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Topographic neighbourhood processing

Fiona Rust

Nigel Roberts, Caroline Sandford, Eleanor Smith, Stephen Moseley, Gavin Evans, Benjamin Ayliffe

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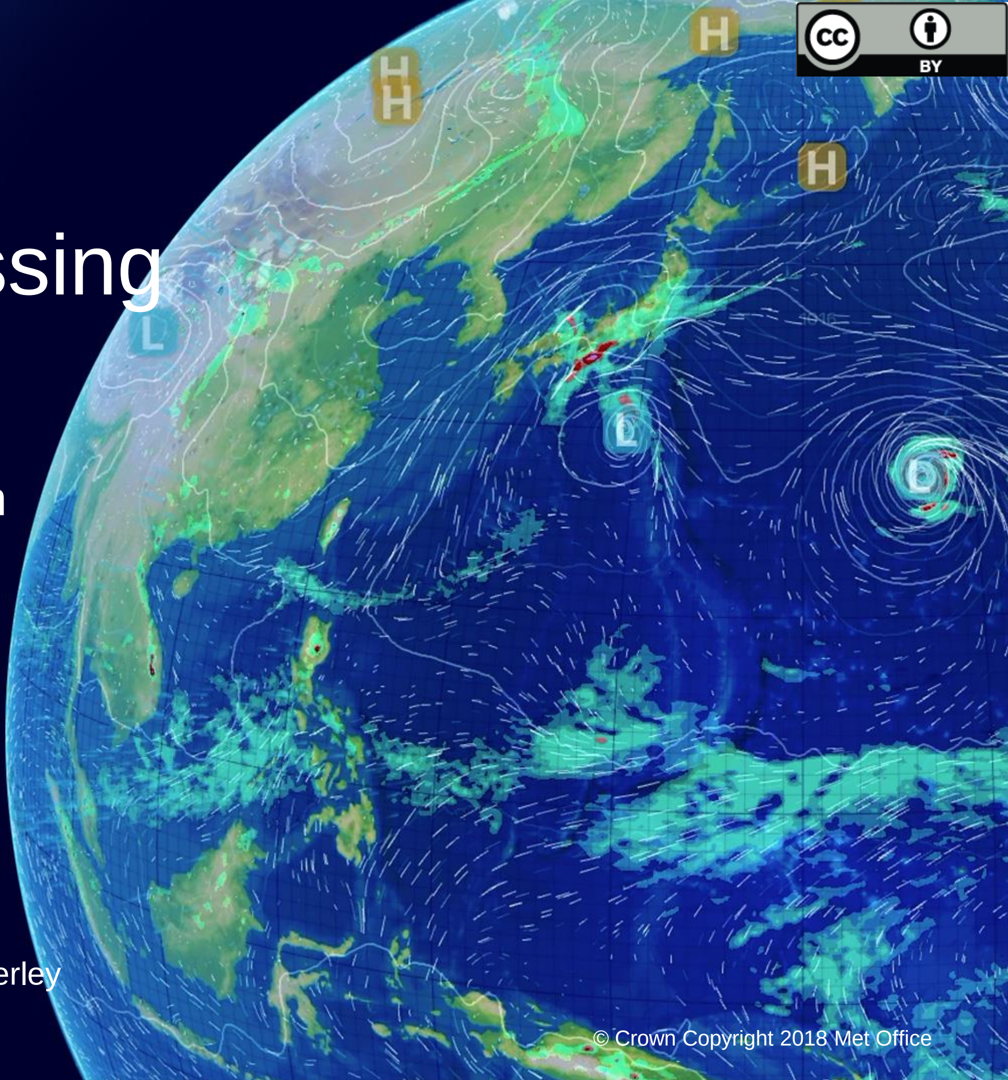

Introduction

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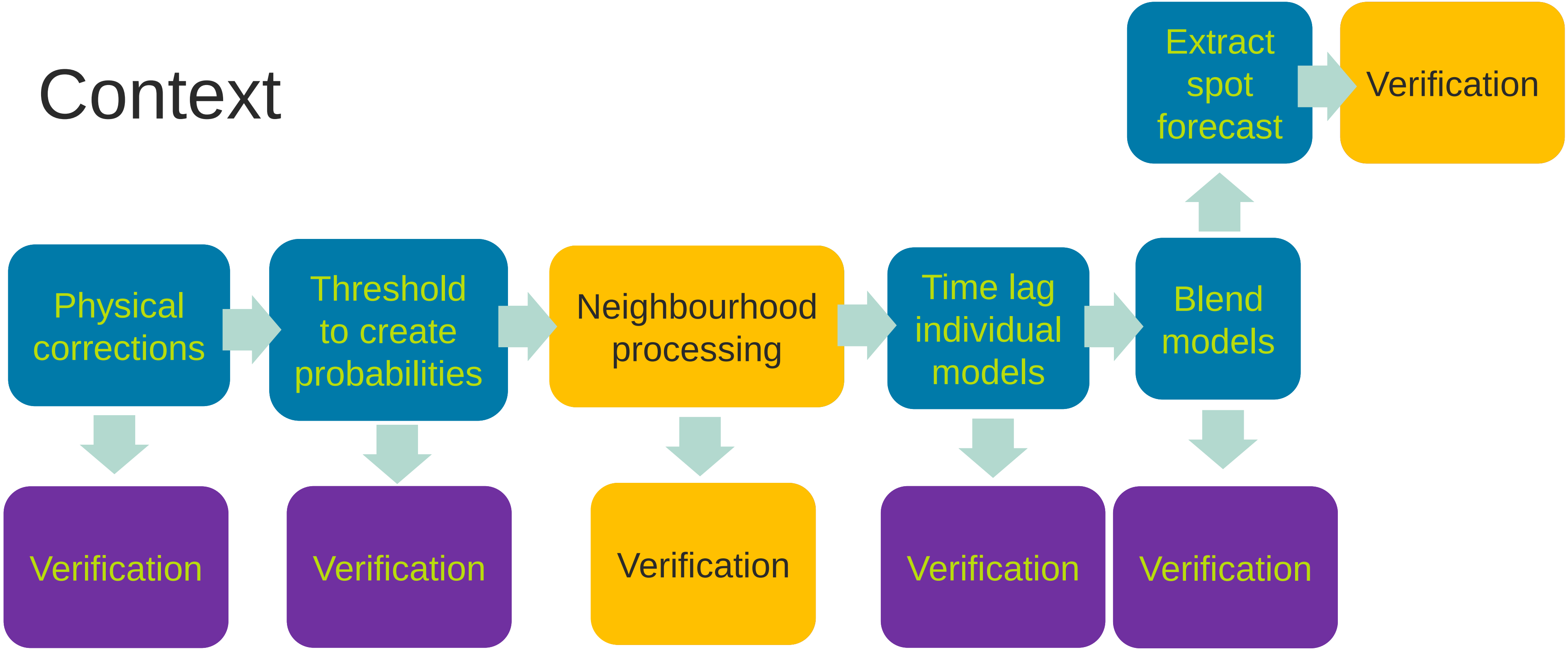
Context



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Neighbourhood processing.

1	1	0	0
1	1	0	0
0	0	0	0
0	0	0	1

Mean in neighbourhood

1	2/3	1/3	0
2/3	4/9	2/9	0
1/3	2/9	2/9	1/6
0	0	1/6	1/4

Maximum in neighbourhood

1	1	1	0
1	1	1	0
1	1	1	1
0	0	1	1

A review by Schwartz and Sobash, 2017 identified these two main types of neighbourhood processing.

We are focussing on “mean in neighbourhood”, although we do use “max in neighbourhood” in IMPROVER too.

Schwartz, C. S. and Sobash, R. A. (2017) *Monthly Weather Review*, 145(9), pp. 3397–3418

Neighbourhood processing.

Why neighbourhood process?

- Take into account spatial uncertainty
- Provide spread for deterministic models
- Increase spread for ensemble models
- Provides smoother probability fields for blending

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Neighbourhood processing.

What have other people done?

- Lots of people have applied neighbourhood processing to precipitation fields
  - e.g Schwartz and Sobash, 2017; Ben Bouallègue and Theis, 2014; Theis, Hense and Damrath, 2005;
- A few have tried other variables with mixed results
  - e.g. Schwartz and Sobash, 2017

Ben Bouallègue, Z. and Theis, S. E. (2014) *Meteorological Applications*, 21(4), pp. 922–929
Ben Bouallègue, Z., Theis, S. E. and Gebhardt, C. (2013) *Meteorologische Zeitschrift*, 22(1), pp. 49–59
Schwartz, C. S. and Sobash, R. A. (2017) *Monthly Weather Review*, 145(9), pp. 3397–3418.
Theis, S. E., Hense, A. and Damrath, U. (2005) *Meteorological Applications*, 12(3), pp. 257–268.

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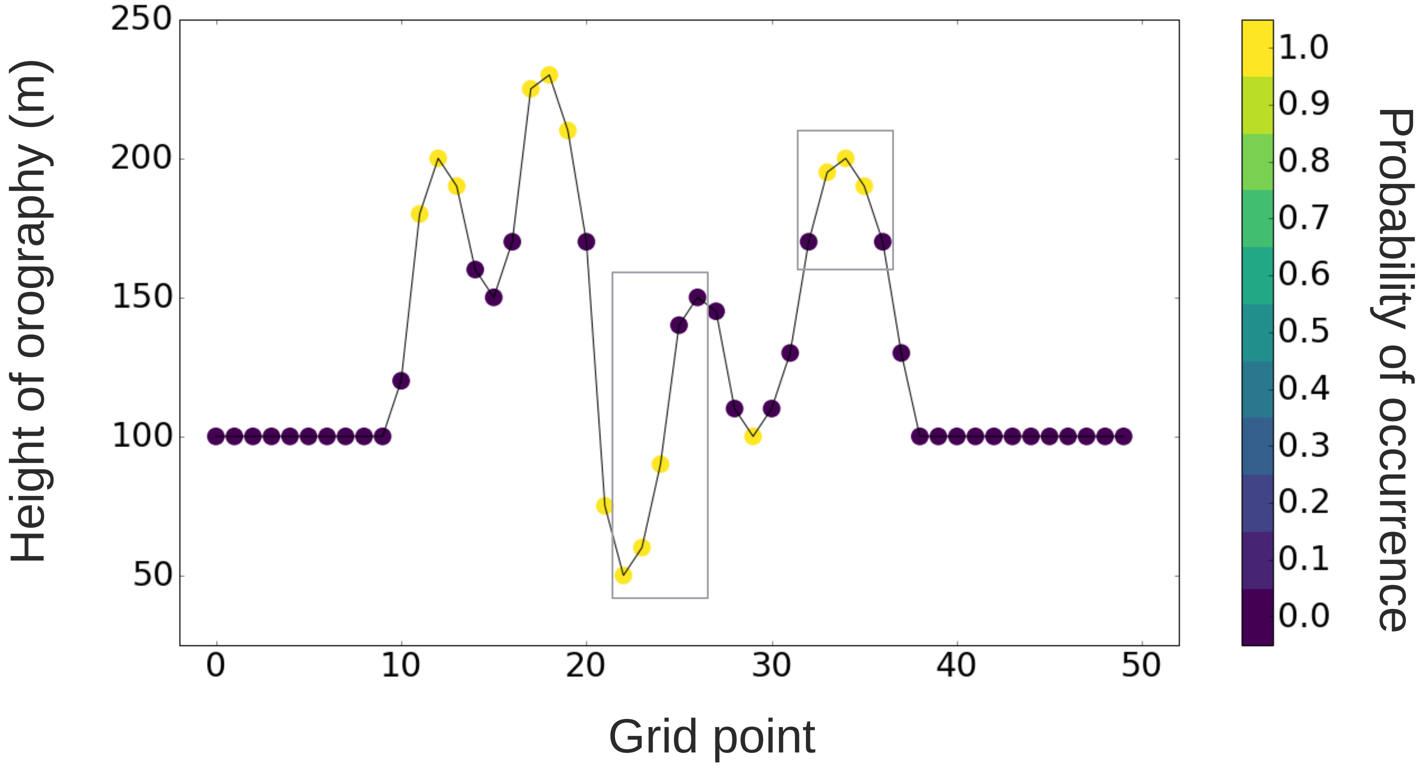
Do we need a more advanced method of neighbourhood processing for diagnostics that depend strongly on altitude?

e.g. Temperature, visibility, wind speed

Topographic neighbourhood processing algorithm

1D simple example

Original probabilities



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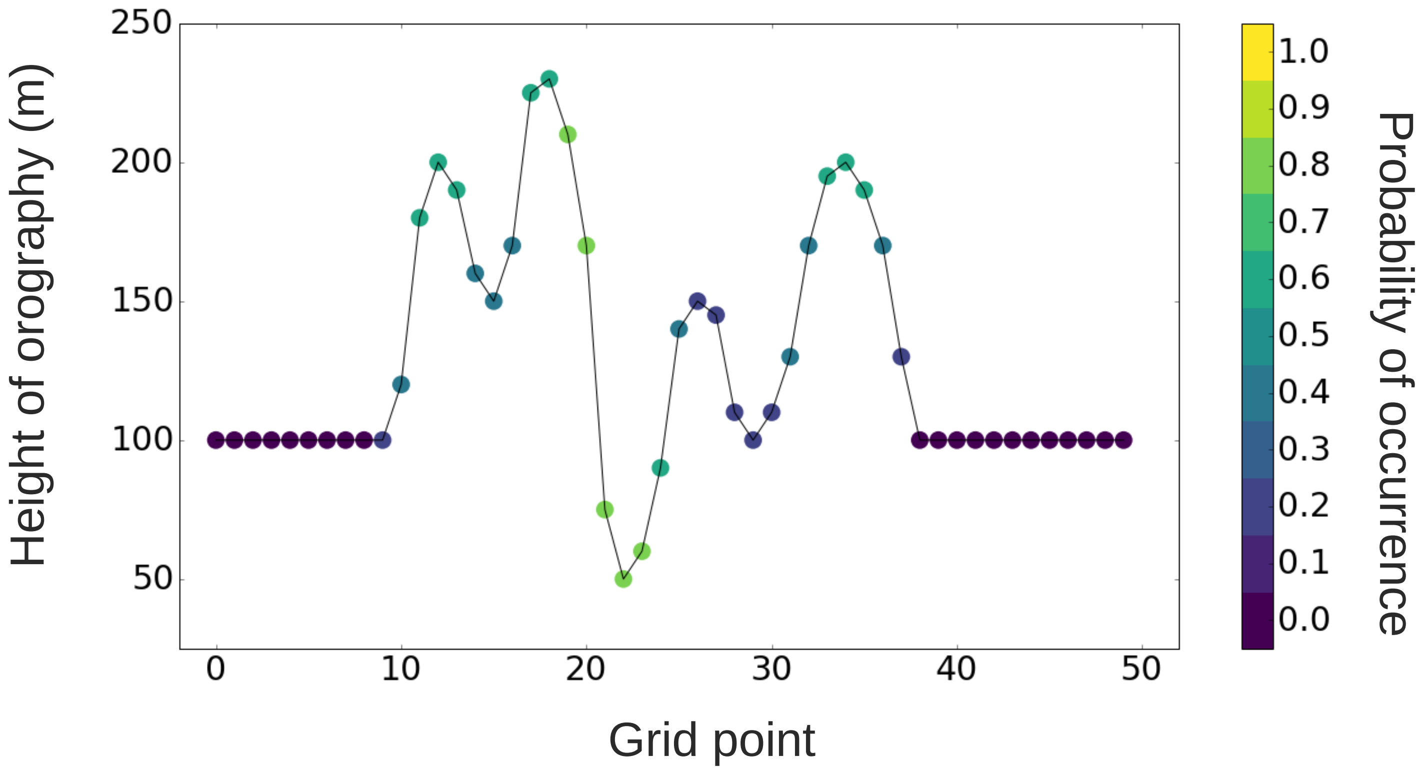
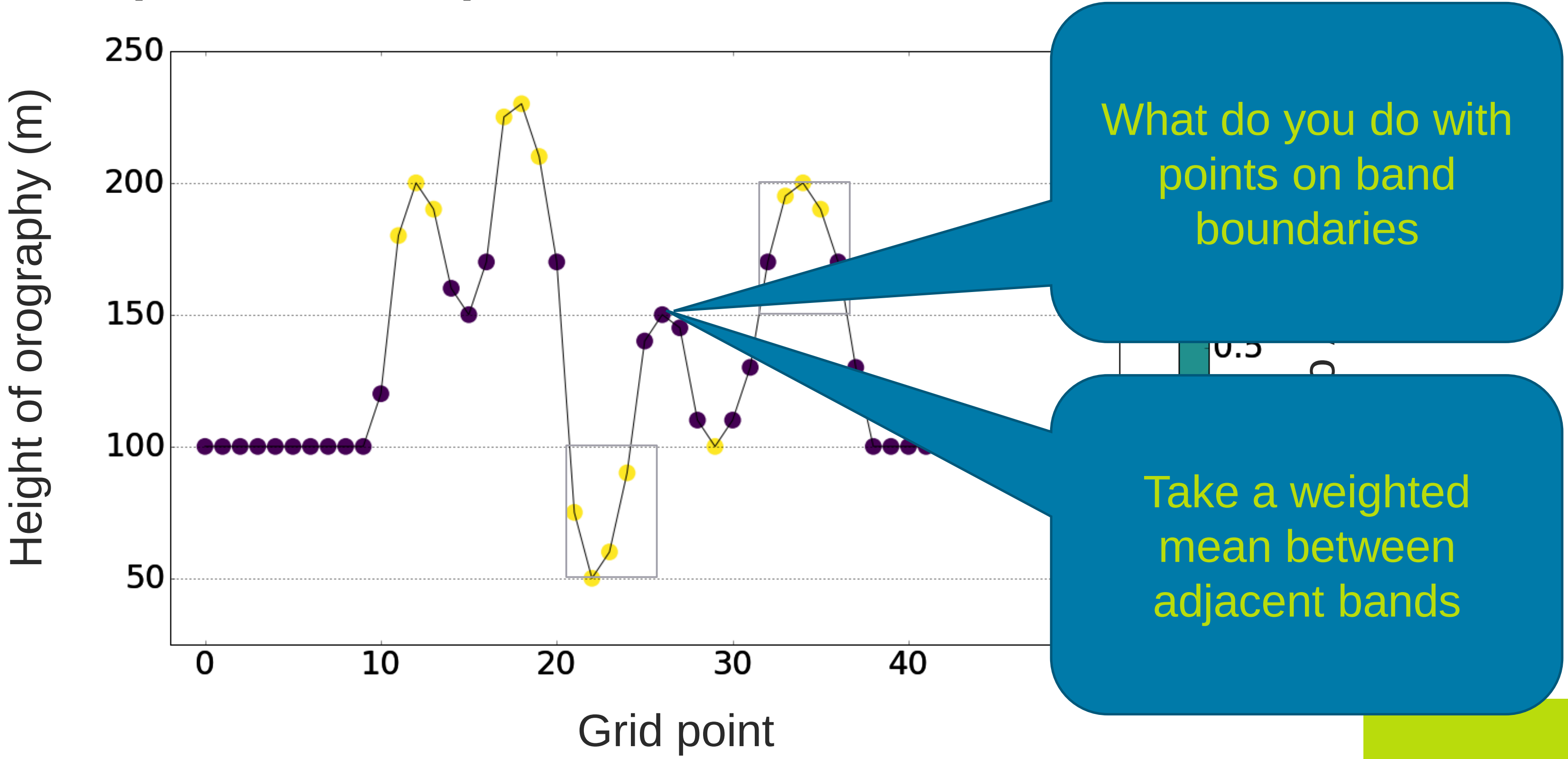
1D simple example

Normal neighbourhood processing



1D simple example

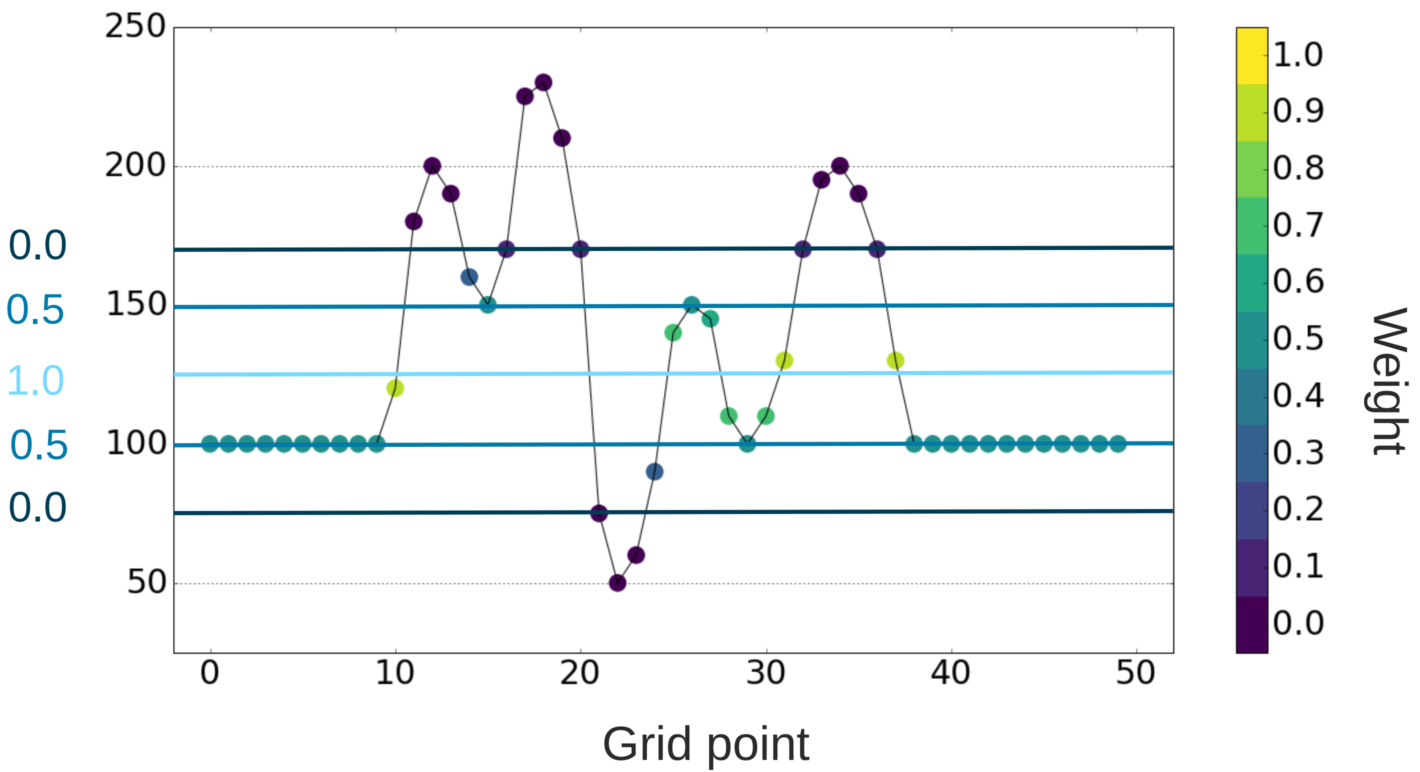
Use topographic bands to choose which points to neighbourhood



1D simple example

Weighting between bands
Orographic dependent weights

Band 100-150m



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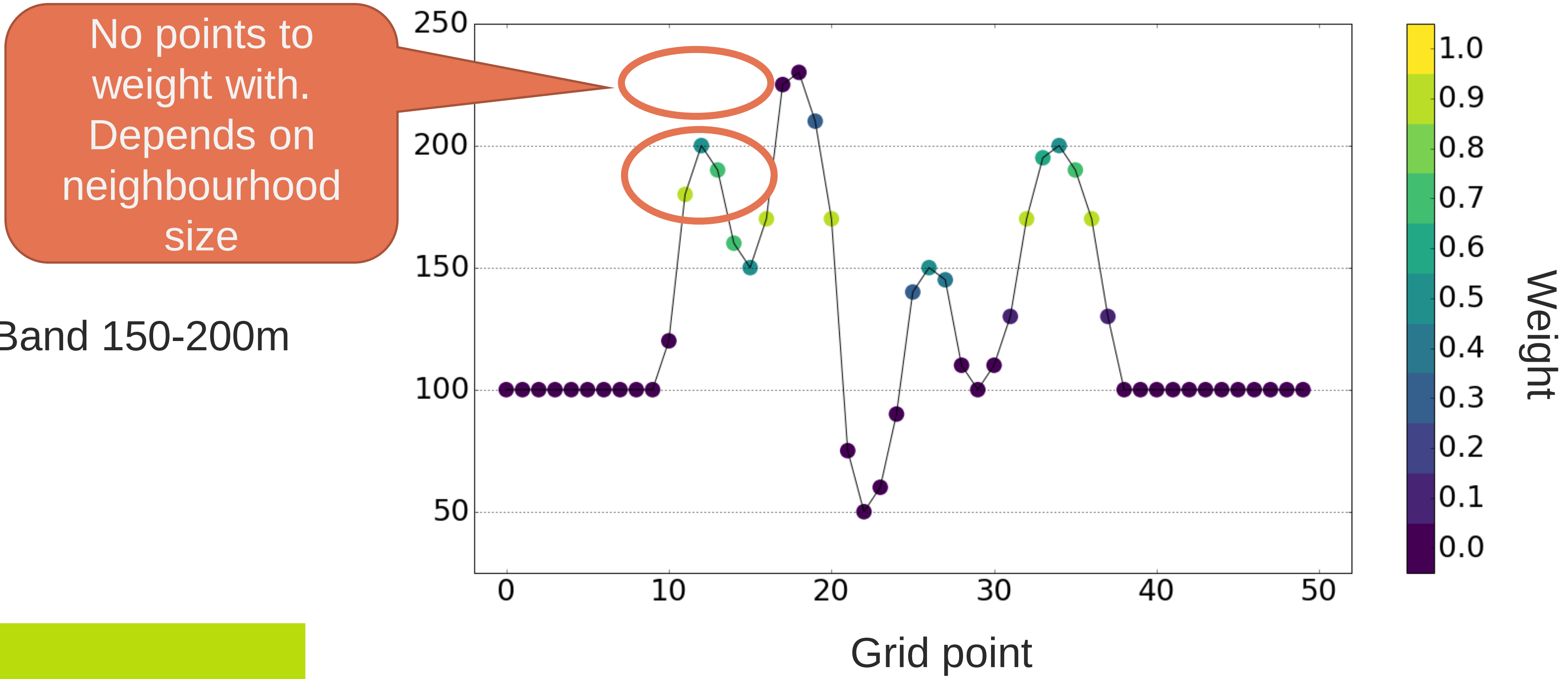
1D simple example

Weighting between bands
Orographic dependent weights

Band 150-200m



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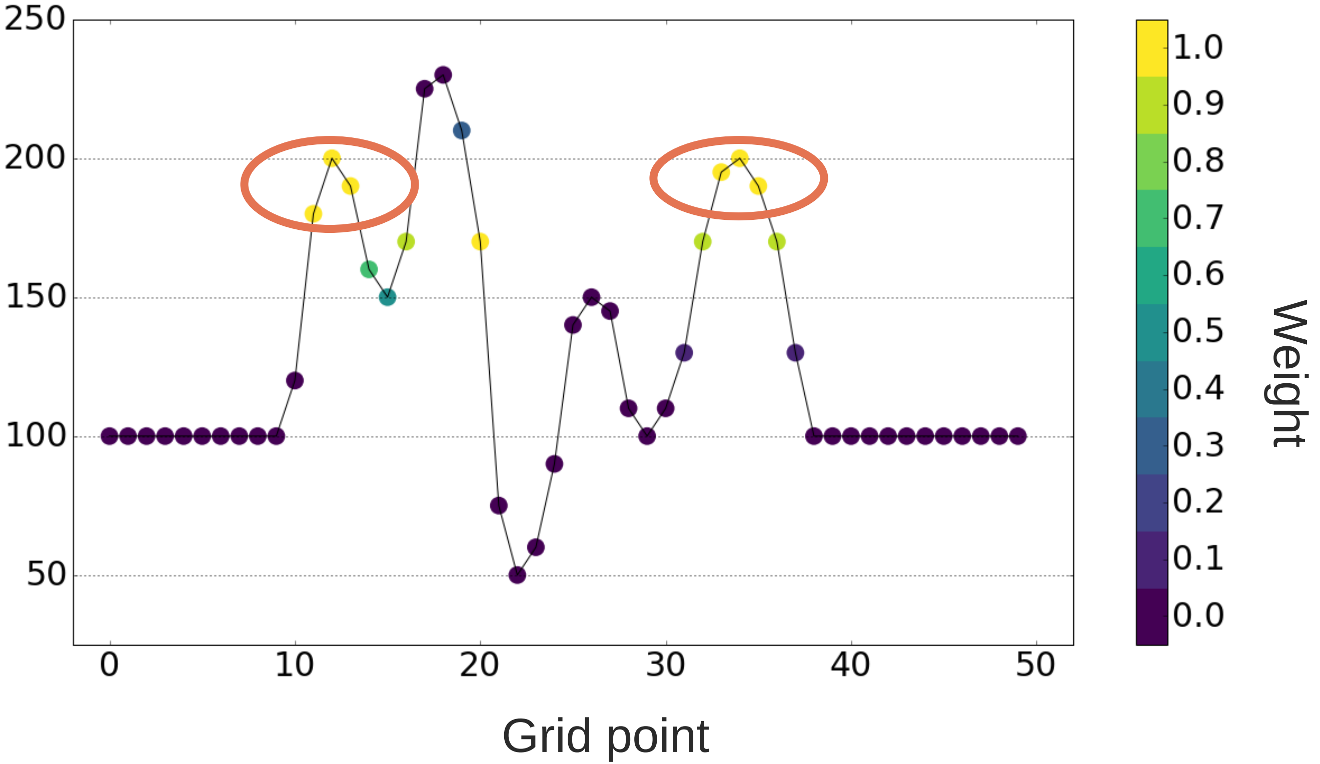
1D simple example

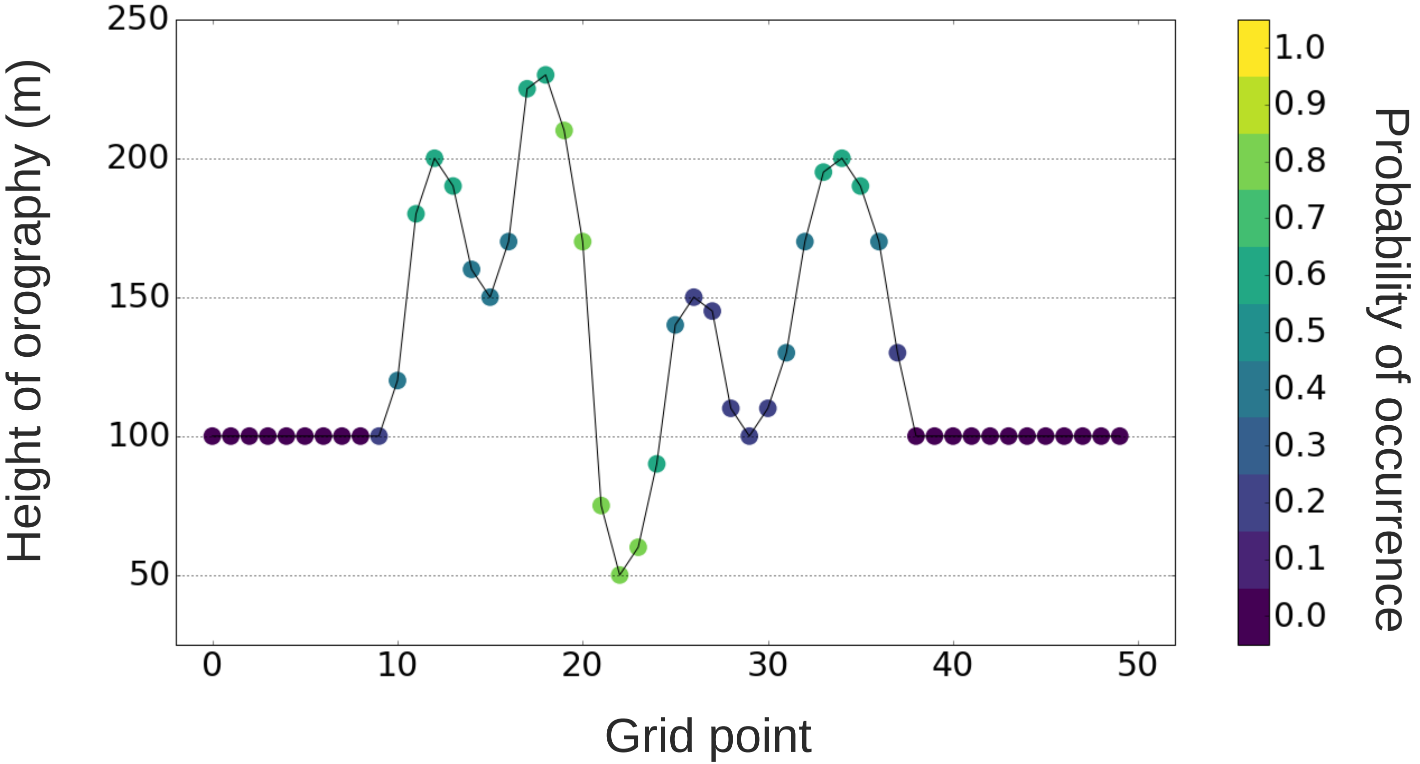
Weighting between bands
Orographic dependent weights

Band 150-200m
Recalculated weights

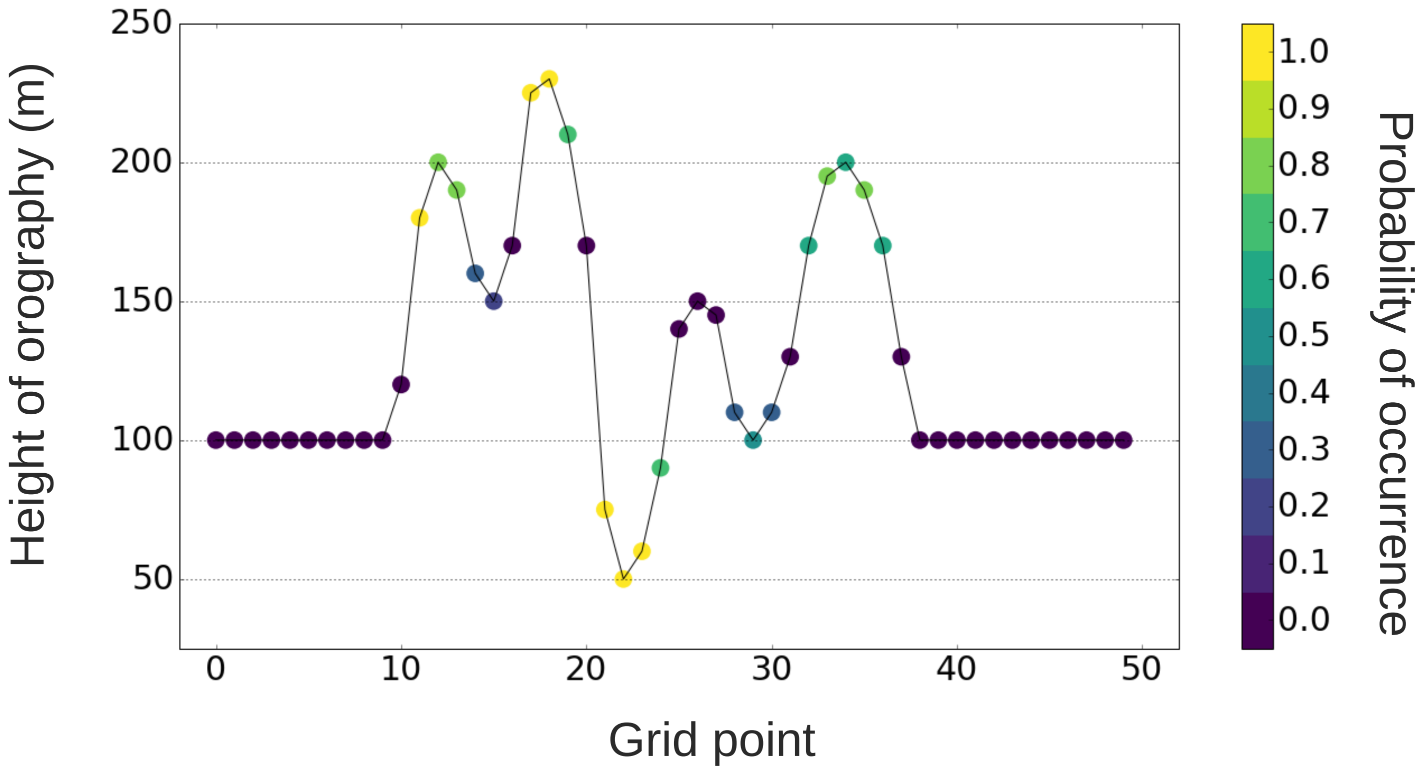


1D simple example

Normal neighbourhood processing



1D simple example



Mogreps-UK probability that air temperature > 11°C

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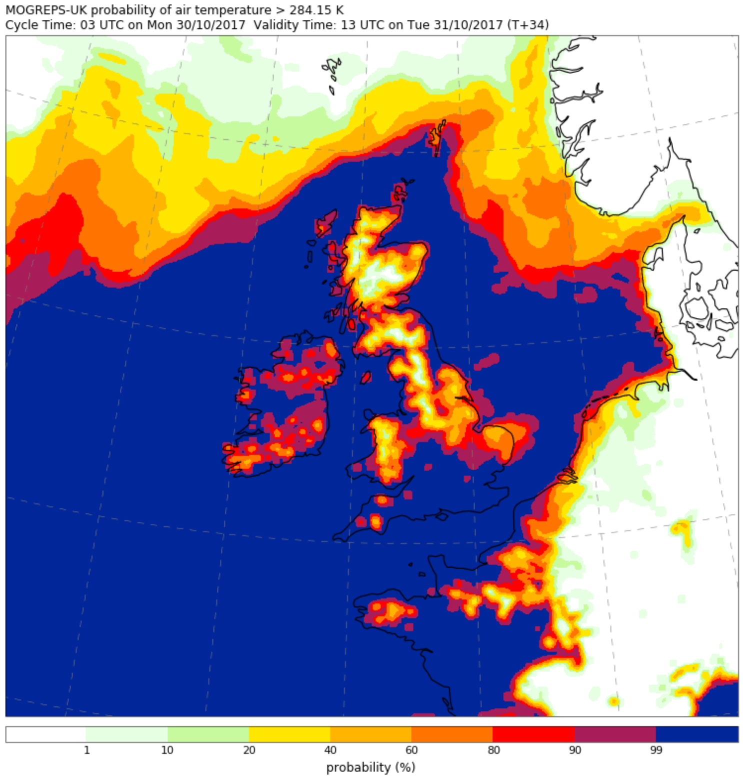
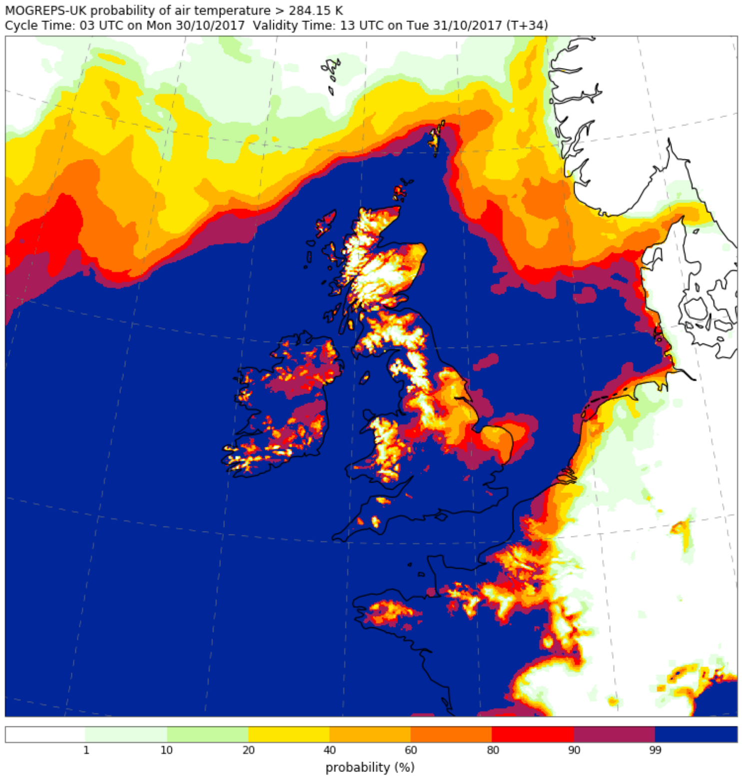
Normal neighbourhood processing



Topographic neighbourhood processing



Results

How should we use this functionality?

- What neighbourhood sizes do we use?
  - For different models?
  - Throughout the forecast?
- Which variables should we apply it to?
- How do we structure our bands?

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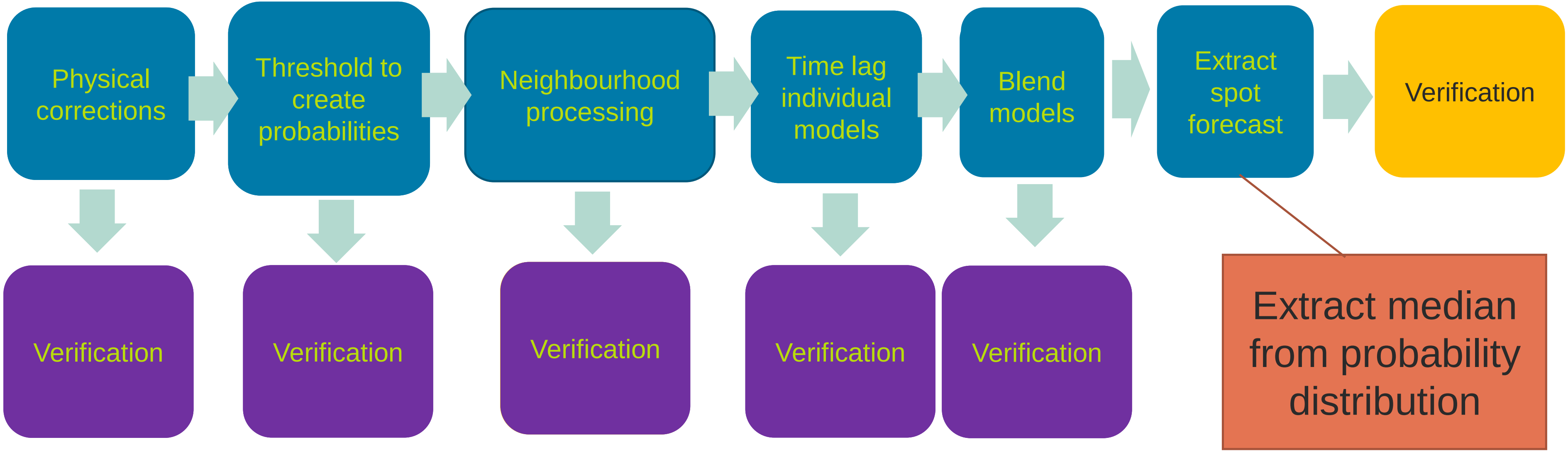
How do we do **end of chain** verification?

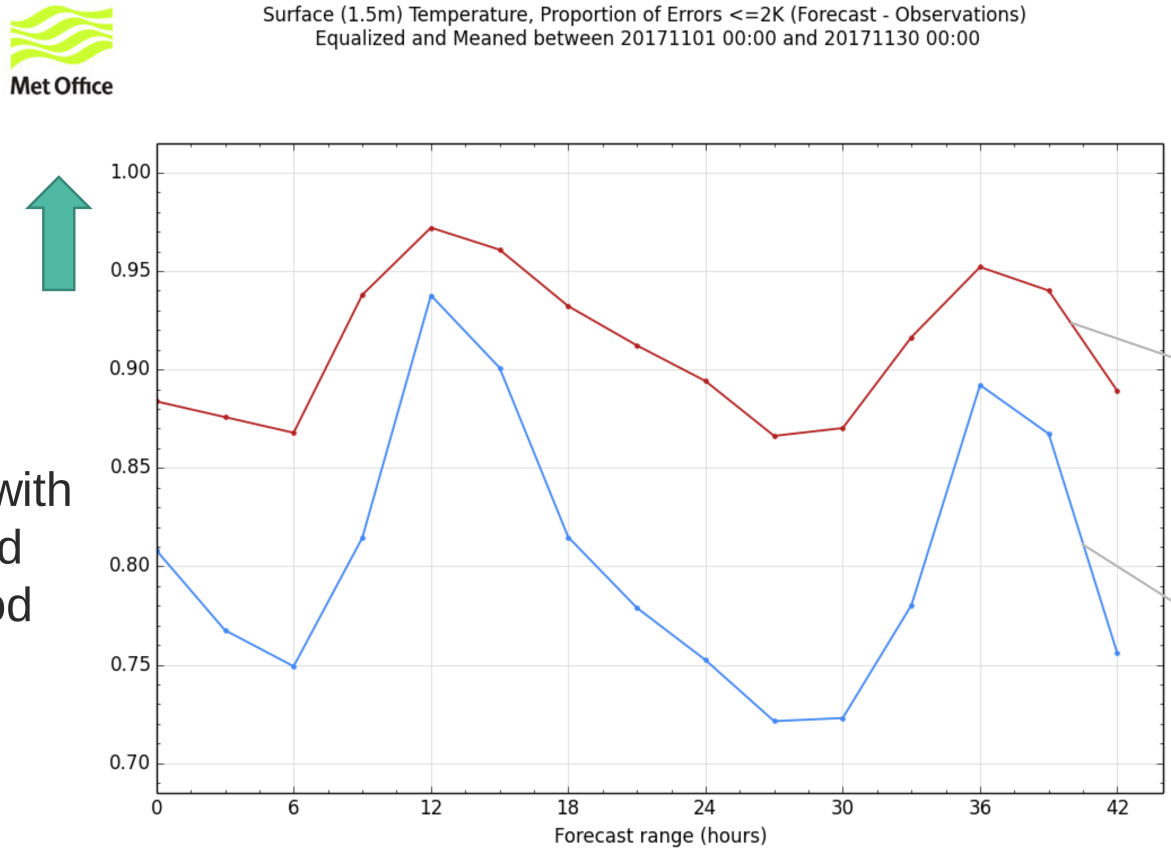
One month trial November 2017



Temperature verification

Higher is better

First set of experiments with large un-tuned neighbourhood sizes

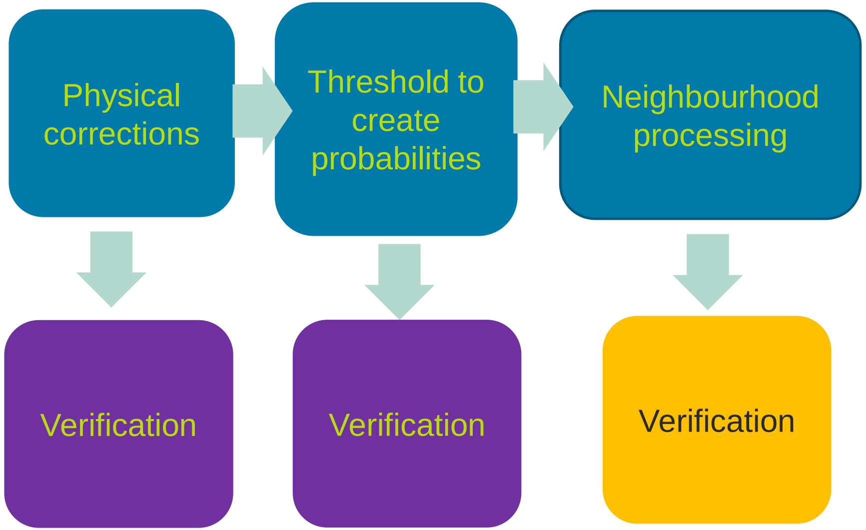


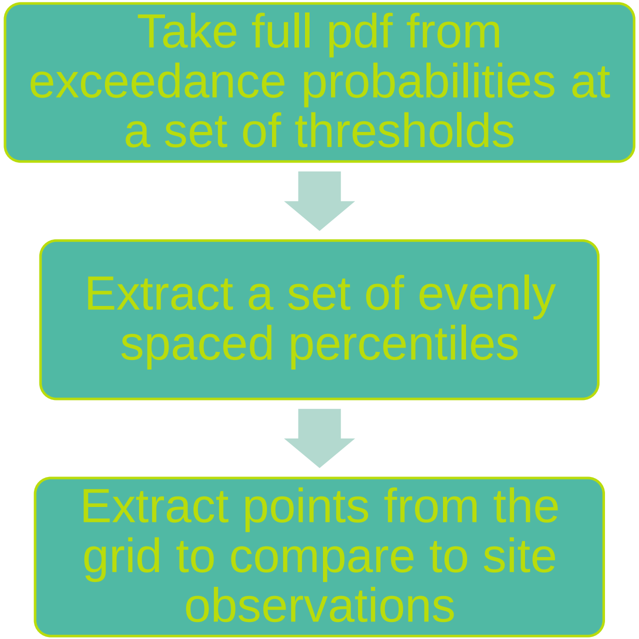
Topographic neighbourhood processing

Non-topographic neighbourhood processing

How do we do **ensemble** verification?

One month trial November 2017





How does it verify?

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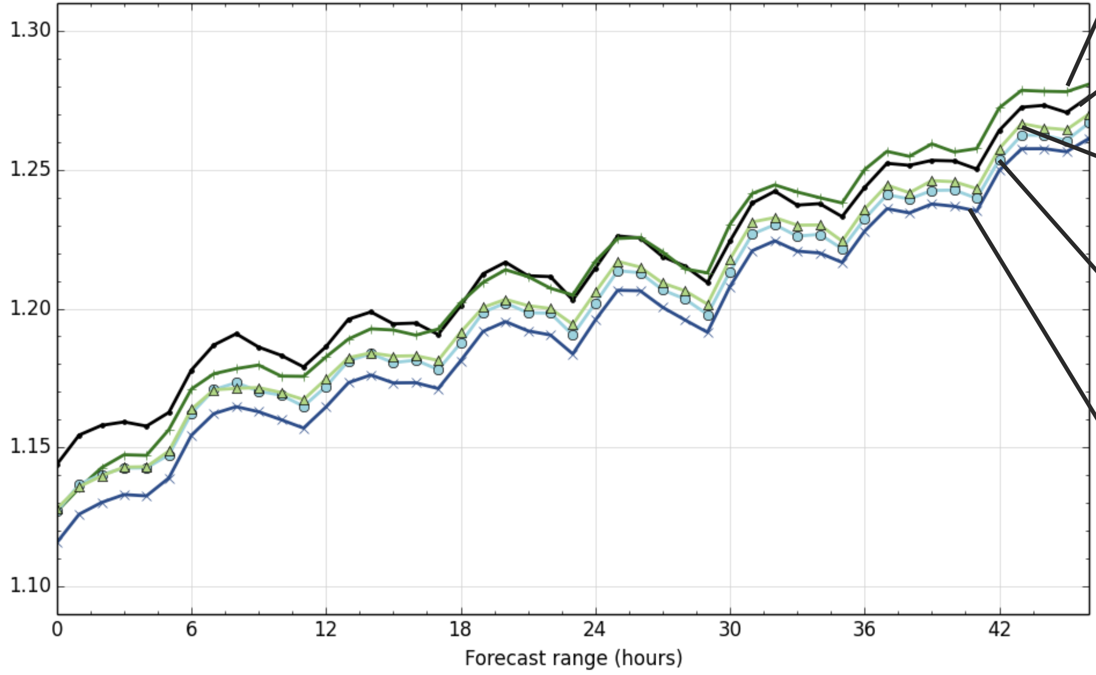
10m wind speed (m/s)
Continuous Rank Probability Score
Mogreps-UK (UK ensemble)



Lower is better

Non-Topographic neighbourhood 6km

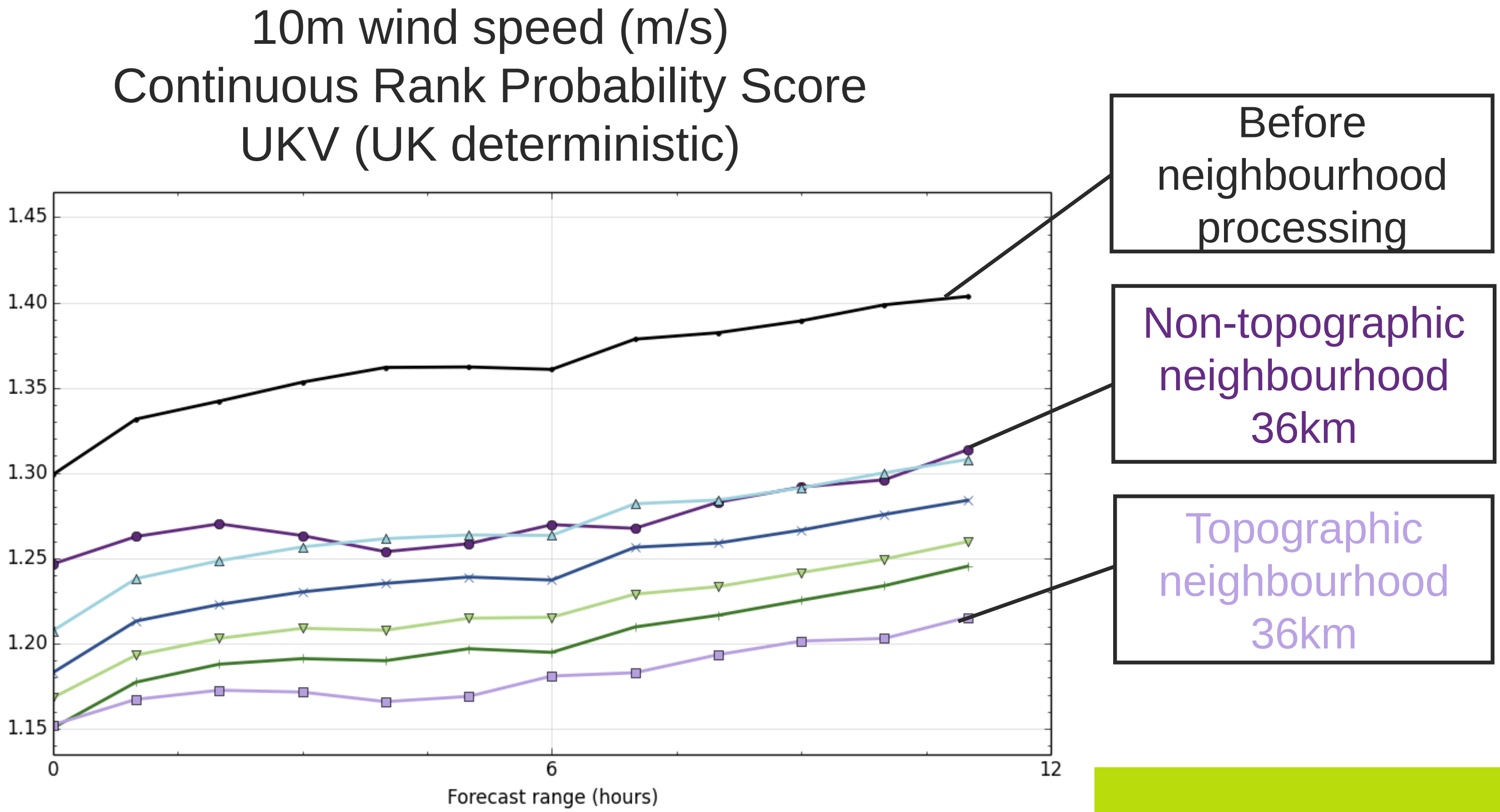
Before neighbourhood processing

Topographic neighbourhood 6km

Topographic neighbourhood 3km

Non-Topographic neighbourhood 3km

How does it verify?



Lower is better

Improvements – What we want to do next

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Next set of experiments

- Test with ensemble calibration and physical downscaling
- Use a subset of mountain stations
- Keep tuning our verification system
- Different band structures
- Other types of masking
- Longer trials and a summer trial

Summary

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Summary

- How we are starting to tune our new IMPROVER system
- A new topographic neighbourhooding algorithm
- Some initial results, showing mixed behaviour, but some positive results on the UK deterministic model
- Some ideas of where we may go next.

Questions?

For more information please contact

www.metoffice.gov.uk

fiona.rust@metoffice.gov.uk

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References

Ben Bouallègue, Z. and Theis, S. E. (2014) ‘Spatial techniques applied to precipitation ensemble forecasts: From verification results to probabilistic products’, *Meteorological Applications*, 21(4), pp. 922–929. doi: 10.1002/met.1435.

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