

A New Index for the Atlantic Meridional Overturning Circulation at 26°N

A. DUCHEZ AND J. J.-M. HIRSCHI

National Oceanography Centre Southampton, Southampton, United Kingdom

S. A. CUNNINGHAM

Scottish Marine Institute Oban, Argyll, Scotland

A. T. BLAKER, H. L. BRYDEN, AND B. DE CUEVAS

National Oceanography Centre Southampton, Southampton, United Kingdom

C. P. ATKINSON

National Oceanography Centre Southampton, Southampton, and Met Office Hadley Centre, Exeter, United Kingdom

G. D. MCCARTHY, E. FRAJKA-WILLIAMS, D. RAYNER, AND D. SMEED

National Oceanography Centre Southampton, Southampton, United Kingdom

M. S. MIZIELINSKI

Met Office Hadley Centre, Exeter, United Kingdom

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ABSTRACT

The Atlantic meridional overturning circulation (AMOC) has received considerable attention, motivated by its major role in the global climate system. Observations of AMOC strength at 26°N made by the Rapid Climate Change (RAPID) array provide the best current estimate of the state of the AMOC. The period 2004–11 when RAPID AMOC is available is too short to assess decadal variability of the AMOC. This modeling study introduces a new AMOC index (called AMOC_{SV}) at 26°N that combines the Florida Straits transport, the Ekman transport, and the southward geostrophic Sverdrup transport. The main hypothesis in this study is that the upper midocean geostrophic transport calculated using the RAPID array is also wind-driven and can be approximated by the geostrophic Sverdrup transport at interannual and longer time scales. This index is expected to reflect variations in the AMOC at interannual to decadal time scales. This estimate of the surface branch of the AMOC can be constructed as long as reliable measurements are available for the Gulf Stream and for wind stress. To test the reliability of the AMOC_{SV} on interannual and longer time scales, two different numerical simulations are used: a forced and a coupled simulation. Using these simulations the AMOC_{SV} captures a substantial fraction of the AMOC variability and is in good agreement with the AMOC transport at 26°N on both interannual and decadal time scales. These results indicate that it might be possible to extend the observation-based AMOC at 26°N back to the 1980s.

1. Introduction

The Atlantic meridional overturning circulation (AMOC) plays a major role in the heat budget of the North Atlantic.

The heat carried by the AMOC accounts for one-quarter of the maximal global meridional heat transport required by the coupled ocean–atmosphere system to balance the global radiation budget (Wunsch 2005; Trenberth and Caron 2001).

Interest in the AMOC has been stimulated by the prospect of its gradual weakening during the twenty-first century as suggested by the climate model scenarios of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). They consider it “very

Corresponding author address: Aurélie Duchez, National Oceanography Centre Southampton, European Way, Southampton SO14 3ZH, United Kingdom.
E-mail: a.duchez@noc.ac.uk