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Estimated PDFs of climate system properties and ensemble predictions for 21st century climate change.

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In the first part of this presentation, we present revised probability density functions (PDF) for climate system properties (climate sensitivity, rate of deep-ocean heat uptake, and the net aerosol forcing strength). The additional natural forcings, primarily the cooling by volcanic eruptions, affect the PDF by requiring a higher climate sensitivity and a lower rate of deep-ocean heat uptake to reproduce the observed temperature changes. The estimated 90% range of climate sensitivity is 1.9 to 5.0 K (including expert prior). The net aerosol forcing strength for the 1980s shifted toward positive values to compensate for the volcanic forcing with 90% bounds of 0.71 to 0.26 W/m^2. The rate of deepocean heat uptake is reduced with the effective diffusivity, K_v, ranging from 0.05 to 4.4 cm^2/s.

In the second part, we discuss the implications for climate change predictions. The significant shift in the estimated PDFs imply that smaller heat-uptake than is simulated by coupled GCMs is an important factor for explaining the observed climate changes of the 20th century, however, the implications for future climate forecasts remains unclear. We will present ensemble predictions based on three SRES forcing scenarios (B1, A1B, A2) based on latin-hypercube sampling of the estimated PDFs. These results compare favorably with similar predictions based on HadCM3 simulations as calibrated using optimal fingerprint detection statistics. The range for the MIT climate model includes rates of deep-ocean heat uptake that are significantly smaller than produced by existing AOGCMs. The consistency between results obtained by the two methods implies a lack of bias in the range produced by the MIT climate model.