

# MURTOO: LiDAR DEM reveals a landform new to science designating rapidly melting Scandinavian Ice Sheet

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*In collaboration with:*

Ojala Antti; Palmu Jukka-Pekka Geological Survey of Finland (GTK)



UNIVERSITY  
OF TURKU

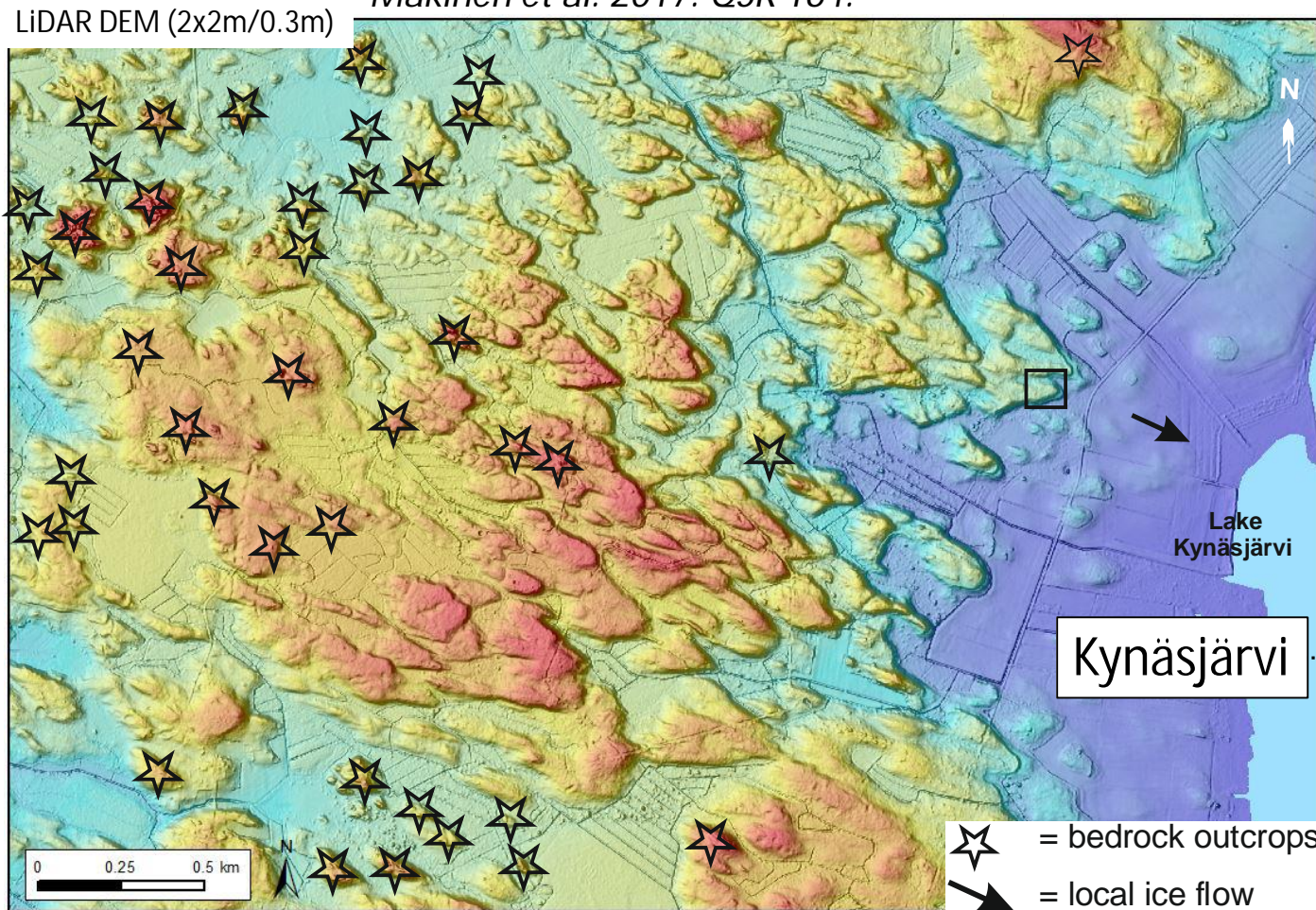
# Murtoo : triangular-shaped new subglacial landform !

Murtoo distribution in Finland

<http://gtkdata.gtk.fi/maankamara/>

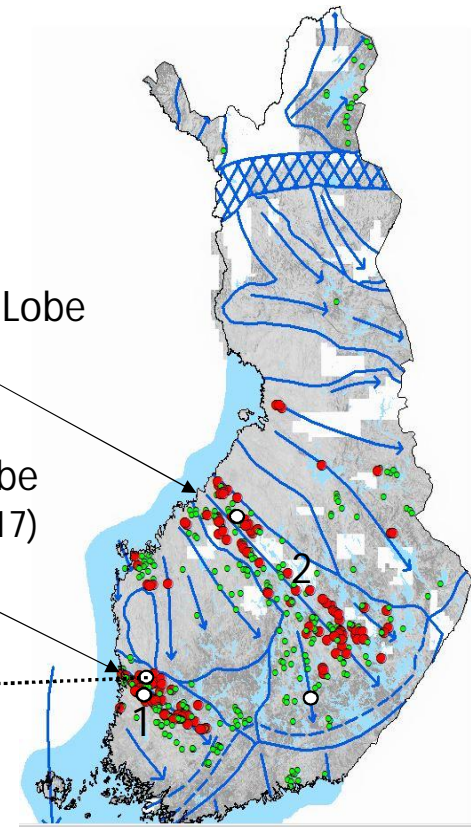
LiDAR data by National Land Survey of Finland

Mäkinen et al. 2017. QSR 164.

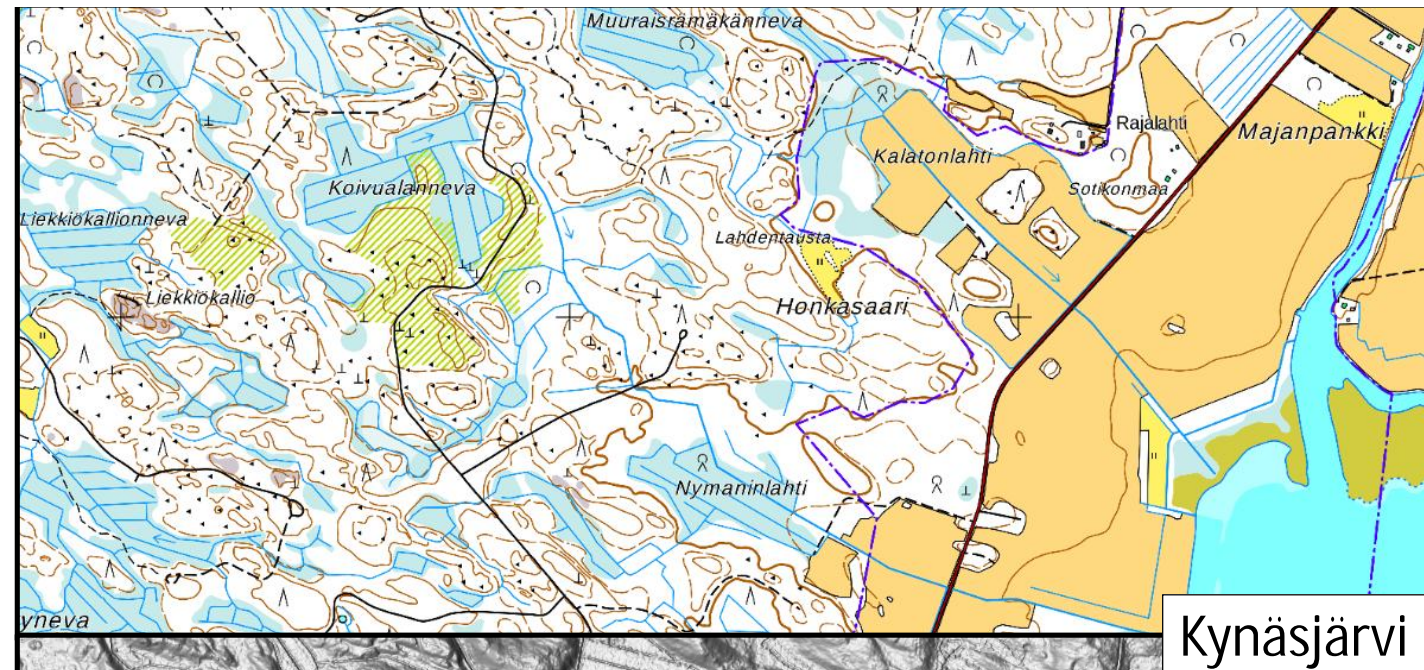


2. Trunk of Finnish Lake District Ice Lobe

1. NE margin of Baltic Sea Ice Lobe (Mäkinen et al. 2017)



Images by A. Ojala (GTK)



Base map

2,5 m contour interval

Note the large amount of boulders

1 km

Kynäsjärvi

LiDAR DEM

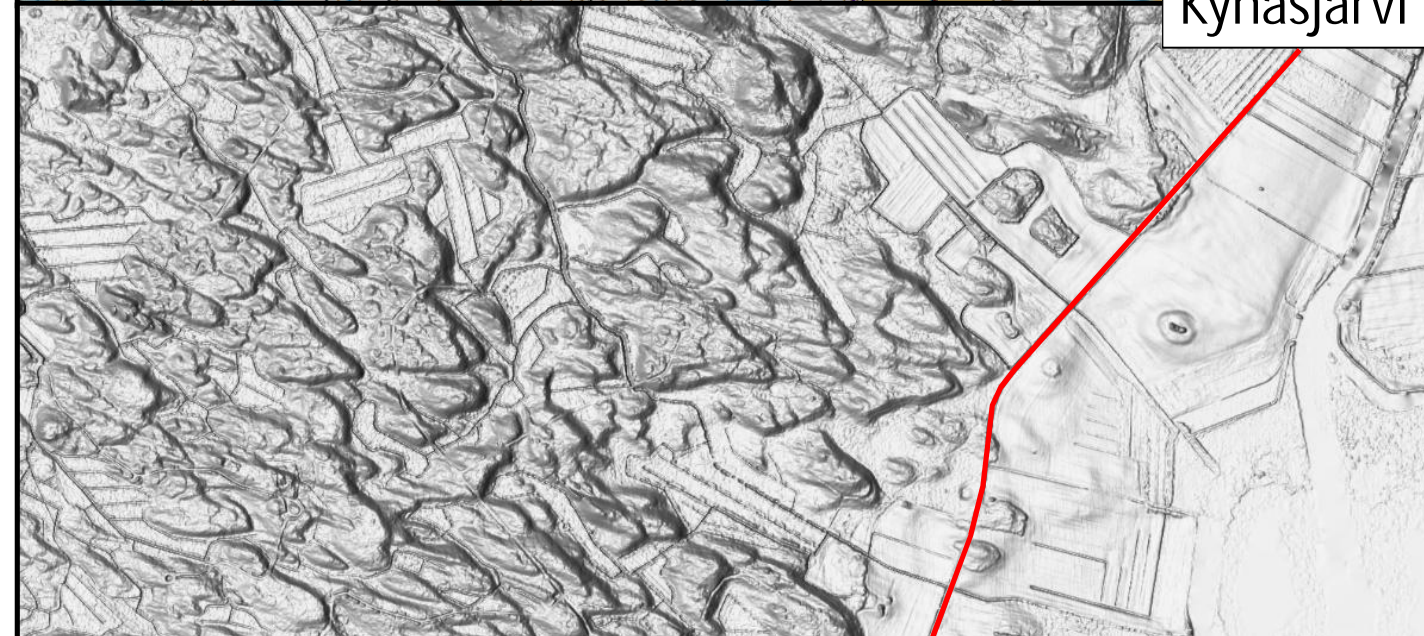
2 x 2 m / 0.3 m

DEM visualizations:

(1) MDOW < multidirectional, oblique-weighted hill shade (Jenness 2013).

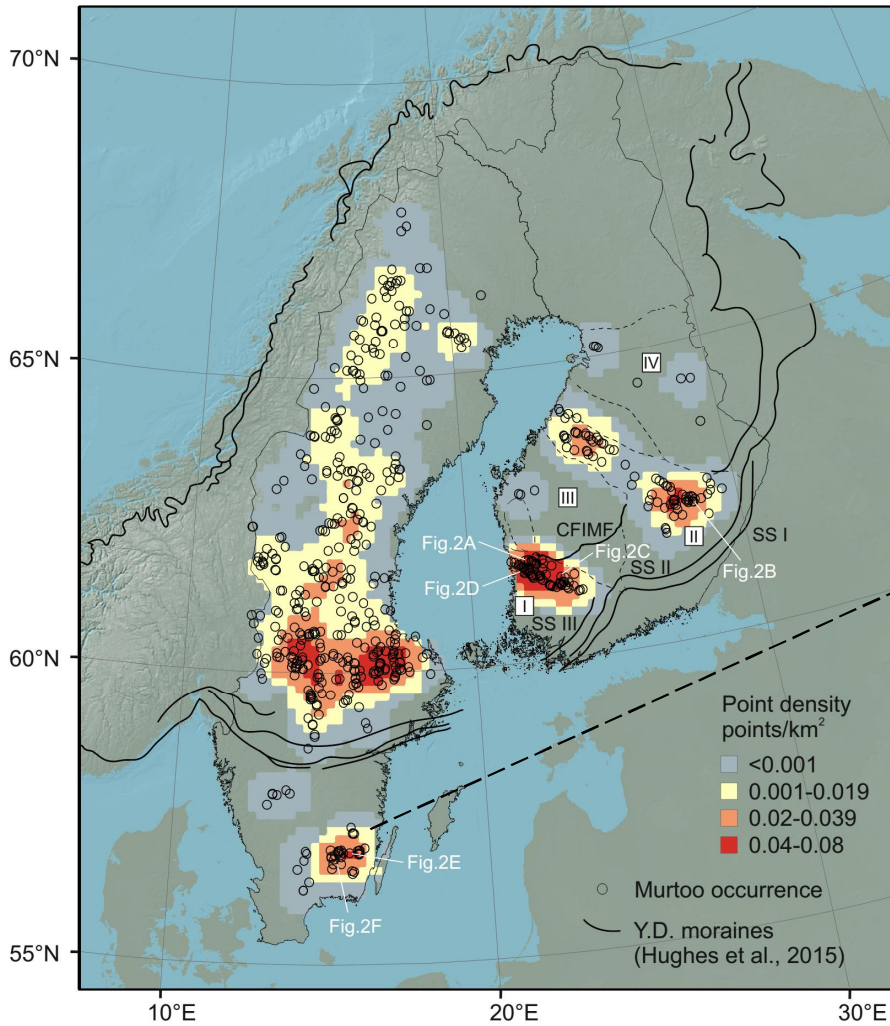
- Primary illumination direction of 315.
- Vertical exaggeration factor of 4.

(2) a slope theme that was accessed dynamically from the DEM data.



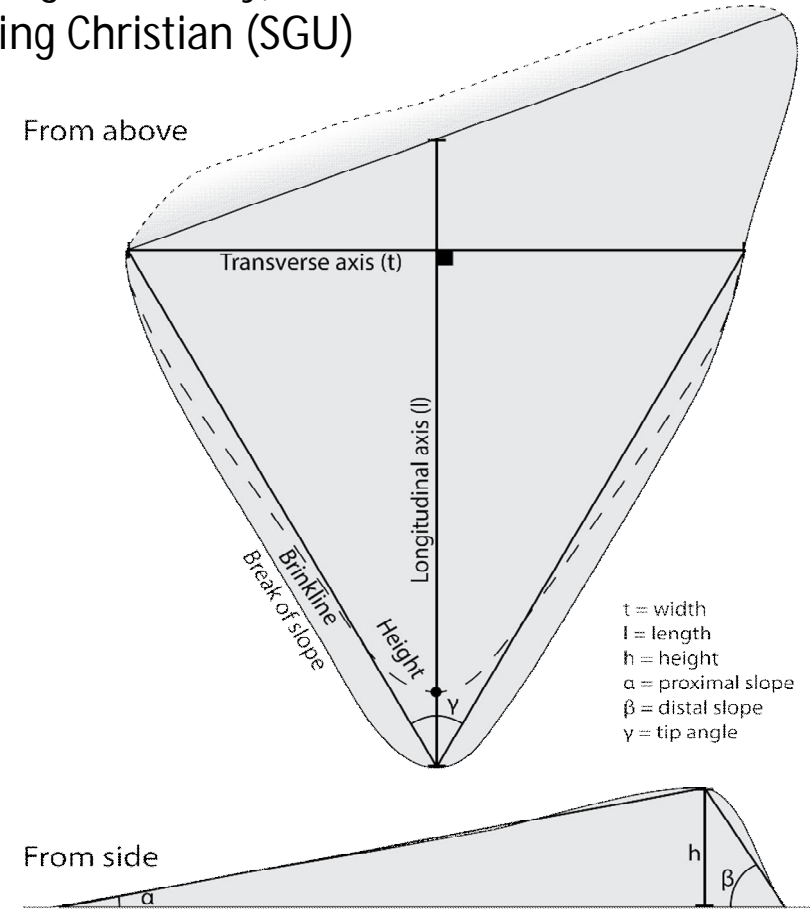
# MURTOO DISTRIBUTION within THE SCANDINAVIAN ICE SHEET (SIS)

Swedish Team:  
 Johnson Mark (Göteborg University)  
 Peterson Gustaf; Öhrling Christian (SGU)

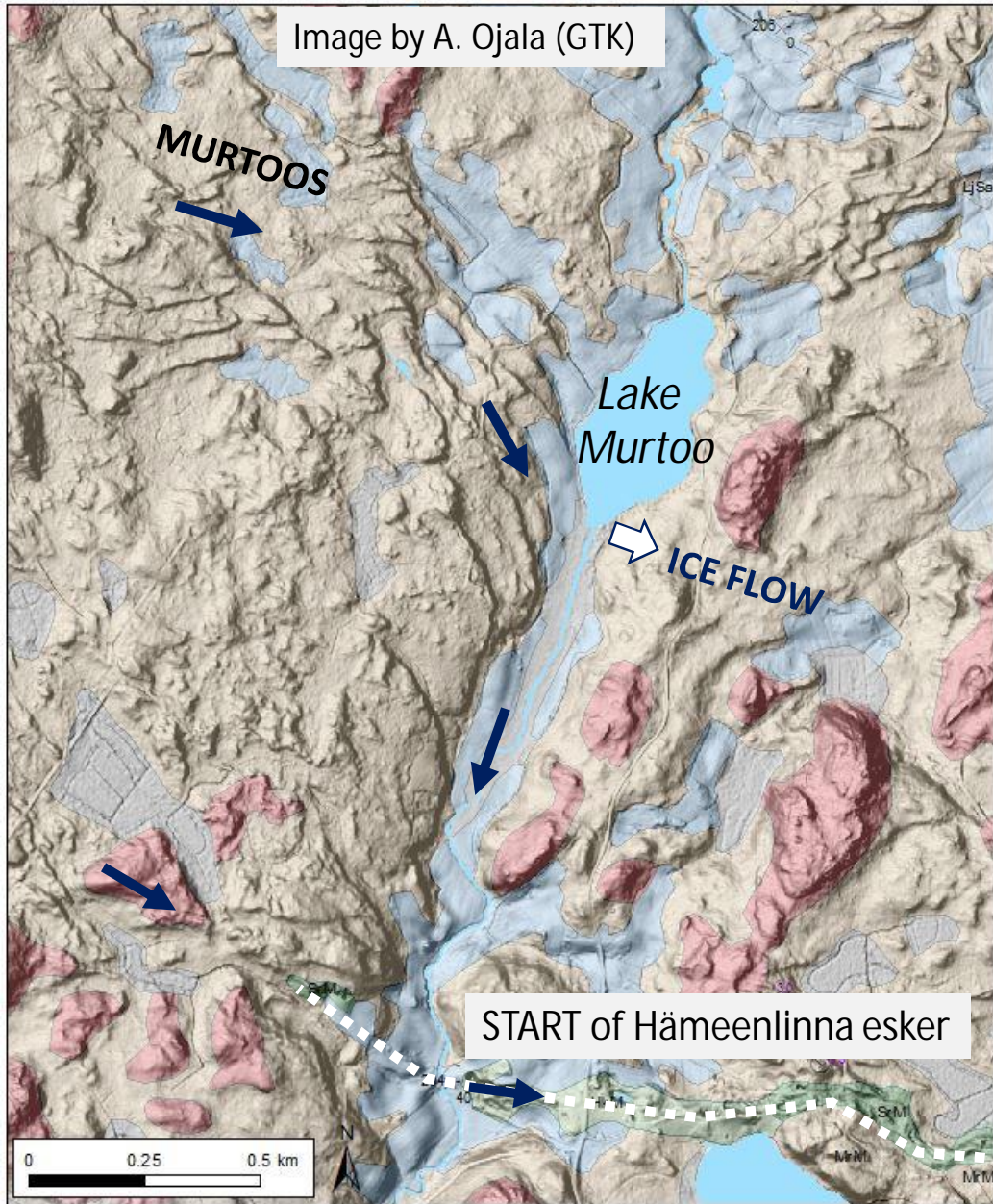


the warm  
 Bølling-Allerød  
 interstadial

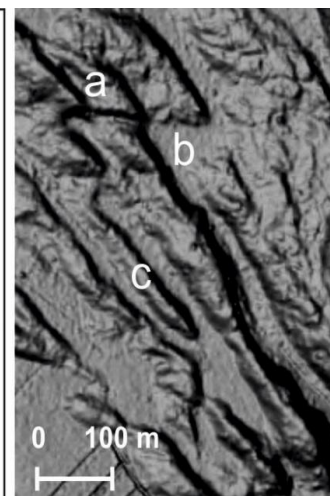
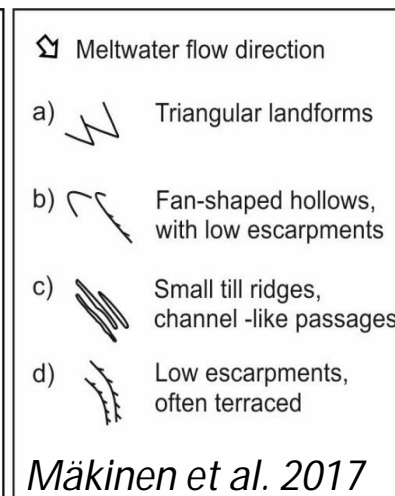
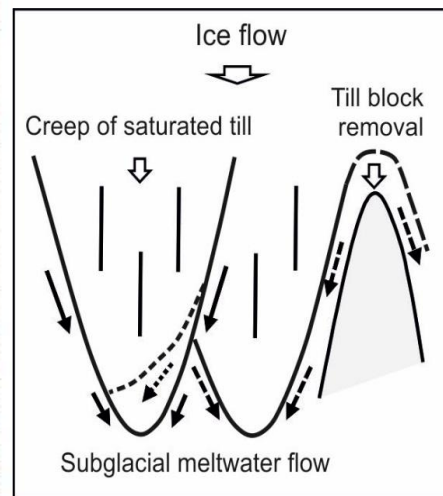
564  
 Murtoo fields



Murtoo distribution in Sweden and Finland Figures by G. Peterson (SGU) Morphometric measurement of murtoos (680)



MURTOOS ARE  
TRANSITIONAL  
TO ESKERS  
and  
ASSOCIATED  
WITH OTHER  
SUBGLACIAL  
FEATURES



# *Murtoos* are *depositional landforms* transitional between tills and glaciofluvial sediments !

Images by J. Mäkinen



Reisjärvi



Sääksjärvi

Low mud content: Poorly rounded clasts: Sand layers: Flow and push structures: Massive/Crudely stratified: Matrix-supported (fine Sand to granules) : Channel infills : Boulders < 1 m, but surface rich in larger boulders

# MURTOOS CUT RIBBED MORAINES

# MURTOOS & FAN-SHAPED HOLLOW

Images from Maankamara map service by GTK



Reisjärvi



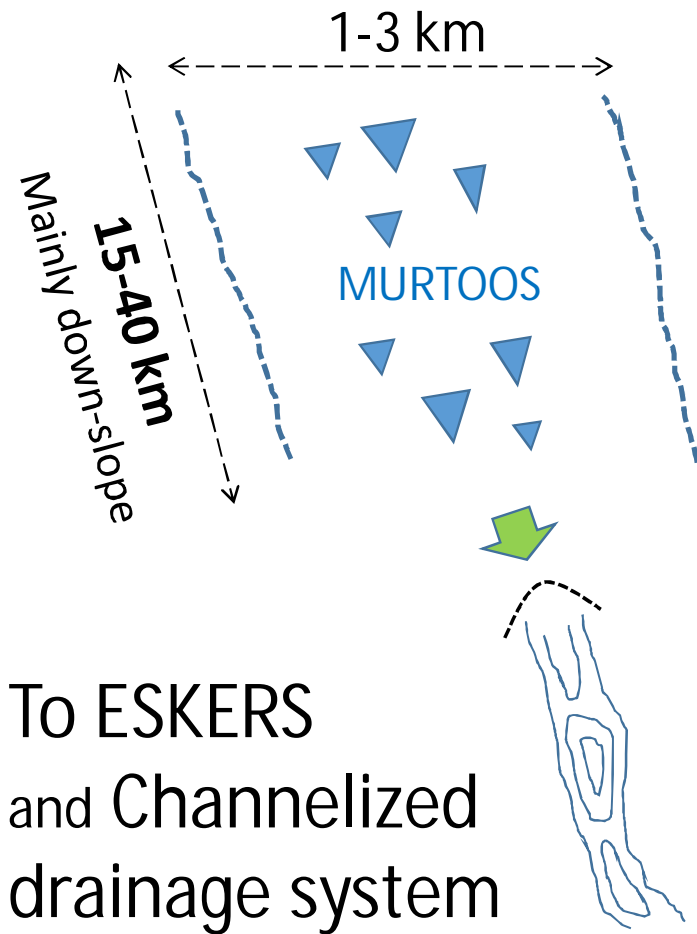
Sääksjärvi

Frozen to Melting ?

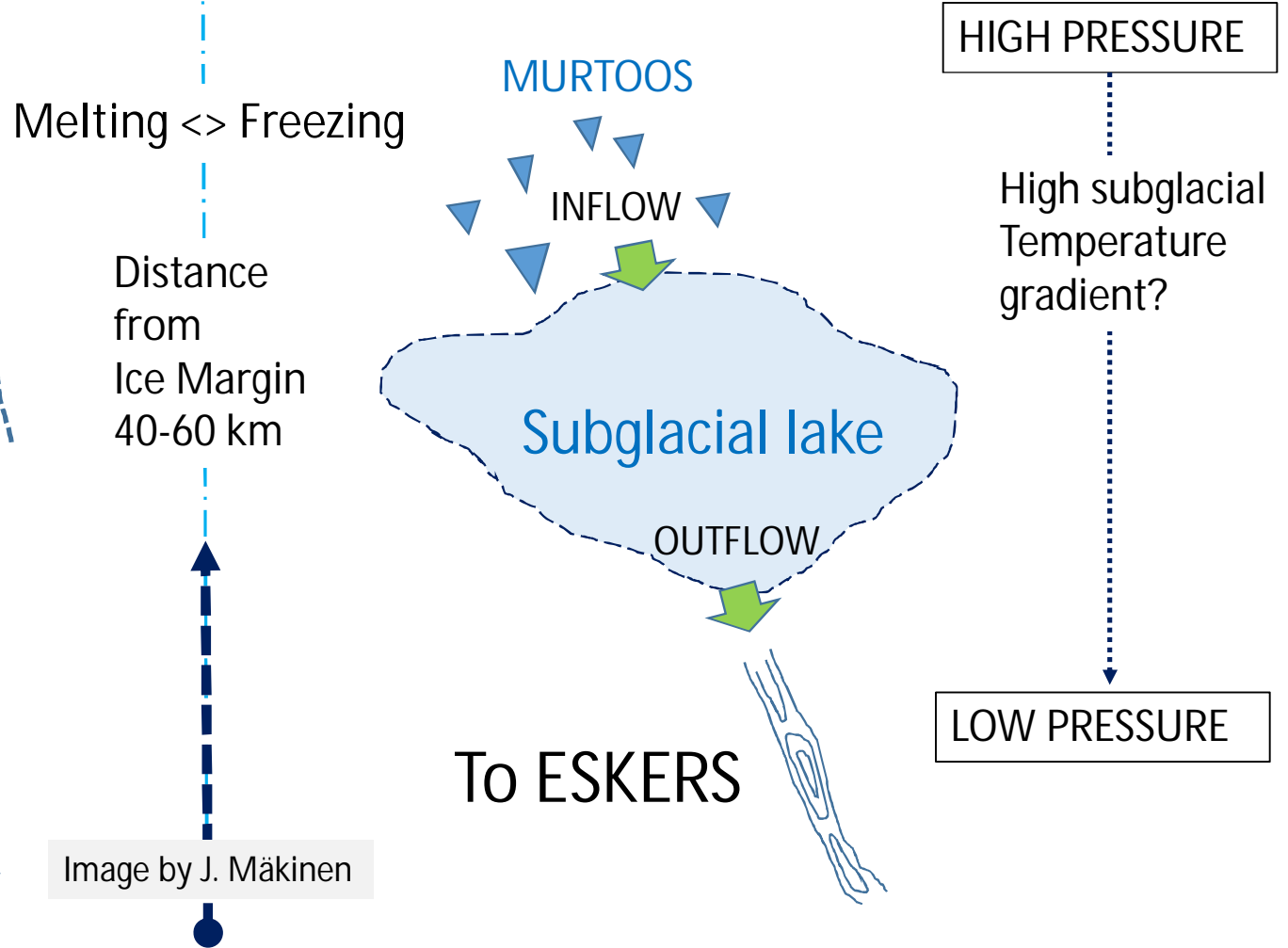
  
excavated Murtoo

Freezing <> Melting ?

# A) From MURTOO routes and Distributed drainage system



# B) From MURTOO fields feeding subglacial lakes

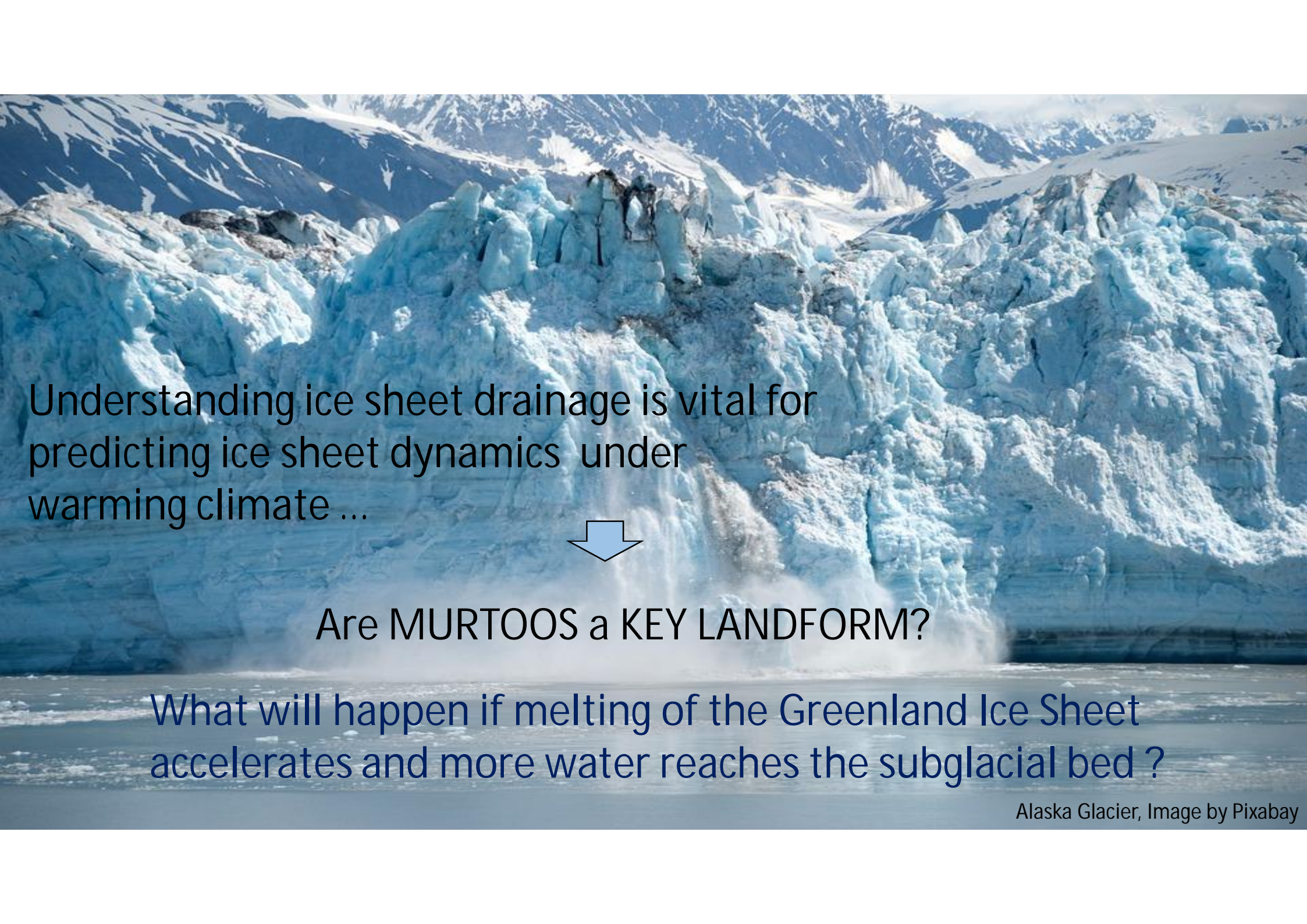




*Murtoos* are a missing element cf. Flowers 2015  
in subglacial drainage system and hydrological models

Do murtoos indicate clogged  
large-scale subglacial "linked cavity" system?

... what is the role of supraglacial meltwater input and  
subglacial lakes ?



Understanding ice sheet drainage is vital for predicting ice sheet dynamics under warming climate ...



Are MURTOOS a KEY LANDFORM?

What will happen if melting of the Greenland Ice Sheet accelerates and more water reaches the subglacial bed ?