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Supplement of

Numerical modeling of the dynamics of the Mer de Glace glacier, French Alps: comparison with past observations and forecasting of near-future evolution

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List of climatic simulations

The climatic models (GCM + RCM) are listed in the Table S1. For the Hindcast we use a simulation from the SAFRAN model (forced with ERA40 reanalysis).

Productor	GCM	RCM	Initialisation	RCP 2.6	RCP 4.5	RCP 8.5
CLM-com	CNRM-CM5	CCLM4-8-17	1950		X	X
CLM-com	ICHEC-EC-EARTH	CCLM4-8-17	1950		X	X
CLM-com	MOHC-HadGEM2-ES	CCLM4-8-17	1981		X	X
CLM-com	MPI-ESM-LRC	CCLM4-8-17	1950		X	X
CNRM	CNRM-CM5	CNRM-ALADIN53	1950		X	X
IPSL	IPSL-IPSL-CM5A-MR	WRF331F	1951		X	X
KNMI	MOHC-HadGEM2-ES	RACMO22E	1981	X	X	X
CSC	MPI-ESM-LR	REMO019	1950	X	X	X
SMHI	CNRM-CM5	RCA4	1970		X	X
SMHI	ICHEC-EC-EARTH	RCA4	1970	X	X	X
SMHI	IPSL-IPSL-CM5A-MR	RCA4	1970		X	X
SMHI	MOHC-HadGEM2-ES	RCA4	1981		X	X
SMHI	MPI-ESM-LR	RCA4	1970		X	X

Table S1. List of climatic simulations

SMB measurement on the tongue

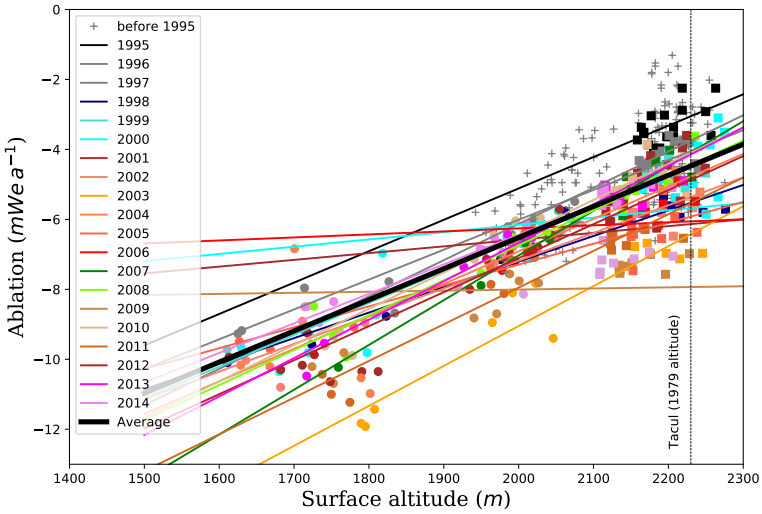

Figure S1. Surface mass balance (ablation) observed on the tongue of Mer de Glace. Linear regression is plotted for each year from 1995 to 2014. Average gradient for this period is plotted in thick black line.

3D mesh

The 3D mesh is constructed from the vertical extrusion of a 2D footprint that covers the 1905 extension of the glacier up to the Leschaux and Tacul boundaries. In this way, the glacier is allowed to advance up to its 1905 maximal extension. The 2D footprint is meshed with unstructured triangular elements at a spatial resolution of $50\ \mathrm{m}$. Tests were performed with 6 and 10 extruded layers and do not show significant sensitivity to the vertical resolution. With six vertical layers, the resulting 3d mesh contains 32,784 nodes. The initial upper surface elevation at the mesh nodes is obtained from a cubic-spline interpolation (Haber et al., 2001) of the 1979 surface DEM. Bedrock elevation at the mesh nodes is obtained using natural-neighbour interpolation (Fan et al., 2005) of all available observations presented in S2.

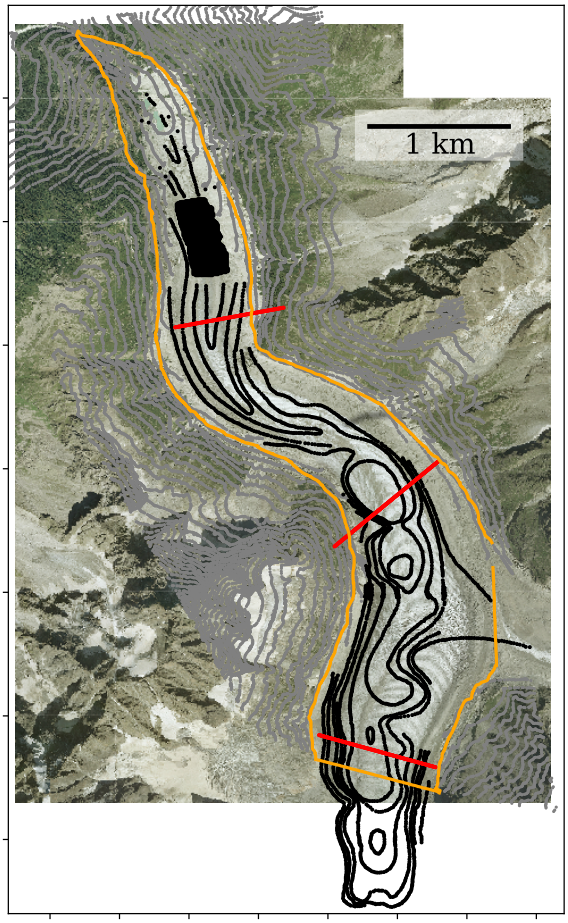

Figure S2. Dataset used for the bedrock interpolation. Isoline elevation infered from mechanical borehole drillings or seismic soundings (Süustrunk, 1951; Vallon, 1961, 1967; Gluck, 1967) are in black and new data obtained during the radar campaign in 2018 (not published) are in red. Unglaciated surface on the border of the glacier, in gray, are from the 2003 surface. The limits of the domain are plotted in orange. The background map of Mer de Glace is an orthophotoplan acquired in 2008 ©RGD74).

Volume and area evolution

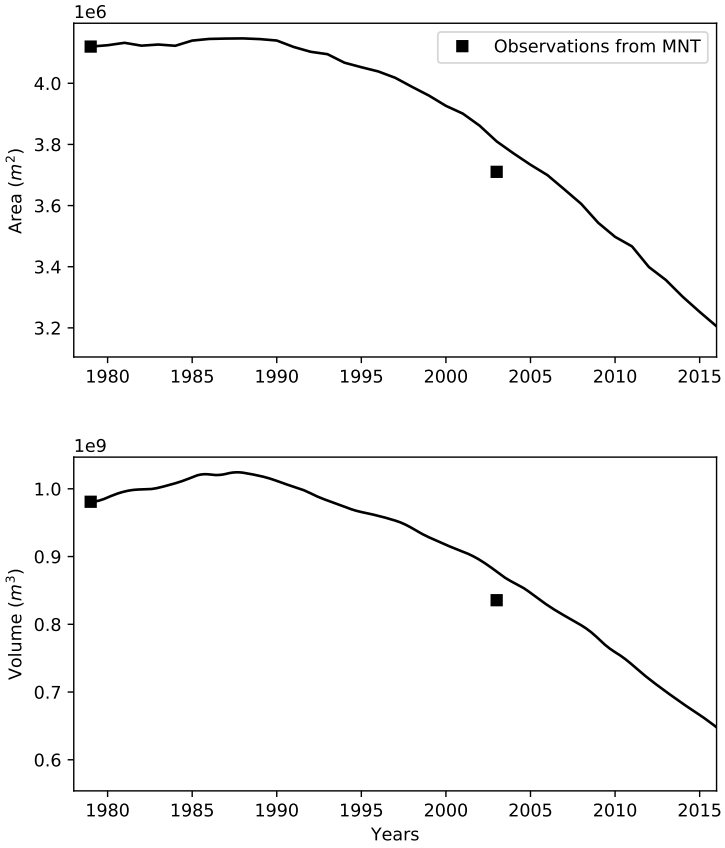

Figure S3. Area and volume evolution for the hindcast simulation.

Sentivity to the SMB vertical gradient

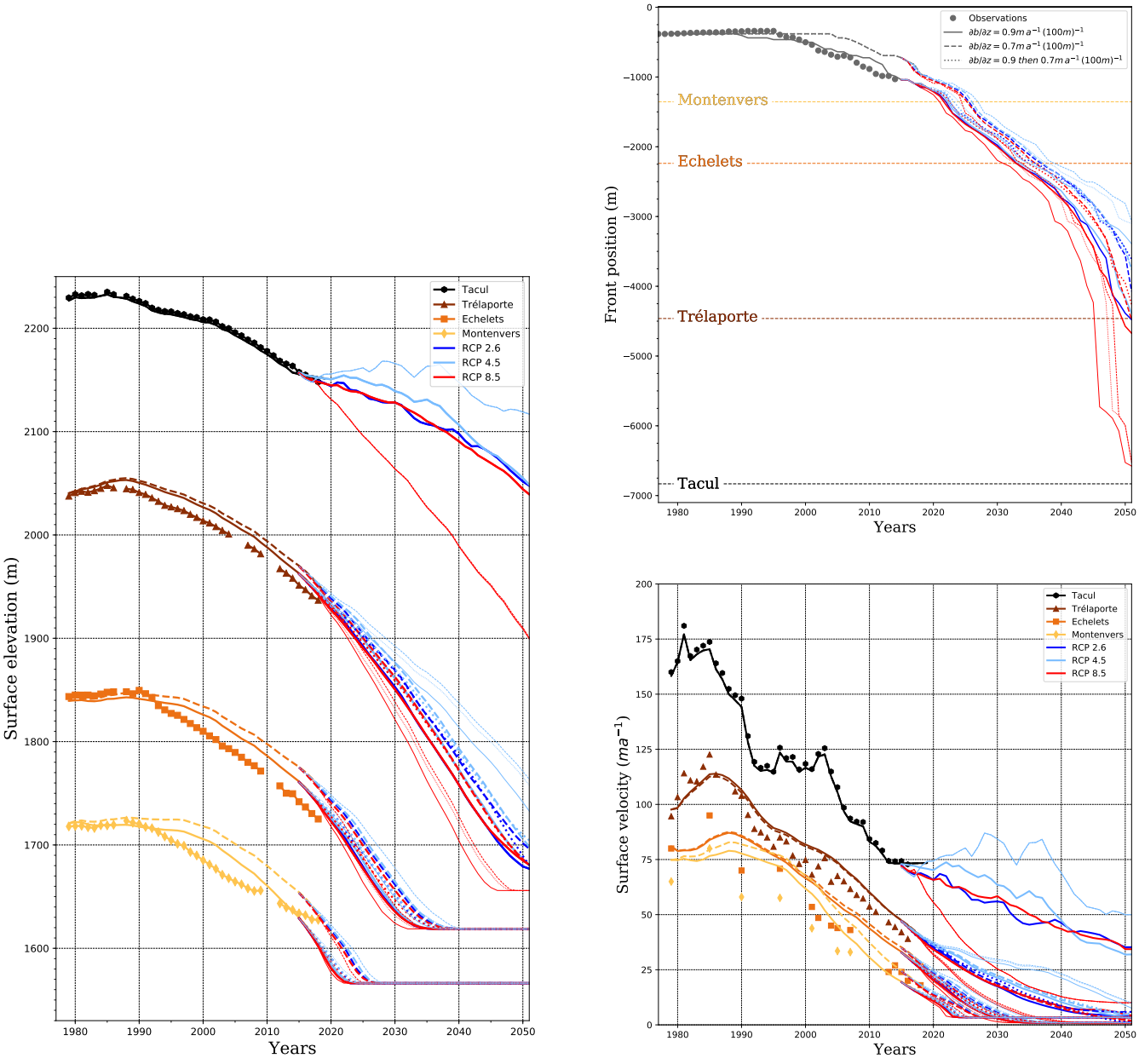

Figure S4. Altitude, front and surface velocity evolution for three scenarios with different SMB vertical gradient of 0.9 $\mathrm{m\,a^{-1}\,(100\,m)^{-1}}$ (solid lines) 0.9 for hindcast and 0.7 $\mathrm{m\,a^{-1}\,(100\,m)^{-1}}$ for forecast (dotted lines), 0.7 $\mathrm{m\,a^{-1}\,(100\,m)^{-1}}$ (dashed lines). Average RCP scenarios are plotted with thick curves, the extremes scenarios with thin curves.

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