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 \( \Delta \)-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 \( \Delta \)-criterion. The uncertainty for \( h_{mix/c} \) is \( \pm 5 \)m for high \((<5)m\) and \( \pm 8\)m for low \((<20)m\) 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.