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Thunderstorms and Fine Tuning The Area of Activity

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INTRODUCTION

While numerical guidance and various assortments of stability indices can aid forecasters in determining potential areas of convective activity, their usefulness at times is questionable because such guidance often fails to delineate areas of little convective activity from areas of extensive activity.

In this note, a situation where satellite pictures could be used to fine-tune the area of convective activity is examined.

CIRCULATION

The last week of April 1979 was characterized by an omega block shown in fig. 1a. The upper ridge extended from eastern Alaska to Idaho. Further west, the circulation was dominated by a west-southwesterly flow towards the Northwestern States which split into 2 branches - one branch heading for the Gulf of Alaska with a second branch across the Central Western States. In effect, the branching resulted in the formation of a zone of diffluence or a deformation zone across the Northwestern States, and northwestward along Vancouver Island. To the east, the slow eastward movement of a large low pressure center over northern Manitoba resulted in a corresponding slow eastward movement of the long wave pattern over western Canada.

CONVECTIVE ACTIVITY LIMITED BY A DEFORMATION ZONE

At the start of the time period in question, extensive heating had taken place over the interior of the Northwestern States where daytime maximums were reaching the low thirties. In contrast, a deep marine layer had kept coastal temperatures in the upper teens. Aloft to the southwest, there was a large trof. Between April 29 and 30, there was a large change in the absolute vorticity offshore (fig. 1b). The following day, the area of greatest change in absolute vorticity has moved northwest with another area further east. This would indicate the passage of one of a series of short waves which moved through the trof and then into the diffluent area. Once in the diffluent zone, one portion of the shortwave moved into Idaho and another portion into the Gulf of Alaska. The continued influx of small scale shortwaves along with the attendant cold air and upper level moisture maintained an easily identifiable deformation zone on the satellite pictures (fig. 2). As well, the deformation zone discernible on the 250 mb charts can be seen advancing towards southwestern B.C. during the period (fig. 1a)

As the deformation zone moved eastward across the coast and over the warmer areas of the interior, extensive convective activity is triggered - the convective activity progressing northeast in line with the movement of the zone.

Fig. 3a to 3e is the cumulation of all weather reports for 23z, 00z and 01z for all stations available from the SA's for the areas of interest. (N.B. Where virga is indicated, there was associated CB activity.) The scallopped shaded edges on fig. 3 shows the position of the deformation zone as inferred from the satellite picture. As can be seen, the cloud edge closely parallels the areas of convective activity throughout the period.

BEHAVIOUR OF THE LFM LI, SLY, and K INDICES

Figure 4a to 4d shows the LFM actual LI at 00z with the corresponding 24 hour LI forecast. Throughout the period, the LFM continually failed to properly distribute the appropriate amount of energy associated with the migrating shortwaves to the stream south of B.C. Hence, it failed to account for the cooling aloft associated with that segment of the shortwave moving towards Idaho.

Fig. 5b shows the behaviour of the LI, K, and Sly Indices as derived from the tephigrams during the 3 days. The behaviour of the indices of Prince George is similar to the behaviour of the indices at Vernon and Spokane, yet the convective activity is limited to areas well south of Prince George. It is obvious that the indices have failed to differentiate areas of no activity from those having extensive activity.

However, there exists one feature unique to the Northwestern States and southwestern B.C. which is not found elsewhere - the deformation zone. Fig. 5a is the tephigram for Spokane during the period. One significant fact that stands out is the temperature change above the 500 mb level which occurs at Spokane during the passage of the deformation zone. The largest temperature change occurred between April 28 and 29 with little additional change between April 29 and 30. The largest change is initially above the 500 mb level - at a level not included in most indices used by the forecasters.

SUMMARY

In many situations, the instability indices may flag the forecasters as to the potential of convective activity in a given geographical area. However, to avoid giving the broad brush treatment and to better fine-tune areas of convective instability, it becomes necessary to examine higher level charts and satellite pictures for features that at first appear insignificant.

During this particular period under examination, the course of events was spread over 3 days. However, the significance of the deformation zone was recognized too late to have been of use for delineating areas of no convective activity from areas of convective activity. The problem arises as to how to document and keep track of these seemingly innocuous upper air features, lest they get lost during the course of normal office operations. Possibly, with the introduction of the new Satellite Section at PWC, new methods for documenting these features along with their surface phenomena can be investigated and developed for quick and easy access by the operational forecasters.

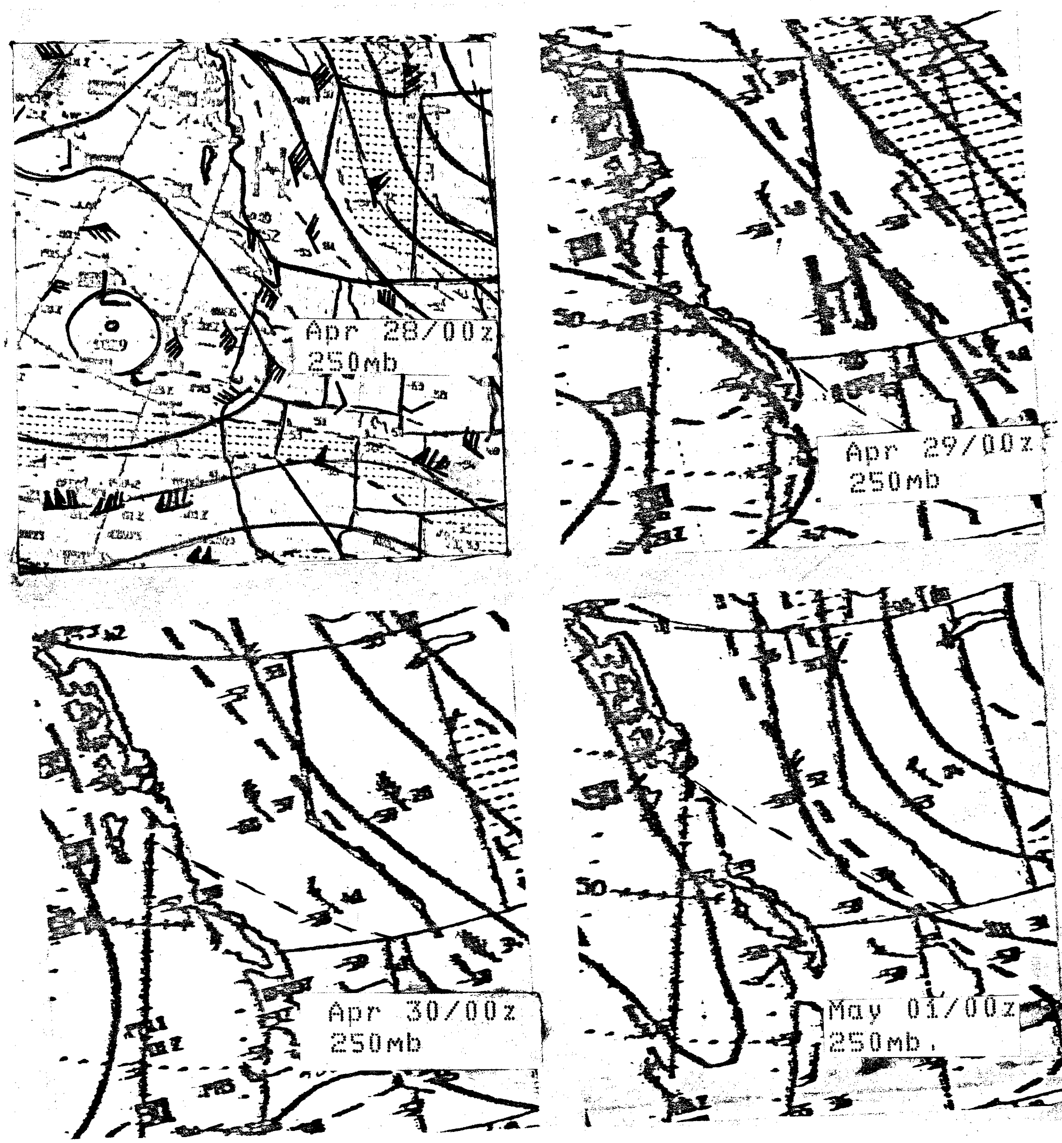


Fig. 1a. The 250mb flow pattern over BC during the period. The dashed line is the position of the deformation zone as extracted from the satellite picture.

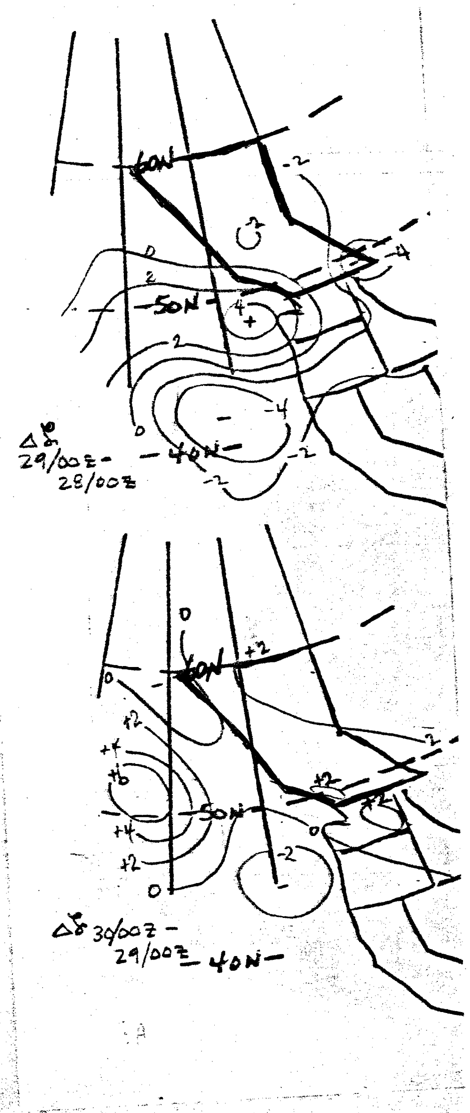
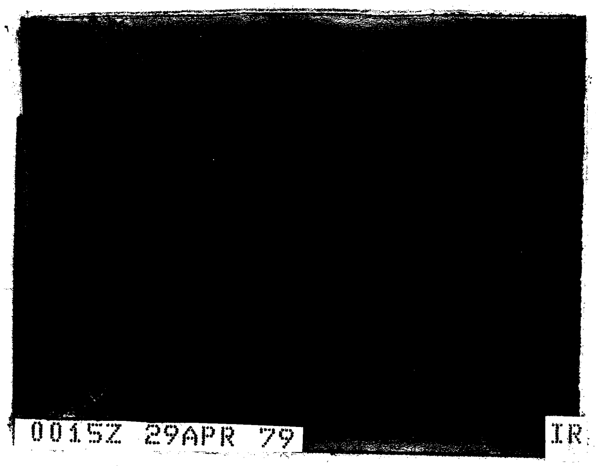
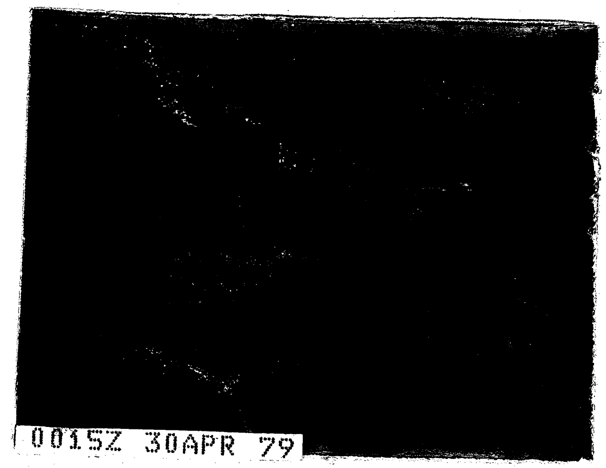
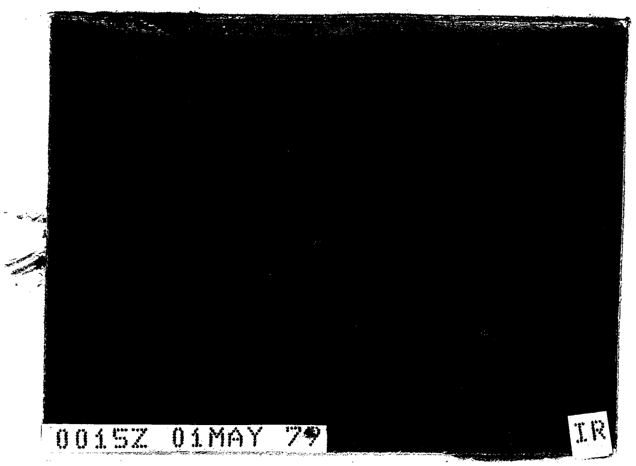


Fig. 1b. The change in absolute vorticity over the region between Apr 28 and 29 and Apr 29 and 30 as extracted from the LFM analysis.







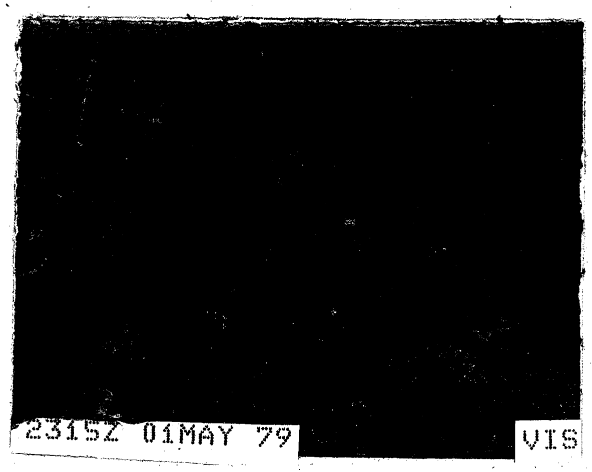


Fig. 2. Satellite pictures showing the slow eastward movement of the deformation zone.

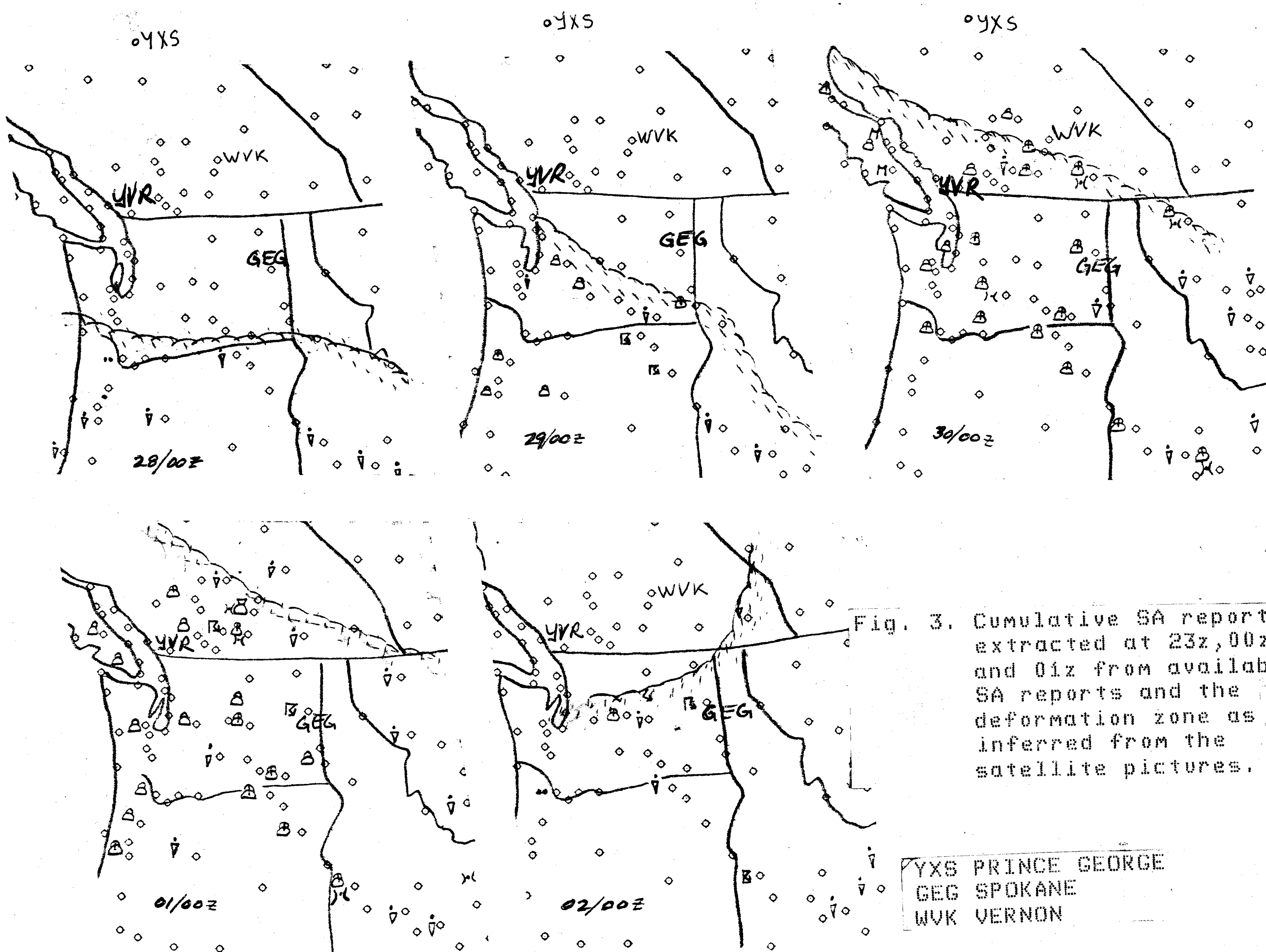


Fig. 3. Cumulative SA reports extracted at 23z, 00z, and 01z from available SA reports and the deformation zone as inferred from the satellite pictures.

YXS PRINCE GEORGE
GEG SPOKANE
WVK VERNON

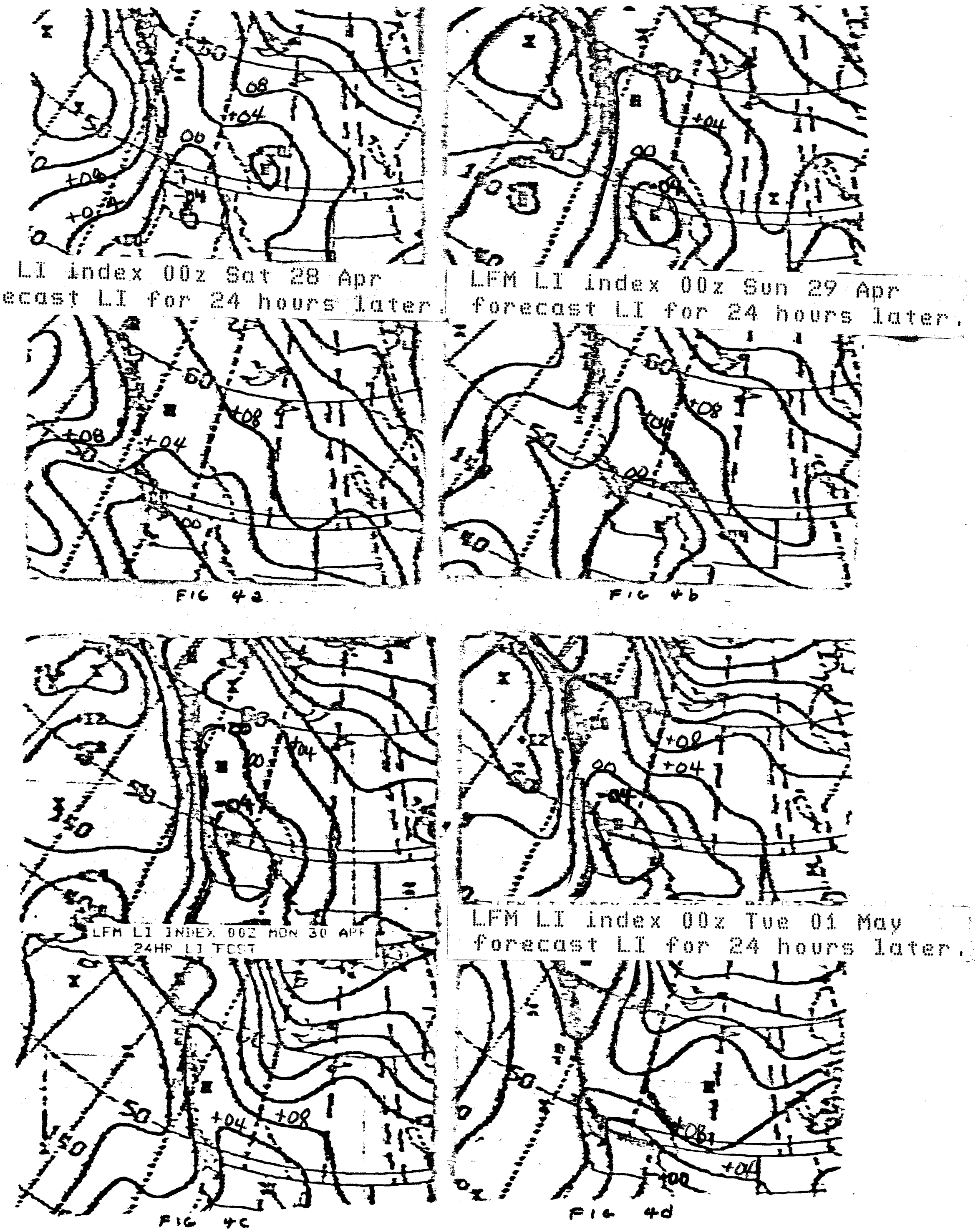


Fig. 4. The actual LFM LI indices for 00z and the 24hr forecast of the LI for a 4 day period.