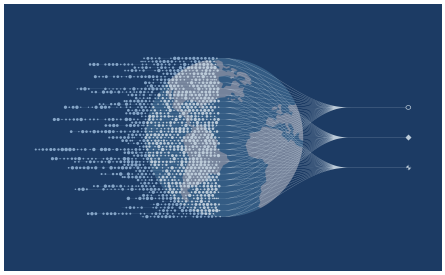

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-Acoustic Analysis of Near Surface Explosions in Europe

In the absence of active nuclear explosive testing, large chemical explosions provide an opportunity to test our ability to monitor for explosions over broad regions. Accidental explosions, most of them occurring near the surface, provide a good test for monitoring at low yield, where the seismic signals are further reduced due to the weaker coupling at shallow depths. Effective explosion monitoring needs to include event detection, location, identification, and source characterization. Lawrence Livermore National Laboratory (LLNL) in the United States and the Federal Institute for Geosciences and Natural Resources (BGR) in Germany are collaborating to analyze a series of near surface explosions in Europe. We will be considering a gas explosion in Ghislenghien, Belgium in 2004, munitions explosion in Euskirchen, Germany in 2014, gas explosion in Baumgarten, Austria in 2017, refinery explosion in Ingolstadt, Germany in 2018, and munitions explosion in Nea Anchialos, Greece in 2023. For each, we will be testing and refining various methods for signal detection (using seismic and infrasound), event location (including joint seismo-acoustic locations and relative relocation methods), event identification (using methods to discriminants, such as high-frequency P/S ratios), and source characterization (including depth-of-burial/height-of-burst estimation, acoustic yield estimates and, when possible, joint seismo-acoustic estimates).

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