



Impact of dangerous cryogenic processes on the transport infrastructure in the Arctic

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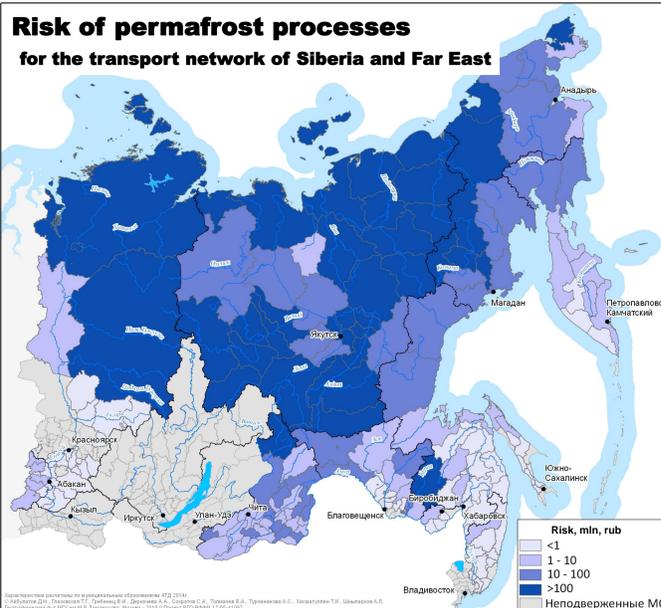
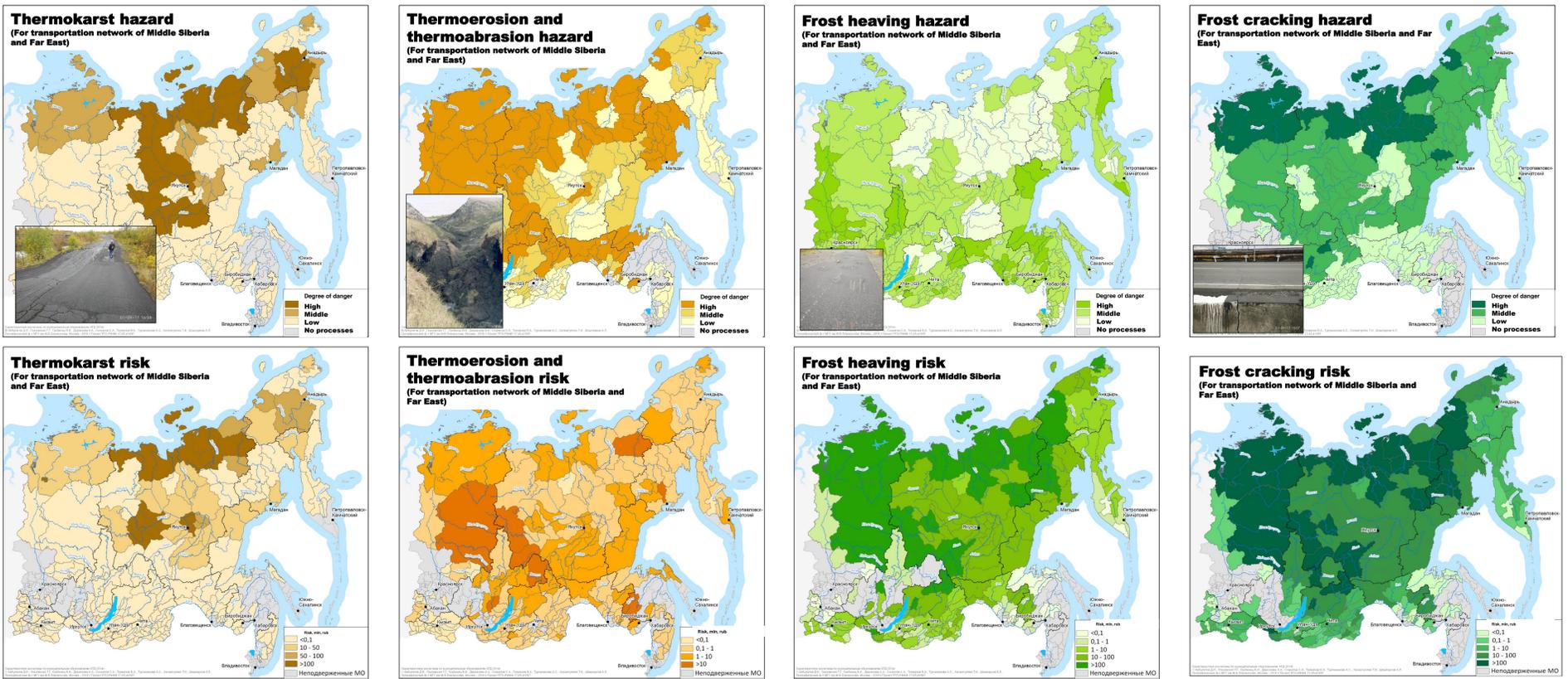
Dangerous nival-glacial and cryogenic processes and their impact on infrastructure in the Arctic (Field investigations in the Arctic)

The aim is the comparative assessment of the territories of municipalities of Siberia and the Far East in relation to their current and potential exposure to such dangerous natural processes. The latter include thermokarst, thermal erosion and thermal abrasion, frost heaving, frost cracking, icing, kurums and rock glaciers. The expected result is a contribution to the development strategy of the automobile and railways of the regions, with the dynamics of the listed dangerous natural processes accounted for.

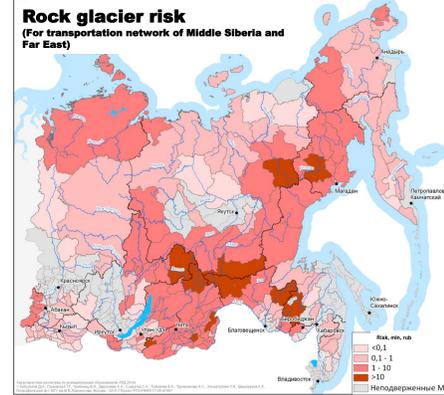
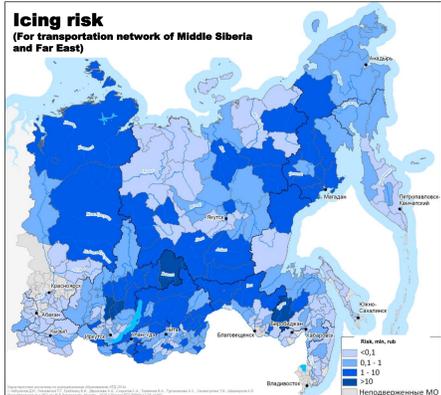
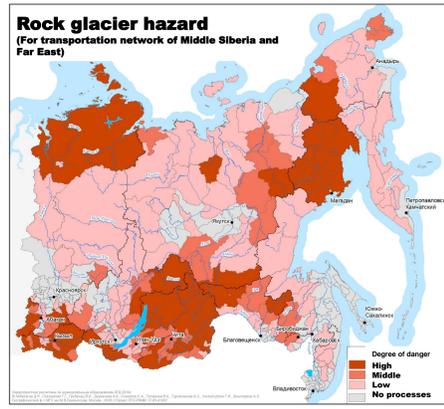
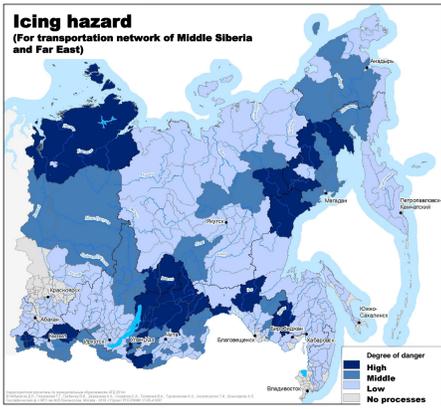
Spread, Duration and Repeatability of cryogenic processes in the Russian Arctic (Decree of the President of the Russian Federation "On Land Territories of the Arctic Zone of the Russian Federation", May, 2, 2014) (*) – municipalities partly located southern of the polar circle

Federal district	Subject of the federation	Municipality, 2014	Frost Cracking			Kurums			Frost Heaving			Icing			Thermokarst			thermoerosion&Thermoabrasion		
			Spread	Duration	Repeat ability	Spread	Duration	Repeat ability	Spread	Duration	Repeat ability	Spread	Duration	Repeat ability	Spread	Duration	Repeat ability	Spread	Duration	Repeat ability
Sibirskiy federalnyy okrug	Krasnoyarsk Krai	aimyr Dolgan-Nenets district	0.15	0.3	1	0.125	0.85	1	0.75	0.25	1	0.12	0.7	1	0.15	0.3	1	0.0007	0.3	1
Sibirskiy federalnyy okrug	Krasnoyarsk Krai	Turukhansky District	0.002	0.2	1	0.002	0.85	1	0.8	0.38	1	0.035	0.6	1	0.01	0.42	1	0.0005	0.42	1
Dalnevostochnyy federalnyy okrug	Sakha Republic (Yakutiya)	Abyysky ulus *	0.175	0.3	1	0.03	0.7	1	0.7	0.2	1	0.005	0.7	1	0.35	0.33	1	0.00025	0.33	1
Dalnevostochnyy federalnyy okrug	Sakha Republic (Yakutiya)	Allaikhovskiy ulus	0.2	0.3	1	0.002	0.9	1	0.9	0.25	1	0.0003	0.8	1	0.45	0.33	1	0.0005	0.33	1
Dalnevostochnyy federalnyy okrug	Sakha Republic (Yakutiya)	Anabar ulus	0.2	0.33	1	0.03	0.8	1	0.45	0.2	1	0.0001	0.8	1	0.3	0.33	1	0.0002	0.33	1
Dalnevostochnyy federalnyy okrug	Sakha Republic (Yakutiya)	Bulunskiy Ulus	0.2	0.33	1	0.002	0.8	1	0.9	0.15	1	0.0005	0.8	1	0.28	0.33	1	0.0005	0.33	1
Dalnevostochnyy federalnyy okrug	Sakha Republic (Yakutiya)	Verkhnekolymskiy ulus	0.15	0.33	1	0.008	0.7	1	0.65	0.17	1	0.0015	0.7	1	0.3	0.42	1	0.0005	0.42	1
Dalnevostochnyy federalnyy okrug	Sakha Republic (Yakutiya)	Verkhoyanskiy ulus*	0.15	0.33	1	0.015	0.8	1	0.5	0.15	1	0.03	0.6	1	0.075	0.42	1	0.0003	0.42	1
Dalnevostochnyy federalnyy okrug	Sakha Republic (Yakutiya)	Zhiganskii Ulus	0.1	0.33	1	0.001	0.8	1	0.8	0.25	1	0.002	0.6	1	0.18	0.5	1	0.0003	0.5	1
Dalnevostochnyy federalnyy okrug	Sakha Republic (Yakutiya)	Momskiy Ulus *	0.15	0.38	1	0.1	0.9	1	0.45	0.15	1	0.2	0.7	1	0.015	0.5	1	0.00075	0.5	1
Dalnevostochnyy federalnyy okrug	Sakha Republic (Yakutiya)	Nizhnekolymskiy ulus	0.2	0.33	1	0	0	0	0.85	0.2	1	0.0007	0.6	0.3	0.5	0.33	1	0.0005	0.33	1
Dalnevostochnyy federalnyy okrug	Sakha Republic (Yakutiya)	Olenyok ulus	0.075	0.3	1	0.015	0.9	1	0.65	0.22	1	0.003	0.7	1	0.03	0.5	1	0.00025	0.5	1
Dalnevostochnyy federalnyy okrug	Sakha Republic (Yakutiya)	Srednekolymskiy ulus*	0.1	0.33	1	0.001	0.9	1	0.65	0.2	1	0.05	0.7	1	0.45	0.5	1	0.02	0.5	1
Dalnevostochnyy federalnyy okrug	Sakha Republic (Yakutiya)	Ust-Yanskiy Ulus	0.15	0.38	1	0.01	0.9	1	0.85	0.17	1	0.0075	0.7	0.5	0.35	0.33	1	0.00075	0.33	1
Dalnevostochnyy federalnyy okrug	Sakha Republic (Yakutiya)	eno-Bytantayskiy national u	0.015	0.3	1	0.125	0.9	1	0.45	0.2	1	0.04	0.66	1	0.002	0.33	1	0.0002	0.33	1
Dalnevostochnyy federalnyy okrug	Chukotskiy autonomous okrug	Anadyr district	0.0075	0.25	1	0.01	1	1	0.65	0.3	1	0.025	0.66	1	0.2	0.42	1	0.0002	0.5	1
Dalnevostochnyy federalnyy okrug	Chukotskiy autonomous okrug	Beringovskiy district*	0.01	0.25	1	0	0	0	0.7	0.25	1	0.02	0.6	1	0.12	0.42	1	0.00025	0.5	1
Dalnevostochnyy federalnyy okrug	Chukotskiy autonomous okrug	Bilibinskiy district	0.08	0.45	1	0.08	0.7	1	0.55	0.2	1	0.1	0.7	1	0.15	0.33	1	0.002	0.4	1
Dalnevostochnyy federalnyy okrug	Chukotskiy autonomous okrug	city district Anadyr*	0.00025	0.15	0.75	0	0	0	0.6	0.33	1	0.001	0.4	0.7	0.05	0.42	1	0	0	0
Dalnevostochnyy federalnyy okrug	Chukotskiy autonomous okrug	Lulinskiy district	0.06	0.25	1	0.015	1	1	0.65	0.3	1	0.02	0.66	1	0.025	0.33	1	0.00015	0.4	1
Dalnevostochnyy federalnyy okrug	Chukotskiy autonomous okrug	Providenskiy district	0.0075	0.3	1	0.02	0.7	1	0.75	0.25	1	0.01	0.75	1	0.03	0.42	1	0.0003	0.5	1
Dalnevostochnyy federalnyy okrug	Chukotskiy autonomous okrug	Chaunskiy district	0.005	0.42	1	0.08	0.7	1	0.8	0.25	1	0.008	0.6	1	0.15	0.33	1	0.00015	0.33	1
Dalnevostochnyy federalnyy okrug	Chukotskiy autonomous okrug	Chukot district	0.05	0.33	1	0.03	0.7	1	0.85	0.33	1	0.01	0.75	1	0.15	0.33	1	0.0005	0.4	1
Dalnevostochnyy federalnyy okrug	Chukotskiy autonomous okrug	Shmidtovskiy district	0	0.38	1	0.02	0.7	1	0.7	0.2	1	0.03	0.8	1	0.05	0.33	1	0.0002	0.33	1

Cartographic display of hazard and risk assessment results for the eastern part of the permafrost zone of Russia



The required for overall understanding of the situation the integral hazard and the integral risk can also be calculated in different ways. The most obvious approach is the expert assessment of the relative "weight factor" for the analyzed hazardous natural processes and phenomena. Moreover, the danger and risk will be different for different objects of infrastructure. In the case of the transportation network (railways and auto roads) and extracting the geocryological processes from whole the list:



Conclusions

Mass deformations of buildings and structures in the cryolithozone are caused by a complex of geological, geographical, and economic and social reasons that manifest themselves primarily in the intensification of dangerous cryogenic processes. The degree of infestation of territories with this or that permafrost process ranges from 0 to 85%. Infrastructure is most at risk in regions with a wide range of ice-rich soils, as well as significant dissection of the relief. The multi-scale, multi-temporal and multi-directional nature of cryogenic processes in built-up areas creates an intricate mosaic of influence that is complicated by noticeable trends to climate change.