Small-scale temporal variability of surface winds in Adelie land

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Antarctic surface winds play a key role in defining the climate of the ice sheet and its mass balance. For instance, extreme wind-speed events account for a significant fraction (up to 35%) of the sublimation of the snow in the atmosphere. Winter downslope eastwards surface winds in Adélie land are frequently described as "katabatic". However, it is not necessarily the case, as surface winds are the result of a combination of both large-scale pressure gradient and surface-induced processes (katabatic and thermal wind responses) that are often aligned. Using high-frequency outputs from the regional atmospheric model (MAR) with a 35km grid resolution, we perform a momentum-budget decomposition to separate the contribution of synoptic and surface-induced accelerations. We focus on the winter-time season, when the katabatic acceleration is at its maximum: the surface is able to cool down the air mass above the ice sheet by longwave upward radiation throughout the entire day, without a diurnal cycle.We demonstrate that, from the coast up to ~250 km inland, the katabatic acceleration is responsible for the seasonal variations of surface winds. However, at a smaller temporal scale, due to compensation of the katabatic acceleration by thermal wind, large-scale synoptic variations dominate the variability of surface winds. Thus, most of the documented “katabatic high wind-speed events” that have happened in Adélie land during winter-times could be more accurately described as “coupled synoptic and katabatic events”, or even “purely synoptic events”.