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Non-climatic signal in ice core records: Lessons from Antarctic mega-dunes

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We present the results of glaciological investigations in the mega-dune area located 30 km to the east from Vostok Station (central East Antarctica) implemented during the 58th and 59th Russian Antarctic Expedition (January 2013 and January 2014). Snow accumulation rate and isotope content (δD and δ18O) were measured along the 2-km profile across the mega-dune ridge accompanied by precise GPS altitude measurements and GPR survey. It is shown that the spatial variability of snow accumulation and isotope content covaries with the surface slope. The accumulation rate regularly changes by 1 order of magnitude within the distance < 1 km, with the reduced accumulation at the leeward slope of the dune and increased accumulation in the hollow between the dunes. At the same time, the accumulation rate averaged over the length of a dune wave (25 mm w.e.) corresponds well with the value obtained at Vostok Station, which suggests no additional wind-driven snow sublimation in the mega-dunes comparing to the surrounding plateau. The snow isotope content is in negative correlation with the snow accumulation, which could be explained by post-depositional snow modification and/or by enhanced redistribution by wind of winter precipitation comparing to summer precipitation. Using the GPR data, we estimated the dune drift velocity (5.5 $\pm$ 1.3 m yr-1). The full cycle of the dune drift is thus about 340 years. Since the spatial anomalies of snow accumulation and isotope content are supposed to drift with the dune, an ice core drilled in the mega-dune area would exhibit the non-climatic 340-yr cycle of these two parameters. We made an attempt to simulate a vertical profile of isotope content with such a non-climatic variability in a virtual ice core, using the data on the dune size and velocity. The obtained results are discussed in terms of real ice core data interpretation.