Project: **885**

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

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Report period: **2017-01-01 to 2017-12-31**

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 (Timmreck et al., to be submitted to GMD 201&). Unfortunately the start of the experiments had to be postponed to 2018 as the experiment protocols have been discussed again in 2017 in the international consortia in several rounds before they finally get fixed. Hence, the performance of the ISA-MIP experiments is delayed, and multi model analyses could not be carried out so far. The experiments are now defined (see Appendix) and the data protocol is finished. An overview paper will be submitted to Geoscientific Model Development within the next weeks describing the rationale, observations and experimental specifications and the experimental design (Timmreck et al., to be submitted to GMD 2017).

It is expected that the global stratospheric aerosol modeling groups will start to submit their contributions from spring 2018 onwards. An audit of global stratospheric aerosol models find recently 16 models with a range of sophistication in resolution, aerosol scheme and chemistry (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:

Kremser, S. L. W. Thomason, M. von Hobe, M. Hermann T. Deshler, C. Timmreck, M. Toohey, A. Stenke, F. Prata, J. Schwarz, R. Weigel, S. Fueglistaler, J.-P. Vernier, B. Luo, H. Schlager, J. Barnes, J.-C. Antuna-Marrero, D. Fairlie, M. Palm, E. Mahieu, J. Notholt, M. Rex, R. Neely, C. Bingen, A. Bourassa, J. Plane, D. Klocke, S. Carn, C. Lieven, A. James, S. Borrmann, L. Rieger, T. Trickl, C. Wilson, and B. Meland (2016) Stratospheric aerosol - Observations, processes, and impact on climate. Rev. Geophys., 54, doi:10.1002/2015RG000511.

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Timmreck, C. G. W. Mann, V. Aquila, C. Brühl, S. Carn, M. Chin, S. S. Dhomse, T. Diehl, J. M. English, R. Hommel, L. A. Lee, M. J. Mills, R. Neely, J.-X. Sheng, M. Toohey and D. Weisenstein, ISA-MIP: A co-ordinated intercomparison of Interactive Stratospheric Aerosol models: Motivation, experiments and specifications to be submitted to GMD.

[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 Chichon,1963 Agung	for each (x3) eruption (Control, median and 4 (2x2) of hi/lo deep/shallow	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]	Perturbed parameter ensemble of runs to quantify uncertainty in each model's predictions	Each model to vary , 5 or 3 of 8 parameters (7 per parameter = 56 35 or 21)	5 per parameter	280, 175 or 105 (8, 5 or 3)	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