ANALYSIS OF THE SEISMICITY IN THE LOS HUMEROS MEXICAN GEOTERMAL FIELD WHITING THE FRAMEWORK OF THE CONSORTIUM GEMEX

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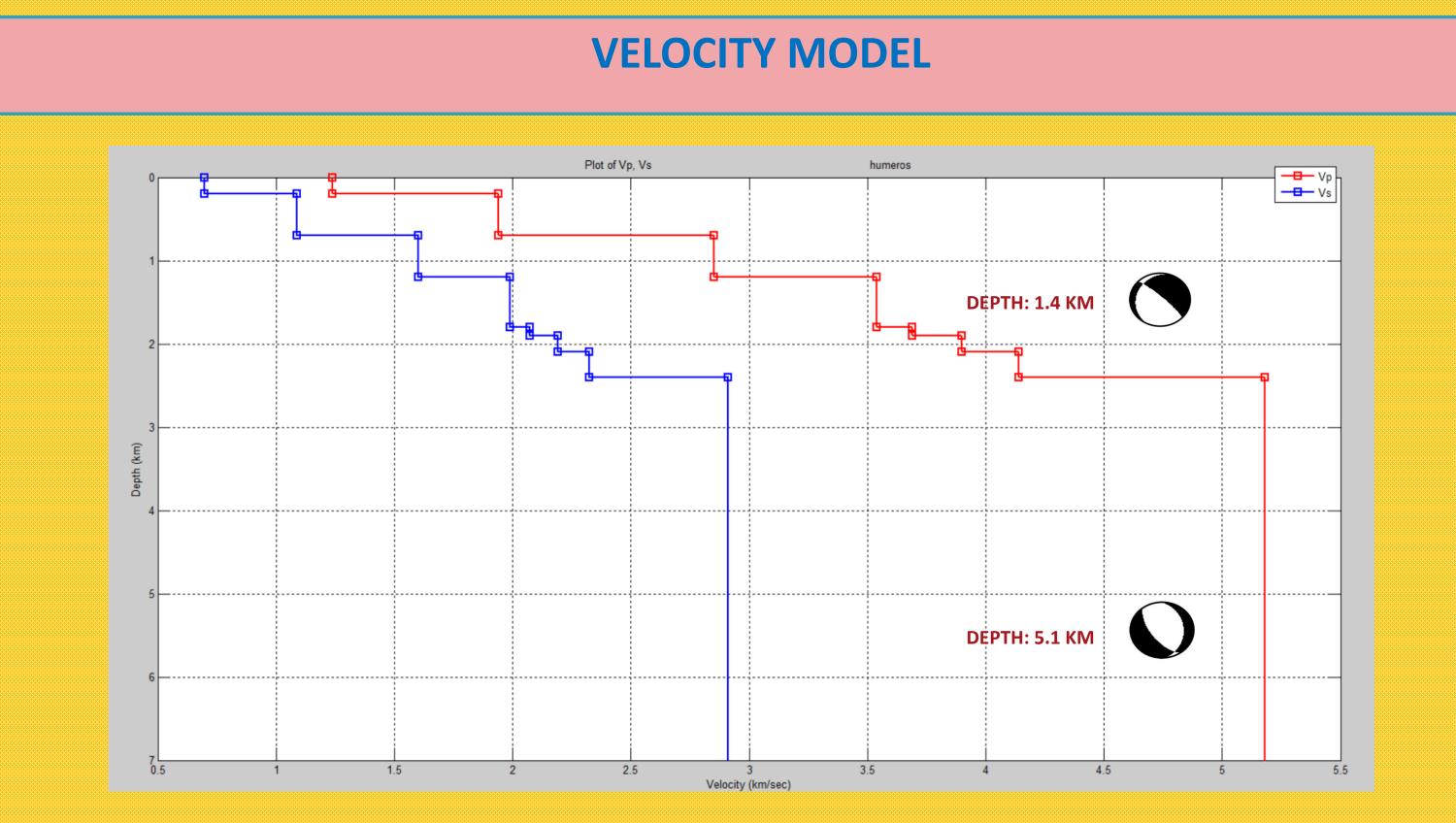Marco Calò (IG-UNAM) Philippe Jousset (GFZ-POTSDAM), Víctor Hugo Márquez Ramírez (UNAM-JURIQUILLA)

ABSTRACT:

The Geothermal Field of Humeros Puebla, Mexico, is one of the most important in the country due to its production of 85 Mwh. Previous studies indicate that most of the seismicity is concentrates in two large areas mostly located in the northern part of the field, near the areas of injection and re-injection of fluids (Urban et al, 2013, Lermo et al 2001, 2002, 2005 2008).
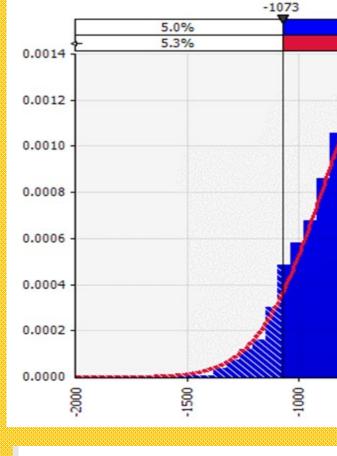
In the framework of the Working Package 5.2 of the GEMex bilateral Project between Mexico and the European Union, a seismic network has been installed consisting of 20 short period and 25 broad band stations. This seismic networ represents the largest monitoring network installed in a geotermal field in Mexico.
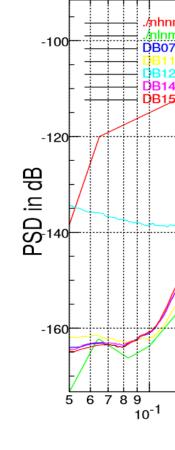
The seismic noise of the stations has been analyzed to determine i) the quality of the seismograms and ii) the level of noise in the high frequency range (> 1 Hz), which could be attributed to the extraction plants, steam pipilines or the effect of o human activity. For this purpose, we analyzed the power spectral density function, using free software such as Seismic Analysis Code (SAC). Likewise, the spectral ratios have been calculated for each station of the network in order to characterize and determine the site effects.

We also show the location of 15 local events occured from September 1st, 2017 to September 30th, 2017, calculated using a 1D velocity model optimized for the area (Urban and Lermo, 2013). The location of this events was performed using the location subrutine contained in the SEISAN package (Hanskov and Ottermoller, 2003). This program used as input data: station name, latitude, longitude, altitude, picking of the P and S arrival times, duration of an earthquake, velocity ratio Vp/Vs and velocity model.

VELOCITY MODEL

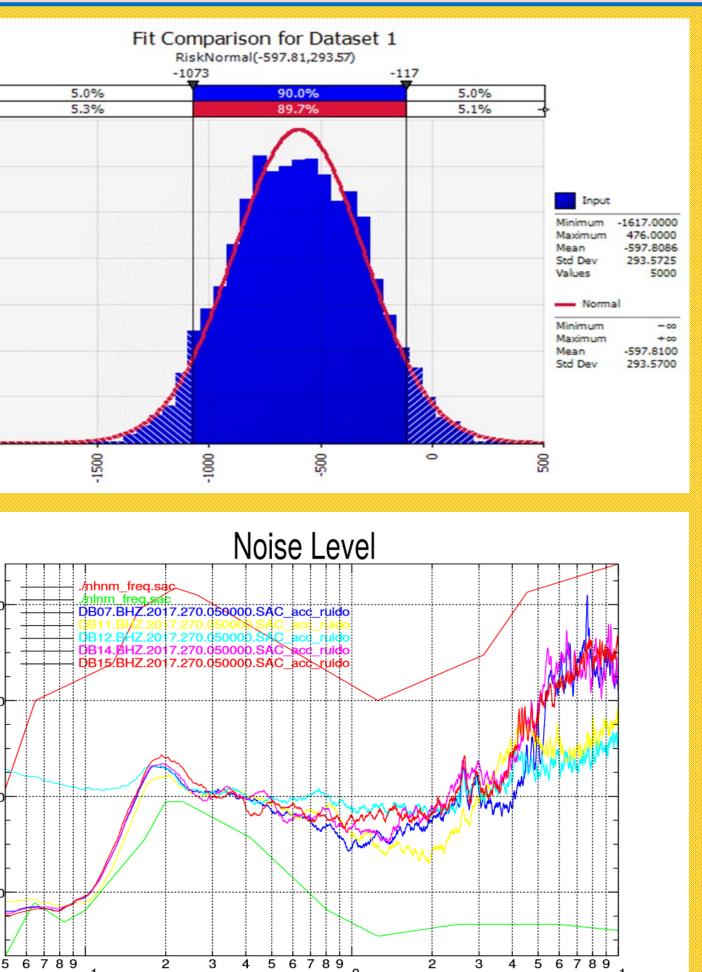## INSTALLATION AND SEISMIC NOISE LEVEL:

Installation tests were performed with sensors located at different depths to determine the quality of the records and to determine the standard procedure for the installation of the whole network, according to the sensibility of the records of noise.

The seismic noise is a stochastic process and its energy is quantified by the power spectrum density (PSD), which is calculated by the method of McNamara and Buland (2004) .
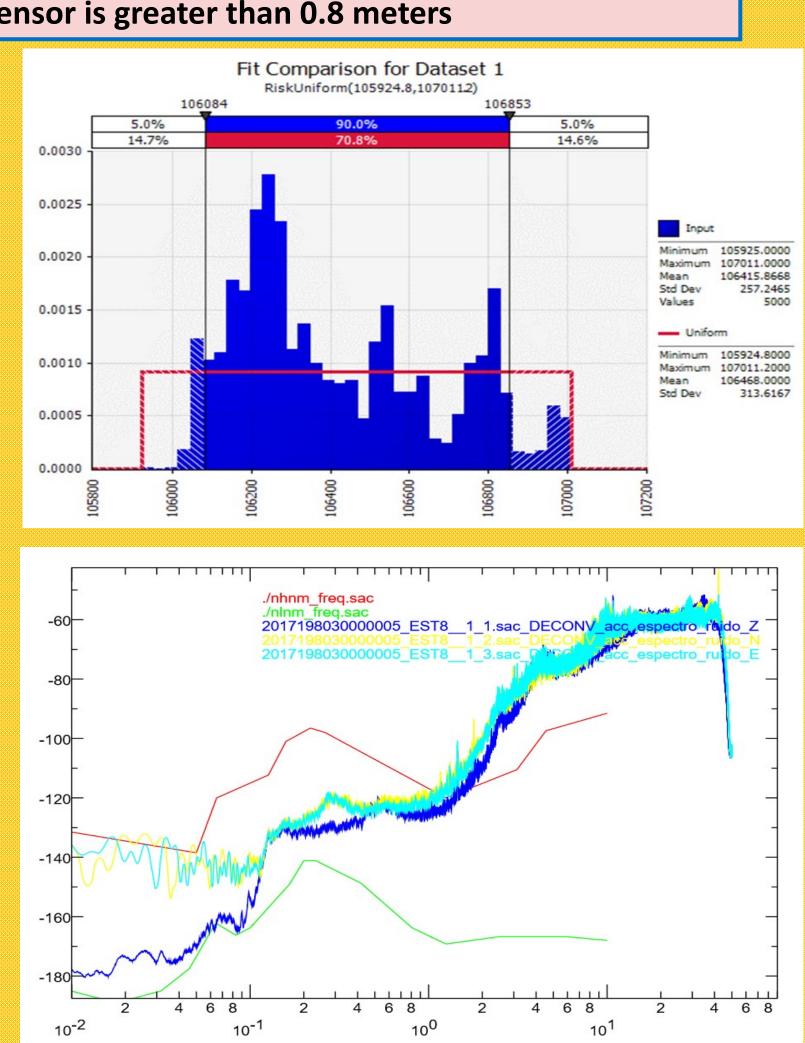
Based on these test, we determined that the minimum installation depth that have to be reached to ensure acceptable noise level and reduce the effect related to temperature variation was 1 meter, where the sensor is place inside a plastic pot insulated with fiberglass and fixed to a concrete base 15-20 cm thick.

Our records indicates that the noise levels are aceptables compared with the model of Peterson (1993), whics allows us to characterize low magnitude events within the geothermal field.
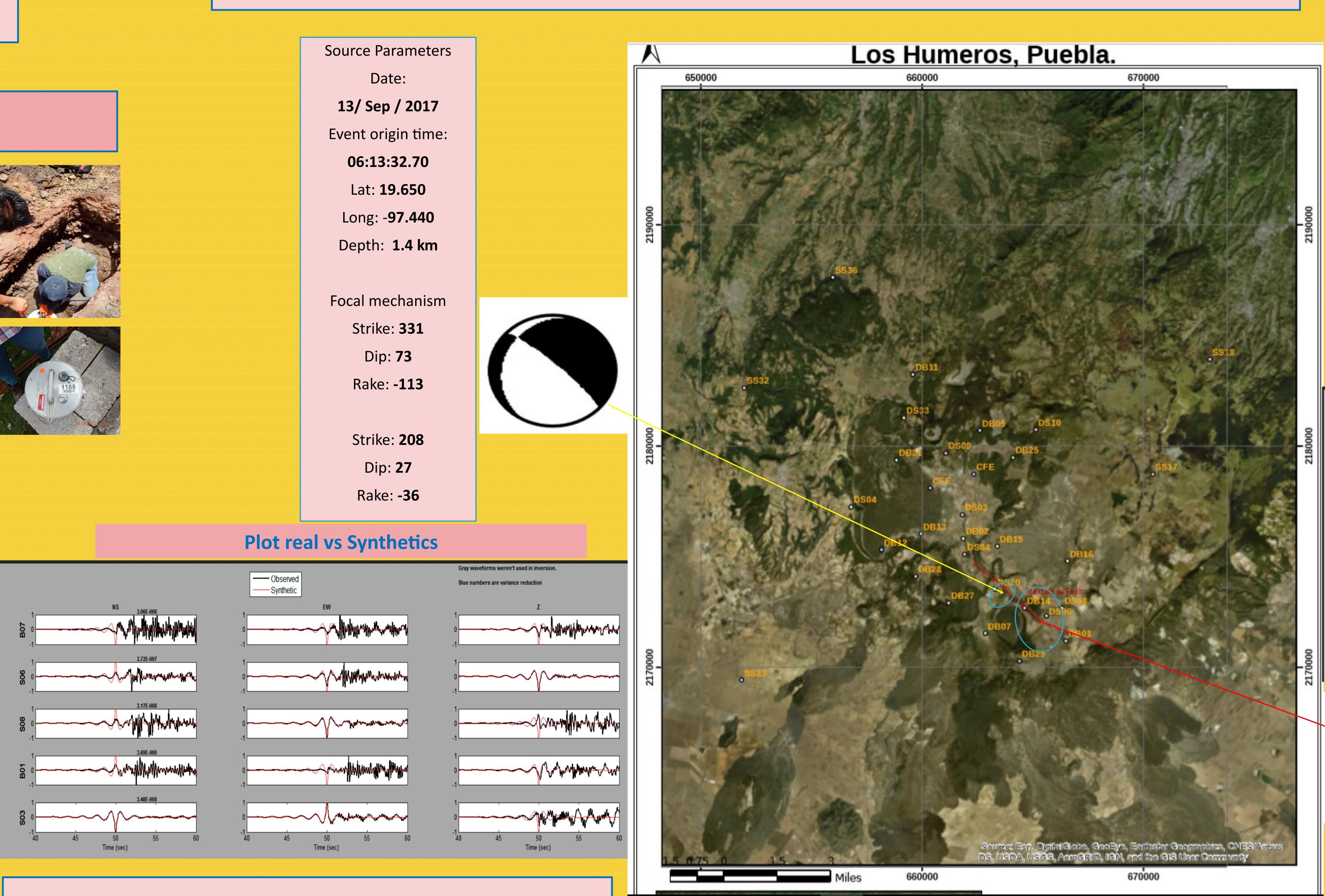
In the following images we show the noise levels as function of the stations depth. Installation at 1m depth shows a good level of seismic noise. We also performed a statistical analisys in order to characterize the gaussianity of the seismic records as a function of the installation technique, determining the probability distributions that presented a better fit with the observed data. One conclusion is that the seismic noise is considered Gaussian when the installation depth of the sensor is greater than 0.8 meters

Source Parameters

Date:

13/ Sep / 2017

Event origin time:

06:13:32.70

Lat: **19.650**

Long: **-97.440**

Depth: **1.4 km**

Focal mechanism

Strike: **331**

Dip: **73**

Rake: **-113**

Strike: **208**

Dip: **27**

Rake: **-36**
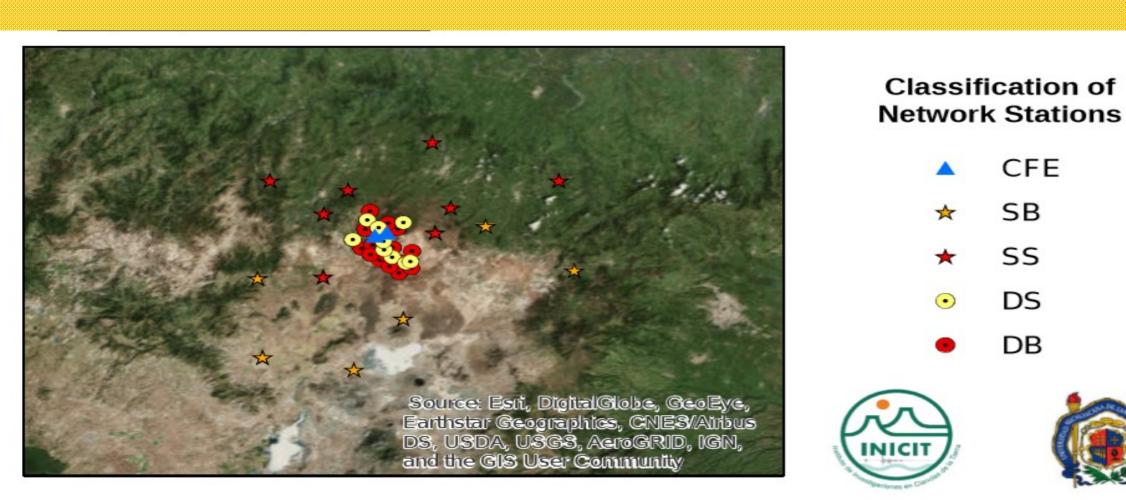
Plot real vs Synthetics

Los Humeros, Puebla.

We note that the location of the 15 events occurs mainly in two zones: the north-west zone (probably by injection and re-infection of fluids) and the south-east zone.

We also stimated the source mechanisms for two events magnitud 2.2 and 2.4, respectively, using the waveform invesion proposed by Sokos and Zahradnik (2008). The first eventoccurred in September 13th, 2017 at 06:13:32.70 and other one in September 16th, 2017 at 07:43:40 (GMT), located in the south area. We compute the moment tensor for these events using the program ISOLA .
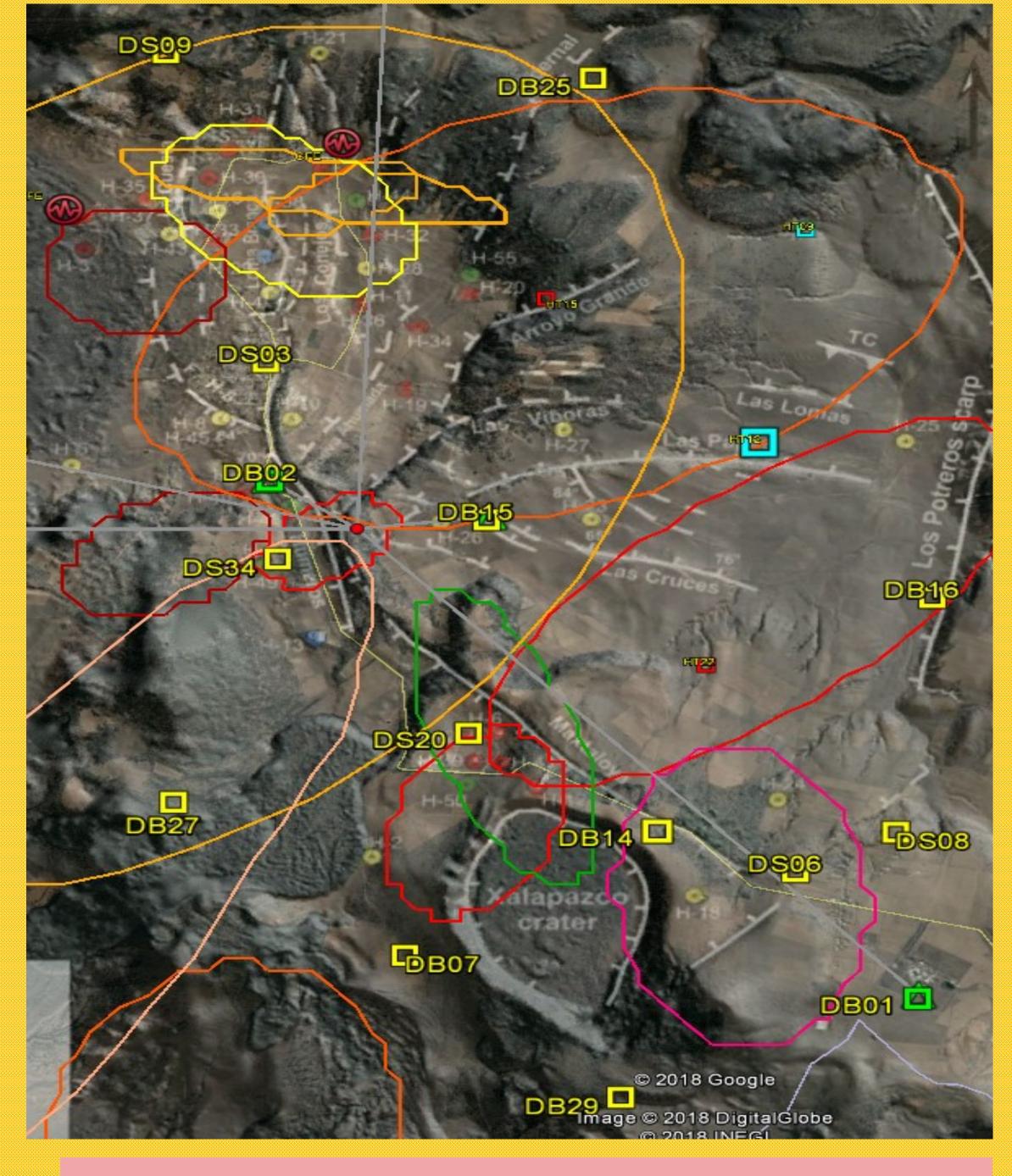
Classification of Network Stations

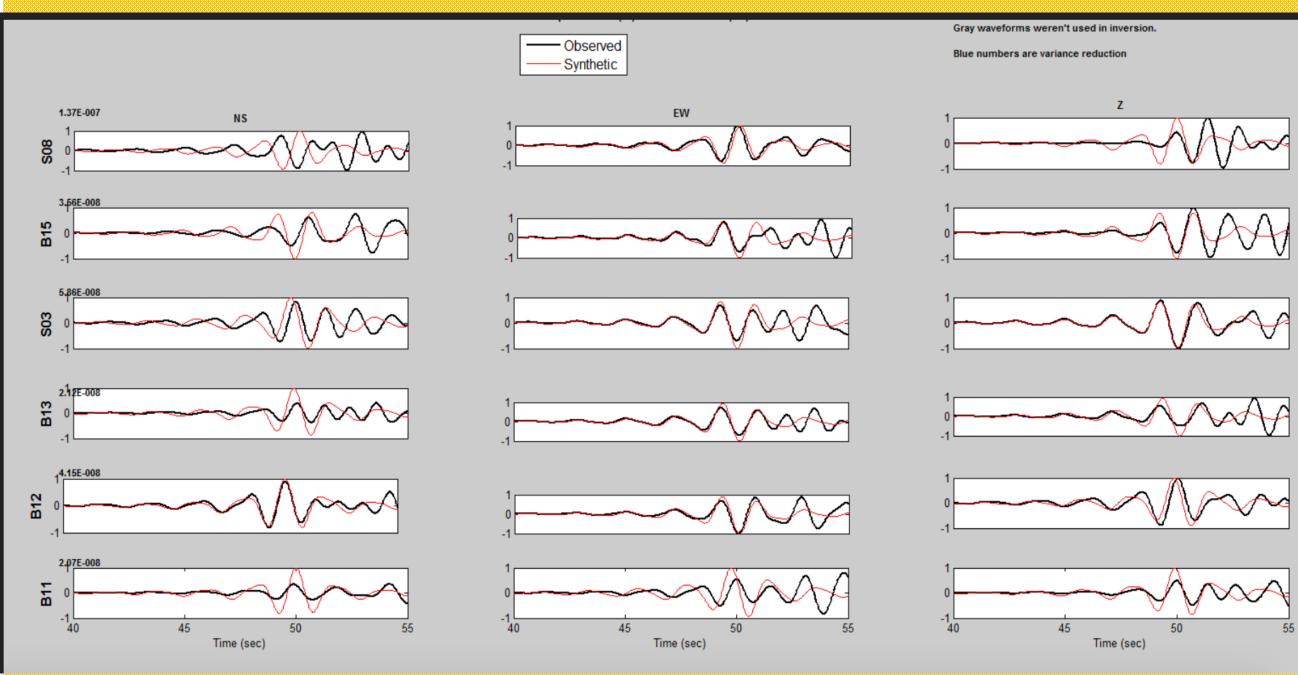Coordinate system:
UTM 14N

Elaborated by:
Luis Alberto Oregel Morales
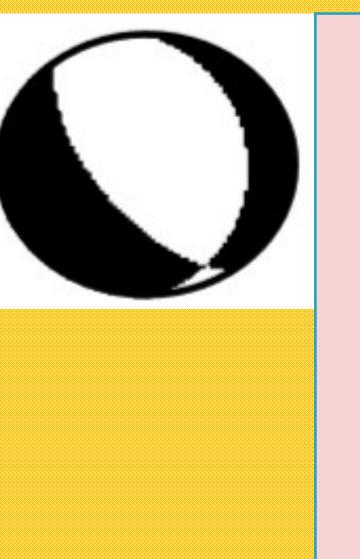Master Student at INICIT
UMSNH
Morelia Michoacán, México

Location Seismic Events and Error Elipses

Plot real vs Synthetics

Source Parameters

Date:

16/ Sep / 2017

Event origin time:

07:43:40

Lat: **19.637**

Long: **-97.424**

Depth: **5.1 km**

Focal mechanism

Strike: **144**

Dip: **62**

Rake: **-106**

Strike: **357**

Dip: **32**

Rake: **-61**