

PALAOA – an autonomous SAM device in the Atka bay

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Introduction

The PerenniAL Acoustic Observatory in the Antarctic Ocean (PALAOA, Hawaiian “whale”) was set up on the Ekström ice shelf, Antarctica in December 2005 near the German Neumayer Station (Boebel et al., 2006). It is intended to record the underwater soundscape in the vicinity of the shelf ice edge over the duration of several years. These long-term recordings will allow studying the acoustic repertoire of whales and seals continuously in an environment almost undisturbed by humans. The data will be analyzed to (1) register species specific vocalizations, (2) infer the approximate number of animals inside the measuring range, (3) calculate their movements relative to the observatory, and (4) examine possible effects of the sporadic shipping traffic on the acoustic and locomotive behaviour of marine mammals. The data, which are largely free of anthropogenic noise, provide also a base to set up passive acoustic mitigation systems used on research vessels. Noise-free bioacoustic data thereby represent the foundation for the development of automatic pattern recognition procedures in the presence of interfering sounds, e.g. propeller noise.

Acoustic Livestream from the Antarctic Ocean

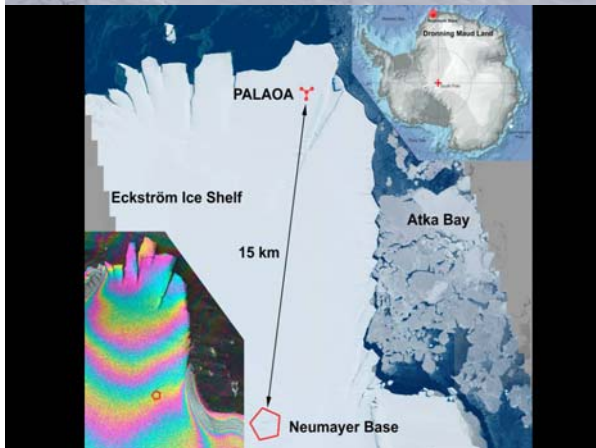
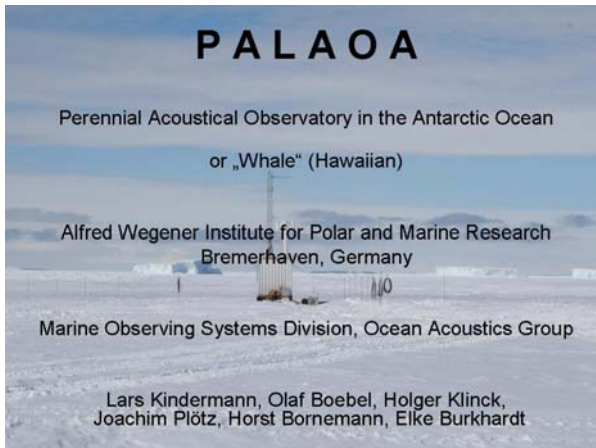
Providing an acoustic live stream of the Antarctic underwater soundscape is a formidable challenge. After all, more than 15000 km lie between Antarctica and the institute in Germany. Underwater sound is recorded by means of four hydrophones attached to the autonomous, wind and solar powered station. The data stream is transmitted via wireless LAN from PALAOA to the German Neumayer Base. From there, a permanent satellite link transmits the data to the AWI in Germany. It can be accessed live at <http://www.awi.de/acoustics>

First Results

So far, Weddell seals, crabeater seals, Ross seals, leopard seals, killer whales, blue whales, fin whales and minke whales have been identified in the recordings along with several vocalizations which could not be assigned to a species yet. Additionally many non biological sounds were recorded, mainly generated by ice and some anthropogenic events like ships passing by and activities on the ice.

References

Boebel, O., Kindermann, L., Klinck, H., Bornemann, H., Plötz, J., Steinhage, D., Riedel, S., Burkhardt, E. (2006). Acoustic Observatory Provides Real-Time Underwater Sounds from the Antarctic Ocean, EOS, 87, 361-372.



Technical Specs:

- Array of four hydrophones, arranged as an oblate tetrahedron of 500 m base length, located 70 m resp. 90 m (central) below the ice shelf
- 3 RESON TC4032 Hydrophones with built in preamp, Frequency range: 10 Hz -120kHz, Sensitivity 170 dB re 1V/μPa
- Center: RESON TC4033, passive, can be used as sound projector
- CTD for monitoring conductivity (salinity), temperature and pressure
- Each hydrophone will be galvanically isolated and driven by a dedicated battery to avoid interference (spherics). Digitizers are connected by optical cables
- 4 Channels of audio and a GPS 1PPS signal are recorded with 24Bit/192kHz, buffered, partly downsampled, FLAC compressed by a local embedded PC, and transferred by a WLAN link to Neumayer Base (15km) with up to 2 Mbit
- Additionally / alternatively, a mono 24kbit Ogg-Vorbis stream is send live to Bremerhaven via Intelsat and is available at www.awi.de/acoustics/livestream
- A Megapixel Webcam allows for monitoring ice coverage and bergs at Atka-Bay



Energy consumption:

- 25 Watts minimal configuration to 100 Watts full operation
- Main Consumers: PC & WLAN Booster 25 Watt each

Energy Supply:

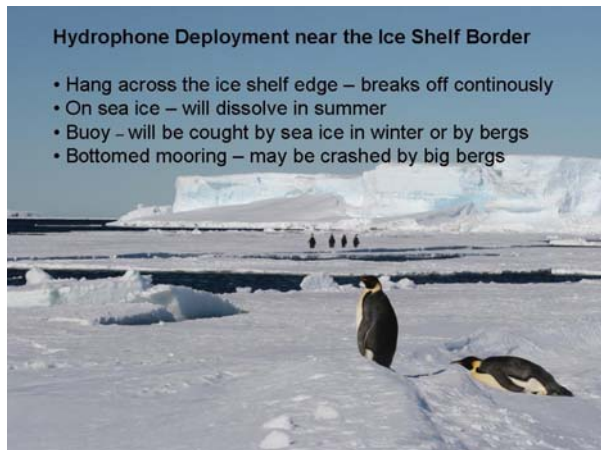
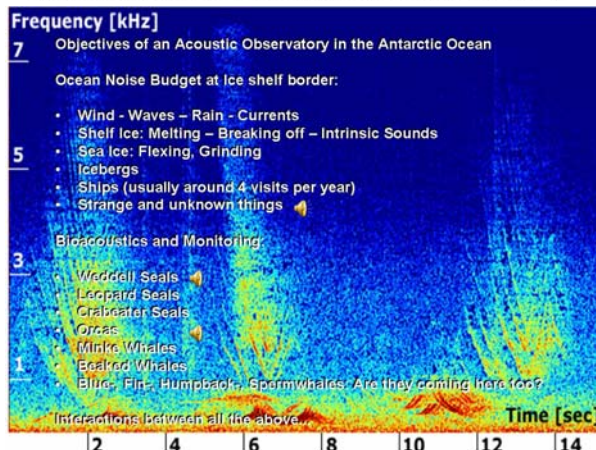
- 8 Solar cells, 400 Watts max
- Wind Generator, 270 Watts max
- Methanol Fuel cell, 50 Watts (for emergency, operational for 3 month only)
- 24 Backup Batteries, 120 Ah each to bridge periods of darkness and calm

Control:

- Microcontroller monitors energy consumption and battery state
- Records weather data, CTD and GPS data
- Charges the hydrophone batteries in cycles
- Selectively disables less important devices on energy shortage
- Can be controlled and programmed remotely

Security:

- IRIDIUM phone with embedded GPS transmits position once a day via SMS
In case it breaks off the ice shelf it can be recovered by RV POLARSTERN





The only safe Place:

- Below the ice shelf
- At a safe distance from the edge



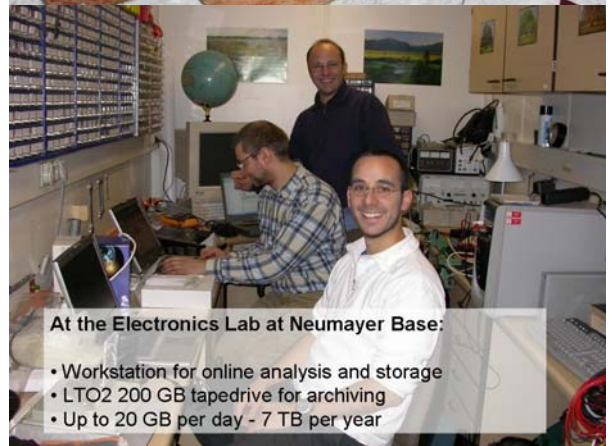
Hot water drilling: 100m depth, 60°C

- Setup time: Two days
- Staff: 4 people
- Drilling time: 12 hours
- Energy consumption: 700 kilowatts



Inside the Instrumentation Container:

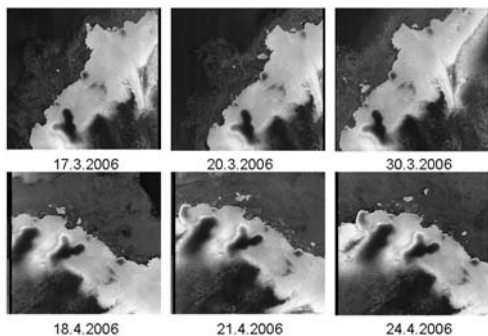
- Easy access for maintenance
- Shelter in case of bad weather



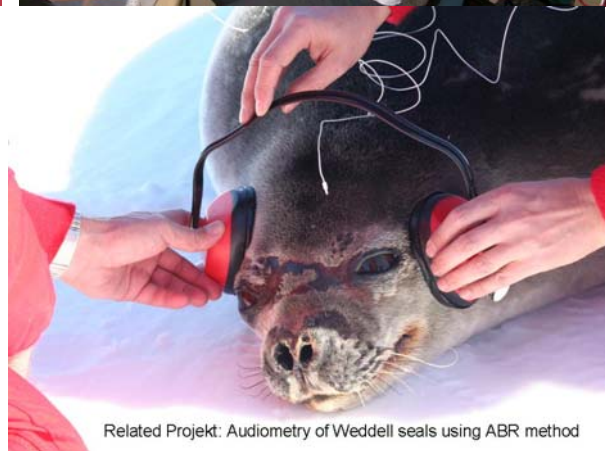
At the Electronics Lab at Neumayer Base:

- Workstation for online analysis and storage
- LTO2 200 GB tapedrive for archiving
- Up to 20 GB per day - 7 TB per year

Loudest Event so far: Colliding Icebergs?



19.4.2006 18:14-18:25 UTC: Received Level much louder than 160 dB re 1µPa Zero-Peak (System Overload)
At 40 km distance (+46dB) the nominal source level was > 206 dB. Main energy was centered around 60 Hz



Related Projekt: Audiometry of Weddell seals using ABR method

Discussion:

The discussion focused on the technical difficulties associated with the running of this project in Antarctica. Tapes of recordings will be recovered next summer. The sampling rate only allows recordings up to 80 kHz. Because of the close magnetic field lines at the poles, there is a lot of electro-magnetic noise which produces clicks in the audible frequency range. The ring antenna are thus extremely sensitive to static noise from lightning.