



EGUsphere, author comment AC2
<https://doi.org/10.5194/egusphere-2022-80-AC2>, 2022
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Reply on RC2

Giorgio Doglioni et al.

Author comment on "Dynamical perturbation of the stratosphere by a pyrocumulonimbus injection of carbonaceous aerosols" by Giorgio Doglioni et al., EGU Sphere,
<https://doi.org/10.5194/egusphere-2022-80-AC2>, 2022

Review of "Dynamical Perturbation of the stratosphere by a pyrocumulonimbus injection of carbonaceous aerosols" by Goglioni et al., 2022, submitted to ACP

Doglioni et al. successfully modeled the anticyclone (SWIRL) in a pyrocb event using GEOS CCM. This study finds that the diabatic heating from the smoke aerosol is critical to maintain the SWIRL structure. In general, I find this study very interesting and important, and the author team has done a very impressive job by simulating the SWIRL in a climate model. I suggest publication with minor revision.

Can the authors comment on the resolution of a model needed to reproduce the SWIRL? This study uses 50 km, will 100-km or 200-km models will fail?

The issue of which resolution is the most appropriate to detect and resolve features of a SWIRL is a very interesting one. To properly answer this question, a sensitivity analysis would be needed, exploring different resolutions and comparing the resulting outcome, which would constitute a paper by itself. We predict that a finer resolution would have a strong impact at injection and shortly afterwards, as the aerosol concentrations in one gridbox would be larger and therefore also the heating rates. On the other hand, a coarser resolution would probably decrease the impact of the aerosol on the meteorology and possibly the maintenance of the swirl. A study that figures out the resolution threshold needed for the swirl would be indeed very interesting, but it does require additional ensembles of simulations, too much to be included in this paper.

Just curious, since the author have successfully modeled the SWIRL, it is very interesting (at least to me) to know how much smoke mass is associated with the SWIRL vs. how much smoke are out of SWIRL. Will that be different between the 2017 PNE and 2019 ANY events? Note, I am not asking for more runs, some comments are helpful here if the authors know that.

To the authors' knowledge no published results are available in the literature providing an estimate of SWIRL aerosol mass from observations, therefore we do not have any comparison between the 2017 PNE and the 2019/2020 ANY.

We can provide figures for the smoke inside and outside (i.e. in the stratosphere) of the simulated PNE SWIRL on the 23rd of August: outside 225 ktn, inside 5 ktn.

I agree with the authors that seems the vertical resolution of a climate (usually 1 km near tropopause) can be limiting in simulating the SWIRL.

Yes, that is a limitation that needs to be addressed in future studies in order to explore in-depth the vertical structure of the SWIRL.

I found there is limited comparison between model and observations. I understand it is free running mode, I still think comparison like the size of SWIRL; smoke masses; altitudes/durations are helpful to provide readers knowledge of what was happening in the real world.

We thank the reviewer for the useful remark. It is indeed important to put in evidence the comparison between the model and the observations even if the simulated SWIRL had a drastically different stratospheric life than the observed one. This direct comparison can show how realistic the SWIRL we simulated is with respect to the observed one, so it is important to us.

We have added a direct comparison between the path/altitude/duration of the observed and simulated SWIRLS (figure 2-figure 8). Also, some additional remarks focusing on the comparison between real world and simulated SWIRLS have been made.