

## SCOR Working Group 167, RUSTED

### 1. Brief summary with the main highlights (200-300 words)

RUSTED was established in October 2022. In the past nine months much of RUSTED's activities have focused on introducing our goals and establishing collaborative links with the scientific community. Additionally, the groundwork for outputs including a literature review of aerosol leaching methods, the aerosol database, and a RUSTED Special Issue are underway.

#### **Introductions**

Morgane Perron (LEMAR, France) took an early opportunity (with the authorization of SCOR) to introduce RUSTED to the SOLAS Open Science Conference in Cape Town, South Africa, in September 2022.

RUSTED announced its establishment in the newsletters of SCOR, SOLAS, GEOTRACES and IIOES-2 and made relevant SCOR working groups, ExOIS, OASIS, FeMIP, aware of our group.

#### **Meetings**

Two virtual and two hybrid meetings for all members, plus three co-chair meetings have been held since October 2022. The virtual meetings were scheduled to ensure maximum participation by varying the start times. Ten members were able to attend the hybrid meeting in Palma de Mallorca, Spain in person. It was hugely beneficial and a pleasure to meet in person. Members from several developing nations (Argentina, South Africa and Taiwan) were able to attend in person due to the provision of travel funding from SCOR.

#### **Conference sessions**

RUSTED hosted a session at the ASLO Aquatic Sciences Meeting (ASM) in Palma de Mallorca, Spain. This session was well attended and resulted in many questions from the audience. Of the six talks presented, four focused on work conducted in the Southern Ocean. Six posters were also submitted. The poster session was equally well attended.

The RUSTED Town Hall at the ASM saw lively discussion and provided helpful suggestions about how best to meet RUSTED's ToRs. The feedback was positive and there was recognition from the wider scientific community of the importance and timeliness of RUSTED achieving its ToRs.

### 2. Activities since previous report to SCOR (e.g., virtual or in-person meetings, email discussions, special sessions). Limit 1000 words

#### **Meetings**

14 November 2022 (virtual), co-chairs  
22 November 2022 (virtual), all hands,  
19 January 2023 (virtual), all hands, break outs for sub-group discussions  
26 April 2023 (virtual), co-chairs  
5 June 2023 (hybrid), all hands, at ASLO Aquatic Sciences Meeting 2023

9 June 2023 (hybrid), all hands, at ASLO Aquatic Sciences Meeting 2023  
23 June 2023 (virtual), co-chairs

### **Conference sessions**

RUSTED members hosted a session (Atmospheric Supply of Soluble Trace Elements and Isotopes: Advances and Challenges) at the ASLO Aquatic Sciences Meeting (ASM) in Mallorca in June 2023. The two invited speakers were Susanne Fietz (Stellenbosch University, South Africa) and Diego Gaiero (Universidad Nacional de Cordoba, Argentina), both representing institutions from the Global South. This session hosted six talks and six posters, both of which were well attended and received positive feedback. Also at this meeting, RUSTED hosted a Town Hall which saw lively debate about how to achieve the ToRs and where RUSTED fitted within large international programs with overlapping interests.

In addition to the scientific session and Town Hall, we took the opportunity to hold our first full, in-person meetings (in hybrid format) at the ASM. Travel funding from SCOR is gratefully acknowledged. The two meetings were attended by ten members, with six more joining virtually. It was unfortunate that Ashwini Kumar (NIO, India), who had planned to attend in person, was unable to secure a visa in time. This highlighted the need to hold future meetings in locations where barriers to participation, such as obtaining visas for members from developing countries, are central to planning and are minimized. In response, RUSTED proposes to hold the next full meeting to coincide with the SOLAS OSC 2024 in Goa, India.

### **Changes to RUSTED's membership**

From August 2023, Rachel Shelley will be stepping down as co-chair and leaving RUSTED for personal reasons. Akinori Ito (JAMSTEC, Japan) will become a co-chair, Mingjin Tang (GIGCAS, China) will move from associate to full membership and Joo-Eun Yoon (University of Cambridge, UK) will join as an associate member.

### **Iron fertilization**

Douglas Hamilton (North Carolina State University, USA) represented RUSTED at the Exploring Ocean Iron Solutions workshop at WHOI in April 2023. Due to the current renewed interest in oceanic iron fertilization as a tool for mitigating climate change through the sequestration of CO<sub>2</sub>, RUSTED plans to publish a statement clarifying the group's stance on the issue and to act as a link between the those with interests in iron fertilization and the atmospheric science community. RUSTED's core mission to Reduce Uncertainties in Trace Element Deposition is central to understanding where the next generation of iron fertilization experiments should be conducted, and in the identification of oceanic regions likely to have the greatest CO<sub>2</sub> sequestration potential. Joo-Eun Yoon also presented her research on iron fertilization at this meeting and will be a key liaison between RUSTED and the iron fertilization interests.

3. Documents published since previous report to SCOR (e.g., peer-reviewed journal articles, reports, Web pages) and should be limited to publications that resulted directly from WG activities and which acknowledge SCOR support

4. Progress toward achieving group's terms of reference. List each term of reference separately and describe progress on each one. Limit 1000 words

**ToR 1**

An extensive literature review of leaching methods is underway (lead: Morgane Perron, LEMAR, France). The outline of the manuscript has been drafted and tasks assigned to members. The review of aerosol leaching methods is ongoing and has resulted in a new way to classify the numerous leaches for the assessment of aerosol trace metal solubility currently in use. This classification tool will form the basis of advice to end users on how best to use the data and how to select the most appropriate data for their research question/study. As well as providing key information for numerical modellers, the manuscript will provide guidelines on aerosol leaching techniques which will be of particular use to those new to aerosol trace element studies. These guidelines will be a key part of our capacity building activities, as the recommendations made will consider ease of access to equipment and reagents, as well as making a significant step towards standardization of methods. This manuscript will be submitted as the opening paper in a RUSTED Special Issue proposed for the journals, *Atmospheric Chemistry and Physics*, *Atmospheric Measurement Techniques*, and *Biogeosciences*. The target date for submissions is November 2023-2025.

A Glossary of Terms has been started with the aim of reducing inconsistencies in the terminology used by different research communities. This glossary will provide a framework to ensure consistent use of key terms in all publications arising from RUSTED-related activities.

There has been a lot of interest from the wider scientific community about our plans for a new 'one-stop-shop' database for aerosol trace element data. The plan is not to extract data from existing databases but to provide links within the new database to these. The RUSTED database plans to curate quality assured unpublished data, and new data. From the outset, the goal is that the database is more user-friendly than existing databases and follows FAIR principles. Discussions are underway with several potential host organizations. A key stage in the creation of the database is an application to the Powell Center. If successful, this collaboration with the US Geological Service will provide a data scientist and access to invaluable experience in database curation. The deadline for the Powell Center proposal is the end of January 2024.

**ToR 2**

A set of Standard Operating Procedures (SOPs) for commonly used aerosol leaching schemes has a target date of the end of 2023. The SOPs will be informed by the results of an ongoing aerosol trace element solubility intercomparison study being led by Mingjin Tang (Guangzhou Institute of Geochemistry, China). There has been a slight delay in receiving data for the intercomparison due to instrument down time in some of the participating labs, which has had a knock-on effect of the production of the SOPs. As soon as all data has been received and statistically analyzed, the SOPs will be produced as the results are needed to fully inform our recommendations. The results of the intercomparison study will also be submitted to the proposed Special Issue. Target date: early 2024. As a result of the intercomparison and discussions within RUSTED, it has become clear that it is neither practical, nor appropriate, to recommend just one leaching method. Rather, it is important that we standardize the most commonly used methods and are aware of the differences in fractional solubility that arise directly from the use of different methods.

**ToR 3**

This ToR will investigate the wealth of chemical data produced at the same time as aerosol solubility data for bioactive elements in the context of exploring the nature of the controls on aerosol iron solubility. The database, the intercomparison study results and the literature review are all key tools for visualizing the available data to probe this question. An important starting point for this will be to revisit the publications from Sholkovitz et al. (2009, 2012) in light of 10+ years of advances in the study of the nature of aerosol iron solubility. Although a manuscript resulting from this work is not scheduled until year 3, we will begin to build the foundations of this investigation during the coming year.

**ToR 4**

Work on this ToR is not planned to explicitly start until after the publication of the leaching methods review and SOPs, and the conclusion of the intercomparison study (ToRs 1 and 2). However, advice and recommendations for the use of aerosol trace element solubility data resulting from the review and intercomparison study are a step towards the realization of this ToR. Within the next year, a modelling sub-group will be formed of RUSTED members to begin work on ToR4.

5. WG activities planned for the coming year. Limit 500 words

**Publications**

A proposal has been submitted to *Eos* to write an 'Opinion' article. The aim of this article will be to introduce RUSTED's rationale and objectives to a wide audience. Target article submission date: August 2023.

A proposal for a joint Special Issue in *Atmospheric Chemistry and Physics*, *Atmospheric Measurement Techniques*, and *Biogeosciences* has been submitted. Maria Kanakidou (University of Crete, Greece) has accepted our offer to lead the editorial team of this Special Issue. We have proposed to keep the Special Issue open for submissions for two years from November 2023-2025.

The review of aerosol trace element leaching methods (ToR1) will be submitted to the proposed Special Issue of *Atmospheric Chemistry and Physics*, *Atmospheric Measurement Techniques* and *Biogeosciences*. Target submission date: December 2023.

Although not directly a Working Group activity, the intercomparison study of trace element solubility data from aerosol leaches is progressing well. As soon as all data has been submitted, the findings will be used to prepare a set of Standard Operating Procedures for the compared methods. This is an important step towards the standardization of protocols which will make it easier for end users to utilize such data in modelling studies. Data analysis for the intercomparison is expected to be complete by the end of 2023 and will result in a manuscript submitted to the Special Issue. Planned completion date for the Standard Operating Procedures: end of 2023.

**Workshop and meetings**

We propose to hold an Early Career (EC) workshop at the National Institute of Oceanography, Goa, India, in conjunction with the SOLAS Open Science Conference (OSC) in order to maximize the impact of this event while reducing our carbon footprint. A key component of the workshop will be to provide opportunities for ECs to network with established scientists. A follow up virtual component is under consideration.

The next full RUSTED meeting is proposed to be held at the same time as the SOLAS OSC/EC workshop, in September 2024.

**Collaborations**

Douglas Hamilton will lead an application for a collaborative project on managing aerosol trace element data which will be submitted to the Powell Center for Analysis and Synthesis (<https://www.usgs.gov/centers/john-wesley-powell-center-for-analysis-and-synthesis>). The Powell Center’s mission statement that it, “*serves as a catalyst for innovative thinking in Earth system science research by providing the time, creative space, and computational, data manipulation and data management resources to promote synthesis of existing information leading to emergent Earth System science knowledge*” aligns very closely with the objectives of the RUSTED database. We are confident that a collaboration will provide invaluable support and the expertise needed for the curation of the database. Deadline for proposal submission: end January 2024.

**Iron fertilization**

Given the current climate emergency and intense pressure from private enterprise to act quickly to mitigate rising atmospheric CO<sub>2</sub>, it is vital that the science behind climate mitigation actions is well-informed and robust. Consequently, RUSTED members will draft a statement on the subject of oceanic iron fertilization and will continue to provide evidence-based guidance to interested parties.

- 6. Is the group having difficulties expected in achieving terms of reference or meeting original time schedule? If so, why, and what is being done to address the difficulties Limit 200 words

At this stage, RUSTED does not envisage any difficulties in realizing our ToRs within the original time schedule.

- 7. Any special comments or requests to SCOR. Limit 100 words.

None

Additional information can be submitted and may be posted at the SCOR Annual Meeting webpage at the discretion of the SCOR Executive Committee Reporter for the WG and the SCOR Secretariat.