OBS Orientation from Ship Noise Polarization

Alister Trabattoni[1], *Guilhem BARRUOL[1], Richard Dreo[2], Abdel Boudraa[2], Fabrice R. Fontaine[3]

1. Institut de Physique du Globe de Paris, Sorbonne Paris Cité, UMR CNRS 7154, Paris France, 2. IRENav, EA 3634, BCRM Brest, CC 600, 29240 Brest Cedex 9, France, 3. Laboratoire GéoSciences Réunion, Université de La Réunion, IPGP, Saint Denis, France

In the frame of the RHUM-RUM experiment (Réunion Hotspot and Upper Mantle –Réunions Unterer Mantel, www.rhum-rum.net) 57 three-components, broad-band Ocean Bottom Seismometers (OBS) were deployed on the ocean floor around La Réunion from Nov. 2012 to Dec. 2013. The OBS, provided by the German DEPAS and the French INSU OBS national pools, were equipped with wide-band or broad-band three-components seismic and hydro-acoustic sensors.
We present a new approach for orienting the OBS horizontal components based on ship noise polarization analysis. Part of the RHUM-RUM network in the SW Indian Ocean was indeed located beneath a route of heavy marine traffic connecting SE-Asia and the South-Atlantic region, providing a unique opportunity to exploit these anthropogenic signals for geophysical purposes. Both hydro-acoustic and seismic spectra exhibit clear signals associated to vessels in the [1-50 Hz] frequency range, that can be detected several hours before and after their closest point of approach and showing clear Doppler effects.

In this study, we show that combining a ship known position provided by its AIS (Automatic Identification system) data and an OBS known location, it is possible to retrieve the OBS actual orientation on the ocean floor by using the ship noise polarization. We applied time-frequency polarization techniques on the three seismic components to automatically extract the frequency bands containing information relevant to the ship noise from the ambient, unpolarised noise. This allows estimating the accuracy of the horizontal orientation of the seismic components from a single ship measurement, that can be improved by using multiple ships passing in the vicinity of the OBS during its recording period. Based on the analysed data, this ship noise time-frequency polarization analysis provides a good precision in the OBS orientation, in agreement with our estimation determined independently from teleseismic body and surface wave polarization measurements (Scholz et al., GJI, 2017).

Keywords: Ocean Bottom Seismometers, Orientation, Ship noise, Polarisation

