Baumgarten gas accident - Seismologists "hear" the bang on earthquake sensors

The deadly gas explosion at the Baumgarten substation in December 2017 could be heard more than 150 km away - but not by humans. Researchers at the Institute of Meteorology & Geophysics of the University of Vienna have detected pressure waves from the gas explosion in the form of so-called infrasound - on highly sensitive sensors, which actually record the vibrations of earthquakes.

The devastating gas accident at the Baumgarten substation in December 2017 resulted in one fatality and briefly raised the gas price in Europe by more than 80%. After the incident became known, seismologists at the Institute of Meteorology & Geophysics of the University of Vienna searched specifically for possible signals of the explosion. The researchers are part of the European AlpArray project, which has deployed nationwide highly-sensitive seismometers across the Alps and beyond to explore the subsurface of the Alps and better understand earthquake activity - every 40 km a sensor is deployed in each direction the tremors of the soil. The University of Vienna operates thirty of these earthquake sensors in eastern Austria and Slovakia.

These earthquake sensors also recorded a clear signal of the Baumgarten gas explosion - up to 180 kilometers from Baumgarten. To the astonishment of the seismologists, however, the signal spread very slowly and could be observed almost anywhere north and east of Baumgarten. It quickly became clear that the earthquake sensors had measured the pressure wave of the gas explosion, which had spread mainly as an acoustic pressure wave through the atmosphere, even if it remained inaudible to humans. These pressure waves, called infrasound, are often observed after explosions or volcanic eruptions. They are also monitored by the CTBTO as part of nuclear verification for the detection of nuclear tests. Surprising for the seismologists, however, was how clearly these acoustic signals are coupled into the ground and thus become visible to the earthquake sensors - and it raises the exciting question of how many of the "seismic noise signals" are in fact due to acoustic signals, which do not results from underground sources.

Finally, meteorologists at the institute provided the clue to explain why the signal could only be detected to the north and east: In the hours before the gas explosion, a cold front from the west pushed over the east of Austria. This resulted in an extraordinary layering of air layers within the atmosphere: the air temperature did not decrease as usual with altitude; cold air was trapped on the ground - and with it the sound waves of the gas explosion. This special weather situation enabled a detection of the pressure wave in the wider area of Baumgarten. Strong wind from the west also ensured that the pressure wave was carried mainly to the north and east. Other infrasound waves were detected more than 100km away after ascending to a height of more than 30km (stratosphere).

The geophysicists simulated on the computer the expected propagation of the pressure wave on the basis of meteorologists' weather forecast models - and were able to show impressively that the seismometers recorded the signals of the gas explosion exactly where they could be expected from the atmosphere model. And although the measuring devices were at least 30 kilometers away from the distribution station, it was possible by means of the simulations to precisely determine the time of the explosion to the second - a result which also helped the provincial police of Lower Austria in clarifying the accident.