

LA-UR-05-9390

Is the Atlantic meridional overturning circulation slowing down?

December 9, 2005

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The Atlantic Ocean circulation across the latitude of 25°N has been used as a benchmark for characterizing the mass and heat transport from tropics to the northern latitudes. The upper portion of this transport includes the Gulf Stream that is responsible for the moderate climate of Europe. A weakening of the Atlantic meridional overturning circulation and of the Gulf Stream might have unpleasant consequences for European climate^{1,2}.

Ganachaud and Wunsch³ using hydrographic data collected during the World Ocean Circulation Experiment (WOCE) investigated the heat and mass transport in world oceans including the transport across the Atlantic 25°N latitude. The conclusion³ made in the year 2000 was that there was no statistically significant change in mass transports over the past 30 years.

In recent analysis (with added new 2004 measurement) Bryden et al.⁴ concluded that the Atlantic meridional overturning circulation has slowed by about 30% between 1957 and 2004. This inspired the speculation that the anthropogenic increase of carbon dioxide

may be responsible for the weakening of heat transport from the tropics and that such an effect has been now detected⁵. Thus the pleasant climate of Europe may be in danger. Bryden et al.⁴ were apparently not aware of the Ganachaud and Wunsch³ results and so no comments on the discrepancy between the previous³ and the current⁴ results were required.

We wish to point out that the conclusion of a 30% decrease of the Atlantic meridional overturning circulation does not follow from the presented data⁴ and that it is based on an incorrect treatment of errors of the measurements.

The estimated rms error of the measurements in the upper transport layer according to Ganachaud⁶ and Bryden et al.⁴ is about ± 6 Sverdrups ($1\text{ Sv}=10^6\text{ m}^3\text{ s}^{-1}$). According to data presented by Bryden et al.⁴ the 1957 transport in layer shallower than 1000m is 22.9 ± 6 Sv compared to the transport of 14.8 ± 6 Sv in 2004. Consequently the difference in the mass transport between 1957 and 2004 is 8.1 ± 12 Sv and not 8.1 ± 6 Sv as incorrectly stated by Bryden et al.⁴. In other words, the mass transport was somewhere between 16.9 and 28.9 Sv in 1957 and between 8.8 and 20.8 Sv in 2004, which is consistent with no change at all. Thus the observed change is well within the uncertainty of the measurement and not “uncomfortably close” as stated by Bryden et al.⁴. Although Bryden et al.⁴ do not discuss explicitly the statistical significance of their results, an incorrect treatment of errors suggested that the results were statistically significant. The correct conclusion from the presented data (Bryden et al.⁴) is that no statistically significant change in Atlantic meridional overturning circulation at 25°N between the years of 1957 and 2004 has been detected. This conclusion is in agreement with the earlier analysis of Ganachaud and Wunsch³.

References

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