Resolving the influence of ice stream instability on postglacial relative sea-level histories: the case of the St Lawrence river channel ice stream

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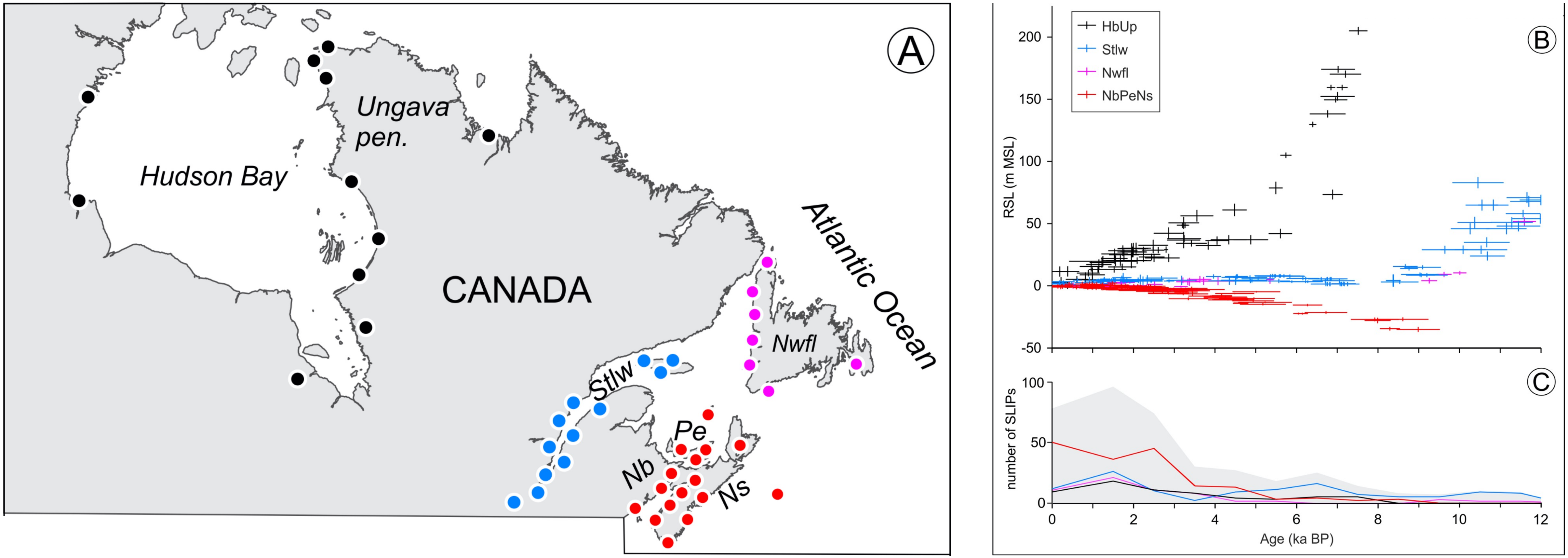
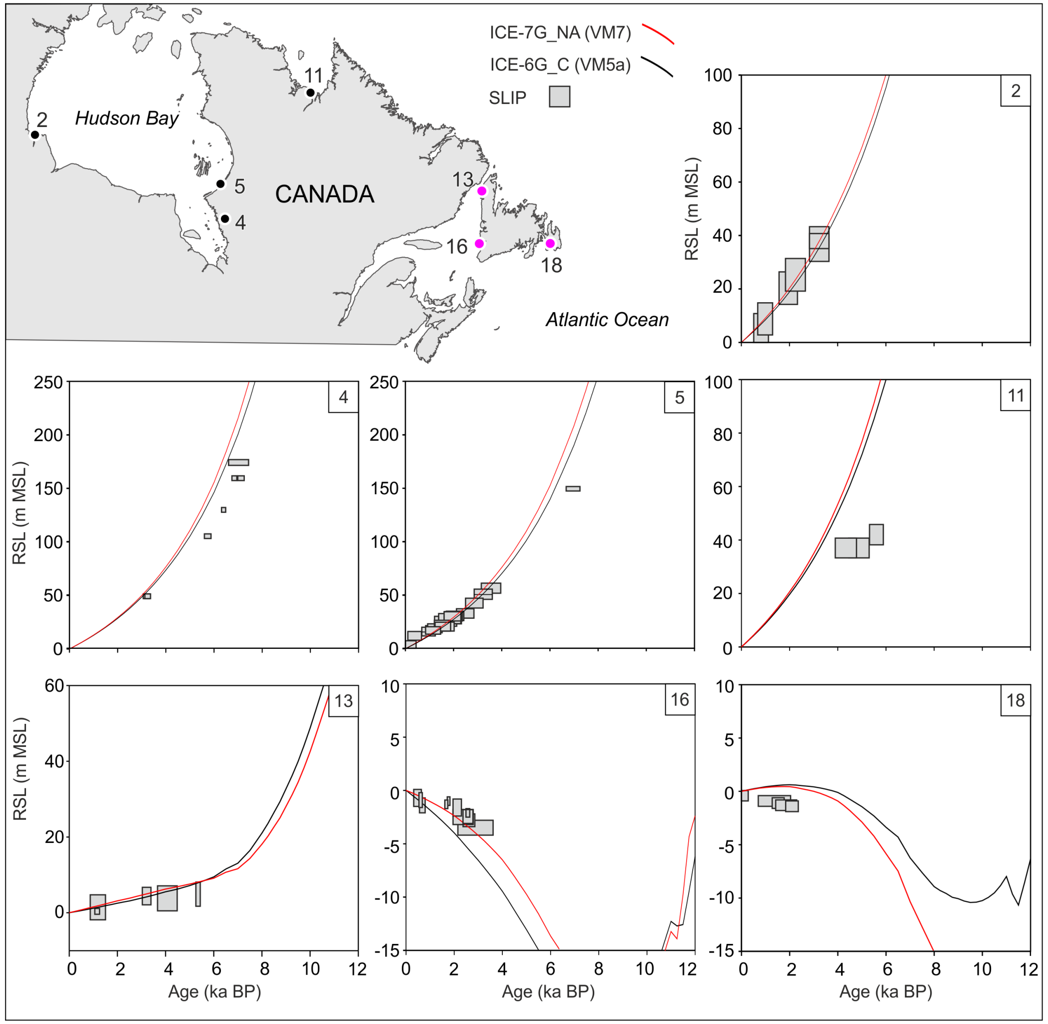
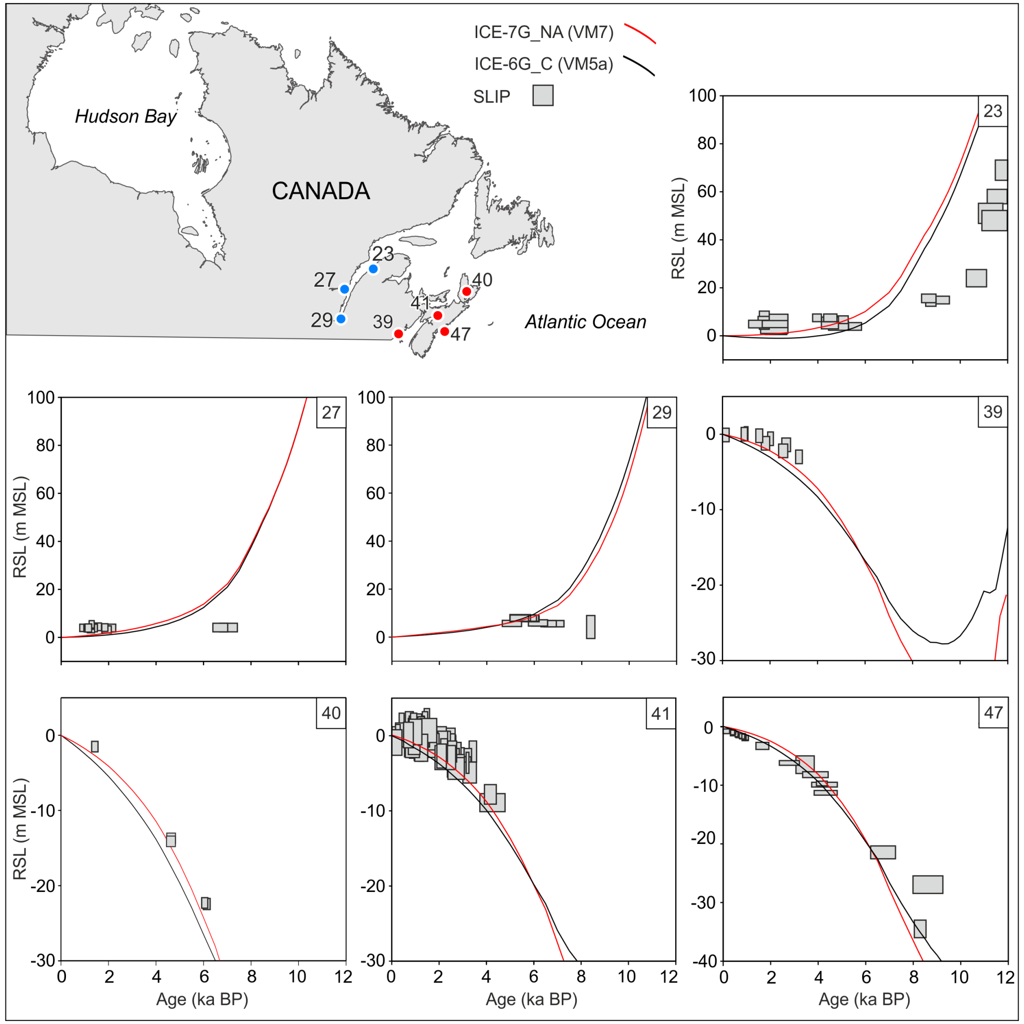
Relative sea-level database



The recent published relative sea-level database along the eastern Canadian coastline (Vacchi et al., 2018) provides a good opportunity to test the GIA models.

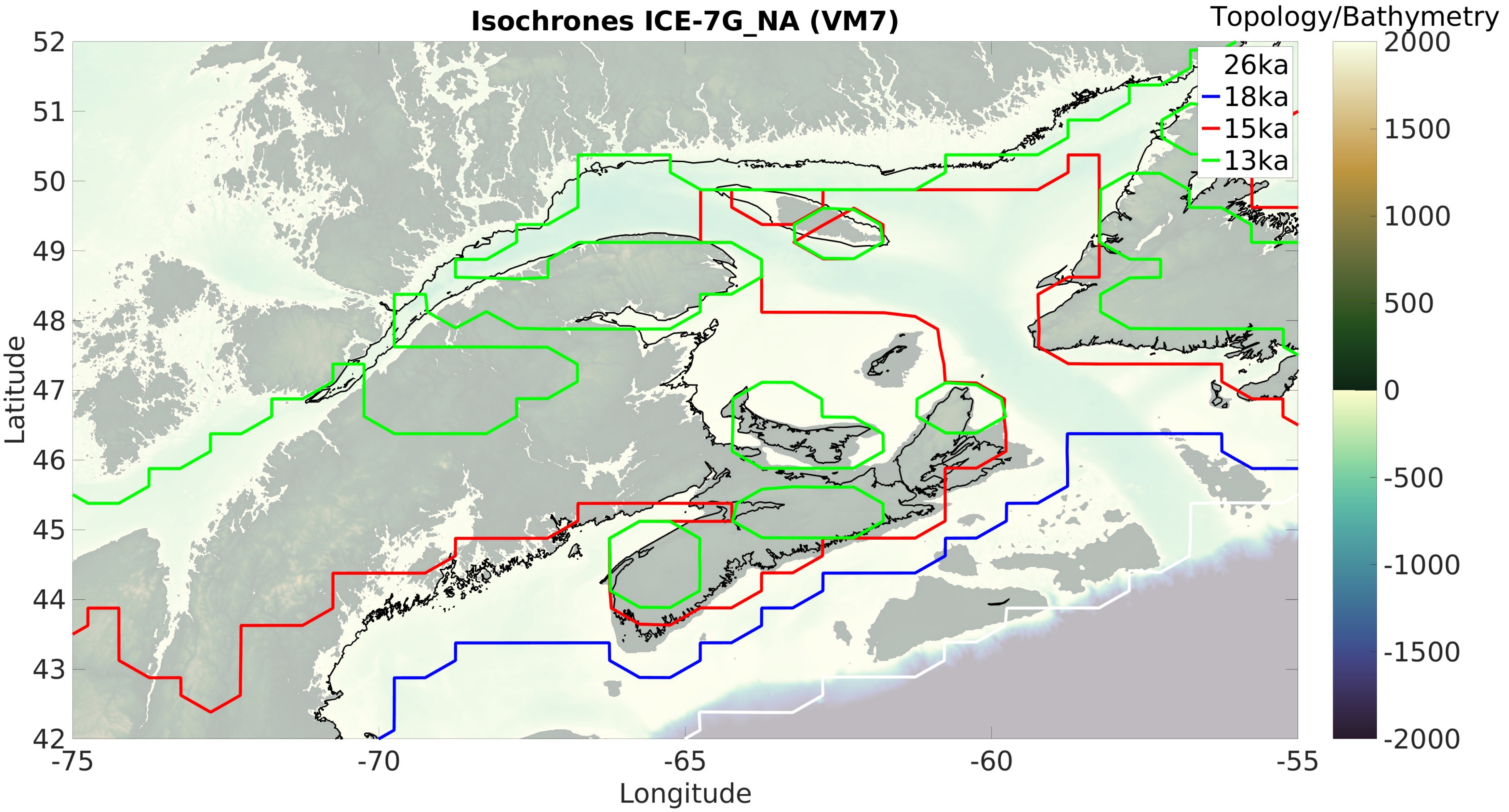
RSL data vs ICE-7G_NA (VM7) & ICE-6G_C (VM5a)



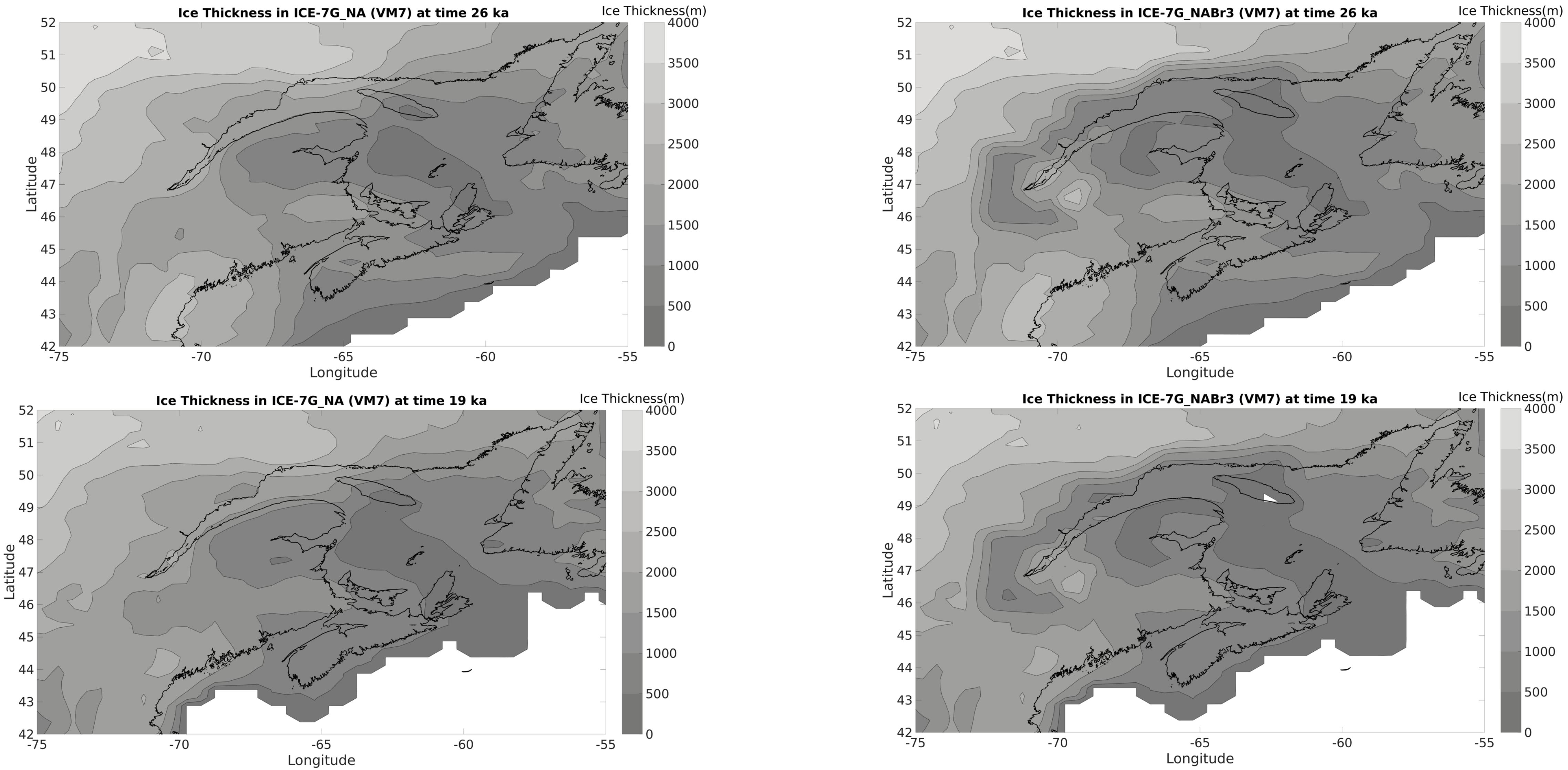


The ICE-6G_C (VM5a) and ICE-7G_NA (VM7) GIA models generally fit the RSL data, but both models show notable misfits in the St Lawrence river channel.

Isochrones of ICE-7G_NA in St Lawrence

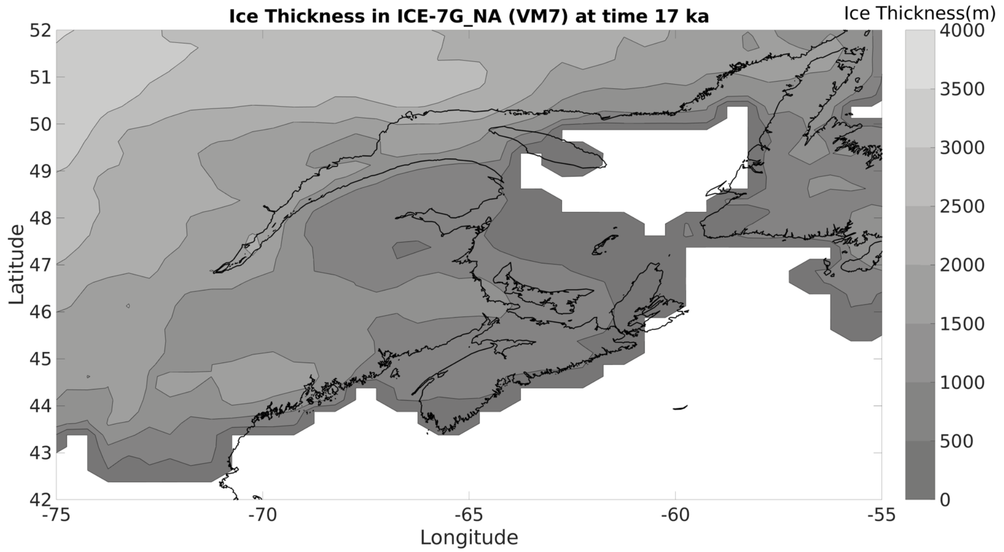


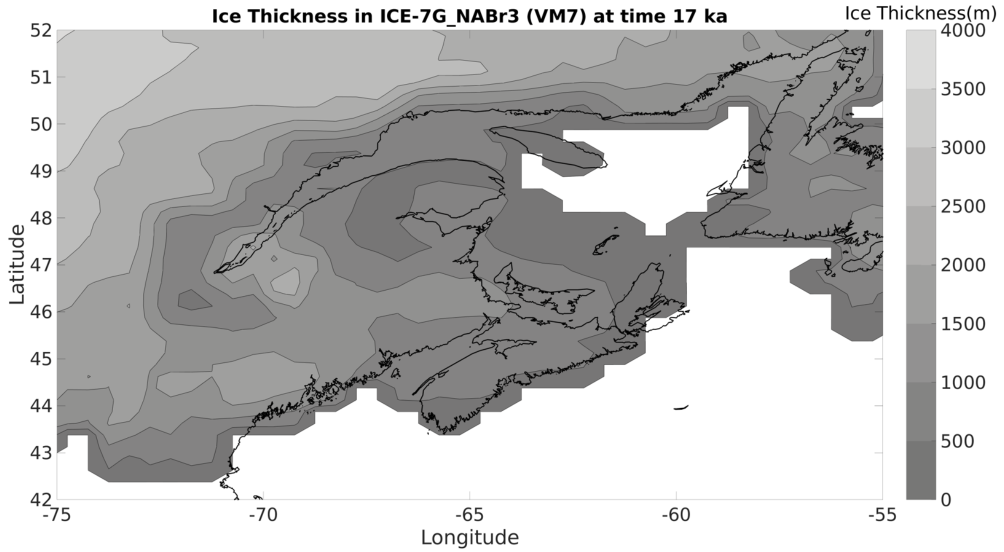
Ice thickness of ICE-7G_NA in St Lawrence

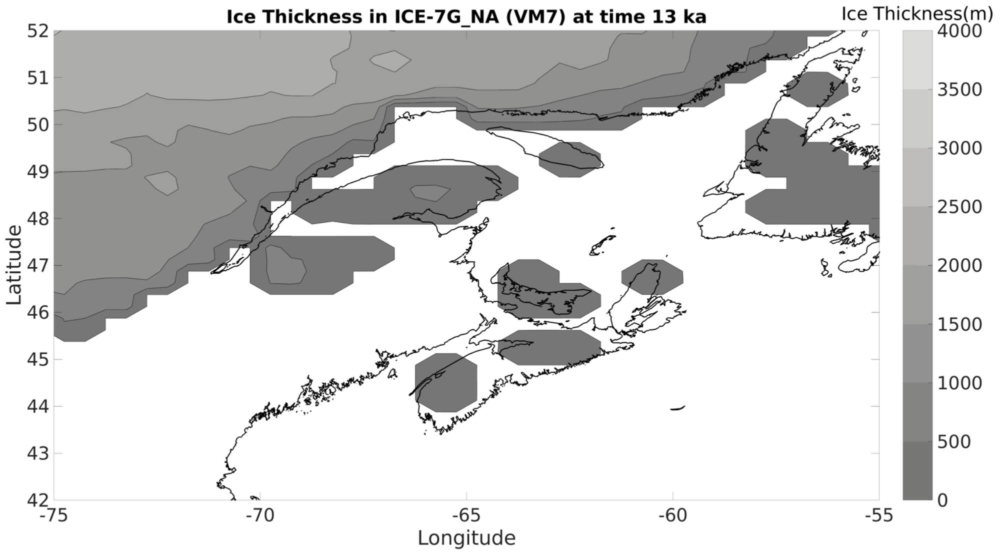


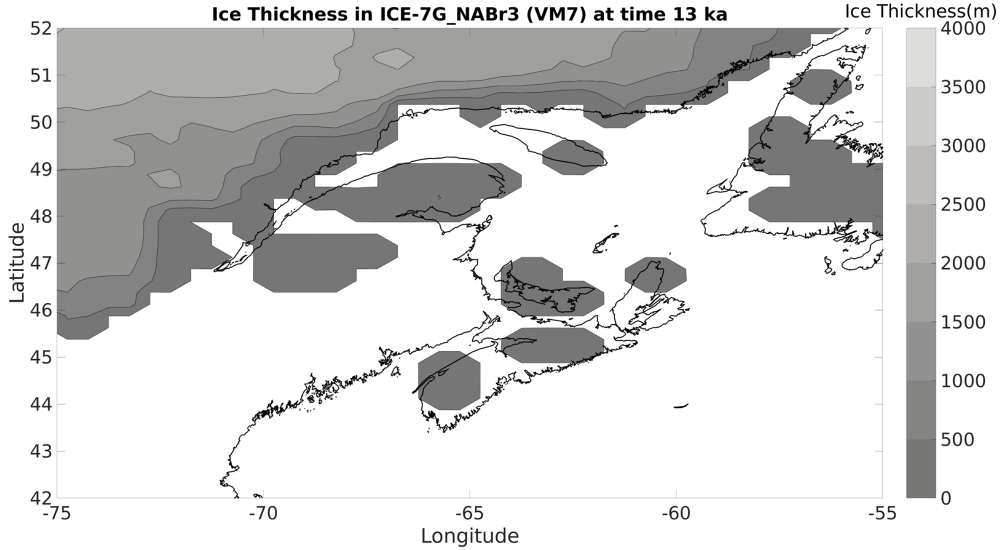
Based on ICE-7G_NA, we locally modified the ice thickness in the St Lawrence river channel since LGM (26 ka BP) and ended with ICE-7G_NABR3.

Ice thickness of ICE-7G_NA in St Lawrence



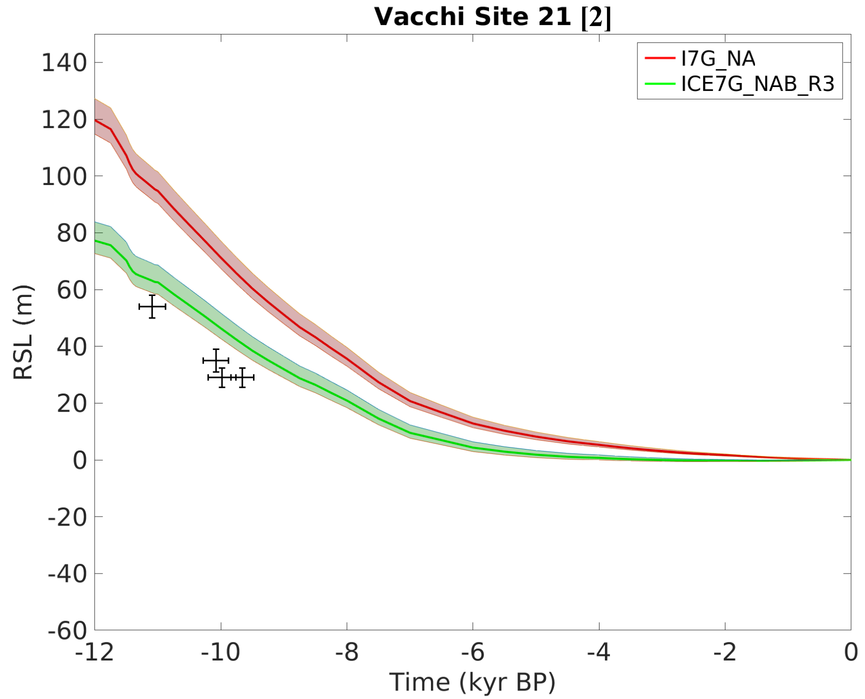


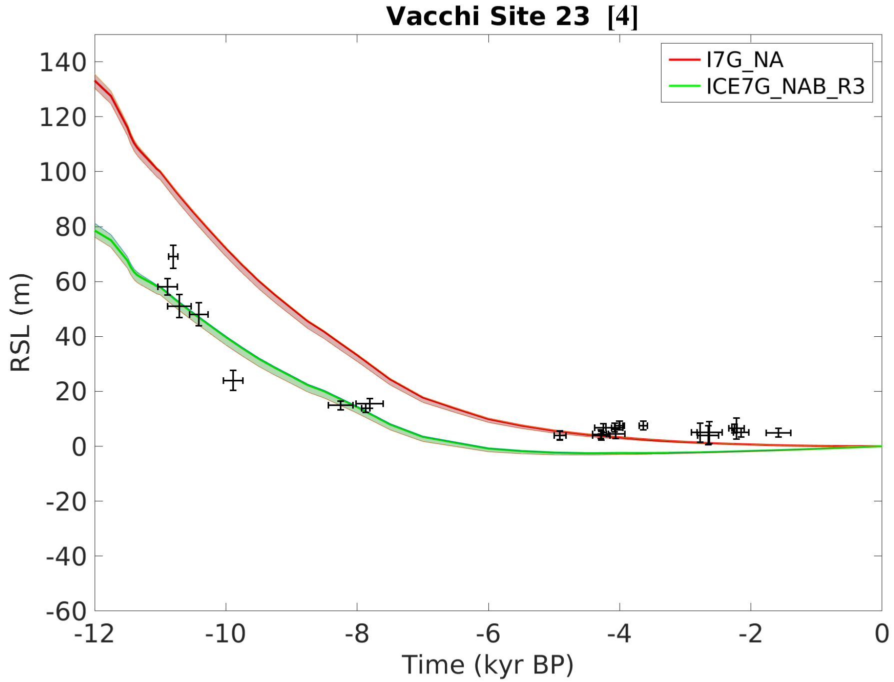




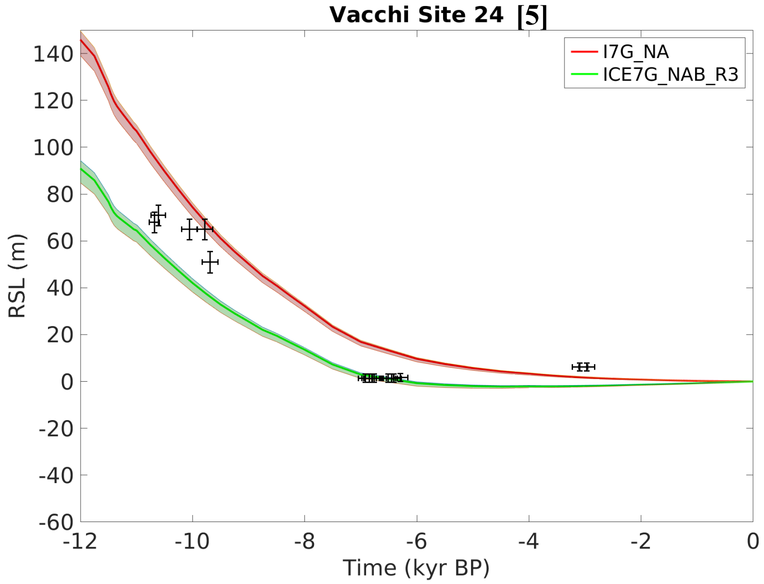
RSL data vs ICE-7G_NA & ICE-7G_NABR3

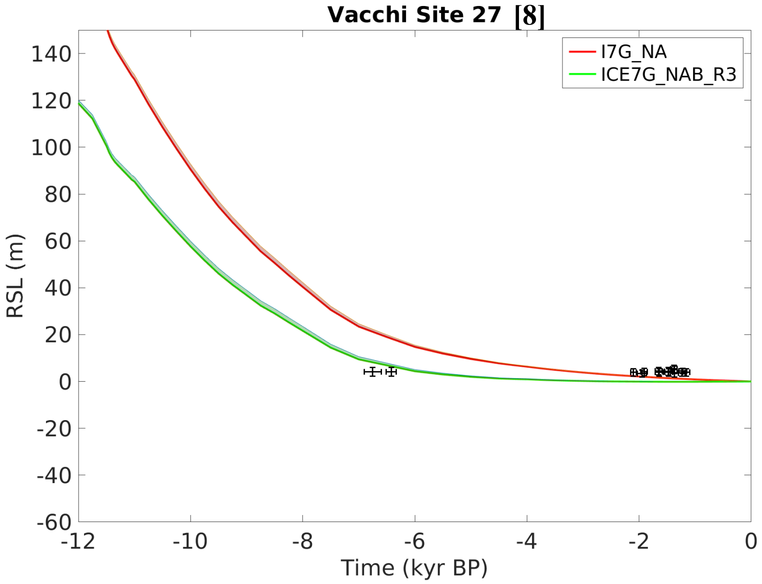
Site	RMS Error (m) ICE-7G_NA VM7	RMS Error (m) ICE-7G_NABR3 VM7	% Difference
Vacchi 20 [1]	1.827	3.057	67.323
Vacchi 21 [2]	39.958	11.450	-71.345
Vacchi 22 [3]	27.508	13.136	-52.247
Vacchi 23 [4]	18.139	8.064	-55.543
Vacchi 24 [5]	13.712	13.007	-5.140
Vacchi 25 [6]	3.201	3.228	0.851
Vacchi 26 [7]	26.280	16.282	-38.045
Vacchi 27 [8]	6.522	4.273	-34.481
Vacchi 28 [9]	8.098	39.618	389.232
Vacchi 29 [10]	5.254	6.772	28.897
Vacchi 30 [11]	34.511	9.224	-73.272
All sites	17.479	10.614	-39.276

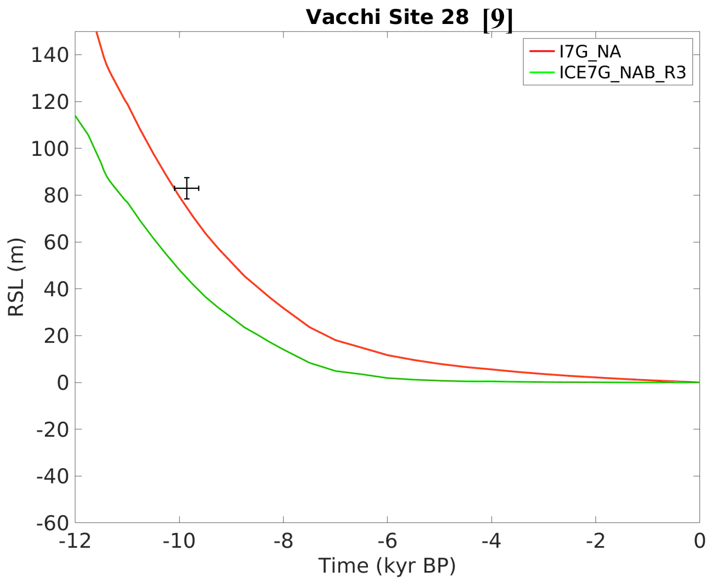


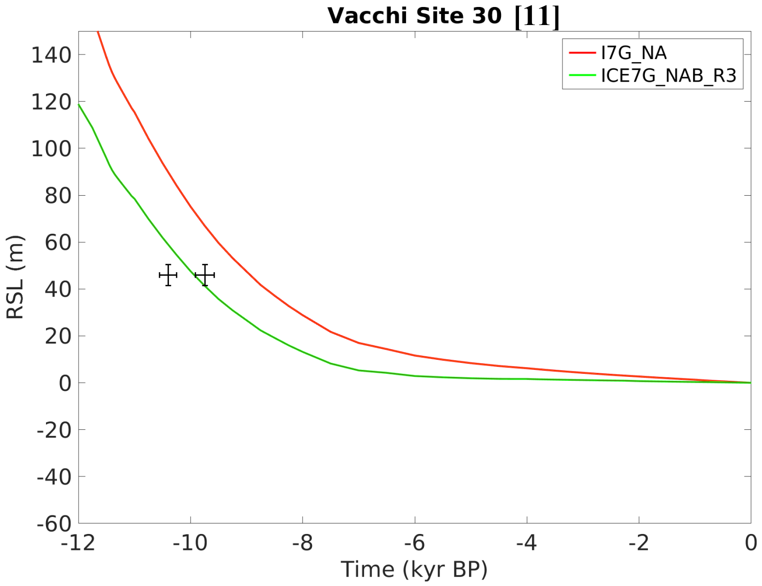


RSL data vs ICE-7G_NA & ICE-7G_NABR3

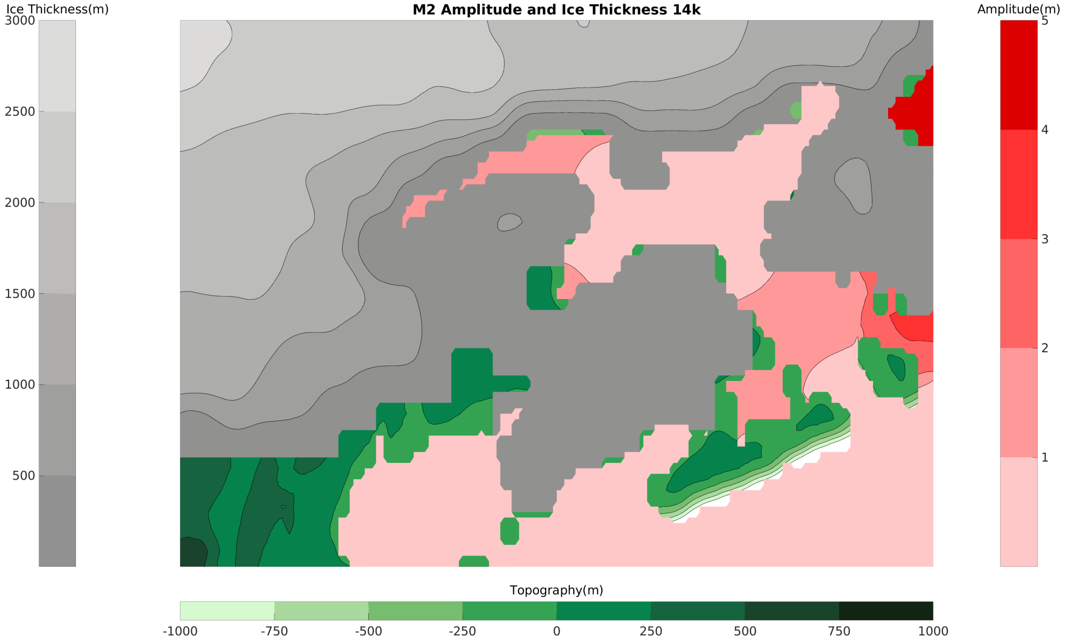


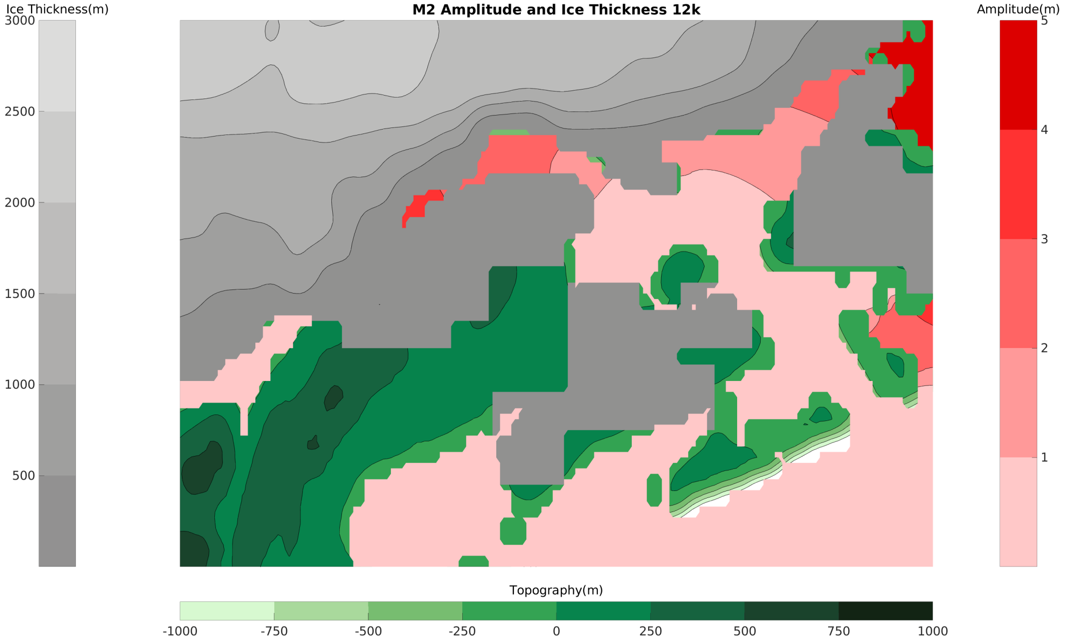






M2 tide amplitude in St Lawrence





The maximum amplitude of M2 tide in St Lawrence River Channel indicates that the M2 tide may have contributed forcing to the retreating ice stream, contributing to the rapidity of collapse during the deglaciation period.

Summary

- Both ICE-6G_C (VM5a) and ICE-7G_NA (VM7) GIA models generally fit the RSL data along the eastern Canadian coastline, but show notable misfits in the St Lawrence river channel.

- Locally modified ice model can improve the fit in St Lawrence river channel by ~40% compared with the original ICE-7G_NA ice model when coupled with VM7 viscosity model.

- Some obvious misfits still exist in St Lawrence river channel, and the maximum amplitude of M2 tide appears in St Lawrence River Channel, which all imply the St Lawrence river channel ice stream instability needs to be further investigated in detail.

- The 3D viscosity structure is not considered here, which also needs to be investigated.