

## **Challenges for continuous seismic record analysis.**

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Seismologists have for long considered that a large part of the records of the motion of the Earth surface consist in useless signals, generally denoted as noise. During the last years new observations contradicted this view and showed that a wealth of information on the deep Earth is actually hidden in this « noise ». An important source of continuous motion is related with the interaction between the solid Earth and its fluid envelopes (atmosphere and oceans). The so-called « microseisms » in the band from 3 to 20 sec of period is produced by the oceanic gravity waves while human activity has a strong effect at high frequency. Furthermore, internal sources, beside classical earthquakes, have been discovered in numerous regions of the world denoted as tremors and low frequency earthquakes. Imaging with purely passive sensors is based on evaluation of the response between two sensors from cross-correlation of ambient noise or earthquake ground motion. We discuss the expected precision of the technique for direct paths in presence of realistic distributions of noise sources. We extend this discussion to multiply scattered waves. We present applications of passive imaging with surface and deep body waves. Continuous records are also used to monitor the changes of seismic velocities affecting the crust, specifically the slight changes of elastic parameters at depth related to strain. We present examples of temporal changes associated with blast, earthquakes and slow slip events. Although changes in shallow layers have been observed for decades, changes at depth are more elusive. We discuss the depth sensitivity of mechanical changes to coda wave delays and decoherence . We present examples indicating that the actual changes associated with deformation at depth can be captured by seismological measurements. The susceptibility of the rock velocity is another parameter to characterize the state of deformation (fracturation, fluid pressure,..). The susceptibility is the ratio between the imposed change of stress and the change of speed. It could be a tool for the monitoring of the short-term evolution of rocks based on their response to known forcings. Continuous array recordings can also be used to detect slight coherent arrivals hidden in the ambient noise and produced by internal sources of short period waves. We present an example of detection of tremors and low frequency earthquakes related with slow slip events on a subduction plane. The precision of location and origin time of a large number of newly detected events can be used for improving the highly noisy GPS data and to reveal the unexpected intermittent nature of slip transients at depth.