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Estimated PDFs of climate system properties including natural and anthropogenic forcings and implications for 21st century climate change predictions.

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In the first part, 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) that include the effect on 20th century temperature changes of natural as well as anthropogenic forcings. 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 2.1 to 8.9 K. The net aerosol forcing strength for the 1980s shifted toward positive values to compensate for the volcanic forcing with 90% bounds of -0.74 to -0.14 W/m^2. The rate of deep-ocean heat uptake is reduced with the effective diffusivity, K_v, ranging from 0.05 to 4.1 cm^2/s. This upper bound implies that many AOGCMs mix heat into the deep ocean (below the mixed layer) too efficiently.

In the second part, we discuss the implications for climate change predictions. The significant shift in the estimated PDFs implies that volcanic forcing is an important factor for explaining the observed climate changes, however, the implications for future climate forecasts remains unclear. We will present initial results into the importance of volcanic forcings for future climate change. At first glance, temperature changes with respect to present-day will be on average affectedly equally throughout the forecast period by a stochastic volcanic forcing time-series. The key issue will be whether unexpected interactions between the responses to anthropogenic forcings and volcanic forcings exist.