DOMAR
PHD PROGRAM IN MARINE SCIENCE, TECHNOLOGY AND MANAGEMENT

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Orientation: Ocean Observation and Global Change
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PhD project: **CO_2 transport and acidification rates in the North Atlantic**

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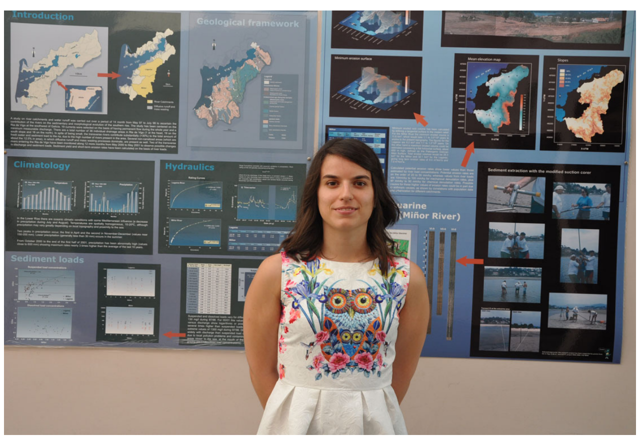
Summary: The increase in atmospheric CO_2 due to human activities (C_{ant}) has been softened by oceanic absorption. This absorption results in a series of chemical changes, collectively known as ocean acidification. The effects of this phenomenon tend to be more severe in high latitude oceans due to the natural chemical state of its waters. In addition, deep waters in regions where vertical movements are relatively rapid, ie areas where water bodies are formed, such as the North Atlantic, are more rapidly exposed to acidification. This thesis focuses on the acidification and transport of water and CO_2 masses in the North Atlantic Sub-polar Giro (GSPAN).

Changes in C_{ant}, pH, total alkalinity (A_T) and aragonite saturation were evaluated in the Irminger and Iceland basins for the period 1981-2014. The absorption of C_{ant} in both basins produced significant acidification rates throughout the water column, and a rise in the saturation horizon of the aragonite. The pH changes were divided into two terms: one derived from the penetration of C_{ant} (ΔpHC_{ant}) and another not directly related to the uptake of C_{ant} (ΔpH_{Var}). In steady state, the term ΔpH_{Var} would be constant and all pH changes would be explained by the term ΔpHC_{ant}. However, in the intermediate waters of the Irminger basin, the ΔpHC_{ant} only explains 64-92% of the observed pH decrease and the ΔpH_{Var} contributes up to 28% to the pH change, mainly due to changes in ventilation . To determine the effect of changes in ocean circulation in the collection and storage of the C_{ant}, the distribution, transport and transformation of the water masses of the GSPAN between 2002-2010 was studied, as well as the interannual variability in the structure of the masses of water between 1997 and 2010.



The reduction of the magnitude of the upper branch of the Atlantic thermohaline circulation (AMOC) between 1997 and 2000 is associated with the reduction in transport of the Central Waters. This reduction is partially compensated by the reduction of the magnitude of the lower branch of the AMOC, associated with the reduction of the transport of the Intermediate Polar Water and the Subpolar Modal Water in the Irminger Basin. The Central Waters, the Labrador Sea Water, the Subarctic Intermediate Water and the Overflow Water from Iceland-Scotland pass from the East Basin of the North Atlantic to the Irminger, crossing over the Reykjanes Ridge, where they are transformed and / or densified, happening to be deep waters. At interannual to decennial time scales, the variability of the AMOC dominates the transport variability of C_{ant} (T_{Cant}), but at longer time scales it is the increase of the C_{ant} which controls the T_{Cant}, being a very expected consequence the increase of the T_{Cant} in the GSPAN.