UNIVERSITY OF GOTHENBURG

‘GEOMORPHOLOGY, DISTRIBUTION AND COMPOSITION OF SUBGLACIAL TRIANGULAR HUMMOCKS (MURTOOS) IN SWEDEN AND FINLAND’

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Abstract (with numbers that relate to the following slides)

1. Triangular hummocks of subglacial origin have been identified in Sweden and Finland due to the increased resolution provided by LiDAR imagery. Their triangular shape is distinctive and recognizable as clearly identifiable landforms.
2. These forms have been previously mapped in some cases as dead-ice hummocks, but geomorphic relationships with eskers, flutes ribbed moraine and De Geer moraines show these to be subglacial. We refer to these new landforms as ‘murtoos.’
3. Morphometric measurements show murtoos to be 50 to 200 m long and 50 to 100 m wide. The orientation of their apices strongly correlates with local ice-flow orientation. They form preferentially on beds that slope down-ice.
4. In many cases, they occur in patches in an ice-flow parallel path with eskers, defining corridors we believe to be of subglacial meltwater origin.
5. Murtoos are composed primarily of heterogeneous diamicton with variable amounts of bedded sand and gravel.
6. Murtoos are most common where glacier-melt rates were high during deglaciation (Bølling-Allerød and Holocene), and they are absent where extensive frozen-bed conditions were present.
7. We suggest murtoos are a landform produced as a glacier-bed adjustment to increased delivery of supraglacial meltwater during deglaciation.

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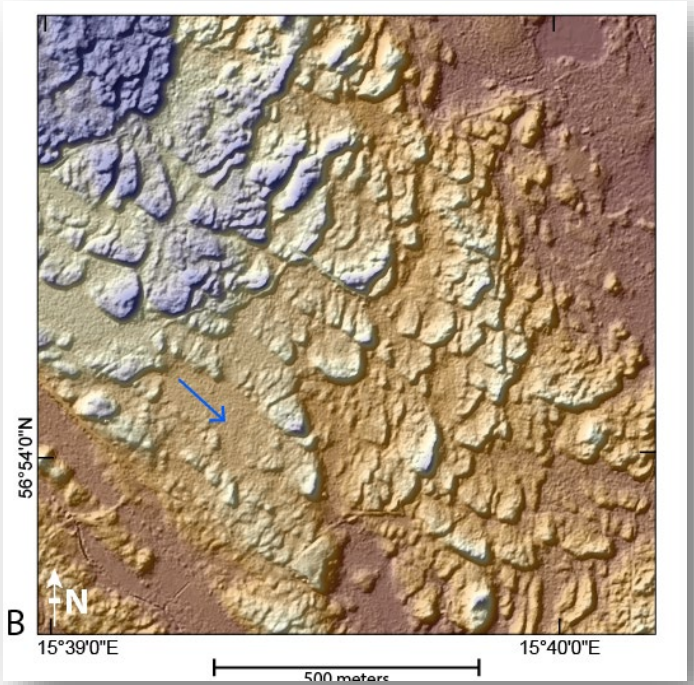
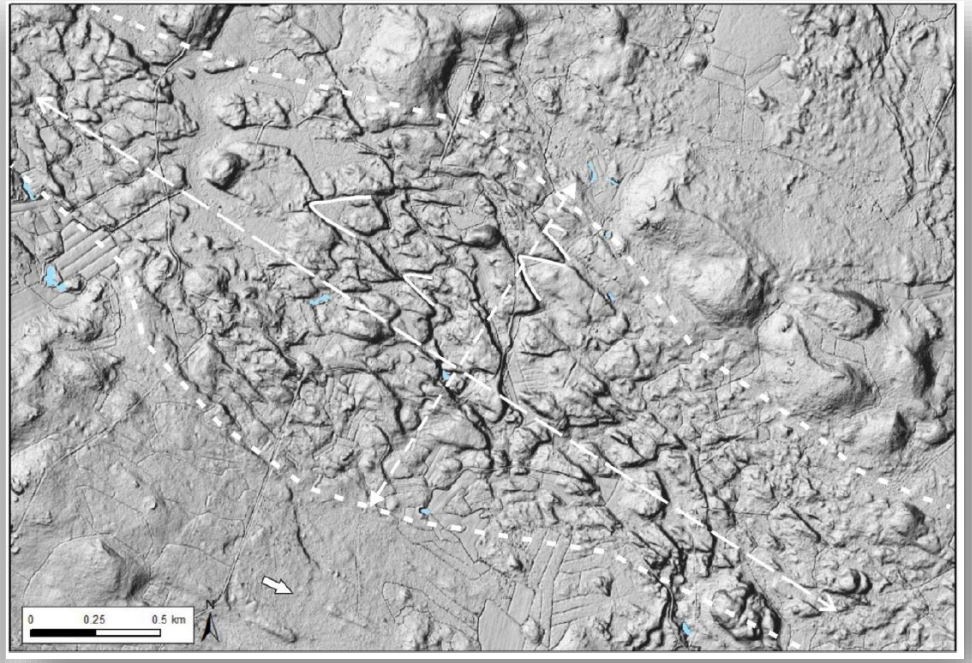


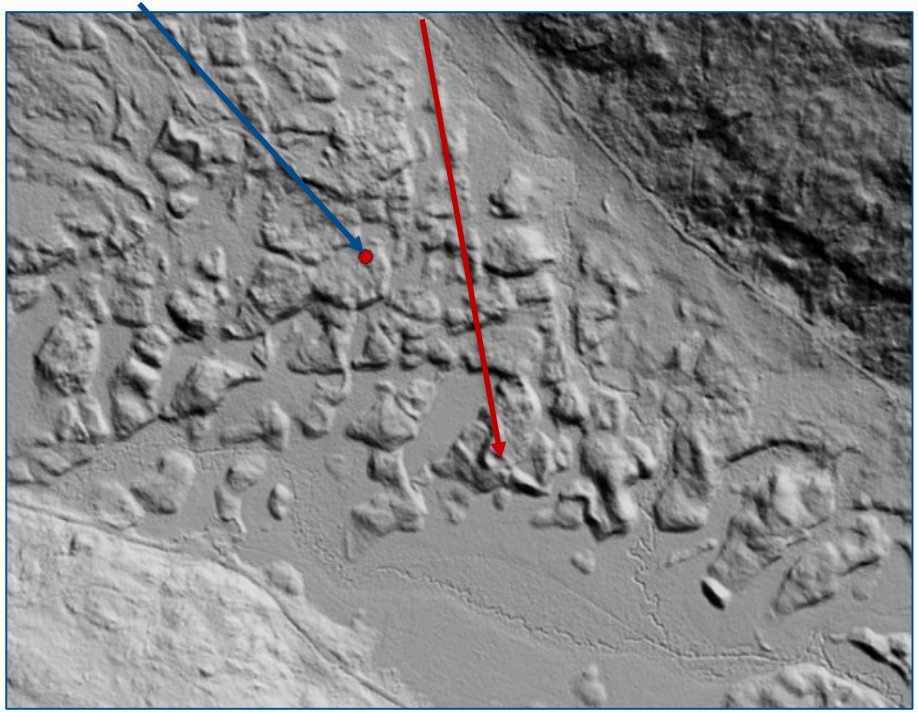
Peterson, et al, JoM, 2017



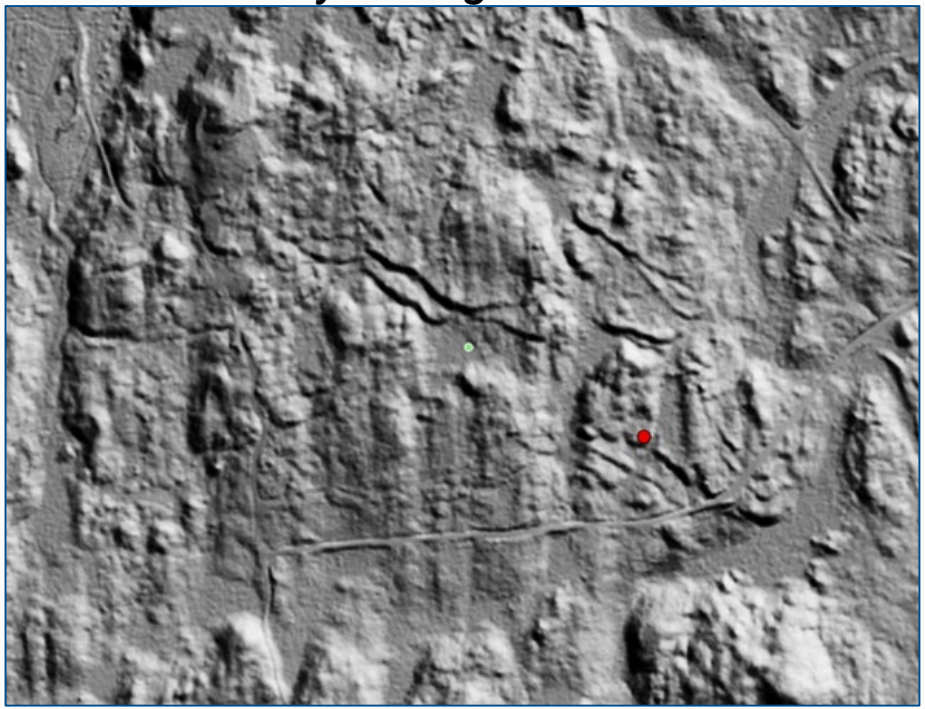
Mäkinen et al, QSR, 2017

2a. These forms have been previously mapped in some cases as dead-ice hummocks, but geomorphic relationships with eskers, flutes, lineations, ribbed moraine and De Geer moraines show these to be subglacial. We refer to these new landforms as 'murtoos.'

murtoos *eskers*

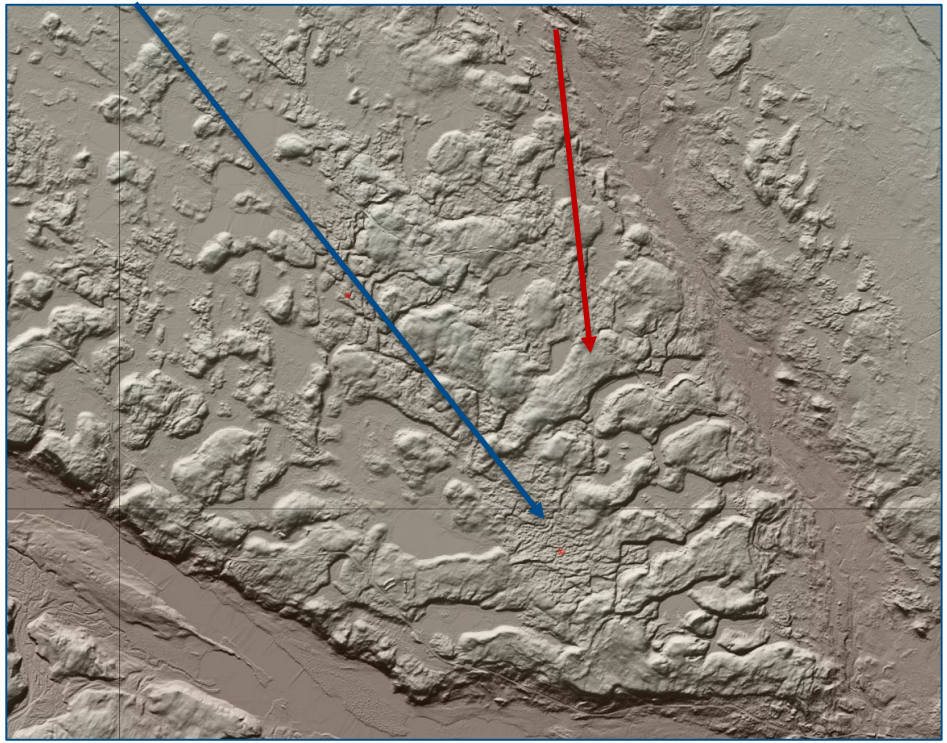


murtoos cut by N-S glacial lineations

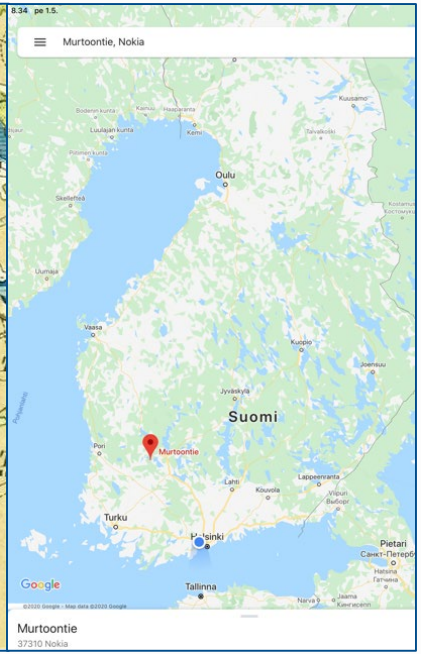


2b. These forms have been previously mapped in some cases as dead-ice hummocks, but geomorphic relationships with eskers, flutes, lineations, ribbed moraine and De Geer moraines show these to be subglacial. We refer to these new landforms as 'murtoos.'

murtoos *ribbed moraine*



- *In Finnish, 'murtoo' refers to 'fragmental' with some landscape implications.*
- *A Finnish word for cross-country skiing is 'murtomaahiihto'*



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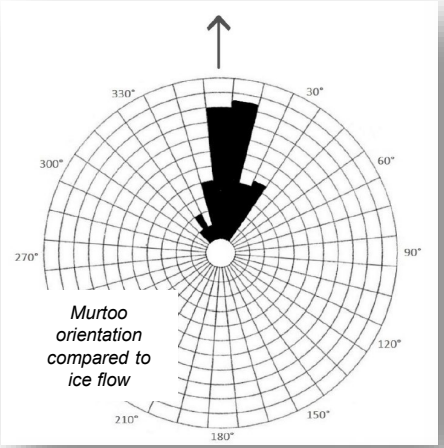

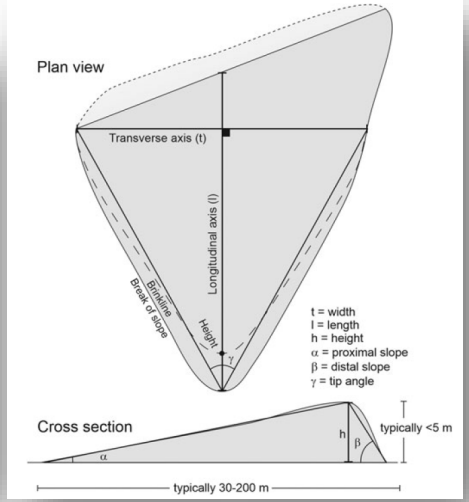

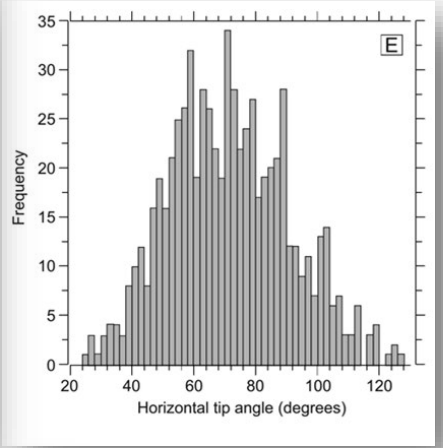

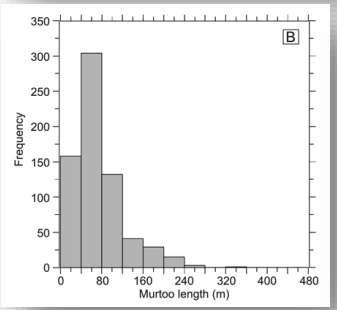

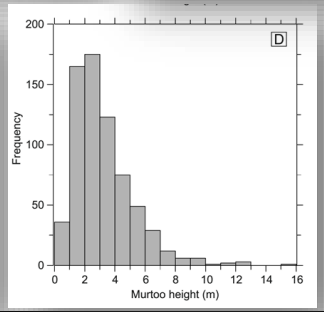

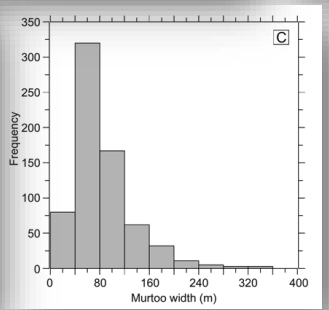

Ojala, et al, J of Glaciology, 2019

Examples from Sweden and Finland

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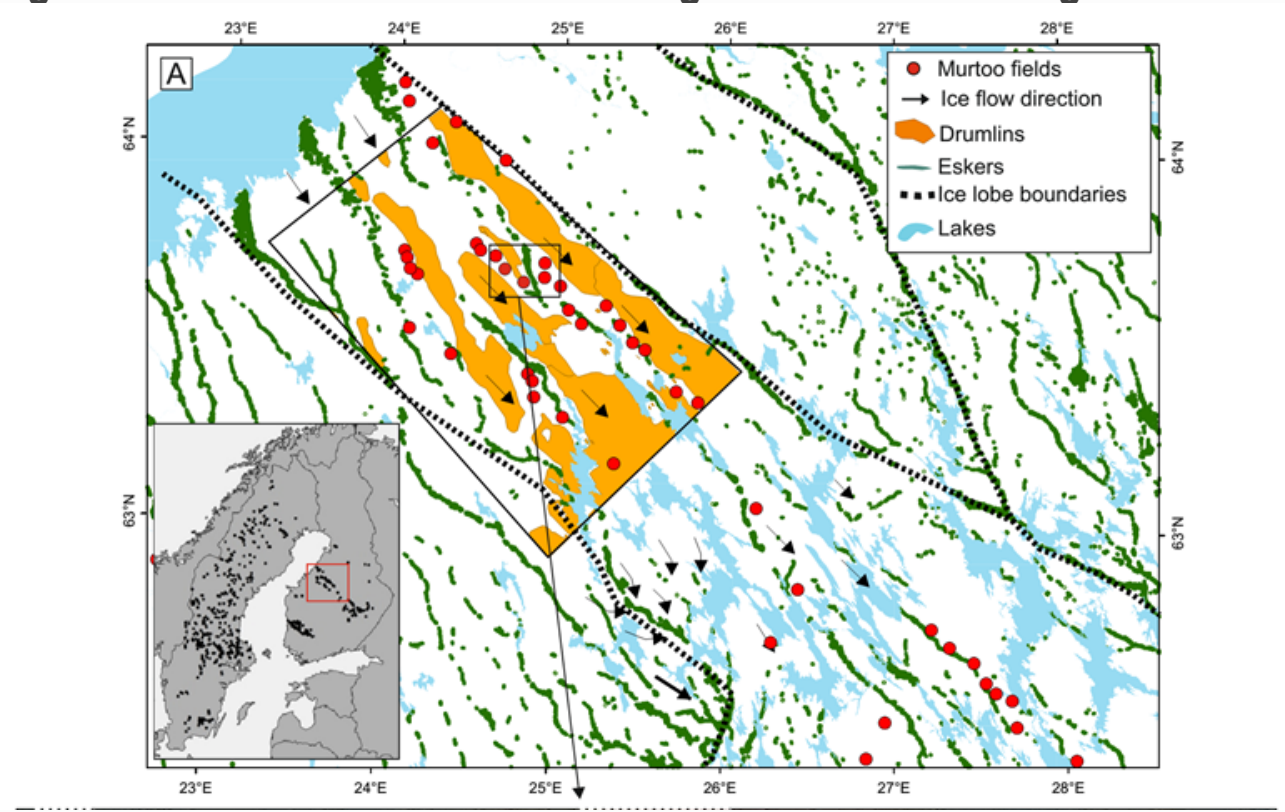

Ojala, et al, J of Glaciology, 2019

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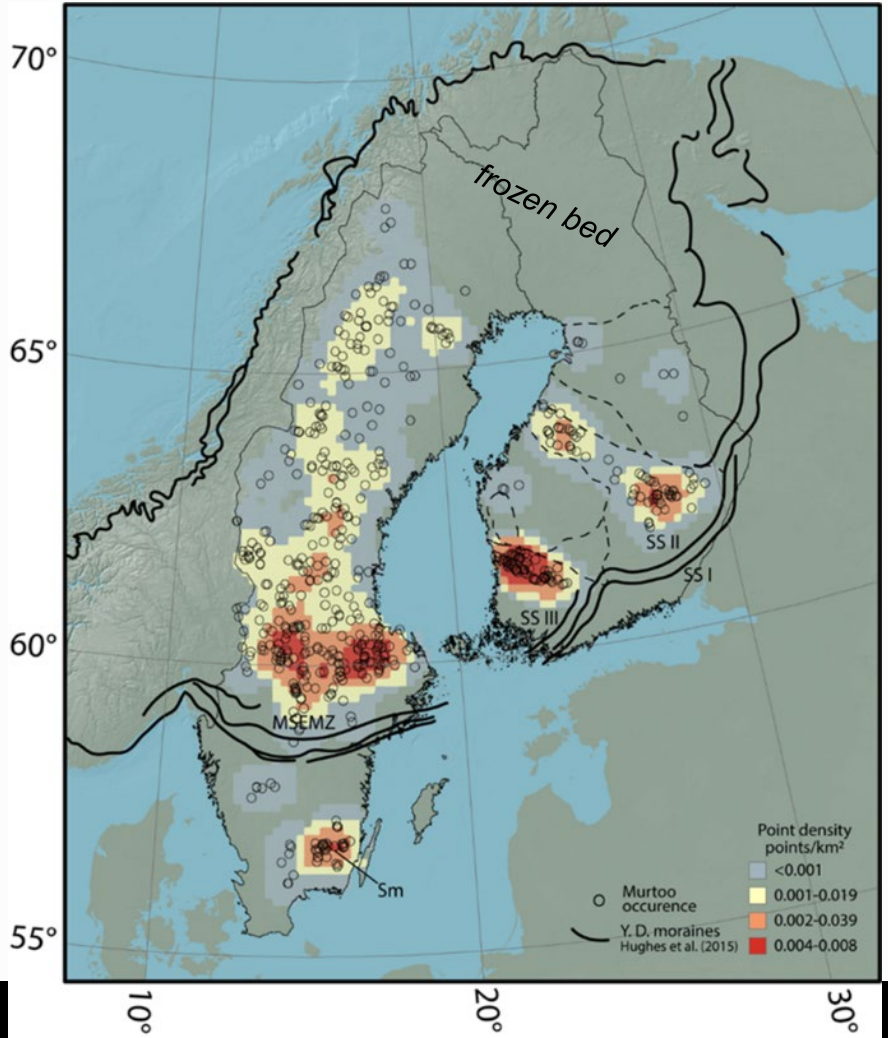

Ojala, et al, J of Glaciology, 2019

7. We suggest murtoos are a landform produced as a glacier-bed adjustment to increased delivery of supraglacial meltwater during deglaciation.

- The gensis of murtoos is not clear.
- However, it is clear to us that they:
  - form subglacially,
  - are oriented in the direction of ice flow
  - are in places occurring with subglacial drainage features
  - contain both till and meltwater sediments, and
  - occur in places were ice-margin rereat was rapid and during times of rapid ice-sheet melting

- Based on these observations, we are most strongly drawn to a model that involves
  - till deformation and
  - erosion by subglacial meltwater penecontemporanously
- The diamicton is drawn into murtoo shapes by sliding and drag (or perhaps extruded as till slurries driven by water-pressure): it is some kind of deformation till
- The sharp 'conjugate' margins are possibly cut and shaped by meltwater
- The murtoo and corridor/esker association leads us to to see murtoo-formation related to subglacial meltwater
- They may represent a landform produced where the bed is changing from a distributed to a channeled subglacial drainage system.