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Cyclonic vs. anticyclonic circulation in the Adriatic Sea

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An analytical, diagnostic model, reproducing circulation generated in a marginal sea by variable density, is developed. It is inspired by the winter situation in the northern Adriatic, with a strong vertical mixing present and the density maximum dominating the centre of the basin. The model employs Boussinesq-type parameterisation of friction and linear slip at the bottom. The results obtained reproduce several well known characteristics of the Adriatic circulation (cyclonic surface flow, downwelling in the central part of the basin compensated by upwelling in the coastal zone) but also predict some phenomena that are still not well understood. For a small value of the lateral friction coefficient cyclonic circulation prevails throughout the water column. Increase of lateral friction results in the formation of a new cell in the bottom layer where the circulation is anticyclonic and thus opposed to that in the surface layer. The anticyclonic cell extends along the vertical as the lateral friction coefficient increases and reaches the half depth level for the maximum value of the coefficient. The model also reproduces the west-east asymmetry, with the wider and weaker current being present on the east side of the basin. It is shown that this feature originates in the corresponding asymmetry of density anomaly. Coastal jets are obtained as well.