Conclusions from the STATISTICS / ACtIon4Cooling workshop on SRM techniques - 17th June 2025

Support for Open-Ended Research

The workshop participants expressed clear support for open-ended research on Solar Radiation Modification (SRM) techniques, particularly through publicly funded mechanisms. Given the deep uncertainties and the high stakes involved with climate mitigation and adaptation, a robust scientific understanding of potential processes, impacts, risks and unintended consequences of SRM must be constrained by neither narrow policy frames nor prematurely operational agendas. Public funding can ensure independence, transparency, and broad stakeholder engagement in setting research priorities. European funding for research explicitly labelled as SRM would build a basis for an independent stance on the topic.

Enhanced Use of Natural Analogues and Existing Observations

Great scientific potential exists in studying natural (and anthropogenic) analogues of SRM, such as explosive volcanic eruptions, low-level degassing volcanoes, changes or variability in traffic (ship) and industry emissions, dust events in the upper troposphere, or contrail cirrus. These opportunities remain underexploited. In particular, satellite datasets—some of which contain relevant but as-yet-unanalysed observations—offer a valuable resource for improving our understanding of aerosol–cloud–radiation interactions. A coordinated effort to mine and integrate such datasets is recommended. In particular, harmonizing assumptions made in models and satellite retrievals would help to better integrate observations and models (e.g. through digital twins). New observing capabilities should also be mobilized.

Field experiments: Clarity of Rationale and Participatory Design Are Crucial

While small-scale field experiments may eventually become necessary to resolve key scientific uncertainties that cannot be addressed by model experiments, natural analogues or laboratory studies alone, their justification and design must be articulated with great clarity. This includes defining specific scientific and/or technical objectives, ensuring transparent public communication, and co-developing experimental plans with a diverse range of stakeholders to maximise legitimacy, scientific and/or technical value, and ethical integrity. An assessment on potential impacts on weather and climate should be provided as part of the planning. It should be noted that field experiments relevant to SRM techniques may also be motivated by process understanding, regardless of SRM objectives.

Improved Observing System with Distinction Between Monitoring and Detection

The current global observing system is insufficient for monitoring key parameters relevant to SRM techniques, especially for Stratospheric Aerosol Injection (SAI), and for detecting SRM experiments below a certain size or uncoordinated deployment. There remain major observational gaps in trace gases, aerosol and cloud properties, vertical distribution, radiative effects, and troposphere-stratosphere coupling. Further risks are associated with the downscaling, or lack of open access availability to European research, of US current and future observing programmes and satellite missions. A dedicated effort is required to document monitoring priorities in order to enhance these capabilities. The ongoing effort to produce long-term homogenised climate data

records relevant to SRM processes should be continued. Observing systems designed to study natural analogues and assess the impacts of planned field experiments may not necessarily be the same as those needed for early detection and attribution of uncoordinated SRM field experiments or deployment.

Improved Modelling Capabilities for Prediction and Attribution

Earth System Models are improving through resolution increase and more comprehensive representation of aerosol and cloud processes, but different models continue to disagree on some key aspects of the climate response to SRM. Moreover, the predictions at subseasonal, seasonal and decadal scales are insufficient to reliably anticipate the impacts of field experiments and potential deployment. Similarly, it is necessary to establish confidence in counterfactual simulations that would be required to quantify intended and unintended impacts of SRM field experiments or deployment. Research is thus required on how trust in counterfactual simulations may be established. Further model improvements may build on insights from natural analogues and hypothetical future field experiments.