



# Middelfart Listening Station

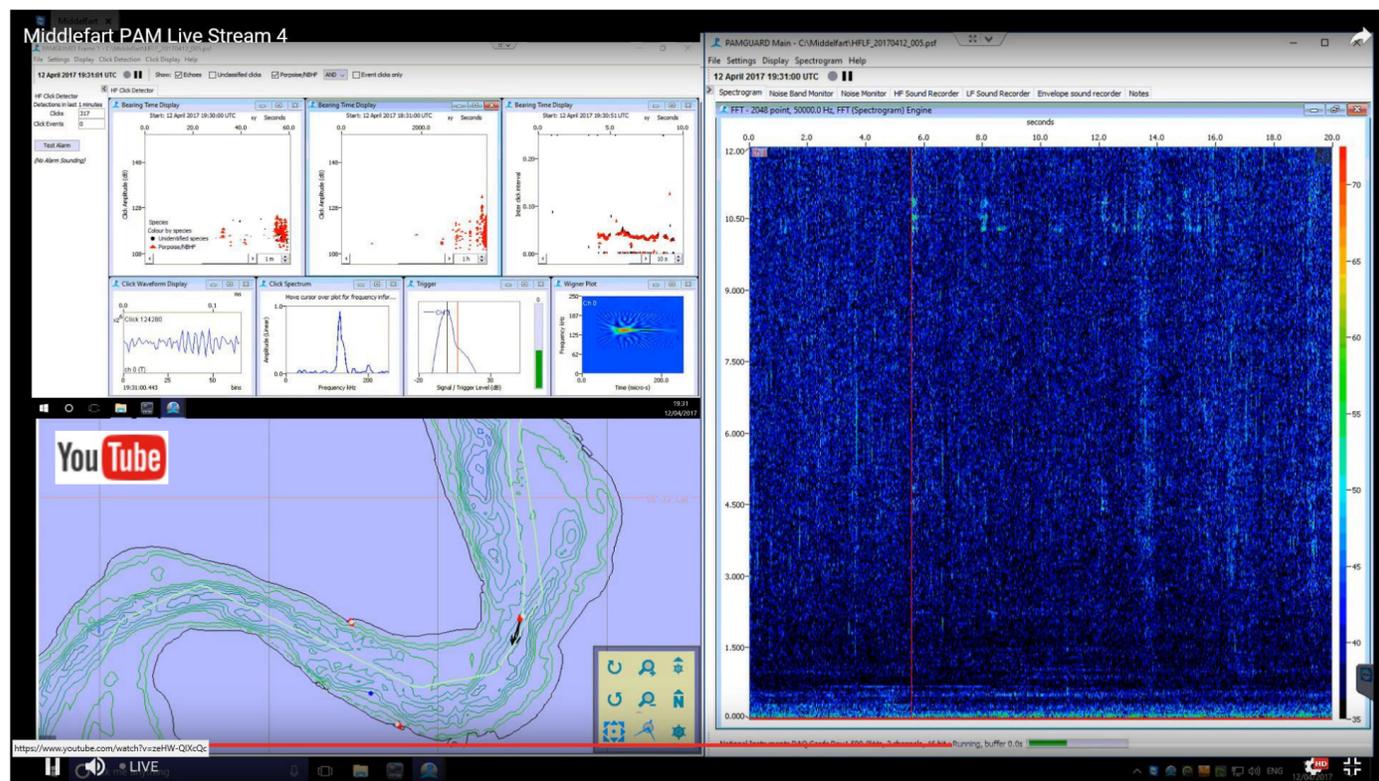
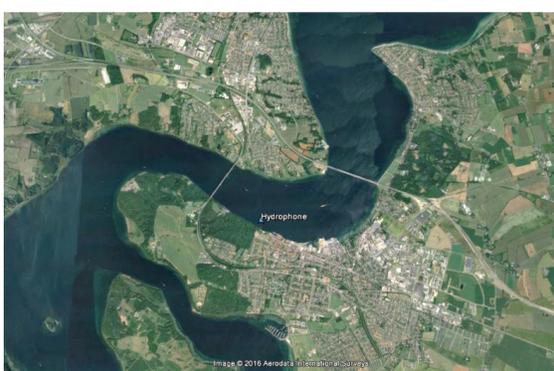


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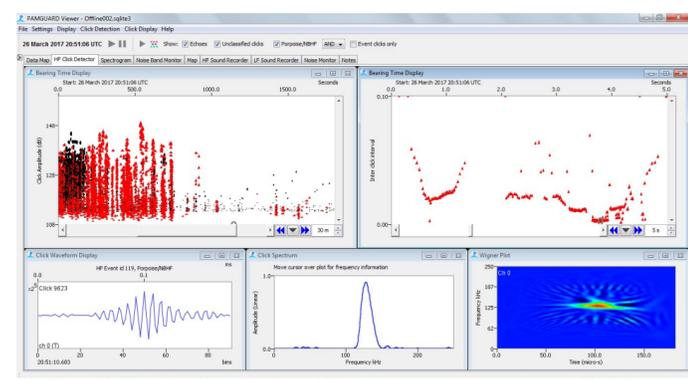
## Seabed Hydrophone Installation

The Middelfart Listening Station hydrophones and preamplifiers are mounted on a pyramidal frame, which has been placed on the seabed at the edge of an artificial reef, in about 15 m water depth. There are two hydrophones: the upper sensor (ch0) is sensitive at high frequencies (2-200 kHz) and is used to detect harbour porpoise echolocation clicks. The lower sensor (ch1) has a lower frequency response (0.02-24 kHz) and is used to record ambient sound levels including noise produced by vessels using the channel. The hydrophones are connected by a cable to shore, a distance of 180 m. The pyramid and cable were deployed from the Aarhus University workboat and secured to the seabed by divers, using concrete weights. The cable runs along the underside of a jetty and into an old boat house where the shore-side electronics are located, from where electrical power (12 V DC) is supplied to the hydrophones. The installation was carried out over a 2-day period in March 2017.

## Shore-side Electronics & Internet Streaming

The old boat house is part of the Middelfart Maritime Museum. This part of the PAM system includes a) power supplies and analogue signal conditioning electronics; b) National Instruments DAQ (sampling 2 ch at 500 kHz per channel, 16-bit); c) RME Fireface 800 sound card (for sound output); an AIS receiver; e) a Windows10 PC running Java and Pamguard 64.

The software TeamViewer is used to remotely access and control the system over the internet. Audio and visual displays are also streamed to the Seiche YouTube channel using X-Split. The live audio stream is a mix of low frequency sound from hydrophone ch1 (0-24 kHz) plus the ch0 output of a Pamguard envelope detector, which transforms porpoise clicks to audible frequencies. An audio cable transmits these sounds to an adjacent public display situated inside a space formed from an old boat's wheelhouse.



## First Results

We analysed continuous sound recordings from the first two weeks that the hydrophones were deployed at Middelfart. These initial data confirmed that porpoises occupy this area on a daily basis, but showed that their acoustic activity is far higher at night than during the day. Detection rates at night are very high, with porpoises present near the hydrophones for long periods. We suspect that porpoises move close inshore at night to feed around the artificial reef. At twilight during the installation, several porpoises were seen and heard blowing very close to the boat house jetty. One area of research will now focus on the automatic detection of feeding buzzes, to enable us to estimate the intensity and the success of night-time foraging.

## Future Plans

- ❖ A network of Listening Stations providing publicly-accessible underwater sound, and a powerful tool for the long-term monitoring of marine mammals and the ambient soundscape.
- ❖ Video – many small boats do not transmit AIS, so we will use high-definition and infrared cameras to help us interpret the hydrophone data. The video stream will be added to our web broadcast.
- ❖ Oceanographic sensors – collaboration with oceanographers will help understand factors that affect porpoise behaviour at Middelfart. For example, current and salinity measurements will help us plot water mass movements through the Little Belt.
- ❖ Localising array – the hydrophone array could be expanded so that we can track harbour porpoise movements in the vicinity of the Listening Station and throughout the water column.

