

Reply

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We appreciate the kind remarks in Telford's comment on the papers by Wilczak (1985) and Wilczak and Businger (1985).

The main issue that Telford raises is one of semantics. He is critical of our use of the term "ramp" in identifying coherent turbulent structures in the surface layer; instead he prefers the term "plume" and suggests that we have introduced new names to describe old and well-established observations.

We agree with Telford that one's choice of words can have a major impact on ideas. It is precisely for this reason that we opted to use the more general and descriptive term "ramp," rather than plume.

Contrary to Telford's belief, we have not introduced "new names for old observations," but have chosen to use terminology which has been commonly accepted in turbulent flow research for almost two decades (Gibson et al., 1966; Gibson et al., 1977; Antonia and Chambers, 1978; Antonia et al., 1979; Phong-Anant et al., 1980; Antonia et al., 1983).

The reason for the generally accepted use of the term "ramp," instead of "plume," is that ramp structures have been shown to be a common feature of scalar fields mixed by sheared turbulence (Gibson et al., 1977) even in situations of neutral or stable stratification (Chen, 1975; Friehe et al., 1975; Kaimal et al., 1976). Since "plume" implies a buoyantly driven structure, it is an inadequate term to describe all cases of observed ramp structures. Antonia et al. (1979) provide a thorough discussion of this issue.

In the shear-convective surface layer, large scale eddies are influenced by both shear and buoyancy, and therefore exhibit similarities to pure thermal plumes as well as to strictly shear generated coherent structures. Wilczak and Tillman (1980) discuss many of these similarities, and point out some of the important differences.

In our present study we have attempted to link much of the work done on coherent structures in the unstably

stratified surface layer to work done in conditions of neutral and stable stratification, both in the atmosphere and laboratory. For this reason we chose to describe the coherent large scale eddies as "ramp structures," while acknowledging earlier observational studies describing a subset of them as "plumes" (Taylor, 1958; Priestly, 1959; Kaimal and Businger, 1970; Kaimal, 1974; Davison, 1974; Manton, 1977; Khalsa, 1980). The conceptual sheared-plume model of Kaimal and Businger (1970) offers explanations for many of the observed characteristics of ramps in the shear-convective surface layer.

Finally, we appreciate that Telford has taken the initiative to describe in detail the many similarities between surface layer ramps and cumulus clouds. Insofar as both structures exist in a shear-convective environment, it is not surprising that similarities exist in many of their features.

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