

Project: **885**

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

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Stratospheric Sulfur and its Role in Climate" (SSiRC) <http://www.sparc-ssirc.org/> (Rex et al., 2012) is an international WCRP/SPARC ¹activity 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 2016). Unfortunately the start of the experiments had to be postponed to 2017 as the experiment protocols are not completely fixed. Hence, the performance of these 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 almost finished. An overview paper will be submitted to Geoscientific Model Development this year describing the rationale, observations and experimental specifications and the experimental design (Timmreck et al., to be submitted to GMD 2016).

It is expected that the global stratospheric aerosol modeling groups will start to submit their contributions from spring 2017 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.

Rex M., C. Timmreck, S. Kremser, L. Thomason, J.-P. Vernier (2012) Stratospheric sulphur and its Role in Climate (SSiRC), SPARC Newsletter 39 , p. 37:

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	<u>Focus</u>	<u>Number of specific experiments</u>	<u>Years per experiment</u>	<u>Total years</u> ^A	<u>Knowledge-gap to be addressed</u>
Background Stratospheric Aerosol [BG]	Stratospheric sulfur budget in volcanically quiescent conditions	1 mandatory + 2 recommended	20	60	20 year climatology to understand sources and sinks of stratospheric background aerosol, assessment of sulfate aerosol load under volcanically quiescent conditions
Transient Stratospheric Aerosol [ITAR]	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 3.2.1)	15	60 (112,144)	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 SO₂ 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. 7	180 (315)	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	Each model to vary 7, 5 or 3 of 8 parameters (7 per parameter = 49, 35 or 21)	5 per parameter	245, 175 or 105 (7, 5 or 3)	Intercompare Pinatubo perturbation to stratospheric 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 ERF for the different complexity models.

Table 3.0 General overview of the SSIRC ISA-MIP experiments.