RADAR OBSERVATION OF SNOW FORMATION

ABSTRACT OF PAPER BY

K. L. S. GUNN and R. H. DOUGLAS

STORMY WEATHER GROUP
McGILL UNIVERSITY
MONTREAL, CANADA

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Stormy Weather Group, McGill University, Montreal

ABSTRACT

The precipitation mechanism responsible for at least two thirds of the snow at the ground in Montreal is studied using the patterns obtained on the height/time display of a fixed vertical beam radar. The snow is formed in compact generating cells aloft which are found to reside on the average in the lower third of a given air mass, or at an average distance of 1,000 ft. above a frontal surface. The generating level for a particular storm can be determined from a comparison of the trail pattern of the snow falling from the generating cells as seen on the radar with that derived from the known upper winds. Similarly, terminal speeds of the falling flakes can be measured from the trail pattern and the upper winds. Measured terminal speeds are found most often to be typical of directly measured aggregate snowflake speeds, and rarely of single crystal speeds. Aggregation at such low temperatures must thus be due to turbulence in the generating cell itself. Theoretical studies of the heat released by growing crystals show that vertical developments of the order of observed cell heights are possible even in the stable air in which the cells are found most often to reside; similarly, velocity gradients which lead to turbulence are to be expected. Actual measurements of the fluctuation in the signal received on a vertical beam radar show measurably greater turbulence in the generating cells than in the region below.

Quite often there may be a dry layer of air at the ground. On these occasions it may take many hours for the snow aloft to saturate the air sufficiently for later snow to reach the ground. At the dry air boundary the evaporating snow cools the air into which it falls, producing vertical downdrafts leading to a pattern of "stalactites" along the lower edge of the snow echo.

A technique to produce plan pictures at any chosen level was described. Early results show that line arrays of generating cells occur at the generating level more often than not, with the orientation of the lines at acute angles of from 15 to 70° to the cell velocity relative to the ground. Pictures in plan of the pattern at the generating level along with wind derived trails, provide a powerful method of short term forecasting of the time and place of arrival of snow at the ground.

The constant altitude plan pictures are currently being used to investigate the snow formation mechanism in the latter part of a storm, which often produces a featureless radar echo, devoid of trail pattern, yet which is responsible for roughly one third of the snow at the ground.

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