Title of the communication: AMOC regulation of the inorganic nutrient content in the North Atlantic

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Abstract:

The Atlantic Meridional Overturning Circulation (AMOC) plays a major role in the climate system by meridional redistribution of heat, carbon, oxygen and nutrients. We combine observations from the RAPID, Argo and GO-SHIP International Programs in the North Atlantic, with time-varying inorganic nutrient (silicate, nitrate and phosphate) fields obtained through a Multilinear regression (MLR) method, to generate continuous time series of the basin-wide meridional nutrient transport for the 2004–2012 period. Repeat hydrographic observations at the 24.5°N and OVIDE sections are used for additional *in situ* estimates of basin-wide nutrient transports during the period in order to evaluate the validity of this approach.

The time series show a robust net southward nutrient transport at 26.5°N (-314 ± 138 kmol-Si s^{-1}, -164 ± 77 kmol-N s^{-1} and -11 ± 5 kmol-P s^{-1}), which declines over the study period (-20 ± 3 kmol-Si s^{-1} y^{-1}, -10 ± 2 kmol-N s^{-1} y^{-1} and -0.8 ± 0.1 kmol-P s^{-1} y^{-1}). The observed variability was found to be primarily driven by the AMOC. An abrupt slowdown in the AMOC by about 30% occurred during 2009/2010 in response to the atmospheric forcing (negative NAO anomaly); this led to anomalous ocean dynamics, which included weakening of the deep western boundary current transport, contraction of the subpolar gyre and increased northward penetration of subtropical waters, southward Ekman transport at subtropical latitudes, and intensified subtropical gyre circulation with heaving isopycnals. In terms of nutrients, this lead to a 3-month south-to-north reversal on the total nutrient fluxes at 26.5°N (13 ± 69 kmol-Si s^{-1}, 16 ± 38 kmol-N s^{-1} and 1.5 ± 2.4 kmol-P s^{-1}), partially due to enhanced northward transport of more nutrient-rich waters by the upper AMOC limb; altogether favouring a (immediate) biological response (enhanced primary production/nutrient consumption) in the upper ocean north of 26.5°N. We suggest our results indicate nutrient accumulation in the North Atlantic in response to a negative AMOC anomaly forcing.

Both the current state of reduced overturning and its likely future decline suggest that significant changes in ocean nutrient distribution and the biological carbon pump are likely to occur, which would ultimately impact the nutrient inventories and deep CO_2 storage capacity of the North Atlantic.