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ZERO RELATIVE VORTICITY LINE STUDY

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INTRODUCTION

It has been stated (Rosendal, 1976) that the zero relative vorticity line (ZRVL) calculated from the 500 mb vorticity charts often corresponds to surface frontal positions. A study was carried out in October, 1980 in which the ZRVL and frontal positions over the Pacific Ocean and the west coast were compared.

Twenty cases were examined: 19 12Z cases (October 5-16, 19, 20, 23-27) and October 16 at 00Z.

The frontal systems in these cases were classified into three general types to facilitate the analysis:

1. upstream systems - those systems west of 145°W.
2. coastal systems - those systems east of 145°W but with most of their length over the Pacific and at most a small part over land.
3. continental systems - those entirely over western North America.

In the comparison of the ZRVL with the surface frontal positions, the "fit" was characterized in three ways:

1. good fit - ZRVL everywhere within 1 degree latitude of the frontal position.
2. reasonable fit - ZRVL everywhere within 3 degrees latitude of the frontal position.
3. poor fit - otherwise.

In general, it was observed that warm fronts, occluded-type systems, and frontal waves (with the exception of very flat waves) were invariably poorly modelled by the ZRVL. The remainder of the study therefore concentrates on cold fronts and trowals and their relation to the position of the ZRVL.

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UPSTREAM SYSTEMS

Twelve such systems were studied. The fit was poor in ten cases, and reasonable in two, although in one of the reasonable cases the fit was good over most of the length of the front, and in one of the poor cases the fit was reasonable over about half the length of the front.

In three cases reanalysis of the surface frontal position so that a good fit results is possible. In a further three cases, a reasonable fit resulting from a slight reanalysis is possible. In the remaining six cases, however, the differences are so great that the poor fit cannot be improved by a reanalysis. Thus it was found that the ZRVL technique was not very useful in the case of upstream systems. The 500mb analyses themselves were undoubtedly at times in error. The two different analyses used (the Canadian spectral and the LFM 500mb analyses) were, however, generally similar, and gave similar positions for the ZRVL. The six poor cases were indeed so far out that even some modification in the 500mb analyses would not improve the fit.

COASTAL SYSTEMS

Seventeen such systems were studied. The fit was poor in nine cases, reasonable in seven cases and good in one case. In four of the poor cases, however, the fit was reasonable on part of the system.

In two of the poor cases, a reanalysis of the surface frontal positions is possible so that the fit becomes reasonable, while in five of the reasonable cases it was judged that a possible slight reanalysis of the surface features would make the fit good. After this process, we end up with seven poor, five reasonable and five good fits. For these coastal systems, then, the number of good or reasonable fits is relatively higher than for upstream systems, while the number of poor fits is correspondingly lower, so that in this case we have somewhat more confidence in the ability of the ZRVL to approximate the analysis position of the surface cold front and trowal than in the upstream case.

The spectral and LFM analyses used were generally similar and felt to be reasonable. We conclude that in the case of coastal systems, the ZRVL can at times be a useful aid in the definition of cold frontal and trowal positions. The fit in the sample did vary substantially, however, from good through poor. At best, the ZRVL should be used in this case only in conjunction with other variables commonly used to locate frontal positions, as it is not reliable enough on its own. One complicating factor is that the 500mb analysis may be more reliable near the coast, where there are radiosonde stations to "anchor" the analysis, than out in the Pacific where there are none (of course, the data from one or more of the stations are at times rejected in the analyses). Indeed, the larger number of good or reasonable fits relative to poor fits in coastal

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systems as compared to upstream systems may be the result of this factor.

CONTINENTAL SYSTEMS

Five such systems were studied. In two cases the fit was poor, and in one case the fit was reasonable. In each of the other two cases, two surface fronts were analyzed, and the ZRVL split the difference between the two. Rosendal has stated that the ZRVL is a useful tool for finding fronts in mountainous terrain. These cases may possibly be an illustration of that point. However, I consider the number of cases to be too small to draw any conclusions concerning these continental systems.

Reference: Rosendal, Hans E., "The Zero Relative Vorticity Line at 500mb as Related to Precipitation and Surface Fronts:, Sixth Conference or Weather Forecasting and Analysis Preprints, 1976, Albany, New York.