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Supplement of

SUHMO: an adaptive mesh refinement SUbglacial Hydrology MOdel v1.0

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1 List of parameters for all cases

Symbol	Units	SHMIP A,B	SHMIP E,F	AMR test case	SHMIP E (SM)
C_b	s^2 m^{-2}	400	400	400	10
ω	-	0.001	0.001	0.001	0.005
A	Pa^{-3} s^{-1}	5 x 10^{-25}	2.5 x 10^{-25}	2.5 x 10^{-25}	5 x 10^{-25}
b_r	m	0.1	0.1	0.1	0.1
l_r	m	2.0	2.0	2.0	2.0
b_c	m	0.0	0.0	0.0001	0.01
$\mathbf{u}_b$	m s^{-1}	$(10^{-6}, 0)$	$(10^{-6}, 0)$	$(10^{-6}, 0)$	$(5 \text{ x } 10^{-7}, 0)$
G	W m^{-2}	0.0	0.05	0.05	0.0
c_t	kg Pa^{-1}	7.5 x 10^{-8}	0.0	7.5 x 10^{-8}	7.5 x 10^{-8}

Table S1: List of varying SUHMO constants and parameters, as employed in all runs presented in the manuscript. Parameters not listed here always use the default values provided in Table 1.

2 SHMIP Suite E with pressure-melt

Suite E of SHMIP (de Fleurian et al. (2018)) is designed to investigate the effect of steep bedrock gradients on the subglacial water distribution, and uses a synthetic valley glacier geometry with curved z_b as depicted in Fig. 2 (b). In the manuscript, we chose to keep our focus on the validation of our implementation, which relies on a structured mesh (for which such geometries are not always straightforward); as a result, we deactivated the pressure term (see c_t for SHMIP E,F in Table S1). For completeness, we also report SUHMO results for this experiment with the pressure-melt activated (see c_t for SHMIP E (SM) in Table S1). Note that parameters for this test case have been adapted to improve the temporal behavior and ensure convergence of the water-filled gap height. All simulations are run for twenty years.

The left hand side of Fig. S1 displays profiles of water gap height, while the efficient and inefficient contributions of the total discharge are reported for the two extreme cases (E1 and E5) on the right hand side. The evolution of the y-averaged effective pressure is also shown, for all test cases. We retrieve the expected behavior as the overdeepening becomes more and more pronounced, with a progressive shutdown of the main channel in the left side of the spatial domain ($x < 2.0$ km) accompanied by a switch from efficient to inefficient drainage regime in this region, starting with Run E3 and completed by E4. For E4 and particularly E5, we also see the emergence of a central channelized flow feature for $x > 2.0$ km, even though it never seem to reach all the way into the end of the domain. Smaller peripheral channels also develop from E3 to E5. Note that SUHMO never exhibits negative effective pressures.

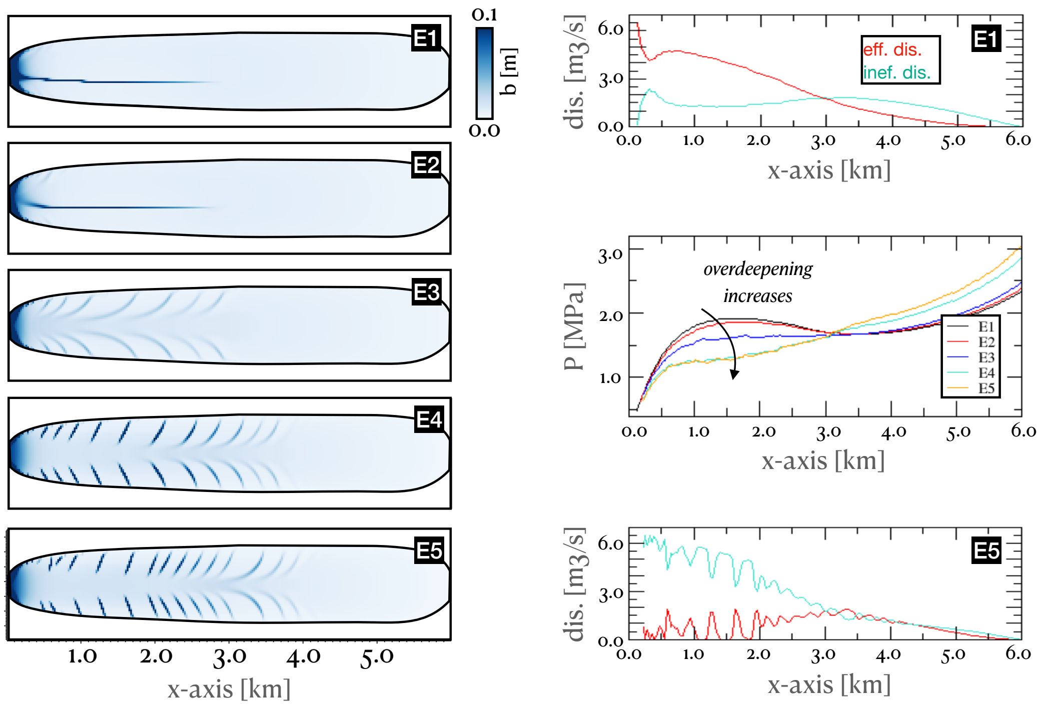

Figure S1: Results for SHMIP Suite E with the pressure melt term activated. (*left*) water gap height profiles, (*right*) efficient and inefficient portions of the discharge for cases E1 and E5 and evolution of the $y-$averaged effective pressure for all cases.

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