Project: **885**

Project title: **Stratospheric Sulfur and its Role in Climate (SSiRC) data project**

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Report period: **2019-01-01 to 2019-12-31**

Stratospheric Sulfur and its Role in Climate" (SSiRC) http://www.sparc-ssirc.org/ (Rex et al., 2012) is an international WCRP/SPARC [1]activity to better understand changes in stratospheric aerosol and its precursor gaseous sulfur species that are a direct input of major volcanic eruptions. One part of SSiRC is an international model data intercomparison project named ISA-MIP with four co-ordinated intercomparison studies. An overview paper describing the rationale, observations and experimental specifications and the experimental design was published in Geoscientific Model Development in July 2018 (Timmreck et al., 2018).

The publication of the Timmreck et al. (2018) paper in GMD marked the completion of the 1st phase, which the project team elected to take longer than planned in order to consider a broader set of opinions on how best to design the co-ordinated model experiments. Unfortunately, this later finalising the experiment protocols meant the start of the 2nd phase of the project, where each modelling group then run the experiments then only began at the end of 2018.

Questionnaires asking each group when they will be able to run the model experiments were emailed to each group in December 2018, and the replies confirming 13 global models will participate in ISA-MIP, their expected timetable to run the experiments varying from mid-2019 to not until 2020.

Hence, although it may seem the performance of the ISA-MIP experiments is delayed, and multi model analyses could not be carried out so far, the co-ordinating team contacted each modelling group in September 2019 to check progress, and sending the CMOR tables matching the variables in the 2018 paper, and we have identified which models are already able to submit their data to the DKRZ archive.

Part of the questionnaire included for each modelling group to describe the aerosol scheme, chemistry scheme and specifics of the host atmosphere model, which we have added to a new ISA-MIP website (www.isamip.eu), which essentially updates on the audit of global stratospheric aerosol models from Kremser et al. (2016). DKRZ resources consumed so far have been used for evaluation purposes. These evaluations have contributed to the definition of the protocol.

References:

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[1] WCRP: World Climate Research Programme, SPARC: Stratosphere-troposphere Processes And their Role in Climate

Appendix ISA-MIP Experiments

Experiment	Focus	Number of specific experiments	Years per experiment	Total years [A]	Knowledge-gap to be addressed
Background Stratospheric Aerosol [BG]	Stratospheric sulphur budget in volcanically quiescent conditions	1 mandatory + 2 recommended	20	20(60)	**20 year climatology** to understand **sources and sinks** of stratospheric background aerosol, assessment of sulfate aerosol load under **volcanically quiescent conditions**
Transient Aerosol Record [TAR]	Transient stratospheric aerosol properties over the period 1998 to 2012 using different volcanic emission datasets	4 mandatory +3 optional experiments recommended are 5 (see also Table 4)	15	60 (75,105)	Evaluate models over the period 1998-2012 with different volcanic emission data sets **Understand drivers and mechanisms for observed stratospheric aerosol changes since 1998**
Historic Eruption SO_2 Emission Assessment [HErSEA]	Perturbation to stratospheric aerosol from SO_2 emission appropriate for 1991 Pinatubo, 1982 El Chichón,1963, Agung	for each (x3) eruption (Control, median and 4 (2x2) of hi/lo deep/shallow (see also Table 6)	4 recom. 6	180 (270)	Assess how injected SO_2 propagates through to radiative effects for different historical major tropical eruptions in the different interactive stratospheric aerosol models Use stratospheric aerosol measurements to constrain uncertainties in emissions and gain new observationally-constrained volcanic forcing and surface area density datasets **Explore the relationship between volcanic emission uncertainties and volcanic forcing uncertainties**
Pinatubo Emulation in Multiple Models [PoEMS][B]	Perturbed parameter ensemble of runs to quantify uncertainty in each model's predictions	10 experiments per parameter , where the number of parameters refers to the minimum (3), reduced (5) or standard (8) parameter set (see also Table 10)	3 per experiment[C]	90, (150, 240)	Intercompare Pinatubo perturbation to strat- aerosol properties with full uncertainty analysis over PPE run by each model. Quantify sensitivity of predicted Pinatubo perturbation stratospheric aerosol properties and radiative effects to uncertainties in injection settings and model processes Quantify and intercompare sources of uncertainty in simulated Pinatubo radiative forcing for the different complexity models.

[A] Each model will need to include an appropriate initialization and spin-up time for each ensemble member (~3-6 years depending on model configuration).

Table 1 General overview of the SSIRC ISA-MIP experiments