Preliminary assessment of rainfall influence in an ongoing seismic velocity monitoring study at the experimental farm of University of Brasilia, Brazil

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Abstract

Seismic interferometry has emerged as an effective tool for the analysis of the subsurface, providing a range of applications from high-resolution imaging to time-lapse monitoring. Environmental factors, such as rainfall, can significantly modify near-surface conditions by altering soil's physical properties, including density, pore pressure, and shear moduli. These changes, primarily induced by water saturation, subsequently impact the propagation velocities of seismic waves. This study aims to evaluate the short-term influence of rainfall on seismic velocity monitoring, leveraging an ongoing study at Fazenda Água Limpa, an experimental farm of University of Brasília, located in the Distrito Federal, Brazil. For this study, a dataset of the first few dozen days of continuous ambient seismic noise recorded by two recently installed, three-component RS3D seismographs (*RaspberryShake®*) was used. The data, originally sampled at a rate of 100 Hz, were saved as daily *miniSEED* files. Following a pre-processing routine and cross-correlation of the vertical component ambient noise wavefield, the Moving-Window Cross-Spectrum (MWCS) method was applied to compute relative changes in seismic velocity (dv/v) within the coda portion of the resulting cross-correlation functions. Preliminary results delineate a relation between rainfall events and temporal fluctuations in seismic velocities. Notably, intervals of velocity decrease were consistently observed following, or concurrent with, rainfall events. This relationship is likely pronounced due to the high permeability of the region's soil, which facilitates rapid changes in the subsurface saturation state in response to rainfall, thereby indicating the sensitivity of seismic interferometry to these hydrologically induced processes. These short-term findings provide compelling initial evidence for a robust link between hydrological and geophysical phenomena in the context of seismic velocity monitoring. They underscore the necessity for further exploration into the interaction between these processes, with a particular focus on longer timescales within the study area. By enhancing our understanding of these dynamics, we can improve the interpretive potential of seismic interferometry and foster more effective applications in geophysical monitoring. This ongoing study represents a step towards that objective, and future results may offer valuable insights into the complex interplay of environmental factors and subsurface geophysics.