Dynamics of the basin-wide North Atlantic Deep Water flux and Deep Western Boundary Current at 26.5°N

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The lower, cold branch of the AMOC, i.e. the North Atlantic Deep Water (NADW), is traditionally considered to be confined within the deep western boundary current (DWBC). In-situ observations from the RAPID-MOCHA-WBTS observing system at 26.5°N find, however, that it has complicated spatial structure that leads to different abyssal volume flux anomalies near the western boundary, western sub-basin and across the section. This study combines an eddy-resolving OGCM (Ocean circulation model for the Earth simulator /OFES) and a simple wind-driven 2-layer model to investigate the relation between the DWBC and the basin-wide NADW flux. The comparisons between the simple model and OGCM results suggest that the DWBC off the Bahamas is modulated by spin-up (spin-down) of the large-scale barotropic wind-driven gyre circulation and westward propagating waves and eddies. However, the NADW anomalies are mainly caused by the mass redistribution between the upper ocean and the abyssal ocean induced by pressure changes at the eastern and western basin boundaries. The processes affecting the boundary pressure profiles can be local Ekman pumping (suction) near the eastern boundary and waves or eddies impinging onto the western boundary. The different dynamics accounting for the DWBC and NADW variability indicate that caution should be taken when using the DWBC as an index for the lower branch of the AMOC.