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Signatures of lightning activity in seismic records

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A thunderstorm with intense lightning activity swept through Hungary on 28th August, 2013 between 00:00-09:00 UTC from the west towards north-east. Characteristic signal patterns could be observed in the time series recorded by seismometers in Hungary during the time the thunderstorm was close to a recording station. The signal patterns occurred coherently both in the vertical and in the horizontal seismic records. The patterns are composed of a sharp spike and a longer lasting disturbance which followed the spike after a gap of several seconds. This disturbance was of increased amplitude and lasted for up to a few tens of seconds. Detection times of spikes in the seismic records were compared to occurrence times of lightning strokes in the thunderstorm. Information on the occurrence time, polarity, type (CG or IC), peak current, and geographical location (including height estimation for IC events) of lightning strokes was provided by the LINET lightning detection network which uses magnetic loop antennas sensitive in the VLF-LF radio bands. A single lightning stroke could be unambiguously associated with each spike in the seismic records. This one-to-one correspondence suggests that the spike was caused by the electromagnetic shock wave from the lightning return stroke. The longer lasting disturbance is, on the other hand, most probably the signature of the subsequent air pressure wave which induced ground waves, too. In more than half of the examined cases, the time between the spike and the detection of a wave packet (peak amplitude) in the disturbance matched the expected propagation time of sound waves between the source location given by LINET and the seismic station. The direct sound wave associated wave packet, however, was not always the first arriving one in the seismic disturbance which suggests that coupling of sound waves and ground waves may not only occur at the seismic detector. The poster shows case studies of lightning associated seismic records and also the correspondence between the source direction from the seismic signals and the lightning stroke location provided by LINET is demonstrated.