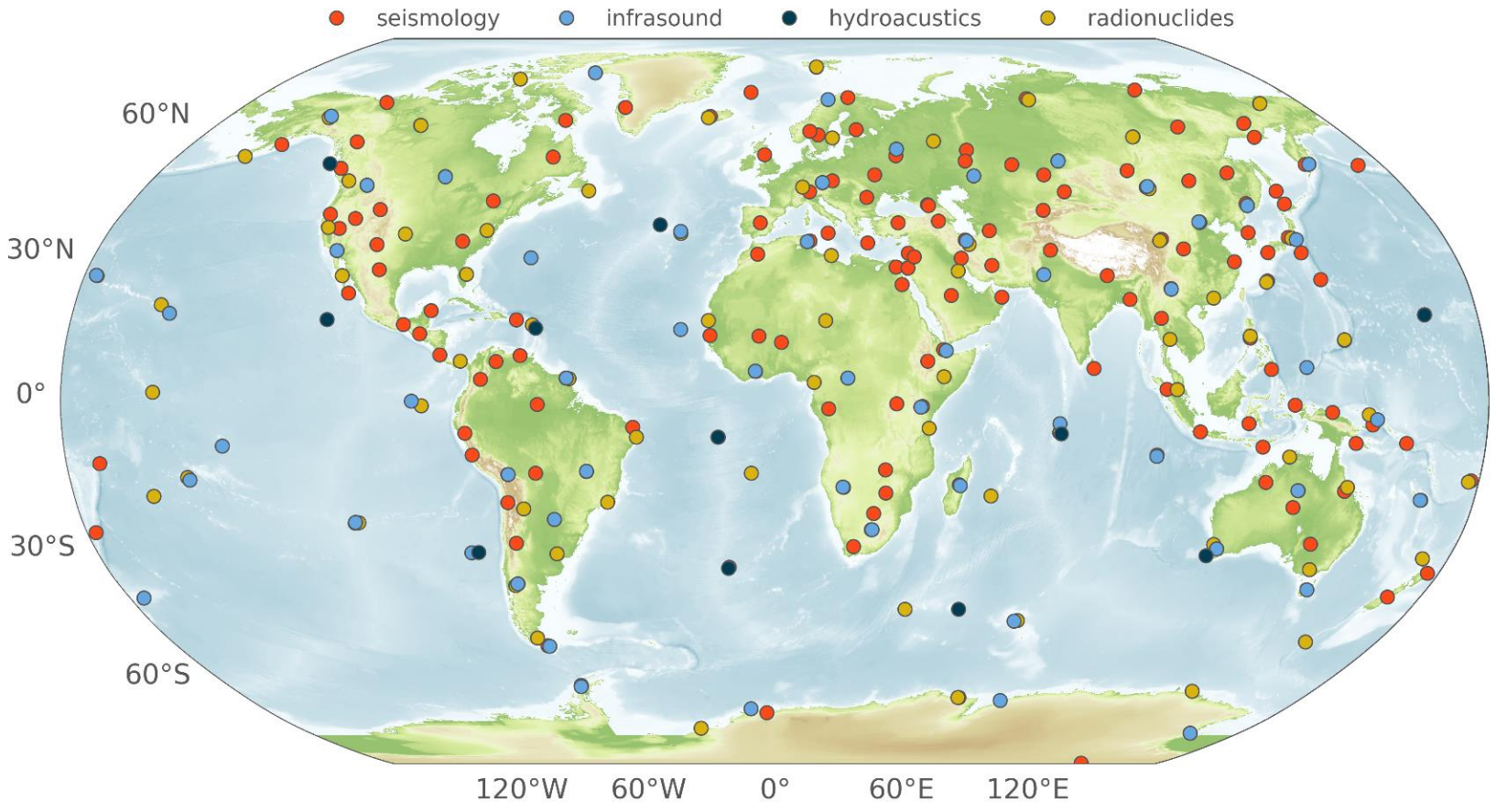
The International Monitoring System & The Chain of Verification

Seismology
170 Stations

Infrasound
60 Stations

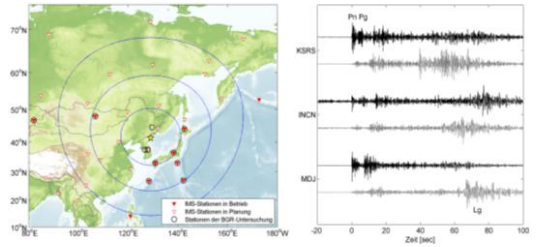
Hydro-acoustic
11 Stations

Radionuclides
80 Stations

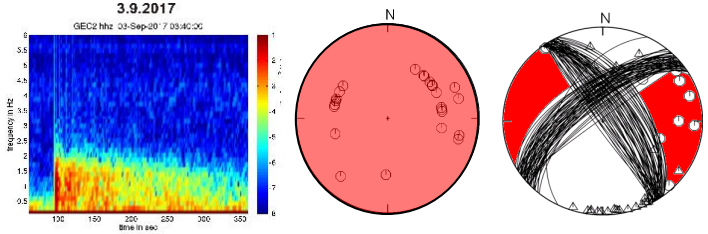


Chain of Verification

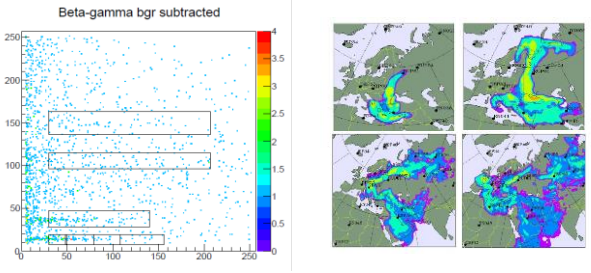
1. Detection (Where/When?)



2. Discrimination (Explosion?)



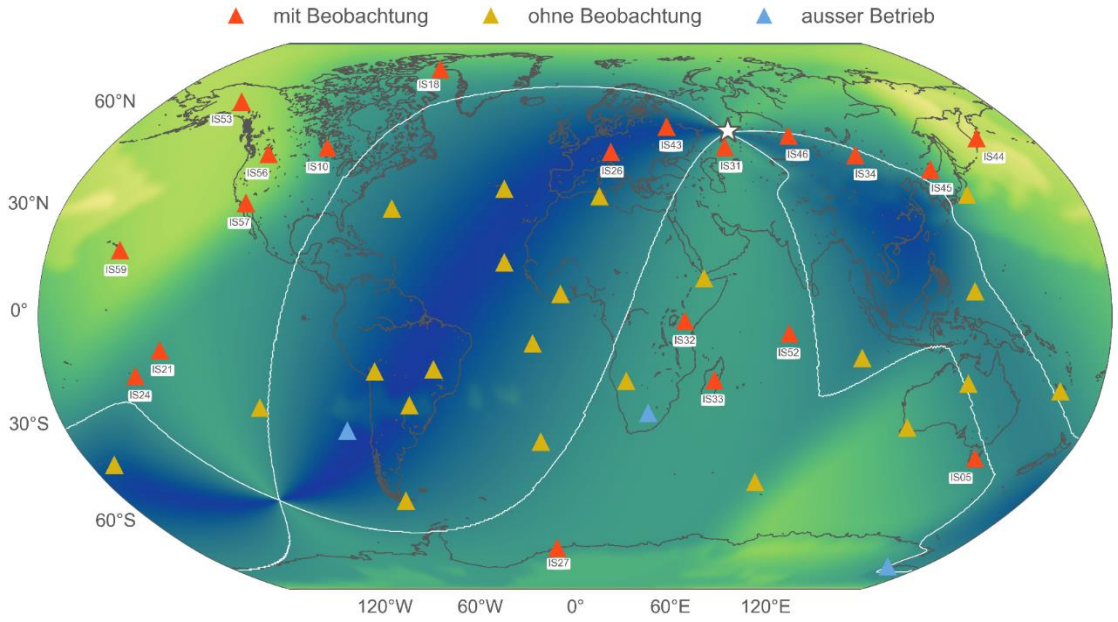
3. Identification (Nuclear?)



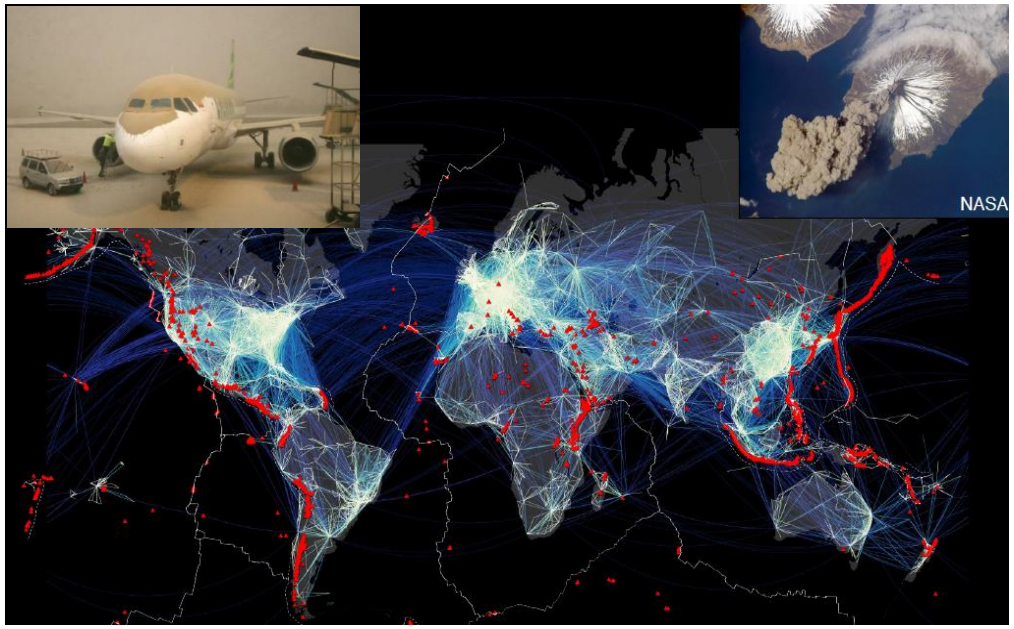
BGR Bundesanstalt für Geowissenschaften und Rohstoffe

Civil and Scientifc Applications of the IMS network I/II

World-wide infrasound recordings of the Chelyabinsk fireball



Mitigating volcanic hazards for civil aviation



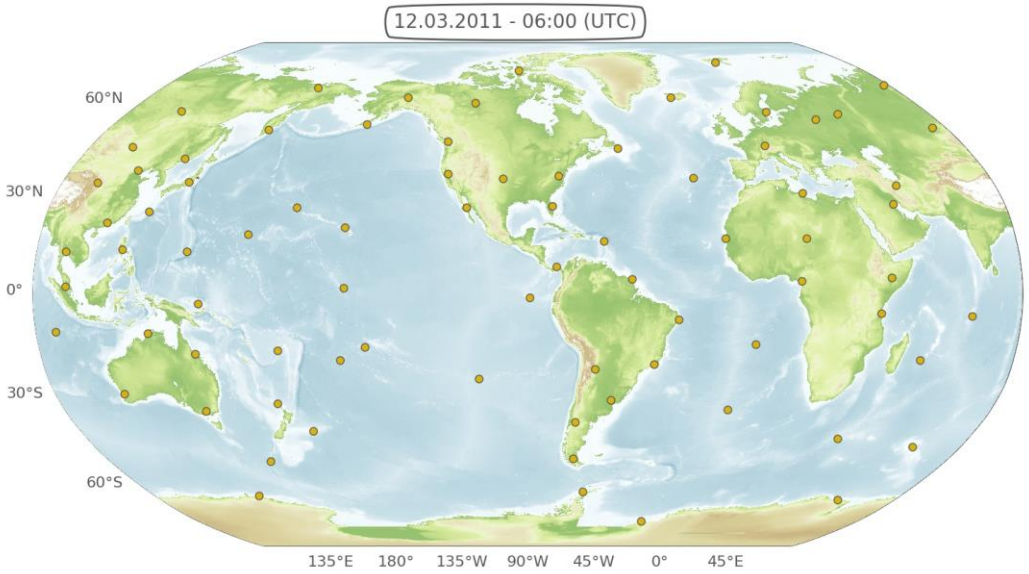
Source and Detections:

- Arrivals after 15 and 25 h @ BGR's Antarctica-Station IS27
- Up to 2.5 globe circumnavigations (IS53)
- Benchmark for global detection capability of the IMS
- Theoretical estimates using geometry, winds, site noise

- ~1500 active volcanoes worldwide in the past 10 ka
- Most volcanoes lack dedicated monitoring instruments
- Infrasound may supplement other monitoring techniques in remote areas poorly instrumented

Civil and Scientifc Applications of the IMS network II/II

Radionuclides from Fukushima, 2011



Civilian benefit:

- IMS-Data very valuable for situation assessment
- Successful prediction of dispersion

CTBT research questions:

- Source Localisation
- Potential IMS blinding for hidden tests

Ruthenium riddle over Europe, 2017

Airborne concentrations and chemical considerations of radioactive ruthenium from an undeclared major nuclear release in 2017

PNAS, Aug 2019

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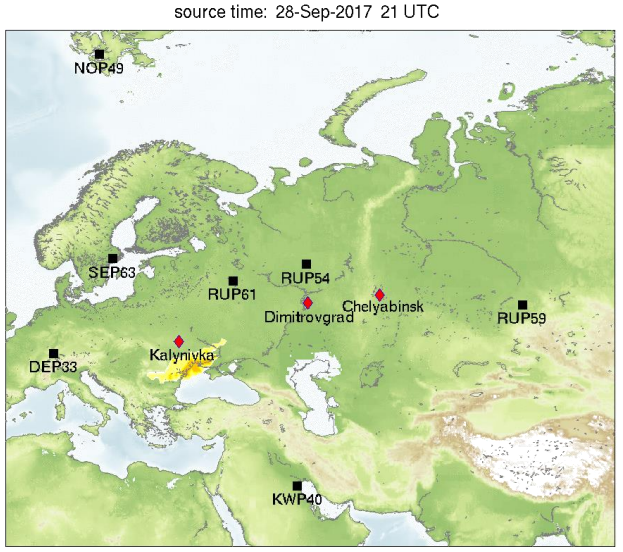
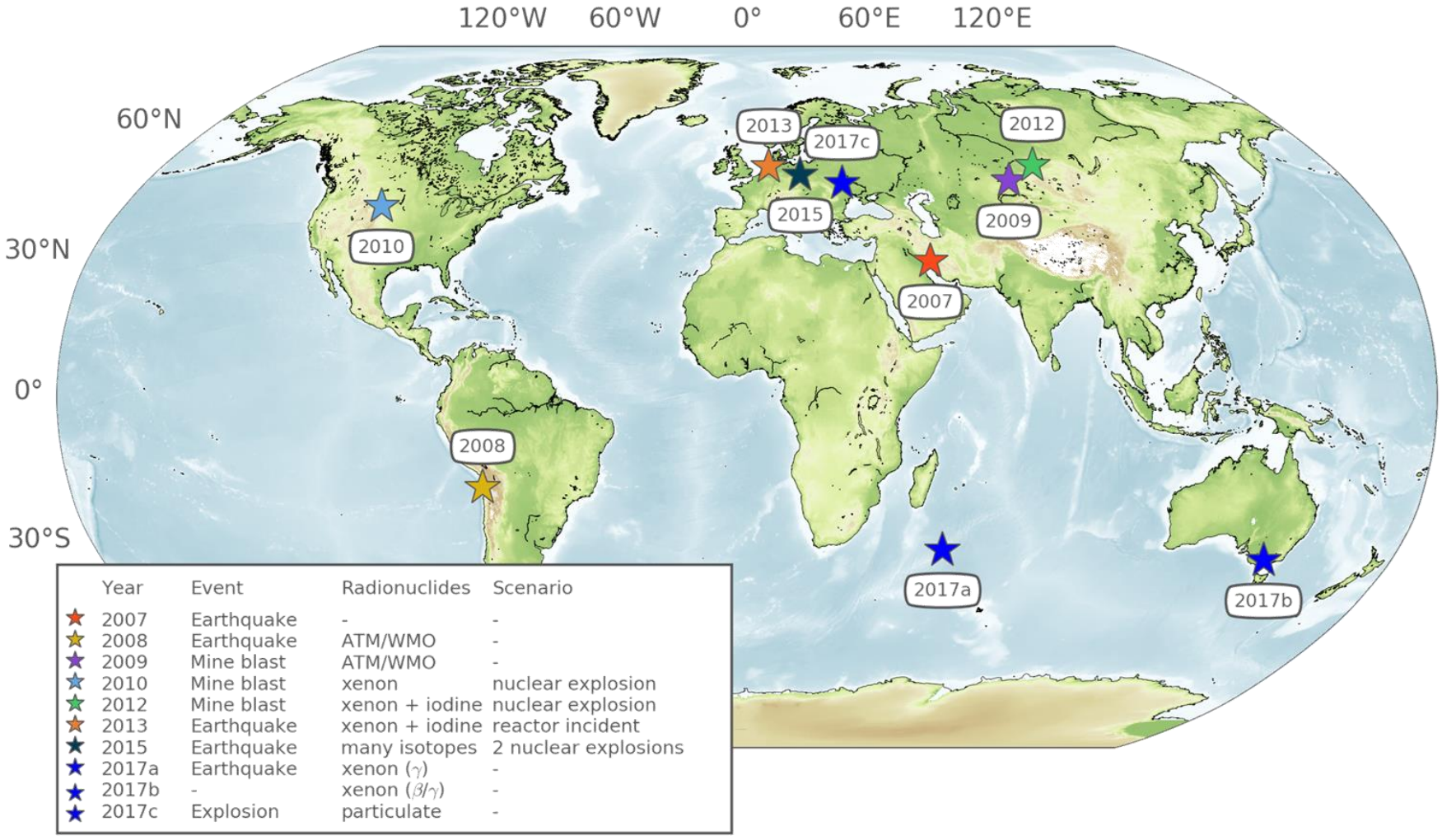


Backward ATM

10 „early“ samples
29-Sep to 04-Oct-2017
10 retro-plumes using HYSPLIT-GDAS 0.5°:
Prague, Ostrava, Vienna, Athens, Beograd, Stockholm, 4x IMS

National Data Centre (NDC) Preparedness Exercise (NPE)

- Simulates Treaty violations
- Real waveform events (REB)
- Simulated radionuclides release
- Challenging NDCs
- Testing capabilities
- Increasing complexity
- **NEW 2019:** ETA and FW
- Appropriate tool for analysing such events: **NDC-in-a-Box**



Year	Event	Radionuclides	Scenario
2007	Earthquake	-	-
2008	Earthquake	ATM/WMO	-
2009	Mine blast	ATM/WMO	-
2010	Mine blast	xenon	nuclear explosion
2012	Mine blast	xenon + iodine	nuclear explosion
2013	Earthquake	xenon + iodine	reactor incident
2015	Earthquake	many isotopes	2 nuclear explosions
2017a	Earthquake	xenon (γ)	-
2017b	-	xenon (β/γ)	-
2017c	Explosion	particulate	-

Monitoring Compliance with the CTBT – Contributions by the German NDC

Motivation:

- Presenting current Research and consulting activities in the field of CTBT
- Providing advice and expertise to policy makers, public and scientific community
- Presenting collaborations between BGR / German NDC und national partners

Topics:

- History of the CTBT in Germany;
- The Contributions to the IMS / CTBT monitoring network;
- The monitoring technologies: seismology, infrasound, hydro-acoustics, radionuclides;
- The North Korean Nuclear Tests from 2006 to 2016 (DPRK-1 to DPRK-5);
- The NPE exercises from 2007 to 2013;
- The Tohoku earthquake and tsunami and the Fukushima reactor accident in 2011;
- The Chelyabinsk fireball in 2013;
- About the quality of wavefrom products derived by the CTBTO/IDC;
- Using satellite observations in the CTBT context as a national technical mean;
- The role of OSI (On-Site Inspection) and SAMS (Seismic Aftershock Monitoring System) in the CTBT context.

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