**Seasonal evolution of supraglacial lakes and rivers on the southwest Greenland Ice Sheet**

Kang Yang1,2, Laurence C. Smith3,4, Matthew G. Cooper5, Lincoln H Pitcher6, Dirk van As7,

Yao Lu1,2, Xin Lu1,2, Manchun Li1,2

1. School of Geography and Ocean Science, Nanjing University, Nanjing, China
2. Jiangsu Provincial Key Laboratory of Geographic Information Science and Technology, Nanjing, China
3. Institute at Brown for Environment and Society, Brown University, Providence, RI, USA
4. Department of Earth, Environmental, and Planetary Sciences, Brown University, Providence, RI, USA
5. Department of Geography, University of California, Los Angeles, Los Angeles, CA, USA
6. Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, Boulder, CO, USA
7. Geological Survey of Denmark and Greenland, Copenhagen, Denmark

**Corresponding author:** Kang Yang, Tel: +86-13814179324; Email: kangyang@nju.edu.cn

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**Figure S1.** Delineation of supraglacial lakes and rivers in Landsat 8 satellite imagery using different width thresholds. Use of a five-pixel width threshold converts a small lake into a short channel (“missing small lake”) but retains small lakes wider than 5 pixels (“detected small lake”). Therefore, small missing lakes have limited impact on the total computed area and volume of supraglacial lakes. Moreover, a lower width threshold may incorrectly convert wide supraglacial river channels into supraglacial lakes. For example, a wide outflow channel is incorrectly converted into three small lakes if a 3-pixel width threshold is used. Use of a four-pixel width threshold correctly classifies this outlet channel as a river but erroneously generates numerous small isolated lakes. For these reasons, this study employs a 5 pixel width threshold (150 m) to classify Landsat 8 images into supraglacial river and lake masks.

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**Figure S2.** Comparison of multi-sized supraglacial streams and rivers as mapped from concurrent Landsat 8, Sentinel-2, and WorldView-2 images over a part of our study region. One 30 m Landsat 8 and one 10 m Sentinel-2 images were acquired on 4 August 2019 and one 2 m WorldView-2 (Copyright DigitalGlobe, Inc) image was acquired on 25 July 2019. Panel (a) shows that Landsat 8 manages to capture broad-scale drainage pattern of large, main-stem supraglacial rivers but misses smaller tributaries, isolated streams, and upstream river segments that are detected in Sentinel-2 images. In this particular area (1339 km2), the total river length detected in a 30 m Landsat 8 image accounts for 42.9% of the corresponding river length detected in a 10 m Sentinel-2 image. Panels (b)-(d) present a close-up (black box in panel (a)) comparison of supraglacial rivers in Landsat 8, Sentinel-2, and WorldView-2 images for a smaller area (97 km2). Both Sentinel-2 and Landsat 8 detect larger supraglacial rivers but miss numerous small supraglacial streams detected in the 2 m WorldView-2 image.

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**Figure S3.** Close-up comparison of supraglacial rivers mapped from concurrent 30 m Landsat 8 and 10 m Sentinel-2 images (both images acquired on 4 August 2019). The same supraglacial river is represented as 2-4 pixels wide in both 30 m Landsat 8 (60-120 m wide) and 10 m Sentinel-2 images (20-40 m wide). Therefore, the widths of supraglacial rivers are overestimated in 30 m Landsat 8 images.

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**Figure S4.** Percentage of surface meltwater stored in (a) lakes and rivers, (b) lakes only, and (c) rivers only during the 2015 melt season compared to cumulative surface runoff simulated by MERRA-2, MAR 3.6, and RACMO 2.3 climate models. Error bars are obtained by multiplying RMSE = 0.38 m of water depth estimation using Landsat 8 coastal and green bands (Pope et al., 2016) by the Landsat 8 pixel size (900 m2) and the number of water pixels.

**Table S1.** Statistics of supraglacial streams/rivers mapped from Landsat 8, Sentinel-2, and WorldView-2 images.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Satellite** | **Image name** | **Acquisition date** | **Spatial resolution** | **Mapping area (km2)** | **Total river length (km)** | **Drainage density (km-1)** |
| Landsat 8 | LC08\_007013\_20190804 | 2019.08.04 | 30 m | 1338.9 | 390.8 | 0.3 |
| Sentinel-2 | L1C\_T22WEV\_A012449\_  20190725T150015 | 2019.08.04 | 10 m | 1338.9 | 967.2 | 0.7 |
| WorldView-2 | 19JUL25150243-M2AS\_ 012878676010\_01\_P001 | 2019.07.25 | 2 m | 96.8 | 3550.9 | 36.7 |