Appendix B Explanation and Decoding of the Daily Weather Map

GEODe ▶ Introduction to the Atmosphere
▶ In the Lab: Reading Weather Maps

Weather maps showing the development and movement of weather systems are among the most important tools used by the meterologist. Some maps portray conditions near the surface of Earth and others depict conditions at various heights in the atmosphere. Some cover the entire Northern Hemisphere and others cover only local areas as required for special purposes.

Principal Surface Weather Map

To prepare the surface map and present the information quickly and pictorially, two actions are necessary: (1) Weather observers and automated observing stations must send data to the offices where the maps are prepared; (2) the information must be quickly transcribed to the maps. In order for the necessary speed and economy of space and transmission time to be realized, codes have been devised for sending the information and for plotting it on the maps.

Codes and Map Plotting

A great deal of information is contained in a brief coded weather message. If each item were named and described in plain language, a very lengthy message would be required, one confusing to read and difficult to transfer to a map. A code permits the message to be condensed to a few five-figure numeral groups, each figure of which has a meaning, depending on its position in the message. People trained in the use of the code can read the message as easily as plain language (see **Figure B.1**).

The location of the reporting station is printed on the map as a small circle (the station circle). A definite arrangement of the data around the station circle, called the *station model,* is used. When the report is plotted in these fixed positions around the station circle on the weather map, many code figures are transcribed exactly as sent. Entries in the station model that are not made in code figures or actual values found in the message are usually in the form of symbols that graphically represent the element concerned. In some cases, certain of the data may or may not be reported by the observer, depending on local weather conditions. Precipitation and clouds are examples. In such cases, the absence of an entry on the map is interpreted as nonoccurrence or nonobservance of the phenomena. The letter *M* is entered where data are normally observed but not received.

Both the code and the station model are based on international agreements. These standardized numerals and symbols enable a meteorologist of one country to use the weather reports and weather maps of another country even though that person does not understand the language. Weather codes are, in effect, an international language that permits complete interchange and use of worldwide weather reports so essential in present-day activities.

The boundary between two different air masses is called a *front.* Important changes in weather, temperature, wind direction, and clouds often occur with the passage of a front. Half circles or triangular symbols or both are placed on the lines representing fronts to indicate the kind of front. The side on which the symbols are placed indicates the direction of frontal movement. The boundary of relatively cold air of polar origin advancing into an area occupied by warmer air, often of tropical origin, is called a *cold front.* The boundary of relatively warm air advancing into an area occupied by colder air is called a *warm front.* The line along which a cold front has overtaken a warm front at the ground is called an *occluded front.* A boundary between two air masses, which shows at the time of observation little tendency to advance into either the warm or cold areas, is called a *stationary front.* Air-mass boundaries are known as *surface fronts* when they intersect the ground and as *upper-air fronts* when they do not. Surface fronts are drawn in solid black; fronts aloft are drawn in outline only. Front symbols are given in **Table B.1**.

A front that is disappearing or weak and decreasing in intensity is labeled *frontolysis.* A front that is forming is labeled *frontogenesis.* A *squall line* is a line of thunderstorms or squalls usually accompanied by heavy showers and shifting winds (Table B.1).

The paths followed by individual disturbances are called *storm tracks* and are shown by arrows (Table B.1). A symbol (a box containing an X) indicates past positions of a low-pressure center at six-hour intervals. HIGH (H) and LOW (L) indicate the centers of high and low barometric pressure. Solid lines are isobars and connect points of equal sea-level barometric pressure. The spacing and orientation of these lines on weather maps are indications of speed and direction of windflow. In general, wind direction is parallel to these lines with low pressure to the left of an observer looking downwind. Speed is directly proportional to the closeness of the lines (called *pressure gradient*). Isobars are labeled in millibars.

Isotherms are lines connecting points of equal temperature. Two isotherms are frequently drawn on large surface weather maps when applicable. The freezing, or 32°F, isotherm is drawn as a dashed line, and the 0°F isotherm is drawn as a dash–dot line (Table B.1). Areas where precipitation is occurring at the time of observation are shaded.

Auxiliary Maps

500-Millibar Map

Contour lines, isotherms, and wind arrows are shown on the 500-millibar contour level. Solid lines are drawn to show height above sea level and are labeled in feet. Dashed lines are drawn at 5° intervals of temperature and are labeled in degrees Celsius. True wind direction is shown by "arrows" that are plotted as flying with the wind. The wind speed is shown by flags and feathers. Each flag represents 50 knots, each full feather represents 10 knots, and each half feather represents 5 knots.

FIGURE B.1 Explanation of Station Symbols and Map Entries

Symbol station model

N	Total cloud cover—Table E
dd	Wind direction
ff	Wind speed in knots or mi/hr—Table F
VV	Visibility in miles
ww	Present weather—Table G
W	Past weather—Table G
PPP	Barometric pressure reduced to sea level (add an initial 9 or 10 and place a decimal point to the left of last number)
TT	Current air temperature in °F
N_h	Fraction of sky covered by low or middle clouds—Table E (ranges from 0 for no clouds to 9 for sky obscured)
C_L	Low clouds or clouds with vertical development—Table C

Sample report

h	Height in feet of the base of the lowest clouds—Table D
C_M	Middle clouds—Table C
C_H	High clouds—Table C
T_dT_d	Dew point temperature in °F
a	Pressure tendency—Table A
pp	Pressure change in mb in preceding 3 hrs(+28 = +2.8)
RR	Amount of precipitation in last 6 hr
R_t	Time precipitation began or ended (0 = none; 1= <1 hr ago; 2 = 1–2 hr ago; 3 = 2–3 hr ago; 4 = 3–4 hr ago; 5 = 4–5 hr ago; 6 = 5–6 hr ago; 7 = 6–12 hr ago; 8 = >12 hr ago; 9 = unknown)

TABLE B.1 Weather Map Symbols

Symbol	Explanation
	Cold front (surface)
	Warm front (surface)
	Occluded front (surface)
	Stationary front (surface)
	Dryline
	Squall line
	Path of low-pressure center
⊠	Location of low pressure at 6-hour intervals
	32° F isotherm
	0° F isotherm

Temperature Map (Highest and Lowest)

Temperature data are entered from selected weather stations in the United States. The figure entered above the station dot shows the maximum temperature for the 12-hour period ending 7:00 P.M. EST of the previous day. The figure entered below the station dot shows the minimum temperature during the 12 hours ending at 7:00 A.M. EST. The letter *M* denotes missing data.

Precipitation Map

Precipitation data are entered from selected weather stations in the United States. When precipitation has occurred at any of these stations in the 24-hour period ending at 7:00 A.M. EST, the total amount, in inches and hundredths, is entered above the station dot. When the figures for total precipitation have been compiled from incomplete data and entered on the map, the amount is underlined. *T* indicates a trace of precipitation (less than 0.01 inch) and the letter *M* denotes missing data. The geographical areas where precipitation has fallen during the 24 hours ending at 7:00 A.M. EST are shaded. Dashed lines show depth of snow on ground in inches as of 7:00 A.M. EST.

TABLE A Air Pressure Tendency

Rising, then falling; same as or higher than 3 hr ago		
Rising, then steady; or rising, then rising more slowly	Barometric pressure now higher than 3 hours ago	
Rising steadily, or unsteadily		
Falling or steady, then rising; or rising, then rising more rapidly		
Steady; same as 3 hr ago		
Falling, then rising; same as or lower than 3 hr ago		
Falling, then steady; or falling, then falling more slowly	Barometric pressure now lower than 3 hours ago	
Falling steadily, or unsteadily		
Steady or rising, then falling; or falling, then falling more rapidly		

TABLE B Cloud Abbreviations

St	stratus
Fra	fractus
Sc	stratocumulus
Ns	nimbostratus
As	altostratus
Ac	altocumulus
Ci	cirrus
Cs	cirrostratus
Cc	cirrocumulus
Cu	cumulus
Cb	cumulonimbus

TABLE C Cloud Types

Low Clouds and Clouds of Vertical Development

- Cu of fair weather, little vertical development and seemingly flattened
- Cu of considerable development, generally towering, with or without other Cu or Sc, bases all at same level
- Cb with tops lacking clear-cut outlines, but distinctly not cirriform or anvil shaped; with or without Cu, Sc, or St
- Sc formed by spreading out of Cu; Cu often present also
- Sc not formed by spreading out of Cu
- St or StFra, but no StFra of bad weather
- StFra and/or CuFra of bad weather (scud)
- Cu and Sc (not formed by spreading out of Cu) with bases at different levels
- Cb having a clearly fibrous (cirriform) top, often anvil shaped, with or without Cu, Sc, St, or scud

Middle Clouds

- Thin As (most of cloud layer semitransparent)
- Thick As, greater part sufficiently dense to hide Sun (or Moon), or Ns
- Thin Ac, mostly semitransparent; cloud elements not changing much and at a single level
- Thin Ac in patches; cloud elements continually changing and/or occurring at more than one level
- Thin Ac in bands or in a layer gradually spreading over sky and usually thickening as a whole
- Ac formed by the spreading out of Cu or Cb
- Double-layered Ac, or a thick layer of Ac, not increasing; or Ac with As and/or Ns
- Ac in the form of Cu-shaped tufts or Ac with turrets
- Ac of a chaotic sky, usually at different levels; patches of dense Ci usually present also

High Clouds

- Filaments of Ci, or "mares' tails," scattered and not increasing
- Dense Ci in patches or twisted sheaves, usually not increasing, sometimes like remains of Cb; or towers or tufts
- Dense Ci, often anvil shaped, derived from or associated with Cb
- Ci, often hook shaped, gradually spreading over the sky and usually thickening as a whole
- Ci and Cs, often in converging bands, or Cs alone; generally overspreading and growing denser; the continuous layer not reaching 45° altitude
- Ci and Cs, often in converging bands, or Cs alone; generally overspreading and growing denser; the continuous layer exceeding 45° altitude
- Veil of Cs covering the entire sky
- Cs not increasing and not covering entire sky
- Cc alone or Cc with some Ci or Cs, but the Cc being the main cirriform cloud

TABLE D Height of Base of Lowest Cloud

Code	Feet	Meters
0	0–149	0–49
1	150–299	50–99
2	300–599	100–199
3	600–999	200–299
4	1000–1999	300–599
5	2000–3499	600–999
6	3500–4999	1000–1499
7	5000–6499	1500–1999
8	6500–7999	2000–2499
9	8000 or above or no clouds	2500 or above or no clouds

TABLE E Cloud Cover

	No clouds
	One-tenth or less
	Two-tenths or three-tenths
	Four-tenths
	Five-tenths
	Six-tenths
	Seven-tenths or eight-tenths
	Nine-tenths or overcast with openings
	Completely overcast (ten-tenths)
	Sky obscured

TABLE F Wind Speed

	Miles per hour	Knots	Kilometers per hour
	calm	calm	calm
	1–2	1–2	1–3
	3–8	3–7	3–13
	9–14	8–12	14–19
	15–20	8–12	14–19
	21–25	18–22	14–19
	26–31	23–27	41–50
	32–37	28–32	51–60
	38–43	33–37	61–69
	44–49	38–42	70–79
	50–54	43–47	80–87
	55–60	48–52	88–96
	61–66	53–57	97–106
	67–71	58–62	107–114
	72–77	63–67	115–124
	78–83	68–72	125–134
	84–89	73–77	135–143
	119–123	103–107	192–198

TABLE G Weather Conditions

Cloud development NOT observed or NOT observable during past hour	Clouds generally dissolving or becoming less developed during past hour	State of sky on the whole unchanged during past hour	Clouds generally forming or developing during past hour	Visibility reduced by smoke
Light fog (mist)	Patches of shallow fog at station, NOT deeper than 6 feet on land	More or less continuous shallow fog at station, NOT deeper than 6 feet on land	Lightning visible, no thunder heard	Precipitation within sight, but NOT reaching the ground
Drizzle (NOT freezing) or snow grains (NOT falling as showers) during past hour, but NOT at time of observation	Rain (NOT freezing and NOT falling as showers) during past hour, but NOT at time of observation	Snow (NOT falling as showers) during past hour, but NOT at time of observation	Rain and snow or ice pellets (NOT falling as showers) during past hour, but NOT at time of observation	Freezing drizzle or freezing rain (NOT falling as showers) during past hour, but NOT at time of observation
Slight or moderate dust storm or sandstorm has decreased during past hour	Slight or moderate dust storm or sandstorm, no appreciable change during past hour	Slight or moderate dust storm or sandstorm has begun or increased during past hour	Severe dust storm or sandstorm, has decreased during past hour	Severe dust storm or sandstorm, no appreciable change during past hour
Fog or ice fog at distance at time of observation, but NOT at station during past hour	Fog or ice fog in patches	Fog or ice fog, sky discernible, has become thinner during past hour	Fog or ice fog, sky NOT discernible, has become thinner during past hour	Fog or ice fog, sky discernible, no appreciable change during past hour
Intermittent drizzle (NOT freezing), slight at time of observation	Continuous drizzle (NOT freezing), slight at time of observation	Intermittent drizzle (NOT freezing), moderate at time of observation	Continuous drizzle (NOT freezing), moderate at time of observation	Intermittent drizzle (NOT freezing), heavy at time of observation
Intermittent rain (NOT freezing), slight at time of observation	Continuous rain (NOT freezing), slight at time of observation	Intermittent rain (NOT freezing), moderate at time of observation	Continuous rain (NOT freezing), moderate at time of observation	Intermittent rain (NOT freezing), heavy at time of observation
Intermittent fall of snowflakes, slight at time of observation	Continuous fall of snowflakes, slight at time of observation	Intermittent fall of snowflakes, moderate at time of observation	Continuous fall of snowflakes, moderate at time of observation	Intermittent fall of snowflakes, heavy at time of observation
Slight rain shower(s)	Moderate or heavy rain shower(s)	Violent rain shower(s)	Slight shower(s) of rain and snow mixed	Moderate or heavy shower(s) of rain and snow mixed
Moderate or heavy shower(s) of hail, with or without rain, or rain and snow mixed, not associated with thunder	Slight rain at time of observation; thunderstorm during past hour, but NOT at time of observation	Moderate or heavy rain at time of observation; thunderstorm during past hour, but NOT at time of observation	Slight snow, or rain and snow mixed, or hail at time of observation; thunderstorm during past hour, but NOT at time of observation	Moderate or heavy snow, or rain and snow mixed, or hail at time of observation; thunderstorm during past hour, but NOT at time of observation

(Continued)

TABLE G Continued

 Haze	 Widespread dust in suspension in the air, NOT raised by wind, at time of observation	 Dust or sand raised by wind at time of observation	 Well developed dust whirl(s) within past hour	 Dust storm or sandstorm within sight of or at station during past hour
 Precipitation within sight, reaching the ground but distant from station	 Precipitation within sight, reaching the ground, near to but NOT at station	 Thunderstorm, but no precipitation at the station	 Squall(s) within sight during past hour or at time of observation	 Funnel cloud(s) within sight of station at time of observation
 Showers of rain during past hour, but NOT at time of observation	 Showers of snow, or of rain and snow, during past hour, but NOT at time of observation	 Showers of hail, or of hail and rain, during past hour, but NOT at time of observation	 Fog during past hour, but NOT at time of observation	 Thunderstorm (with or without precipitation) during past hour, but NOT at time of observation
 Severe dust storm or sandstorm has begun or increased during past hour	 Slight or moderate drifting snow, generally low (less than 6 ft)	 Heavy drifting snow, generally low	 Slight or moderate blowing snow, generally high (more than 6 ft)	 Heavy blowing snow, generally high
 Fog or ice fog, sky NOT discernible, no appreciable change during past hour	 Fog or ice fog, sky discernible, has begun or become thicker during past hour	 Fog or ice fog, sky NOT discernible, has begun or become thicker during past hour	 Fog depositing rime, sky discernible	 Fog depositing rime, sky NOT discernible
 Continuous drizzle (NOT freezing), heavy at time of observation	 Slight freezing drizzle	 Moderate or heavy freezing drizzle	 Drizzle and rain, slight	 Drizzle and rain, moderate or heavy
 Continuous rain (NOT freezing), heavy at time of observation	 Slight freezing rain	 Moderate or heavy freezing rain	 Rain or drizzle and snow, slight	 Rain or drizzle and snow, moderate or heavy
 Continuous fall of snowflakes, heavy at time of observation	Ice prisms (with or without fog)	Snow grains (with or without fog)	Isolated starlike snow crystals (with or without fog)	 Ice pellets or snow pellets
Slight snow shower(s)	Moderate or heavy snow shower(s)	Slight shower(s) of snow pellets, or ice pellets with or without rain, or rain and snow mixed	Moderate or heavy shower(s) of snow pellets, or ice pellets, or ice pellets with or without rain or rain and snow mixed	Slight shower(s) of hail, with or without rain or rain and snow mixed, not associated with thunder
Slight or moderate thunderstorm without hail, but with rain, and/or snow at time of observation	Slight or moderate thunderstorm, with hail at time of observation	Heavy thundestorm, without hail, but with rain and/or snow at time of observation	Thunderstorm combined with dust storm or sandstorm at time of observation	Heavy thunderstorm with hail at time of observation