



Laboratoire Milieu Marin



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INSTM

SEA ENERGY IN THE MEDITERRANEAN SEA AND ALONG TUNISIA COASTS

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UfM Regional Stakeholder Conference on Blue Economy

Naples, 29-30 November 2017

A review: Soukissian et al., 2017, *Energies*

Marine Renewable Energy

- Offshore wind energy : most mature MRE source: higher power produced, more space available.
The installed capacity : North Sea, Irish Sea, Baltic Sea, Atlantic Ocean.
Expected: 100 Euros/MWh by 2020. Absent in Med.
- Waves : high energy density, prototypes (Naples, Pantaleria), Greece
- Tidal elevation : also mature MRE source
- Tidal currents : Tidal barrages; 2.5 m/s Absent in Med.
- Density gradients : vertical difference of temperatures, differences of salinity Absent in Med.

Offshore wind energy

WIND CLIMATE

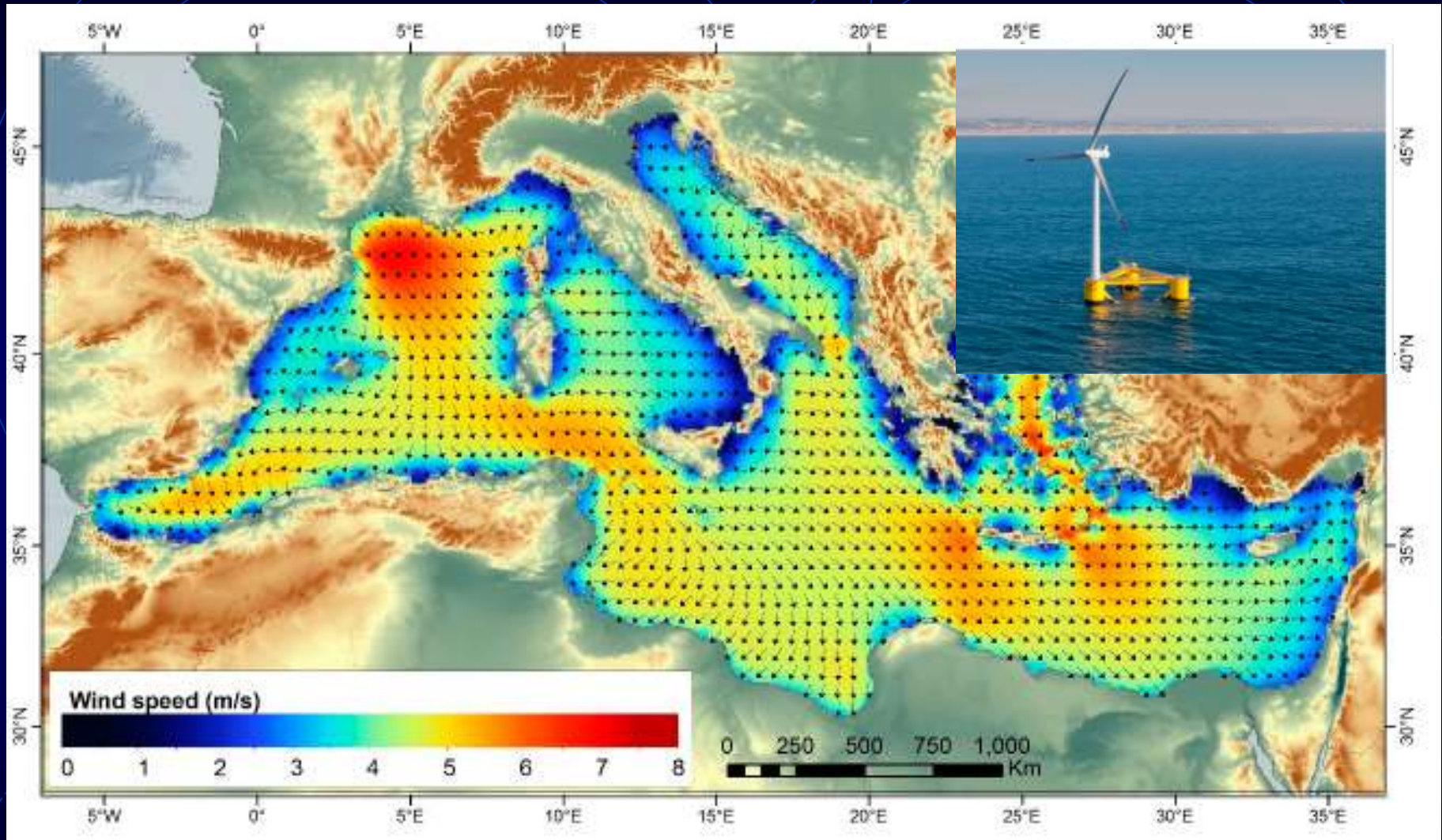


Figure 6. Mean annual wind climate (at 10 m above sea level) in the Mediterranean Sea according to the ETA model. Arrows indicate the mean annual wind direction (Source: [107]). Data analyzed by HCMR.

Off-shore wind speed

Gulf of Gabes

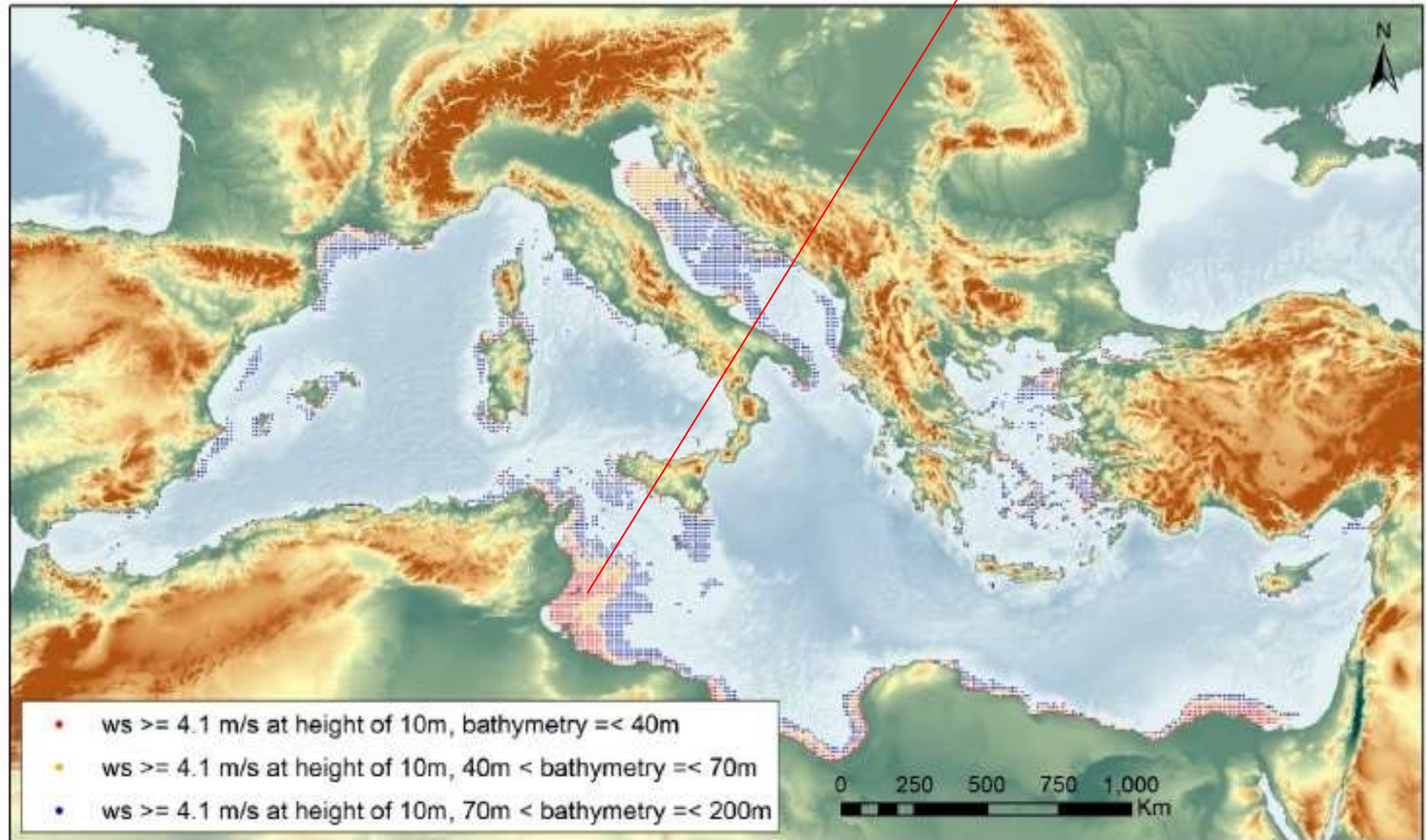
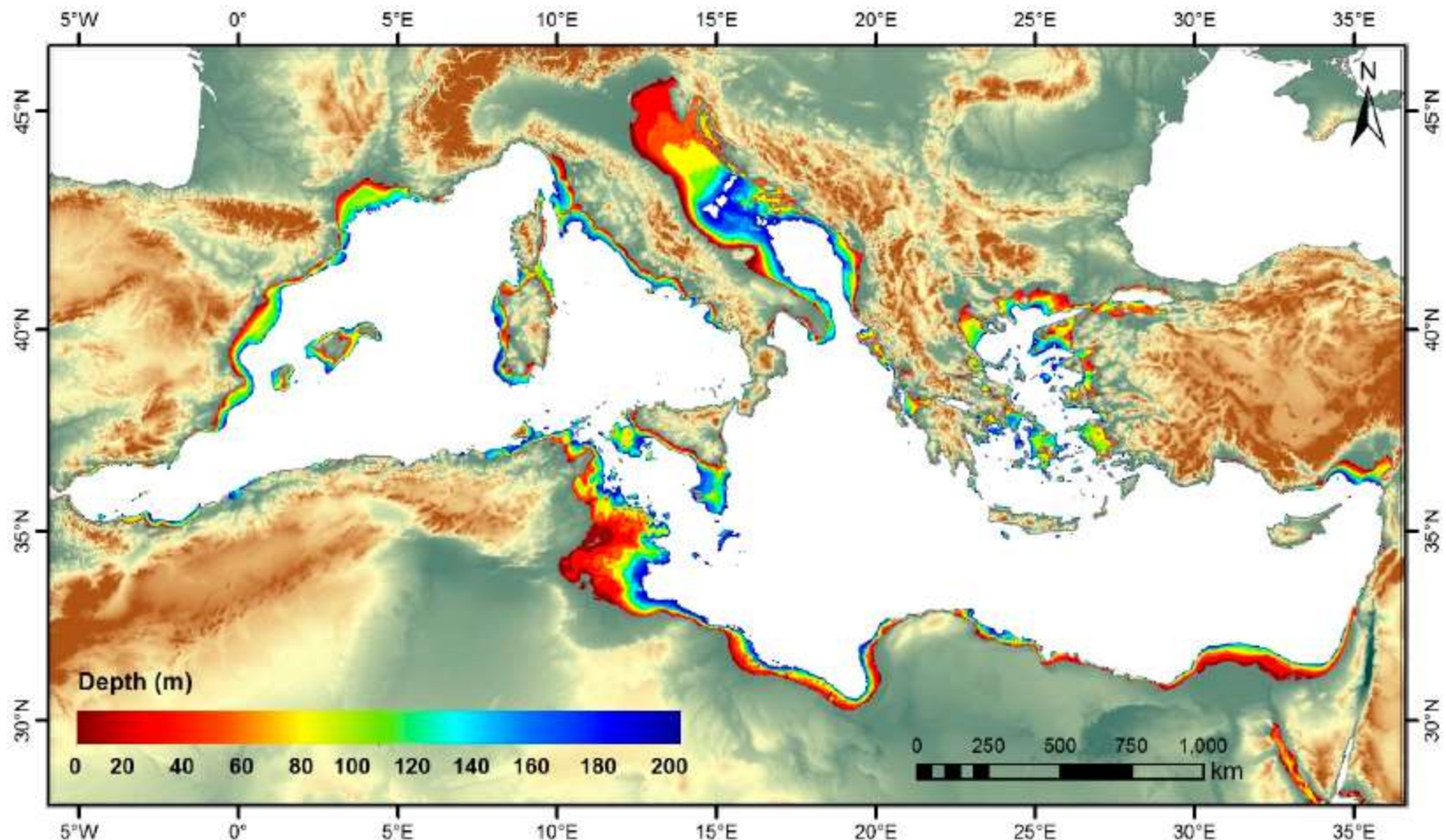


Figure 13. Potential hot-spots for OWF development in the Mediterranean Sea [107]. Data analyzed by HCMR.

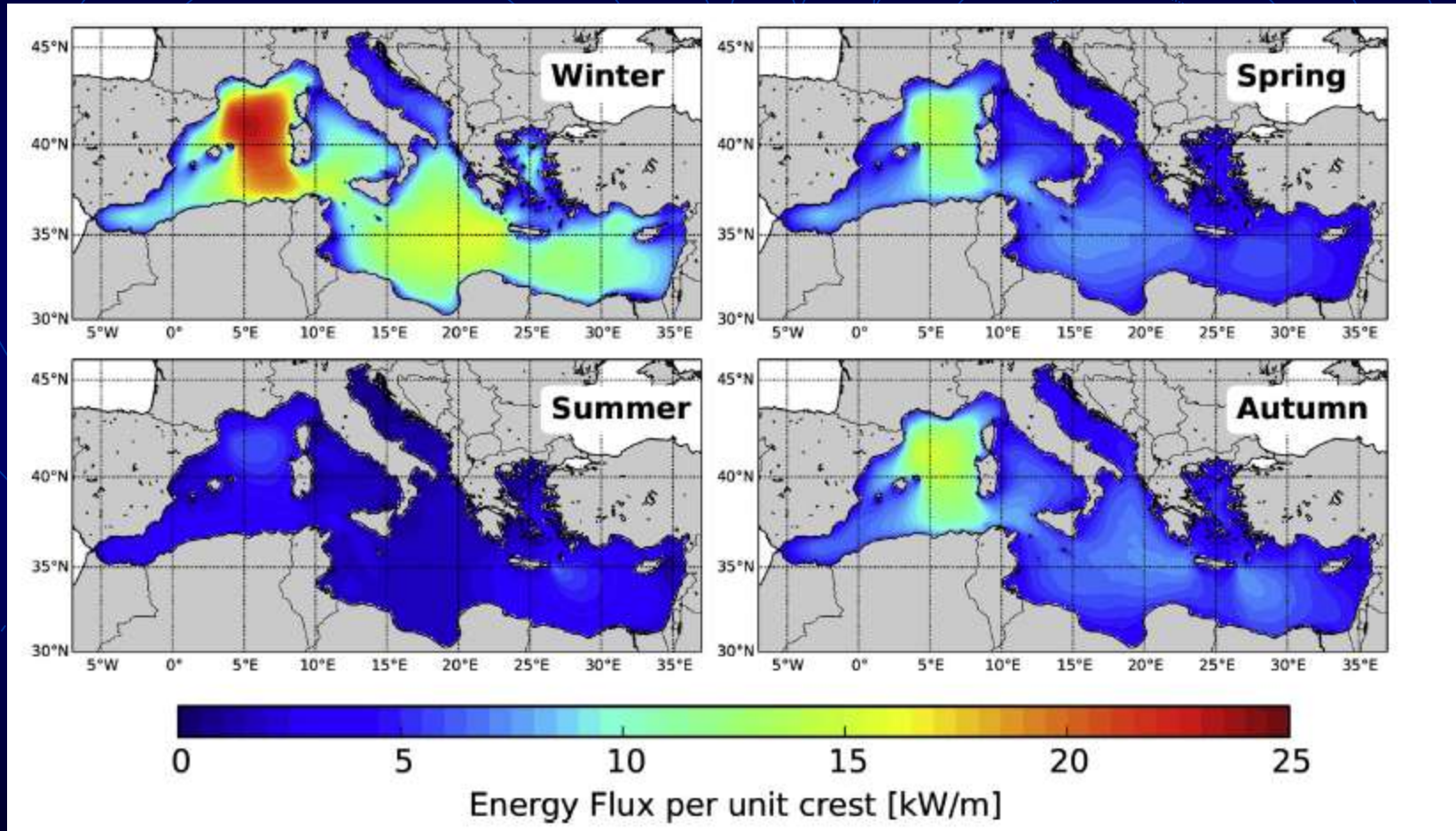
Bathymetry



Source: EMODnet Digital Bathymetry 2016 (DTM grid of $1/8^\circ \times 1/8^\circ$ arc minute of longitude and latitude (ca 230×230 meters))
DOI: 10.12770/c7b53704-999d-4721-b1a3-04ec60c87238

Figure 5. Bathymetric map of the Mediterranean Sea (depth range 0–200 m). Data analyzed by the Hellenic Center for Marine Research (HCMR).

Wave Energy Potential in the Mediterranean



Besio et al., 2016, Energy

Wave Energy Potential in the Mediterranean

SINN Power's single WEC module in Greece
(Photo: SINN Power)



SINN Power's single WEC array

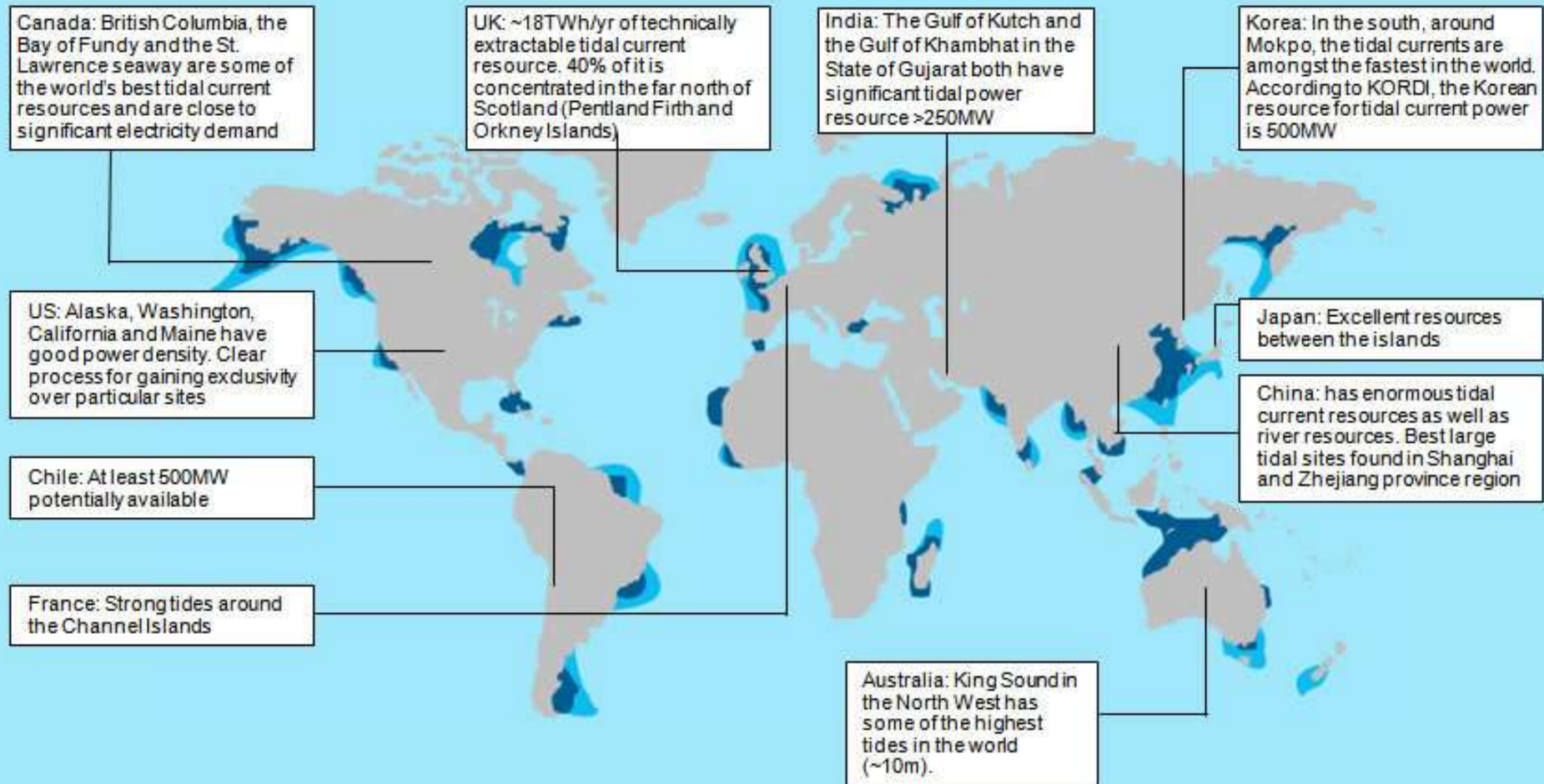
Wave Energy Potential in the Mediterranean

Pelamis Wave Energy Converter

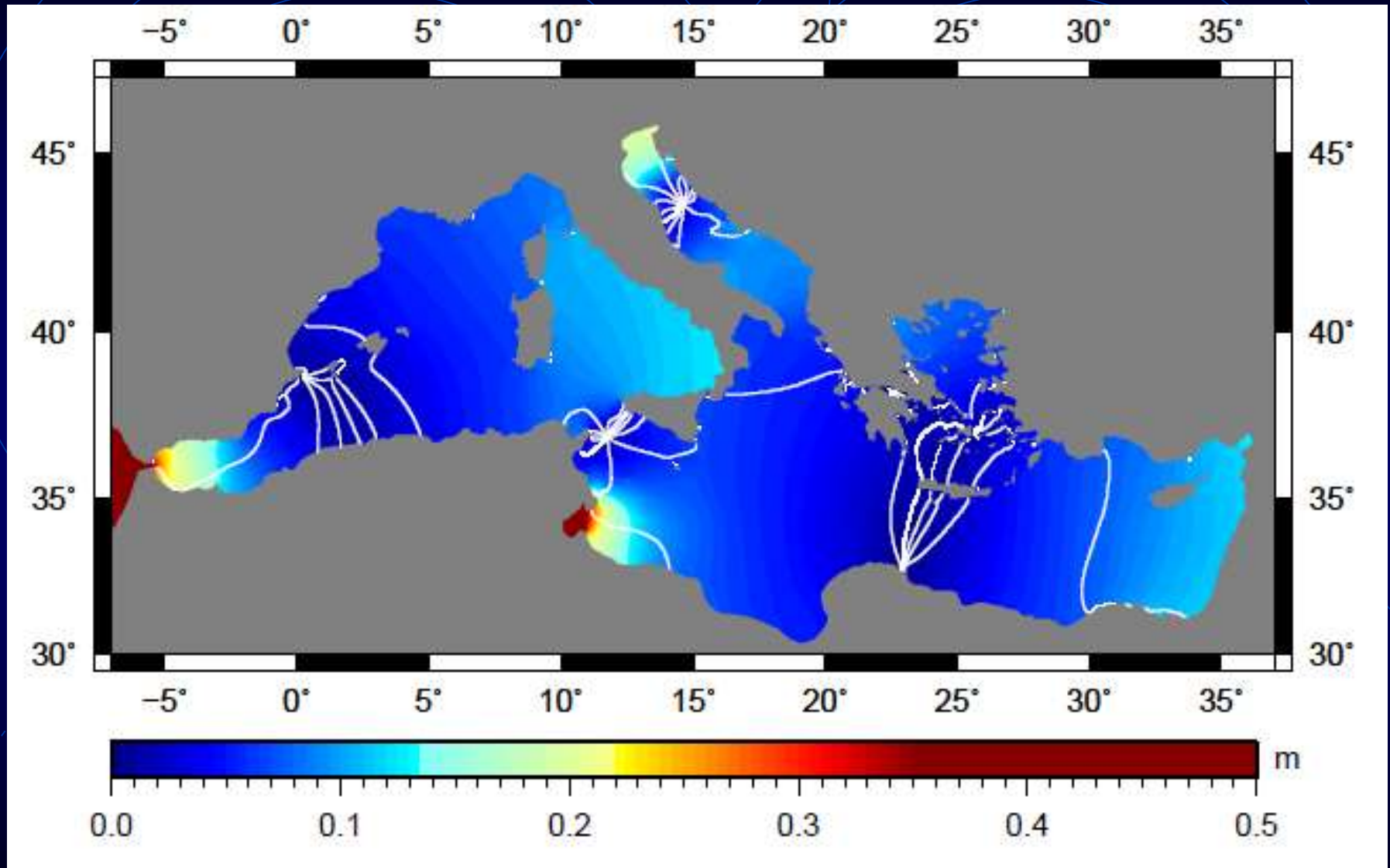


TIDE POTENTIAL

High Potential Areas for Tidal Resources



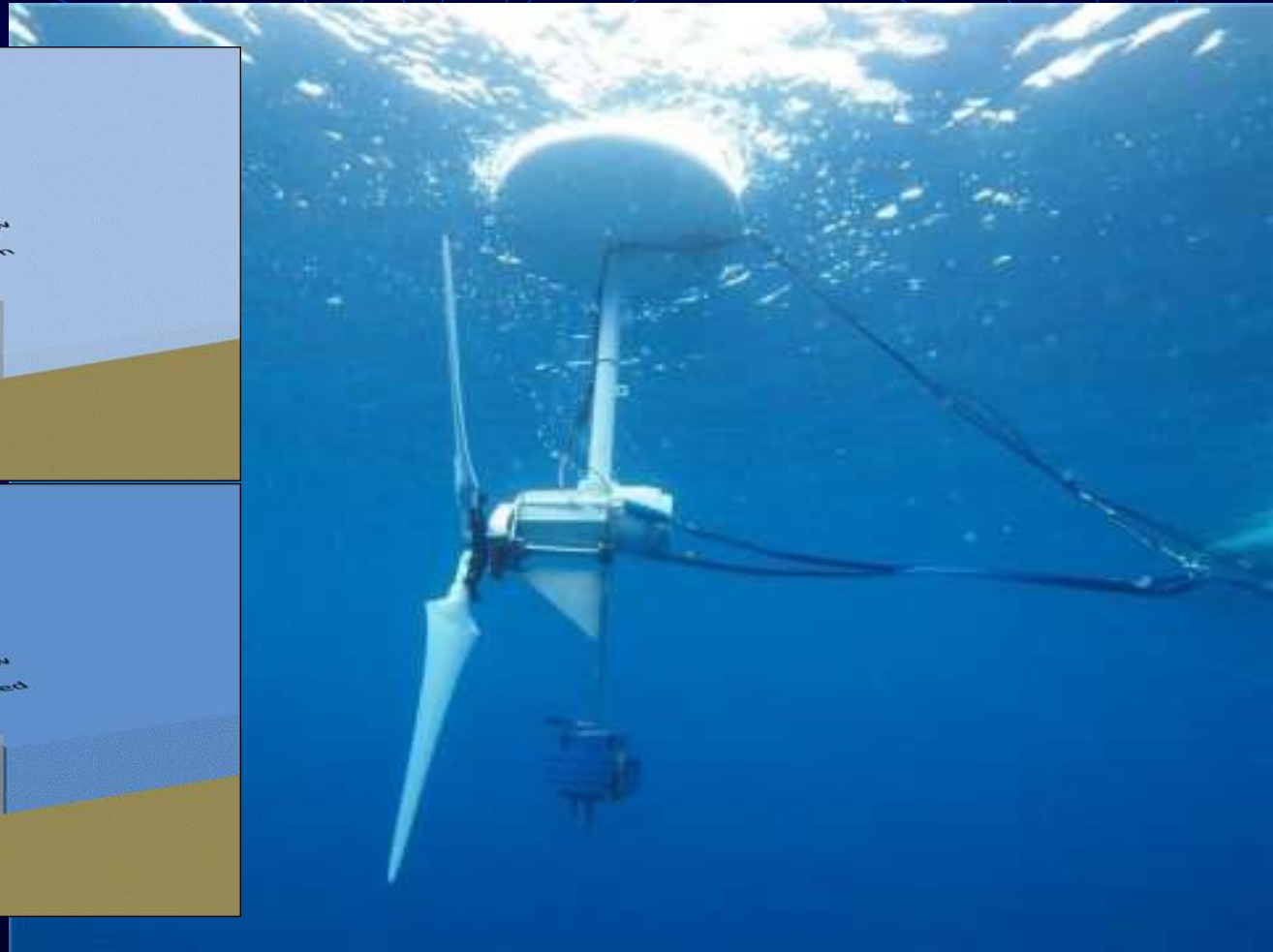
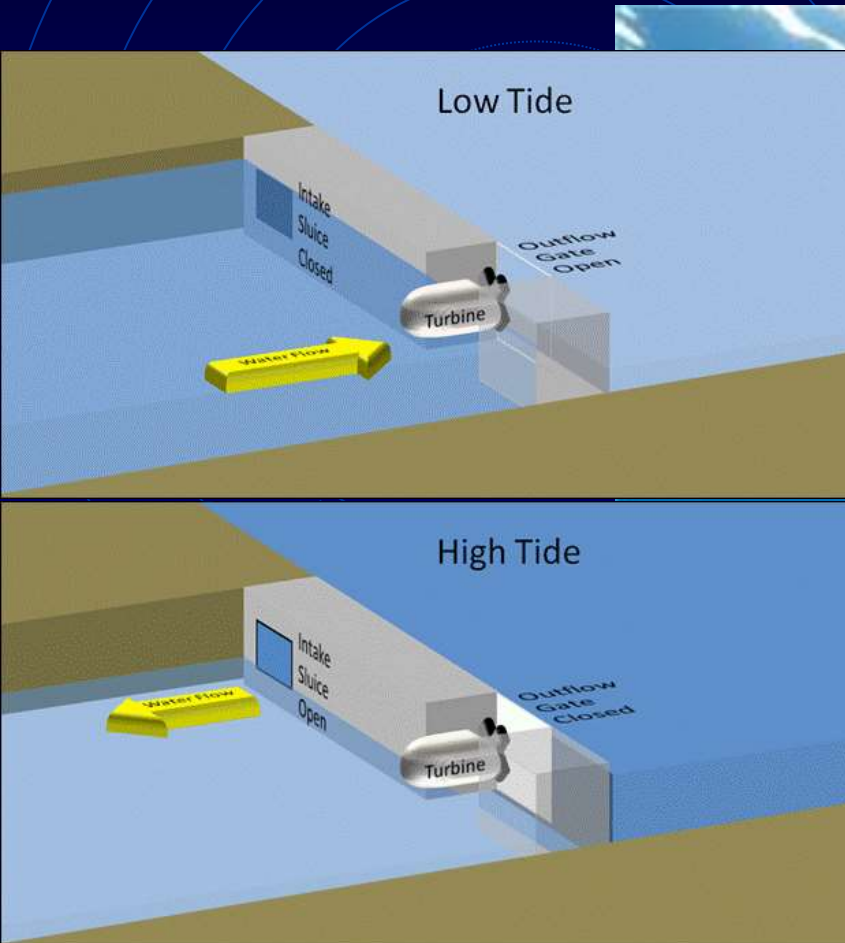
TIDE in the Mediterranean



Arabelos et al., 2010, OScD

Prototype of the ocean-current turbine.

Quantum Wave Microscopy Unit conducted towing experiment at Sea.



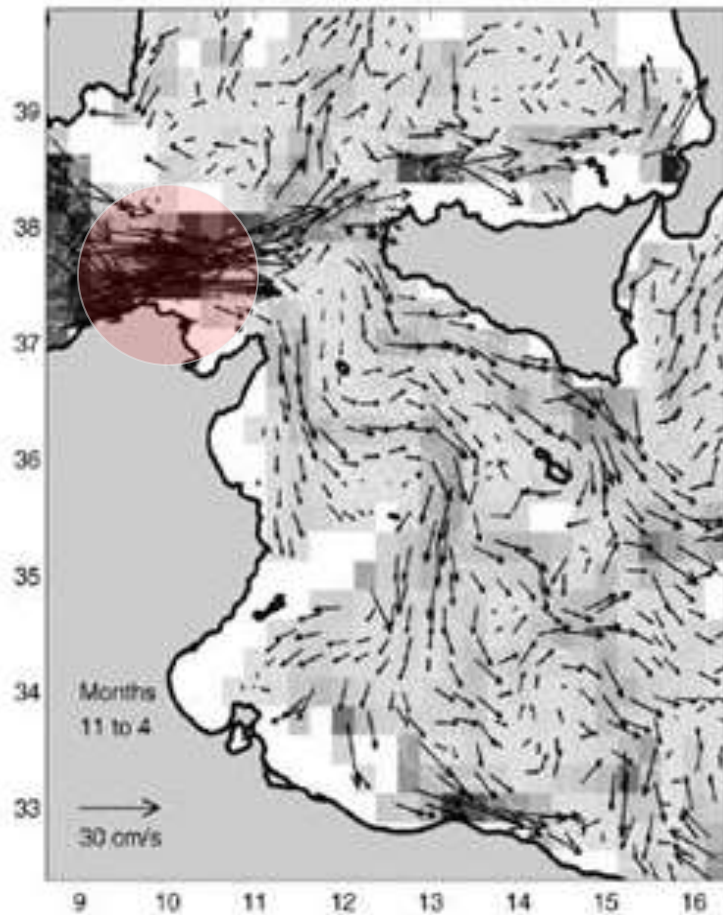
Arabelos et al., 2010, OScD

The background is a solid dark blue. It features three sets of concentric circles in a lighter blue color. One set is on the left, one on the right, and one at the bottom center. These circles are intersected by several thin, light blue lines: a solid vertical line, a dashed diagonal line from the bottom left, and another dashed diagonal line from the top right. The text 'ALONG THE TUNISIA COASTS' is centered in the upper half of the image in a bold, orange, sans-serif font.

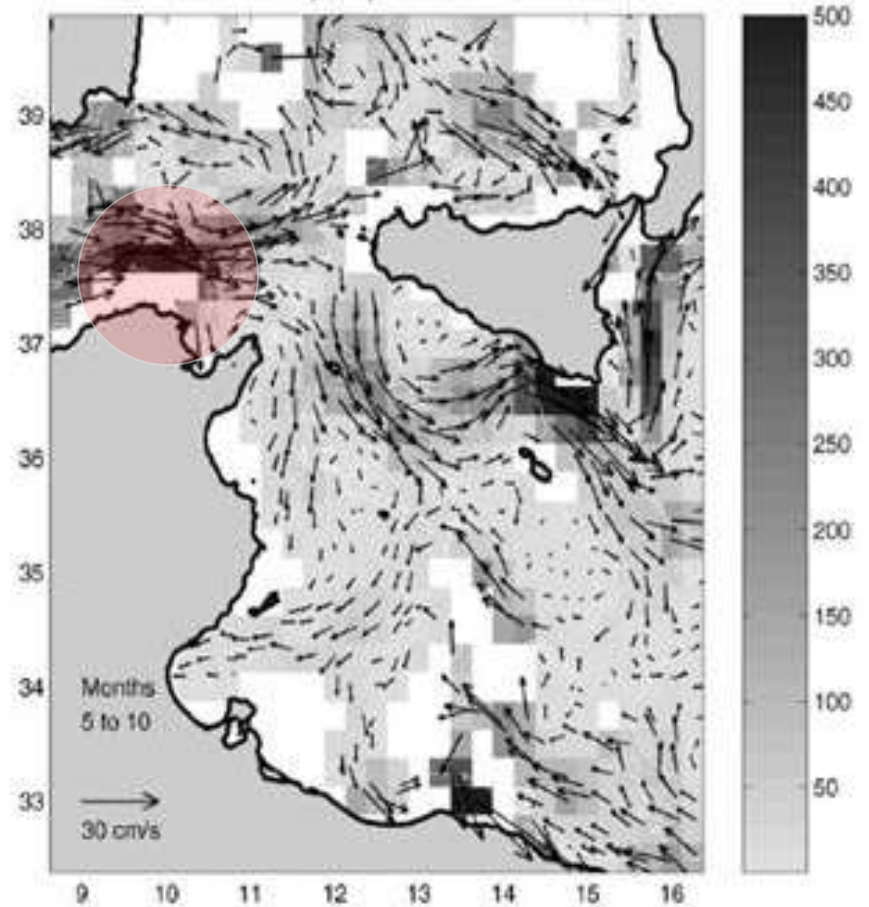
ALONG THE TUNISIA COASTS

SEA CURRENTS

Mean flow and MKE ($n=5$) : 1-Jan-1990 to 1-Jan-2000



Mean flow and MKE ($n=5$) : 1-Jan-1990 to 1-Jan-2000



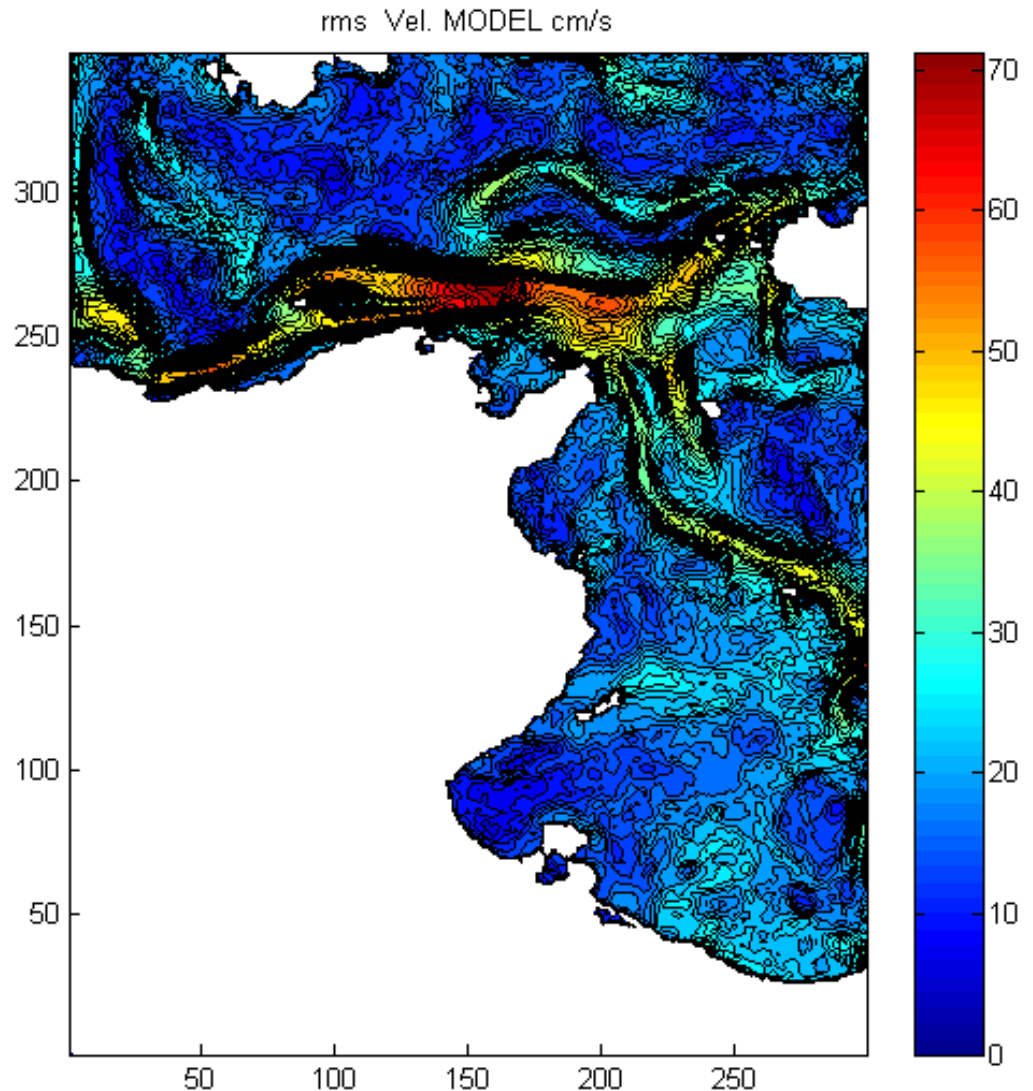


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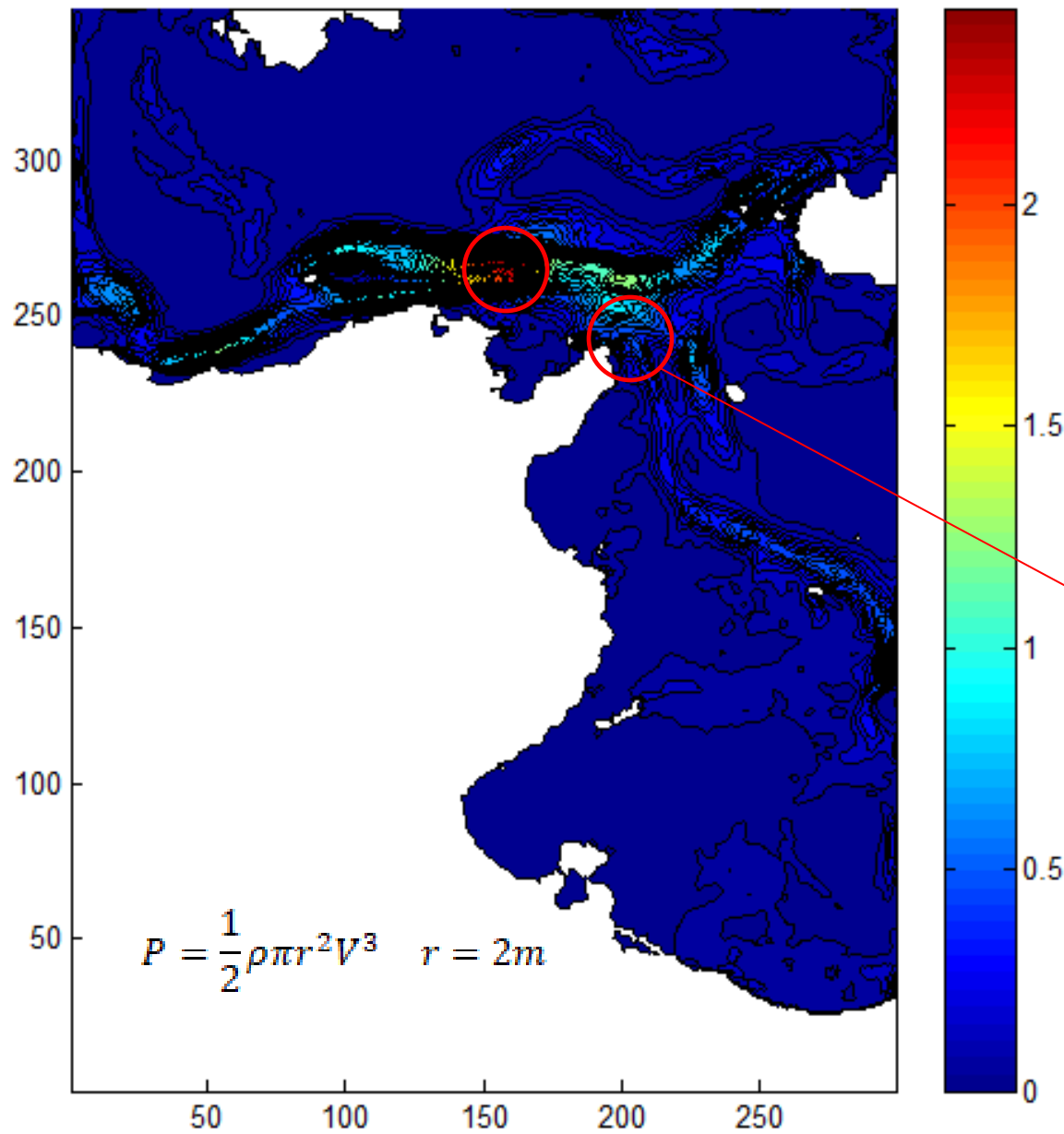
Project 2016-2019

Sea Energy along the Tunisia coasts

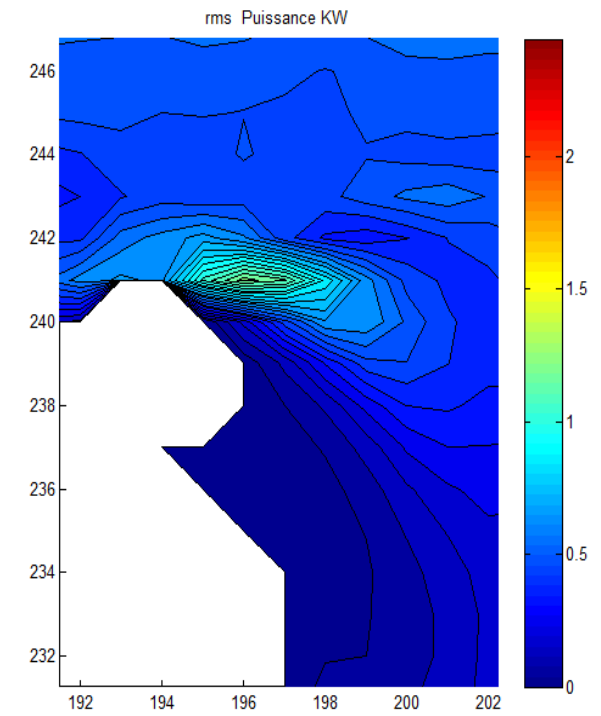


High resolution model

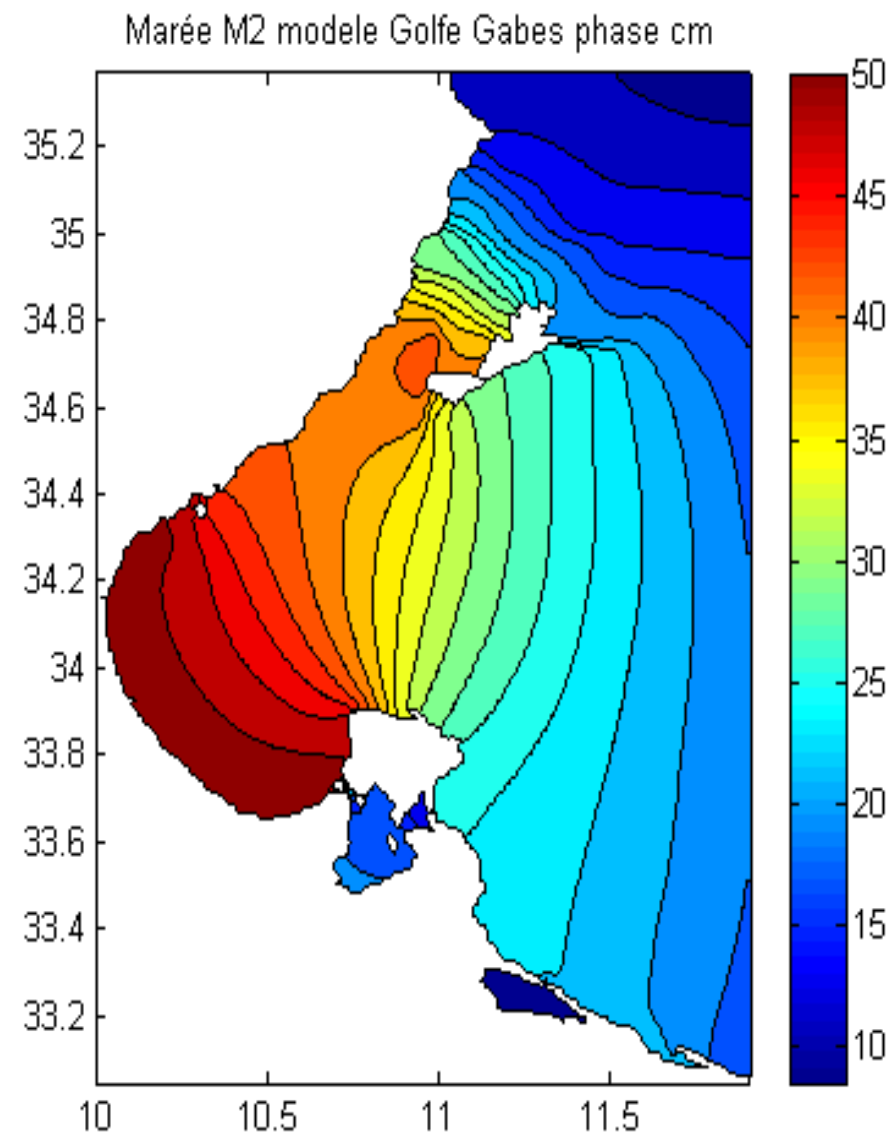
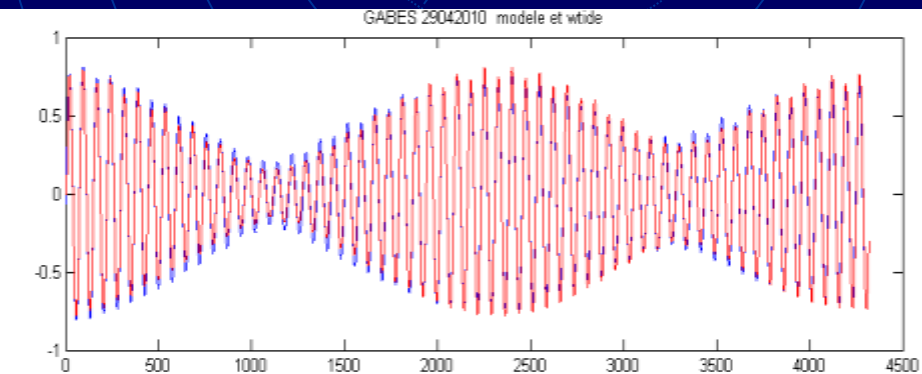
Puissance KW



Current Energy



TIDE AMPLITUDE :



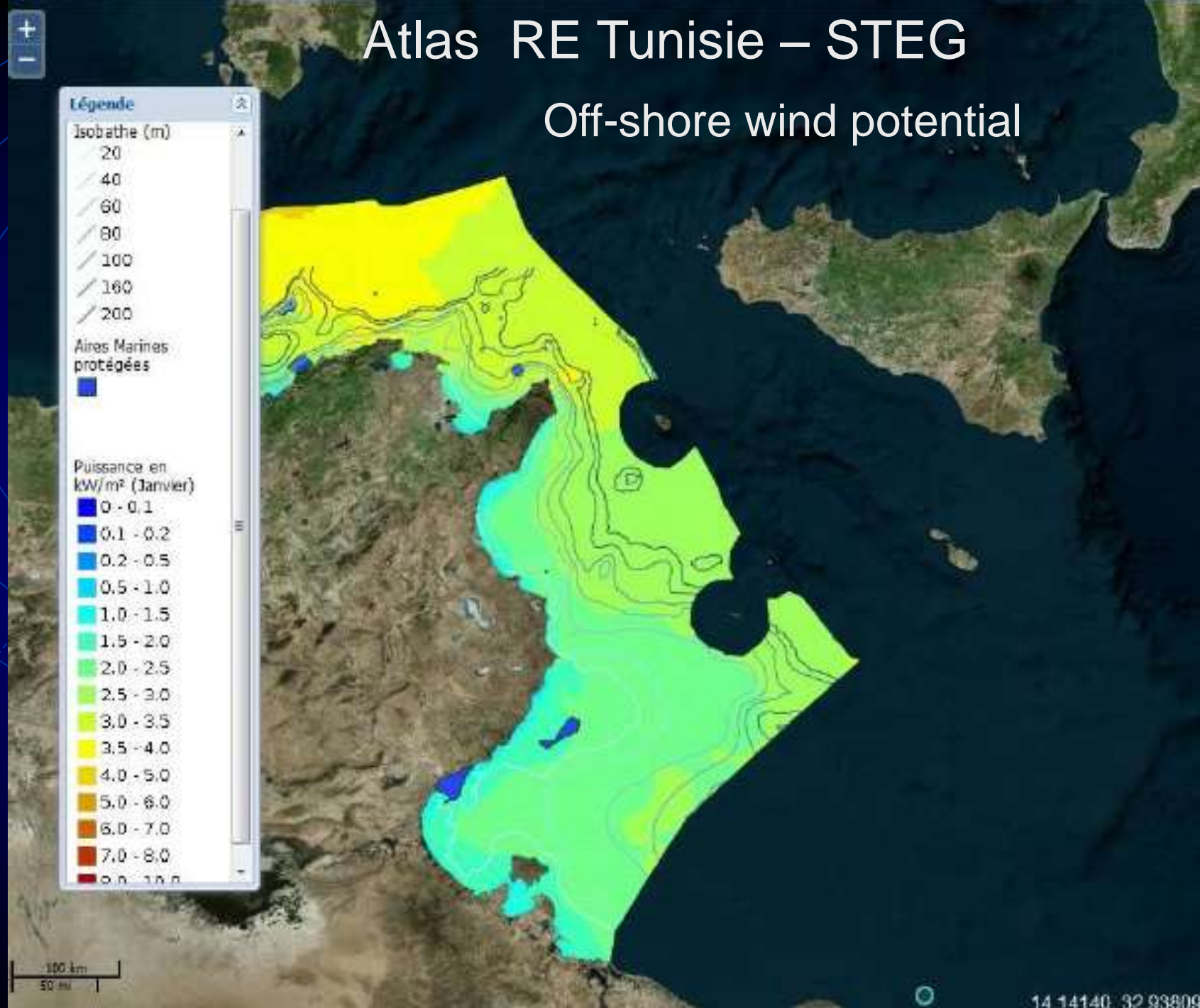
Model : INSTMED

PROBABLE ENERGY POTENTIAL SITES



Atlas RE Tunisie – STEG

Off-shore wind potential



CONCLUSION

- MRE is still not in a mature phase
- There is a potential for MRE in the Med.
- Increasing number of projects & initiatives
- Prototypes