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# Examining robust estimates of climate system property distributions with climate data records to 2010

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Joint probability distributions for climate system properties (equilibrium climate sensitivity, ocean heat uptake efficiency, and net radiative forcing) are presented that are based on new simulations of the MIT Earth System Model (MESM). Differing from earlier estimates, these simulations include historical forcing data through 2010. These input data include anthropogenic greenhouse gases, sulfate aerosols, land-use change, tropospheric and stratospheric ozone, stratospheric aerosols due to volcanic eruptions, and total solar irradiance.

We estimate the likelihood of the climate system properties using the approach of Libardoni and Forest (2013). We include model constraints based on changes in decadal mean, zonal-mean surface temperatures, upper-air temperature trends, and ocean heat content trends and include observational data through 2010. Strong peaks in the distributions are observed at values of aerosol forcing where the model has been run. Two potential causes for these peaks will both be considered: 1) The sampling density is not sufficient within the parameter space, and 2) the statistical tools and diagnostics applied in Libardoni and Forest (2013) are not appropriate. To investigate these issues, a new statistical method will be applied. Radial basis functions, as opposed to linear and quadratic methods, will be used to interpolate goodness-of-fit statistics to parameter locations where the model has not been run. Additionally, computational efficiency issues using intermediate complexity climate models will be considered as they relate to evaluating the likelihood estimates.