HNS-MS stakeholders meeting

Session 4
Environmental and socioeconomic impacts of HNS pollution

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Co-funded by the European Commission, DG-ECHO

Environmental and socioeconomic impacts of HNS pollution

- Objectives of the task
- Part 1 : methodology
- Part 2 : Regional sensitivity maps atlas for the Bonn Agreement Area
- Part 3 : Towards operational sensitivity maps atlas

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Objectives of the task

- **The development of a methodology to elaborate sensitivity maps adapted to HNS spills**

  Under the form of GIS layers providing geographical information on the HNS-sensitive environmental and socioeconomic features

  - Maps at the Bonn Agreement area regional scale
  - Maps at operational scale : a demonstrator for Belgium and a French department coastline

- **To include these maps in the operational decision-support tool for HNS spills**

Environmental and socioeconomic impacts of HNS pollution

Part 1 : methodology to elaborate sensitivity maps

- Existing methodologies and data for oil spill
  - French Polmar methodology
  - Be-Aware project methodology
- HNS MS project methodology for HNS

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Existing methodologies and data

One of the priority in case of marine pollution incident :

To identify the risk posed to the public, the environment and socioeconomic assets upon which coastal communities depend

Since the eighties, National Oil Spill Response Contingency Plans started to include sensitivity maps atlas, a key element for the planning of oil spill response :

- to identify protection priorities,
- to help defining response strategy and techniques
- To allow a first impact assessment and guidance for further monitoring
- To minimize adverse effects of response operations

Objective:

- To gather information on sensitive resources, scattered in various reports and academic studies (administration, universities, NGOs,..)
- To analyse and organise data in maps readily available and usable for authorities and responders

Existing methodologies and data

Example of French polmar methodology to elaborate sensitivity maps in case of oil pollution:

- **3 fields/ separate maps :**
  - Physical (intertidal shoreline type, geomorphology)
  - Statutory protections of ecological resources , heritage sites, natural inventories (Natura 2000…)
  - Economical (sea-based or connected activities and resources : industry, fishing, fish farming, tourism, leisure);

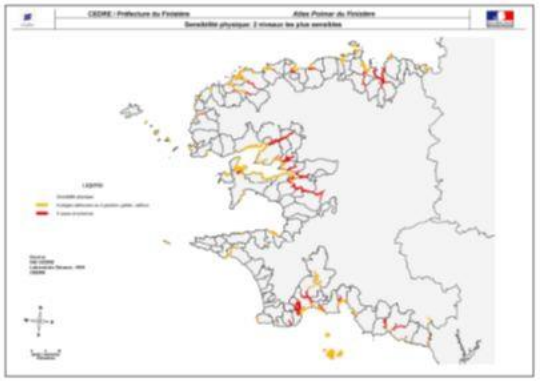
- **Mapping at 2 levels / scales**
  - Decision: synthetic global overview for decision makers (scale: 1/500,000 or 1/250,000)
  - Operational map: detailed local maps for operators and environmental advisers (at scale from 1/10,000 to 1/25,000)

*NOAA : National Oceanographic and Atmospheric Administration

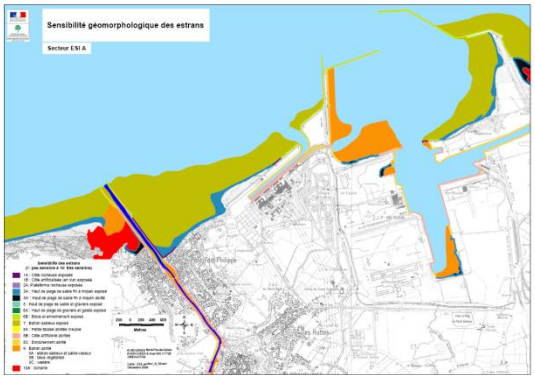
Existing methodologies and data

Example of french polmar methodology :

- **Two type of maps :**
  - Informative maps : location and extension of sensitive ressources
  - Sensititvity maps : rank scores applied to each resources
- **Ranking**
  - Shoreline sensitivity depend on substrate, exposure, persistence, close to initial NOAA Environmental Sensitivity index (ESI) in USA)
  - Ecological sensitivity : sum of protections and inventories
  - Socio-economic : sum of activities by commune (length of interruption of the activities is considered)



Decision map : selection of the most sensitive areas



Operational map: shoreline geomorphology and habitats sensitivity : 10 levels of sensitivity (ESI)

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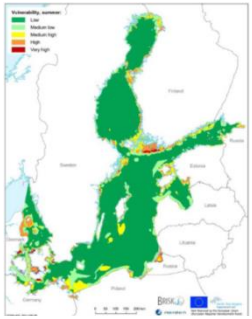
Existing methodologies and data

At the regional scale of Bonn-Agreement area, an important work had been done within Be–Aware projects

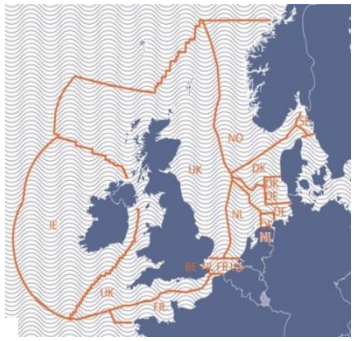
Initiated by The Bonn Agreement Secretariat and contracting parties, with funding from the European Union (DG ECHO) Ireland and Germany

In the frame of the BE- Aware I and II projects (2013 - 2015) an "**Environmental and Socioeconomic Sensitivity Methodology to oil spill"** was developed, adapted from a previous project implemented for the Baltic sea (Brisk, 2012)

- **Characteristics:**
  - 4 fields : Habitats, Species, Protected areas, Socio-economy
  - Subtidal zone is considered (shoreline habitats to deep seafloor ones, water column)
  - Introduction of seasonality (4 seasons considered)
  - Sensitivity is evaluated in case oil is on surface or dispersed in the water column
  - combined sensitivity index (habitats, species, protection, socio-economy)



Vulnerability map (summer) in the Baltic sea (Brisk project)



Bonn-Agreement area

Be-aware vulnerability map of habitats to oil in surface in spring

Existing methodologies and data

Be-Aware methodology :

- **Step 1 : identification of ecological and socioeconomic features** to be mapped and ranked according to their sensibility to oil spill (from bibliography, previous spill case experiences, expert advise) and validated by contracting parties;

- **Step 2** : **collection of numerical data** in existing data bases and GIS, by project partners countries, BA Secretariat and Cowi consulting firm, to prepare Arcgis maps of the location and extent of ecological and socio economic features;
  - some features had to be dropped out due to lack of homogeneity of data provided by the different countries

- **At the end of the process : 26 habitats, 12 species features , 4 types of protected areas, 15 socio-economic features were selected**

Existing methodologies and data

Be-Aware methodology :

26 habitats, 12 species features, 4 types of protected areas, 15 socio-economic features

Shoreline and Coastal habitats
Exposed rocky shores and reefs < 20m
Exposed rocky shores and reefs > 20m
Sheltered rocky shores and reefs < 20m
Sheltered rocky shores and reefs > 20m
Littoral chalk communities
Sandy beaches
Shingle beaches
Tidal sand and mud flats
Salt marshes
Maerl beds
Eelgrass beds (Zostera sp. > 5%)
Estuaries
Coastal lagoons (open to the sea)
Large shallow inlets and bays

Species Features
Breeding areas for birds (incl. foraging areas)
Wintering areas for birds
Staging areas for birds
Spawning areas for fish: during SPRING
Spawning areas for fish: during SUMMER
Spawning areas for fish: during AUTUMN
Spawning areas for fish: during WINTER
· Norwegian spring spawning stock
· Buchan/Shetland herring
· Banks herring and the West of Scotland autumn spawning herring
· Irish autumn/winter spawning herring
· Down herring

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Existing methodologies and data

Be-Aware methodology :

26 habitats, 12 species features , 4 protected areas, 15 socio-economic features

SOCIO –ECONOMIC FEATURES	
Fisheries	***Ports, marinas cruise liner stops***
Offshore fisheries	Ports
Aquaculture	Marinas
Fish farms	cruise liner stops
Shellfish cultures	***Other***
Algae cultures	Heritage sites
Coastal tourism	Densely populated towns and communities
Overnight stays coastal tourist hotels	Mineral extraction sites
Amenity beaches	Offshore wind farms
Main recreational fishing locations	Water intakes

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Existing methodologies and data

Be-Aware methodology :

- **Step 3 : assessment of the vulnerability to surface and dispersed oil** for each of the four seasons (based on scientific literature review of scientific papers and report, of Brisk project, with a validation by the contracting parties experts during a workshop).

Scores
Score 4 = very high vulnerability
Score 3 = high vulnerability
Score 2 = moderate/medium vulnerability
Score 1 = Low vulnerability
Score 0 = Not affected

Seasons
Winter = December; January, February
Spring =March, April, May
Summer = June, July, august
Fall = September, October, November

Ranking matrices

	Floating oil /Surface				Dispersed oil / water column			
	Spring	Sum	Fall	Winter	Spring	Sum	Fall	Winter
HABITATS								
Shoreline and Coastal habitats								
Exposed rocky shores and reefs on < 2 0m	3	3	2	2	3	3	2	2
Exposed rocky shores and reefs > 20m	1	1	1	1	2	2	2	2
Sheltered rocky shores and reefs <2 0m	4	4	3	3	4	4	4	4
Sheltered rocky shores and reefs > 20m	2	2	2	2	4	4	4	4
Littoral chalk communities	4	4	3	3	4	4	3	3
Sandy beaches	2	2	1	1	2	2	1	1
Shingle beaches	3	3	3	3	3	3	3	3
Tidal sand and mud flats	4	4	4	4	4	4	4	4
Salt marshes	4	4	4	4	4	4	4	4
Underwater sandbanks <2 0m depth	3	3	2	2	3	3	3	3
Underwater sandbanks > 20m depth	1	1	1	1	2	2	2	2
Biogenic reefs < 20m depth	4	4	4	4	4	4	4	4
Biogenic reefs > 20m depth	2	2	2	2	4	4	4	4
Maerl beds	4	4	3	3	4	4	4	4
Seagrass beds (zostera sp coverage > 5%)	4	4	4	4	4	4	4	4
Estuaries	4	4	4	4	4	4	4	4
Coastal lagoons (open to the sea)	4	4	4	4	4	4	4	4
Large shallow inlets and bays	3	3	3	3	3	3	3	3

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Existing methodologies and data

Be-Aware methodology :

- **Step 4 : vulnerability mapping**
  At the level of each cell of the map
  Scores are summarised for habitats, species, protected areas and socio-economy that corresponds to vulnerability classes on the vulnerability maps

Vulnerability classes	Habitats (sum of scores)	Species (sum of scores)	Protected areas	Socio-economy
4	6-8	13-18	16	12-24
3	4-5	9-12	12	9-11
2	3	7-8	8	6-8
1	2	4-6	4	3-5
0	1	1-3	-	1-2

Existing methodologies and data

Be-Aware methodology :

- **Step 5 : "total vulnerability" mapping**
  Integrating the four series of seasonal vulnerability maps using a weighting ratio (3 options)

Weighting ratios			
Habitats	Species	Protected areas	Socio-economy
25	25	25	25
35	25	30	10
15	15	20	50
50	10	15	25

Attribute table of the GIS BA regional database (437 964 lines corresponding to each cell of the map)

Table

R_surface_flora_fauna_summ_region

FID	Shape *	ID	i	j	CellType	CellSubtyp	HydroID	MetID	SubregionI	Coast1	Coast2	Coast3	Coast4	MI_STYLE	MI_PRINX	TideID	Ex_ro_u20	Ex_ro_u20R	Ex_ro_o20	Ex_ro_o20R	Sh_ro_u20	Sh_ro_u
0	Polygone ZM	1	22	1	-1	0	1	1	1	0	0	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	1	1	0	3	0	1	0	
1	Polygone ZM	2	22	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	2	1	0	3	0	1	0	
2	Polygone ZM	3	22	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	3	1	0	3	0	1	0	
3	Polygone ZM	4	23	1	-1	0	1	1	1	0	0	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	4	1	0	3	0	1	0	
4	Polygone ZM	5	23	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	5	1	0	3	0	1	0	
5	Polygone ZM	6	23	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	6	1	0	3	0	1	0	
6	Polygone ZM	7	23	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	7	1	0	3	0	1	0	
7	Polygone ZM	8	23	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	8	1	0	3	0	1	0	
8	Polygone ZM	9	23	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	9	1	0	3	0	1	0	
9	Polygone ZM	10	23	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	10	1	0	3	0	1	0	
10	Polygone ZM	11	23	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	11	1	0	3	0	1	0	
11	Polygone ZM	12	23	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	12	1	0	3	0	1	0	
12	Polygone ZM	13	23	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	13	1	0	3	0	1	0	
13	Polygone ZM	14	24	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	14	1	0	3	0	1	0	
14	Polygone ZM	15	24	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	15	1	0	3	0	1	0	
15	Polygone ZM	16	24	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	16	1	0	3	0	1	0	
16	Polygone ZM	17	24	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	17	1	0	3	0	1	0	
17	Polygone ZM	18	24	1	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	18	1	0	3	0	1	0	
18	Polygone ZM	19	24	1	-1	0	1	1	1	0											0	
19	Polygone ZM	20	24	1	-1	0	1	1	1	0											0	
20	Polygone ZM	21	24	1	-1	0	1	1	1	0											0	
21	Polygone ZM	22	24	1	-1	0	1	1	1	0											0	
22	Polygone ZM	23	24	1	-1	0	1	1	1	0											0	
23	Polygone ZM	24	25	1	-1	0	1	1	1	0											0	
24	Polygone ZM	25	25	1	-1	0	1	1	1	0											0	
25	Polygone ZM	26	25	1	-1	0	1	1	1	0											0	
26	Polygone ZM	27	25	1	-1	0	1	1	1	0											0	
27	Polygone ZM	28	25	1	-1	0	1	1	1	0											0	
28	Polygone ZM	29	25	1	-1	0	1	1	1	0											0	
29	Polygone ZM	30	25	1	-1	0	1	1	1	0											0	
30	Polygone ZM	31	25	1	-1	0	1	1	1	0											0	
31	Polygone ZM	32	25	1	-1	0	1	1	1	0											0	
32	Polygone ZM	33	25	1	-1	0	1	1	1	0											0	
33	Polygone ZM	34	26	1	-1	0	1	1	1	0											0	
34	Polygone ZM	35	26	1	-1	0	1	1	1	0											0	
35	Polygone ZM	36	26	1	-1	0	1	1	1	0											0	
36	Polygone ZM	37	26	1	-1	0	1	1	1	0											0	
37	Polygone ZM	38	26	1	-1	0	1	1	1	0											0	
38	Polygone ZM	39	26	1	-1	0	1	1	1	0											0	
39	Polygone ZM	40	26	1	-1	0	1	1	1	0											0	
40	Polygone ZM	41	26	1	-1	0	1	1	1	0											0	
41	Polygone ZM	42	26	1	-1	0	1	1	1	0											0	
42	Polygone ZM	43	26	1	-1	0	1	1	1	0											0	
43	Polygone ZM	44	27	1	-1	0	1	1	1	0											0	
44	Polygone ZM	45	27	1	-1	0	1	1	1	0											0	
45	Polygone ZM	46	27	1	-1	0	1	1	1	0											0	
46	Polygone ZM	47	27	1	-1	0	1	1	1	0											0	
47	Polygone ZM	48	22	2	-1	0	1	1	1	0	0	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	48	1	0	3	0	1	0	
48	Polygone ZM	49	22	2	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	49	1	0	3	0	1	0	
49	Polygone ZM	50	22	2	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	50	1	0	3	0	1	0	
50	Polygone ZM	51	22	2	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	51	1	0	3	0	1	0	
51	Polygone ZM	52	22	2	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	52	1	0	3	0	1	0	
52	Polygone ZM	53	22	2	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	53	1	0	3	0	1	0	
53	Polygone ZM	54	22	2	-1	0	1	1	1	0	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	54	1	0	3	0	1	0	
54	Polygone ZM	55	22	2	-1	0	1	1	1	1	1	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	55	1	0	3	0	1	0	
55	Polygone ZM	56	22	2	0	0	1	1	1	0	0	0	0	Pen (1, 2, 0) Brush (2, 16777215, 16777215)	56	1	0	3	0	1	0	

Ex_ro_u20	Ex_ro_u20R	Ex_ro_o20	Ex_ro_o20R	Sh_ro_u20
0	3	0	1	0
0	3	0	1	0
0	3	0	1	0
0	3	0	1	0
0	3	0	1	0
0	3	0	1	0
0	3	0	1	0
0	3	0	1	0
0	3	0	1	0
0	3	0	1	0
0	3	0	1	0

1 (0 sur *26600 sélectionnés)

R_surface_flora_fauna_spring_region | R_surface_flora_fauna_summ_region

Be-Aware methodology :

Vulnerability mapping:

- Habitats : maximum ranking score in a map cell
- Species : sum of ranking scores (fish and birds)
- Protected areas : sum of ranking scores
- Socio-economic : sum of ranking scores of all activities

Examples of calculation in the data base

SpeciesR = BirdsR + FishR

FishR = (Fish_spri * Fish_spriR) + (Fish_sum * Fish_sumR) + (Fish_fall * Fish_fallR) + (Fish_win * Fish_winR) + (No_spr_he * No_spr_heR) + (Buc_her * Buc_herR) + (Scot_her * Scot_herR) + (Ir_her * Ir_herR) + (Down_her * Down_herR)
BirdsR = (Bird_win * Bird_winR) + (Bird_stag * Bird_stagR) + (Bird_bree * Bird_breeR)

SocioecoR = SumR_1_8 + SumR_9_15
SumR_1_8 = (Fisheries * FisheriesR) + (Fishfarms * FishfarmsR) + (Shellfish * ShellfishR) + (Algae * AlgaeR) + (Am_beach * Am_beachR) + (Marinas * MarinasR) + (Tou_stays * Tou_staysR) + (Dens_pop * Dens_popR)
SumR_9_15 = (Rec_fish * Rec_fishR) + (Cruise_li * Cruise_liR) + (Heritage * HeritageR) + (Ports * PortsR) + (Mineral * MineralR) + (Windfarms * WindfarmsR) + (Wa_inlets * Wa_inletsR

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Map : Species/seasons

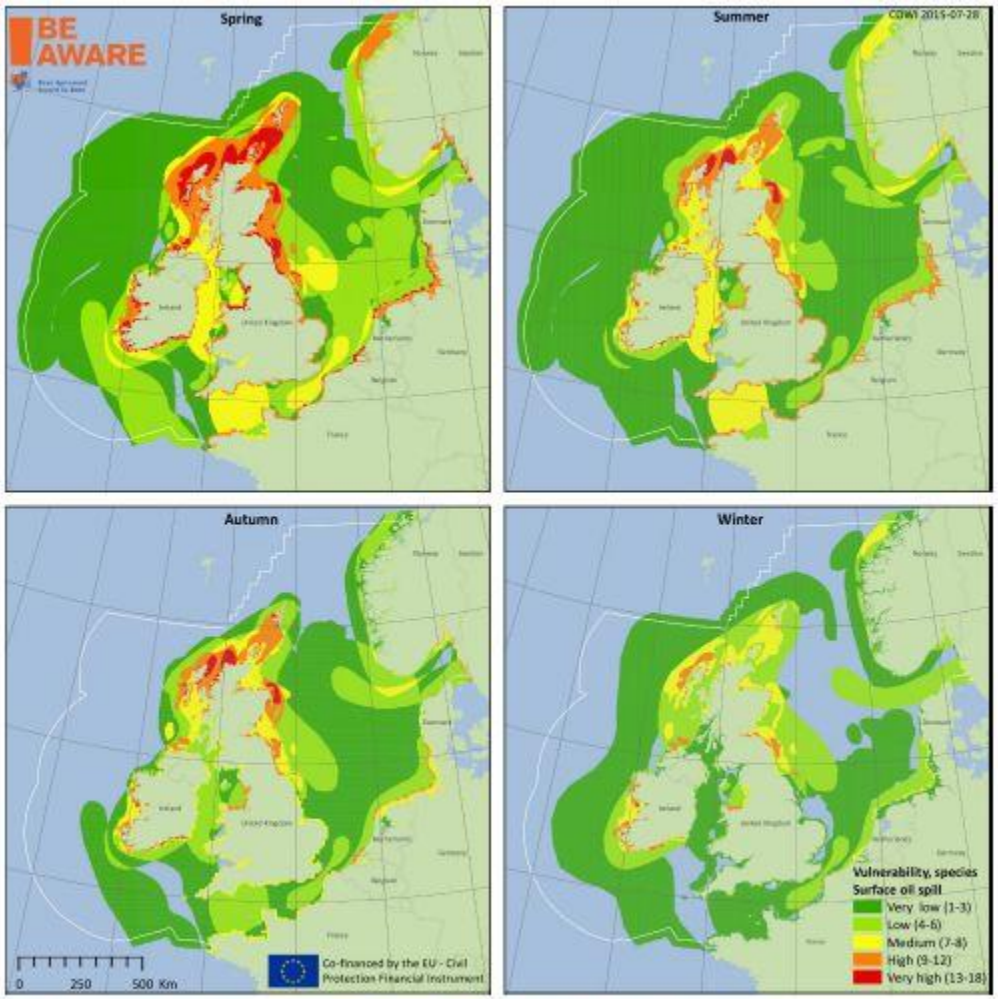


Figure 9-3 Seasonal vulnerability of species to undispersed oil spill.

oil on surface

oil in the water column

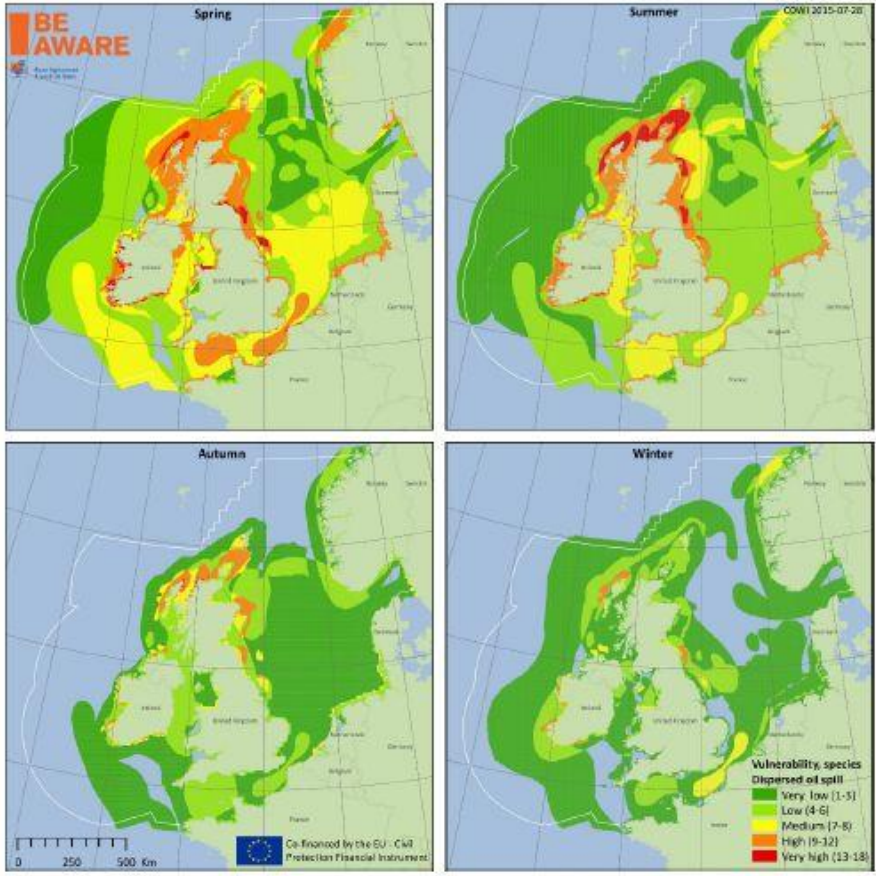


Figure 9-4 Seasonal vulnerability of species to dispersed oil spill.

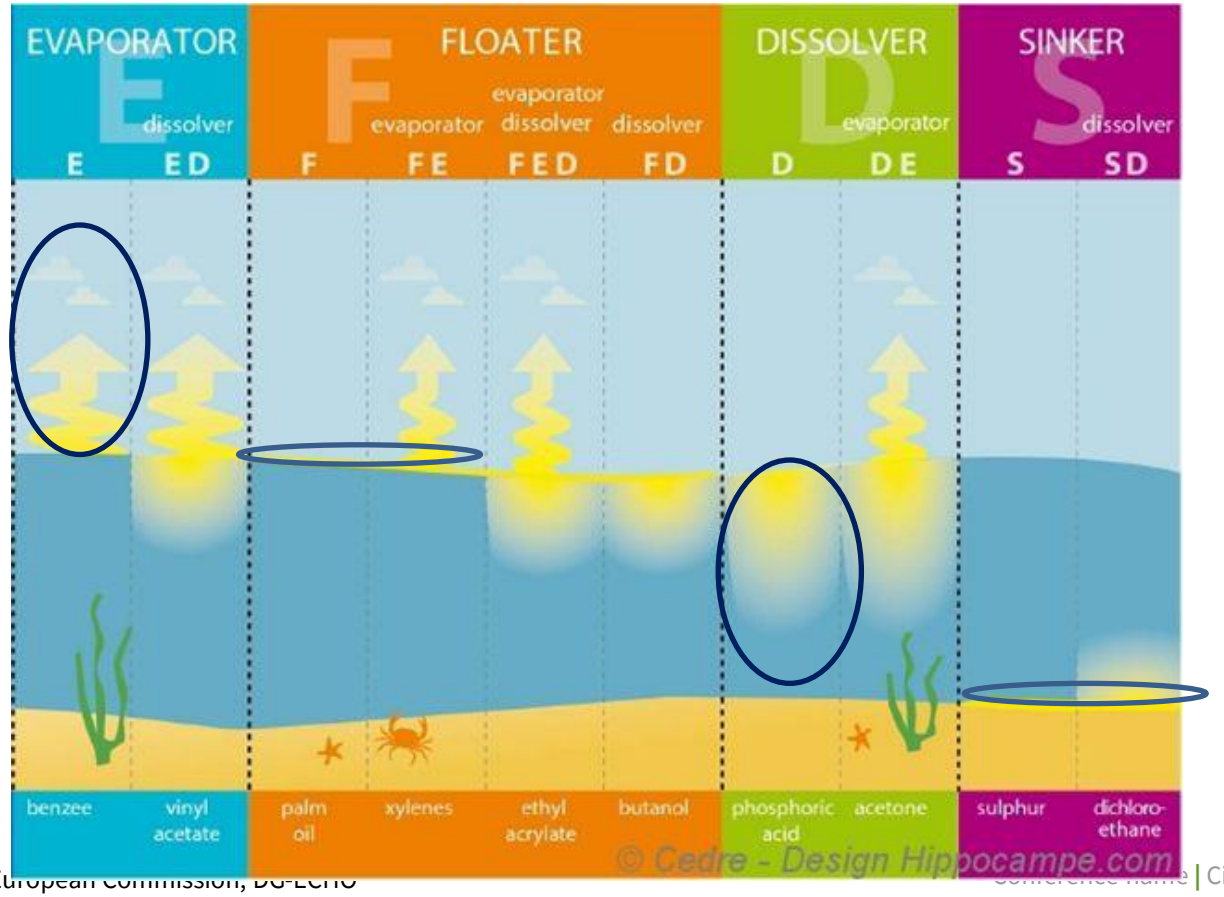
Environmental and socioeconomic impacts of HNS pollution

- **Part 2 :** Regional vulnerability maps atlas for the Bonn Agreement Area for HNS pollution

Adaptation of BA region-wide sensitivity maps to HNS spill scenarios

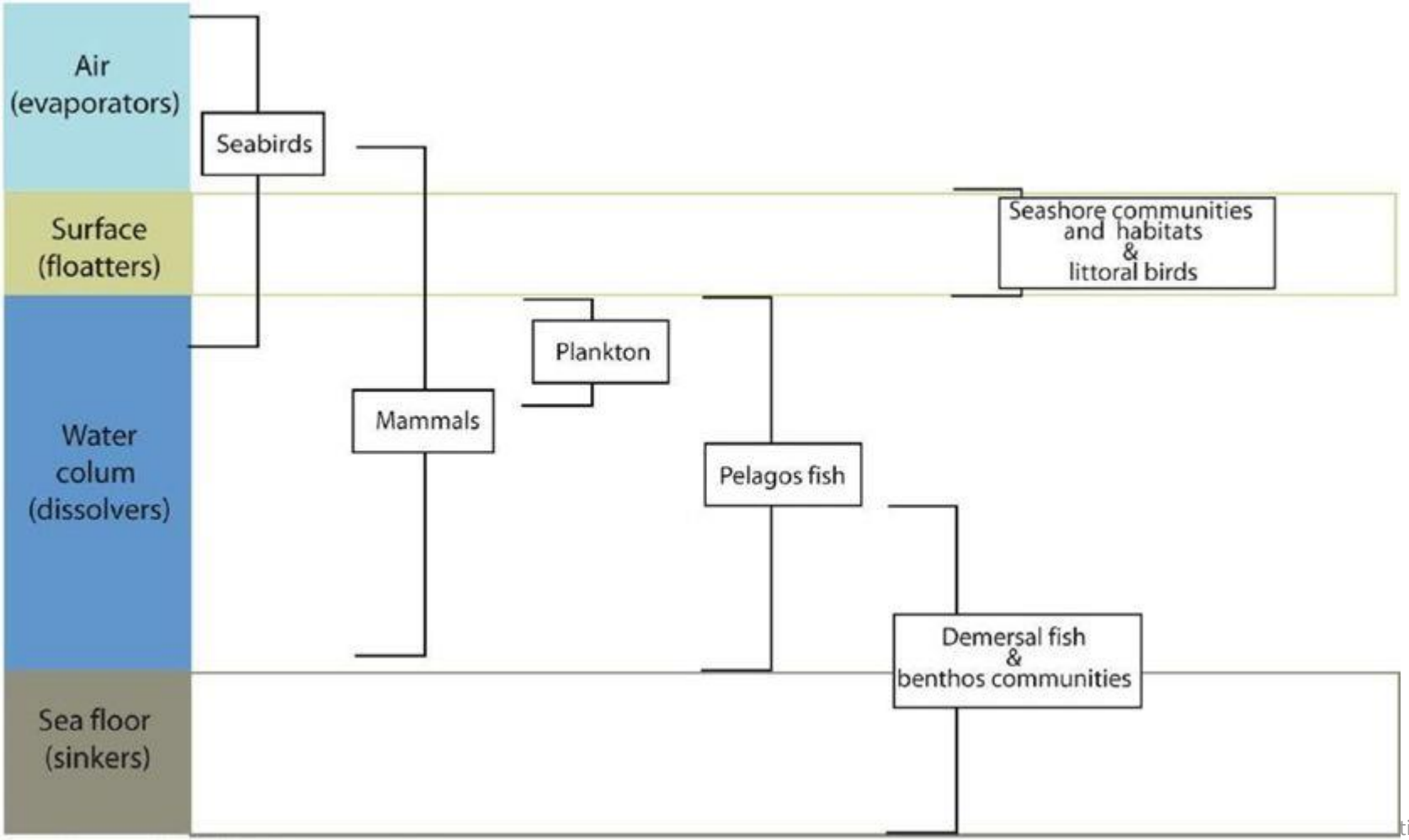
HNS behaviours

SEBC: Standard European Behaviour Classification : 4 main categories for liquids and solids



Adaptation of BA region-wide sensitivity maps to HNS spill scenarios

Marine life compartments potentially affected by chemicals depending on HNS behaviours and sensitivity of organisms



Adaptation of BA region-wide sensitivity maps to HNS spill scenarios

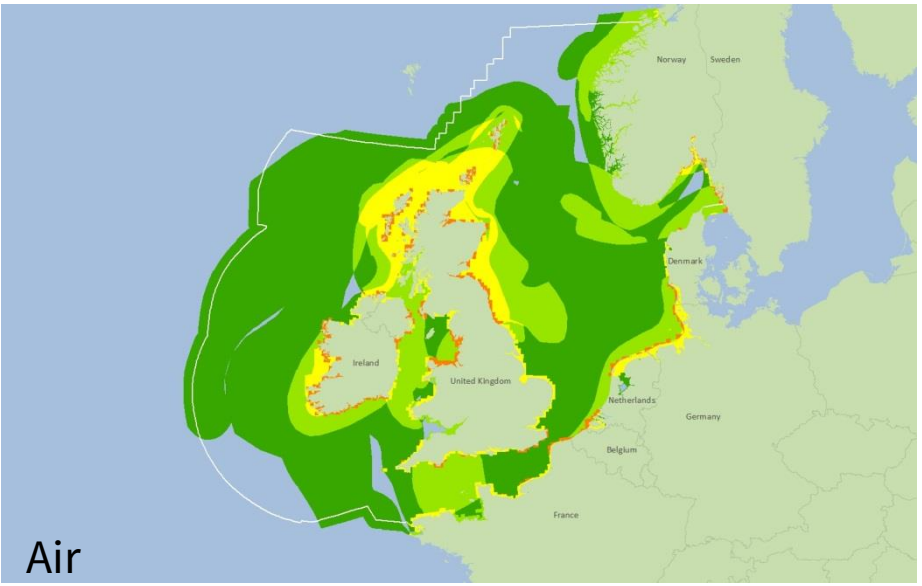
- Same features than those selected and validated by BA Region contracting parties in Be-Aware project
- Resources sensitive to surface oil are likely to be sensitive and likely to be exposed to a floater HNS
- Resources sensitive to dispersed oil are likely to be sensitive and likely to be exposed to a dissolver HNS
  - ➢ **The two matrices elaborated for oil on surface and oil dispersed in the water column were reused without any change**
- A ranking was defined for the same features for evaporator and sinker HNS
  - ➢ **New matrices were elaborated for AIR and Seabed compartments**

Adaptation of BA region-wide sensitivity maps to HNS spill scenarios

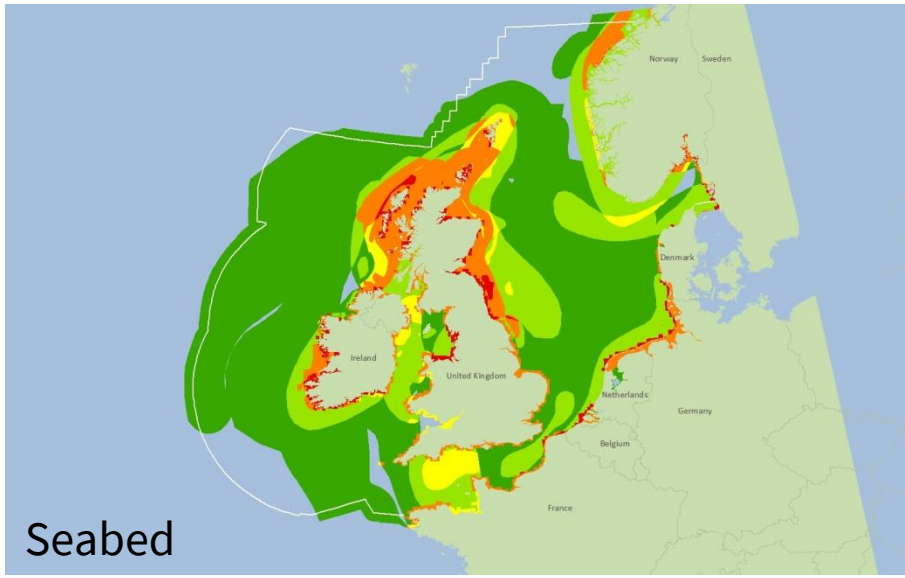
	Sea bed				Air			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
HABITATS BE AWARE ET								
Shoreline and Coastal habitats								
Exposed rocky shores and reefs on less than 20m depth	3	3	2	2	1	1	1	1
Exposed rocky shores and reefs on more than 20m depth	2	2	2	2	0	0	0	0
Sheltered rocky shores and reefs on less than 20m depth	4	4	4	4	1	1	1	1
Sheltered rocky shores and reefs on more than 20m depth	4	4	4	4	0	0	0	0
Littoral chalk communities	4	4	3	3	1	1	1	1
Sandy beaches	2	2	1	1	1	1	1	1
Shingle beaches	3	3	3	3	1	1	1	1
Tidal sand and mud flats	4	4	4	4	1	1	1	1
Salt marshes	4	4	4	4	1	1	1	1
Underwater sandbanks on less than 20m depth	4	4	3	3	1	1	1	1
Underwater sandbanks on more than 20m depth	3	3	3	3	0	0	0	0
Biogenic reefs on less than 20m depth	4	4	4	4	1	1	1	1
Biogenic reefs on more than 20m depth	4	4	4	4	0	0	0	0
Maerl beds	4	4	4	4	1	1	1	1
Eelgrass beds (Zostera sp. > 5%)	4	4	4	4	1	1	1	1
Estuaries	4	4	4	4	1	1	1	1
Coastal lagoons (open to the sea)	4	4	4	4	1	1	1	1
Large shallow inlets and bays	4	4	3	3	1	1	1	1

Species/spring

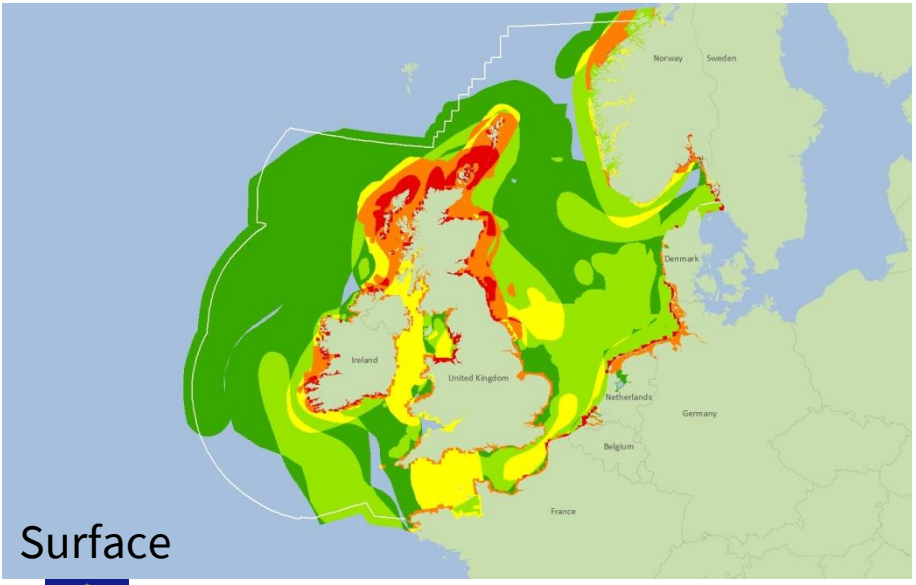
Very low (1-3)
Low (4-6)
Medium (7-8)
High (9-12)
Very high (13-18)



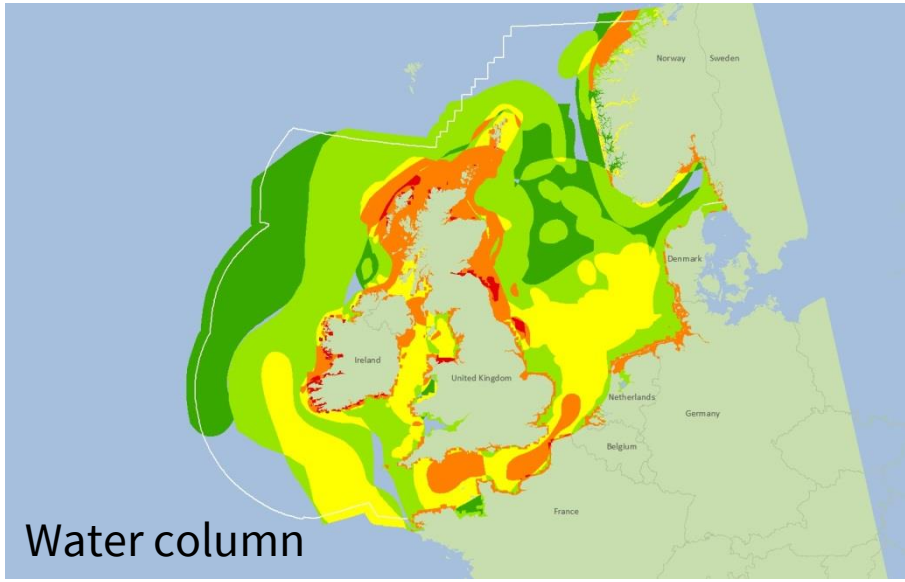
Air



Seabed



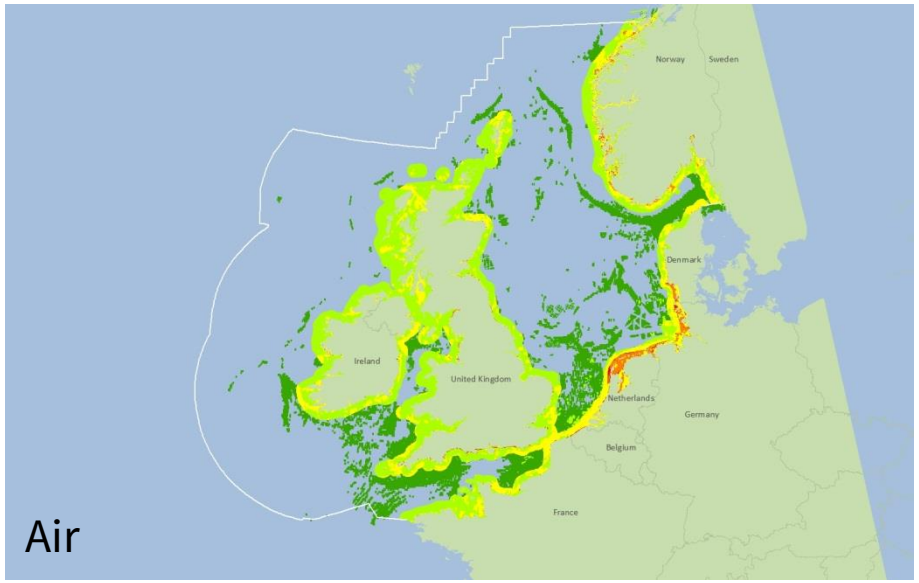
Surface



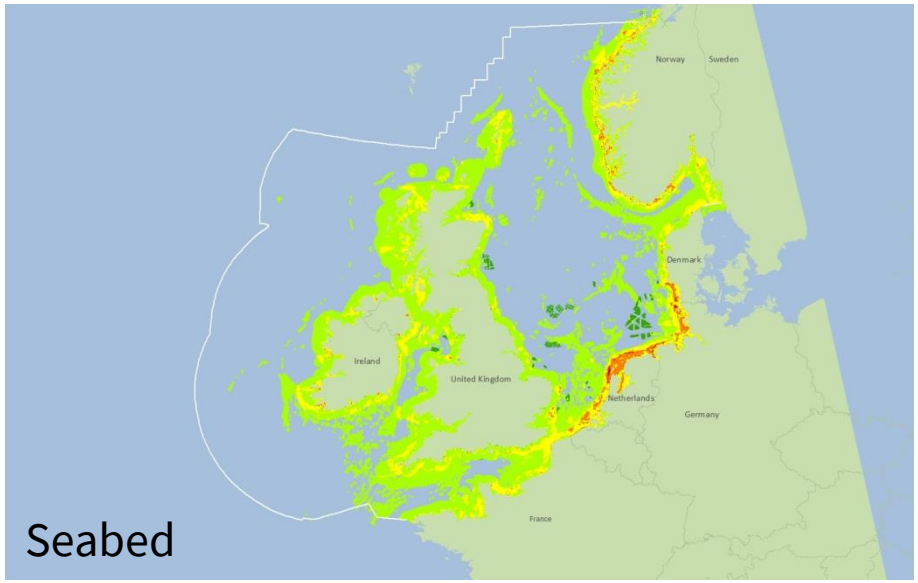
Water column

Co-funded by the European Commission, DG-ECHO

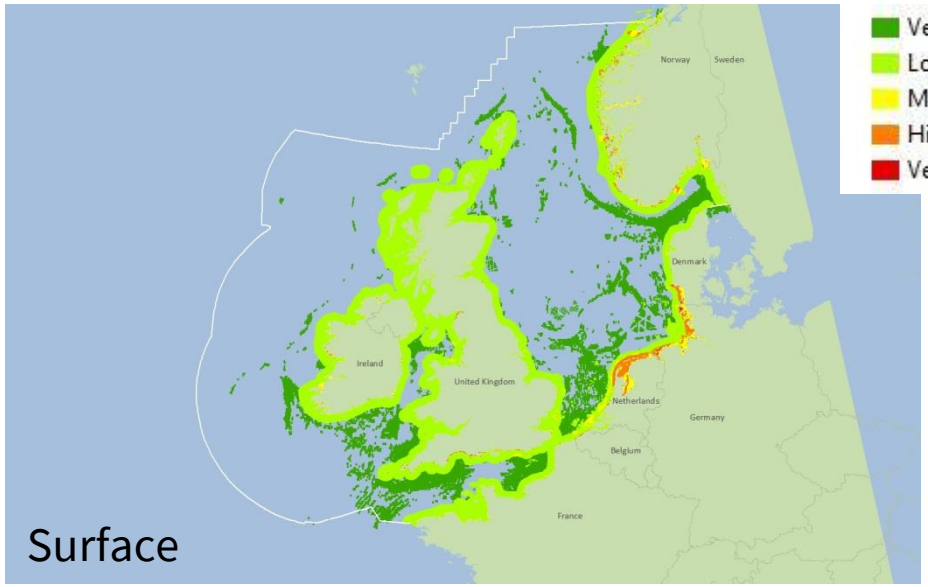
Socio-economy/spring



Air

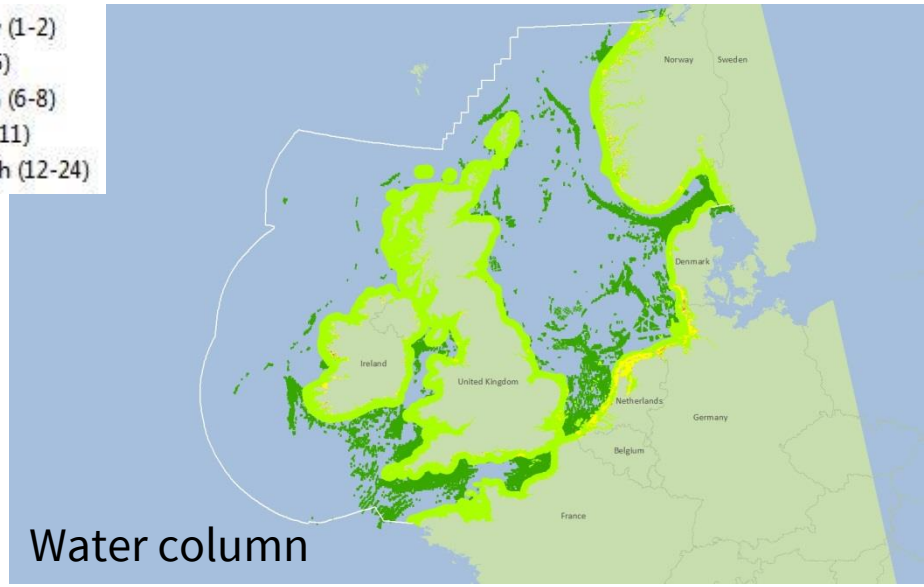


Seabed



Surface

Very low (1-2)
Low (3-5)
Medium (6-8)
High (9-11)
Very high (12-24)



Water column

Co-funded by the European Commission, DG-ECHO

Environmental and socioeconomic impacts of HNS pollution

- **Part 3 :** Towards operational vulnerability maps atlas
  - For Belgium coastline
  - For French department in north of France: Pas –de Calais

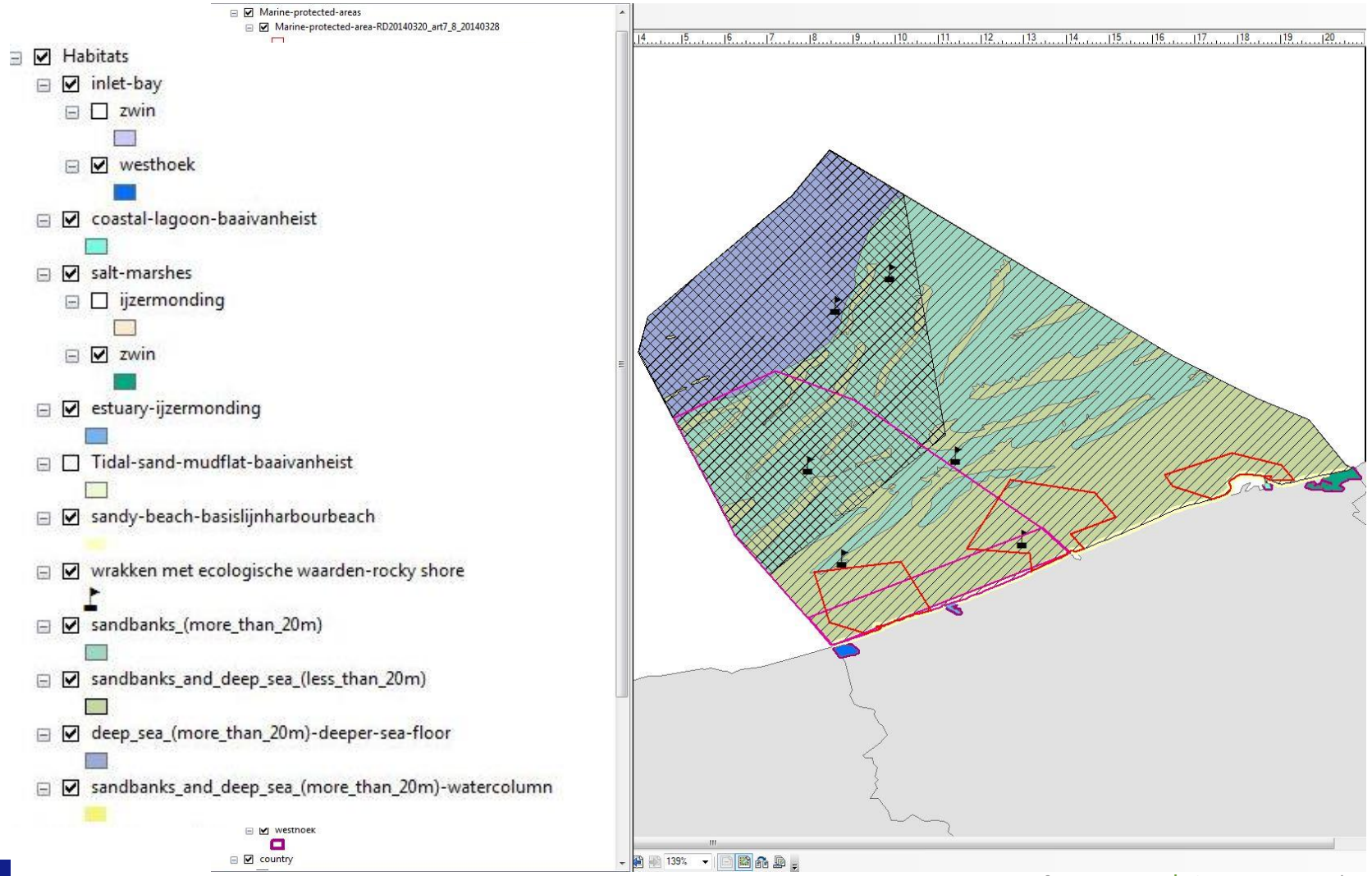
Environmental and socioeconomic impacts of HNS pollution

- operational vulnerability maps atlas for Belgium coastline

Co-funded by the European Commission, DG-ECHO

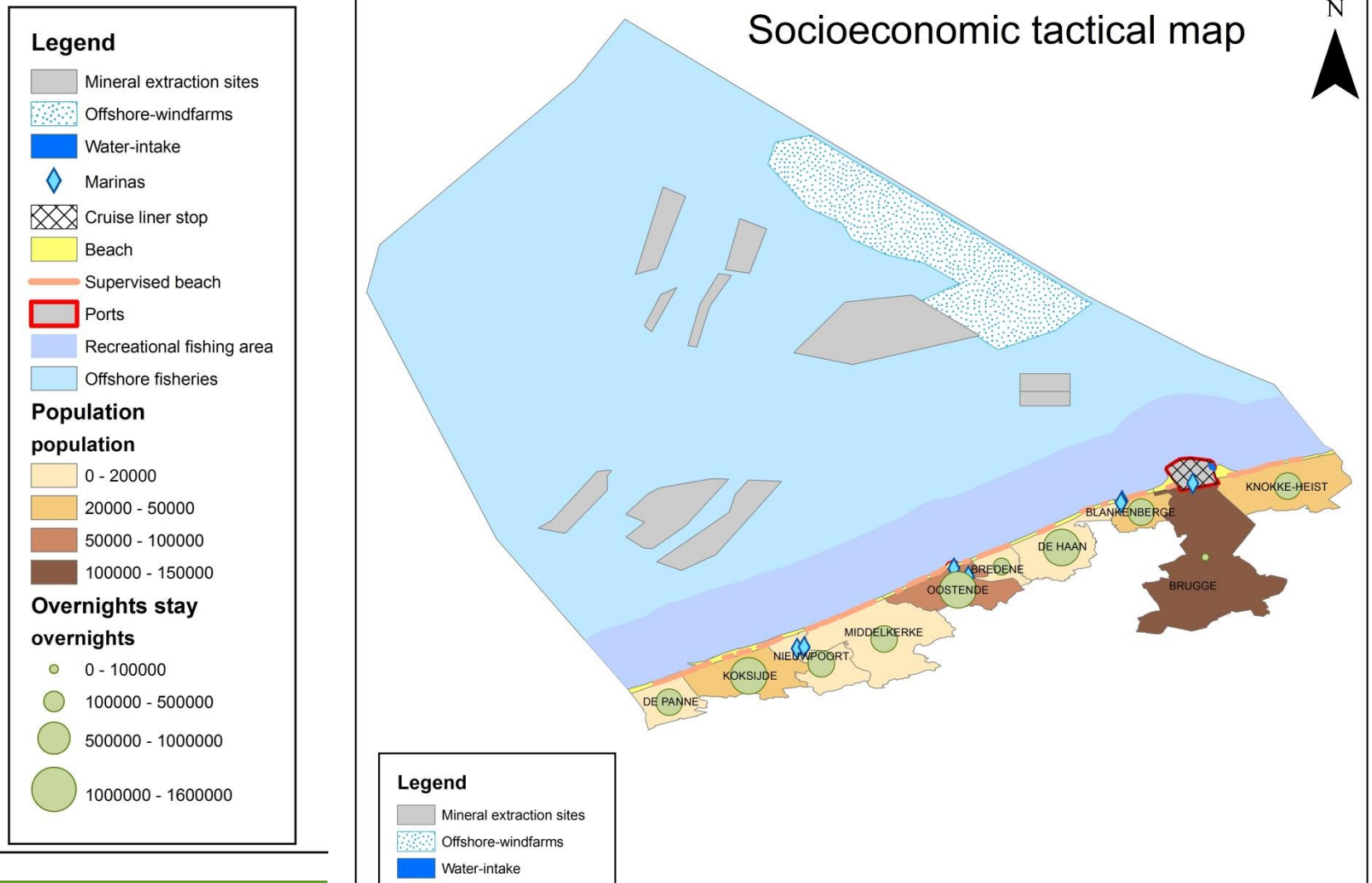
operational vulnerability maps atlas for Belgium coastline

Step 1: identification and location of naturel sensitive habitats and protected areas



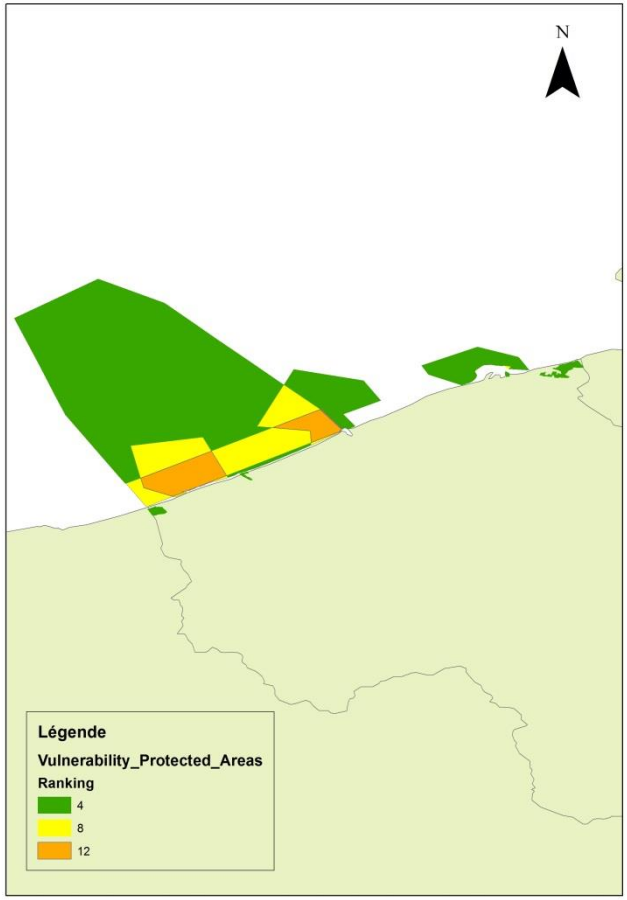
operational vulnerability maps atlas for Belgium coastline

- **Step 1: identification and location of socio-economic sensitive resources**

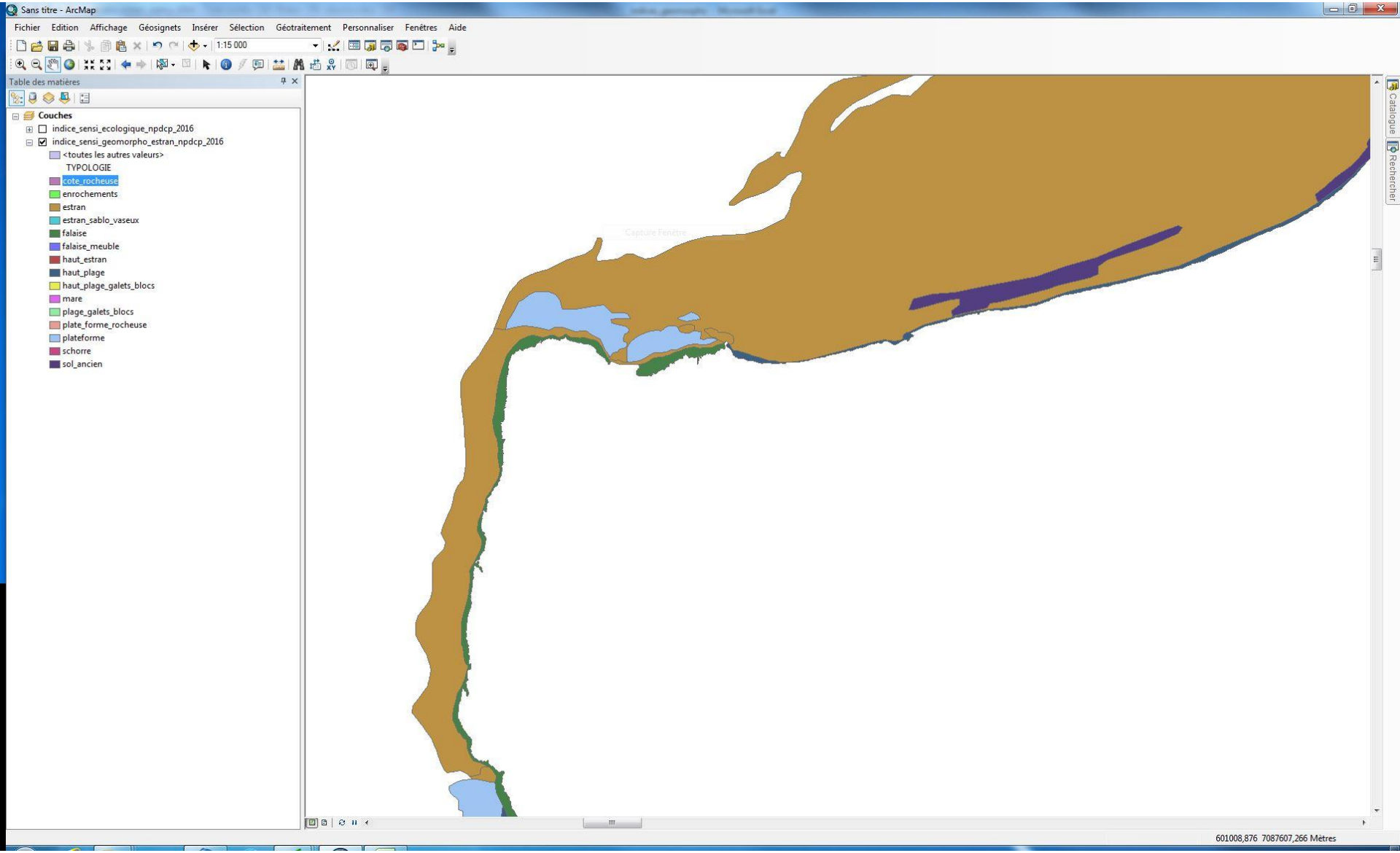


operational vulnerability maps atlas for Belgium coastline

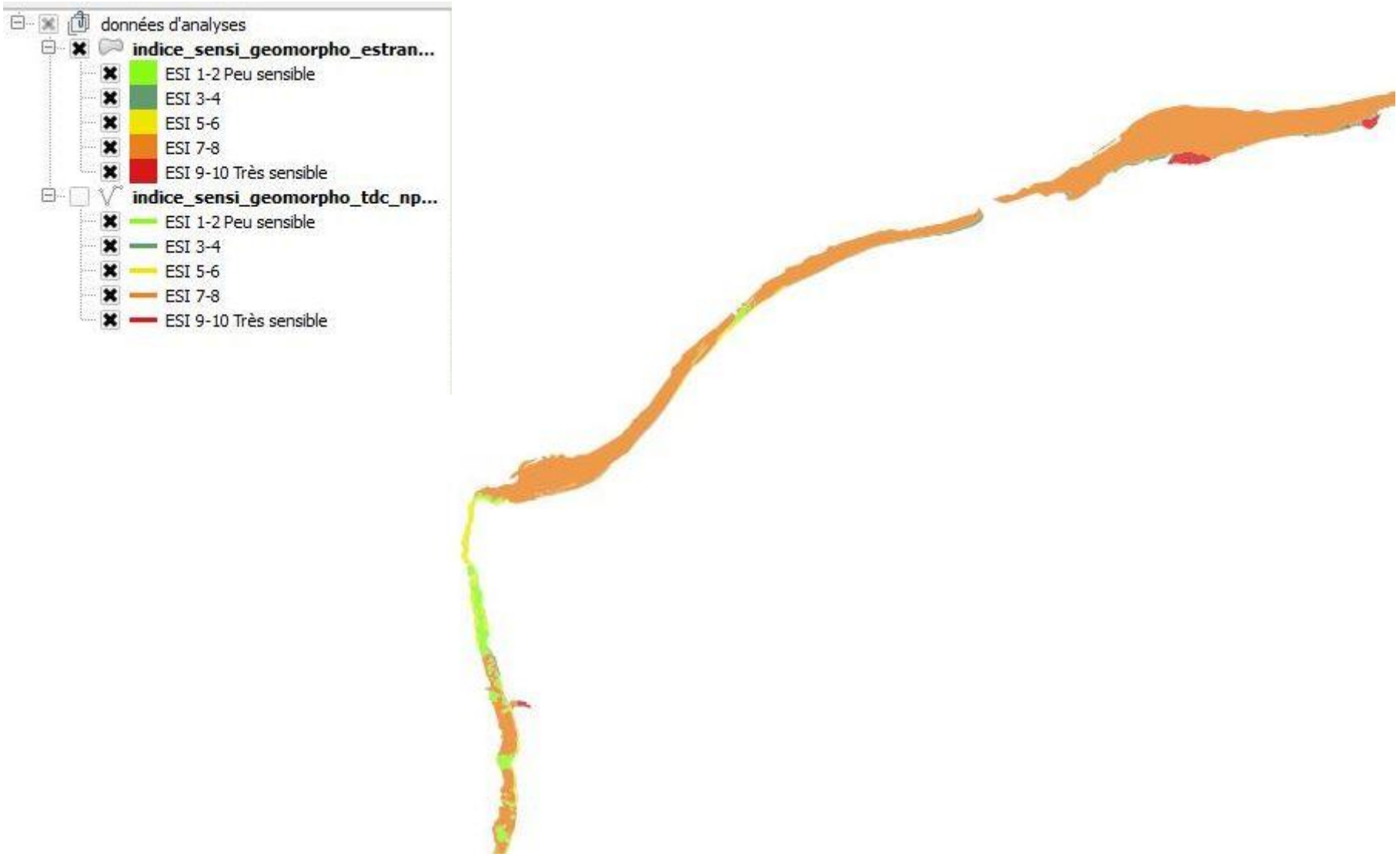
Step 2 : ranking of protected areas (sum of protections)



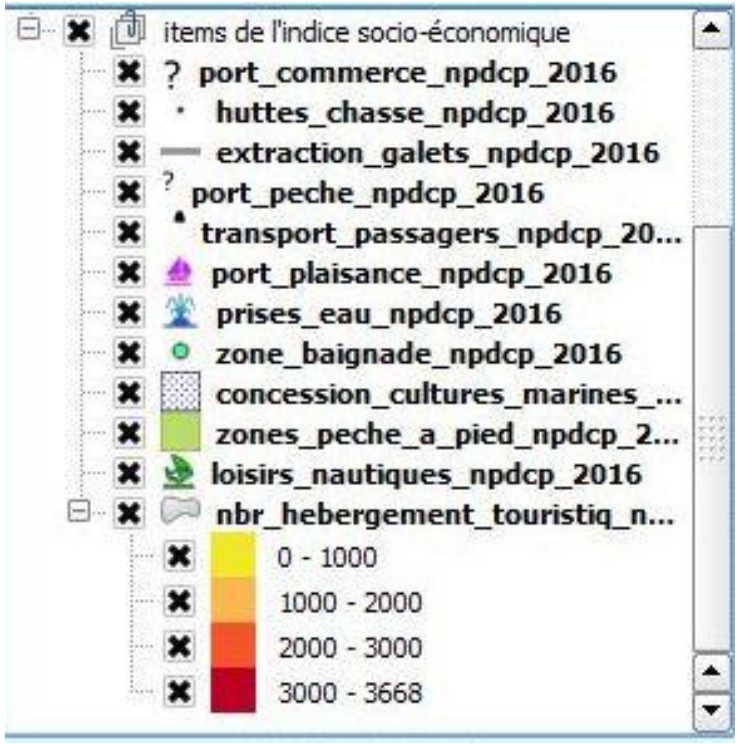
Pas-de Calais : Shoreline geomorphological categories

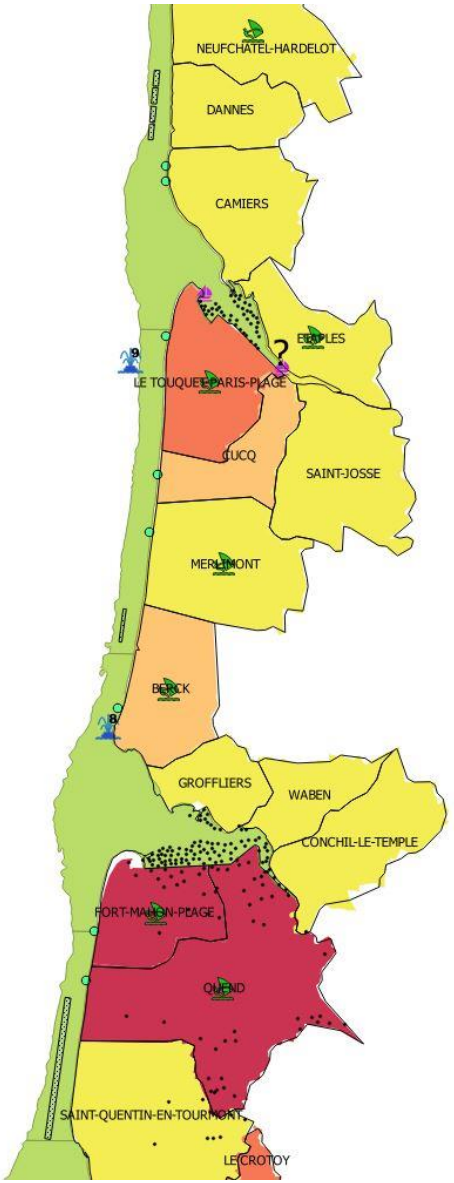


Pas-de Calais : Shoreline geomorphological sensitivity ranking

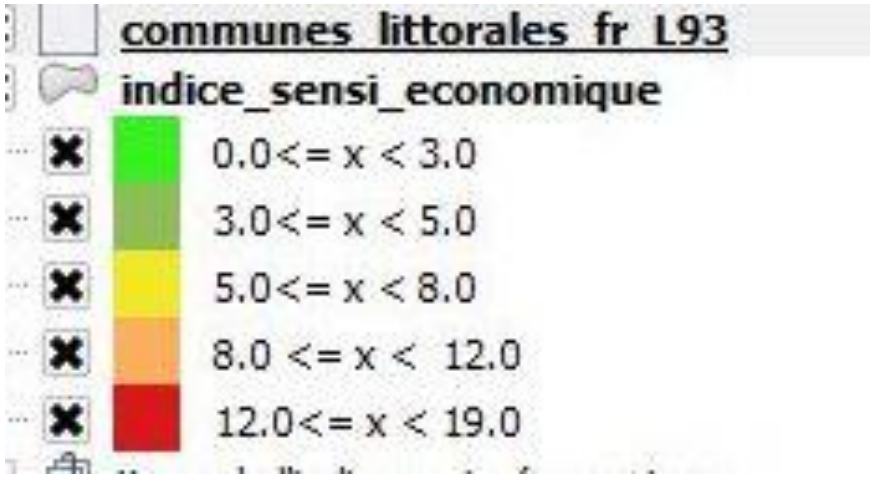


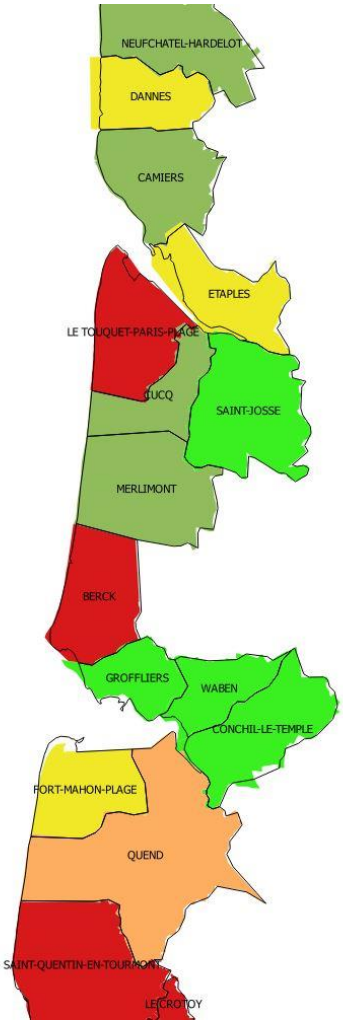
Pas-de Calais : socio-economy sensitive resources identification and mapping





Pas-de Calais : socio-economy sensitivity/vulnerability ranking





Pas-de Calais : operational sensitivity atlas for HNS pollution

To propose a demonstrator with adaptations of existing atlas

- Main changes :
  - To include data and mapping of subtidal zone
  - To Develop matrices for Air, Seabed, Water-column compartments
  - To include ranking by season