Formation of Shallow Cumulus Patterns Using a Warm Cloud-Precipitation Competition Model

Michelle K. Kanipe [1] , Peter Jan van Leeuwen [1] , Graham Feingold[2]

[1](Presenting author underlined) Colorado State University, Fort Collins, Colorado
[2]NOAA Chemical Sciences Laboratory, Boulder, Colorado

Shallow cumulus evolution and self-organization into different cloud patterns is a complicated process, with many not well understood elements. To shed more light on the physical processes involved we study the dynamical behaviour of a simple predator-prey type model of warm cloud evolution, consisting of four nonlinear differential equations for vertical motion, cloud water concentration, rain water concentration, and cloud droplet concentration. Each evolution equation consists of simple parameterizations of the physical processes that control cloud growth and decay. Adjacent clouds are then coupled together across a 2D grid to describe the different processes of interaction and advection. These interactions are governed by the vertical motions within each cloud resulting in local circulations. By adjusting the method and strength of these interactions as well as the conditions of the surrounding environment we can see different patterns of shallow cumulus emerge, from the small randomly-distributed clouds colloquially known as sugar, to the larger clusters known as flowers. We then discuss the dominant drivers that produce these different patterns as they relate to observations in nature.