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ABSTRACT

Snow cover stratigraphy as a source of information about weather and pollutants deposition history - a case study from SW Spitsbergen

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Snow cover properties depend on atmospheric conditions, which cause different kinds of metamorphism and change the shape of accumulated snow crystals. This allows to recognize weather conditions occurring in the past, when there is no meteorological instruments nearby. When the meteorological conditions are well known and physico-chemical properties of snow are obtained yet before start of the ablation season, there is a possibility to define quite accurate dates of formation of following layers of seasonal snow and define associated weather events. With such knowledge in turn, we can get the information, from what period and from where, thanks to HYSPLIT air masses trajectory model, pollutants accumulated in snow cover come.

Snow stratigraphy measurements were done in ablation zone of Hansbreen glacier (185 m asl) located in southwestern Spitsbergen during spring 2014, in maximum of snow accumulation period, right before start of the ablation season. In 1.6m deep snow pit 14 layers were recognized. Meteorological data (temperature and wind speed) from nearby Automatic Weather Station combined with weekly snow depth probing, ablation stakes measurements and precipitation measurements from Hornsund meteorological station let to assign precise dates of formation for each layer. Measured snow water equivalent reached 630 mm, which is almost three and a half times greater value, than precipitation sum recorded in Hornsund meteorological station (10 m asl). In the record of weather and snow pit data, recognized was the rainfalls, which occurred on this altitude zone of the glacier. Obtained snow stratigraphy was unusual due to very warm winter observed in the Svalbard archipelago that season. Long influence of wet metamorphism caused creation of 3 cm thick ice layer. Chemical analyses of samples from snow pit, revealed the pH values in range from 4.05 to 5.02, which proves of occurrence acidic precipitation on Spitsbergen. Conductivity and chemical composition of particular snow layers were also measured with the ion chromatography technique. These data were compared with backward trajectories from HYSPLIT model, which allowed to identify the sources of pollutants inflow in particular layers. Major

problem for such analysis, were frequent occurrence of quite intense winter thaws, which could cause elution of pollutants from lower snow layers.

Obtained results were confronted with data gathered in the same area in spring 2006, which was the season with high level of air pollution and significant acidic snowfalls.