

Non-local turbulent mixing parameterization derived from microstructure signal processing:

Potential application to small scale biological-physical data analysis

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Abstract

The effects of mixing can be one of the key factors in understanding the dynamics of many biological processes at small scale. The centimetre-scale structure of biological and chemical tracers, estimated with recently developed new instrumentation, represents a potential limitation for using the classical models based on the eddy diffusivity concept. Estimating the turbulent fluxes of biological parameters using the eddy diffusivity approach may be inadequate, as this approach fails when the vertical scale of the eddies is larger than the vertical scale of the parameter structure. Non-local mixing closure is an alternative approach that not only overrides this limitation but also provides better descriptors for anisotropy, another important factor when considering the effects of mixing in ecological dynamics. Up to now, the main constraint for applying non-local mixing closures has been the high complexity and the difficulty in obtaining reliable parameterization. The present study proposes a new parameterization of non-local mixing closure derived from microstructure data processing. The proposed method obtains empirically the coefficients of the transilient matrix, this being the discrete descriptor used in non-local mixing closure. The parameterization is based on microstructure data analysis, in particular Thorpe displacement profiles, and is decomposed in three main steps: turbulent patch identification, turbulent patch characterization and data integration. The results obtained with field data indicate that the estimated transilient coefficients, and the mixing parameters derived from them, are in accordance with those expected from the background external forcing and the observed thermal structure.