



Multi parameter uncertainty analysis of a bifurcation point

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Parameter uncertainty analysis of climate models has become a standard approach for model validation and testing their sensitivity. Here we present a new approach in this field that allows investigating the robustness of a bifurcation point in a multi-parameter space. For this study we use a box model of the Indian monsoon that shows a saddle-node bifurcation against a parameter that governs the heat balance of the system. The bifurcation brings about a change from a wet summer monsoon regime to a one that is characterised by low precipitation what would certainly have a great impact on the local population. Therefore, the aim of this study is to come up with conclusions concerning the reliability of the bifurcation point within this model.

As the model contains a variety of physical parameters, the uncertainty analysis of this bifurcation point is twofold. We first carry out a multi-parameter global sensitivity analysis with 20 model parameters with respect to the occurrence and the location of the bifurcation point. From this preliminary survey we extract the five most sensitive parameters. We then scan this 5-dimensional parameter space on an equidistant grid for the appearance of the bifurcation point. This allows us to conclude the robustness of the occurrence of this bifurcation.

The innovative and model-independent methodology that we apply is based on the multi-run simulation environment SimEnv (<http://www.pik-potsdam.de/software/simenv>). The model is interfaced to the simulation environment and analysed by the bifurcation analysis software AUTO. With SimEnv samples are drawn from the parameter spaces. Each sample corresponds to the goal of the sensitivity and/or scan experiment. During experiment post-processing the combined parameter and model output space is navigated and several operators can be applied.