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Climate of the Past Discussions

Interactive comment on "Uncertainty of the CO_2 threshold for melting a hard Snowball Earth" *by* Y. Hu and J. Yang

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A note on our reply to Prof. Kasting's reviews

The results of Figure 2 in our previous reply to Prof. Kasting's reviews were obtained with a saturated water-vapor profile in the troposphere (relative humidity equals to 100% in the troposphere). The new figure attached here is obtained using the Manabe-Wetherald type vertical distribution of relative humidity, with surface relative humidity of 80%. Therefore, surface temperatures in the new figure are lower our previous results. To raise global mean surface temperature above 273 K, the CO2 mixing ratio has to be about 0.18 (the corresponding CO2 partial pressure is about 0.35 bars) as pressure-broadening and collision-induced CO2 absorption are all considered.

Figure caption. Surface temperature as a function of CO2 volume mixing ratio, simulated with the radiative-convective model developed by Kasting (see http://vpl.astro.washington.edu/sci/AntiModels/models09.html). Dashed-dotted-circle line: surface air pressure (Ps) remains constant, i.e., 1 bar, solid black-square line: Ps increases with increasing CO2 volume mixing ratio, with pressure-broadening of CO2 absorption considered, and dashed-square line: Ps increase with increasing CO2, with both pressure-broadening and collision-induced absorption of CO2 considered. The solar constant is 94% of the present, surface albedo is 0.663, zenith angle is 60°, and the moist adiabatic process is applied. The vertical distribution of relative humidity is the Manabe-Wetherald type ,with surface value of 80%.

Interactive comment on Clim. Past Discuss., 6, 1337, 2010.

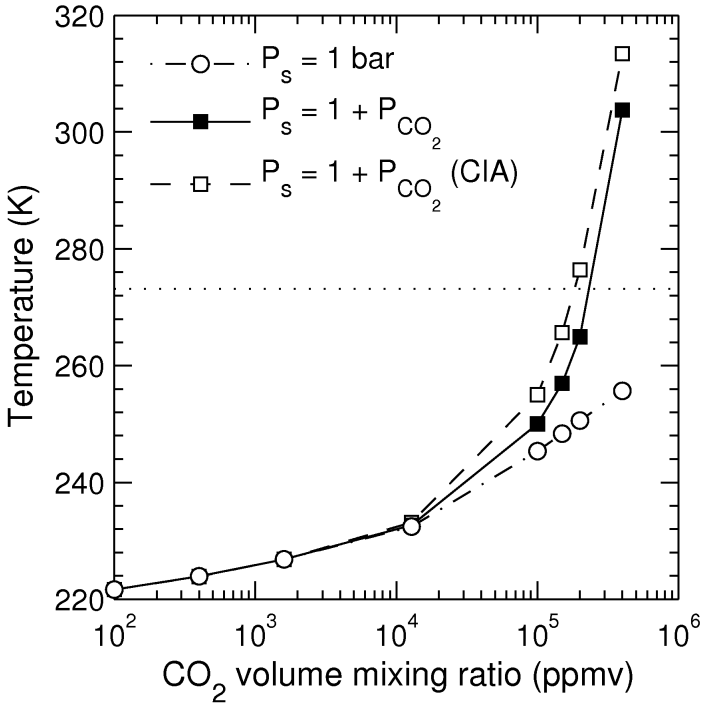
320
300
280
260
240
220
Temperature (K)
10^2
10^3
10^4
10^5
10^6
CO_2 volume mixing ratio (ppmv)
P_s = 1 bar
$P_s = 1 + P_{CO_2}$
$P_s = 1 + P_{CO_2}$ (CIA)

Fig. 1.