

Clim. Past Discuss., referee comment RC3
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Comment on cp-2021-78

Anonymous Referee #3

Referee comment on "The blue suns of 1831: was the eruption of Ferdinandea, near Sicily, one of the largest volcanic climate forcing events of the nineteenth century?" by Christopher Garrison et al., *Clim. Past Discuss.*, <https://doi.org/10.5194/cp-2021-78-RC3>, 2021

This is an interesting paper that comes up with a new hypothesis concerning the now-unknown (previously attributed to Babuyan Claro) 1831 eruption. The volcanic signature seen in ice cores is attributed to an eruption in the vicinity of Sicily, which according to its assigned VEI should not have had a big impact on the stratosphere. However, associated cross-tropopause exchange could have injected sulfur from this plume into the stratosphere. The authors present a detailed study of sightings of coloured sun, which beautifully align. They are consistent with a plume that travelled around the globe from East to West in the lower stratosphere. The paper is very interesting and thought-provoking. I think this is the sort of papers that play an important role in the discussions in the community. Combining historical documentary sources and scholarly expertise with scientific reasoning is interesting. This is fascinating and should be published with some minor revisions. However, at some instances this reasoning should be strengthened, as is outlined below.

- The time (and space) between the eruption and the first observations is very small. Sightings of coloured suns were made immediately (days) after the eruption and near the location of the eruption. This sounds plausible, but is this to be expected? We read that a radius of ca. 0.5 μm is required for the volcanic aerosols to have this effect. I am not a microphysicist, but in the case of tropical eruptions, sulfate aerosols, forming from the gas phase, need some time to grow to that size. This could take 2-3 months. During that time the cloud would long have circled the globe. Perhaps this is different in this case, but I would appreciate a discussion of the aerosol formation and growth process.
- Is there a role of ash or is ash too large anyway for that?
- How likely is it that "tropospheric" plumes at these latitudes reach the stratosphere due to trop-strat exchange? There are examples from other locations, but is there also evidence from this region, e.g., from Etna eruptions?
- 20 m/s is superfast. Perhaps you can provide some context for this?
- You mention 20CRv3, but then do not show it. I agree that for this region and time period, this data set might not show much, but a plot would still be nice (the data go

back to 1806 on NCAR's website).