



# SCOUT-TEMPERATURE

The SCOUT-Temperature tag is a prototype that generates temperature profiles from animals that may not travel vertically (up or down) through the water columns. These horizontal or delayed-vertical movements to and from the surface result in “sub-optimal profiles” of the water column. Sharks and other fish are good examples of sub-optimal profilers since they do not necessarily perform “dives” or regularly return to the surface.

## Tags Containing This Data Product

SCOUT-Temp
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Collected temperature profiles provide information about the tagged animal’s environment during the deployment period and are often used to supplement buoy-collected oceanographic data from around the world. Wildlife Computers tags report temperature profiles as “Profiles of Depth and Temperature” (PDT). A PDT is developed by measuring the external (environmental) temperature as a function of depth. On the Scout-Temp tag, profiles are generated using a broken stick algorithm since the animals may not travel directly from depth to the surface.

### Broken Stick PDT Data

While wet, the SCOUT-Temp tag records external temperature (environment) every second. These readings are stored in a table that is binned by depth with an 8 m resolution. Each depth entry has an accompanying timestamp. As the tag moves through the water, the most recent temperature recorded at a particular depth is retained as part of the “profile.” For example, if an animal moves up and down past 30 m in depth before returning to the surface, the tag records the temperature from the last time it passed 30 m to show in the profile. An expiration time is applied to all data in the table. This time limit is configurable from one minute to 45 days. Any data older than this will be ignored. Once the tag reaches the surface (reads “dry”) after also recording a depth deeper than the user-configurable minimum, the tag will generate a Broken Stick PDT message for transmission via Argos.

The broken stick profile is generated using the most recent data in the depth table that are recorded BEFORE a dry reading; consequently, all profiles are ascents from depth or ‘upcasts’ starting at the deepest depth in the summary period (Figure 1). A broken stick algorithm (piecewise linear regression) is used to choose the break points for the “profile” that will be transmitted. Generally, a broken stick algorithm is an iterative process that selects data points of maximum difference between the “original data” and the “profile.” The data are reconstructed by linear interpolation between the current point, and points selected during the previous iterations. The first and last points are forced to be the minimum and maximum depths, with another breakpoint forced to occur at the bottom of the Mixed Layer (shallowest depth prior to the temperature dropping 0.5° C from the temperature at the surface). The algorithm will then identify eight more break points for the profile using the iterative process described above.

The transmitted message will contain the depth-temperature data from each point in the broken stick profile, and will also include the age of the oldest data point (to the nearest 15 minutes). This is reported in order to detect possible horizontal movement between water bodies. Each entry is also flagged as a discontinuity if the time between consecutive depths in the profile is more than 60 minutes.

# SCOUT-TEMPERATURE – CONTINUED

Depth is transmitted in units of 8 m and temperature in 0.1° C steps from -5° C to 40° C.

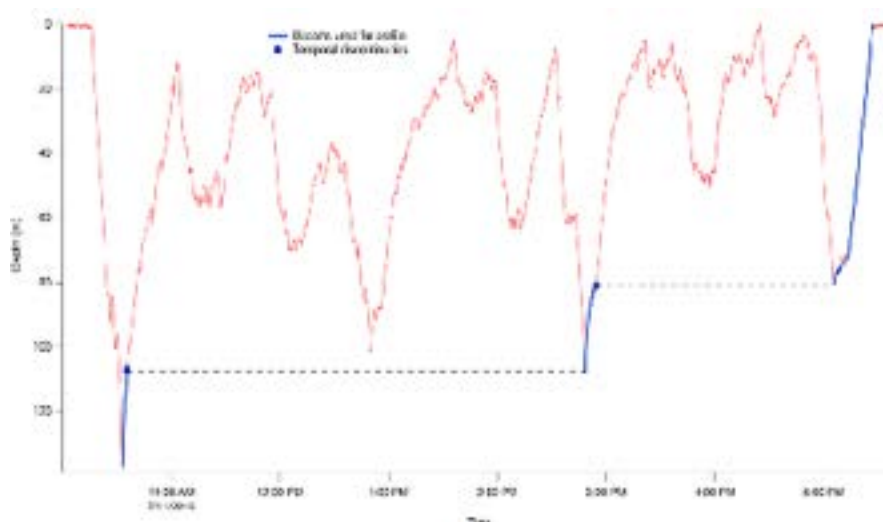


Figure 1—The transmitted profile uses the most recent temperature readings at each depth (blue). This means that the deeper depths will be flagged as having a temporal discontinuity since they only occurred earlier in the summary period and the last ascent to the surface did not contain depths deeper than 80 m.

## ECD—Depth

During each summarization period, the tag builds an Empirical Cumulative Distribution (ECD) of depth and temperature, which are sampled every two seconds. These distributions describe the independent probabilities that the depth and temperature will have a value  $\leq X\%$ . In other words, if the minimum depth reported is 0 m and the 25% depth ECD has a value of 15, then 25% of that summary period was likely spent between 0 – 15 m.

The data are reported in the ECDHistos.csv file, which contains the minimum and maximum observed values, as well as the 25%, 50%, and 75% distribution values for depth and temperature. Depth is reported in 1 m increments, temperature in 0.1°C increments.

## Mixed Layer

The mixed layer (ML) is a “layer” in the water column where active turbulence has homogenized the temperature over some depth ranges. The surface mixed layer is a layer where this turbulence is generated by winds, heat fluxes, or processes like evaporation or sea ice formation. The SCOUT-Temp tag reports the percent of time the tag was in the ML and the number of dry readings that occurred during the summary period. Additionally, it reports the minimum and maximum ML temperatures, the deepest depth considered as part of the ML, and the minimum and maximum depths recorded during the summary period.

## Locations

SCOUT-Temp records both Argos and Fastloc® GPS locations. The locations are transmitted via the Argos satellite system.

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