1 Introduction

Along the East Greenland Shelf Break to the south of Denmark Strait there exists a sharp hydrographic front separating cold and fresh Arctic-origin water from warm and salty Atlantic-origin water (Figure 1). This front and its associated jet - known as the East Greenland Irminger Current - is one of the main routes by which fresh water and intermediate density Arctic water is advected southwards into the North Atlantic.

It has been long established that the front and its jet are both highly variable in time and unstable, with lenses of Irminger Water being observed on the inshore side of the front as early as 1930 (Golterman). Such cross-frontal exchange with the open Atlantic may be driven either by strong down-front barrier winds adjacent to the Greenland Plateau, or by baroclinic instability of the boundary current. In the period 2001-2007, four high resolution hydrographic/velocity sections were made during summer across the shelf and continental slope close to 66°N (Figure 2). These were designed to resolve the detailed cross-stream structure of the boundary current for the first time and to determine the shelf-basin exchange processes taking place.

Figure 1: Boundary currents of the Irminger Sea. IC = Irminger Current; EGC = East Greenland Current; DWBC = Deep Water Boundary Current, along with the Spill Jet.

Figure 2: Positions of the hydrographic stations occupied during the four crossings of the boundary current: 2001 (red triangles), 2003 (purple squares), 2004 (blue circles), 2007 (green crosses).

2 Structure of the Boundary Current System

From the four occupations, mean sections of potential temperature, salinity and absolute geostrophic velocity were constructed. The EGC/IC can be identified as a strong surface intensified current flowing equatorward close to the shelf break, whilst the DWBC is seen near the base of the continental slope. A third component of the boundary current system, first identified in a single section by Pickart et al. (2005), is a bottom-intensified velocity maximum in the vicinity of the shelf break and upper slope. This “Spill Jet” (Figure 3) is thought to be formed by dense water on the outer shelf cascading over the shelf break onto the upper slope, providing a route by which Arctic-origin water can enter the interior of the basin. The cross-shelf exchange process appears to be two way, with warm and salty lenses of Irminger Water observed shoreward of the main front in all four years. The Spill Jet itself also appears to be a persistent feature, being observed in all four occupations with a volume transport as large or larger than the DWBC at this latitude (Table 1).

Figure 3: Mean vertical sections of (a) absolute geostrophic velocity (cm/s), referenced to vessel-mounted ADCP and overlain by potential density (kg/m^3), (b) potential temperature (°C) overlain by potential density and (c) salinity overlain by potential density.