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Climate of the Past Discussions

Interactive comment on "Linking glacial and future climates through an ensemble of GCM simulations" *by* J. C. Hargreaves et al.

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The principle result of this study is that there is an asymmetry between positive and negative forcings in the context of the LGM. This issue was also recently addressed in Hansen et al (2005, "Efficacies of Climate Forcings", JGR) and the results shown there are a useful context for these results.

Specifically, Hansen et al show that reductions in greenhouse gases are less efficacious than increases in greenhouse gases in the GISS model (GISS-ER)- similar to the results shown here (figure 5 for instance). However, there are two elements to this. First, the radiative forcing in the model (adjusted stratospheric temperatures, using the WMO tropopause, Fa - Table 1) is slightly asymmetric: 2xCO2 is 4.12, while 0.5xCO2 is -4.07. Secondly, the efficacy of these forcings is different as well (Ea=0.94 for a cooling,

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Ea=1.02 for a warming). This leads to an overall factor of 0.91 (=4.07*0.94/(4.12*1.02)) less temperature change for a nominally equivalent GHG forcing in the cooling case.

This is almost exactly the factor seen in the mean of these experiments (i.e. 0.91*0.76 = 0.69 which is close to the mid point of the figure 5 historgram). Thus, there is already published support for these results in another model (at least for the pure GHG forcings). Note also that these are fully coupled model results. However, there are a couple of lessons as well. Firstly, the radiative forcings in any specific model cannot be assumed to follow the line-by-line calculations of Myrhe et al or IPCC (2001). These should be calculated. Forster and Taylor (in press) have these numbers for the AR4 models at 2xCO2 and they range from 3.5 to 4.1 W/m2 (MIROC (medres) is 3.66 for 2xCO2 so this might not be very important in this case, but the LGMGHG forcing should be calculated similarly). Secondly, the efficacies of other forcings - in particular those with significant spatial structure (surface albedo from the ice sheets, dust or vegetation) - may have values that are substantially different from those seen in the GHG case. Generally, those forcings which are weighted towards the poles have a bigger impact than those concentrated in the tropics due to the increased strength of the ice albedo feedback.

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