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Eskers in the Keewatin region of the Laurentide Ice Sheet – inventory comparisons

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Eskers are the casts of subglacial, englacial or supraglacial meltwater channels, or ice-walled canyons and thus can provide a window into paleo ice-sheet hydrology. However, detailed, ice-sheet scale inventories (maps) are rare and, while recent studies provide new insights about the proxy value of esker morphology and internal structure, for a robust understanding of esker glaciological significance, more eskers need to be studied in detail. This poster compares two recent high-resolution inventories of eskers in the Keewatin region of the Laurentide Ice Sheet in order to better understand their reliability for paleo-glaciological inferences and morphogenetic investigations. The latest published inventory (A) of Keewatin eskers was produced by mapping ridge crestlines on 15 m cell-size Landsat ETM+ orthorectified imagery (Storrar et al., 2013). A new inventory (B) of Keewatin esker crestlines has been mapped from 10 m cell-size, orthorectified SPOT-4/5 satellite imagery (freely available at http://geogratis.gc.ca); Google Earth® imagery was used for verifying cases interpreted as potential eskers based on SPOT imagery. In this poster, we: i) present a morphometric comparison of the two inventories; and ii) assess whether the morphometric differences have a significant impact on derived interpretations by applying the same analysis framework (trends in esker morphometry over time based on ice sheet margin positions) used in recent studies based on inventory A to inventory B. In the compared datasets, gaps between esker ridges are not specified as non- or post-depositional.

Inventory B generally displays higher esker ridge density and sinuosity, and lower ridge continuity (and thus length) than inventory A. These systematic differences are due to differences in spatial resolution (10 m vs. 15 m cell size) of the imagery, which determines the size of both the thinnest and shortest ridges and gaps that can be identified. On the other hand, differences in mapped ridge density vary spatially and sometimes exceed the differences that could be expected to result from cell-size differences and variations in image quality alone. Such non-systematic differences may be due to differences in land cover (lakes, snow and vegetation) and to mapper subjectivity. An example of relatively large differences between the two inventories is a 41,000 km2 area of the Athabasca region in northern Saskatchewan, where mean length is 8x lower, and number of ridges, total length, and mean sinuosity are 21.3x, 2.4x and 1.13x higher, respectively, for inventory B. In contrast, at the ice sheet scale, chronological trends in morphometric indices (e.g., number of ridges per 100 km of ice margin, per 1000-year time step) are similar between the two inventories. Particularly prone to subjectivity and important for glacio-hydrological interpretations, is the expert's interpretation of the nature of the gaps (e.g., post- or non-depositional) between esker ridges, which directly influences the definition of esker networks; whether two ridges mediated by a gap are assigned to a single esker or to separate eskers, depends on that interpretation.

Reference:
Storrar RD, Stokes CR, Evans DJ. A map of large Canadian eskers from Landsat satellite imagery. Journal of maps. 2013 Sep 1;9(3):456-73.