

# ON THE USE OF CLOUD SYMBOLOLOGY IN MODERN FORECASTING

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## Abstract

*Cloud symbology have appeared on surface analyses for decades, but lately they seem to go unused by large portions of the meteorological community. While qualitative in nature, these data can still provide a wealth of information about the vertical thermodynamic structure of the atmosphere above a station when actual measurements are unavailable. A brief case study is provided utilizing the symbology, followed by an argument for the revitalization of cloud symbology usage.*

## 1. Introduction

With the rate of expansion in meteorological technology and the need to quantify observed elements such as temperature, dew point, and pressure, among others, data of a more qualitative nature is often neglected. Such appears to be the case with cloud genera (type) symbols (Fig. 1) on surface weather charts.

The fate of their appearance on modern surface analyses would seem to be subtly uncertain. With the advent of satellites and automated surface observing systems which, as yet, cannot make fine distinctions between the 27 reported cloud types, there are fewer people collecting these data regardless of its potential value. Is this information a dusty remnant of an archaic (though more elegant) period in the history of meteorology, or are data on cloud genera still relevant and useful? We shall demonstrate that cloud genera can yield valuable clues to the vertical thermodynamic structure of the atmosphere.

## 2. The Status Quo

Cloud genera are still observed and reported every three hours in synoptic and surface airways observations. The dominant genera in the high, middle, and low étages are reported in coded form at 0000, 0300, 0600 UTC, etc. While the National Centers for Environmental Prediction (NCEP) still use cloud genera symbols on their surface analyses, and software packages such as GEMPAK also have such abilities, the characters are largely ignored. Indeed, the majority of meteorologists queried by the first author on this topic corroborates this neglect. That may be why the coded cloud group is being discontinued in the new METAR surface report format beginning in mid 1996.

Perhaps the rationale for their disregard is that the information they supply is only qualitative. It is possible that the use of cloud genera to infer the state of the atmosphere above a station is considered too inexact. A more *practical* reason could be the fact that the cloud symbols on NCEP analyses did not often survive the facsimile transmission process with enough clarity to be of use. The resolution of the NMC analyses, however, have improved markedly as of late. Lastly, it has been suggested that those teaching synoptic meteorology no longer emphasize cloud symbol interpretation in their classes.

As a result, modern students of meteorology may be unaware of the symbology and how to use it effectively.

Yet, cloud genera data can provide a wealth of information regarding the status of the atmosphere over a given location. Brooks (1951) noted that cloud observations can be used to supplement more direct, quantitative data which is not always available. While it should not be used solely (just as is the case with any information source), cloud genera can augment other information, such as sounding data. When utilized with other sources of data, knowledge of cloud genera can aid meteorologists in deducing the vertical nature of the atmosphere when direct measurements are unavailable, due either to temporal (e.g., in between sounding times) and/or spatial (e.g., location not close to rawinsonde site) concerns.

## 3. An Example

A series of surface plots were examined for a typical summer day in the Midwestern United States. Figures 2a-d depict 3-hourly surface analyses at 1200, 1500, 1800, and 2100 UTC on 19 August 1994. Starting with 1200 UTC, a weak trough was present at 500 mb (not shown) over Minnesota and Iowa. An associated surface cold front was also present at this time. Two stations exhibited changes in cloud genera that were strongly indicative of the changes in the atmosphere aloft.

Observations at Spencer (3SE) in northwest Iowa displayed the most profound change. At 1200 UTC, altocumulus (Ac) were observed in the middle étage, the result of spreading cumulus (Cu), likely from below. If we interpret the symbol strictly, then this was indicative of a stable layer above the level of Ac formation, which was capable of suppressing early morning (0700 LDT) convection. Figure 3 is a skew-T log P diagram for St. Cloud, MN (STC) at 1200 UTC 19 August 1994. Clearly the atmosphere is conditionally unstable from about 840 mb through at least 550 mb. Within that layer, however, is a very shallow locally stable layer near the level of the Ac at 3SE at the same time. A similar structure was present over Omaha, NE (OAX; not shown) at approximately the same height. STC, OAX, and 3SE are all approximately the same distance from, and along a line parallel to, the cold frontal zone, with 3SE nearly equidistant from STC and OAX. Thus, representative soundings do support the possibility of stable layers in the mid-troposphere, capable of inhibiting Cu growth. It is assumed, though, that the Ac formed as a result of spreading Cu at 3SE was likely the result of a deeper, more pronounced stable layer. Nonetheless, this is just the sort of information we would hope to infer from cloud symbology.

By 1500 UTC, the Ac remained while the dew point at 3SE increased to 70 °F from 63 °F just three hours earlier. However, no low étage clouds were observed, and with veering winds it appeared that 3SE was *in* the frontal zone. To the west and north, behind the surface trough, northwest winds of 5.0–7.5 m s<sup>-1</sup> (10.0–15.0 kt) were observed. The 1800 and 2100 UTC




























	$C_L$	Clouds $C_M$	$C_H$
0	No Sc, St, Cu, or Cb clouds.	No Ac, As, or Ns clouds.	No Ci, Cc, or Cs clouds.
1	 Ragged Cu, other than bad weather, or Cu with little vertical development and seemingly flattened, or both.	 As, the greatest part of which is semi-transparent through which the sun or moon may be faintly seen as through ground glass.	 Filaments, strands or hooks of Ci, not increasing.
2	 Cu of considerable development, generally towering with or without other Cu or Sc; bases at same level.	 As, the greatest part of which is sufficiently dense to hide the sun or moon, or Ns.	 Dense Ci in patches or twisted sheaves, usually not increasing or Ci with towers resembling cumuliform tufts.
3	 Cb with tops lacking clear-cut outlines, but distinctly not cirriform or anvil-shaped: Cu, Sc, or St may be present.	 Thin Ac, mostly semitransparent: other than crenelated or in cumuliform tufts; cloud elements change but slowly with bases at same level.	 Ci, often anvil-shaped, derived from or associated with Cb.
4	 Sc formed by spreading out of Cu; Cu may also be present.	 Patches of semitransparent Ac that are at one or more levels; cloud elements are continuously changing.	 Ci, hook-shaped and/or filaments, spreading over the sky and generally becoming dense as a whole.
5	 Sc not formed by spreading out of Cu.	 Semitransparent Ac in bands, or Ac in one more or less continuous layer gradually spreading over sky and usually thickening as a whole; the layer may be opaque or a double sheet.	 Ci, often in converging bands, and Cs or Cs alone but increasing and growing denser as a whole; the continuous veil not exceeding 45° above the horizon.
6	 St in a more or less continuous layer and/or ragged shreds, but no Fs of bad weather.	 Ac formed by the spreading out of Cu.	 Ci, often in converging bands, and Cs, or Cs alone, but increasing and growing denser as a whole; the continuous veil exceeds 45° above the horizon but sky not totally covered.
7	 Fs and/or Fc of bad weather (scud) usually under As and Ns.	 Double-layered Ac or an opaque layer of Ac, not increasing over the sky; or Ac coexisting with As or Ns or with both.	 Veil of Cs completely covering the sky.
8	 Cu and Sc (not formed by spreading out of Cu); base of Cu at a different level than base of Sc.	 Ac with sprouts in the form of small towers or battlements, or Ac having the appearance of cumuliform tufts.	 Cs not increasing and not completely covering the sky.
9	 Cb having a clearly fibrous (cirriform) top, often anvil-shaped, with or without Cu, Sc, St, or scud.	 Ac generally at several layers in a chaotic sky, dense Ci is usually present.	 Cc alone, or Cc accompanied by Ci and/or Cs, but Cc is the predominant cirriform cloud.

Fig. 1. Cloud genera symbols plotted on surface weather maps. Column one is the low étage (St, Sc, Cu, Cb); column two is the middle étage (Ac, As, Ns); column three is the high étage (Ci, Cc, Cs) (After Djurić 1994).

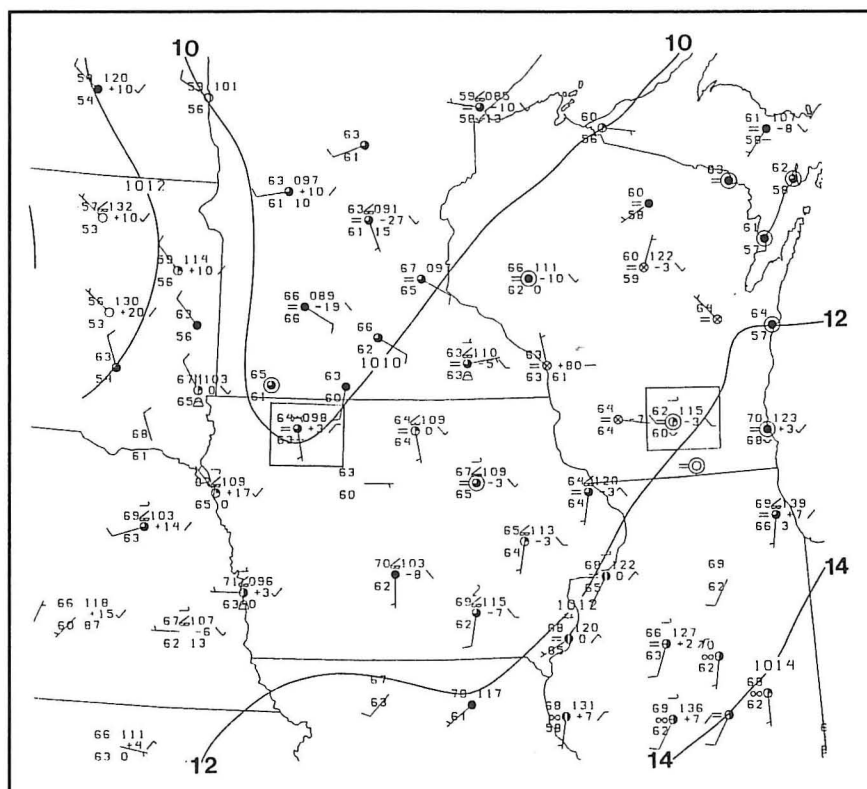


Fig. 2a. Surface analyses for 1200 UTC 19 August 1994. Station model follows standard notation. Temperature and dew point are in  $^{\circ}\text{F}$ , sea-level pressure in mb, pressure tendency in  $0.1 \text{ mb } (3 \text{ h})^{-1}$ . Wind speed in knots. Six-hour precipitation values appear to the lower right of the station circle (hundredths of an inch). Solid lines are isobars (mb). Boxed stations are Spencer, IA (3SE) and Madison, WI (MSN).

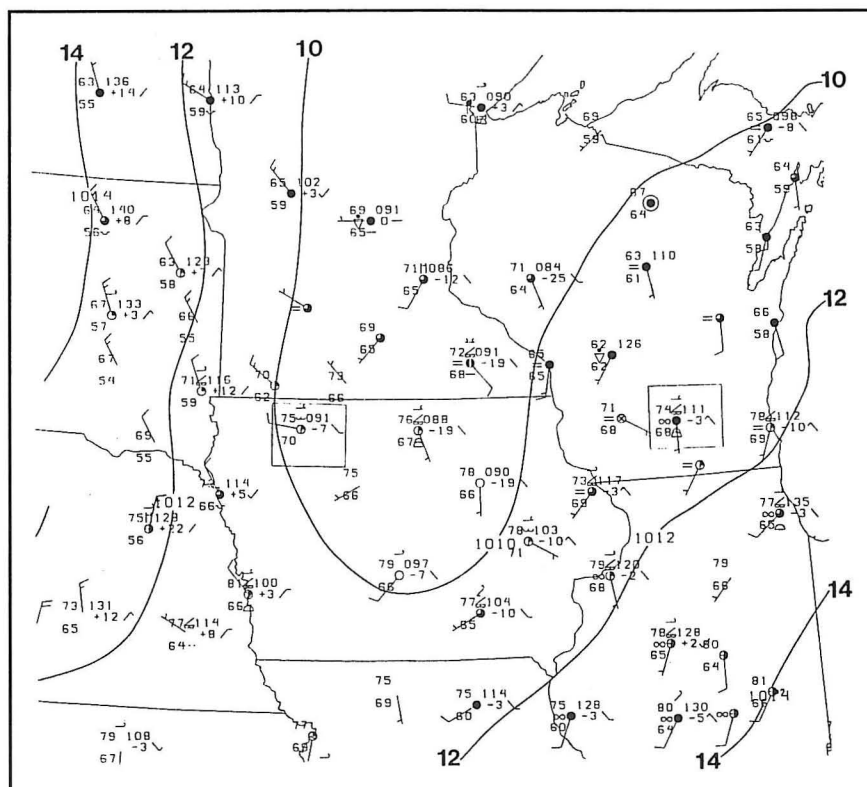


Fig. 2b. As in Fig. 2a, except for 1500 UTC.



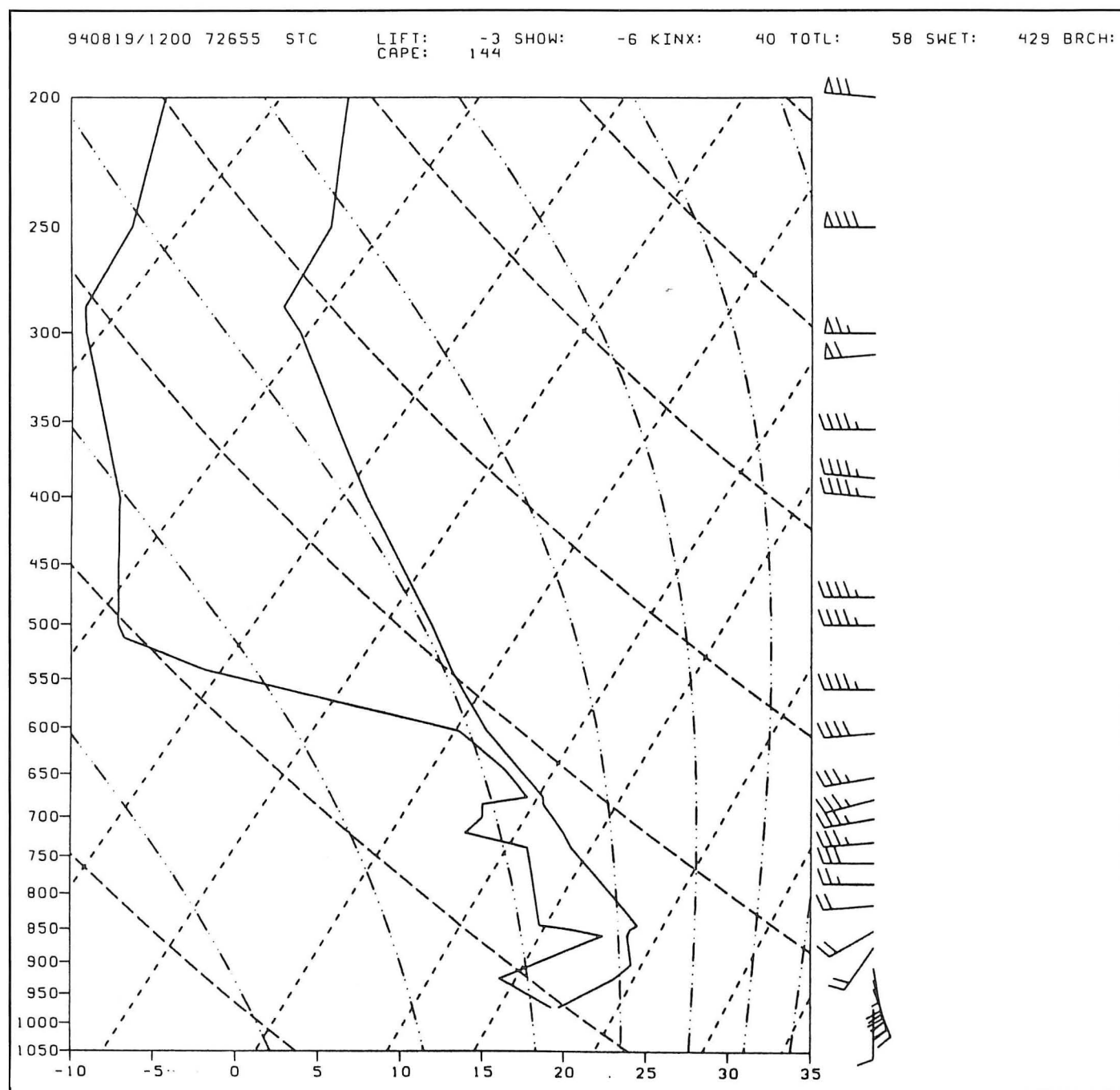


Fig. 3. Skew-T log p diagram for St. Cloud, MN (STC) at 1200 UTC 19 August 1994. Temperature and dew point reported in °C, winds reported in kt.

maps indicate that significant convection did not occur at 3SE later that day.

Meanwhile, Madison (MSN) in southern Wisconsin was reporting interesting cloud changes as well. At 1200 UTC the lower troposphere was marginally stable, as evidenced by observations of stratocumulus (Sc) in the low étage. Three hours later, the stability in the low layer was eroded, as shown by the observation of cumulonimbus (Cb) without clear-cut tops. Significant Ac had appeared in mid-levels, and may have been mixed with altostratus (As) and nimbostratus (Ns). Clearly, moisture was present in the middle layers, which could potentially minimize dry air entrainment into subsequent convection and reduce its severity. Showers were occurring to the northwest of MSN, and by 1800 UTC a trace of rain had fallen at the station. The surface pressure continued to fall with time, but more importantly, the sky condition remained unchanged. The lower troposphere was still unstable, as confirmed by the continued observation of Cb, and the middle levels were still moist.

Numerous stations to the west of MSN reported altocumulus castellanus (Accas), indicating that the middle troposphere was becoming unstable just ahead of the front at 1200 UTC. At 2100 UTC, MSN was pre-frontal and a thunderstorm was in progress at the station.

#### 4. Looking to the Future

What is to become of cloud genera data? If indeed this information goes unused, then perhaps it should be eliminated from the observation and reporting routine. The authors believe, however, that such an action (as is slated to occur with METAR implementation in the United States in July 1996) would be a mistake. On the contrary, there should be a concerted effort to supplement satellite imagery and other data with careful interpretations of what cloud genera data convey. J. T. Moore (1995, personal communication) observed that cloud symbols can be a useful agent when utilized in conjunction with other meteorological data, especially for single-station forecasting. This opinion mirrors that of Brooks (1951), who wrote "... if we do not use the cloud portion of the weather picture, we are depriving ourselves of this considerable advantage in analyzing the weather situation and in following current trends."

These map symbols can aid forecasters in interpreting the state of the atmosphere aloft; that was the original intention of these data. Moreover, there have been suggestions of using cloud genera in applications from short-term mesoscale forecasting to climatological studies. With regard to the former, any aid to the operational forecaster when dealing with rapidly changing meteorological conditions should be considered, especially when it can be applied readily and has spatial and temporal resolutions superior to the current rawinsonde network. It has been suggested that cloud symbology could possibly be applied to a mesoscale forecasting decision tree. Regardless, with the advent of improved observational technology (e.g., GOES-8, WSR-88D, wind profilers, etc.), such symbology no longer seems to be of use; cloud genera data appears too vague

and imprecise. This is not to say that information gained from less rigorous origins is no longer effective in the operational environment; a prime example is the "magic chart," a combination of 12-hour 700 mb net vertical displacement and 12-hour prognosis of 850 mb temperature (see Chaston 1989), used to predict snowfall amounts. It may be highly empirical in nature, but its success makes it a useful tool, so its explicitly non-mathematical basis is conveniently overlooked.

Cloud symbology tells us the types of cloud formations present over a given surface observation station. Many of these formations can also imply something about the thermodynamic condition of the atmosphere aloft (e.g., stable/unstable layers, depth/degree of instability, etc.). While the information provided should not be used alone to determine the vertical structure of the atmosphere, it is certainly a significant supplement. To this end, basic cloud genera data deserve another chance and should not be allowed to become extinct.

#### Acknowledgments

The authors wish to thank Drs. James T. Moore and Charles E. Graves, Mr. Sean M. Nolan, and Ms. Ann K. McCarthy for their assistance and support in the preparation of this manuscript. In addition, the authors would like to express their appreciation to Dr. Richard P. McNulty and Mr. Paul J. Hebert for their careful review of this manuscript, which resulted in a stronger, more clarified end product. Special thanks to Dr. David J. Crossley for his aid in the publication of this manuscript. This work was supported by the Department of Earth and Atmospheric Sciences at Saint Louis University.

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