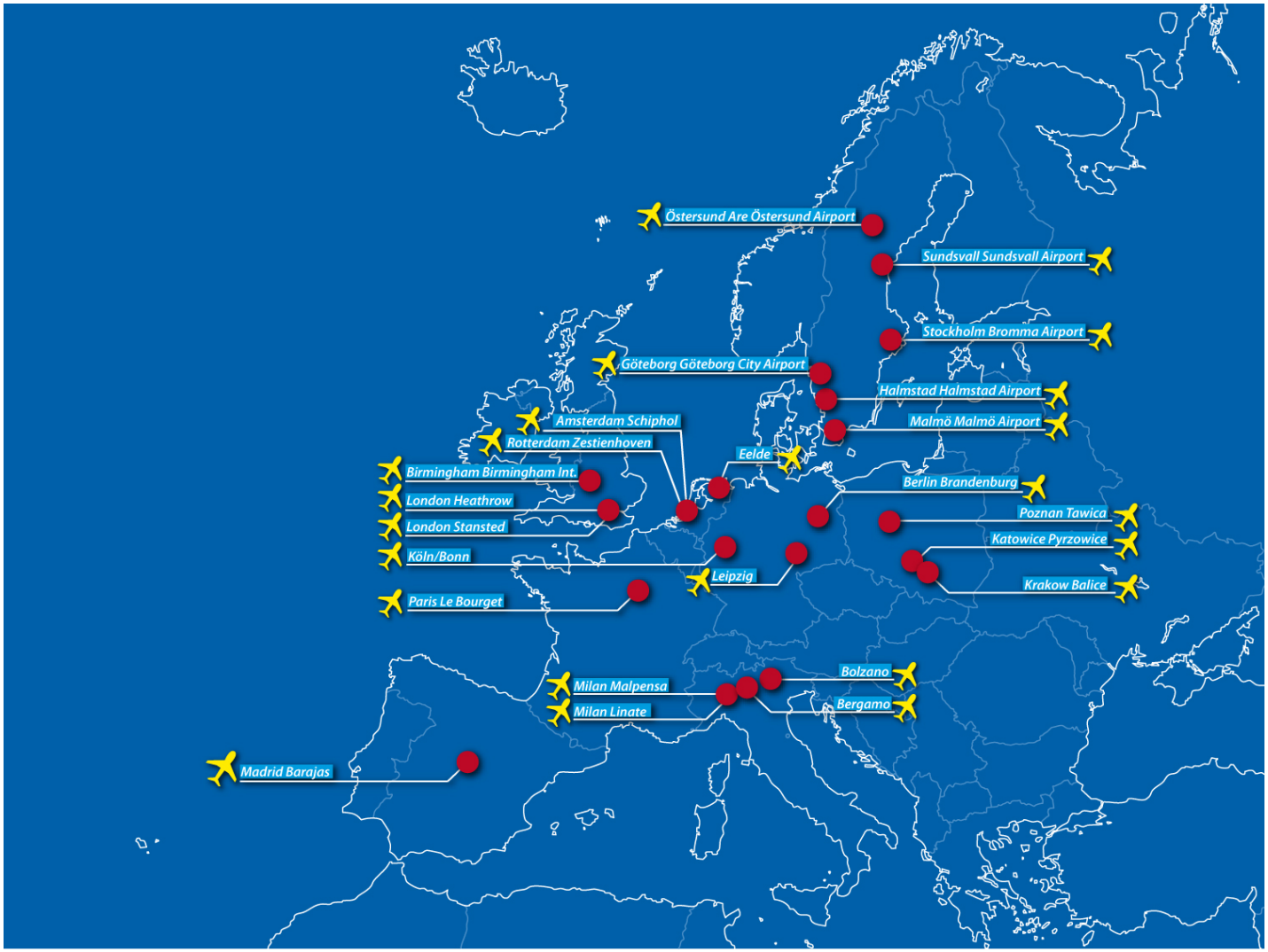
MeteoGroup offices

Winter clients

Airports


Östersund Are Östersund Airport
Sundsvall Sundsvall Airport
Stockholm Bromma Airport
Göteborg Göteborg City Airport
Halmstad Halmstad Airport
Malmö Malmö Airport
Amsterdam Schiphol
Rotterdam Zestienhoven
Eelde
Birmingham Birmingham Int.
London Heathrow
London Stansted
Köln/Bonn
Berlin Brandenburg
Poznan Tawica
Katowice Pyrzowice
Leipzig
Krakow Balice
Paris Le Bourget
Bolzano
Milan Malpensa
Milan Linate
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MRD

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MRD

=

Meteorological **R**esearch and **D**evelopment

http://research.meteogroup.com

25 people

Products (examples)

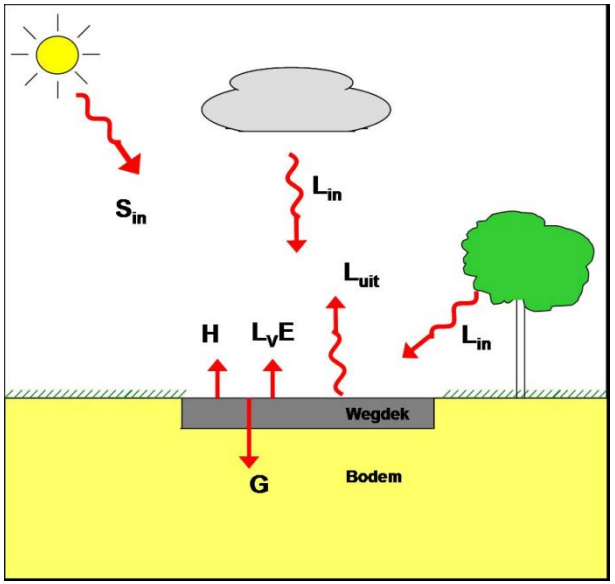
- MOS and downscaling
- Energy forecasts: wind and solar power
- Run WRF
- Road forecasts
- Leaf fall model
- Consultancies

Road model

Input elements:

- Air temperature (MOS)
- Cloudiness
- Dewpoint (MOS)
- Precipitation
- Windspeed
- Soil temperature
- Road type (bridge?)

Energy balance method



Road surface temperature and condition

Combined physical and statistical model

Route based forecasting

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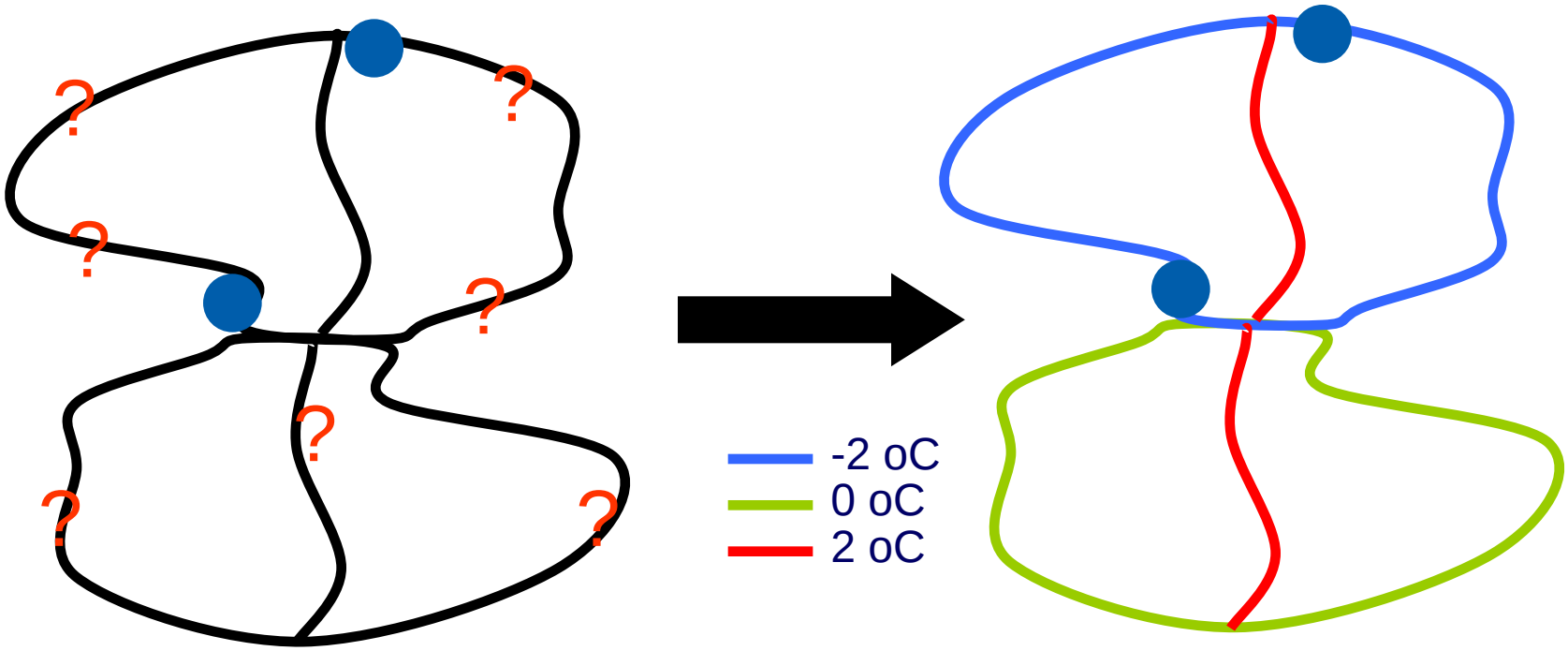
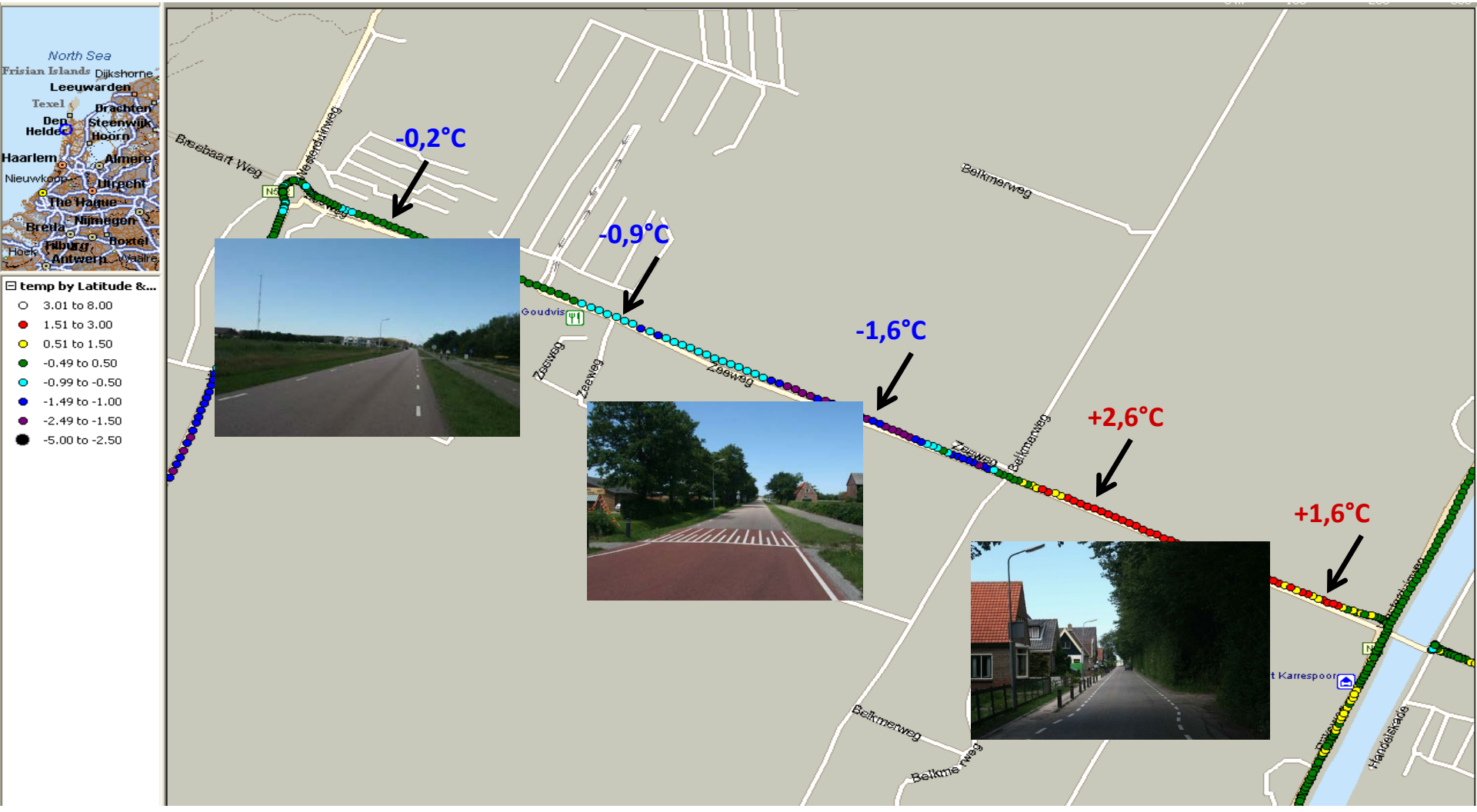
Route based forecast instead of point forecast



Infrared measurement



Gritting

RWIS often in coldest part.

Entire road section is treated in the same way.

↓

Is this useful?

↓

Reduction possible!

↓

Route based forecast

Route based forecast

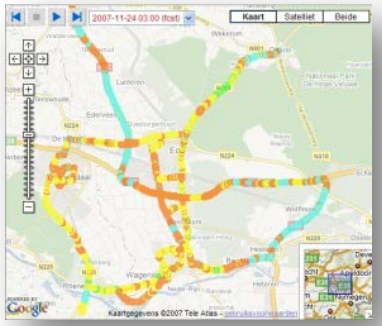
What do we need?

- Information about incoming and outgoing radiation
  - Skyview measurements
  - Solar view
- Meteorological information
  - Detailed weather forecast
  - RWIS site
  - (Air temperature / humidity measurement)
- Environmental information
  - (Thermal map)

Route based forecast

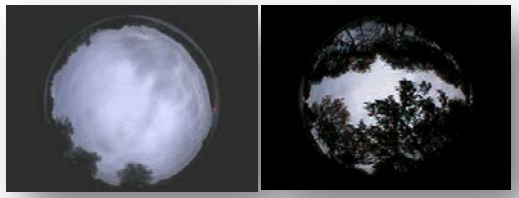
High resolution weather forecast on a grid

Model for calculating road surface temperatures



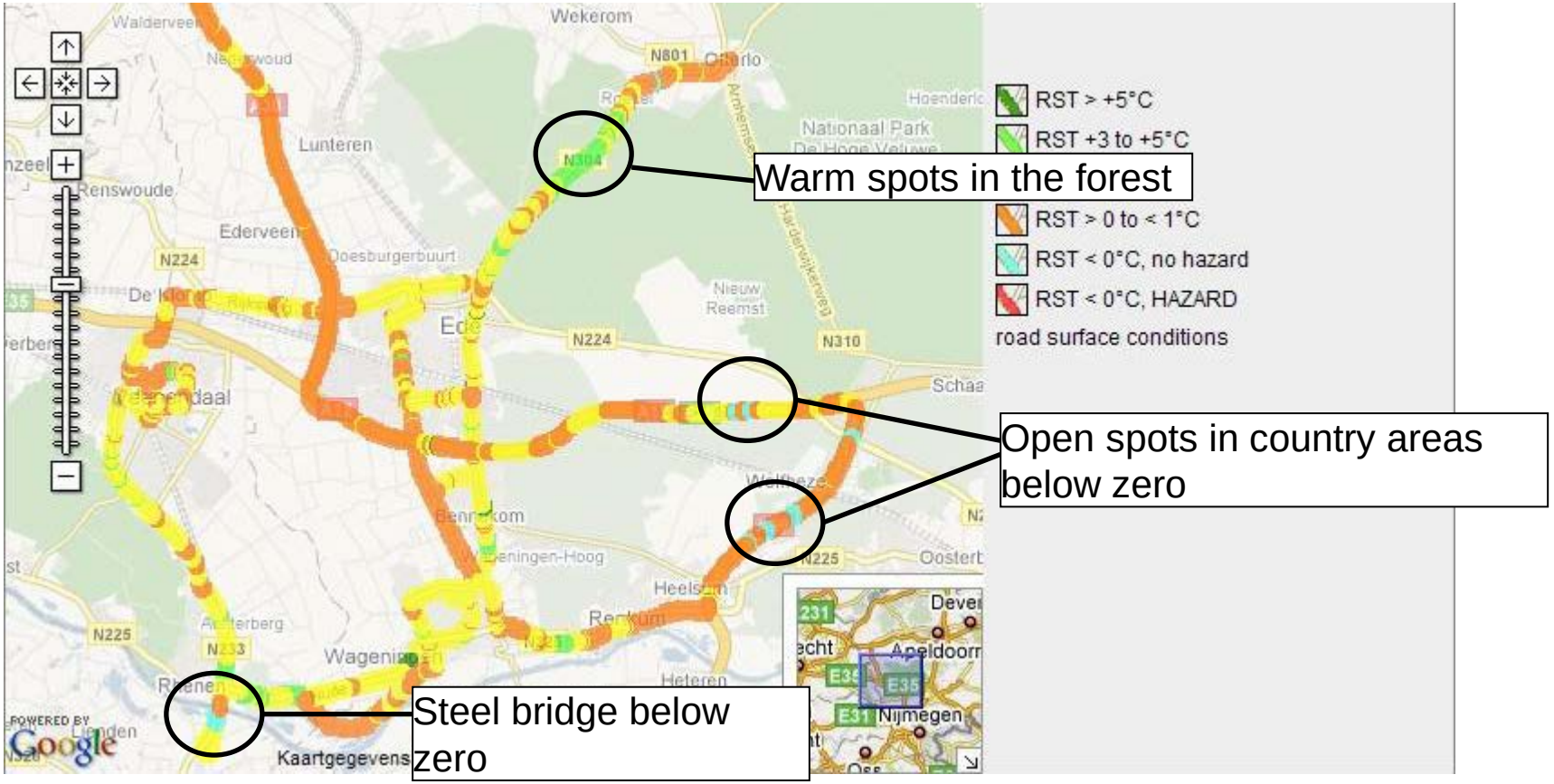
Route based forecast

Thermal map, TT/RH measurement

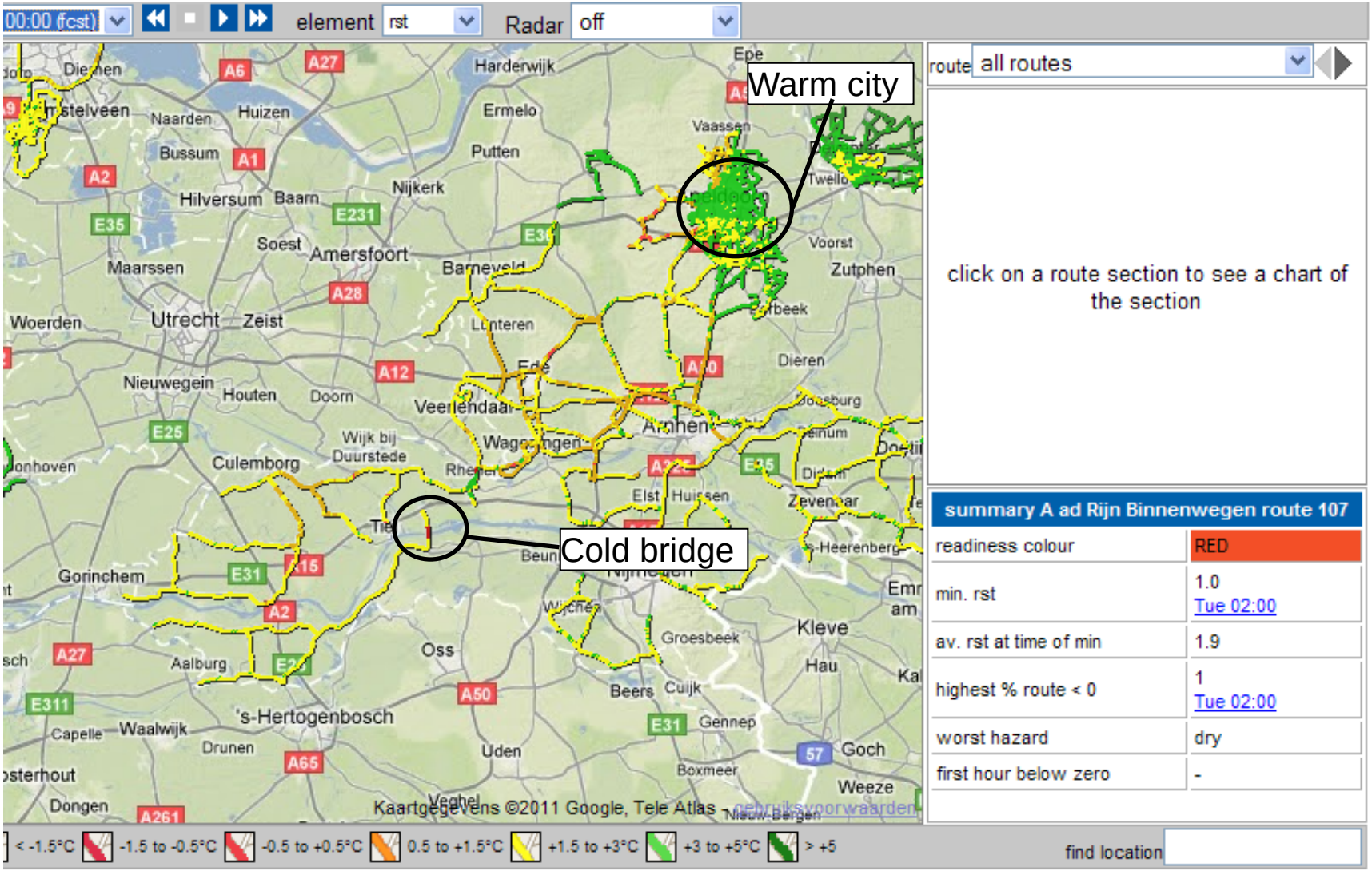


Database with for all routes: *sky* and *solar* view factor

Examples network forecast

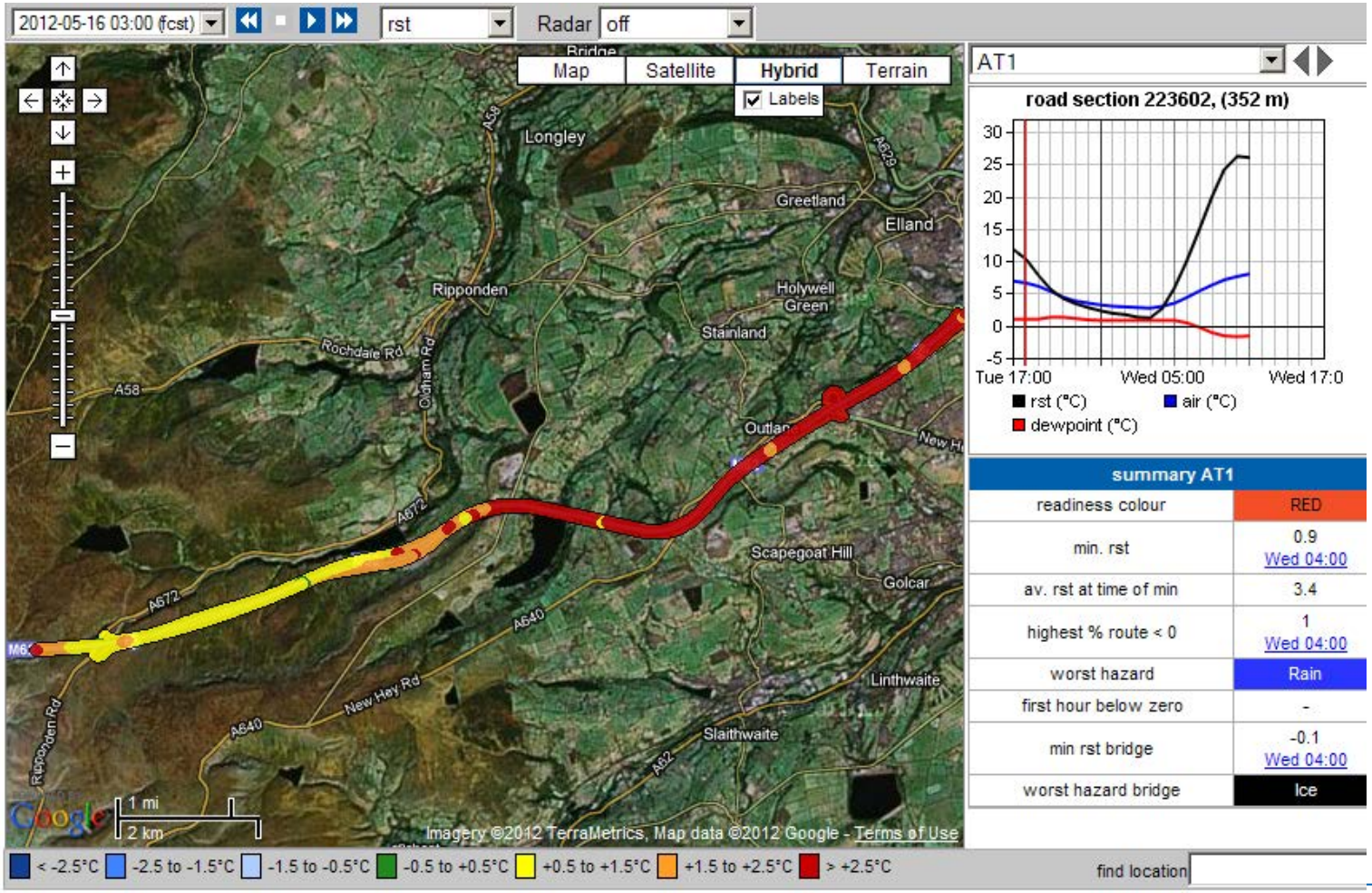


Examples network forecast



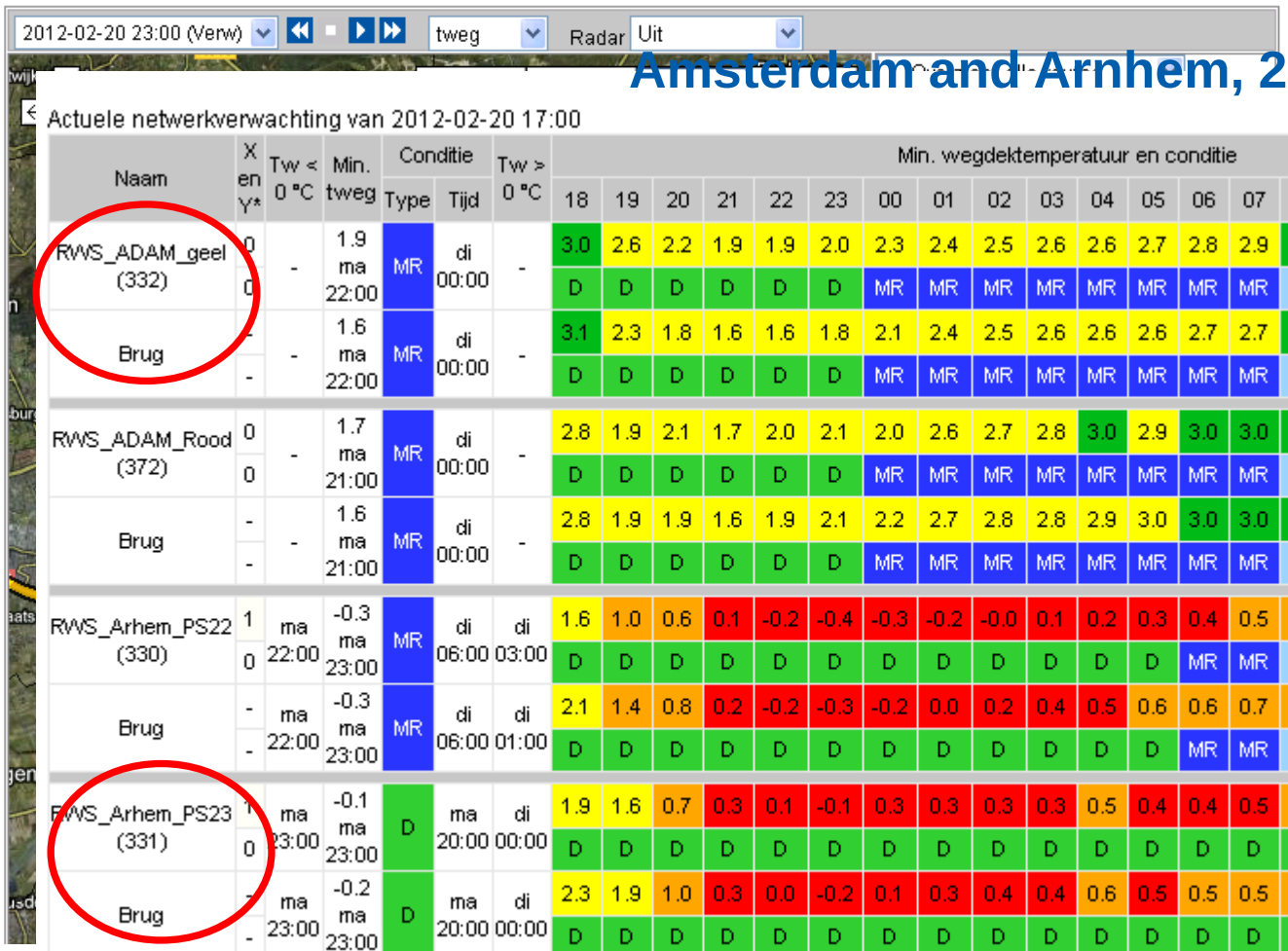
Examples network forecast

UK Yorkshire 16-05-2012



Examples network forecast

Amsterdam and Arnhem, 20 Feb 2012



Actuele netwerkverwachting van 2012-02-20 17:00

Naam	X en Y*	Tw < 0 °C	Min. tweg	Conditie Type	Conditie Tijd	Tw > 0 °C	Min. wegdektemperatuur en conditie 18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13
RWS_ADAM_geel (332)	0	-	1.9 ma 22:00	MR	di 00:00	-	3.0	2.6	2.2	1.9	1.9	2.0	2.3	2.4	2.5	2.6	2.6	2.7	2.8	2.9	3.2	4.0	4.7	5.4	6.0	6.4
	0						D	D	D	D	D	D	MR	MR	MR	MR	MR	MR	MR	MR	N	N	N	N	N	N
Brug	-	-	1.6 ma 22:00	MR	di 00:00	-	3.1	2.3	1.8	1.6	1.6	1.8	2.1	2.4	2.5	2.6	2.6	2.6	2.7	2.7	3.1	3.8	4.6	5.3	5.9	6.4
	-						D	D	D	D	D	D	MR	MR	MR	MR	MR	MR	MR	MR	N	N	N	N	N	N
RWS_ADAM_Rood (372)	0	-	1.7 ma 21:00	MR	di 00:00	-	2.8	1.9	2.1	1.7	2.0	2.1	2.0	2.6	2.7	2.8	3.0	2.9	3.0	3.0	3.3	4.1	4.8	5.5	6.0	6.4
	0						D	D	D	D	D	D	MR	MR	MR	MR	MR	MR	MR	MR	N	N	N	N	N	N
Brug	-	-	1.6 ma 21:00	MR	di 00:00	-	2.8	1.9	1.9	1.6	1.9	2.1	2.2	2.7	2.8	2.8	2.9	3.0	3.0	3.0	3.4	4.1	4.8	5.5	6.1	6.6
	-						D	D	D	D	D	D	MR	MR	MR	MR	MR	MR	MR	MR	N	N	N	N	N	N
RWS_Arhem_PS22 (330)	1	ma 22:00	-0.3 ma 23:00	MR	di 06:00	di 03:00	1.6	1.0	0.6	0.1	-0.2	-0.4	-0.3	-0.2	-0.0	0.1	0.2	0.3	0.4	0.5	0.8	1.5	2.4	3.3	4.3	5.1
	0						D	D	D	D	D	D	D	D	D	D	D	D	MR	MR	N	N	D	D	D	D
Brug	-	ma 22:00	-0.3 ma 23:00	MR	di 06:00	di 01:00	2.1	1.4	0.8	0.2	-0.2	-0.3	-0.2	0.0	0.2	0.4	0.5	0.6	0.6	0.7	1.0	1.8	2.7	3.7	4.7	5.5
	-						D	D	D	D	D	D	D	D	D	D	D	D	MR	MR	N	D	D	D	D	D
RWS_Arhem_PS23 (331)	1	ma 23:00	-0.1 ma 23:00	D	ma 20:00	di 00:00	1.9	1.6	0.7	0.3	0.1	-0.1	0.3	0.3	0.3	0.3	0.5	0.4	0.4	0.5	1.0	2.0	2.9	3.8	4.7	5.5
	0						D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Brug	-	ma 23:00	-0.2 ma 23:00	D	ma 20:00	di 00:00	2.3	1.9	1.0	0.3	0.0	-0.2	0.1	0.3	0.4	0.4	0.6	0.5	0.5	0.5	1.0	2.0	3.1	4.1	5.0	5.8
	-						D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D

(* x = max. percentage v route < 0 °C
y= max. percentage v. route met gladheid.)

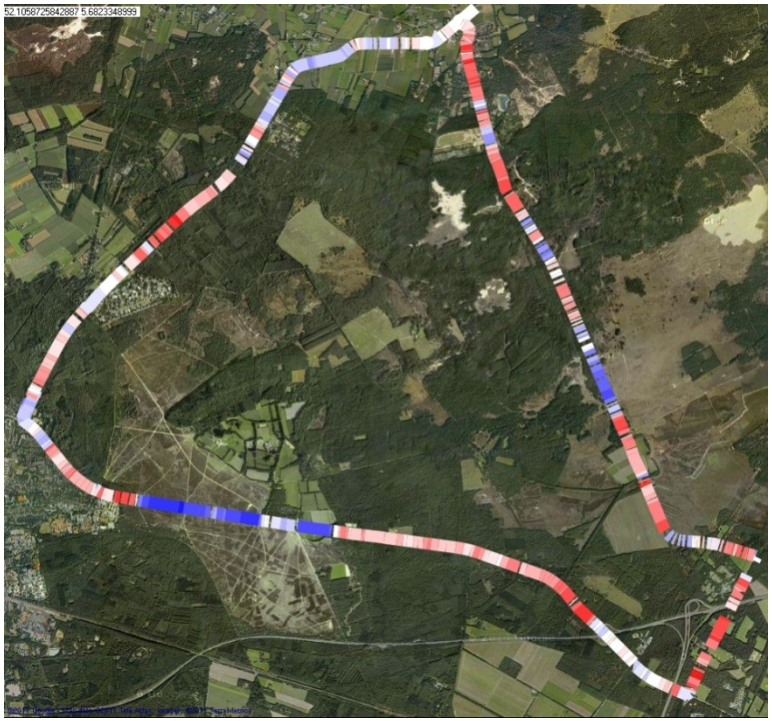
21/02/2012 13:00	6.4	6.9	N	6.4	N	0	0

Verification

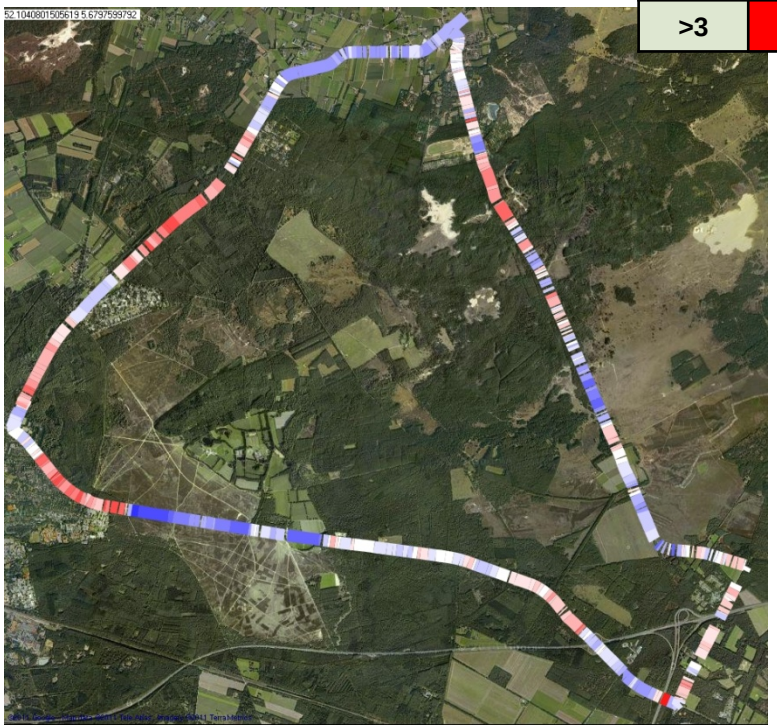
17 February 2011, Ede – Otterlo - Arnhem

RST	
< -1	
1	
>3	

Observation

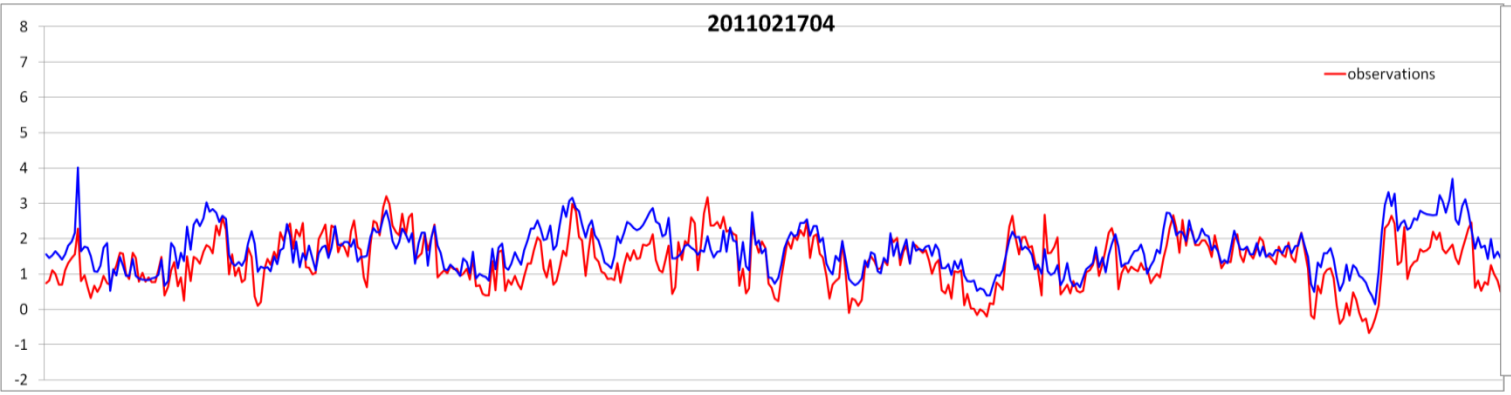


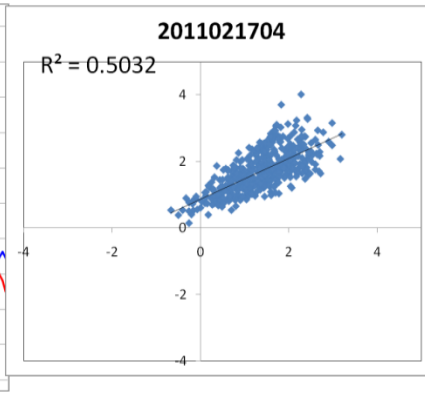
Networkmodel



Verification

17 February 2011, Ede – Otterlo - Arnhem

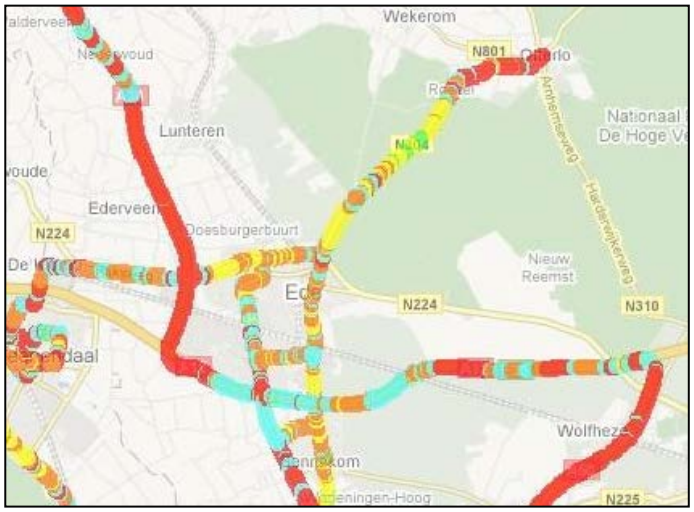




Observation

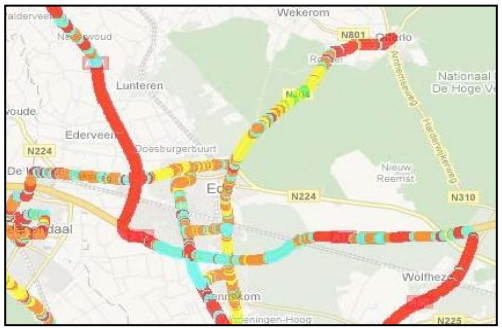
Networkmodel

Communication to gritting machine



Road temperature and condition

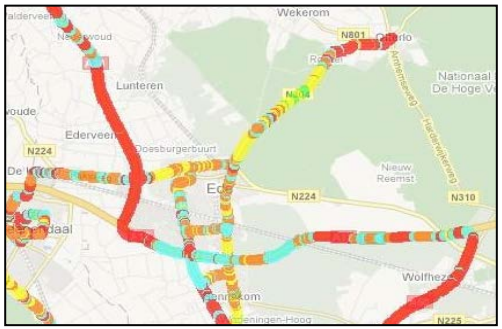
Communication to gritting machine



Road temperature and condition

For extra safety: measure actual road surface temperature to check forecast

Communication to gritting machine



Road temperature and condition

Two ways to optimize gritting:

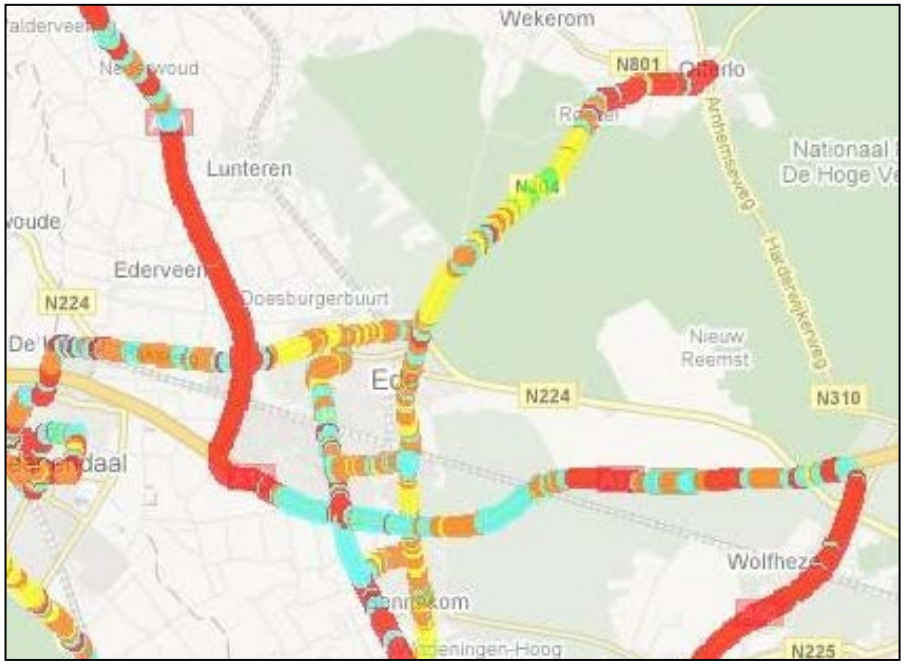
1. Dynamic gritting
2. Dynamic routes

1: Dynamic gritting

Use a variable amount of salt

Example :

Critical:	7 g/m^2
RST < 0ºC:	3 g/m^2
0 < RST < 1ºC:	3 g/m^2
Rest:	0 g/m^2



2: Dynamic routes

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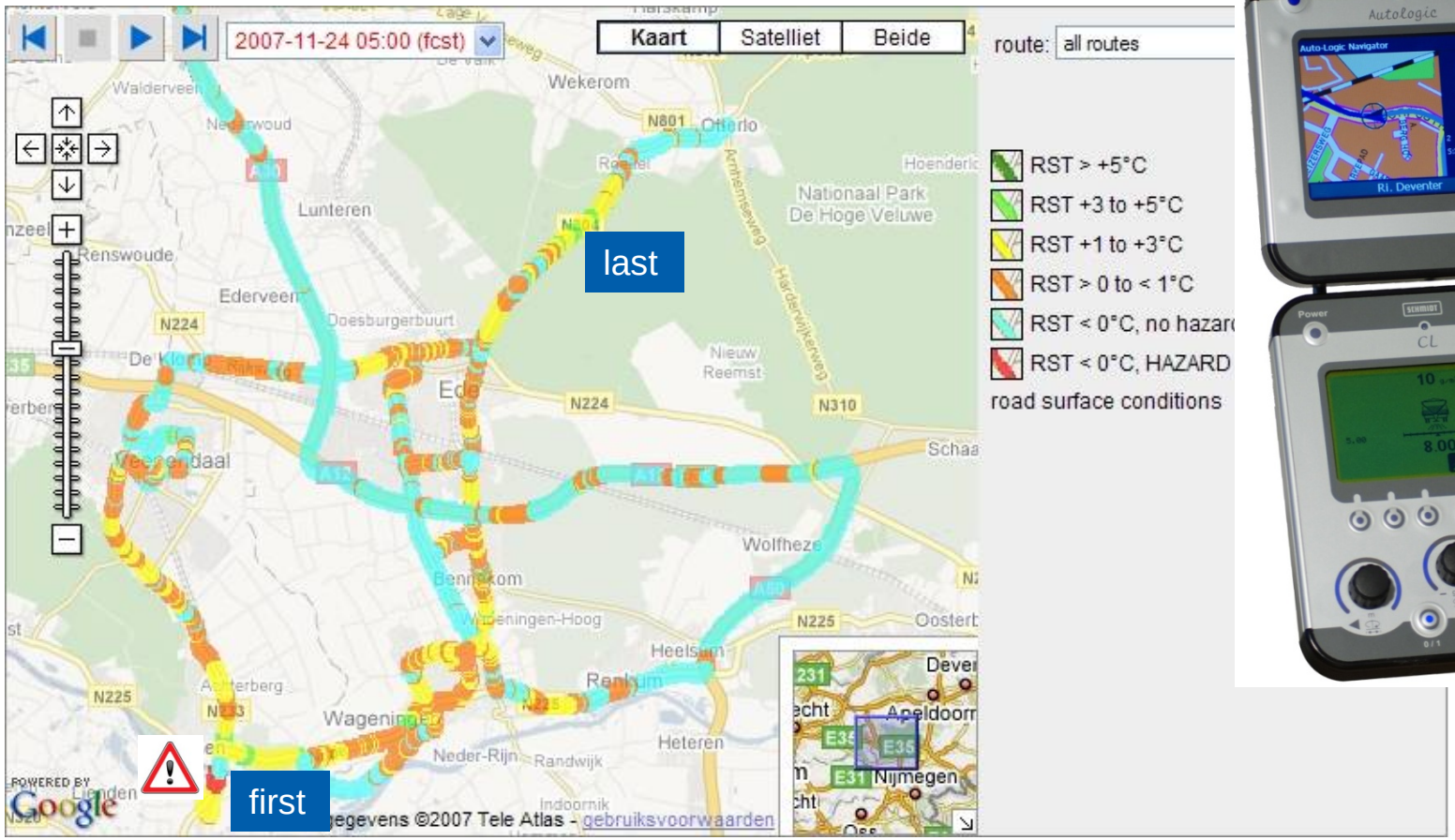
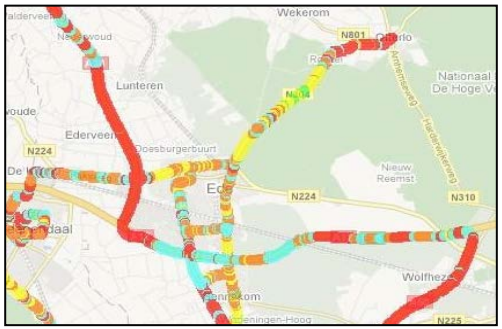
Optimize routes to treat critical places first.



Efficiency



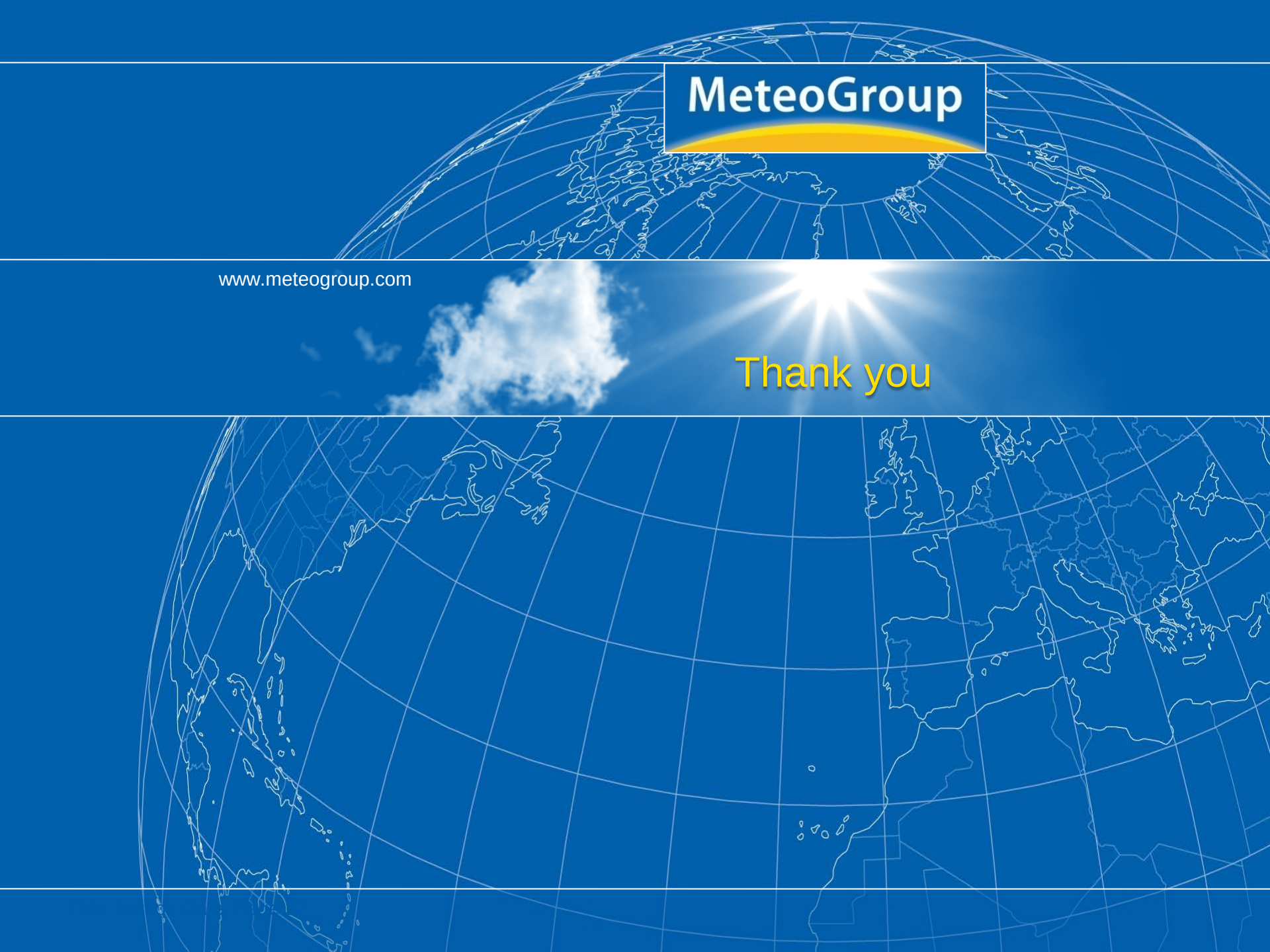
Road temperature and condition

Types of slipperiness:

- Precipitation → Dynamic routes possible
- Black ice → Dynamic routes possible
- Condensation → Dynamic gritting possible

➢ Last (snowy) winter in 20% of cases dynamic gritting could have been applied.

➢ Normal winter: > 50% of cases can be dynamic.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Thank you