Geophysical Research Abstracts
Vol. 19, EGU2017-4671, 2017
EGU General Assembly 2017

A mechanical diagnosis of the ice flow around Dome C: Elmer/Ice 3D simulations constrained by measured surface velocities and radar isochrones.

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The Dome C region has been densely surveyed and studied for the last decades, in particular to describe the shape of the ice surface, the bedrock relief, the surface velocity, the age and fabric structure of the ice, and its vertical temperature profile. No comprehensive ice flow modelling constrained by all of these field data has been done so far in this region. In particular, the Dome C has recently been targetted as an oldest-ice area, so that we intend to take advantage of a 2016 airborne radar survey that revealed the deep radar isochrones south-west of Dome C, and provides unprecendented constraints for the ice flow description.

The Stokes equations are solved with the Elmer/Ice finite element solver, on a 80x110 km^2 3D domain, for three different values of the Glen exponent n (1, 3 and 4.5), and for different fabric profiles. The goal of this study is threefold. First, as the range of stress types (longitudinal, transverse, and vertical compression-only) are well covered around Dome C, the observed surface velocities should efficiently constrain the possible values of the rheological parameters (Glen exponent and fluidity), and the basal sliding. Then, we apply an anisotropic flow law to correctly model the age structure, observed on the top $4/5^{th}$ of the ice thickness, so that we induce mechanically-correct ages for the basal layers. Finally, once the ice mechanics is obtained, we compare the modelled vertical velocity profiles with 1D synthetic profiles, to assess the validity conditions of 1D modelling approaches, which are much more flexible tools for ensemble simulations or inversions.