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A new, fast and unified subglacial hydrological model applied to Thwaites Glacier, Antarctica

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Subglacial hydrology is a crucial element for understanding the dynamics of marine ice sheets. Indeed, the presence of subglacial water modulates the ice basal motion, resulting in a modified ice flow across the entire ice sheet. Nonetheless, the subglacial environment is difficult to reach, which makes it necessary to develop models. Many efforts have recently been made in the glaciological and hydrological communities to improve their accuracy and efficiency. Even so, the models currently being developed are typically fairly costly in terms of computing time. As a consequence, conducting numerical simulations over long time scales or running ensemble simulations remains particularly challenging.

Here, we propose a simplified approach for coupling subglacial hydrology with the motion of ice. First, we introduce a computationally efficient subglacial hydrology model that is suited for hard and soft bed types as well as efficient and inefficient drainage systems. Then, we show some numerical results based on our implementation of this model within the Kori-ULB ice-sheet code. We first study the impact of subglacial hydrology in the idealized MISMIP configuration. Subsequently, we show results of simulations conducted over Thwaites Glacier which suggest that the coupling of subglacial hydrology with ice flow could significantly increase the contribution of marine ice sheets to future sea-level rise.