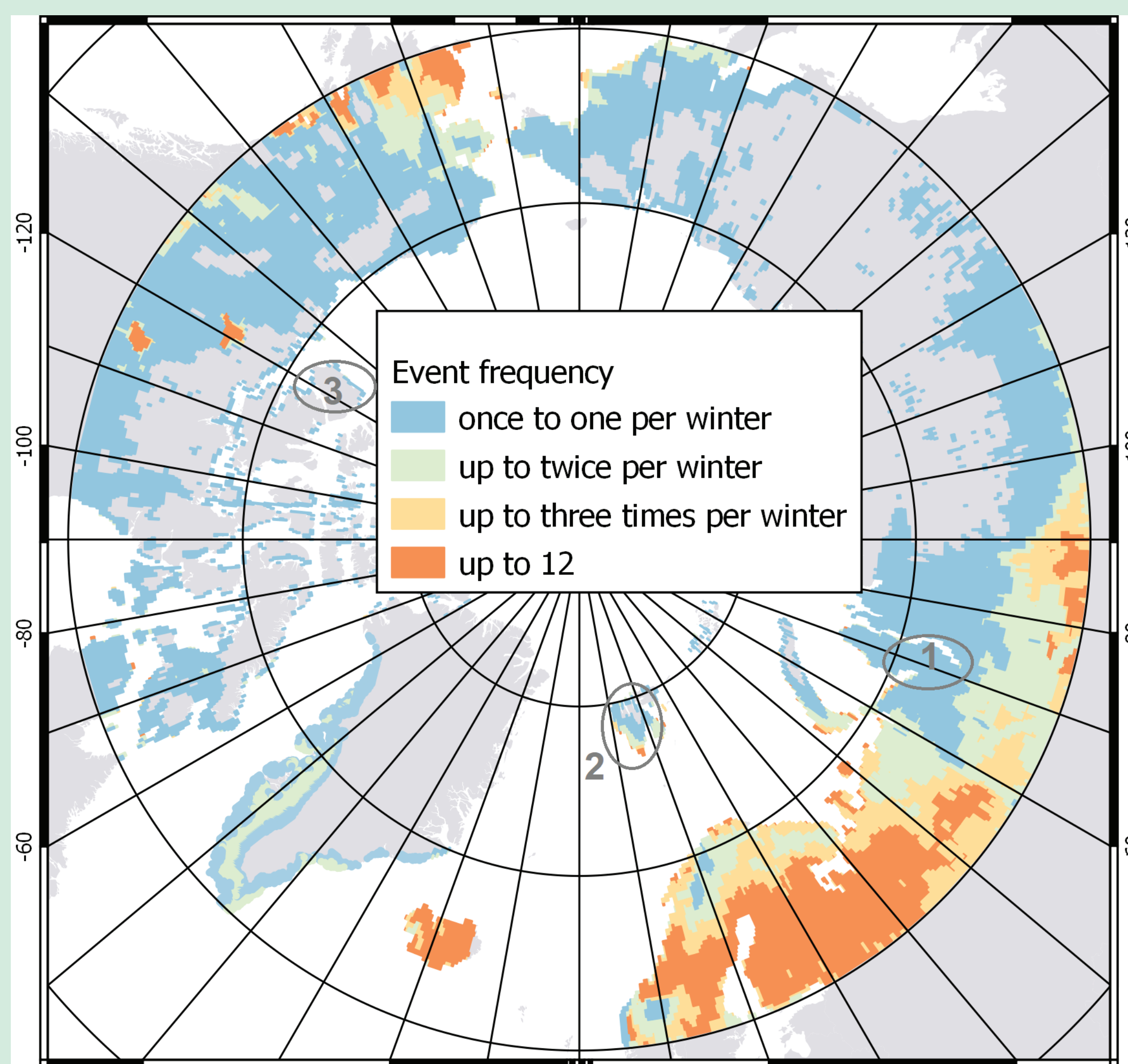




# Arctic Rain on Snow Events: Bridging Observations to Understand Environmental and Livelihood Impacts

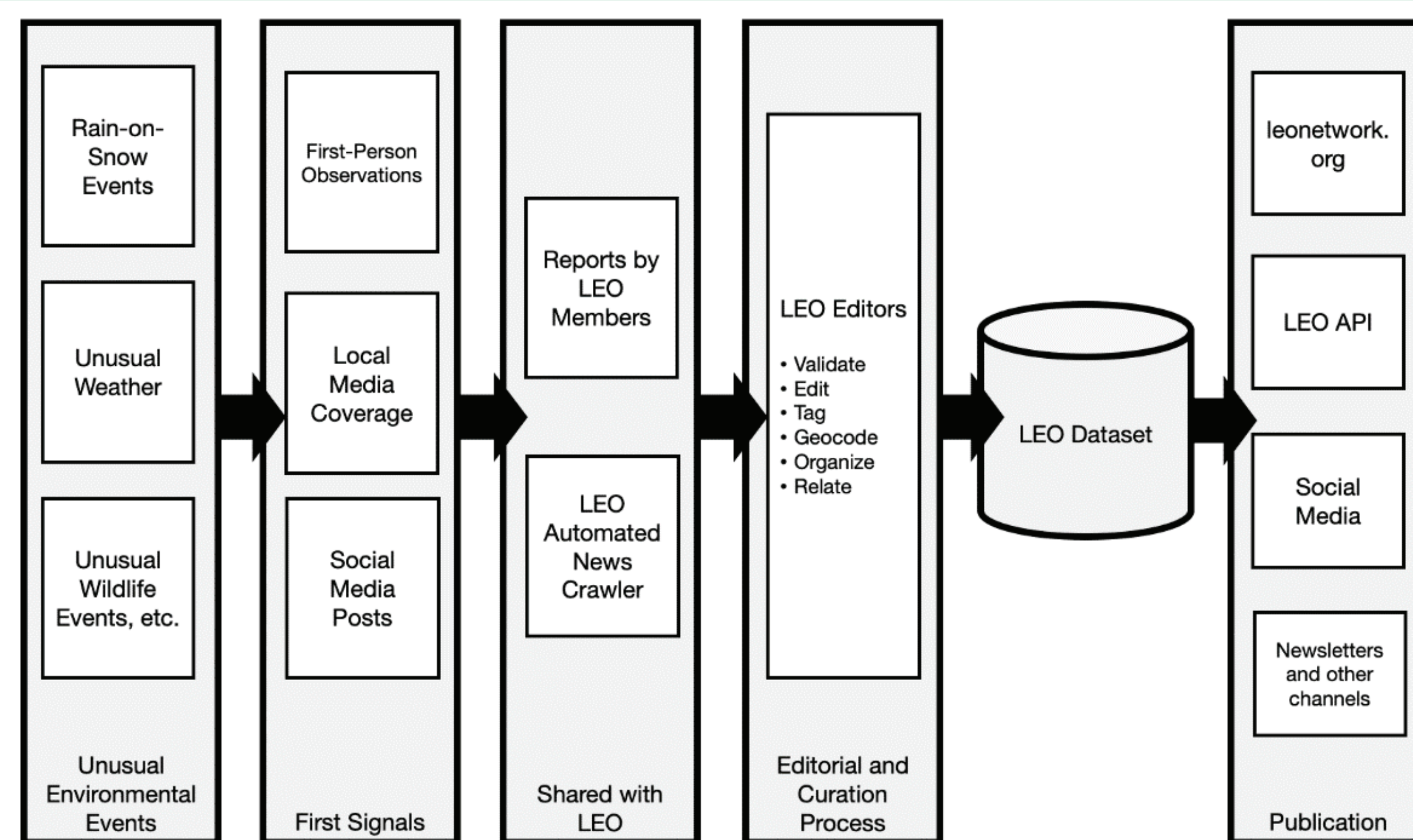
Mark C. Serreze, Julia Gustafson, Andrew Barrett, Matthew Druckenmiller, Shari Fox, Julienne Stroeve, Jessica Voveris, Betsy Sheffield, Bruce C. Forbes, Sirpa Rasmus, Roza Laptander, Mike Brook, Mike Brubaker, Michelle McCrystall, Annett Bartsch



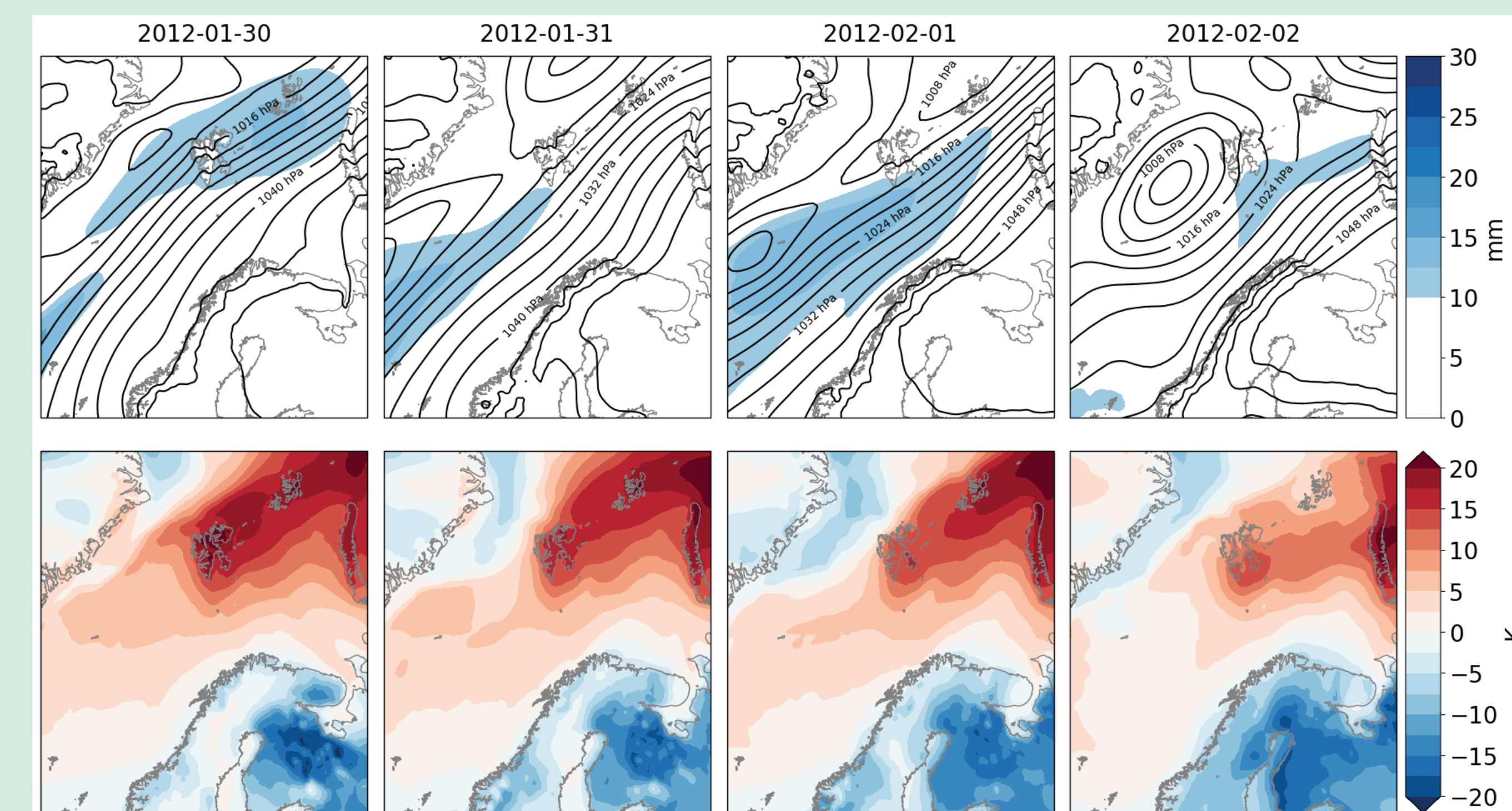
ROS detection makes use of satellite data, atmospheric reanalyses and surface observations including Indigenous and local knowledge. This figure shows potential ROS events per year for November through February of the winters 2000/1–2008/9 dB as detected with Ku-band QuikSCAT (Bartsch 2010, Bartsch et al., 2010; Freund and Bartsch 2020).

## The Arctic Rain on Snow Study (AROSS)

Rain on Snow (ROS) events occur when rain falls onto an existing snowpack and freezes, forming a hard ice crust. These events can foster avalanches, influence snow structure, warm underlying permafrost, and lead to large animal die-offs. There is increasing recognition that Arctic ROS events are becoming more common with significant and sometimes even catastrophic impacts on the physical and living environments of the North.



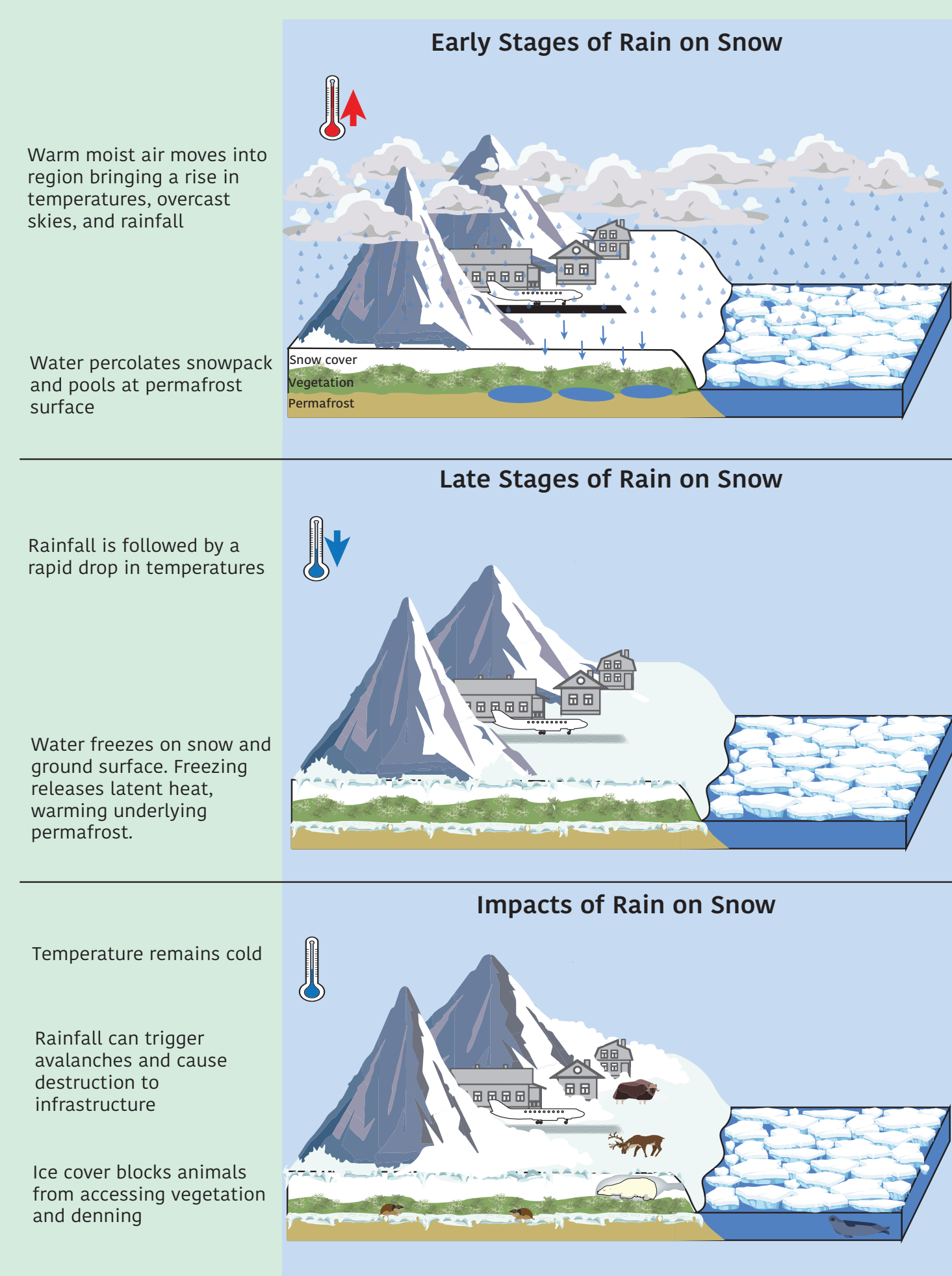
AROSS is partnering with the Local Environmental Observer (LEO) Network to provide context for the ground level impacts of ROS events. The LEO Network collects reports of ROS events by gathering quantitative data, photos and videos, and first-hand accounts from individuals.



A key part of AROSS is understanding the meteorology of ROS events. This figure shows daily mean sea level pressure and precipitable water (top row), and anomalies of daily mean 2m air temperature (bottom row) from ERA5 over the North Atlantic and Svalbard Archipelago during a ROS event between 30 January and 2 February 2012.



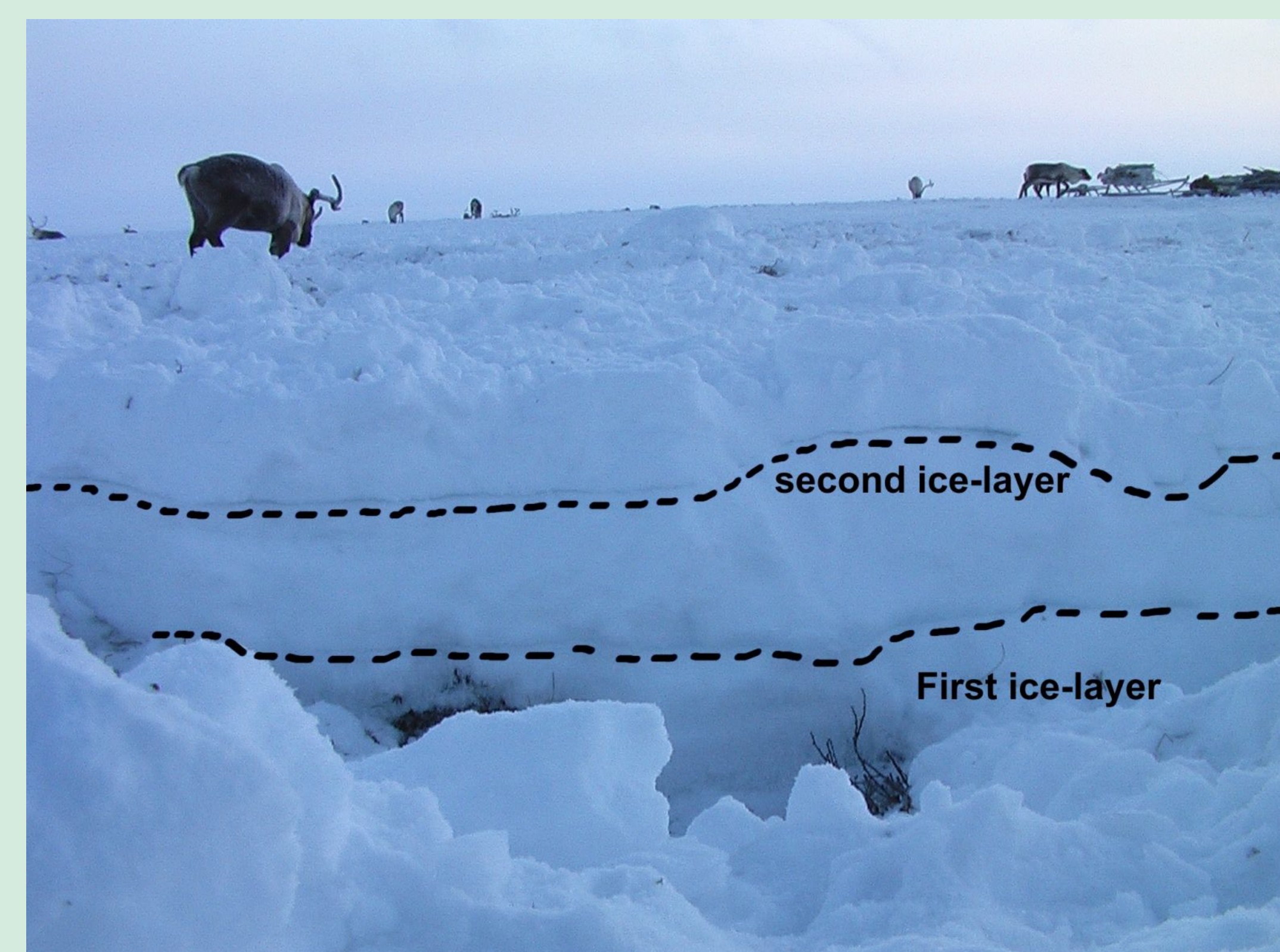
A herder on Yamal Peninsula leads draught reindeer and a dog across the tundra in July 2014. Photo: Bruce C. Forbes, University of Lapland



The stages of rain on snow and its potential impacts over Arctic lands and ocean. Credit: Julia Gustafson, NSIDC

## Impacts

Impacts from ROS events range from mild inconveniences, such as an inability to travel to work or school, to severe consequences that result in the starvation of tens of thousands of animals, damage to infrastructure, and harm to communities. Perhaps the most devastating impact of ROS events, however, is that ice layers, in creating barriers that prohibit foraging, can lead to massive die-offs of large herbivores, with concomitant social-economic impacts, especially in regions where humans depend on reindeer for food, transportation and other needs.



Ice layers within the snowpack associated with two separate ROS events, November 2006. Photo: Florian Stammler.



After a rain-on-snow event this cellular tower turned into an ice-crust snow tower, disrupting cellular service in western Alaska in 2018. Credit: www.adn.com

AROSS is an international effort under the NSF Navigating the New Arctic initiative that seeks to better understand ROS events and their impacts.