Investigation of the Magnetospheric-Ionospheric-Lithospheric Coupling on occasion of the 14 August 2021 Haitian Earthquake

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In the last few decades, the effort of the scientific community to clarify the issue of short-term forecasting of earthquakes has grown fast also thanks to the increasing number of data coming from networks of ground stations and satellites. This led to the discovery of several atmospheric and ionospheric anomalies statistically related to seismic activity, such as ionospheric plasma density perturbations and/or atmospheric temperature and pressure changes. With the aim to contribute in the understanding of the physical mechanisms behind the coupling between the lithosphere, lower atmosphere, ionosphere and magnetosphere during an earthquake, this paper presents a multi-instrumental analysis of a low latitude seismic event (Mw = 7.2), occurred in the Caribbean region on 14 August 2021. The earthquake happened during both super solar quiet and fair weather conditions, representing an optimal case study to the attempt of reconstructing the seismic scenario in terms of the link between lithosphere, atmosphere, ionosphere and magnetosphere. The proposed reconstruction based on ground and satellites high quality observations, suggests that the fault break generated an atmospheric gravity wave able to perturb mechanically the ionospheric plasma density, which, in turn, drove the generation of both electromagnetic waves and magnetospheric field line resonance frequency variation. The comparison between observations and the recent analytical Magnetospheric Ionospheric Lithospheric Coupling (M.I.L.C.) model confirms the activation of the lithosphere–atmosphere–ionosphere–magnetosphere chain. In addition, the observations of the China Seismo-Electromagnetic Satellite (CSES-01), which was flying over the epicentre some hours before the earthquake, confirms both the presence of electromagnetic wave activity coming from the lower ionosphere and plasma density variation consistent with the anomaly distribution of plasma density detected at ground by a chain of Global Navigation Satellite System stations located around the epicentre.