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Interannual Variability in the Pathways of the North Atlantic Current over the Mid-Atlantic Ridge

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Parts of the North Atlantic subpolar gyre circulation undergo significant interannual changes in response to variability in atmospheric forcing, in particular, the North Atlantic Oscillation (NAO). There are indications that the southern limb of the subpolar gyre, represented by the multiple branches of the eastward-flowing North Atlantic Current (NAC), is locked to particular latitudes by fracture zones (gaps) in the mid-Atlantic ridge (MAR). Bower et al. (Nature, 2002) report about subsurface float trajectories at 100-1000 m collected during 1997-1999 indicating that there were at least two NAC branches crossing the MAR in 1997-1999, and that they were semi-locked to the Charlie Gibbs Fracture Zone (CGFZ; 52˚-53˚N) and the Faraday Fracture Zone (FFZ; 50˚-51˚N). This may constrain the current's ability to respond to variability in wind forcing.

This poster presents an analysis of surface geostrophic velocities from satellite radar altimeter observations spanning the period of 1992-2006. The geostrophic velocities confirm that the pattern observed by the float observations extended to the surface. They further show that the two branches originated from the splitting of a single branch located upstream of the ridge, specifically the most northern NAC branch, also called the subpolar front. However, this pattern did not persist outside of the float time period, and there is significant interannual variability in the strength and location of the NAC branches over the ridge. Three pathway modes are identified: a single branch mode with one strong current branch over the CGFZ (1992-1996 and 2000-2001), a double branch mode with one branch over the CGFZ and another over the FFZ (1996-1999) and a southern mode of one year duration with the major branch crossing over the ridge south of the FFZ (2002-2003). For the period after 2001 the circulation is

generally weaker than for the period 1992-2001 and continuous well-defined branches are not as evident.

A previous study (Schott et. al, GRL, 1999) showed how northward excursions of the NAC can block the westward flow of Iceland-Scotland Overflow Water through the CGFZ. From the time series of surface geostrophic velocity, this poster suggests that this situation may occur as much as 5-10% of the time.