# TERMINAL FORECAST REFERENCE FILE

## VOLUME I

DETACHMENT 4
8TH WEATHER SQUADRON

LORING AFB





JUNE 1969



71

TABLE OF CONTENTS

## REVISIONS

| Number | Date | Part and Section Changed |
| --- | --- | --- |

# PART 1

SECTION A

TOPOGRAPHY

## TOPOGRAPHY

Loring AFB, Maine is located at 46° 57'N and 67° 53'W or nine nautical miles northeast of Caribou, Maine. The St Johns River, which is on the border of Maine and the Province of New Brunswick, lies seven miles to the east. Runway elevation is 746 feet MSL. This is the highest point in the immediate area resulting in excellent drainage of cold air.

The foot hills of the Maine-New Hampshire mountains start about 35 miles west of Loring and extend west and north to the St Lawrence River and southwestward to the Appalachian Range. These mountains have a mean elevation in the north of approximately 1800 feet, rising rapidly to the southwest with numerous peaks more than 4000 feet in elevation. Mt Washington, the highest (6288 feet), is located in northern New Hampshire, 215 nautieal miles southwest of Loring. The highest peak in Maine, Mt Katahdin with an elevation of 5273 feet, is 78 nautical miles south-southwest of Loring. The range of mountains has a drying effect on systems moving from the west or north. Another range of hills in New Brunswick is located about 30 nautical miles east of Loring. It extends about 25 miles southward, 40 nautical miles northward and is about 30 miles wide. The highest peak, Mt Carlton is 50 nautical miles northeast of Loring. Its elevation is 2690 feet although the average elevation of these hills is about 1500 feet. This ridge also has a drying and retarding effect on low clouds and precipitation moving toward Loring from the east. Weather can cross over this ridge and affect Loring but only under a persistent easterly dirculation.

Loring AFB Area
Scale 1:500,000


Figure 1 - A - 1

There are two bodies of water that have a great influence on the local weather; both are a part of the North Atlantic. Most important is the Bay of Fundy, 120 nautical miles to the southeast. The second is the Gulf of St Lawrence, 120 nautical miles to the northeast The St Lawrence River, 90 nautical miles to the north and northwest, does not seem to affect the weather significantly at Loring.

# SECTION B

# ATMOSPHERIC POLLUTION SOURCES

## ATMOSPHERIC POLLUTION SOURCES

There are no large industrial areas to affect our weather. However, smoke from local fires at dumps, the heating plant just south of the runway, and Wherry Housing to the west, cause some slight restriction to visibility. On very cold days this smoke provides condensation nuclei resulting in snow or ice crystals forming from clear skies.

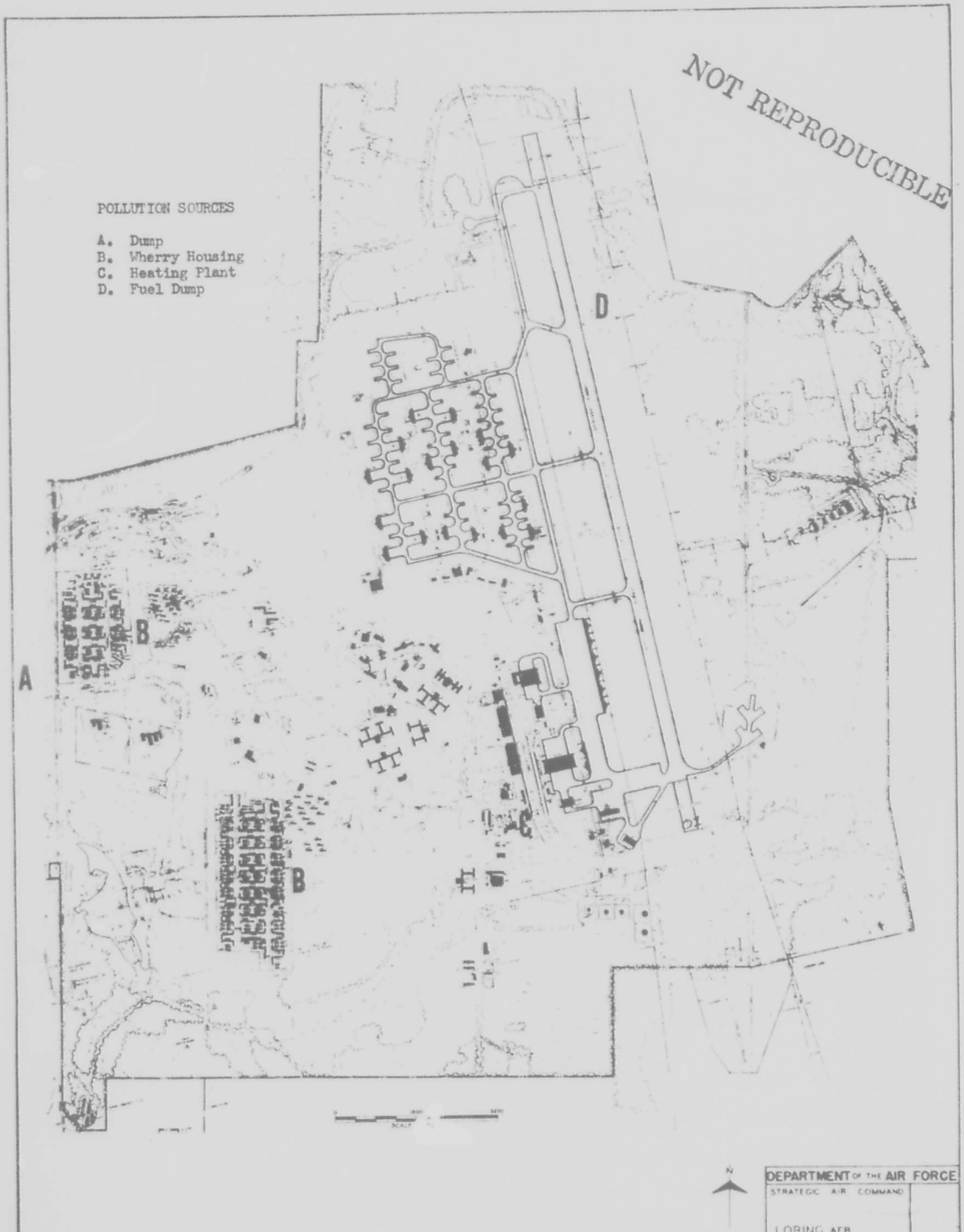


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Figure 1 - B - 1

# SECTION C

# INSTRUMENTATION

EXPOSURE OF OBSERVING INSTRUMENTS

The weather station is located in the Base Operations building and has been there since December 1950 when the base opened.

The Weather Observation Site Building (WOSB) was completed in 1956. It is located 650 feet west of center line, 5200 feet north of the south end of the runway. The WOSB is eight feet above ground. Trees to the north and east obstruct the view to a varying degree, depending on the extent of the foliage.

Meteorological equipment is located as follows:

1. WIND: Loring now has AN/GMQ-11 wind transmitters located on each end of the runway. The transmitter on the south is 800 feet east of center line and 2024 feet north of the end of the runway. It is 13 feet above the ground and is located in a fairly level area. The north transmitter is 500 feet east of centerline and 1183 feet south of end of the runway. It is on a 30-foot mast in a small north-south valley. Both transmitters give a fairly representative reading of the wind conditions at 13 feet above the runway surface, although a light wind might be funneled slightly on the north end.

The GMQ-11 on the south end was installed in its present location in February 1963 when the transmitter on the north end also became operative. Neither transmitter has been moved since.

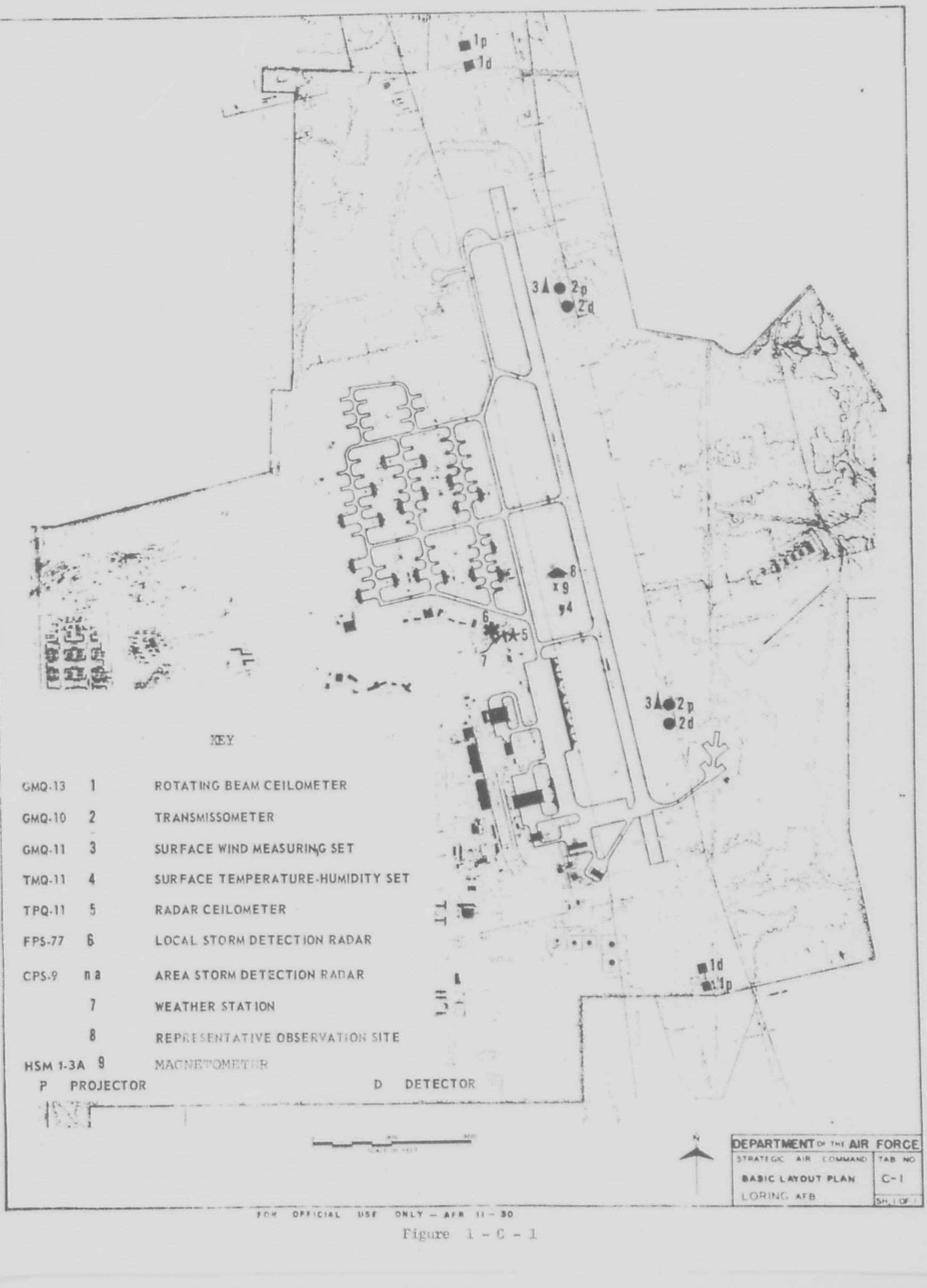


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Figure 1 - C - 1

2. CEILING: Two GMQ-13A Rotating Beam Ceilometers are used to obtain ceiling measurements below 3900 feet. One set is located on the center line 3900 feet north of the end of the runway. The second set is 358 feet east of center line, 3267 feet south of the runway. Both instruments are at the same elevation as the runway and both give similar readings under a given ceiling. The GMQ-13A on the south end of the runway was installed in January 1958 and that on the north end in October 1961.

In November of 1967, the TPQ-11 Radar Ceiling Detector was put into full-time operation. (It had been used sporadically since November 1966). The TPQ-11 transmitter and receiver are located 15 feet north of Base Operations. Bases and tops of clouds from approximately 3000 to 60,000 feet may be measured if the clouds are directly over the equipment.

3. VISIBILITY: In October 1961, AN/GMQ-10 Transmissometers were installed at Loring. One receiver is 676 feet east of center line, and 1500 feet north of the south end of the runway. The projector is 500 feet north. The second receiver is 850 feet east of center line and 1685 feet south of the north end of the runway. The projector is 500 feet north. The transmitters are 13 feet above the runway. It is possible for fog forming in the trees to the east, to affect the transmissometers before restricting visibility on the runway, but this is not a common occurrence.

In December 1967, FMN-1 Runway Visual Range computer equipment was installed in the WOSB to record visibility measurements below 6000 feet. The installation is such that the FMN-1 records conditions on the active end of the runway while the transmissometer is indicating conditions on the inactive end.

4. TEMPERATURE AND HUMIDITY: The TMQ-11 Temperature-Humidity sensors are located 650 feet west of centerline and 4400 feet north of the south end of the runway. The area is quite flat with a line of trees approximately 1500 feet to the east and with Base Operations and the alert hangars 1000 feet to the west On a cold night with a west wind, some heating could be caused by the Base complex, but it should not be significant. The TMQ-11 was installed in September 1961.

5. RADAR: The FPS-77 Local Storm Detection Radar became operational in April 1969. The antenna is located 100 feet above ground on a tower just west of Base Operations. The top of the control tower, about 300 feet to the east, offers a minor obstruction to the horizon from 088° to 090°.

6. PRECIPITATION: A ML-17, Rain Gauge, is located 54 feet south of the WOSB. It was apparently installed here in 1956 when the WOSB was completed.

7. PRESSURE: A ML-512, Mercurial Barometer, and a ML-102D Aneroid Barometer, are located in the WOSB.

8. A HSM-1-3A Magnetometer is located 180 feet west southwest of the WOSB. The magnetometer fulfills requirements to collect and disseminate geomagnetic variation readings used in high precision satellite operations

History of Past Observing Sites and Instrument Locations

The Weather Station has been located in the Base Operations building since 1950 The observer took his observations from the control tower until the WOSB was completed in 1956.

There is no record of the wind equipment in use prior to April 1953 when an AN/GMQ-1A was installed on top of the control tower, 85 feet above ground. In April 1954, the equipment was raised to 90 feet above ground. A GMQ-11 was installed in April 1956 near the south end of the runway and east of centerline. It was moved several times, (always in the same general area) before it was placed in its current location in 1963.

The original temperature-humidity equipment, a TMQ-8 was installed in 1957. In September 1961, it was replaced by the TMQ-11 which was located in the same place as the TMQ-8.

Ceiling measurements were taken with an AN/GMQ-2 Ceilometer prior to January 1958. Its location is unknown because of lack of records

| STATION NO: | STATION NAME: | LATITUDE | LONGITUDE | BAROMETER ELEVATION | |
|---|---|---|---|---|---|
| 14623 | LIMESTONE MAINE/LORING AFB | N 46 57 | W 067 53 | 752 | KLIZ |

## STATION HISTORY AND WIND EQUIPMENT INFORMATION

| DATE OF CHANGE | TYPE OF STATION CHANGE | WIND EQUIPMENT LOCATION | TYPE OF TRANSMITTER | TYPE OF RECORDER | HEIGHT ABOVE GROUND |
|---|---|---|---|---|---|
| Sep 50 | Limestone AFB Det G-2 2060 Sq | Not available | N/A | N/A | N/A |
| 4/10/53 | Det 7 2 Wea Sq | Located on top of control tower of Operations Building | AN/GMQ-1A | ML-204-B (wind panel) | 85 Ft. |
| 4/1/54 | No change | No change | No change | No change | 90 Ft. |
| 4/3/56 | No change | Located on E side of runway, 750 Ft. from centerline, approximately 1000 Ft. N of S end of runway or about 5100 Ft. from the weather station | AN/GMQ-11 | RO-2 | 13 Ft. |
| 4/3/57 | Det 23 5 Wea Gp | Located on E side of runway approximately 1000 Ft. from S end | No change | No change | No chge |
| 4/3/58 | No change | Located 500 Ft. E of S end of runway | No change | No change | No chge |
| 4/9/59 | No change | Located 1600 Ft. N and 600 Ft. E of S end of runway | No change | No change | No chge |
| 4/5/60 | No change | Located on SE side of runway 01 | No change | No change | No chge |
| 11/4/60 | Det 4 8 Wea Sq | No change | No change | No change | No chge |
| 4/5/61 | No change | No change | No change | No change | 15 Ft. |
| 3/5/62 | No change | Located 2100 Ft. down and 800 Ft. to the right of centerline of runway 01. | No change | No change | 13 Ft. |
| 4/2/63 | No change | 1. Located 1600 Ft. from end and 665 Ft. E centerline runway 01.<br>2. Located 1685 Ft. from end and 600 Ft. E centerline runway 19. | T-420 B/GMQ-11<br>No change | No change (1 recorder) | No chge<br>30 Ft. |
| 4/4/66 | No change | Located 2000 Ft. down runway 01 and is 800 Ft. to the left of the centerline. | AN/GMQ-11 | No change | 13 Ft. |

Figure 1 - C - 4

PART 2

Loring AFB, Maine          Elev 746 Ft     46 57N     67 53W     Prepared — January 1969

Period of Record - September 1950 - December 1966

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Temperature (Deg. F)** | | | | | | | | | | | | |
| Extreme Max | 47 | 49 | 72 | 69 | 88 | 92 | 95 | 92 | 85 | 77 | 66 | 59 |
| Mean Daily Max | 20 | 23 | 32 | 45 | 60 | 69 | 74 | 71 | 63 | 51 | 38 | 24 |
| Mean Daily Min | 4 | 5 | 16 | 29 | 40 | 50 | 55 | 52 | 44 | 36 | 26 | 9 |
| Extreme Min | -30 | -29 | -13 | 2 | 24 | 34 | 41 | 38 | 26 | 18 | -4 | -24 |
| Mean No Days | | | | | | | | | | | | |
| Max 90F or more | 0 | 0 | 0 | 0 | 0 | * | 1 | * | 0 | 0 | 0 | 0 |
| Min 32F or less | 31 | 28 | 31 | 21 | 5 | 0 | 0 | 0 | 2 | 12 | 24 | 30 |
| Min 00F or less | 13 | 10 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Precipitation** | | | | | | | | | | | | |
| Mean No Days | | | | | | | | | | | | |
| Precip | 15 | 14 | 13 | 11 | 12 | 13 | 14 | 13 | 11 | 12 | 15 | 15 |
| Snowfall | 14 | 13 | 11 | 5 | 1 | 0 | 0 | 0 | * | 2 | 7 | 13 |
| Snowfall 1.5 in | 5 | 5 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 5 |
| Mean Amount (in) | | | | | | | | | | | | |
| Precip | 3 | 3 | 2 | 3 | 3 | 3 | 4 | 5 | 3 | 3 | 4 | 3 |
| Snowfall | 23 | 28 | 20 | 8 | * | 0 | 0 | 0 | * | 4 | 9 | 22 |

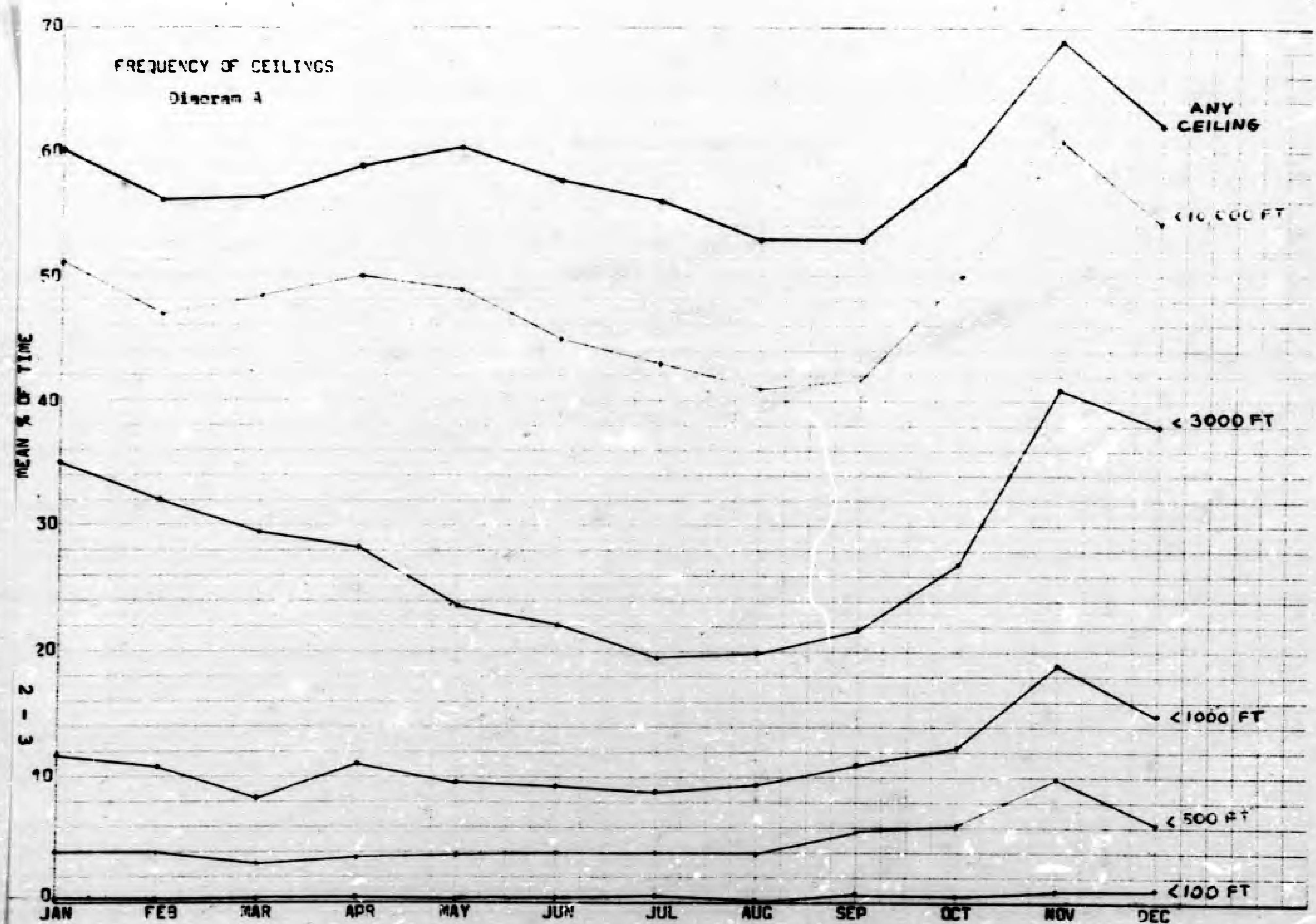
## LORING AFB, MAINE

### Percentage Frequency Ceiling Below 1000 Ft and/or Visibility Below 2.00 Mi

| Hour (LST) | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 00 - 02 | 14.4 | 14.1 | 9.8 | 13.5 | 10.4 | 11.1 | 11.5 | 9.3 | 11.7 | 13.9 | 19.3 | 17.5 |
| 03 - 05 | 15.7 | 13.9 | 10.5 | 16.0 | 14.0 | 15.8 | 15.7 | 14.5 | 15.4 | 15.2 | 20.3 | 17.3 |
| 06 - 08 | 16.3 | 14.6 | 13.1 | 14.8 | 15.1 | 15.8 | 14.9 | 18.3 | 16.9 | 16.9 | 20.1 | 18.6 |
| 09 - 11 | 17.0 | 15.2 | 11.4 | 12.2 | 10.9 | 10.8 | 9.1 | 12.6 | 13.1 | 16.0 | 20.5 | 18.7 |
| 12 - 14 | 15.7 | 14.1 | 10.8 | 11.2 | 8.1 | 6.4 | 5.1 | 8.1 | 8.5 | 12.3 | 21.0 | 16.2 |
| 15 - 17 | 14.5 | 14.3 | 10.4 | 10.6 | 6.1 | 6.0 | 4.7 | 5.7 | 7.1 | 10.7 | 19.9 | 16.9 |
| 18 - 20 | 11.9 | 13.3 | 11.2 | 10.1 | 6.8 | 6.9 | 4.9 | 4.2 | 7.6 | 11.0 | 18.4 | 15.6 |
| 21 - 23 | 12.6 | 14.2 | 10.3 | 10.3 | 8.3 | 8.1 | 7.6 | 6.0 | 8.5 | 11.1 | 18.7 | 16.5 |
| | 14.8 | 14.2 | 10.9 | 12.3 | 10.0 | 10.1 | 9.2 | 9.9 | 11.1 | 13.4 | 19.8 | 17.2 |

### Percentage Frequency Ceiling Below 200 Ft and/or Visibility Below 0.5 Mi

| Hour (LST) | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 00 - 02 | 2.1 | 2.0 | 1.4 | 1.9 | 0.9 | 2.1 | 2.4 | 1.3 | 2.5 | 3.4 | 4.1 | 3.0 |
| 03 - 05 | 1.7 | 1.8 | 1.9 | 2.6 | 2.4 | 3.9 | 5.4 | 3.4 | 3.9 | 3.6 | 4.4 | 3.7 |
| 06 - 08 | 1.9 | 2.9 | 2.2 | 1.8 | 1.4 | 1.9 | 2.1 | 2.4 | 3.3 | 3.9 | 3.9 | 3.8 |
| 09 - 11 | 3.1 | 2.8 | 1.5 | 0.6 | 0.1 | 0.0 | 0.1 | 0.2 | 1.1 | 1.3 | 3.3 | 4.2 |
| 12 - 14 | 1.9 | 2.2 | 1.6 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.9 | 2.4 | 3.8 |
| 15 - 17 | 1.8 | 2.5 | 1.7 | 0.9 | 0.1 | 0.1 | 0.2 | 0.1 | 0.3 | 1.1 | 2.9 | 3.4 |
| 18 - 20 | 1.4 | 2.2 | 1.1 | 1.5 | 0.3 | 0.0 | 0.1 | 0.3 | 1.2 | 2.0 | 2.6 | 3.0 |
| 21 - 24 | 1.5 | 2.0 | 1.3 | 0.8 | 0.9 | 0.3 | 0.7 | 1.1 | 1.8 | 1.6 | 3.5 | 3.0 |
| All | 1.9 | 2.3 | 1.6 | 1.4 | 0.8 | 1.0 | 1.4 | 1.1 | 1.8 | 2.2 | 3.4 | 3.5 |


FREQUENCY OF CEILINGS
Diagram 4
MEAN % OF TIME
70
60
50
40
30
20
10
0
ANY CEILING
< 10,000 FT
< 3000 FT
< 1000 FT
< 500 FT
< 100 FT
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

## PERCENT OF DAYS WITH VARIOUS ATMOSPHERIC PHENOMENA

(1950-1965)

Diagram 9

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| THUNDERSTORMS | 0 | 0 | 0 | 1.1 | 6.0 | 13.1 | 18.9 | 12.7 | 3.3 | 2.2 | 0 | 0 | 4.7 |
| RAIN AND/OR DRIZZLE | 17.6 | 14.6 | 17.2 | 43.1 | 57.3 | 59.6 | 60.8 | 56.7 | 52.9 | 47.3 | 41.3 | 20.6 | 40.7 |
| SNOW AND/OR SLEET | 72.5 | 67.5 | 57.0 | 33.8 | 4.7 | .4 | 0 | 0 | 2.2 | 17.2 | 48.7 | 68.6 | 31.2 |
| FOG | 27.7 | 29.0 | 22.4 | 34.4 | 29.5 | 34.7 | 39.6 | 41.2 | 37.3 | 34.2 | 41.6 | 30.3 | 33.4 |
| BLOWING SNOW | 17.6 | 17.9 | 12.5 | 2.2 | .4 | 0 | 0 | 0 | 0 | .4 | 3.3 | 14.2 | 5.7 |
| SMOKE AND/OR HAZE | 10.1 | 9.2 | 6.0 | 5.8 | 6.7 | 10.7 | 16.6 | 16.6 | 9.6 | 9.0 | 8.7 | 7.7 | 9.7 |
| FREEZING RAIN AND/OR FREEZING DRIZZLE | 9.7 | 8.7 | 3.9 | 1.6 | 0 | 0 | 0 | 0 | 0 | 0 | 8.0 | 5.8 | 3.1 |

Yearly:

Percentage of days with precipitation . . . . . . . . . . . . . 62.8
Percentage of days with obstructions to vision. . . . . . . . 39.9

FREQUENCY OF WIND DIRECTIONS BY MONTH

(1951-1966)

Diagram C

| % FREQUENCY OF WIND DIRECTION | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 14 | 12 | 14 | 16 | 12 | 10 | 8 | 8 | 9 | 11 | 10 | 10 |
| NE | 6 | 6 | 9 | 8 | 6 | 6 | 3 | 4 | 3 | 5 | 7 | 6 |
| E | 6 | 7 | 9 | 7 | 8 | 6 | 4 | 4 | 4 | 5 | 6 | 6 |
| SE | 4 | 5 | 6 | 6 | 8 | 8 | 6 | 5 | 5 | 6 | 6 | 5 |
| S | 11 | 11 | 8 | 14 | 17 | 20 | 20 | 17 | 20 | 17 | 16 | 14 |
| SW | 10 | 10 | 7 | 9 | 10 | 12 | 17 | 17 | 17 | 14 | 13 | 11 |
| W | 15 | 15 | 12 | 11 | 12 | 11 | 14 | 14 | 14 | 14 | 15 | 16 |
| NW | 23 | 21 | 25 | 18 | 17 | 15 | 14 | 16 | 15 | 16 | 16 | 18 |
| CALM | 11 | 13 | 10 | 11 | 10 | 12 | 14 | 15 | 13 | 12 | 11 | 14 |

WIND VELOCITY

PERCENT OCCURRENCE
(1951-1967)
Diagram D

ANNUAL:

Calm . . . . . . . . . . . . . . . . . . . . . 12.1%

10 kts or less . . . . . . . . . . . . . . . . . . . . . 69.3%

11 - 21 kts . . . . . . . . . . . . . . . . . . . . . 17.9%

22 kts or more . . . . . . . . . . . . . . . . . . . . . 0.7%

Annual average (in knots) . . . . . . . . . . . . . . . 6.9

MONTHLY:

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 kts or less | 63 | 63 | 62 | 67 | 72 | 75 | 75 | 74 | 72 | 71 | 71 | 66 |
| 11 - 21 kts | 25 | 22 | 26 | 21 | 18 | 13 | 11 | 11 | 15 | 17 | 18 | 20 |
| 22 kts or more | 1 | 2 | 2 | 1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Calm | 11 | 13 | 10 | 11 | 10 | 12 | 14 | 15 | 13 | 12 | 11 | 14 |
| Average speed in knots | 8 | 8 | 8 | 7 | 7 | 6 | 6 | 6 | 6 | 7 | 7 | 7 |

Maximum winds ever recorded . . . . . . . . . . . . . . 51 kts (17 May 1967)

Flying Weather

(1950 - 1966)

Diagram E

| Month | % of Time With Visibility Below 1 Mile | % of Time With IFR Conditions* | % of Time With Conditions Below 200-1/2 | % of Time With Conditions Below 100-1/4 |
|---|---|---|---|---|
| Jan | 4.7 | 17.1 | 1.9 | .9 |
| Feb | 5.6 | 16.9 | 2.3 | .7 |
| Mar | 4.1 | 12.7 | 1.6 | .6 |
| Apr | 2.6 | 13.2 | 1.4 | .6 |
| May | 0.7 | 10.2 | 0.8 | .3 |
| Jun | 1.1 | 10.6 | 1.0 | .5 |
| Jul | 1.7 | 9.7 | 1.4 | .7 |
| Aug | 1.4 | 10.5 | 1.1 | .5 |
| Sep | 1.8 | 11.7 | 1.8 | .9 |
| Oct | 2.4 | 14.0 | 2.2 | .9 |
| Nov | 4.6 | 20.6 | 3.4 | 1.3 |
| Dec | 6.4 | 18.9 | 3.5 | 1.5 |

* IFR = Ceiling less than 1000 ft or visibility less than 3 miles

TEMPERATURE

(1950-1965)

Diagram F

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MEAN | 11.9 | 14.6 | 24.3 | 37.5 | 50.0 | 59.6 | 64.9 | 62.0 | 53.7 | 43.5 | 32.2 | 16.9 | 39.1 |
| AVE. MAX | 19.9 | 23.3 | 32.1 | 45.1 | 59.6 | 69.2 | 73.9 | 71.1 | 62.7 | 51.2 | 38.2 | 24.0 | 47.4 |
| AVE. MIN | 3.6 | 5.4 | 16.0 | 29.4 | 40.0 | 49.5 | 55.4 | 52.3 | 44.3 | 35.3 | 25.8 | 9.3 | 30.4 |

SNOW FALL

Monthly Amount (inches)

(1950-1965)

Diagram G

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MEAN | 23.0 | 27.6 | 20.4 | 7.7 | .1 | Tr | 0 | Tr | .1 | 3.8 | 8.8 | 21.7 |
| GREATEST | 33.7 | 47.1 | 51.3 | 19.8 | .8 | .2 | 0 | Tr | 1.3 | 12.5 | 24.2 | 47.7 |
| LEAST | 7.8 | 11.3 | 6.1 | Tr | 0 | 0 | 0 | 0 | 0 | Tr | .4 | 9.8 |

ANNUAL 113.2

# PART 3

# SECTION A

# INTRODUCTION

## INTRODUCTION

Loring is within 100 miles of most of the major storm tracks in North America. As a result, the frequency of bad weather is high, and the multitude of different types of systems can make forecasting difficult. The major problem areas are listed below:

a. Forecasting fog and stratus which are often responsible for near or below minimum conditions.

b. Judging the movement of Atlantic coast lows which can bring severe weather to this area.

c. Timing the passage of fronts which come from the northwest.

d. Determining whether precipitation will be frozen, liquid or freezing.

SECTION B

GENERAL CIRCULATION

## GENERAL CIRCULATION

Air Masses. During the months of September through May, the mean position of the polar front reaches as far south as the southeast U.S. Continental polar air is the dominant air mass affecting northern Maine. As this cP air moves south and southeastward from its source region, it becomes somewhat modified in its lower layers through absorption of heat and moisture. Consequently, the air mass becomes more unstable as it approaches northern Maine and produces stratocumulus clouds and scattered snow showers. During the winter months, November through March, continental arctic air frequently invades the Loring area plummeting the temperatures well below zero. Modified maritime tropical air is rarely observed during the winter. However, its occurrence is accompanied by low ceilings, fog and temperatures as high as 40°F.

During the summer months of June, July and August, the mean position of the polar front retreats to the Gulf of St. Lawrence. Modified maritime tropical air becomes predominant, producing warm temperatures and a great likelihood of fog. However, the maritime tropical air is frequently disrupted by invasions of modified continental polar air which becomes unstable from surface heating and produces daytime stratocumulus and cumulus clouds.

Fronts. Although Loring is more often affected by the low accompanying frontal systems than by the fronts themselves, fronts do affect the area.

Occluded fronts are the most common type of frontal passage at Loring. Southerly flow advects moisture into Maine ahead of these fronts and their usual passage over the Great Lakes brings in even more moisture. Warm frontal type weather usually begins well ahead of these fronts, and little change in intensity of weather is associated with the front itself.

Cold front passing through northern Maine may be broadly divided into two classes; those with a north-south orientation and those with a east-west or southwest-northeast orientation. The east-west oriented fronts are outbreaks of continental polar air. During summer, the cold, unstable air accompanying these fronts is responsible for the most severe weather at Loring. A major problem with these fronts is timing. They are often oriented parallel to the flow which, combined with the mountainous terrain to the west, tends to slow down or stop these fronts in the St. Lawrence River Valley. Fronts with a north-south orientation are less difficult to time, but a longer period of weather will accompany them because of their passage over the moist area of the Great Lakes and because of southerly flow over the region. In the winter, cold frontal passages are not common.

Because of the mountainous terrain round Loring, warm frontal passages are very infrequent. Warm fronts may be observed to move as far north as Houlton but then dissipate as they reach the higher terrain in the northern end of Aroostook County. Overrunning effects of warm fronts to the south, however, are very important to the weather at Loring.

SECTION C

SEASONAL WEATHER REGIMES

SEASONAL WEATHER REGIMES

The longest and most evident season in northern Maine is winter, which begins during the middle of November and holds its icy grip through the month of March. The mean temperature during this period averages well below freezing with the coldest temperatures occurring in January when the mean temperature is near $12^{o}$F. (Diagram F) Most storm systems that enter North America during winter eventually pose a threat to northern Maine. These systems produce predominantly snow in varying amounts. In fact, nearly 90% of the total yearly snowfall occurs in this period. The maximum occurrence of active synoptic systems during the winter produces IFR (ceiling less than 1000 feet or visibility less than 3 miles) conditions 12-20% of the time. (Diagram E.)

The spring months of April through the middle of June are characterized by moderating temperatures. Precipitation in this regime is mostly in the form of showers. A few significant snowfalls can occur during the early spring, but usually melt rapidly within a day or two. Frequent large day to day variations in the weather pattern occur at Loring during this transitional period. As late as May, temperatures in the sunny 50's on one day can be followed by light snow and near freezing temperatures on the next.

The summer regime from the middle of June through August is usually characterized by mild days and cool nights, as maximum temperatures average in the 70's and night-time minimums average in the low 50's. (Diagram F.) With the principal storm tracks generally to the north of Maine, major precipitation occurs in showers and thunderstorms caused by the passage of cold fronts. This absence of large scale synoptic systems accounts for the yearly minimum of both cloudiness and IFR conditions during this season. (Diagrams A and E.)

The fall regime from September through the middle of November is characterized by a rapid return of colder temperatures and an increase of days with steady precipitation and fog, as significant middle latitude storms become more intense and frequent. The first frost usually occurs by the end of September while hard freezing temperatures become common by the first of November. Snowfall returns during the early part of this transitional season, usually making its first appearance in the form of flurries. The first significant snowstorm normally will occur in November.

## Winter Regime

During the winter season in middle latitudes, the large scale zonal circulation is the strongest, and as a result, surface pressure systems usually move more rapidly from west to east. The winter normal 500 millibar chart reflects an intense cyclone in northeastern Canada with a trough extending southwestward to the Great Lakes, and a ridge located along the Pacific Coast. The normal sea level chart shows deep cyclonic circulation east of Greenland and in the Aleutians; and high pressure in northwestern Canada, the Northern Rockies, and the Southeastern United States.

1. Synoptic Patterns Producing Precipitation. The principal tracks of lows for the Winter season, as depicted in Figures 4, 5, 6, 7, and 8 show that most of the low pressure disturbances in North America eventually affect or threaten northern Maine. These cyclonic disturbances along with thermal and dynamic instability processes, produce precipitation on seven out of every ten days during the Winter. Although a very high percentage of the precipitation at Loring occurs as snow, slow moving, deep lows to the west or southwest of Maine will eventually pump enough warm air into the area to produce precipitation in the form of rain.

a. Lows that Move Eastward Along the Canadian Border. Lows that develop along the northern Pacific Coast or in western Canada and move rapidly eastward are associated with high zonal index. As these lows approach the Great Lakes, they usually intensify and recurve eastnortheastward to northeastward up the St Lawrence River Valley, passing very close to Loring and its surrounding area. Such a pattern usually produces light snow (1-2 inches) over northern Maine. However, if the central pressure of this cyclone is less than 1000 millibars, significant snowfall (2-5 inches) is likely. Because of the rapid movement of these disturbances, continuous snow occurs for only four to eight hours. The passage of the low is followed by an outbreak of polar air that moves eastward and southeastward out of central Canada. Usually, when this particular storm track is established, several lows tend to develop in a series and affect Loring with a periodicity of two to three days. Therefore, this is the storm type that most frequently affects the weather in northern Maine in the Winter.

b. Lows in the South Central United States that move Northeastward. The 500 millibar flow associated with these lows reflects a major trough in the central United States and a well defined ridge in the East. Usually, the surface low originates in the Rockies (but may have its origin way up in the Gulf of Alaska) and moves east to southeastward to the plains where it begins to deepen due to the influx of moisture from the Gulf of Mexico. At this point, the low starts to recurve northeastward as it now moves along in the forward portion of the upper level trough. The low continues to deepen as it moves rapidly on a path close to the St. Lawrence River Valley.

The rate at which precipitation spreads into northern Maine is usually sooner that one would expect if only the speed and path of the disturbance were considered. This early outbreak of precipitation is due to either the rapid intensification of the warm front to the south causing overrunning or cyclogenesis along the coast. This latter point will be discussed later under coastal storms.

An infrequent variation of this type occurs when a blocking high is situated over northeastern United States and eastern Canada. Then the cyclone in the south central United States moves northward into Canada and causes a marked warming trend throughout New England. Precipitation is very slow in spreading eastward; rain instead of snow in northern Maine becomes a distinct possibility.

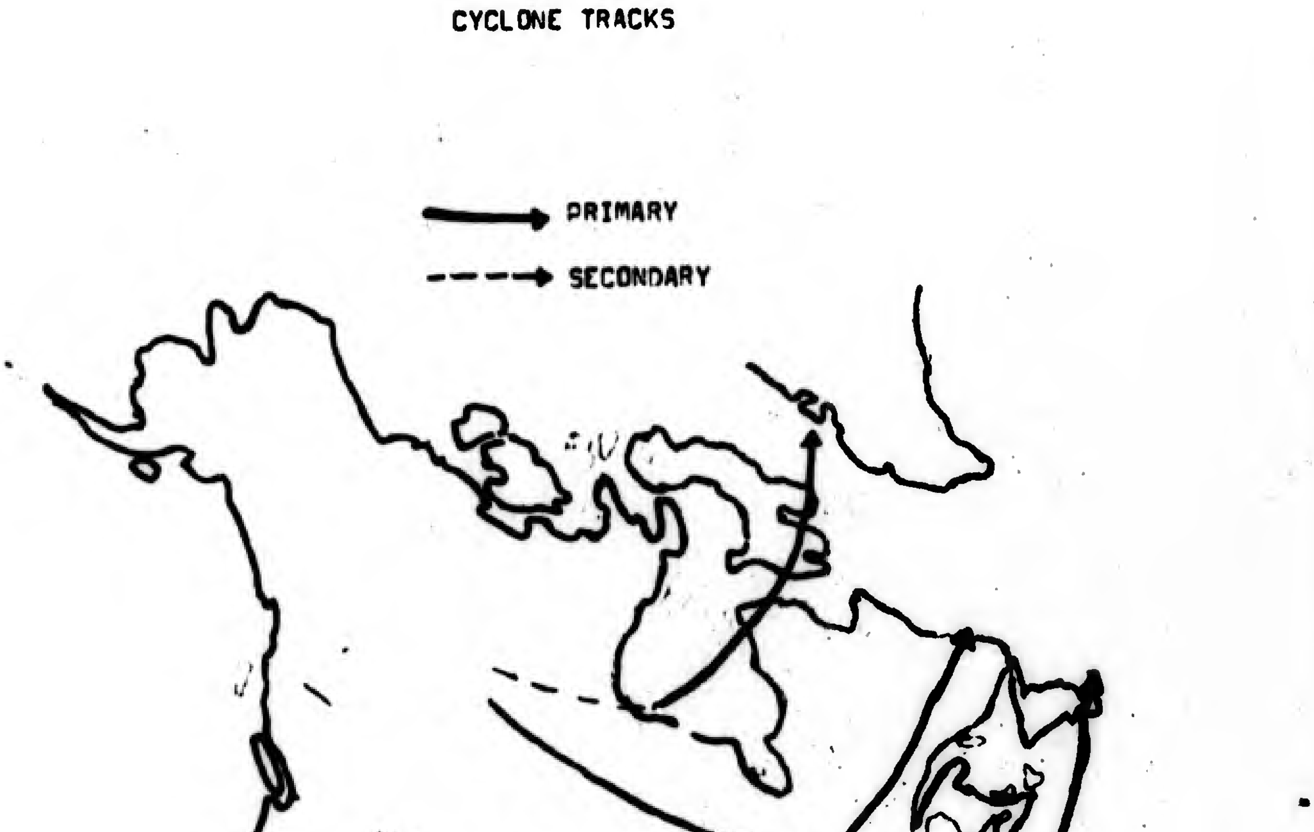
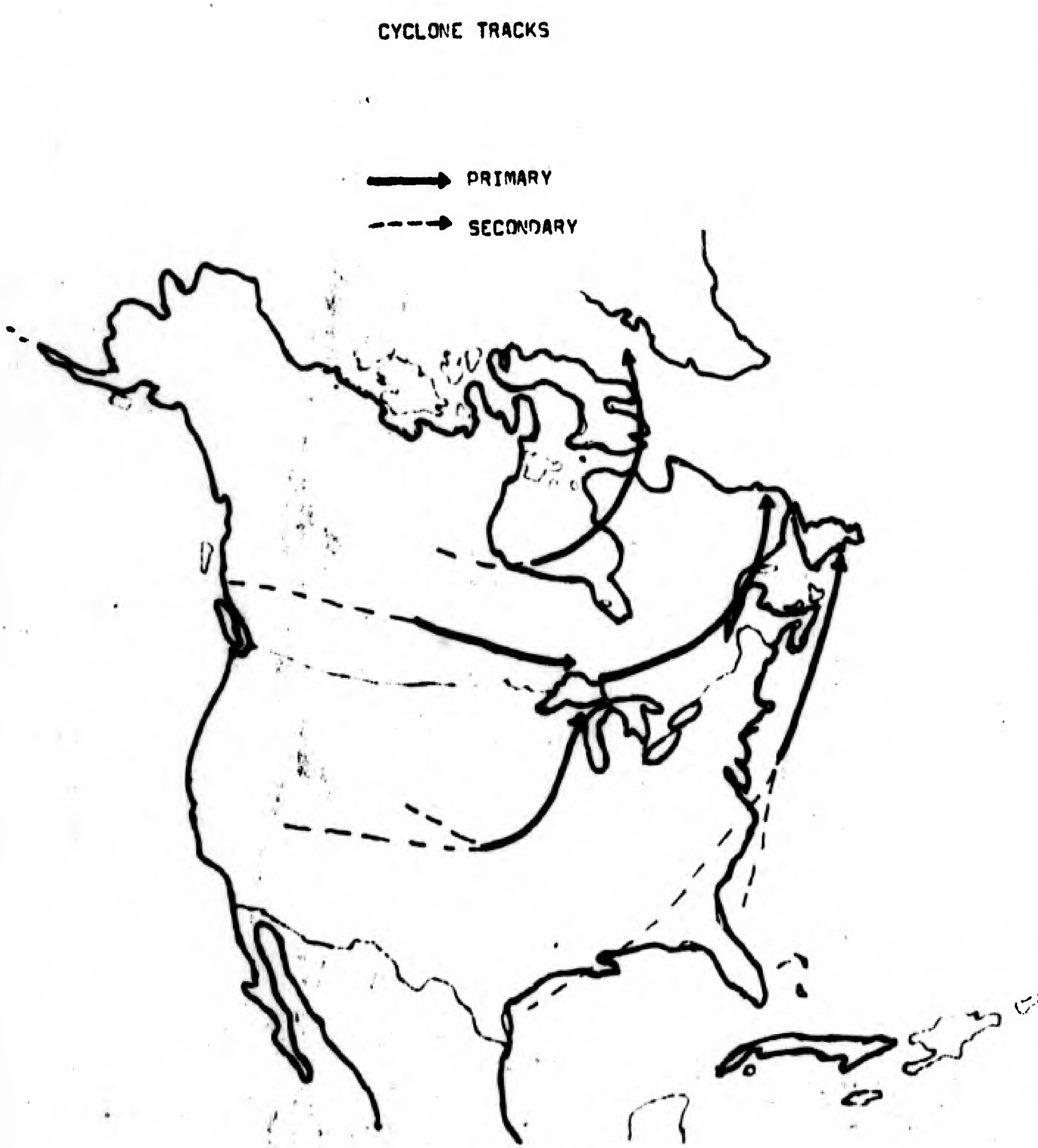



Figure 3 - C - 4a




DECEMBER

Figure 3 - C - 4b

CYCLONE TRACKS


Figure 3 - C - 4c

CYCLONE TRACKS


FEBRUARY

Figure 3 - C - 4d

CYCLONE TRACKS

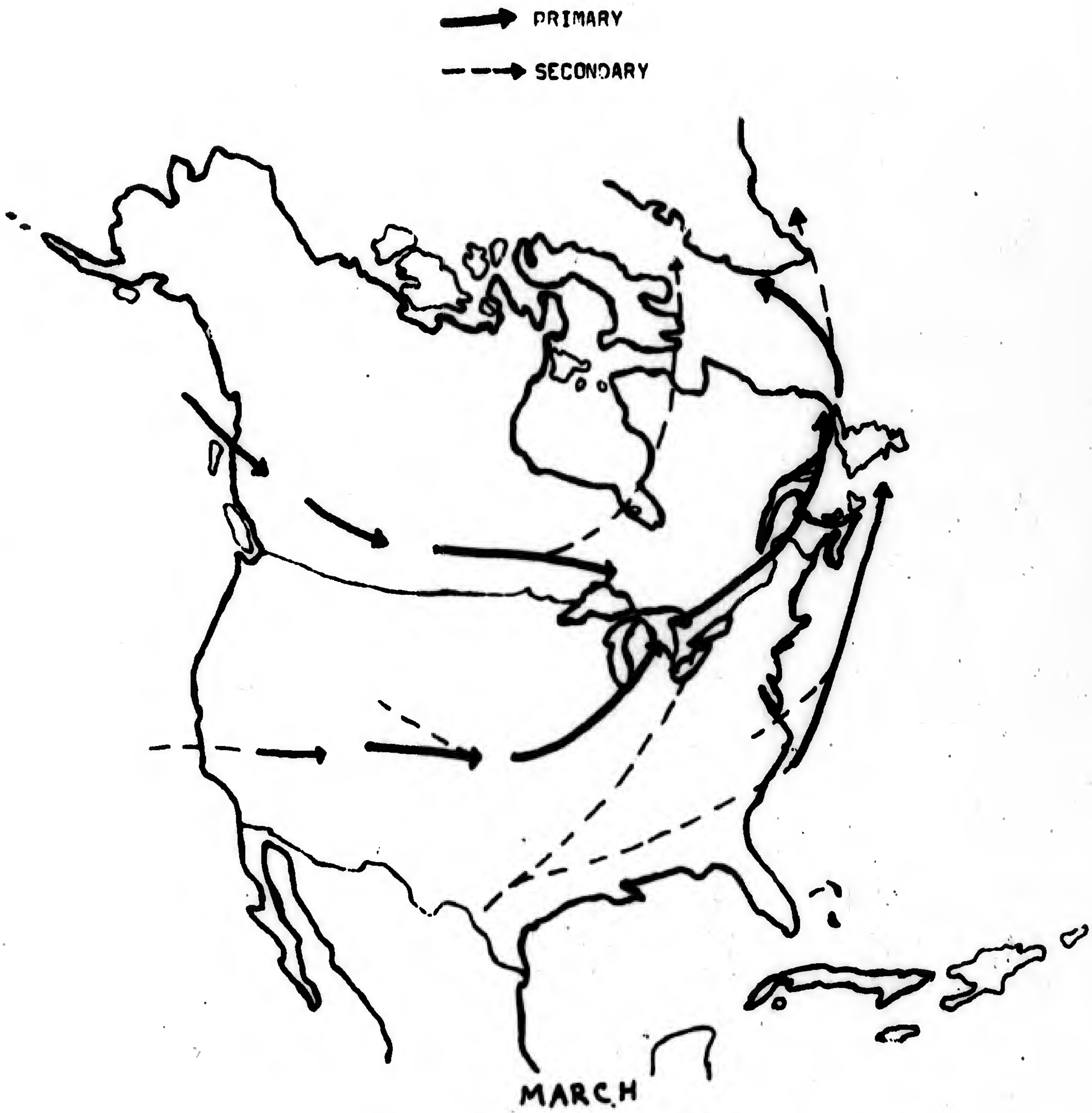



Figure 3 - C - 4e

c. Coastal Storms. Some of the most severe weather that the Northeast experiences is associated with cyclones originating along the Atlantic Coastal region. At times, the cyclogenesis is so rapid that it may transform an apparently insignificant situation into an intense low in less than 24 hours. This cyclogenesis can be generally separated into two types.

(1) Coastals that Develop Along a Cold Front. The upper air characteristics associated with these coastal developments are a long wave trough located over the Eastern United States and ridges along the Pacific Coast and in the Western Atlantic Ocean. The sequence of events starts with a low moving eastward along the Canadian border with an associated surface cold front pushing south and eastward through the United States. As the surface front approaches the coast, the upper level trough deepens, producing near parallel upper level flow to the surface front. This occurrence along with the presence of a pronounced blocking surface anticyclone in the western Atlantic will act to retard a portion of the cold front. This retardation occurs in such a way as to form a wave, that moves in a general northeastward direction. These waves usually develop in the vicinity of Cape Hatteras, but cyclogenesis of this type has occurred from the Gulf of Mexico to New England.

(2) Coastals that Develop to the Southeast of an Older Cyclone. Prior to the formation of this coastal type, the primary cyclone may be located in the lower or mid-Mississippi Valley and be

moving northeastward. The prediction problem is whether the cyclone will continue northeastward down the St. Lawrence River Valley (paragraph 1b) or become stationary or very slow moving, and fill while a secondary storm forms along the Atlantic Coast. Coastal cyclogenesis is favored when there is a stagnant surface high in Canada to the northeast of the primary cyclone, with a sharp upper trough east of the Mississippi River. These coastal lows usually intensify rapidly and move northeastward while the old, now occluded low starts filling rapidly and drifting slowly east to northeast. These coastal types also develop predominantly along the mid-Atlantic Coast, but occasionally cyclogenesis occurs as far north as the Gulf of Maine. This occurs when the primary low, which has been moving rapidly eastward to northeastward, becomes stalled in the St. Lawrence River Valley. The low center appears to jump to the Gulf of Maine, then intensifies as it tracks northeastward into the Maritime Provinces.

When precipitation from coastal lows extends into Maine, it is almost always in the form of snow. Coastal storms have produced six to ten inches of snow at Houlton, Maine (HUL), but only a trace at Loring. The forecasting problem, therefore, is one of accurately predicting the path of the storm. It has been observed that cyclones that move east of Yarmouth, Nova Scotia (QI), do not appreciably affect Loring, while systems that move up the Bay of Fundy to the west of Yarmouth deposit a heavy amount of snow (5 inches or more). The use of extrapolation, the 500 millibar and 700 millibar fow for steering, and analyses of the pressure and the wind field tendencies over New England and the Maritime Provinces are invaluable aids in predicting the future path of these coastal lows. Once a predicted track has been determined as east or west of Yarmouth, a reasonable snow forecast can be made.

2. Instability Phenomena

a. Effects from Old Primary Low. Snow showers may continue for several hours after the steady precipitation from a secondary coastal storm has ended. This occurs in association with instability caused by the old primary low as it drifts slowly eastward through New England. (Paragraph 1c(2).)

b. Cyclonic Circulation. Snow showers are nearly always occurring over northern Maine when cyclonic circulation exists to 700 millibar in association with strong low level cold air advection. Generally with this circulation, daytime stratocumulus clouds with snow showers develop due to heating of the cold unstable air. These snow showers are particularly intense in the more hilly areas to the west and southwest of the base. This cloudiness will usually dissipate at night except under conditions of very strong cyclonic circulation. Usually with strong cyclonic circulation, several minor surface troughs are imbedded in the flow which enhance the instability as these troughs approach Loring.

## Spring Regime

The strong upper level zonal circulation noted during the winter regime continually weakens as the spring transitional season advances. The 500 millibar trough, which normally had been in the vicinity of northeastern Canada and the Great Lakes during the winter, is now displaced to the east of New England. The 500 millibar ridge, which was normally along the Pacific Coast in the winter, is located in the Rocky Mountain region. Instability type precipitation becomes more important during the spring regime and snow becomes rare after the first of May (Diagram G.)

1. Synoptic Patterns Producing Precipitation

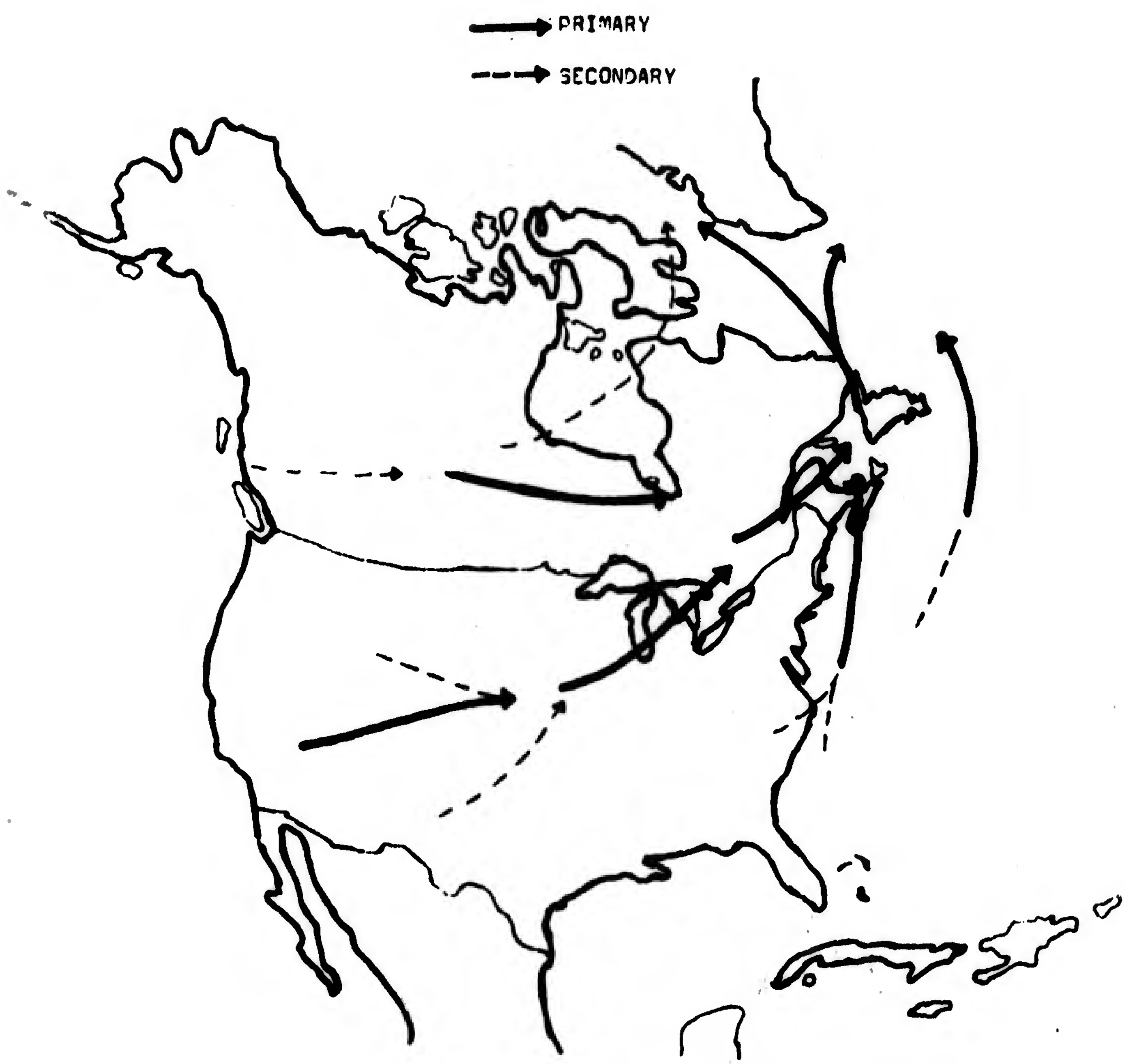
a. Cyclonic Systems. The principal tracks of cyclones during the spring season are very similar to those of the winter season. (Figures 9, 10 and 11.) Lows approaching Loring from along the Canadian border, from the plains of the south central United States, and from the Middle Atlantic coast, as discussed in the Winter Regime, are important precipitation producers during the early part of the spring. However, as this transitional season progresses, the frequency and intensity of coastal and plains cyclones decrease considerably and the storm track along the Canadian board recedes northward into central Canada. Therefore, by the end of May, most of the precipitation occurs in the form of showers that are produced by the trailing cold fronts from the lows moving through central Canada.

CYCLONE TRACKS


APRIL

**Figure 3 - C - 8a**

CYCLONE TRACKS




MAY

Figure 3 - C - 8b

CYCLONE TRACKS


JUNE

Figure 3 - C - 8c

b. Wave Activity on Fronts. Common to spring is the condition of prolonged cloudiness with intermittent light rain or showers. This is indicated by the secondary maximum of cloudiness noted in mid-spring on diagram A. This prolonged unsettledness is usually caused by successive wave activity along a quasi-stationary front situated through central New England or just off the New England coast.

(1) East-West Oriented Front. This unsettled weather situation occurs with high zonal index. The upper level flow over northeastern United States is from a general westerly direction and remains unchanged for an extended period. The main features on the surface are a large high pressure system in eastern Canada and a quasistationary front oriented east-west through central or southern New England. Successive waves on the front produce light precipitation in a band several hundred miles to the north of the front with cloudiness maintained between waves by the continued low level easterly flow. Clearing weather will develop if the upper level flow becomes northwesterly pushing the front southward, or if the surface high in Canada is displaced.

(2) North-South Oriented Front. This situation develops with a blocking ridge in the western Atlantic and a very pronounced trough near the Atlantic coast. Due to this pronounced trough, a north-south oriented polar front becomes stationary to the east of

New England. Successive wave activity is the source of the precipitation. This stagnant pattern breaks down when the block relaxes or when the frontal trough weakens.

2. Instability Phenomena. Besides the showery conditions produced by frontal activity, light daytime showers can occur due to the influx of unstable cold air. The air becomes more unstable with the increased daytime surface heating, and stratocumulus clouds, cumulus clouds, and possible showers develop which usually dissipate at night. A good indication of the formation of this phenomena is the presence of cold air advection at the 850 millibar level.

Summer Regime

The zonal circulation during the summer season is relatively weak as the stronger westerlies are displaced northward. At 500 millibars, the normal springtime eastern trough and Rock Mountain ridge are displaced some $10^{o}$ to the east during the summer, and a weak trough is evident along the Pacific coast of the United States.

1. Synoptic Patterns Producing Precipitation. Most of the principal storm tracks during the summer season are displaced well north of Loring. (Figures 11, 12, and 13.) Therefore, the precipitation that occurs is mainly convective activity produced by the passage of cold fronts. Also, air mass thunderstorms and showers can be quite vigorous after several days of moist southerly flow. They are especially severe in the more hilly terrain to the west

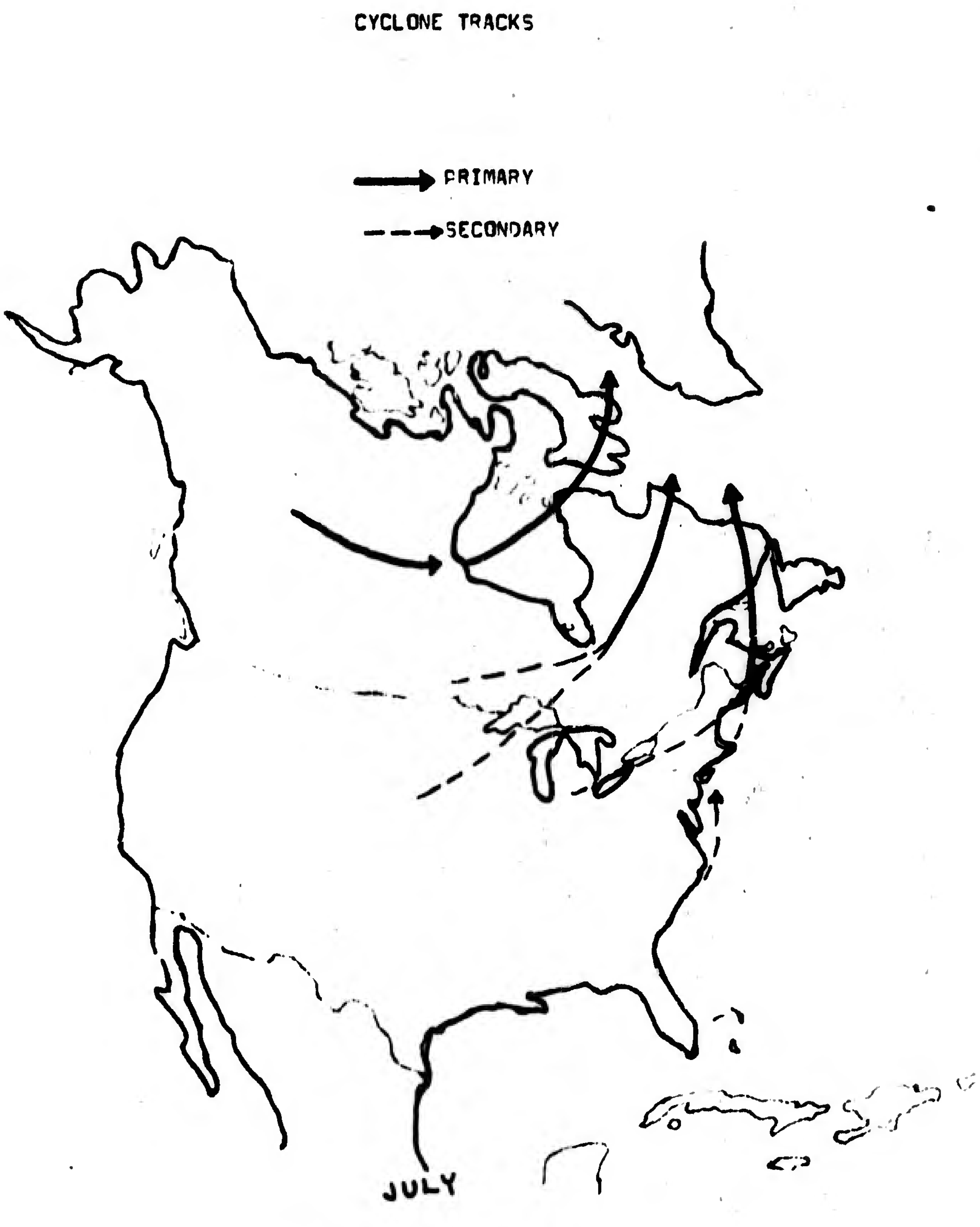



Figure 3 - C - 10a

CYCLONE TRACKS


AUGUST

Figure 3 - C - 10b

and southwest of Loring due to the orographic lifting. This maximum of convective activity is indicated by the maximum percent of thunderstorm days during July noted in Diagram B.

a. Frontal Systems. As frontal systems move onto the North Pacific coast, the question arises as to whether the front will be oriented east-west or north-south when it reaches northern Maine. Fronts that take on an east-west orientation are usually associated with minor upper level troughs. The large scale upper level flow is characterized by weak zonal flow across the United States with a pronounced long wave trough in the eastern Pacific. At sea level, an anticyclone is located over Hudson Bay and a low over the Gulf of Alaska. Successive cyclones stream into the northwest United States from the Gulf of Alaska, preventing any significant southward displacement of the polar front. However, almost all east-west oriented fronts will pass the Loring area. The lows then move rapidly through central Canada. This general pattern may be changed by upper level deepening over the eastern United States, resulting in a shift to a north-south oriented front.

Cold fronts that move into the north central United States are likely to pass through Maine with a northeast-southwest orientation.

Cold fronts will likely come into Maine from the west (north-south orientation) when a major upper level trough is associated with the front.

b. Cyclonic Systems. Continuous precipitation in Northern Maine usually results from coastal waves or Canadian lows.

(1) Coastal Waves. Waves that form on cold fronts along the mid-Atlantic coast may move northward to produce steady rain at Loring. The less pronounced upper troughs and the weaker thermal fields produce relatively minor disturbances in the summer as compared to the intense coastal waves in the winter.

(2) Canadian Lows. Occasionally an active warm front forms through central or northern New England in association with a low moving eastward across Canada. With a warm front to the southwest of Loring, more or less steady rain will occur until the front passes.

2. Fog and Stratus. Fog and stratus become more frequent during the summer at Loring, (Diagram B), as a southerly wind direction becomes predominant (Diagram C). Upslope or advection fog will usually occur at night after two or more days of southeasterly flow, which funnels moisture northward from the Gulf of Maine. The gradual upslope in terrain from the Atlantic Ocean to Loring is ideal for the formation of this fog type. Prolonged southeasterly flow will usually be generated by a quasistationary anticyclone over Nova Scotia or Newfoundland, or a slow moving low to the southwest of Loring. A characteristic of upslope and advection fog is that it may persist in relatively strong winds.

When moisture is available, radiation fog can occur during clear nights with light winds. Such fog usually forms over the low-lying marsh around the base and may drift over the runway.

## Fall Regime

The overall circulation increases as the fall season advances. At 500 millibars, the normal summer east coast trough is displaced westward to the Great Lakes, and a fairly pronounced ridge exists over the Pacific states. The normal sea level chart shows significant lows over the Aleutians and Iceland.

1. Synoptic Patterns Producing Precipitation. Showers become less frequent during this transitional regime as more active frontal waves start to become the main source of precipitation. The east-west oriented front that moves southward into Maine becomes less frequent (see Summer Regime). During the early part of fall, the principal storm tracks, as depicted in figures 14, 15, and 4, are still well north of Maine. In November, however, the Canadian border lows, the South Central United States lows, and the coastal lows, as discussed in the Winter Regime, begin to affect Northern Maine. Snow becomes a possibility by the end of September, but substantial snowfall is not likely until November. (See Diagrams B and G.)

Fog. Radiation fog becomes most frequent and intense in the fall, especially during the month of November (Diagram B.) The development

CYCLONE TRACKS


SEPTEMBER

Figure 3 - C - 13a

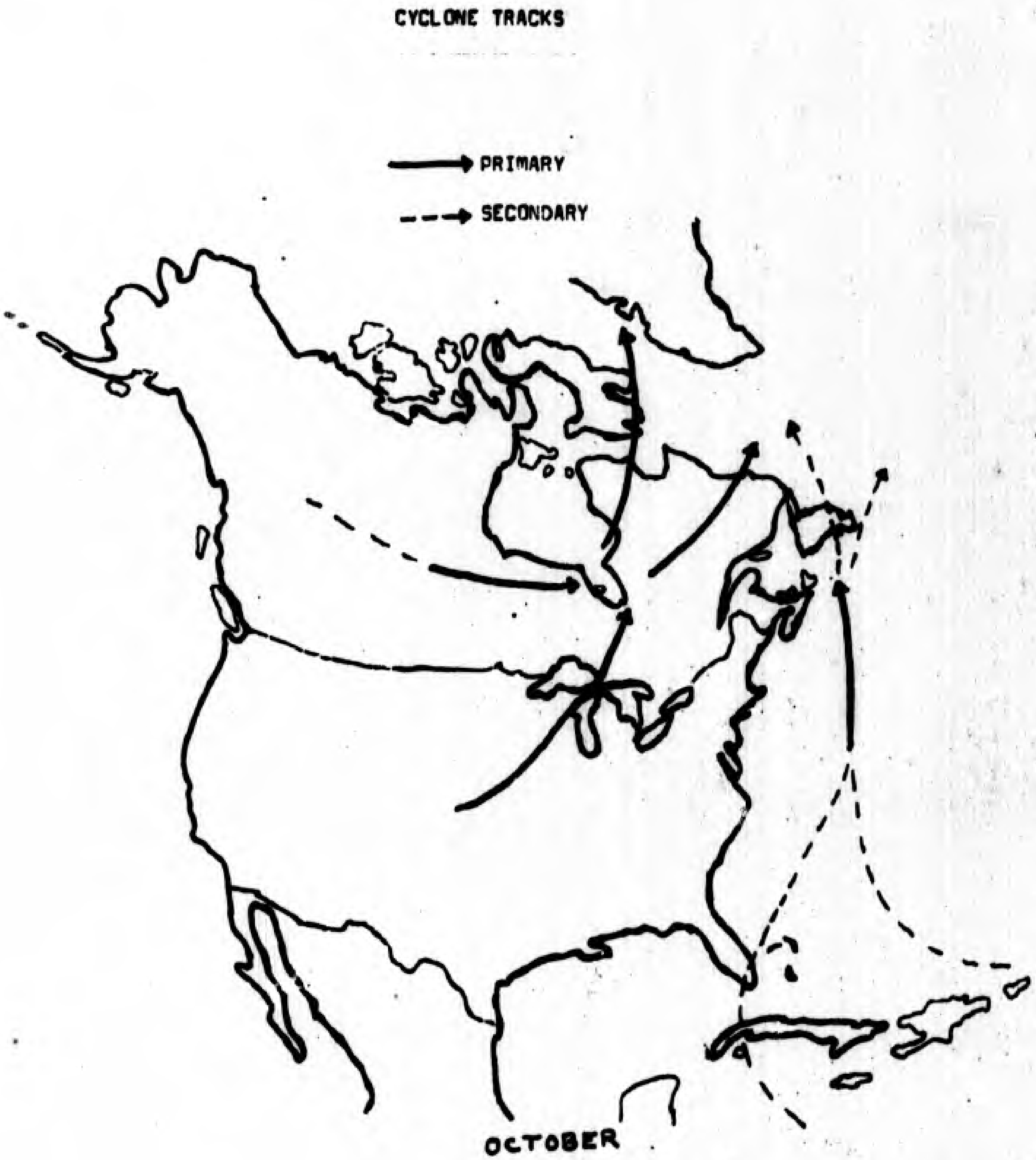



Figure 3 - C - 13b

of this fog type is favored by damp ground and moist air near the ground, clear skies, and light winds. Radiation fog forms readily during a clear quiet night which has been preceded by an overcast day or by an early evening shower. Once fog has occurred in Maritime Tropical air, it will usually recur each night until there is a change in air mass. As mentioned in the Summer Regime, the most intense radiation fog forms over the adjoining low lying marshes, and may drift over the Base. This fog type usually dissipates rapidly (1-3 hours) after sunrise, but on an occasion it may lift to a low stratus deck before dissipating.

See Summer Regime for a discussion of upslope and advection fog.

# SECTION D

# SPECIAL PHENOMENA AND REFERENCES

SPECIAL PHENOMENA AND REFERENCES

None

# PART 4

SECTION A

RULES OF THUMB

## RULES OF THUMB

WIND.

1. The 2000 foot wind on the Caribou RAOB is a good indication of the maximum surface gusts that can be expected.

2. If a strong temperature inversion exists in the lower levels, strong, gusting surface winds are not likely. (Does not work in winter)

3. Except under periods of intense gradient during the winter, surface winds rarely gust above 15 knots between 00Z and 12Z.

PRECIPITATION.

1. Amounts of snowfall that can be expected with storms:

   a. System from South . . . . . . . . average 6-8"

   b. System from West . . . . . . . . average 1-4"

   c. System from Northwest . . . . . less than 2"

2. If the jetstream is south of Maine a storm will rarely cross north of the jet to affect Loring.

RAIN vs. SNOW.

The following thickness rules are a good indication of the type of precipitation that may be expected at Loring:

| | |
|---|---|
| a. Snow if | 1000-500mb thickness 5340m.<br>1000-700mb thickness 2800m. |
| b. Rain if | 1000-500mb thickness 5460m.<br>1000-700mb thickness 2870m. |
| c. Mixed or freezing if | 1000-500mb thickness 5340 to 5460m.<br>1000-700mb thickness 2800 to 2870m. |

FRONTS.

1. Warm fronts infrequently pass Loring.

2. Frontal systems approaching Loring from the West or Northwest often slow down considerably after passing east of the St. Lawrence River. In the summer, the deceleration frequently leads to rapid dissipation of thunderstorms within an hour after sunset.

CEILINGS.

After two hours of continuous precipitation ceilings will be 1000 feet or less.

FOG.

1. Advection fog will form at Loring if there is a prolonged (2 days or more) southerly flow of moist air and if there is a surface based temperature and dewpoint inversion.

2. When warm frontal fog is present at sunrise any marked improvement in visibility is unlikely before 1000 LST.

3. Frequently ground fog is observed in the surrounding area but not on the field at Loring.

SECTION B

FORECAST STUDIES

SECTION Z

FRUITLESS FILE

Security Classification

## DOCUMENT CONTROL DATA - R&D

*(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)*

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3. REPORT TITLE

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| N/A | Hq Air Weather Service (MAC)<br>Scott AFB, Illinois 62225 |

13. ABSTRACT

A reference file for forecasters containing a description of the local area, climatology, discussion of weather regimes, rules of thumb and forecast studies.

DD FORM 1 JAN 64 1473

UNCLASSIFIED

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| 14. KEY WORDS | LINK A | | LINK B | | LINK C | |
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