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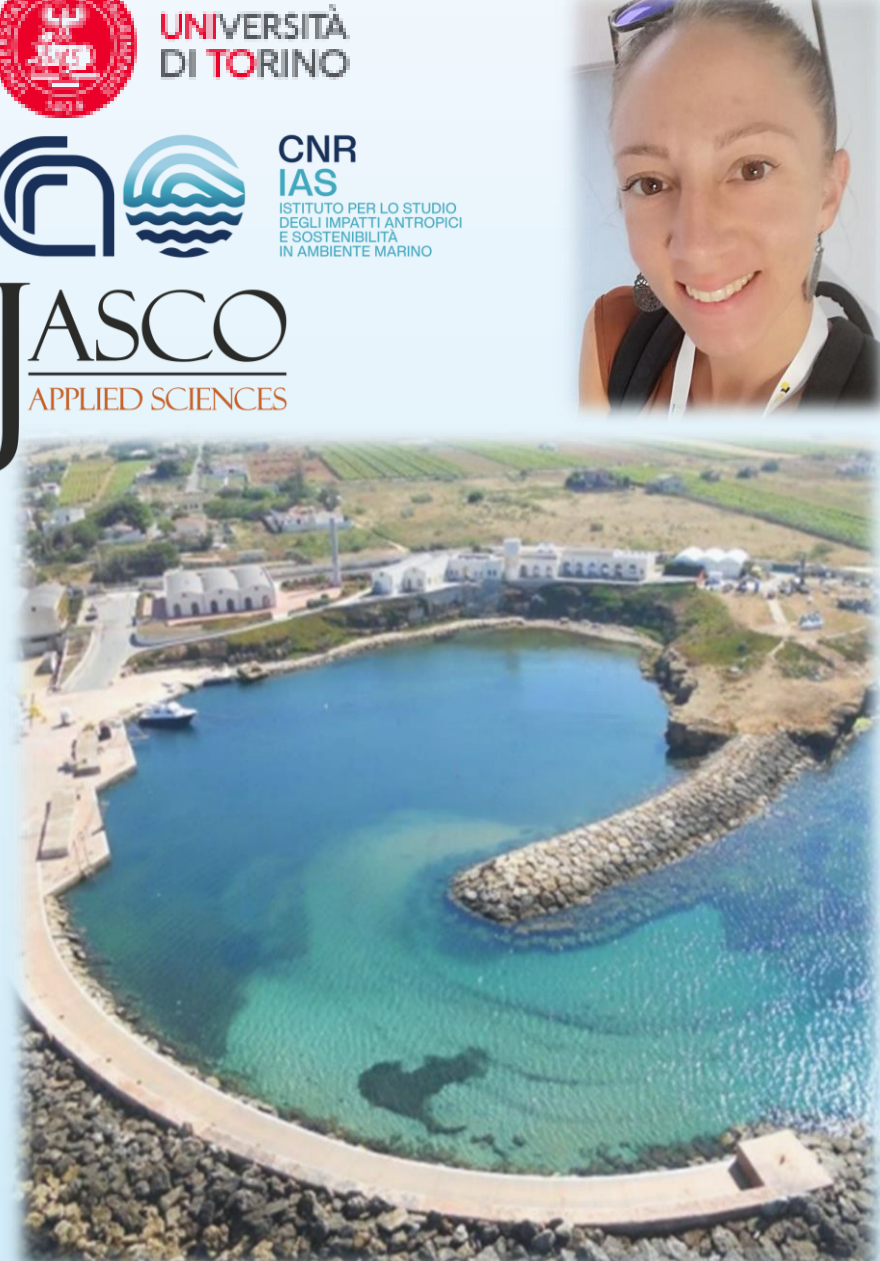
Underwater sound modelling of floating offshore wind farms in the Strait of Sicily

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INTRODUCTION

There are several projects to install **floating offshore wind farms (FOWFs)** in Italian territorial waters, comprising just a few to hundreds of turbines. However, only few studies have focused on **operational noise** generated by FOWFs due to the scarcity of these technologies in activity. Also, attention should be paid to **vessel noise** resulting from maintenance operations required throughout the activity of the wind farm, which can contribute substantially to the aggregate acoustic footprint. Given the rapid increase of offshore wind farms in both number and size, the collective noise output from several turbines should be considered in evaluating impacts on marine mammal species.

AIMS

- Evaluate **underwater sound** generated by **three FOWFs** in the **Strait of Sicily (Italy)** through acoustic propagation modelling.
- Evaluate the contribution of underwater sound generated by an **offshore support vessel** to the acoustic footprint of one FOWF.

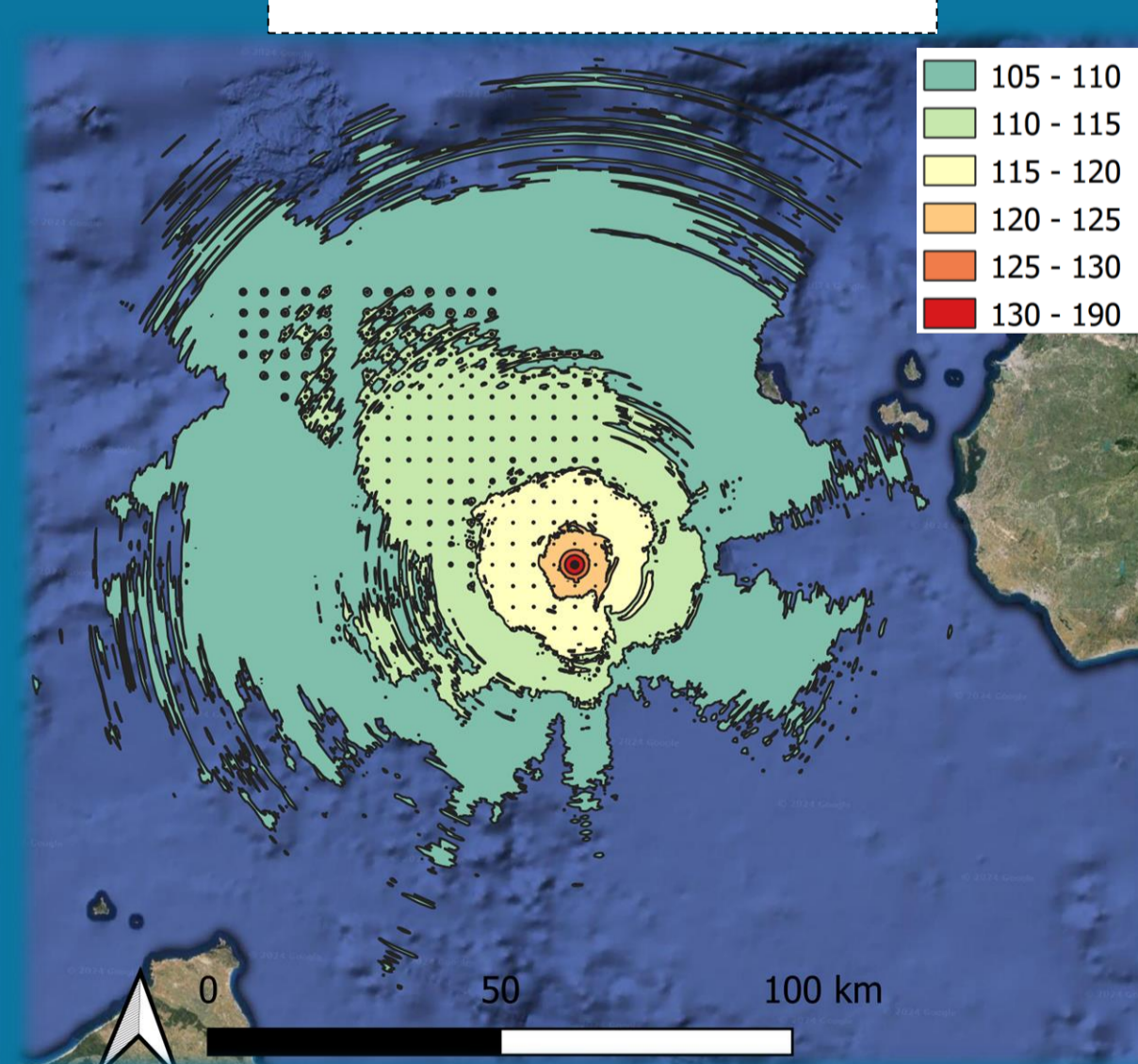
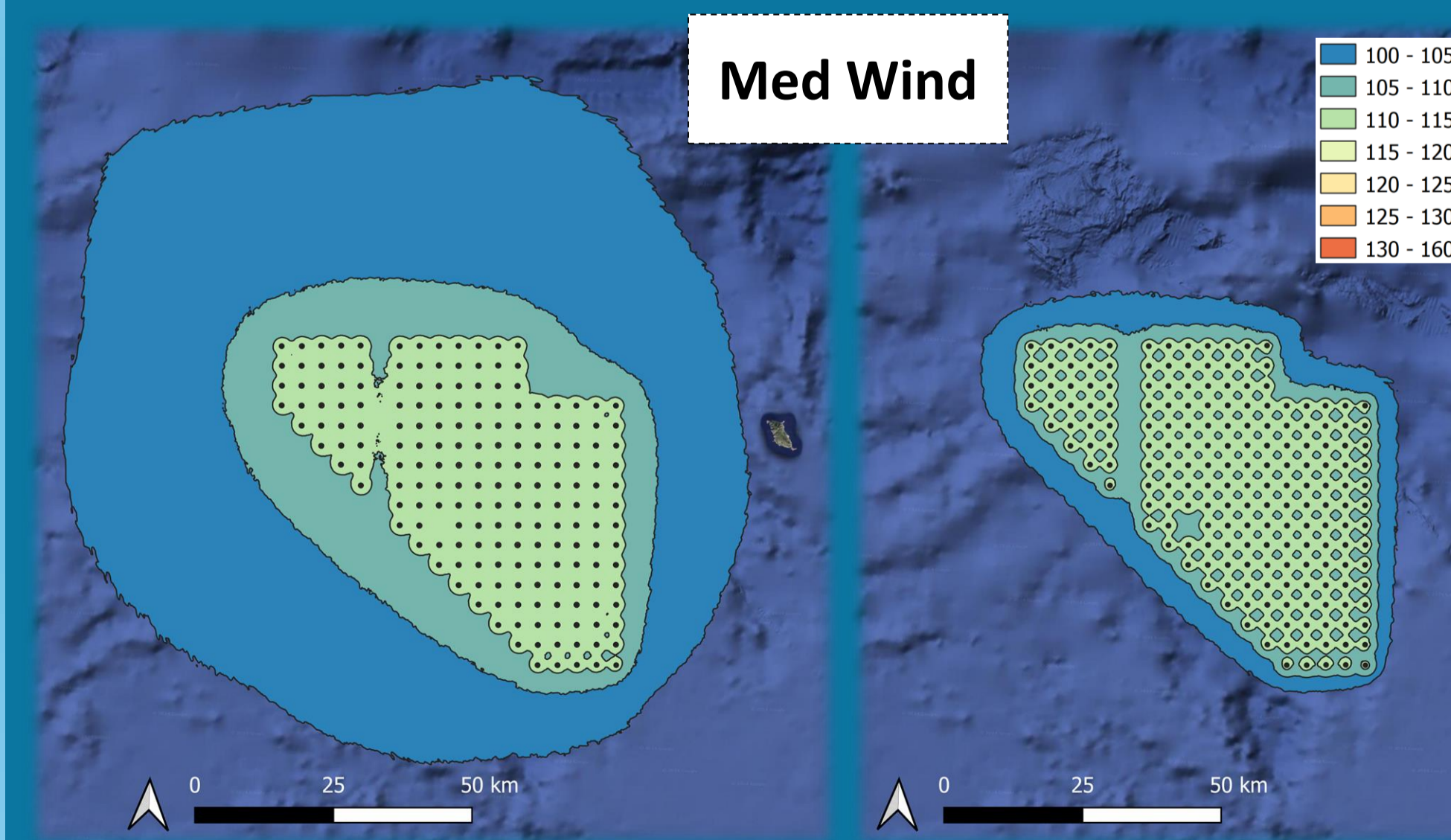
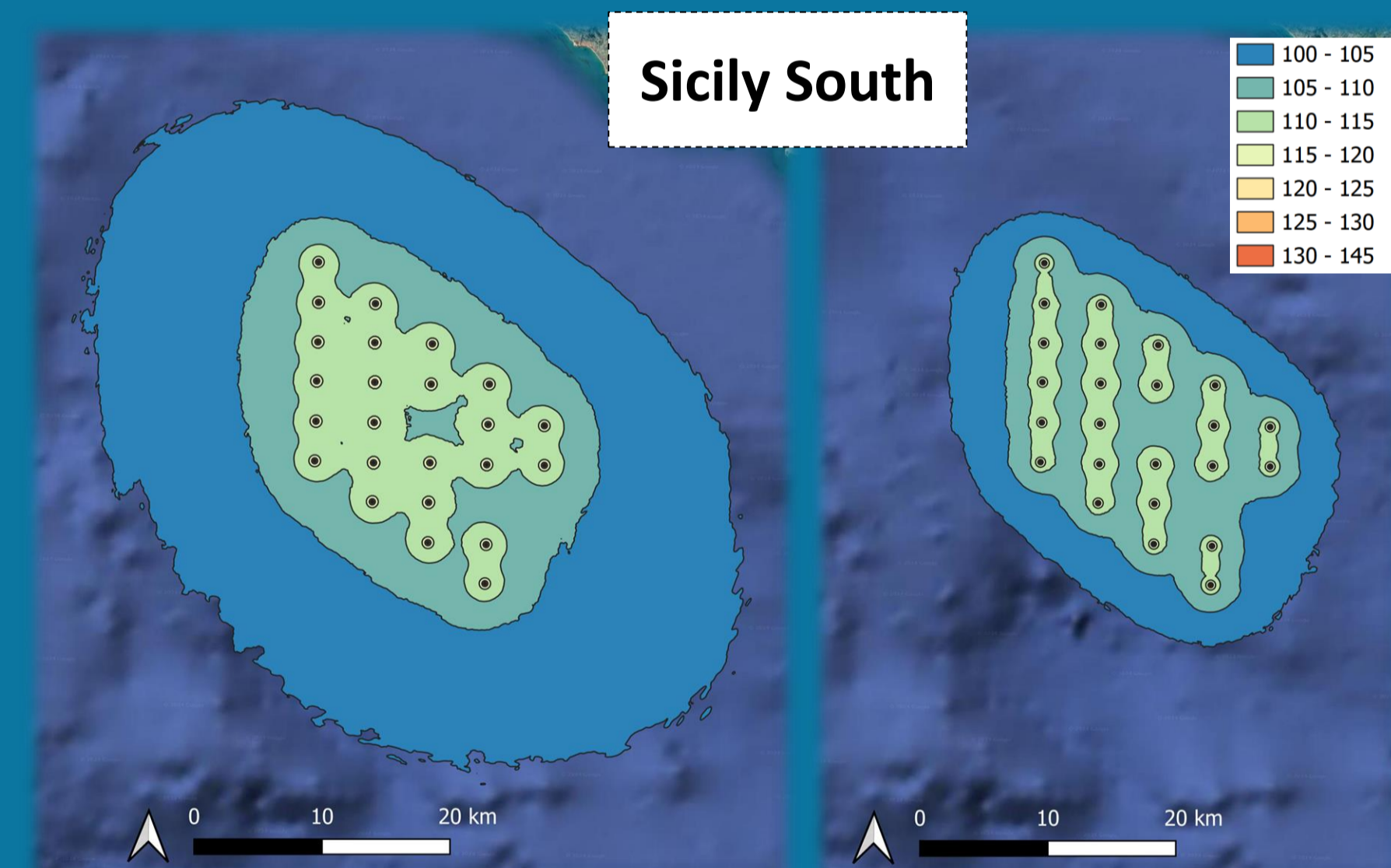
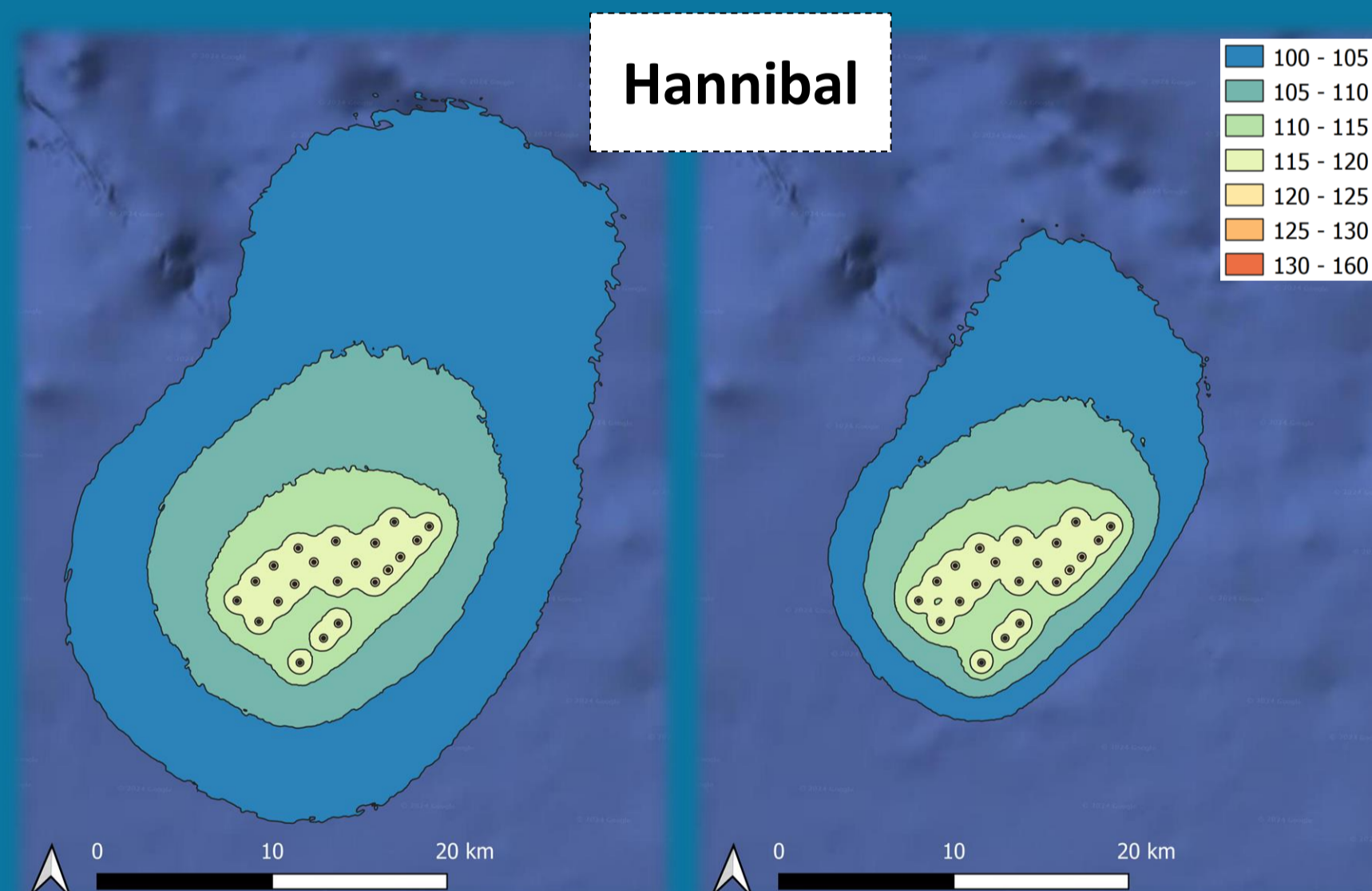
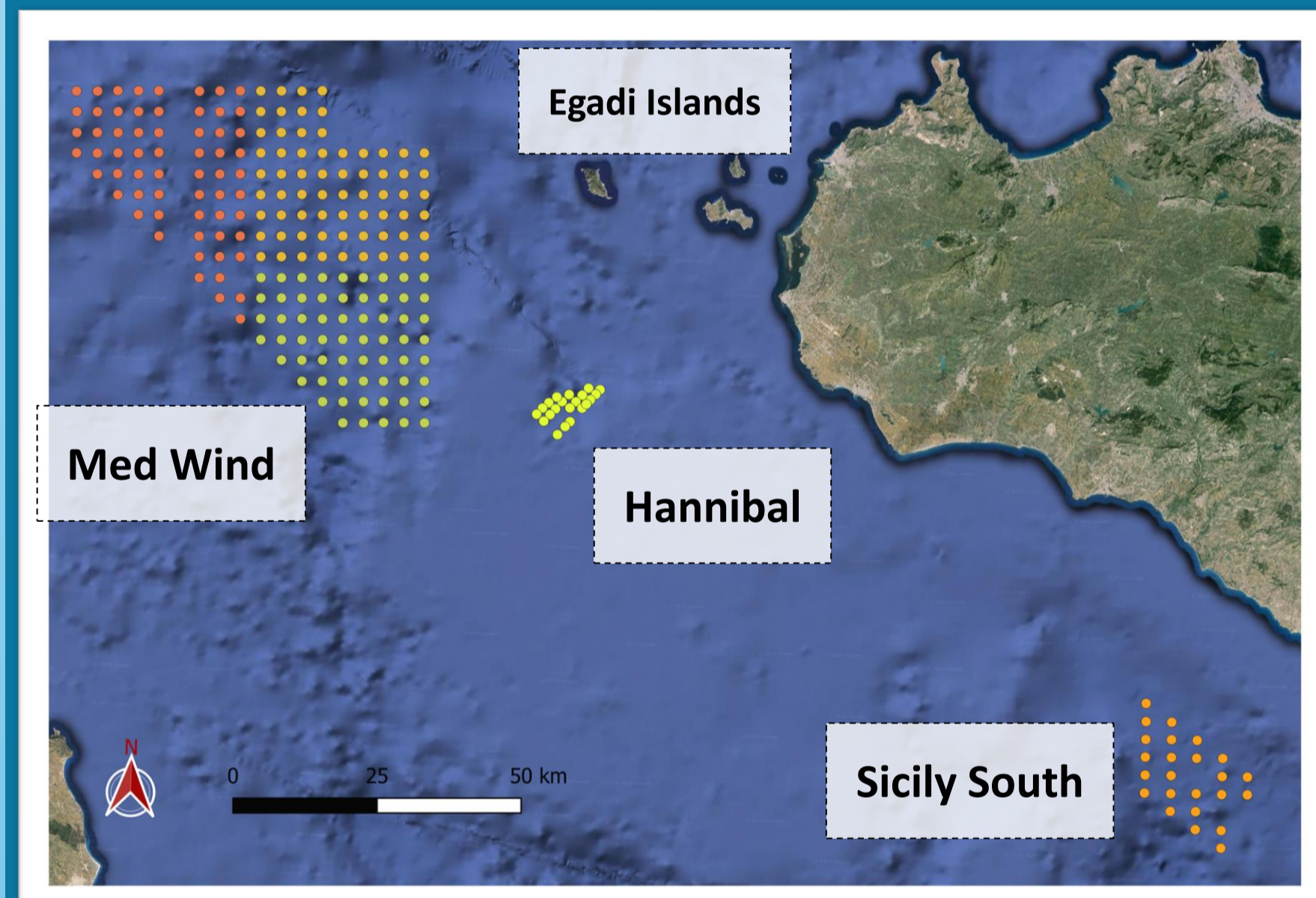
METHODS

- Med Wind, 190 turbines, depth range: from 100 m to 900 m.
- Hannibal, 25 turbines, depth range: from 200 m to 350 m.
- Sicily South, 48 turbines, depth range: from 290 to 525 m.

Source of bathymetry and sediment information: EMODnet. February and August sound speed profiles were applied.

Propagation losses were modelled in decidecade bands using **JASCO's Marine Operations Noise Model** based on the parabolic equation method for frequency bands from 10 to 800 Hz, combined with **BELLHOP** beam-tracing model from 1 to 25 kHz. The source was modeled at a depth of 10m. After having modelled the propagation losses, source levels that correspond to the operational noise generated by spar flotation types were applied. To obtain aggregate sound maps of the wind farms, single source grid outputs were moved to each turbine coordinates for each wind farm. SIEM Sapphire was chosen as an example of offshore supply ship (91 m long, draught of 7 m) for Med Wind. The source was modeled at a depth of (0,7*draught) m in dynamic positioning.

RESULTS



For all pairs of images: the one on the **left** was obtained by applying **February** sound speed profile; the one on the **right** applying **August** sound speed profile.

Tables showing, for each FOWF, sound levels (SPL) and the corresponding distances (in km).

SPL [dB re 1µPa]	Hannibal		Sicily South		Med Wind		Med Wind + Vessel
	February	August	February	August	February	August	February
160	0.04	0.04	-	-	190	-	0.02
145	0.04	0.04	0.04	0.04	165	-	0.02
135	0.04	0.04	0.06	0.06	135	10.04	10.04
130	0.08	0.08	0.09	0.09	130	10.08	10.08
125	0.15	0.15	0.16	0.13	125	10.15	10.15
120	0.27	0.26	0.27	0.24	120	10.23	10.23
115	1.26	1.16	0.53	0.43	115	10.44	10.41
110	4.28	3.37	2.90	1.86	110	11.65	11.08
105	10.59	7.50	6.69	3.85	105	23.03	12.64
100	24.68	17.55	20.71	8.36	100	55.01	17.63

DISCUSSION

Aggregate noise levels from multiple operating turbines could be perceptible several km away from a FOWF. Noise levels typically remain below ambient levels unless in close proximity to individual turbines. The noise of a ship in dynamic positioning dominates the sound field of the wind farm.

REFERENCES

Pace F. et al. 2024. Underwater Sound Emissions from the Moorings of Floating Wind Turbines: HYWIND Scotland Case Study. In: Popper, A.N., Sisneros, J., Hawkins, A.D., Thomsen, F. (eds) The Effects of Noise on Aquatic Life. Springer, Cham.
 Tougaard J, Hermanssen L, Madsen PT. 2020. How loud is the underwater noise from operating offshore wind turbines?. *J. Acoust. Soc. Am.*; 148 (5): 2885–2893.