

Dynamic interaction between the polar ice sheet and the sub-glacial environment (a Belgian contribution to IPY by AMICS)

AMICS (Antarctic ice-sheet dynamics and climatic change: Modeling, Ice Composition and Seismic studies) is an interdisciplinary research cluster, established in 2001 during the fifth phase of Antarctic research included in the Second Scientific Support Plan for a Sustainable Development Policy of the Belgian Federal Office for Scientific, Technical and Cultural Affairs (OSTC).

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Objectives :

The AMICS objectives are to clarify the interactions between the ice sheet and its basal boundary condition, to elucidate the effect of these interactions on the transient behavior of the Antarctic ice sheet with changing climate, and to understand the ice flow complexity involved so that paleo-records (ice cores, erosional imprints and sedimentary remnants on the Antarctic shelves) can be better understood and interpreted more accurately. This is – among other things – envisaged through high-resolution numerical modeling, analysis of the composition of ice from the basal parts of the Antarctic ice sheet, and seismic and bathymetric sounding along the continental shelf margin.

AMICS proposal to IPY:

The sub-glacial environment opens up new frontiers in Antarctic explorations, as this dynamic interface still needs to be explored in terms of glaciological, geological, geochemical and biological research efforts. As 50 years ago the IGY was characterized by major advances in space research (probing the ice from space), the survey of the ice by over-snow traverses, the future IPY could be considered as the kickoff to 'probing the bed through the ice', a research theme already considered and proposed by SALE for future exploration of sub-glacial lakes. The AMICS cluster broadly follows these lines of thought and proposes a multidisciplinary approach to study the dynamical properties of the interface in its broad sense between the polar ice sheet and the sub-glacial environment, such as sub-glacial lakes, basal hydrology, ice streams, ice-stream onsets, grounding line dynamics, and the imprints

(erosional) and remnants (glacial sedimentation) of past basal ice presences on the continental shelves. All these summed-up interfaces are characterized by a distinct transition zone between different types of ice flow and result in complex dynamical systems that have an impact on the global behavior of ice sheets, ice drainage and global sea-level changes. Recent investigations show that inland ice flow is much more complex than previously thought. Enhanced ice flow penetrates far inland, associated with onsets of fast and/or complex ice flow. These onsets are the result of a dynamical interaction of the ice sheet with sub-glacial processes such as basal melting and refreezing, sub-glacial sediment deformation, sub-glacial hydrology and the presence of weak spots within the basal substrate.

The AMICS approach to this interdisciplinary study is based on numerical modeling of the ice-sheet system – including basal processes –, isotopic and geochemical analysis of ice cores and basal ice samples, and seismic and bathymetric investigations on the continental shelf in areas close to the edge of the ice sheet (grounding lines, ice streams) and in areas previously (i.e. during the LGM) covered by the ice sheet. All teams have a long-standing internationally-acclaimed experience in their respective research fields. The VUB-team is many years involved in the development and application of ice-sheet models that also cope with complex ice flow; the ULB-team has analyzed the basal ice sequence of all major deep ice-core drillings from Greenland and Antarctica; the UG-team is specialized in the geophysical study – at very high-resolution – of the morphology, internal structure and evolution of Antarctic continental shelves and margins.

The project relies on the integration of expertise of ice-sheet modelers, basal-ice researchers (isotopic and geochemical analyses) and marine-geologists. This project aims at highlighting the dynamic interaction between the polar ice sheet and the sub-glacial environment – considered as being a major IPY theme – as the sub-glacial interface is a central issue in glacial processes.

Relationship with other bodies

Currently, the AMICS project is related to large ongoing international projects such as EPICA, SALE, ANTIME, ACE or ISMIP.