

The GRISLI ice sheet model (version 2.0): calibration and validation for multi-millennial changes of the Antarctic ice sheet

Aurélien Quiquet¹, Christophe Dumas¹, Catherine Ritz², Vincent Peyaud², and Didier M. Roche^{1,3}

¹Laboratoire des Sciences du Climat et de l'Environnement (LSCE), UMR8212, CEA/CNRS-INSU/UVSQ, Gif-sur-Yvette Cedex, France

²Université Grenoble Alpes, CNRS, IRD, IGE, F-38000 Grenoble, France

³Earth and Climate Cluster, Faculty of Science, Vrije Universiteit Amsterdam, Amsterdam, the Netherlands

Correspondence to: A. Quiquet (aurelien.quiquet@lsce.ipsl.fr)

Supplementary material

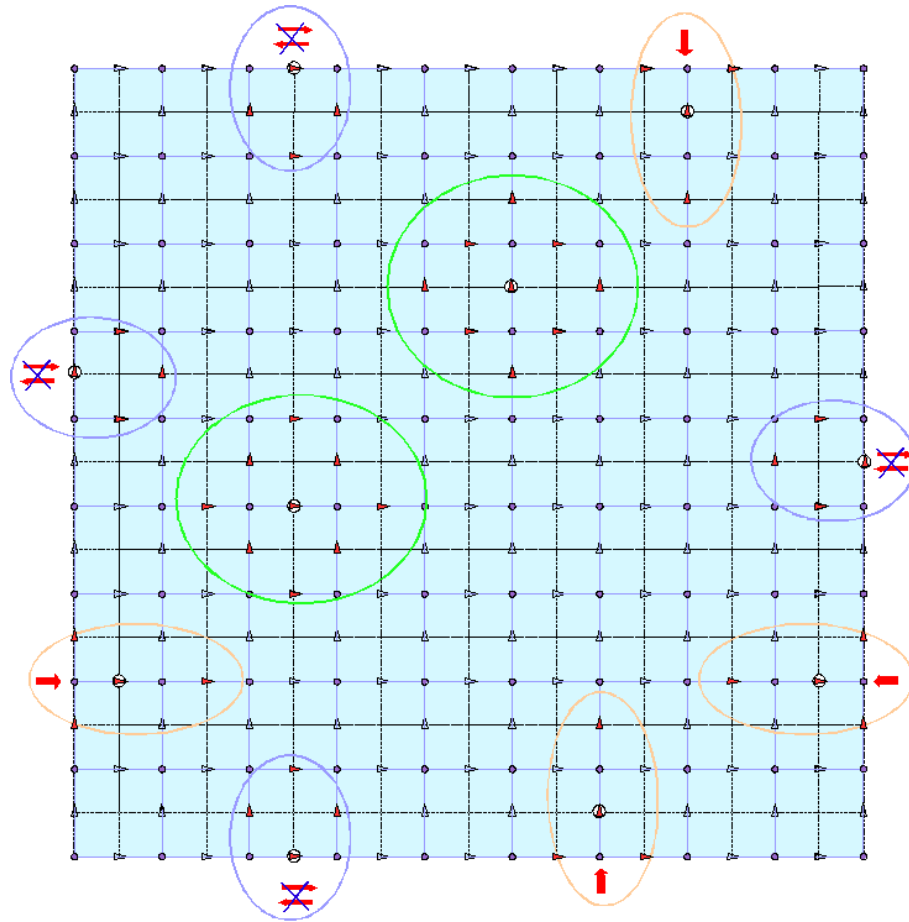


Figure S1. A few examples of typical boundary conditions for the elliptic equations when the ice shelves are artificially extended towards the edges of the geographical domain. The conditions at the front are in this case either normal or tangential to the x and y axis. The staggered velocity grid points are materialised with arrows whilst the centred grid points are represented by dots. In this figure each ellipse shows all the nodes involved in the resolution of the elliptic equation for the velocity node displayed with a small circle. Green ellipses are the standard case inside the domain; in orange is a case where we apply the normal pressure at the ice shelf front; in blue we impose no horizontal shearing at the front.

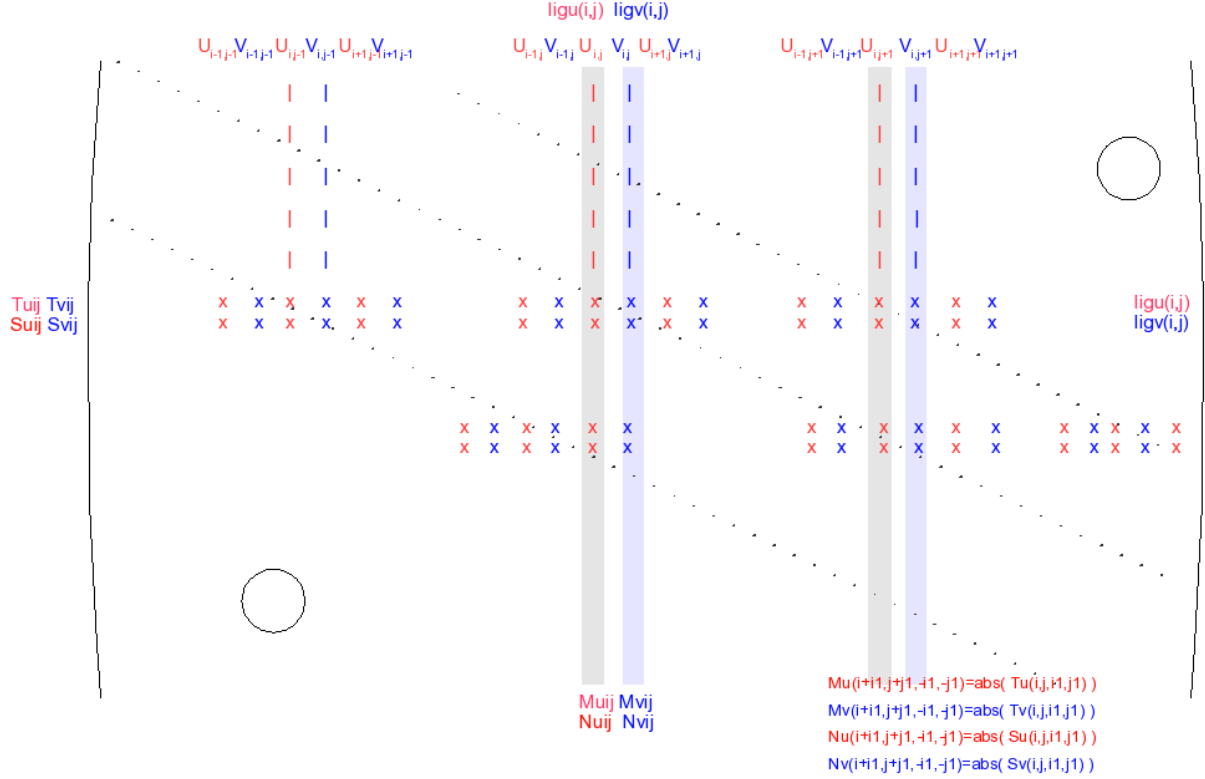


Figure S2. Schematic representation of the matrix used to solve the elliptic equation (Eq. 14). Here is shown the matrix \tilde{A} , when Eq. 14 is written as $\tilde{A} \tilde{\mathbf{u}} = \tilde{B}$, with $\tilde{\mathbf{u}}$ the vector alternating u_x and u_y components for all the velocity grid points. This very large matrix contains mostly non-zeros values for the sub/sur diagonals. In the first discretised SSA equation solving for the node U_{xij} : T_{uij} is a vector containing all the coefficients affecting u_x velocities, T_{vij} the one for coefficients for u_y velocities. S_{ij} is the equivalent of T_{uij} for the second equation solving for U_{yij} . $M_{uij}, M_{vij}, N_{uij}$ and N_{vij} are columns of the same matrix and are used to determine when a node can be considered as “ghost”.