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Idealized simulations of solar Gleisberg and Schwabe cycle using coupled climate models

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The goal of this study is to gain a better understanding of the role of solar variations on different timescales for the climate. This examination focuses on the Gleisberg and Schwabe cycle and its effects on global circulation regimes like the Hadley and Walker circulation.

We use the coupled model ECHO-G (T30/L19-ECHAM4 atmosphere and T42/L20-HOPEG ocean with equator refinement). The model is forced by a sinusoidal change of total solar irradiance (TSI) mimicking the solar cycle variability. A 760 years long run has been made simulating the Gleisberg cycle with a solar period of 76 years. For comparison a simulation of the better known Schwabe cycle is computed (165 years). In this case the TSI varied with a period of 11 years. The idealized experiments are performed to get a clearer response to the forcing and to provide a basis for a systematic investigation of different mechanisms within the climate system. In order to assess the role of the stratosphere we repeated the experiments with a middle atmosphere version of ECHO-G with 39 vertical levels, a model top of 80km and a better representation of the middle atmosphere dynamics (EGMAM).

The analyses concentrate on the tropical region of the Indian and Pacific ocean. Both, the 11 and 76 years cycle experiments with ECHO-G lead to similar responses. During solar maximum the Walker circulation is reinforced in January while the Hadley circulation in the Pacific region weakens. This coincides with a La Nina like situation. During nothern summer the Indian and American monsun are strengthened, but there are no changes in the Pacific Hadley or Walker circulation. Even a transport of the solar signal from the tropics to higher latitudes in the ocean is found in the simulation of the Gleisberg cycle. Comparisons with reanalysis data show simular patterns. There

are indications that the inclusion of the stratosphere modulates the oceanic response.