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

A Seiscomp pipeline for seismo-acoustic events

Jelle Assink, Simon Schneider, Gert-Jan van den Hazel and Läslo Evers
Royal Netherlands Meteorological Institute (KNMI)

Bernd Weber
gempa GmbH

Royal Netherlands Meteorological Institute
Ministry of Infrastructure and Water Management

gempa

SeisComP

INTRODUCTION AND MAIN RESULTS

In this presentation we present a recent development of a pipeline in Seiscomp for the automatic processing and localisation of seismo-acoustic events. We present the design of the pipeline, discuss various example cases and show event statistics. We also preview the upcoming extension of the Dutch seismo-acoustic network.

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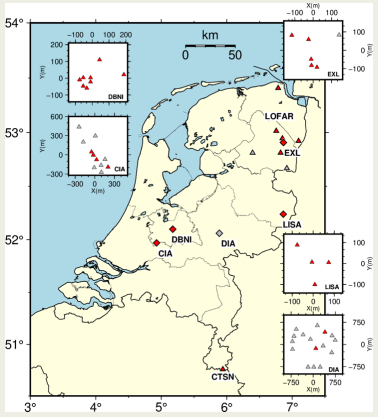
P2.2-352

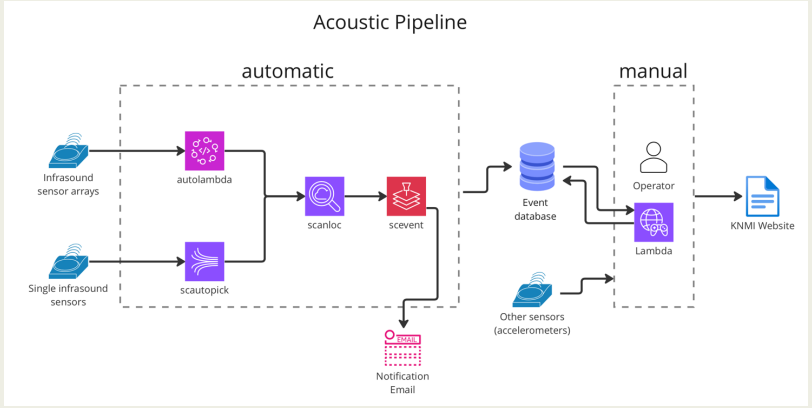
Introduction

The department of Seismology and Acoustics (RDSA) at the Royal Netherlands Meteorological Institute (KNMI) monitors seismic and acoustic activity in the Netherlands with a dense network of seismometers and infrasound sensors. An important motivation for measuring infrasound in the Netherlands is to discriminate between vibrations originating from the solid earth, e.g. earthquakes, and from the atmosphere, e.g. sonic booms and explosions. This information is used to inform the general public. In this presentation we present a recent development to develop a pipeline in Seiscomp for the automatic processing and localisation of seismo-acoustic events. The pipeline is running in parallel to existing seismic pipelines in Amazon Web Services (AWS).



(left) Map showing the location of Dutch infrasound arrays / stations. All data is freely available via rdsa.knmi.nl and eida.orfeus-eu.org:18000
(right) Photo of an infrasound element of the De Bilt (DBN) array showing sensor and wind-noise reduction filter (dome)

Methods/Data



Design of the Seiscomp pipelines for seismo-acoustic processing

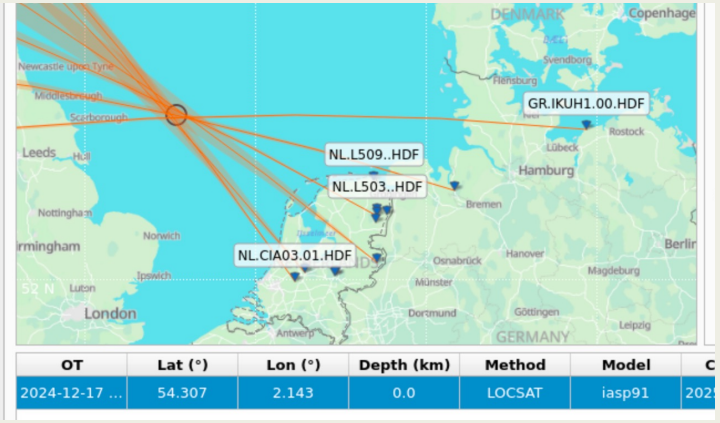
Seedlink and FDSN webservices are used to access real-time and archived waveform data, respectively.

Waveform data is automatically processed in the 2-8 Hz band: **(auto)lambda** (beampacking) provides detections for array stations, **scautopick** (STA/LTA) for single infrasound sensors.

The **scanloc** module combines (clusters) infrasound detections and, through LOCSAT, provides an origin. To reduce bogus events, filter are applied on slowness / back azimuth data (via scanloc/scevent C++ plugins). With the formation of an event, an e-mail is sent out.

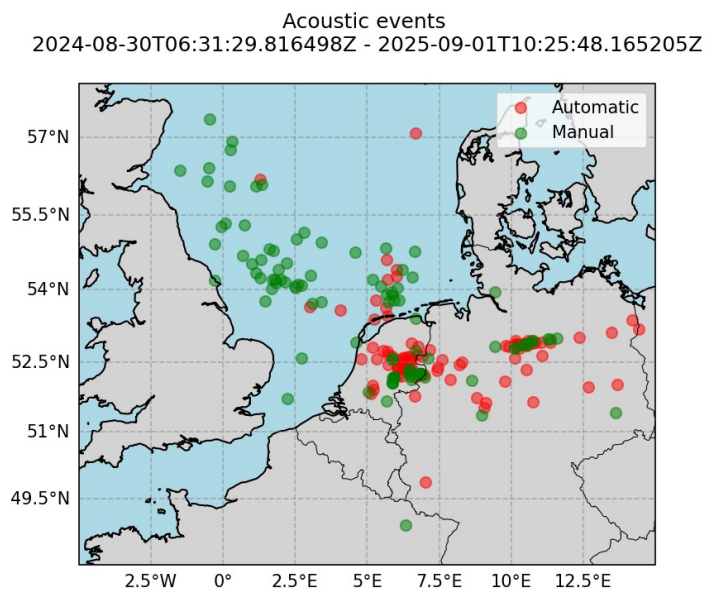
The automatic event can then be re-analyzed using the **Lambda** analysis tool. Various array processors are available (Beampacking/FK/PMCC).

Results



OT	Lat (°)	Lon (°)	Depth (km)	Method	Model	C
2024-12-17 ...	54.307	2.143	0.0	LOCSAT	iasp91	202

(top) Example analysis of a sonic boom on 17 Dec 2024.
See next slide(s) for further detail.
(bottom) One year of automatic and reviewed events.



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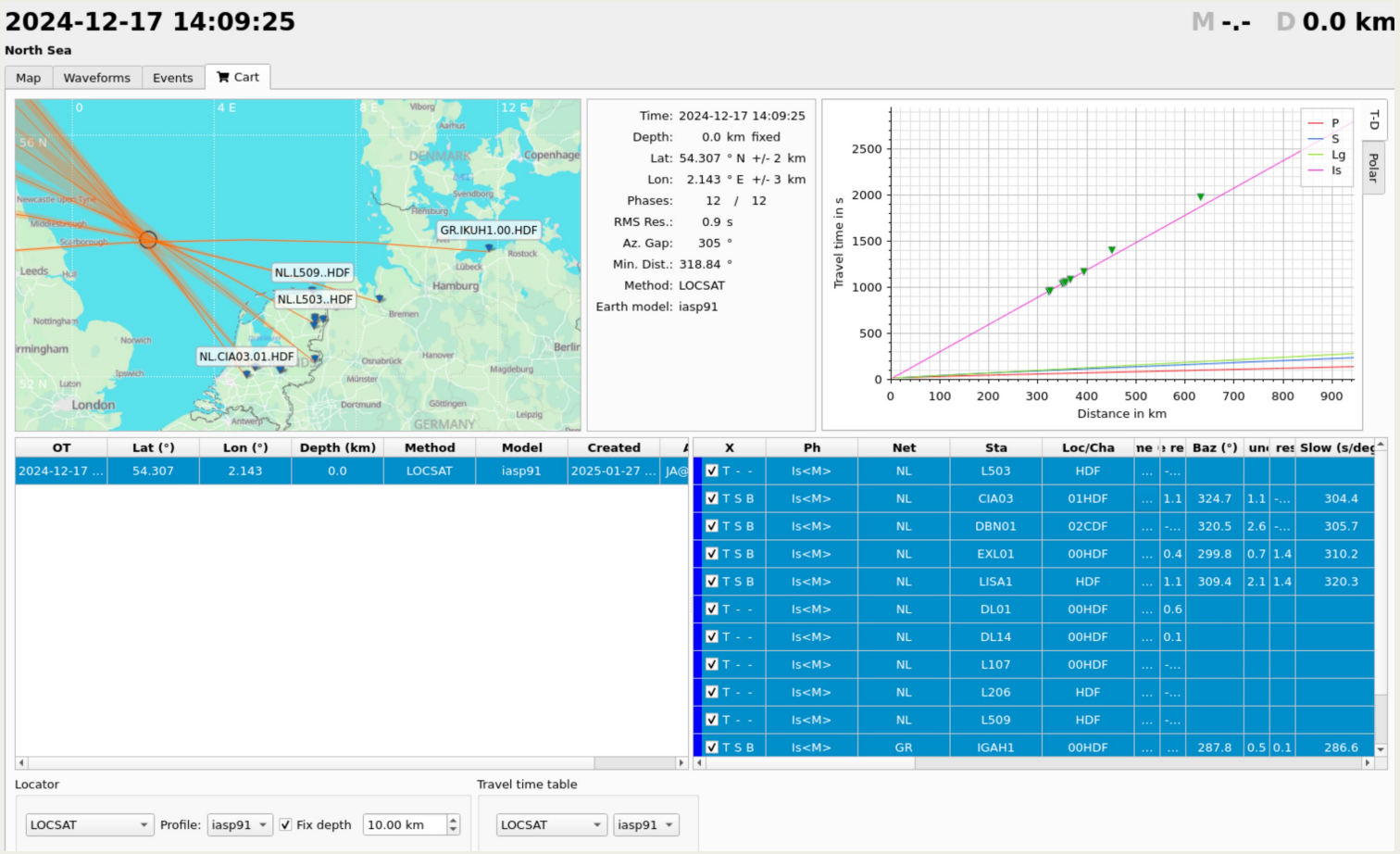
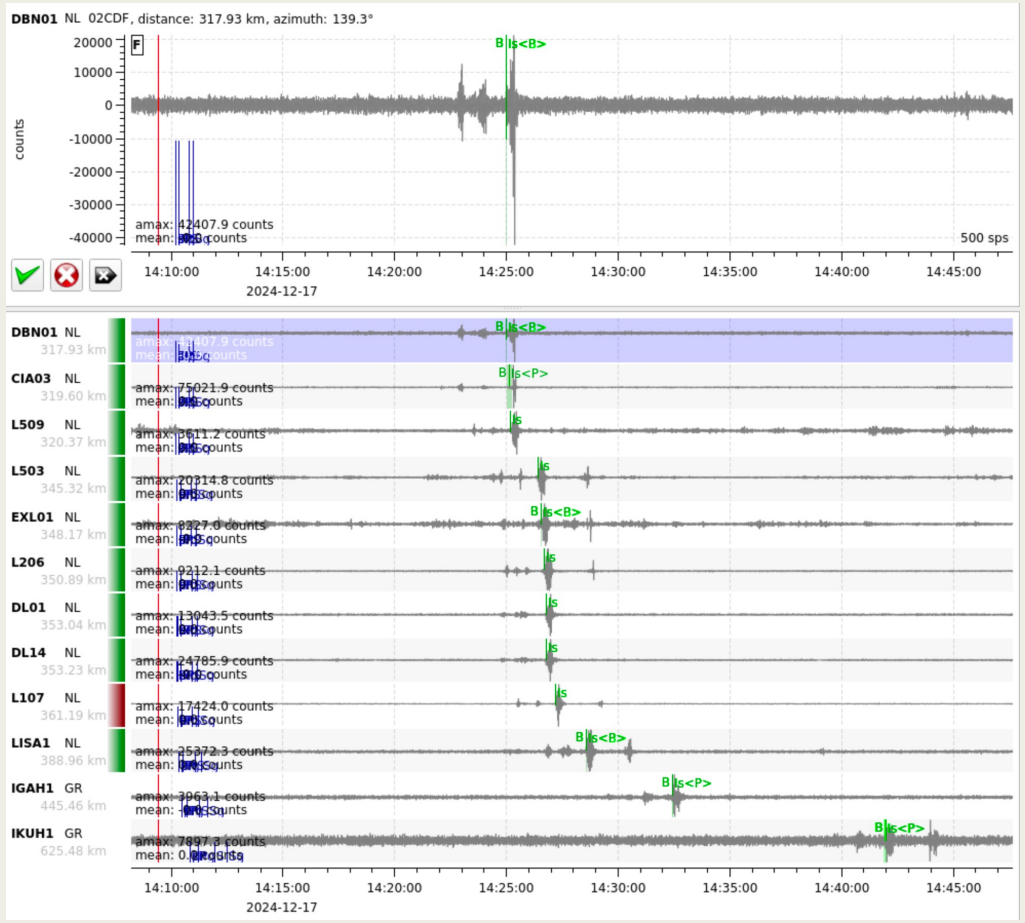
2024-12-17 Sonic boom event





We acknowledge Patrick Hupe, Christoph Pilger and colleagues at BGR for providing access to the GR infrasound network

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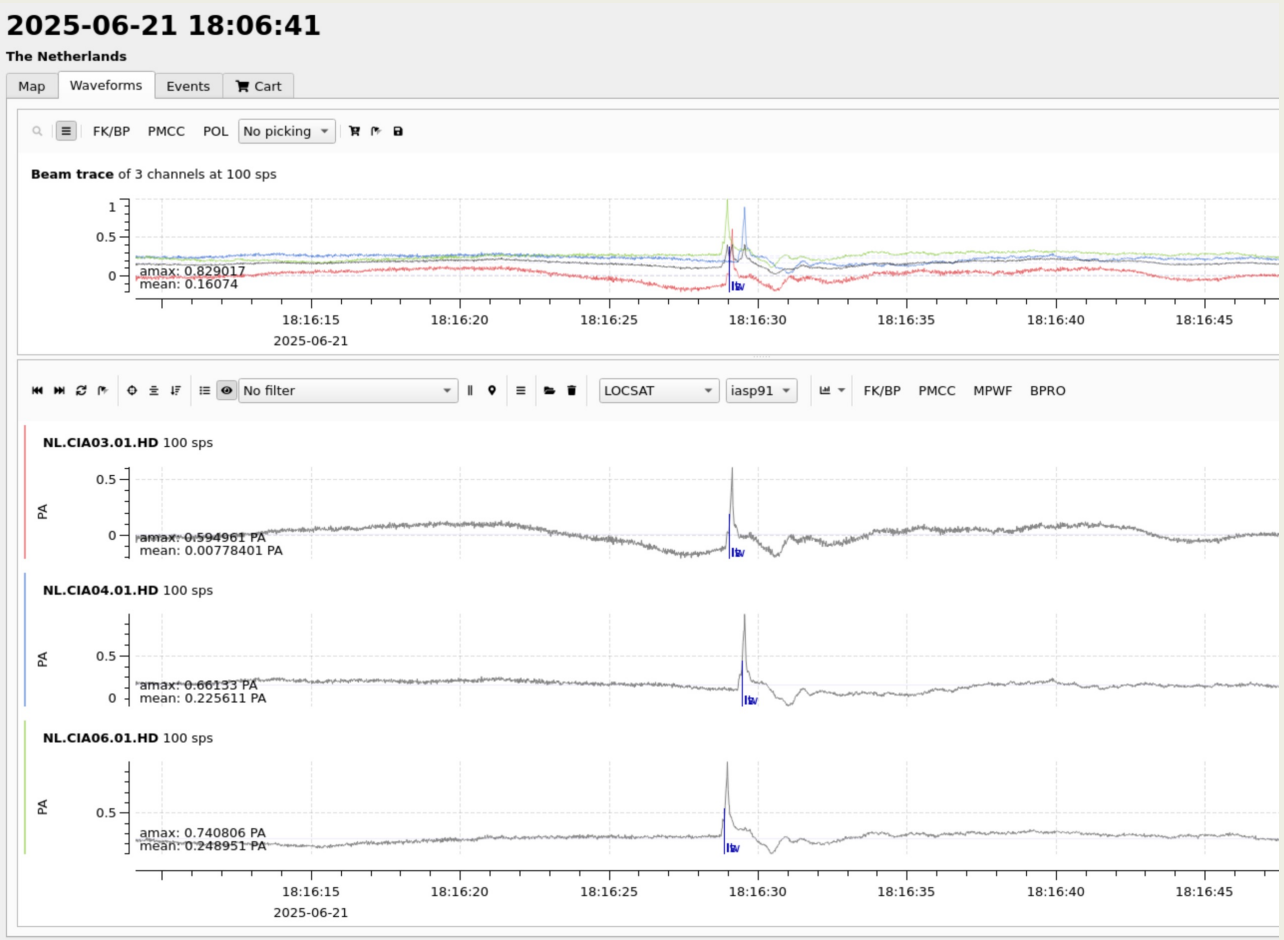
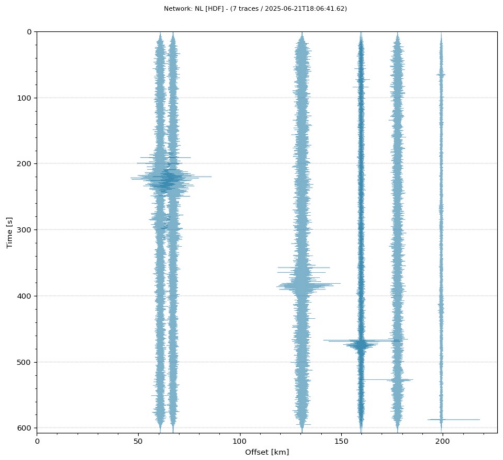
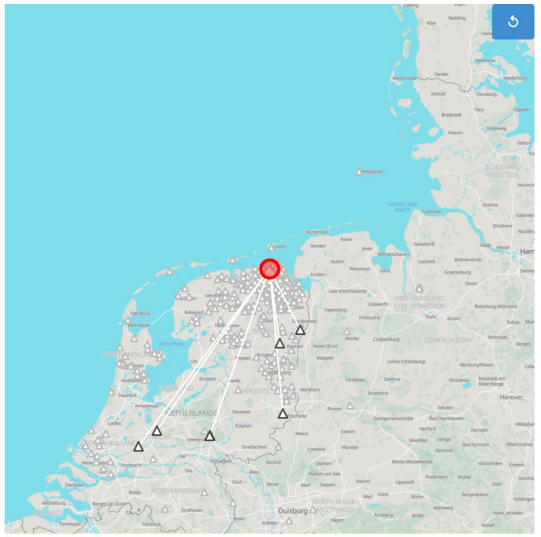
P2.2-352

2025-06-21 Fireball event



Evaluation	Origin Time (UTC)	Magnitude	Event Type	Latitude	Longitude	Depth (km)	Location	RMS	Phases
manual	2025-06-21 18:06:41	-	Overig	53.41	6.686	0.0	Uithuizen	4.08	7





Station	Network	Distance (km)	Pick Mode	Phase	Time (UTC)	Residual (s)	Pha Weigh	Magnitude	Mag Weight
L107	NL	61.0	manual	Is	18:09:38.666	-2.36	1.0	-	-
L206	NL	67.3	manual	Is	18:10:08.067	8.62	1.0	-	-
LISA1	NL	131.0	manual	Is	18:13:02.935	-3.64	1.0	-	-
DL01	NL	159.8	manual	Is	18:14:28.603	-2.79	1.0	-	-
DL14	NL	160.4	manual	Is	18:14:30.560	-2.67	1.0	-	-
DBN01	NL	178.2	manual	Is	18:15:28.380	2.91	1.0	-	-
CIA03	NL	199.8	manual	Is	18:16:28.965	-0.07	1.0	-	-

Number of phases: 7

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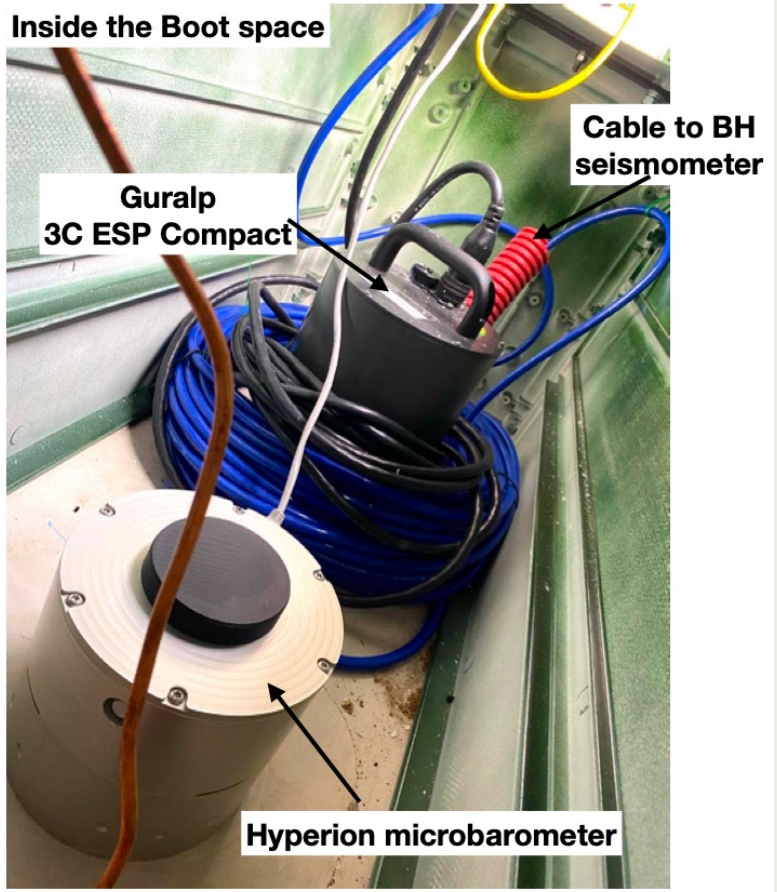
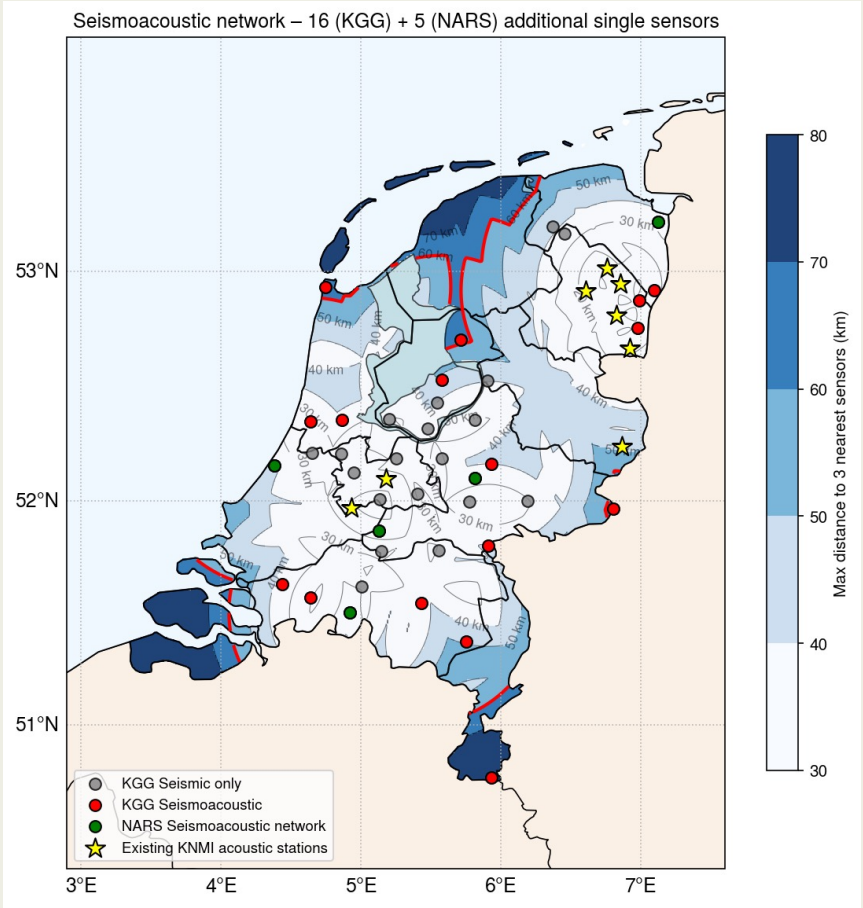
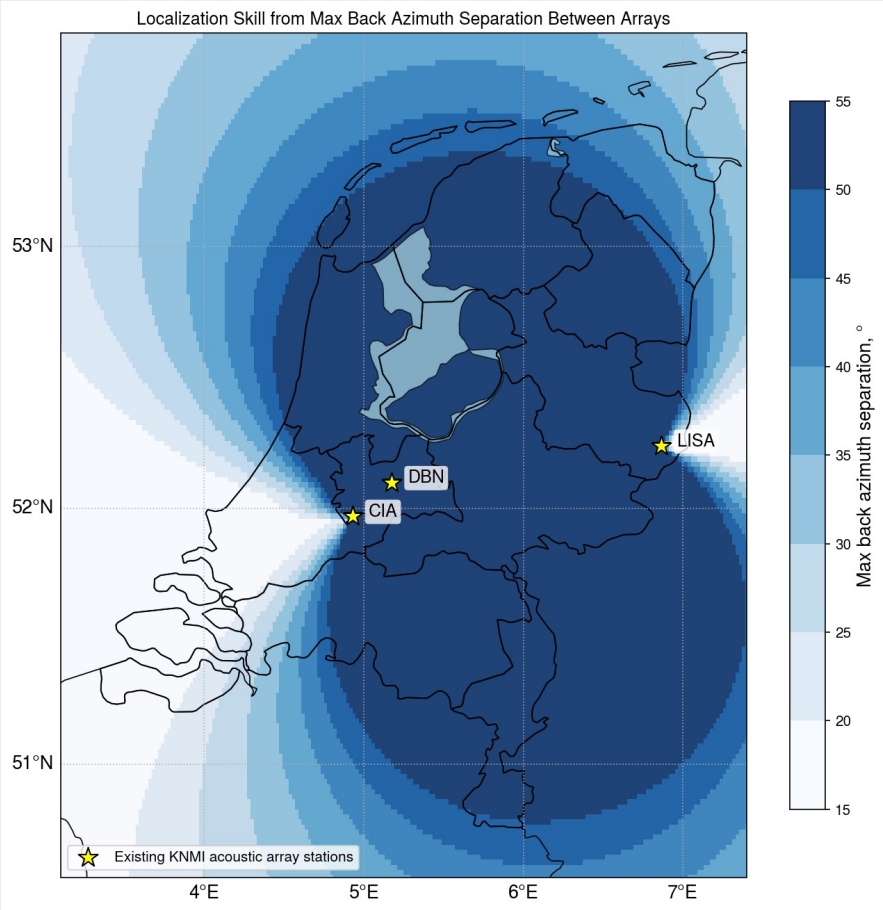
Seismoacoustic station CTSN



Expansion of the seismo-acoustic network





KNMI is expanding its seismo-acoustic network over the next few years, working towards a national seismic network with an interstation distance of ~30 km. At a selection of sites, we will co-locate microbarometers. We are currently working on optimizing our network design to reach optimal coverage.

Photo courtesy of Shahar Shani-Kadmiel (KNMI)