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Features and extent of meltwater impact on glacial bay's flow pattern, water level and salinity revealed through multi-scenario 3D modelling and *in situ* measurements in Admiralty Bay, Antarctica

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A 3D modelling of glacial bay hydrodynamics has been performed in Admiralty Bay (AB), King George Island, Antarctica, using Delft3D Flow model with tides and density gradients as its drivers. It was conducted in multiple scenarios of varied glacial input - a baseline case without meltwater added, and scenarios with meltwater input divided into two modes: drained through entire glacial front and with glacial input solely added to the surface layers of the ocean. Each mode was further divided into three cases dependent on the volume of freshwater added, with estimated small, medium and large volume input case per each mode. Through these seven studied scenarios a character of glacial impact on overall glacial bay flow patterns, water level changes and salinity was shown. Results revealed general circulation pattern in AB, consisting of two cyclonic circulation cells that control water exchange between the bay and the ocean. Cells are separated by a boundary area, located approximately 7 km from the bay's opening, dividing Admiralty Bay into waters primarily driven by the ocean, and inner waters significantly influenced by glacial input. This pattern is consistent in all studied cases, however its intensity and specific location is controlled by the volume of glacial input and tidal phases. Although water level changes have been found to be overall predominantly driven by tides, areas within the boundary and top 50-60 m of the water column are substantially influenced by glacial forcing, regardless of the scenario mode. Salinity distribution showed strong water column stratification, classifying AB as a salt-wedge estuary. Gathered results have been confronted with abundant *in situ* measurements consisting of ADCP probing validating water flow velocities and CTD+ profile measurements consistently carried out in 31 locations in AB, throughout three-year long period. Modelled calculations compared with measurement dataset allowed an estimation of summerly glacial inflow volume into AB from adjacent twenty tidewater glaciers. These values contrasted with CTD+ data from different seasons permitted assessment of glacial input volume variability during the course of the year. Altogether results of the study give first in this scale and detail image of seasonally changing impact of glaciers on Antarctic bay waters.