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Climate sensitivity and climate response

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Recent findings of non-equilibrium statistical mechanics allow to frame in a novel way the crucial problem of understanding how the statistical properties of a chaotic system change when small perturbations are added to the underlying dynamics. The theory applies both for time-independent and time-dependent perturbations, and both at a finite and infinite time horizon. In this contribution we wish to show how the theory can be applied for computing rigorously in an Earth-like climate model at the same time the climate response to e.g. changes in the CO_2 concentrations and the climate sensitivity, interpreted as zero-frequency response. This approach allows for eliminating the need for simulating many different CO_2 concentration scenarios, as formal mathematical operations can be used instead, and allows for treating in a unified way different climate observables (e.g. surface temperature, emission temperature) at different spatial resolutions. Same approach can be used for investigating the response of the climate system to changes in the solar irradiance.