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Ocean mixed layer depth: A subsurface proxy of ocean-atmosphere variability

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A new criterion, based on the shallowest extreme curvature of near surface layer density or temperature profiles, is established for demarking the mixed layer depth, h_{mix}. Using historical global hydrographic profile data, including CTD and XBT data obtained during WOCE, its seasonal variability and monthly to interannual anomalies are computed. Unlike the more commonly used Δ-criterion, the new criterion is able to deal with both different vertical resolutions of the data set and a large variety of observed stratification profiles. For about two-thirds of the profiles our algorithm produces an $h_{mix/c}$ that is more reliable than the one of the Δ-criterion. The uncertainty for $h_{mix/c}$ is $\pm$5m for high ($<$5m) and $\pm$8m for low ($<$20m) resolution profiles. A quality index, QI_{mix}, that compares the variance of a profile above h_{mix} to the variance to a depth of $1.5\times h_{mix}$, shows that for the 70% of the profile data for which a clearly recognizable well-mixed zone exists near the surface, our criterion identifies the depth of the well-mixed zone in all cases. The standard deviation of anomalous monthly $h_{mix/c}$ is typically 20%–70% of the long-term mean $h_{mix/c}$. Comparisons between observed $h_{mix/c}$ and MIT-OGCM-ECCO simulated mixed layer depth indicate, that the KPP algorithm captures in general a 30% smaller mixed layer depth than observed.