STIMA DEL RISCHIO DA IMPATTO DI IDROCARBURI

T4.3 – CARTOGRAFIA DELLE ZONE AD ALTO RISCHIO

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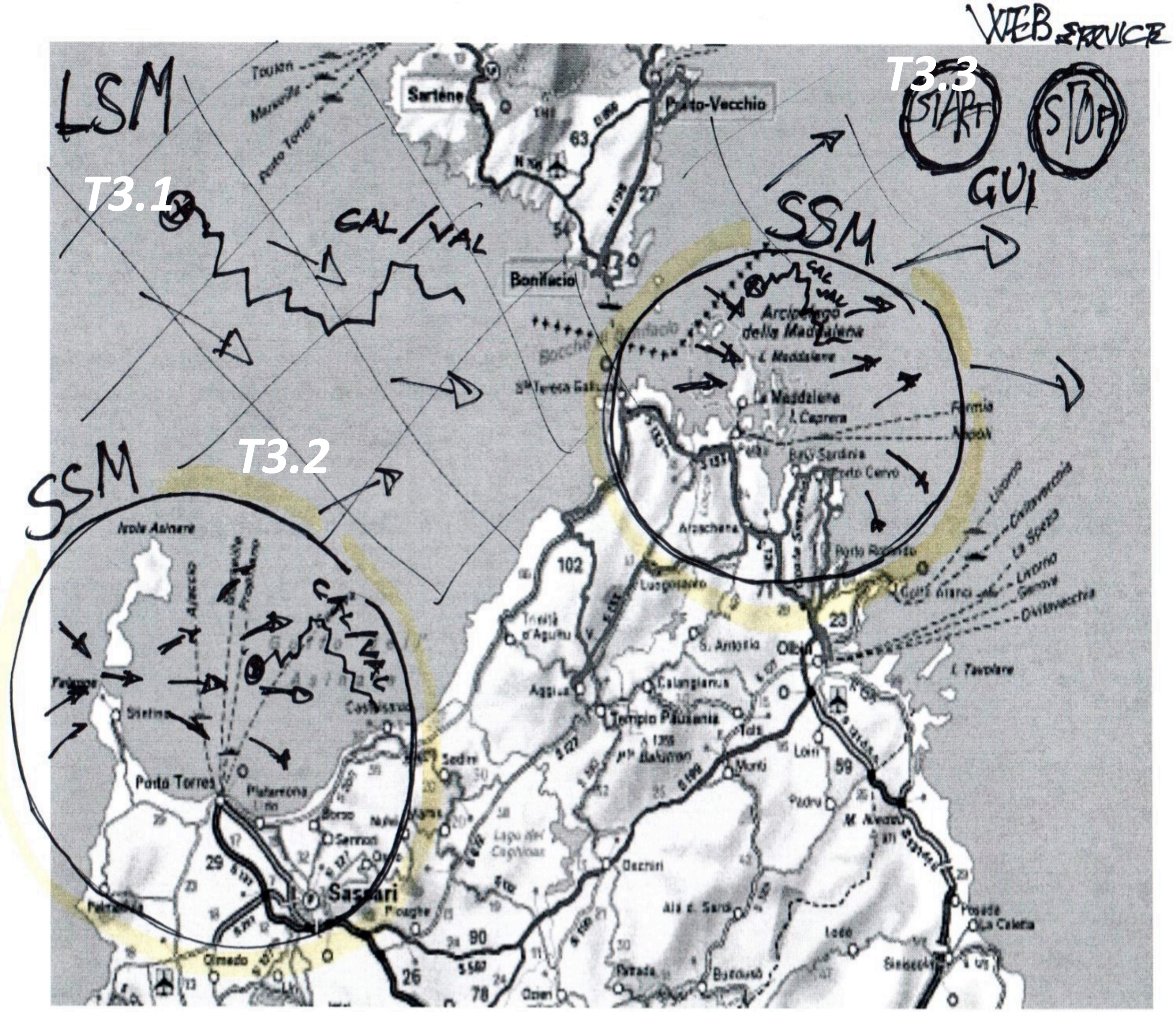
T4.3 – CARTOGRAFIA DELLE ZONE AD ALTO RISCHIO - ATTIVITÀ IAS-CNR IN A NUT



PROD. T4.3.1 – MAPPE TEMATICHE DEL TRAFFICO MARINO ….

- Analisi dei dati IAS rilasciati dal portale EMODNET per l’area Bocche di Bonifacio e Golfo dell’Asinara

PROD. T4.3.2 – MAPPE DI SENSITIVÀ AMBIENTALE DELLO SPAZIO TRANSFRONTALIERO

- Stima del grado di sensibilità ESI dei tratti di costa di Corsica e Sardegna per l’area Bocche di Bonifacio e Golfo dell’Asinara

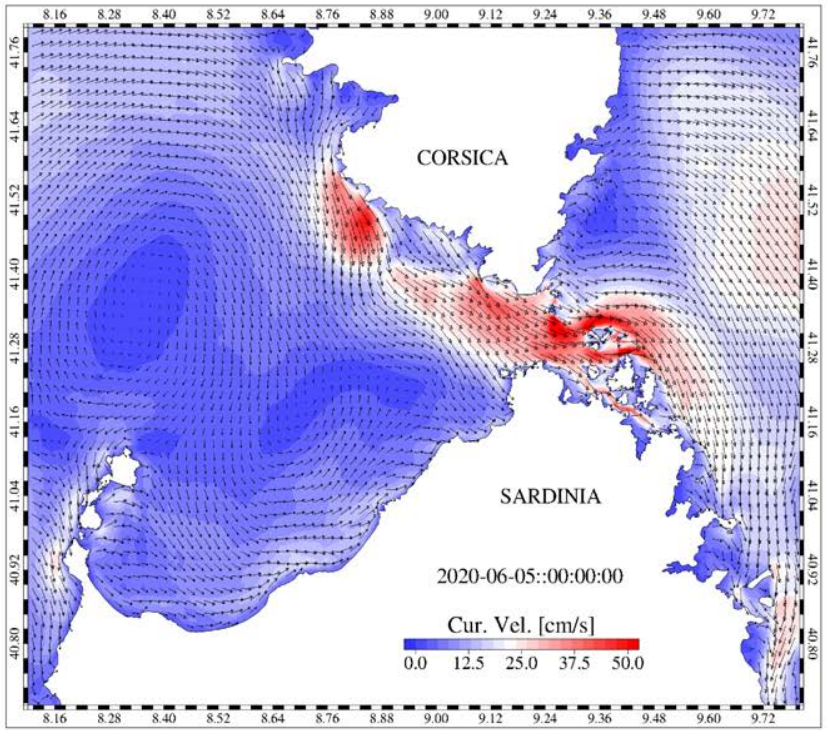
PROD. T4.3.3 – MAPPE DI VULNERABILITÀ E RISCHIO AMBIENTALE

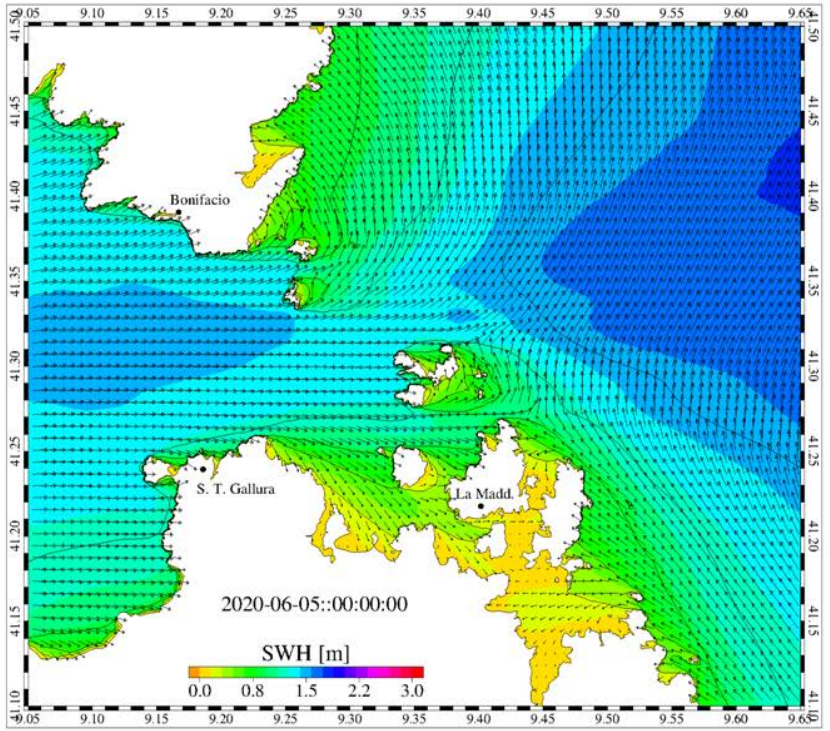
- Simulazione del rischio di impatti di idrocarburi a costa e valutazione della vulnerabilità

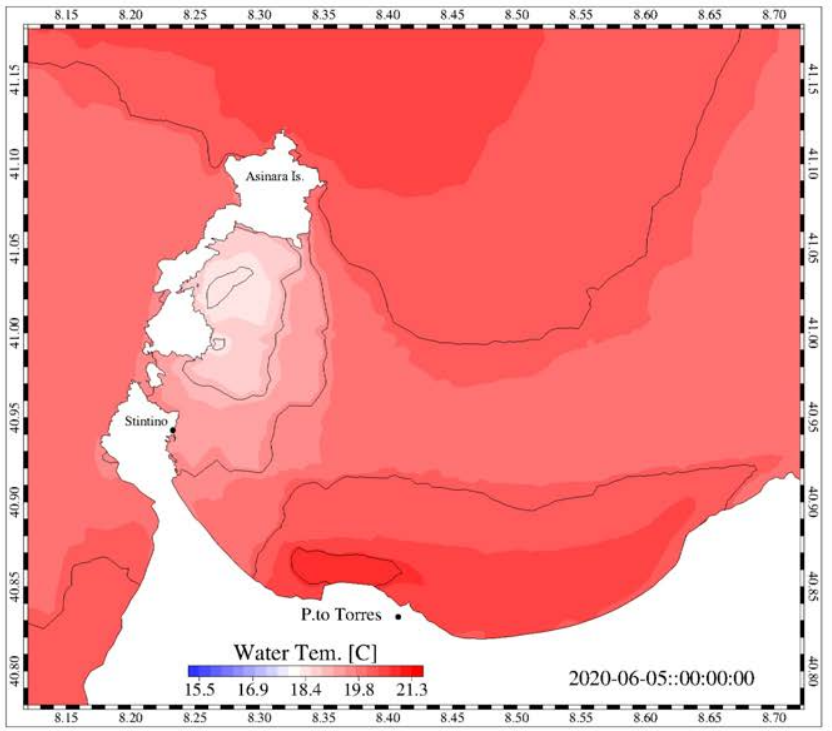
……. T3 - SISTEMI INTEGRATI DI PREVISIONE OCEANOGRAFICA

PREVISIONI OCEANOGRAFICHE A FREQUENZA QUADRIDIURNA PER UN INTERVALLO DI TEMPO PARI A 3 GIORNI

- **PRODOTTI RILASCIATI: CORRENTE SUPERFICIALE E TEMPERATURA SUPERCIALE (z=2.5 m) E SWH CON DIREZIONE ONDA**
- **4 AREE DI INTERESSE: BOCCHE DI BONIFACIO, GOLFO DELL'ASINARA, ARCIPELAGO DELLA MADDALENA E GOLFO DI OLBIA**



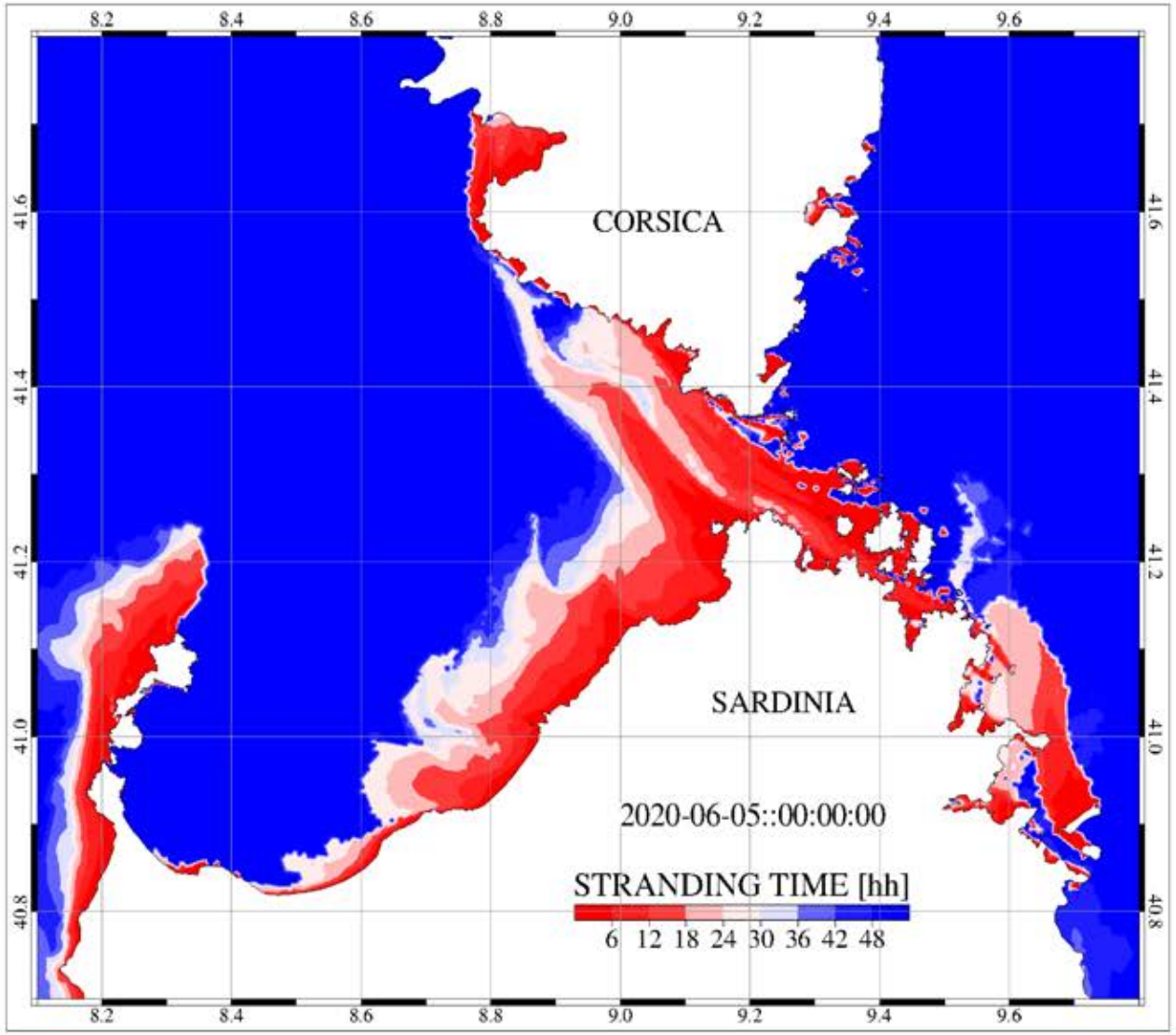




…… T3 - SISTEMI INTEGRATI DI PREVISIONE OCEANOGRAFICA

PREVISIONE GIORNALIERA CON FREQUENZA QUADRIDIURNA DELLO *"STRANDING TIME"*

UTILIZZO DI PTM OPERATIVO PER CALCOLARE I TEMPI DI IMPATTO A RIVA DI POTENZIALI SVERSAMENTI



As part of the output, the ***Stranding Time*** is also reported in the Panel D of Figure 5. It consists on the time needed by numerical particles that are released at the sea surface to reach the littoral.

…….

The spatial distribution of the *stranding time* is computed **each 6 hours for the 1st day** of prediction using the hydrodynamic model and accounting for the transport processes induced by wind and currents of the **next 48 hours**.

……

This quantity reverses the paradigm of the risk from pollutant at sea identifying potentially endangered waters instead of coastal zones. The stranding time distribution, in fact, allows the detection of the areas where a hypothetical oil-spill could reach the coast quickly, for stranding time lower then few hours, or after longer period.

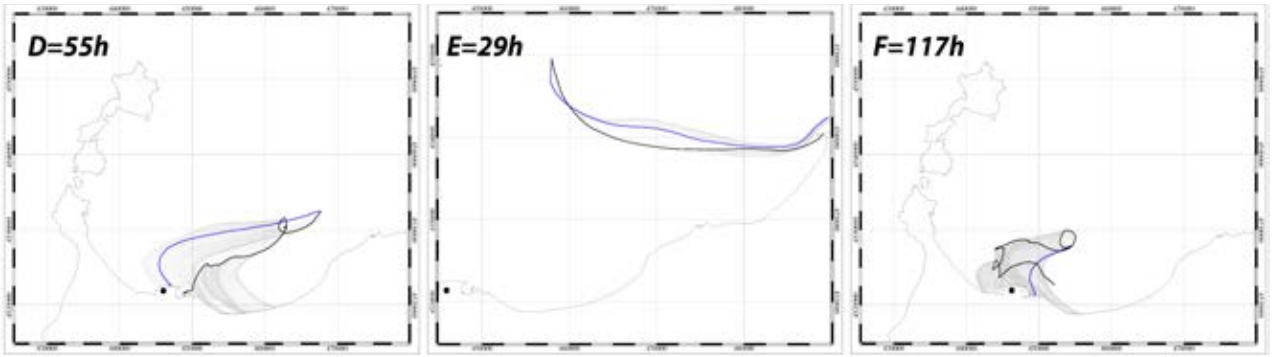
…… T3 - SISTEMI INTEGRATI DI PREVISIONE OCEANOGRAFICA

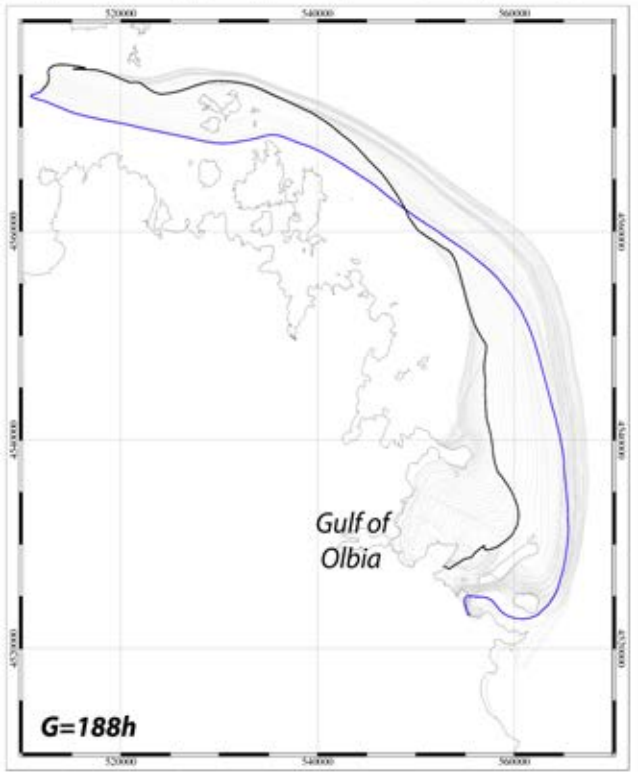
RIDUZIONE DELL'INCERTEZZA DEI SISTEMI DI PREVISIONE DELLA CORRENTE MARINA

….. for each model run the obtained results were compared with observations and the TRE was computed according to the following formula:

$$TRE(t) = \frac{\left(\sqrt{(x_o - x_m)^2 + (y_{do} - y_m)^2}\right)}{D_o}$$

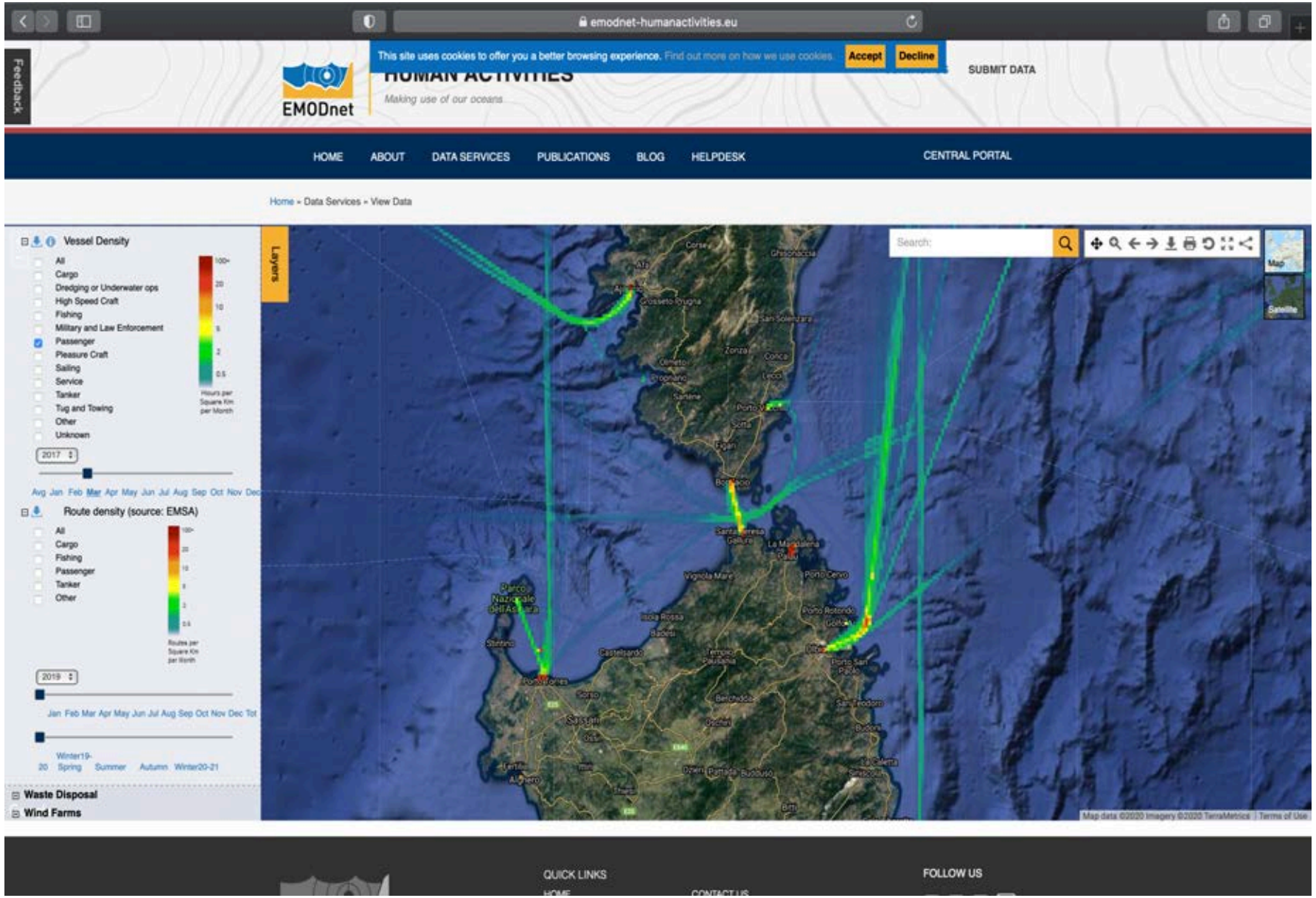
TRE24 ranging between 0.12 and 0.34 and with an average of about 0.2. The discrepancies between numerical particles and drifter's location after the first 24 hours predictions varied on average between 1.3 km up to around 7.7 km





PROD. T4.3.1 – MAPPE TEMATICHE DEL TRAFFICO MARINO

DEFINIZIONE DELLE SORGENTI DI POTENZIALI SVERSAMENTI – DATI DI TRAFFICO MARITTIMO



EMODNET DATASET – ANNO 2018

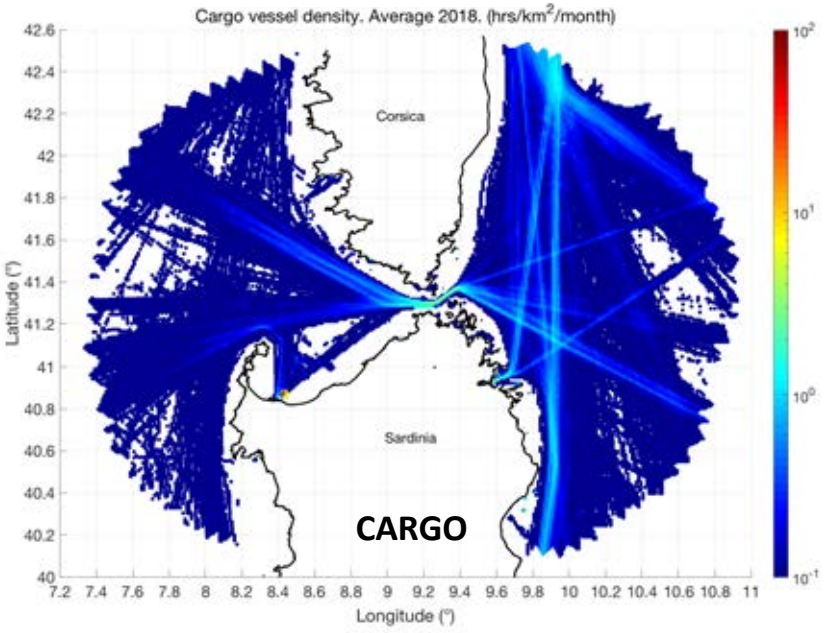
…. sources of **ANTHROPOGENIC DANGER** were derived by monthly values of the **MONTHLY VESSEL DENSITY [hr/km^2]**

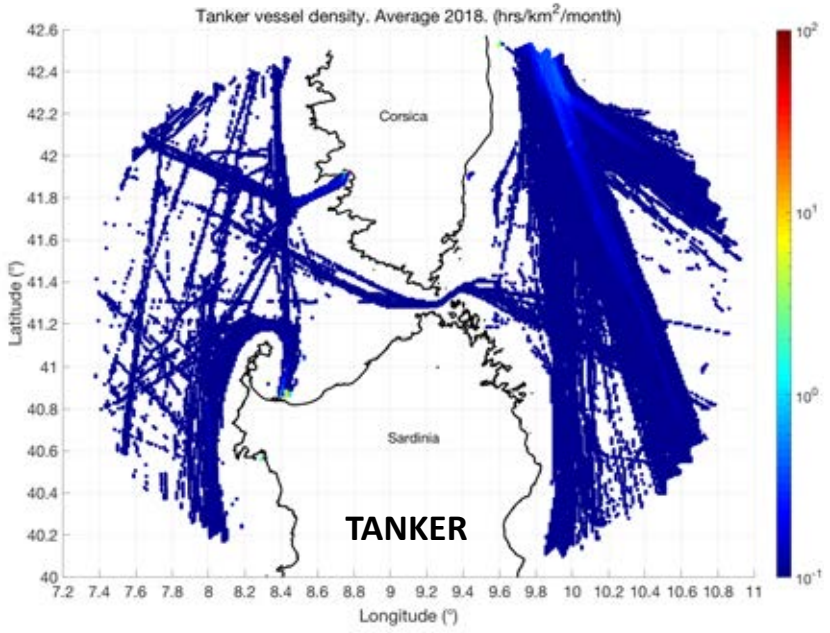
…. a georeferenced grid composed by **squared cells of 1 km** per side and indicating the total time per surface unit during which the cells are occupied by ships

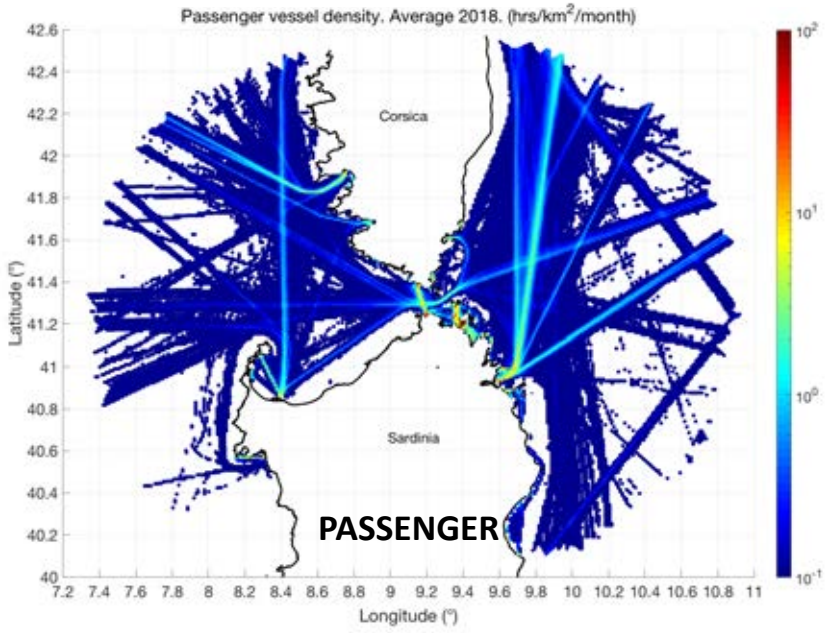
…. defined for **TANKER**, **CARGO** and **PASSENGER VESSELS**

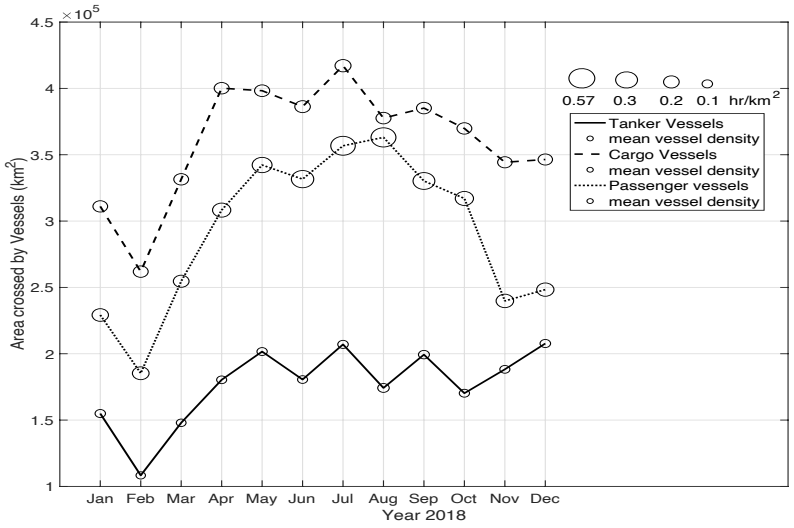
PROD. T4.3.1 – MAPPE TEMATICHE DEL TRAFFICO MARINO

ANALISI DATI 2018 - MONTHLY VESSEL DENSITY – CARGO, TANKER, PASSENGER



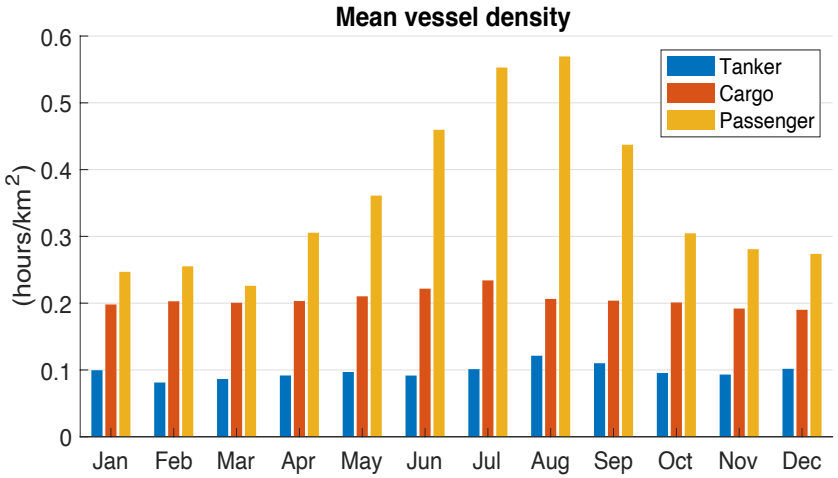






…. **monthly extent** of those areas that, within the SoB domain, are crossed by such type of vessels

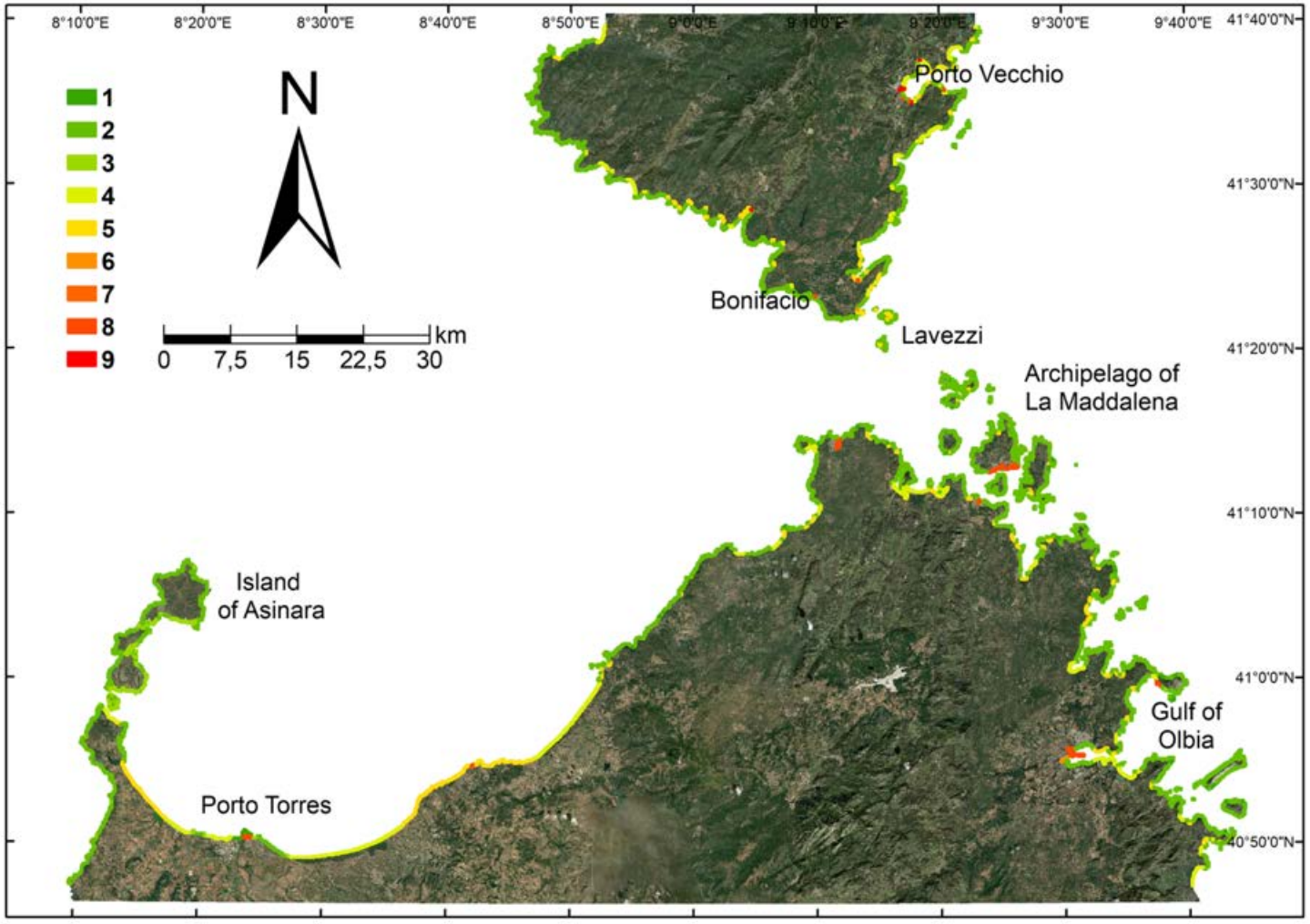
… ***mean vessel density*** per month showS a weak variability for tanker and cargo vessels all year long and an increase for passenger category during the best weather season.



PROD. T4.3.2 – MAPPE DI SENSITIVÀ AMBIENTALE DELLO SPAZIO TRANSFRONTALIERO

STIMA DEL GRADO DI SENSIBILITÀ DEI TRATTI COSTIERA – I DATI ESI

ESI - Environmental Sensitivity Index - to classify shoreline sensitivity in relation to oil stranding (NOAA, 2002).



ESI rank = {1, 2} high-energy shorelines, regularly exposed to large waves or strong tidal currents during all seasons,

ESI rank = {3, 4, 5, 6} medium-energy shorelines that often have seasonal patterns in storm frequency and wave size

ESI rank = {7, 8} low-energy shorelines that are sheltered from wave and tidal energy, except during unusual or infrequent events

ESI rank = {9} anthropized shorelines

SoB

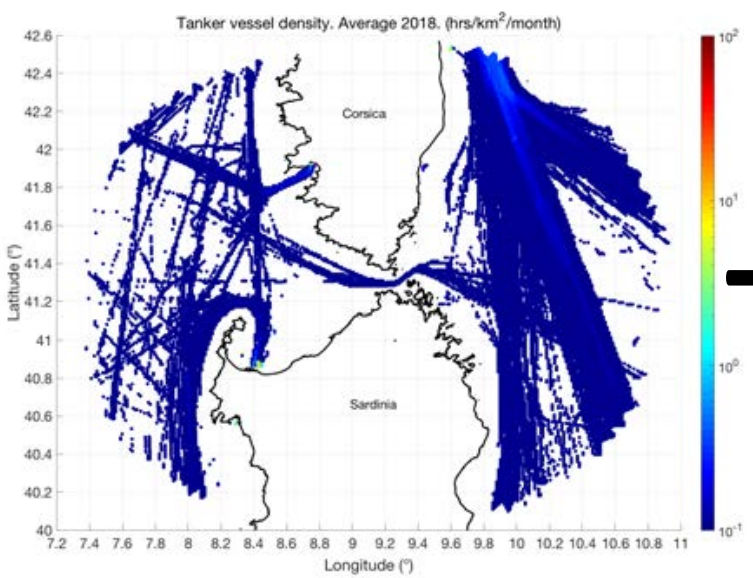
ESI rank {1, 2} = 75%. High slope littorals

***ESI rank {3, 6}* = 22 %. Medium slope littorals**

***ESI rank {7, 9}* = 3 %. Low slope littorals**

PROD. T4.3.3 – MAPPE DI VULNERABILITÀ E RISCHIO AMBIENTALE

SIMULAZIONE DEL RISCHIO DI IMPATTI DI IDROCARBURI A COSTA E VALUTAZIONE DELLA VULNERABILITÀ



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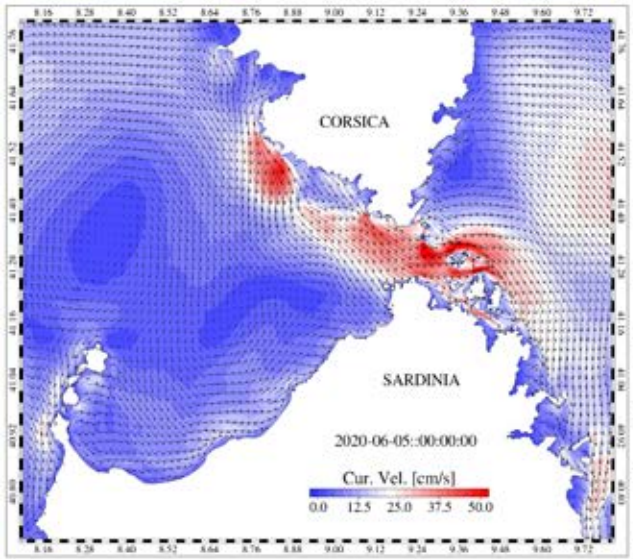
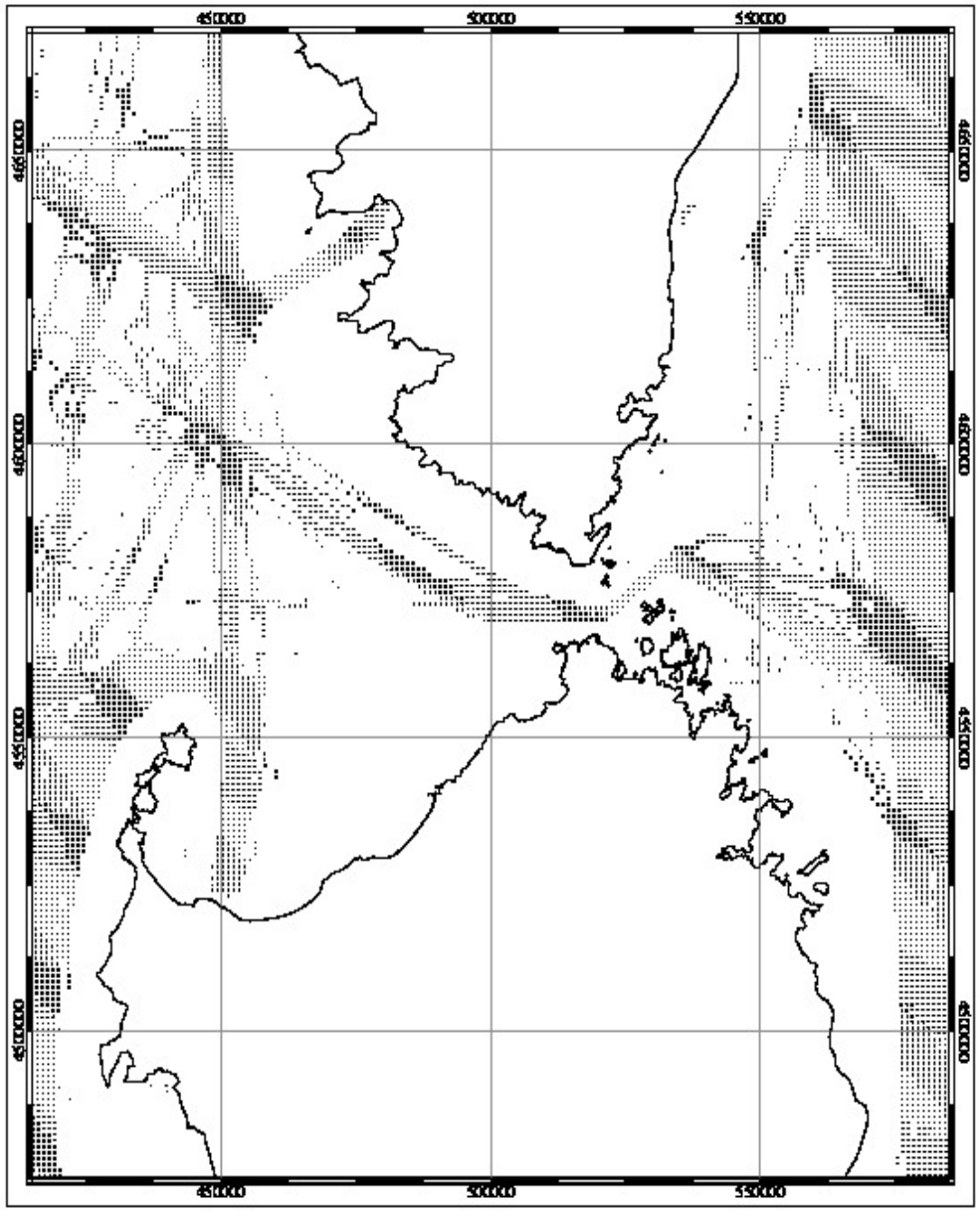




Utilizzo di un **PTM** per simulare il trasporto generato da corrente superficiale, vento e onde su particelle rilasciate in corrispondenza dei punti di **VESSEL DENSITY**

Rilasci quotidiani di circa 600000 particelle per un totale di circa 200000000 per anno 2018.

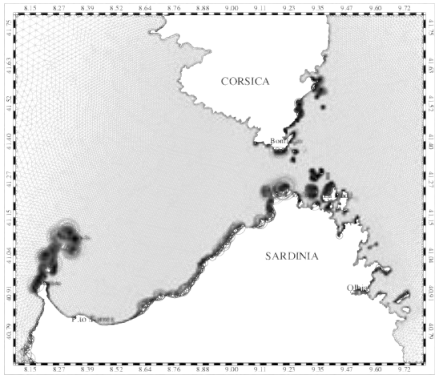
Calcolo impatto delle particelle a costa.

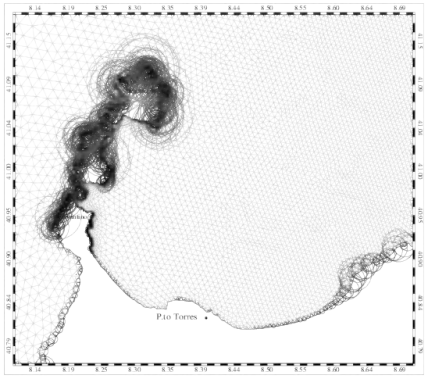
AD OGNI PARTICELLA SONO ASSOCIATE LE INFORMAZIONI SUL *VESSEL DENSITY* DELLA POSIZIONE DI PAETENZA E SUL TEMPO TRASCORSO IN MARE PRIMA DI IMPATTARE A COSTA

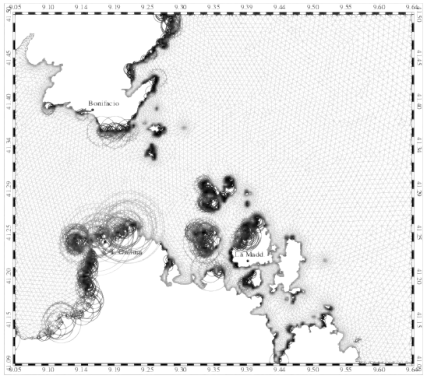
PROD. T4.3.3 – MAPPE DI VULNERABILITÀ E RISCHIO AMBIENTALE

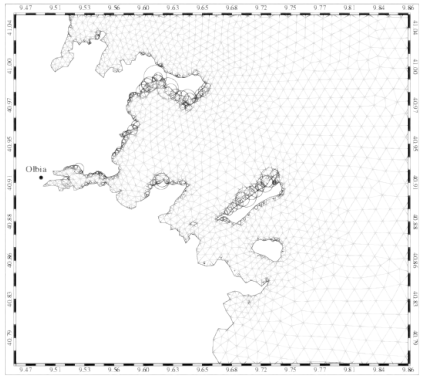
IMPATTI SU AREE COSTIERE – ANALISI DELLE CARATTERISTICHE MEDIE DELLE PARTICELLE IMPATTATE

IMPACTS DENSITY (ID): number of particles divided by the coast length

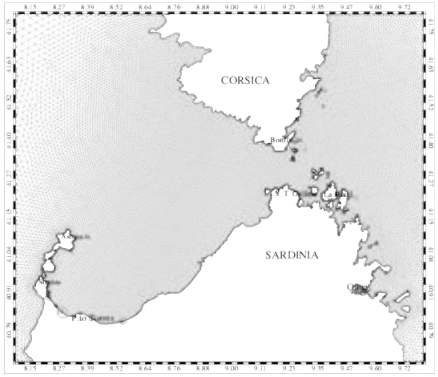


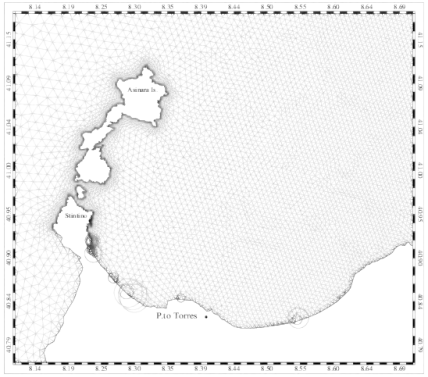


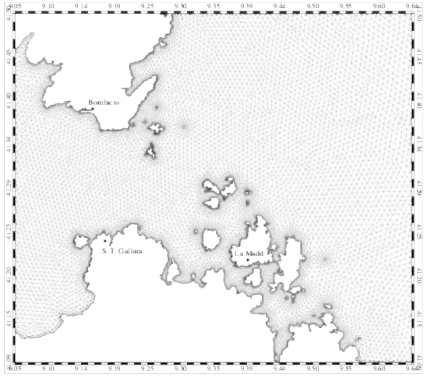


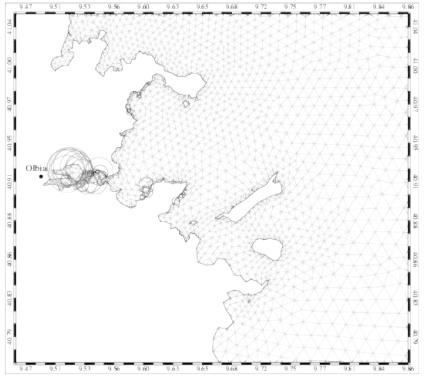


VESSEL FREQUENCY (VD) of the particles at the release point

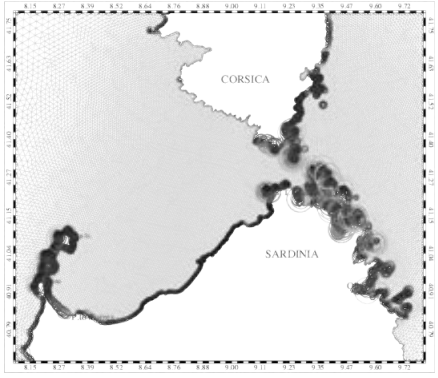


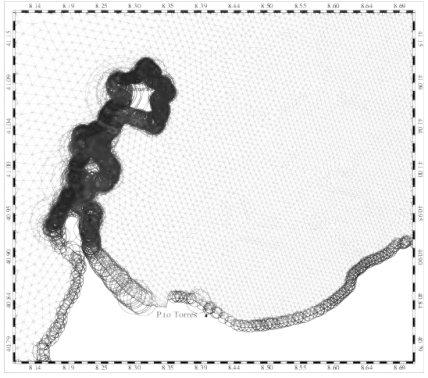


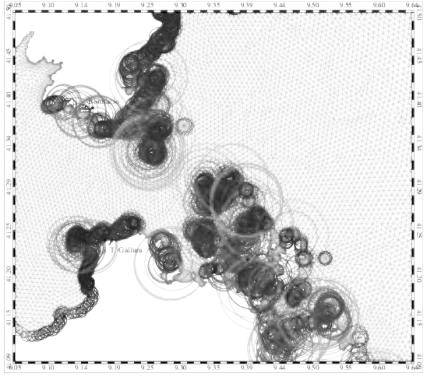
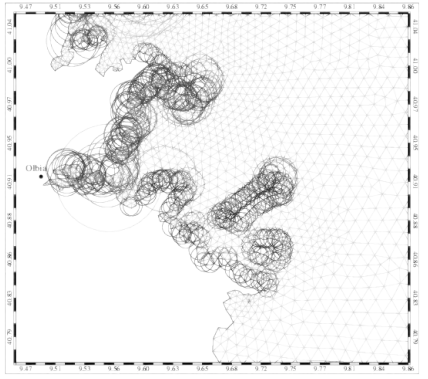




PARTICLE AGE (age): 1/age distribution



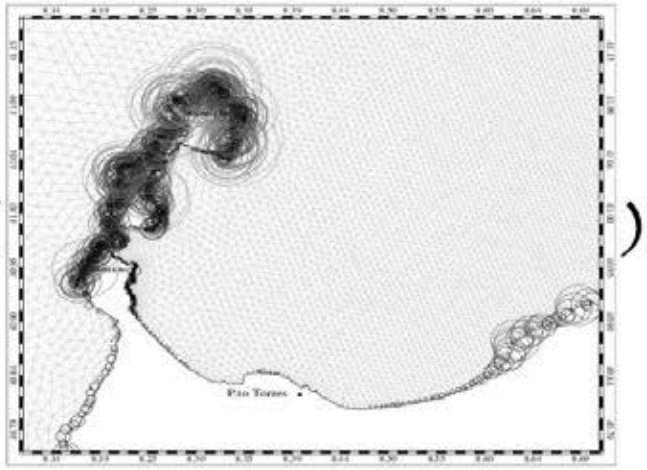


PROD. T4.3.3 – MAPPE DI VULNERABILITÀ E RISCHIO AMBIENTALE

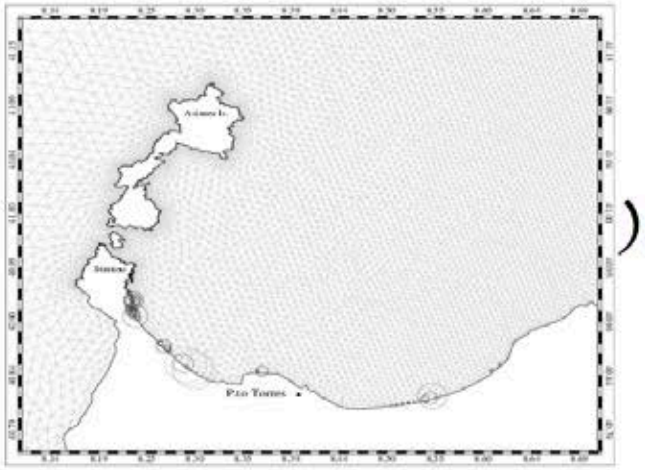
CALCOLO DEL RISCHIO

IMPACTS DENSITY

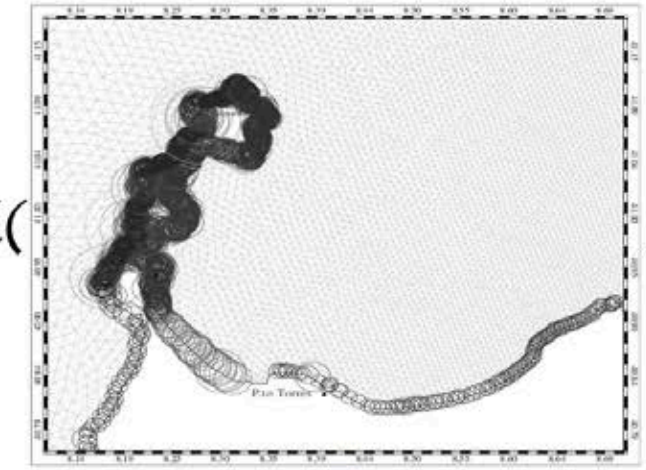


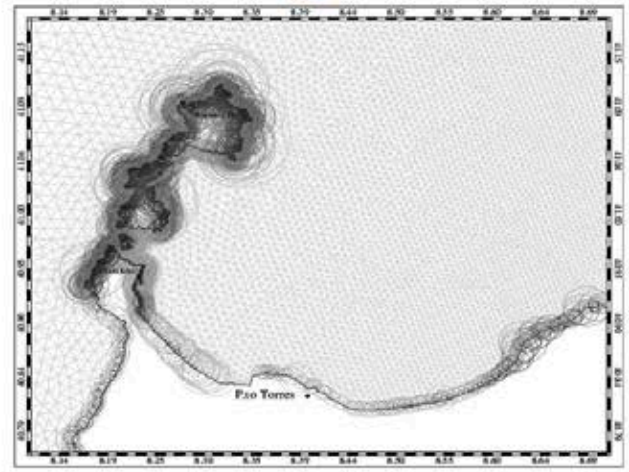
$f($ $)$ ✖ $g($ $)$ ✖ $h($ $)$

VESSEL MONTHLY FREQEUNCY AT THE RELEASE POINT



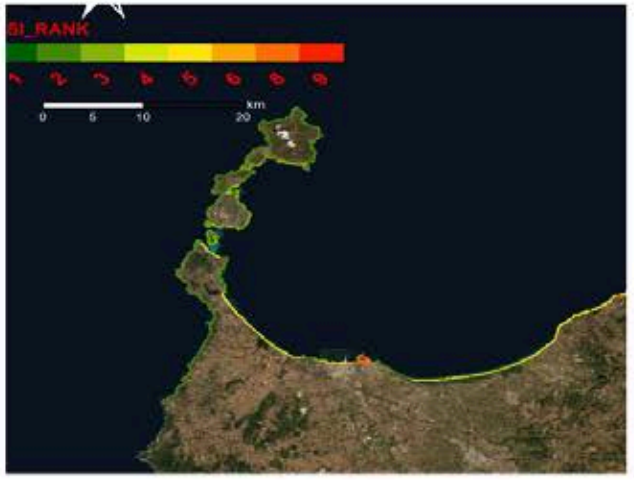
PARTICLES AGE AT THE IMPACT



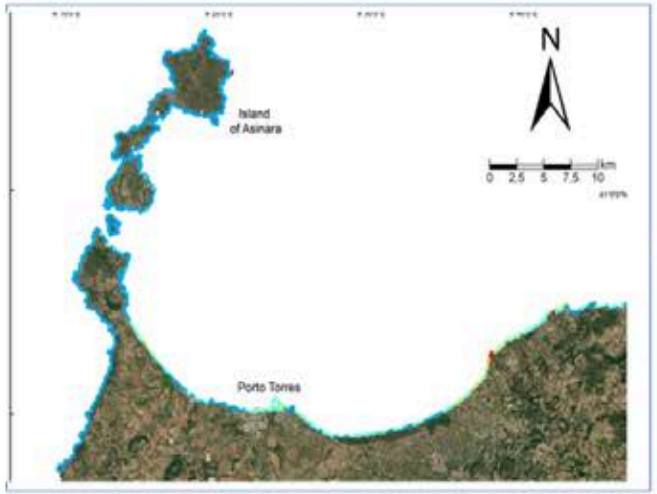


NORMALIZED HAZARD INDEX

✖



NORMALIZED VULNERABILITY INDEX



NORMALIZED RISK INDEX

PROD. T4.3.3 – MAPPE DI VULNERABILITÀ E RISCHIO AMBIENTALE

CALCOLO DEL RISCHIO

1. IMPACT DENSITY $$ID_j = \frac{n_j}{L_j}$$

n total number of particles that reach the j^{th} coastal segment.

2. AVERAGE VESSEL DENSITY $$A\_VD_j = \frac{1}{n_j}\sum_{i=1}^{n_j} VD_{j,i}$$

3. AVERAGE PARTICLES AGE $$A\_age_j = \frac{1}{n_j}\sum_{i=1}^{n_j} age_{j,i}$$

4. WEATHERING PROCESSES

$$VLO_j(t) = g(A\_age_j) \quad VHO_j(t) = f(A\_age_j)$$

residual volume of light (VLO) and heavy oil (VHO)

$$VO_j^s = \left(r^s * VLO_j^s + m^s * VHO_j^s\right)$$

residual volume of oil (VO)

s={T, C, P}; *r= m= 0.5* if one considers the volume of oil carried by tanker (crude oil plus fuel), *r = 1* and *m = 0* if we consider the volume of oil carried by cargo or passenger vessels (fuel only).

4. WEATHERING PROCESSES - ESTIMATE OF *g* AND *f*

MEDSLIK APPLICATION TO ESTIMATE THE TIME DEPENDENDING OIL VOLUME REDUCTION DUE TO WEATHERIN PROCESSES

Remaining oil volume at the sea surface when subjected to weathering processes (%)

Days since release	Arabian Heavy (API = 28.2)		Brent (API = 38.2)		F3- OIL (API = 46.3)	
	Summer	Winter	Summer	Winter	Summer	Winter
0.0	100.00	100.00	100.00	100.00	100.00	100.00
0.5	64.5	64.53	64.12	62.65	67.11	66.73
1.0	64.50	64.52	54.91	53.66	58.04	57.68
2.0	64.44	64.49	44.72	44.39	48.68	48.28
3.0	64.39	64.45	39.33	39.01	43.21	42.89
4.0	64.35	64.43	35.64	35.34	39.00	39.25
5.0	64.31	64.40	32.90	32.60	36.28	36.58
6.0	64.28	64.37	30.75	30.45	34.71	34.51
7.0	64.25	64.35	30.32	28.71	33.14	32.84
8.0	64.20	64.32	28.59	27.25	31.05	31.45
9.0	64.16	64.30	27.15	26.00	30.17	30.27
10.0	64.13	64.00	25.93	24.91	28.91	29.24

5. HAZARD $$HZ_j^s = ID_j^s * A\_VD_j^s * VO_j^s$$

6. RISK $$RI_j^s = HZ_j^s * ESI_j$$

PROD. T4.3.3 – MAPPE DI VULNERABILITÀ E RISCHIO AMBIENTALE

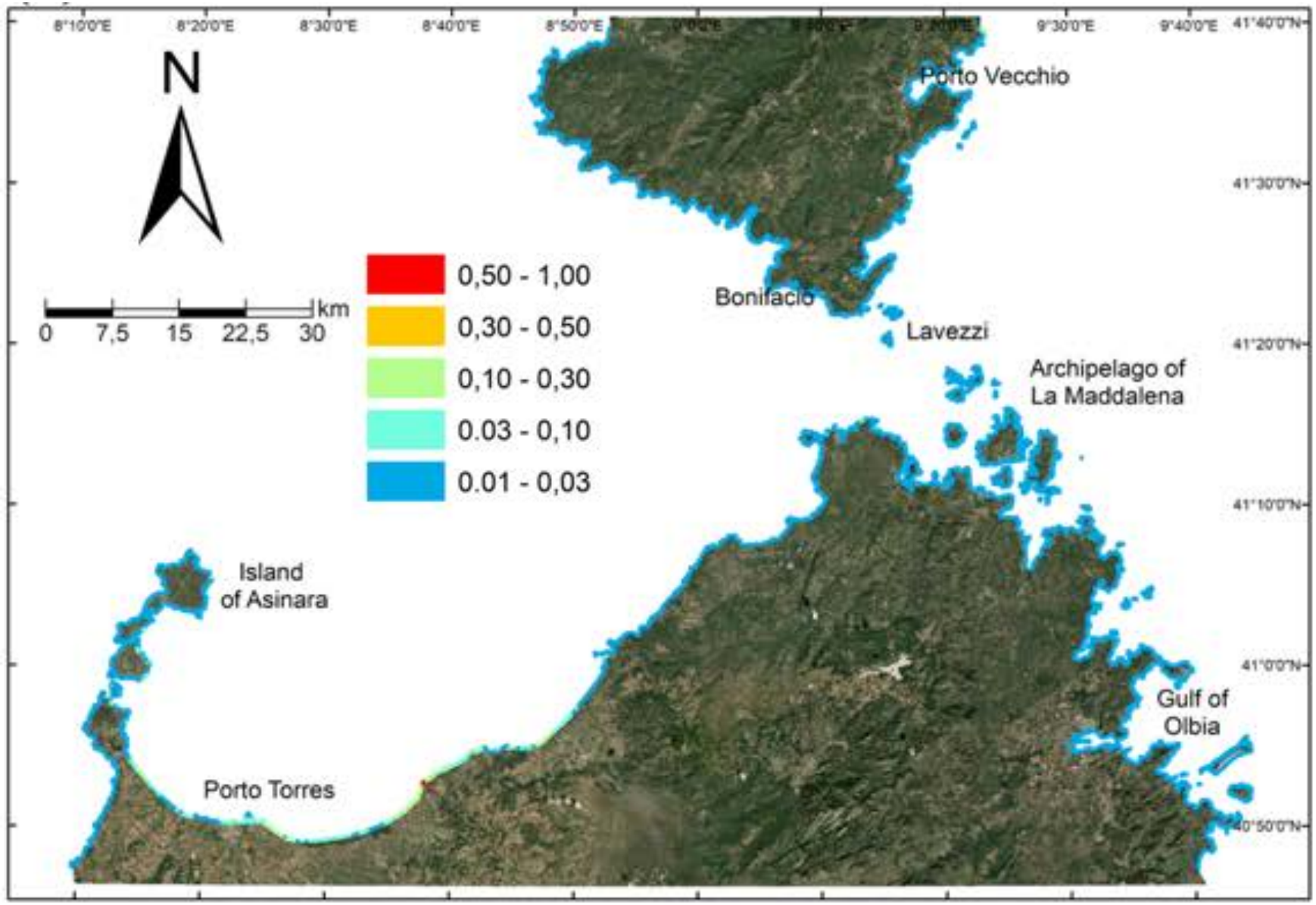
HAZARD MAPS – 2018

$$HZ_j^S = ID_j^S * A\_VD_j^S * VO_j^S$$

.. f(IMPACT DENS., VESSEL DENS., WEATHERING PROC.)

Hazard maps of the assessment 2018 in relation to dangerous sources derived by ***TANKER*** vessels density and routes.

The maps display the main localities and their toponomy and the normalized values **(ranging in between 0 and 1)** of ***HAZARD*** in correspondence of the littorals of the SoB domain.



PROD. T4.3.3 – MAPPE DI VULNERABILITÀ E RISCHIO AMBIENTALE

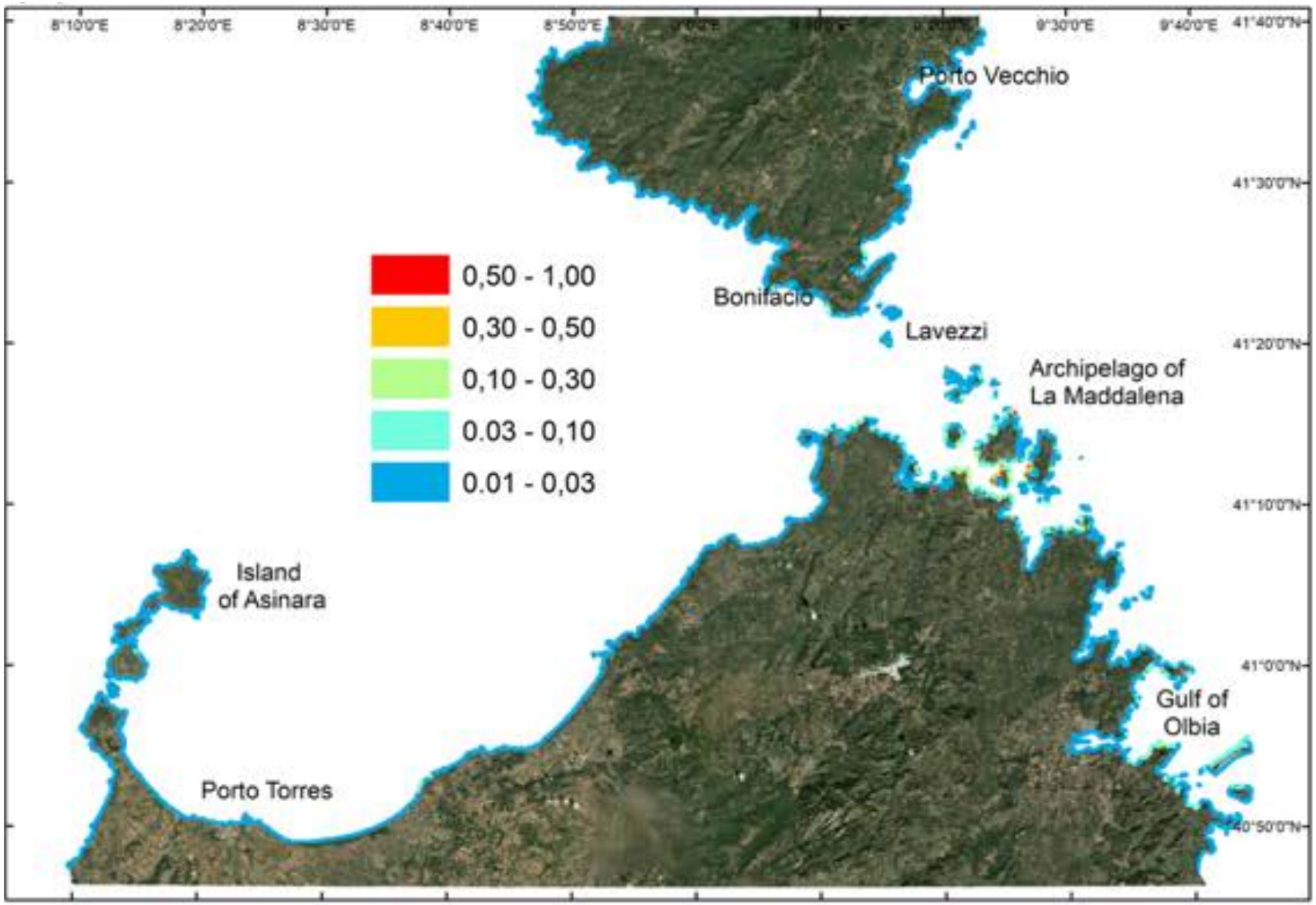
HAZARD MAPS - 2018

$$HZ_j^s = ID_j^s * A\_VD_j^s * VO_j^s$$

.. f(IMPACT DENS., VESSEL DENS., WEATHERING PROC.)

Hazard maps of the assessment 2018 in relation to dangerous sources derived by ***PASSENGER*** vessels density and routes.

The maps display the main localities and their toponomy and the normalized values **(ranging in between 0 and 1)** of ***HAZARD*** in correspondence of the littorals of the SoB domain.



PROD. T4.3.3 – MAPPE DI VULNERABILITÀ E RISCHIO AMBIENTALE

RISK MAPS - 2018

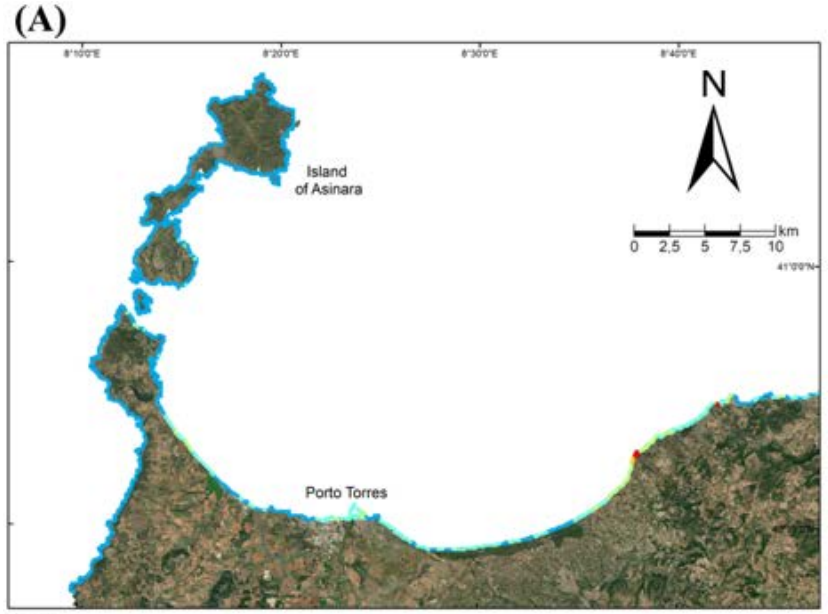
$$RI_j^s = HZ_j^s * ESI_j$$

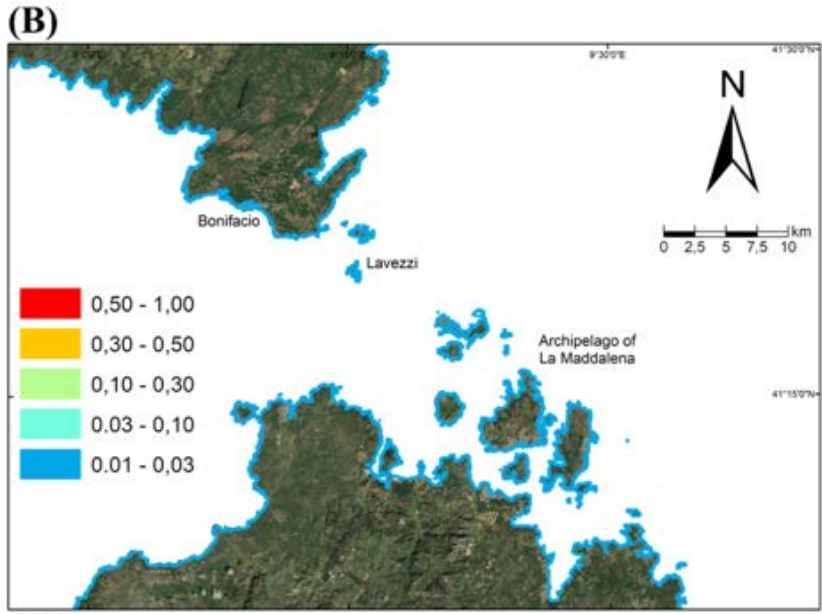
.. f(HAZARD, VULNERABILITY)

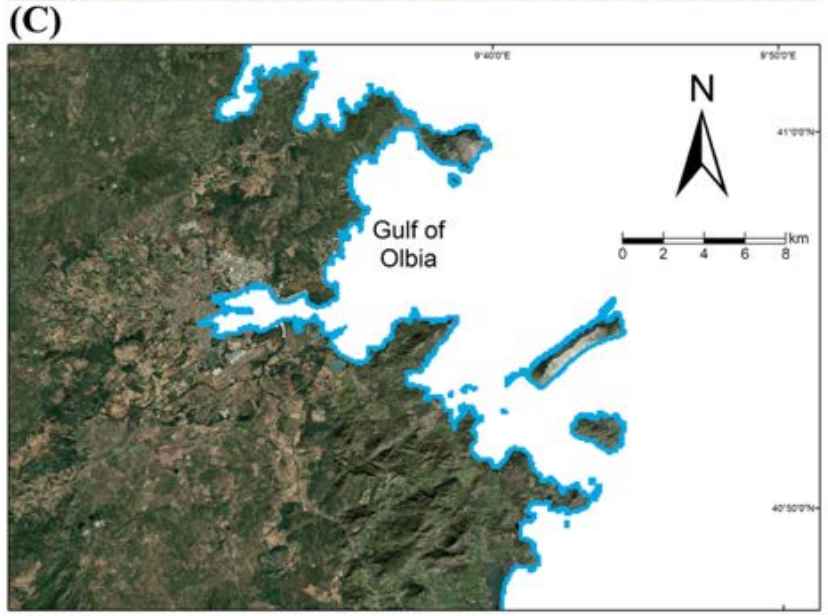
Risk assessment 2018 in relation to dangerous sources derived by routes and vessels density of ***TANKER*** vessels.

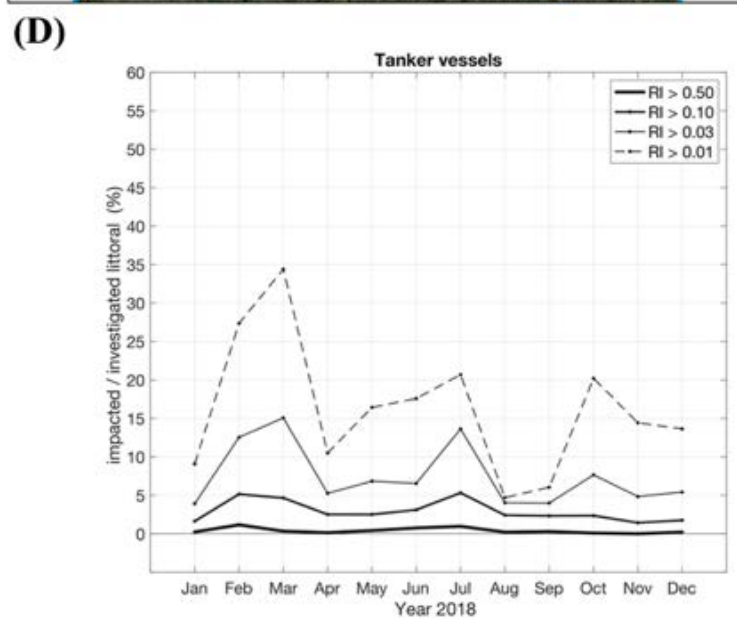
Panel A, B and C display magnifications of the SoB domain risk map in correspondence of the Asinara Island, the SoB and the Gulf of Olbia.

Panel D displays the **monthly percentage of the impacted littoral** in relation to different thresholds of the risk. (**RI = 0.5 indicating very high risk, RI = 0.1 high risk, RI = 0.03 intermediate risk and RI = 0.01 low risk**).









PROD. T4.3.3 – MAPPE DI VULNERABILITÀ E RISCHIO AMBIENTALE

RISK MAPS

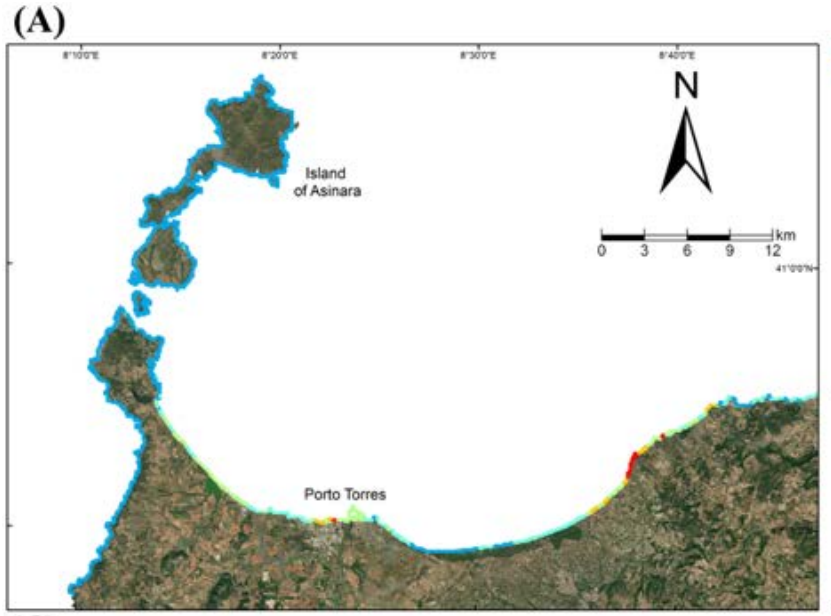
$$RI_j^s = HZ_j^s * ESI_j$$

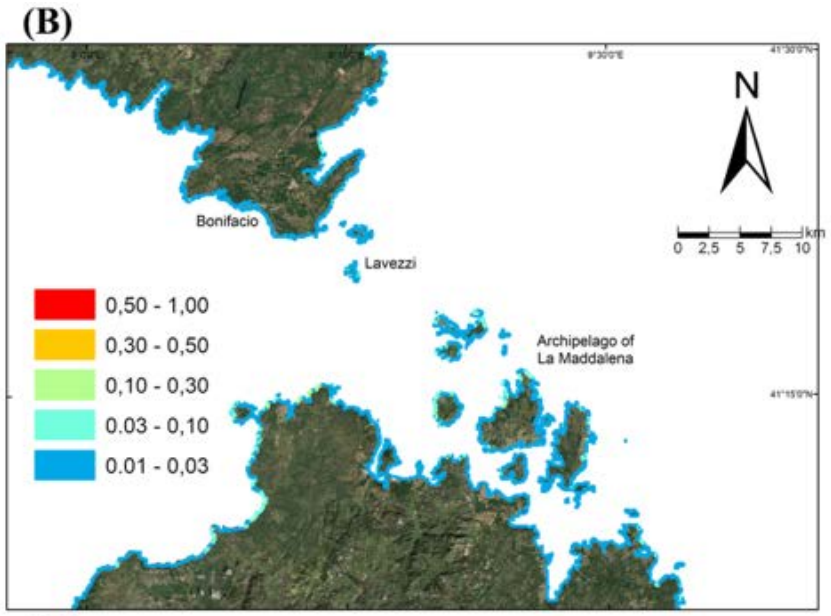
.. f(HAZARD, VULNERABILITY)

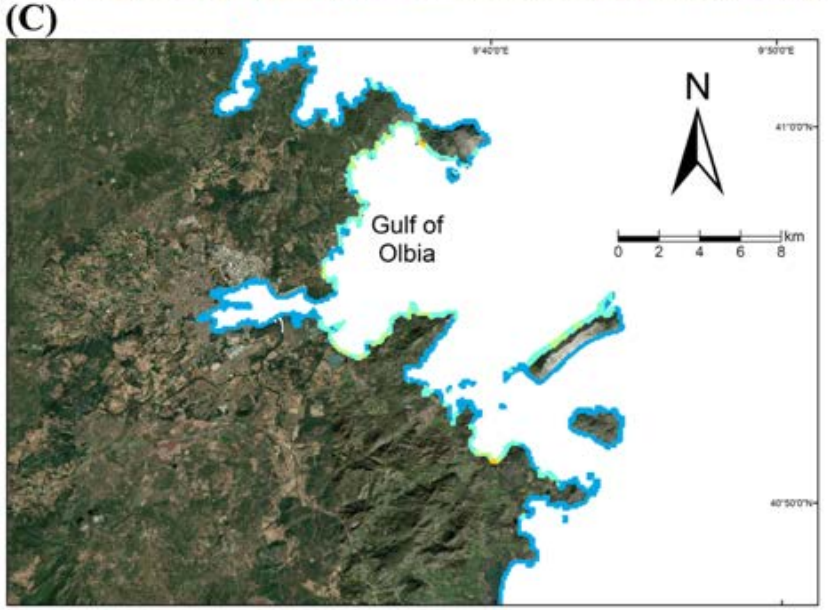
Risk assessment 2018 in relation to dangerous sources derived by routes and vessels density of ***CARGO*** vessels.

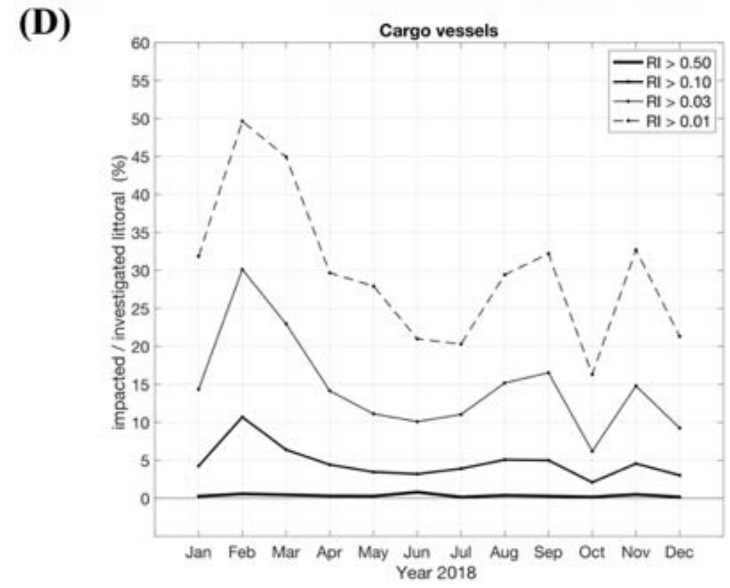
Panel A, B and C display magnifications of the SoB domain risk map in correspondence of the Asinara Island, the SoB and the Gulf of Olbia.

Panel D displays the **monthly percentage of the impacted littoral** in relation to different thresholds of the risk. (**RI = 0.5 indicating very high risk, RI = 0.1 high risk, RI = 0.03 intermediate risk and RI = 0.01 low risk**).









PROD. T4.3.3 – MAPPE DI VULNERABILITÀ E RISCHIO AMBIENTALE

RISK MAPS

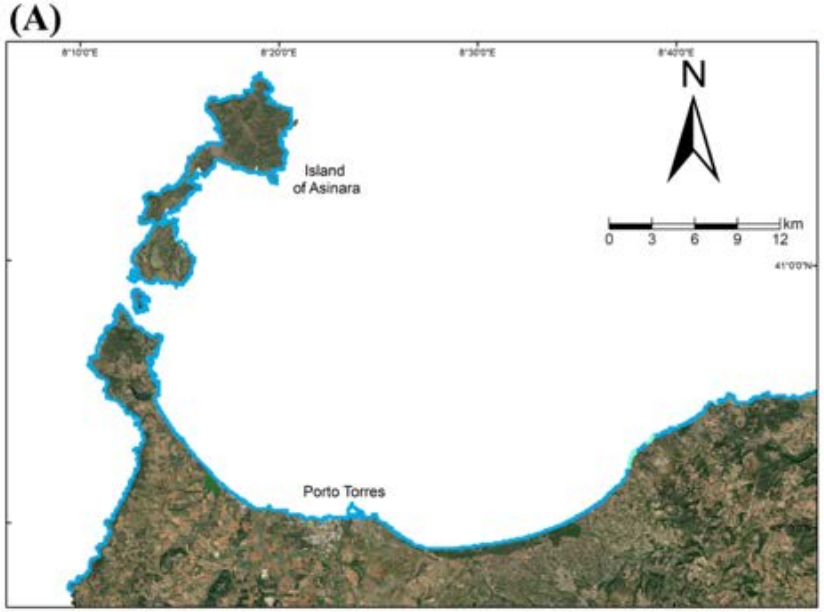
$$RI_j^s = HZ_j^s * ESI_j$$

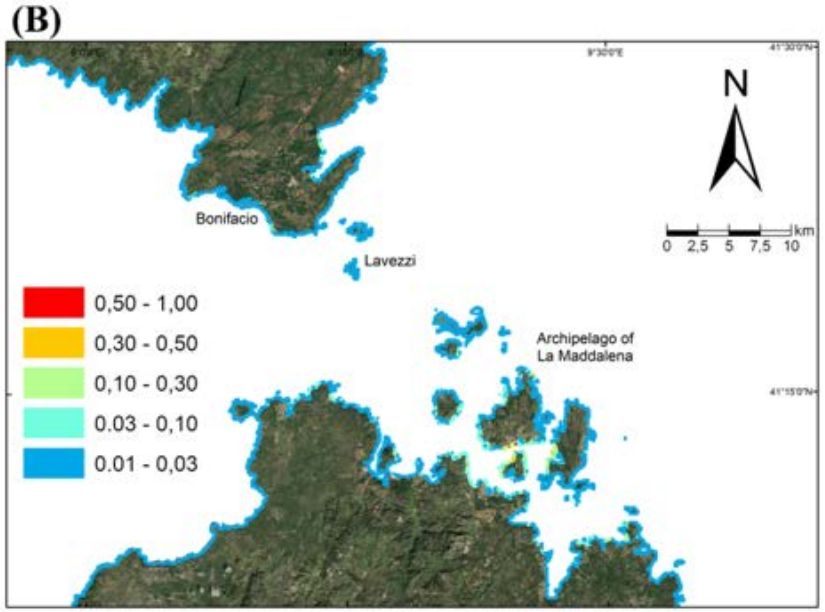
.. f(HAZARD, VULNERABILITY)

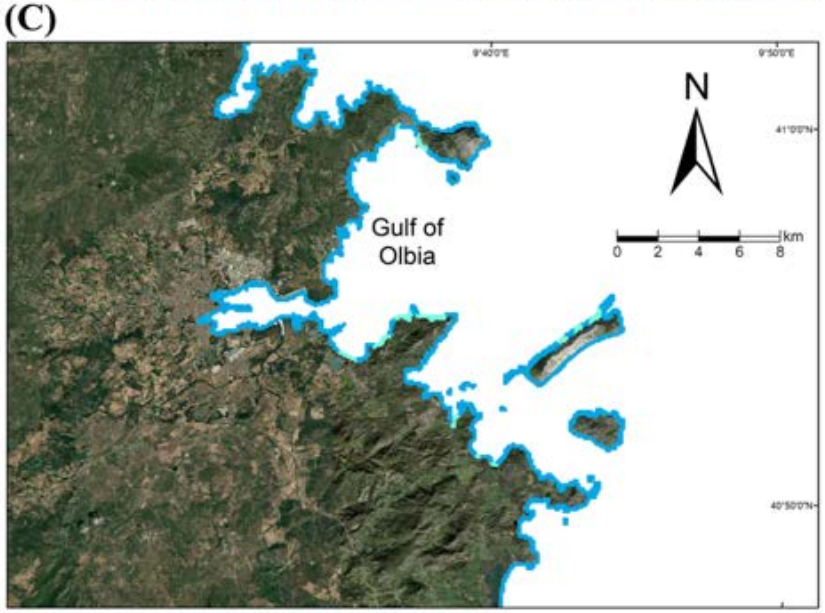
Risk assessment 2018 in relation to dangerous sources derived by routes and vessels density of ***PASSENGER*** vessels.

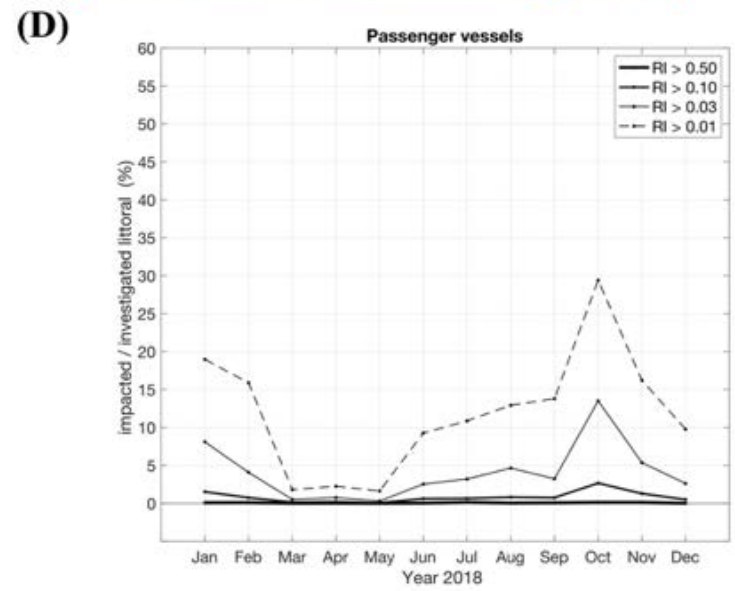
Panel A, B and C display magnifications of the SoB domain risk map in correspondence of the Asinara Island, the SoB and the Gulf of Olbia.

Panel D displays the **monthly percentage of the impacted littoral** in relation to different thresholds of the risk. (**RI = 0.5 indicating very high risk, RI = 0.1 high risk, RI = 0.03 intermediate risk and RI = 0.01 low risk**).









PROD. T4.3.3 – MAPPE DI VULNERABILITÀ E RISCHIO AMBIENTALE

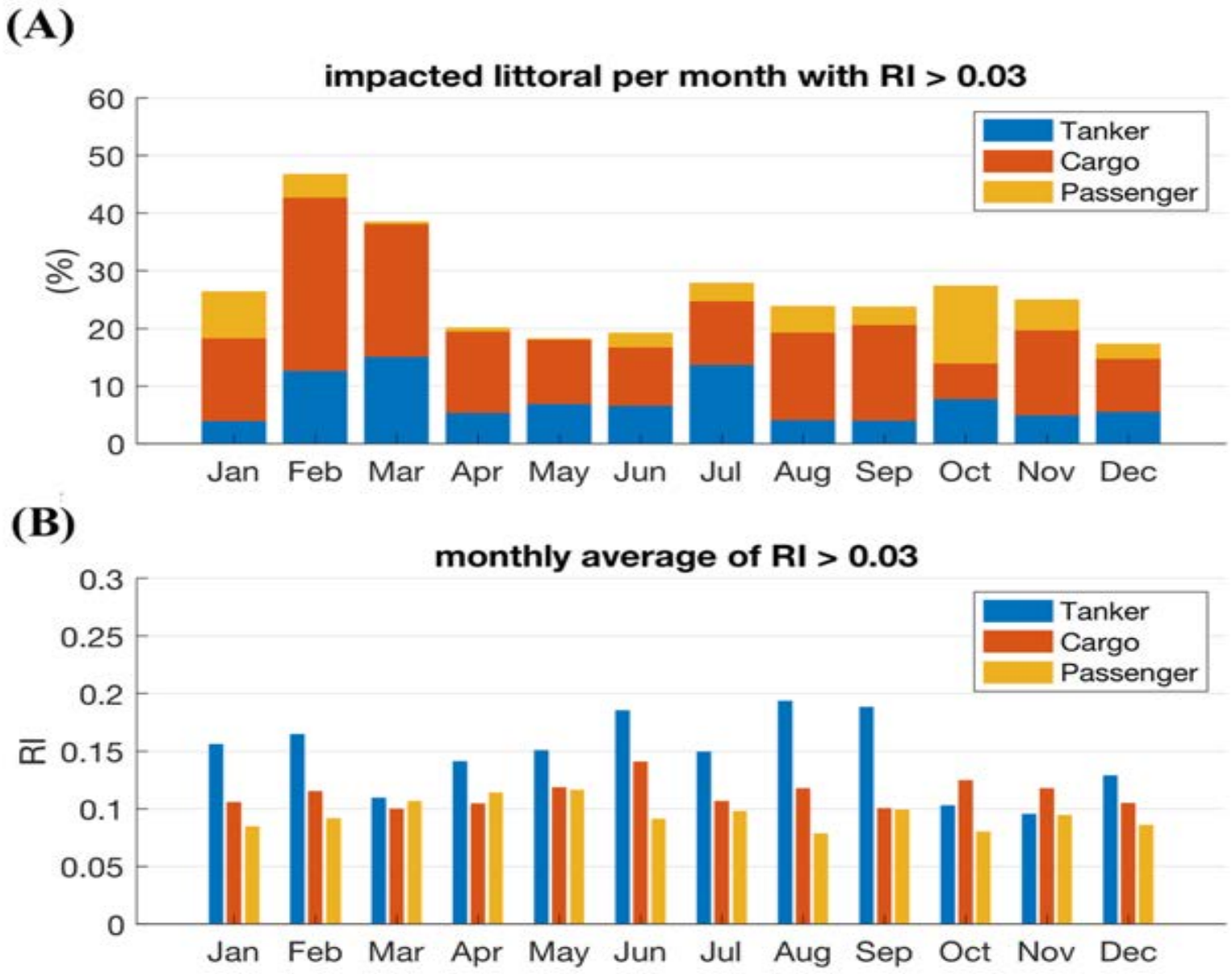
RISK MAPS ANALISYS – COMPARISON AMONG TYPE OF VESSELS

$$RI_j^s = HZ_j^s * ESI_j$$

.. f(HAZARD, VULNERABILITY)

Monthly variation of the cumulative (tanker, cargo and passenger vessels) percentage of impacted littoral when RI values are greater than 0.03 (Panel A).

Mean values of a RI data set greater than 0.03, per month and vessels category (Panel B).

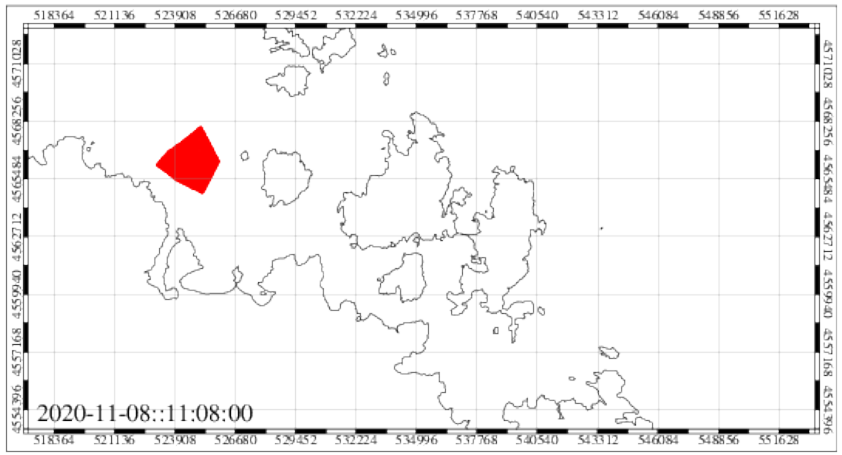


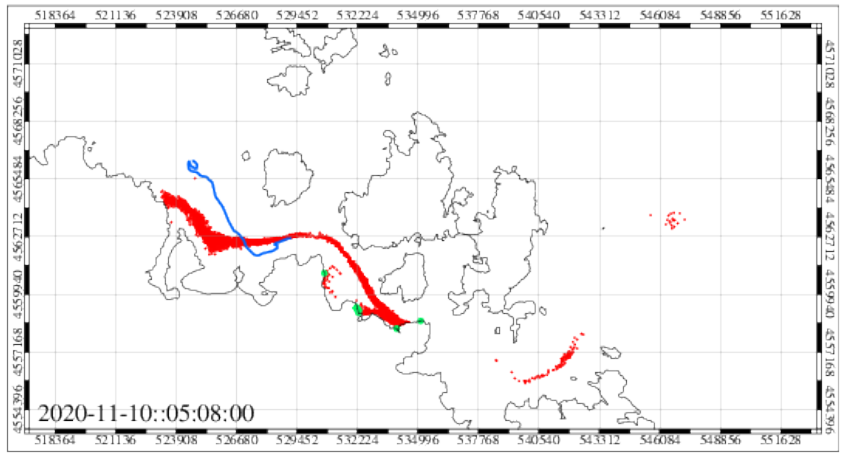
SICOMARPLUS

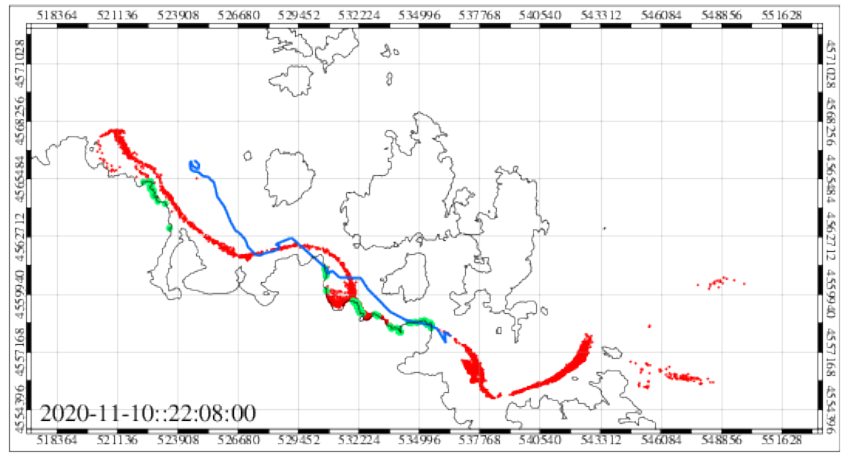
SIstema transfrontaliero per la sicurezza in mare COntro i rischi della navigazione e per la salvaguardia dell'ambiente MARino

T3 - SISTEMI INTEGRATI DI PREVISIONE OCEANOGRAFICA

IMPLEMENTAZIONE DI MODELLI OPERATIVI PTM PER SAR E ANTI-INQUINAMENTO







SERVIZIO ON DEMAND CON

ACCESSO LOGIN - SEEDING

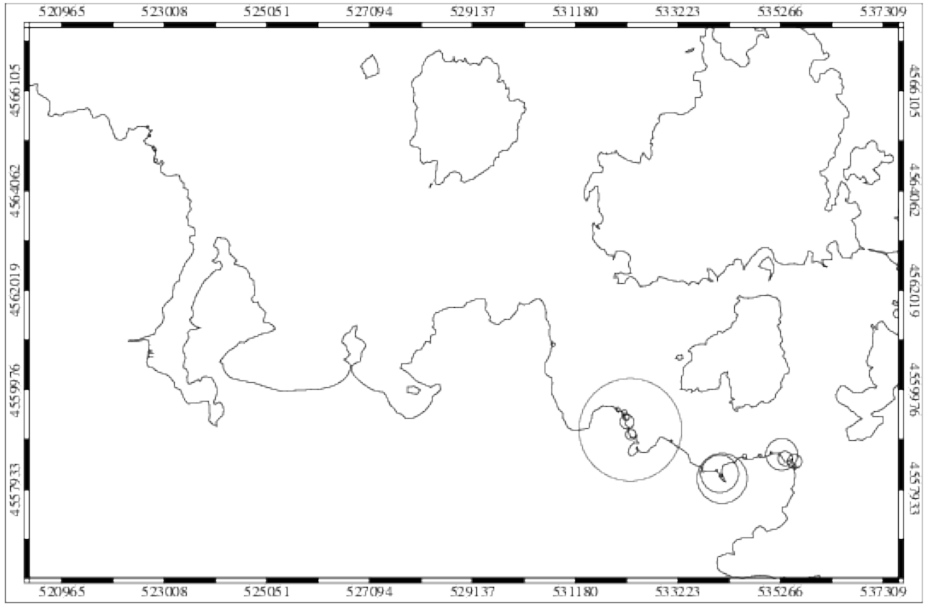
PARTICELLE - PREVISIONI

TRAIETTORIE - PREVISIONE

IMPATTI A COSTA - CALCOLO

DANNO IN BASE A

VULNERABILITÀ AREA



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http://www.seaforecast.cnr.it/sicomarplus/index.php/previsioni/