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Visualization of uncertainty in climate projections imposed by volcanic activity

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In this work, we apply and combine state-of-the-art visualization techniques for analyzing a large climate projection ensemble that samples plausible volcanic eruption scenarios.

Ensemble simulations with coupled Earth system models are regularly used to model the internal variability of the climate system. Analysis of ensembles of future projections allow for deriving the mean developments for different scenarios as well as the respective uncertainties due to internal variability. However, the variability due to volcanism is also an important factor for the climate system's natural variability, which so far mostly has not been taken into account in the context of model projections of the twenty-first century. In their recent work, Bethke et al. [1] reported for an IPCC RCP4.5 projection ensemble forced with plausible volcanic futures that the mean temperature development of single realizations can clearly leave the internal model variability range due to clustered volcanic eruptions.

Based on their simulations, we use state-of-the art 2D and 3D visualization techniques to explore the uncertainty space imposed by possible future volcanic activity. For better understanding impacts of stochastic volcanism on spatio-temporal development of the temperature field, we created simple synchronized animated side-by-side visualizations of the two ensemble members with the strongest and the weakest volcanic activity, complemented by a graph of the according volcanic forcing. In that way, the correspondence between series of strong eruptions and sustained cold periods can easily be depicted. With further visualizations we aim at a deeper understanding of the ensemble data and its uncertainty dimension.

[1] Bethke, I., Outten, S., Otterå, O. H., Hawkins, E., Wagner, S., Sigl, M., and Thorne, P.: Potential volcanic impacts on future climate variability, Nature Climate Change 7, 799–805 (2017), doi:10.1038/nclimate3394