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A model-based study of foehn impacts on the near-surface climate over the Larsen ice shelf (Antarctic)

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The region of the Antarctic Peninsula (AP) has experienced dramatic changes over the past decades. Its warming rates of about 3 K for the last 50 years are among the highest on Earth. The AP is the only region of the Antarctic where widespread surface melting occurs, which is considered to play a significant role in the disintegration of ice shelves in recent decades. The increased atmospheric flow over the AP since the 1960s has increased surface melt and is likely to have initiated the collapse of the Larsen A and B ice shelves.

The role of katabatic winds and foehn effects for the region of the Larsen Ice Shelf has been investigated using the regional climate model COSMO-CLM (CCLM) at 5 km (C05) and 15 km (C15) resolution. The model was run for the whole Weddell Sea region for the period 2002-2016 with nesting in ERA-Interim reanalyses. Sea ice concentrations were taken from microwave satellite measurements and were updated daily to allow for a close-to-reality hindcast.

Comparison between CCLM and ERA-Interim for the AP region show that katabatic winds are higher over the slopes, which leads also to higher temperatures. Foehn events were detected from C15/05 simulations 2002-2015 using objective criteria for changes in wind, temperature and humidity. Only foehn events exceeding 6h were considered, the longest event lasted 48h. The climatology for the 2 m-temperature of foehn and non-foehn events for the Larsen ice shelf shows that foehn events cause melting frequently even for spring and autumn. In winter, a few cases occur as well. Considering that the recent temperature increase has occurred mainly for autumn, winter and spring, the temperature rise expected for the coming century will probably lead to a large increase in melting events due to foehn also in winter.