

Reply

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Ramage's comment on our earlier study of regression forecasting of the Indian monsoon seems to be based on his conviction that a new investigation on a subject with uncertain results by previous investigators should be discouraged through the professional organization.

On the first suggestion by Dr. Ramage that the *Bulletin of the American Meteorological Society* should compile negative research results to warn off others, it is only logical that scientific advancement has been and is made through challenge to formidable prob-

lems. In fact, I wonder if anyone in the scientific community should be allowed to hold such a license to decide the fate of science.

On the material criticism of our paper, we regret that our earlier results in Kung and Sharif (1980) were not at the level of our subsequent improvement, which was later published by Kung and Sharif (1982). I hope that the results of forecast experiments shown in our 1982 paper for the monsoon onset and rainfall (see Figs. 1 and 2) will support our viewpoint that the new attack on long-range forecasting of the Indian

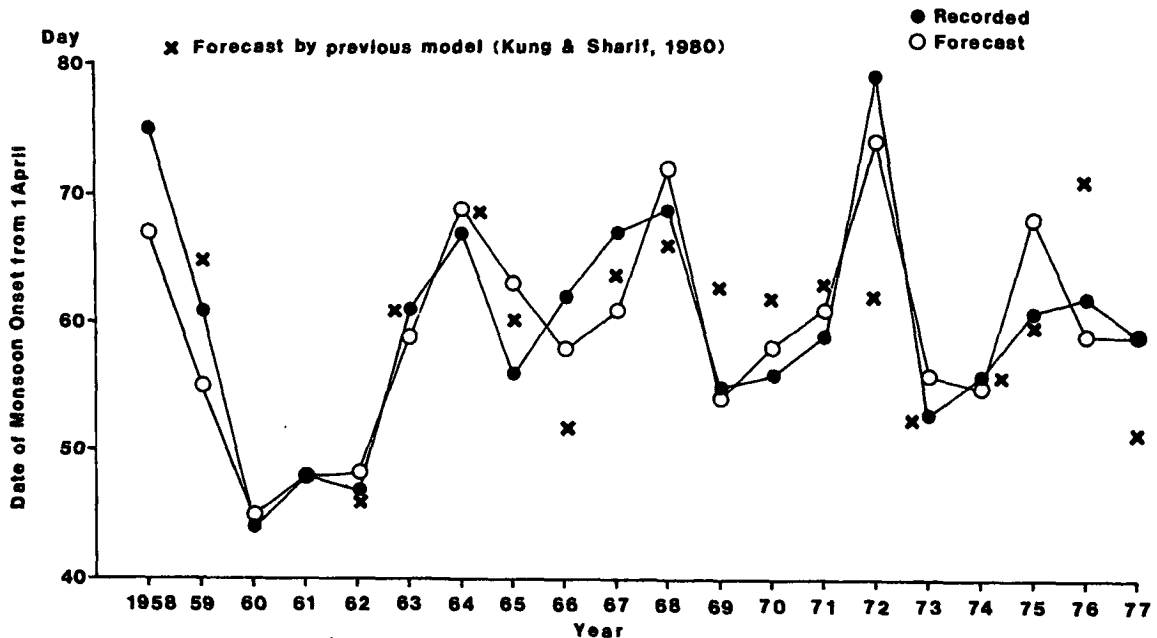


FIG. 1. The recorded and forecasted dates of monsoon onset on the Kerala coast from 1958 to 1977. [After Kung and Sharif, 1982.]

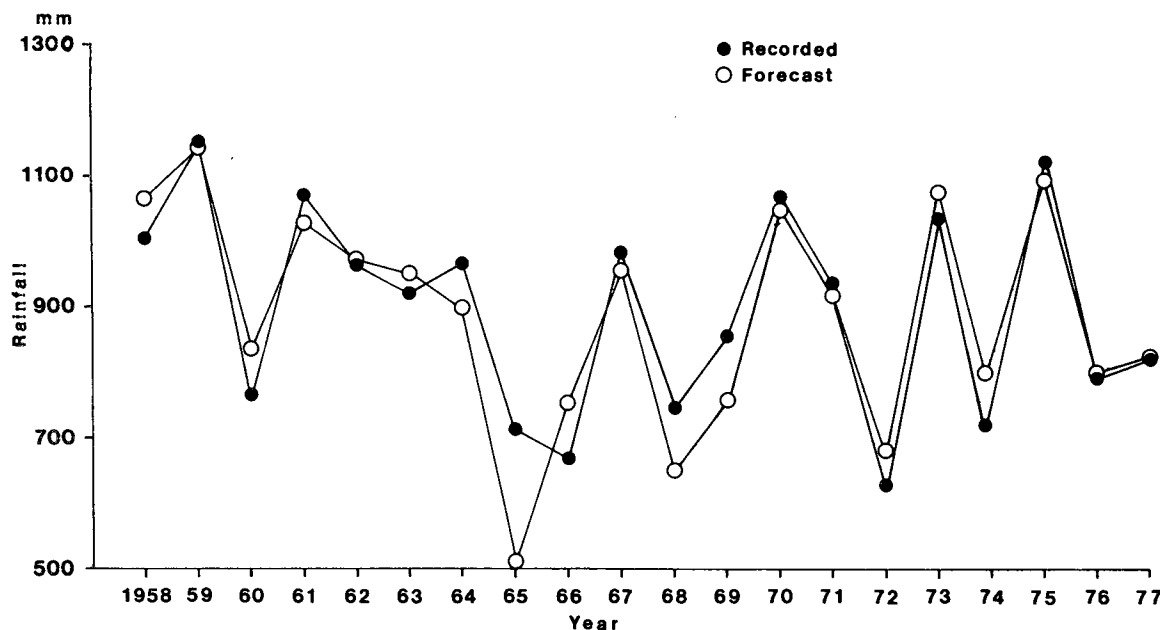


FIG. 2. The recorded and forecasted total seasonal rainfall in central India. [After Kung and Sharif, 1982.]

monsoon is sound. The forecasted date of onset and total seasonal rainfall in central India are both fairly close to the recorded dates and rainfall through the period of the experiment. The “extreme” year of 1972, as stressed by Dr. Ramage, is also well predicted. Our improved scheme for onset prediction reduced the number of predictors from eight to five, and forecast of the rainfall used six predictors. These parameters included upper air parameters over India and Australia and the sea surface temperature in the Indian region.

In the forecast experiments reported in our 1980 and 1982 papers, the data of the forecast year were excluded in evaluating regression coefficients, but the entire data base was involved in the selection of predictors at the beginning. In our continuing study in the transient eddy areas of the middle latitudes, we have revised the experiment scheme to reselect predictors and re-evaluate their coefficients both without involving the data of the forecast year. Our ongoing study (NSF-NOAA-NASA GARP Grant ATM-8108216) confirms that the selected predictors will stay the same during the experimental period, implying the general adequacy of our experimental procedures in previous reports.

We are aware of the enormous amount of work done by many in the past, including that of Ramage himself (1971). We pay due respect to those works of the past. Our position in doing this research is clearly stated in both of our papers. We recognize the fact that the regression cannot be stabilized. Indeed,

it is a basic nature of the general circulation whose patterns undergo continuous variations at various time scales. This is the basic premise of the alternative, workable scheme we try to develop. Our regression research also involves the examination of a large group of physical parameters without trying to prove a presumption of the physical mechanisms. There is a practical limitation to the size of the initial group of possible predictors. However, it is on the order of a thousand (Kung and Sharif, 1982), rather than a customary small group.

Dr. Ramage obviously believes that forecasting is out of order unless answers to all the physical problems involved are found. This would essentially deny the existence of forecast operations as well as techniques of parameterizations and approximations so extensively utilized in the numerical models. I hope that the result of our regression analysis in our papers will speak for itself by virtue of our effort and its distinction from the available past works.

REFERENCES

- Kung, E. C., and T. A. Sharif, 1980: Regression forecasting of the onset of the Indian summer monsoon with antecedent upper air conditions. *J. Appl. Meteor.*, **19**, 370-380.
- , and —, 1982: Long-range forecasting of the Indian summer monsoon onset and rainfall with upper air parameters and sea surface temperature. *J. Meteor. Soc. Japan*, **60**, 672-681.
- Ramage, C. S., 1981: *Monsoon Meteorology*. Academic Press, 296 pp.