SIMULATIONS OF PRECIPITATION IN THE COMPLEX TERRAIN OF ICELAND AND COMPARISON WITH GLACIOLOGICAL OBSERVATIONS

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1. INTRODUCTION

Precpitation in Iceland from 1987 to 2003 is simulated with the PSU/NCAR MM5 model (Wang et al., 2001). The results are compered to observed accumulated winter precipitation on two large glaciers in SE-Iceland and one glacier in central Iceland. The simulations are further compared to observed precipitation at two coastal synoptic stations in NE- and SW-Iceland.

The simulated data is post-processed with a newly developed, open source, software suite named MM5IDL (Rögnvaldsson and Rögnvaldsson, 2004).

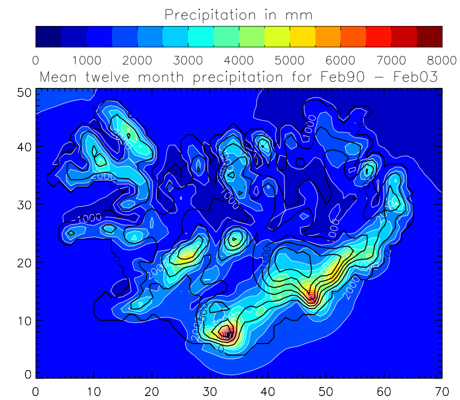

Figure 1: *Mean twelve month precipitation for 1990 to 2003.*

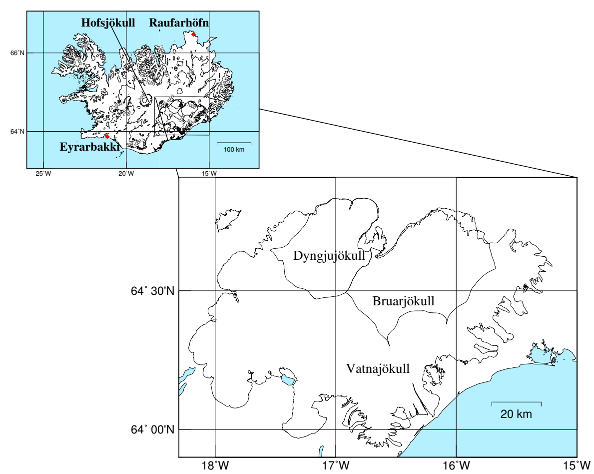

Figure 2: *Overview of Dyngjujökull and Brúarjökull glaciers in SE-Iceland along with synoptic stations Eyrarbakki and Raufarhöfn.*

2. EXPERIMENTAL SETUP

In this study, the turbulent boundary layer is parameterized according to Hong and Pan (1996) and cloud physics and precipitation processes according to Grell et al. (1995) and Thompson et al. (2004), respectively. The simulations are carried out with horizontal resolution of 8 km with initial and boundary conditions from the European Centre for Medium-Range Weather Forecasts (ECMWF). The domain size is 123×95 points, centered at 65.0°N and 19.5°W, with 23 vertical levels.

3. RESULTS

Figure 1 shows the mean annual precipitation as simulated with the MM5 model. It shows a realistic precipitation pattern with the greatest precipitation over the large ice shelves in S- and SE-Iceland and over the three large glaciers in central and NW-Iceland. The two synoptic stations in NE- and SW-Iceland are shown in Figure 2, the enlarged part of the same figure shows the two glaciers, Dyngjujökull (1040 km^2) and Brúarjökull (1695 km^2), in SE-Iceland. Figure 3 shows Hofsjökull glacier in central Iceland. The red circle indicates the location of point "h18" at the top of the glacier. In the current study we only use data of accumulated winter precipitation from this single point. However, it should be noted that this location is representative for an area of similar size as the mesh used in the current MM5 simulations. Figure 4 shows the accumulated winter (October through May) precipitation for 1991 to 2002

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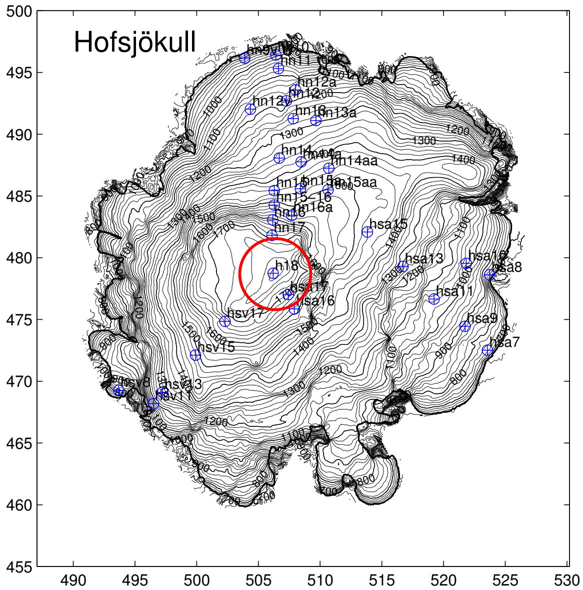

Figure 3: *Hofsjökull glacier in central Iceland. Red circle shows the location of point h18. Axis are in km.*

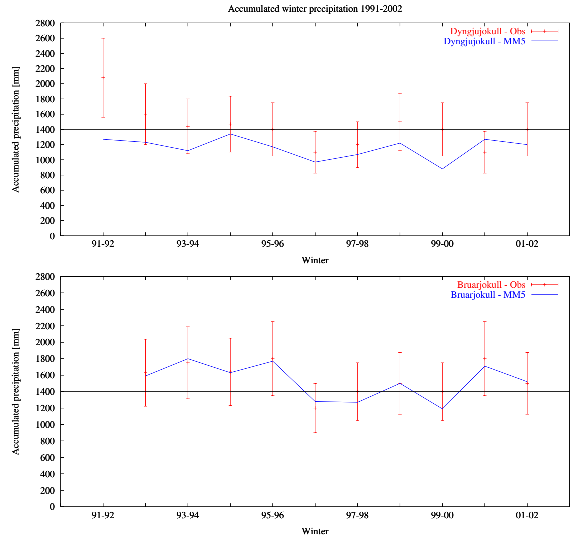

Figure 4: *Observed (red) and simulated (blue) winter precipitation at Dyngjujökull (top) and Brúarjökull (bottom) glaciers, SE-Iceland.*

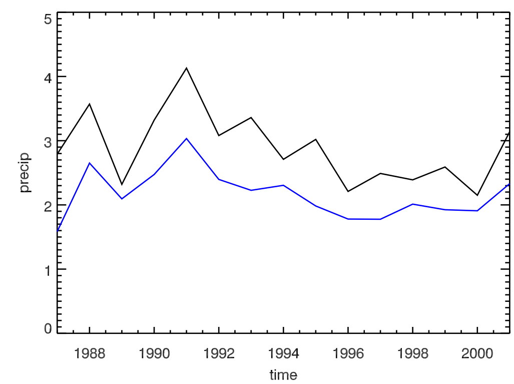

Figure 5: *Observed (black) and simulated (blue) winter precipitation at point "h18" at the top of Hofsjökull glacier, central Iceland, between 1987 and 2002. The precipitation is shown in meters.*

for the two large glaciers in SE-Iceland, both simulated and observed. There is very good agreement between simulated and observed precipitation for Brúarjökull glacier. The agreement is not quite as good for Dyngjujökull as the model consistently underestimating the precipitation. Still, the simulations are nearly always within reasonable error margins of the observations and they reproduce correctly the interannual variability. Figure 5 shows the comparison between observed and simulated accumulated winter precipitation at point h18 at Hofsjökull glacier, central Iceland. The model is underestimating the observed precipitation by 25% in average. It should be noted that the altitude of the observation point is about 1800 meters but the model height is only about 1500 meters. This can presumably to some extend explain the underestimation in the simulated precipitation.

Figures 6 and 7 show the comparison between observed and simulated three month accumulated precipitation for stations Raufarhöfn (NE-Iceland) and Eyrarbakki (SW-Iceland). The MM5 model is in general overestimating the precipitation at Raufarhöfn but least so during summer months (JJA). The climate is such that a large part of this discrepancy can be explained by wind loss of solid precipitation and loss due to wetting of the rain gauge and evaporation in summer. At Eyrarbakki (Figure 7) the simulations are in better agreement with observations which is consistent with the fact that the proportion of solid precipitation to liquid precipitation is much lower at Eyrarbakki than at Raufarhöfn.

4. CONCLUSIONS

We conclude that the simulated precipitation agrees well with observations, especially those of snow accumulation which are not riddled with wind loss. It corresponds also reasonably well with precipitation observed with conventional methods when systematic errors in such observations are considered.

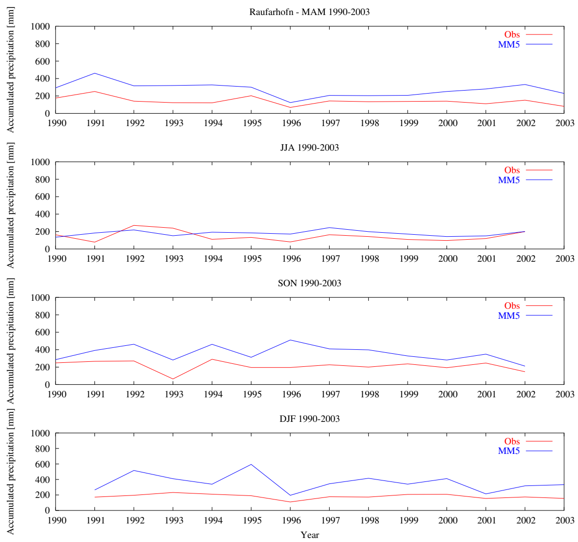

Figure 6: *Observed (red) and simulated (blue) three month precipitation at Raufarhöfn.*

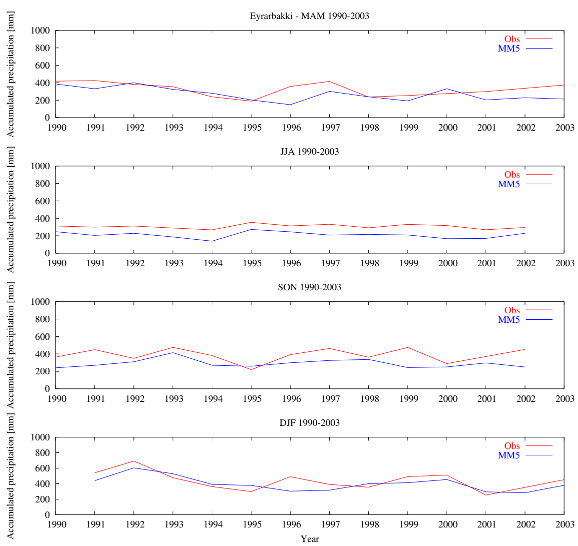

Figure 7: *Observed (red) and simulated (blue) three month precipitation at Eyrarbakki.*

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