

Abstract

We study explosions and earthquakes which occur in our region and worldwide to contribute to stopping nuclear explosions and support the Comprehensive Nuclear-Test-Ban Treaty (CTBT) verification regime. The National Data Center (NDC) in Iraq was established to enable the country to have access to the International Monitoring System (IMS) data and the International Data Center (IDC) products. In our capacity we are helping to verify compliance with the CTBT. Our center has technical expertise in seismic and radionuclide technologies. Recently we started working with IMS infrasound data. We analyzed an explosion in Ukrainian ammunition depot, which took place on 9 October 2018. We used IDC products and data from infrasound stations to analyze this event with software DTK-(G)PMCC (Progressive Multi-Channel Correlation). Also, we applied the NDC-in-a-Box software package (Geotool, SeisComp3) to analyze a seismic event that occurred at the Iran-Iraq border on 06-01-2019. Recently a Capacity Building System (CBS) was installed by the CTBTO team in our NDC. We are using IDC data and products and CBS data for the purpose of developing our capacity to receive, analyze and investigate incident events.

Introduction

The aim of CTBTO is to make the world safe and secure from nuclear weapons and aside from this order, Signatory States can also gain a lot of benefits from its monitoring activities. Even though Iraq does not host any of the monitoring stations, data is received daily by the capacity building system and from IDC products to monitor the region for Treaty compliance as well as scientific purposes. Iraq, signatory to the treaty has benefited immensely in the use of seismic data to monitor its regional seismic activities such as the earthquake occurred on 6 January 2019, in Iraq-Iran border with 5.3 magnitude at 13:41:58.7. The explosion occurred in a Ukrainian ammunition depot on 9 October 2018 was checked and analyzed using IDC products by National Data Centre (NDC) staff, the event by three infrasound and three seismic stations a magnitude 3.2 earthquake at 01:01:24 which was consistent with the media announcement. This proved that IDC bulletins can provide reports of the location and magnitude of earthquakes rapidly and could also be used to support emergency response and relief efforts.

Analysis of Ukraine event

In REB we see that this event was detected by three infrasound stations: I31KZ, I43RU, I46 RU. So, station I46 RU detected the infrasound signal by the phase I at about 04:10:00 and I43RU detected the infrasound signal by the phase I at about 01:42:05 of the seismo-acoustic event that happened 01:01:24.57 of 09.10.2018. In the analysis of that event with GPMCC, we observe that picks at about that time and we found the propagation of infrasound waves, from that time, is 286.44 (I46RU) and 203.35 (I43RU) degree with azimuth as shown in the interactive BEAMS from pixels associated to most energetic arrivals selected.

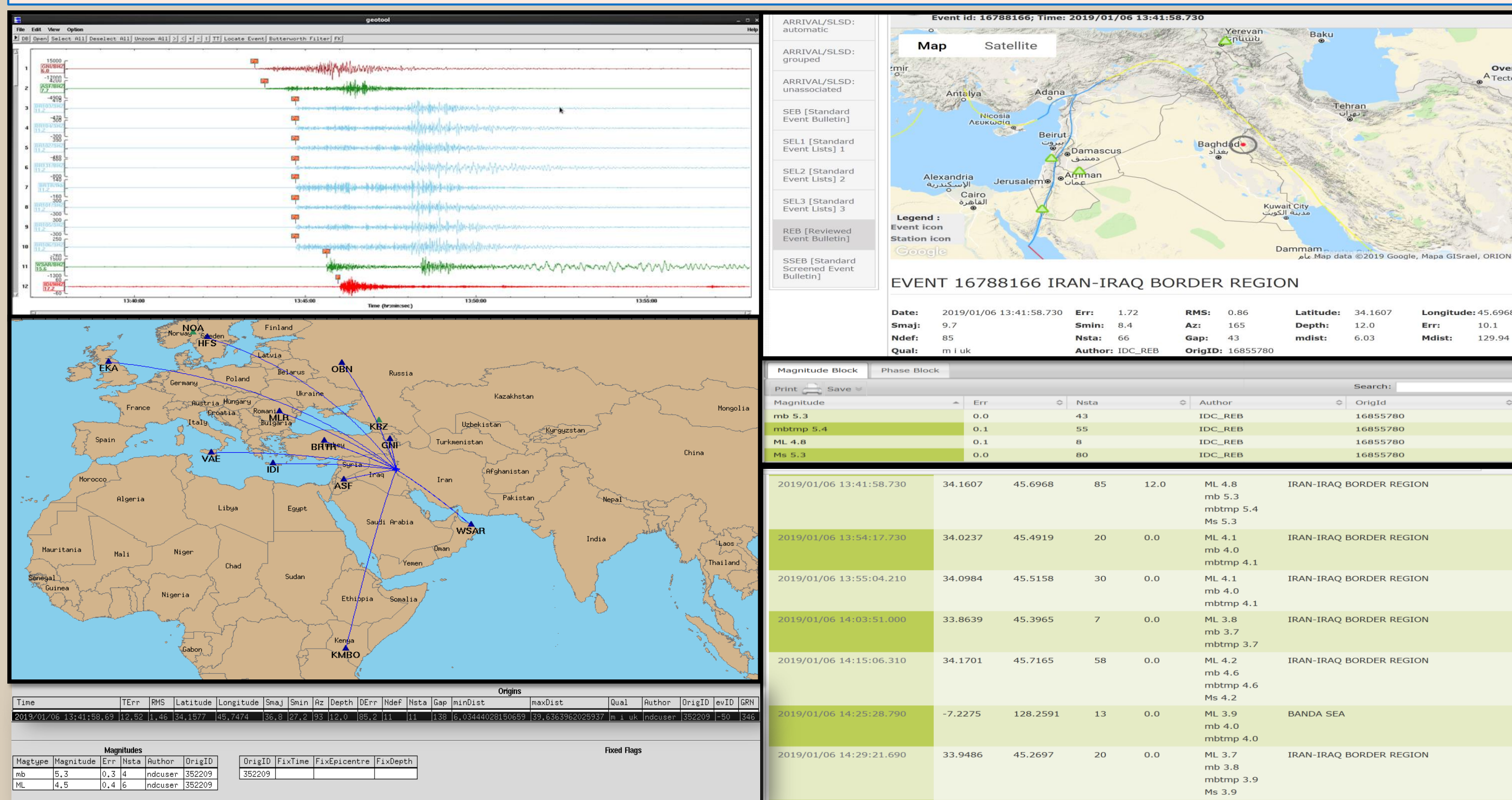
REB Ukraine infrasound bulletin analysis :

Station	Distance	Phases	Time	Azim	Slow
I43RU	6.58	I	2018/10/09 01:42:05	202.7	322.6
I46RU	31.65	I	2018/10/09 04:10:00	286.4	320.8

Analysis of Iran - Iraq Border event at 2019/01/06

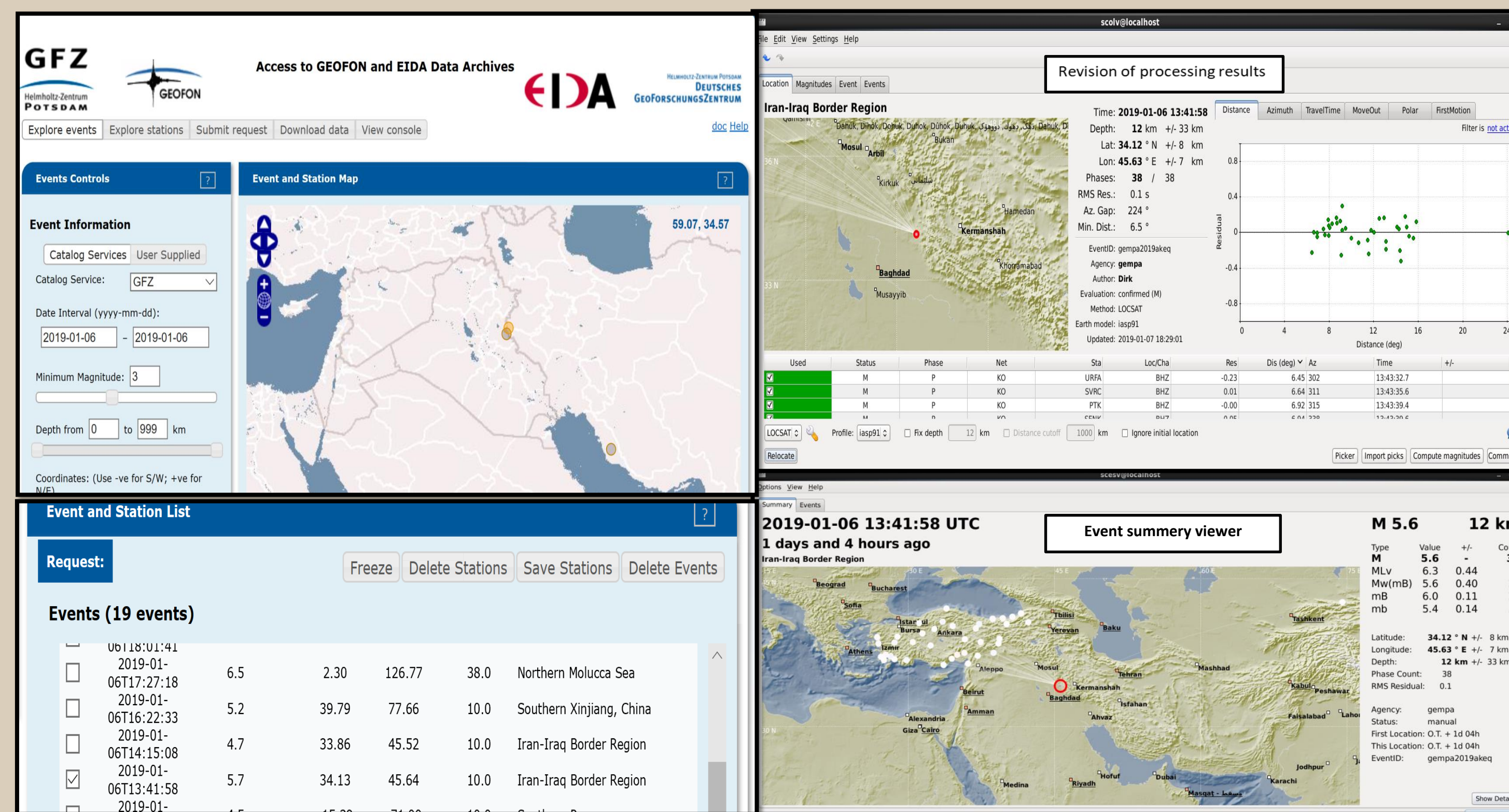
An earthquake of 5.3 magnitude has occurred in the northern Iran - Iraq border at 2019/01/06, 13:41:58.7, 130 km northeast of Baghdad and 20 km from the Iraq-Iran border, at a depth of 12.0 km. After shocks continued to be felt in surrounded region. Many earthquakes happened after the event happened in the same place. Reviewed Event Bulletin (REB) throw IDC product shows that this event was detected by Many seismic monitoring stations. We are using new command-line client for data retrieval, by requesting the relevant primary and auxiliary station data (GNI, ASF, BRTR, WSAR, IDI, MLR, VAE, HFS, KMBO, EKA, OBN).

1- The **Geotool software** was used to analyze seismic data and compare results of Iraqi (NDC) with the results of the International Data Center (IDC - REB)



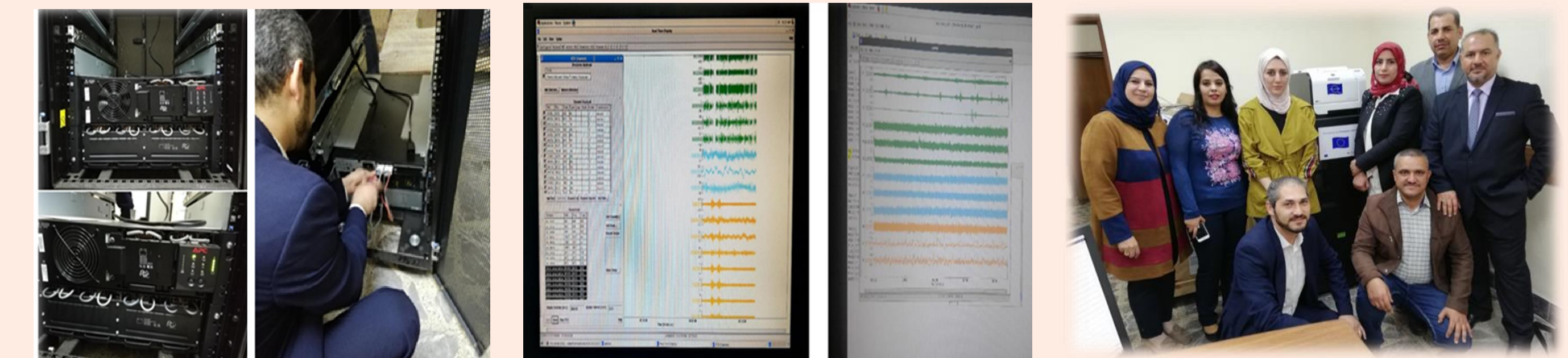
Results	Lat	Lon	Depth	Time	Mag
IDC Result	34.1607	45.696	12.0	13:41:58.7	mb:5.3, ML:4.8
NDC Result	34.1577	45.747	12.0	13:41:58.69	mb:5.3, ML:4.5

2- Using the real-time earthquake monitoring software (**SeisComp3**). We detected this event in GEOFON and EIDA Data Archives and request minised waveform from geofon network code (KO) (Kandilli Observatory BB and SW stations [KOERI]). The results of non-IMS stations has small difference than the results of IMS stations as follows:



CBS (capacity building system) Was installed in Iraq

The CTBTO supporting Iraqi National Data Center in scientific and technical techniques through installed the capacity building system from 18-22/11/2018 by the CTBTO staff and training the Iraqi center staff. The analysts at the Iraqi National Data Center extend thanks and appreciation to the organization for the efforts made by everyone who worked in the equipping the equipment. Through the use the CBS data we detected the many events such as Iran-Iraq border earthquake at 6-1-2019 13:41:58, which analyzed it using the last release of NDC_in_a_box version 4.3 on the workstation provided with CBS equipment.

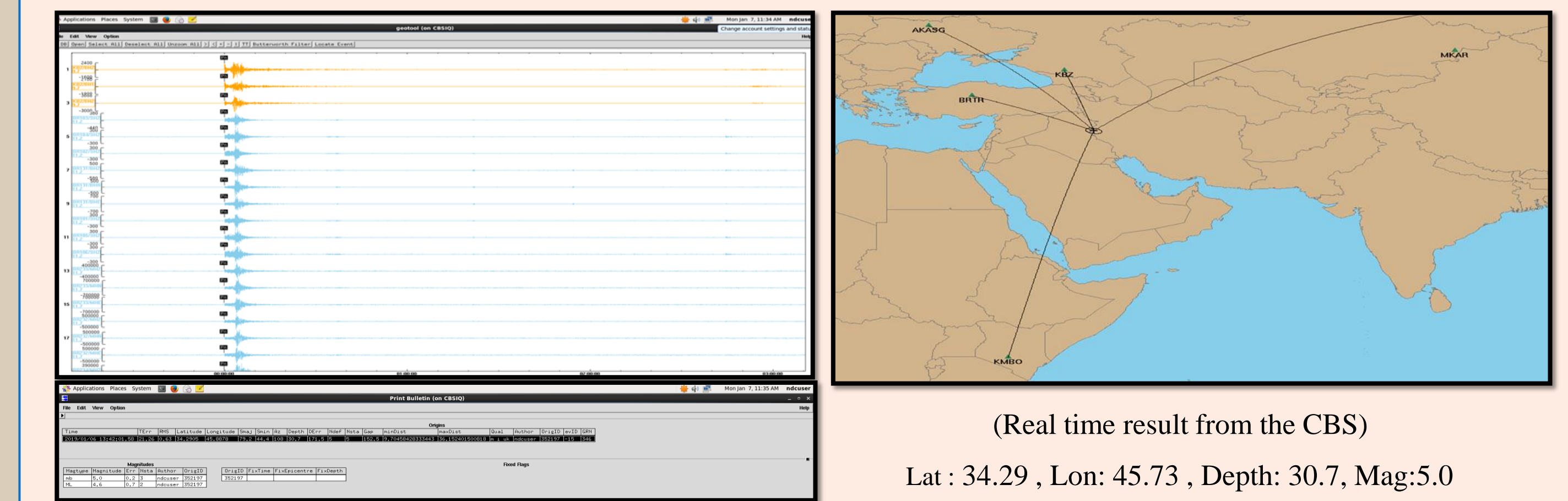


Building in the UPS and testing the batteries

Receiving Real time data through the CBS

Wrap - up meeting

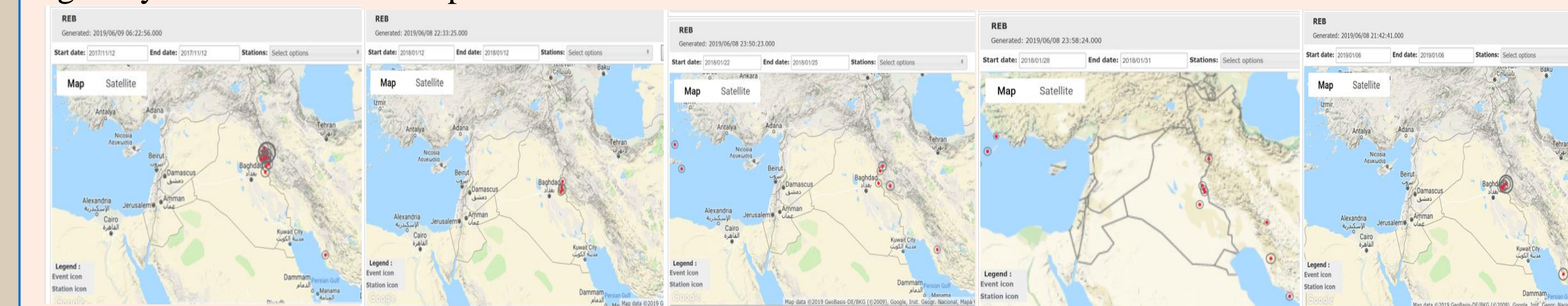
CBS analysis (event of Iran-Iraq border Region:2019/01/06 13:41:58.7)



Earthquakes in Iraq and Iran-Iraq border

Four major tectonic plates (Arabia, Eurasia, India, and Africa) and small tectonic block (Anatolia) are responsible for seismic events in the Middle East and Iraqi surrounding region at the northeastern edge of the Arabian plate. Its seism tectonic framework is a product of the NE motion of the plate and the continental collision along Zagros mountains belt. Many earthquakes occur near the boundary between the Arabian Plate and the surrounding tectonic plates. The collision of the Arabia and Eurasia plates forms the approximately 1,500 km long fold and thrust belt of the Zagros Mountains, which crosses almost western border of Iran and extends into Iraq-north. the Arabia plate is moving towards the north with respect to Eurasia at a rate of about 26 mm/yr.

An earthquake of 6.1 magnitude has occurred in the Iran-Iraq border in northern region at 12/11/2017 centered about 220 kilometers northeast of Baghdad-Iraq at a depth of 00.0 km. The earthquake was felt as far away as Turkey, Kuwait, Jordan, Lebanon, Saudi Arabia and Qatar. Also, we experiencing earthquakes regularly as indicated in IDC products in 2018 and 2019.



Conclusions

- 1-Three infrasound stations belong to the IMS: I46RU in Russia and I43RU in Russia and I31KZ Kazakhstan, detected infrasound signals generated from the Ukrainian ammunition depot. the infrasound signals at regional IMS stations located in the downwind direction. Corrected azimuth of the stratospheric phase resulted in moderate location accuracy, which was comparable to the seismic locations. Furthermore, the detection represents a validation of the extension of infrasound monitoring technology, originally focused on atmospheric explosions, to verify underground explosions by combining of IMS stations and regional networks.
- 2- The integration of seismic and infrasound waveform analysis is helpful in identification, classification and categorization of the source of that event.