UNIVERSITY OF LJUBLJANA
Faculty of Maritime Studies and Transportation

Simulation Based Emergency Response Training Exercises: Contribution to Maritime Education, Environment and Safety

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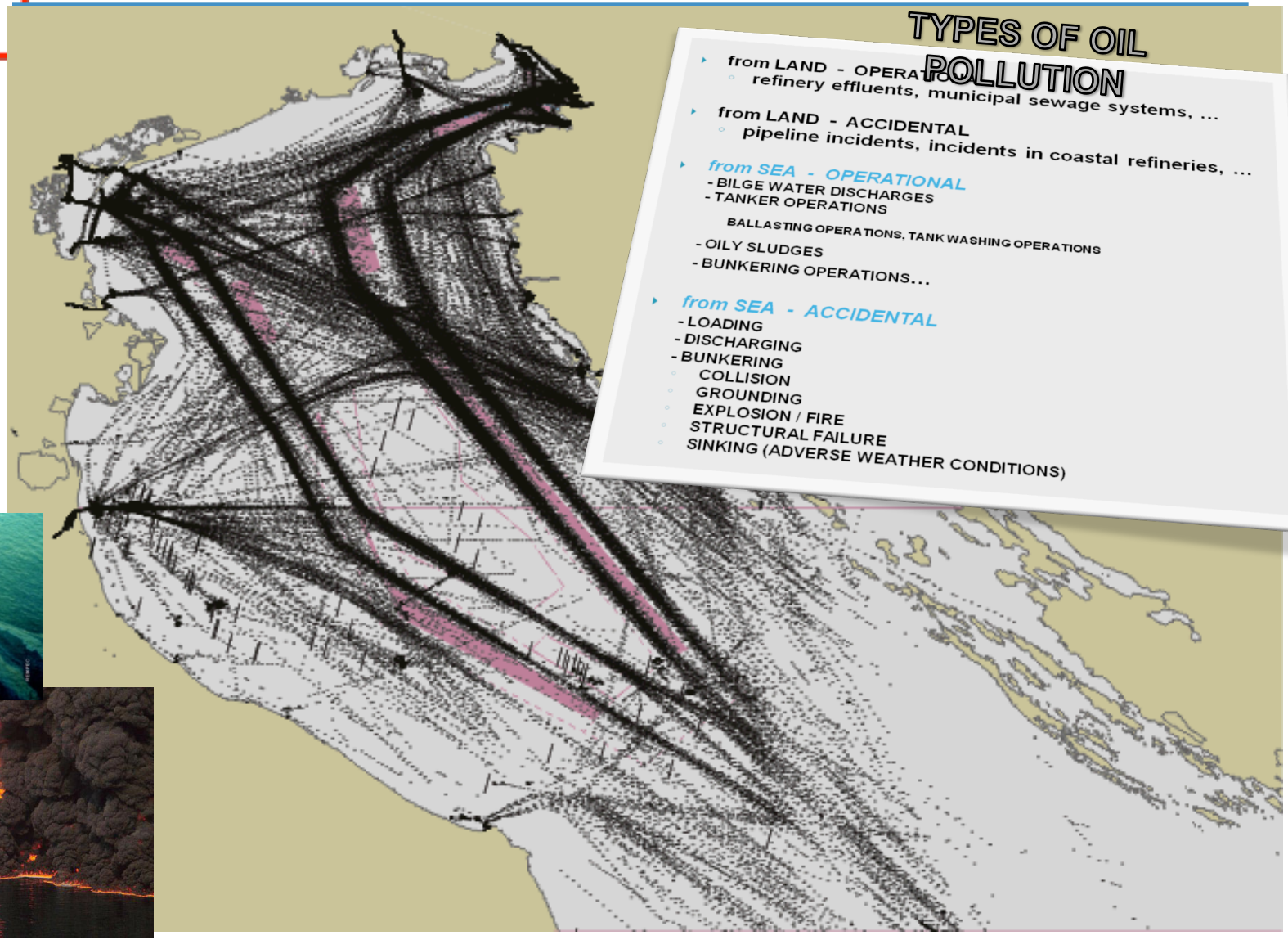
London, 14th March 2012

Presentation layout

1. Introduction;
   - Shipping and Consequences
2. Maritime Education and Training;
   - Simulation Based Education, Training and Researching by Using Maritime Complex Integrated Simulation System
3. Maritime Environment;
   - Illicit Oil Polluters Identification
   - Oil Pollution Crisis Management at Sea
4. Maritime Safety;
   - Maritime Traffic Risk Identification and Analyses
   - Port and Waterway Design

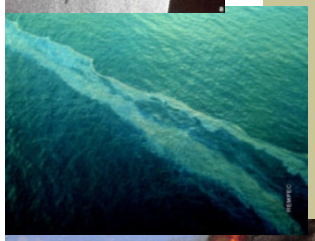
1. Introduction; Shipping overview

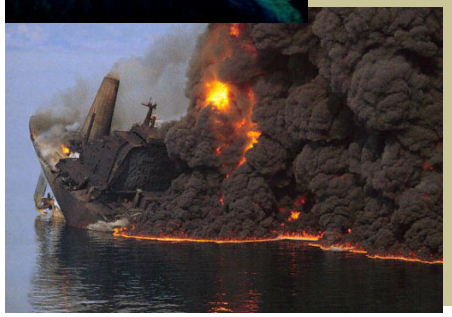
Consequence; Safety and environmental challenges !!!



TYPES OF OIL POLLUTION

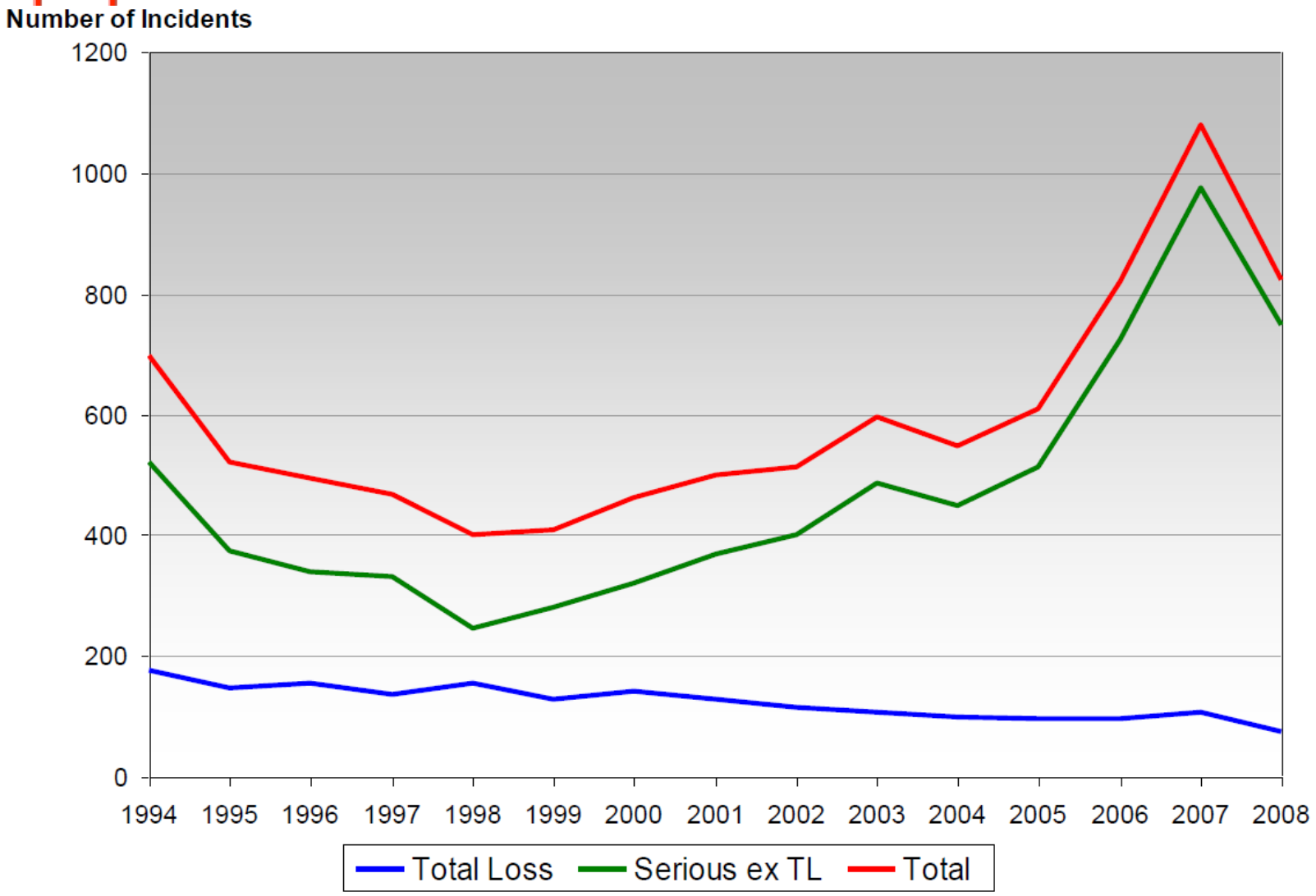
- from LAND - OPERATIONAL
  - refinery effluents, municipal sewage systems, ...
- from LAND - ACCIDENTAL
  - pipeline incidents, incidents in coastal refineries, ...
- *from SEA - OPERATIONAL*
  - BILGE WATER DISCHARGES
  - TANKER OPERATIONS
    - BALLASTING OPERATIONS, TANK WASHING OPERATIONS
  - OILY SLUDGES
  - BUNKERING OPERATIONS...
- *from SEA - ACCIDENTAL*
  - LOADING
  - DISCHARGING
  - BUNKERING
  - COLLISION
  - GROUNDING
  - EXPLOSION / FIRE
  - STRUCTURAL FAILURE
  - SINKING (ADVERSE WEATHER CONDITIONS)





Safety at sea

Serious losses show a very steep increase in number – well above fleet growth

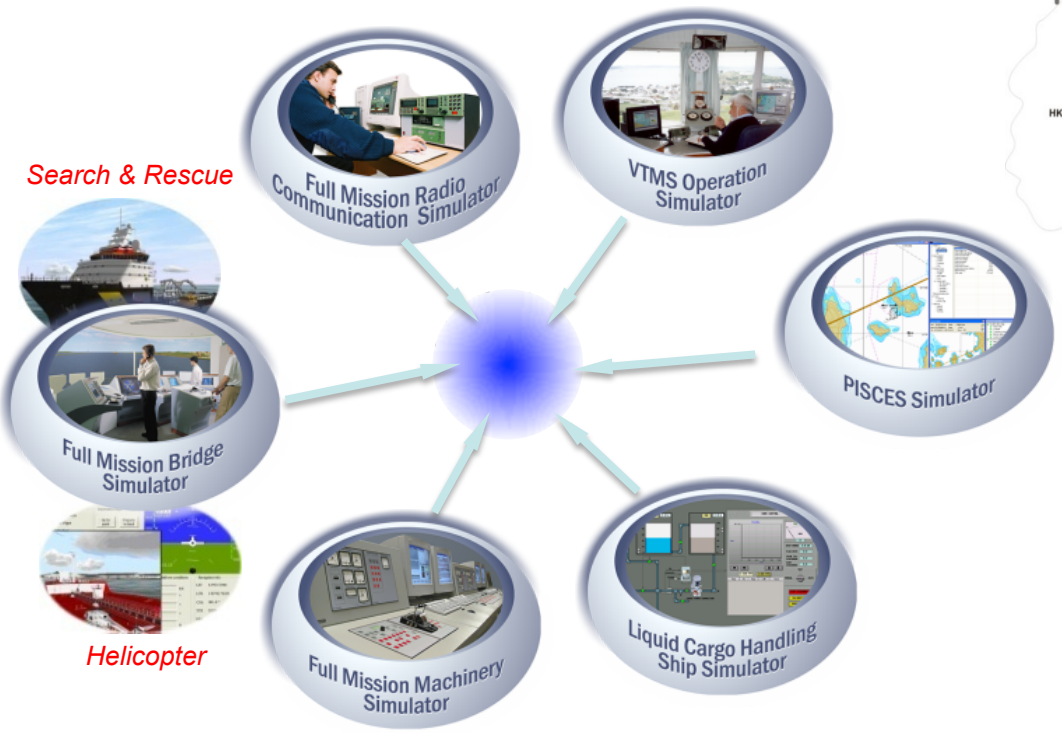


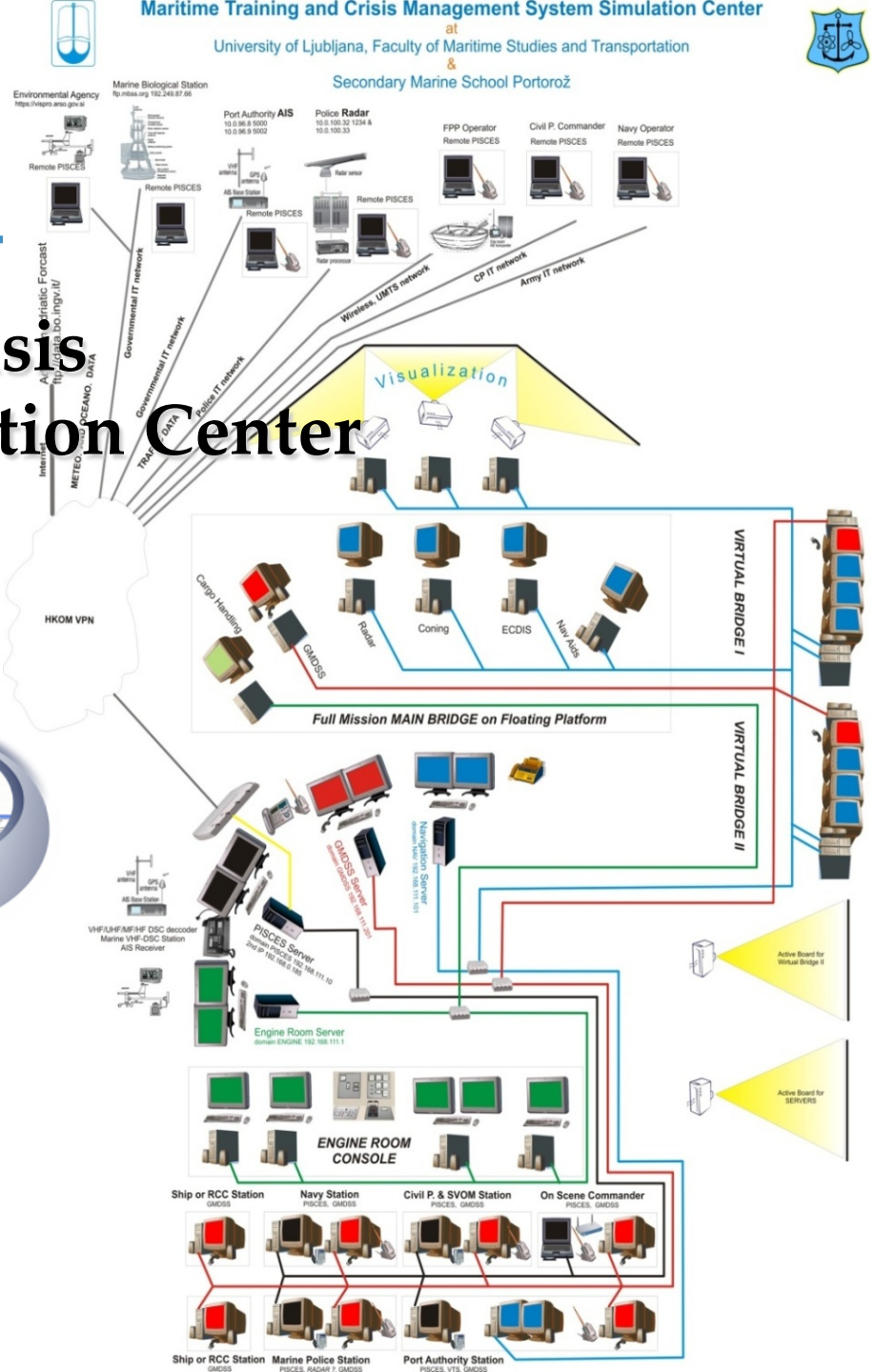
Source: ISL, UNCTAD, LMIU

1. Introduction; Shipping is facing several environmental challenges

Source: The Torvald Kvalness Group

2. Maritime Training and Crisis Management System Simulation Center





Safety at sea - Education/Training
Still challenges to be met

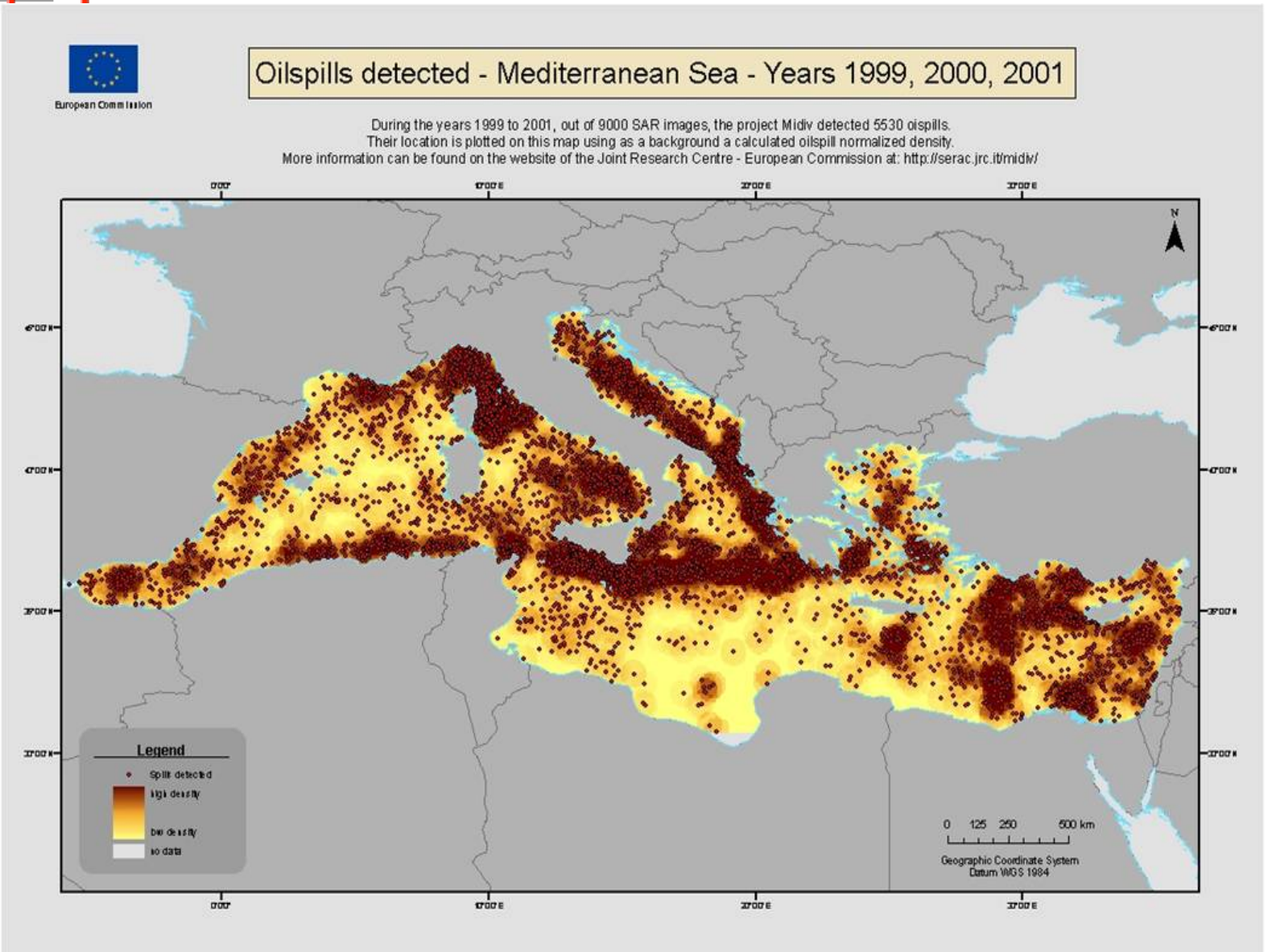
Curriculum 1852/53

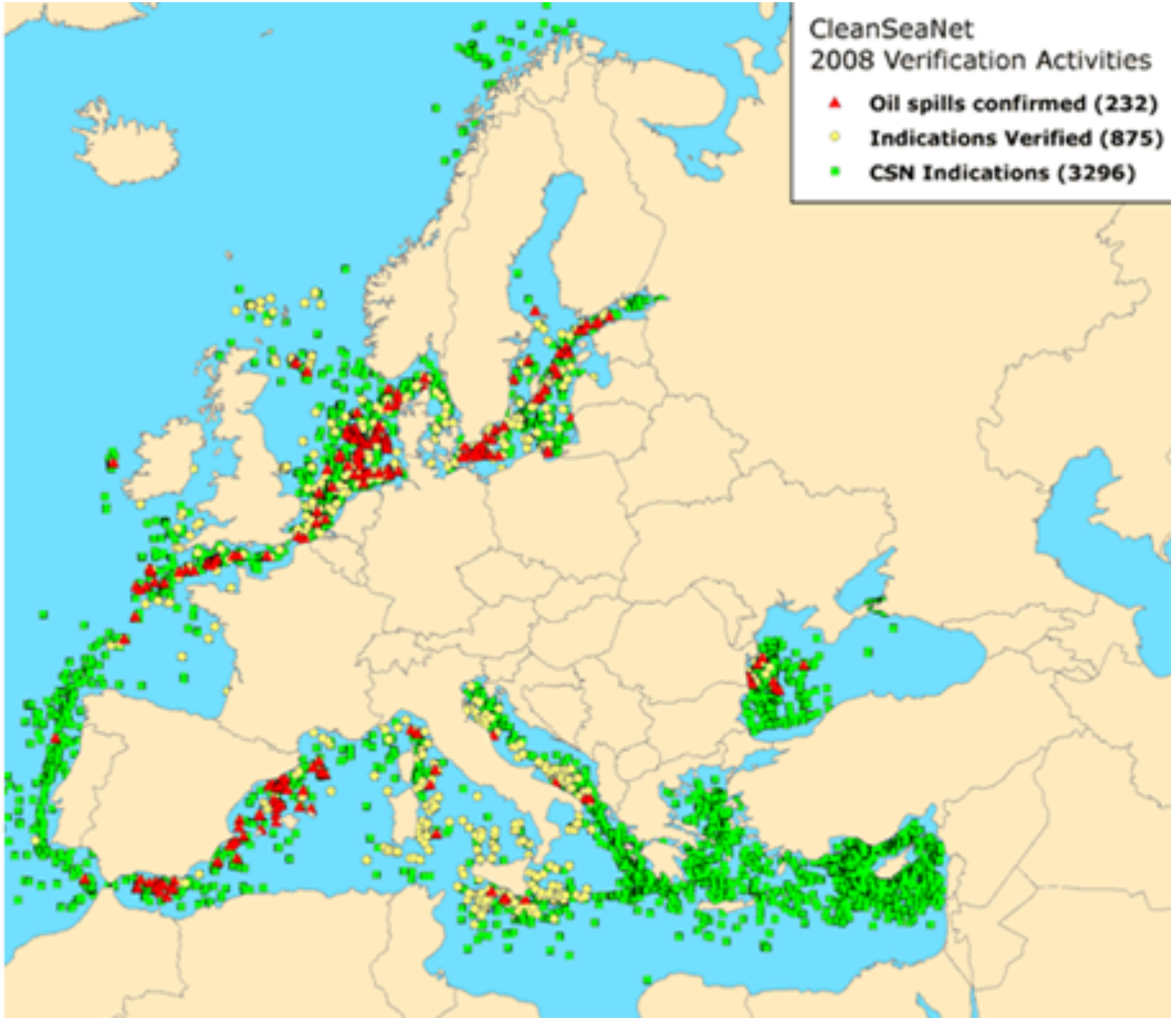
Subject	Teaching hours/ week	
	I. year	II. year
Religious	2	2
Mathematics	4	2
Commercial science	2	-
Practical seamanship	3	-
Nautical science	-	3
Shipbuilding	-	3
∑	11	10

Curriculum 2008/09

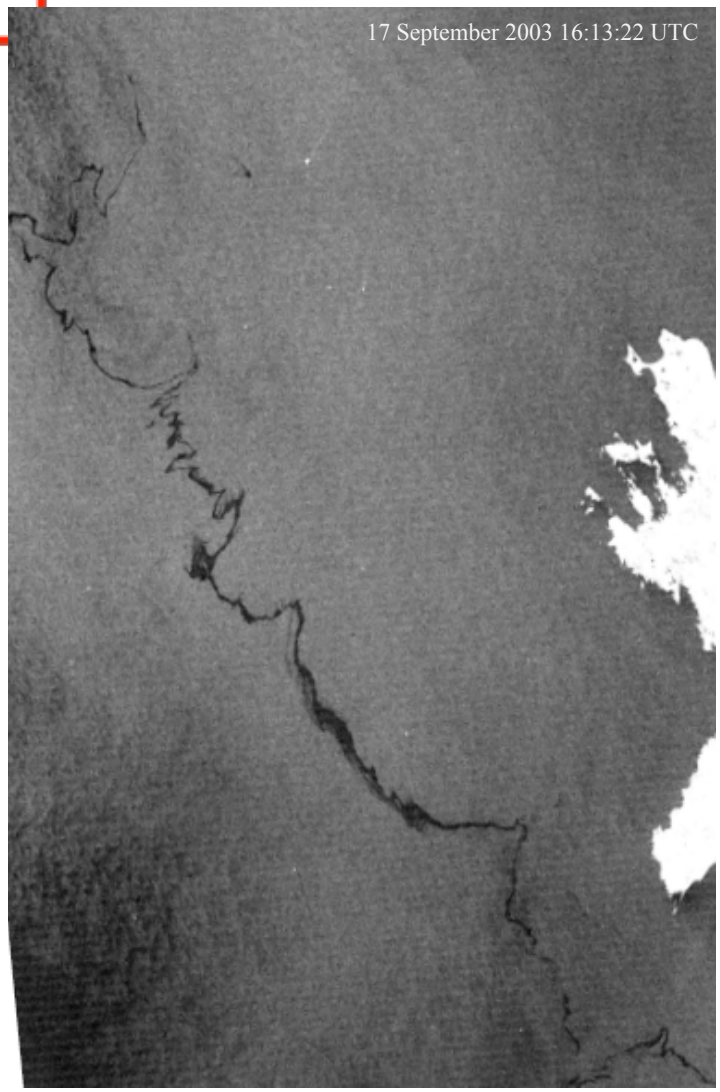
1st Year		Contact hours P	S	V	D	∑	ECTS	Simulation
1. semester		**240**		**195**	**15**	**450**	**30**	
1	Selective chapters of physics and math's	60		60		120	8	
2	Maritime and economic law	30		30		60	4	
3	Maritime transport systems	30		15	15	60	4	☹ LCH, SH
4	Materials and welding	30		30		**60**	4	
5	Thermodynamics	45		30		**75**	5	☹ CBT, ERS
6	Fuels, lubricants and water	45		30		**75**	5	☹ CBT, ERS, CM
2. semester		**210**	**15**	**165**	**60**	**450**	**30**	
7	Mechanics and hydrodynamics	60		60		120	8	☹ CBT, SIM
8	Engineers graphics and technical	**30**	**0**	**30**		**60**	**4**	☹ ERS
9	Electro systems for engineers	45	15	30	15	105	7	☺ CBT, ERS
10	Basic seamanship for engineers	45		15	15	75	5	☹ CBT
11	Maritime skills for engineers	30		30	30	**90**	6	
		450	**15**	**360**	**75**	**900**	**60**	
2nd Year		**Contact hours P**	**S**	**V**	**D**	**∑**	**ECTS**	
3. semester		**210**	**15**	**115**	**60**	**450**	**30**	
12	Ship's construction elements	45	15	15	15	90	6	☹ CBT
13	Pneumatics and hydraulic	30			30	60	4	☺ CBT, ERS
14	Maritime English	30		30		60	4	
15	Regulation and automation	45		30	15	90	6	☺ CBT, ERS, SIM
16	Computing and informatics for engineers	30	15	30	15	90	6	☹ CBT, ERS
17	Human resources	30	15	10	5	60	4	☺ ERS, INTG
4. semester		**195**	**45**	**120**	**90**	**450**	**30**	
18	Diesel propulsion	45		15	30	90	6	☺ CBT, ERS, INTG
19	Shipping management	30		15		45	3	☹ CBT, ERS
20	Auxiliary systems	45	15	45	15	120	8	☺ CBT, ERS
21	English language for ship engineers	45	15	30	15	105	7	☺ CBT, ERS
22	Watch keeping in engine room	30	15	15	30	**90**	6	☺ ☺ CBT, ERS
		405	**60**	**235**	**150**	**900**	**60**	
3rd Year		**Contact hours P**	**S**	**V**	**D**	**∑**	**ECTS**	
5. semester		**135**	**90**	**135**	**90**	**450**	**30**	
23	Technical measurements	15	15	15	15	**60**	5	☹ CBT, ERS
24	Steam and gas propulsion	15	15	15	15	60	4	☺ CBT, ERS
25	Safety aboard ships	15	15	15	15	60	4	☺ CBT, CM, INTG
	Block of optional subjects (3)	**90**	**45**	**90**	**45**	**270**	**18**	
op1	*Maritime information systems*	*30*	*15*	*30*	*15*	*90*	*6*	☺ LCH, ERS, INTG
op2	*Tankers*	*30*	*15*	*30*	*15*	*90*	*6*	☺ LCH
op3	*Ship's maintenance*	*30*	*15*	*30*	*15*	*90*	*6*	☺ CBT
op4	*Ship's propulsion II*	*30*	*15*	*30*	*15*	*90*	*6*	☺ CBT, ERS, INTG, SIM
op5	*Marine refrigeration technology II*	*30*	*15*	*30*	*15*	*90*	*6*	☺ CBT, ERS, SIM
op6	*Corrosion and material protection*	*30*	*15*	*30*	*15*	*90*	*6*	☺ *CBT*
op7	*Navy ship's fighting systems*	*30*	*15*	*30*	*15*	*90*	*6*	☺ CBT, ERS
6. semester		**0**	**0**	**30**	**420**	**450**	**30**	
26	Engine room simulator training	0	0	30	60	90	6	☺ CBT, ERS, INTG
27	Industry practice for engineers	0	0	0	210	210	14	
28	Dissertation	0	0	0	150	150	10	☺ CBT, ERS, INTG
		150	**90**	**165**	**495**	**900**	**60**	
Sum of programme		**960**	**210**	**805**	**720**	**2700**	**180**	

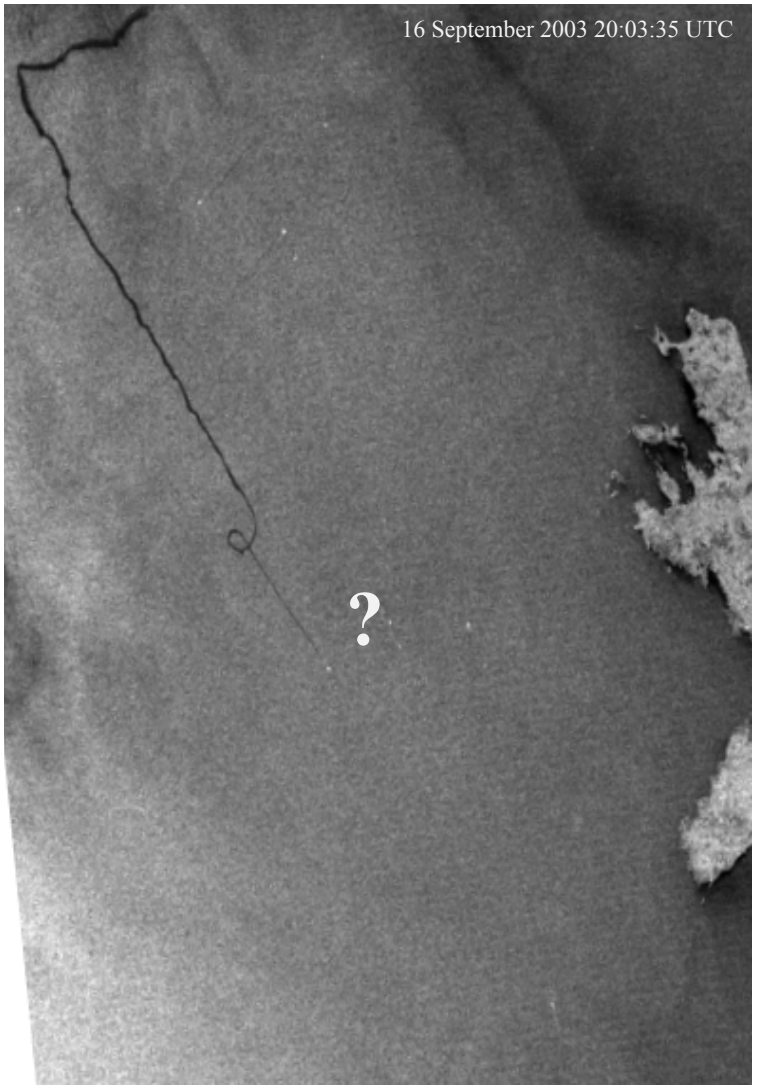
3. Maritime Environment
Operational and accidental pollution




CleanSeaNet
2008 Verification Activities
Oil spills confirmed (232)
Indications Verified (875)
CSN Indications (3296)

Operational pollution and polluter identification challenges' !!!

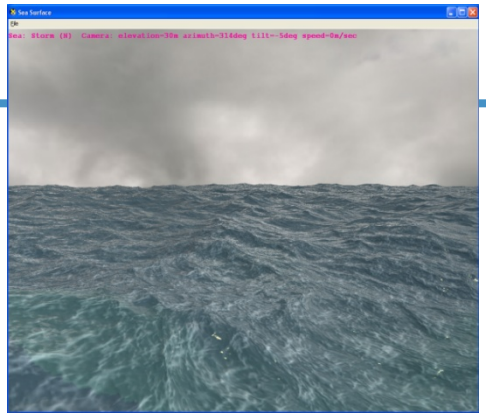


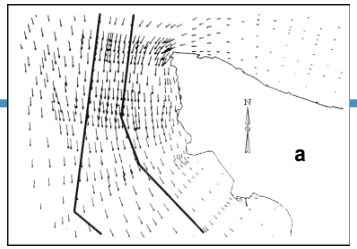


Source: OCEANIDES

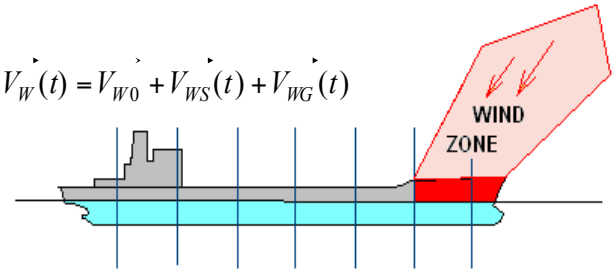
METOCEAN; data validation

Wind modeling allows the determination of aerodynamic forces and moments taking into consideration sections of over water hull, superstructure and deck equipment exposed to wind





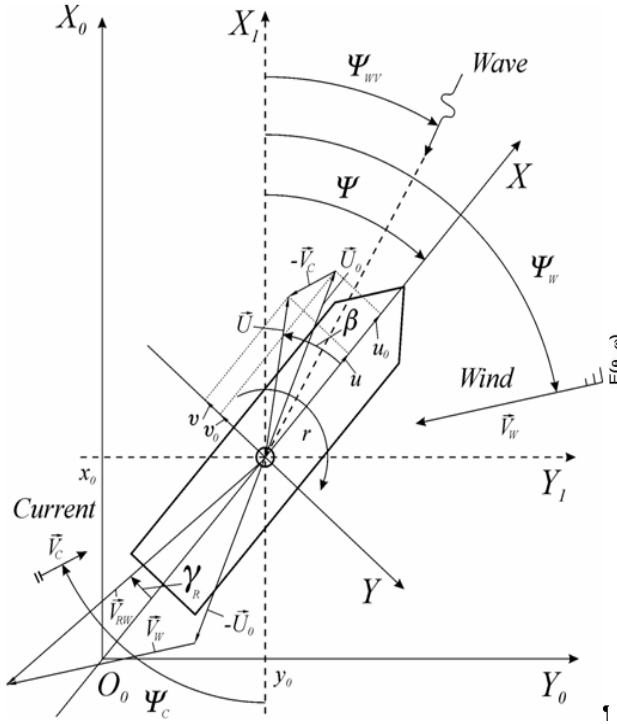
$$\vec{V}_W(t) = \vec{V}_{W0} + \vec{V}_{WS}(t) + \vec{V}_{WG}(t)$$



Hydrodynamic forces and moments on the ship hull depending on the speed of current. Total side force and yaw moment can be expressed as follows:

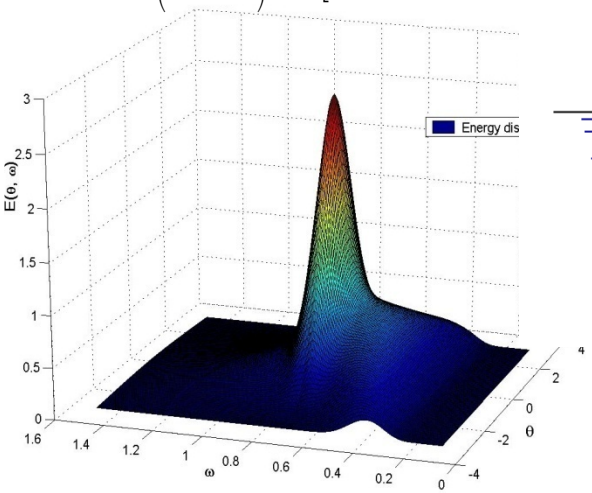
$$Y_C = -\frac{\rho}{2}\int_{-l_a}^{l_f} T(x) C_{CFD}(x) (v_C(x) - v_C(0)) |v_C(x) - v_C(0)| dx;$$

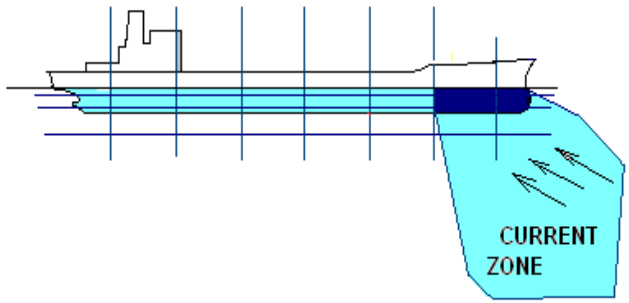
$$N_C = -\frac{\rho}{2}\int_{-l_a}^{l_f} T(x) C_{CFD}(x) (v_C(x) - v_C(0)) |v_C(x) - v_C(0)| x dx,$$



$$S(\omega) = \frac{\alpha g^2}{\omega^5}\exp\left(-\frac{5}{4}\left(\frac{\omega_p}{\omega}\right)^4\right)\gamma^{\psi(\omega)} \quad \alpha = 0.0076\left(\frac{U_{10}^2}{Fg}\right)^{0.22}$$

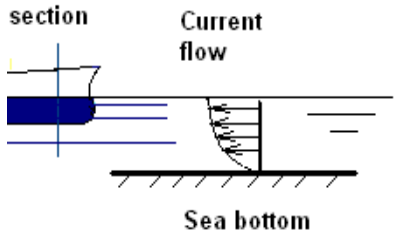
$$\psi(\omega) = \exp\left(\frac{(\omega-\omega_p)^2}{2\sigma^2\omega_p^2}\right), \quad \sigma = \begin{bmatrix} 0.07, & \omega \le \omega_p \\ 0.09, & \omega > \omega_p \end{bmatrix}$$





Sway wave force:

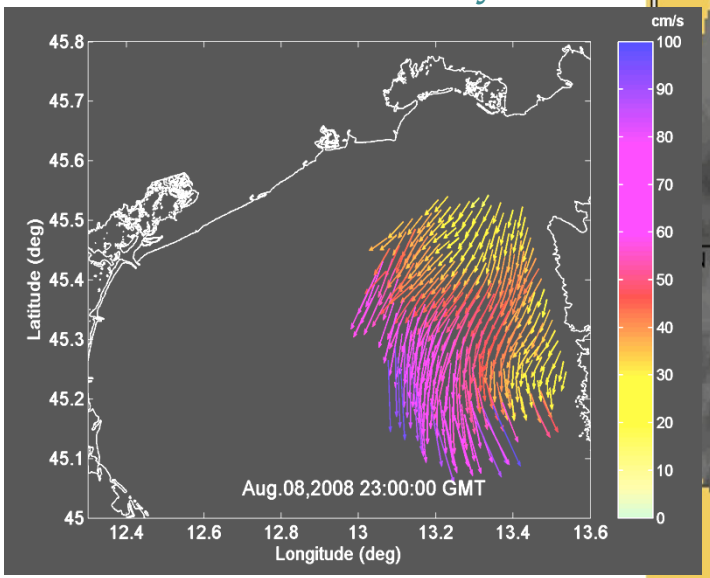
$$Y_1(t) = \sum_{i=1}^{N} \kappa_{iy}(\omega_i, \chi_i) mg \frac{\partial \zeta_i(x,y,t)}{\partial l_i}$$

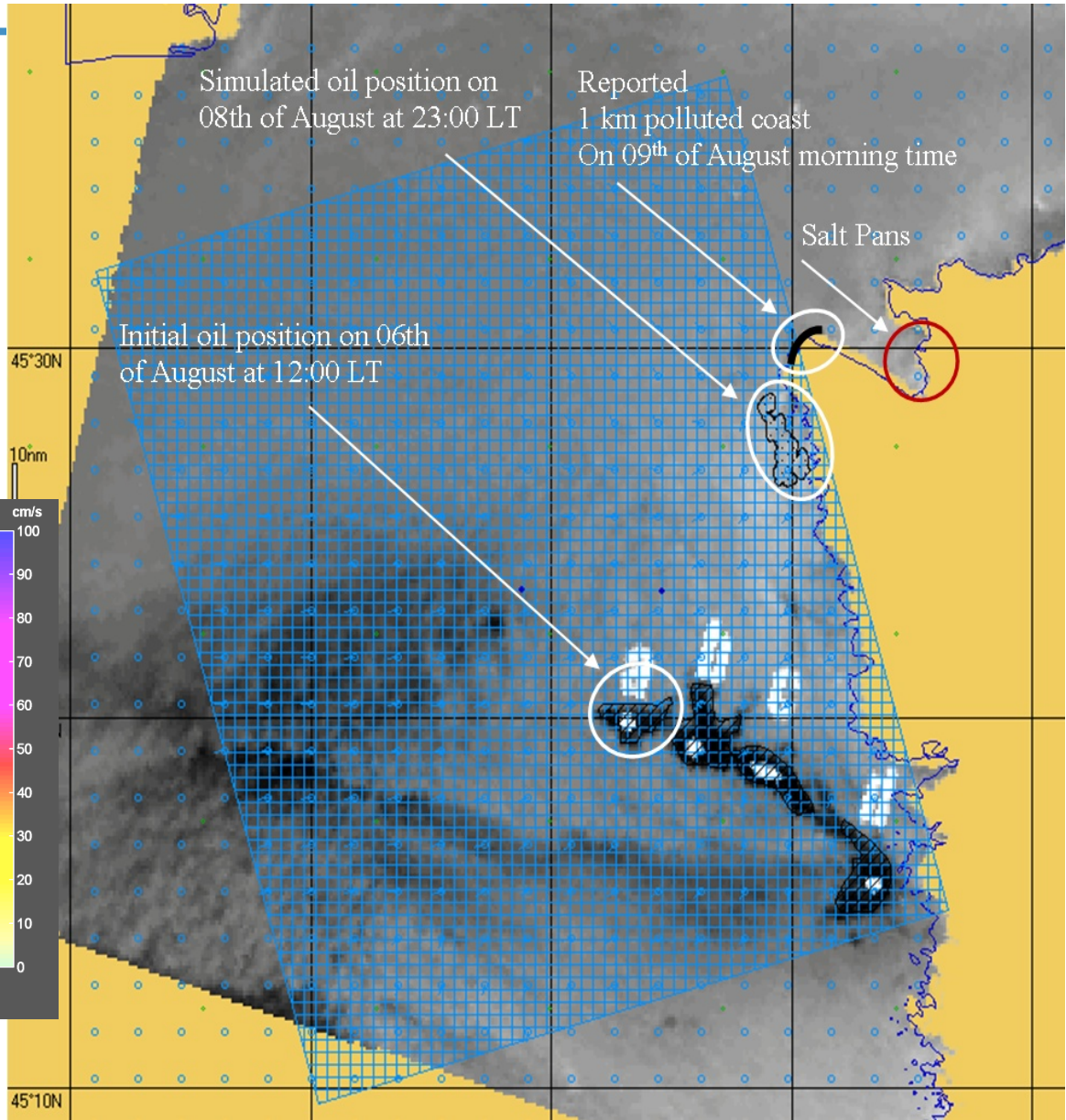


COMPLEX CASE; Highly weathered oil slick
Respond and backtracking issue “dt 60 h”

Identification feasible with:

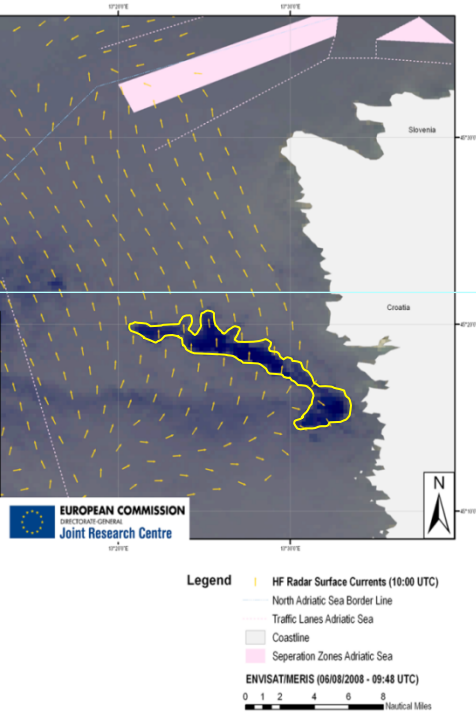
HF currents,
Accurate AIS,
Low wind area,
Persistent oil,
Uniform salinity...



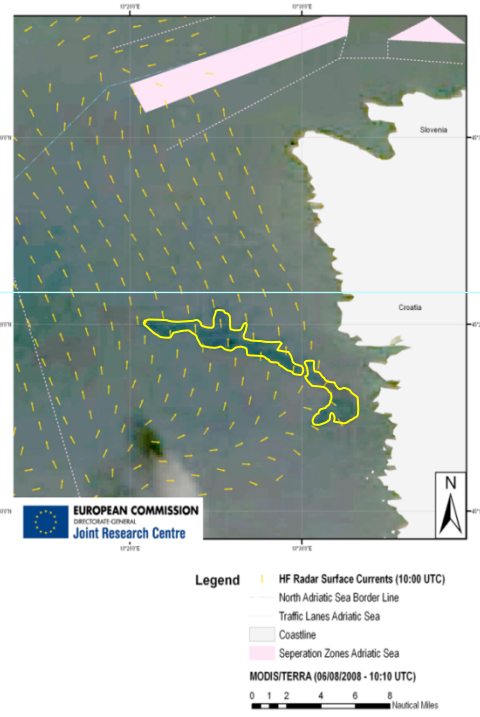


HF currents validation

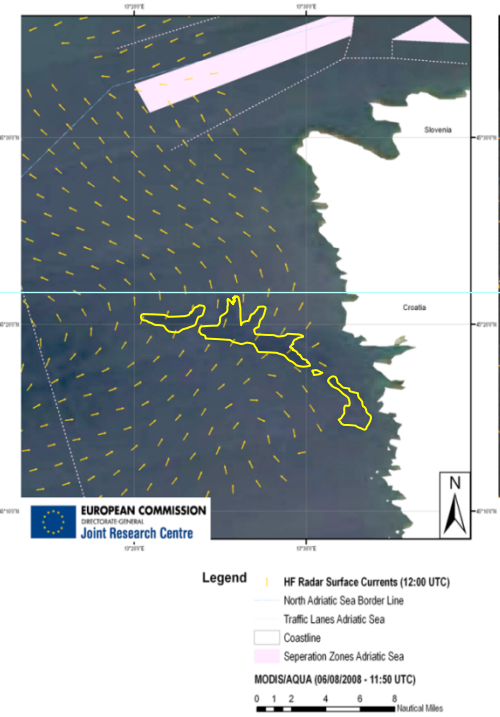
"finger print vs. sensor, time, response and HF currents"



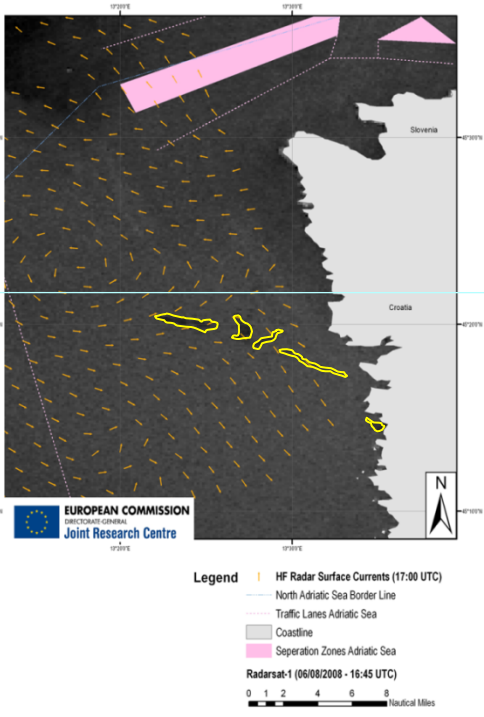
(ESA) ENVISAT/MERIS 09:48



(NASA) MODIS/TERRA 10:10



(NASA) MODIS/AQUA 11:50

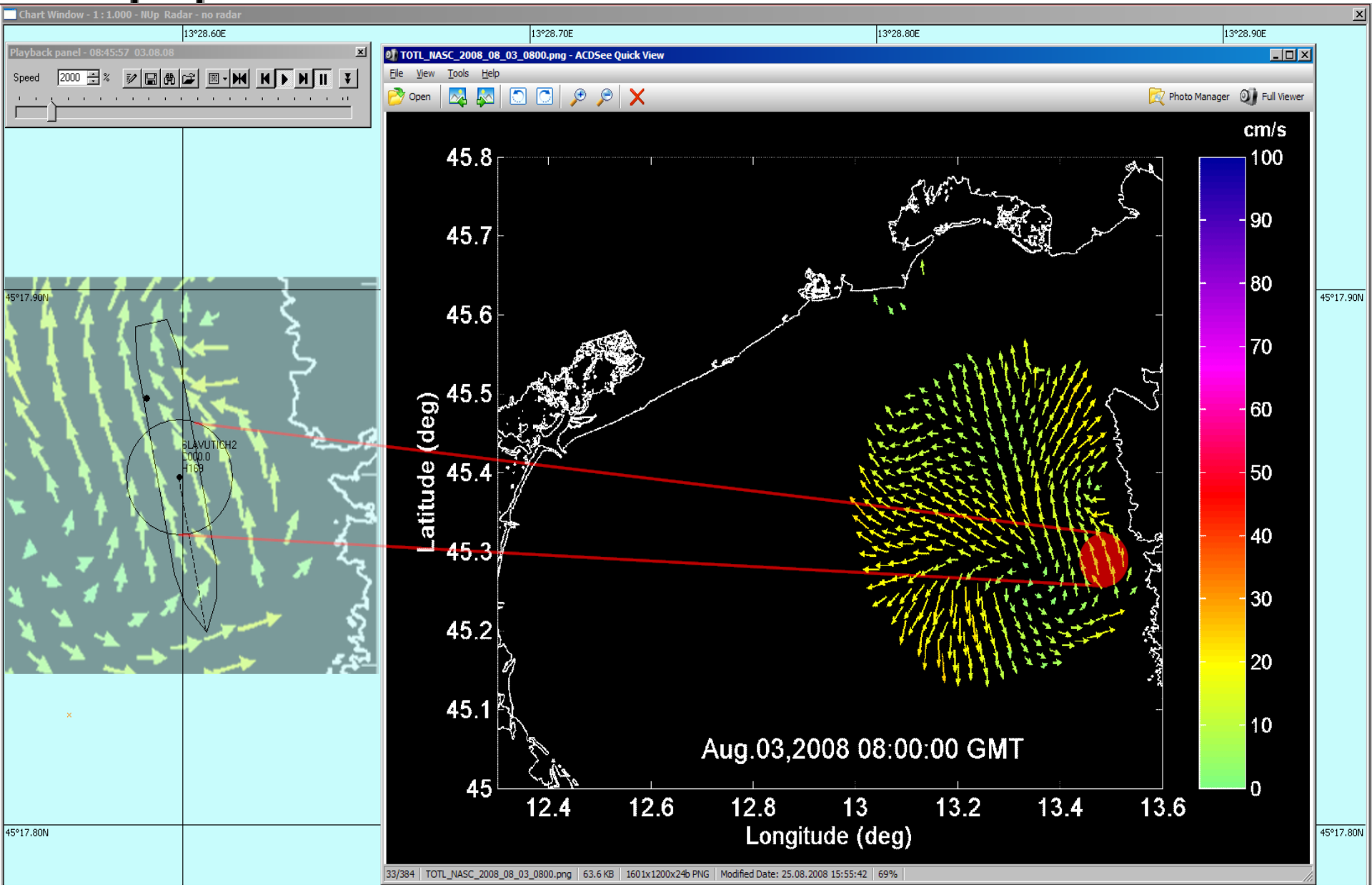


(MDA/CSA) RADARSAT-1 16:45

EMSA – CSN 18:45

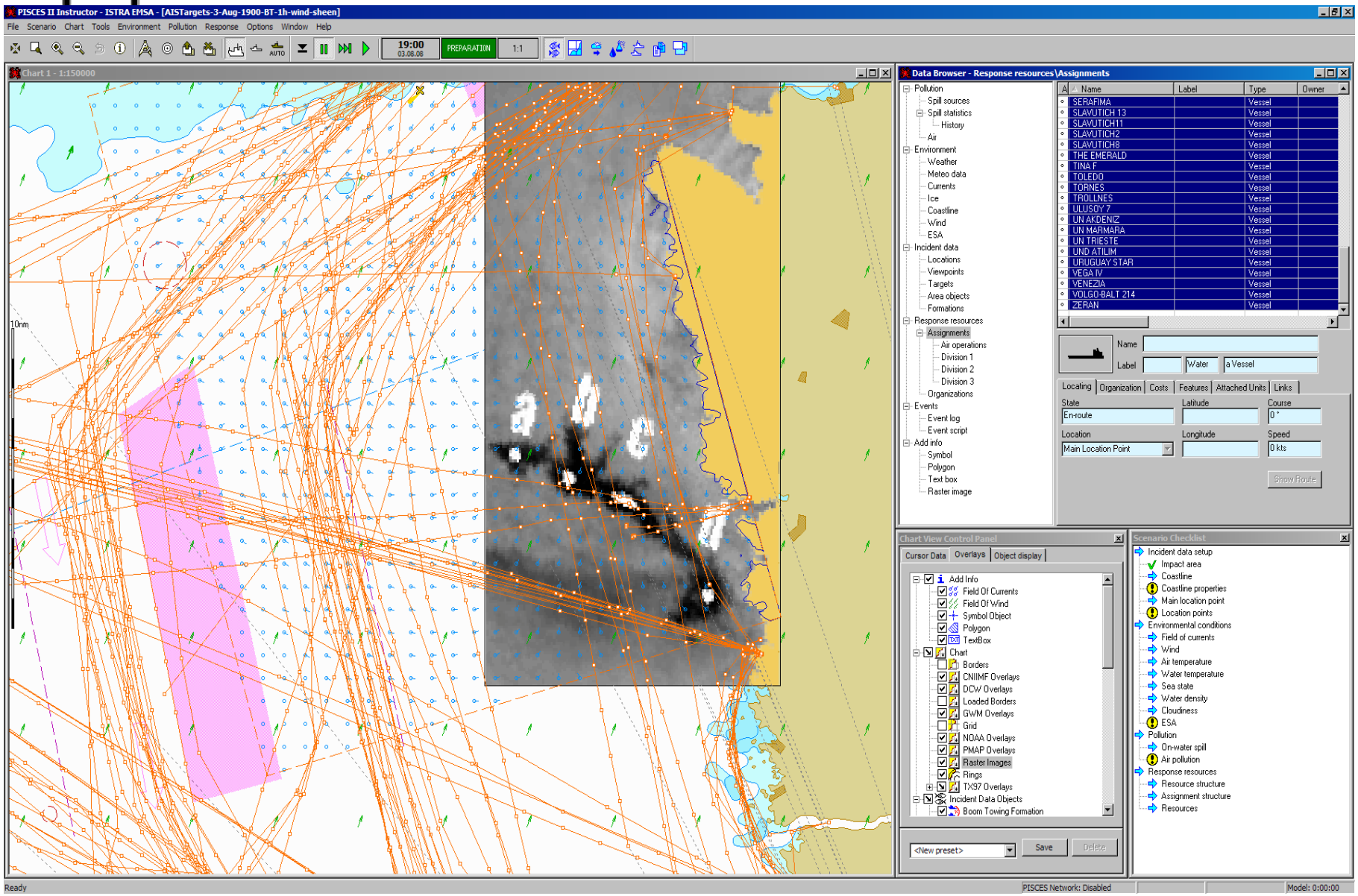
HF currents validation

“additional HF currents validation – anchored ships”



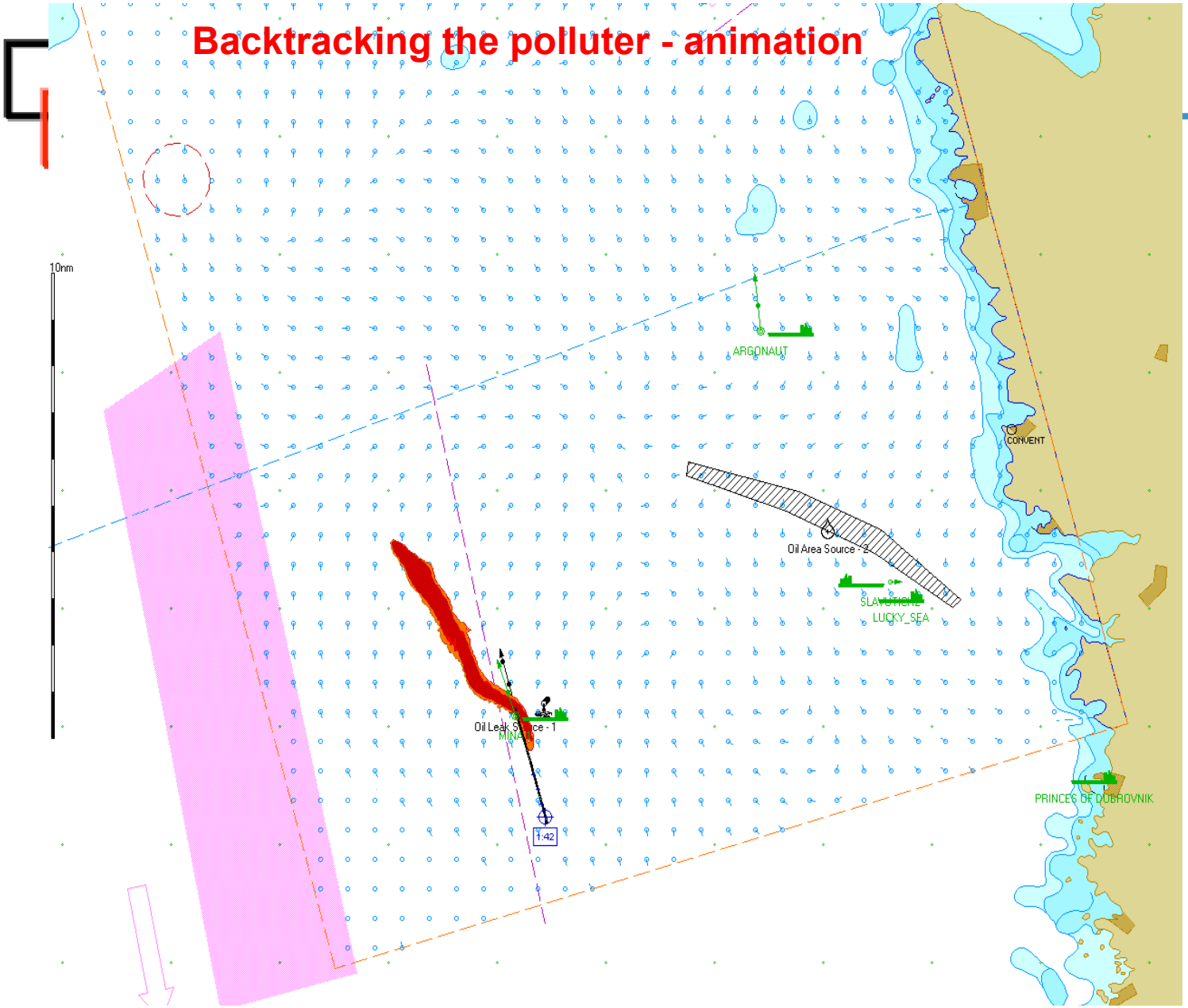
INTEGRATION

Sat image, AIS shipping, HF currents and Wind Stress on top Navigational chart



INGV – ***NASCUM project on HF currents*** **ESA** - **ENVISAT/MERIS** **PISCES 2** - ***Transas Technology***

Backtracking the polluter - animation



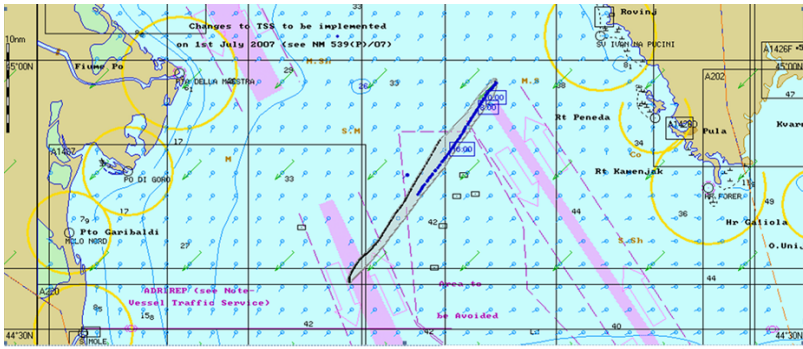
3. Maritime Environment

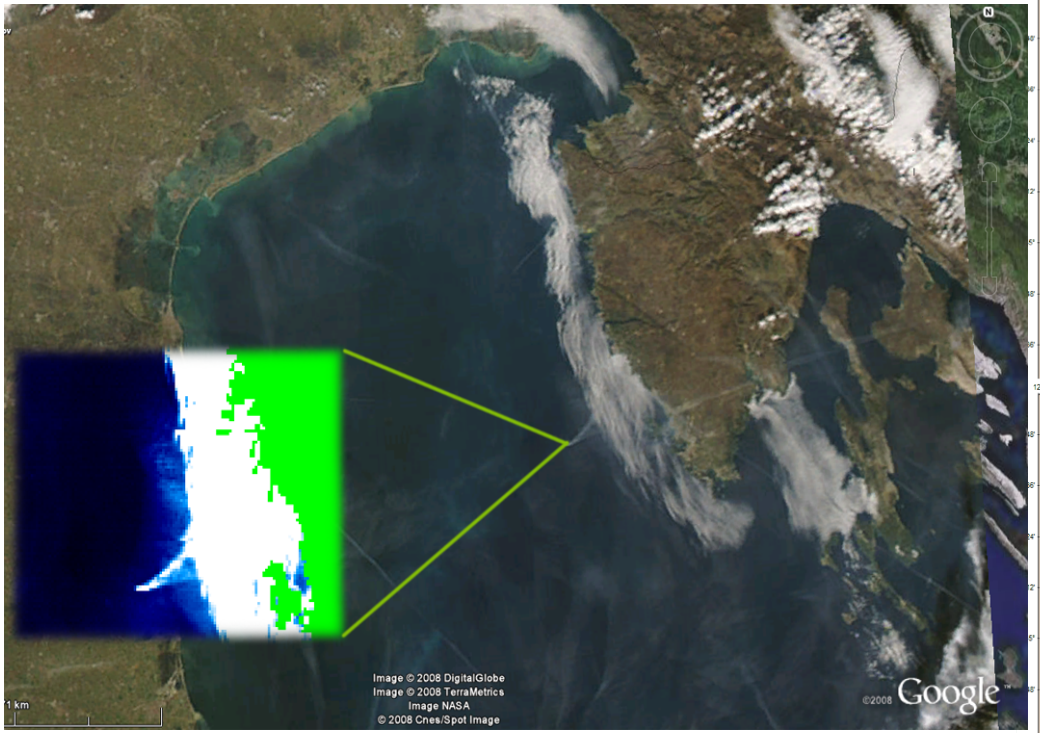
Crisis Management – "Und Adriyatik" Case

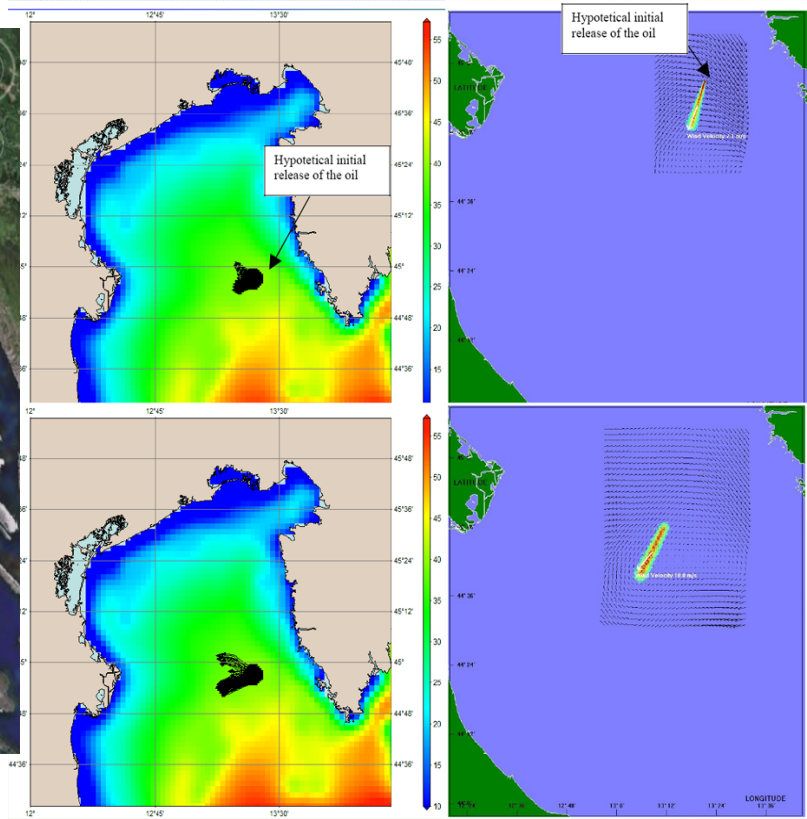
Simulation based decision making
Contingency planning

Croatia - Istria - Premantura / Medulin [Options]

GFS 06.02.2008 06 UTC	We 06. 07h	We 06. 10h	We 06. 13h	We 06. 16h	We 06. 19h	We 06. 22h	Th 07. 04h	Th 07. 07h	Th 07. 10h	Th 07. 13h	Th 07. 16h	Th 07. 19h	Th 07. 22h	Fr 08. 04h	Fr 08. 07h	Fr 08. 10h	Fr 08. 13h	Fr 08. 16h	Fr 08. 19h	Fr 08. 22h	Sa 09. 04h	Sa 09. 07h	Sa 09. 10h	Sa 09. 13h	Sa 09. 16h	Sa 09. 19h	Sa 09. 22h
Wind speed (knots)	10	5	4	2	3	6	11	12	12	11	9	11	14	14	16	18	20	21	22	20	15	14	14	11	11	15	16
Wind direction	→	→	↗	↘	↓	↓	↓	↓	↓	↓	↓	↙	↙	↙	↙	↙	↙	↙	↙	←	↙	↙	↙	↙	↙	↙	↙
Temperature (°C)	10	11	11	11	10	10	10	10	11	11	11	10	9	7	7	7	8	8	7	8	7	7	8	9	10	9	8
Cloud cover (%)	-	46	56	50	56	79	68	67	43	43	49	35	8	7	9	12	16	12	13	11	9	12	12	11	5	5	4
Rain (mm/3h)	-																										
Windguru rating							★	★	★		★	★	★	★	★	★★	★★	★★	★★	★★	★	★	★	★		★	★★





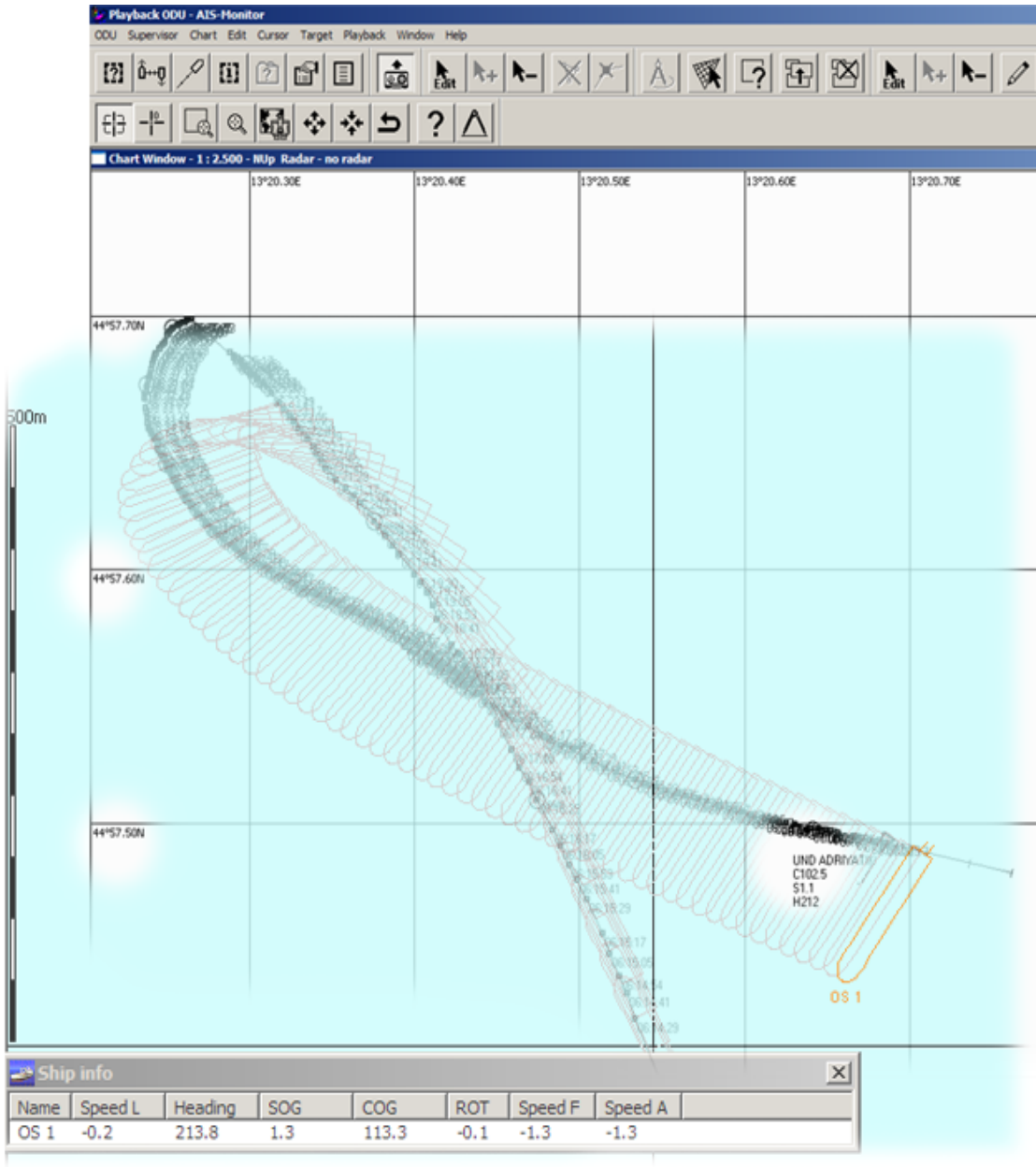


Simulation based decision making
Determining wind and currents
Contingency planning

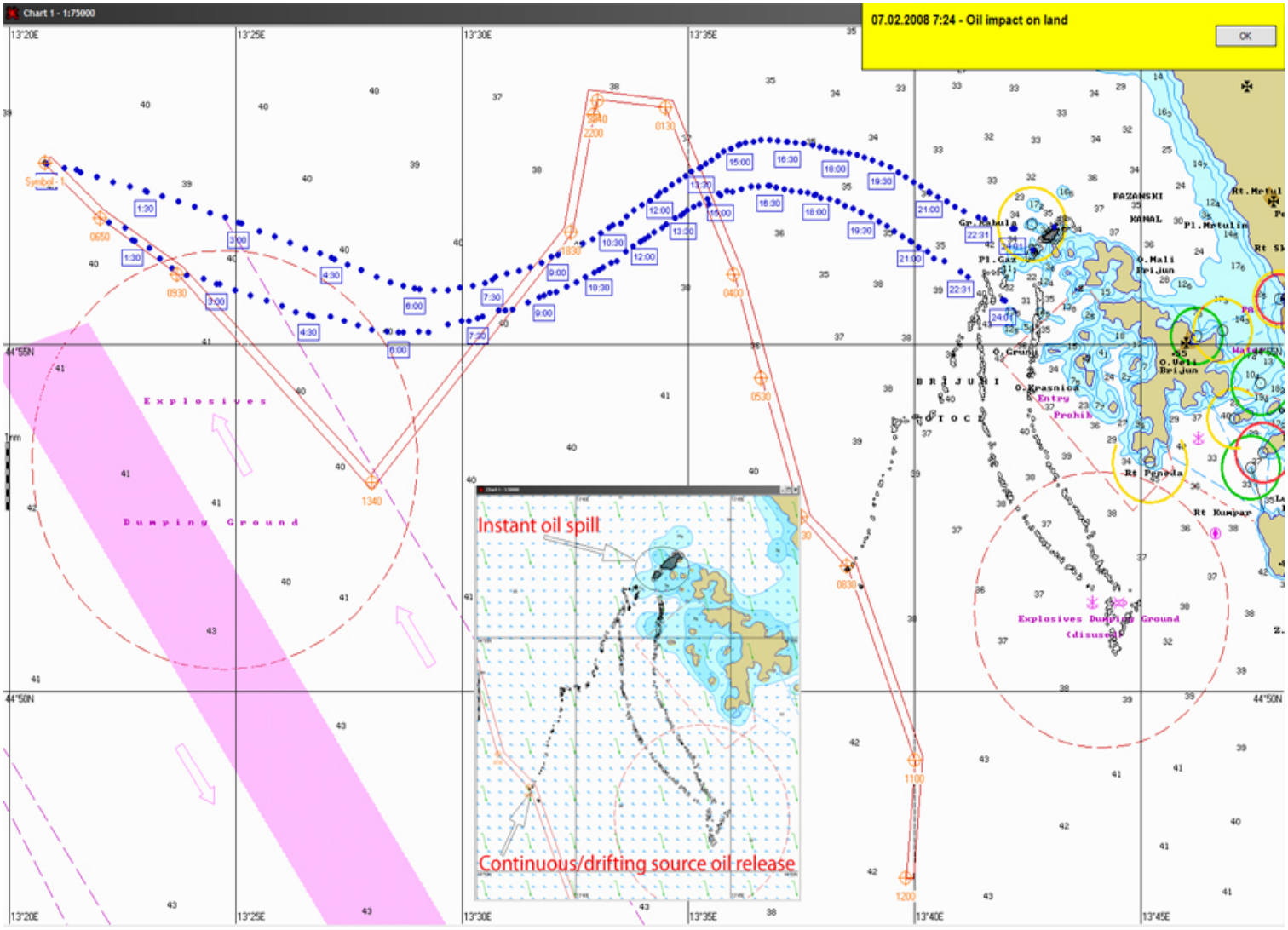
Comparison of the ship's drift based on the real AIS trajectory with the simulated one .

Analyzing the life raft drift !

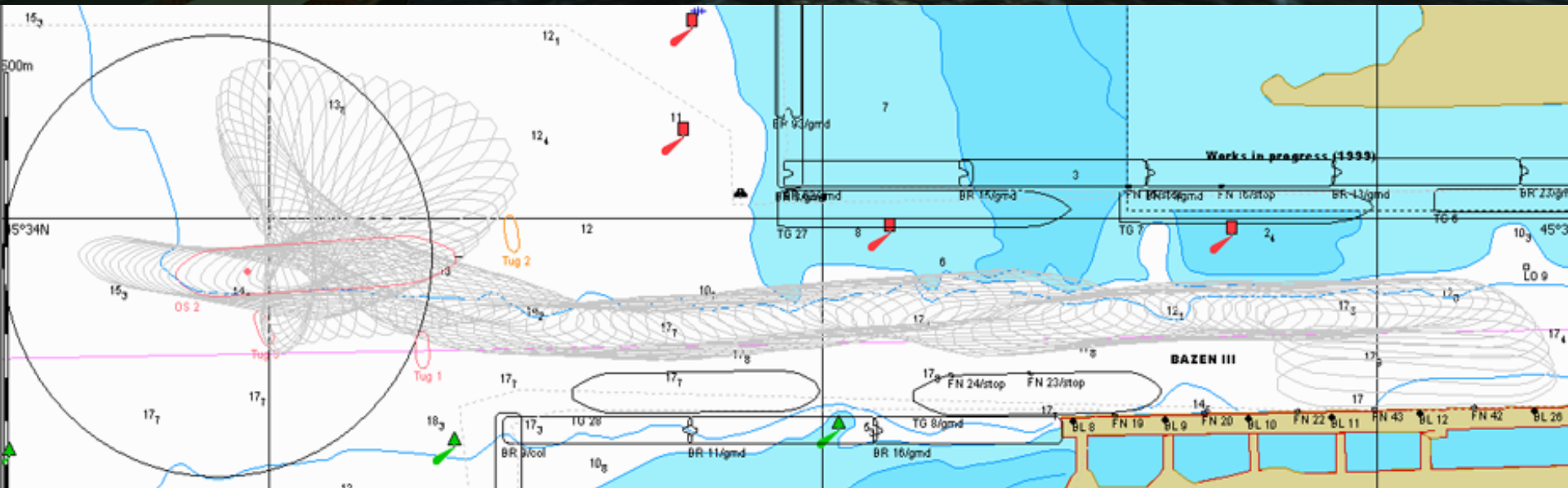
Ship handling simulator was used as a tool for modeling the ship's drift

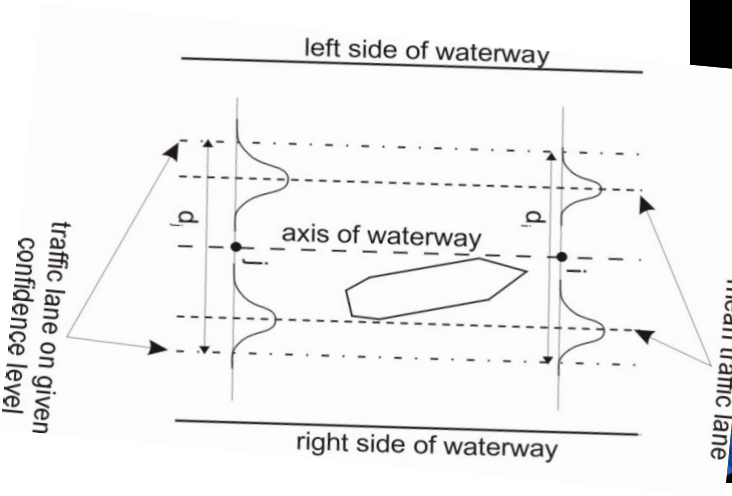


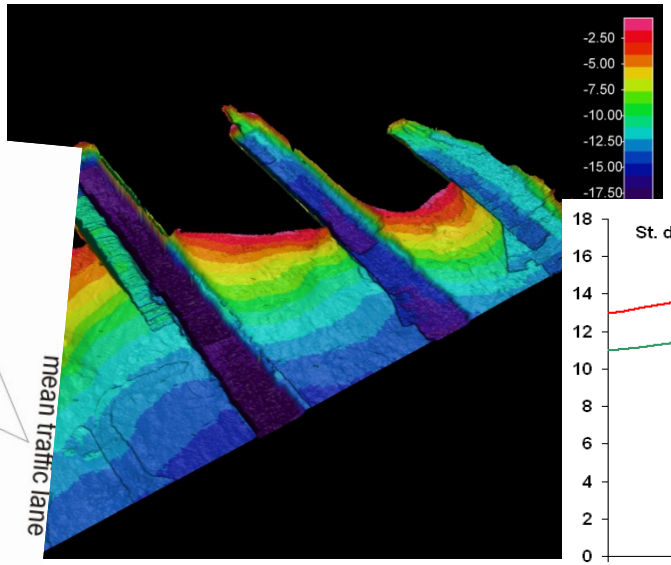
Oil spill simulation – with the winds and the field of surface currents (Δt=24h)

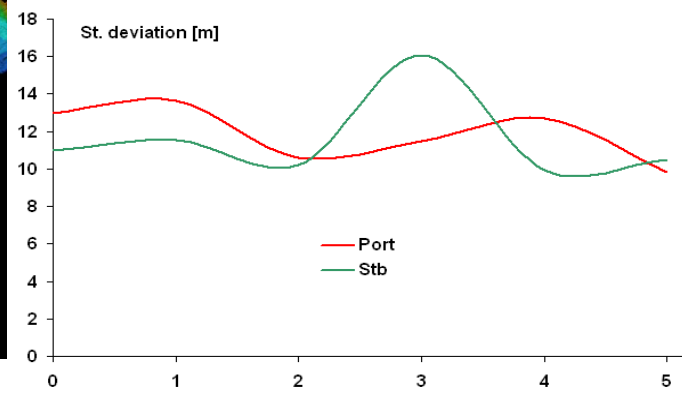


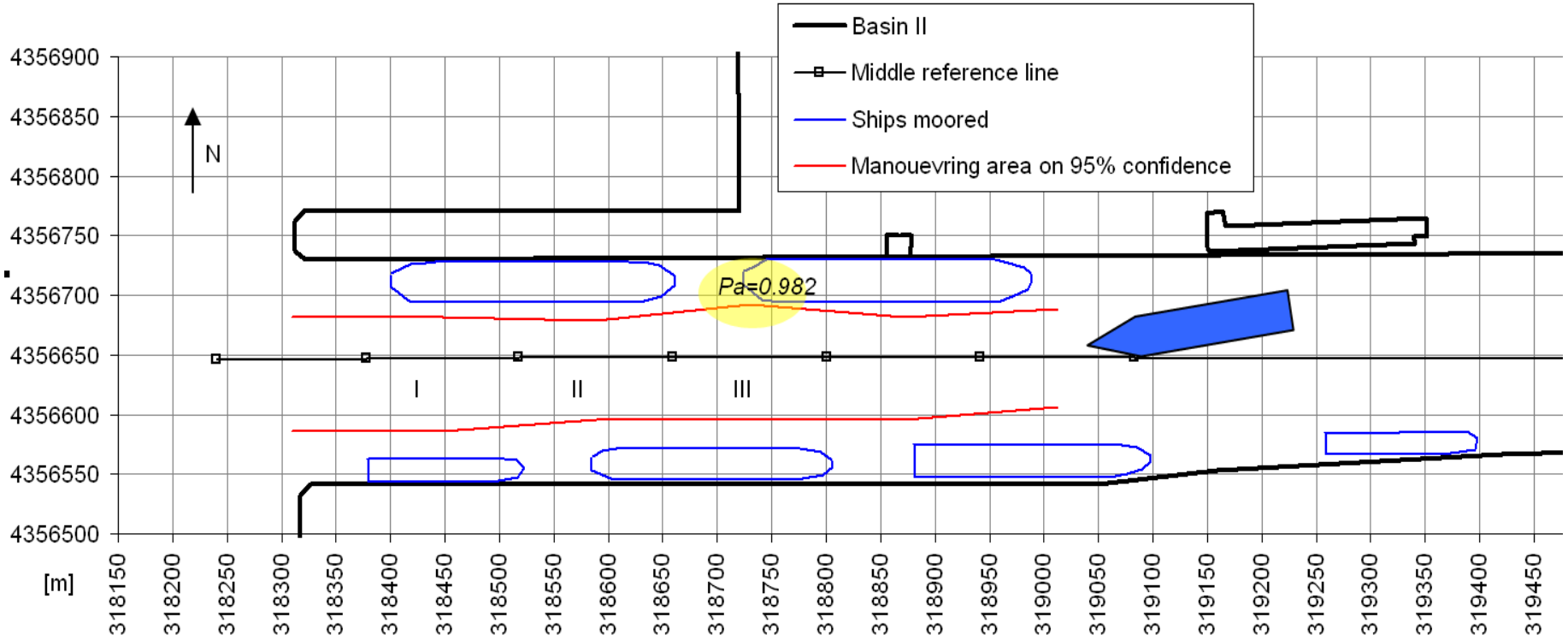

1. Maritime Sa
Port and Waterway D


Works in progress (1999)
BAZEN III
Tug 1
Tug 2
OS 2
FN 24/stop
FN 23/stop
FN 19
FN 20
FN 22
FN 43
FN 42
BR 16/gmd
BR 11/gmd
TG 8/gmd
TG 27


left side of waterway
axis of waterway
d
d
traffic lane on given confidence level
right side of waterway


-2.50
-5.00
-7.50
-10.00
-12.50
-15.00
-17.50
mean traffic lane


St. deviation [m]
Port
Stb


Basin II
Middle reference line
Ships moored
Manouevring area on 95% confidence
N
Pa=0.982
I
II
III
[m]

Thank You