Ramboll Barents

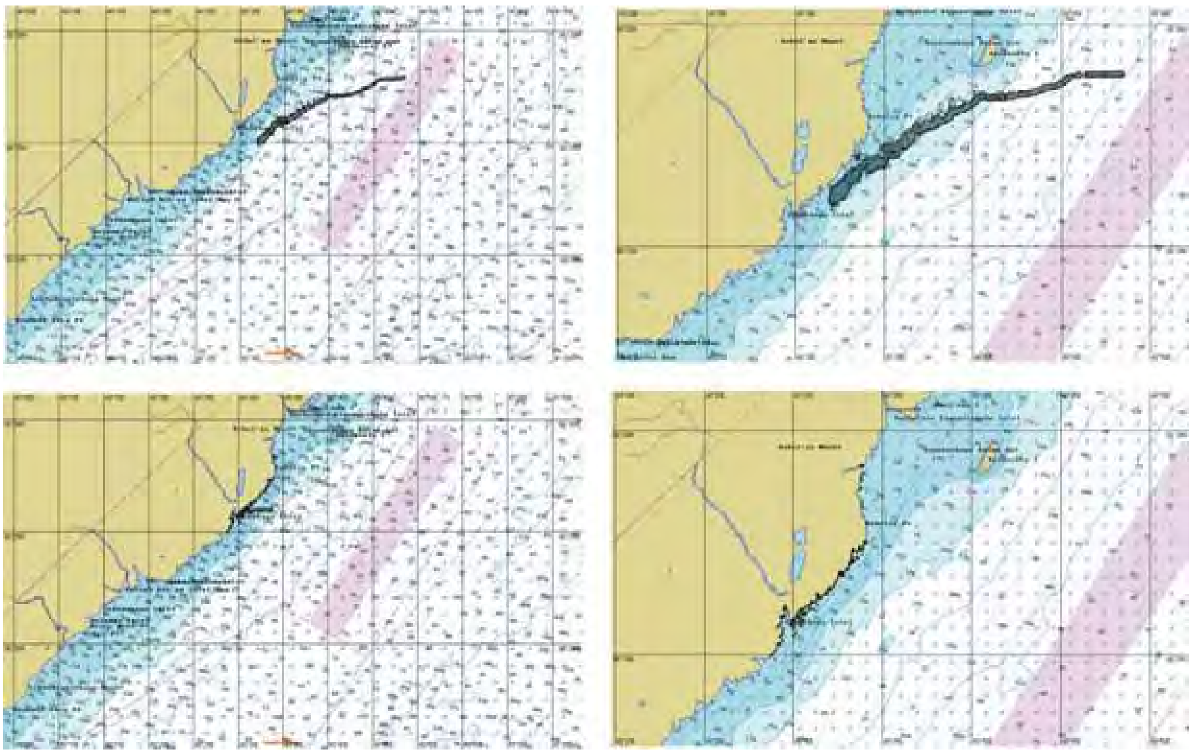
**UNEP/GEF Project**
**Russian Federation – Support to the National Programme of Action for the Protection of the Arctic Marine Environment**

**Barents Hot Spots Facility**

Pilot Project:

# IMPROVEMENT OF THE EMERGENCY OIL SPILL RESPONSE SYSTEM UNDER THE ARCTIC CONDITIONS FOR PROTECTION OF SENSITIVE COASTAL AREAS (CASE STUDY: THE BARENTS AND THE WHITE SEAS)

Water surface modeling of basic oil types transported in the Barents and White seas in various hydro-meteorological conditions. Volume II.



Murmansk, 2010

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## INTRODUCTION

The present volume sets out results of potential oil and oil product spill modelling, as well as gas condensate spill modelling in the analyzed water areas within the framework of the pilot project "Improvement of the Emergency Oil Spill Response System under the Arctic Conditions for Protection of Sensitive Coastal Areas (Case Study: the Barents and the White Seas)"

Oil spill behaviour modelling is implemented with the help of the computer-based simulation system TRANZAS. The simulator for emergency action exercises (PICSES-II) is a unit of the Emergency Action Operation Control System manufactured by TRANZAS and is successfully applied for desktop and field-based exercises of the personnel and command staff of the interacting service teams in the modelled emergencies: oil spillage, failures at high potential risk facilities, maritime and aviation accident salvage and rescue operations, as well as for mathematical trajectory modelling, evaporation, shoreline impact and high risk potential impact of oil or chemical spill offshore.

The programme PICSES-II meets the requirements of MARPOL 73/78, OPR-90, OPA-90, as well as the Rules of the Measures for Prevention and Elimination of oil spills in the territory of the Russian Federation. The programme is adapted in compliance with the requirements of the EMERCOM of Russia.

In compliance with the percentage ratio of the shipped oil and oil product volumes and based on their physical-chemical properties four substances have been selected for modelling purposes:

1. Crude Oil
2. Black Oil;
3. Gas Condensate;
4. Naphtha – stable natural gasoline.

The term " oil" in the present report pertains to crude oil, refined oil products and gas condensate.

The term " oil slick" pertains to any crude oil slick, refined product slick or gas condensate slick spreading on the water surface.

The abbreviation «OS» pertains to any oil spill, refined products spill or gas condensate spill.

"Ч+…" in figures means time after start of oil spill (in hours).

# 1 OIL TRAJECTORY MODELLING IN THE BARENTS SEA

## 1.1 Approved oil trajectory modelling conditions in the Barents Sea

### 1.1.1 The area and point of modelling

Based on the analysis of provisions of the Mode of Navigation in the Barents and White Seas (Summary Description…, 2007) and the Pilot of the Barents Sea (Pilot of the Barents Sea, 1995) the shipping route area with the highest navigation risk has been selected in the Barents Sea. The area is bounded by lines connecting points with the coordinates as follows:

Area 1. The Barents Sea:

| | | |
|---|---|---|
| 1) | 69°17,94'N, | 33 32,62'E; |
| 2) | 69 19,00 | 33 30,15 |
| 3) | 69 20,67 | 33 31,90 |
| 4) | 69 23,63 | 33 31,90 |
| 5) | 69 23,00 | 33 37,10 |
| 6) | 69 22,02 | 33 45,40 |

Resulting from the analysis of the set shipping routes in the selected area of the Barents Sea, the point of intersection of basic shipping routes by tankers/carbon carriers with the coordinates as follows (figure 1):

Point OS-1. The Barents Sea: 69°22,00'N, 33°37,00'E; (figure 1)


Figure. 1 The Modelling Point OS-1

### 1.1.2 Types of oil

Based on the analysis of types of oil shipped across the Barents Sea the following types have been accepted for modelling: crude oil (Varandey oil grade), black oil of M-100 grade, stable gas condensate (SGC), naphtha (stable natural gasoline).

Tables 1.1.2.1 – 1.1.2.4. present the basic physical-chemical properties of crude oil types applied for computer-based modelling.

*Table 1.1.2.1. Physical-chemical properties of the crude oil (Varandey oil grade)*

| No | GOST P 51858-2002 Index Name | Value |
|---|---|---|
| 1. | Density at $20^0$C, kg/m$^3$ | 901 |
| 2. | Water content, % | 0,5 |
| 3. | Mass fraction of solids % | 0,05 |
| 4. | Mass fraction of sulphur, % | 1,98 |
| 5. | Saturated vapour pressure, kPa, (mm Hg) | 26,7<br>(200) |
| 6. | Fractions yield, % at temperature:<br>200 °C<br>300 °C | <br>22,4<br>36,0 |
| 7. | Mass fraction of paraffin, % | 0,5 |

*Table 1.1.2.2. Physical-chemical properties of black oil, grade M-100 type VI*

| No | GOST 10585–99 Index Name | Value |
|---|---|---|
| 1. | Viscosity at T not exceeding $80^0$C:<br>kinematic, m$^2$/s (cSt) | 66,<br>9,0 |

| | | |
|---|---|---|
| | funnel, degrees FV | |
| 2. | Ash content, mass fraction % | 0,037 |
| 3. | Mass fraction of solids % | 0,034 |
| 4. | Mass fraction of water % | 0,24 |
| 5. | Content of water-soluble acids and alkalis | absence |
| 6. | Flashpoint COC,$^0$C | 136 |
| 7. | Mass fraction of sulphur % | 2,68 |
| 8. | Congelation point,$^0$C | 21 |
| 9. | Combustion heat, kJ/kg | 43825 |
| 10. | Hydrogen sulfide and volatile mercaptans | absence |
| 11. | Density at 20$^0$C, kg/m$^3$ | 975,2 |

*Table 1.1.2.3. Physical-chemical properties of SGC*

| No | OST 51.65-80 Index Name | Value |
|---|---|---|
| 1. | Density at 20$^0$C, kg/m$^3$ | 739,5 |
| 2. | Kinematic viscosity at 20$^0$C, m$^2$/c (cSt) | 1,058 |
| 3. | Saturated vapour pressure, kPa, (mm Hg) | 56,6 (425,3) |
| 4. | Mass fraction of solids % | absence |
| 5. | Mass fraction of water % | absence |
| 6. | Mass fraction of chloride salts, mg/l | 0,7 |
| 7. | Mass fraction of the total sulphur, % of mass | Less than 0,01 |
| 8. | Fractions yield<br>Start of boiling, °C<br>10% (vol.)<br>50% (vol.)<br>90% (vol.)<br>End of boiling, °C<br>Yield, % (vol.)<br>Residue, % (vol.)<br>Loss, % (vol.) | <br>39,0<br>67,0<br>139,0<br>295,0<br>312,0<br>94,0<br>2,5<br>3,5 |

*Table 1.1.2.4. Physical-chemical properties of naphtha(stable natural gasoline, grade BT)*

| No | STO 11605031-019-2007 Index Name | Value |
|---|---|---|
| 1. | Fractional composition:<br>Initial boiling point, $^0$C, not below<br>End of boiling, $^0$C, not higher | <br>31<br>150 |
| 2. | Density at 15 $^0$C, kg/m$^3$ | 714 |
| 3. | Mass fraction of sulphur, % | 0,005 |
| 4. | Concentration of actual gum, mg per 100 sm$^3$ of naphtha | absence |
| 5. | Mass fraction of paraffin, % | 68,1 |
| 6. | Mass fraction of aromatic hydrocarbons, % | 6,7 |
| 7. | Mass fraction of naphthenic hydrocarbons % | 25,2 |
| 8. | Water and solids | absence |
| 9. | Saturated vapour pressure, kPa, not exceeding | 71,5 |

### 1.1.3 Volume of oil

Based on the cargo characteristics of the tankers shipping oil in the Barents Sea waters and the legal requirements to determination of maximum volume of oil spill occurred from tankers, i.e. the volume of two adjacent tanks, the following parameters have been accepted for modelling:

a) Crude oil spill volume – 20 000 m$^3$

b) Black oil spill volume – 12 000 $m^3$
c) SGC spill volume – 20 000 $m^3$
d) Naphtha spill volume – 10 000 $m^3$

### 1.1.4 Hydro-meteorological conditions of modelling

The basic parameters of the hydro-meteorological conditions accepted for oil and oil product spill behaviour modelling in case of oil spill in the White Sea are shown in table 1.1.4.1.

*Table 1.1.4.1: Hydro-meteorological conditions of modelling in the Barents Sea*

| No | Parameter | Indices | |
|---|---|---|---|
| 1. | Season | **Autumn** | **Spring** |
| 2. | Average air T, $^{O}C$ | -3 | -2 |
| 3. | Average water T, $^{O}C$ | +3 | +3 |
| 4. | Density of surface water, kg/$m^3$ | 1023 | 1023 |
| 5. | Prevailing wind | S, SW | N, NW |
| 6. | Average monthly wind speed, m/s | 12 | 2 |
| 7. | Heaving, m | 2 | 2 |
| 8. | Current velocity, km/h | 1 | 1 |
| 9. | Cloud conditions | 9 | 9 |

### 1.1.5 Oil and oil product spill scenarios in the Barents Sea

16 the scenarios have been determined for the purpose of oil spill behaviour modelling in the point OS-1 for all the four types of oil and oil products. The scenario codes, oil spill volumes and explanation are shown in table 1.1.5.1.

*Table 1.1.5.1.: OS modelling scenarios in the Barents Sea.*

| No | The scenario Code | OS Volume, $m^3$ | Explanation |
|---|---|---|---|
| 1. | **COV-Aut-S-1** | 20 000 | COV – crude oil (Varandey grade); Aut – autumn; S – south wind; 1 – modelling point OS-1 |
| 2. | **BO-Aut-S-1** | 12 000 | BO – black oil; Aut – autumn; S – south wind; 1 – modelling point OS-1 |
| 3. | **GC-Aut-S-1** | 20 000 | GC – gas condensate; Aut – autumn; S – south wind; 1 – modelling point OS-1 |
| 4. | **Na-Aut-S-1** | 10 000 | Na – naphtha; Aut – autumn; S – south wind; 1 – modelling point OS-1 |
| 5. | **COV-Aut-SW-1** | 20 000 | COV – crude oil (Varandey grade); Aut – autumn; SW – south-west wind; 1 – modelling point OS-1 |
| 6. | **BO-Aut-SW-1** | 12 000 | BO – black oil; Aut – autumn; SW – south-west wind; 1 – modelling point OS-1 |
| 7. | **GC-Aut-SW-1** | 20 000 | GC – gas condensate; Aut – autumn; SW – south-west wind; 1 – modelling point OS-1 |
| 8. | **Na-Aut-SW-1** | 10 000 | Na – naphtha; Aut – autumn; SW – south-west wind; 1 – modelling point OS-1 |
| 9. | **COV-Spr-N-1** | 20 000 | COV – crude oil (Varandey grade); Spr – spring; N – north wind; 1 – modelling point OS-1 |
| 10. | **BO-Spr-N-1** | 12 000 | BO – black oil; Spr – spring; N – north wind ; 1 – modelling point OS-1 |
| 11. | **GC-Spr-N-1** | 20 000 | GC – gas condensate; Spr – spring; N – north wind; 1 – modelling point OS-1 |
| 12. | **Na-Spr-N-1** | 10 000 | Na – naphtha; Spr – spring; N – north wind; 1 – modelling point OS-1 |

| | | | |
|---|---|---|---|
| 13. | **COV-Spr-NW-1** | 20 000 | COV – crude oil (Varandey grade»); Spr – spring; NW – north-west wind; 1 – modelling point OS-1 |
| 14. | **BO-Spr-NW-1** | 12 000 | BO – black oil; Spr – spring; NW – north-west wind; 1 – modelling point OS-1 |
| 15. | **GC-Spr-NW-1** | 20 000 | GC – gas condensate; Spr – spring; NW – north-west wind; 1 – modelling point OS-1 |
| 16. | **Na-Spr-NW-1** | 10 000 | Na – naphtha; Spr – spring; NW – north-west wind; 1 – modelling point OS-1 |

## 1.2 Oil spill behaviour modelling in the Barents Sea under the autumn southward wind

### 1.2.1 Oil slick behaviour modelling as per the scenario COV-Aut-S-1

*Table 1.2.1.1: Oil slick spreading parameters as per the scenario COV-Aut-S-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil / water mixture volume afloat | Average slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 5528 | 100 | 5503 | 99,5 | 14,93 | 0,27 | 10,19 | 0,18 | 0 | 0 | 6443 | 24,33 | 264848 | 98,1 |
| H +02:00 | 11459 | 100 | 11379 | 99,3 | 51,57 | 0,45 | 31,18 | 0,27 | 0 | 0 | 13358 | 25,61 | 521593 | 139 |
| H +03:00 | 16076 | 100 | 15912 | 99,0 | 110,9 | 0,69 | 53,05 | 0,33 | 0 | 0 | 23032 | 26,73 | 861814 | 180 |
| H +04:00 | 20000 | 100 | 19725 | 98,6 | 184,3 | 0,92 | 78,54 | 0,39 | 0 | 0 | 30751 | 28,22 | 1089537 | 225 |
| H +05:00 | 20000 | 100 | 19649 | 98,2 | 252,2 | 1,26 | 103,4 | 0,50 | 0 | 0 | 33815 | 30,67 | 1102559 | 305 |
| H +05:38 Landfall | 20000 | 100 | 19595 | 98,0 | 294,9 | 1,47 | 110,9 | 0,55 | 0 | 0 | 35039 | 30,59 | 1145339 | 345 |
| H +06:00 | 20000 | 100 | 19562 | 97,8 | 316,4 | 1,58 | 116,2 | 0,58 | 6,6 | 0,03 | 35539 | 31,52 | 1127628 | 365 |
| H +09:00 | 20000 | 100 | 19319 | 96,6 | 485,0 | 2,40 | 168,5 | 0,84 | 34,1 | 0,17 | 36907 | 30,35 | 1216039 | 454 |
| H +12:00 | 20000 | 100 | 19116 | 95,6 | 628,7 | 3,14 | 224,9 | 1,12 | 34,1 | 0,17 | 36734 | 25,51 | 1440129 | 496 |
| H +15:00 | 20000 | 100 | 18911 | 94,6 | 769,9 | 3,85 | 284,3 | 1,42 | 34,1 | 0,17 | 36365 | 18,88 | 1925931 | 533 |
| H +18:00 | 20000 | 100 | 18730 | 93,7 | 888,7 | 4,44 | 350,2 | 1,75 | 34,1 | 0,17 | 36019 | 20,40 | 1765315 | 564 |
| H +24:00 | 20000 | 100 | 18407 | 92,0 | 1078 | 5,39 | 482,9 | 2,41 | 34,1 | 0,17 | 35397 | 20,01 | 1768658 | 619 |
| H +36:00 | 20000 | 100 | 17648 | 88,2 | 1446 | 7,23 | 852,7 | 4,26 | 34,1 | 0,17 | 33919 | 11,83 | 2867202 | 760 |
| H +48:00 | 20000 | 100 | 17251 | 86,3 | 1676 | 8,38 | 1039 | 5,19 | 34,1 | 0,17 | 33176 | 7,74 | 4287296 | 831 |

Within the first 4 hours as of the OS start the oil slick spreads westward of the modelling point OS-1 under the action of the wind and current. After 4 hours as of the start of OS the slick semi-perimeter makes 1842 m, the volume of the evaporated oil – 0,92%, the volume of the dispersed oil – 0,39%. Further the slick drifts northward and in 5 hours 38 minutes reaches the coastline in the area of the Cape Set-Navolok in the point with coordinates $69^0$22,5N; $33^0$28E. Further the oil slick moves along the Cape Set-Navolok polluting the coastline at the length of 2,94 km. After 9 hours as of the OS start the slick commences drifting from the Cape Set-Navolok towards the open sea. After 9 hours as of the OS start the slick semi-perimeter makes 1954 m, the volume of the evaporated oil – 2,4%, the volume of the dispersed oil – 0,84%. Further the slick moves north-eastward blocking commercial marine traffic along the set shipping routes inbound and outbound of the Kolskiy Gulf. After 24 hours as of the OS start the slick semi-perimeter makes 2357 m, the volume of the evaporated oil – 5,39%, the volume of the dispersed oil – 2,41%. The volume of the oil/water mixture has increased compared to the OS volume with 78%. To the moment of the modelling completion (48 hours), the oil slick centre is located in the point with coordinates $69^0$35N; $33^0$45E, the average oil slick thickness makes 7,7 mm.
The graphic display of the oil slick spreading as per the scenario COV-Aut-S-1 is shown on figure 3 – 16.
The charts of the processes typical for oil behaviour on water are shown in figures 17-19.

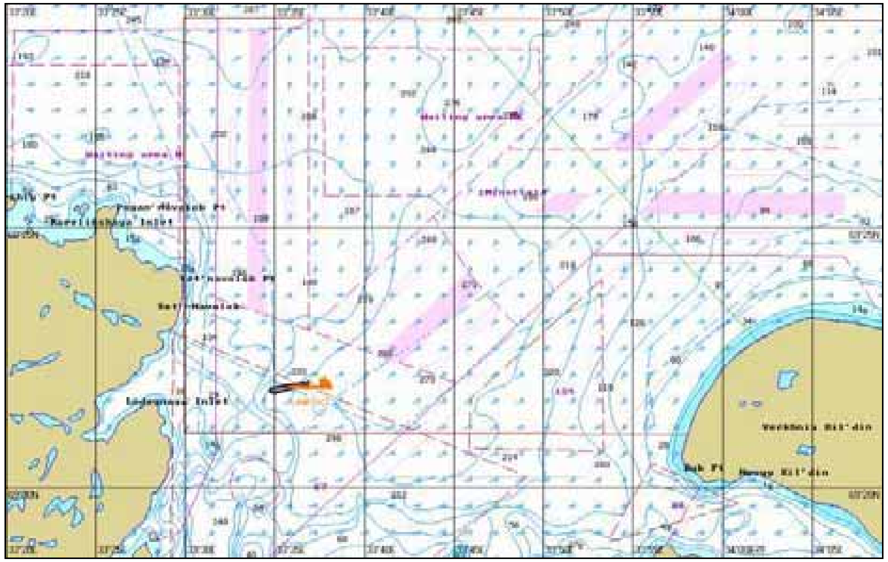


Figure. 3. H+01:00. Oil slick spreading as per the scenario COV-Aut-S-1.

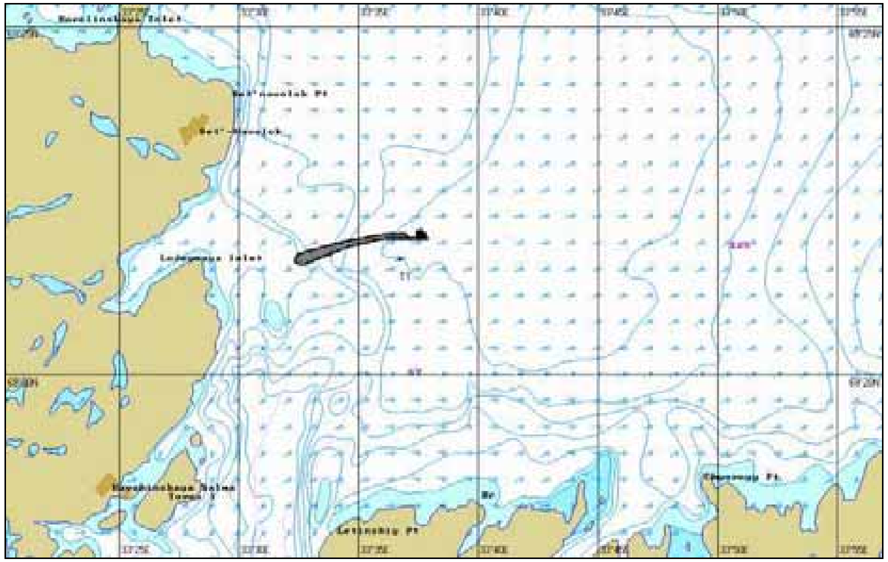


Figure. 4. H+02:00. Oil slick spreading as per the scenario COV-Aut-S-1.

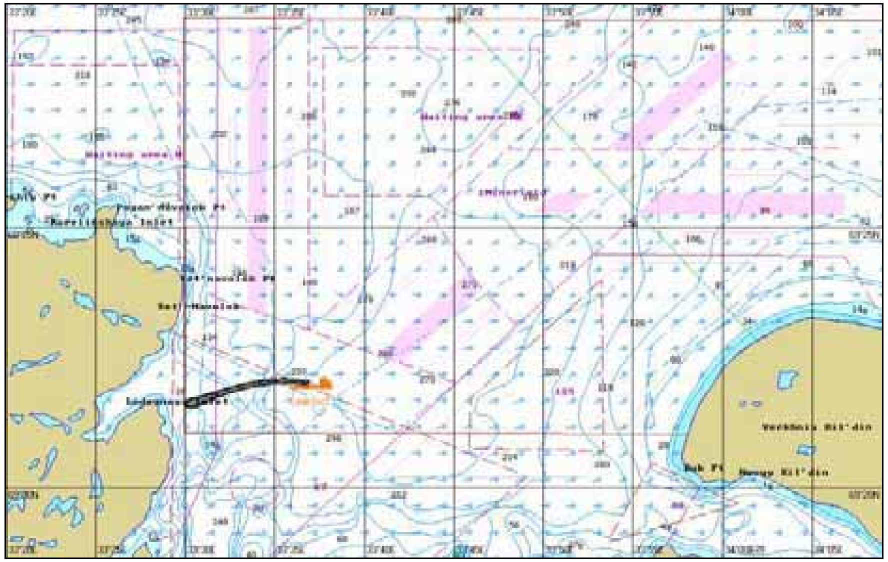


Figure. 5. H+03:00. Oil slick spreading as per the scenario COV-Aut-S-1.

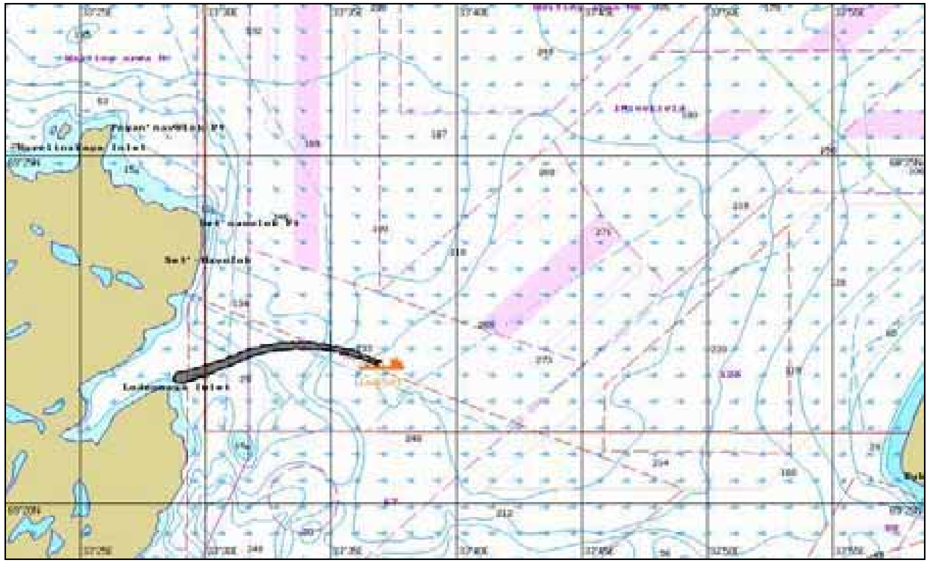


Figure. 6. H+04:00. Oil slick spreading as per the scenario COV-Aut-S-1.

Figure. 7. H +05:00. Oil slick spreading as per the scenario COV-Aut-S-1.

Figure. 8. **H +05:38.** Oil slick spreading as per the scenario COV-Aut-S-1.

Figure 9. H +06:00. Oil slick spreading as per the scenario COV-Aut-S-1.

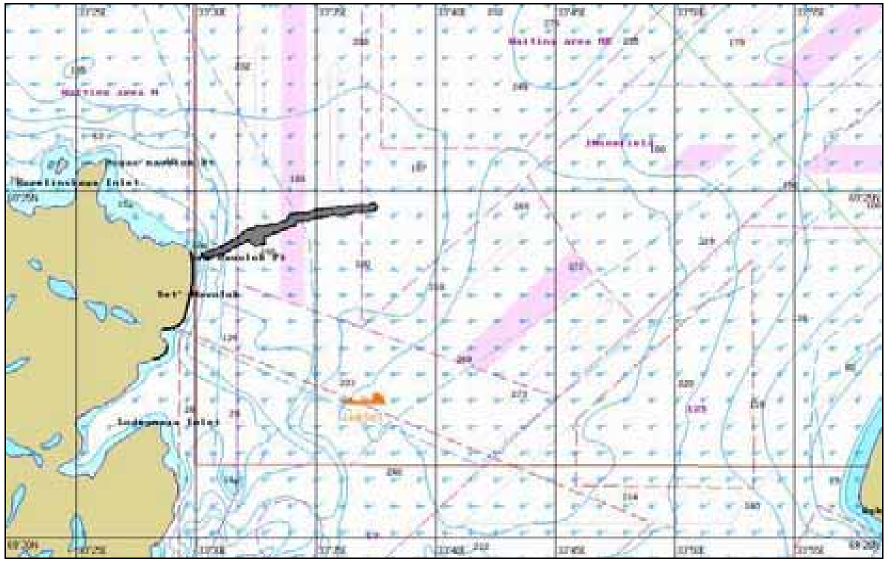


Figure. 10. H +09:00. Oil slick spreading as per the scenario COV-Aut-S-1.

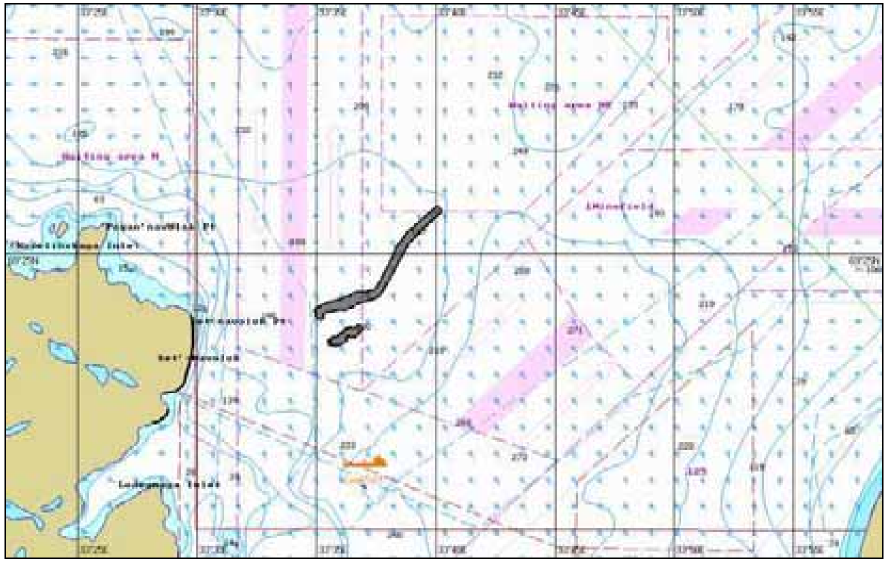


Figure 11. H +12:00. Oil slick spreading as per the scenario COV-Aut-S-1.

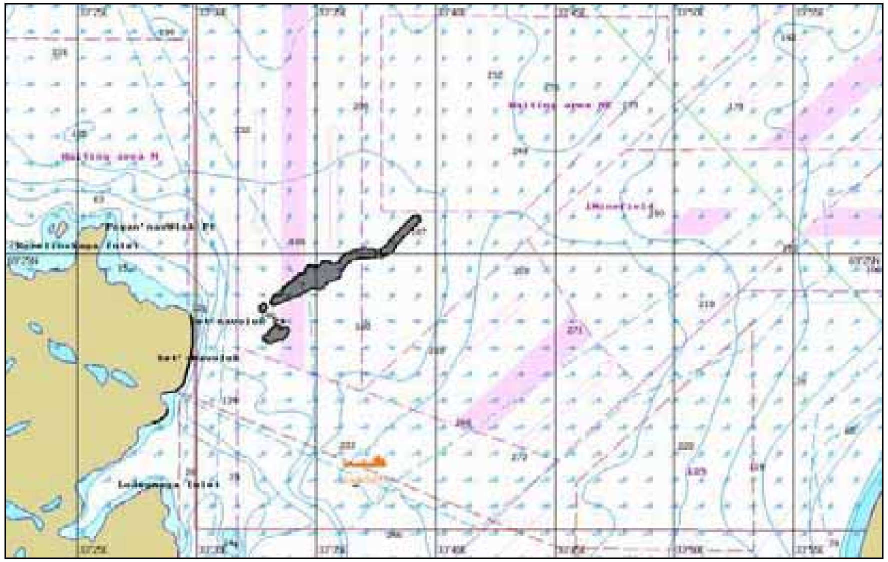


Figure 12. H +15:00. Oil slick spreading as per the scenario COV-Aut-S-1.

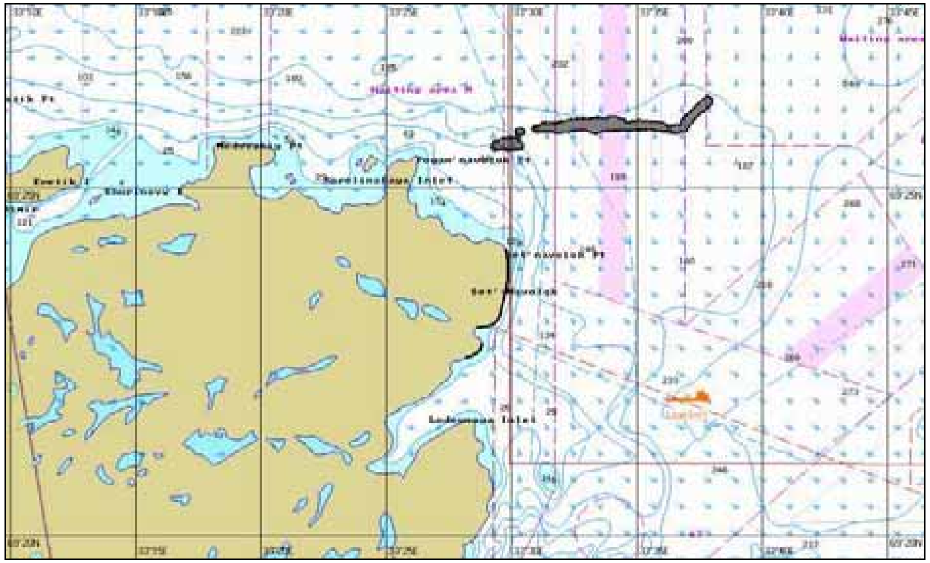


Figure 13. H +18:00. Oil slick spreading as per the scenario COV-Aut-S-1.

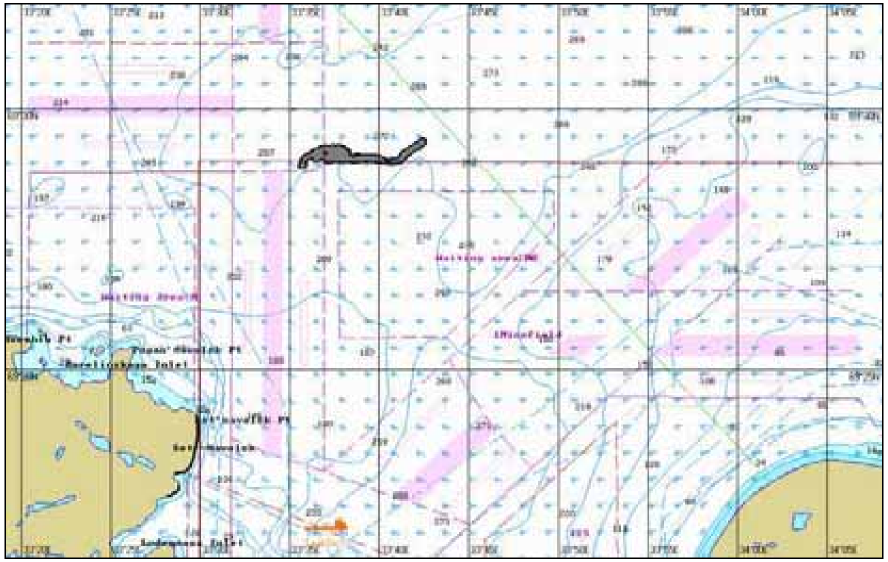


Figure 14. H +24:00. Oil slick spreading as per the scenario COV-Aut-S-1.

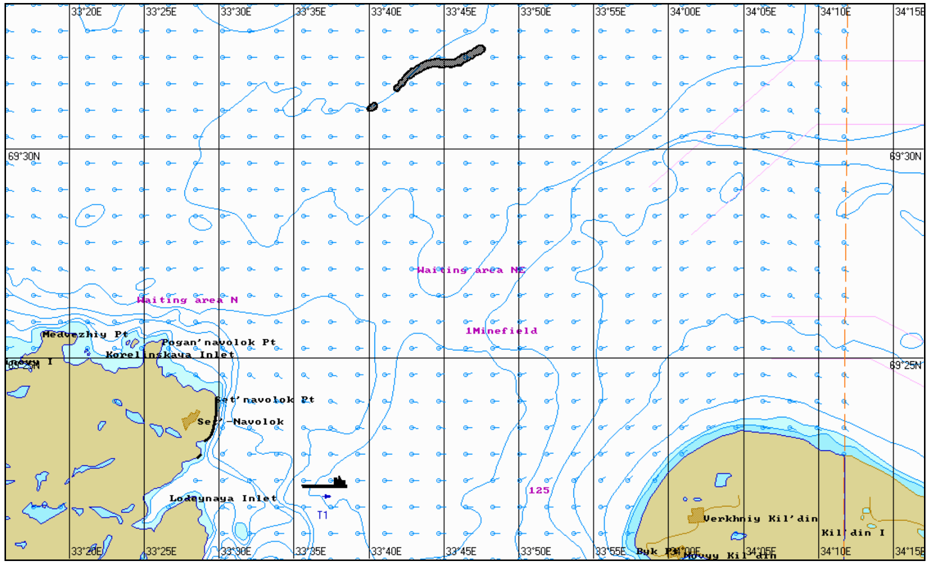



Figure. 15. H +36:00. Oil slick spreading as per the scenario COV-Aut-S-1.

Figure. 16. H +48:. Oil slick spreading as per the scenario COV-Aut-S-1.

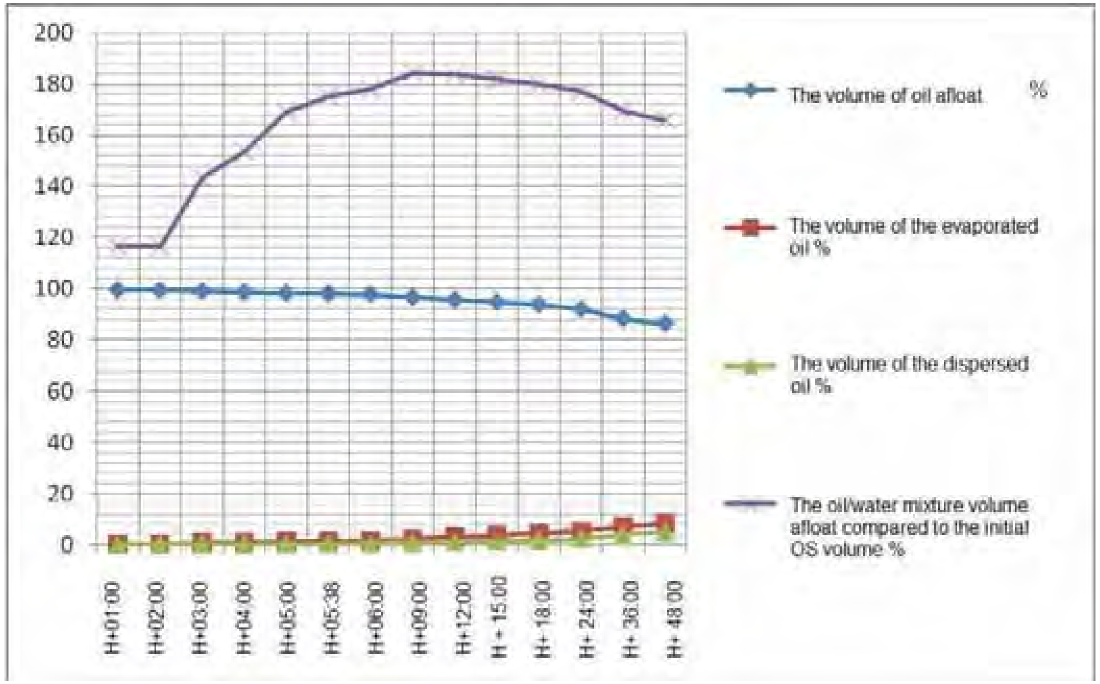



Figure 17. The chart of processes as per the scenario COV-Aut-S-1.

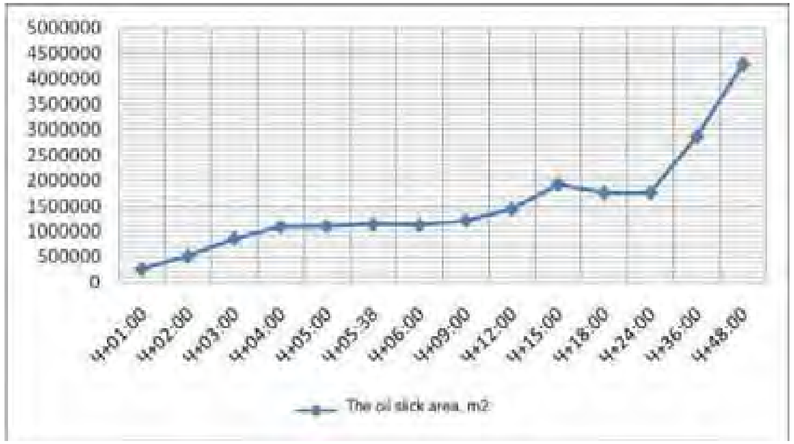



Figure 18. Oil slick area change dynamics as per the scenario COV-Aut-S-1.

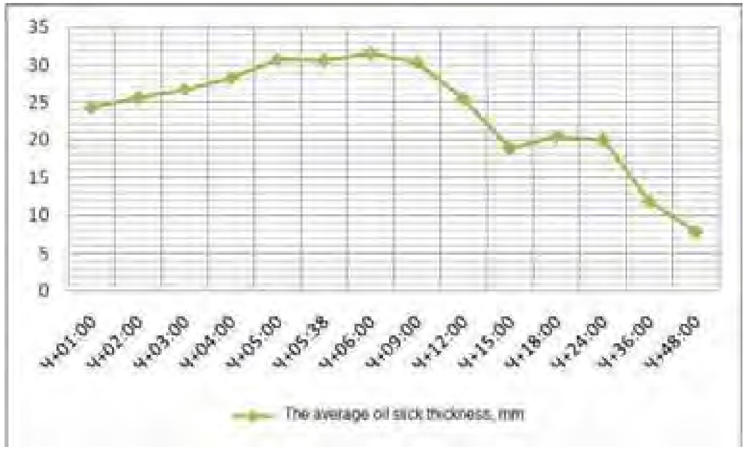



Figure 19. Oil slick thickness change dynamics as per the scenario COV-Aut-S-1.

### 1.2.2 Oil slick behaviour modelling as per the scenario BO-Aut-S-1

*Table 1.2.2.1: Oil slick spreading parameters as per the scenario BO-Aut-S-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil / water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $м^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 3059 | 100 | 3059 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 3059 | 32,30 | 94717 | 15541 |
| H+02:00 | 6142 | 100 | 6142 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 6142 | 27,94 | 219812 | 15541 |
| H+03:00 | 9071 | 100 | 9071 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 9071 | 26,34 | 344381 | 15541 |
| H+04:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 24,71 | 485262 | 15541 |
| H+05:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 28,37 | 422982 | 15541 |
| H+05:56 **Landfall** | 12000 | 100 | 11999 | 100 | 0 | 0 | 0 | 0 | 1,8 | 0,02 | 11999 | 30,03 | 399580 | 15541 |
| H+07:00 | 12000 | 100 | 11985 | 99,9 | 0 | 0 | 0 | 0 | 16,3 | 0,14 | 11985 | 30,05 | 398779 | 15541 |
| H+09:00 | 12000 | 100 | 11985 | 99,9 | 0 | 0 | 0 | 0 | 16,3 | 0,14 | 11985 | 31,31 | 382745 | 15541 |
| H+12:00 | 12000 | 100 | 11985 | 99,9 | 0 | 0 | 0 | 0 | 16,3 | 0,14 | 11985 | 32,12 | 373164 | 15541 |
| H+15:00 | 12000 | 100 | 11985 | 99,9 | 0 | 0 | 0 | 0 | 16,3 | 0,14 | 11985 | 32,93 | 363954 | 15541 |
| H+18:00 | 12000 | 100 | 11985 | 99,9 | 0 | 0 | 0 | 0 | 16,3 | 0,14 | 11985 | 33,48 | 357979 | 15541 |
| H+24:00 | 12000 | 100 | 11985 | 99,9 | 0 | 0 | 0 | 0 | 16,3 | 0,14 | 11985 | 36,65 | 327016 | 15541 |
| H+36:00 | 12000 | 100 | 11985 | 99,8 | 0 | 0 | 0 | 0 | 16,3 | 0,14 | 11985 | 48,04 | 249478 | 15541 |
| H+48:00 | 12000 | 100 | 11985 | 99,8 | 0 | 0 | 0 | 0 | 16,3 | 0,14 | 11985 | 30,76 | 389686 | 15541 |

Within the first 4 hours the oil slick under the action of the wind and current spreads westward of the modelling point OS-1. After 4 hours as of the start of OS the slick semi-perimeter makes 1234 m, the evaporation and dispersion processes are not detected by the programme. Further the oil slick drifts northward and after 5 hours and 56 minutes reaches the coastline in the area of the cape Set-Navolok in the point with coordinates $69^0$22,5N; $33^0$28E. Further the oil slick moves along the Cape Set-Navolok polluting the coastline at the length of 1,73 km. After 9 hours as of the OS start the slick commences drifting from the Cape Set-Navolok towards the open sea, the oil slick break-up process is observed After 9 hours the semi-perimeter of the oil slick based on the total area makes 1096 m, the evaporation and dispersion processes are not detected by the programme. Further the oil slick moves north-eastward comprised of several separate oil slicks, blocking commercial marine traffic along the recommended shipping routes inbound/outbound of the Kolskiy Gulf. The total oil slick area after 24 hours makes 327016 $m^2$, the volume of the oil/water mixture compared to the OS volume does not increase. At the moment of the modelling completion (48 hours), the oil slick moves along the parallel $69^0$35N. The average oil slick thickness makes 30,76 mm, the slick is broken up in several separate slicks.
The graphic display of the oil slick spreading as per the scenario BO-Aut-S-1 is shown on figure 20 – 33.
The charts of the processes typical for black oil behaviour on water are shown in figures 34-36.

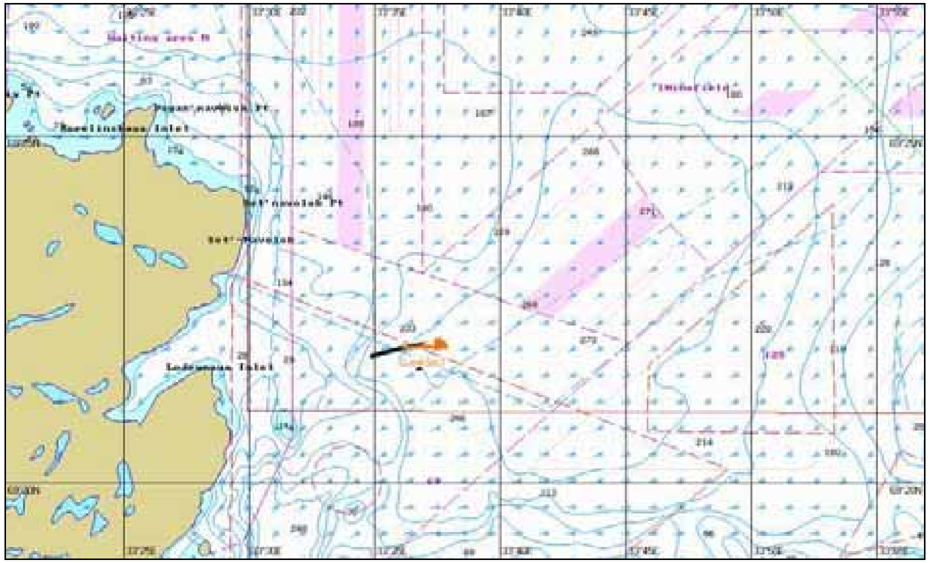


Figure 20. H +01:00. Oil slick spreading as per the scenario BO-Aut-S-1.

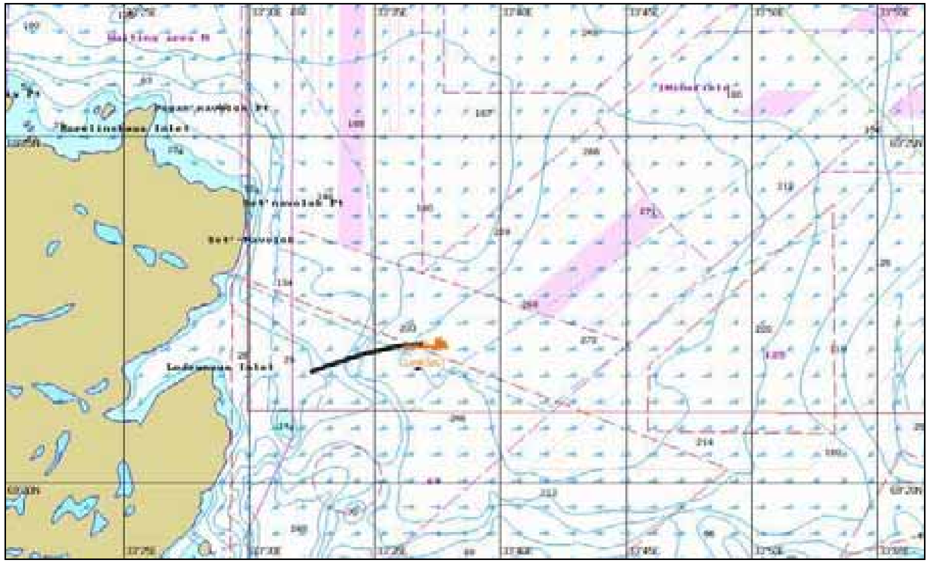


Figure 21. H +02:00. Oil slick spreading as per the scenario BO-Aut-S-1.

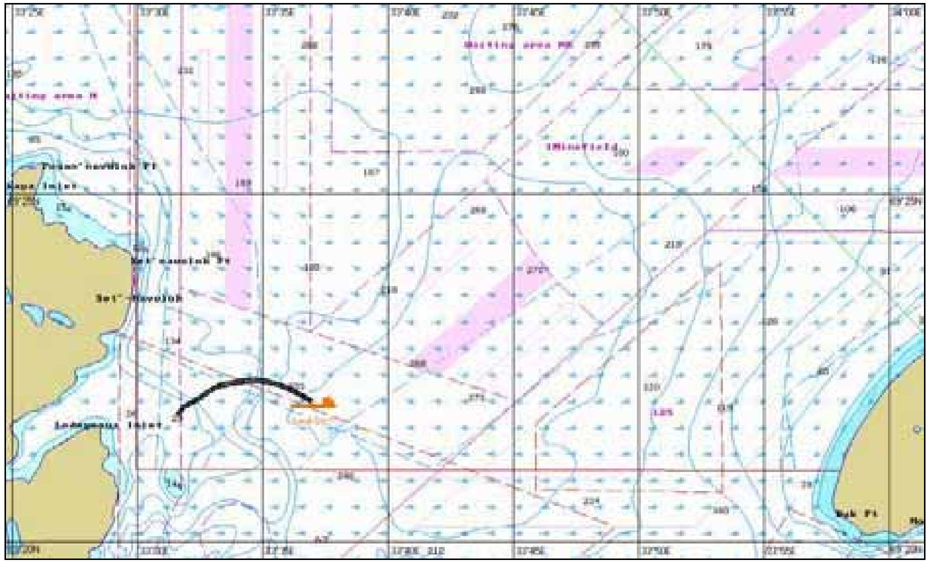


Figure 22. H +03:00. Oil slick spreading as per the scenario BO-Aut-S-1.

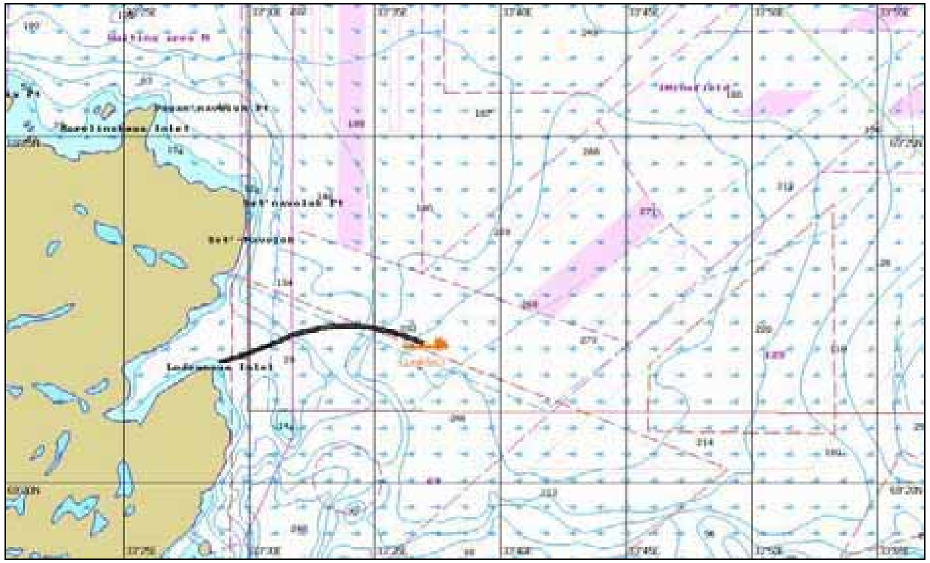


Figure 23. H +04:00. Oil slick spreading as per the scenario BO-Aut-S-1.

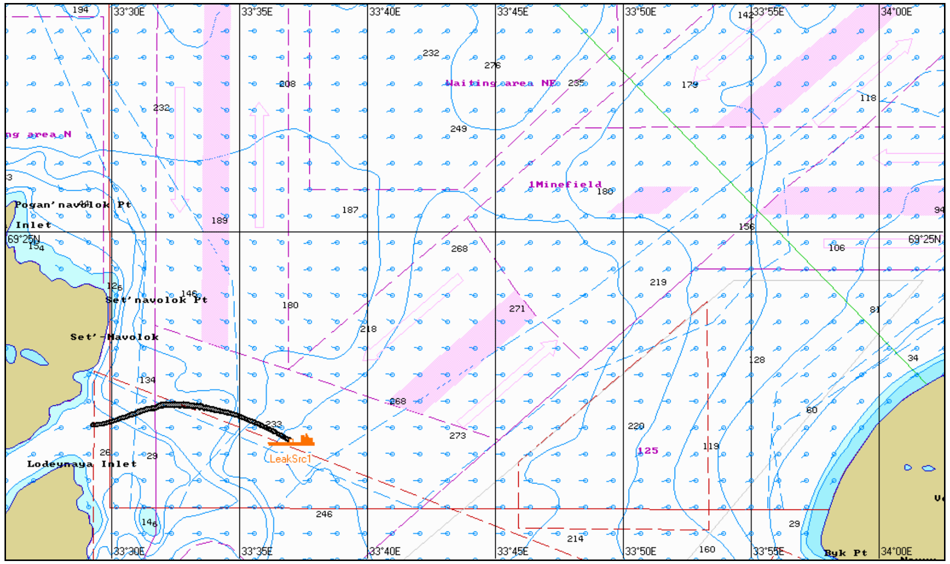



Figure 24. H +05:00. Oil slick spreading as per the scenario BO-Aut-S-1.

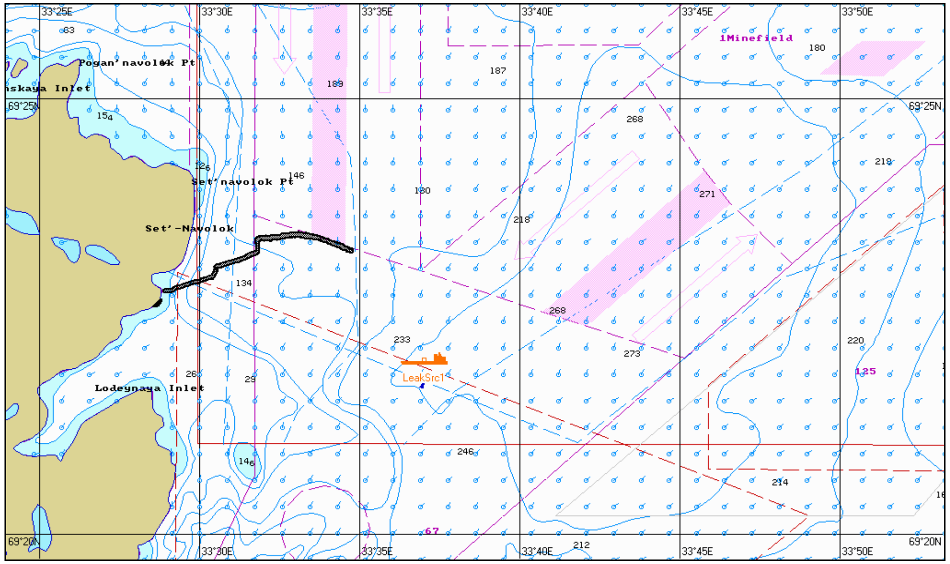



Figure 25. **H +05:56.** Oil slick spreading as per the scenario BO-Aut-S-1.

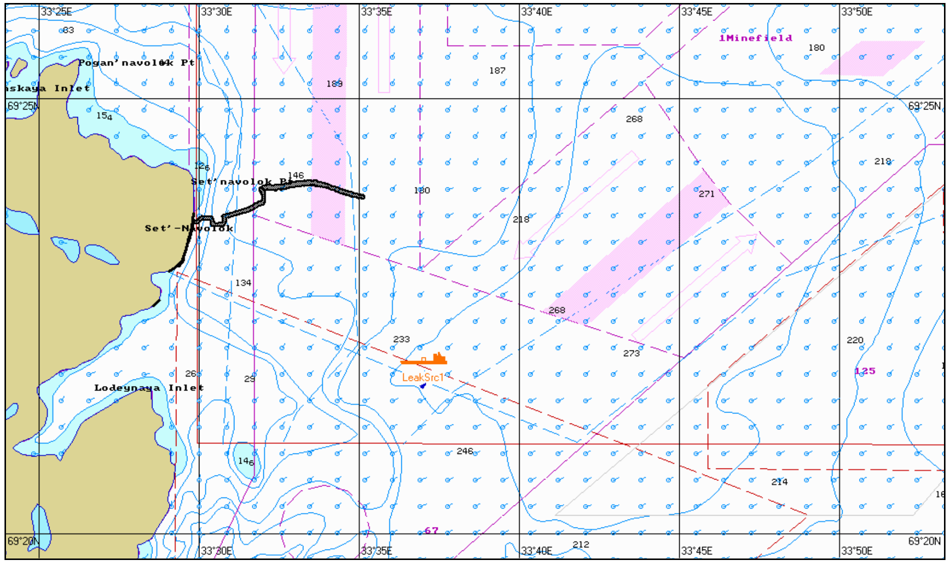



Figure 26. H +07:00. Oil slick spreading as per the scenario BO-Aut-S-1.

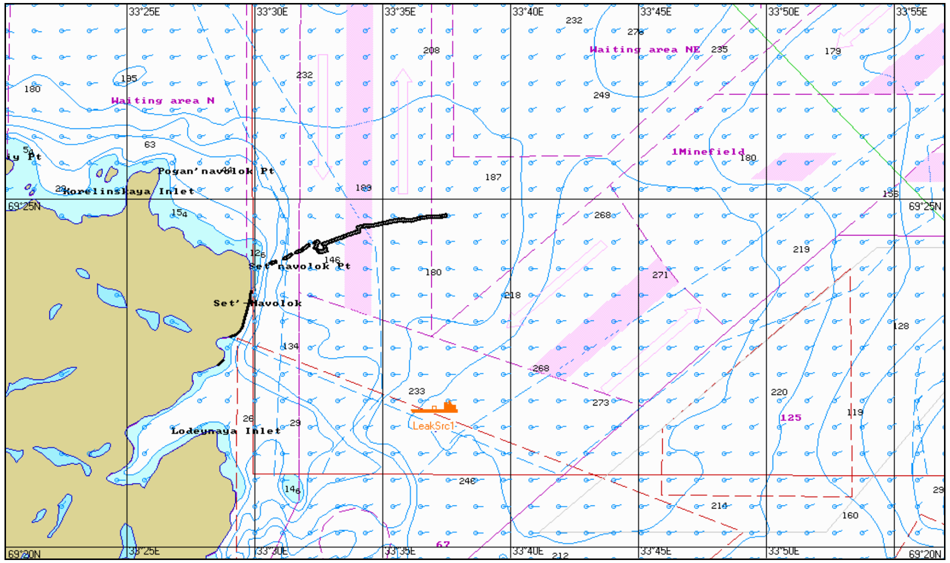



Figure 27. H +09:00. Oil slick spreading as per the scenario BO-Aut-S-1.

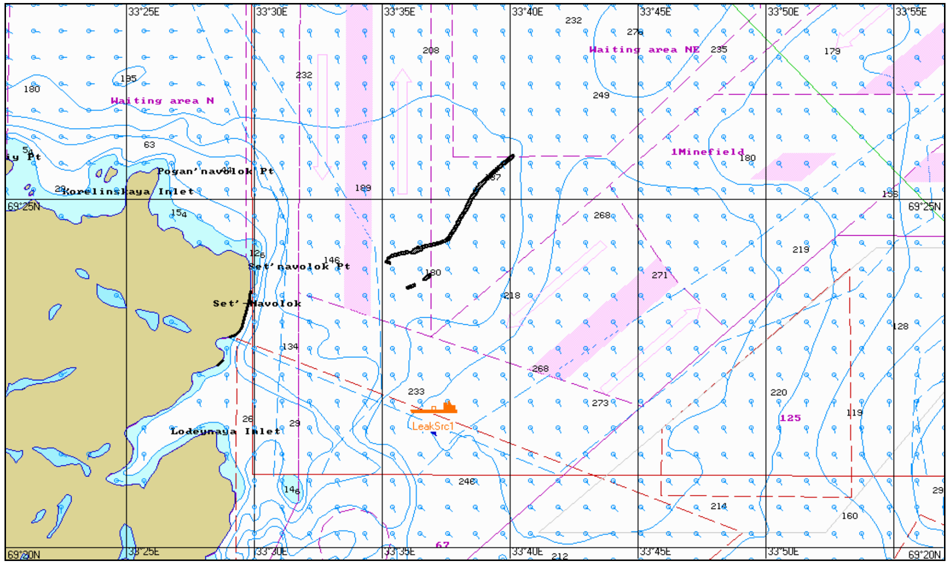



Figure 28. H +12:00. Oil slick spreading as per the scenario BO-Aut-S-1.

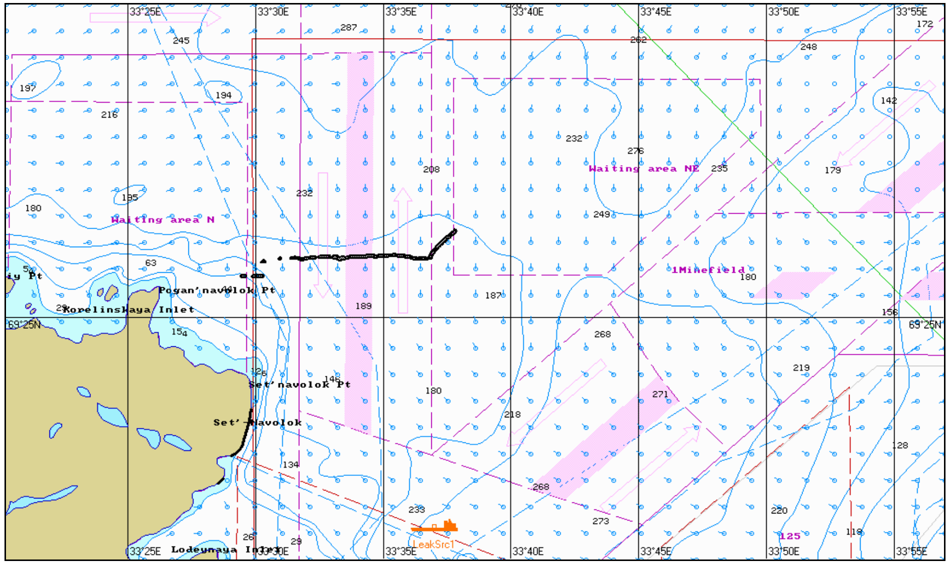



Figure 29. H +15:00. Oil slick spreading as per the scenario BO-Aut-S-1.

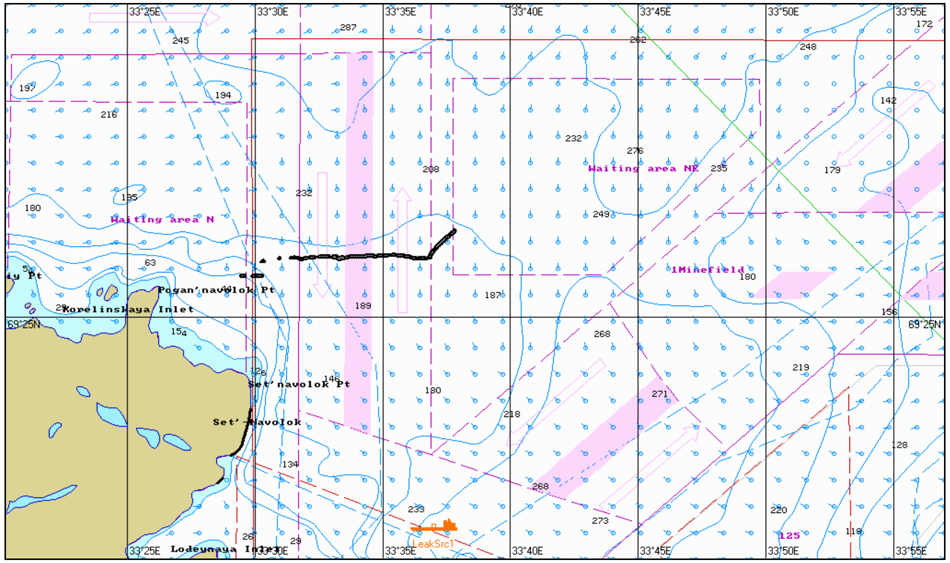



Figure 30. H +18:00. Oil slick spreading as per the scenario BO-Aut-S-1.

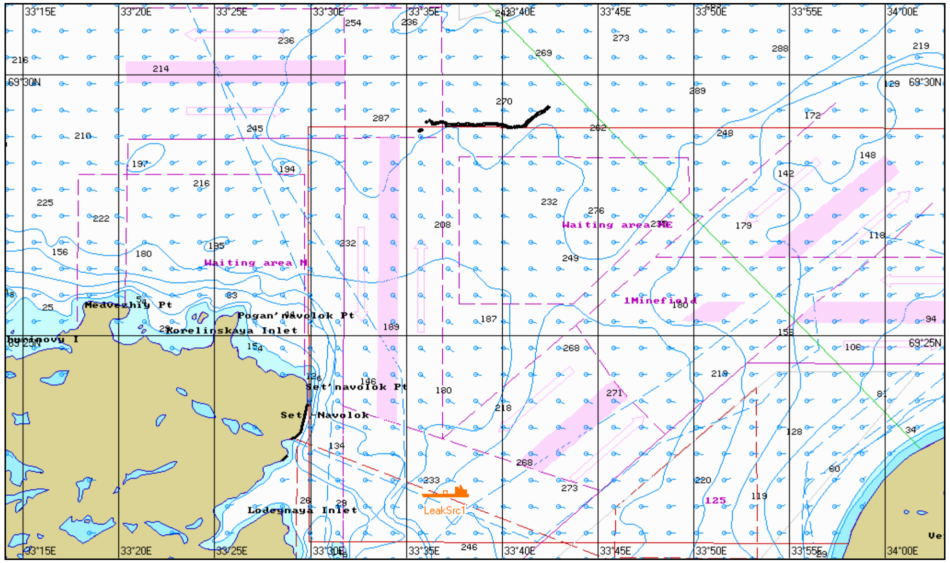



Figure 31. H +24:00. Oil slick spreading as per the scenario BO-Aut-S-1.

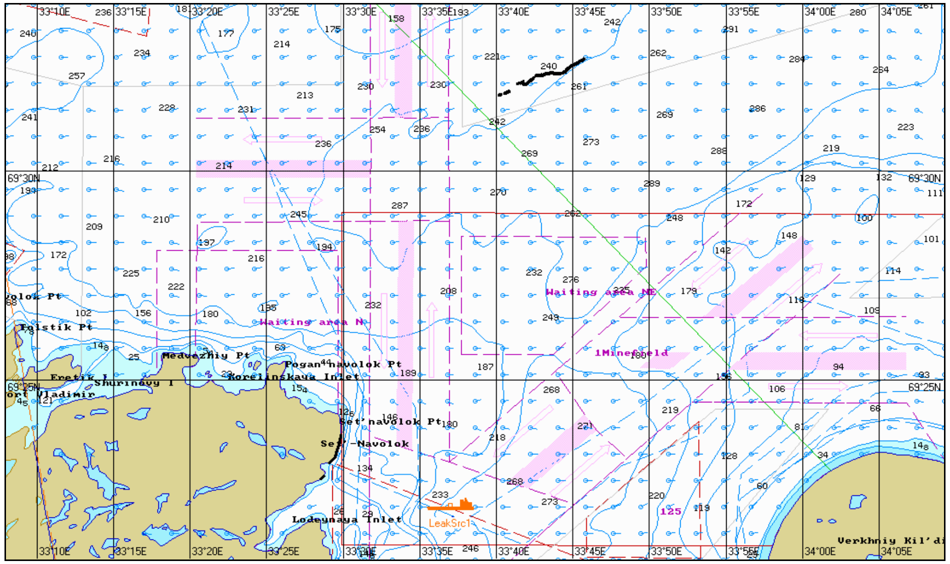


Figure 32. H+36:00. Oil slick spreading as per the scenario BO-Aut-S-1.

Figure 33. H +48:00 Oil slick spreading as per the scenario BO-Aut-S-1.

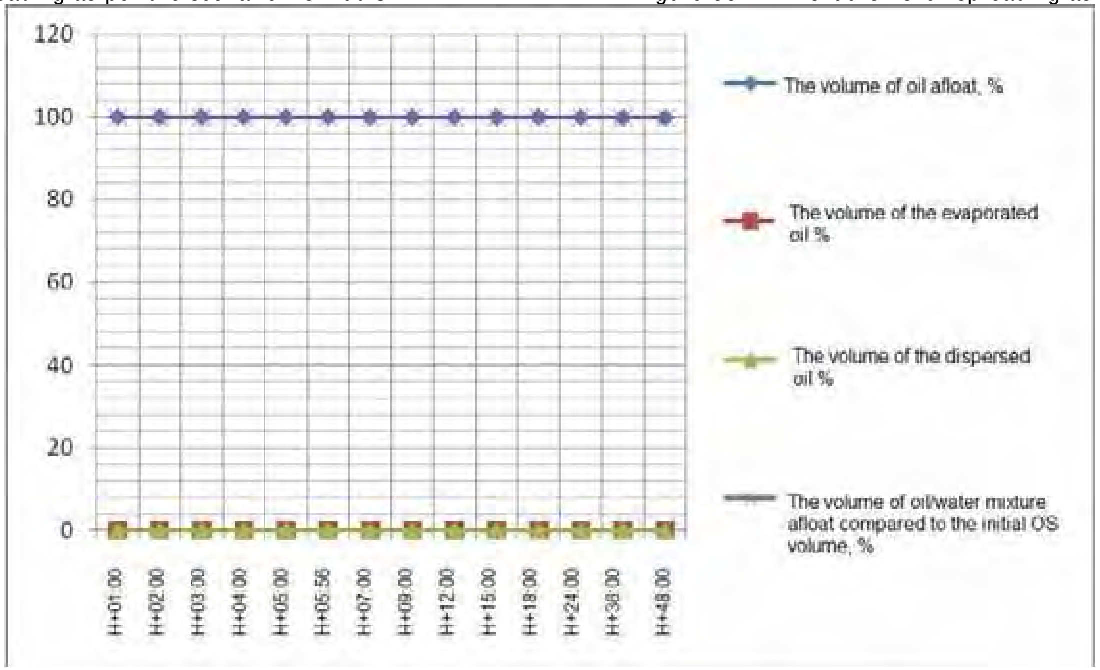


Figure. 34. The chart of processes as per the scenario BO-Aut-S-1.

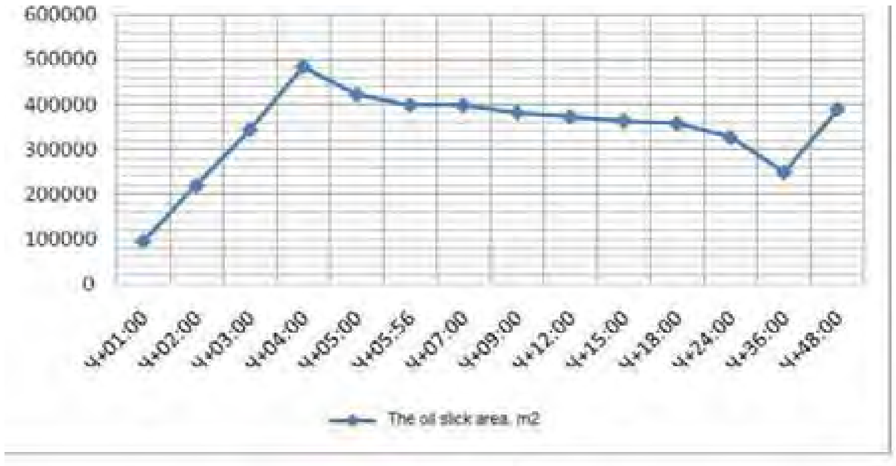



Figure 35. Oil slick area change dynamics as per the scenario BO-Aut-S-1.

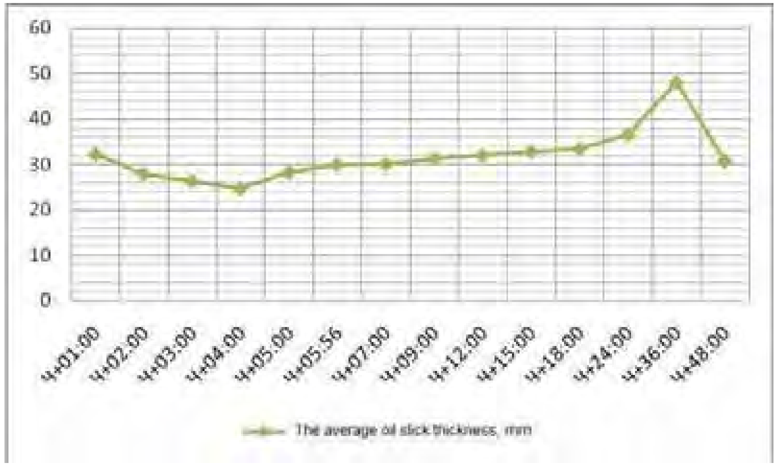



Figure. 36. Oil slick thickness change dynamics as per the scenario BO-Aut-S-1.

### 1.2.3 Oil slick behaviour modelling as per the scenario GC-Aut-S-1

*Table 1.2.3.1: Oil slick spreading parameters as per the scenario GC-Aut-S-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil / water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $м^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 5384 | 100 | 4924 | 91,5 | 292,9 | 5,44 | 167 | 3,10 | 0 | 0 | 5750 | 15,91 | 361504 | 3,9 |
| H +02:00 | 10557 | 100 | 9206 | 87,2 | 811,9 | 8,82 | 366,4 | 3,98 | 0 | 0 | 12196 | 16,14 | 755659 | 8,6 |
| H +03:00 | 15729 | 100 | 13036 | 82,9 | 1912 | 12,2 | 777 | 4,94 | 0 | 0 | 18822 | 16,37 | 1149813 | 13,2 |
| H +04:00 | 20000 | 100 | 15856 | 79,3 | 3065 | 15,3 | 1078 | 5,39 | 0 | 0 | 24625 | 16,64 | 1480249 | 21,9 |
| H+05:32 Landfall | 20000 | 100 | 14188 | 70,9 | 4477 | 22,4 | 1332 | 6,66 | 2,3 | 0,01 | 25758 | 15,64 | 1647314 | 67,1 |
| H +06:00 | 20000 | 100 | 13811 | 69,1 | 4804 | 24,0 | 1375 | 6,88 | 9,2 | 0,05 | 25723 | 16,09 | 1598655 | 84,4 |
| H +08:00 | 20000 | 100 | 12529 | 62,6 | 5920 | 29,6 | 1508 | 7,54 | 42,9 | 0,21 | 24616 | 14,54 | 1692751 | 169 |
| H +10:00 | 20000 | 100 | 11603 | 58,0 | 6750 | 33,8 | 1605 | 8,03 | 42,9 | 0,21 | 23106 | 10,08 | 2292442 | 263 |
| H +12:00 | 20000 | 100 | 10729 | 53,6 | 7538 | 37,7 | 1690 | 8,45 | 42,9 | 0,21 | 21439 | 7,49 | 2860531 | 391 |
| H +15:00 | 20000 | 100 | 9794 | 49,0 | 8382 | 41,9 | 1782 | 8,91 | 42,9 | 0,21 | 19585 | 5,97 | 3282256 | 592 |
| H +18:00 | 20000 | 100 | 9182 | 45,9 | 8914 | 44,6 | 1861 | 9,31 | 42,9 | 0,21 | 18363 | 6,01 | 3055558 | 769 |
| H +24:00 | 20000 | 100 | 8116 | 40,6 | 9842 | 49,2 | 2000 | 10,0 | 42,9 | 0,21 | 16232 | 4,82 | 3368684 | 1213 |
| H +36:00 | 20000 | 100 | 6372 | 31,7 | 11380 | 56,9 | 2220 | 11,1 | 42,9 | 0,21 | 13441 | 2,23 | 6037363 | 2355 |
| H +48:00 | 20000 | 100 | 4976 | 24,9 | 12604 | 63,0 | 2377 | 11,9 | 42,9 | 0,21 | 9953 | 1,35 | 7363979 | 4709 |

Within the first 4 hours as of the OS start the oil slick spreads westward of the OS point under the action of the wind and current. After 4 hours the semi-perimeter makes 2156 m, the volume of evaporated oil makes 15,3%, the volume of the dispersed oil - 5,4%. Further the oil slick drifts northward and in 5 hours and 32 minutes SGC reaches the coastline in the area of the Cape Set-Navolok in the point with coordinates $69^0$22,5 N; $33^0$28 E. Further the oil slick moves along the cape Set-Navolok polluting the coastline at the length of 4,27 km. After 10 hours as of the OS start the oil slick commences drifting from the Cape Set-Navolok to the open sea. After 10 hours the semi-perimeter of the oil slick makes 2683 m, the volume of the evaporated oil - 33,8%, the volume of the dispersed oil - 8%. Further the oil slick moves north-eastward blocking commercial marine traffic along the set shipping routes inbound/outbound of the Kolskiy Gulf. After 24 hours the semi-perimeter of the oil slick makes 3252 m, the volume of the evaporated oil - 49,2%, the volume of the dispersed oil - 10%. The volume of the oil/water mixture has decreased compared to the OS volume with 18,8%. At the moment of modelling completion (48 hours) about 24,9% of the hazardous substance remain afloat, the oil slick centre is located in the point with coordinates $69^0$37N; $33^0$50E, the average oil slick thickness makes 1,35 mm.
The graphic display of the oil slick spreading as per the scenario GC-Aut-S-1 is shown on figure 37 – 50.
The charts of the processes typical for SGC behaviour on water are shown in figures 41-53.

Figure 37. H+01:00. Oil slick spreading as per the scenario GC-Aut-S-1.

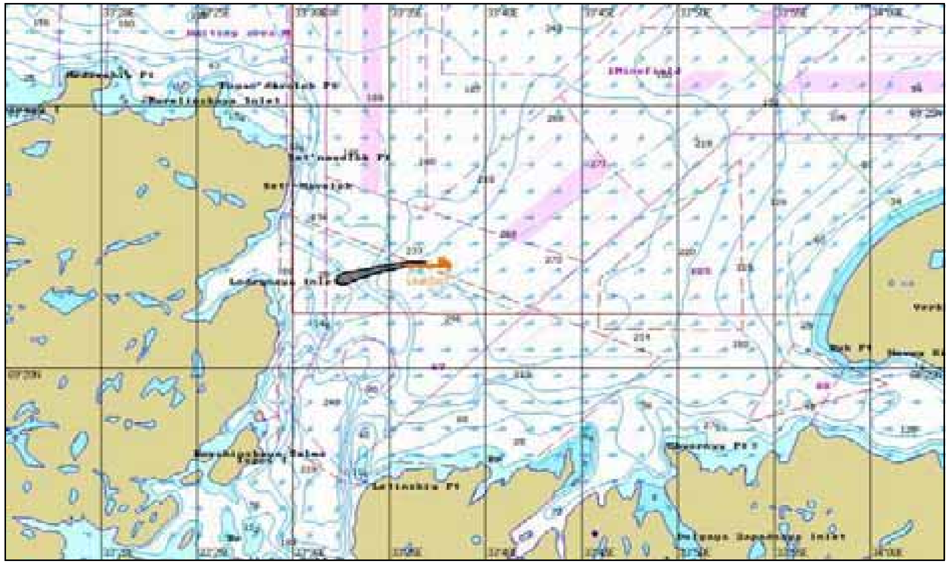


Figure 38. H +02:00. Oil slick spreading as per the scenario GC-Aut-S-1.

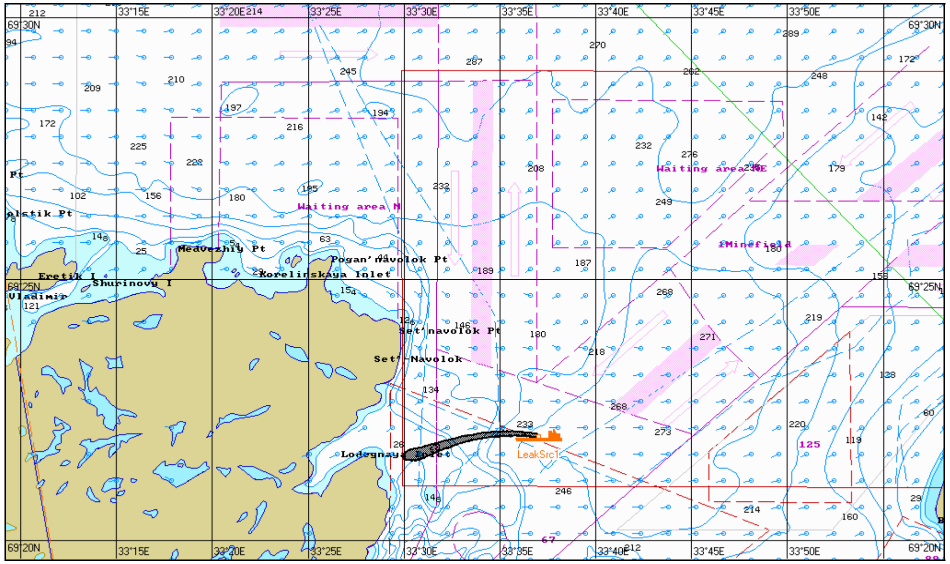



Figure 39. H +03:00. Oil slick spreading as per the scenario GC-Aut-S-1.

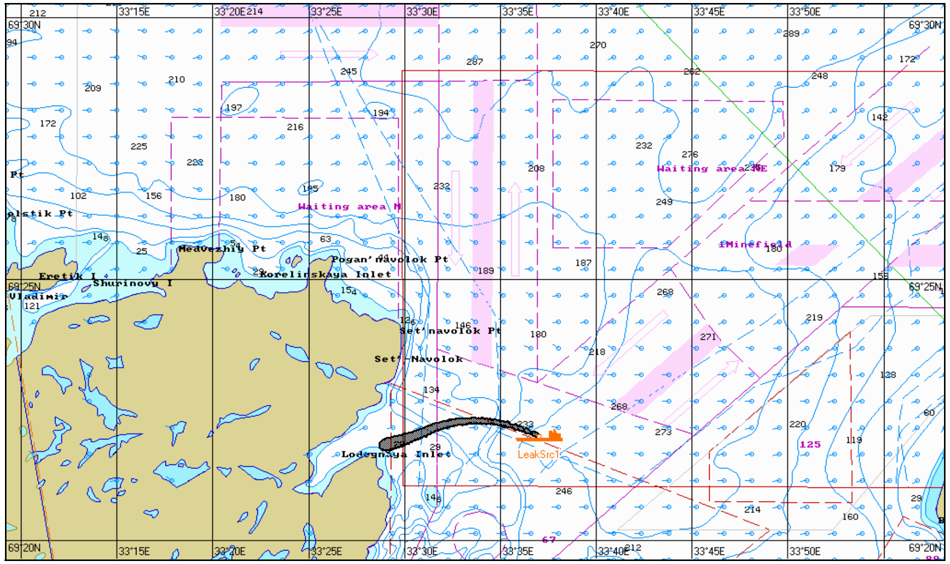



Figure 40. H +04:00. Oil slick spreading as per the scenario GC-Aut-S-1.

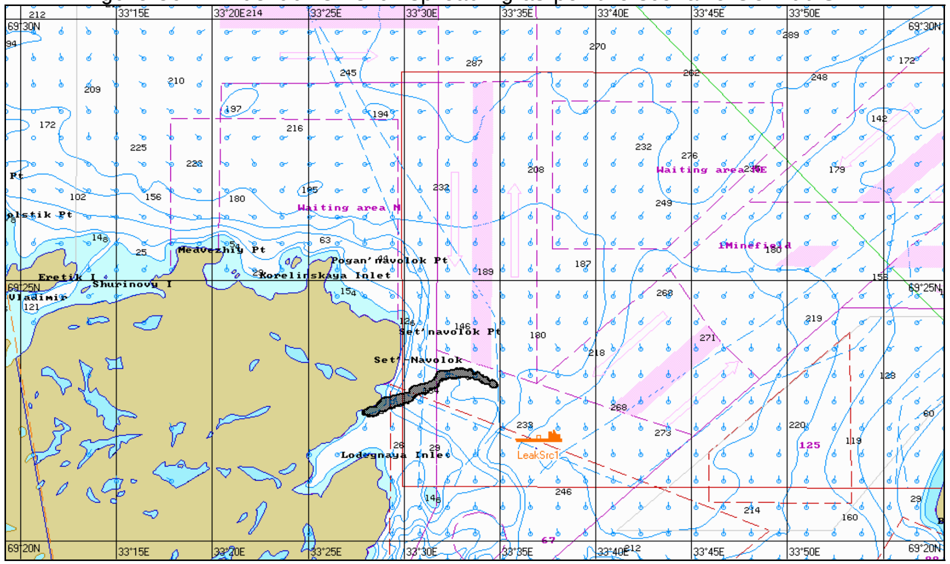



Figure 41. **H+05:32.** Oil slick spreading as per the scenario GC-Aut-S-1.

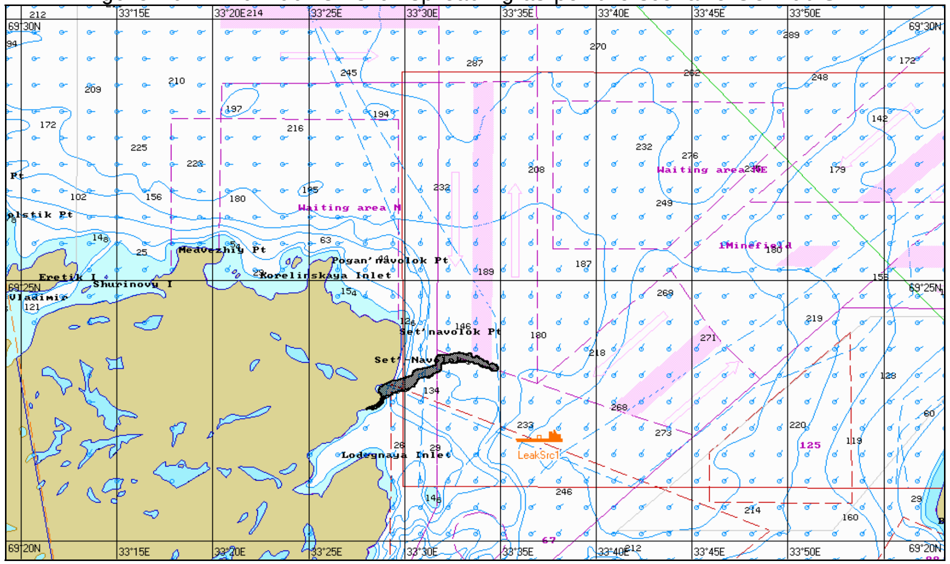



Figure 42. H+06:00. Oil slick spreading as per the scenario GC-Aut-S-1.

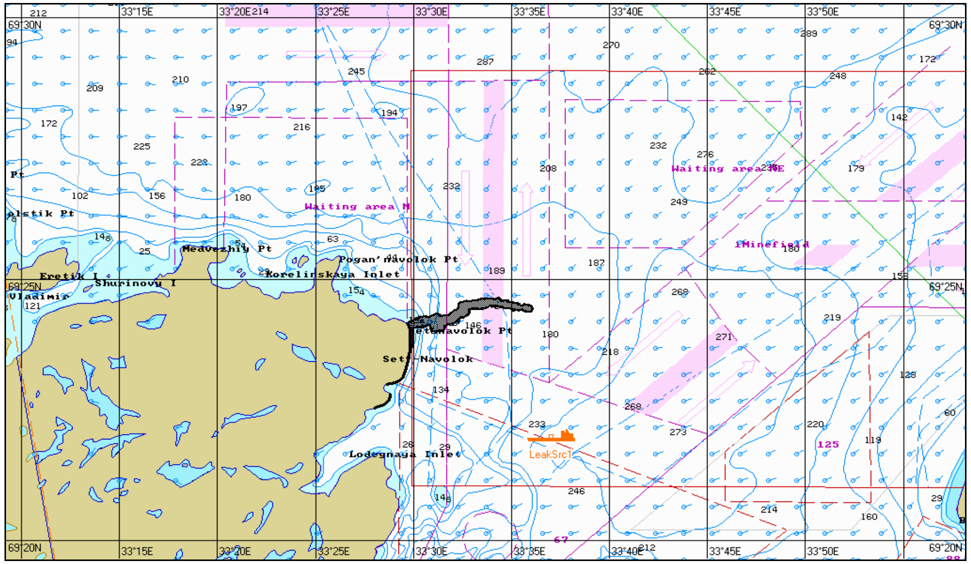



Figure 43. H +08:00. Oil slick spreading as per the scenario GC-Aut-S-1.

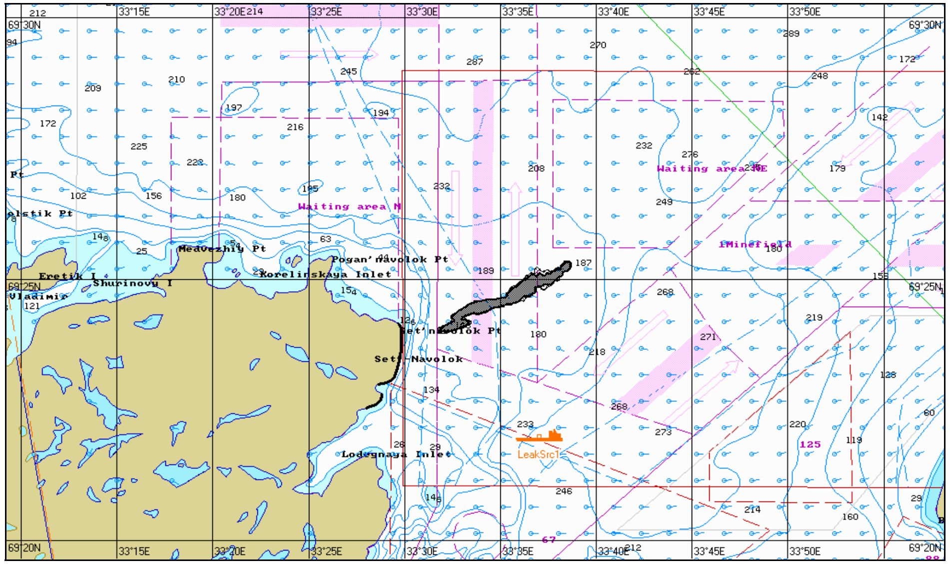



Figure 44. H +10:00. Oil slick spreading as per the scenario GC-Aut-S-1.

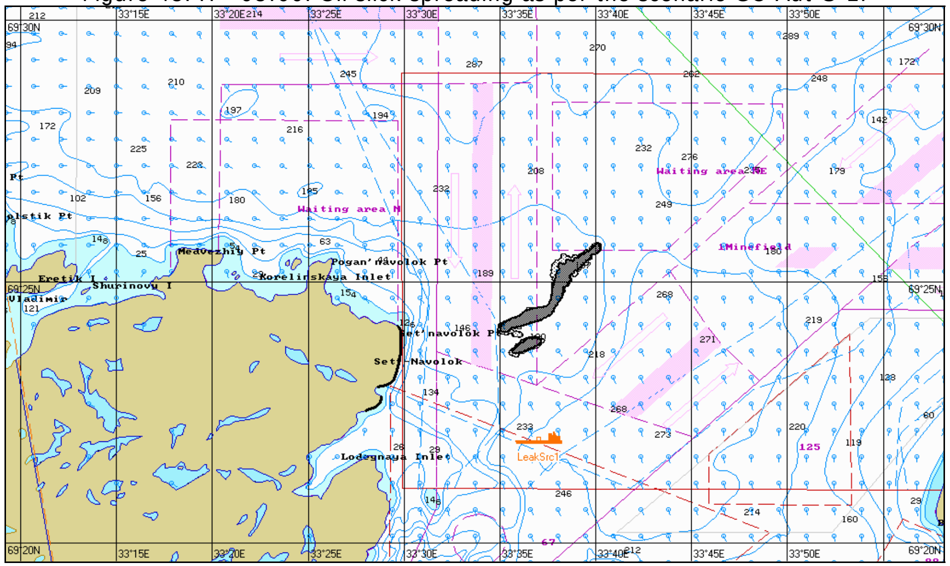



Figure 45. H+12:00. Oil slick spreading as per the scenario GC-Aut-S-1.

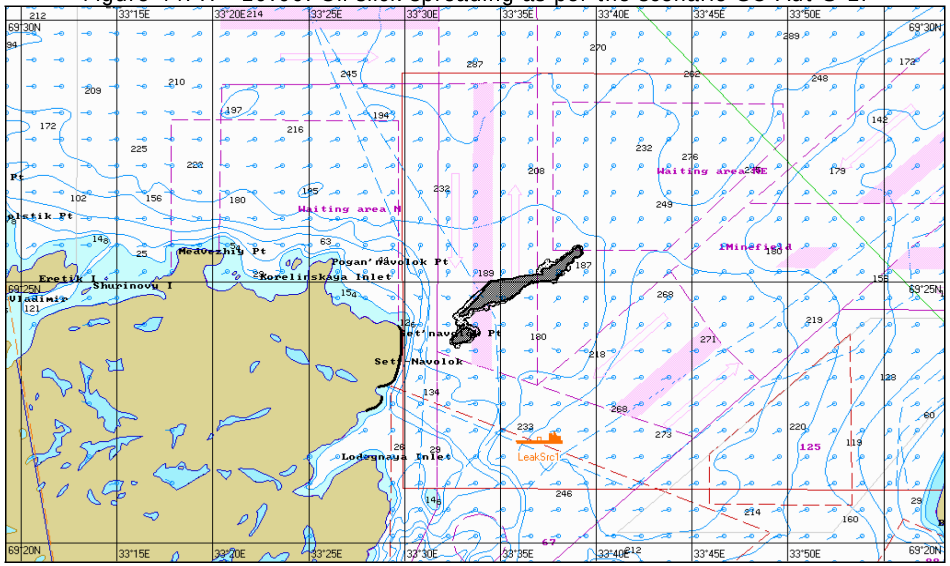



Figure 46. H +15:00. Oil slick spreading as per the scenario GC-Aut-S-1.

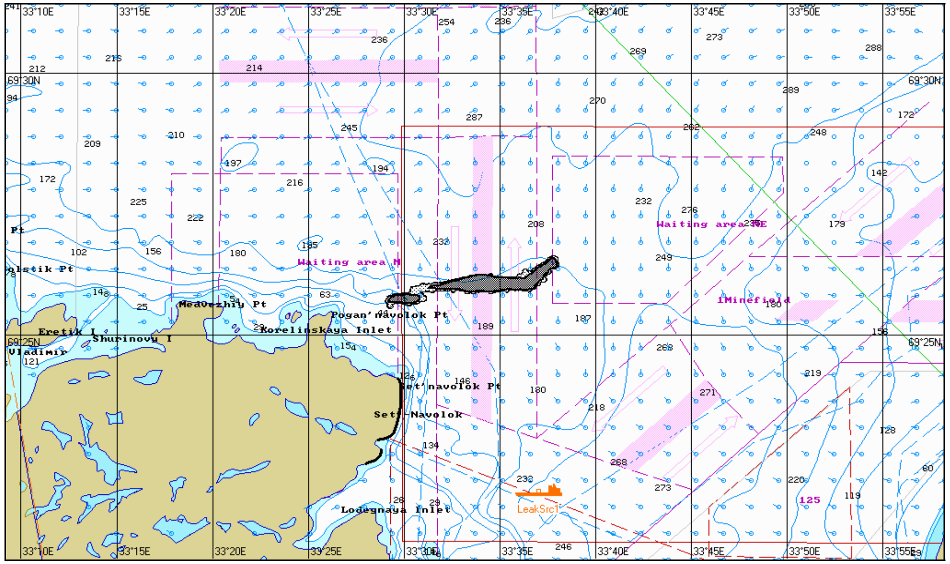



Figure 47. H +18:00. Oil slick spreading as per the scenario GC-Aut-S-1.

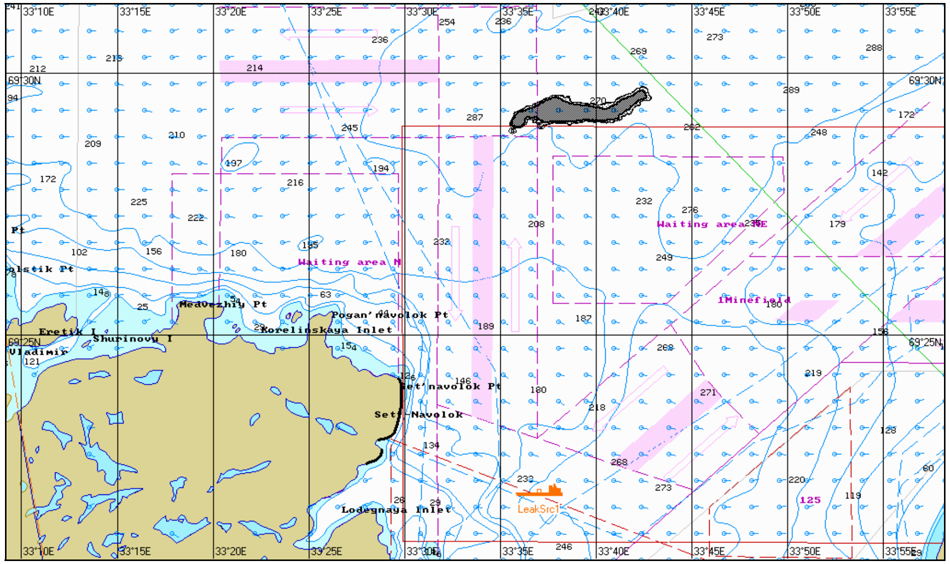



Figure 48. H +24:. Oil slick spreading as per the scenario GC-Aut-S-1.

Figure 49. H +36:00. Oil slick spreading as per the scenario GC-Aut-S-1.

Figure 50. H +48:00. Oil slick spreading as per the scenario GC-Aut-S-1.

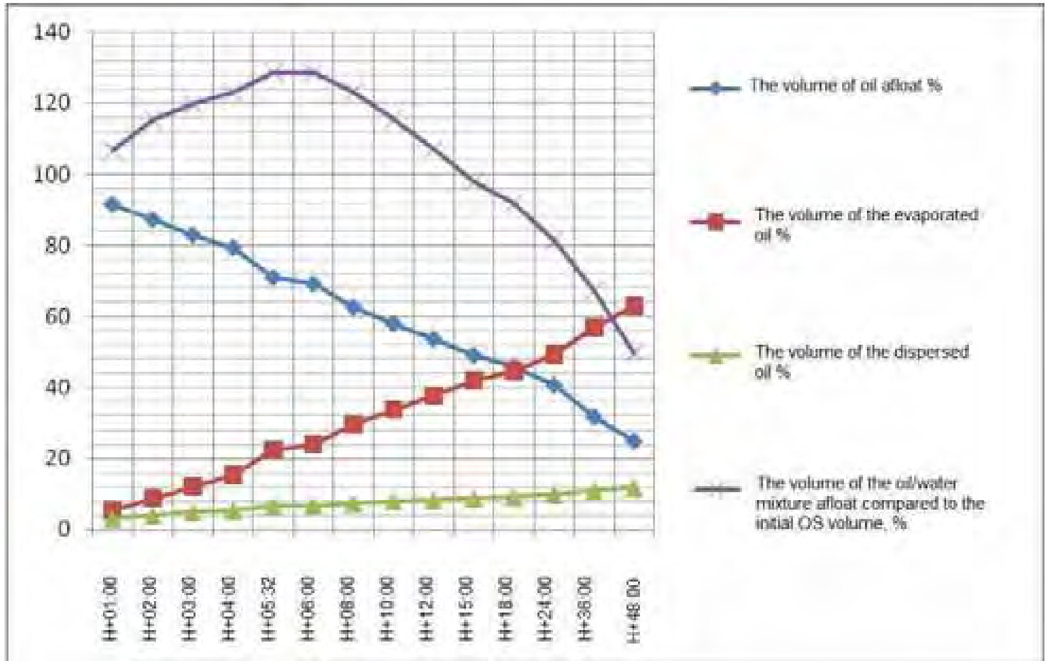



Figure 51. The chart of processes as per the scenario GC-Aut-S-1.

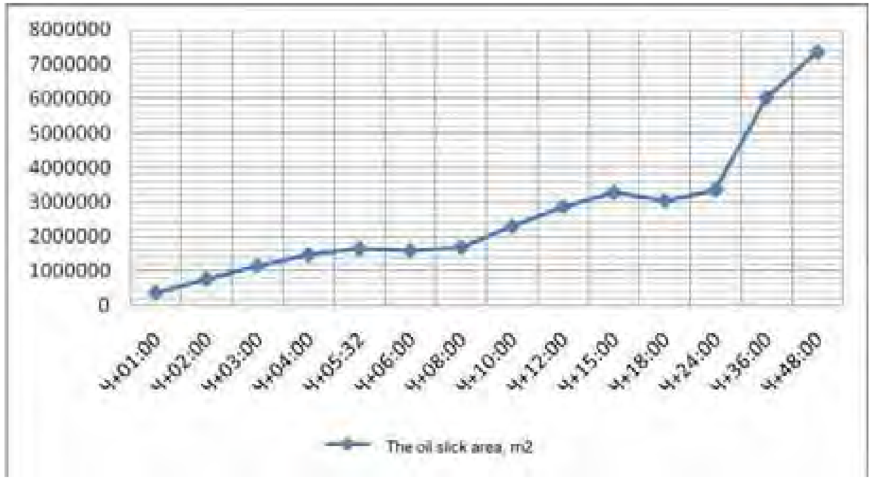



Figure 52. Oil slick area change dynamics as per the scenario GC-Aut-S-1.

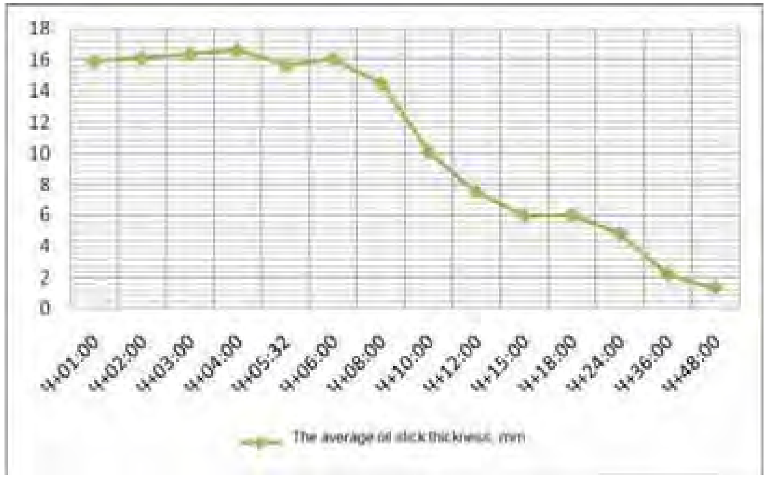


Figure 53. Oil slick thickness change dynamics as per the scenario GC-Aut-S-1.

### 1.2.4 Oil slick behaviour modelling as per the scenario Na-Aut-S-1

*Table 1.2.4.1: Oil slick spreading parameters as per the scenario Na-Aut-S-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil / water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 2846 | 100 | 2493 | 87,6 | 331 | 11,6 | 22 | 0,77 | 0 | 0 | 2842 | 9,24 | 307665 | 3,5 |
| H +02:00 | 5715 | 100 | 4542 | 79,5 | 1113 | 19,5 | 60,5 | 1,06 | 0 | 0 | 5556 | 8,04 | 690638 | 9,2 |
| H +03:00 | 8135 | 100 | 5864 | 72,1 | 2171 | 26,7 | 100 | 1,23 | 0 | 0 | 7527 | 6,89 | 1092263 | 21,2 |
| H +04:00 | 10000 | 100 | 6530 | 65,3 | 3339 | 33,4 | 132 | 1,32 | 0 | 0 | 8696 | 5,54 | 1570627 | 44,3 |
| H +05:00 | 10000 | 100 | 5575 | 55,8 | 4278 | 42,8 | 148 | 1,48 | 0 | 0 | 7831 | 4,37 | 1790416 | 128 |
| H+05:34 Landfall | 10000 | 100 | 5202 | 52,0 | 4644 | 46,4 | 152 | 1,52 | 2,2 | 0,02 | 7395 | 4,01 | 1843960 | 189 |
| H +07:00 | 10000 | 100 | 4532 | 45,3 | 5278 | 52,8 | 158 | 1,58 | 32,6 | 0,33 | 6506 | 3,53 | 1841116 | 361 |
| H +08:00 | 10000 | 100 | 4203 | 42,0 | 5599 | 56,0 | 161 | 1,61 | 37,2 | 0,37 | 6043 | 3,57 | 1695082 | 497 |
| H +09:00 | 10000 | 100 | 3967 | 39,7 | 5833 | 58,3 | 164 | 1,64 | 37,2 | 0,37 | 5706 | 3,41 | 1672016 | 627 |
| H +12:00 | 10000 | 100 | 3357 | 33,6 | 6437 | 64,4 | 170 | 1,70 | 42,6 | 0,43 | 4829 | 2,22 | 2174096 | 1136 |
| H +15:00 | 10000 | 100 | 2809 | 28,1 | 6981 | 69,8 | 174 | 1,74 | 37,2 | 0,37 | 4041 | 1,44 | 2805002 | 1940 |
| H +18:00 | 10000 | 100 | 2460 | 24,6 | 7327 | 73,3 | 177 | 1,77 | 37,2 | 0,37 | 3538 | 1,46 | 2423796 | 2729 |
| H +24:00 | 10000 | 100 | 1791 | 17,9 | 7990 | 79,9 | 182 | 1,82 | 37,2 | 0,37 | 2577 | 0,84 | 3057320 | 5253 |
| H +36:00 | 10000 | 100 | 598 | 5,98 | 9180 | 91,8 | 187 | 1,87 | 37,2 | 0,37 | 859 | 0,51 | 1698028 | 17005 |
| H +48:00 | 10000 | 100 | 150 | 1,50 | 9626 | 96,3 | 188 | 1,88 | 37,2 | 0,37 | 216 | 0,14 | 1490359 | 26401 |
| H +54:00 | 10000 | 100 | 26,0 | 0,26 | 9750 | 97,5 | 188 | 1,88 | 37,2 | 0,37 | 37,1 | 0,06 | 618885 | 29877 |

Within the first 4 hours as of the moment of OS start the oil slick spreads westward of the OS point under the action of the wind and current. After 4 hours the oil slick semi-perimeter makes 2221 m, the volume of the evaporated oil makes 33,4%, the volume of the dispersed oil - 1,32%. Further the oil slick drifts northward and after 5 hours and 34 minutes the naphtha reaches the coastline in the area of the Cape Set-Navolok in the point with coordinates $69^0$22,5 N; $33^0$28 E. Further the oil slick moves along the Cape Set-Navolok polluting the coastline at the length of 4,27 km. After 9 hours as of the OS start the oil slick commences drifting from the cape Set-Navolok to the open sea. After 9 hours the oil slick semi-perimeter makes 2291 m, the volume of the evaporated oil - 58%, the volume of the dispersed oil - 1,6%. Further the oil slick moves north-eastward blocking the commercial marine traffic along the set shipping routes inbound/outbound of the Kolskiy Gulf. After 24 hours the volume of the evaporated oil makes 80% of the OS initial volume. The oil slick semi-perimeter makes 3092 m, the average oil slick thickness 0,84 mm. To the moment of the modelling completion (54 hours), the oil slick with the average thickness of 0,06 mm remains afloat, the oil slick centre is located in the point with coordinates $69^0$37N; $33^0$52E.

The graphic display of the oil slick spreading as per the scenario Na-Aut-S-1 is shown in figures 54 – 69.

The charts of processes typical for naphtha behaviour on water are shown in figures 70-72.

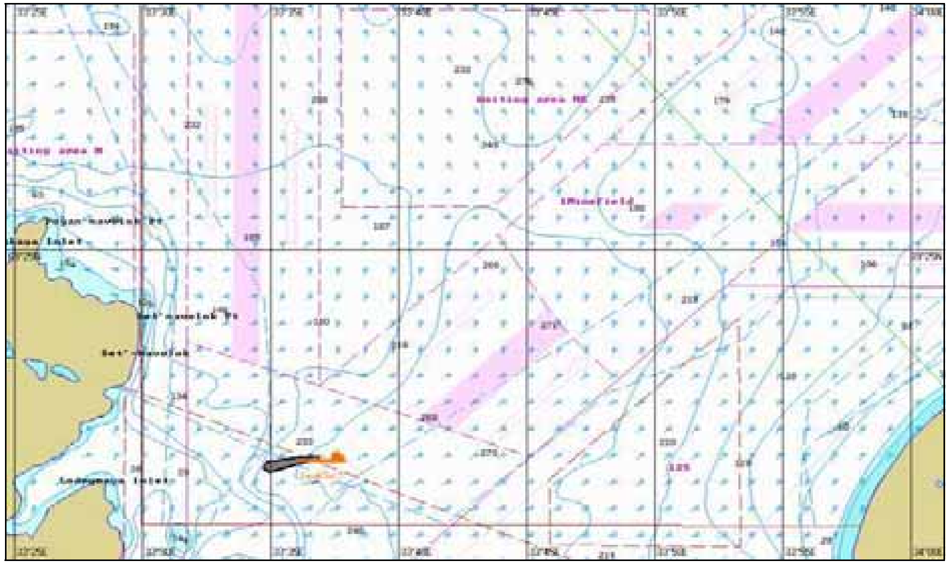


Figure 54. H+01:00. Oil slick spreading as per the scenario Na-Aut-S-1.

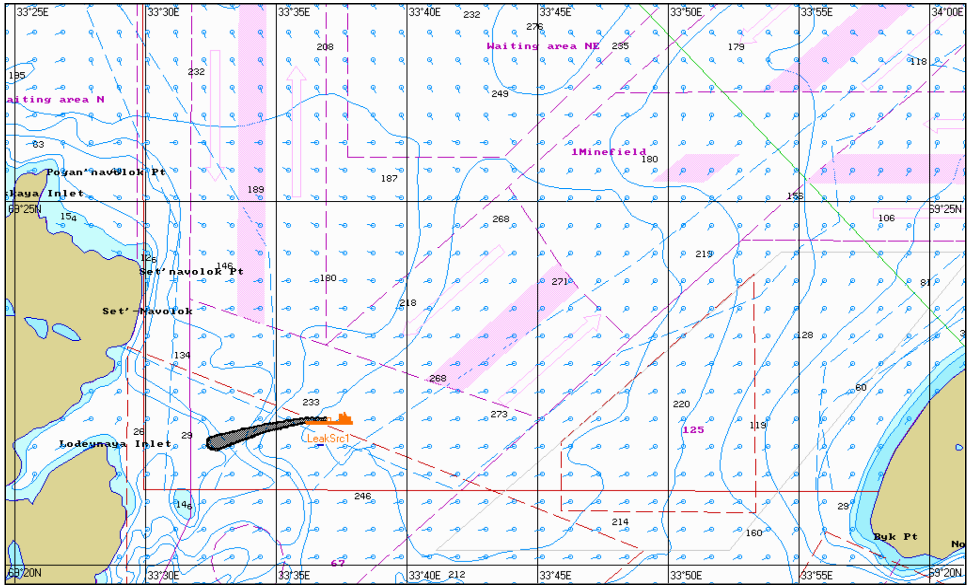


Figure 55. H +02:00. Oil slick spreading as per the scenario Na-Aut-S-1.

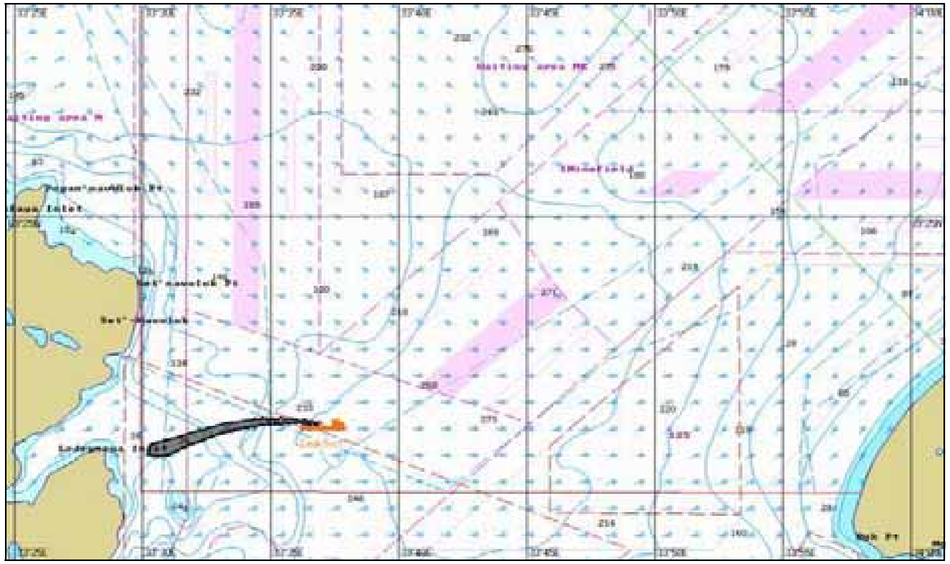


Figure 56. H +03:00. Oil slick spreading as per the scenario Na-Aut-S-1.

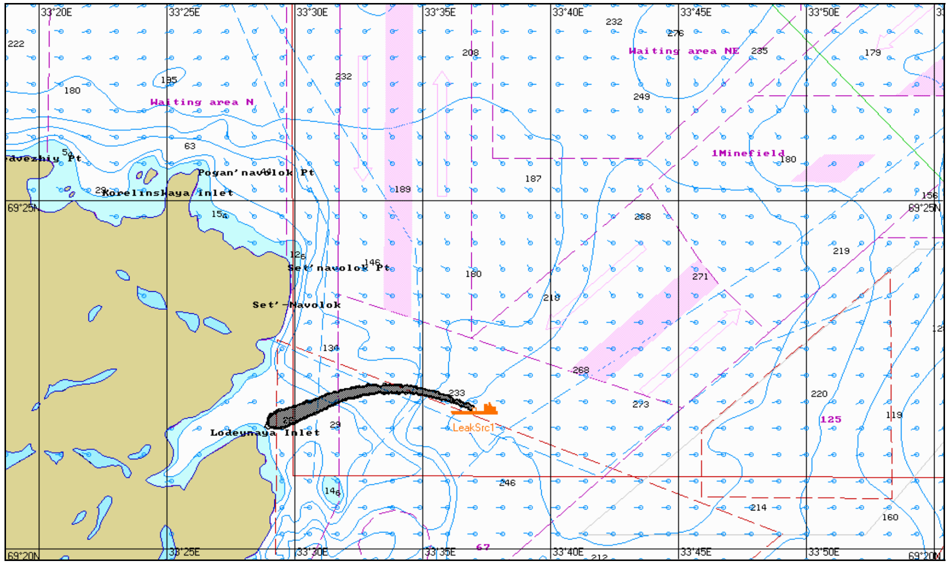


Figure 57. H +04:00. Oil slick spreading as per the scenario Na-Aut-S-1.

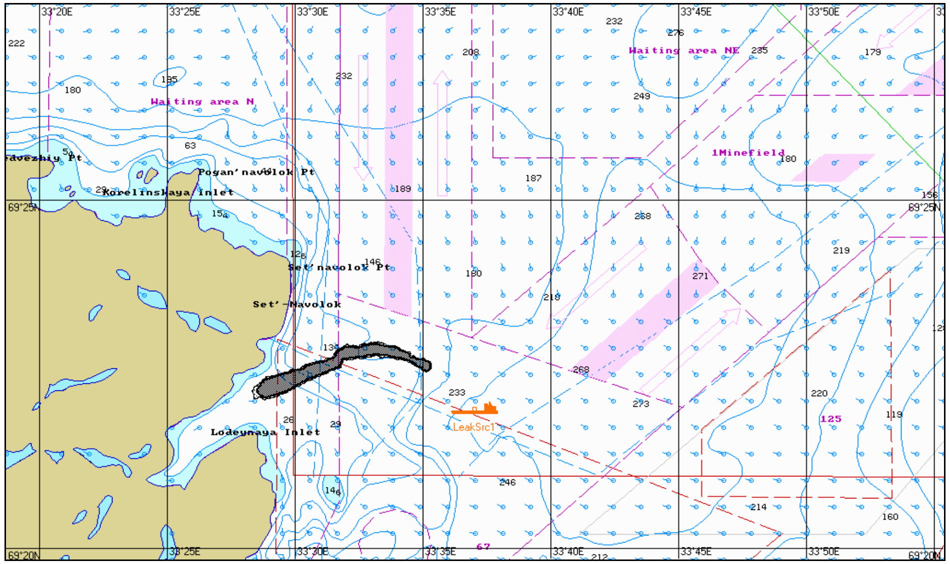



Figure 58. H +05:00. Oil slick spreading as per the scenario Na-Aut-S-1.

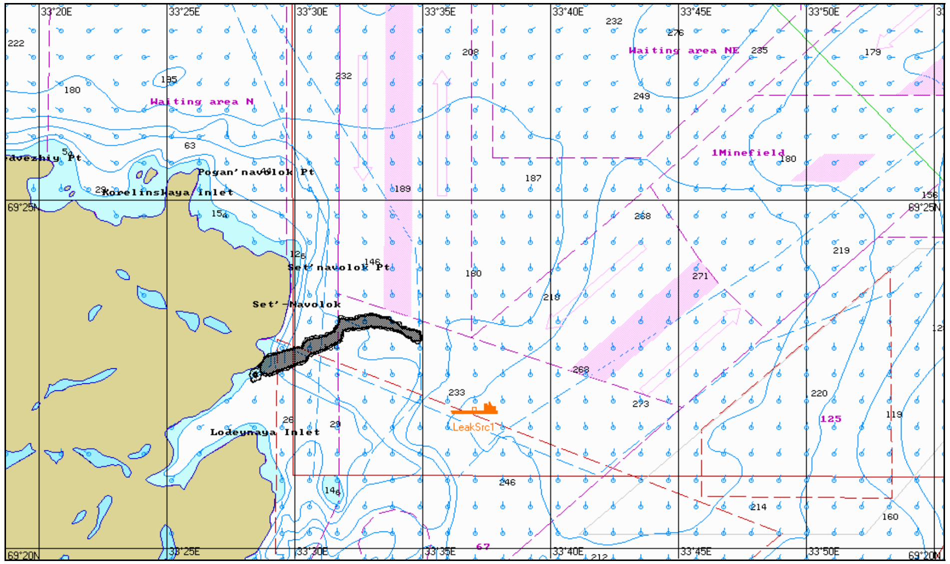



Figure 59. **H+05:34.** Oil slick spreading as per the scenario Na-Aut-S-1.

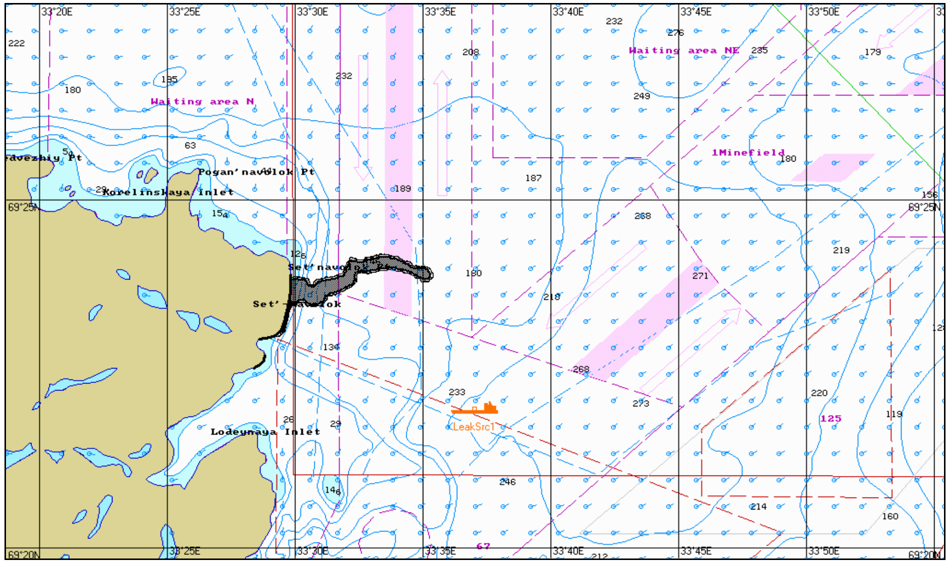



Figure 60. H +07:00. Oil slick spreading as per the scenario Na-Aut-S-1.

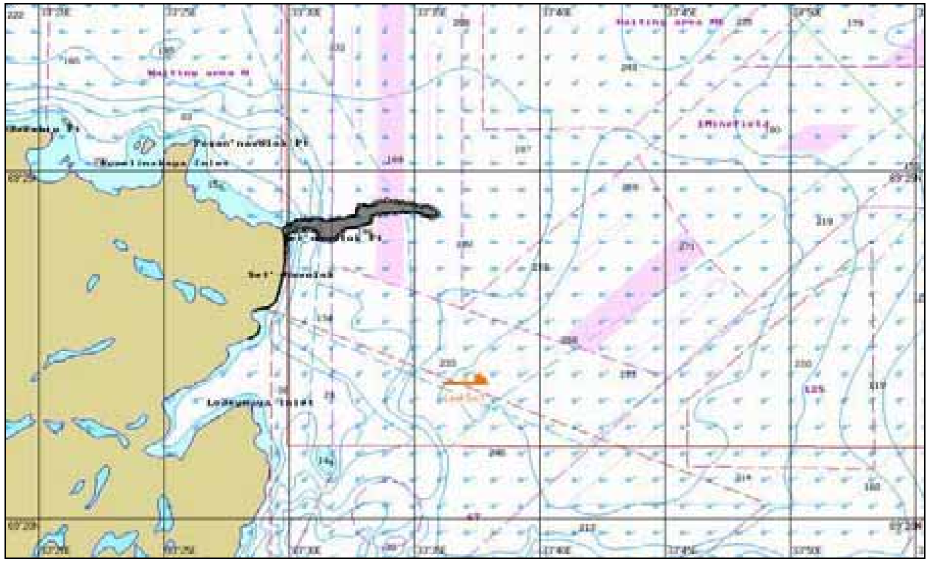


Figure 61. H +08:00. Oil slick spreading as per the scenario Na-Aut-S-1.

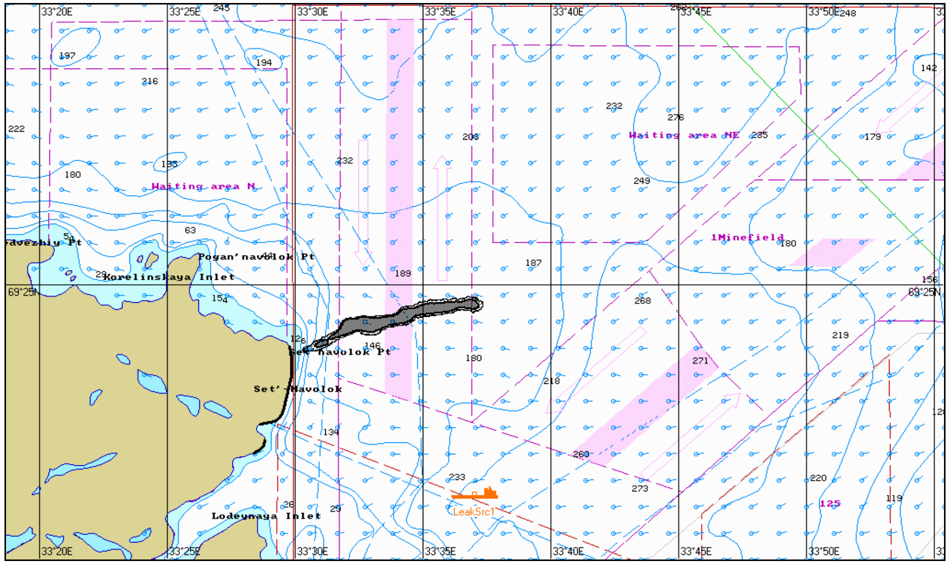


Figure 62. H +09:00. Oil slick spreading as per the scenario Na-Aut-S-1.

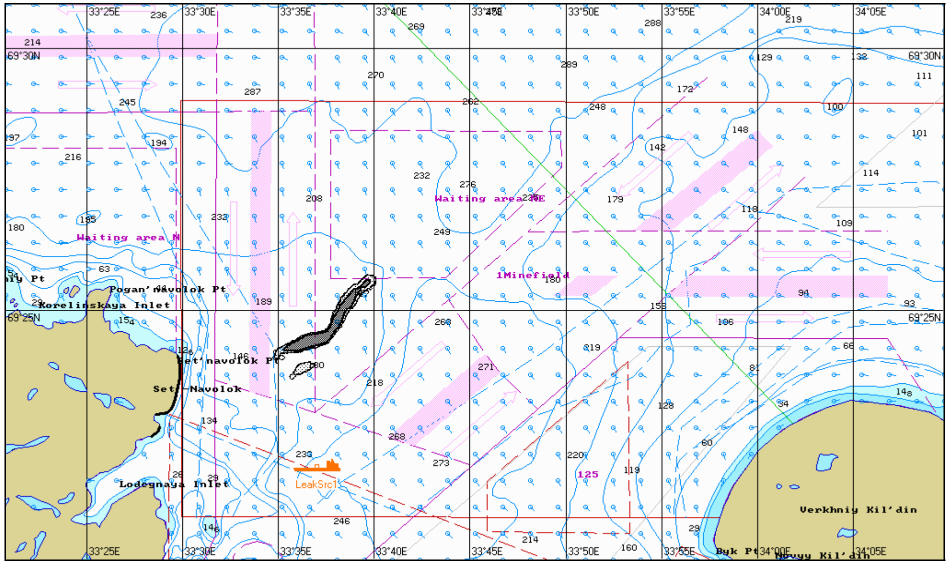


Figure 63. H +12:00. Oil slick spreading as per the scenario Na-Aut-S-1.

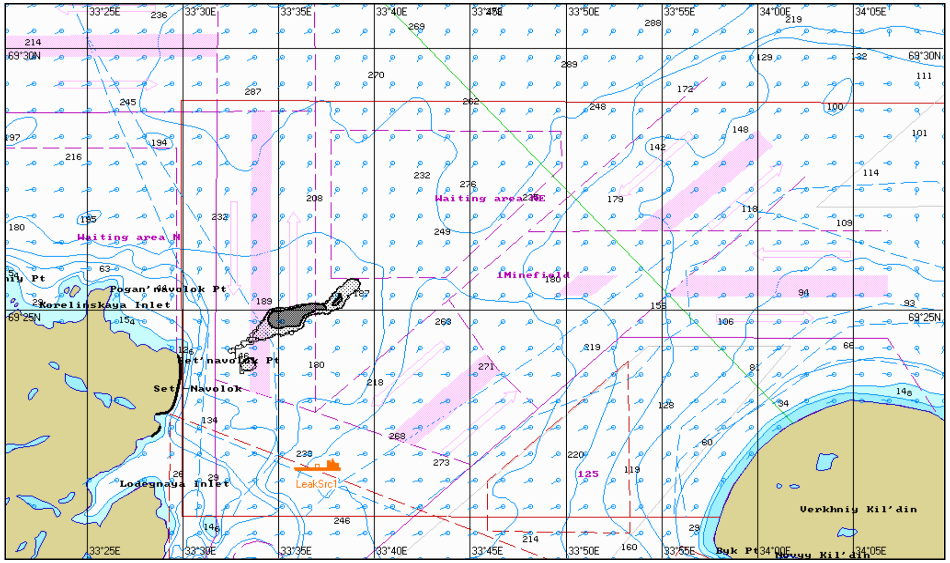


Figure 64. H +15:00. Oil slick spreading as per the scenario Na-Aut-S-1.

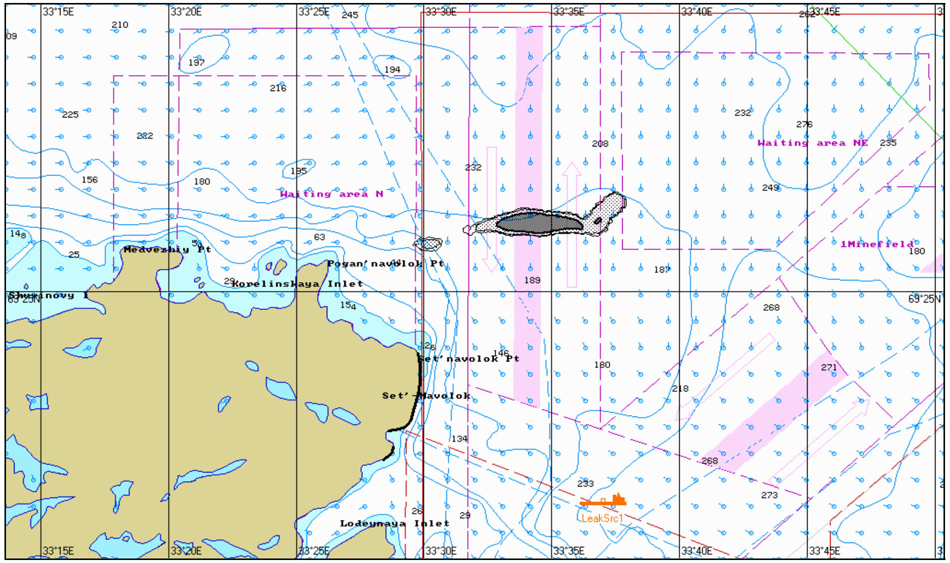


Figure 65. H +18:00. Oil slick spreading as per the scenario Na-Aut-S-1.

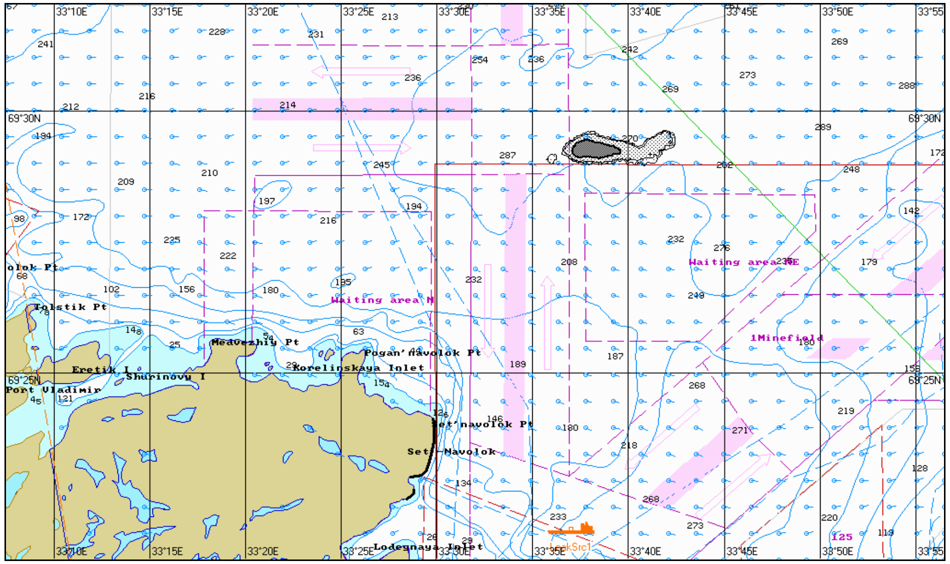



Figure 66. H +24:00. Oil slick spreading as per the scenario Na-Aut-S-1.

Figure 67. H +36:. Oil slick spreading as per the scenario Na-Aut-S-1.

Figure 68. H +48:00. Oil slick spreading as per the scenario Na-Aut-S-1.

Figure 69. H +54:00. Oil slick spreading as per the scenario Na-Aut-S-1.

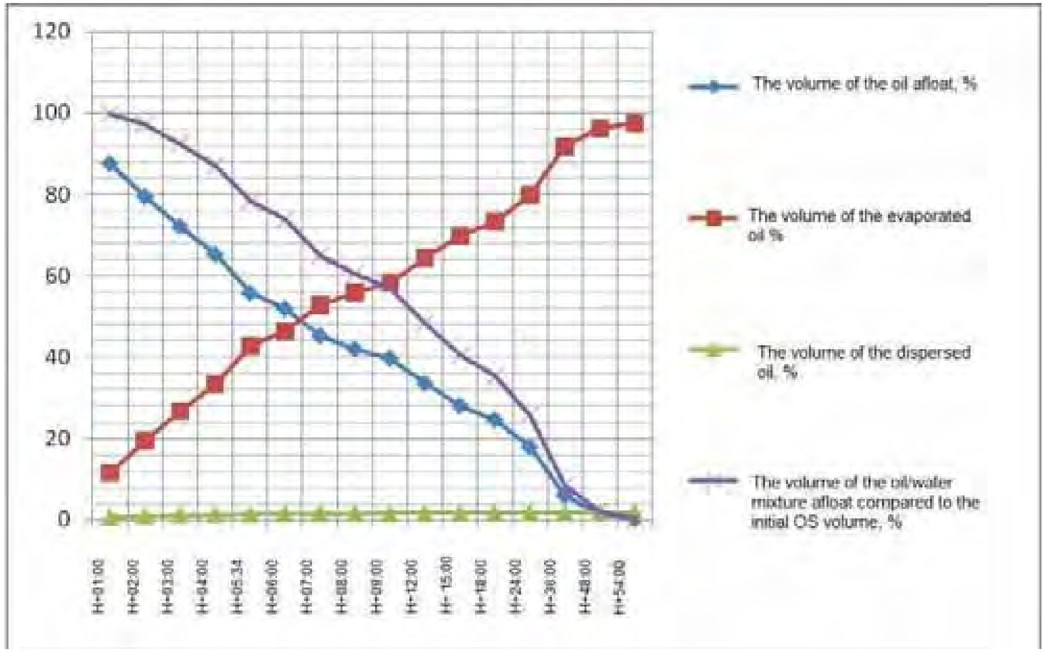



Figure 70. The chart of processes as per the scenario Na-Aut-S-1.

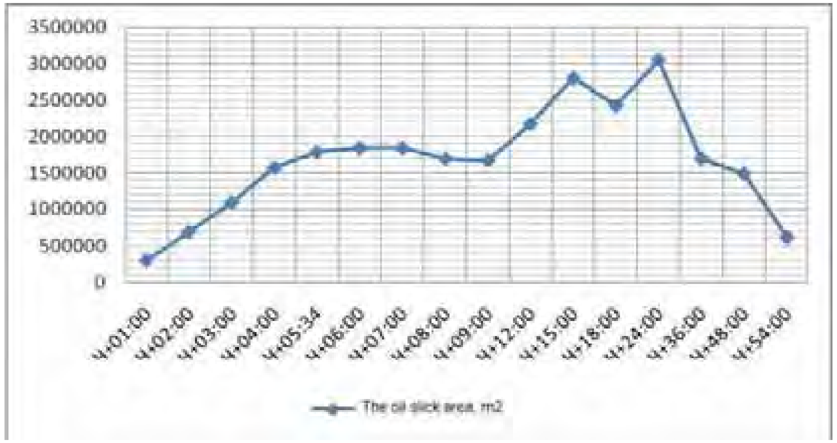



Figure 71. Oil slick area change dynamics as per the scenario Na-Aut-S-1.

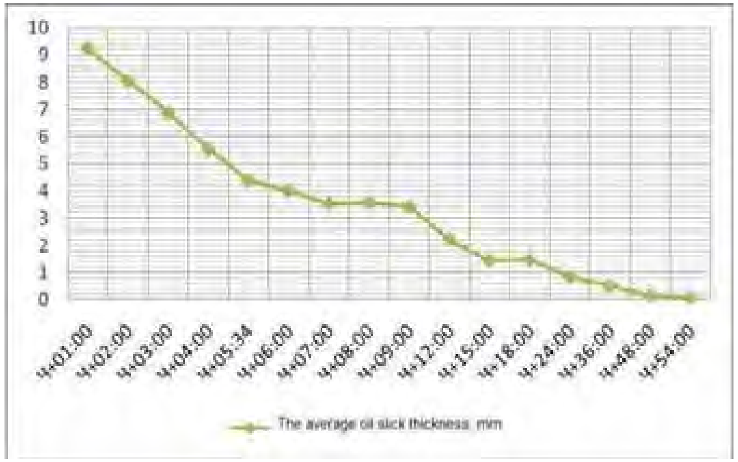



Figure 72. Oil slick thickness change dynamics as per the scenario Na-Aut-S-1.

## 1.2.5 The process dynamics typical for oil spill behaviour in the Barents Sea under the autumn southward wind (Aut-S-1)

Figures 73-77 display dynamics of processes typical for oil spill behaviour in the Barents Sea as per the scenarios Aut-S-1.

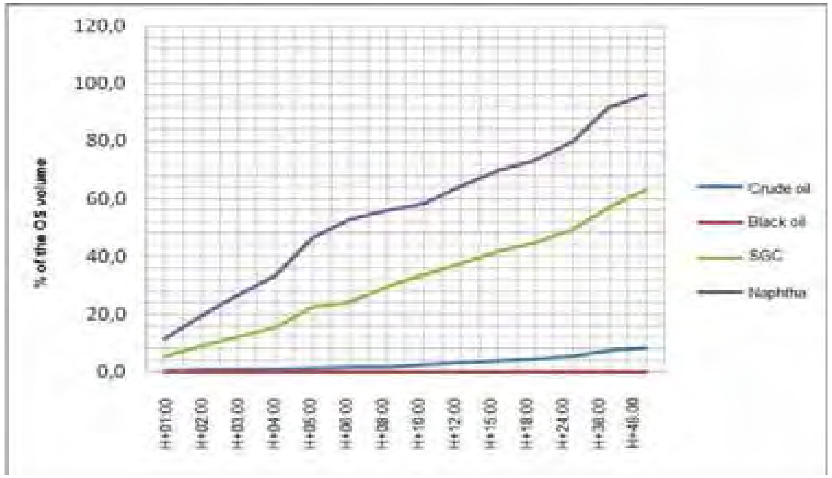



Figure 73. The chart of the evaporation process as per the scenarios Aut-S-1.

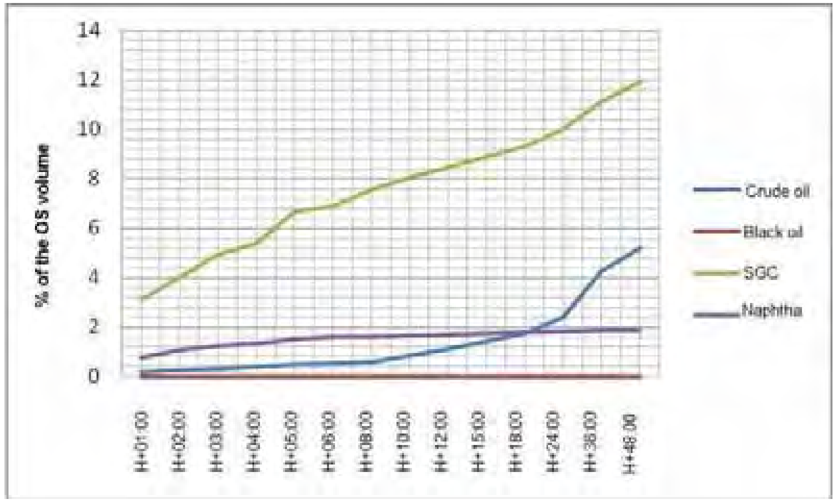



Figure 74. The chart of the dispersion process as per the scenarios Aut-S-1.

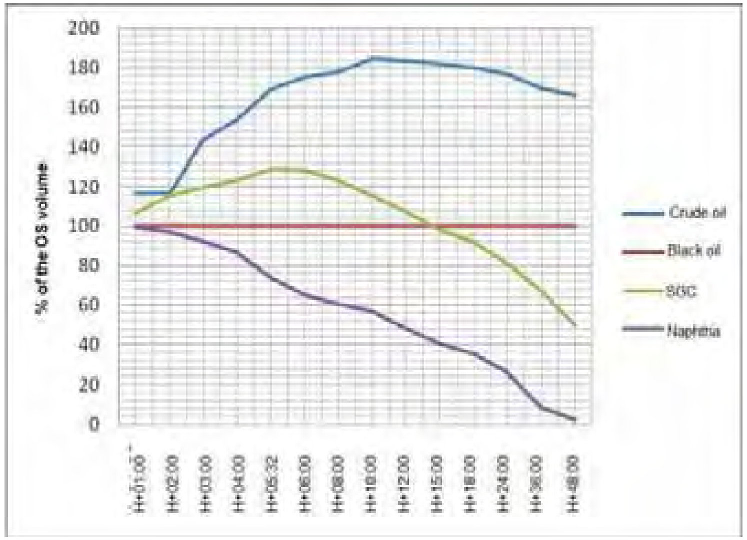



Figure 75. Oil/water mixture volume change dynamics as per the scenarios Aut-S-1.

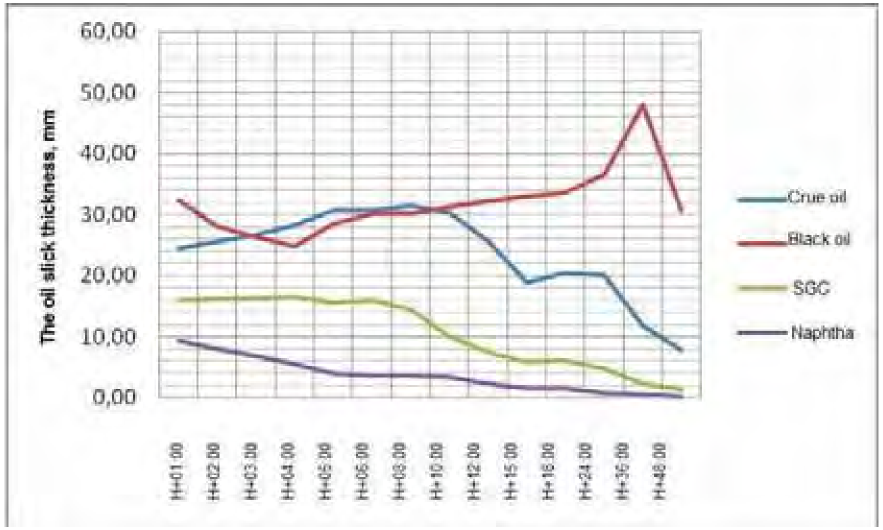



Figure 76. Oil slick thickness change dynamics as per the scenarios Aut-S-1.

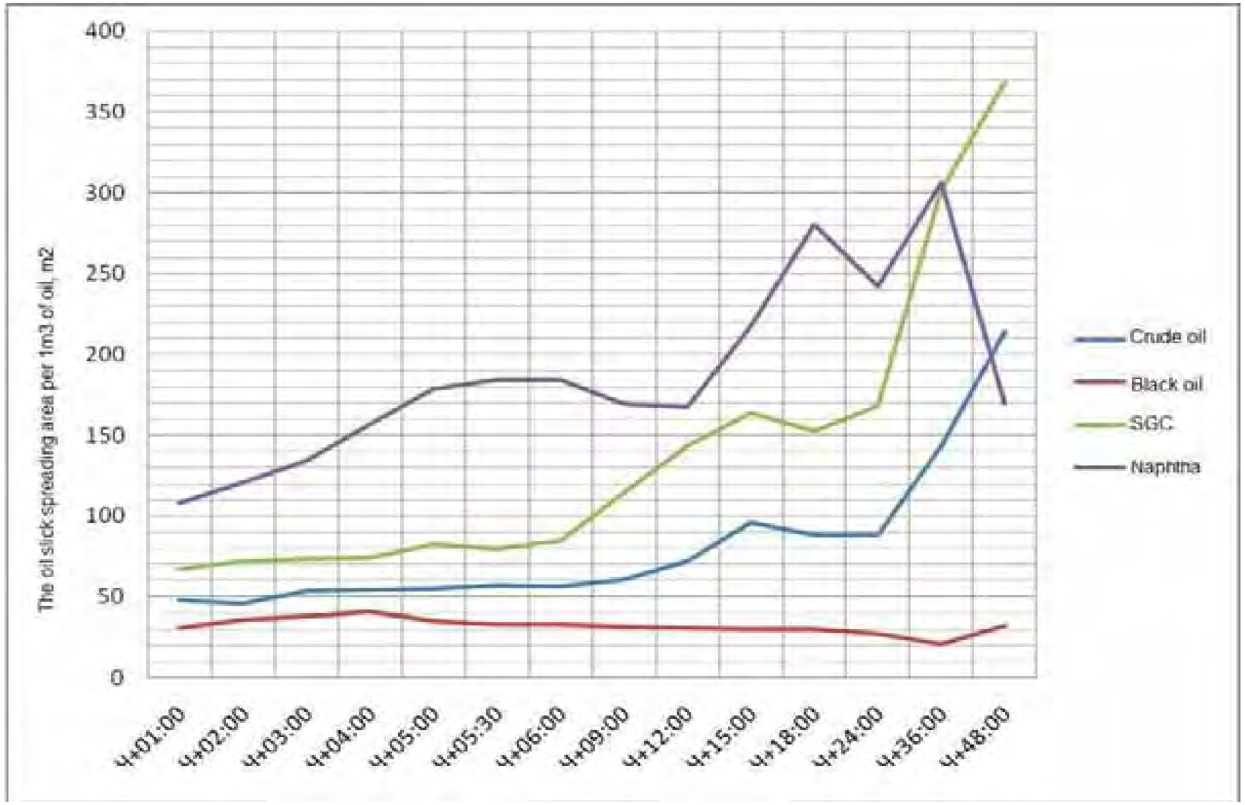



Figure 77. Change dynamics of the spreading area per 1 м $^3$ of different types of oil as per the scenarios Aut-S-1.

## 1.3 Oil slick behaviour modelling in the Barents Sea under the autumn south-westward wind

### 1.3.1 Oil slick behaviour modelling as per the scenario COV-Aut-SW-1

*Table 1.3.1.1: Oil slick spreading parameters as per the scenario COV-Aut-SW-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil/water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 5507 | 100 | 5483 | 99,6 | 13,8 | 0,25 | 9,7 | 0,18 | 0 | 0 | 6416 | 31,2 | 205901 | 97,8 |
| H +02:00 | 10785 | 100 | 10708 | 99,3 | 46,8 | 0,43 | 29,5 | 0,27 | 0 | 0 | 14173 | 28,1 | 505136 | 138 |
| H +03:00 | 15781 | 100 | 15628 | 99,0 | 99,7 | 0,63 | 52,9 | 0,34 | 0 | 0 | 22592 | 28,7 | 785827 | 178 |
| H +04:00 | 19973 | 100 | 19731 | 98,8 | 164 | 0,82 | 78,3 | 0,39 | 0 | 0 | 30614 | 33,7 | 908702 | 220 |
| H +05:00 | 20000 | 100 | 19678 | 98,4 | 221 | 1,11 | 100 | 0,50 | 0 | 0 | 33737 | 37,3 | 904448 | 297 |
| H +06:00 | 20000 | 100 | 19608 | 98,0 | 274 | 1,37 | 118 | 0,59 | 0 | 0 | 35561 | 38,6 | 921948 | 356 |
| H +07:00 | 20000 | 100 | 19541 | 97,7 | 323 | 1,62 | 135 | 0,68 | 0 | 0 | 36504 | 39,7 | 919253 | 395 |
| H +08:00 | 20000 | 100 | 19475 | 97,4 | 372 | 1,86 | 153 | 0,77 | 0 | 0 | 36926 | 36,6 | 1010211 | 422 |
| H +09:00 | 20000 | 100 | 19415 | 97,1 | 414 | 2,07 | 171 | 0,86 | 0 | 0 | 37082 | 43,8 | 847015 | 439 |
| H +12:00 | 20000 | 100 | 19249 | 96,2 | 521 | 2,61 | 231 | 1,16 | 0 | 0 | 36989 | 37,6 | 983807 | 471 |
| H +15:00 | 20000 | 100 | 19083 | 95,4 | 621 | 3,11 | 296 | 1,48 | 0 | 0 | 36695 | 38,0 | 966608 | 495 |
| H +18:00 | 20000 | 100 | 18938 | 94,7 | 638 | 3,19 | 364 | 1,82 | 0 | 0 | 36420 | 37,8 | 964304 | 514 |
| H +24:00 | 20000 | 100 | 18653 | 93,3 | 840 | 4,20 | 507 | 2,54 | 0 | 0 | 35870 | 28,5 | 1256966 | 522 |
| H +36:00 | 20000 | 100 | 18101 | 90,5 | 1093 | 5,47 | 806 | 4,03 | 0 | 0 | 34810 | 35,9 | 969647 | 625 |

Within the first 4 hours as of the OS start the oil slick spreads westward of the OS point under the action of the wind and current. After 4 hours as of the OS start the oil slick semi-perimeter makes 1689 m, the volume of the evaporated oil – 0,82%, the volume of the dispersed oil – 0,39%. Further the oil drifts northward to the open sea. After 9 hours from the OS start the oil slick semi-perimeter makes 1630 m, the volume of the evaporated oil – 2,07%, the volume of the dispersed oil – 0,86%. After 9 hours as of the OS start the oil slick commences drifting north-eastward blocking the commercial marine traffic along the set shipping routes inbound/outbound of the Kolskiy Gulf. After 24 hours as of the OS start the oil slick semi-perimeter makes 1987 m, the volume of the evaporated oil – 4,20%, the volume of the dispersed oil – 2,54%. The oil/water mixture has increased compared to the OS volume with 79,4%. To the moment of modelling completion (36 hours), the oil slick centre is located in the point with coordinates $69^0$25N; $33^0$45E, the average oil slick thickness makes 35,9 mm.
The graphic display of the oil slick spreading as per the scenario COV-Aut-SW-1 is shown in figures 78 – 91.
The charts of processes typical for oil behaviour on water are shown in figures 92-94.

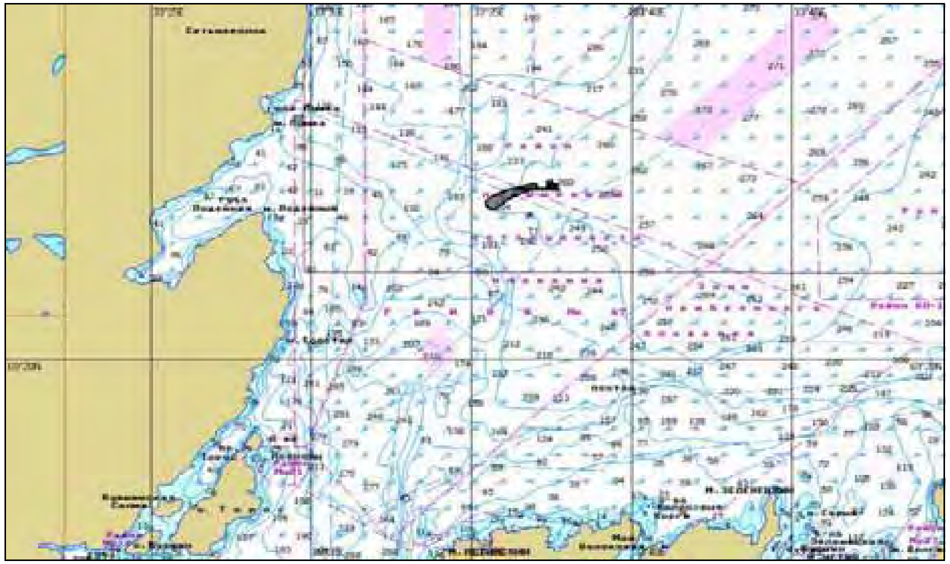


Figure 78. H+01:00. Oil slick spreading as per the scenario COV-Aut-SW-1.

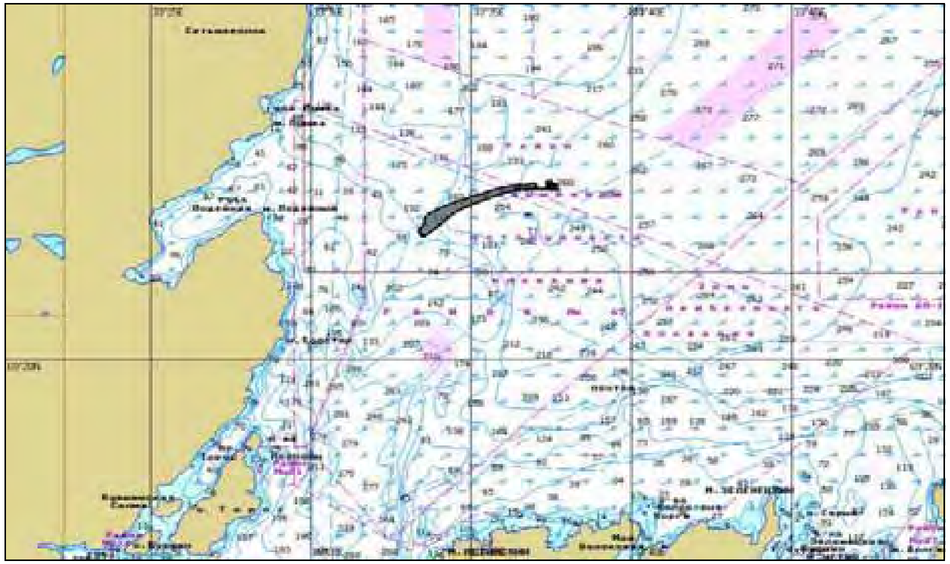


Figure 79. H +02:00. Oil slick spreading as per the scenario COV-Aut-SW-.

Figure 80. H +03:00. Oil slick spreading as per the scenario COV-Aut-SW-1.

Figure. H +04:00. Oil slick spreading as per the scenario COV-Aut-SW-1.

Figure 82. H +05:00. Oil slick spreading as per the scenario COV-Aut-SW-1.

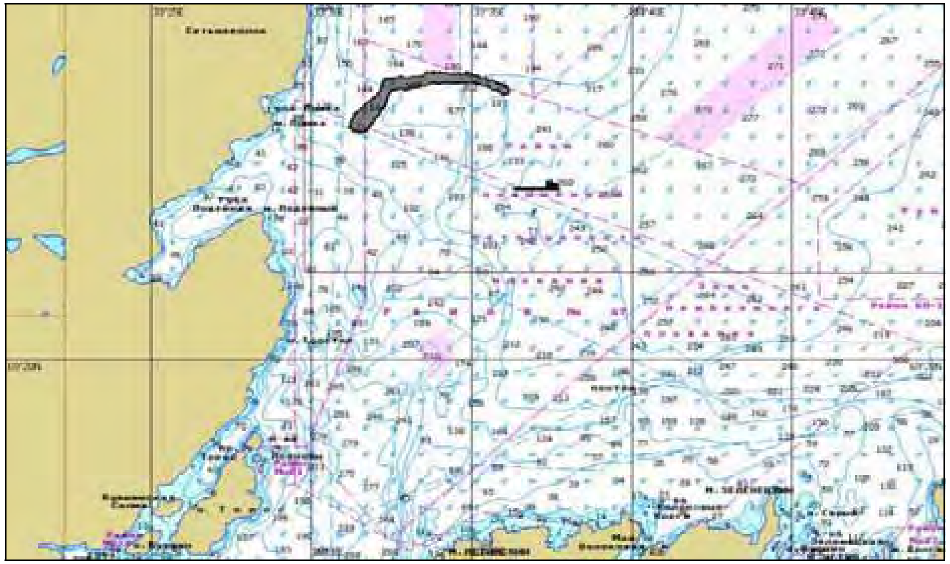


Figure 83. H +06:00. Oil slick spreading as per the scenario COV-Aut-SW-1.

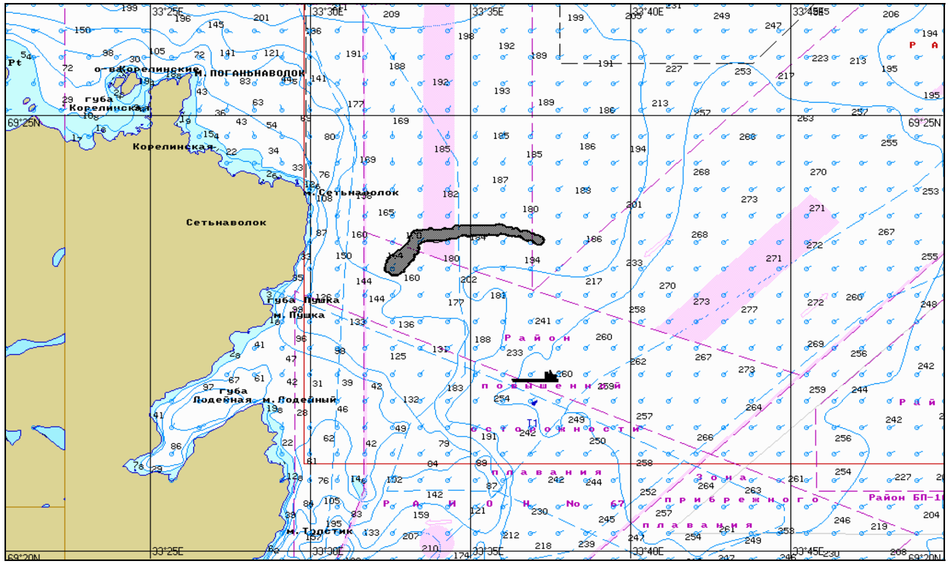


Figure 84. H +07:00. Oil slick spreading as per the scenario COV-Aut-SW-1.

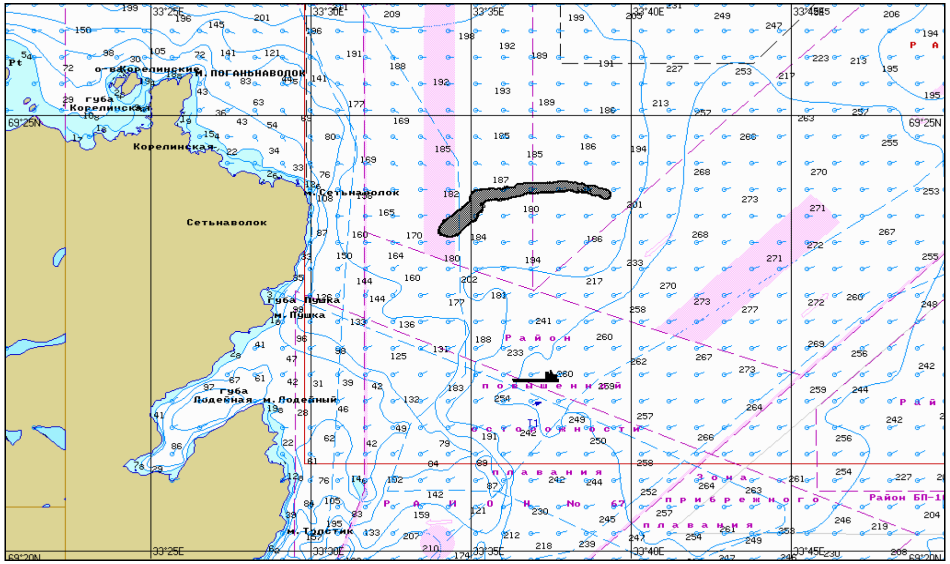


Figure 85. H +08:00. Oil slick spreading as per the scenario COV-Aut-SW-1.

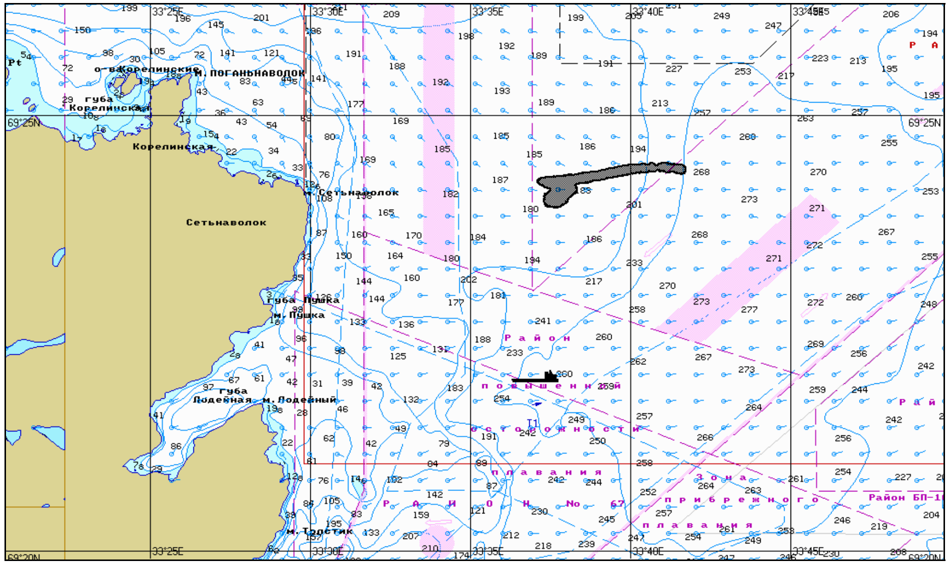


Figure 86. H +09:00. Oil slick spreading as per the scenario COV-Aut-SW-1.

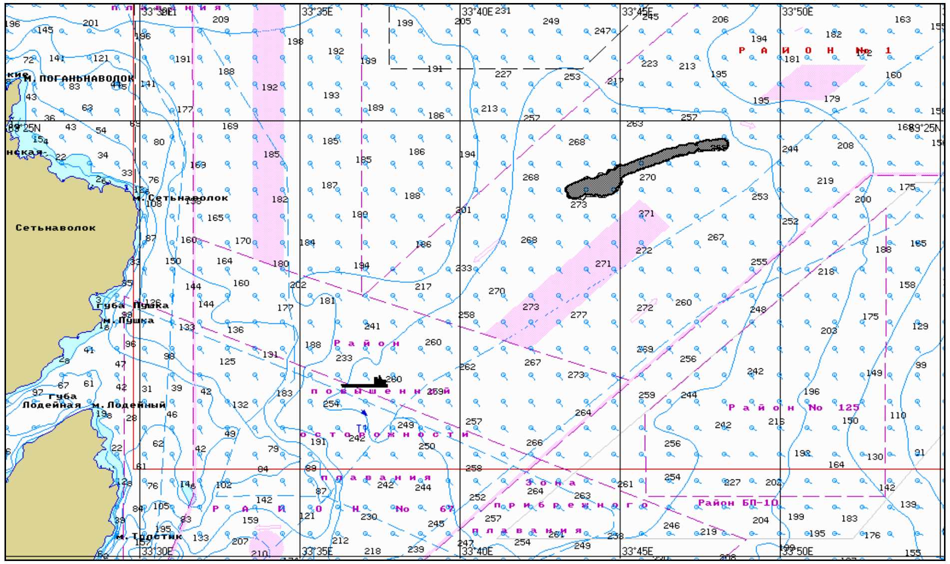


Figure 87. H +12:00. Oil slick spreading as per the scenario COV-Aut-SW-1.

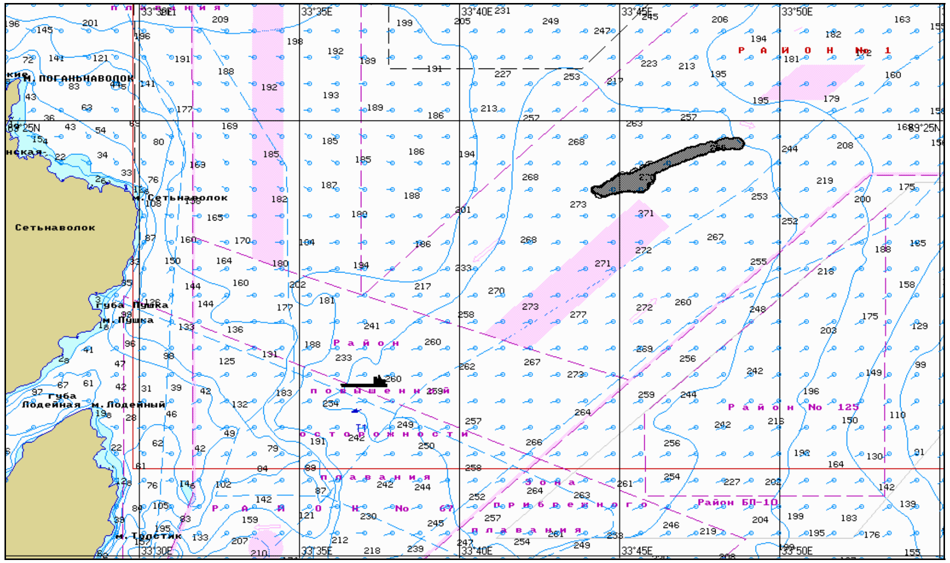


Figure 88. H +15:00. Oil slick spreading as per the scenario COV-Aut-SW-1.

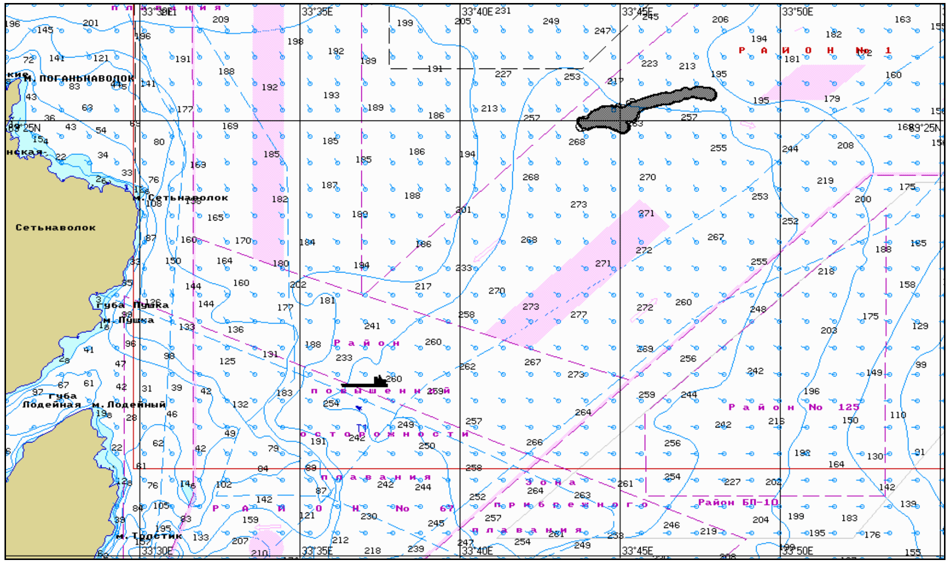


Figure.89. H +18:00. Oil slick spreading as per the scenario COV-Aut-SW-1.

RAMBOLL

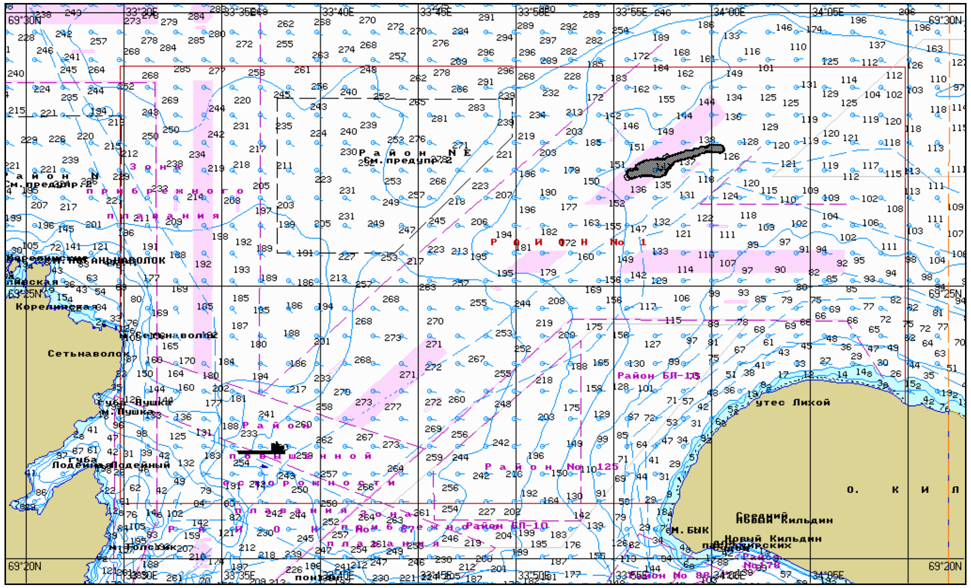



Figure 90. H +24:00. Oil slick spreading as per the scenario COV-Aut-SW-1.

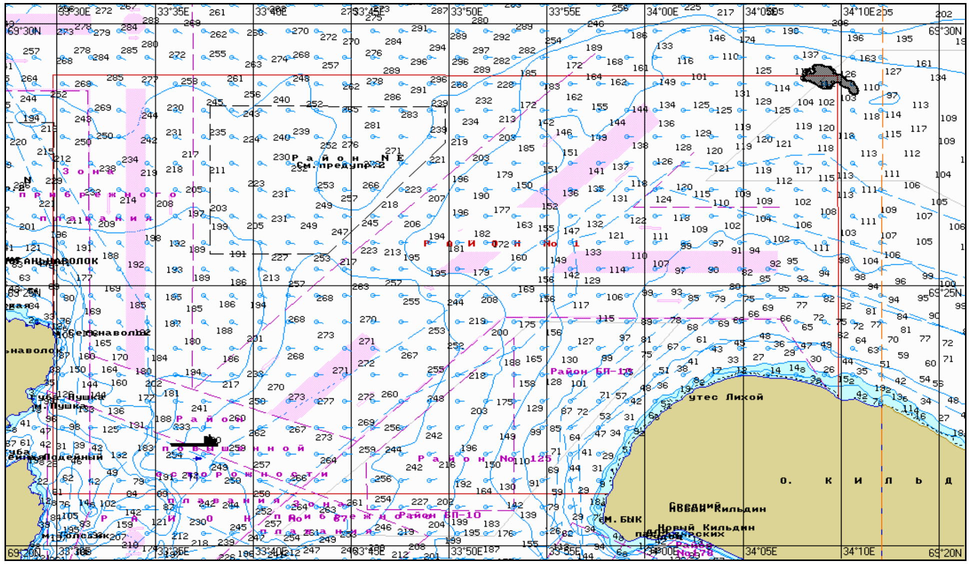



Figure 91. H +36:00. Oil slick spreading as per the scenario COV-Aut-SW-1.

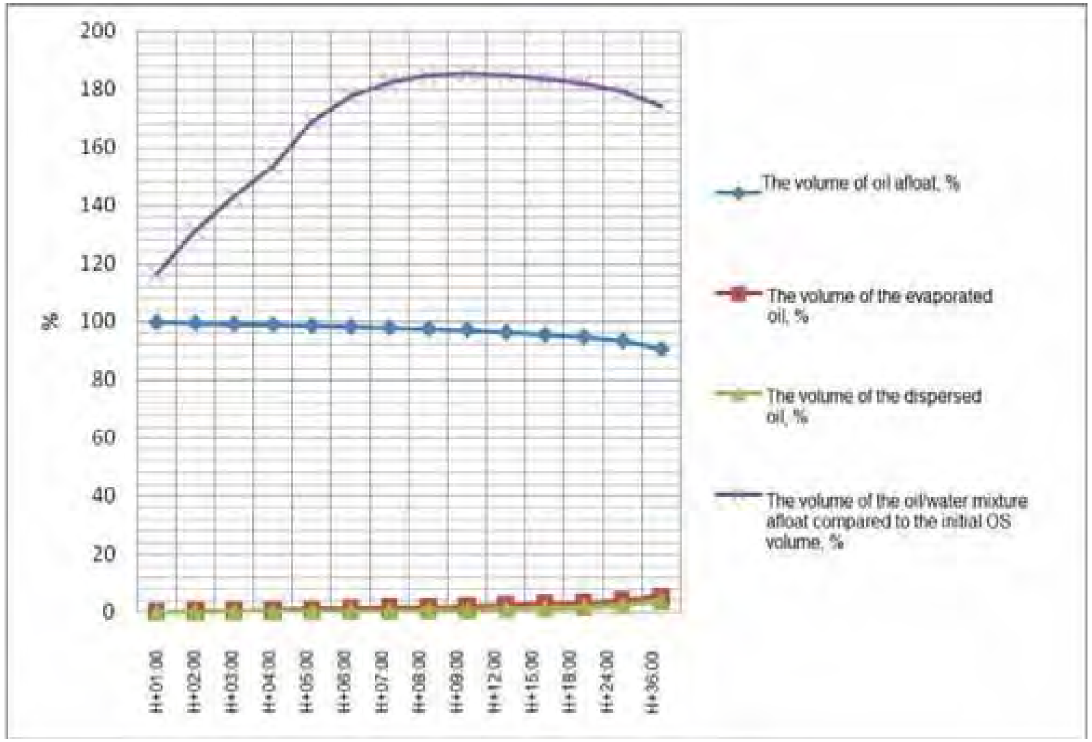



Figure 92. The chart of processes as per the scenario COV-Aut-SW-1.

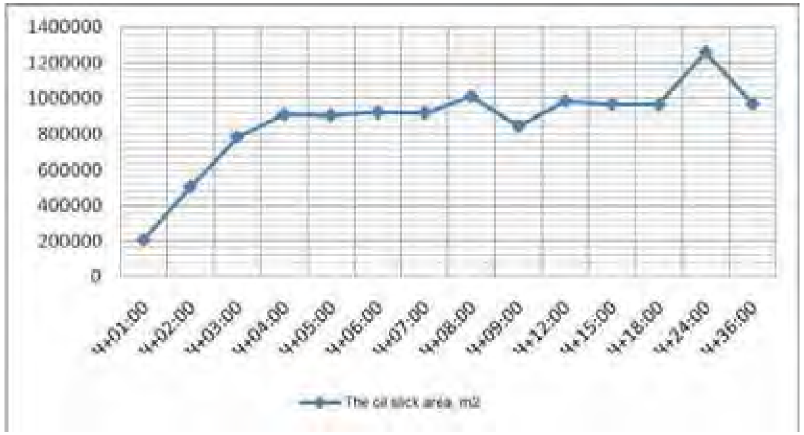



Figure 93. Oil slick area change dynamics as per the scenario COV-Aut-SW-1.

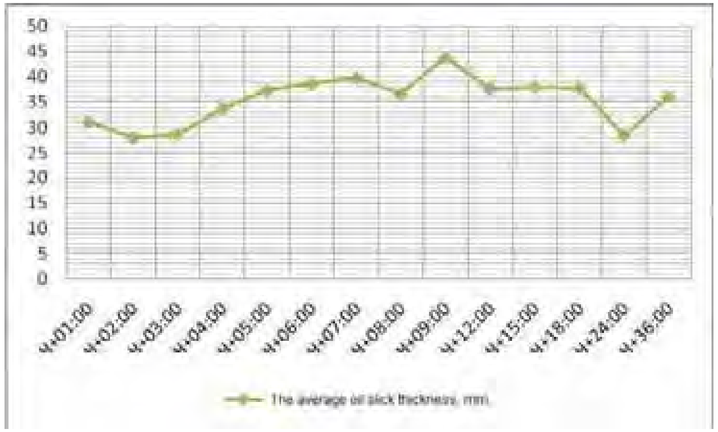



Figure 94.Oil slick thickness change dynamics as per the scenario COV-Aut-SW-1.

### 1.3.2 Oil slick behaviour modelling as per the scenario BO-Aut-SW-1

*Table 1.3.2.1: Oil slick spreading parameters as per the scenario BO-Aut-SW-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil/water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 3046 | 100 | 3046 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 3046 | 42,6 | 71459 | 15541 |
| H +02:00 | 6117 | 100 | 6117 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 6117 | 33,5 | 182831 | 15541 |
| H +03:00 | 9187 | 100 | 9187 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 9187 | 30,2 | 303880 | 15541 |
| H +04:00 | 12000 | 100 | 11991 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 11991 | 30,5 | 392542 | 15541 |
| H +05:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 33,8 | 355094 | 15541 |
| H +06:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 35,3 | 339970 | 15541 |
| H +07:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 37,0 | 324077 | 15541 |
| H +08:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 37,1 | 323027 | 15541 |
| H +09:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 44,4 | 270335 | 15541 |
| H +12:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 41,8 | 286943 | 15541 |
| H +15:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 47,0 | 255216 | 15541 |
| H +18:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 52,0 | 230946 | 15541 |
| H +24:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 45,6 | 263110 | 15541 |
| H +36:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 42,6 | 161507 | 15541 |

Within the first 4 hours the oil slick spreads westward of the OS point under the action of the wind and current. After 4 hours as of the OS start the oil slick semi-perimeter makes 1110 м, the evaporation and dispersion processes are not detected by the programme. Further the oil slick drifts northward to the open sea. After 9 hours as of the OS start the oil slick semi-perimeter makes 921 m, the evaporation and dispersion processes are not detected by the programme. Further the oil slick moves north-eastward blocking the commercial marine traffic along the set shipping routes inbound/outbound of the Kolskiy Gulf. After 24 hours the oil slick semi-perimeter makes 909 m, the oil/water mixture volume compared to the OS volume does not increase. To the moment of the modelling completion (36 hours), the oil spill centre is located in the point with coordinates $69^0$29N; $34^0$09E, the average oil slick thickness makes 42,6 mm.
The graphic display of the oil slick spreading as per the scenario BO-Aut-SW-1 is shown in figures 95 – 108.
The charts of processes typical for black oil behaviour on water are shown in figures 109-111.

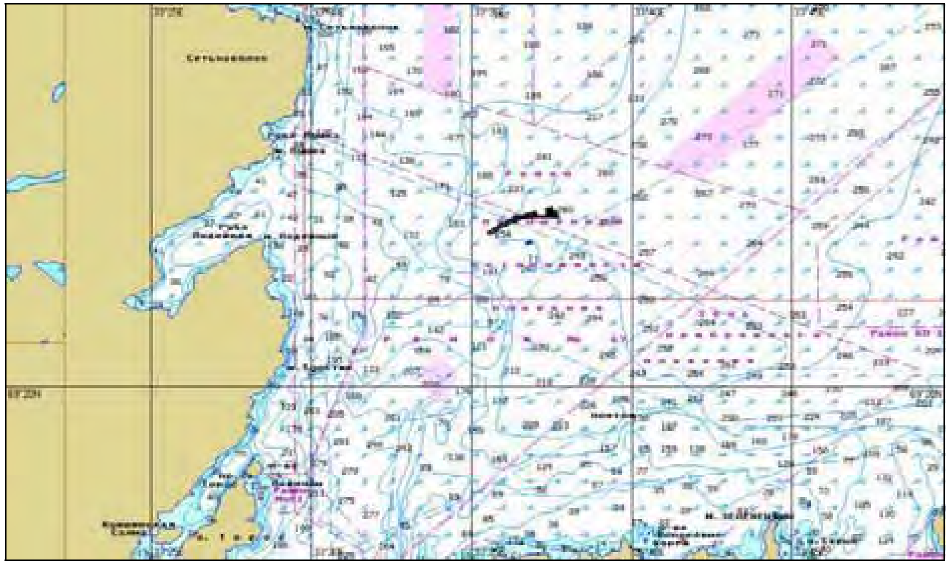


Figure 95. H +01:00. Oil slick spreading as per the scenario BO-Aut-SW-1.

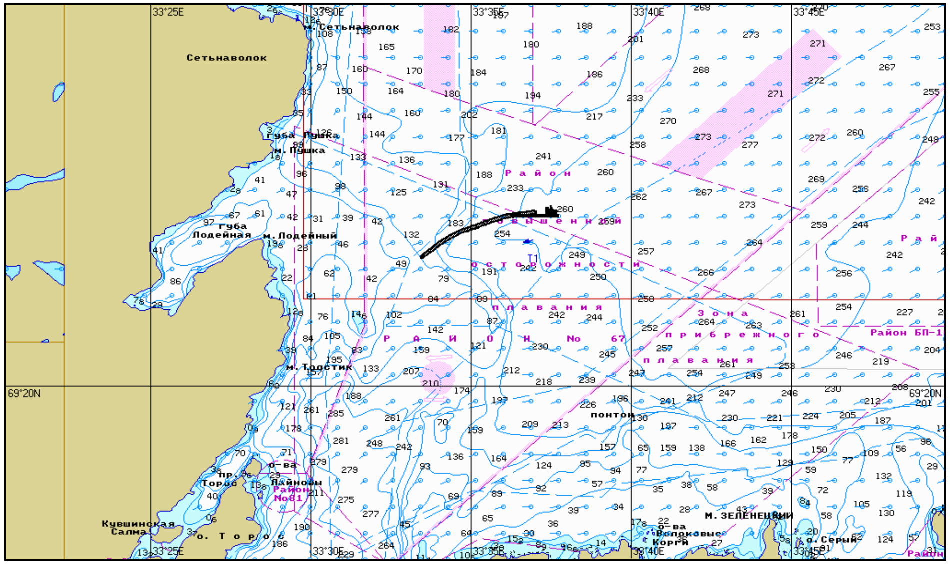


Figure 96. H +02:00. Oil slick spreading as per the scenario BO-Aut-SW-1.

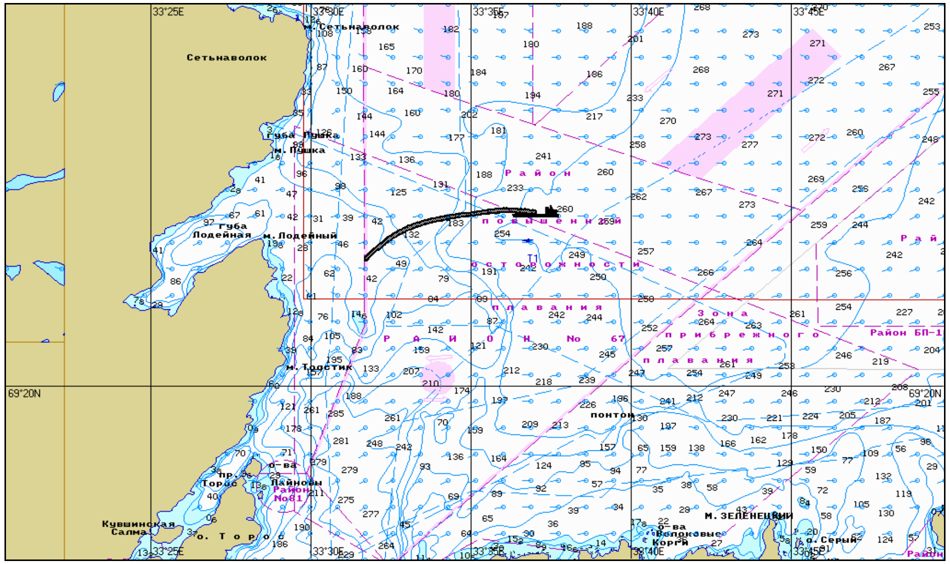


Figure. 97. H +03:00. Oil slick spreading as per the scenario BO-Aut-SW-1.

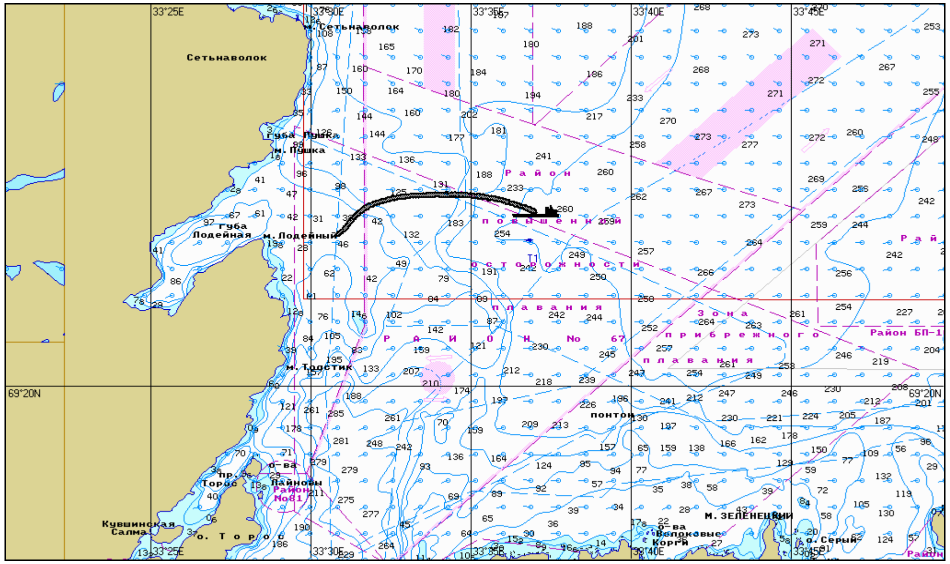


Figure 98. H +04:00.Oil slick spreading as per the scenario BO-Aut-SW-1.

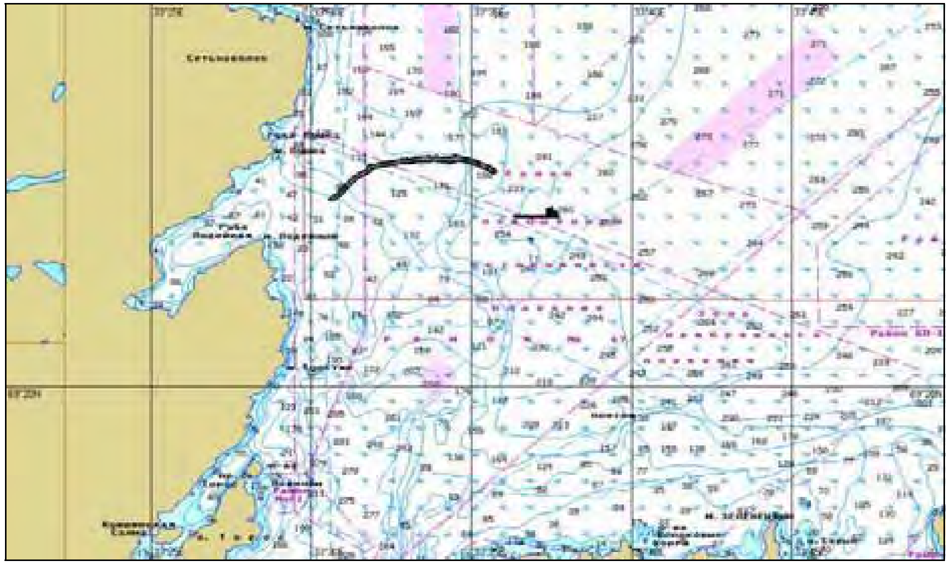


Figure 99. H +05:00. Oil slick spreading as per the scenario BO-Aut-SW-1.

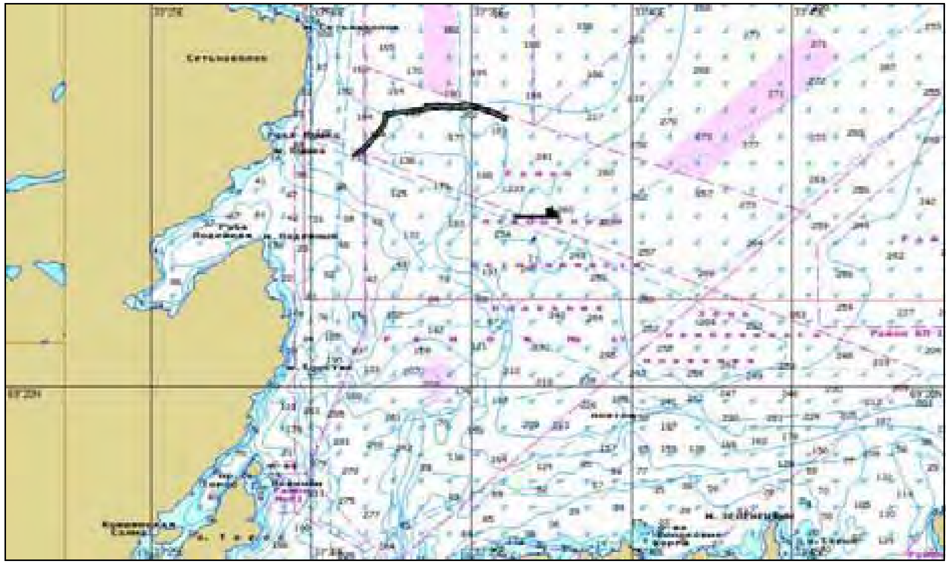


Figure 100. H +06:00. Oil slick spreading as per the scenario BO-Aut-SW-1.

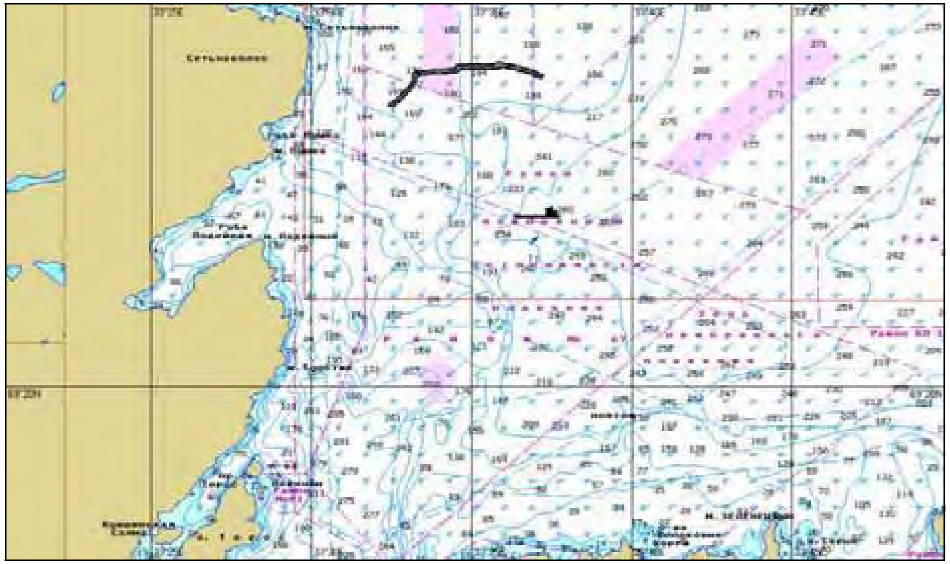


Figure 101. H +07:00. Oil slick spreading as per the scenario BO-Aut-SW-1.

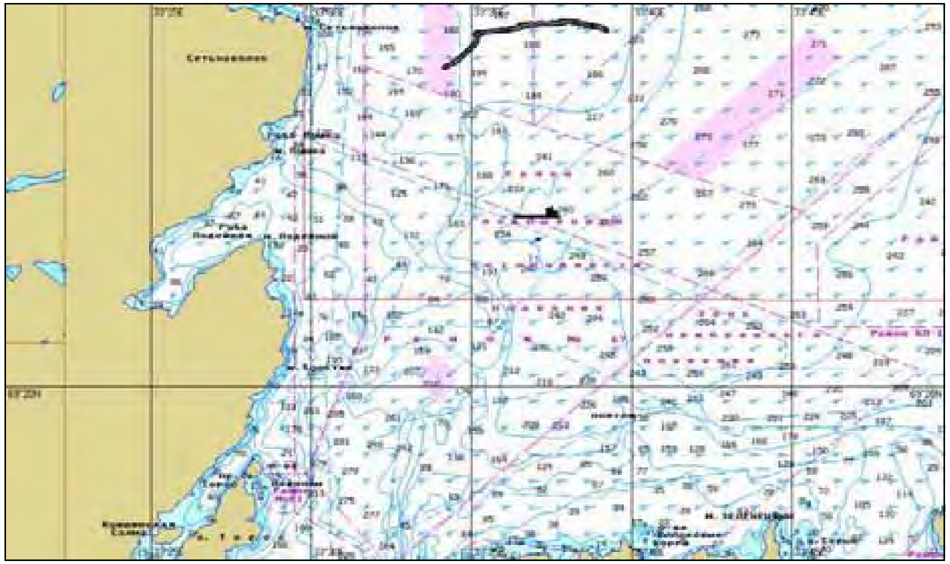


Figure 102. H +08:00. Oil slick spreading as per the scenario BO-Aut-SW-1.

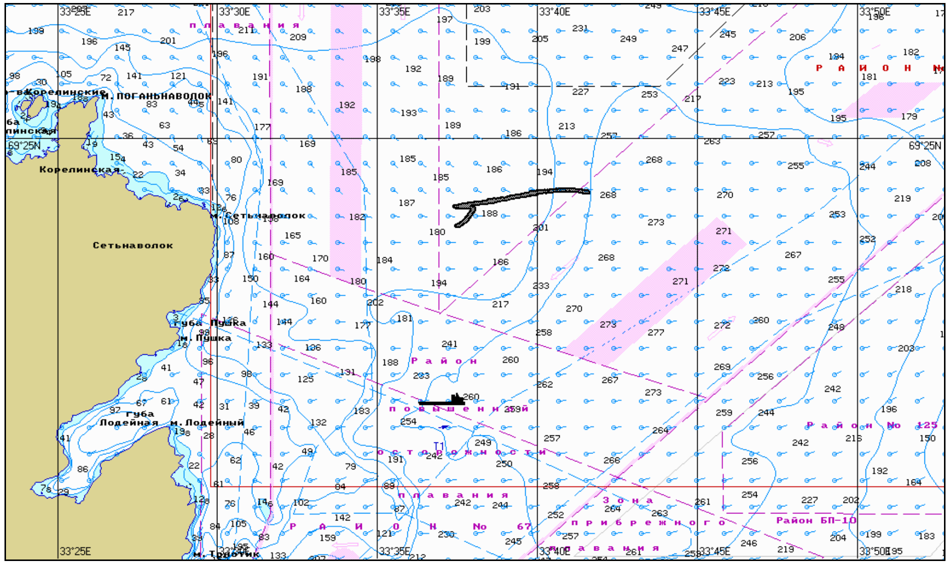


Figure 103. H +09:00. Oil slick spreading as per the scenario BO-Aut-SW-1.

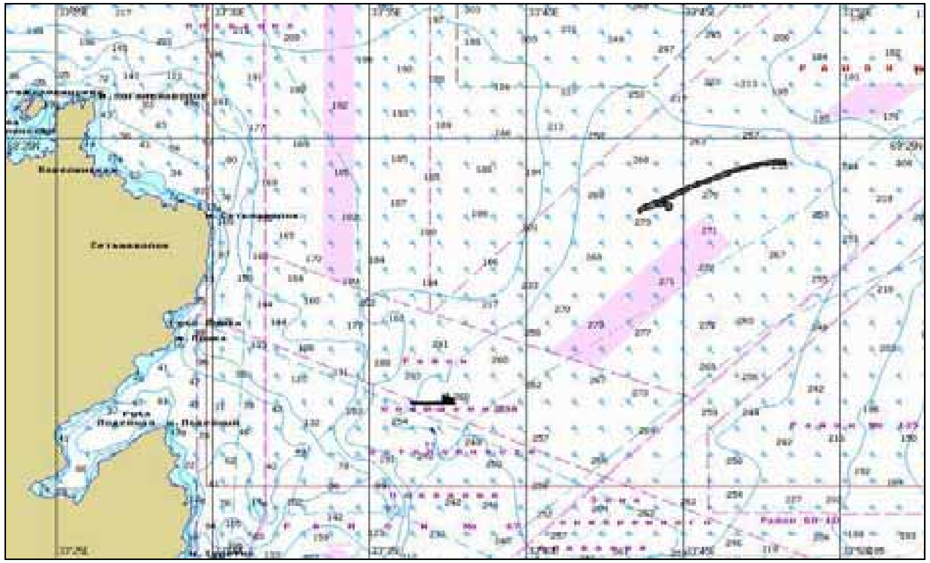


Figure 104. H +12:00. Oil slick spreading as per the scenario BO-Aut-SW-1.

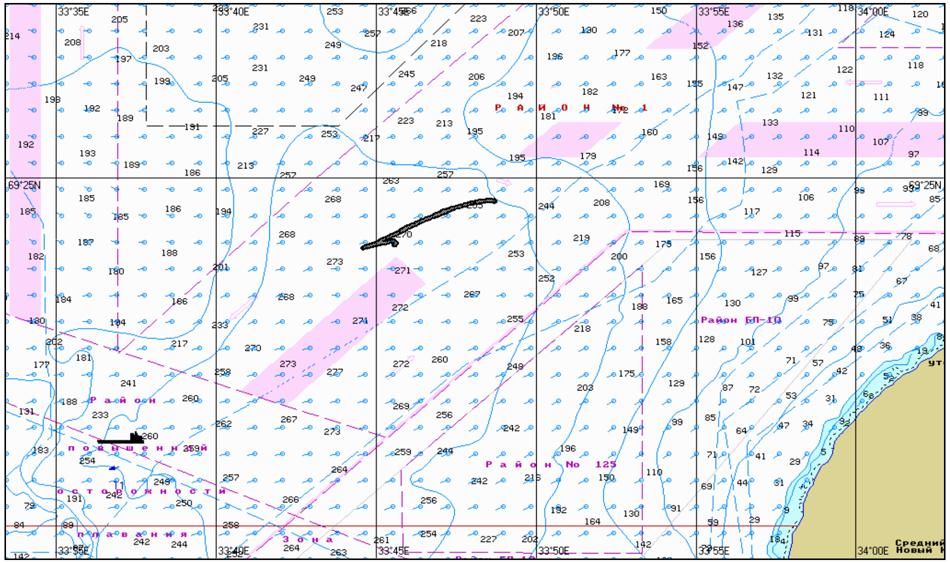


Figure 105. H +15:00. Oil slick spreading as per the scenario BO-Aut-SW-1.

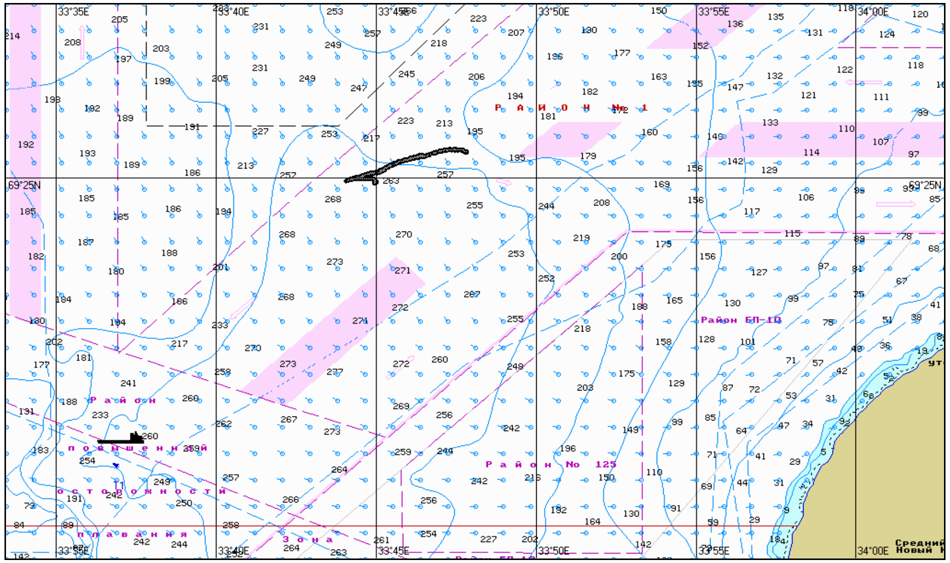


Figure 106. H +18:00. Oil slick spreading as per the scenario BO-Aut-SW-1.

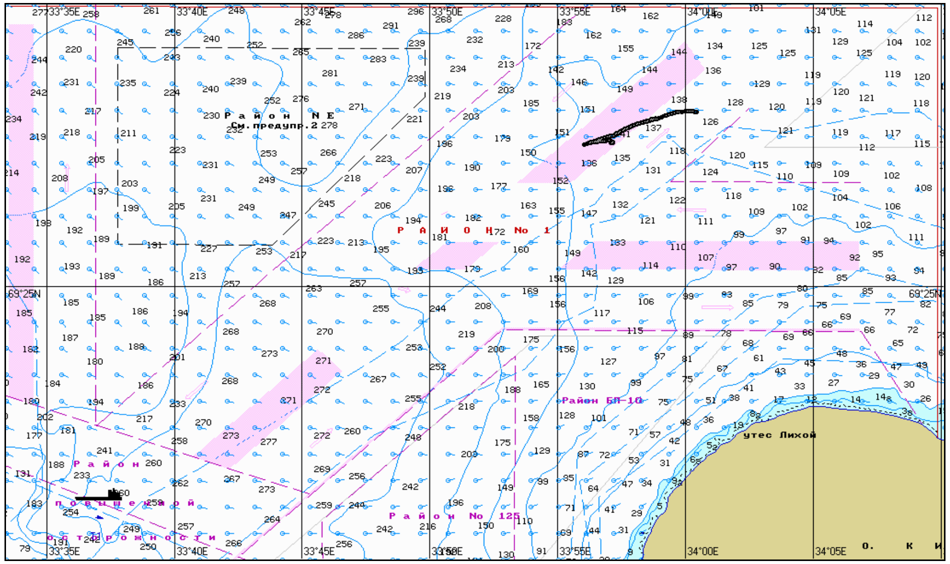



Figure 107. H +24:00. Oil slick spreading as per the scenario BO-Aut-SW-1.

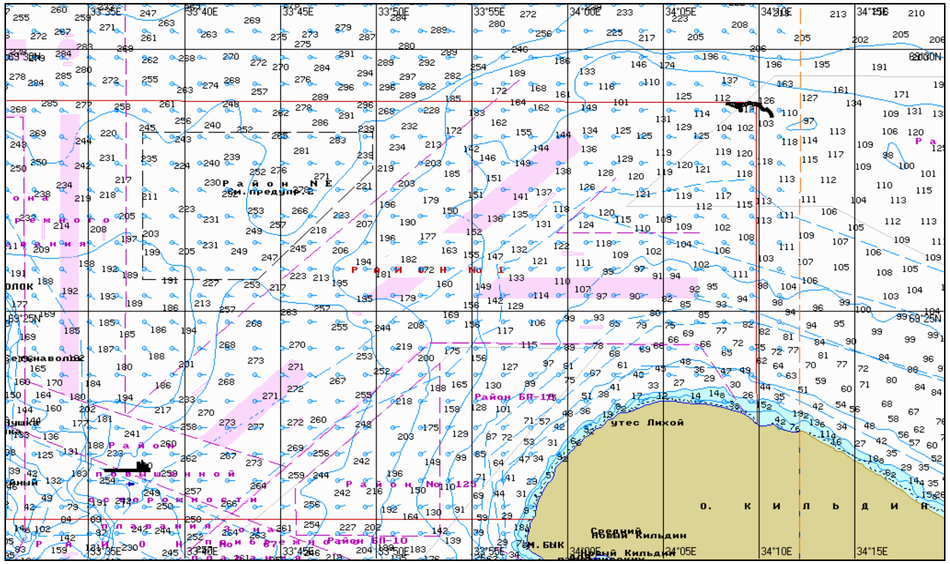



Figure 108. H+36:. Oil slick spreading as per the scenario BO-Aut-SW-1.

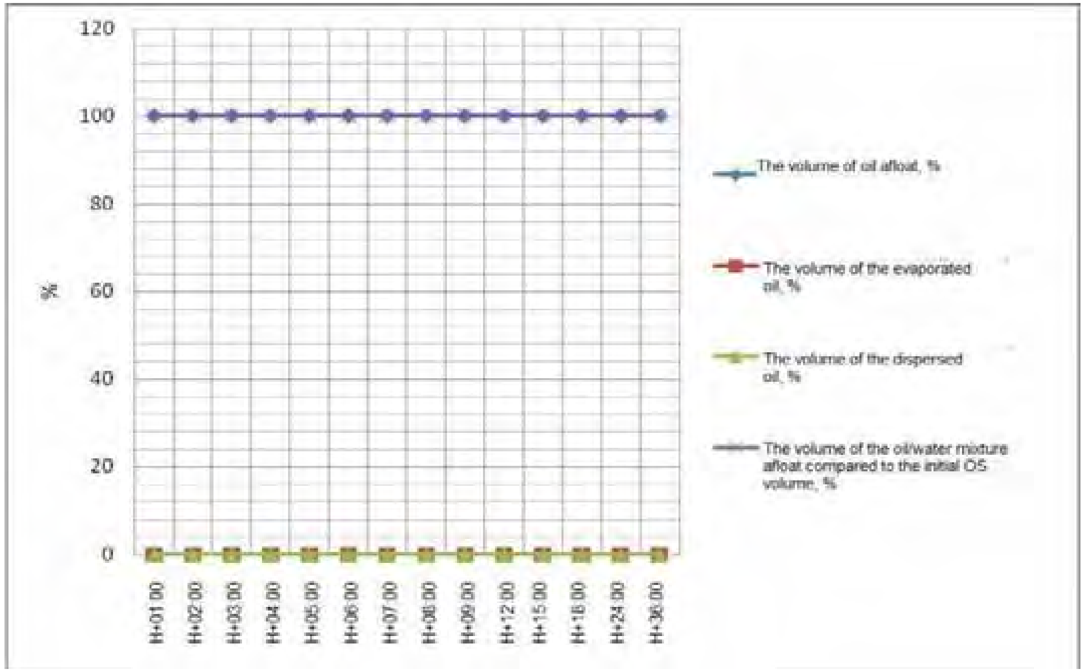



Figure 109. The chart of processes as per the scenario BO-Aut-SW-1.

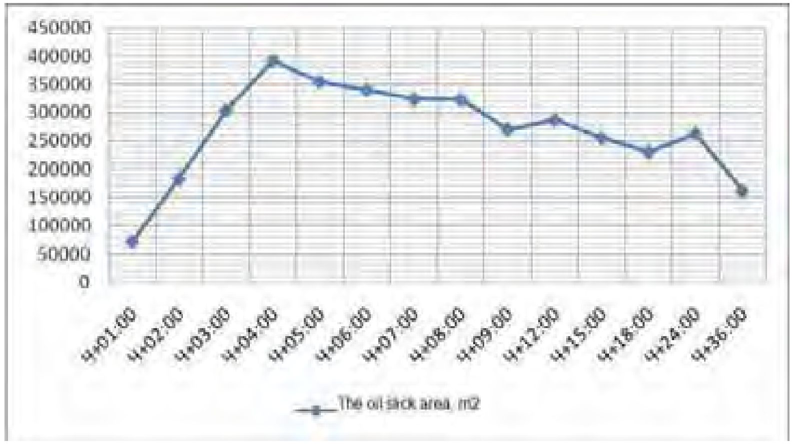



Figure 110. Oil slick area change dynamics as per the scenario BO-Aut-SW-1.

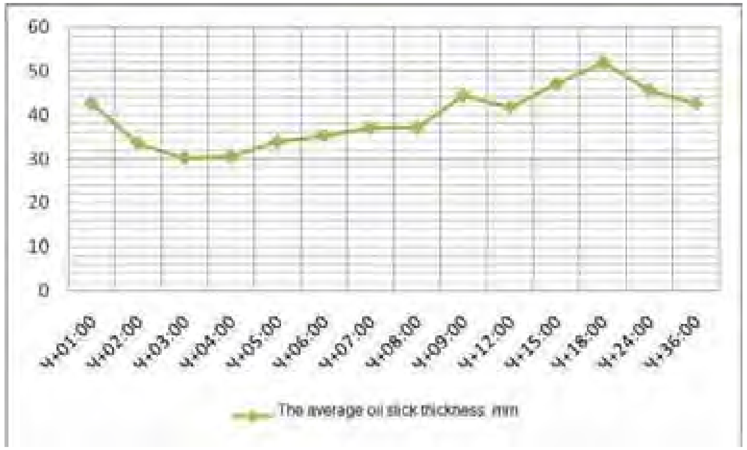



Figure 111. Oil slick thickness change dynamics as per the scenario BO-Aut-SW-1

### 1.3.3 Oil slick behaviour modelling as per the scenario GC-Aut-SW-1

*Table 1.3.3.1: Oil slick spreading parameters as per the scenario GC-Aut-SW-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil/water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 5362 | 100 | 4916 | 91,7 | 277 | 5,17 | 169 | 3,15 | 0 | 0 | 5739 | 19,82 | 289550 | 3,8 |
| H +02:00 | 10767 | 100 | 9415 | 87,4 | 885 | 8,22 | 467 | 4,34 | 0 | 0 | 12370 | 17,43 | 709839 | 6,9 |
| H +03:00 | 15707 | 100 | 13122 | 83,5 | 1786 | 11,4 | 799 | 5,09 | 0 | 0 | 18942 | 17,37 | 1090807 | 12,2 |
| H +04:00 | 19967 | 100 | 16002 | 80,1 | 2850 | 14,3 | 1115 | 5,58 | 0 | 0 | 24832 | 18,96 | 1309543 | 19,7 |
| H +05:00 | 20000 | 100 | 14936 | 74,7 | 3733 | 18,7 | 1330 | 6,65 | 0 | 0 | 26025 | 18,62 | 1397559 | 41,6 |
| H +06:00 | 20000 | 100 | 14093 | 70,5 | 4454 | 22,3 | 1452 | 7,26 | 0 | 0 | 26237 | 17,68 | 1484328 | 71,1 |
| H +07:00 | 20000 | 100 | 13418 | 67,1 | 5040 | 25,2 | 1541 | 7,71 | 0 | 0 | 25882 | 16,98 | 1524645 | 104 |
| H +08:00 | 20000 | 100 | 12831 | 64,2 | 5555 | 27,8 | 1614 | 8,07 | 0 | 0 | 25203 | 15,81 | 1594467 | 141 |
| H +09:00 | 20000 | 100 | 12385 | 61,9 | 5936 | 29,7 | 1678 | 8,39 | 0 | 0 | 24551 | 18,07 | 1358351 | 174 |
| H +12:00 | 20000 | 100 | 11315 | 56,6 | 6846 | 34,2 | 1839 | 9,20 | 0 | 0 | 22606 | 12,04 | 1876806 | 278 |
| H +15:00 | 20000 | 100 | 10386 | 51,9 | 7649 | 38,2 | 1965 | 9,83 | 0 | 0 | 20770 | 10,53 | 1972723 | 413 |
| H +18:00 | 20000 | 100 | 9705 | 48,5 | 8224 | 41,1 | 2070 | 10,4 | 0 | 0 | 19410 | 8,88 | 2186199 | 548 |
| H +24:00 | 20000 | 100 | 8543 | 42,7 | 9214 | 46,1 | 2243 | 11,2 | 0 | 0 | 17087 | 5,82 | 2938180 | 890 |
| H +36:00 | 20000 | 100 | 6884 | 34,4 | 10618 | 53,1 | 2498 | 12,5 | 0 | 0 | 13767 | 5,30 | 2603203 | 1773 |

Within the first 4 hours as of the OS start the oil slick spreads westward of the OS point under the action of the wind and current. After 4 hours the oil slick semi-perimeter makes 2028 m, the volume of the evaporated oil makes 14,3%, the volume of the dispersed oil 5,6%. Further the oil slick drifts northward to the open sea. After 9 hours as of the OS start the oil slick semi-perimeter makes 2069 m, the volume of the evaporated oil – 29,7%, the volume of the dispersed oil – 8,4%. After 9 hours as of the OS start the oil slick commences drifting north-eastward blocking the commercial marine traffic along the set shipping routes inbound/outbound of the Kolskiy Gulf. After 24 hours as of the OS start the oil slick semi-perimeter makes 3037 m, the volume of the evaporated oil – 46,1%, the volume of the dispersed oil – 11,2%. The volume of the oil/water mixture has decreased compared to the OS volume with 14,6%. To the moment of modelling completion (36 hours), 34,4% of the hazardous substance remain afloat, the oil slick centre is located in the point with coordinates $69^0$29N; $34^0$10E, the average oil slick thickness makes 12,5 mm.

The graphic display of the oil slick spreading as per the scenario GC-Aut-SW-1 is shown in figures 112 – 125.

The charts of processes typical for SGC behaviour on water are shown in figures 126-128.

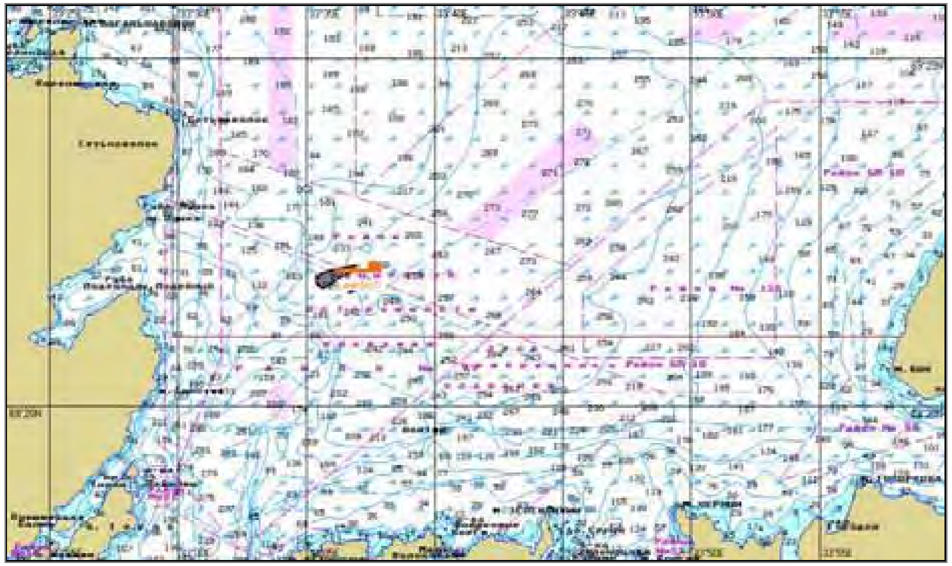


Figure 112. H+01:00. Oil slick spreading as per the scenario GC-Aut-SW-1.

Figure 113. H+02:00. Oil slick spreading as per the scenario GC-Aut-SW-1.

Figure 114. H+03:00. Oil slick spreading as per the scenario GC-Aut-SW-1.

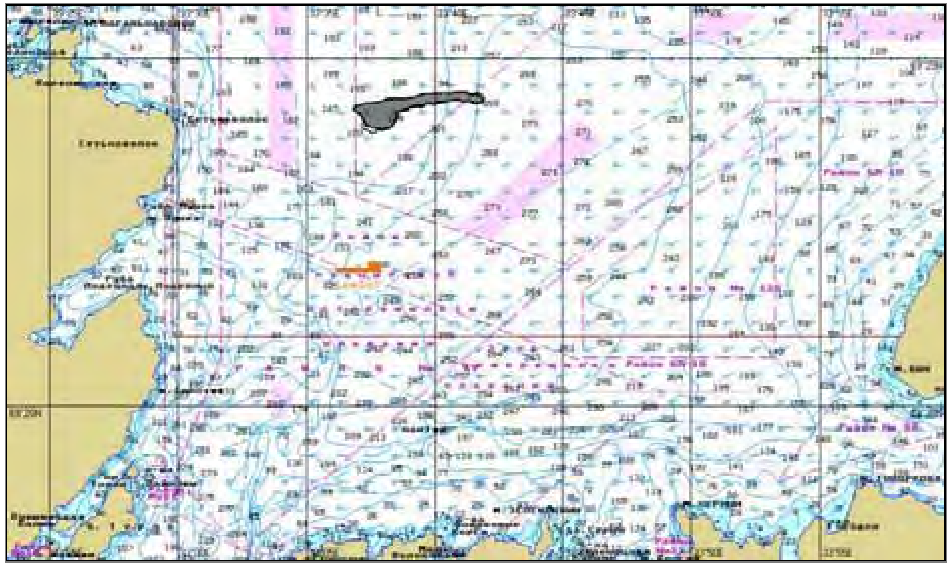
Figure 115. H+04:00. Oil slick spreading as per the scenario GC-Aut-SW-1.

Figure 116. H+05:00. Oil slick spreading as per the scenario GC-Aut-SW-1.

Figure 117. H+06:00. Oil slick spreading as per the scenario GC-Aut-SW-1.

Figure 118. H+07:00. Oil slick spreading as per the scenario GC-Aut-SW-1.

Figure 119. H+08:00. Oil slick spreading as per the scenario GC-Aut-SW-1.



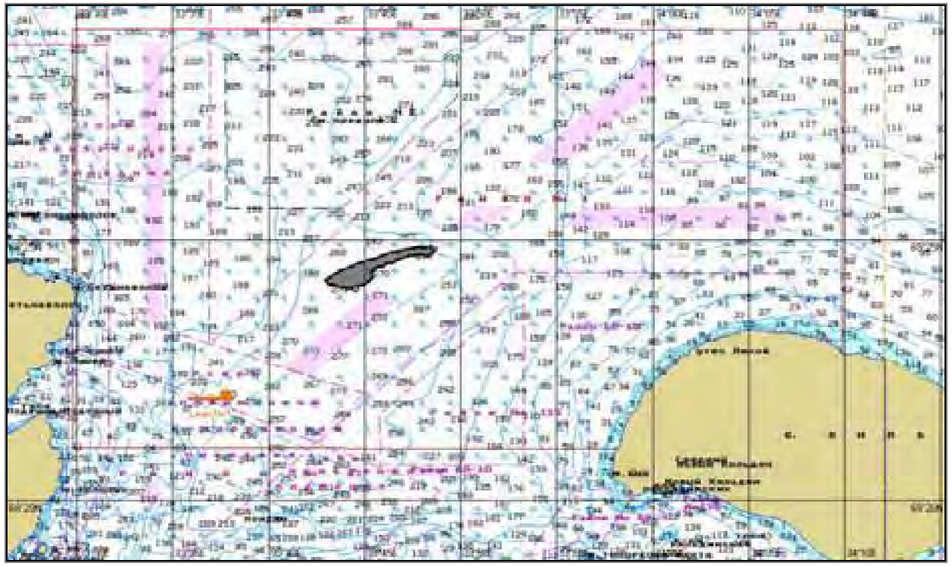
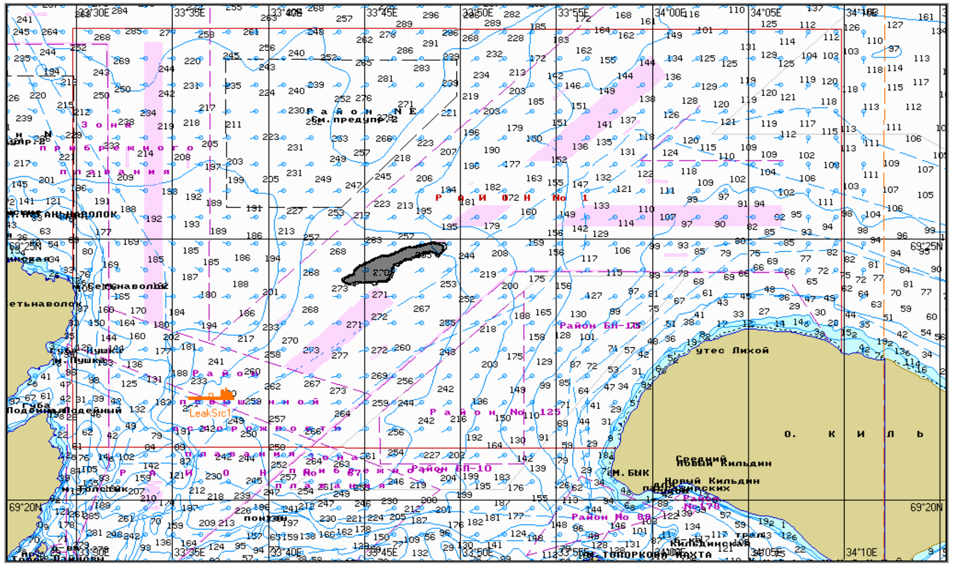


Figure 120. H+09:00. Oil slick spreading as per the scenario GC-Aut-SW-1.

Figure 121. H+12:00. Oil slick spreading as per the scenario GC-Aut-SW-1.



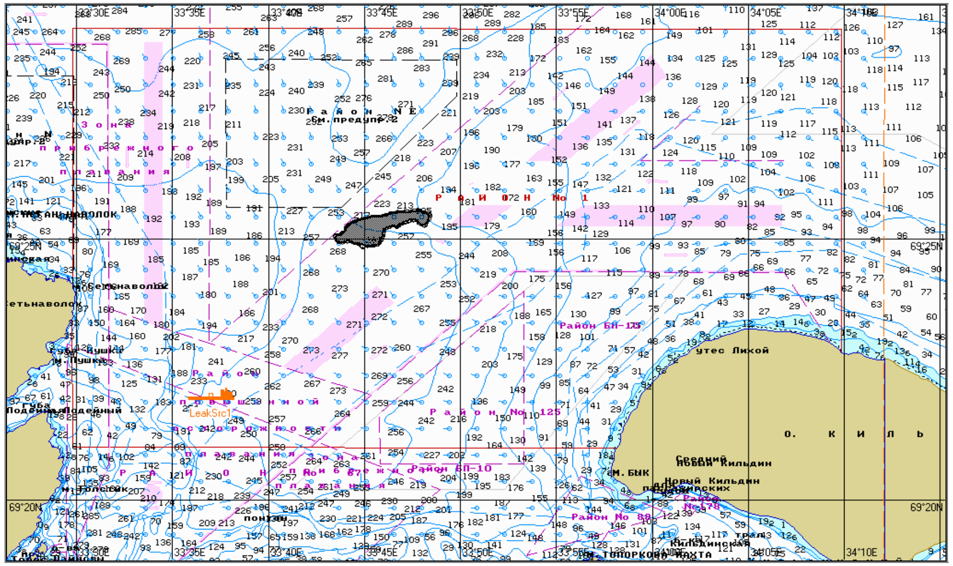


Figure 122. H+15:00. Oil slick spreading as per the scenario GC-Aut-SW-1.

Figure 123. H+18:00. Oil slick spreading as per the scenario GC-Aut-SW-1.

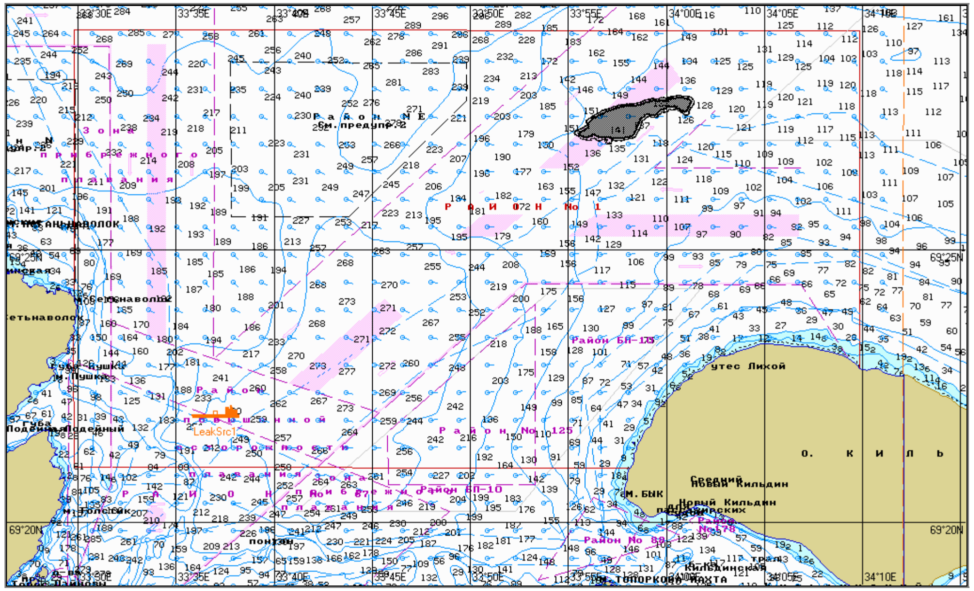



Figure 124. H+24:00. Oil slick spreading as per the scenario GC-Aut-SW-1.

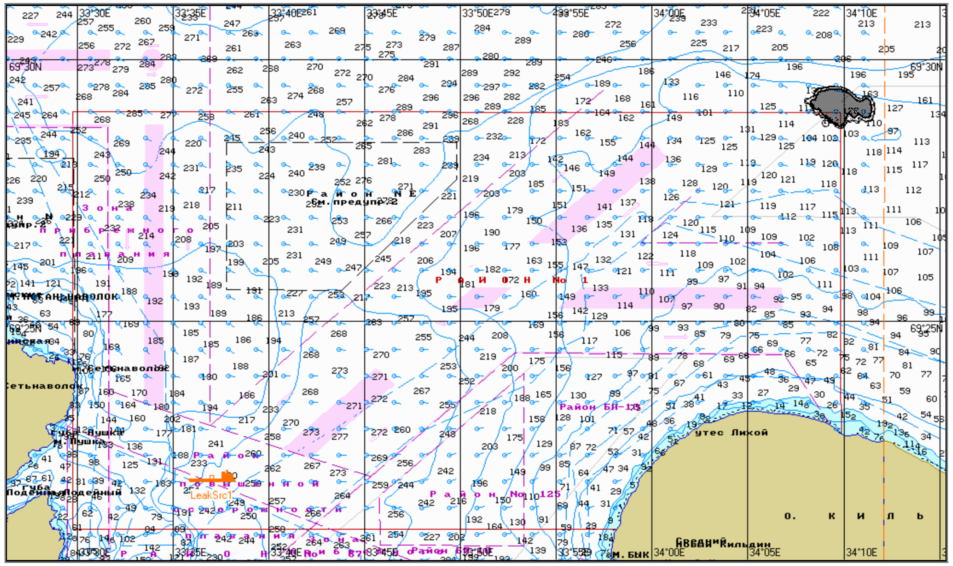



Figure 125. H+36:. Oil slick spreading as per the scenario Gc-Aut-SW-1.

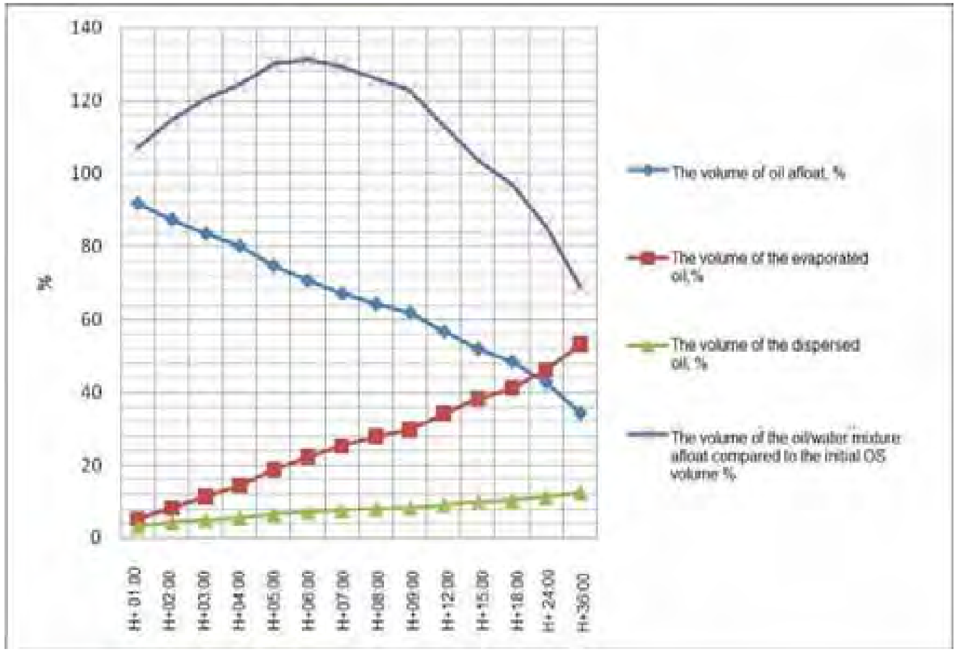



Fig. 126. The chart of processes as per the scenario GC-Aut-SW-1

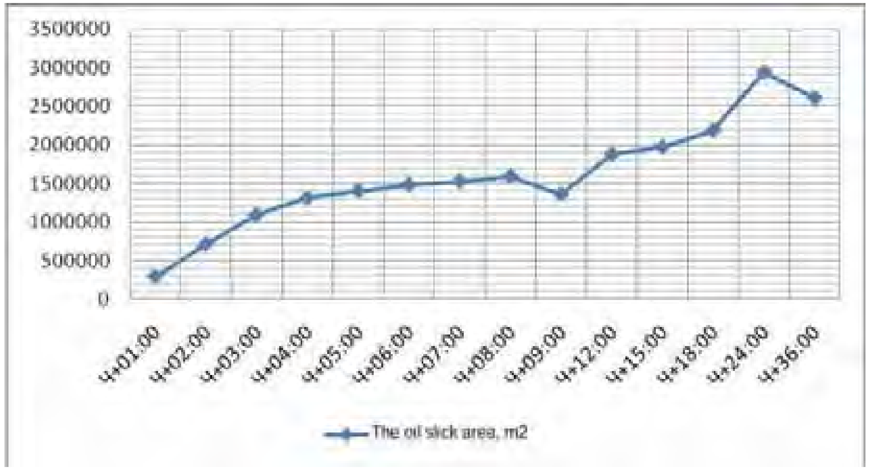



Figure 127. Oil slick area change dynamics as per the scenario GC-Aut-SW-1.

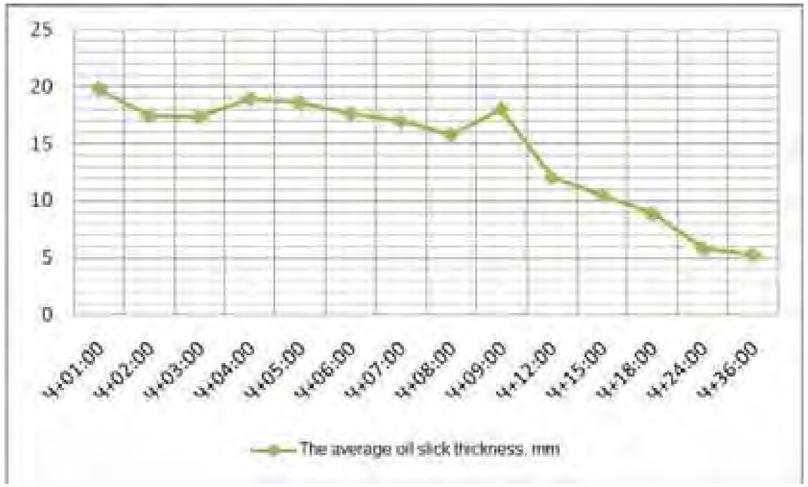



Figure 128. Oil slick thickness change dynamics as per the scenario GC-Aut-SW-1.

### 1.3.4 Oil slick behaviour modelling as per the scenario Na-Aut-SW-1

*Table 1.3.4.1: Oil slick spreading parameters as per the scenario Na-Aut-SW-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil/water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 2764 | 100 | 2421 | 87,6 | 307 | 11,1 | 35,3 | 1,28 | 0 | 0 | 2762 | 11,4 | 242239 | 3,4 |
| H+02:00 | 5408 | 100 | 4302 | 79,5 | 998 | 18,5 | 108 | 2,00 | 0 | 0 | 5276 | 8,44 | 625025 | 8,4 |
| H+03:00 | 7909 | 100 | 5699 | 72,1 | 2014 | 25,5 | 196 | 2,48 | 0 | 0 | 7277 | 6,97 | 1044060 | 18,6 |
| H+04:00 | 10000 | 100 | 6559 | 65,6 | 3153 | 31,5 | 288 | 2,88 | 0 | 0 | 8617 | 6,63 | 1300327 | 37 |
| H+05:00 | 10000 | 100 | 5576 | 55,8 | 4052 | 40,5 | 372 | 3,72 | 0 | 0 | 7756 | 4,70 | 1651259 | 101 |
| H+06:00 | 10000 | 100 | 4877 | 48,8 | 4677 | 46,8 | 446 | 4,46 | 0 | 0 | 6912 | 3,88 | 1781506 | 196 |
| H+07:00 | 10000 | 100 | 4366 | 43,7 | 5119 | 51,2 | 516 | 5,16 | 0 | 0 | 6223 | 3,32 | 1875262 | 307 |
| H+08:00 | 10000 | 100 | 3945 | 39,5 | 5472 | 54,7 | 583 | 5,83 | 0 | 0 | 5632 | 3,02 | 1862421 | 435 |
| H+09:00 | 10000 | 100 | 3636 | 36,4 | 5715 | 57,2 | 649 | 6,49 | 0 | 0 | 5193 | 3,20 | 1621178 | 553 |
| H+12:00 | 10000 | 100 | 2871 | 28,7 | 6287 | 62,9 | 842 | 8,42 | 0 | 0 | 4101 | 1,77 | 2314923 | 971 |
| H+15:00 | 10000 | 100 | 2180 | 21,8 | 6795 | 68,0 | 1027 | 10,3 | 0 | 0 | 3113 | 1,31 | 2379972 | 1597 |
| H+18:00 | 10000 | 100 | 1663 | 16,6 | 7139 | 71,4 | 1197 | 12,0 | 0 | 0 | 2376 | 0,98 | 2419979 | 2244 |
| H+24:00 | 10000 | 100 | 985 | 9,85 | 7637 | 76,4 | 1379 | 13,8 | 0 | 0 | 1407 | 0,73 | 1932014 | 3656 |
| H+32:00 | 10000 | 100 | 452 | 4,52 | 8070 | 80,7 | 1479 | 14,8 | 0 | 0 | 645 | 0,40 | 1607563 | 5574 |

Within the first 4 hours as of the OS start the oil slick spreads westward of the OS point under the action of the wind and current. After 4 hours the oil slick semi-perimeter makes 2020 m, the volume of the evaporated oil makes 32,5%, the volume of the dispersed oil 2,88%. Further the oils slick drifts northward to the open sea. After 9 hours as of the OS start the oil slick semi-perimeter makes 2256 m, the volume of the evaporated oil– 57,2%, the volume of the dispersed oil – 6,49%. After 9 hours as of the OS start the oil slick commences drifting north-eastward blocking commercial marine traffic along the set shipping routes inbound/outbound of the Kolskiy Gulf. After 24 hours the volume of the evaporated oil makes 76,4% of the initial OS volume. The oil slick semi-perimeter makes 2463 m, the average oil slick thickness - 0,73 mm. To the moment of modelling completion (32 hours), the oil slick with the average thickness of 0,40 mm remains afloat, the centre of the oil slick is located in the point with coordinates $69^0$28N; $34^0$00E.

The graphic display of the oil slick spreading as per the scenario Na-Aut-SW-1 is shown in figures 129 – 142.

The charts of processes typical for naphtha behaviour on water are shown in figures 143-145.

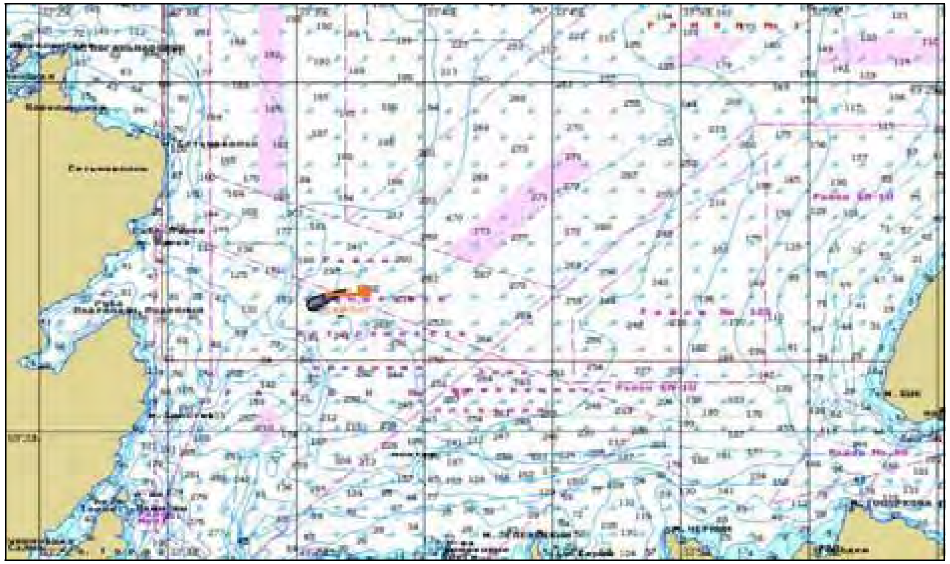


Figure 129. H+01:00. Oil slick spreading as per the scenario Na-Aut-SW-1.

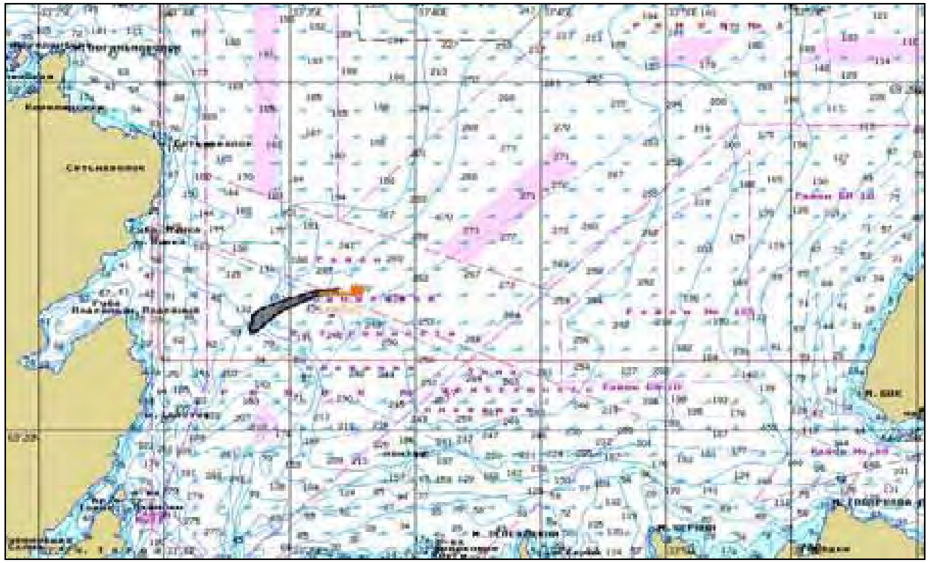


Figure 130. H+02:00. Oil slick spreading as per the scenario Na-Aut-SW-1.

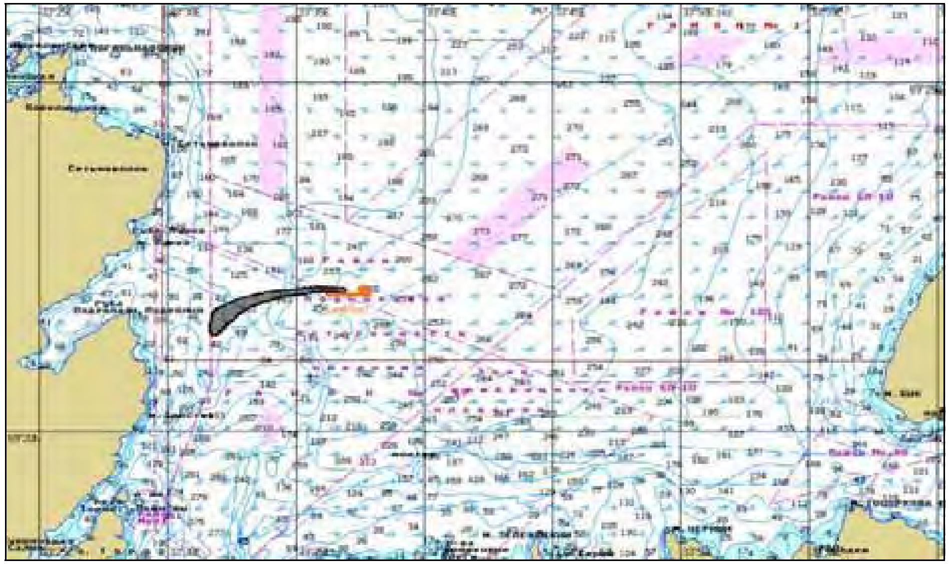


Figure 131. H+03:00. Oil slick spreading as per the scenario Na-Aut-SW-1.

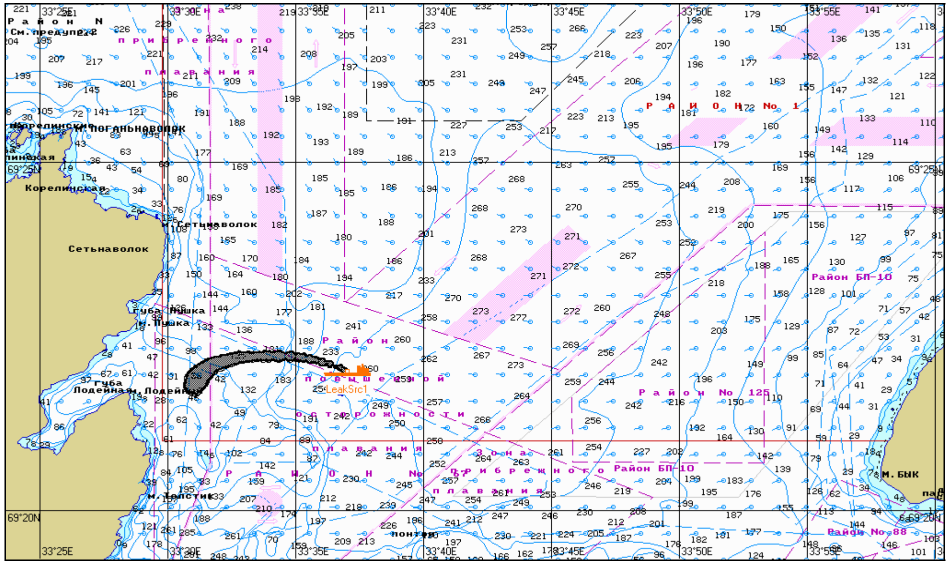


Figure 132. H+04:00. Oil slick spreading as per the scenario Na-Aut-SW-1.

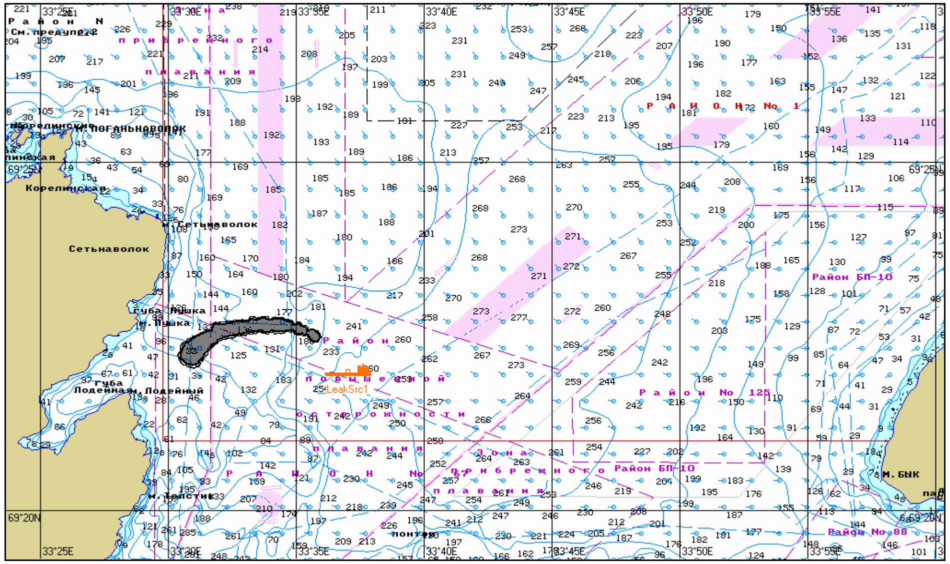


Figure 133. H+05:00. Oil slick spreading as per the scenario Na-Aut-SW-1.

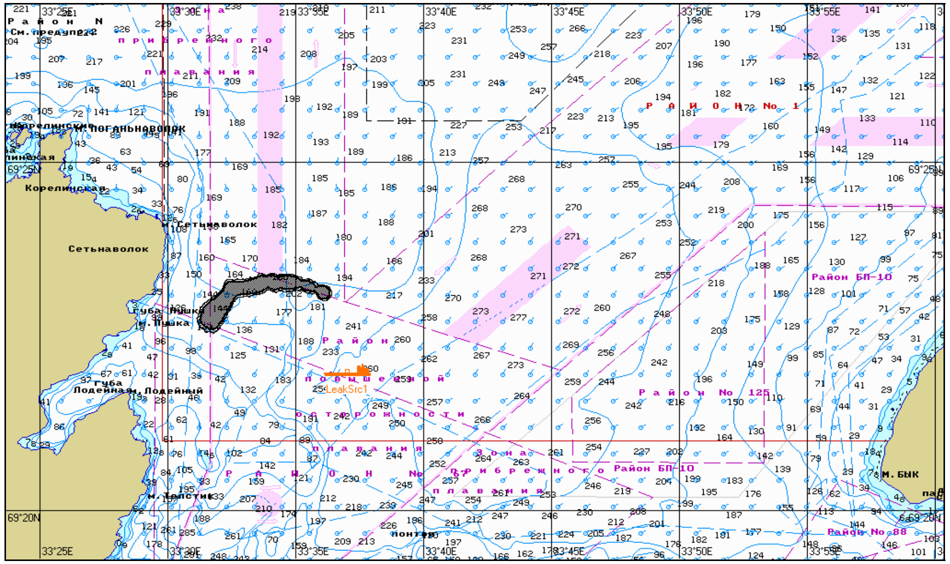


Figure 134. H+06:00. Oil slick spreading as per the scenario Na-Aut-SW-1.

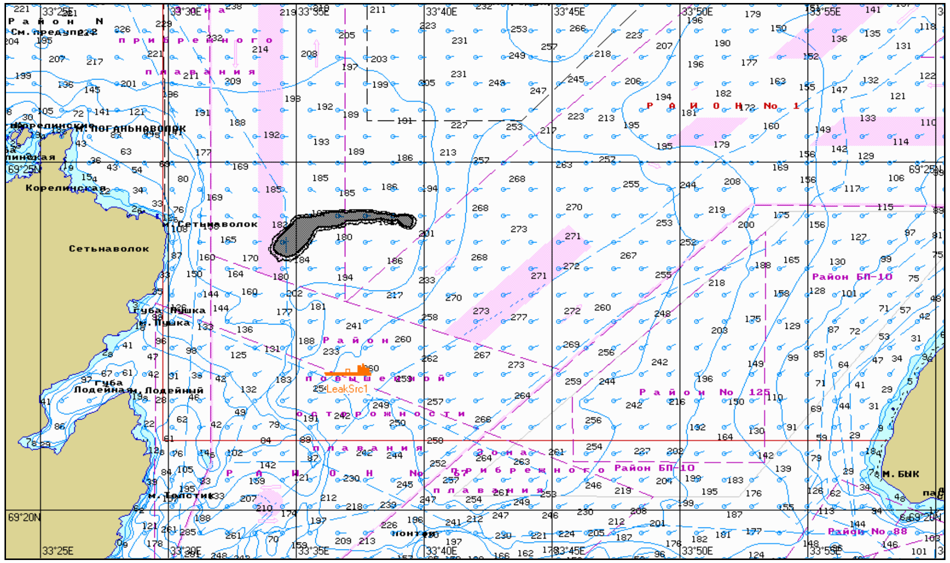


Figure 135. H+08:00. Oil slick spreading as per the scenario Na-Aut-SW-1.

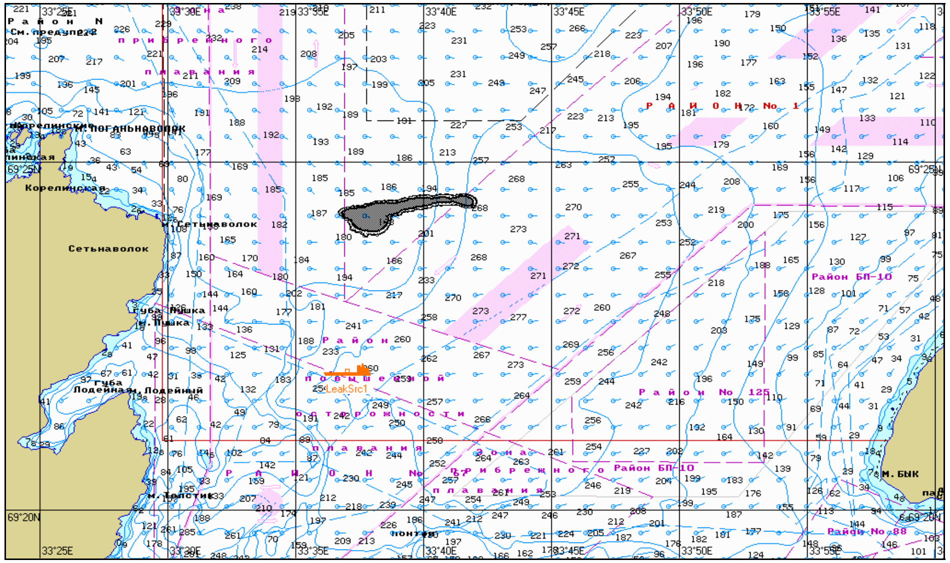


Figure 136. H+09:00. Oil slick spreading as per the scenario Na-Aut-SW-1.

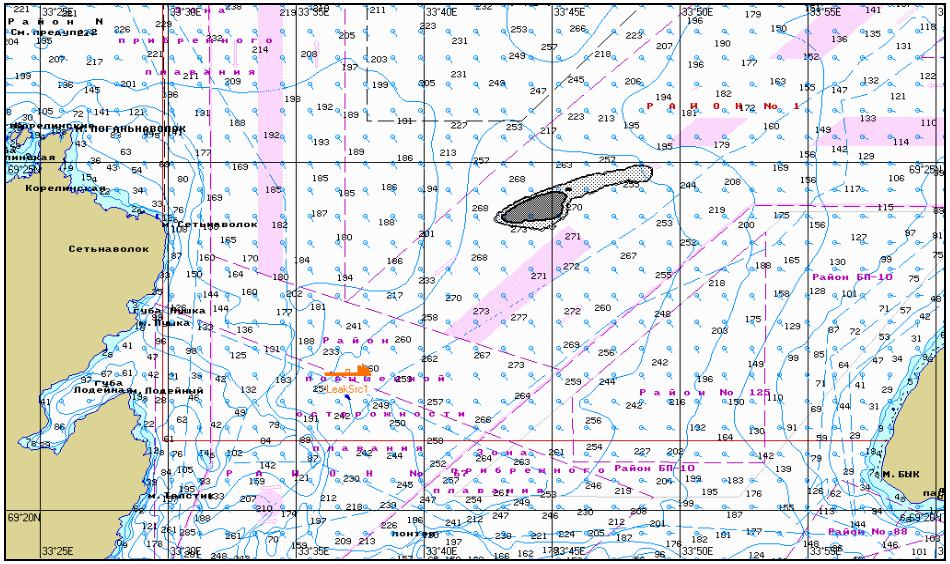


Figure 137. H+12:00. Oil slick spreading as per the scenario Na-Aut-SW-1.

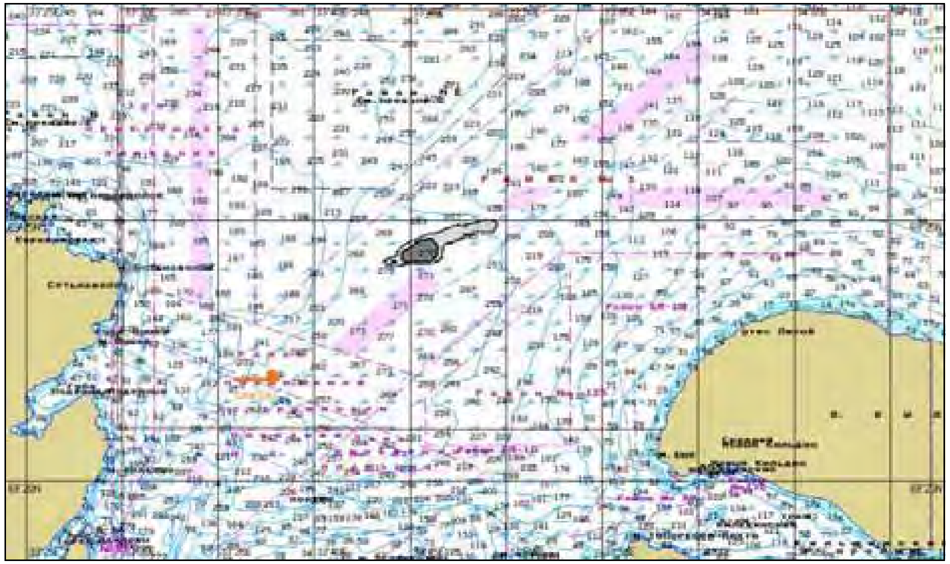


Figure 138. H+15:00. Oil slick spreading as per the scenario Na-Aut-SW-1.

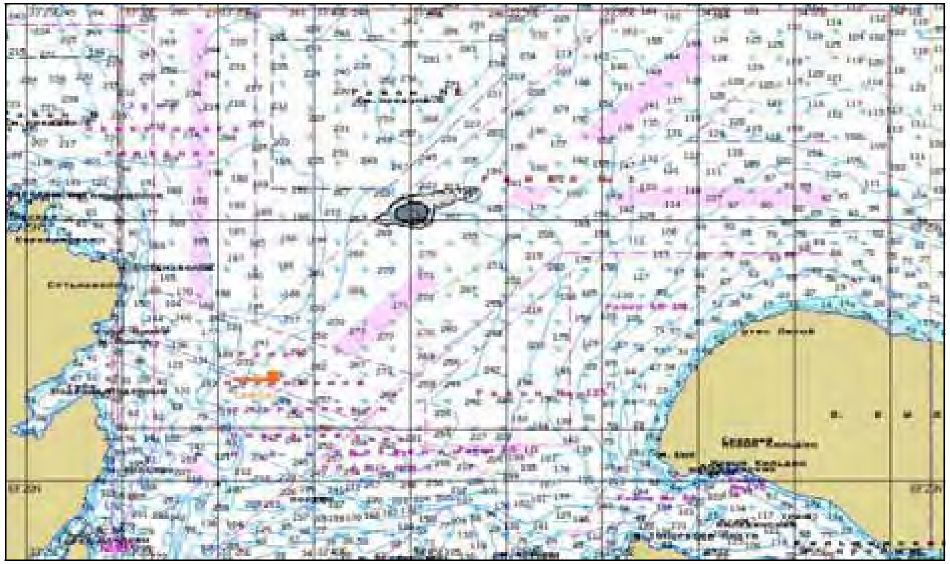


Figure 139. H+18:00. Oil slick spreading as per the scenario Na-Aut-SW-1.

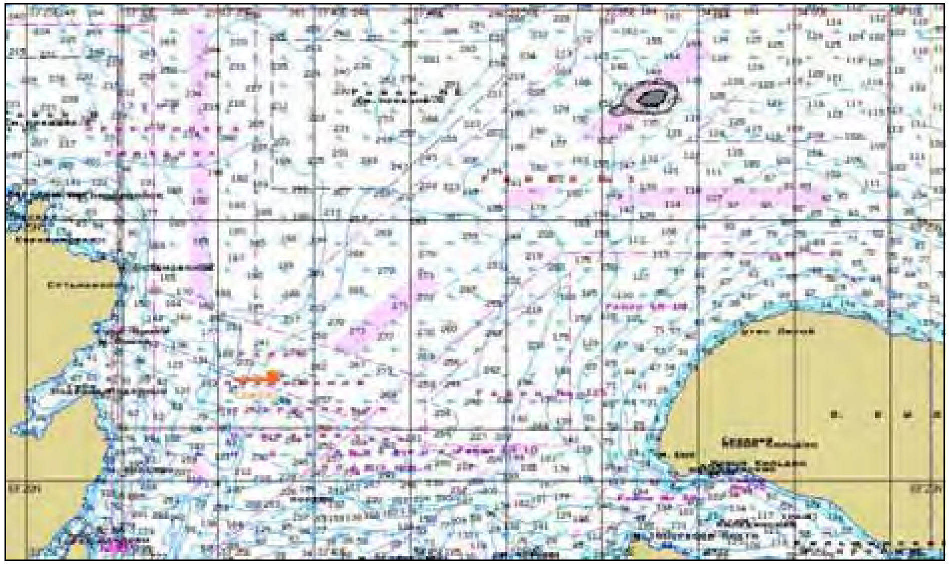


Figure 140. H+24:00. Oil slick spreading as per the scenario Na-Aut-SW-1.

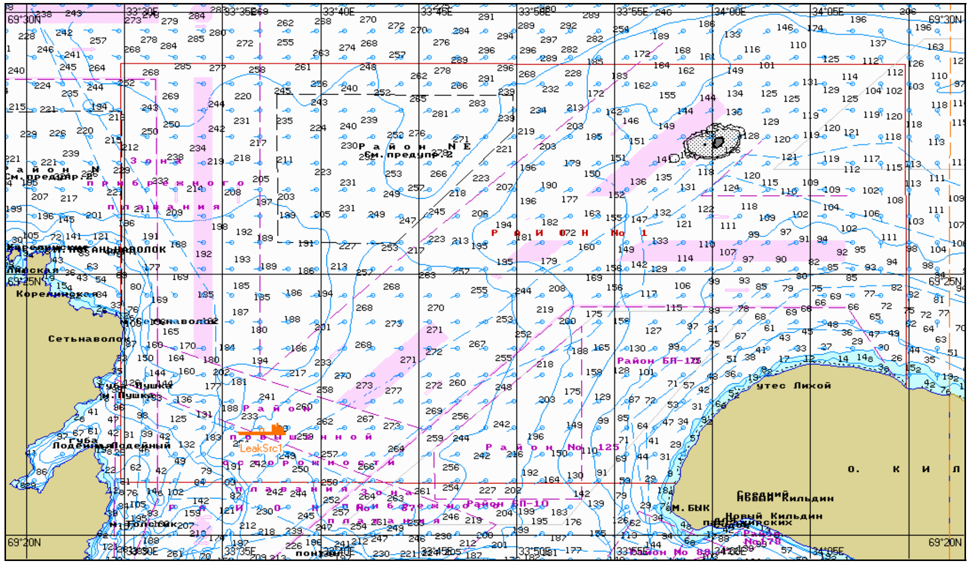


Figure 141. H+28:00. Oil slick spreading as per the scenario Na-Aut-SW-1.

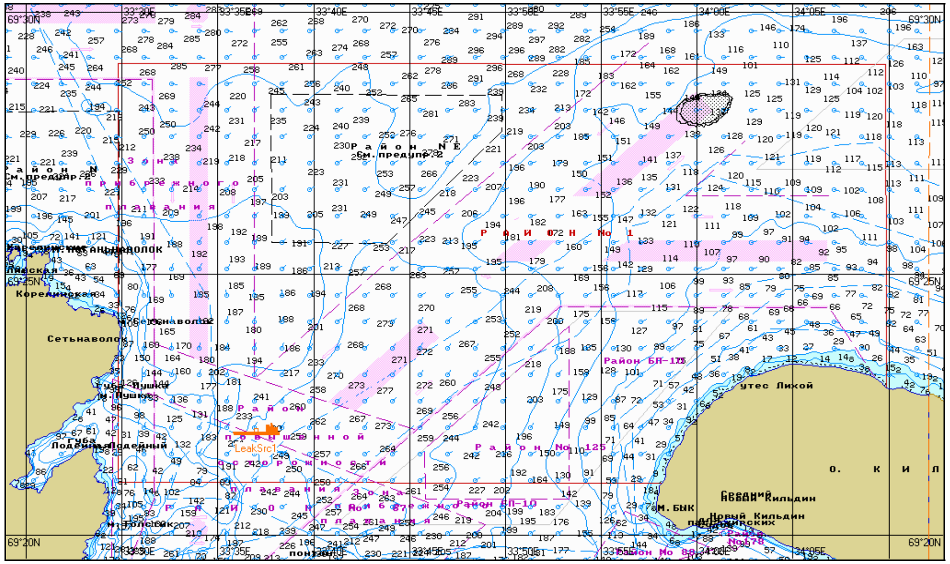


Figure 142. H+32:. Oil slick spreading as per the scenario Na-Aut-SW-1.

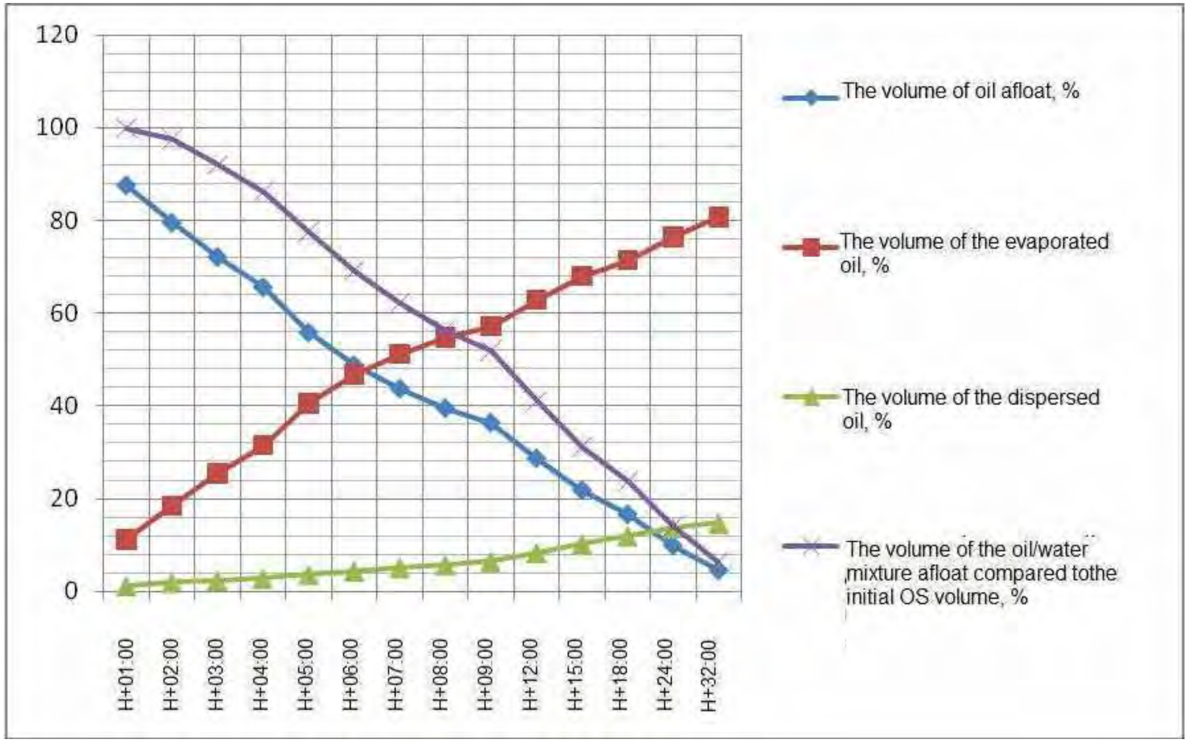



Figure 143. The chart of processes as per the scenario Na-Aut-SW-1.

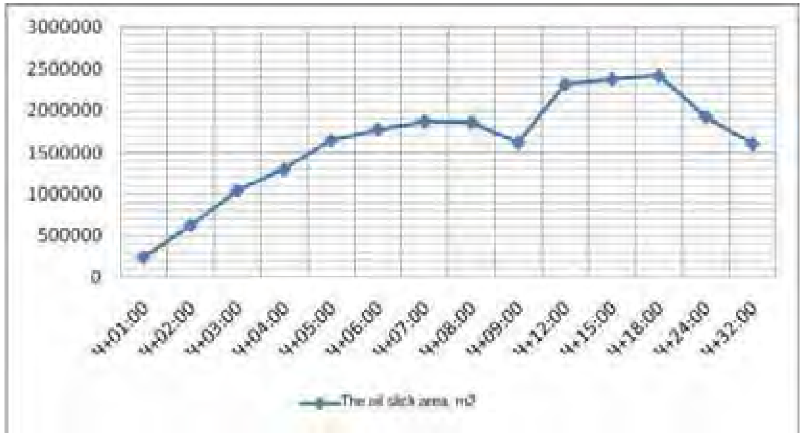



Figure 144. Oil slick area change dynamics as per the scenario Na-Aut-SW-1.

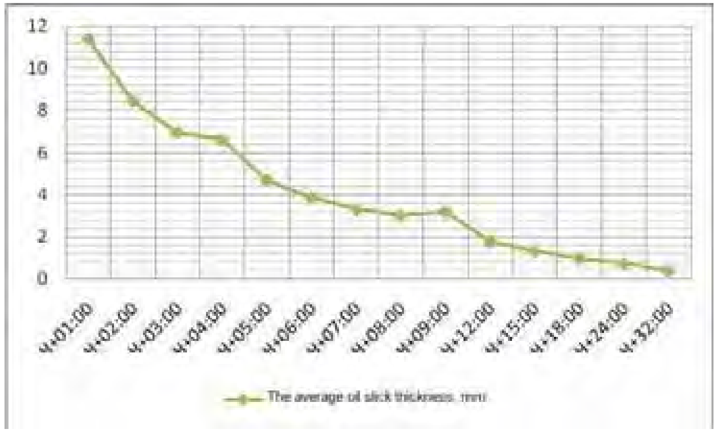



Figure 145. Oil slick thickness change dynamics as per the scenario Na-Aut-SW-1.

### 1.3.5 The process dynamics typical for oil spill behaviour in the Barents Sea under the autumn south-westward wind (Aut-SW-1)

Figures 146-150 show dynamics of processes typical for oil behaviour in the Barents Sea as per the scenario Aut-SW-1.

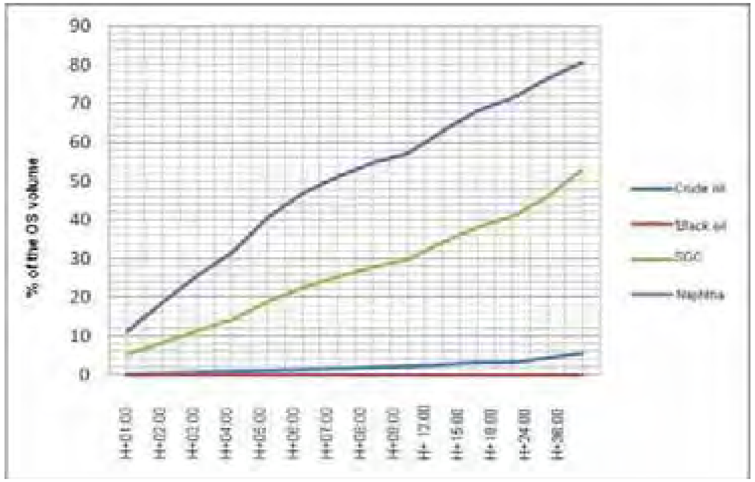



Figure 146. The evaporation process chart as per the scenario Aut-SW-1.

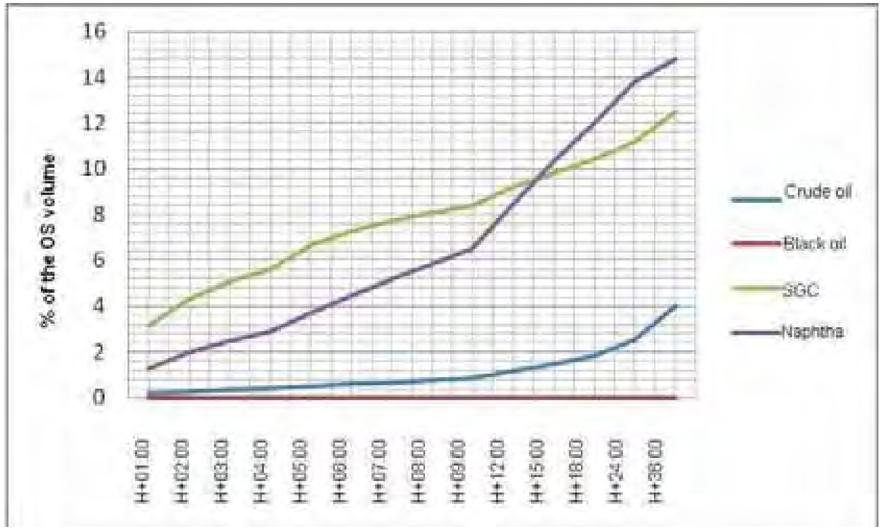



Figure 147. The dispersion process chart as per the scenario Aut-SW-1.

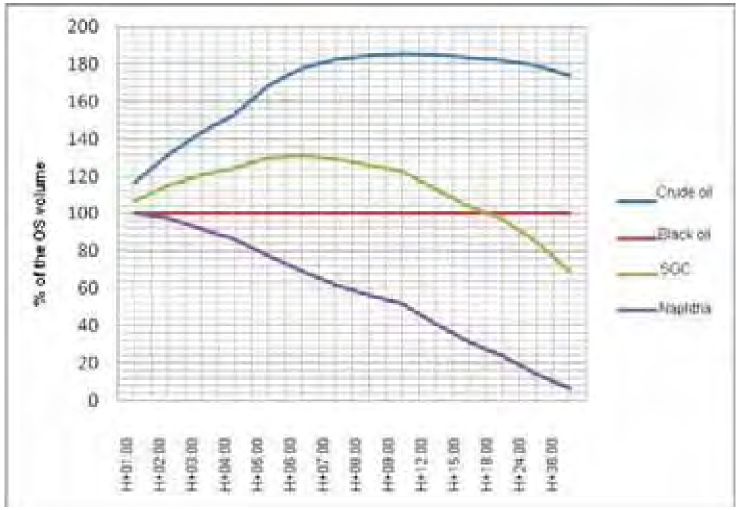



Figure 148. Oil/water mixture volume change dynamics as epr the scenario Aut-SW-1.

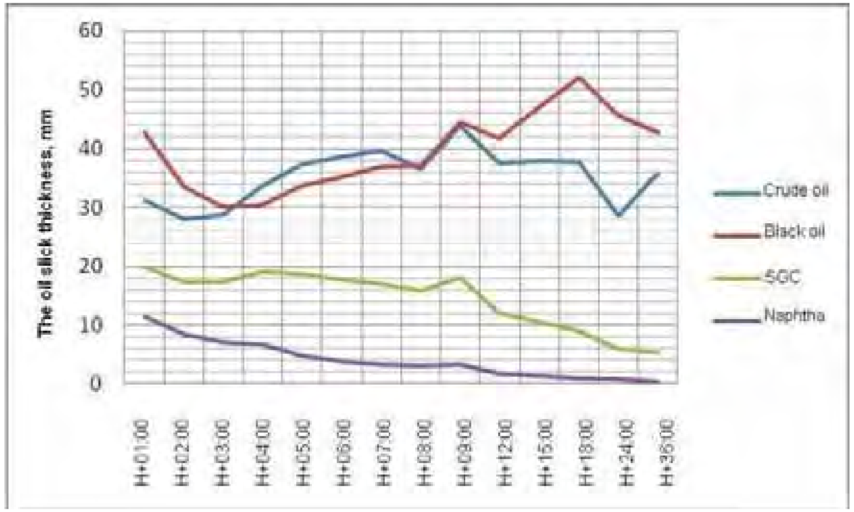



Figure 149. Oil slick thickness change dynamics as per the scenario Aut-SW-1.

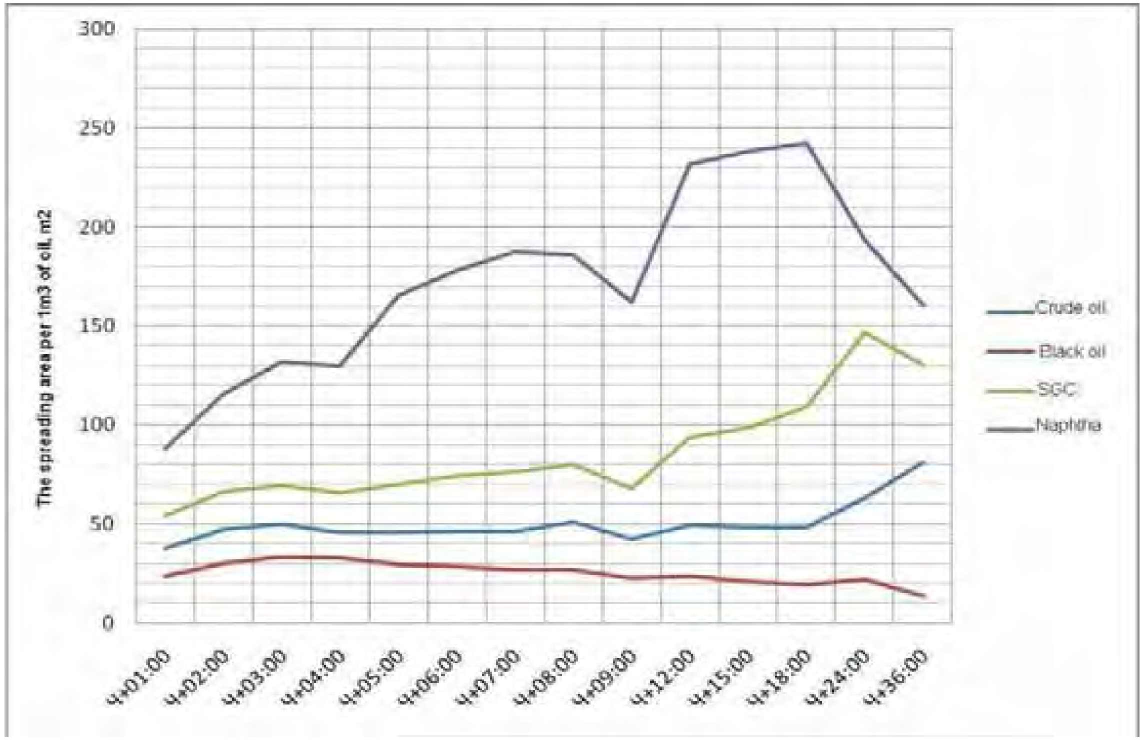



Figure 150. Dynamics of the spreading area change per 1 м $^{3}$ of various types of oil as per the scenario Aut-SW-1.

## 1.4 Oil spill behaviour modelling in the Barents Sea under the spring northward wind

### 1.4.1 Oil slick behaviour modelling as per the scenario COV-Spr-N-1

*Table 1.4.1.1: Oil slick spreading parameters as per the scenario COV-Spr-N-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil/water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 5507 | 100 | 5472 | 99,4 | 21,8 | 0,40 | 12,7 | 0,23 | 0 | 0 | 6949 | 18,3 | 380255 | 123 |
| H+02:00 | 10785 | 100 | 10663 | 98,9 | 86,2 | 0,80 | 35,7 | 0,33 | 0 | 0 | 15704 | 16,4 | 955823 | 190 |
| H+03:00 | 15781 | 100 | 15531 | 98,4 | 189 | 1,20 | 60,8 | 0,39 | 0 | 0 | 24838 | 17,2 | 1443467 | 248 |
| H+04:00 | 19973 | 100 | 19570 | 98,0 | 316 | 1,58 | 86,8 | 0,43 | 0 | 0 | 33138 | 17,5 | 1892271 | 301 |
| H+05:00 | 20000 | 100 | 19456 | 97,3 | 437 | 2,19 | 108 | 0,54 | 0 | 0 | 35775 | 17,1 | 2089615 | 400 |
| H+06:00 | 20000 | 100 | 19323 | 96,6 | 552 | 2,76 | 125 | 0,63 | 0 | 0 | 36636 | 15,1 | 2419942 | 461 |
| H+07:00 | 20000 | 100 | 19194 | 96,0 | 662 | 3,31 | 144 | 0,72 | 0 | 0 | 36754 | 13,5 | 2719214 | 499 |
| H+08:00 | 20000 | 100 | 19068 | 95,3 | 768 | 3,84 | 164 | 0,82 | 0 | 0 | 36623 | 11,4 | 3206322 | 530 |
| H+09:00 Landfall | 20000 | 100 | 18938 | 94,7 | 877 | 4,39 | 185 | 0,93 | 0 | 0 | 36405 | 9,00 | 4045577 | 561 |
| H+10:00 | 20000 | 100 | 18787 | 93,9 | 991 | 4,96 | 208 | 1,04 | 15,0 | 0,08 | 36124 | 7,17 | 5041562 | 594 |
| H+12:00 | 20000 | 100 | 18485 | 92,4 | 1173 | 5,87 | 225 | 1,13 | 87,3 | 0,44 | 35547 | 8,88 | 4003109 | 649 |
| H+15:00 | 20000 | 100 | 18131 | 90,7 | 1306 | 6,53 | 331 | 1,66 | 232 | 1,16 | 34867 | 16,0 | 2174910 | 694 |
| H+18:00 | 20000 | 100 | 17969 | 89,8 | 1349 | 6,75 | 411 | 2,06 | 271 | 1,36 | 34556 | 58,0 | 595545 | 708 |
| H+24:00 | 20000 | 100 | 17660 | 88,3 | 1415 | 7,08 | 583 | 2,92 | 342 | 1,71 | 33962 | 41,4 | 819772 | 731 |

Within the first 4 hours as of the OS start the oil slick spreads south-westward of the OS point under the action of the wind and current. After 4 hours as of the OS start the oil slick semi-perimeter makes 2438 m, the volume of the evaporated oil – 1,58%, the volume of the dispersed oil – 0,43%. After 6 hours the oil slick reaches the eastern coast of the Toros island. Further the oil slick drifts south-eastward in the direction of the Cape Letinskiy. The oil slick break-up in several fields is observed. After 9 hours after the OS start the oil slick semi-perimeter based on the total area makes 3564 m, the volume of the evaporated oil – 4,39%, the volume of the dispersed oil – 0,93%. Further the oil slick is washed ashore while moving eastward. After 10 hours as of the OS start about 5 km of the coastline is polluted in the area of the Cape Letinskiy. After 12 hours as of the OS start the oil slick semi-perimeter makes 3545 m, the volume of the evaporated oil – 5,87%, the volume of the dispersed oil – 1,13%. The volume of the oil/water mixture has increased compared to the OS volume with 77,8%. More than 10 km of the coastline has been polluted. To the moment of modelling completion (24 hours), the oil slick has broken up in parts and virtually total oil volume has reached the coastline of the Barents Sea. The eastern coastline from the Cape Baklaniy to the Cape Dolgy and the western coastline – the Oleniy islands, the Ekaterininskiy Island and the Cape Gavanskiy with the total length of more than 30 km have been polluted with oil. The volume of the evaporated oil – 7,08%, the volume of the dispersed oil – 2,92% the average oil slick thickness makes 41,4 mm.
The graphic display of the oil slick spreading as per the scenario COV-Spr-N-1 is shown in figures 151 – 164.
The charts of processes typical for oil behaviour on water are shown in figures 165-167.

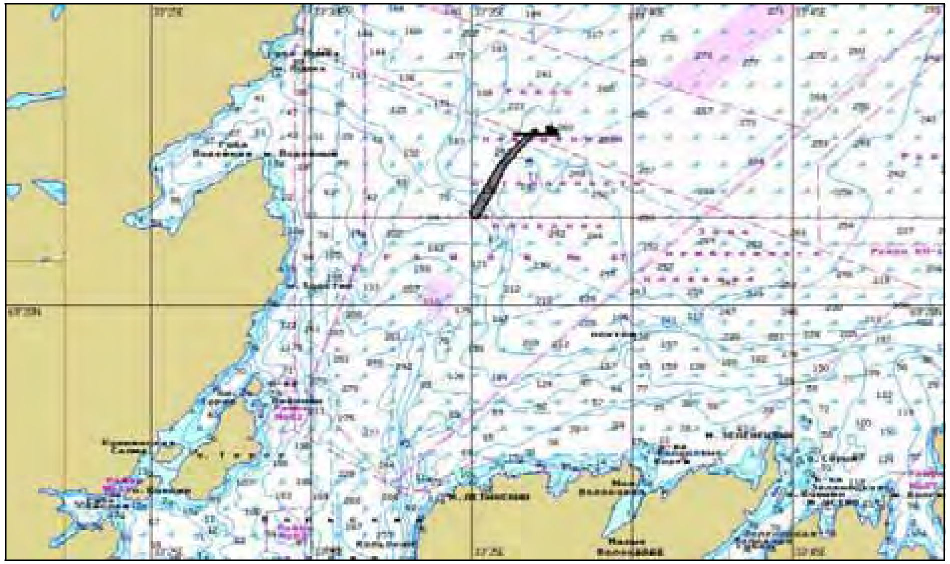


Figure 151. H+01:00. Oil slick spreading as per the scenario COV-Spr-N-1.

Figure 152. H+02:00. Oil slick spreading as per the scenario COV-Spr-N-1.

Figure 153. H+03:00. Oil slick spreading as per the scenario COV-Spr-N-1.

Figure 154. H+04:00. Oil slick spreading as per the scenario COV-Spr-N-1.

Figure 155. H+05:00. Oil slick spreading as per the scenario COV-Spr-N-1.

Figure 156. H+06:00. Oil slick spreading as per the scenario COV-Spr-N-1.

Figure 157. H+07:00. Oil slick spreading as per the scenario COV-Spr-N-1.

Figure 158. H+08:00. Oil slick spreading as per the scenario COV-Spr-N-1.

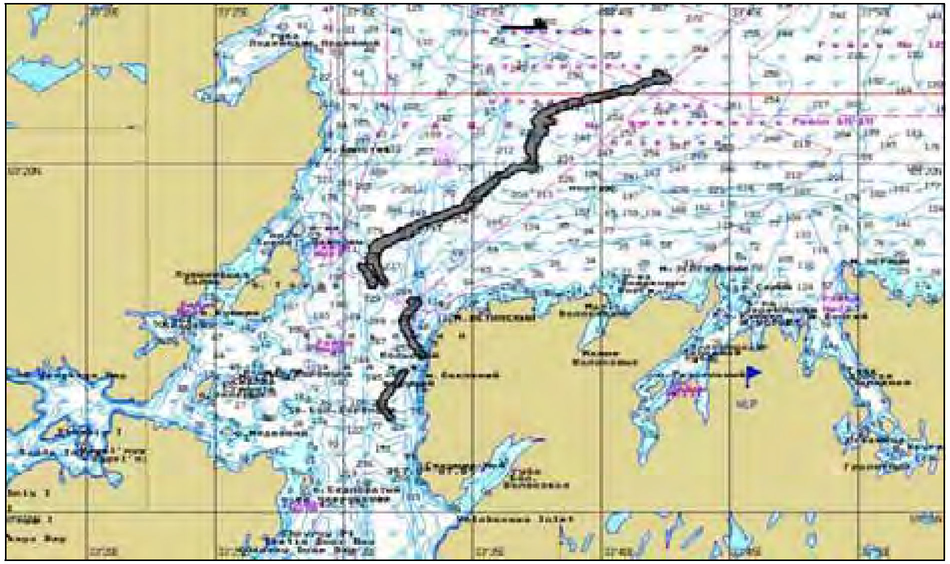


Figure 159. **H+09:00.** Oil slick spreading as per the scenario COV-Spr-N-1.

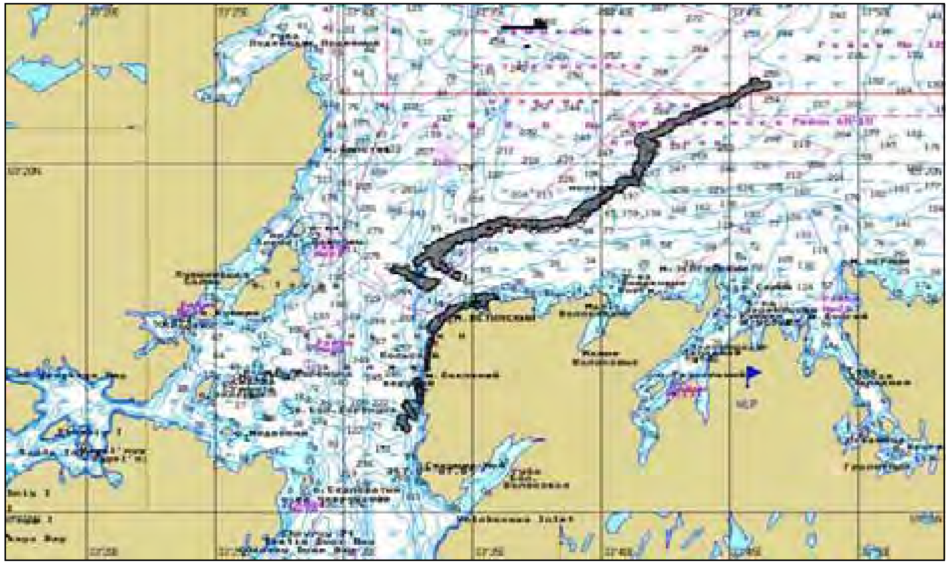


Figure 160. H+10:00. Oil slick spreading as per the scenario COV-Spr-N-1.

Figure 161. H+12:00. Oil slick spreading as per the scenario COV-Spr-N-1.

Figure 162. H+15:00. Oil slick spreading as per the scenario COV-Spr-N-1.

Figure 163. H+18:00. Oil slick spreading as per the scenario COV-Spr-N-1.

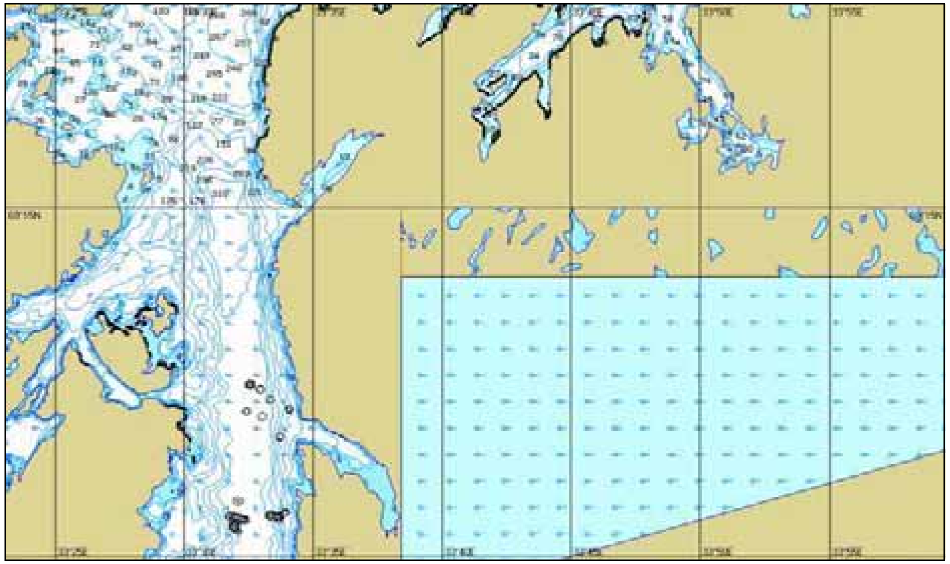


Figure 164. H+24:00. Oil slick spreading as per the scenario COV-Spr-N-1.

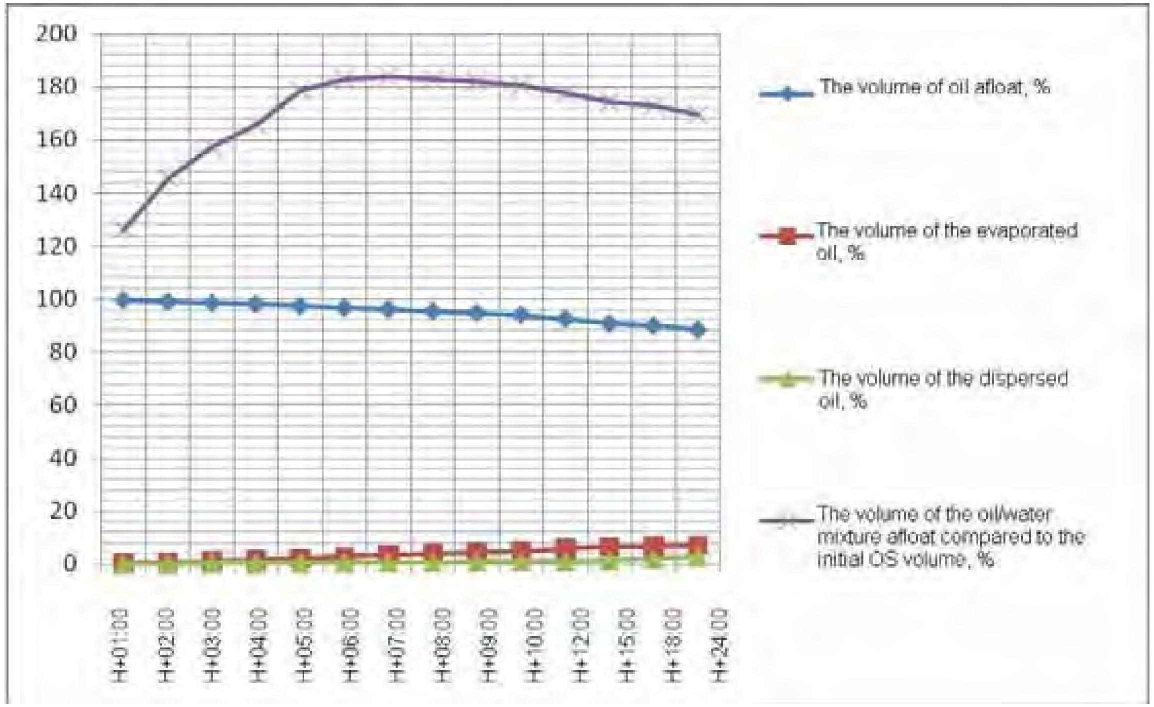



Figure 165. The chart of processes as per the scenario COV-Spr-N-1.

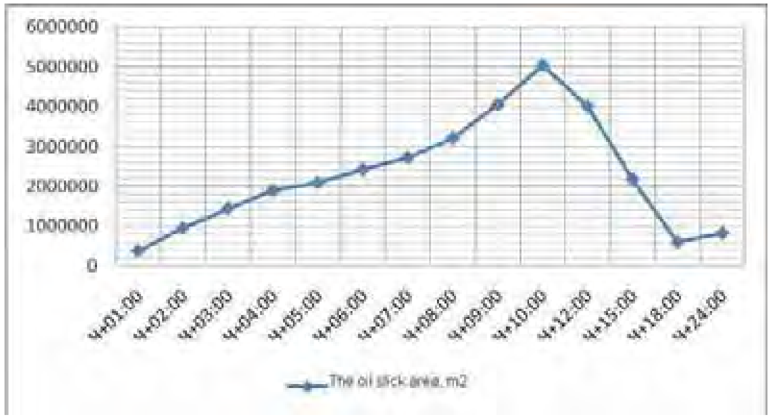



Figure 166. Oil slick area change dynamics as per the scenario COV-Spr-N-1.

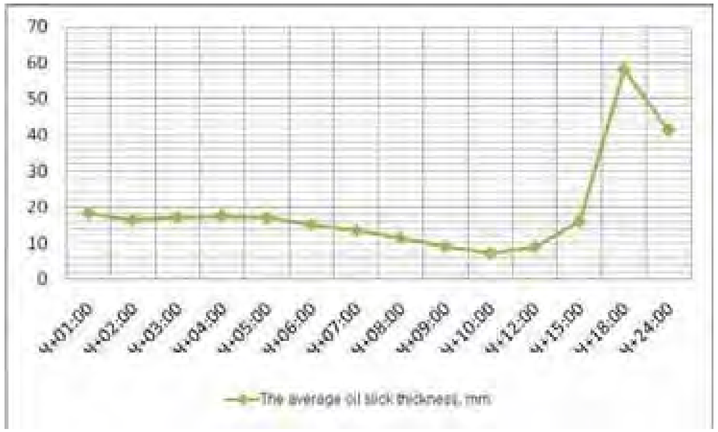



Figure 167. Oil slick thickness change dynamics as per the scenario COV-Spr-N-1.

### 1.4.2 Oil slick behaviour modelling as per the scenario BO-Spr-N-1

*Table 1.4.2.1: Oil slick spreading parameters as per the scenario BO-Spr-N-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil/water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 3046 | 100 | 3046 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 3046 | 20,0 | 152089 | 15541 |
| H+02:00 | 6117 | 100 | 6117 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 6117 | 16,1 | 379977 | 15541 |
| H+03:00 | 9187 | 100 | 9187 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 9187 | 14,9 | 616789 | 15541 |
| H+04:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 14,5 | 824910 | 15541 |
| H+05:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 14,7 | 815053 | 15541 |
| H+06:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 13,8 | 870944 | 15541 |
| H+07:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 13,3 | 905223 | 15541 |
| H+08:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 11,6 | 1033160 | 15541 |
| H+09:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 9,89 | 1213601 | 15541 |
| H+09:24 Landfall | 12000 | 100 | 11998 | 100 | 0 | 0 | 0 | 0 | 1,6 | 0 | 11998 | 9,18 | 1306340 | 15541 |
| H+12:00 | 12000 | 100 | 11946 | 99,6 | 0 | 0 | 0 | 0 | 53,9 | 0,45 | 11946 | 10,9 | 1095594 | 15541 |
| H+15:00 | 12000 | 100 | 11798 | 98,3 | 0 | 0 | 0 | 0 | 202 | 1,68 | 11798 | 24,4 | 484161 | 15541 |
| H+18:00 | 12000 | 100 | 11781 | 98,2 | 0 | 0 | 0 | 0 | 119 | 0,99 | 11781 | 250 | 47117 | 15541 |
| H+20:00 | 12000 | 100 | 11766 | 98,1 | 0 | 0 | 0 | 0 | 234 | 1,95 | 11766 | 227 | 51832 | 15541 |

Within the first 4 hours as of the OS start the oils slick spreads south-westward of the OS point under the action of the wind and current. After 4 hours ass of the OS start the oil slick semi-perimeter makes 1609 m, the evaporation and dispersion processes are not detected by the programme. Further the oil slick drifts south-eastward to the Cape Letinskiy. The oil slick breaks up in several fields. After 9 hours as of the OS start the slick semi-perimeter based on the total area makes 1952 m, the evaporation and dispersion processes are not detected by the programme. Further the oil slick is washed ashore while moving eastward. After 9 hours 24 minutes as of the OS start the oil slick reaches the coastline in the area of the Cape Baklaniy. The oil slick semi-perimeter makes 2025 m. After 12 hours as of the OS start about 10 km of the coastline in the area of the Capes Baklaniy and Letinskiy have been polluted. The volume of the oil/water mixture compared to the OS volume has not increased. To the moment of the modelling completion (20 hours), the oil slick has broken up in parts and virtually the total oil volume has reached the Barents Sea coastline. The eastern coastline from the Cape Baklaniy to the Cape Dolgiy with the total length of more than 25 km has been polluted with oil. The evaporation and dispersion processes are not detected by the programme, the average oil slick thickness makes 22,7 sm.

The graphic display of the oil slick spreading as per the scenario BO-Spr-N-1 is shown on figure 168 – 181.

The charts of the processes typical for the oil behaviour on water are shown in figures 182-184.

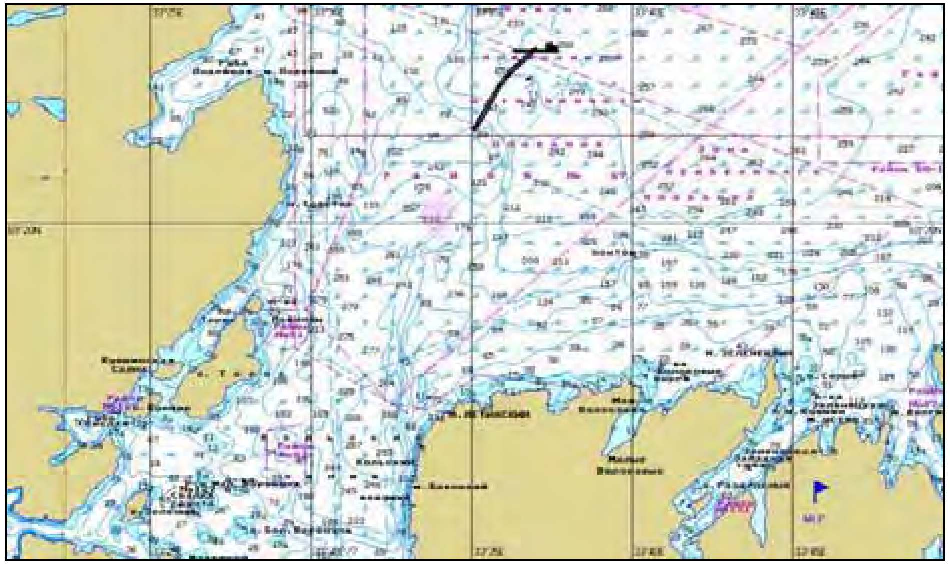


Figure 168. H+01:00. Oil slick spreading as per the scenario BO-Spr-N-1.

Figure 169. H+02:00. Oil slick spreading as per the scenario BO-Spr-N-1.

Figure 170. H+03:00. Oil slick spreading as per the scenario BO-Spr-N-1.

Figure 171. H+04:00. Oil slick spreading as per the scenario BO-Spr-N-1.

Figure 172. H+05:00. Oil slick spreading as per the scenario BO-Spr-N-1.

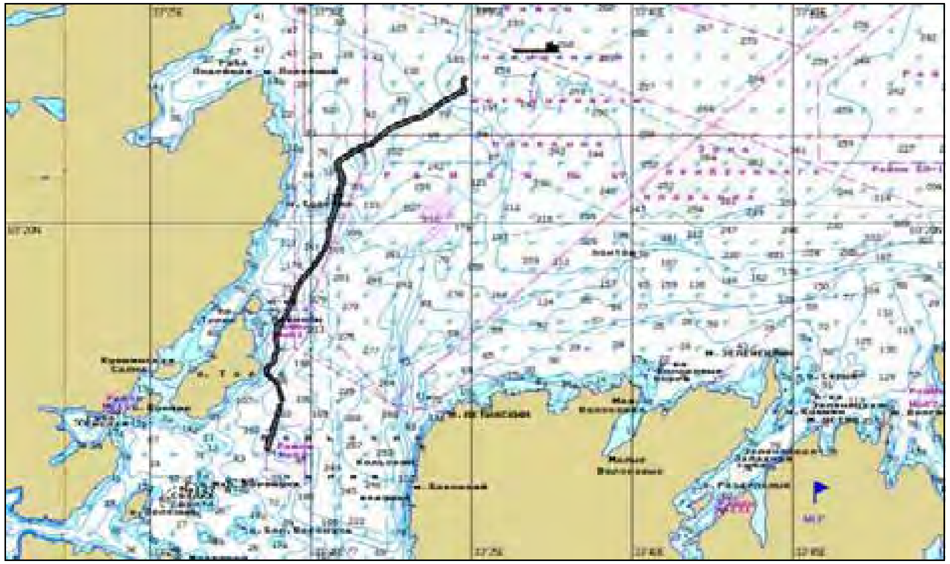


Figure 173. H+06:00. Oil slick spreading as per the scenario BO-Spr-N-1.

Figure 174. H+07:00. Oil slick spreading as per the scenario BO-Spr-N-1.

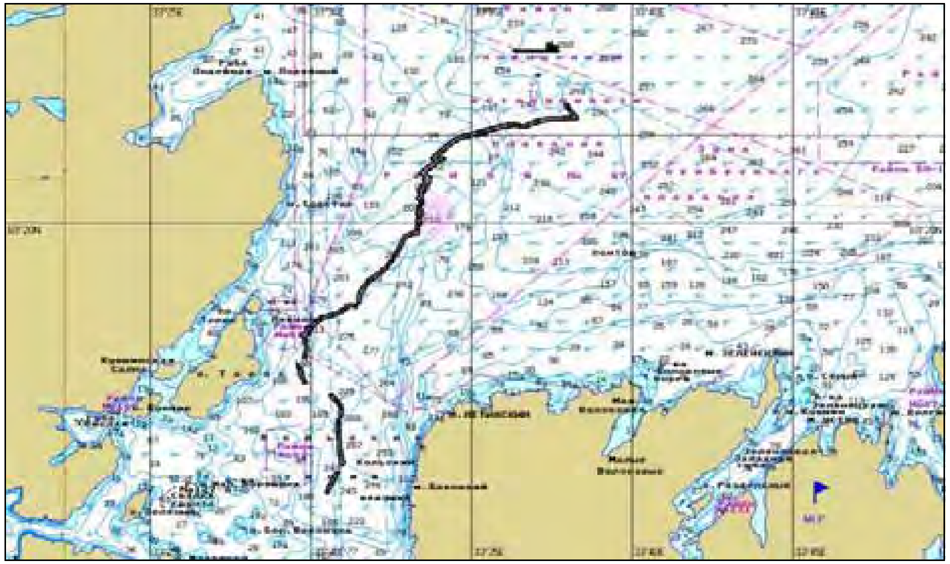


Figure 175. H+08:00. Oil slick spreading as per the scenario BO-Spr-N-1.

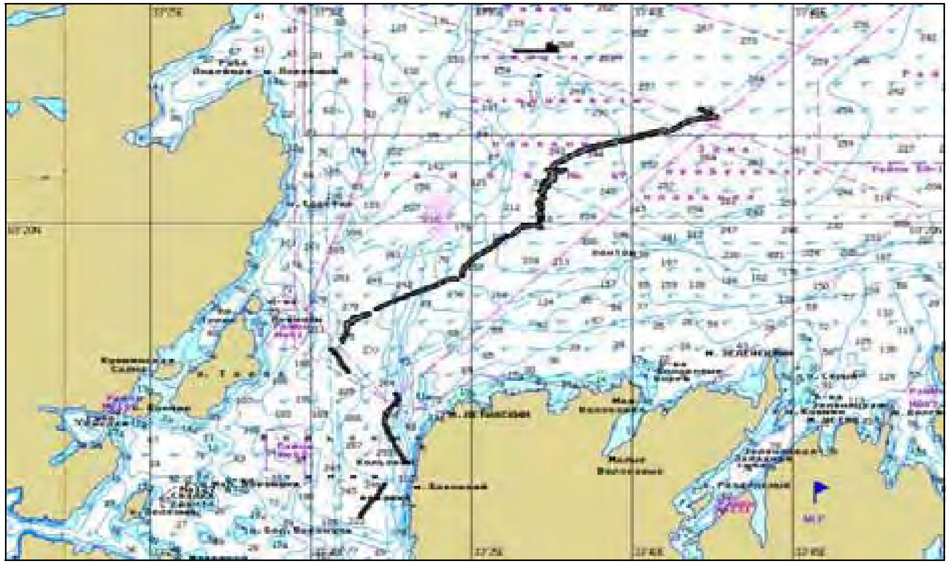


Figure 176. H+09:00. Oil slick spreading as per the scenario BO-Spr-N-1.

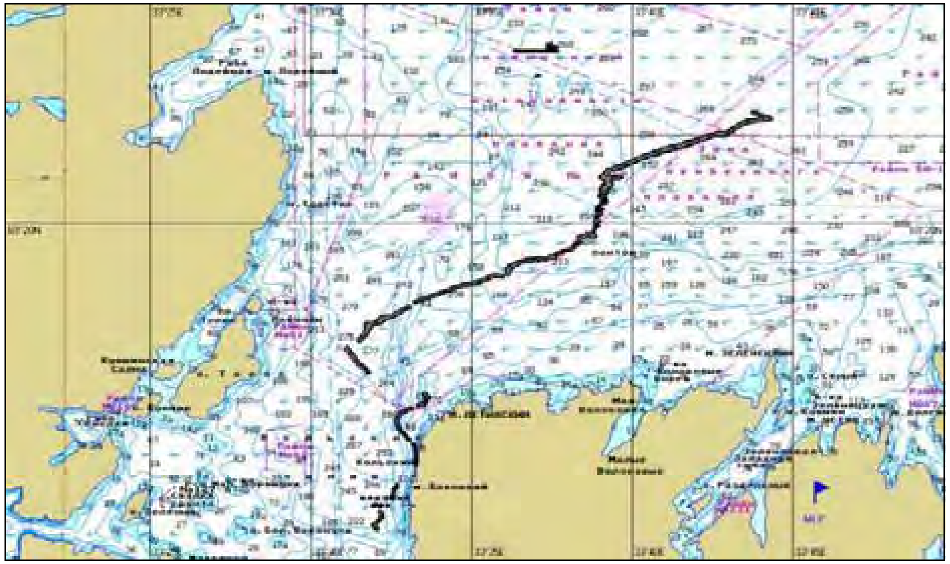


Figure 177. **H+09:24.** Oil slick spreading as per the scenario BO-Spr-N-1.

Figure 178. H+12:00. Oil slick spreading as per the scenario BO-Spr-N-1.

Figure 179. H+15:00. Oil slick spreading as per the scenario BO-Spr-N-1.

Figure 180. H+18:00. Oil slick spreading as per the scenario BO-Spr-N-1.

Figure 181. H+20:00. Oil slick spreading as per the scenario BO-Spr-N-1.

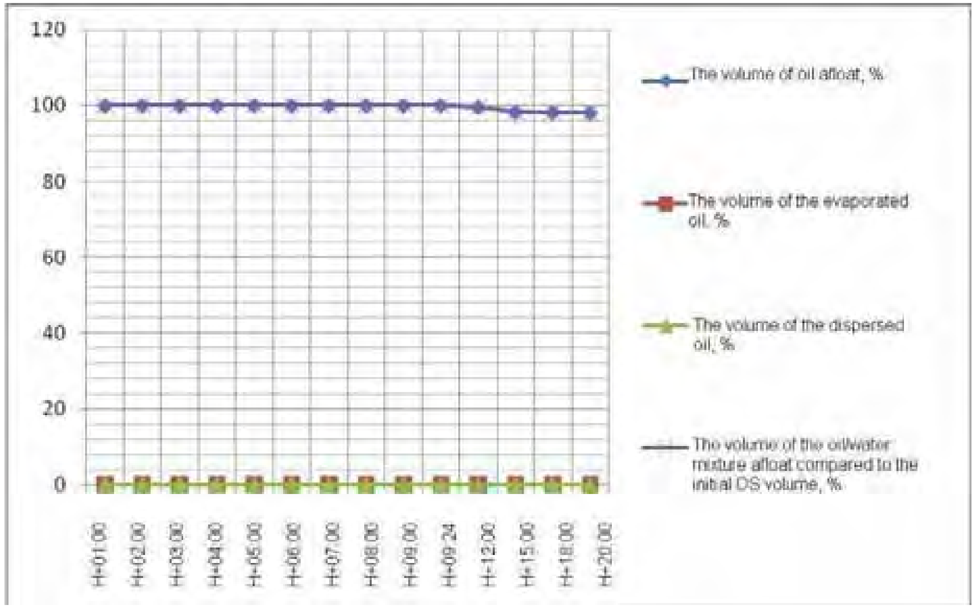



Figure 182. The chart of processes as per the scenario BO-Spr-N-1.

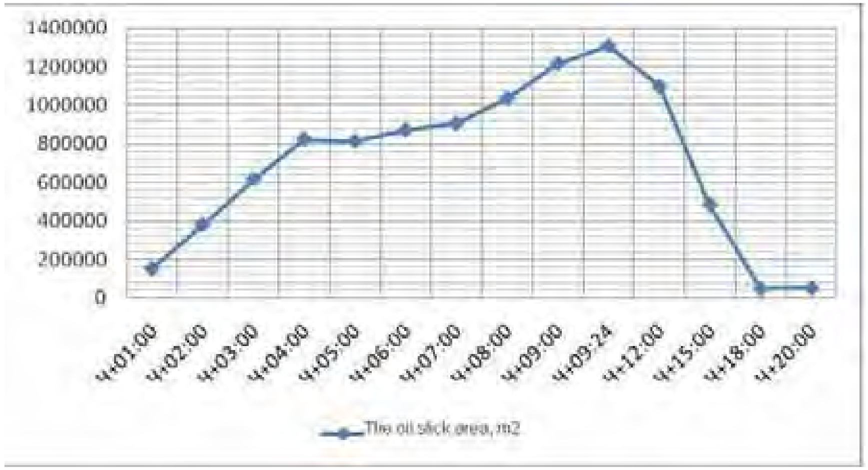



Рис. 183. Oil slick area change dynamics as per the scenario BO-Spr-N-1.

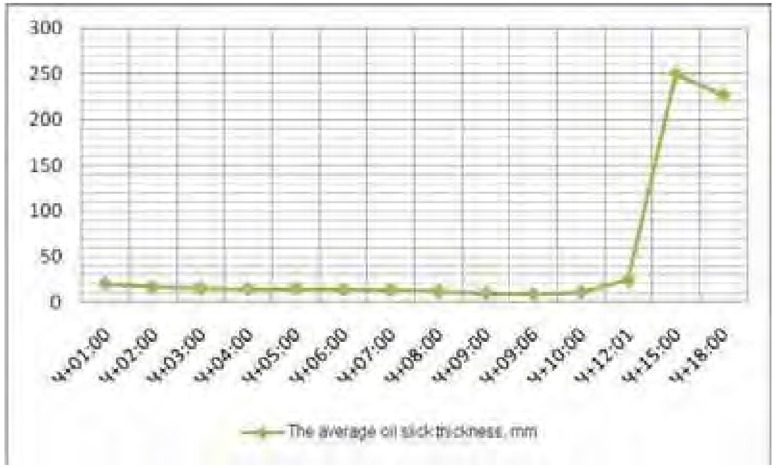



Figure 184. Oil slick thickness change dynamics as per the scenario BO-Spr-N-1.

### 1.4.3 Oil slick behaviour modelling as per the scenario GC-Spr-N-1

*Table 1.4.3.1: Oil slick spreading parameters as per the scenario GC-Spr-N-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil/water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 5384 | 100 | 4743 | 88,1 | 405 | 7,52 | 214 | 3,97 | 0 | 0 | 6000 | 11,7 | 512990 | 5,9 |
| H+02:00 | 10767 | 100 | 8788 | 81,6 | 1428 | 13,3 | 551 | 5,12 | 0 | 0 | 12815 | 9,98 | 1283615 | 15,1 |
| H+03:00 | 15707 | 100 | 11953 | 76,1 | 2849 | 18,1 | 905 | 5,76 | 0 | 0 | 19109 | 9,91 | 1928298 | 31,2 |
| H+04:00 | 19967 | 100 | 14341 | 71,8 | 4394 | 22,0 | 1232 | 6,17 | 0 | 0 | 24295 | 9,53 | 2548194 | 53,5 |
| H+05:00 | 20000 | 100 | 12931 | 64,7 | 5646 | 28,2 | 1423 | 7,12 | 0 | 0 | 24348 | 8,30 | 2934174 | 132 |
| H+06:00 | 20000 | 100 | 11864 | 59,3 | 6619 | 33,1 | 1518 | 7,59 | 0 | 0 | 23263 | 6,67 | 3488474 | 237 |
| H+07:00 | 20000 | 100 | 11006 | 55,0 | 7406 | 37,0 | 1588 | 7,94 | 0 | 0 | 21877 | 5,42 | 4038525 | 361 |
| H+08:00 | 20000 | 100 | 10294 | 51,5 | 8059 | 40,3 | 1647 | 8,24 | 0 | 0 | 20548 | 4,34 | 4736917 | 503 |
| H+09:00 | 20000 | 100 | 9653 | 48,3 | 8648 | 43,2 | 1699 | 8,50 | 0 | 0 | 19296 | 3,22 | 6001302 | 673 |
| H+09:11 Landfall | 20000 | 100 | 9534 | 47,7 | 8756 | 43,8 | 1708 | 8,54 | 1,9 | 0,01 | 19059 | 2,98 | 6394781 | 710 |
| H+10:00 | 20000 | 100 | 9039 | 45,2 | 9191 | 46,0 | 1745 | 8,73 | 24,2 | 0,12 | 18075 | 2,38 | 7597452 | 880 |
| H+12:00 | 20000 | 100 | 8110 | 40,6 | 9957 | 49,8 | 1827 | 9,14 | 106 | 0,53 | 16219 | 2,82 | 5743633 | 1283 |
| H+15:00 | 20000 | 100 | 7324 | 36,6 | 10468 | 52,3 | 1931 | 9,66 | 277 | 1,39 | 14649 | 4,50 | 3255870 | 1649 |
| H+18:00 | 20000 | 100 | 6958 | 34,8 | 10685 | 53,4 | 2025 | 10,1 | 331 | 1,66 | 13917 | 15,2 | 912657 | 1834 |
| H+24:00 | 20000 | 100 | 6338 | 31,7 | 10961 | 54,8 | 2268 | 11,3 | 433 | 2,17 | 12675 | 6,65 | 1907430 | 2101 |

Within the first 4 hours as of the OS start the oil slick spreads south-westward of the OS point under the action of the wind and current. After 4 hours as of the OS start the oil slick semi-perimeter makes 2829 m, the volume of the evaporated oil – 22%, the volume of the dispersed oil – 6,2%. After 6 hours the oil slick reaches the eastern coastline of the Toros island. Further the oil slick drifts south-eastward to the Cape Letinskiy. The oil slick breaks up in several fields. After 9 hours as of the OS start the oil slick semi-perimeter based on the total area makes 4341 m, the volume of the evaporated oil – 43,2%, the volume of the dispersed oil – 8,5%. Further the oils slick is washed ashore while moving eastward. After 10 hours as of the OS start about 10 km of the coastline in the area of the Capes Baklaniy and Letinskiy has been polluted. After 12 hours the oil slick semi-perimeter makes 4247 m, the volume of the evaporated oil – 49,8%, the volume of the dispersed oil – 9,14%. The volume of the oil/water mixture has decreased compared to the OS volume with 18,9%. More than 25 km of the coastline has been polluted. To the moment of modelling completion (24 hours) the oil slick has broken in parts and virtually all oil has reached the Barents Sea coastline. The eastern coastline from the Cape Baklaniy to the Cape Dolgiy and the western coastline – the Oleniy islands, the Ekateriniskiy island and the Cape Gavanskiy with the total length of more than 35 km have been polluted with oil. The volume of the evaporated oil – 54,8%, the volume of the dispersed oil – 11,3%, 31,7% of the total OS volume remains afloat, the average oil slick thickness makes 2,7 mm.

The graphic display of the oil slick spreading as per the scenario GC-Spr-N-1 is shown in figures 185 – 199.

The charts of processes typical for oil behaviour on water are shown in figures 200-202.

Figure 185. H+01:00. Oil slick spreading as per the scenario GC-Spr-N-1.

Figure 186. H+02:00. Oil slick spreading as per the scenario GC-Spr-N-1.

Figure 187. H+03:00. Oil slick spreading as per the scenario GC-Spr-N-1.

Figure 188. H+04:00. Oil slick spreading as per the scenario GC-Spr-N-1.

Figure 189. H+05:00. Oil slick spreading as per the scenario GC-Spr-N-1.

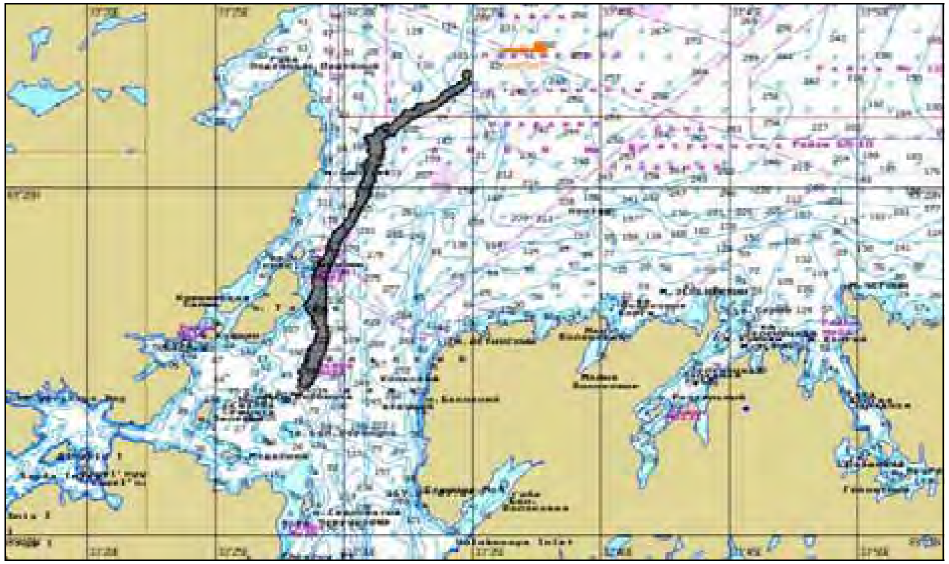


Figure 190. H+06:00. Oil slick spreading as per the scenario GC-Spr-N-1.

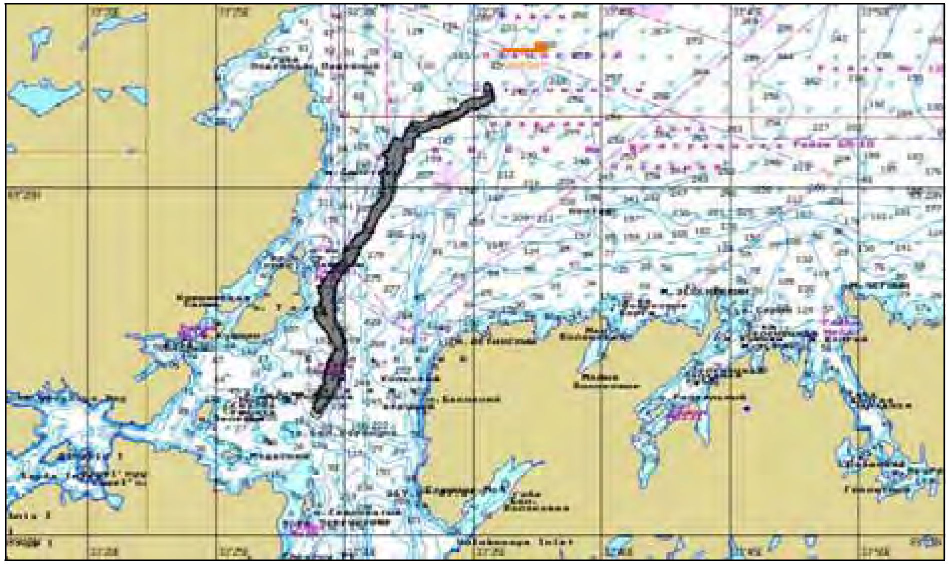


Figure 191. H+07:00. Oil slick spreading as per the scenario GC-Spr-N-1.

Figure 192. H+08:00. Oil slick spreading as per the scenario GC-Spr-N-1.

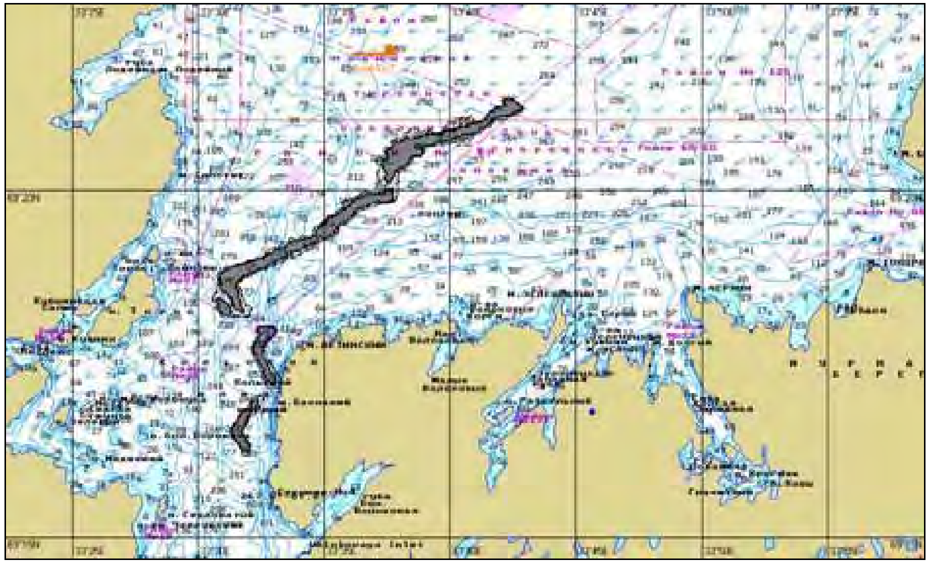


Figure 193. H+09:00. Oil slick spreading as per the scenario GC-Spr-N-1.

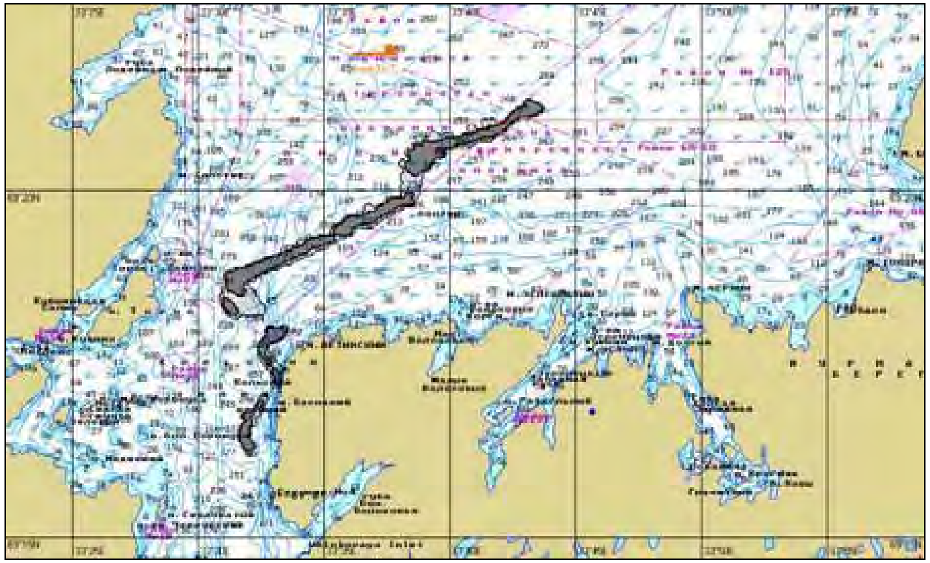


Figure 194. **H+09:11.** Oil slick spreading as per the scenario GC-Spr-N-1.

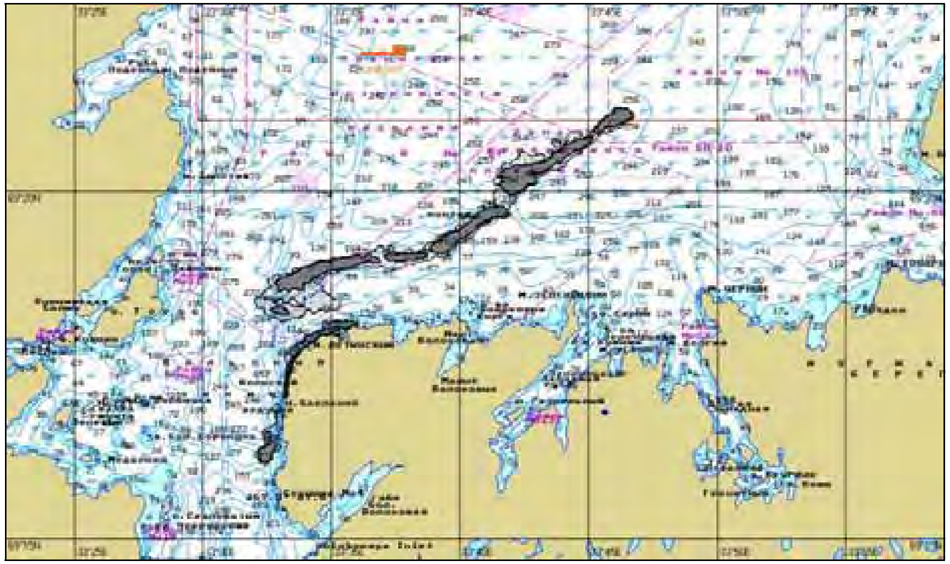


Figure 195. H+10:00. Oil slick spreading as per the scenario GC-Spr-N-1.

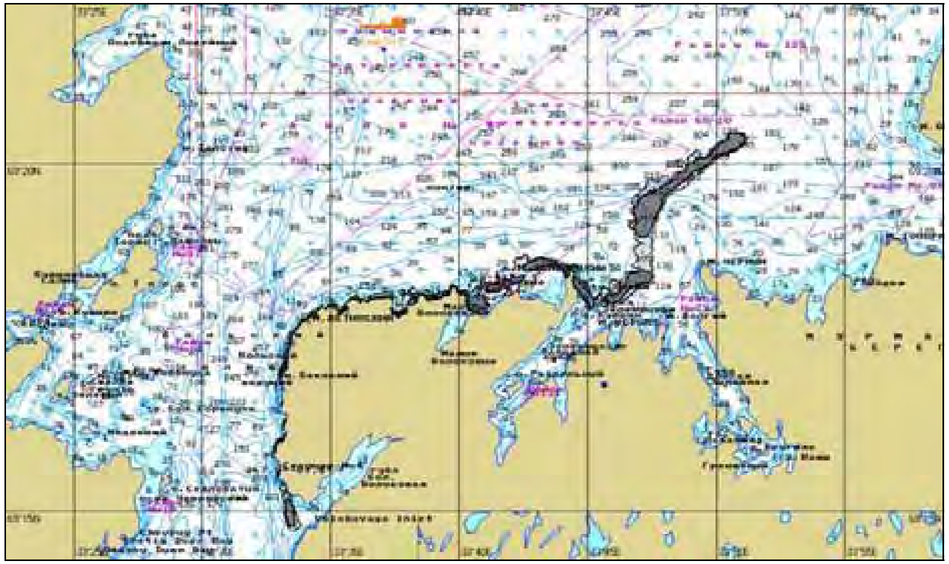


Figure 196. H+12:00. Oil slick spreading as per the scenario GC-Spr-N-1.

Figure 197. H+15:00. Oil slick spreading as per the scenario GC-Spr-N-1.

Figure 198. H+18:00. Oil slick spreading as per the scenario GC-Spr-N-1.

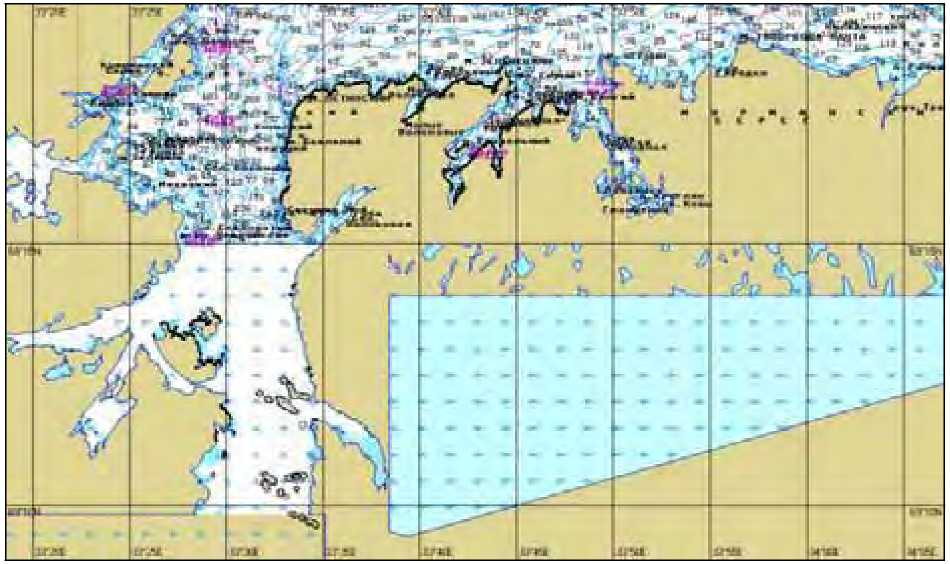


Figure 199. H+24:00. Oil slick spreading as per the scenario GC-Spr-N-1.

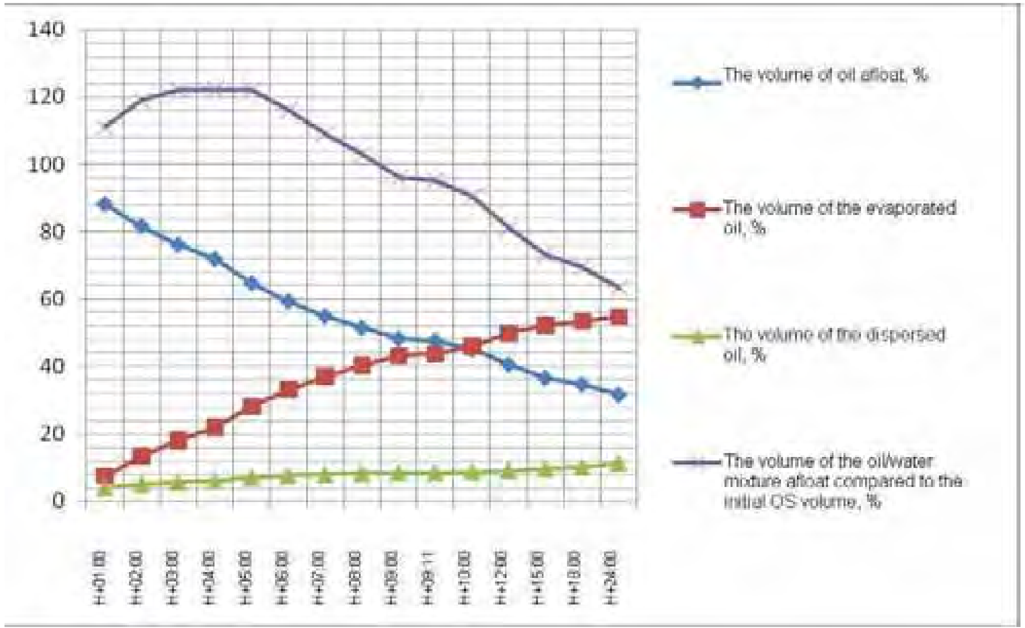



Figure 200. The chart of processes as per the scenario GC-Spr-N-1.

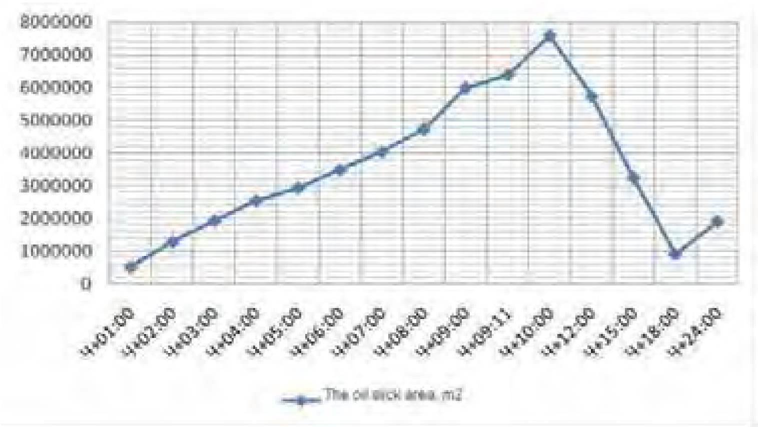



Figure 201. Oil slick area change dynamics as per the scenario GC-Spr-N-1.

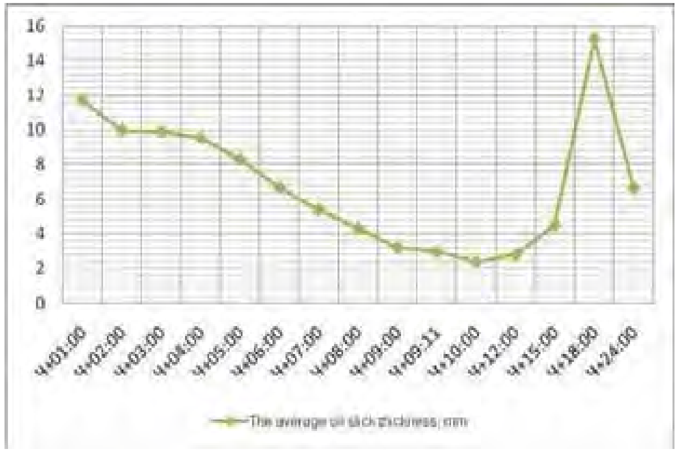


Figure 202. Oil slick thickness change dynamics as per the scenario GC-Spr-N-1.

### 1.4.4 Oil slick behaviour modelling as per the scenario Na-Spr-N-1

*Table 1.4.4.1: Oil slick spreading parameters as per the scenario Na-Spr-N-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil/water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 2764 | 100 | 2274 | 82,3 | 443 | 16,0 | 46,4 | 1,68 | 0 | 0 | 2728 | 6,35 | 429400 | 6,2 |
| H+02:00 | 5408 | 100 | 3777 | 69,8 | 1496 | 27,7 | 134 | 2,48 | 0 | 0 | 4840 | 4,23 | 1142907 | 23,3 |
| H+03:00 | 7909 | 100 | 4815 | 60,9 | 2858 | 36,1 | 236 | 2,98 | 0 | 0 | 6353 | 3,42 | 1856366 | 57,6 |
| H+04:00 | 10000 | 100 | 5406 | 54,1 | 4253 | 42,5 | 343 | 3,43 | 0 | 0 | 7287 | 2,76 | 2643518 | 115 |
| H+05:00 | 10000 | 100 | 4296 | 43,0 | 5268 | 52,7 | 438 | 4,38 | 0 | 0 | 6082 | 1,87 | 3245936 | 352 |
| H+06:00 | 10000 | 100 | 3509 | 35,1 | 5966 | 59,7 | 526 | 5,26 | 0 | 0 | 5008 | 1,27 | 3930261 | 711 |
| H+07:00 | 10000 | 100 | 2898 | 29,0 | 6490 | 64,9 | 613 | 6,13 | 0 | 0 | 4140 | 0,92 | 4480671 | 1192 |
| H+08:00 | 10000 | 100 | 2412 | 24,1 | 6896 | 69,0 | 693 | 6,93 | 0 | 0 | 3446 | 0,67 | 5155472 | 1776 |
| H+09:00 | 10000 | 100 | 1953 | 19,5 | 7273 | 72,7 | 774 | 7,74 | 0 | 0 | 2791 | 0,43 | 6562006 | 2570 |
| H+09:06 Landfall | 10000 | 100 | 1910 | 19,1 | 7308 | 73,1 | 781 | 7,81 | 0,5 | 0,01 | 2729 | 0,40 | 6796195 | 2660 |
| H+10:00 | 10000 | 100 | 1518 | 15,2 | 7611 | 76,1 | 849 | 8,49 | 22,8 | 0,23 | 2169 | 0,27 | 7894954 | 3580 |
| H+12:00 | 10000 | 100 | 844 | 8,44 | 8067 | 80,7 | 987 | 9,87 | 101 | 1,01 | 1206 | 0,24 | 5079990 | 5615 |
| H+15:00 | 10000 | 100 | 364 | 3,64 | 8301 | 83,0 | 1099 | 11,0 | 236 | 2,36 | 520 | 0,29 | 1803981 | 7068 |
| H+18:00 | 10000 | 100 | 239 | 2,39 | 8420 | 83,6 | 1133 | 11,3 | 275 | 2,75 | 343 | 1,07 | 320028 | 7505 |

Within the first 4 hours as of the OS start the oil slick spreads south-westward of the OS point under the action of the wind and current. After 4 hours as of the OS start the oil slick semi-perimeter makes 2881 m, the volume of the evaporated oil – 36,1%, the volume of the dispersed oil – 3,4%. After 6 hours the oil slick reaches the eastern coast of the Toros Island. Further the oil slick drifts south-eastward to the Cape Letinskiy After 9 hours as of the OS start the oil slick semi-perimeter makes 4540 m, the volume of the evaporated oil – 72,7%, the volume of the dispersed oil – 7,7%. Further the oil slick is washed ashore while moving eastward. After 10 hours as of the OS start about 4 km of the coastline in the area of the Capes Baklaniy and Letinskiy has been polluted. After 12 hours as of the OS start the volume of the evaporated oil – 80,7%, the volume of the dispersed oil – 9,9%. The volume of the oil/water mixture has decreased compared to the OS volume with 87,9%. To the moment of modelling completion (18 hours), the oil slick has spread here and there over the Barents Sea coastline from the Maly Berezov Island to the Cape Dolgiy. The volume of the evaporated oil – 83,6%, the volume of the dispersed oil – 11,3%, about 2,4% of the OS volume remains afloat, the average oil slick thickness makes 1,07 mm.

The graphic display of the oil slick spreading as per the scenario Na-Spr-N-1 is shown in figures 203 – 164.

The charts of processes typical for oil behaviour on water are shown in figures 165-167.

Figure 203. H+01:00. Oil slick spreading as per the scenario Na-Spr-N-1.

Figure 204. H+02:00. Oil slick spreading as per the scenario Na-Spr-N-1.

Figure 205. H+03:00. Oil slick spreading as per the scenario Na-Spr-N-1.

Figure 206. H+04:00. Oil slick spreading as per the scenario Na-Spr-N-1.

Figure 207. H+05:00. Oil slick spreading as per the scenario Na-Spr-N-1.

Figure 208. H+06:00. Oil slick spreading as per the scenario Na-Spr-N-1.

Figure 209. H+07:00. Oil slick spreading as per the scenario Na-Spr-N-1.

Figure 210. H+08:00. Oil slick spreading as per the scenario Na-Spr-N-1.

Figure 212. H+09:00. Oil slick spreading as per the scenario Na-Spr-N-1.

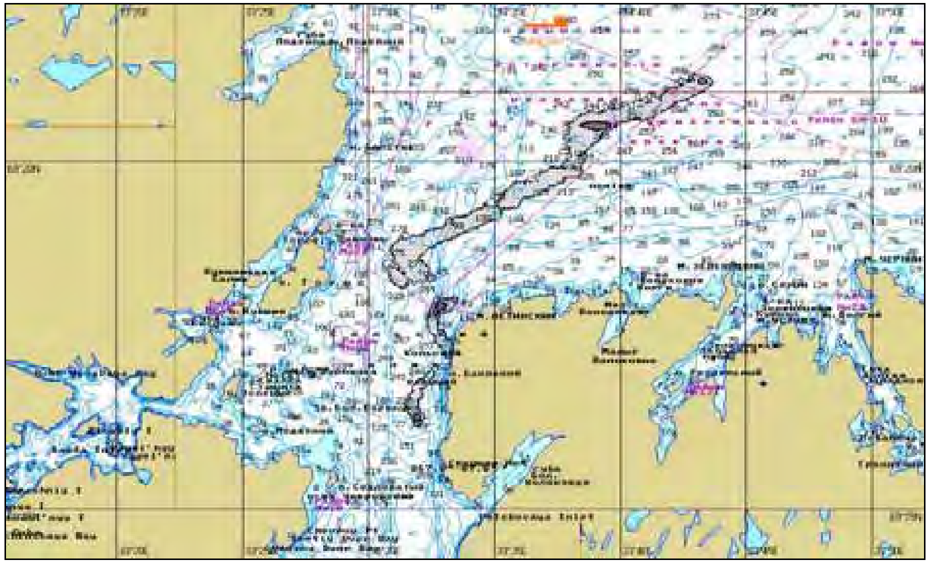


Figure 213. **H+09:06.** Oil slick spreading as per the scenario Na-Spr-N-1.

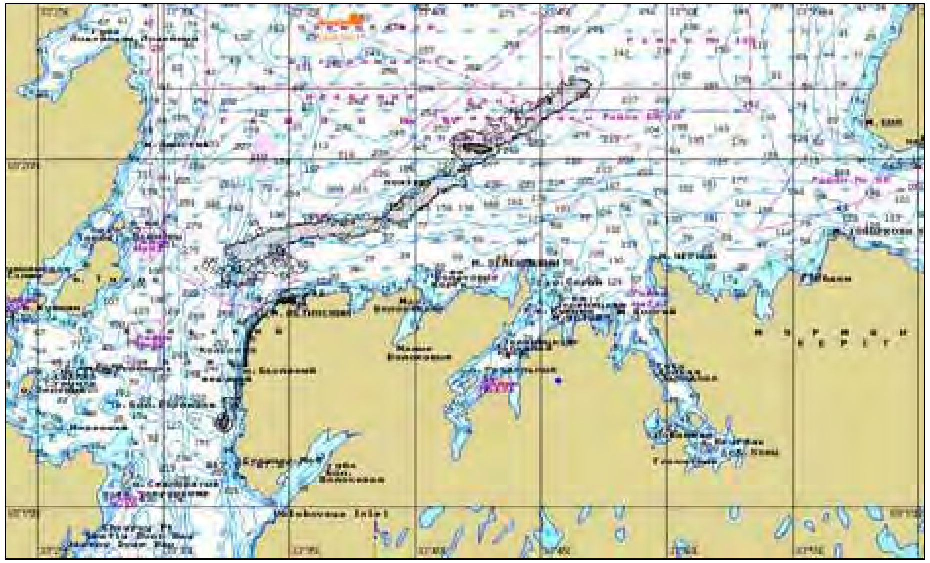


Figure 214. H+10:00. Oil slick spreading as per the scenario Na-Spr-N-1.

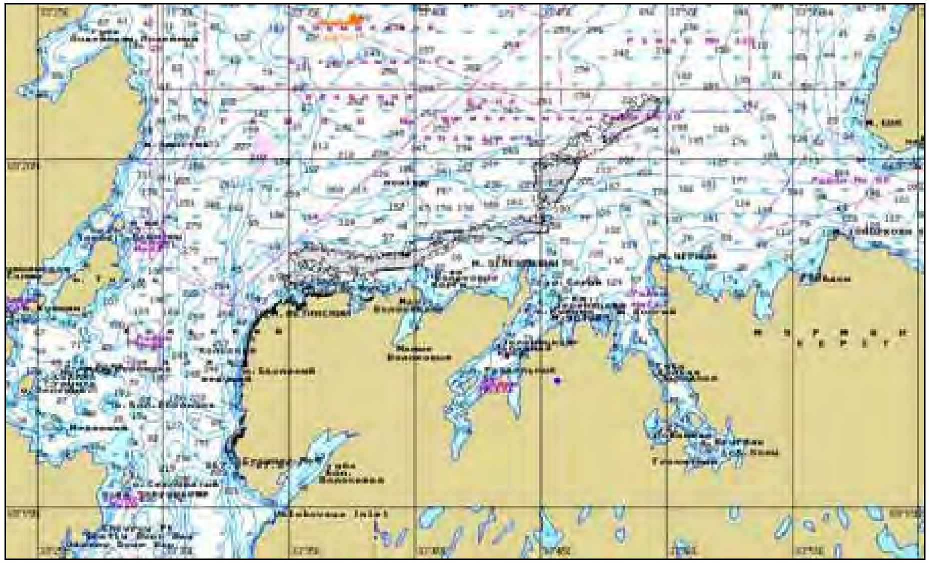


Figure 215. H+12:00. Oil slick spreading as per the scenario Na-Spr-N-1.

Figure 216. H+15:00. Oil slick spreading as per the scenario Na-Spr-N-1.

Figure 217. H+18:00. Oil slick spreading as per the scenario Na-Spr-N-1.

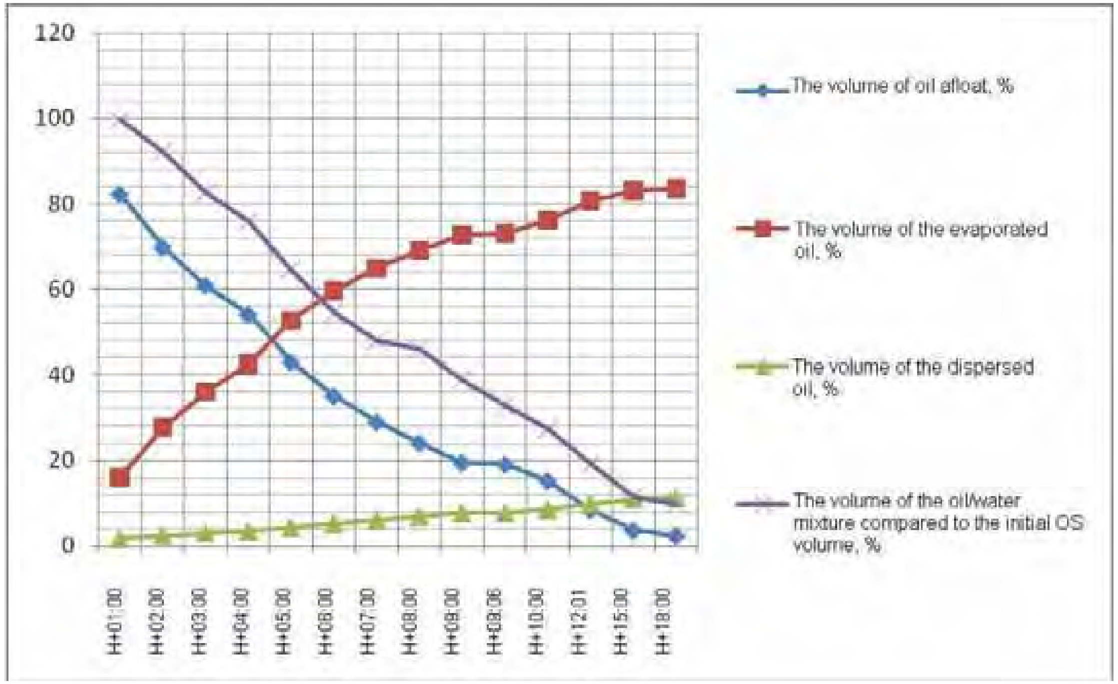



Figure 218. The chart of processes as per the scenario Na-Spr-N-1.

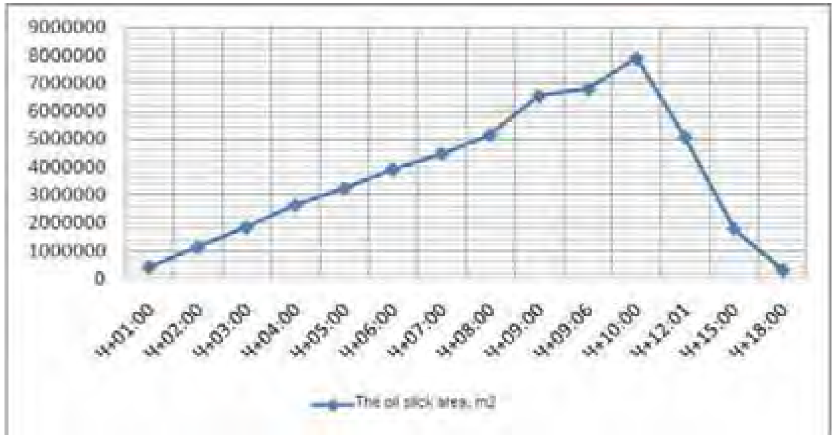



Figure 219. Oil slick area change dynamics as per the scenario Na-Spr-N-1.

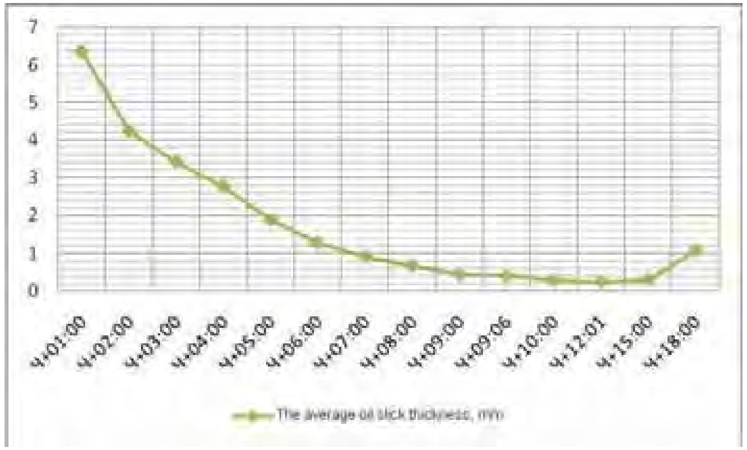



Figure 220. Oil slick thickness change dynamics as per the scenario Na-Spr-N-1.

### 1.4.5 The process dynamics typical for oil spill behaviour in the Barents Sea under the spring northward wind (Spr-N-1)

Figures 221-232 show the dynamics of processes typical for oil behaviour in the Barents Sea as per the scenarios Spr-N-1.

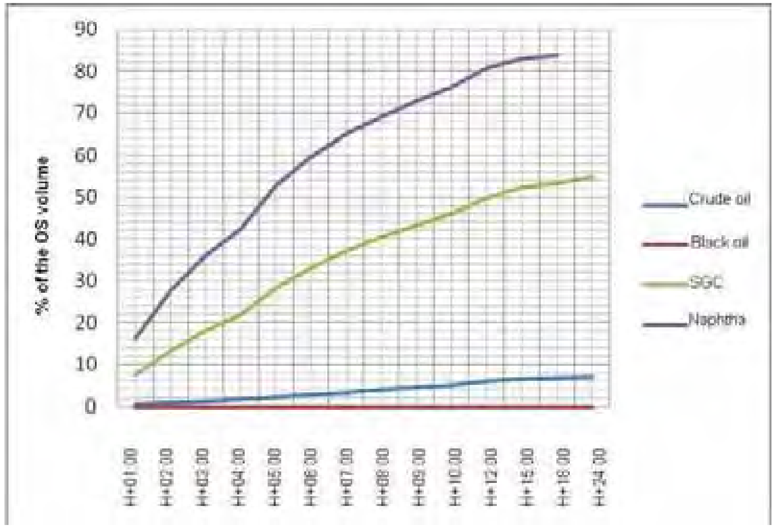



Figure 221. The evaporation process chart as per the scenarios Spr-N-1.

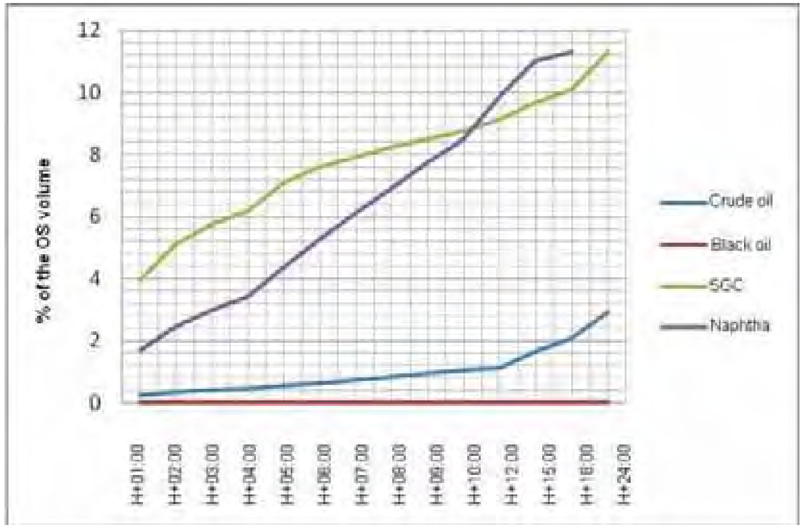



Figure 222. The dispersion process chart as per the scenarios Spr-N-1.

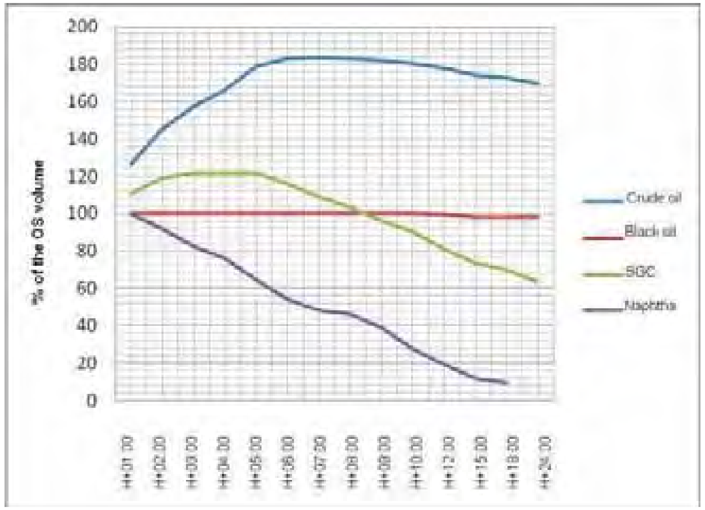



Figure 223. Dynamics of the oil/water mixture volume changes as per the scenarios Spr-N-1.

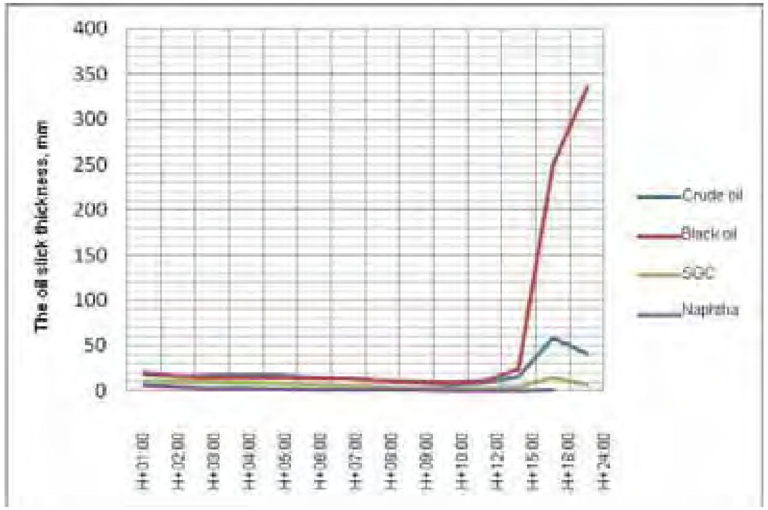



Figure 224. Dynamics of the oil slick thicnkness change as per the scenarios Spr-N-1.

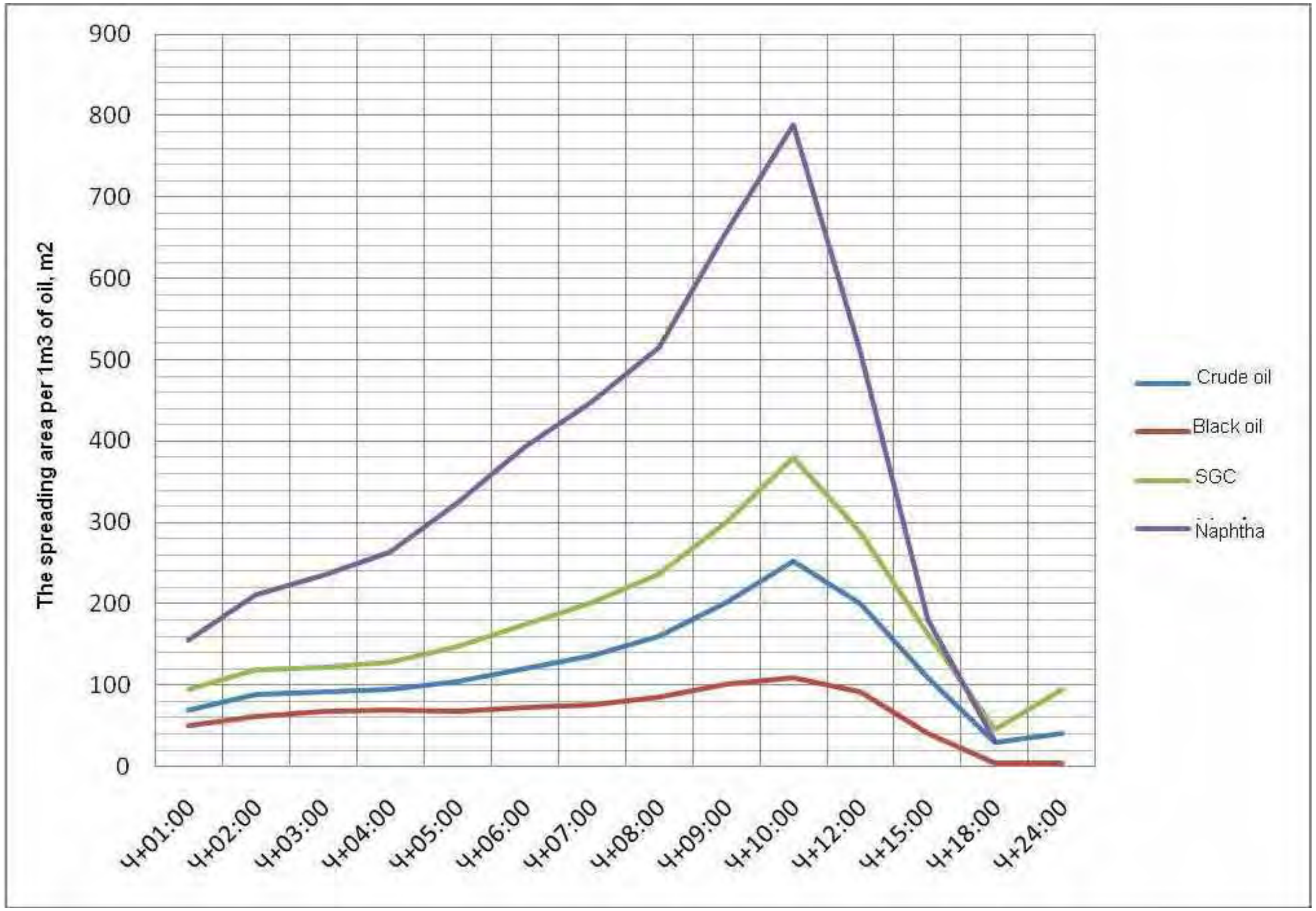



Figure 225. Dynamics of the spreading area change per 1 м $^{3}$ of various types of oil as per the scenarios Spr-N-1.

## 1.5 Oil spill behaviour modelling in the Barents Sea under the spring north-westward wind

### 1.5.1 Oil slick behaviour modelling as per the scenario COV-Spr-NW-1

*Table 1.5.1.1: Oil slick spreading parameters as per the scenario COV-Spr-NW-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil/water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 5507 | 100 | 5475 | 99,4 | 19,2 | 0,35 | 12,7 | 0,23 | 0 | 0 | 6952 | 26,7 | 259891 | 122 |
| H+02:00 | 10785 | 100 | 10677 | 99,0 | 72,1 | 0,67 | 35,9 | 0,33 | 0 | 0 | 15726 | 19,9 | 789943 | 188 |
| H+03:00 | 15781 | 100 | 15555 | 98,6 | 164 | 1,04 | 62,4 | 0,40 | 0 | 0 | 24879 | 19,3 | 1292322 | 244 |
| H+04:00 | 19973 | 100 | 19607 | 98,2 | 276 | 1,38 | 89,6 | 0,45 | 0 | 0 | 33205 | 22,6 | 1467165 | 295 |
| H+05:00 | 20000 | 100 | 19510 | 97,6 | 378 | 1,89 | 112 | 0,56 | 0 | 0 | 35877 | 22,7 | 1581116 | 389 |
| H+06:00 | 20000 | 100 | 19391 | 97,0 | 478 | 2,39 | 131 | 0,66 | 0 | 0 | 36767 | 19,5 | 1882950 | 444 |
| H+07:00 | 20000 | 100 | 19274 | 96,4 | 575 | 2,88 | 151 | 0,76 | 0 | 0 | 36908 | 16,8 | 2197659 | 479 |
| H+07:06 Landfall | 20000 | 100 | 19261 | 96,3 | 585 | 2,93 | 153 | 0,77 | 0,8 | 0 | 36901 | 16,7 | 2213141 | 482 |
| H+08:00 | 20000 | 100 | 19146 | 95,7 | 668 | 3,34 | 172 | 0,86 | 13,7 | 0,07 | 36773 | 14,3 | 2573292 | 505 |
| H+09:00 | 20000 | 100 | 19021 | 95,1 | 760 | 3,80 | 195 | 0,98 | 22,9 | 0,11 | 36565 | 12,6 | 2894698 | 530 |
| H+10:00 | 20000 | 100 | 18895 | 94,5 | 848 | 4,24 | 220 | 1,10 | 37,2 | 0,19 | 36332 | 11,6 | 3126126 | 554 |
| H+11:00 | 20000 | 100 | 18777 | 93,9 | 919 | 4,60 | 246 | 1,23 | 58,7 | 0,29 | 36109 | 13,5 | 2672376 | 573 |
| H+12:00 | 20000 | 100 | 18664 | 93,3 | 974 | 4,87 | 272 | 1,36 | 89,2 | 0,45 | 35893 | 15,2 | 2368141 | 589 |
| H+15:00 | 20000 | 100 | 18407 | 92,0 | 1094 | 5,47 | 357 | 1,79 | 142 | 0,71 | 35398 | 24,0 | 1473917 | 625 |
| H+18:00 | 20000 | 100 | 18246 | 91,2 | 1151 | 5,76 | 445 | 2,23 | 158 | 0,79 | 35088 | 78,9 | 444575 | 643 |
| H+20:00 | 20000 | 100 | 18135 | 90,7 | 1183 | 5,92 | 506 | 2,53 | 176 | 0,88 | 34874 | 75,0 | 465254 | 653 |

Within the first 7 hours as of the OS start the oil slick spreads southward of the OS point under the action of the wind and current. After 4 hours as of the OS start the oil slick semi-perimeter makes 2146 м, the volume of the evaporated oil – 1,38%, the volume of the dispersed oil – 0,45%. After 7 hours 06 minutes as of the OS start the oil reaches the coastline in the area of the Cape Letinskiy. Further the oil slick drifts south-eastward in the direction of the Kildin Island. The oil slick breaks up in several fields. After 9 hours as of the OS start the oil slick semi-perimeter based on the total area makes 3015 m, the volume of the evaporated oil – 2,93%, the volume of the dispersed oil – 0,77%. Further the oil slick drifts eastward and is partially washed ashore to the Murmansk coastline of the Barents Sea. After 12 hours as of the OS start the oil slick semi-perimeter makes 2727 m, the volume of the evaporated oil – 4,87%, the volume of the dispersed oil – 1,36%. The volume of the oil/water mixture has increased compared to the OS volume with 79,5%. More than 10 km of the coastline has been polluted. To the moment of modelling completion (20 hours), all oil has reached the Barents Sea coastline. Strips of the Barents Sea coastline from the Cape Letinskiy to the Cape Toporkov Pakhta with the total length of more than 8 km have been polluted with oil. The volume of the evaporated oil – 5,9%, the volume of the dispersed oil – 2,5%, the average oil slick thickness makes 75 mm. The graphic display of the oil slick spreading as per the scenario COV-Spr-NW-1 is shown in figures 226 – 241

The charts of processes typical for the oil behaviour on water are shown in figures 242-244.

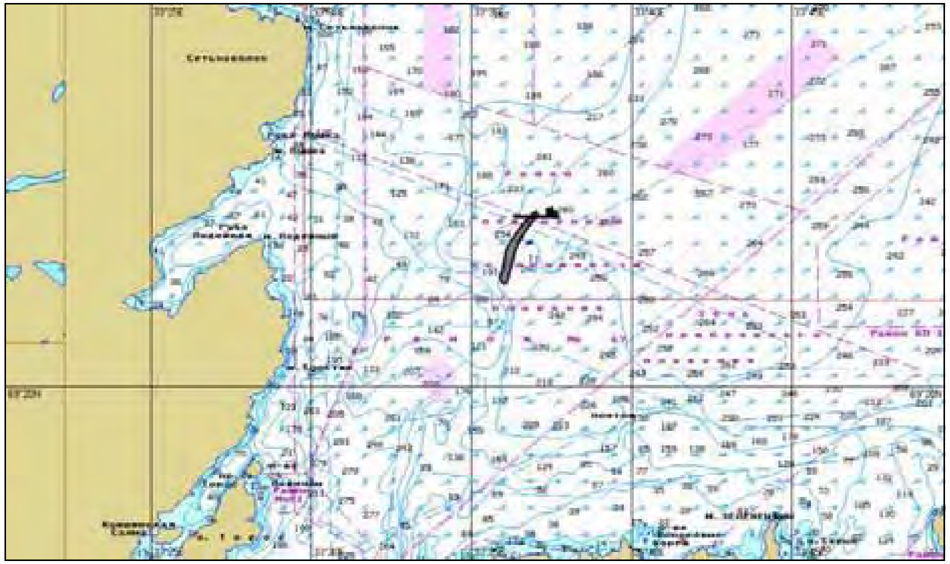


Figure 226. H+01:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

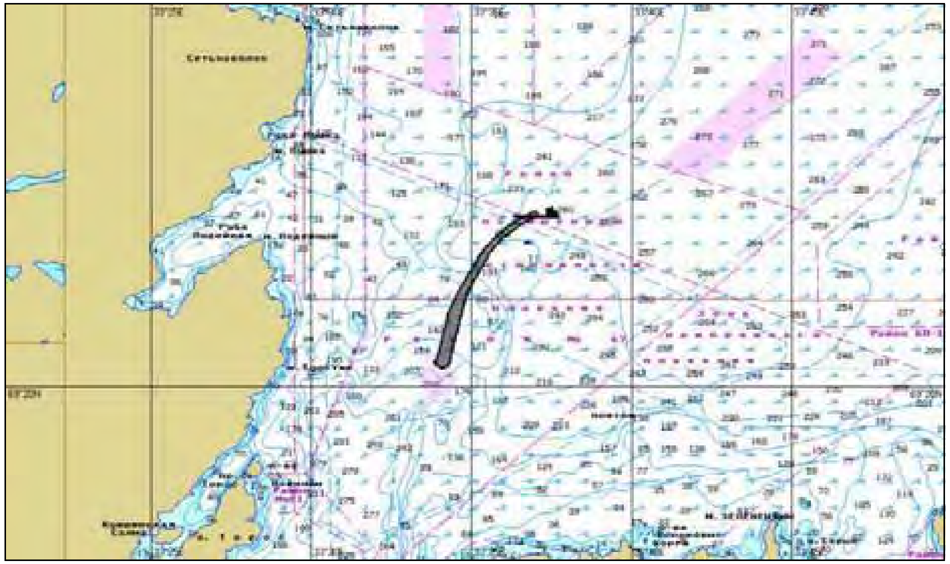


Figure 227. H+02:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

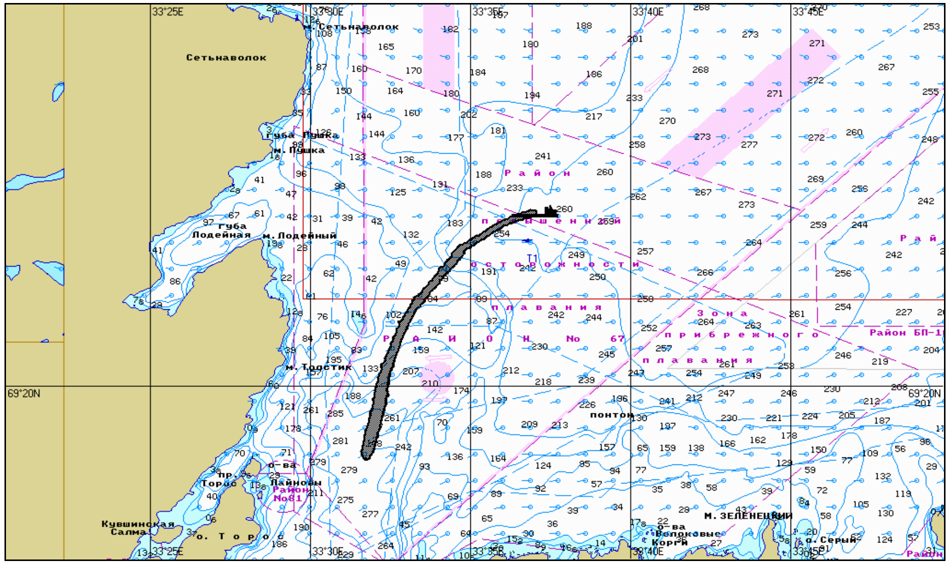


Figure 228. H+03:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

Figure 229. H+04:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

Figure230. H+05:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

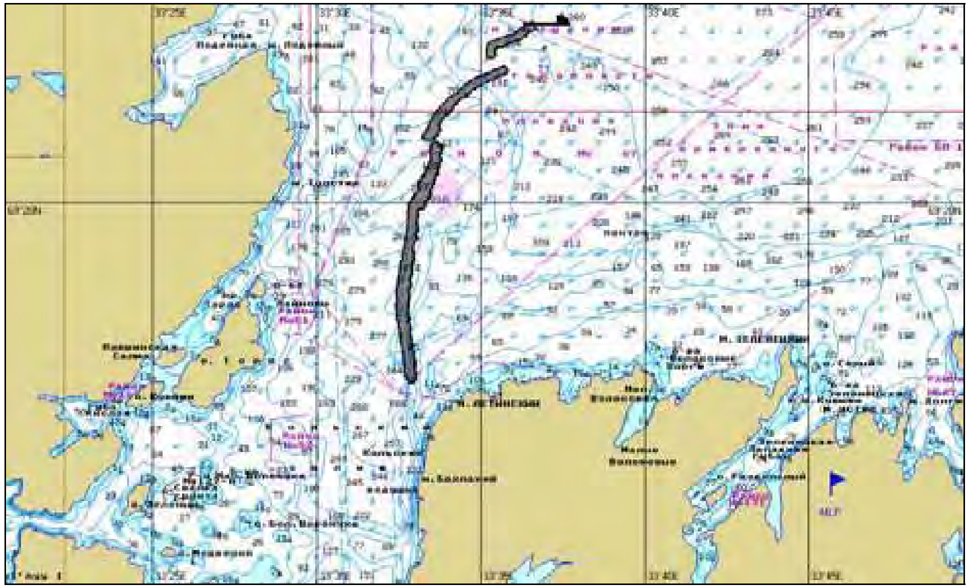


Figure231. H+06:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

Figure 232. H+07:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

Figure 233. **H+07:06.** Oil slick spreading as per the scenario COV-Spr-NW-1.

Figure 234. H+08:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

Figure 235. H+09:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

Figure 236. H+10:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

Figure 237. H+11:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

Figure 238. H+12:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

Figure 239. H+15:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

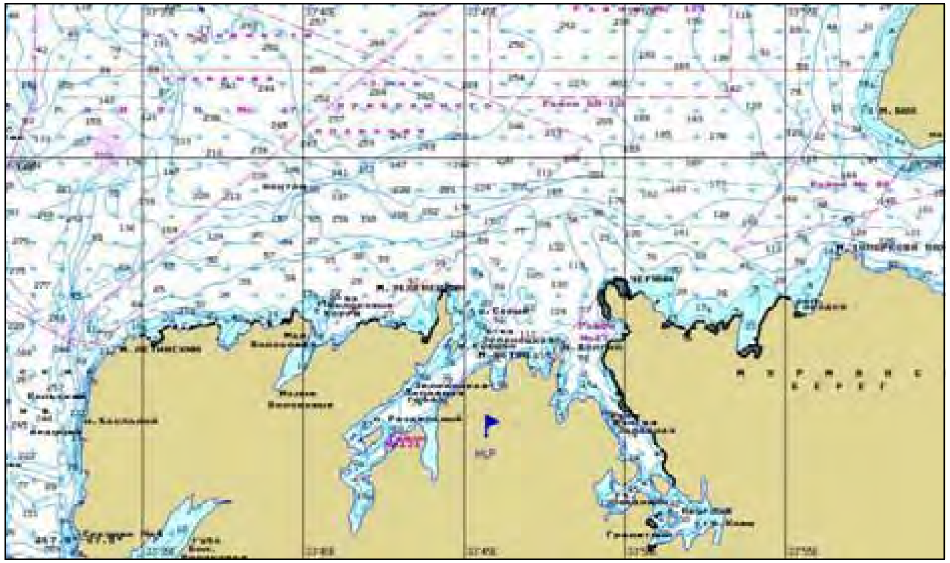


Figure 240. H+18:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

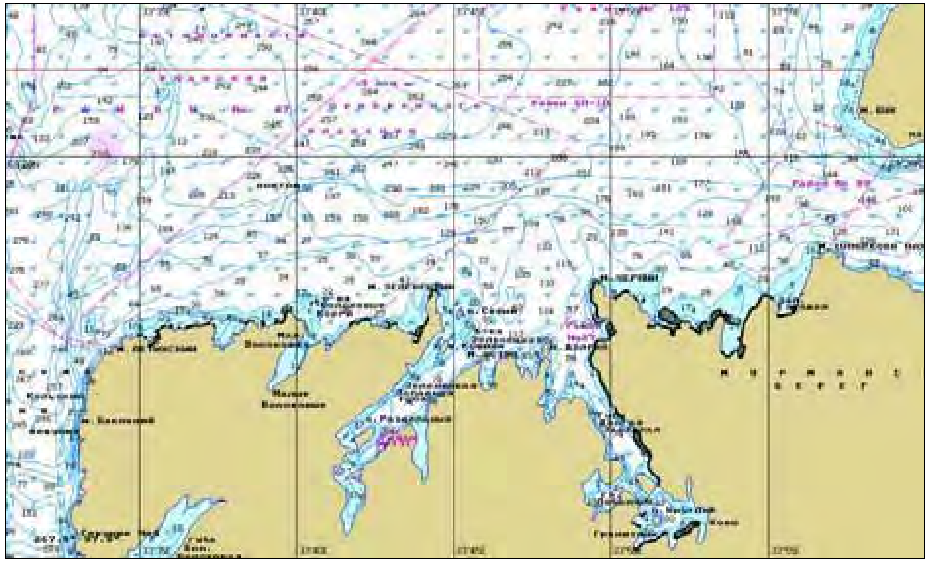


Figure 241. H+20:00. Oil slick spreading as per the scenario COV-Spr-NW-1.

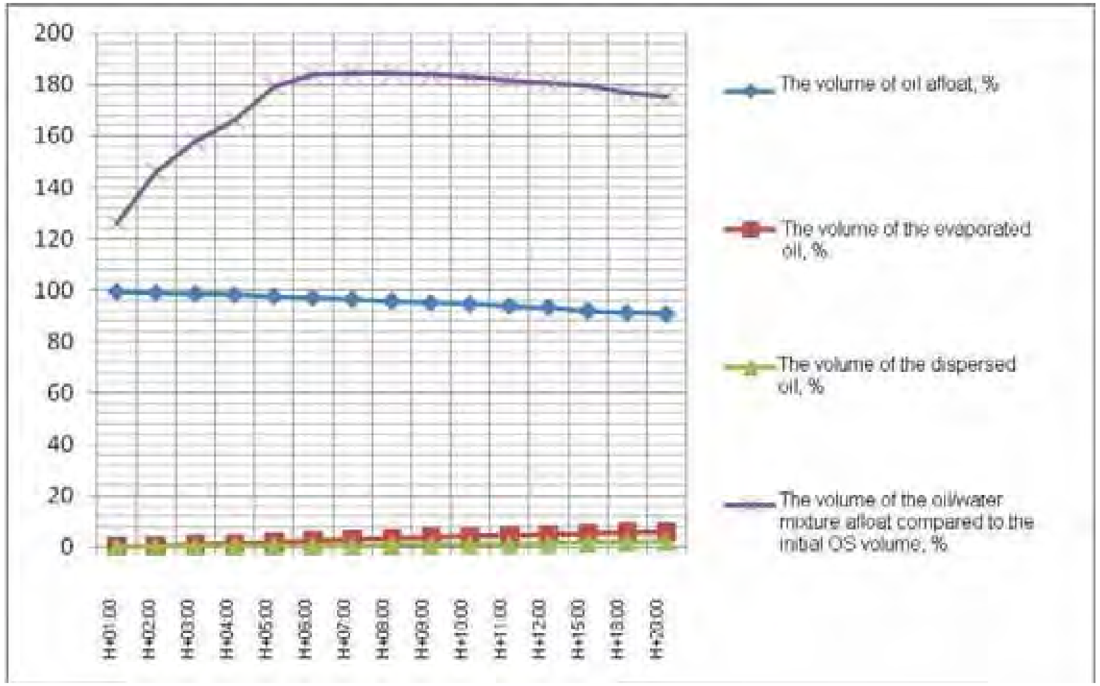



Figure 242. The chart of processes as per the scenario COV-Spr-NW-1.

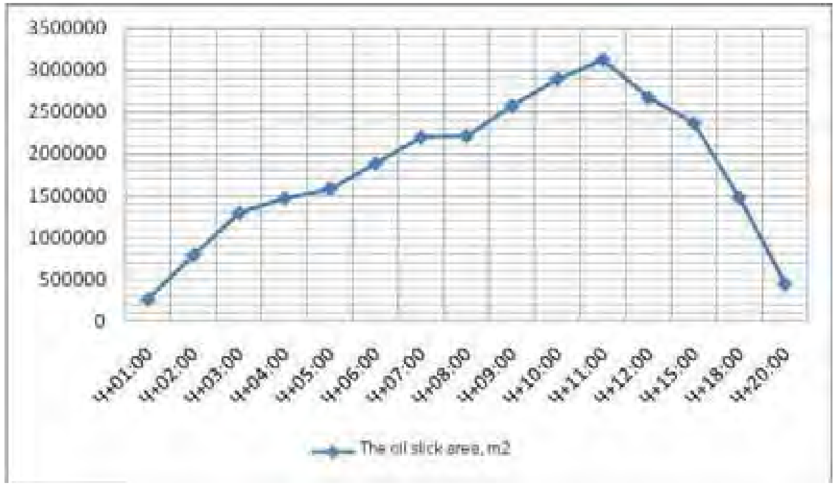



Figure 243. Oil slick area change dynamics as per the scenario COV-Spr-NW-1.

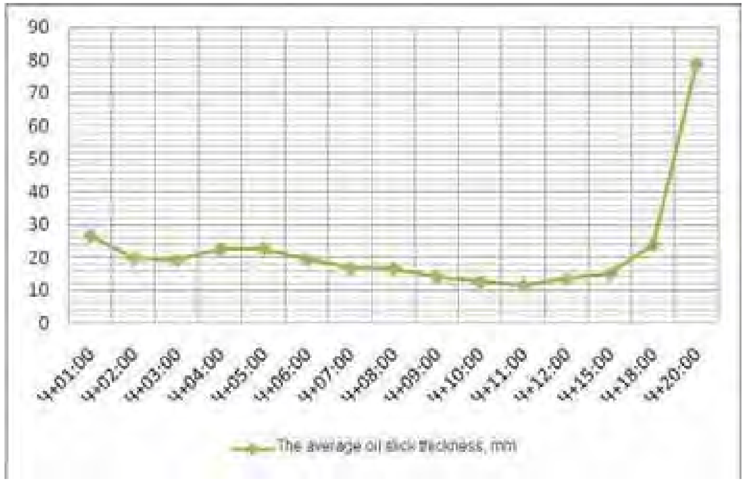



Figure 244. Oil slick thickness change dynamics as per the scenario COV-Spr-NW-1.

### 1.5.2 Oil slick behaviour modelling as per the scenario BO-Spr-NW-1

*Table 1.5.2.1: Oil slick spreading parameters as per the scenario BO-Spr-NW-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil / water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 3046 | 100 | 3046 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 3046 | 30,7 | 99234 | 15541 |
| H+02:00 | 6142 | 100 | 6142 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 6142 | 22,3 | 275343 | 15541 |
| H+03:00 | 9187 | 100 | 9187 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 9187 | 17,5 | 524581 | 15541 |
| H+04:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 18,7 | 642501 | 15541 |
| H+05:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 19,8 | 607461 | 15541 |
| H+06:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 19,0 | 631173 | 15541 |
| H+07:00 | 12000 | 100 | 12000 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 12000 | 18,7 | 643125 | 15541 |
| H+07:44 Landfall | 12000 | 100 | 11999 | 100 | 0 | 0 | 0 | 0 | 0,9 | 0 | 11999 | 18,3 | 656123 | 15541 |
| H+08:00 | 12000 | 100 | 11997 | 100 | 0 | 0 | 0 | 0 | 2,7 | 0,02 | 11997 | 17,4 | 690034 | 15541 |
| H+09:00 | 12000 | 100 | 11989 | 99,9 | 0 | 0 | 0 | 0 | 10,8 | 0,09 | 11989 | 14,9 | 802712 | 15541 |
| H+12:00 | 12000 | 100 | 11940 | 99,5 | 0 | 0 | 0 | 0 | 60,4 | 0,50 | 11940 | 21,8 | 547564 | 15541 |
| H+15:00 | 12000 | 100 | 11902 | 99,2 | 0 | 0 | 0 | 0 | 97,6 | 0,81 | 11902 | 35,3 | 337619 | 15541 |
| H+18:00 | 12000 | 100 | 11886 | 99,1 | 0 | 0 | 0 | 0 | 114 | 0,95 | 11886 | 201 | 59187 | 15541 |
| H+20:00 | 12000 | 100 | 11871 | 98,9 | 0 | 0 | 0 | 0 | 129 | 1,08 | 11871 | 336 | 35379 | 15541 |

Within the first 7 hours as of the OS start the oil slick spreads southward of the OS point under the action of the wind and current. After 4 hours as of the OS start the oil slick semi-perimeter makes 1420 m, the evaporation and dispersion processes are not detected by the programme. After 7 hours and 44 minutes as of the OS start the black oil reaches the coastline in the area of the Cape Letinskiy. Further the oil slick drifts south-eastward in the direction of the Kildin Island. The oil slick breaks up in several fields. After 9 hours as of the OS start the oil slick semi-perimeter based on the total area makes 1588 m, the evaporation and dispersion processes are not detected by the programme. Further the oil slick drifts eastward and is partially washed ashore on the Murmansk coast of the Barents Sea. After 12 hours as of the OS start the oil slick semi-perimeter makes 1311 m. The volume of the oil/water mixture volume compared to the OS volume has not increased. To the moment of modelling completion (20 hours), all oil reaches the Barents Sea coastline. Strips of the Barents sea coastline from the Cape Letinskiy to the Cape Toporkov Pakhta with the total length of more than 7 km have been polluted with oil. The evaporation and dispersions processes are not detected by the programme, the average oil slick thickness makes 33,6 sm.

The graphic display of the oil slick spreading as per the scenario BO-Spr-NW-1 is shown in figures 245 – 267.

The charts of processes typical for oil behaviour on water are shown in figures 268-270.

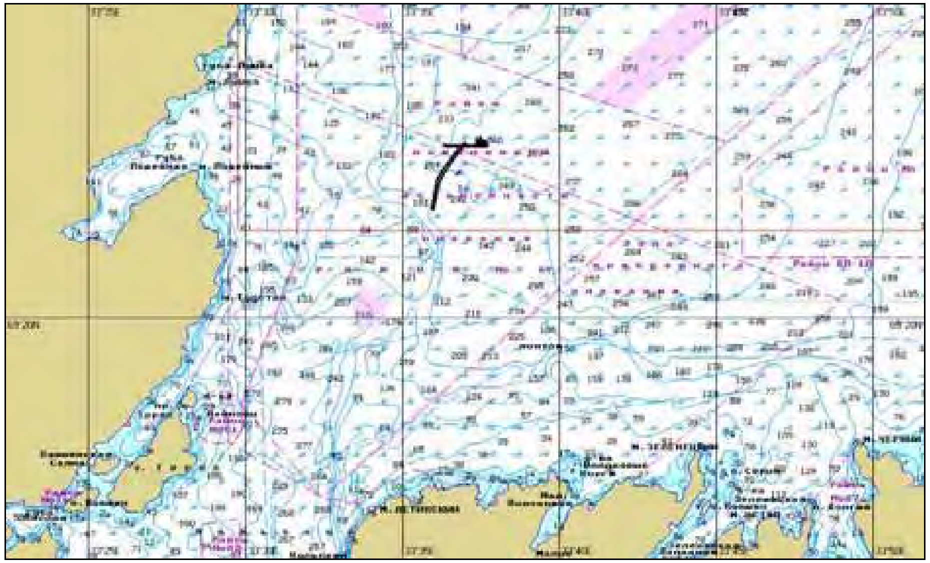


Figure 245. H+01:00. Oil slick spreading as per the scenario BO-Spr-NW-1.

Figure 246. H+02:00. Oil slick spreading as per the scenario BO-Spr-NW-1.

Figure 247. H+03:00. Oil slick spreading as per the scenario BO-Spr-NW-1.

Figure 248. H+04:00. Oil slick spreading as per the scenario BO-Spr-NW-1.

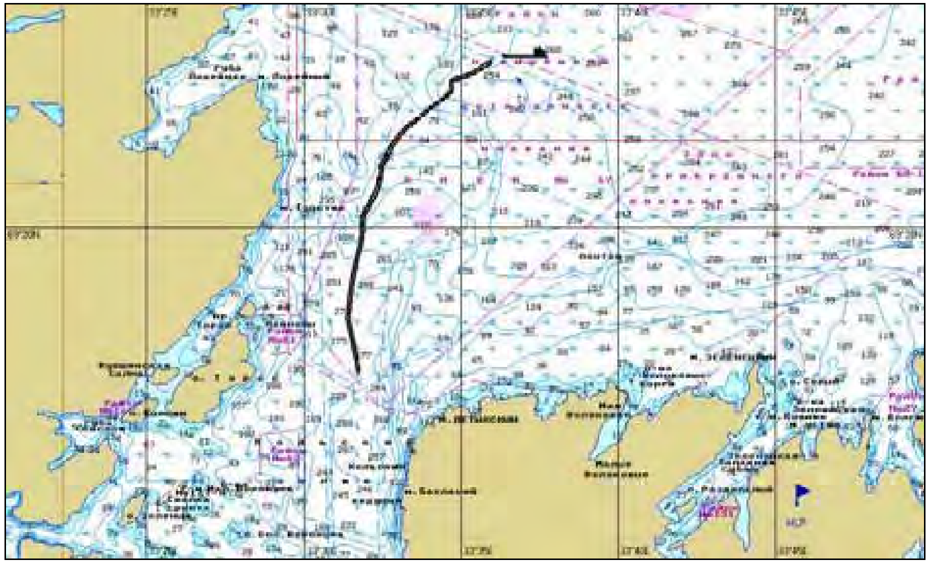


Figure 249. H+05:00. Oil slick spreading as per the scenario BO-Spr-NW-1.

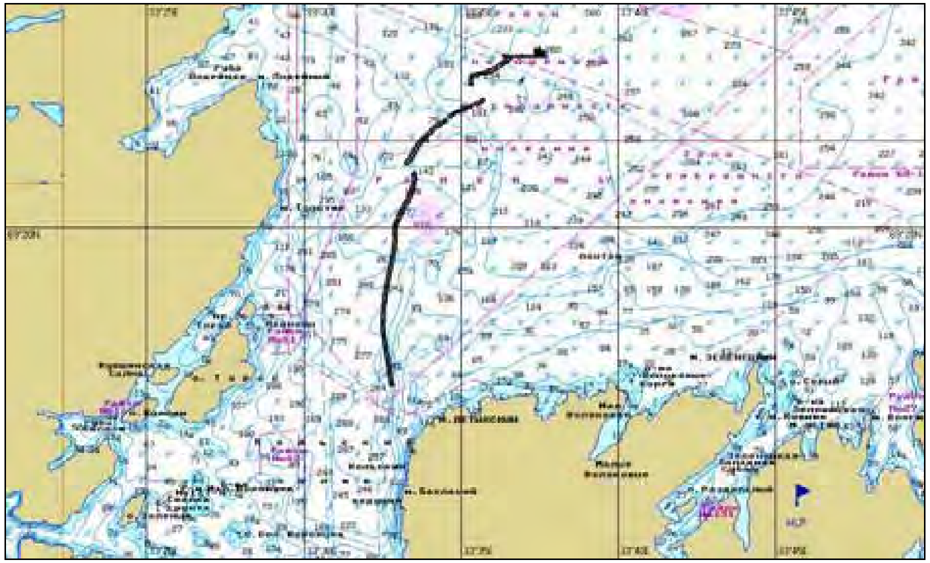


Figure 250. H+06:00. Oil slick spreading as per the scenario BO-Spr-NW-1.

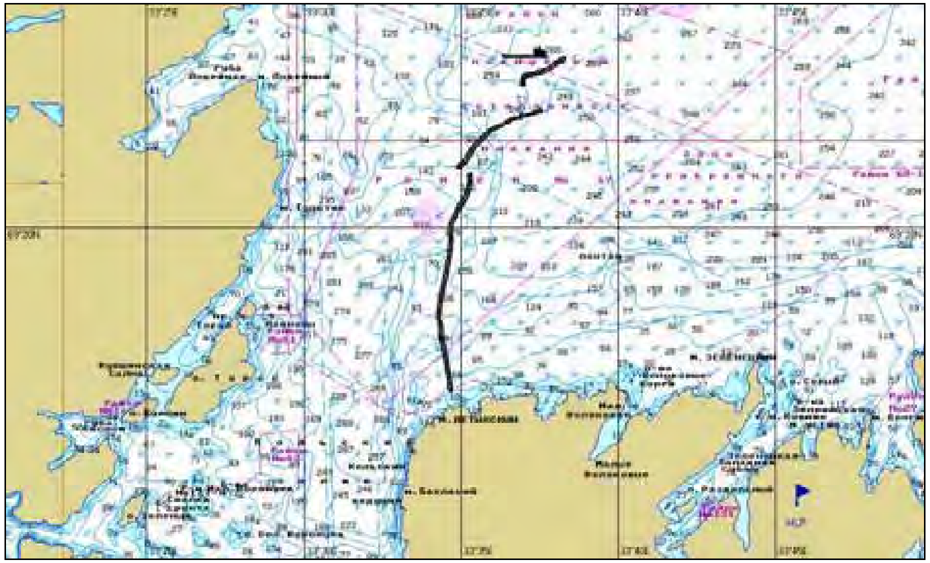


Figure 260. H+07:00. Oil slick spreading as per the scenario BO-Spr-NW-1.

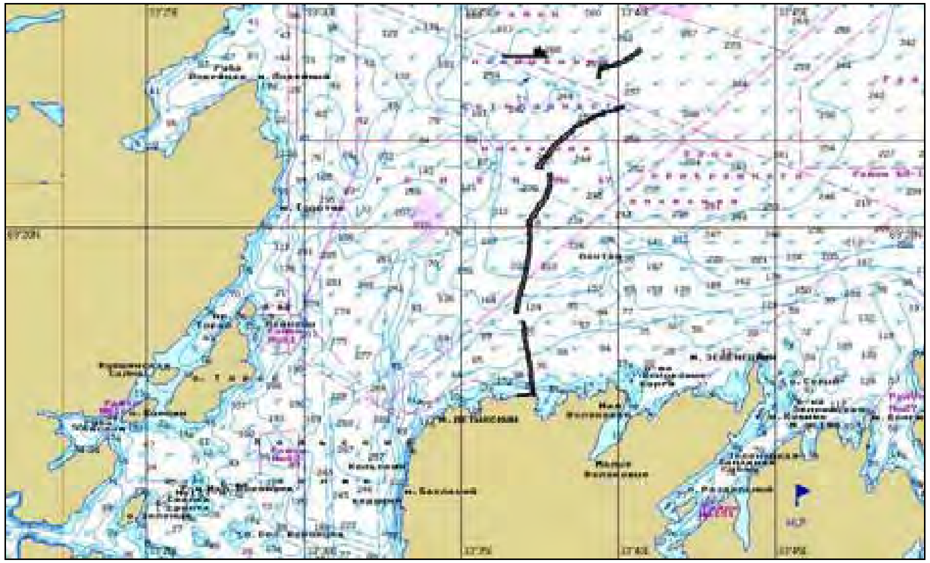


Figure 261. **H+07:44.** Oil slick spreading as per the scenario BO-Spr-NW-1.

Figure 262. H+08:00. Oil slick spreading as per the scenario BO-Spr-NW-1.

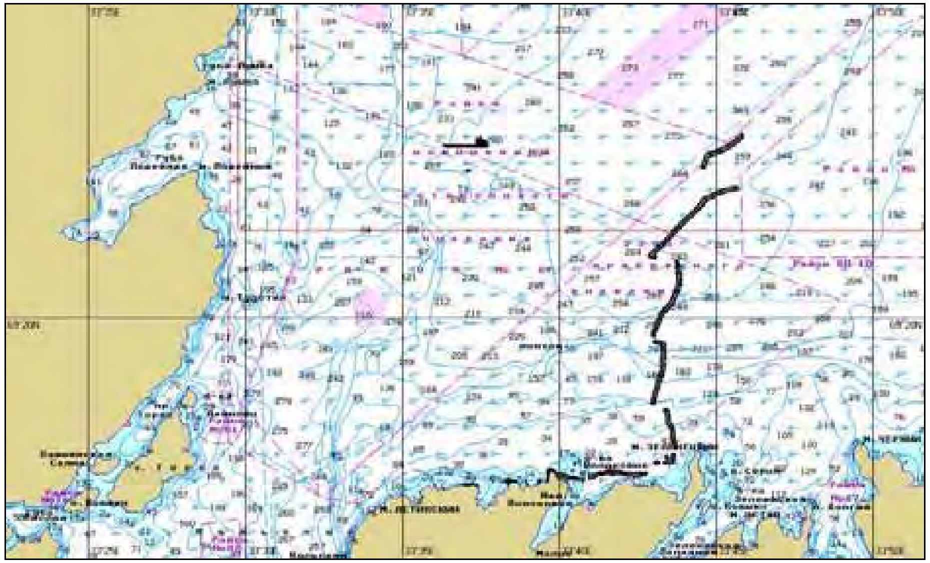


Figure 263. H+09:00. Oil slick spreading as per the scenario BO-Spr-NW-1.

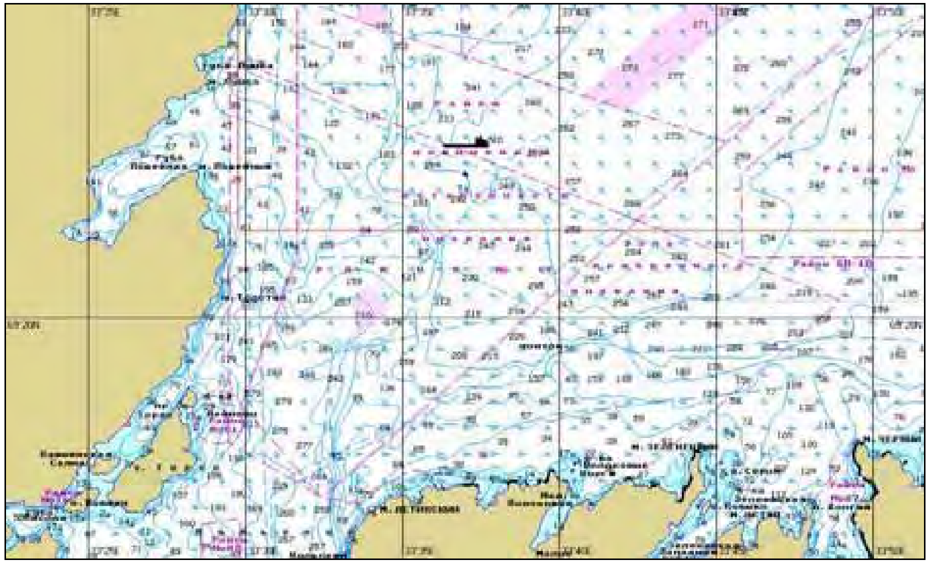


Figure 264. H+12:00. Oil slick spreading as per the scenario BO-Spr-NW-1.

Figure 265. H+15:00. Oil slick spreading as per the scenario BO-Spr-NW-1.

Figure 266. H+18:00. Oil slick spreading as per the scenario BO-Spr-NW-1.

Figure 267. H+20:00. Oil slick spreading as per the scenario BO-Spr-NW-1.

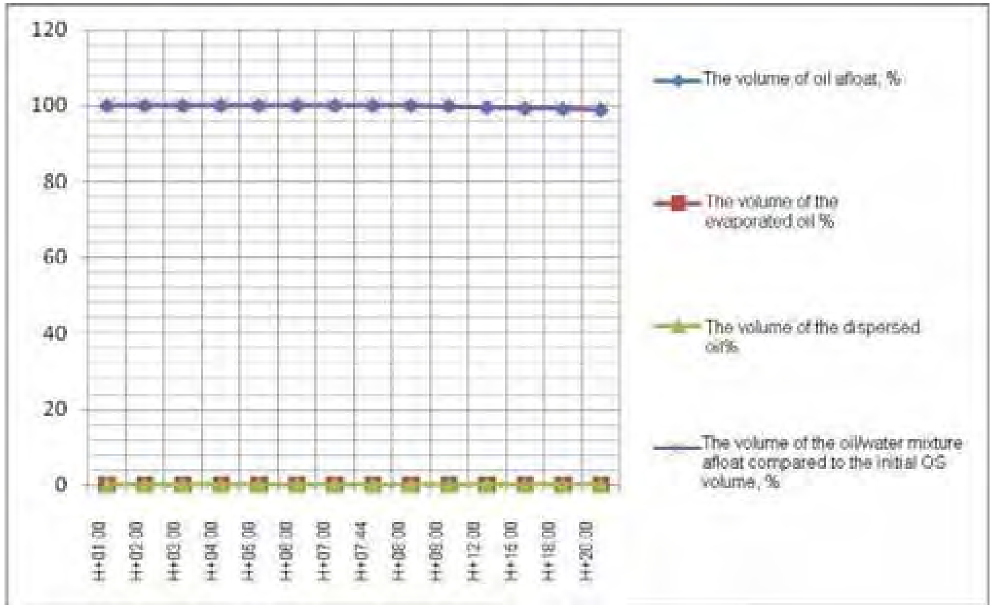



Figure 268. The chart of processes as per the scenario BO-Spr-NW-1.

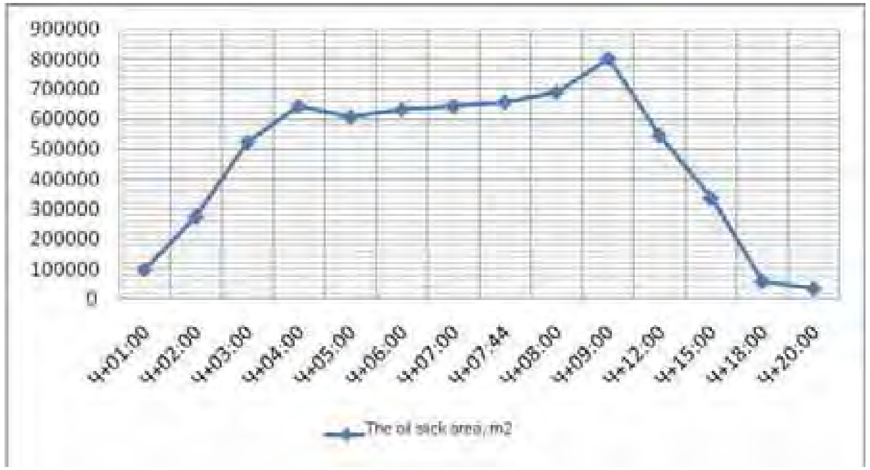



Figure 269. Oil slick area change dynamics as per the scenario BO-Spr-NW-1.

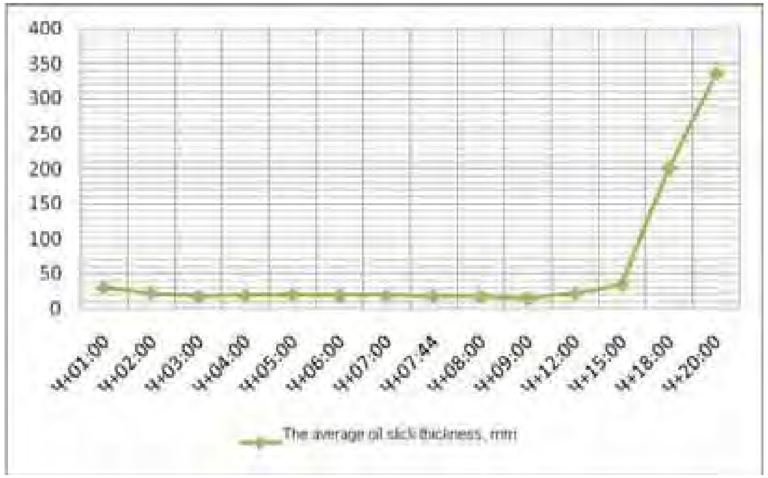



Figure 270. Oil slick thickness change dynamics as per the scenario BO-Spr-NW-1.

### 1.5.3 Oil slick modelling behaviour as per the scenario GC-Spr-NW-1

*Table 1.5.3.1: Oil slick spreading parameters as per the scenario GC-Spr-NW-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil / water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 5362 | 100 | 4777 | 89,1 | 367 | 6,84 | 218 | 4,07 | 0 | 0 | 6046 | 16,9 | 357841 | 5,5 |
| H+02:00 | 10767 | 100 | 8936 | 83,0 | 1260 | 11,7 | 571 | 5,30 | 0 | 0 | 13056 | 11,9 | 1093623 | 13,0 |
| H+03:00 | 15707 | 100 | 12165 | 77,4 | 2596 | 16,5 | 946 | 6,02 | 0 | 0 | 19470 | 11,1 | 1760153 | 26,8 |
| H+04:00 | 19967 | 100 | 14628 | 73,3 | 4040 | 20,2 | 1300 | 6,51 | 0 | 0 | 24816 | 12,8 | 1931462 | 45,2 |
| H+05:00 | 20000 | 100 | 13330 | 66,7 | 5152 | 25,8 | 1517 | 7,59 | 0 | 0 | 25104 | 11,8 | 2122162 | 103 |
| H+06:00 | 20000 | 100 | 12318 | 61,6 | 6045 | 30,2 | 1637 | 8,19 | 0 | 0 | 24153 | 9,27 | 2605898 | 179 |
| H+06:50 Landfall | 20000 | 100 | 11589 | 57,9 | 6692 | 33,5 | 1717 | 8,59 | 1,3 | 0 | 23008 | 7,53 | 3054067 | 254 |
| H+08:00 | 20000 | 100 | 10742 | 53,7 | 7428 | 37,1 | 1809 | 9,05 | 20,6 | 0 | 21443 | 5,79 | 3704443 | 369 |
| H+09:00 | 20000 | 100 | 10112 | 50,6 | 7975 | 39,9 | 1880 | 9,40 | 33,5 | 0 | 20211 | 5,01 | 4036383 | 484 |
| H+10:00 | 20000 | 100 | 9550 | 47,8 | 8455 | 42,3 | 1943 | 9,72 | 52,3 | 0,26 | 19096 | 4,29 | 4450849 | 613 |
| H+11:00 | 20000 | 100 | 9101 | 45,5 | 8815 | 44,1 | 2001 | 10,0 | 82,5 | 0,41 | 18202 | 4,71 | 3866672 | 732 |
| H+12:00 | 20000 | 100 | 8744 | 43,7 | 9078 | 45,4 | 2054 | 10,3 | 124 | 0,62 | 17488 | 5,39 | 3244424 | 832 |
| H+15:00 | 20000 | 100 | 7898 | 39,5 | 9712 | 48,6 | 2192 | 11,0 | 197 | 0,99 | 15797 | 4,95 | 3189364 | 1136 |
| H+18:00 | 20000 | 100 | 7430 | 37,2 | 10029 | 50,1 | 2304 | 11,5 | 236 | 1,18 | 14861 | 11,9 | 1243804 | 1328 |
| H+24:00 | 20000 | 100 | 6913 | 34,6 | 10269 | 51,3 | 2509 | 12,5 | 310 | 1,55 | 13826 | 17,1 | 808252 | 1493 |

Within the first 6 hours as of the OS start the oils slick spreads southward of the OS point under the action of the wind and current. After 4 hours as of the OS start the oil slick semi-perimeter makes 2463 m, the volume of the evaporated oil – 20,2%, the volume of the dispersed oil – 6,5%. After 6 hours and 50 minutes as of the OS start the oil reaches the coastline in the area of the Cape Letinskiy. Further the oil slick drifts south-eastward in the direction of the Kildin Island. After 9 hours as of the OS start the oil slick semi-perimeter makes 3560 m, the volume of the evaporated oil – 39,9%, the volume of the dispersed oil – 9,4%. Further the oil slick drifts eastward and is partially washed ashore on the Murmansk coastline of the Barents Sea. After 12 hours as of the OS start the oil slick semi-perimeter makes 3192 m, the volume of the evaporated oil – 45,4%, the volume of the dispersed oil – 10,3%. The volume of the oil/water mixture has decreased compared to the OS volume with 12,6%. To the moment of modelling completion (24 hours) all oil has reached the Barents sea coastline. Strips of the Barents Sea coastline from the Cape Letinskiy to the Cape Toporkov Pakhta with the total length of more than 25 km have been polluted with oil. The volume of the evaporated oil – 51,3%, the volume of the dispersed oil – 12,5%, 34,6 % of the OS volume remains afloat. The average oil slick thickness makes 1,55 mm.

The graphic display of the oil slick spreading a per the scenario GC-Spr-NW-1 is shown in figures 271 – 284.

The charts of processes typical for the oil behaviour on water are shown in figures 285-287.

Figure 271. H+01:00. Oil slick spreading as per the scenario GC-Spr-NW-1.

Figure 272. H+02:00. Oil slick spreading as per the scenario GC-Spr-NW-1.

Figure 273. H+03:00. Oil slick spreading as per the scenario GC-Spr-NW-1.

Figure 274. H+04:00. Oil slick spreading as per the scenario GC-Spr-NW-1.

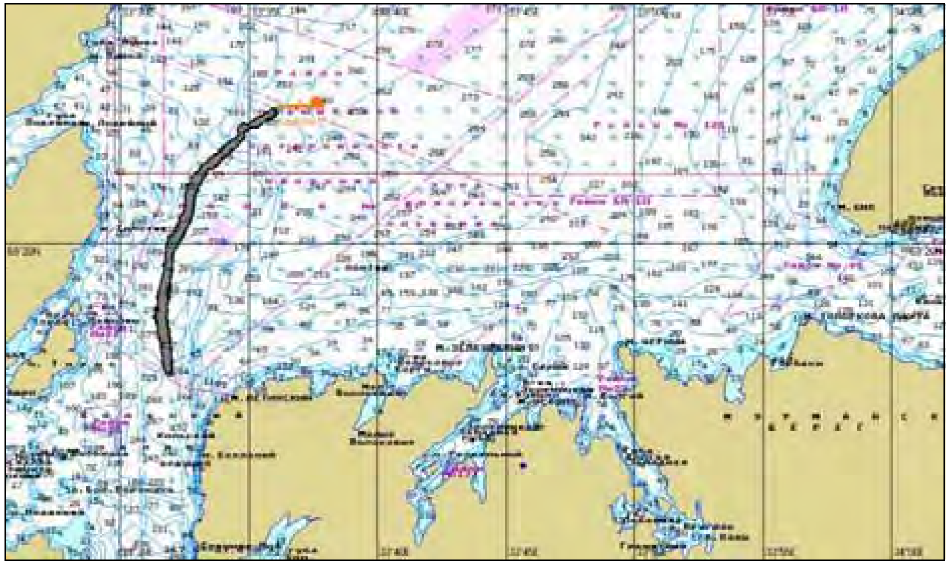


Figure 275. H+05:00. Oil slick spreading as per the scenario GC-Spr-NW-1.

Figure 276. H+06:00. Oil slick spreading as per the scenario GC-Spr-NW-1.

Figure 277. **H+06:50.** Oil slick spreading as per the scenario GC-Spr-NW-1.

Figure 278. H+08:00. Oil slick spreading as per the scenario GC-Spr-NW-1.

Figure 279. H+09:00. Oil slick spreading as per the scenario GC-Spr-NW-1.

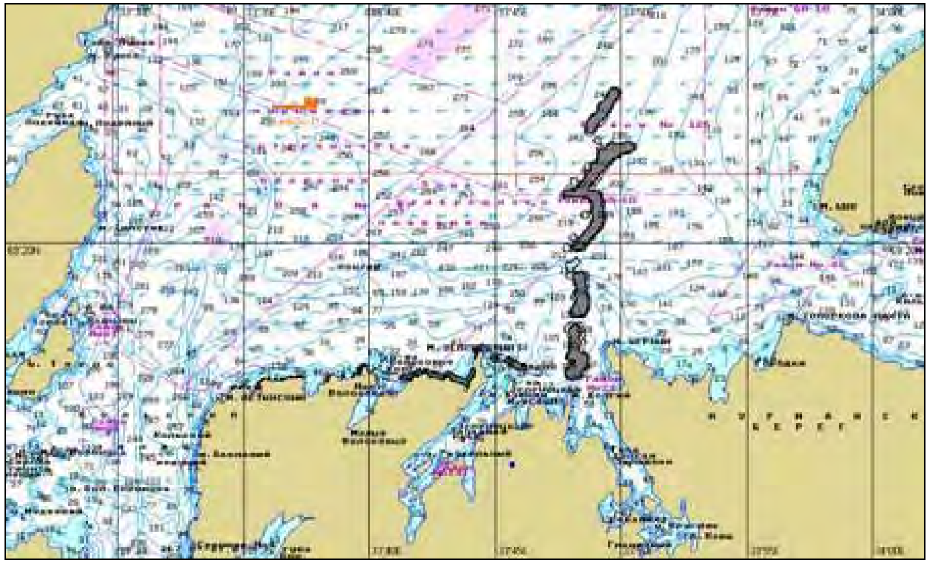


Figure 280. H+10:00. Oil slick spreading as per the scenario GC-Spr-NW-1.

Figure 281. H+11:00. Oil slick spreading as per the scenario GC-Spr-NW-1.

Figure 282. H+12:00. Oil slick spreading as per the scenario GC-Spr-NW-1.

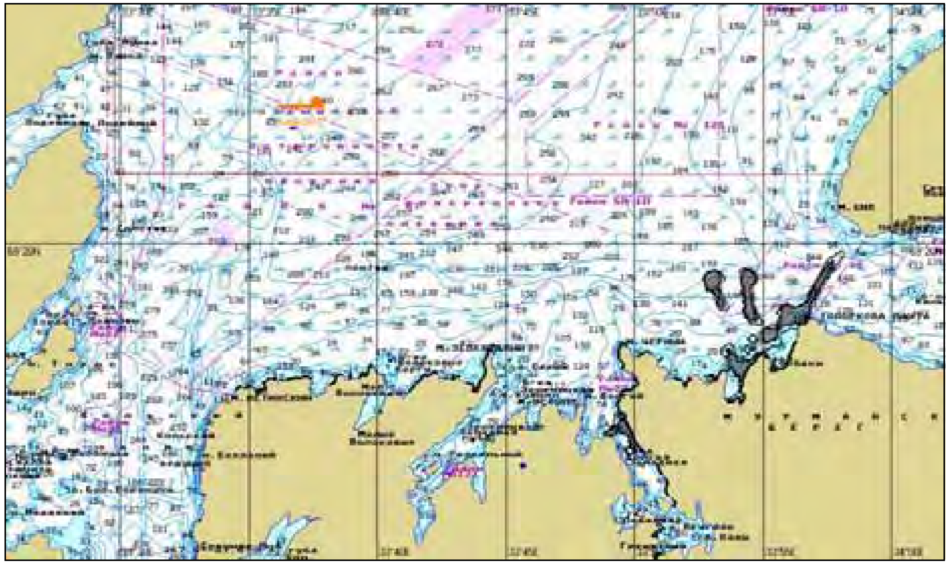


Figure 283. H+15:00. Oil slick spreading as per the scenario GC-Spr-NW-1.

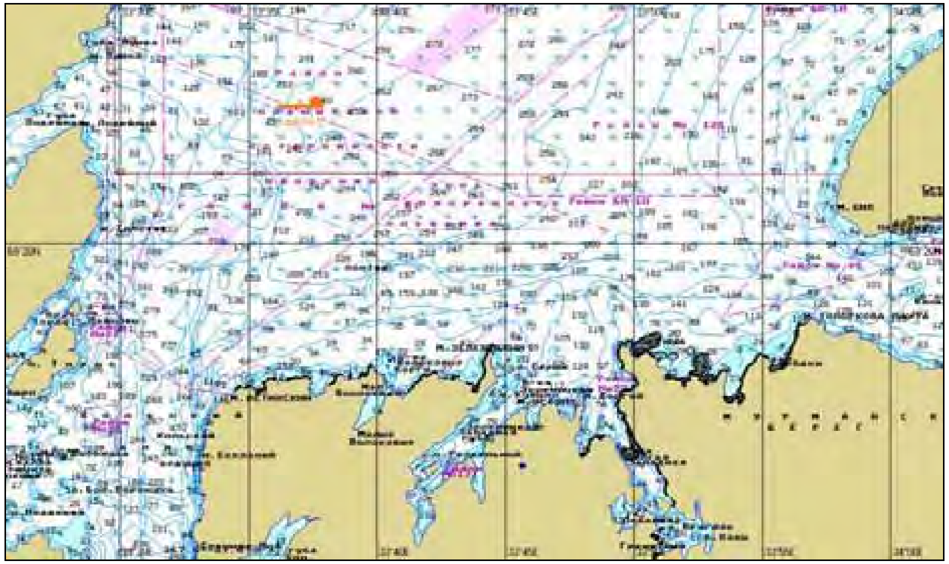


Figure 284. H+18:00. Oil slick spreading as per the scenario GC-Spr-NW-1.

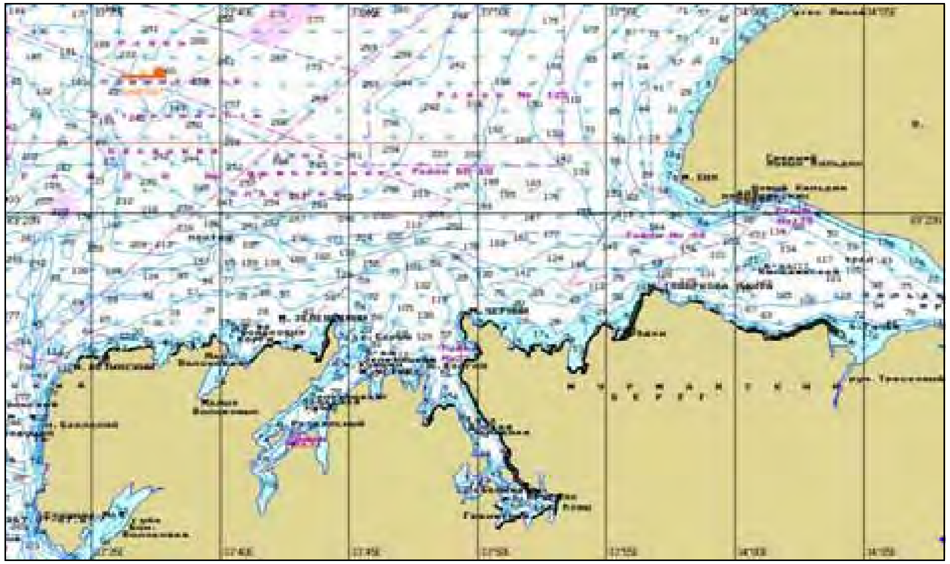


Figure 284. H+24:00. Oil slick spreading as per the scenario GC-Spr-NW-1.

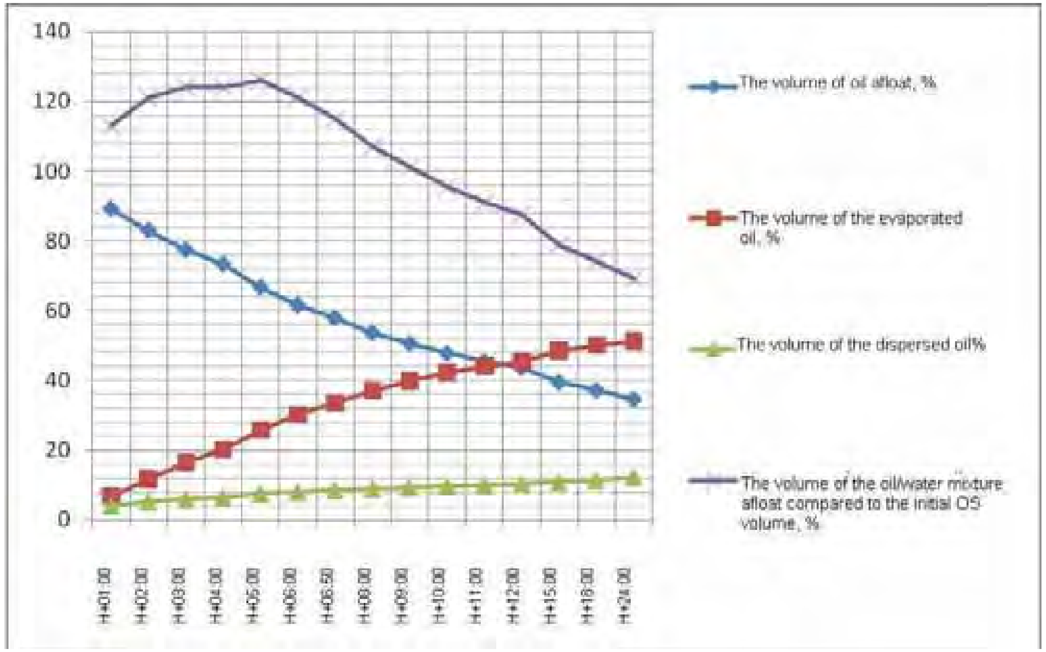



Figure 285. The chart of processes as per the scenario GC-Spr-NW-1.

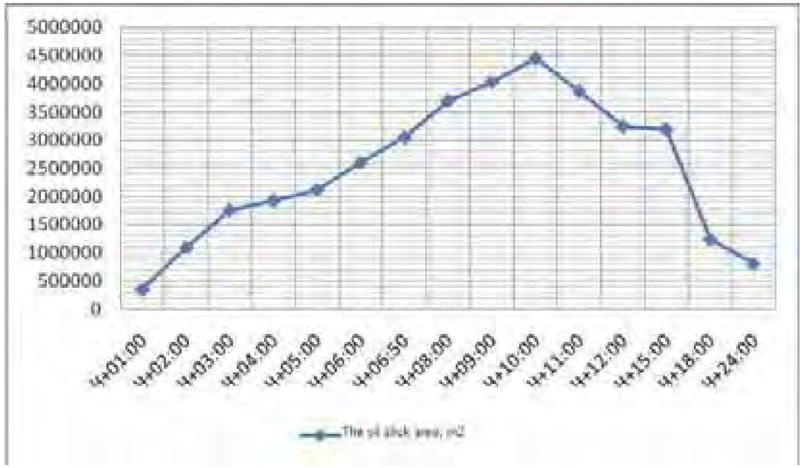



Figure 286. Oil slick area change dynamics as per the scenario GC-Spr-NW-1.

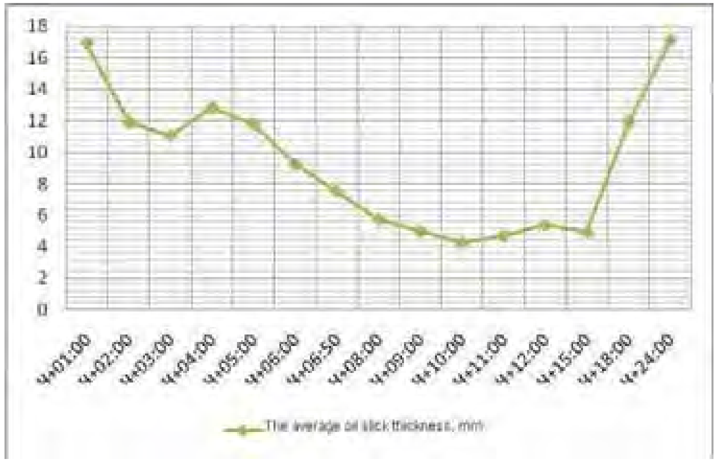



Figure 287 Oil slick thickness change dynamics as per the scenario GC-Spr-NW-1.

### 1.5.4 Oil slick behaviour modelling as per the scenario Na-Spr-NW-1

*Table 1.5.4.1: Oil slick spreading parameters as per the scenario Na-Spr-NW-1*

| Modelling interval | Oil spill volume | | Oil volume afloat | | Evaporated oil volume | | Dispersed oil volume | | Oil volume ashore | | Oil/water mixture volume afloat | Average oil slick thickness | Oil slick area | Viscosity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | % | $m^3$ | mm | $m^2$ | cSt |
| H+01:00 | 2764 | 100 | 2313 | 83,7 | 404 | 14,6 | 47 | 1,70 | 0 | 0 | 2757 | 9,17 | 300595 | 5,4 |
| H+02:00 | 5408 | 100 | 3908 | 72,3 | 1364 | 25,2 | 136 | 2,51 | 0 | 0 | 4983 | 5,11 | 974723 | 18,4 |
| H+03:00 | 7909 | 100 | 4982 | 63,0 | 2685 | 33,9 | 242 | 3,06 | 0 | 0 | 6534 | 3,85 | 1697564 | 46,8 |
| H+04:00 | 10000 | 100 | 5618 | 56,2 | 4029 | 40,3 | 353 | 3,53 | 0 | 0 | 7580 | 3,68 | 2061930 | 92,4 |
| H+05:00 | 10000 | 100 | 4561 | 45,6 | 4984 | 49,8 | 457 | 4,57 | 0 | 0 | 6459 | 2,74 | 2357697 | 267 |
| H+06:00 | 10000 | 100 | 3820 | 38,2 | 5630 | 56,3 | 550 | 5,50 | 0 | 0 | 5450 | 1,88 | 2905373 | 512 |
| H+06:45 Landfall | 10000 | 100 | 3354 | 33,5 | 6024 | 60,2 | 621 | 6,21 | 0 | 0 | 4790 | 1,44 | 3315835 | 755 |
| H+07:00 | 10000 | 100 | 3217 | 32,2 | 6135 | 61,4 | 643 | 6,43 | 5,06 | 0,05 | 4595 | 1,36 | 3369336 | 842 |
| H+08:00 | 10000 | 100 | 2717 | 27,2 | 6530 | 65,3 | 732 | 7,32 | 22,4 | 0,22 | 3880 | 0,99 | 3901859 | 1239 |
| H+09:00 | 10000 | 100 | 2296 | 23,0 | 6850 | 68,5 | 818 | 8,18 | 36,8 | 0,37 | 3280 | 0,80 | 4107128 | 1697 |
| H+10:00 | 10000 | 100 | 1912 | 19,1 | 7130 | 71,3 | 903 | 9,03 | 55,2 | 0,55 | 2733 | 0,61 | 4468761 | 2232 |
| H+12:00 | 10000 | 100 | 1339 | 13,4 | 7481 | 74,8 | 1063 | 10,6 | 117 | 1,17 | 1913 | 0,61 | 3113596 | 3153 |
| H+15:00 | 10000 | 100 | 811 | 8,11 | 7766 | 77,7 | 1241 | 12,4 | 182 | 1,82 | 1159 | 0,65 | 1791428 | 4185 |
| H+18:00 | 10000 | 100 | 678 | 6,78 | 7837 | 78,4 | 1282 | 12,8 | 204 | 2,04 | 968 | 2,67 | 362267 | 4492 |

Within the first 6 hours as of the OS start the oil slick spreads southward of the OS point under the action of the wind and current. After 4 hours as of the OS start the oil slick semi-perimeter makes 2545 m, the volume of the evaporated oil – 40,3%, the volume of the dispersed oil – 3,5%. After 6 hours and 45 minutes the oil slick reaches the eastern coastline of the Toros Island. Impacting first the coastline in the area of the Cape Letinskiy. Further the oil slick drifts south-eastward in the direction of the Kildin Island. After 9 hours as of the OS start the slick semi-perimeter makes 3591 m, the volume of the evaporated oil – 68,5%, the volume of the dispersed oil – 8,2%. The oil slick drifts eastward and is partially washed ashore on the Murmansk coastline of the Barents Sea. After 12 hours ass of the OS start the volume of the evaporated oil – 74,8%, the volume of the dispersed oil – 10,6%. The volume of the oil/water mixture has decreased compared to the OS volume with 80,9%. To the moment of the modelling completion (18 hours) , the oil slick has spread along the strips of the Barents Sea coastline from the Cape Letinskiy to the cape Toporkov Pakhta. The volume of the evaporated oil – 78,4%, the volume of the dispersed oil – 12,8%, 6,8% of the OS volume remains afloat, the average oil slick thickness makes 2,7 mm.

The graphic display of the oil slick spreading as per the scenario Na-Spr-NW-1 is shown in figures 288 – 164.

The charts of processes typical for the oil behaviour on water are shown in figures 165-167.

Figure 288. H+01:00. Oil slick spreading as per the scenario Na-Spr-NW-1.

Figure 289. H+02:00. Oil slick spreading as per the scenario Na-Spr-NW-1.

Figure 290. H+03:00. Oil slick spreading as per the scenario Na-Spr-NW-1.

Figure 291. H+04:00. Oil slick spreading as per the scenario Na-Spr-NW-1.

Figure 292. H+05:00. Oil slick spreading as per the scenario Na-Spr-NW-1.

Figure 293. H+06:00. Oil slick spreading as per the scenario Na-Spr-NW-1.

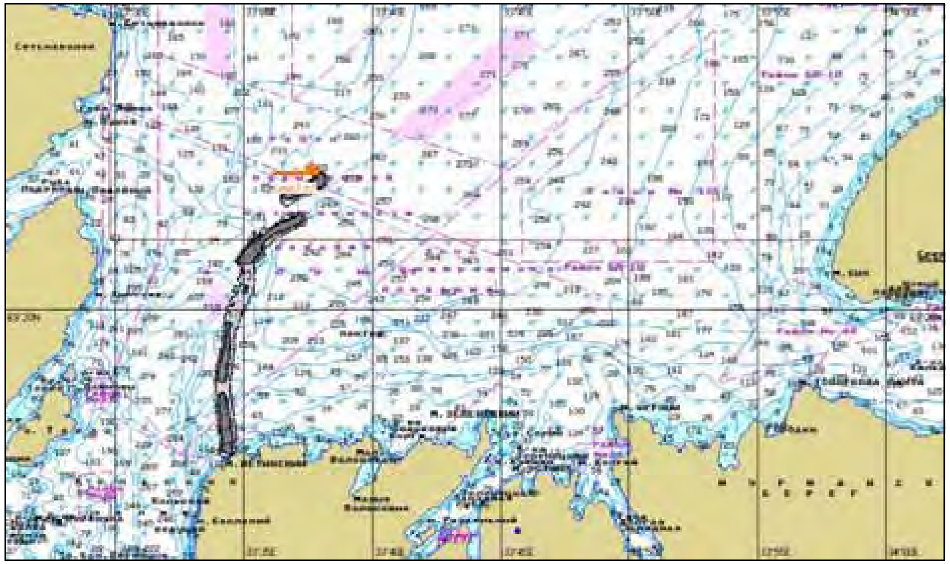


Figure 294. **H+06:45.** Oil slick spreading as per the scenario Na-Spr-NW-1.

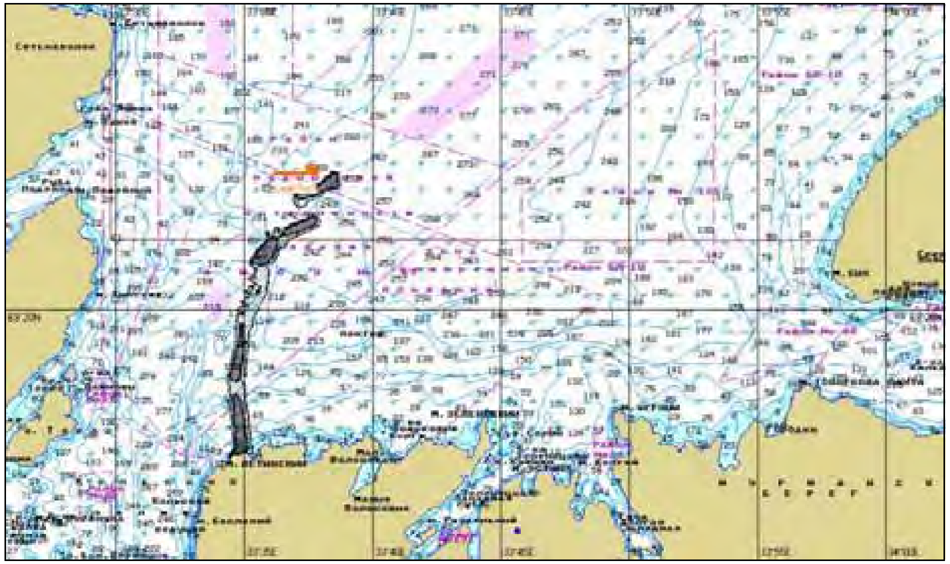


Figure 295. H+07:00. Oil slick spreading as per the scenario Na-Spr-NW-1.

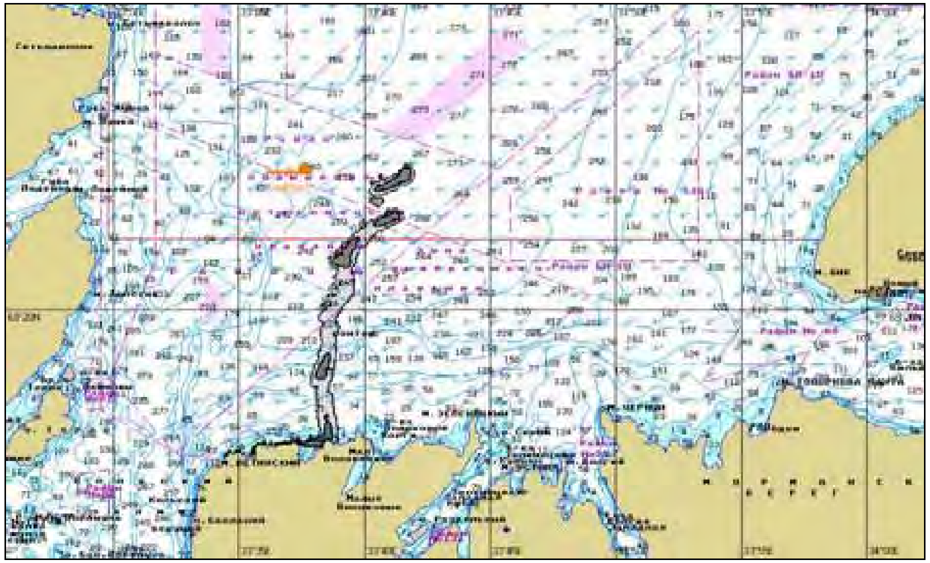


Figure 296. H+08:00. Oil slick spreading as per the scenario Na-Spr-NW-1.

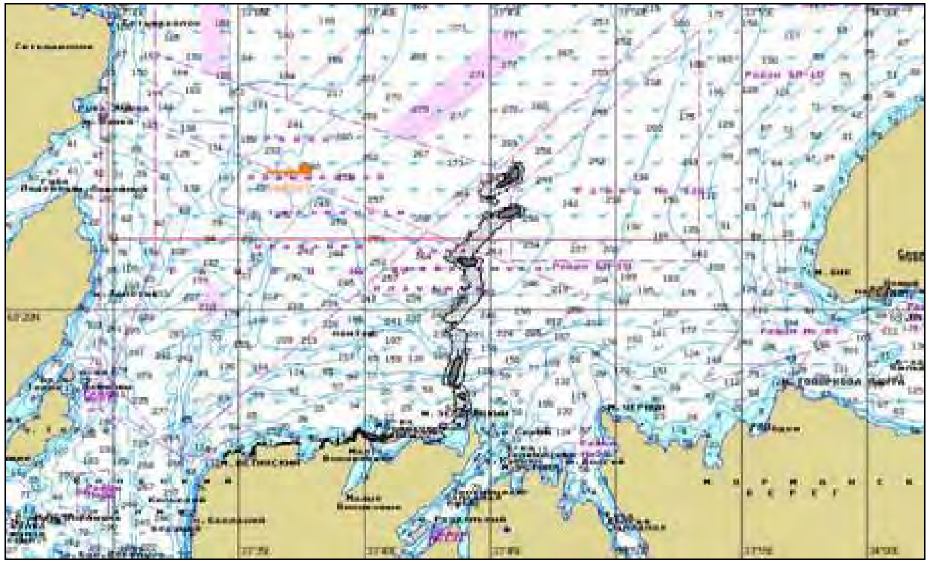


Figure 297. H+09:00. Oil slick spreading as per the scenario Na-Spr-NW-1.

Figure 298. H+10:00. Oil slick spreading as per the scenario Na-Spr-NW-1.

Figure 299. H+12:00. Oil slick spreading as per the scenario Na-Spr-NW-1.

Figure 300. H+15:00. Oil slick spreading as per the scenario Na-Spr-NW-1.

Figure 301. H+18:00. Oil slick spreading as per the scenario Na-Spr-NW-1.

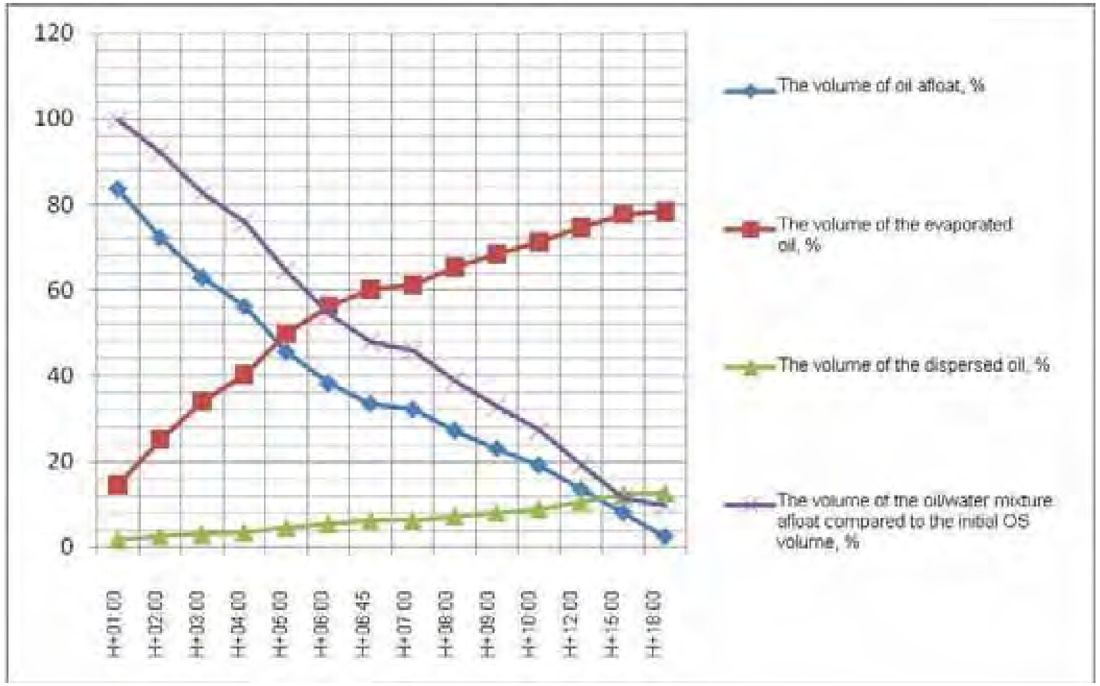



Figure 301. The chart of processes as per the scenario Na-Spr-NW-1.

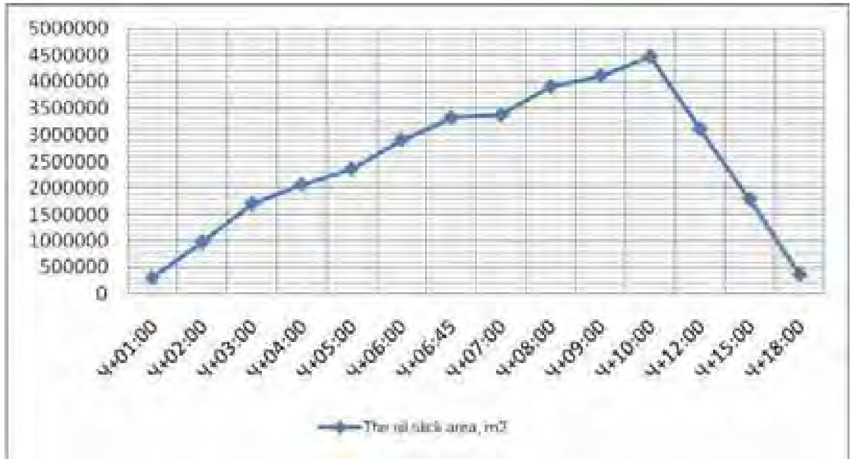



Figure 302. Oil slick area change dynamics as per the scenario Na-Spr-NW-1.

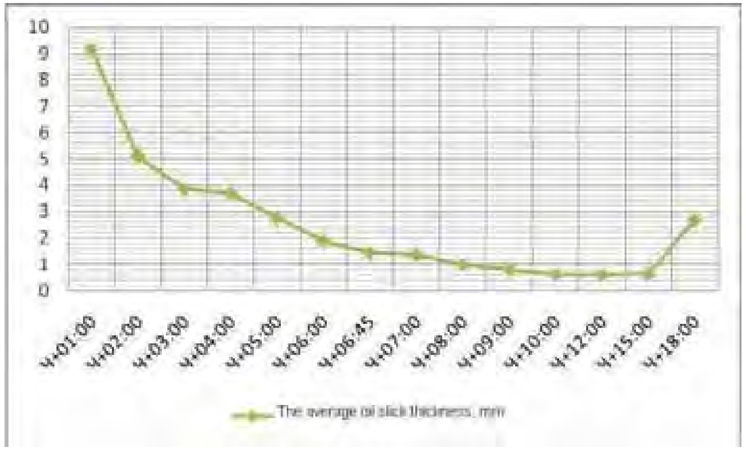



Figure 303. Oil slick thickness change dynamics as per the scenario Na-Spr-NW-1.

## 1.5.5 The process dynamics typical for oil spill behaviour in the Barents Sea under the spring north-westward wind (Spr-NW-1)

Figures 304-308 show dynamics of processes typical for the oil behaviour in the Barents Sea as per the scenarios Spr-NW-1.

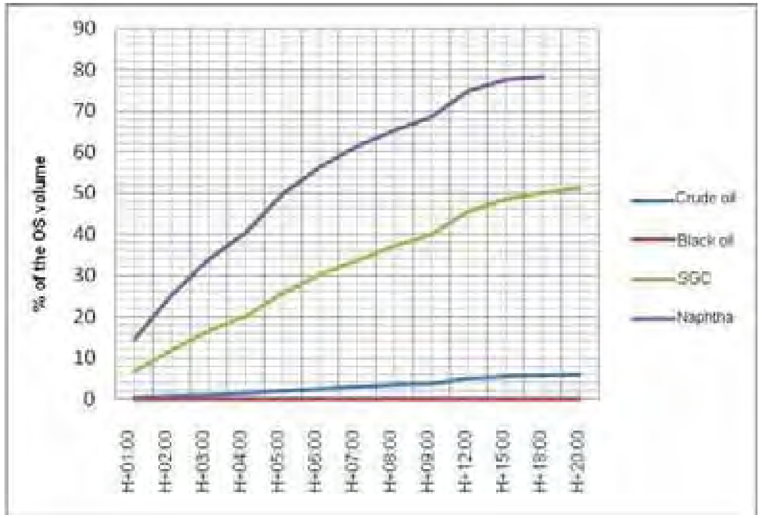



Figure 304. The evaporation process chart as per the scenarios Spr-NW-1.

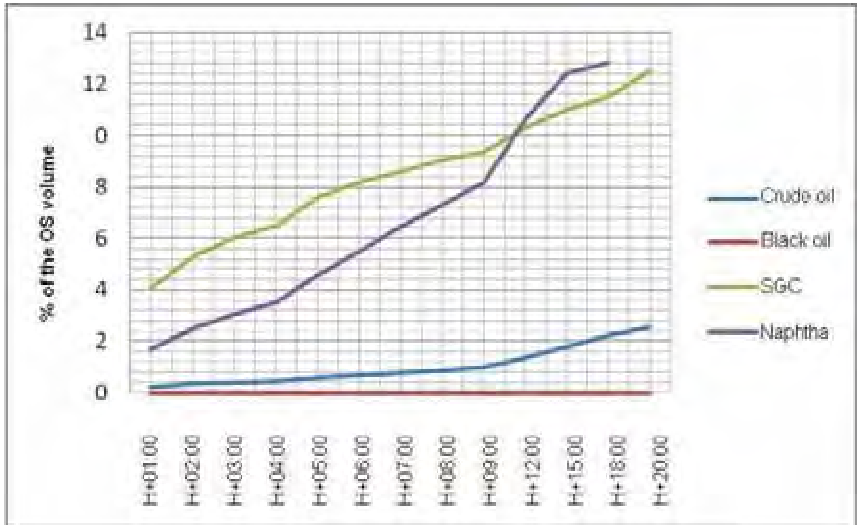



Figure 305. The dispersion process chart as per the scenarios Spr-NW-1.

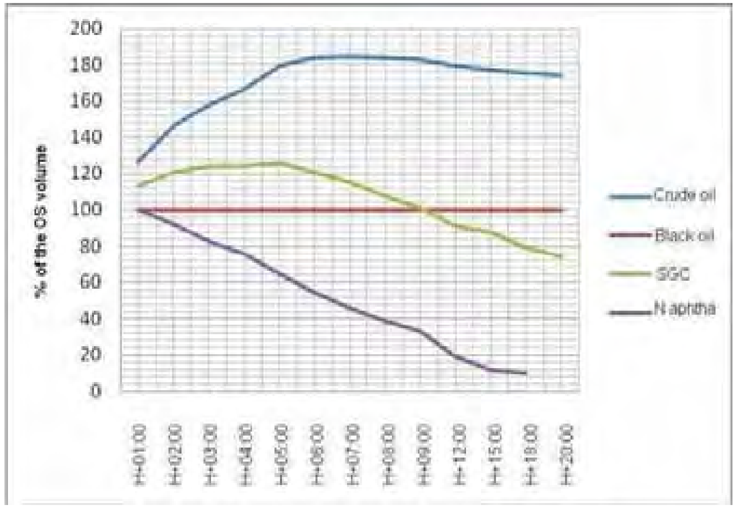



Figure 306. Oil/water mixture volume change dynamics as per the scenarios Spr-NW-1.

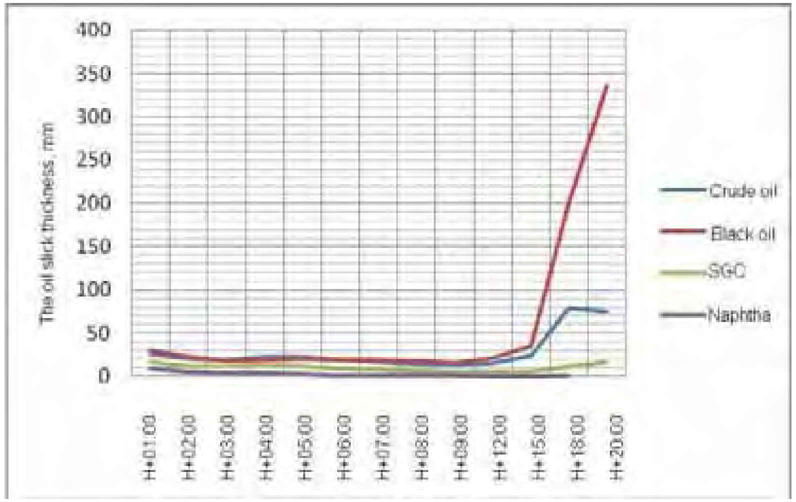



Figure 307. Oil slick thickness change dynamics as poper the sceanrios Spr-NW-1.

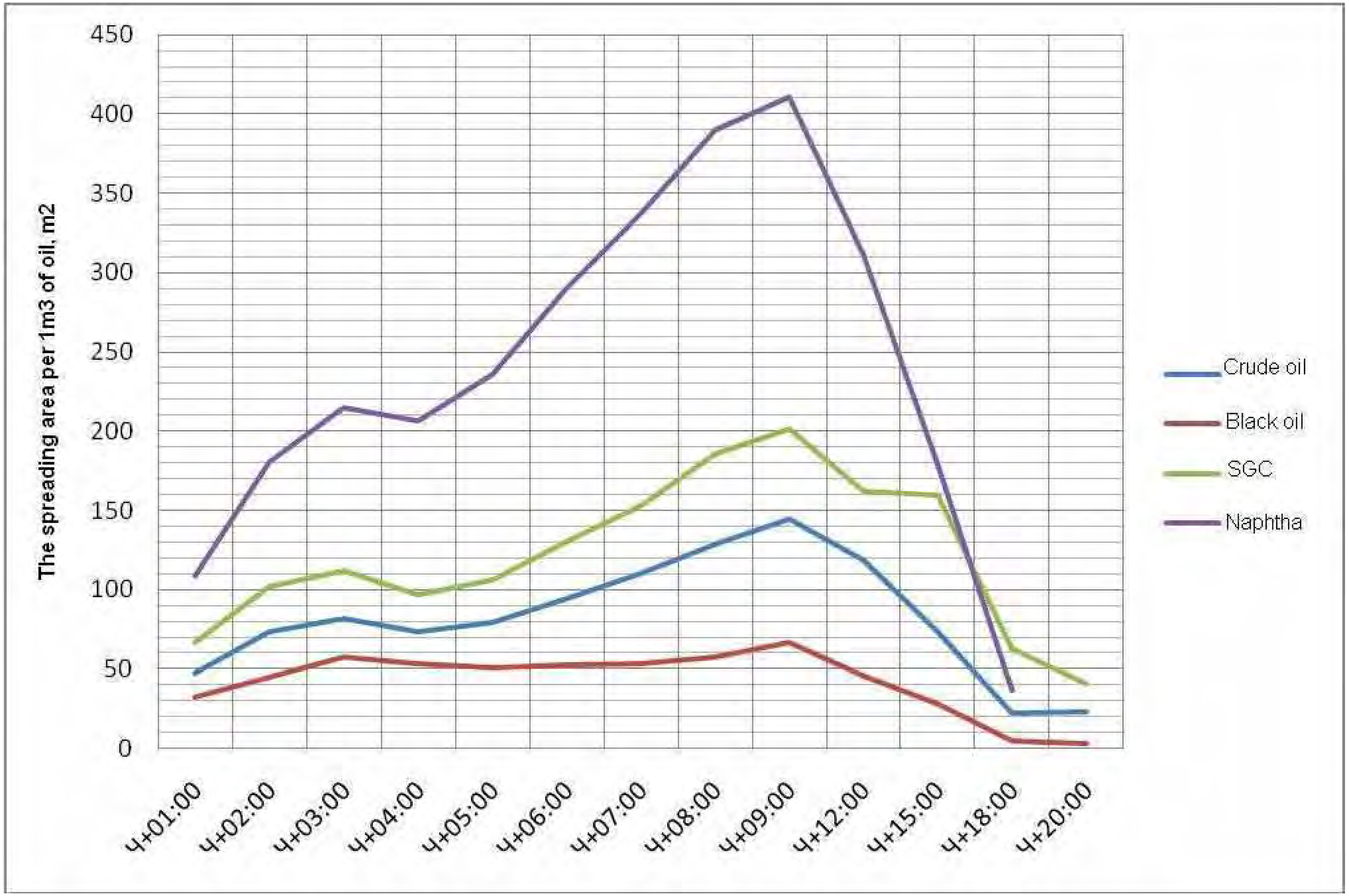



*Figure 308. Oil spill spreading area change dynamics per 1 м $^{3}$ of various types of oil as per the scenarios Spr-SW-1.*