Under The Tongue: Fluid-Ice Structure Interaction of the Drygalski Ice Tongue

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The Drygalski Ice Tongue (DIT) is the largest floating glacier in Antarctica, extending approximately 100km into McMurdo Sound, and exhibits a significant influence upon the prevailing northward current, as the ice draft of the majority of the DIT is greater than the depth of the observed well-mixed layer near the surface. While it is known to have localized effects on McMurdo sound circulation, it is difficult to characterize this influence using conventional methods such as in-situ Acoustic Doppler Current Profilers (ADCP) measurements, vertically collected profiles or semi-permanent moorings as these are generally relatively sparse datasets. In order to better relate measurements across the entire region of influence of the DIT region, a set of Computational Fluid Dynamics (CFD) simulations were conducted using a generalized topography of a mid-span transect of the DIT. Conductivity-Temperature-Depth (CTD) and ADCP measurements made in close (<100 m) proximity of the DIT were used as boundary conditions for the model. These measurements revealed a layered structure in the water column typical of the region, with salinities varying from 34.69 ppt near the surface to 34.81 ppt at nearly 1200 m depth. The degree of mixing and the associated sharpening of the pycnocline varied greatly over the observation period of 4 days and was thought to result from tidal influences interacting with the DIT. CFD simulations, using both Shear Stress Transport (SST) and Baseline Reynolds Stress (BSL) turbulence models for a homogeneous two layer water column independently produced an estimated region of influence of the ice structure approximately 5km and 20km fore and aft of the DIT respectively. Numerical modeling of environmental flows around ice structures advances the knowledge of fluid particle transport in not only the region surrounding the DIT but also provides a clearer insight into fluid-ice structure interactions and, potentially, the long-term fate of floating glaciers.