**Supplementary material for:**

**Modeling the surface mass balance of Penny Ice Cap, Baffin Island, 1959-2099**

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**Figure S1:** (a, b)Comparison between in-situ daily mean air temperatures measured at the AWS at the ice cap summit and the modeled 2 m air temperature from the closest RACMO2.1 grid cell. (c, d) Comparison between in-situ spring snowpack measurements at two mass balance stakes closest to the AWS (P000 and P101) versus RACMO2.1 cumulative winter total precipitation (snow and rain). Each year’s snow pack values in c, for both the in-situ and RACMO2.1 data, refer to the end of winter (~April) and represent the accumulated snowfall since the end of the previous summer (~Sept.). For example, the year 2008 refers to snow pack measurements obtained in April 2008 that represent the accumulated snowfall since Sept. 2007. The black line in Figure 2b and 2d is the 1:1 line.



**Figure S2**: Range of tested parameter combinations (black line) that meet the requirements (section 5). A larger circle size indicates a better fit (higher r2 and lower RMSE). Thirty-four of the combinations had an RMSE >0.5 m w.e and 13 had an RMSE ≤0.5 m w.e. when compared to the in-situ and NASA altimetry data from 2006-2014 (section 5.0). These 13 combinations are connected with a line and each parameter value is labeled with the number of times it was used for a parameter combination with an RMSE ≤0.5 m w.e.