Atmospheric Transport Modelling and Radionuclide Analysis for the NPE 2015 Scenario

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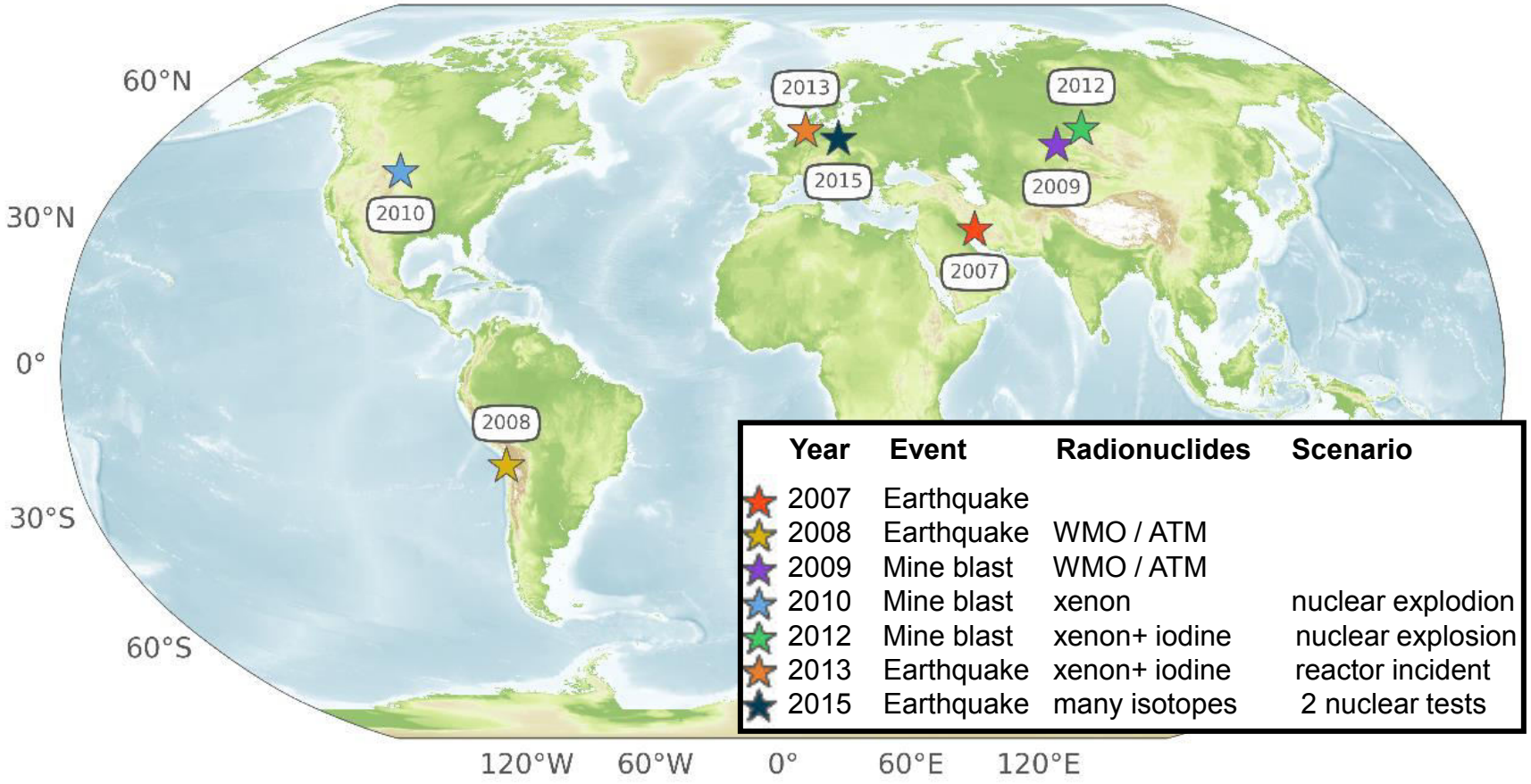
BGR Bundesanstalt für Geowissenschaften und Rohstoffe

National Data Center Preparedness Exercises (NPE)

Scenarios of (partly simulated) CTBT violations

- NPE scenarios consist of:
  - Real waveform event
  - Simulated radionuclodes
- Test of NDC procedures and IDC products
- International and interdisciplinary exchange
- Organized by BGR since 2007
- NPE 2015 created by international scenario team
- Artifitial spectra for the first time
- Supplementary information on request



Year	Event	Radionuclides	Scenario
2007	Earthquake		
2008	Earthquake	WMO / ATM	
2009	Mine blast	WMO / ATM	
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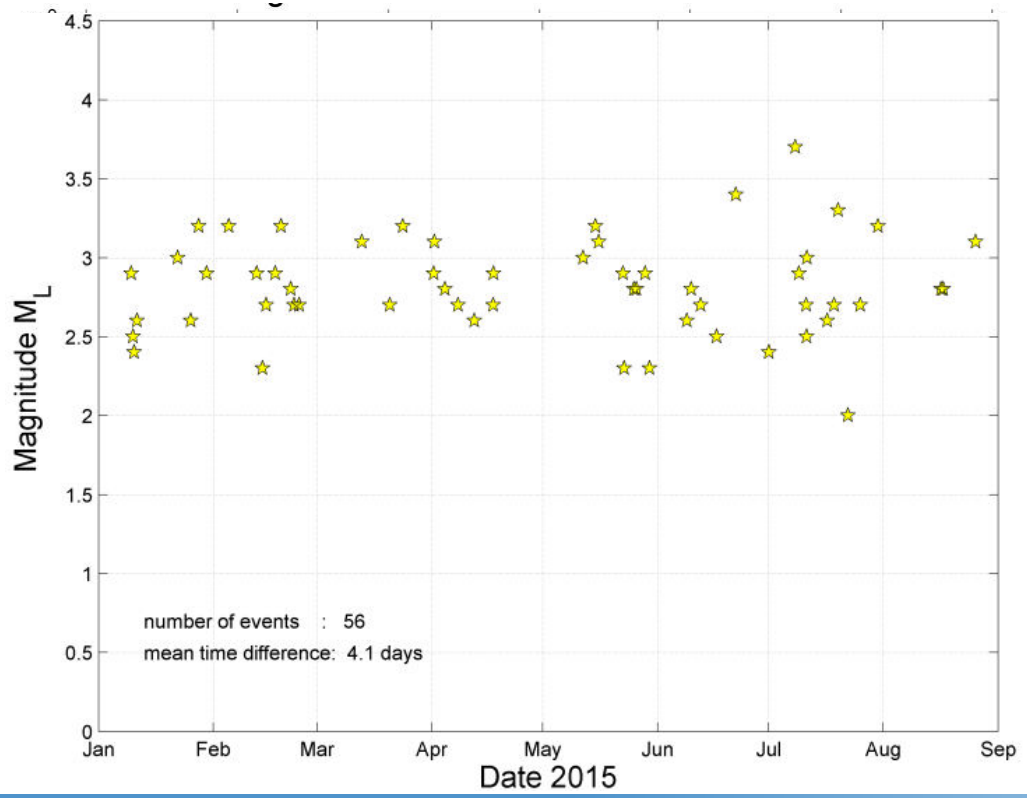
2013	Earthquake	xenon+ iodine	reactor incident
2015	Earthquake	many isotopes	2 nuclear tests

NPE 2015 Scenario – Monitoring & Verification task

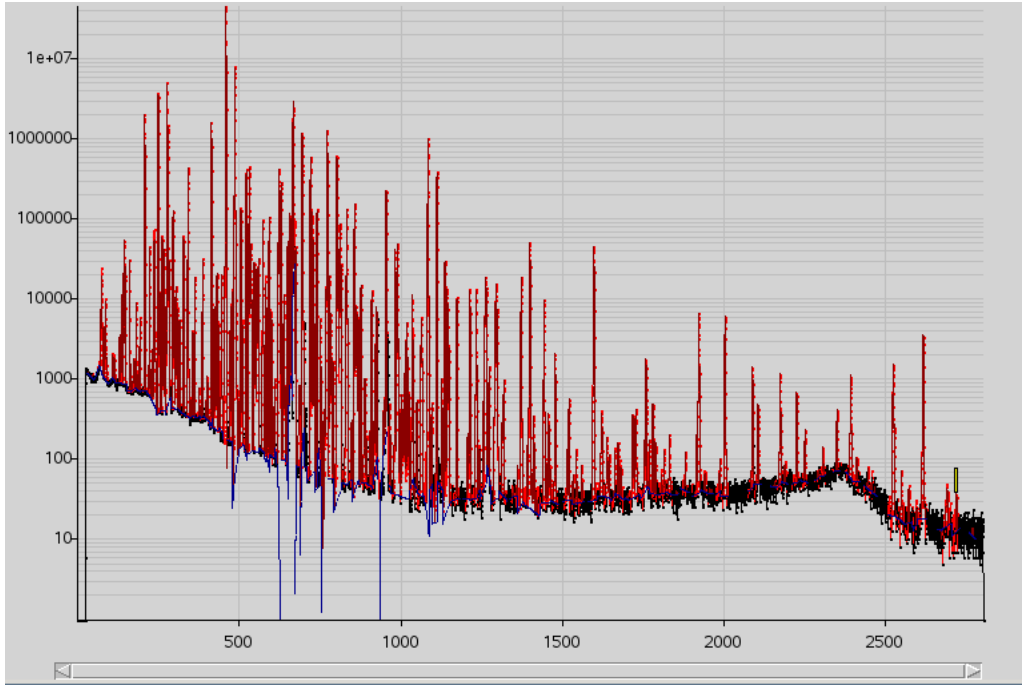
Seismological Framework

- Suspicious activtities in the fictitious state of ENPEDOR
- Monitor closely events in Nov/ Dec 2015
- Regular seismic activity in ENPEDOR



Radionuclide Scenario

- International control team choses waveform event as
- Forward ATM for radionuclides
- Generate artificial spectra



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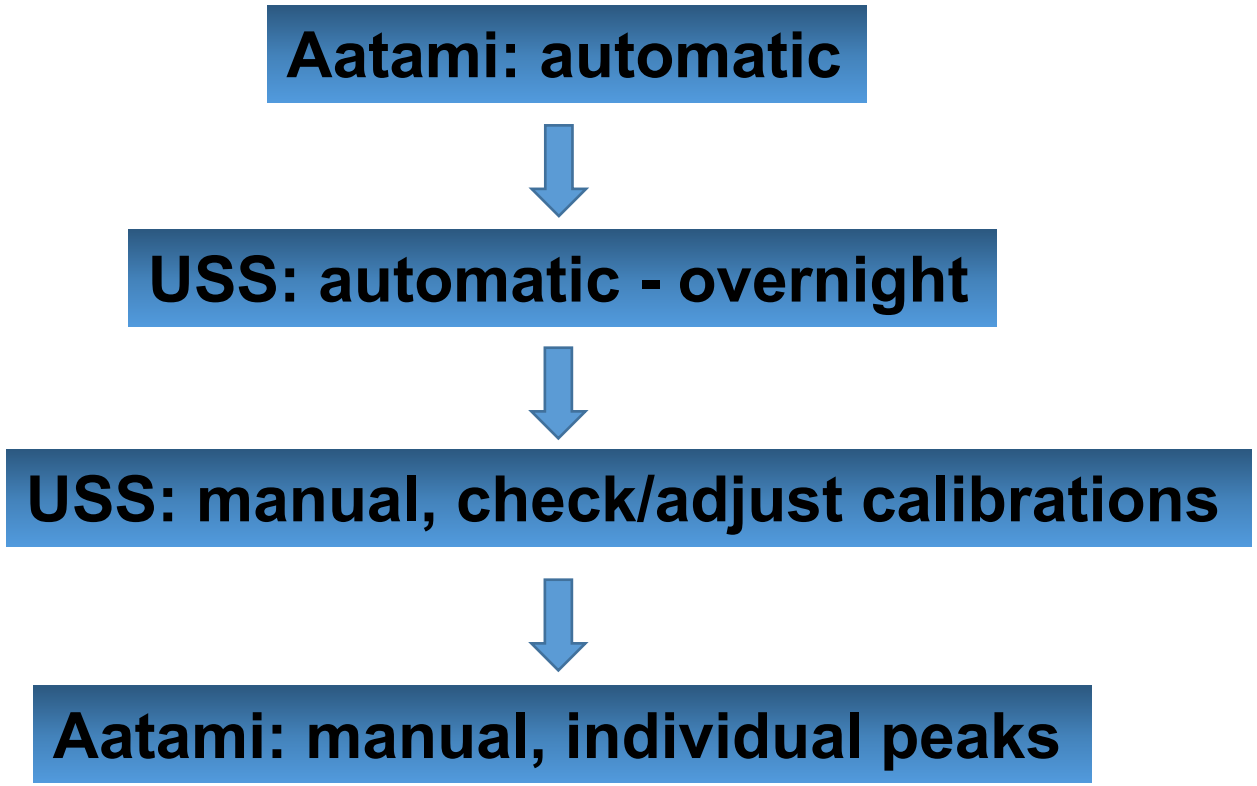
Radionuclide Analysis at BfS

Workflow



First findings

- Large number of spectra
- Large number of lines in spectra

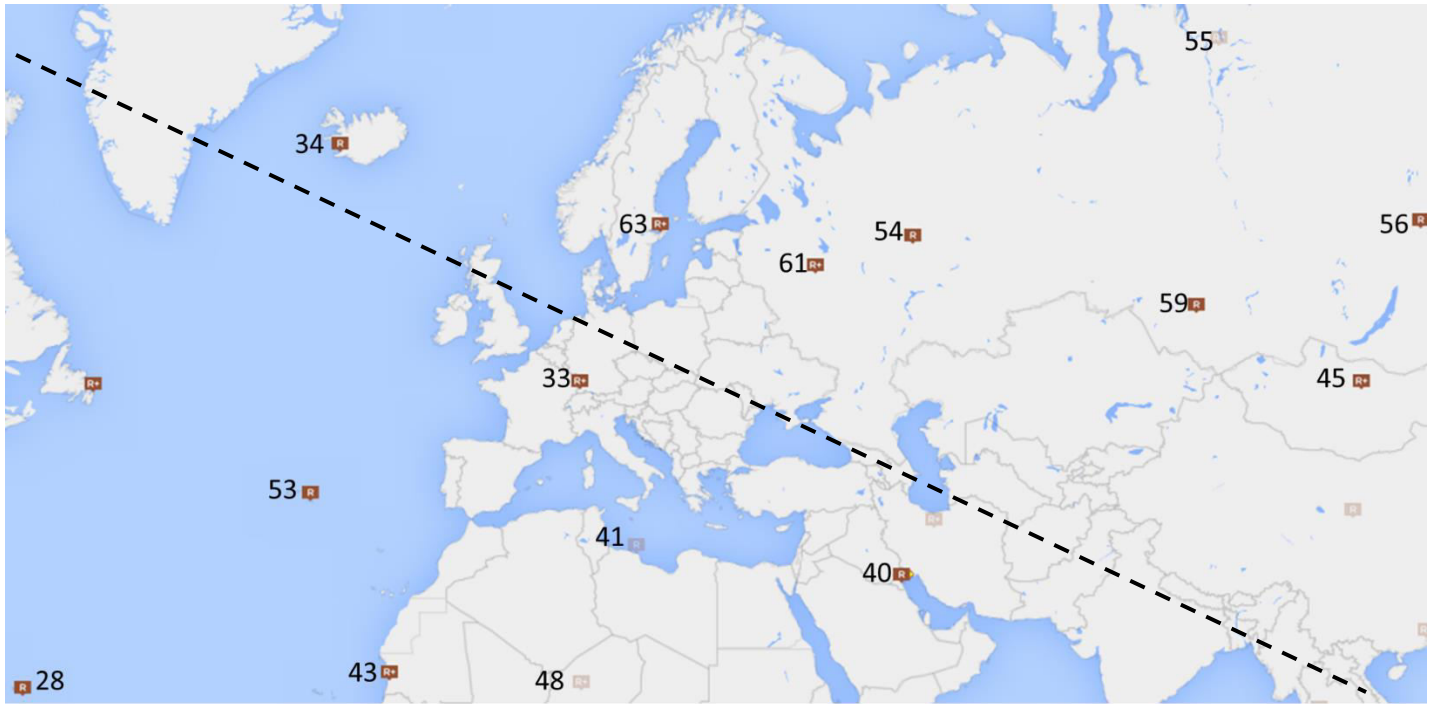
Issues encontered in some spectra with

- file format
- energy calibration
- Compton background

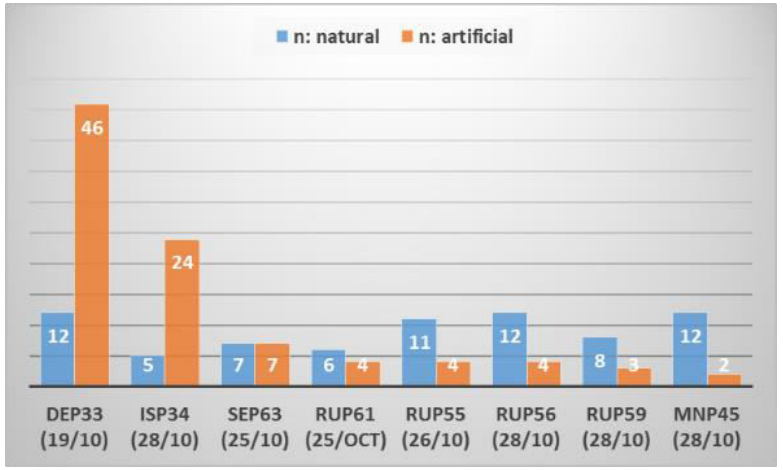
Radionuclide analysis at BfS – qualitative overall picture

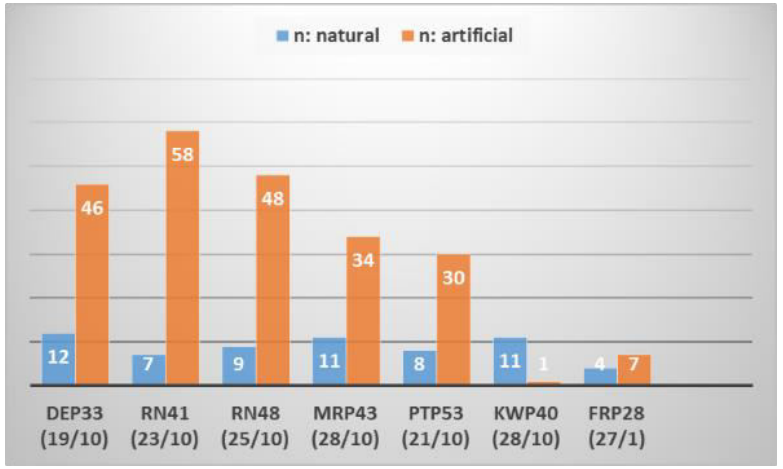
Affected IMS radionuclide stations

- Eastern stations: less isotopes present
- In the South-West (+ Iceland) many isotopes present



Number of isotopes present





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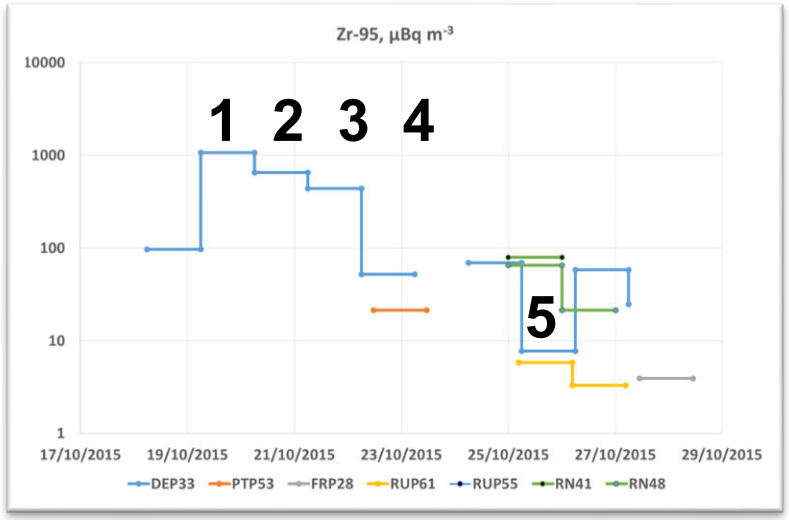
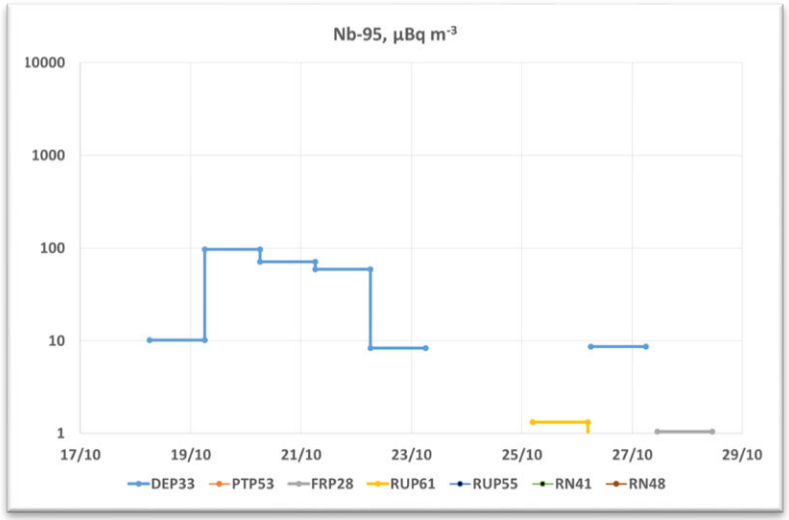
Radionuclide analysis – quantitative: time zero





Zr-95/Nb-95 event timing

RN 33
(1) 16/10/2015 14:35
(2) 16/10/2015 13:04
(3) 16/10/2015 5:55
(4) 15/10/2015 21:24

RN 61
(5)15/10/2015 2:51

October 16th or 15th as day of the event.

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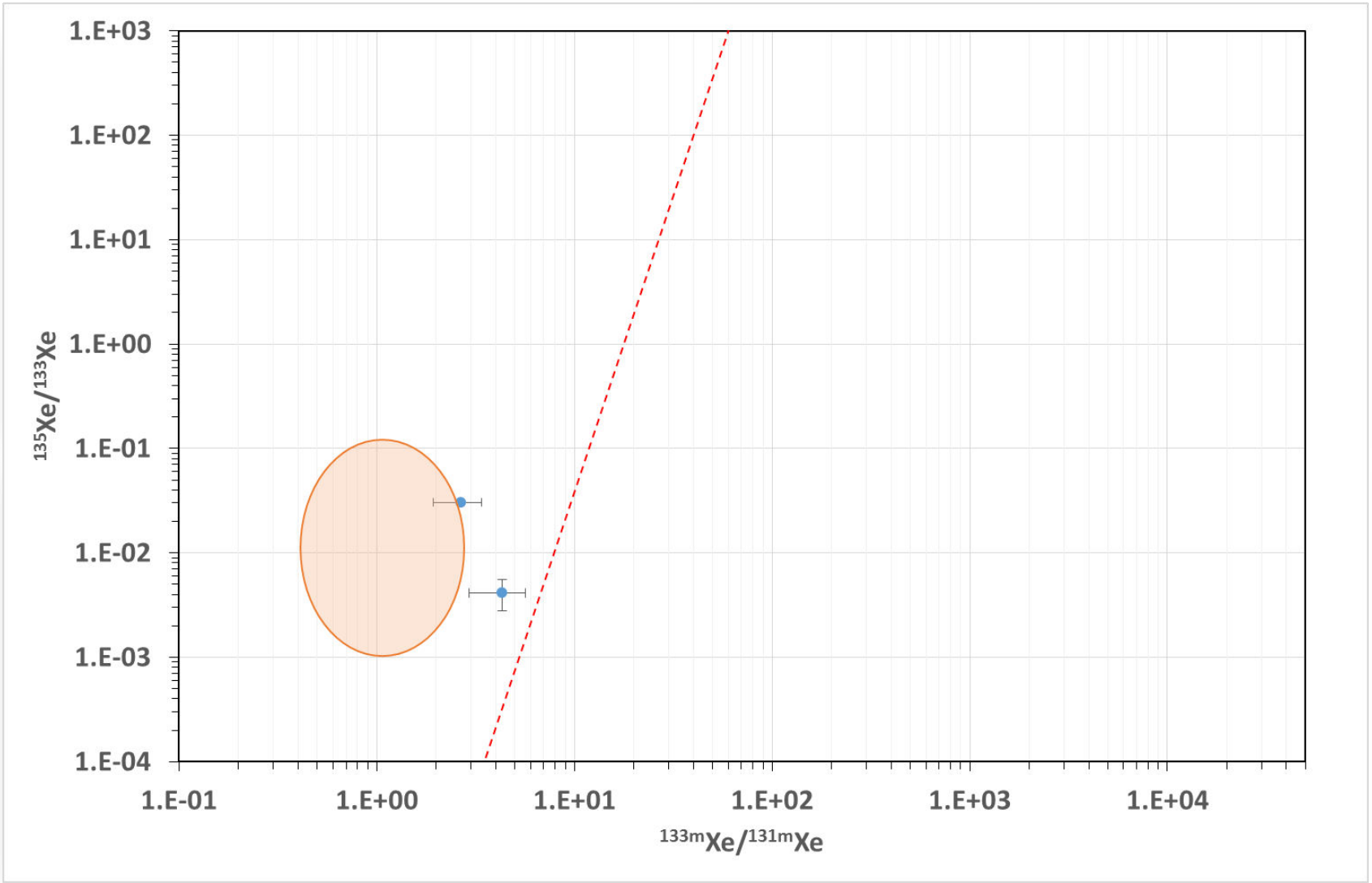
Radionuclide analysis – quantitative: xenon isotopes



No consistent explosion timing by analysis of xenon isotopic ratios

Some mixing present

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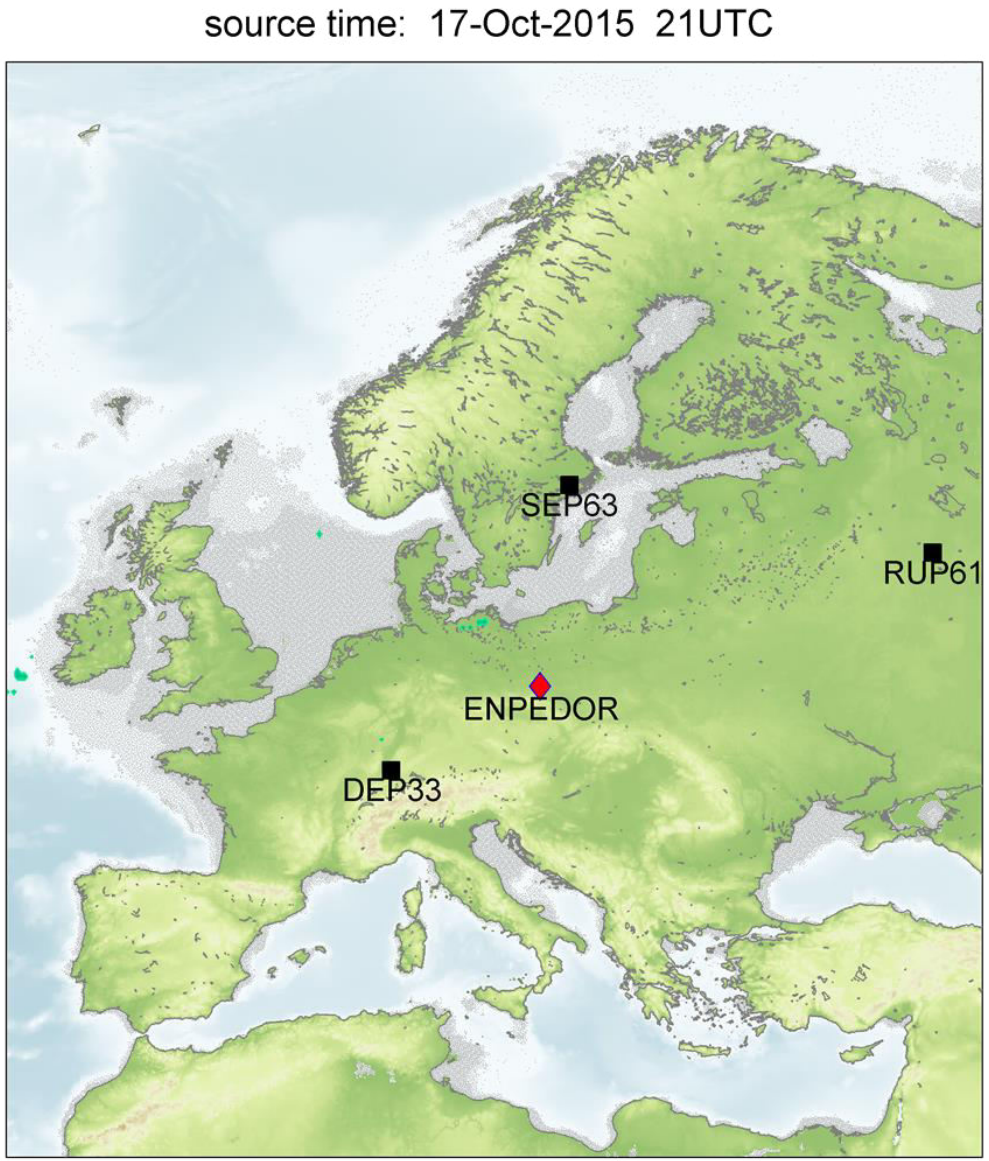
Atmospheric Backtracking – Coincidence localization approach

HYSPLIT (NOAA-ARL)

- Backward mode
- ECMWF analysis
- Horizontal 0.2° x 0.2°
- Vertical 60 leves
- 500.000 Particle per sample

Performed for CollStops:

DEP33_20151018
DEP33_20151019
DEP33_20151020
DEP33_20151021
DEP33_20151022
DEP33_20151023
DEP33_20151024
DEP33_20151025
DEP33_20151026
PTP53_20151021
PTP53_20151022
PTP53_20151023
PTP53_20151024
RN041_20151023
RN041_20151024
RN041_20151025
RN041_20151026
RN041_20151027
RN048_20151026
RN048_20151027
RN055_20151027
RUP61_20151024
RUP61_20151025
RUP61_20151026



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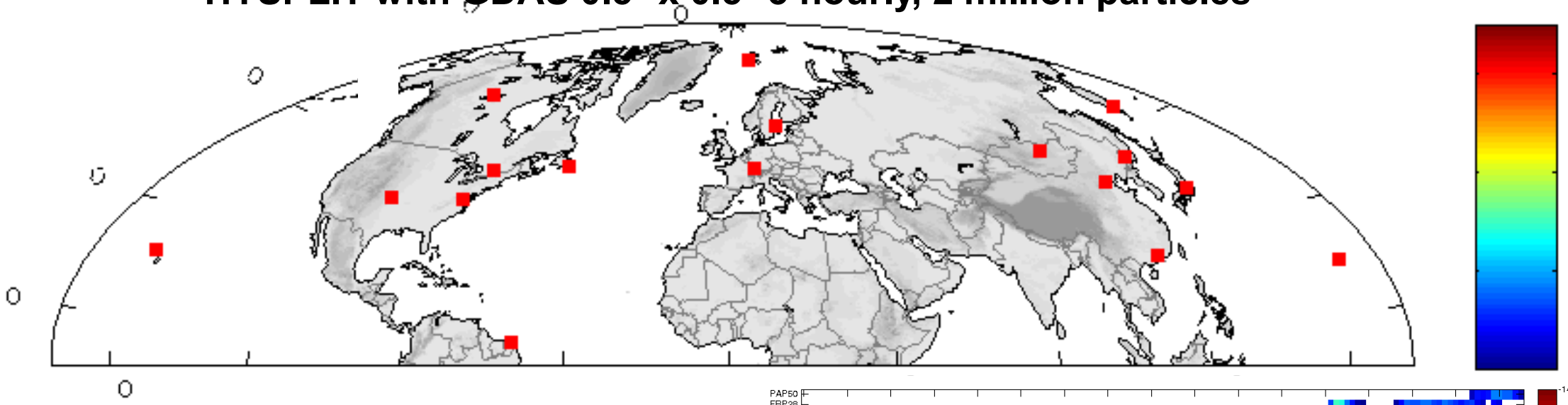
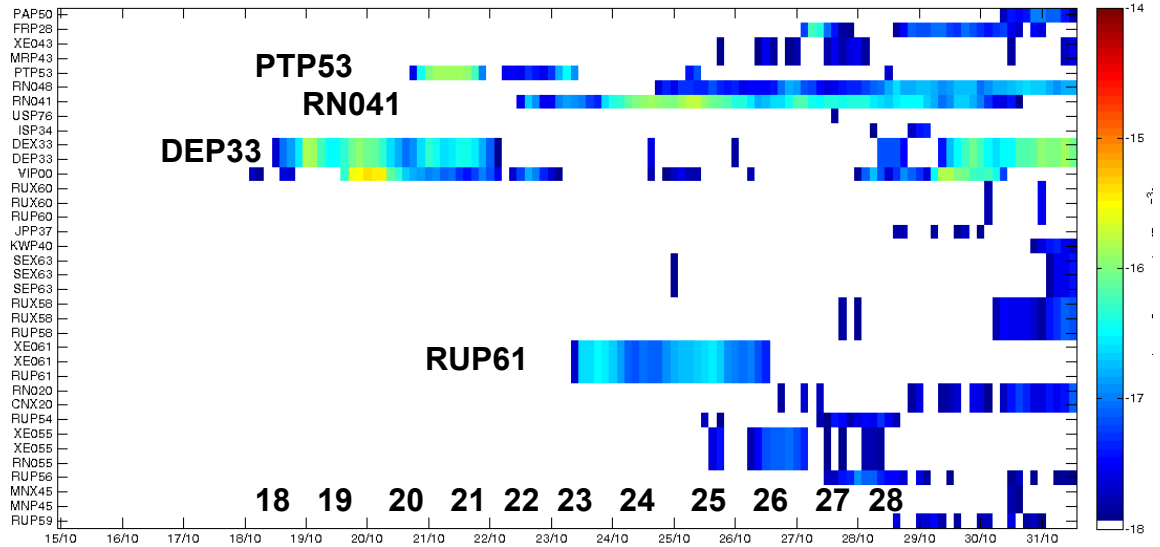
Forward ATM for candidate REB

HYSPLIT with GDAS 0.5° x 0.5° 3 hourly, 2 million particles



Forward Modelling also performed for 5 other REB events in ENPEDOR and Fleurus.



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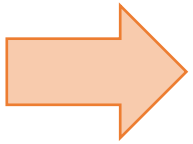
(Con-) Fusion with RN analysis

Overall picture consistent with release in Central Europe on 15/16 Oct 2015…

…but:

- Zr/Nb timing gives 16 Oct but better ATM consistency for 15 Oct
- Xenon timing not consistent – seems some mixing present
- RUP61 lower concentrations than expected from ENPEDOR
- ISP34 more isotopes than expected for ENPEDOR release

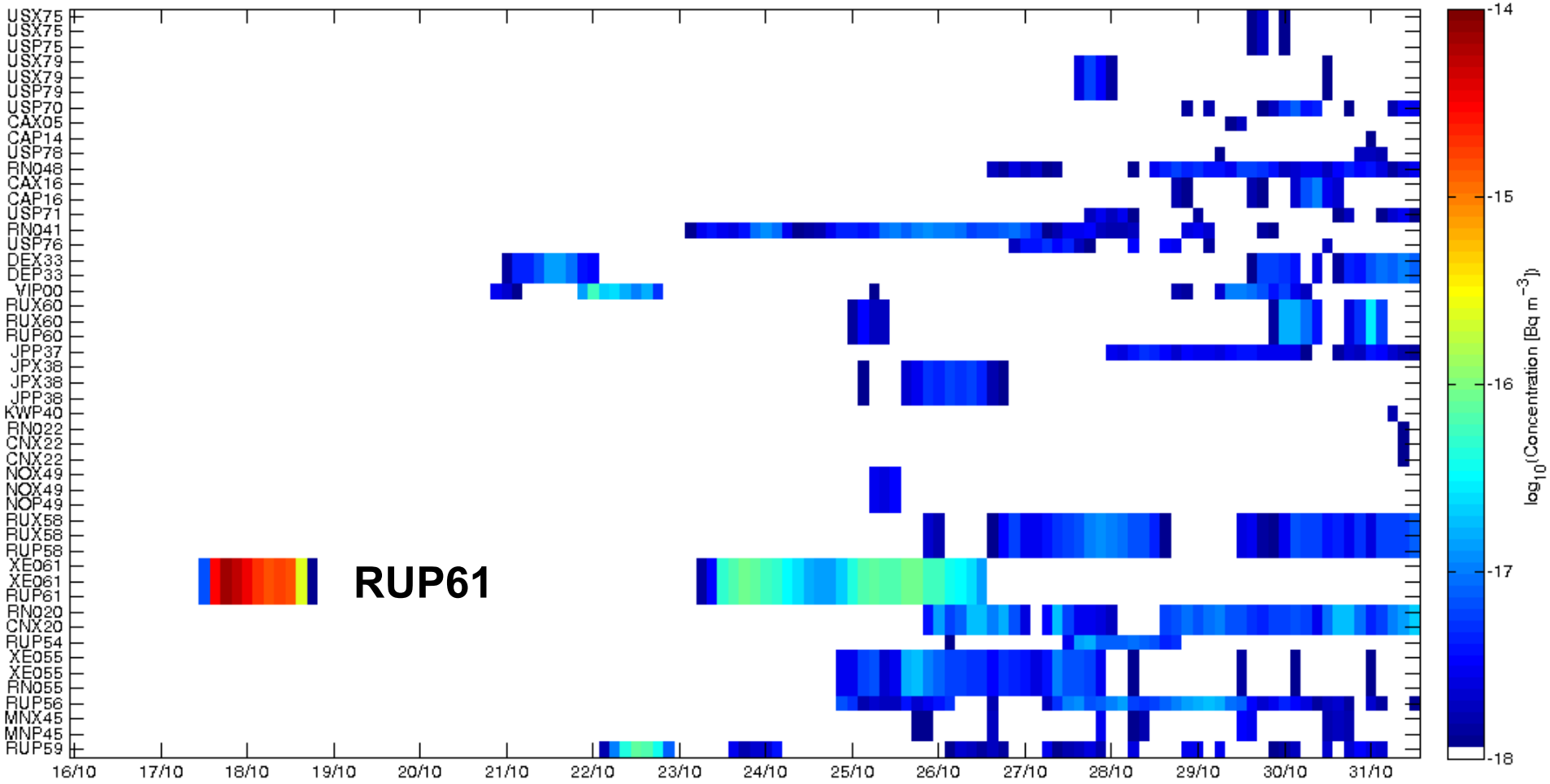


Indication for other / additional source (s)

REB with associated Infrasound detection

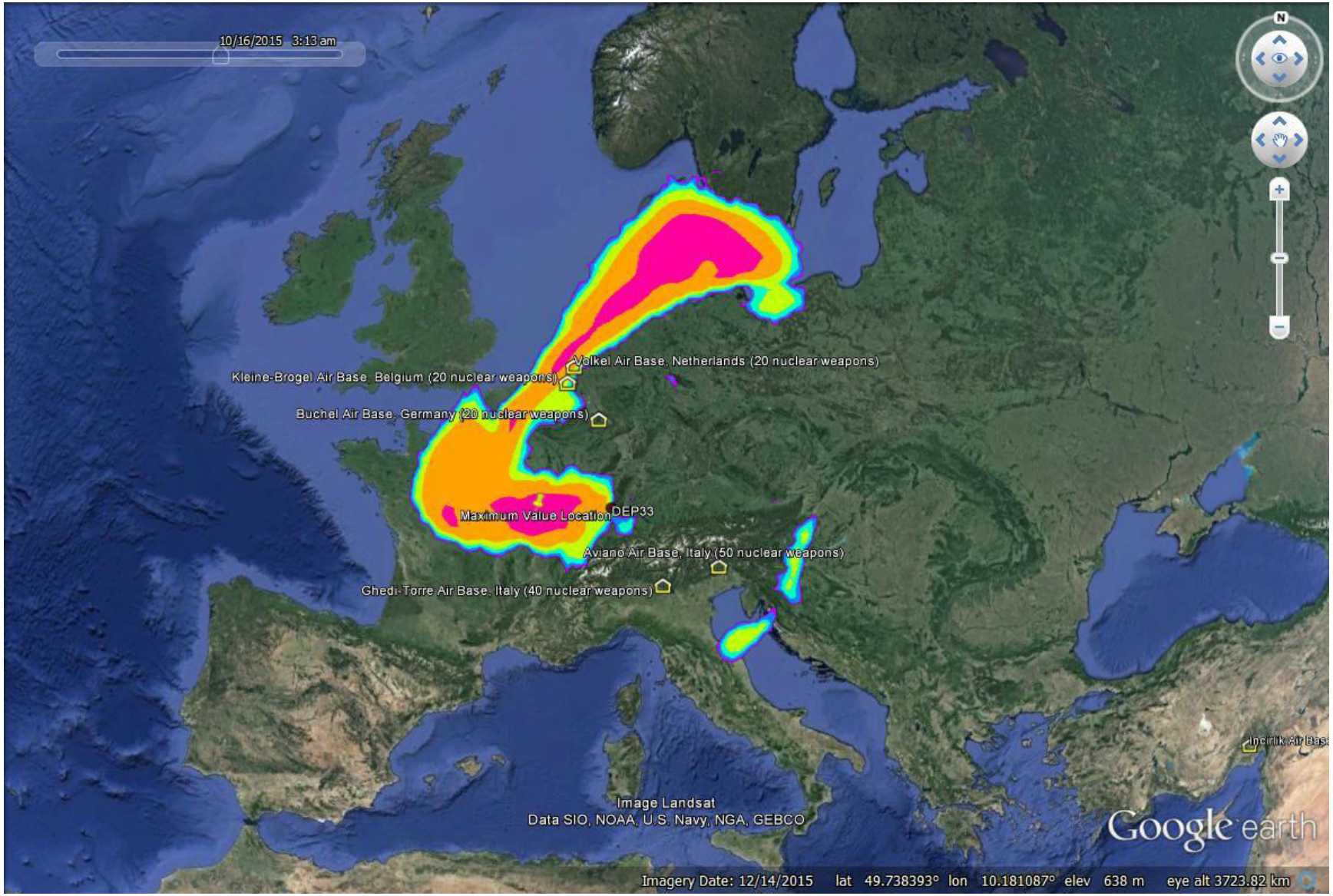
2015/10/14 09:00:32.240	52.2222	35.6534	8	0.0	ML 3.3mbtmp 3.9	BALTICS-BELARUS-NW RUSSIA REG.
2015/10/14 10:45:50.200	63.0433	27.9304	6	0.0	ML 2.5mbtmp 3.2	FINLAND
2015/10/15 08:23:17.560	47.7491	108.4214	4	0.0		MONGOLIA
2015/10/15 09:49:24.420	50.7509	47.588	3	0.0		BALTICS-BELARUS-NW RUSSIA REG.
2015/10/16 07:18:25.140	50.0516	78.7446	8	0.0	ML 2.5mbtmp 2.8	EASTERN KAZAKHSTAN
2015/10/16 08:00:48.220	47.996	33.4337	5	0.0	ML 2.9mbtmp 2.4	UKRAINE-MOLDOVA-SW RUSSIA REGION
2015/10/16 09:56:44.510	53.6662	88.1708	6	0.0	ML 2.3mbtmp 2.9	SOUTHWESTERN SIBERIA, RUSSIA

Forward ATM for REB with associated Infrasound detection



Simulated detection pattern does clearly not match the NPE2015 scenario

Backward ATM for RN 33 detections



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NPE 2015 scenario analysis findings

The detection pattern is consistent with a release in ENPEDOR

- two collocated candidate events in REB on early 15 October 2015
- from RN perspective sufficient evidence for an OSI at REB location

But there are inconsistencies:

- between isotopic composition in different samples
- between concentration patterns and ATM simulation (ISP34/RUP61)

→ In case of additional source(s) outside ENPEDOR

- low localization capability of ATM
- no matching prominent waveform event found

Other information sources needed, e.g. Satellite imagery or Intelligence Agencies

Conclusion on NPE 2015

Recommendation after radionuclide/ATM investigation:

1. Request On-Site Inspection in ENPEDOR around REB location of 15 October
2. Consultation and Clarification with western neighbours of ENPEDOR

Result of seismological analysis (See poster T3.4-P10 by Nicolai Gestermann et al.):

1. No signature of an explosion – typical mining induced events
2. No other matching SHI-event elsewhere

Solution by
Scenario Control Teams
Two nuclear explosions!

15 Oct 3:46 underground
ENPEDOR
16 Oct 12:00 atmospheric
Western Europe

Outlook – NPE 2017 ?

NPE 2015:

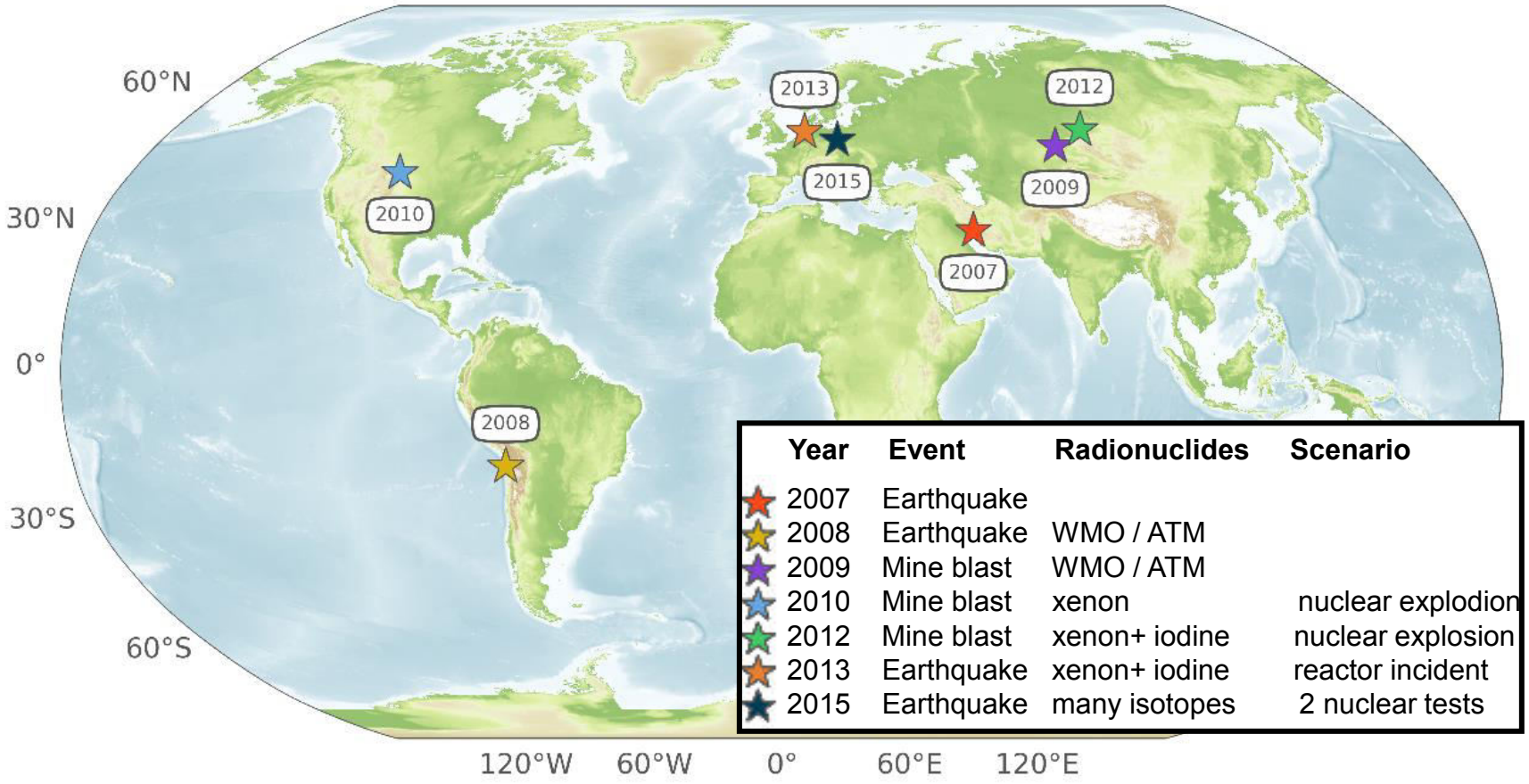
Challenging but valuable

NPE 2017:

Scenario needed

NDC Session
Wednesday 17:00
Geheime Ratsstube

Volunteers welcome!



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