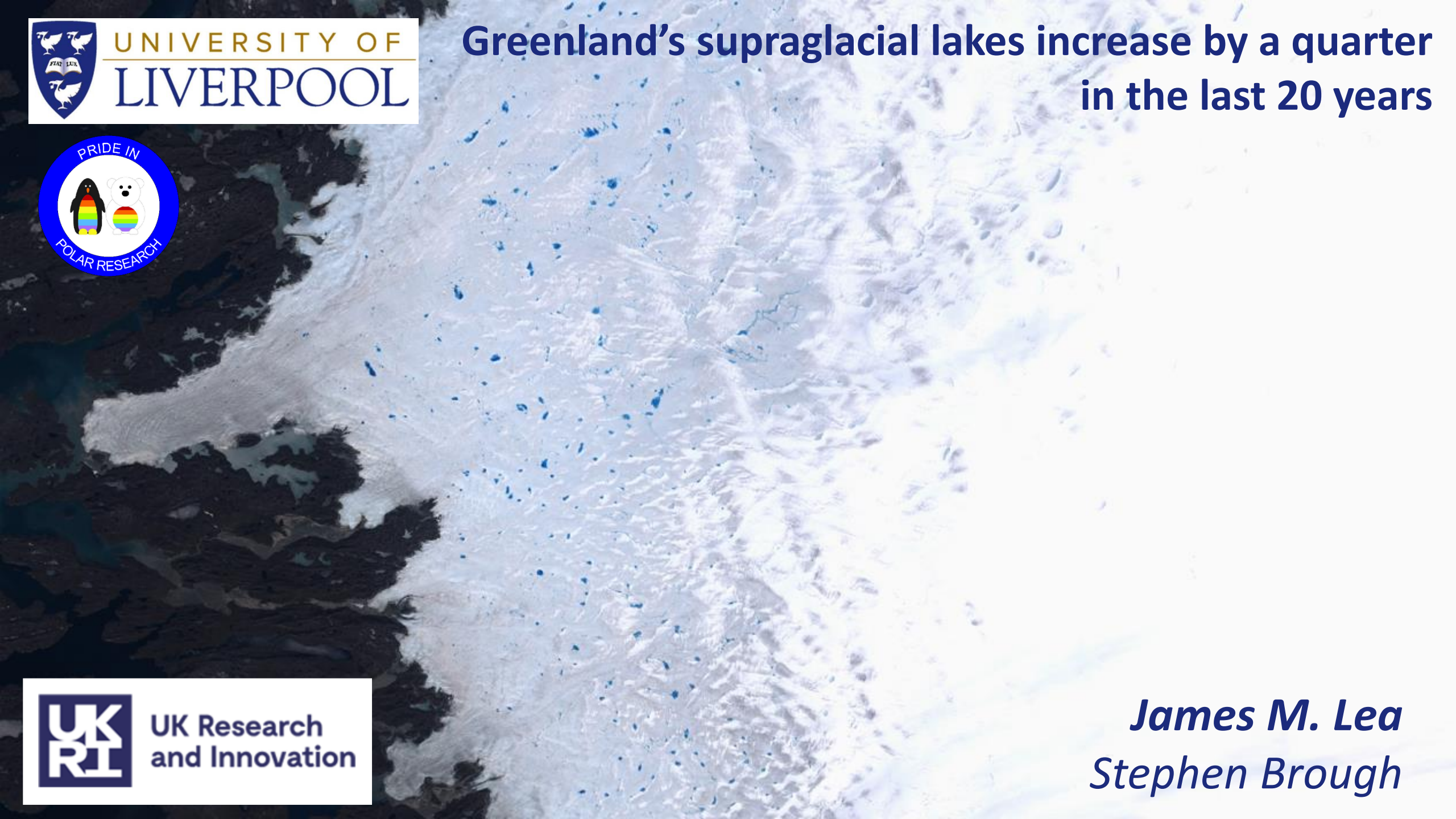

Greenland's supraglacial lakes increase by a quarter in the last 20 years

James M. Lea

Stephen Brough

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 to apply this to daily MODIS Terra imagery of all of Greenland
   - Study period for each year limited to May 1st to September 30th
   - All available imagery for 2000-2019 melt seasons analysed

2. **Results**
   - Between 2000-2019 total lake frequency **has increased by 29%**
   - Total lake area has **increased by 36%**
   - Increases in lake frequency and area are being **driven at higher elevations**
   - Comparison to modelled runoff (MAR; Fettweis et al., 2017) shows **lake formation has different sensitivities to melt** by region and elevation
   - Ice slab extents (MacFerrin et al., 2019) coincide with maximum lake elevation limit

Please feel free to make use of the comments and chat to ask questions or just to say hello!

See also: Brough and Lea, Greenland ice sheet supraglacial lake drainages in 2019

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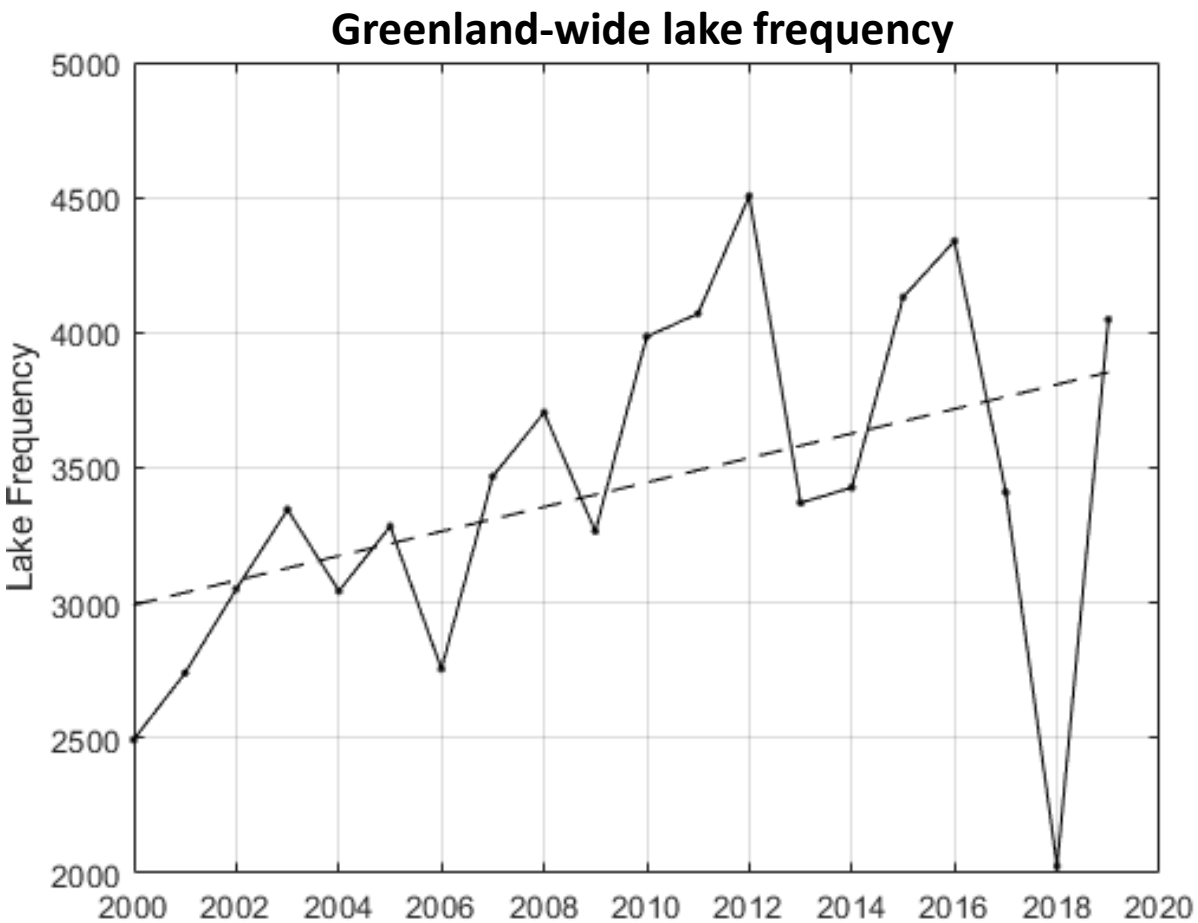
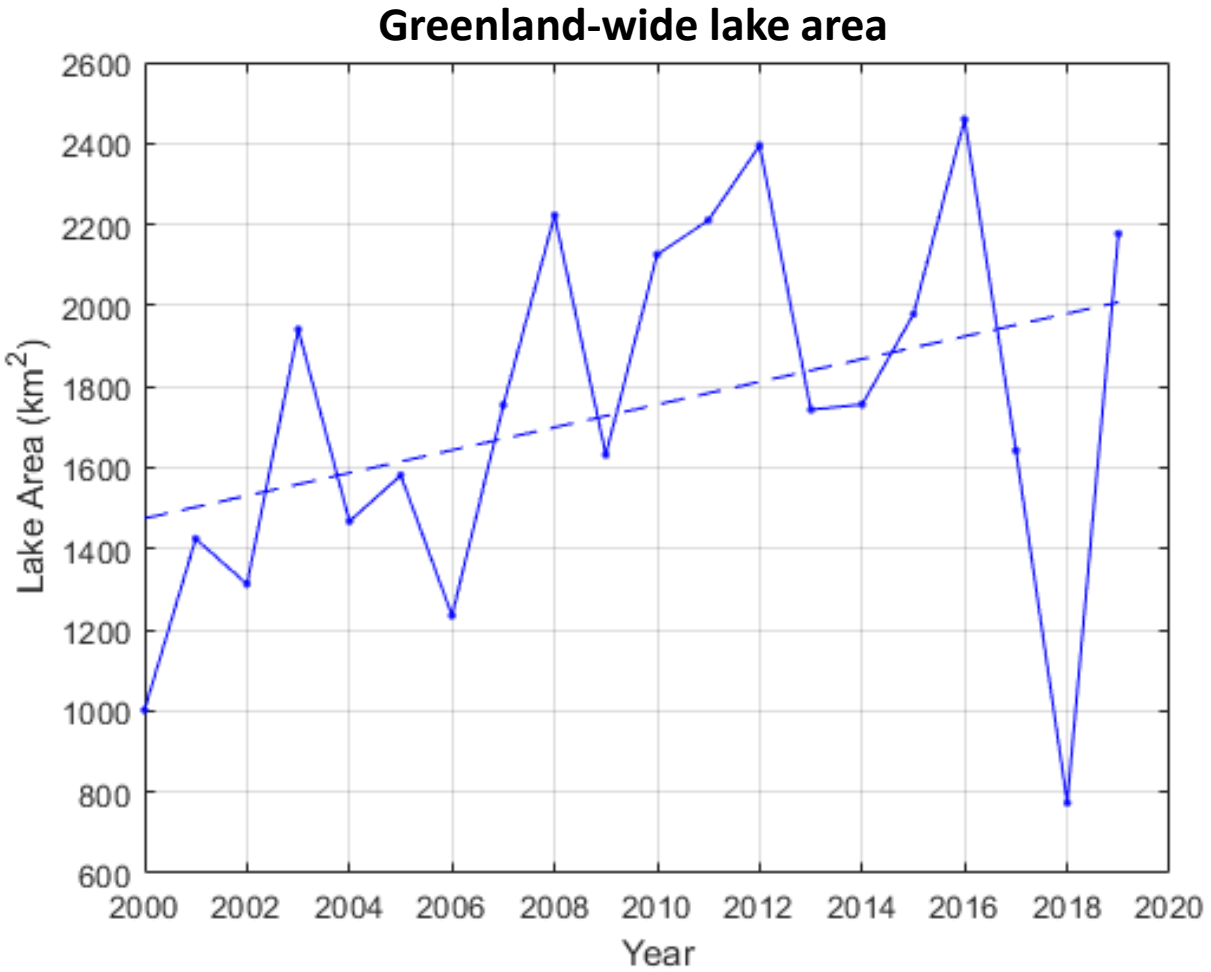
Greenland-wide results





- Mann-Kendall statistic shows significant monotonic increase in frequency (p = <0.01) and area (p = 0.03) for the ice sheet as a whole

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Greenland-wide results by elevation

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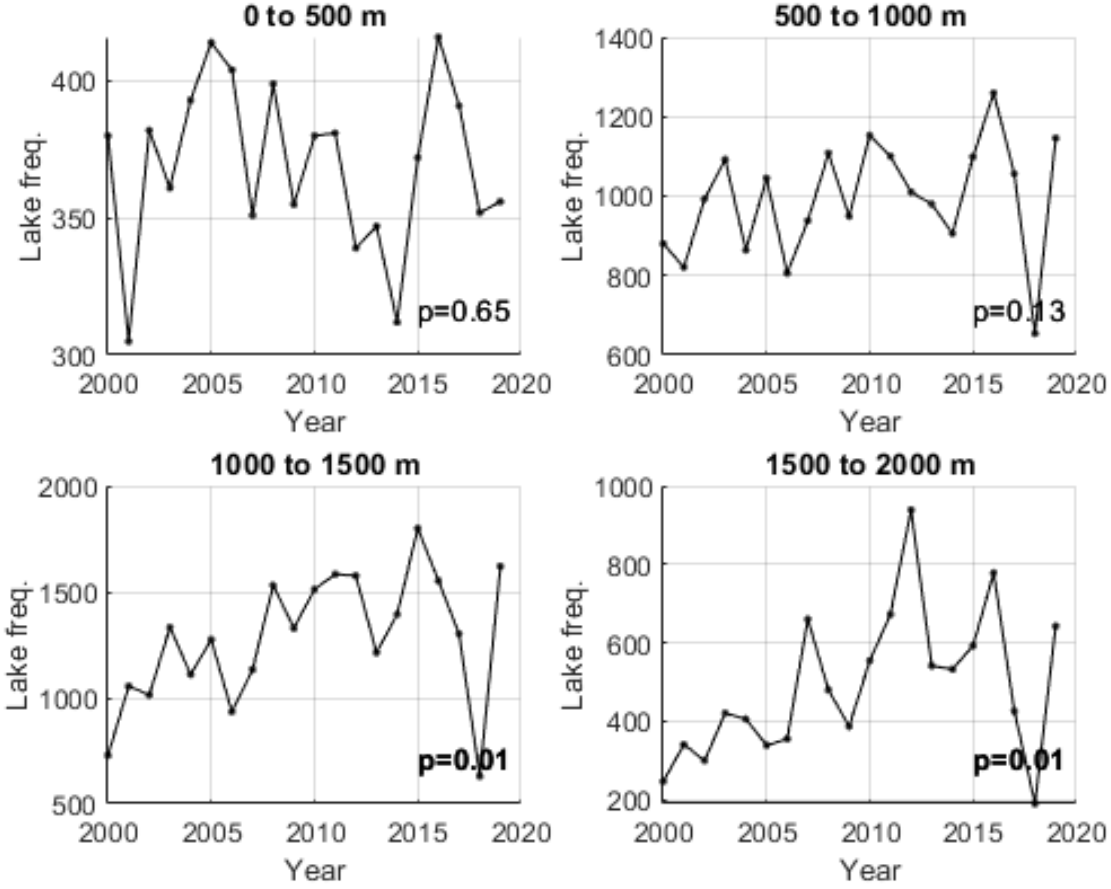
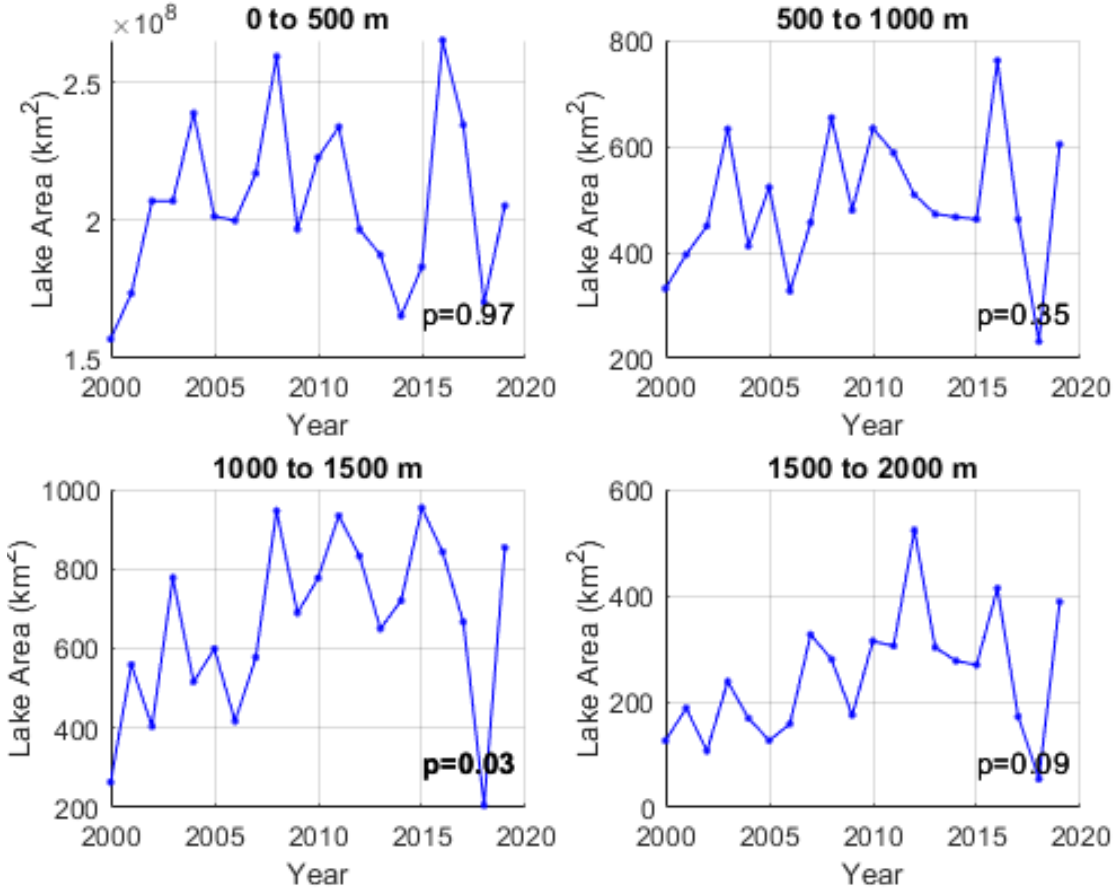
Greenland-wide lake frequency by elevation band



Greenland-wide lake area by elevation band



- Increase in frequency and elevation driven primarily within 1000-1500 m elevation band
- Lack of trends at lower elevations indicate they may already be “at capacity” and largely insensitive to melt
- See end of presentation for plots broken down by region

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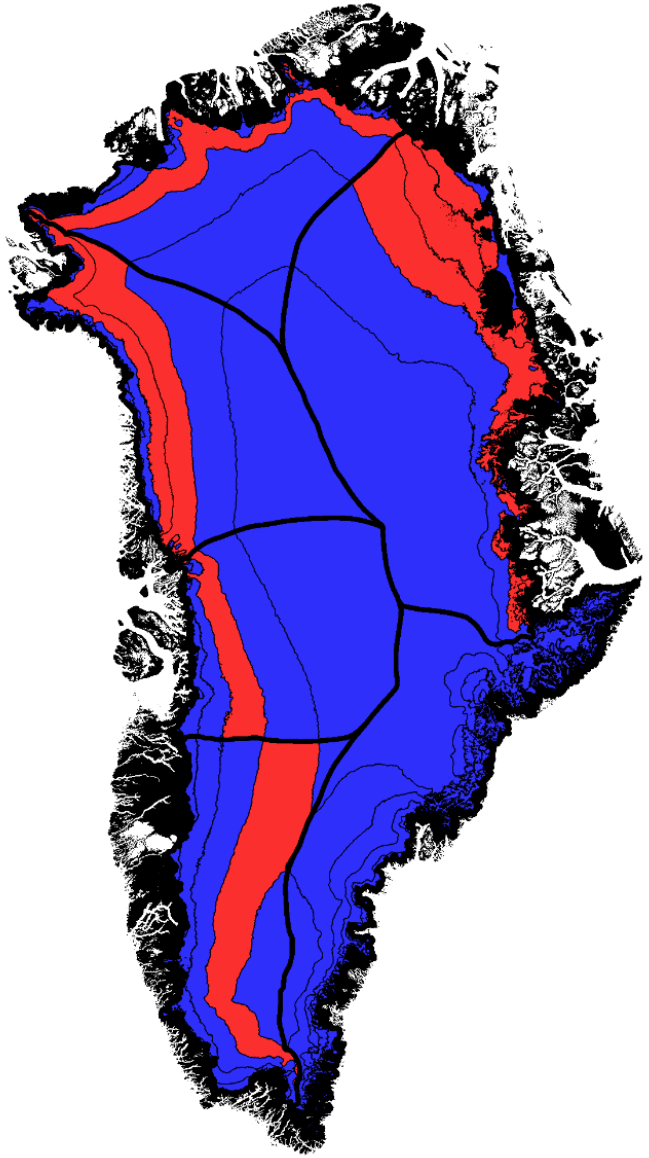
Sensitivity of lake frequency to runoff by sector & elevation



- Compared to runoff totals from MAR surface mass balance model (Fettweis et al., 2017)
- Lakes and runoff separated by Rignot et al. (2013) sectors
- Where significant ($p < 0.05$) correlations exist, shown in red
- Where no significant correlation exists, shown in blue
- **Red highlighted elevation bands are areas *currently* most sensitive to future high runoff years**
- NEGIS region has higher sensitivity to lake formation in high melt years

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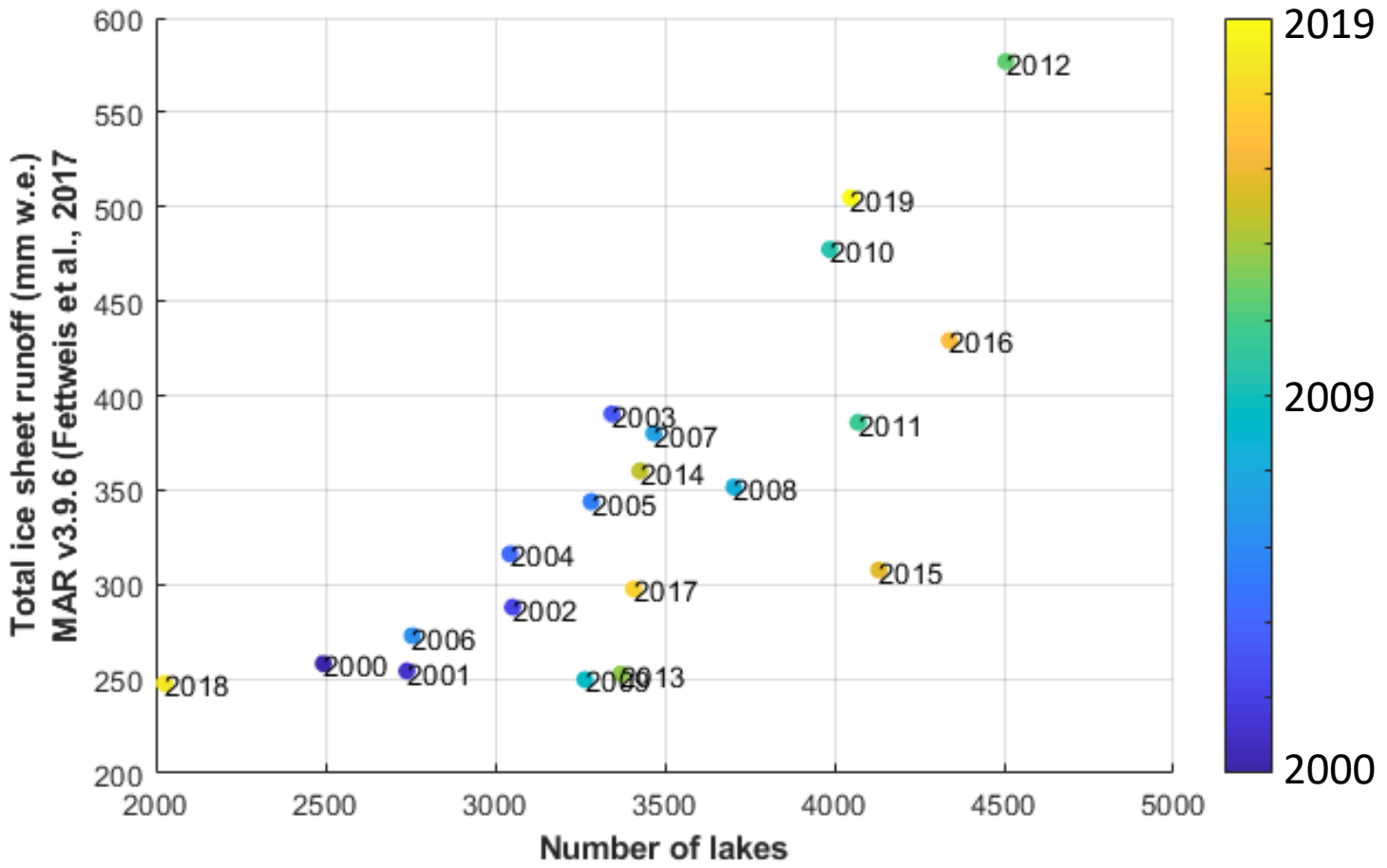
Changing sensitivity to runoff over the last 20 years?



- More lakes formed for a given volume of runoff for 2010-19 compared to 2000-2009
- Suggests the ice sheet has become more sensitive to lake formation within last 20 years

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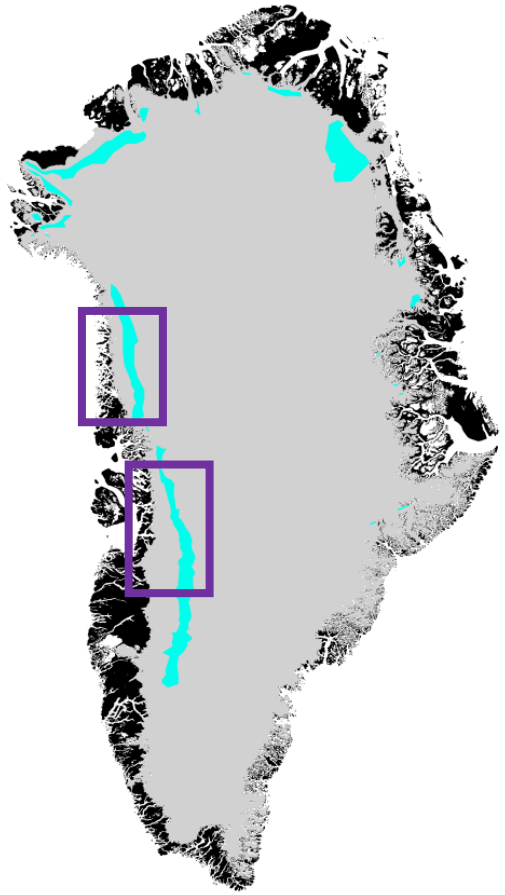
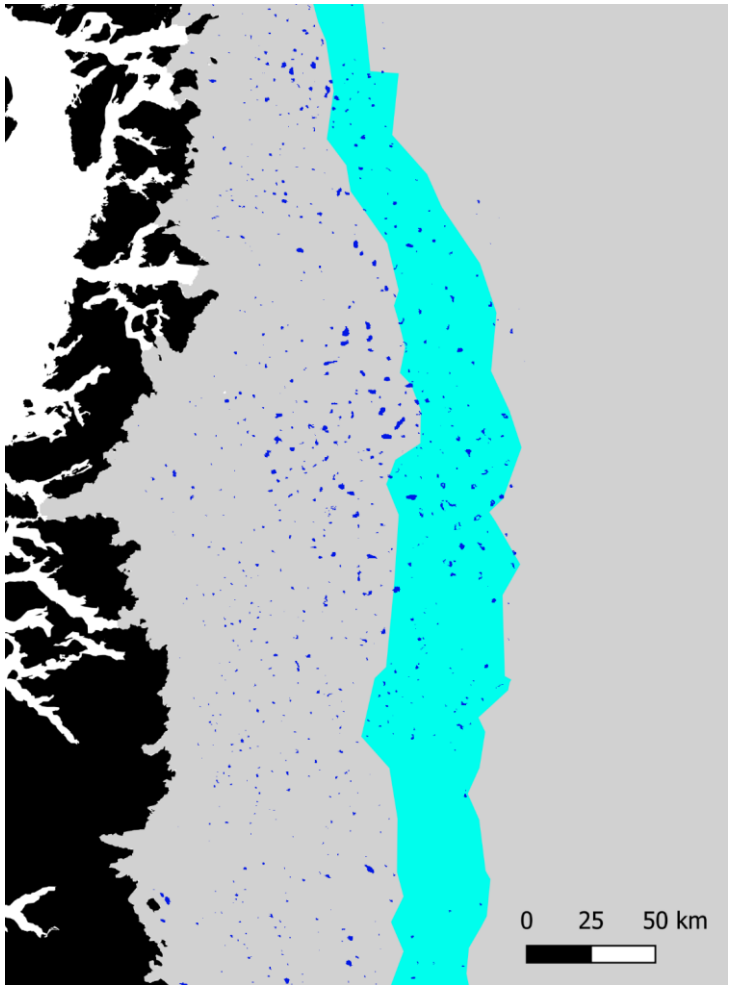
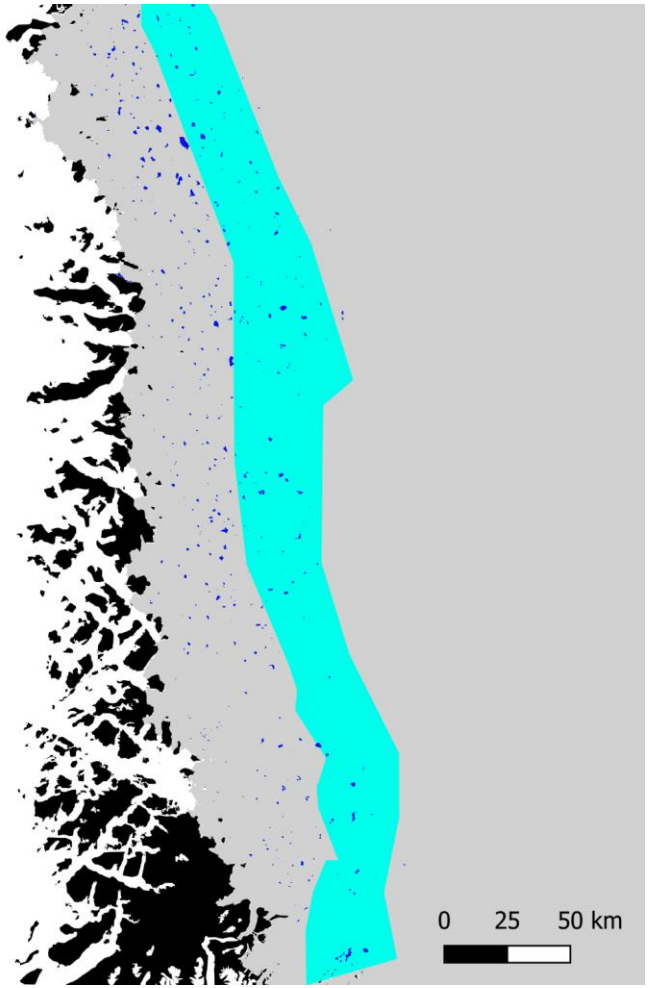
Ice slab extent an upper limit to lake formation?







- Ice slab extents (MacFerrin et al., 2019) show excellent match to highest lake extents
- Suggests that the melt refreezing capacity of firn will buffer future inland migration of supraglacial lakes

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Summary

- Lake frequency and area have increased by 29% and 36% respectively from 2000-2019
- Increases are being driven at higher elevations, primarily between 1000-1500 m
- Lake frequency in different sectors of the ice sheet are sensitive to runoff over different ranges of elevations
- Ice sheet appears to have become more sensitive to lake formation over the last 20 years
- Extent of ice slabs represents and upper limit to the inland extent of lakes
- Refreezing capacity of firn will buffer inland spread of lakes into the future

If you have any questions or comments, do make use of the chat/comments functionality or email/DM me on Twitter using the contact details below.

Interested in lake drainages? Take a look at this too!

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