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The preparatory phase of the Mw=7.5 Indonesia earthquake occurred on 28 September 2018

Dedalo Marchetti (1,2), Angelo De Santis (1), Alessandro Piscini (1), Loredana Perrone (1), Saioa A. Campuzano (1), Gianfranco Cianchini (1), Claudio Cesaroni (1), Luca Spogli (1), and Dario Sabbagh (1)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy (angelo.desantis@ingv.it), (2) Nanjing University of Information Science and Technology, Nanjing, China (002990@nuist.edu.cn)

A 7.5MW earthquake occurred on September 28th, 2018 at 10:02:45 UTC, in Indonesia (0.256°S 119.845°E; 20 km depth), which is a complex convergence region of many different plates (e.g. Australia, Sunda, Pacific, and Philippine Sea Plates). The epicentre was located in the middle of the Molucca microplate. The earthquake destroyed about 680,000 houses and, unfortunately, produced more than 2,100 victims and around 4,600 injured people.
In this study, we search for possible effects due to the Lithosphere Atmosphere Ionosphere Coupling (LAIC) as described by different models (e.g. Freund et al. JAES 2011, Kuo et al., JGR 2014, Pulinets and Ouzounov, JAES 2011), identifying a possible chain of processes that could be linked to the earthquake preparation phase.
Firstly we conduct an analysis of the earthquakes happened in this region from 5 years before and select different areas and depths as the region presents high seismic activity at depth until more than 500 kilometres. We then concentrate only on shallow lithospheric earthquakes (depth $\leq$ 50 km), finding a seismic acceleration preceding the mainshock. Furthermore, possible alterations in physical and/or chemical composition of the atmosphere (e.g. skin temperature, aerosol optical thickness) are investigated from meteorological/climatological dataset provided by European Center for Medium-range Weather Forecast (ECMWF) and NASA / MERRA2. We calculate the historical mean and standard deviation (based on about 38 years) for the investigated parameters for the area surrounding the epicentre and compare these values with the ones in the months prior to the Indonesia earthquake, concentrating on the values that overpass the two standard deviations. This method was already successfully applied to Central Italy earthquakes (Piscini et al. PAGEOPH 2017).
To investigate for possible ionospheric disturbances due to seismic activity we analyse the Swarm magnetic and electron density data during geomagnetic quiet time to avoid possible disturbances due to solar activity. We then investigate also the data provided from the recent launched mission China Seismo-Electromagnetic Satellite (CSES) ZhangHeng-01. To analyse the satellite data we apply different techniques. A technique is based on the comparison of the root mean square inside a small moving window compared with the root mean square of the whole track (i.e. inside +/-50 degrees of geomagnetic latitude) and it is intended to search for rapid variations of the parameter under investigation due, for example, to waves or particles emissions. This technique was already successfully applied to 2015 M7.8 Nepal earthquake (De Santis et al. EPSL 2017). Another applied technique is based on the analysis of the absolute values of the parameters (e.g. Y component of magnetic field, magnetic absolute scalar intensity, electron density) to search if their values overpass by a certain threshold (for example Ne greater than 30% the background in geomagnetically quiet time). With both techniques, we find interesting anomalies that will be discussed to understand their possible relationship with the impending earthquake, i.e. their eventual lithospheric source.
Finally, comparing the anomalies detected in lithosphere, atmosphere and ionosphere, we infer a possible chain of physical phenomena that could happen before the earthquake occurrence.