

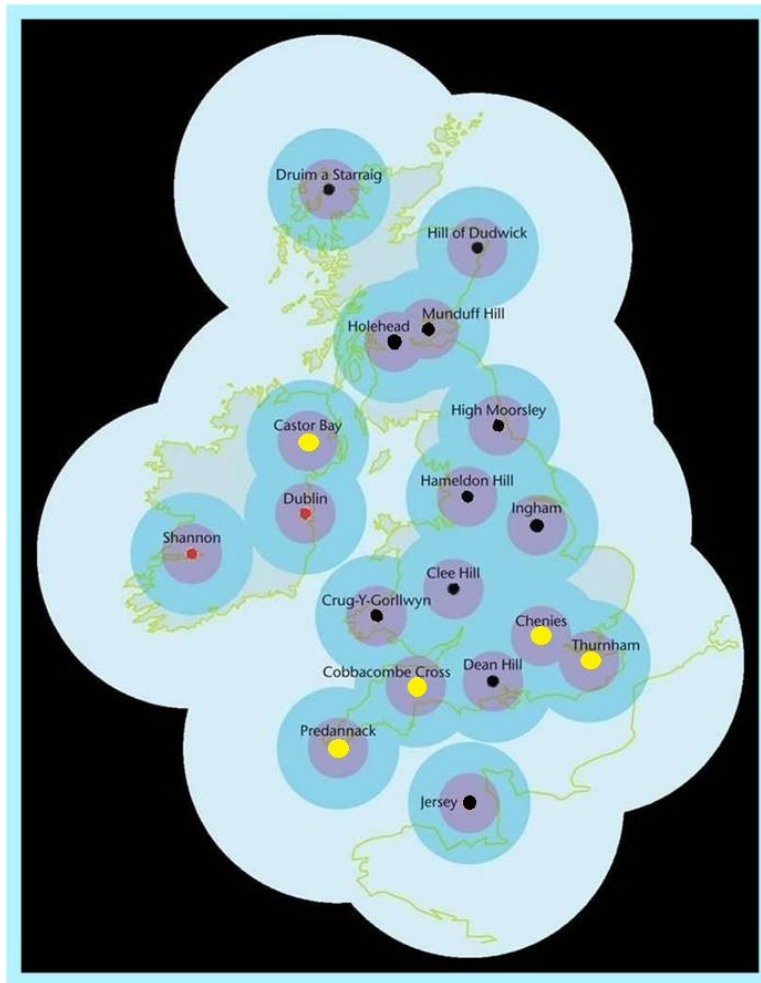


# High resolution radar products over central London

Dr Jacqueline Sugier, Observations R&D, Met Office  
RAINGAIN, National Observers Group Meeting, London  
21<sup>st</sup> March 2014



# UK radar network



UK radar network is operated by the Met Office. It is comprised of 15 Operational systems:

- 10 Doppler Radar (black dots)
- and 5 Dual polarisation Radar (yellow)

UK network is one of the densest Network in the World.

Large area of the UK have under the coverage of 2 or more radars for increase accuracy and resilience.

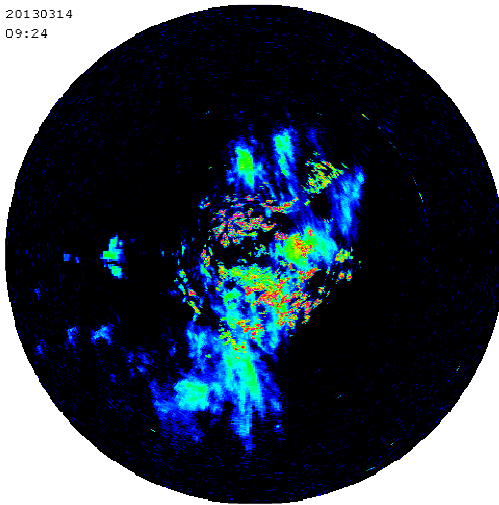
All UK radars operate at C-band

Status March 2014

# Operational radar products

Operational products are generated around the clock every 5 mins.

20130314  
09:24

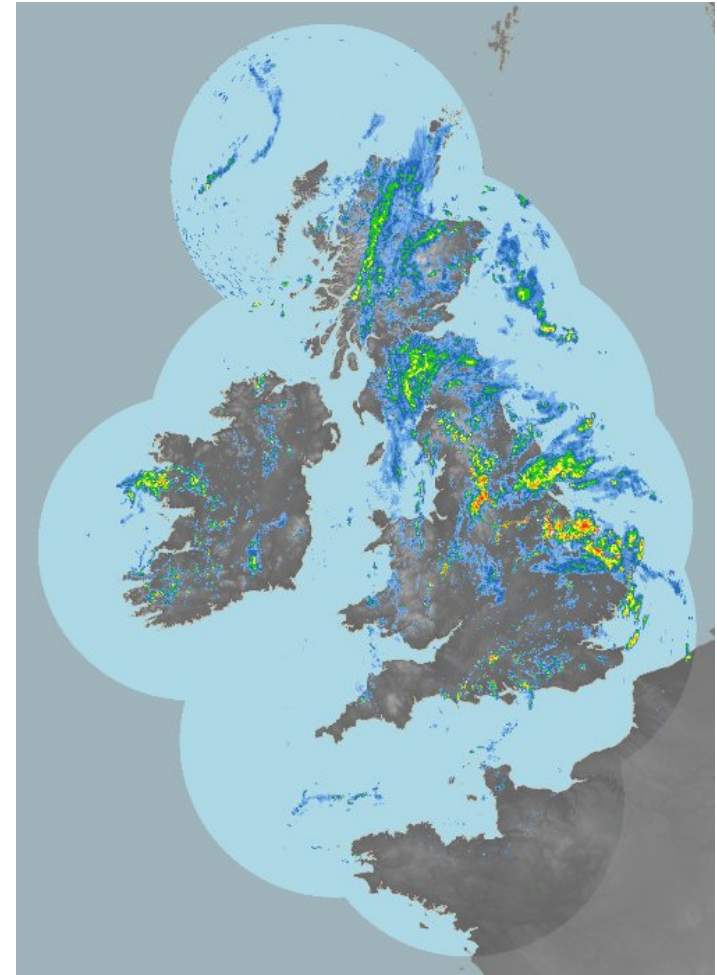


## Rainfall products

derived from radar reflectivity



Rainfall products are generated at 5km, 1km, and 500m resolution.



Vital tool to many Met Office services, particularly those related to severe weather forecasting.

Attenuation



Frequency

Attenuation

Increasing Antenna  
size (and cost)



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Used in the  
US and areas  
prone to  
tropical storms

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Widely used  
throughout  
Europe

Used in the  
US and areas  
prone to  
tropical storms

Frequency

Attenuation

Increasing Antenna  
size (and cost)



Used in  
mountainous  
and for portable  
applications  
such as  
research



Widely used  
throughout  
Europe



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Frequency

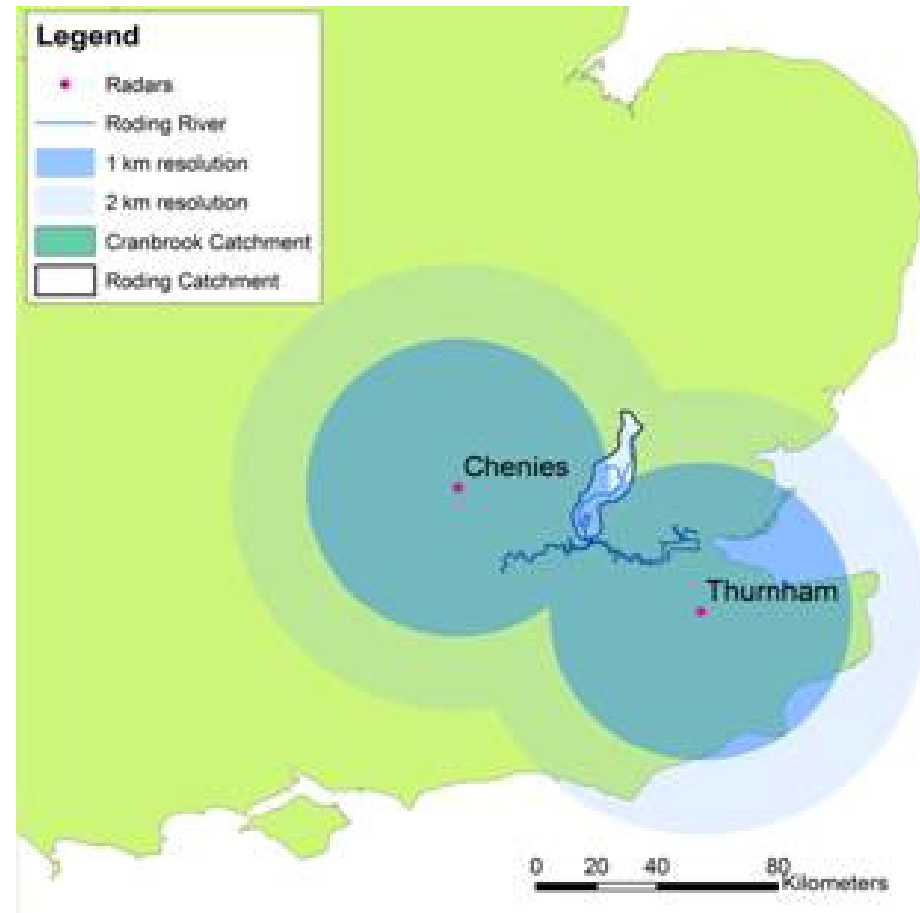




# UK Pilot site: London

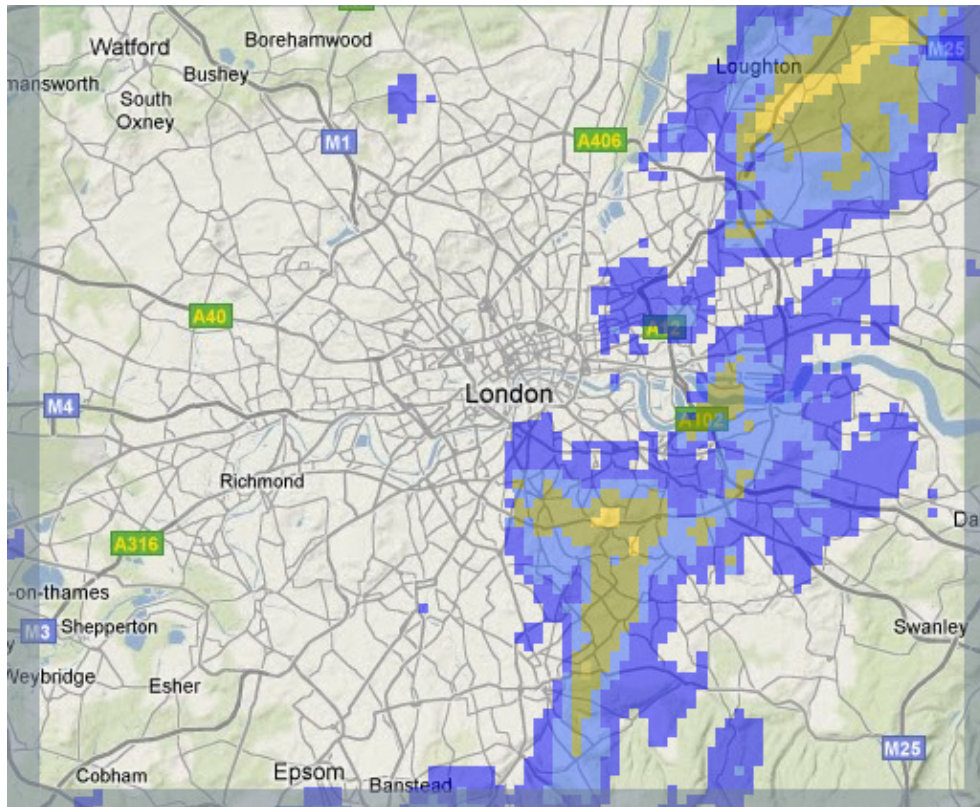


- Cranbrook catchment
- Predominantly urban area
- History of pluvial and fluvial floods
- Located within the coverage of 2 national network radars





# High-resolution product

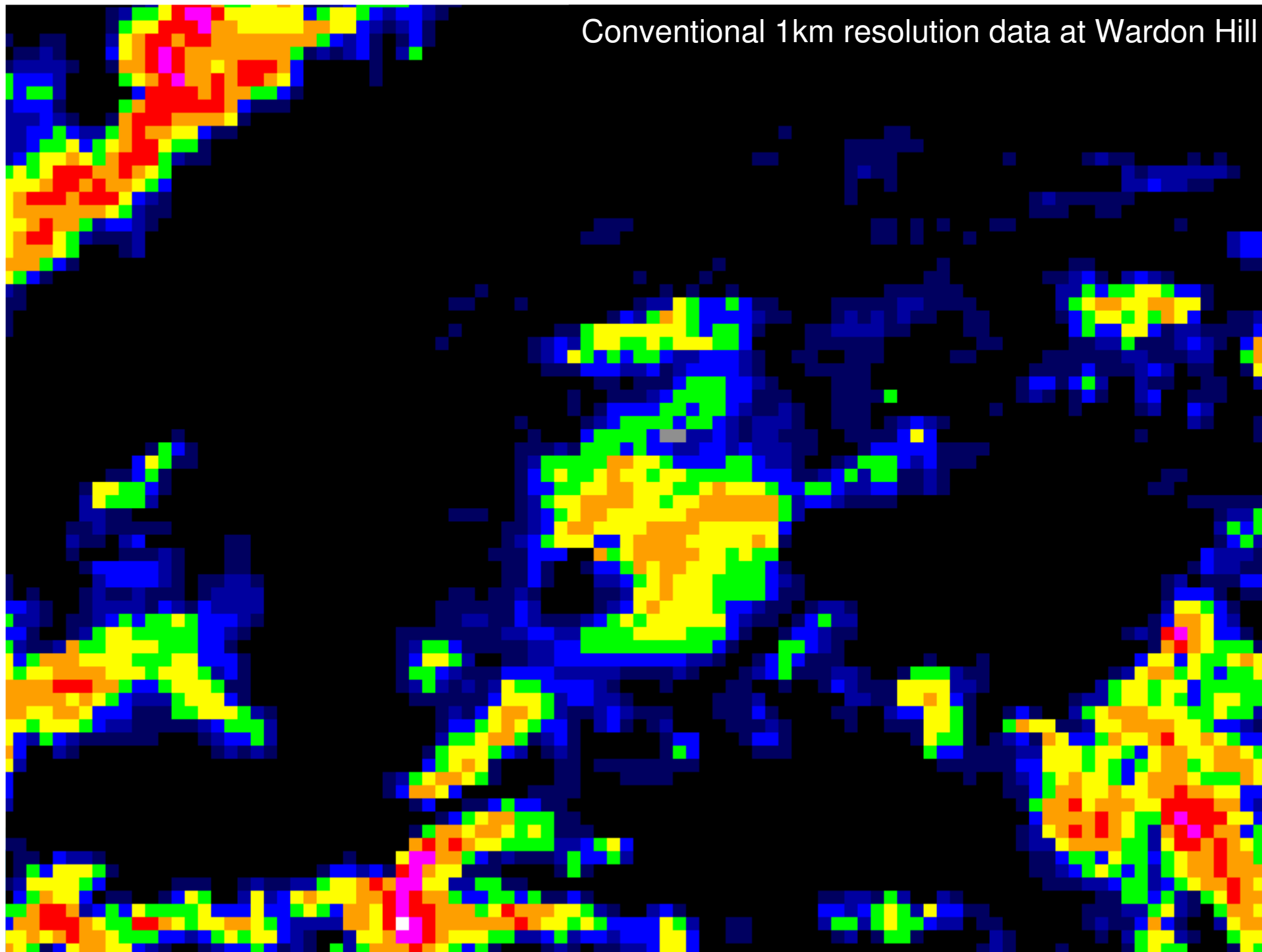


500m data

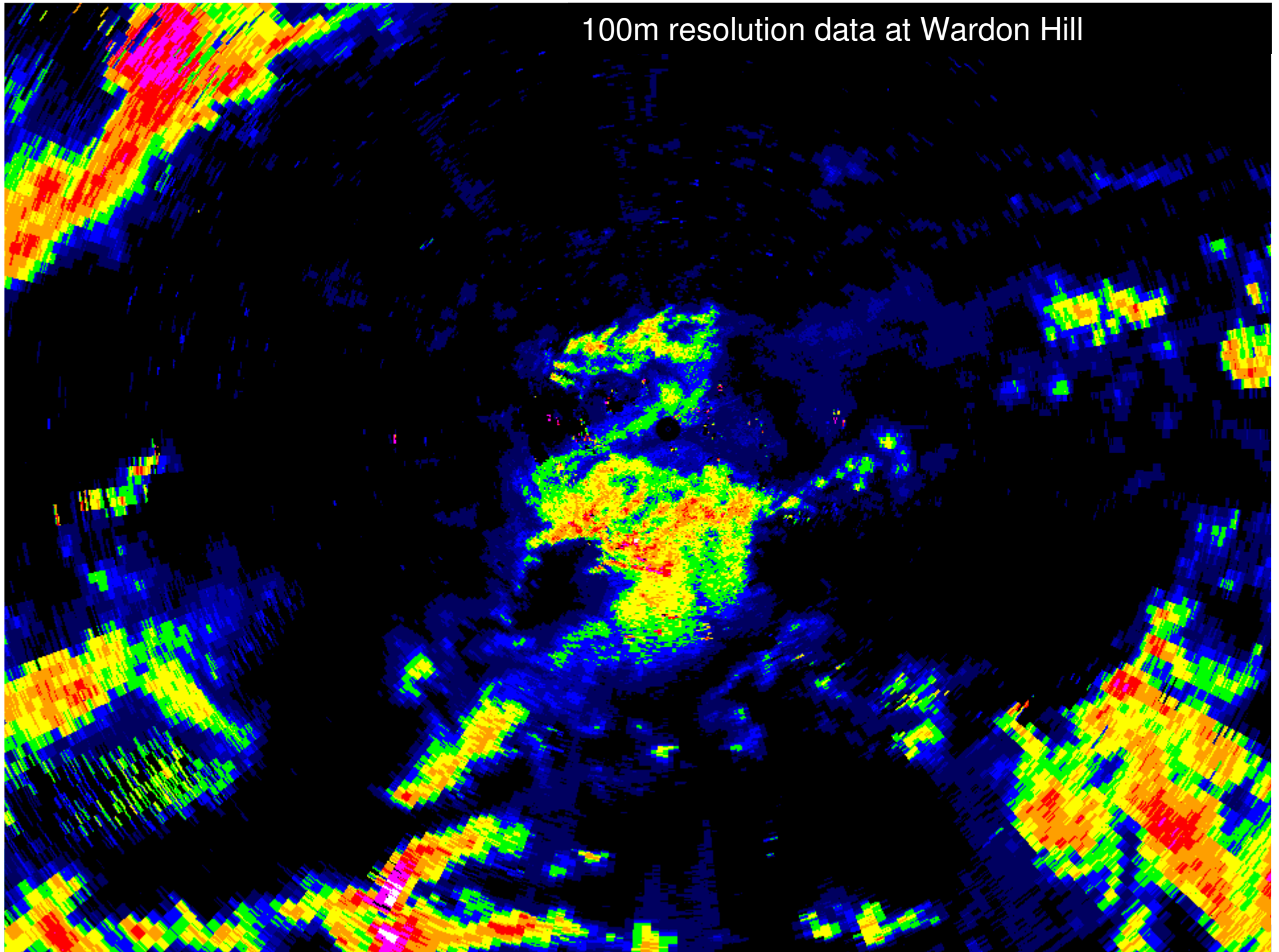
- Can we refine resolution of the rainfall estimates for urban catchments? (Whilst maintaining /improving quality)
- **Our goal: 100 m over central London by Apr 2014**



Conventional 1km resolution data at Wardon Hill



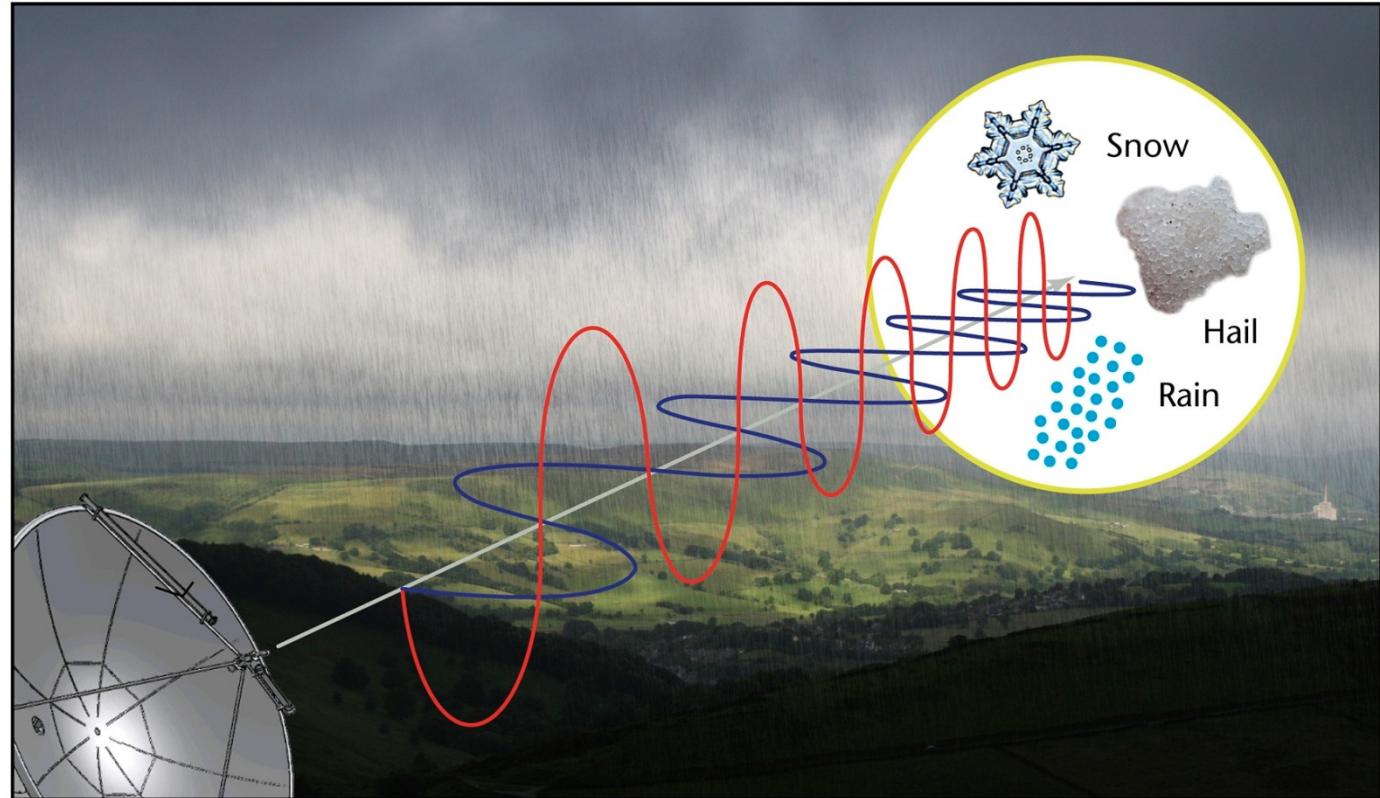
100m resolution data at Wardon Hill





# Dual-Polarisation radar

Conventional radars send and receive microwave signals at one polarization.

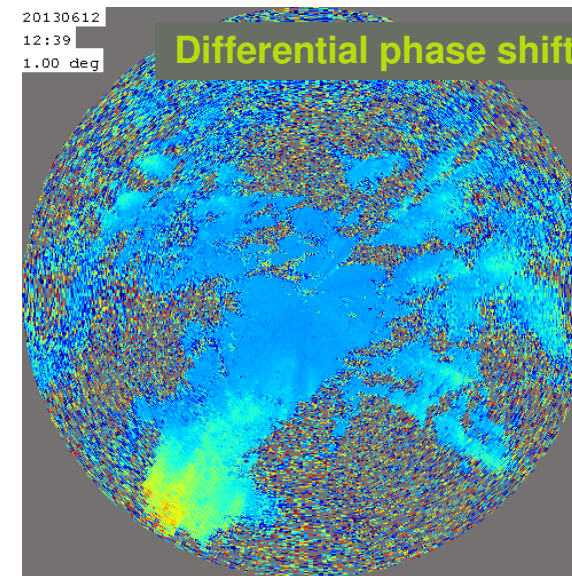
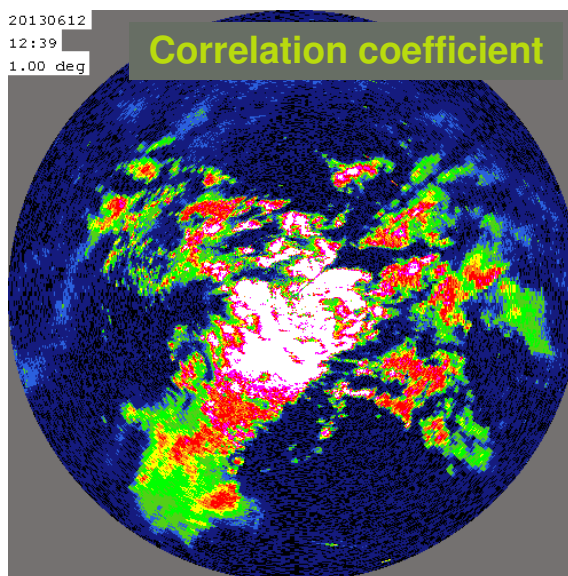
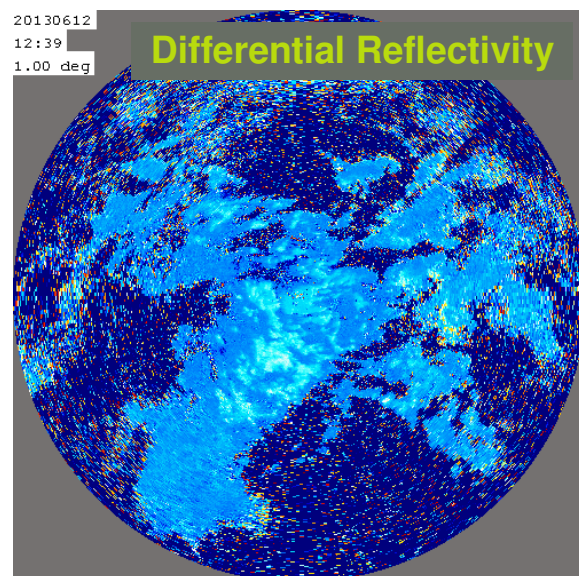
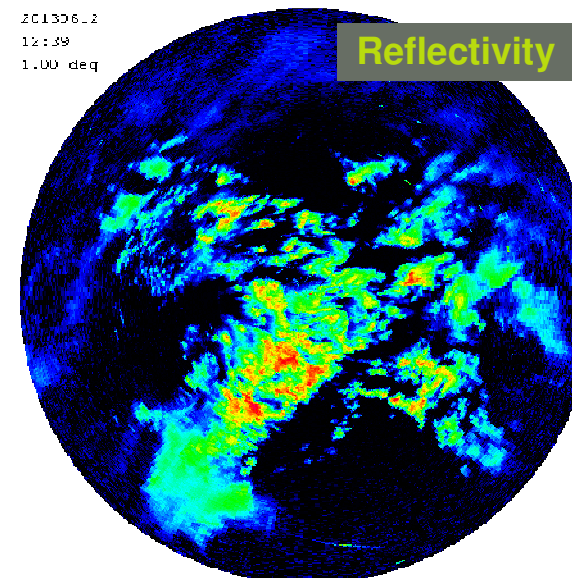


Dual-polarization radars are equipped to transmit and receive microwave signals at two polarization i.e. horizontal (H) and vertical (V).

By comparing H and V reflected signal e.g. power ratios, correlations, etc., we can obtain information on the size, shape, and ice density of precipitation particles.

# Additional information provided by Dual-Polarisation radar

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





# Improving the quality of our products using dual polarisation

FLOODFORECASTINGCENTRE

a working partnership between  Environment Agency |  Met Office



**A major limitation to using radar derived quantitative precipitation estimates into hydrological models is the identification and removal of non-precipitation echoes.**

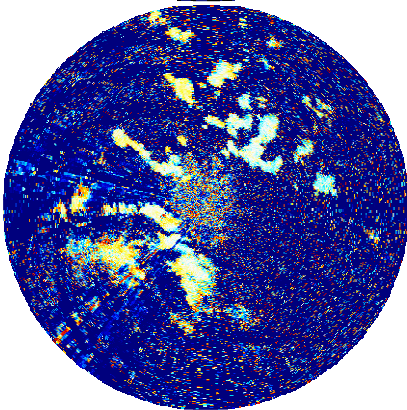
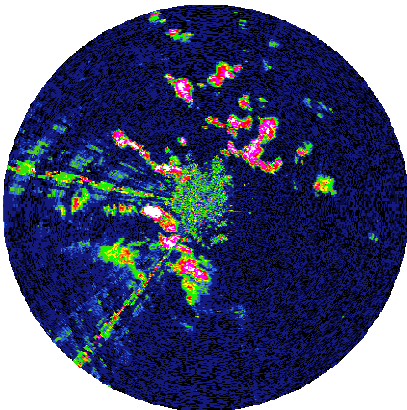
Dual polarisation provides additional information regarding the shape and type of the object contained within the radar sampling volume. This information can be used for hydrometeor classification (rain/ice/snow) or to remove non-meteorological echoes from the radar image.



# Spurious echoes filtering

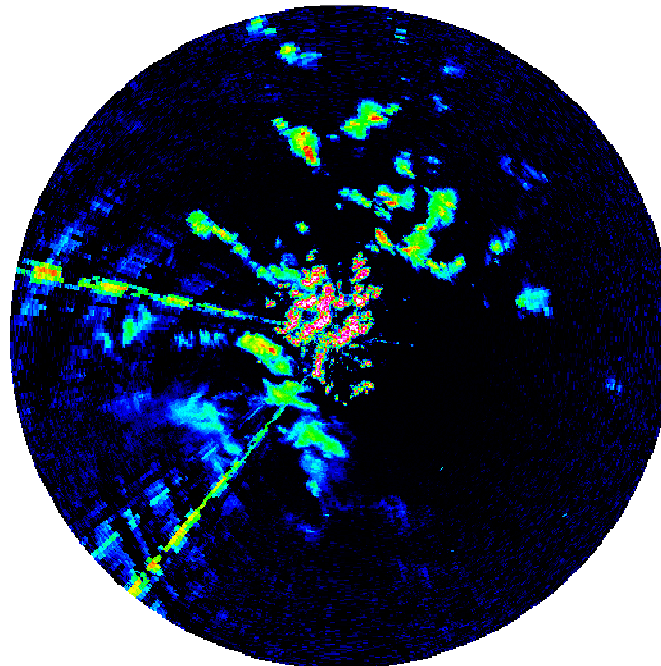
Dr Nawal Husnoo

Correlation coefficient

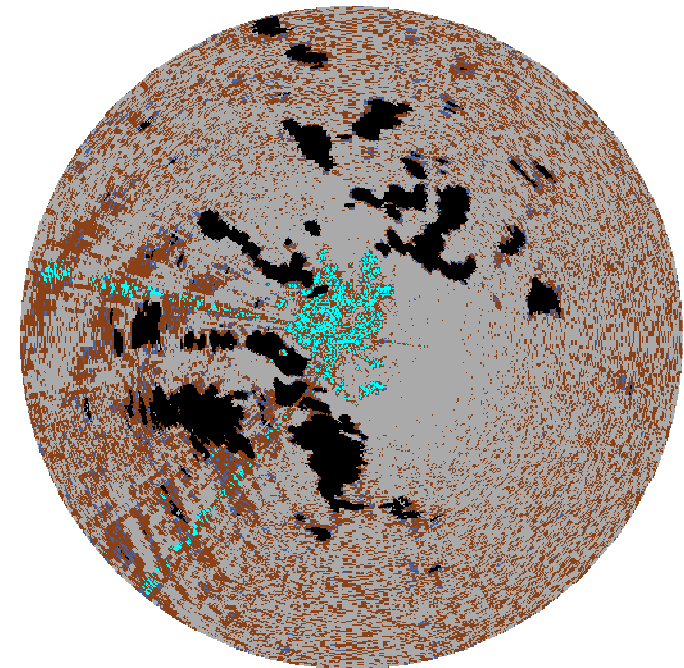


Differential Reflectivity

Reflectivity



Classification



**Black = Precipitation**

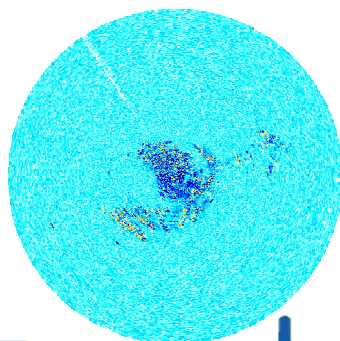
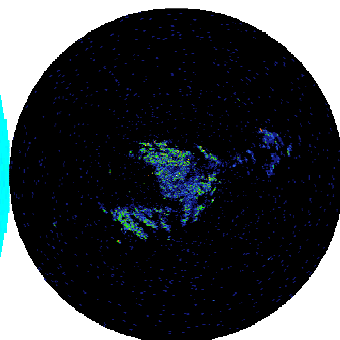
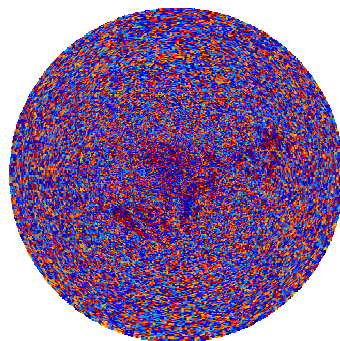
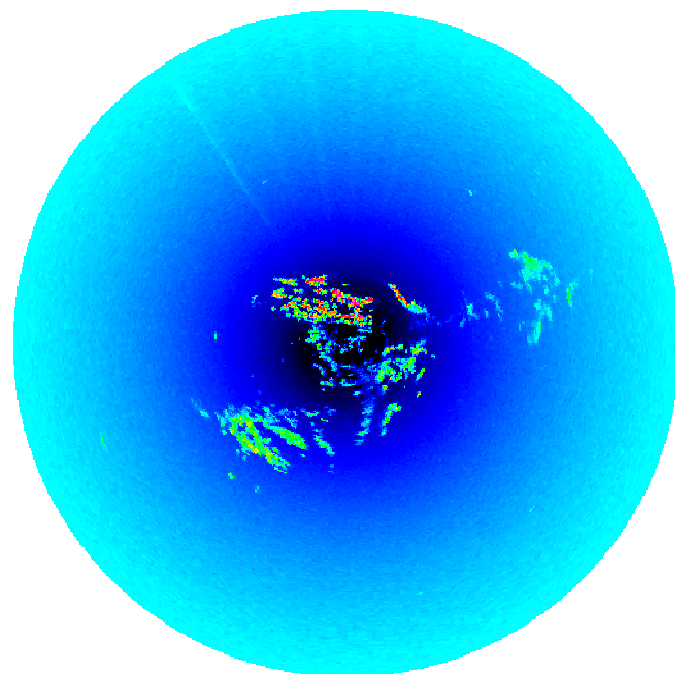




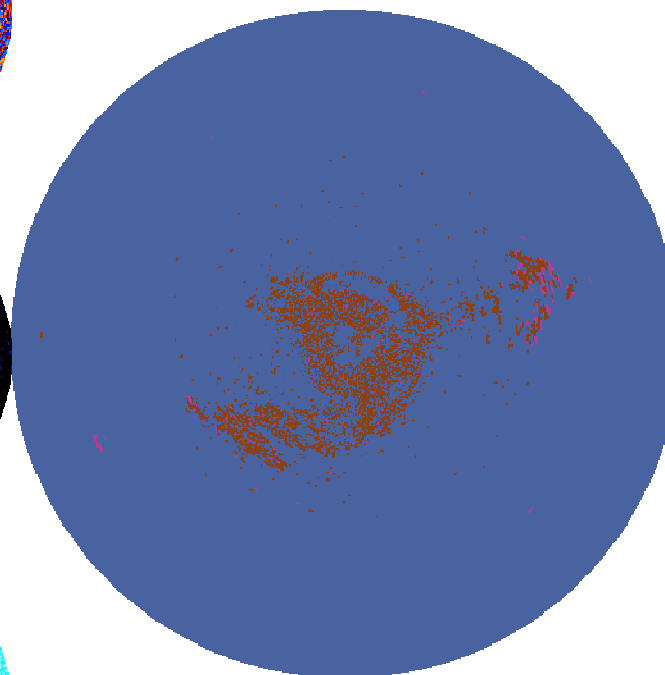
# Spurious echoes filtering at finer resolution



Reflectivity



Classification



- not set
- no data 1
- no data 2
- RF interference
- noise
- wind turbine
- clutter
- speckle
- anaprop
- minor occ
- major occ
- DP nonPP echo

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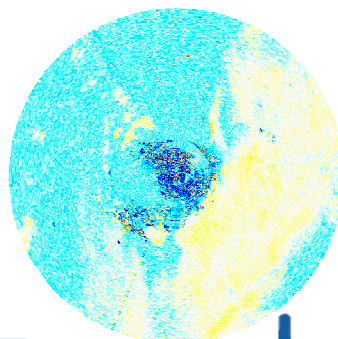
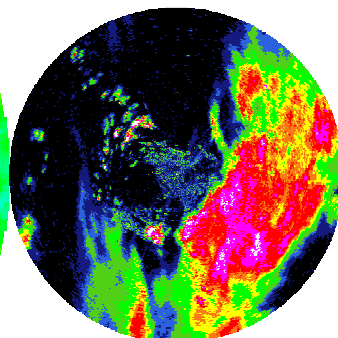
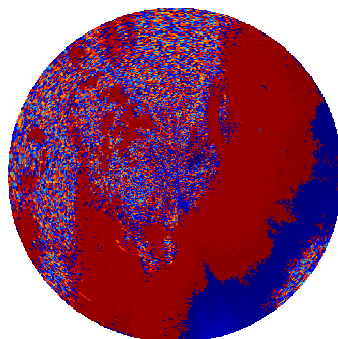
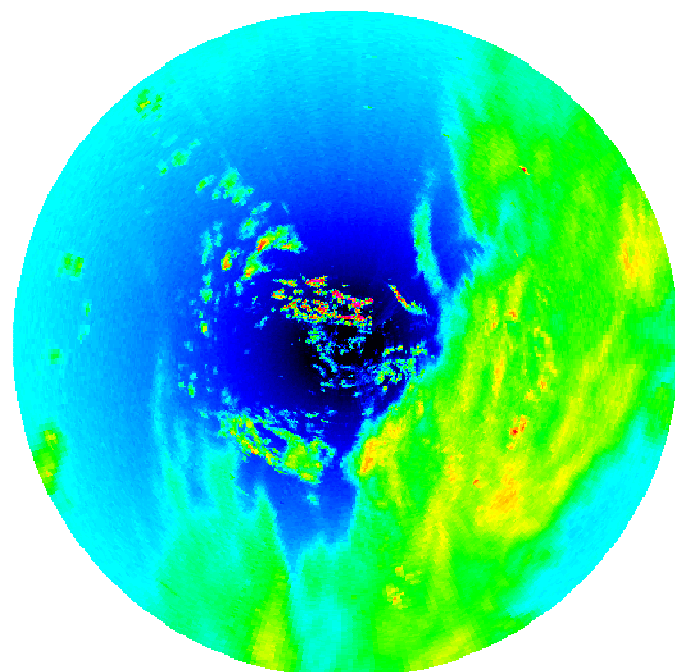




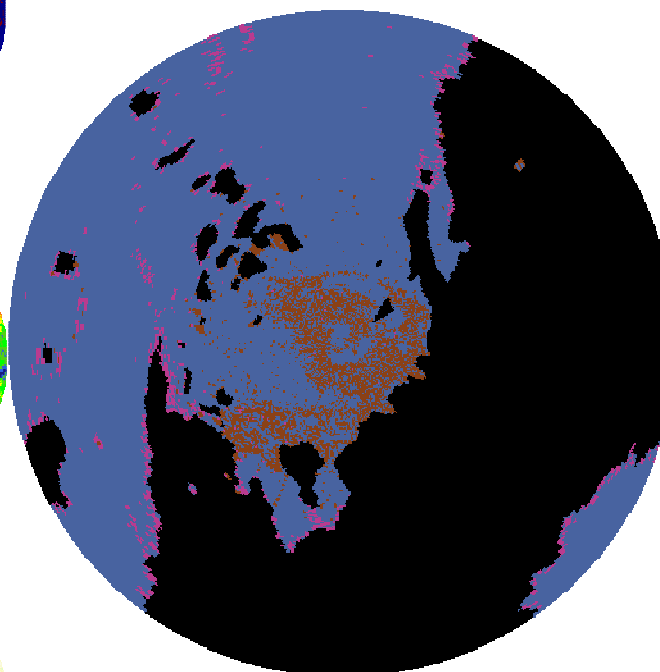
# Spurious echoes filtering at finer resolution



Reflectivity

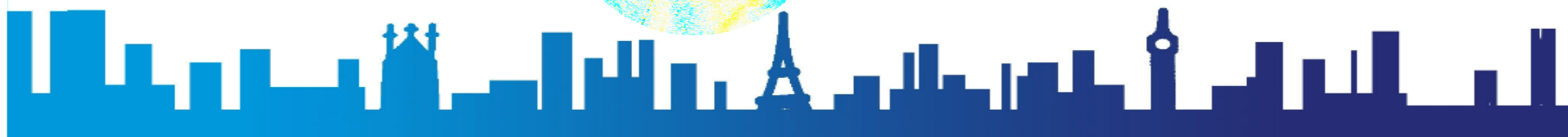


Classification

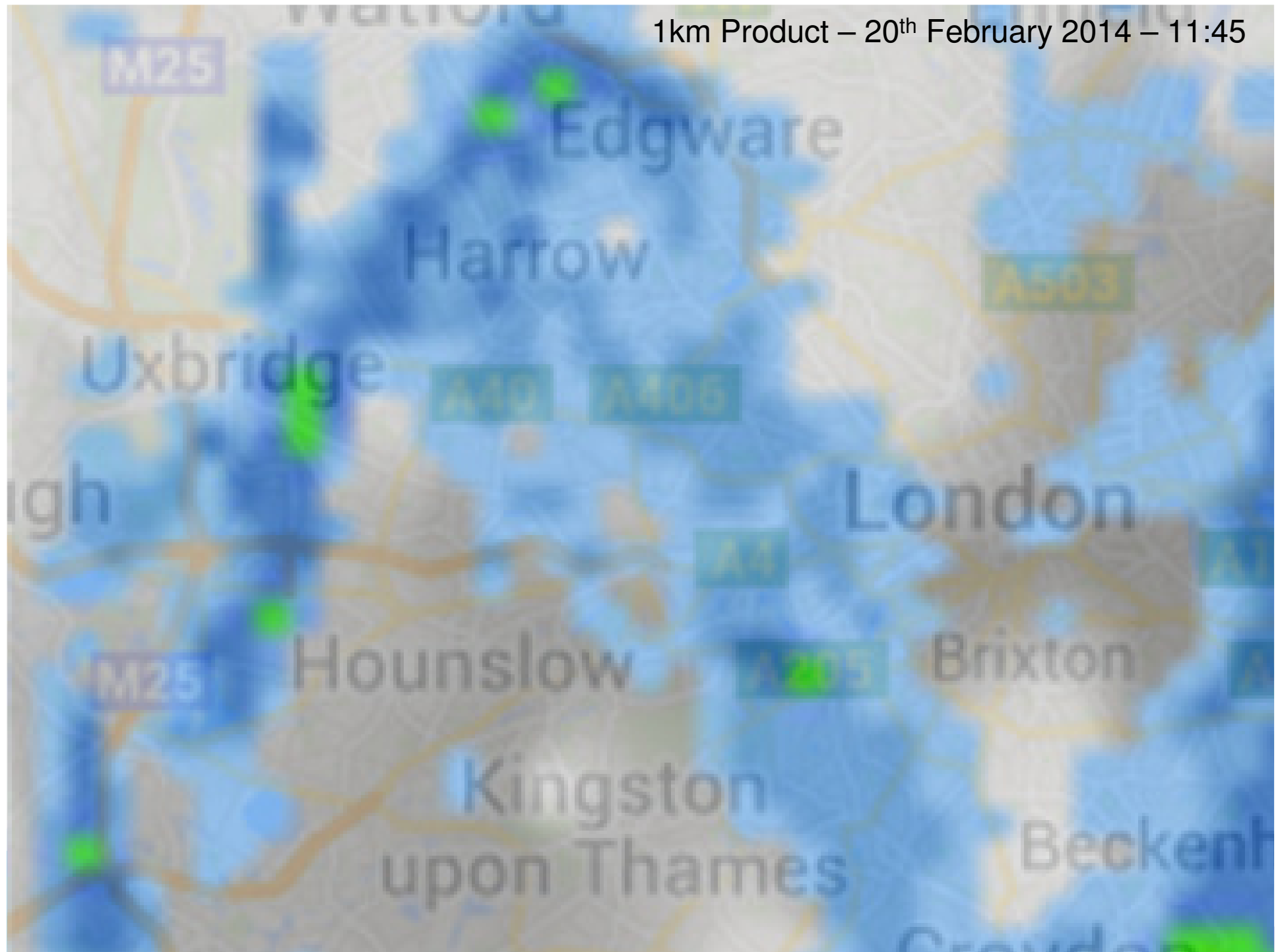


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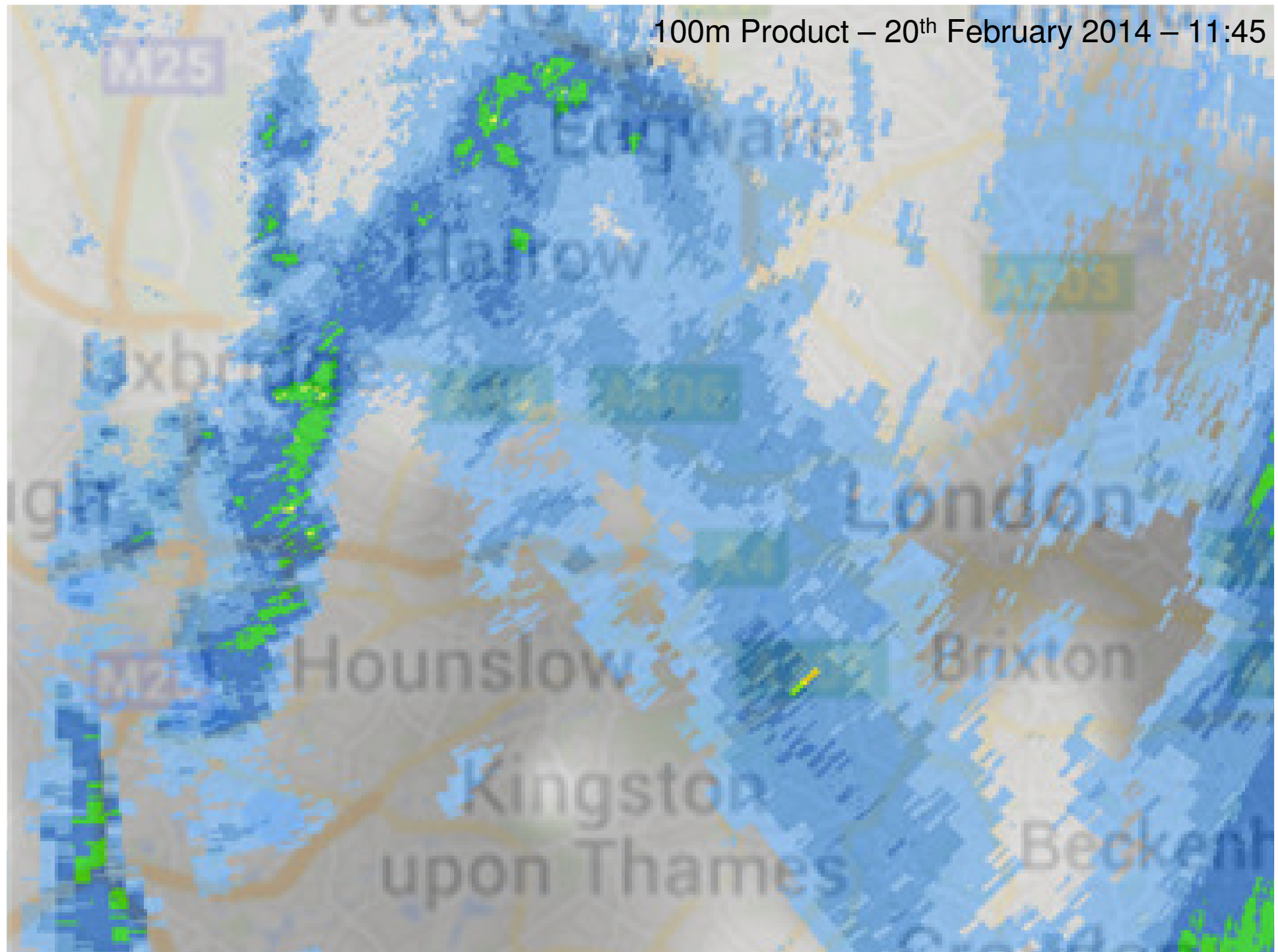
Dr Nawal Husnoo



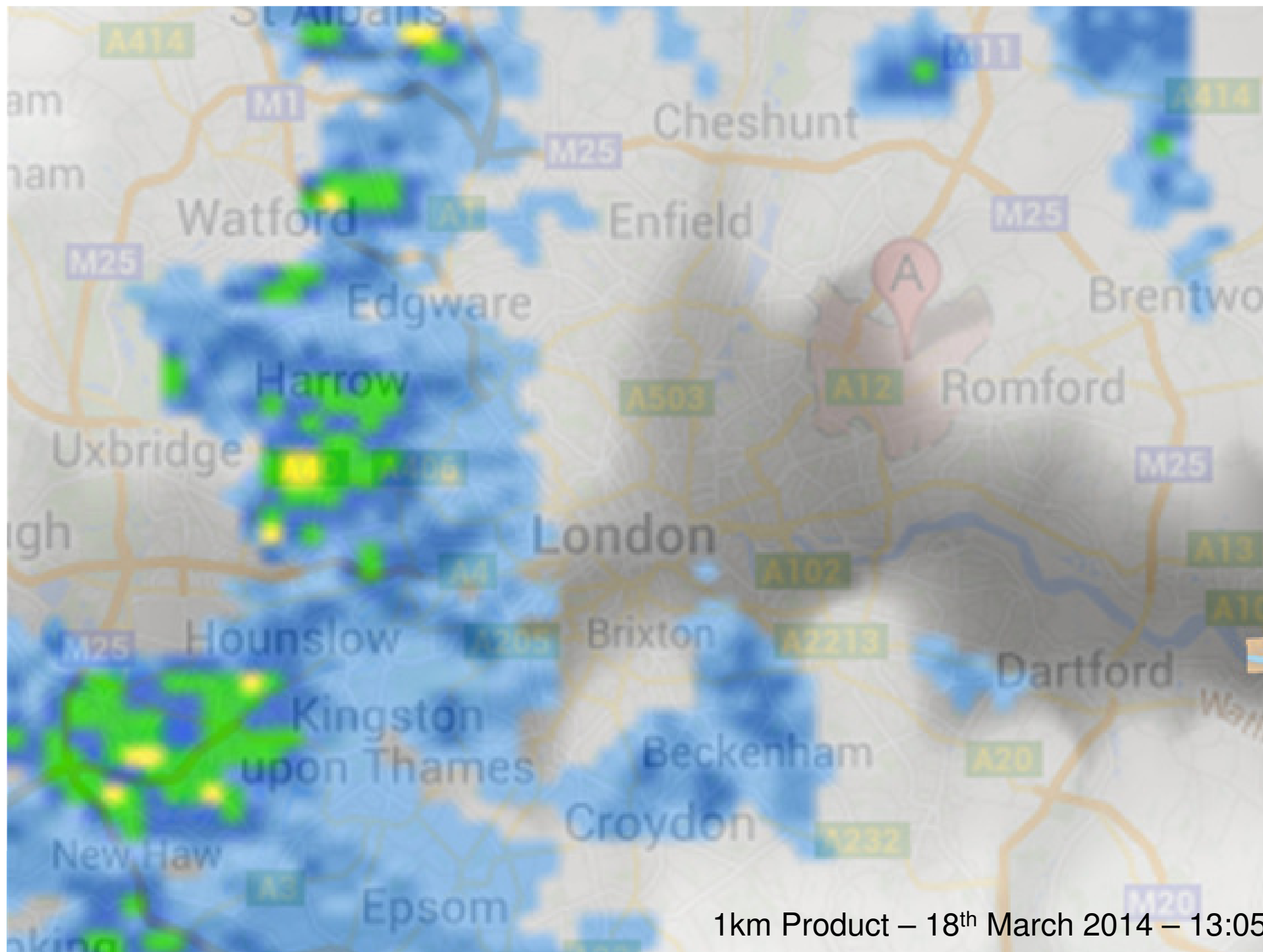
1km Product – 20<sup>th</sup> February 2014 – 11:45



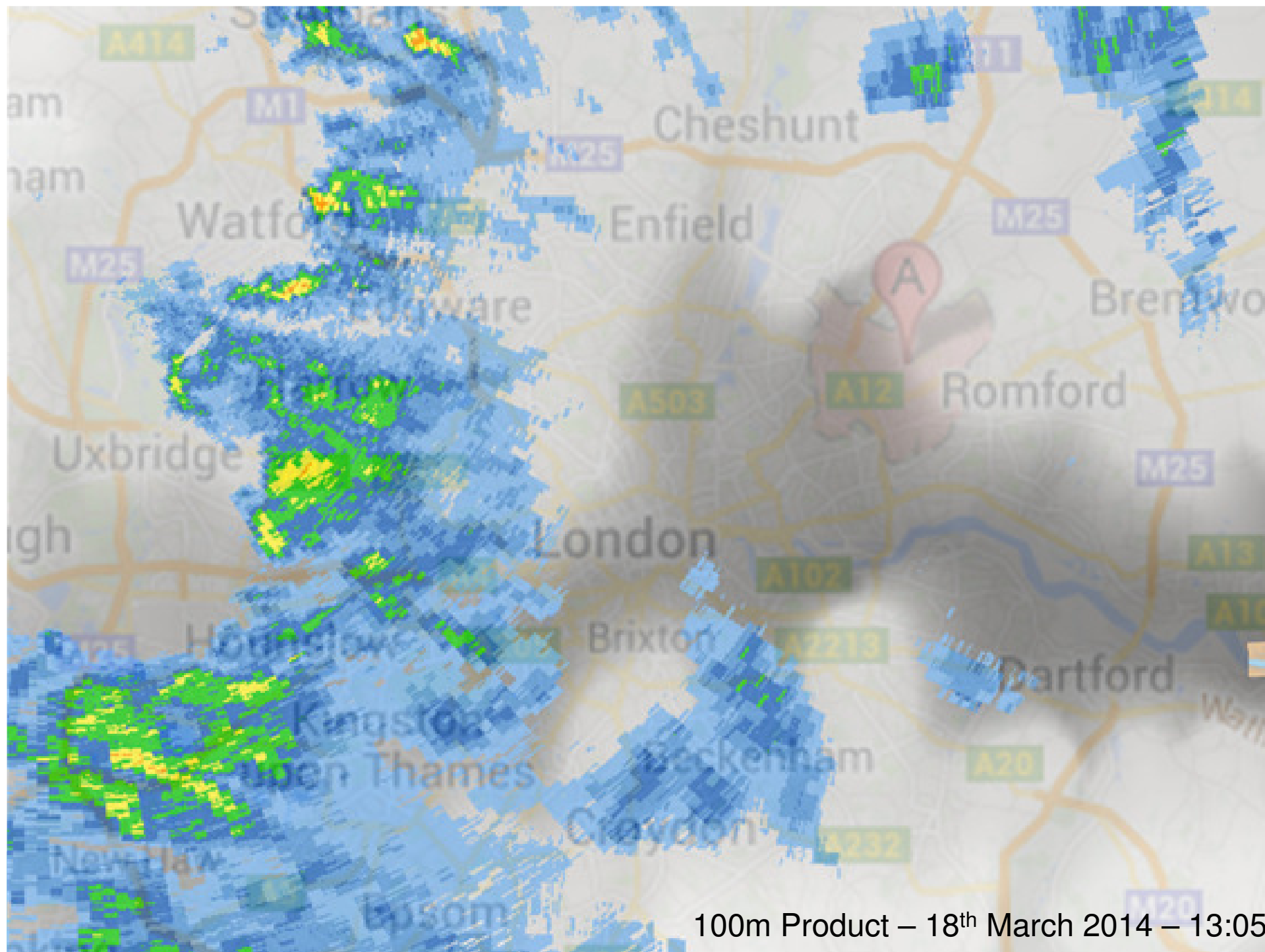
100m Product – 20<sup>th</sup> February 2014 – 11:45







1km Product – 18<sup>th</sup> March 2014 – 13:05



100m Product – 18<sup>th</sup> March 2014 – 13:05



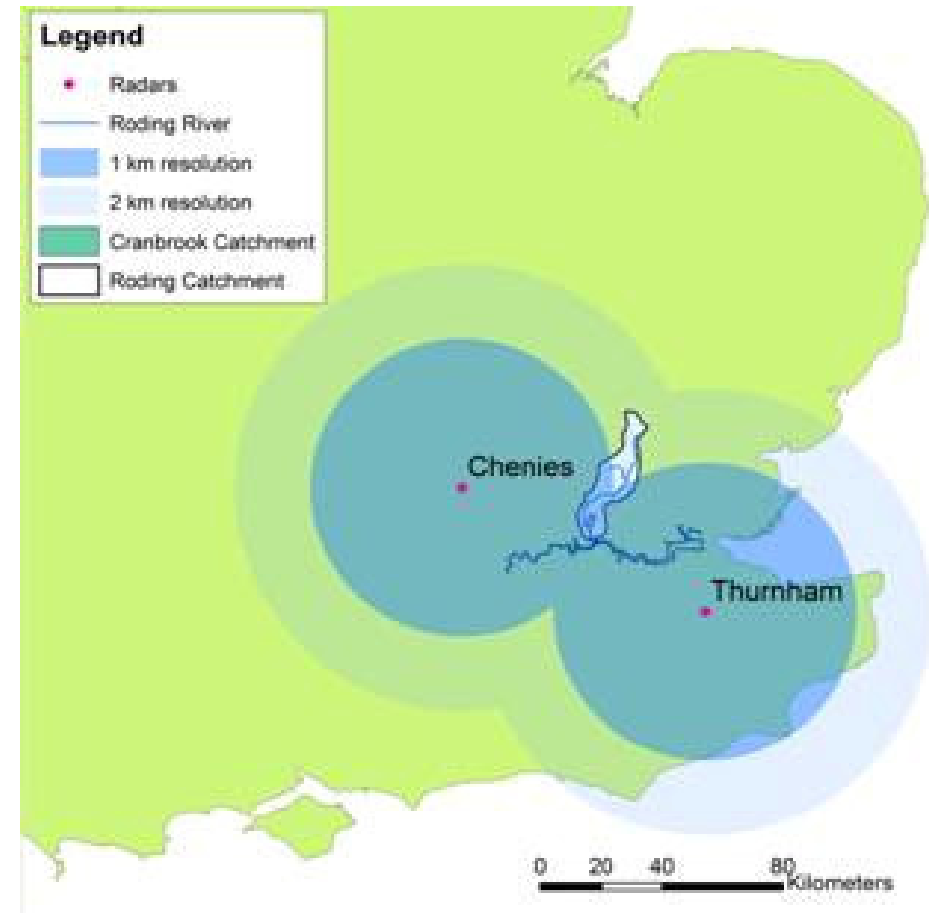
# Wind drift correction



- 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.



- 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).





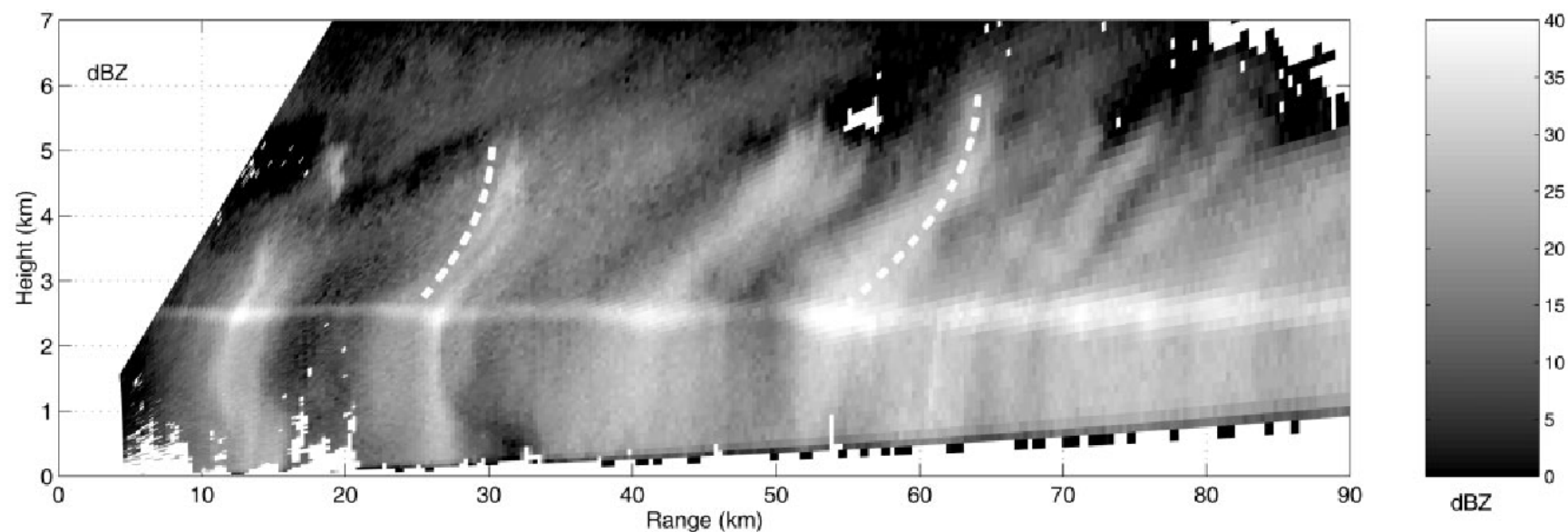


Figure 10. RHI for 1340 UTC on 18 August 2000 at 25° azimuth showing clear fall streaks. Fall-streak trajectories calculated using Eq. (4) are superimposed.

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. *QJRM*, **130**, 2105-2123.



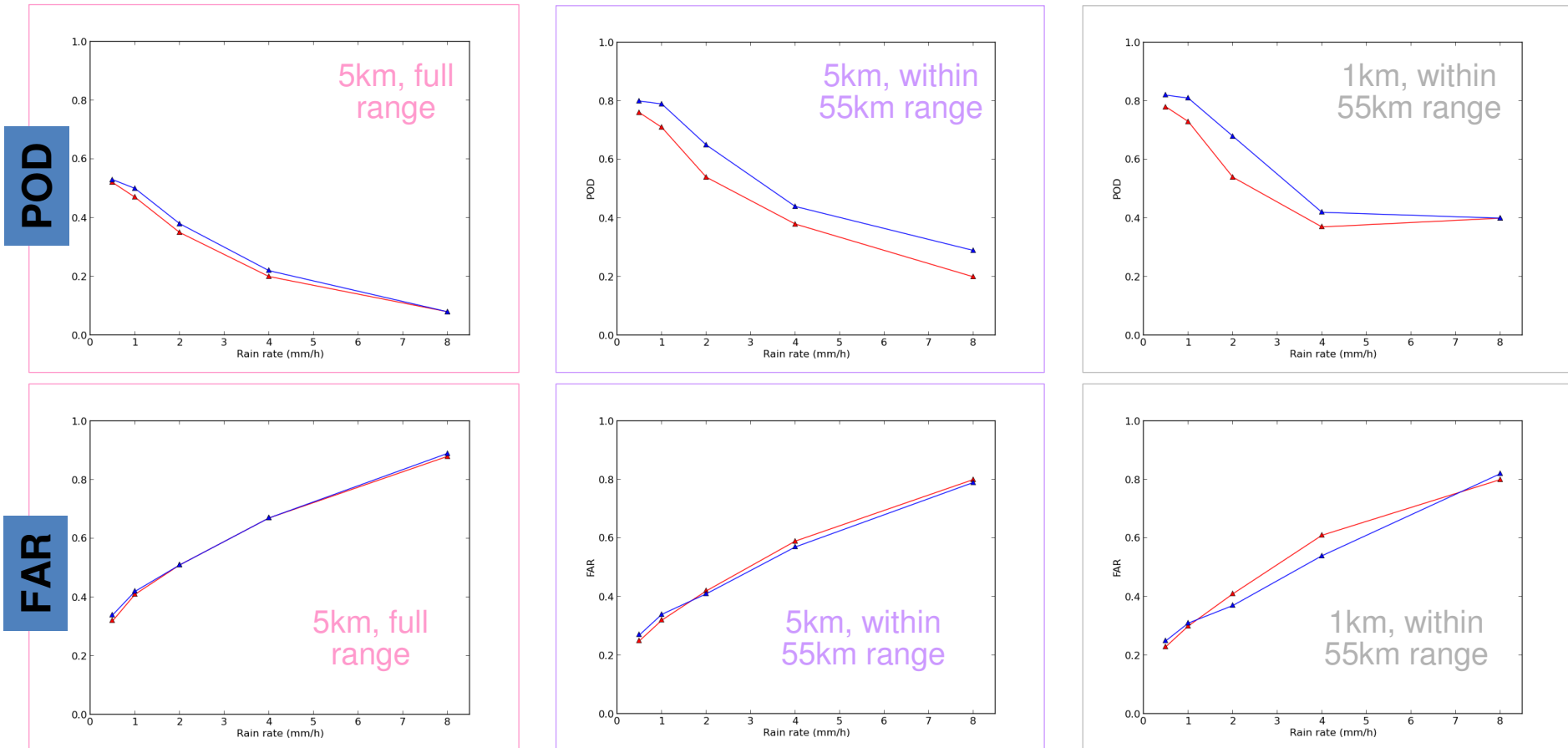


# Wind drift correction performance analysis



(RED) Control (BLUE) with wind drift correction

Caroline Sandford



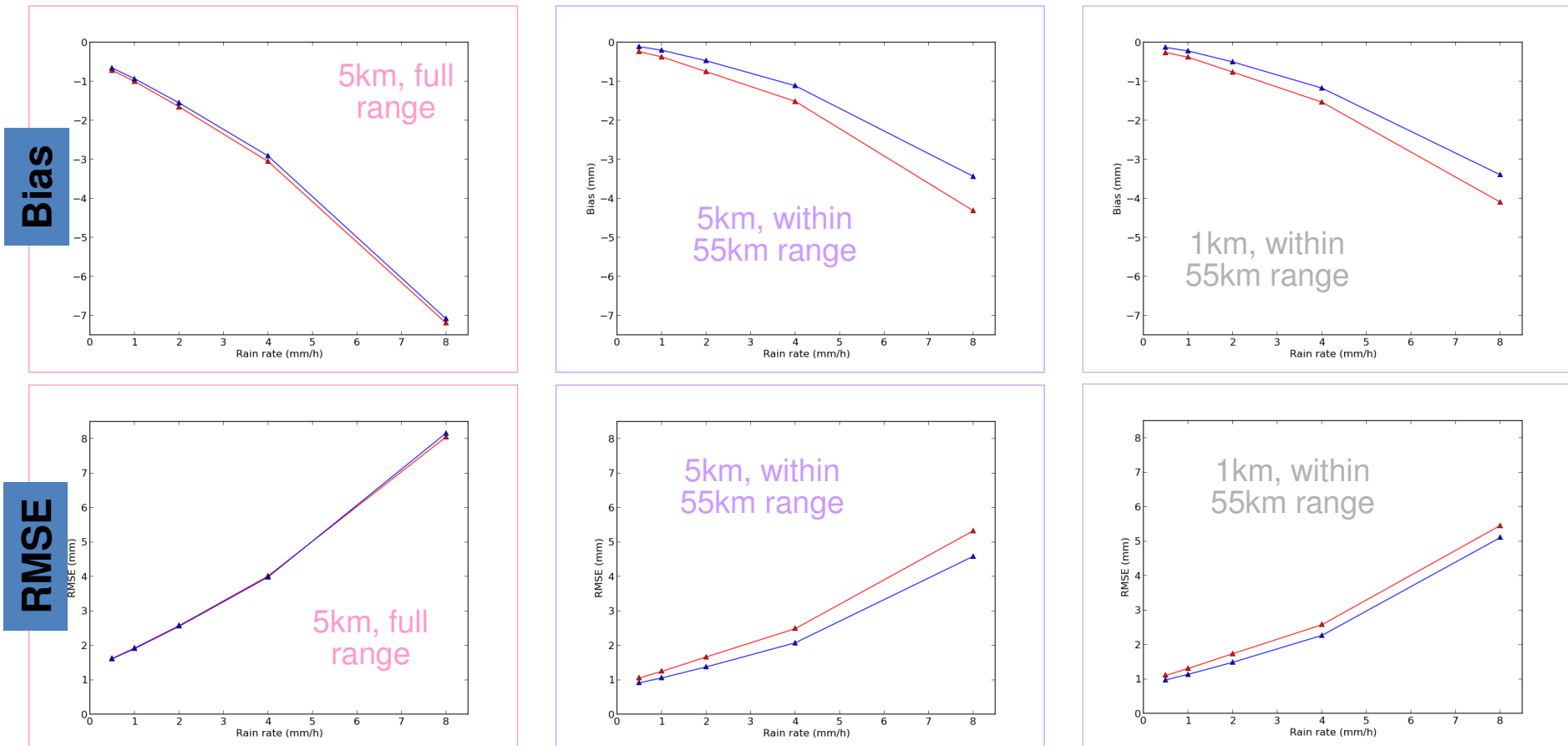


# Wind drift correction performance analysis



(RED) Control (BLUE) with wind drift correction

Caroline Sandford





# 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



- 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.







# 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.





Any questions?