

RECENT TRENDS IN IMPROVEMENT OF
WINTER PRECIPITATION MEASUREMENTS

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WALTER T. WILSON

U. S. Weather Bureau, Washington, D.C.

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The purpose of this paper is to assemble and augment some recent ideas on the measurement of winter precipitation. Gerdel, et al (Reference 1) have described the application of a radio-isotope thickness-type gage to measurement of snowpack water equivalent. Practical considerations of field operation include the following points. An optimum degree of collimation of the rays from the radio-active source is necessary. Excessive dispersion would dissipate the signal so that the Geiger counter would receive too little of the energy, and only shallow snow could be measured. Also, with wide dispersion of the rays, the variation of density in the snow profile would cause varying refraction from different strata. Thus the count would be a product of the density profile in addition to the mass of the snow. With concentration of the beam into too narrow a cone, difficulties would arise from the need for maintaining perfect alignment of the source and the Geiger counter — these difficulties coming from unequal settlement of supporting members of the installation, and even temporary deflection from wind at the time of observation. Rigid support of the Geiger counter for heavy shielding against cosmic-ray background, or to prevent deflection from wind, might require a large enough structural member to collect snow which at times might melt and fall onto the underlying pack, and lead to an unnatural accretion at the point of measurement. Examination of data from this type of instrument indicates that it samples no more of the snowpack than a single point in a snow course. The radio-active snow gage, with the radio-transmitting, relay and receiving equipment, is expensive, but has worked satisfactorily at a number of places in California where the Corps of Engineers is using it.

Another method of measuring winter precipitation is by a heated gage. Possible deficiencies of heated gages include the effect of the heating element on the gage catch. Excessive heat, by itself, may lead to evaporation of some of the caught snow, and may cause rising convective currents above the gage and diminish its catch. Also, heated gages, used primarily for remote reporting, usually require a rather large housing which may deflect the air upward as it passes the gage, and reduce the catch, particularly of slowly falling snow flakes. Recent development of a heated gage has been reported by the Bureau of Reclamation.

In a recent paper, Rockney (Reference 2) described the use of photographs of a radar image in combination with data from key precipitation gages to calibrate an isohyetal pattern. There is need for a precipitation gage that includes a digital recorder, to eliminate the costly process of manual chart reduction. Several people are now working on this problem. The greatest obstacle seems to be in the economics of selling enough such gages to pay for their development and manufacture. While remote gages are important, emphasis should be given to good attendance where possible.

Historically, there seems to have been an inordinate amount of attention to instruments themselves, at the expense until recently of too little attention to broader problems, such as appraising the effects of local site and of larger scale orographic parameters. A recent paper by Wilson (Reference 3) indicates that the effects of local exposure are more important than the effects of different kinds of gage. This paper suggests modification of the traditional rules for exposing gages, and relates efficiency of catch to wind speed at the gage site.

It seems important to maintain consistency among all the steps of measuring precipitation: quality and frequency of point measurement, areal sampling density, degree of refinement in processing and analyzing the data, and requirements of the practical applications. Optimum length of record of special networks is a consideration. Economics is another aspect of this problem. For example, a universal gage would be futile. Such a gage would be too costly for widespread areal sampling. A better balanced program is a system of first-order installations incorporated with a larger number of less refined and less costly stations.

The inelegantly named bucket survey is an example of integrating precise data with a wide sampling of other data. There is an increasing trend in the West to use a relatively small number of regular snow courses to define the snowpack density pattern in an area where aerial observations are made of snow depth. Water equivalent is then estimated by applying appropriate density factors to the observed depth. For portrayal of the rainfall intensity-frequency regime over areas lacking recording raingage data, relationships of short-duration intensities to daily data may be derived from nearby first-order stations and applied to daily data in the area of interest. Examples of this and similar techniques appear in Weather Bureau Technical Paper No. 24, Parts I and II, "Rainfall Intensities for Local Drainage Design in the United States."

References

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- (2) Rockney, Vaughn D., "Precipitation Measurement by Photographic Integration of Radar Echoes", given orally at AMS meeting at Miami, Fla., Nov. 17, 1954.
- (3) Wilson, Walter T., "Analysis of Winter Precipitation Observations in the Cooperative Snow Investigations", MWR, pp. 183-199, July 1954.
- (4) Allen, F.C., R.E. Glover, W.V. Garstka, and H.M. Posz, "Heated Precipitation - Gauge Intake Tube", TAGU, V. 36 pp. 311-314, April 1955.