

deep-ocean thermometry using IMS hydroacoustic arrays

We develop a method to retrieve phase-velocity in the SOFAR channel between two neighboring IMS hydroacoustic arrays (HA) for the purpose of monitoring deep-ocean temperature variations which are sparsely sampled. Previous studies (Wolf et al., 2015; Evers et al., 2017; Sambell et al., 2019) have used an ambient acoustic field cross-correlation approach to resolve lag time as a proxy for temperature. Classical interferometry is not possible since the ambient acoustic field is not sufficiently equipartitioned. Moreover, as IMS HA are linked to a shore facility on a nearby island, part of the field is blocked, intrinsically preventing uniform illumination. In addition, such an approach is sensitive to mechanical interactions with the hydroacoustic sensor through the anchoring system to the ocean floor, thus resolving the surface wave propagation velocity instead of the water column acoustic propagation velocity.

In this study, we use acoustic signals from impulsive events, i.e., earthquakes and volcanic eruptions, that have a direct line of sight to two HA on either side of the shore facility island. We use array processing to: (1) distinguish between mechanical interactions with the hydroacoustic sensor and pressure-wave interactions due to acoustic propagation in the water column and the SOFAR channel, and (2) Retrieve wavefront parameters and beamform in the back-azimuth direction. In the next stage we cross-correlate 16 traces ($(3 + 1)^2$; 3 elements/array + 1 bestbeam, 2 arrays) using only the part of the signal associated with SOFAR channel propagation to retrieve lag time. We correct for the back-azimuth offset relative to the great circle path connecting the two arrays and calculate the temperature.

Primary author: SMETS, Pieter (KNMI - Royal Netherlands Meteorological Institute)

Presenter: SMETS, Pieter (KNMI - Royal Netherlands Meteorological Institute)

Track Classification: 2. Data analysis and signal processing methods for CTBT verification purposes