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

O2.4-879

Sustainable preservation of analogue seismic data in Germany – Digitization test and reference event source parameters

Galina Kulikova[1], Frank Krüger[1], Celine Hadziioannou[2]

1) UP Transfer GmbH at the University of Potsdam
2) Institute of Geophysics, University of Hamburg

11 September 2025

Sustainable preservation of analogue seismic data in Germany – Digitization test and reference event source parameters

Galina Kulikova

O2.4-879

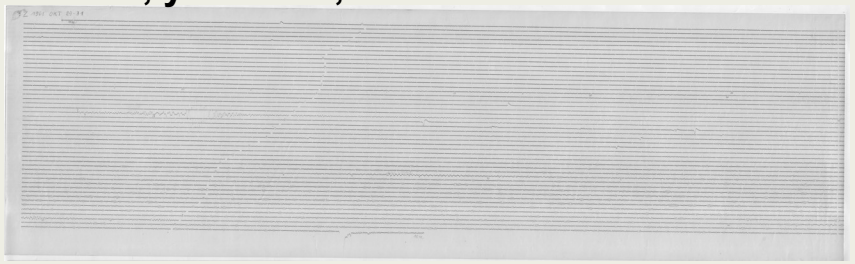
Motivation

1889 ... mid-1970s ⇒ Analogue seismic records ⇒ ~90y

mid-1970s ... 2025 ⇒ Digital seismic records ⇒ ~50y
Representative?

- Most of the world's largest earthquakes were recorded only by analogue instruments.
- The majority of nuclear tests occurred during the analogue seismic era.

The analog seismic recording of the Potsdam station, year 1961, Galitzin instrument



The analog seismic recording of the Hamburg station, year 1911, Wiechert instrument

Sustainable preservation of analogue seismic data in Germany – Digitization test and reference event source parameters

Galina Kulikova

O2.4-879

Project introduction

MAIN GOAL: Estimate the effort required for the sustainable preservation, digitization and **open access** of analogue seismic data in Germany.

1. WP1 – Data Inventory
   - Compilation of an analogue seismic catalogue
2. WP2 – Digitization Test Procedure
   - Time-limited trial with scanning and partial vectorization to estimate workload and support manual drafting.
3. WP3 – Working Plan
   - Strategy for the preservation and digitization of analogue seismograms

*This project is funded by BGR..

BGR Bundesanstalt für Geowissenschaften und Rohstoffe

Universität Potsdam

UH

up TRANSFER GmbH

Sustainable preservation of analogue seismic data in Germany – Digitization test and reference event source parameters

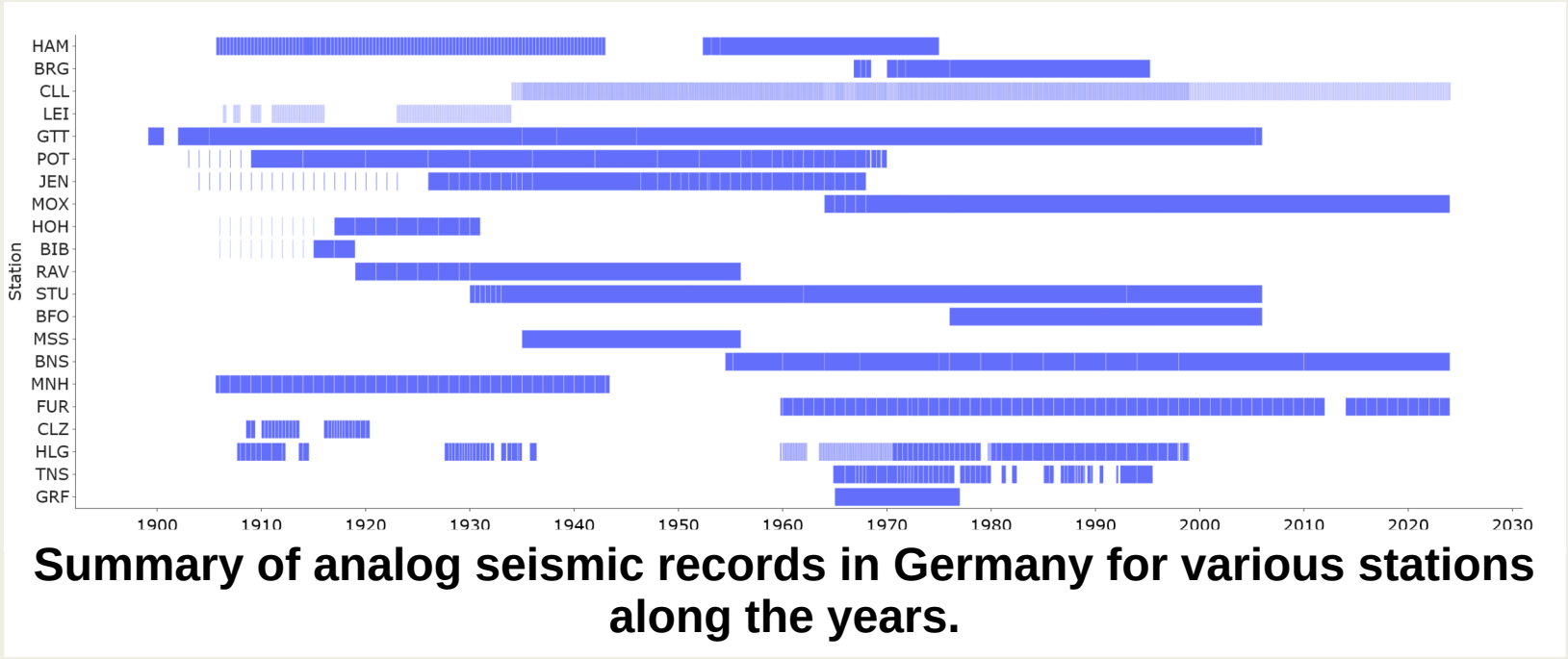
Galina Kulikova

O2.4-879

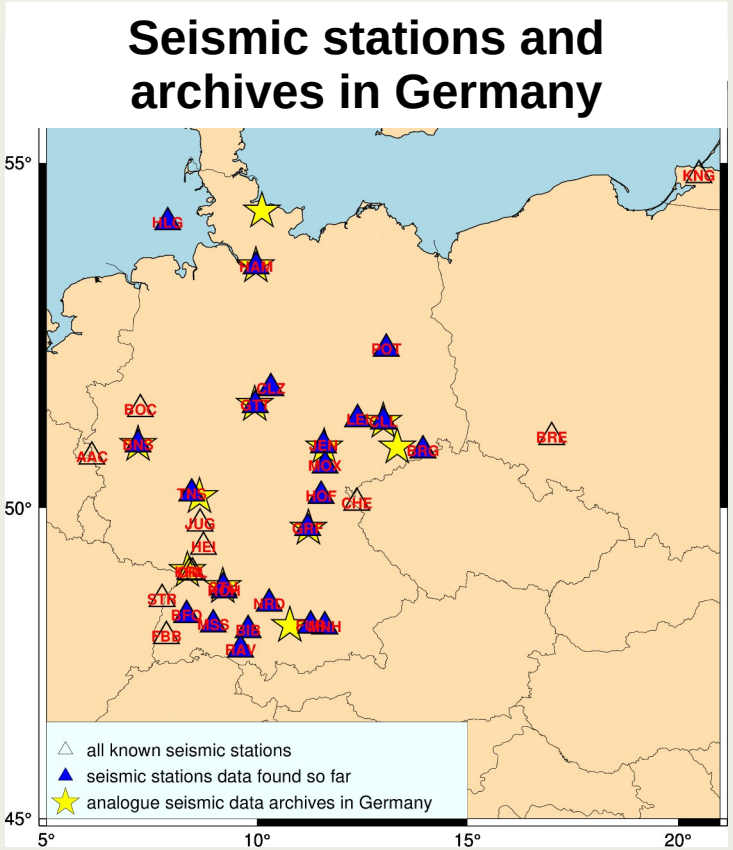
Data inventory (Analogue seismic catalogue)

First Step – Data inventory:

- Visit to the archives (12 Archives)
- A detailed account of the contents found in the archives



Summary of analog seismic records in Germany for various stations along the years.



Danger!

up TRANSFER GmbH

Sustainable preservation of analogue seismic data in Germany – Digitization test and reference event source parameters

Galina Kulikova

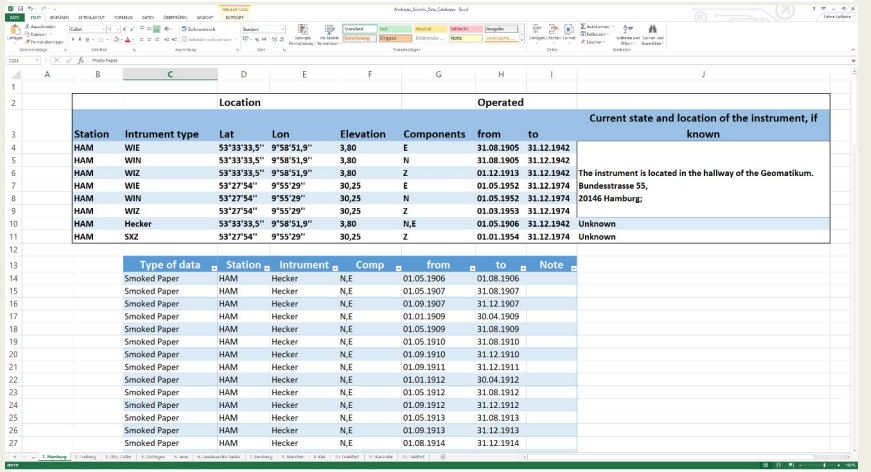
O2.4-879

Analogue seismic catalogue

Analogue Seismic Data Catalogue for German Archives

- Archive overview
- Descriptions of seismic instruments and metadata
- Count of seismic recordings (paper, smoked paper, photographic paper)
- Available supplementary data (clock corrections, station logs)
- List of additional analogue data (photo films, magnetic tapes, etc.)

A sample sheet of the analog seismic data catalogue. Example seismic station Hamburg.



		Location			Operated		
Station	Intrument type	Lat	Lon	Elevation	Components	from	to	Current state and location of the instrument, if known
HAM	WIE	53°33'33,5"	9°58'51,9"	3,80	E	31.08.1905	31.12.1942	
HAM	WIN	53°33'33,5"	9°58'51,9"	3,80	N	31.08.1905	31.12.1942	
HAM	WIZ	53°33'33,5"	9°58'51,9"	3,80	Z	01.12.1913	31.12.1942	The instrument is located in the hallway of the Geomatikum.
HAM	WIE	53°27'54"	9°55'29"	30,25	E	01.05.1952	31.12.1974	Bundesstrasse 55,
HAM	WIN	53°27'54"	9°55'29"	30,25	N	01.05.1952	31.12.1974	20146 Hamburg;
HAM	WIZ	53°27'54"	9°55'29"	30,25	Z	01.03.1953	31.12.1974	
HAM	Hecker	53°33'33,5"	9°58'51,9"	3,80	N,E	01.05.1906	31.12.1942	Unknown
HAM	SXZ	53°27'54"	9°55'29"	30,25	Z	01.01.1954	31.12.1974	Unknown

Type of data	Station	Intrument	Comp	from	to	Note
Smoked Paper	HAM	Hecker	N,E	01.05.1906	01.08.1906	
Smoked Paper	HAM	Hecker	N,E	01.05.1907	31.08.1907	
Smoked Paper	HAM	Hecker	N,E	01.09.1907	31.12.1907	
Smoked Paper	HAM	Hecker	N,E	01.01.1909	30.04.1909	
Smoked Paper	HAM	Hecker	N,E	01.05.1909	31.08.1909	
Smoked Paper	HAM	Hecker	N,E	01.05.1910	31.08.1910	
Smoked Paper	HAM	Hecker	N,E	01.09.1910	31.12.1910	
Smoked Paper	HAM	Hecker	N,E	01.09.1911	31.12.1911	
Smoked Paper	HAM	Hecker	N,E	01.01.1912	30.04.1912	
Smoked Paper	HAM	Hecker	N,E	01.05.1912	31.08.1912	
Smoked Paper	HAM	Hecker	N,E	01.09.1912	31.12.1912	
Smoked Paper	HAM	Hecker	N,E	01.05.1913	31.08.1913	
Smoked Paper	HAM	Hecker	N,E	01.09.1913	31.12.1913	
Smoked Paper	HAM	Hecker	N,E	01.08.1914	31.12.1914	

~ 1.6 Million Seismograms

Sustainable preservation of analogue seismic data in Germany – Digitization test and reference event source parameters

Galina Kulikova

O2.4-879

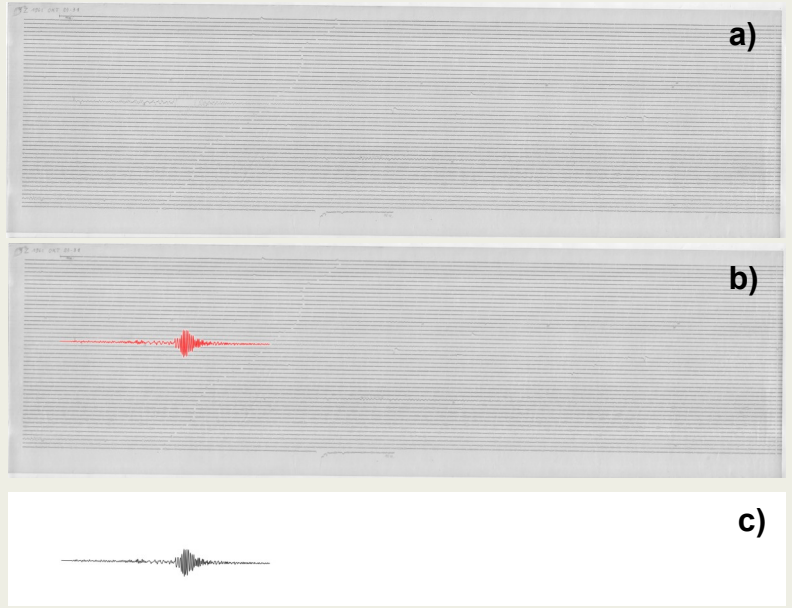
Digitization test

*Under digitization, we comprehend the two-step process:

1)Scanning

2)Vectorizing

- We have performed a digitization test on a portion of the analogue data (3 test events,3 seismic stations,3 months period)
- The data were collected, scanned, and vectorized.
- We have tested three vectorization tools (among many others) and have provided recommendations regarding them.



Seismic record of the atmospheric nuclear explosion on October 30, 1961 (Tsar Bomba).
a) Original scanned record
b) the record traced with GIMP Path tool,
c) extracted event record as a vector graphic.

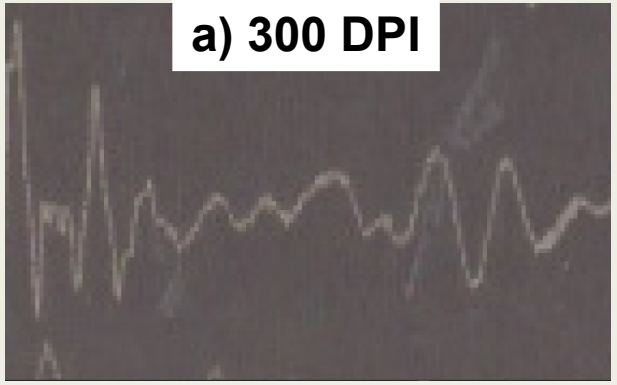
Sustainable preservation of analogue seismic data in Germany – Digitization test and reference event source parameters

Galina Kulikova

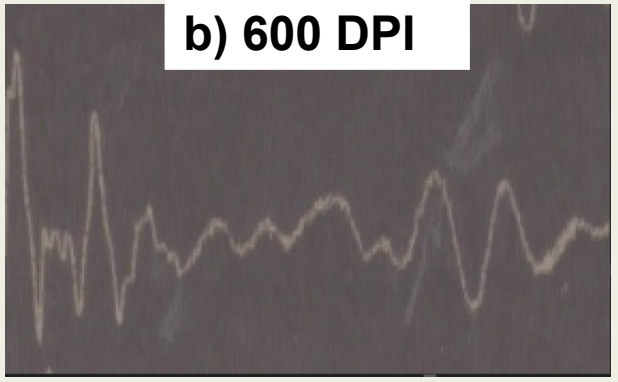
O2.4-879

Scanning and vectorizing test - Examples of digitisation results for the images with higher and lower resolution.

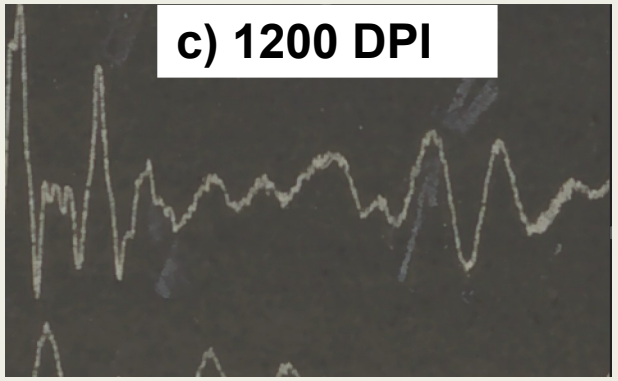
a) 300 DPI



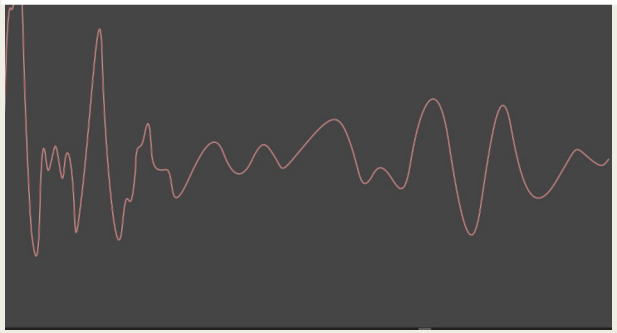
b) 600 DPI



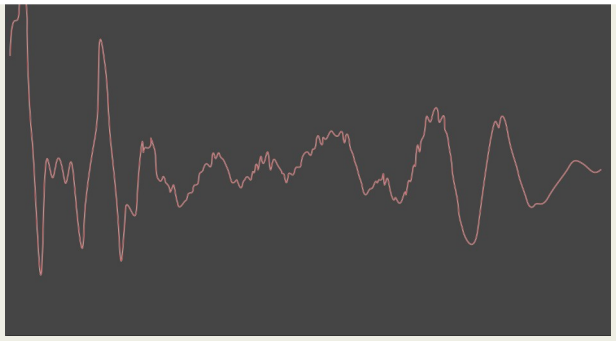
c) 1200 DPI



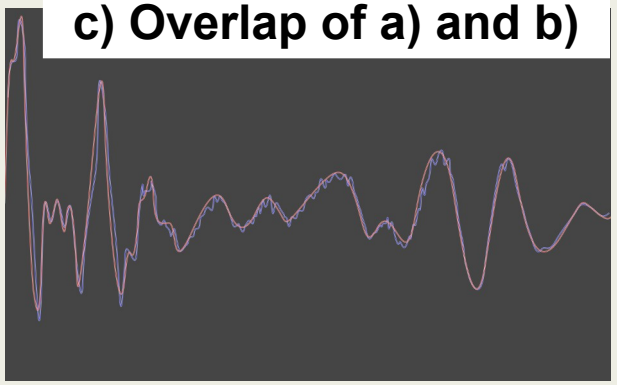
a) 300 DPI image vectorized



b) 1200 DPI image vectorized



c) Overlap of a) and b)



Sustainable preservation of analogue seismic data in Germany – Digitization test and reference event source parameters

Galina Kulikova

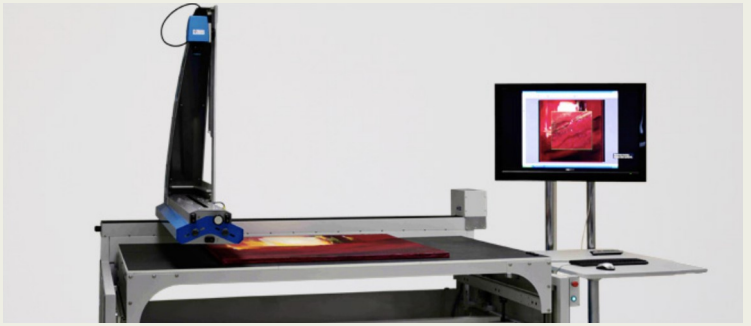
O2.4-879

Tested scanning parameters

Resolution	Color depth	Scanning time	Size of the scanned image
300 dpi	24 bit, color	0m 20sec	200 MB
600 dpi	8 bit, GS	0m 22sec	250 MB
600 dpi	**24 bit, color**	**1m 05sec**	**660 MB**
1200 dpi	8 bit, GS	1m 30sec	1.0 GB
1200 dpi	**24 bit, color**	**5m 20 sec**	**2.4 GB**
2400 dpi	8 bit, GS	24m 20 sec	5 GB

Summary of reference scanning parameters combinations for an A0 size scan (3 to 5 seismograms at once).

Examples of A0 scanner



up TRANSFER GmbH

Sustainable preservation of analogue seismic data in Germany – Digitization test and reference event source parameters

Galina Kulikova

O2.4-879

Work package 3 - Working plan development

Working Plan: Preservation and Digitization of Analogue Seismograms

3.1 Summary of international experience

3.2 Estimation of digitization effort:

- Time
- Personnel
- Hardware
- Coordination

3.3 Proposal for a web service to access digitized records and digital catalogues of analogue seismic data

3.4 Overview of potential funding opportunities

Danger!

Sustainable preservation of analogue seismic data in Germany – Digitization test and reference event source parameters

Galina Kulikova

O2.4-879

Summary

- Analogue seismic data are a unique scientific resource. We risk of losing ~90 years of data without preservation
- Preliminary inventory in Germany:
  - ~1.6 million seismograms + metadata
- Preserving and digitizing analogue seismic data is a major challenge, but this study marks an important first step toward addressing it.
- **Information outreach matters!**
  - **First success: Collm Observatory archive rescued**

Collm Observatory

Sustainable preservation of analogue seismic data in Germany – Digitization test and reference event source parameters

Galina Kulikova

O2.4-879

Acknowledgement

I sincerely thank:

- Our colleagues participating in this project and guiding us through their archives
- Everyone working on the preservation of historical data
- All those who maintain seismic data archives worldwide
- Those who initiate and lead projects aimed at collecting and digitizing analogue seismograms and related literature

Thank you!

Wiechent instrument located in Moxa Observatory in Germany