ESTIMATING ERRORS IN WINTERTIME PRECIPITATION OBSERVATIONS BY COMPARISON WITH SNOW OBSERVATIONS

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Abstract: The water equivalent of snow on the ground is calculated from snow observations from Hveravellir, Iceland from the period 1965-2003. The result is compared to conventional precipitation observations and formulas for correction of precipitation observations in winds and sub-zero temperatures are derived. The reults open a way for improvements of the mapping of precipitation in windy and snowy regions.

Keywords *–precipitation corrections, raingauge observations, snow, strong winds, frost*

1. INTRODUCTION

Measuring precipitation in strong winds and sub-zero temperatures is a difficult task. Conventional raingauge observations are known to underestimate grossly the true precipitation (Förland, 1996). The available correction formulas only apply at relatively low wind speeds and there is large uncertainty involved. In this study, the water equivalent of the mean daily changes in the snow on the ground at Hveravellir, Central-Iceland is computed and compared to raingauge observations. The result is presented as correction factors for observed precipitation (K)

$$R = K * R_m$$

where R is true ground precipitation and R_m is observed precipitation.

2. DATA

Snow depth has been observed Hveravellir (640 m.a.s.l., Fig. 1), every day with snow on the ground during the period 1965-2003. The mean snow depth is calculated from observations at 37 and later 35 snow poles (Fig. 2). The density of the snow is also measured about once every week during the snow season. Wind, temperature and precipitation are also observed regularly and for the precipitation observations, a Hellman-type raingauge with a windshield is employed. In this study, we only use data on days when the maximum temperature is below freezing and the mean daily temperature is no less than -5°C.

3. RESULTS

Figure 3 shows an example of snow density observations at different wind speeds. There is quite a scatter in the data, but still a clear increase in the density of the snow as the wind speed increases. The mean density obtained by these measurements is used to calculate the water equivalent of the new snow every day. Figure 4 shows a comparison of observed precipitation and precipitation calculated from the mean snow depth for days with maximum daily wind speed between 7 and 9 m/s. Again, there is substantial scatter, but we calculate the best linear fit and obtain a slope of 3.1. Similar calculations for other wind speeds and for the mean daily wind speed as well as the maximum daily wind speed are carried out and the result is summarized in Fig. 5 and Fig. 6.

Figure 1. The Hveravellir observation site (photo: S.H.Haraldsdóttir)

4. DISCUSSION

The results in Figs. 5 and 6 indicate that for snowfall in wind speeds of 6-12 m/s, only about one third of the true ground precipitation is observed by conventional raingauges. For greater wind speeds, there is no correlation between observed precipitation and change in the mean snow depth. That may be associated with snow being blown into the raingauge or the snow observations no longer being representative for the true mean snow on the ground.

5. CONCLUSION

The precipitation correction coefficients obtained in this study will be used for a revised version of mapping of precipitation in Iceland. Such a revised map is expected to be in better agreement with numerical simulations of the precipitation (Rögnvaldsson et al., 2004). There are no obvious reasons for these correction factors not being employed in other regions of the world.

REFERENCES

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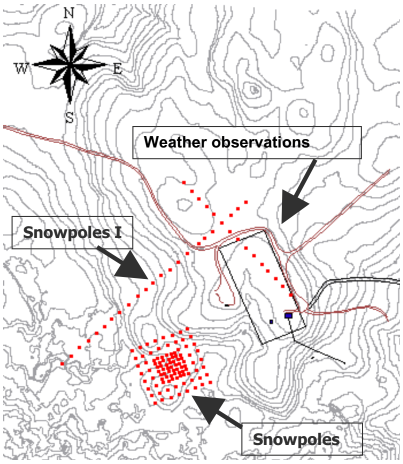

Figure 2. Location of the snowpoles in Hveravellir. Terrain is shown with intervals of 0.5 m. The snowpoles forming a cross (Snowpoles I) are used for this study. There are 20 m inbetween the poles forming the cross.

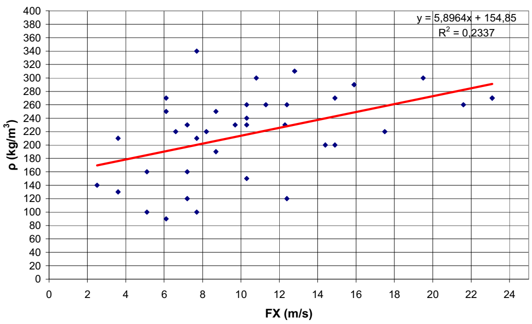

Figure 3. Observed density of new snow as a function of maximum daily wind speed

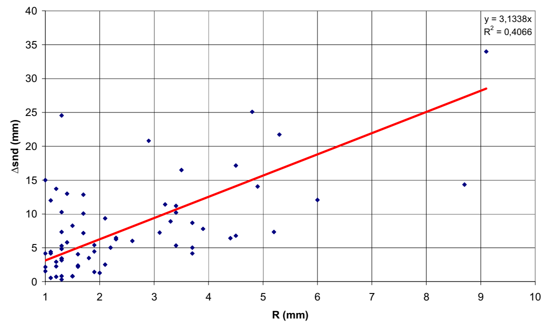

Figure 4. Water equivalent of the mean new snow as a function of observed precipitation (R)

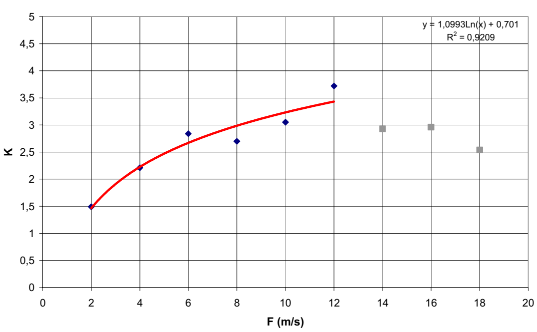

Figure 5. Precipitation correction coefficient (K) as a function of mean daily wind speed. Valid for -5°C<T<0°C

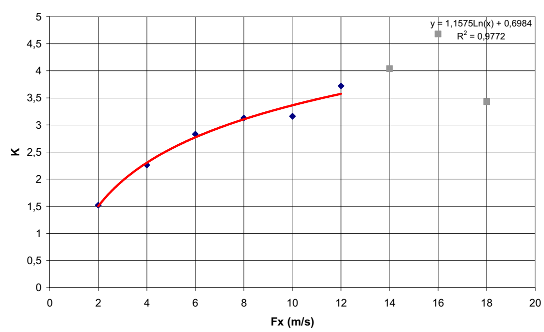

Figure 6. Precipitation correction coefficient (K) as a function of max daily wind speed. Valid for -5°C<T<0°C