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A piecewise curve-fitting technique for vertical oceanographic profiles and its application to density distribution

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A unified method of approximation, extrapolation, and objective layering is offered for processing vertical oceanographic profiles. The method is demonstrated using seawater density and consists of adjustable splitting of each individual profile into N vertical layers based on tentative, piecewise linear homogeneous approximation with specified accuracy and a final fitting of an N-layered analytical model to data. A set of $3N$ coefficients of the model includes one density value at the sea surface; N–1 depths of layer interfaces; and N pairs of coefficients that describe a profile shape within the n-th layer—an asymptotic density value (a key parameter for extrapolation) and a vertical scale of maximum density variability (related to vertical gradient). Several distinctive characteristics of the technique are: (1) It can be used for the analysis of the vertical structure of individual profiles when N is an unknown parameter, and spatial interpolation when N should be equal for all profiles. (2) A justified downward extrapolation of incomplete data is possible with the model, especially if historical deepwater profiles are available. (3) Layer interfaces, as well as other coefficients, are derived with only one fitting to the ntire profile. (4) The technique, using its general formulation, can serve as a parent for developing various types of models. The simpler step-like (with hyperbolic or exponential approximation) and more complicated smooth (continuous in gradient space) models were designed and tested against a large number of density profiles from the Sea of Okhotsk and the Gulf of California. Comparison of parametric, z-levels and isopycnal averaging was done for the *region off the northeastern coast of Sakhalin.*

Palabras clave: Piecewise curve-fitting, splitting into layers, homogeneous approximation, vertical extrapolation, nonlinear least squares method, density profile, Sea of Okhotsk.