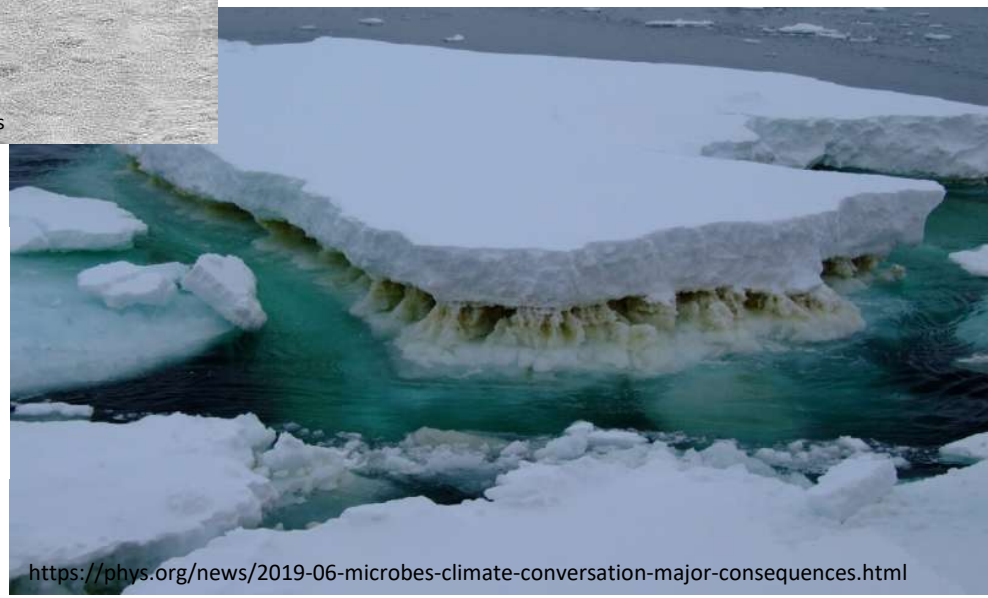
https://www.straitstimes.com/world/melting-arctic-permafrost-may-release-diseases Photo:Reuters

WHAT DO WE KNOW?

Exploring the Potential Risk of Human and Animal Exposure to Threats

infectious pathology



https://phys.org/news/2019-06-microbes-climate-conversation-major-consequences.html

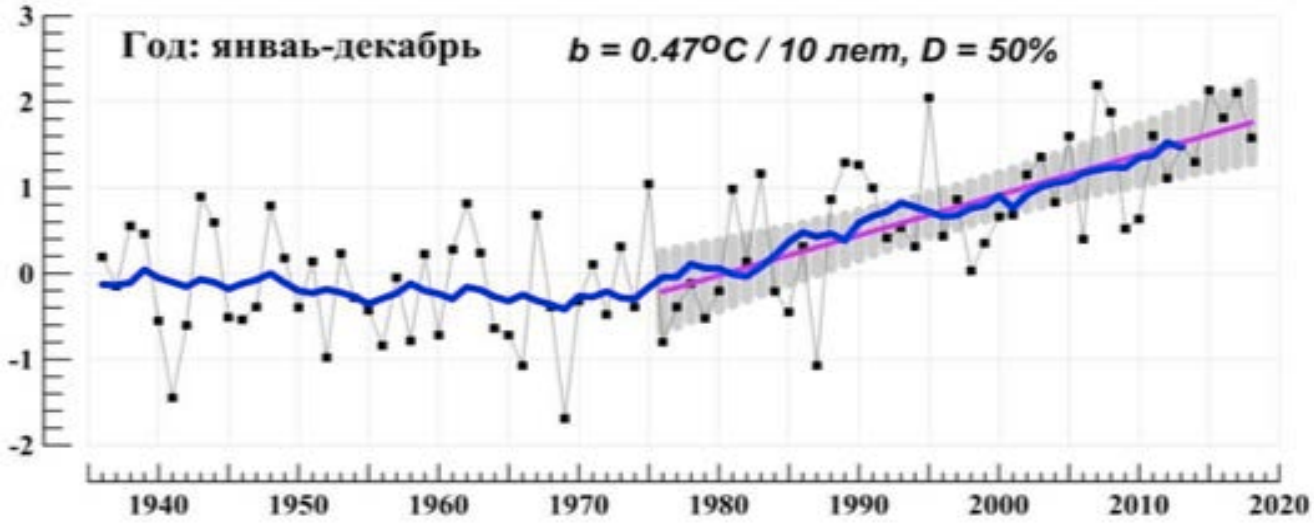
Pshenichnaya Natalia

MD, Dsci., Prof.
National Medical research Center of Phthiziopulmonology and Infectious Diseases,
Moscow, Russia

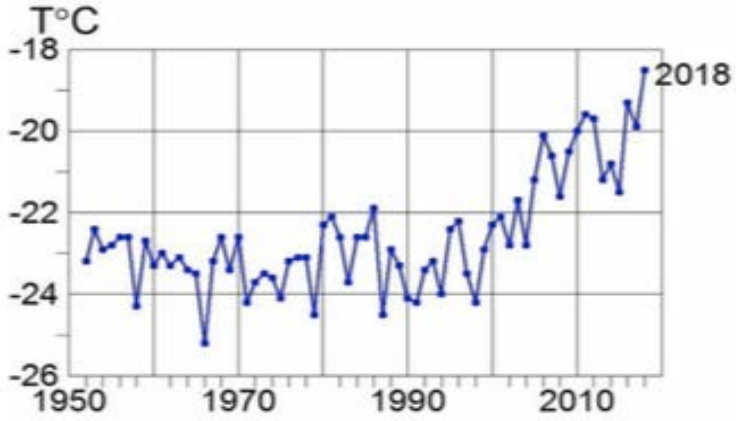
Understanding and Responding to Global Health Security Risks from Microbial Threats in the Arctic: A Workshop

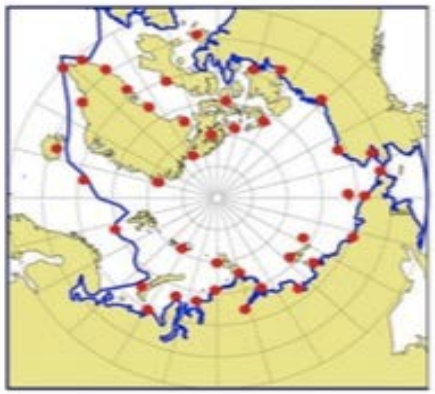
Hannover, Germany, November 6, 2019 – November 7, 2019

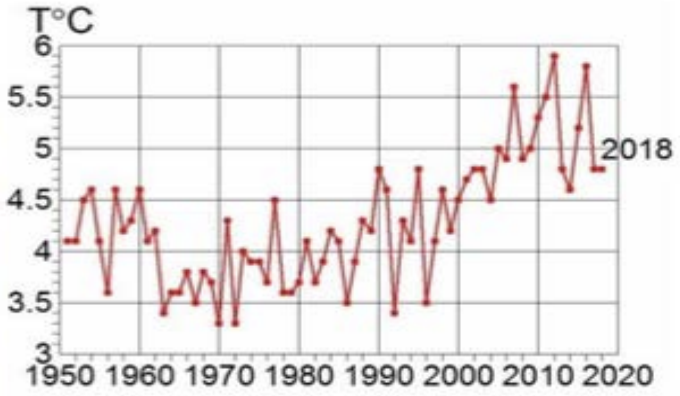
Climate warming in Russia (1930-2020)



Annual surface air temperature anomalies (°C), averaged over the territory of Russia, 1936-2018





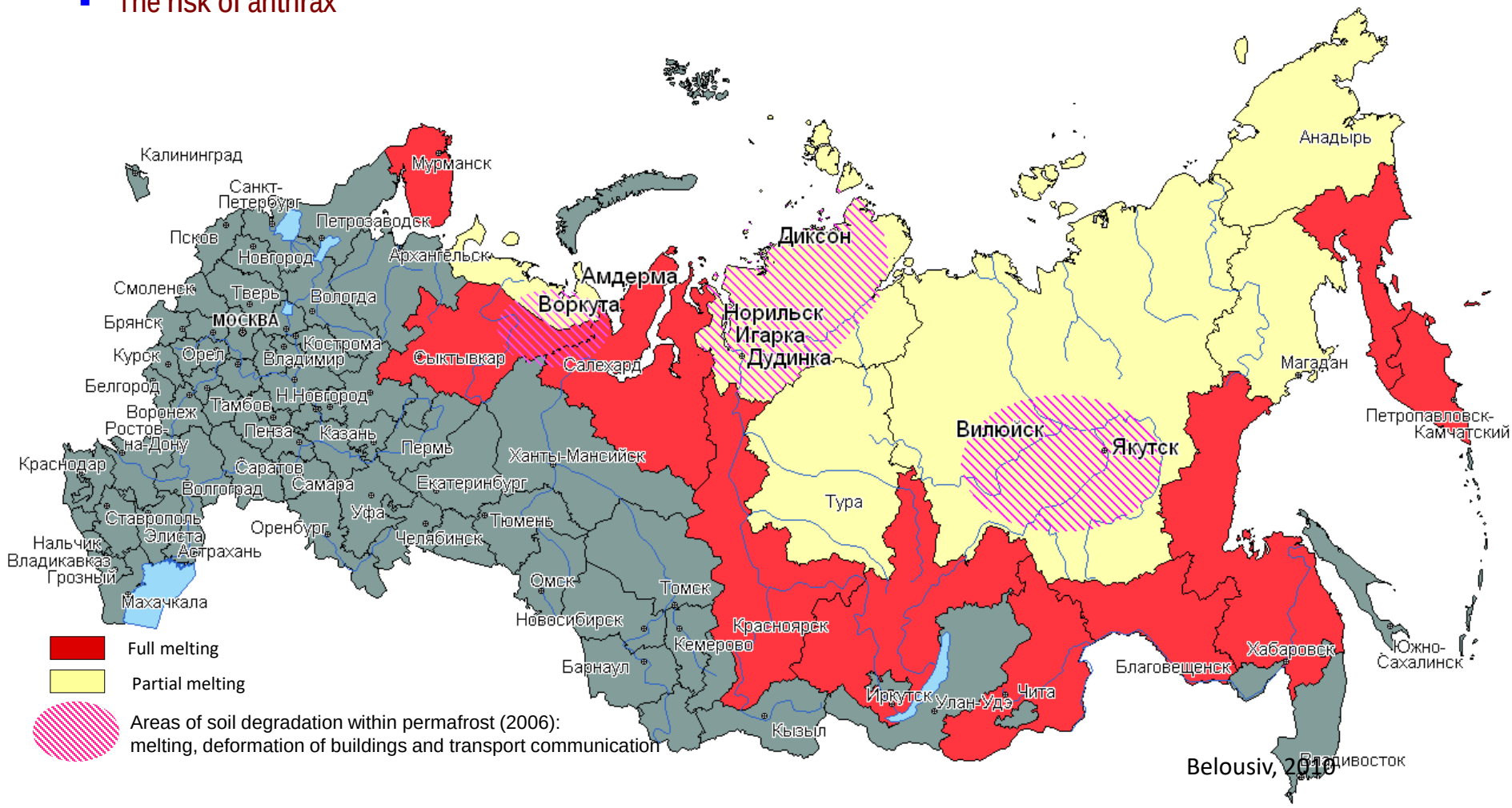


Annual surface air temperature anomalies (°C) winter and summer in the marine Arctic 1936-2018

Roshydromet report, 2018 http://www.meteorf.ru/upload/pdf_download/o-klimate-rf-2018.pdf/

Permafrost melting

- Risks to human health
- Transport interruptions
- Difficulty in accessing health care
- Insulation
- Destruction of infrastructure
- The risk of anthrax



Belousiv, 2010

Permafrost melting – risk of release of dangerous known microorganisms from graves

- Influenza H1N1 (spanish flu) (Alaska)

- plague (theoretically)

- anthrax (Siberia)

http://www.bbc.com/earth/story/20170504-there-are-diseases-hidden-in-ice-and-they-are-waking-up

July-August
2016 – epizootic among the reindeer
and an anthrax outbreak
among the indigenous inhabitants of Yamalo-Nenets
Autonomous Okrug
(24 confirmed, including 1 lethal)

Photo: Zubov L.A.

Permafrost melting – risk of release of ancient microorganisms

Viable prokaryotic and eukaryotic microorganisms can persist in conditions of permafrost from several thousand to 2-3 million years.

The following microorganisms were isolated from permafrost:

- aerobes (Zvyagintsev D. G. et al., 1985; Vorobyova E. Et al., 1997);
- anaerobes (Rivkina E., 2007),
- green and blue-green microalgae (Vishnivetskaya T. A., 1997)

(Methanosarcina mazei strain JL01 VKM B-2370, Methanobacterium sp. strain M2 VKM B-2371 and Methanobacterium sp. strain MK4 VKM B-2440 Methanosarcina mazei strain JL01 VKM B-2370 - , Methanobacterium sp. strain M2 VKM B-2371 and Methanobacterium sp. strain MK4 VKM B-2440 – released for the first time) ,

- yeast (Faizutdinova R. et al., 2005),
- mycelial fungi (Kochkina G. A. et al., 2001),
- viable cysts of free-living protozoa (Shatilovich A.V. et al., 2010)

Some of them can be resistant to natural antibiotics

The awakened bacteria will begin to produce carbon dioxide, methane, and other gases and lead to even greater climate warming

Звягинцев Д.Г., Гиличинский Д.А., Благодатский С.А. и др.Длительность сохранения жизнеспособных микроорганизмов в постоянно мерзлых осадочных породах и погребенных почвах // Микробиология, 1985, т. 54, с. 153–163.

Vorobyova E., Soina V., Gorlenko M. et al. The deep cold biosphere: facts and hypothesis // FEMS Microbiol. Rev., 1997, No. 20, p. 277–290.

Rivkina E., Shcherbakova V., Laurinavichuis K. et al. Biogeochemistry of methane and methanogenic archaea in permafrost // FEMS Microbiol. Ecol., 2007, No. 61, p. 1–15.

Вишнивецкая Т.А., Ерохина Л.Г., Гиличинский Д.А., Воробьева Е.А. Синезеленые и зеленые водоросли из вечномерзлых осадочных пород Арктики // Криосфера Земли, 1997, т. I, № 2, с. 71–76.

Faizutdinova R., Suzina N., Duda V. et al. Yeasts Isolated from Ancient Permafrost // Life in Ancient Ice. Princeton, Princeton Univ. Press, 2005, ch. 8, p. 118–126.

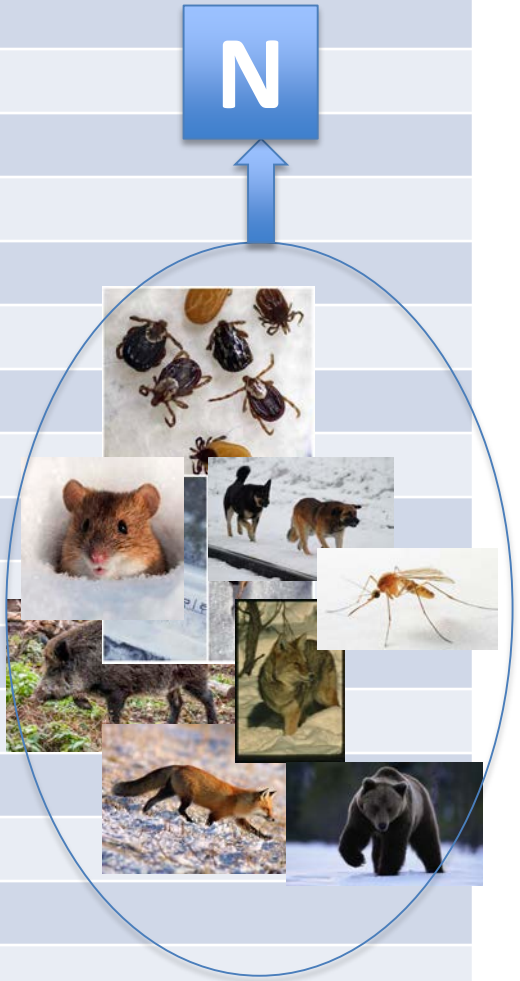
Кочкина Г.А., Иванушкина Н.Е., Карасев С.Г. и др. Выживание микромицетов и актинобактерий в условиях длительной природной криоконсервации // Микробиология, 2001, т. 70, № 3, с. 412–420.

Шатилович А.В. Жизнеспособные простейшие в вечной мерзлоте Арктики /, Л.А. Шмакова , С.В. Губин, Д.А. Гиличинский // Криосфера Земли, 2010, т. XIV, № 2, с. 69–78.

https://www.vox.com/2017/9/6/16062174/permafrost-melting

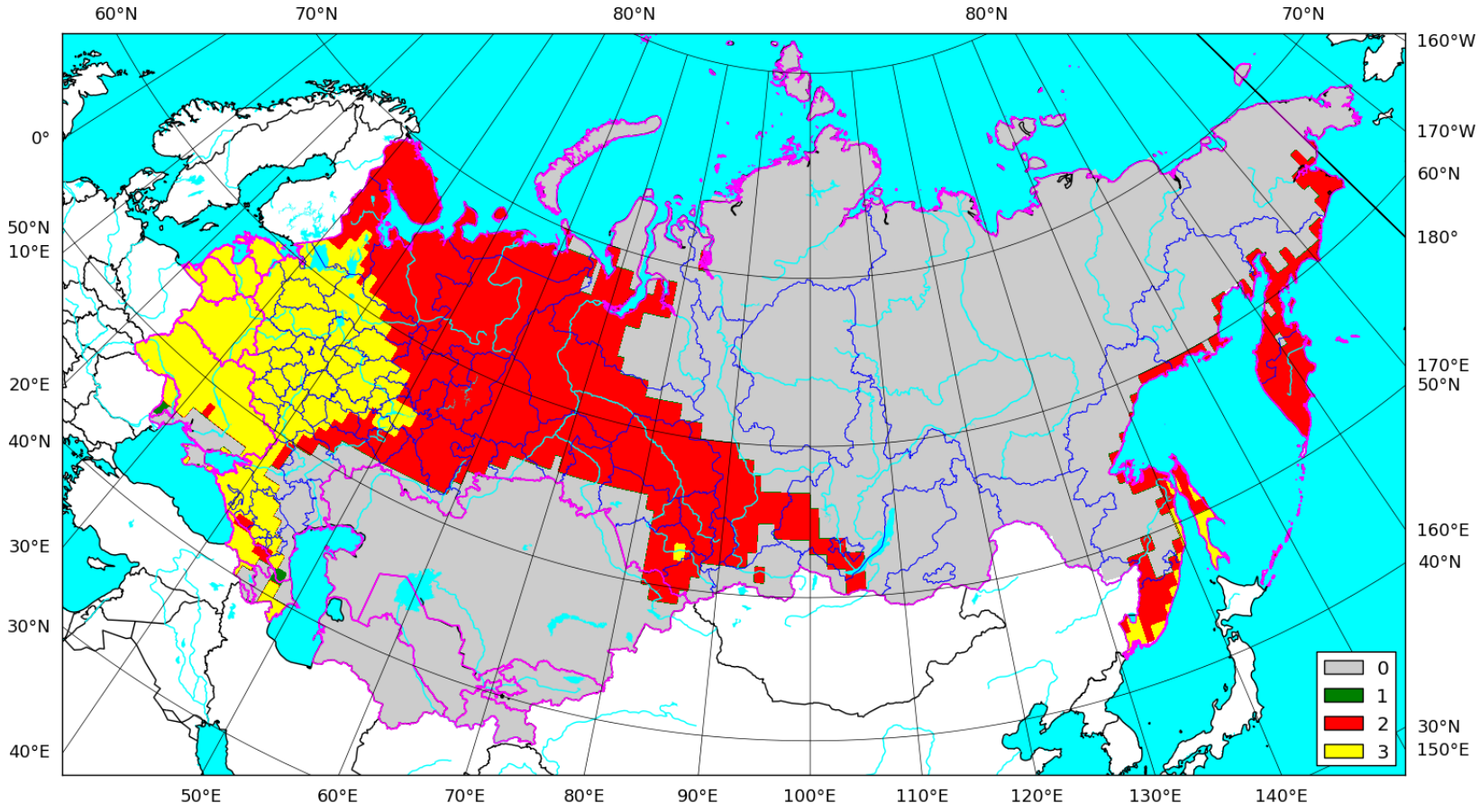
Climate-Dependent infectious diseases with focus with a focus on the North

Возбудители	Нозологии
Vector-borne diseases (zoonosises)	
Viral	Tick-borne encephalitis
	West Nile fever
	Hemorrhagic fever with renal syndrome
	Karelian fever caused by Sindbis virus
	Rabies
	Chikungunya
Bacterial	Lyme disease
	Tularemia
	Brucellosis
	Anthrax
Parasitic	Echinococcosis
	Trichinosis
	Dirofilariasis
Anthroponosises (fecal-oral transmission)	
	Hepatitis A
	Infectious diarrhea (viral and bacterial), etc….



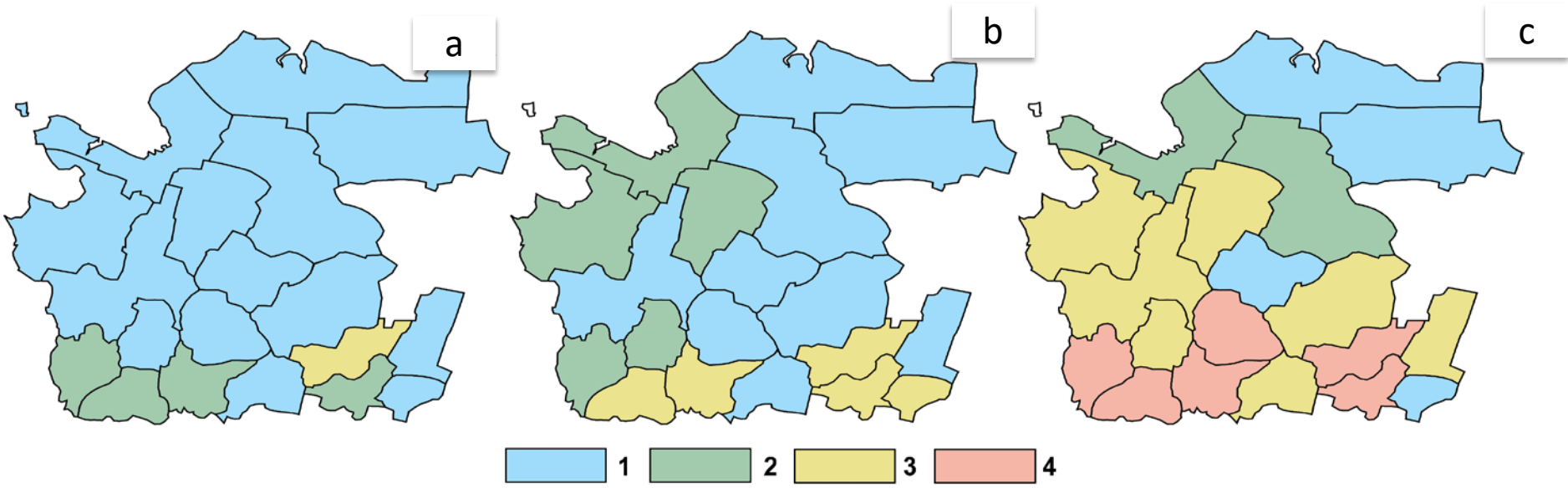
Tick-borne encephalitis in the North of Russia

Expected changes in the climatic habitat of the Ixodes ricinus on the territory of Russia and neighboring countries by the period 2080-2099 compared to 1981-2000 for multimodel climate in the extreme scenario RCP8. 5. Designations: 0-out of habitat , 1-reduction of habitat , 2-expansion of the habitat , 3-common habitat for both periods

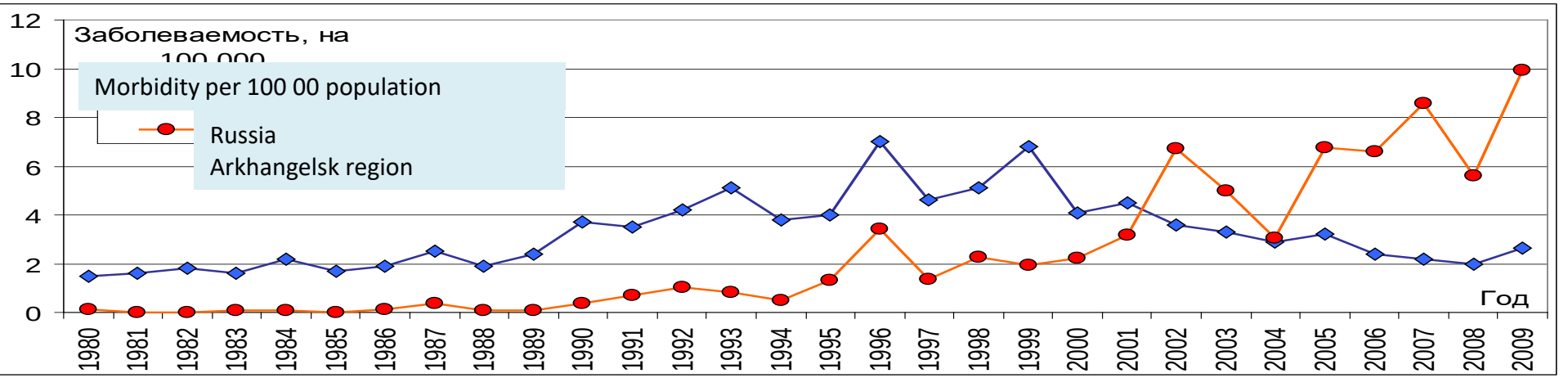


Popov I.O.Climatic changes of autecological habitats of Ixodes ricinus and Ixodes persulcatus in Russia and CIS countries, PhD thesis, Moscow 2016
http://old.timacad.ru/catalog/disser/kd/popov/disser.pdf

TBE morbidity in the Arkhangelsk region of Russia



a - 1980-1989, b - 1990-1999, c - 2000-2009 TBE incidence rate: 1 - 0.0-0.1 2 - 0.1-1.0 3 - 1-10 4 - 10-100 per 100,000 population.

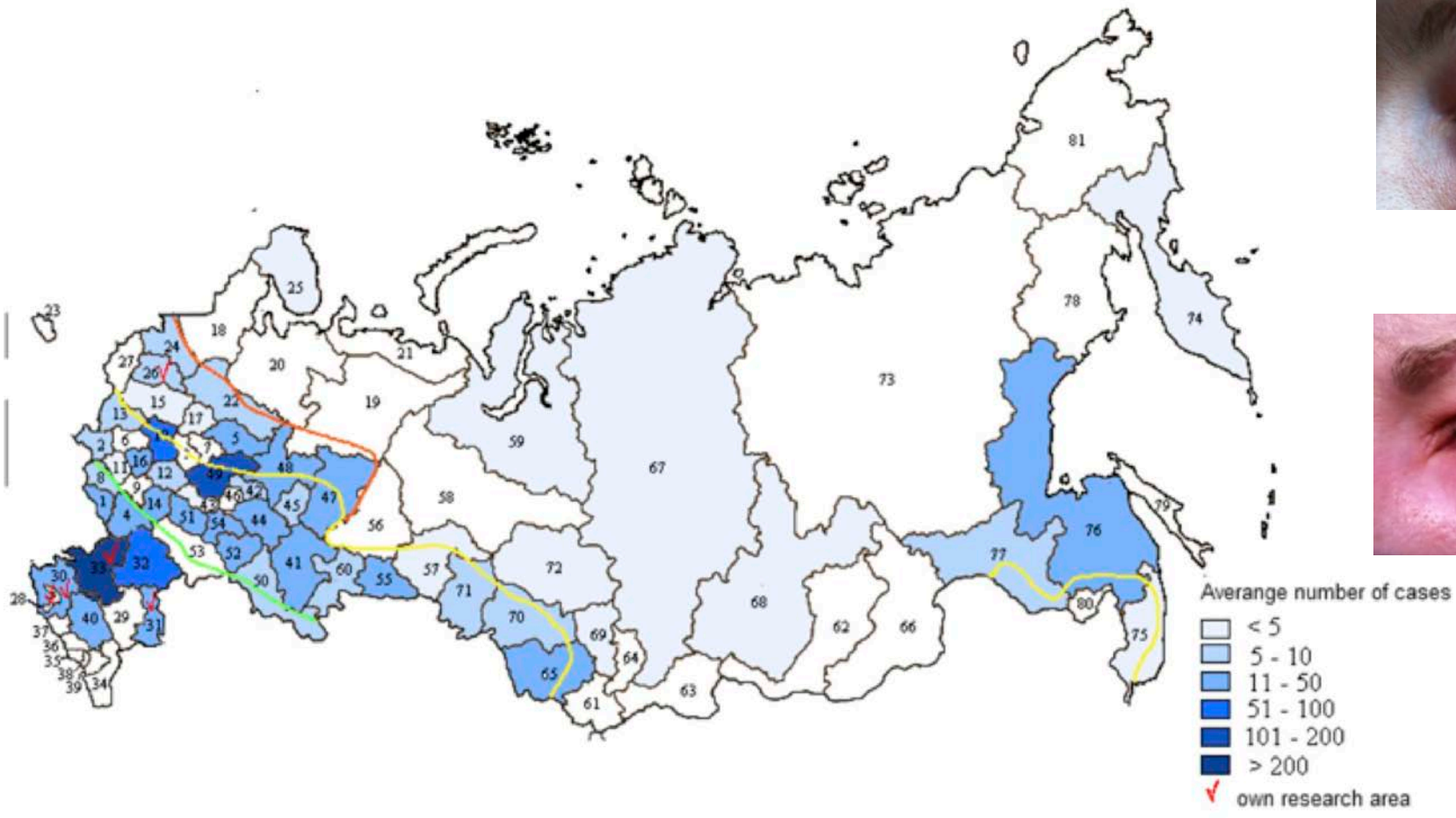


Balaeva T. V., Boltenkov V. P., Buzinov R. V., Bushueva V. A., varakina Zh. l. Pshenichnaya N. Yu., Revich B. A. et al. Assessment of vulnerability and ability of health adaptation to climate change in the Arkhangelsk region and the Nenets Autonomous district of the Russian Federation / T. V. Balaeva, V. P. Boltenkov, R. V., Buzinov," et al. " Tver: Triad, 2012. 90 PP.

Changing the model habitat of Ae. albopictus (B) in accordance with the scenario of extreme anthropogenic impact on the climate system for the period 2080-2099. in comparison with the period 1981-2000.

Yasyukevich V.V. et al. ADVENTIVE TYPES OF AEDES IN THE RUSSIAN TERRITORY — RISK ASSESSMENT OF THE NEW BIOLOGICAL THREAT TO HEALTH OF THE POPULATION OF RUSSIA // Problems of ecological monitoring and modeling of ecosystems. - 2017. - V. 28. - No. 3. - S. 51-71.

Dirofilariasis-journey from South to North



Borders of zones of potential risk for contamination of human by D. repens (according to Darchenkova N.N., 2009)

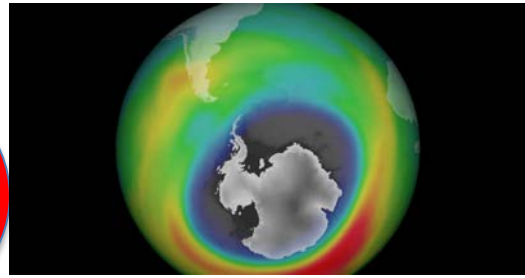
zone of low risk. zone of moderate risk. zone of sustainable risk

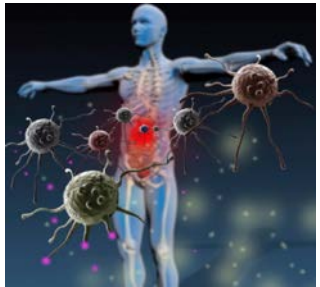
Ermakova, L. A., Nagorny, S. A., Krivorotova, E. Y., Pshenichnaya, N. Y., & Matina, O. N. (2014). Dirofilaria repens in the Russian Federation: current epidemiology, diagnosis, and treatment from a federal reference center perspective. *International Journal of Infectious Diseases*, *23*, 47-52.

Other factors, which influence on the infectious diseases in th North

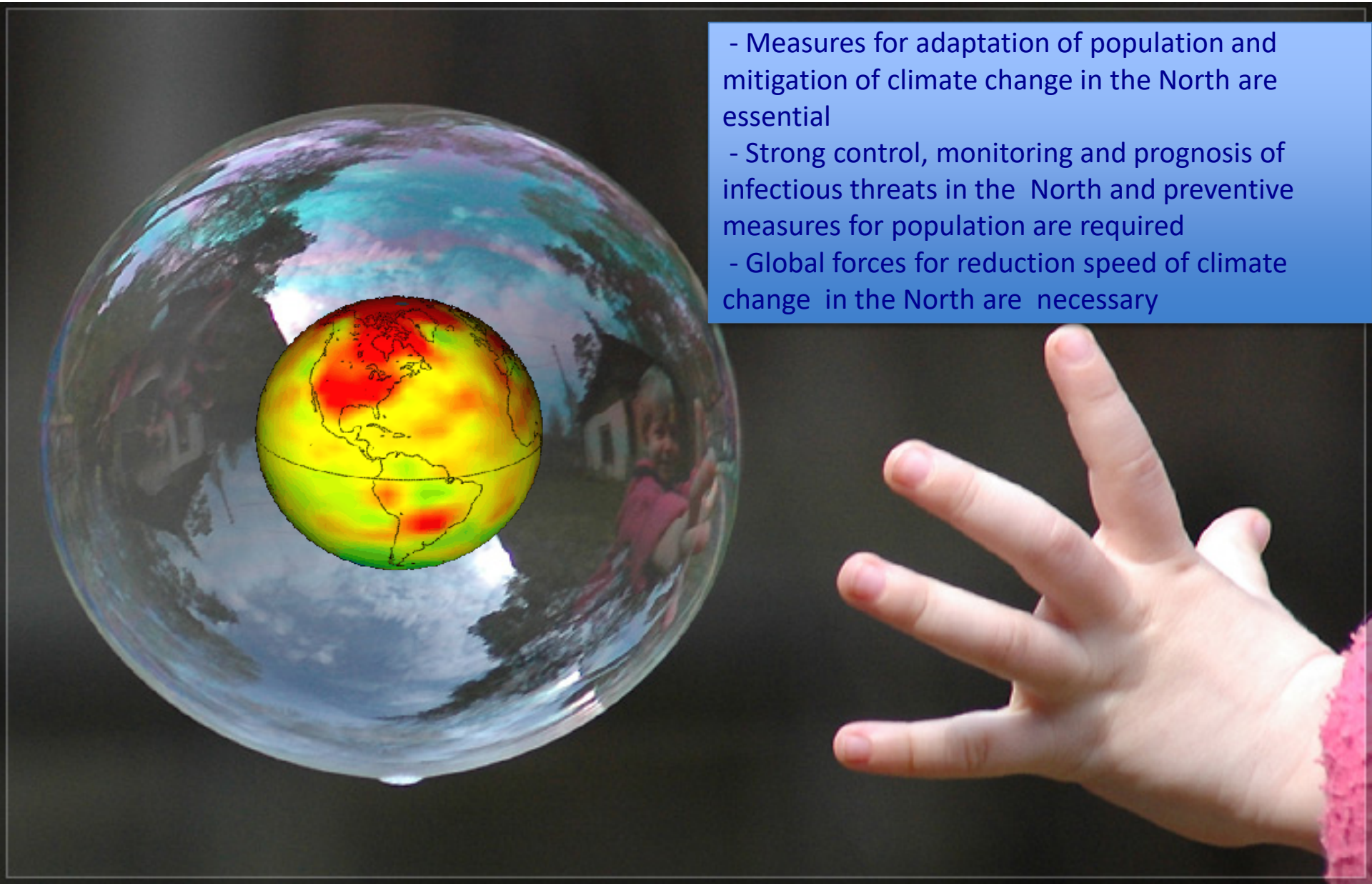
1.Occurrence and expansion of ozone holes
2.Increased air pollution, the emergence of new species of flora
3.Increasing the duration of high temperatures, the number of heat waves:
- growth of allergy,
- reduction of factors of innate immunity,
- stress

Increase susceptibility to any infectious diseases, particularly, infectious of respiratory tract:
- acute respiratory infections,
- pneumonia





Epidemiological well-being in a changing climate is illusory!!!



- Measures for adaptation of population and mitigation of climate change in the North are essential
- Strong control, monitoring and prognosis of infectious threats in the North and preventive measures for population are required
- Global forces for reduction speed of climate change in the North are necessary

Only together we can find a solution!

Thank you for attention!