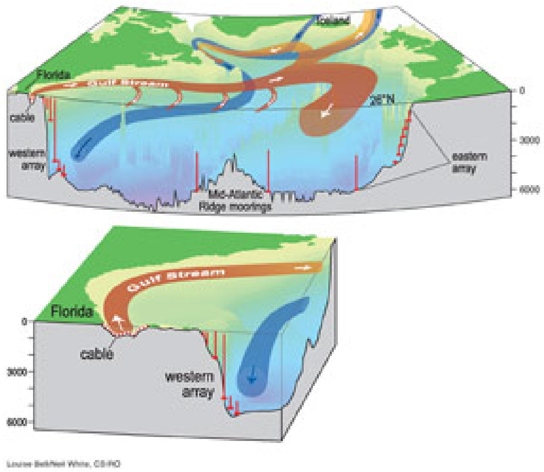
Call for network to monitor Southern Ocean current



A schematic of ocean currents in the North Atlantic that are now being measured by a network of moored instruments. Image credit – CSIRO

The senior science advisor to the World Climate Research Programme (WCRP) has called for the establishment of a Southern Hemisphere network of deep ocean moorings to detect any change in ocean circulation that may adversely influence global climate.

In a commentary published in the journal Science today, Dr John Church of the Antarctic Climate and Ecosystem Cooperative Research Centre and CSIRO, through the Wealth from Oceans Flagship, said a Southern Hemisphere observing network is needed to complement a network of moorings now spanning the North Atlantic Ocean.

The North Atlantic moored network (at latitude 26ºN) provides measurements of the Gulf Stream – a significant feature in moderating European and North American climate by moving warm waters towards high latitudes.

It monitors two key elements of what is called the 'North Atlantic overturning circulation': the northward flow of near-surface, warm water which is controlled by a combination of surface winds and gradients of temperature and salinity, and; the southward flow of cold, deep water.

"An equivalent Southern Hemisphere monitoring network to measure changes in the Southern Ocean limb of the overturning circulation, where water mass changes have also been observed, is yet to be designed," Dr Church said.

"However, the establishment of such a system in the Southern Hemisphere is critical to providing the additional data ocean scientists need to more accurately monitor any shifts in the global ocean circulation that influence world climate," he said.

In a paper published earlier this year in Science, Cunningham et al. estimate they can measure any variation in the annual average overturning to better than 10 per cent, which would be sufficient to detect any large scale abrupt transition in the overturning circulation. In another paper published in Nature in 2005, UK scientists (Bryden et al) used five decades of measurements to estimate changes of 30 per cent in the overturning circulation in the North Atlantic and a 20 per cent reduction in the amount of heat being transported to the region.

"Prior to the current observations, it was unclear how large and rapid the variations in this overturning circulation were," Dr Church said. "The latest results show that the variation in the overturning over a year was as large as the changes previously observed by Bryden et al.

"Even though an assessment of the current generation of climate models indicate that a large abrupt transition is unlikely during the 21st Century, monitoring and understanding the variability will be critical to detecting any change and to improving models, thus allowing more reliable projections of climate change.

"A recent study suggests it would take several decades of observations to detect any trends in the circulation and a similar time frame to assess which if any other the models most accurately reflects reality," Dr Church said.

"Verifying our climate projections and continuing to assess the stability of the overturning circulation remains a priority of the WCRP," he said.

Background: Southern Ocean Current

One public image of climate change is a rapid and dramatic collapse of the northward flow of warm water to high latitudes, with possible serious implications for North American and European climate.

This warm water flows from the Florida Strait northward along the east coast of America as the Gulf Stream. After leaving the coast of North America, the warm water flows northeastward before it diverges, with some water continuing northward beyond Iceland and the remainder returning in a broad southward flow in the upper kilometre of the ocean.

Throughout its northward journey, the warm water loses heat to the atmosphere and becomes denser. The colder denser water sinks at high latitudes north of Iceland and returns southward at depths of 2-5 kilometres.

Two processes can prevent high-latitude water from sinking: surface warming and decreased salinity caused by freshwater runoff from rain and glacier meltwater from glaciers and the Greenland Ice Sheet. This would disrupt the overturning circulation.

Observations indicate there has been a freshening of the North Atlantic while climate change models in which carbon dioxide concentrations quadruple over 140 years project a decrease in the overturning circulation by 10-50 per cent.

Source: CSIRO