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Multidisciplinary analysis of near fault observatory data: example from the Alto Tiberina fault (Northern Apennines, Italy)

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Earthquakes, intricate natural events spanning multiple spatio-temporal scales, necessitate a comprehensive understanding of the physical and chemical processes driving a broad spectrum of fault slip modes. To achieve this, the acquisition of multidisciplinary and dense datasets is imperative. Near Fault Observatories (NFOs) play a pivotal role by offering spatially and temporally dense, high-precision near-fault data, fostering the generation of novel observations and innovative scientific insights. However, the integration and interpretation of diverse datasets from various disciplines (geophysics, geochemistry, hydrology, etc.) present challenges. These datasets often consist of time-series depicting the temporal evolution of different parameters, sampling diverse temporal and spatial scales, depths, and the distinct or cumulative effects of various multiscale processes. In this presentation, we share outcomes from the INGV multidisciplinary project MUSE: Multiparametric and mUltiscale Study of Earthquake preparatory phase in the central and northern Apennines. Our emphasis lies in showcasing the approaches developed to analyze, integrate, and extract new knowledge from the EPOS Near Fault Observatory TABOO. This state-of-the-art observatory, managed by the Istituto Nazionale di Geofisica e Vulcanologia (INGV), boasts a dense network with an average inter-distance of approximately 5 km between multidisciplinary sensors. These sensors, deployed at the surface and within shallow boreholes, include seismometrical, geodetic, geochemical, hydrological, and strain stations. The project's core objective is to unravel the interconnections between different observables and explore the causal relationships among them. We will present the datasets, the methods employed, and discuss the significance of considering the interaction between fluid and solid geophysical processes in comprehending earthquake phenomena. Additionally, we will articulate the potential innovative scientific products that can arise from this research, contributing to a deeper understanding of earthquake processes.