Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile

Interreg Mediterranean

EUROPEAN UNION

Project co-financed by the European Regional Development Fund

PELAGOS

Ocean Energy assessment and forecast for the Southern European Seas based on Copernicus data

Rome April 16th 2018

Gianmaria Sannino / Head of the Climate Modelling and Impacts Laboratory @ ENEA

Ocean Energy: Ongoing Activities @ ENEA

- **PELAGOS**:Promoting innovative nEtworks and cLusters for mArine renewable energy synerGies in mediterranean cOasts and iSlands.
  https://pelagos.interreg-med.eu/

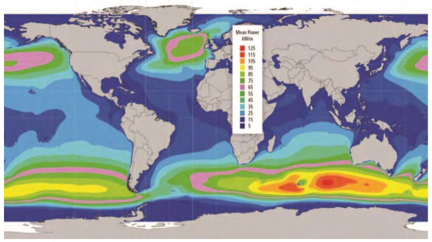
- **SET-Plan**: ENEA is Italian representative at the WG 'Ocean Energy' of the European Strategic Energy Technology Plan (SET-Plan).

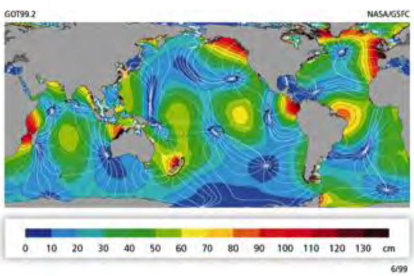
- **European Energy Research Alliance:** ENEA is the Italian representative in the Joint Programm 'Ocean Energy' . www

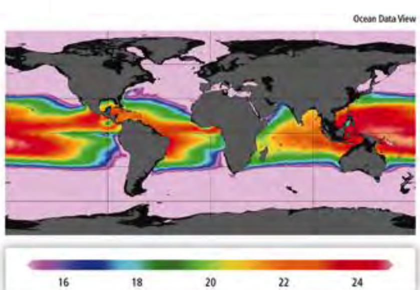
- **SOCLIMPACT**: DownScaling CLImate imPACTs and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond (H2020 Project)

Global ocean energy

The RE resource in the ocean comes from six distinct sources, each with different origins and requiring different technologies for conversion







- **Waves**: derived from the transfer of the kinetic energy of the wind to the upper surface of the ocean.
- **Tidal Range (tidal rise and fall)**: derived from the gravitational forces of the Earth-Moon-Sun system.
- **Tidal currents**: water flow resulting from the filling and emptying of coastal regions as a result of the tidal rise and fall.
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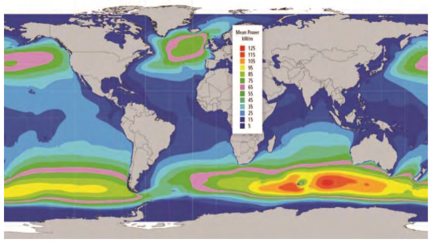

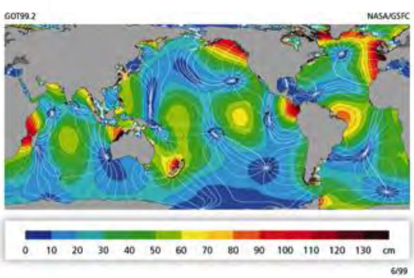

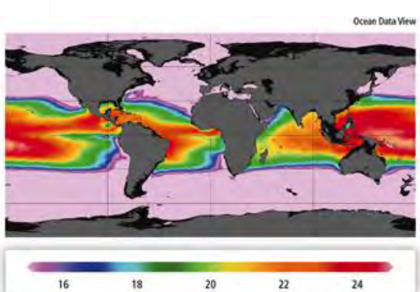

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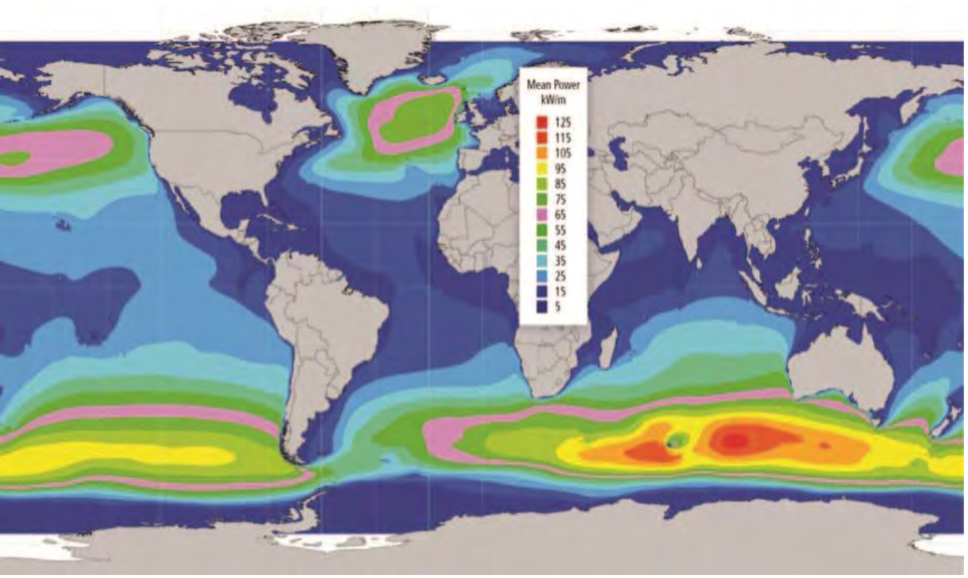
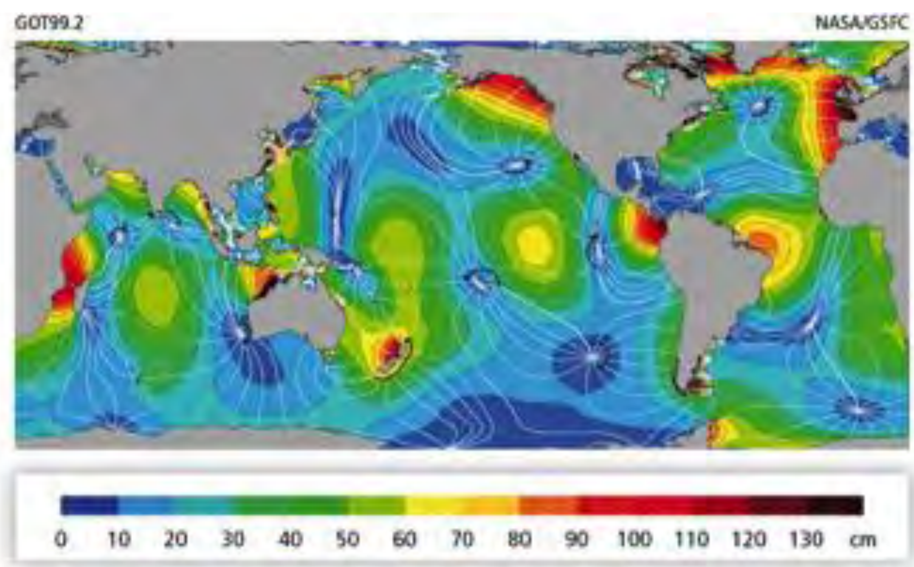
EU ocean energy potential

Wave energy is the largest untapped form of renewable energy in the world. It is on track to produce 10% (**500 GW**)of the global energy demand in the upcoming decades. The global installed capacity of wind and solar power at the end of 2014 was 360 GW and 150 GW respectively.

The estimates of global potential of **tidal energy** generation vary, but it is widely agreed that tidal stream energy capacity could exceed **120 GW** globally.





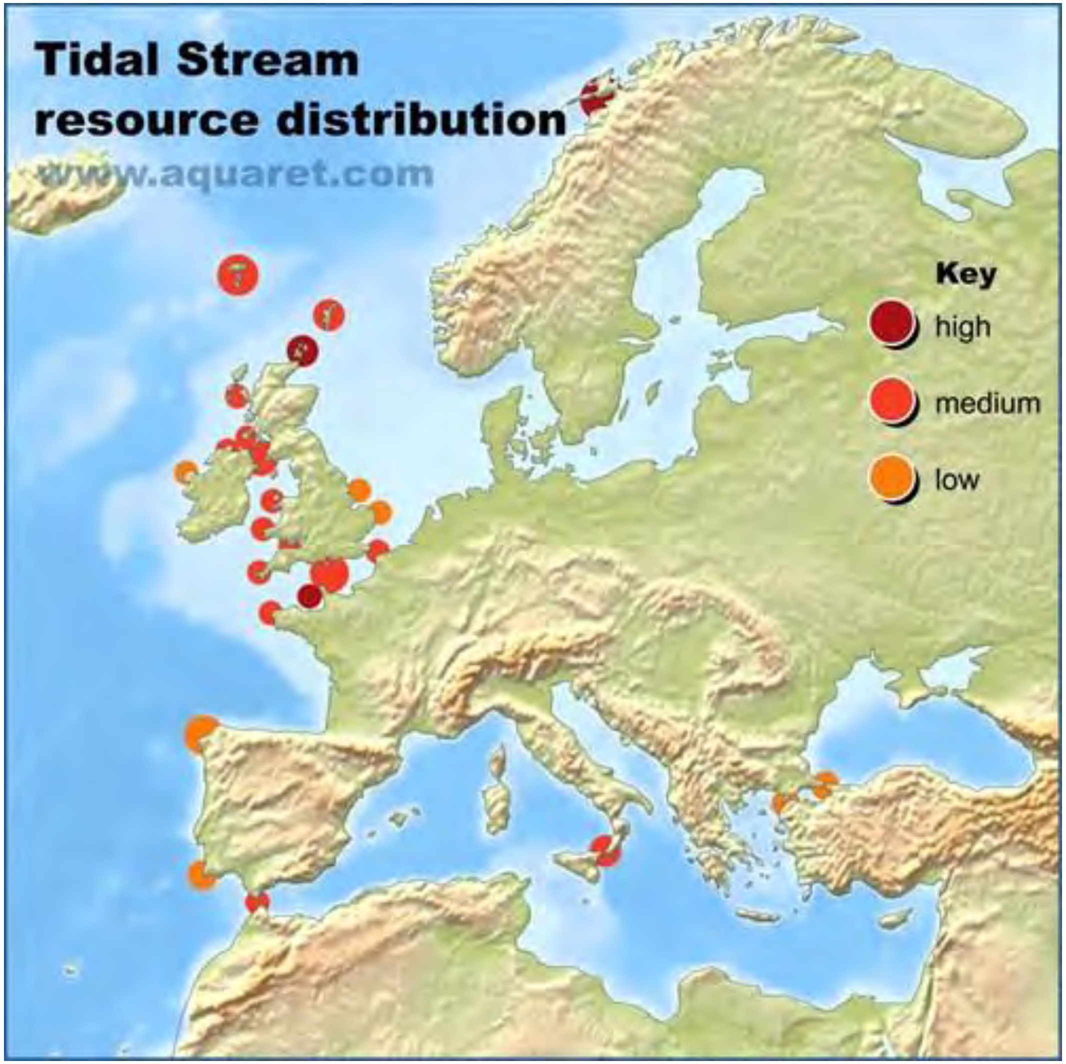
EU wave energy potential

TABLE 1: REGIONAL THEORETICAL POTENTIAL OF WAVE ENERGY

REGION	Wave Energy TWh/yr
Western and Northern Europe	2,800
Mediterranean Sea and Atlantic Archipelagos (Azores, Cape Verde, Canaries)	1,300
North America and Greenland	4,000
Central America	1,500
South America	4,600
Africa	3,500
Asia	6,200
Australia, New Zealand and Pacific Islands	5,600
TOTAL	**29,500**

Source: Mørk et al. (2010)

EU tidal energy sources



Source: Aqua-RET (2012)

Copernicus Marine and Ocean Energy Europe

Main Research Centers and Energy Authority

Main Italian Universities involved in OE

Large Enterprises

Large Enterprises and SMEs

Italian R&D activities: Position paper published

Edited by

G. Sannino and G. Pisacane, ENEA

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ENEA http://www.enea.it/it/seguici/pubblicazioni/pdf-volumi/v2017_ocean-energy-italy.pdf

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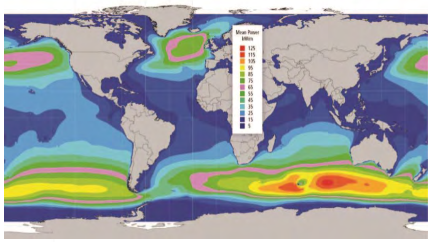

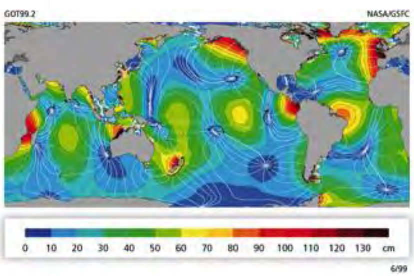

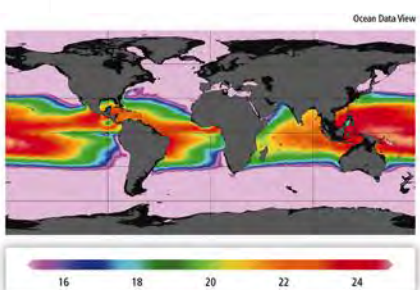

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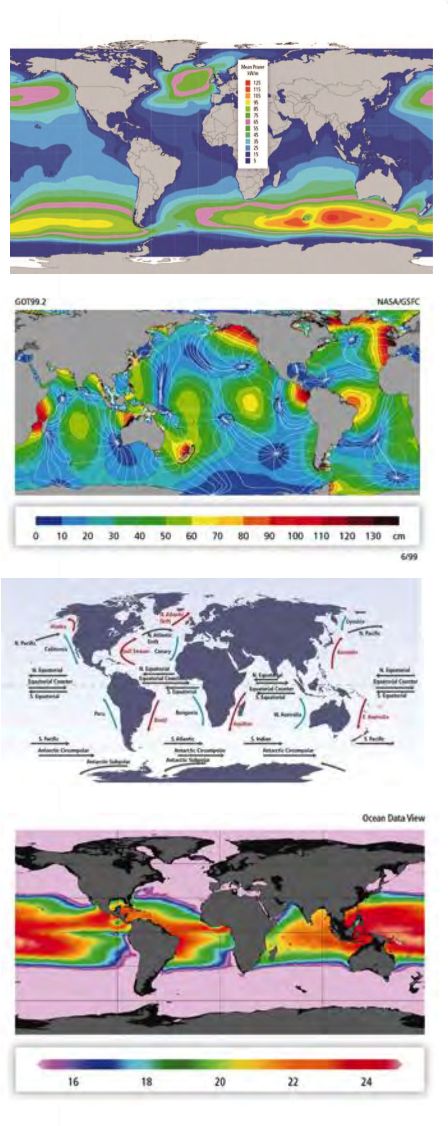
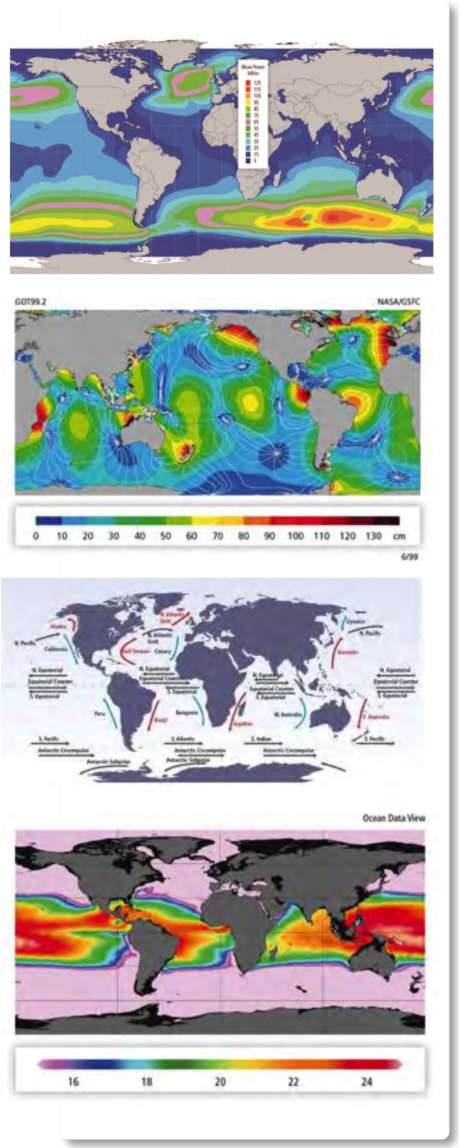
Mediterranean wave energy forecast validation



Where to install the converter

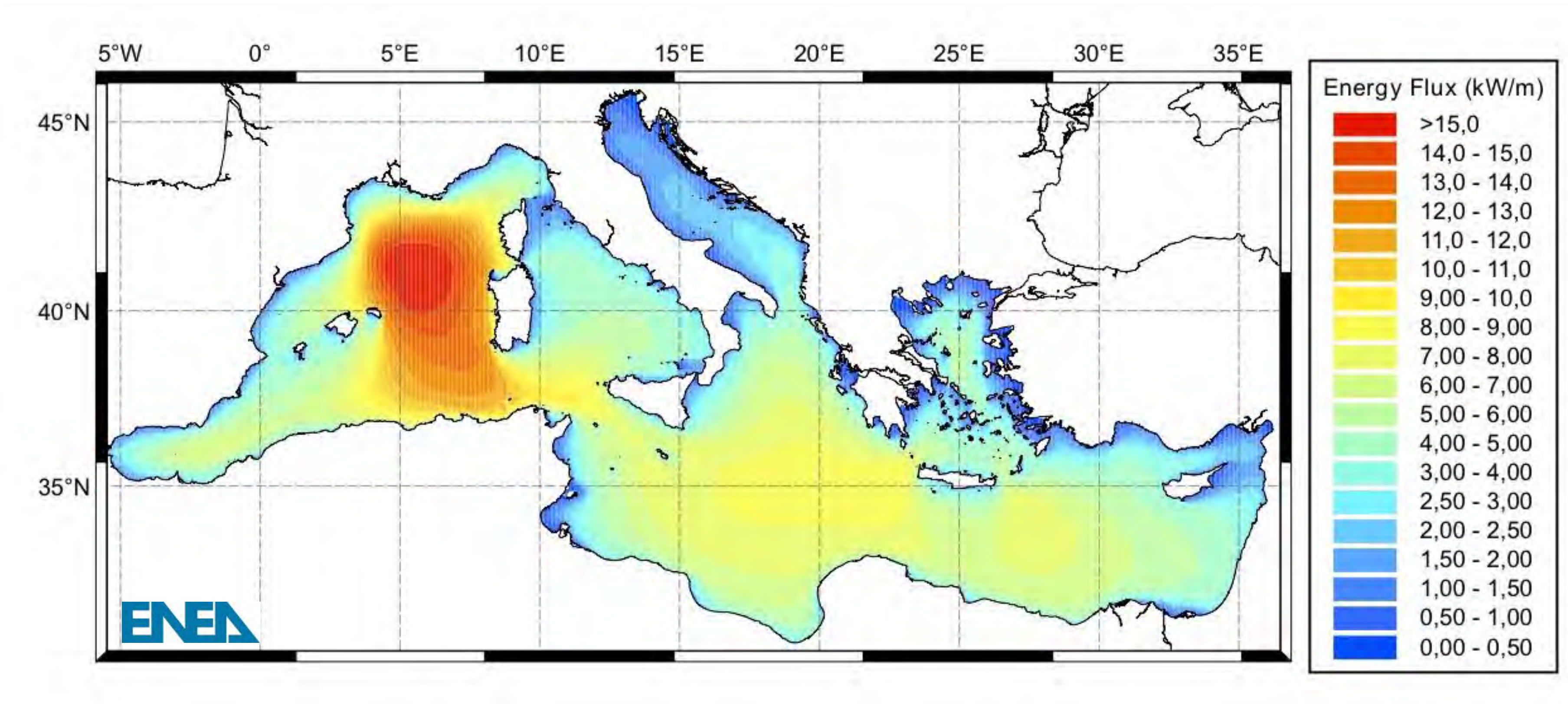
How much energy will be delivered in the electric grid?

Mediterranean wave energy forecast validation



Where to install the converter

Wave energy in the Mediterranean Sea



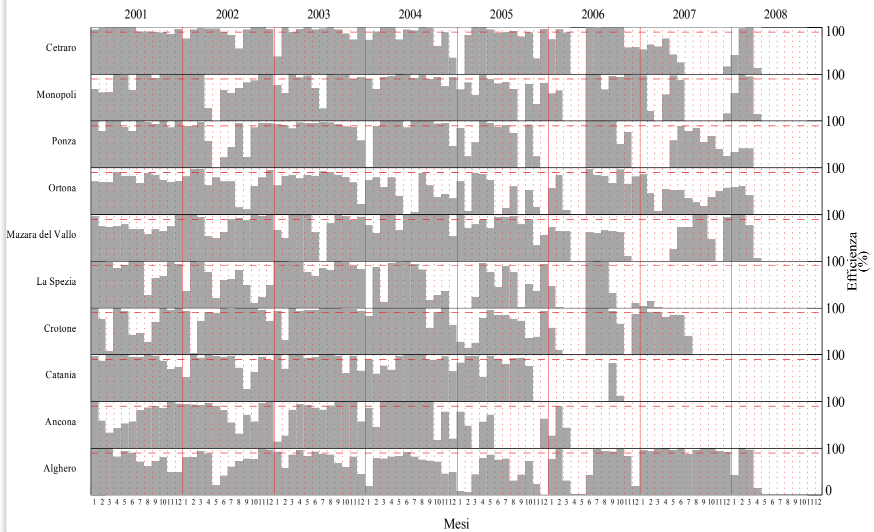
Distribution of average power per unit crest in the Mediterranean between 2001 and 2010.

$$J = \frac{\rho g^2}{64\pi} T_e H_s^2$$

Liberti, Carillo, Sannino, Ren. Energy. 2013

Wave energy assessment along the Italian coasts

Traditional approach: using the Italian Wave measuring Network (Rete Ondametrica Nazionale, RON) managed by Institute for Environmental Protection and Research (ISPRA)



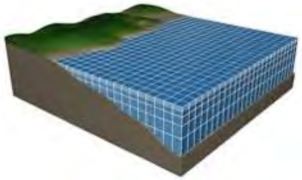
ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

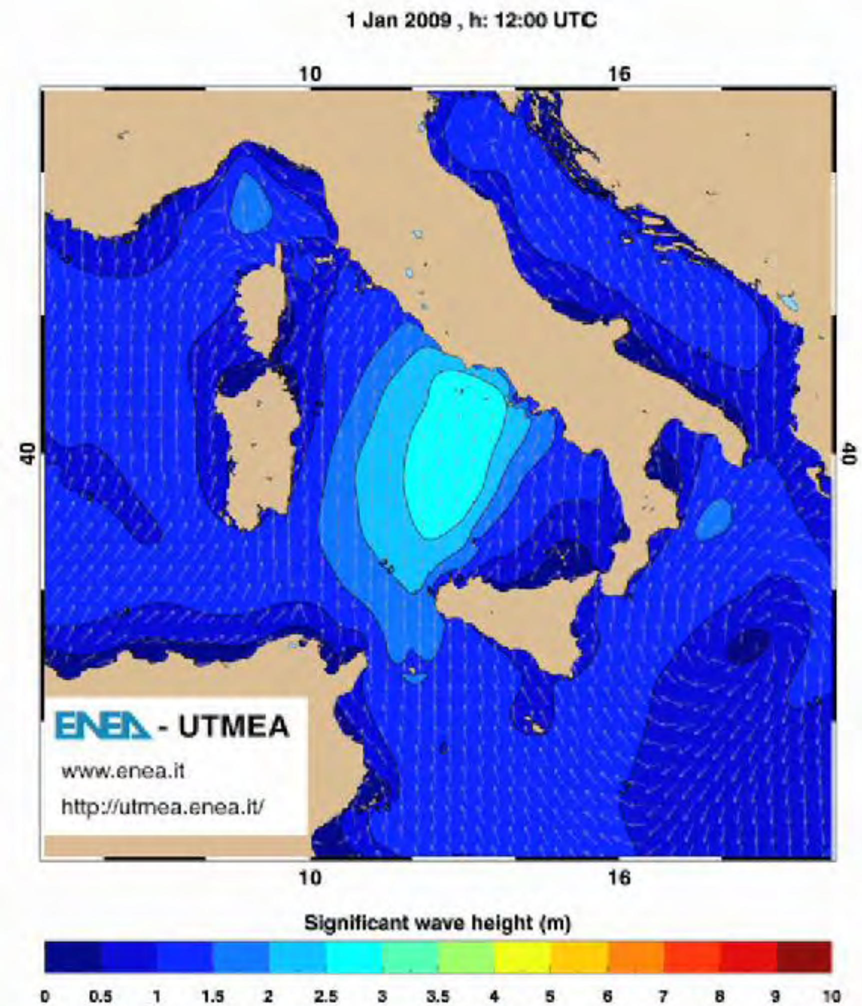
Buoy	First Record	Last Record	3hr Records after 1/1/2001	Expected 3hr records	Efficiency (%)
Alghero	01/07/1989	05/04/2008	15283	21210	72.1
Catania	01/07/1989	05/10/2006	12549	16827	80.2
Crotone	01/07/1989	15/07/2007	14962	19093	78.4
La Spezia	01/07/1989	31/03/2007	10952	18240	60.0
Mazara del Vallo	01/07/1989	04/04/2008	15323	21207	72.3
Monopoli	01/07/1989	05/04/2008	15641	21209	73.7
Ortona	01/07/1989	24/03/2008	12786	21113	60.6
Ponza	01/07/1989	31/03/2008	14479	21169	68.4
Cetraro	28/02/1999	05/04/2008	16630	21209	78.4
Ancona	10/03/1999	31/05/2006	10212	15812	64.6
Capo Comino	01/01/2004	12/09/2005	3813	5664	67.3
Capo Gallo	01/01/2004	31/03/2008	9001	12408	72.5
Capo Linaro	02/01/2004	12/09/2006	5441	7872	69.1
Punta della Maestra	02/01/2004	24/11/2004	2616	7872	62.8
Cagliari	06/02/2007	02/03/2008	1986	3120	63.7

Wave energy assessment for the Mediterranean Sea

Our approach: using a relatively high resolution wave model

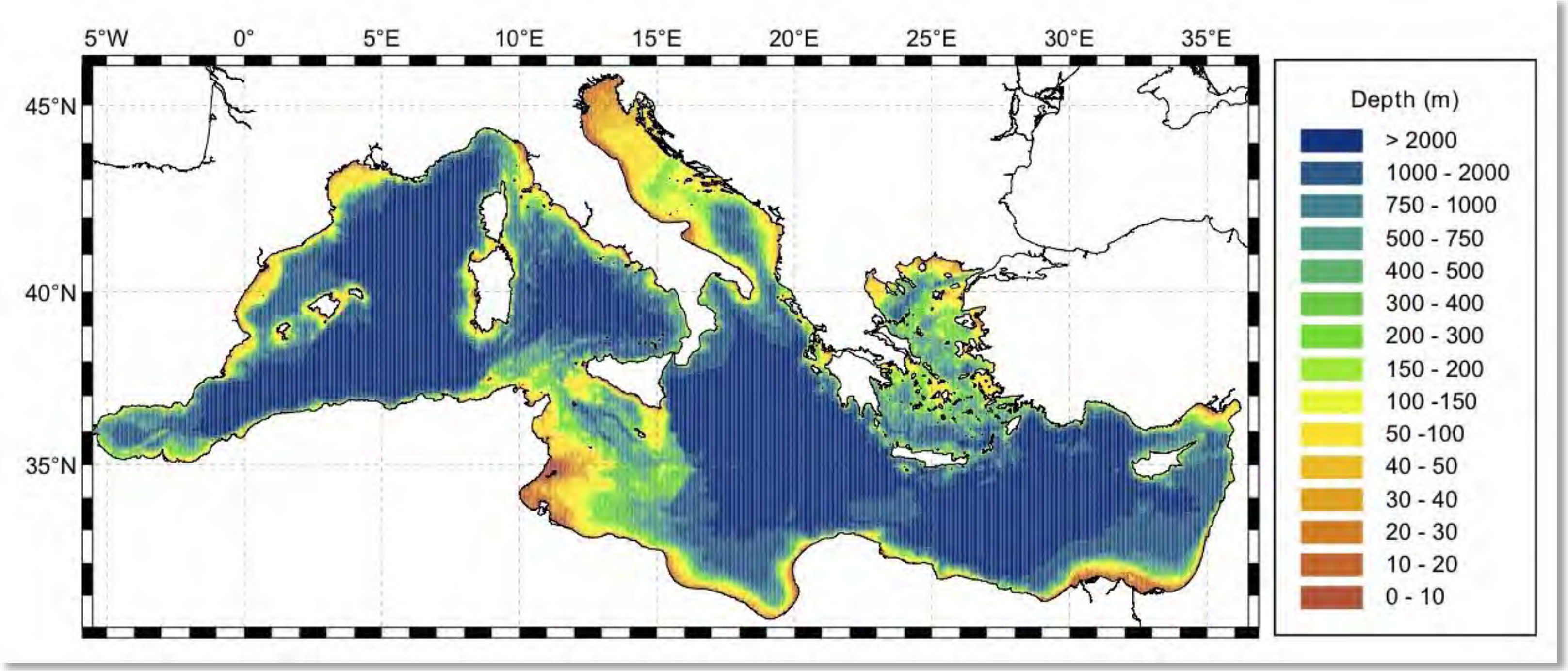
www.cresco.enea.it





Wave energy assessment for the Mediterranean Sea

Numerical Wave model description



Model computational domain and bathymetry

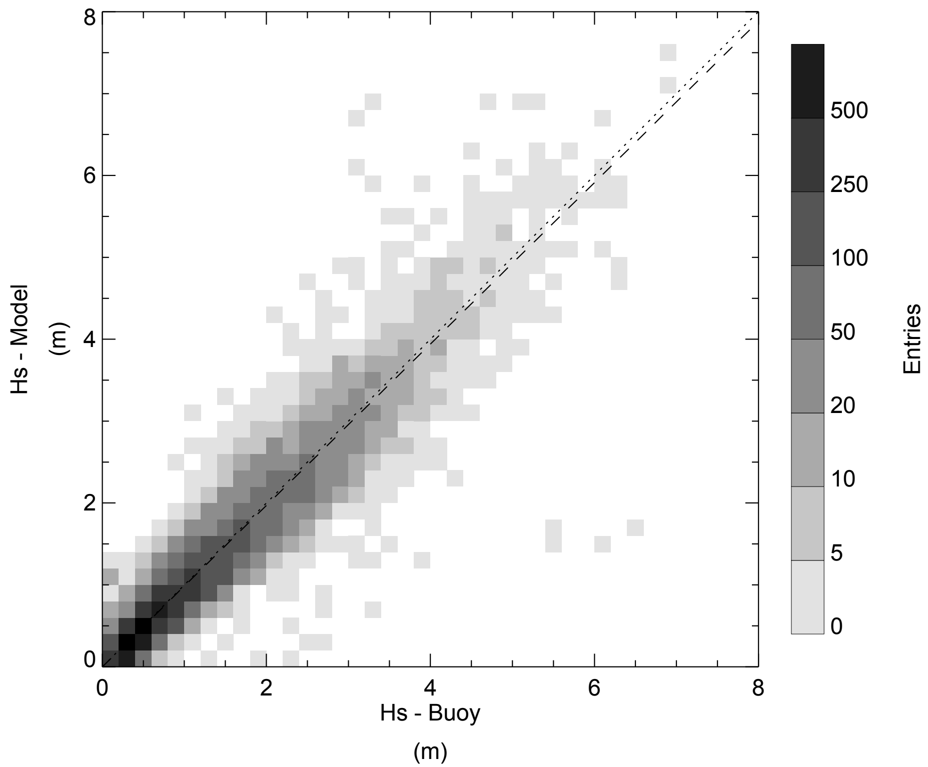
Model implemented: WAM (*Wave prediction Model*)

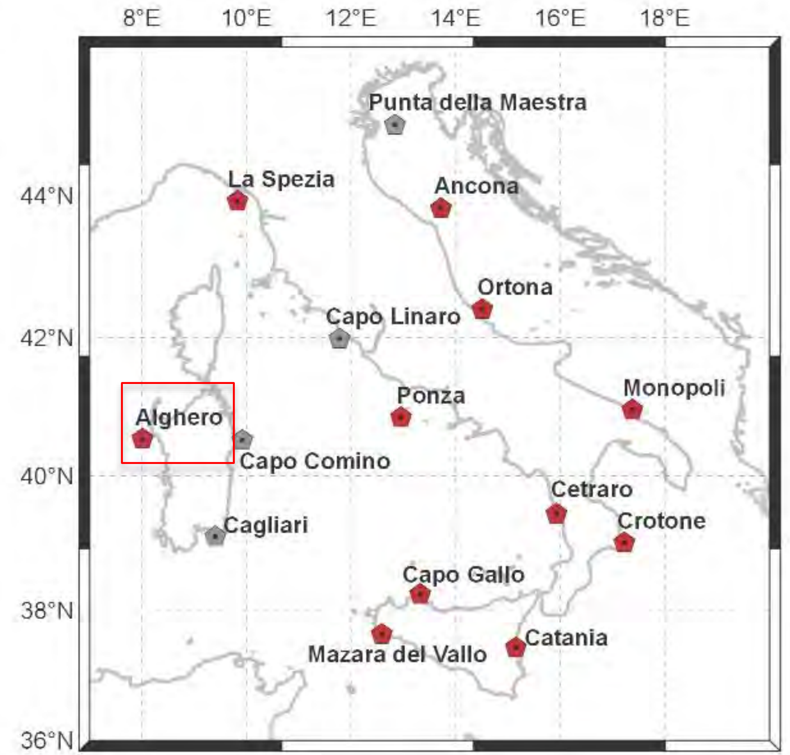
Resolution 1/16° x 1/16° (about 7Km)

ECMWF (European Centre for Medium range Weather Forecast) wind field data (analysis 2001-2010)

Numerical wave model validation (Hs)

ALGHERO





Correlation between buoy and model *Hs* at **Alghero**. Dashed line is the best fit line between model and buoy data points.

Period considered 2001-2010

Model implemented: WAM (*Wave prediction Model*)

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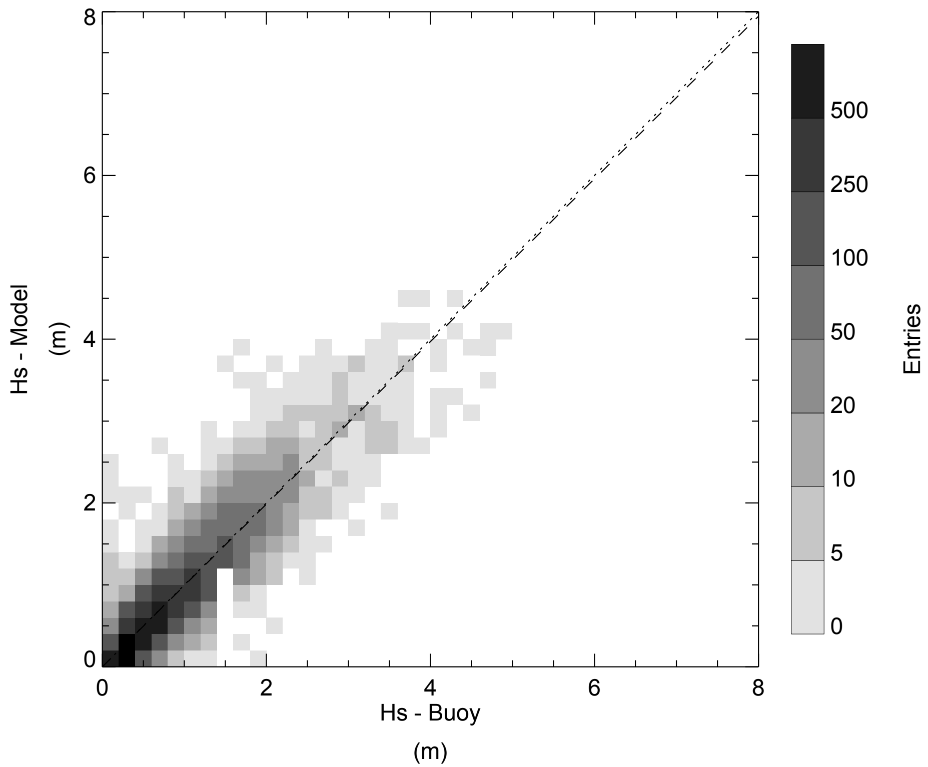
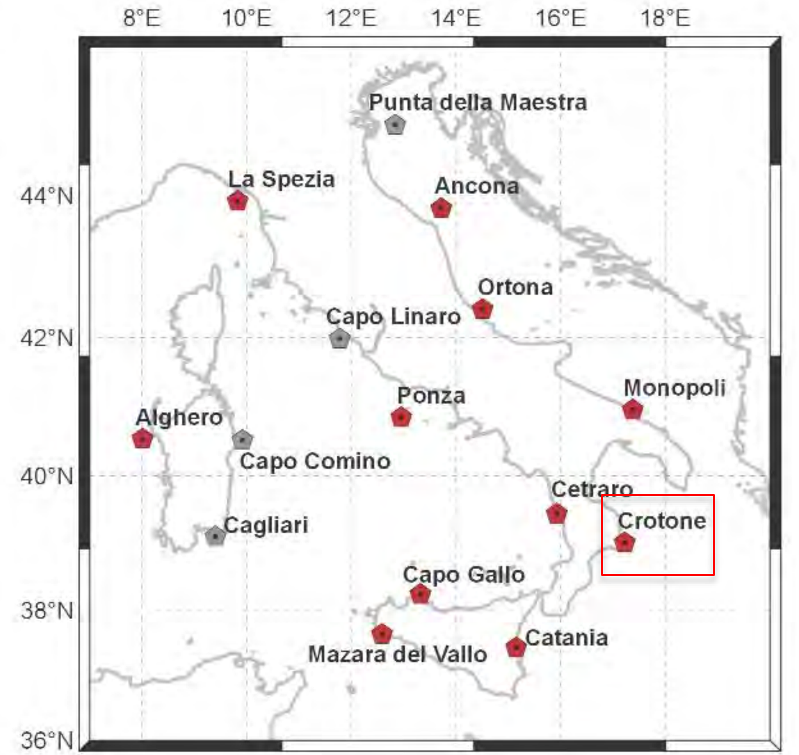
Numerical wave model validation (Hs)

CROTONE





Correlation between buoy and model *Hs* at **Crotone**. Dashed line is the best fit line between model and buoy data points.

Period considered 2001-2010

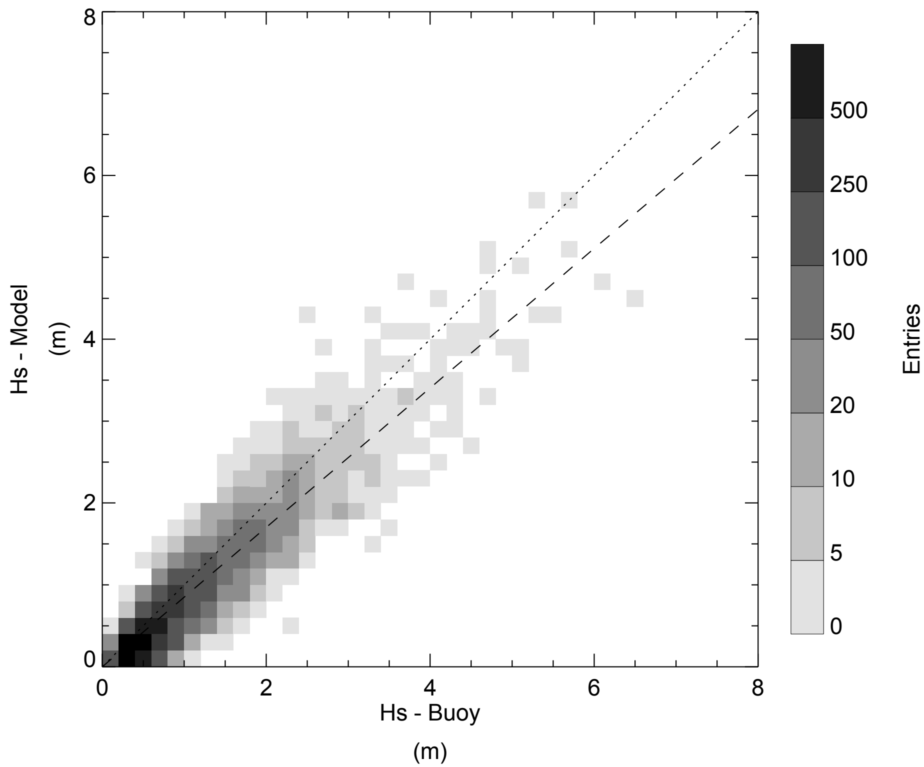
Model implemented: WAM (*Wave prediction Model*)

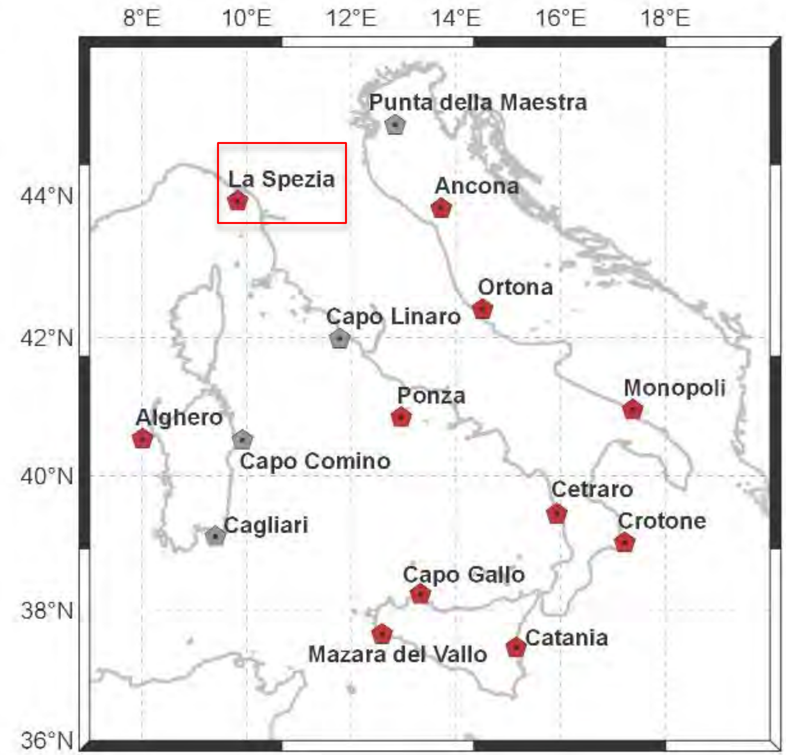
Resolution 1/16° x 1/16° (about 7Km)

ECMWF (European Centre for Medium range Weather Forecast) wind field data (analysis 2001-2010)

Numerical wave model validation (Hs)

LA SPEZIA





Correlation between buoy and model *Hs* at **La Spezia**. Dashed line is the best fit line between model and buoy data points.

Period considered 2001-2010

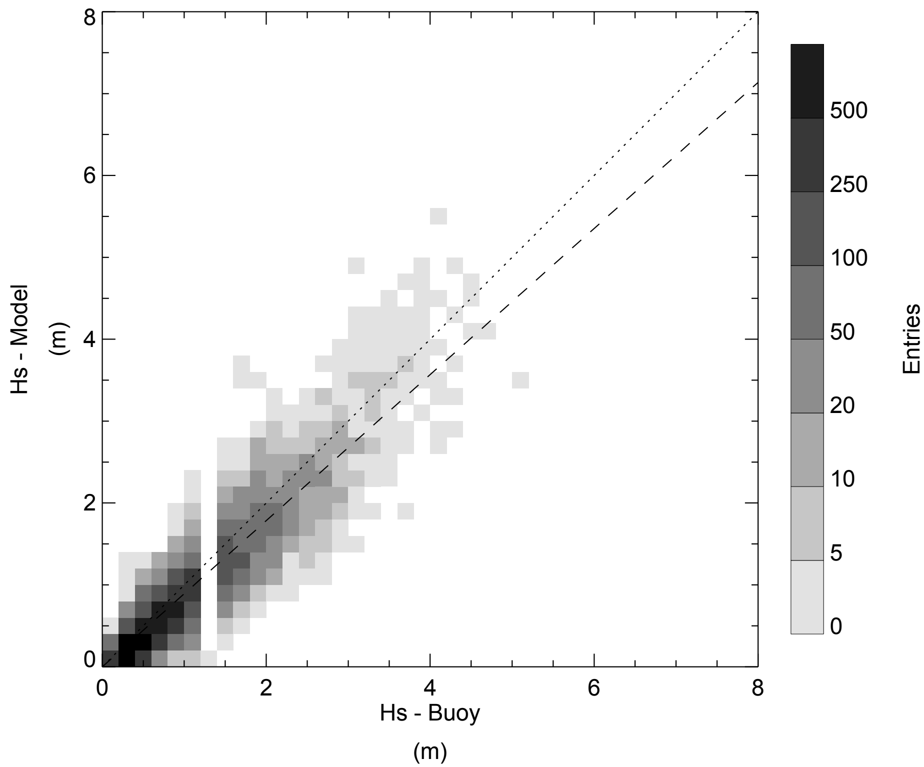
Model implemented: WAM (*Wave prediction Model*)

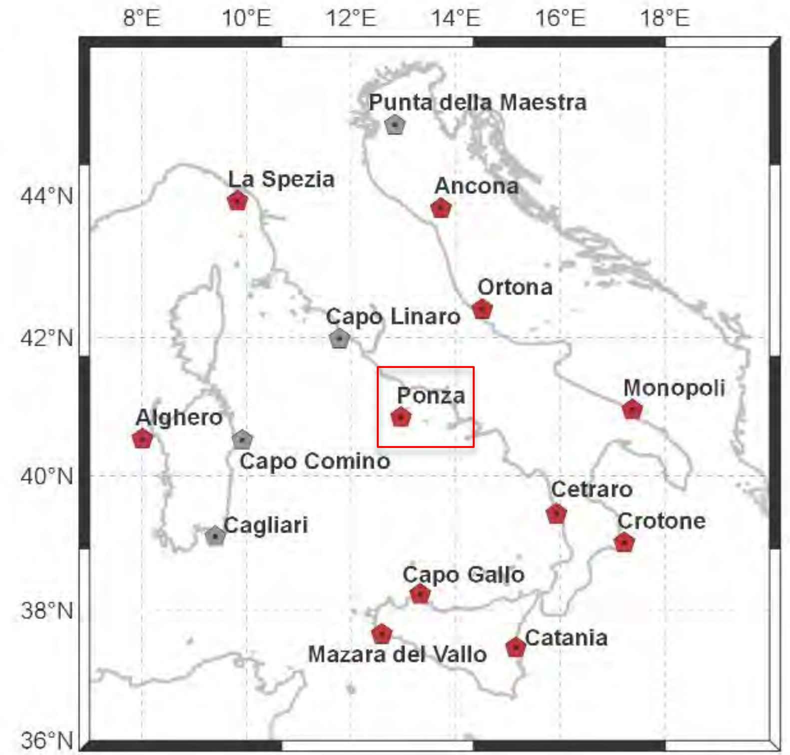
Resolution 1/16° x 1/16° (about 7Km)

ECMWF (European Centre for Medium range Weather Forecast) wind field data (analysis 2001-2010)

Numerical wave model validation (Hs)

PONZA





Correlation between buoy and model *Hs* at **Ponza**. Dashed line is the best fit line between model and buoy data points.

Period considered 2001-2010

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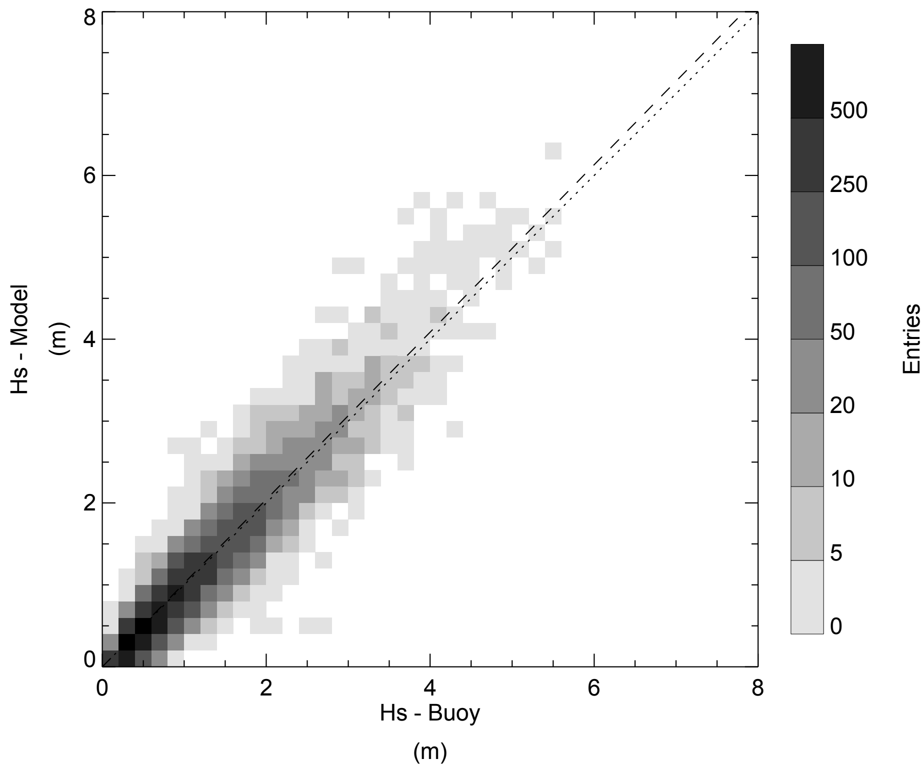
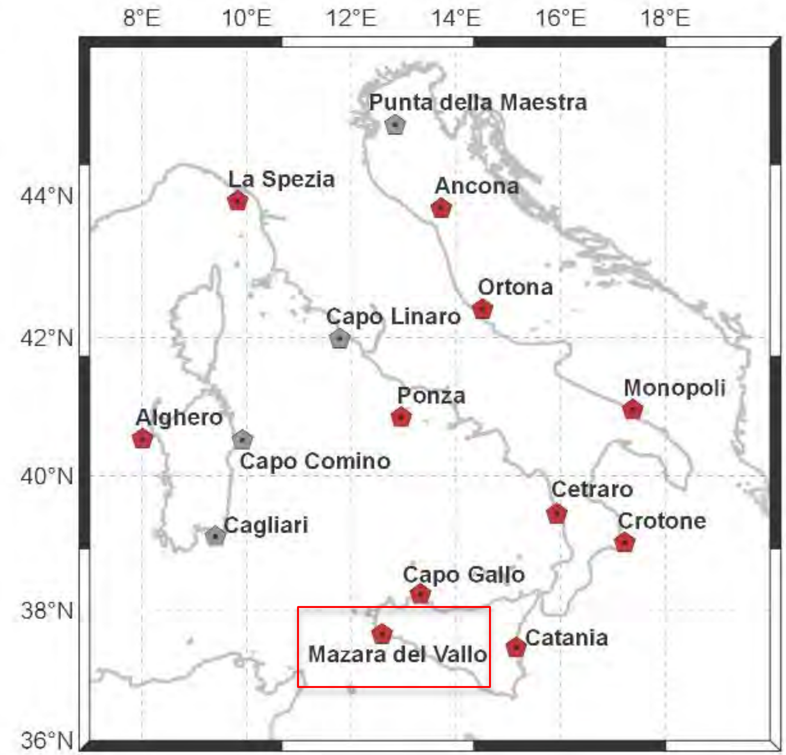
Numerical wave model validation (Hs)

MAZARA del VALLO





Correlation between buoy and model *Hs* at **Mazara del Vallo**. Dashed line is the best fit line between model and buoy data points.

Period considered 2001-2010

Model implemented: WAM (*Wave prediction Model*)

Resolution 1/16° x 1/16° (about 7Km)

ECMWF (European Centre for Medium range Weather Forecast) wind field data (analysis 2001-2010)

Numerical wave model validation (Hs)

Numerical Wave model vs buoy: statistics

$$bias = \frac{1}{n}\sum_{i=1}^{n}(y_i - x_i)\,,$$

$$rmse = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(y_i - x_i)^2},$$

$$si = \frac{rmse}{\frac{1}{n}\sum_{i=1}^{n} y_i},$$

$$slope = \frac{\sum_{i=1}^{n} x_i y_i}{\sum_{i=1}^{n} x_i x_i}.$$

Buoy	Bias (m)	Rmse (m)	Slope	Si
Alghero	-0.005	0.311	0.985	0.278
Ancona	-0.214	0.361	0.725	0.477
Catania	-0.178	0.308	0.747	0.501
Crotone	0.004	0.276	0.993	0.374
La Spezia	-0.143	0.283	0.851	0.354
Mazara del Vallo	0.013	0.257	1.022	0.253
Ortona	-0.150	0.284	0.753	0.460
Ponza	-0.103	0.273	0.892	0.328
Monopoli	-0.124	0.307	0.836	0.427
Cetraro	-0.070	0.241	0.897	0.341
Capo Gallo	0.019	0.255	1.040	0.339

Statistics of buoy and model significant wave height (*Hs*) comparison.

Period considered 2001-2010

Numerical wave model validation (Direction)

Numerical Wave model vs buoy: statistics

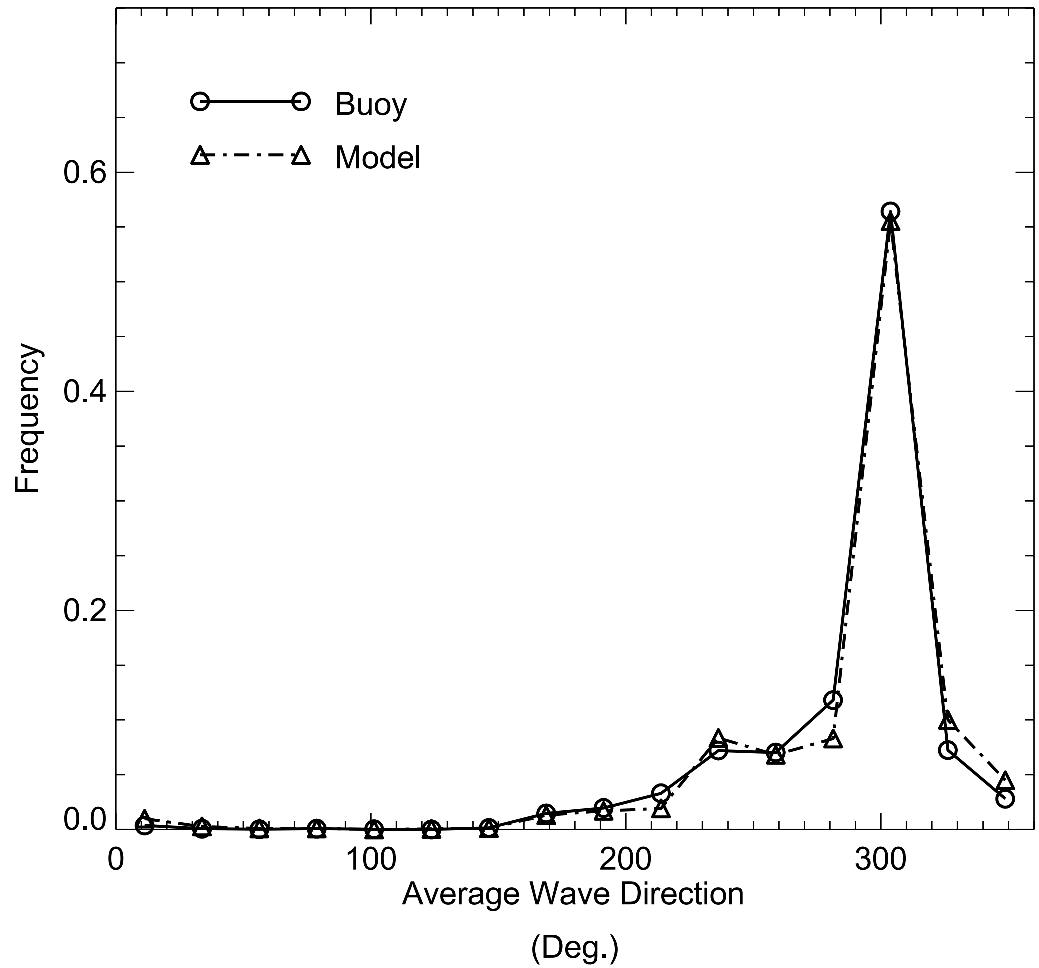
$$\bar{S} = \frac{1}{n}\sum_{i=1}^{n} \sin\left(y_i - x_i\right),$$

$$\bar{C} = \frac{1}{n}\sum_{i=1}^{n} \cos\left(y_i - x_i\right),$$

$$\bar{R} = \left(\bar{C}^2 + \bar{S}^2\right)^{\frac{1}{2}},$$

$$bias^\circ = \arctan\left(\bar{S}/\bar{C}\right),$$

$$var^\circ = \left(1 - \bar{R}\right).$$



Frequency distribution of model and buoy average wave direction at **Alghero**. Only records with *Hs* > 1 m are considered. Incoming wave direction is indicated as degrees in clockwise direction from the north.

Period considered 2001-2010

Numerical wave model validation (Direction)

Numerical Wave model vs buoy: statistics

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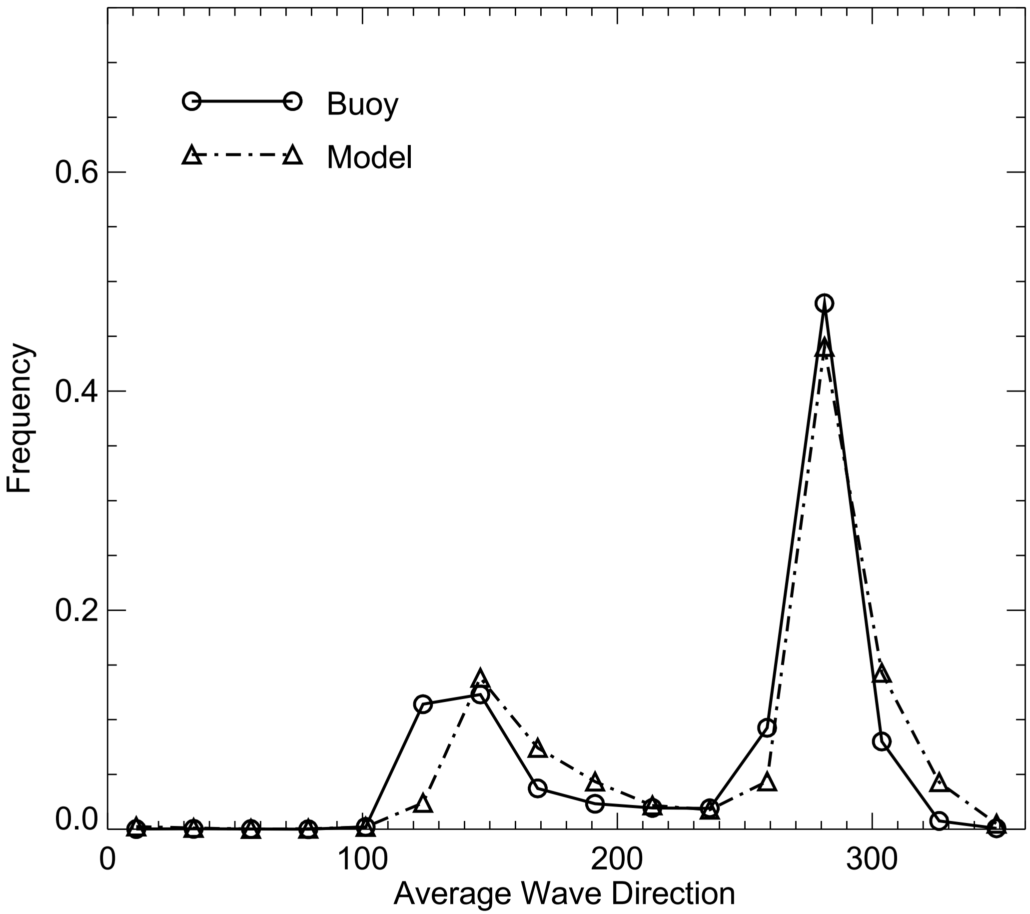

Frequency distribution of model and buoy average wave direction at **Mazara del Vallo**. Only records with *Hs* > 1 m are considered. Incoming wave direction is indicated as degrees in clockwise direction from the north.

Period considered 2001-2010

ENEA

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$$\bar{R} = \left(\bar{C}^2 + \bar{S}^2\right)^{\frac{1}{2}},$$

$$bias^{\circ} = \arctan\left(\bar{S}/\bar{C}\right),$$

$$var^{\circ} = \left(1 - \bar{R}\right).$$

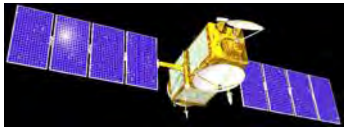
Buoy	$Bias^{\circ}$ (Deg.)	Var°
Alghero	4.51	0.036
Ancona	9.41	0.230
Catania	14.81	0.053
Crotone	8.09	0.085
La Spezia	2.94	0.056
Mazara del Vallo	11.00	0.057
Ortona	13.48	0.101
Ponza	8.76	0.116
Monopoli	5.00	0.121
Cetraro	6.39	0.063
Capo Gallo	-5.21	0.026

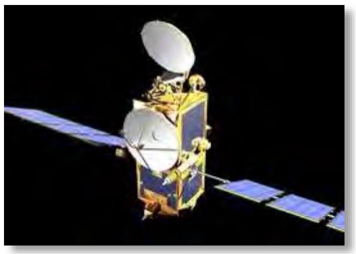
Circular statistics of buoy and model wave average spectral direction comparison.

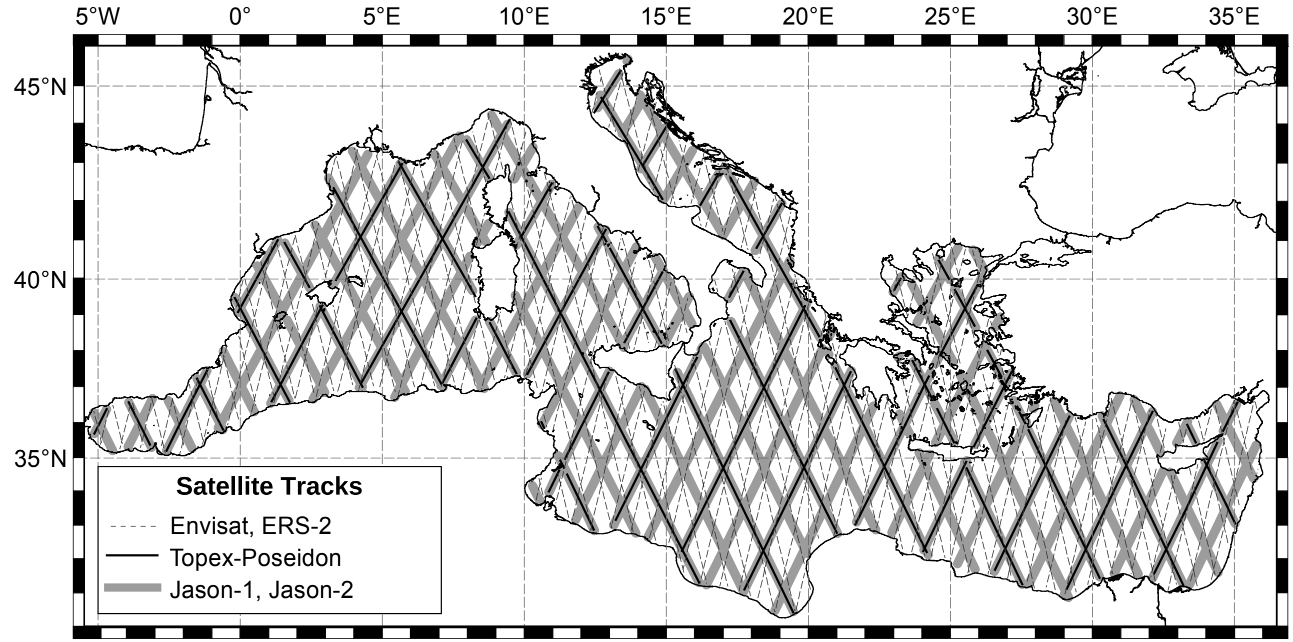
Period considered 2001-2010

Numerical wave model validation

Numerical Wave model vs satellite altimeter







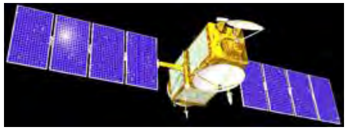
Ground tracks of satellites considered in model validation. Thick grey lines identify **Jason-1** and **Jason-2** tracks. Black lines partially overlying the grey ones symbolize **Topex-Poseidon** tracks while thin dashed lines represent **Envisat** and **ERS-2** tracks

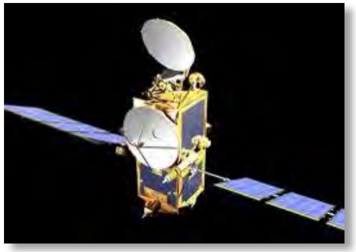
Satellite	Repeat Cycle (days)	Used Period	Track Separation at Equator (km)
Topex-Poseidon	10	Jan. 2001 - Oct. 2005	315
Jason-1	10	Jan. 2002 - Dec. 2010	315
Jason-2	10	Jun. 2008 - Dec. 2010	315
Envisat	35	Oct. 2002 - Oct. 2010	80
ERS-2	35	Jan. 2001 - Dec. 2006 Jan. 2008 - Dec. 2010	80

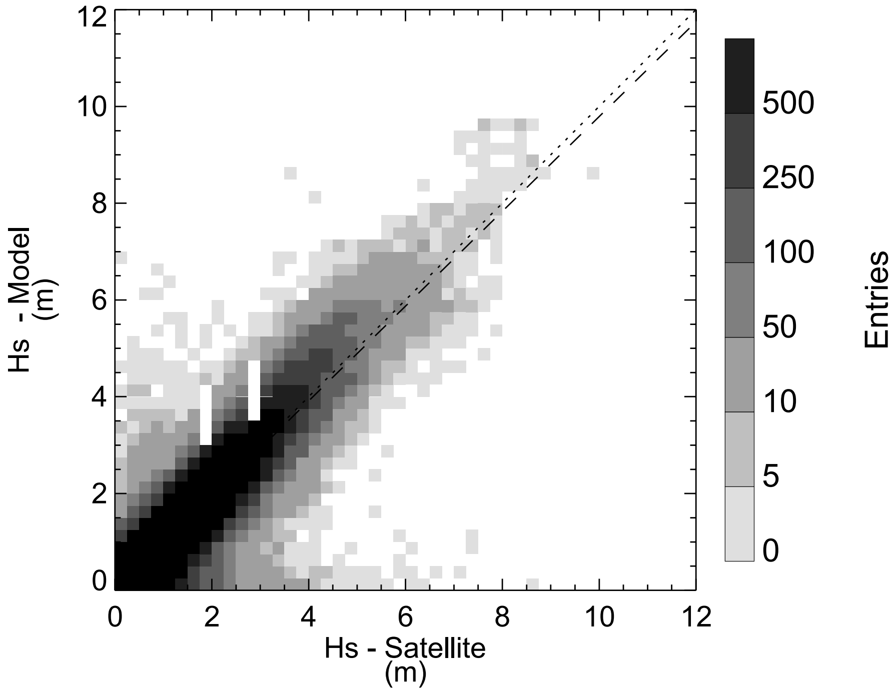
Characteristics of satellites used in this study.

Numerical wave model validation

Numerical Wave model vs satellite altimeter





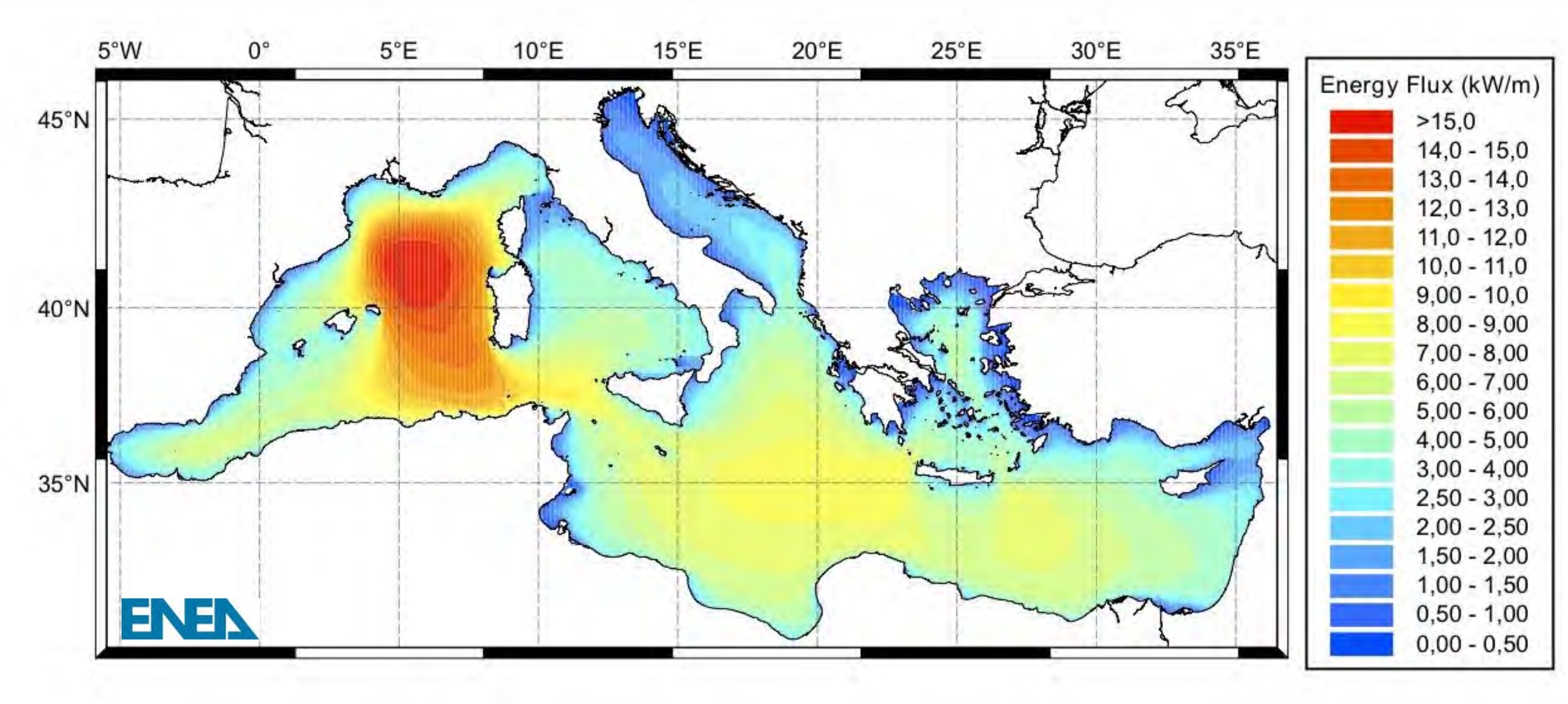


Scatter plot of model vs. Jason-1 *Hs* for the entire Mediterranean. Value pairs are grouped in 0.25 m wide bins, corresponding areas are painted according to the number of entries in each bin. Dashed line is the best fit line between model and satellite data points.

Satellite	Repeat Cycle (days)	Used Period	Track Separation at Equator (km)
Topex-Poseidon	10	Jan. 2001 - Oct. 2005	315
Jason-1	10	Jan. 2002 - Dec. 2010	315
Jason-2	10	Jun. 2008 - Dec. 2010	315
Envisat	35	Oct. 2002 - Oct. 2010	80
ERS-2	35	Jan. 2001 - Dec. 2006 Jan. 2008 - Dec. 2010	80

Characteristics of satellites used in this study.

Wave energy assessment for the Mediterranean



Distribution of average power per unit crest in the Mediterranean between 2001 and 2010.

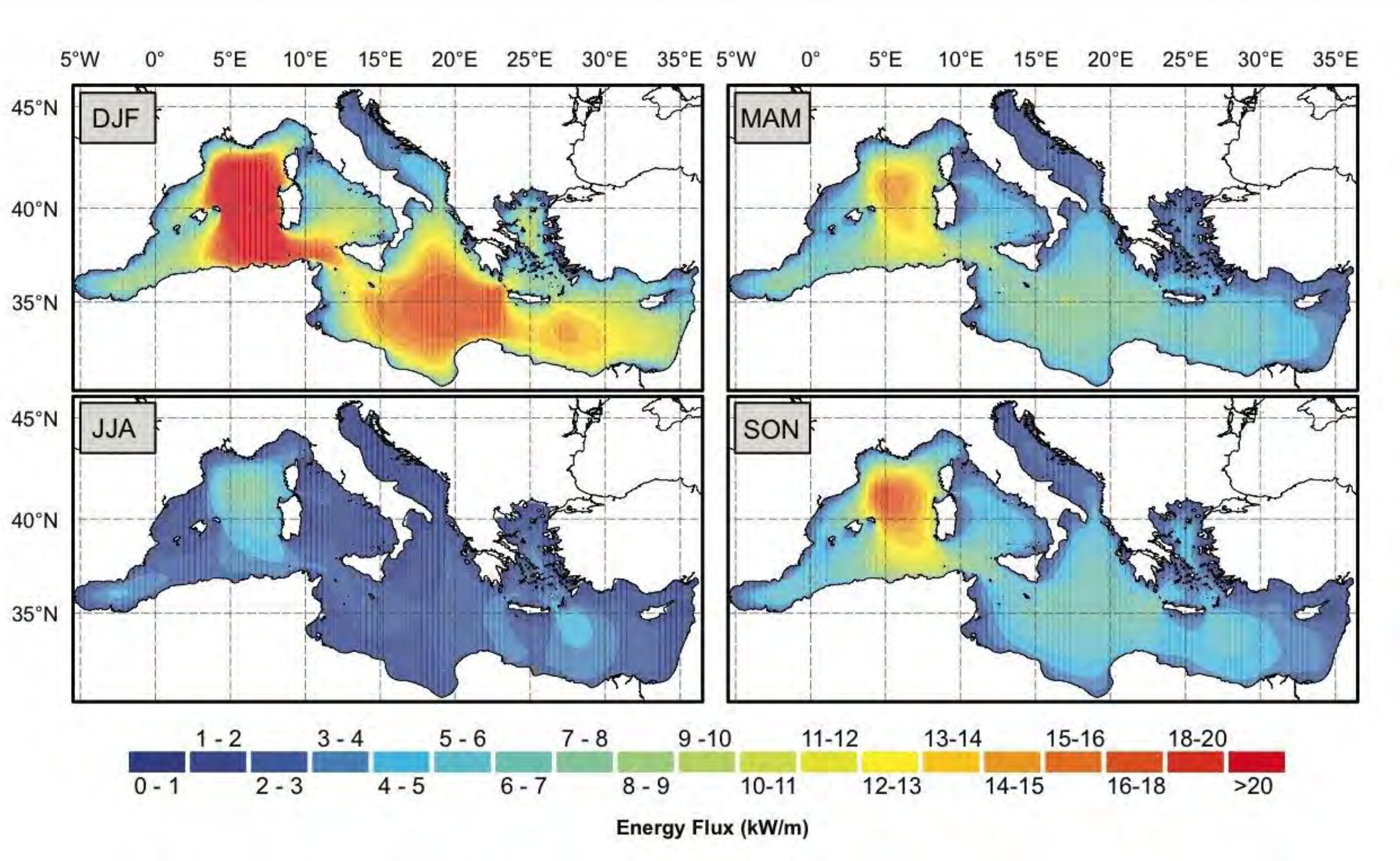
$$J = \frac{\rho g^2}{64\pi} T_e H_s^2$$

ENEA

Liberti, Carillo, Sannino, Ren. Energy. 2013

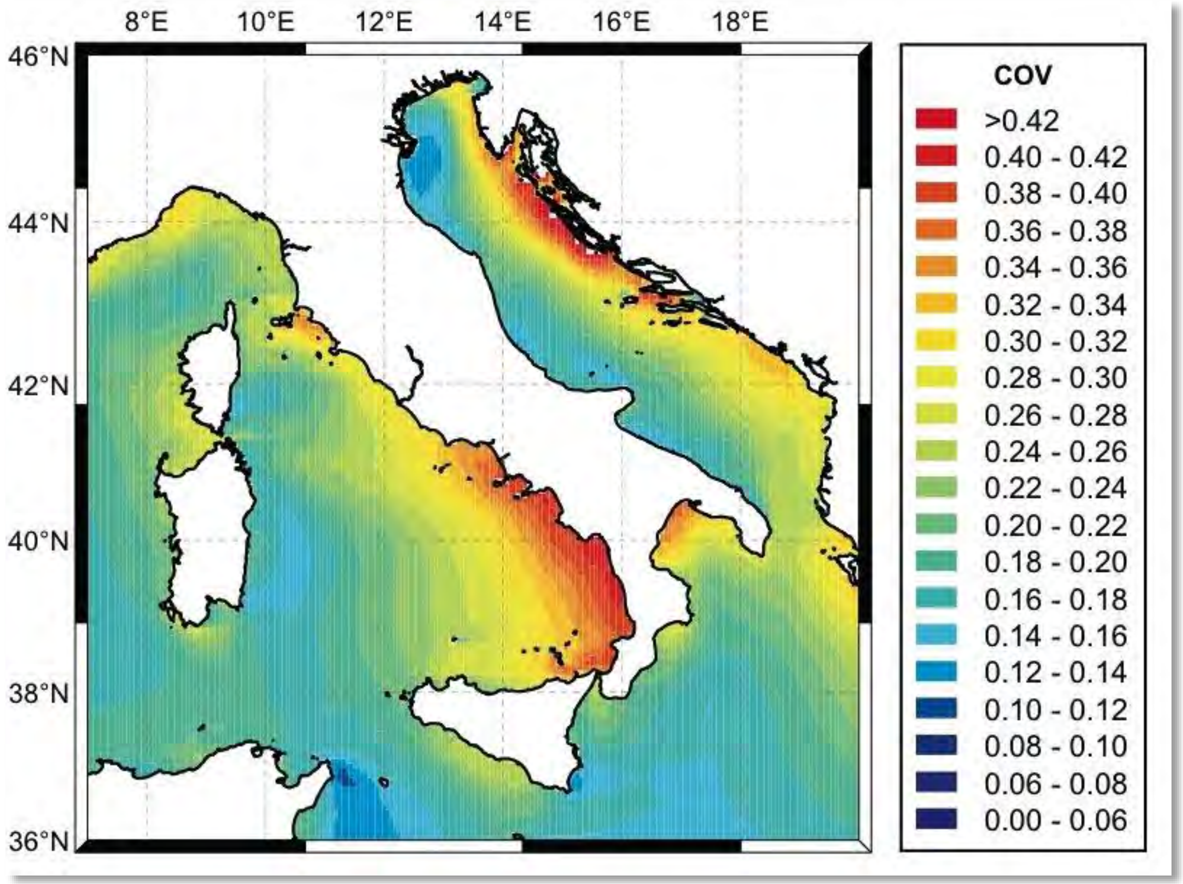
Wave energy assessment for the Mediterranean

Seasonal average energy flux



Wave energy assessment along the Italian coasts

Yearly average variability



Distribution of the Coefficient of Variation (COV) of the yearly average power fluxes for years 2001-2010 around Italy.

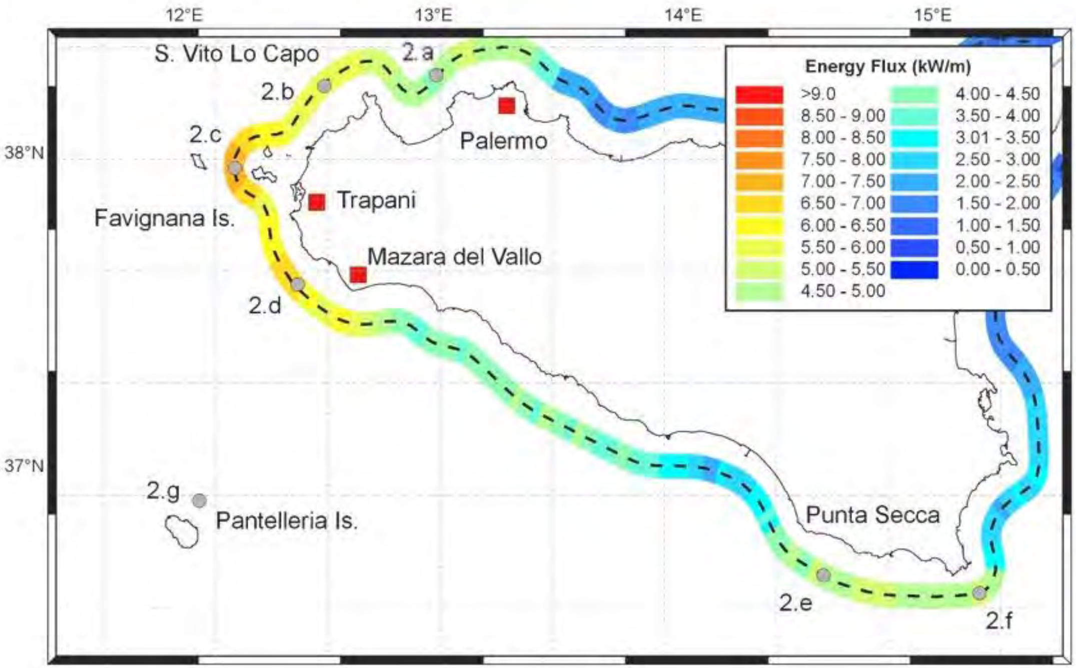
σ Standard deviation (yearly)

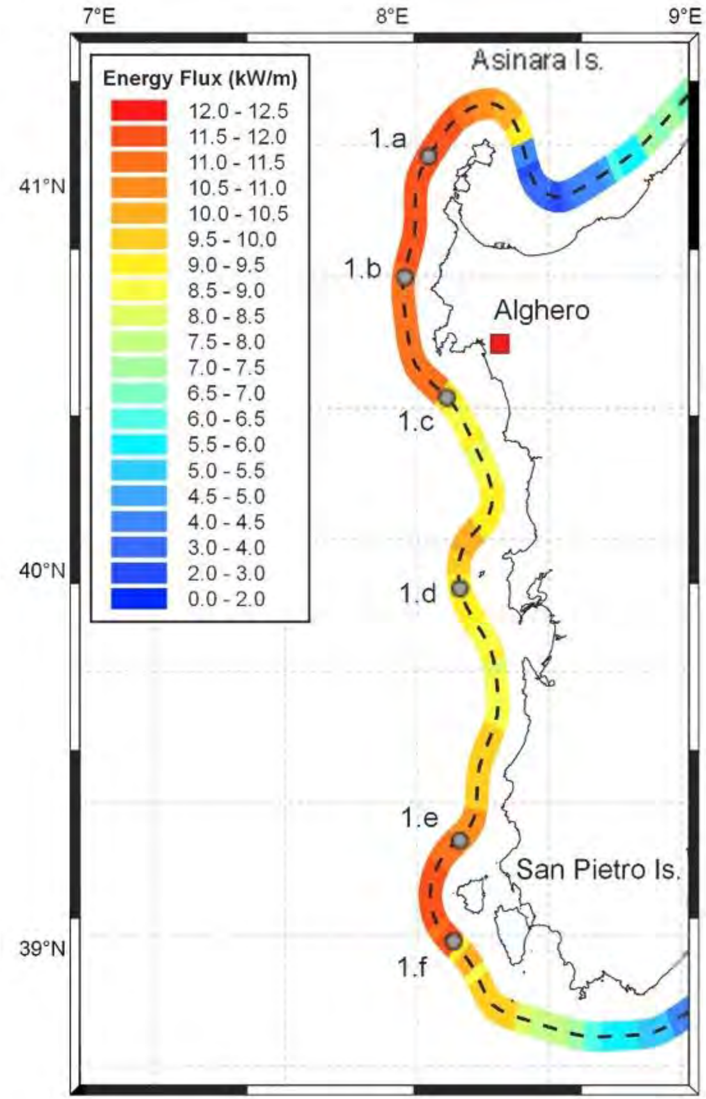
μ Averaged yearly value

$$COV = \frac{\sigma}{\mu}$$

Wave energy assessment along the Italian coasts

Distribution of average wave power flux along Sicily and west Sardinia

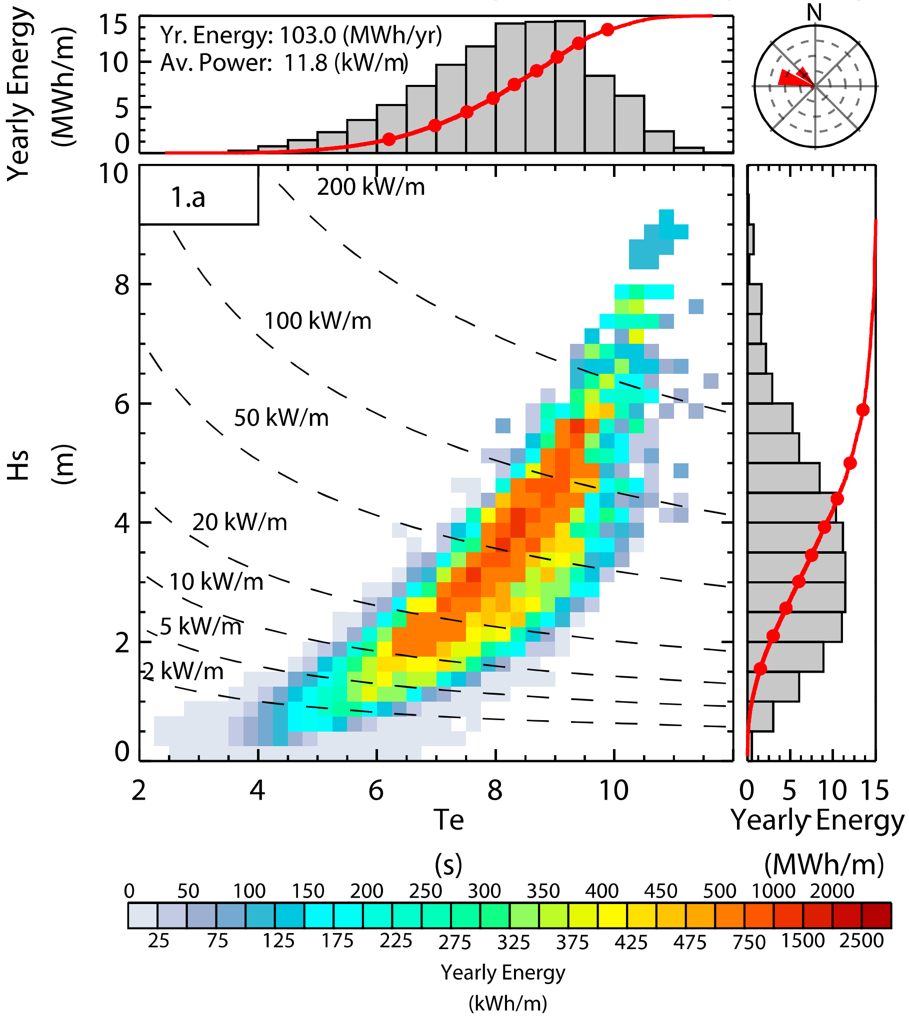


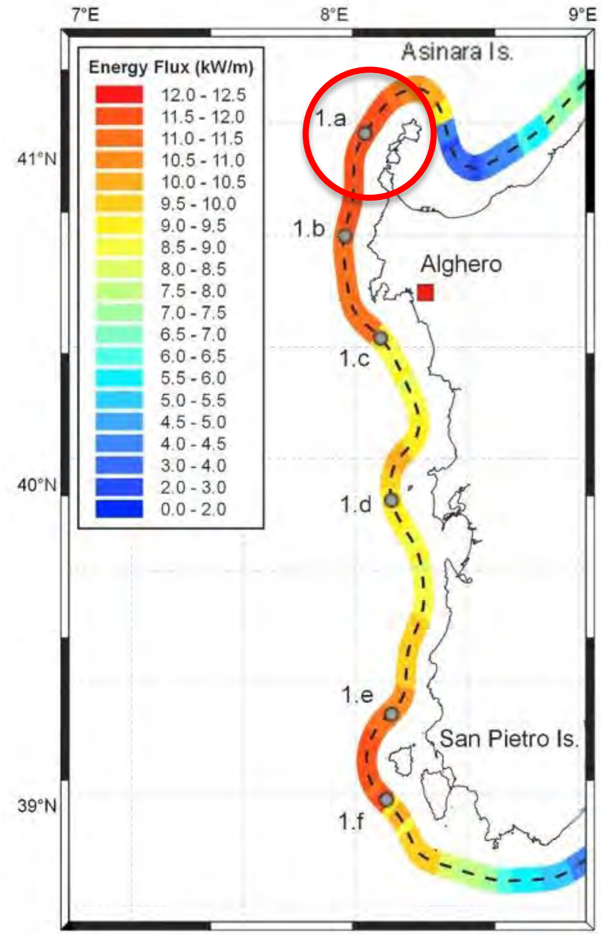


Distribution of average wave power flux per unit crest on western Sardinia and Sicilian coastline. Values are calculated on a line located 12 km off the coast.

Wave energy assessment along the Italian coasts

Distribution of yearly average wave energy along west Sardinia

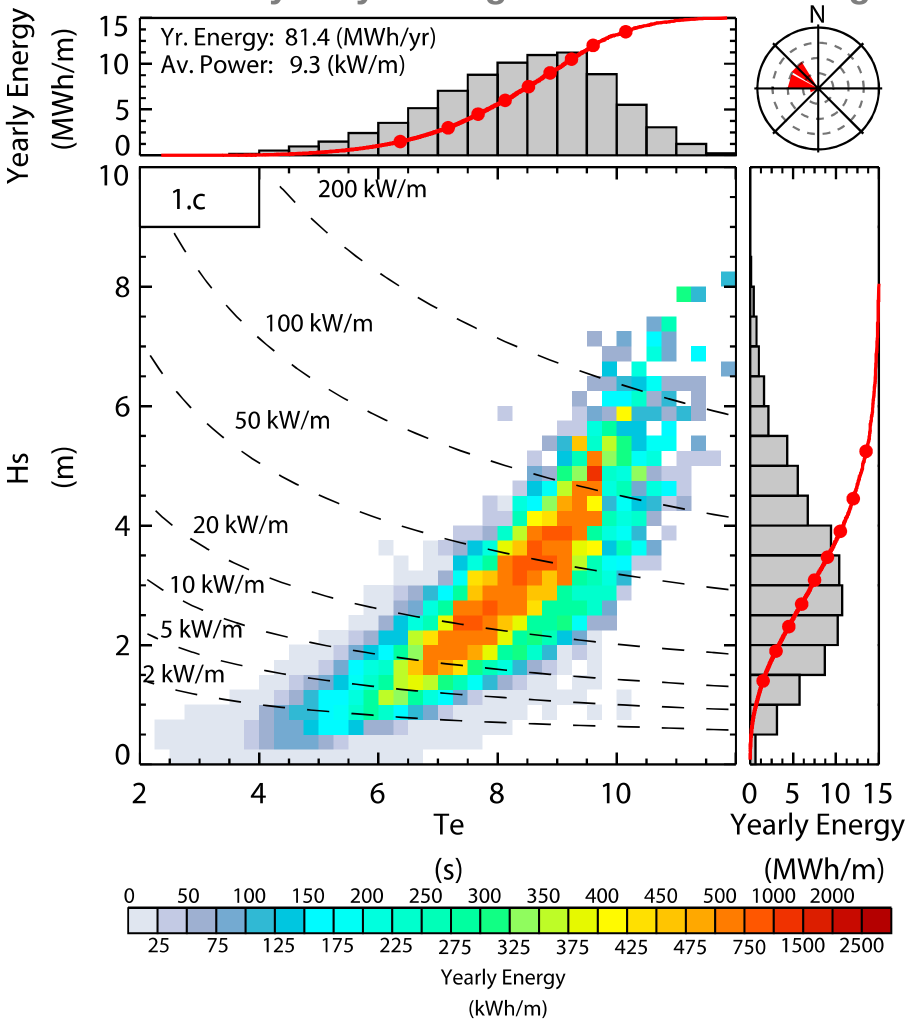


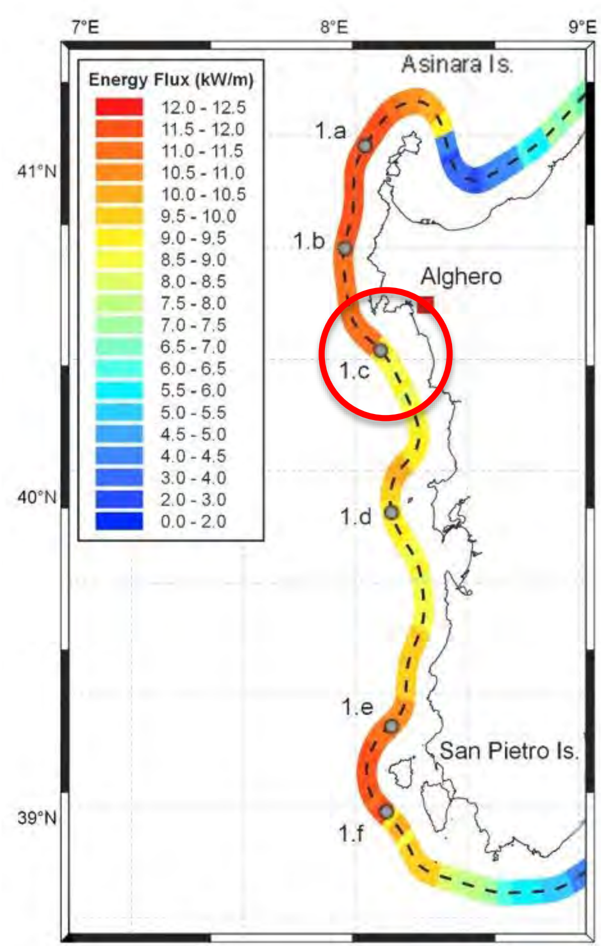


Distribution of wave energy as a function of significant wave period and significant wave height at specific points. Lower left panel shows the average yearly energy associated with sea states identified by *Te* and *Hs* couples. Dotted lines mark reference power levels. Upper panel shows the energy distribution as a function of *Te* only; right panel as a function of *Hs* only. Red lines in the upper and right panels are the cumulative energy as a percentage of the total. Red dots on the cumulative lines mark each 10*th* percentile. Rose plot in the upper right panel shows energy distribution over wave incoming direction. Each circle represents 20% fractions of the total energy.

Wave energy assessment along the Italian coasts

Distribution of yearly average wave energy along west Sardinia





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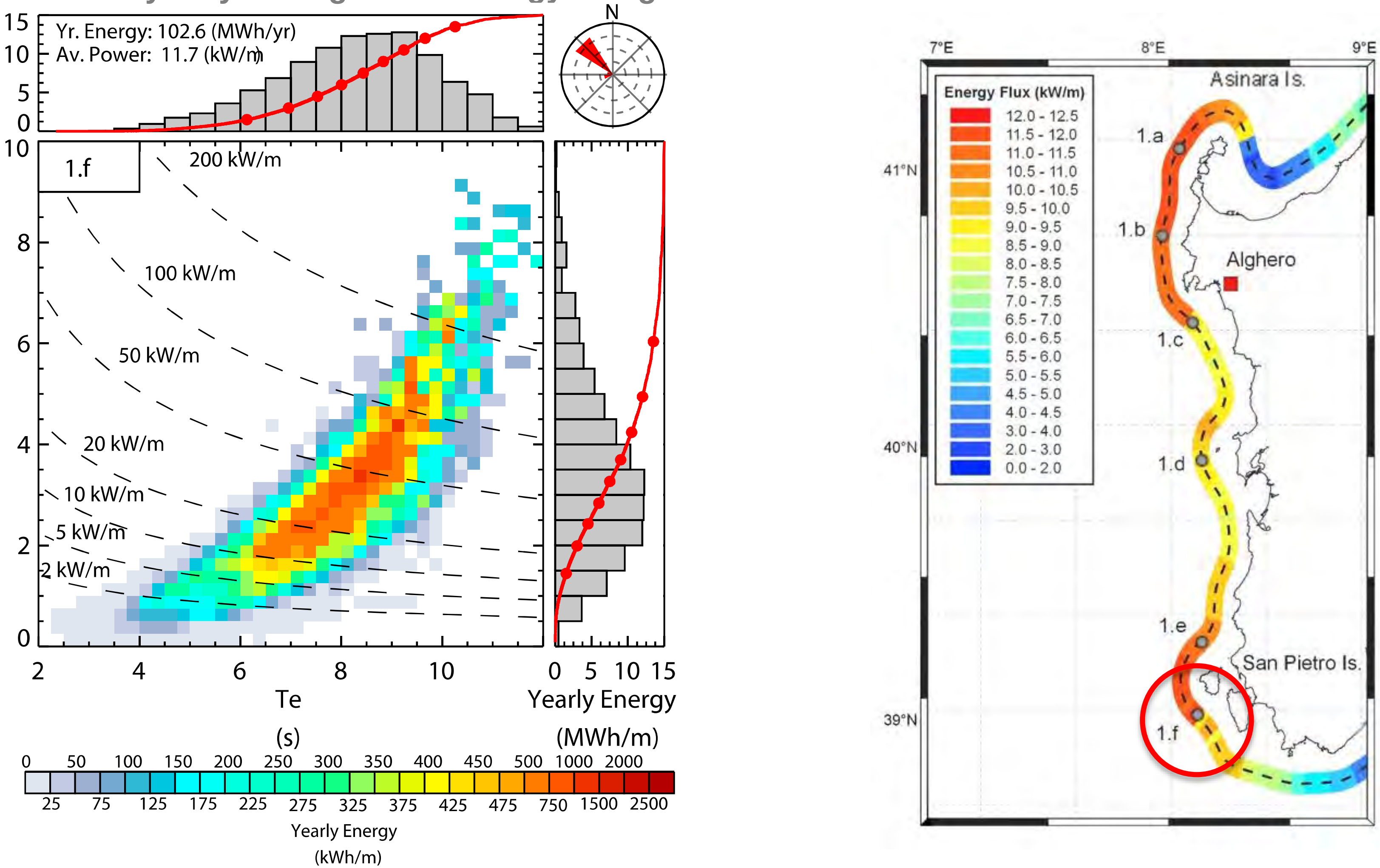
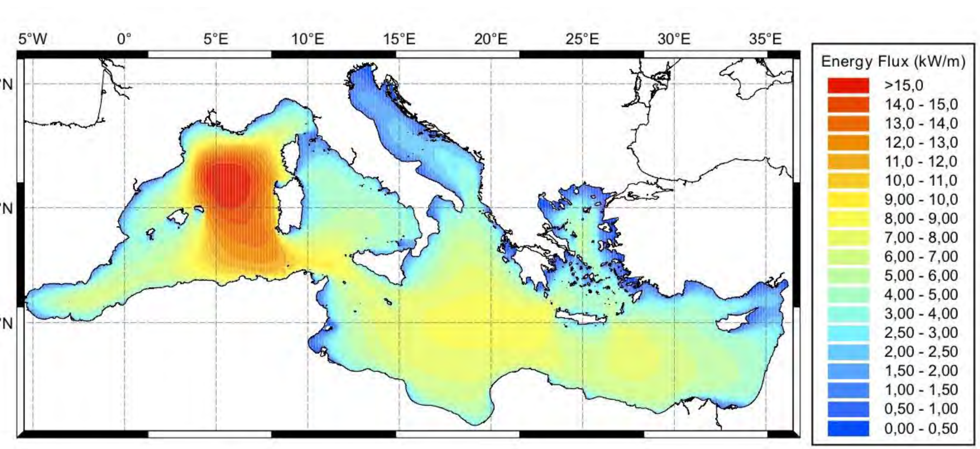
Wave energy assessment along the Italian coasts

Distribution of yearly average wave energy along west Sardinia

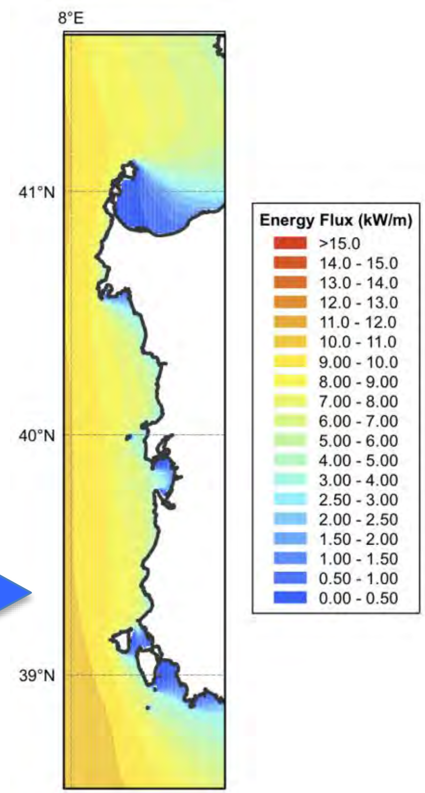


Distribution of wave energy as a function of significant wave period and significant wave height at specific points. Lower left panel shows the average yearly energy associated with sea states identified by *Te* and *Hs* couples. Dotted lines mark reference power levels. Upper panel shows the energy distribution as a function of *Te* only; right panel as a function of *Hs* only. Red lines in the upper and right panels are the cumulative energy as a percentage of the total. Red dots on the cumulative lines mark each 10*th* percentile. Rose plot in the upper right panel shows energy distribution over wave incoming direction. Each circle represents 20% fractions of the total energy.

Wave energy assessment along the Italian coasts



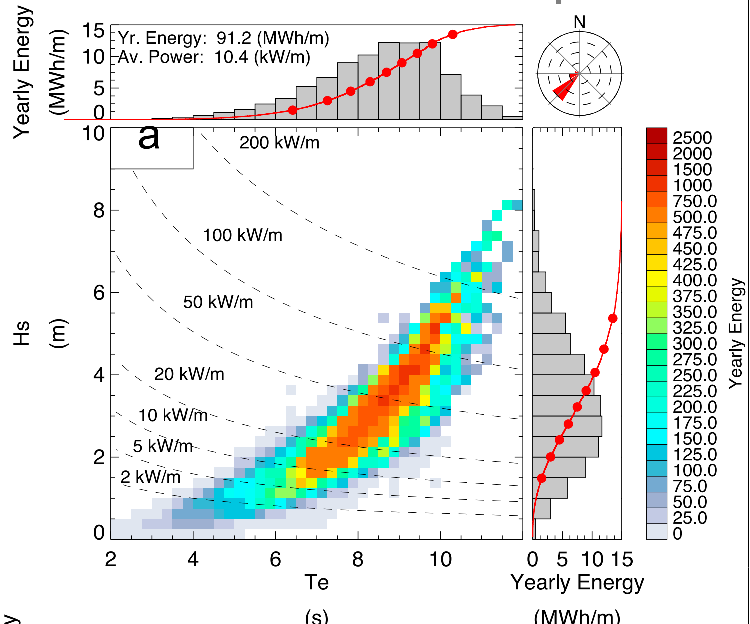
WAM
(1/16°x1/16°)

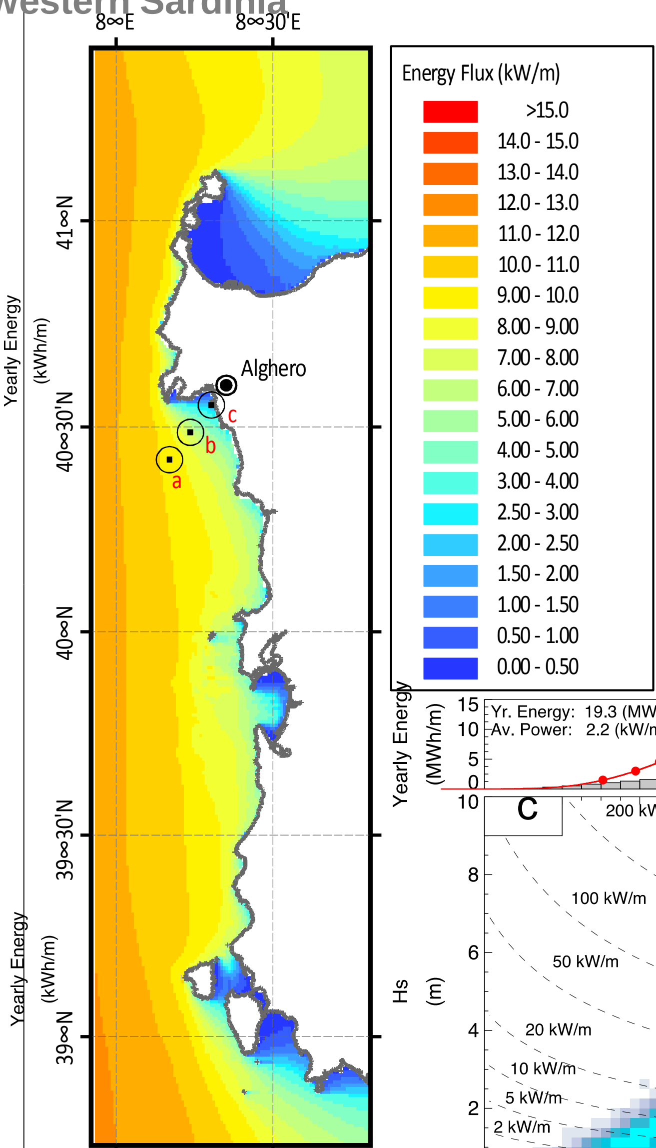


WAM/SWAN
(1/120°x/120°)

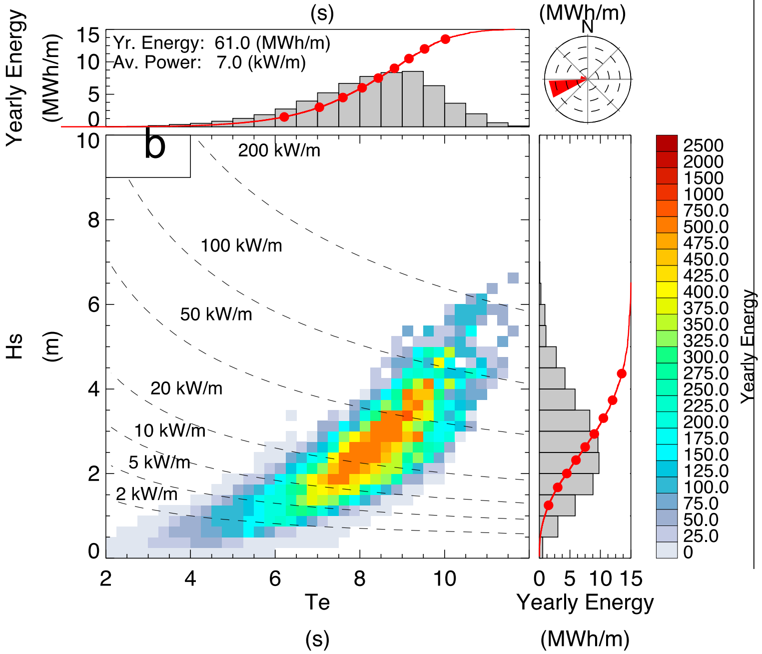
Wave energy assessment along the Italian coasts

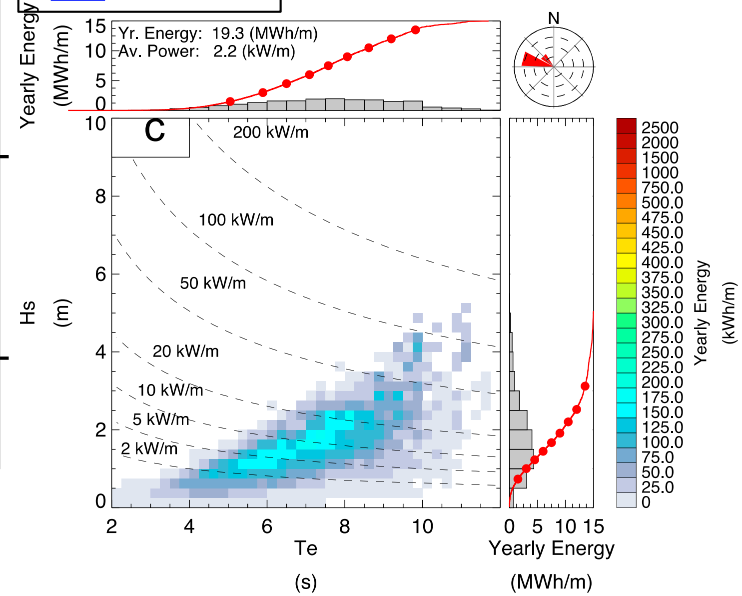
Numerical Wave model description for western Sardinia



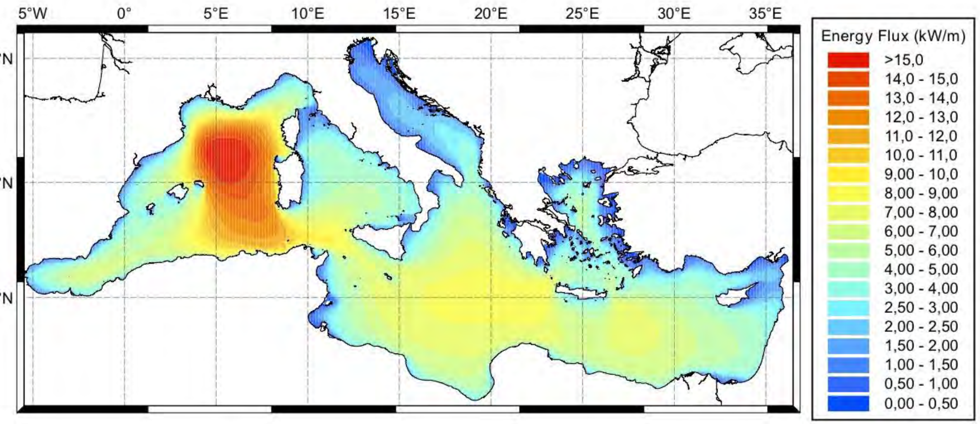


a,b,c: three points located at 19600 m, 9300 m and 830 m respectively from the coast. These points are distributed along a straight line pointing offshore from Alghero, at decreasing depths ranging from 13m to 114 m

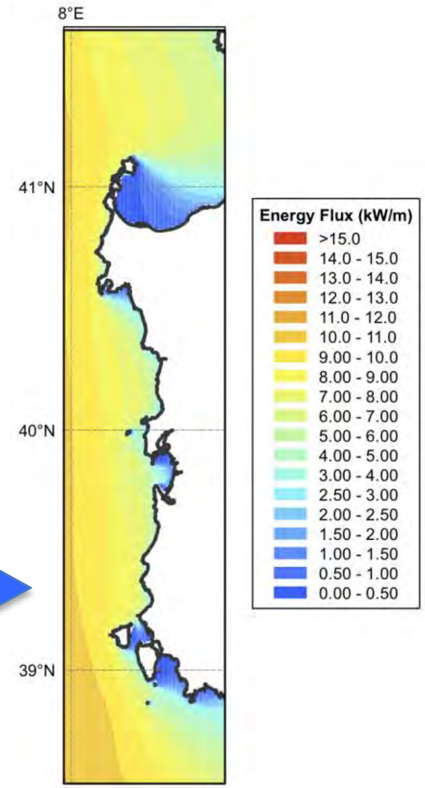


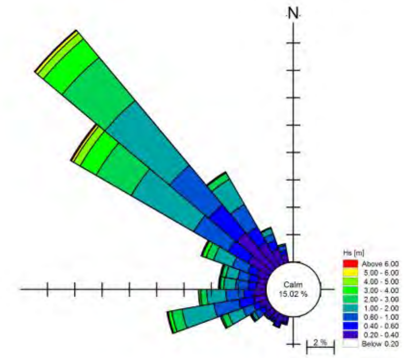


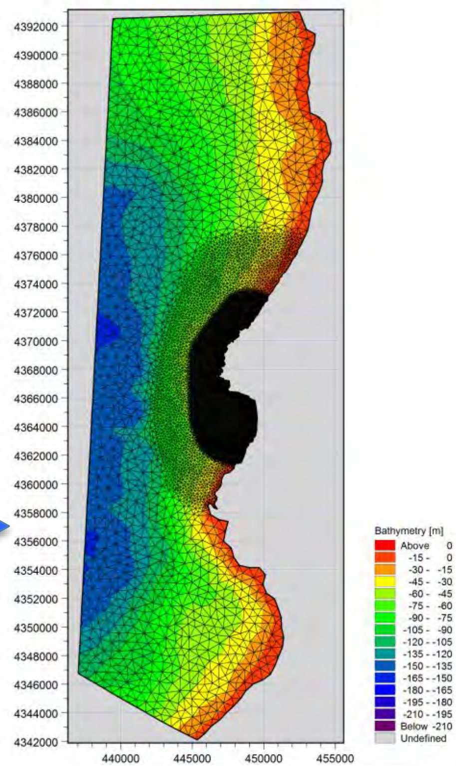
Wave energy assessment along the Italian coasts



WAM
(1/16°x1/16°)



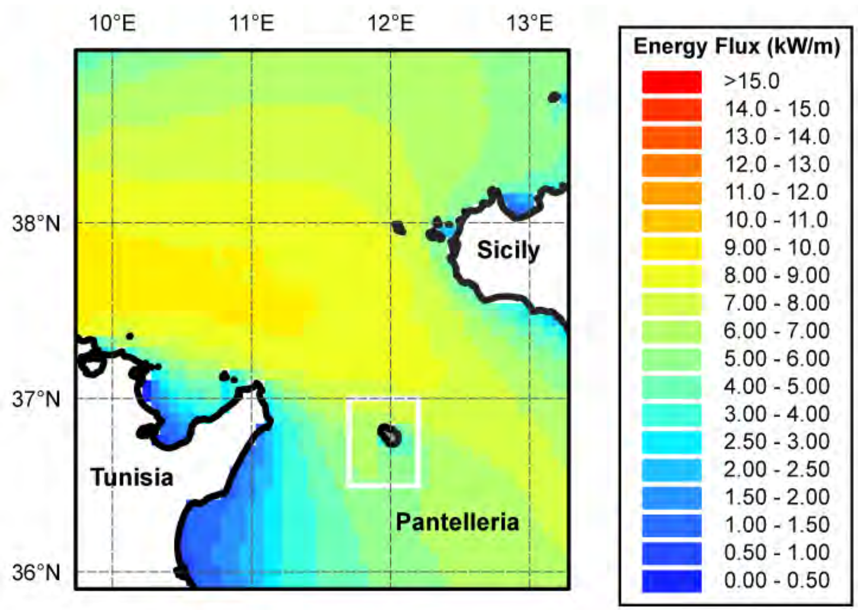




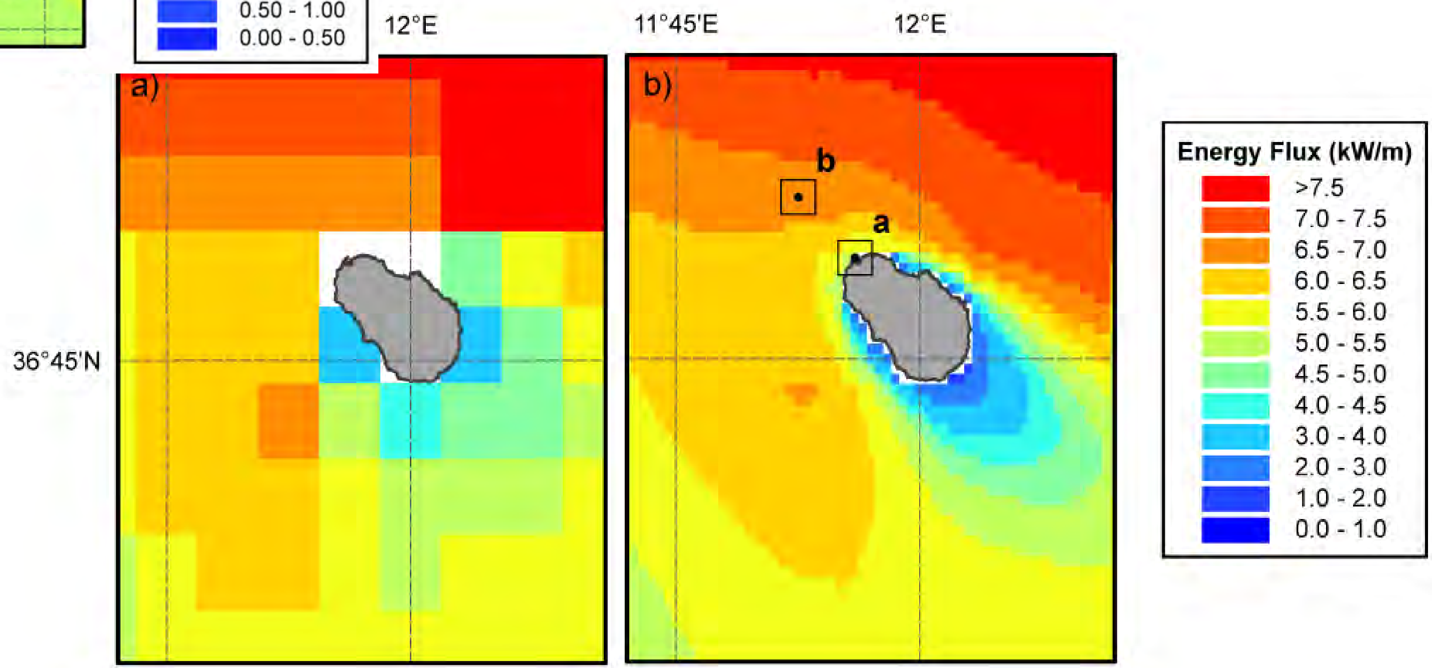
WAM/SWAN
(1/120°x/120°)

Wave energy assessment along the Italian coasts

PANTELLERIA

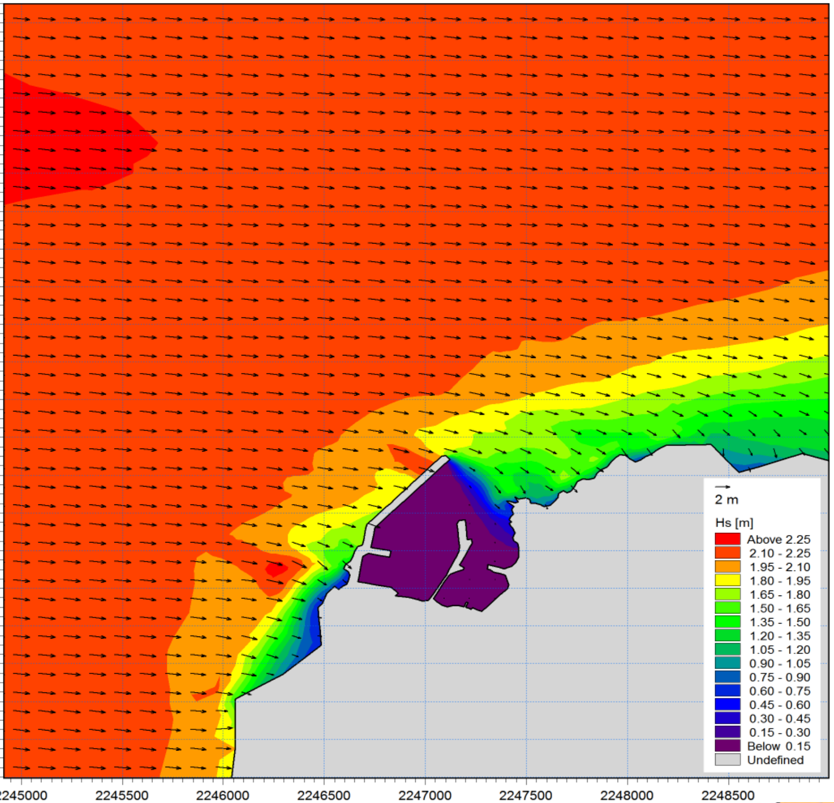


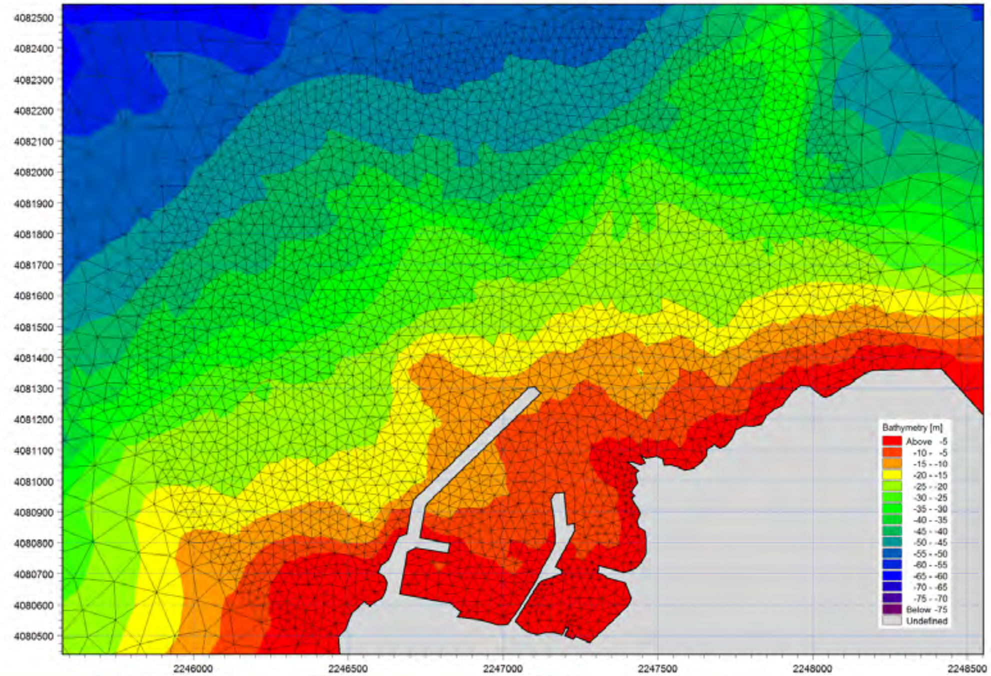
SWAN model laterally forced by the WAM simulation

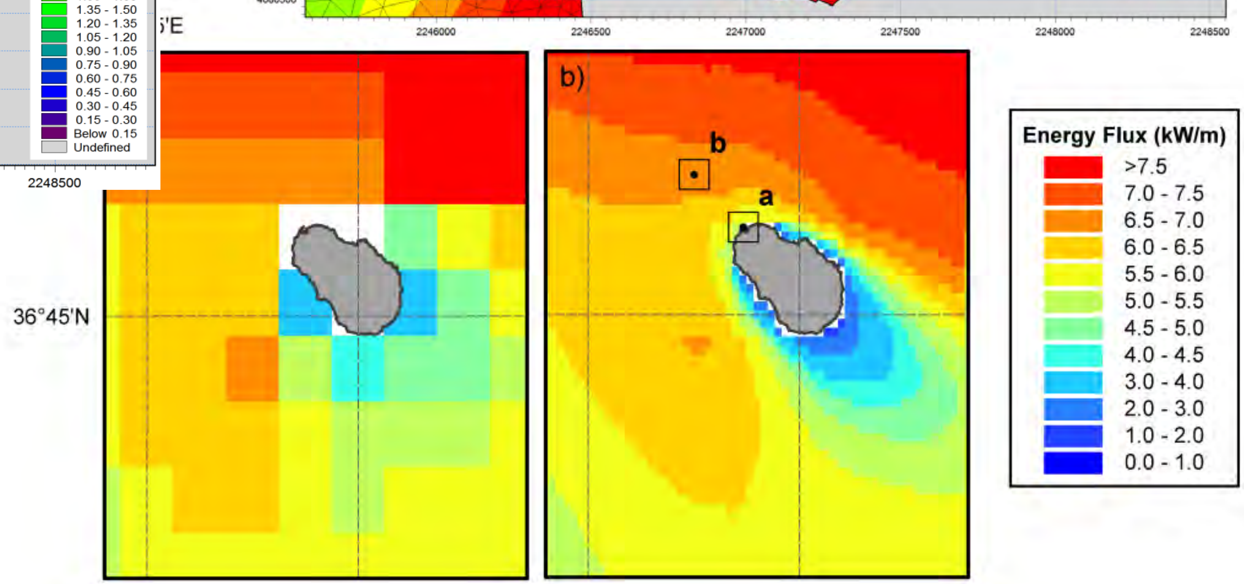


Wave energy assessment along the Italian coasts

PANTELLERIA

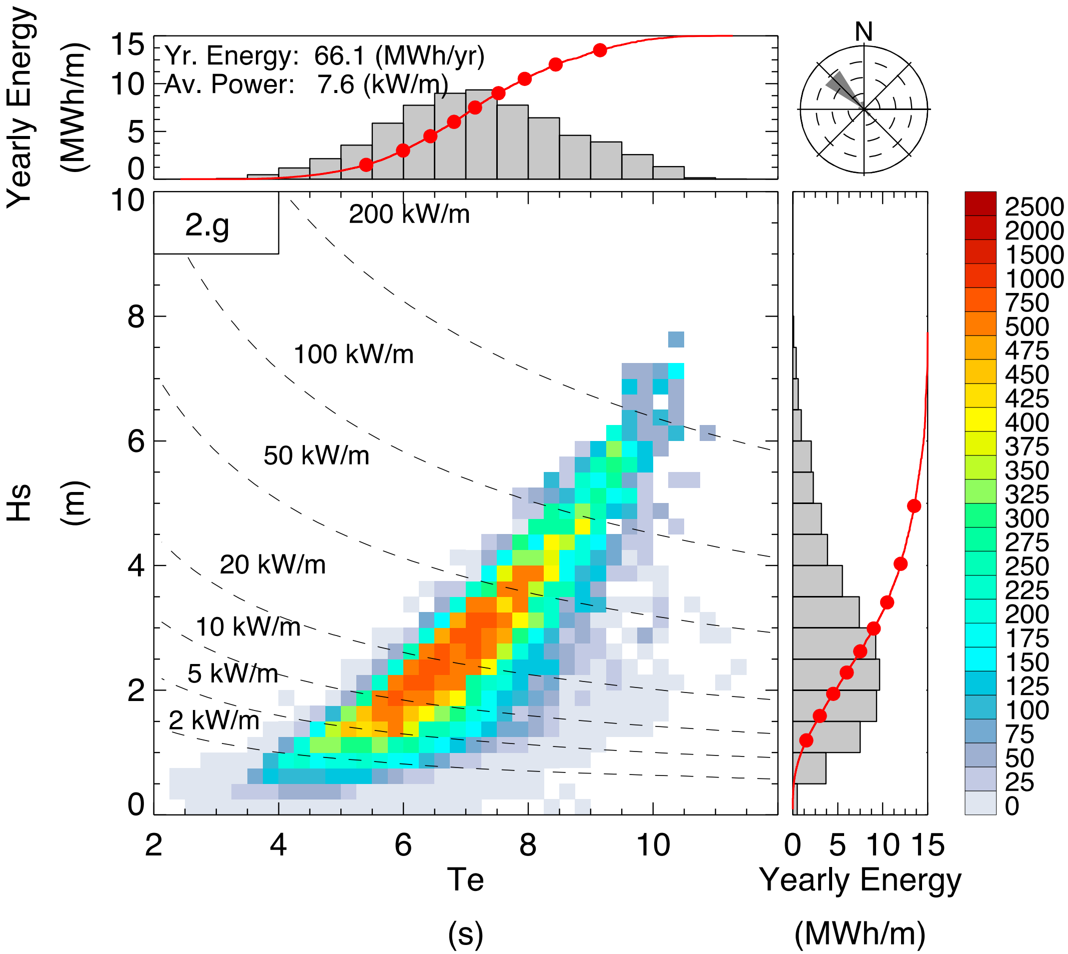


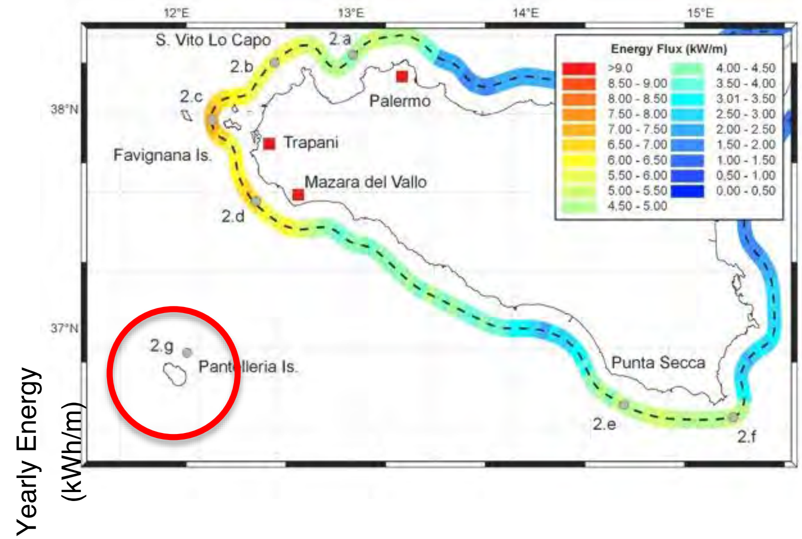




Wave energy assessment along the Italian coasts

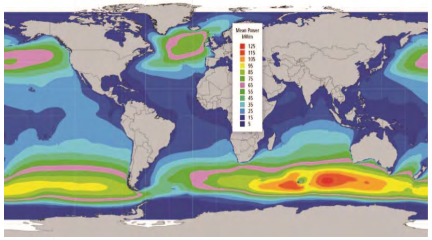
Distribution of yearly average wave energy near PANTELLERIA

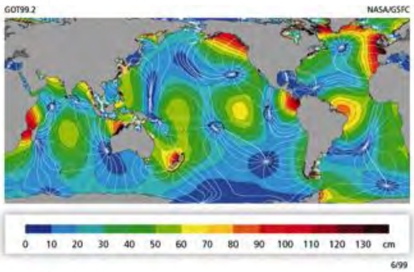


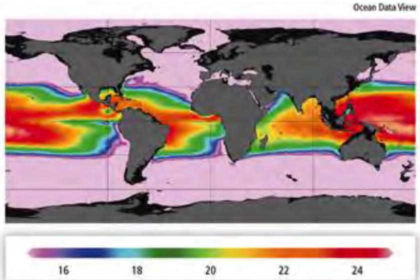


Distribution of wave energy as a function of significant wave period and significant wave height at specific points. Lower left panel shows the average yearly energy associated with sea states identified by *Te* and *Hs* couples. Dotted lines mark reference power levels. Upper panel shows the energy distribution as a function of *Te* only; right panel as a function of *Hs* only. Red lines in the upper and right panels are the cumulative energy as a percentage of the total. Red dots on the cumulative lines mark each 10*th* percentile. Rose plot in the upper right panel shows energy distribution over wave incoming direction. Each circle represents 20% fractions of the total energy.

Mediterranean wave energy forecast validation



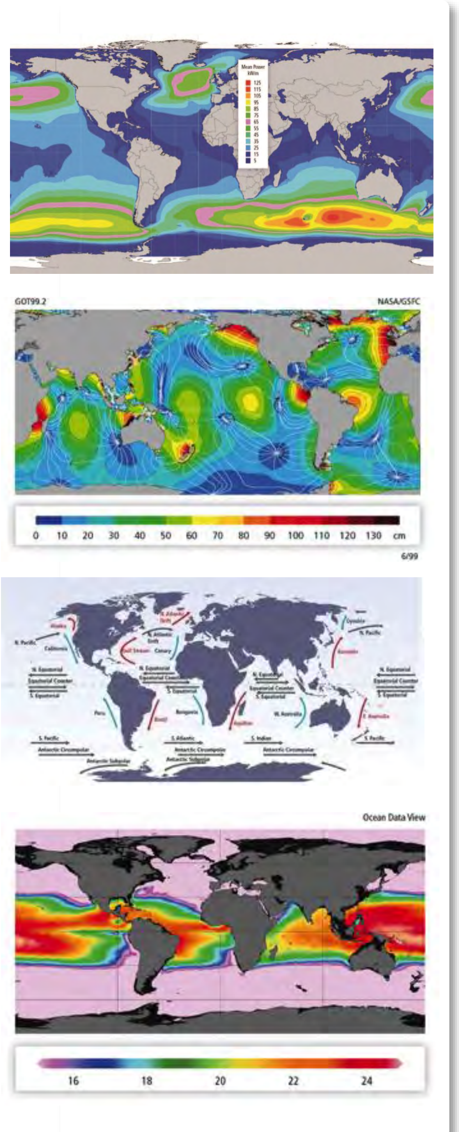




Where to install the converter

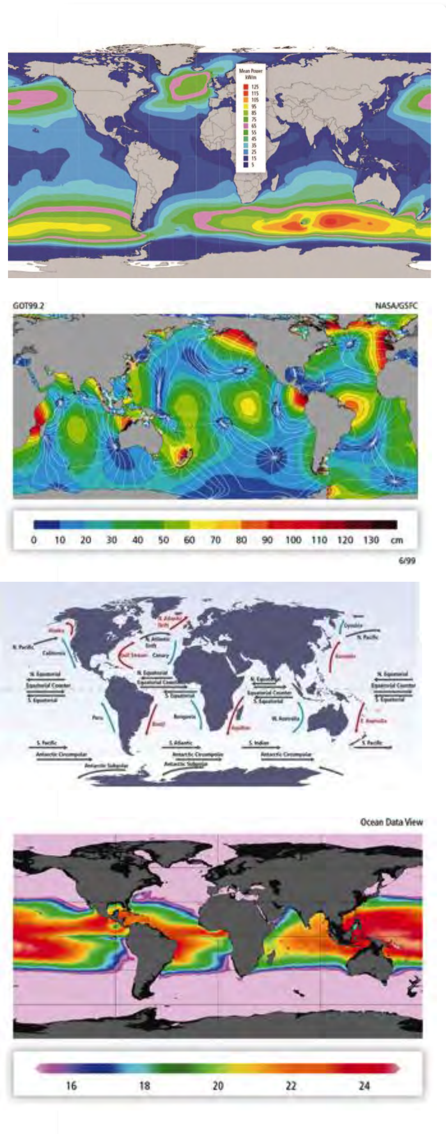
How much energy will be delivered in the electric grid?

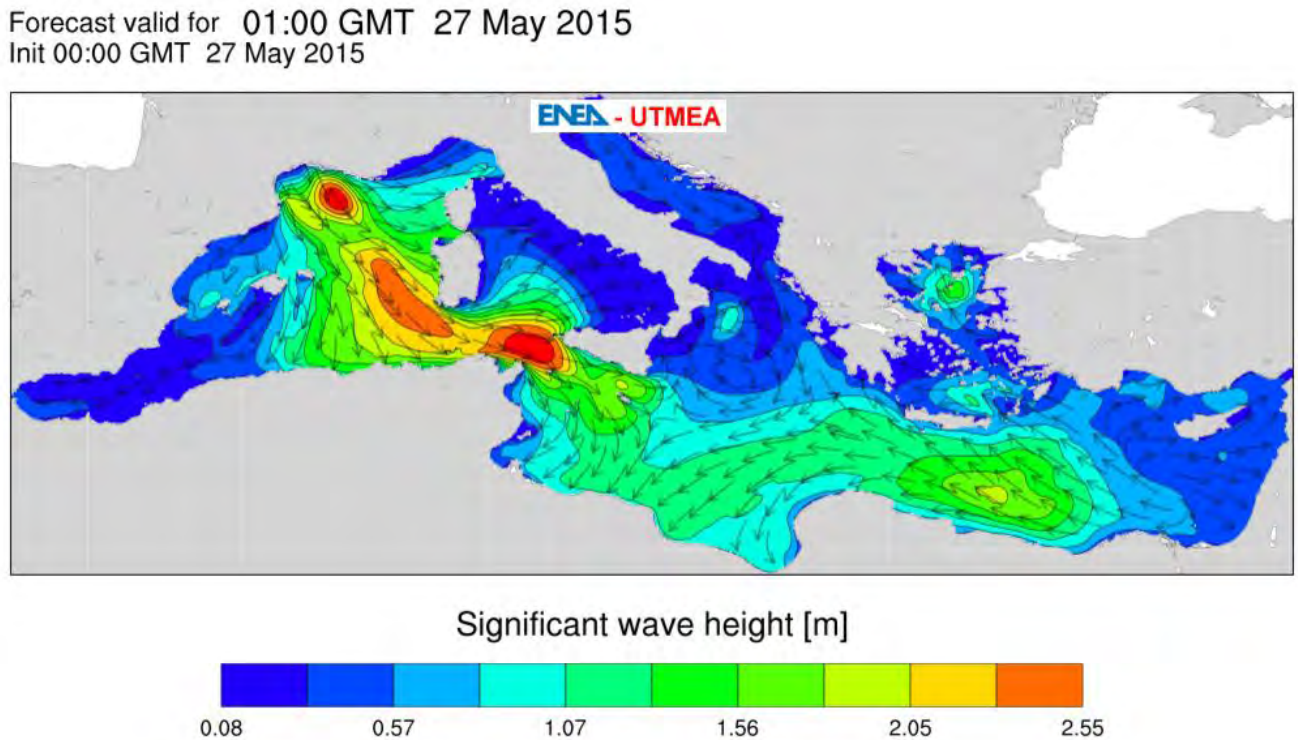
Mediterranean wave energy forecast validation



How much energy will be delivered in the electric grid?

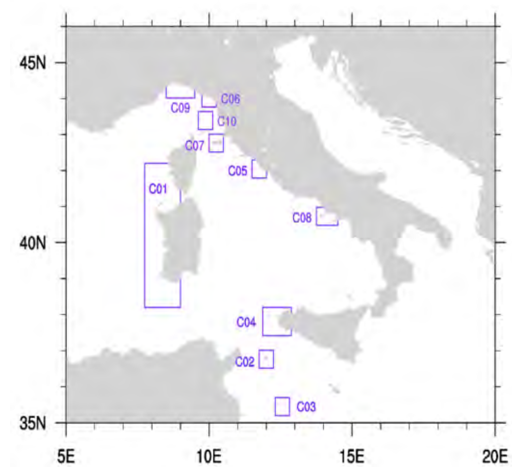
Mediterranean wave energy forecast



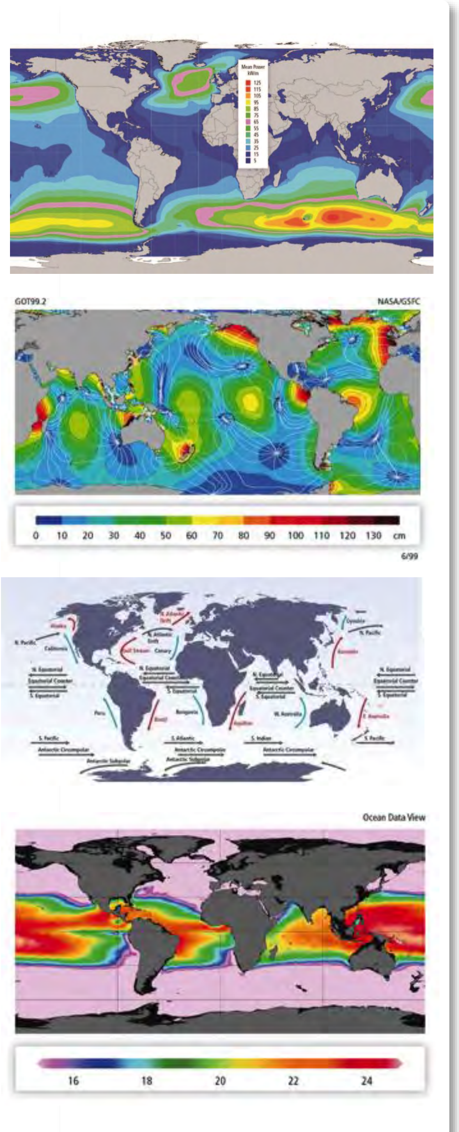


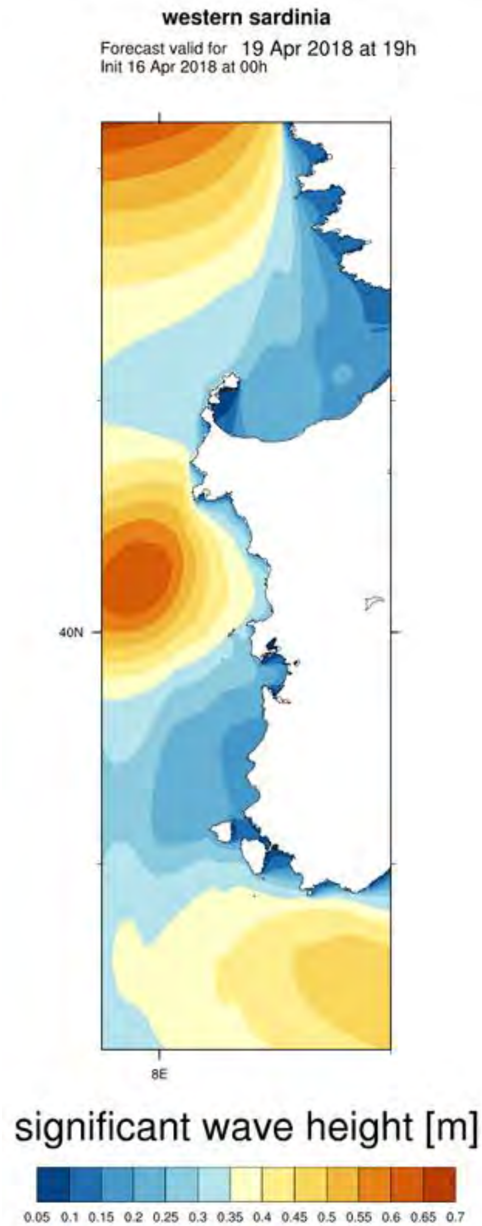
- Model implemented: WAM (*Wave prediction Model*)
- Resolution 1/32° x 1/32° (about 3.5Km)
- Forced by SKIRON data

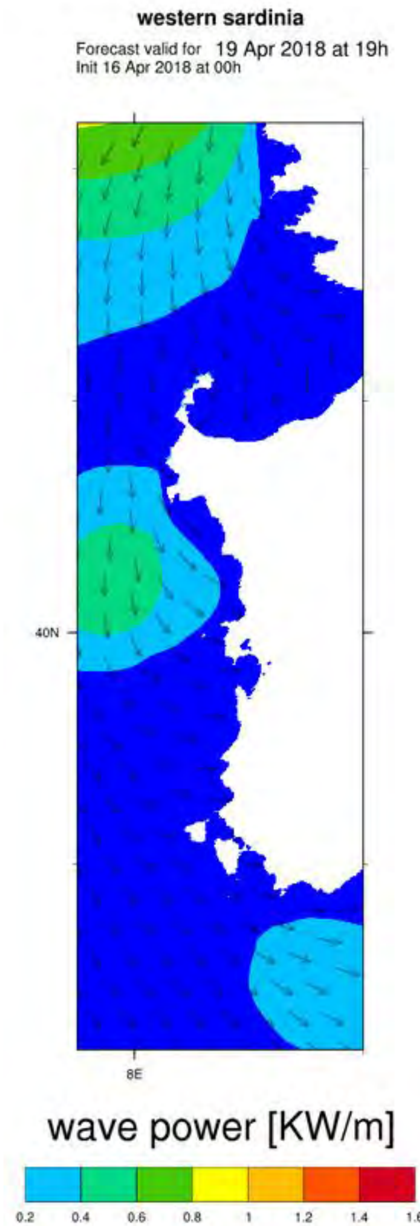
- Model implemented: SWAM
- Resolution 800m
- Forced by SKIRON data



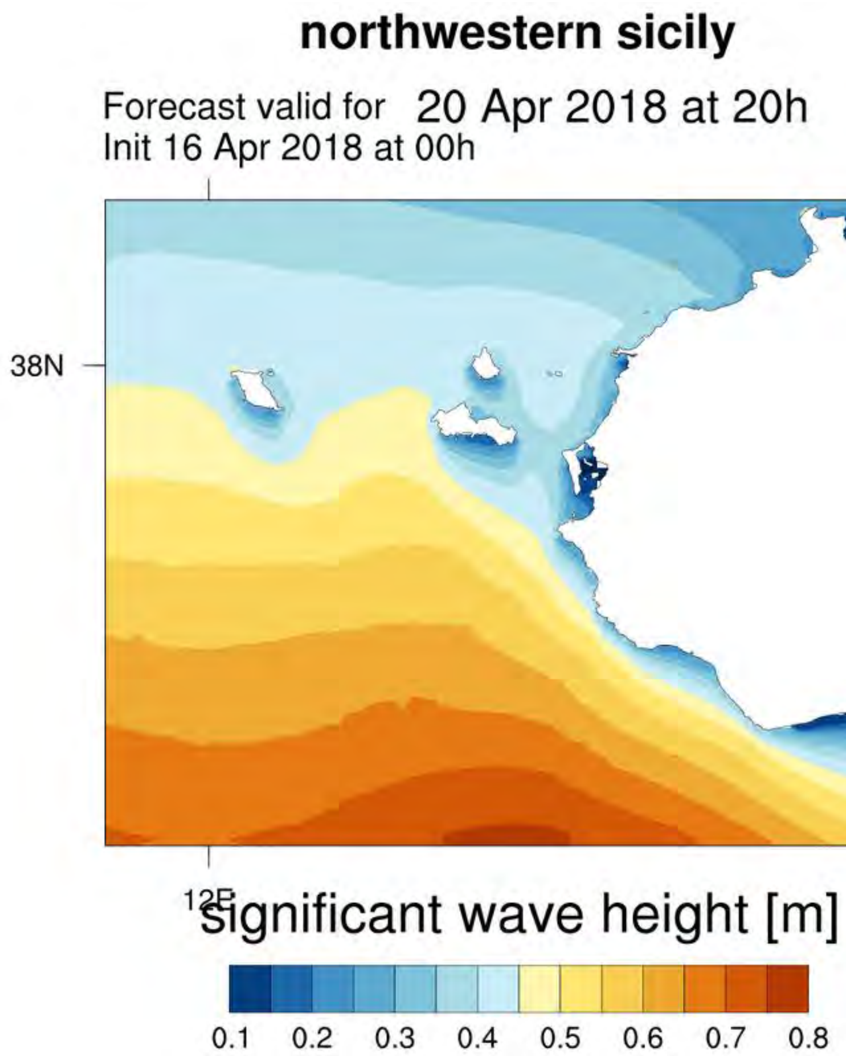
Mediterranean wave energy forecast

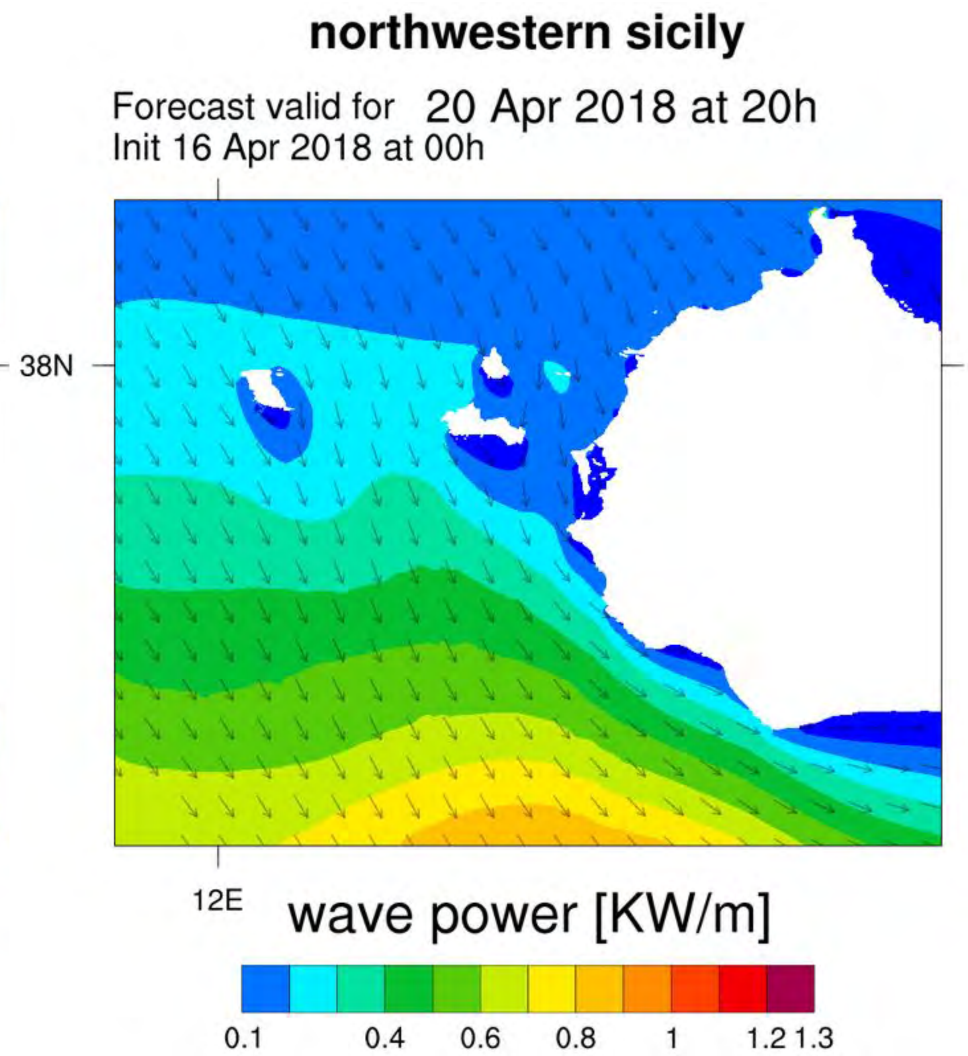




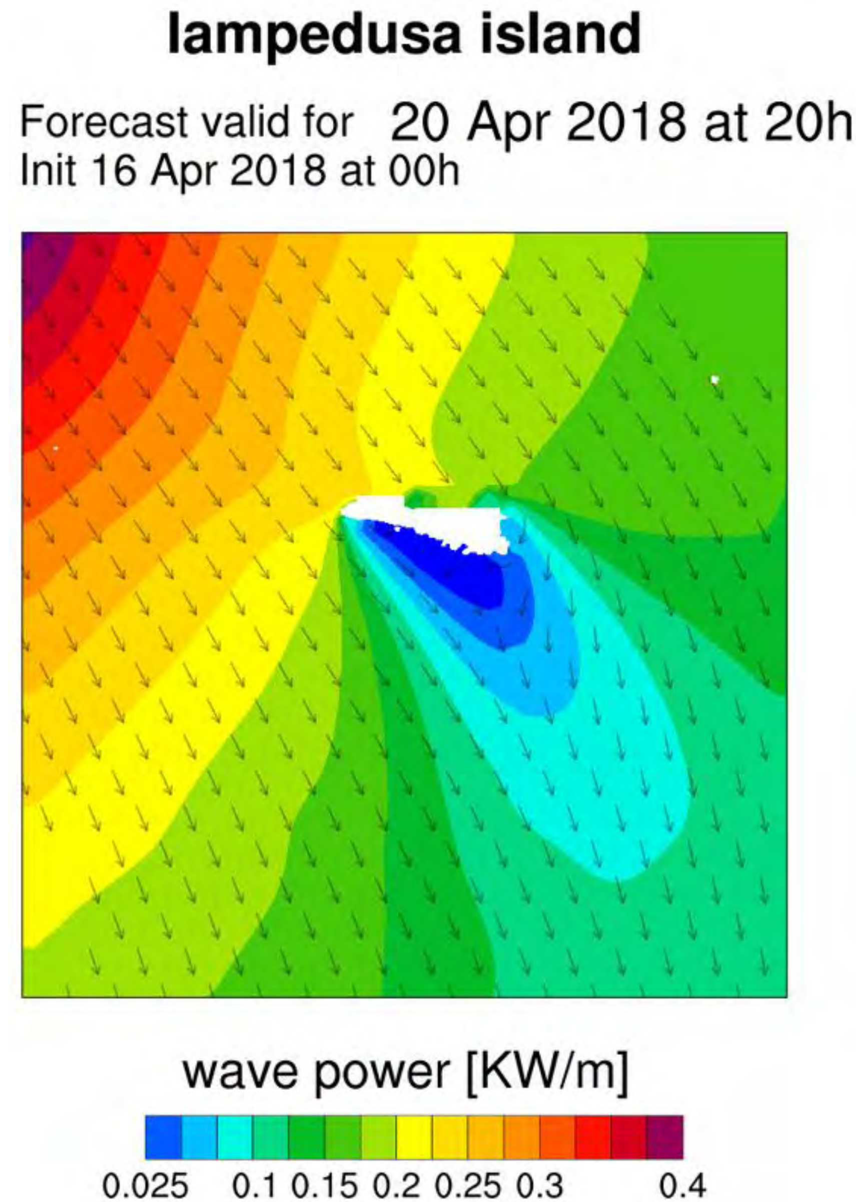


Mediterranean wave energy forecast



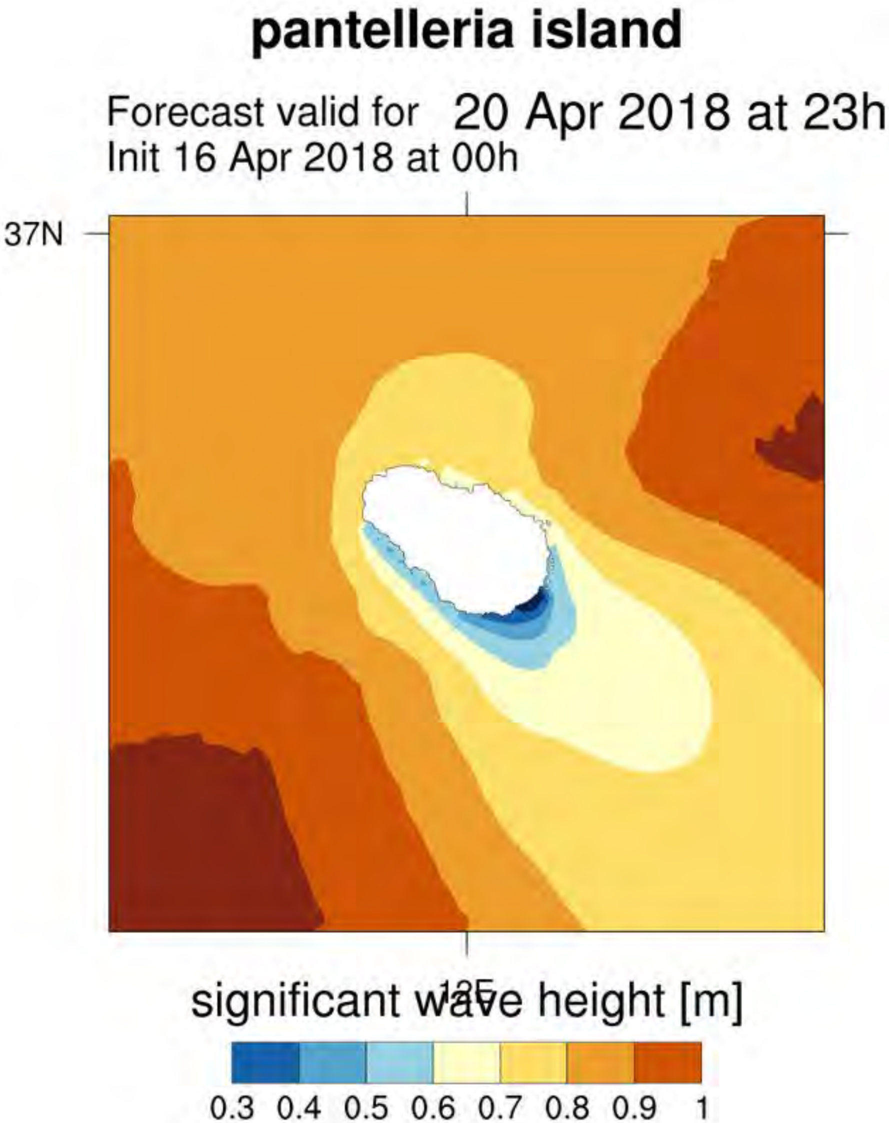


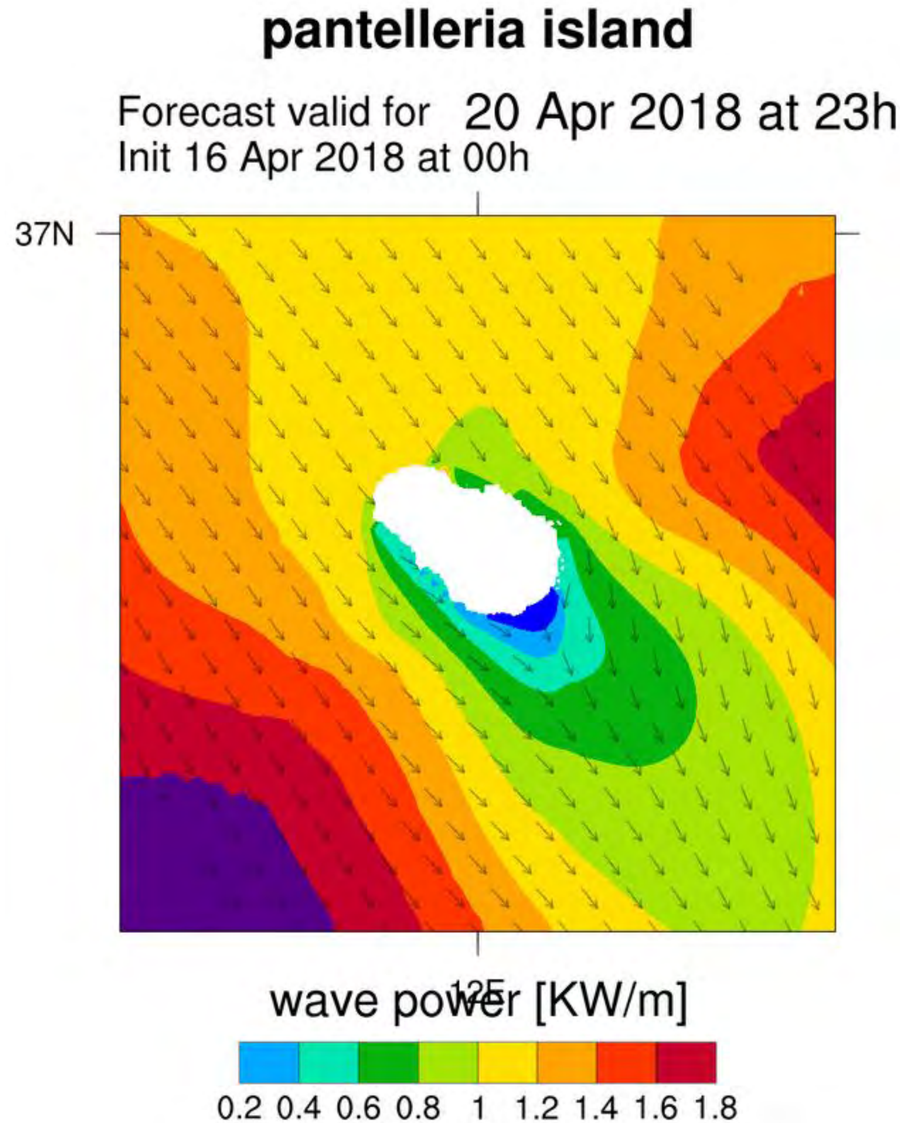
Mediterranean wave energy forecast



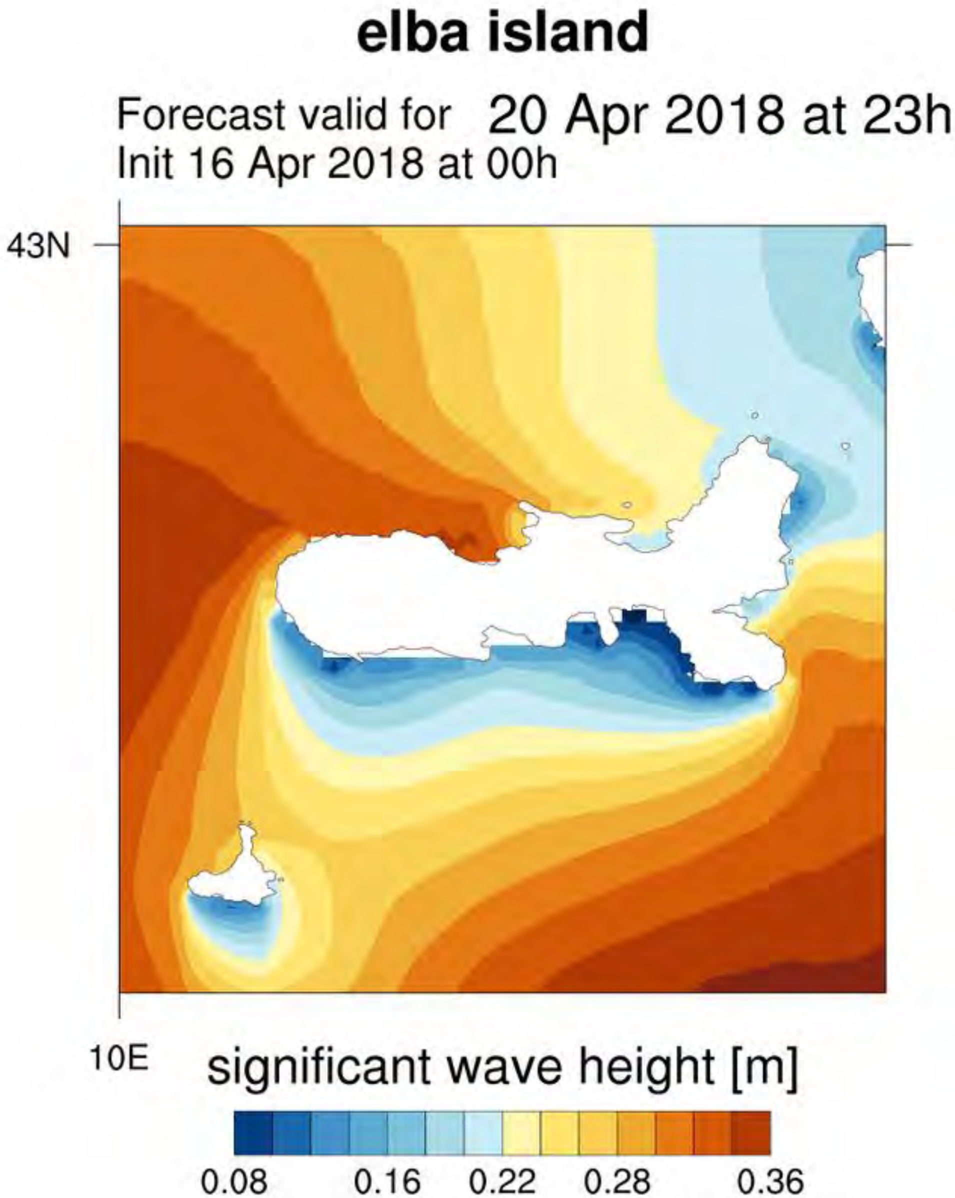
ENEA

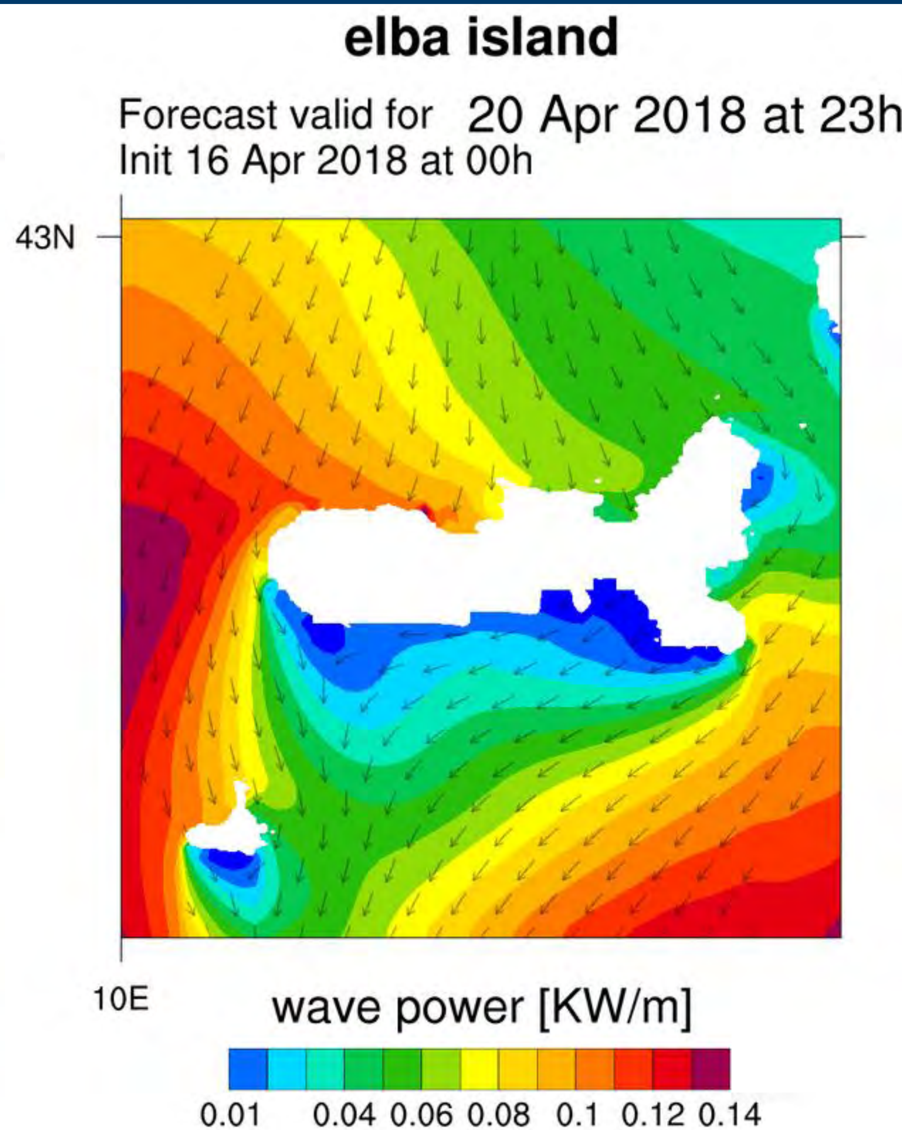
Mediterranean wave energy forecast



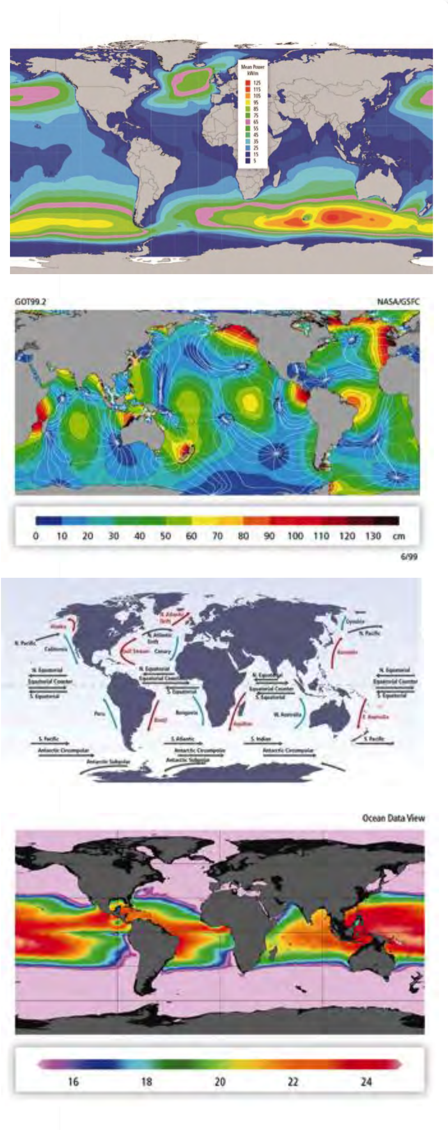


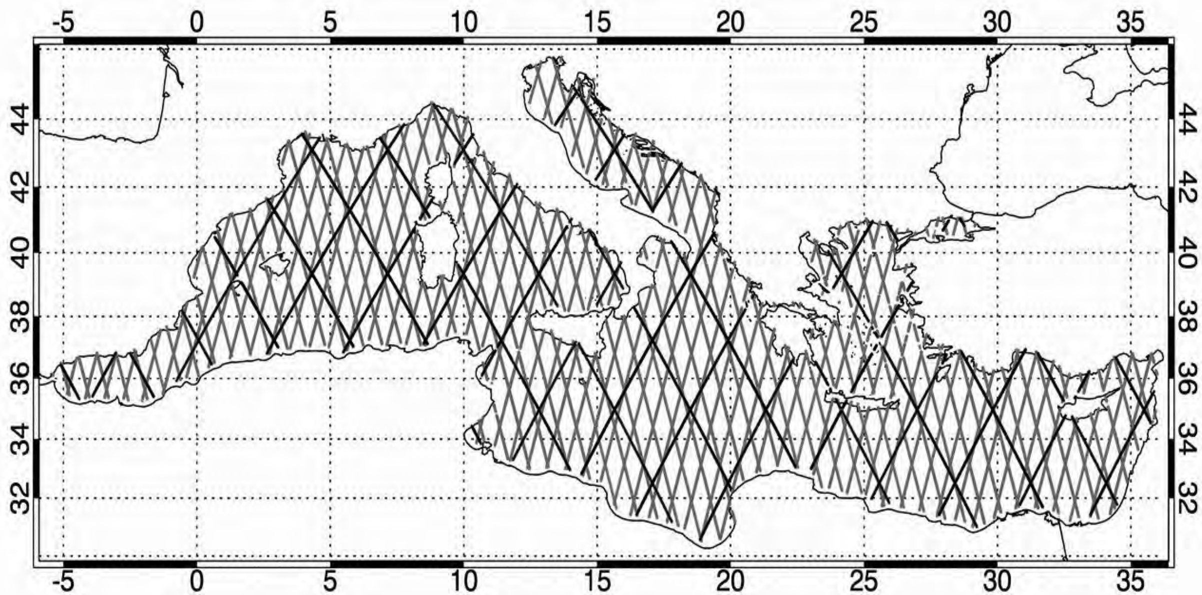
Mediterranean wave energy forecast





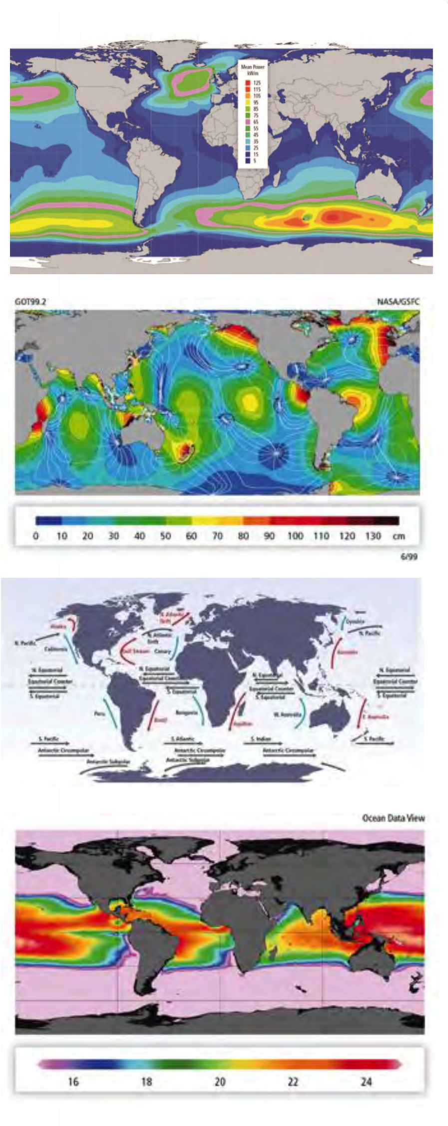
Mediterranean wave energy forecast validation





Ground tracks of satellites considered in model validation. Black lines identify **Jason-2** and gray lines are for **Saral/Altika.**

Mediterranean wave energy forecast validation

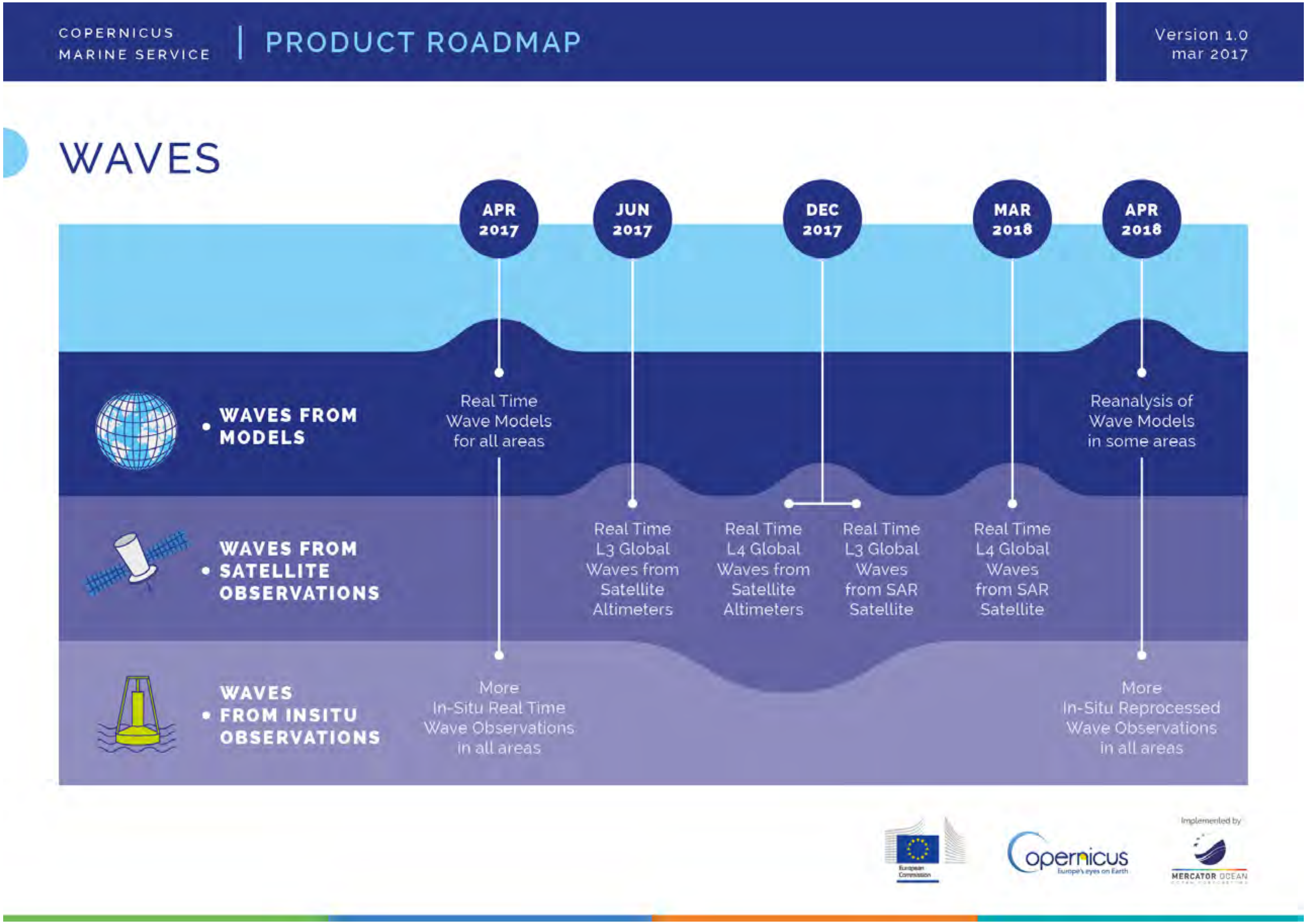


Satellite	forecast	samples	Bias (m)	Rmse (m)	si	slope	d
Jason-2	day 1	100,399	0.20	0.40	0.34	0.83	0.93
	day 2	101,036	0.22	0.44	0.37	0.81	0.92
	day 3	99,386	0.24	0.50	0.42	0.78	0.89
Saral/Altika	day 1	74,709	0.19	0.38	0.36	0.82	0.93
	day2	74,896	0.20	0.42	0.39	0.80	0.91
	day 3	74,691	0.21	0.46	0.44	0.78	0.89

Statistics of satellite and model significant wave height (*Hs*) comparison.

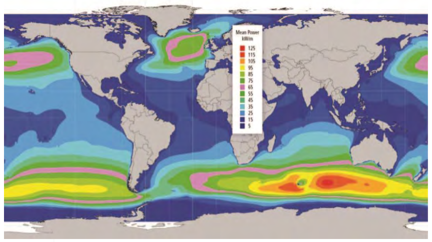
Mediterranean wave energy forecast: next improvements

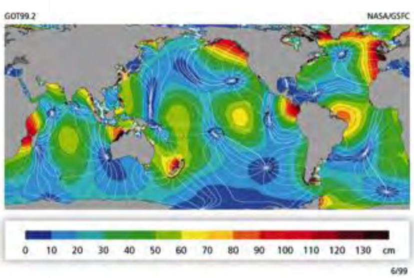
Copernicus data for model validation

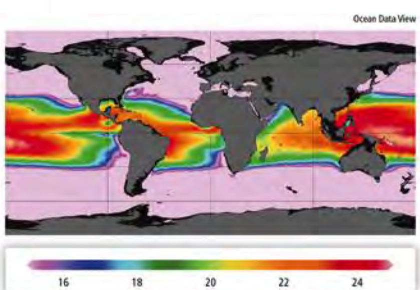


Global ocean energy

The RE resource in the ocean comes from six distinct sources, each with different origins and requiring different technologies for conversion



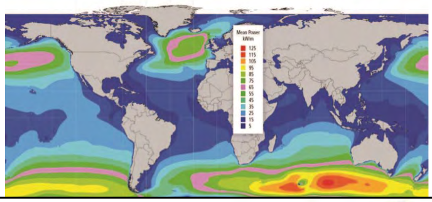




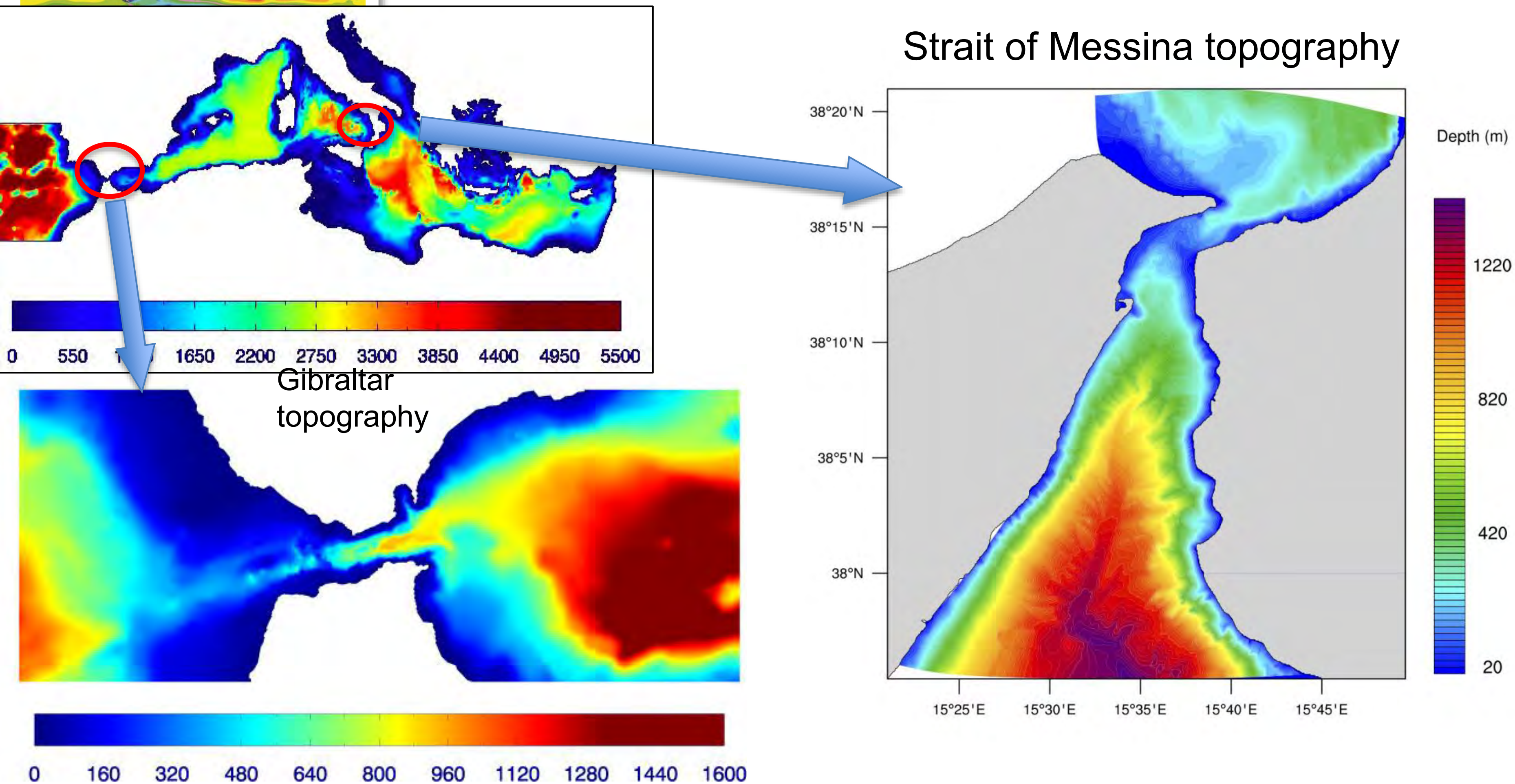
- **Waves**: derived from the transfer of the kinetic energy of the wind to the upper surface of the ocean.
- **Tidal Range (tidal rise and fall)**: derived from the gravitational forces of the Earth-Moon-Sun system.
- **Tidal currents**: water flow resulting from the filling and emptying of coastal regions as a result of the tidal rise and fall.
- **Ocean Currents**: derived from wind-driven and thermohaline ocean circulation.
- **Ocean Thermal Energy Conversion (OTEC)**:derived from temperature differences between solar energy stored as heat in upper ocean layers and colder seawater, generally below 1,000 m.
- **Salinity Gradients (osmotic power)**: derived from salinity differences between fresh and ocean water at river mouths.

Tidal energy assessment for the Mediterranean

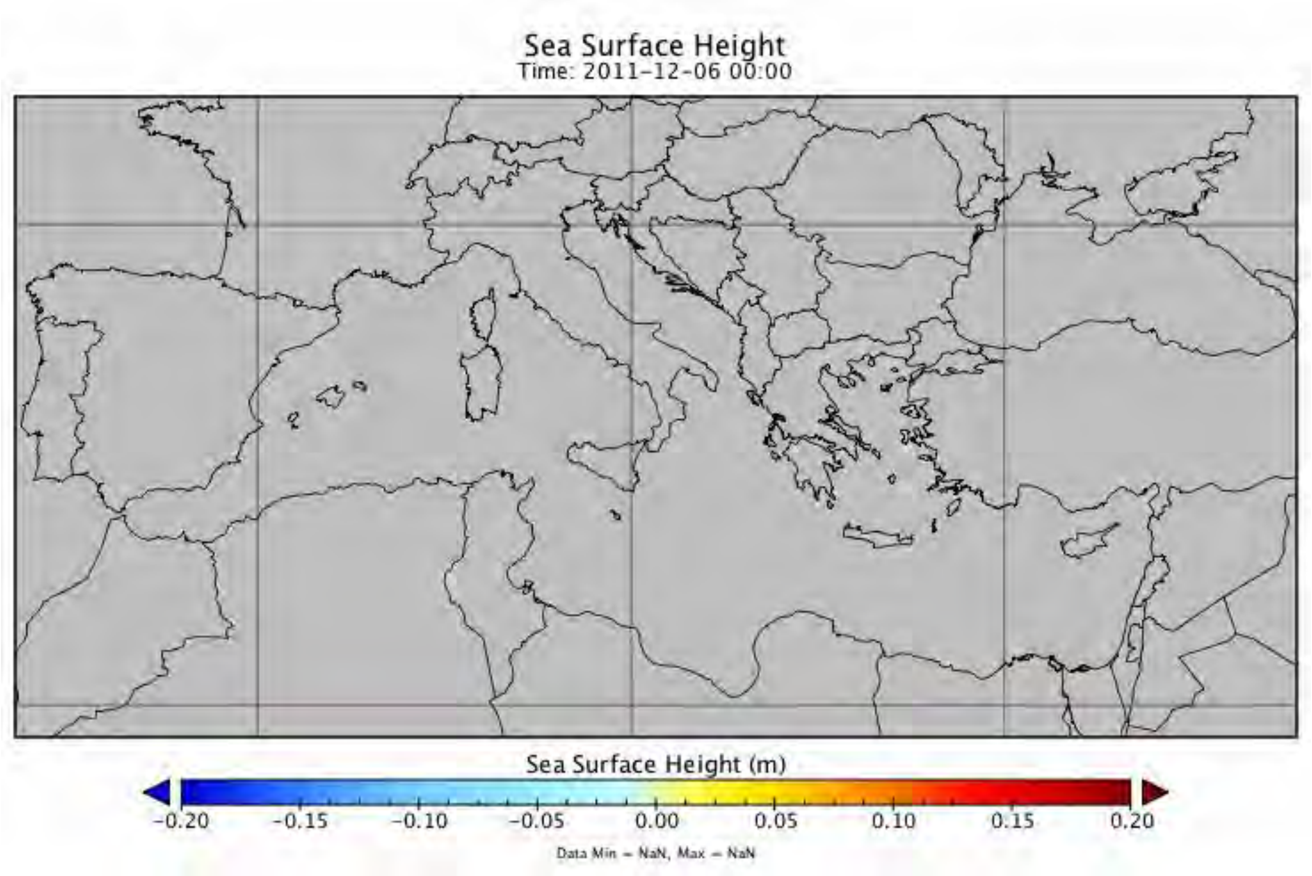
The RE resource in the ocean comes from six distinct sources, each with different origins and requiring different technologies for conversion



- **Tidal currents**: water flow resulting from the filling and emptying of coastal regions as a result of the tidal rise and fall.

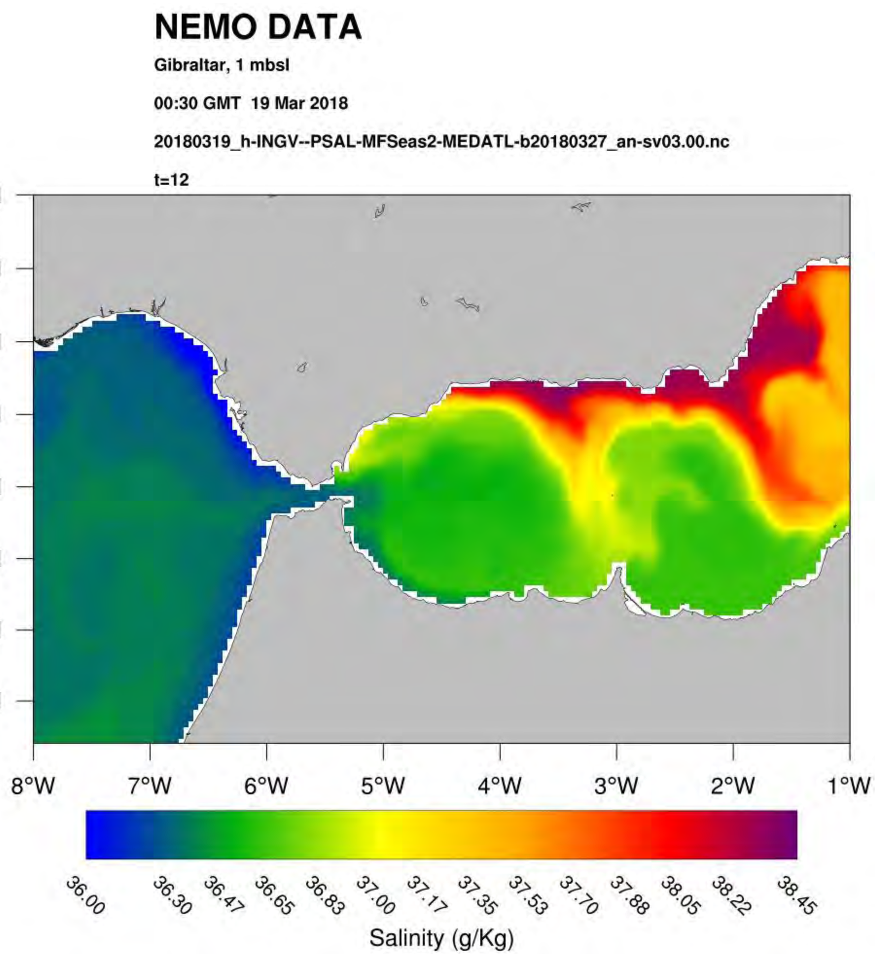


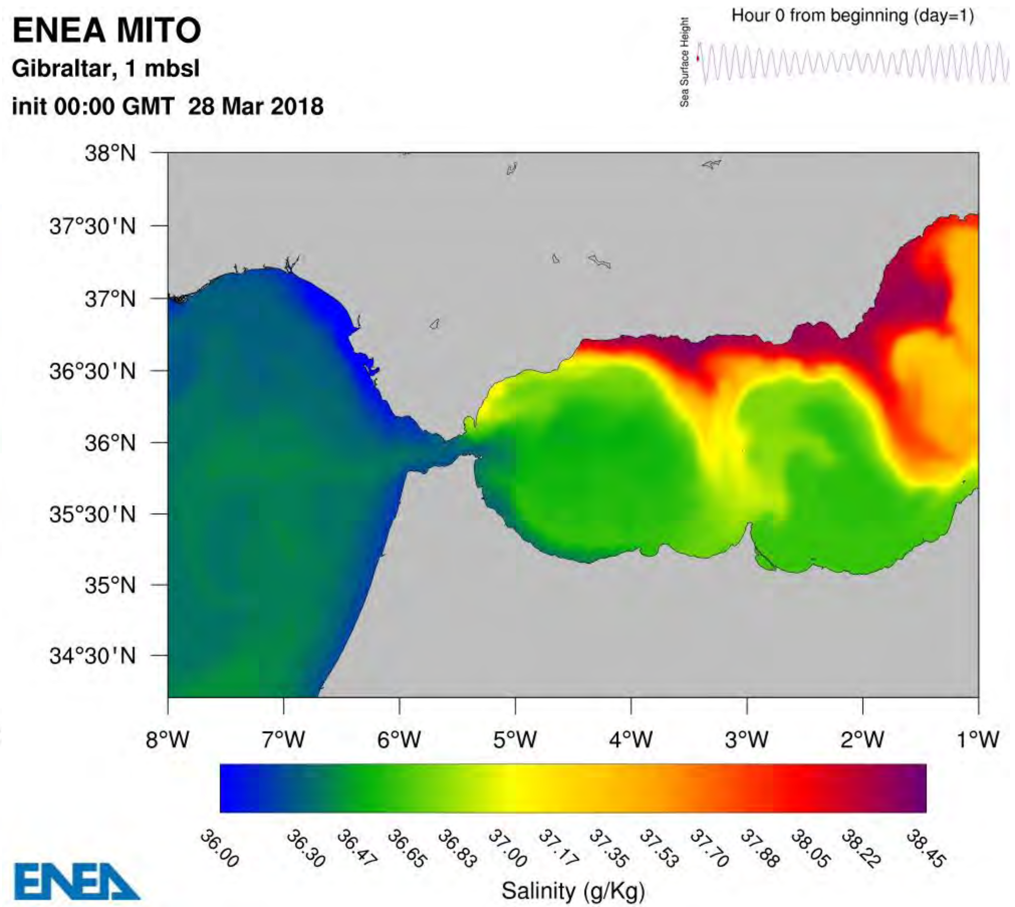
Tidal energy assessment for the Mediterranean



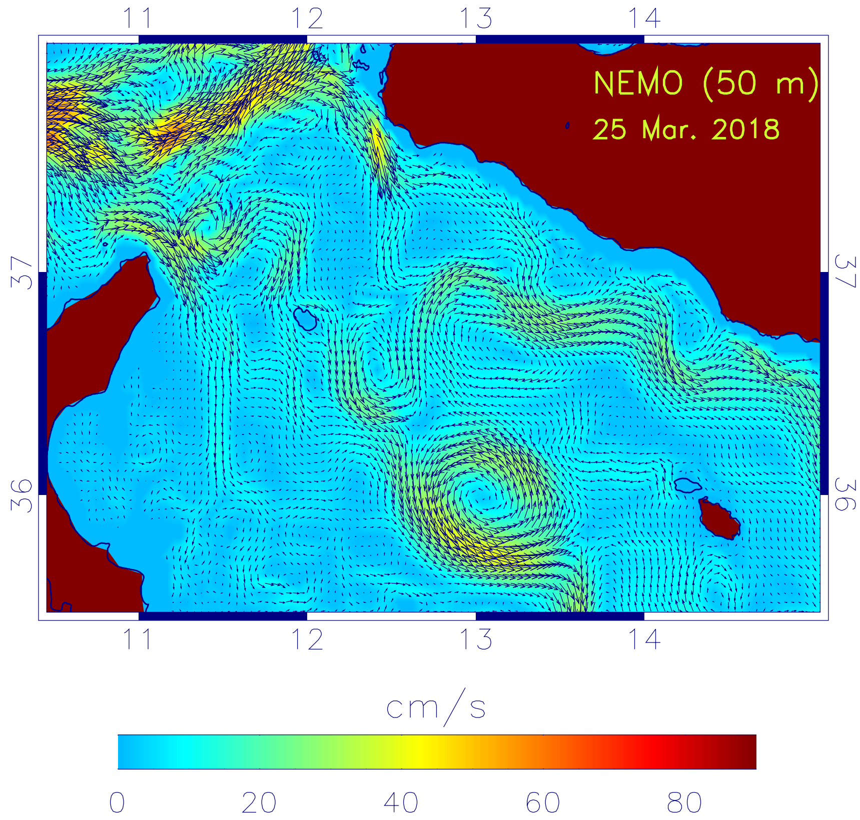
MITgcm – Explicit Tides (M2,S2, K1, O1) – Lateral Tide + Tidal Potential
Average resolution 1/48° (2.3 Km)
Minimum resolution 230m (Gibraltar and Turkish Straits)
100 Vertical Levels
Initialized with Copernicus data!

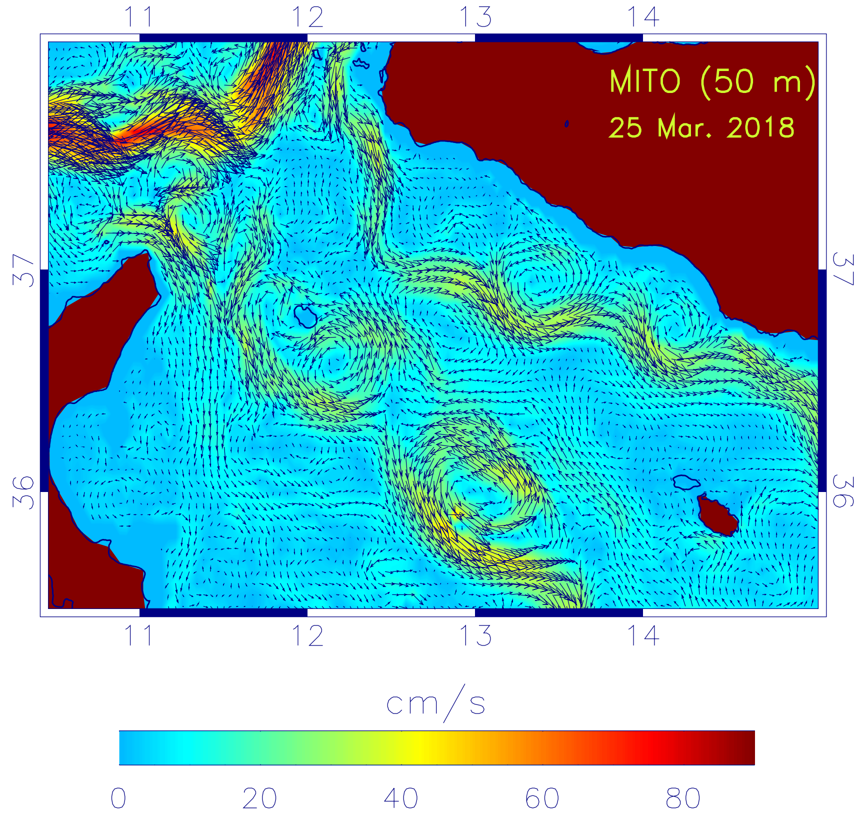
Tidal energy forecast for the Mediterranean



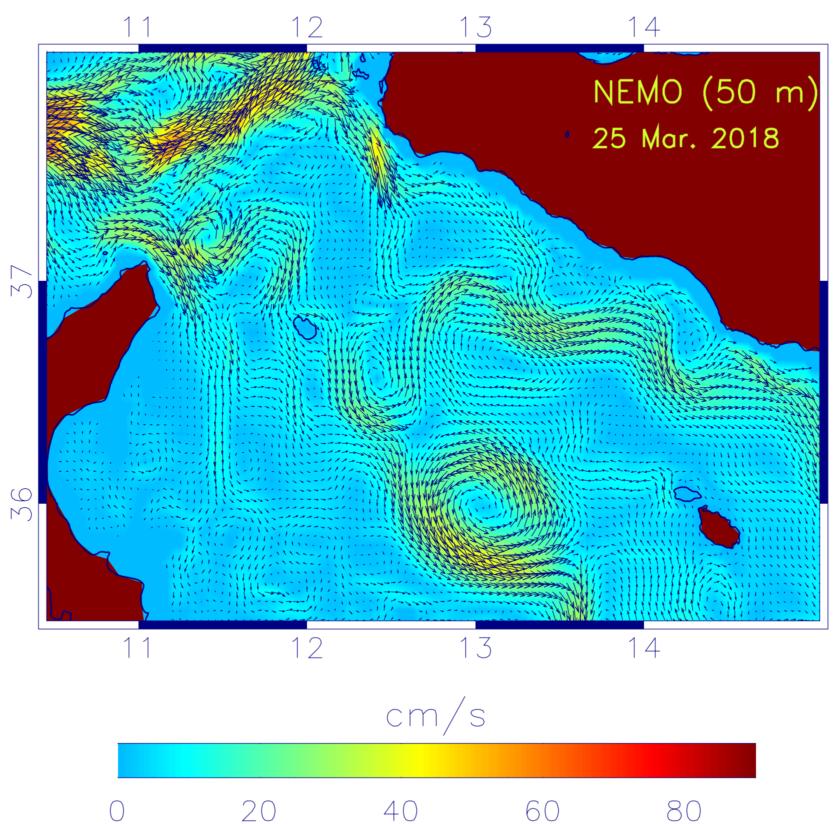


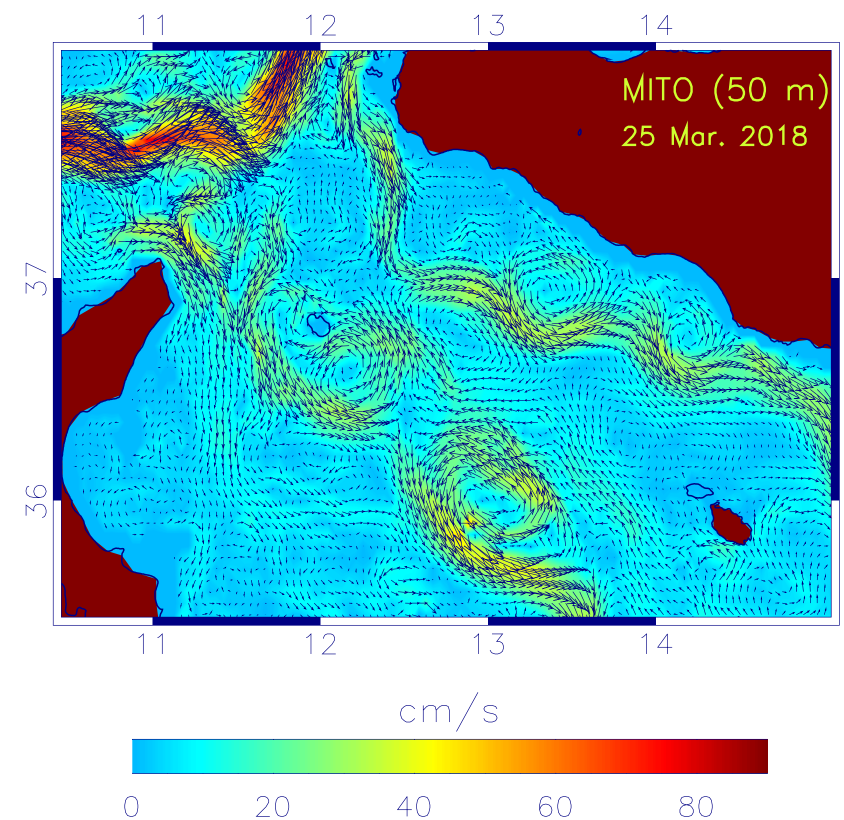
Forecasted circulation for the Mediterranean

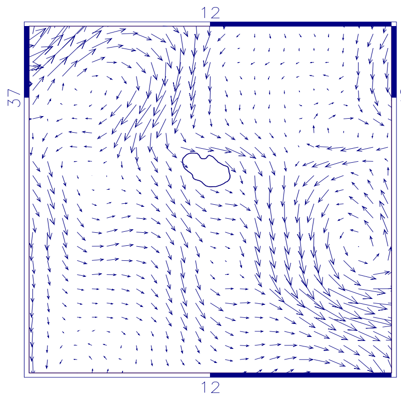




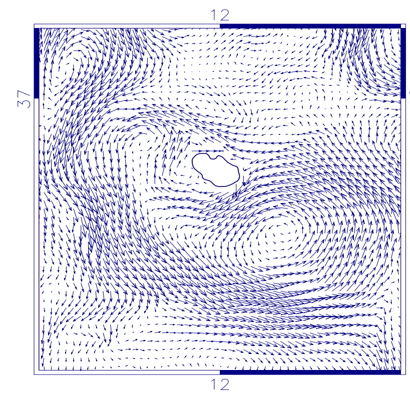
Forecasted circulation for the Mediterranean





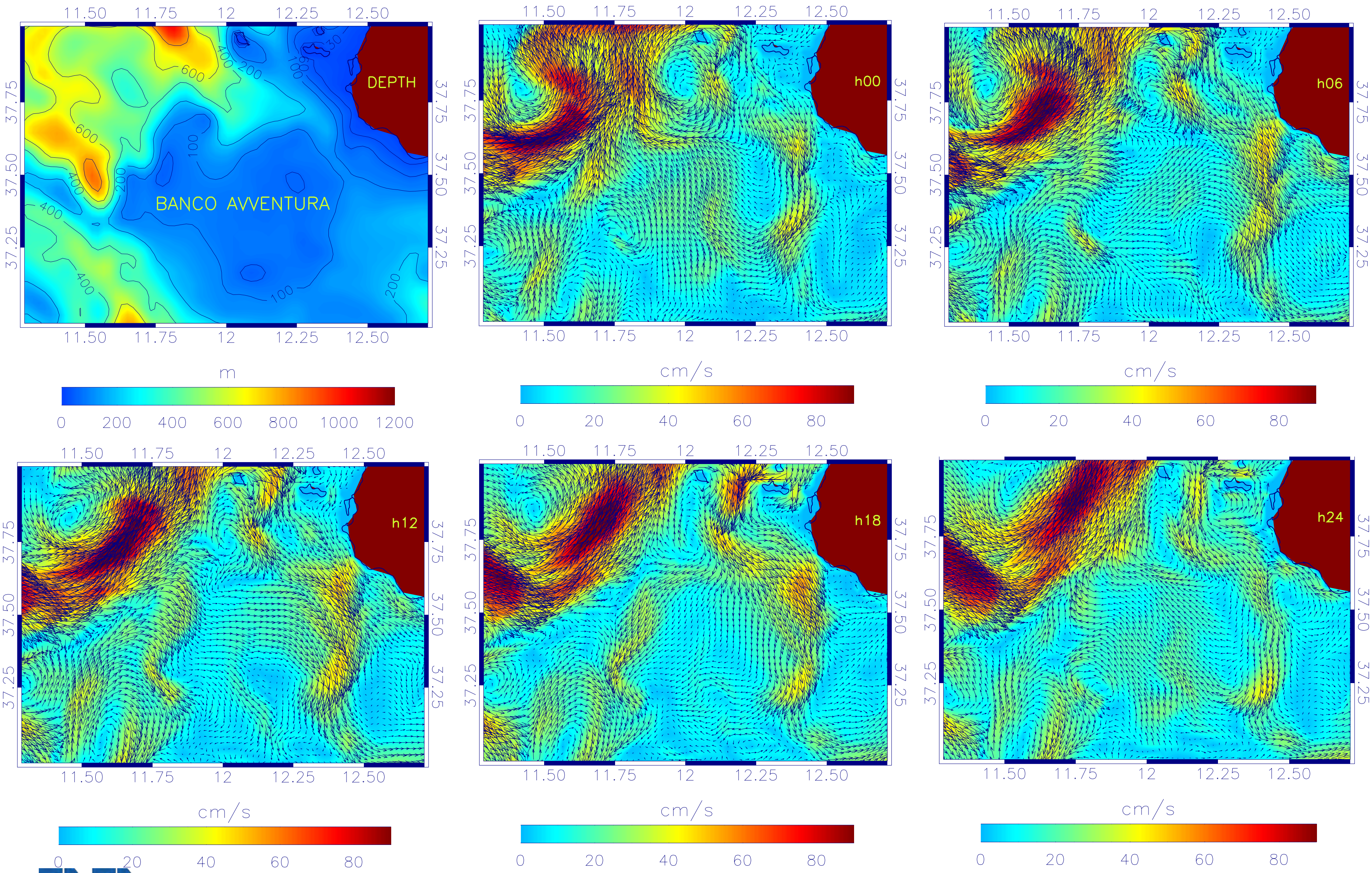


Zoom around Pantelleria



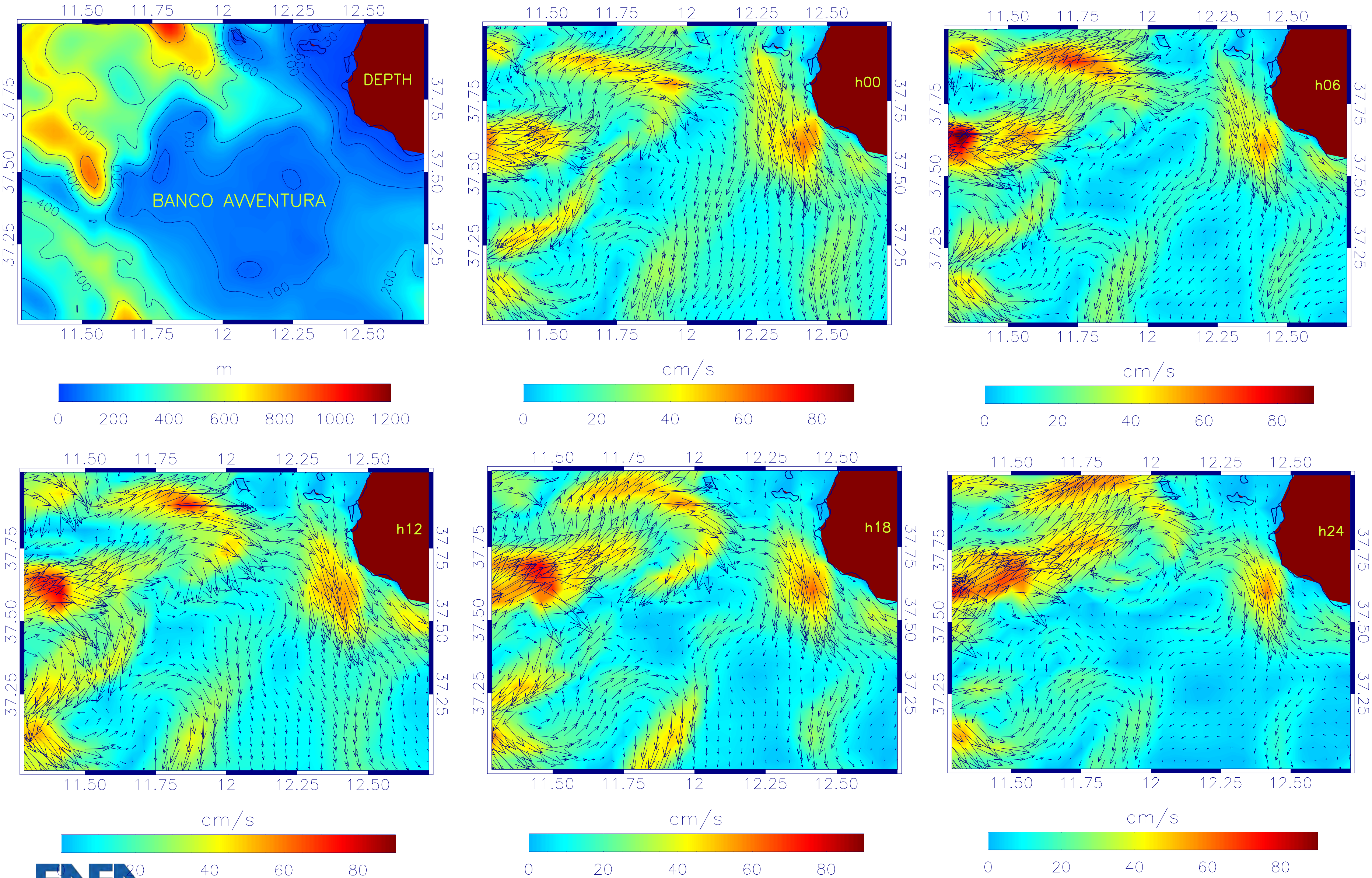
Forecasted circulation for the Mediterranean

Banco AVVENTURA - Sicily Channel

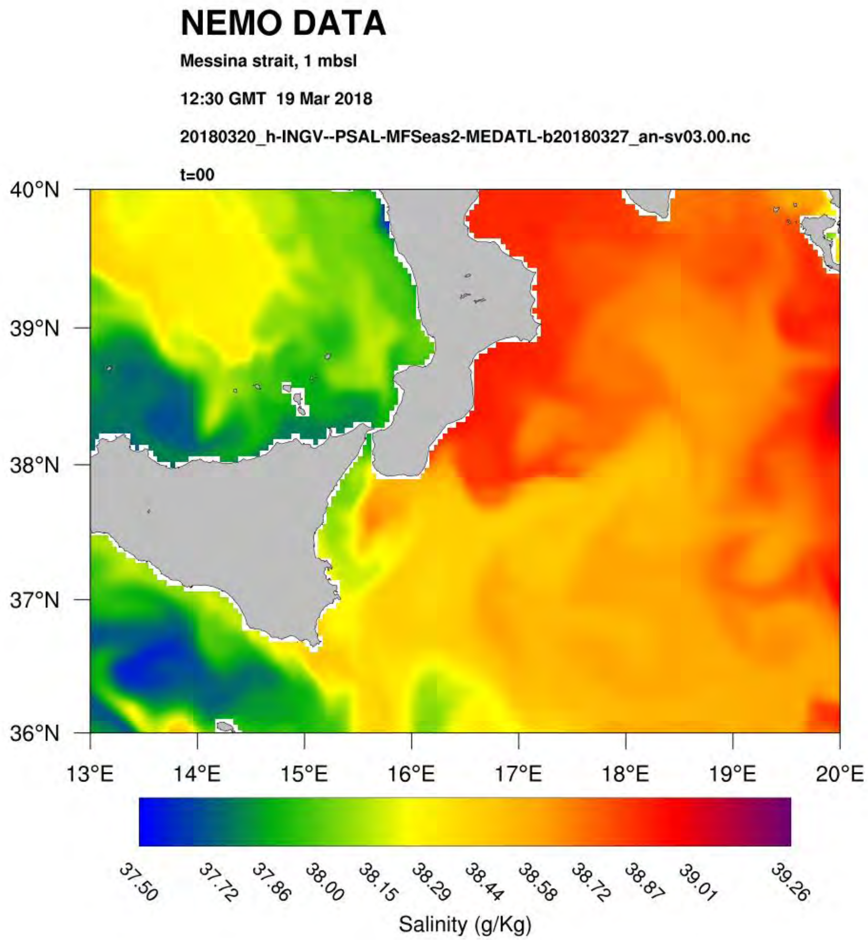


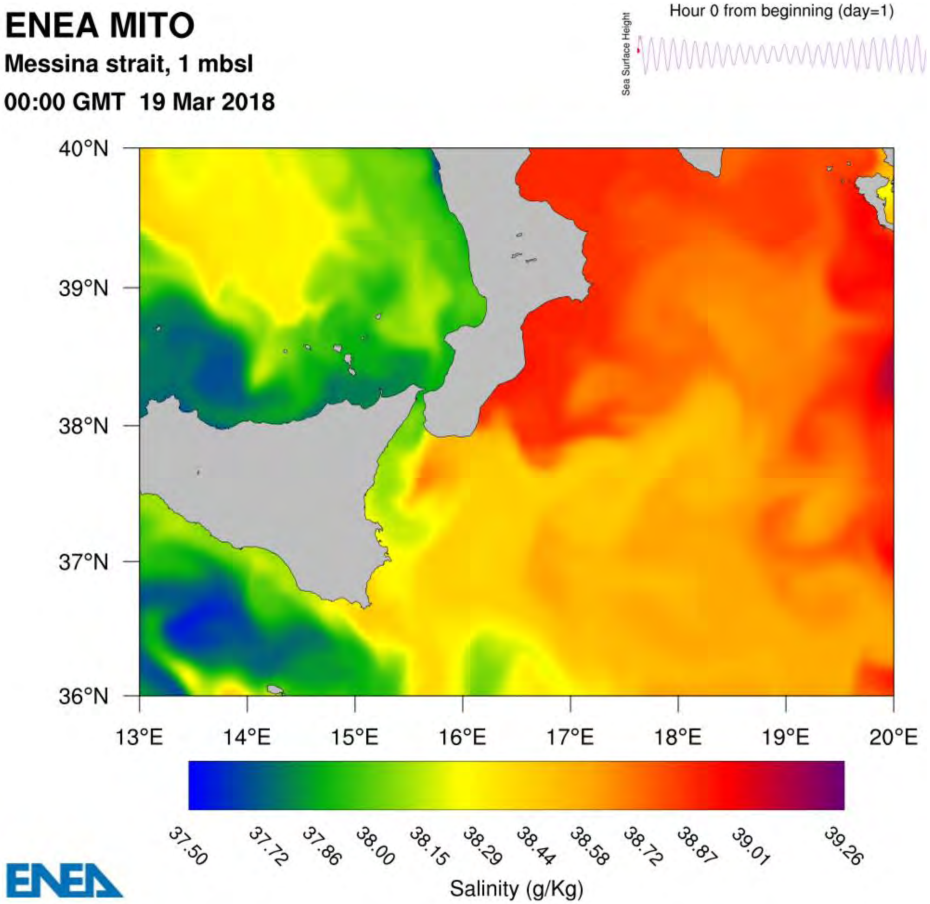
Forecasted circulation for the Mediterranean

Banco AVVENTURA - Sicily Channel

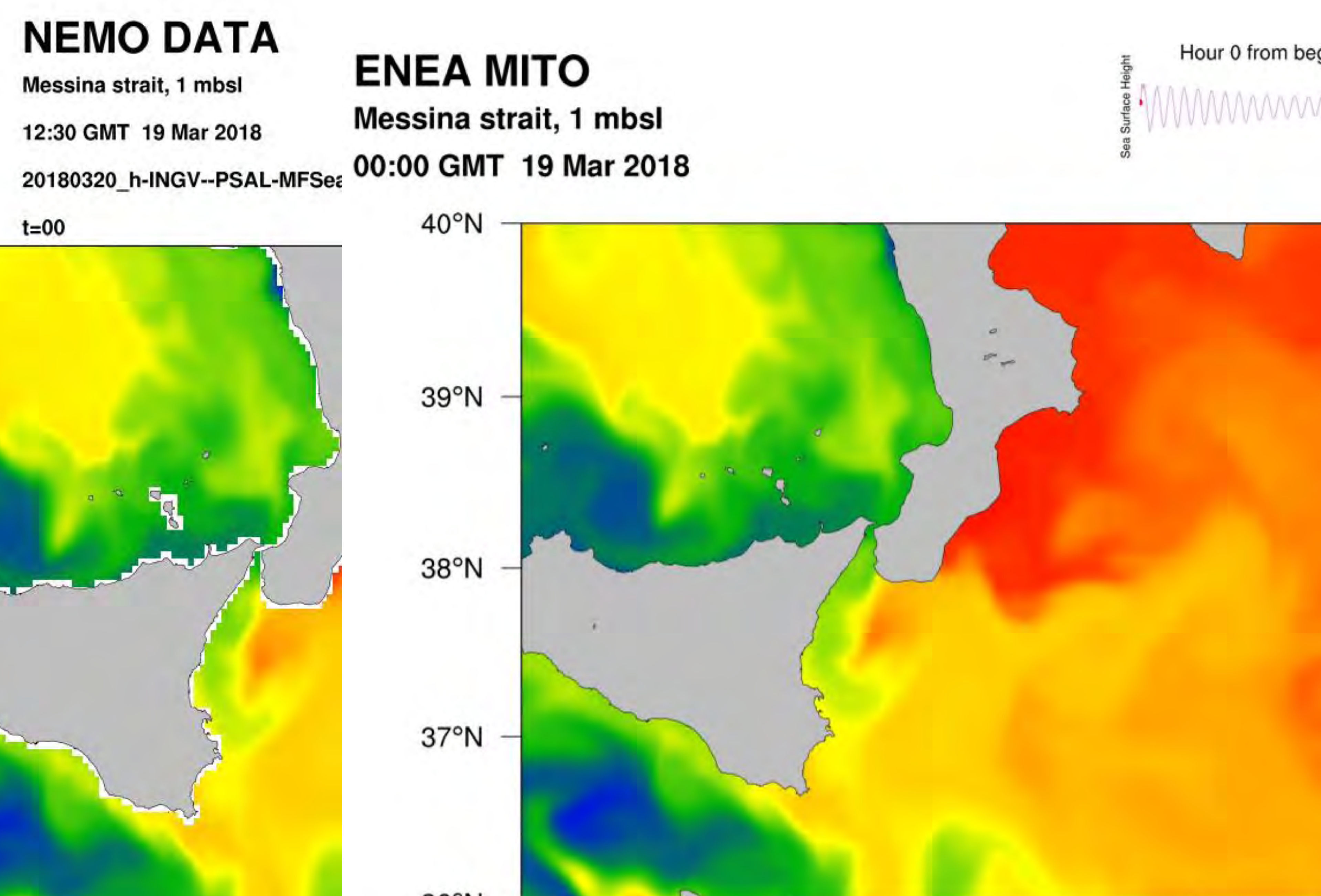


Tidal energy forecast for the Mediterranean



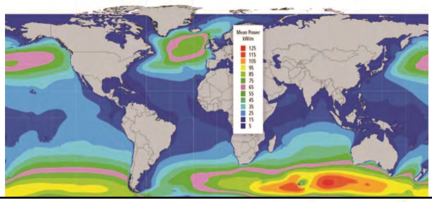


Tidal energy forecast for the Mediterranean

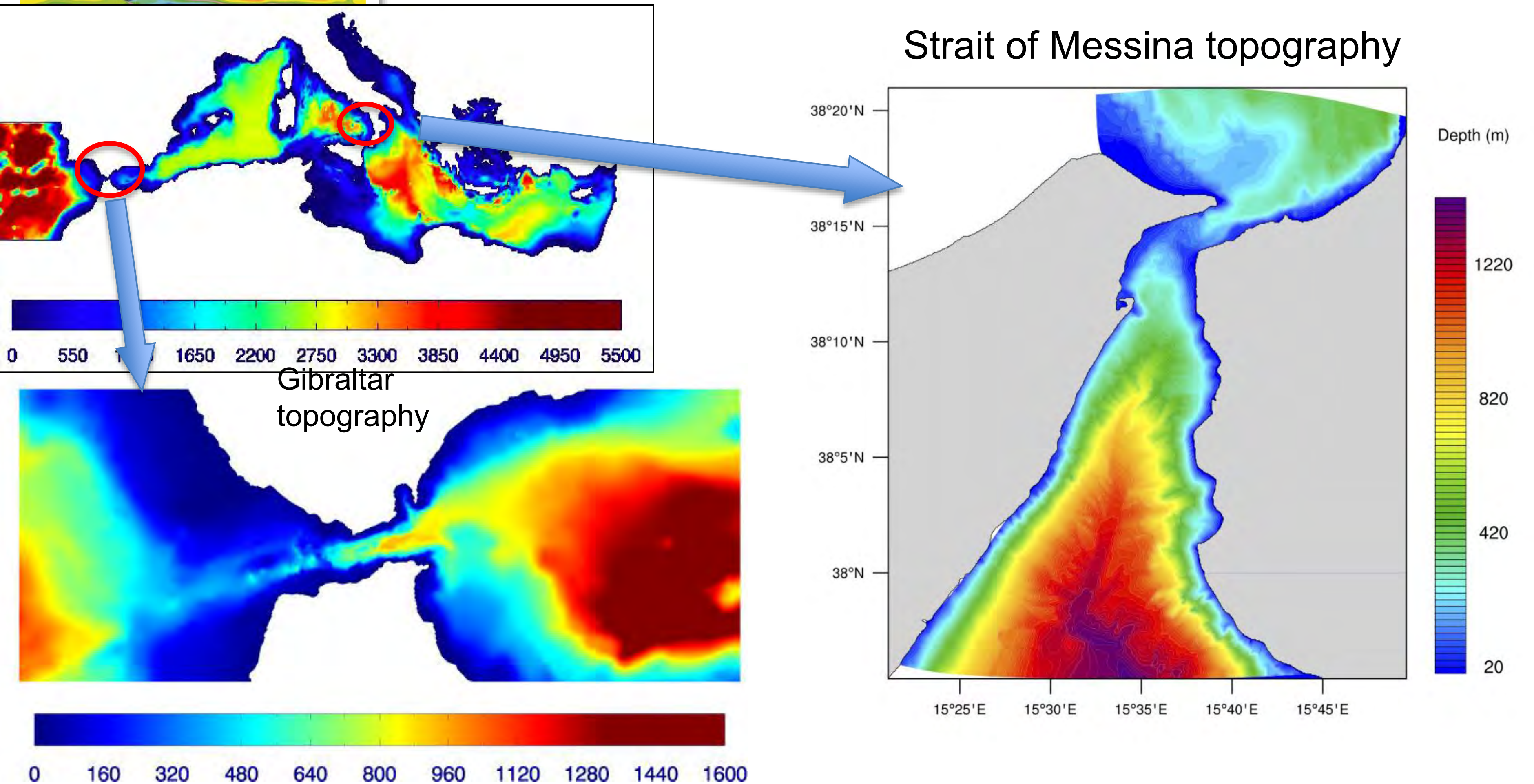


Tidal energy assessment for the Mediterranean

The RE resource in the ocean comes from six distinct sources, each with different origins and requiring different technologies for conversion

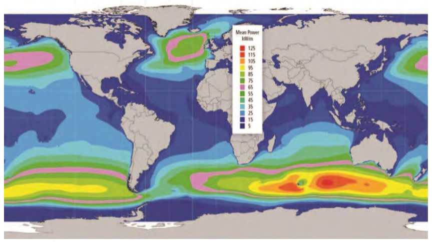


- **Tidal currents**: water flow resulting from the filling and emptying of coastal regions as a result of the tidal rise and fall.



Tidal energy assessment for the Mediterranean

The RE resource in the ocean comes from six distinct sources, each with different origins and requiring different technologies for conversion



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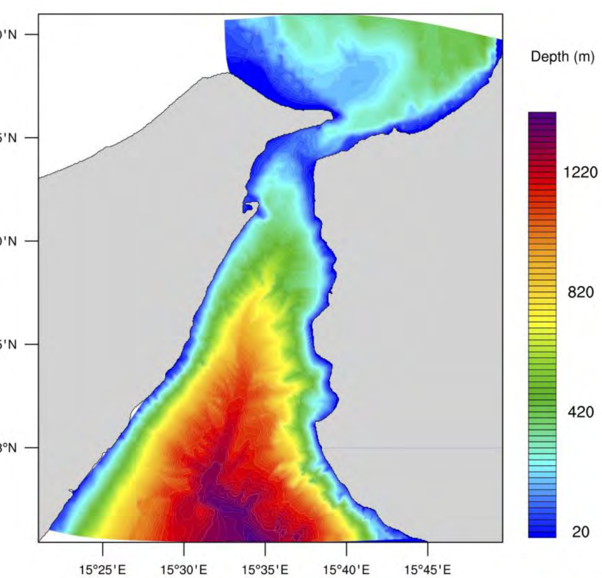

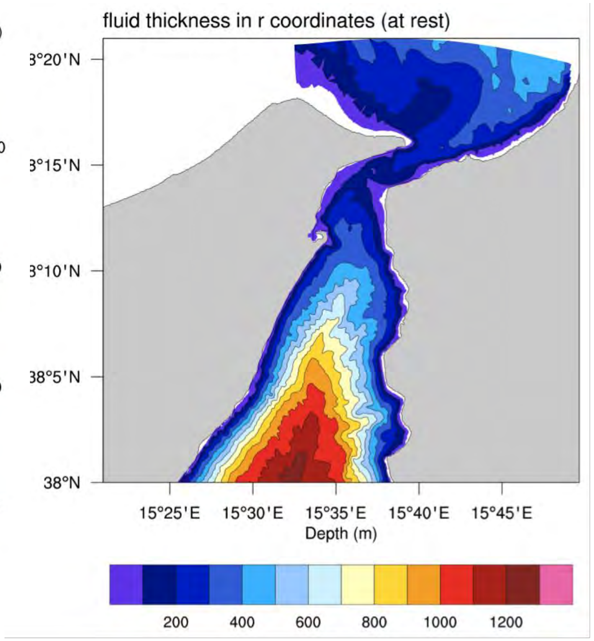

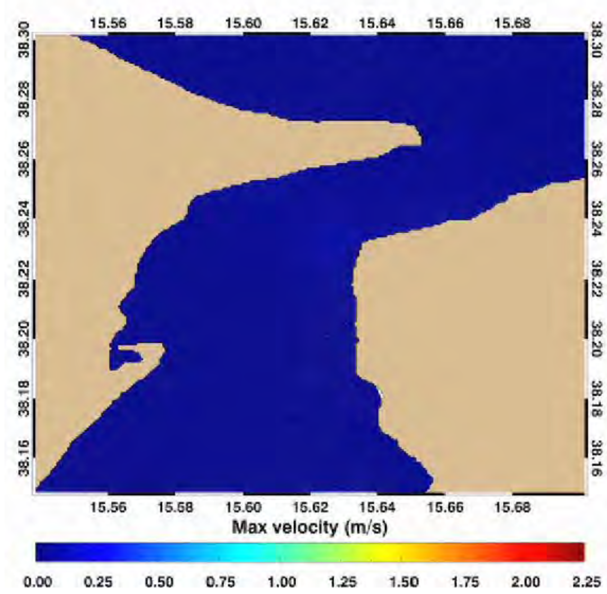

Tidal energy assessment for the Strait of Messina

Messina tidal model

ADAG Aircraft Design & AeroFlightDynamics Group

DIPARTIMENTO DI INGEGNERIA INDUSTRIALE
SEZIONE INGEGNERIA AEROSPAZIALE

UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

Tabella 22. Produzioni fattorie – sistema GEM

<u>*GEM*</u>										
Località riferimento	Lat.	Lon.	Vmax (m/s)	Area impianto (km^2)	Densità (unità/km^2)	Numero unità	Potenza max unità (kW)	Potenza installata (kW)	Energia annua (MWh)	Ore equivalenti (h)
Punta Pezzo	38°14'00"N	15°38'00"E	2.95	0.5538	36	19	1001.1	19021.47	46240.5	2431.0
Località riferimento	Lat.	Lon.	Vmax (m/s)	Area impianto (km^2)	Densità (unità/km^2)	Numero unità	Potenza max unità (kW)	Potenza installata (kW)	Energia annua (MWh)	Ore equivalenti (h)
Adiacenze NW di T. Cavallo	38°15'00"N	15°40'40"E	1.60	1.1068	36	39	1001.1	39044.1	17959.4	460.0
Spiaggia tra Ganzirri e Torre Faro	38°15'24"N	15°37'54"E	2.17	0.8004	36	28	1001.1	28031.6	26144.6	932.7
Adiacenze di S. Agata	38°14'54"N	15°36'24"E	1.83	1.1819	36	42	1001.1	42047.5	28394.3	675.3
Adiacenze di Pace	38°14'09"N	15°35'12"E	1.61	2.0578	36	74	1001.1	74083.6	26420.6	356.6
								Etot=	145159.5	MWh
						eta_wake=	0.712	Etot_wake=	103353.6	MWh

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ENEA

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MINISTERO DELL'AMBIENTE
E DELLA TUTELA DEL TERRITORIO E DEL MARE

OpERATE

Ocean Energy
Resources Assessment
for Maldives

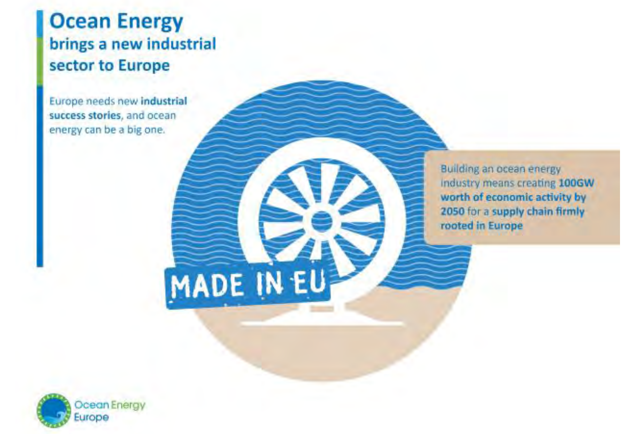
ENEA

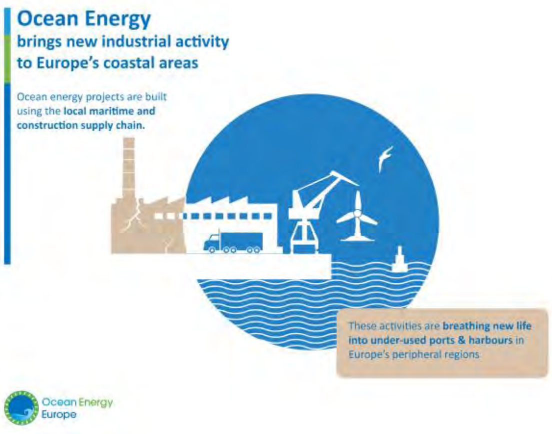
Gianmaria Sannino

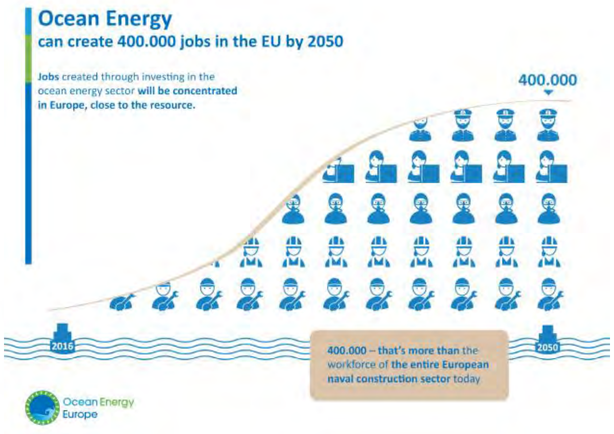
gianmaria.sannino@enea.it

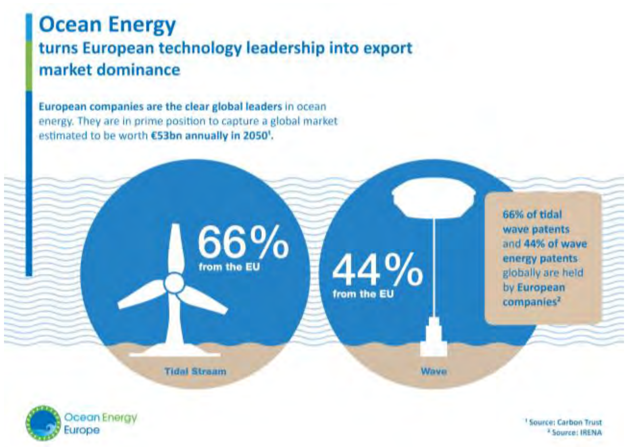
Additional Slides

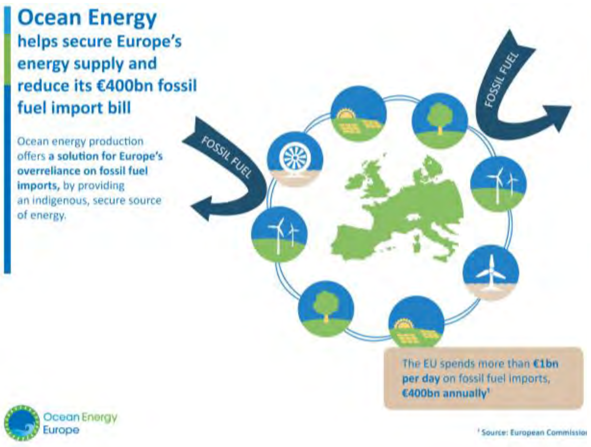
10 Reasons why we need ocean energy

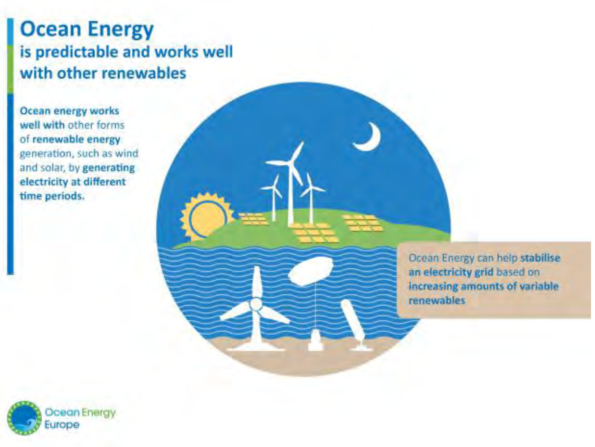




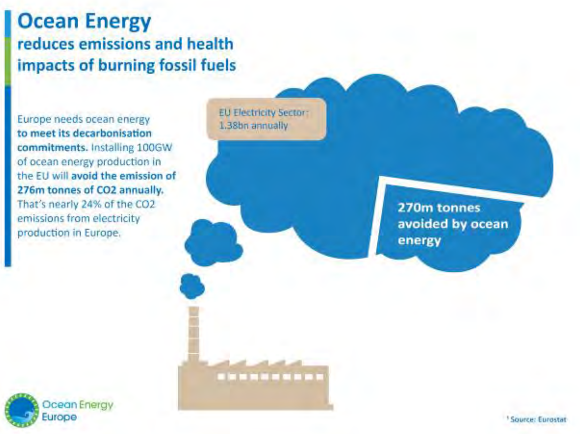


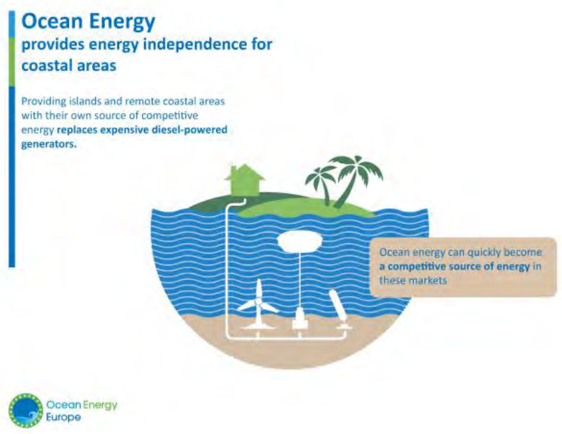


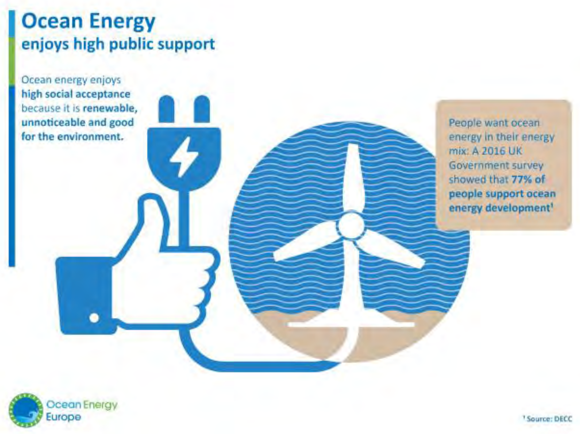


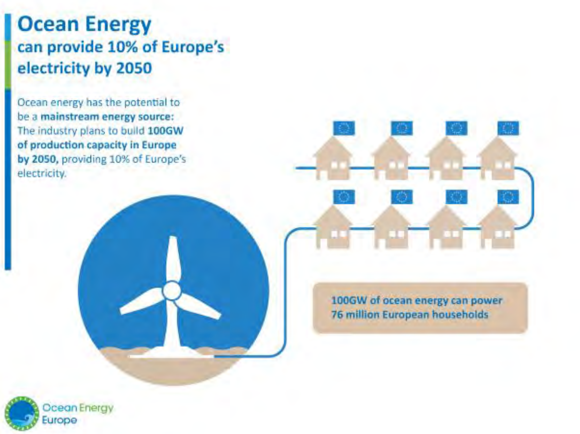


10 Reasons why we need ocean energy

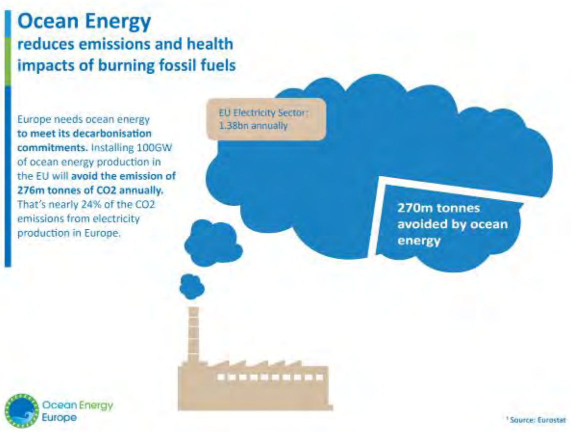


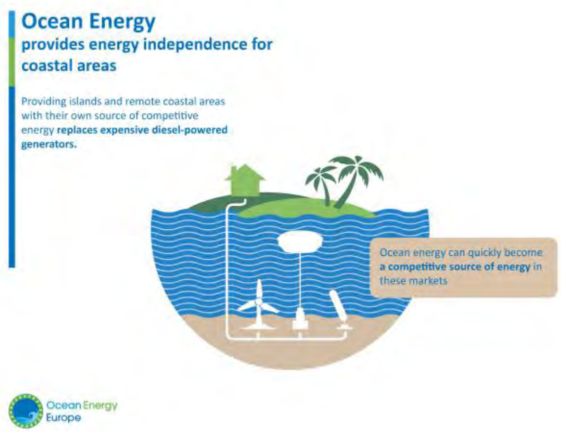


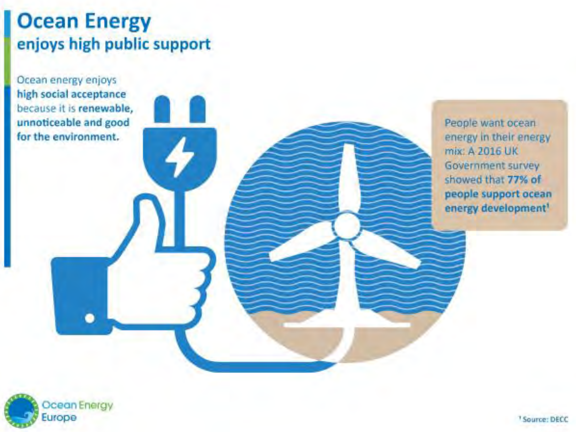


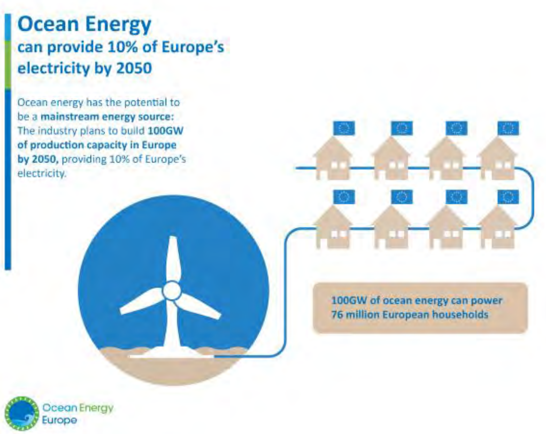


10 Reasons why we need ocean energy

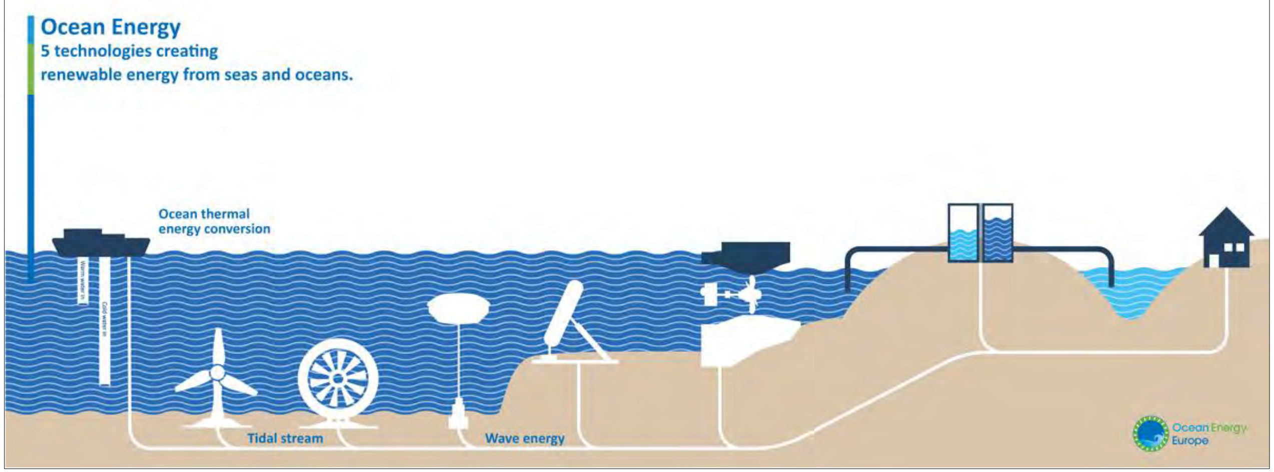








** Technology convergence needed **

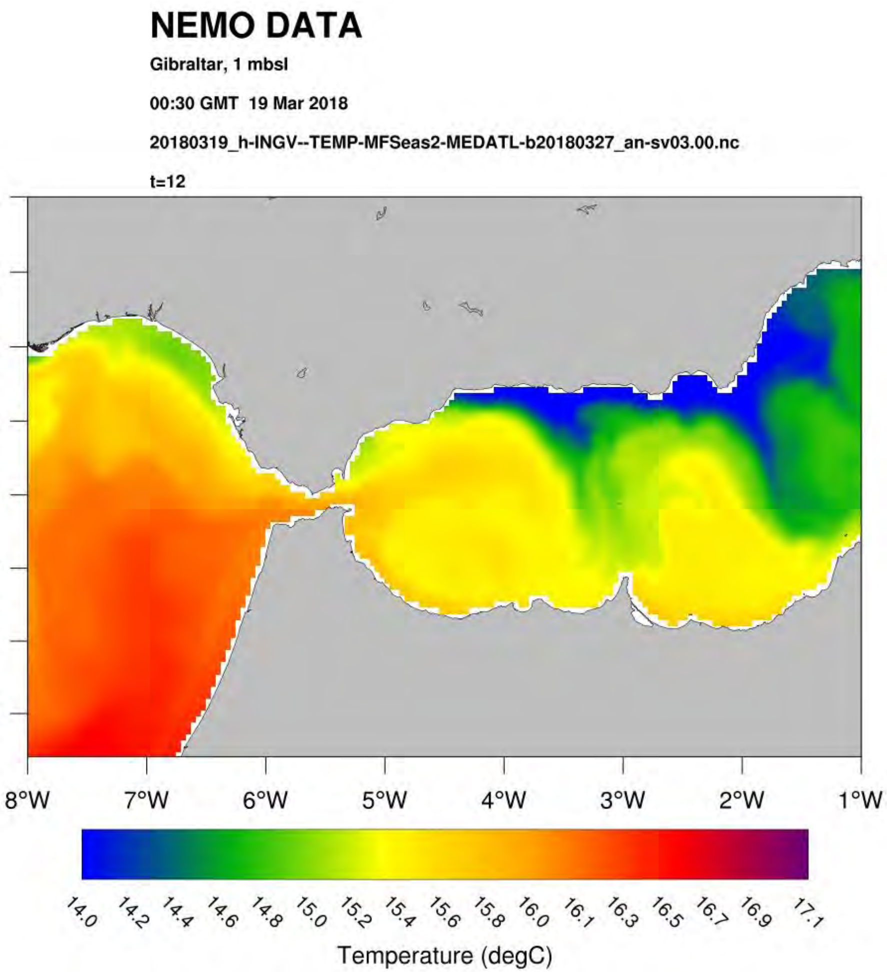


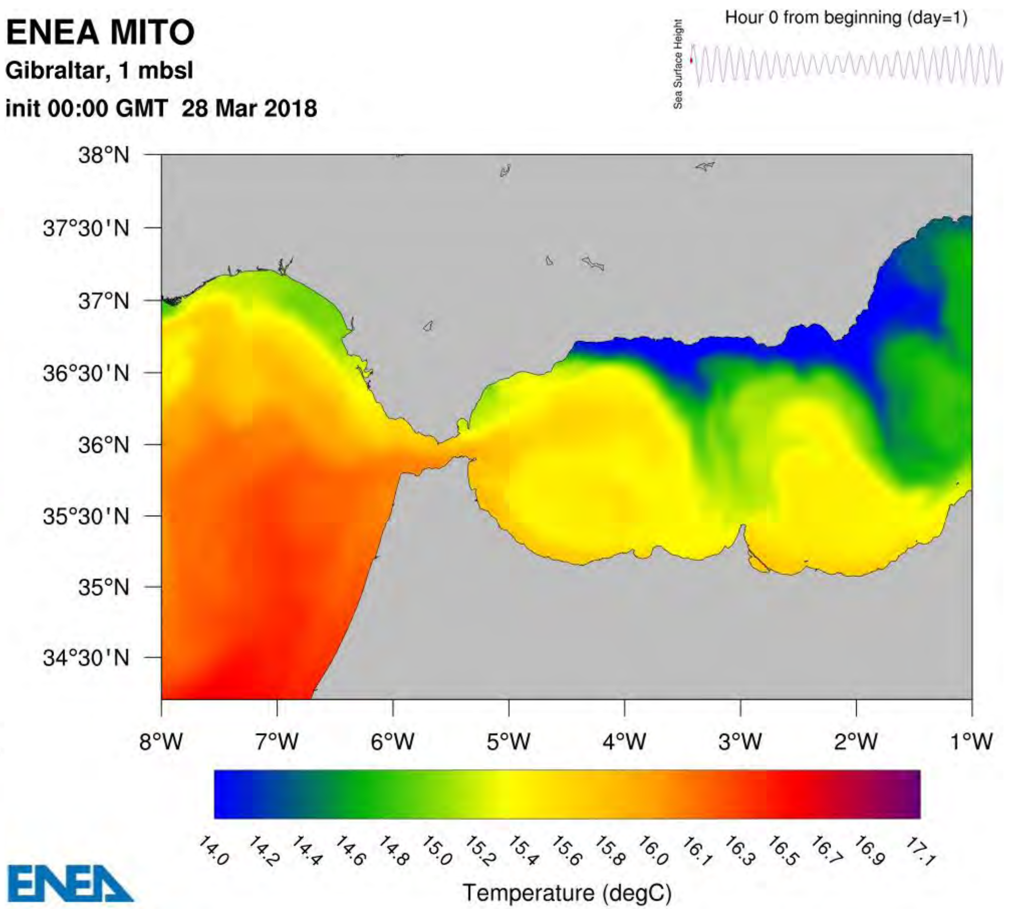
EU SET-Plan Recommendation

The Plan recommends to concentrate efforts on a **limited number of promising technologies** for energy conversion from tidal streams and waves, targeting a reduction in the LCoE for tidal stream energy converters to at least **15 ct€/kWh by 2025** and **10 ct€/kWh by 2030**, and a similar, although slower, reduction in the LCoE for wave energy converters to **20 ct€/kWh by 2025**, 15 ct€/kWh by 2030 and **10 ct€/kWh by 2035**.

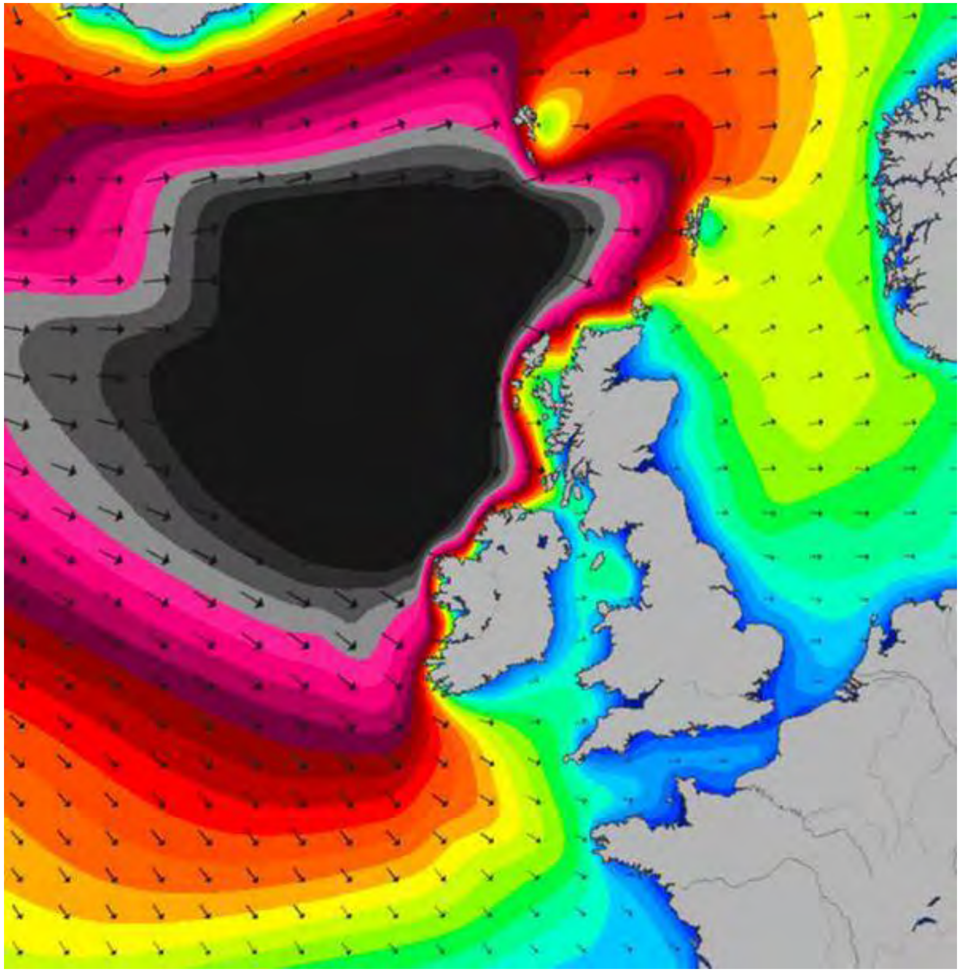
EUROPEAN COMMISSION

Wave energy assessment for the Mediterranean





Wave energy in the North Sea



Storms
December 2013 – February 2014

Wave energy in the North Sea: waves from the shore

Wave energy in the North Sea: waves from the shore

Effect of wave energy in the North Sea


Porthcothan Bay: Before

After: 6 January 2014
SWNS

Pom Pom rock: 29 December 2013

After: 6 January 2014

Recent H2020 Project

Downscaling climate impacts and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond

SOCLIMPACT

SOCLIMPACT

SoClimPact project has received funding from the European Union´s Horizon 2020 Research and Innovation Programme under Grant Agreement No 77661

Downscaling climate impacts and decarbonisation pathways in EU islands, and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond.

The project aims at modelling and assessing downscaled CC impacts and low carbon transition pathways in European islands and archipelagos for 2030 - 2100, complementing current available projections for Europe, and nourishing actual economic models with non-market assessment.

Specific objectives

1
Develop a thorough understanding on how Climate Change will impact the EU islands located in different regions of the world, considering their specific vulnerability, thus improving the existing climate impact models for Europe by:

2
Contribute to the improvement of the economic valuation of climate impacts and related policies for Europe, by adapting Discrete Choice Experiments (DCE) methods to measure and analyse, on one hand, the non-market costs of different Climate Change scenarios, and on the other hand, the benefits of climate actions (mitigation and adaptation).

3
Increase the effectiveness of the economic modelling of climate impact chains, through the implementation of an integrated methodological framework (GINFORS, GEM-E3 and non-market indicators), in the analysis of climate-induced socioeconomic impacts in 11 EU islands case studies, under different climate scenarios for 2030-2100, with a cross-sectorial perspective (EU Blue Economy sectors), providing a step further to the results of the PESETA project .

4
Facilitate climate-related policy decision making for Blue Growth, by ranking and mapping the more appropriate and viable mitigation and adaptation pathways and risk management strategies, and building a common framework for the governance of Blue Economy sectors and a permanent regional information exchange system (REIS) for Europe and EU islands.

5
Deliver, through innovative decision-making support tools, downscaled and accurate information to policy makers, practitioners and other relevant stakeholders, about the environmental and socio-economic consequences of global Climate Change in the EU Blue Economy, and formulate science-based recommendations to incentivise the EU islands´medium to long-term low-carbon transition, thus strengthening science-policy interface, increase social awareness, and contribute to the competitiveness of the European coastal and maritime industry.

Work Plan

WP1
Ethics.

WP 2
Project coordination and management.

WP 3
Climate Change vulnerability assessment framework and complex impact chains.

WP 4
Modelling climate impacts in 11 EU islands´case studies.

WP 5
Measuring non-market costs of CC and benefits of climate actions for Europe.

WP 6
Modelling socio-economic impacts for EU islands in Blue Economy sectors, over the longer term 2030 -2100.

WP 7
Ranking and mapping transition pathways in islands and enabling networking and information system for regional and EU policy design.

WP 8
Communication and Dissemination. Raising social awareness and supporting decision making processes of policymakers and practitioners.

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