

Complex propagation of explosion-generated infrasound revealed by the large-scale AlpArray seismic network

Thursday 27 June 2019 17:15 (15 minutes)

On September 1st, 2018 a devastating explosion occurred on the facility of an oil refinery near Ingolstadt, Germany. We analyzed data of 400 permanent and temporary seismic stations and find strong seismo-acoustic signals on more than 80 seismic stations. The infrasound signal is detectable on seismic stations within 10 - 400 km from the source, with 40 km spatial resolution. We confirm the explosion site both by the seismic and seismo-acoustic arrivals. Apart from seismic P- and S-waves, we identified three separate acoustic phases with celerities of 332, 292, and 250 m/s, respectively, each of which has a particular spatial pattern of positive detections at the ground. Seismo-acoustic amplitudes are strongly affected by the type of seismic installation but still allow insight into regional infrasound attenuation. Our observations likely represent tropospheric, stratospheric, and thermospheric phases. We performed 3D acoustic raytracing to validate our findings. Tropospheric and thermospheric arrivals are to some extent reproduced by the atmospheric model. However, raytracing does not predict the observed acoustic stratospheric ducts. Our findings suggest that small-scale variations had considerable impact on the propagation of infrasound generated by the explosion.

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Session Classification: T1.4 Interaction Among the Earth's Subsystems

Track Classification: Theme 1. The Earth as a Complex System