Adapting the UK MetOffice linear model for NWP-based nowcasting

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UKMO linear model for NWP-based nowcasting

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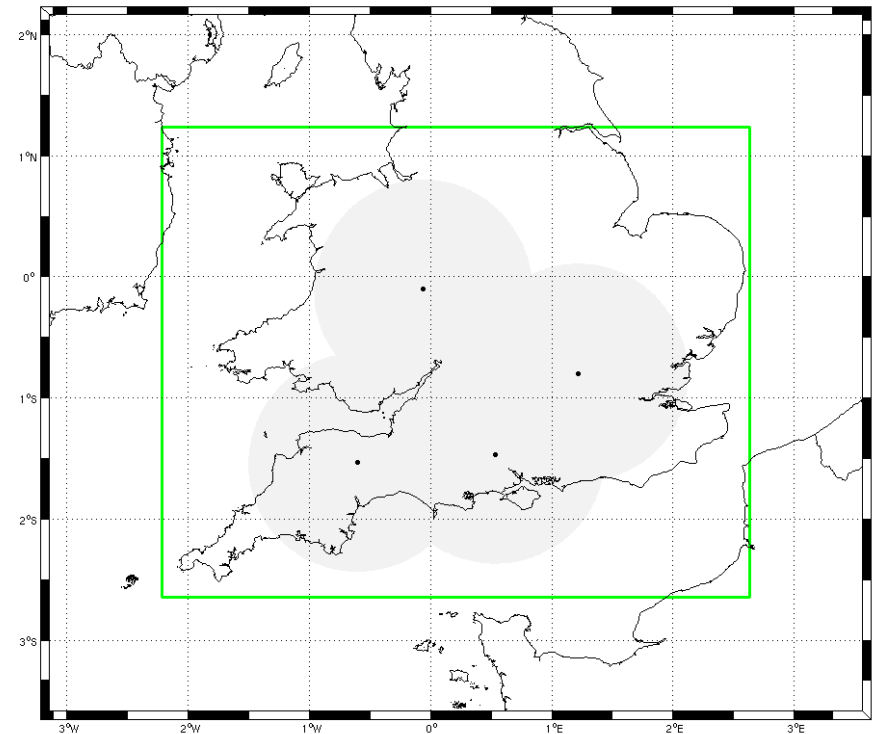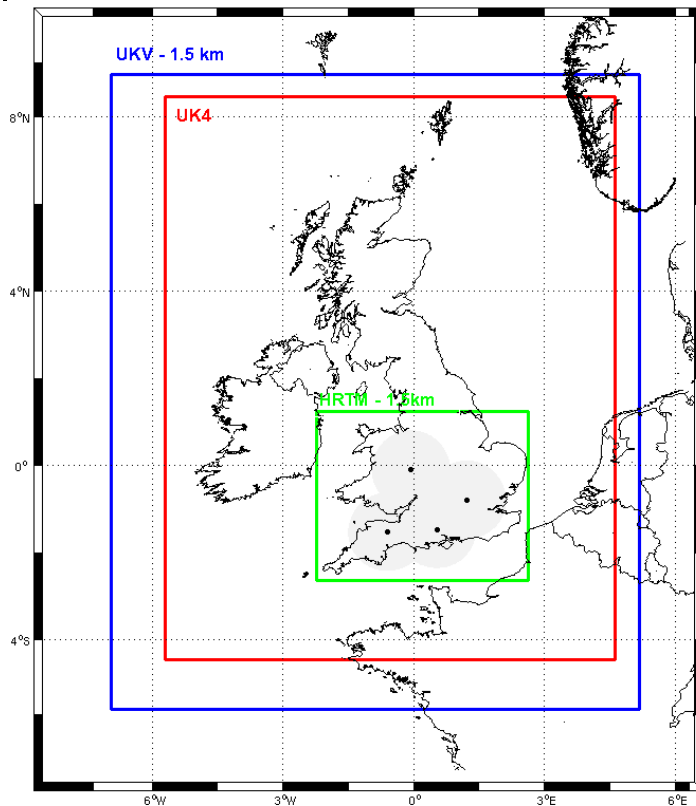# What is a Nowcasting system?

What is a "Nowcasting" system?

• Forecasting system designed for very high spatial (1.5km) and temporal (0-6 hours) resolutions.

• Aims to predict severe or hazardous weather conditions (eg. extreme rainfall, hail and lightning)

• Designed to be fast forecasting technique: update forecasts when new observations available (~1 hour).

• Develop fixed resolution 1.5 km hourly-updated NWP forecasting system using hourly assimilation cycles with forecasts out to 6 or 12 hours.

• Goal to give customer analyses and forecasts within 1 hour of data time.

Nowcasting Model Domain

Model	Resolution	VAR	Time Window	Cycling	Forecast Length
UK4 / UKV	4 km / 1.5km	3D-Var 4/3km	3 hr	3 hr	T+36
South UK Fixed	1.5 km	3D/4D-Var 1.5/3km	1 hr	1 hr	T+6 or T+12

Nowcasting System

- NWP-based nowcasting system is non-hydrostatic model that resolves convection explicitly.

- Nonlinear **U**nified **M**odel (UM) is 1.5 km resolution (360 x 288 x 70 levels), has model top at 40 km, and uses 50 s timestep.

- Linear **P**erturbation **F**orecast (PF) model and its adjoint: 3 km resolution (180 x 144 x 70 levels) and 100 s timestep.

- 4D-Var uses hourly assimilation windows with linearization states for PF model updated every 10 minutes.

- Observations are extracted in the observation time window T-30 to T+30 minutes. Might change to T-60 to T+0.

- 4D-Var increments are added to UM at initial forecast time T-30 mins (first UM time step). Might change to T-60.

# Observations for assimilation at high resolution

Observations needed

- Nowcasting requires dense network of observations corresponding to the scale of the phenomena (eg. convection) to be forecast.

- Need reporting, quality control and processing of observations to be quick.

- Need effective, fast DA methods to extract best initial conditions for each forecast.

UK Weather Radar Network

- Reflectivity Only
- Doppler
- Doppler Capable
- Dual Polarisation
- Non Met Office
- Test & Development

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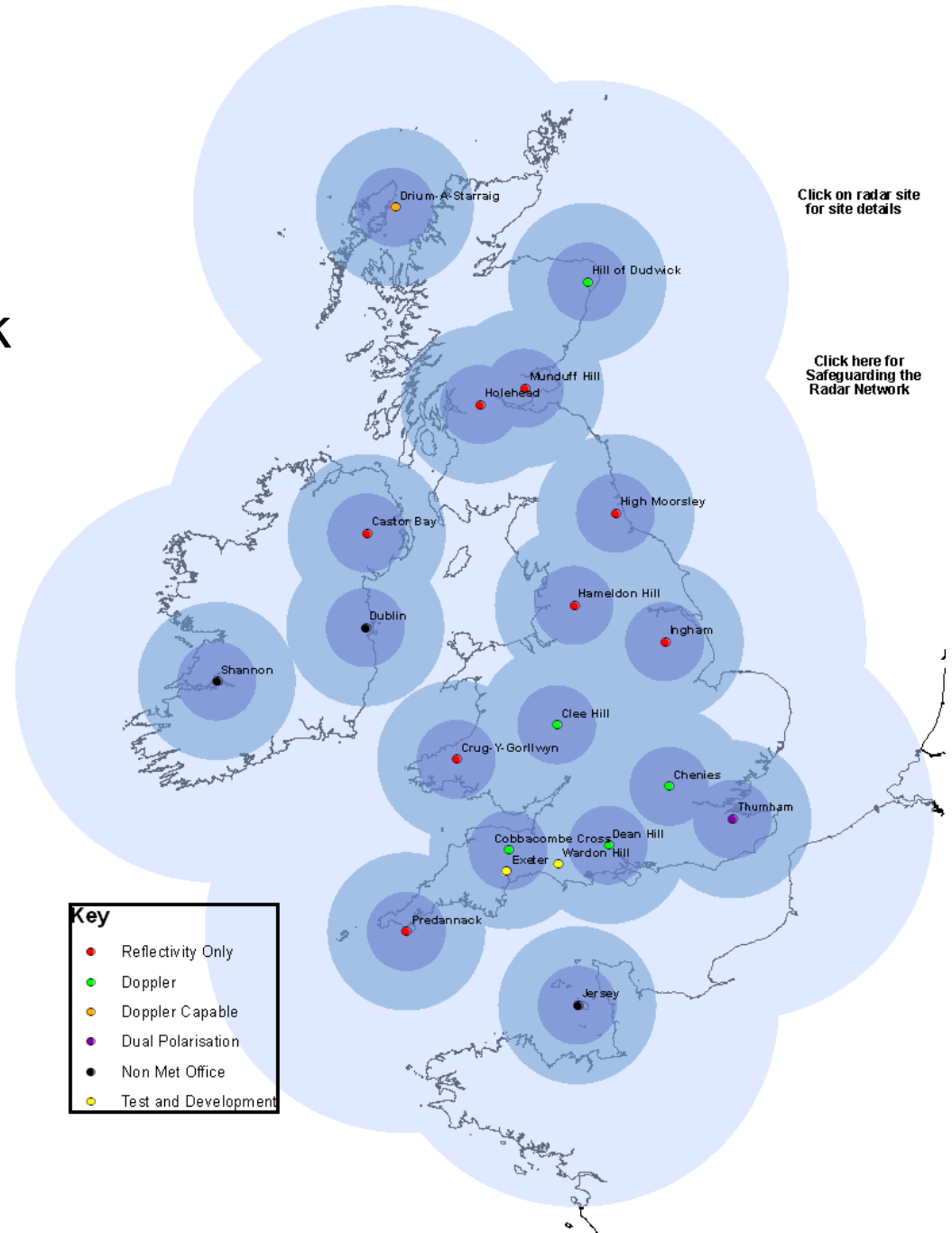
Selected Observations

Currently available in database:

- Doppler radar radial winds [5 min] T-15, T+0, T+15 (3per hour)

- Radar reflectivity [5 min] not used

- Rain rates (radar-derived) [15 min] 15 min

Work underway on testing indirect and direct assimilation

- Radar reflectivity

Future:

- Radar refractivity (indirect: near-surface q)

Limitations of UKMO linear model