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# The potential of explaining low-frequency temperature variability by a linear model

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The Earth surface temperature responds to both dynamical and stochastic forcing on a myriad of temporal scales, and the high thermal inertia of the ocean is the major reason for the time-delayed responses to the forcing. To understand how the surface temperature can have decadal- to millennial-scale variability – also in the absence of deterministic external forcing – it is crucial to understand the slow physical processes acting to redistribute heat between the surface and the deeper ocean layers.

We investigate how well the multiscale variability of the global sea surface temperature can be produced by a simple energy balance model, consisting of N vertically distributed boxes that exchange heat. In particular, we investigate the possibility of modeling the heat exchange in this N-box model using only linear terms. In addition, we investigate which criteria must be satisfied for this model to have a surface temperature that is well approximated by the observed scaling properties.

Potential temperature data from all vertical ocean layers in some CMIP5 models are used to estimate the parameters in the N-box model. Once we know these, we also have an estimate for the response/Green's function for global sea surface temperature. Furthermore, we can estimate the expected temperature variations both in the case of purely stochastic forcing and with any deterministic forcing. We should however keep in mind that these model parameters are derived solely from complex climate models, so it is also necessary to test this N-box model against observation data in order to verify/reject it as a suitable model.