551.573

EVAPORATION DURING THE SPRING SNOWMELT SEASON

by

H. Simojoki

Finnish Hydrological Office, Helsinki

Abstract

A description of the meteorological conditions in which evaporation occurs during the spring snowmelt season.

The evaporation from the snow surface during the spring snowmelt has been determined according to calculations made by the Bureau for the Regulation of Water Systems and kindly placed at my disposal. In Cartesian coordinates where the coordinates represent the water content of the snow at a given time and the discharge at mean maximal water, each spring is denoted by a point. A regression line associated with these points is drawn in the coordinates. The position of a point representing an individual spring in relation to the regression line shows the deviation from the mean value of the discharge from the drainage area in that spring (Fig. 1). If the discharge at mean maximal water was considerably smaller than the discharge indicated by the regression line (the point is on the left of the regression line) it may be assumed that evaporation was greater than usual. If, on the other hand, the discharge from the area was greater than the value indicated by the regression line there is reason to assume that evaporation was smaller than usual.

In evaluating the method consideration should be paid to factors increasing the uncertainty: here attention has been paid only to runoff from the drainage area. Water that may be stored in the area has not been considered. It is possible that e.g. timber floating may have caused disturbances.

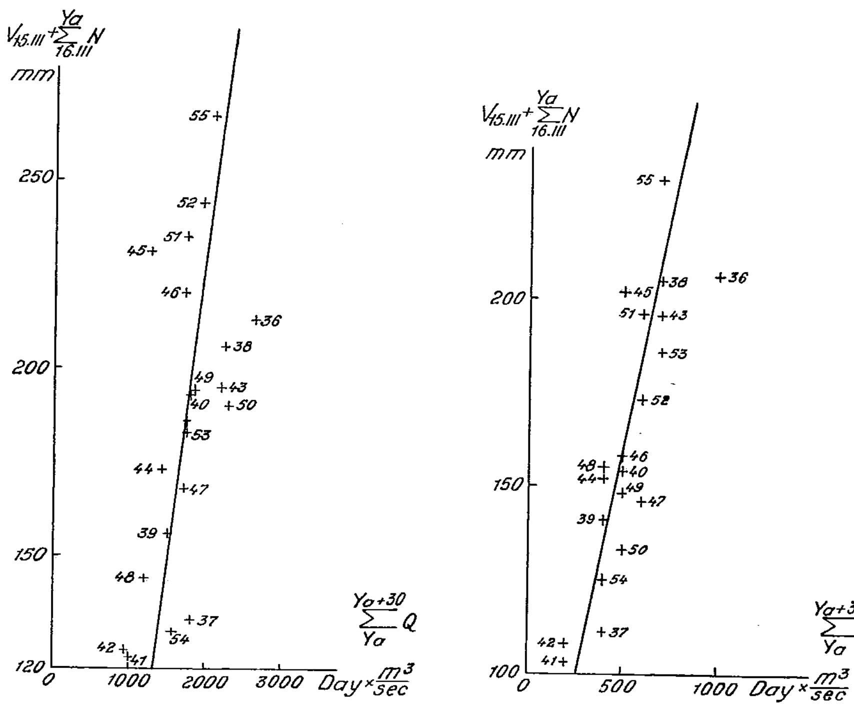

Fig. 1. Correlation between the water content of snow and the discharge in the drainage areas of Lylykoski (left) and Alaluosta (right) in the springs of 1936—55. The figures next to the point refer to the year of the respective spring.

The material used comprised observations for the drainage areas of Lylykoski and Alaluosta in 1936—1955. The location of the observation stations and the area and lake percentages of the drainage areas were as follows:

	Latitude	Longitude	Drainage area in sq. km	Lake %
Lylykoski	62°46′	30°42′	4290	8.4
Alaluosta	63°16′	28°28′	545	5.0

The meteorological observations used were taken chiefly in Joensuu (lat. 62°36′, long. 29°46′) which may be considered to represent the common climatological conditions of both these drainage areas. The location of the observation stations is given in the map (Fig. 2).

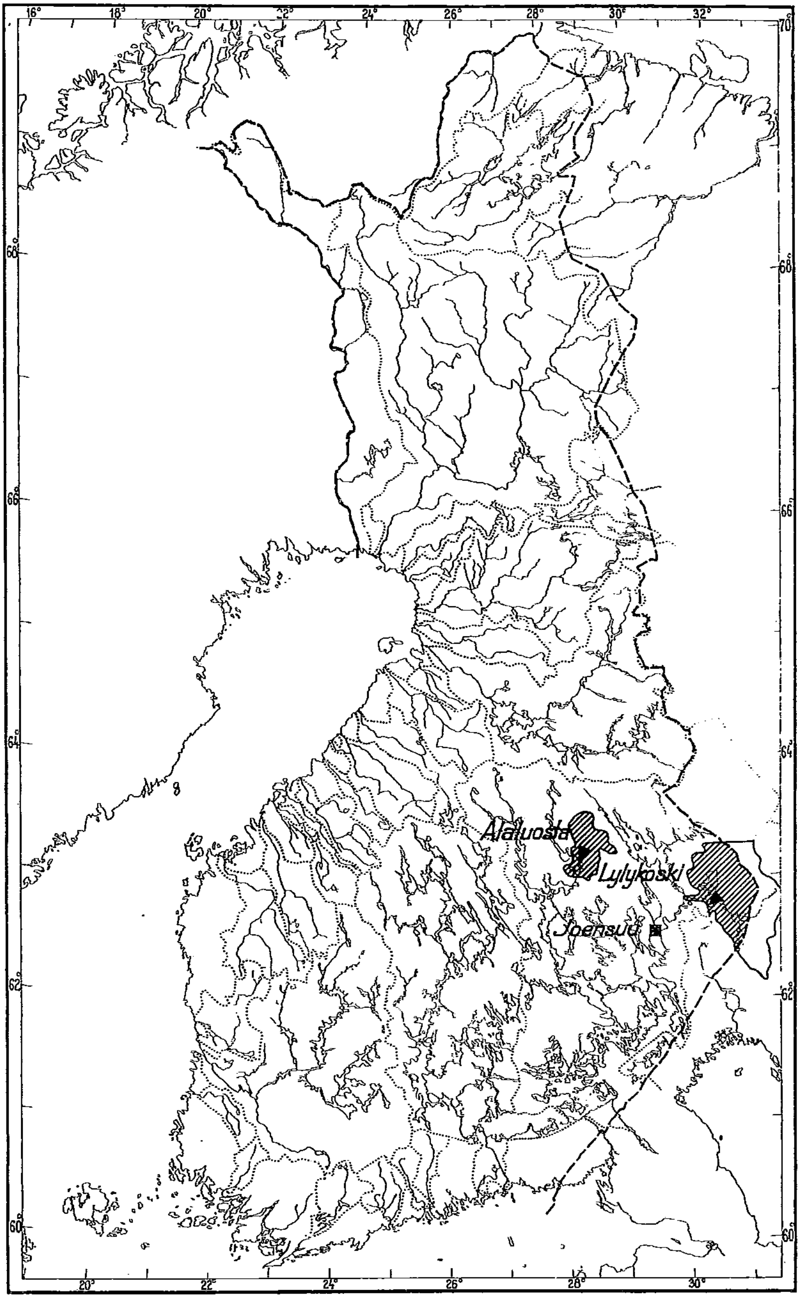

Fig. 2. Location of the observation stations.

In the estimate of evaporation, the precipitation between March 15 and the point of time Y_a at which maximal water level is reached (Fig. 1) was added to the water content of the snow on March 15. The discharge from the area was calculated 30 days forward from the attainment of maximal water level.

The material was divided into 3 different classes: cases in which the deviations from the regression line were clearly negative (greater than normal evaporation), cases in which the deviations were clearly positive (smaller than normal evaporation), and cases which were nearly normal. The following table gives the results of the analysis.

Discharge $\left(\text{day} \times \frac{\text{m}^3}{\text{sec}}\right)$ as deviations from the water quantities indicated by the regression line

Spring	Negative deviations		Spring	Positive deviations	
	Alaluosta	Lylykoski		Alaluosta	Lylykoski
1945	−160	−750	1936	310	750
1942	−100	−400	1947	150	150
1955	− 90	−150	1950	100	500
1948	− 80	−300	1937	100	400
1941	− 70	−350	1953	100	50
1944	− 70	−250	1943	60	400
1951	− 40	−250	1949	50	100

It will be seen from the above figures that the maximum parallel deviations generally occurred in both drainage areas in the same spring. This indicates that the deviations might have a common explanation independent of the area, probably evaporation. In the following, the group »strong evaporation» includes the above 7 cases of negative deviation and the group »weak evaporation» includes correspondingly the 7 cases of positive deviation.

Fig. 3. illustrates the average meteorological conditions of the different groups at Joensuu at the time of the snowmelt. It shows that springs with evaporation greater than normal were considerably colder than springs with a fairly small evaporation. There also seems to have been a distinct difference in cloudiness. When evaporation was great cloudiness was relatively light, and when evaporation was probably smaller than usual cloudiness was relatively heavy. The behaviour of vapour pressure can also be anticipated. During the assumed great evaporation, the vapour

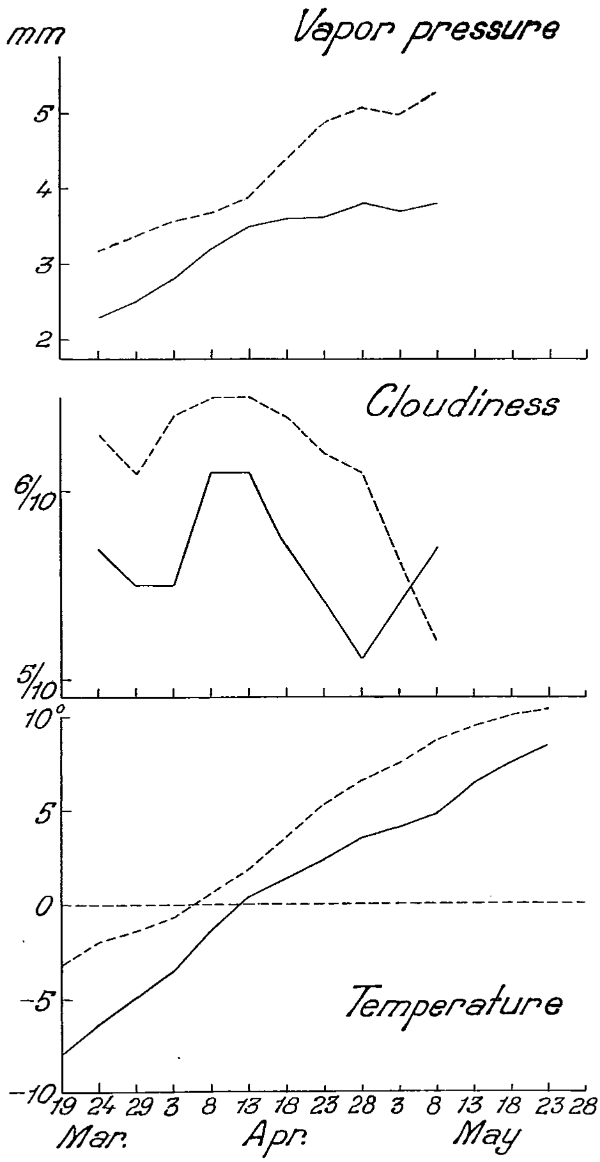

Fig. 3. The average course of air temperature, cloudiness and vapour pressure at Joensuu during »strong evaporation» (continuous line) and »weak evaporation» (broken line).

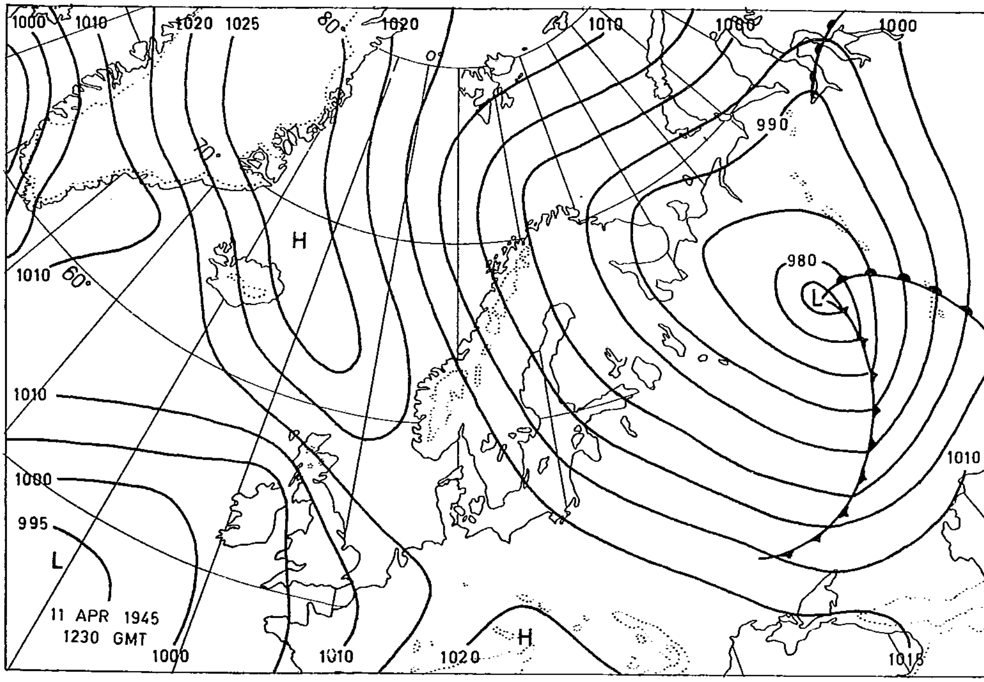

Fig. 4. Synoptic surface chart on April 11, 1945, at 1230 GMT.

pressure values were lower on the whole than during »weak evaporation».

As regards wind velocity, no distinct difference could be observed between the different groups. On the other hand, the wind direction records showed that during »strong evaporation» in April there were NW—NE winds 30% of the time but during »weak evaporation» only 17% of the time in the same month.

To establish the weather conditions during which evaporation was greater than normal, observations at 5-day intervals on the water content of the snow were used in addition to the meteorological observations. It seemed apparent that considerable evaporation occurred in the prevalence of weather conditions called »N»- and »NW-Lage»: a dry northerly air current, generally bright weather and a relatively low air temperature. Solar radiation warms the surface of the snow and produces a current of humidity directed upwards. The situation is probably similar to that mentioned by Sverdrup [1] concerning the evaporation in Arctic regions.

Fig. 4 shows a weather situation obviously with a considerable evaporation. The situation in question was a typical so-called »NW-Lage».

REFERENCES

1. Sverdrup, H. U., 1936: The eddy conductivity of the air over a smooth snow field. *Geofys. Publ.* **11**. 34—39.