Environment Canada Imaging Cover Page

Report N.: *ORTN-87-05*

SKP Box Number: 672572448

ONTARIO REGION TECHNICAL NOTES

ORTN-87-5

THE DAMAGING WIND STORM OVER SOUTHERN ONTARIO ON APRIL 30, 1984

by

Elzbieta Ros
Meteorologist
Ontario Weather Centre

Environment Canada / Environnement Canada
Atmospheric Environment Service / Service de l'environnement atmosphérique

April 1987

Canada

THE DAMAGING WIND STORM OVER SOUTHERN ONTARIO

ON APRIL 30, 1984

Table of Contents

THE DAMAGING WIND STORM OVER SOUTHERN ONTARIO ON APRIL 30, 1984

1. INTRODUCTION

On Monday morning, April 30, 1984, a rapidly deepening system moved over the upper Great Lakes and then northwestward to northern Quebec (Fig. 1).

Storm force winds gusting to 120 km/h knocked down trees, tore roofs off barns and homes, snapped electrical wires and smashed boats onto the shore. Severe damage caused by soil erosion occurred in agricultural areas.

Six Ontario residents were killed as a result of the winds; three of them under the falling roofs; three others while fishing on Lake Erie. The destructive storm, according to the insurance companies, is estimated to have caused 50-100 million dollars damage.

One Toronto insurance company alone paid 27 Thousand Dollars for car damage and 2.5 million for property damage. Nutrient loss from soil erosion in Simcoe County was estimated at 160 Thousand Dollars.

The purpose of this paper is to examine and present the meteorological factors associated with the storm which caused the occurence of exceptionally strong winds over southern Ontario.

2. EXAMINATION OF FACTORS CONTRIBUTING TO WIND VELOCITY DURING THE STORM

Time: April 30, 1984; 18Z
Location: Southern Ontario west of Toronto, including Toronto and Lake Erie

Synoptic situation: An intense low, central pressure 980 MB just north of Lake Superior moving northeastward at 30 knots. A sharp maritime cold front extending from Sudbury through Muskoka just east of Toronto and then southeastward. A warm front extending from Sudbury eastward (Fig. 2).

The strongest mean winds reported ahead of the maritime cold front at 18Z occurred in Peterborough and were 19 knots with gusts to 29 knots. At the same time, the strongest mean winds behind maritime cold front were reported in Hamilton and reached 40 knots with gusts to 54 knots.

2. **EXAMINATION OF FACTORS CONTRIBUTING TO WIND VELOCITY DURING THE STORM** continued

The strongest wind gusts reported over southern Ontario occurred in Wiarton between 16 and 17Z behind the maritime cold front and reached 68 knots (Table 1).

Wind Analysis

1. Geostrophic wind Vg.	70 knots
2. Stability over the land	Unstable
Stability over the water	Stable
3. Curvature	Strait or slightly anticyclonic isobars
4. Isollobaric wind	Component in the same direction as Vg, Fig. 5

5. Wind observations at 850 MB, 12Z, April 30, 1984

	Direction	Speed
Flint FNT	215 degrees	53 knots
Buffalo BUF	225 degrees	63 knots
Pittsburgh PIT	220 degrees	52 knots
Huntington HTS	220 degrees	69 knots

6. Actual winds observations at 18Z, April 30

	Direction	Speed
Lake Erie (ship report)	240 degrees	45 knots
Toronto YYZ	230 degrees	33G37 knots
Wiarton YVV	230 degrees	33G55 knots
London YXU	240 degrees	36G43 knots
Windsor YQG	220 degrees	26G47 knots
Hamilton YHM	240 degrees	40G54 knots

The highest gust at 68 knots was reported between 16 and 17Z in Wiarton.

3. REMARKS

The time and location were chosen according to approximate time of occurrence of strong winds over southern Ontario. A detailed surface analysis was available at that time.

Stability at 1800Z was derived from 12Z tephigrams using the 18Z surface temperatures. At 18Z, the surface temperatures behind the maritime cold front were 12 to 16 degrees.

An isallobaric wind contribution was given as a positive or negative factor. The isallobaric gradient is strong and estimation with the isallobaric wind scale may lead to significant errors.

4. DISCUSSION

After examination of data available before and at the time of occurrence of strong winds, it appears that a number of coincident factors contributed to the storng winds experienced over southern Ontario behind the cold front.

The low was very intense and it resulted in a strong pressure gradient.

850 MB analysis from 12Z, April 30, 1984, shows a low level jet stream located over central Lake Erie as well as over central Indiana and Illinois with highest wind speed 55-70 knots reported in Flint, Buffalo, Pittsburgh, Huntington (Fig. 4). However, the measurement of the geostrophic winds from contours on the 850 MB map indicates that maximum geostrophic winds of 80 knots were possible.

The tephigram analysis from 12Z April 30, from Dayton (Fig. 6) shows a very unstable airmass behind the maritime cold front with further destabilization shown on tephigram analysis from Dayton from 00Z, May 01, 1984 (Fig. 7). As a result, the strongest winds in the mixing layer were easily transported to the surface.

The surface analysis at 18Z, April 30, shows a strong isallobaric high (rise 11 MB/3 hrs) over central Wisconsin with an intense isallobaric gradient behind the maritime cold front. In the area where the strongest winds occurred, the isallobaric wind amplified the already strong southwesterly flow (Fig. 5).

4. **DISCUSSION** continued

In addition, a straight or slightly anticyclonic wind field just behind the maritime cold front resulted in a realization of the full strength of the geostrophic winds.

The strongest gusts were observed just after the frontal passage. The evidence on the surface: strongest gusts occurred within 1 to 3 hours after frontal wind shift. An example: windshift in Wiarton between 13 and 14Z, strongest gust between 16 to 17Z; windshift in London between 13 to 14Z, strongest gust 1647Z. Windshift in Toronto between 16 and 17Z, strongest gust 1922Z.

For Lake Erie, the surface pressure gradient and the southwest surface winds were aligned with the long axis of the lake (Fig. 3), resulting in the longest fetch, and therefore, minimum reduction in surface wind speed due to friction.

Even though the air was stable over Lake Erie, (water temperature 4 to 8 degrees), the length of fetch and lack of friction still resulted in observed winds of 45 knots over the lake.

5. **CONCLUSIONS**

The April 30th storm was an exceptional example of an Ontario storm. An explosive deepening of the low resulted in the formation of a strong baroclinic zone and development of the low level jet stream along the maritime cold front, as well as increased significance of all the factors contributing to wind velocity. The strongest winds over southern Ontario and Lake Erie (mean wind speed 30 knots and above, and gusts 40 knots and above) occurred behind the maritime cold front and lasted from 9 to 12 hours. During that time, all the factors contributed positively to increase the southwesterly flow.

It is worth noting, for the purpose of forecasting, that the strongest wind gusts (near 70 knots) were equal to the value of the strongest winds reported at 850 MB. With the very unstable air behind the maritime cold front, the strongest winds in the mixing layer were easily transported to the surface.

The duration of the strong winds and the strength of the gusts combined with large waves on the lakes, caused extensive damage.

6. REFERENCES

Ontario Region Note 84-3, "Marine Wind Forecasting Techniques for the Great Lakes", R. Lefebvre, March. 1984.

Training Branch 1983, "Wind Forecasting".

Pettersen, "Weather Analysis and Forecasting", Vol 1, pp.67-71.

PEAK WIND SPEEDS (GUSTS) WITH DIRECTION - STORM OF APRIL 30, 1984

LOCATION	WIND FROM DIRECTION	KNOTS	MPH	KM/H	TIME E.S.T
ATIKOKAN A	NORTH-NORTHEAST	20	23	37	0241
BIG TROUT LAKE A	NORTH-NORTHWEST	27	31	50	2322
EARLTON A	SOUTH-SOUTHWEST	65	75	120	14-1500
GERALDTON A	NORTH	37	43	69	1223
GORE BAY A	SOUTH-SOUTHWEST	45	52	83	1200
HAMILTON A	SOUTHWEST	60	69	111	1455
KAPUSKASING A	NORTHWEST	35	40	65	01-MAY1
KENORA A	NORTH-NORTHWEST	28	32	52	1143
KINGSTON A	WEST-SOUTHWEST	41	47	76	1743
LANSDOWNE HOUSE A	NORTH-NORTHWEST	22	25	41	01-MAY1
LONDON A	SOUTHWEST	58	67	107	1047
MOOSONEE A	NORTH	28	32	52	2115
MOUNT FOREST	SOUTH-SOUTHWEST	55	63	102	1200
MUSKOKA A	SOUTHWEST	45	52	83	13&14
NORTH BAY A	NORTHWEST	52	60	96	1800
OTTAWA INTL A	WEST-SOUTHWEST	42	48	78	2028
PETAWAWA A	WEST-SOUTHWEST	52	60	96	1830
PETERBOROUGH A	WEST-SOUTHWEST	53	61	98	1603
PICKLE LAKE A	NORTH	28	32	52	1633
RED LAKE A	NORTHWEST	27	31	50	1616
ST.CATHARINES A	WEST-SOUTHWEST	64	74	119	1542
SARNIA A	SOUTHWEST	59	68	109	0945
SAULT STE MARIE A	WEST	48	55	89	1955
SIMCOE	WEST-SOUTHWEST	64	74	119	13-1400
SIOUX LOOKOUT A	NORTH-NORTHWEST	25	29	46	1400
TIMMINS A	SOUTH-SOUTHWEST	30	35	56	15-1600
PEARSON INT A(TORONTO)	SOUTHWEST	54	62	100	1322
TORONTO ISLAND A	SOUTHWEST	54	62	100	1536
TRENTON A	WEST-SOUTHWEST	54	62	100	1552
SUDBURY A	SOUTH-SOUTHWEST	65	75	120	1445
THUNDER BAY A	NORTHWEST	41	47	76	1105
WATERLOO-WELLINGTON A	SOUTHWEST	53	61	98	1202
WAWA A	EAST-NORTHEAST	27	31	50	0410
WIARTON A	SOUTH-SOUTHWEST	68	78	126	10-1100
WINDSOR A	SOUTHWEST	49	56	91	1110

Table - 1 -

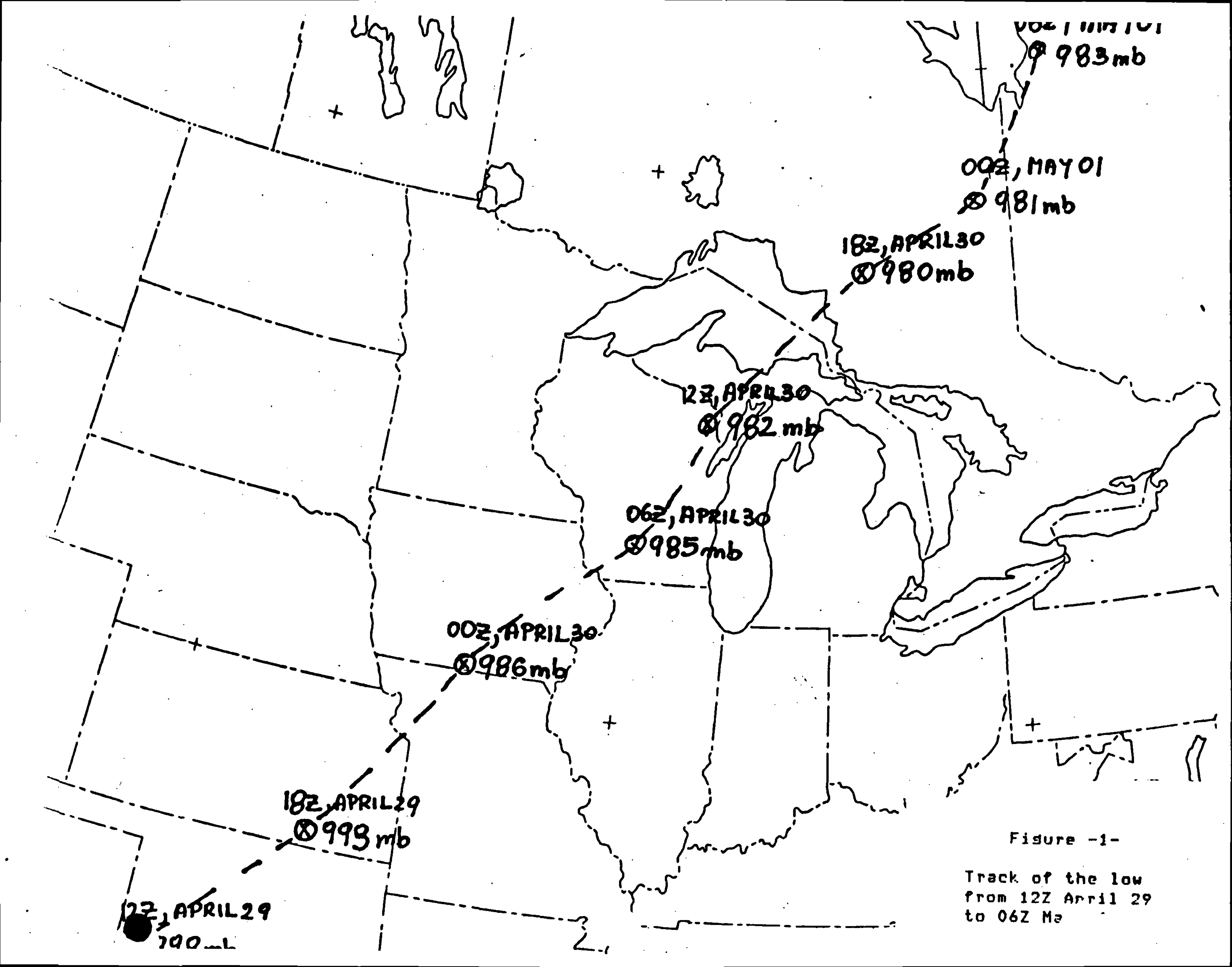

Figure -1-

Track of the low from 12Z April 29 to 06Z Ma

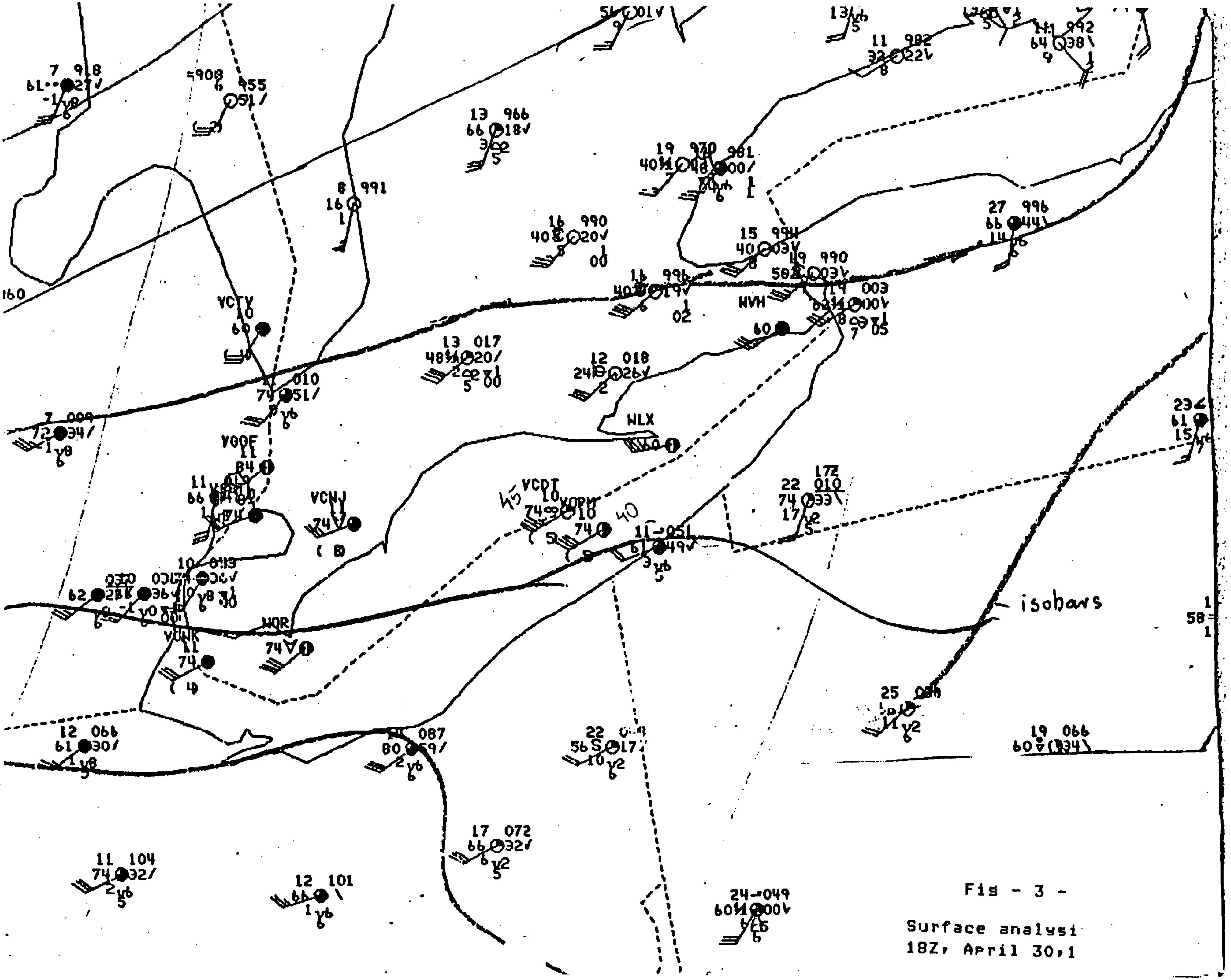

Fig - 3 -

Surface analysi
18Z, April 30,1

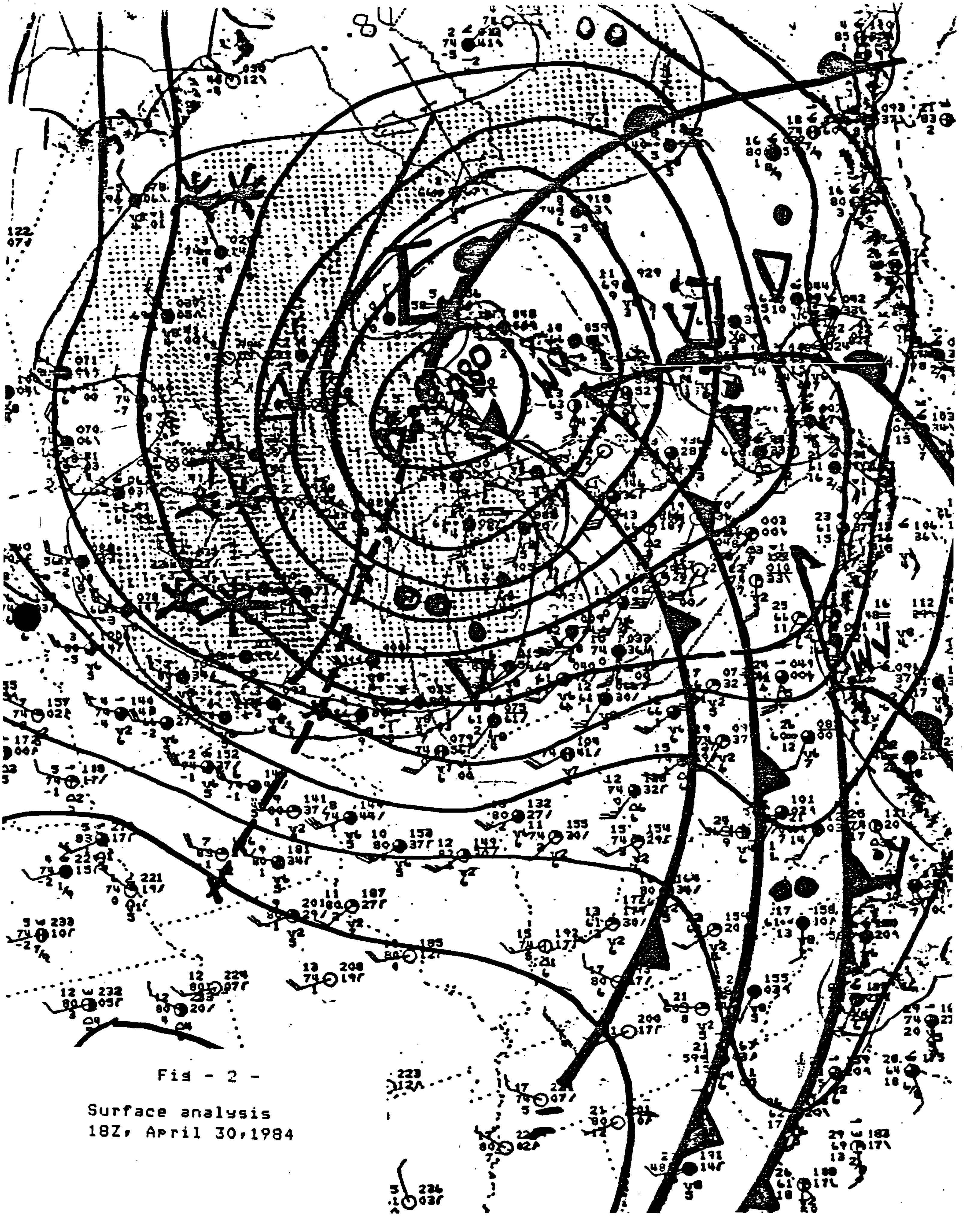

Fig - 2 -

Surface analysis
18Z, April 30,1984

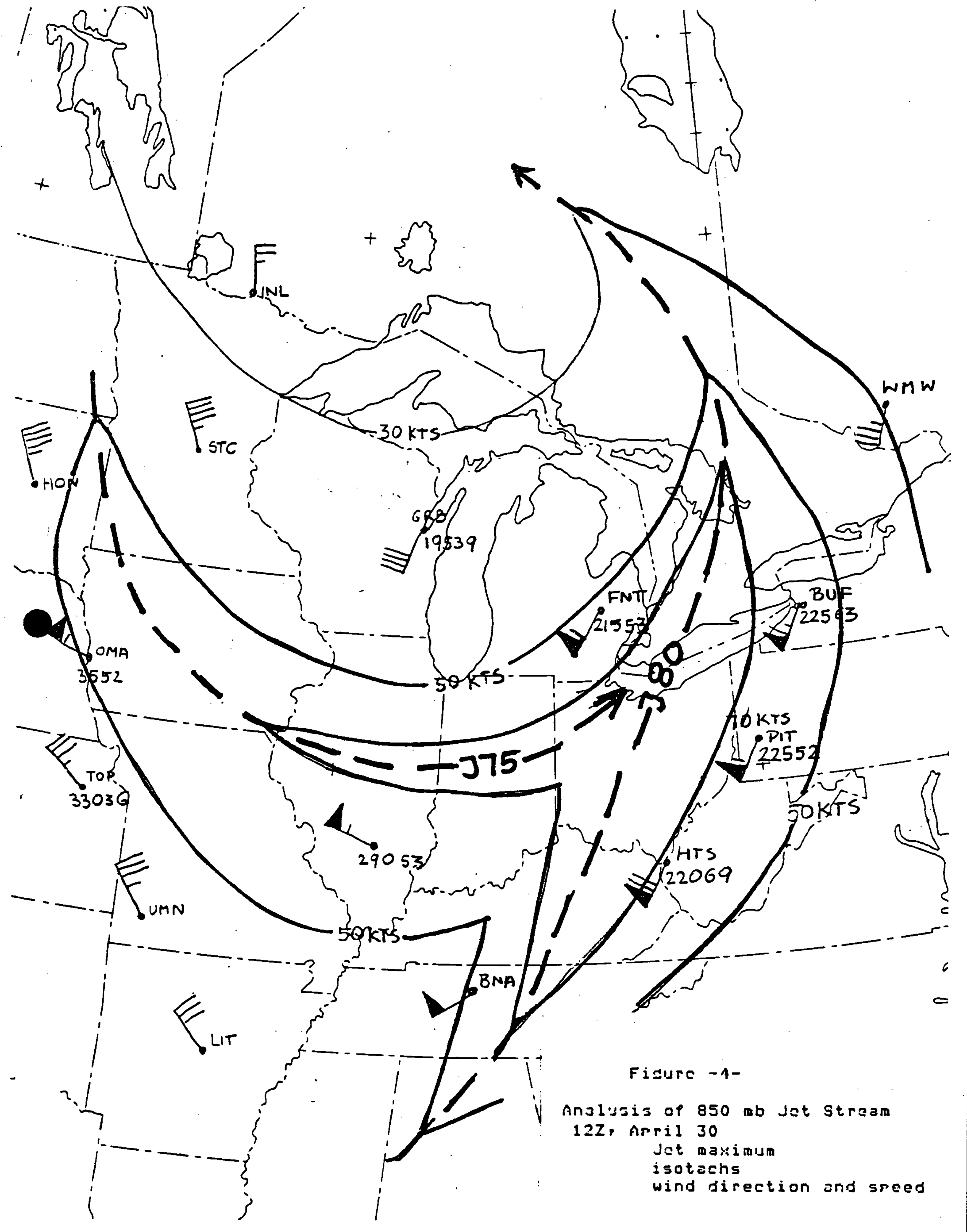

Figure -4-

Analysis of 850 mb Jet Stream
12Z, April 30
Jet maximum
isotachs
wind direction and speed

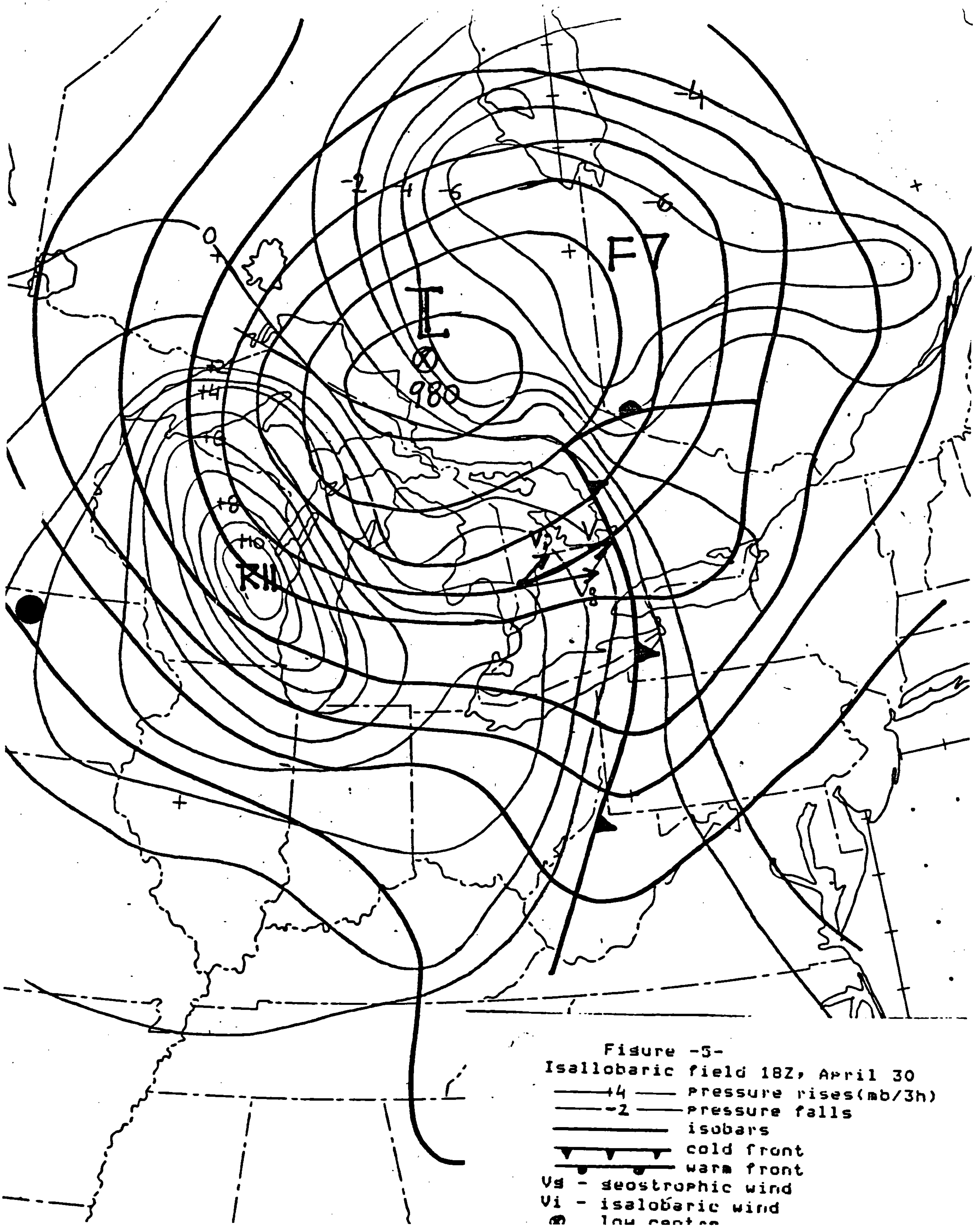

Figure -5-
Isallobaric field 18Z, April 30

——+4—— pressure rises(mb/3h)
——-2—— pressure falls
isobars
cold front
warm front
Vg - geostrophic wind
Vi - isallobaric wind
low center

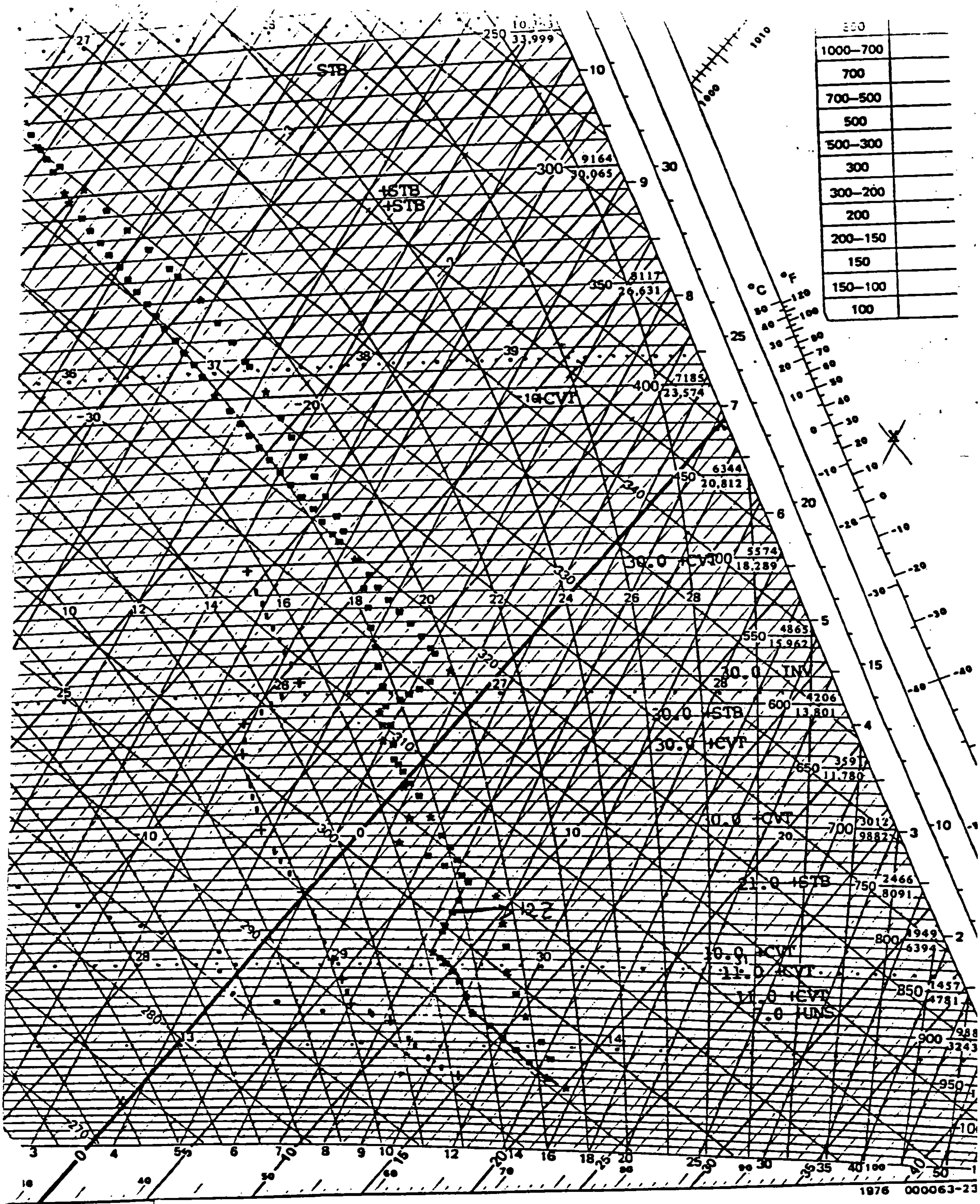

Fig - 6 -

DAY Tephigram analysis 12Z, April 30, 1984

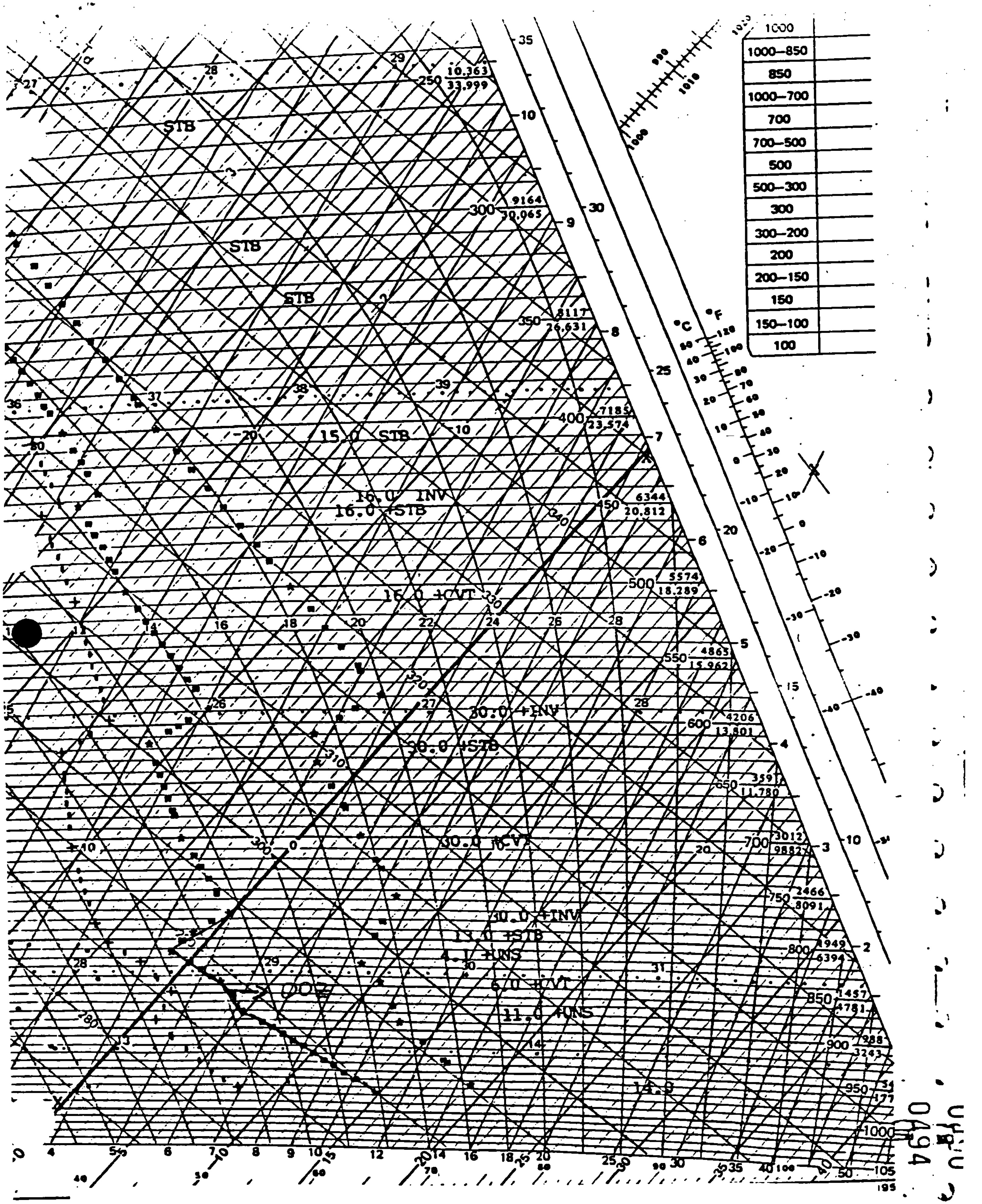

Fig - 7 -

DAY Tephigram analysis 00Z, May 01, 1984