Interreg North Sea Region Jomopans European Regional Development Fund EUROPEAN UNION

JOMOPANS

JOINT MONITORING PROGRAMME FOR AMBIENT NOISE IN THE NORTH SEA

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Rijkswaterstaat
Ministerie van Infrastructuur en Waterstaat

A permanent underwater sound monitoring station in Belgian North Sea
The Westhinder measurement pile experience

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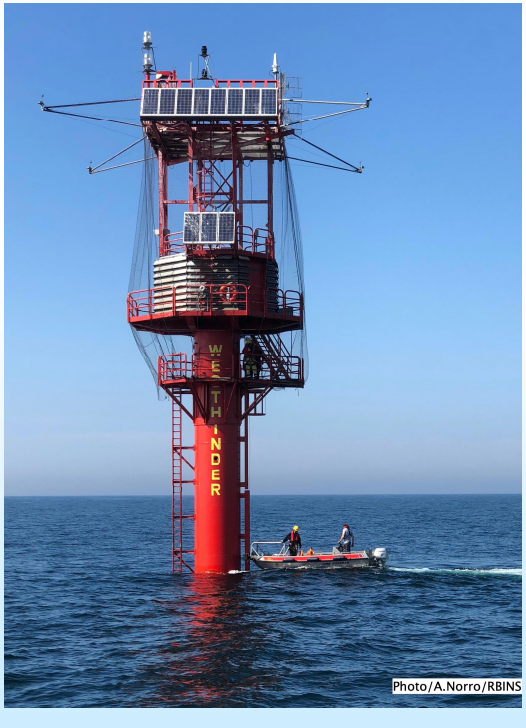
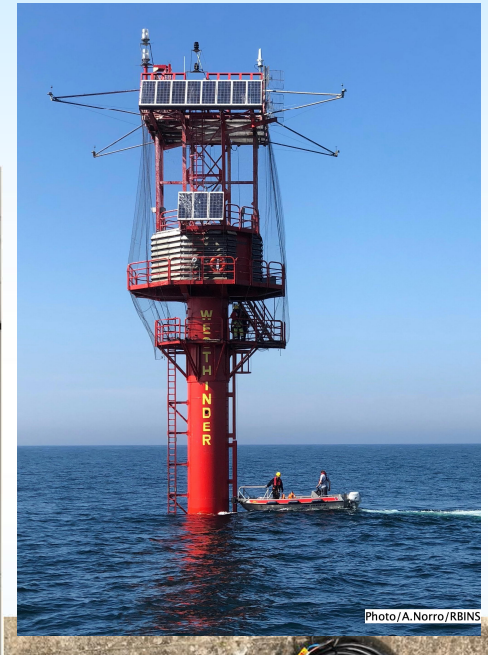
JOMOPANS - Project (2018-2021)

- for MSFD purposes D11C2 ambient sound, 13 measuring sites, one in Belgium water
- For the first time, a continuous measurement station was installed at Westhinder measuring pile end May 2019

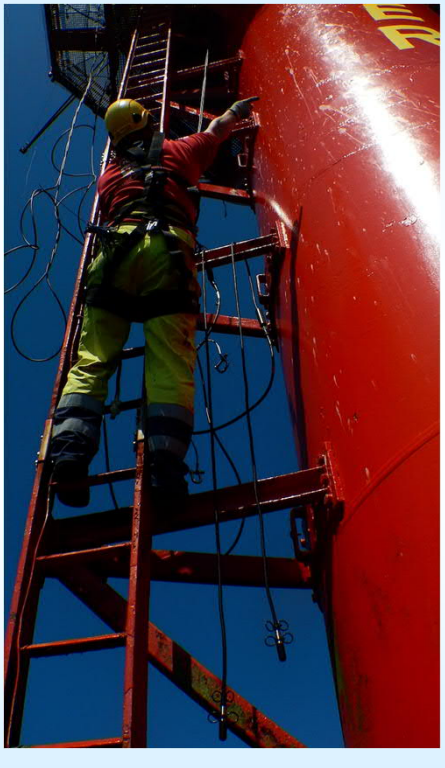


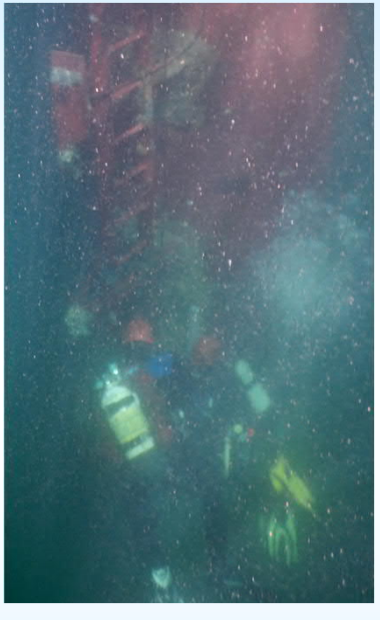
The Station
RTsys EA-SDA-14 / cabled Hydrophones B&K 8104

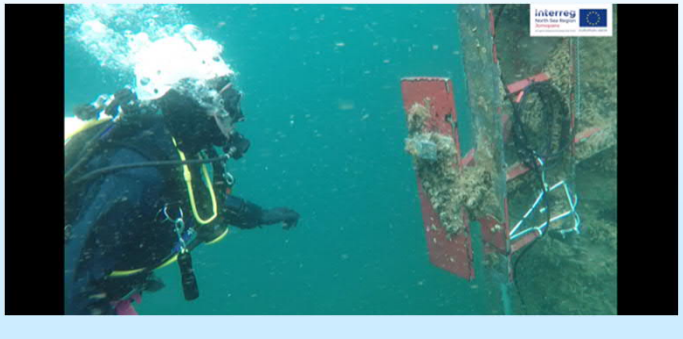


The Station
RTsys EA-SDA-14 / cabled Hydrophones B&K 8104

- Cables are used to connect the station to the hydrophone
  One is close to the monopile (4 m depth) the other on is on the seafloor away from the pile and by 12 m depth





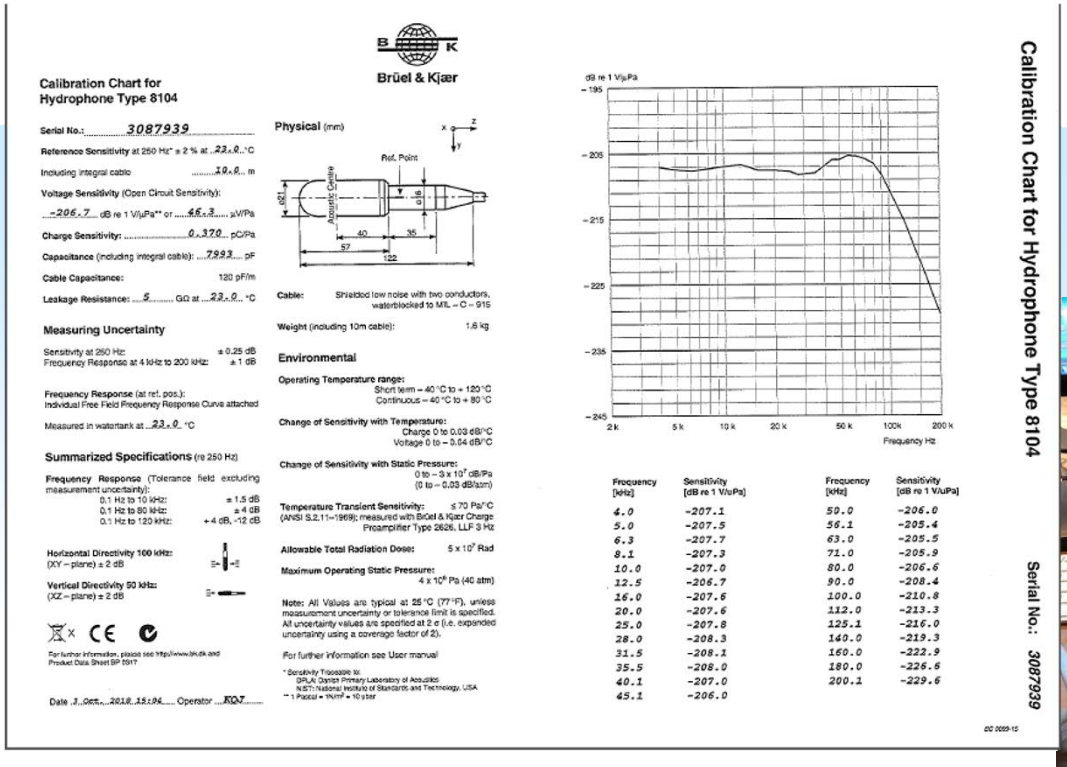


The Station
RTsys EA-SDA-14 / cabled Hydrophones B&K 8104

- System is Powered in 12 v (9 -14) ~ 6 w from the pile power station

- Transmission by VHF to the shore of a limited number of data every minute. 95 percentile of 1/3 octave level at 63 Hz,125 Hz and 1kHz, size of both hard drives

Calibration



Calibration Chart for Hydrophone Type 8104

Brüel & Kjær

Serial No.: 3087939

Calibration Chart for Hydrophone Type 8104

Serial No.: 3087939

Reference Sensitivity at 250 Hz* ± 2 % at 23.0 °C

Including integral cable 10.0 m

Voltage Sensitivity (Open Circuit Sensitivity):

−206.7 dB re 1 V/µPa** or 46.3 µV/Pa

Charge Sensitivity: 0.370 pC/Pa

Capacitance (including integral cable): 7993 pF

Cable Capacitance: 120 pF/m

Leakage Resistance: 5 GΩ at 23.0 °C

Measuring Uncertainty

Sensitivity at 250 Hz: ± 0.25 dB

Frequency Response at 4 kHz to 200 kHz: ± 1 dB

Frequency Response (at ref. pos.):
Individual Free Field Frequency Response Curve attached

Measured in watertank at 23.0 °C

Summarized Specifications (re 250 Hz)

Frequency Response (Tolerance field excluding measurement uncertainty):

0.1 Hz to 10 kHz: ± 1.5 dB
0.1 Hz to 80 kHz: ± 4 dB
0.1 Hz to 120 kHz: + 4 dB, -12 dB

Horizontal Directivity 100 kHz: (XY – plane) ± 2 dB

Vertical Directivity 50 kHz: (XZ – plane) ± 2 dB

For further information, please see http://www.bk.dk and Product Data Sheet BP 1917

Date 3. Oct. 2018 15:04 Operator RDT

Physical (mm)

Ref. Point

Acoustic Centre

ø21, ø16, 40, 35, 57, 122

Cable: Shielded low noise with two conductors, waterblocked to MIL – C – 915

Weight (including 10m cable): 1.6 kg

Environmental

Operating Temperature range:
Short term – 40 °C to + 120 °C
Continuous – 40 °C to + 80 °C

Change of Sensitivity with Temperature:
Charge 0 to 0.03 dB/°C
Voltage 0 to – 0.04 dB/°C

Change of Sensitivity with Static Pressure:
0 to – 3 x 10^7 dB/Pa
(0 to – 0.03 dB/atm)

Temperature Transient Sensitivity: ≤ 70 Pa/°C
(ANSI S2.11–1969); measured with Brüel & Kjær Charge Preamplifier Type 2626, LLF 3 Hz

Allowable Total Radiation Dose: 5 x 10^7 Rad

Maximum Operating Static Pressure:
4 x 10^6 Pa (40 atm)

Note: All values are typical at 25 °C (77 °F), unless measurement uncertainty or tolerance limit is specified. All uncertainty values are specified at 2 σ (i.e. expanded uncertainty using a coverage factor of 2).

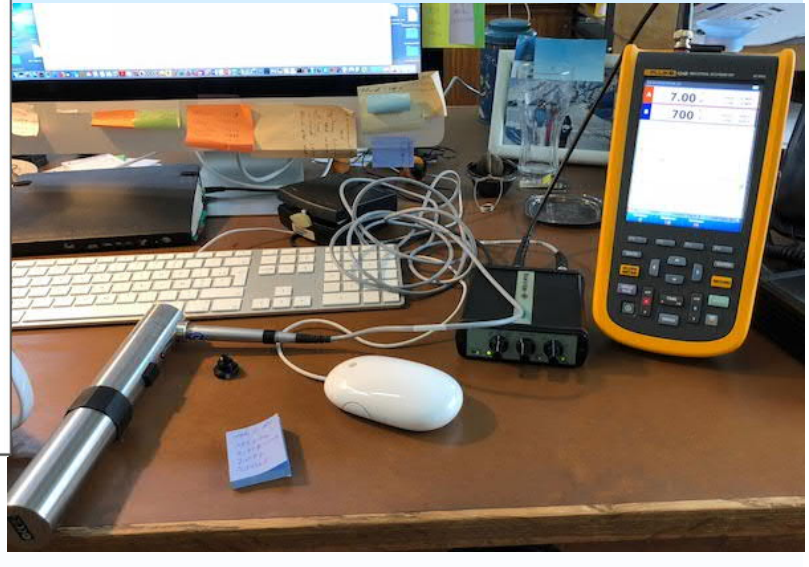
For further information see User manual

* Sensitivity Traceable to:
DPLA: Danish Primary Laboratory of Acoustics
NIST: National Institute of Standards and Technology, USA
** 1 Pascal = 1N/m² = 10 µbar

dB re 1 V/µPa
−195
−205
−215
−225
−235
−245
2 k
5 k
10 k
20 k
50 k
100k
200 k
Frequency Hz

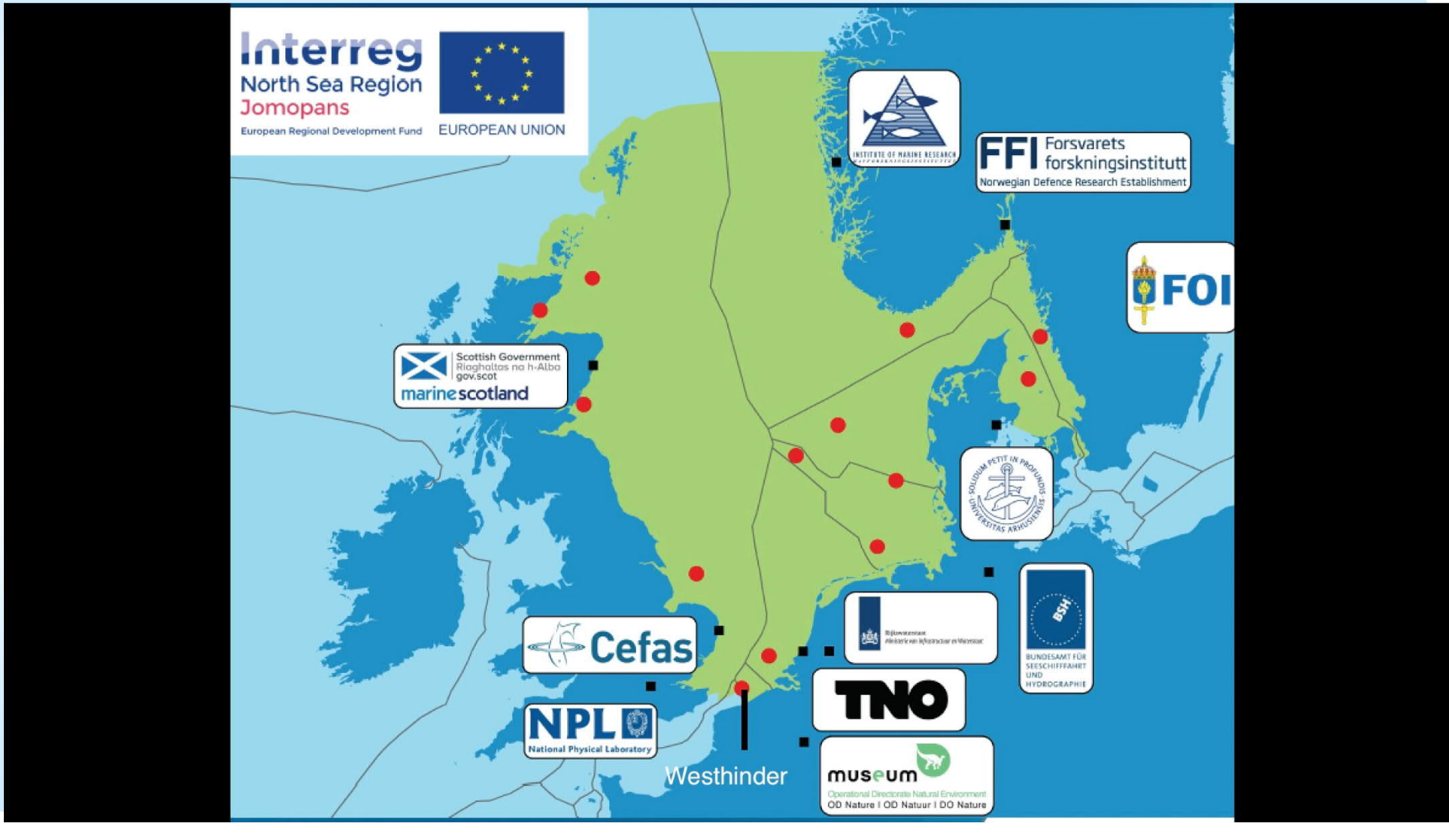
Frequency [kHz]	Sensitivity [dB re 1 V/uPa]	Frequency [kHz]	Sensitivity [dB re 1 V/uPa]
4.0	-207.1	50.0	-206.0
5.0	-207.5	56.1	-205.4
6.3	-207.7	63.0	-205.5
8.1	-207.3	71.0	-205.9
10.0	-207.0	80.0	-206.6
12.5	-206.7	90.0	-208.4
16.0	-207.6	100.0	-210.8
20.0	-207.6	112.0	-213.3
25.0	-207.8	125.1	-216.0
28.0	-208.3	140.0	-219.3
31.5	-208.1	160.0	-222.9
35.5	-208.0	180.0	-226.6
40.1	-207.0	200.1	-229.6
45.1	-206.0		

BD 0059-15



- Hydrophones are fully calibrated after manufacture by B&K
- Acquisition board is calibrated by RTsys after manufacture of the recorder (cross talk & frequency response of every channel)
- The complete system (hydro - amplifier - cable & acquisition board) calibration is further verified at 250Hz with a B&K pistonphone & B&K reference microphone

deployment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Cefas
TNO
NPL
National Physical Laboratory
Westhinder
museum
Operational Directorate Natural Environment
OD Nature | OD Natuur | DO Nature

Information sent to the coast

MP7.BP3_001_MP7JMPBP3001.txt

Westhinder - Measuring pile (UTC time)	Channel B - 63 Hz percentile (Hz)
2019-06-01T00:00:00+00:00	125.00
2019-06-01T00:01:00+00:00	125.00
2019-06-01T00:02:00+00:00	125.00
2019-06-01T00:03:00+00:00	125.00
2019-06-01T00:04:00+00:00	125.00
2019-06-01T00:05:00+00:00	125.00
2019-06-01T00:06:00+00:00	124.00
2019-06-01T00:07:00+00:00	124.00
2019-06-01T00:08:00+00:00	124.00
2019-06-01T00:09:00+00:00	124.00
2019-06-01T00:10:00+00:00	124.00
2019-06-01T00:11:00+00:00	123.00
2019-06-01T00:12:00+00:00	123.00
2019-06-01T00:13:00+00:00	123.00
2019-06-01T00:14:00+00:00	123.00
2019-06-01T00:15:00+00:00	123.00
2019-06-01T00:16:00+00:00	123.00
2019-06-01T00:17:00+00:00	123.00
2019-06-01T00:18:00+00:00	123.00

MP7.BP2_001_MP7JMPBP2001.txt

Westhinder - Measuring pile (UTC time)	Channel B - 125 Hz percentile (Hz)
2019-06-01T00:00:00+00:00	122.00
2019-06-01T00:01:00+00:00	123.00
2019-06-01T00:02:00+00:00	123.00
2019-06-01T00:03:00+00:00	123.00
2019-06-01T00:04:00+00:00	123.00
2019-06-01T00:05:00+00:00	124.00
2019-06-01T00:06:00+00:00	124.00
2019-06-01T00:07:00+00:00	124.00
2019-06-01T00:08:00+00:00	124.00
2019-06-01T00:09:00+00:00	124.00
2019-06-01T00:10:00+00:00	124.00
2019-06-01T00:11:00+00:00	124.00
2019-06-01T00:12:00+00:00	124.00
2019-06-01T00:13:00+00:00	124.00
2019-06-01T00:14:00+00:00	124.00
2019-06-01T00:15:00+00:00	124.00
2019-06-01T00:16:00+00:00	124.00
2019-06-01T00:17:00+00:00	124.00
2019-06-01T00:18:00+00:00	124.00
2019-06-01T00:19:00+00:00	124.00
2019-06-01T00:20:00+00:00	124.00
2019-06-01T00:21:00+00:00	124.00

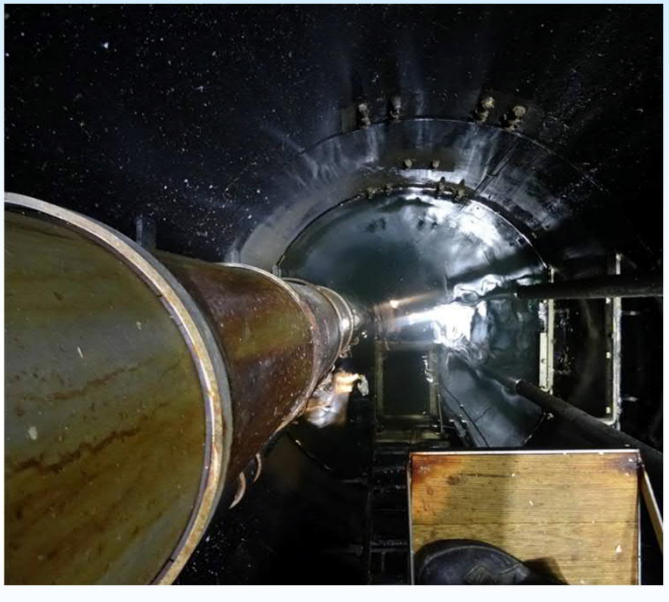
MP7.BP1_001_MP7JMPBP1001.txt

Westhinder - Measuring pile (UTC time)	Channel B - 1 kHz percentile (Hz)
2019-06-01T00:00:00+00:00	116.00
2019-06-01T00:01:00+00:00	116.00
2019-06-01T00:02:00+00:00	116.00
2019-06-01T00:03:00+00:00	116.00
2019-06-01T00:04:00+00:00	116.00
2019-06-01T00:05:00+00:00	116.00
2019-06-01T00:06:00+00:00	116.00
2019-06-01T00:07:00+00:00	116.00
2019-06-01T00:08:00+00:00	116.00
2019-06-01T00:09:00+00:00	116.00
2019-06-01T00:10:00+00:00	116.00
2019-06-01T00:11:00+00:00	116.00
2019-06-01T00:12:00+00:00	116.00
2019-06-01T00:13:00+00:00	116.00
2019-06-01T00:14:00+00:00	116.00
2019-06-01T00:15:00+00:00	116.00
2019-06-01T00:16:00+00:00	116.00

- 95 Percentile of 1/3 Octave band 63 Hz & 125 Hz (D11C2) and 1 kHz
- Size of both hard drive
- Raw data logged on 2 * 4 TB HDD on compressed format

Difficulties-lessons learned

- Hydrophones have been trawled away during covid closure including damages to cables
- Cables are re-routed by the inside of the monopile and are better protected against wave action in an remote off-shore location
- Having a back-up recorder is essential during the development/setup phase of the station
- Access to the hard drive/station is difficult due to weather



Acknowledgements

- MDK – Coastal Division-Flemish Hydrography Johan Vercruysse, Broes Benoot
- Officers and Crew of R/V Belgica and R/V Simon Stevin
- Scientific diving team of RBINS and VLIZ
- Bob Rumes for some of the photos