Freshwater Fluxes into the Labrador Sea

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Freshwater is one of the key players in climate due to its impact on the ocean's vertical stability and ice-formation. Indeed, models show how even relatively small changes in the amount of freshwater flowing into the North Atlantic can result in large climate changes. Thus, it is important to measure the amount of freshwater flowing into this region and to monitor its variability.

Freshwater reaches the North Atlantic through three major pathways (Figure 1): Fram Strait (between the Arctic Ocean and the Nordic Seas – between Iceland and Greenland), Davis Strait (between the Arctic Ocean and the Labrador Sea – between Greenland and northeastern Canada) and Hudson Strait (between the Hudson Bay drainage basin and the Labrador Sea).

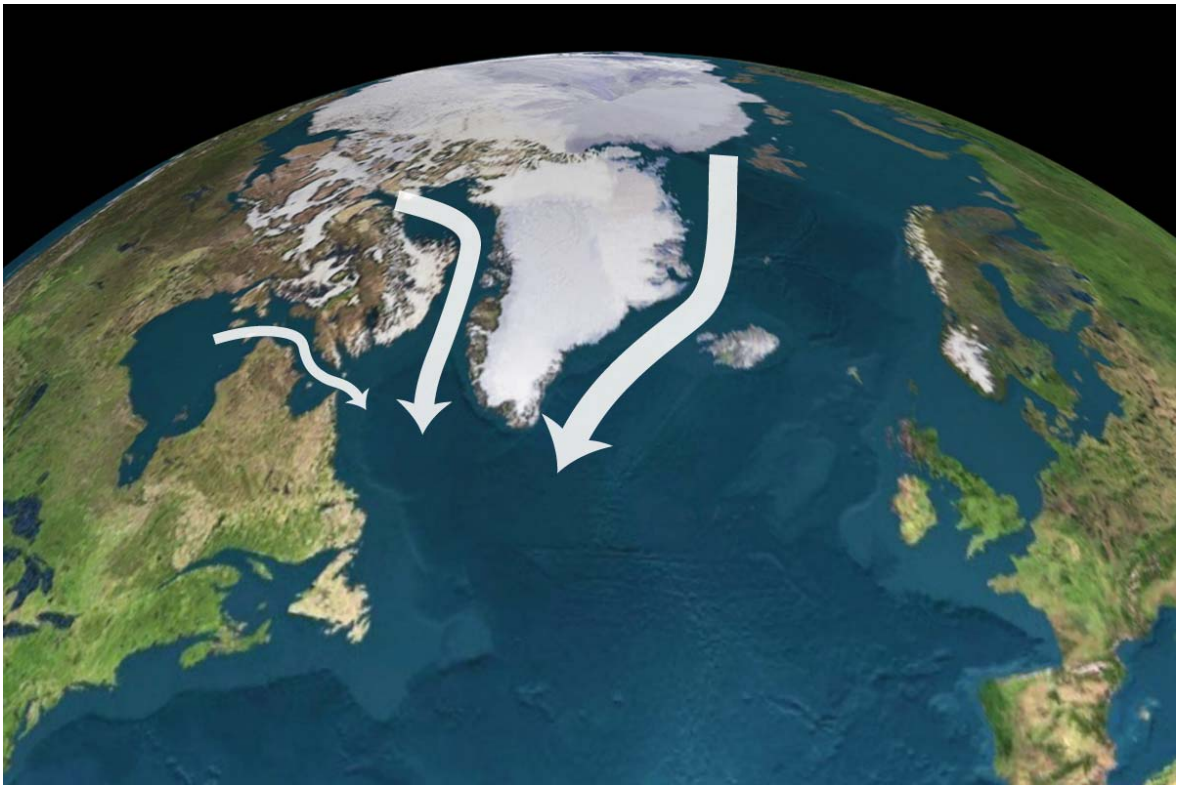
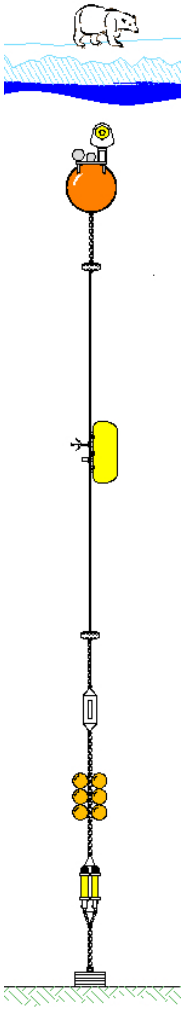


Figure 1. Freshwater flux into the North Atlantic. Right arrow, Hudson Strait; center arrow, Davis Strait; left arrow, Fram Strait. Measurements were taken in the Hudson Strait for this project.

As bottlenecks focusing the flow, these straits are ideal locations for measuring freshwater flux into the North Atlantic. On the other hand, the convergence of sea-ice and icebergs through these tight passages poses a serious challenge to year-round monitoring and measurement operations. Until recently, observations were limited to the deeper part of the flow to avoid instrument contact with ice and resulting equipment damage. Since freshwater is lighter than seawater, the freshwater tends to float above the seawater. Hence, measurements that extend all the way to the surface (or ice) are absolutely necessary for freshwater monitoring.

Last year, several WHOI engineers developed an instrument to solve the difficulties described above. This instrument, the Arctic Winch (Figure 2), consists of a profiler attached to a winch. The winch can be mounted on the top of a mooring, several tens of meters below the sea-surface; and, hence, beneath the reach of sea-ice and most icebergs. Once a day the winch allows the profiler to rise to the surface, recording temperature and salinity on the way. The winch then rapidly pulls the profiler back down.



Figures 2 & 3. Left: Top float for the WHOI mooring with the Arctic Winch mounted on the top. The winch consists of a motor (black) and a profiler (white and yellow), which rises to the surface once a day measuring temperature and salinity. Right: Mooring arrangement diagram depicting the Arctic Winch just under the ice cover.

Using this new technology, we implemented a project to measure the freshwater flux through Hudson Strait, a region not yet monitored by the widespread international effort to quantify the freshwater flowing into the North Atlantic. The first phase of this project was concluded in August 2004 with the deployment of three moorings in Hudson Strait from the Canadian Coastguard icebreaker, the *Pierre Radisson* (Figure 4). The deployment was successful, and the WHOI mooring (containing the Arctic winch as well as instruments to measure current velocity, ice-thickness, temperature and salinity) was complemented by two other moorings provided by Canadian colleagues. The Canadian moorings will be instrumental in mapping the horizontal extent of the structures observed. All of the moorings will be in the water for one year and will be retrieved in August/September 2005. This is the first attempt ever made to measure the freshwater flow (both in liquid and solid form) through Hudson Strait.

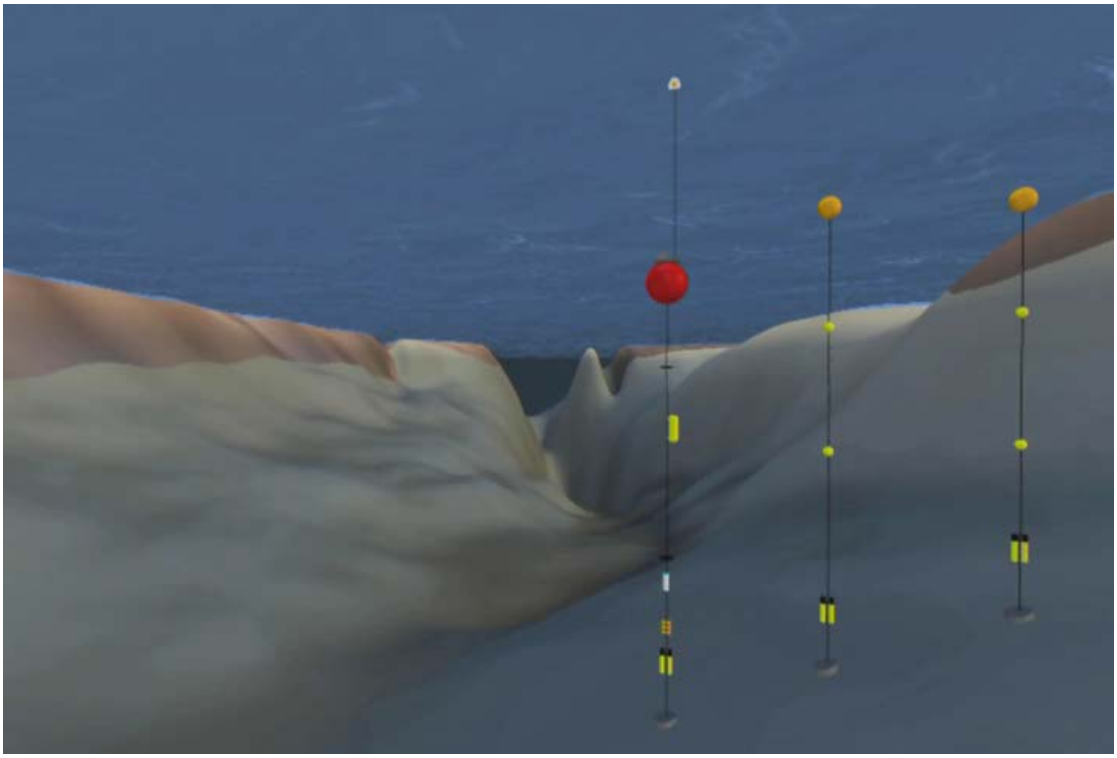


Figure 4. Artist's depiction of the three moorings deployed under water in the Hudson Strait. The WHOI mooring is shown on the left; ice covers the surface above.