Geophysical Research Abstracts
Vol. 13, EGU2011-5106-1, 2011
EGU General Assembly 2011

Constraining Climate Sensitivity using Top Of Atmosphere Radiation Measurements.

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Considerable uncertainty still exists about the equilibrium sensitivity of the climate system to external forcings with the most recent report of the IPCC estimating a *likely* range of 2.0 to 4.5K with a best estimate of 3K. Though the IPCC did not rule out climate sensitivities greater than 4.5K. These uncertainties lead to considerable uncertainty in the possible response of the climate system to changes in greenhouse gases. Uncertainty in climate sensitivity largely arises from uncertainty in modelling processes such as cloud formation, convection and rainfall in the atmosphere as well as changes in snow and ice which act to modify the "greenhouse" effect and albedo of the planet. Analysis of observed change has, so far, failed to produce tight constraints on climate sensitivity. One recent fruitful area of analysis is perturbed physics ensembles. In these key parameters in a climate model are varied within their uncertainty ranges and the response of this ensemble to changes in CO_2 explored leading to the possibility of very high climate sensitivities. Here we show that requiring the perturbed physics configurations of the HadAM3 model to be consistent, at a p-value of 99% or better, with recent Top Of Atmosphere Reflected Shortwave Radiation and Outgoing Longwave Radiation observations and in near radiative balance gives climate sensitivities in the range 2.7 to 3.8K. Comparison of a set of similar, though not identical, AMIP-style atmospheric models simulations carried out for the 3rd assessment report with the same radiation observations suggests that only models with a climate sensitivity of 2.7 to 4.4K are consistent with observations at a p-value of 99% and that many of these models are inconsistent with satellite observations of top of atmosphere radiation. Therefore, our results suggest that low or very high climate sensitivities can be ruled out on the basis of recent satellite measurements.