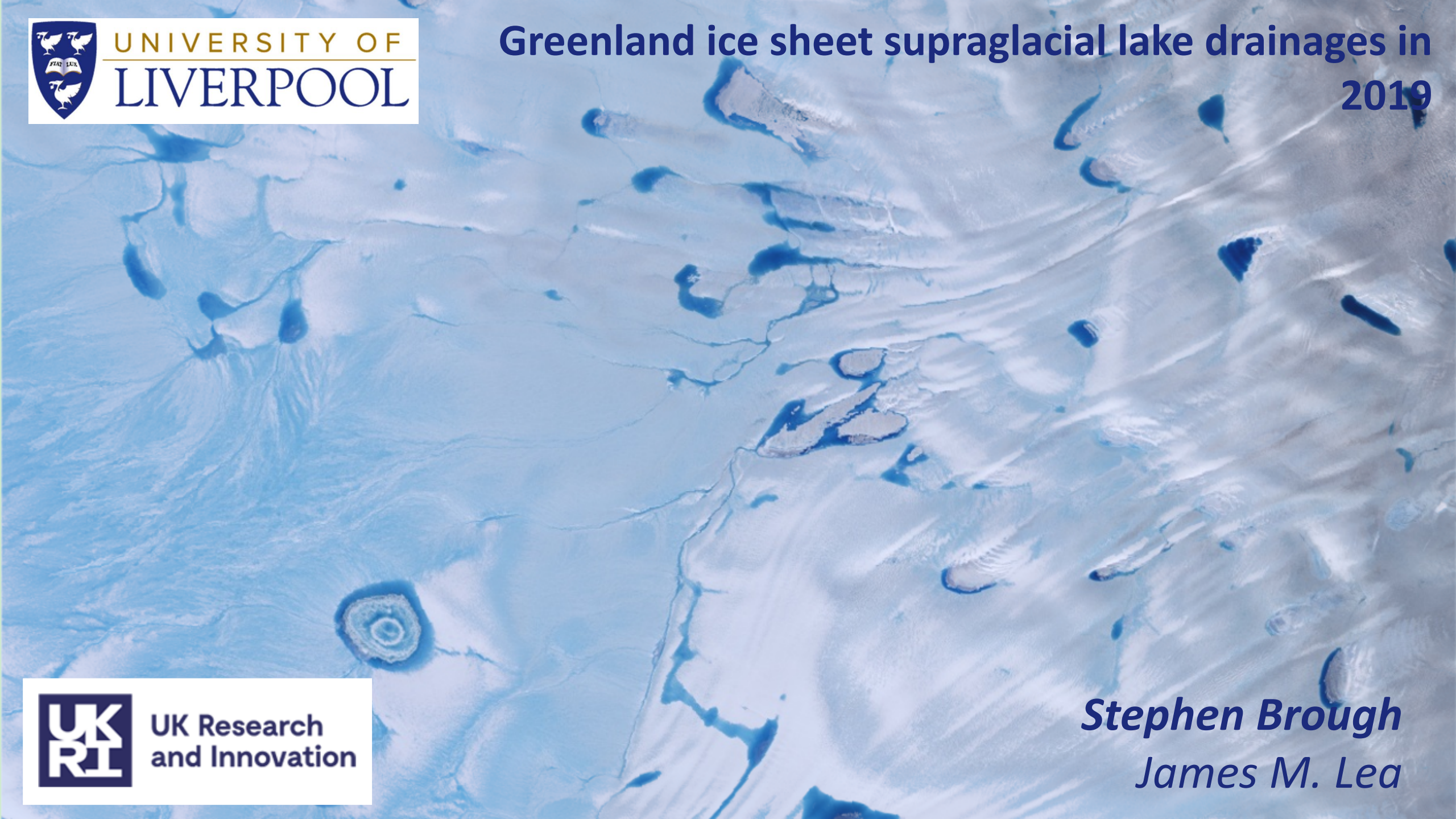

Greenland ice sheet supraglacial lake drainages in 2019

Stephen Brough

James M. Lea

In this study….

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1. ***Methods***
   - Used dynamic thresholding method for supraglacial lake identification (Selmes et al., 2011)
   - Used Google Earth Engine (GEE) to apply this to daily MODIS Terra imagery of all of Greenland
   - All available imagery for 2019 melt seasons analysed (May 1st to September 30th)
   - 'Rapid' lake drainages calculated using a variety of thresholds (6-, 4-, and 2-day [e.g. Cooley and Christoffersen, 2017; Fitzpatrick et al., 2014; Liang et al., 2012, Morriss et al., 2013])

2. **Some (very) preliminary results…needs quality checking (and GEE code refining)**
   - Identified a total of 1548 lakes in 2019 (SW – 383; CW – 291; NW – 214; NO – 203; NE – 372; SE – 79)
   - A total of 1042 (67 %), 889 (57 %), and 610 (39 %) drainages events identified for 6-, 4-, and 2-day drainage periods
     - ➢ High % of 'rapid' lake drainages suggests false positives remain in the dataset and further refinement needed (see SE – affected by missed nunataks?)

See also: Lea and Brough, Greenland's supraglacial lakes increase by a quarter in the last 20 years (different workflow implemented)

Session: Hydrology of ice shelves, ice sheets and glaciers – from the surface to the base. Chat: Friday 08:30-10:15 CEST

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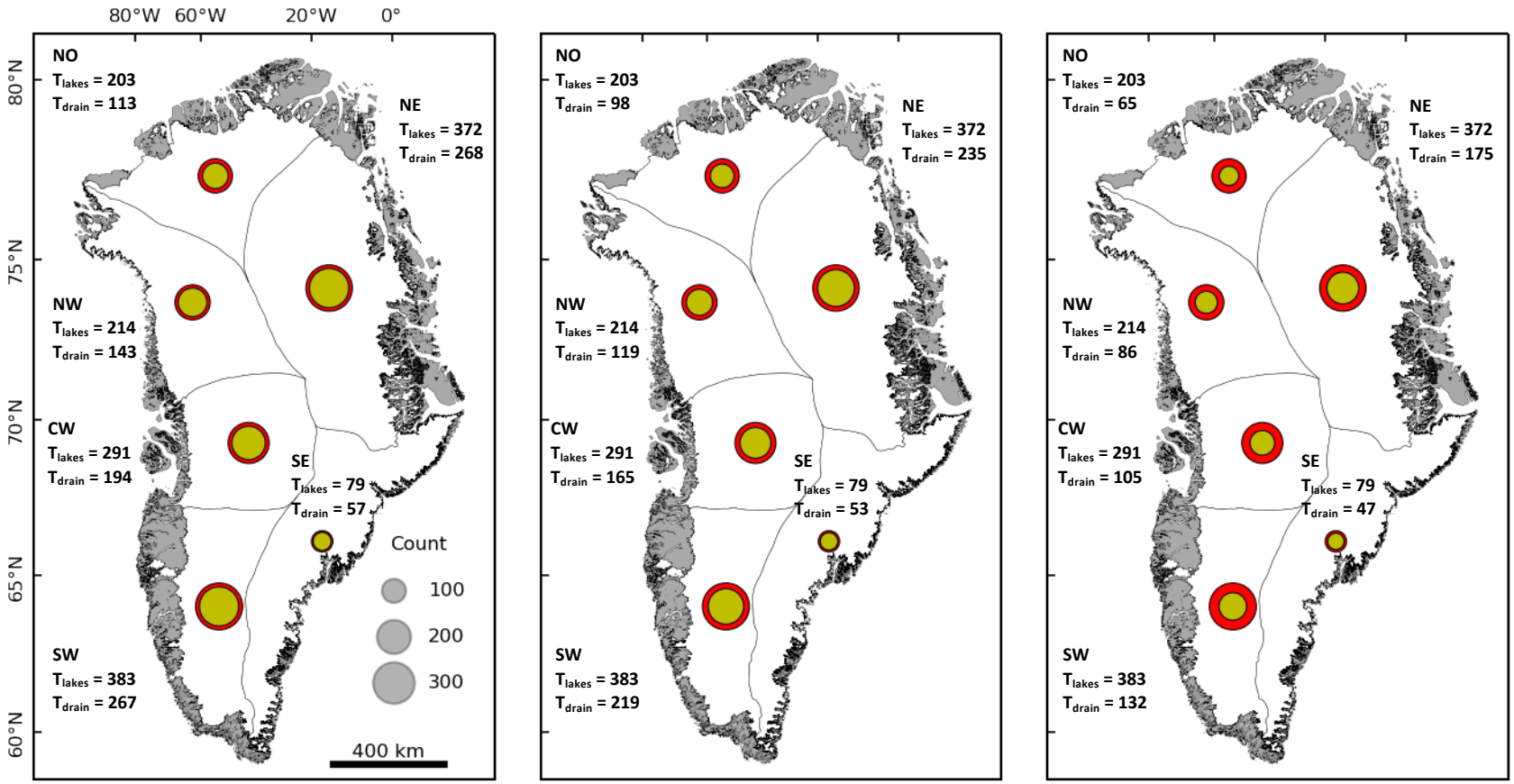
Number of lakes (red) and number of rapid lake drainages (yellow)



6-day drainage period

4-day drainage period

2-day drainage period

- Highest number of lakes is in the SW sector, but more drainages in the NE sector
- But by percentage, more lake drainages in SE
  - ➢ False positives caused by missed nunatacks?

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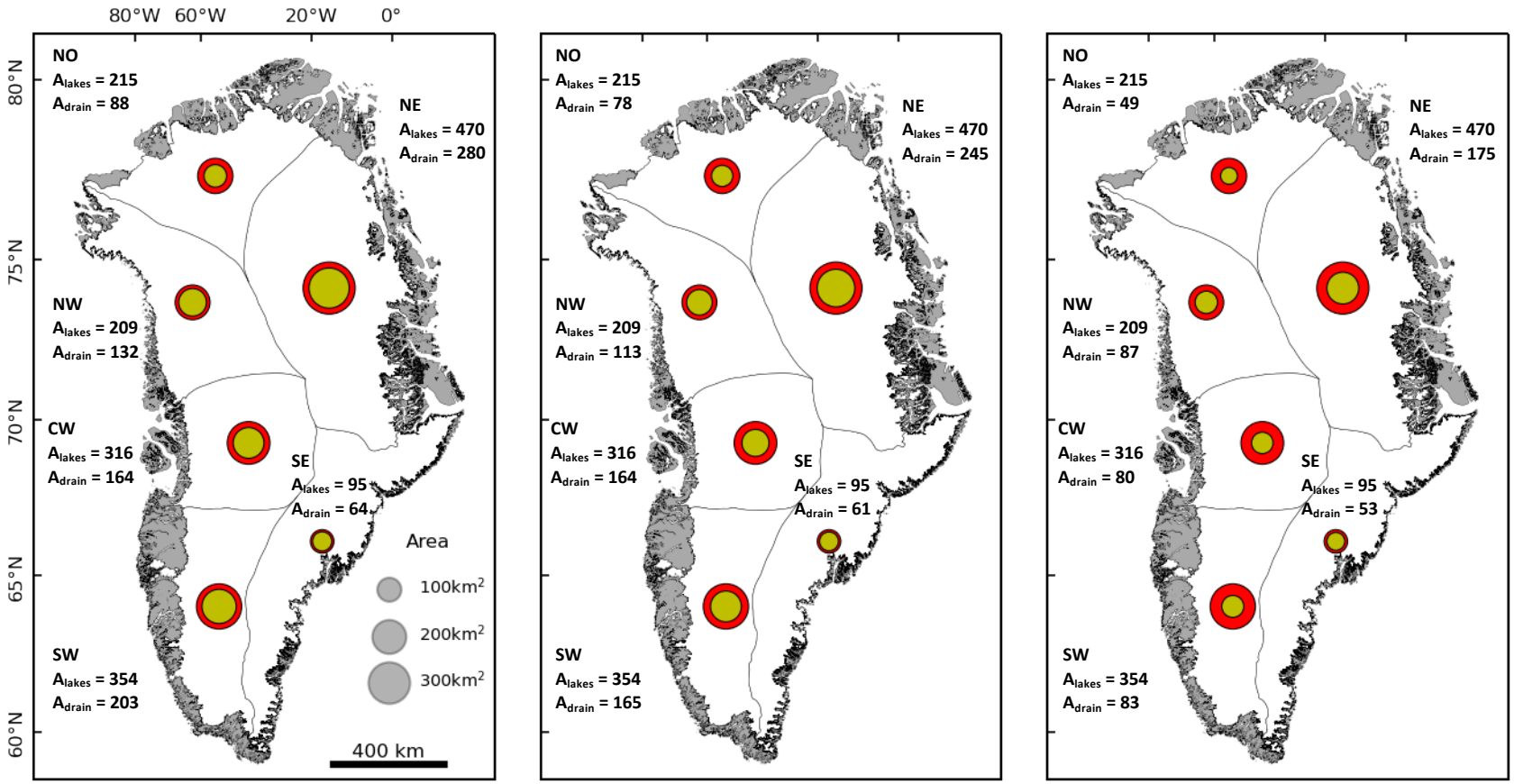
Total lake area (red) and total area of lakes that drained (yellow)



6-day drainage period

4-day drainage period

2-day drainage period

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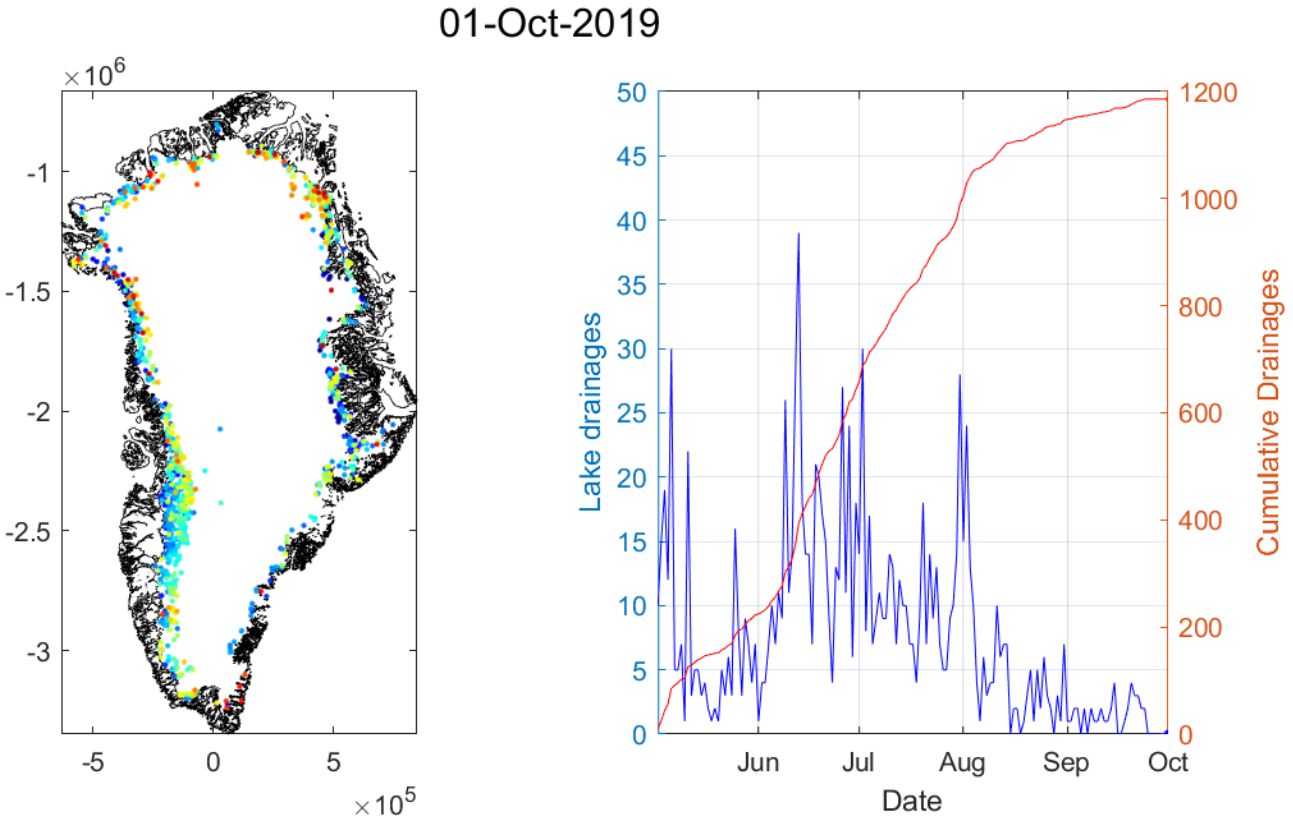
Lake drainage daily time-series



6-day drainage period – animation at end of presentation

- General trend of increasing daily lake drainages in early part of melt season (through June), before declining steadily (post July)
- Spike in August appears to coincide with a melt event

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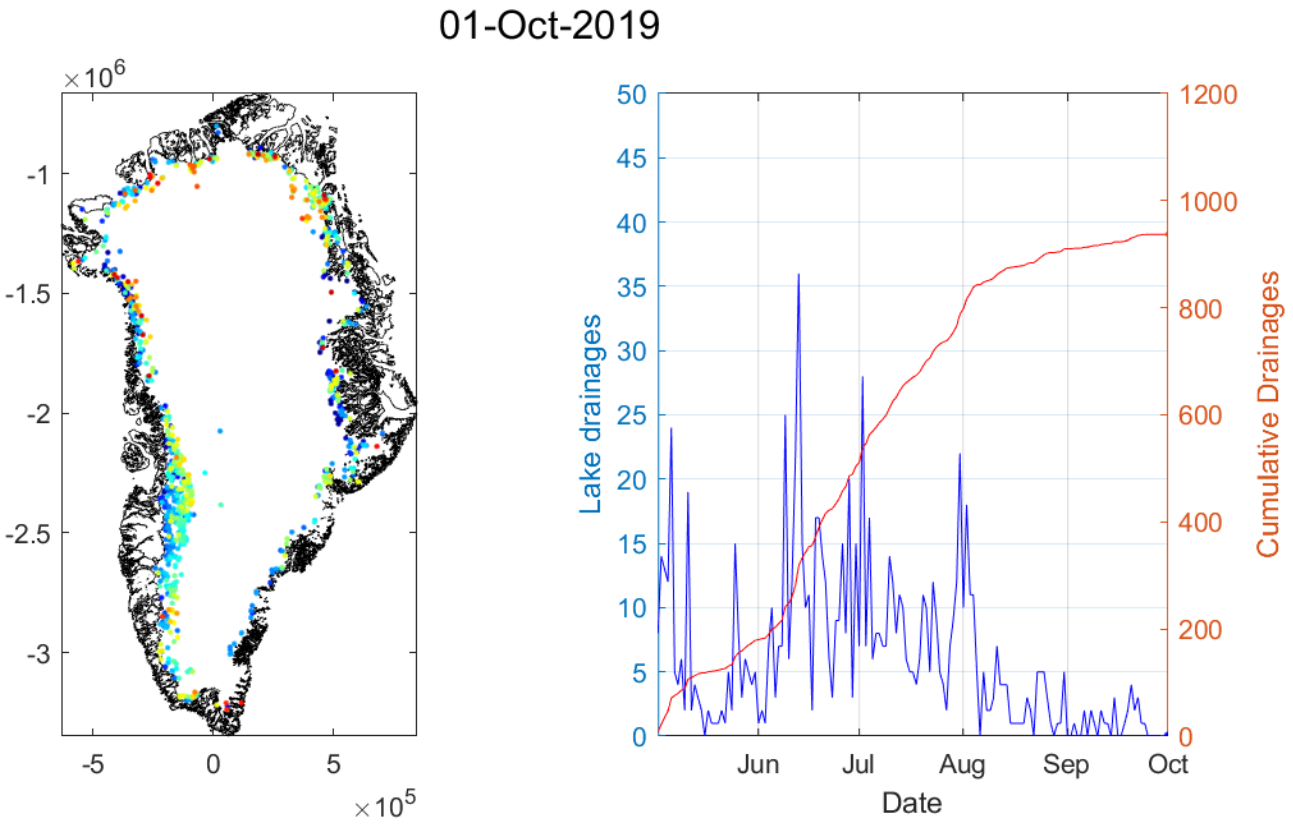
Lake drainage daily time-series



- General trend of increasing daily lake drainages in early part of melt season (through June), before declining steadily (post July)
- Spike in August appears to coincide with a melt event

4-day drainage period – animation at end of presentation

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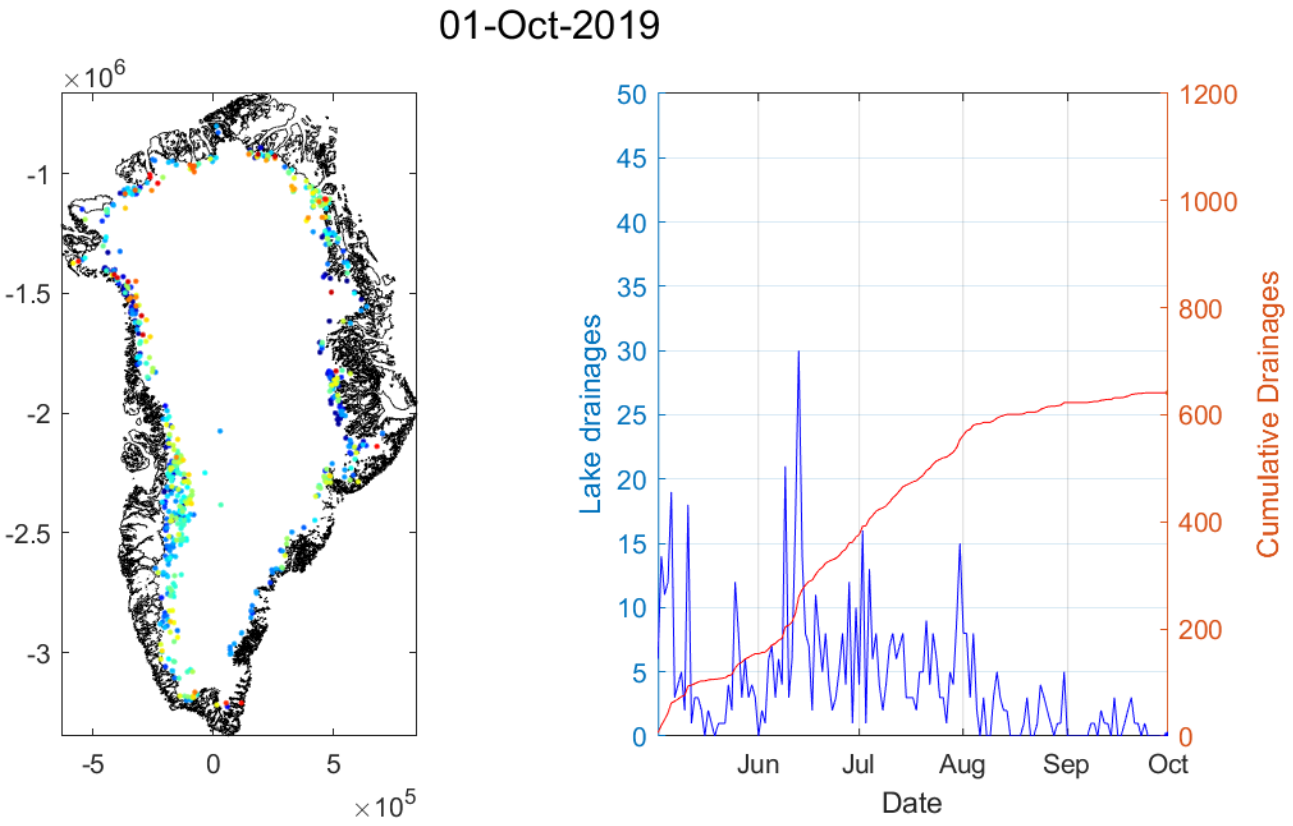
Lake drainage daily time-series



- General trend of increasing daily lake drainages in early part of melt season (through June), before declining steadily (post July)
- Spike in August appears to coincide with a melt event

2-day drainage period – animation at end of presentation

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Summary

- Fully automated method for supraglacial lake drainage identification in Google Earth Engine from MODIS imagery for all Greenland in 2019 (153 images processed at 250 m resolution in ~1 day on the servers)

- Implements a hierarchy of different lake drainage identification criteria following Cooley & Christoffersen (2017)

- Initial results indicate lake drainages in 2019 peaked in mid-June, though notable spike associated with late July/early August heatwave

- Next steps:
  - Validate results and workflow through manual comparison to imagery for selected areas

  - Apply workflow for all years between 2000 and 2019

See also: Lea and Brough, Greenland's supraglacial lakes increase by a quarter in the last 20 years (different workflow implemented)

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