



Use errors in observation data to discover valuable information for road forecasting

Ingeborg Smeding, Jelle Wisse, Tom de Ruijter, Menno Mimpfen, Matthijs Dubbeldam

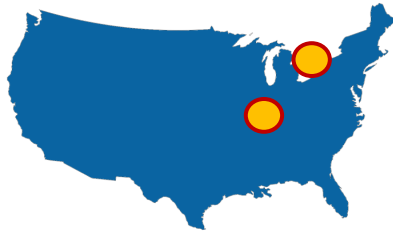


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31st May 2018

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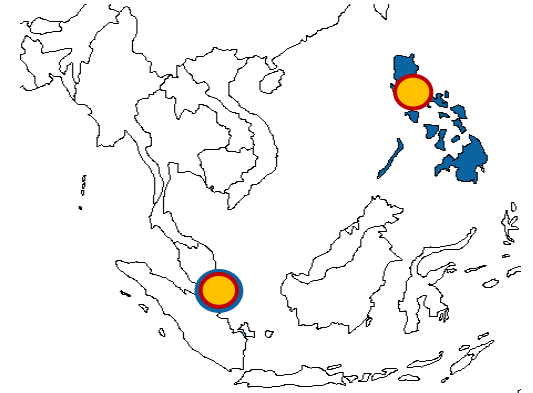
North America



Europe



South-East Asia



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Road



Rail



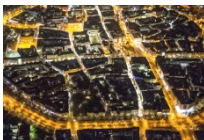
Aviation



Shipping



Offshore



Energy



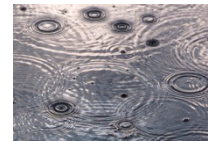
Renewables



Media



Consumer



Hydrology



Insurance



Construction



Agriculture



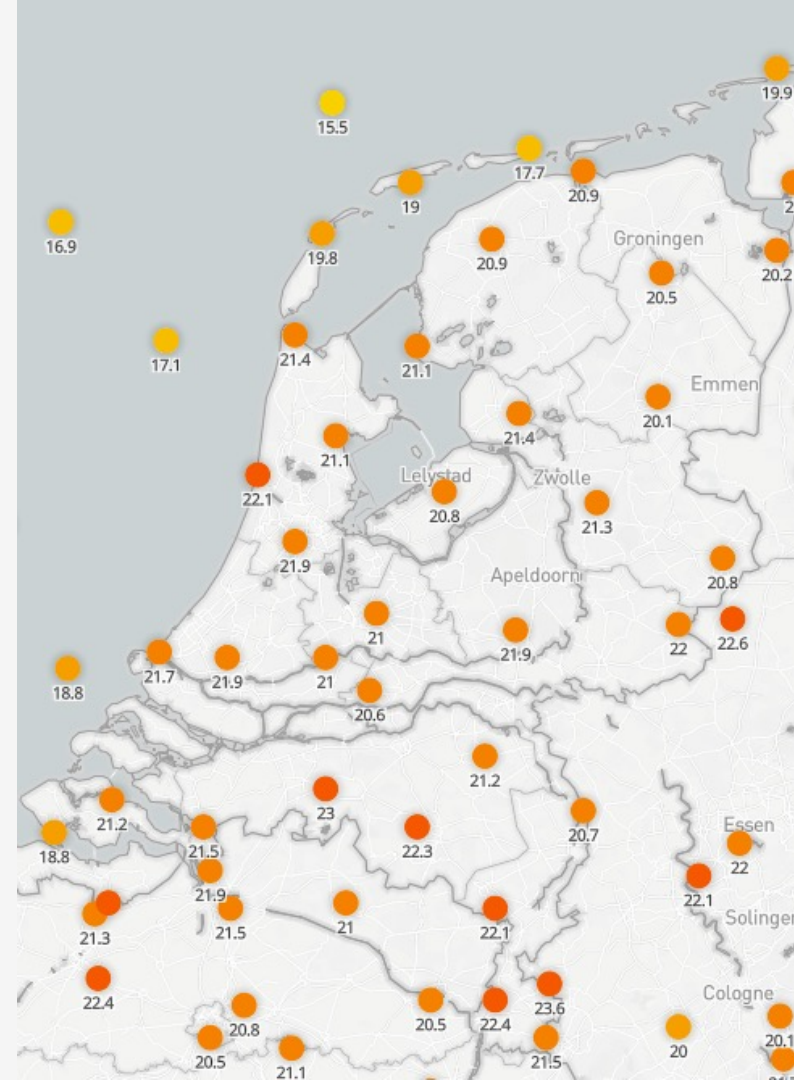
Retail



Leisure

Weather stations in NL

Traditional weather stations (WMO) – limited number,
~35. Quality +++

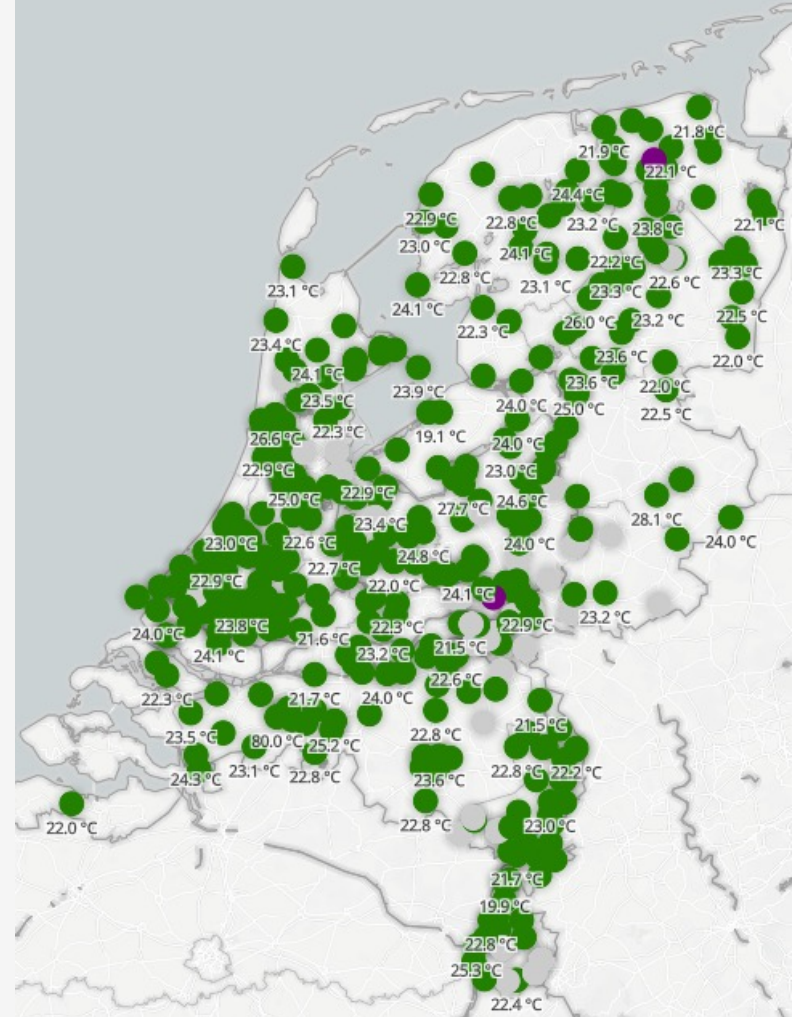


Weather stations in NL

Traditional weather stations (WMO) – limited number, ~35.

Quality +++

Road weather stations – better coverage, ~700. Quality ++



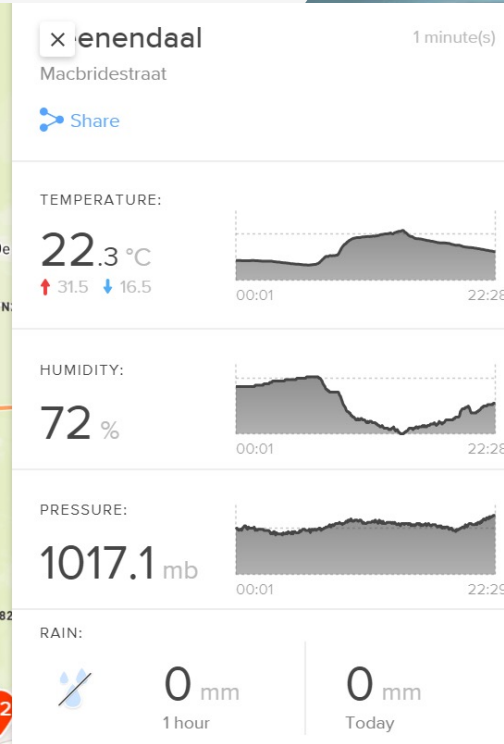
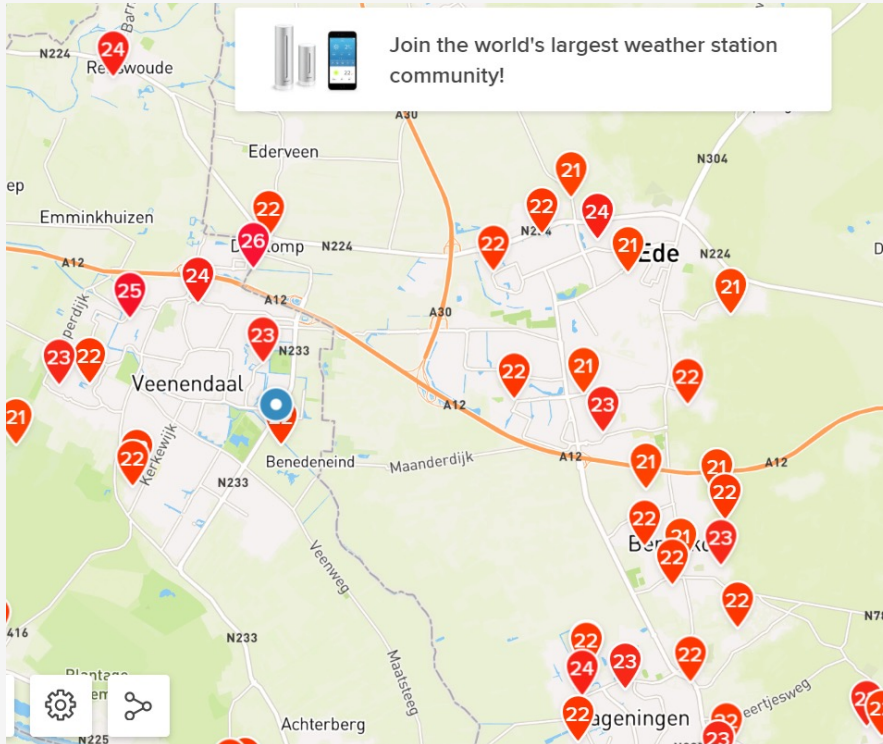
Netatmo weather station

Consumer weather station, measuring temperature, pressure, relative humidity. Optional sensors for precipitation and wind speed. Resolution: 5 minutes.



Netatmo weather station

App and online map to see data

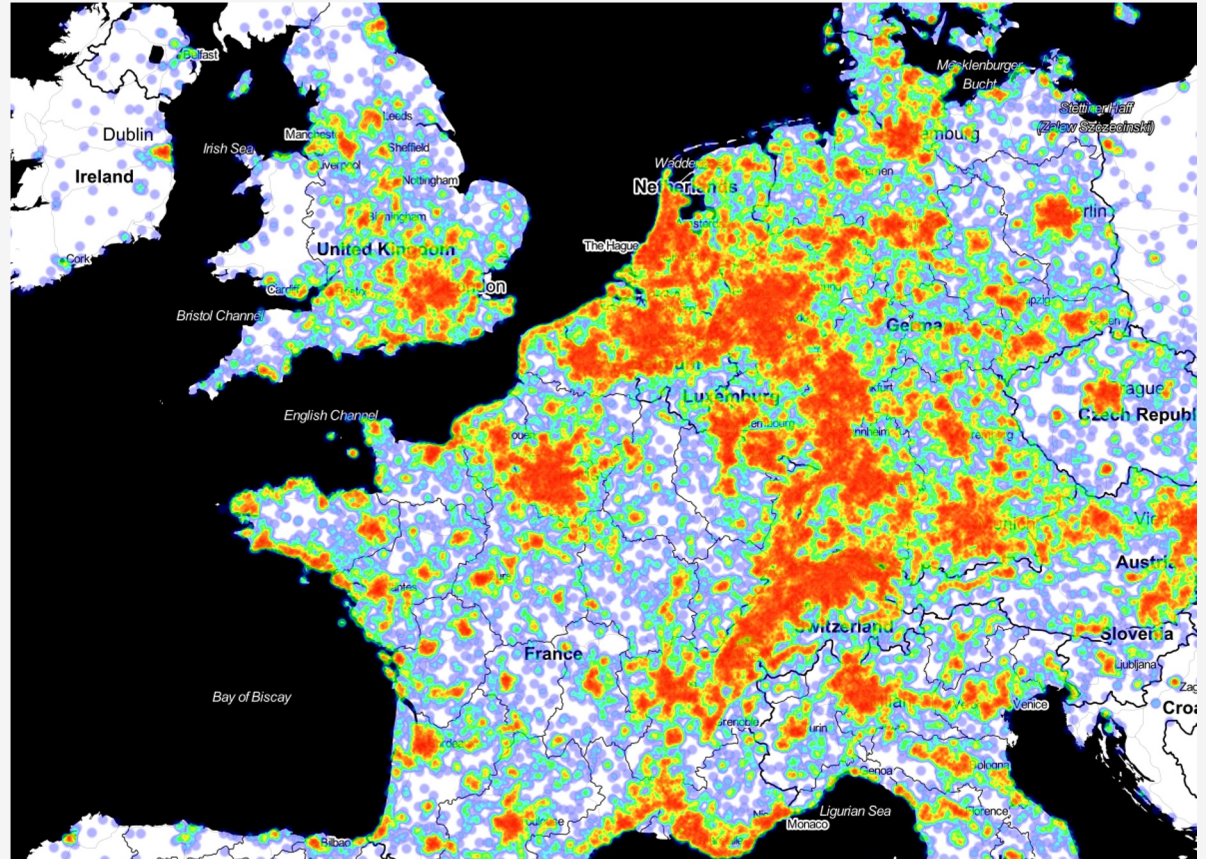


Netatmo weather station

Station density in
western Europe

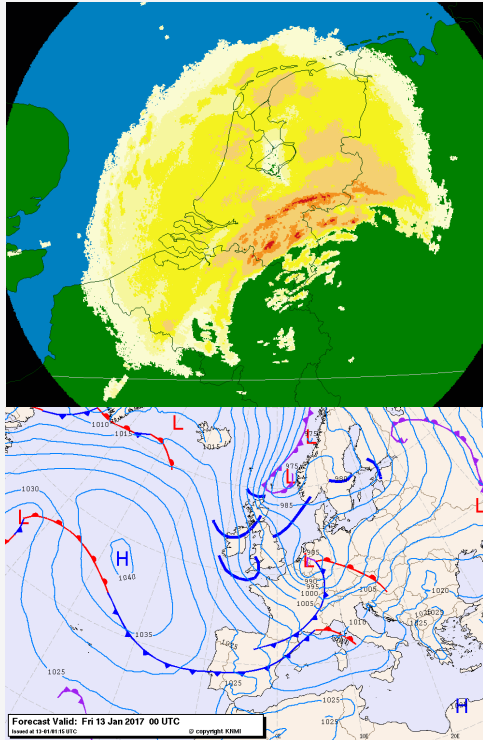
Worldwide
approximately 200,000
stations

Data freely available at
<http://dev.netatmo.com>

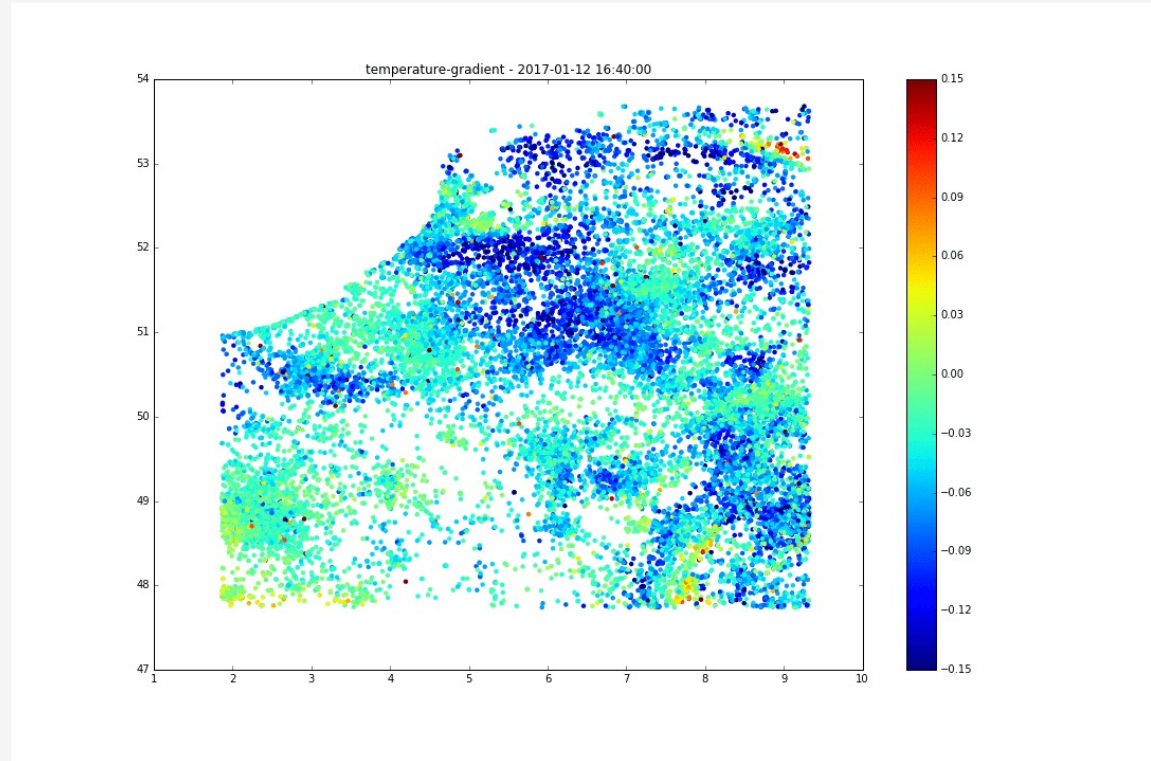


Example of (big) data

Radar



Temperature change



Quality of these observations

Private weather stations are often not properly installed, maintained or equipped



We have to look to a lot of stations, not to individual stations



Combine with other data sources to get most value

Error

Big data

Data science

Can we use these consumer stations for road weather forecasting?

Two examples:

1. Snow detection
2. Night-time cloud cover



Snow detection



“Error” in the station: with solid precipitation ice formation or cups filled with snow. Rain gauge stops working



For one station this can have a different reason, but if this happens for lot of stations at the same time, it contains information.



Combine with radar images

Error

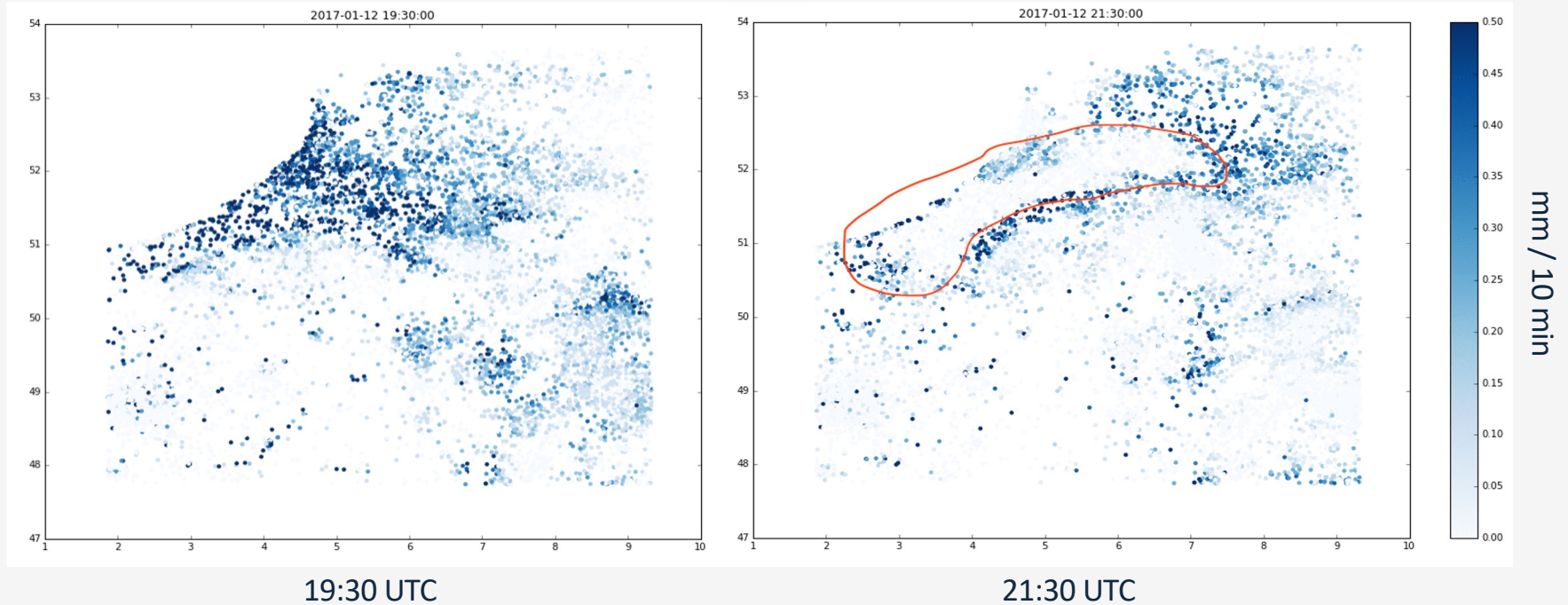
Big data

Data science



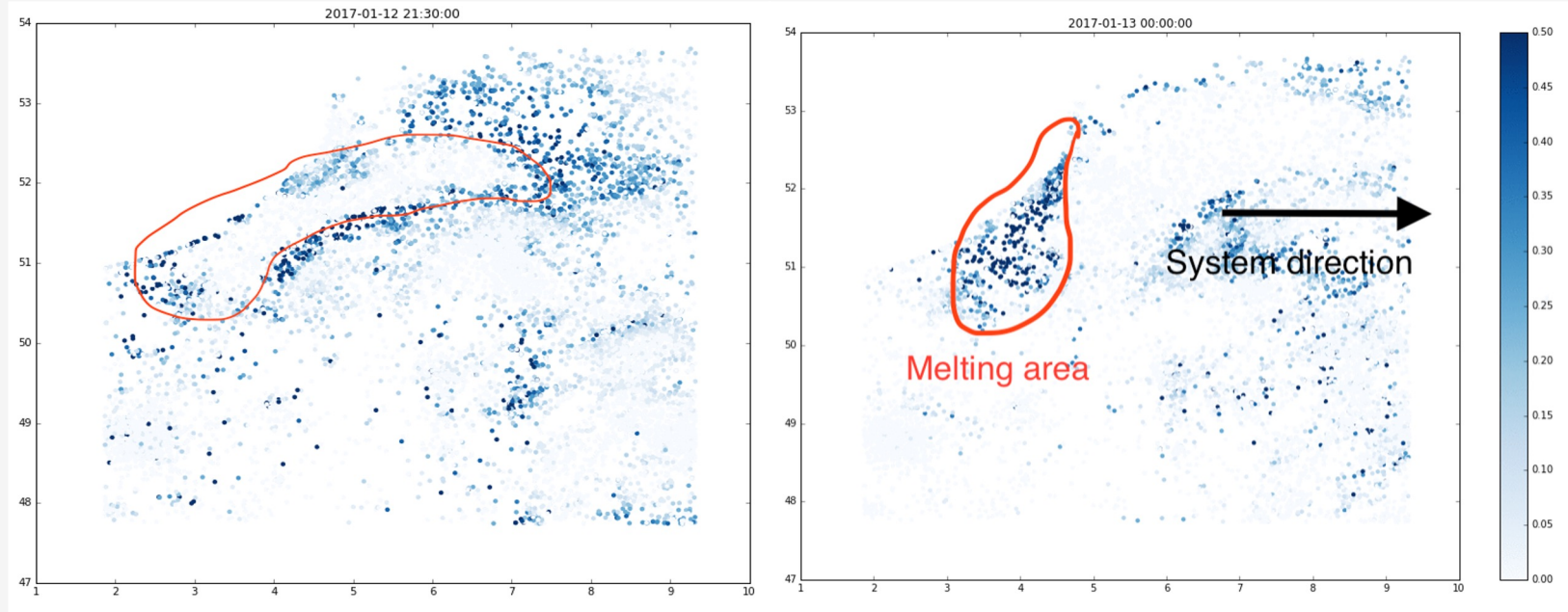
Snow detection

Netherlands – 12 January 2017



Snow detection

Netherlands – 12 January 2017

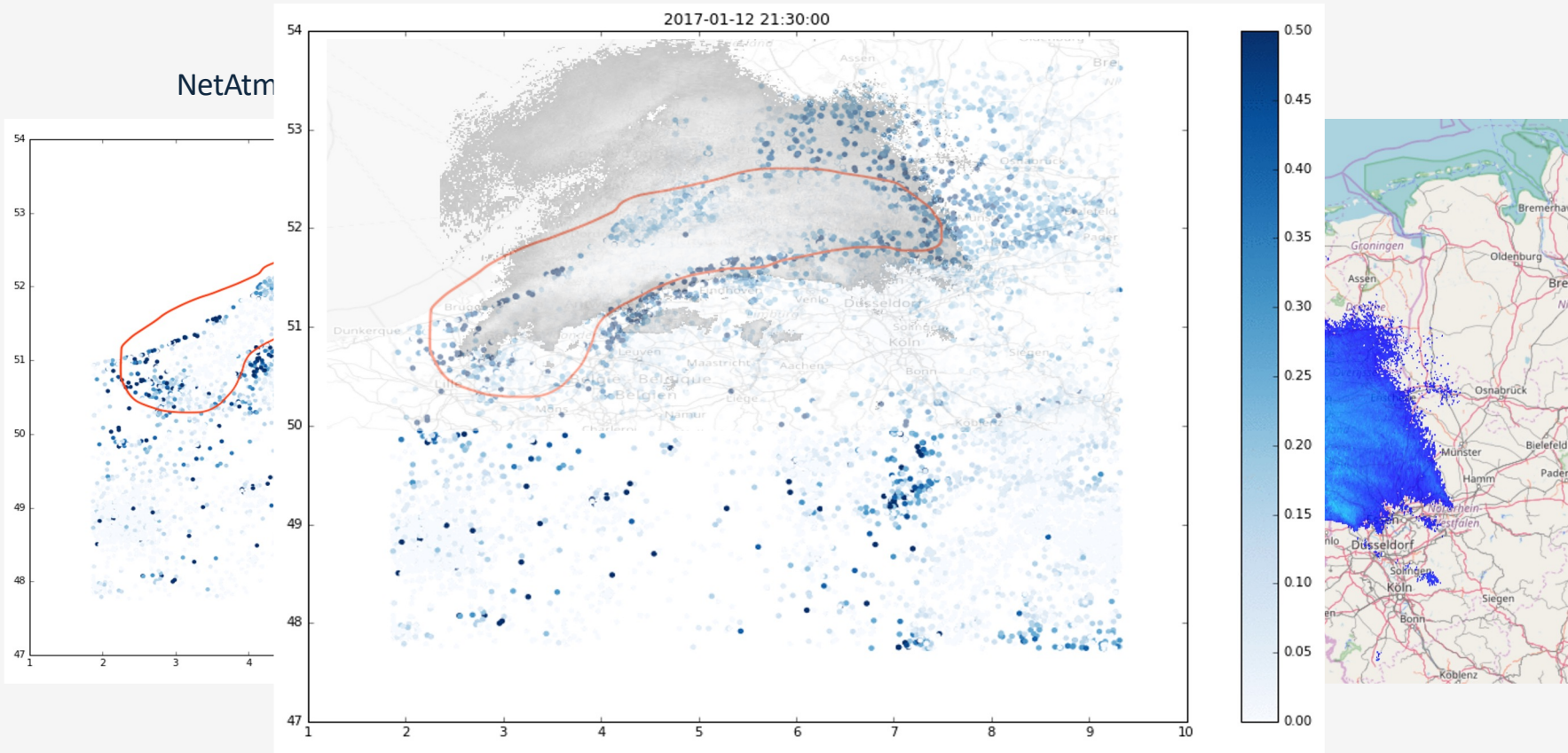


21:30 UTC

0:00 UTC

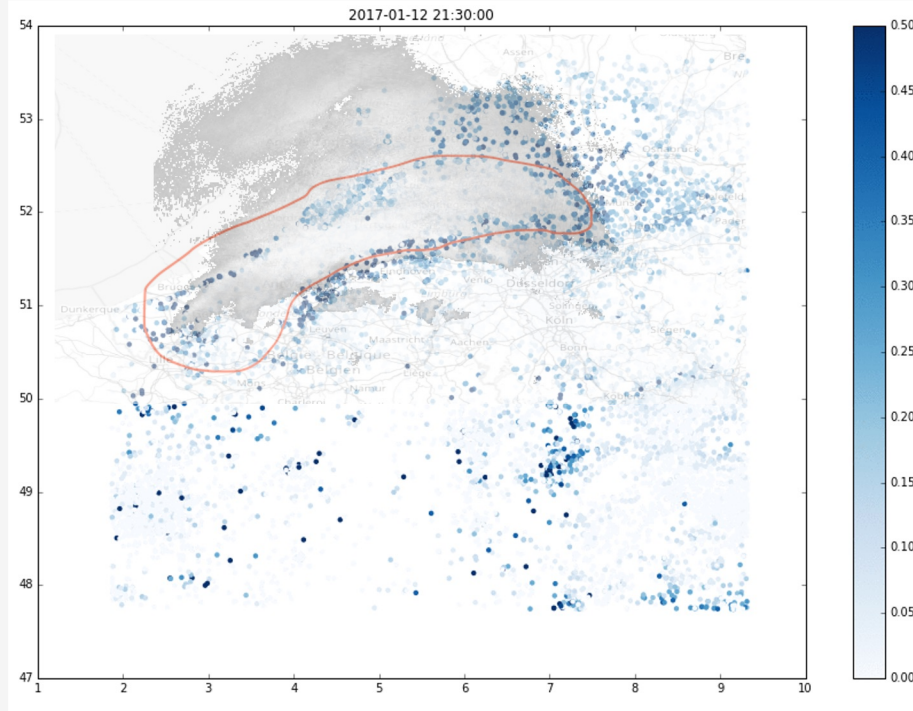
Snow detection

Radar overlay

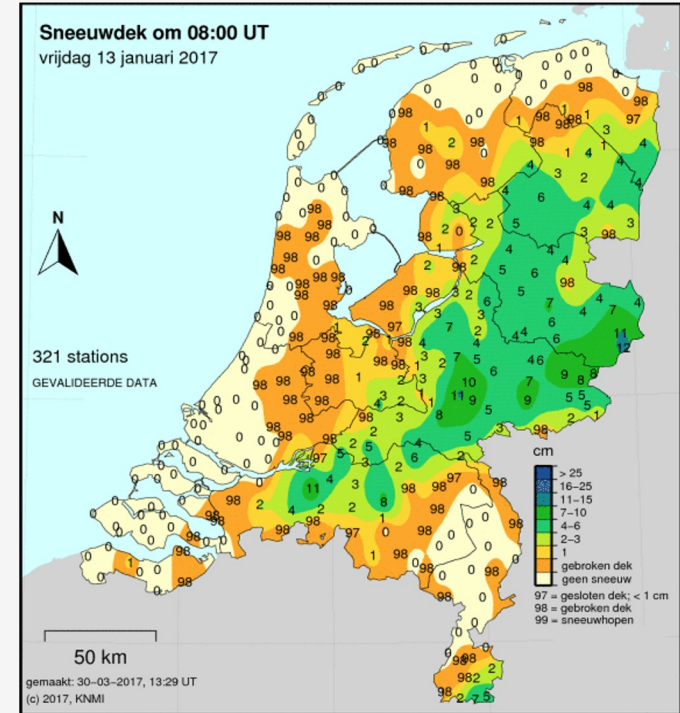


Snow detection

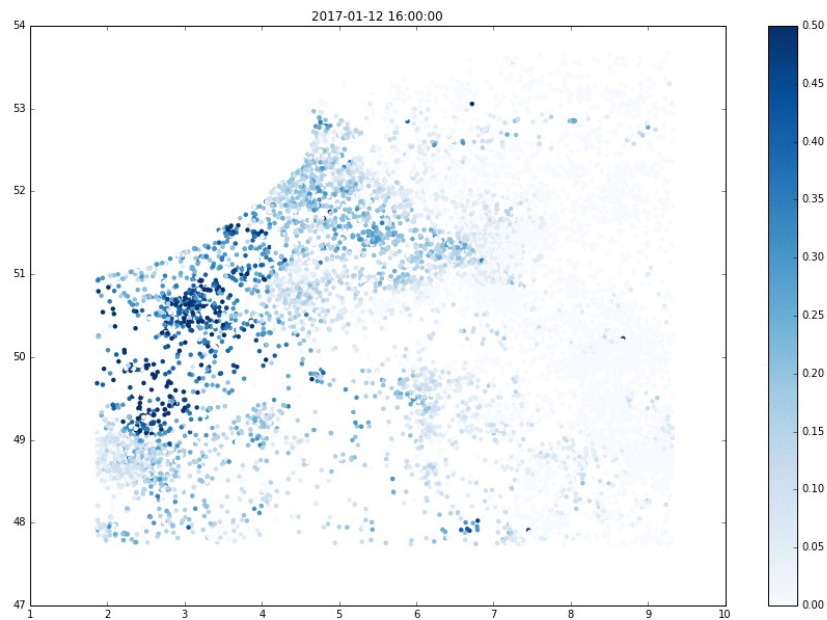
Radar overlay



Snow depth next day



Snow detection



Snow detection

Benefit: very local precipitation type information, close to real-time.

Phase change between solid and liquid precipitation can be detected.

Important for road winter maintenance!



Can we use these consumer stations for road weather forecasting?

Two examples:

1. Snow detection
2. Night-time cloud cover



Night-time cloud cover

“Error” in the station: no ventilated radiation shield, so more sensitive to longwave radiation, indicating clear spells



For one station this can have a different reason, but if this happens at lot of stations at the same time, it contains information.



Combine with satellite or station observations.
Or derive machine learning model.

Error

Big data

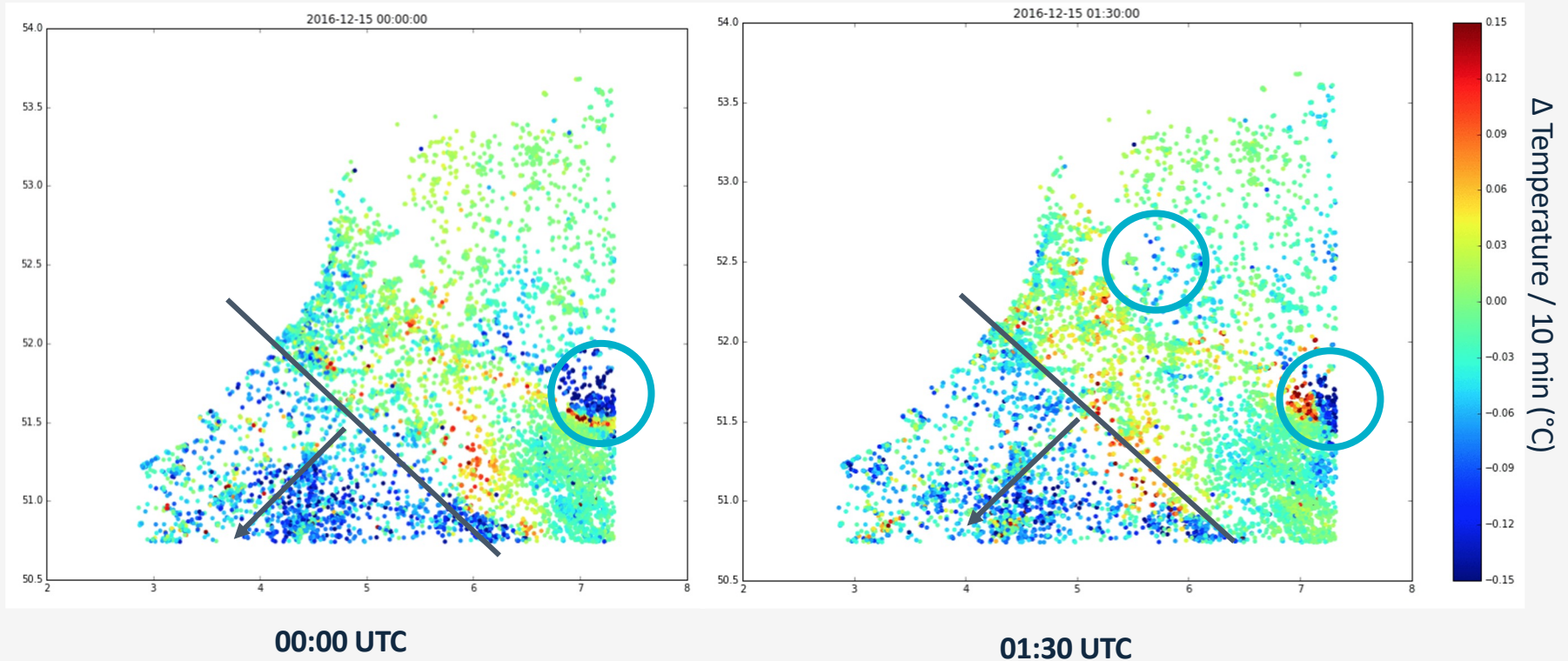
Data science



Night-time cloud cover

Netherlands - 15 december 2016

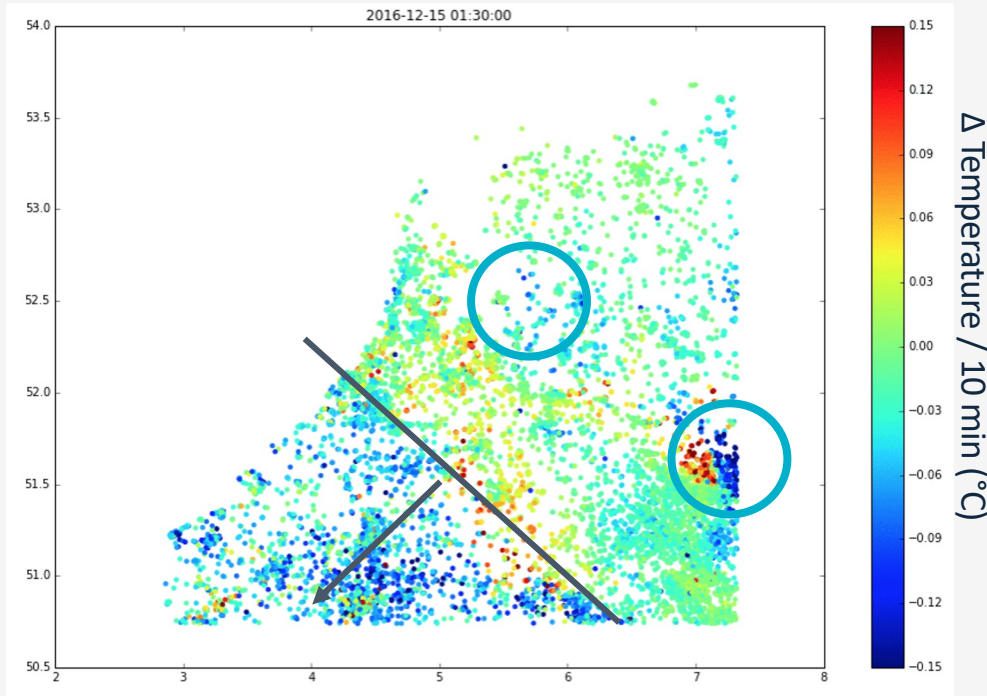
Temperature changes over time



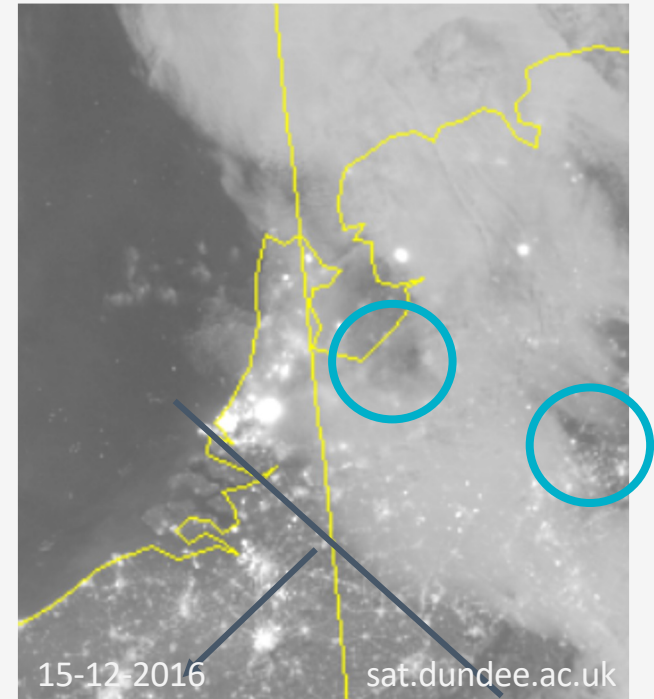
Night-time cloud cover

Netherlands - 15 december 2016

Temperature changes over time



01:30 UTC



01:30 UTC

Night-time cloud cover

Benefit: clear spells can cause quick drops in road surface temperature and therefore local slippery roads. With this method there is real-time information about where clear spells occur.



Can we use these consumer stations for road weather forecasting?

Yes!

Even measurement errors are valuable.

Further ideas:

- Daytime cloud cover map
- Precipitation type “radar”
- Extend to other consumer data sources
- Implement machine learning models



Thank you

Ingeborg Smeding-Zuurendonk

Application Domain Expert/Delivery Manager Transport

I.Smeding@meteogroup.com

