

Short time changes of permafrost degradation triggered by anthropogenic impact and climatic events in Yamal Peninsula, Western Siberia 2010 – 2013/2015

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The Arctic is affected by rapid climate change, which has substantial impact on permafrost regions and the world as a whole (Raynolds et al., 2014). In the last 30 years Arctic temperatures have risen 0.6 °C per decade, twice as fast as the global average (AMAP, 2011, Schuur et al., 2015). This in turn leads to the degradation of ice-rich permafrost (Grosse et al., 2011) and modifies drainage, increases mass movements and alters landscapes (Nelson et al., 2001; Anisimov et al., 2007, Romanovsky et al., 2010b).

Although permafrost regions are not densely populated, their economic importance has increased substantially in recent decades. This is related to the abundance of natural resources in the polar region and improved methods of hydrocarbon extraction, transportation networks to population centers and engineering maintenance systems (Nelson et al., 2002; Mazhitova et al., 2004, AMAP, 2011).

The Yamal Peninsula in North West Siberia is experiencing some of the most rapid land cover and land use changes in the Arctic due to a combination of climate change and gas development in one of the most extensive industrial complexes (Kumpula et al., 2006; Walker et al., 2011; Leibman et al., 2015). Specific geological conditions with nutrient-poor sands, massive tabular ground ice and extensive landslides intensify these impacts (Walker et al., 2011). The

combination of high natural erosion potential and anthropogenic influence cause extremely intensive rates of erosion (Gubarkov et al., 2014). A considerable amount of recent work has focused on the effects of industrial development to ecological and social implications (Forbes, 1999; Kumpula et al., 2010; Walker et al., 2011). This study aims at exemplarily investigating a region that has been affected by natural and anthropogenic large-scale disturbances within a very short period. The construction of the world's northernmost railway for the Bovanenkvo Gas Field was finished in 2010. In addition the region experienced an extremely warm and wet summer in 2012.

The objectives of this study are

- to map surface disturbances of central Yamal between 2010 and 2013/2015 based on high-resolution satellite imagery and on the most recent SPOT5-TAKE-5 imagery in 2015,
- to quantify natural and anthropogenic impacts in terms of permafrost degradation,
- to use meteorological data from the nearest climate station (Marre Sale, Yamal) and from reanalyses climate data on air temperature and precipitation.