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Supplement of

Future projections for the Antarctic ice sheet until the year 2300 with a climate-index method

Ralf GREVE[1,2], Christopher CHAMBERS[1], Takashi OBASE[3], Fuyuki SAITO[4], Wing-Le CHAN[3,4], Ayako ABE-OUCHI[3]

[1]Institute of Low Temperature Science, Hokkaido University, Sapporo, Japan
[2]Arctic Research Center, Hokkaido University, Sapporo, Japan
[3]Atmosphere and Ocean Research Institute, University of Tokyo, Kashiwa, Japan
[4]Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan

Correspondence: Ralf Greve <greve@lowtem.hokudai.ac.jp>

Original vs. index-extrapolated MIROC4m climate fields

For the RCP8.5 pathway, we compare briefly original MIROC4m results until 2300 with those obtained by extrapolating MIROC4m results until 2100 with the climate-index method (main paper, Sect. 2) to assess the performance of the latter.

Figure S1 shows the 2291–2300 surface temperature, ocean temperature (at 450 m depth) and precipitation anomalies relative to 1995–2014 obtained by both methods. For the two surface climate fields, the agreement is reasonably good. For the ocean temperature, this also holds in general, but there are notable regional differences. Most conspicuously, in the Weddell sector (c) the directly computed ocean temperature shows a clear warming, whereas the warming is much less pronounced for the extrapolated counterpart.

The ocean temperature at 450 m depth is investigated further in Figure S2, which shows 1850–2300 time series for the four sectors marked in Figure S1. In the original MIROC4m results, sectors (a) (Thwaites) and (b) (Totten) are already quite warm initially (1850–2020) due to the intrusion of warm Circumpolar Deep Water (CDW), while for regions (c) (Weddell) and (d) (Dronning Maud Land) the presence of cold water associated with sea-ice formation

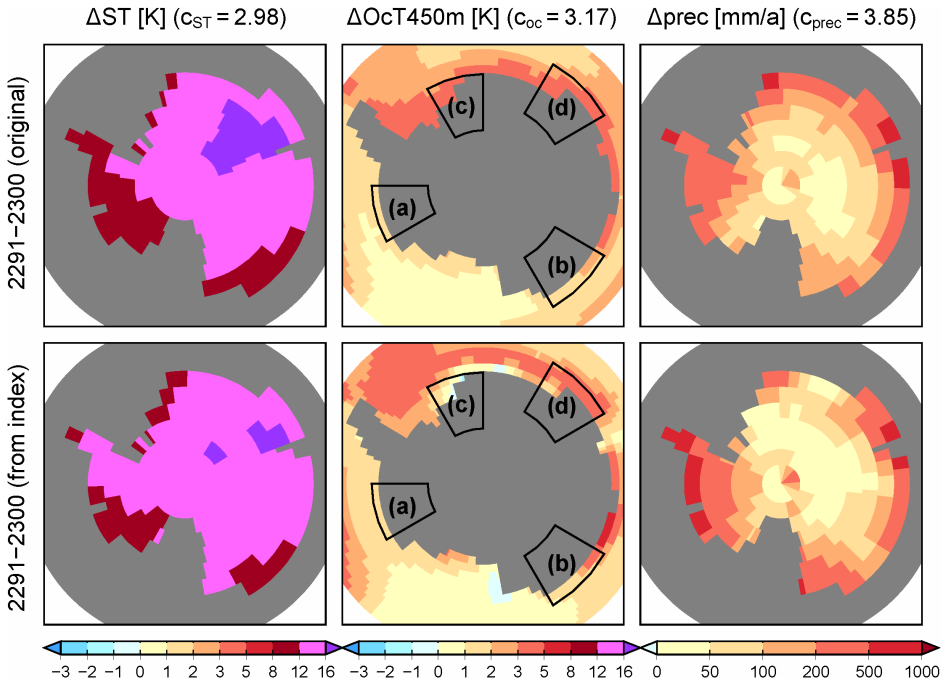

Figure S1: Climate fields for RCP8.5, 2291–2300 relative to 1995–2014: surface temperature (ΔST), ocean temperature at 450 m depth (ΔOcT450m), precipitation (Δprec). Top row: computed directly with MIROC4m, bottom row: computed with the MIROC4m-based climate-index method. The climate indices for each variable (c_{ST}, c_{oc}, c_{prec}) are given in parentheses. The indicated sectors [(a) Thwaites, (b) Totten, (c) Weddell, (d) Dronning Maud Land, DML] are referred to in Figure S2.

prevents CDW intrusion. By contrast, by 2300, CDW intrudes into all four regions, so that their final temperatures are similar. For sectors (a) (Thwaites), (b) (Totten) and (d) (Dronning Maud Land), the trends of the original MIROC4m results are reproduced fairly well by the climate-index extrapolation. By contrast, for sector (c) (Weddell), the strong warming produced by MIROC4m is not reflected in the extrapolated curve. This is so because the sector remains cold until ∼2130, so that the warming has no signal in the 2091–2100 average on which the extrapolation is based (main paper, Eq. (4)). Naturally, such non-linear, regional effects cannot be captured by extrapolating late 21st-century conditions further into the future using a set of climate indices computed for the entire Antarctic ice sheet and its surroundings. This constitutes a source of uncertainty in the extrapolated climate fields.

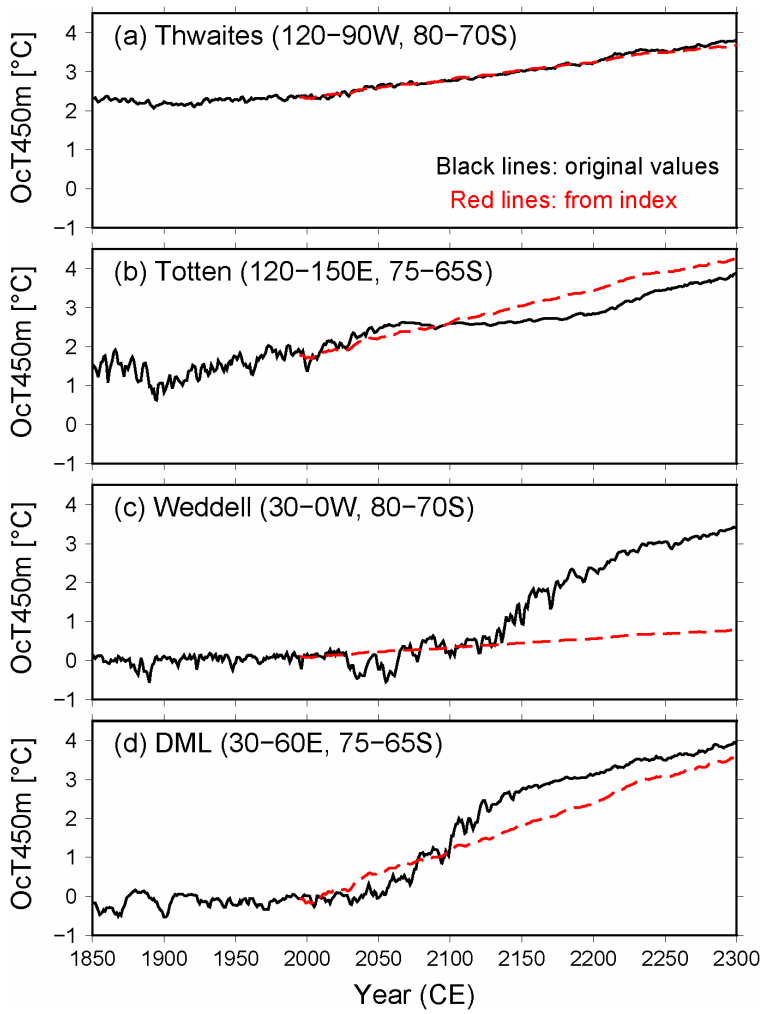

Figure S2: Area-mean, absolute ocean temperature at 450 m depth (OcT450m) for the four sectors (a)–(d) shown in Figure S1; RCP8.5 pathway, period 1850–2300. Black solid lines: computed directly with MIROC4m, red dashed lines: computed with the MIROC4m-based climate-index method for 1990–2300.