

# Enhancing the Nuclear Explosions Waveform Repository: Integrating Data Contributions from National Institutions and Networks

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## INTRODUCTION AND MAIN RESULTS

The “Waveforms From Nuclear Explosions (WFNE)” repository provides access to a very large collection of quality checked raw and parametric data for all the 2,157 worldwide nuclear explosions detonated to date in the world. Since its opening in 2023, waveform data and geophysical information were added, including from legacy data sets of digital data or digitized analog recordings assembled by different institutions, and are presently accessed by users from all over the world.



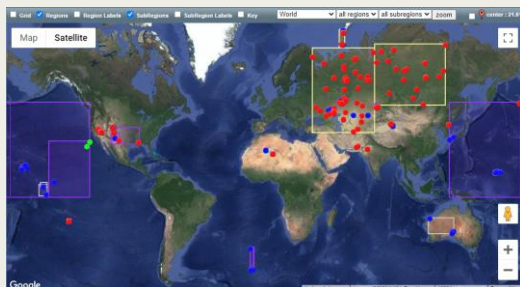
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## Introduction

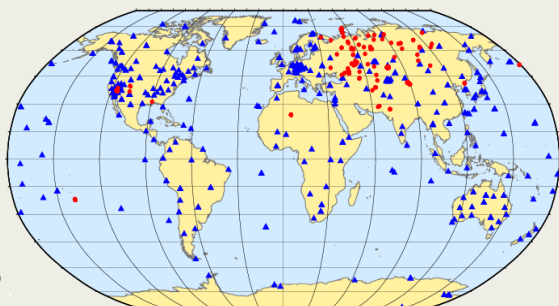
The “Waveforms From Nuclear Explosions (WFNE)” repository includes detailed information (origin, bulletin, other geophysical data) on all the **2,157** nuclear explosions detonated in the world between 1945 and 2017:

518 atmospheric,  
1931 underground  
8 underwater



Includes:

- 147,486 waveforms for 1,109 of the explosions, recorded at 330 stations in 75 countries;
- station and instrument Information;
- seismic bulletins for 1198 explosions;
- geophysical data and event summaries.



Users can visualize and download waveforms and parametric data. If interested in WFNE data, please request access at: <https://www.wfne.info/>

## Methods/Data

**2023 SnT:** opened access to WFNE repository.

- Included “Nuclear Explosion Database (NEDB)” content and geophysical data, waveforms and bulletins collected from open sources: CTBTO IDC/IMS, ISC, FDSN, EIDA, IRIS.

**Since 2023 SnT:**

- High interest from the community
- Over 150 users from 23 countries and CTBTO

- Good feedback
- High data volume added from open sources and legacy data sets of digital data or digitized analog recordings

assembled by different institutions (NE=number of explosions with newly added data, WF=number of newly added waveforms).

Dataset	NE	WF
Western US	104	3,473
Borovoye	356	3,186
LBSN	23	1,534
Blacknest	1,041	60,740
LNN LED	104	1,080

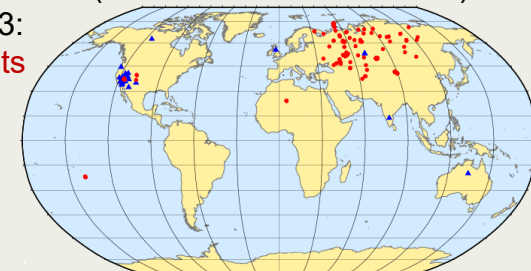
**Procedure** to include new datasets:

- Convert waveforms, station and instrument response consistent with WFNE formats
- QC: estimated first arrival time compared with signal, waveform quality (gaps, constant, noise, etc.)
- Integrate good quality data in WFNE repository and update database content and statistics
- Build “event bundle” for each event
- Update web static and dynamic components

## Results/Conclusions

New waveform data (CSS and SAC formats) were added since 2023:

- for 1,063 tests
- recorded at 24 stations.



### Conclusions

Rich data repository, includes geophysical information and waveforms ranging from digitized analog recordings for the oldest explosions to recent IMS data. Enhanced since 2023:

- Number of waveforms almost doubled: from 77,473 to 147,486
- Number of events with waveforms increased from 677 to 1,109
- Waveforms were added for early tests (in the 1960s or 1970s)
- Waveforms were added for atmospheric tests
- Web presentation enhanced
- WFNE Web interface allows selection and display of any of repository data.
- Information from new sources is being collected and added. Data contributions are invited.

New users are invited!





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## Examples of Newly Added Data in the Last Two Years

## Statistics

1969/09/10 US underground nuclear explosion: web interface for event/stations map, waveform selection and event bundle download.

All waveforms added after 2023 from Blacknest and LBSN data sets



The waveforms marked as "a" under DIGITAL column were digitized from analog media.

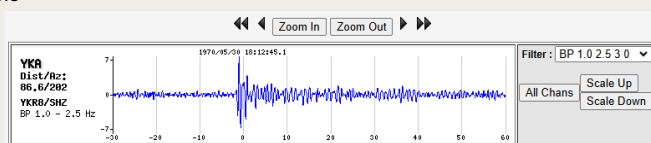
[View Waveforms](#) [Download Event Bundle](#)

M	STA	TRACE	DIGITAL	NCHAN	DELTA (DEG)	DELTA (KM)	AZIMUTH	LAT	LOX	NAME	COUNTRY
<input checked="" type="checkbox"/>	LDS		a	13	4.76	529.83	61.4	37.2425	-113.3514	Leeds, Utah	United States of America
<input checked="" type="checkbox"/>	ELY		a	8	5.39	599.85	84.9	39.1317	-114.8922	Ely, NV	United States of America
<input checked="" type="checkbox"/>	NLS		a	13	6.6	733.91	54	35.7122	-114.8433	Nelson, NV	United States of America
<input checked="" type="checkbox"/>	BMN		a	8	7.2	800.57	95.2	40.4314	-117.2217	Battle Mountain, NV	United States of America
<input checked="" type="checkbox"/>	TPH		a	16	7.37	819.33	76.7	38.075	-117.2225	Tonopah, NV	United States of America
<input checked="" type="checkbox"/>	DAC		a	16	8.24	916.62	64.8	36.2769	-117.5936	Darwin, California	United States of America
<input checked="" type="checkbox"/>	YKA		a	16	23.45	2607.43	167	62.4932	-114.6053	Yellowknife Array	Canada
<input checked="" type="checkbox"/>	EKA		a	18	65.98	7736.43	305.1	55.3332	-3.1588	Eskdalemuir Array, Scotland	United Kingdom
<input checked="" type="checkbox"/>	WRA		a	20	123.67	13751.11	55.3	-19.9426	134.3394	Warramunga Array	Australia

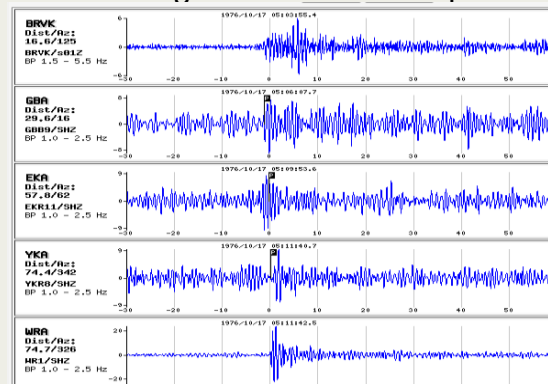
1970/05/30 Polynesia atmospheric nuclear explosion: ISC bulletin and YKA waveform

EVENT	2039 TUAMOTU ARCHIPELAGO REGION																			
Date	Time	Err	RMS	Latitude	Longitude	Smaj	Smin	Az	Depth	Err	Ndef	Nsta	Gsp	mdist	Mdist	Qual	Author			
1970/05/30	17:59:59.93	0.77	1.107	-22.2249	-138.7831	34.98	24.93	143	0.0f		25	25	108	60.48	152.71	m i k x	ISC			
Magnitude	Err	Nsta	Author	OrigID																
mb	4.4	0.1	5	ISC	7533															
Sta	Dist	EvAz	Phase	Time	TRes	Azim	AzRes	Slow	SRes	Def	SNR	Amp	Per	Qual	Magnitude	ErrID				
TUC	60.48	27.2	P	18:10:12.000	0.2											26137555				
TFQ	61.98	25.7	P	18:10:23.000	1.6							1.4	mb	4.6	26137556					
JAS	62.29	16.3	P	18:10:25.200	1.3									cs	26137557					

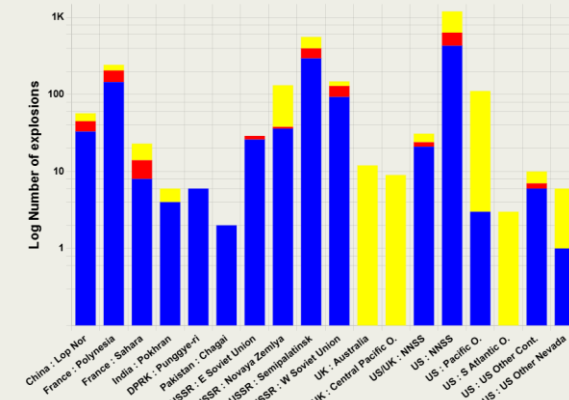
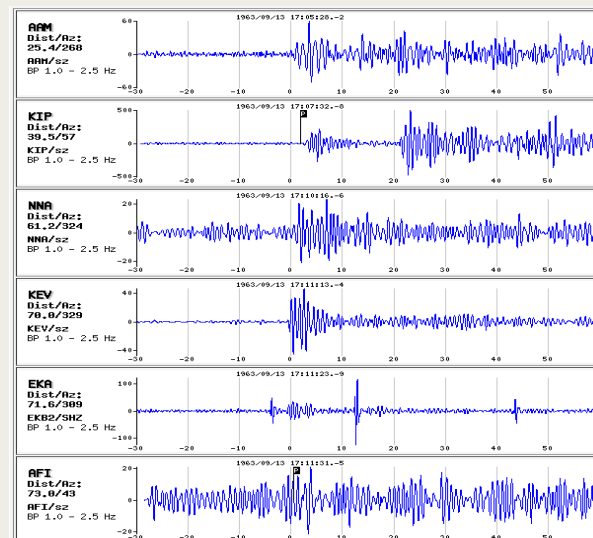
... 25 stations



1976/10/17 China underground nuclear explosion: all waveforms added after 2023 from Blacknest and Borovoye data sets



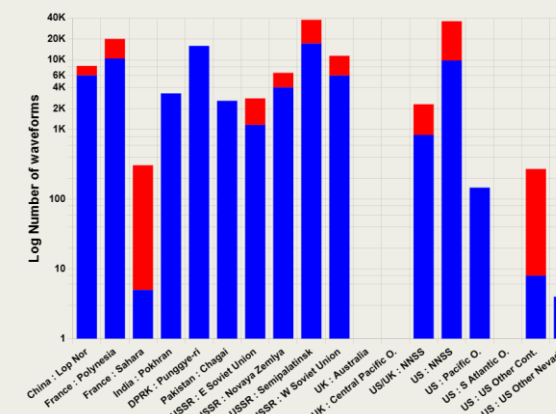
1963/09/13, US: one of oldest explosions with waveforms in WFNE. EKA data newly added



Total no. events  
677  
432  
1048

Number of explosions (log scale) for each test site with waveforms collected:

■ prior 2023 ■ since 2023 ■ no waveforms



Total number waveforms  
77,473  
70,013

Number of waveforms (log scale) for each test site