SnT 2025 8 SEPTEMBER ONLINE DAY 9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

P3.5-758

The Idaho National Laboratory Seismic Network: A Brief History and Overview of Current Capabilities

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Idaho National Laboratory (INL)

Idaho National Laboratory INL

INTRODUCTION AND MAIN RESULTS

The INL seismic monitoring project began in 1973. In its current configuration, the network consists of over 100 instruments including broadband seismometers, accelerometers, GPS and infrasound stations. Recently, the network recorded a 5,000 lbs detonation along with a sonic boom, thought to be created by a bolide. This presentation showcases the current configuration of the network along with recordings and results of the recent detonation and sonic boom.

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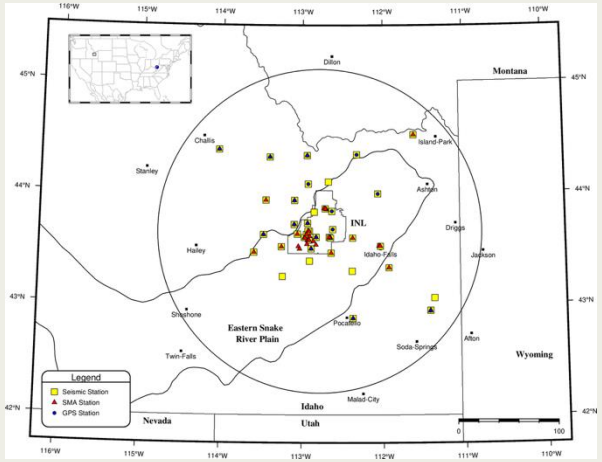
History

The INL has a history of operating nuclear test reactors and is currently designated as a Reactor Innovation Center. The seismic monitoring program began as a single station in 1973. Since its inception, the network has grown to over 100 instruments including 40 broadband seismometers, 47 strong motion accelerometers, 16 GPS instruments and 3 infrasound sensors.

The primary purpose of the monitoring is three-fold:

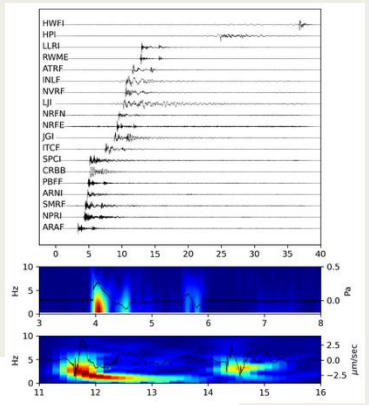
1. Support the safety of structures, systems, and components
2. Safety of workers and the public
3. Support the operations of INL nuclear facilities and waste management

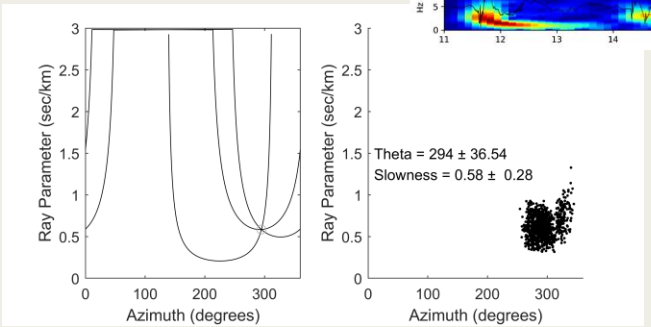


Bolide Over The INL

Bolide seismic signal

A proposed bolide travelled over the INL and was well recorded on many of the seismic stations along with a single infrasound instrument. Arrival times were recorded and used in array tripartite analysis to determine slowness and azimuth of the incoming wave. The incoming wave displays an N-wave on the infrasound sensor as well as a W-wave on the seismic instruments, both of which are usually associated with sonic booms.





Modelling the Trajectory

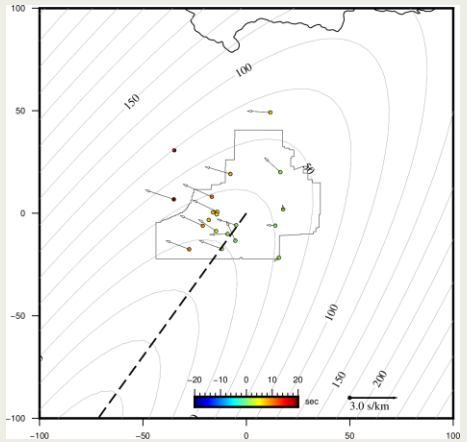
The method outlined in Ishihara et al. (2003) is used to model the trajectory. A grid search method was used to minimize the rms of the predicted vs the actual travel times using the following equations:

$$t_{pred} = t_0 + \left(\frac{\sqrt{X^2 + Y^2}}{\tan \beta} - Z \right) / v$$

$$\sin \beta = {}^{c}/_{v}$$

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} \cos\gamma \sin\theta & \sin\gamma \sin\theta & -\cos\theta \\ -\sin\gamma & \cos\gamma & 0 \\ \cos\gamma \cos\theta & \sin\gamma \cos\theta & \sin\theta \end{bmatrix} \begin{bmatrix} x - x_0 \\ y - y_0 \\ z \end{bmatrix}$$

The results are below:



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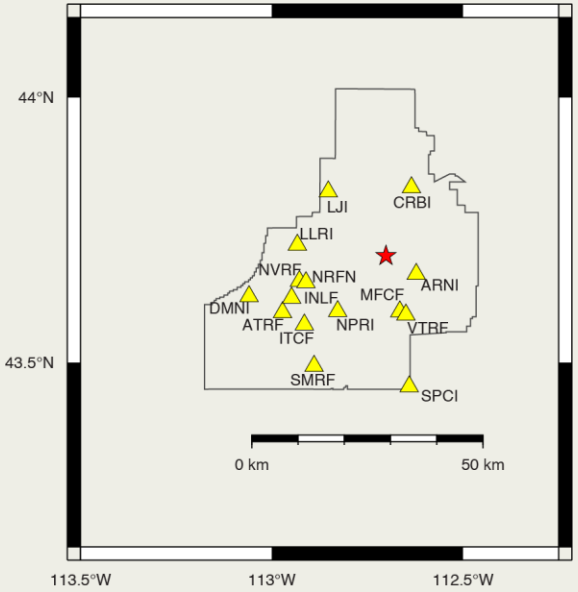
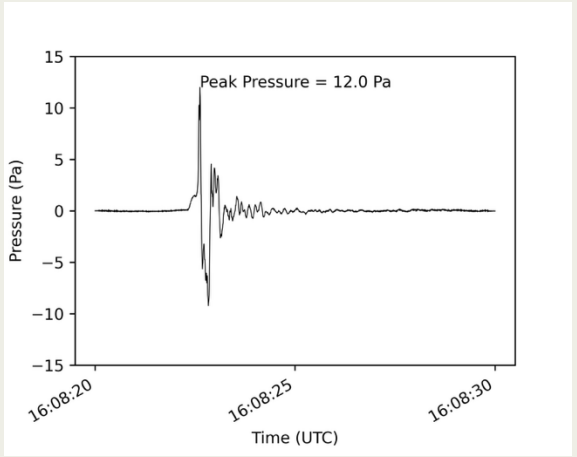
INL National Security Test Range

The INL is also home to the National Security Test Range (NSTR). This range is a dedicated facility in the remote desert of Eastern Idaho. The range features diverse terrain, restricted airspace, and specialized testing pads designed for explosives, ballistic impacts, barrier testing, and the evaluation of emerging technologies.

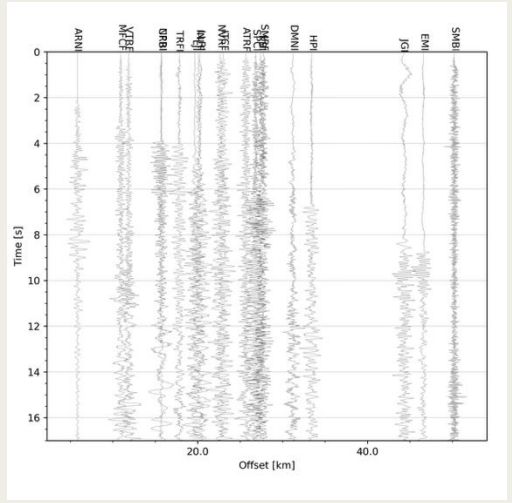
Recently, the INL seismic monitoring network has installed infrasound sensors near the NSTR. To the right is an example of a 5,000 lbs explosion (red star) which was measured by the INL seismic monitoring network (yellow triangles).

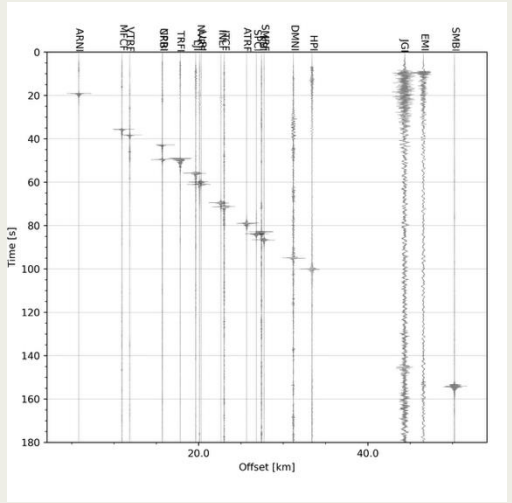
5,000 lbs explosion





Record Sections





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