О необходимости спутникового мониторинга строительства морского газопровода «Норд Стрим» в Балтийском море

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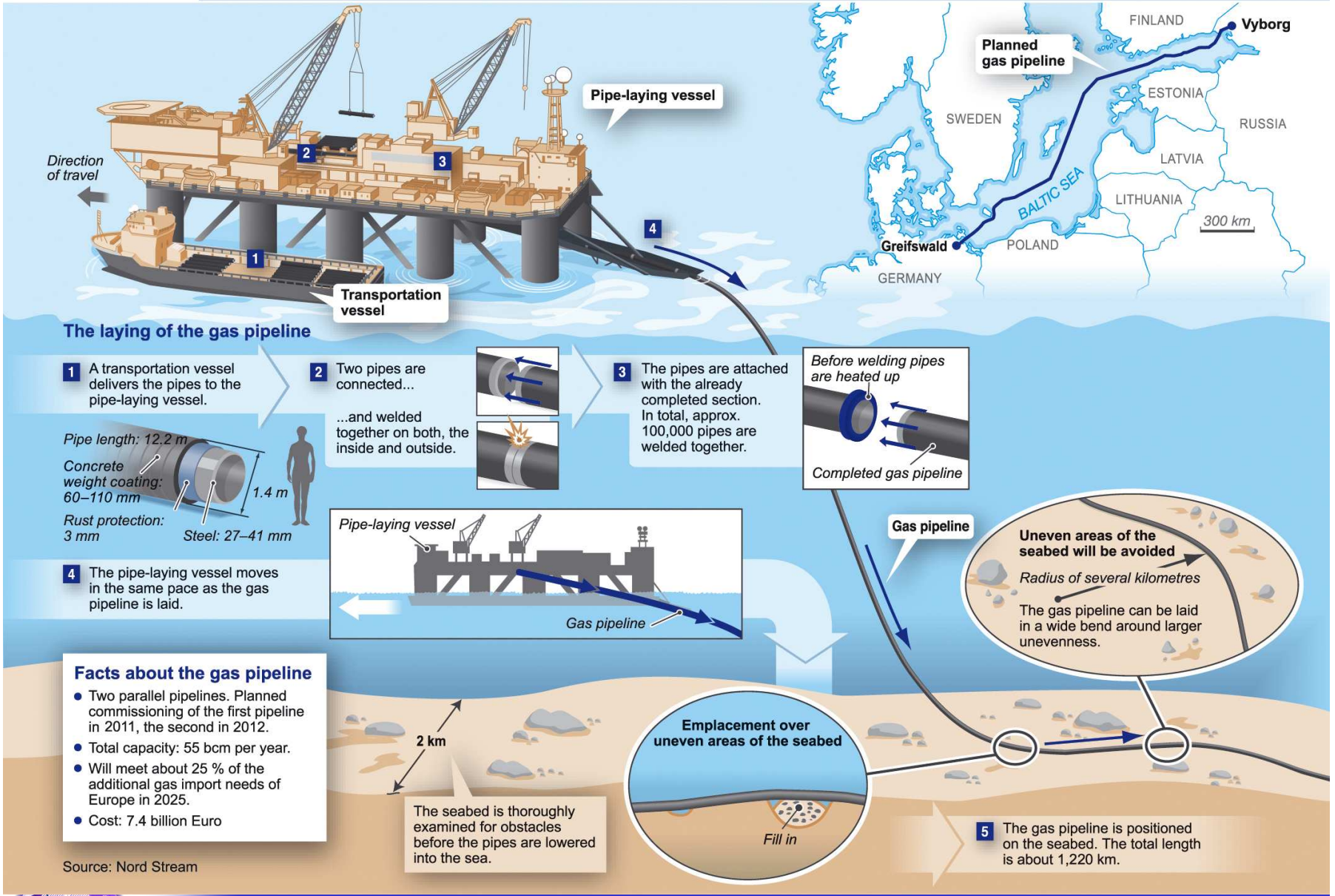
The Nord Stream is a more than 1200-km long gas pipeline that will link Russia to Europe via the Baltic Sea from Vyborg in Russia to Greifswald in Germany. It will carry 55 billion m^3 of natural gas each year to supply both businesses and households.

The first line of the Nord Stream is scheduled to be completed in 2011 and to deliver the first gas after a test phase in spring 2012. The second, parallel pipeline will be constructed in 2012.

The pipeline has been planned with deep awareness of the environmental issues and specific conditions of the Baltic Sea, basing on the comprehensive Environmental Impact Assessment program that was conducted before implementing the project.

Nord Stream
The new gas supply route for Europe

THE NATURAL GAS PIPELINE ACROSS THE BALTIC SEA



Source: Nord Stream

NORD STREAM gas pipeline construction
Solitaire pipelay ship

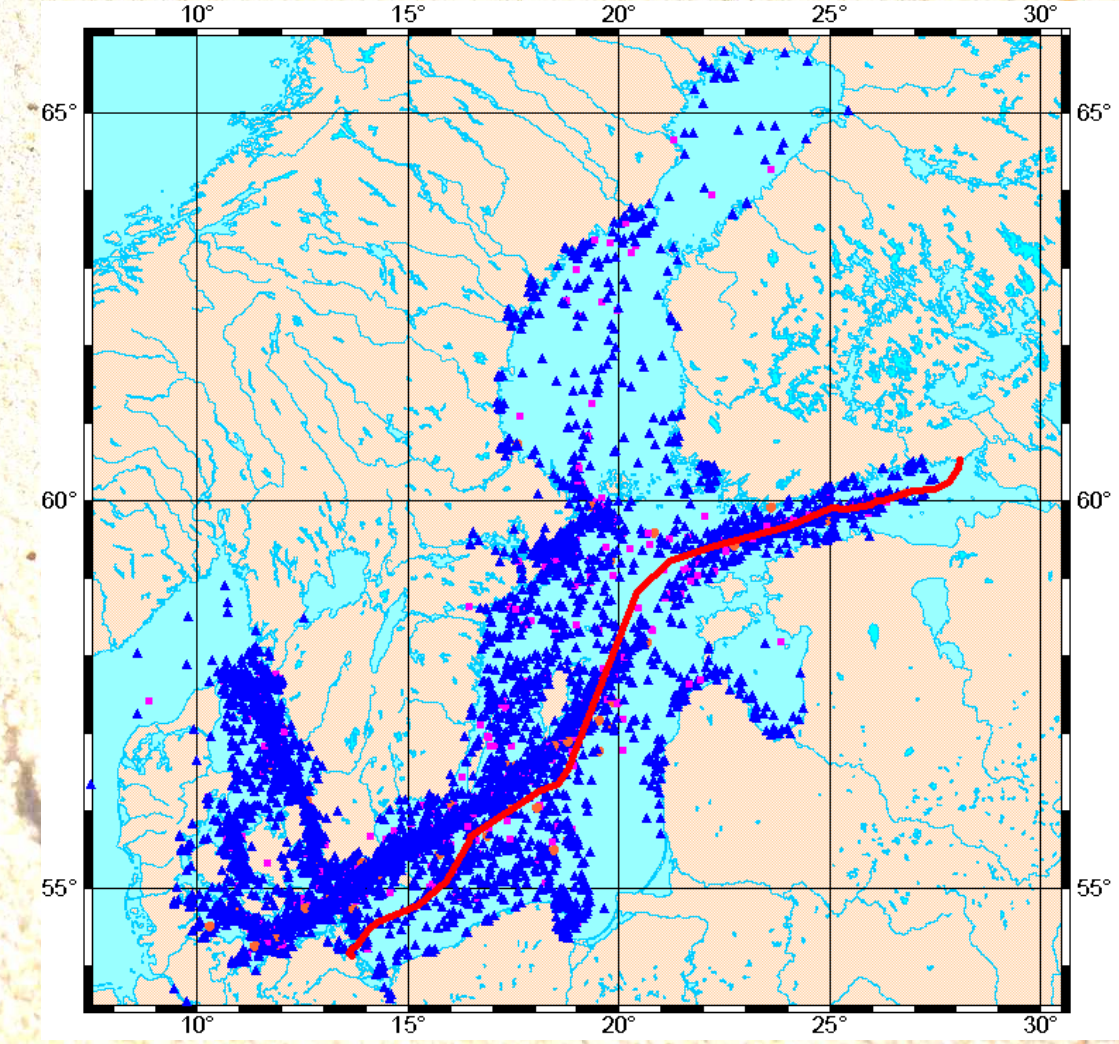
The construction process of the pipeline may cause, in particular, the following impact on the marine environment:

(i) oil pollution due to the operation of ships, pipelay vessel, dredge ships and mechanisms in the sea;

(ii) increase of suspended matter concentration due to dumping of sand and gravel, and dredging operations;

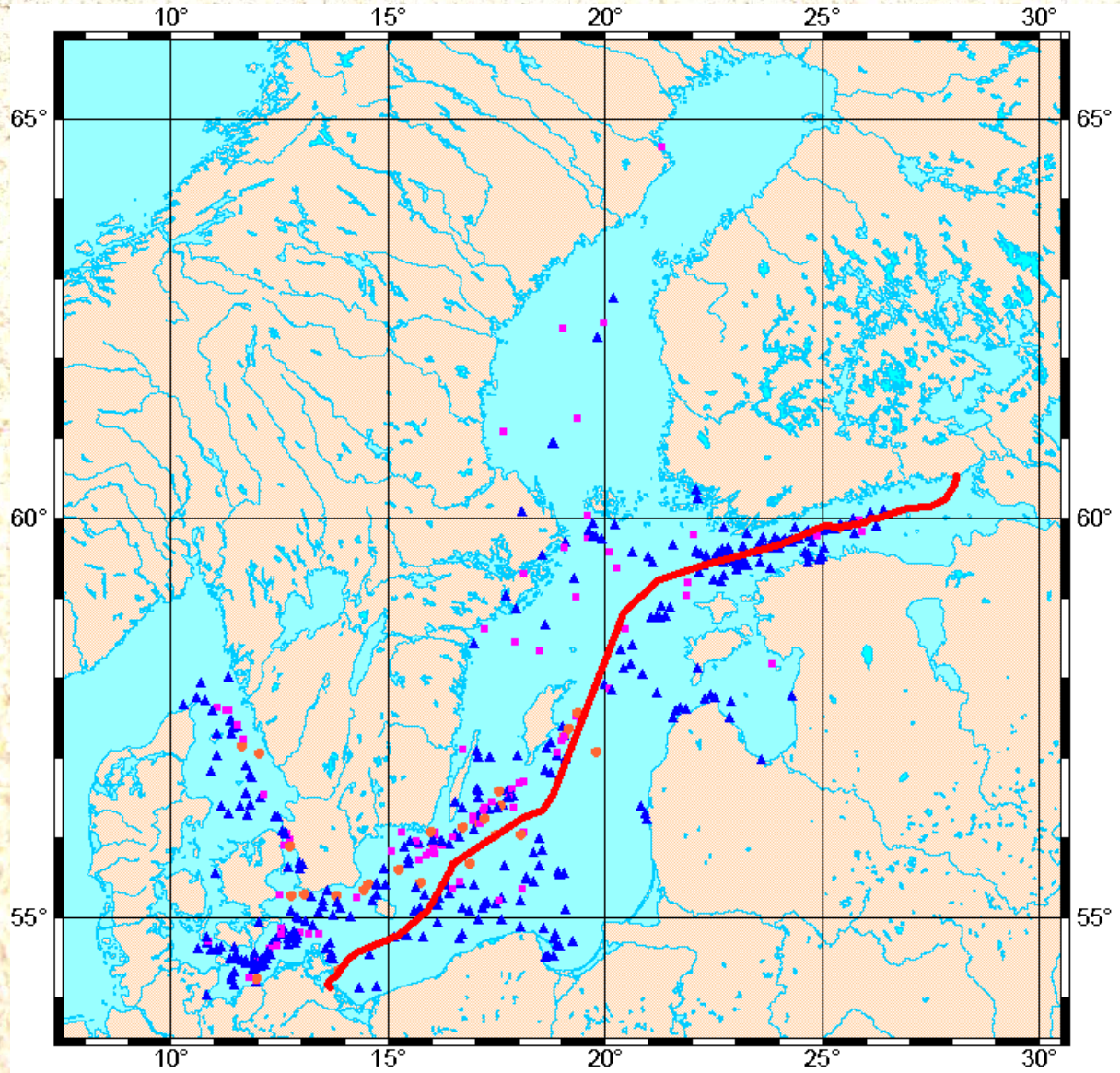
(iii) provoking of local algal bloom events in summertime due to vertical mixing resulted from dumping and dredging works.

But in many parts of the Baltic Sea the pipeline coincides with the main ship route crossing the sea from the Gulf of Finland to the southwestern part of the Baltic Sea. Along this ship route we have already been yearly observing the maximum of oil spills discharged from ships well before the Nord Stream construction.

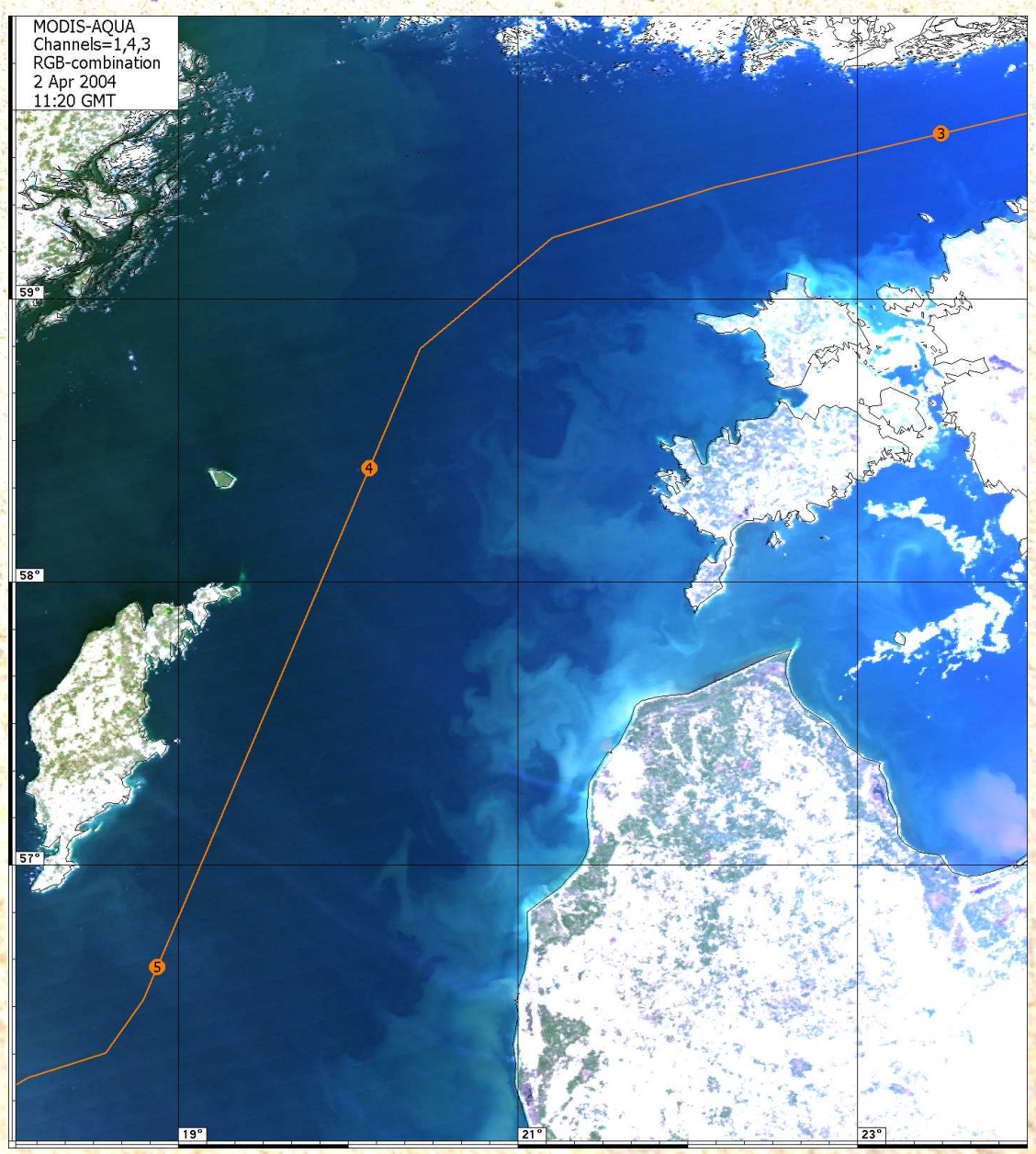


Oil spills in the Baltic Sea (1989-2002)
HELCOM (1989-2002)

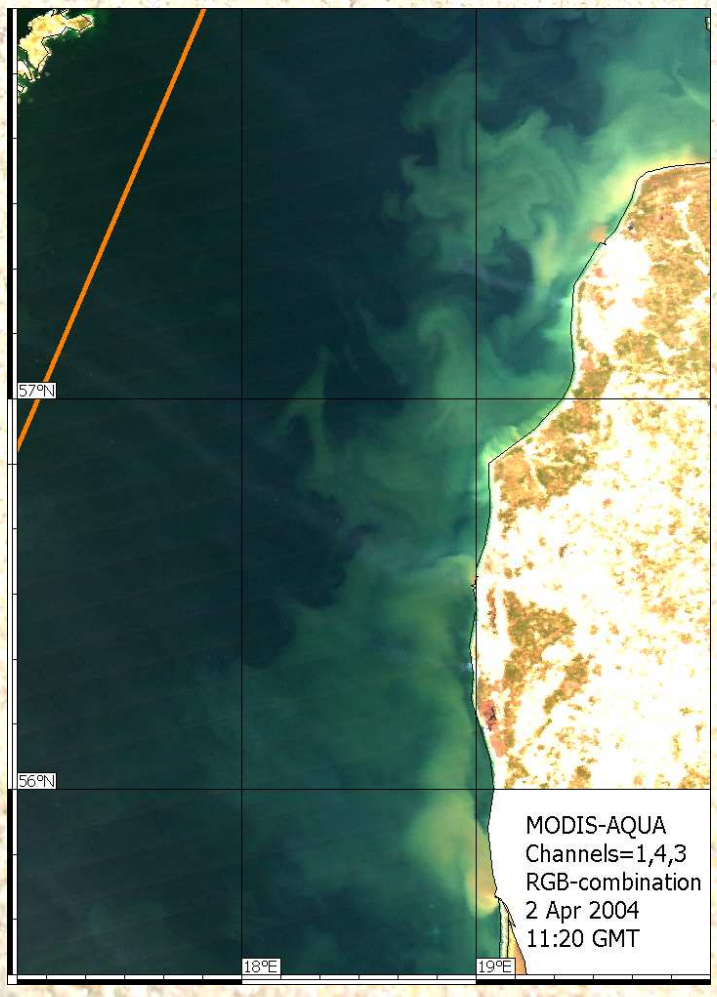
Oil spills in the Baltic Sea (2000)
HELCOM (2000)

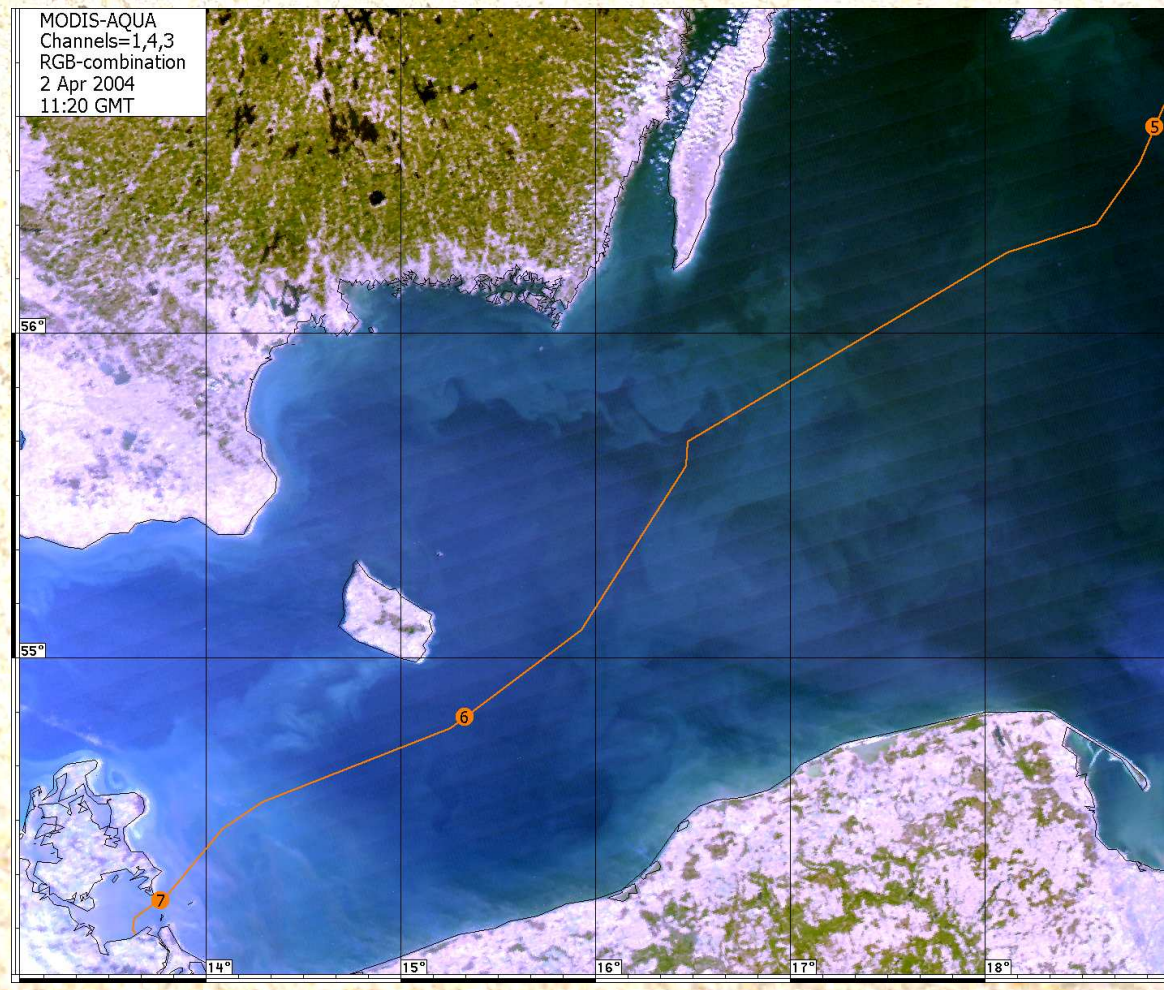


Besides, in many parts of the Baltic Sea, which will be crossed by the pipeline, we observe very large areas of water with a high concentration of suspended matter and areas of very intense algal bloom. Both are observed yearly and have natural reasons.

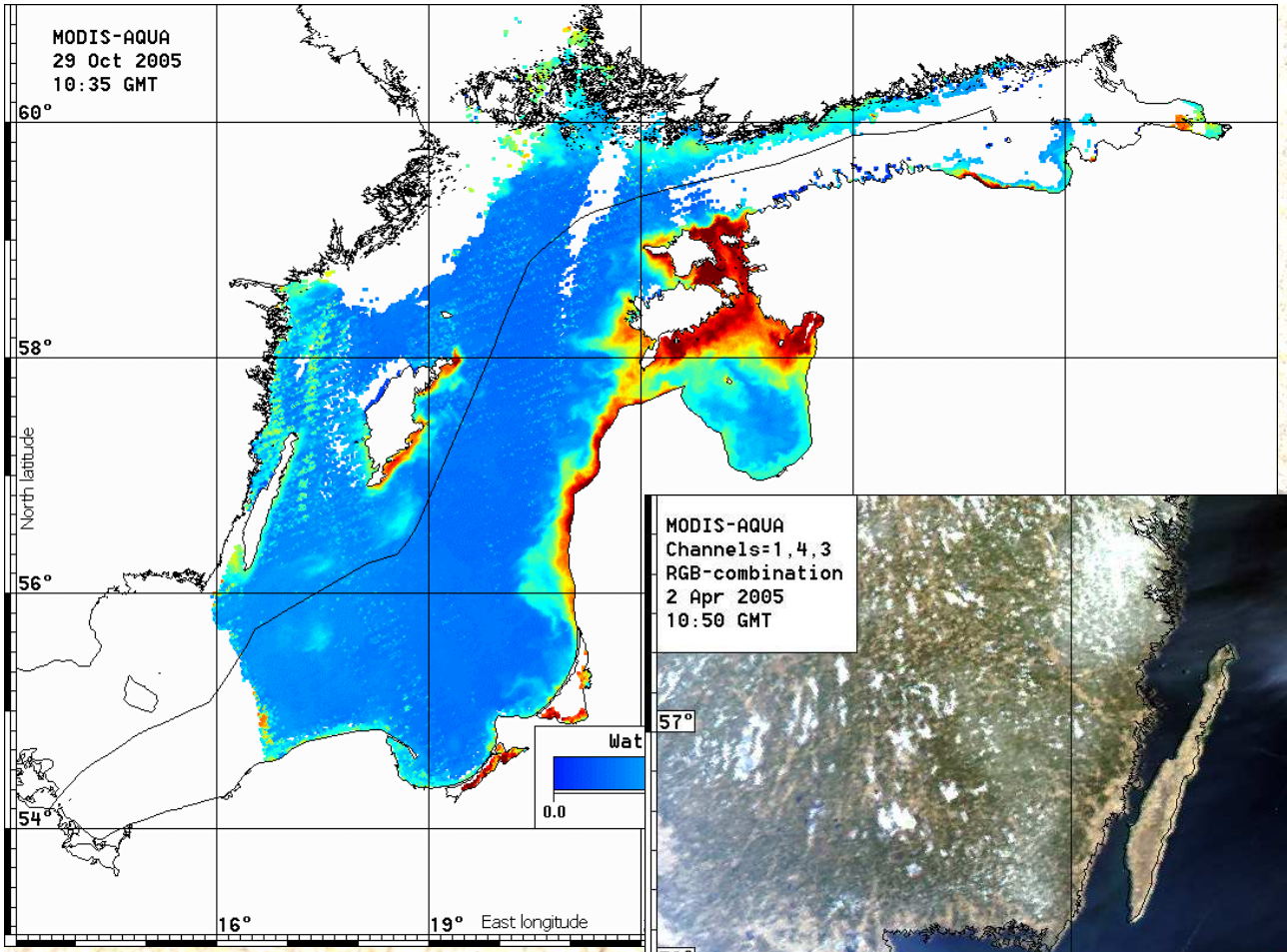


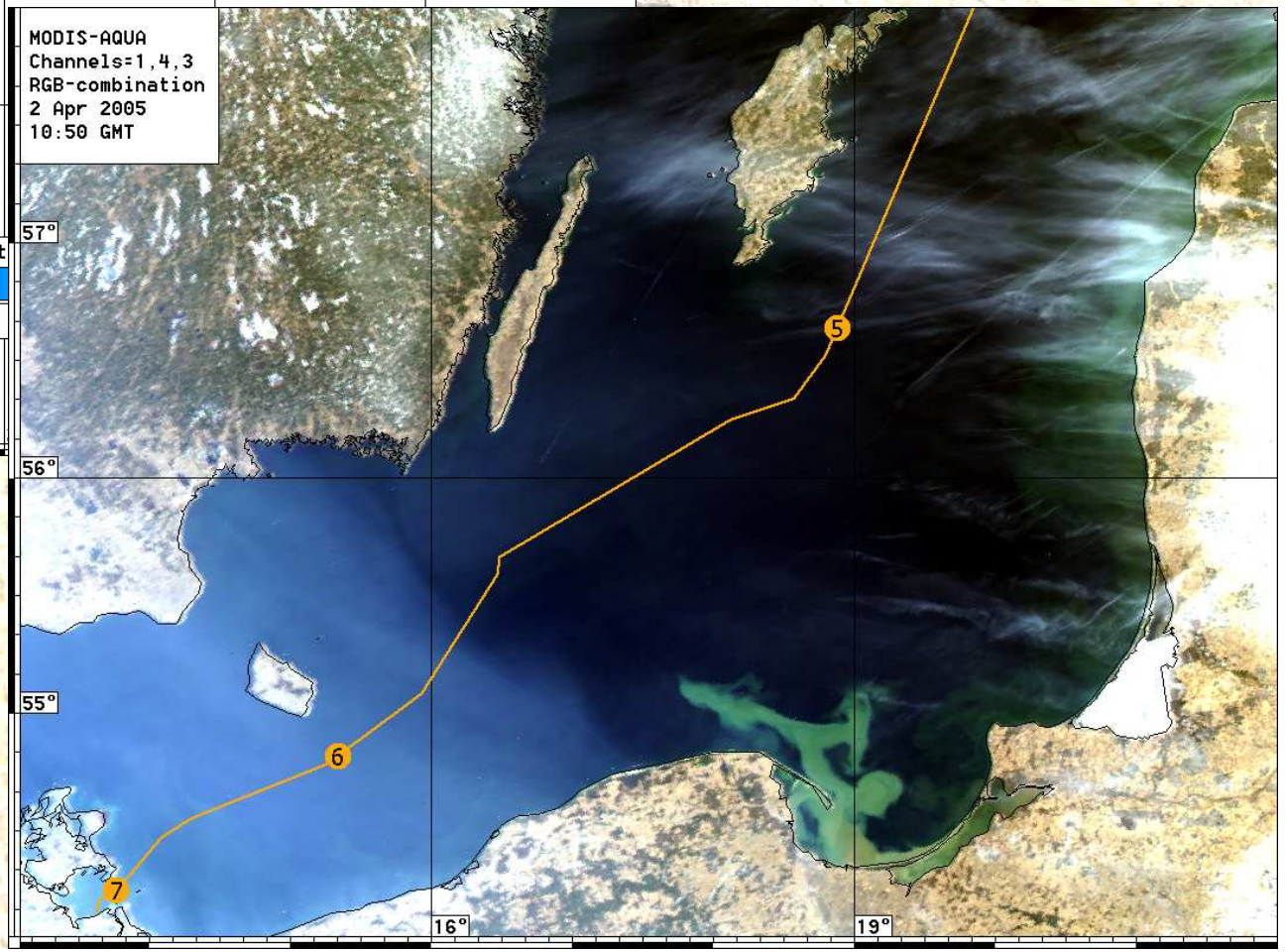
Suspended matter in the Baltic Sea on 2 April 2004



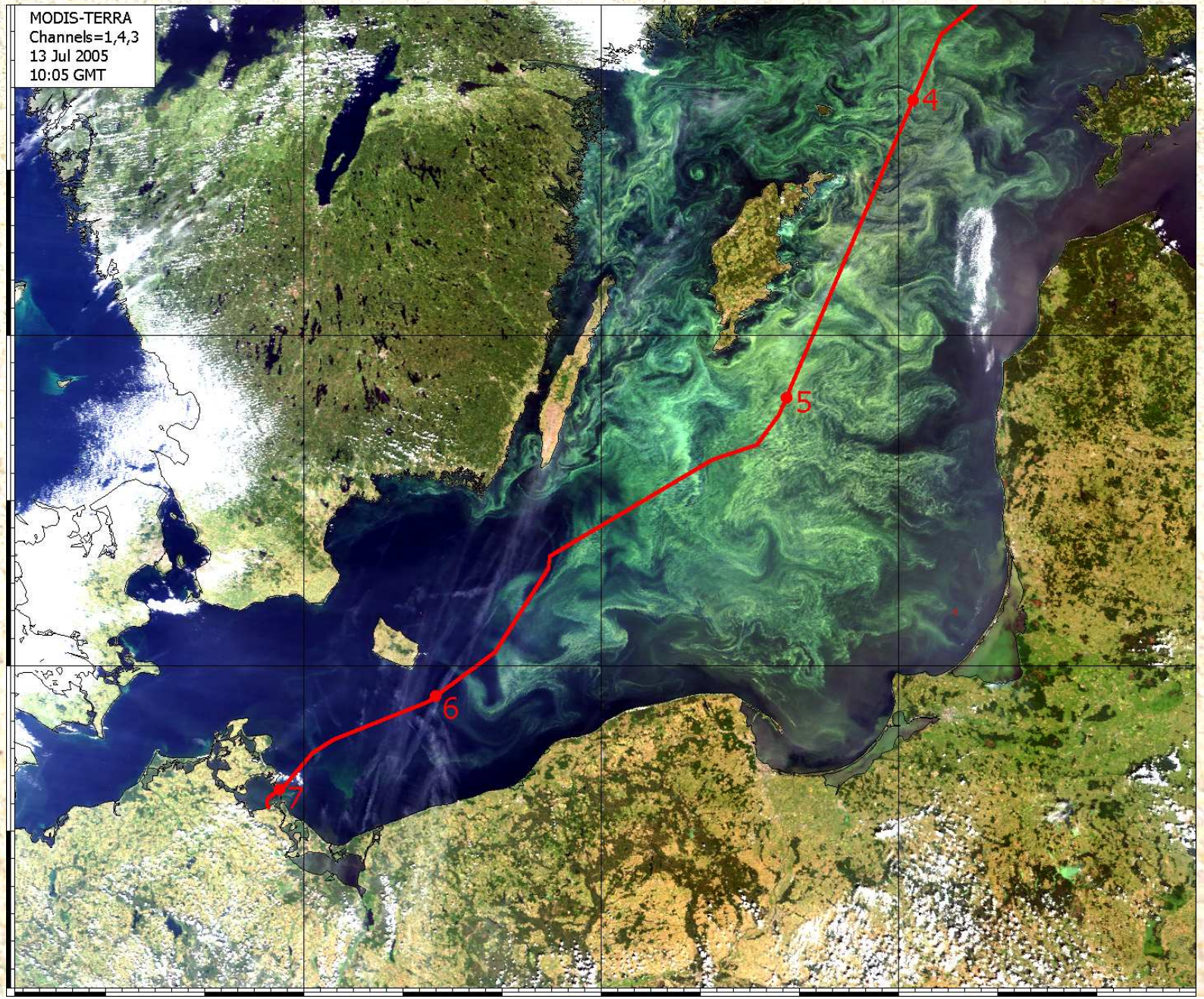


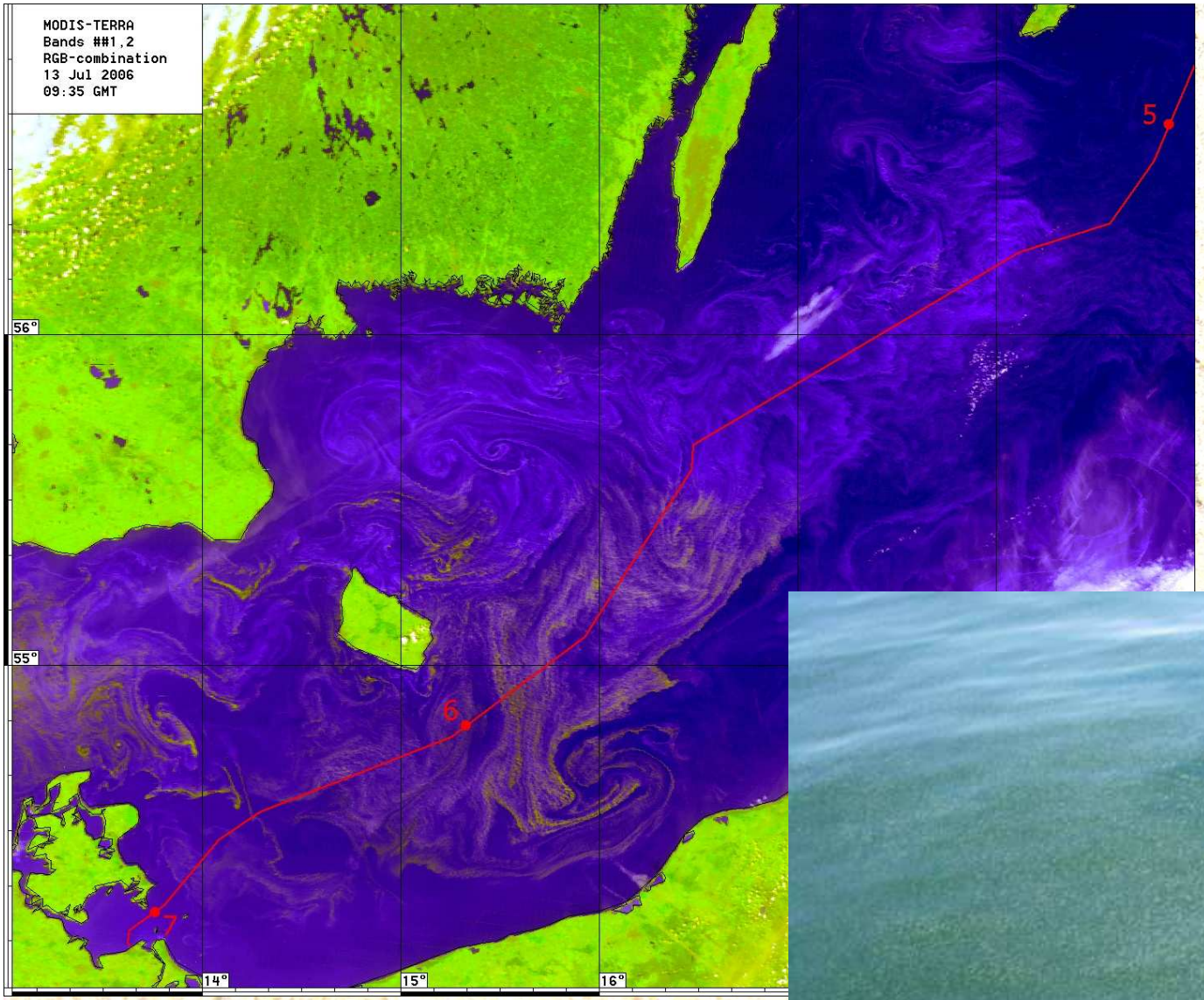
Suspended matter in the Baltic Sea on 2 April 2005 and 29 October 2005





Algal bloom in the Baltic Sea on 13 July 2005





Algal bloom in the Baltic Sea on 13 July 2006

Thus, there are two very important and interrelated tasks:

(i) to monitor in the operational regime the ecological state of the sea at the site of the pipeline construction, and

(ii) to discriminate between natural effects and anthropogenic impacts, related to the construction itself.

Moreover, oil spills must be distinguished between “own” pollution and “alien” pollution belonging to the transient ships.

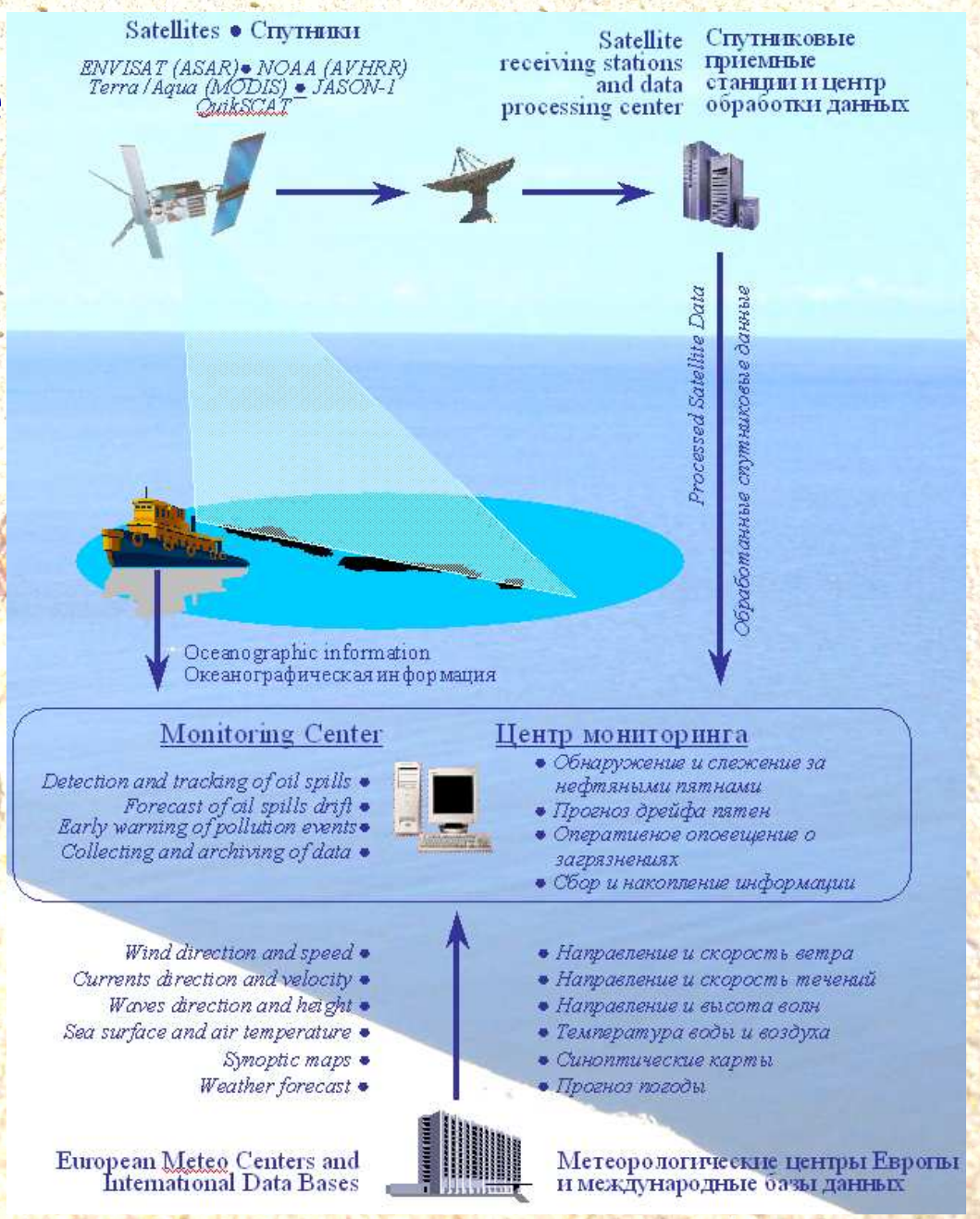
Satellite remote sensing of the sea surface in the operational regime can solve these problems. Thus, the ecological monitoring of the Nord Stream gas pipeline in the Baltic Sea have to include the operational satellite monitoring of:

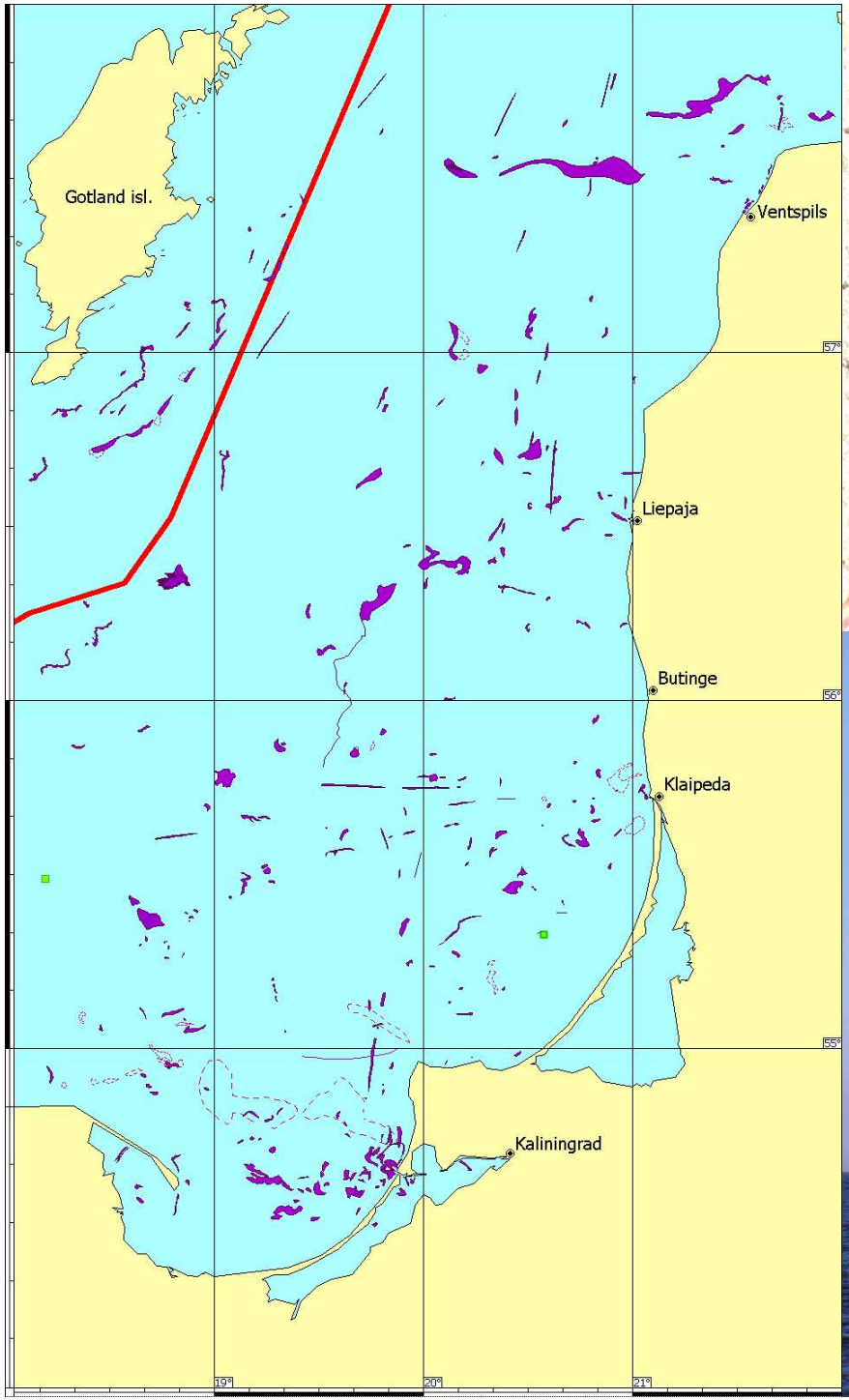
(i) all oil spillages detected in the vicinity of the site of the pipeline construction – determination of their characteristics, establishment of the pollution sources and forecast of probable trajectories of the oil spill transport;

(ii) suspended matter – determination of its spatial and temporal characteristics, discrimination between natural and anthropogenic effects;

(iii) algal bloom events – determination of their spatial and temporal characteristics, discrimination between natural and anthropogenic effects.

We elaborated a detailed plan of the complex satellite monitoring of the "Nord Stream" gas pipeline construction in the operational regime, which is based on our previous experience in the complex satellite monitoring of the ecological state of the Southeastern Baltic Sea, related to the operational control of oil pollution around the D-6 oil platform operated by Lukoil-Kaliningradmorneft (Kaliningrad, Russia).



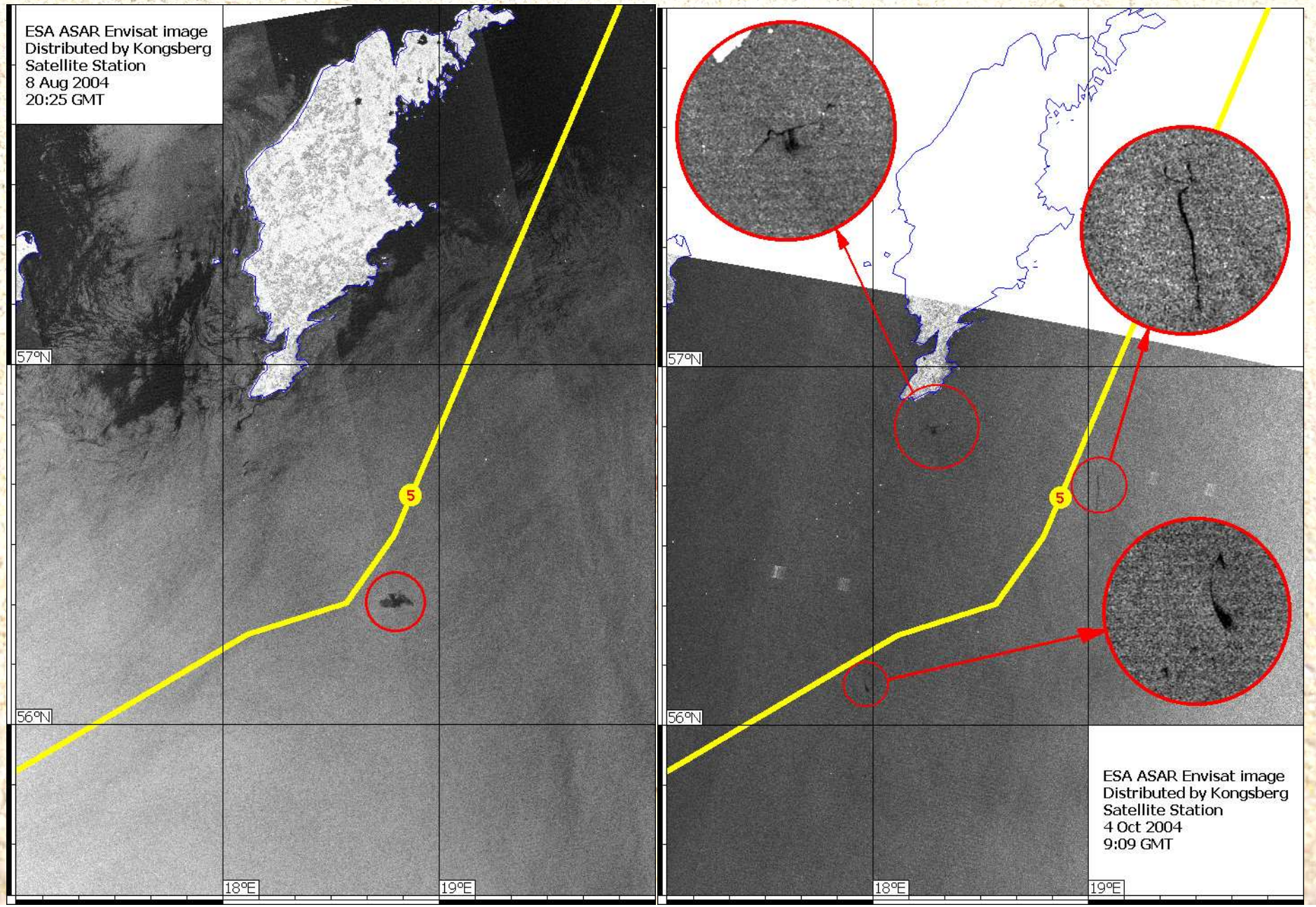


Complex satellite monitoring of the ecological state in the Southeastern Baltic Sea (D-6 oil platform) in 2004-2005

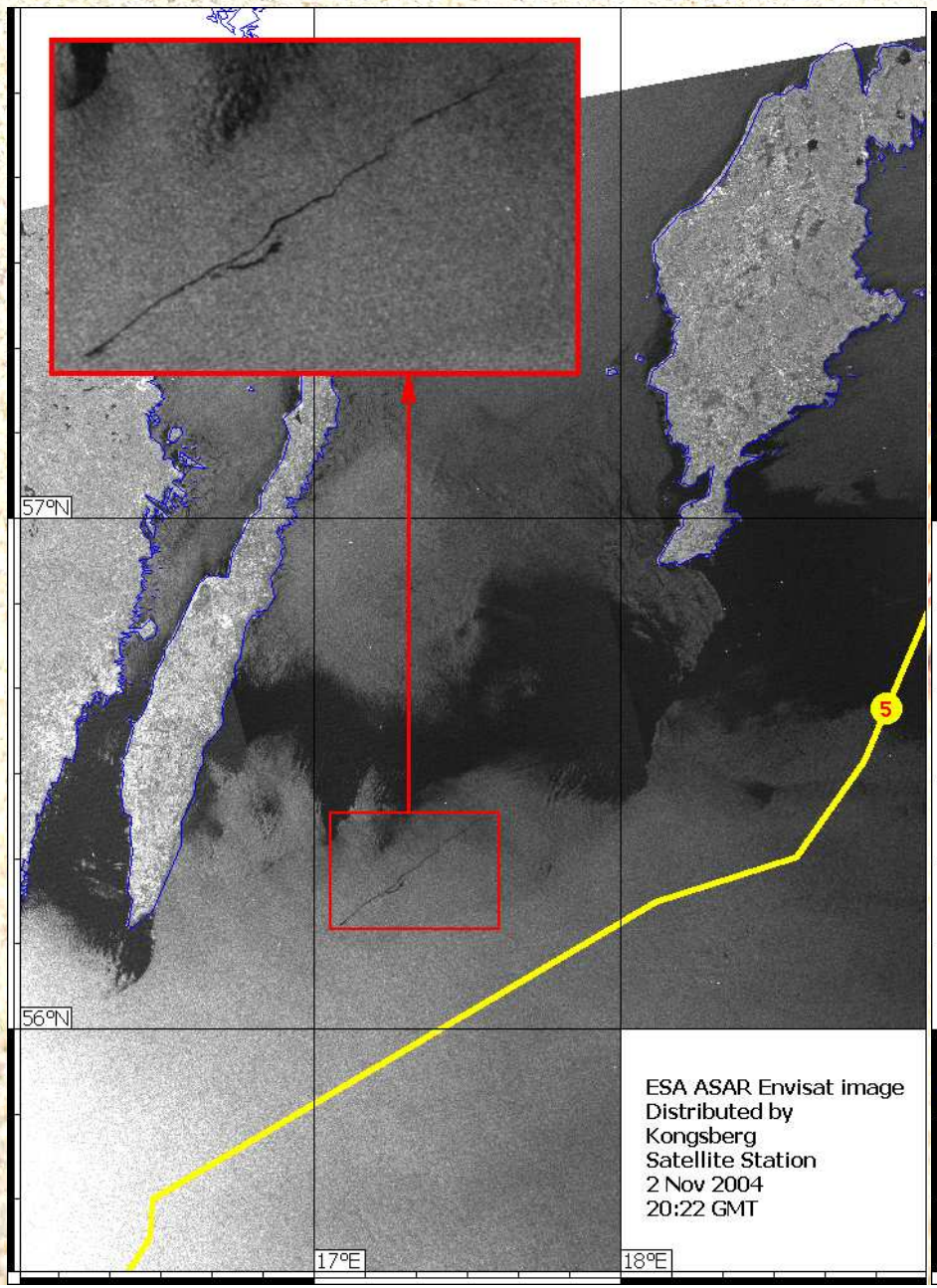
231 ASAR images (Envisat + Radarsat)

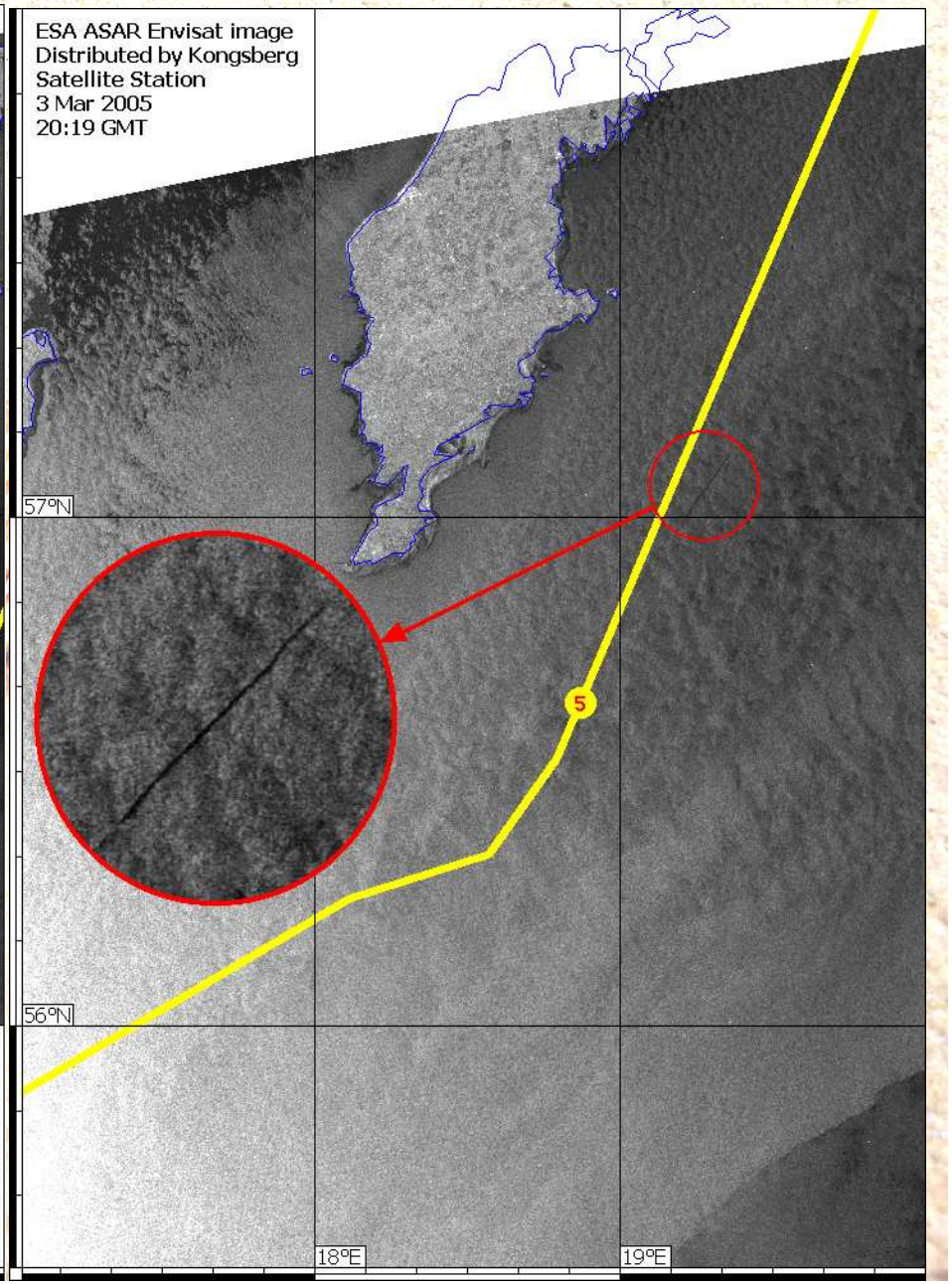
270 oil spills detected

Oil spill gallery in the vicinity of the “Nord Stream”

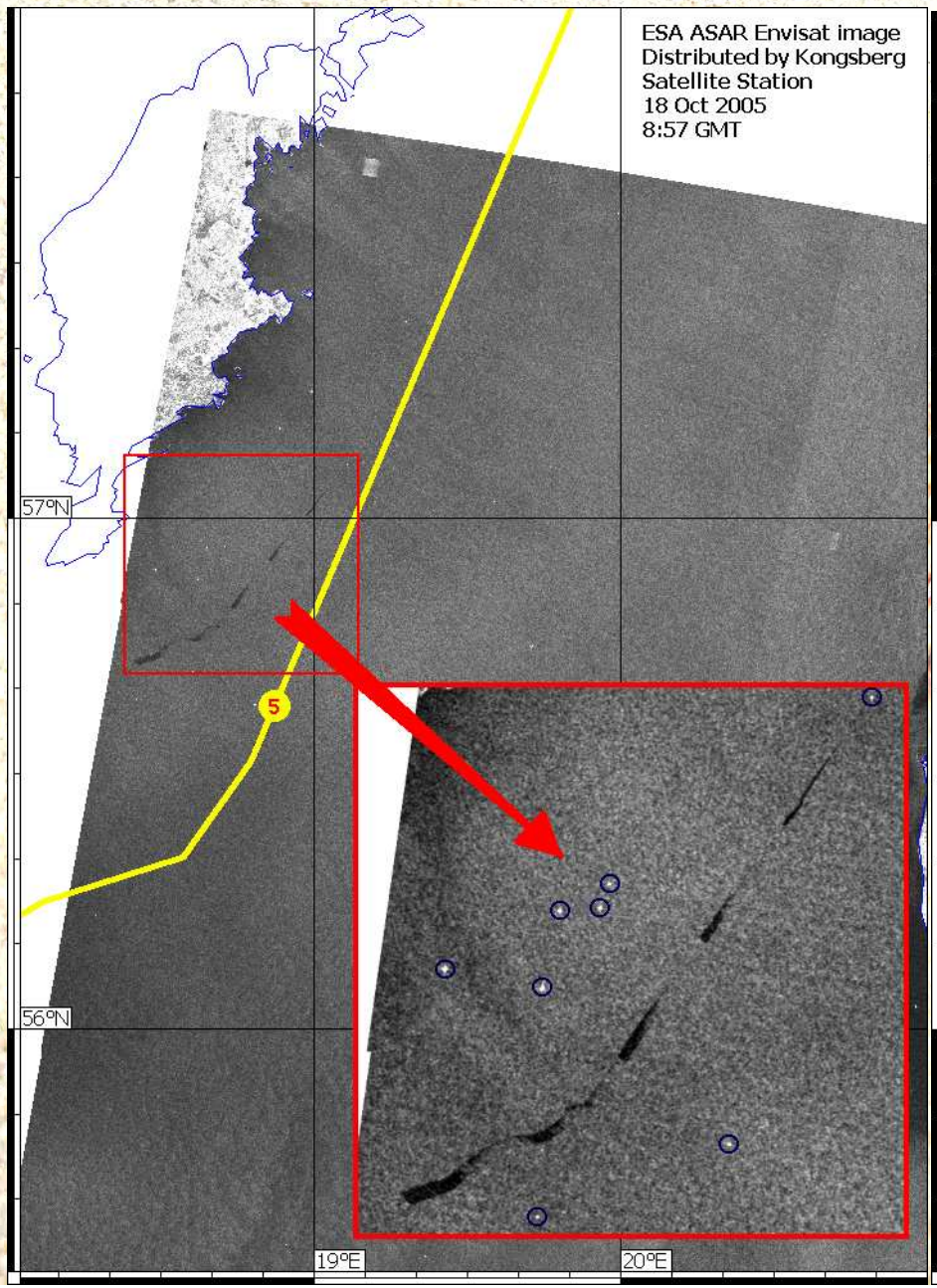


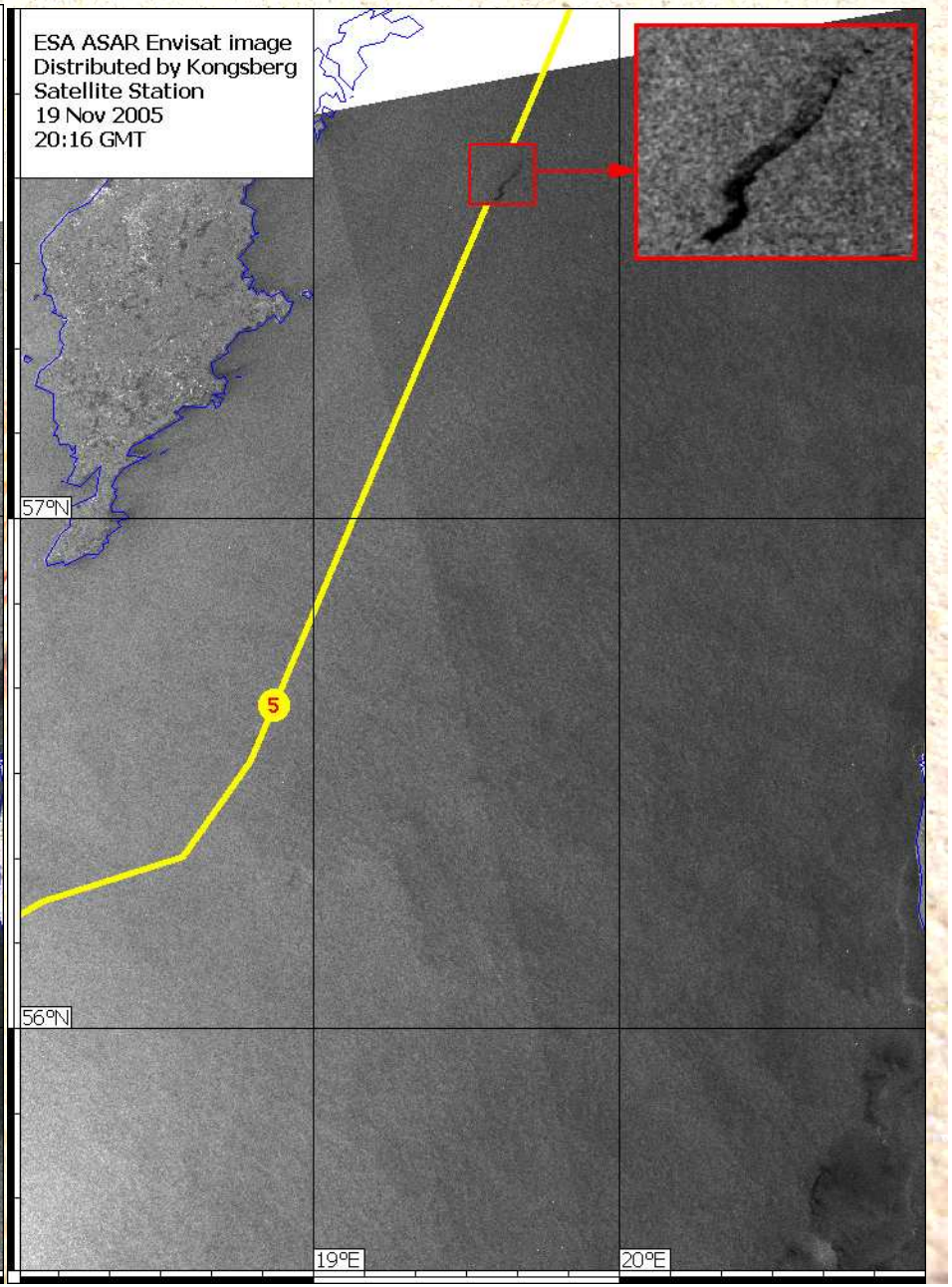
Oil spill gallery in the vicinity of the “Nord Stream”





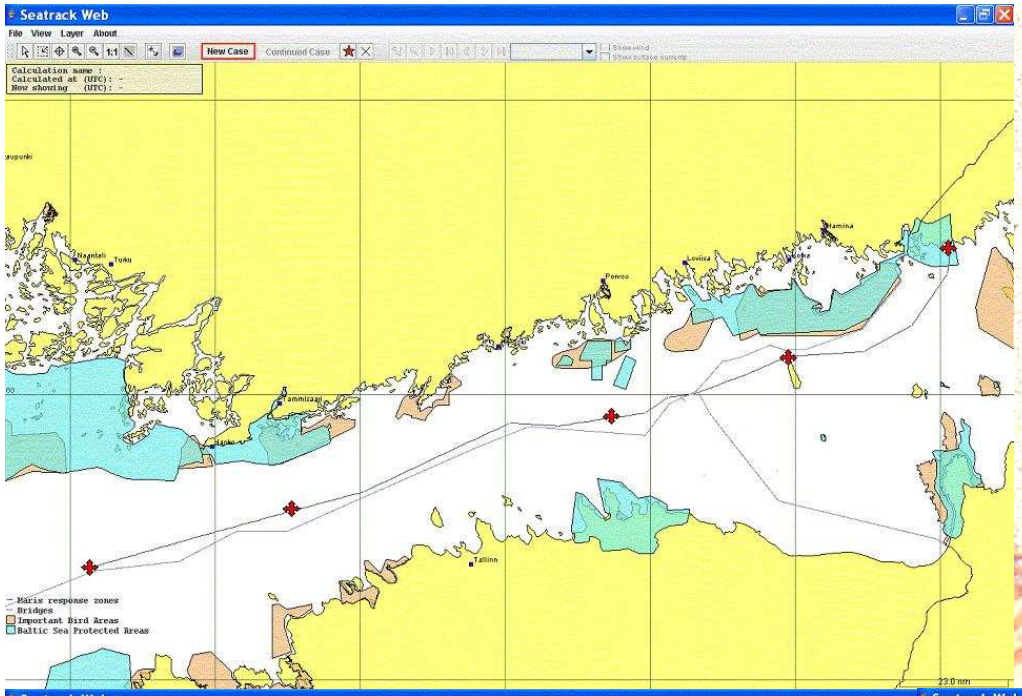
Oil spill gallery in the vicinity of the “Nord Stream”

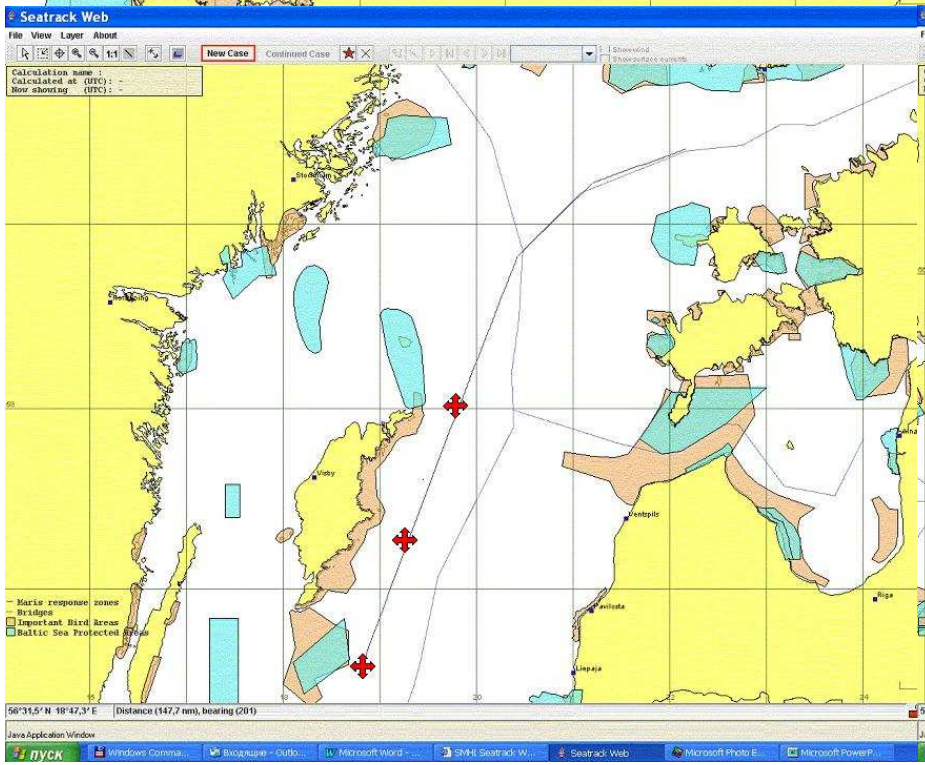


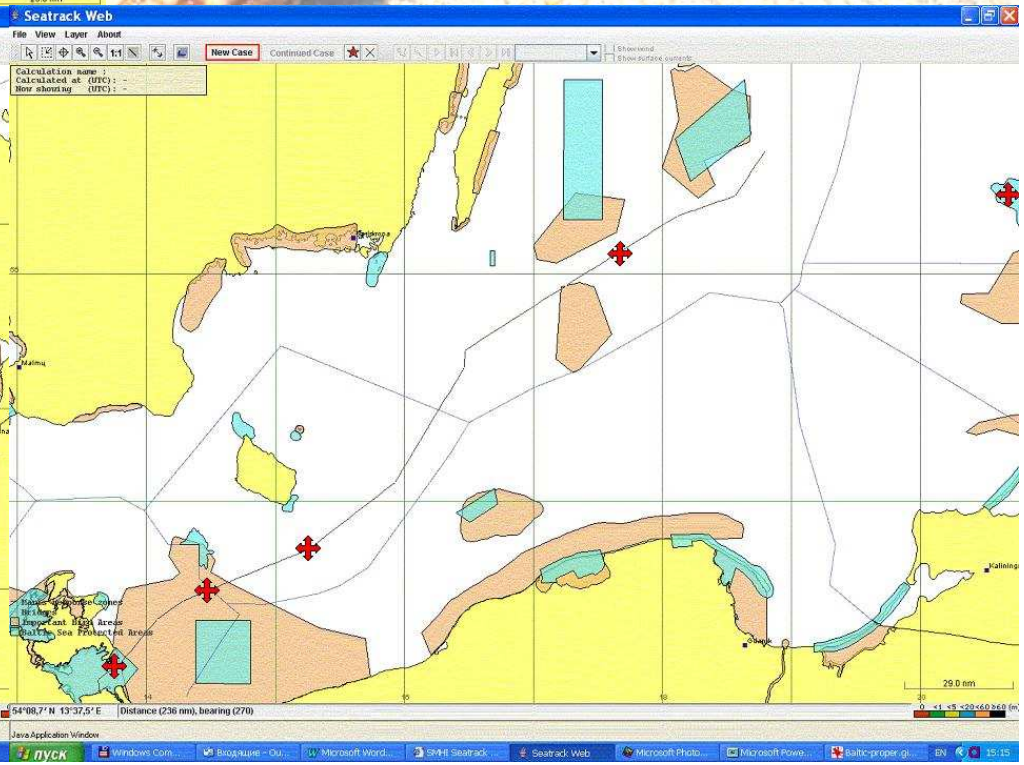


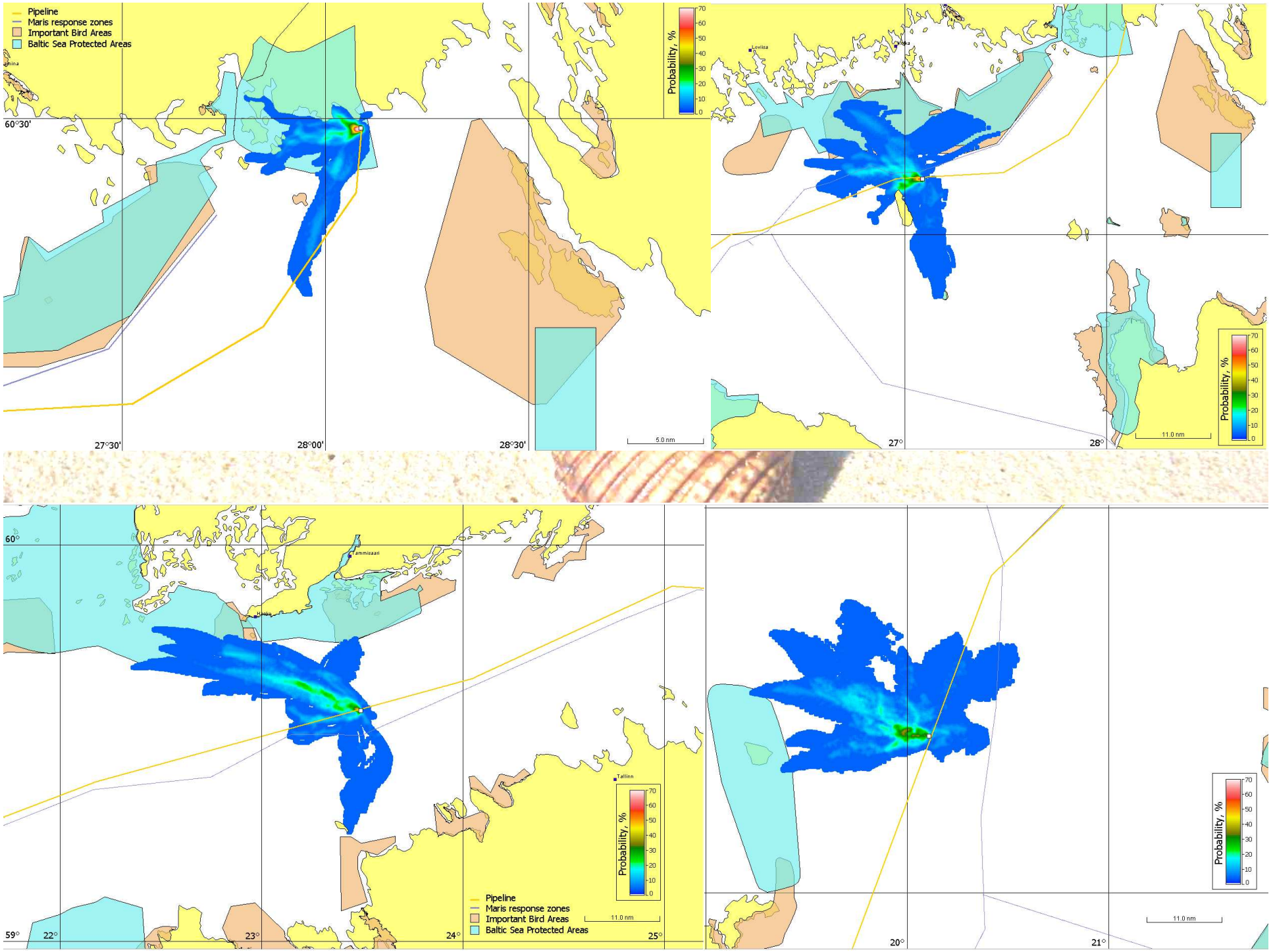
The interactive numerical model Seatrack Web SMHI will be used for forecasting of the drift of the detected oil spills in the vicinity of the pipeline construction for assessment of ecological risks related to potential oil pollution of the neighbouring coasts and marine protected areas in the Baltic Sea.

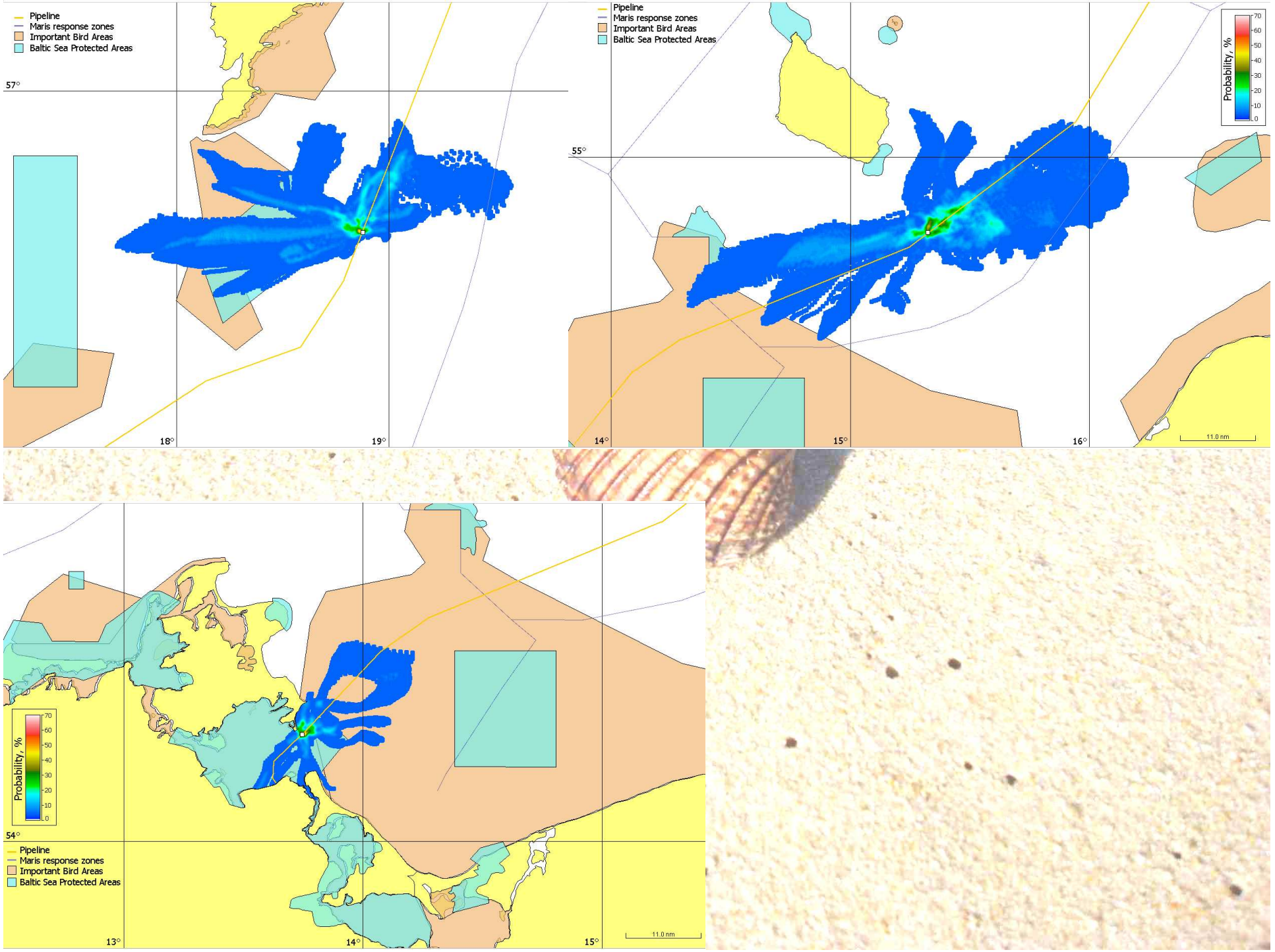
Modelling points in the Gulf of Finland, Baltic Proper and Southwestern Baltic Sea



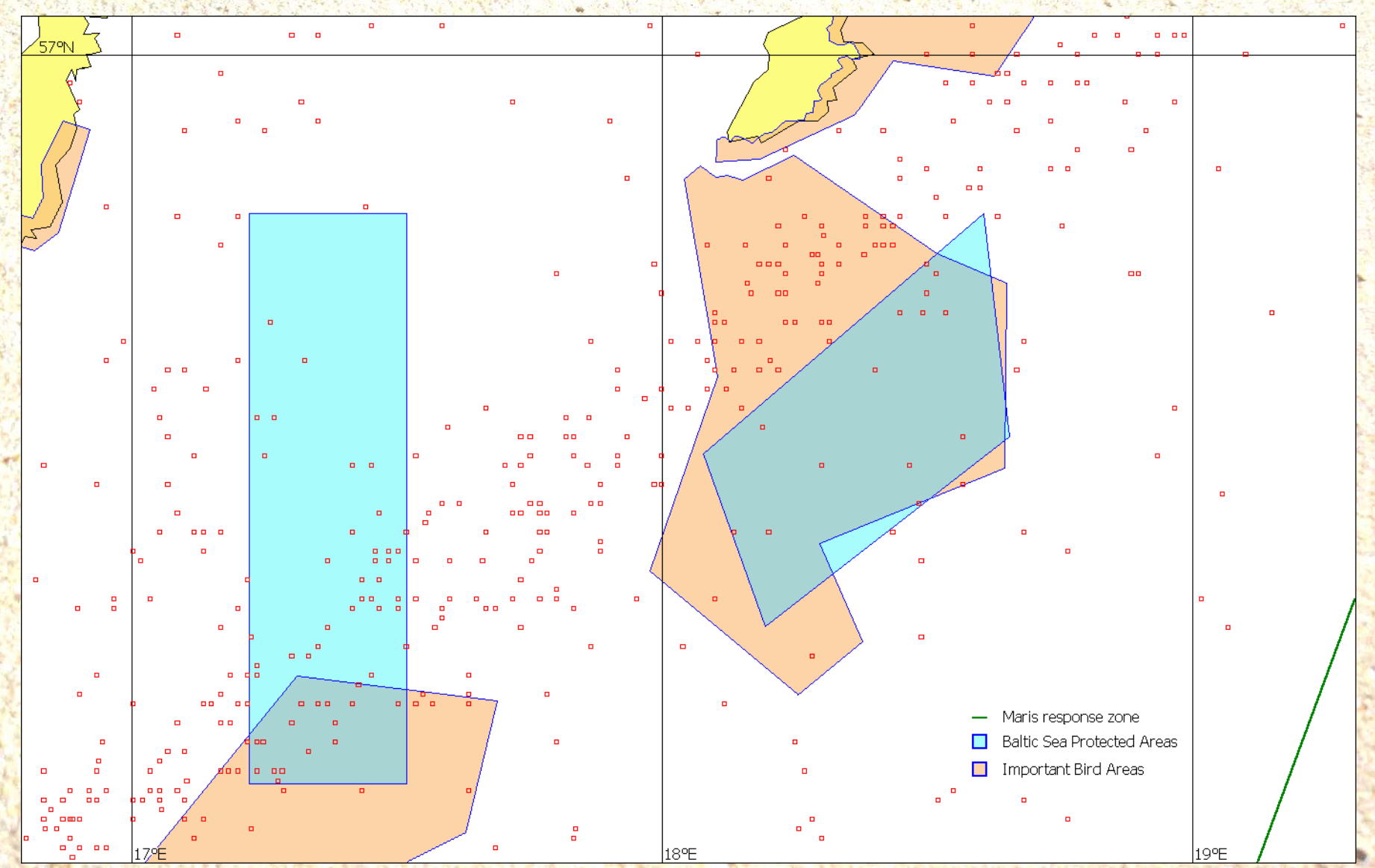




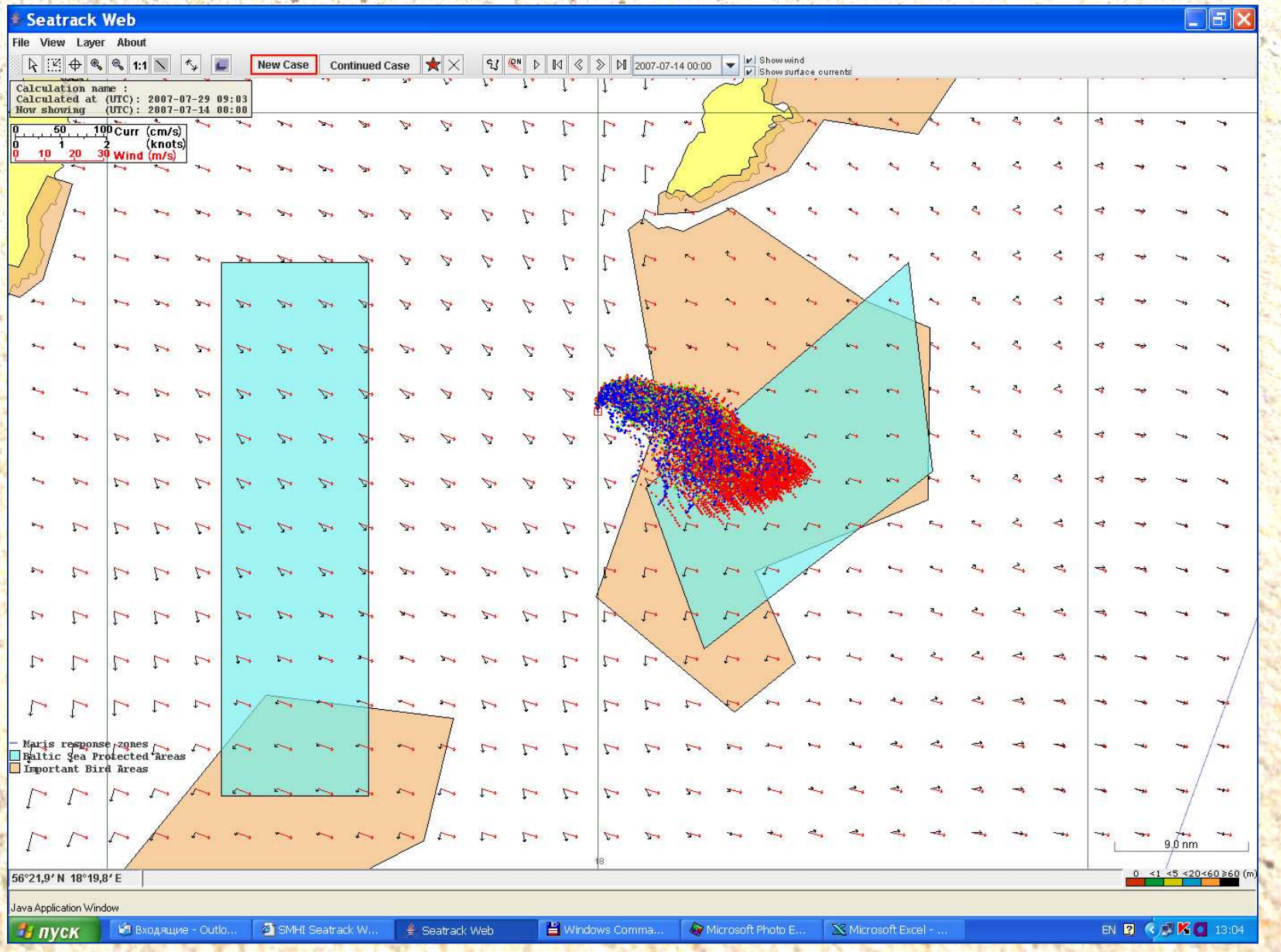

Pipeline
Maris response zones
Important Bird Areas
Baltic Sea Protected Areas
Probability, %
70
60
50
40
30
20
10
0
60°30'
27°30'
28°00'
28°30'
5.0 nm
Loviisa
27°
28°
11.0 nm
60°
Tallinn
59°
22°
23°
24°
25°
20°
21°


Pipeline
Maris response zones
Important Bird Areas
Baltic Sea Protected Areas
57°
18°
19°
55°
14°
15°
16°
Probability, %
70
60
50
40
30
20
10
0
11.0 nm
54°
13°

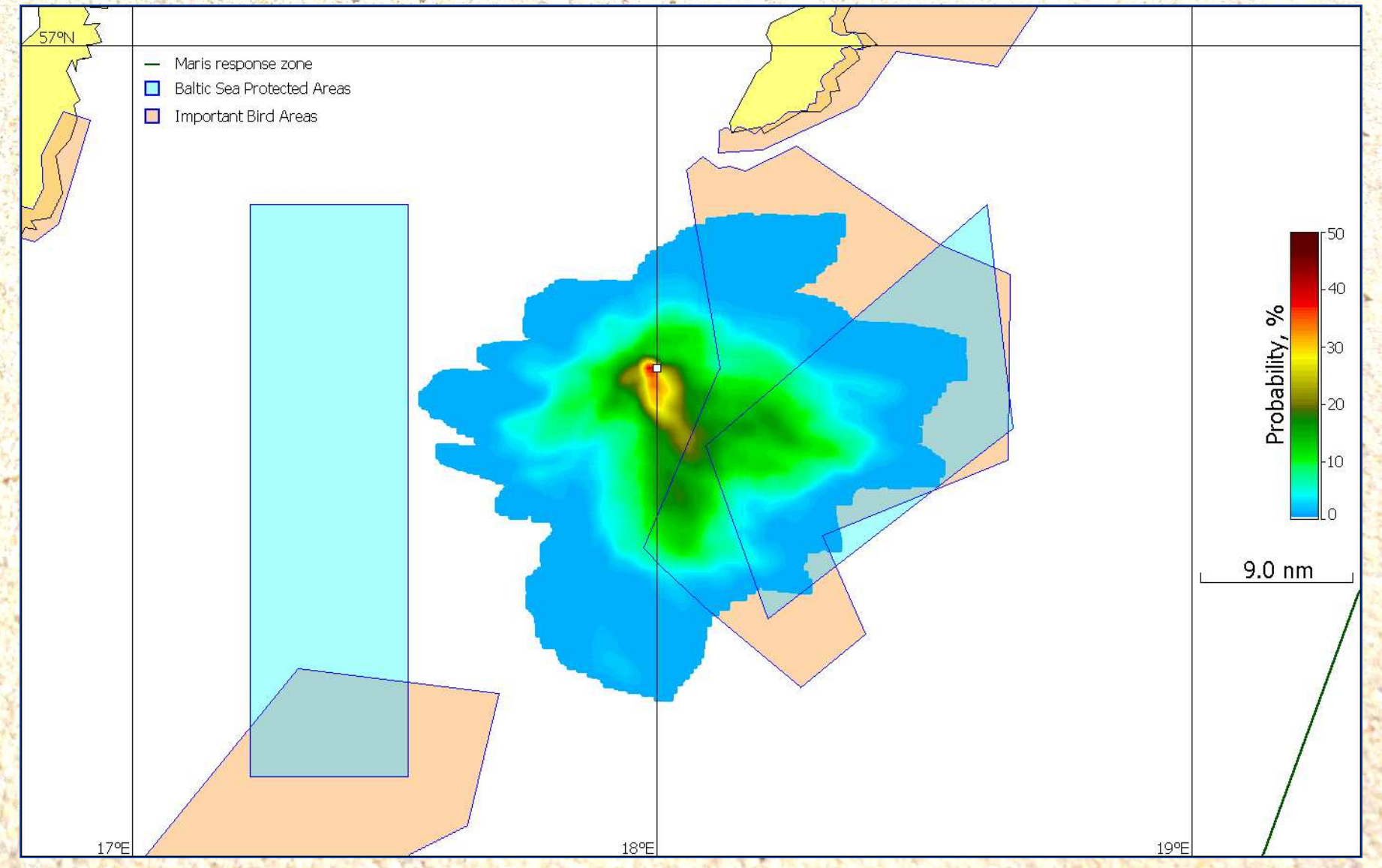
Oil spills at the ship route southward of Gotland (1989-2002)



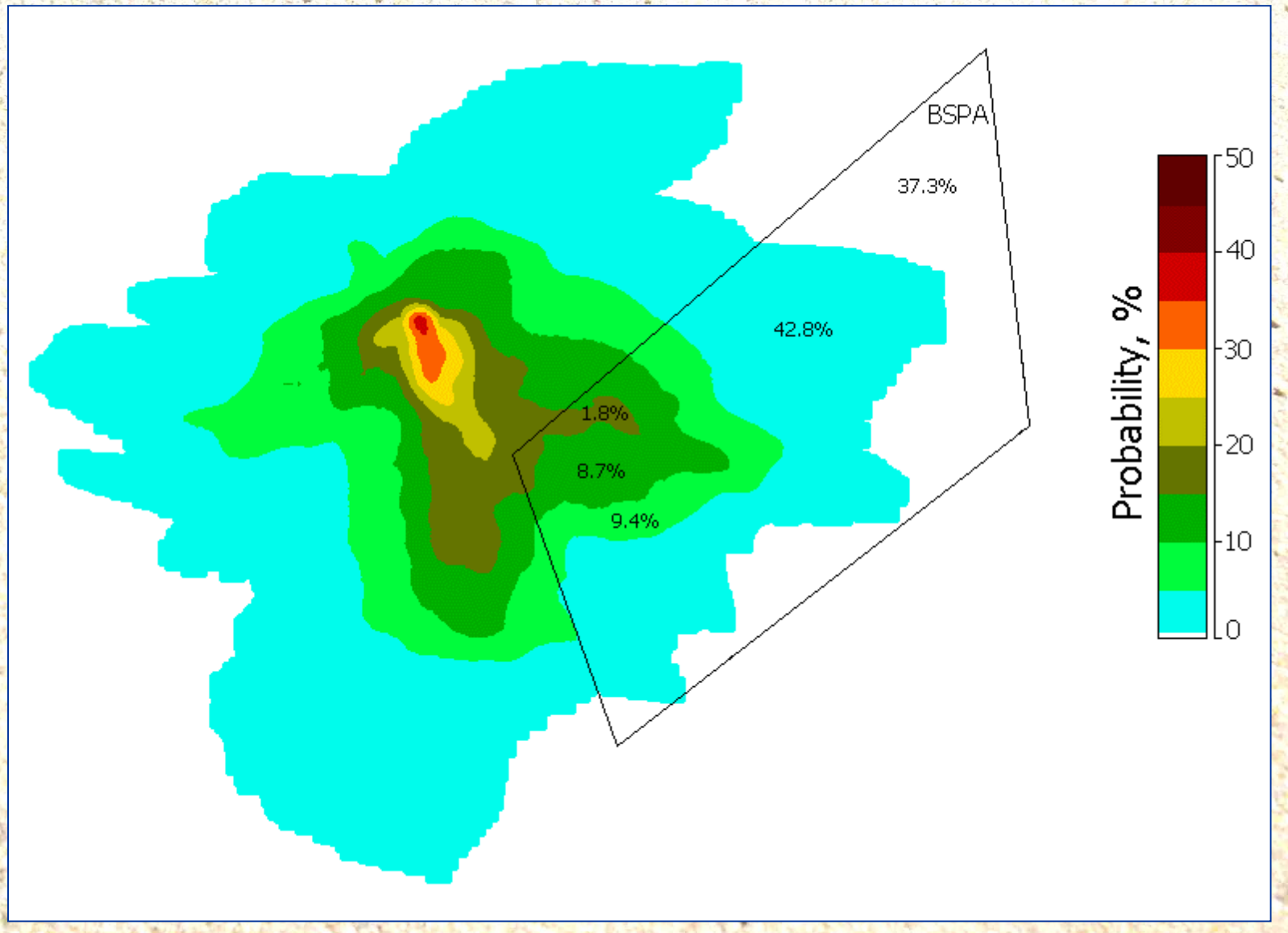
Modelling of oil spill drift southward of Gotland. Oil spill drift on 12 July 2007.



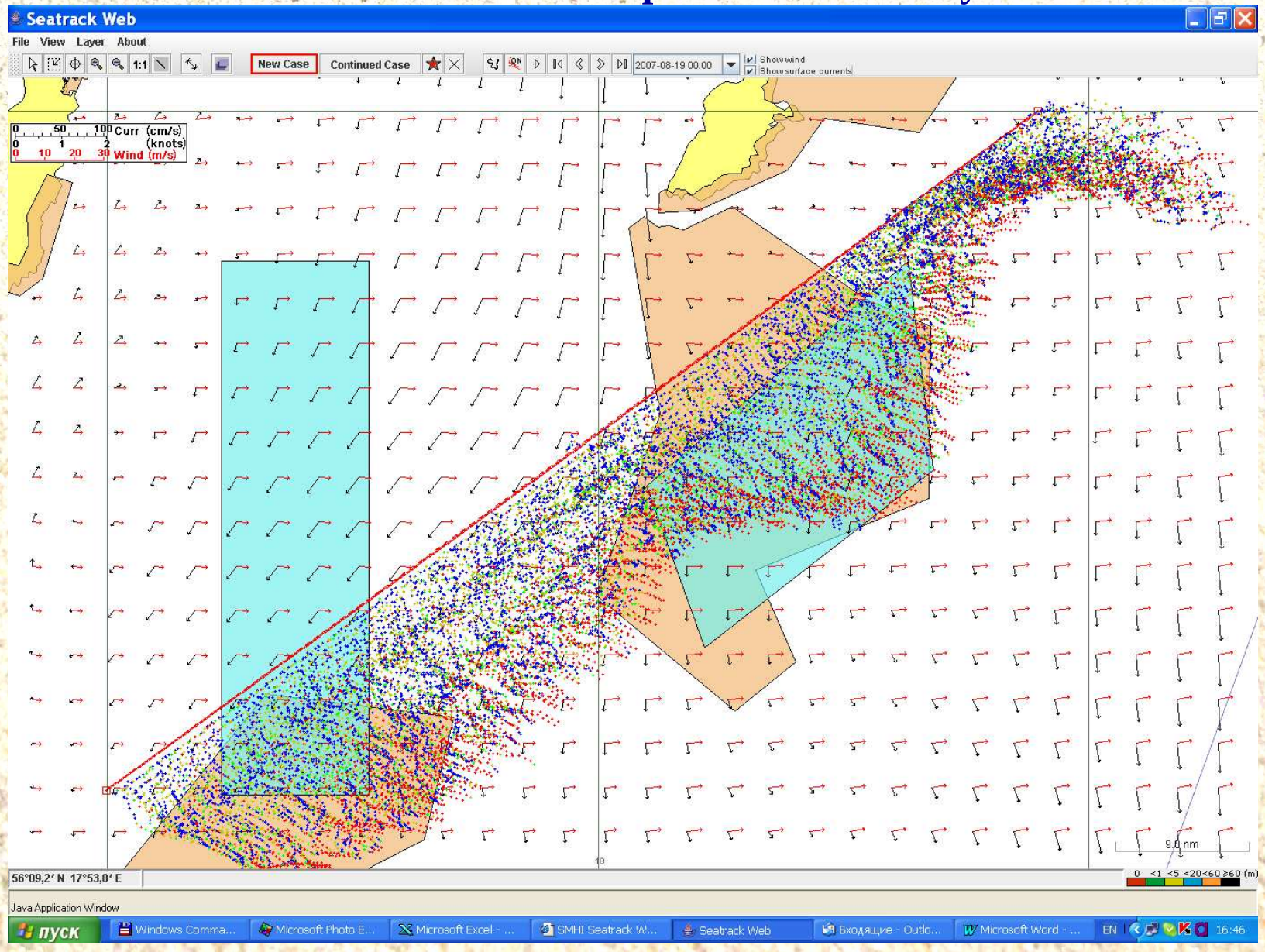
Probability (%) of oil spill drift calculated on the base of daily modelling at this point for real wind and currents conditions in July-August 2007.



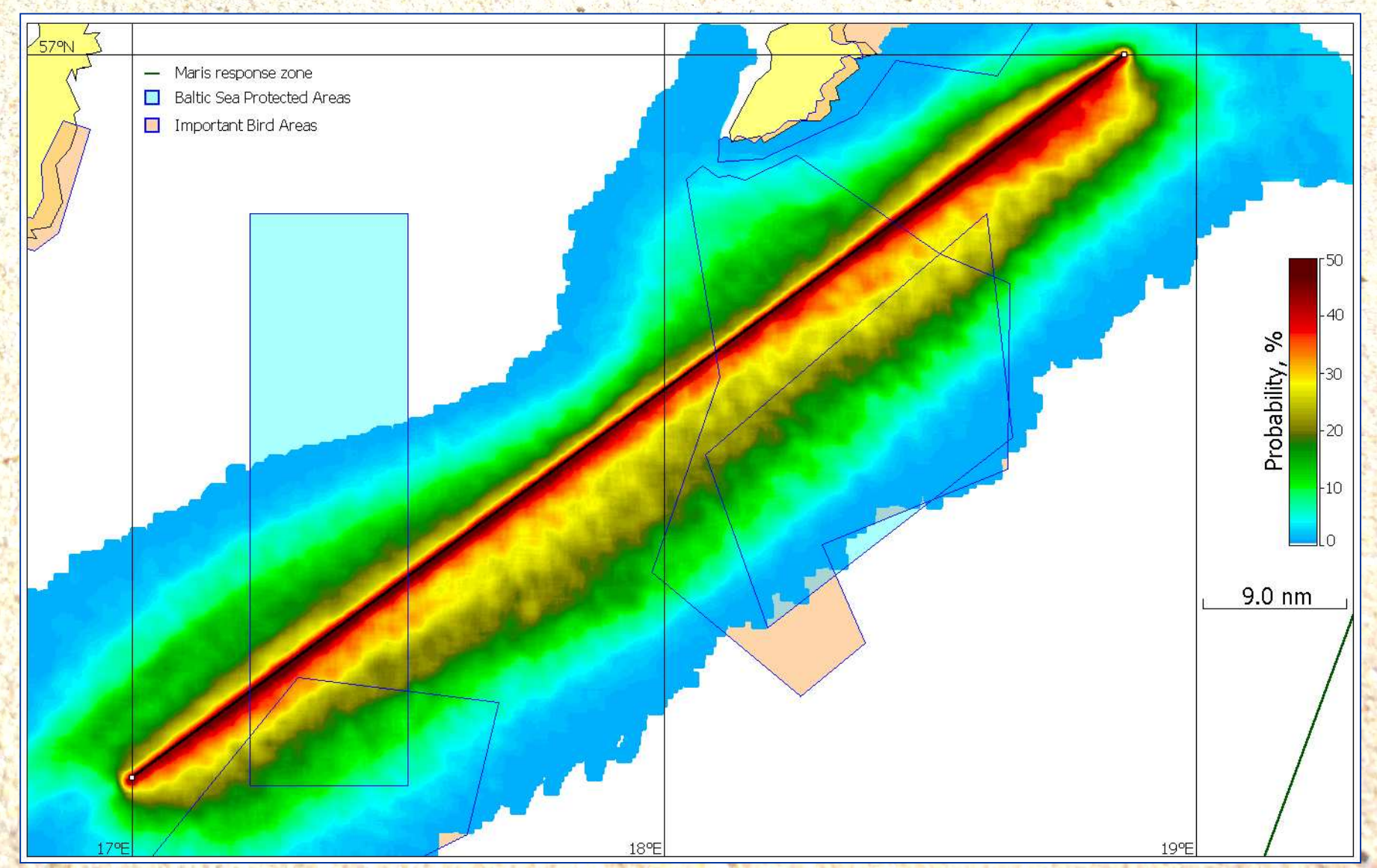
The impact of this point in the ship route on the BSPA.



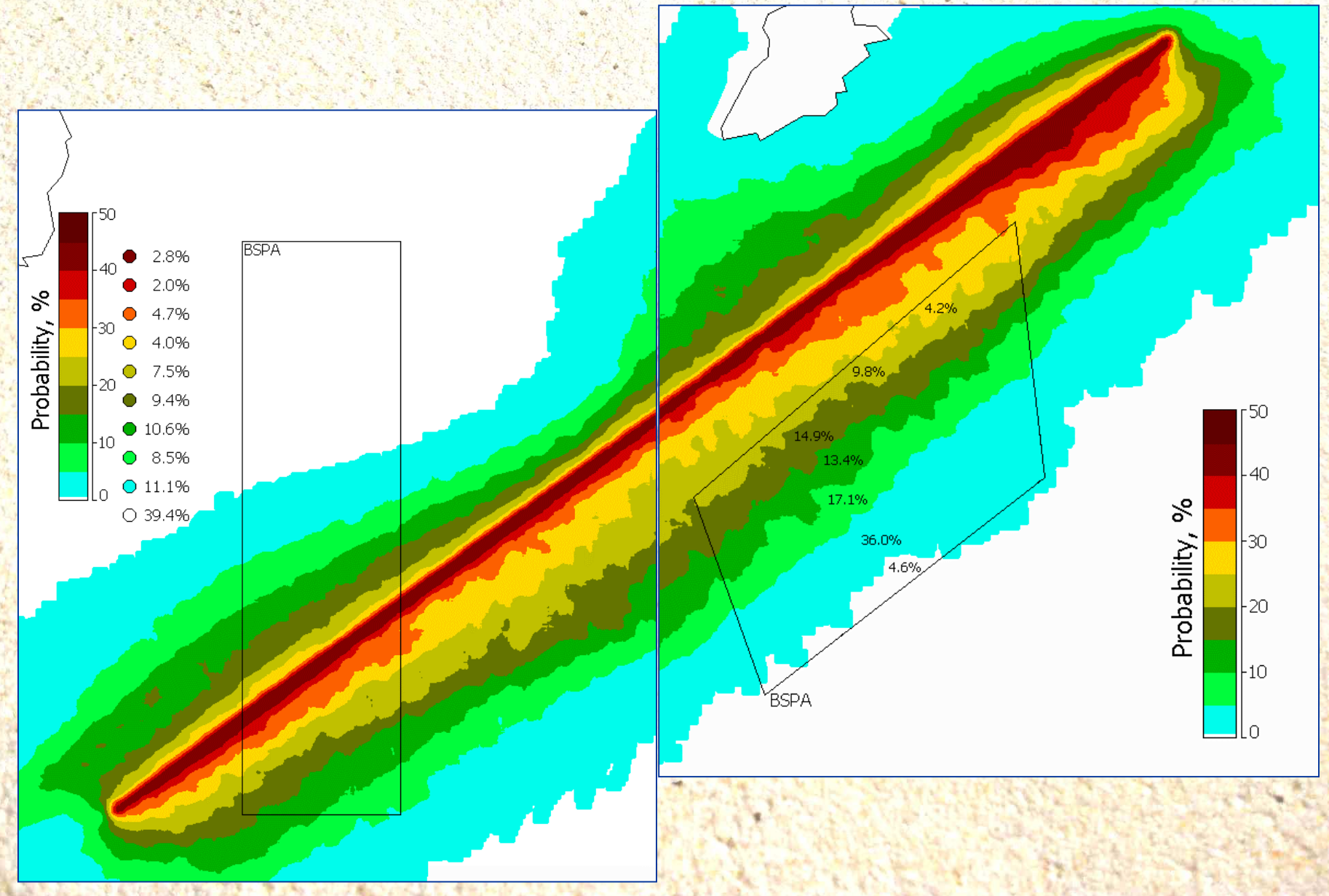
Modelling of oil spill drift released from a long part of the ship route located southward of Gotland. Oil spill drift on 12 July 2007.



Probability (%) of oil spill drift calculated on the base of daily modelling at this line for real wind and currents conditions in July-August 2007.



The impact of this part of the ship route on both BSPAs.



CONCLUSIONS:

We can conclude that ENVISAT ASAR provides effective capabilities to monitor oil spills, in particular, in the Baltic Sea. Combined with satellite remote sensing of SST, suspended matter, sea level, chlorophyll concentration, mesoscale dynamics, wind and waves, this observational system, that includes also a Seatrack Web numerical model of SMHI, represents a powerful method for long-term monitoring of ecological state over the Baltic Sea, as well as smaller areas of particular interest, such as marine protected areas and/or "Nord Stream" gas pipeline. Seatrack Web model allows also to assess quantitatively the ecological risks related to potential oil pollution of every MPAs in the Baltic Sea resulted from main ship routes, oil terminals and ports, and "Nord Stream" gas pipeline construction.