

Comments by referees are in blue.

Our replies are in black.

Changes to the manuscript are highlighted in red both here and in the revised manuscript.

Reply to referee #2

General Comments:

The impact of iron (Fe) on marine ecology and climate has been a major research focus since the “Iron Hypothesis” was proposed in the 1980s, and substantial data have been accumulated to date. However, analytical methods for dissolved Fe vary significantly across laboratories, research objectives, and projects, creating challenges in synthesizing these datasets. A critical first step is to conduct systematic intercomparisons of results obtained from different methods or laboratories. This study is a significant step toward harmonizing aerosol trace element solubility. Overall, the topic is of very suitable for ATM, and this is a well-written manuscript that presents a logically structured argument supported by rigorous experimental data. A minor revision is suggested before it can be published.

Reply: We would like to thank ref#2 for reviewing our manuscript and recommending it for publication after minor revision. We have addressed these comments and revised the manuscript accordingly. Please find more details below.

Specific Comments:

1) Table 1 should comprehensively list all 26 samples analyzed by each institute, with clear definitions provided for abbreviations like C1-C7 in either the caption or a footnote.

Reply: In the revised manuscript (page 6), we have added one table (Table 1) to provide an overview of the aerosol samples collected in this study, and in this table we have provided further information for the four sample groups (A, B, C and D) to help readers understand our work. In addition, we have made the following changes to make their definitions clearer (please note that we have already provided definitions of C1-C7 and D1-D26 in the original manuscript):

(I) “For the homogeneity test, all eight portions of each filter collected at Guangzhou (A1-A6) were subjected to the same digestion procedure by a single group at GIG...” (page 7)

(II) “The 33 samples (and six lab blanks and seven field blanks, B1-B13) collected in Qingdao were distributed to all participating laboratories for soluble trace element analysis.” (page 8)

2) The presentation of methodological information could be enhanced by: a) Consolidating all sample details (methods and sample numbers per institute) into Table 1; b) Creating a separate Table 2 summarizing all leaching methods with corresponding sample counts.

Reply: As suggested, in the revised manuscript (page 6) we have added one new table (Table 1) in which samples numbers are provided, and find more information in our reply to comment #1.

The methods used by each institute are thoroughly described in the text and supplementary tables S1-S6; therefore, we do not think that this information needs to be added to the original Table 1 (which is now Table 2 in the revised manuscript).

Each institute analysed all the samples they received using the method in use in their own laboratory, as shown in the original Table 2 (which is now Table 3 in the revised manuscript). To make this clearer, in the revised manuscript (page 8) we have added one sentence: “Each laboratory analyzed the samples they received using only the method associated with them in Table 3.”

3) While the authors have noted the limitation regarding standard solutions, the discussion should further emphasize how using identical standard solutions across laboratories would reduce calibration variability and improve intercomparability.

Reply: In our original manuscript (page 31, line 552-553; page 32, line 586-590), we have suggested that (I) liquid-phase reference materials (rather than standard solutions) could be used to enhance future studies of this type; (II) distributing liquid phase reference materials would have helped to improve intercomparability by allowing all of the groups' calibrations to be directly compared, without the confounding factor of the different leaching methods employed by the different institutes.

In practice it can be very difficult to ask different laboratories to use the same standard solutions for calibration.

4) Figure 1 could be strengthened by including additional trajectory data (e.g., altitude or pressure) where available. An analysis of Fe solubility across different airmasses source samples (including the data comparison in Figure 7) is not essential unless these source differences directly affect methodological variations.

Reply: Our aim in using airmass back trajectories to classify the D samples was to determine whether the difference in soluble trace element released from ambient aerosols depended on aerosol source or other factors related to atmospheric transport. The analysis presented in Figure 7 indicates that source differences do indeed directly affect methodological differences in several cases. However, further analysis of the trajectory information goes beyond the aims of our study.

5) Table 5 requires clarification of undefined terms like “UEA-a” and “UEA-” through either table footnotes or explanatory text.

Reply: In our original manuscript (page 8, line 194-197) we have already defined these abbreviations. In order to make this clearer, in the revised manuscript (page 9) we have added one sentence to list the abbreviation of eight protocols examined: “In this work, we report results produced using eight different leaching protocols (i.e. GIG-u, NIO-u, UEA-a, UTAS-u, UTAS-a, UGA-u, UGA-b, and UoP-u).”

6) To improve accessibility, schematic diagrams illustrating all leaching procedures could be included in the Supplementary Information. Readers can quickly grasp all key information from this paper alone, improving both readability and audience engagement.

Reply: The investigated methods, which are commonly used leaching protocols, are detailed in the SI (Tables S1-S6, with key references provided), and their key features are highlighted in Table 2 of the original manuscript. Interested readers are kindly referred to our SI and original references for more information.

7) Appropriate references should be added to support the discussion at Line 512.

Reply: As suggested, in the revised manuscript (page 31) we have added a few references to support our discussion: “Enhanced trace element solubility in YS samples compared to N samples may be due to increased atmospheric processing of particles transported over the ocean (particularly for lithogenic elements) (Longo et al., 2016; Hamilton et al., 2022; Sakata et al., 2023) or to anthropogenic emissions of highly soluble trace elements to the marine atmosphere (e.g. V, Ni from shipping) (Sholkovitz et al., 2009; Chen et al., 2024).”