IMPROVER - the new probabilistic post processing system at the Met Office

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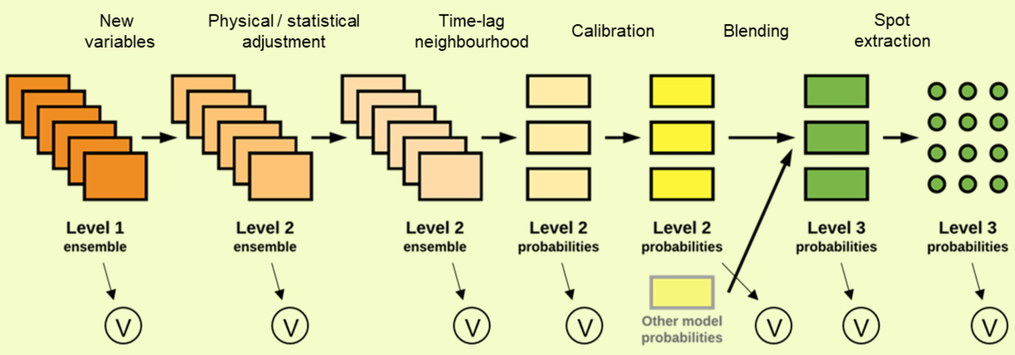
What is required from forecast “post processing”?

What is post processing?
Post processing is what is done to enhance the output from Numerical Weather Predication (NWP) forecasts.
Enhancement means:
- Improving forecast skill by accounting for model errors coming from biases representativeness or forecast uncertainty
- Producing products that make the best use of NWP outputs and are tailored to user needs.

Modern-day challenges:
- The public expect local, automated and accurate forecasts, frequently updated, anywhere anytime
- Forecasts should have consistency of message (visual, app, warning)
- We should fully exploit our NWP model forecasts, including km-scale models and ensembles
- Outputs should provide useful indicators of severe weather from which meteorologists can produce warnings
- Multiple high-resolution forecasts every hour risks meteorologists experiencing data overload unless key signals can be extracted
- The nature of forecast corrections has changed with higher resolution

A probabilistic approach:
- Post processing should be inherently probabilistic:
  - NWP is moving much more towards ensembles
  - Probabilities give a more honest and useful picture by specifying uncertainty
  - Probabilities allow seamless blending between NWP models
  - Probabilities provide a much more consistency and flexibility for end products

IMPROVER – a seamless multi-model probabilistic system



IMPROVER consists of a collection of parallel chains - one for each variable.

Forecasts come in as realisations and are turned into probabilities and blended

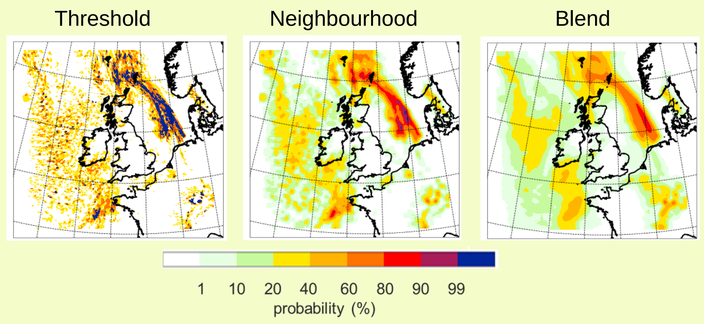
Forecasts for specific locations are extracted at the end

Verification is performed at every stage

Probabilities can be blended between several models (deterministic or ensemble) at different forecast lengths allowing forecasts from 15 minutes to 2 weeks

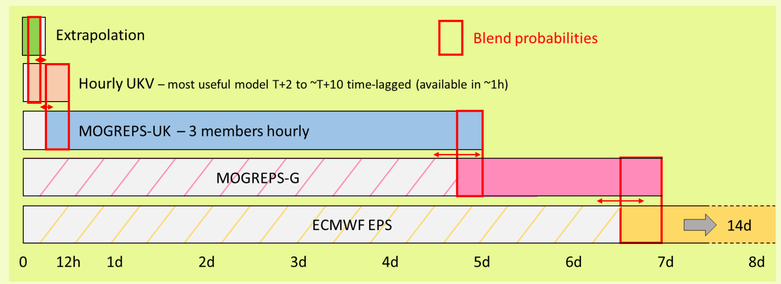
Downscaling / calibration required to map coarser resolutions to 2km UK grid

The ECMWF ensemble to be incorporated in 2019

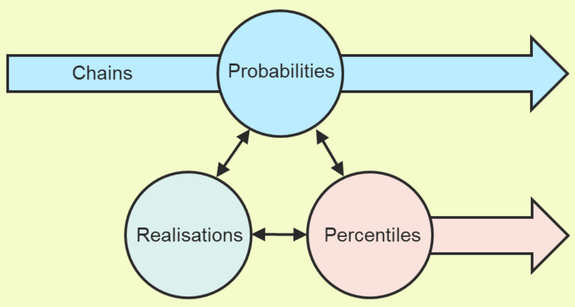


Thresholds are used to generate probabilities
(e.g. P (rain rate) > 1 mm/hr)

Neighbourhood processing produces smoothly-varying probabilities for blending with older forecasts and different models



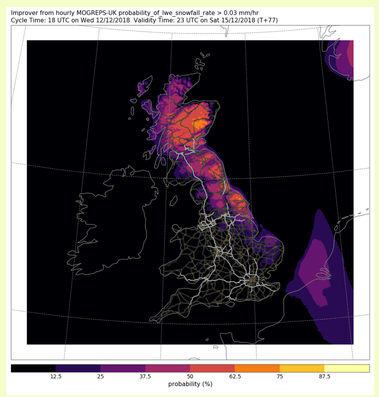
Extracting useful information



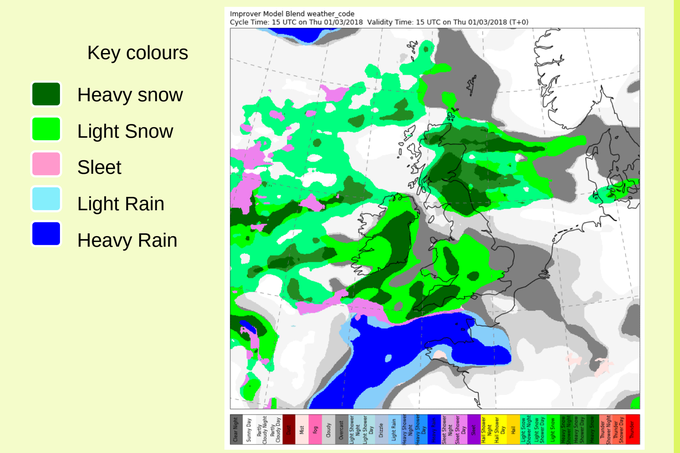
Probabilities can be converted into percentiles or realisations and back again

Probabilities are typically more suitable for discontinuous variables or severe weather whereas percentiles are typically more suitable for more continuous variables or “ordinary” weather

Conversions can be used for calibration and verification



Probability of snow using neighbourhood processing of MOGREPS-UK ensemble forecasts to obtain smooth spatial uncertainty along with topographical variability



Probabilities (or percentiles) can be converted into more deterministic outcomes such as either the most likely or highest-impact weather type at each grid square / location at a time or over a time window.

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