



Ship Noise Time-Frequency Polarisation Analysis from Ocean Bottom Seismometers

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The RHUM-RUM project (Réunion Hotspot and Upper Mantle – Réunions Unterer Mantel, www.rhum-rum.net) allowed to deploy 57 three-components, broad-band Ocean Bottom Seismometer (OBS) on the ocean floor around La Réunion from Nov. 2012 to Dec. 2013. Interestingly, part of the network was located beneath a route of heavy ship traffic connecting SE-Asia and the South-Atlantic region. By combining the trajectories of passing ships - provided by AIS (Automatic Identification system) GPS data - with our geophysical data recorded on the ocean floor, we show that both hydro-acoustic and seismic spectral analyses exhibit clear signals associated to vessels in the high frequency range of our seismic data (between 1 and 50 Hz). Large cargo vessels are detected several hours before and after their closest point of approach and show clear Doppler effects.

By applying time-frequency polarization methods on the three seismic components, we automatically extract from the ambient noise the frequency bands containing information relevant to a ship noise, leading to accurate estimations of the horizontal polarisation. This spectral approach allows discriminating the different azimuths of simultaneous noise sources of as soon as they have non-overlapping frequencies.

We used such ship noise polarisation for retrieving the orientation of the OBS horizontal components on the ocean floor with respect to the geographic reference frame. Our estimation of OBS orientations are in good agreement with those determined independently from teleseismic body and surface wave polarization methods (Scholz et al., GJI, 2017). This time-frequency polarization analysis of ship noise provides a good precision in the OBS orientation. The precision is increased by averaging results over the numerous ship passing by.