Annexure

The criterion for the mixed layer depth estimation used by different authors are;

The mixed layer depth criteria used by researchers vary widely. Various schemes based on fixed temperature gradient (Ali and Sharma, 1998), fixed density difference (Levitus, 1982; Gopalan et al, 2000), statistical significance criterion of Bathe, (1972), and fixed temperature difference (Monterey and Levitus, 1997) have been utilized in the past. Sprintall and Tomczak, (1992) pointed out that the temperature criterion for mixed layer depth estimation ignores salinity effects, which can lead to errors of typically 10–20 m. Recently, Kara et al., (2003) made a detailed study of the temperature and density criterion used for defining the surface mixed layer of the world ocean. In regions like Bay of Bengal, where due to the fresh water influx, the stratification is high; the two criteria may lead to quite different values. Hence it is necessary to compare the different mixed layer depth criteria. However, the lack of adequate CTD data on longer timescales hampers study in Bay of Bengal. In the future, profiling ARGO floats (see http://www.argo.ucsd.edu/whatisargo.html) will provide salinity as well as temperature profiles and make significant improvements to data availability. Here we compute mixed layer depth from both temperature and density profiles in order to assess the differences. The approach is different than the one adopted by Kara et al., (2003). We considered the Levitus criteria for computing mixed layer depth with density profiles. For this purpose, subsurface profiles from the Woods
Hole Oceanographic Institution (WHOI) mooring in the central Arabian Sea were used. Mixed layer depth computed from density (Levitus criteria) and temperature (0.1°C from water temperature at the surface) profiles for the yearlong observations are shown in Figure app. Mixed layer depth computed from the two criteria match well over a large part of the mooring record. The average difference between the two MLDs is about 14 m. During 15 February to 15 March, the two estimates show large differences. In this period, mixed layer depth (computed using density criteria) fluctuations were also too large. This is a period of intense heating, leading to enhanced stratification, and shallow MLDs, which are represented well by the temperature criteria. However, MLDs computed with the density criteria show some isolated large values. It is known that salinity variations are generally not large in this region, and when we looked at the salinity data from this period, no abnormal pattern in its distribution is noted. This indicates that differences in the mixed layer depth estimates, computed using the two criteria, are derived from the different values selected as thresholds for determining mixed layer depth from temperature and density profiles. One point worth noting is that almost throughout the period, mixed layer depth is slightly deeper using density criteria than the temperature one. However, the results remain qualitatively the same regardless of the particular criterion used; that is, the time series patterns of mixed layer properties are equivalent. However, the differences between the two mixed layer depth series vary from 4 to 80m (differences are large during February–March, the reason for which has already been explained). This certainly cannot be
considered to be statistically insignificant. Hence one should be cautious in using the temperature criteria to define mixed layer depth.

**Fig. app:** Time series of MLD (meters) computed with density (dashed line) and temperature (solid line) criteria at the data buoy location in central Arabian Sea.