



Verification of area-based probabilistic first-guess severe weather warnings from MOGREPS

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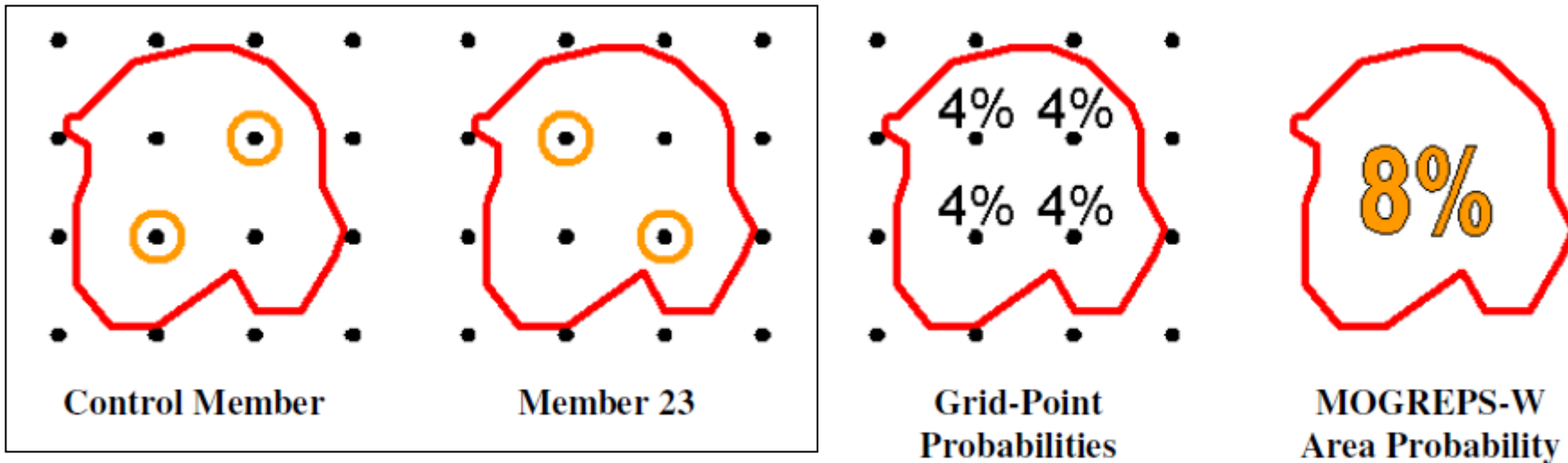
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Introduction to MOGREPS-W Area Probability Calculations

For this county, assume only 2 members (out of 24) contain one or more grid-points which exceed the parameter threshold (e.g. 70mph Gusts)



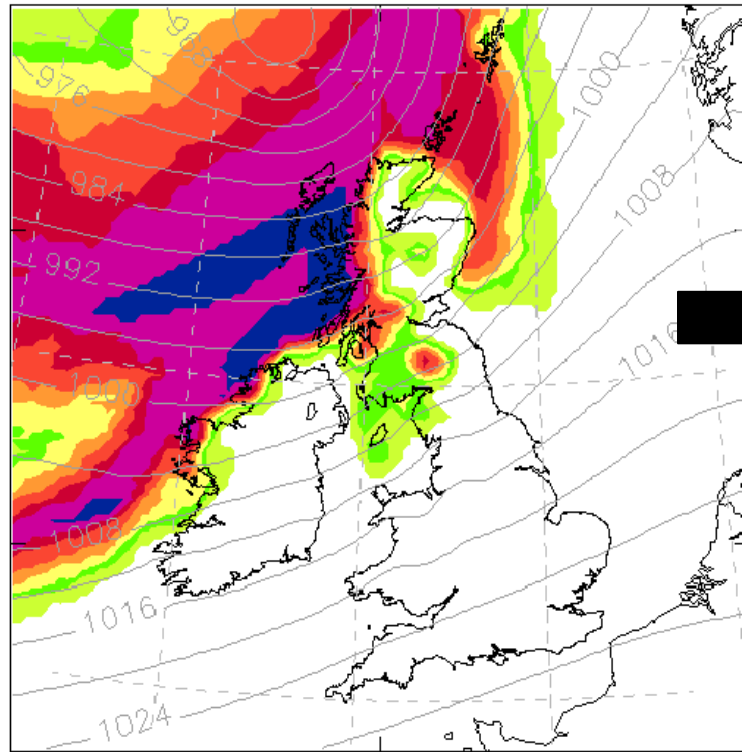
→ 2 out of 24 members exceed the parameter threshold at one or more grid-points (~ 8% area probability)



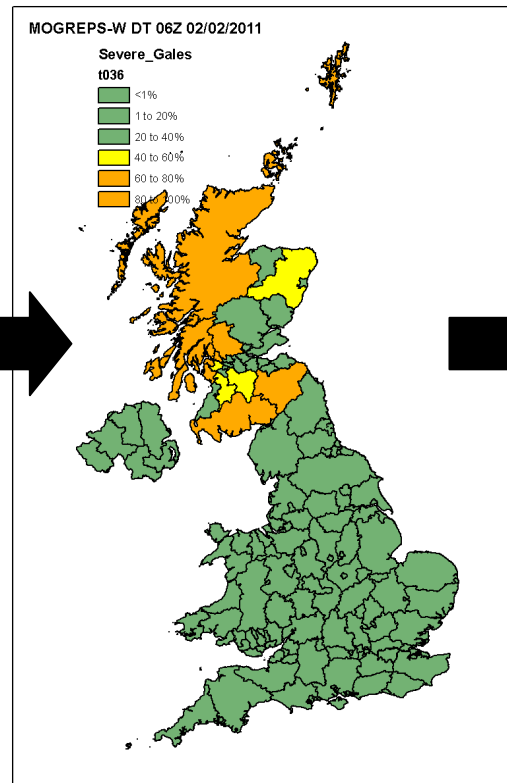
Introduction to MOGREPS-W

Severe Gales: 3rd February 2011

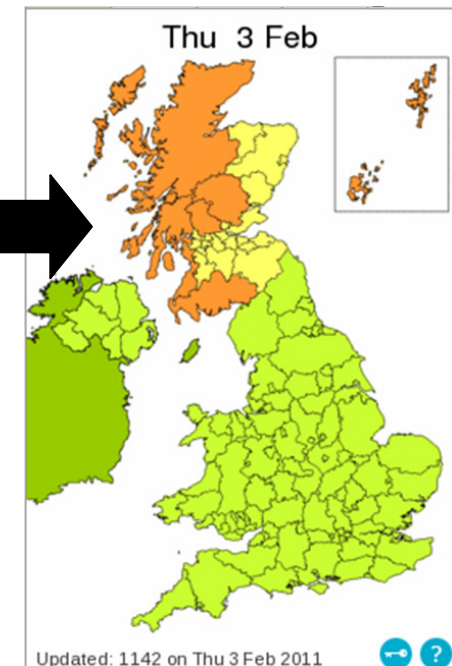
DT: 06Z WED 02/02/2011 VT: 18Z THU 03/02/2011



MOGREPS-R Grid-Point Probs (≥ 70mph)



MOGREPS-W Probability Severe Wind Gusts (≥ 70mph)



Forecaster Issued Warnings of Severe Wind Gusts (≥ 70mph)





Verification Setup

- Verified against Met Office 2km UK Post-Processing (UKPP) analysis.
- Event observed in a county if $\geq 1\%$ of the UKPP grid-points exceed the parameter threshold.
- Lower parameter thresholds have been used in an attempt to increase the number of forecast and observed events.
- Forecasts verified according to 4 forecast periods...

Forecast Period	Description
Period 0 (P0)	T+09h to T+54h (16 forecast lead times) - P1 to P4
Period 1 (P1)	T+09h to T+18h (4 forecast lead times)
Period 2 (P2)	T+21h to T+30h (4 forecast lead times)
Period 3 (P3)	T+33h to T+42h (4 forecast lead times)
Period 4 (P4)	T+45h to T+54h (4 forecast lead times)



How does county size affect forecast accuracy?

- Considering the MOGREPS-W area probability definition* and verification methodology**, there should be little difference in forecast accuracy between large and small counties, assuming the model has good spatial accuracy.
- To test this assumption, three groups of counties (large, medium and small) have been verified individually.

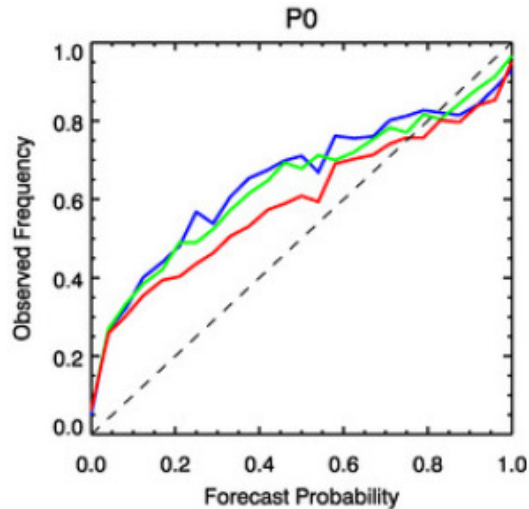
* Probability that the event will occur at any model grid-point within the county area

** An event occurs within a county if it is observed in $\geq 1\%$ of the UKPP grid-points



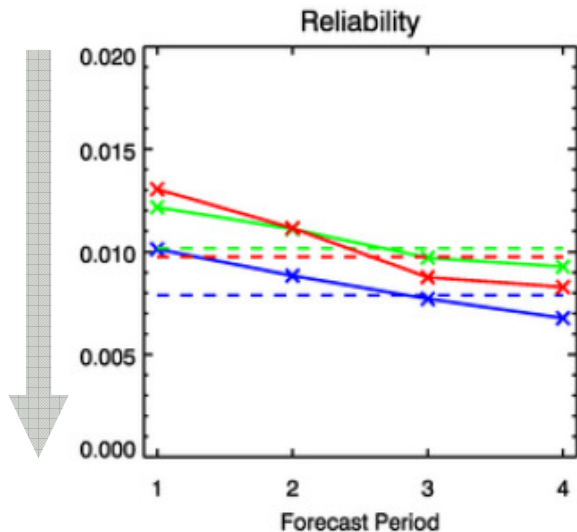
Reliability

Max. 3hr wind gust $\geq 40\text{mph}$
 Sept – Dec 2010



- All county size groups under-forecast
- Large counties have the best reliability for probabilities between 20 and 80%

$$REL = \frac{1}{N} \sum_{i=1}^I n_i (f_i - o_i)^2$$



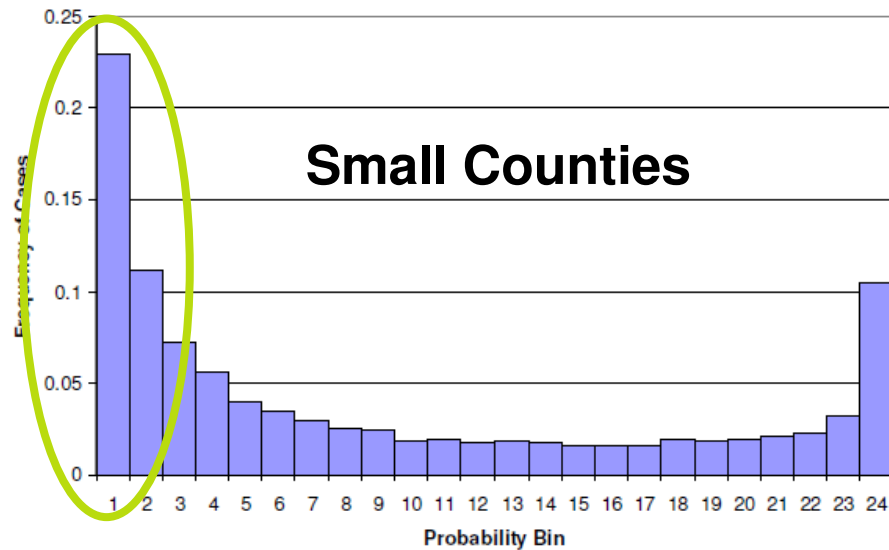
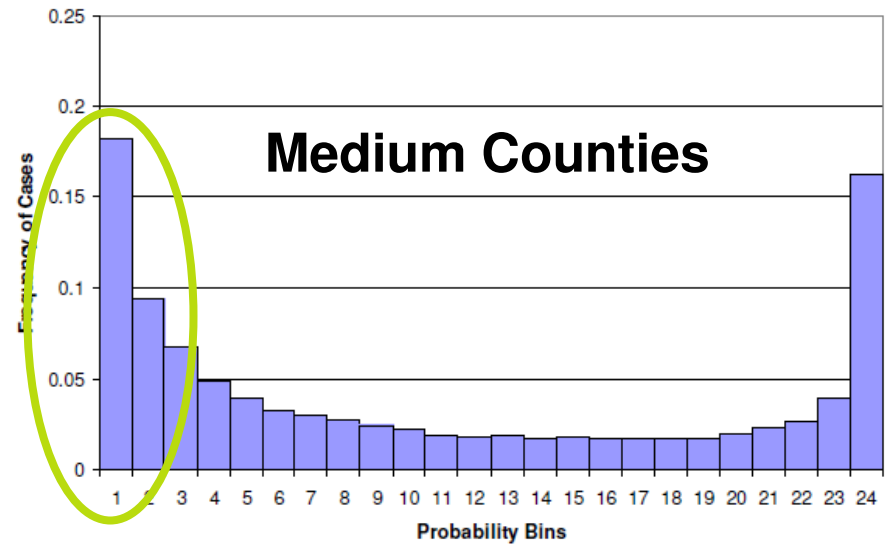
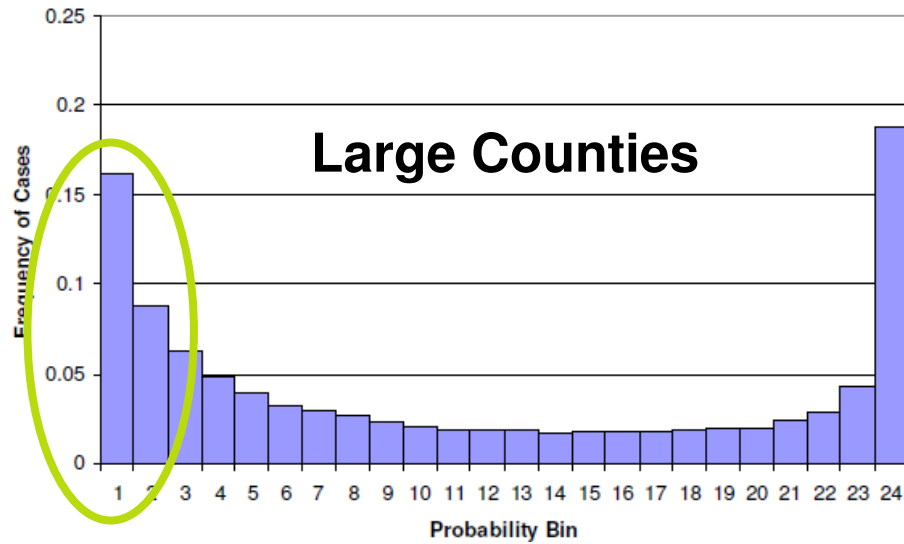
- The reliability scores shows that small counties have best reliability (over all probability bins).
- Strong winds are rarer in smaller counties so there is a greater proportion of cases close to the 0% probability bin.



Sharpness Diagrams

Max. 3hr wind gust ≥ 40 mph

Sept – Dec 2010

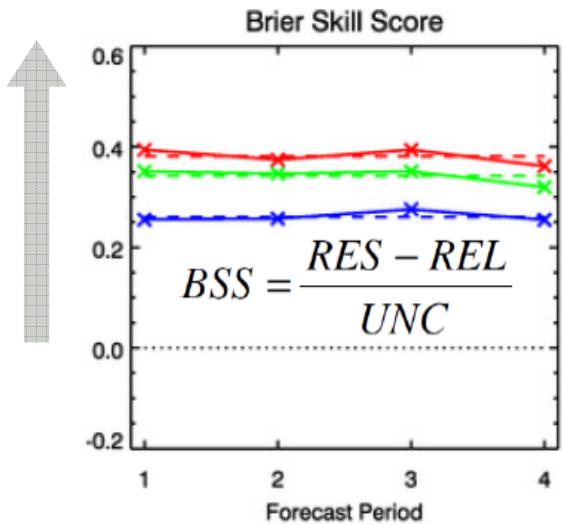
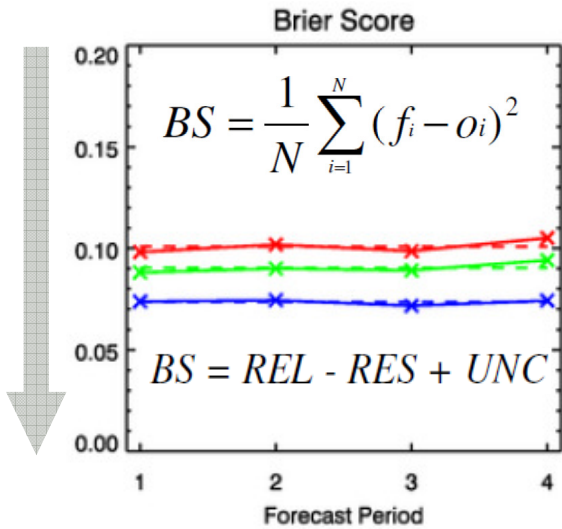




Brier / Brier Skill Score

Max. 3hr wind gust $\geq 40\text{mph}$
 Sept – Dec 2010

—	Large Counties
—	Medium Counties
—	Small Counties



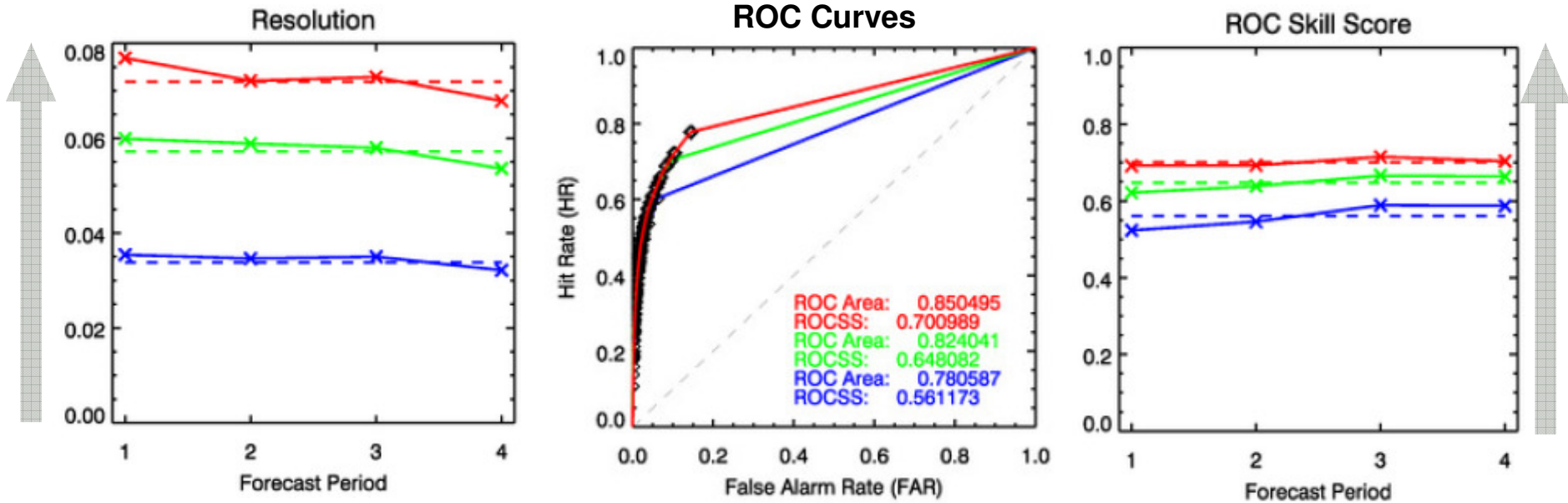
- Small counties have better brier scores.
- $UNC = c(1 - c)$
- For rare events, c is likely to be closer to 0, creating a smaller uncertainty value.
- Small counties tend to produce better brier scores, without necessarily having any better skill than forecasts from larger counties.
- The brier skill score looks at the relative skill of a forecast system compared to a reference forecast (in this case sample climatology).
- The larger the county, the greater the improvement in forecast skill compared to sample climatology.



Resolution and ROC

Max. 3hr wind gust $\geq 40\text{mph}$
 Sept – Dec 2010

—	Large Counties
—	Medium Counties
—	Small Counties



$$RES = \frac{1}{N} \sum_{i=1}^I n_i (o_i - c)^2$$

$$FAR = F / (R + F)$$

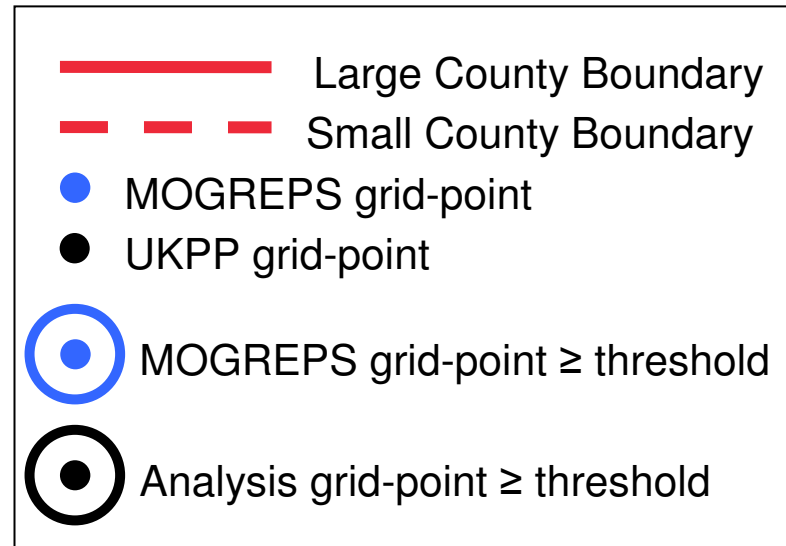
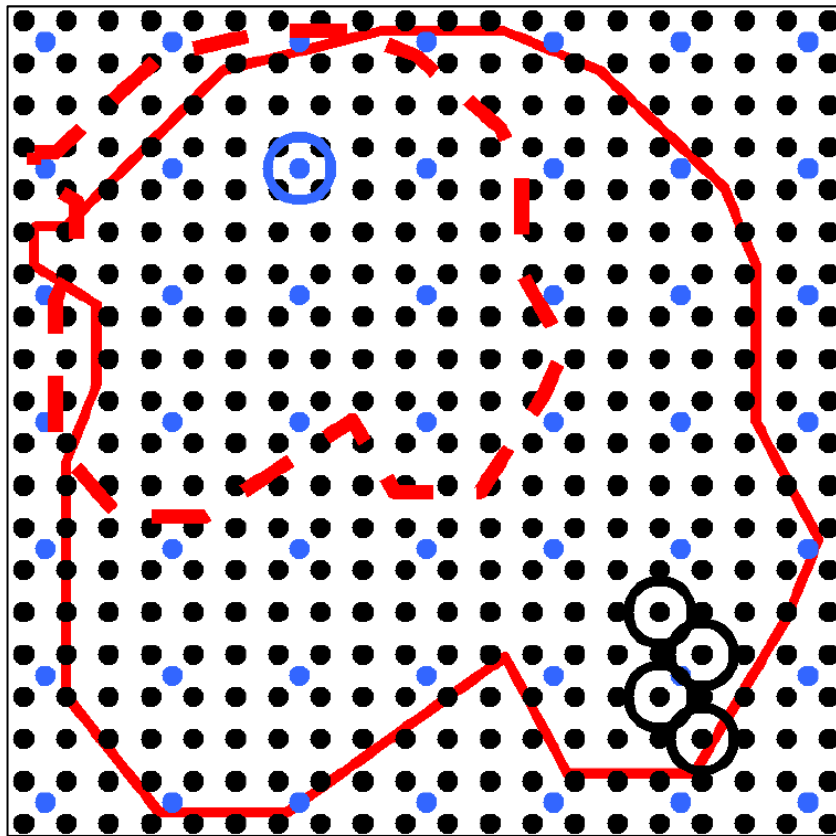
$$HR = H / (H + M)$$

$$ROCSS = 2A - 1$$

Large counties have the best resolution and ROC Skill Score.



Large counties can benefit from any spatial inaccuracies in the model (an example...)

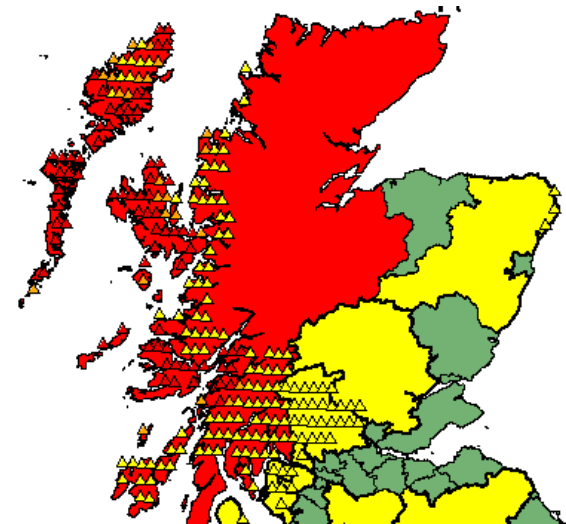


- The large county scores a hit, even though the event was forecast to occur at the opposite end of the county to the observations.
- The small county scores a false alarm.



Conclusion

- MOGREPS-W under forecasts some severe events.
- Large counties have better forecast accuracy.
 - A larger area allows for spatial inaccuracies within the model.
 - This applies to both precip (not show) and wind gusts.
- It is important to consider several verification scores
 - E.g. reliability scores on their own may be misleading without use of reliability and sharpness diagrams.
- If a warning is triggered for a large county, a forecaster should examine gridded fields to determine which parts are affected.
 - This functionality is being built into the new version of MOGREPS-W (under development...)





Met Office

Questions and Answers