Cryosphere

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- ice sheets
- ice shelves
- glaciers
- sea ice - *best effort*
- *terrestrial snow covered by hydrology*

Cryosphere

Guided by two overreaching Decadal Survey questions:

1. How will sea level change, globally and regionally, over the next decade and beyond? [S-3, C-1] [Most Important]
2. What will be the consequences of amplified climate change in the Arctic and Antarctic? [C-8] [Very Important]

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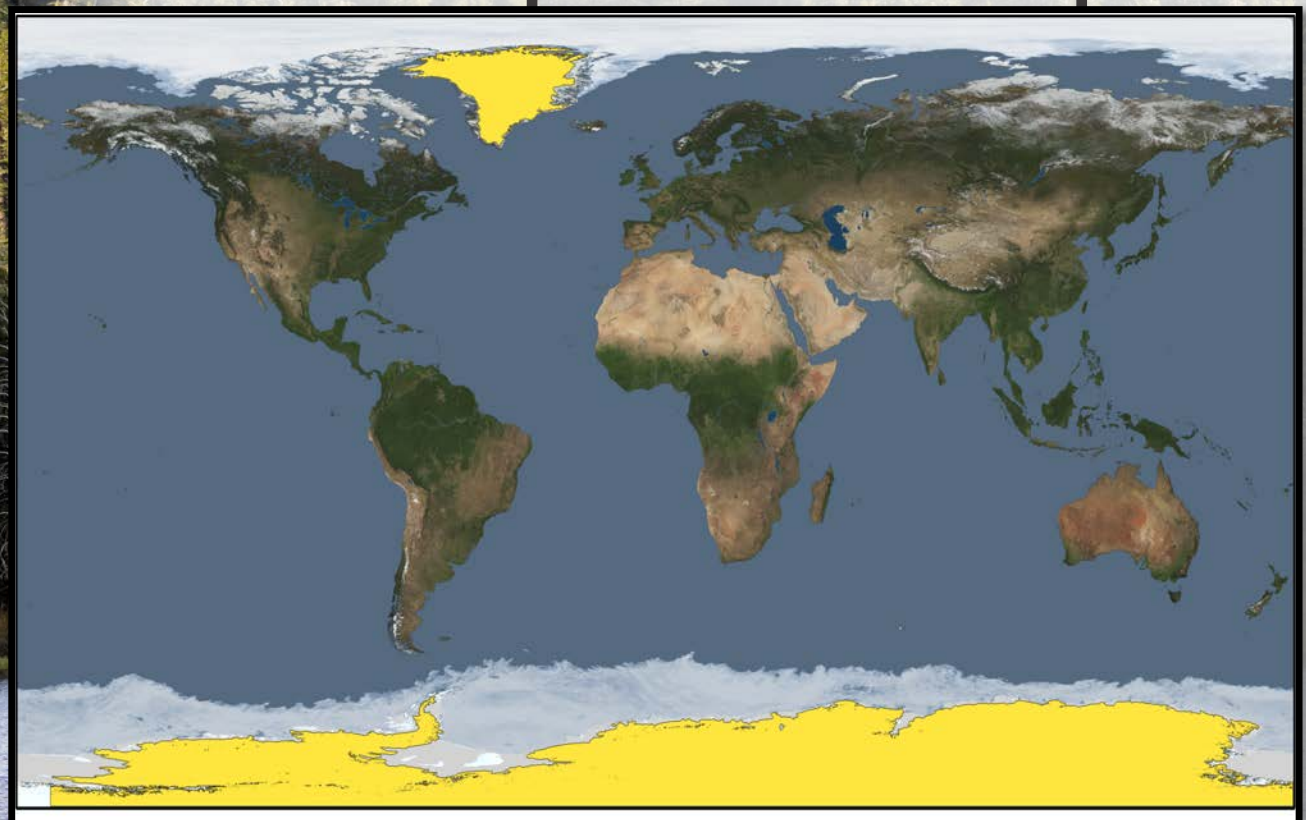
How will sea level change, globally and regionally, over the next decade and beyond?

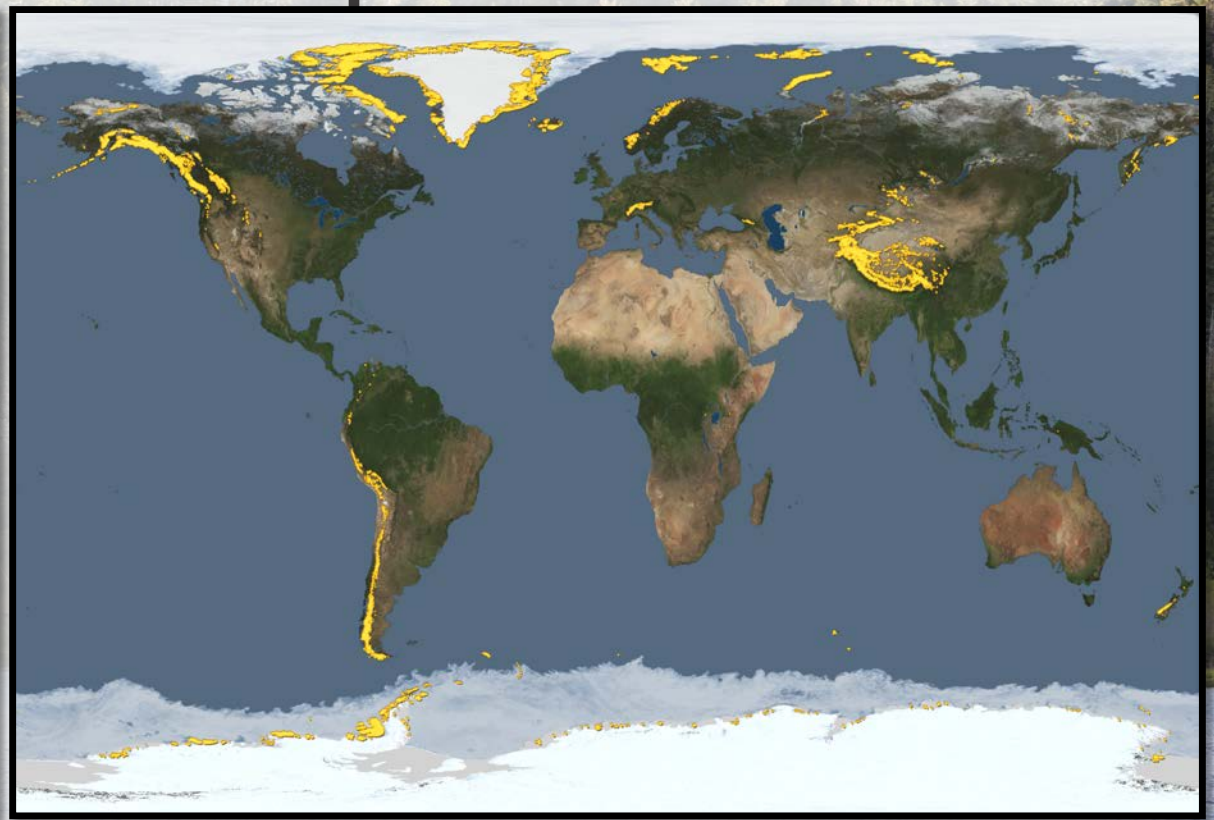
- Sea level budget closer is necessary but not sufficient
- Requires advancement in understanding of key time-evolving processes that regulate ice sheet flow, and exchanges of mass and energy at boundaries between ice-and-ocean and ice-and-atmosphere
- It is your and my job to define the measurements needed to make these advancements

Cryosphere

Land ice and sea level rise

	Greenland IS	Antarctic IS	Glaciers
Sea Level Potential	7.4 m	57.2 m	0.3 m
Rate of SLE loss	0.6 mm/yr	0.3 mm/yr	0.8 mm/yr





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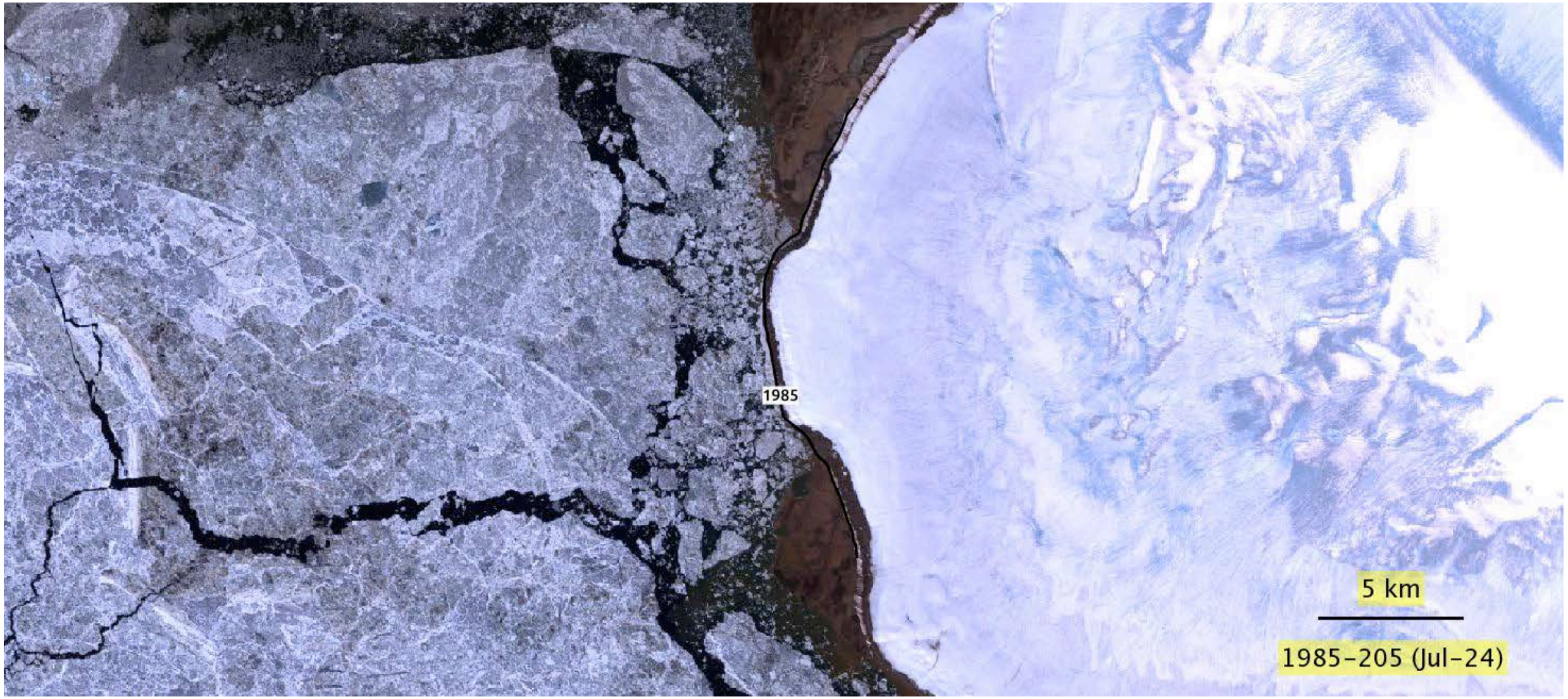
Key processes relevant to STV

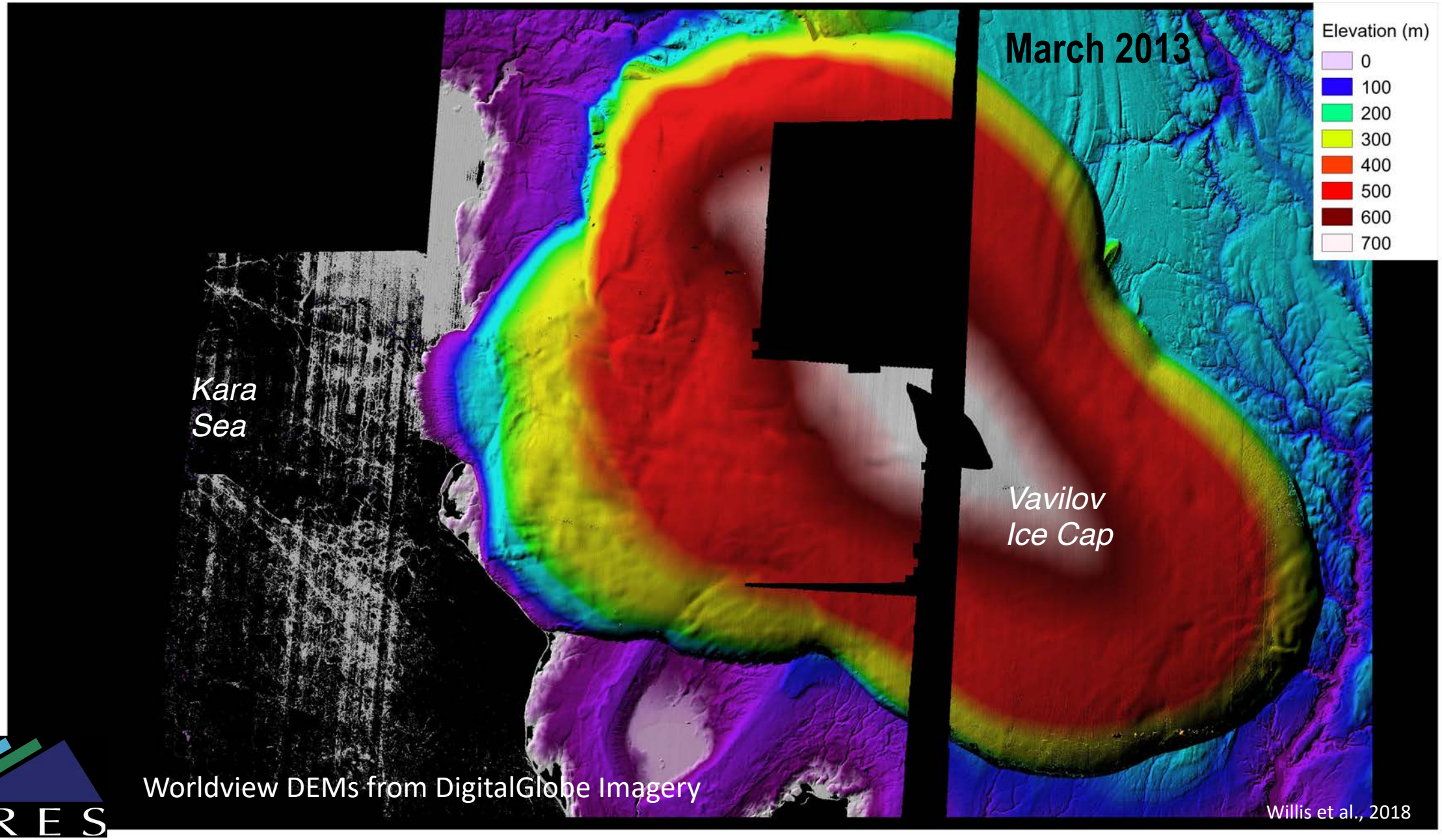
- Glacier sliding
- Ice shelf and glacier calving
- Ice shelf melting by ocean
- Pre-existing ice sheet imbalance
- Grounding zone mechanics
- Shear margin mechanics
- Surface mass balance
- Ice fracture
- *Did I miss anything?*



Video by Whyjay Zheng, Cornell.

Willis et al. "**Massive destabilization of an Arctic ice cap**." *Earth and Planetary Science Letters*, 2018
DOI: 10.1016/j.epsl.2018.08.049

Vavilov Ice Cap



Worldview DEMs from DigitalGlobe Imagery

Willis et al., 2018

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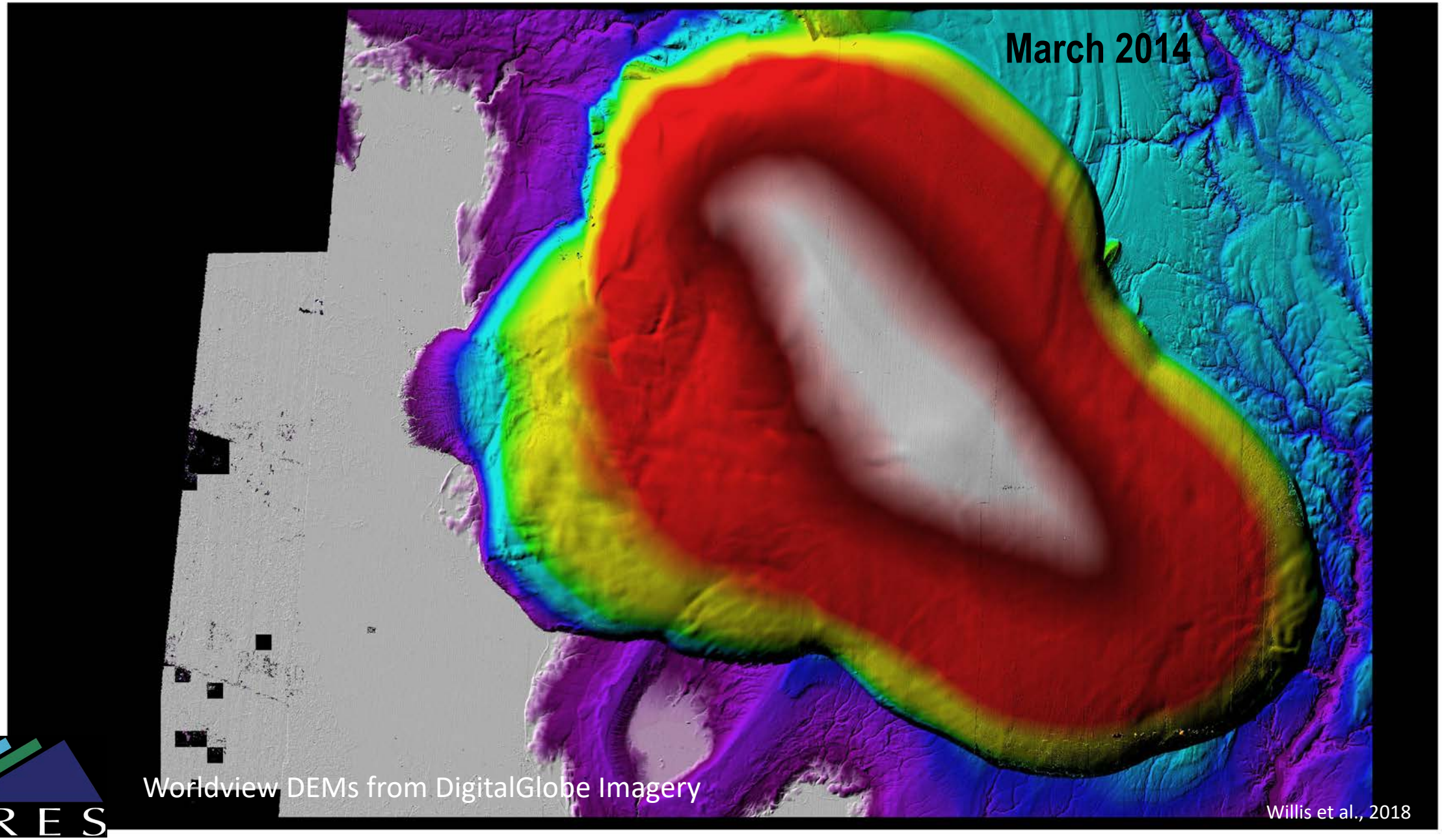
Vavilov Ice Cap



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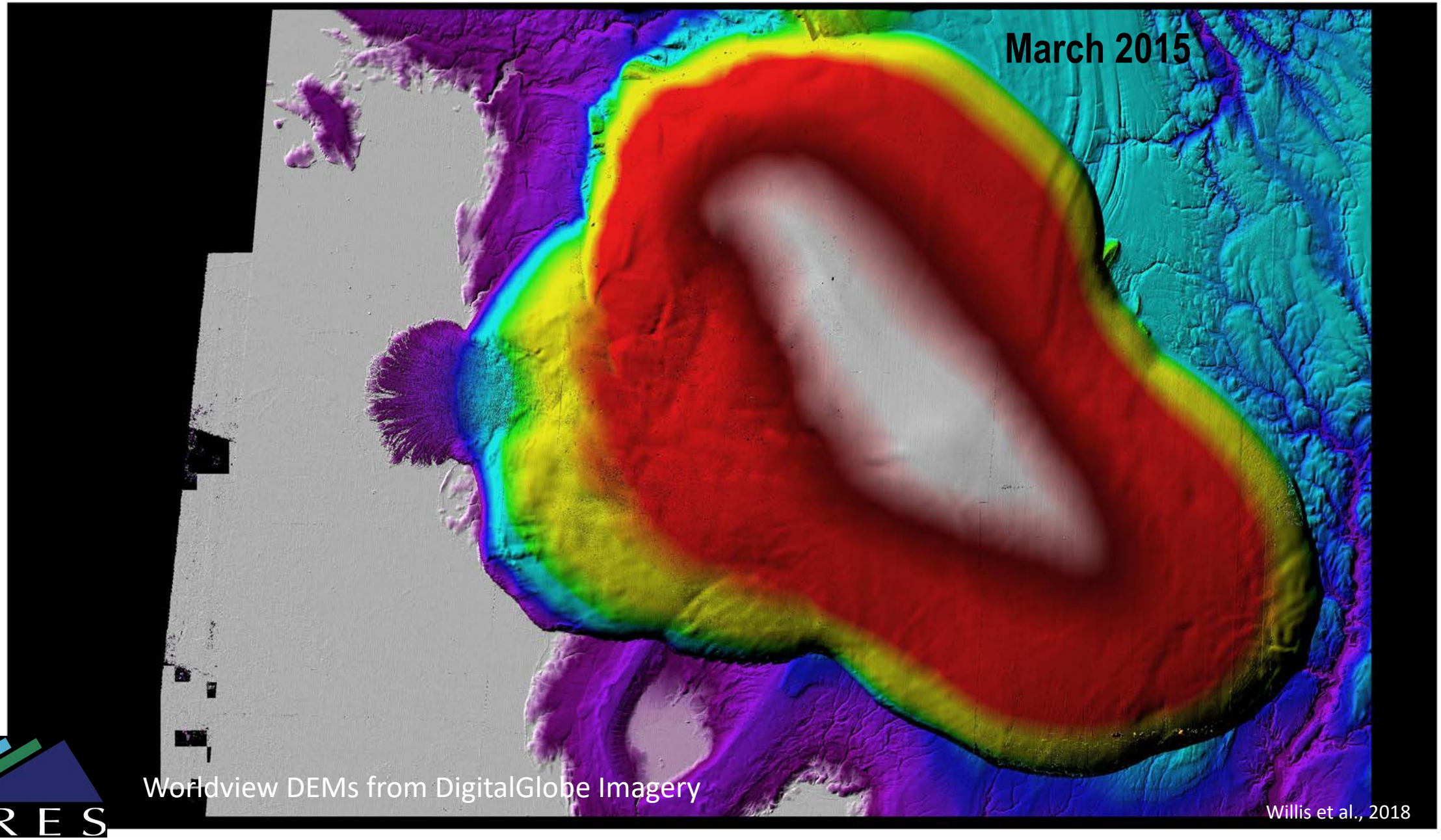

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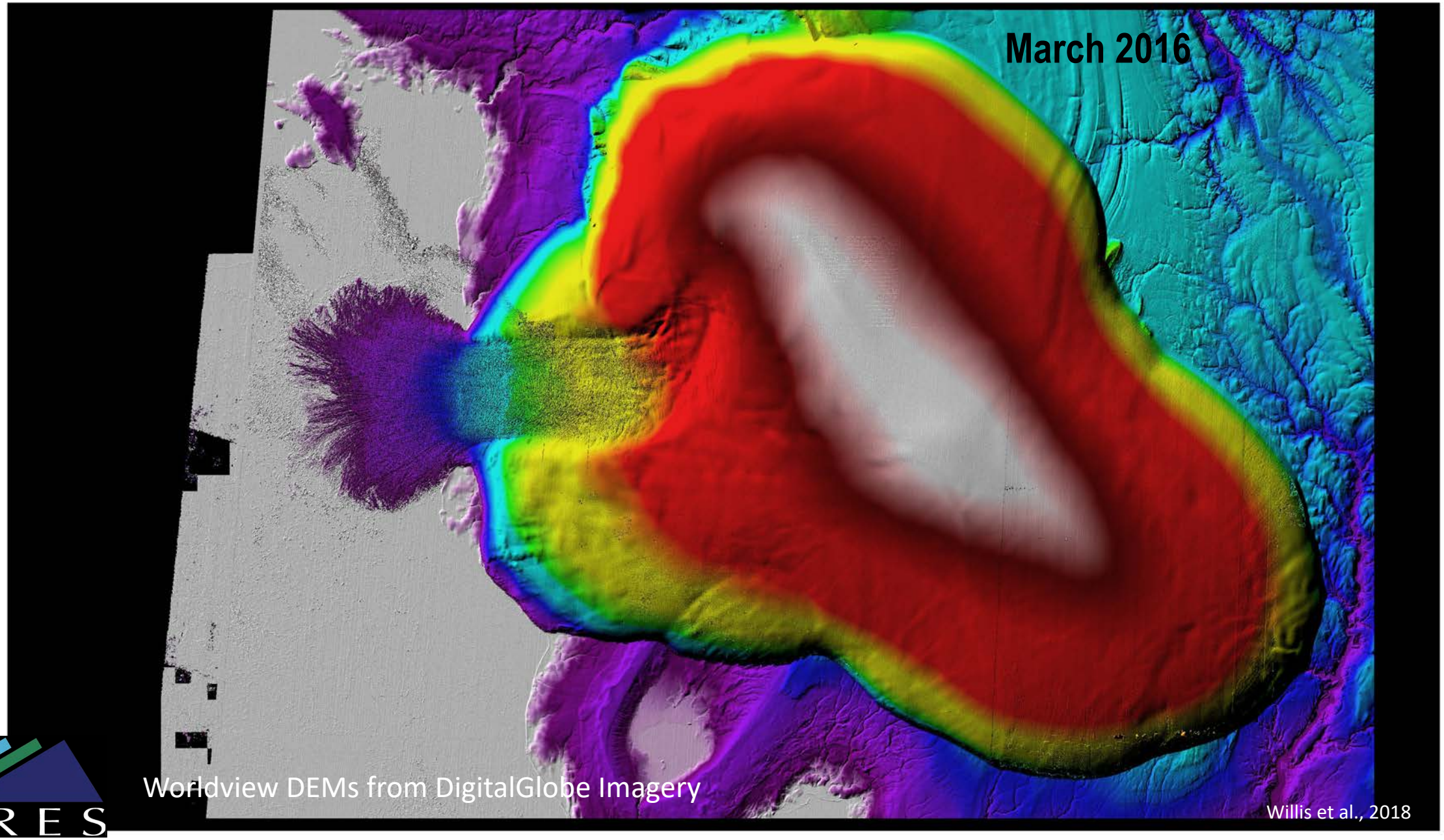

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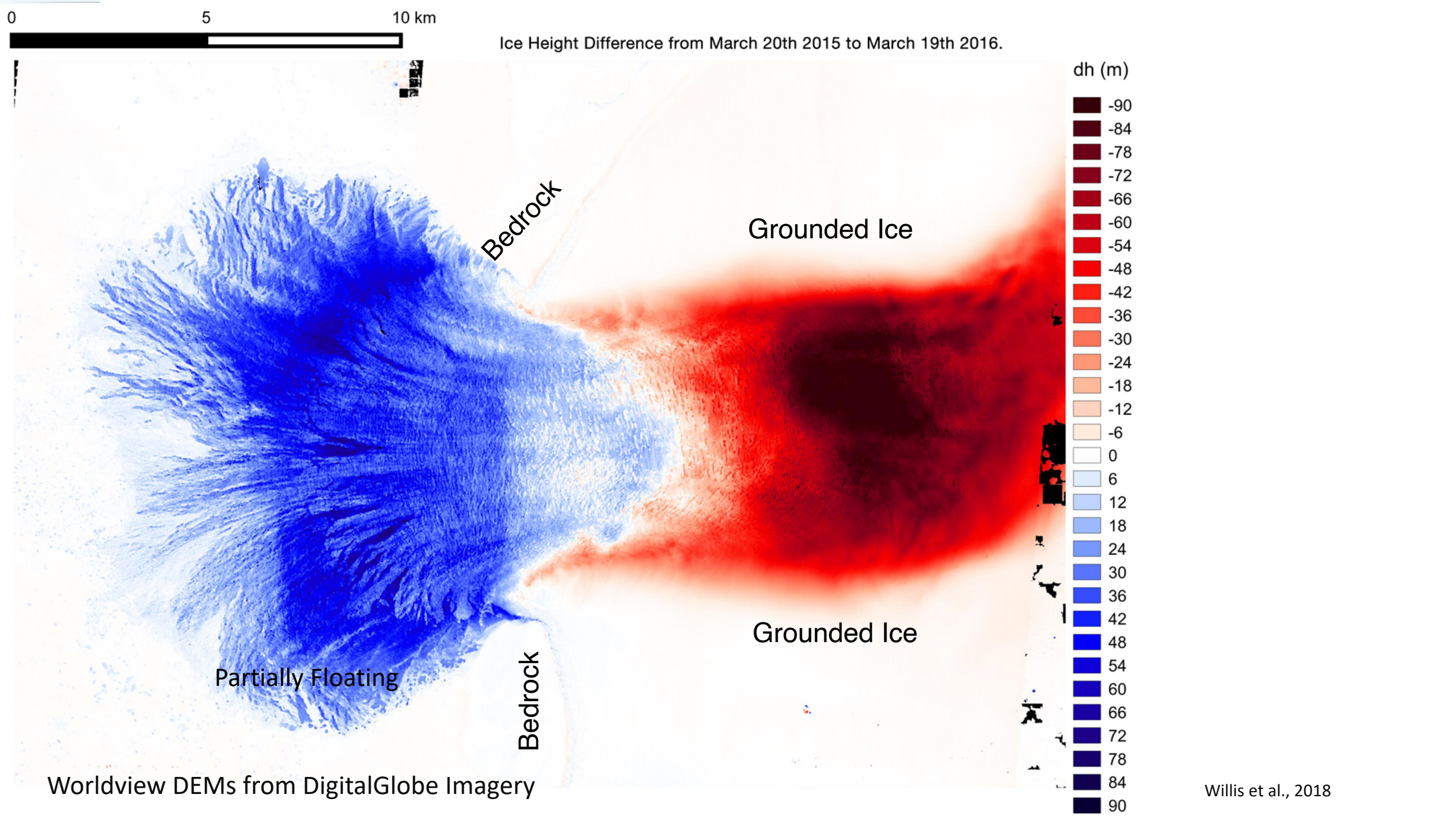

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What will be the consequences of amplified climate change in the Arctic and Antarctic? [C-8] [Sea Ice - Very Important]

- How will sea ice change (thickness and coverage) in response to changes in ocean and atmosphere conditions
- ** Need more input from the broader sea ice community **

Measurement needs

Can be broken down into five target surfaces:

1. Fast Moving portions of Ice Sheets and Ice Caps
2. Slow Moving portions of Ice Sheets and Ice Caps
3. Ice Shelves
4. Mountain glaciers (larger than 50 km sq.)
5. Arctic and Southern Ocean Sea Ice Cover

Measurement needs

For each surface we need to define

1. Spatial scales*
2. Temporal repeat*
3. Measurement accuracy and precision*

*Only as needed for answering high level DS questions

Cryosphere

How good is good enough?

- What is the **ideal** STV measurement needed for rapid advancement in the understanding of identified cryosphere processes?
- What is the **sufficient** measurement needed to make substantive progress in our understanding identified cryosphere processes?

- How do we objectively make these decisions with sufficient traceability that they will stand up to inter-discipline / inter-observation competition in a resource limited environment and will be realized for the next generation of cryosphere researchers that will work to answer some of societies most pressing questions.