EMODnet Marine data for the offshore renewable energy sector in the Mediterranean Sea and Black Sea

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Mapping Environmental Impact of Offshore Energies

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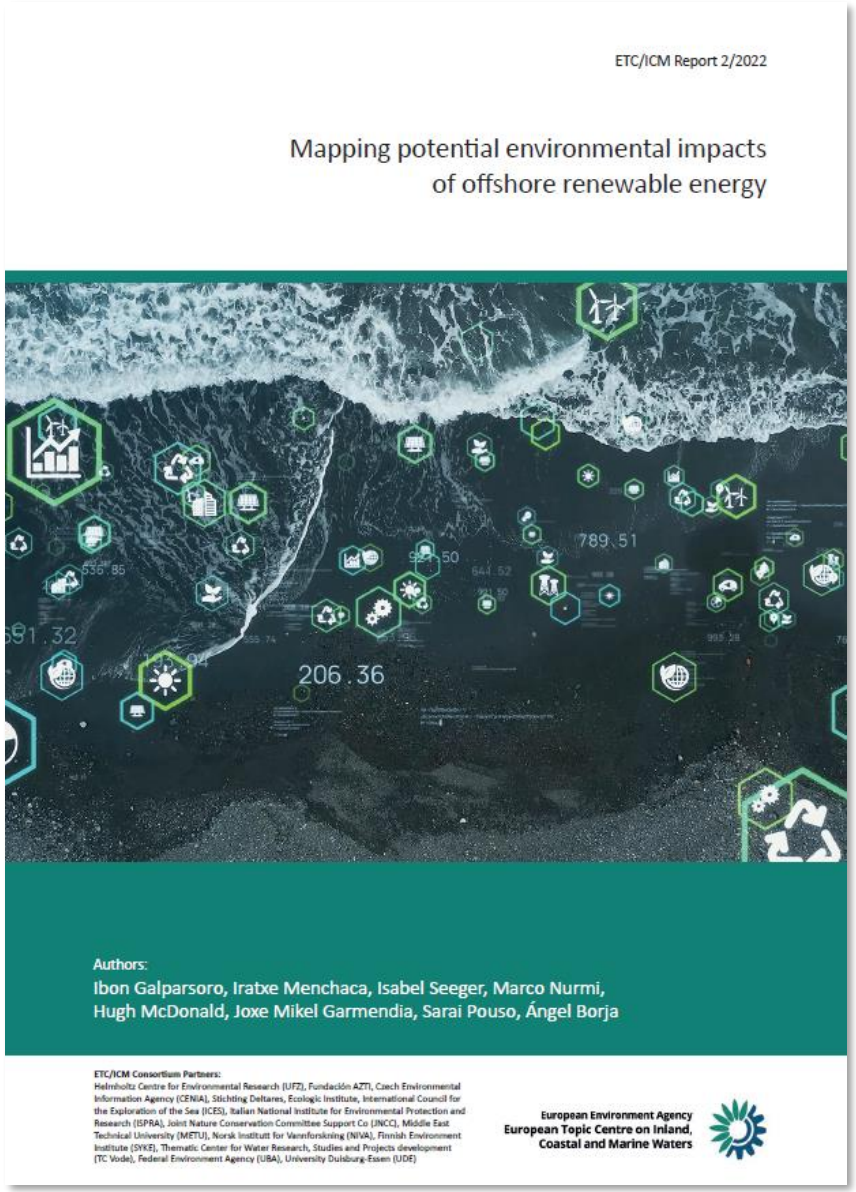
#MarineData4OffshoreEnergy



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https://www.eionet.europa.eu/etcs/etc-icm/products/etc-icm-reports/etc-icm-report-2-2022-mapping-potential-environmental-impacts-of-offshore-renewable-energy

European Environment Agency
European Topic Centre on Inland, Coastal and Marine Waters

Nº OCP/EEA/NSS/18/002-ETC/ICM

Mapping potential environmental impacts of offshore renewable energy

The main driver for this work is to **support** Member States and the EU in fulfilling 2050 **vision of the offshore renewable energy strategy** whilst ensuring that the expansion of offshore energy does **not imperil achievement of the Biodiversity Strategy or Marine Strategy Framework Directive**

It **contributes** to the offshore renewable energy strategy by overcoming one of the **non-technological barriers** that could hinder the objectives of the strategy, namely the **environmental risk** over the marine environment that offshore renewables may entail– notably offshore wind, but also tidal and ocean energy

Contents

Section I. Identification of main ecological risks → Literature review → Evidence of interactions between devices and ecosystem elements → Most relevant **pressures**

Evidence of interactions between devices and ecosystem elements → Most **sensitive** ecosystem **elements**

Section II. Production of maps → Maps of the current development of projects → Maps of the distribution of the most sensitive ecosystem components → **Risk maps**

Section III. Renewable energies in MSP context → Policy review → **Renewable** sector consideration in **plans**

Policy review → **Conflicts**

Offshore wind farms

Bibliographic search result: 2703
Reviewed documents: 159

Pressure type	Ecosystem element	Effect type	Impact magnitude	Spatial extent	Phase	Reference
Electromagnetic field	Fish	Behaviour	Low	Around the cable	Operational	Hutchison et al. (2020)
	Invertebrates	Behaviour	Low	Around the cable	Operational	Sigray and Westerberg (2008)
New habitat /Artificial reef effect	Benthic habitats	Habitat heterogeneity	Moderate	Inside the wind farm	Operational	Mavraki et al. (2020)
	Invertebrates	Mortality/alteration through sediment removal	High	Inside the wind farm	Construction	Dannheim et al., 2019
		Colonisation by non-indigenous species	Moderate	From shipping, ballast water, translocated equipment	Operational	Degraer et al. (2020); Dannheim et al. (2019a)
		Increased hard-substrate fauna (increasing moderate organic enrichment, severe reductions in sediment oxygenation)	Moderate	Inside the wind farm	Operational	Dannheim et al. (2019b)
		Altered food availability	High	Inside the wind farm	Operational	Dannheim et al. (2019b)
	Fish	Aggregation	Moderate	Inside the wind farm	Operational	Stenberg et al., 2015; Raoux et al. (2017)
Barrier effect	Birds	Injury / mortality	Low-High (?)	Local	Operational	Brabant et al. (2015); Fox and Petersen (2019)
		Behaviour (displacement)	High	<1-3-16 km	Operational	Mendel et al. (2019)
	Wind	Radius of deformation	Moderate (?)	5-20 km	Operational	van Berkel et al. (2020)
	Hydrodynamic	Alteration seawater's vertical density stratification	Moderate?	Inside the wind farm	Operational	Floeter et al. (2017)
		Changes of the sedimentary characteristics	High	100-200 m	Operational	Coates et al. (2014)
Mechanical sea floor disturbance	Invertebrates	Soft sediment macrobenthic biomass/abundance/species richness	Moderate	15-50 m	Operational	Coates et al. (2014)
	Phytoplankton	Primary production reduction (turbidity/suspended matter increased and light penetration reduction)	High	10 km	Operational	Vanhellemont and Ruddick (2014)

Offshore current and tidal farms

Bibliographic search result: 241
Reviewed documents: 101

Pressure	Pressure	Ecosystem element	Effect type (Positive/negative)	Impact magnitude	Spatial extent of the effect	Proxy for spatial extent of the effect	Reference
Physical disturbance	Presence of tidal farm	Ecosystem structure, functions and processes	Negative	High	>100 km	Effects on the surrounding area	Van Der Molen et al. (2016)
				Low	0 km	Farm extension	Robins et al. (2014)
					3 km	Effects in the surrounding area	Auguste et al. (2020)
					15 km	-	(Guillou and Thiébot, 2016)
				Moderate	10 km	Effects on the surrounding area	Robins et al. (2014)
					7 km	Effects in the surrounding area	Auguste et al. (2020)
				None	0 km	Farm extension	Auguste et al. (2020)
			Positive	High	>100 km	Effects on the surrounding area	Van Der Molen et al. (2016)
				Low	0 km	Farm extension	Van Der Molen et al. (2016)
		Fish	Negative	Very low	0 km	Farm extension	Copping et al. (2015)
		Mammals	Negative	High	0 km	Farm extension	Copping et al. (2015)
				Low	0 km	Farm extension	Sparling et al. (2018)
		Marine birds	Negative	Moderate	0 km	Farm extension	Copping et al. (2015)
		Seabed (benthic)	Negative	High	-	Farm extension	du Feu et al. (2019)
			Positive	Low	-	Farm extension	du Feu et al. (2019)

Offshore wave energy farms

Bibliographic search result: 364
Reviewed documents: 184

Type of pressure	Pressure	Pressure	Ecosystem element	Effect type	Impact magnitude	Spatial extent of the effect	Spatial proxy for calculation	Reference
Energy	Substances, litter and energy	Electromagnetic fields	Fish	Negative	Low-Moderate	-	-	Frid et al. (2012)
					Moderate	-	-	Frid et al. (2012)
			Invertebrates	Negative	None	-	-	Frid et al. (2012)
			Mammals	Negative	Very low	-	-	Copping et al. (2015)
			Marine birds	Negative	Very low	-	-	Copping et al. (2015)
			Reptiles	Negative	High	-	-	Frid et al. (2012)
					Low	-	-	Copping et al. (2015)
HydroChange	Physical	Presence of wave farm	Ecosystem structure, functions and processes	Negative	High	<5 km	Hydrodynamic effect in the surrounding area	Carballo and Iglesias (2013)
					Low	>20 km	Wave farm extension	Millar et al. (2007)
						26 km	Changes in hydrodynamic conditions in the surrounding area	Palha et al. (2010)
					Moderate	6 km	Sealed area by foundations	Iglesias and Carballo (2014)
						-	-	Frid et al. (2012)
				Positive	High	6 km	Sealed area by foundations	Iglesias and Carballo (2014)
					Moderate	10 km	-	Diaconu and Rusu (2013)
						-	-	Frid et al. (2012)

Floating photovoltaic farms

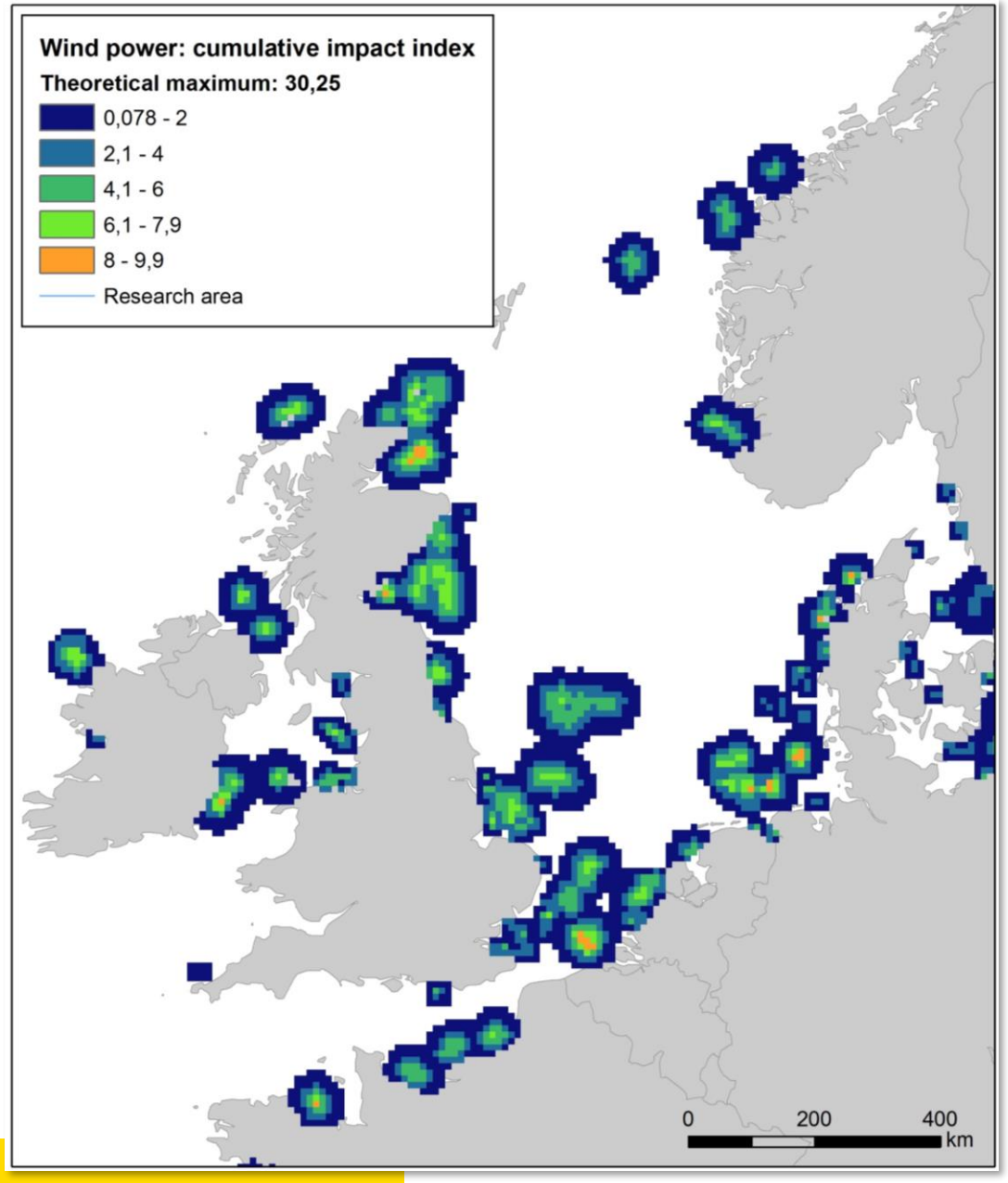
Bibliographic search result: 196
Reviewed documents: 93

Platform-induced light deficit (blocking sunlight penetration),
with net primary production decreasing than 10 % (for 20% coverage of the model surface with platforms)

Ocean thermal energy conversion

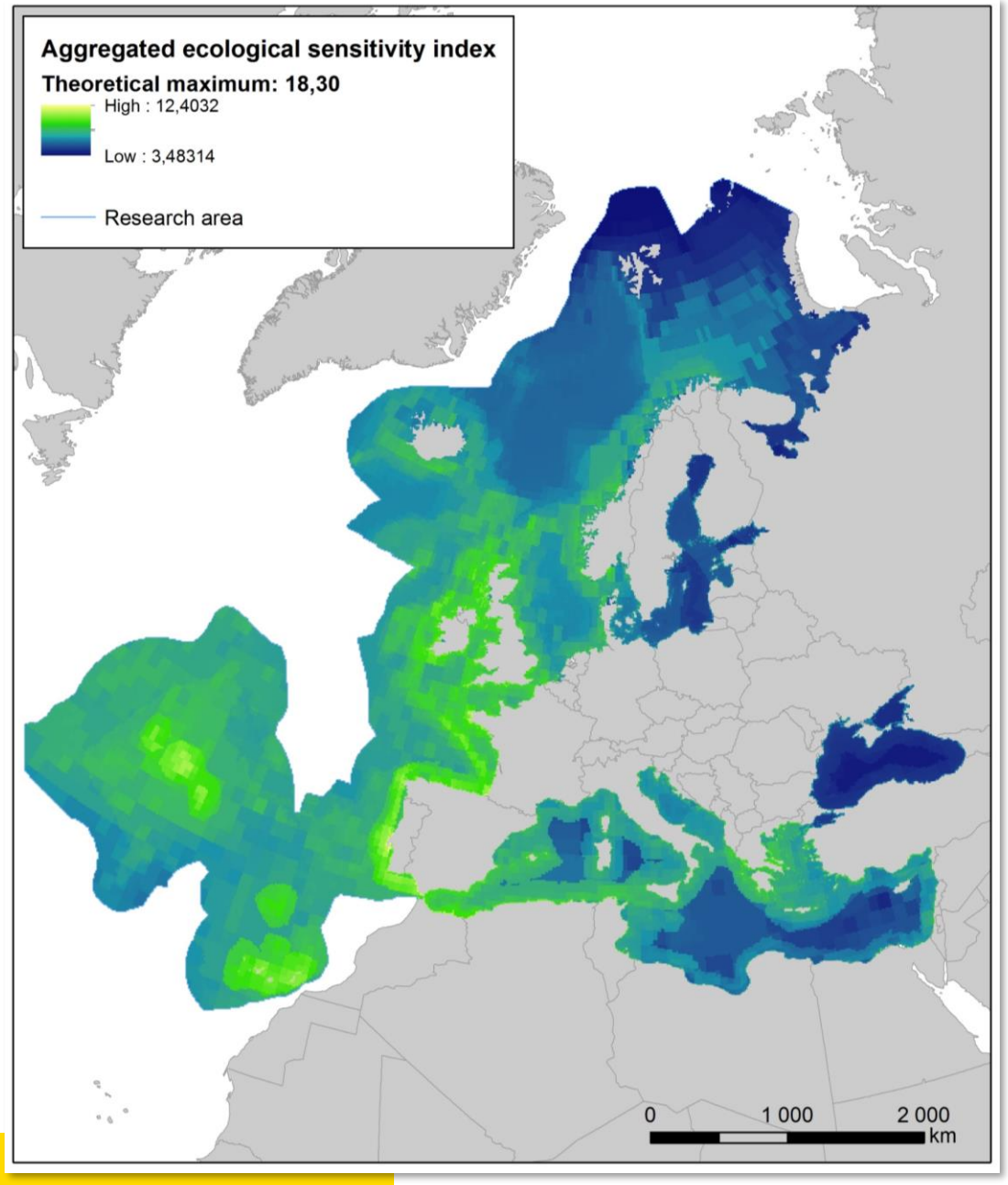
Bibliographic search result: 139
Reviewed documents: 68

Type of pressure	Pressure (theme)	Ecosystem element	Effect type (Positive/negative)	Impact magnitude	Spatial extent of the effect	Proxy for the spatial extent of the effect	Reference
Water	Substances, litter and energy	Ecosystem structure, functions and processes	Negative	High	<1 km^2	Effects on the surrounding area	Giraud et al. (2019a)
				Medium	8 km^2	Effects on the surrounding area	Wang et al. (2016)
				Medium	<1 km^2	Effects on the surrounding area	Giraud et al. (2019a)
			Positive	Medium	8 km^2	Effects on the surrounding area	Wang et al. (2016)
			Unknown	Medium	8 km^2	Effects on the surrounding area	Wang et al. (2016)



Environmental risk maps

- Includes effects from farms in or soon-to-be-in construction phase.
- Farm construction can affect bird and mammal behaviour up to 16 and 50 km from the farms, respectively.
- Main cumulative impact occurs at the site of the farm.
- Operational offshore wind farms can affect primary production reduction and fish behaviour up to 10 and 15 km respectively.



Ecological sensitivity to pressures

The aggregated ecological sensitivity map indicates that the coastal waters around Portugal, Spain, the British Isles, the Azores archipelago, Madeira and the Canary Islands have high concentrations of ecosystem components sensitive to the stressors.

Limitations:

- The large **spatial scale** (raster cell size of 10*10 km) of the cumulative impact maps includes inherent limitations. **Impacts are site-specific** and should be considered at a local level.
- **Impacts** should be considered at the **species level** (ecosystem components for animals were grouped into mammals, turtles, birds, invertebrates, and fish). Most information for **northern species**.
- The analysis does not consider the **potential benefits** that offshore renewable energy installations might have on some ecosystem components
- The indices are **not meant to be the definitive answer** to where ecosystems are most affected by offshore renewable energy installations.

Utility:

- The **potential cumulative impact maps** can be used to identify areas where stressors from offshore energy installations and ecosystem components that are affected by said stressors overlap
- Support for decision-making, further research, and advancing the methodology for producing cumulative impact maps.

MSP plan analysis

MSP plans have multiple objectives

- Achieve climate and energy objectives, focus on offshore wind
- Protect and improve the marine environment, but no binding measures

All MSP plans explicitly acknowledge the need to balance trade-offs between offshore renewable energy and environmental protection

Conclusions (based on a limited review of 4 plans)

- MSP is useful for balancing climate/environmental objectives as a process

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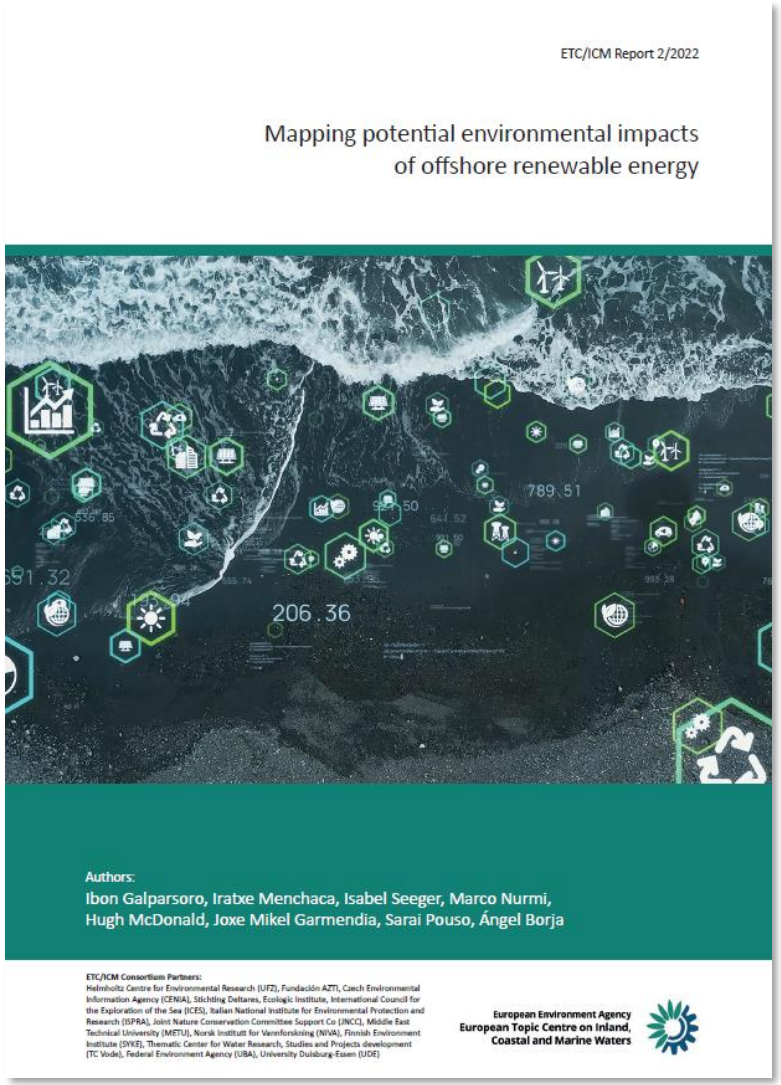

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