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Energy balance and meridional energy transport in PCMDI/CMIP3 GCMs

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We perform a thorough analysis of the energy balance at the top of the atmosphere (TOA) and at surface (SUR) of the GCMs included in the PCMDI/CMIP3 dataset. We consider preindustrial controls runs and SRESA1B future climate scenario runs. Most models feature serious positive imbalances (up to over $3W/m^2$) when the TOA budget is considered, which implies that a spurious, offsetting cooling must be present in order to determine the observed driftless climate. None of the atmospheric, land and ocean components are balanced. In each SRESA1B run, global warming corresponds to positive TOA budget which peaks during the 100 years of increasing concentration of CO_2. When the CO_2 concentration is stabilized at 720 ppm, the positive balance decays exponentially with a tau of about 500 years, which corresponds to the slowest - oceanic - time scale. The TOA radiative offset of the newly adjusted climate is different from that of the preindustrial control run. This flaw may partially explain why the GCMs' span of temperature increases due to CO_2 concentration change is so large. When considering meridional energy transports, we observe that in both hemispheres the location and value of the peak of the atmospheric and oceanic transport greatly differ among models, whereas the models' agreement for the total transport is better. This suggests that some compensation may be in place. In increased CO_2 concentration conditions, the total meridional transport increases, resulting from a relevant increase of the atmospheric component and a slight decrease of the oceanic component. Instead, the position of the peaks of the meridional transport is basically unchanged.