Multi-decadal pacemaker simulations with an intermediate-complexity climate model

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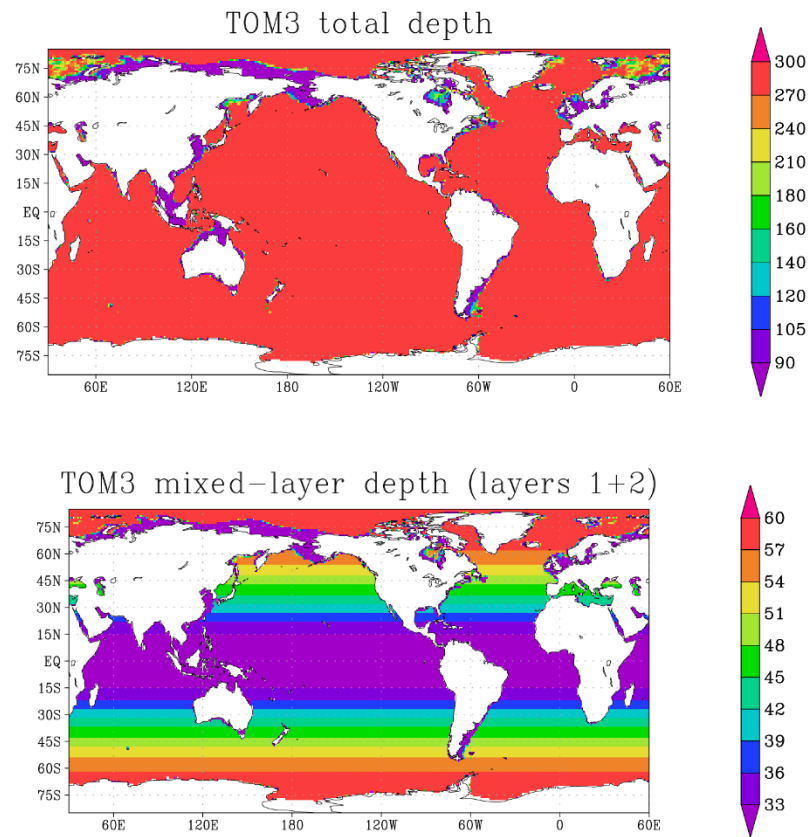*Correspondence to*: Fred Kucharski (kucharsk@ictp.it)

Supplementary Information

Figure S1: Total depth (top) and mixed-layer depth (bottom), in metres, in the TOM3 model used for the coupled ensemble.
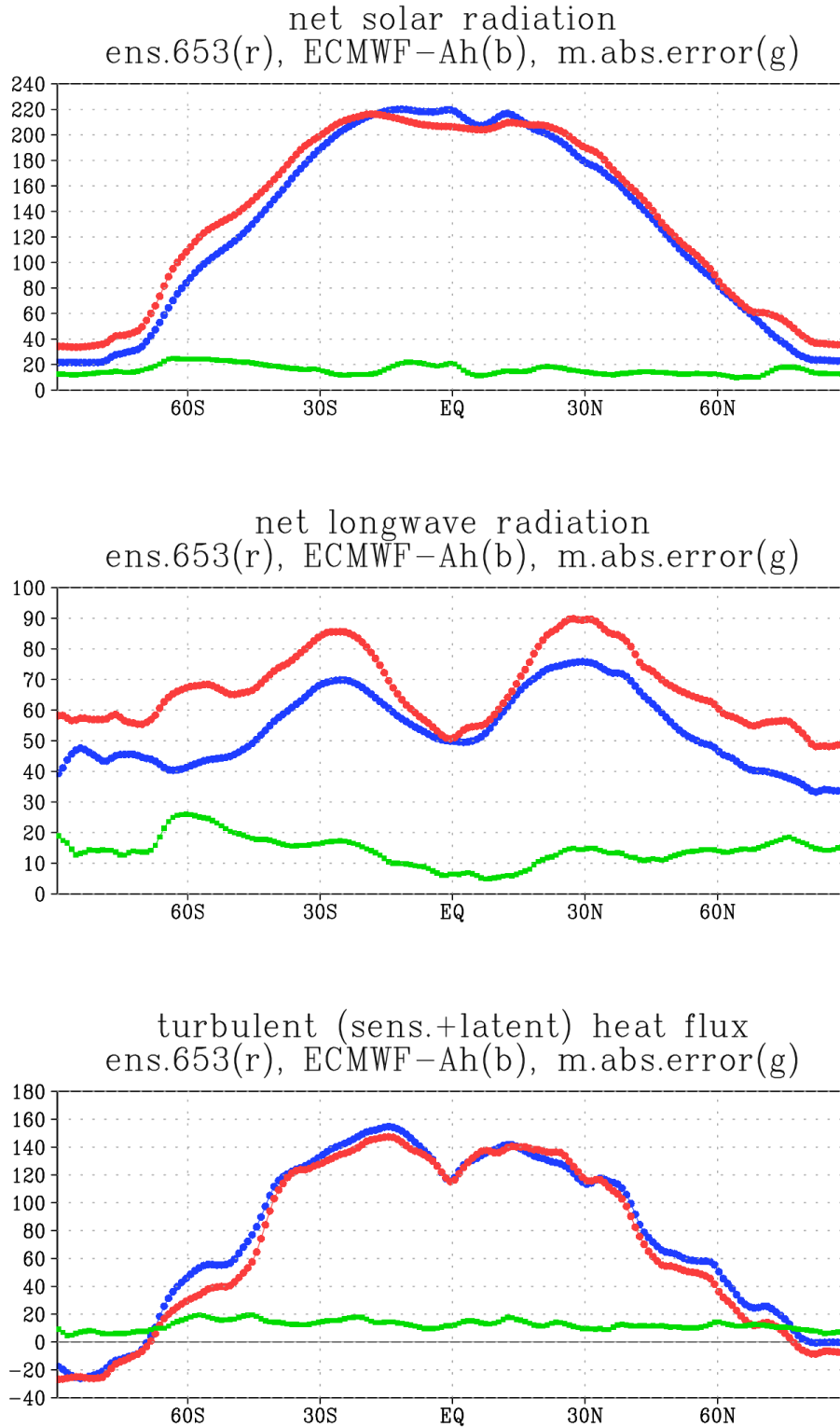
Figure S2: Zonal- and annual-mean values of surface heat fluxes from the SPEEDY ensemble (red curves) and the ECMWF historical ensemble (blue curves) with prescribed SST, as described in Sect. 3.1. Green curve: mean absolute difference between grid-point values of the two ensemble-mean fluxes at each latitude. Unit: W/m^2.
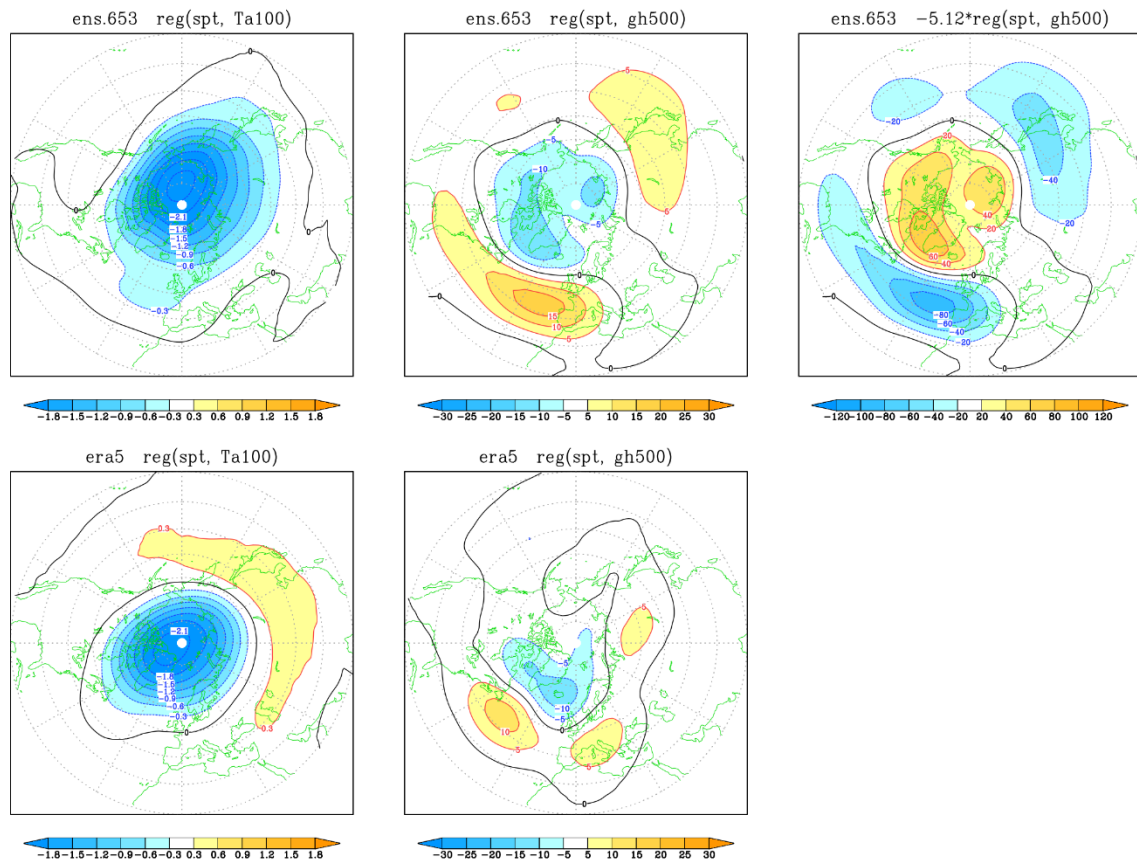
Figure S3: Regression maps against the stratospheric polar temperature (SPT) index defined in Sect. 3.2, for 100-hPa temperature (left, in $^\circ K/^\circ K$) and 500-hPa height (centre, in $m/^\circ K$), from the ensemble with prescribed SST (ens.653, top) and ERA5 data (bottom), for JF 1981-2020. The top-right panel shows the model 500-hPa regression multiplied by the difference in the SPT index between the climatologies of two ensembles with v.42 and v.41 parametrizations respectively. This represents the linear contribution of the stratospheric changes to the difference in 500-hPa height climatology shown in Fig. 8f.
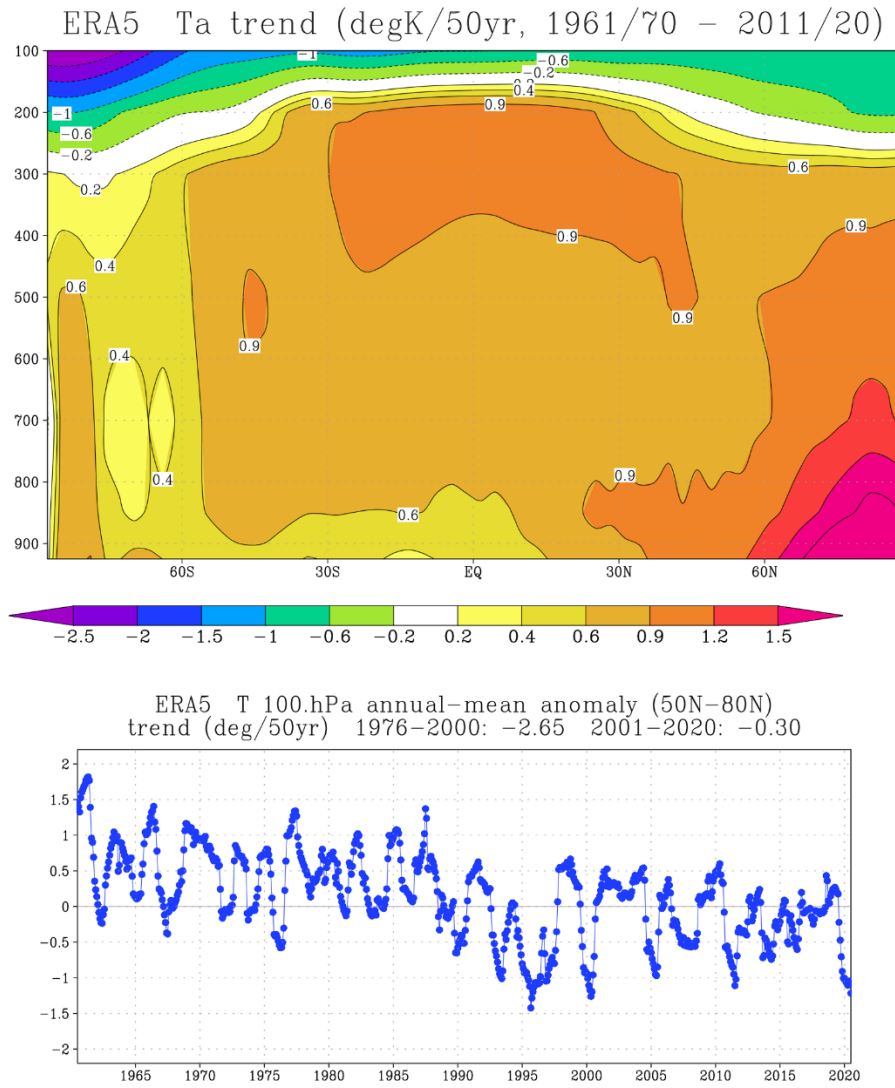
Figure S4: Top: Cross section of the linear trend of atmospheric temperature in the ERA5 re-analysis, computed from overlapping 10-yr means from 1961/70 to 2011/20. Units: ºK/50-yr. Bottom: time series of annual-mean anomaly (w.r.t. 1981-2010) of 100-hPa temperature in ERA5, averaged between 50N and 80N. Trends in specific periods (rescaled to ºK/50-yr) are listed above the panel.
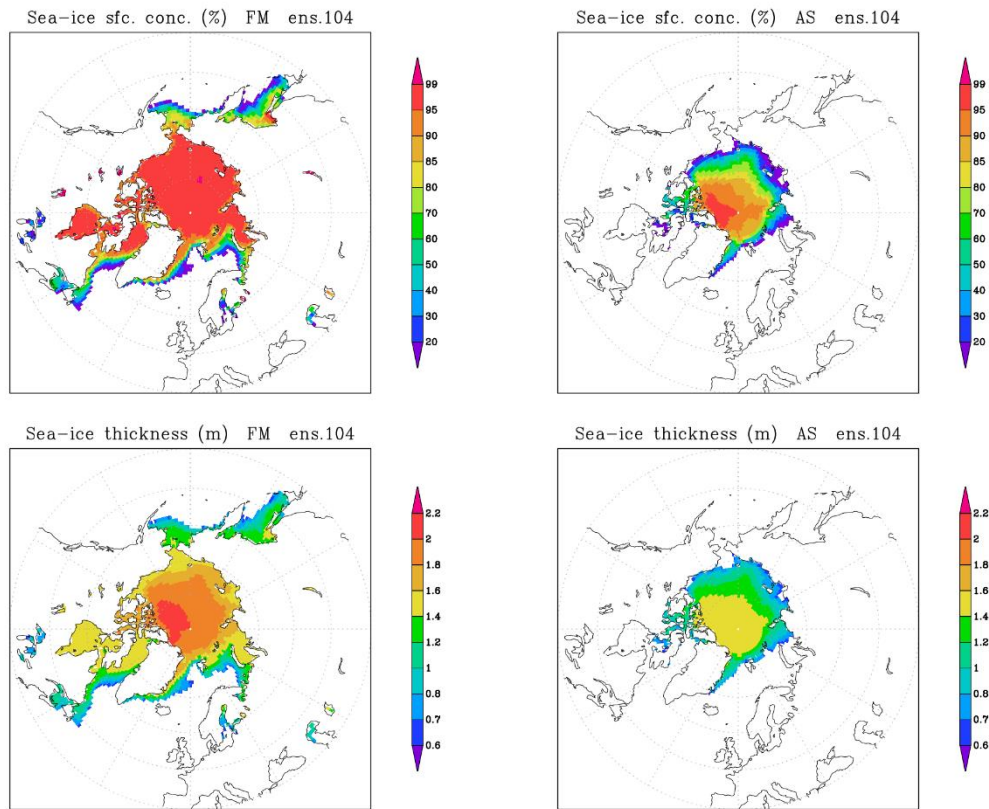
Figure S5: Climatology of sea-ice properties in February-March 1981-2010 (left) and August-September 1981-2010, derived from ERA5 data and used in the TOM3 simulations with prescribed ice mass (as in the coupled ensemble 104). Top row: surface concentrations from ERA5. Bottom row: estimates of ice thickness derived from ice concentration and surface temperature data, as described in the Appendix.