# ETIP Ocean Webinar: Solutions for environmental monitoring
## Underwater noise monitoring

Erica Cruz

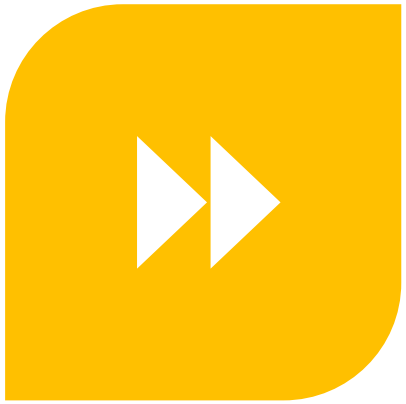
19/05/2020, ETIP Ocean Webinar

European Technology & Innovation Platform for Ocean Energy

# Outline

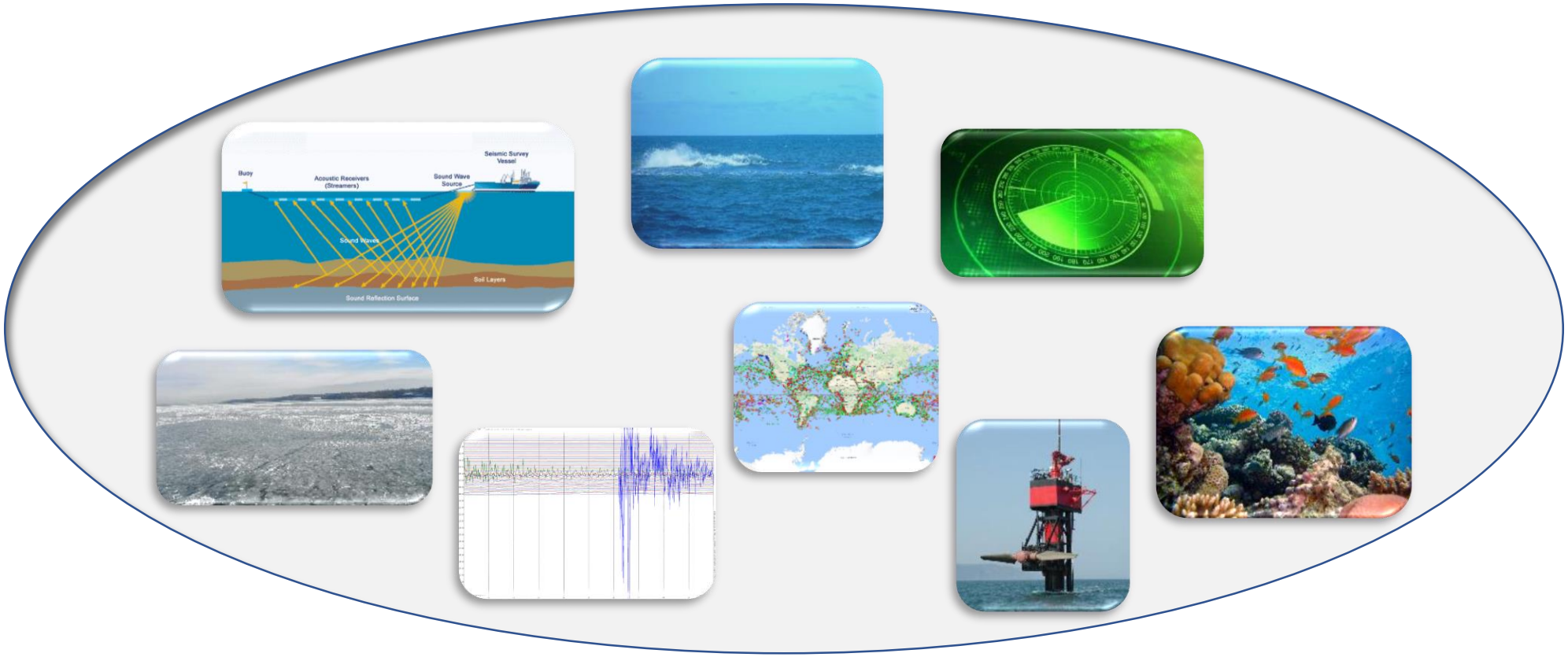
WHY TO MONITOR UNDERWATER NOISE?

HOW CAN WE DO THAT?



NEXT STEPS

# Marine soundscape…




**Marine soundscape**

**Noise = unwanted sound, potential for negative impact**

# Why to monitor underwater noise?

**Sound is important to many marine animals**

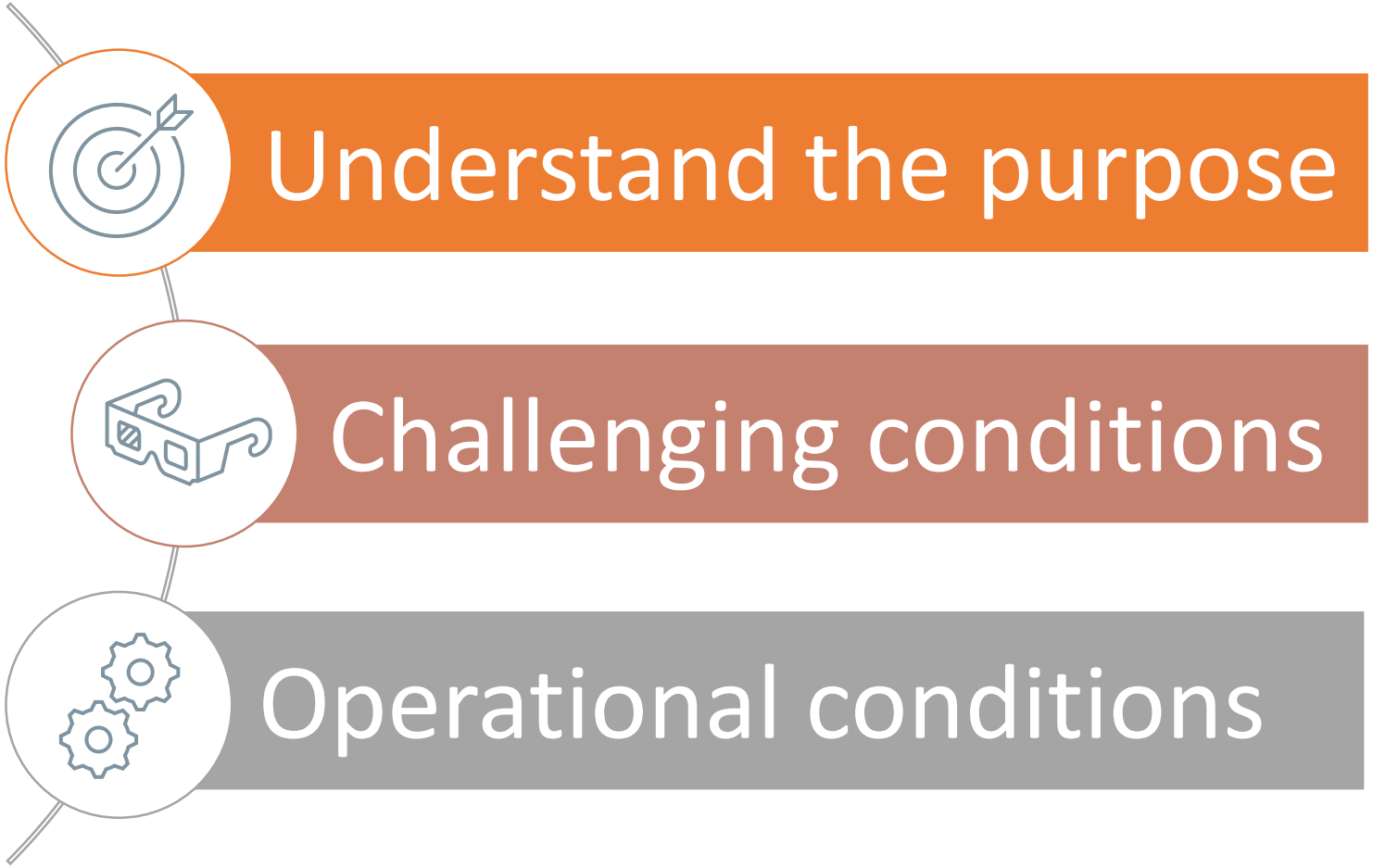
- Communication
  - Reproduction and territoriality
  - Maintenance of group structure
- Protection
- Prey location
- Navigation
- Understand their environment

**Understanding the impacts leads to a better management of human activity in the sea**

# Why to monitor underwater noise?

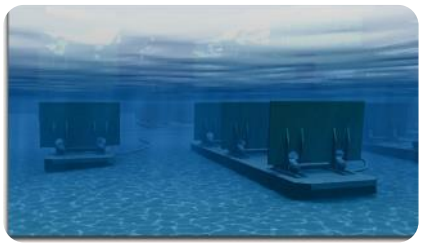
- MSFD - Directive 2008/56/EC of 17 June 2008
- Good Environmental Status (GES)
- 11 descriptors
- Descriptor 11: Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.

# How to monitor underwater noise?



# Sources of noise

- Wave
  - the motion of floats
  - power-take off
  - mooring systems

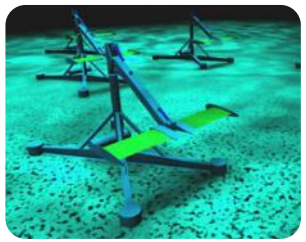


Waveroller (2015)

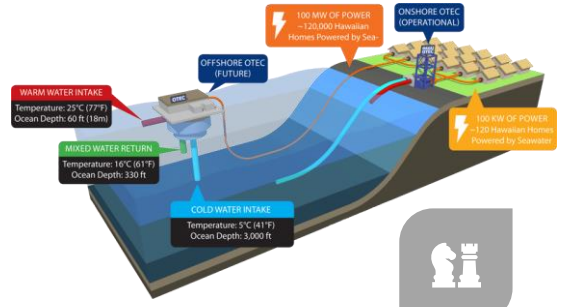
Marmok -A

Pelamis

- Tidal
  - the motion of blades or foils
  - powertrain components



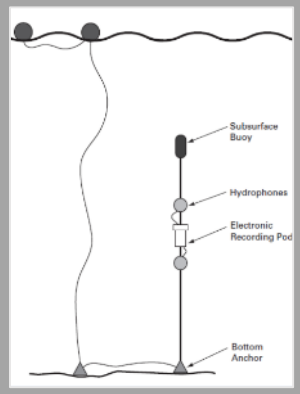
- OTEC
  - machinery
  - fluid flow through process piping
  - seawater flow through intake pipes, plant ducting and heat exchangers
  - discharge pipes



# Data collection

Cabled hydrophone or autonomous recorders

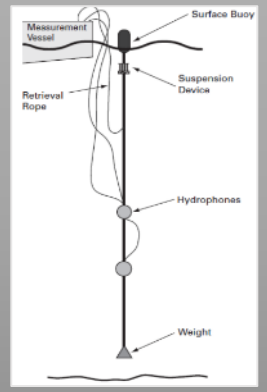
FIXED MEASUREMENTS




Robinson *et al*., 2014

- **Source characterization**
- **Temporal** resolution

DRIFTING MEASUREMENTS



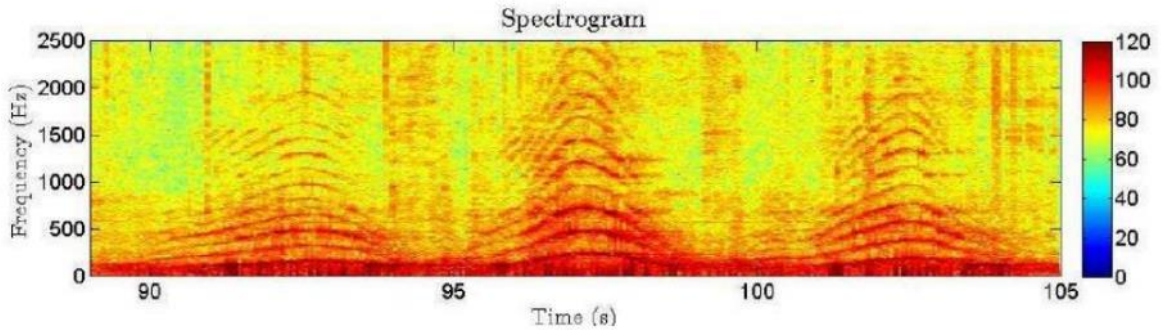

Robinson *et al*., 2014

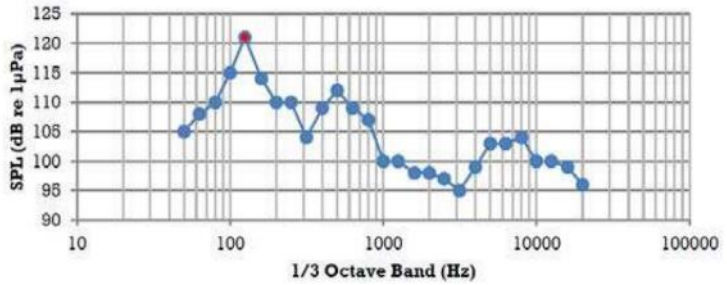
- **Propagation loss**
- **Spatial** resolution

Robinson, S.P., Lepper, P. A. and Hazelwood, R.A., (2014). *Good Practice Guide for Underwater Noise Measurement*, National Measurement Office, Marine Scotland, The Crown Estate, NPL Good Practice Guide No. 133, ISSN: 1368-6550.

# Sound analysis

- Sound properties
  - SPL re 1 µPa
  - Frequency
  - Duration
  - Periodicity
- Statistics
  - Mean
  - Median
  - Interquartile range (25$^{th}$ and 75$^{th}$ percentile)




Cruz *et al*. 2015
https://tethys.pnnl.gov/sites/default/files/publications/Cruz-et-al-2015-EWTEC.pdf

# Complementary data

## Device operation

- All components that can produce sound
- Energy output

## Sound speed profiles

## Bathymetry and seabed composition

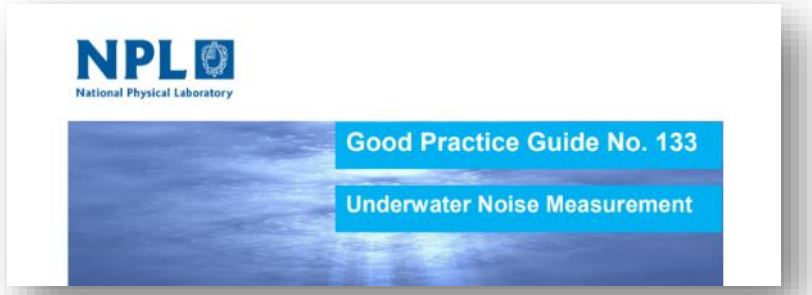
## Met-ocean conditions

- Wave height - Hm0
- Energy period – Te
- Wind speed
- Current speed and direction

# Guidelines and best practices

- Technical specification IEC (International Electrotechnical Commission) TS 62600-40:2019: Marine energy – Wave, tidal and other water current converters – Part 40: Acoustic characterization of marine energy converters
  - To provide uniform methodologies
  - Wave, current and ocean thermal
  - Guidance on measurements, analysis and reporting

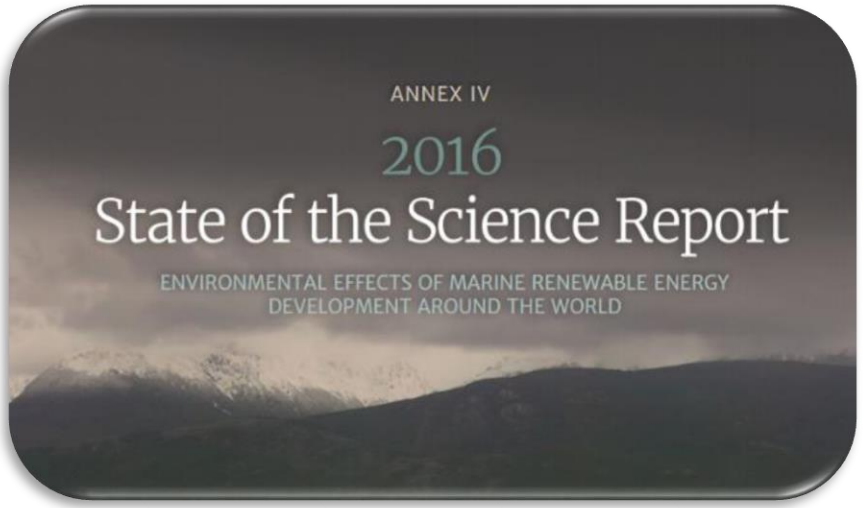

Lepper, P., Robinson, S., Humphrey, V. and Butler, M. (2014). *Underwater Acoustic monitoring a wave and tidal energy sites: guidance notes for regulators*. The European Marine Energy Centre Ltd.




Robinson, S.P., Lepper, P. A. and Hazelwood, R.A., (2014). *Good Practice Guide for Underwater Noise Measurement*, National Measurement Office, Marine Scotland, The Crown Estate, NPL Good Practice Guide No. 133, ISSN: 1368-6550.

# What are the impacts?

- Significant uncertainties
- Noise may be audible
- Potential to induce behavioural reactions
- Acoustic injury unlikely




Copping, A., Sather, N., Hanna, L., Whiting, J., Zydlewski, G., Staines, G., Gill, A., Hutchison, I., O'Hagan, A., Simas, T., Bald, J., Sparling C., Wood, J., and Masden, E. 2016. Annex IV 2016 *State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World*

# Next steps

- Difficult to assess if it is related with noise or any other aspects
- Limited number of devices installed
- Large device-to-device variations in radiated noise
- Uncertainty about the impact of parks
- Models need to be optimized, might not reflect the reality
- Studies about hearing thresholds and threshold shifts
- Differentiation between device noise and ambient noise

# Next steps


http://wese-project.eu/


http://www.emec.org.uk/projects/ocean-energy-projects/environmental-monitoring/sea-wave-strategic-environmental-assessment-of-wave-energy-technologies/

Projects co-funded by the European Maritime and Fisheries Fund (EMFF) of the European Union

WavEC
Offshore Renewables

**Edifício Diogo Cão**
Doca de Alcântara norte
1350-352 Lisboa |Portugal
T: +351 218482 655
www.wavec.org

**FOLLOW US**