We found inter-annual and decadal variability in the distribution of the main water masses of the North Atlantic Subpolar Gyre and in their relative contributions to the Atlantic Meridional Overturning Circulation (AMOC) for the period 1997-2000s. This time span marks a transition from high NAO (North Atlantic Oscillation) index (more intense horizontal circulation associated) to neutral/low NAO index (weaker circulation).

- The distribution of the main water masses obtained from an Optimum Multiparameter (OMP) analysis (Tomczak and Large, 1989; Álvarez et al., 2004; Carracedo et al., 2012; Pardo et al., 2012) were combined with the velocity field resulting from a box inverse model (Cherminier et al., 2007, 2010; Gourcuff et al., 2011; Mercier et al., 2013), thus providing the net transport of each water mass.

The northward circulation of the upper limb of the AMOC weakened from 17.3 Sv in 1997 to 9.4 Sv in the 2000s, mainly due to a reduction in the transports associated to the North Atlantic Central Waters (ENACW) and to ENACW. This loss of strength of the upper limb of the AMOC within this period was partially balanced by the weakening of the transports associated to intermediate waters: the Labrador Sea Water (LSW) (from 4.6 Sv to 3.6 Sv) and the Subpolar Mode Water from the Irminger Sea (SPMW) (from 8.2 Sv to 4.7 Sv).

The North Atlantic Subpolar Gyre’s (NASPG) circulation and interactions with the atmosphere contribute to the warm-to-cold water mass transformation, a process that impacts the intensity of the Atlantic Meridional Overturning Circulation (AMOC). In the NASPG, the North Atlantic Oscillation (NAO) is the dominant mode of the atmospheric variability, which influences the shape of the gyre and hence its circulation.

Our aim is to study the water mass structure and the water mass transports in the NASPG. This allows us to provide the relative contributions of each water mass to the AMOC and to evaluate the water mass transformation in the North Atlantic. We also investigate the inter-annual and decadal variability in the water mass distributions and transports between two periods under different NAO regimes.

The Central Waters present two cores: a thicker one associated with the northward flow of the North Atlantic Current and a narrower one associated with the southward recirculation of these waters over the eastern flank of the Rockall Ridge. The two cores are separated by the SAW.

The sinking of the LSPMW and the ISPMW can be associated to the processes of transformation that undergo these waters, which some earlier studies postulated to be the result of entrainment of the waters from below. In fact, the western core of the SPMWs (LSPMW+ISPMW) extends to the center of the Irminger Basin and erodes the upper part of the LSW, which indicates deep convection. The weakening of the SPMWs is associated with a greater presence and a deepening of the LSW.

The distribution of the MW coincides with the tongue of maximum S and minimum O in each section. The presence of the PSW supports the statement of the existence of shelf waters entrainment into the DSWO. No substantial temporal changes can be appreciated in both overflows (DSWO and DSimO).

The older NEADW, represents the dominant deep water mass south of 40°N and its distribution follows the high SO4 concentrations at the bottom of the Iberian Basin (influence of Antarctic Bottom Water).

The AMOC upper limb=Central Waters+LSPMW+ISPMW+NEADW=Northward flow of 19.7 Sv in 1997 and 14.4 Sv in the 2000s.

- The weakening of the upper limb of the AMOC from 1997 to the 2000s is mainly attributed to a weakening of the northward transport of the Central Waters.
- AMOC lower limb=ISPMW+LSPMW+DSWO+PSW=Southward flow of 18.2 Sv in 1997 and 13.9 Sv in the 2000s.
- The weakening of the upper limb of the AMOC is partially balanced by a weakening of the southward transports of the ISPMW and LSPMW.

Based on this, the NASPG is also an important region of the AMOC, despite its lower transport rate (approximately 12 Sv), which is about a half of the AMOC upper limb. This study provides a basis for further investigations on this region and its role in the AMOC.