Referee comment for acp-2021-973, Quantifying the impact of meteorological uncertainty on emission estimates and volcanic ash forecasts of the Raikoke 2019 eruption by *Natalie J. Harvey, Helen F. Dacre, Cameron Saint, Andrew Prata, Helen N. Webster, and Roy G. Grainger*

This study presents the results of using ensemble meteorology from the Met Office Global and Regional Ensemble Prediction System (MOGREPS-G) to drive dispersion simulations used in the Inversion Technique for Emissions Modelling (InTEM) algorithm. The authors use variables retrieved from Himawari satellite observations using the Met Office algorithm in the InTEM inversions. This results in a constrained eruption emission profile.

The success of the inversions are then assessed using variables retrieved from the same Himawari data, but using the independent Optimal Retrieval of Aerosol and Cloud (ORAC) algorithm. The results presented show how NAME dispersion simulations initialised using the constrained eruption emission profile show improved agreement with observation.

Finally, the authors show how the predicted risk to aircraft is reduced when the constrained emission profile is used in NAME simulations, and that disruption to air traffic could have been reduced.

The paper is well written and is highly suitable for publication in Atmospheric Chemistry and Physics after some clarifications and added explanations.

A slight concern I would like addressed regards the limitation of the satellite retrievals of mass column loadings. My understanding is that the mass retrievals are severely underestimated for pixels with high column loadings – which is likely to have been the case in the first 24hrs or so of the Raikoke eruption. Would it not be the case that missing this part of the ejected mass would result in the posterior mass profile being under estimated?

On a related note, it would be good to have some more discussion on how independent the two retrievals really are – they are after all using the same observations, so tuning the emission profile to get close to one set of satellite retrievals, and then using the other set to assess the success could be viewed as problematic. Some more discussion as to why this is ok please!

Please can the authors consider adding a table in the methods and data section giving a brief outline of each method, what they are used for, and some date ranges?

Minor points:

L66 Bent over plumes are discussed – would this reduce the mass estimate using the Mastin relationship?

L94 Brier skill score – please explain what this is

L127 – The MOGREPS met data is on a 20km grid resolution – my understanding is that this is less than the UM met data that is used in NAME operationally – please

comment on the effect of using lower resolution met data on the accuracy of the resulting dispersion simulations.

L158 – This is the first mention of InTEM – please define here.

L193 – Is the Hobbs et al. size distribution simply cut off, of has the shape been modified?

L161 – Do the Met Office and ORAC methods use met data? Do they both use the same? Is this ensemble data? Could the independence of the two satellite methods be improved by using ECMWF data for ORAC?

L257 and elsewhere – figure -> fig. I think ACP style asks for fig. unless at the start of a sentence – please check

L 263 – 265 I'm not sure what these sentences mean, please clarify.

L 269 – fig. 3(a) seems to show variation with height – I thought the prior was constant from vent to plume top?

Figure 5(a) and 6(a) – please explain what the grey pixels are

L325 – "In this case the cross section intersects the simulated ash plume in 3 locations" – it seems to me that the dashed line in fig. 6 a – b intersects the simulated plume almost entirely. Please clarify.

Figure 8 and discussion of same - The posterior emission profile is constrained using satellite data out until 00:00 25 June? L381 then claims that the disruption to air traffic could have been reduced on 22 and 23 June - Can the NAME simulation initialised using this profile then really be called forecasts as they could not have been produced prior to 25 June?

References – author names have been capitalised and I think some doi numbers are missing. Please check.