

EGU21-7025

<https://doi.org/10.5194/egusphere-egu21-7025>

EGU General Assembly 2021

© Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.



High-fidelity ocean seismo-acoustic propagation modelling for signal interpretation at the CTBT IMS hydroacoustic stations

Peter Nielsen¹, Mario Zampolli¹, Ronan Le Bras¹, Georgios Haralabus¹, Kevin Heaney², Emanuel Coelho², Jeffrey Stevens³, and Jeffrey Hanson³

¹Preparatory Commission for the Comprehensive Nuclear Test-Ban-Treaty Organization, VIC, P.O. Box 1200, 1400, Vienna, Austria

²Applied Ocean Sciences, 11006 Clara Barton Dr., Fairfax Station, VA 22039, USA

³Leidos, Inc., 10260 Campus Point Drive, San Diego, CA 92121, USA

The Comprehensive Nuclear-Test-Ban Treaty's (CTBT) International Monitoring System (IMS) is a world-wide network of stations and laboratories designed to detect nuclear explosions underground, in the oceans and in the atmosphere. The IMS incorporates four technologies: seismic, hydroacoustic and infrasound (collectively referred to as waveform technologies), and radionuclide (particulate and noble gas). The hydroacoustic component of the IMS consists of 6 hydroacoustic stations employing hydrophones suspended underwater near the axis of the Sound Fixing and Ranging (SOFAR) channel in the oceans and 5 near-shore seismic stations, called T-phase stations, located on islands or continental coastal regions. The T-phase stations are seismometers emplaced near the shore with the aim of detecting hydroacoustic signals that couple into the Earth's crust near the coast. The main purpose of these hydroacoustic facilities is to detect nuclear test explosions in the oceans or near the surface of the oceans. Hydroacoustic signals propagate in the oceans very efficiently (little attenuation) and therefore the relatively small number of hydroacoustic stations suffice to cover most of the world's oceans. However, interpretation of recorded signals even from known events can be difficult, since these signals propagate over very long distances. The ocean seismo-acoustic signals may on a global scale be affected by three-dimensional refraction, reflection and diffraction before arrival at a hydroacoustic station. In addition, ocean acoustic signals undergo a complex conversion to in-ground seismic signals when interacting with coastal regions that may modify signal features and evidence related to an explosion in the ocean before arrival at a T-station. The CTBTO has an ongoing effort to improve automatic detection, classification and localization of events, and to assist human analysts in interpreting these complex signals by incorporating knowledge obtained from high-fidelity seismo-acoustic modelling capabilities in the processing procedures. This presentation provides an overview of this project including justification of the choice of signal modelling approaches and validation of the models to fulfill accuracy criteria relevant for CTBTO. Examples of seismo-acoustic signal computations produced for inter-model comparisons and for assessing the relevance of such modelling capability to real operational scenarios are shown. Envisaged approaches for exploiting the complex modelling results and observations to improve the performance of the data processing are also presented.

