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Corrigendum to

"Forcing the snow-cover model SNOWPACK with forecasted weather data" published in The Cryosphere, 5, 1115–1125, 2011

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Abstract. This corrigendum is written to correct a misinterpretation of data used for the analysis of the paper entitled "Forcing the snow-cover model SNOWPACK with forecasted weather data". In the following we will provide corrected figures, equations and tables where applicable.

1 Introduction

Bellaire et al. (2011) forced the snow cover model SNOWPACK with forecasted weather data from the Canadian numerical weather prediction model GEM15. They focused their analysis on the simulation of snow heights and new snow amounts as well as qualitatively on snow cover stratigraphy. In order to assess the performance of such a model chain, forecasted weather data were initially compared with observed values. They found an overestimation of the forecasted precipitation amounts, resulting in a general overestimation of snow heights. Therefore bias corrections were suggested and verified to reduce this deviation.

However, the above-mentioned overestimation of the forecasted precipitation amounts was due to a misinterpretation of the forecasted precipitation amounts. The forecasted precipitation amounts were predicted every 3 h, i.e. a value every three hours. The authors assumed that these precipitation amounts corresponded to the amounts predicted for each 3 h step. However, the analyzed forecasted values were cumulative values, i.e. precipitation amounts that increase with each subsequent forecasting step, resulting in large precipitation amounts and therefore in an overestimation compared to the observed values.

This corrigendum documents how this misinterpretation of the forecasted precipitation was corrected and the entire analysis repeated with the correct forecasted precipitation amount.

2 Bias correction of precipitation amounts

Bellaire et al. (2011) suggested three bias corrections for forecasted precipitation amounts derived from a comparison of forecasted and observed values. They calculated the ratio R of the forecasted (P_{GEM}) and observed (P_{OBS}) precipitation amounts (Eq. 1, Bellaire et al., 2011) and the difference D between forecasted and observed precipitation amounts per precipitation class (Eq. 2). In addition, the median ratio C was used for bias correction. This analysis was repeated with the corrected data and results are shown in Fig. 1 (replaces Fig. 2 of the original manuscript).

The newly derived bias corrections, i.e. linear regression, are now

$$R = -0.25 + 0.05\,P_{\mathrm{CLASS}}, \tag{1}$$

$$D = -2.1 + 0.52\,P_{\mathrm{CLASS}}. \tag{2}$$

Thus, new precipitation amounts tend to be underestimated by GEM15 for all precipitation amounts smaller than 4 mm compared to the overestimation found by Bellaire et al. (2011) for almost all classes. This is also evident from the new median ratio C of 0.62 compared to the factor 1.32 published in Bellaire et al. (2011).

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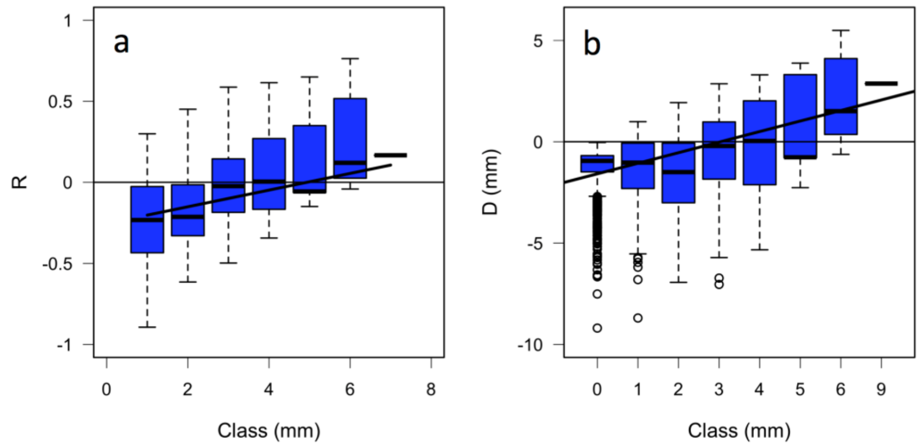

Fig. 1. (a) Boxplots of newly calculated ratio R and **(b)** difference D for forecasted and observed precipitation amounts per precipitation class. Solid line shows a linear regression through the median value of each class.

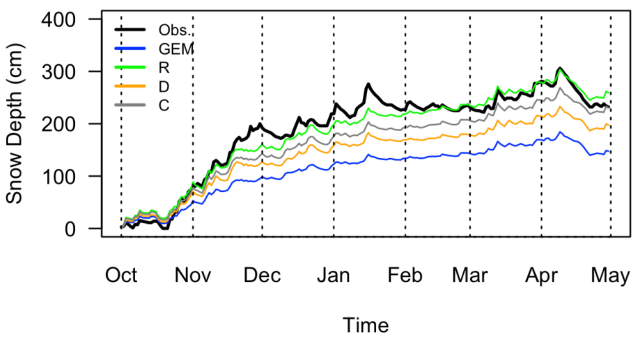

Fig. 2. Comparison of observed (black) and simulated snow heights using uncorrected (blue) and bias corrected (green, orange and grey) data. Replaces Fig. 3 of the original paper.

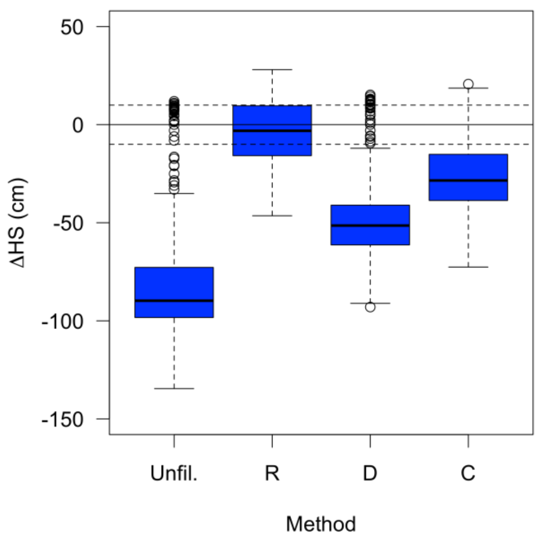

Fig. 3. Difference between simulated and observed snow heights for simulations using unfiltered and bias corrected precipitation amounts. Dashed lines are located at ±10 cm. Replaces Fig. 4 in Bellaire et al. (2011).

3 Simulated snow heights and new snow amounts

Using the misinterpreted data to force the snow cover model SNOWPACK consequently resulted in incorrect snow cover simulations. SNOWPACK was again forced with original and bias corrected data, i.e. applying bias correction methods R, D, C. The new results of the comparison of measured and simulated snow heights are shown in Fig. 2 (former Fig. 3).

Clearly shown in Fig. 2 is the general underestimation (former overestimation) of the simulated snow heights (blue line) if uncorrected forecasted data are used. This is a direct result of the underestimation of the forecasted precipitation amounts. The ratio method R (green line) shows the best performance of all three bias correction methods, as indicated by the smallest deviation from the measured snow height (Fig. 3).

The simulated 24 h new snow amounts showed a similar, but a slightly better agreement to the observed amounts (Fig. 4). However, larger snow events still seem to be underestimated, related to an overestimation of the new snow densities as well as to the underestimation of the precipitation amounts (Table 1).

Bellaire et al. (2011) found an overestimation of the snow height during the early winter season and explained this by the fact that during the early season the model treated precipitation events exclusively as snow events instead of rain or a mixture of snow and rain. This trend is still true although less pronounced due to the general underestimation of precipitation amounts.

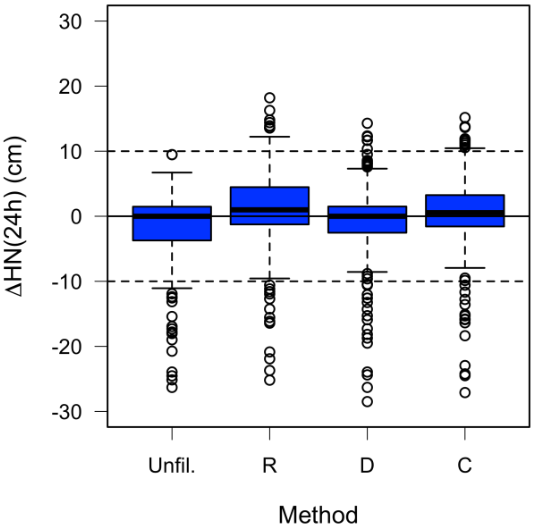

Fig. 4. Difference between simulated and observed 24 h new snow amounts. Replaces Fig. 5 of the original paper.

Table 1. Comparison of three measured and simulated 24 h new snow events HN (24 h). In addition, the measured (Obs.) and forecasted (GEM) precipitation amounts are given as well as the corresponding snow density for the three days. Replaces Table 2 of the original paper.

Date	HN (24 h)		P (24 h)		Rho (24 h)	
	Obs. cm	GEM cm	Obs. mm	GEM mm	Obs. $kg\,m^{-3}$	GEM $kg\,m^{-3}$
14 Jan	7.8	8.4	6.4	5.8	75.2	63.5
15 Jan	52.3	16.2	30.4	11.8	53.3	66.9
16 Jan	25.9	8.1	12.5	5.1	44.3	57.6

4 Snow cover stratigraphy simulation

Bellaire et al. (2011) compared an observed snow cover profile to the corresponding simulation (Fig. 8, original paper). The same comparison of the observed and simulated profile is now shown in Fig. 5. The general structure as well as relevant critical layers are still simulated with the model chain. However, additional surface hoar layers were buried, which can be explained by the fact that due to the underestimation of precipitation amounts, surface hoar formation periods last longer and surface hoar can grow larger and therefore exceed the size threshold needed to become buried during the next storm.

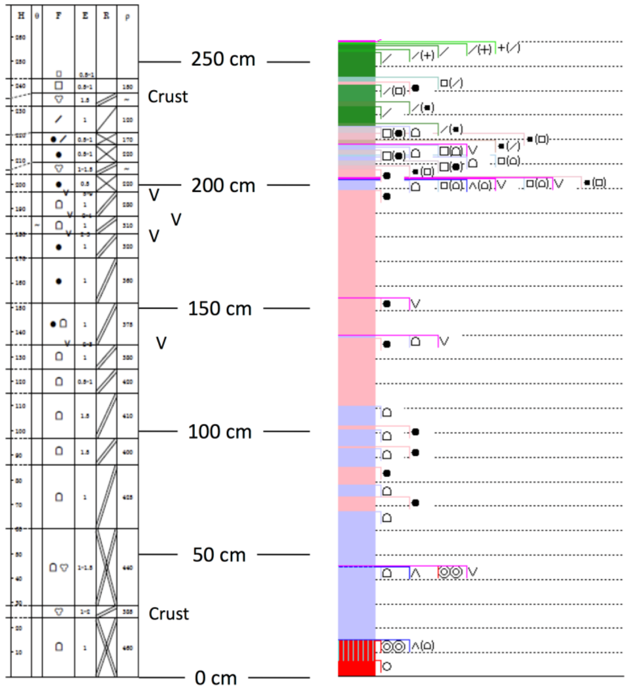

Fig. 5. Comparison of observed (left) and simulated profile (right) for 20 March 2010 at Mt. Fidelity. Replaces former Fig. 8.

5 Conclusions

The authors apologize for this error and for any inconvenience this may have caused. Although this error needed to be corrected, our revised analysis shows that the general conclusions of Bellaire et al. (2011) are still valid after applying the new bias correction methods. Bias corrections for forecasted parameters will differ between numerical weather prediction models and can even differ within the own model domain, e.g. in different climate regions. Therefore, we still conclude the model chain consisting of a numerical weather prediction model and the snow cover model SNOWPACK shows promising potential to provide additional information in data sparse areas.

References

Bellaire, S., Jamieson, J. B., and Fierz, C.: Forcing the snow-cover model SNOWPACK with forecasted weather data, The Cryosphere, 5, 1115–1125, doi:10.5194/tc-5-1115-2011, 2011.