

## Reply

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We are interested to hear Schwarz's remarks on the important question of the "additive vs distributive" role of embedded cumulus. We feel, however, that the question loses much of its meaning when applied to any area smaller than the total rainstorm, since, given a distribution of large-scale vertical motion, the role of cumulus becomes more additive the smaller the area considered. The drainage area studied by Schwarz is much smaller than the area covered by our winter

rainstorms, which was typically about 500,000 mi<sup>2</sup>.

The association between thunderstorms and heavy rain is to be expected; evidence to the contrary would have been surprising. We feel that the association is due to a third factor, warm moist air with small stability, which produces heavy storm-total precipitation in our cumulus-free model and produces numerous thunderstorms in the real atmosphere. Finally, we do not follow the reasoning in Schwarz's last paragraph.