

## Reply

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For many years the Israeli cloud seeding experiments were widely viewed as one of the few (if not the only) demonstrations that artificial cloud seeding can significantly increase precipitation on the ground. There were two reasons for its unique position in this respect. 1) It appeared to verify the venerable and plausible *static seeding* hypothesis, which postulated that augmentation of (naturally deficient) ice particles in clouds by artificial glaciogenic seeding can enhance precipitation. 2) It appeared to be supported by strong statistical results.

The importance in the Israeli experiments of *both* the physical hypothesis and its apparent statistical verification were emphasized by Dennis (1989) who stated the following.

The credibility of the reported rainfall increases from Israel I and II is due to impressive compilations of statistics and to Dr. Gagin's cloud physics studies, which provided a plausible explanation for the rainfall increases suggested by the statistical analyses. His pioneering work emphasized the continentality of convective winter clouds in Israel. He postulated that the lack of an active coalescence process in those clouds, coupled with a scarcity of natural ice nuclei effective at tem-

peratures above roughly  $-20^{\circ}\text{C}$ , made them ideal candidates for seeding with artificial ice nuclei to increase their precipitation efficiency. His successful attempts to combine radar observations, aircraft data, and raindrop observations at the ground into a coherent picture of the physical processes involved made the apparent rainfall increases credible.

The purpose of our paper (Rangno and Hobbs 1995) was to reevaluate both the physical and statistical arguments that have been advanced to support the thesis that artificial seeding increased (and sometimes decreased) rainfall in the Israeli cloud seeding experiments. We concluded that neither stands up to close scrutiny. Dennis and Orville (1997) do not question our conclusions in this regard. Rather, they suggest an alternative physical hypotheses, based on some numerical modeling results, which might conceivably still be used to support a seeding potential in Israel. We do not wish to comment on this speculation, other than to note that, like any seeding hypothesis, it should be based on measurements of the clouds in question (which it is not) and tested through randomized statistical experiments (which it has not been).

### REFERENCES

- Dennis, A. S., 1989: Editorial. *J. Appl. Meteor.*, **28**, 1013.  
 —, and H. D. Orville, 1997: Comments on "A new look at the Israeli cloud seeding experiments." *J. Appl. Meteor.*, **36**, 277–278.  
 Rangno, A. L., and P. V. Hobbs, 1995: A new look at the Israeli cloud seeding experiments. *J. Appl. Meteor.*, **34**, 1169–1193.

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