Study of regional sea level rise in climate model simulations using CMIP2 data

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Gregory et al, 2001 and the IPCC TAR chapter on sea level rise (Church et al, 2001) have documented a wide range of different regional patterns of sea level rise with recent climate simulations using the same greenhouse gas/sulphate scenario. There is agreement across a majority of models on a few aspects of the regional patterns, e.g. changes in the North Atlantic, higher than average global sea level rise in the Arctic, lower than average global sea level rise values in the Southern Ocean. For most of the world however, the models show no similarity in the patterns. This difference in regional patterns has implications for the range of uncertainty when applying the sea level results to coastlines which may be particularly vulnerable.

The aim of this study is to look at the cause of the difference in regional sea level rise using the CMIP2 data archive. There are two main sources that are hypothesized for this difference in sea level rise, the first being the different histories of heat fluxes momentum fluxes and freshwater fluxes that are imposed during the climate simulation, the second is on how the different ocean model components of the coupled models represent the basic water mass structure of the ocean which will depend on the physical parameterizations of each ocean component model (e.g. mixing).

We propose to address both of these issues, the first by using fluxes from the available transient model simulations and impose them on a single model version that is used at CSIRO so a direct comparison can be made of the effect of the individual fluxes within the same model environment. Further flux experiments will be undertaken with the models of other couple modelling groups, e.g. at the Hadley Centre. These sets of experiments will enable us to extend our understanding of how the models respond to the fluxes, and contribute to answering the second issue on how different ocean model density structure effects the regional pattern of sea level rise. Due to resource requirements for the extra simulations it is probable that not all the CMIP models will be able to be included. The most obvious sub-set to choose will be those models that participated in the intercomparsion on sea level rise in the IPCC chapter, though the group of CMIP2+ set of models also make a viable sub-set.

Through reviewing the literature on experiments using fluxes from coupled model simulations (Mikolajewicz and Voss, 2000, Dixon et al, 1999, Power, personal communication 1998, Delworth and Greatbatch, 2000), it appears experiments with both stand alone ocean and coupled model could be instructive. The fluxes would be added singly and in combination. The final design of the experiments will be decided when the project is

underway.

A proposal was made in the past to CMIP undertake similar such experiments by Scott Power, and we are including him in this proposal as he had not proceeded with the earlier proposal due to a change in job commitments.

We are requesting data from both the CMIP2+ and CMIP2 archive, for the heat fluxes, freshwater and momentum fluxes, sea ice extents and the full 3-dimensional temperature and salinty fields for the monthly fileds (CMIP2+) and each of the twenty-year periods (CMIP2) in the control and transient simulations. The aim of getting the CMIP2 data is as a backup in that not all the models used in the IPCC sea level intercomparison will be entered in the CMIP2+ archive, so some experiments may be needed to be done with the averaged data.

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