Correlation of the Density of New Snow With 700 MB Temperature

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CORRELATION OF DENSITY OF NEW SNOW WITH 700 MB TEMPERATURE

by

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In recent correspondence in the Journal of Meteorology by Gold & Powers (1952), it was shown that the type of snow crystal that fell during a storm was related to its estimated temperature of formation.

The density of new snow is probably a function of the size and type of snow crystal. Investigations by Nakaya (1951) and Aufm Kampe (Aufm Kampe et al., 1951) have shown that the type of ice crystal formed is dependent upon the air temperature and degree of supersaturation at the time of formation. Even though the snow crystal may be considerably modified during its descent to the ground, this should affect chiefly the size of the crystal.

According to Nakaya (1951), needles form predominantly above temperatures of -8°C; between -8°C and -20°C, plates and dendrites predominate; and, below -20°C, columns predominate. Needle and column crystals might be expected to pack together more easily than dendrite crystals and higher-density snow might result from snow crystals formed at temperatures above -8°C and below -20°C, while temperatures between -8°C and -20°C would favor a low density snow. Upper air temperatures were available only between 0°C and -15°C for the present study, and the relationships shown are applicable only for this range.

During the winter of 1951-52, the density of new snow was measured at the Central Sierra Snow Laboratory near Donner Summit in the Sierra Nevada at frequent intervals during many snowfalls. The air temperature at both 700 and 500 mb levels has been used to study the relationship between upper air conditions and density of new snow. The upper air temperatures were determined from radiosonde flights made at Oakland, California, which is 150 miles southeast of the Central Sierra Snow Laboratory. The temperatures used in this study were determined immediately prior to or about the same time as that when the density of new snow was being measured.

The air temperatures at the 700 mb level over Oakland have been plotted against the density of new fallen snow at the Central Sierra Snow Laboratory (Fig. 1). Although there is a broad scatter of points, a definite relationship between the two variables is indicated. The correlation coefficient of 0.639 is significant at the 1 percent level. No relationship was found between the 500 mb air temperatures and density of new snow.

The surface air temperatures have been plotted against the density of new snow in Figure 2. The correlation coefficient between the variables is 0.503 which is significant at the 1 percent level. This correlation is probably due to the relationship between the temperatures at the surface and at the 700 mb level, since the surface elevation is 6900 feet, or about 3000 feet below the 700 mb level. Studies on the relationship between the density of new snow and atmospheric phenomena are being continued, and a more extensive report will be presented later.

REFERENCES CITED


Density of new snow related to air temperature

\[ y = 0.122 + 0.0047 \]

\[ r = 0.639 \]

Figure 1
Figure 2

\[ \rho = 0.0038 + 0.0036t \]

\[ r = 0.503 \]

DENSITY OF NEW SNOW RELATED TO AIR TEMPERATURE

\( \rho \), DENSITY OF NEW SNOW (g cm\(^{-3} \))

\( t \), SURFACE AIR TEMPERATURE (°F)

(sfc = 6890 FT.msl)