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A Jupyter Notebook devoted to a multiparametric investigation of the Amatrice-Norcia Italian seismic sequence 2016-2017

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Central Italy experienced a catastrophic seismic sequence that suddenly started on 24 August 2016 at 1:36:32 UTC with an Mw = 6.0 earthquake. Buildings damaged by the shaking of this event caused about 300 fatalities, and several towns (e.g., Amatrice, Accumuli, Arquata del Tronto) were destroyed entirely. A seismic sequence started from this event, and the largest event occurred more than two months later on 30 October 2016 at 6:40:17 UTC with magnitude Mw = 6.5. On 18 January 2017, a resurgent of the seismic sequence occurred with four events of magnitude equal to or greater than 5.0 in a Southern sector of the interested region (close to Capitignano/Montereale/Campotosto Lake). Then, the sequence followed a typical multi-year decay. The impact was huge, and from an energetic point of view, the event of 30 October 2016 was one of the largest recorded in the last 40 years in Italy.

Considering this particular case study, we developed a multidisciplinary and multiparametric Jupyter Notebook which can be run, e.g. in a Virtual Research Environment (VRE). The Open Source Code and friendly environment of Jupyter Notebook permit future users to adopt the same VRE to study other earthquakes.

The Jupyter Notebooks retrieves data mainly from the European Plate Observing System (EPOS) platform (Bailo et al., 2023, https://doi.org/10.1038/s41597-023-02697-9), integrating with other sources such as climatological archives and *Swarm* magnetic satellites of European Space Agency (ESA). EPOS is a European research infrastructure devoted to understanding plate tectonics through multidisciplinary and multiparametric studies. EPOS has already implemented a portal (https://www.epos-eu.org/dataportal, last accessed 10 January 2024) where users can retrieve data grouped into 10 disciplines (Thematic Core Services – TCS).

The Italian seismic sequence interests the extensional plate typical of the Central Apennine Mount Chain, and multiparametric data can help to understand the physical and chemical processes that could occur before and during the earthquake. The VRE relies on the results published by (Marchetti et al., 2019) but using updated algorithms such as the one used to study the Arabian Plate earthquake doublets (Ghamry et al., 2024, https://doi.org/10.3390/atmos15111318). We will also include other atmospheric investigations of specific parameters (e.g., Piscini et al., 2017, https://doi.org/10.1007/s00024-017-1597-8). Such previous studies propose evidence for

anomalies in the organised chain of lithosphere, atmosphere, and ionosphere that were identified before the Italian seismic sequence 2016-2017.

These preliminary studies contribute to investigating the relations between geo-layers in our Earth's system and the influence of seismic activity on them. Furthermore, this VRE adds a tool to the EPOS platform with potentially several applications, such as investigations of other significant earthquakes or other natural hazards, such as volcano eruptions.