



Defrosting of the Siberian permafrost zone in changing climate: recognition, diagnosis and hazard assessment

V. Melentyev (1), O. Johannessen (2), L. Bobilev (1)

(1) Nansen International Environmental and Remote Sensing Centre, St Petersburg, Russia, (2) Nansen Environmental and Remote Sensing Centre (NERSC), Bergen, Norway,
(vladimir.melentyev@niersc.spb.ru / Phone: + 7 812 234 39 24)

The objectives are to detect the patterns of global warming in the different part of Siberian Arctic and study modification of the parameters of permafrost (PF) and seasonally frozen grounds (SFG) as a natural hazard. SMMR/SSM/I microwave data have been used for charting and quantitative assessment of the scale of the defrosting and moistening on tundra/PF/boreal forest zone. Synthetic aperture radar images (satellite ERS/RADARSAT/Envisat SAR data) were attracted also. Transparency of dry snow for radio waves allows remote surveillance of sub-surfaces processes for different types of frozen grounds in the absence of influence of cloudiness and irrespective of weather conditions.

Traditional in situ land surface data including the Circumpolar Active-Layer Permafrost System (CAPS) were involved in the analysis. The thermal regime and seasonal/annual modification of the PF is studied for the vast region of the European and Siberian Arctic with coordinate 75°N/40°E - 75°N/80°E - 55°N/40°E - 55°N/80°E. Recognition of defrosting patterns of PF and SFG zone is provided relating to frozen grounds situated along the satellite track on meridian 70°E. Named transect is selected for environmental diagnostics and hazard assessment as one of the most climate sensitive geographic area in the Siberia. Note apart that by this time the studied areas are used intensively for industrial development and nowadays consequences of thawing and moistening of PF are very essential.

A numerical modelling indicates the presence of contrast of microwave emissivity and contrast of brightness temperature of different types of frozen grounds, as well its dependence on air temperature and water content. It means that microwave character-

istics can be applied for evaluation of the defrosting features of PF and SFG (thawing, moistening and degradation). Elicited fact is a basic for our study aimed on the development a methodology of satellite recognition and diagnosis of area-related frozen zone in the different part of European and Siberian Arctic.

Analysis of microwave SMMR/SSMI data allows fixing that monthly averaged brightness temperature of PF and SFG zones is a climate sensitive parameter that was used for monitoring defrosting processes and controlling of the natural hazard patterns. According to long-term 1979-1999 satellite data, the defrosting microwave retrieval trend was established and the scale of softening of frozen grounds conditions in the Jamal Peninsula and the northern part of Western Siberia was revealed. The retrieval frozen soils conditions has regional features, enhanced softening dominating in the permafrost zone. Selected zone of maximum temporal changeability of PF defrosting features are assessed as a zone of potential hazard. According to satellite instrumental studies, a seasonal warming in Siberia in 1979-1999 was mostly determined by the type of winter severity in January. Thematic interpretation allows fixing that the 65°N is the emplacement of southern limit of continuous permafrost (SLCP) that was fixed for the 70°E transect. The 66°30'N is revealed as the position of the southern limit of the PF zone containing mineralized water of the continental origin undercooled below 0°C. The studied regularities of freezing and defrosting of different types of frozen grounds in fall-winter and spring-summer seasons will be demonstrated.