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Hydrofracture analysis and spatio-temporal evolution of a supraglacial lake in West Greenland from observational and modeling tools.

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Supraglacial lakes are pools of meltwater that form during summer in depressions of ice sheet surface, affecting ice sheet dynamics and surface features. Over the recent years, several studies using different modeling and observational tools have been carried out to better understand the spatio-temporal evolution of such lakes and the mechanisms of the interaction between the surface meltwater and englacial drainage systems.

In this study, we report results regarding the spatio-temporal evolution of supraglacial lake in Western Greenland from in-situ and satellite measurements. Pressure transducers positioned in a place where the lake would form recorded the temporal evolution of the lake depth, since its beginning phase to a rapid (90 minutes) drainage. We report, for the first time to our knowledge, measurements quantifying the ablation of the bottom of the lake. Satellite data are then used to augment in-situ measurements and estimates the area and the volume of the lake when data were collected and before its draining. Concurrently, runoff simulated by a snow-atmospheric model is used in conjunction with the catchment area estimated from a digital elevation model to study the discharge in the basin where the lake was present and compare it with the volume of the lake. Finally, the draining event is studied by estimating the speed at which an hydrofracture would propagate, the width of the crack that could allow the measured discharge (average of $\sim$ 600 m3/s) and the temporal evolution of the basal crack, at the ice-bedrock interface.