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The 20th Century evolution of energy budgets and meridional transports in two AMIP-like experiments

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The 20th century evolution and spatial patterns of the Top-of-Atmosphere (TOA), atmospheric, and surface energy budgets (EB) are investigated in this work. These are computed as the balance between the radiative and heat fluxes at the TOA and at the surface. Total, atmospheric and oceanic meridional energy transports are computed from the EBs. Two AMIP-like ensemble simulations are considered: Integrated Forecast System (IFS) simulations of the ERA-20CM experiment, and ECHAM5-HAM model simulations. With the latter, additional sensitivity experiments are carried out by constraining either Sea-Surface Temperatures (SST) and Sea-Ice Cover (SIC) or aerosol concentrations to climatological values.
The recent decades estimates of the EB are in reasonable agreement in the two models, while they are not for what concerns the global scale evolution. Particularly, in the 1970s ERA-20CM shows a fast transition from negative to positive EBs at Top of Atmosphere (TOA) that is not found in ECHAM5-HAM. The impact of aerosols, as evidenced by the sensitivity experiments with ECHAM5-HAM, is seen to set up an inter-hemispheric gradient in the TOA and surface budget after 1960. This is also reflected by an increased total poleward transport in the Northern Hemisphere and decreased in the Southern Hemisphere. This feature is not found in ERA-20CM. SST variations do not seem to induce long-term variations in the patterns of TOA budget and related total meridional transport. Nevertheless most of the surface and atmospheric budget and transport inter-annual variability is attributable to the evolution of SST, and much more agreement is observed among the two models in this respect.

Reference: Lembo V, Doris F, Martin W, and Lionello P (2015) Energy budgets and transports: global evolution and spatial patterns during the 20th Century as estimated in two AMIP-like experiments, Clim. Dyn., subm.