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Exploring the impact of neighbourhood size and height stratification in neighbourhood-based methods using single-site observations

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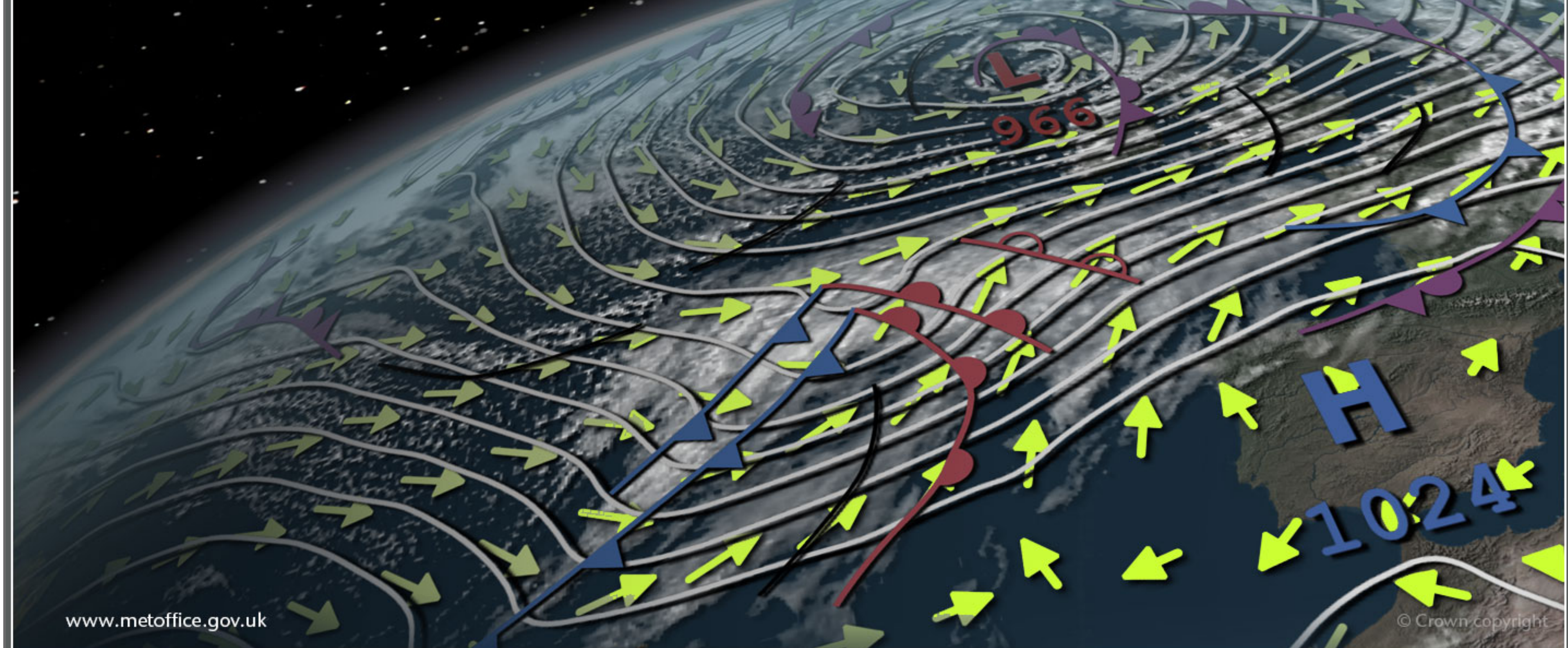
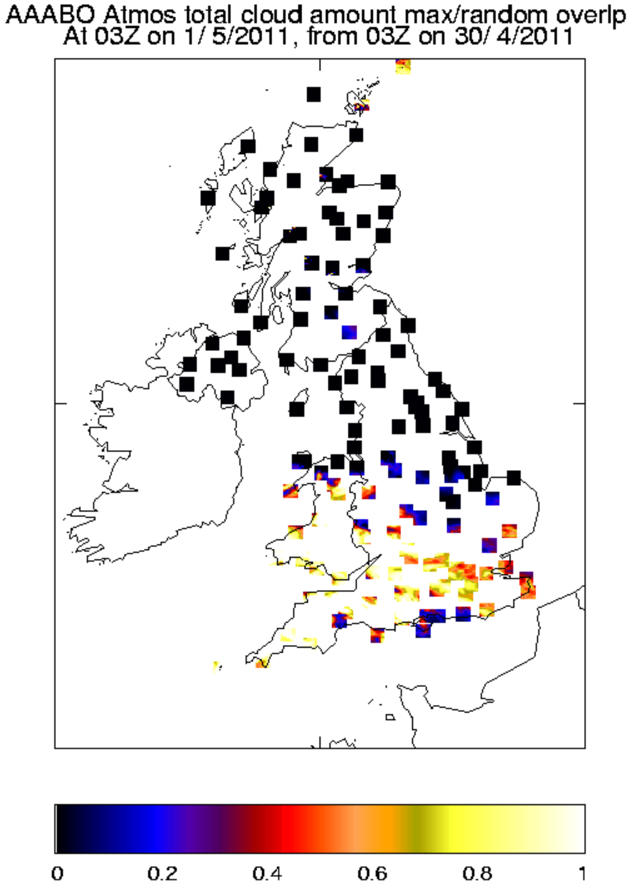
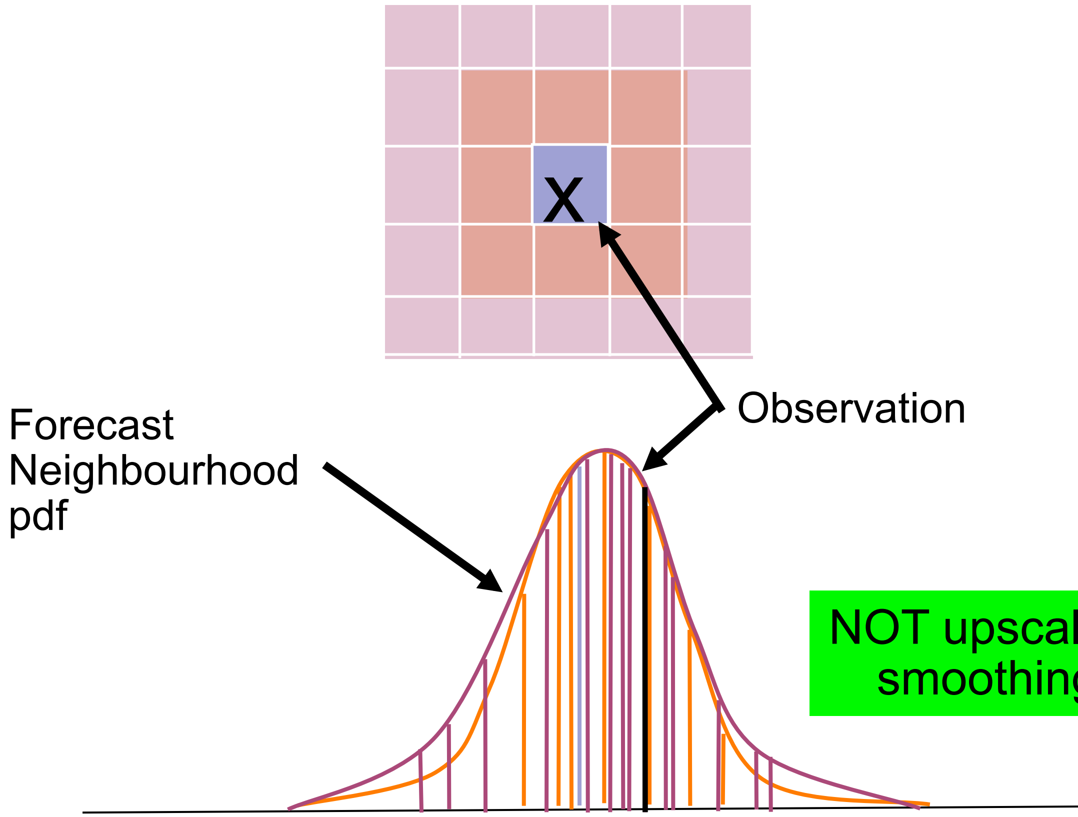


Spatial sampling

- Make use of spatial verification methods which compare **single observations** to a **forecast neighbourhood around the observation location**. → **SO-NF**

17 x 17





NOT upscaling/ smoothing!

Only ~130 1.5 km grid points in >500 000 domain used to assess entire forecast!
Note the variability in the neighbourhoods.

High Resolution Assessment framework*

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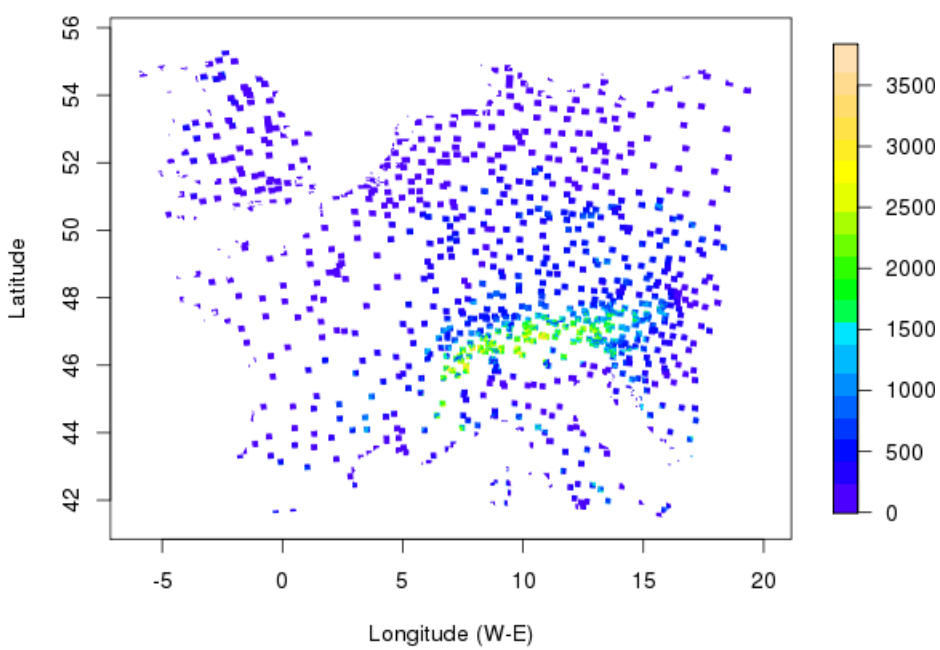
- How to **consistently demonstrate skill** in increasingly higher-resolution models?
- **Single-observation-neighbourhood-forecast** approach (SO-NF).
- Verifying at observing sites is **relevant to the user.**
- Based on the **premise that every grid square forecast is equi-probable** at the observing site.
- Key perceived shortcoming is that the method is "ignorant" of whether grid squares in the neighbourhood are **land or sea** and **checking the impact of including grid squares at different heights.**

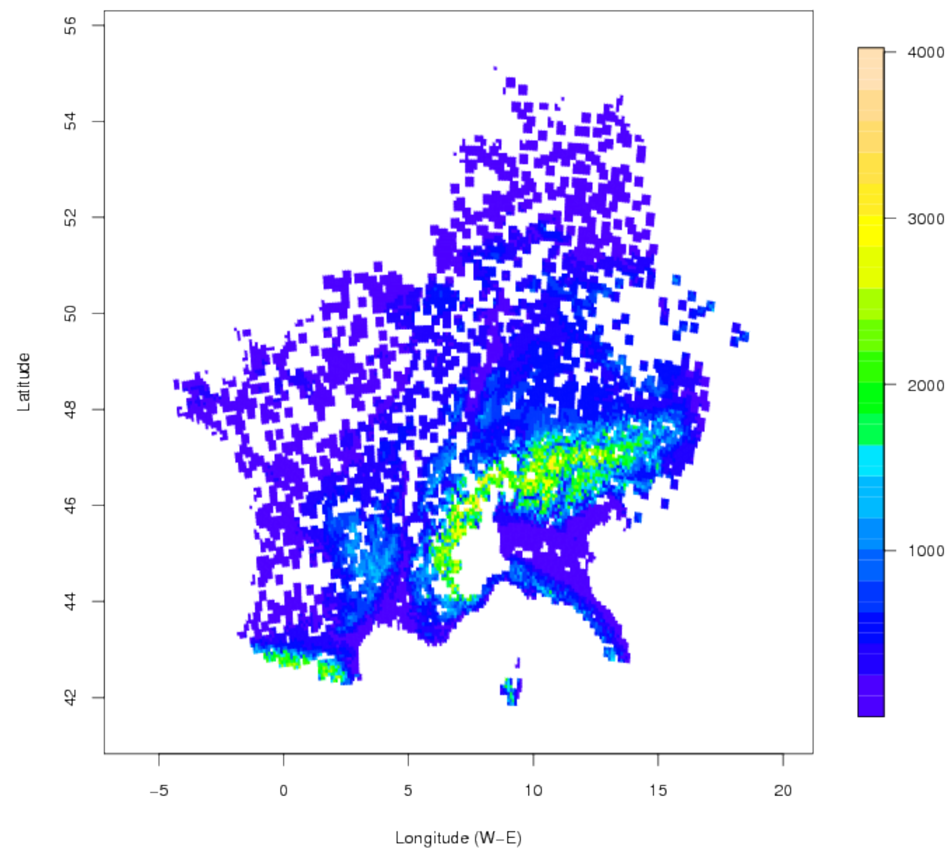
*Mittermaier M.P., 2014: A Strategy for Verifying Near-Convection-Resolving Model Forecasts at Observing Sites. Wea. Forecasting, 29, 185–204.

Neighbourhood heights (m) (3 x 3 @ 8 km)

GTS



Non-GTS



Analysis procedure

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- Compare interpolated model neighbourhoods on 8 km grid to observations.
- Case 1 for COSMO2 and CMC-GEM-H.

- Investigate impact of reducing within-neighbourhood height fluctuations.
- Investigate impact of neighbourhood size (2 sizes → 3 x 3 and 5 x 5).

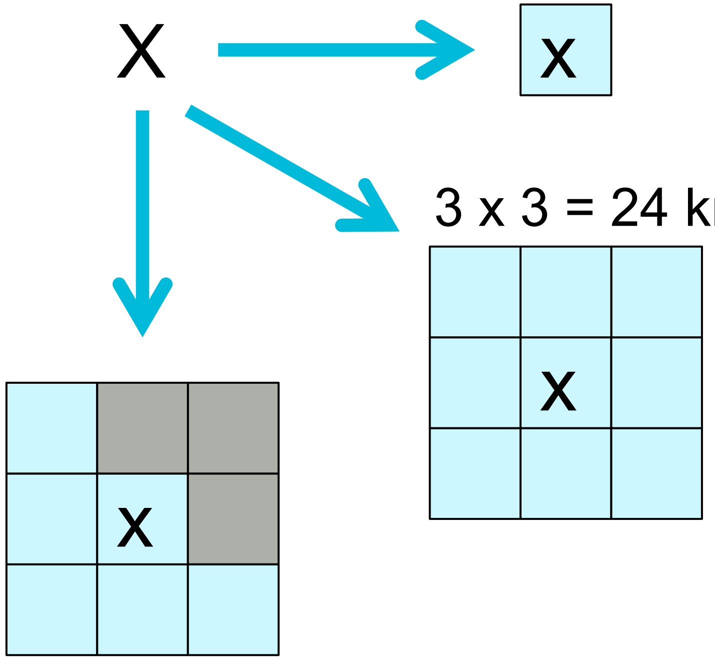
- Five thresholds for hourly precipitation: 0.5, 1, 2, 4 and 8 mm/h
- Calculate BS for each site for all lead times in case 1.

Analysis procedure 2

Obs location

Nearest 8 km fcst grid square

3 x 3 = 24 km^2 fcst neighbourhood



3 x 3 = 24 km^2 fcst neighbourhood minus grid squares outside height tolerance

[Grid squares need to be within 10% of Nearest grid square height.]

$$BS = \frac{1}{N}\sum_{i=1}^{N}(p_i - o_i)^2$$

p_i = forecast probability
o_i = observed occurrence (0 or 1)

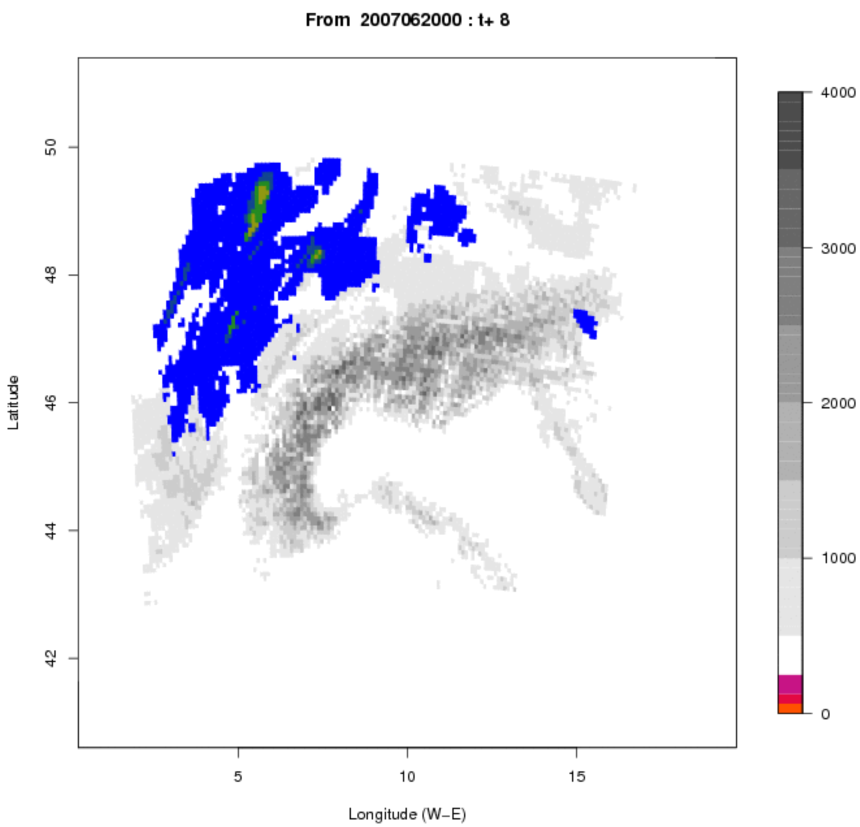
Perfect score = 0

$$BS_{alt} = \frac{1}{N^*}\sum_{i=1}^{N}(p_i - o_i)^2$$

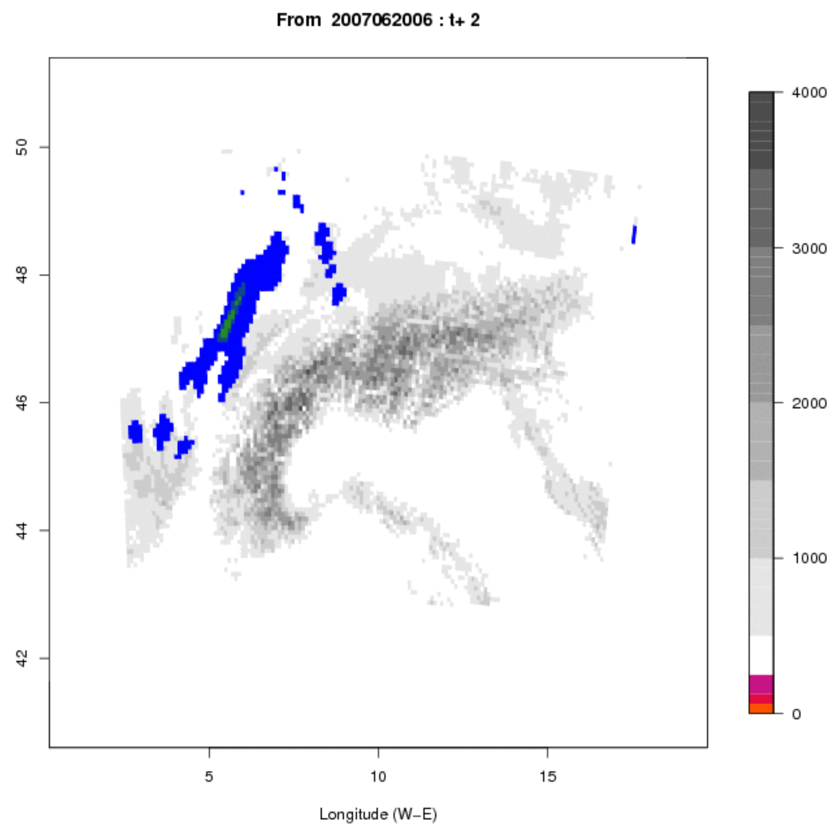
Where N*= obs > 0 & fcst > 0

Case 1: 20-22 June 2007

COSMO2



CMC-GEM-H

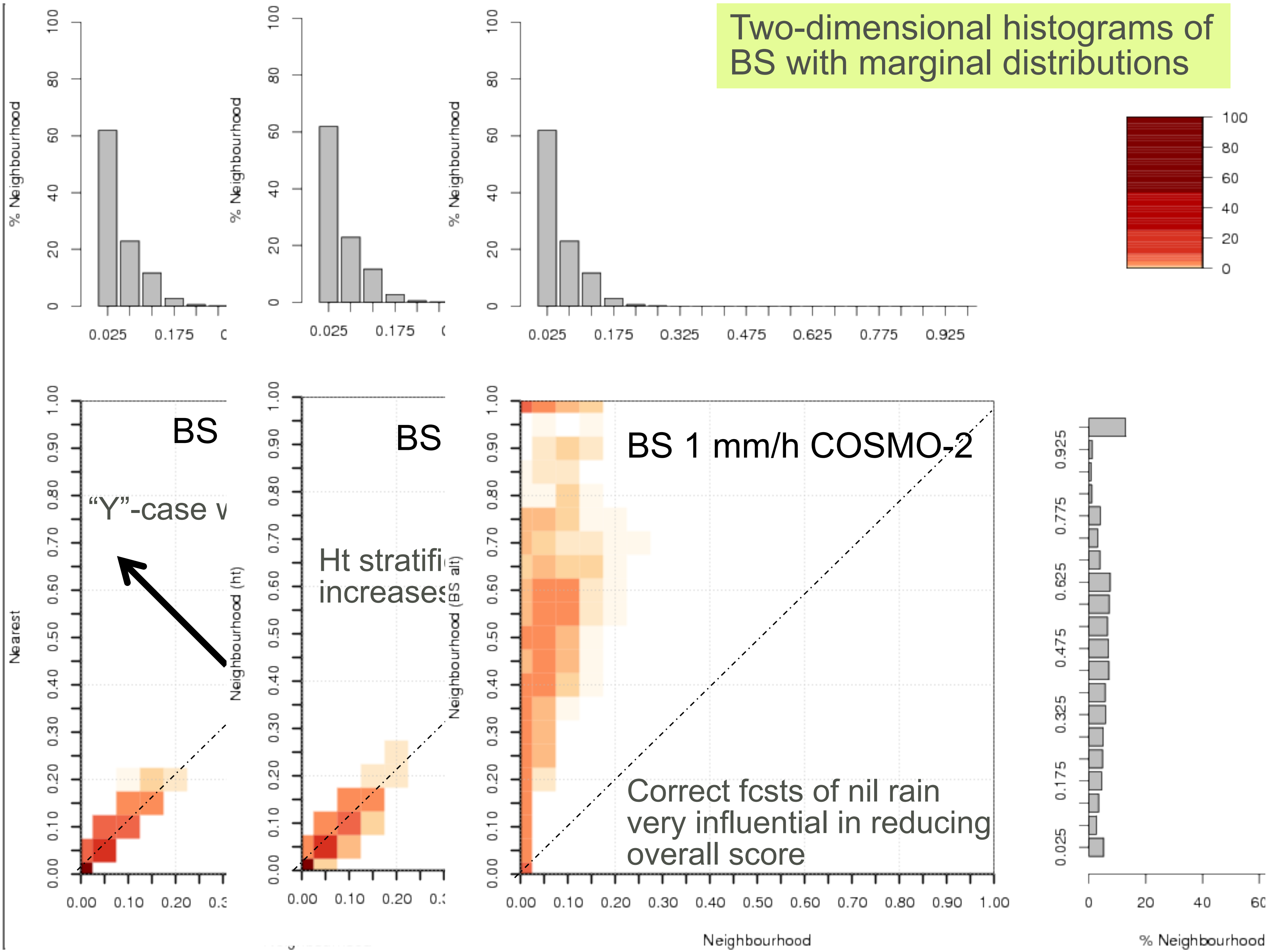


CO2 initialised at 00Z
t+7->t+24h

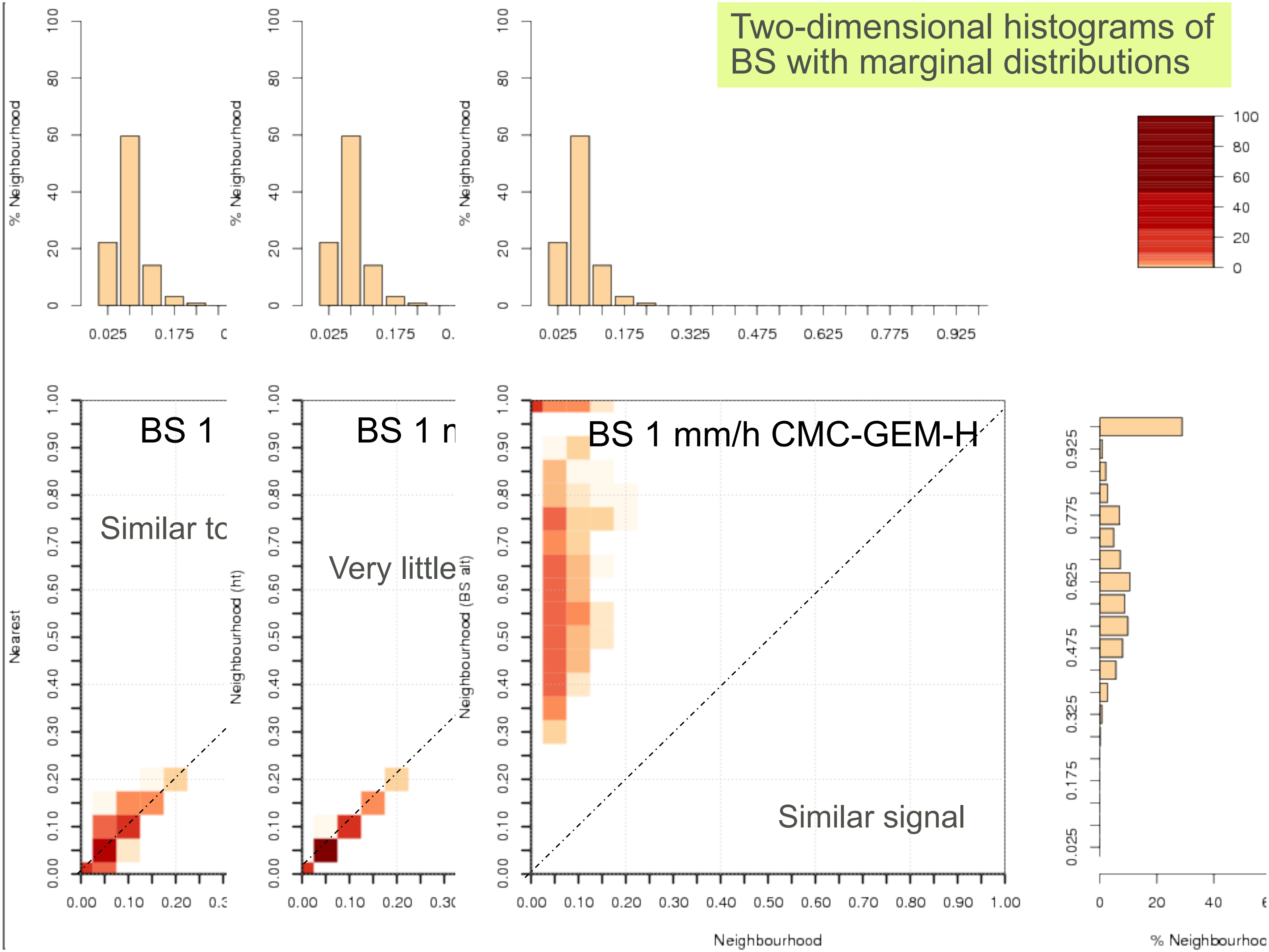
In grey height above 500 m

CMC initialised at 06Z
t+1->t+18h

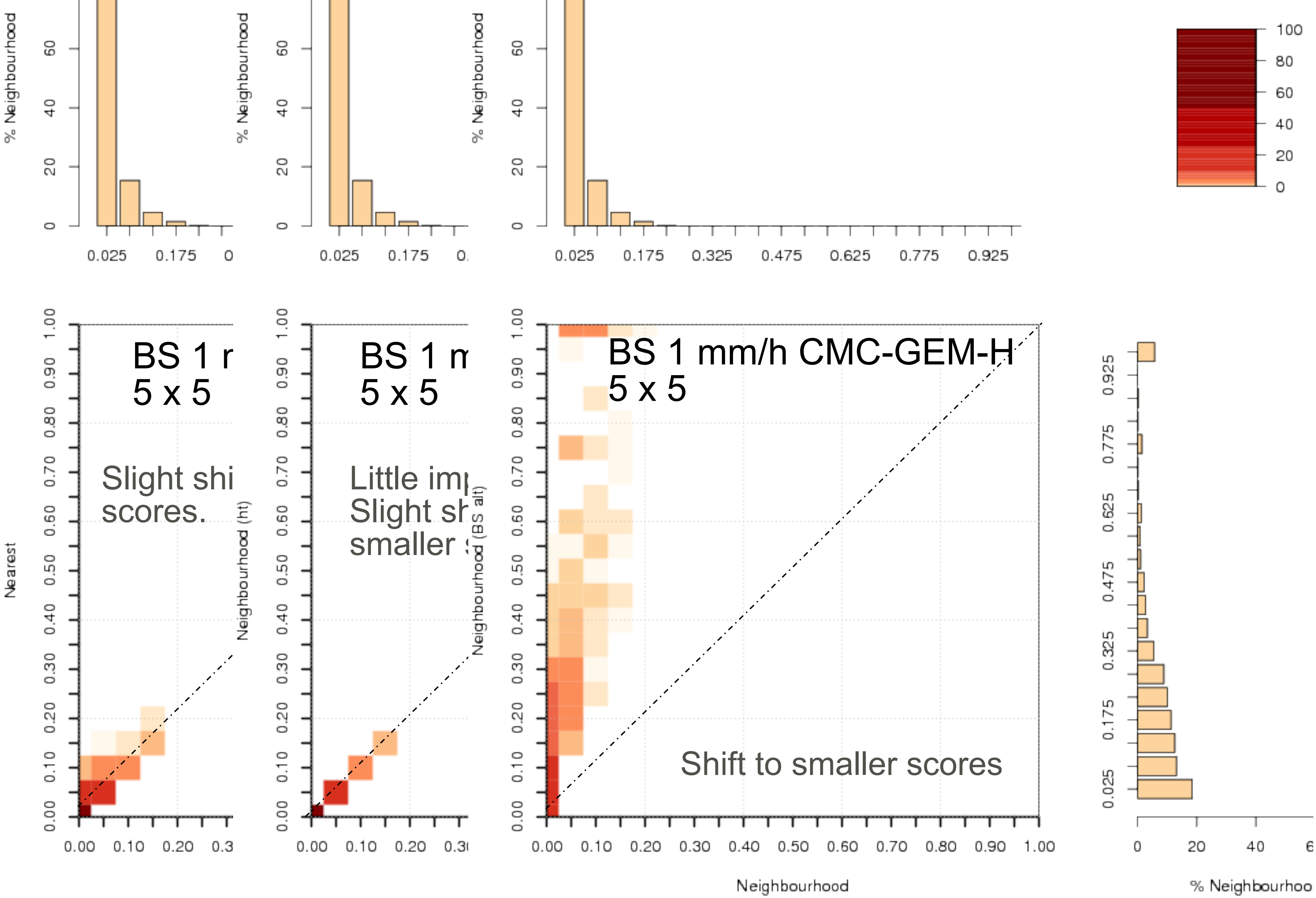
Two-dimensional histograms of BS with marginal distributions



Two-dimensional histograms of BS with marginal distributions



Two-dimensional histograms of BS with marginal distributions



Preliminary conclusions

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- Only exploratory results so far.

- A **3 x 3 neighbourhood may be too small** if some of the grid squares are lost because of greater than 10% height differences.
- **Use of N* is potentially controversial** but it shows the level of credit models receive for correctly forecasting "trivial" events.
- The **presence of correct forecasts of zero precipitation appears to have more impact** than the exclusion of grid squares with more than 10% height difference.
- Using a **larger neighbourhood does improve the accuracy of the forecast** (lower scores).
- This approach is probably best applied to the raw model grid rather than at 8 km grid, though the VERA grid enables other aspects of the study yet to be explored, e.g. uncertainty.

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Questions?