Supporting Information

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SI Text

The Response of the Seasonal Cycle over Greenland at Younger Dryas (YD: 12.9–11.7 ka) and Oldest Dryas (OD: 18.0–14.6ka). The response of the seasonal cycle of precipitation, surface air temperature and precipitation $\delta^{18}O_p$ over Greenland are shown in Fig. S1 for each grid point over Greenland in isoCAM3. The precipitation increases dramatically throughout the year from YD to OD, with the amplitude of the seasonal cycle almost doubled [notice different scales for YD (Fig. S1*B*2) and OD (Fig. S1*B*1)]. In contrast, the seasonal cycle of temperatures remain comparable in YD and OD (Fig. S1*C*1 and *C*2). The temperature at YD is higher than OD throughout the year, with an increasing magnitude towards the north (Fig. S1*C*3). The largest change of temperature through the year occurs from summer to fall, with the maximum warming in late summer declining rapidly to the minimum warming in October. Otherwise, the warming is very stable from month to month with a magnitude approximately 4–6 °C depending on the location. Thus, the overall warming between YD and OD is not caused by the change of the seasonal cycle. In contrast to the all year round warming, the change of $\delta^{18}O_p$ from YD to OD is negative throughout the year over Greenland (except for the northernmost region in the midsummer) (Fig. S1*A*3). In spite of this opposite change of $\delta^{18}O_p$ and temperature throughout the year, a comparison of the seasonal cycle responses of temperature (Fig. S1*C*3) and $\delta^{18}O_p$ (Fig. S1*A*3) shows some positive correlation between $\delta^{18}O_p$ and temperature, with both peaking in summer and decreasing towards fall and spring. It therefore appears that the inconsistent $\delta^{18}O_p$ and temperature relationship over Greenland is caused mainly by a year-round change in the background field. This background change can be attributed by the lowering of the Laurentide Ice Sheet, which leads to an increased rainfall all year round (Fig. S1*C*3) and the increased moisture transport from the North Pacific due to with the increased westerly wind across the North America continent. In the mean time, it should also be noted that, even in the seasonal cycle, there is substantial inconsistence between the changes of $\delta^{18}O_p$ and temperature. For example, the minimum warming occurs briefly in the fall while the minimum $\delta^{18}O_p$ occurs in spring. This maximum reduction of $\delta^{18}O_p$ in spring may be caused by the strong low level westerly jet and, in turn, increased moisture source from the North Pacific.

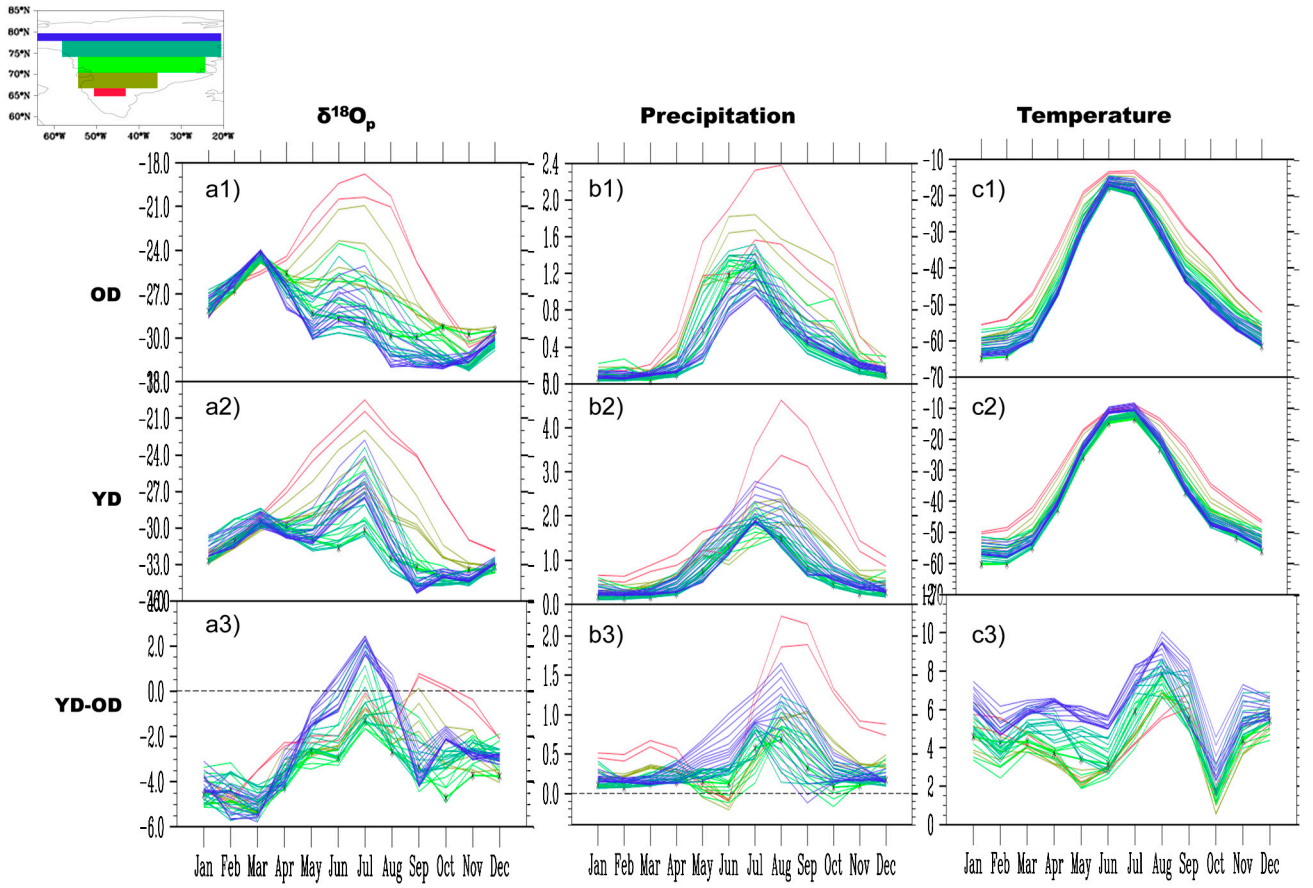

Fig. S1. The seasonal cycle of (*A*1–*A*3) $\delta^{18}O_p$, (*B*1–*B*3) precipitation (mostly snow) and (*C*1–*C*3) surface air temperature for about 30 grid points over Greenland simulated in isoCAM3 for OD (*Top*), YD (*Middle*) and the difference of YD-OD (*Bottom*). The color of each curve indicates its location as shown in the *Inset* on the *Top-Left* corner.