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3. Use of simple climate models

3.1 Simple models used only as tools for extrapolation/interpolation GCM results to estimate the effect of different scenarios or sensitivities?

1-D UD/EBMs (upwelling-diffusion energy balance models), such as the Wigley and Raper (1992) model updated in Raper et al. (1996), in my opinion, come into this category. I along with Jonathan Gregory and Tim Osborn have completed a very detailed comparison of this and several alternative 1-D models with HadCM2 results. With the addition of a sea ice parameter the Raper et al. model reproduces well the HadCM2 results for global mean surface temperature and thermal expansion out to 2100, for several scenarios.

However, the distinction between 3.1 and 3.2 below is not clearcut. By the end of the 900 year 2xCO2 experiment the thermal expansion for the HadCM2 model is nearly 5 times larger than that simulated by the fitted (over 1860-2100) UD/EBM, and unlike the UD/EBM shows no sign of coming to equilibrium. In our analysis we conclude that it is not immediately obvious which if either model is correct. The difference serves to highlight the uncertainty in the thermal expansion commitment. Incidentally a fitted pure diffusion/EBM gives good simulation of the HadCM2 results in both the short and long term.

3.2 Simple models used to offer independent climate predictions?

It would probably be difficult to use 2+D models for 3.1, so they may belong here.

I think, 3.1 and 3.2 serve different purposes. Both may be desirable.

3.3 Depending on the answers to 3.1 and 3.2.....

Whichever 3.1, 3.2 or both is adopted the results and the attendant simple model versus A/OGCM comparisons should be given in the projections chapter. A selection of the results should then carry over to the sea level chapter. This consistency is very important.

It is a separate question as to whether the simple climate model results should subsequently be used as scaling factors for regional scenario development in the scenario chapter.

3.4 How many simple climate models are needed...

For 3.1 in order to fit the A/OGCM results extensive comparisons using alternative parameter values/models (for example, UD versus pure diffusion) will be necessary. As well as my HadCM2 comparison mentioned above a comparison with ECHAM3/LSG results is also well underway. In both cases the work shows that it is advisable to calculate the effective climate sensitivity of the A/OGCMs for use in the simple model. We found that the effective climate sensitivity is non-constant but apparently varies with the surface temperature in these models. For this calculation and for comprehensive model comparisons a specific list of A/OGCM output is required. This includes decade ocean mean temperature profiles, a measure of the strength of the thermohaline circulation, the A/OGCM forcing change for 2xCO2 etc. I am keen to continue these comparisons specifically as input to the new IPCC assessments. Unfortunately, and I think mistakenly, the US DOE have recently decided to discontinue this line of research. An endorsement of the need for this work by the IPCC would help my attempts to acquire funding elsewhere.

For 3.2 there would be no need of tuning to A/OGCM results and many model results could be used to give a range. This would serve a different purpose to 3.1 where A/OGCM results are interpolated/extrapolated for different sensitivities and forcings.

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