Geophysical Research Abstracts
Vol. 21, EGU2019-5186, 2019
EGU General Assembly 2019

A regional underwater soundscape forecasting system

Jose M. Gonzalez-Ondina, Georgy Shapiro, and Francesco Devoto
University of Plymouth, School of Bilogical and Marine Sciences, Plymouth, Devon, United Kingdom
(gshapiro@plymouth.ac.uk)

Over recent years, underwater noise has increased and is considered to pose a significant threat to the marine ecosystem. As a consequence, several intergovernmental organizations, including the Convention on Migratory Species (CMS), the International Maritime Organization (IMO) and the European Commission, have recognised the anthropogenic underwater ambient noise as pollution, identified as descriptor 11 in the EU Marine Strategic Framework Directive.

Human activities in the oceans like shipping, construction, sonar use, etc. produce noise that propagates underwater. As these activities have proliferated in the last decades, the human-generated underwater ambient noise has also increased. In addition, there is growing evidence of the detrimental effects of anthropogenic underwater noise on marine life. High levels of ambient noise can affect the communication and echolocation of marine mammals, body malformations of fish and invertebrates, higher egg mortality or developmental delays and even increased mortality of zooplankton. An important source of underwater noise is shipping. In recent decades, the number of ships has increased significantly; for instance, since 1980 the world merchant fleet has increased almost three-fold.

The full underwater acoustic wave equation requires high resolution 3D meshes, so its solution is only possible for domains much smaller than the ones needed in real applications. To overcome this limitation, several simplified acoustic propagation models have been proposed including the energy flux theory. As it is usually the case, there is a trade-off between computation speed and model accuracy.

Additionally, for regional models, it is difficult to obtain accurate data to feed the model, such as bathymetry, seabed characteristics, water temperature and salinity, and ship locations. However, since the ambient noise at any point is the incoherent sum of the sound produced by tens or even hundreds of ships, if all these errors are fairly unbiased, the final noise level estimate can be accurate for practical purposes.

We present a regional, vertically integrated computational model that computes background underwater noise in a very fast and efficient manner, allowing to produce results in minutes on a typical desktop PC. Our model is based on the Weston (energy flux) model for sound propagation. The novelty of our approach is the development a "visibility" map technique for taking into account the blocking effect of land masses, e.g. islands and headlands. Visibility maps for each mesh node are precomputed for the domain and stored using Run Length Encoding (RLE). This technique avoids checking visibility between each pair of grid nodes and allows for very fast calculations. The noise source level of the ships is given by the modified Ross formula (Erbe et al., 2012) and for the ship location and velocity we have used the data from the Marine Traffic project. The new model is validated against the reference (more accurate but much slower) RAM model (Collins, 1995) for a frequency of 50 Hz in the area of the Arabian Sea and show a good agreement.