OX2 – Triton Offshore Wind Farm

Note on environmental input parameters used in sound propagation modelling.

1 Introduction

This note is intended as an appendix to the reports "OX2 Triton OWF – Technical report for underwater sound propagation" (Mikaelsen & Olsen, 2021a) and "OX2 Triton Seismic Survey - Underwater Noise Technical report" (Mikaelsen & Olsen, 2021b), providing additional technical details of the environmental inputs to the sound propagation model.

This includes information on:

- The geoacoustic properties of seabed sediment layers
- Salinity and temperature profiles

The note is not intended to be read as an independent document, and the reader is referred to the main report, (Mikaelsen & Olsen, 2021a) and (Mikaelsen & Olsen, 2021b), respectively for pile driving underwater noise study and seismic survey underwater noise study.

2 Geoacoustic properties of seabed sediment layers

The sediment model used for the sound propagation calculations, is a multilayer, multipoint model, based on available knowledge for the geographical region on, and near the offshore wind farm (OWF) area. The model is illustrated in Figure 2.1, as presented in the full reports, where the top soil layer (layer 1) is shown in color code for each point in the model. The top soil type is based on the Emodnet geology portal, https://www.emodnet-geology.eu/map-viewer/?p=seabed_substrate. The model includes 1348 points. For each point the top soil thickness, along with lower soil types and thicknesses were determined, to the extent possible, through examining available literature on sediment profiles in and near the OWF area.

For this project, the available knowledge consist of cross section geological profiles for the Energy Island Bornholm site, located southeast of the Triton OWF area. The nearest geological profile is at a distance of approximately 10 km from the eastern edge of Triton. The profile shows a very thin (~5m) layer of top soil, directly on top of chalk (COWI, 2020). The chalk layer thickness was set based on information in (Danmarks Geologiske Undersøgelse (DGU), 1994).

For each point in the model, the layer types were then translated into geoacoustic parameters, in accordance with Table 2.1, utilizing information from (Jensen, et al., 2011). For mixed layers, such as muddy sand, the geoacoustic profile was chosen to be 85% main layer and 15% of the secondary layer. It is recognized that this approach does not accurately reflect actual conditions, however it is not deemed possible to make a more accurate model without detailed seismic survey results, and even then, the results would only be applicable within the surveyed area. It must be recognized, that the level of knowledge available is very limited.

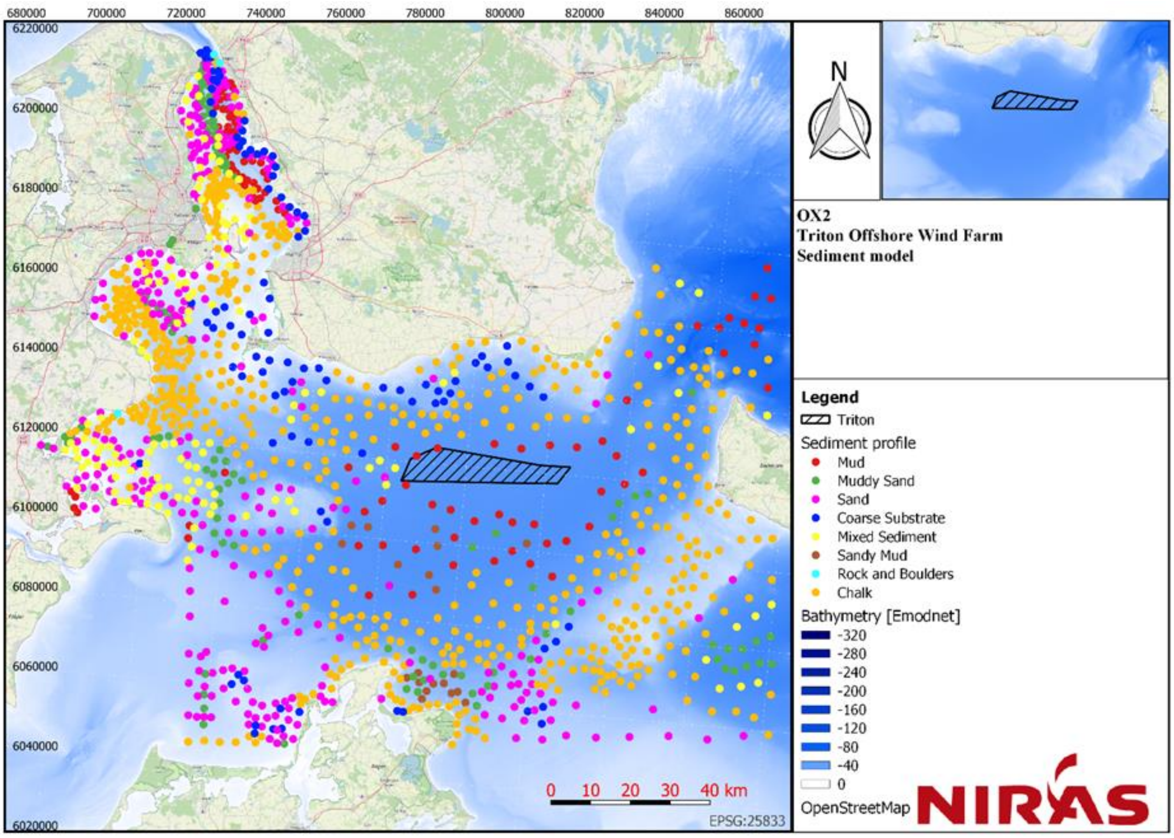

Figure 2.1: Sediment model for Triton project area and surroundings.

Table 2.1: Geoacoustic properties of sediment layers used in the environmental model.

Sediment	Sound Speed [m/s]	Density [kg/m³]	Attenuation factor [dB/λ]
Clay	1500	1500	0.2
Silt	1575	1700	1.0
Mud	1700	1500	1.0
Sandy mud	1690	1550	1.0
Sand	1650	1900	0.8
Muddy sand	1660	1850	0.8
Coarse substrate	1800	2000	0.6
Mixed sediment	1700	1900	0.7
Rock and boulders	5000	2700	0.1
Chalk	2400	2000	0.2

3 Salinity and temperature profiles

Sound speed profiles for the OWF area and surroundings were presented in the main report for the months used in the sound propagation model. The underlying data, consisting of the salinity and temperature profiles, extracted from the World Ocean Atlas 2018 v2 database (Boyer, et al., 2018) were not presented in the main report, however has been added below in Figure 3.1 - Figure 3.2 (salinity) and Figure 3.3 - Figure 3.4 (temperature). The profiles are arranged based on geographical position, and for each point in the sediment model, the nearest profiles were implemented in the sound propagation model. Note that empty plots indicate areas where no profile is available (land).

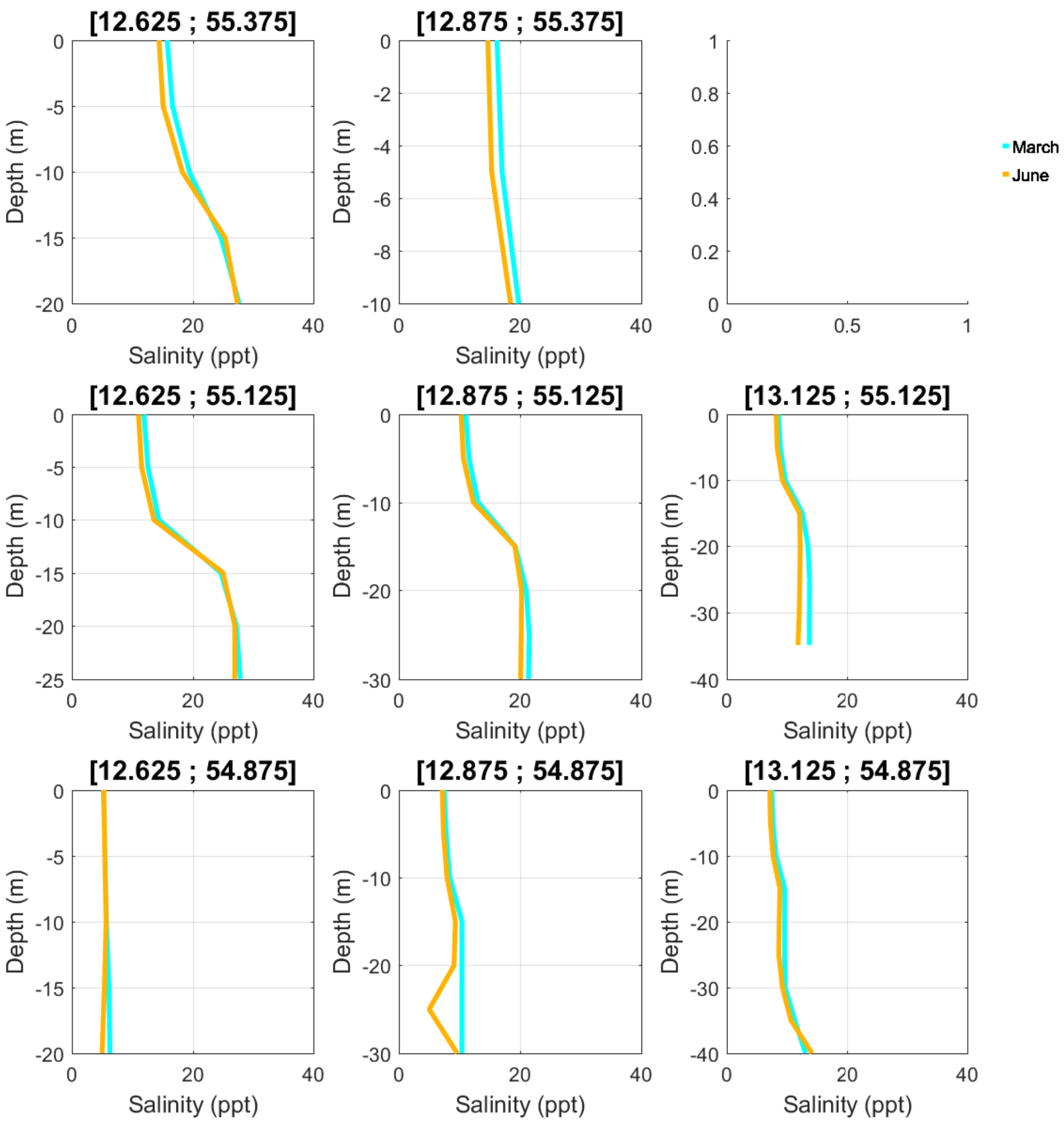

Figure 3.1: Salinity profiles for the West part of the Baltic Sea (South of Skåne), representative for parts of the investigation corridor, for the month of March and June.

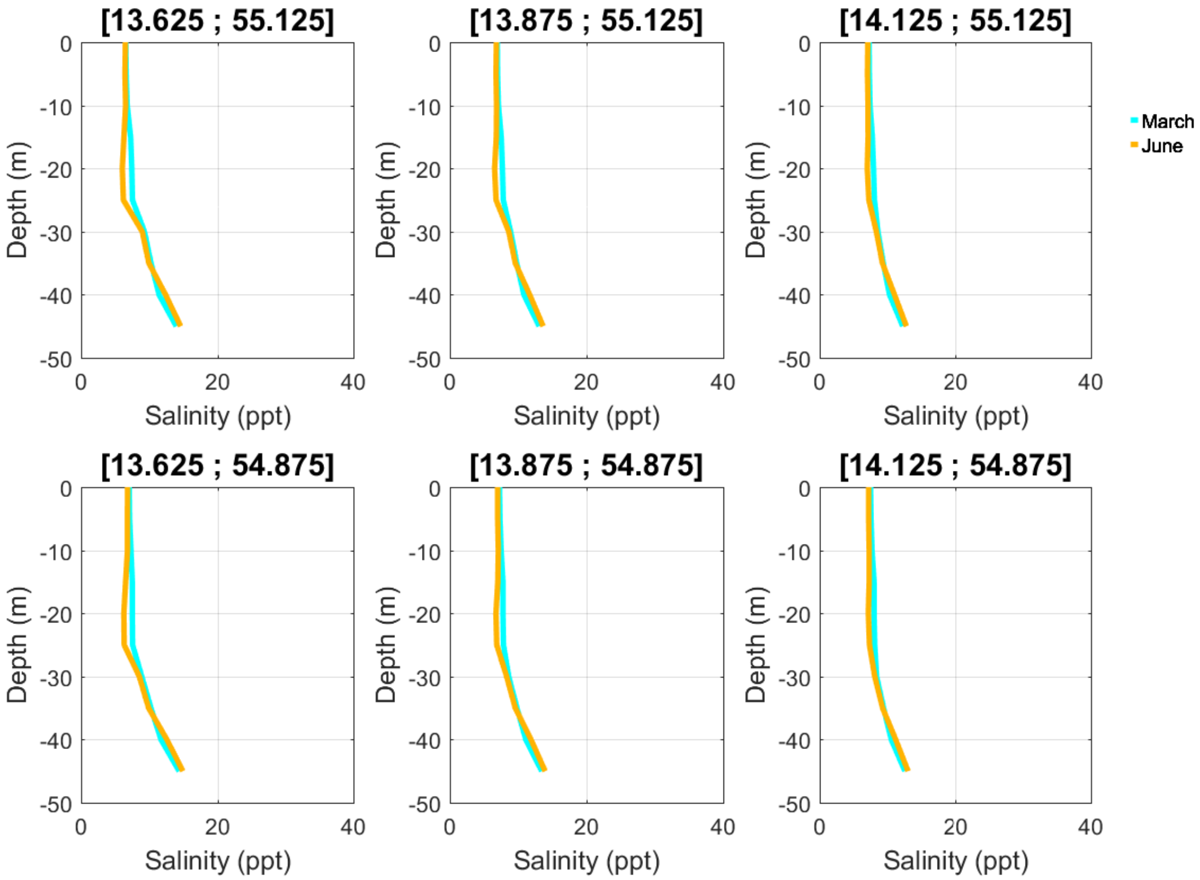

Figure 3.2: Salinity profiles for the OWF area, for the month of March and June.

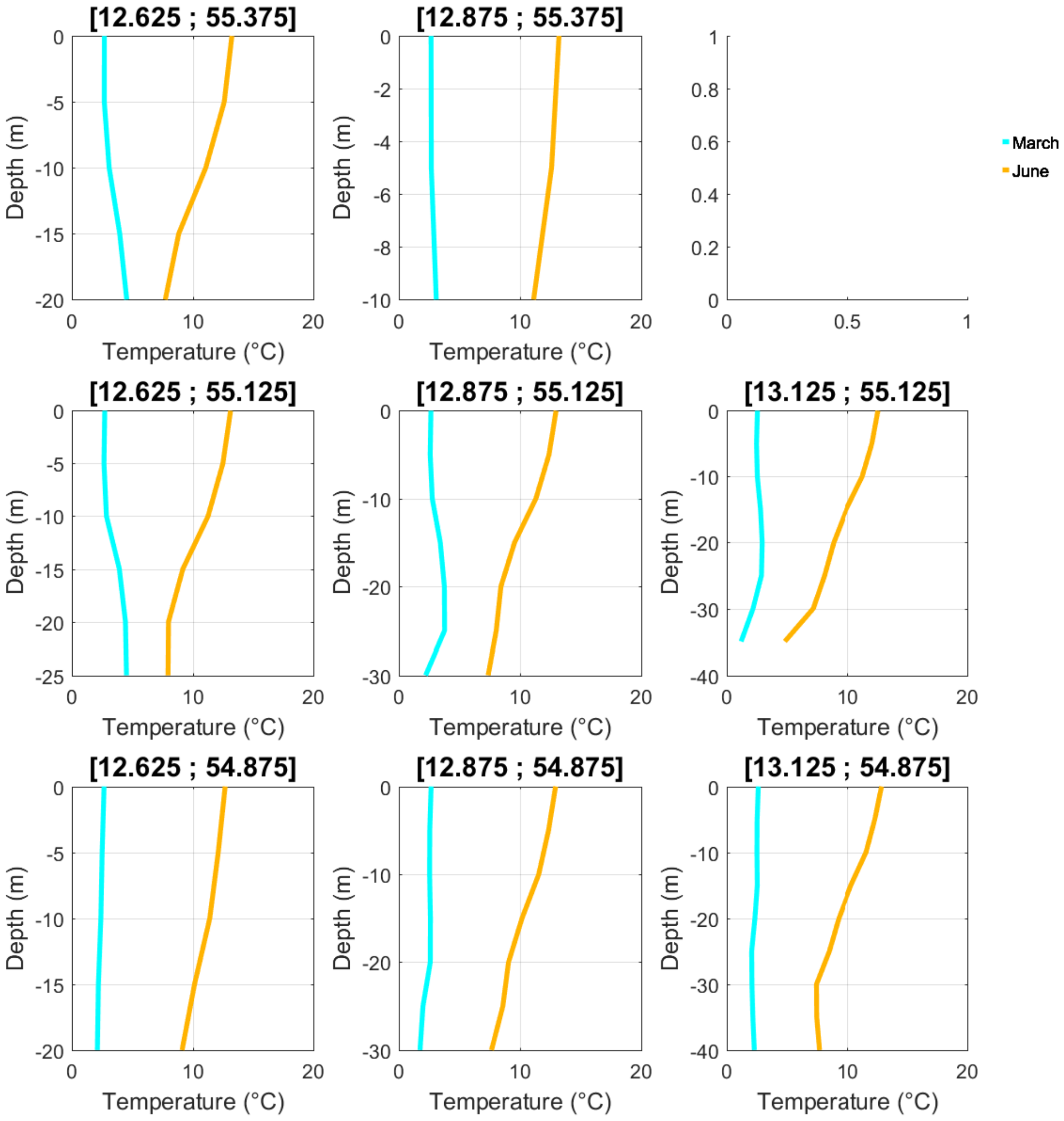

Figure 3.3: Temperature profiles for the West part of the Baltic Sea (South of Skåne), representative for parts of the investigation corridor, for the month of March and June.

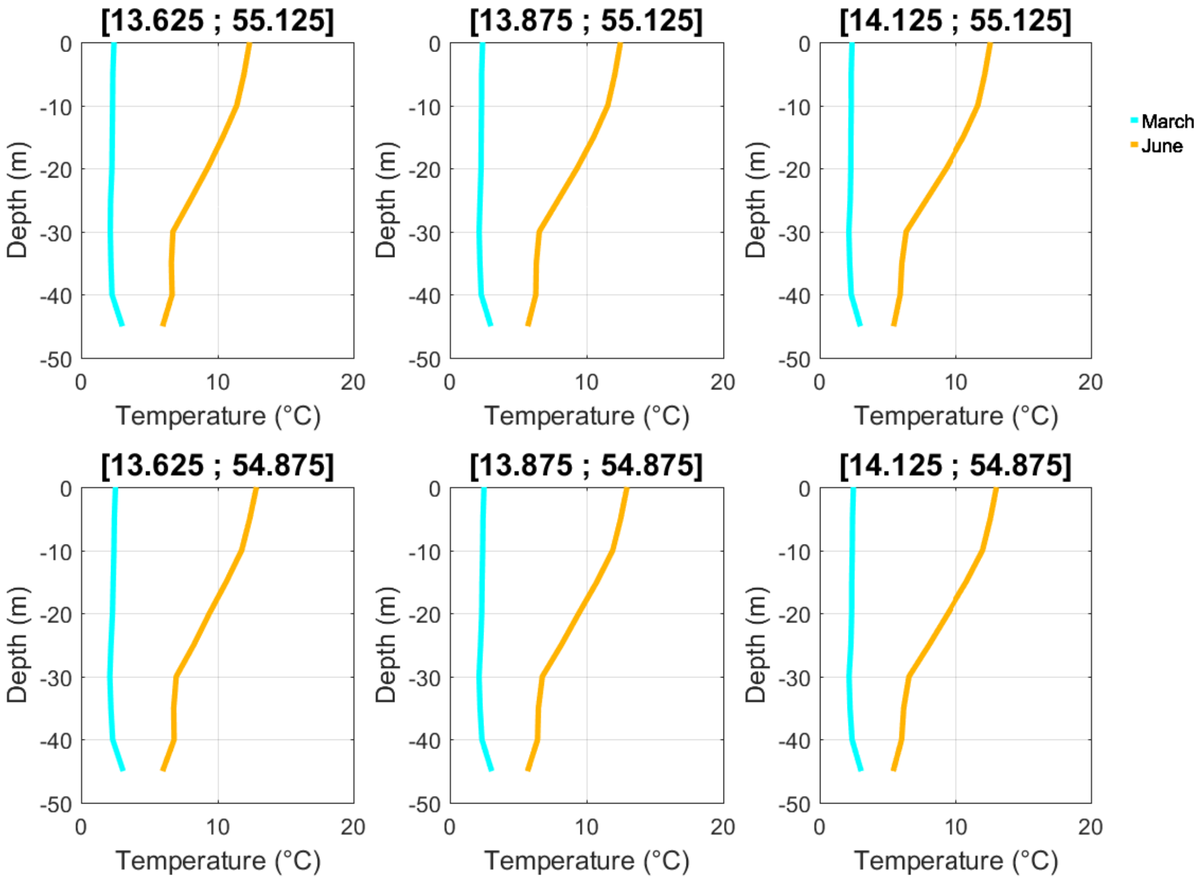

Figure 3.4: Temperature profiles for the West part of the Baltic Sea (South of Skåne), representative for parts of the investigation corridor, for the month of March and June.

4 Bibliography

Boyer, T. P. et al., 2018. *World Ocean Atlas 2018,* Dataset. https://accession.nodc.noaa.gov/NCEI-WOA18, accessed 2019-05-01: NOAA National Centers for Environmental Information.

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