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FUPSOL: Modelling the Future and Past Solar Influence on Earth Climate

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Global warming is becoming one of the main threats to mankind. There is growing evidence that anthropogenic greenhouse gases have become the dominant factor since about 1970. At the same time natural factors of climate change such as solar and volcanic forcings cannot be neglected on longer time scales. Despite growing scientific efforts over the last decades in both, observations and simulations, the uncertainty of the solar contribution to the past climate change remained unacceptably high (IPCC, 2007), the reasons being on one hand missing observations of solar irradiance prior to the satellite era, and on the other hand a majority of models so far not including all processes relevant for solar-climate interactions.

This project aims at elucidating the processes governing the effects of solar activity variations on Earth's climate. We use the state-of-the-art coupled atmosphere-ocean-chemistry-climate model (AOCCM) SOCOL (Schraner et al, 2008) developed in Switzerland by coupling the community Earth System Model (ESM) COSMOS distributed by MPI for Meteorology (Hamburg, Germany) with a comprehensive atmospheric chemistry module. The model solves an extensive set of equations describing the dynamics of the atmosphere and ocean, radiative transfer, transport of species, their chemical transformations, cloud formation and the hydrological cycle.

The intention is to show how past solar variations affected climate and how the decrease in solar forcing expected for the next decades will affect climate on global and regional scales.
We will simulate the global climate system behavior during Dalton minimum (1790 and 1830) and first half of 21st century with a series of multiyear ensemble experiments and perform these experiments using all known anthropogenic and natural climate forcing taken in different combinations to understand the effects of solar irradiance in different spectral regions and particle precipitation variability.
Further on, we will quantify the solar influence on global climate in the future by evaluating the simulations and using information from past analogs such as the Dalton minimum.

In the end, the project aims at reducing the uncertainty of the solar contribution to past and future climate change, which so far remained high despite many years of analyses of observational records and theoretical investigations with climate models of different complexity.

References

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