Abstract The parameterization of cumulus convection is still one of the great challenges in global climate modeling. After several decades of climate research and simulation of global climate, there is no satisfactory treatment of cumulus clouds in today's GCMs (General Circulation Models). In fact, the entire "cloud description" in large scale models remains an unsolved problem.
This work attempts to describe essential statistical characteristics of convective cloud fields in GCMs. In the first chapter, as a motivation, a concrete example is given for the importance of a real physical description of convection in global climate models. Since the climate system is a highly non-linear system, even a small change in the latent heat release due to convective clouds can lead to large scale effects in the global circulation.
In the further chapters we propose a new Convective Cloud Field Model (CCFM). Chapter 2 gives, both a mathematical and conceptual description of the model based on fundamentals of population dynamics. First model results are presented. Since the model proposed in chapter 2 is by far too time consuming for larger global climate simulations, we have developed a reduced and effective model version which is described in chapter 3. This reduced model, although much less complex regarding to the numerical cost, shows a very similar behavior to the full model. Both model versions are compared with LES model simulations. Since we intended to run the reduced model in a global GCM mode we give in chapter 4 some basic results of global experiments done with the reduced model. We show also some statistical cloud field data provided by our model. Finally, we end up with chapter 5. Here we give our concluding remarks, some concrete perspectives on how to use our model for future research, and a more general prospective.