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Interactive comment on "A new convective cloud field model based on principles of self-organisation" *by* F. J. Nober and H. F. Graf

Anonymous Referee #1

This paper presents a cumulus parameterization that for the first time uses an ensemble of cumulus elements whose vertical velocities are treated AND allows for interaction among these cumulus elements. It's an important contribution to the literature on cumulus parameterization.

Cumulus vertical velocities are central to many of the interactions between cumulus clouds and large-scale flows. Interactions between convection, microphysics, and radiation are primary examples, as are aerosol-cloud interactions (including indirect effects of aerosols) and gravity-wave generation by deep convection. Despite this, only limited results are available on vertical velocities in deep convection. As this paper references, Naveau and Moncrieff (2003, incorrectly cited as 2001 in this paper) characterize vertical velocities in high-resolution cloud-model calculations, and Donner (1993) and Donner et al. (2001) construct and implement in an AGCM a cumulus parameterization

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including convective vertical velocities. Donner's approach uses observations of cumulus vertical velocities to construct a spectrum of entrainment rates, which are then used to build an ensemble of cumulus clouds using a cumulus model similar to that used here. (Holding the relative numbers of radii and vertical velocities at cloud base constant in the present paper would be roughly equivalent to using a fixed spectrum of entrainment rates.) Donner's approach does not allow for interactions among cumulus clouds. Two important questions regarding the approach in this paper arise: (1) How important are the cloud-cloud interactions? The simultaneous treatment of both vertical velocities and cloud-cloud interactions is the novel feature of the approach presented in this paper. It's very important to understand what adding cloud-cloud interactions does to change the behavior of the cumulus ensemble. (2) How realistic are the distributions of vertical velocities generated by the approach used here? The authors indicate agreement with LES is limited in their test case of shallow convection. Of crucial importance will be the behavior of these distributions for deep convection (as well as other aspects of deep convection, which are not treated in this paper). I am hopeful further research will answer these questions about the approach presented in this paper.

The AGCM implementation appears not to allow stratiform clouds to contribute to cumulus forcing, which is a detail which should be reconsidered. Also, the first CAPE on the right side of Eq. (6) should be $CAPE_i$, and the two equation references in the text on pages 3679 and 3680 should be to Eq. (7), not Eq. (9).

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 3669, 2004.

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