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# Three-dimensional parabolic equation models of the acoustic coverage of the CTBT hydrophone station at Crozet

Mario Zampolli (1), Georgios Haralabus (1), Mark K. Prior (1), Kevin D. Heaney (2), and Richard Campbell (2)
(1) CTBTO, Vienna, Austria (mario.zampolli@ctbto.org), (2) OASIS Inc, Lexington, MA 02421, USA

Hydrophone stations of the Comprehensive Nuclear-Test-Ban Organisation (CTBTO) International Monitoring System (IMS), with the exception of one in Australia, comprise two triplets of submerged moored hydrophones, one North and one South of the island from which the respective system is deployed. Triplet distances vary approximately between 50 – 100 km from the island, with each triplet connected to the receiving shore equipment by fibre-optic submarine data cables. Once deployed, the systems relay underwater acoustic waveforms in the band 1 – 100 Hz in real time to Vienna via a shore based satellite link. The design life of hydroacoustic stations is at least 20 years, without need for any maintenance of the underwater system. The re-establishment of hydrophone monitoring station HA04 at Crozet (French Southern and Antarctic Territories) in the South-Western Indian Ocean is currently being investigated.
In order to determine appropriate locations and depths for the installation of the hydrophones a number of constraints need to be taken into account and balanced against each other. The most important of these are (i) hydrophone depth in a region where the sound-speed profile is mostly upward refracting and the Sound Fixing and Ranging (SOFAR) channel is not well defined, (ii) a safe distance from the surface currents which occupy the first few hundred meters of the water column, (iii) seabed slopes that enable the safe deployment of the hydrophone mooring bases, (iv) avoidance of regions of high internal tide activity, (v) choice of locations to optimize basin and cross-basin scale acoustic coverage of each triplet and (vi) redundancy considerations so that one triplet can partially cover for the other one in case of necessity. A state-of-the-art three-dimensional (3-D) parabolic equation acoustic propagation model was used to model the propagation for a number of potential triplet locations. Criteria for short-listing candidate triplet locations were based on acoustic coverage towards the North and South, as well as overall acoustic coverage, taking into account different scales of source strength. An increase in the predicted area coverage compared to predictions based on 2-D modelling was observed and attributed to diffraction around sharp localized features such as islands or sea-mounts.