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Widespread development of supraglacial lakes around the margin of the East Antarctic Ice Sheet

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Supraglacial lakes (SGLs) are important to ice sheet mass balance because their development and subsequent drainage has been linked to changes in flow velocity and ice shelf disintegration. However, little is known about their distribution on the world's largest ice sheet in East Antarctica. In this paper, we apply an automated method (Normalised Difference Water Index) to ∼5 million km2 of high-resolution satellite imagery (Landsat 8 and Sentinel 2A) and identify >65,000 lakes around the peak of a single melt season (January 2017). We find that SGLs are far more widespread than previously recognized and occur in most peripheral regions of the ice sheet. In some regions, lake area densities are similar to values reported for well-studied regions of the Greenland Ice Sheet. We also discover SGLs in several regions where their widespread development has not been previously documented. The cumulative area of SGLs amounts to 1,383.5 ± 13.8 km2 and individual lakes range in area from 0.0002 km2 (our minimum threshold for lake detection) to a maximum of 71.6 ± 0.7 km2. Our analysis indicates that SGLs typically develop at low elevations (<100 m) on low surface slopes (< 1°), but exist 500 km inland and at elevations >1500 m, where they are typically found in close proximity to nunataks. Significantly, SGLs are clustered near grounding lines and ∼60% (>80% by area) develop on ice shelves, including several that are thought to be vulnerable to hydro-fracturing. This suggests that some parts of the ice sheet may be more sensitive to future climate warming than previously thought.