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Probabilistic forecast for 21st century climate based on an ensemble of simulations using a business-as-usual scenario

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The behavior of the climate system is examined in an ensemble of runs using an Earth System Model of intermediate complexity. Climate "parameters" varied are the climate sensitivity, the aerosol forcing, and the strength of ocean heat uptake. Variations in the latter were accomplished by changing the strength of the oceans' background vertical mixing. While climate sensitivity and aerosol forcing can be varied over rather wide ranges, it is more difficult to create such variation in heat uptake while maintaining a realistic overturning ocean circulation. Therefore, separate ensembles were carried out for a few values of the vertical diffusion coefficient. Joint probability distributions for climate sensitivity and aerosol forcing are constructed by comparing results from 20th century simulations with available observational data. These distributions are then used to generate ensembles of 21st century simulations; results allow us to construct probabilistic distributions for changes in important climate change variables such as surface air temperature, sea level rise, and magnitude of the AMOC. Changes in the rate of air-sea flux of CO2 and the export of carbon into the deep ocean are also examined.