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VERIFICATION OF CMC VORTICITY ANALYSIS

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AN ANALYSIS OF THE LOCATIONS, INTENSITIES AND SHAPES OF ABSOLUTE VORTICITY MAXIMA AS FOUND ON THE EARLY 500 MB SPECTRAL ANALYSIS PRODUCED BY CMC COMPARED WITH THE LOCATIONS, INTENSITIES AND SHAPES OF ABSOLUTE VORTICITY MAXIMA AS FOUND ON THE GOES SATELLITE IMAGERY DURING THE MONTH OF FEBRUARY 1978.

INTRODUCTION

In most cases locations of vorticity centers , vorticity advection areas and the shape of vorticity advection areas are highly correlated to important weather events at our latitudes. These events may be areas of cloudiness, precipitation areas or areas where wind velocities may be quite high. Until the advent of Goes imagery it has not been possible to assess the accuracy of a computer produced analysis over data (upper air) sparse regions with any degree of confidence. Granted some assumptions can be made from surface synoptic data andhow these relate to some frontal concepts. However, this approach seems highly unsatisfactory since on the GOES imagery changes have frequently been noted that would escape any previously conventional analysis methods. Beginning on the first of February the Goes imagery as received at the Pacific Weather Center was examined in some considerable detail and part of the examination included an assessment of the CMC initial analysis at the 500 MB level. This analysis in effect deals with the results of these examinations.

PROCEDURE

1. All vorticity centers as they appeared on the satellite imagery were noted and transferred to the initial CMC 500 mb analysis.
2. The shape of the vorticity advection areas was related to the implied cloud patterns on the satellite imagery and also transferred to the CMC 500 mb analysis.
3. The intensity of the vorticity advection areas was related to the cloud types the upper level flow pattern and indications from surface synoptic data.
4. The distance between the implied location of the vorticity center on the satellite imagery and its location on the 500 mb chart was noted in degrees latitude as was the direction from the implied satellite center. (090 degrees means that the satellite center was to the east of the 500 mb center, and 270 degrees means that the satellite center was to the west of the 500 mb center)
5. Subjective assessments of good, fair or poor were assigned to the intensity and shape of the vorticity patterns.

6. A system was classed as major if there was a clearly identifiable dry slot associated with the satellite imagery. In all cases a system classed as major had a surface system associated with it.

7. Only that part of the Pacific from the North American coast to the date-line was examined since the satellite imagery of the UC-2 sector ends about at the date-line.

8. Only the shapes and intensities of vorticity centers that were found to be within one degree from the satellite imagery implied locations were examined. In other words how well did these patterns correspond to implied cloud structures when the location of a system was deemed to be correct.

DISCUSSIONS

1. If one assumes that an accuracy in location of vorticity centers of two degrees latitude or less will produce an acceptable analysis; then slightly more than half of the vorticity centers which occurred over the Pacific east of the date-line were analysed adequately with respect to position. This was true for all systems examined as well as for major systems. A two degree error in location at an average speed of 40 knots will produce a timing error initially of about 3 hours in a forecast. It is interesting to note that the extemely large position errors occurred with major systems. It should also be noted that eight systems did not appear on the 500 mb analysis at all although these systems were identifiable on the satellite imagery. Furthermore, one of these eight systems was a major system.

2. Not too much can said about the directional error associated with position errors. In general the systems were analysed too far to the west of the indicated satellite position. This would probably indicate a subsequent slowness for the resulting prognoses. For the large position errors this also appeared to be true.

3. When the shapes and intensities of the 84 good position reports were examined it was found that the intensities were better analysed than the shapes of the vorticity patterns. An adequate representation of these two indicators would have occurred in 50 to 75 percent of the systems that were located correctly. This would indicate that if one were to demand that both the location and the shapes and intensities of vorticity patterns be correct then for the Pacific area this would occur in less than 50 percent of the systems that occurred in February.

4. An examination of the location errors as one approaches the west coast of Noth America showed that out of 22 systems east of 130W longitude 18 were adequately positioned. Similarly, out of the 22 systems 18 were adequately represented with regard to shape and intensity. Also of the 13 systems correctly located only 2 showed poor shape and intensity patterns. This leads one to conclude that the influence of the one-sided data distribution along the coast raises the position correctness to about 75 percent while at the same time the shape and intensity correctness on perfectly located systems is raised to above 75 percent. It should also be noted that the three five degree position errors that did occur were located at 130W longitude.

5. An examination of the large position errors indicates that these are confined to an area bounded by latitudes 30N and 50N and longitudes 135W and 180W. This coincides with an area completely without upper air soundings. Similarly, six of the systems which were completely missed on the analysis also fell into this region. The other two systems which were missed coincided with the occurrence of missing upper air soundings at Annette, Alaska.

6. Furthermore, an examination of the 12Z 500 mb data as compared to the 12 hour 500 mb prognosis prepared from the 00Z data revealed that there was no assurance that the 12Z 500 mb analysis was better than the 12 hour prognosis. In more than a few cases the 12 hour prognosis was actually better than the 12Z analysis.

7. Unfortunately, no similar analysis could be carried out for the LFM or PE models, since the initial analysis of these models is not received at the Pacific Weather Center. However , the prognostic performance of the PE and the CMC spectral models is attaced and clearly shows that during the month of February the PE outperformed the CMC progs over the Pacific Region by a considerable margin. Was this due to better initial analysis? It is planned to carry out an analysis of the effect of poor initial analysis on the prognosis of the spectral progs after the end of March.

LOCATION OF VORTICITY CENTERS

DISTANCE BETWEEN IMPLIED SATELLITE CENTER AND VORTICITY CENTER ON 500 MB CHART	NUMBER OF CASES	
ONE DEGREE LATITUDE OR LESS	84	
FROM ONE TO TWO DEGREES LATITUDE	27	
FROM TWO TO THREE DEGREES LATITUDE	18	
FROM THREE TO FOUR DEGREES LATITUDE	23	
FROM FOUR TO FIVE DEGREES LATITUDE	15	
FROM FIVE TO SIX DEGREES LATITUDE	2	
FROM SIX TO SEVEN DEGREES LATITUDE	1	
FROM SEVEN TO EIGHT DEGREES LATITUDE	2	
FROM EIGHT TO NINE DEGREES LATITUDE	1	
FROM NINE TO TEN DEGREES LATITUDE	2	
TOTAL	175	
NUMBER OF VORTICITY CENTERS NOT ON 500 MB CHART BUT IMPLIED ON SATELLITE IMAGERY	8	ONE MAJOR
GRAND TOTAL	183	
NUMBER OF VORTICITY CENTERS ON 500 MB CHART BUT NOT EVIDENT ON SATELLITE IMAGERY	2	

AVERAGE SPEED OF VORTICITY MAXIMA DURING MONTH OF FEBRUARY

35 to 45 KNOTS

DIRECTIONAL ERROR RELATED TO DISTANCE ERROR

DISTANCE ERROR IN DEGREES LATITUDE

FREQUENCY OF DIRECTIONAL ERROR	2	3	4	5	6	7	8	9	10
	9-090	6-090	5-360	8-090	1-060	1-360	1-060	1-090	2-090
	3-060	6-360	4-060	1-060	1-280		1-070		
	3-130	2-060	4-090	1-180					
	3-180	1-080	2-270	1-270					
	3-270	1-270	1-020	1-360					
	2-360	1-280	1-140	1-130					
	1-280	1-130	1-220	1-120					
	1-230		1-110	1-080					
	1-120		1-130						
	1-070		1-230						
			1-120						
			1-180						
TOTAL NUMBER OF SYSTEMS	27	18	23	15	2	1	2	1	2

DIRECTIONAL ERROR OF MAJOR SYSTEMS RELATED TO DISTANCE ERROR

DISTANCE ERROR IN DEGREES LATITUDE

FREQUENCY OF DIRECTIONAL ERROR	2	3	4	5	6	7	8	9	10
	3-090	3-360	3-090	5-090	1-280		1-060	1-090	2-090
	2-360	2-060	2-060	1-080			1-070		
	1-070	1-090	1-230	1-130					
	1-180		1-270	1-360					
	1-130		1-360						
	1-060		1-020						
			1-110						
TOTAL NUMBER OF SYSTEMS	9	6	10	8	1	0	2	1	2

SHAPES OF VORTICITY PATTERNS

GOOD	FAIR	POOR	TOTAL
55	15	22	92

OF THOSE WHICH RATED POOR 12 WERE MAJOR SYSTEMS

OF THOSE WHICH RATED FAIR 2 WERE MAJOR SYSTEMS

INTENSITIES OF VORTICITY PATTERNS

GOOD	FAIR	POOR	TOTAL
70	6	16	92

OF THOSE WHICH RATED POOR 4 WERE MAJOR SYSTEMS

OF THOSE WHICH RATED FAIR 1 WAS A MAJOR SYSTEM

NOTE: IN THE TOTAL OF 92 ARE INCLUDED THE EIGHT SYSTEMS WHICH DID NOT APPEAR ON THE 500 MB CHARTS BUT WERE IDENTIFIED ON THE SATELLITE IMAGERY, AND THESE HAVE BEEN RATED AS POOR BOTH IN SHAPE AND INTENSITY.

COMPARISON OF CMC AND PE S1 SKILL SCORES FOR FEBRUARY, 1978

MEANS

	CMC	PE	WO
FULL GRID	.85	.69	.68
BC AREA	.89	.70	.65
NO. OF PE PROGS		52	
NO. OF CMC PROGS		56	

FULL GRID COMPARISON

	PE	CMC
WO BETTER	25	51
WO EQUAL	4	0
WO WORSE	23	5

NOTE- EQUAL MEANS DIFFERENCE IN SCORES IS .005 OR LESS.