Bornemann, Horst (2003) ARGOS - Description of method, Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, hdl:10013/epic.26907.d001

Method

ARGOS

ARGOS is a satellite-based location and data collection system reserved for environmental applications. It is operated by CLS (Collecte, Localisation, Satellites), a CNES subsidiary near Toulouse, France, and by Service Argos, Inc., a CLS subsidiary in Largo, near Washington, DC, USA. Several types of ARGOS transmitters are designed to provide marine mammals' at-sea locations by measuring the Doppler shift on the transmitter signals. ARGOS categorizes locations by accuracy into classes (B, A, 0, 1, 2, 3). The classes are based on satellite/transmitter geometry during message reception, and transmission stability. The location classes are denoted as

0 = manually entered location

1 = interpolated location

2 = ARGOS location class B; no estimate of location accuracy

3 = ARGOS location class A; no estimate of location accuracy

4 = ARGOS location class 0; estimated location accuracy >1000 m

5 = ARGOS location class 1; estimated location accuracy 350 m – 1000 m

6 = ARGOS location class 2; estimated location accuracy 150 m – 350 m

7 = ARGOS location class 3; estimated location accuracy ≤150 m

Locations classified as invalid by ARGOS (denoted as ARGOS location class Z) are discarded. For further details on the ARGOS system refer to ARGOS user's manual online, www.cls.fr, and www.argosinc.com.

Extraction and Processing of our data is done by OPTIMARE Sensorsystems AG. All data relayed from ARGOS satellite transmitters are being received on file via the CLS data distribution system daily. ARGOS Filtering algorithms were changed from least squares to Kalman in November 2011. The raw ARGOS data files of Wildlife Computer units are being processed and locations extracted using the SATPAK 3.0 software package of Wildlife Computers. SATPAK also decodes the diverse behavioural parameter messages dealing with the diving and surfacing of marine mammals. Special software programmed by Optimare Sensorsystems AG aggregates the data in order to make them fit into the routines of PANGAEA. All data inside PANGAEA are aggregated referring to an "event label". The event label as used in Marine Mammal Tracking contains information such as where, when, and species descriptors; e.g. DRE1998_cra_a_m_01 is decoded as Drescher Inlet 1998 crabeater seal adult male 01 of the campaign. All metadata information following each data set title allows for immediate transparency of data set and content.

Location files denoted as At-surface *location* on spot (DSB) may contain the ARGOS-flag only. Data processing for this information may differ between manufacturers, though the information principally derives from the same data sources denoted as dispose and diagnostic files. SDR data processed via SATPAK software merge locations from both ARGOS files, while others rely on the dispose location file.

In order to assign a location to each data transmission, locations are being calculated based on the six-hour sampling periods of the satellite-relayed data loggers. Timing of these six-hour periods is user-defined to allow coverage of "night", "dawn", "day" and "dusk", and matches with the start of each of the four six-hour histogram periods of summarized behavioural data collected per day. The "Further Details" section of each event label provides information on how Local Time corresponds to UT, where applicable.

Given locations always correspond to the ARGOS location class with highest accuracy within a six-hour period. If more than one location fix is on par with the same accuracy within a period, the location closest in time to the middle of the interval is being selected. To remove locations barring a substantial error, an iterative forward/backward averaging

filter algorithm described by B.J. McConnell, C. Chambers and M.A. Fedak (1992), Antarctic Science 4(4):393-398, was applied. Locations exceeding a conservatively estimated maximum velocity of 3.50 ms^{-1} (12.6 kmh^{-1}) are therefore rejected. When applying the filter algorithm to data on emperor penguins, locations exceeding a maximum velocity of 4.17 ms^{-1} (15.0 kmh^{-1}) are rejected. Positions are interpolated where data transmission lack location fixes.

Data collected by SMRU Satellite Relayed Data Logger Series 7000 or higher have not undergone the same velocity filter. These data have been subjected to a filter defined by the SMRU. Due to an interpolation process defined by SMRU, data derived from their devices contain no ARGOS flag. All locations are therefore an approximate position for the end of a dive, interpolated along the track joining the filtered positions either side of the dive in time. For further details see www.smru.st-and.ac.uk.

We use ARGOS satellite transmitters of several manufacturers. It is therefore imperative to read the "Further details" section of each event label prior to data retrieval and analyses. The section summarizes the hardware configuration and the user-defined settings upon deployment. For technical specifications on hard- or software configurations of the diverse satellite transmitters refer to the web pages of the respective manufacturers at www.seimac.com, www.sirtrack.com, www.smru.st-and.ac.uk, www.telonics.com, or www.wildlifecomputers.com.