Daily Series SYNOPTIC WEATHER MAPS Part I

HISTORICAL BACKGROUND

The modern series of historical sea-level weather maps for the Northern Hemisphere begins with January 1899 and extends through June 1957. Upper-air maps of the 500-millibar pressure surface were added beginning with the month of December 1944 and extending through June 1957.

A special series of sea-level and 500-millibar maps was prepared for the period July 1957 through December 1958 in connection with the International Geophysical Year. The analyses were based on checked data on microcards prepared by the World Meteorological Organization as a primary data source, and were coordinated with similar maps for the remainder of the world. Together, they result in a set of IGY World Weather Maps. The Northern Hemisphere sea-level and 500-millibar maps were published for this period under the title of "International Geophysical Year World Weather Maps, Part I, Northern Hemisphere."

Data tabulations were added to the synoptic map series beginning with the October 1945 issue. Except for two gaps, November and December 1945, and January 1954 through June 1955, these monthly data listings are complete and are available in published form through December 1963 and in the form of microfilm beginning with data for January 1964.

Beginning with January 1961, the 500-millibar charts were prepared from computer-analyzed charts produced at the National Meteorological Center, except for a few of the earlier issues for which machine-analyzed charts were not available. During the months of January through April 1961, isotherms were not included on the machine-analyzed charts, so they were added by reference to observations and comparisons with other hand-drawn charts.

INTRODUCTION

This series of Northern Hemisphere Weather Maps, beginning with January 1959, is similar to the series which begins with maps for January 1949[1], and is produced by the Environmental Science Service Administration. Each volume consists of Northern Hemisphere maps for one month, there being one sea-level map and one 500-millibar map for each day at 1200 GMT.*

Data tabulations of the following are also available: synoptic surface reports for 1200 GMT for selected stations; radiosonde and rawinsonde reports for 0000 GMT and 1200 GMT for North America (WMO Region IV), the Atlantic and Pacific Ocean weather stations, and for stations outside Region IV for which data are available, including Greenland and the North Pacific Ocean; radiosonde and rawinsonde reports for 0000 GMT for the remainder of the Northern Hemisphere; and upper wind reports for 0000, 0600, 1200 and 1800 GMT for Canada and a few additional stations.[2]

SEA LEVEL MAPS

DATA

The sea-level maps in this series were prepared from data observed at or near 1200 GMT providing continuity with other series of Northern Hemisphere Weather Maps that have already been completed, or that are in the process of being completed.

Synoptic reports were plotted from every available source: special forms, listings, or punched cards furnished for this publication by cooperating National Meteorological Services; data and charts published by those Services; punched cards prepared by selected stations in the United States, and for the ocean weather stations; weather logs of commercial ships; and collections of radio and teletypewriter reports from all available areas of the Northern Hemisphere.

An abbreviated International Plotting Code model is used in plotting the maps. The positions of the elements in relation to the land and ship station circles have been printed on each map. More complete synoptic reports of the stations plotted may be found in Part II, and a description of the elements plotted and/or listed may be found in the WMO publication No. 9, TP. 4, Volume B in effect at the time of the observations.

ANALYSIS

In the analysis of the Northern Hemisphere sea-level charts, all frontal structures with well-established histories were retained until the data showed that frontolysis had taken place. In those cases, frontolysis has been shown and the front has been dropped from the maps. Every effort has been made to carry all major frontal systems. Minor fronts were carried on the maps only when the data indicated that a minor front did exist and the resulting weather was significant. Every effort was made to distinguish between a cold front and a polar trough, both over land and over water. Great care was exercised to include all frontal boundaries causing significant weather. However, it is physically beyond the scope of these charts, presented in 24-hour intervals, to indicate in detail each secondary or swiftly redeveloped frontal system whose inception, growth, and full development may easily have taken place in the interval between maps. Representation of these features must necessarily be shown, in some cases, as merely an indication of what took place in the interim. These indications have been considered a major part of the analysis and have been represented in the most feasible fashion in accordance with the particular situation being analyzed.

Analyses of the sea-level (and upper-air) charts were aided by careful study of weather maps published by various National Meteorological Services, and by study of intermediate charts prepared by the Weather Bureau's National Meteorological Center. The original observation forms of the weather reporting ships at sea, in addition to transocean flight reports, were available and were used by the analysis unit as an aid to continuity.

Analyses in tropical areas are necessarily incomplete. In areas of few or no data a reasonable isobaric pattern has been carried for completeness in lieu of entering the mean position of the Intertropical Convergence Zone for that particular time of year. Whenever available data made it possible to determine the position of the zone of convergence, that position was entered.

Easterly waves, westerly troughs, and shear lines were entered only when the data definitely supported these phenomena and intermediate charts confirmed them.

Instability or squall-lines were entered on the charts when the associated weather warranted them and after close study of 6-hourly intermediate charts, when available.

In areas of relatively sparse data, the sequence of weather reports was carefully studied to obtain the best possible solution. The analysts preparing this series of charts have had considerable experience in Northern Hemisphere analysis and in maintaining continuity in areas of sparse data coverage. With minor exceptions, in areas of few data, every attempt was made to check the data and the many sources of data for accuracy and representativeness and then to analyze accordingly, with established mean patterns used only as a control factor.

500-MILLIBAR MAPS

DATA

The large amount of data available for these maps permitted a more detailed analysis than had been possible on maps in the early years of the series. All of the major circulation systems were shown together with a large percentage of the lesser systems which could be logically identified on consecutive maps.

ANALYSIS

The computer-produced 500-millibar charts from the National Meteorological Center have been objectively analyzed using Cressman's (1959)[4] successive-approximation technique which is based on a method developed by Bergthórsson and Döös (1955)[3]. In this analysis technique a given first approximation field is adjusted to fit the observations.

The first approximation (or "guess") for the 500-millibar analysis is a function of (a) the 12-hour forecast based on the previous 0000GMT data, and (b) the analyses at the lower constant-pressure surfaces which are completed prior to the 500-millibar analysis. The use of the forecast maintains time-continuity of the major systems, and the use of the lower-level analyzed parameters maintains vertical consistency. This "first-guess" field consists of point values at regular intervals on the base map.

The observations are used to adjust the gridpoint values of the "guess" field. The amount of the adjustment depends upon the distance from gridpoint to observation, the departure of the observed value from the "guess" value, the number of observations in the vicinity of the gridpoint, etc. The analysis is refined by several iterations through the "guess" field, so that the field is gradually brought to a satisfactory fit with the observations. The data are tested for errors during the analysis process, and the monitoring analyst decides whether to discard those data which failed the tests and inserts information to correct errors.

Later refinements were made to each machine-analyzed chart before publication to eliminate detectable errors in analysis, and to smooth and adjust isolines which were found to be inconsistent with the corresponding sea level charts. Comparisons were also made with other hand-drawn 500-millibar charts, and inconsistencies resolved. These adjustments were made a sufficiently long time after the map date to allow the use of late reports, when deemed advisable, and for close coordination with the sea-level charts which, themselves, were analyzed after receipt of the greatest possible number of reports.

Height contours were drawn as solid lines at intervals of 200 feet from the beginning of the series through June 1957, at intervals of 80 meters from July 1957 through December 1960, and at intervals of 200 feet from January 1961 on. Isotherms at 5° C. intervals were drawn as single dashed lines.

1. (a) U. S. Weather Bureau. Daily Synoptic Series Historical Weather Maps, Northern Hemisphere Sea Level, January 1899 to June 1939, inclusive.
   (b) U. S. Weather Bureau. Daily Series Synoptic Weather Maps, Northern Hemisphere Sea Level Charts, July 1939 to November 1944, inclusive.
   (c) U. S. Weather Bureau. Daily Series Synoptic Weather Maps, Northern Hemisphere Sea Level and 500-Millibar Charts, December 1944 to September 1945, inclusive.
   (d) Headquarters, Air Weather Service, AAF. Northern Hemisphere Historical Weather Maps, Sea Level and 500-Millibars, October 1945 to December 1948, inclusive.
   (e) U. S. Weather Bureau. Daily Series Synoptic Weather Maps, Northern Hemisphere Sea Level and 500-Millibar Charts, January 1949 to June 1957, inclusive.
   (f) U. S. Weather Bureau. IGY World Weather Maps, Part I, Northern Hemisphere, Sea Level and 500-Millibar Charts, July 1957 to December 1958, inclusive.
   (g) U. S. Weather Bureau. Daily Series Synoptic Weather Maps, Part I, Northern Hemisphere Sea Level and 500-Millibar Charts, January 1959 to January 1960, inclusive.
   (h) Environmental Science Services Administration. Daily Series Synoptic Weather Maps, Northern Hemisphere Sea Level and 500-Millibar Charts, February 1960, et seq.
2. (a) U. S. Weather Bureau. Daily Series Synoptic Weather Maps, Part II, Northern Hemisphere Data Tabulations, July 1955 to September 1964, inclusive.
   (b) Environmental Science Services Administration. Daily Series Synoptic Weather Maps, Northern Hemisphere Sea Level and 500-Millibar Charts, October 1964, et seq.
3. Bergthórsson, P., and B. Döös, 1955: Numerical Weather Map Analysis, Tellus, Vol. 7, pp 329-340.
4. Cressman, G. P., 1959: An Operational Objective Analysis System, Monthly Weather Review, Vol. 87, pp 367-374.

* Beginning with the maps for April 1, 1957, all observations are 1200 GMT except those for stations operated by Canada and the United States. Time of these observations changes from 1230 GMT for sea-level and 1500 GMT for 500-millibars, to 1200 GMT for both levels on June 1, 1957, unless otherwise indicated.

LIST OF SYMBOLS USED ON MAPS

SEA-LEVEL MAPS

- COLD FRONT -- SURFACE
- COLD FRONT ALOFT
- WARM FRONT -- SURFACE
- WARM FRONT ALOFT
- QUASI-STATIONARY FRONT -- SURFACE
- OCCLUDED FRONT -- SURFACE
- OCCLUDED FRONT ALOFT
- FRONTOGENESIS, RESULTING IN THE FORMATION OF A COLD FRONT AT THE SURFACE
- FRONTOGENESIS, RESULTING IN THE FORMATION OF A WARM FRONT AT THE SURFACE

SEA-LEVEL MAPS

- FRONTOGENESIS, RESULTING IN THE FORMATION OF A QUASI-STATIONARY FRONT AT THE SURFACE
- COLD FRONT AT THE SURFACE, UNDERGOING FRONTOLYSIS
- WARM FRONT AT THE SURFACE, UNDERGOING FRONTOLYSIS
- QUASI-STATIONARY FRONT AT THE SURFACE, UNDERGOING FRONTOLYSIS
- OCCLUDED FRONT AT THE SURFACE, UNDERGOING FRONTOLYSIS
- INSTABILITY LINE (NON-FRONTAL LINE ALONG WHICH SQUALLS OR OTHER EVIDENCES OF MARKED INSTABILITY EXIST)
- TROUGH LINE
- INTERTROPICAL CONVERGENCE ZONE

500-MILLIBAR MAPS

- HEIGHT CONTOUR
- ISOTHERM
- 1--2 KNOT WIND
- 3--7 KNOT WIND
- 10 KNOT WIND
- 55 KNOT WIND