Snowfall on Thwaites Glacier: climatology, variability, and large-scale drivers

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Remote sensing data indicate that the Thwaites Glacier (TG) system has experienced rapidly enhanced solid ice discharge, grounding line retreat on a reverse-sloping bed, and ice shelf thinning since the 1990s. Contemporaneous observations of surface mass balance (SMB) indicate that catchment-wide accumulation has not changed; however, knowledge gaps remain, especially in the low-elevation portions of the glacier that receive the highest snowfall rates. Here we use atmospheric reanalyses and the high-resolution (5.5 km) regional atmospheric climate model RACMO2 focused on the TG to analyze the seasonal, inter-annual, and spatial variability of snowfall and SMB over the period 1979-2016. We show that snowfall displays high spatial variability on the TG ice shelf and low elevations, as well as a substantial seasonal cycle, which is muted at higher elevations. Controversially, our analysis indicates that high snowfall events on the TG are not controlled by the Amundsen Sea Low, but are clearly linked to atmospheric blocking at mid-latitudes. This atmospheric pattern, aided by the unique location and geometry of TG, enables intrusion of marine air that originates at lower latitudes. Our results highlight the important role of remote sources in producing snowfall on the TG, and can aid in understanding atmospheric drivers of TG change in the present and future climate.