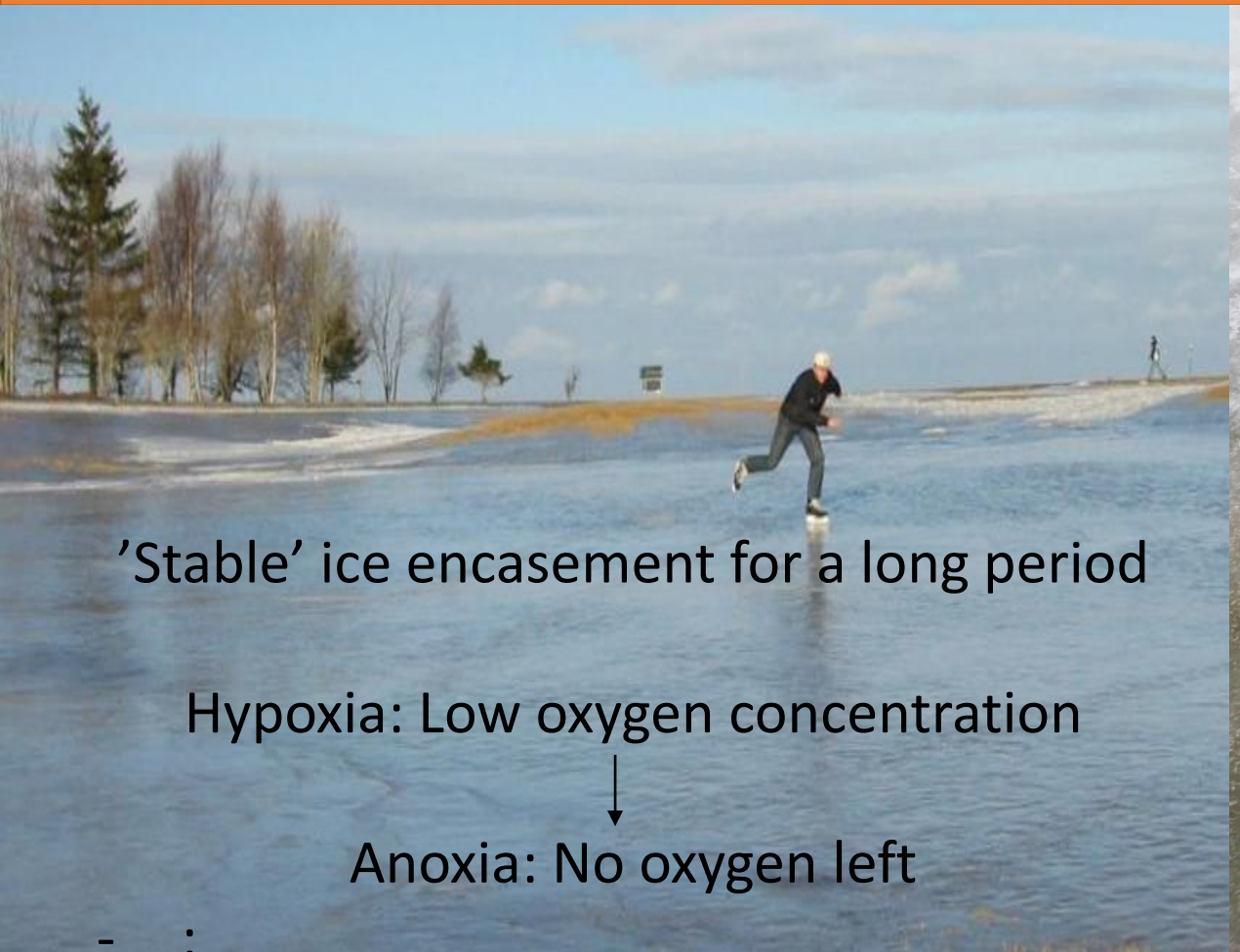
The two main types of ice and water damage: Anoxia vs. crown hydration / freezing

Clarification of terminology

NIBIO
NORWEGIAN INSTITUTE OF BIOECONOMY RESEARCH

ICE-BREAKER Final seminar, Quality Airport Hotel, Gardermoen, Nov. 3rd, 2023

Norges Golfforbund
The Research Council of Norway
Sterk

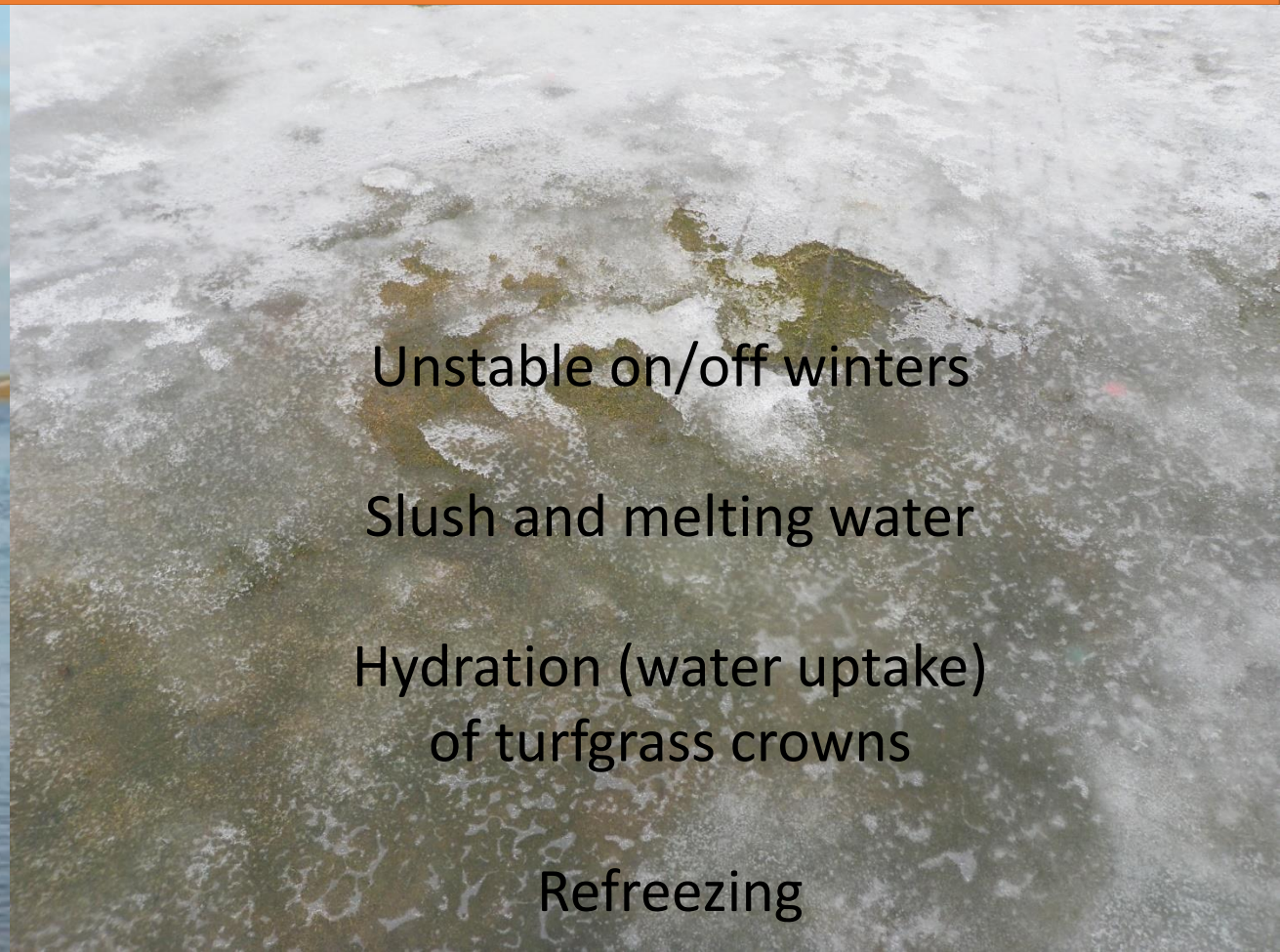


’Stable’ ice encasement for a long period

Hypoxia: Low oxygen concentration

↓

Anoxia: No oxygen left



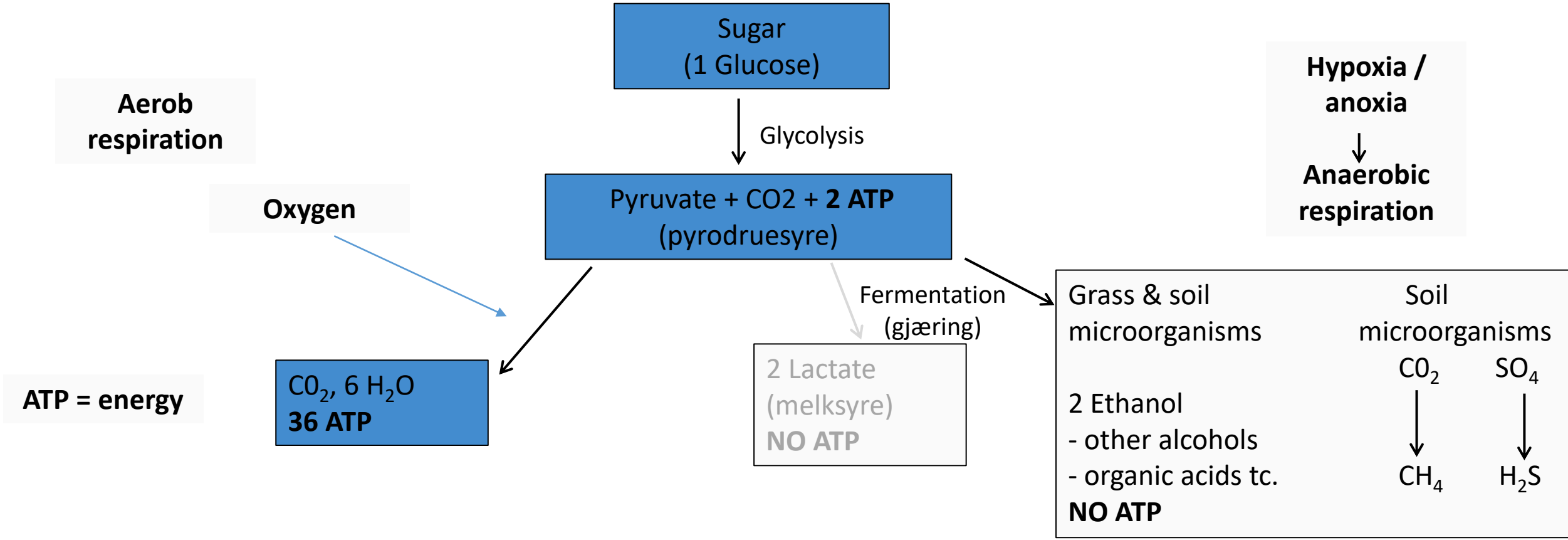
Unstable on/off winters

Slush and melting water

Hydration (water uptake) of turfgrass crowns

Refreezing

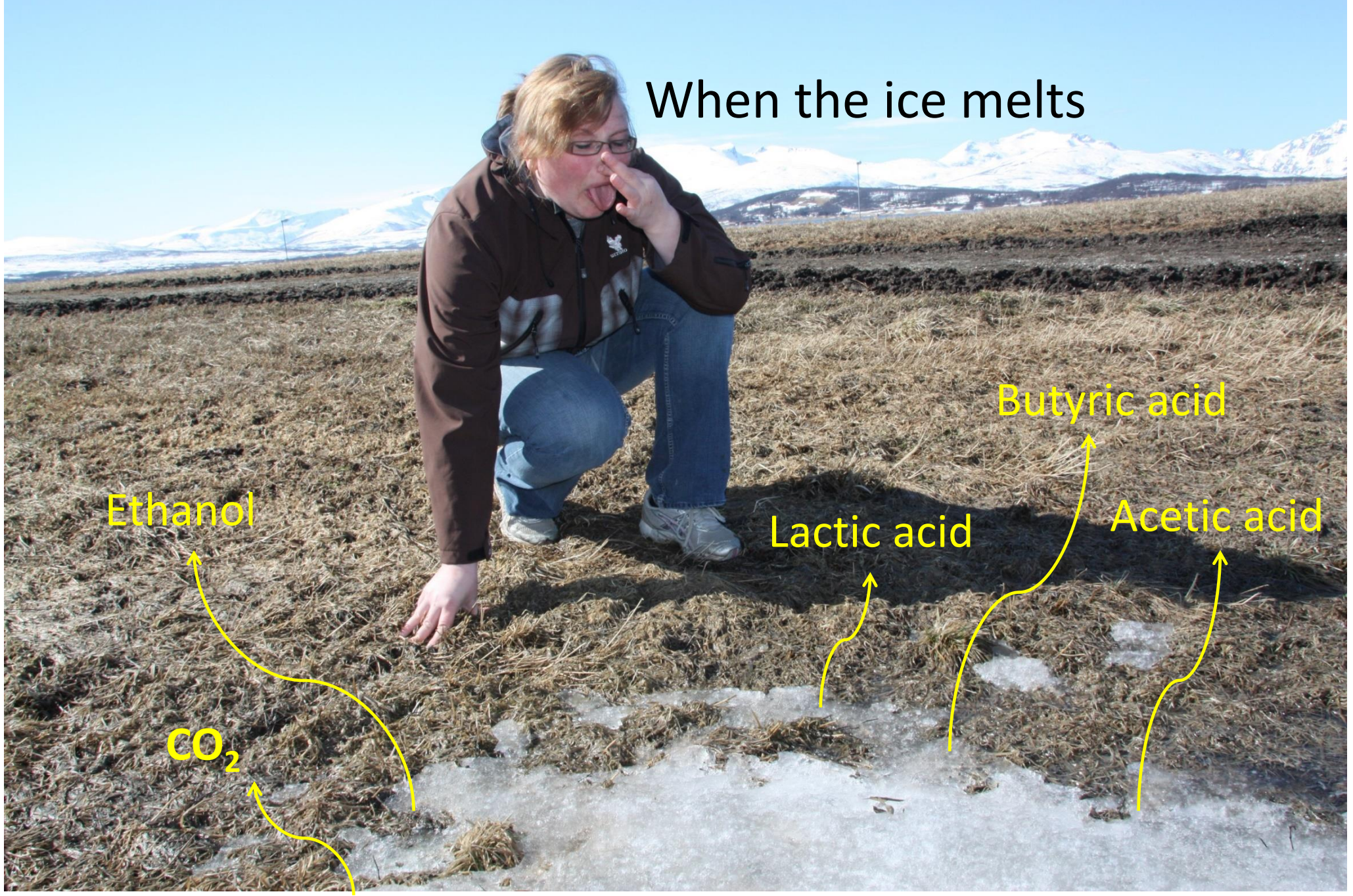
Type 1: Hypoxia / anoxia: Lack of oxygen changes respiration pathways



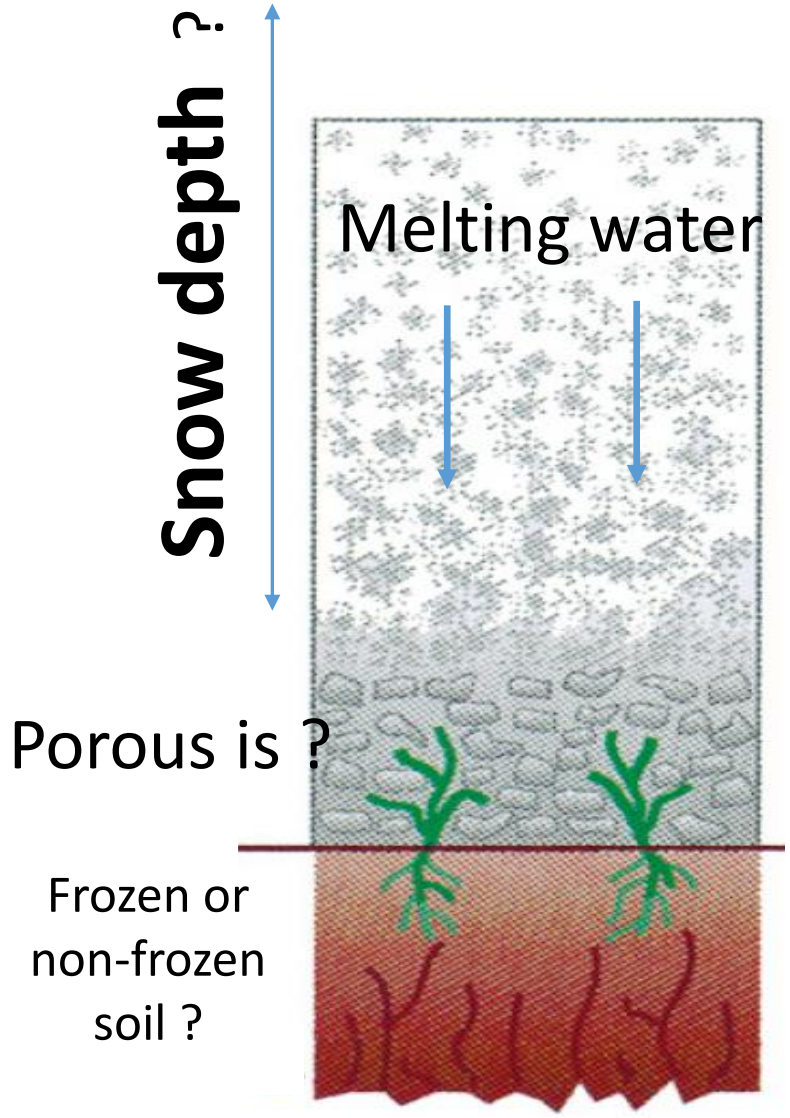
The grass dies because of:

- Starvation: Too little energy (ATP) production
- Accumulation of toxic (bad-smelling) substances produced by grass and microorganisms
- Acidosis: Production of organic acids – low pH in plant cells

Anaerobic respiration under ice


When the ice melts
Ethanol
CO_2
Lactic acid
Butyric acid
Acetic acid

How porous is the ice: -Gray vs. black ice
-1st vs. 2nd generation ice




Type 2. Slush & melting water
Grenland GC, Photo: Steinar Selle


SCANGREEN, Landvik, January 2018


Vestfold GC, 2018
Photo: Oddbjørn Tidemann

Experimental green, Apelsvoll March 1st, 2021

Crown hydration / dehydration and freeze/thaw injury

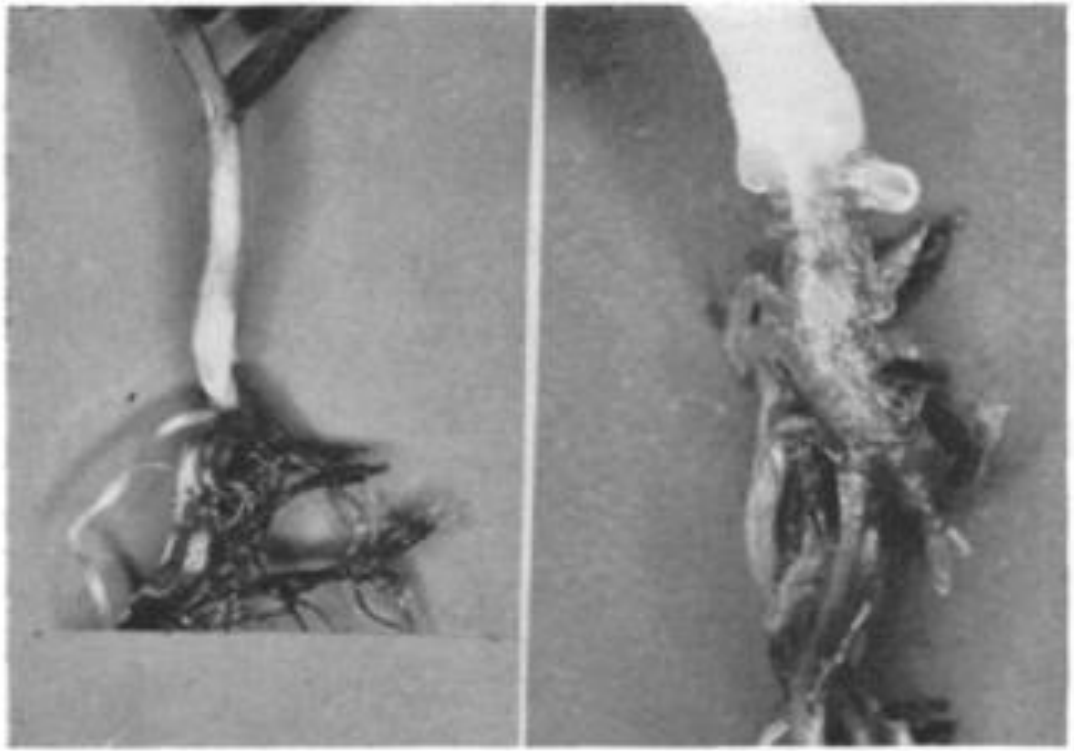
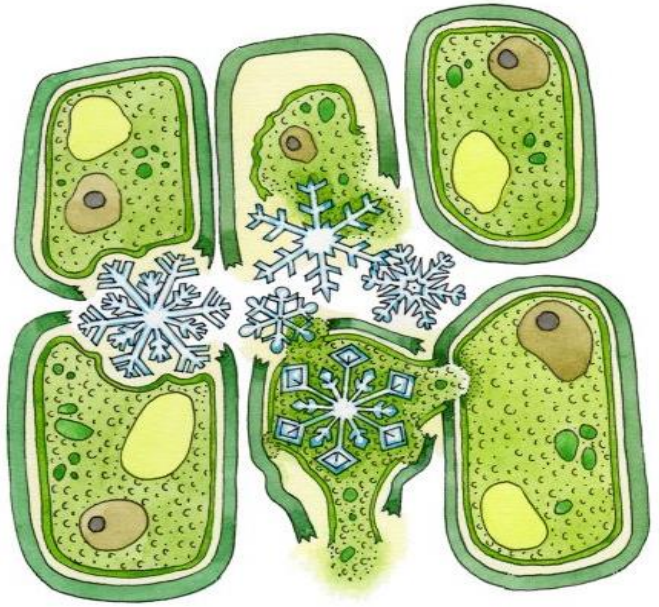


Figure 1—Annual bluegrass plant in an initial stage of recovery following spring thaw. Note total degeneration of all roots



Damage to cell membranes

Beard, J.B. and C.R. Olien. 1963. Low temperature injury in the lower portion of Poa annua L. crowns. Crop Sci. 3:362-363.

Which type of damage is most important ?

Cold hardiness was not affected by low, hypoxic (5%) O_2 conditions; however, once anoxic conditions are detected immediate action should be taken. *Kathie Dodson, Olds College, Alberta, Canada, 2015*

Ice per se is far less damaging than is turfgrass crown hydration and subsequent freezing during freeze-thaw cycles. *Wayne Kussow, University of Wisconsin, 1993*

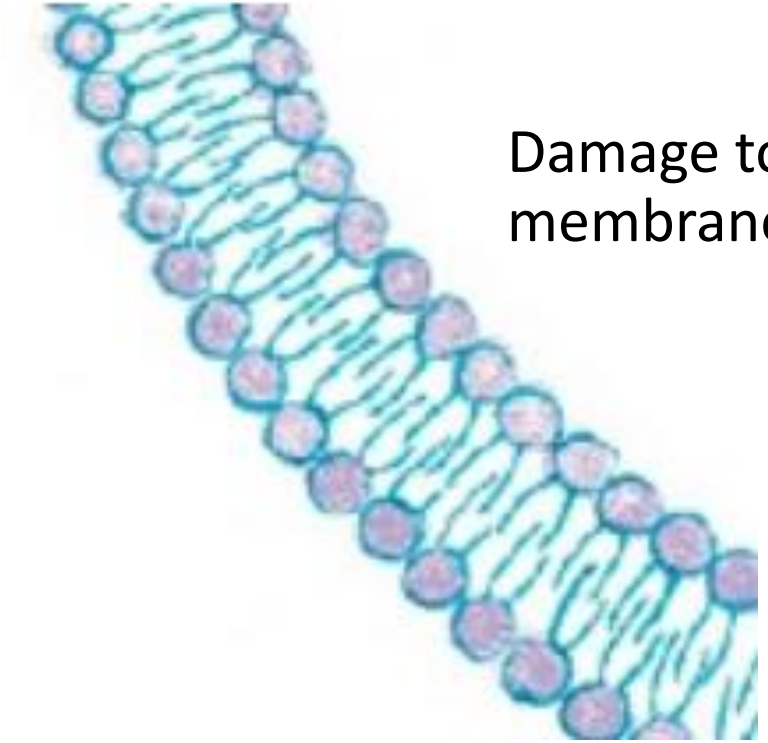
The significant decrease in survival as a result of the turf being in contact with water or slush as the temperature drops below freezing indicates that ice encasement damage can occur at the time of initial freezing and may not be dependent on the duration of the ice coverage.
George Hamilton, Penn State University, 2001

In our case, it was not necessarily the thickness of ice cover the duration of ice cover that determined annual bluegrass injury, instead it was the fact that plants were killed in the short period after initial encasement by ice. We have observed a significant decrease in survival when annual bluegrass plants are in direct contact with water or slush that freezes, causing ice encasement.
Federico Valverde & David D. Minner, Iowa State University, 2007

But the the two types are also connected

Anoxia

Accumulation of toxic compounds



Damage to cell membranes

Less freezing tolerance

Our next speaker was invited because she studies turfgrass winter survival at the crown level

Current Outlook on Ice Encasement Stress and Management Strategies in Turfgrasses

Emily Merewitz[1]

ADDITIONAL INDEX WORDS. annual bluegrass, cool-season grasses, ice cover, *Poa annua*, winter preparatory management

SUMMARY. Ice encasement of perennial cool-season turfgrasses is a common problem in many northern regions of the world, and the incidence of ice encasement may increase with climate change. The objective of this review was to discuss recent advances in knowledge of how ice encasement affects turfgrass systems, current knowledge gaps, and current and potential future management strategies that can be used by turfgrass managers to mitigate ice encasement

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A warm welcome to Emily Merewitz Holm !