

# Supplementary Information

"High-CO<sub>2</sub> Cloud radiative forcing feedback over both land and ocean in a global climate model"  
D.S. Abbot, M. Huber, G. Bousquet, and C.C. Walker

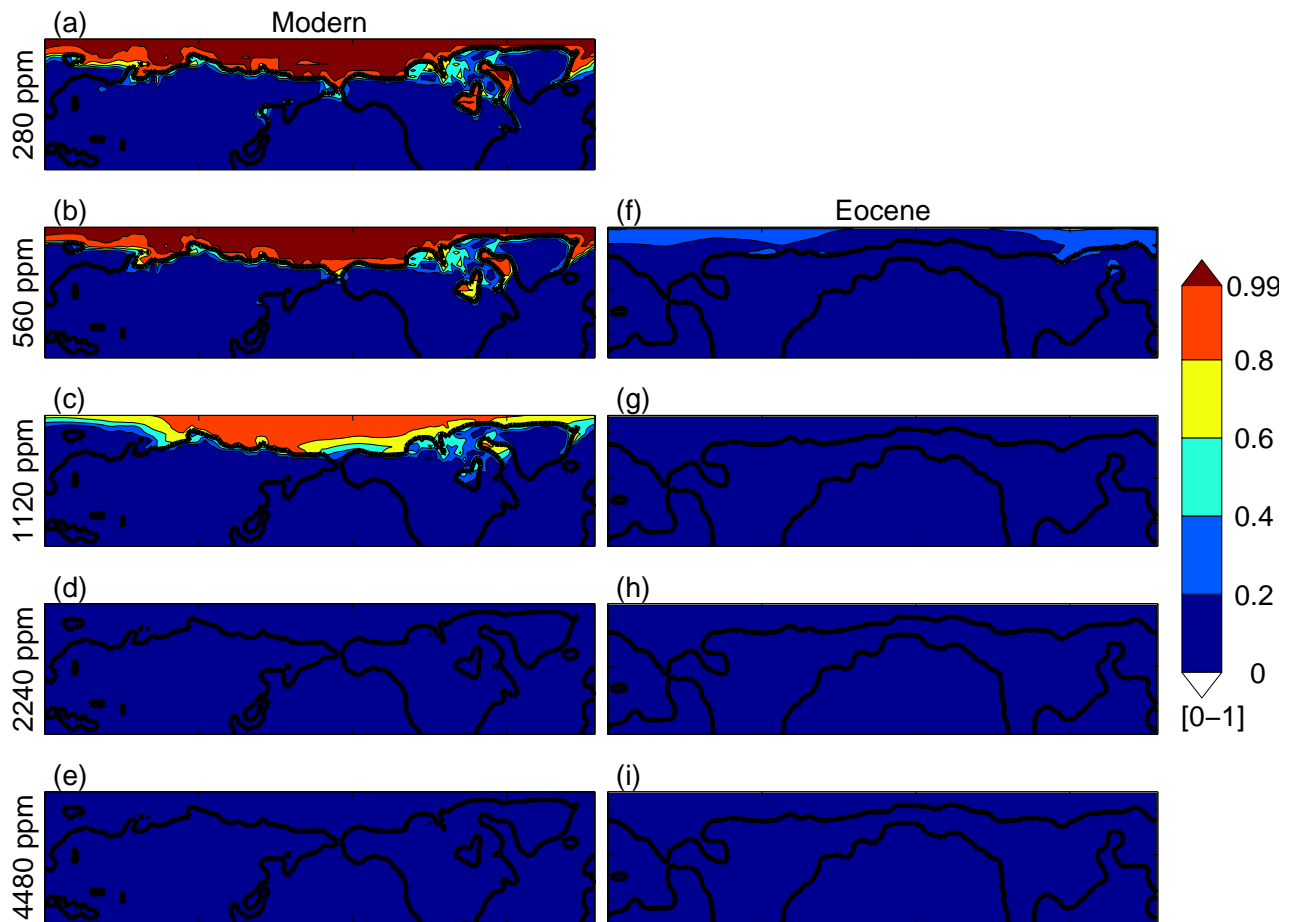


Figure S1: As in Fig. 1, but for sea ice concentration.

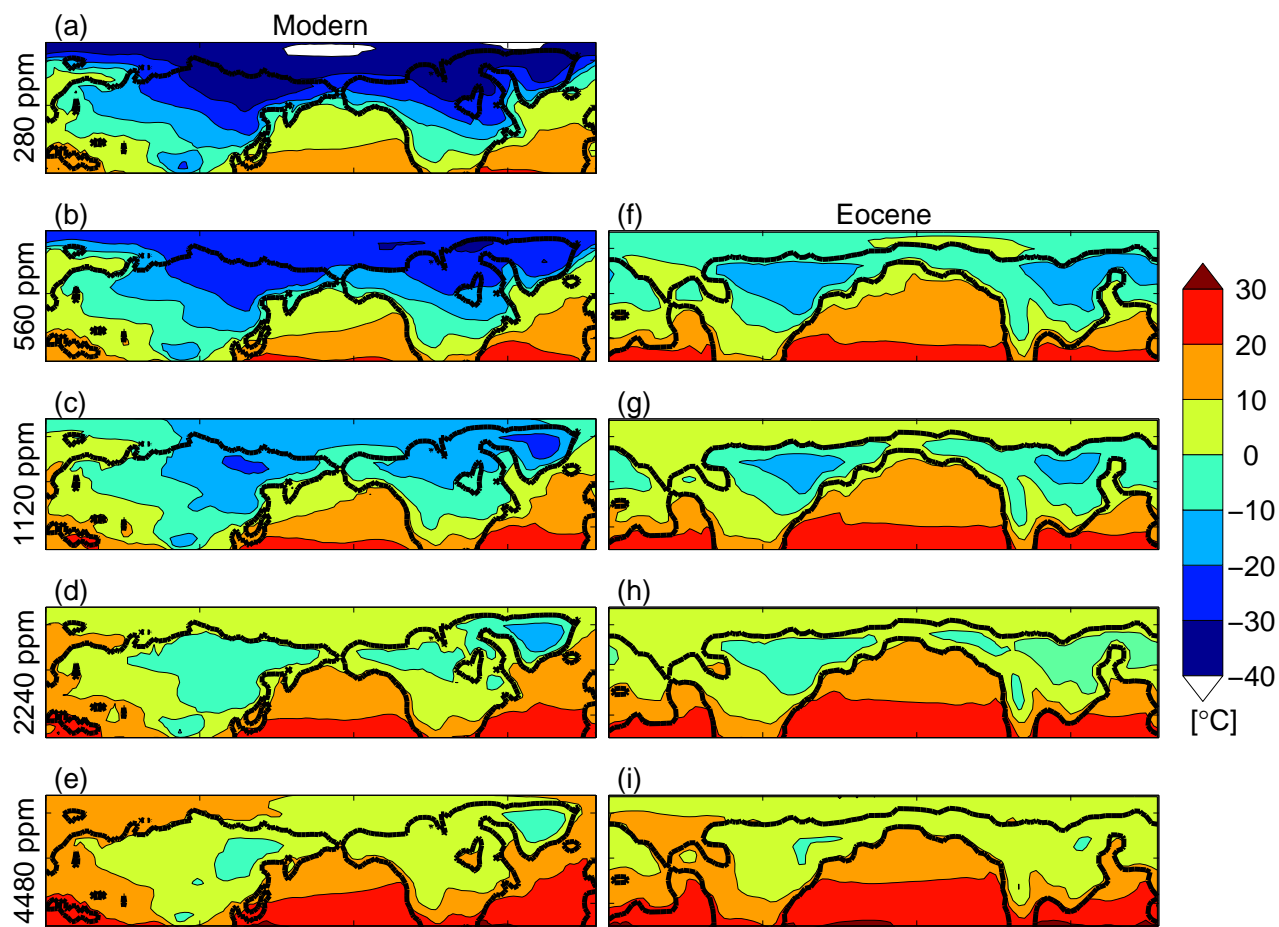


Figure S2: As in Fig. 1, but for surface temperature.

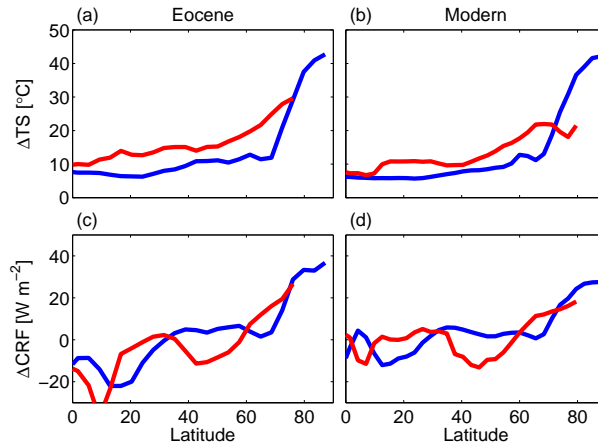


Figure S3: Difference in the zonal average of winter (DJF) northern hemisphere surface temperature (a,b) and cloud radiative forcing (c,d) over both land (red) and ocean (blue) between (1)  $\text{CO}_2=2240$  ppm runs in the CCSM coupled ocean-atmosphere GCM with Eocene boundary conditions (a,c) and the CAM atmospheric GCM with modern boundary conditions (b,d) and (2) a  $\text{CO}_2=280$  ppm run in the CAM atmospheric GCM with modern boundary conditions.

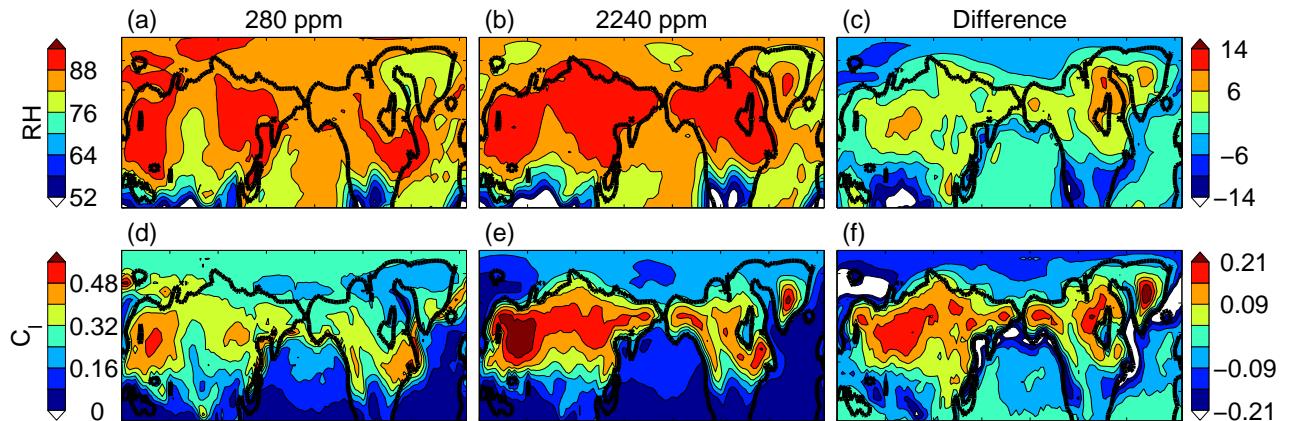


Figure S4: Increase in relative humidity (a-c) and layered cloud fraction (d-f) at an altitude of  $\sigma=0.93$  in the CAM atmospheric GCM with modern boundary conditions as the  $\text{CO}_2$  is increased from 280 ppm (a,d) to 2240 ppm (b,e). Layered cloud fraction is diagnosed from relative humidity alone.

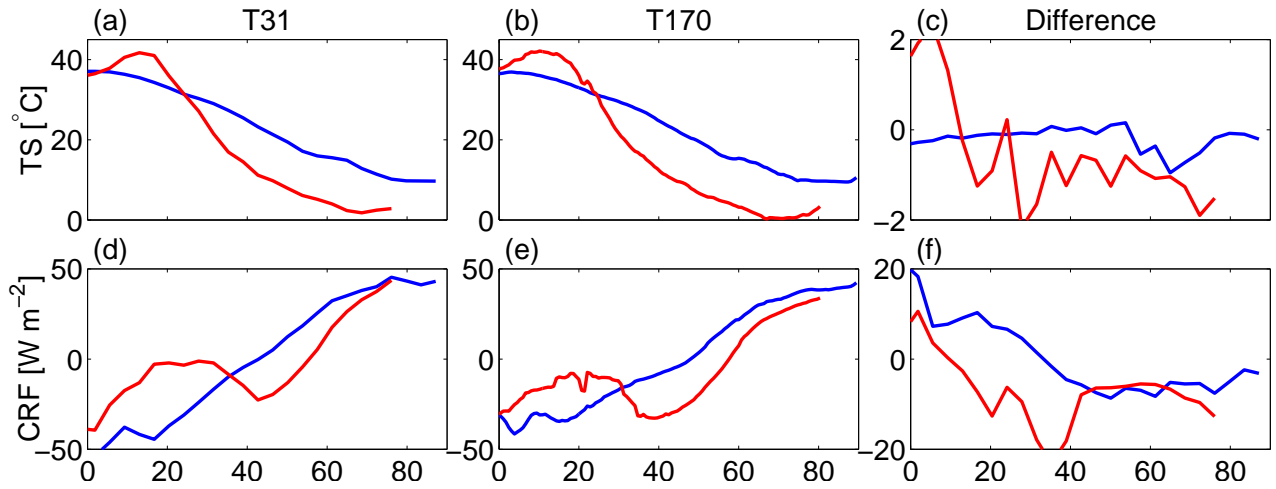


Figure S5: Comparing the zonal average over land (red) and ocean (blue) of surface temperature (a-c) and cloud radiative forcing (d-f) in the Eocene-configuration CCSM at spectral resolutions of T31 (a,d) and T170 (b,e) and the difference between the two (c,f).

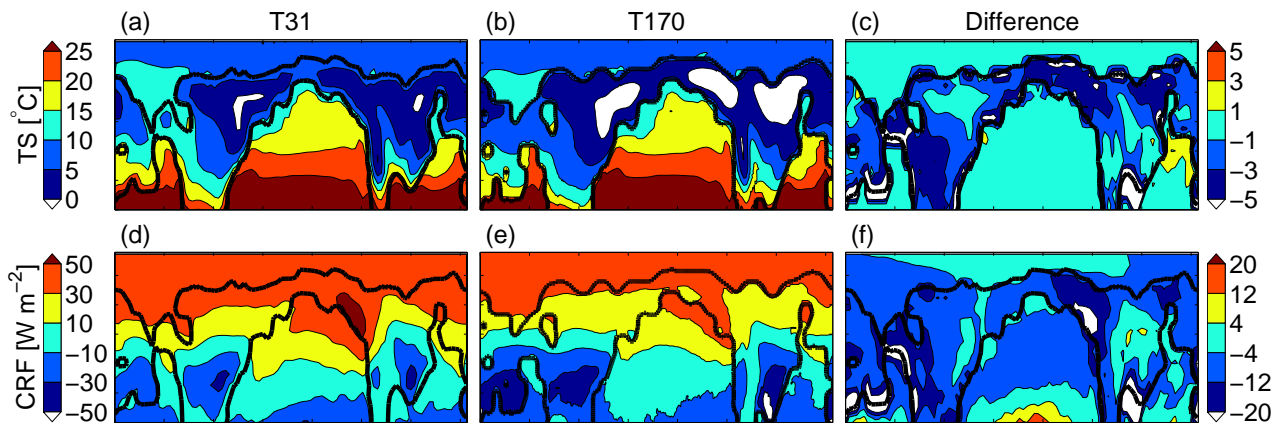


Figure S6: Comparing surface temperature (a-c) and cloud radiative forcing (d-f) in the Eocene-configuration CCSM at spectral resolutions of T30 (a,d) and T170 (b,e) and the difference between the two (c,f).

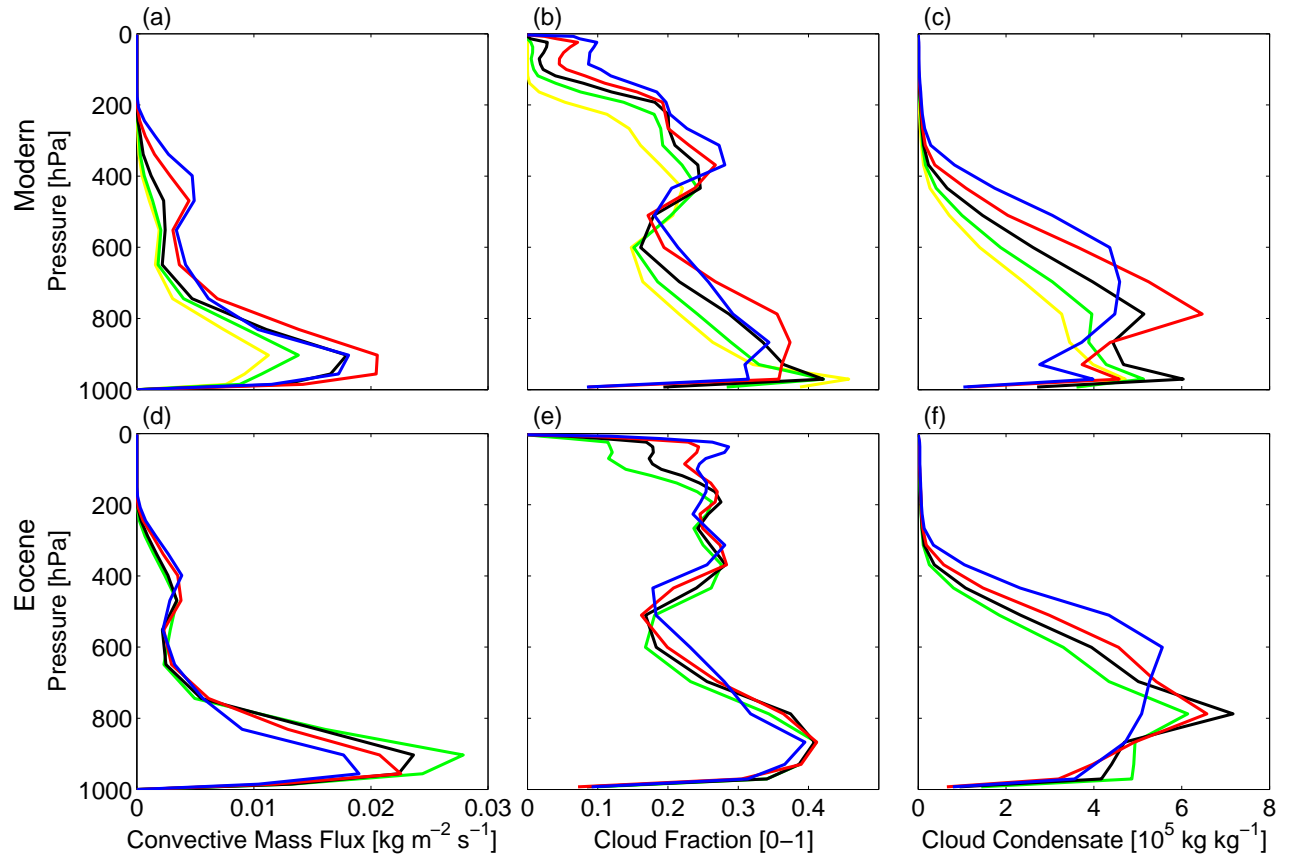


Figure S7: Winter (a,d) convective mass flux, (b,e) cloud fraction, and (c,f) total cloud condensate averaged over ocean north of 60°N as a function of altitude in (a-c) modern and (b-f) Eocene configuration. Each color represents a different CO<sub>2</sub> concentration: 280 ppm - yellow, 560 ppm - green, 1120 ppm - black, 2240 ppm - red, and 4480 ppm - blue.

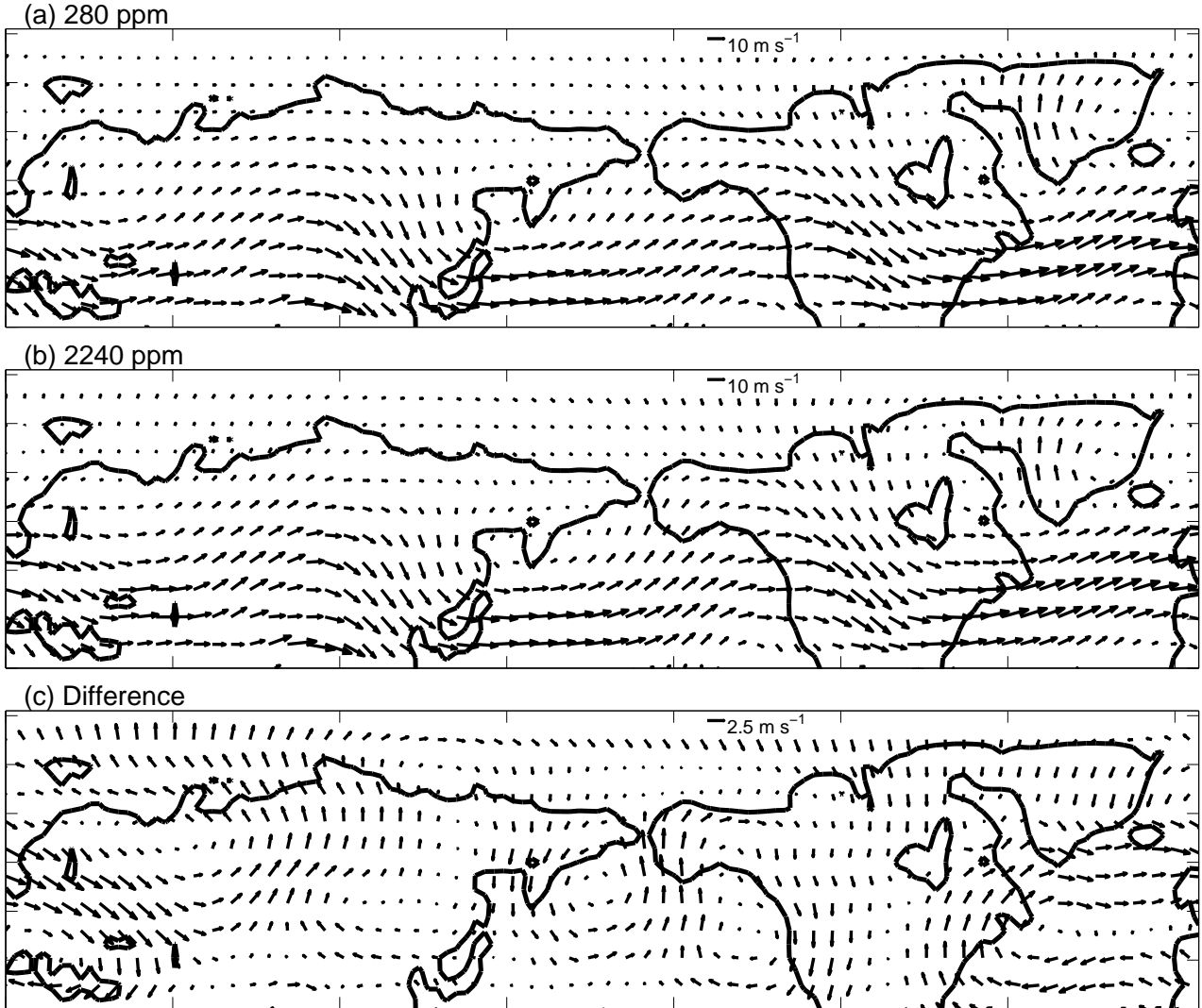


Figure S8: Horizontal velocities at  $\sigma=0.79$  in CAM in modern configuration at a  $\text{CO}_2$  concentration of 280 ppm (a), 2240 ppm (b), and the difference between 2240 ppm and 280 ppm. The velocities are similar for other levels below  $\sigma=0.7$ .

Table S1: Comparison of terms in winter (DJF) top of the atmosphere heat balance averaged north of 60°N for CAM in modern configuration at a CO<sub>2</sub> concentration of 280 ppm and 2240 ppm. SW stands for shortwave radiation, LW stands for longwave radiation, OHT stands for ocean heat transport, AHT<sub>wet</sub> stands for atmospheric transport of latent energy, AHT<sub>dry</sub> stands for atmospheric heat transport of potential and internal energy, and Net is the sum of the previous terms. CRF stands for cloud radiative forcing and is given for comparison. The increase in CRF acts to reduce the magnitude of the negative LW term when CO<sub>2</sub>=2240 ppm.

CO <sub>2</sub>	SW	LW	OHT	AHT <sub>wet</sub>	AHT <sub>dry</sub>	Net	CRF
280 ppm	+6.4	-168.4	-51.5	+15.7	+163.7	-34.2	+13.6
2240 ppm	+6.5	-182.7	-51.5	+28.8	+133.8	-65.0	+29.5