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Wavefield analysis of the background seismic signal recorded at Volcàn de Colima, Mexico

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We have analyzed the background seismic signals recorded at Volcàn de Colima by four broad-band three-component seismometers in the period December 2005 – May 2006.
The basic spectral content is contained in the range 0.1-0.4 Hz. The main time-stable peaks are close to 0.15 Hz and 0.3 Hz, with the latter generally dominating. Independent Component Analysis – a decomposition technique based on forth-order statistics working in time-domain - separates the seismic wavefield into two independent signals (Independent Components - ICs) labelled as IC1 and IC2. Their spectra are contained in the frequency range 0.05-0.20 Hz (IC1) and 0.2-0.5 Hz (IC2), respectively.
The amplitude of both the ICs ranges within about one orders of magnitude. Moreover, the amplitude of IC1 is higher than that of IC2 along almost all the data-set, except for some few-day-long intervals. We have defined this time-interval as Phase A, whereas the remaining part of the data-set is labelled as Phase B. Polarization vector of both ICs is generally stable and shallow. During Phase B the polarization vectors of IC1 and IC2 are equal within the error at three sensors and do not point towards the crater. At the remaining sensor (which is the closest to the crater), they are different, with the polarization vector of IC2 pointing stably towards the crater. We find a significant variation in the polarization parameters during a time-interval of about 12 hours occurring within Phase A. This time-interval has been labelled as Phase A1, whereas the remaining part of Phase A has been labelled as Phase A2. During Phase A1, the polarization vector of IC2 points to the crater at two sensors, while Phase A2 shares the same basic polarization properties of Phase B.
During Phase B and Phase A2, the cross-correlation functions relative to IC1 and IC2 have low-value maxima and the corresponding shifts are scattered. When Phase A1 occurs, the maxima of the cross-correlation function increase and the corresponding shifts between the sensors indicate that a coherent wave is crossing the array with an apparent velocity of about 3 Km/s.
We infer that the background seismic signal of Volcàn de Colima is principally generated by the microseismic noise, which induces preferential directions of oscillation possibly modified by local geological structures. The microseismic noise affects both IC1 and IC2, but the strongest effects are visible on IC1. On the other hand, another source is volcano-related and is located close to the crater. It has low energy and affects only IC2. Its effects are basically visible only in near field, except when the energy of the microseismic noise decreases and, consequently, this source extends its influence to a larger radius range. This volcanic source may be induced by the continuous degassing interacting with the volcanic plumbing structures.