

UNIVERSITY OF BERGEN  
EERA DeepWind Conference 2022

# **Underwater acoustic noise under the effects of varying oceanic and sea-state conditions: Modelling**

Tiril Konow, Master's student in Energy, Geophysical Institute University of Bergen  
[tiril.konow@uib.no](mailto:tiril.konow@uib.no)

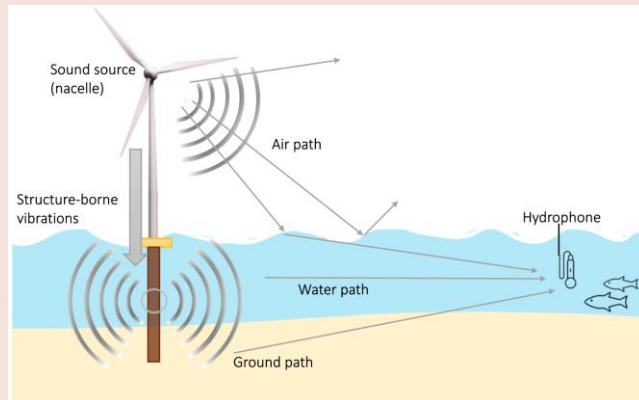
Mostafa Bakhoday-Paskyabi, Geophysical Institute University of Bergen, and Bergen Offshore Wind Centre,  
[mostafa.bakhoday-paskyabi@uib.no](mailto:mostafa.bakhoday-paskyabi@uib.no)

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# Introduction

Important to determine the disturbances from the turbines, and how it affects the environment.



# Approach

Observational data

Modelling

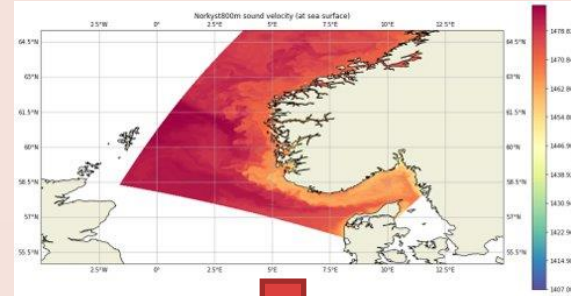
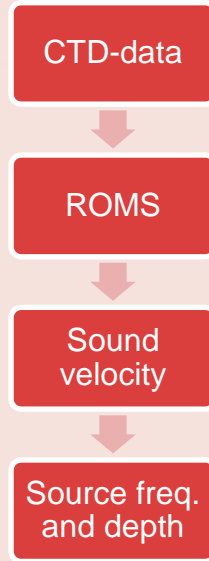
Inverse problem



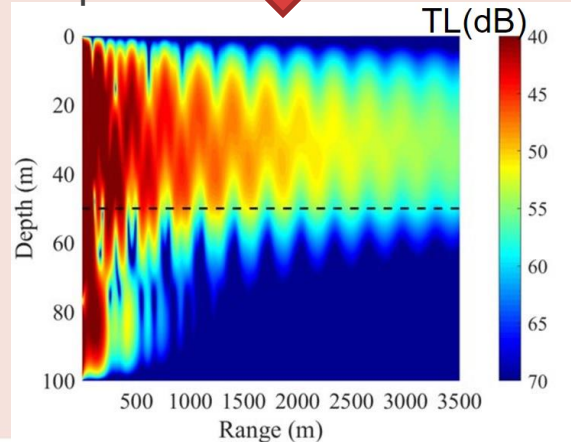
# Propagation model

Normal modes model

Input:

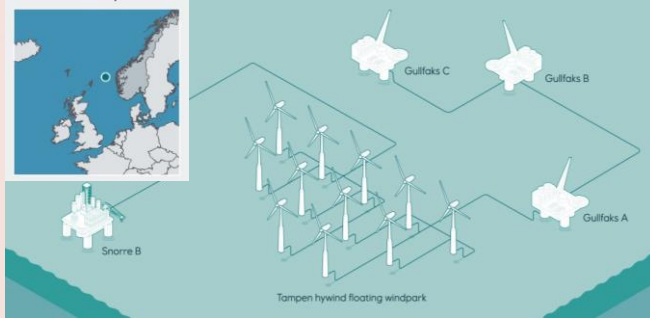


Output:



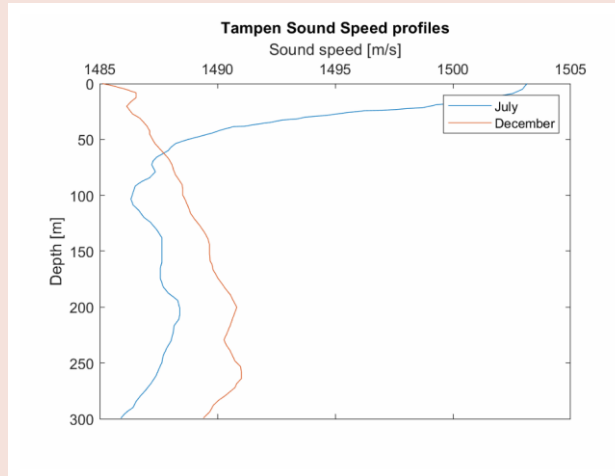
# Example: Hywind Tampen

## Oscillations from floating turbine influence noise



11×8MW floating wind turbines  
In operation third quarter of 2022

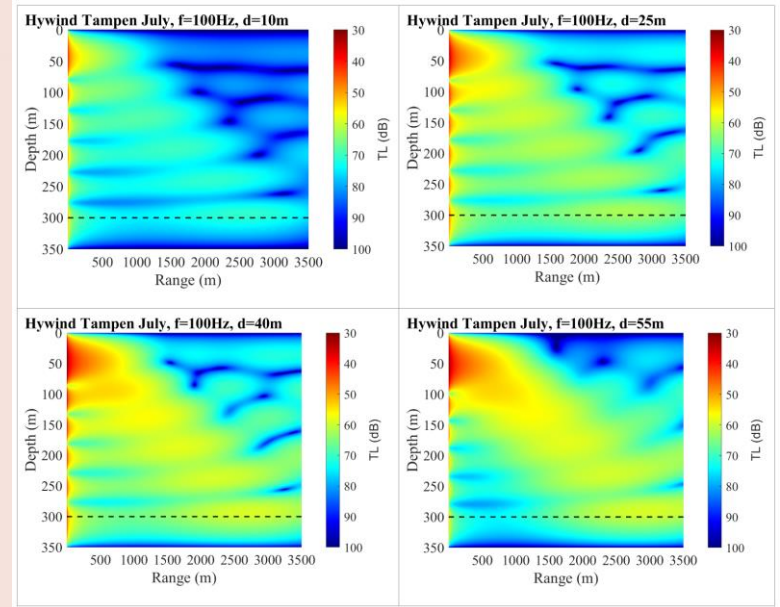
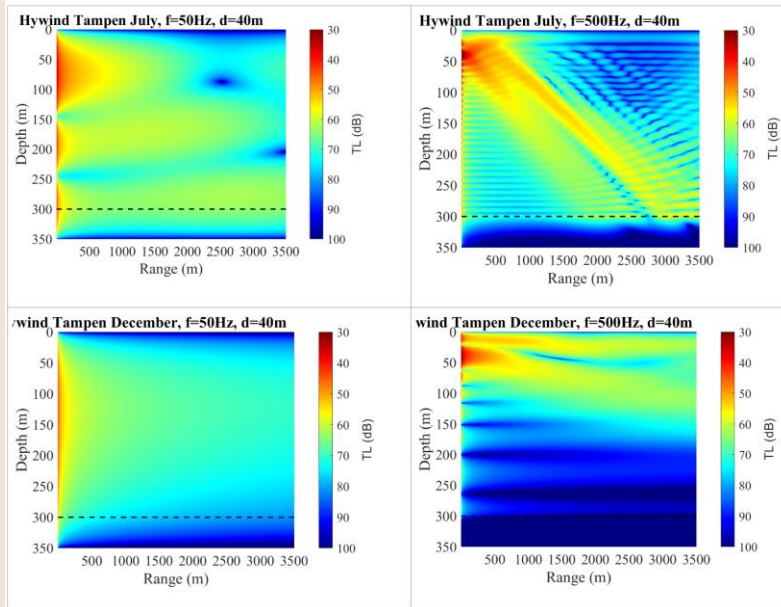
Environmental conditions at  
this area → sound speed



# Example: Hywind Tampen

Modelling for different source frequencies and seasons

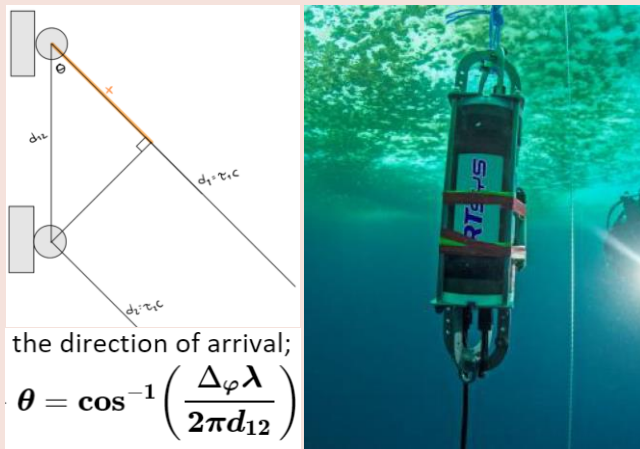
Modelling for changing source depth



# Future work

## Inverse problem

- Sensor deployment
- Complete beamforming/DOA



## Pre-construction noise

- RAVE – FINO1
- Signal processing

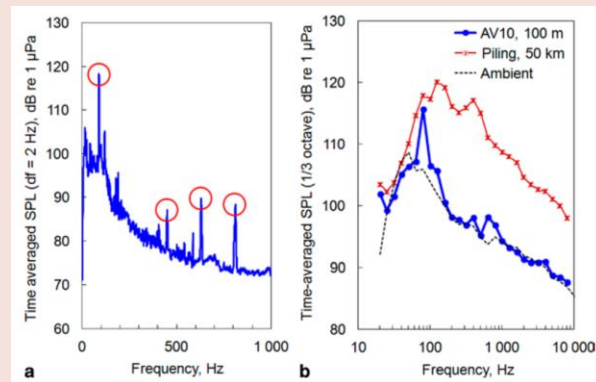


Figure from *Ecological Research at Alpha Ventus* (2014)  
 a): Narrowband spectrum from turbine (AV10) at rated power  
 b): 1/3 octave spectrum, Ambient curve was recorded in 2008  
 before the turbines were installed

# References

BSH & BMU (2014). Ecological Research at the Offshore Windfarm alpha ventus – Challenges, Results and Perspectives. Federal Maritime and Hydrographic Agency (BSH), Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). Springer Spektrum. 201 pp.

FINO1 - Research Platform in the North and Baltic Seas No. 1

<https://www.fino1.de/en/>

Tu, H., Wang, Y., Lan, Q., Liu, W., Xiao, W., & Ma, S. (2021). A Chebyshev-Tau spectral method for normal modes of underwater sound propagation with a layered marine environment. *Journal of Sound and Vibration*, 492.

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Equinor. (2019). *Noise Impact Assessment Hywind Tampen*. Retrieved from [www.equinor.com](http://www.equinor.com)



# Thank you!

email: [tiril.konow@uib.no](mailto:tiril.konow@uib.no)

