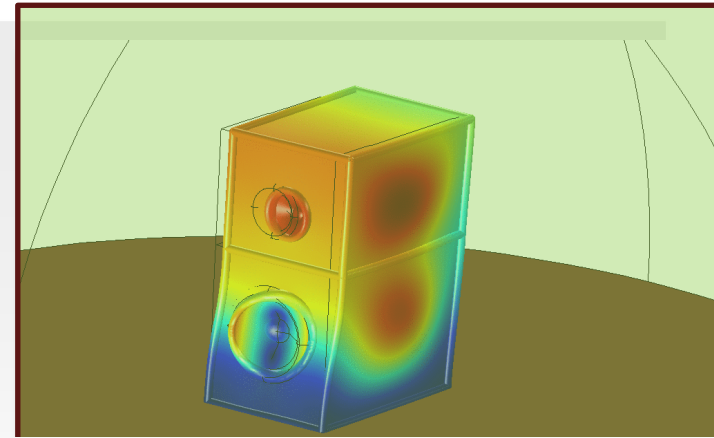


Environmental impacts of floating Hywind Tampen turbine: Noise measurement during WindSYS project's campaign

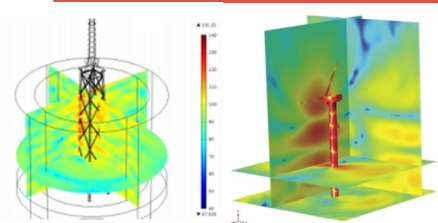


<https://www.comsol.com/multiphysics/acoustics>

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M. M. Penchah

¹University of Bergen (UiB),

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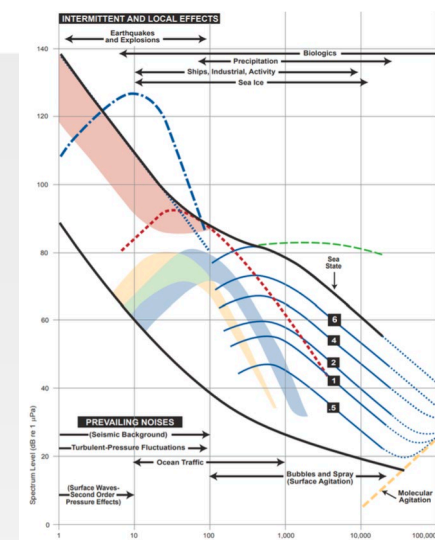
Mostafa.Bakhoday-Paskyabi@uib.no

Learning Objectives

The primary objective is introducing the WindSYS project and

- Reflect on how wind turbines radiate noise in the ocean.
- Understand on how the turbine-induced noises propagate in the ocean.

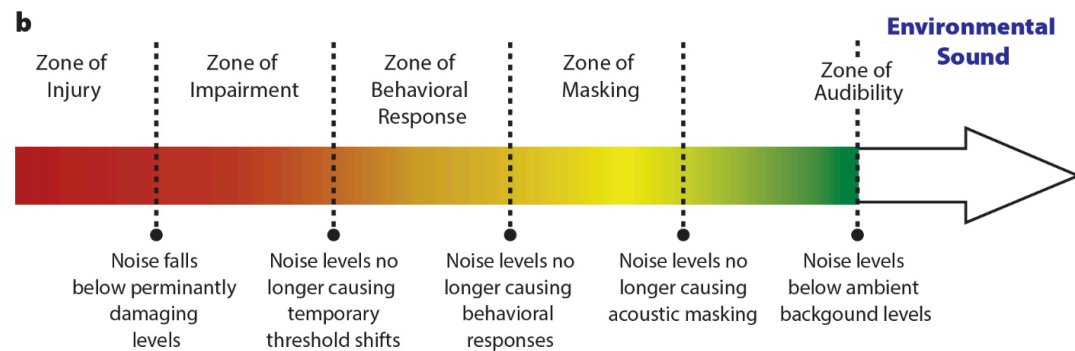
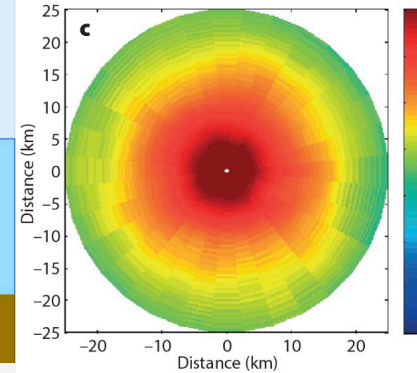
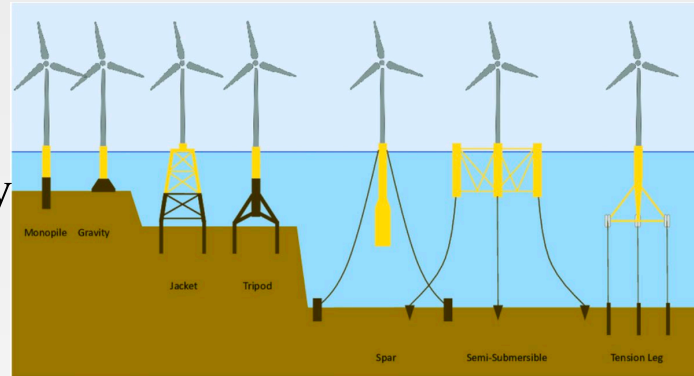
Noise generation (OWF): Site surveys, construction, operation and maintenance, and decommissioning



Noise generation: Pile driving

➤ Pile driving produces extremely powerful impulsive underwater noise.

➤ The impacts decrease as distance from the turbine increases.

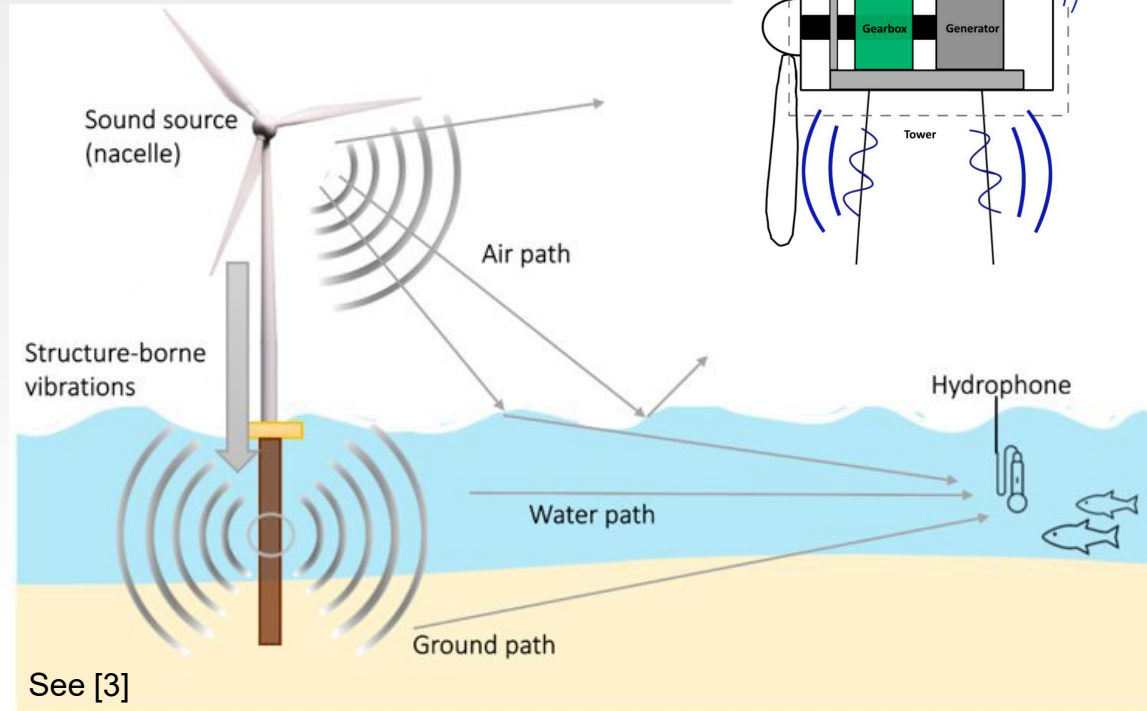


See [5,8,9,12]

Noise generation

Mechanical noise originates from components such as the gear box, generator or the hydraulic system.

Such vibrations lead to tonal and low-frequency vibrations that are transmitted to the air and through the tower.



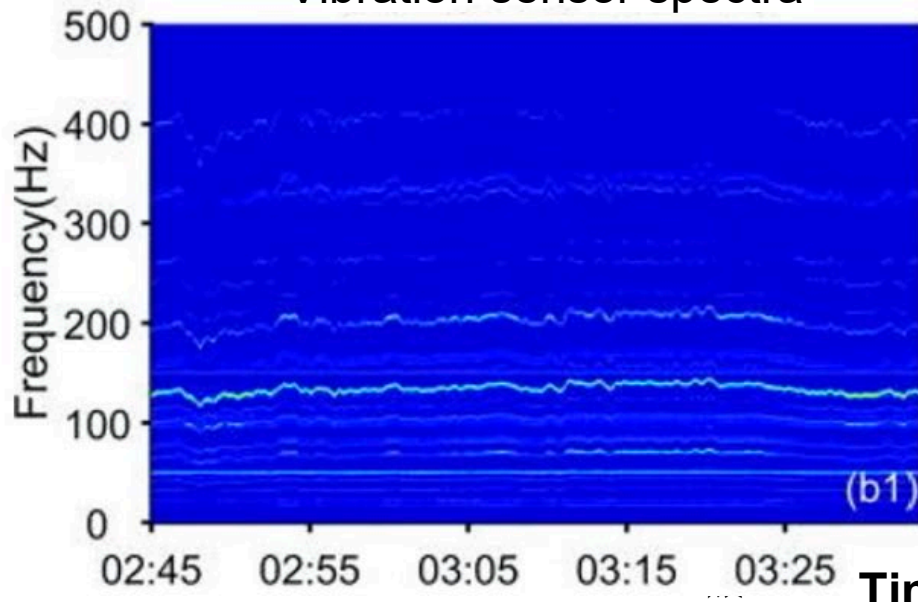
Noise generation: Operating turbine

Vibration of the turbine's gear box and generator is guided downwards and radiated as sound from the tower wall

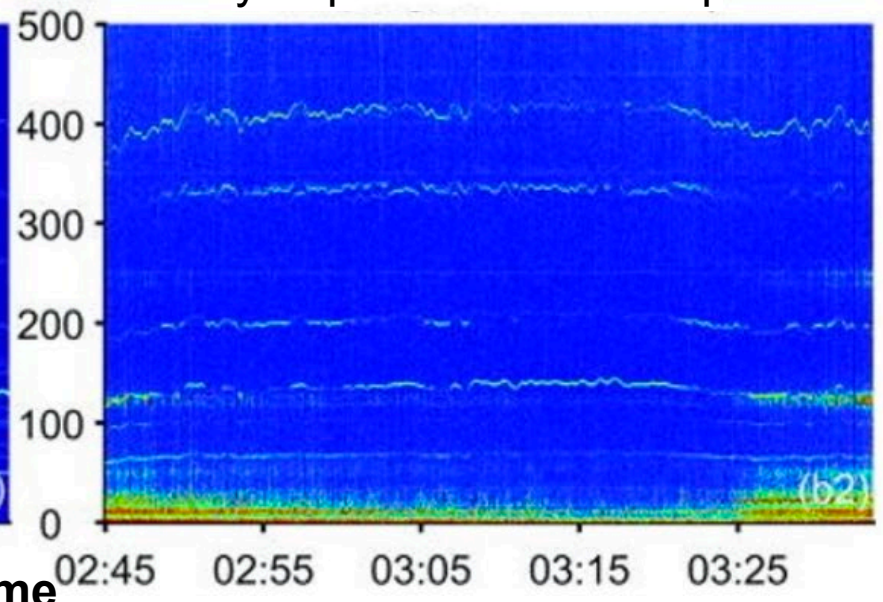
Mechanical vibrations and noise are highly correlated mainly for the low-frequencies

A 3-MW Turbine

Vibration sensor spectra



Hydrophone recorded spectra

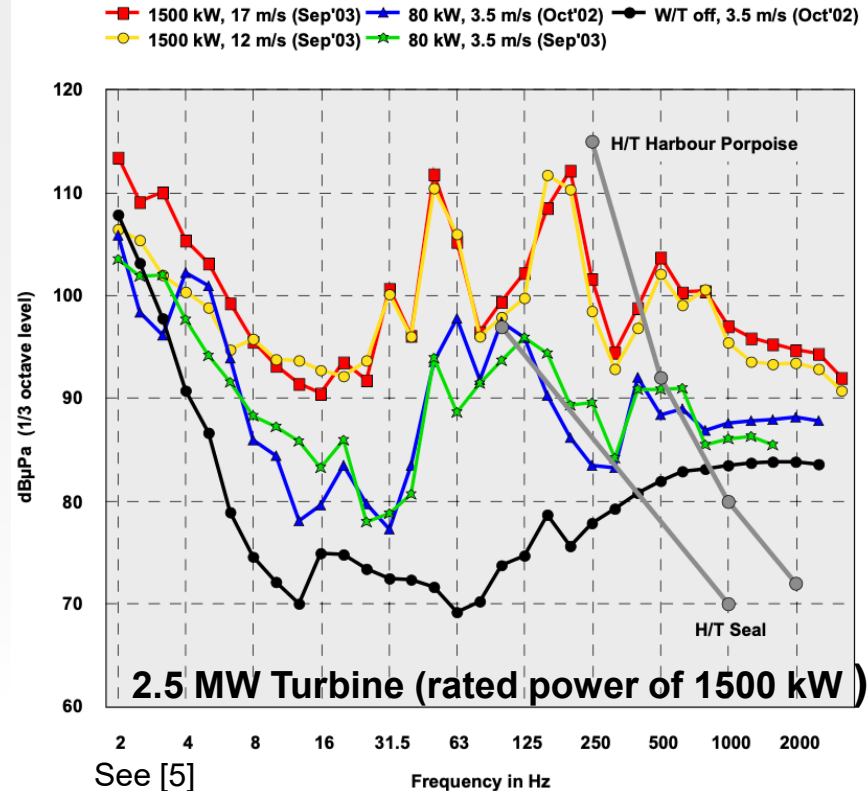


See [5,6]

Noise generation: Operating turbine

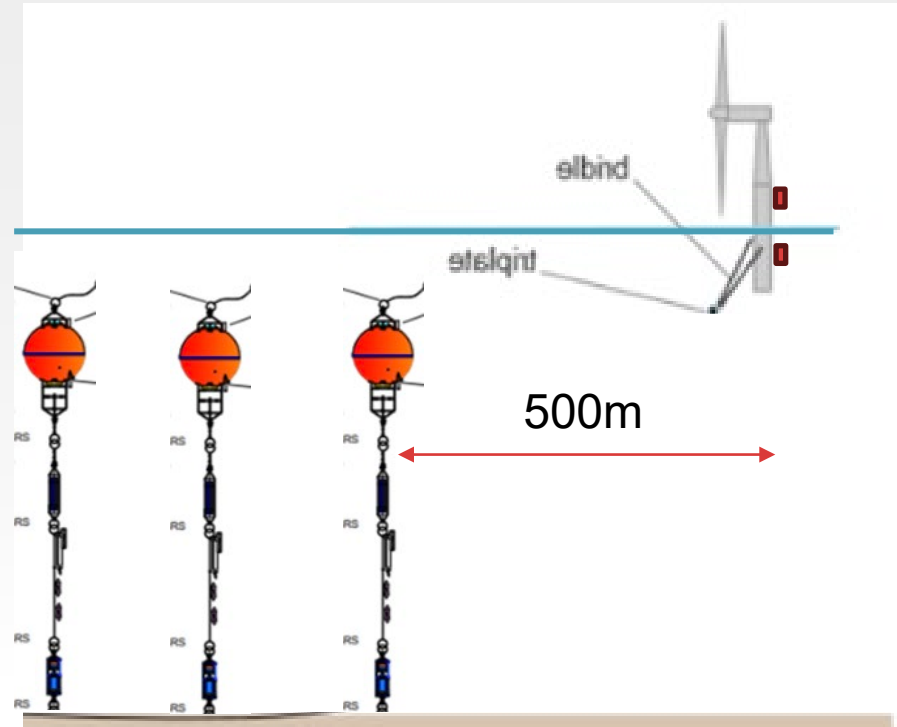
Wind speed at hub height

- Underwater sound pressure levels measured 110 m away from the turbine for different operating condition.
- Hearing thresholds for two marine mammals are shown by gray curves.
- The sound levels will not cause any damage to the hearing organ, but the impact becomes intense very close to the turbine.



WinSYS project: Campagin in March 2023

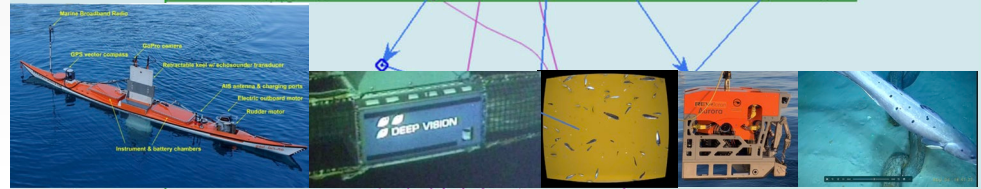
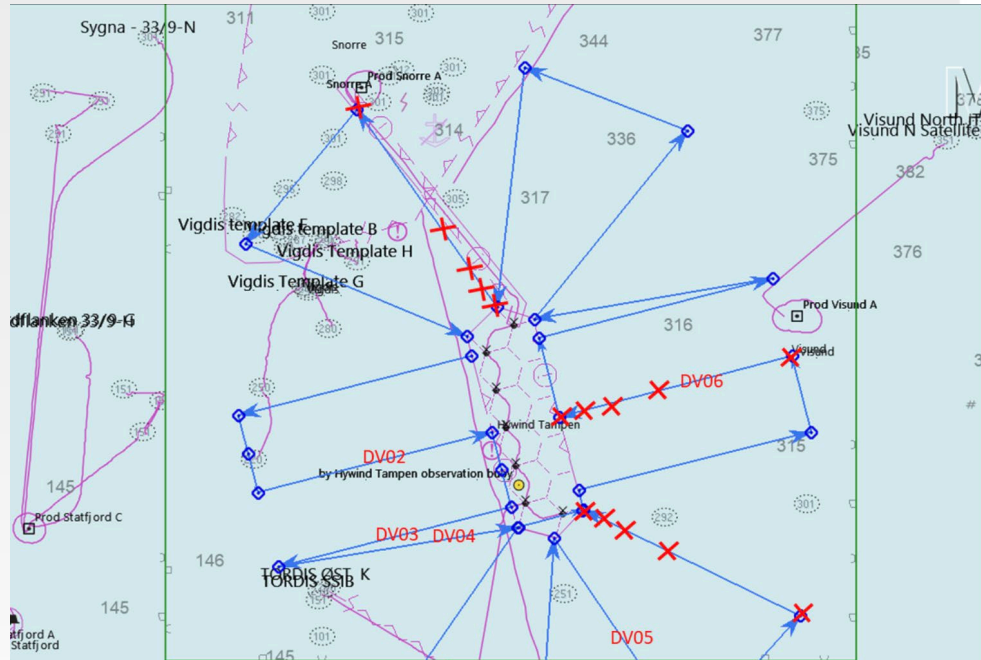
- WindSys: Effects of floating wind farms on the marine ecosystem, with a focus on pelagic fish
- Treårig prosjekt (2023–2025)
- Partnerar: Havforskningsinstituttet (HI), Universitetet i Bergen (UiB), Norsk institutt for naturforskning (NINA), SINTEF, Runde miljøseniter, Fiskeridirektoratet, Fiskebåt, Equinor
- Norges fiskarlag, Norsk olje og gass, NIVA og Miljødirektoratet er involverte som interessentar, saman forskingsinstitusjonar i Skottland, Nederland og Tyskland



Hywind Tampen



The acoustic transect around Hywind Tampen, conducted by G.O. Sars using broadband acoustics

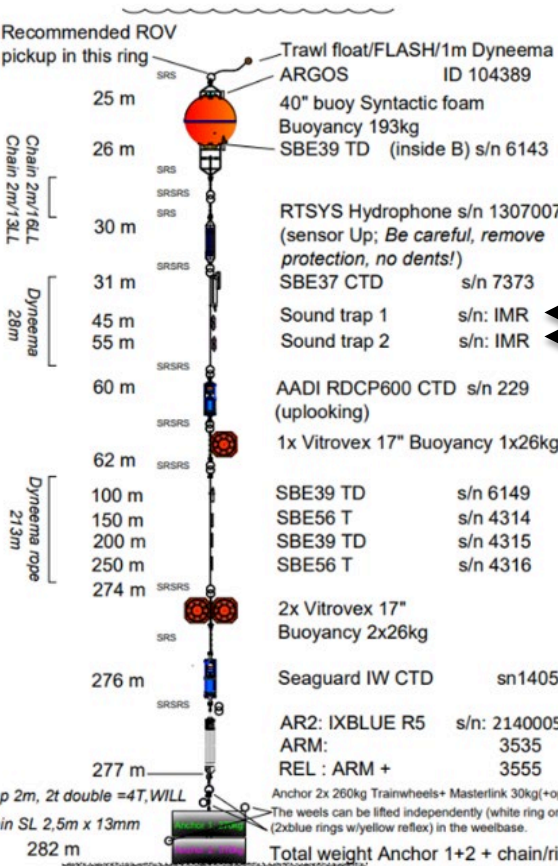


X marks the positions for CTD, eDNA and nutrient samples. The position of Deep Vision trawl stations are marked with trawl station number (DV02 to DV06)

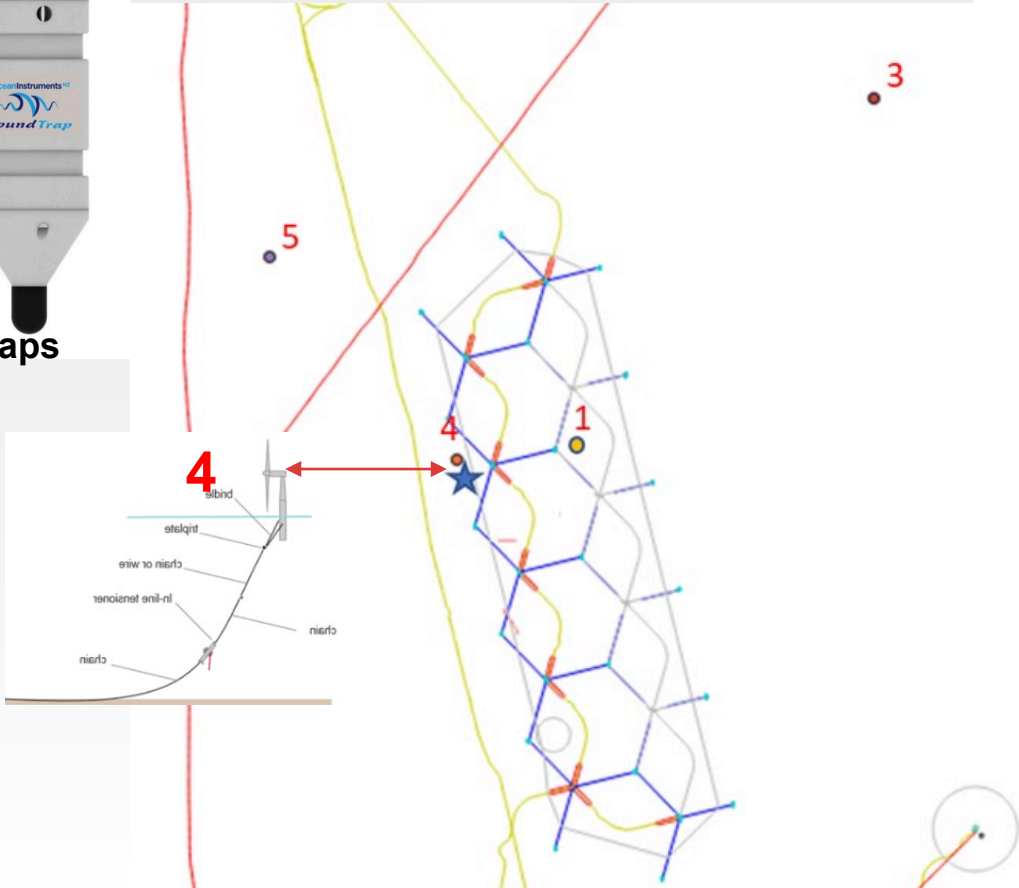
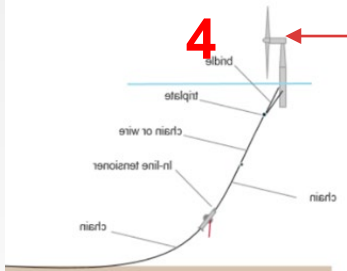
Turbines are positioned in the middle of three anchor-chains.



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Geofysisk Institutt	
HYWIND	
Mooring name:	Hydroacoustic mooring
Project:	HYWIND Offshore Wind Energy SIB
Location:	HYWIND Tampen
Position:	Lat 0.00 N
	Lon 0.00 E
Depth:	282 m
Deployed:	Planned: 15. Mars 2023
	G.O Sars cruise 13-25.3.2023
Recover:	Planned: 24. Mars 2023
Notes:	
All instruments pre-programmed to start.	
Argos will need to be started (connect butt)	
Flash switch to vertical position	



SoundTraps



Positions where we deployed moorings at Hywind Tampen. yellow line is cable, blue lines are anchor-chains.

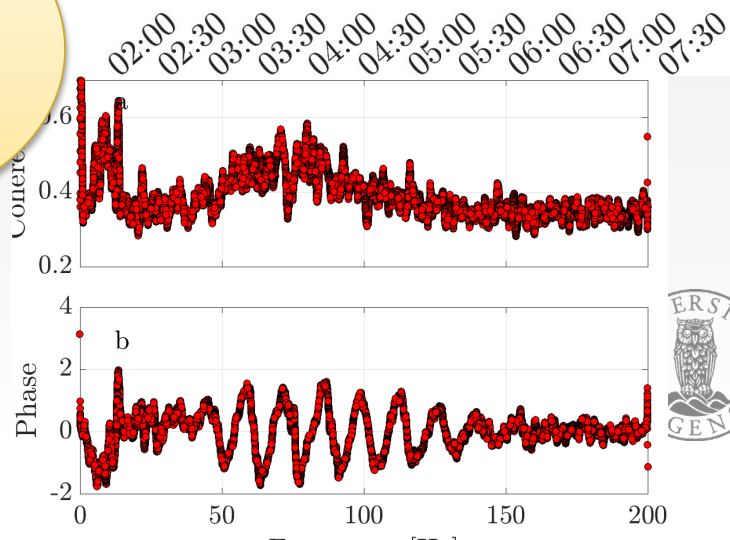
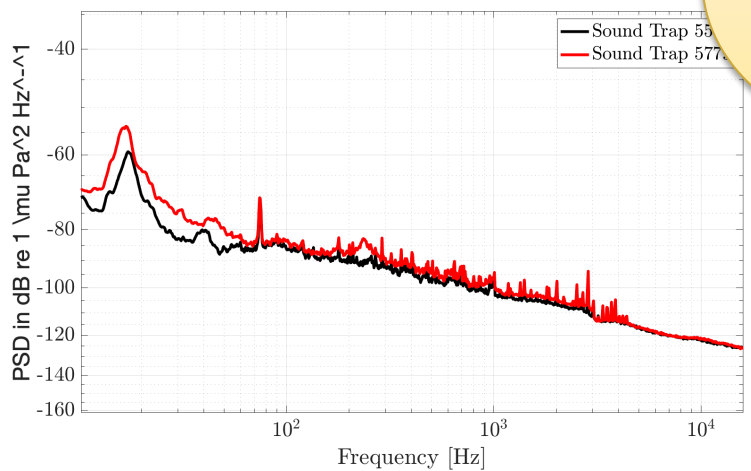
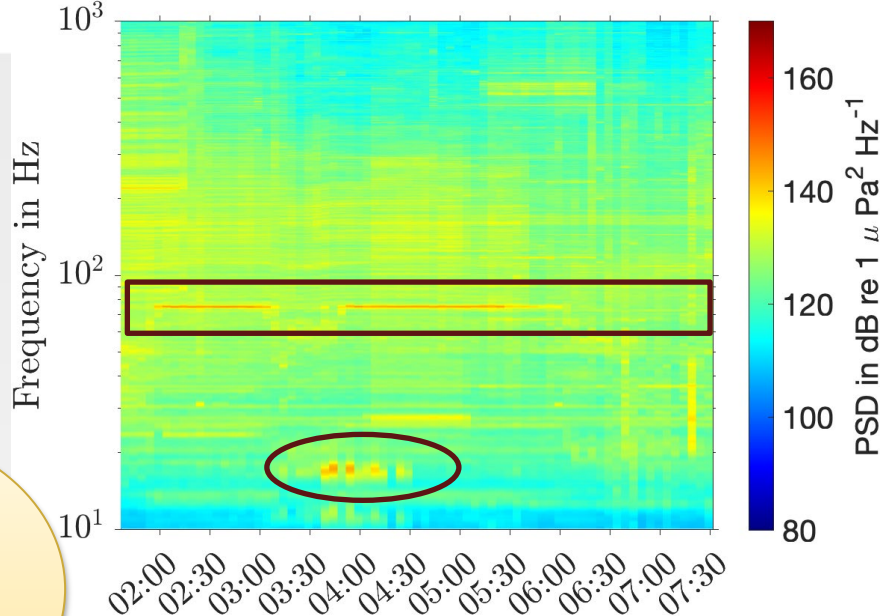


Results

Soundtrap 5533

2023-03-20T01:36:28

Spectral
comparison
&
coherence



Summary

In this lecture you have learnt:

- The noise is generated by moving component in drive train and is propagated in the air and transmitted through the tower to the ocean.
- There are two important noises related to the offshore wind turbines: during piling; and operational noise.
- Noise propagation in the ocean depends on ocean hydrodynamic properties.
- We have made noise measurements in a distance of about 500m from one of Hywind Tampen wind turbines from an array of hydrophones mounted on a mooring system.



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Thank you!



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