Reply on RC2

Susan J. Leadbetter et al.

Author comment on "Assessing the value meteorological ensembles add to dispersion modelling using hypothetical releases" by Susan J. Leadbetter et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-638-AC2, 2021

I would like to thank the reviewer for their comprehensive review of the paper. They have highlighted some interesting issues which I have attempted to answer both within the paper and in the response below. The reviewer's comments are shown in italics and my response to their comments is shown in plain text. I've also attached the same comments as a pdf document for readability.

General comments

Line 120, 178 and 420-422. The discussion of configuring ensembles to perform better for certain variables and certain parts of the atmosphere is interesting and would benefit from a lengthier description. In this study, simulations are performed using the MOGREPS-G meteorological ensemble. Has this ensemble been optimised to produce a maximum growth rate of the ensemble spread at a certain forecast lead time? Would differently configured ensembles be more suitable for dispersion applications?

The configuration of meteorological ensembles and their suitability for dispersion ensembles is a very interesting topic. In the past meteorological ensembles were optimised to produce a maximum growth rate of the ensemble error at a certain forecast lead times but recent work in this field has focussed on ensuring that the ensemble is optimised for all forecast lead times. As far as the authors are aware dispersion studies using ensemble meteorology have focussed on single case studies and single ensemble meteorological data sets (or multi-model ensembles) so have not considered whether differently considered ensembles would be more suitable for dispersion applications. We have added a sentence noting this below line 178.

Line 331. The authors correctly state that the BSS provides a comparison of the performance of the ensemble relative to the deterministic forecast and does not provide information about the individual performance of the ensemble. Therefore, if the deterministic forecast is accurate the BSS can be negative even if the ensemble forecasts are also representative of the analysis. I would like to see this argument in the introduction section if possible as it's an important point for interpreting these relative skill scores. This is particularly exemplified in figures 12 and 13. By eye the ensemble forecast appears to perform in a very similar manner to the deterministic forecast, but the BSS shows that relatively, this ensemble is worse.

We have expanded the text mentioning this point in the location where the Brier skill score is first mentioned towards the end of section 2.0.3.

Line 204, 282, 291 and elsewhere. The Brier Score is calculated for a single output grid square. Does the size of the grid matter? For example, the authors state that the ensemble runs perform better than the deterministic runs at later time steps and hypothesise that this is due to increased ensemble spread at later times. Another reason could be that the plume has spread out more at later times reducing the potential for a double penalty issue. This issue also highlighted in figures 5 and 6, do the negative BSS occur when the plume is narrow, i.e. at the start of the simulations? When calculating BSS at the grid scale small displacements in the plume location can result in large differences compared to the analysis. This occurs particularly when the size of the eddies causing dispersion are large compared to the width of the plume. Would it be possible to show the BSS vs area covered by plume, in an analogous way to fig 7.

Investigating the impact of the grid size was out of the scope of this project. However, I have plotted the Brier skill score against area of the plume (below). This shows that the spread of Brier skill scores is greater when the area exceeding the threshold is smaller but there is no bias towards negative or positive skill scores for large or small areas.

Please also note the supplement to this comment:
https://acp.copernicus.org/preprints/acp-2021-638/acp-2021-638-AC2-supplement.pdf