Geophysical Research Abstracts
Vol. 13, EGU2011-7871, 2011
EGU General Assembly 2011

Understanding current induced noise on broadband ocean bottom seismometers using Computational Fluid Dynamics

Thomas Spenkuch (1), Nicholas Harmon (2), and Stephen Turnock (1)

(1) University of Southampton, Faculty of Engineering and the Environment, Southampton, United Kingdom (t.spenkuch@soton.ac.uk), (2) University of Southampton, School of Ocean and Earth Science, Southampton, United Kingdom (n.harmon@soton.ac.uk)

Seismology is the main tool for understanding the structure and dynamics of the Earth's interior. Yet, due to the extreme environment and remoteness of the deep ocean basins there is a lack of seismic station coverage in this setting which accounts for more than 60% of the Earth's surface. Within the past decade broadband ocean-bottom seismographs (OBS) have been developed that can be deployed onto the seabed from oceanographic vessels, record data autonomously for over a year, and be successfully recovered from the seafloor for data downloading. While the data quality for these instruments for the vertical component of ground motion approaches that of similar temporary broadband instrument deployments on land, the horizontal components, which record shear waves, are plagued by high noise levels as a result of tilting of the sensitive instrument sensor by ocean-bottom currents. The poor data quality of the horizontal components is a serious limitation for the subsequent data analysis, and greatly hinders our ability to study both the dynamics of the deep Earth's interior and fundamental tectonic processes that occur beneath the ocean floor, which produce earthquakes, volcanism and tsunamis.

One means of mitigating OBS horizontal noise is to stabilize the flow around the sensor. In this paper we test the hypothesis that a smaller profile hydrodynamically stable sensor package can yield significant improvement in horizontal component noise levels. We will achieve this goal by a combination of fluid dynamic analysis and numerical flow simulations to establish a set of innovative sensor package shapes. Special focus will be put in coupling of the sensor pack to the seafloor and the minimization of current interaction.

In deep water, ocean bottom current speeds are typically less that 1 m/s. We show using Large Eddy Simulation and Detached Eddy Simulation, that traditional sensor packages with spherical or cylindrical pressure housings 28-43 cm in height, in this flow regime, generate turbulent vortices. These vortices are generated and interact with the sensor with a period of a few seconds or longer at the periods of seismic interest (>1-100 s) thus degrading signal to noise. As a result, those traditional sensor package shapes are not optimal for minimizing rotations and tilting caused by horizontal motions in the water column. We investigate traditional pressure housings, such as cylinder and sphere and show their effect on the signal noise. Furthermore, we show that a shell-shaped package is less prone to vortex generation at the periods of interest and may be an optimal and cost effective configuration for future sensor package design.