

## Reply

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We appreciate the comments provided by Kahl (1990) concerning our paper (Stocker et al. 1990).

The author of the Comment is correct and has pointed out effectively that sparse upper-air data and coarse time resolution can result in the incorrect representation of the movement of air parcels in a trajectory model. Unfortunately, while randomly perturbing the wind field to simulate spatial and temporal interpolation errors can assist in providing a perspective regarding the accuracy of a trajectory, it cannot represent the effects of coherent atmospheric structure on a scale smaller than the resolution of the radiosonde network. Such structure includes thermal- and terrain-forced mesoscale circulations, areas of deep cumulus convection, etc. that can dramatically influence the dispersion of initially adjacent air parcels. Even diurnal

variations of boundary layer structure and/or a horizontally homogeneous geostrophic thermal wind can substantially influence dispersion patterns as illustrated in McNider et al. (1989).

As a result of such dispersion, due to temporally and spatially varying mesoscale and synoptic vertical and horizontal winds and to turbulent diffusion, a single meandering balloon will *not* generally be entrained into a well-defined mean flow (e.g., see Pielke et al. 1987a,b). Even an ensemble of releases will not represent a useful mean flow if the spatial variability of the flow is large. Figure 1 from Stocker et al. (1990) demonstrates this point. This figure shows the balloon and model trajectories from Los Angeles, California and suggests that an ensemble average is meaningless for this case. A single balloon does not always tend towards the mean flow due to the dominance of mesoscale circulations under certain synoptic conditions.

Finally, since a substantial part of the actual trajectories are influenced by coherent (rather than random) atmospheric effects, even long-term pollution studies will be inaccurate unless these coherent effects are included.

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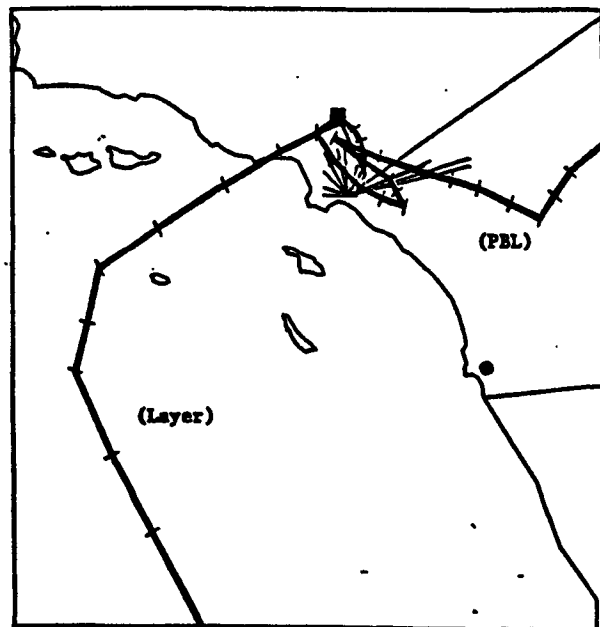


FIG. 1. Comparison of balloon and ATAD results for a light wind polar high situation. PBL and layer trajectories along with balloon resultant motion from Los Angeles, California, are shown (solid square represents ATAD origin, solid circle represents nearest sounding).