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SATELLITE IMAGERY AND THE EVOLUTION OF A CUT-OFF LOW

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INTRODUCTION.

The decision whether or not a cut-off low will form in a meridional trof situation usually has profound implications as to the subsequent weather regimes. If a cut-off low forms, the baroclinic zone associated with a meridional trof will change dramatically. No longer will warm frontal waves move northeastward to the east of the trof with the possibility of some major cyclogenesis, but instead that portion to the east of the trof generally most subjected to cloud and precipitation may come under the influence of a weak high aloft as the cut-off develops and the main circulation shifts further north. Satellite imagery can provide valuable clues as to whether a cut-off low is about to form, and also to some degree on the location and intensity of the cut-off low.

DISCUSSION.

The following satellite pictures and 500 mb. maps are attached:

1. June 3. 1978, 1215Z enhanced Ir
2. June 3. 1978, 2315Z Visible
3. June 4. 1978, 1215Z enhanced Ir
4. June 4. 1978, 2315Z Visible
5. June 5. 1978, 1215Z enhanced Ir
6. June 5. 1978, 2315Z Visible
7. June 3. 1978, 1200Z 500 mb. analysis
8. June 4. 1978, 0000Z 500 mb. analysis
9. June 4. 1978, 1200Z 500 mb. analysis
10. June 5. 1978, 0000Z 500 mb. analysis

It should be noted that the 500 mb. analyses are those transmitted from CMC for Run 0, and they have been included to show the general flow patterns. No attempt has been made to fit the vorticity advection patterns to the satellite imagery, and careful examination of the imagery does reveal areas where the analyses appear to be incorrect.

The imagery for 1215Z of June 3. indicates a deep meridional trof along longitude 150W. To the east of this trof considerable high and middle clouds are shown on the picture, while cold air has penetrated well to below latitude 40N between longitude 145W to 155W. There appears to be little evidence of easterly winds to the north of 50N latitude along longitude 145W. This is supported by the 500 mb. analysis for 1200Z of June 3., where this analysis shows a very slack wind field from 50N latitude to the southern coast of Alaska along 150W longitude.

The visible imagery for 2315Z of June 3. still shows baroclinic zone cirrus to the east of the trof, cold air from latitude 45N southward along 150W longitude and evidence of stable low clouds to the north of 45N latitude along longitude 150W. The 500 mb. analysis for June 4. 0000Z supports the general flow patterns indicated on the imagery.

The satellite picture of June 4. 1215Z indicates some marked changes which are in progress. To the north of the cold, convectively unstable air the high level clouds

are now moving westward, and the characteristic comma shape can be noticed in the high level cloud structure. To the south of the westward moving high level clouds the cold, convectively unstable air is now moving eastward. Furthermore, at latitude 55N between longitudes 130W and 140W the high and middle clouds are diminishing rapidly. The frontal zone which in the 1215Z picture of June 3. was oriented southwest to northeast is now taking on a distinct cyclonic curvature. It is quite likely that by this time more of an easterly circulation should be shown on the 500 mb. analysis for June 4. 1200Z between latitudes 40N and 45N and between longitudes 140W and 150W.

By 2315Z of June 4. the cut-off is complete. One can see the characteristic dry slot, comma shape and deformation zone. The 500 mb. analysis for June 5. 0000Z supports this cut-off, but the vorticity pattern on the analysis does not fit the cloud patterns on the imagery too well.

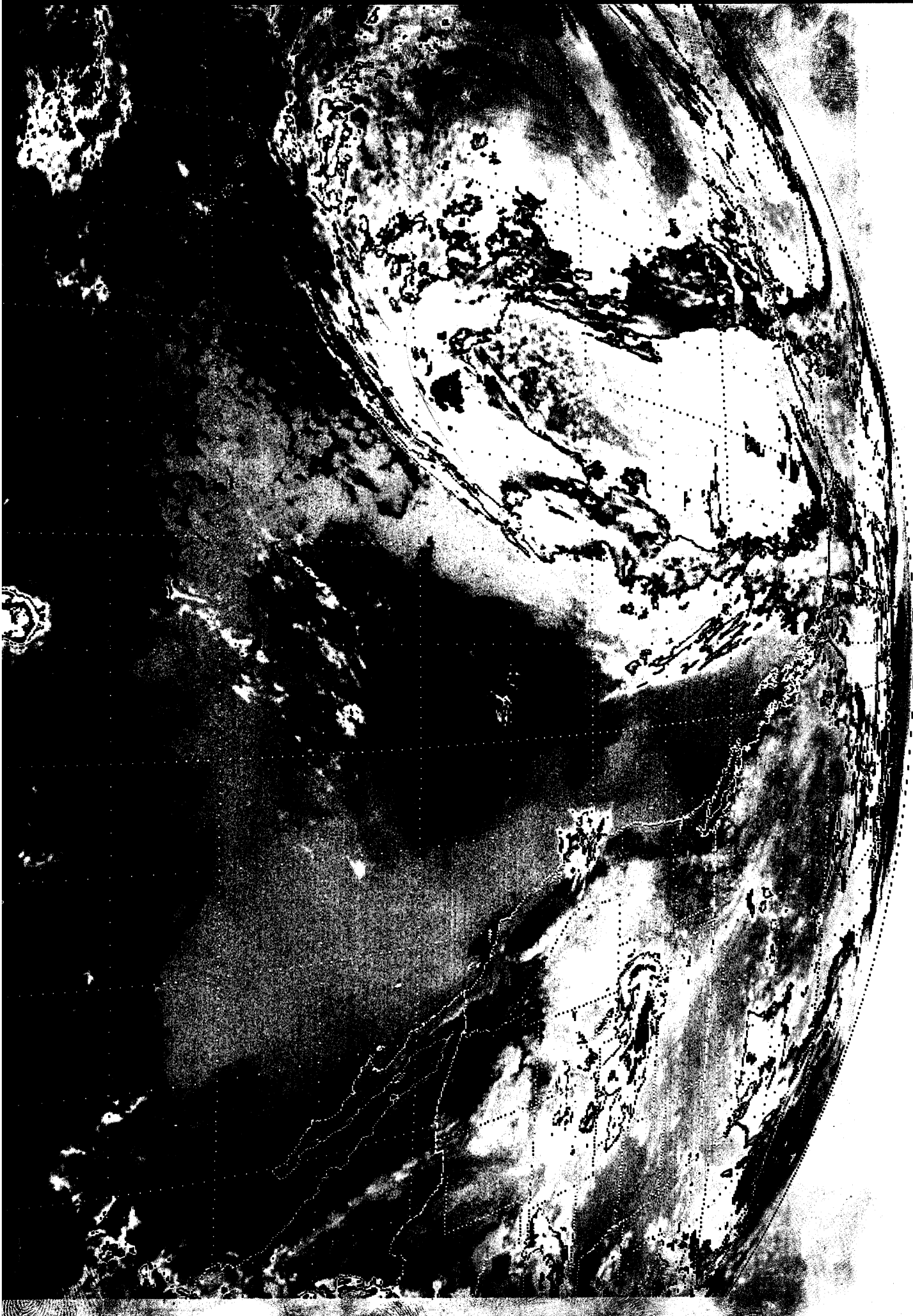
The satellite pictures of June 5. 1215Z and 2315Z show that the vortex extends high into the atmosphere, since high clouds have completely circled the center of the vortex. Also, the cold air has become involved in the circulation and the clouds both to the west and south of the center are becoming more stable. Usually, from this point on the circulation gradually weakens with the high clouds becoming less organized and gradually dissipating, followed by a gradual structural break-up of the low clouds.

CONCLUSIONS.

1. Goes satellite imagery is extremely useful in monitoring the development of a cut-off low. Thus, the prediction of a cut-off low by computer prognosis can be critically assessed using satellite imagery.
2. Two features which appear to be necessary for the formation of a cut-off low are the stable low clouds in the meridional trof to the north of where the cut-off is likely to occur, and the cold, convectively unstable air to the west of the meridional trof.
3. The gradual rotation of the frontal cloud band from southwest to south to southeast also appears to be a good indication that the low will likely cut-off.
4. By the time the high level clouds begin to move westward to the north of the implied cut-off location, the cutting-off process is already well underway.
5. The development of the characteristic dry slot, comma shape and deformation zone, and the gradual dissipation of the high level cloudiness to the northeast of the meridional trof all indicate that the circulation center is in the process of cutting-off.
6. The intensity of the cut-off low is probably best related to the areal extent and intensity of the cold, convectively unstable air during the initial stage of development, and to the distinctiveness of the comma shaped cloud pattern at the later stage.
7. The position of the cut-off will likely be in the trof at the northern edge of the convective cloud pattern or the southern edge of the stable cloud pattern.
8. It should be pointed out that during the evolution, cyclogenesis at the surface also takes place, and the resulting circulation pattern at the surface may cover a large area even though the central pressure of the surface circulation may not be very low.

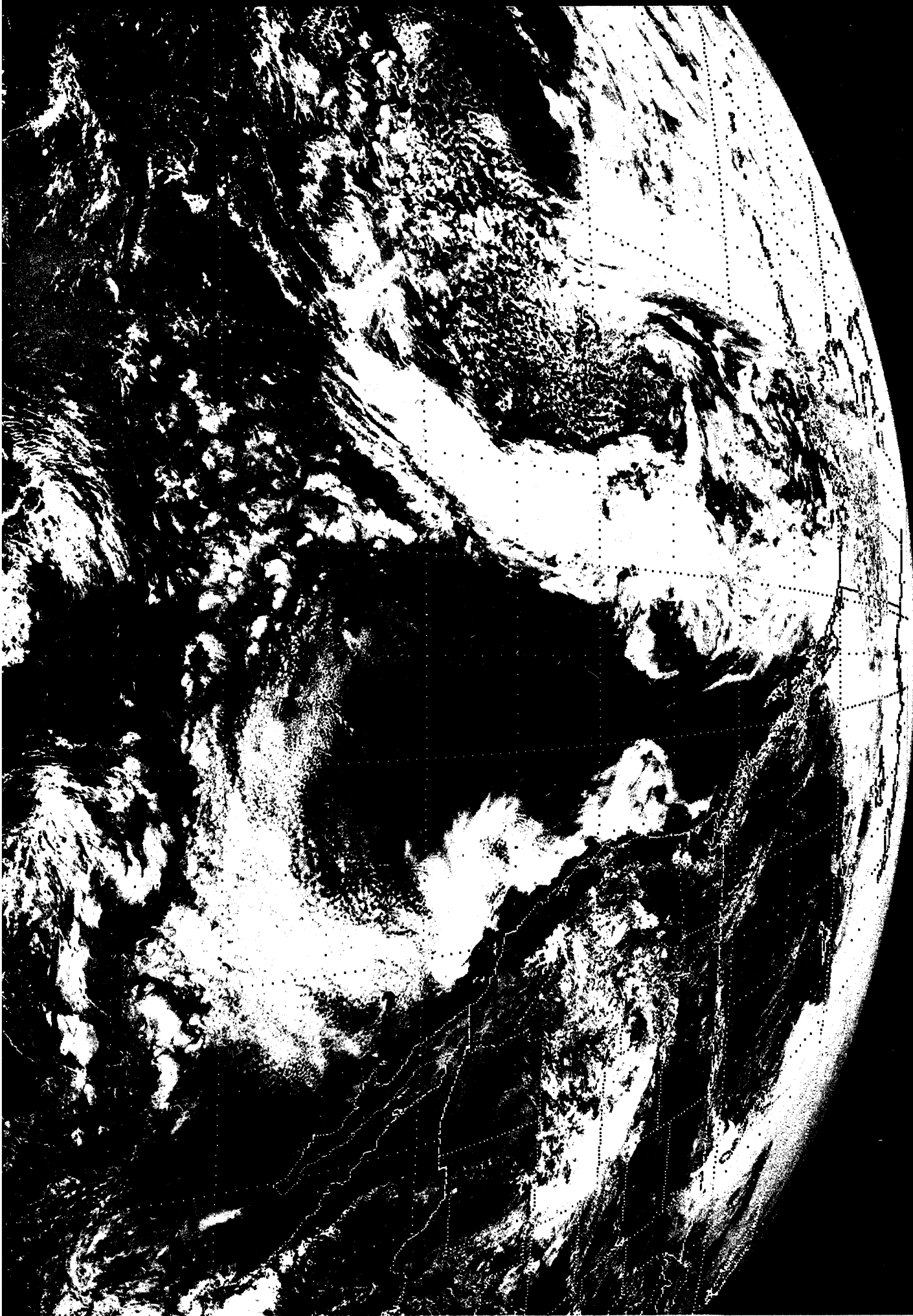
NOTE. The example used to illustrate the formation of the cut-off low was chosen because the event took place over the Pacific and therefore the the evolutions of the cloud patterns were not influenced by orographic effects or the removal of a moisture source.

1215 03JUN78 33E-2EC 00321 19141 UC2

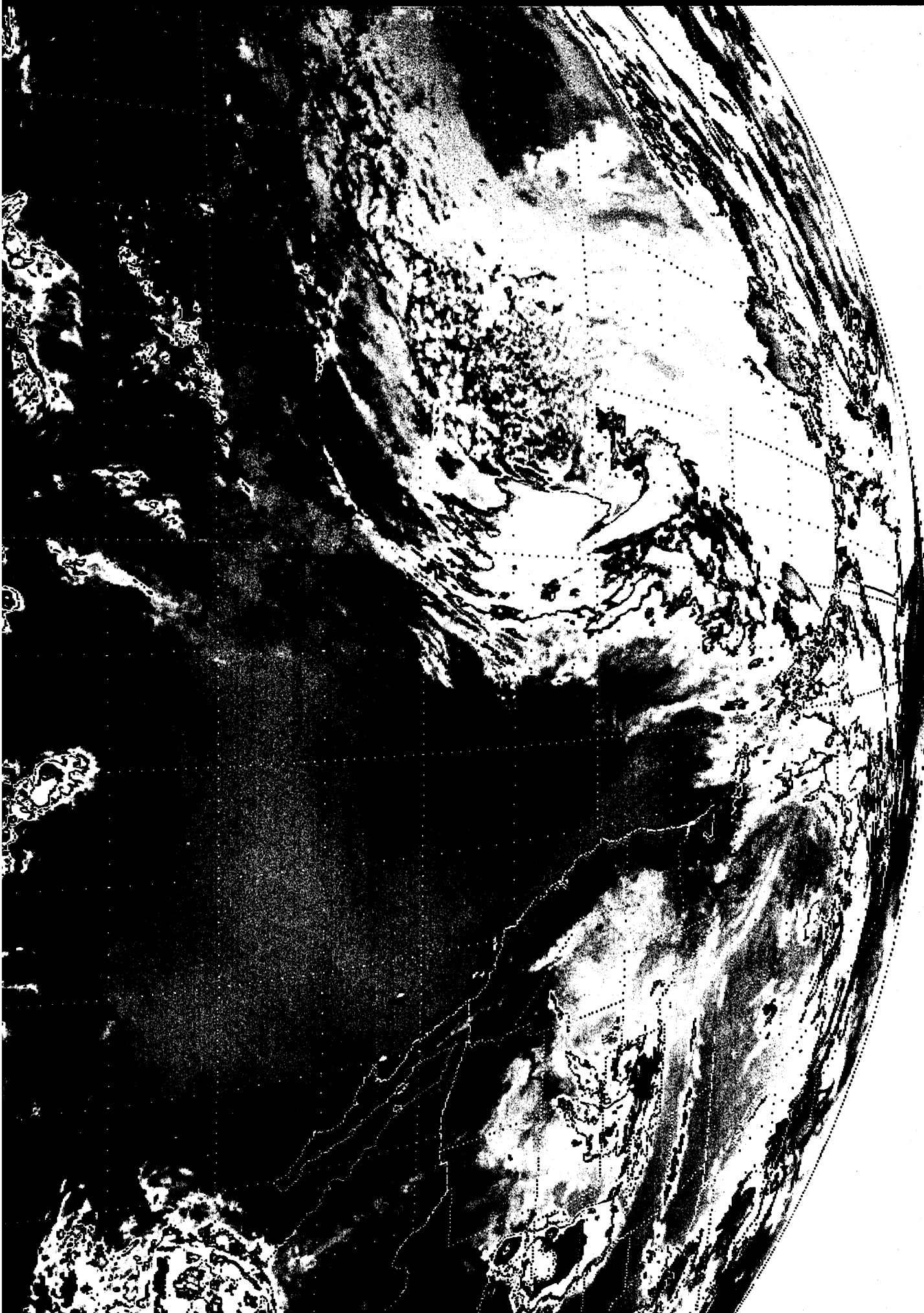


2315 03JN78 33A-2 00371 19231 UC2

~~THUR~~. SAT



1215 04JN78 33E-2EC 00571 19181 UC2



2315 04JN78 33A-2 00011 19251 UC2

~~REF~~. SCAN



1215 05JN78 33E-2EC 00821 19161 UC2



2315 05JN78 33A-2 00281 19251 UC2



0 DMC CANADA CDR
RNL 50000 33
VIZZ JUNE 3 JUN 1973 PD

0 DMC CANADA CDR
RNL 50000 4
VIZZ JUNE 4 JUN 1973 PD

0 DMC CANADA CDR
RNL 50000 33
VIZZ JUNE 4 JUN 1973 PD

0 DMC CANADA CDR
RNL 50000 4
VIZZ JUNE 5 JUN 1973 PD