Yamal Peninsula Anthrax Outbreak: Climate Change and Infectious Diseases

John Faller
Jane Dmochowski, ENVS 301

Abstract

Global climate change has many associated risks, one of which being an increased incidence of infectious diseases due to shifting climates and animal-human interactions. The 2016 anthrax outbreak on the Yamal Peninsula in Northwest Siberia that killed 2,350 reindeer and one human is an example of this increasing risk. The outbreak has been linked to a variety of factors, from climate conditions to the cessation of human attempts to monitor wildlife health. The most alarming fact to arise from this event is that the anthrax surfaced from thawing permafrost, and similar outbreaks are likely to occur in the future due to shifting temperature and precipitation patterns.

Figure 1: A veterinarian checks reindeer for anthrax on the Yamal Peninsula after the outbreak.

Background

- Anthrax is an epizootic disease that impacts many different species of animals, primarily grazing animals
- Anthrax spreads through spores that are resistant to environmental factors and can remain dormant for extended periods of time
- The Russian government halted reindeer anthrax vaccinations in 2007 after the bacteria was effectively eliminated from the region
- Irregular precipitation patterns in prior years and higher temperatures in the months preceding the outbreak increased the rate of thawing and led to the anthrax spores being reactivated
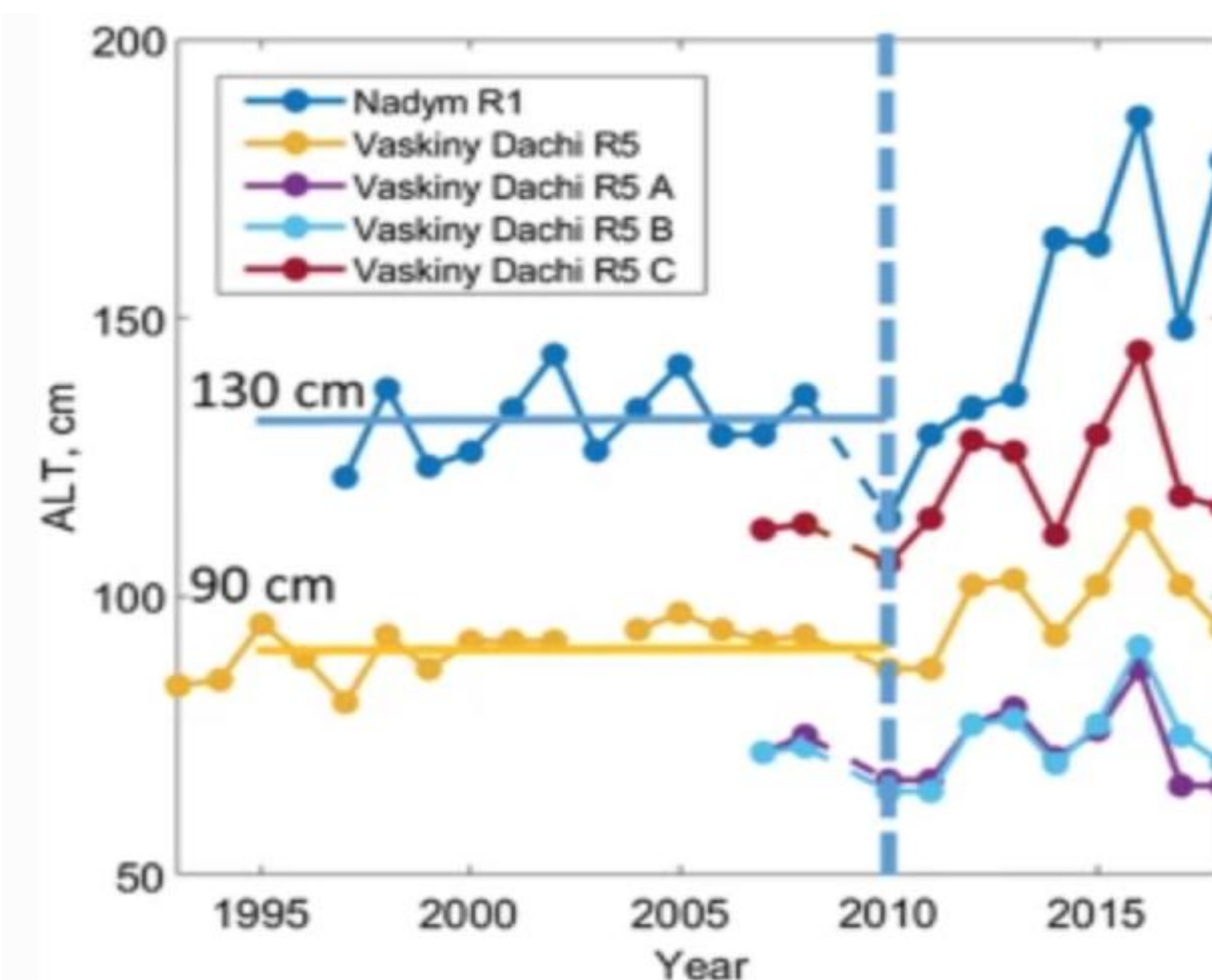
Stakeholders

- Inhabitants of Siberia, including the indigenous Nenets people
- Russian and international public health officials
- Climate scientists
- Infectious disease experts
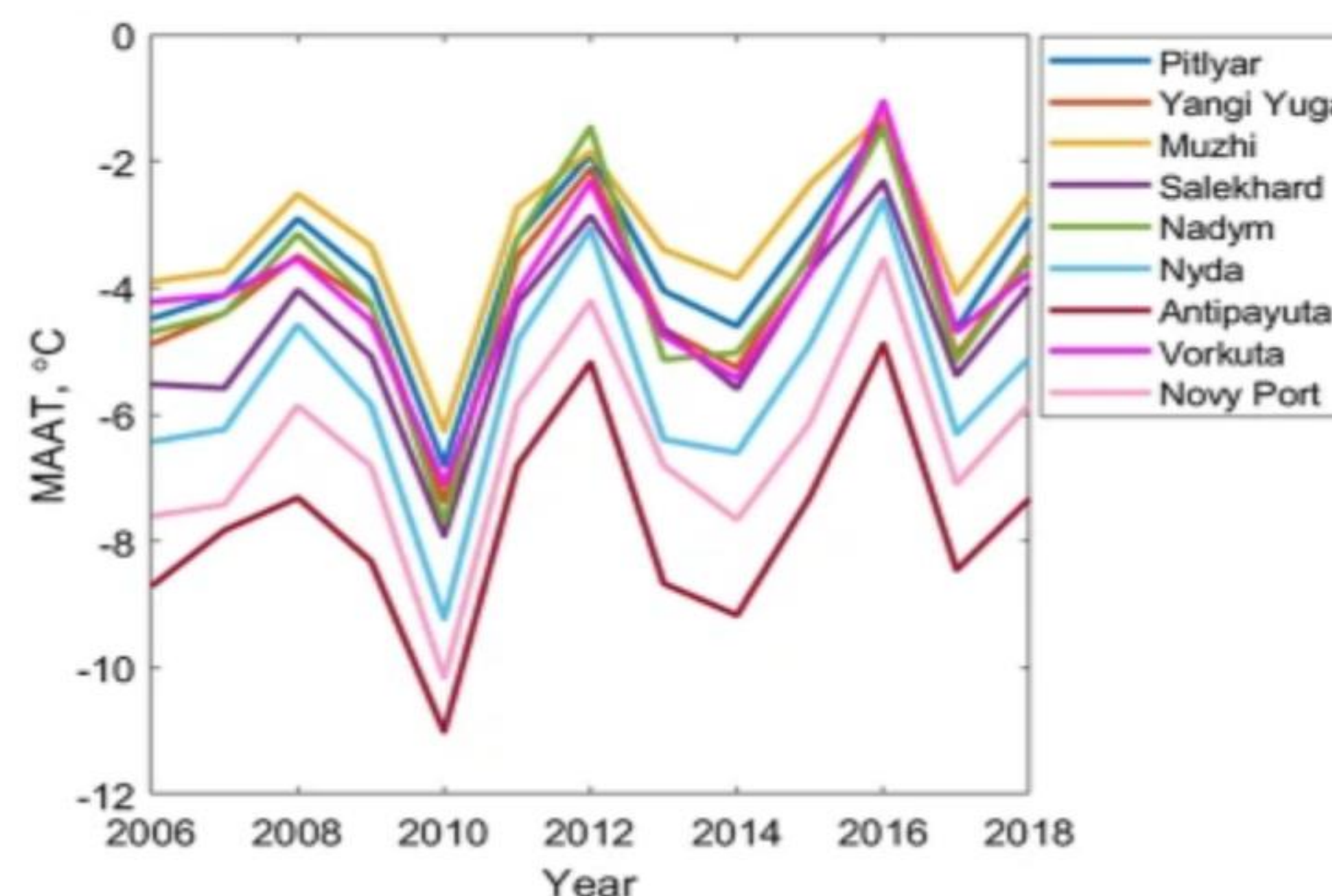- Russian wildlife and wildlife officials
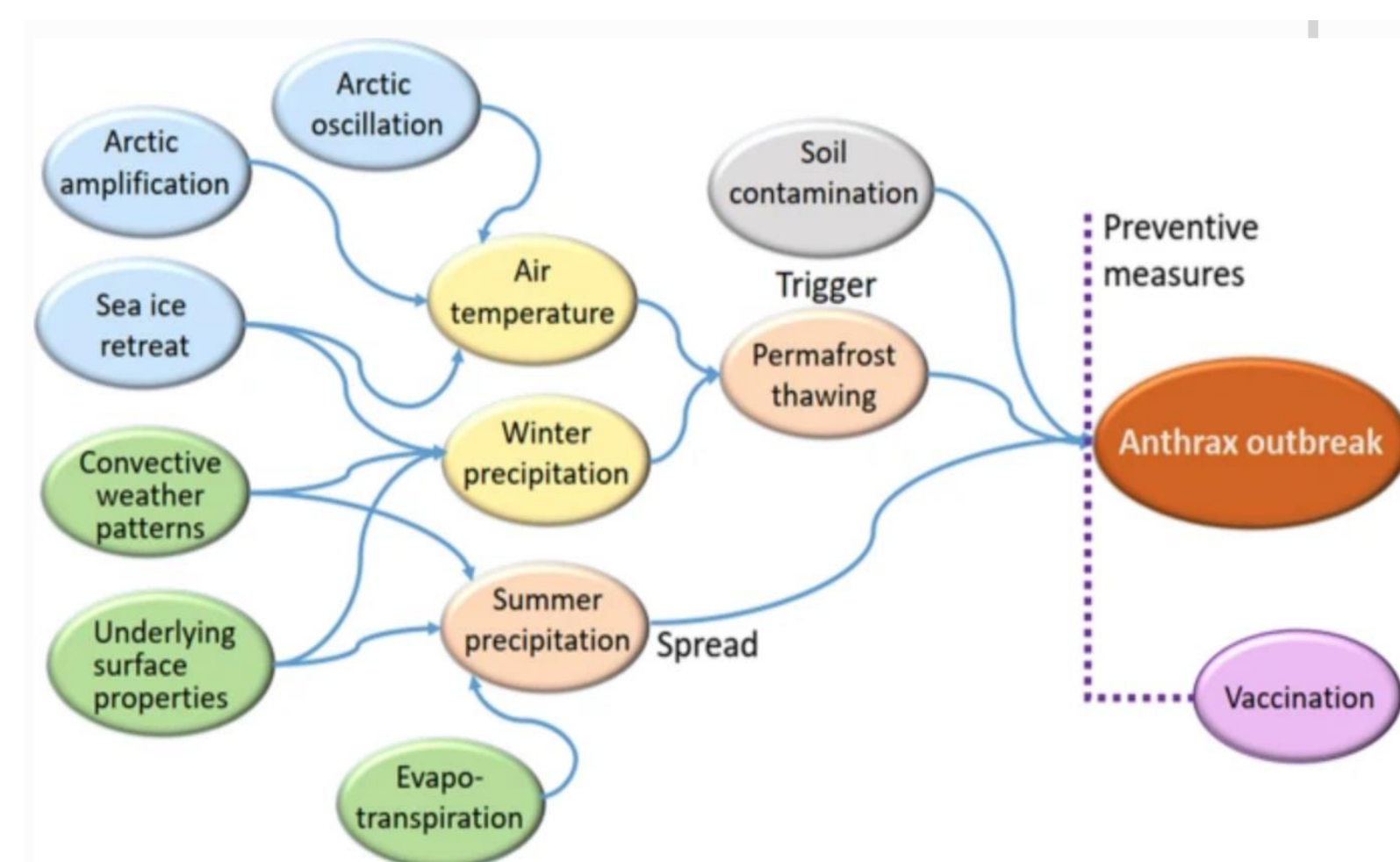
Figure 2: A flowchart of how climatic factors affect the development of an anthrax outbreak. Copied from (Ezhova et. al., 2021).

Details and Data

Figure 3: Active layer thickness (ALT) of locations near the outbreak area. ALT is a parameter that describes the maximum annual thaw depth of permafrost. Copied from (Ezhova et. al., 2021).


Figure 4: Mean average air temperatures (MAAT) for locations across northern Russia and Siberia. The graph depicts a peak temperature in 2016. Copied from (Ezhova et. al., 2021).
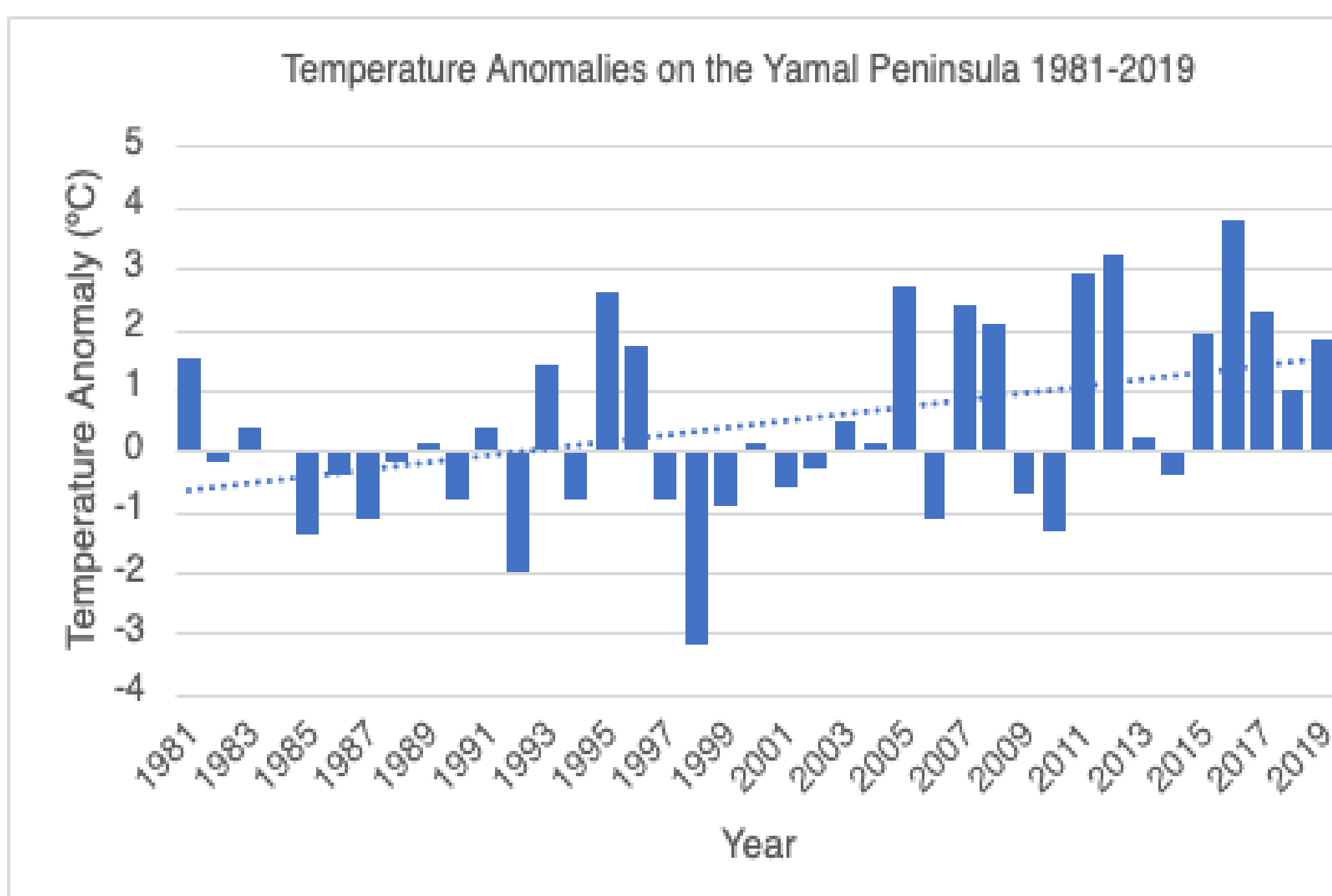
Figure 5: Yearly temperature anomalies on the Yamal Peninsula, relative to the mean air temperature of the 1981-2010 reference period. Data are from the Copernicus Climate Change Service's ERA5 atmospheric reanalysis program.

Response

Appropriate steps taken by stakeholders to control the outbreak and learn about its implications. A roadmap for officials confronting shifting climates and infectious diseases.
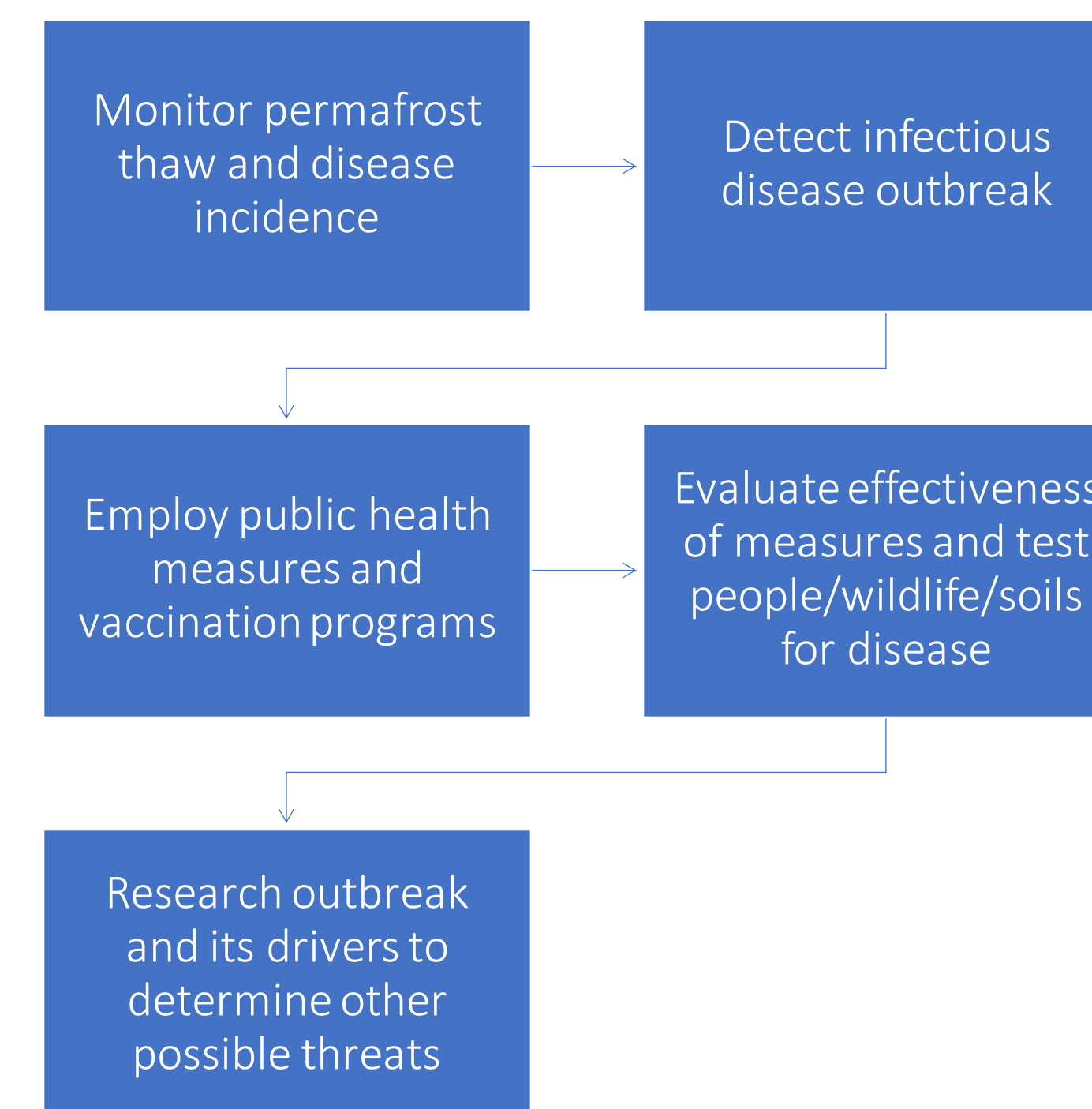
Conclusions

- Shifting precipitation and temperature patterns due to climate change will increase the incidence of disease outbreaks from thawing permafrost in the future
- Russia restarted the reindeer vaccination program following the outbreak to reduce the risk of future anthax outbreaks
- Russian officials considered culling reindeer populations, however this would hurt the indigenous Nenets people's livelihood
- There is uncertainty regarding other diseases that could be unearthed from thawing permafrost, so greater monitoring and research is required

Lesson Plan

Objectives
- Climate and infectious diseases
- Mitigation and adaptation

Pre-Class
- Read case study and supporting articles
- Answer background questions

In-Class
- Research climate-sensitive diseases in small groups
- Present findings to class

Sources
https://link.springer.com/article/10.1007/s10393-021-01549-5
https://cds.climate.copernicus.eu/cdsapp#!/software/app-era5-explorer?tab=app
https://www.abc.net.au/news/2016-08-11/scientists-warn-anthrax-just-one-threat-as-russian-permafrost-m/7720362
https://www.frontiersin.org/articles/10.3389/fvets.2021.668420/full#B40
https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report.pdf