Supplementary Materials

Appendix A Meteorological and precipitation climatologies from observations and LMDZiso

From GNIP/IAEA data, the mean seasonal cycle of temperature, precipitation amount and isotopic composition has been calculated for Grønnedal. As shown in Figure A.1, mean temperature varies from $-5°\mathrm{C}$ (from December to March) to $+8°\mathrm{C}$ (peaking in July-August). The mean precipitation amount is 85 mm/year, with maximum values in autumn. On the same Figure are also presented the daily temperatures obtained during our observation period. This period is characterised by temperatures mainly in the range of GNIP observations, but with temperatures unusually high in summer 2012 associated with Greenland ice melt record, and unusually low in March 2012 (but there is no water vapour isotopic measurement on this period). A $\delta^{18}\mathrm{O_p}$ seasonal cycle of $\sim 4‰$ is depicted, with maximum values in June and minimum values in January. A high level of variability (or noise) is seen on $\mathrm{d_p}$, which seems minimum in summer and maximum in spring and autumn, with an overall amplitude of $10‰$.

Model climatologies were extracted from monthly LMDZiso outputs at Ivittuut terrestrial grid cell (see Section 2.8). The period 1961-1974 is used for comparison with the GNIP/IAEA observations (Figure A.1). Only months were GNIP/IAEA data are available where used to compute mean values and standard deviations. This comparison shows that LMDZiso has a cold and wet bias (in terms of precipitation amount), especially in summer. This may be due to the representation of the topography and surface albedo of the model grid point, which encompasses part of the Greenland ice sheet. Consistent with the cold bias, LMDZiso produces precipitation $\delta^{18}\mathrm{O_p}$ which are significantly more depleted than observed, with the exception of its peak summer level (in August). Finally, the simulated $\mathrm{d_p}$ seasonal cycle appears particularly flat, compared to the GNIP/IAEA data, with a small ($2‰$) magnitude, an early summer minimum and a winter maximum.

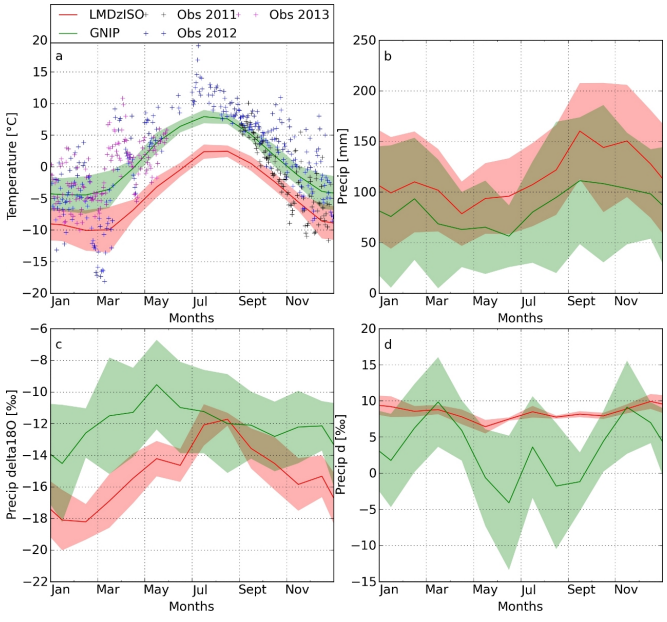

Fig. A.1. Climatology on period 1961 to 1974 from GNIP/IAEA (green) observations at Grønnedal and from LMDZiso simulations on periods over data coverage by GNIP/IAEA data at grid cell 62.11°N, 48.75°W (red): mean values (curves) and standard deviations (shades). For temperature, observations daily values from 01-09-2011 to 31-05-2013 are represented (black, blue and magenta crosses for years 2011, 2012 and 2013 respectively). Temperature (a), precipitation amount (b), $\delta^{18}\mathrm{O}$ in precipitation (c) and d in precipitation.

Appendix B Maps of isotopic values in LMDZiso

Figures B.1 and B.2 display maps of $\delta^{18}\mathrm{O_v}$ and $\mathrm{d_v}$ from the first vertical layer of LMDZiso model, averaged over each season of 2012. For $\delta^{18}\mathrm{O_v}$, we observe strongly depleted values over Greenland and Canada, and less depleted values over the Atlantic Ocean and the southern United States. For $\mathrm{d_v}$, LMDZiso produces high values above high latitude continents (Canada, Greenland), and low values at the surface of the Atlantic ocean. Intermediate $\mathrm{d_v}$ values are simulated over the United States.

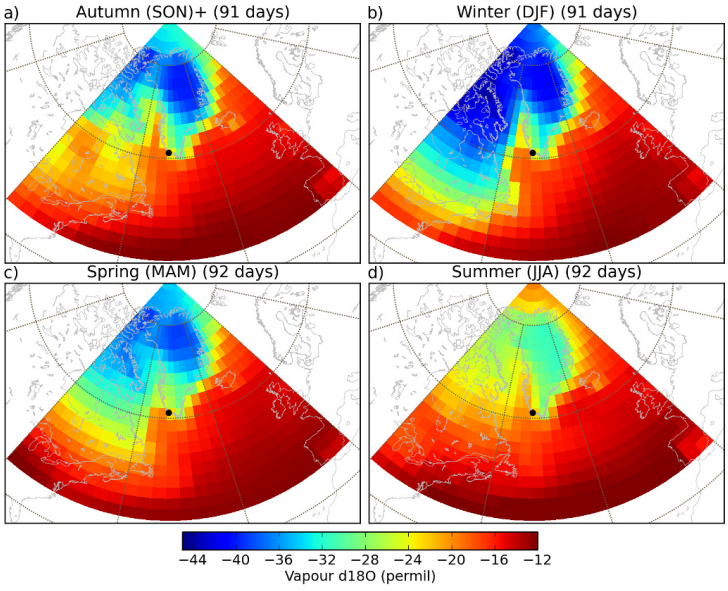

Fig. B.1. Seasonal $delta^{18}O_v$ maps from LMDZiso outputs in 2012. Autumn (September, October, November); winter (December, January, February); spring (March, April, May); summer (June, July, August).

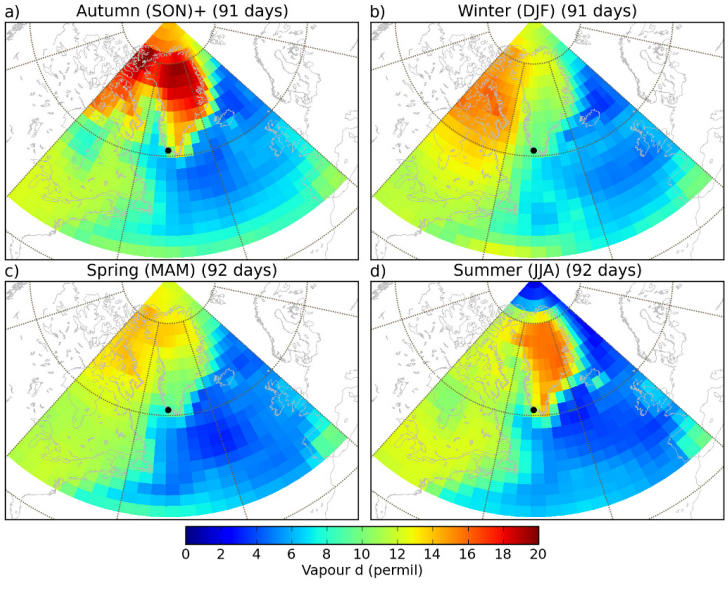

Fig. B.2. Same as Figure B.1 for $\mathrm{d_v}$.