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Constraining Climate Sensitivity using Top Of Atmosphere Radiation Measurements

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An optimisation method was used to tune perturbed physics configurations of the HadAM3 atmospheric model driven with observed sea surface temperatures (SST) and sea ice to observations. Four key parameters, that previous research found affected climate sensitivity, were adjusted. The observations used were the global average Reflected Shortwave Radiation (RSR) and Outgoing Longwave Radiation (OLR) from the CERES (Clouds and Earth's Radiant Energy System) instruments combined with observations of ocean heat content. Total uncertainty was estimated by combining independent Gaussian distributions from uncertainty arising from: satellite Measurements, observational radiation imbalance, total solar irradiance, radiative forcing, natural aerosol, internal climate variability, SST and that arising from untuned parameters. Using the combined uncertainty estimate and optimisation methods model configurations were generated that sampled the edge of the plausible uncertainty range. Configurations were generated, using the same methods, that were consistent with earlier ERBE results. Using an emulator built from 14,000 evaluations of "slab" models carried out for the climate*prediction*.net ensemble the climate sensitivity for each configuration was estimated. Combining different prior probabilities for model configurations with the likelihood for each configuration, and taking account of uncertainty in the emulated climate sensitivity gives, for the HadAM3 model, a 5-95% range for climate sensitivity of 2.5-4.0 K.