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Evaluation of Forecast Research Division (ARMF) Products during CASP

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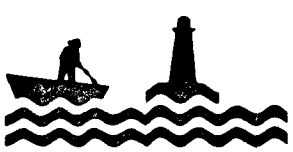
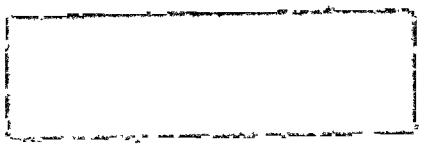
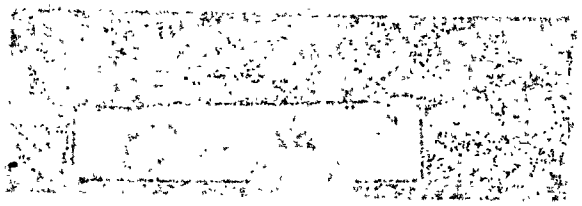






Abstract

During the Canadian Atlantic Storms Program (CASP) several statistical and analysis products were produced by Forecast Research Division in Toronto and transmitted to the forecasters for real-time use and evaluation. Several cases studies are presented to illustrate the product format and their perceived strengths and weaknesses.

The CASP forecasters found the map display format very acceptable. Bar graphs for the probability products were considered an excellent substitute for numerical output. The accuracy of the individual products was quite variable with trends handled much better than any one forecast time period. Adjustments to the statistical products, based on synoptic analysis and model assessment, was frequently required.

Evaluation of ARMF Products

1.0 Introduction

During the Canadian Atlantic Storms Program (CASP), Jan 15 to Mar 15 1986, a number of forecasting products were sent from Forecast Research Division (ARMF) of Meteorological Services Research Branch (MSRB), AES headquarters Toronto, to the CASP Forecast Centre in Bedford Nova Scotia. The focus of this report will be on an operational evaluation of a subset of the ARMF package consisting of statistical products and streamline analyses. Isentropic analysis was not received sufficiently often to be evaluated with any degree of confidence.

Several case studies comprise the main thrust of the evaluation with qualitative observations presented on the products. Real-time usefulness comments by the forecasters are also presented.

2.0 Data Delivery System

The ARMF work station consisted of an IBM PC and an external X-Y Roland plotter. All products were pre-packaged by ARMF before transfer so that the terminal was used only to receive data and display it, without forecasters having to manipulate the data.

Upon completion of the production cycle, the ARMF operator phoned the CASP forecaster, who then initiated data transfer using BLAST and a DATAPAC 2400 baud line. Transferred data was stored on the IBM PC hard disk for retrieval by the display program. Data was displayed in map form. Examples of each data type can be found in the Case Studies in the Appendices.

Further details on the work station, data transfer and their effectiveness can be found in Abraham (1986).

3.0 Review of the ARMF Statistical Products

The predictands of each of the statistical products will be presented as outlined by L. Wilson at a pre-CASP workshop. Examples of each product can be found in the Appendices.

3.1 MOS Spot Temperatures

The predictand is a spot temperature at a single station in three hour intervals. The equations are formulated in local time with a seperate set for each of four seasons. Equations for maximum and minimum temperatures for the climatological day were also formulated, however, due to time restrictions on data transfer were not available for evaluation.

3.2 MOS Winds

The predictands are single station surface wind components and wind speed averaged over three hours centred on 12 hour GMT intervals. Separate equations are formulated for 12Z and 00Z, for three seasons and each projection time.

3.3 MOS Maximum Winds

The predictand is the maximum hourly reported wind speed during a six hour period (local time) for a single station. There are separate equations for 12Z and 00Z, for four seasons and each projection time.

3.4 Perfect Prog Winds

There are two aspects to the perfect prog winds: the land winds and the marine winds each of which is treated in a different fashion.

The land wind predictand is a three hour average wind component and wind speed at a single station. There are separate equations for each wind component (u, v) and speed (s), for three seasons (winter, summer, transition) and both 12Z and 00Z.

The marine wind predictand is the surface observed wind speed and direction from ships in the east coast marine area and is based on data from 1982. There is one equation for all areas for each of three seasons and both 12Z and 00Z. Wind speeds and direction are interpolated to any desired marine location at 12 hour intervals.

3.5 MOS Minimum Ceiling

The predictand is the lowest ceiling in a six hour GMT period using five categories: zero up to but not including 500 feet, 500 up to but not including 1000 feet, 1000 up to but not including 3000 feet, 3000 up to but not including 5000 feet and 5000 feet or more. Four stations are calculated at a time for each of two seasons.

3.6 MOS Minimum Visibility

The predictand is the lowest visibility in a six hour GMT period using four categories: zero up to but not including 1 mile, 1 up to but not including 3 miles, 3 up to but not including 6 miles and 6 miles or more. Four stations are calculated at a time for each of two seasons.

3.7 MOS Conditional Precipitation Type

The predictand is the probability of precipitation type in three categories, liquid, frozen and freezing, given that precipitation occurs, otherwise, the probability is undefined. Mixed precipitation is classified as frozen. There is one season (Sept 20 - May 20 for the Maritimes) with four stations computed at a time.

3.8 MOS Average Cloud Cover

The predictand is the average opacity (tenths) in six hour (local) time periods. There are separate equations for each of four seasons with stratification into four categories: CLEAR (0-1 tenth), SCATTERED (2-5 tenths), BROKEN (6-9 tenths) and OVERCAST (10 tenths).

4.0 Evaluation Procedure

The evaluation of the ARMF products consists of two sections: Case Studies and forecaster real-time comments.

4.1 Case Studies

The CASP field study consisted of several Intensive Observation Periods (IOPs) lasting from 12 to 36 hours and covering the whole Atlantic region or only a few sites. However, each IOP was associated with significant weather features. An attempt was made to collect ARMF products for each IOP. Due to time constraints on the forecasters or technical difficulties at ARMF, not all IOPs were recorded.

A variety of synoptic situations were collected, each with as many products as available. These are summarized in Table 1. The Case Study data together with a description of the synoptic situation and a short discussion of the products is presented in Appendices A-L. Figure 1 is a reference map with station names and identifiers. Overall conclusions and comments are presented in section 4.

4.2 Forecaster Real-time Comments

A variety of mesoscale, site specific forecasts were written by the CASP forecasters. Attached to each forecast was a check list of products together with a usefulness scale. A space was also available for general comments. Forecasters were encouraged to note which products were, or were not, used in preparing the forecast, and why.

An examination of the check lists shows that the CASP forecasters did not use the ARMF statistical products or streamlines in preparing their forecasts. The data was frequently not available when required and, in some instances, was several days old.

A questionnaire was distributed to the forecasters to further elicit comments on the products evaluated in this report. The overall consensus was that the products were not useful on a real-time basis mainly due to data delivery difficulties. Few comments on the perceived accuracy of the individual products were received.

5.0 Conclusions

1) The streamline analysis was often useful in locating areas of low level convergence, which correlated quite well with episodes of moderate or heavy precipitation.

2) In cold air outflow situations, streamline patterns correlate very well with streamers shown on satellite pictures; a prognostic chart could be operationally useful in predicting occurrence of circulation snow showers.

3) The CASP forecasters agreed that the map display of statistical forecast products, such as temperatures and winds, is preferred to the bulletin format. A map allows easy assimilation of the information, provides needed areal coverage and makes for easier interpretation and assessment.

4) The display of probability data, such as MOS minimum ceilings, in bar graph format is very good, though requires a period of time to become familiar with the chart and its proper interpretation. The visual display of statistical data, ignoring numbers, removes certain inherent prejudices; the categories are compared to each other rather than some arbitrary standard such as 50 %.

5) Bar graph products are, at times, difficult to use operationally as probabilities are often distributed fairly evenly throughout all categories. The lack of discrimination translates into "no useful guidance to the operational decision making process".

6) The statistical products perform better in displaying trends than for a specific site at a given time. However, there are several cases where site specific forecasts verify very well, especially temperatures and maximum winds.

7) Even though the wind speed products frequently verify quite well, they are considered to be of limited value operationally as they ignore gusts. Gusts are frequently perceived by the public as the true wind condition; aviation operations can be limited by gusty winds.

8) Wind shifts are handled quite well, but must be assessed on an individual basis.

9) All statistical products must be constantly evaluated according to the synoptic situation and the performance of the associated numerical model. Adjustment is frequently required, but with few systematic errors, can be quite difficult.

10) The detail found in the statistical products, particularly the bar graph maps, may be misleading, given a sense of accuracy which is, in reality, not present.

Further evaluation comments are contained in the individual Case Studies in Appendices A-L.

	Case Study											
	A	B	C	D	E	F	G	H	I	J	K	L
Surface Analysis		x	x	x	x	x	x	x	x	x	x	**
Satellite Pictures	x	x	x	x	x	x	x	x		x	x	
Streamlines	x	x	x	x	x		x*		x	x	x	
Spectral Prog						x				x	x	
MOS Spot Temperatures		x	x	x	x	x				x	x	
MOS Spot Winds		x	x	x	x	x	x			x	x	
MOS Max Winds		x	x	x	x	x				x	x	
Perfect Prog Winds		x			x	x				x	x	
MOS Minimum Ceiling		x	x	x	x	x		x		x	x	
MOS Minimum Visibility		x	x	x	x	x		x		x	x	
MOS Condtnl Pcpn Type		x	x	x	x	x		x		x	x	
MOS Average Cloud Cover		x	x									

* Intercomparison with McIDAS
** Isentropic Analysis: ARMF and McIDAS

Table 1: Summary of the contents of each Case Study collected during CASP Jan 15 - Mar 15 1986.

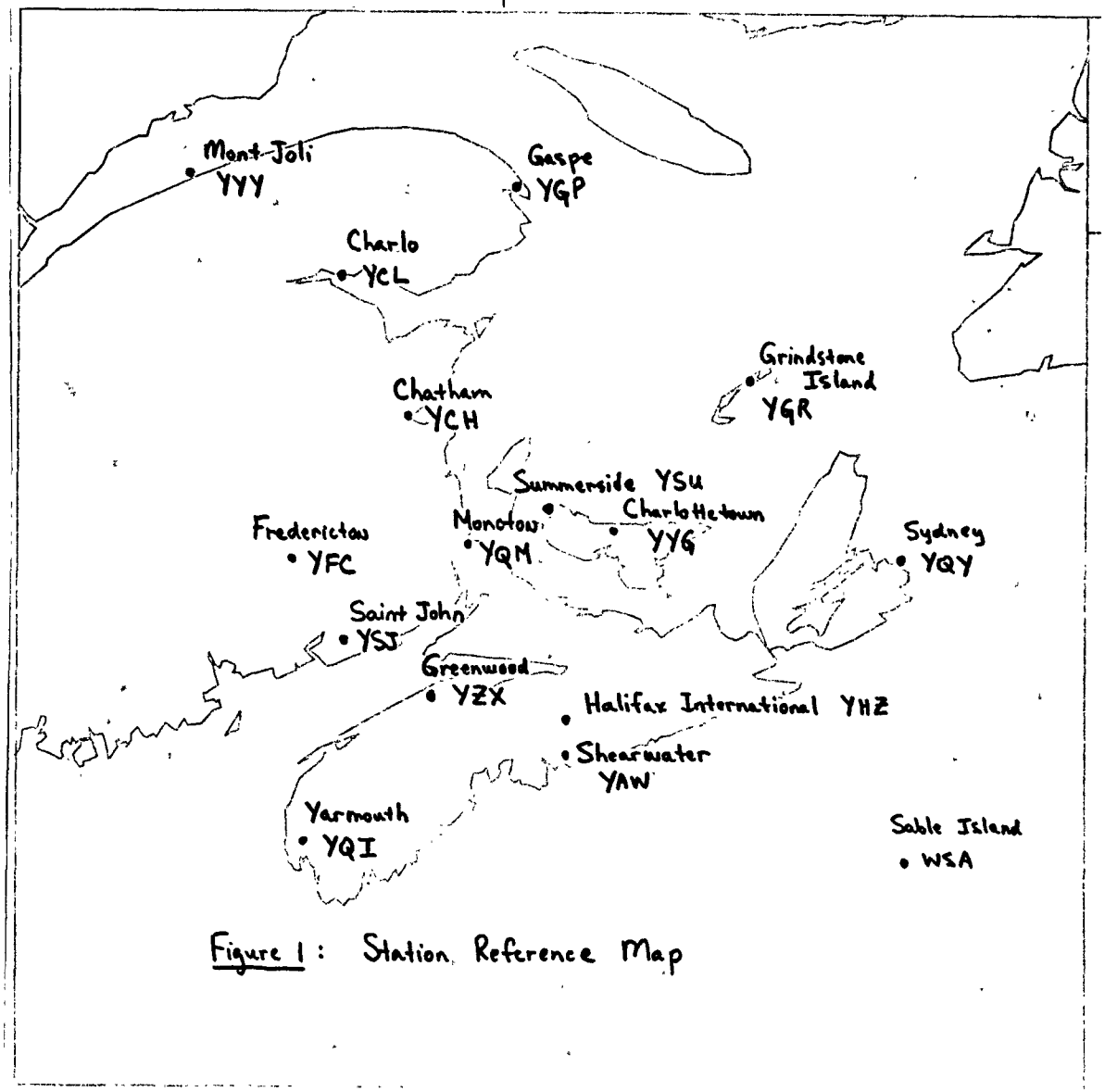


Figure 1: Station Reference Map

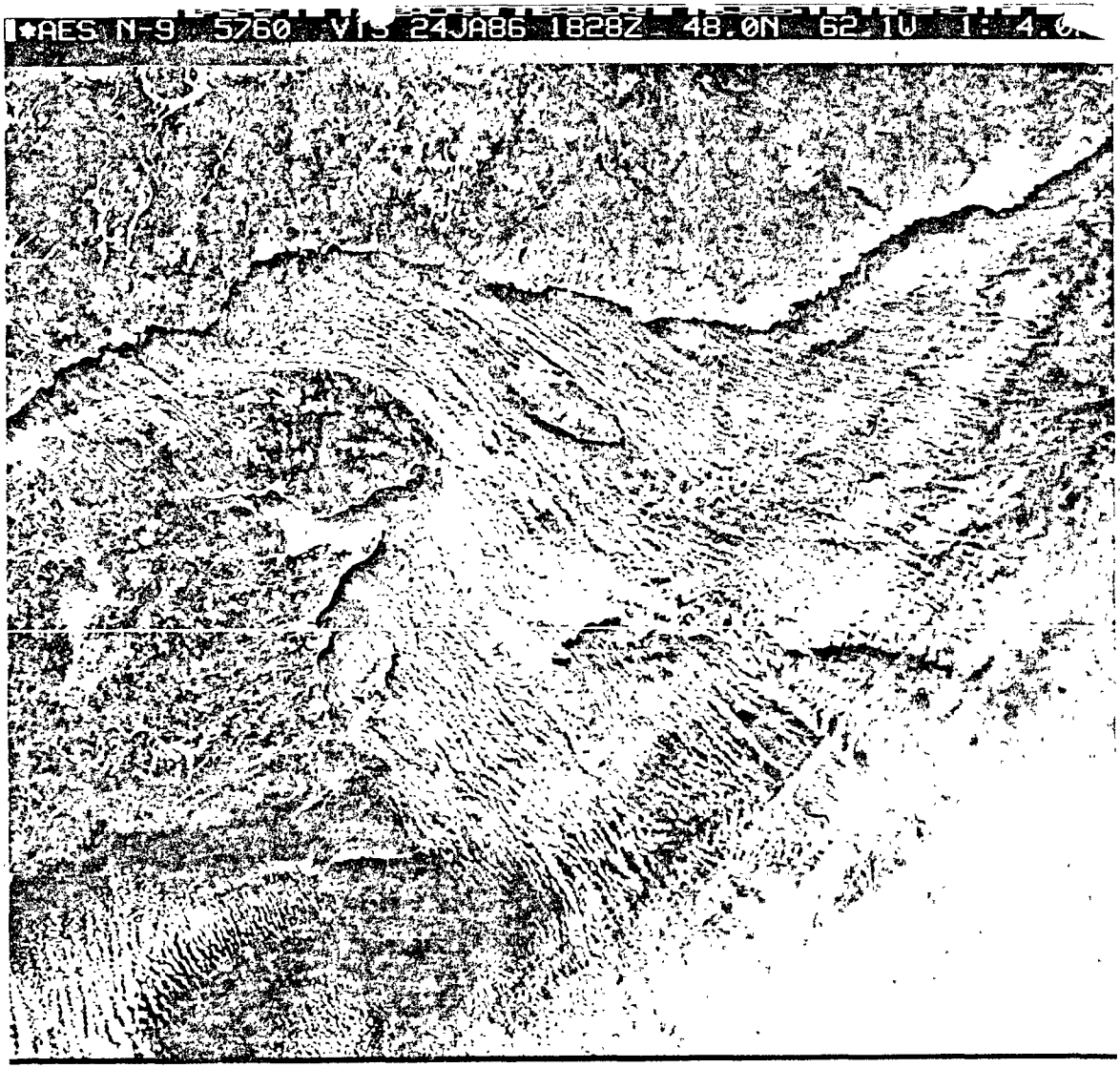
Appendix A: 18Z Jan 24 1986

Synoptic Situation

A low pressure centre over eastern Quebec gave a strong northwest flow of cold air over the Maritimes resulting in circulation cloud and snowflurries along windward coasts.

Streamlines

The outflow from the high is clearly visible. The direction and curvature of the streamlines fits the streamers on the satellite picture quite well; in particular note those over the Gulf of St Lawrence. The slacker streamline pattern over south central Nova Scotia corresponds to weak or non-existent streamers.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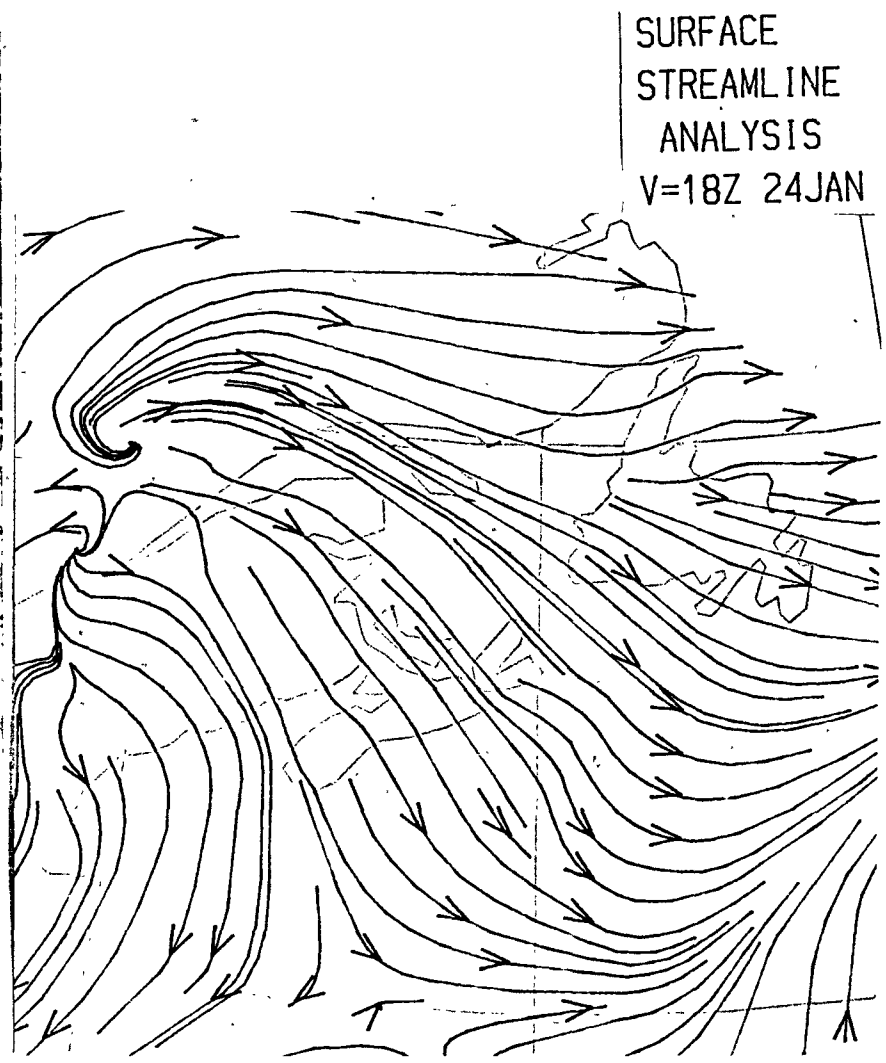

SURFACE
STREAMLINE
ANALYSIS
V=18Z 24JAN

A

Appendix B: 12Z Jan 28 - 00Z Jan 29 1986

Synoptic Situation

A quasi-stationary frontal trough was located in a north-south line over New England. A series of low centres tracked northward in the trough. The final low in the series began near Cape Cod early on Jan 28 and moved rapidly northward across western New Brunswick with pressure falls of 18 mb in 12 hours. The associated cold front pushed across the Maritimes giving an abnormal temperature trend. An area of hangback snow followed the front into much of the district.

Streamlines

Note the strong convergence west of Anticosti Island at 18Z. Hourly observations for Baie Comeau (YBC) on Jan 28 show an increase in snow intensity coincident with the enhanced low level convergence depicted in the streamline pattern.

MOS Spot Temperatures

The abnormal temperature trend initiated by the cold frontal passage is evident in the forecasts. The temperatures at 16Z are underforecast by 2 to 4 degrees except for YYY which is poorly handled. The predicted 22Z values are too cold except for YYY. The net temperature drop is handled very well. The 6 degree drop at YFC is accurately predicted; the 8 degree drop at YYG agrees favourably with the predicted value of 9.

MOS Spot Winds

Note from the plotted observed winds that gusts are not incorporated into this product, hence further discussions will ignore gusts. The lack of gust information is considered a major limitation on the usefulness of this product. The southerly to southwesterly wind shift with the cold frontal passage verifies quite well. Accuracy of wind speeds is quite variable eg. YSU excellent, YAW poor. Wind directions are reasonably depicted except for YYY at 12Z.

Perfect Prog Winds

At 12Z several wind directions were poorly forecast with errors of > 90 degrees at YFC, YSU, YYG and YQM. Wind speeds were predominately underforecast but exceptions were noted such as at YQY. At 00Z winds directions at YSU, YYG and YQY have significant errors. Wind speeds remain underforecast. An error in the equation formulation and/or computation is suspected.

MOS Max Winds

Errors ranged from 0 kts at YQI to 11 kts at YSJ, but were typically in the 2 to 5 kt range. With the exception of YYG maximum winds were underforecast. Note that gusts are ignored in this product and limits its usefulness. For example, at 18Z YQM had gusts to 42 kts, much greater than the verifying 22 kts. Operationally this difference could be very important particularly to aviation concerns.

MOS Average Cloud Cover

The trend forecast by this product was for less cloud with a shift from higher to lower categories during the period. For example, YQI was overcast becoming predominately broken. The verification does not support this trend with broken conditions predominating throughout.

However, the SA record indicates the early part of the 10-16Z period was overcast with broken skies developing in the latter hours. The verification does not do justice to the accuracy of the forecast trend.

MOS Minimum Ceiling

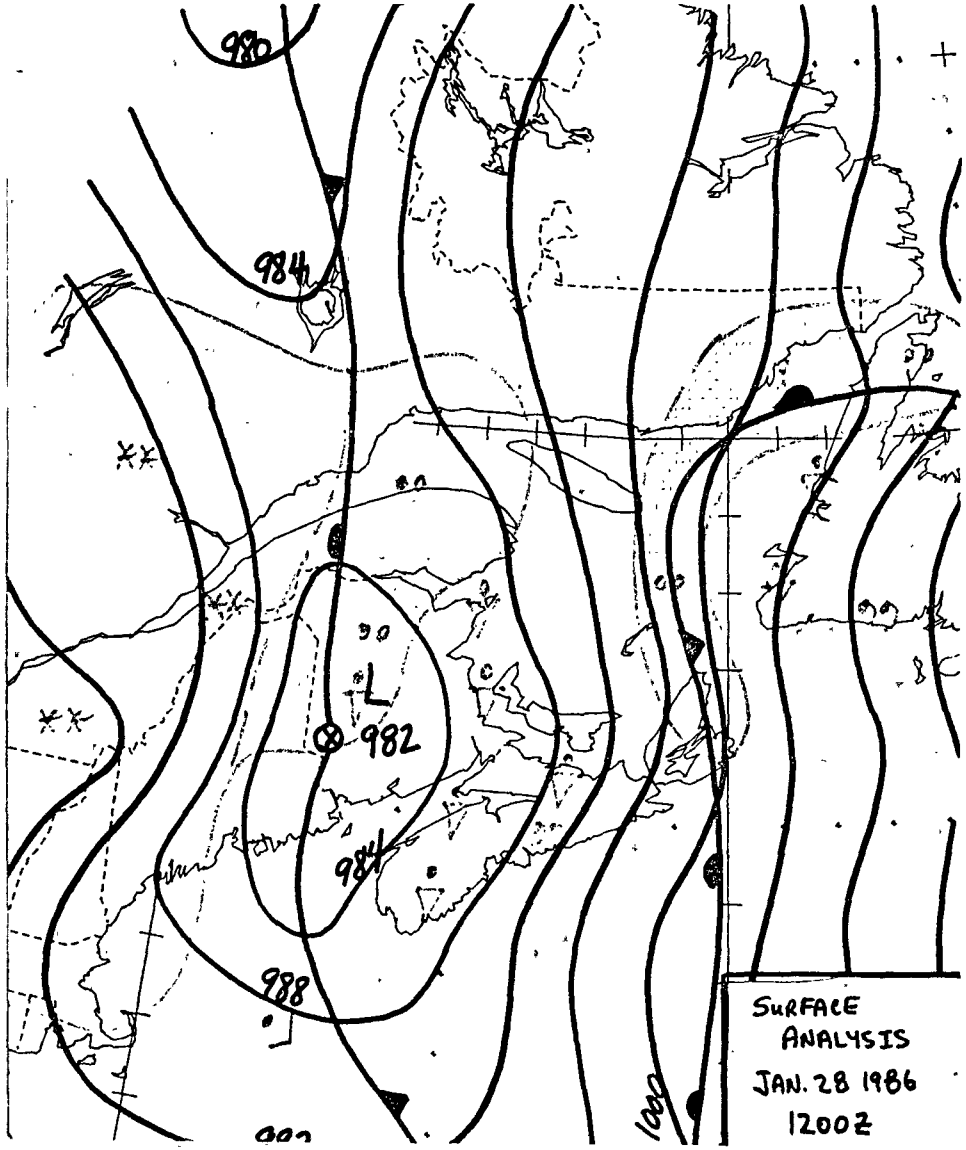
WSA, YAW and YHZ were poorly handled with ceilings forecast too low. There was little discrimination at some sites. YQI has highest probability in category 3 (as observed), but significant probability of category 1 or 2 as well. This product provides little assistance in preparing an operationally useful forecast for YQI. Similar comments apply to YQM, YSU and YYG.

MOS Minimum Visibility

YQY is poorly handled. There is little difference in categories for several sites, for example YQM and YGP, with significant probabilities in all categories. YAW and YHZ have nearly equal probabilities in categories 1 and 4.

MOS Conditional Precip Type

The rain/snow boundary is quite evident on the forecast map. YSU is near the boundary but verifies as being on the wrong side. YQI is inconclusive as to type at 00Z. However, a rain changing to snow trend is evident from the pattern with a shift from category 1 to category 2 indicated.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SURFACE
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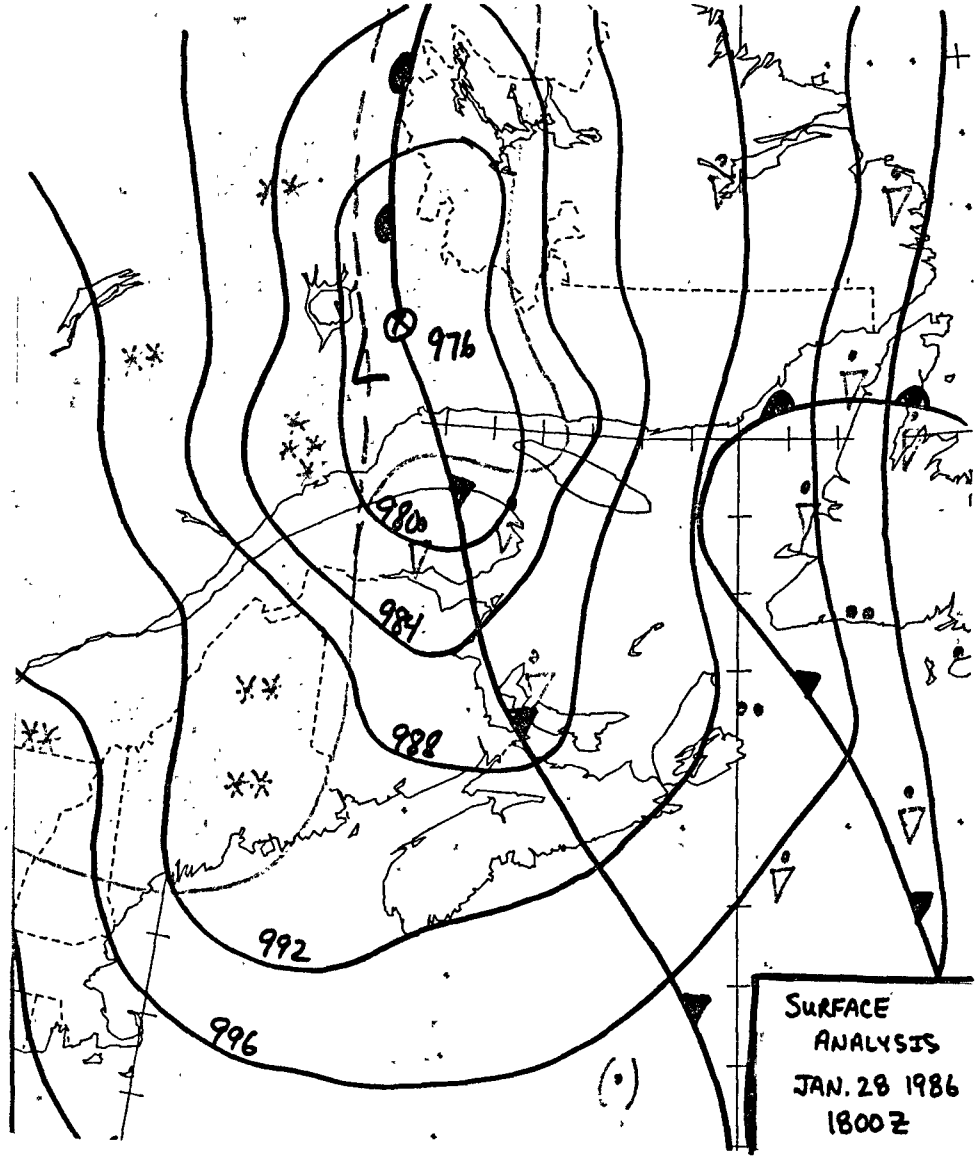
JAN. 28 1986
1200Z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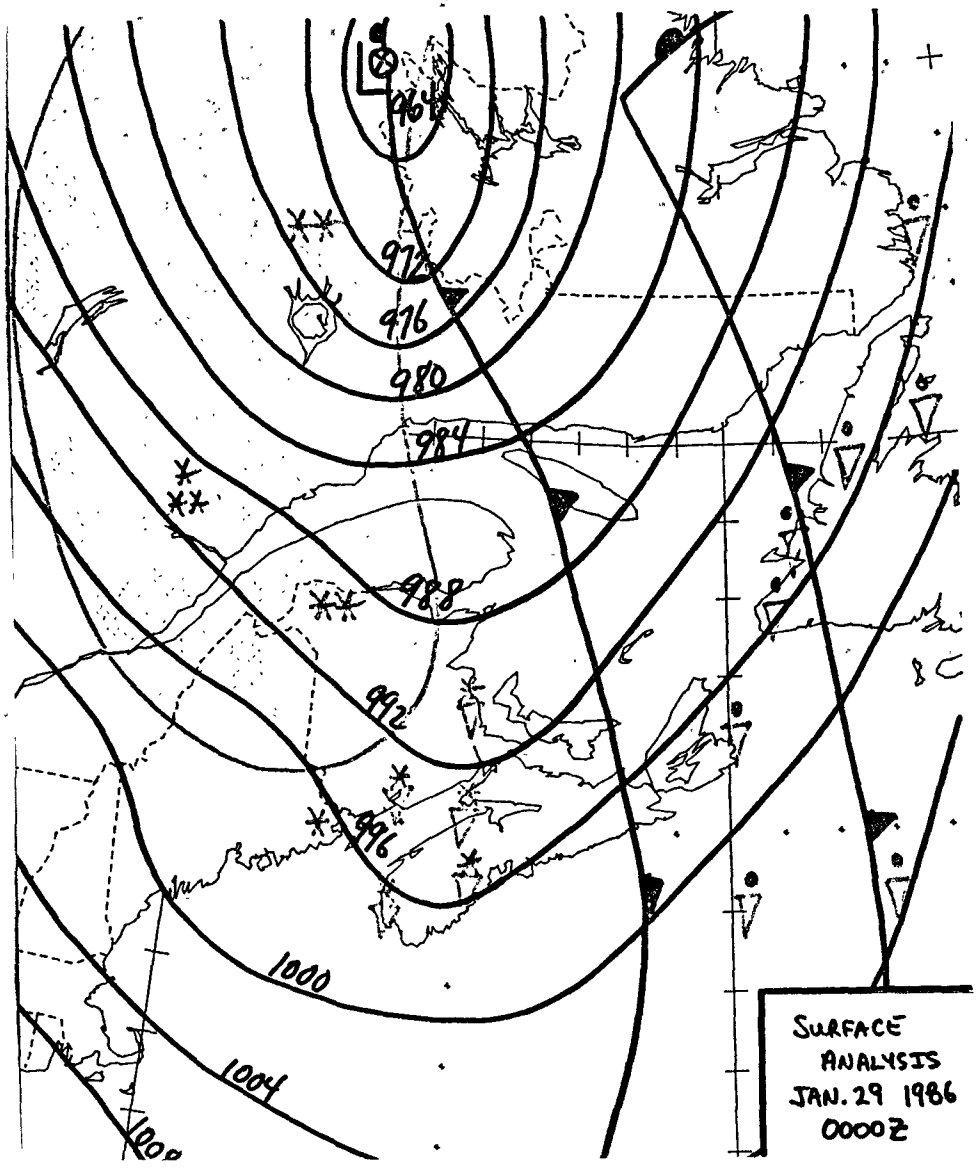
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JAN. 29 1986
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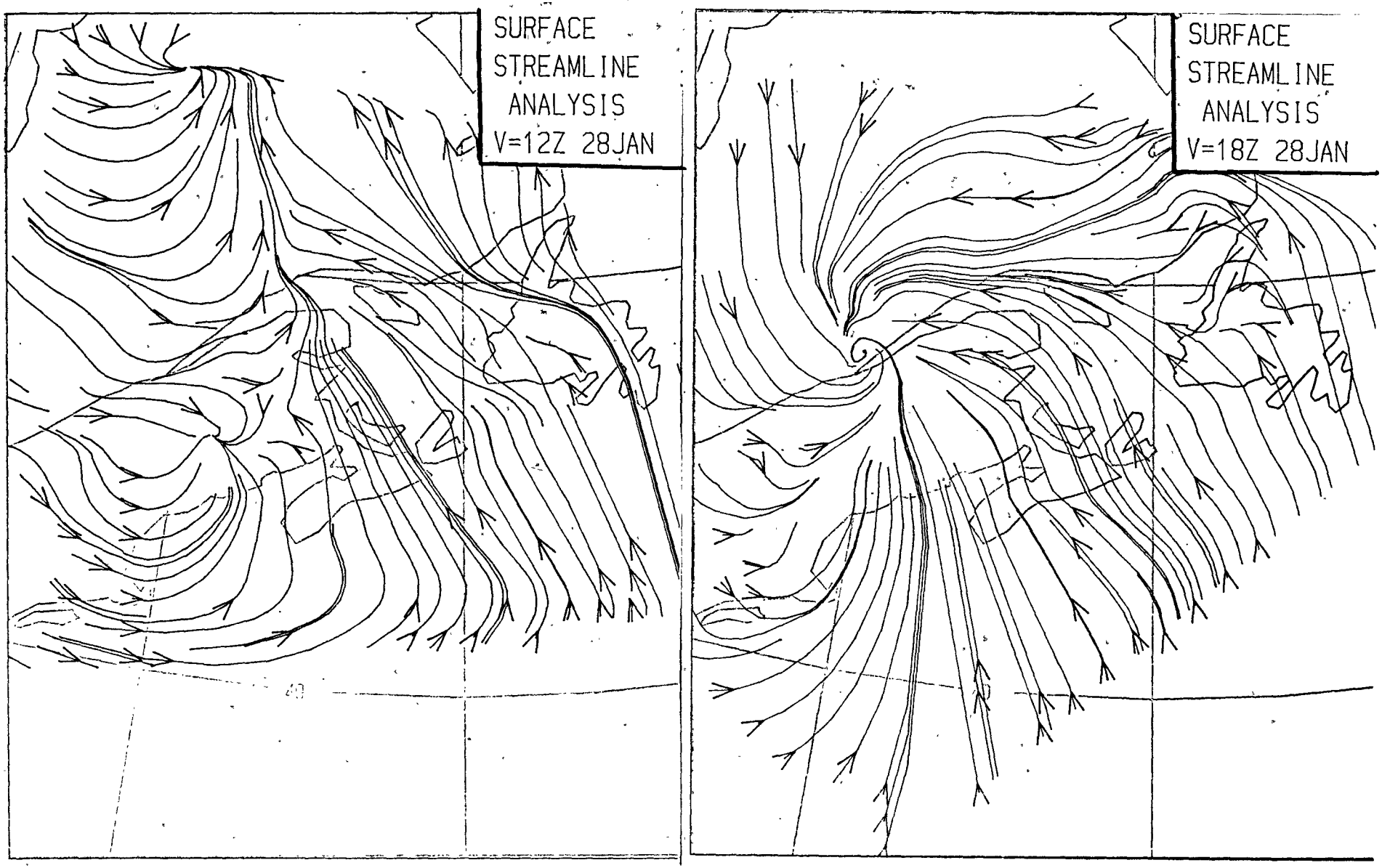
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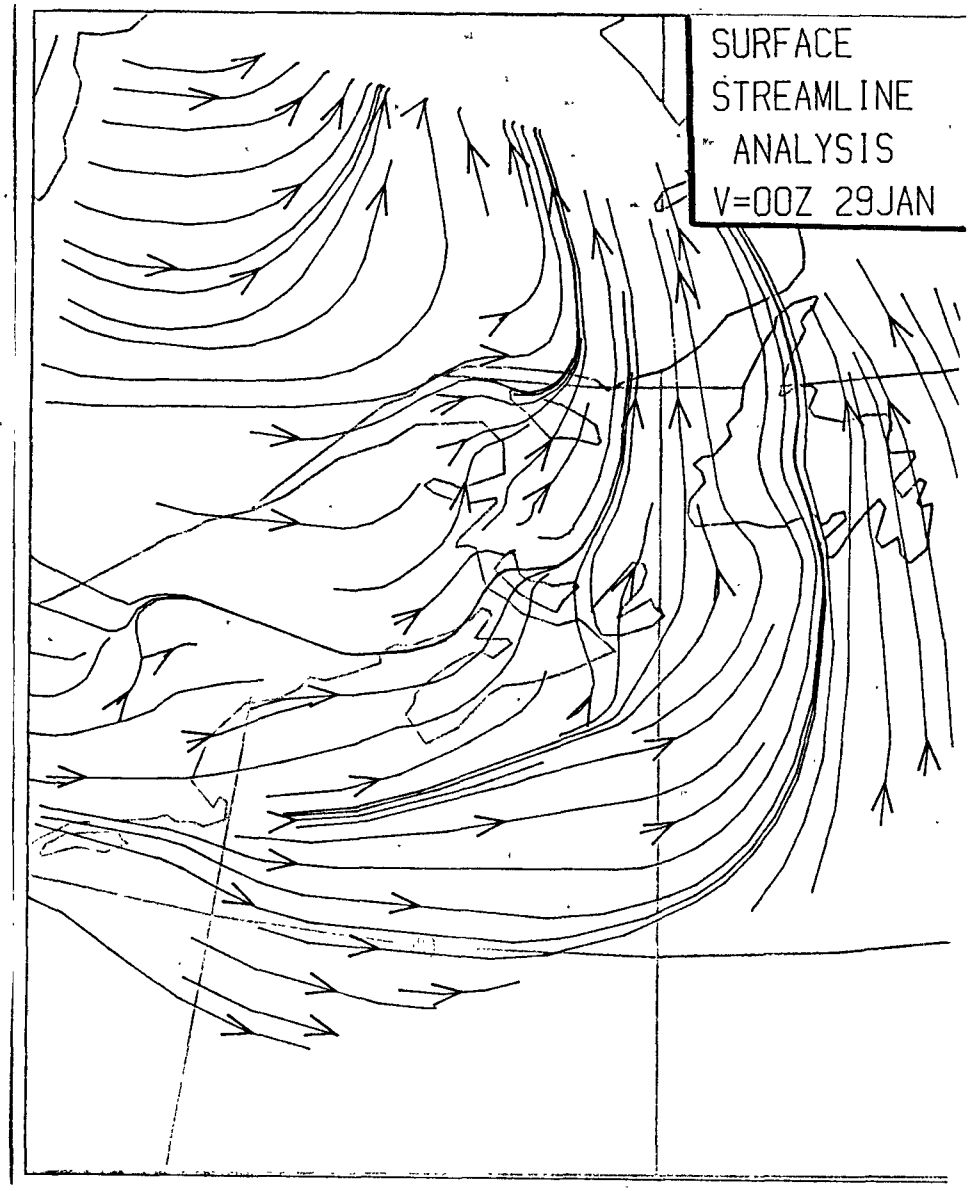
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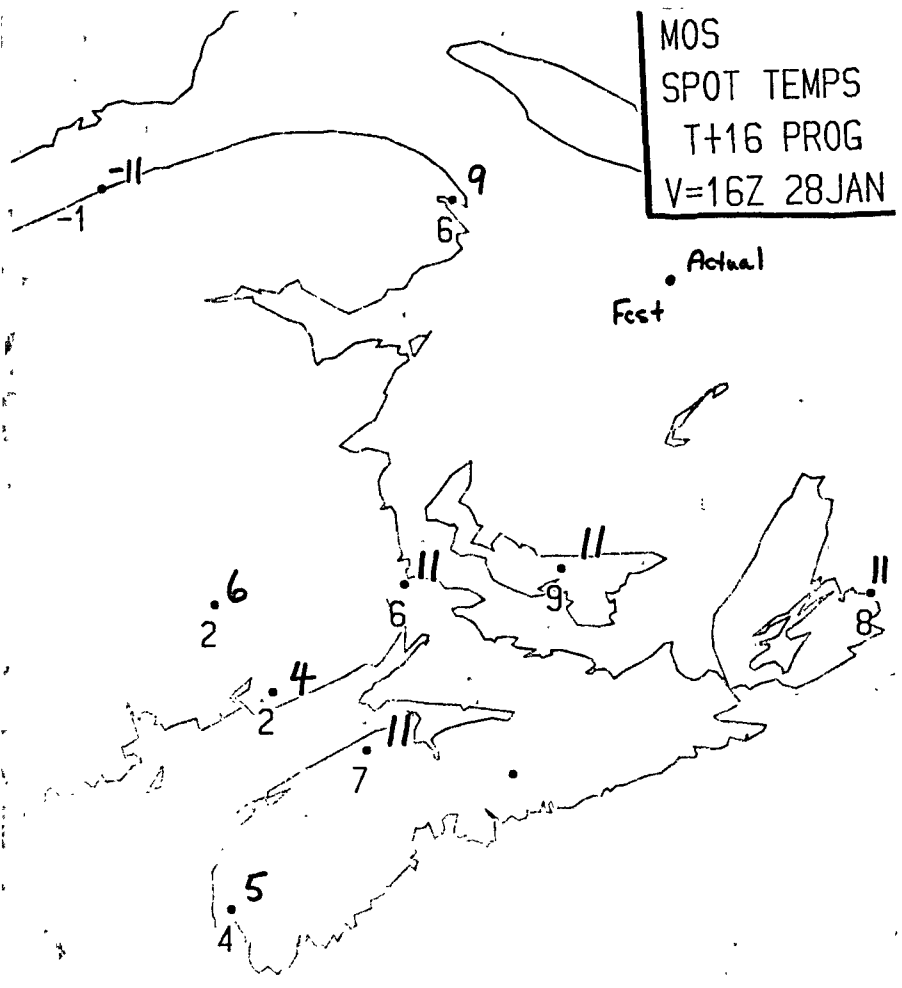
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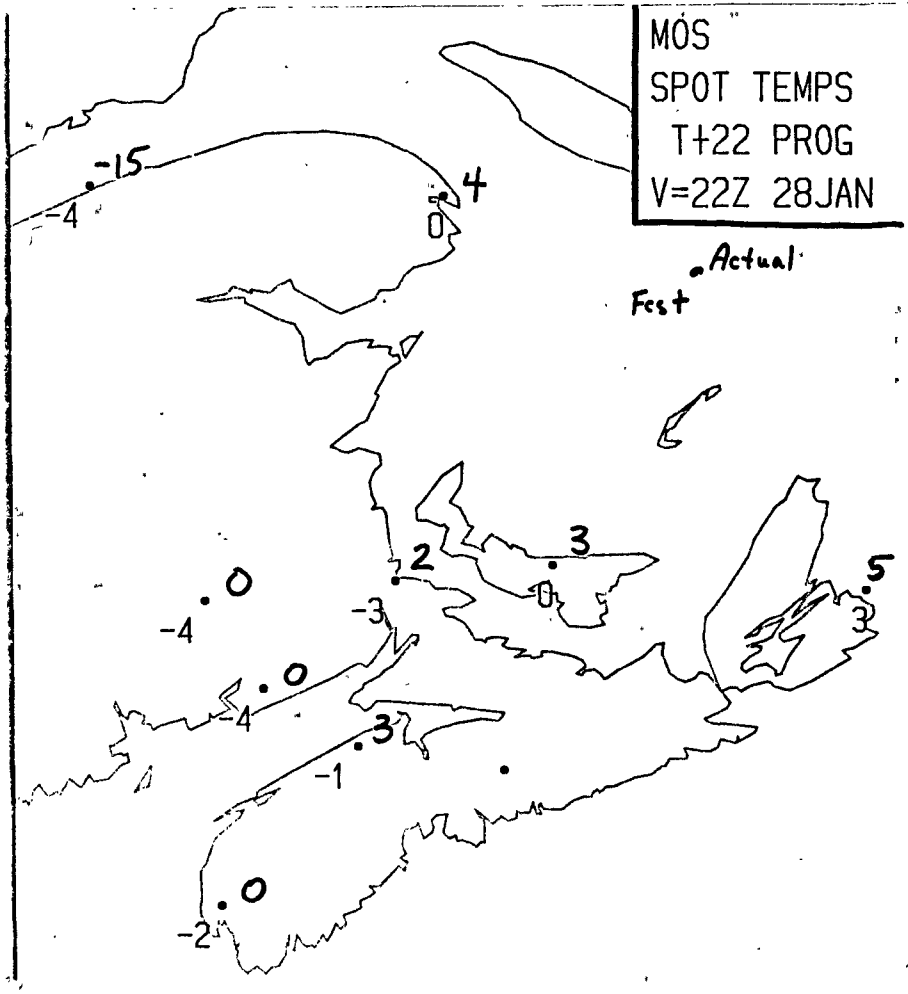
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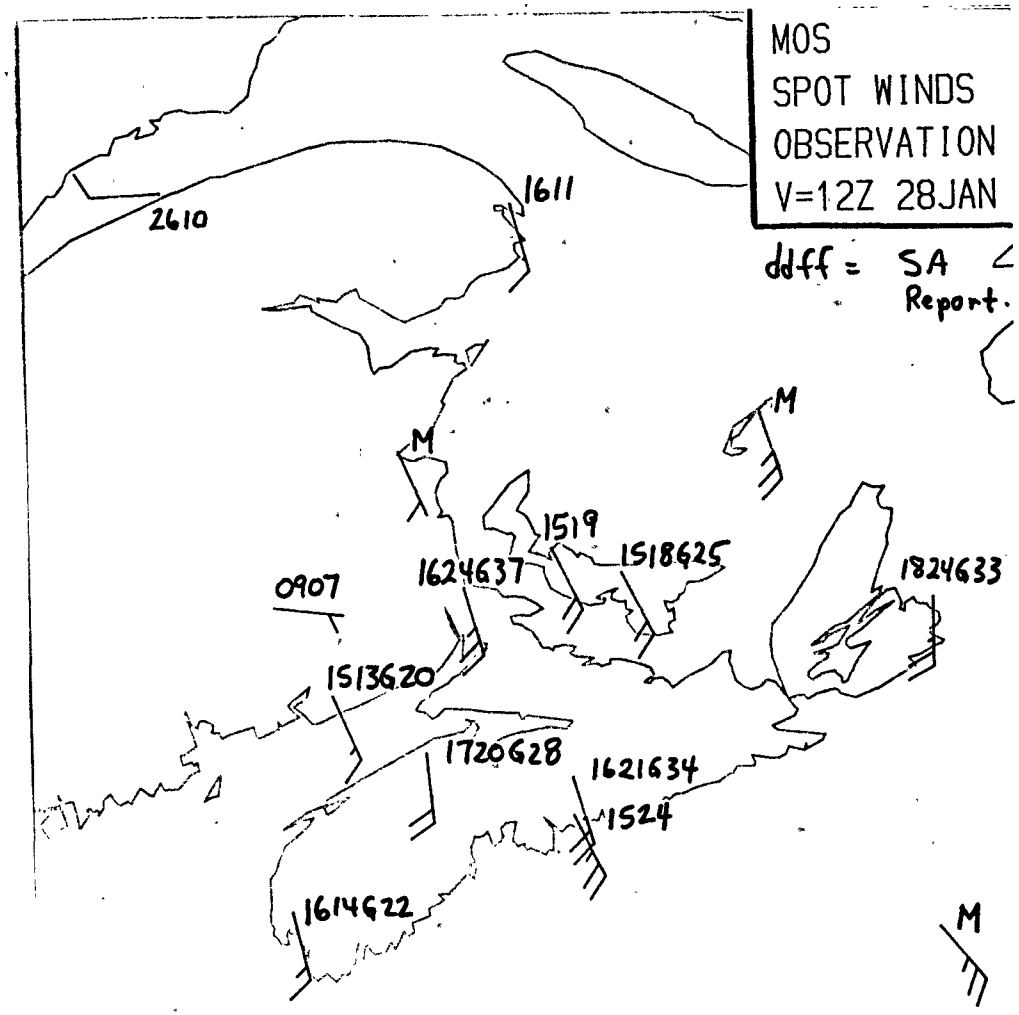
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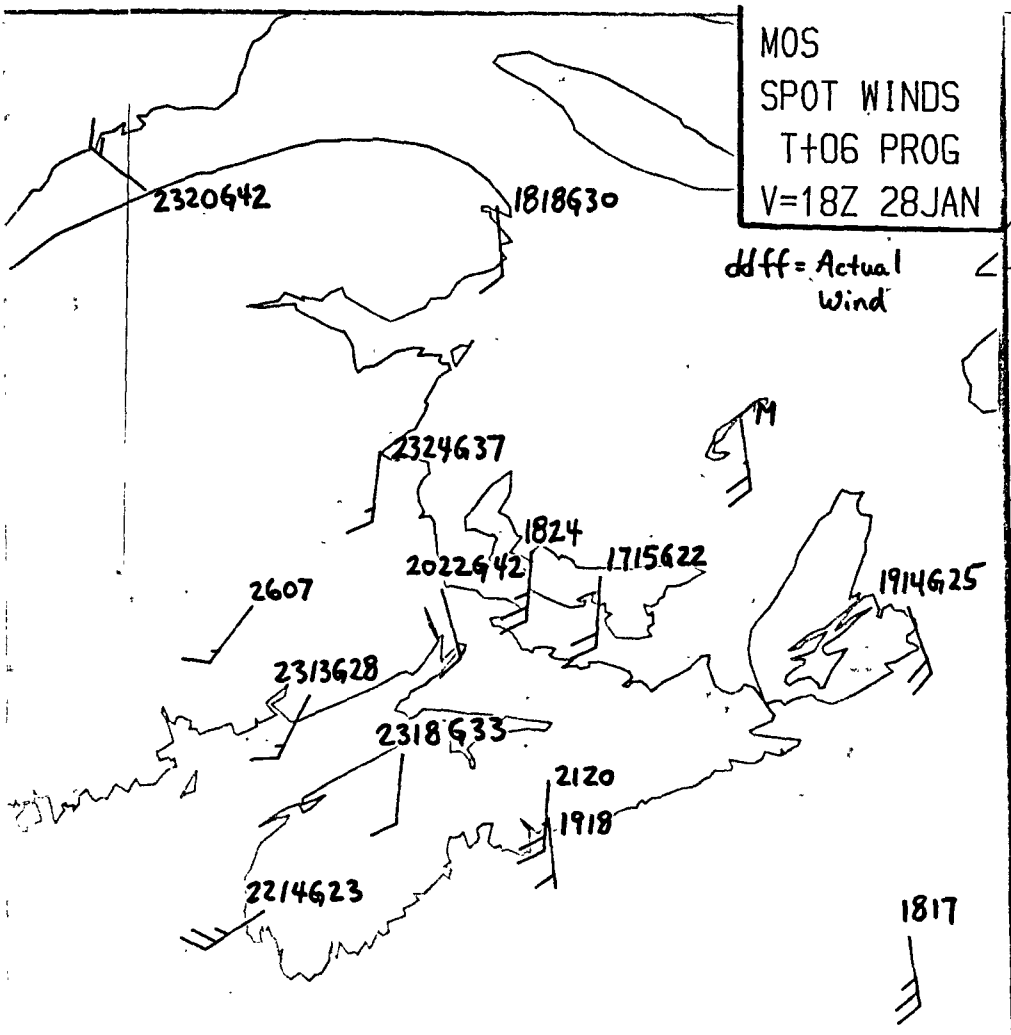
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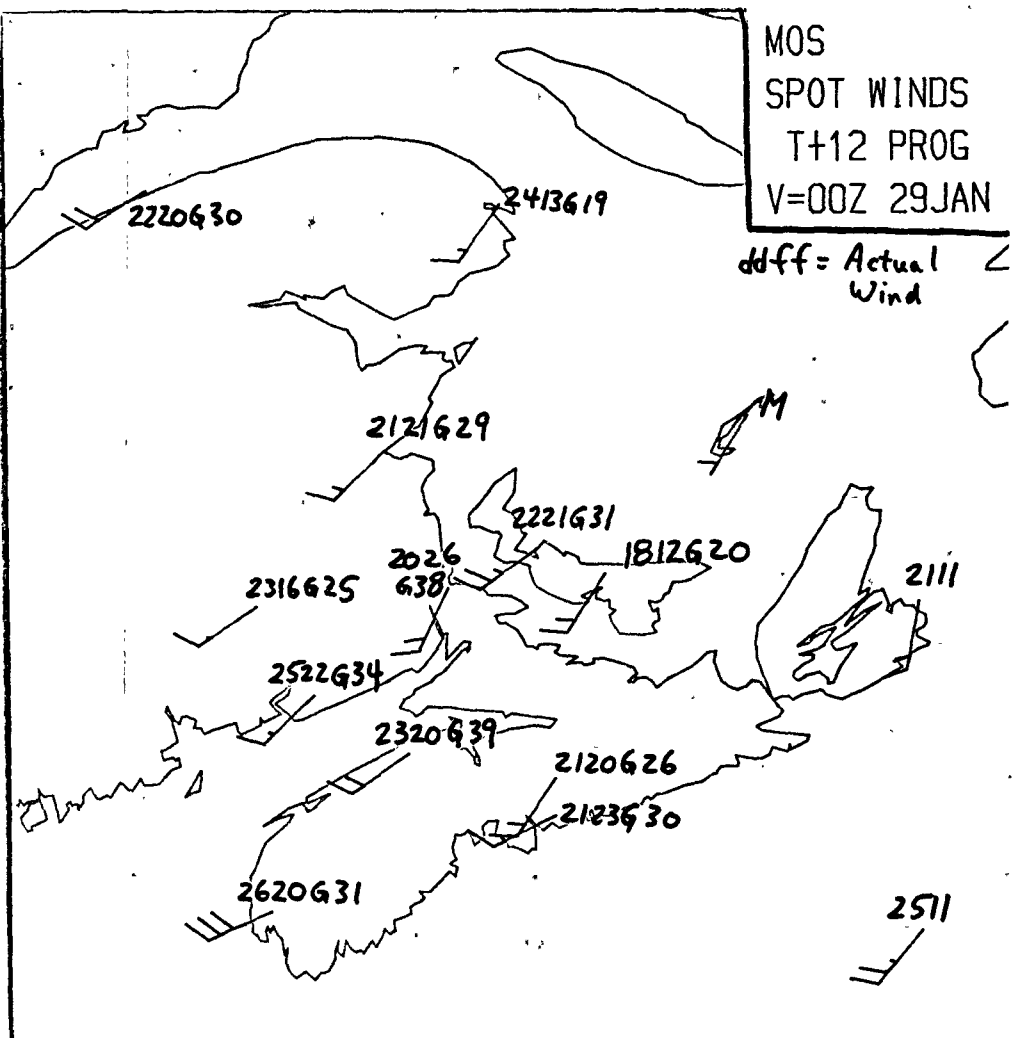
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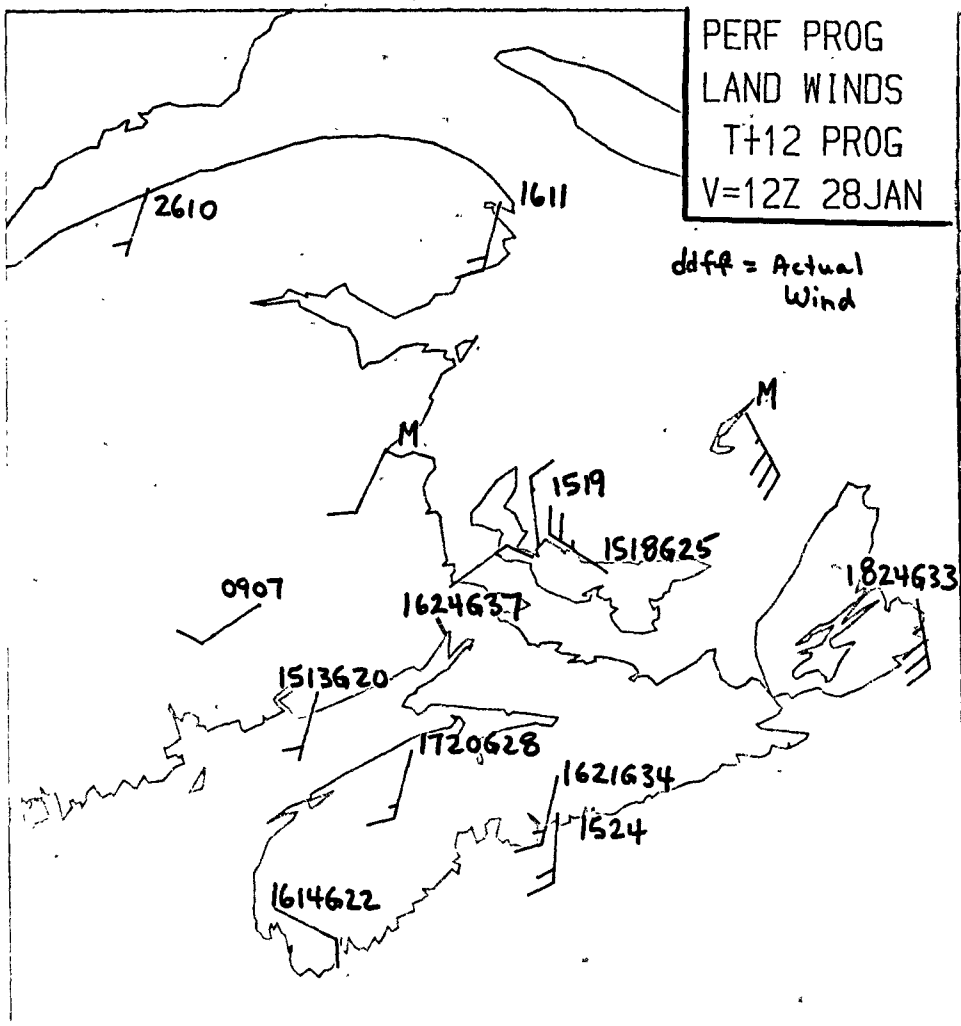
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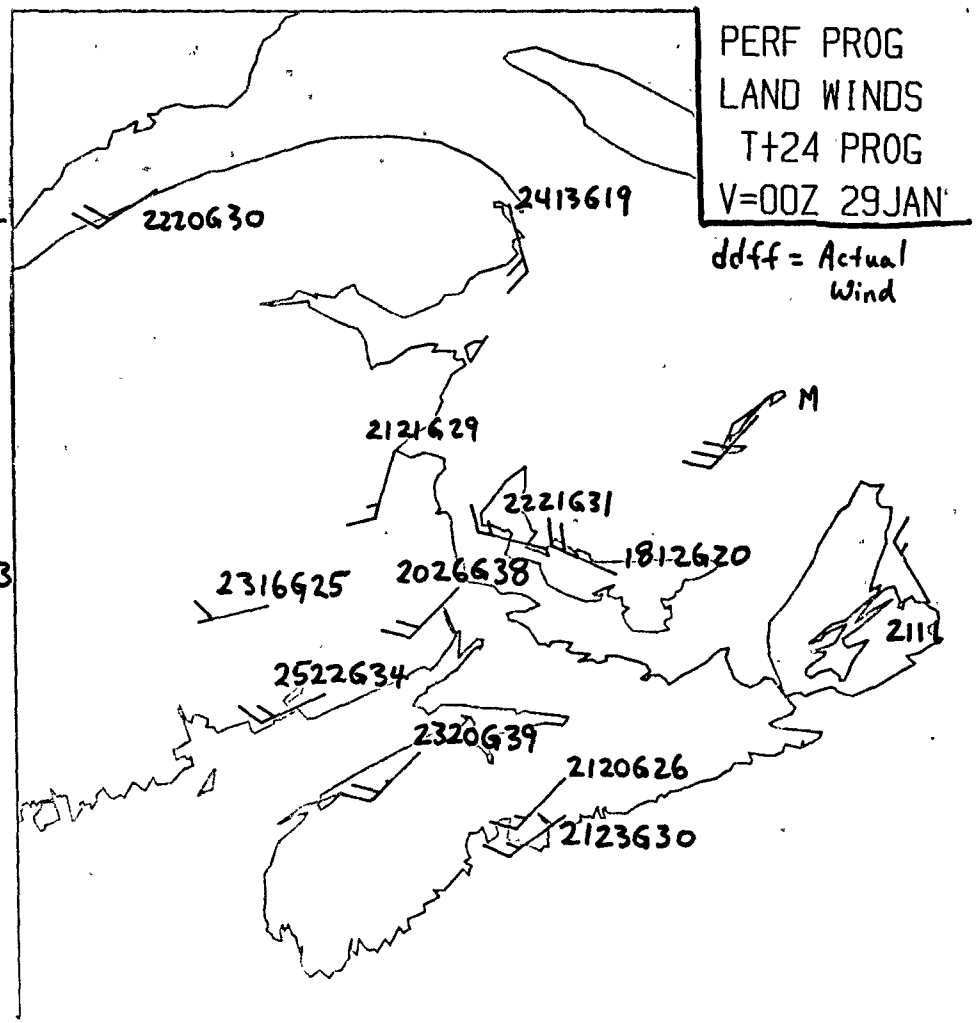
PERF PROG
LAND WINDS
T+24 PROG
V=00Z 29JAN
ddff = Actual Wind
2220630
2413619
M
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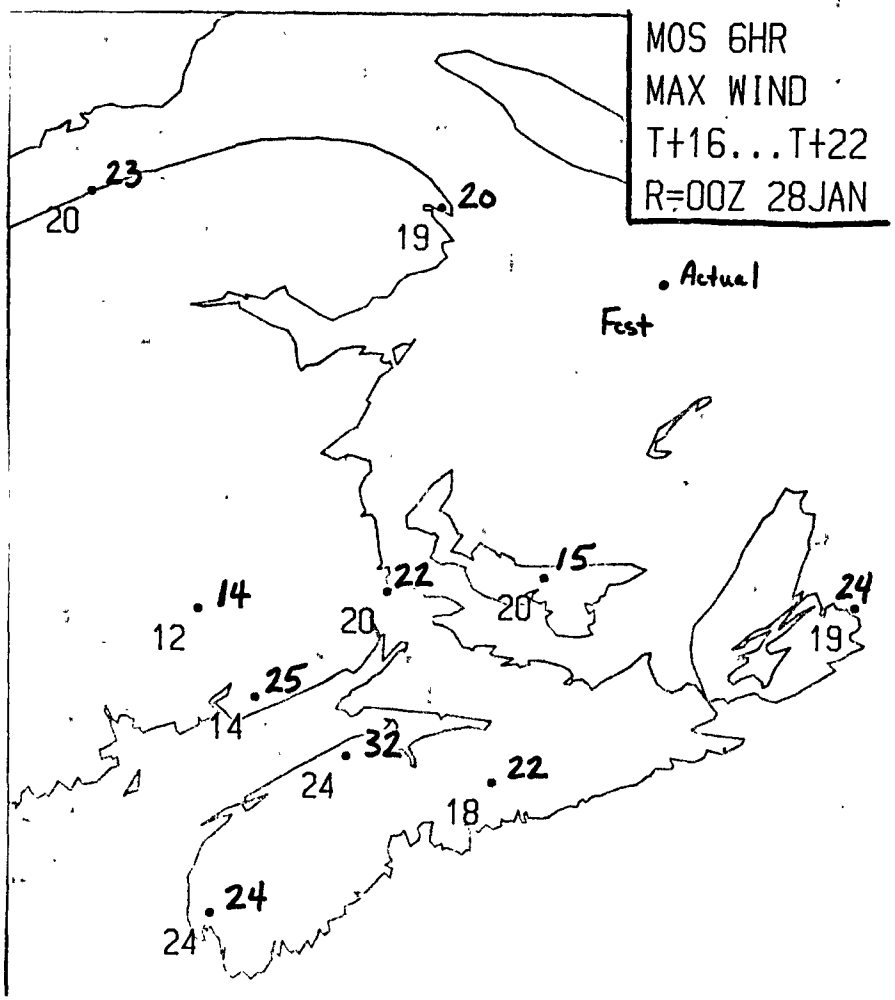
2221631
1812620
2316625
2026638
2114
2522634
2320639
2120626
2123630


MOS 6HR
MAX WIND
T+16...T+22
R=00Z 28JAN
Actual
Fcst
23
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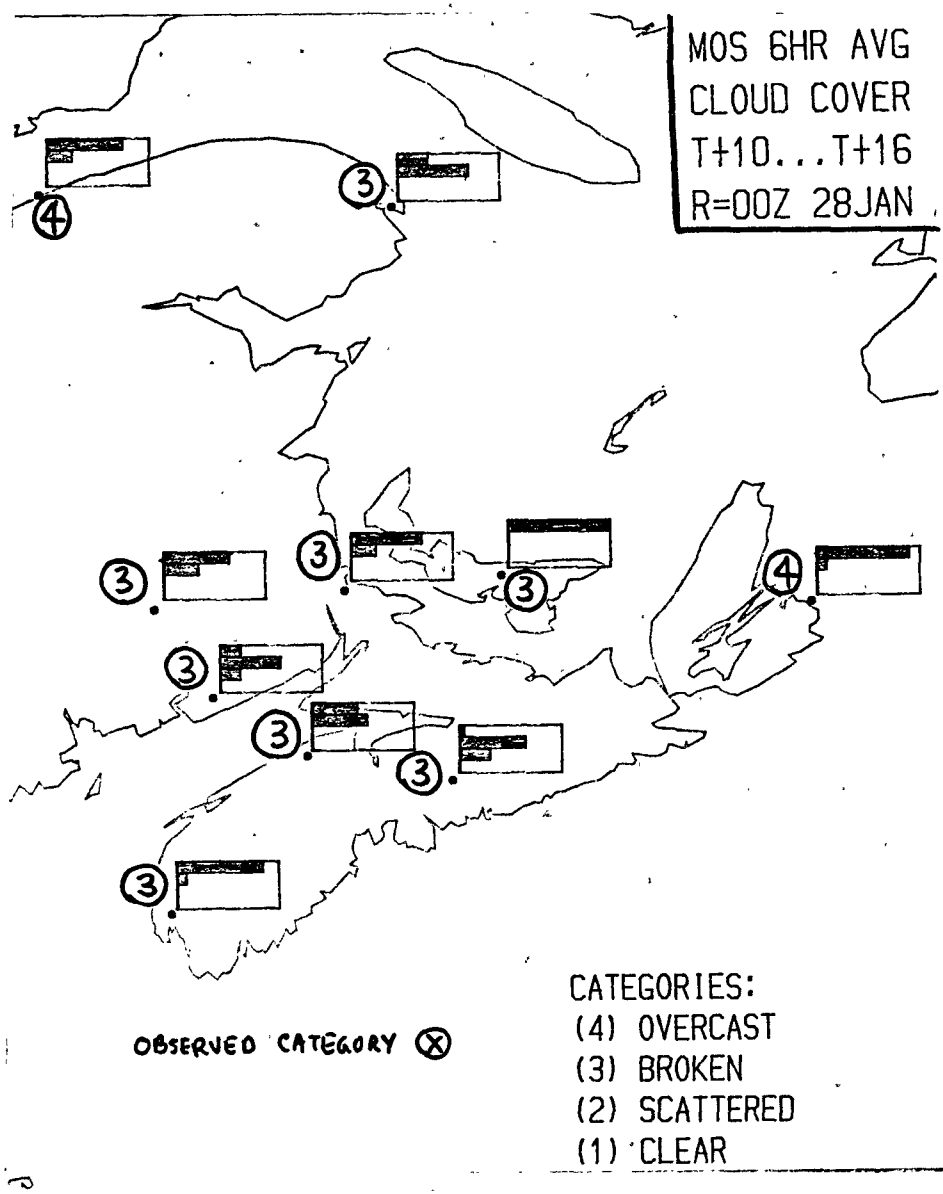
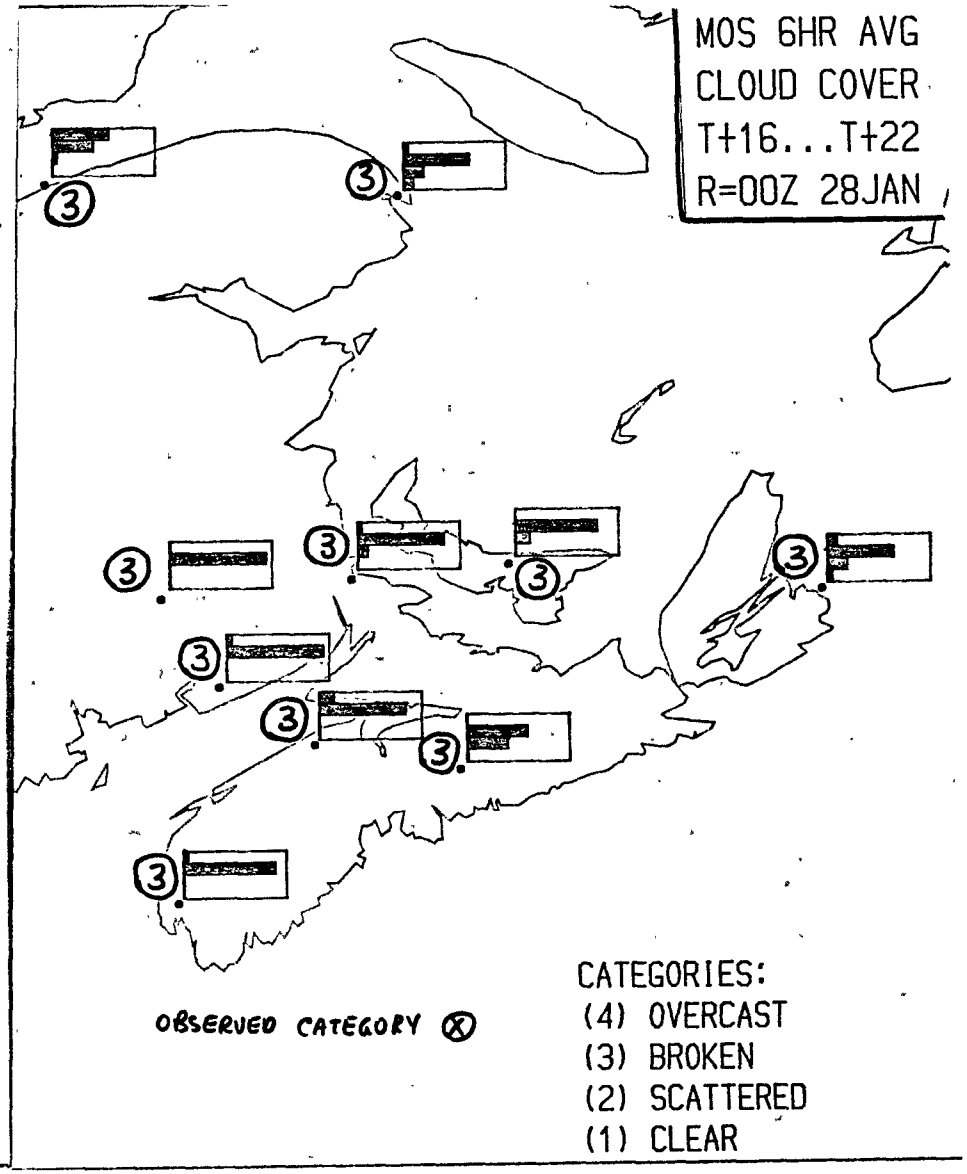
18
24
24


MOS 6HR AVG
CLOUD COVER
T+10...T+16
R=00Z 28JAN
OBSERVED CATEGORY ⊗
CATEGORIES:
(4) OVERCAST
(3) BROKEN
(2) SCATTERED
(1) CLEAR


MOS 6HR AVG
CLOUD COVER
T+16...T+22
R=00Z 28JAN
OBSERVED CATEGORY ⊗
CATEGORIES:
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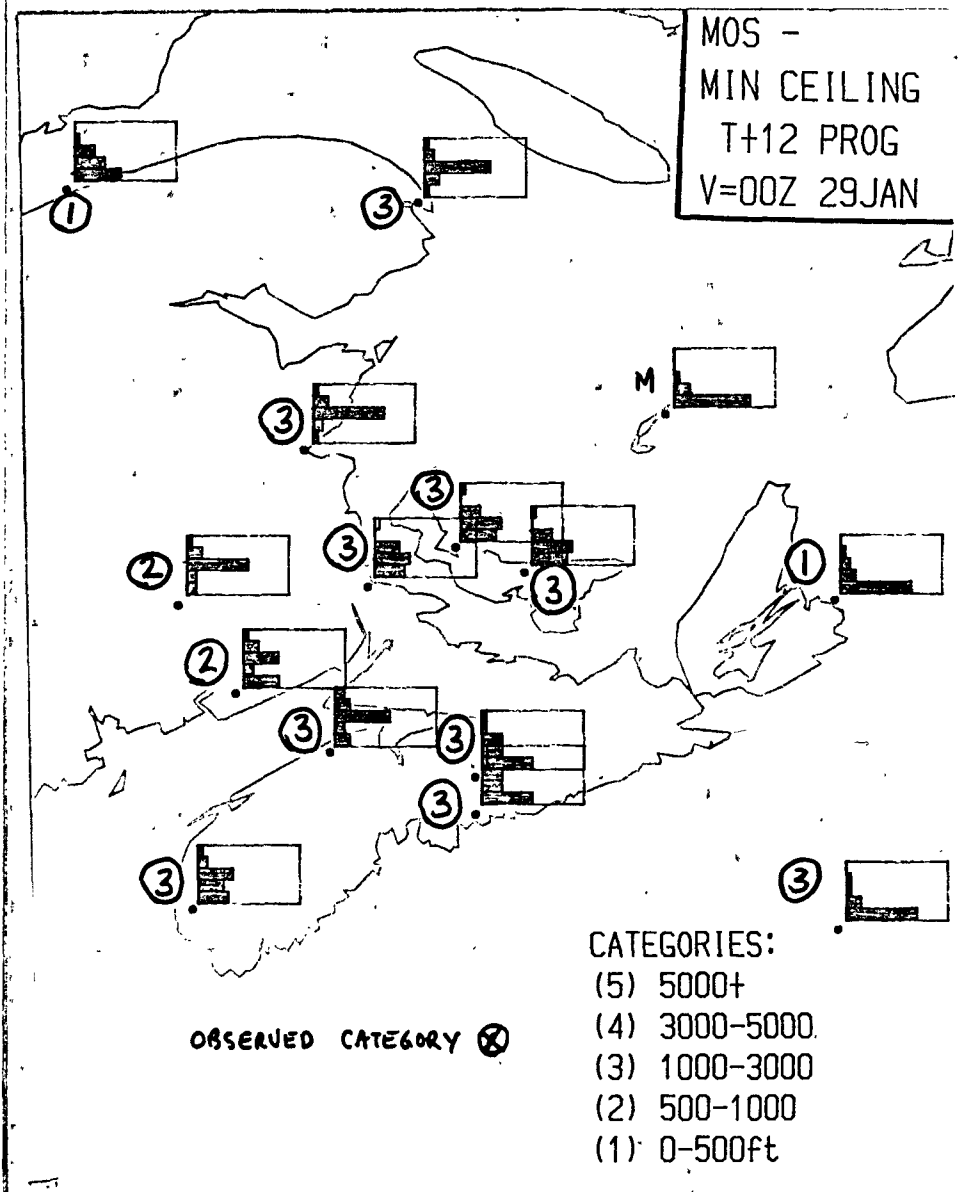
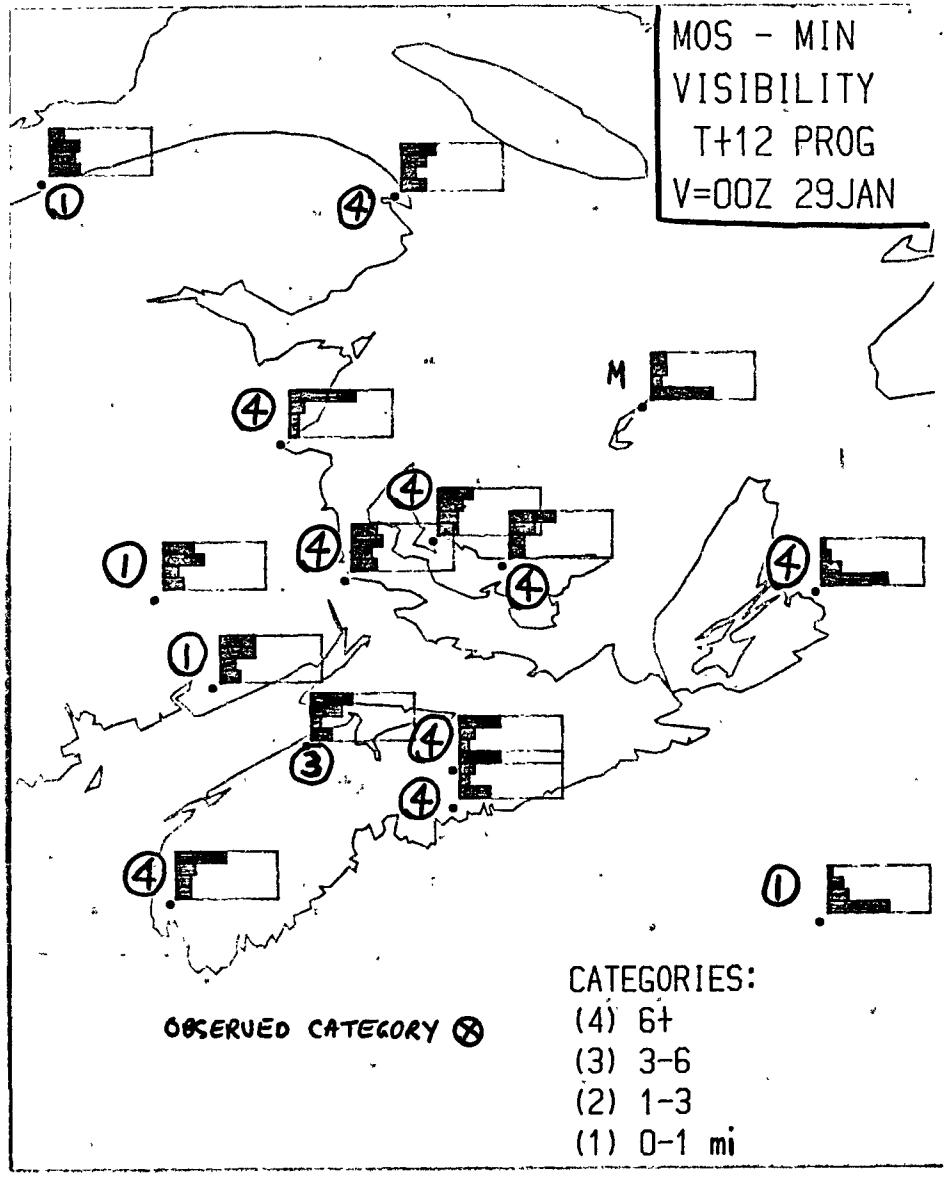
(3) BROKEN
(2) SCATTERED
(1) CLEAR


MOS -
MIN CEILING
T+12 PROG
V=00Z 29JAN
M
OBSERVED CATEGORY ⊗
CATEGORIES:
(5) 5000+
(4) 3000-5000
(3) 1000-3000
(2) 500-1000
(1) 0-500ft


MOS - MIN
VISIBILITY
T+12 PROG
V=00Z 29JAN
M
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CATEGORIES:
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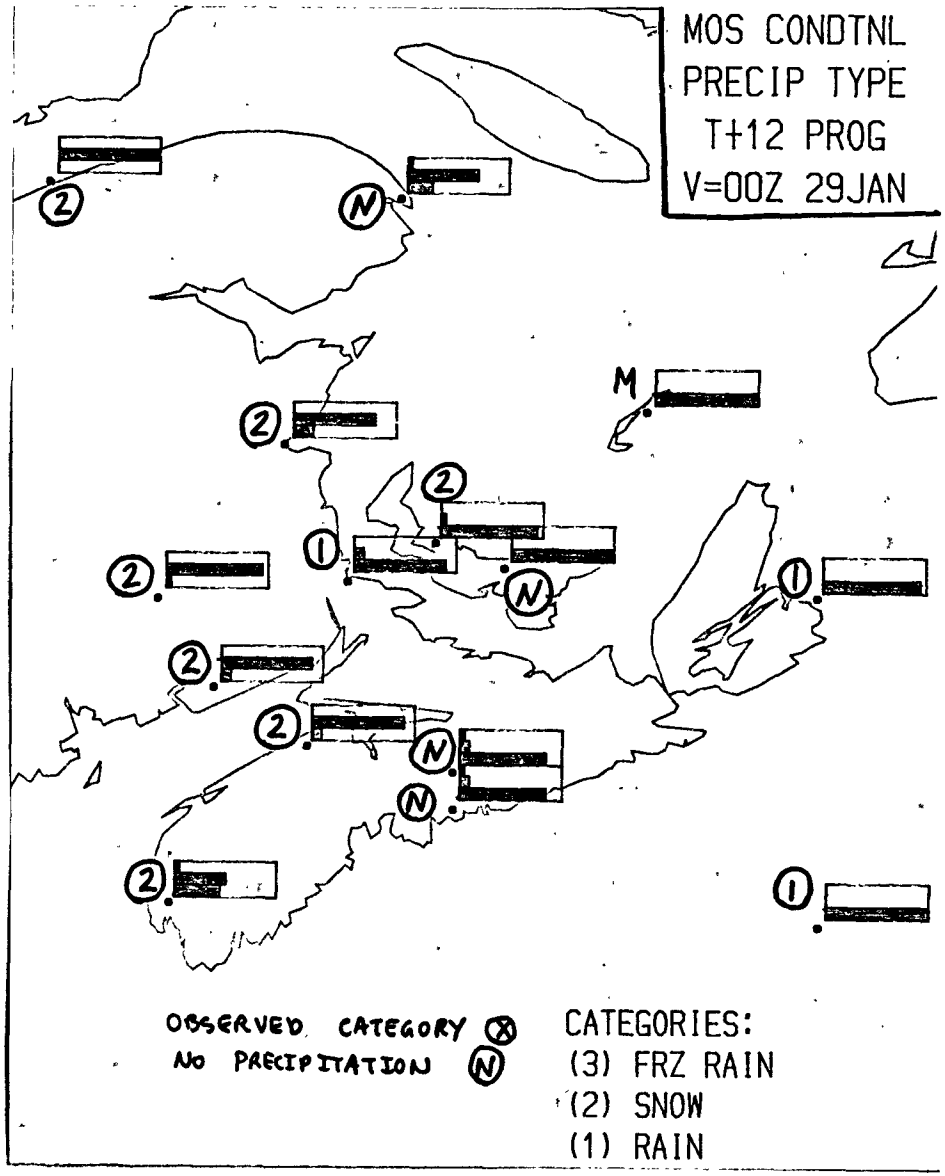
(3) 3-6
(2) 1-3
(1) 0-1 mi


MOS CONDTNL
PRECIP TYPE
T+12 PROG
V=00Z 29JAN
OBSERVED CATEGORY ⊗
NO PRECIPITATION (N)
CATEGORIES:
(3) FRZ RAIN
(2) SNOW
(1) RAIN

Appendix C: 06Z Jan 30 - 00Z Jan 31 1986

Synoptic Situation

A 1010 mb centre located northeast of Cape Hatteras at 00Z Jan 30 tracked northeastward reaching Sable Island as a 1001 mb centre at 00Z Jan 31. Snow spread into the southern Maritimes on Jan 30 with the rain/snow boundary touching the south coast of Cape Breton late on Jan 30. An east-west ridge line across the northern Maritimes persisted until the latter part of the period.

Streamlines

The 18Z map shows the outflow from the ridge with convergence south of Nova Scotia. This flow persists throughout the period. Low level convergence into the area of the low centre is well marked on the 06Z and 18Z maps, but less evident at 12Z and 00Z. The convergence near YQI at 06Z produced localized snow several hours before the main precipitation event. The streamers across the northern Gulf of St Lawrence at 06Z correspond to snowflurry activity along the west coast of Newfoundland.

MOS Spot Temperatures

Forecast temperatures were too cold at 04Z and 10Z with average errors of 2.4 and 1.3 degrees respectively. The 16Z forecasts are very good with < 1 degree average error. The 22Z forecasts reverse the previously noted trend and are generally too warm. They appear to be showing a diurnal warming trend which, because of the cold outflow, is not realized.

MOS Spot Winds

The overall wind field agrees well with the observed light northeasterly flow over the district. The trend of winds to back with time is well handled. Ignoring the very light wind cases, wind speeds and directions are reasonably accurate, except for WSA, where the speed is significantly underforecast at 18Z and 00Z.

MOS Max Winds

The maximum winds are overforecast at most locations in all three time periods. YAW in the 28 to 34 hour period is an exception indicating the overforecasting is not a systematic error. The average error of 3 kts in the 16 to 22 hour period increased to 3.6 kts by the 28 to 34 hour period; a gradual deterioration in the accuracy of the forecast with time.

MOS Average Cloud Cover

A clearing trend over western New Brunswick is indicated in the first two panels as probabilities shift from category 4 toward lower categories. However, the trend is not maintained in the last panel which is contrary to observed conditions. The trend at YQI is broken becoming overcast, the opposite of that which is observed.

MOS Minimum Ceiling

The 12 hour forecasts show category 3 as the dominant condition for YFC and YSJ deteriorating to category 2 with a significant probability of category 1 by 18Z. However, category 5 prevailed throughout. WSA and YQY shift from mainly category 5 to category 1 in the 12Z to 18Z period which verifies poorly.

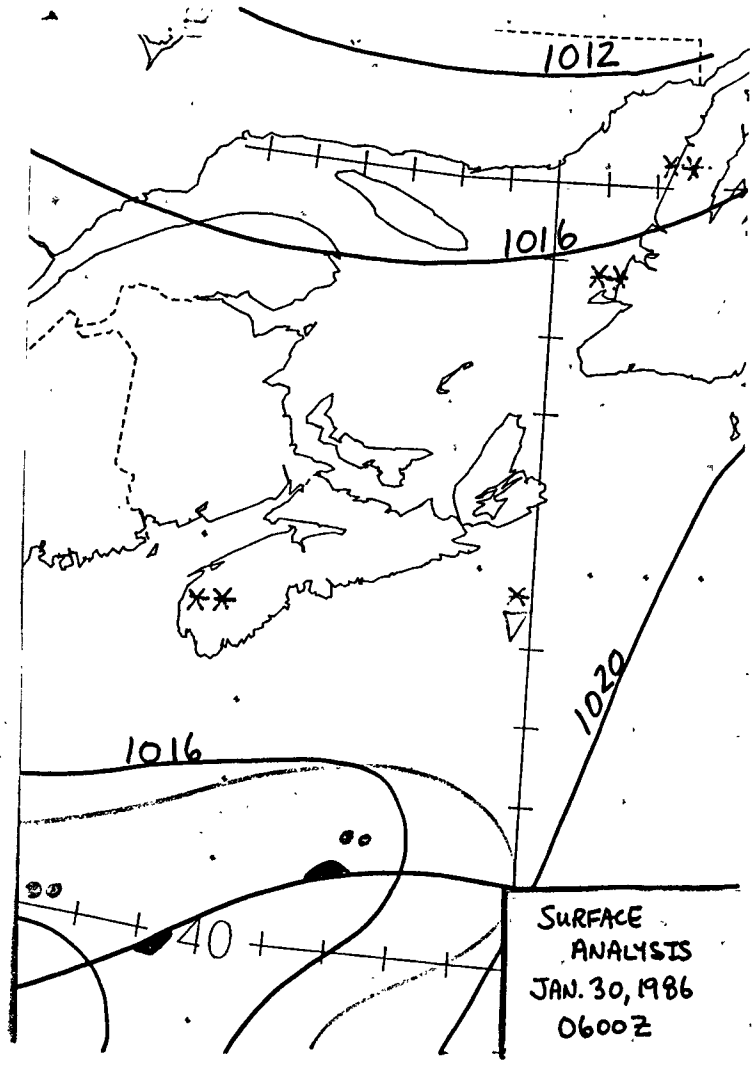
The 24 hour forecasts overforecast the areal extent of low IFR ceilings (category 1). The 24 hour WSA forecast is also poorly handled; however, YQY verifies quite well.

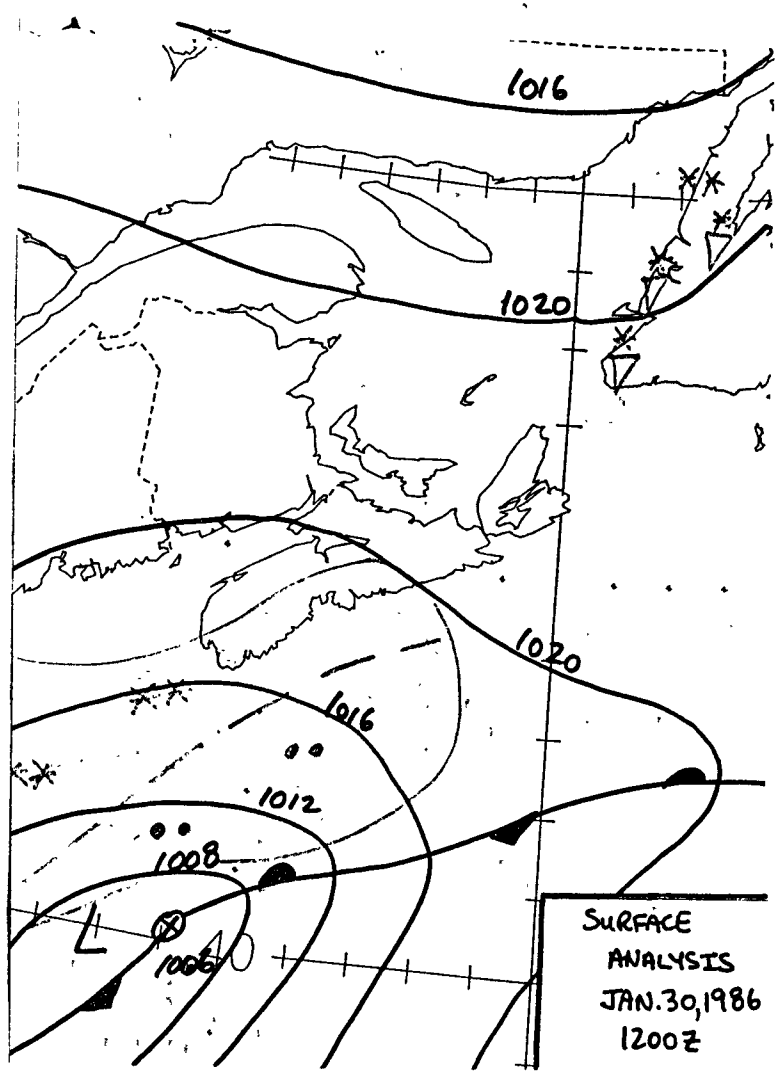
MOS Minimum Visibility

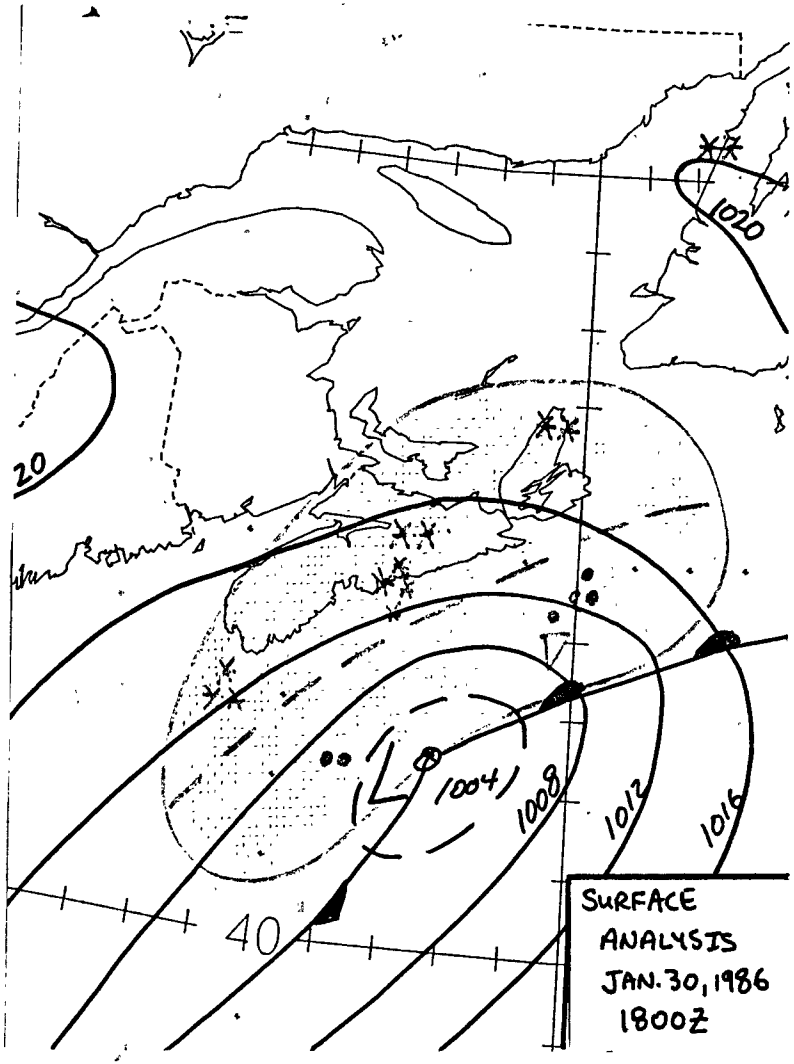
The 12 hour forecasts are poorly handled at several sites such as YAW, YHZ and YQI. There is little discrimination at most sites. The forecast trend at 18 hours is towards lower categories which leads to over forecasting the areal extent of category 1 by 24 hours.

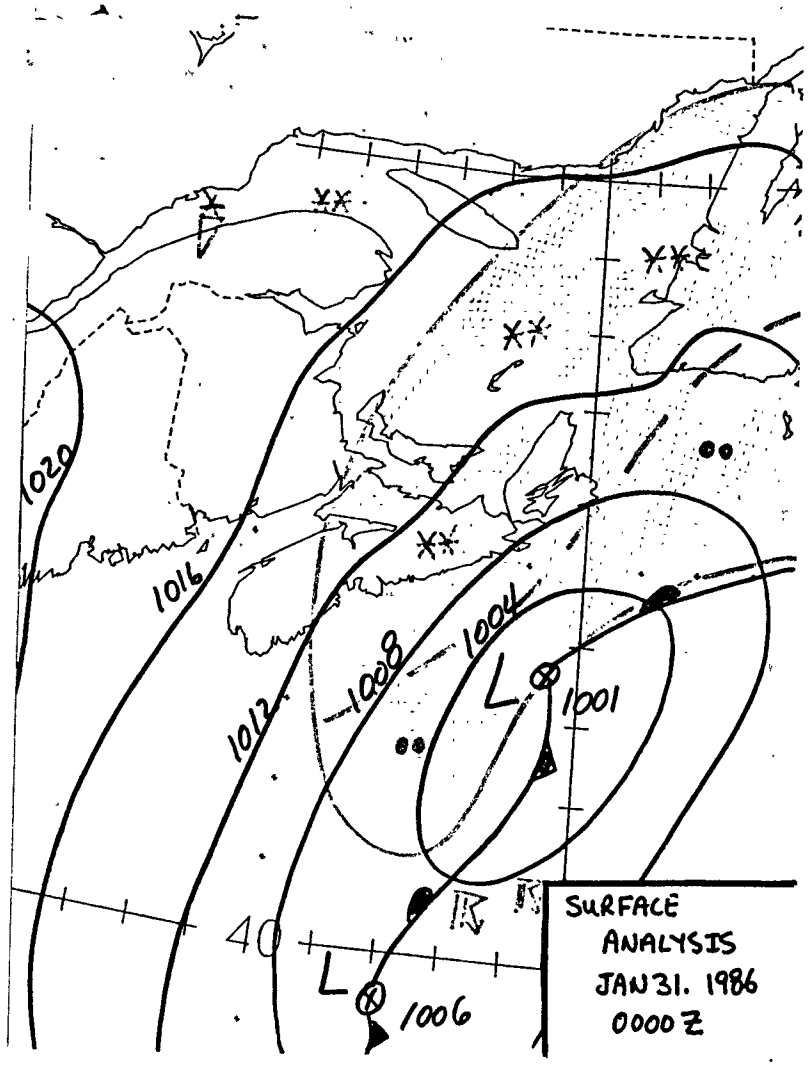
MOS Conditional Precip Type

The increased probabilities in category 1 at YQI, YHZ, YAW and YQY from 12Z to 18Z reflect the approach of the low and of the rain/snow boundary. However, the rain/snow boundary is pushed too far north, across Prince Edward Island, where significant probability of freezing rain is indicated. The latter does not verify. Freezing rain at YQY at 24 hours is missed.

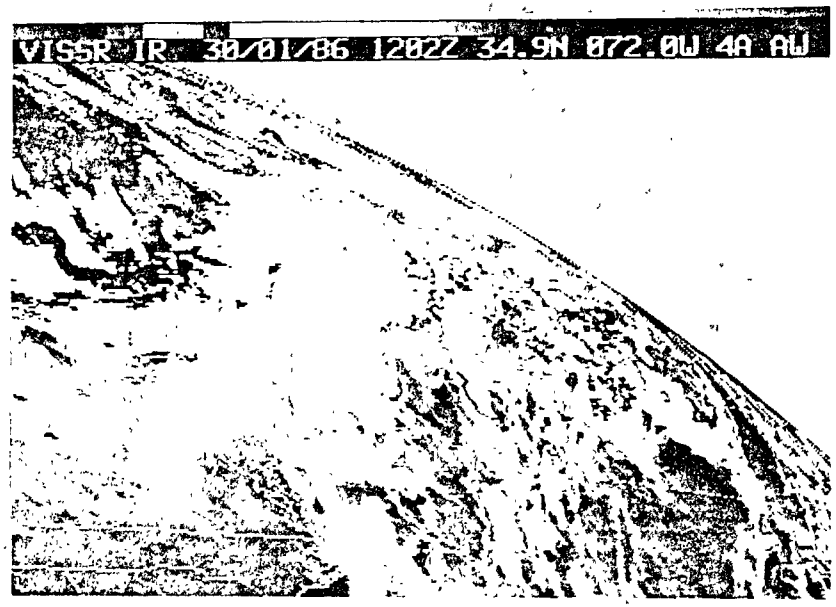

1012
1016
1020
1016
40
SURFACE
ANALYSIS
JAN. 30, 1986
0600Z


1016
1020
1020
1016
1012
1008
L
1006
40
SURFACE
ANALYSIS
JAN. 30, 1986
1200Z

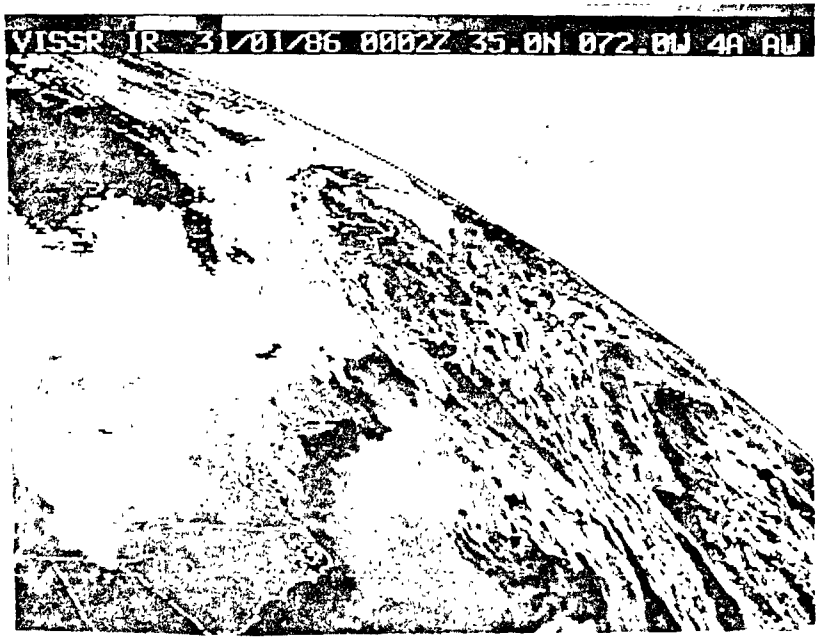

1020
20
1004
1008
1012
1016
40
SURFACE
ANALYSIS
JAN. 30, 1986
1800Z


1020
1016
1012
1008
1004
1001
1006
40
SURFACE
ANALYSIS
JAN 31. 1986
0000Z


VISSR IR 30/01/86 0601Z 35.0N 072.0W 4A AW


VISSR IR 30/01/86 1202Z 34.9N 072.0W 4A AW


VISSR IR 30/01/86 1802Z 35.0N 072.0W 4A AW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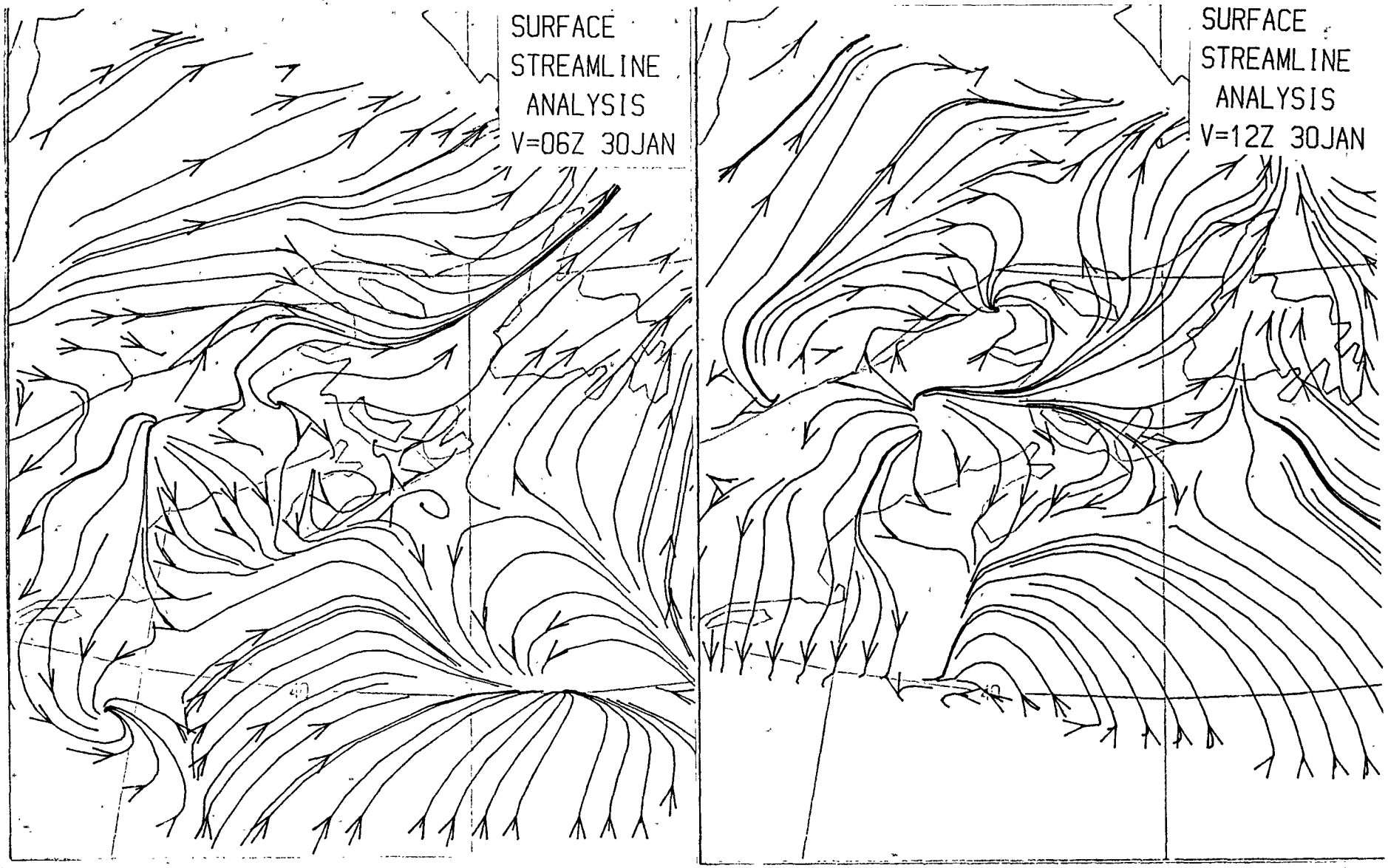
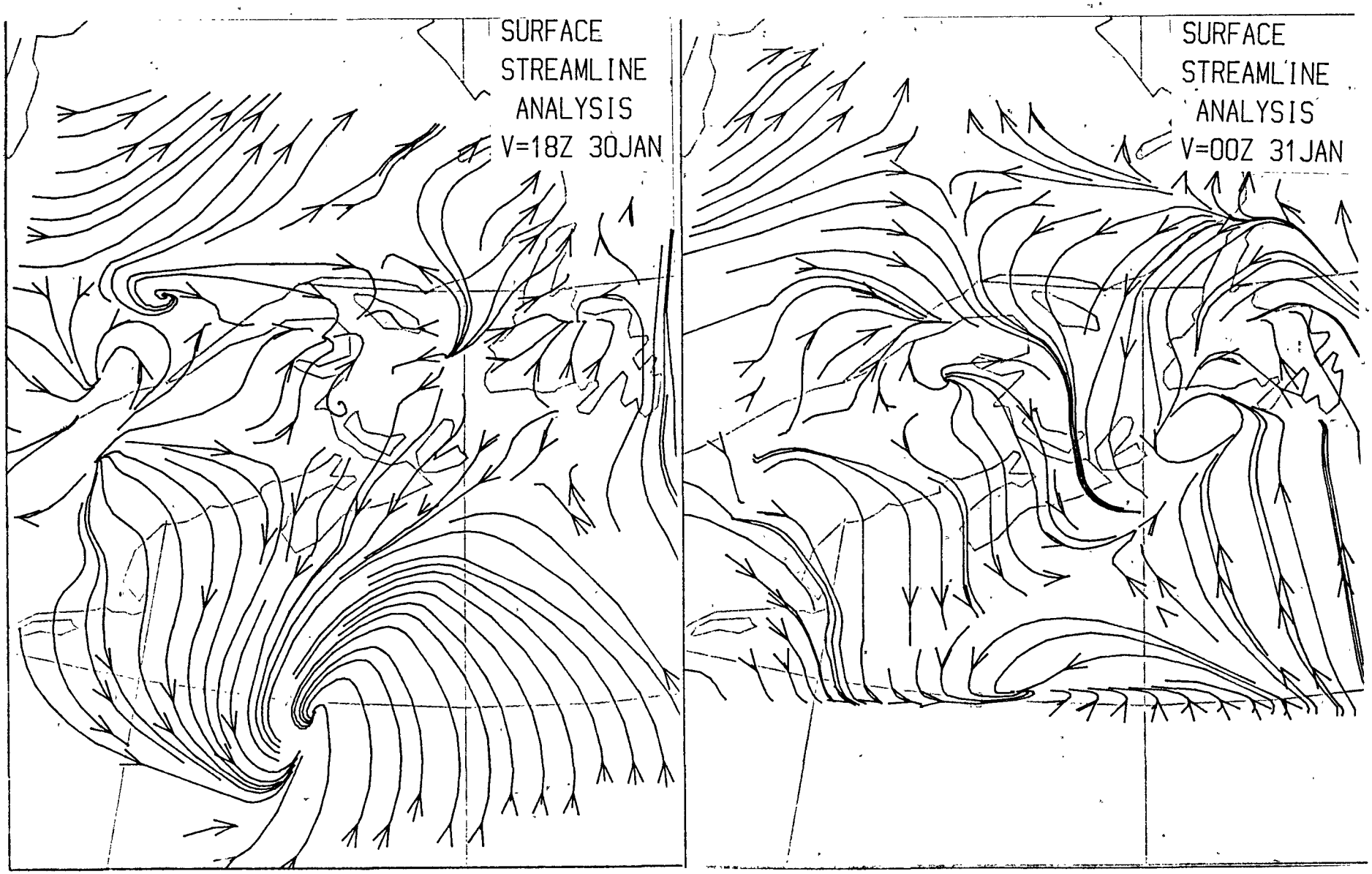

SURFACE
STREAMLINE
ANALYSIS
V=06Z 30JAN
SURFACE
STREAMLINE
ANALYSIS
V=12Z 30JAN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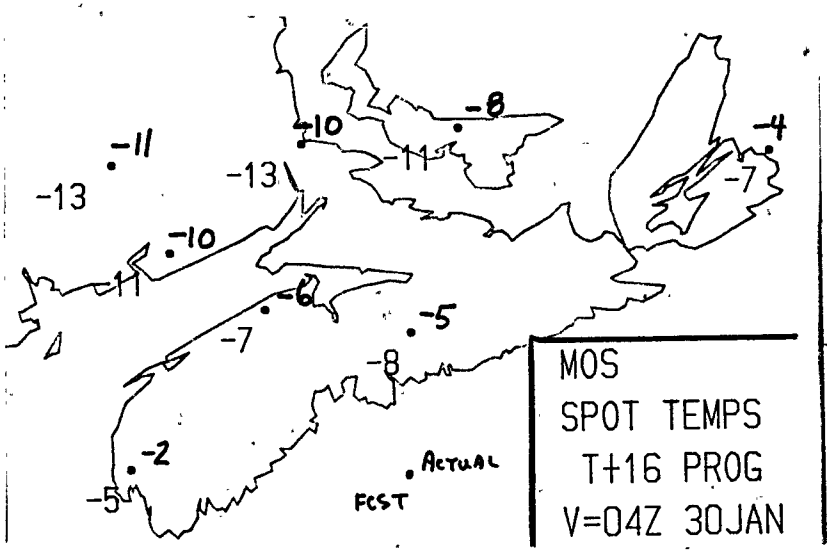
STREAMLINE
ANALYSIS
V=18Z 30JAN
SURFACE
STREAMLINE
ANALYSIS
V=00Z 31JAN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-4
-7
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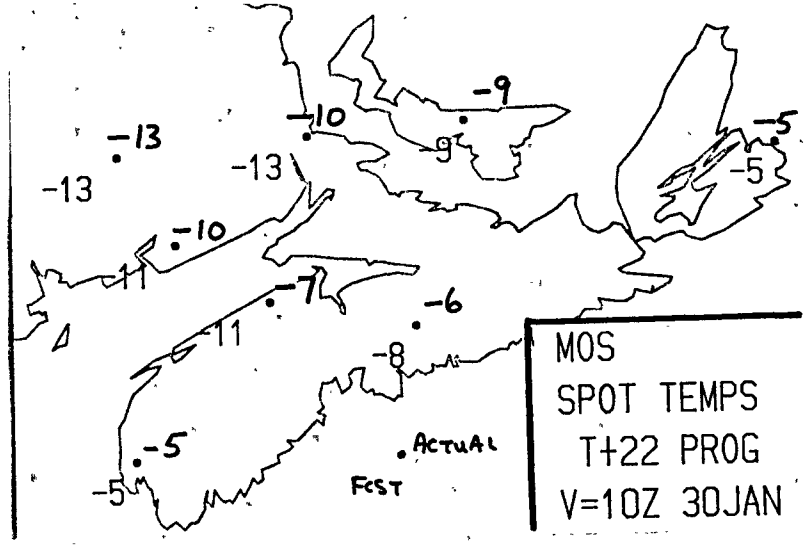
-5
-8
-2
-5
ACTUAL
FCST
MOS
SPOT TEMPS
T+16 PROG
V=04Z 30JAN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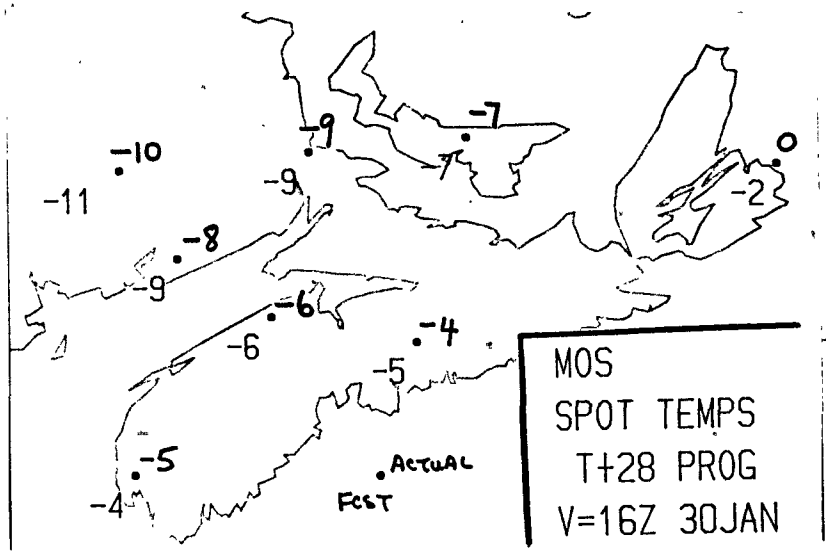
ACTUAL
FCST
MOS
SPOT TEMPS
T+22 PROG
V=10Z 30JAN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-2
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-6
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-4
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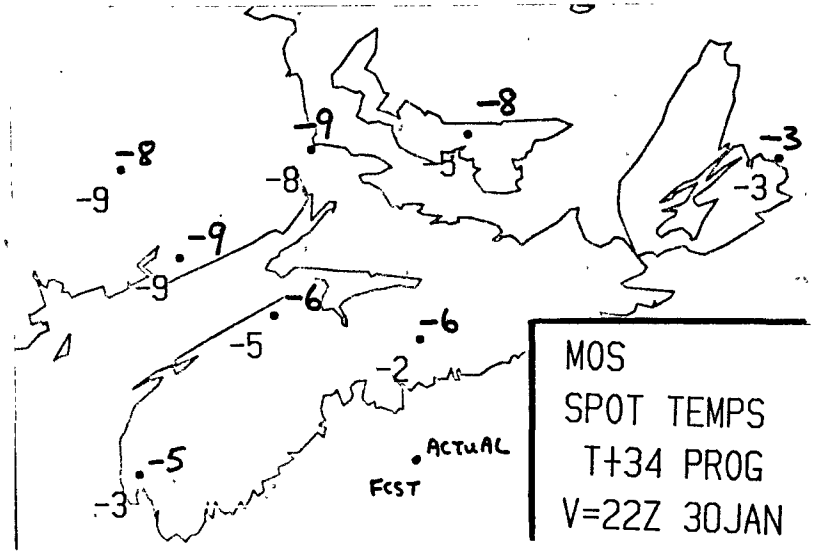
-4
ACTUAL
FCST
MOS
SPOT TEMPS
T+28 PROG
V=16Z 30JAN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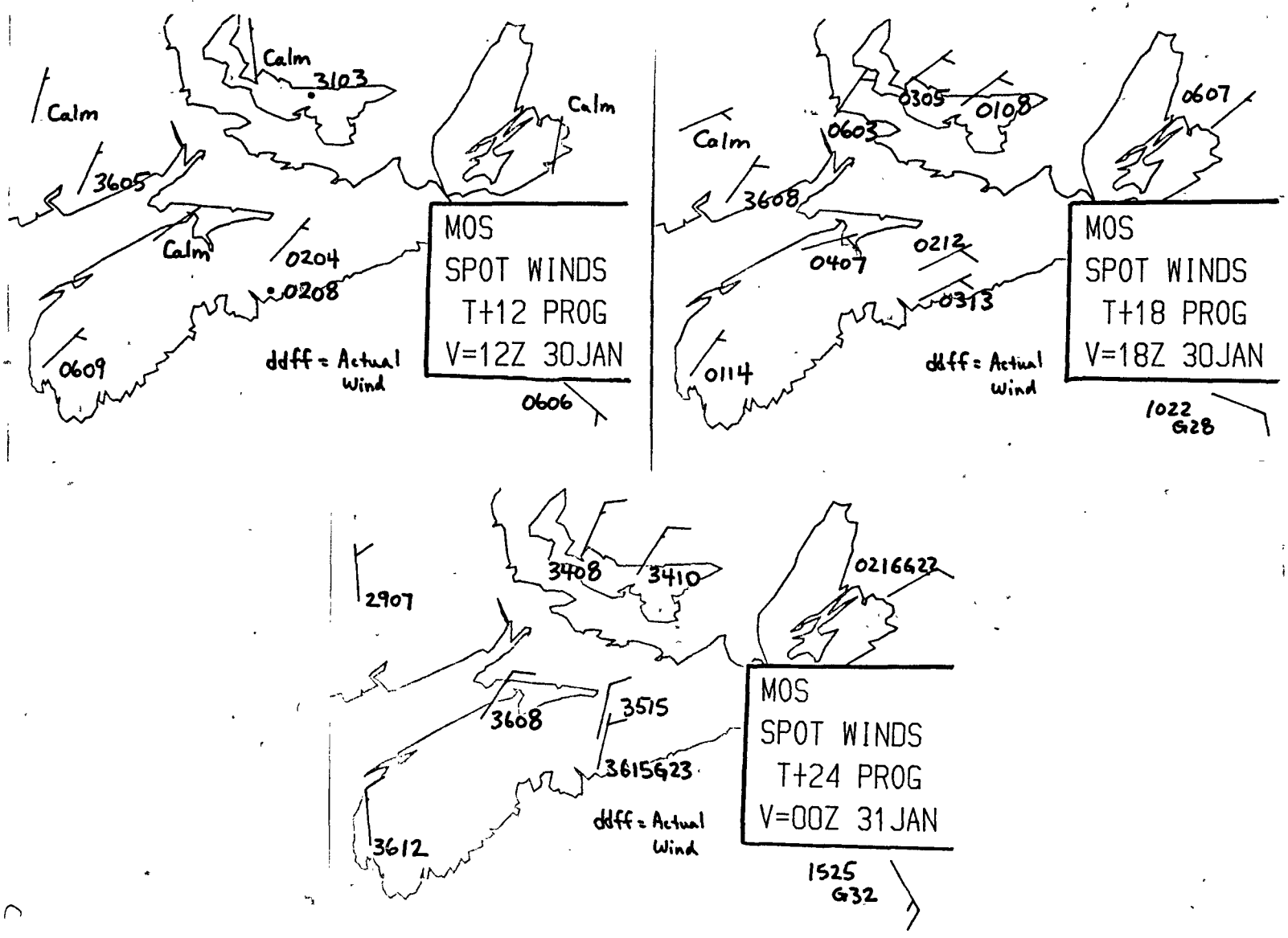
-2
-5
-3
ACTUAL
FCST
MOS
SPOT TEMPS
T+34 PROG
V=22Z 30JAN


Calm
Calm
3103
Calm
3605
Calm
0204
0208
0609
ddff = Actual Wind
MOS
SPOT WINDS
T+12 PROG
V=12Z 30JAN
0606
Calm
0305
0108
0607
0603
3608
0407
0212
0313
0114
ddff = Actual Wind
MOS
SPOT WINDS
T+18 PROG
V=18Z 30JAN
1022
G28
2907
3408
3410
0216622
3608
3515
3615623
3612
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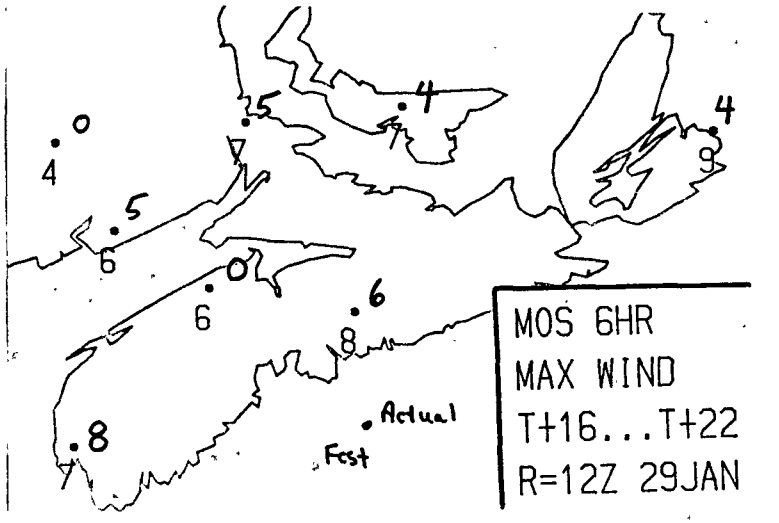
SPOT WINDS
T+24 PROG
V=00Z 31JAN
1525
G32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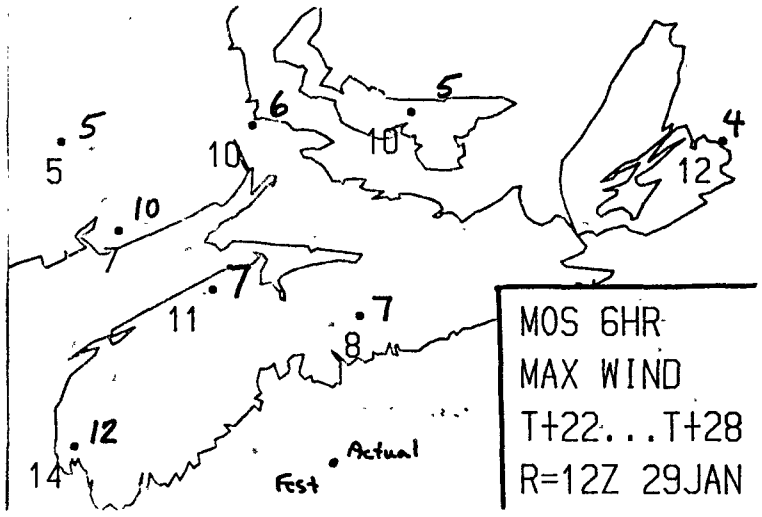
Actual
Fcst
MOS 6HR
MAX WIND
T+16...T+22
R=12Z 29JAN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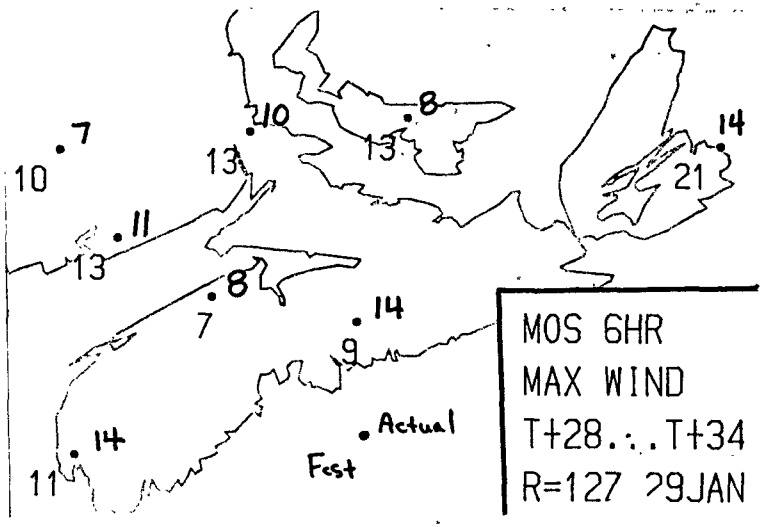
Actual
Fcst
MOS 6HR
MAX WIND
T+22...T+28
R=12Z 29JAN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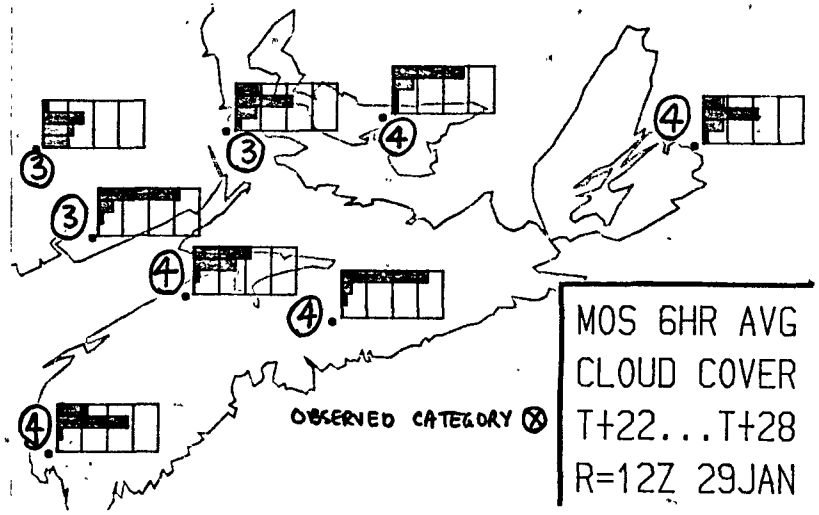
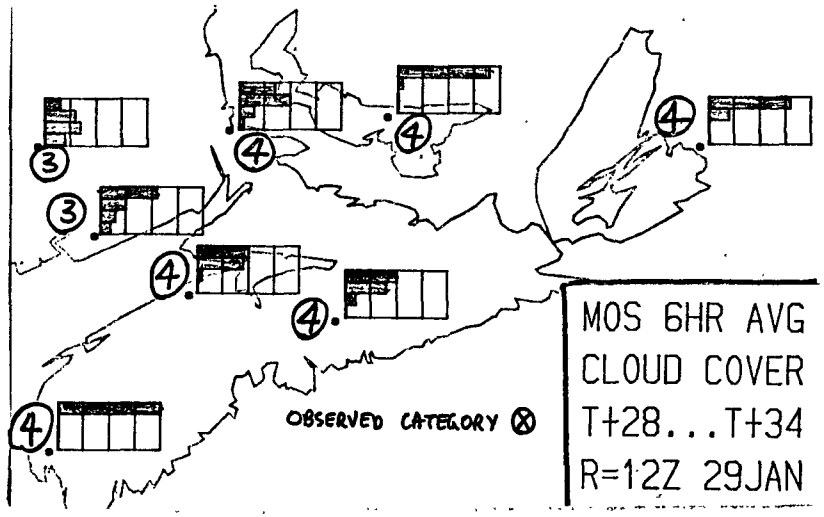
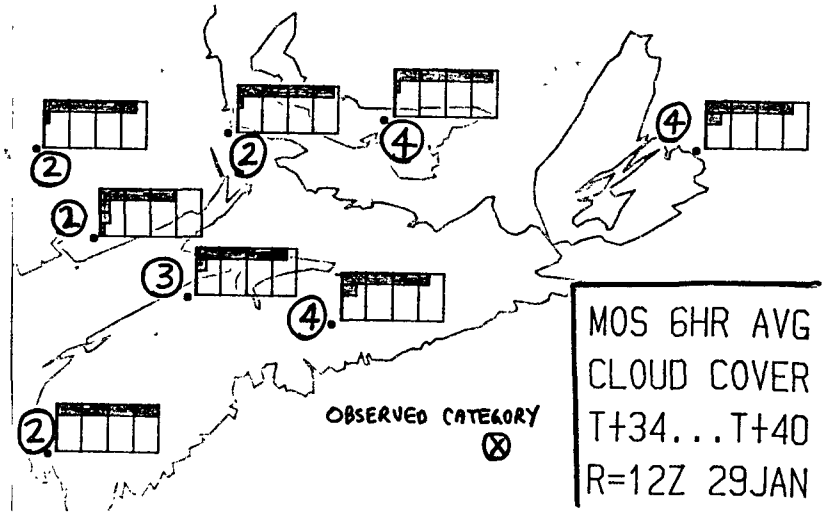
11
Actual
Fcst
MOS 6HR
MAX WIND
T+28...T+34
R=12Z 29JAN



MOS 6HR AVG
CLOUD COVER
T+22...T+28
R=12Z 29JAN

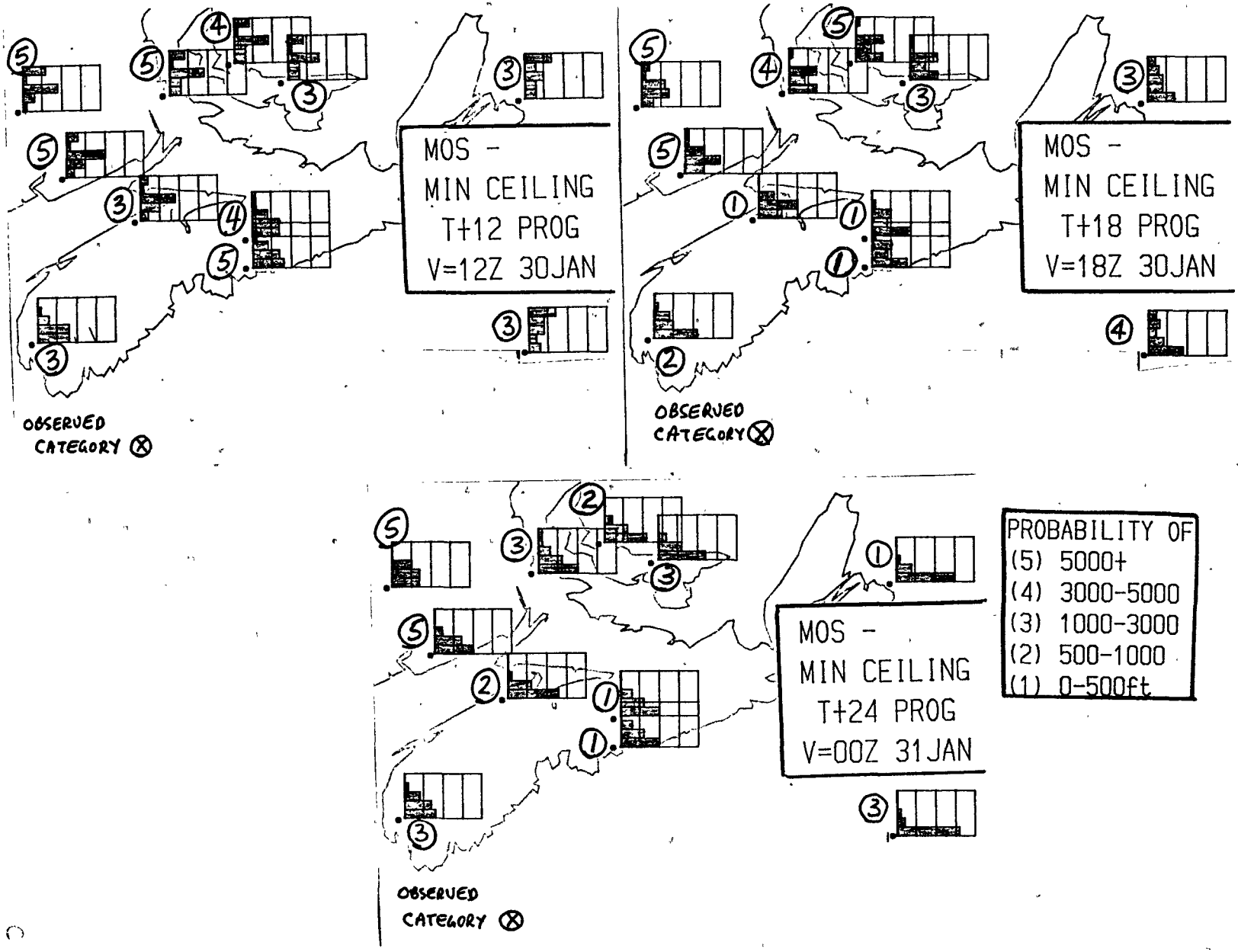


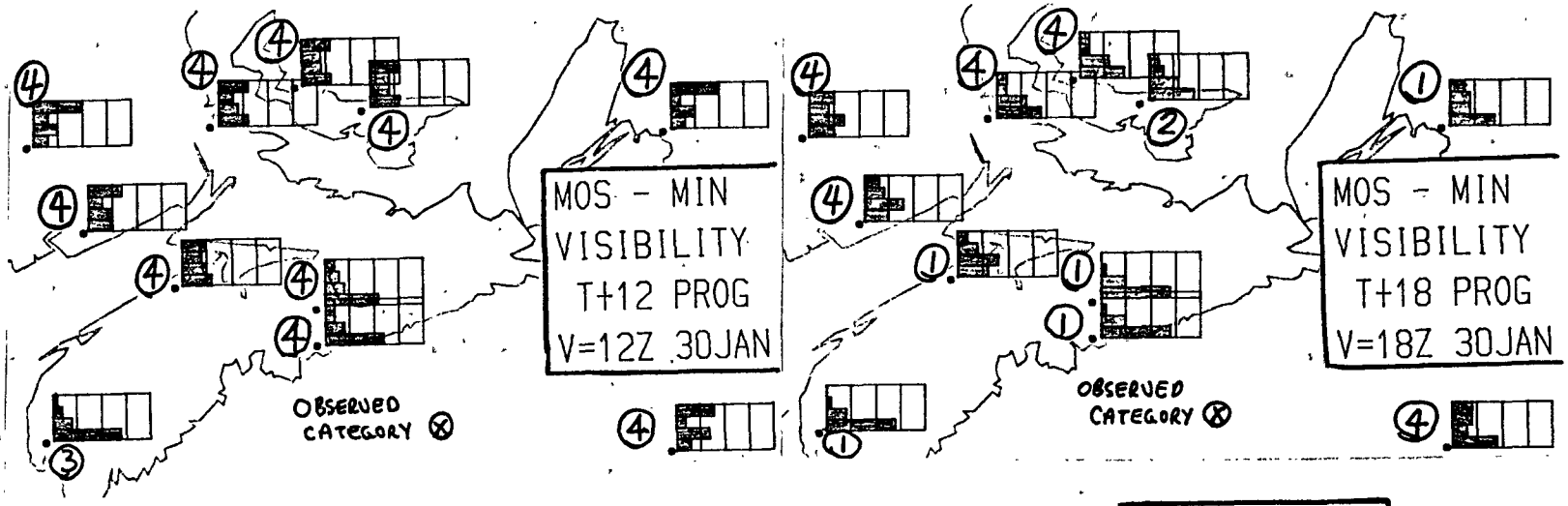
MOS 6HR AVG
CLOUD COVER
T+28...T+34
R=12Z 29JAN

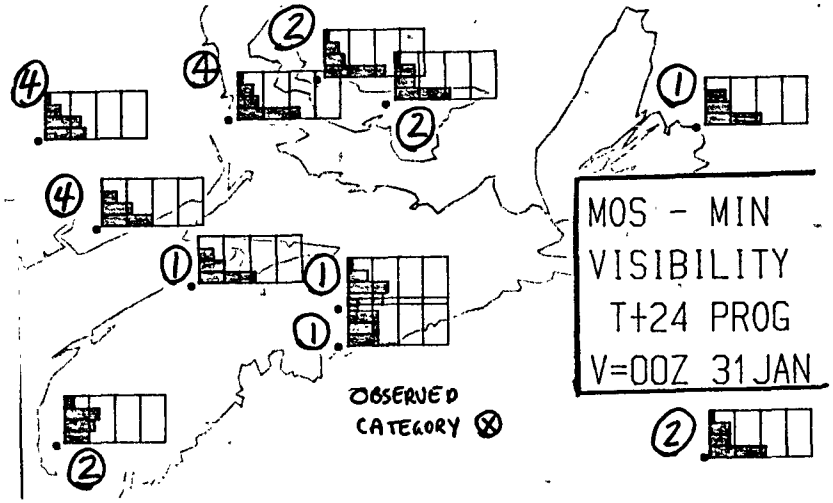


MOS 6HR AVG
CLOUD COVER
T+34...T+40
R=12Z 29JAN

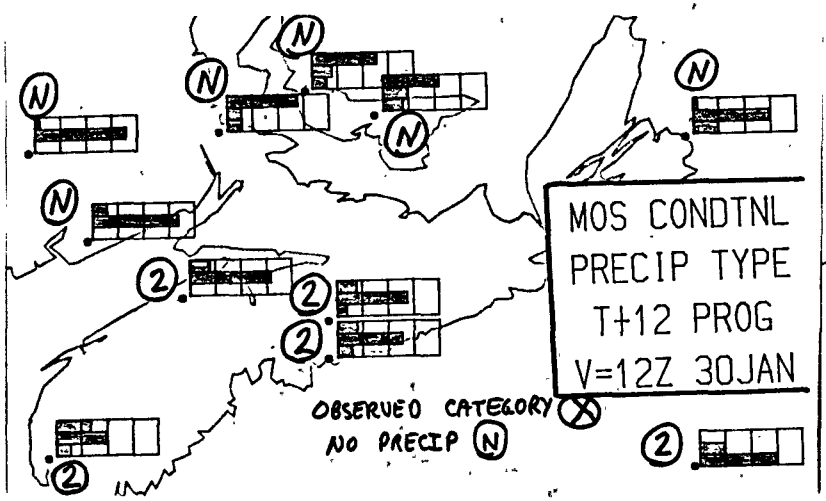
PROBABILITY OF
(4) OVERCAST
(3) BROKEN
(2) SCATTERED
(1) CLEAR

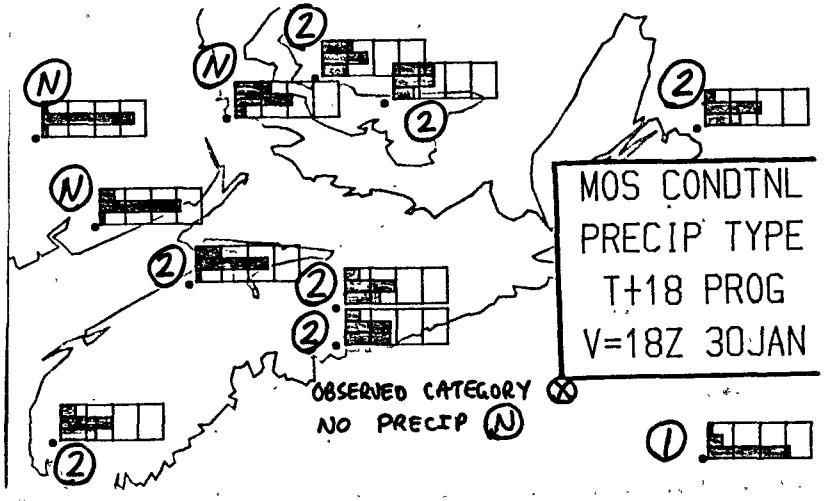

MOS -
MIN CEILING
T+12 PROG
V=12Z 30JAN
OBSERVED
CATEGORY ⊗
MOS -
MIN CEILING
T+18 PROG
V=18Z 30JAN
OBSERVED
CATEGORY ⊗
MOS -
MIN CEILING
T+24 PROG
V=00Z 31JAN
OBSERVED
CATEGORY ⊗
PROBABILITY OF
(5) 5000+
(4) 3000-5000
(3) 1000-3000
(2) 500-1000
(1) 0-500ft

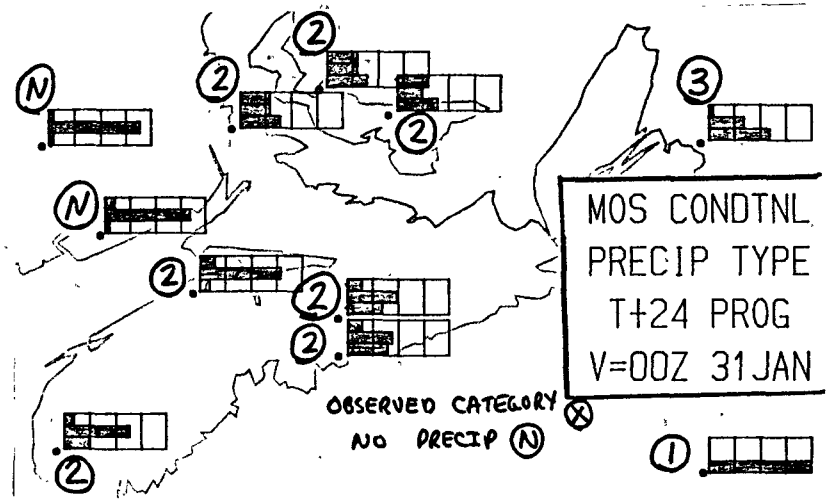




PROBABILITY OF
(4) 6+
(3) 3-6
(2) 1-3
(1) 0-1 mi







PROBABILITY OF
(3) FRZ RAIN
(2) SNOW
(1) RAIN

Appendix D: 06Z Feb 2 - 06Z Feb 3 1986

Synoptic Situation

A 1012 mb low pressure centre over eastern Lake Ontario at 06Z Feb 2 was moving rapidly eastward with little development. Strong pressure falls near Cape Cod suggested a centre jump/re-development in the Gulf of Maine. By 18Z a 1006 mb low was located just west of Yarmouth. The low tracked northeastward along the south coast of Nova Scotia deepening to 999 mb by 06Z Feb 3. An extensive area of snow spread into the Maritimes by 12Z Feb 2, becoming moderate to heavy snow across the southern Maritimes and changing to rain over southwestern Nova Scotia. By 06Z Feb 3 all but eastern regions were improving.

Streamlines

No discussion presented.

MOS Spot Temperatures

The 10Z, 16Z and 22Z temperatures were too cold with average errors of 4.6, 1.6 and 1.9 degrees respectively. YQY was an exception throughout with YQM an exception at 16Z and 22Z. The temperatures were in good agreement by 04Z with no systematic error. The average error was 1.4 degrees.

The zero degree isotherm was forecast to lie east-west near YQI, but nosed further north to YZX at 22Z then translated eastward into YHZ by 04Z.

MOS Spot Winds

The depicted wind field indicates a low tracking through central New Brunswick with winds veering at YQM, YSJ and YZX. Winds were observed to back due to the more southerly track of the low. YQI is not veered enough and still forecast southwesterly at 00Z; similar comments apply to YAW and YHZ at 06Z. Wind speeds are reasonably well forecast. YQI at 12Z, WSA at 18Z and again at 06Z are notable exceptions.

MOS Max Winds

The wind speeds are, in general, underforecast in the 10-16Z period with average error of 3.4 kts. YQI is missed by 7 kts in this period and again in the 16-22Z period. No specific trend is indicated in the 16-22Z interval with average error 3.8 kts. The remaining two time periods show an underforecasting trend with deterioration in accuracy; errors of 4.0 and 4.8 respectively. YZX is very poorly handled in the last time period with an error of 13 kts. Wind speeds are forecast to increase at most sites, but this is not confirmed by observation.

MOS Minimum Ceiling

The overall trend indicated by this product is for ceilings to lower to category 1 by 00Z then slowly improve from the northwest by 06Z. YQI shows this deterioration, but the forecast improvement is too slow with category 3 observed by 06Z versus a forecast category 1. YQY and WSA are poorly handled at 00Z and 06Z with insufficient probability in the lower categories. There do not appear to be any systematic errors.

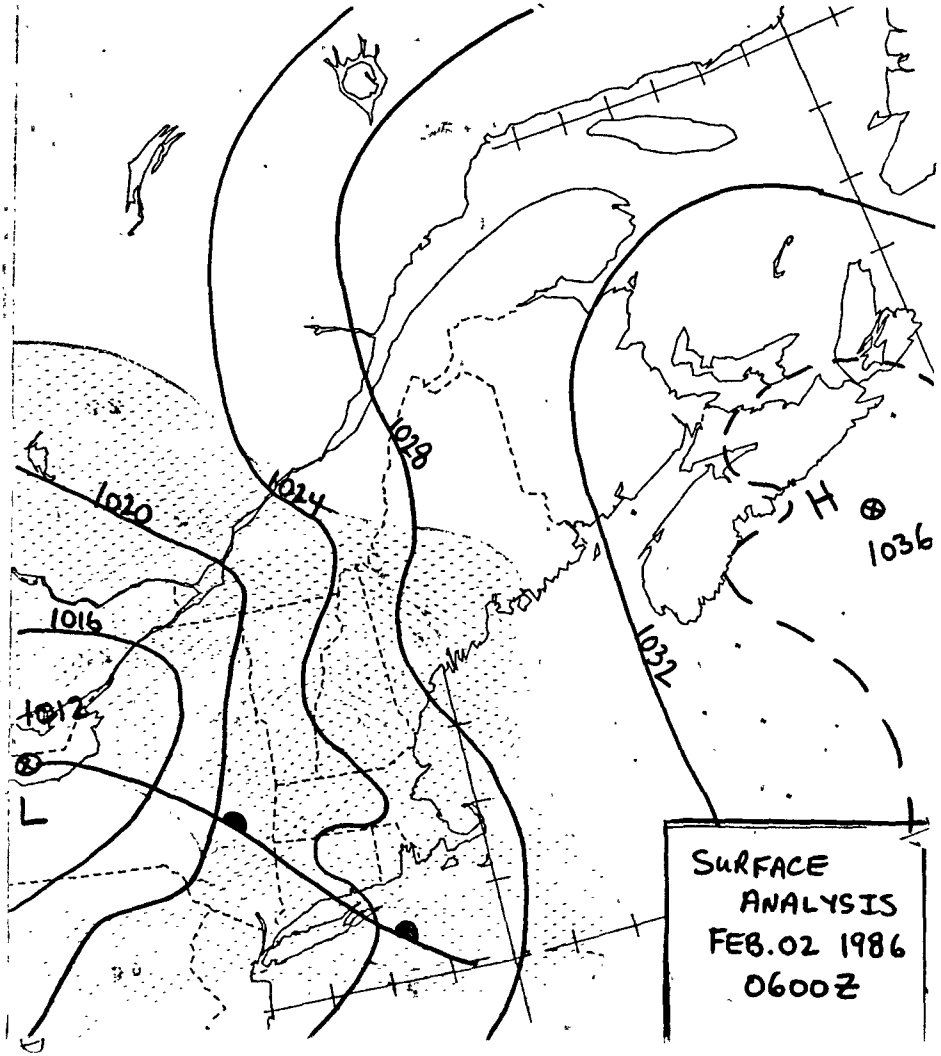
MOS Minimum Visibility

The distribution of probabilities at the different sites does not reflect the very low visibility in snow observed at 12Z and 18Z, but is better at 00Z. However, at 00Z there is little discrimination in the lower three categories. For example, YAW has nearly equal probability of being category 1, 2 or 3 which limits its usefulness in making an operation decision. Similar comments apply to YFC, YSJ and YQM at 06Z.

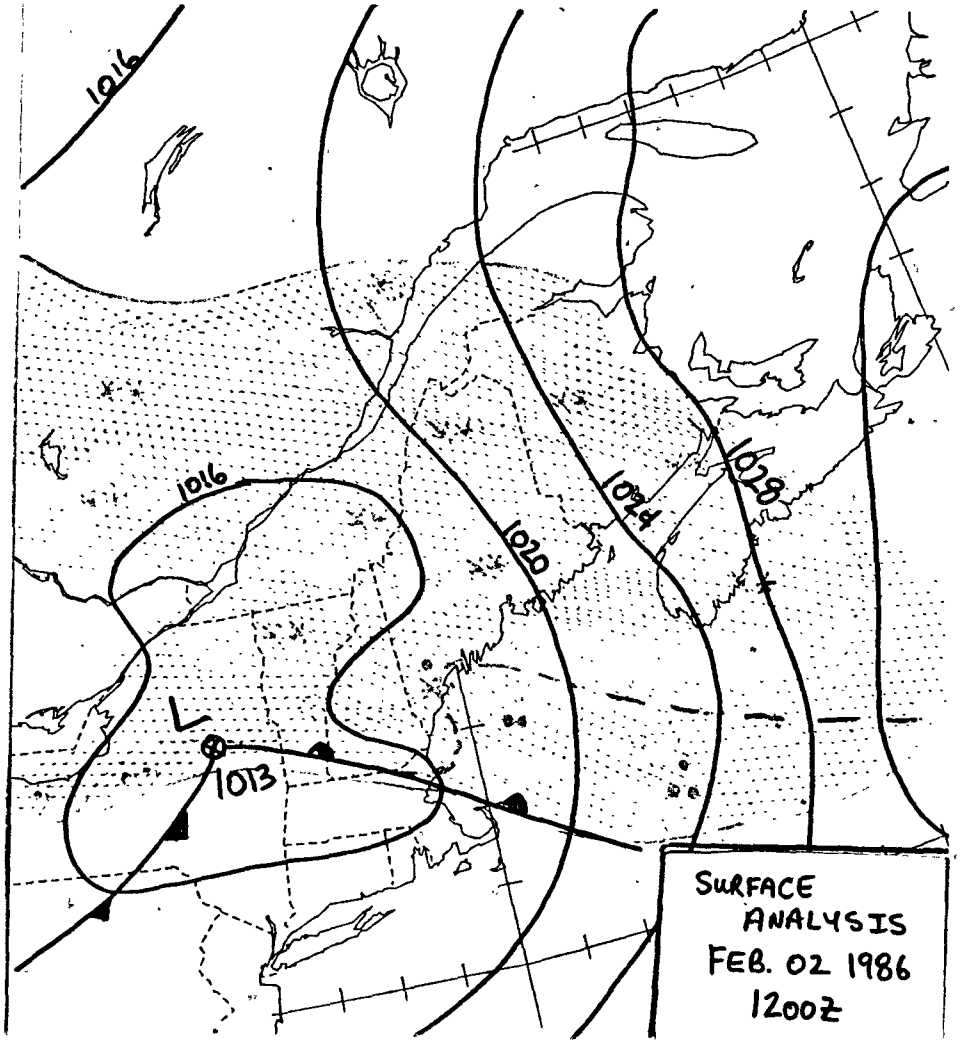
MOS Conditional Precip Type

The 36 hour prog valid at 00Z is quite definite: snow everywhere except rain at YQI, which agrees with observation. The 24 hour prog valid at the same time is not as definite: rain/snow mixed at YQI and much higher probabilities of rain over the eastern Maritimes. For example, YQM is nearly 50/50 whereas the earlier prog was 75/25 rain/snow probability.

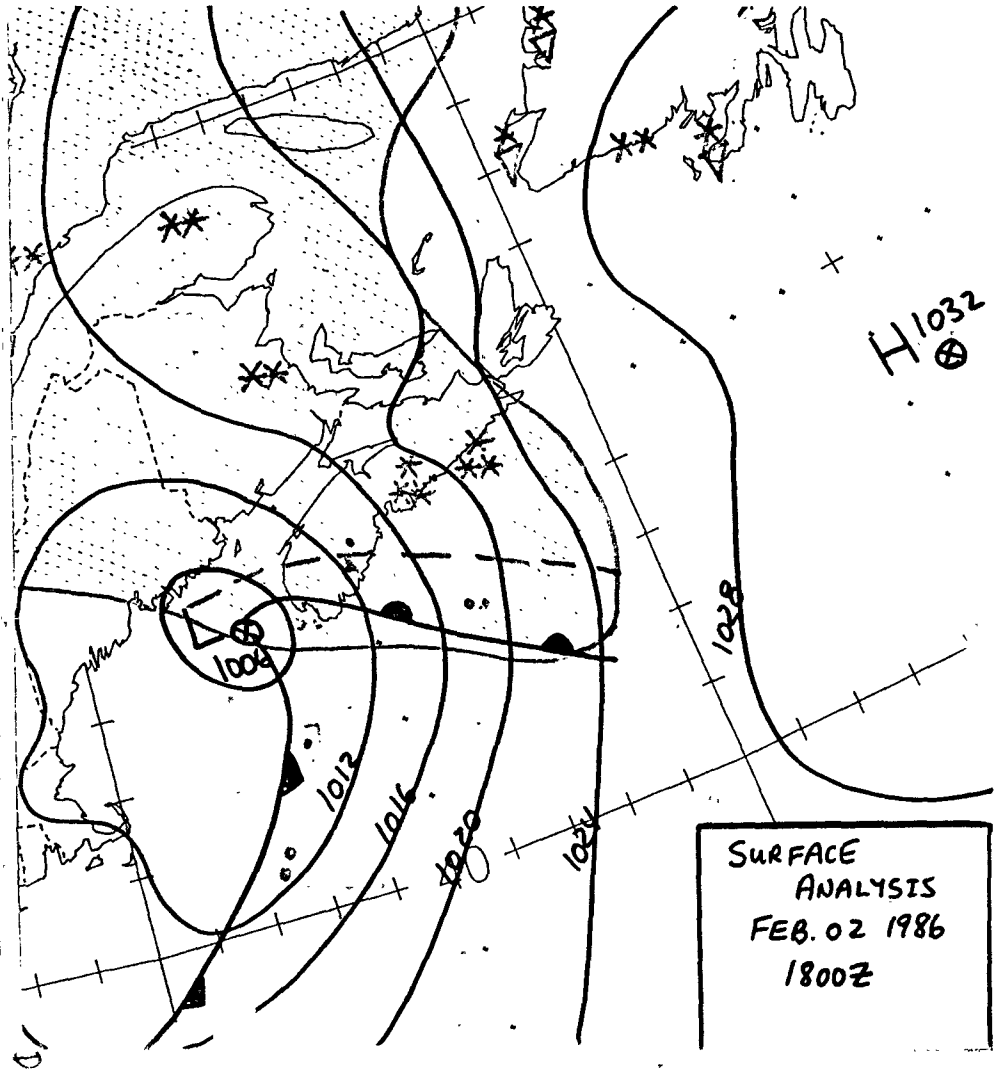
The high probability of freezing rain indicated at YCH, YCL and YGP on the 18 and 30 hour progs is highly suspicious in light of the probability distributions at surrounding stations.

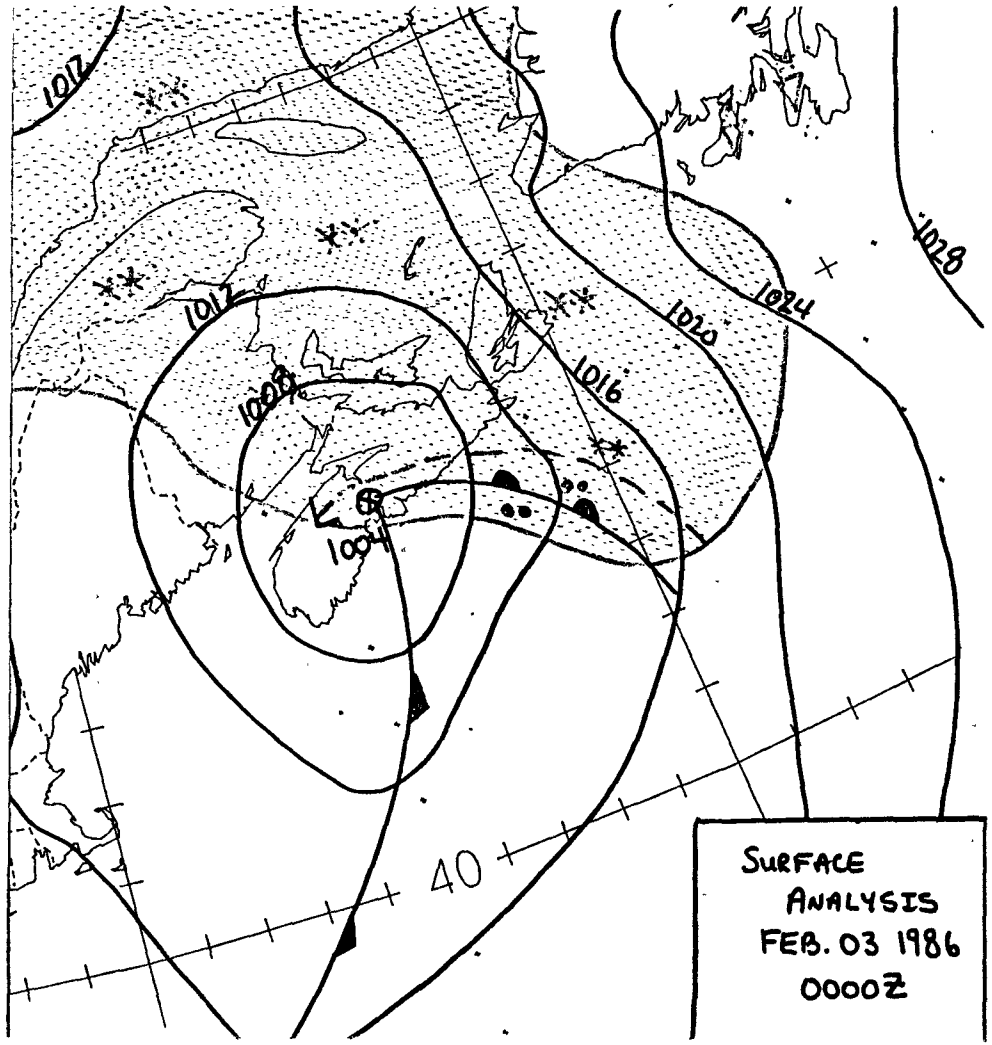


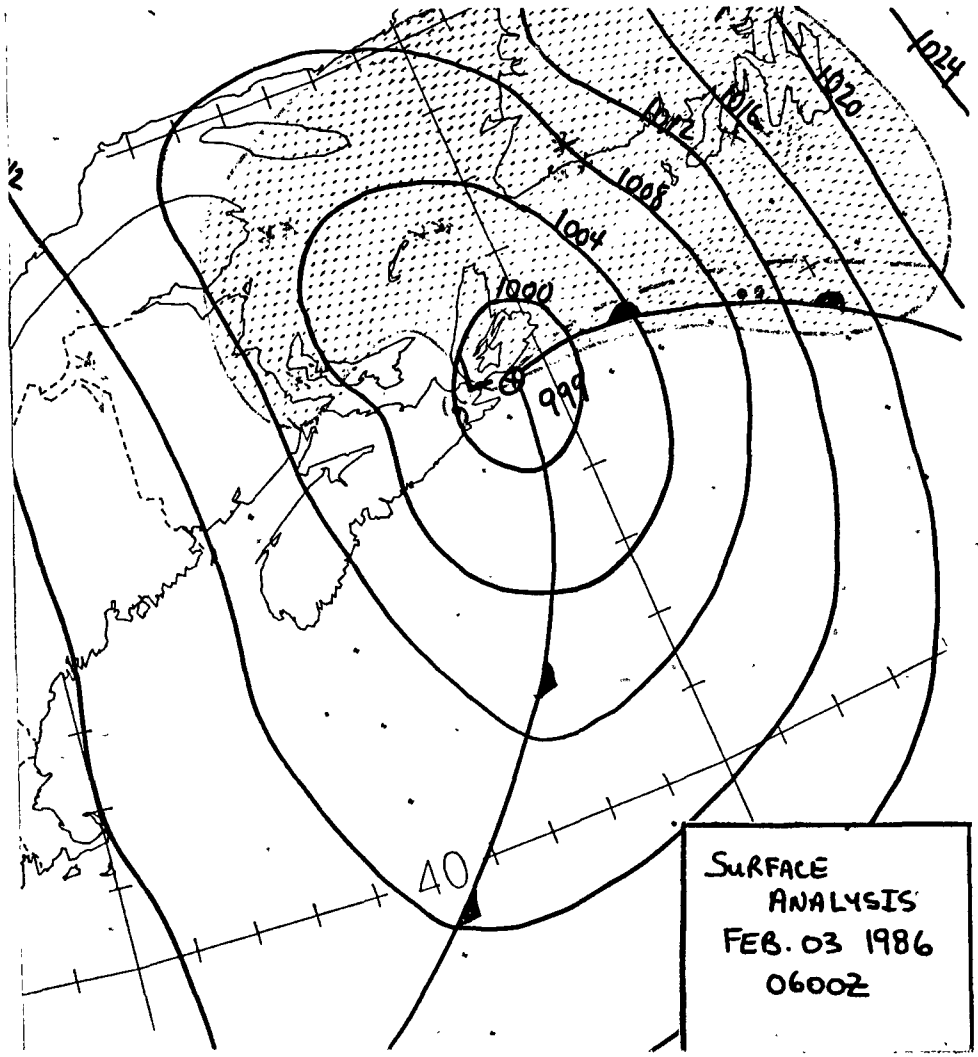
SURFACE ANALYSIS
FEB. 02 1986
0600Z

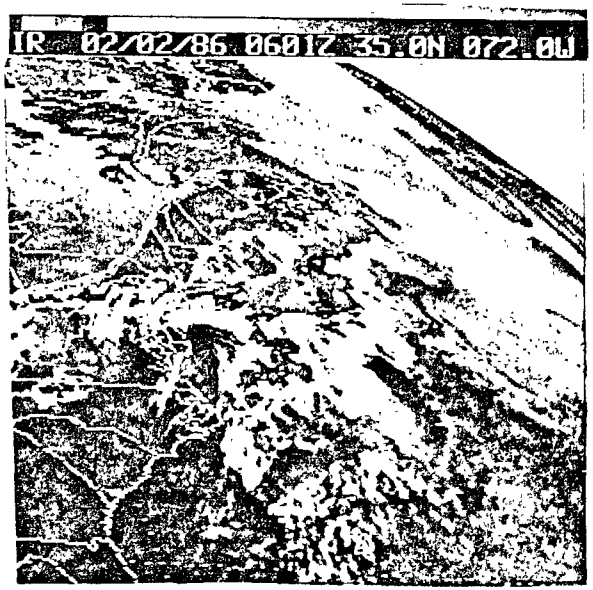


SURFACE ANALYSIS
FEB. 02 1986
1200Z


H 1032
1008
1012
1016
1020
1024
1028
40
SURFACE
ANALYSIS
FEB. 02 1986
1800Z

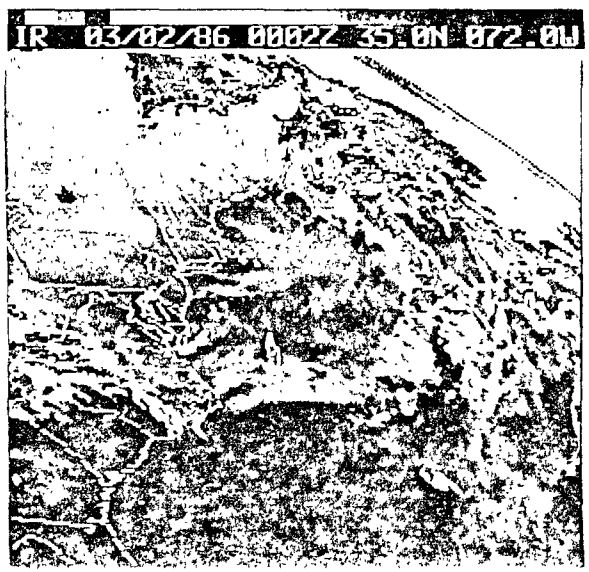

1012
1008
1004
1016
1020
1024
1028
40
SURFACE
ANALYSIS
FEB. 03 1986
0000Z


1024
1020
1016
1012
1008
1004
1000
996
40
SURFACE
ANALYSIS
FEB. 03 1986
0600Z


IR 02/02/86 0601Z 35.0N 072.0W


IR 02/02/86 1202Z 35.0N 072.0W


IR 02/02/86 1802Z 35.0N 072.0W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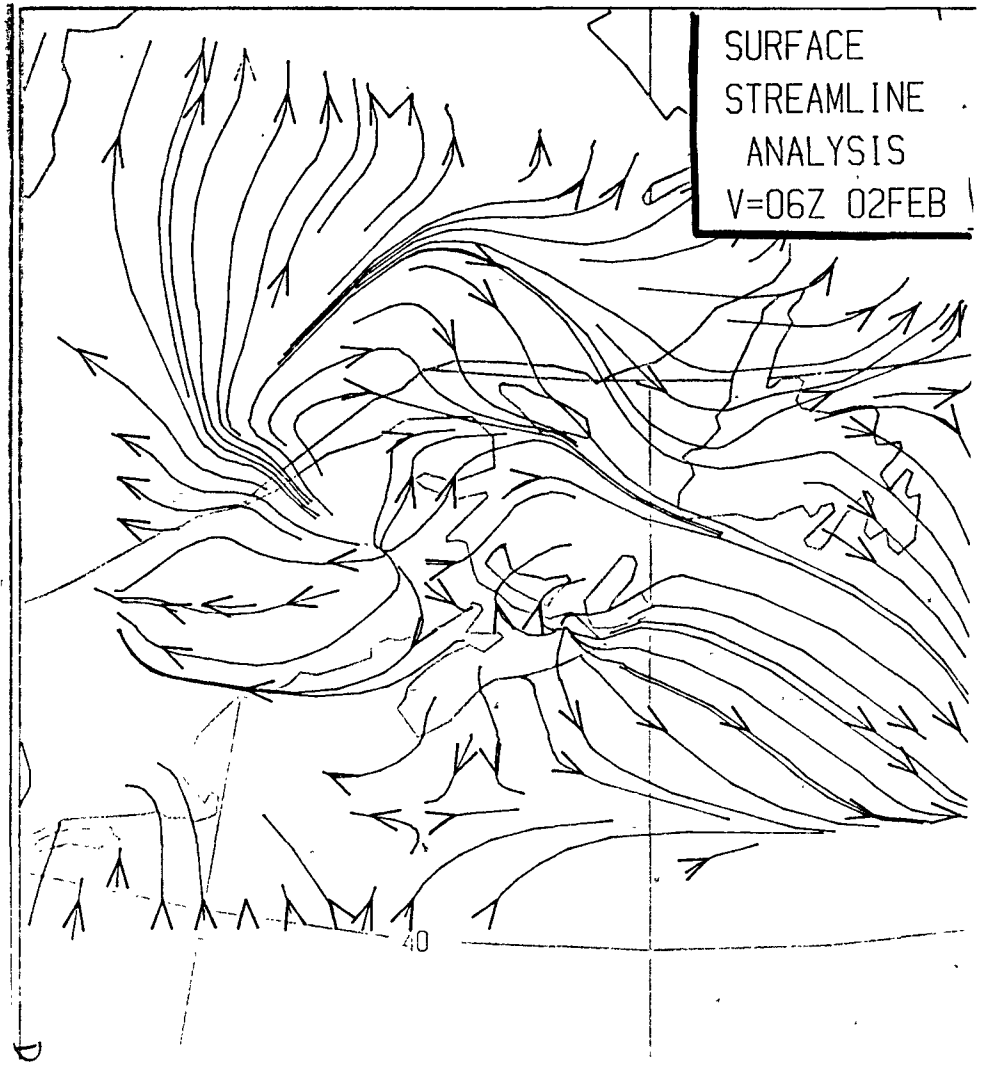
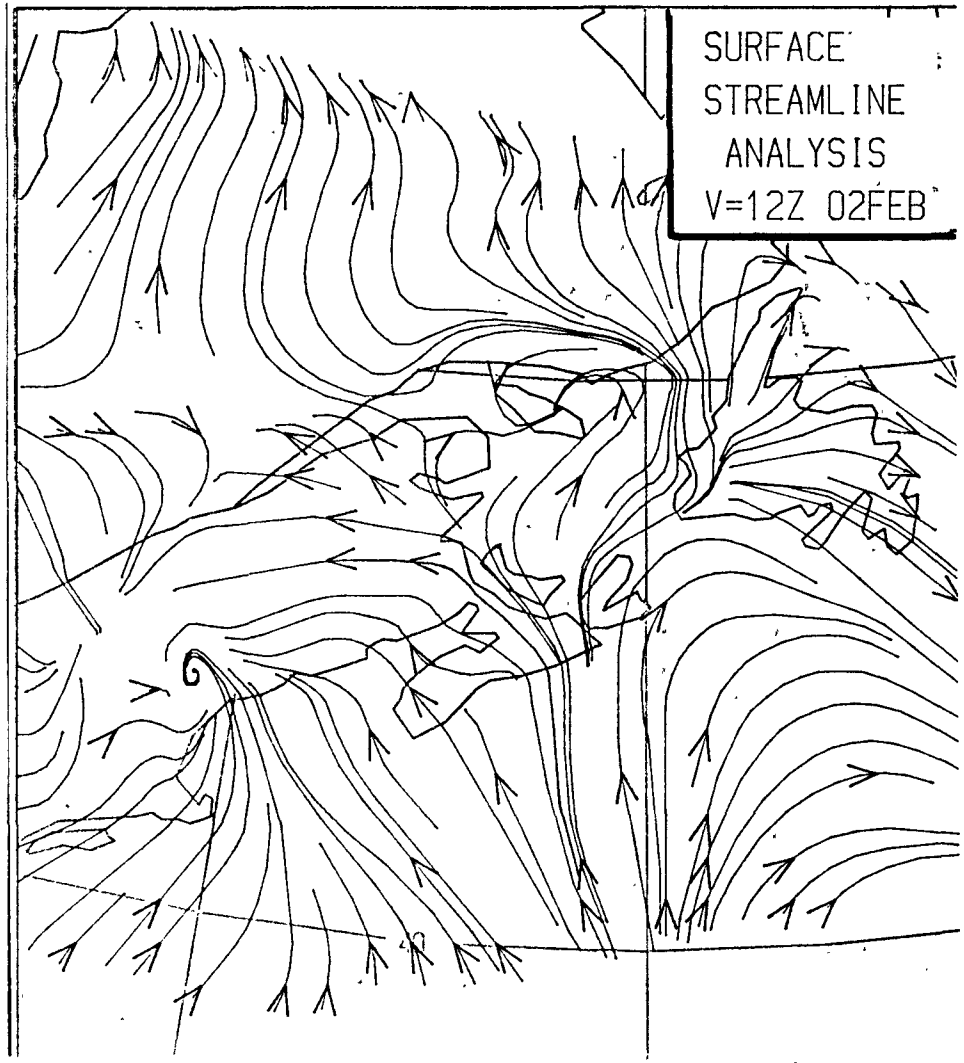
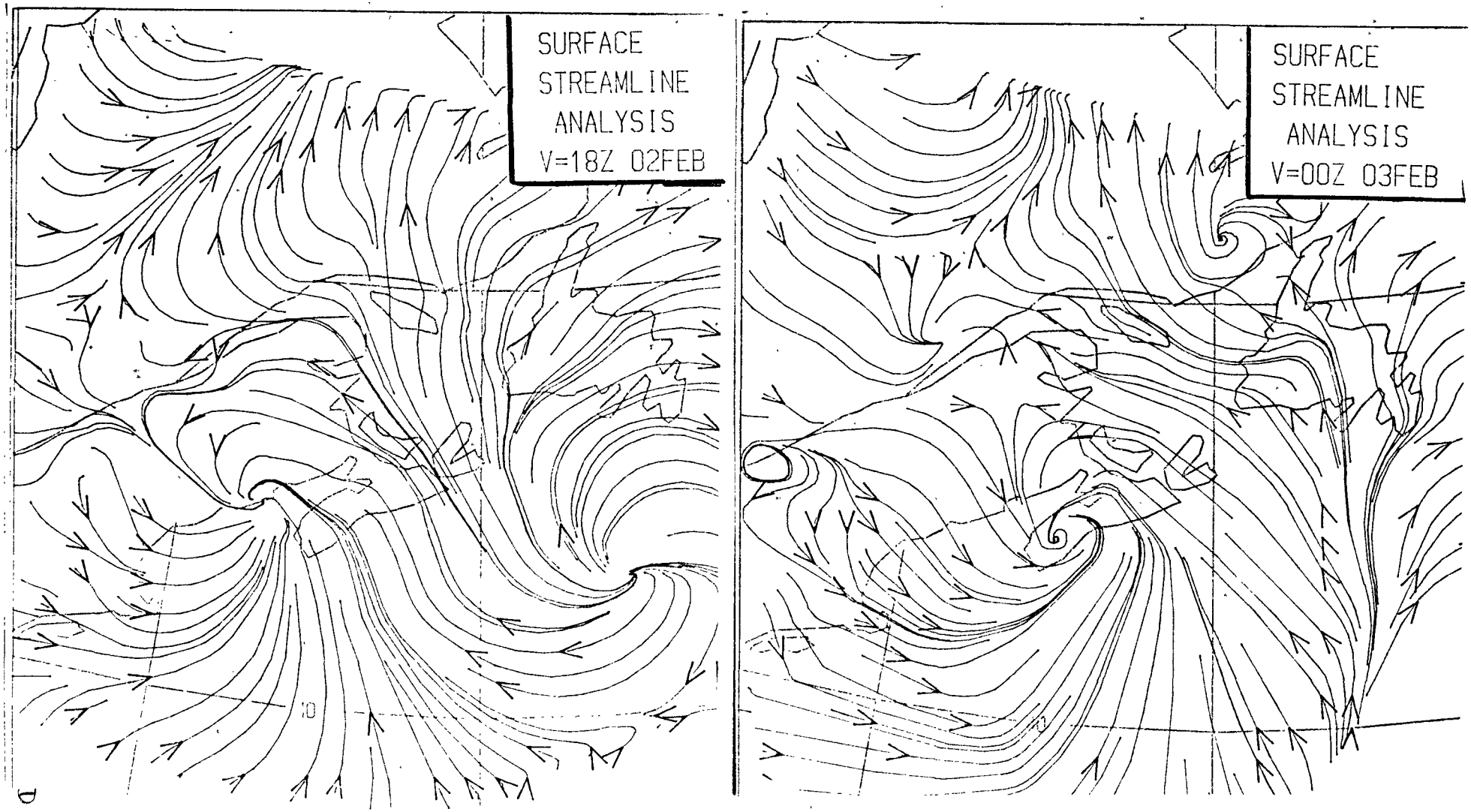
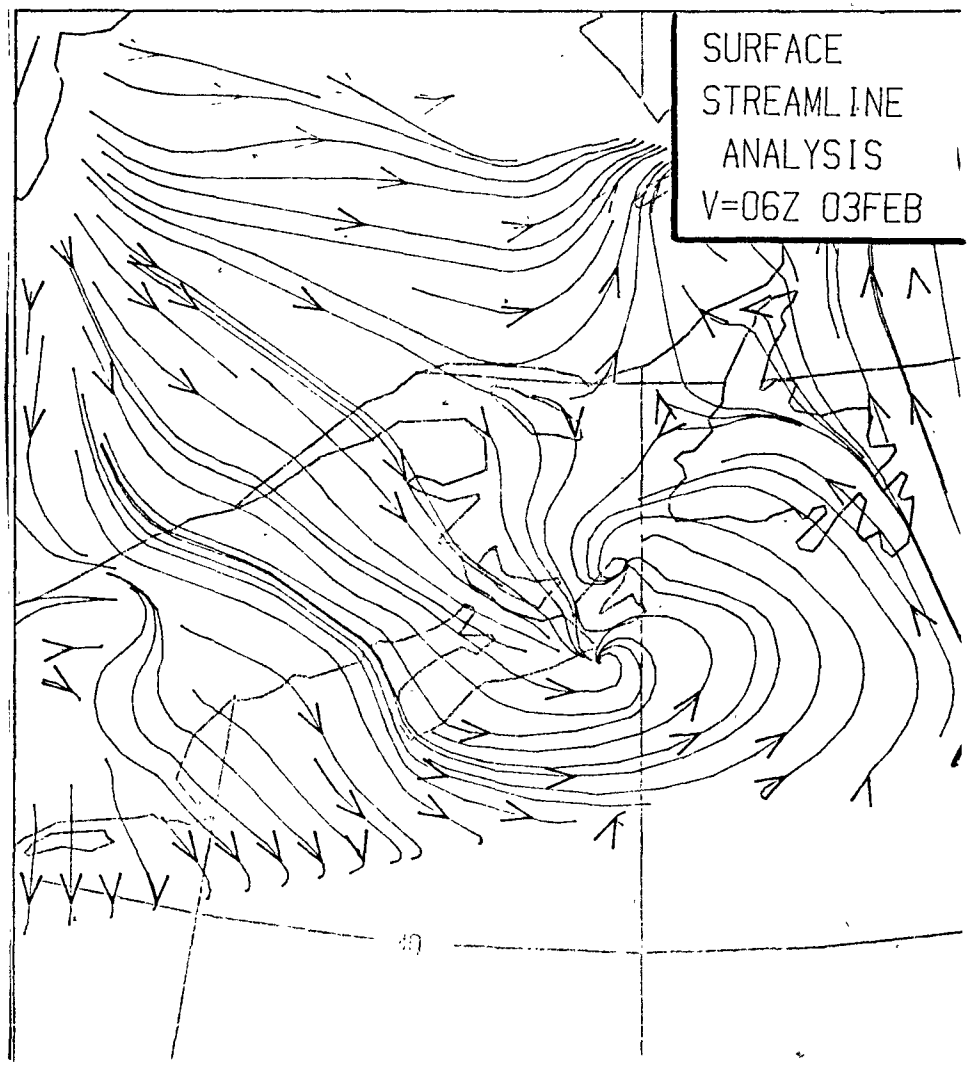
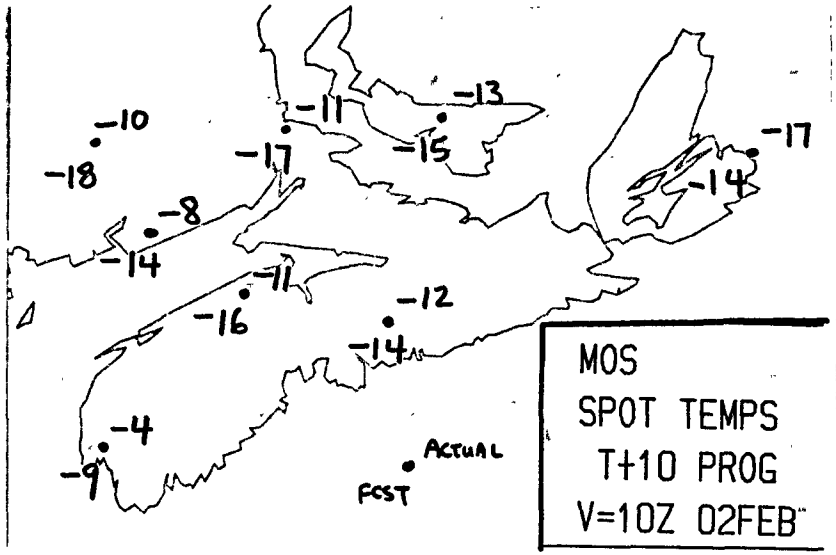

SURFACE
STREAMLINE
ANALYSIS
V=06Z 02FEB
40

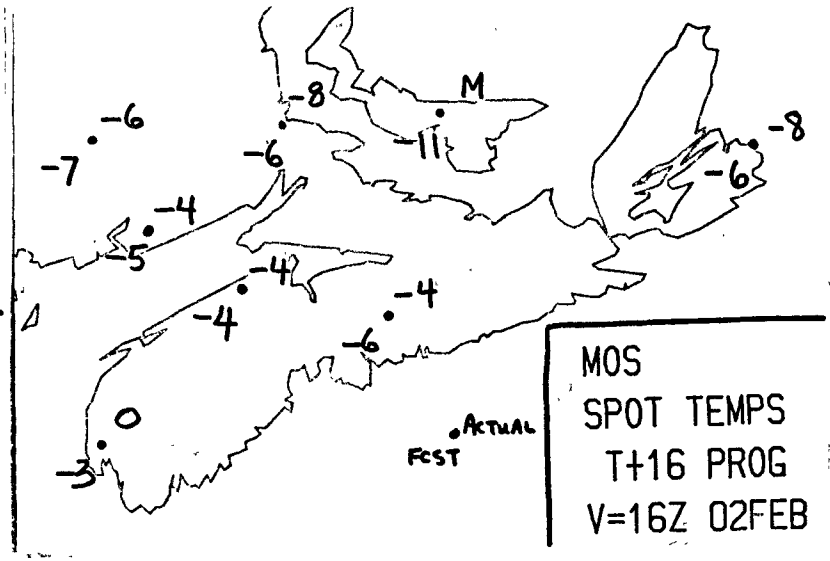

SURFACE
STREAMLINE
ANALYSIS
V=12Z 02FEB


SURFACE
STREAMLINE
ANALYSIS
V=18Z 02FEB
SURFACE
STREAMLINE
ANALYSIS
V=00Z 03FEB

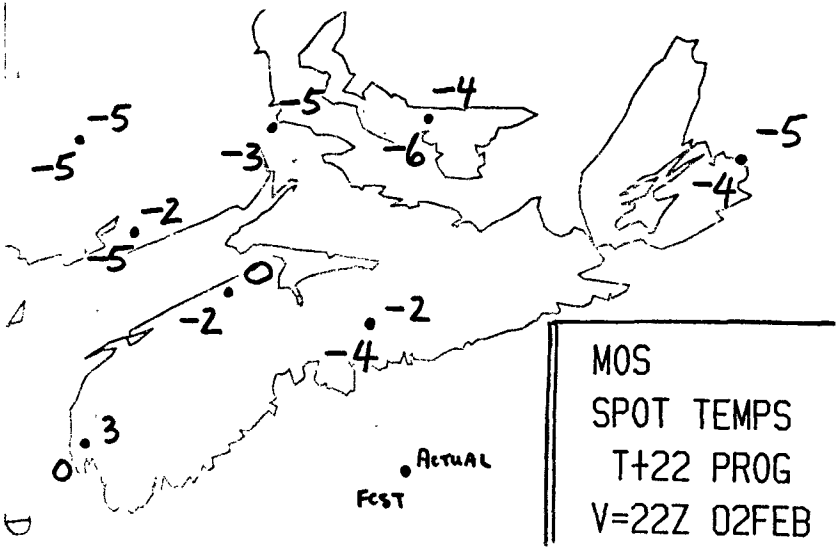

SURFACE
STREAMLINE
ANALYSIS
V=06Z 03FEB



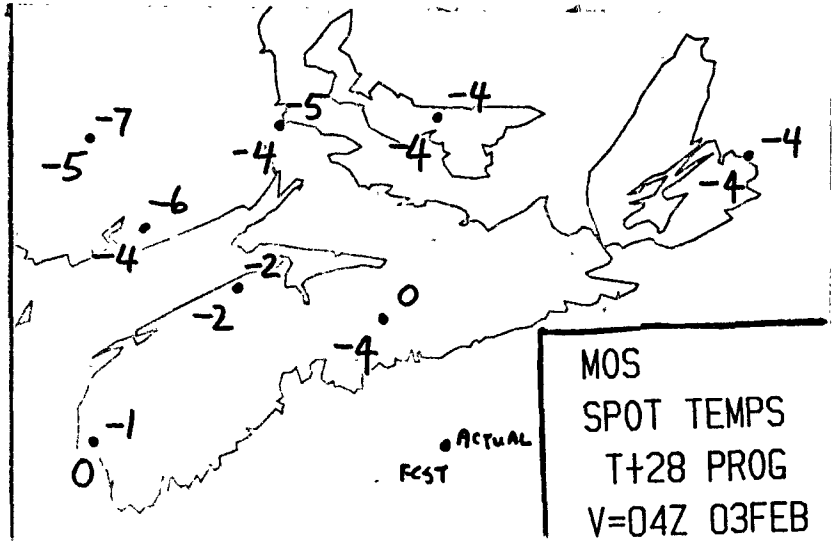
MOS
SPOT TEMPS
T+10 PROG
V=10Z 02FEB



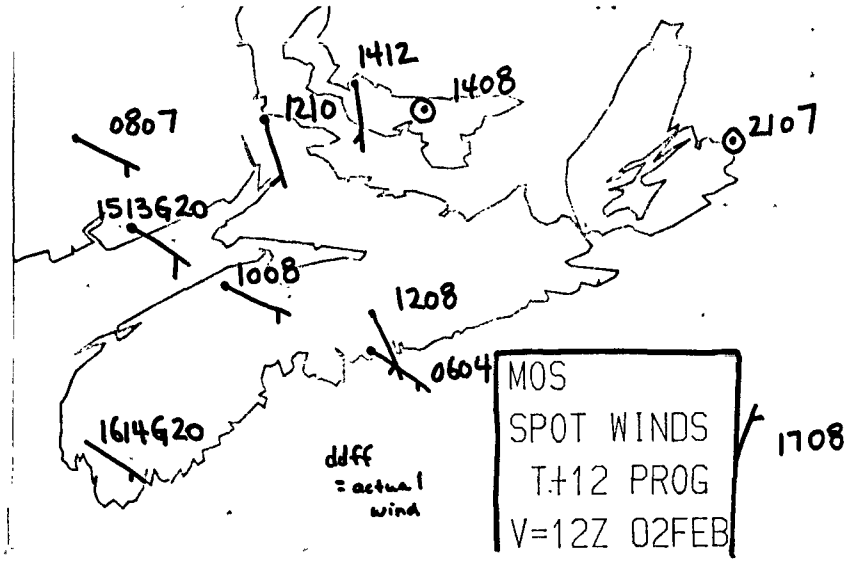
MOS
SPOT TEMPS
T+16 PROG
V=16Z 02FEB

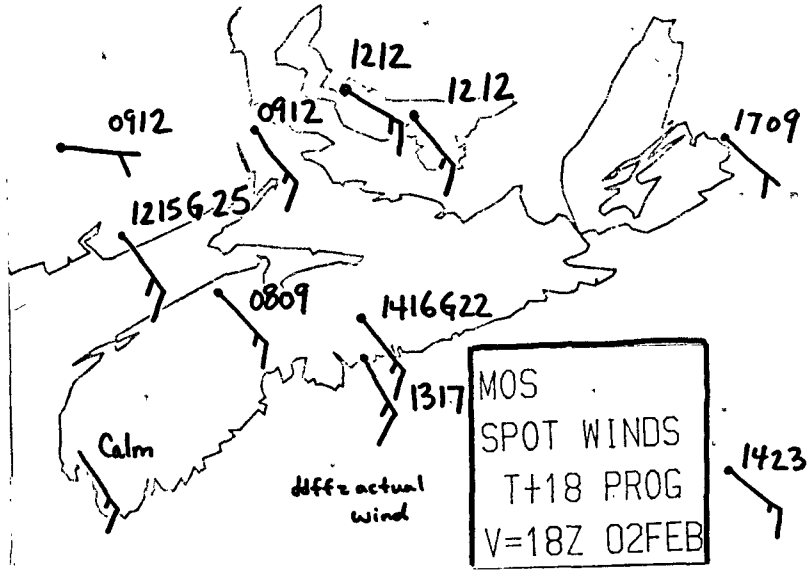


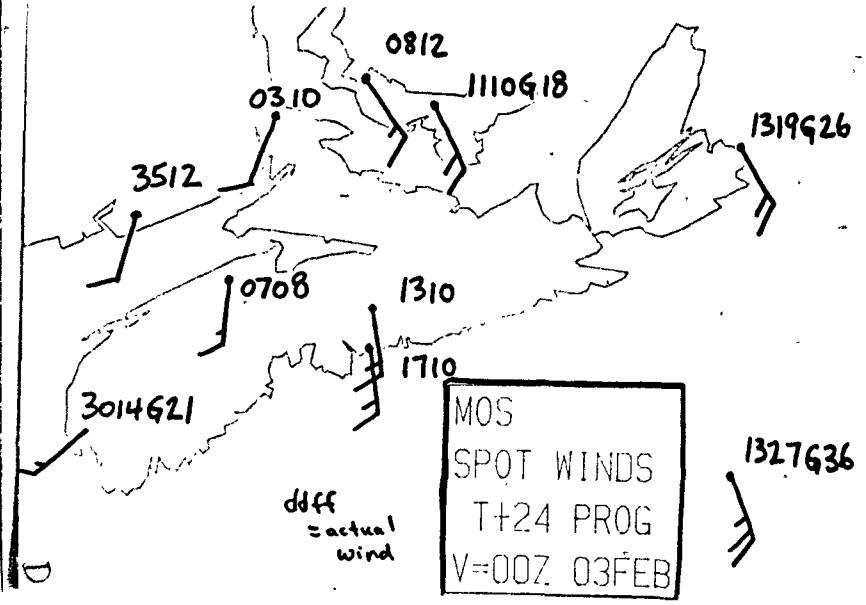
MOS
SPOT TEMPS
T+22 PROG
V=22Z 02FEB

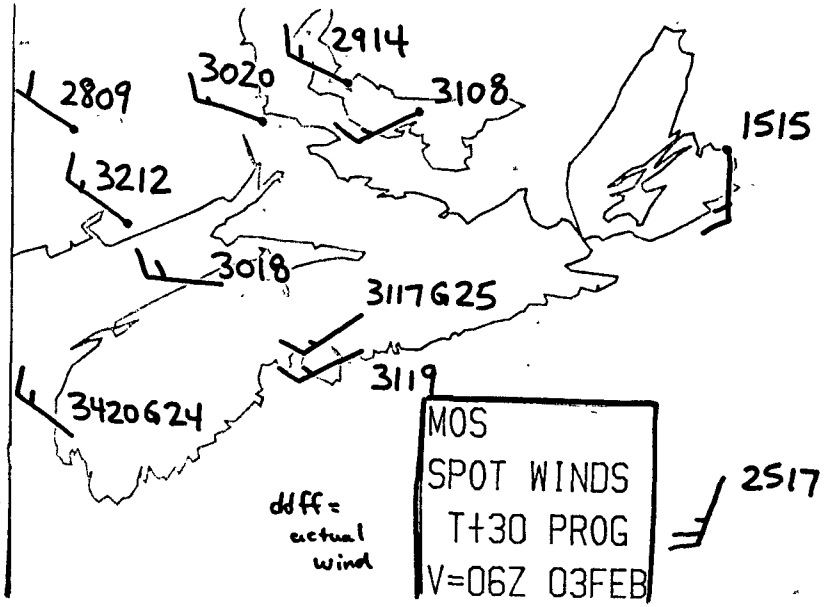


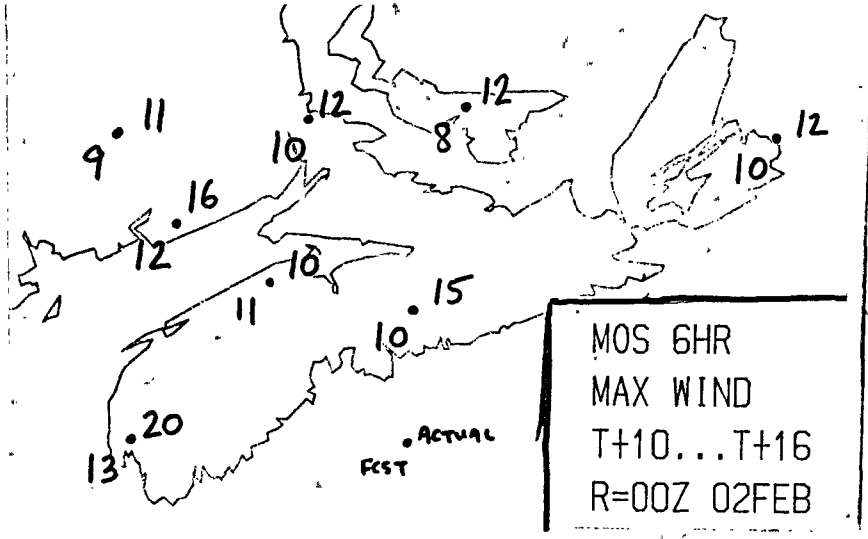
MOS
SPOT TEMPS
T+28 PROG
V=04Z 03FEB

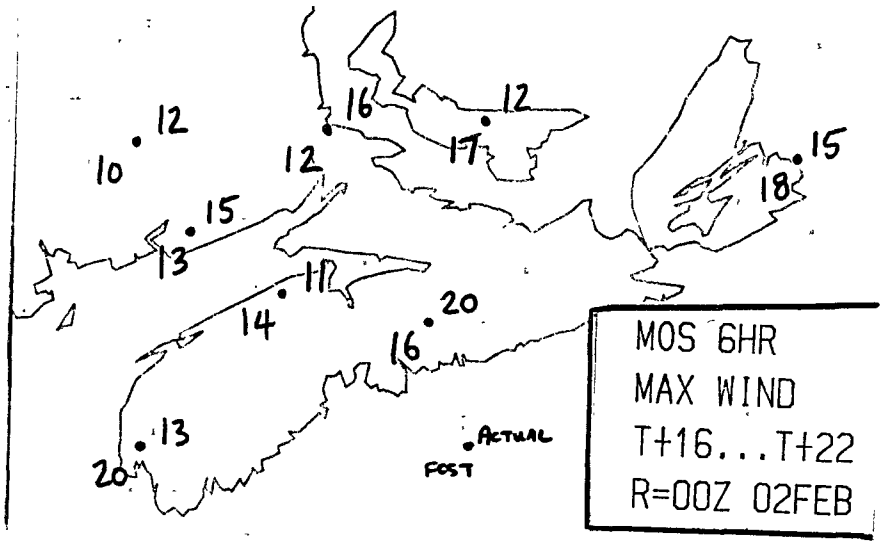

0807
1513G20
1008
1614G20
1210
1412
1408
1208
0604
2107
1708
ddff = actual wind
MOS
SPOT WINDS
T+12 PROG
V=12Z 02FEB

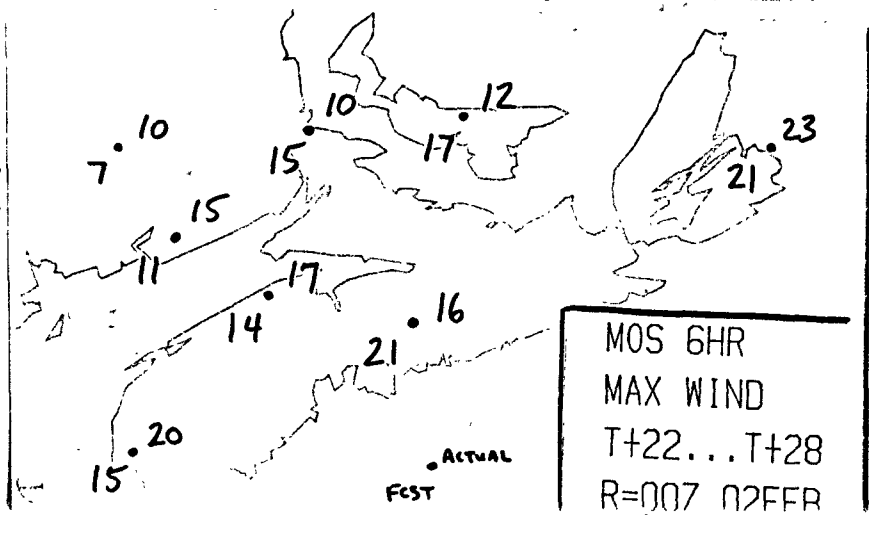

0912
1215G25
Calm
0912
1212
1212
0809
1416G22
1317
1709
1423
ddff = actual wind
MOS
SPOT WINDS
T+18 PROG
V=18Z 02FEB

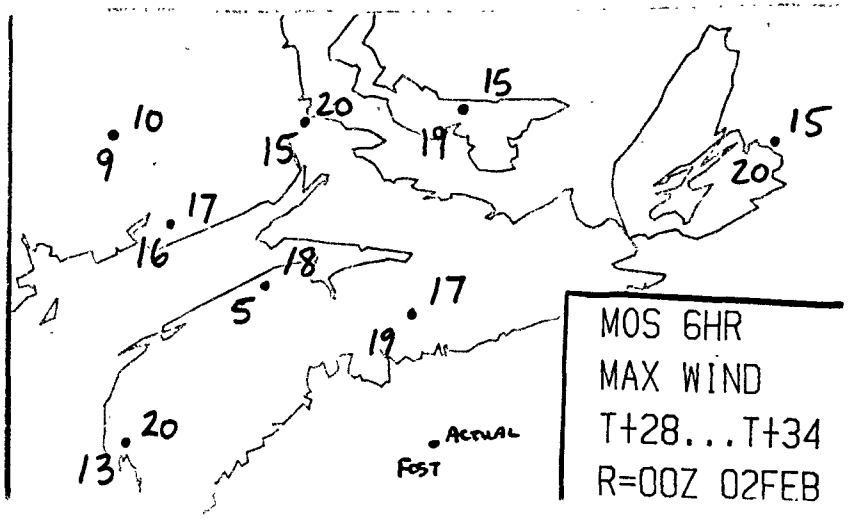

3512
3014G21
0310
0812
1110G18
0708
1310
1710
1319G26
1327G36
ddff = actual wind
MOS
SPOT WINDS
T+24 PROG
V=00Z 03FEB

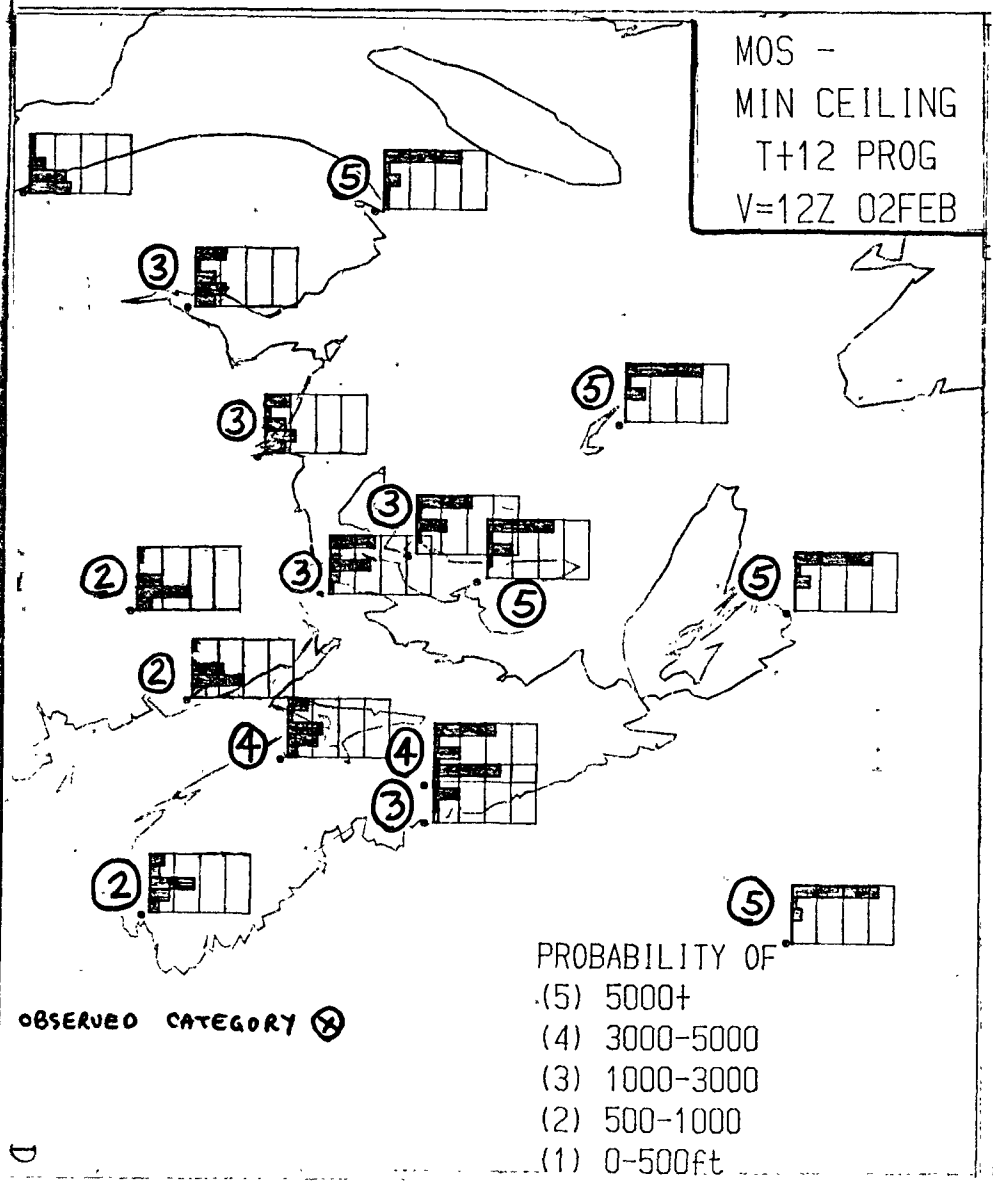

2809
3212
3420G24
3020
2914
3108
3018
3117G25
3119
1515
2517
ddff = actual wind
MOS
SPOT WINDS
T+30 PROG
V=06Z 03FEB

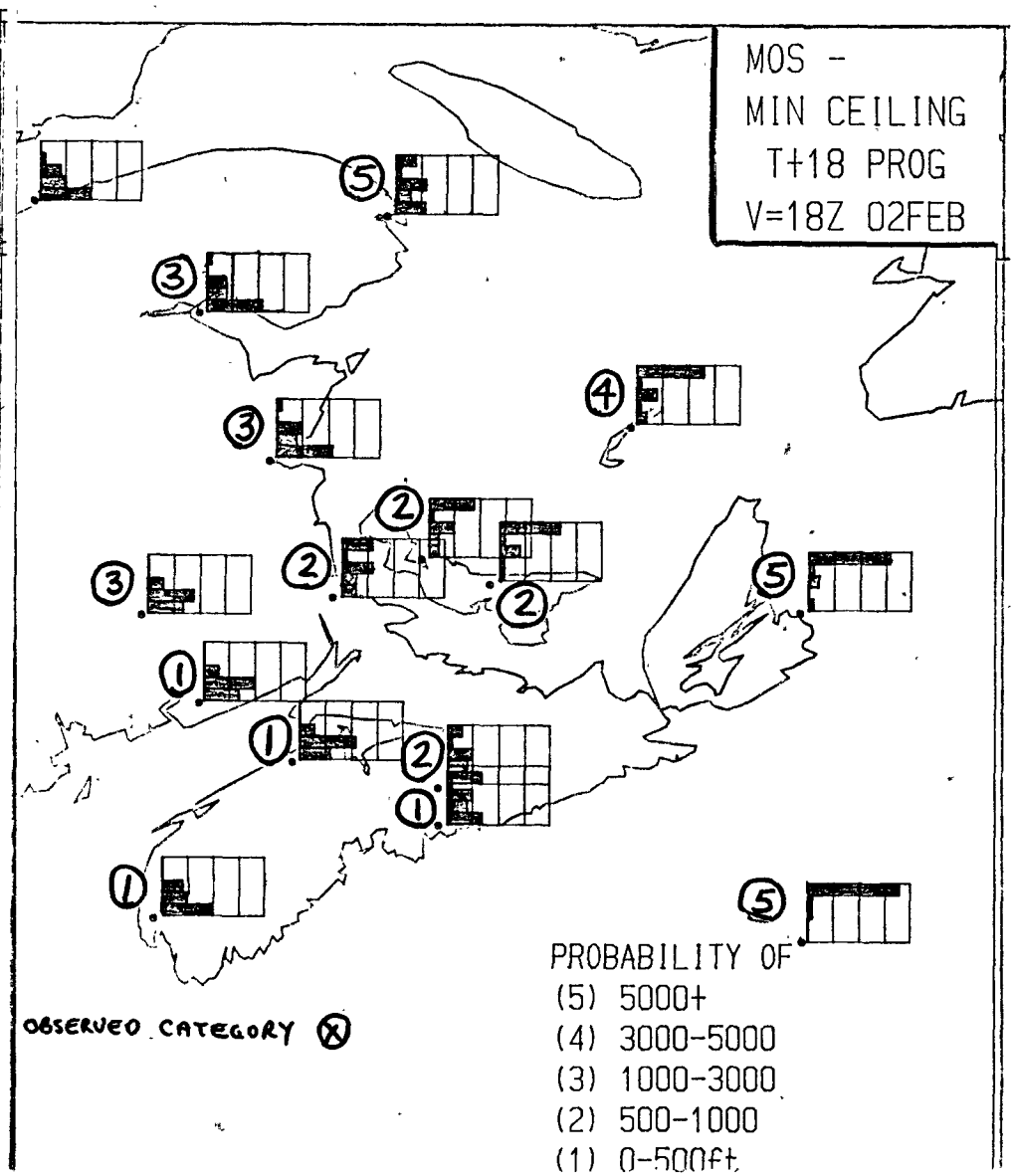

9 11 12 10 12 8 12 10 12
16 12 10 11 10 15
20 13
ACTUAL
FCST
MOS 6HR
MAX WIND
T+10...T+16
R=00Z 02FEB

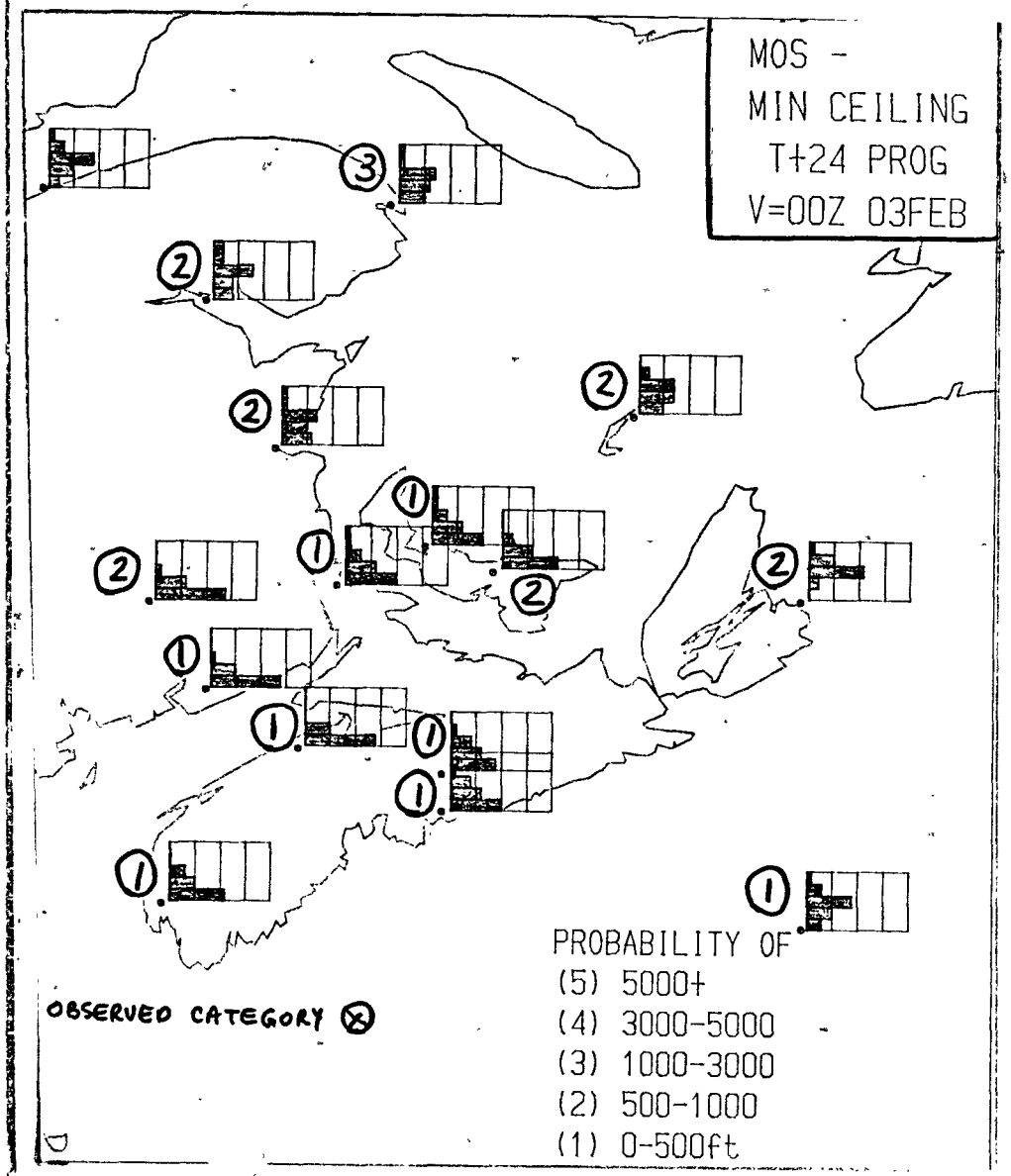

10 12 16 12 17 15 18
12 15 13 11 14 20 16
13 20
ACTUAL
FCST
MOS 6HR
MAX WIND
T+16...T+22
R=00Z 02FEB

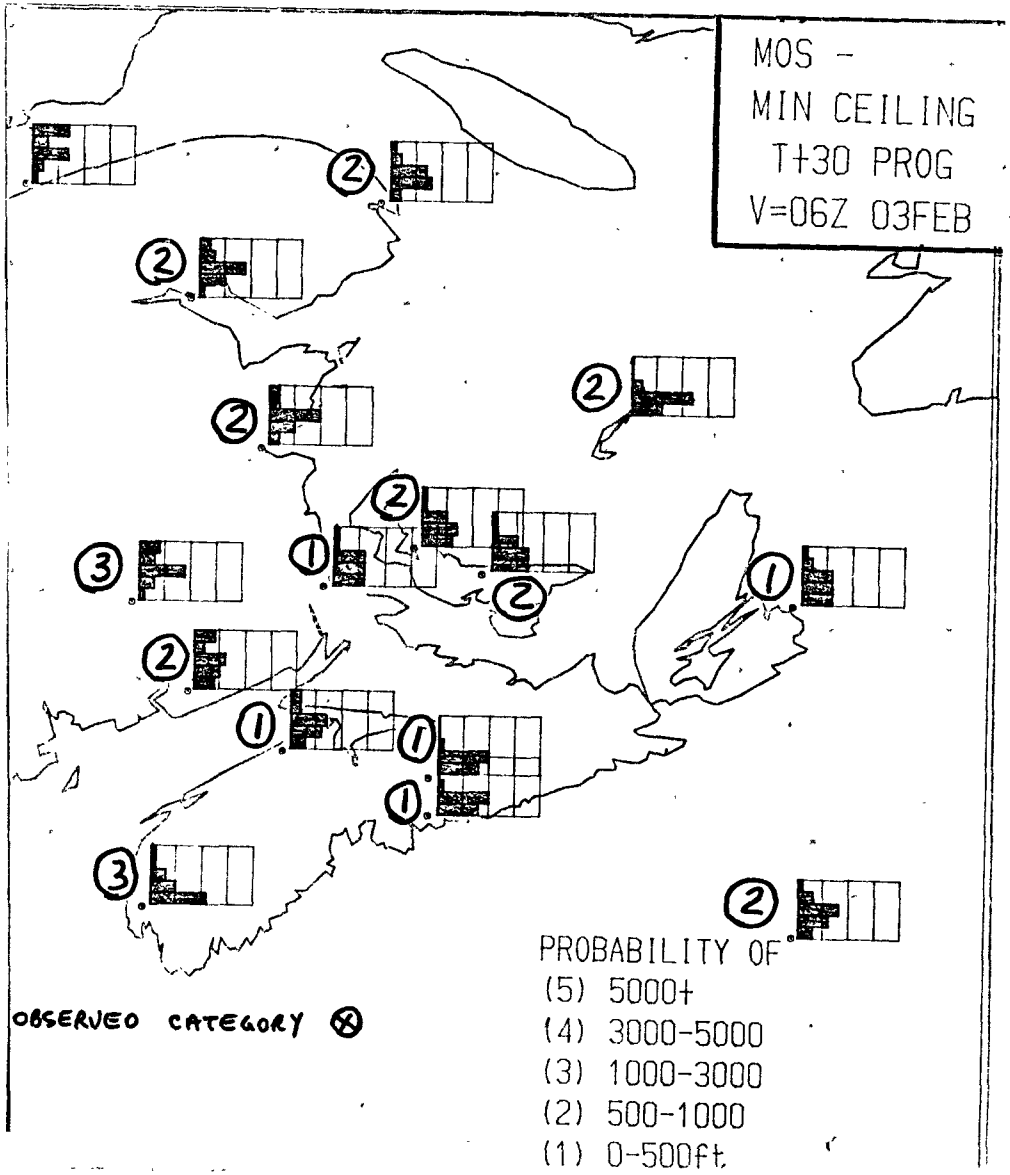

7 10 10 12 17 23 21
15 15 11 17 14 16 21
20 15
ACTUAL
FCST
MOS 6HR
MAX WIND
T+22...T+28
R=00Z 02FEB

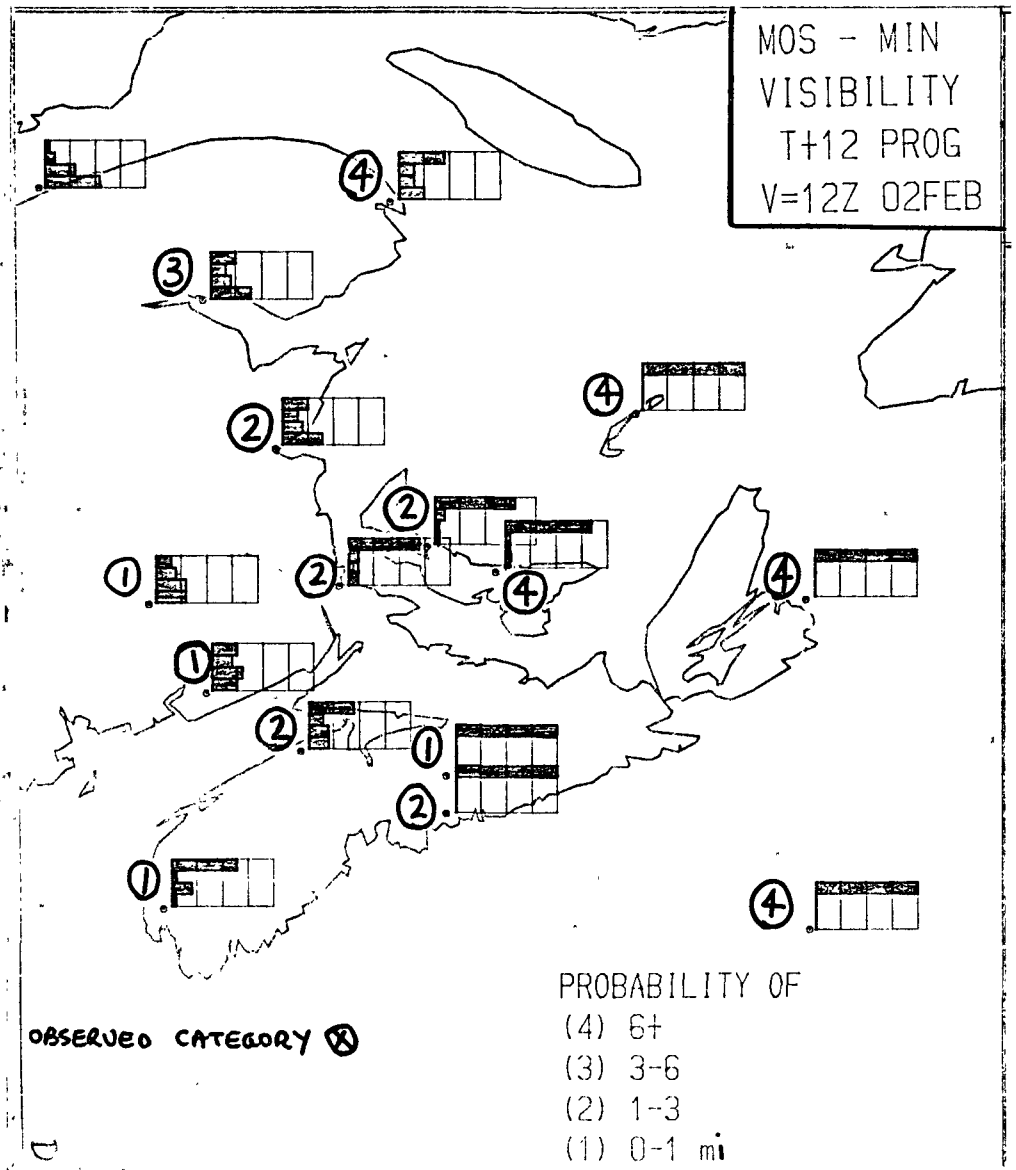

9 10 15 20 15 19 15 20 15
16 17 18 5 17 19
13 20
ACTUAL
FCST
MOS 6HR
MAX WIND
T+28...T+34
R=00Z 02FEB

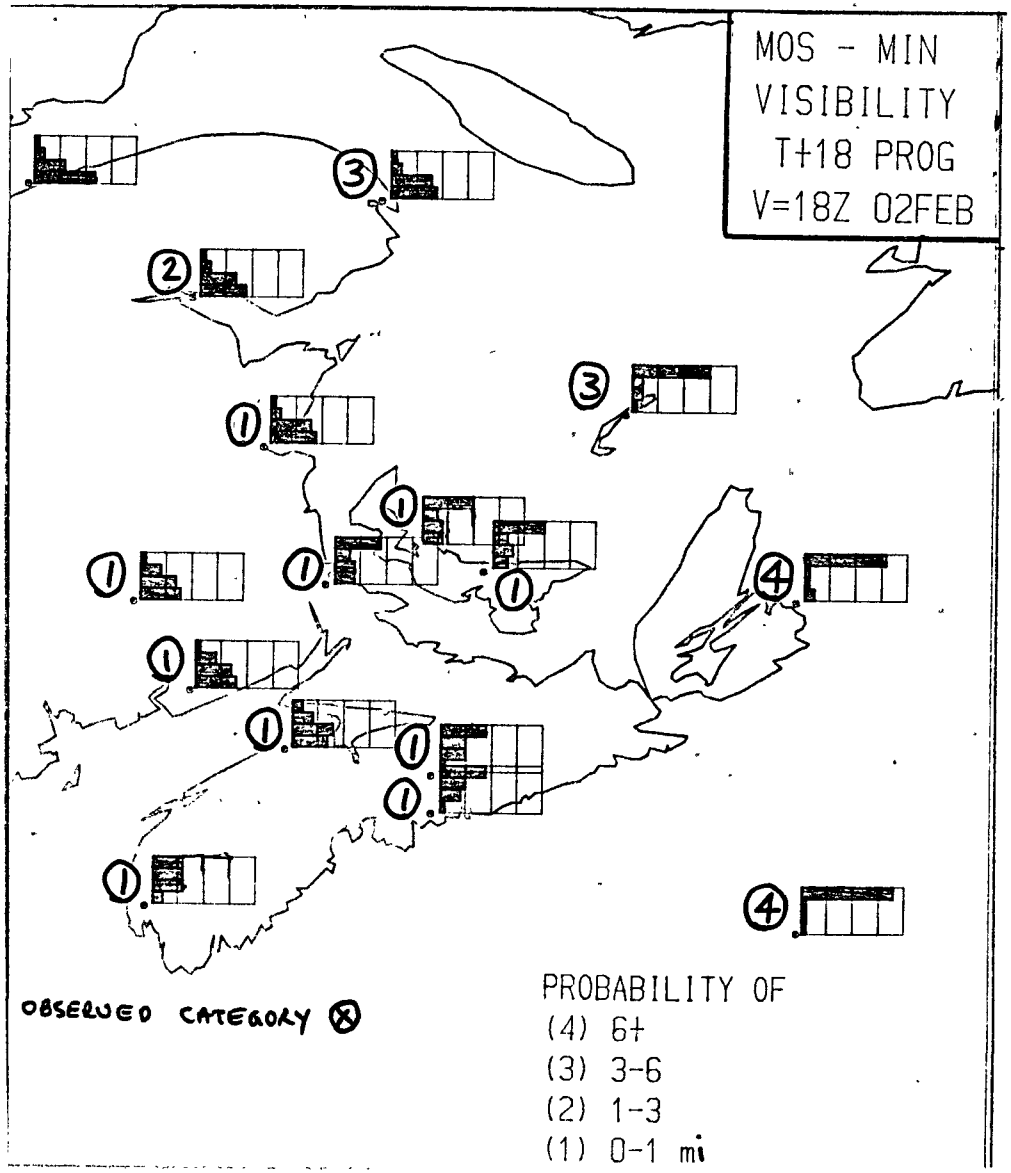

MOS -
MIN CEILING
T+12 PROG
V=12Z 02FEB
PROBABILITY OF
(5) 5000+
(4) 3000-5000
(3) 1000-3000
(2) 500-1000
(1) 0-500ft
OBSERVED CATEGORY ⊗

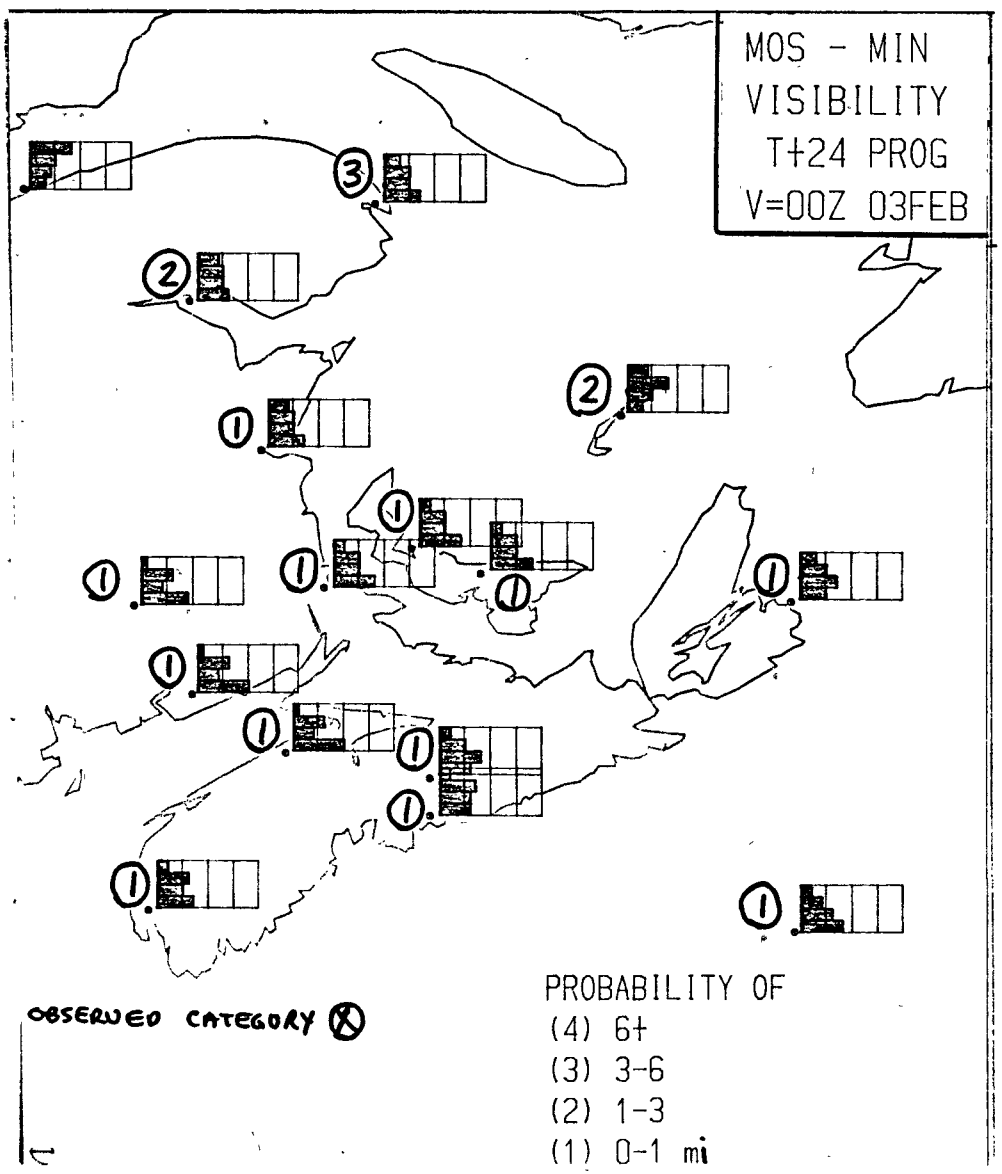

MOS -
MIN CEILING
T+18 PROG
V=18Z 02FEB
PROBABILITY OF
(5) 5000+
(4) 3000-5000
(3) 1000-3000
(2) 500-1000
(1) 0-500ft
OBSERVED CATEGORY ⊗

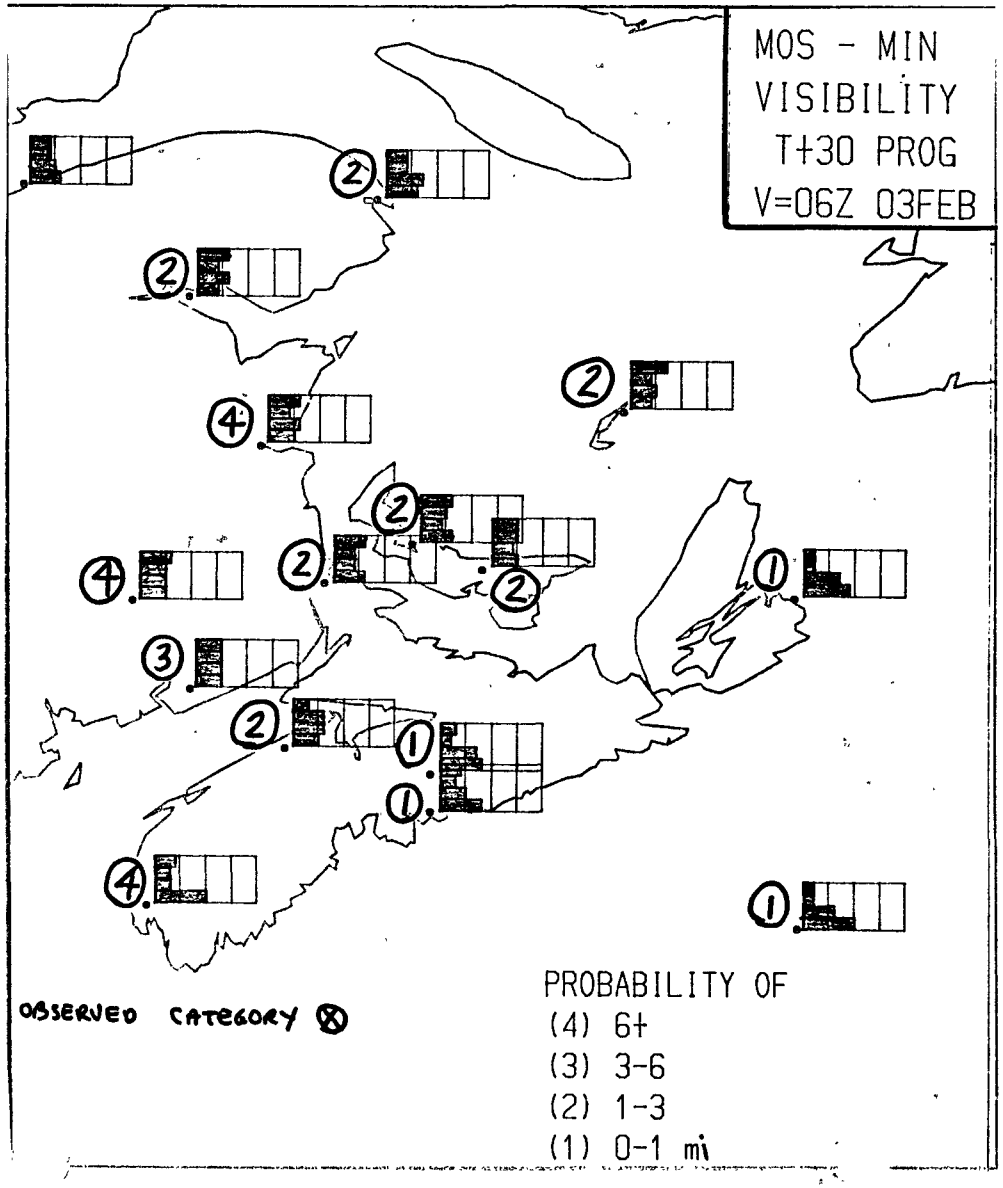

MOS -
MIN CEILING
T+24 PROG
V=00Z 03FEB
OBSERVED CATEGORY ⊗
PROBABILITY OF
(5) 5000+
(4) 3000-5000
(3) 1000-3000
(2) 500-1000
(1) 0-500ft

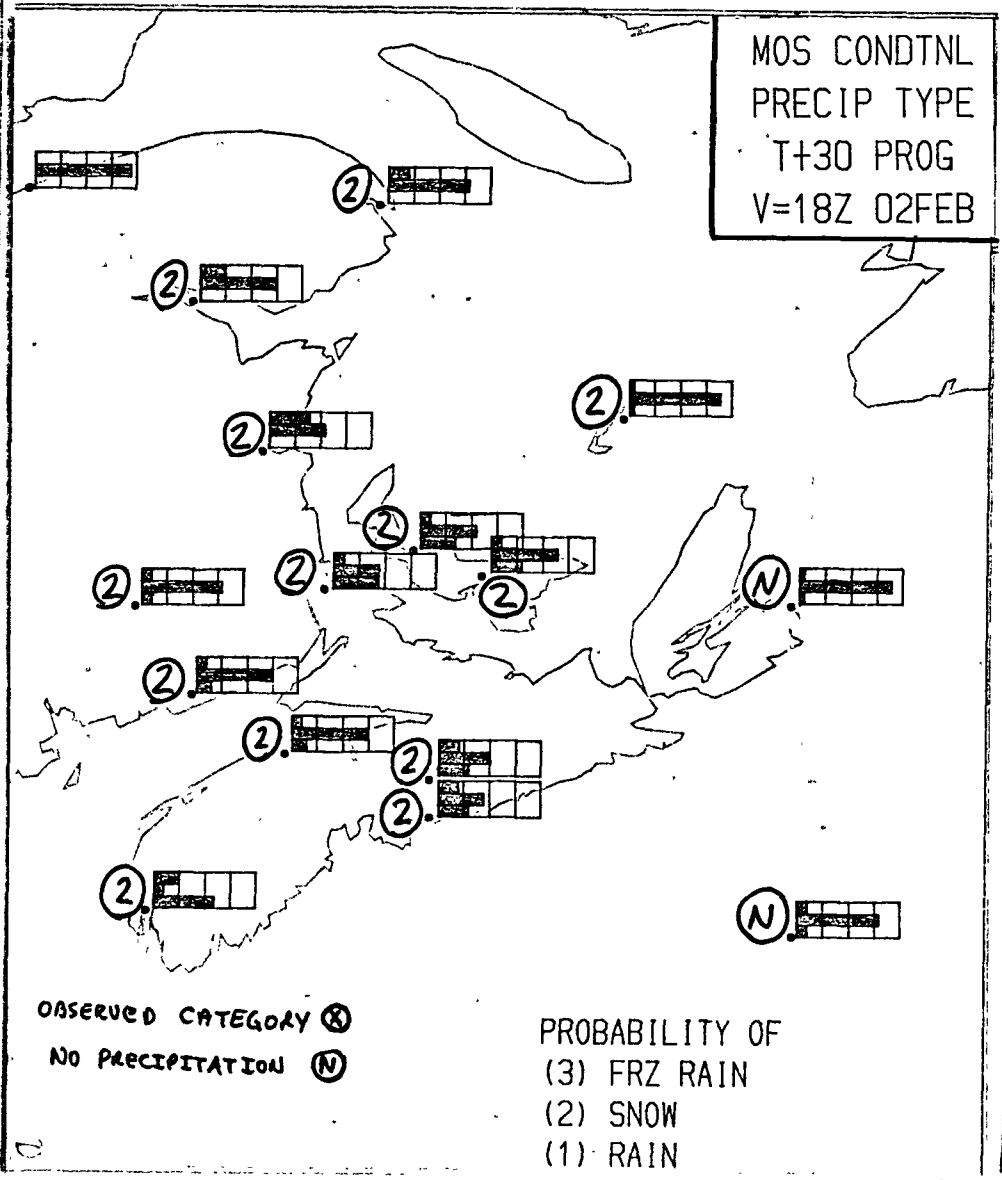

MOS -
MIN CEILING
T+30 PROG
V=06Z 03FEB
OBSERVED CATEGORY ⊗
PROBABILITY OF
(5) 5000+
(4) 3000-5000
(3) 1000-3000
(2) 500-1000
(1) 0-500ft

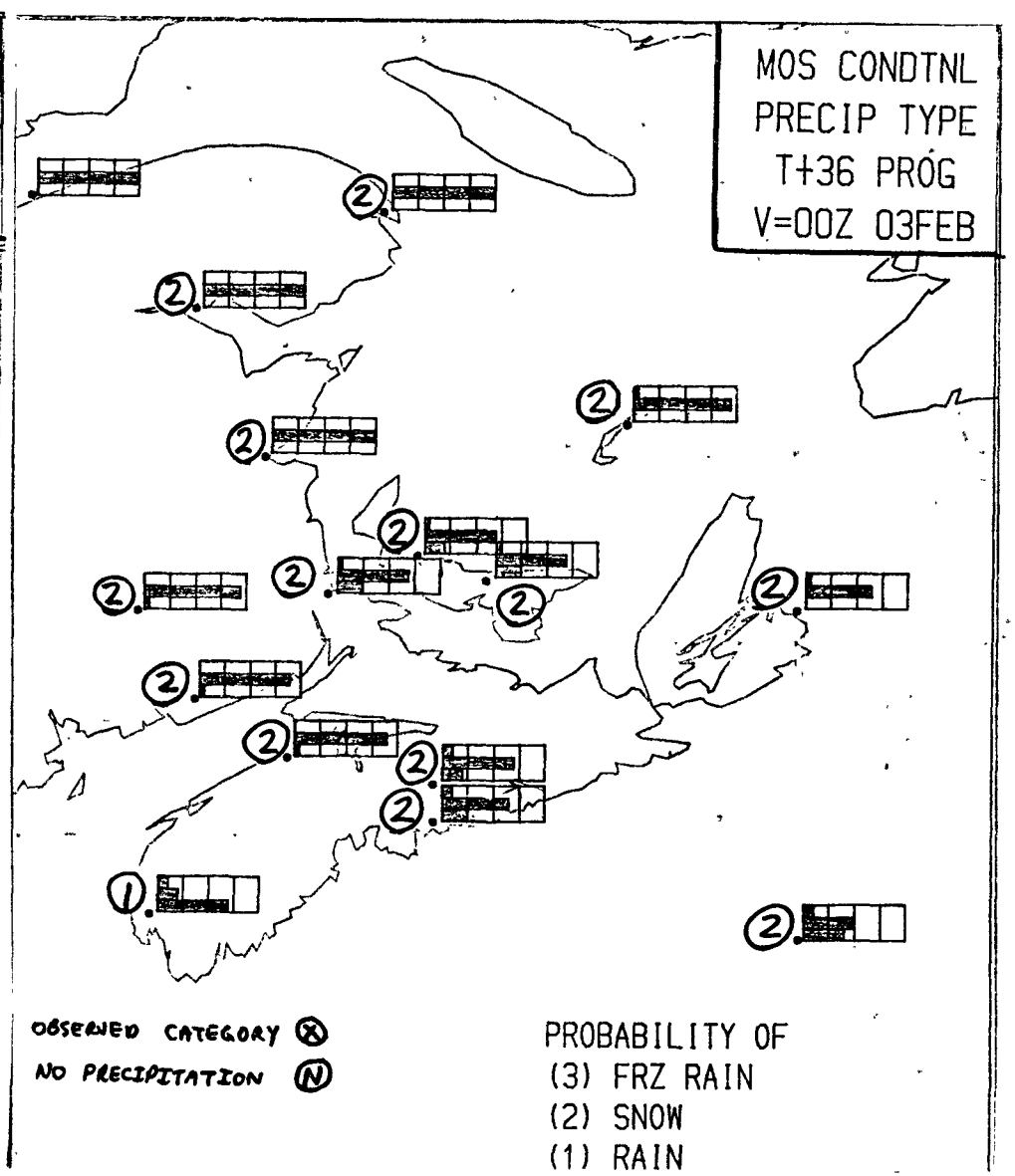

MOS - MIN
VISIBILITY
T+12 PROG
V=12Z 02FEB
OBSERVED CATEGORY ⊗
PROBABILITY OF
(4) 6+
(3) 3-6
(2) 1-3
(1) 0-1 mi

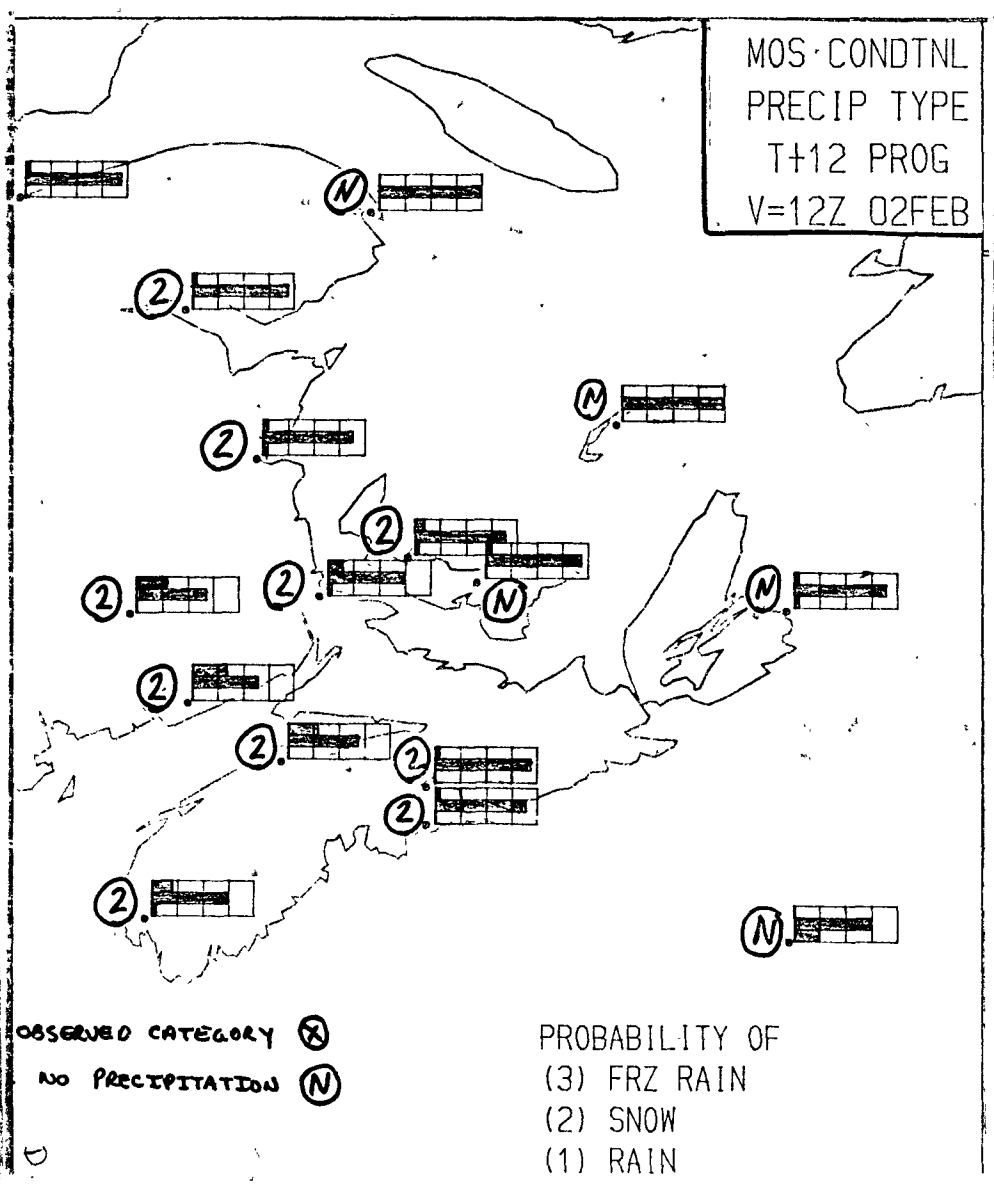

MOS - MIN
VISIBILITY
T+18 PROG
V=18Z 02FEB
OBSERVED CATEGORY ⊗
PROBABILITY OF
(4) 6+
(3) 3-6
(2) 1-3
(1) 0-1 mi

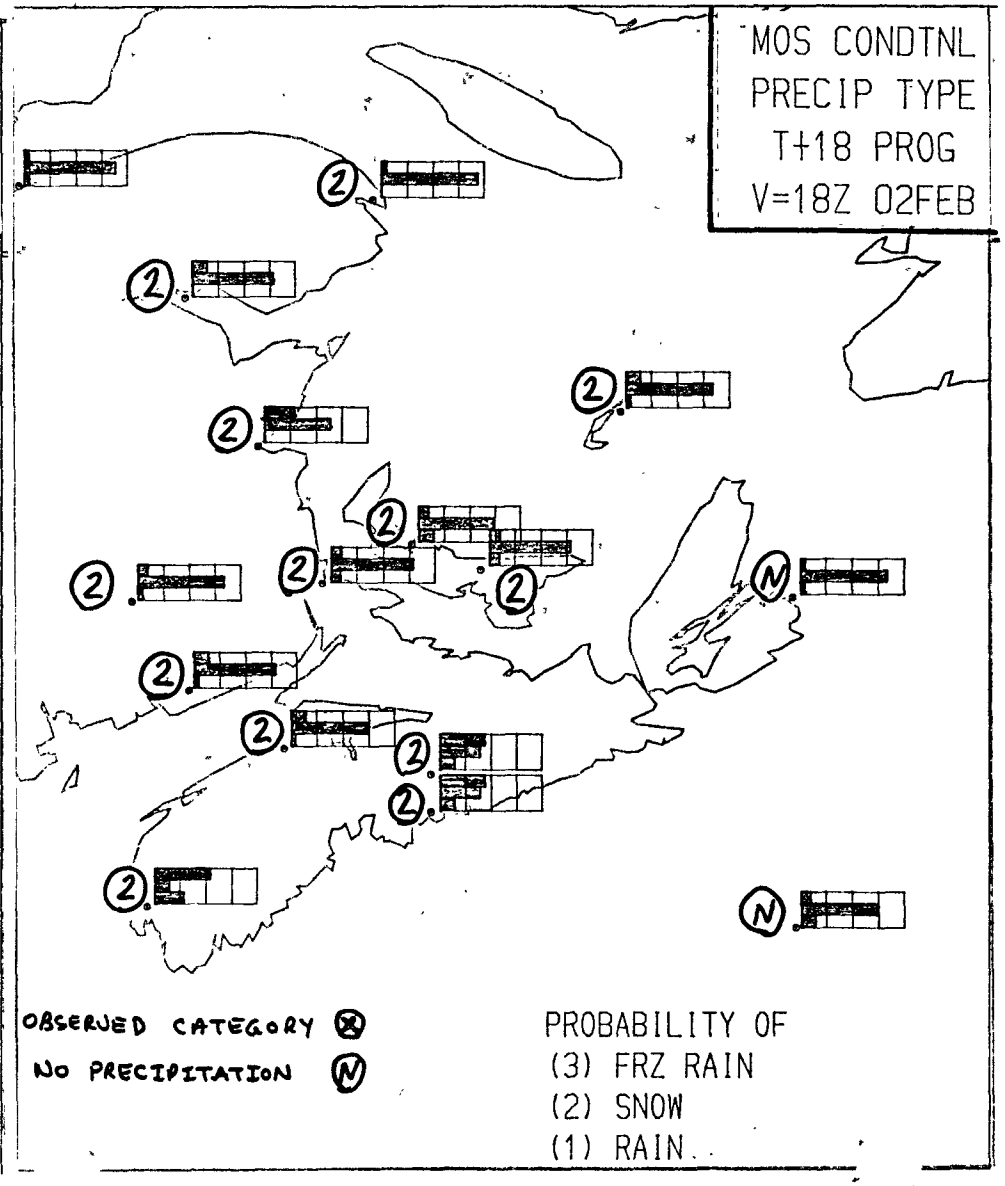

MOS - MIN
VISIBILITY
T+24 PROG
V=00Z 03FEB
OBSERVED CATEGORY ⊗
PROBABILITY OF
(4) 6+
(3) 3-6
(2) 1-3
(1) 0-1 mi

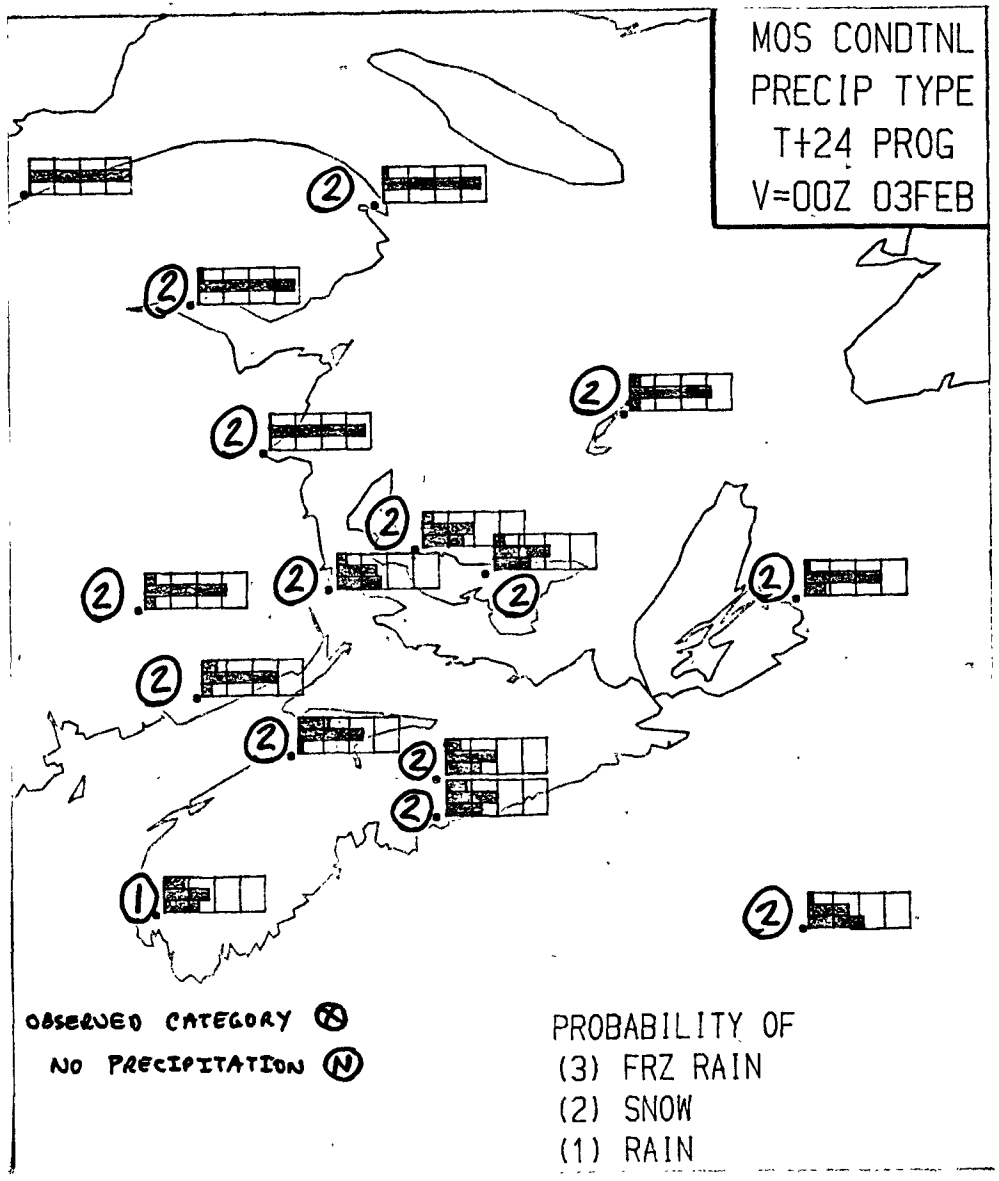

MOS - MIN
VISIBILITY
T+30 PROG
V=06Z 03FEB
OBSERVED CATEGORY ⊗
PROBABILITY OF
(4) 6+
(3) 3-6
(2) 1-3
(1) 0-1 mi


MOS CONDTNL
PRECIP TYPE
T+30 PROG
V=18Z 02FEB
OBSERVED CATEGORY ⊗
NO PRECIPITATION Ⓝ
PROBABILITY OF
(3) FRZ RAIN
(2) SNOW
(1) RAIN


MOS CONDTNL
PRECIP TYPE
T+36 PROG
V=00Z 03FEB
OBSERVED CATEGORY ⊗
NO PRECIPITATION Ⓝ
PROBABILITY OF
(3) FRZ RAIN
(2) SNOW
(1) RAIN


MOS CONDTNL
PRECIP TYPE
T+12 PROG
V=12Z 02FEB
OBSERVED CATEGORY ⊗
NO PRECIPITATION (N)
PROBABILITY OF
(3) FRZ RAIN
(2) SNOW
(1) RAIN


MOS CONDTNL
PRECIP TYPE
T+18 PROG
V=18Z 02FEB
OBSERVED CATEGORY ⊗
NO PRECIPITATION (N)
PROBABILITY OF
(3) FRZ RAIN
(2) SNOW
(1) RAIN


MOS CONDTNL
PRECIP TYPE
T+24 PROG
V=00Z 03FEB
OBSERVED CATEGORY ⊗
NO PRECIPITATION Ⓝ
PROBABILITY OF
(3) FRZ RAIN
(2) SNOW
(1) RAIN

Due to length Appendices E through L will only be supplied upon request.