

Observing and Modelling the Meridional Overturning Circulation in the South Atlantic (SAMOC)

The **South Atlantic Meridional Overturning Circulation (SAMOC)** program is an effort carried out by an international group of researchers to study the role of the South Atlantic in the Meridional Overturning Circulation (MOC).



Why is this important for our planet and society?

The MOC is a primary mechanism for the transport and storage of heat, freshwater, oxygen and carbon by the ocean, with a large impact on climate and its variability. Changes in the MOC have been linked to past climate variations throughout geological time, and are also known to contribute to climate variability on shorter timescales.

How does MOC influence climate?

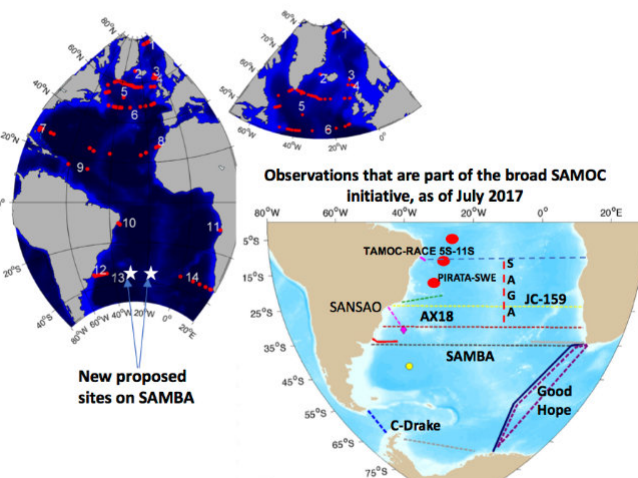
In climate models, deep ocean heat uptake is well correlated with climate sensitivity, with greater ocean heat uptake implying a larger commitment to future warming and sea level rise. The degree to which the deep ocean takes and redistributes heat throughout the basins is one of the largest uncertainties in determining climate sensitivity. The same holds for the ocean uptake and transport of carbon dioxide. Hence, monitoring the MOC in key locations together with deep ocean measurements of key thermodynamic variables is crucial to reducing uncertainty in projections of global warming and sea level rise.



Participants of the SAMBA/GO-SHIP Cruise in January 2017, onboard the German RV Maria S. Merian. Most are students/young scientists from different countries, some supported by POGO.

The Atlantic Meridional Overturning Circulation Observing System

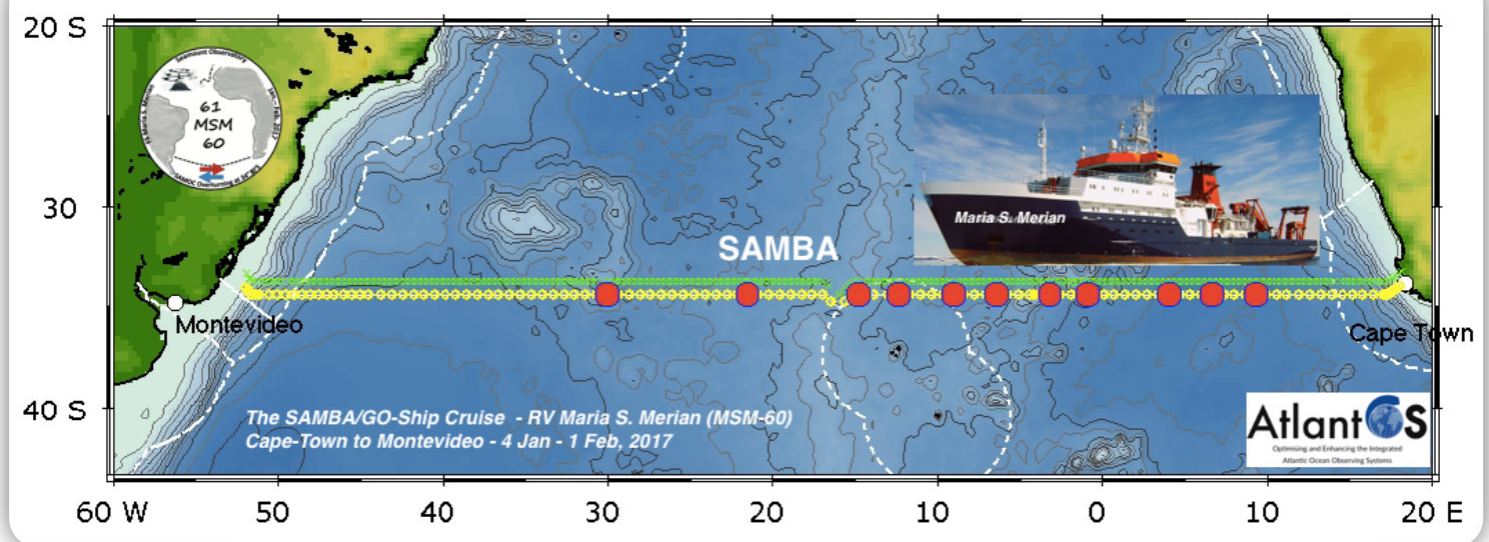
1. Fram Strait
2. Denmark Strait
3. Faroe Bank Channel
4. Faroe Shetland Ridge
5. OSNAP: Overturning in the Subpolar NA Program
6. NOAC: North Atlantic Change
7. & 8. RAPID-MOC/MOCHA/WBTS
9. MOVE
10. 11°S/Brazil
11. 11°S/Angola
- 12., 13. and 14. SAMBA



Are the North and the South Atlantic Ocean monitored equally?

No, at least not at present. While the North Atlantic is the sole provider of North Atlantic Deep Water (NADW) to the global ocean, the South Atlantic is also the sole conduit for upper and bottom waters flowing into the North Atlantic. The export of NADW to other ocean basins is compensated for by net northward flow of surface, intermediate and bottom water layers through the South Atlantic and across the equator. The relevance of the South Atlantic to the MOC depends on whether these waters are affected during their passage through that basin. Modifications of the water masses participating in the return flow within the South Atlantic can potentially lead to alterations of the thermohaline circulation and the associated meridional heat and freshwater fluxes. Thus, monitoring equally the MOC in both the South and North Atlantic is fundamental for the better understanding of its role in the Earth's climate system.





Which legal, political, technical and financial challenges do scientists face in monitoring global phenomena like MOC?

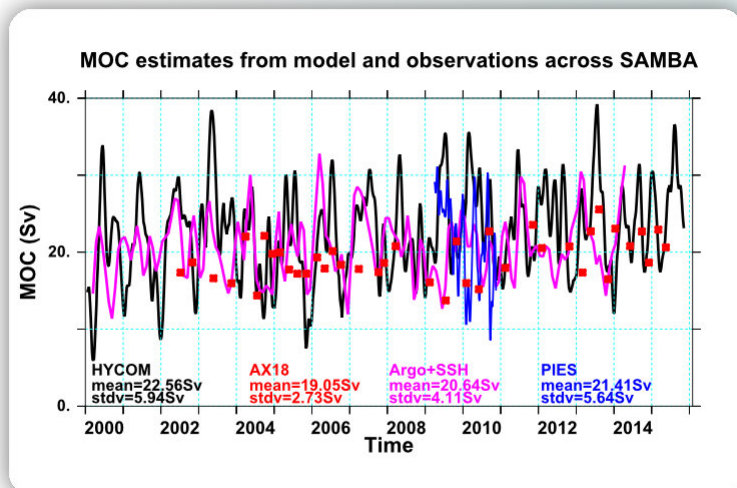
There are some legal and political issues related to monitoring the MOC but these are minimised by international cooperation. The major challenges are technical and financial. The creation and maintenance of MOC monitoring arrays require large amounts of money, adequate institutional infrastructure and human capacity. While this is a big issue in the North Atlantic, in the southern regions of the basin it is even more problematic. The task can only be accomplished by a well-coordinated international consortium of institutions from the northern and southern hemispheres.

dialogue between the groups was the SAMBA/GO-SHIP cross-basin cruise along 34.5° S. The concept was first discussed in September 2015 and the cruise successfully conducted in January 2017, sponsored by the EU-2020 Project AtlantOS. Another example was the preparation of a proposal for augmentation of the SAMOC Basin Wide Array (SAMBA), which involves nearly 50 scientists from a large number of countries. Neither of these two could have been accomplished in such a short period without the catalytic role of the Working Group.

Key Recommendations

SAMOC has been conducted as an effort of individuals, with no long-term institutional commitments. While highly necessary, the passionate involvement of scientific personnel is not enough to guarantee its continuation as a sustainable observing system. So, among the recommendations of the Working Group, the most important are:

- *To seek ways to have the monitoring efforts endorsed or embraced by operational institutions in the participating countries;*
- *To involve young scientists to assure a continuous flow of researchers and scientific projects related to the monitoring of the MOC;*
- *To invest in research and publication of scientific papers that would demonstrate the value of a sustained MOC observing system;*
- *To consider conducting a cross-basin full-depth hydrographic cruise across the SAMBA array at least once per decade;*
- *To expand the array further.*



Estimates of the MOC across SAMBA, from a global experiment with the Hybrid Coordinate Ocean Model (HYCOM) and from observations (After Campos et al., J. Clim, 2017, in review)

How does the current working group try to support SAMOC in addressing this inequality?

The POGO SAMOC Working Group was instrumental in boosting the already existing cooperation among scientists from Africa, Europe, North America and South America. The activities conducted with POGO support helped to create a more efficient channel of communication among scientists from the different institutions. One important outcome of the enhanced