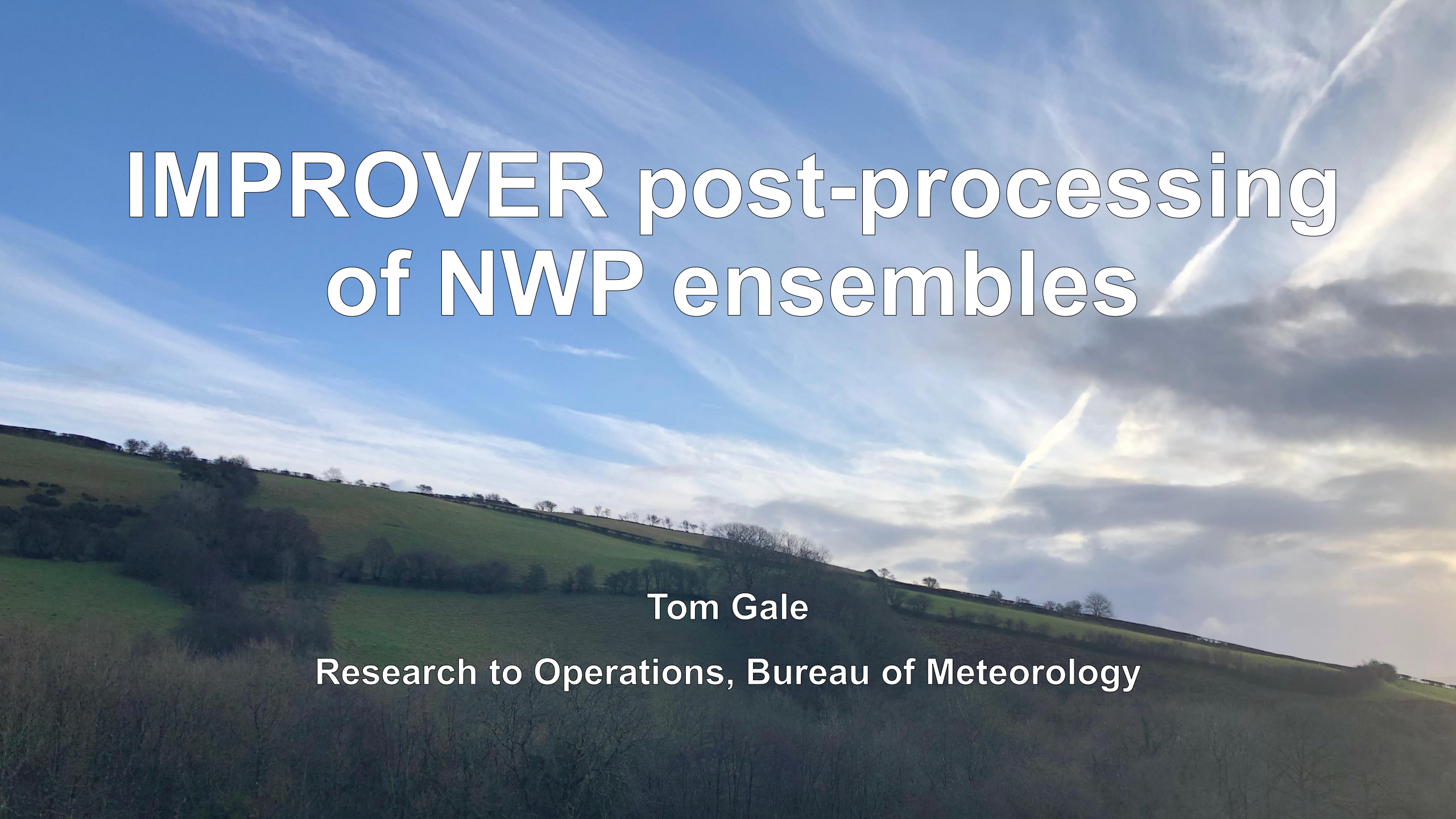


IMPROVER post-processing of NWP ensembles

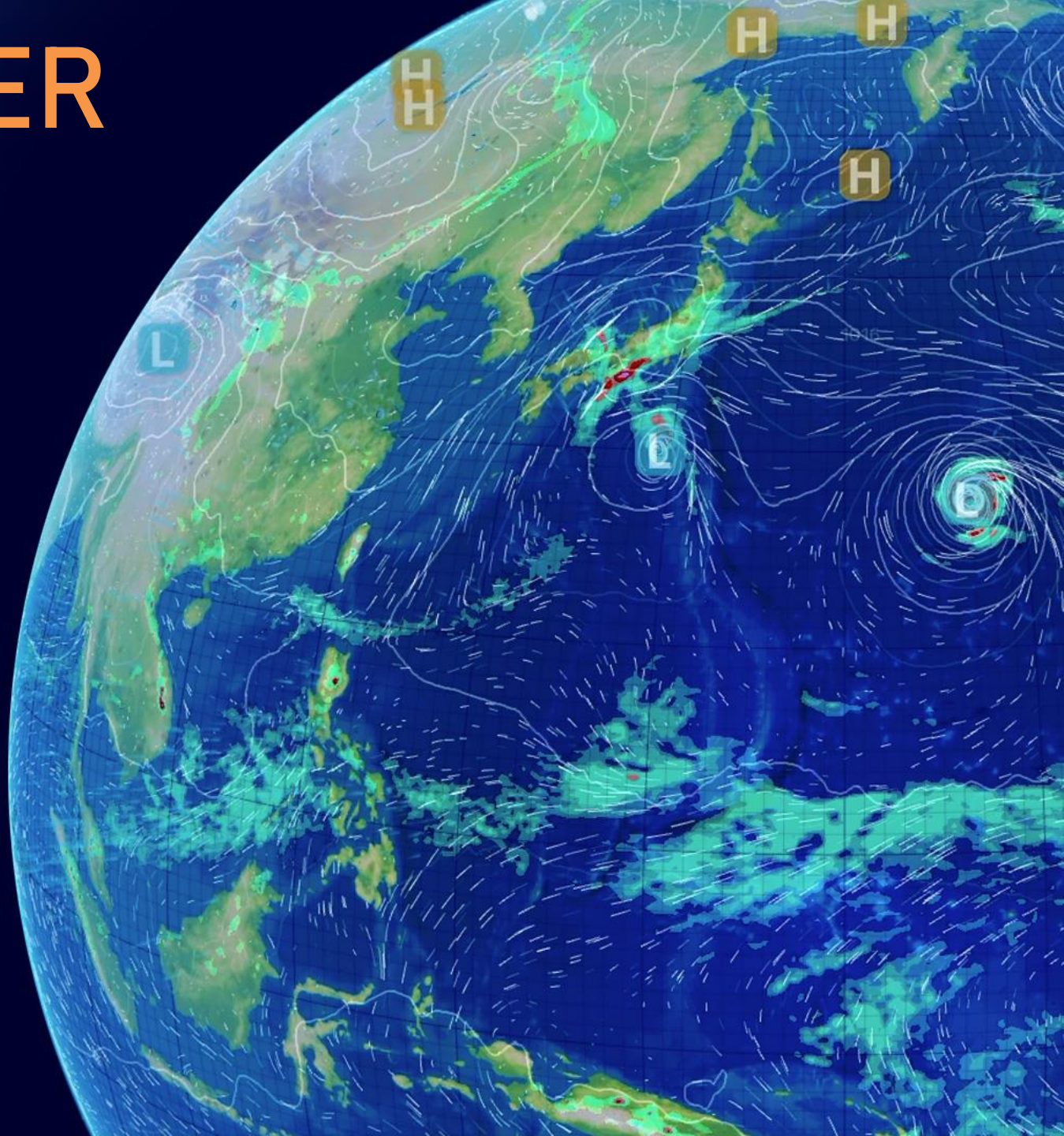
Tom Gale

Research to Operations, Bureau of Meteorology

Met Office

IMPROVER

Ben Ayliffe, Paul Abernethy, Si Backhouse, Laurence Beard, Neil Crosswaite, Gavin Evans, Ben Fitzpatrick, Leigh Holly, Katie Howard, Katharine Hurst, Simon Jackson, Fiona Rust, Stephen Moseley, Ken Mylne, Nigel Roberts, Caroline Sandford, Chris Sampson, Michael Sharpe, Tomasz Trzeciak, Bruce Wright



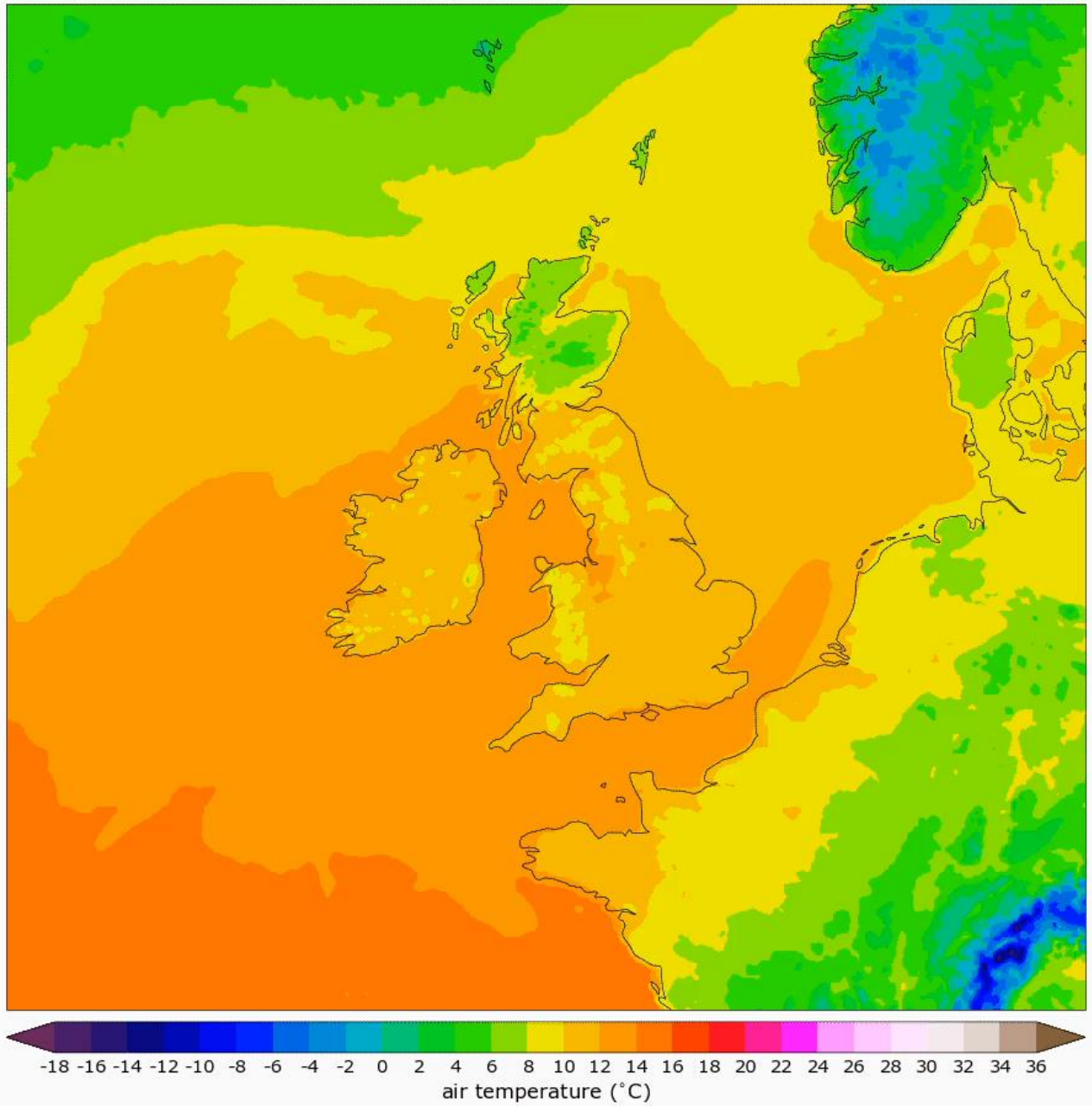
Australian Government
Bureau of Meteorology

James Canvin, Julian Fan, Tom Gale, Tim Hume, Fiona Law, Lucy Liu, Daniel Mentiplay, Anja Schubert, Belinda Trotta, Gary Weymouth

IMPROVER

- A new, international best practice post processing system
- Physical, statistical and neighbourhood post processing
- Probabilistic at the core, focusing on ensemble NWP model outputs
- Verification of each processing step
- Seamless from nowcast (1 hour) to medium range weather forecast (15 days)
- Supports public weather services
- Probabilities for all fields to support risk and impact based decision support
- Plug-in modular framework
- Modern software – Python 3, Iris 2, Rose 8, Cylc 2
- Modern development practices – open source, automated CI, good test coverage, code reviews

Air Temperature 10 Percentile
Valid at 0000 UTC on Tue 17/11/2020
IMPROVER Multi-Model Blend
Last Updated at 2330 UTC on Mon 16/11/2020



Air Temperature 50 Percentile
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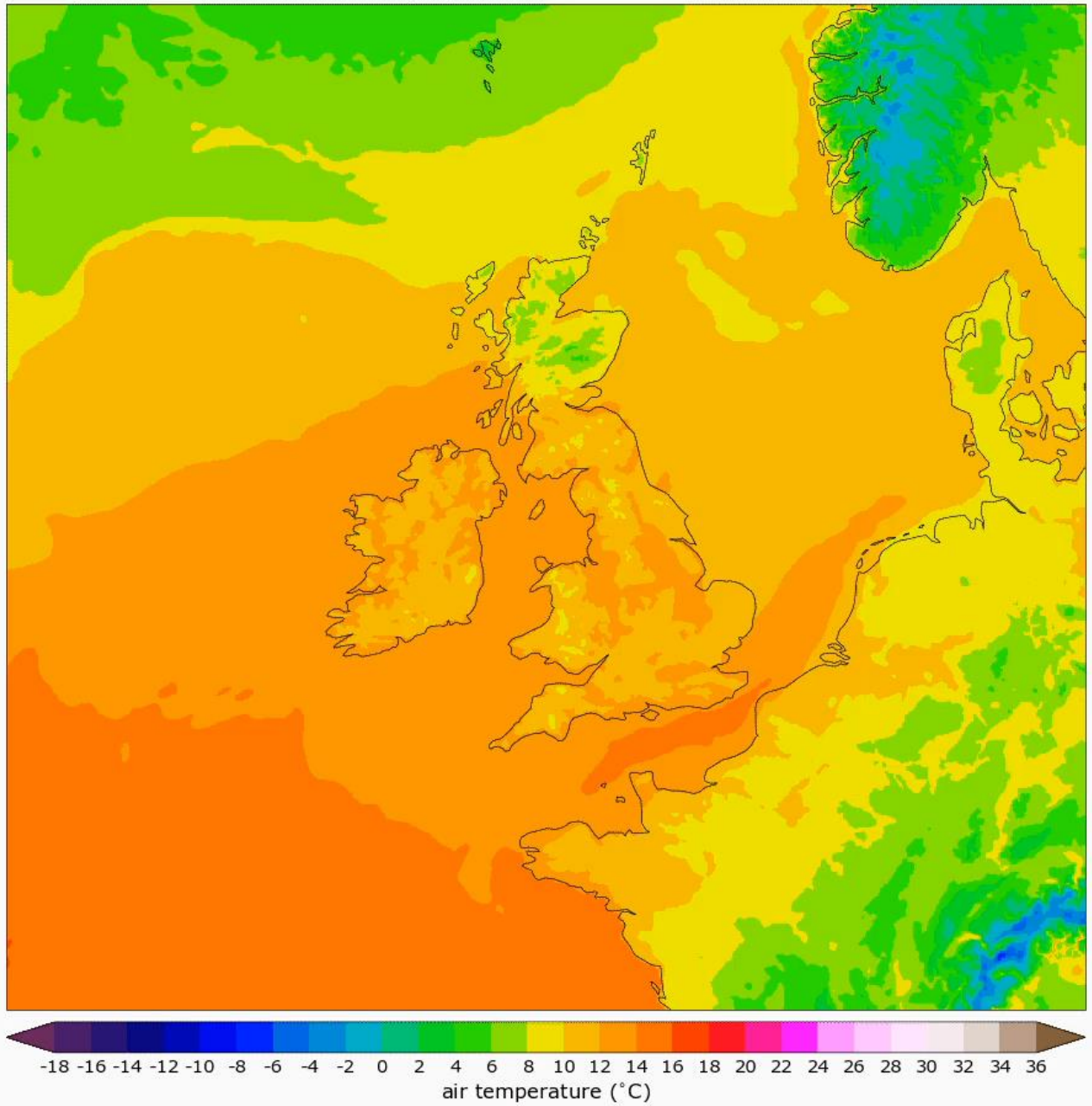
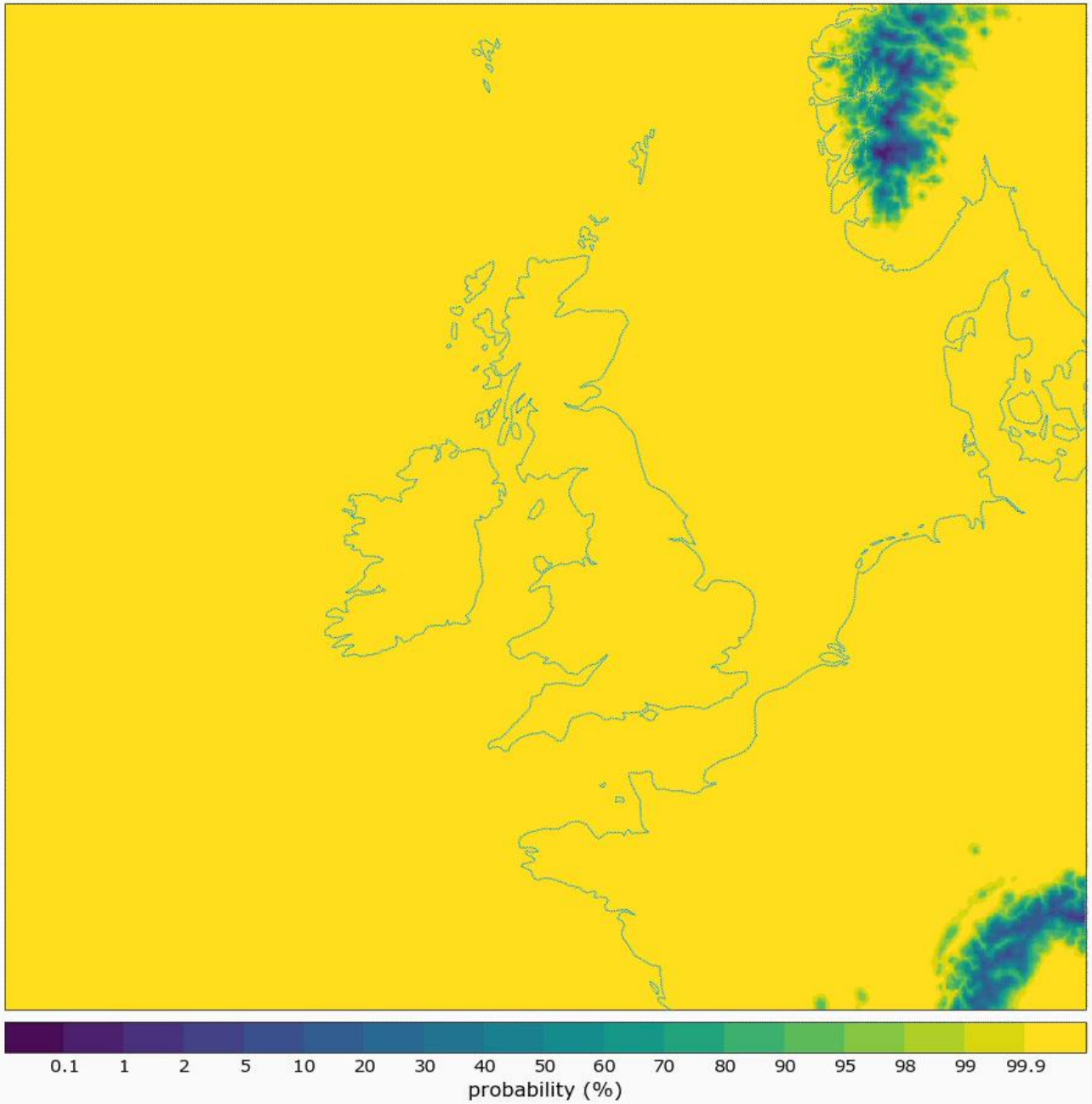
IMPROVER Multi-Model Blend
Last Updated at 2330 UTC on Mon 16/11/2020



Probability of Air Temperature > 273.15 K
Valid at 0000 UTC on Tue 17/11/2020
IMPROVER Multi-Model Blend
Last Updated at 2330 UTC on Mon 16/11/2020



IMPROVER for Australia

Australia	UK
National Analysis System (NAS) analyses plus site observations	T=0 forecasts from UK domain deterministic model
Six ACCESS-C/CE input model domains, single Australia wide output domain	One UK domain
“City” models run to 36 hours forecast time (APS3)	UK domain models run for 5 days forecast time
Model blend to include deterministic and ensemble, local and international models – BOM ACCESS, ECMWF, UKMO, NCEP GFS, JMA, CMC	Model blend currently uses in-house UKMO models only, intend to add ECMWF EPS
Global and city models run every 6 hours (APS3)	“Firehose of model data” – new UK domain ensemble members every hour, new model run has started before previous one finishes
Supporting increased forecast automation as part of Public Services Transformation program	Public weather services already near fully automated

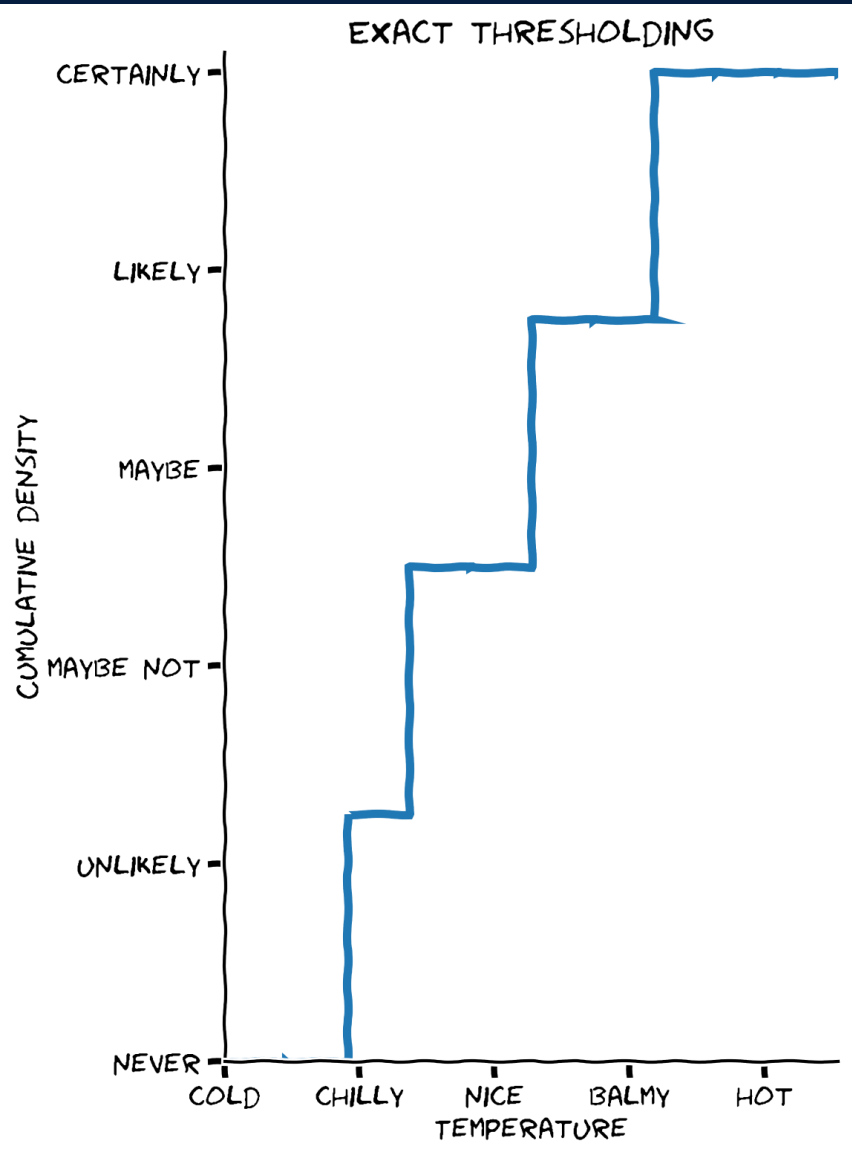
IMPROVER processing of high resolution convection allowing ensembles

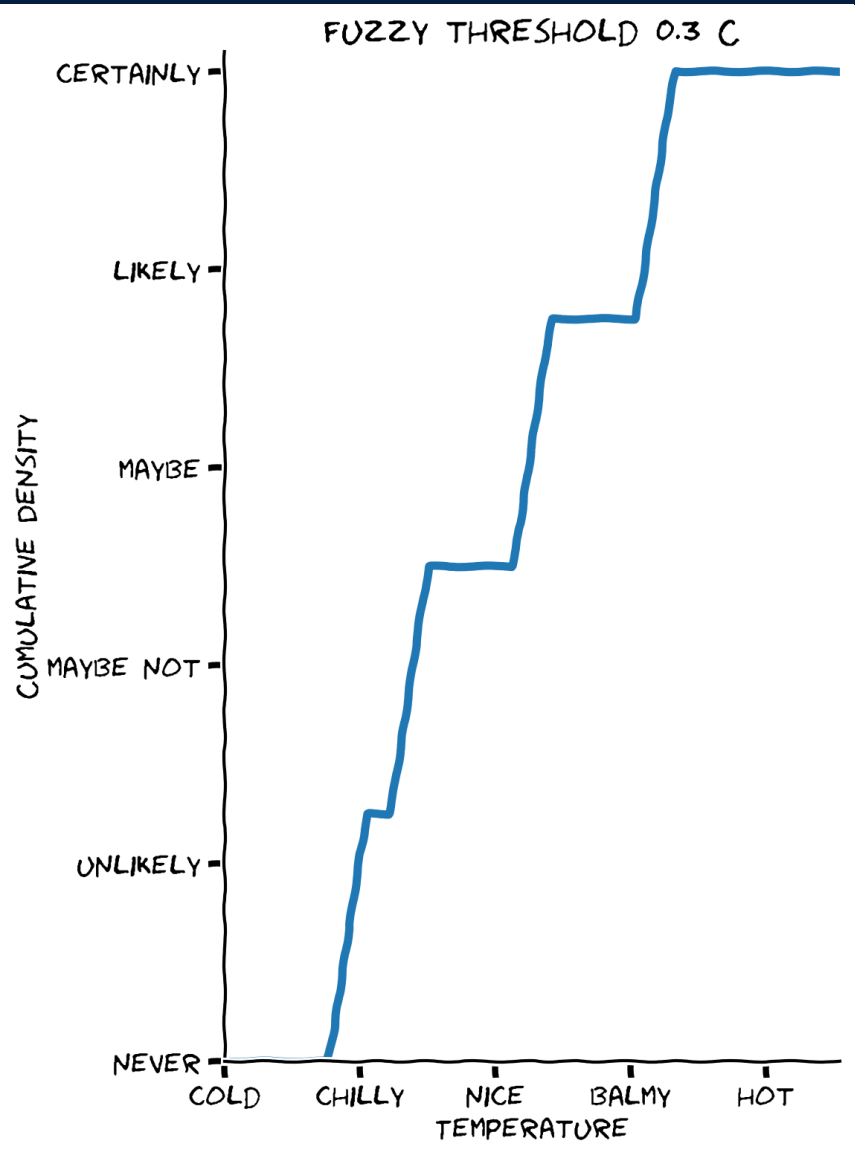
- Manage forecastable detail to produce good probabilities
- Suite designed to trickle data through system as produced by model timesteps
- Ability to convert between three probability forecast representations – realisations, thresholds, percentiles
- Calibrate probabilities so that limited area and global models can be blended to a seamless output

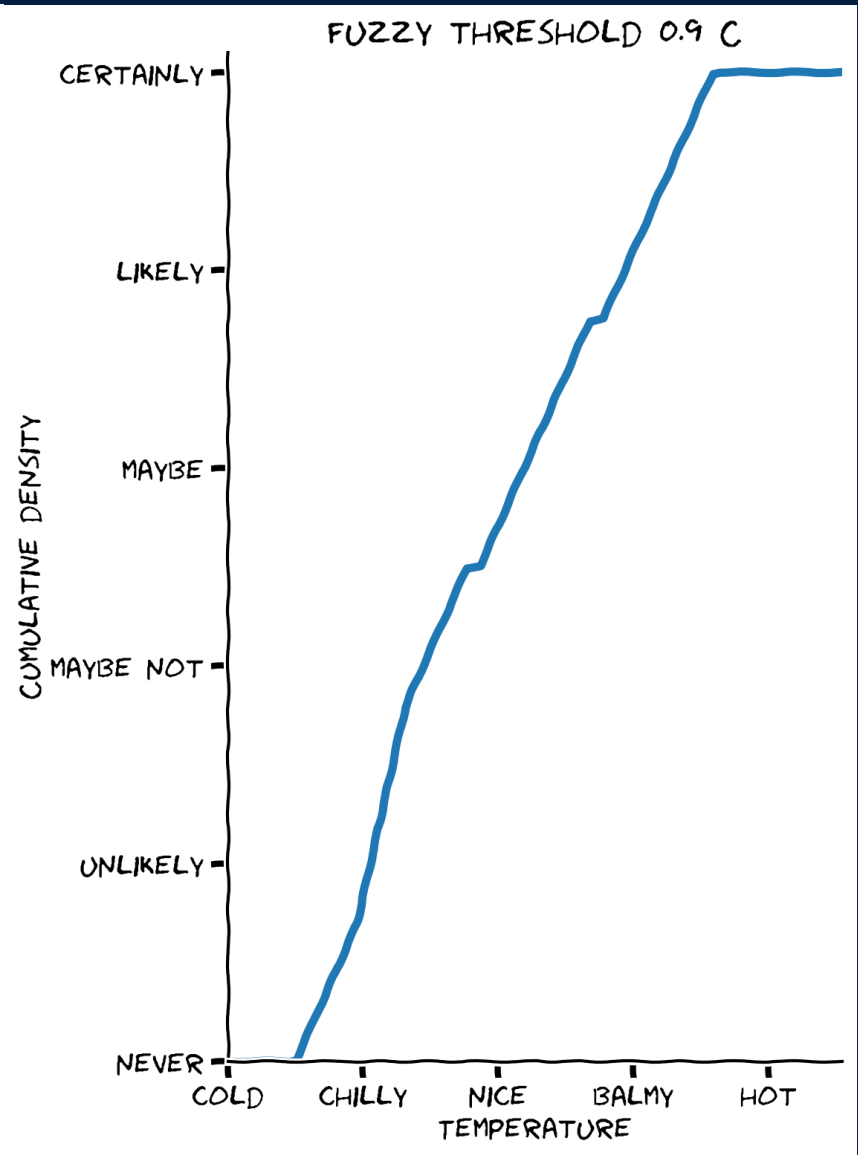
IMPROVER processing of high resolution convection allowing ensembles

- Step through common IMPROVER post processing plugins
  - Regridding
  - Fuzzy thresholding
  - Topography aware neighbourhooding
  - Triangle time blending
  - Blend cycles (lagging)
  - Topography aware smoothing
  - Reliability calibration
  - Multi-model weighted blending
- Cartoon graphs – not actual data!

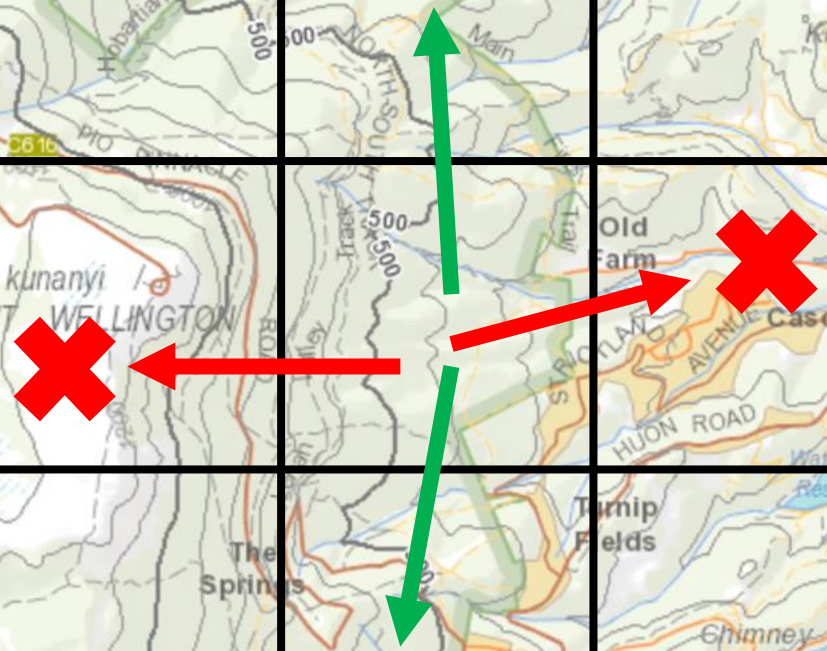
Fuzzy thresholding



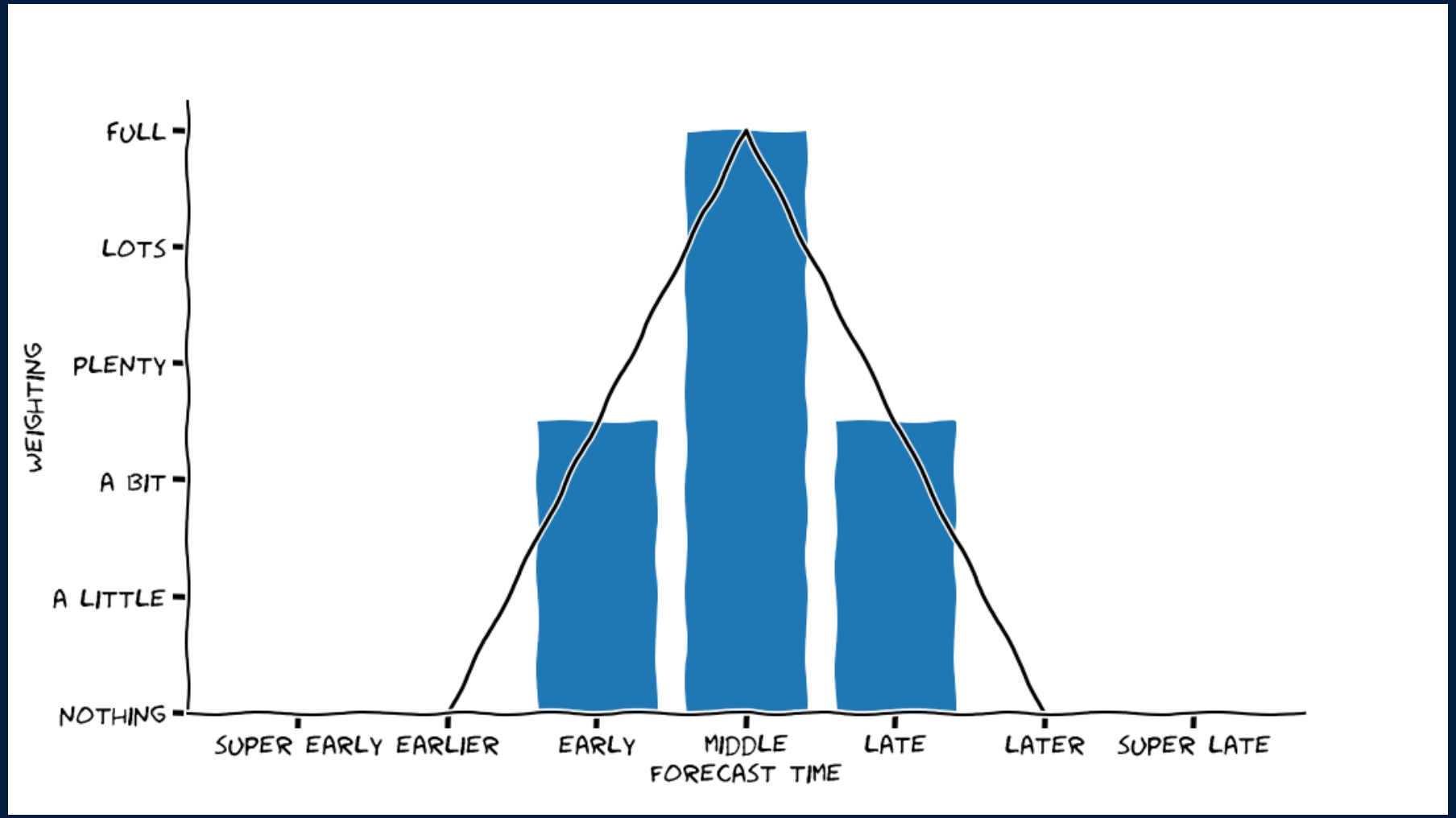




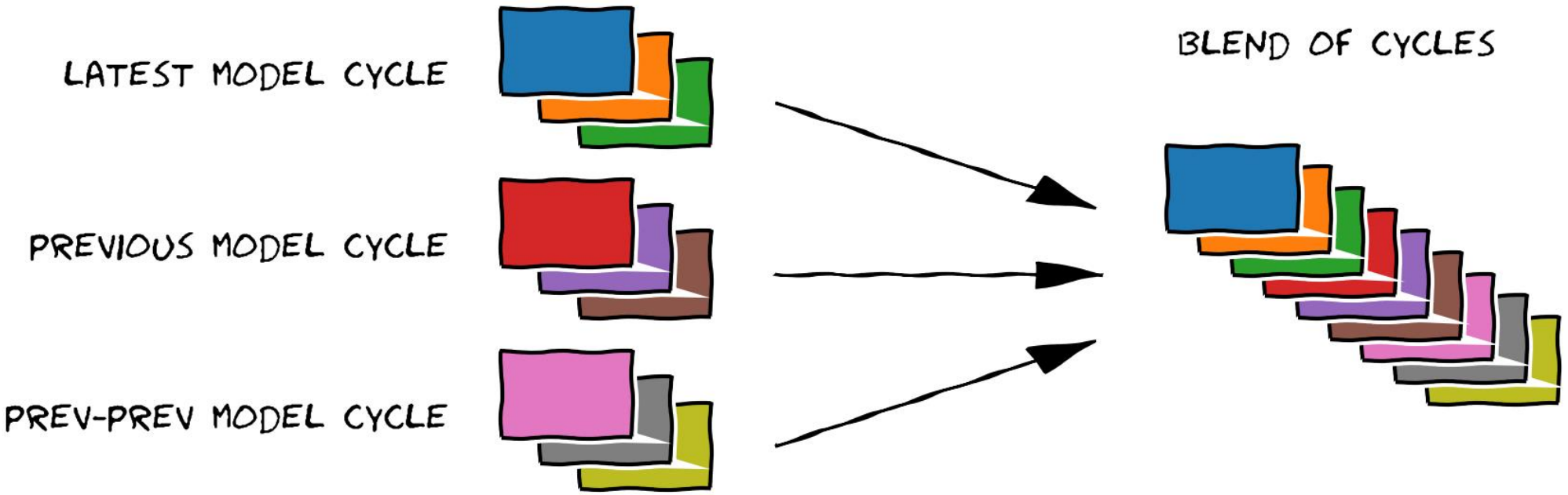
Topography aware neighbourhoods



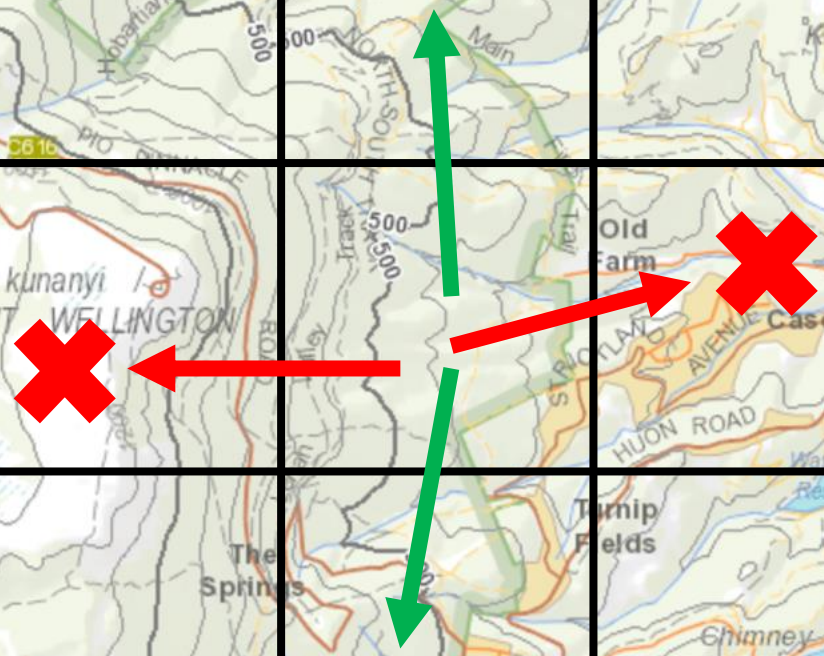
Triangle time blending

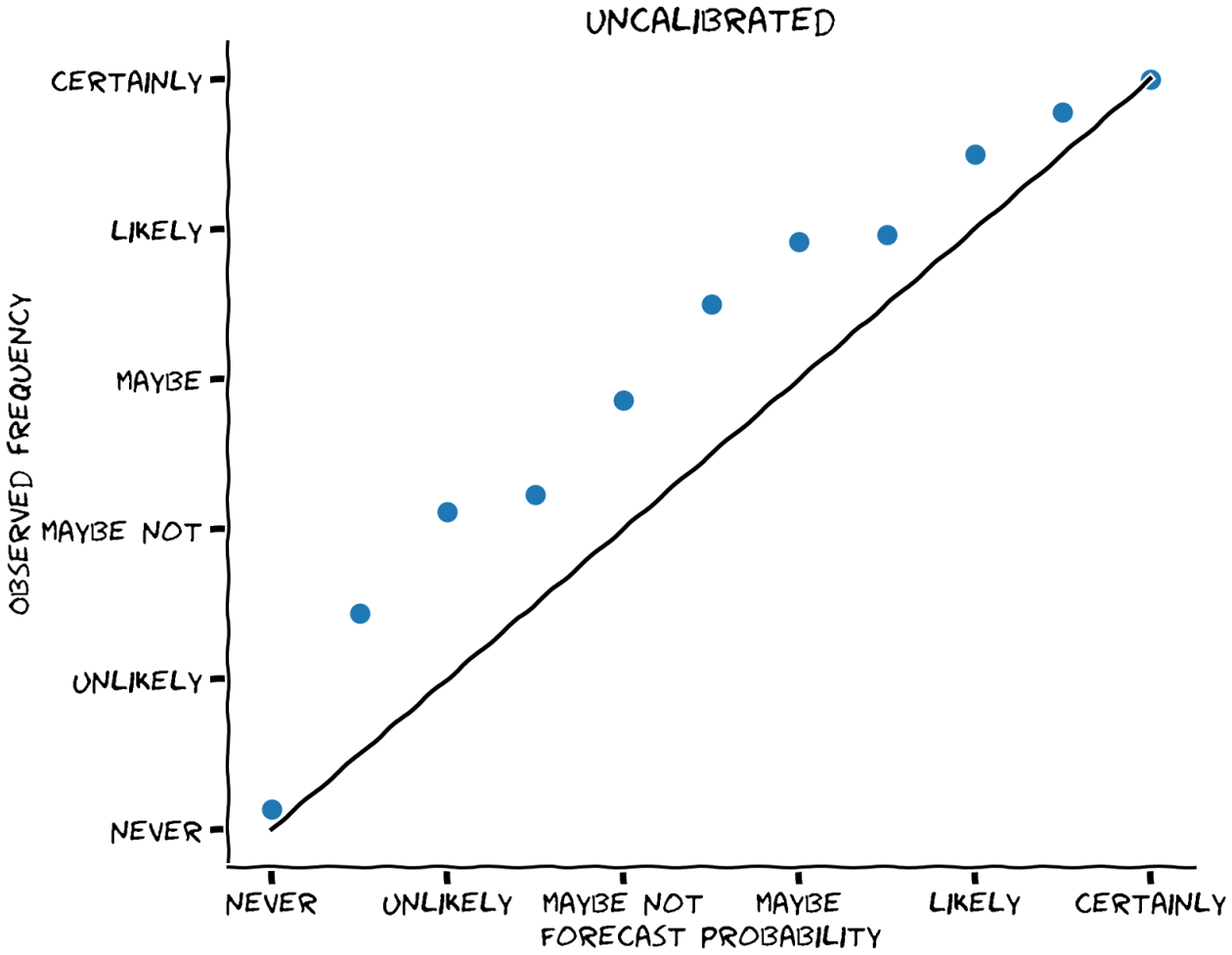


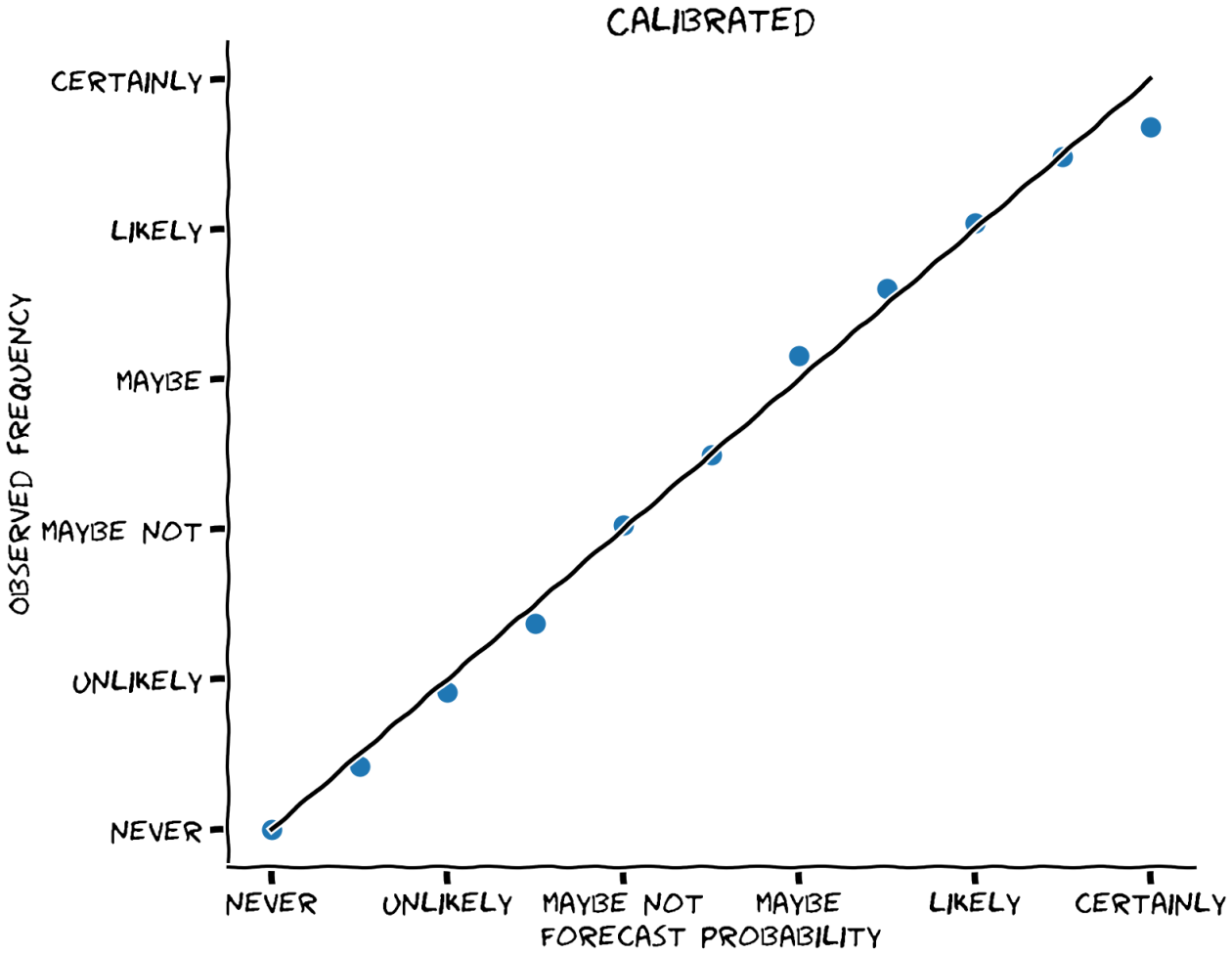
Cycle blending



Topography aware smoothing filter



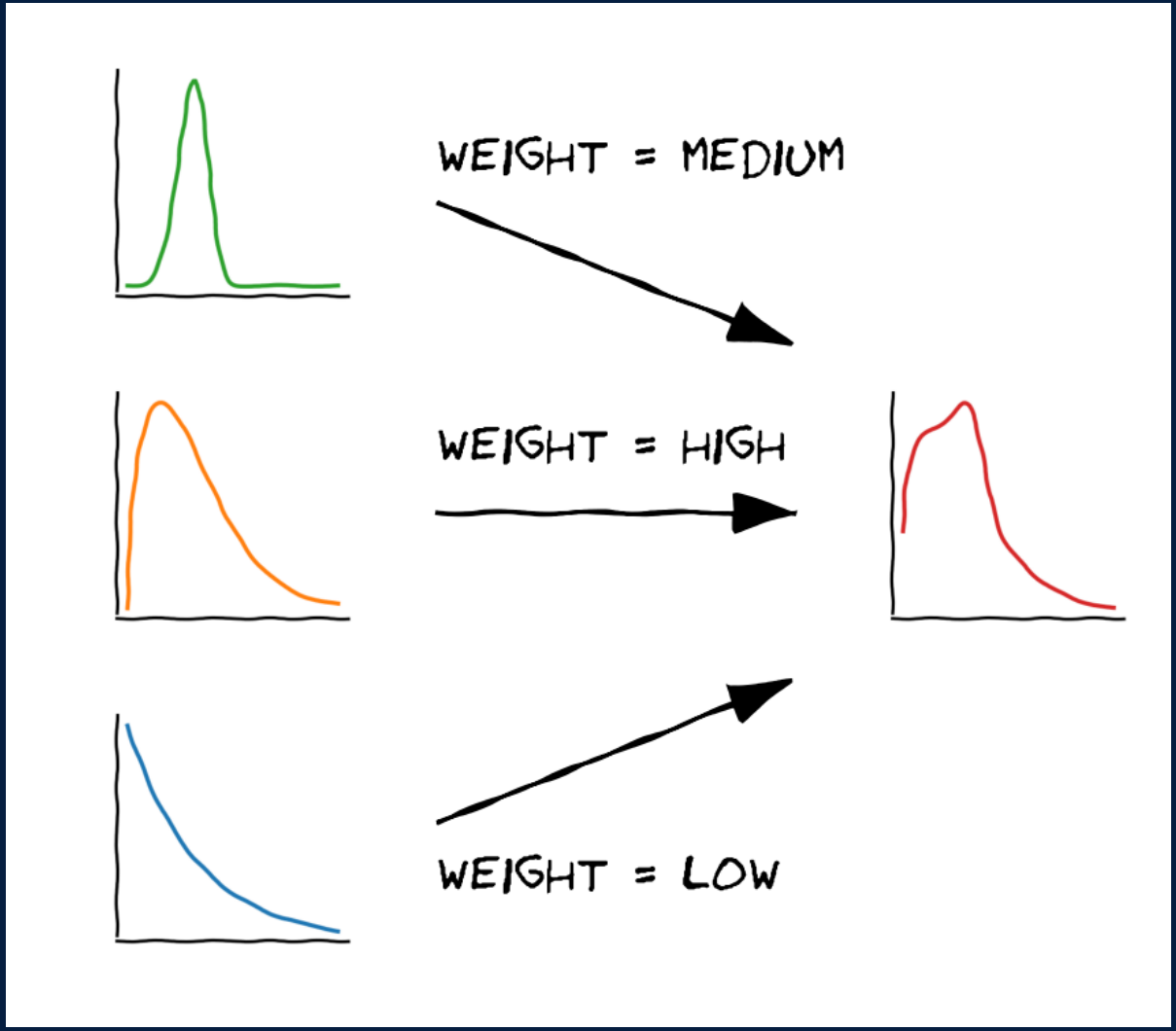




Reliability calibration

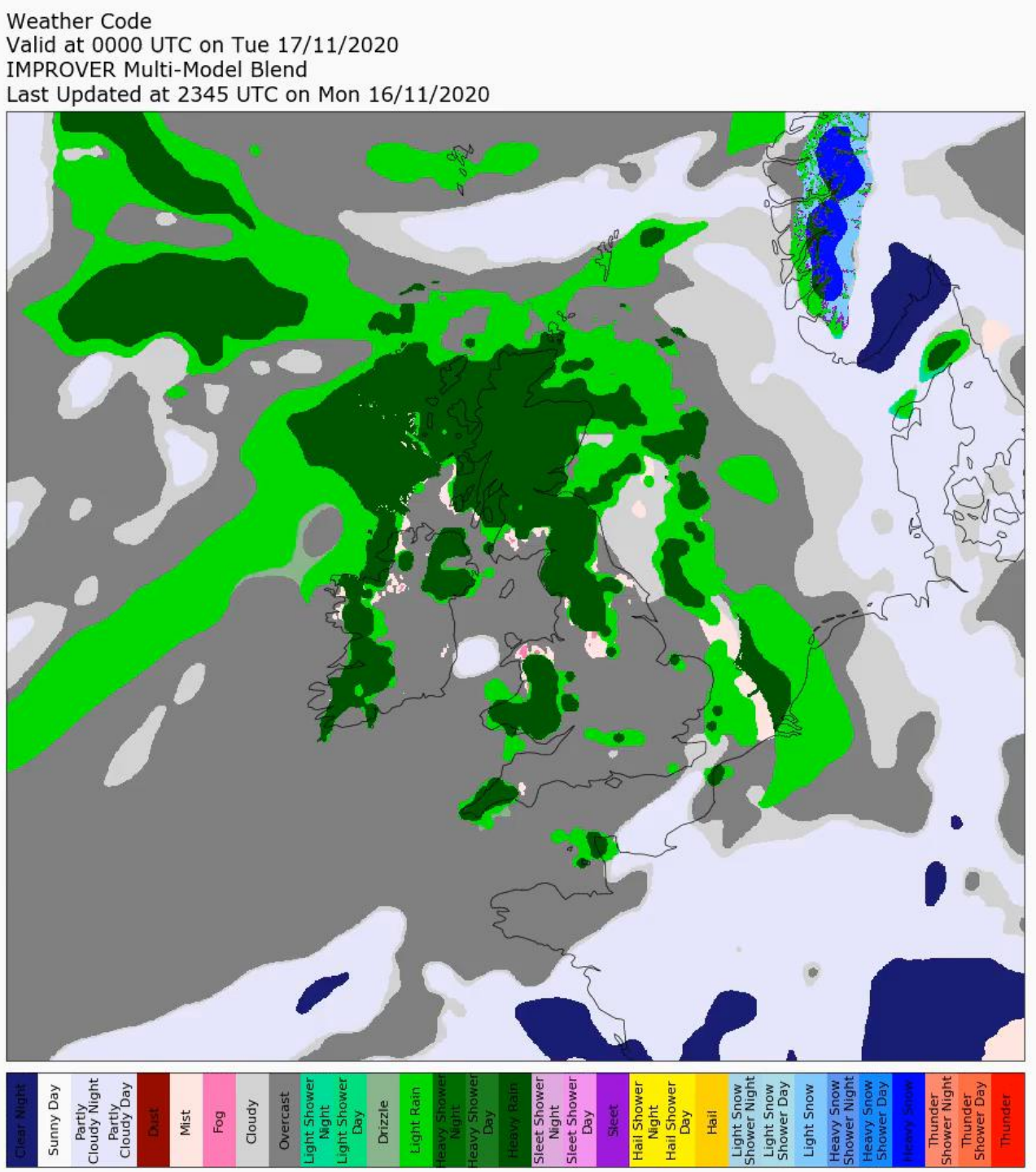
Gather → aggregate → apply

Multi-model weighted blending



IMPROVER operational plans

- Planned for operational beta at Met Office February 2021
- Planned for operations at Bureau of Meteorology early 2022
- Future work on multi-parameter indices and basic impacts
- IMPROVER provides post processing capability for current and upcoming high resolution models



Questions