

## Introduction

iMARL the “Insitu Marine Laboratory for Geosystems Research” is a network of various types of ocean floor located sensors, hosted by the Dublin Institute for Advanced Studies (DIAS).

- It comprises broadband Ocean Bottom Seismographs (OBS), broadband hydroacoustic sensors, a tsunameter and sensors for measuring absolute water pressure and temperature at the ocean floor.
- The sensor pool is largely mobile and can, in principle, be deployed around the world. The current focus is on the North-East Atlantic, offshore Ireland.
- Very recently it now includes a long-term OBS and absolute pressure gauge (APG) that will ultimately become a real-time sensing offshore element of the Irish National Seismic Network (INSN).

### Ocean Bottom Seismometer (OBS) Network



- A fleet of 18 NAMMU from K.U.M in Germany
- The instrument has four simultaneous channels (three seismic one hydrophone)
- 120 sec broadband trillium compact seismometer from Nanometrics
- Currently the smallest instrument designed for long-term deployments
- Maximum water depth 6000m
- Maximum deployment time 15 months
- 32 bit @ 250 sps, 142 dB at 300 mW total power consumption

### Long-Term OBS



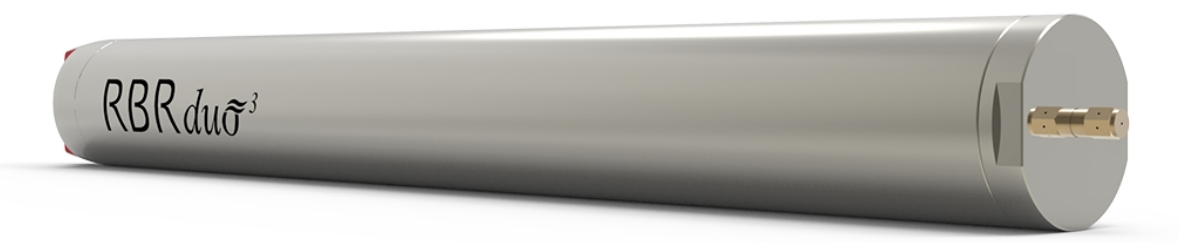
- The Guralp Aquarius+ System comprises of an OBS, a buoy unit and a shore station.
- Communication between the OBS and the buoy unit by subsurface Sonardyne modem with OBS with up to 9000 bps transmission.
- The buoy communicates with the shore station via gimbaled Inmarsat satellite modem.
- Deck unit for use onboard ship during deployment which communicates with the OBS by cable (on deck) or via acoustic modem (in water).

### Hydroacoustic Sensor Network



- The hydroacoustic network can be used for locating and tracking sound sources in the ocean including whales, dolphins, environmental noise and acoustic noise due to ocean-atmosphere interaction.
- The network comprises a set of ten RSAQUA ORCA72D underwater acoustic data recorders and signal processors capable of supporting multiple input channels.
- The ORCA72D recorder can support 5 synchronously sampled hydrophone inputs with flexible sampling rates ranging from 1500 Hz to 384 kHz.
- The network comprises 10 broadband (0.01 Hz to 8 kHz) and 10 medium-to-high (2Hz to 50kHz) frequency hydrophones for use with the ORCA72D recorder.

### Ocean Absolute Pressure Sensor Network



The Ocean Absolute Pressure Network comprises shallow and deep water instruments with:

- 5 RBRquartz3 BPRs (bottom pressure recorders) with a depth rating of 7000m, static to 20Hz bandwidth. High resolution – 10ppb which equates to 70 micrometres whilst deployed up to 7,000m below the surface. Suitable for short and long term studies.
- 1 Seabird Scientific SBE54 Tsunameter with a depth rating of 2000m and 1Hz max sampling frequency
- 6 Enduro absolute pressure, temperature and tilt sensors with a depth rating of 250m and 1Hz max sampling frequency

## Current Applications

### Ocean Bottom Seismometer Network (OBS)

At present the 18 NAMMU OBS are deployed at the bottom of the North Atlantic Ocean for the SEA-SEIS project (Structure, Evolution And Seismicity of the Irish offshore). The network covers the entire Irish offshore, with a few sensors also in the UK and Iceland's waters (Figure 1). The OBS are due to be retrieved in early summer 2020.



Photos L to R: Deploying K.U.M NAMMU OBS's from the Celtic Explorer RV in September 2018 during the SEA-SEIS project

### Long-Term OBS

The new long-term OBS system was deployed in October 2019 (see location on Figure 1). It includes an OBS and absolute pressure gauge (APG) and will ultimately become a real-time sensing offshore element of the Irish National Seismic Network (INSN).

Triggered seismic events will be transmitted via acoustic modem in near real-time to DIAS from the buoy unit which is installed on the M6 Met Eireann weather buoy. DIAS sends a request via satellite link to the buoy system which wakes and sends a request for data from the OBS. Complete downloads will be carried out yearly during services. All data will be available as part of the INSN data centre in DIAS.



Left: The new M6 buoy which was deployed in June 2019 with the acoustic and satellite communication equipment for the OBS installed. Right: Guralp Aquarius+ been deployed in October 2019

### Hydroacoustic Sensor Network

The iMARL hydrophones and the ORCA72D recorders were used to great success in a deployment in June 2018 in an offshore survey to measure sound propagation in the Porcupine Basin. Researchers at NUI Galway, in conjunction with DIAS Geophysics and iCRAG, are studying this noise as it propagates across the Irish continental margin. Under the Marine Strategy Framework Directive (MSFD) anthropogenic noise in the ocean is classed as pollution and Ireland has been tasked with measuring and monitoring that noise.

NUIG and UCD have another project underway from end of October to the beginning of November 2019 in Dundalk Bay to conduct a geophysical survey across an area which holds multiple proposed wind turbine sites. A side effect of the planned survey will be the generation of anthropogenic noise in the water column. Broadband and medium-to-high hydrophones with the ORCA72D recorders will be used.

Right: RSAQUA ORCA72D been deployed in June 2018 from the Celtic Voyager

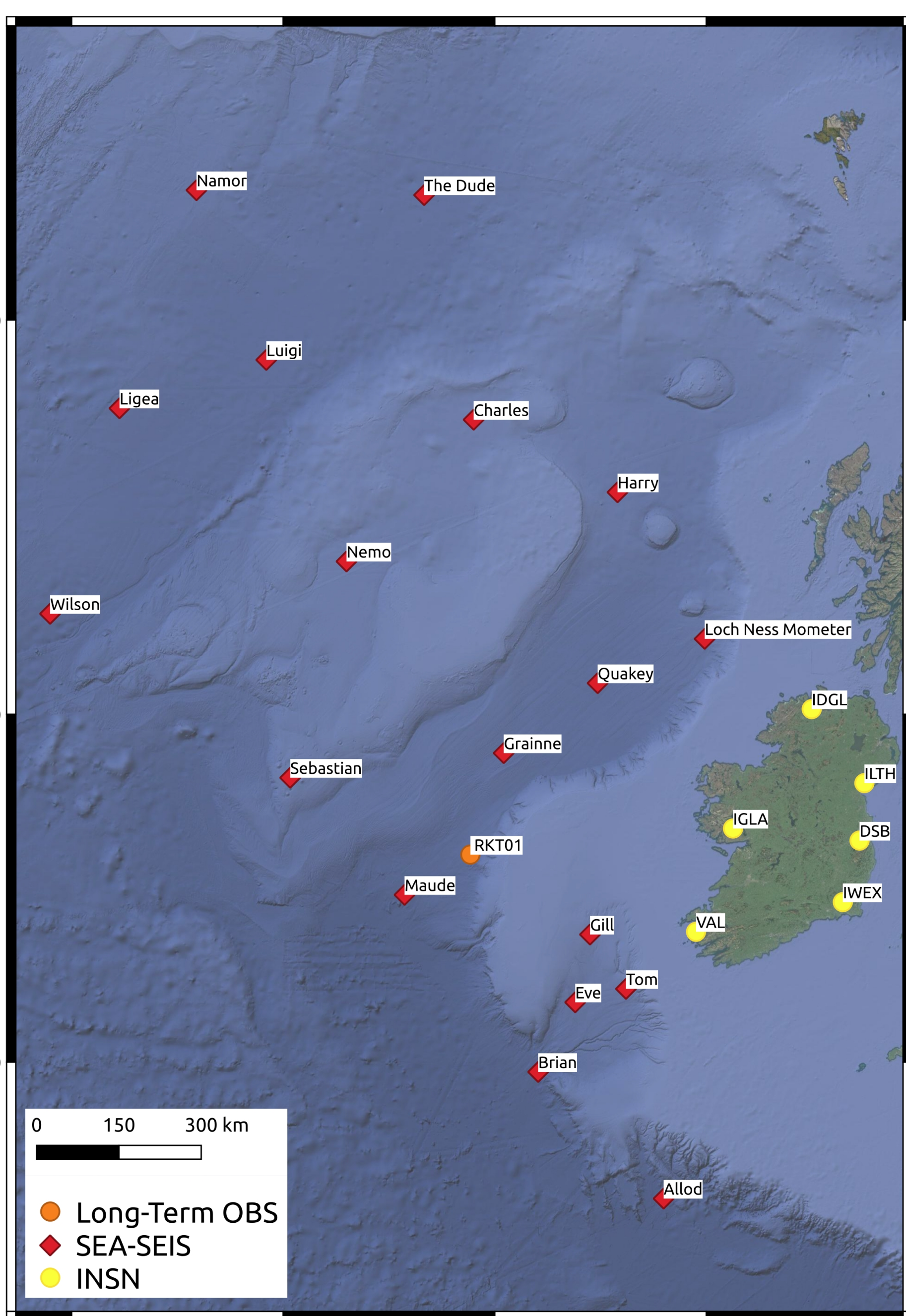


Figure 1: Map showing the position of the long term OBS (RKT01) in relation to the SEA-SEIS OBS positions and the INSN locations in Ireland

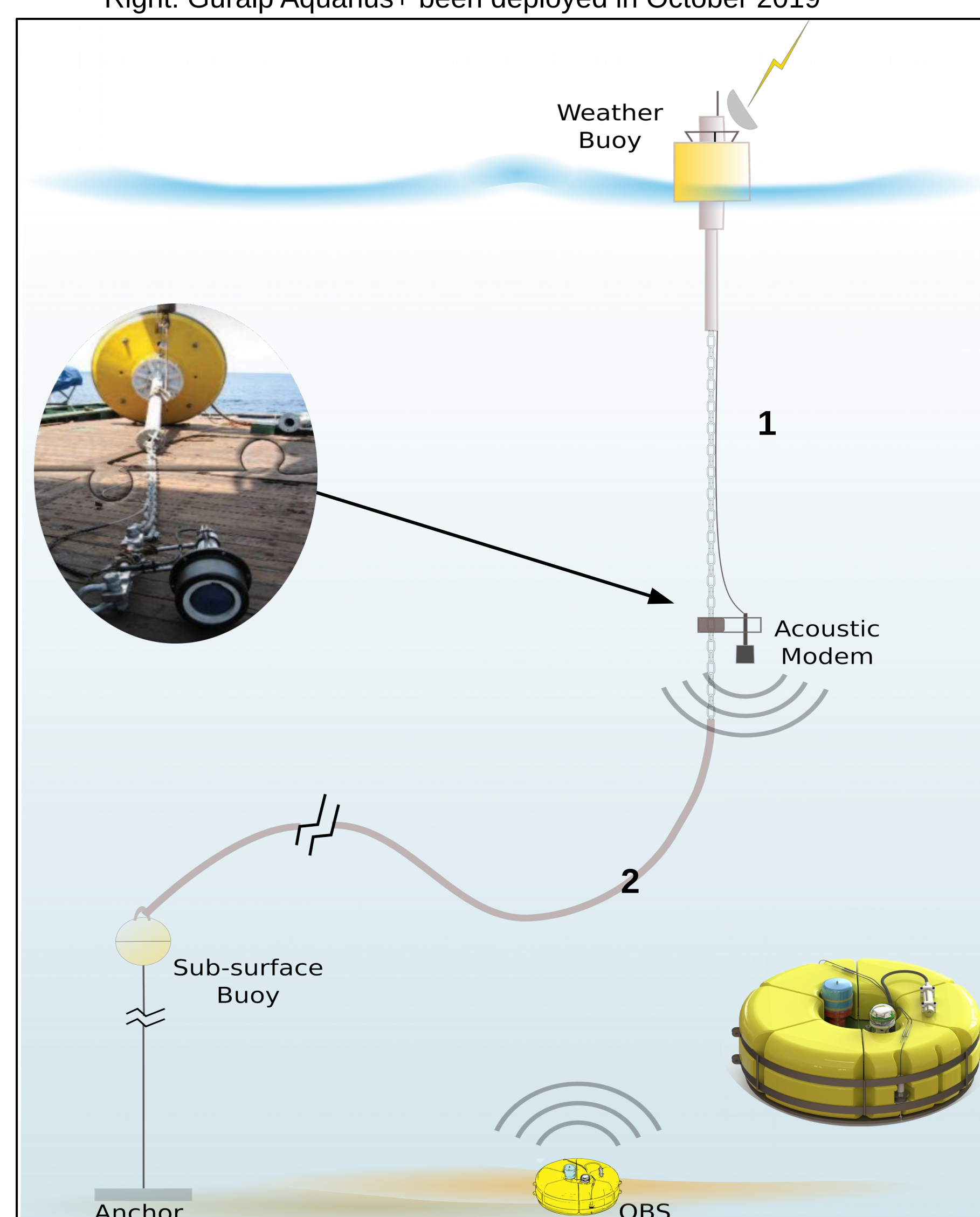


Figure 2: Graphic of the off-shore OBS and communication system (Not to scale) Inset 1: Image of the acoustic modem attached to the buoy anchor chain. Inset 2: Guralp Aquarius+ OBS

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### Access Charge Plan

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The plan can be summarised as follows:

- The user pays for mobilisation/de-mobilisation costs (batteries/ship time/transport)
- There is a surcharge of 15% on the cost of the consumables (which must be bought through the iMARL facility) to cover
  - > The cost price of a DIAS offshore technician during the equipment deployment
  - > The hardware cost of ongoing cable and other pre-deployment repairs to the equipment (onshore technician time is free as it is part of the institutional contribution)
- There is no rental charge for the equipment
- Data handling and shore-side technical help is 100% covered by institutional contributions to the iMARL facility.