

## **Short-Term Perturbations Within the D-Region Detected Above the Mediterranean**

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The ionospheric D-region lies in the altitude range of  $\sim 60$ -95 km. This part of the atmosphere is highly sensitive to waves propagating upwards from the troposphere, either as pressure perturbations (gravity and acoustic waves) or electromagnetic (EM) perturbations from lightning discharges (resulting in EMPs, sprites, elves, etc.). These perturbations can affect the temperature, wind, species concentration, conductivity, and ionization in the upper atmosphere.

Very low frequencies (VLF) radio signals, generated by man-made communication transmitters, have been recorded using ground-based VLF receivers in Israel. These radio waves propagate over long distances within the Earth-ionosphere waveguide, reflected off the Earth's surface and the D-region. The characteristics of the received signals depend on several parameters along the path, but are fairly constant over short periods of time. In this study we present analysis of VLF narrowband data transmitted from Sicily, Italy, spanning one year, and detected in Tel Aviv, Israel. We show observations of the interaction between both pressure and EM perturbations from thunderstorms with the narrowband VLF signals aloft. We clearly observe short period ( $\sim 2$ -4 minutes) acoustic waves, longer period gravity waves ( $\sim 5$ -7 minutes periods), while also many transient events related to heating and ionization of the D-region. Comparisons with WWLLN lightning data show the potential link between tropospheric thunderstorms and D-region variability.