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2019 Dynamic Planet – Glaciers

Regional Science Olympiad

FIGURE PACKET

for Division ** B **

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Please do not write on these figures.

Figure 1: Axial tilt diagram (Source: http://www.indiana.edu/~geol105/images/gaia_chapter_4/milankovitch.htm)

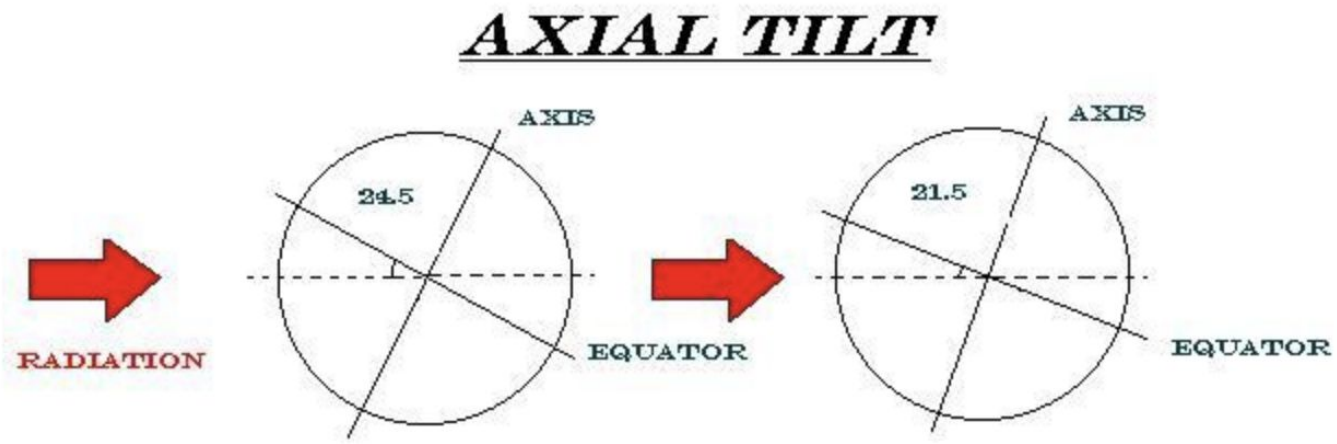

Figure 2: Milankovitch cycles and orbital variations. (Source: https://earthobservatory.nasa.gov/features/Milankovitch/milankovitch_3.php)

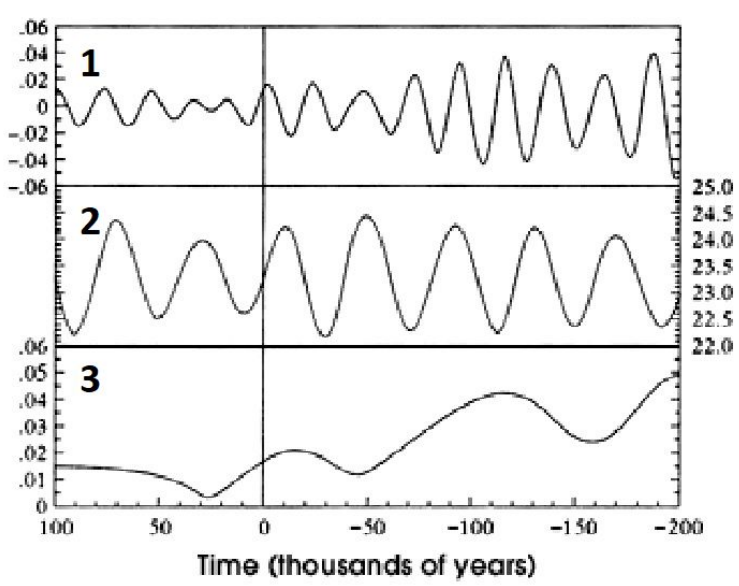

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Figure 3: Frozen water example #1. (Source: AMS (2008). https://journals.ametsoc.org/toc/bams/89/9)

Figure 4: Frozen water example #2. (Source: NOAA. http://oceanservice.noaa.gov/facts/)

Figure 5: Frozen water example #3. (Source: SwissEduc/Alean. https://www.swisseduc.ch/glaciers/glossary)

Figure 6: Sedimentary sequence (Source: http://formontana.net/glaciers.html)

Figure 7: Sedimentary sequence (Source: https://wmblogs.wm.edu/wp-content/uploads/2013/11/RCfig6.jpg)

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Figure 8: SumDum (D-4), Alaska map (Source: USGS topoView)

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Figure 9: Whitewater, WI map (Source: USGS topoView)

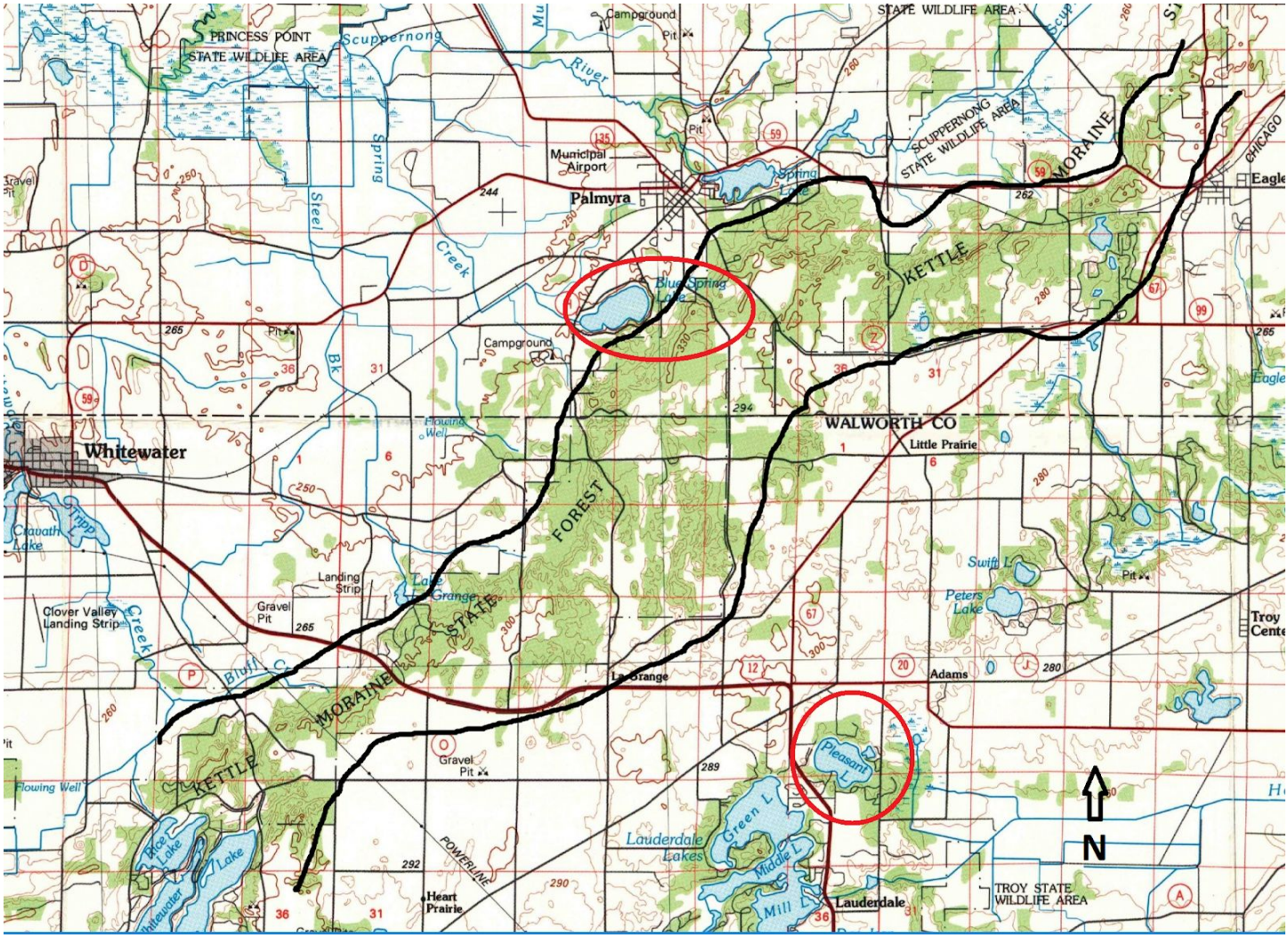

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Figure 10: Overall Matterhorn Peak area map (Source: USGS topoView)

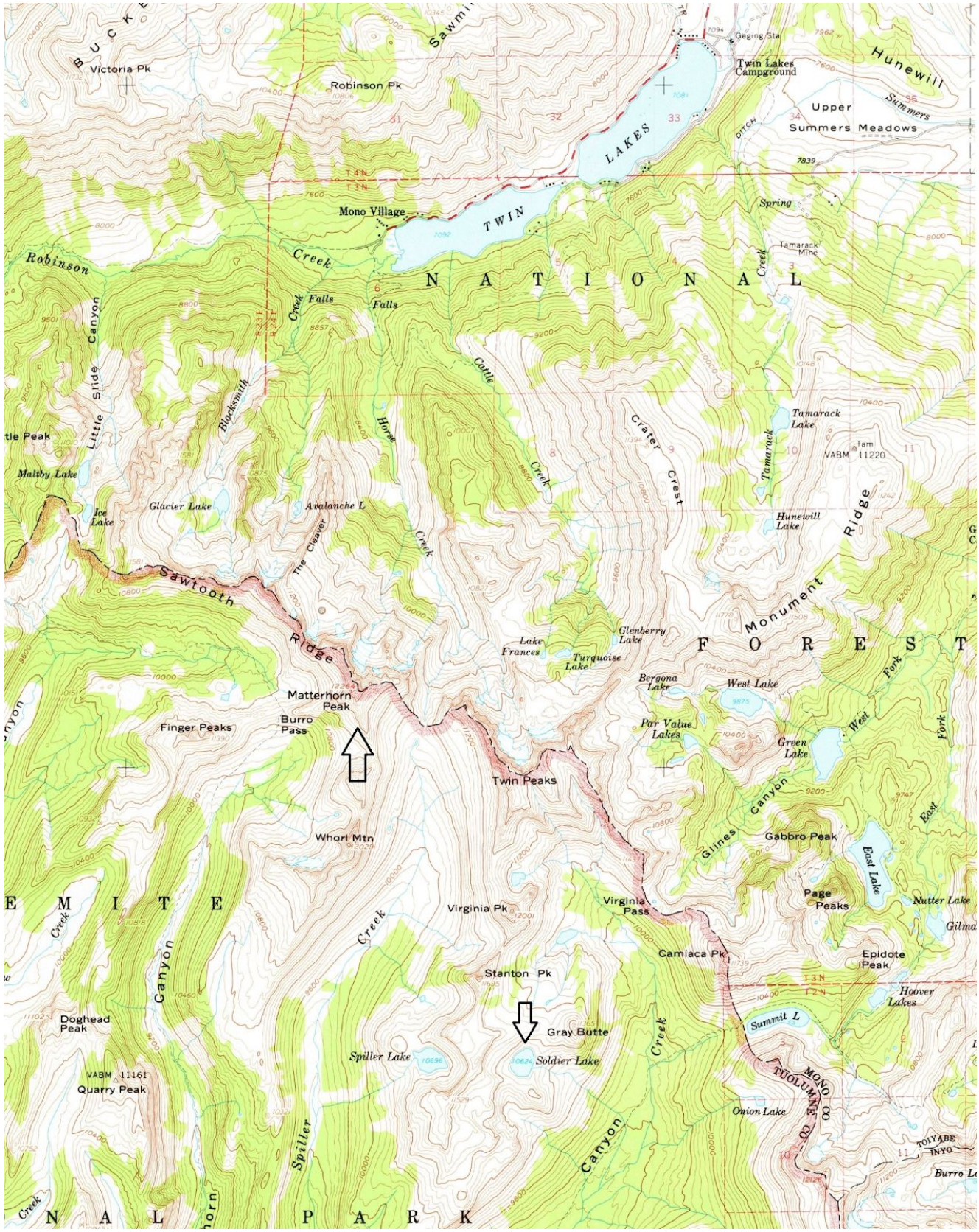

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Figure 11: Close-up of Matterhorn Peak area (Source: USGS topoView)

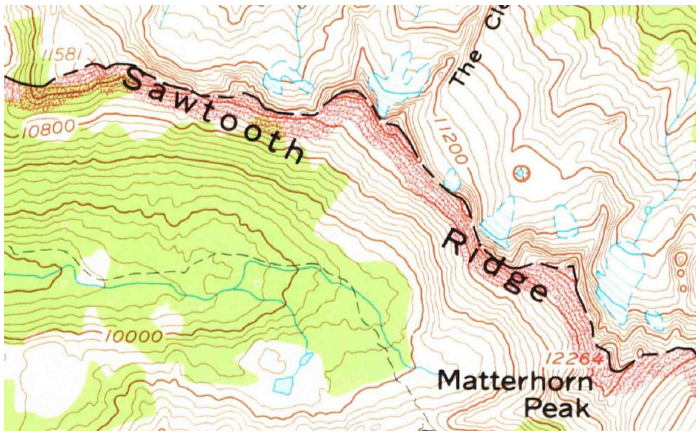

Figure 12: Close-up of Soldier Lake area (Source: USGS topoView)

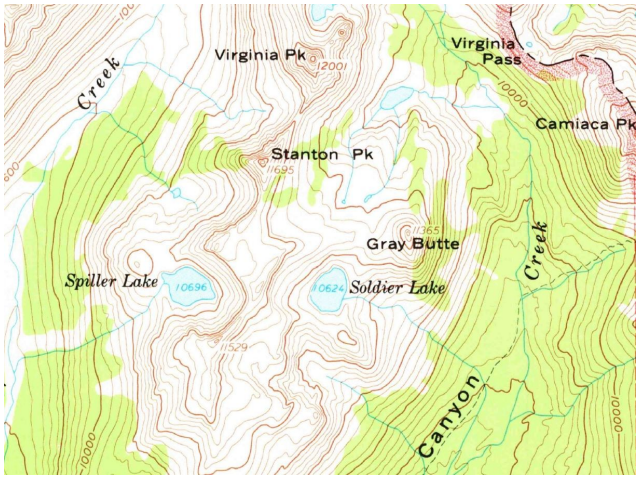

Figure 13: Sodus, NY area (Source: USGS topoView)

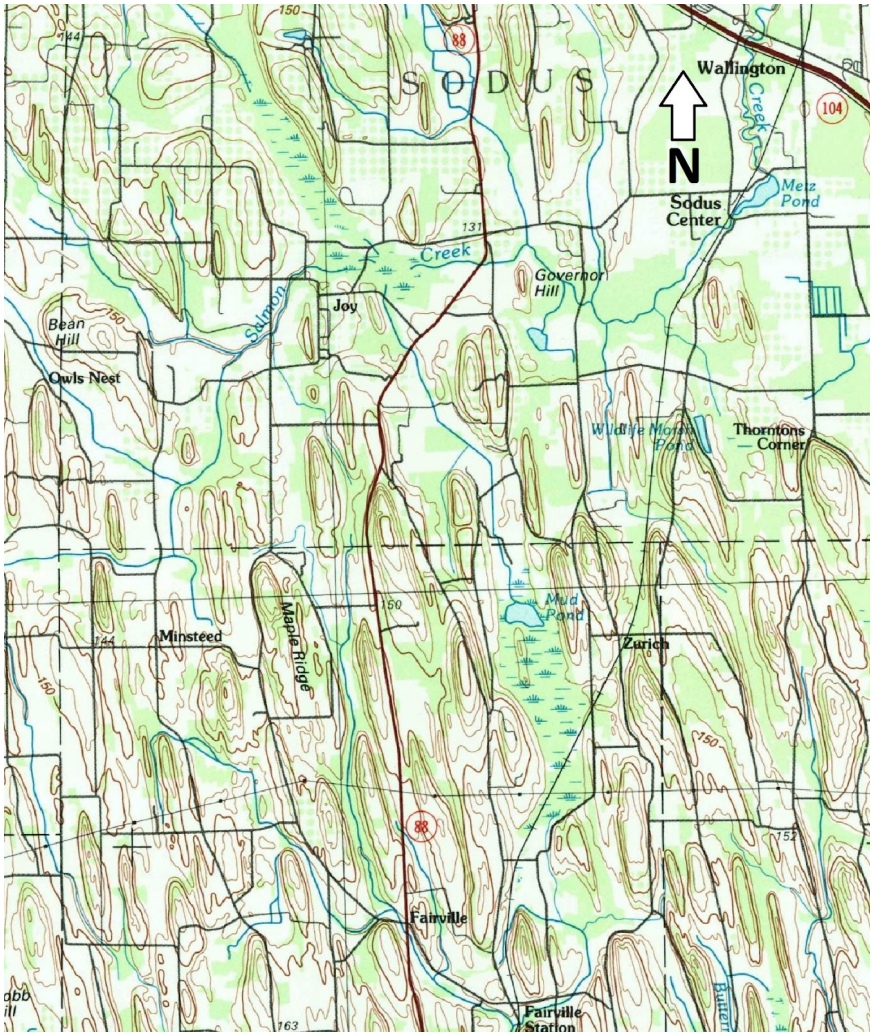

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Figure 14: Blue Ridge, Michigan area (Source: USGS topoView)

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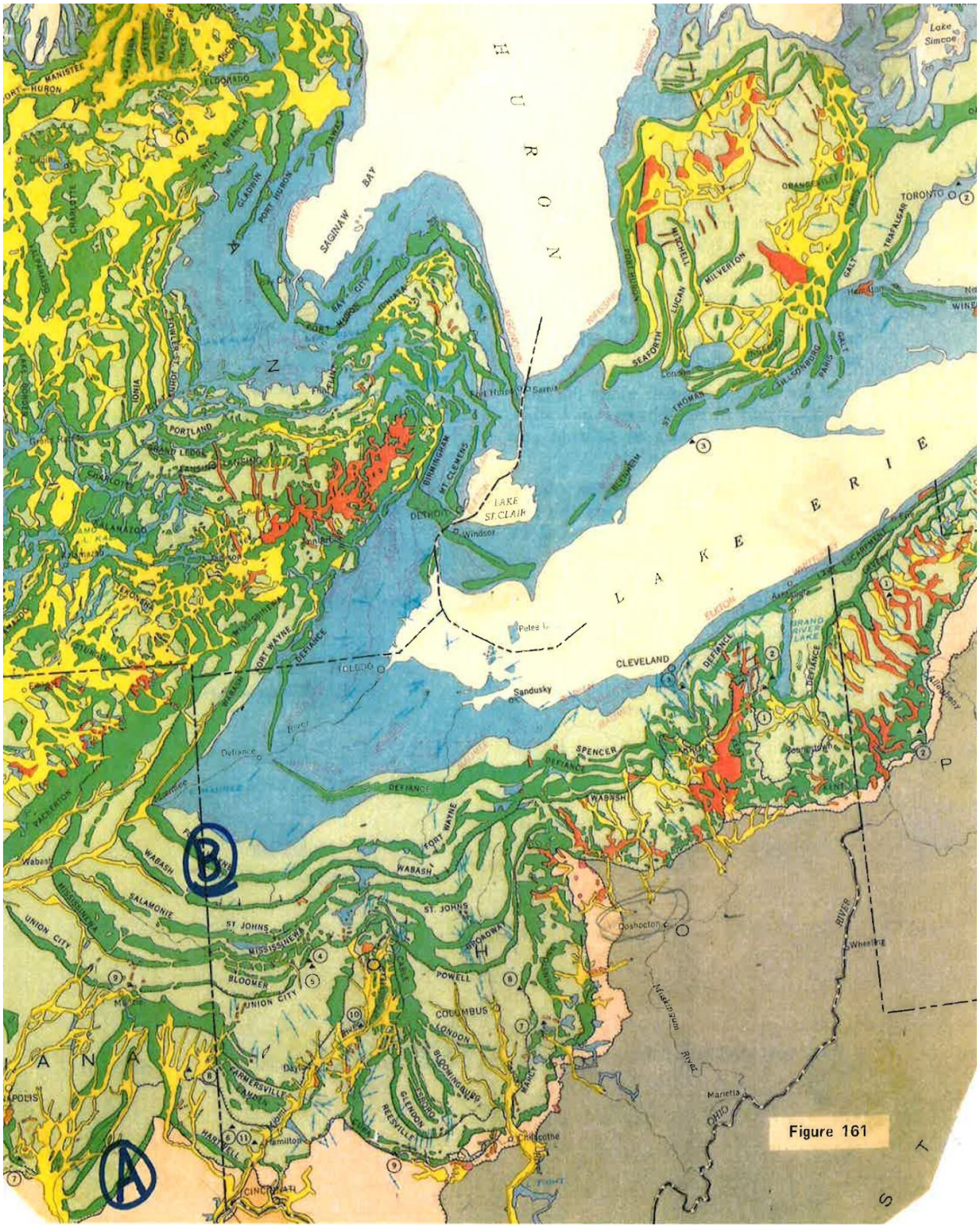
Figure 15: Map of glacial features in the Midwest and southeastern Canada.



Note that glacial features correspond to certain colors as shown below:

eskers → orange
end moraines → dark green
ground moraine and other "drift" → light green and peach
outwash → yellow
lake sediments → blue
areas that were not glaciated → gray

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Figure 16: Insolation versus $\delta^{18}O$ for the Vostok ice core from Antarctica (Source: Petit et al. (1999), https://www.nature.com/articles/20859)

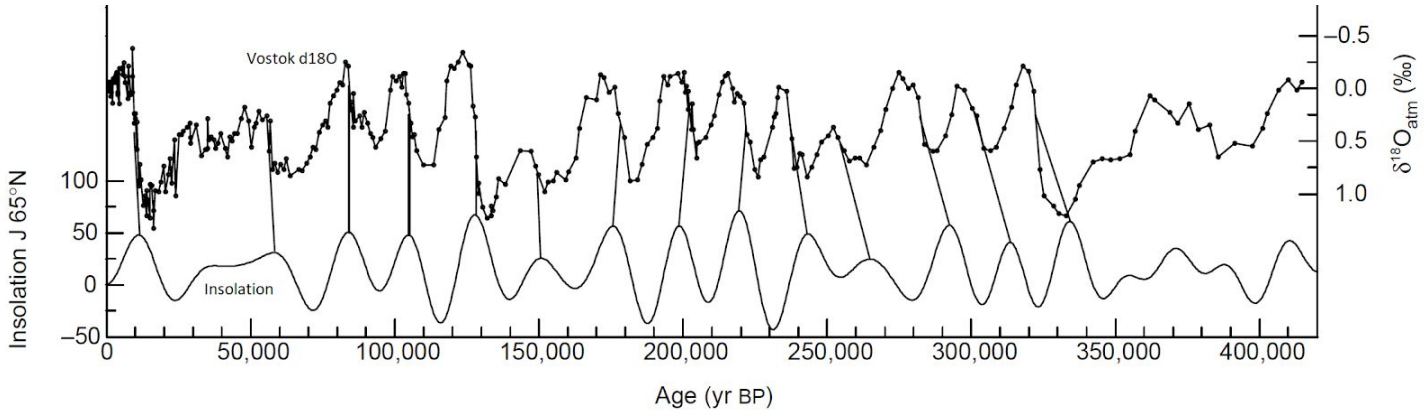

Figure 17: Eastern United States, with coastline at peak of last glacial maximum. (Source: USGS, https://water.usgs.gov/edu/graphics/wss-wuse-ice-atlantic-coast-last-iceage.jpg)

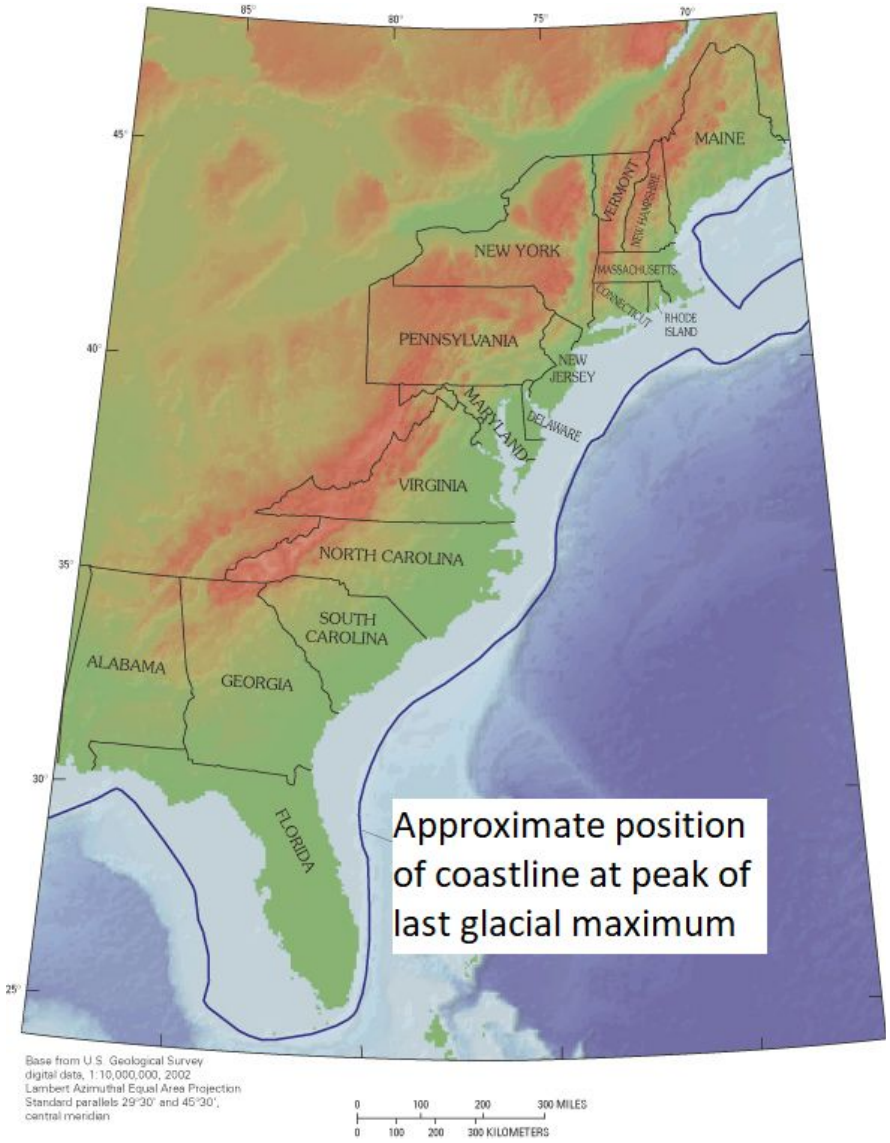

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Figure 18: Laurentide ice sheet thickness

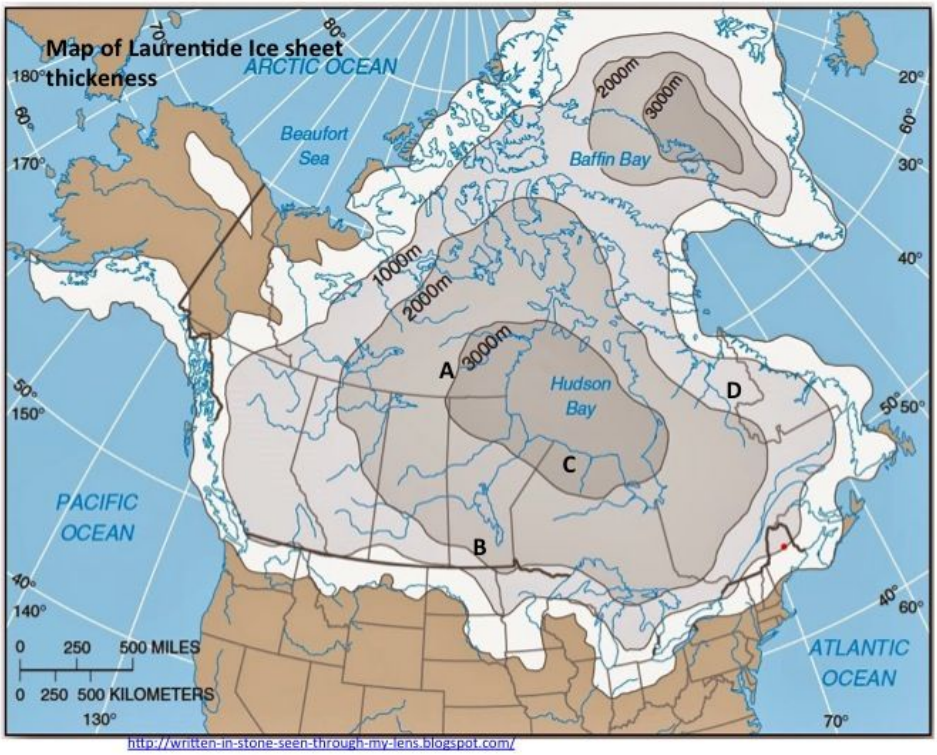

Figure 19: Uplift rates of crust in Canada.

https://www.researchgate.net/publication/286867540_Crustal_motion_and_deformation_monitoring_of_the_Canadian_landmass

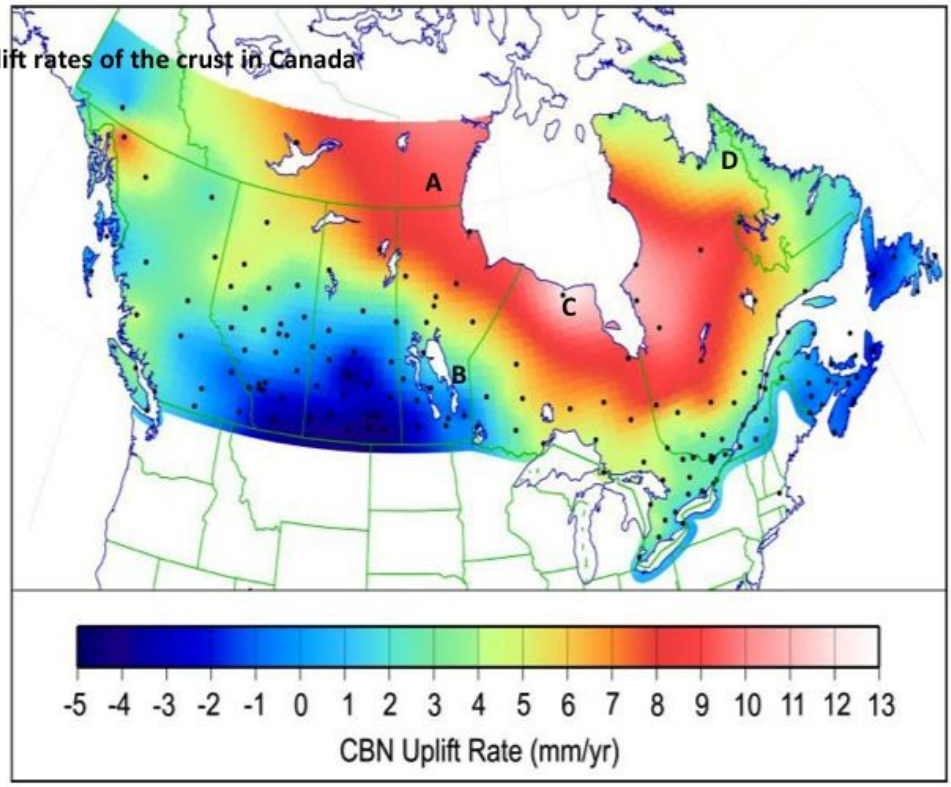

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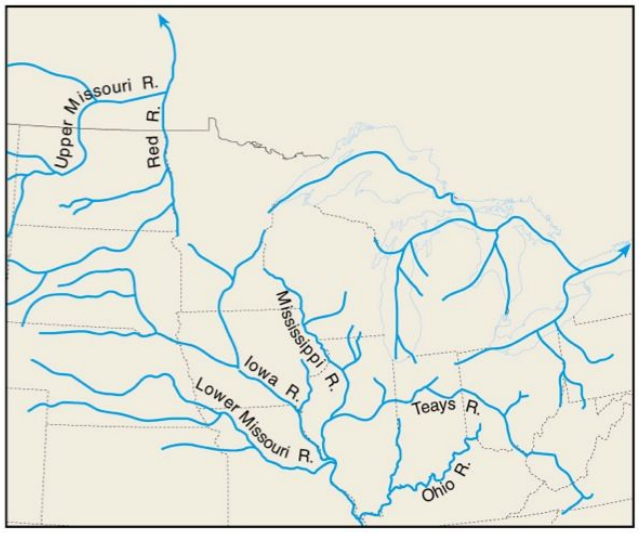
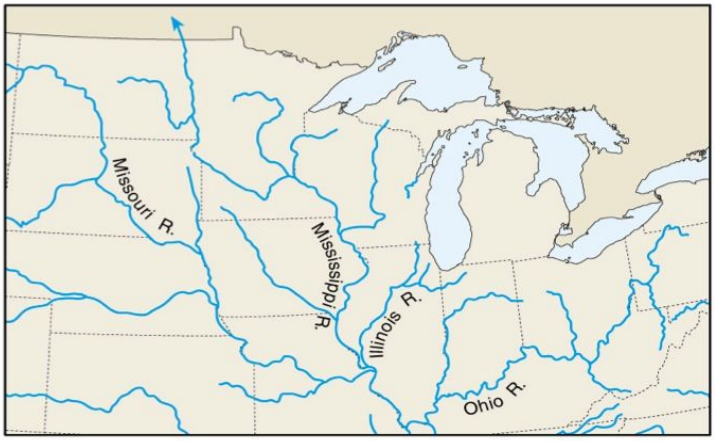
Figure 20: *Pre*glacial drainage patterns in the Midwest U.S.



Preglacial drainage Midwest U.S. (from Tarbuck and Lutgens 2011)

Figure 21: *Post*glacial drainage patterns in the Midwest U.S.



B. Postglacial drainage Midwest U.S. (from Tarbuck and Lutgens 2011)

Figure 22: A sensor on the Landsat satellite measured surface temperatures on and around the Larsen C ice shelf in Antarctica in September 2017. In the image below, Iceberg A-68 is shown, as of September 2017, after it broke off Antarctica's Larsen C ice shelf in July of 2017. (Source: NASA, https://earthobservatory.nasa.gov/blogs/eokids/wp-content/uploads/sites/6/2018/08/EOKids_Ice508.pdf).

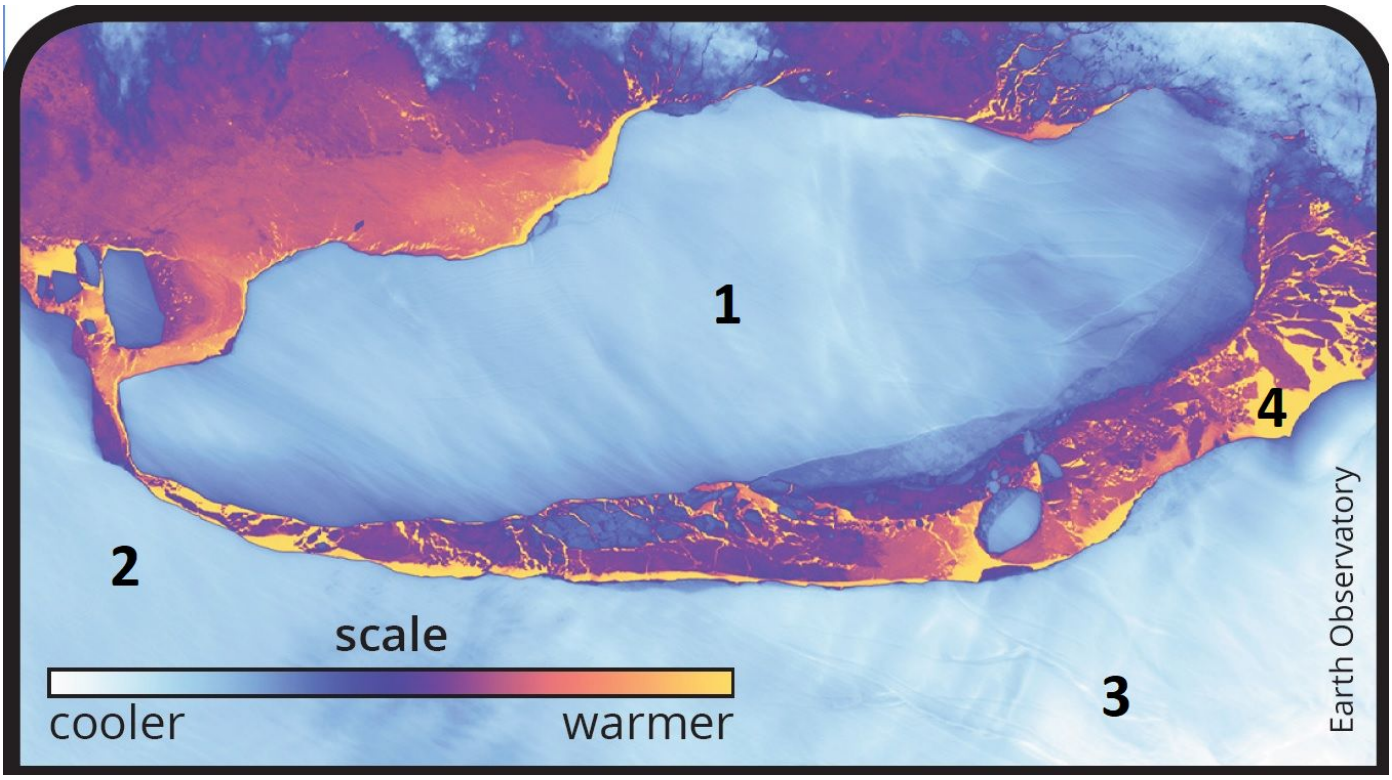


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Figure 23: ICESat-2 launch. (Source: NASA/Kim Shiflett, https://blogs.nasa.gov/icesat2/2018/09/15/icesat-2-successfully-launched-on-final-flight-of-delta-ii-rocket/)

Figure 24: Artist-generated image of ICESat-2, prior to launch. (Source: https://www.nasa.gov/social/ice-ice-baby-experience-the-launch-of-nasa-s-icesat-2-and-the-final-delta-ii-rocket)

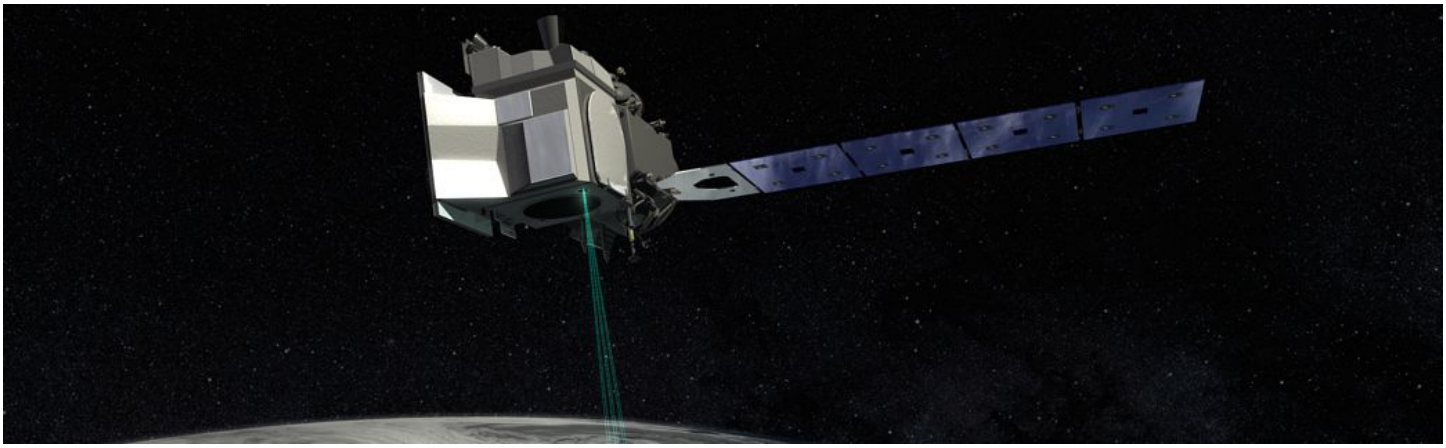

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Figure 25: Elevation data derived from data collected by the ATLAS instrument on ICESat-2, as the satellite orbited over Antarctica after its launch. ICESat-2's science team shared data from the ICESat-2 satellite at the American Geophysical Union's annual meeting in December 2018, in Washington, D.C. Mission managers expect to release the data to the public in early 2019. (Source: NASA Earth Observatory/Joshua Stevens/Kate Ramsayer, https://www.nasa.gov/feature/goddard/2018/icesat-2-reveals-profile-of-ice-sheets-sea-ice-forests)

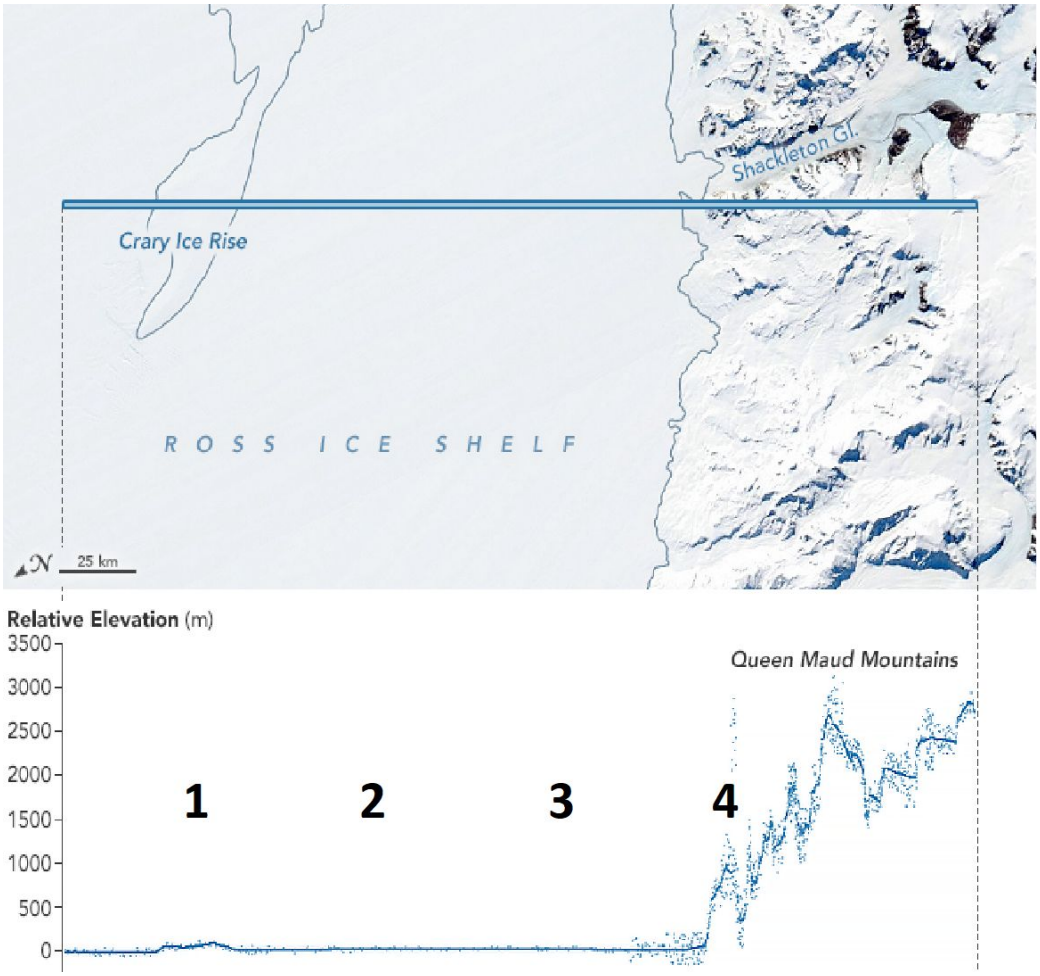

Figure 26: Mer De Glace Glacier (Source: Richard Jones/nsidc.org) →