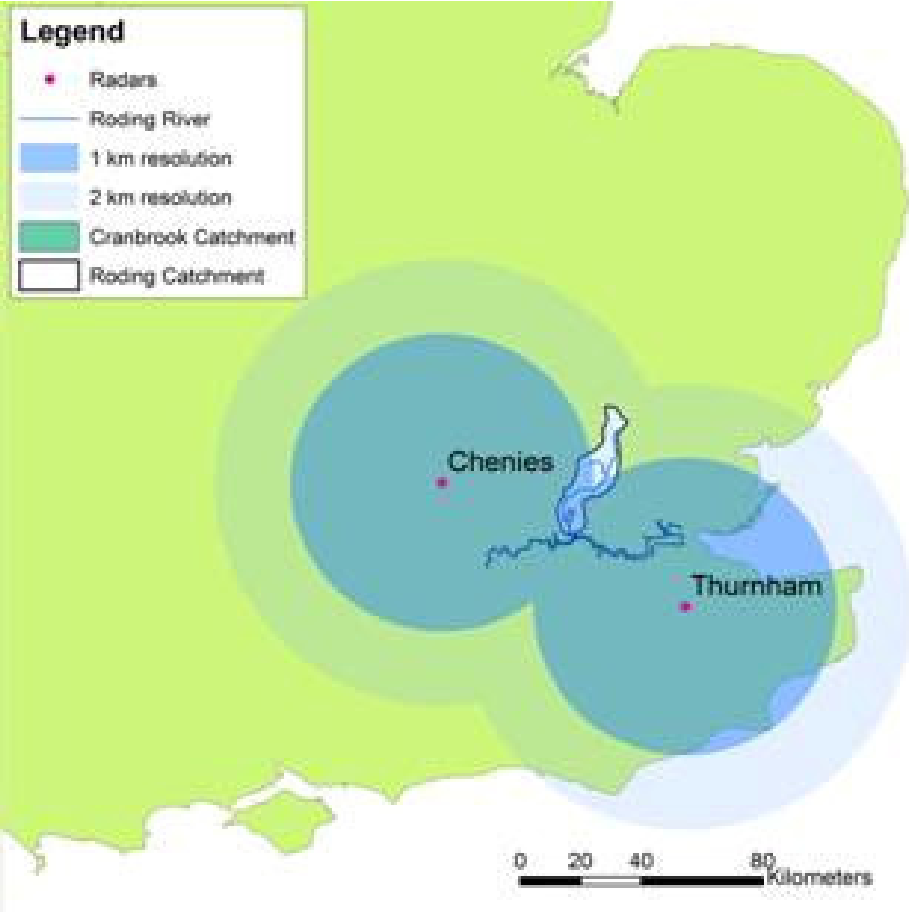
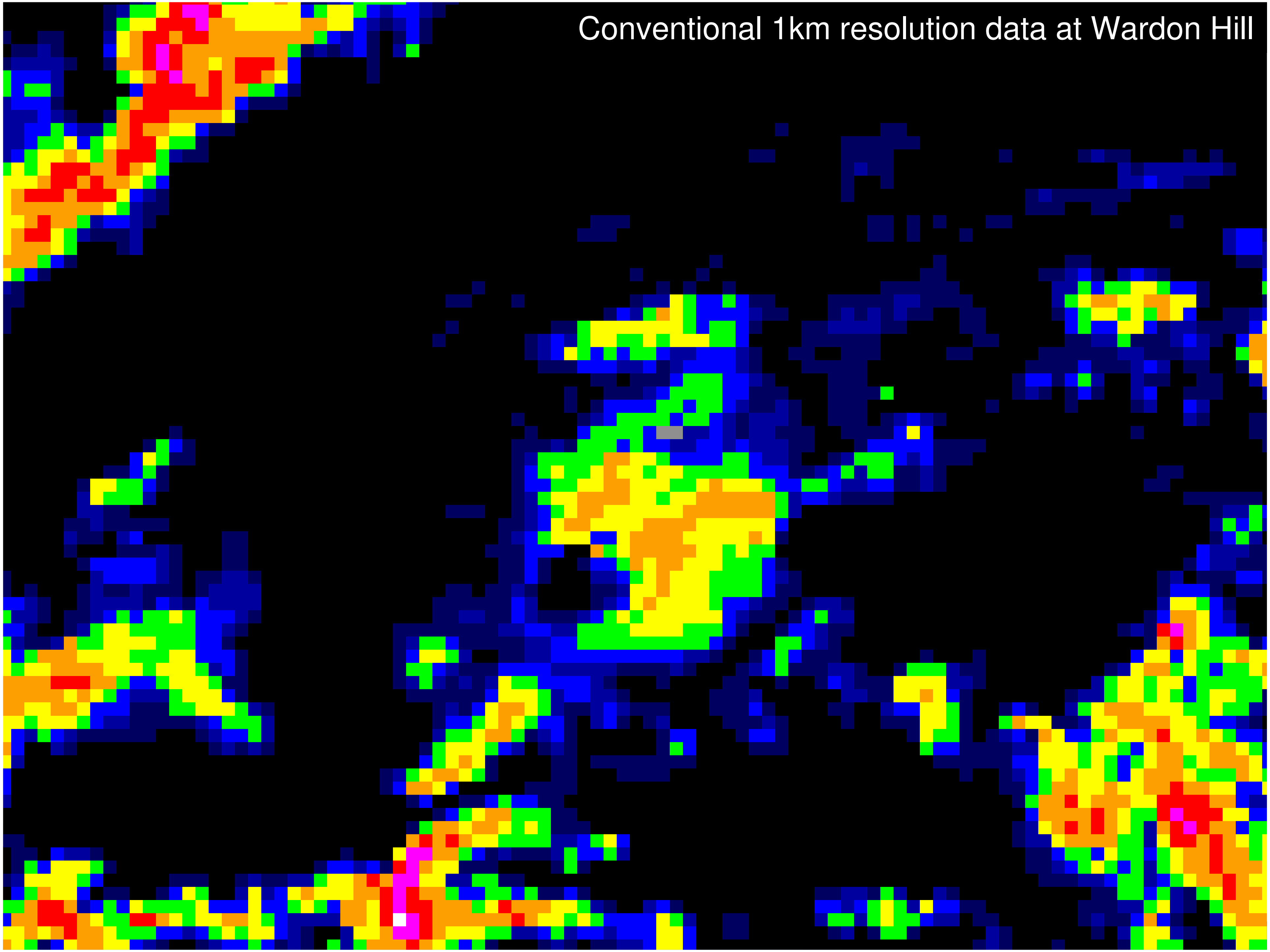
High resolution radar products over central London – status update

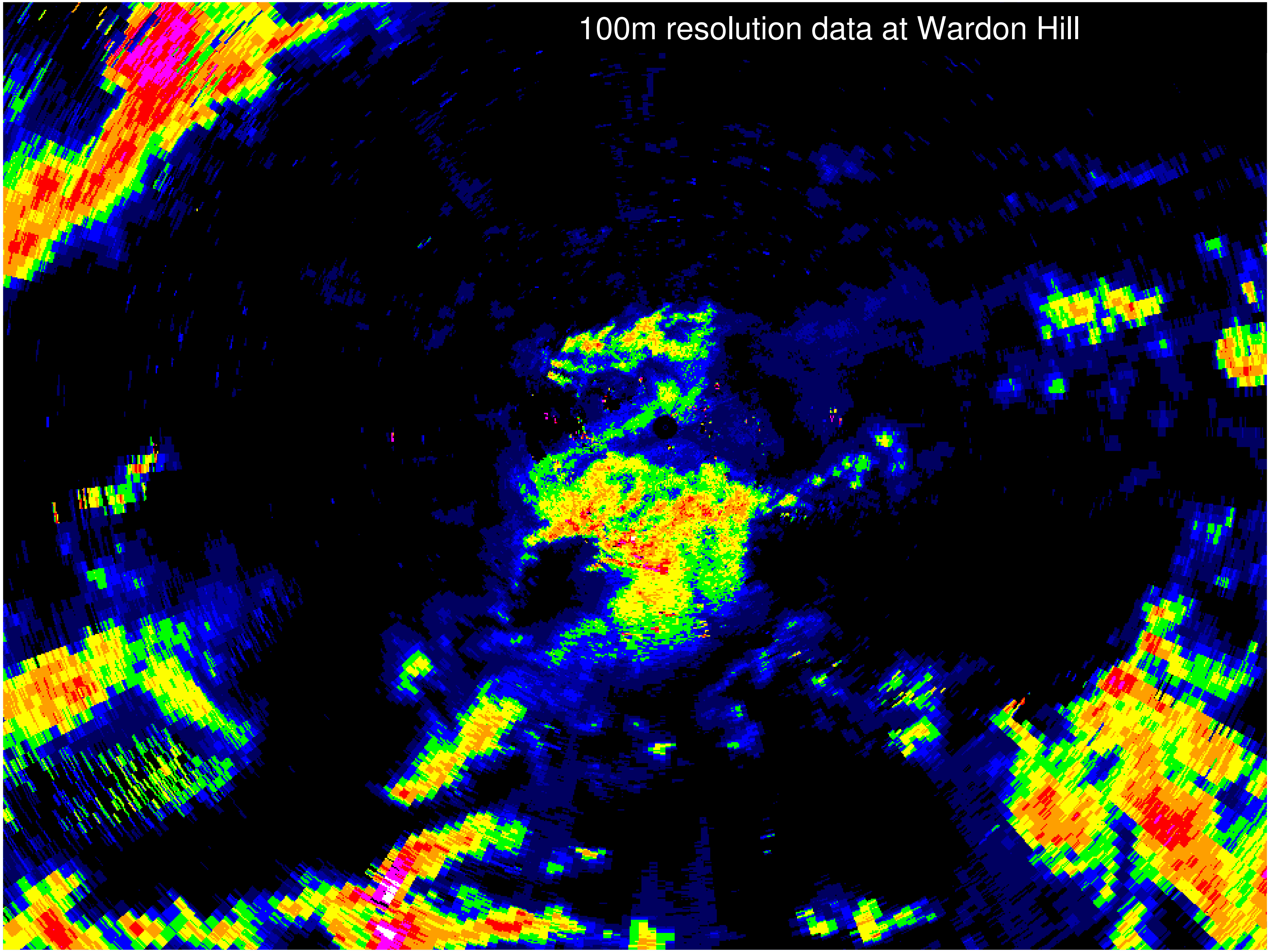
Timothy Darlington
Met Office
31st March 2014

UK Pilot site: London

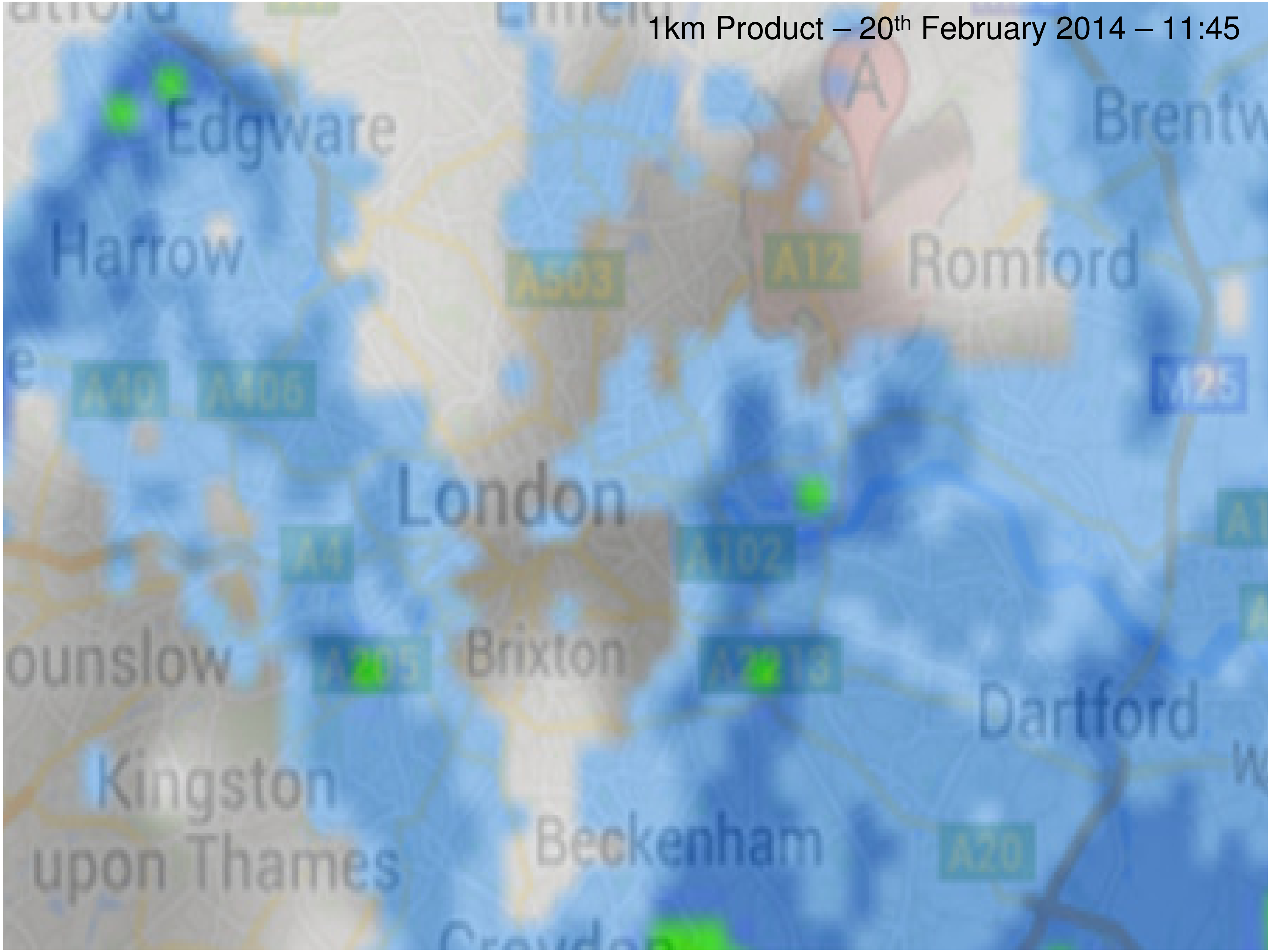
- Chenies and Thurnham upgraded to Dual Pol.
- Trials of experimental high res. at Wardon Hill ongoing
- Initial trials over London using Chenies and Thurnham 75 m data



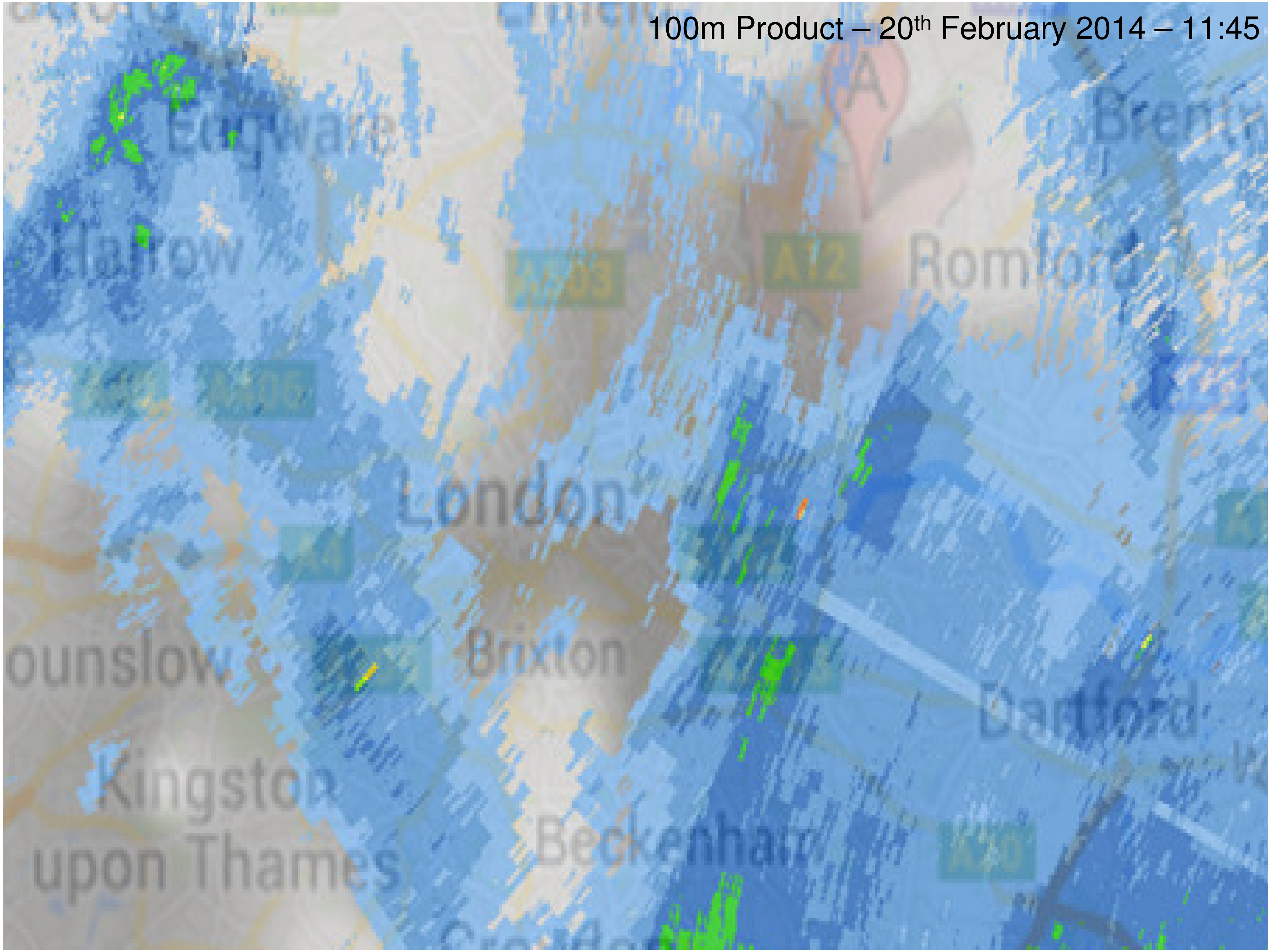

Conventional 1km resolution data at Wardon Hill

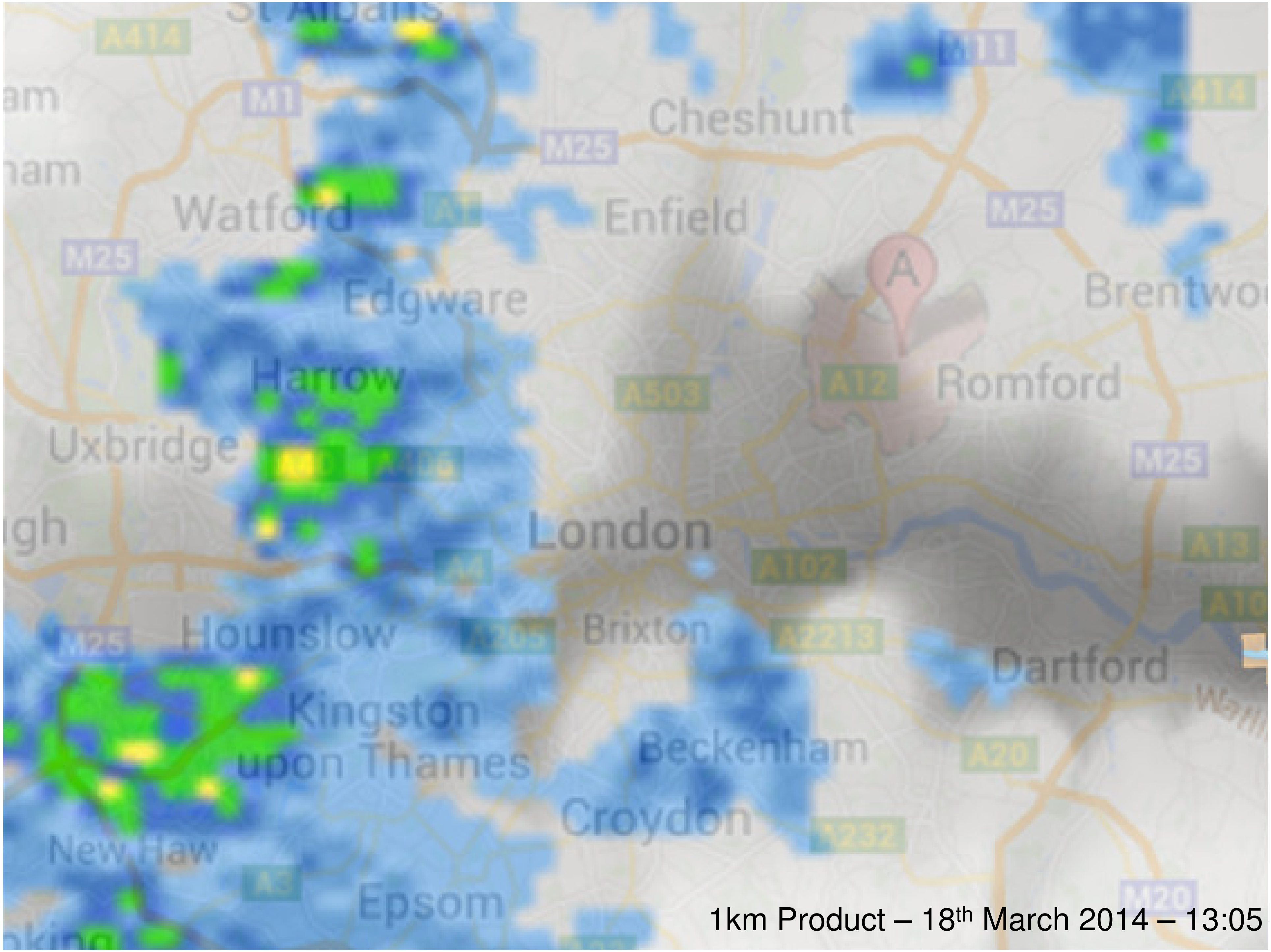

100m resolution data at Wardon Hill

1km Product – 20th February 2014 – 11:45

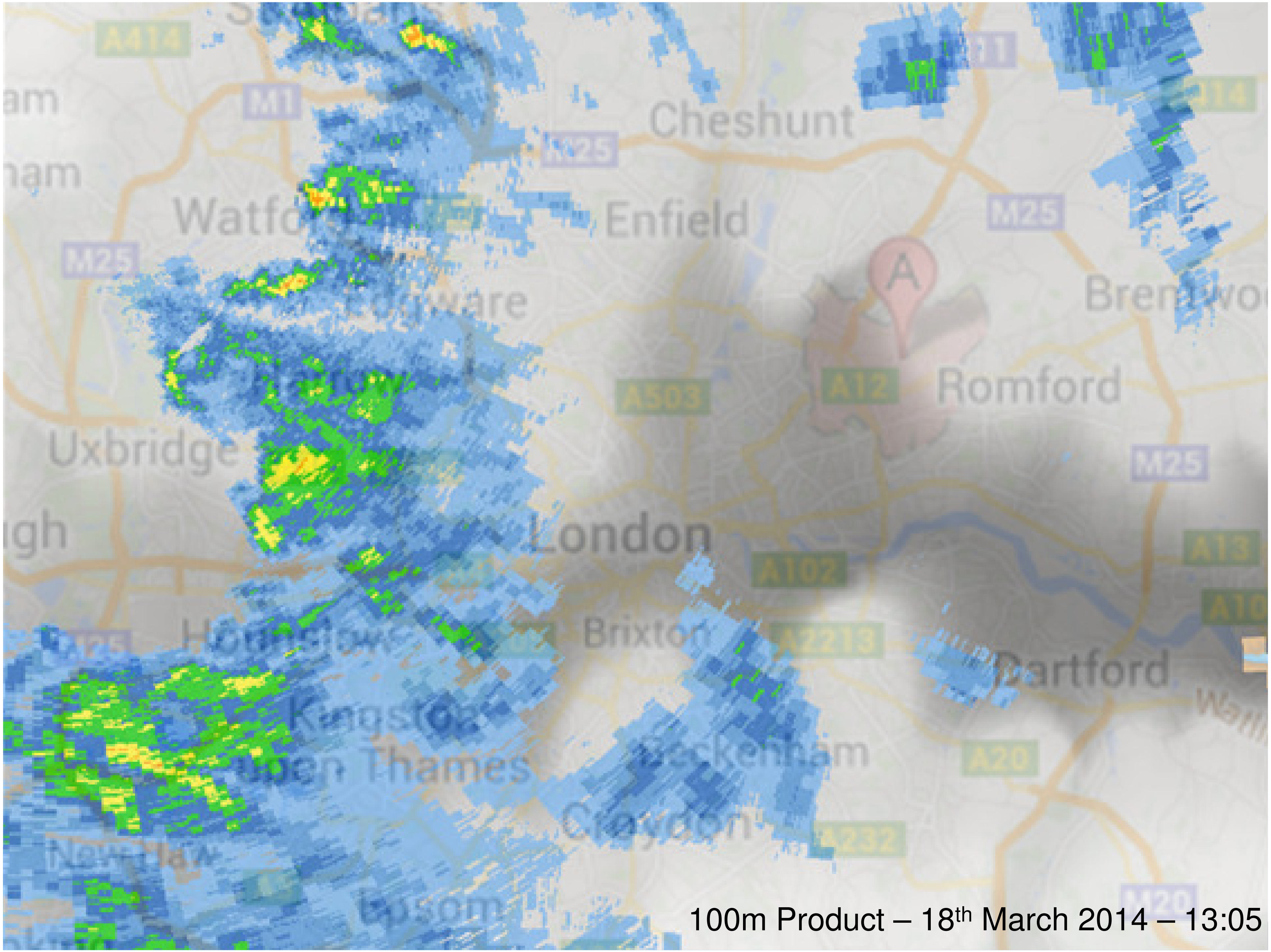


100m Product – 20th February 2014 – 11:45





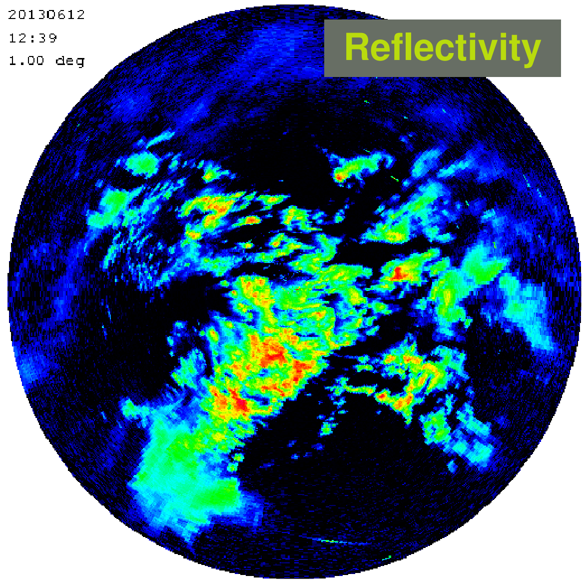
1km Product – 18th March 2014 – 13:05

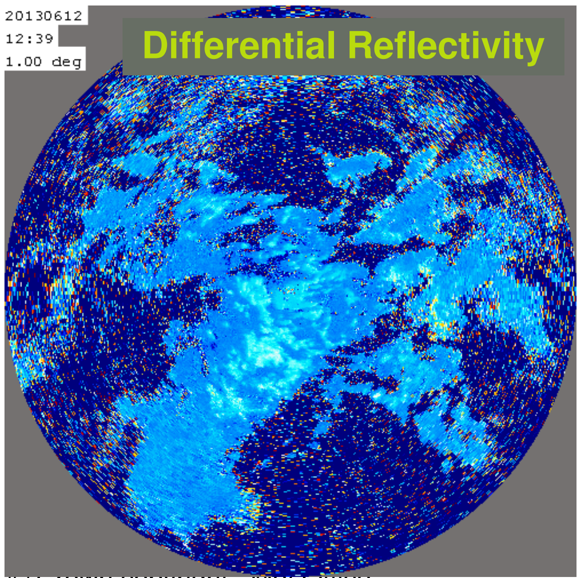


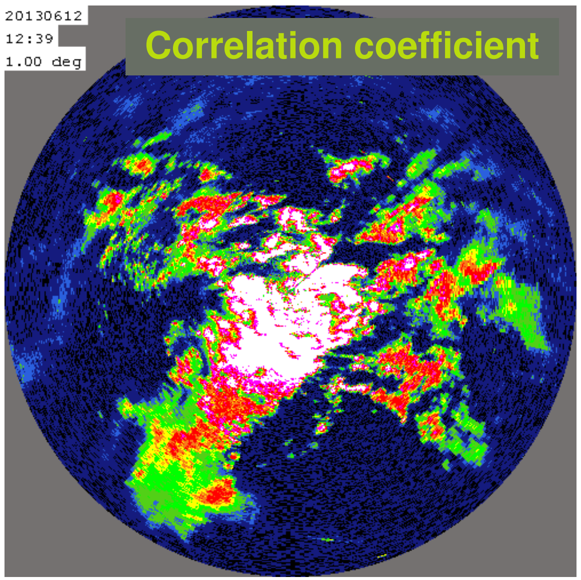
100m Product – 18th March 2014 – 13:05

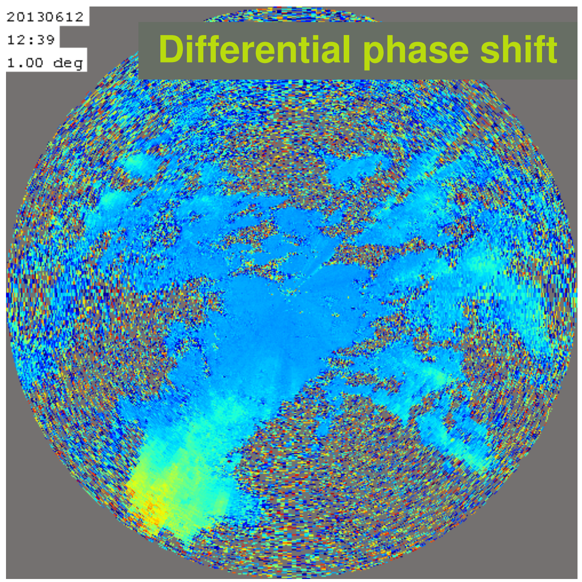
Additional information provided by Dual-Polarisation radar

Polarisation mode	Transmit	Receive
Dual	H & V	H & V
Single	V	V





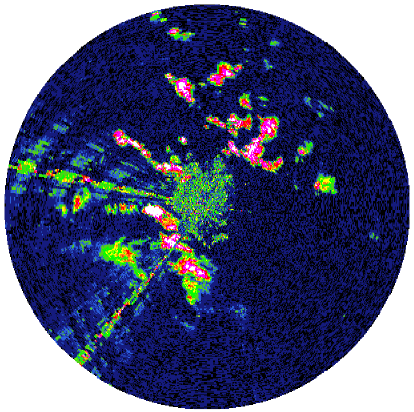


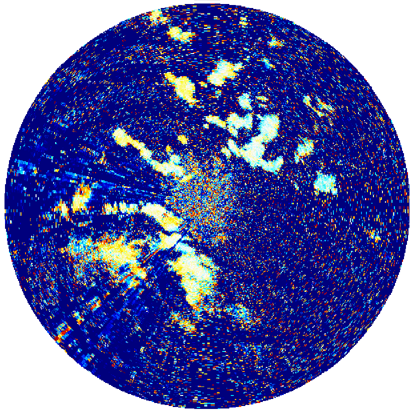


Spurious echoes filtering

Dr Nawal Husnoo

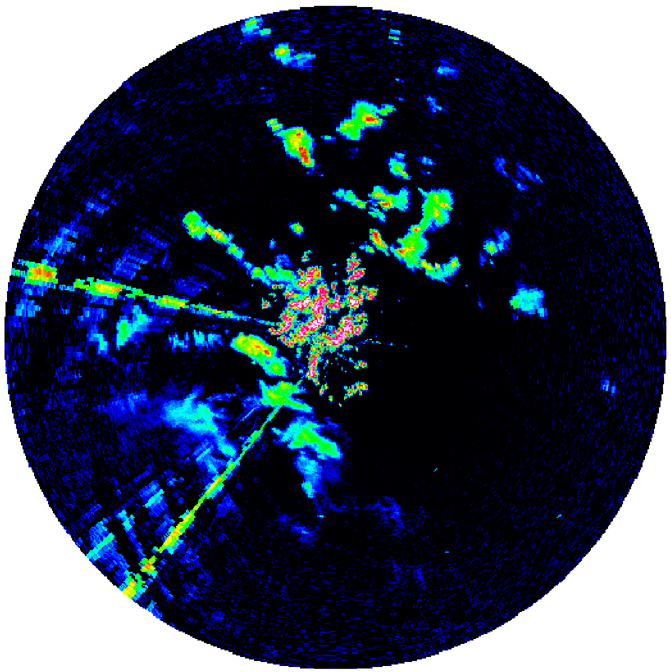
Correlation coefficient



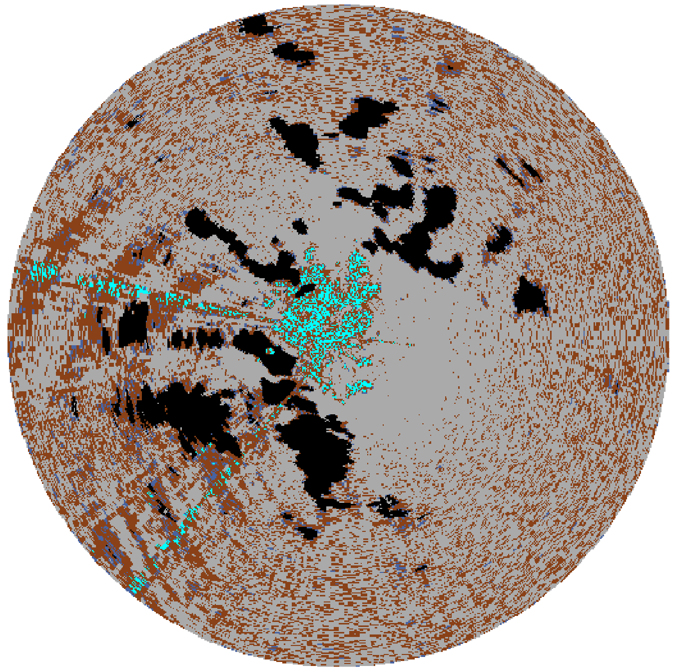


Differential Reflectivity

Reflectivity



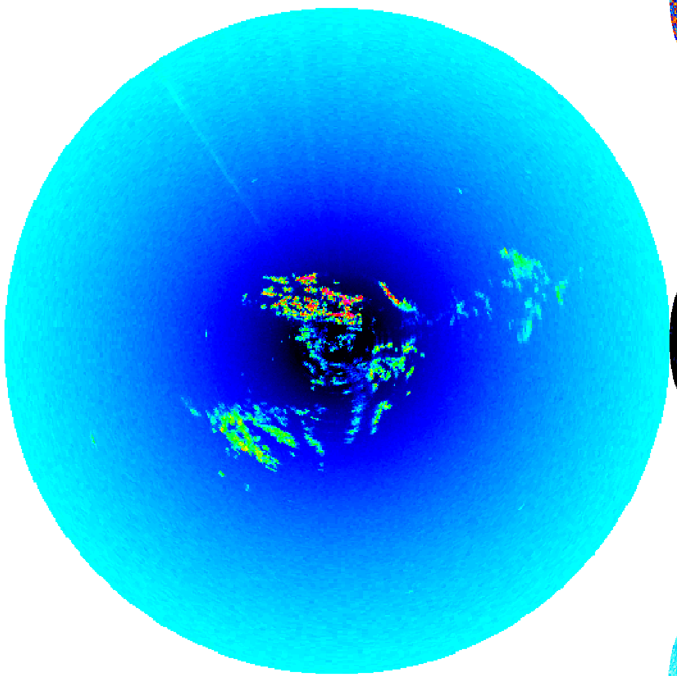
Classification

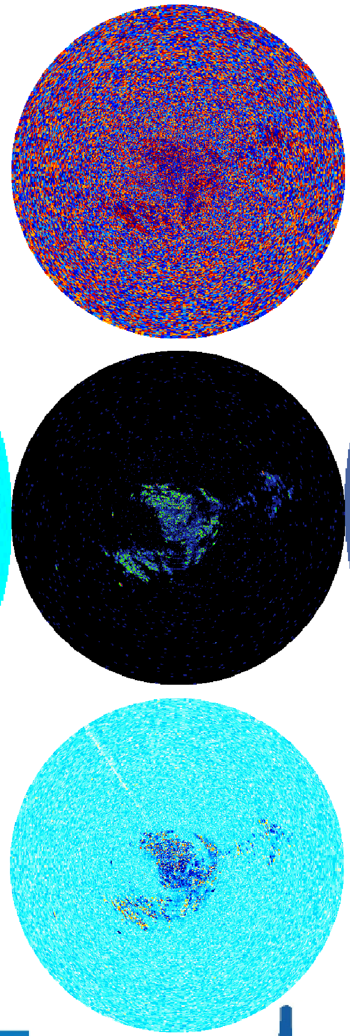


Black = Precipitation

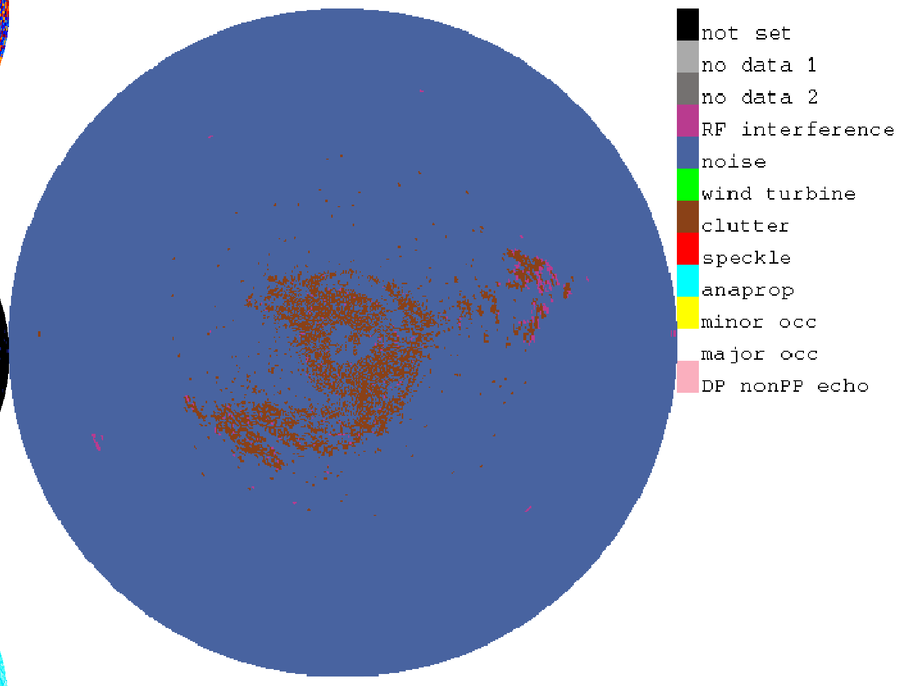
Spurious echoes filtering at finer resolution

Reflectivity





Classification



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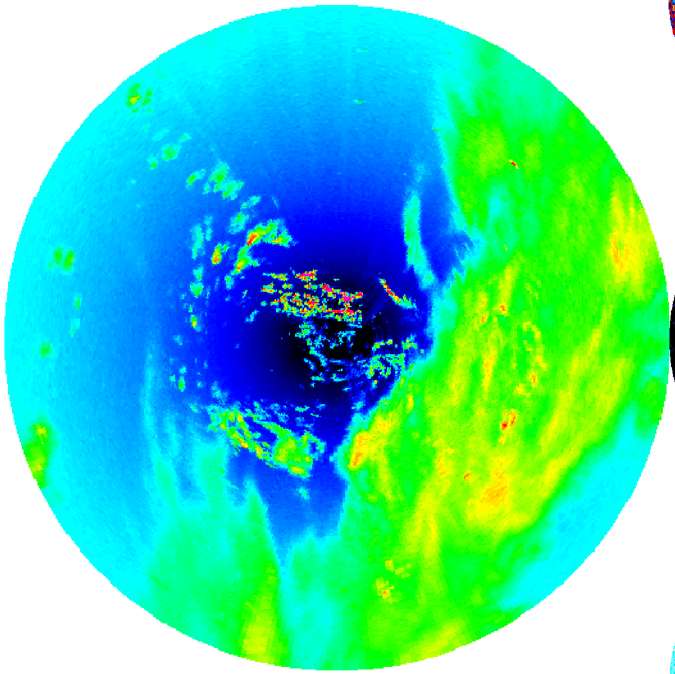
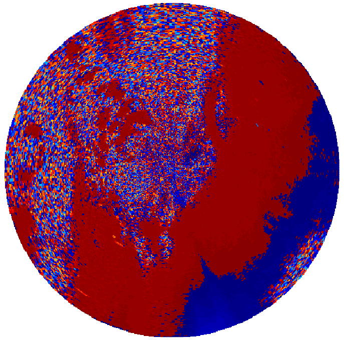
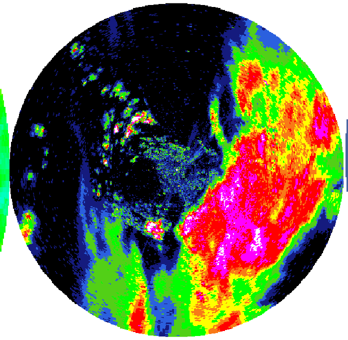
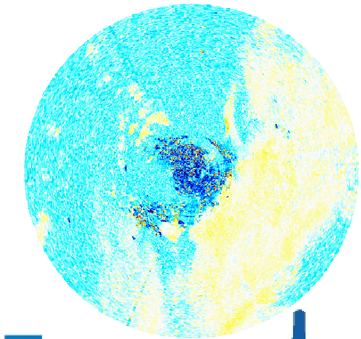
Spurious echoes filtering at finer resolution

Reflectivity

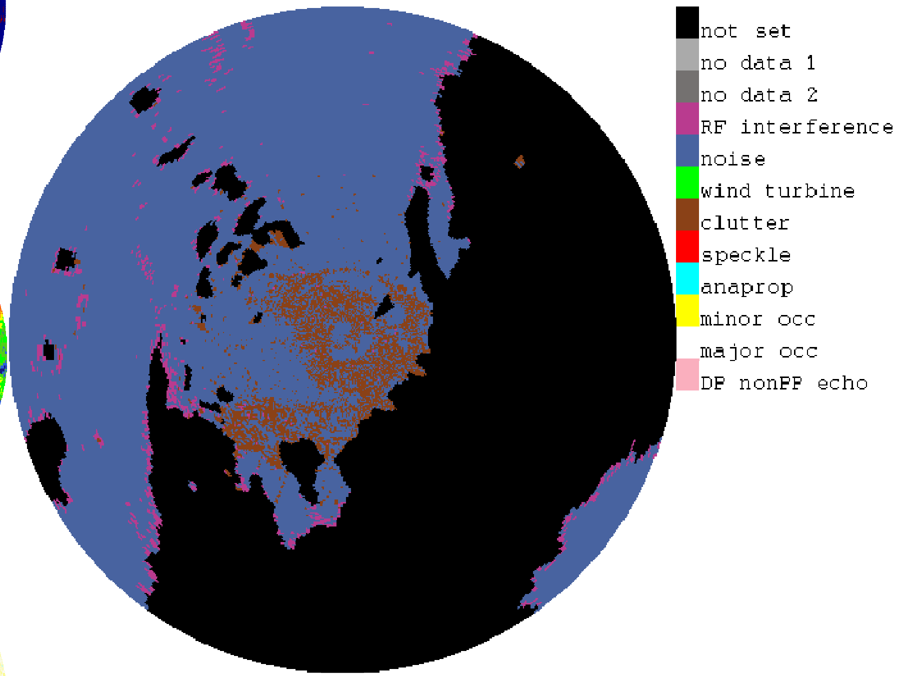








Classification



Dr Nawal Husnoo

Summary

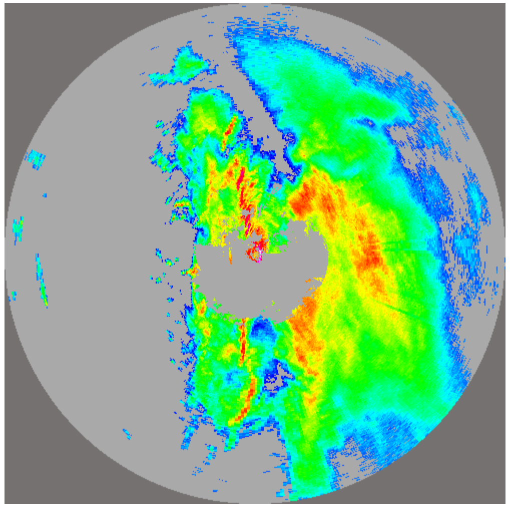
- A live prototype 100m rainfall rate product is generated over Central London since February 2014.
- Spurious echoes removal scheme currently been adapted for the 100m products.
- Further improvement to the quality control of the data will be included over the course of next year. – e.g. Doppler Filtering for lower elevation scans

High resolution radar products over central London – future plans

Katie Norman, Observations R&D, Met Office
RAINGAIN, Antwerp
31st March 2014

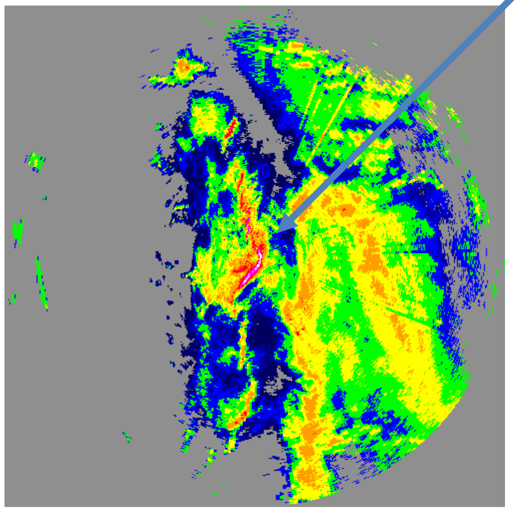
Improving Convection Diagnosis

Convection not detected by existing operational algorithm

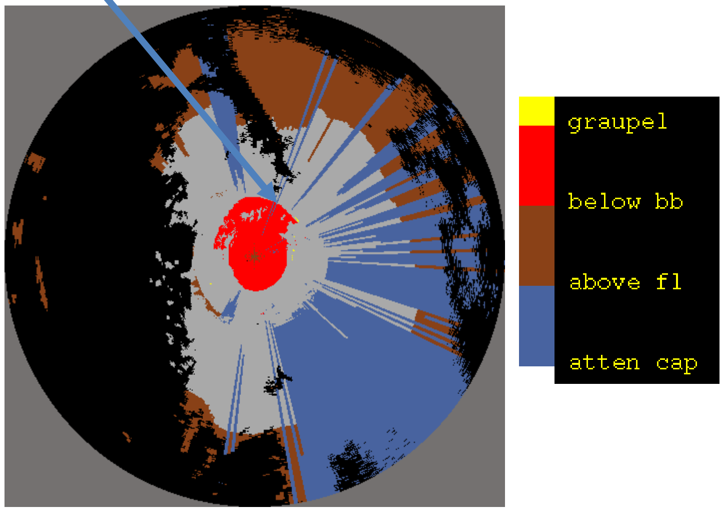


Quality controlled reflectivity

(lowest elevation scan)

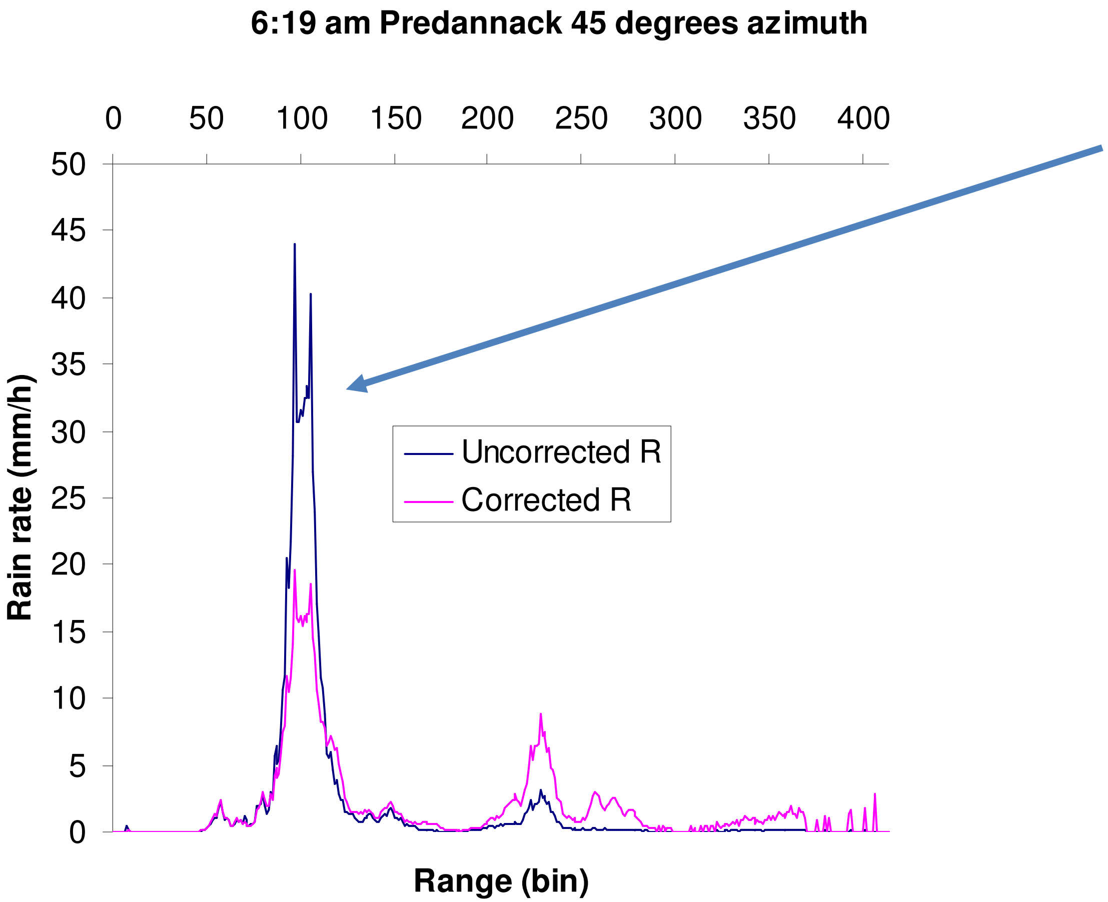


Surface Precipitation Rate



Algorithm for correcting for vertical profile of reflectivity

Improving Convection Diagnosis



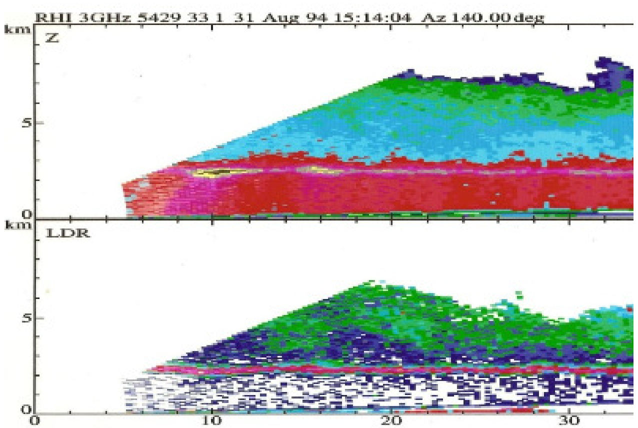
Convection not detected by existing operational algorithm:

A correction for the bright-band was made, causing final Radar Rainfall estimate to be significantly lower than the true rainfall rate.

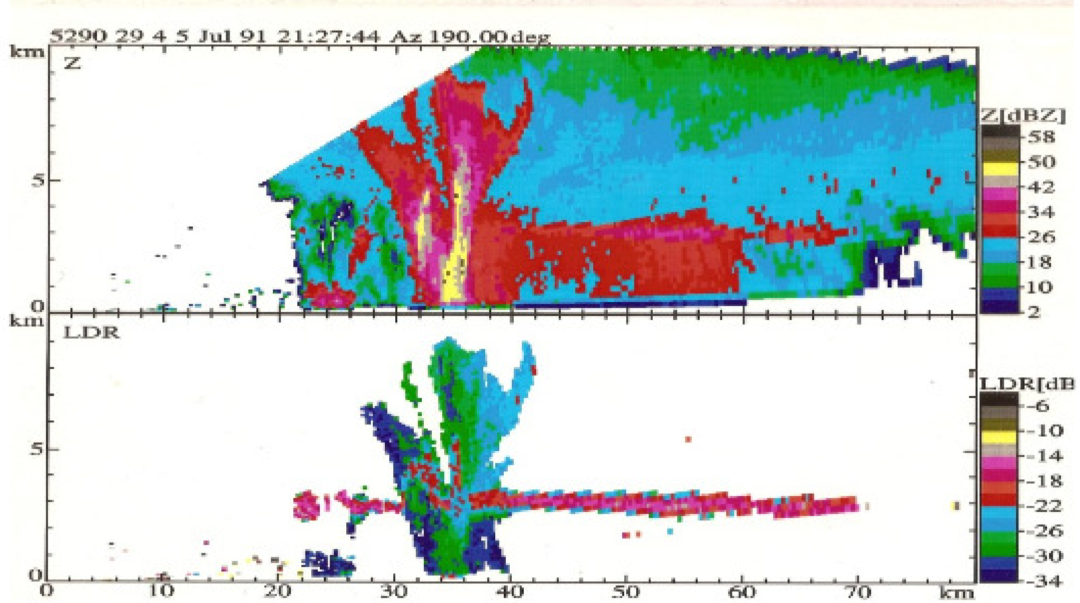
Improving Convection Diagnosis with Dual-Pol

Linear Depolarisation Ratio can be used to identify discontinuities in the bright band associated with embedded convection.

Images from Illingworth and Thompson. Weather Radar and Hydrology (IAHS Publ. 351, 2012),64-68 Radar bright band correction using the linear depolarisation ratio.



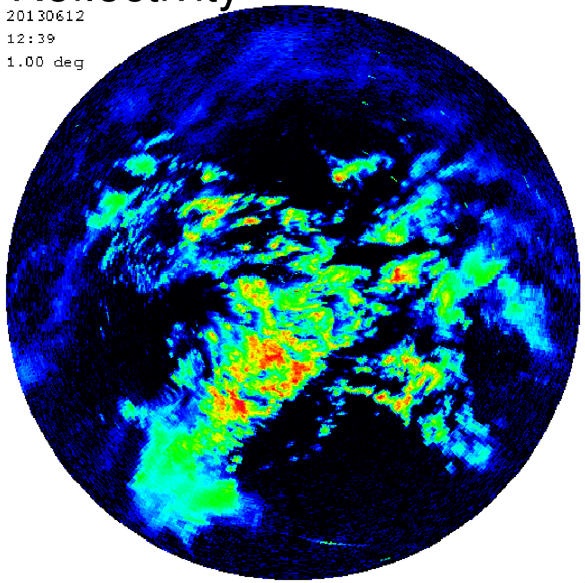
Range Height Indicator (RHI) plots from Chilbolton Radar



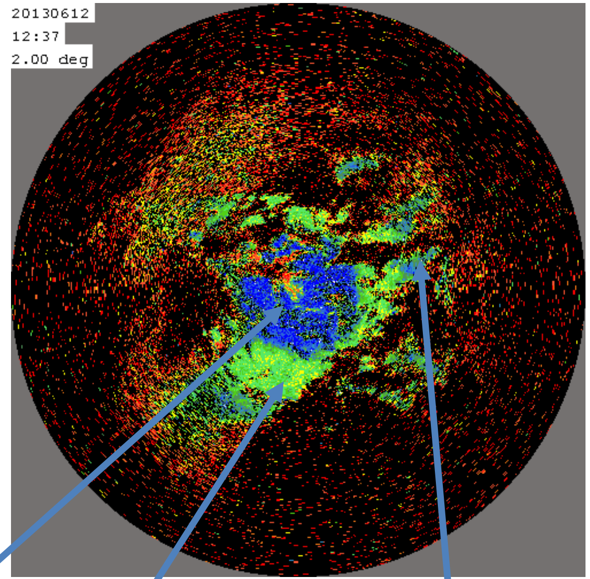
What is LDR?

- Measure of the depolarisation of the H wave
- LDR is sensitive to the particle shape, dielectric constant and orientation of the particle major axis with respect to the plane of the radar polarisation.
- Measured in a different mode – all power is transmitted in H, rather than split in H and V as is the case for other dual polarisation measurements

Reflectivity



LDR



LDR is less than -24 dB below the melting layer or bright band

LDR drops to about -20 dB above the melting layer.

LDR increases to about -15 dB within the melting layer.

Need to do some “house-keeping” as assumptions acceptable for generating 1 km resolution products may not be acceptable for 100 m products.

What about wind drift?

Analysis of method uses shows errors of the order of ~ 1 km in the method trialled.

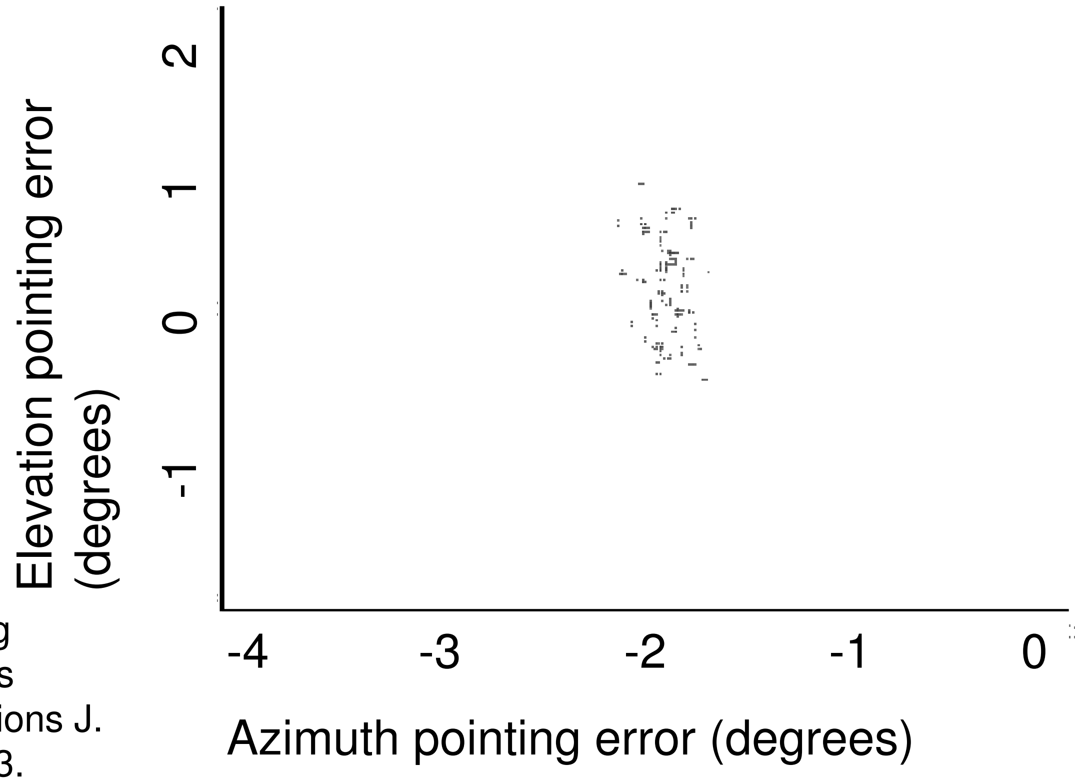
New methodology focussing on the attributes of the RAINGAIN domain over London is being developed – we can make assumptions about interest in snow and low beam heights and fall-times.

Where are we looking – Antenna Pointing

Radar antennas detect radiation from the sun.

This information can be used to tell us where the radar is pointing.

Small rotational offsets can have a large impact on the accuracy of radar products during events with fine structures.

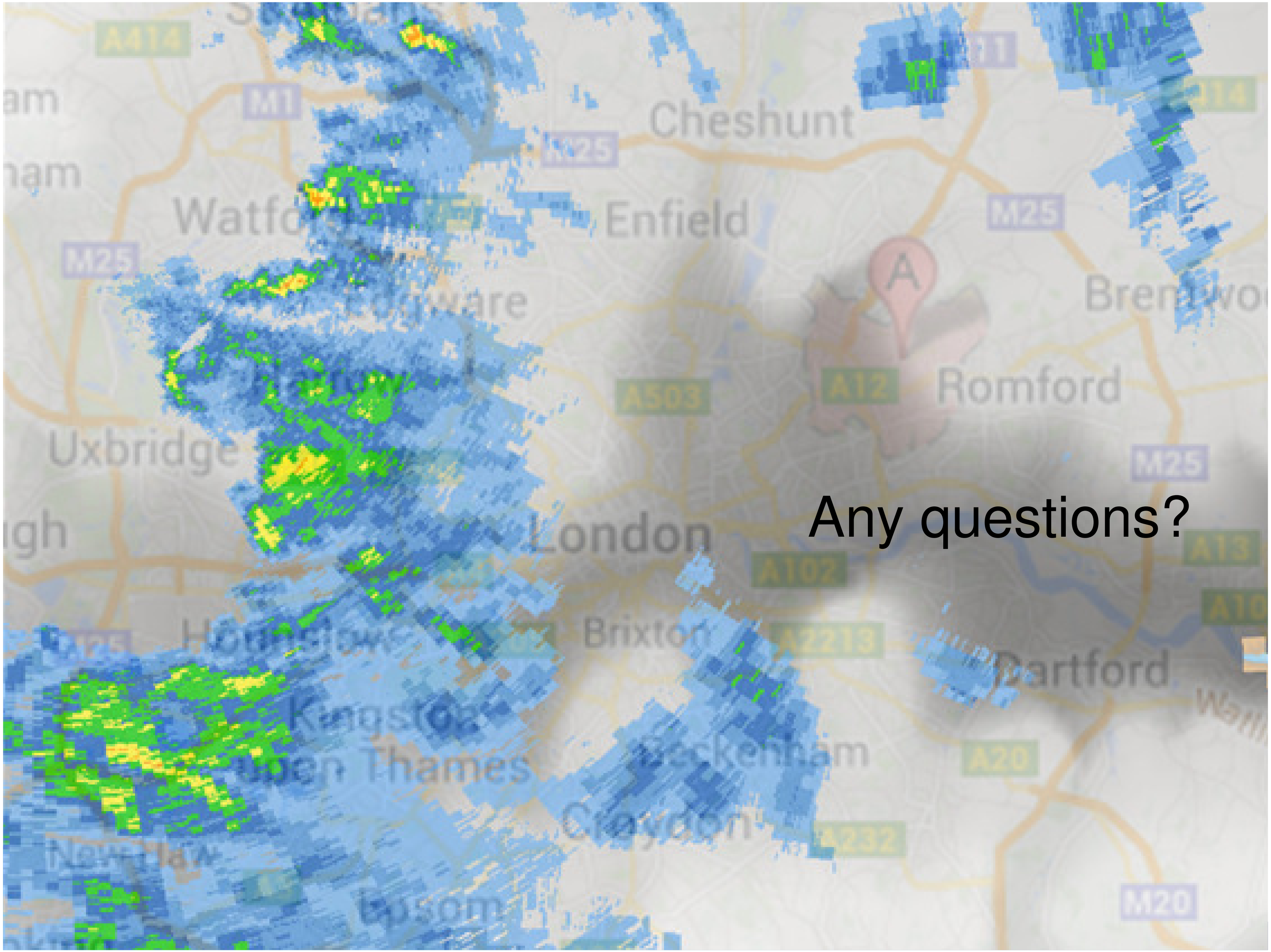


Huuskonen, A. and I. Holleman, Determining weather radar antenna pointing using signals detected from the sun at low antenna elevations J. Atm. Oceanic Technol., 2007, 24, 3, 476-483.

Summary

Over the next year:

- Implement and test revised wind drift methodology
- Start investigating improved convection diagnosis algorithms to improve QPE in embedded convective events
- Improve the quality control of high resolution data
- Review the use of high resolution spatial information combined with antenna pointing estimates.



Any questions?

Wind drift correction

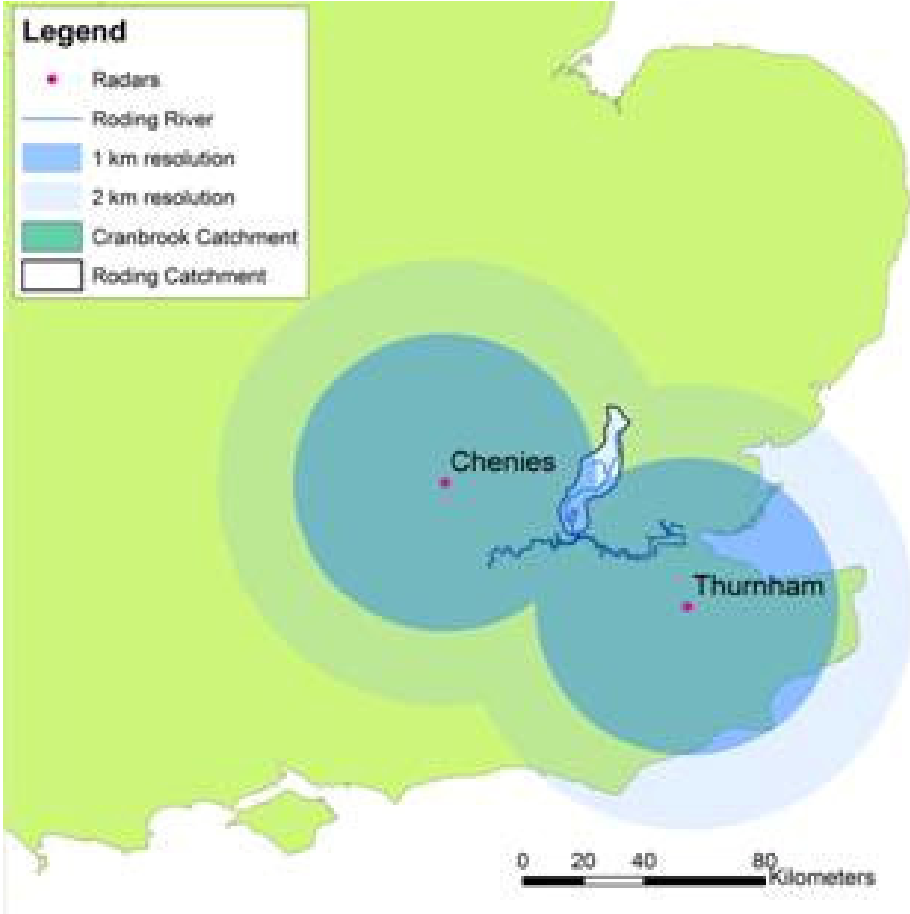
- Rain drops intercepted by the radar beam several 100s meters (sometime kilometres) above ground are used to derive rainfall rates at ground level directly below.
- In reality, wind shear results in slanting the track of the rain drops, with rain reaching the ground at a point displaced horizontally from where it was intercepted by the radar beam.
- Rainfall rate measurements derived from radars are very rarely corrected for this effect.
- The impact of the errors becomes more serious at higher spatial data resolutions.

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB

Wind drift correction

- Chenies radar is 40 km from catchment.
- Thurnham radar is 45km from catchment.
- Radar beam below 2km above sea level.

- Wind drift displacement typically around 2-3km (estimated during Dec 2012 case study).



Wind drift correction

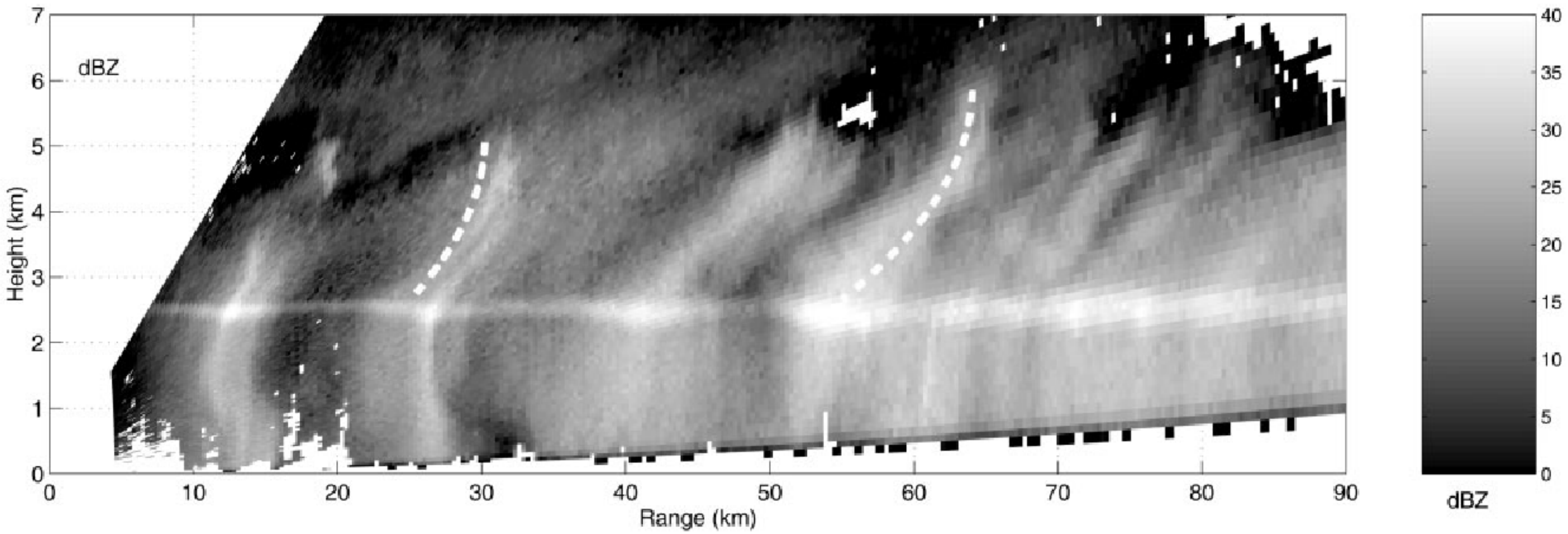


Figure 10. RHI for 1340 UTC on 18 August 2000 at 25° azimuth showing clear fall streaks. Fall-streak trajectories calculated using Eq. (4) are superimposed.

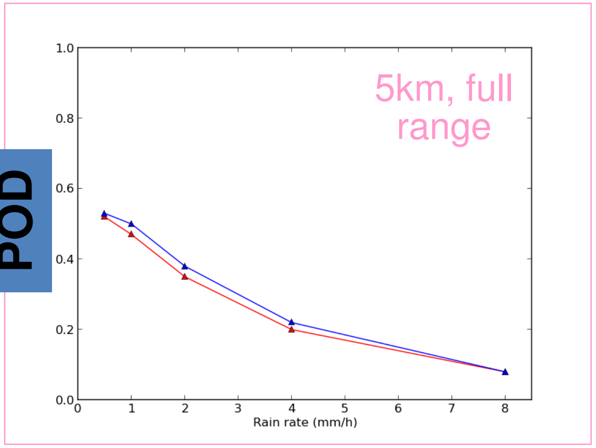
Mittermaier, M. P., R. J. Hogan, and A. J. Illingworth, 2004: Using mesoscale model winds for correcting wind-drift errors in radar estimates of surface rainfall. *QJRMS*, **130**, 2105-2123.

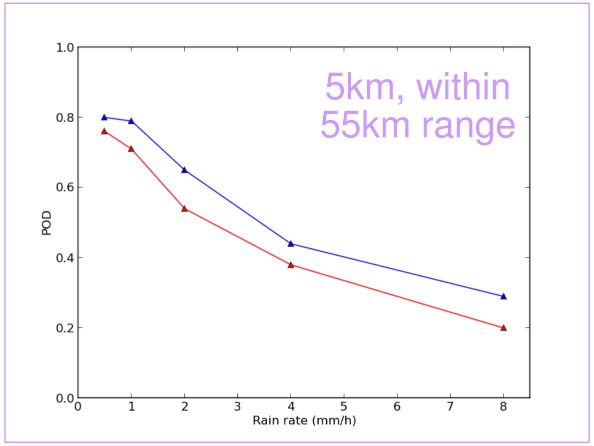
Wind drift correction performance analysis

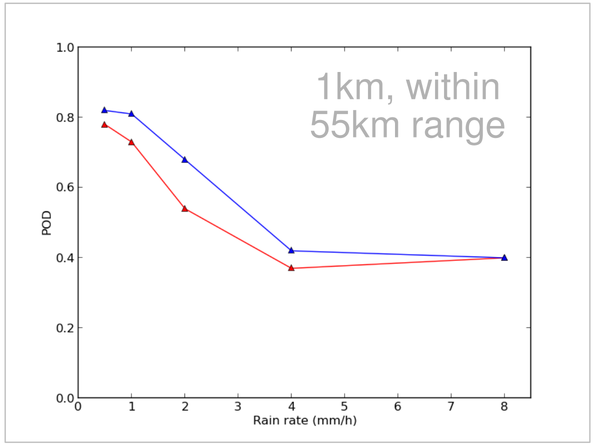
(**RED**) Control (**BLUE**) with wind drift correction

Caroline Sandford

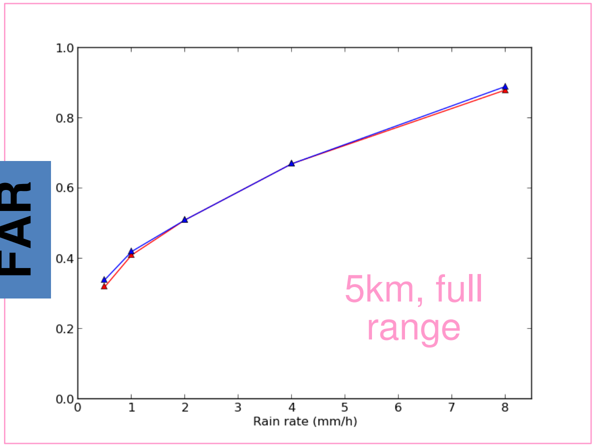
POD

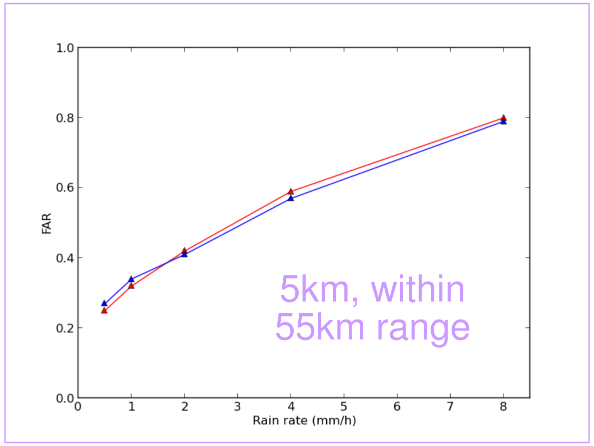


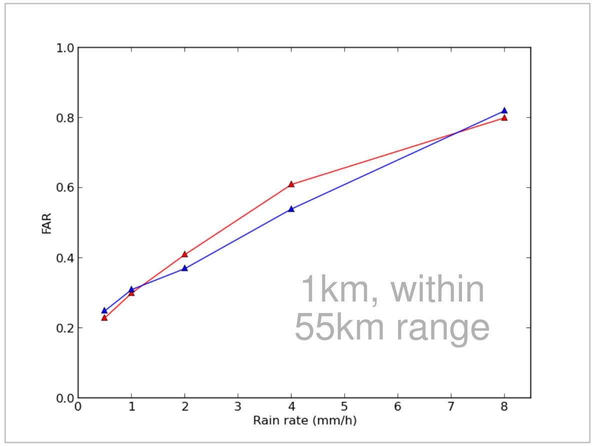




FAR





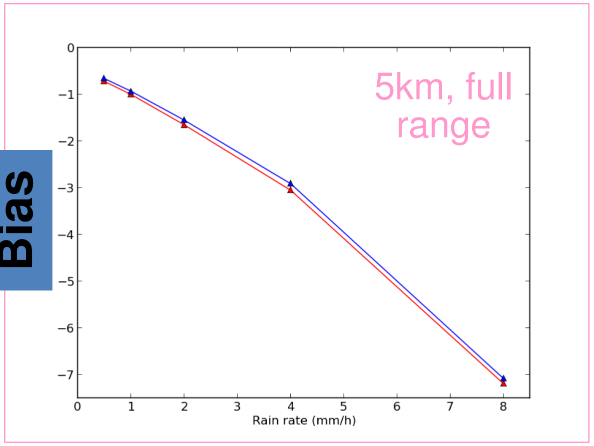


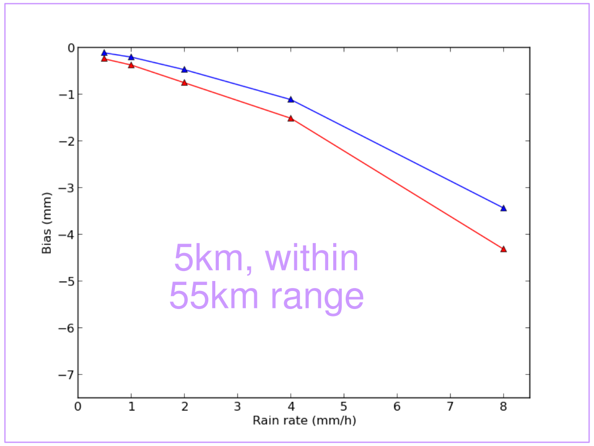
Wind drift correction performance analysis

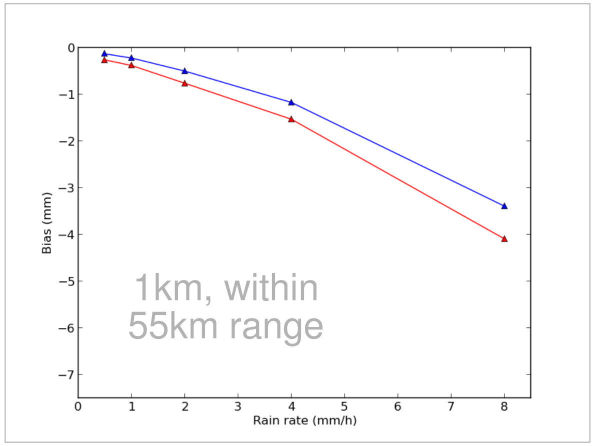
(**RED**) Control (**BLUE**) with wind drift correction

Caroline Sandford

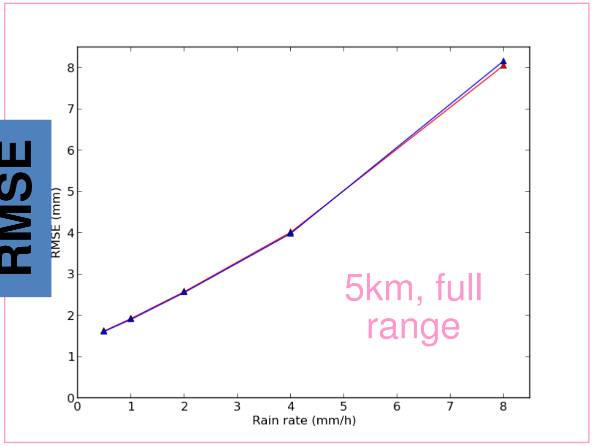
Bias

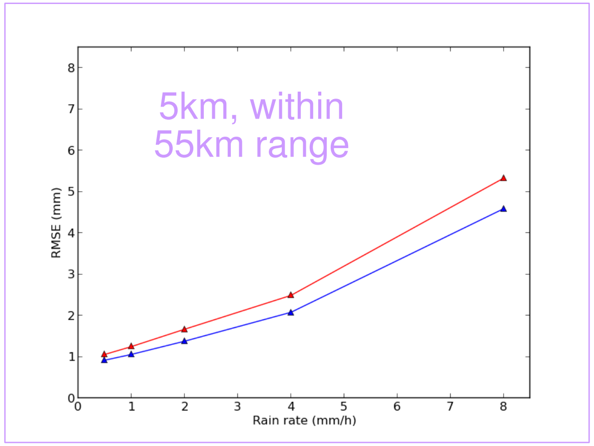


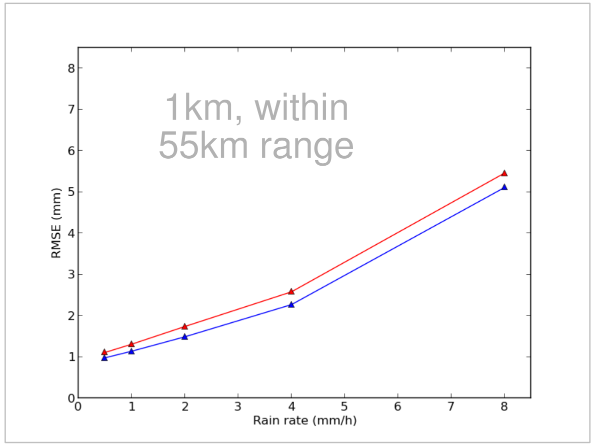




RMSE







Wind drift initial work

- Current scheme shows skill up 1km resolution.
- 100m trial in progress but so far the current method is showing lack of skills.
- Further research and development over the coming year.

Summary

- Wind drift correction shows some improvement on 5km and 1km products, but so far, no improvement on the 100m products.

- Further work is underway to explore other wind drift correction methods to the 100m products.