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Multiple-point sodar observations of structures in the summertime ABL over slightly sloped glacier in Antarctica.

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A set of Doppler sodars was operated for about 1.5-month period during austral Summer 2014-2015 at a slightly sloped homogeneous surface of a glacier near the Finnish Antarctic station Aboa in Dronning Maud Land. The set consisted of three identical vertically-pointing mini-sodars LATAN-3m and one 3-component full-sized sodar LATAN-3. The minisodars were located on a vertexes of an equilateral triangle at distances of 200∼m from the big one. The sodars of two types were operated at 3 and 6 seconds temporal and 10 and 20 meters vertical resolution respectively. The sodars provided vertical profiles of vertical velocity and backscatter-echo intensity, the 3-component sodar provided also the profiles of wind speed. The surface-layer fluxes and profiles were recorded by means of a 10-m mast equipped with two 3D sonic anemometers, 6 2D anemometers and 7 thermometers. All measurements were timestamped synchronously with less than 0.1 second accuracy, which makes them suitable for studies of spatio-temporal structure of inhomogeneities in the ABL at scales of few hundreds of meters.

Numerous quasi-periodic structures in the sodar echogramme were observed at the site earlier during measurements in 2010-2011 austral summer. It was unclear, however, what are the spatial scales of the structures and what is the spatial extent of their occurrence. The multipoint setup of 2014-2015 revealed a complex structure of the wave-like events. The patterns of Kelvin-Helmholtz type instabilities in sodar echogrammes differ noticeably at a spatial separation of few hundred meters, indicating that such events are quite local and have spatial extent of few hundred meters.

The multipoint setup allowed also for revealing convective structures. The spatio-temporal correlations of echo-signal patterns and velocity components distinguish between cell- and roll-type convection. The aspect ratio of both types of structures was about 2:1. Both types of structures quite clearly modulate surface fluxes of sensible and latent heat.