



Contribution ID: 21

Type: Talk

Weakening of the Atlantic Meridional Overturning Circulation Abyssal Limb in the North Atlantic

Tuesday 18 July 2023 14:15 (15 minutes)

The abyssal limb of the Atlantic Meridional Circulation (AMOC) redistributes heat and carbon northward as it carries Antarctic Bottom Water (AABW) from the Southern Ocean to the subtropical North Atlantic Ocean. Using primarily mooring observations from different AMOC observing arrays and hydrographic data from multiple sources, we show that northward flowing AABW is mainly constrained below 4500 m with a mean volume transport of 2.40 ± 0.25 Sv at 16°N . During 2000-2020, the northward transport of abyssal waters into the North Atlantic subtropics weakened by approximately 0.35 ± 0.13 Sv, corresponding to a $12 \pm 5\%$ decrease. This weakening of the AMOC's abyssal cell likely results from the circulation adjustment to the reduction of AABW formation rates since the 1960s due to anthropogenic climate change and is associated with abyssal warming observed throughout the Atlantic Ocean. Specifically, in the tropical and subtropical North Atlantic, we estimate that the warming of the AABW layer is, on average, $1\text{ m}^\circ\text{C}/\text{year}$ in the last two decades due to the downward heaving of abyssal isopycnals resulting in a contribution to the increase of the abyssal heat content and, hence, sea-level rise of the North Atlantic. Finally, this warming trend is approximately half of the AABW trends in the South Atlantic and parts of the Southern Ocean, indicating a dilution of the signal as the AABW crosses the Equator.

Topic

Value of AMOC observing –what have we learned?

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Session Classification: Value of AMOC Observing / Observational Priorities

Track Classification: Value of AMOC Observing