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Solar forcing and secular variability of the surface temperature during the last millennium in the IPSLCM4_v2 climate model

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Studying the climate of the last millennium gives the possibility to assess a pre-industrial period of several centuries more and more documented through surface temperature reconstructions. The Northern Hemisphere temperature reconstructions show common secular pattern reflecting the so-called Medieval Climate Anomaly and the Little Ice Age and understanding the causes of such events is a key issue in understanding natural climate variability. Many modelling have concluded that the climate during the preindustrial part of the last 1000 years was mainly affected by the variations of Total Solar Irradiance (TSI) and volcanic aerosols of the major eruptions. We present two millennium-long numerical simulations performed with the IPSLCM4_v2 fully coupled climate model, designed to focus on the impact of TSI variability during the last millennium: a 1000 yr control run with constant preindustrial boundary conditions and a simulation forced with three reconstructions of secular forcings, comprising a widely used reconstruction of TSI variability [Crowley, 2000], variations of CO2 concentration and orbital parameters.

We discuss the Northern Hemisphere surface temperature variability of the forced simulation through a comparison with four Northern Hemisphere temperature reconstructions [Ammann and Wahl, 2007; Crowley and Lowery, 2000; Mann et al., 2008; Moberg et al., 2005]. This discussion is held by the evaluation of the contribution of solar, CO2 and orbital forcings to the temperature variability in the simulation through a statistical decomposition of the NH temperature signal.

We then assess the amplitude of forced versus internal variability as a function of the spatial scale considered. The diagnostic aims at evaluating the spatial scale at which the variance of the forced simulation is significantly different from the internal variability represented by the control simulation, involving the detectability of the forcings.

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