Probabilistic cellular automata: an application in atmospheric sciences

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Clouds and convection are difficult to represent in global numerical weather and climate models. The poor representation of these subgrid processes results in model errors. Cloud feedback is the largest source of uncertainty in climate predictions. Therefore, new methods are needed to represent convective clouds. An emerging topic in atmospheric sciences is stochastic parameterization of subgrid processes including the use of probabilistic cellular automata.

We use a new method to parameterize convective clouds with data-inferred Markov chains and since clouds are often spatially organized we also introduce local interaction between the Markov chains. These spatially coupled Markov chains are effectively probabilistic cellular automata (PCA).

Challenges are: the statistical inference from data of the PCA having several states and the coupling of the PCA to the discretized partial differential equations used by weather and climate models. We will give two examples of the statistical data inference of the PCA: using high-resolution model data and observational radar data.