Stability of an Australian inverse bay

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Hervey Bay, a large coastal embayment situated off the central eastern coast of Australia, is a shallow tidal area (average depth = 15m), close to the continental shelf. It shows features of an inverse estuary, due to the high evaporation rate (approx. 2 m/year), low precipitation (less than 1 m/year) and on average almost no freshwater input from three rivers that drain into the bay.
We applied a multi-purpose three-dimensional ocean general circulation model to compute the temperature, density and salinity distribution within the bay. The numerical studies are performed with the COupled Hydrodynamical Ecological model for REgioNal Shelf seas (COHERENS). A model validation and calibration was carried out after recent field campaigns.
The investigations showed that the bay is almost vertically well mixed throughout the year and that the horizontal distribution of properties follows the bathymetry. As in other inverse/negative estuaries, the year-round salinity increases toward the shore to form a nearly persistent salinity gradient. This leads especially in the transition from summer to autumn to the formation of a dense water mass thereby establishing gravity currents. The high saline water can sink beyond 200 m, flow over the continental shelf to form a ‘Hervey Bay’ water mass that is advected with the East Australian Current southwards.
The investigation further showed that air temperature and wind direction are the main driving forces for the strength of the salinity gradient across the bay.