We thank the reviewers for clear, concise and helpful comments. The blue text was added to the review reports by the authors.

Report from reviewer 1

This is an intriguing study, using satellite data, of the water vapor and aerosol produced by the Hunga Ha'apai volcanic eruption in January 2022. The paper suggests that the rapid onset of aerosol formation and the rather large sizes can be explained by the salt residue released from the seawater lofted by the volcanic eruption. In fact estimates of the mass of such a residue based on the water vapor reaching the stratosphere easily exceeds the aerosol mass missing when SO2 alone is used to estimate the aerosol formed, from the measured SO2 emitted by the volcano. This is a new, and seemingly reasonable, suggestion to explain the large and rapid Hunga Ha'apai impact on aerosol optical depth.

The stumbling block in this study is the suggestion that the source of this missing aerosol is:

"Widespread damage to the seafloor in runouts exceeding 100 km was caused by volcaniclastic density currents causing a boiling sea that supplied buoyancy-forming hot water vapor that amplified the eruption column. Intense aerosol formation from bubble bursting in the boiling ocean provides sea salt aerosol being a plausible explanation for the unexpectedly high AOD."

Evidence for such a boiling sea is not presented here. Nor are there calculations to show that a hot magma source could provide enough energy to cause a 100 km diameter region of the ocean to boil. In addition, suggesting that the salt produced from bursting bubbles in a boiling sea explains the missing aerosol ignores the need to transport that aerosol deep into the stratosphere.

It is clear that a large amount of seawater was transported deep into the stratosphere, evidenced by the water vapor measured there. This was seawater entrained into the plume of the volcanic eruption. Along with the water is the sea salt left as the water in the plume evaporates. Wouldn't this sea salt be carried, along with the water, to similar heights? The amount of sea salt residue can be calculated from the mass of water injected, as the authors have done, and amounts to 4.8 Tg, 4 times what is needed to supply the missing 1.1 Tg of aerosol mass. So why isn't the conclusion the following? Sea salt lofted in the seawater, which evaporates in the volcanic plume, provides the missing aerosol. Even assuming inefficient transport of salt to the deep stratosphere, caused by large particle sedimentation and capture by clouds in the cooling plume (degrading the final aerosol reaching the stratosphere by a factor of four), there is still enough aerosol to account for the missing source. There is no need to go further to speculate about a boiling sea for which no evidence is presented.

In this regard the title should be changed to something like. Stratospheric aerosol formed from the salt carried with the seawater lofted by the 2022 Hunga Ha'apai volcanic eruption.

1. Thank you for the suggestion.

With the removal of the statements concerning a boiling sea, for which no evidence is given, and a few other small changes, this paper should be published. Without these changes, or additional strong evidence in support of the authors' current hypothesis, it should be rejected.

2. We agree to change the title. We also clarify that other explanations for the large emissions of water could be valid.

Concerning the hypothesis that se salt provides the missing aerosol, wouldn't such an aerosol have a depolarization signal? It seems the salt aerosol would not be spherical considering the low RH, unless it is coated with sulfate. Or perhaps the sizes are too small to create a detectable signal. A comment on why such a depolarization signal from the sea salt aerosol is not observed, if that is the case, should be included.

3. We agree and add comments in two places in the manuscript.

Here are other suggestions/comments. Some of which will be redundant to the above at the appropriate locations.

26-27 This statement needs a reference or some kind of support.

4. The statement is based on Gupta et al., 2022 that is mentioned in the following sentence. We clarify in the revised manuscript.

38-39 Is there any observational evidence of the sea boiling? If so it needs to be mentioned. While the magma is hot, the volume of water claimed to be boiling is immense. Could it really be raised to the boiling temperature by the heat source. It seems this could be estimated, and if it occurred, been observed. Are there sea surface temperature observations over the area available? Evidence of such a boiling sea is required, otherwise this is just speculation without a strong basis.

5. We might have overinterpreted the fascinating observations and modelling results of the three papers that we refer to in this context. The beauty of their results is that they together explain the explosive nature of the eruption, the extensive water emissions, the low injections of ash and SO2 into the stratosphere and provide a scenery for the elevated AOD and the timing of the onset of the AOD. However, we change the manuscript to open for other possible scenarios of the volcanism – sea water interaction.

88-91 Hasn't this already been stated in the introduction. It only needs to be done once.

6. OK, thank you.

Fig 4a The colors make it difficult to distinguish what the legend points to. In particular it is very difficult to distinguish the shallow BD from the Sum. Better colors with more clarity are advised. Also use the various colors in the words in the legend to aid the distinctions.

7. Thank you, we have changed the figure.

218 Delete mentioned

8. OK.

276 Change which to what.

9. OK.

291-292 Do the authors mean? To explain the calculations in Fig. 5d any pre-existing aerosol would have to mimic what would be expected from aerosol formation from 1.1 Tg SO2?

10. This is clarified in the revised manuscript.

295-300 Suggesting that the salt produced from bursting bubbles in a boiling sea is the source of the missing aerosol ignores the need to transport that aerosol deep into the stratosphere. Also, as mentioned above, a boiling sea is not required to provide the missing aerosol.

11. The enhanced bubble-bursting hypothesis involves hot water vapor emitted into the base of the volcanic column in accordance with the model results of Mastin et al (2024), where the aerosol particles are lifted with the buoyancy-forming hot water vapor. We have clarified that other mechanisms are possible in the manuscript.

307-308 "Applying a … (Fig. 5e). is not a sentence. It is a clause. Suggest, "Applying … variations in settling velocity leads to Fig. 5e.

12. Thank you, we use your suggestion.

326-327 Suggest: Because of gravitational settling aerosol remain in the stratosphere for much less time than gases with low chemical reactivity.

13. Thank you, we change the wording.

382-386 There is scant to no evidence presented here to support the statement that the eruption created a "boiling sea. " For the purposes of this paper and the insight provided by the authors as to the possible source of the rapid evidence of aerosol formation and an explanation of the rather large size, there doesn't need to be. The water clearly injected into the stratosphere from the main volcanic plume was seawater and therefore carried a sea salt residue with it, which would have also stayed in the stratosphere and would have easily had enough mass to form the requisite additional 1.1 Tg of missing aerosol.

Evidence for this idea of,

"Widespread damage to the seafloor in runouts exceeding 100 km was caused by volcaniclastic density currents causing a boiling sea that supplied buoyancy-forming hot water vapor that amplified the eruption column. Intense aerosol formation from bubble bursting in the boiling ocean provides sea salt aerosol being a plausible explanation for the unexpectedly high AOD."

has not been presented here, and, for the paper, this suggestion is not necessary. See earlier comments on this point.

14. We agree that this statement should be removed from the conclusions.

Review report by Daniele Visioni (Review 2)

This is a really well done study, analyzing the Hunga-Tonga volcanic plume based on a wide range of observations, that are thoroughly analyzed and explained by the authors. The study is of high quality and can be promptly accepted after one thing is addressed:

I do agree with the first reviewer that the focus of the title and conclusions on a hypothesis that is never demonstrated, but only presented as a possibility, for something that could simply be explained by the composition of the lofted water, actually spoils the study. It is fine to include it as an hypothesis, but not make it the focus of it.

15. We agree. See the reply to Reviewer 1, answers 5 & 11.

Personally I'd suggest a title that focuses on the actual finding, which is "Stratospheric plume from the Hunga Ha'apai volcanic eruption dominated by salts from the seawater". I think adding some nuance will have to be a must for this paper to be accepted, and that the contribution would be larger if this was the focus.

16. Thank you for the suggestion.