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Water exchange and renewal times of a micro-tidal fjord in isohaline coordinates

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In micro-tidal coastal systems, the hydrodynamics in fjords reduce to a competition between horizontal density gradient, friction and wind stress. Depending on the depth of the entrance sill, the importance of these factors for water exchange varies within the vertical layer structure of fjords. This study investigates these renewals of water bodies in an isohaline framework, using the example of the Gullmar Fjord on the west coast of Sweden, a transitional area between the brackish Baltic Sea and the northeastern region of the North Sea.

To estimate the influence of wind and baroclinic pumping on volume and salinity transport and their importance on the exchange time scales, a well-validated, realistic, and highly resolved 3D coastal ocean model (GETM) is used, calibrated with especially designed observations. Simulations were combined with passive numerical tracers and evaluated with the mathematical analysis framework of the Total Exhange Flow (TEF).

The results highlight the advantage of isohaline coordinates in the study of water mass transformations within the fjord, compared to geographic coordinates, and the high sensitivity of the exchange flow to sub-grid turbulence.