Supplement of

A non-explicit representation of macropores in the SVS land surface model improves streamflow simulations under frozen soil conditions

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S1: Score maps for noFr and Fr experiments

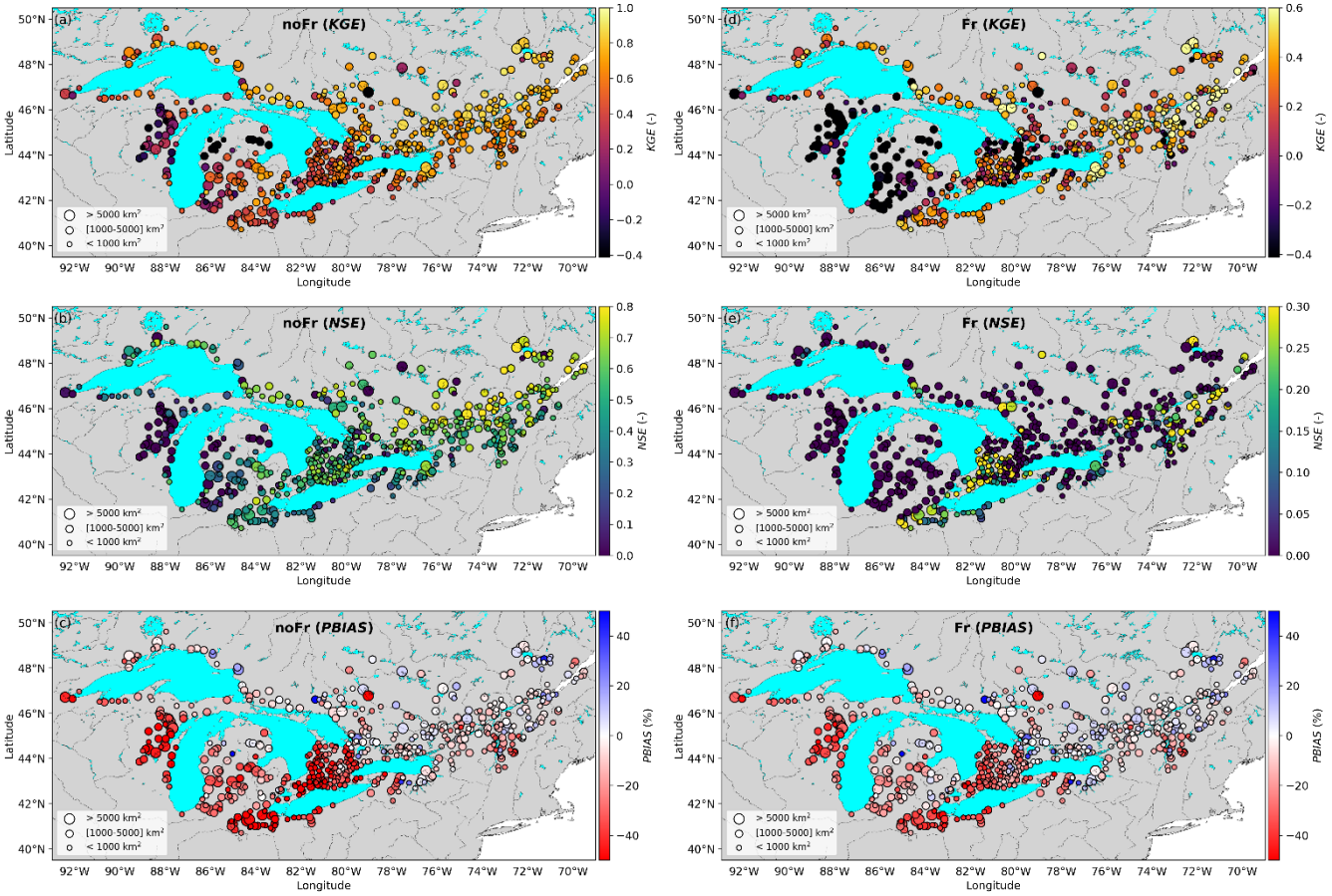

Figure S1: Maps of the Great-Lakes and Saint-Lawrence domain showing the *KGE*, the *NSE* and the *PBIAS* at each station for the noFr experiment (a–c) and the Fr experiment (d–f) over the 2016-2021 period. In (a), (b), (d) and (e), best performance of each experiment is represented by yellow shades. In (c) and (f), underestimation of streamflow is shown by red colors while an overestimation is shown by blue colors. Pale red and blue dots show a low absolute bias in (c) and (f).

S2: Near-surface meteorological variable evaluation of the Fr experiment

	period/ variable	Full period 2016-09-01 to 2021-08-31	Winter 11/01 to 02/28	Spring 03/01 to 06/30	Summer 07/01 to 10/31
Δ***BIAS*** **(°C)**	*TD*	**0.024**	**0.012**	**0.033**	0.005
	TT	**0.029**	**0.055**	**0.027**	0.006
Δ***RMSE*** **(°C)**	*TD*	**0.011**	0.006	**0.018**	0.002
	TT	**0.013**	**0.018**	**0.016**	0
Δ***STD*** **(°C)**	*TD*	0.003	0.005	0.004	0
	TT	0.008	0.008	0.008	0.002

Table S1: Differences of the bias (*BIAS*), root mean square error (*RMSE*) and standard deviation of the error (*STD*) for the 2 m dew point temperature (*TD*) and the 2 m air temperature (*TT*) between the soil freezing experiment without macropores (Fr) and the experiment without soil freezing (noFr). The performances are evaluated over the full period (from 1 September 2016 to 31 August 2021) and seasonally with winter period spanning from 1 November to 28 February, spring period from 1 March to 30 June and summer period from 1 July to 31 October. Positive values greater than 0.01°C are shown in bold and represent an improvement of the Fr experiment compared to noFr.

S3: Hydrographs of the Richelieu, Ottawa and Mistassini Rivers.

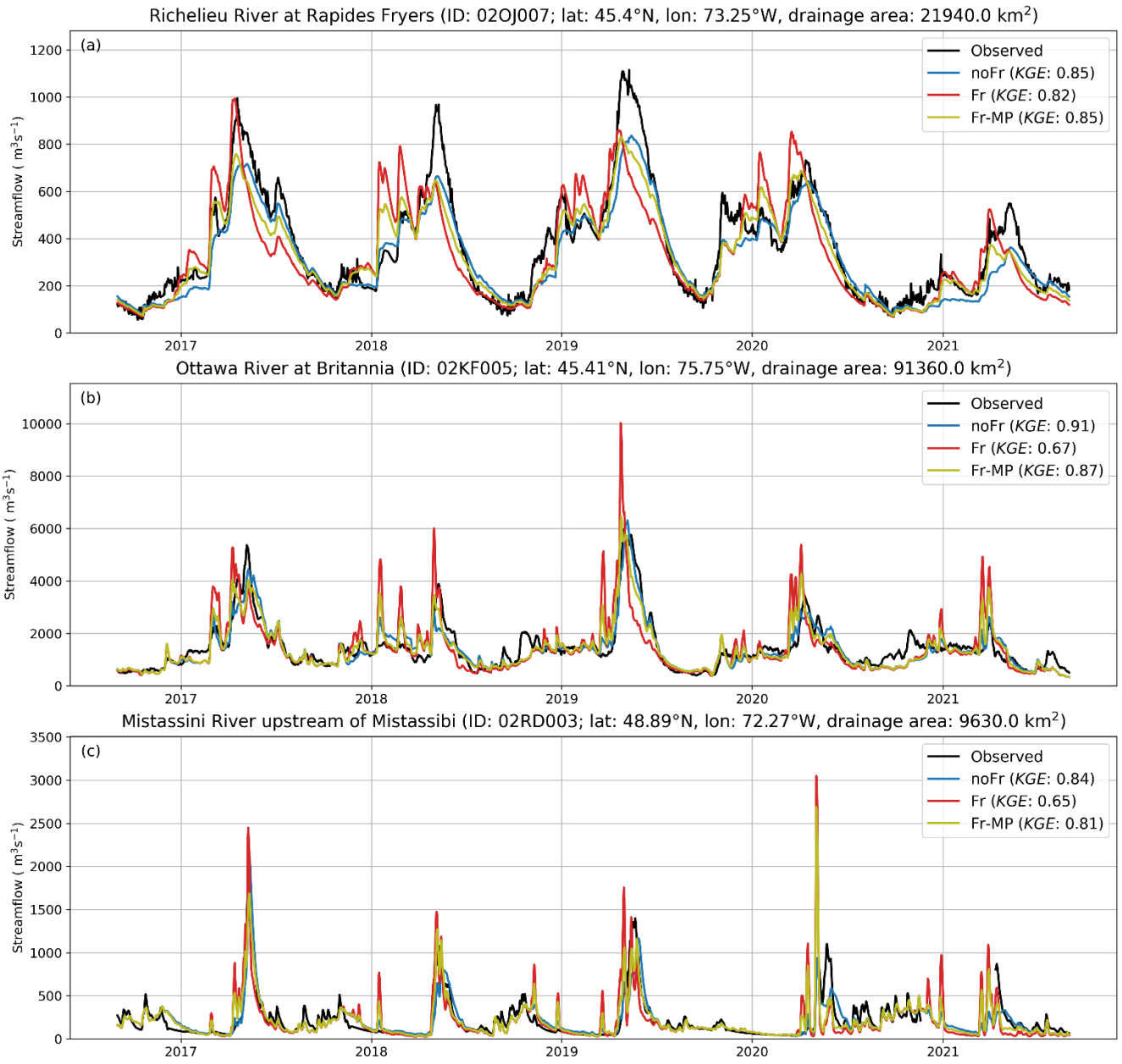

Figure S2: Observed and simulated streamflow of the Richelieu River (station ID: 02OJ007) (a), the Ottawa River (station ID: 02KF005) (b) and the Mistassini River (station ID: 02RD003) (c) for the 2016-2021 evaluation period. Simulations of the no freezing experiment (noFr) are in blue, the soil freezing experiment (Fr) in red and the soil freezing with macropores (Fr-MP) in yellow.

S4: Score maps of simulated freezing depth for the Fr experiment

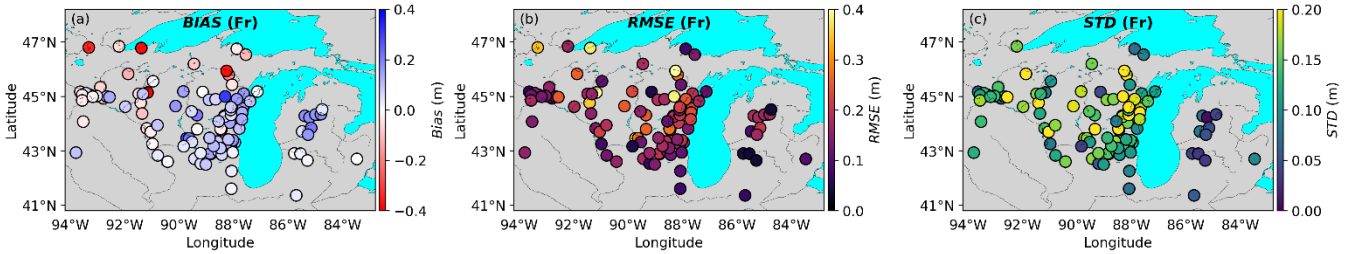

Figure S3: Freezing depth score maps of the *BIAS* (a), *RMSE* (b) and standard deviation *STD* (c) at each station over the 2016-2021 period for the Fr experiment for the region of Central U.S.