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Investigation of seismo-acoustic signals from the Baumgarten and Ingolstadt explosions in December 2017 and September 2018

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Within a year's time two heavy explosions occurred in Eastern Austria and Southern Germany, respectively. Both explosions were detected at close-by seismic networks and more distance infrasound arrays. While the Baumgarten explosion on 12 December 2017 was well recorded by the dense seismic AlpArray deployment showing only vague seismic phases but clear acoustic arrivals to distances of some 150 km, the second explosion, near Ingolstadt on 1 September 2018, exposed clear seismic phases at the nearby Gräfenberg Array (GRF) for distances to more than 100 km. Both explosions occurred at gas/oil processing facilities with the detonation near the surface above ground, and hence, infrasound signals are expected at regional acoustic arrays. For the Baumgarten explosion such a signal was found to the east in a distance of 230 km at a newly deployed array (PSZI) in Hungary, while for the Ingolstadt explosion equivalent signals are found not only at the IMS infrasound station I26DE 150 km away in the Bavarian Forest, but were also reported for more distant infrasound stations in the Czech Republic, Hungary and Romania.

For the Baumgarten explosion occurring around 7:45 UTC we found a signal at 7:58 UTC from Progressive Multichannel Correlation (PMCC) detection processing and Frequency-Wavenumber (F-K) analysis arriving at PSZI from an azimuth close to 300º and a duration of about 1-2 seconds. Due to the large deviation from the theoretical backazimuth (282º) we are applying 3D raytracing methods to evaluate if this residual can be explained by the atmospheric conditions, as implied by the European Centre for Medium-Range Weather Forecast (ECMWF) model.

For the Ingolstadt explosion, with an origin time at 03:11:45 UTC from seismic event location, GRF stations show clear Pg and Sg arrivals as well as a seismo-acoustic phase. For the co-located IMS stations GERES (seismic) and I26DE (infrasound) equivalent signals are found, with the infrasound signal matching the theoretical back-azimuth to the source in this case. For this explosion atmospheric wave propagation modelling is used as well to verify the parameters of the acoustic arrivals within a 150 km distance range. Finally we compare the seismic and acoustic features generated by both explosions.