Comments on "Time-Continuous Assimilation of Remote-Sounding Data and its Effects on Weather Forecasting"

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The Automated Forecast Method (AFM) presented by Ghil *et al.* (1979) is a novel approach and could make application of numerical model output useful, allowing for precipitation forecasts which differ from the circulation model's own internal parameterization. Without disagreeing with the stated justification for such an approach, one nevertheless wonders how well the GISS model's uncorrected precipitation forecasts would compete with those of the AFM. Indeed, six GISS model predictions verified by Druyan *et al.* (1975, Section 4) showed reasonable skill even up to two days. In contrast, the AFM verification which was described used a "perfect prognostic" (i.e., an analyzed rather than a forecast atmospheric state).

In reviewing the AFM decision procedure given in the Appendix (Ghil *et al.*), the question arises as to how the particular parameter intervals were chosen—empirically, theoretically, based on subjective experience, or to some extent arbitrarily. This is relevant because the outcome of a particular forecast hinges on whether one of the computed parameters falls to one or the other side of an interval limit. Also important is the order in which the checklist is tested.

Results of a limited study of moisture, vorticity advection and rainfall occurrence in Israel are relevant to this last point. The investigation used computer-drawn 500 mb vorticity charts and objectively-analyzed fields of saturation deficit (opera-

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tional analyses of the Israel Meteorological Service), both over areas including the Middle East and both twice daily, at 0000 and 1200 GMT. The advection of the absolute vorticity over Isreal was estimated subjectively and categorized on a scale of 1 to 5, from strong negative (NVA+) to strong positive (PVA+) with 3 indicating neutral vorticity advection. The saturation deficit was interpolated to the same region and recorded. These vorticity and moisture characteristics were matched with the precipitation record at Bet Degan (near Tel Aviv) which gives the accumulation for the 24 h period ending at 0600 GMT. Examination of data from six winter months of different years showed a cutoff value of saturation deficit (corresponding to a mean lower tropospheric relative humidity of <70%). When achieved at either synoptic time, this accounted for 83% of all the days of reported precipitation (including a trace) while 81% of the days on which this condition was satisfied included at least one rain observation. However, the rain days did *not* show a preponderance for PVA nor a higher frequency of PVA than the rainless days in any moisture interval, and most of the rainless days, even when moist, were not influenced by NVA.

Considering that most rain-producing systems influence Israel for at least 12 h, it is not likely that significant vorticity advection was missed between map times. One might imagine that local, nonsynoptic mechanisms are operating were it not for the common experience of forecasters that almost all rain events are connected with upper air cyclonic systems. It is conceivable that weak but significant vorticity advection areas were classified neutral by visual inspection, thus causing misleading results. More likely, the computed vorticity advection does not adequately represent the dynamic processes relevant to precipitation: the 360 km grid spacing may not be optimum, the network of radiosonde stations over the eastern Mediterranean may be too coarse and the sense of advection at the single level sometimes may not reflect the sense of the vertical variation of vorticity advection as intended. However, the problem could be a general one; in statistical testing by the Techniques Development Laboratory, NOAA, vorticity advection was found *not* to be a useful predictor of precipitation probability or amount over the United States (W. Klein, personal communication).

The question, "What is the optimum horizontal resolution for computing the vorticity advection which represents the precipitation-causing processes?" is perhaps addressed by the authors' use of 12 points rather than four in the computation; these might have given a just-smooth-enough representation. In any case, there is room for additional investigation of the efficacy of the vorticity advection test within the overall AFM.

REFERENCES

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