DIPARTIMENTO DI GEOSCIENZE
DEPARTMENT OF GEOSCIENCES

Seminario - *Arduino Lecture*

From Pole to Pole – new challenges in ice core sciences –

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Aula Arduino

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Abstract:

The Greenland ice sheet has been one of the largest contributors to global sea-level rise over the past 20 years, at present accounting for 0.7 mm yr−1 of a total of 3.0 mm yr−1 and the contribution is rapidly increasing. A significant portion of this contribution is associated with the speed-up of the ice streams in southeast, west and northwest Greenland. We know from recent scientific literature that the northeast Greenland ice stream, which extends more than 600 km into the interior of the ice sheet, is now undergoing sustained dynamic thinning, linked to regional warming, after more than a quarter of a century of stability. A focused study of this ice stream including an ice core through the ice stream, surface studies combined with ice flow modelling. The observations will provide information needed to understand the flow of the basal meltwater and the processes involved in the flow of the ice stream. When included in ice stream models and combined with ocean and calving models, the future evolution of ice stream can be improved thus reducing the uncertainty on sea level projections.

The first challenge would therefore be to drill an ice core in the large North East Greenland Ice Stream (NEGIS) at a site where the surface velocity is of the order 100m/yr. The goals of such a project would be to learn about ice stream sliding and deformation by observing the ice structure and deformation especially near the base. Deep ice cores have never been drilled in an ice stream and one from such a dynamic area would give new insight into the study of ice sheet dynamics, which need to be understood urgently to predict the future ice loss from the Greenland ice sheet.

Moving South to the Antarctic continent, there are other challenges waiting for ice core scientists. The recent report of the IPCC states that the ongoing “warming of the climate system is unequivocal” and that “human influence on the climate system is clear”. These ongoing and future climate changes have very long-term consequences for many components of the Earth system, such as the carbon cycle or ice sheets, extending thousands of years into the future. The IPCC stresses that the future warming is determined by cumulative emissions of CO2, but major uncertainties in the climate change expected from a given scenario of greenhouse gas emissions exist due to limited knowledge of long-term climate-greenhouse gas feedbacks, which determine the fate of human greenhouse gas emissions. These uncertainties are critical given the long-term radiative forcing and sea level change commitments that current emissions pathways imply, but cannot be narrowed down further through modelling studies and recent observations alone. Improved estimates of climate sensitivity to CO2 changes and feedbacks in the Earth System, can be gained by greatly extending the time scale of observations based on a new Antarctic ice core reaching back in time through previously undocumented periods of major climate changes including warmer periods in the past and the crossing of Earth system thresholds.

Proponente: Bernardo Cesare