# Spatially explicit climate model evaluation with complex networks highlight challenges in modeling rainfall dynamics of the South American monsoon system

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In this study we introduce two local difference measures on complex networks which allow for a spatially explicit network-based evaluation of climate models. The utility of this approach is exemplified by the analysis of statistical and dynamical regional climate simulations of the South American monsoon system. We construct networks on precipitation data in two ways to characterize both the general rainfall dynamics and those of extreme events. An evaluation against TRMM data demonstrates the distinct levels of difficulty the models have reproducing the observations. While they perform comparably well in simulating the general rainfall networks they do much worse in the case of extreme rainfall with the dynamical model clearly outperforming the statistical one. The spatial distribution of errors is found to differ considerably between the two cases, most prominently in Amazonia, where the general rainfall networks are modeled with high but the extreme rainfall networks with poor accuracy. A comparison of the model performances to that of a suitable random network model shows that it is a priori more difficult to reproduce the extreme rainfall networks. However, we also show that this alone does not explain the large performance gap between the two network types.