Atmos. Chem. Phys. Discuss., 14, C1115–C1117, 2014
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Basic convective element: bubble or plume? A historical review" *by* J.-I. Yano

Anonymous Referee #2

Received and published: 4 April 2014

The purpose of this review is to trace the historical development of the choice of whether bubbles or plumes are the most useful prototype for convective elements. The author does not take a stand one way or the other.

Though I found this review of the literature to be interesting and informative, it was unsatisfying toward the end as it glossed over many important points (some examples below) and did not really explain what key advantages and disadvantages of plumes vs. bubbles have been put forward in the literature. For example, in Section 8 it is stated that the bubble is experiencing a renaissance, but only one study is cited to support this, and nothing is said about why this study chose to support the bubble prototype.

Many technical terms (entrainment, detrainment, starting plume, jet, ...) are invoked

and are not explained at all, or are explained briefly later after they have been invoked (which will be frustrating to readers). A figure or two, perhaps simply illustrating a thermal and a plume and showing their key differences, would be very helpful.

I also was unconvinced by the author's claim that to incorporate bubbles it would be necessary to start from scratch and to develop time-dependent theories of convection. Kinematically, how is a steady plume any different from a steady stream of bubbles originating at plume base and rising to plume top? Indeed plume properties are usually based on "parcel" calculations. So I see no obstacle to reformulating steady plume theories in terms of bubbles. The converse however seems to be true: an unsteady model for convection, should we want one, would be better expressed in terms of bubbles rather than plumes. If the author still thinks I am wrong about this, he should explain better in the manuscript why existing plume equations cannot be trivially reinterpreted as describing a steady distribution of bubbles.

This begs the question of what difference it makes whether we think in terms of plumes or bubbles (assuming we continue with the steady convection assumption). The real difference must lie in the fluid dynamics, with flow around a bubble differing from subsidence around a plume, thus affecting the equations of motion for the rising entities. In most deep convective schemes, however, no such equations are explicitly used; instead, it is usually assumed that rising parcels simply stop when they become nonbouyant. Given this situation it seems almost not to matter whether one uses a bubble or plume, and I would say that this is the real reason plumes have been used: they are easier to think about, and it makes no difference which one one uses if one pays no attention to plume/bubble fluid dynamics. Do we need to worry about nonsteady convection in a parameterization? Do the dynamical differences between a plume and bubble matter? These questions need more comment in the article, in my opinion.

Some minor comments:

Everywhere. There are many grammatical mistakes, and this article needs to be read

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and corrected by a native English speaker.

3341:19 It is not obvious that the dynamic pressure is not negligible–please give a reference or explain.

3342:24-28 This description of a starting plume is not clear.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 3337, 2014.