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ESTIMATING THE HEIGHT OF CIRRIFORM CLOUDS

William C. France
WSFO Pittsburgh, Pa.

Stone (1) showed that estimates of the height of cirriform cloud bases made without the aid of radiosonde, pilot reports, or radar capable of detecting cirrus clouds can be grossly in error. In comparing ground observer estimates and U.S. Air Force aircraft reports, he found the former 9,600 feet (2.9 km) low, on the average. The International Cloud Atlas (2) lists the approximate height range of cirriform clouds to be 16,500 to 45,000 feet (5.0-13.7 km) in temperate regions. The values are lower for polar regions, and higher for tropical regions. The Stone report references a study by Clodman who showed seasonable differences in aircraft reports of cirrus heights. Between 35°N and 40°N over the U.S., he found a maximum occurrence of winter cirrus near 30,000 feet (9.1 km) and summer cirrus near 35,000 feet (10.7 km).

Temperature is a more realistic indicator than altitude for the likelihood of ice crystals in clouds. According to Best (3) ice crystal clouds (cirriform) normally occur at heights where the temperature is below about -20°C. At temperatures warmer than about -15°C, clouds are unlikely to consist wholly of ice crystals. Project Wiback (4), based on a small data sample, substantiates a maximum frequency of cirrus bases in the -20°C to -25°C range. Although experiments show ice crystal formation at much wider range of temperature (5), they do not seem to refute the value of -20°C, or colder, for maximum likelihood of cirriform bases. A height within the temperature range of -20°C to -25°C will give a better estimate of the altitude of cirrus than any standard height independent of temperature. For example, with a warm ridge and 500 mb temperatures around -8°C, it should be evident that cirrus clouds would be almost impossible at the 18,000-foot (5.5 km) level and very unlikely as low as 20,000 feet (6.0 km). Conversely a 500 mb temperature around -30°C would suggest cirriform cloud possibility at 18,000 feet (5.5 km) or even lower. Temperatures are favorable for cirrus at lower heights when the tropopause is lowest. The tropopause is known to dip unusually low above cold arctic surface highs and is found to the north of the polar jet stream. Higher cirrus occurs south of the jet stream.

Upper-air temperatures available from facsimile charts and teletype data should be referred to in estimating cirrus heights. It is well to remember, however, that a single sounding is merely an instantaneous picture at one location of a dynamic condition that has probably since changed. Better results may be obtained by using the closest sounding in conjunction with other upper-air data, and short-range predictions to allow for the changes occurring in time and space. Automated Predictions of upper-air temperatures are transmitted on teletype Service A with a message heading of WBC FD1/2/3 (winds and temperature aloft forecast).

The procedure of estimating the base of cirrus cloud heights within the range of the height of the -20°C to -25°C temperature should provide a good estimate when pilot reports or other indications, such as the temperature dew point spread, are not available. In the near future, perhaps satellite-derived temperature information will be routinely available to observers to assist in determining the height of cirrus cloud tops. This, of course, would also help to establish the upper limit of the height of the cloud base.

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