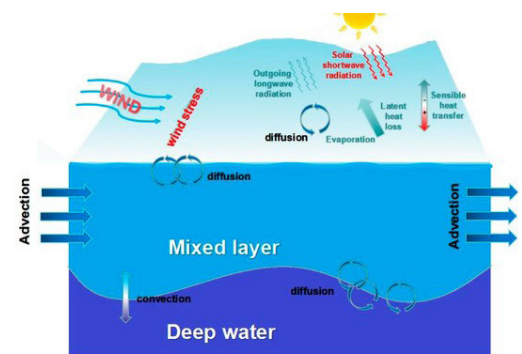# MIXED LAYER

The mixed layer is a "layer" in the water column where active turbulence has homogenized the temperature over some range of depths. The surface mixed layer is a layer where this turbulence is generated by winds, surface heat fluxes, or processes such as evaporation or sea ice formation that result in an increase of salinity in addition to homogenizing temperature. The Wildlife Computers Mixed Layer (ML) data product only looks at the homogenized temperature and not salinity or density, and is available on our Pop-up Archival Transmitting (PAT) tags. These data provide a summary of the ML and the time the tag spends within it. This was designed to report the amount of time an animal spends in this layer regardless of its thickness not to estimate the depth of the layer.

Tags Containing This Data Product
MiniPAT

Data Processing

To identify the surface ML, the tag uses a time series of temperature-depth pairs that were recorded throughout the deployment period. The general idea is if the tag was in the ML (homogenized temperature), all the temperature readings should be within 0.5° C of each other. If there is little change in temperature as the tag moves vertically in the water column, then mixing is assumed and that temperature is the ML estimated temperature. All readings within 0.5° C of that temperature will be considered part of the ML. The onboard processor will run through all of the temperature-depth pairs and flag those it thinks are within the ML (± 0.5° C of the current mixed layer estimate).

Specifically, there are two processes running onboard the tag to identify and/or update the ML estimate:

1. Keep a running estimate of the Mixed Layer Temperature (MLT).

2. For every temperature-depth pair that is < 200 m, compare the temperature to the current MLT estimate - 0.5° C. If the temperature is > MLT - 0.5° C, then that data point is IN the ML.

The MLT estimate will be updated if the following criteria are met:

A. Sea Surface Temperature (SST) reading is encountered (any temperature within 10 m of the surface). If an SST data reading occurs, the MLT estimate is updated to the SST reading.

B. Adequate vertical mixing to form the ML is assumed when there is < 0.05° C change in temperature associated with a depth change > 15 m. If Δt/Δd is less than 0.05° C/15 m, and the depth is less than 50 m, then update the MLT to the temperature at this depth.

One thing to keep in mind is the processor will only compare temperature readings to the current MLT estimate if the depth is < 200 m, and it will not update the MLT reference temperature if the depth is below 50 m.

Data Summarization

Once all records have been flagged as either in or out of the ML, the following information is calculated for each user-programmable summary period:

- **Percent Time in the Mixed Layer**: percent of time during the summary period that the tag was in the ML.

- **Mixed Layer Temperature (MLT)**: reported as the min, max, and average. Calculated using all records flagged as being in the ML during the summary period.

- **Mixed Layer Depth (MLD)**: the deepest observed depth reading that was considered part of the ML during the summary period (MLDExtreme).

- **Sea Surface Temperature (SST)**: reported as the min, max, and average. Calculated using all records that were shallower than 5 m during the summary period. (These values are useful for quality checks and confirming the ML values.)

- **Temperature Minimum**: the minimum temperature encountered during the summary period.

- **Overall Depth**: the min and max depths encountered during the summary period.

The ranges of the ML and SST can be considered quality measures. A large range (max-min) could indicate that the tag moved between multiple bodies of water. These data are reported in the MixLayer.csv file.