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Yield estimation of the 2020 Beirut explosion using open access waveform and remote sensing data

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We report on a multi-technique analysis using publicly available data for investigating the huge, accidental explosion that struck the city of Beirut, Lebanon, on August 4, 2020. Its devastating shock wave led to thousands of injured with more than two hundred fatalities and caused immense damage to buildings and infrastructure. Our combined analysis of seismological, hydroacoustic, infrasonic and radar remote sensing data allows us to characterize the source as well as to estimate the explosive yield. The latter ranges between 0.8 and 1.1 kt TNT (kilotons of trinitrotoluene) equivalent and is plausible given the reported 2.75 kt of ammonium nitrate as explosive source. Data from the International Monitoring System of the CTBTO are used for infrasound array detections. Seismometer data from GEOFON and IRIS complement the source characterization based on seismic and acoustic signal recordings, which propagated in solid earth, water and air. Copernicus Sentinel data serve for radar remote sensing and damage estimation. As there are strict limitations for an on-site analysis of this catastrophic explosion, our presented approach based on openly accessible data from global station networks and satellite missions is of high scientific and social relevance that furthermore is transferable to other explosions.