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Estimating the model forcing for LGM_sens runs

A seed for discussion by Masa Yoshimori and Julia Hargreaves.

In order to investigate sensitivity of the climate system to different forcing (LGM vs. CO2 increase), we need to know the radiative forcing of each model rather accurately. As we consider the LGMGHG experiment, we would like to know the LGMGHG forcing as well. The forcing form individual models have not been provided before and often forcing from a particular model is used to interpret different model results.

One popular method to estimate radiative forcing is so-called Gregory method in which the forcing is applied instantaneously (e.g., CO2 is quadrupled abruptly), and the following 150 years of transient response is analyzed using the linear regression. This method is probably not useful to estimate the forcing that include large ice sheets.

Alternately, we can estimate the ice sheet and orbital forcing using approximate PRP method (APRP) of Taylor et al. (2006). Then, what we need to know is forcing of CO2 increase (2x or 4xCO2) and LGMGHG. The Gregory method requires 150 years of integrations to obtain these numbers, and this is perhaps costly for many groups for the purpose of just to get the forcing.

The alternate method is to use AGCM with fixed preindustrial SST. Although this includes the response of land surface temperature change by design, this is well-established method (aerosol forcing, including indirect effect, is estimated in this way for example). This likely requires only 10 to 15 years of integration without ocean and thus relatively inexpensive.

What we propose to start the discussion is

1. To use the APRP method to estimate ice sheet and orbital forcing, separately (we need standard monthly output and land ice mask)
2. To use AGCM with prescribed preindustrial SST to estimate 4xCO2 and LGMGHG forcing (the net radiative imbalance gives the effective forcing).
3. We add LGMGHG forcing, ice sheet forcing from APRP, and orbital forcing from APRP to get the total LGM forcing.