SUPPLEMENTARY INFORMATION

Climate Model Experiments. 20th century historical forcing simulations and corresponding control runs have been analyzed from 13 different modeling groups. In some cases more than one realization was available (see Table S1 below). All model data was obtained from the WCRP CMIP3 multi-model dataset archived at the U.S. Dept. of Energy's Program for Climate Model Diagnosis and Intercomparison (PCMDI).

Simulation Processing and Drift Removal. All model ocean temperature data was regridded horizontally to the WOA-2005 1° ×1° latitude/longitude grid and vertically to the WOA-2005 standard depth levels. The model data was then masked in an identical fashion to the observations, including only ice free ocean equatorward of 65°N and 65°S.

While none of the models used here employs flux adjustments, most still show appreciable control-run drift in ocean temperatures, particularly in the intermediate and deep ocean. To account for this, the signals in ocean heat content were defined by subtracting temporally-coincident control results from the perturbed-run data. The global ocean volume-integrated heat content is calculated from the annual mean temperature of each grid cell. For the thermal expansion calculations, we use the standard equation of state for seawater with values of the coefficient of thermal expansion taken from

UNESCO, *International Oceanographic Tables*, vol. 4, Paris, 1987. As with heat content, the expansion is calculated at each grid cell. Sea-level changes are determined by dividing the total volume changes by the global ocean surface area. Climatological salinity was used in calculating thermosteric expansion. These methods and approximations have been demonstrated to be appropriate for global average calculations and applied by previous investigators[34].

Modeling Groups Contributing to WCRP CMIP3 Database. Although 19 modeling groups had performed a wide range of simulations in support of the IPCC Fourth Assessment Report, at the time this research was conducted only 13 modeling groups had provided complete fields of potential temperature from the ocean model output and had been regridded as described above. Climate data from these simulations were made available to the scientific community through the PCMDI.

One of the simulations (the so-called "20c3m" run) involved historical changes in a number of anthropogenic and natural forcings. The following modeling groups provided multiple realizations of the 20c3m run (the number of realizations is listed after the text in parentheses that gives the official model designation): the Canadian Centre for Climate Modeling and Analysis (CCCma-CGCM3.1(T47), five); the Commonwealth Scientific and Industrial Research Organization in Australia (CSIRO-Mk3.0, three); the National Center for Atmospheric Research, Boulder, CO (CCSM3, six); the Institute for Atmospheric Physics in China (FGOALS-g1.0, three); the Goddard Institute for Space Studies in New York (GISS-AOM, two; GISS-EH, four; GISS-ER, eight); the Center for

Climate System Research, National Institute for Environmental Studies, and Frontier Research Center for Global Change in Japan (MIROC-CGCM2.3.2(medres), three; MIROC-CGCM2.3.2(hires), one); the Meteorological Research Institute in Japan (MRI-CGCM2.3.2, five); and the Hadley Centre for Climate Prediction and Research in the U.K. (UKMO-HadCM3, two). Individual realizations were supplied by: the Geophysical Fluid Dynamics Laboratory, Princeton, NJ (GFDL-CM2.0) and by Météo-France/Centre National de Recherches Météorologiques (CNRM-CM3). Several groups provided results for several different model configurations.

Forcings Used in 20c3m Runs. Details of the natural and anthropogenic forcings used by different modeling groups in their IPCC "historical forcing" simulations are given in Table S1. This table was compiled using information that participating modeling centers provided to the PCMDI (http://www-pcmdi.llnl.gov/ipcc/model_documentation/ipcc_model). Model acronyms are defined in the previous section. A total of 11 different forcings are listed in Table S1. A letter Y denotes inclusion of a specific forcing. As used here, "inclusion" signifies the specification of time-varying forcings, with changes on interannual and longer time scales. Forcings that were varied over the seasonal cycle only, or not at all, are identified with a dash. A question mark indicates a case where there is uncertainty regarding inclusion of the forcing.

References (Supplementary Information)

34. Gregory, J.M., and Lowe, J.A., Predictions of global and regional sea-level rise using AOGCMs with and without flux adjustment *Geophys.Res.Lett*. **27**, 3069-3072 (2000).

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Table S1. CMIP3 historical forcing ("20th Century") simulations

Model	Runs[1]	Well-mixed greenhouse gases	Tropospheric and stratospheric ozone	Sulfate aerosol direct effects	Sulfate aerosol indirect effects	Black carbon	Organic carbon	Mineral dust	Sea salt	Land use change	Solar irradiance	Volcanic aerosols
CCCma-CGCM3.1 T47	5	Y	-	Y	-	-	-	-	-	-	-	-
CCSM3	?	Y	Y	Y	-	Y	-	-	-	-	Y	Y
CNRM-CM3	1	Y	Y	Y	-	Y	?	-	-	-	-	-
CSIRO-Mk3.0	3	Y	Y	Y	-	-	-	-	-	-	-	-
FGOALS-g1.0	3	Y	-	Y	?	-	-	-	-	-	-	-
GFDL-CM2.0	1	Y	Y	Y	-	Y	Y	-	-	Y	Y	Y
GISS-AOM	2	Y	-	Y	-	-	-	-	Y	-	-	-
GISS-EH	4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
GISS-ER	9	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
MIROC3.2 (medres)	3	Y	Y	Y	?	Y	Y	Y	Y	Y	Y	Y
MIROC3.2 (hires)	1	Y	Y	Y	?	Y	Y	Y	Y	Y	Y	Y
MRI-CGCM2.3.2	5	Y	-	Y	-	-	-	-	-	-	Y	Y
UKMO-HadCM3	2	Y	Y	Y	Y	-	-	-	-	-	-	-

[1] The number of realizations performed with the same model but with different initial conditions.