Blended probabilistic nowcasting with the IMPROVER post-processing system

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IMPROVER Team

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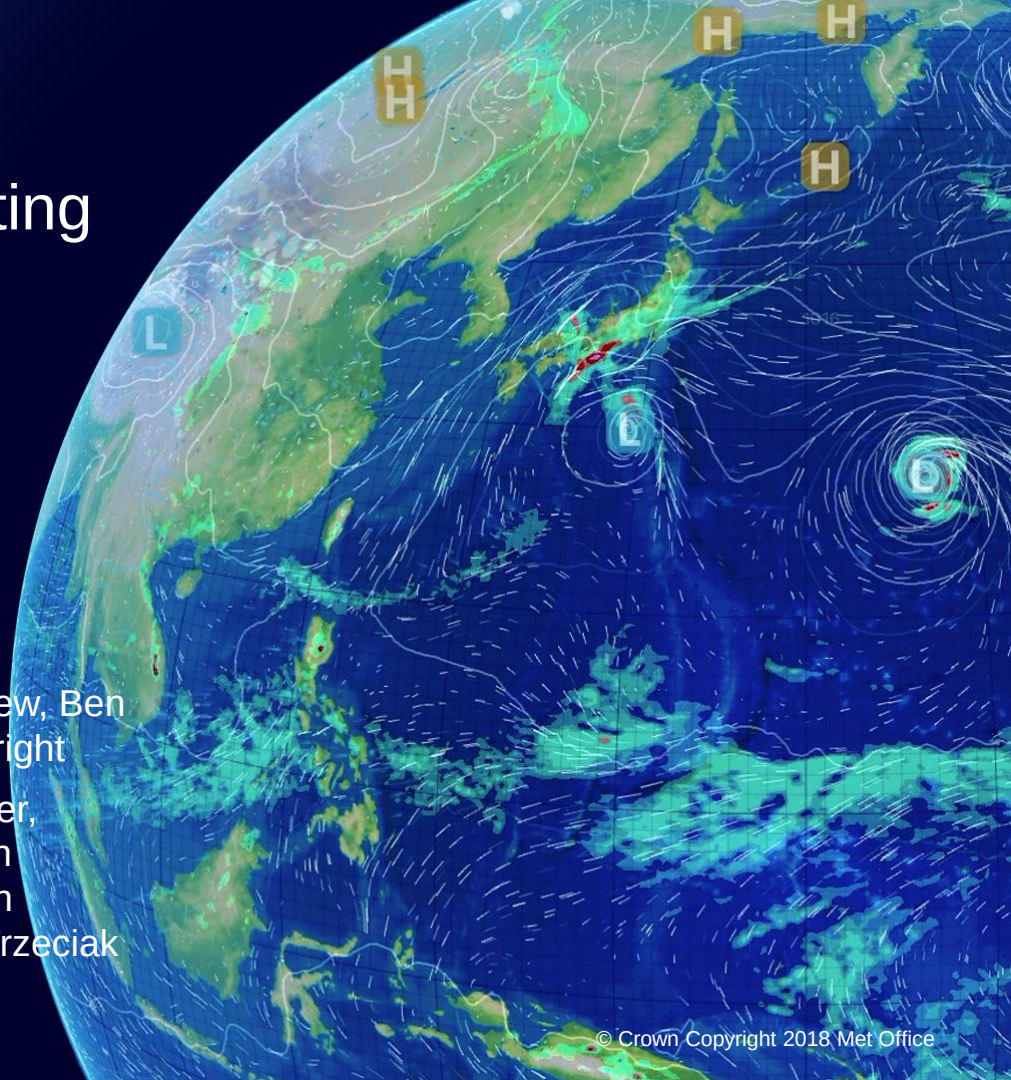
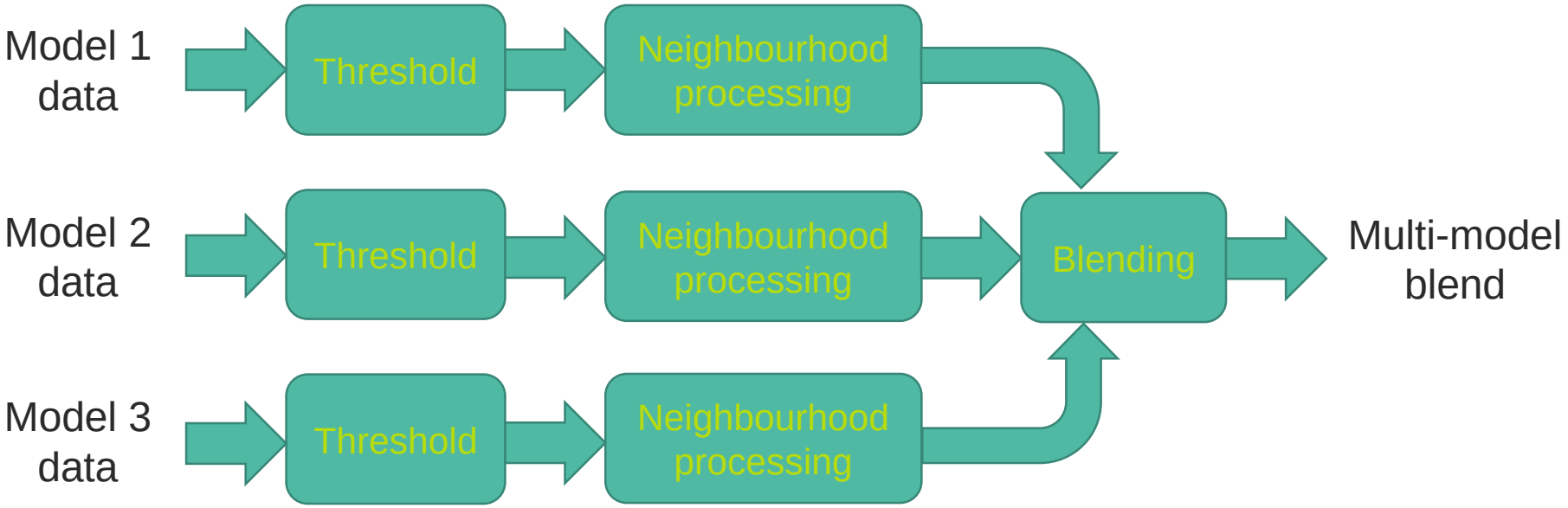


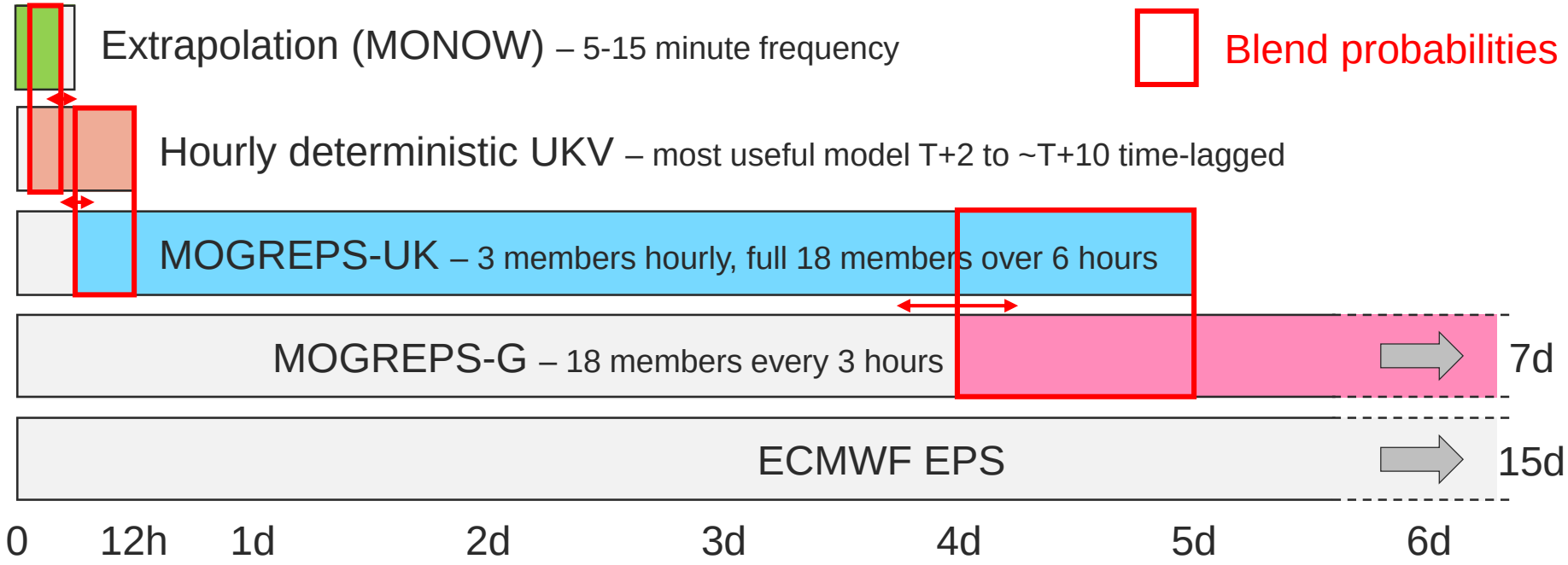
Context: the IMPROVER project

Current Met Office post-processing & nowcasting systems (UKPP / STEPS)	New systems in development (IMPROVER / MONOW)
• Not designed to cope with ensembles • Deterministic (processes individual diagnostic fields) • Blending in parameter space • Complex code design • Fortran • Proprietary	• Designed to fully exploit ensemble forecasts • Probabilistic processing chains for different models • Blending in probability space • Simple, modular processing chains • Python • Open source: https://github.com/metoppv/improver

IMPROVER post-processing: simplified chains

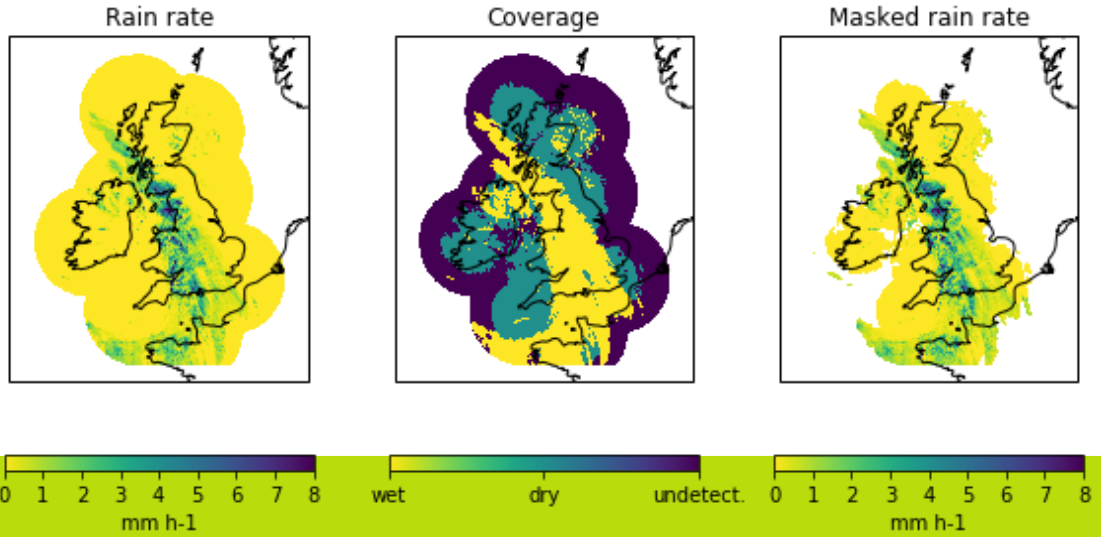


Multi-model probabilistic blending



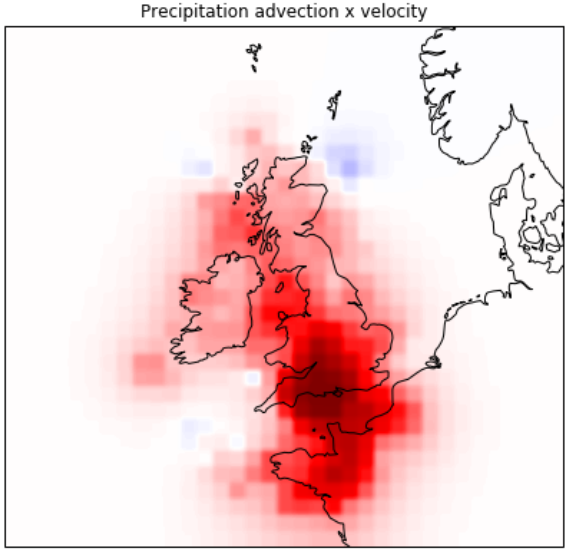
Radar extrapolation nowcasting: MONOW

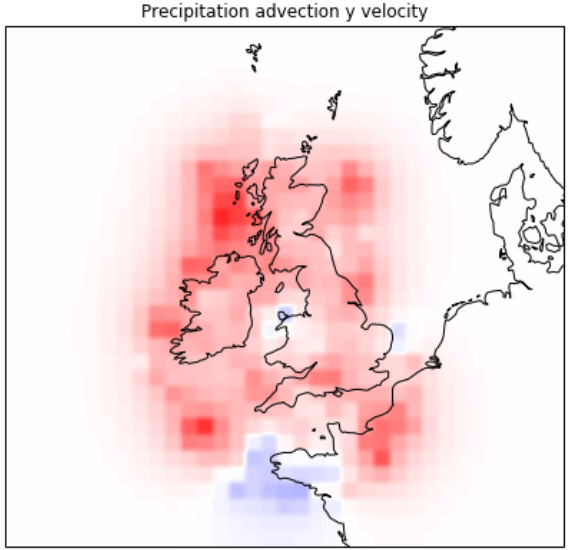
UK radar QPE & coverage composites



Masked radar T+0
Nowcast T+15 mins
Nowcast T+30 mins
Nowcast T+45 mins
…
Nowcast T+6 hours

Deriving advection velocities: optical flow (1)





Example: 27 November 2018:

- Forecast start time 14:00
- Optical flow advection velocities calculated from radar data at 13:30, 13:45 and 14:00

(Bowler *et al* 2004, STEPS)

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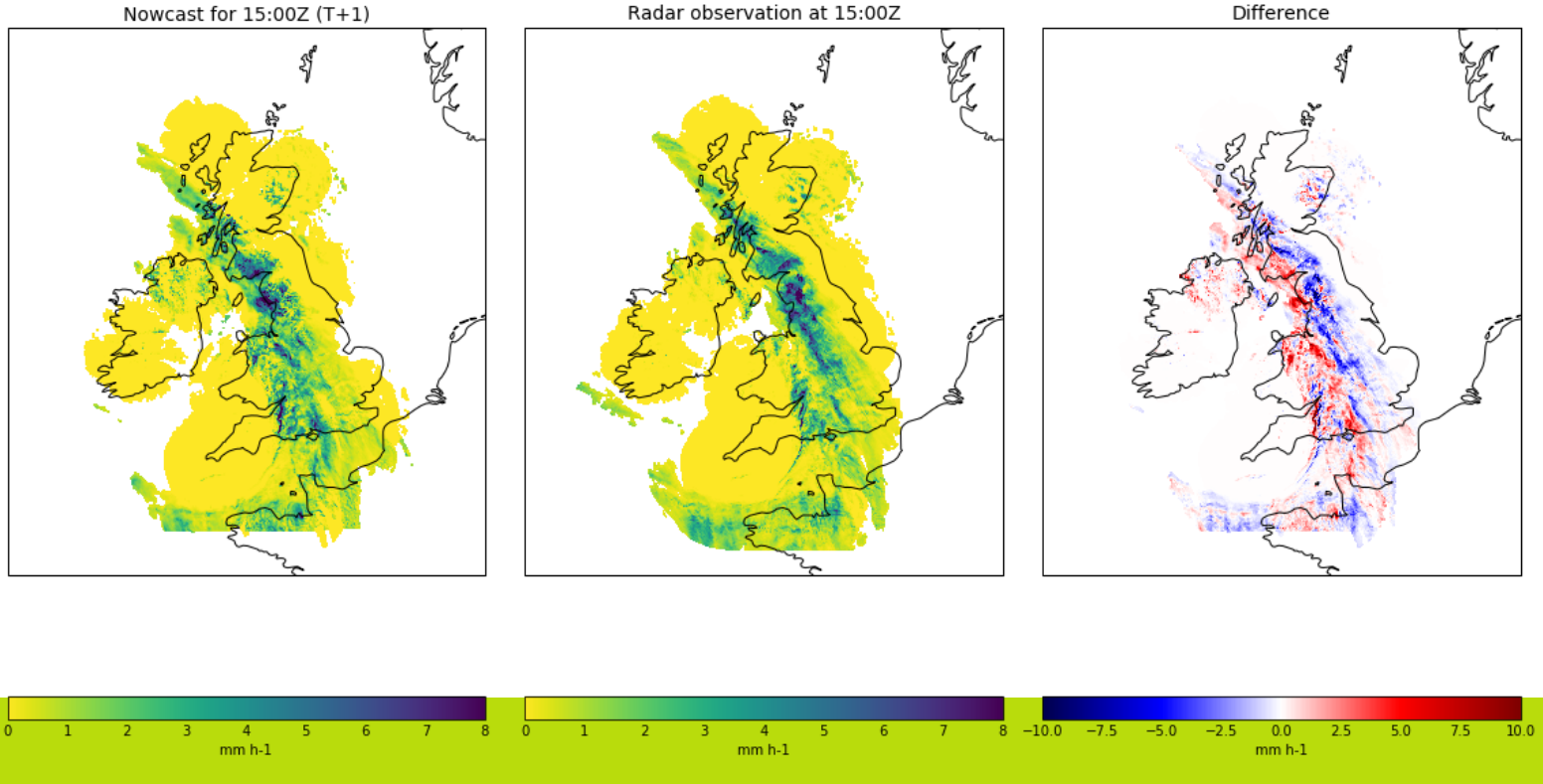
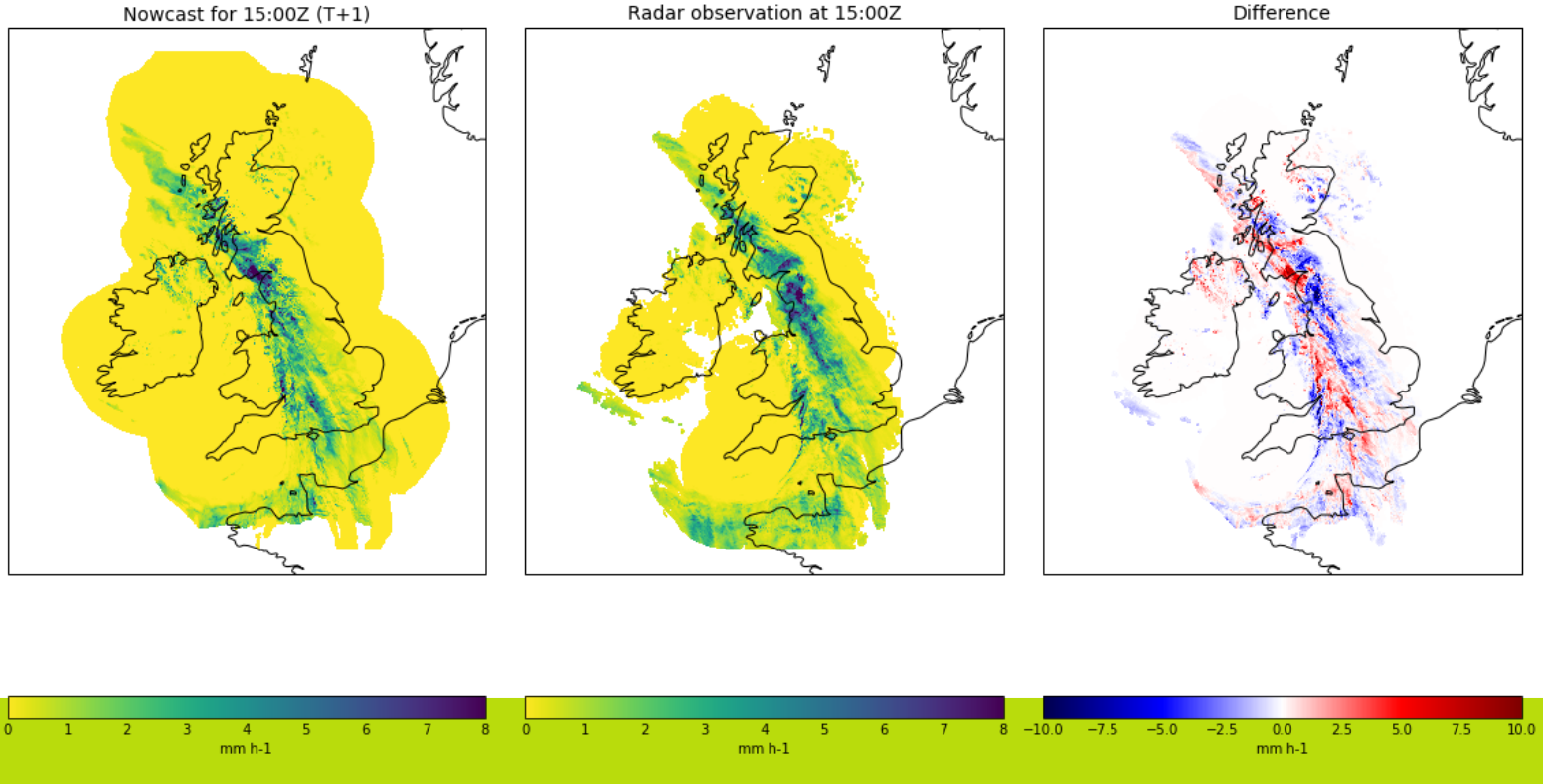
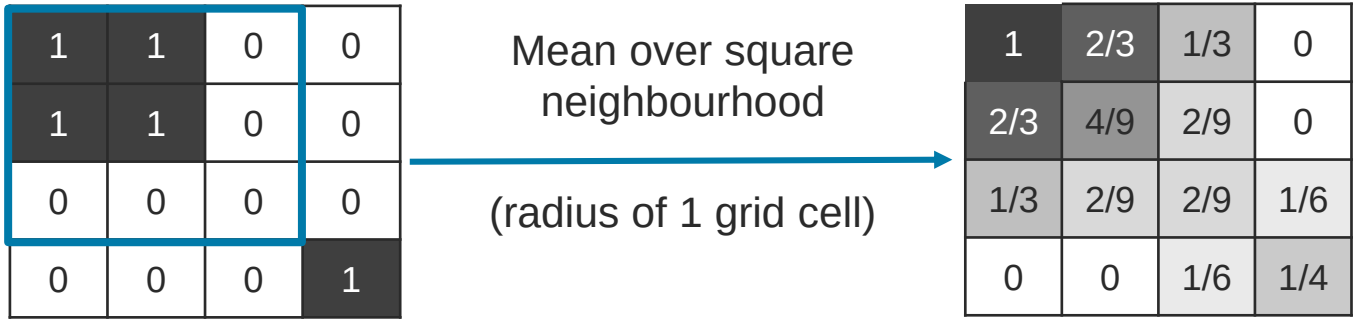
Deriving advection velocities: optical flow (2)



Advection velocities: model steering flow

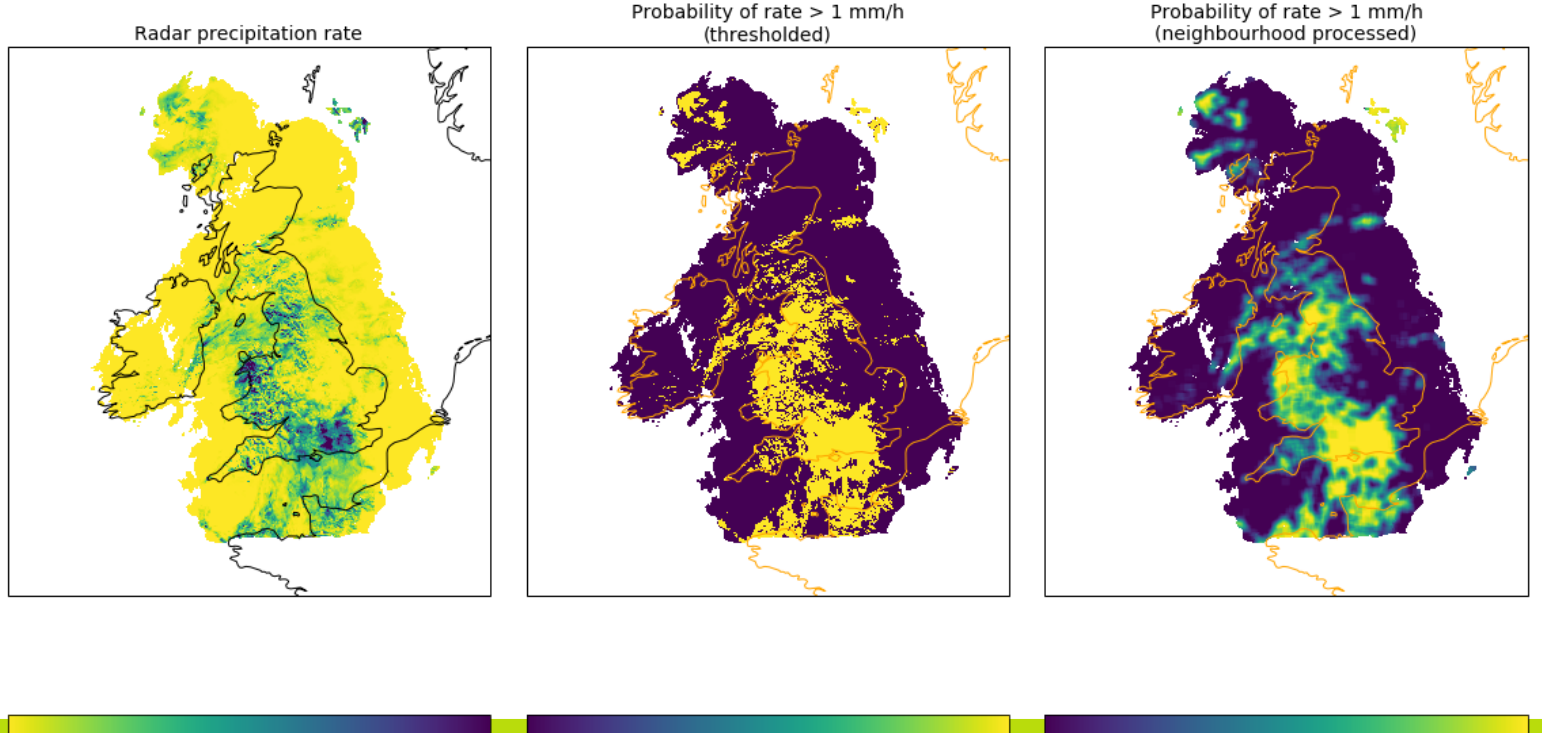


Neighbourhood processing (1)

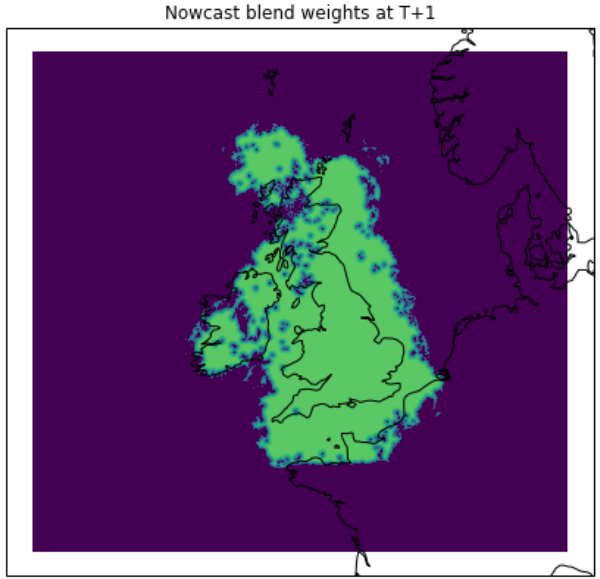


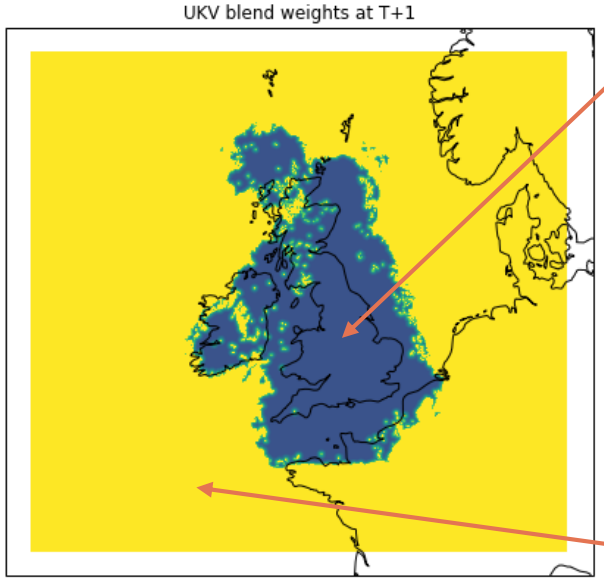
- Increases ensemble spread / creates spread in deterministic forecasts by representing spatial uncertainty
- Probability of occurrence in one grid cell refined by considering fraction of occurrences (P=1) in surrounding grid cells
- Radii empirically tuned to optimise verification metrics

Neighbourhood processing (2)



Nowcast-UKV blend weights



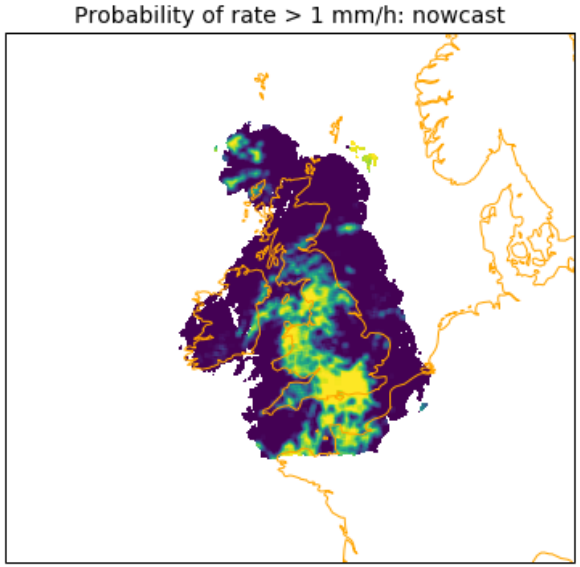


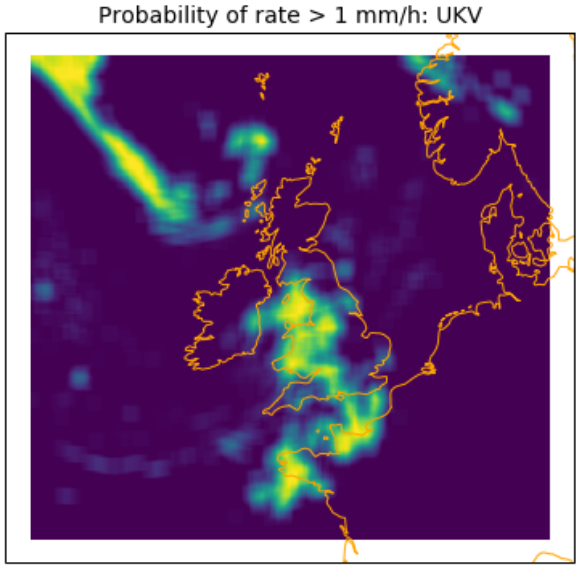
Mainland UK: 25% UKV, 75% nowcast at T+1

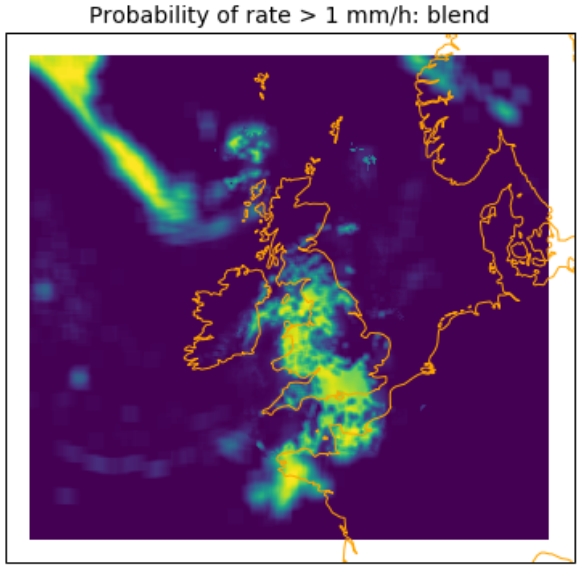
Linear increase in UKV weighting with lead time (100% at T+4)

Smooth increase to 100% UKV outside nowcast coverage

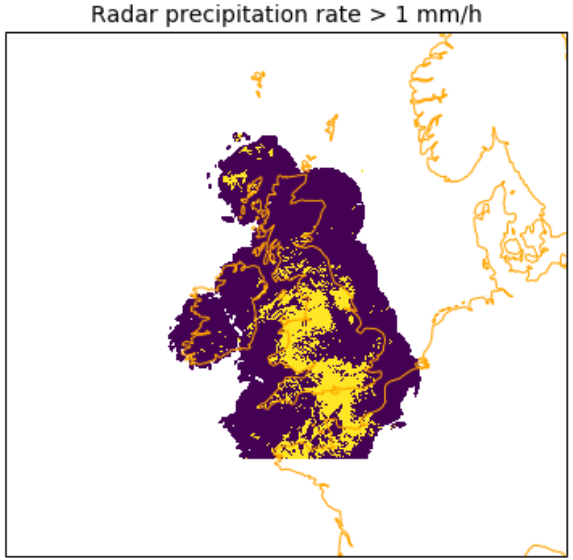
Nowcast-UKV probabilistic blend

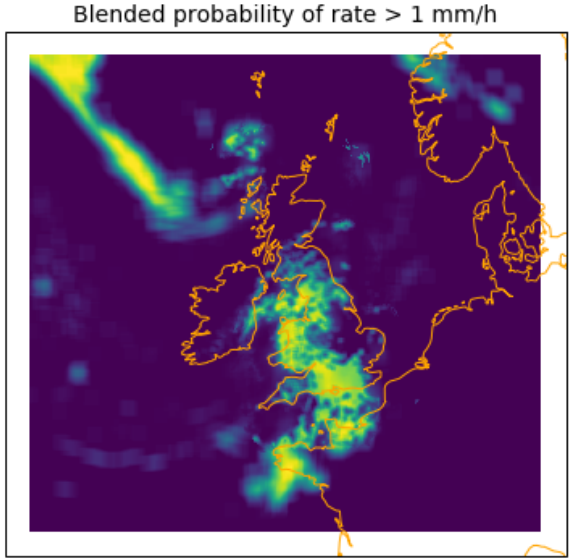


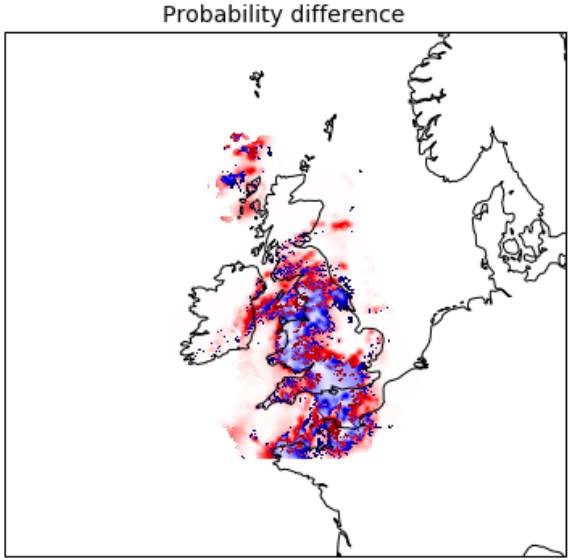




Comparison with "truth" at 1 hr lead time







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Conclusions

- The current Met Office post-processing systems (STEPS & UKPP) are complex and expensive to maintain, and aren’t designed to exploit ensemble models
- IMPROVER will generate post-processed probabilistic forecasts and nowcasts from deterministic and ensemble models via a simple modular processing chain
- Spatial uncertainty in the MONOW nowcast is represented via neighbourhood processing, rather than stochastic noise at different scales, and the IMPROVER framework provides opportunities to tune neighbourhood radii and multi-model blend weights according to skill
- “Proof of concept” shows sensible-looking nowcast probability fields with no visible artefacts
- Quantitative validation is a work in progress