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Comment on acp-2021-623

Anonymous Referee #2

Referee comment on "Long-range transport of anthropogenic air pollutants into the marine air: Insight into fine particle transport and chloride depletion on sea salts" by Liang Xu et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-623-RC2, 2021

This study investigates long-range transport of particles into the marine air and aging of sea salt particles. The authors investigated samples from research ship from the Eastern China seas (ECS) to the Northwestern Pacific Ocean (NWPO). They utilized transmission electron microscopy (TEM) to study the morphology and elemental composition of individual particles. They classified particles into different groups and found that S-rich organic matter and S-rich soot (anthropogenic aerosol, ~87%) dominated in the ECS, while sea salt particles were most abundant (~90%) in the NWPO. They further investigated aging of sea salt particles and classified them as fresh sea salt, partially aged and fully aged salt particles. They found higher number fraction of fully aged sea salt particles in the ECS site (86%) compared to the NWPO site (31%). The authors argue that significant Cl depletion of particles at the NWPO site and presence of minor fraction of anthropogenic aerosol, indicated anthropogenic gases transported to the site and responsible for the ageing of sea salt particles.

While the study is interesting, but several issues need to be addressed before it can be considered for publication.

Specific comments:

One of the main highlights of this study is that anthropogenic gases transported longer distances compared to the anthropogenic aerosol. However, the results are not supported by any gas phase measurements. The authors should be carefully about some of the bold claims.

The authors talk about primary and secondary aerosol, but their differentiation is not supported by any quantitative number. The authors should discuss about the O:C ratio. Also, particle classification sounds more subjective. The classification of different aging of salt particles is based on morphology and elemental composition. Perhaps a fixed criterion of elemental ratios would be useful to classify them along with morphologies.

The discussion of size dependent aging is not convincing. Some discussion is needed

regarding possible Cl depletion of those particles by organics or sulfate? In general, do you see more organic coating for smaller particles?

The authors talk about long-range transport, but discussion of air mass transport and ageing time are vague.

What about the background ozone concentration at the sites? Aqueous sea salt particles, in presence of light and ozone can undergo rapid Cl2 formation via OH generation in the aqueous phase photochemistry of dissolved ozone.

The meteorological data is not discussed properly. Some of samples were collected at high RH conditions that may have aqueous sea salt particles, how that affect the aging of particles and transport of gases.

Samples from ECS to NWPO is very confusing. Please note the Fig.3 and Fig. 7 should have same notations. It seems like some of the samples that show higher aging of sea salt particles (samples 13, 13 and 15 in Fig 7). Are those same samples that also contain higher number fraction of anthropogenic particles?

The average number fraction of fully aged and partially aged sea salt particles seems ~45-50% from Fig. 7. Are there any bias for some of the high Cl depleted samples collected at the NWPO site?