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Sensitivity in ECHAM5 to variations at low sun elevations

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In preliminary studies deviations were found for the TOA solar insolation of GCMs contributing to international projects such as IPCC-FAR (S.Kinne et al. 2006) from ISCCP, GEWEX-SRB, ERBE and CERES climatology projects. Systematically different meridional profiles in particular during months of both transitional seasons were found. The plane-parallel approximation, the non-uniformity of the angular speed of Earth's orbit and the assumption of a typical zenith angle for a single model box are a source of uncertainty when simulating the zenith angle at sunrise and sunset.
In the first phase of this sensitivity study we compute a mask in the radiation code of the ECHAM5 model for zenith angles above 87.5°, producing different cut-off angle assumptions for sunrise and sunset (92.5° and 89.2°) besides the original one in the control experiment (90°).

We simulated 22 years, using a coarse resolution T31 L19 and climatological SSTs. The 92.5° and 89° assumptions produce respectively enhanced (+5W/m^2) and weaker (-2W/m^2) insolation at TOA. The task of the sensitivity study is to find significant patterns related to a change in the general circulation rather than to intrinsic variability of the General Circulation Model, in order to assess the model sensitivity of the ECHAM5 to uncertainties in modelling the solar forcing.

To achieve this, we perform a t-test statistic of several meteorological parameters over the simulated period. In the enhanced insolation case (92.5°) a systematic change in the computed general circulation is found in transitional seasons,where the strongest

positive forcing is produced at TOA.