In the manuscript submitted by Xue et al., the authors conducted a comprehensive investigation into the mixing state and ice nucleation abilities of ambient particles collected over the Western Pacific and the Southern Ocean. Considering that the aerosol samples were collected on a broad spatial scale and there were limited studies on ice nucleating particles (INP) over the covered regions, I suggest that this paper fits well within the scope of ACP. Nevertheless, there is a need for overall improvement in the English language expression, and a major revision is recommended before publication.

Major comments:

1. The manuscript needs overall improvement in English language expression.

2. In the introduction section, there is a lack of discussion on the state-of-the-art information regarding how the mixing state influences the ice nucleation of particles. The limited studies in the literature could serve as a significant motivation for the present study.

3. The method section lacks details concerning the sampling time, cut-off size of particles used in different analyses, and operational procedures.

4. One of the major conclusions on coating thickness or coating compositions may influence the ice nucleation efficiency of collected particles is not sufficiently supported by the present work. The discussion focuses on one sample (S14) with a low ice nucleation efficiency.

5. The author has developed several parameterizations to predict the heterogeneous ice nucleation of marine aerosols. However, the motivation behind deriving these parameterizations is not clearly presented. The derived parameterizations have different assumptions, and their forms vary among different particle classes. How to apply these parameterizations and to which aspect can they contribute to the prediction of particle ice nucleation are not clearly explained. I would suggest focusing on one or two parameterizations that are atmospheric-relevant and feasible.

Specific comments:

1. Quantified results need to be included in the abstract. For example, the percentage of different aerosol sources that contribute to the collected particles (L27-L28).

2. Some statements in the abstract are unclear. For example, the statement "We tested different ice nucleation parameterizations of marine atmospheric particles for their applicability. Finally, we discuss how the mixing state of particle populations impacts ice nucleation in the atmosphere" lack specific outcomes. Could you provide more details on the results of these tests and discussions?

3. L85-L87 are repeating with L73-L75.

4. L96-L97: Consider deleting L96-L97, as the main focus in this paragraph is on chemical composition and mixing state.

5. L138-L140 should be moved to the following paragraph.

6. The collection time for each sample exhibits large variation (Table S1). Could the authors provide an explanation for this and include these details in the SI? This information will help indicate the atmospheric representativeness of the aerosol samples.

7. L161-L163: Were both the TEM grid and silicon wafer chips collected using the SKC sampler? It is not clear whether they were collected in parallel or not. This should be clarified for better understanding.

8. L167-L168: Are only samples in the fourth state used for further measurements? Could the authors explain the rationale behind applying such a small cut-off size?

9. L196: What kind of particle size do you mean here. Is it referring to the aerodynamic size (AD) determined by the SKC sampler, or is it the electrical mobility diameter (ECD)? This should be clarified in the main text.

10. L222: Any citations for using 0.8 as a specific threshold value for fresh and aged SS?

11. L229. Line 229: There is a missing period in this sentence.

12. L244: Why was a hemispherical shape of particles assumed rather than a sphere?

13. L308: Which particle sample, TEM or silicon wafer?

14. L316: Ice formation of one particle or all particles on the grid/chip? I assumed you have many particles in one sample?

15. Figure 3: Is the scale unit on TEM images missing?

16. L431: Citations are needed here regarding particle formation from biogenic emissions in the Rose Sea.

17. L488-L489: Not sure if I followed this sentence.

18. Table 1: BBA exhibits relatively larger particle size compared to particles from other sources. Could the author provide an explanation for this?

19. L540-L541: The negative correlation between the number percentages of AgedSS and SS/Sulf particles and χ is not supported by the low R^2 (<0.11) in Figure 6B. Therefore, the statement on "The negative correlation between the number percentages of AgedSS and SS/Sulf particles and χ indicates that aging resulted in a more externally mixed particle population." needs justification.

20. Figure 6C: The negative correlation between the number percentages of CNOS and χ needs justification, as it is likely caused by a few extreme points. I would suggest repositioning these extreme points and conducting the fitting again.

21. Equation 12. The legend used here is confusing. If A represents a certain class of particles and N is the number of particles in that class, it may make more sense for N_A^{INP} to be represented as N_{INP}^A?

22. L723-L724. I would refrain from asserting that S14 is ice-active given the large uncertainties in its onset conditions (Figure 11). This is also contrary to the author's earlier statement (L578) that "The RHice onsets were only about 3% lower than the homogeneous nucleation limits between 228 K to 220 K, and thus samples dominated by BBA may not have been efficient heterogeneous ice nuclei."