Peter K. Taylor, Southampton Oceanography Centre, March 2004

As part of a larger study of the Atlantic meridional overturning circulation (MOC) we are proposing to undertake hydrographic sections in the North Atlantic and the Southern Ocean. The principal measurements will be of the physical parameters needed to quantify the oceanic heat and freshwater transports, and the carbon system parameters needed to quantify aspects of the ocean's role in the carbon cycle. This note will summarise that part of our proposed work which has relevance to the IPY. A more detailed discussion and scientific rationale can be provided if required. The research represents a collaboration between the Southampton Oceanography Centre and the Laboratory for Global Marine and Atmospheric Chemistry, University of East Anglia (PI A. Watson).

Cruises

(1) "Arctic Gateway"

An 'Arctic Gateway' section from Scotland to Canada, via Cape Farewell will enable the calculation of absolute transports, and the evaluation of exchanges with the Arctic (assuming transports through Bering Strait have been separately determined). The analysis will be integrated with results from a mooring array near Cape Farewell funded mainly by the NERC RAPID directed programme (the Deep Western Boundary Current, DWBC, monitoring array; PI S. Bacon, SOC) and with the research programme Ovide (PI H. Mercier, IFREMER). The section is proposed for 2006 to allow the DWBC to be serviced. However the analysis, together with the mooring array results, might be considered a contribution to the IPY.

Measurements to be taken

The measurement programme would be broadly similar on each cruise, and would be conducted to international standards. We propose coast-to-coast hydrographic sections with a station spacing of 50 km as standard, but reduced appropriately over sloping topography and near fronts. We would measure the standard physical parameters (temperature, salinity, and currents) over the full depth of the water column with a state-of-the-art CTD/LADCP[1] system. We would also employ a 24 x 10 litre water sampling rosette, which would enable water sample analyses for salinity, oxygen, inorganic nutrients, CFCs, alkalinity and total dissolved inorganic carbon (DIC).

Proposed Analysis programme

Transports and Inventories

Initially, data from each of the proposed sections would be analysed independently to estimate the meridional transports of volume (the MOC and the horizontal circulation), heat, freshwater, nutrients, and both pre-industrial and anthropogenic carbon. We will also calculate the total amount (inventory) of carbon on each section.

Inverse Modelling

We would combine the individual sections described, together with other available sections, into unified and consistent descriptions of the North Atlantic and Southern Oceans by means of inverse analysis methods.

For the North Atlantic, an inverse model would be constructed from the 'Arctic Gateway' and 26°N ("RAPID" programme) sections, together with the UK consortium measurements from 36°N, and selected sections from the CLIVAR/Carbon survey The circulation from this inverse calculation would be combined with chemical tracers to provide transports and divergences of heat, freshwater, and carbon. To derive a reliable circulation scheme, careful consideration must be given to the details of the ocean variability on each

[1] A Conductivity Temperature and Depth probe combined with a Lowered Acoustic Doppler Current Profiler.

section and to making realistic choices for the prior uncertainties in the model. For the North Atlantic, there will be two new sources of data on ocean variability. One will be time series from the RAPID MOC array at 26°N, and from the DWBC array off southern Greenland. The other will be the analysis of Argo profiling floats.

For the Southern Ocean, we would perform an inverse of the three near-synoptic sections proposed. Again, detailed estimates of variability are central to determining the uncertainty of the solutions in the region. To this end, we would employ the ongoing time series of physical measurements in the Drake Passage to test the sensitivity of the calculation to interannual and decadal variability.

For both regional studies, we will make maximum use of the Argo profiling float programme (in which each float provides a hydrographic profile to 2000 m every 10 days or so). The array of floats will enable unprecedented views of upper ocean variability, including through the winter months, that will be used to improve the reliability of the inverse solutions.