ANNEX 07 : OIL SPILL MODELLING REPORT

A part of BMT in Energy and Environment

Aegean Sea:
Oil Spill Modelling Assessment

Reference: A.BMT.193W
Client: Energean Oil & Gas
Date: February 2016
Confidential

Intentionally blank page

Document Control

Document Title	Aegean Sea: Oil Spill Modelling Assessment
Client	Energean Oil & Gas
BMT Cordah Document Ref.	A.BMT.193
Rev.	V2.0
Terms	This report is confidential. No part may be cited without the express permission of BMT Cordah Ltd or Energean Oil & Gas. It must not be published or made available in any publicly available form such as a website without written permission. Additionally, to minimise the risk of identity fraud, this page containing signatures must be removed.

Rev.	Description	Prepared	Checked	Approved	Date
1.0	Draft Issue to Client	L Lépissier	C Hinton	J Ferris	19.02.16
2.0	Final Issue to Client following comments	L Lépissier	N MacDonald	J Ferris	19.02.16

BMT Cordah Limited
Broadfold House, Broadfold Road
Bridge of Don, Aberdeen
UK, AB23 8EE

Tel: +44(0)1224 414200
Fax: +44(0)1224 414250
Email: enquiries@bmtcordah.com
Website: www.bmtcordah.com

Contents

1.0 INTRODUCTION....................1

2.0 MODELLING APPROACH AND DESCRIPTION....................2

2.1 Modelling Approach....................2

2.2 Modelling Description....................2

2.3 Assumptions....................2

3.0 MODEL SCENARIOS....................3

3.1 Oil Type....................4

3.2 Meteorological Data....................4

3.3 Hydrodynamic Data....................4

3.3.1 Tidal Model....................5

4.0 MODEL RESULTS....................5

4.1 Well Blow-out Results....................5

4.1.1 Winter scenarios....................5

4.1.2 Summer scenarios....................14

4.2 Pipeline Release....................20

4.2.1 Winter scenarios....................20

4.2.2 Summer scenarios....................28

4.3 Loading Buoy....................34

5.0 DISCUSSION....................36

6.0 REFERENCES....................37

APPENDIX A:....................38

MODELLING INPUT DATA....................38

1.0 INTRODUCTION

BMT Cordah Ltd (Cordah) was commissioned by Energean Oil & Gas to undertake a suite of oil spill modelling scenarios in support of a development for a proposed offshore structure in the North Aegean Sea, approximately, 6 km south of Kavala in water depths ranging between 30 and 40 m.

In order to gain financing for the proposed development, the banks require that a suite for 2-Dimensionsal oil spill modelling is undertaken. The suite of simulations, as developed by Energean Oil & Gas, are intended to replicate the passage of spilt oil under a likely range of metocean conditions which could be experienced at the site. Thus, a total of 25 simulations, covering summer and winter conditions, have been assessed and are presented within this document.

The oil spill assessments have allowed for surface oil releases as a:

- Continuous release resulting from a well blow-out at the Lamda platform;
- Continuous release from the product pipeline; and
- An instantaneous release from an incident at the loading buoy.

2.0 MODELLING APPROACH AND DESCRIPTION

The modelling reported in this assessment has been undertaken to provide a high level indication of the likely trajectories, beaching locations and volumes resulting from a series of accidental spill events occurring within the Aegean Sea.

This section provides an overview of the modelling approach and a description of the oil spill model applied within the project.

2.1 Modelling Approach

The modelling approach adopted within this study was selected in-line with a need to understand key resultant parameters associated with a series of hypothetical accidental spill events. Further a consideration of the pre-existing environmental characteristics was also undertaken to guide the approach, specifically the:

- Local water depths, documented to be in the range 30 to 40 m at the three different release locations; and
- Metocean conditions, an assessment of which indicates that the regular (daily) current speeds are negligible (BMT Argoss, 2015). This is further supported by an assessment of the extreme surface current speeds. For a 1 year return period, extreme current speeds range between 0.10 m/s and 0.54 m/s, originating from the northwest and west, respectively.

2.2 Modelling Description

BMT's Oil Spill Information System (OSIS) model can simulate the fate and dispersion of surface oil slicks. OSIS was jointly developed by BMT and AEA Technology plc. (Walker, 1995). OSIS is a particle-tracking model that represents an oil slick as a collection of free moving particles, which simulate the spreading slick. The weathering model and associated algorithms within OSIS have been validated against controlled actual spills at sea and real spill events, supported with laboratory calibration. These models combine the following parameters to define the fate of oil at sea:

- Weathering algorithms that determine physical change in a slick as it spreads.
- Transport processes acting on the oil due to the current, wind, waves, diffusion and buoyancy in the ocean surface layer.
- Changes due to evaporation, emulsification and natural dispersion of oils.
- Prediction of physical properties such as density, viscosity and flash point changes.

OSIS supports several model types, but are generally characterised as either deterministic (trajectory) or stochastic. Deterministic models allow simulation of a point source spill scenario under a defined set of metocean parameters. Stochastic models allow simulation of a point source spill under a specified number of different probable metocean conditions (wind speed and direction).

2.3 Assumptions

A number of assumptions and limitations have been considered in this study:

- The well blow-out and pipeline release scenarios have been modelled as surface release, however in reality these releases are subsea events. Modelling have been undertaken under deterministic mode, with a fixed wind blowing for pre-specified durations (hours to days). The simulations should therefore be considered as worst-case scenarios as it is improbable that wind conditions will remain constant in terms of wind speed and direction over such time periods.

- The volumes of oil beached correspond to emulsified oil. Consequently it should be expected that the volume of oil beached will be greater than the volume of oil released. This is due to the emulsification process. Most oils will absorb droplets of water under the action of waves on the sea surface. The resulting water in oil emulsion can increase the volume of pollutant by up to 5 times and is usually very viscous and more persistent than the original oil (ITOPF, 2012).Considering emulsified oil is more realistic when considering volumes that may need to be responded to during an oil spill incident.

3.0 MODEL SCENARIOS

Deterministic models were used to simulate a point source spill scenario under a range of metocean conditions. A total of 25 deterministic scenarios were undertaken using a release date corresponding to the worst case scenario of the summer and winter periods. The scenarios represent the trajectory of the spilt contaminant from three different locations within the Aegean Sea, namely:

- Well blow-out (five summer scenarios; seven winter scenarios);
- Product pipeline release (five summer scenarios; seven winter scenarios); and
- Loading buoy incident release (one summer scenario).

The release parameters considered for the modelling are presented in Table 1.

Table 1: Deterministic scenarios – oil spill characteristics

Scenario	Location	Oil spill characteristics		
		Total quantity released (m^3)	Release rate ($m^3\ h^{-1}$)	Release duration (h)
Well blow-out	24° 27' 12.97"E 40° 48' 33.55"N	475	19.8	24
Product pipeline release	24° 31' 02.02"E 40° 52' 01.09"N	410	48.2	8.5
Loading buoy incident release	24°31'32.79"E 40°56'2.16"N	60	1800	0.033

The model simulations were undertaken until the oil on the sea surface becomes insignificant, which correspond to the end of the simulation.

The following information is presented for each scenario:

- Trajectory and position of spilt oil at three pre-specified times:
  - three hours following initial release (which corresponds to the maximum time required to mobilise the spill response team);
  - when the spill first reaches the shoreline; and

- o when the amount of oil at sea becomes insignificant.
- Beaching locations; and
- Volumes of beached oil (as emulsified oil).

3.1 Oil Type

The two oil types found at the Lamda Platform and within the pipeline are not available in the OSIS oil database. Consequently, and in line with best practise, an analogue was selected based on a best matching of oil characteristics (Table 2).

Table 2: Oil types and characteristics

Oil type	Specific gravity	API (^{O})	Pour point (˚)	Dynamic viscosity (mPA/S or cP	Wax content (% wt)
Well blow-out					
Epsilon Fluid	0.844	36	<-36	9	3.9
OSIS analogue: Kirkuk	0.844	36	-34	1.15 - 9	-
Product pipeline release/ Loading buoy incident release					
Export Fluid: Epsilon +Prinos	0.852	34.5	<-24	8	1.7
OSIS analogue: Basrah Light	0.852	34.6	-30	1.35 - 9	-

3.2 Meteorological Data

For each scenario, specific wind speed and direction were specified by Energean Oil & Gas for the application in the modelling during winter and summer seasons. Details of the wind characteristics are summarised in Appendix A.

The average seasonal temperatures at the location of interest are presented in Table 3.

Table 3: Sea and air temperatures used for modelling

Season	Month of reference	Sea temperature (˚C)*	Air temperature (˚C)**
Winter	February	12.0	7.5
Summer	July	24.0	25.2

*Sea temperatures have been provided by Energean Oil & Gas.

**Air temperatures have been sourced from BMT Argoss, 2015.

3.3 Hydrodynamic Data

Residual and tidal current datasets are combined for oil spill modelling using OSIS. In the preparation of the datasets the data are interpolated onto a standard time frame (e.g. one hourly).

3.3.1 Tidal Model

Tidal data have been generated by BMT Argoss's own tidal model. BMT Argoss tidal model provides the water motions associated with the eight most significant harmonic constituents of tidal oscillation including the principal lunar and solar semi-diurnal constituents; another 12 constituents are inferred. The global tidal information is based on the integration of, approximately, 5,000 tidal stations and 15 years of satellite radar altimeter measurements into depth average global and regional tidal models (the 2DH model).

The model spatial resolution in the region is 00°01’ x 00°01’. Depth-averaged tidal currents are scaled to the surface assuming a logarithmic profile although at the study site the differences through the water column are negligible (BMT Argoss, 2015).

4.0 MODEL RESULTS

This section presents the results of the modelling simulations undertaken for the following release scenarios:

- Well blow-out at the Lamda Platform (winter and summer);
- Pipeline release (winter and summer); and
- Loading buoy (summer).

For each scenario, images of beaching locations, spill trajectory and position of oil are presented at three pre-specified times:

- Three hours following initial release (which corresponds to the maximum time required to mobilise the spill response team).
- When the spill first reaches the shoreline.
- When the amount of oil at sea becomes insignificant (which corresponds to the end of the simulation).

The results clearly show the limited lateral movement of the spilt oil from the main trajectory, as determined by the direction of the predominant wind condition. This is a direct consequence of the negligible current speeds experienced within the study area, and as confirmed within the project specific metocean assessment (BMT Argoss, 2015).

4.1 Well Blow-out Results

Deterministic results of the winter and summer seasons for the well blow-out scenarios are presented in Section 4.1.1 and 4.1.2, respectively.

4.1.1 Winter scenarios

For each winter scenario, images of beaching locations, spill trajectory and position of oil are presented at three pre-specified times such as:

- Figure 1: Well blow-out 1A.
- Figure 2: Well blow-out 1B.
- Figure 3: Well blow-out 1C.
- Figure 4: Well blow-out 1D.

- Figure 5: Well blow-out 1E.
- Figure 6: Well blow-out 1F.
- Figure 7: Well blow-out 1G.

For each winter scenario simulation for the well blow-out, the volume of emulsified oil beached and the associated minimum arrival time to shore are presented in Table 4.

Table 4: Volume of emulsified oil beached and associated minimum arrival time for the Well blow-out winter scenarios

Scenario	Beaching volume (m³)	Minimum arrival time until beaching (hours)
Well blow-out 1A	319	32
Well blow-out 1B	546	16
Well blow-out 1C	228	36
Well blow- out 1D	322	28
Well blow-out 1E	214	53
Well blow-out 1F	469	71
Well blow-out 1G	809	34

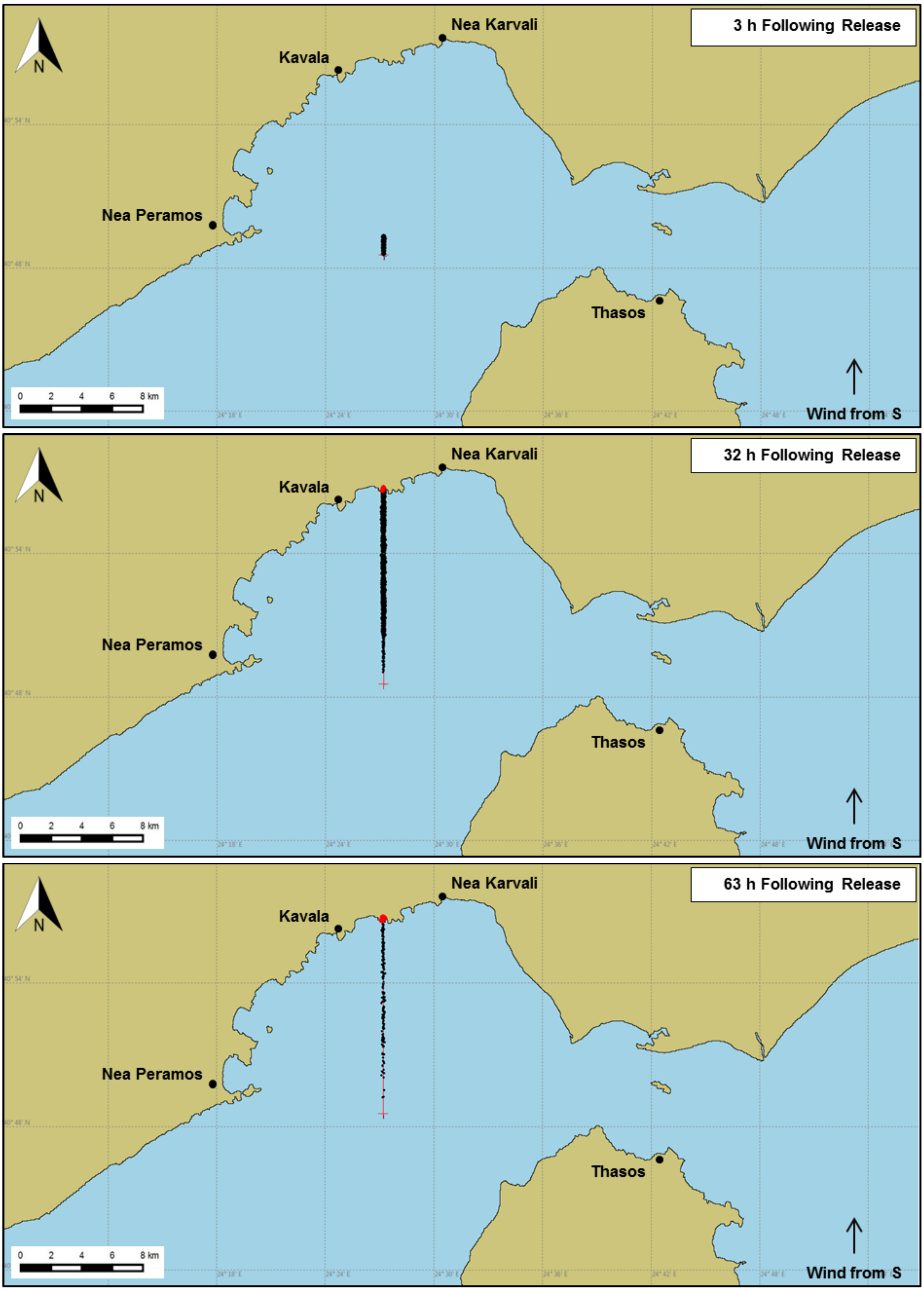

Figure 1: Well blow-out 1A scenario. Deterministic results 3 hours after release (maximum response time); 32 hours after release (minimum arrival time until beaching) and 63 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

Figure 2: Well blow-out 1B scenario. Deterministic results 3 hours after release (maximum response time); 16 hours after release (minimum arrival time until beaching) and 64 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

Figure 3: Well blow-out 1C scenario. Deterministic results 3 hours after release (maximum response time); 36 hours after release (minimum arrival time until beaching) and 65 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

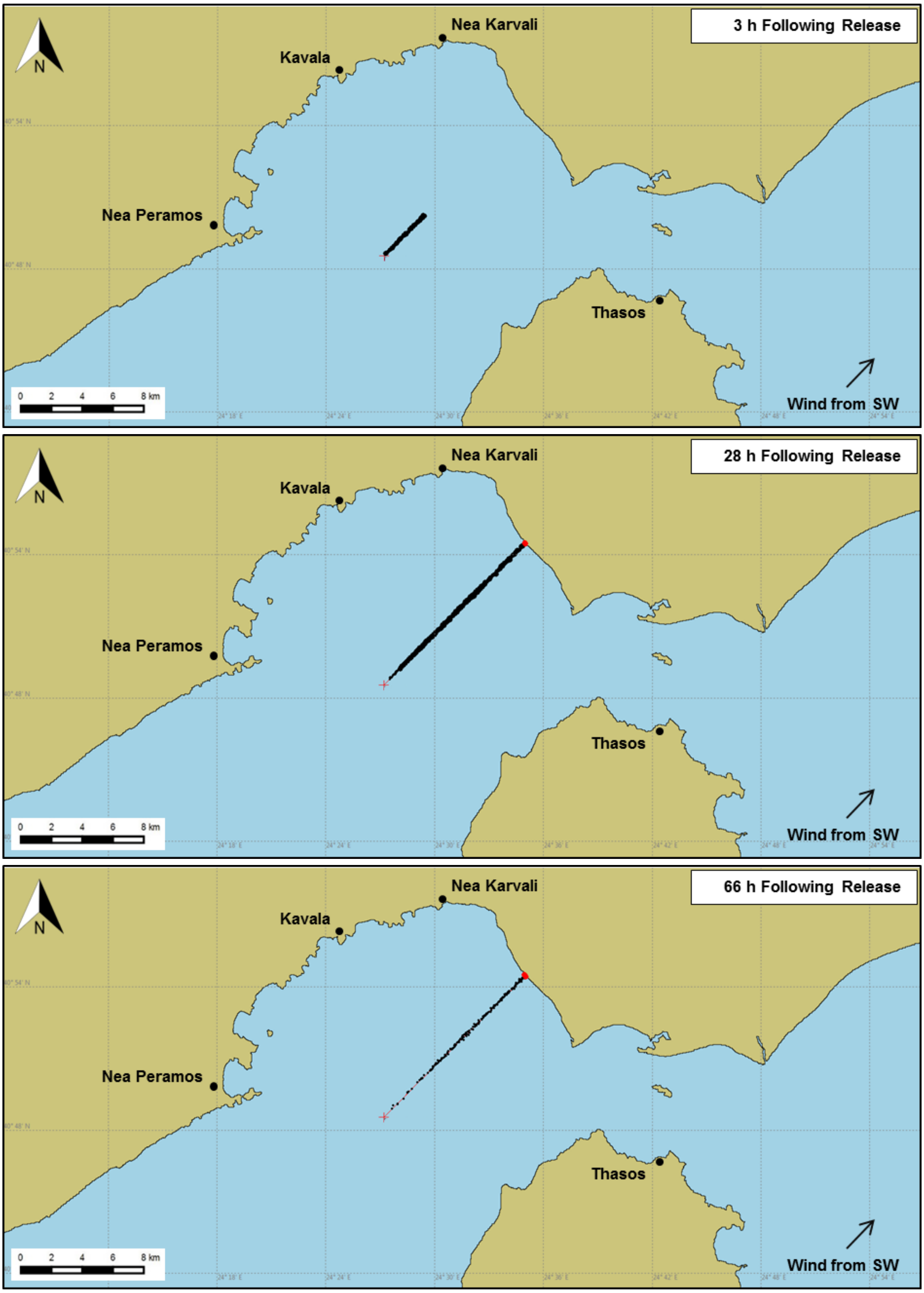

Figure 4: Well blow-out 1D scenario. Deterministic results 3 hours after release (maximum response time); 28 hours after release (minimum arrival time until beaching) and 66 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

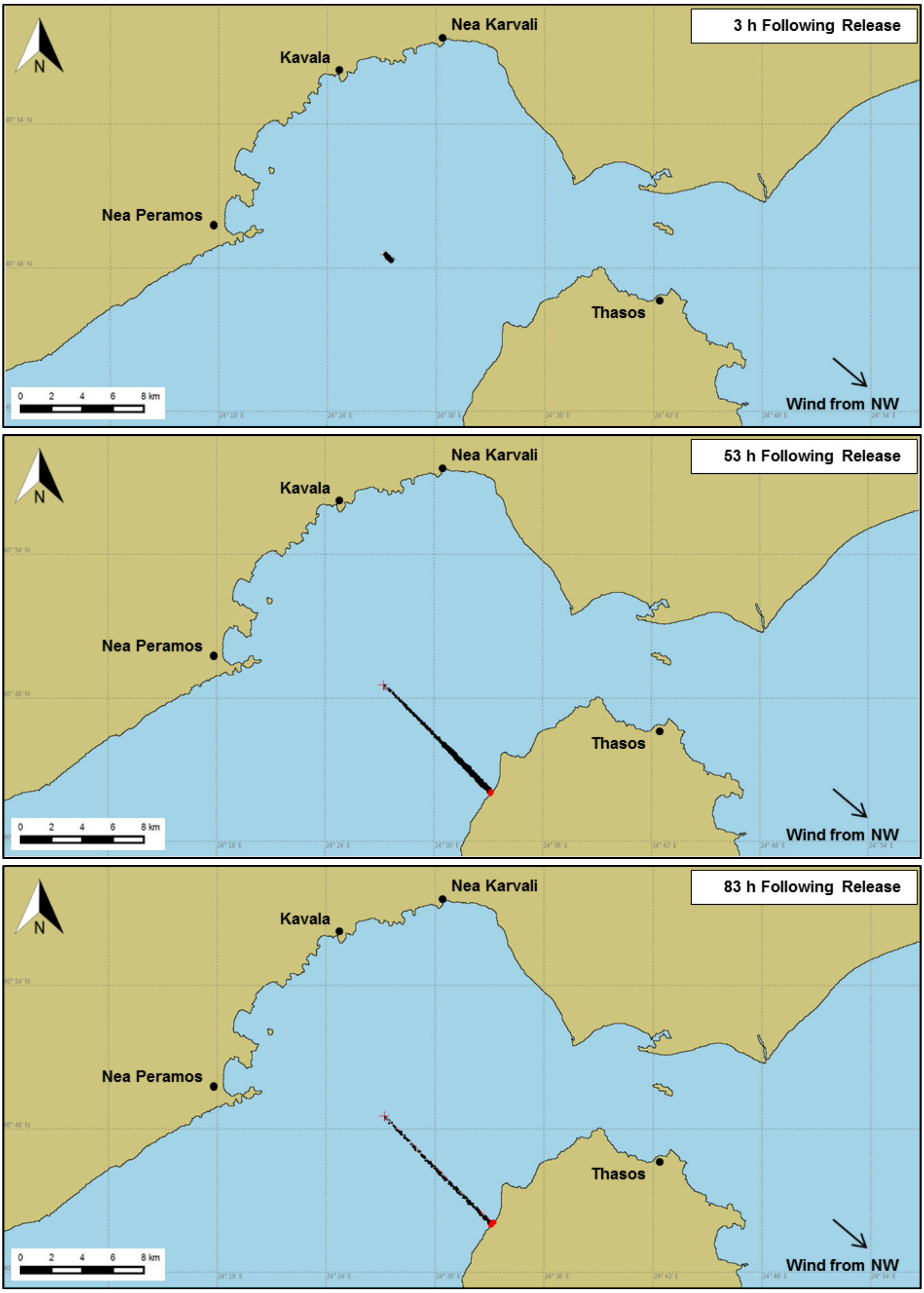

Figure 5: Well blow-out 1E scenario. Deterministic results 3 hours after release (maximum response time); 53 hours after release (minimum arrival time until beaching) and 83 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

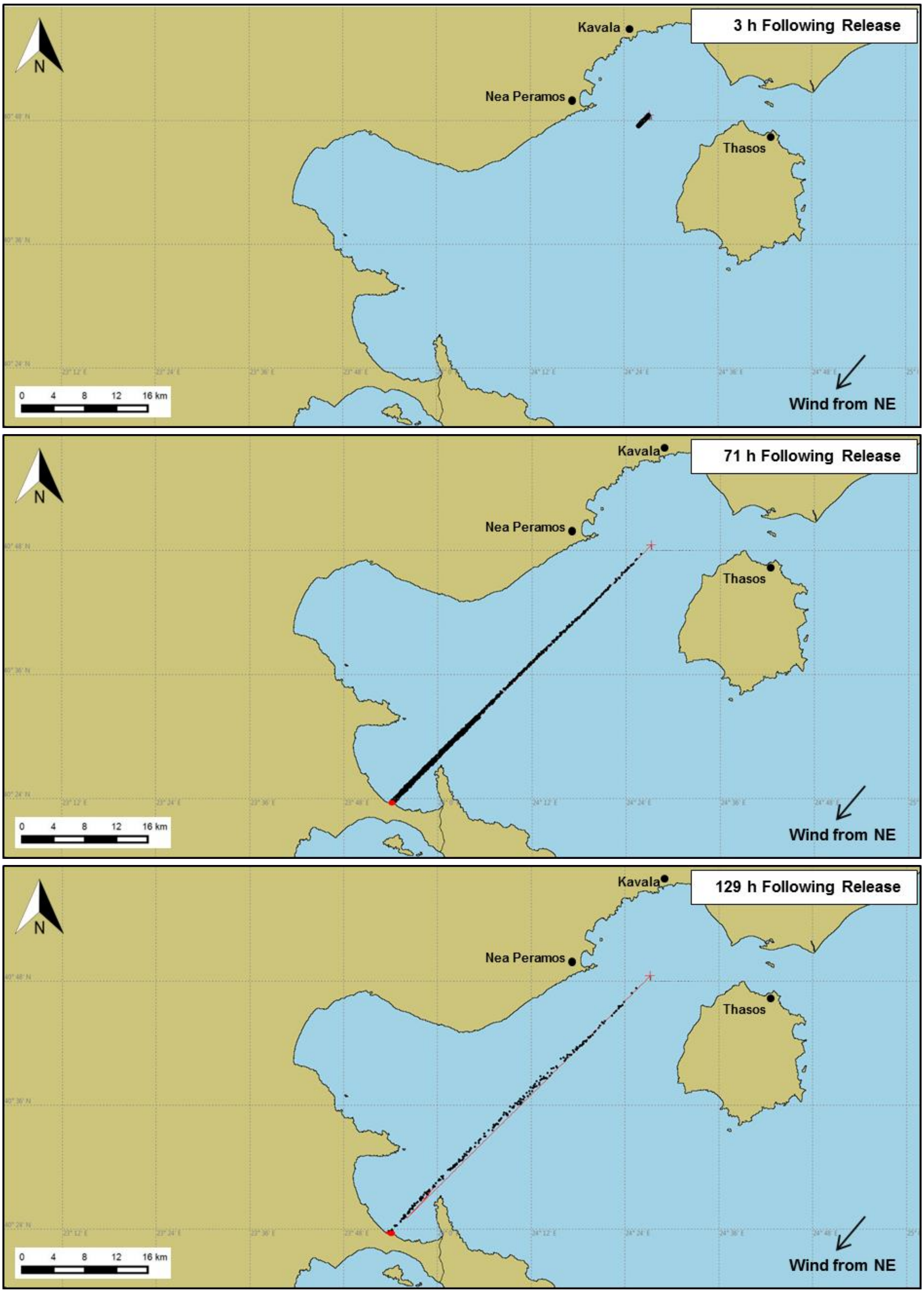

Figure 6: Well blow-out 1F scenario. Deterministic results 3 hours after release (maximum response time); 71 hours after release (minimum arrival time until beaching) and 129 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

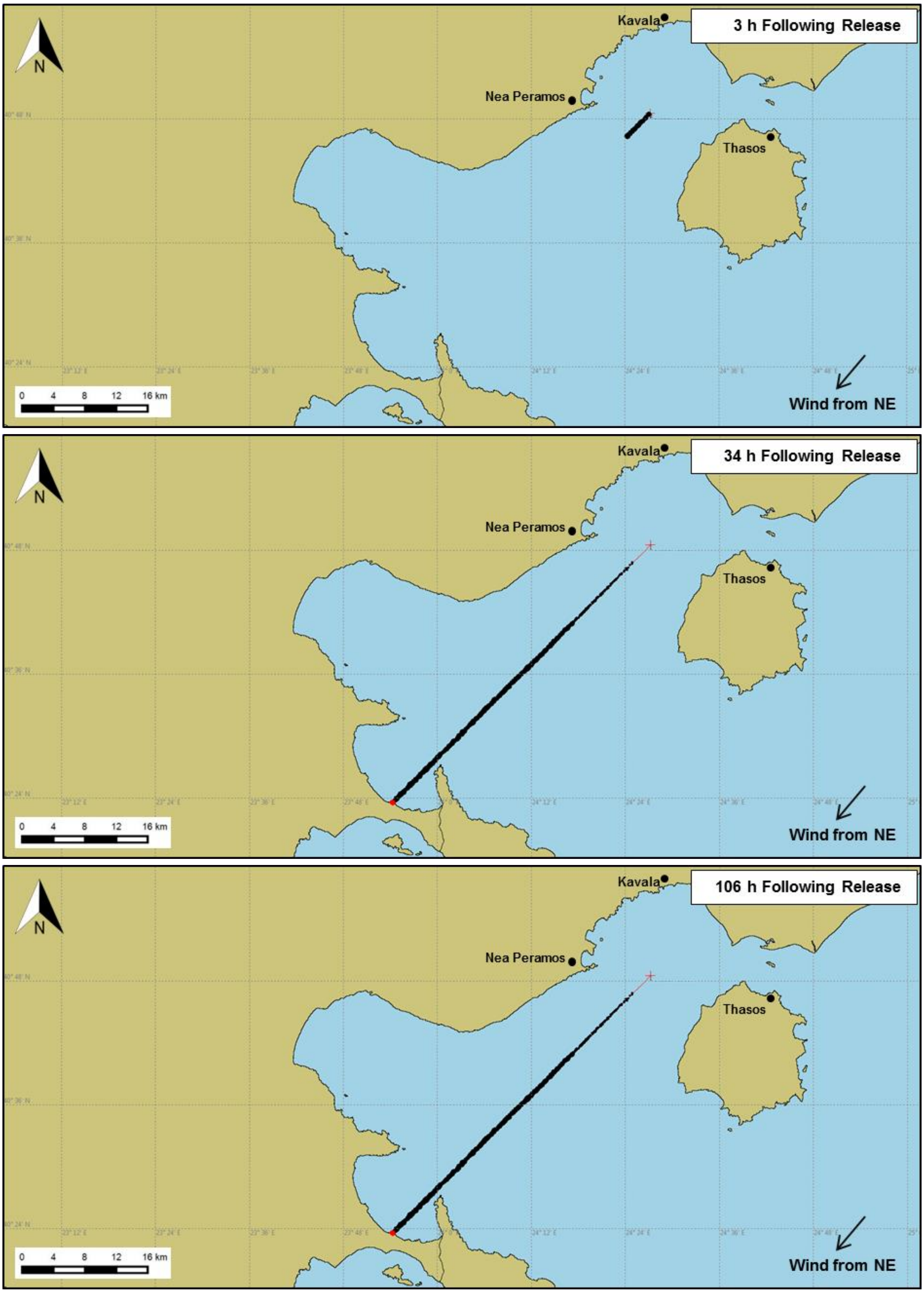

Figure 7: Well blow-out 1G scenario. Deterministic results 3 hours after release (maximum response time); 34 hours after release (minimum arrival time until beaching) and 106 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

4.1.2 Summer scenarios

For each summer scenario, images of beaching locations, spill trajectory and position of oil are presented at three pre-specified times such as:

- Figure 8: Well blow-out 2A
- Figure 9: Well blow-out 2B
- Figure 10: Well blow-out 2C
- Figure 11: Well blow-out 2D
- Figure 12 Well blow-out 2E

For each summer scenario of the well blow-out, the volume of emulsified oil beached and the associated minimum arrival time to shore are presented in Table 5.

Table 5: Volume of emulsified oil beached and associated minimum arrival time for the Well blow-out summer scenarios

Scenario	Beaching volume (m^3)	Minimum arrival time until beaching (hours)
Well blow-out 2A	128	56
Well blow-out 2B	237	36
Well blow-out 2C	215	48
Well blow- out 2D	503	111
Well blow-out 2E	540	99

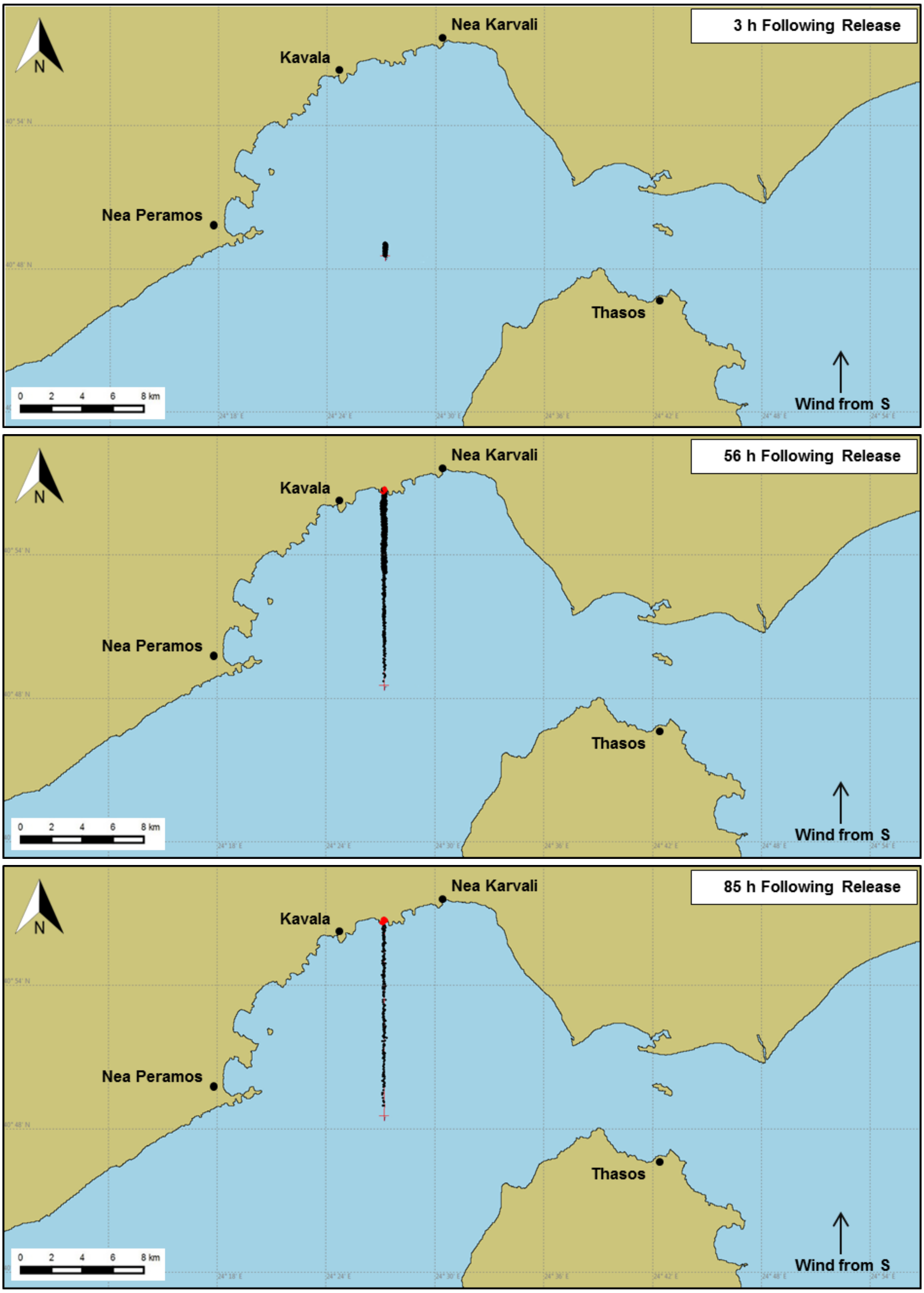

Figure 8: Well blow-out 2A scenario. Deterministic results 3 hours after release (maximum response time); 56 hours after release (minimum arrival time until beaching) and 85 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

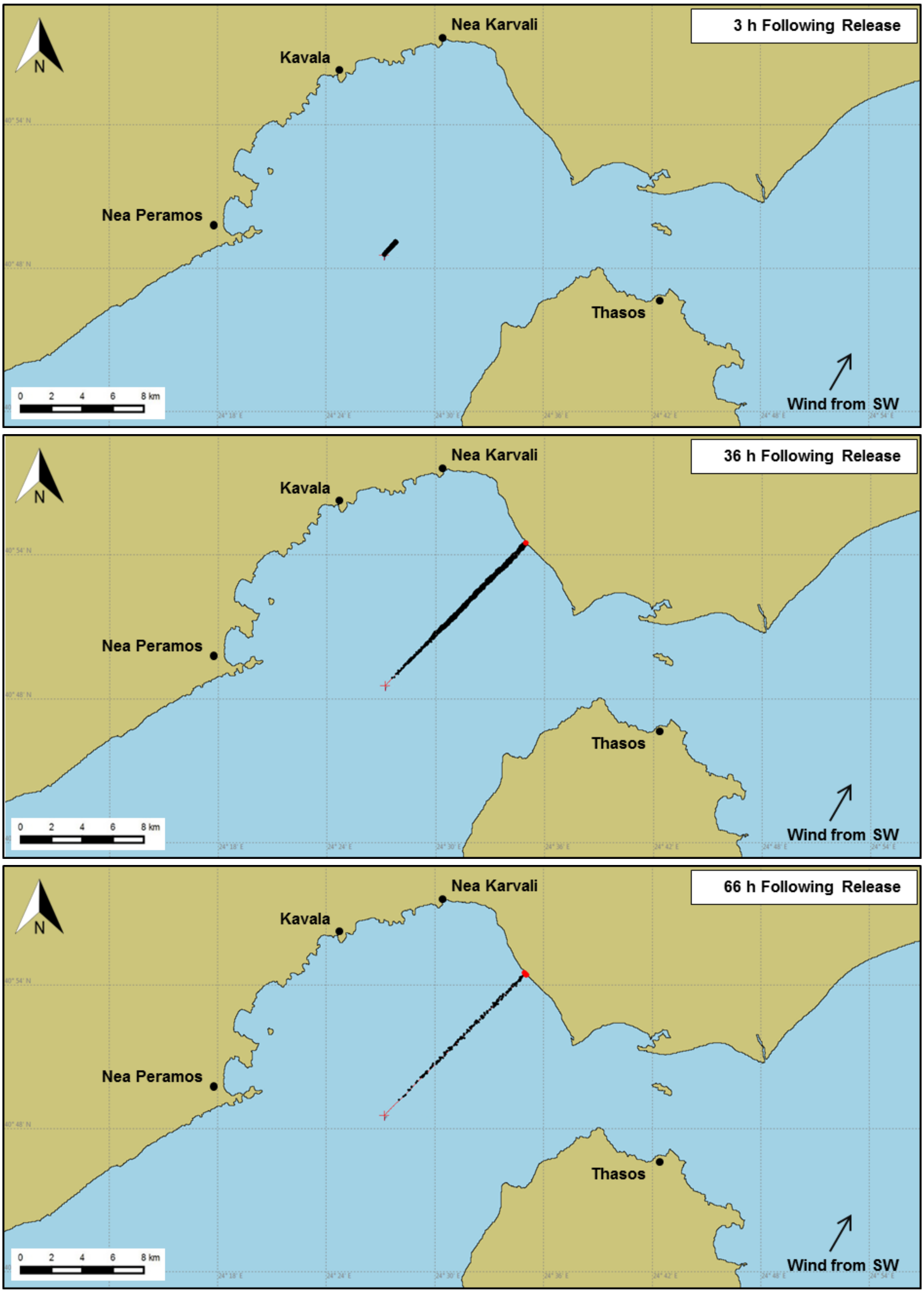

Figure 9: Well blow-out 2B scenario. Deterministic results 3 hours after release (maximum response time); 36 hours after release (minimum arrival time until beaching) and 66 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

Figure 10: Well blow-out 2C scenario. Deterministic results 3 hours after release (maximum response time); 48 hours after release (minimum arrival time until beaching) and 81 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

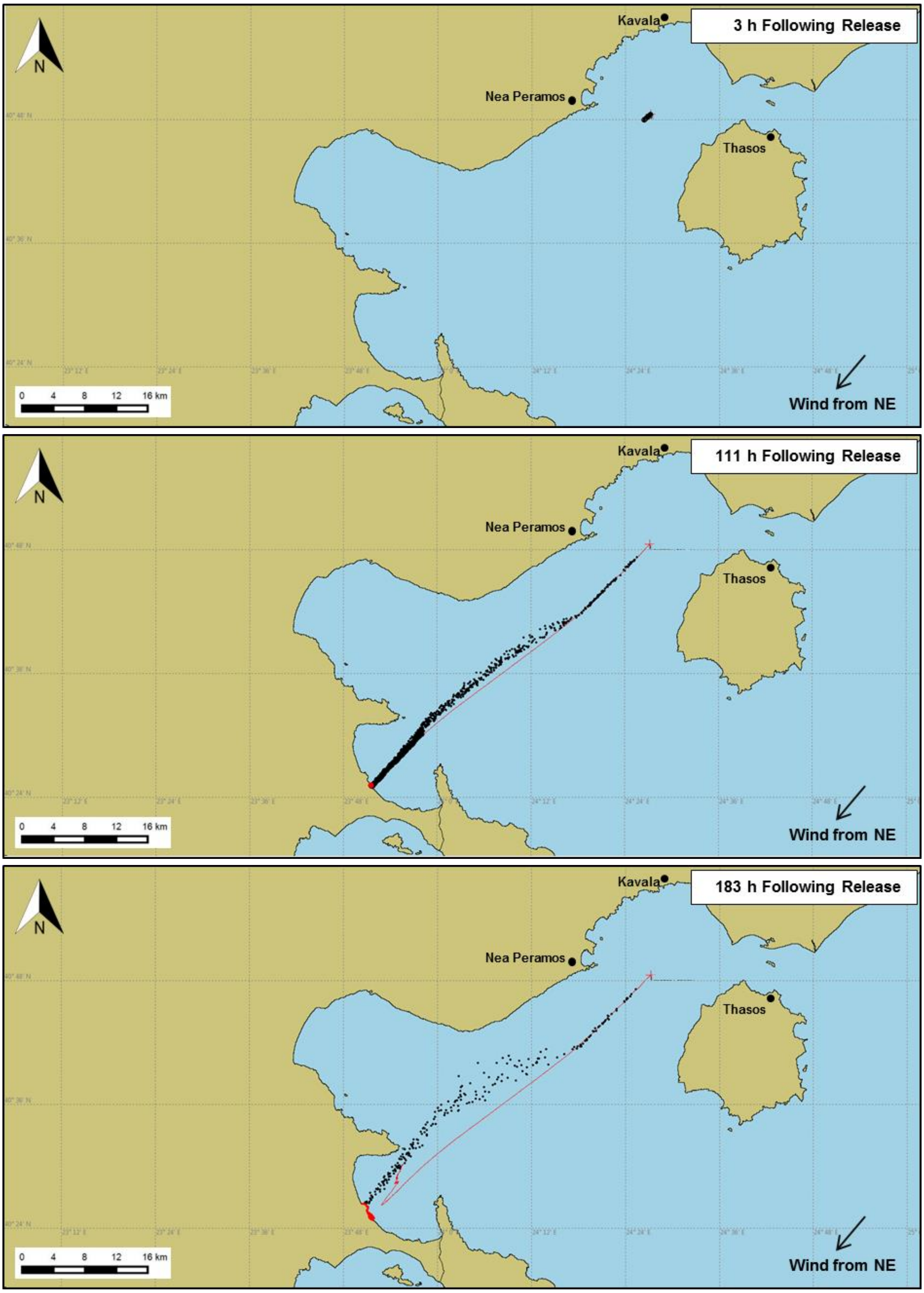

Figure 11: Well blow-out 2D scenario. Deterministic results 3 hours after release (maximum response time); 111 hours after release (minimum arrival time until beaching) and 183 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

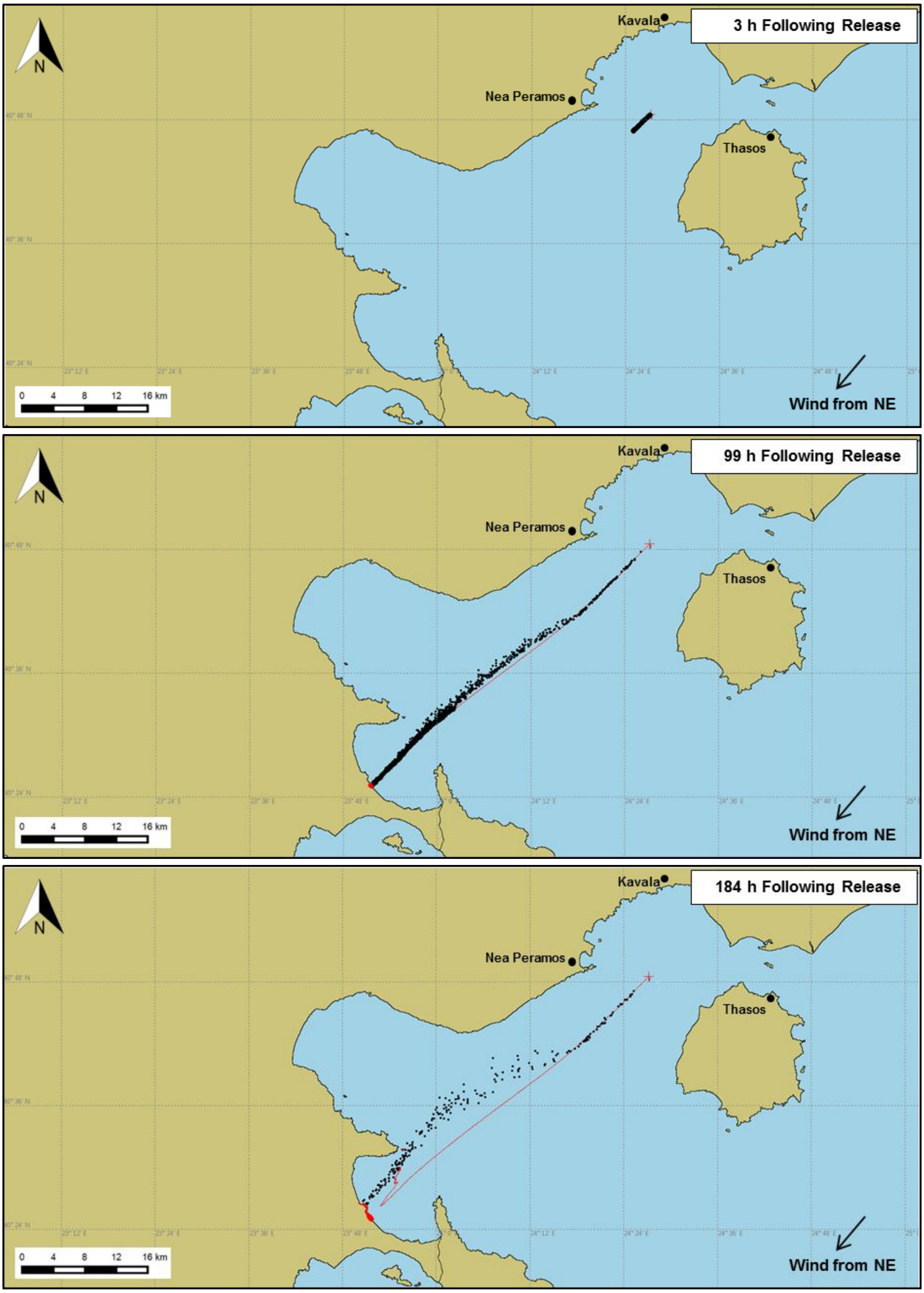

Figure 12: Well blow-out 2E scenario. Deterministic results 3 hours after release (maximum response time); 99 hours after release (minimum arrival time until beaching) and 184 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

4.2 Pipeline Release

Deterministic results of the winter and summer seasons for the pipeline release scenarios are presented in Section 4.2.1 and 4.2.2, respectively.

4.2.1 Winter scenarios

For each winter scenario, images of beaching locations, spill trajectory and position of oil are presented at three pre-specified times such as:

- Figure 13: Pipeline release 1A;
- Figure 14: Pipeline release 1B;
- Figure 15: Pipeline release1C;
- Figure 16: Pipeline release 1D;
- Figure 17: Pipeline release 1E;
- Figure 18: Pipeline release 1G;
- Figure 19: Pipeline release 1F.

For each winter scenario of the pipeline release, the volume of emulsified oil beached and the associated minimum arrival time to shore are presented in Table 6.

Table 6: Volume of emulsified oil beached and associated minimum arrival time for the Pipeline release winter scenarios

Scenario	Beaching volume (m^3)	Minimum arrival time until beaching (hours)
Pipeline release 1A	291	22
Pipeline release 1B	1,042	7
Pipeline release 1C	257	17
Pipeline release 1D	567	9
Pipelinel release 1E	185	59
Pipeline release 1F	498	81
Pipeline release 1G	812	38

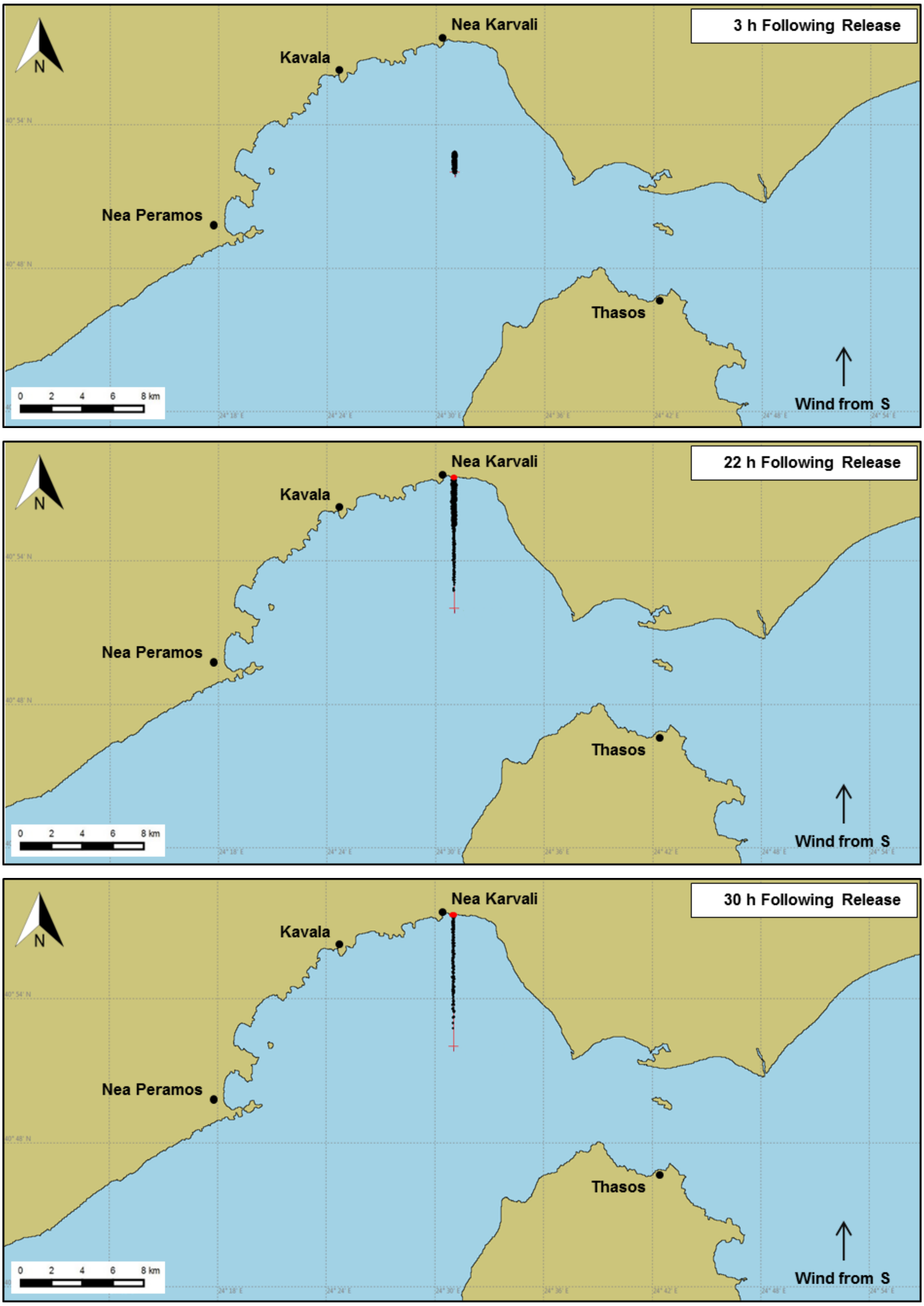

Figure 13: Pipeline release 1A scenario. Deterministic results 3 hours after release (maximum response time); 22 hours after release (minimum arrival time until beaching) and 30 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

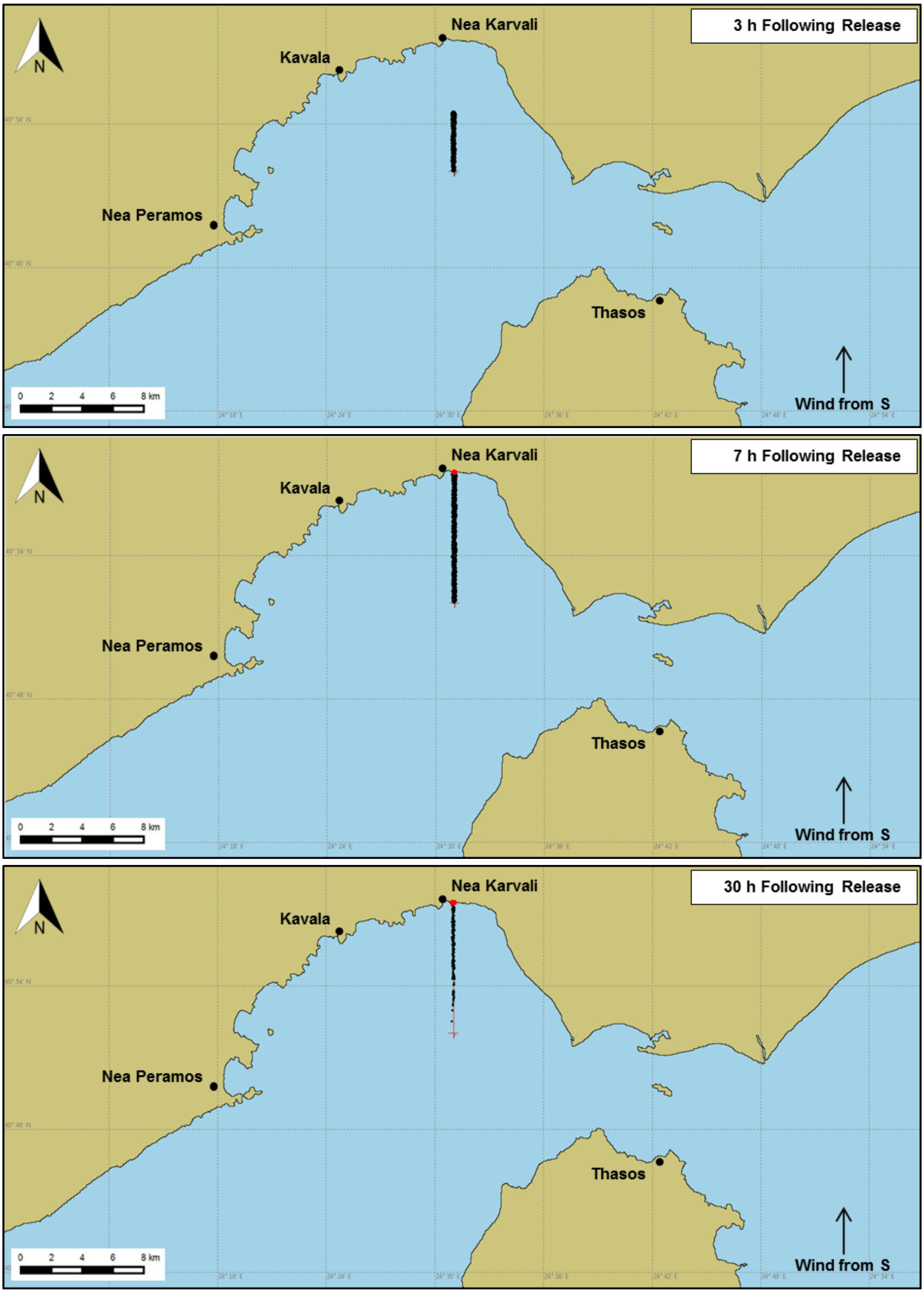

Figure 14: Pipeline release 1B scenario. Deterministic results 3 hours after release (maximum response time); 7 hours after release (minimum arrival time until beaching) and 30 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

Figure 15: Pipeline release 1C scenario. Deterministic results 3 hours after release (maximum response time); 17 hours after release (minimum arrival time until beaching) and 25 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

Figure 16: Pipeline release 1D scenario. Deterministic results 3 hours after release (maximum response time); 9 hours after release (minimum arrival time until beaching) and 25 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

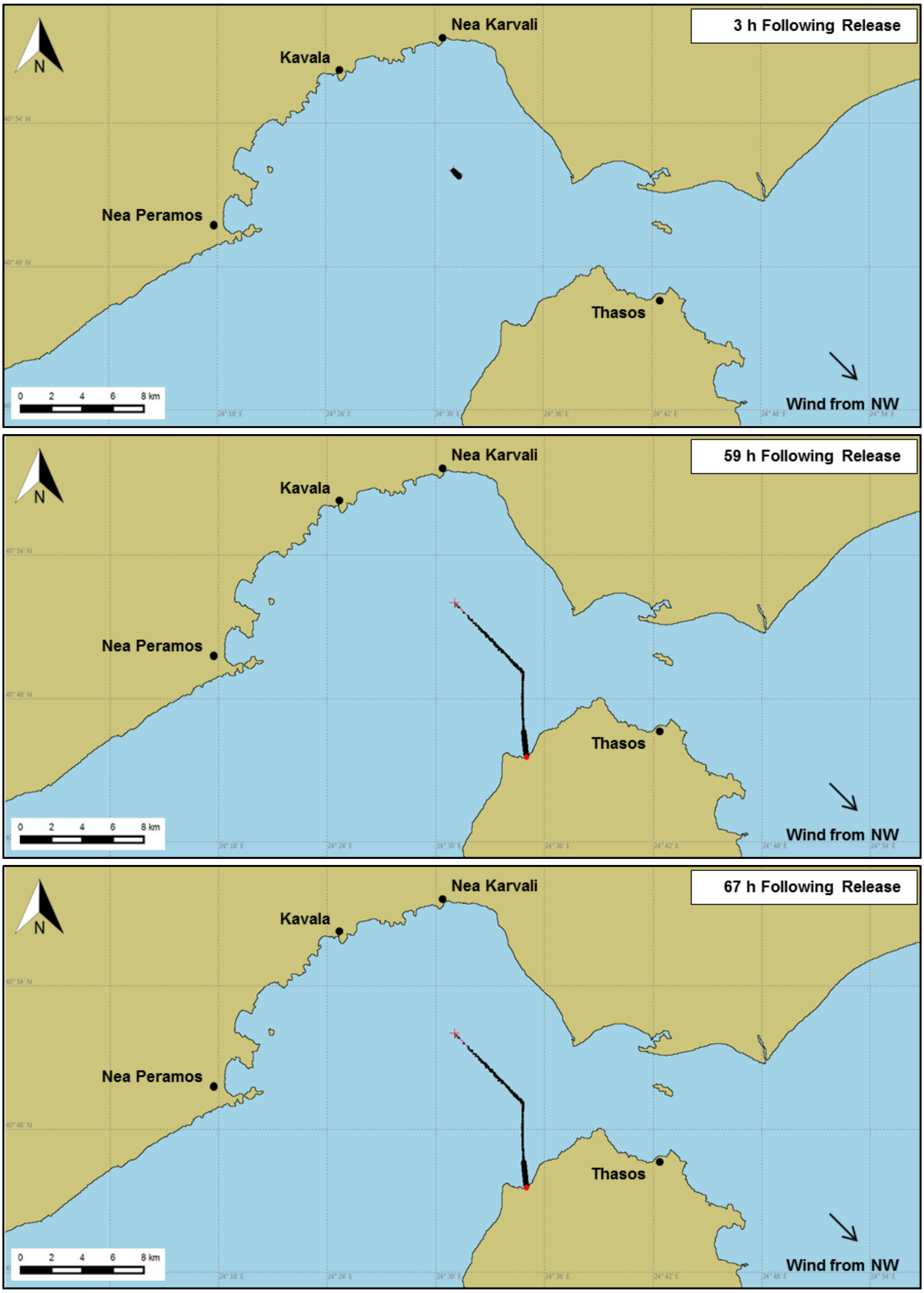

Figure 17: Pipeline release 1E scenario. Deterministic results 3 hours after release (maximum response time); 59 hours after release (minimum arrival time until beaching) and 67 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

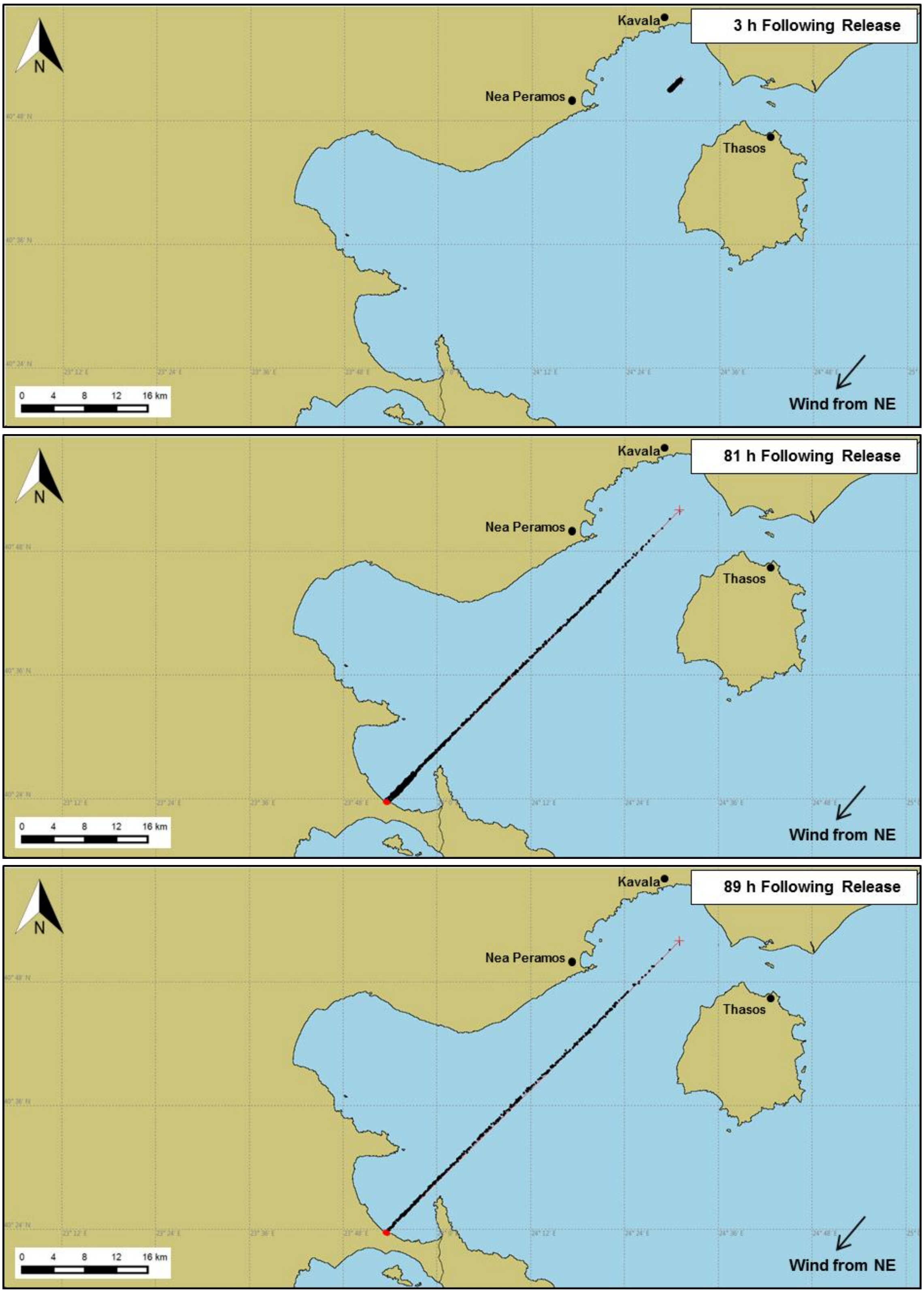

Figure 18: Pipeline release 1F scenario. Deterministic results 3 hours after release (maximum response time); 81 hours after release (minimum arrival time until beaching) and 89 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

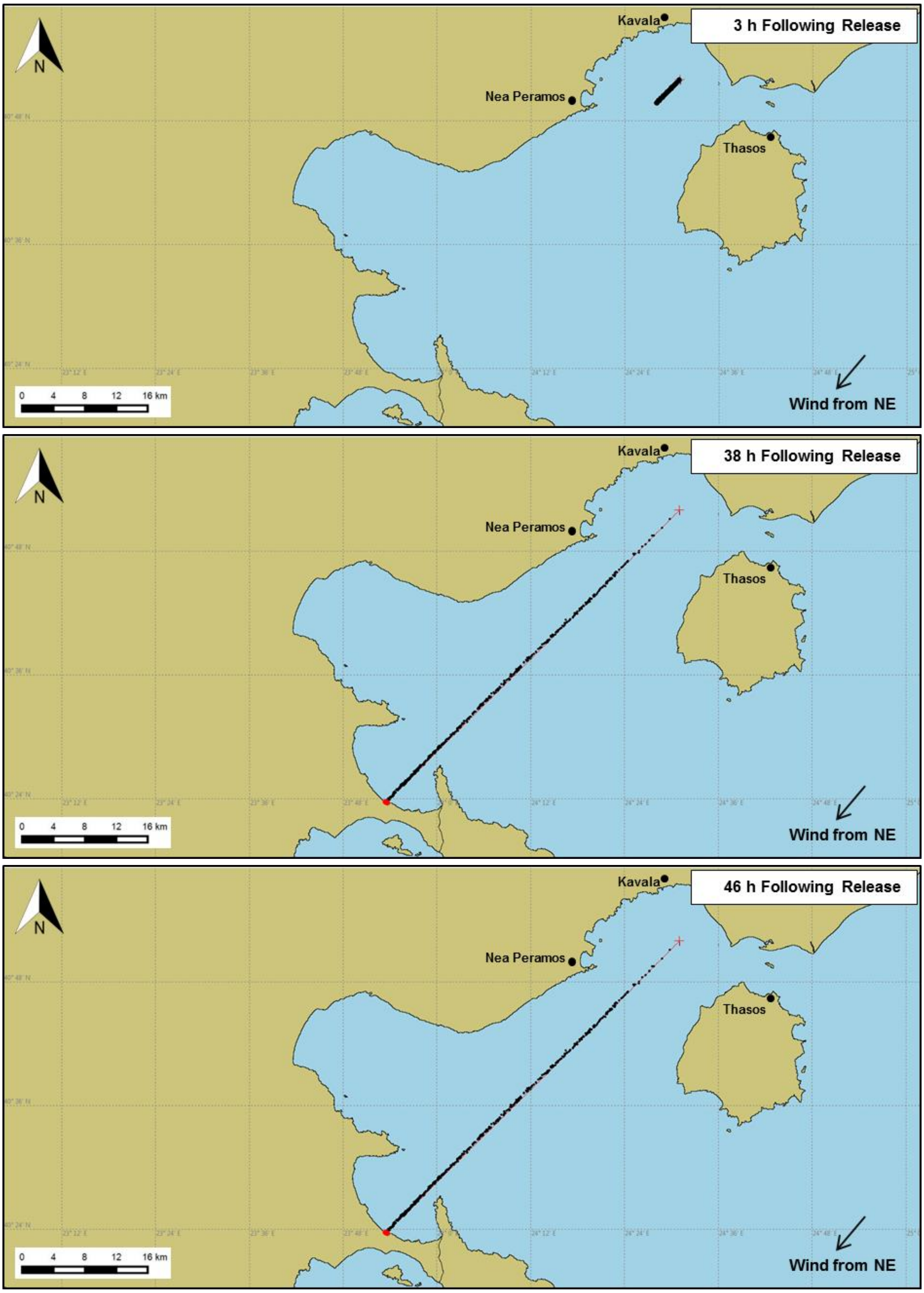

Figure 19: Pipeline release 1G scenario. Deterministic results 3 hours after release (maximum response time); 38 hours after release (minimum arrival time until beaching) and 46 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

4.2.2 Summer scenarios

For each summer scenario, images of beaching locations, spill trajectory and position of oil are presented at three pre-specified times such as:

- Figure 20: Pipeline release 2A;
- Figure 21: Pipeline release 2B;
- Figure 22: Pipeline release 2C;
- Figure 23: Pipeline release 2D;
- Figure 24: Pipeline release 2E.

For each summer scenario of the pipeline release, the volume of emulsified oil beached and the associated minimum arrival time to shore are presented in Table 7.

Table 7: Volume of emulsified oil beached and associated minimum arrival time for the Pipeline release summer scenarios

Scenario	Beaching volume (m^3)	Minimum arrival time until beaching (hours)
Pipeline release 2A	162	38
Pipeline release 2B	246	17
Pipeline release 2C	193	57
Pipeline release 2D	488	126
Pipeline release 2E	562	114

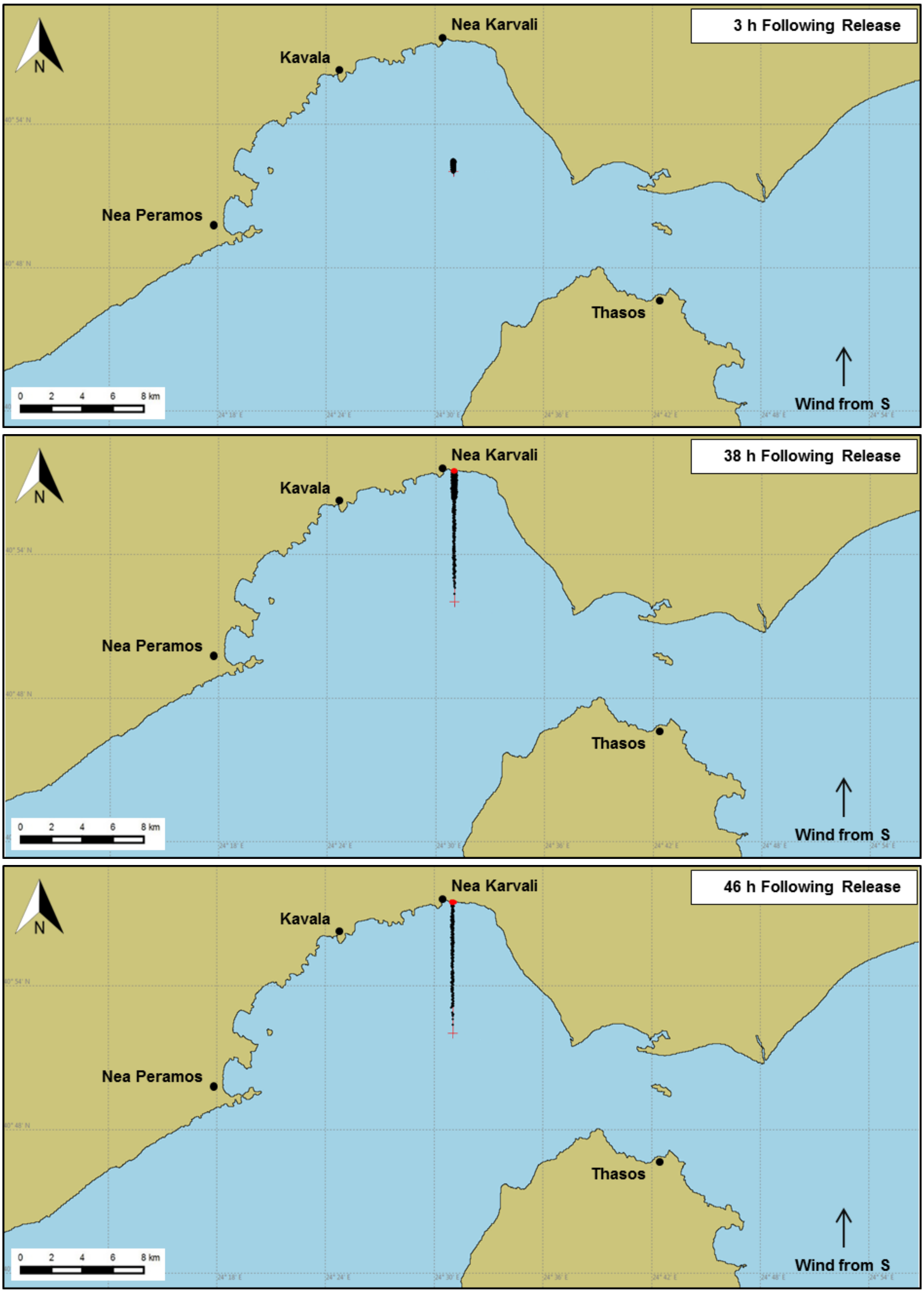

Figure 20: Pipeline release 2A scenario. Deterministic results 3 hours after release (maximum response time); 38 hours after release (minimum arrival time until beaching) and 46 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

Figure 21: Pipeline release 2B scenario. Deterministic results 3 hours after release (maximum response time); 17 hours after release (minimum arrival time until beaching) and 25 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

Figure 22: Pipeline release 2C scenario. Deterministic results 3 hours after release (maximum response time); 57 hours after release (minimum arrival time until beaching) and 65 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

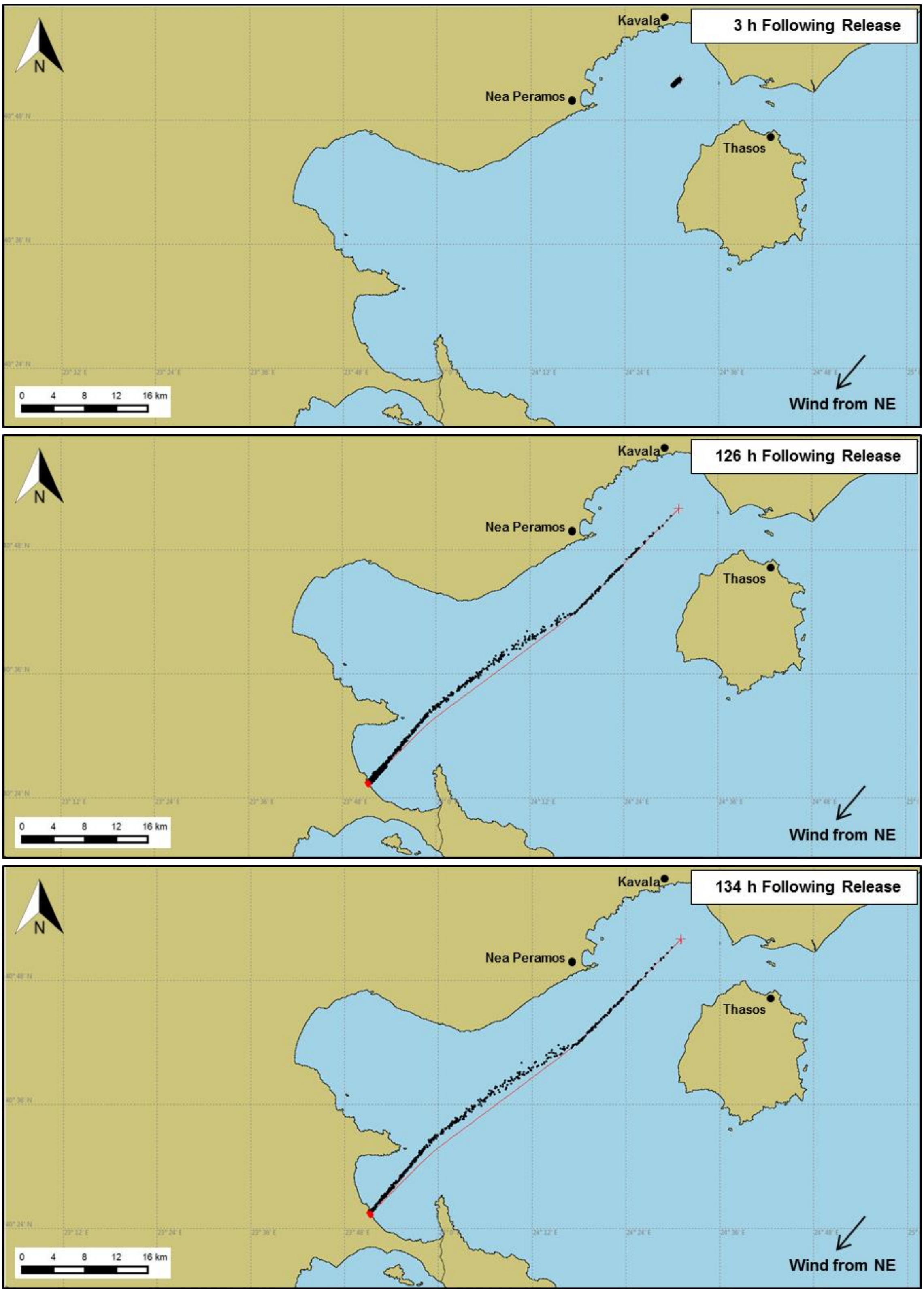

Figure 23: Pipeline release 2D scenario. Deterministic results 3 hours after release (maximum response time); 126 hours after release (minimum arrival time until beaching) and 134 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

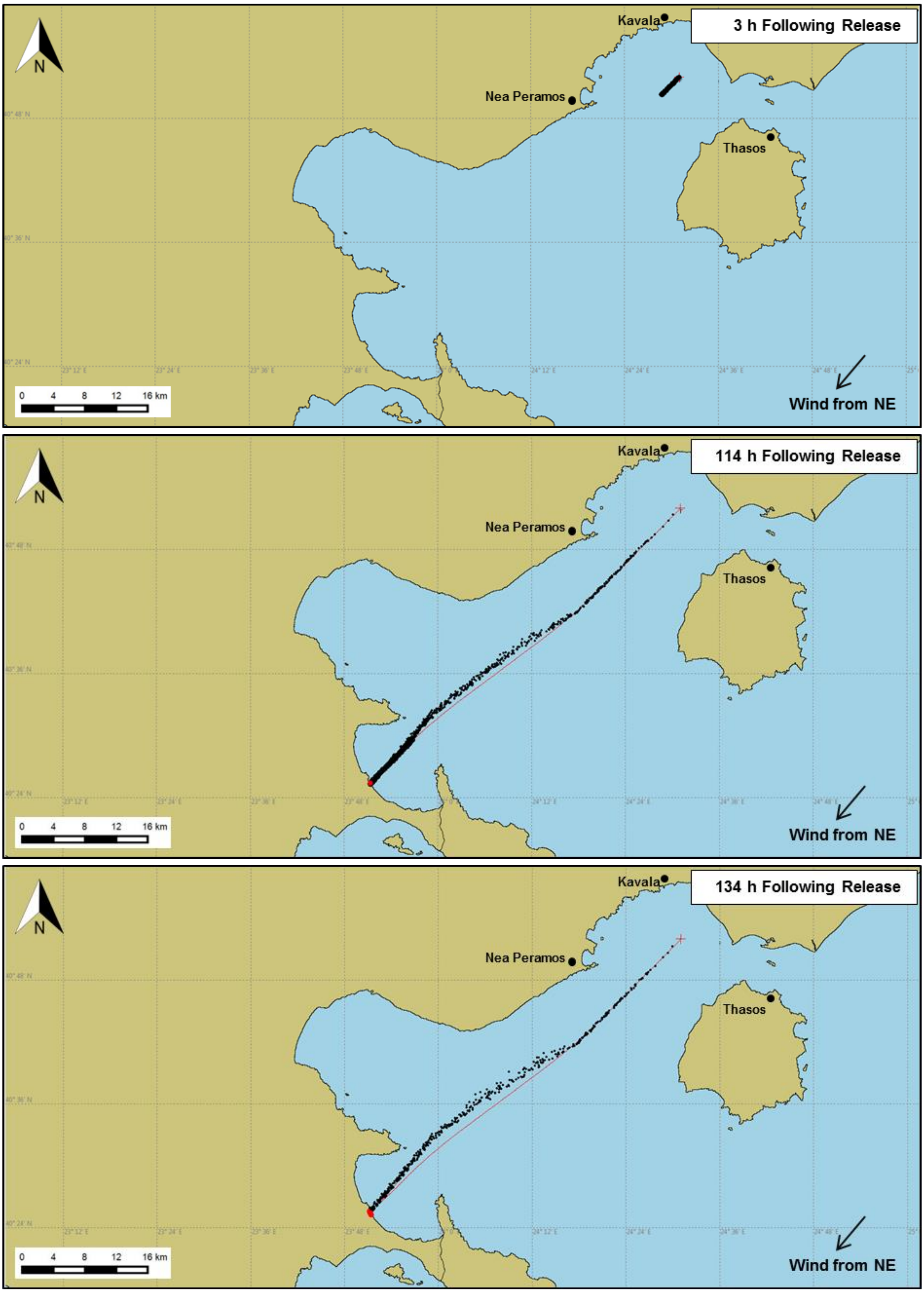

Figure 24: Pipeline release 2E scenario. Deterministic results 3 hours after release (maximum response time); 114 hours after release (minimum arrival time until beaching) and 134 hours after release (end of simulation). [Key: Red cross for the release point; track and beaching locations (red); final particle positions (black)]

4.3 Loading Buoy

For the loading buoy scenario, images of beaching locations, spill trajectory and position of oil are presented at three pre-specified times in Figure 25.

The volume of emulsified oil beached and the associated minimum arrival time to shore are presented in Table 8.

Table 8: Volume of emulsified oil beached and associated minimum arrival time for the loading buoy scenario

Scenario	Beaching volume (m^3)	Minimum arrival time until beaching (hours)
Loading Buoy	36	10

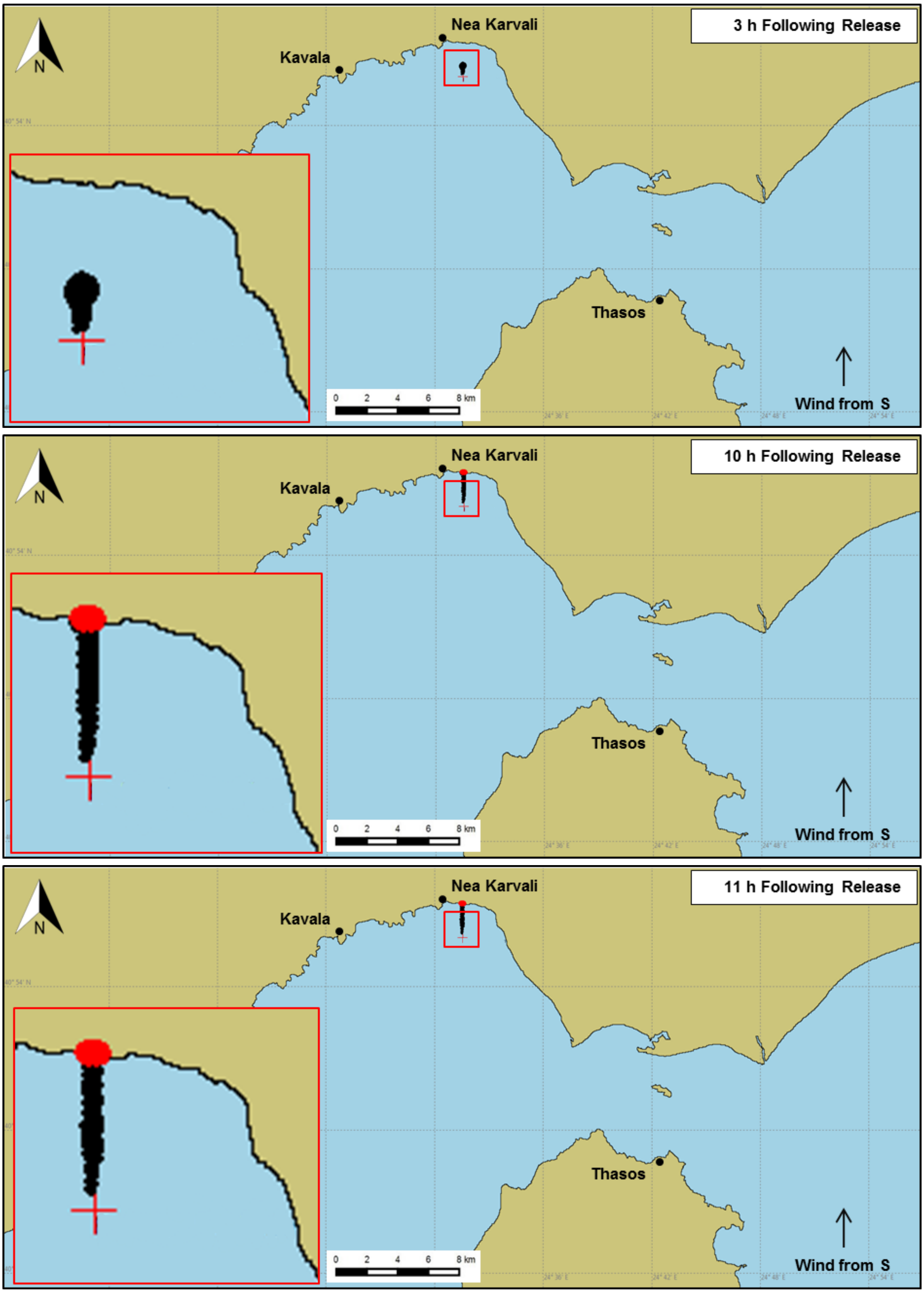

Figure 25: Loading buoy scenario. Deterministic results 3 hours after release (maximum response time); 10 hours after release (min. arrival time until beaching) and 11 hours after release (end of simulation). [Key: Red cross for the release point; red square: zoom; track and beaching locations (red); final particle positions (black)]

5.0 DISCUSSION

Oil spill modelling using the OSIS 2D model has been undertaken for Energean Oil & Gas. Numerical modelling has been conducted for the following oil release scenarios:

- A continuous release resulting from a well blowout at Lamda platform;
- A continuous release from the product pipeline; and
- An instantaneous release from an incident at the loading buoy.

Modelling has been undertaken under a deterministic mode, with a fixed wind speed and direction blowing for temporal periods ranging from multiple hours to days. The deterministic mode should be considered here to represent a worst-case scenario. In reality wind directions will exhibit greater natural variability over such time periods. Nevertheless, the deterministic modelling results (images, volume beached and minimum arrival time of oil to shore) satisfies the high level requirements of this study, providing indications of the spilt oil trajectories, locations of beached oil and associated volumes.

The volumes of oil beached correspond to emulsified oil, as would be expected from an actual hydrocarbon release. Seeing a volume of oil beached greater than the volume of oil released is to be expected.

Of note is that comparable input parameters may lead to different outputs in terms of beaching location, beaching volume and arrival time to shore depending upon the tidal state during the modelling period. Here it should be noted that the characteristics of tidal currents and wind interact on a non-linear basis. Further, variability in the similar scenarios under summer and winter conditions can exhibit different results due to the different sea and air temperatures. Evaporation can be favoured in warmer conditions.

In order to further understand the potential consequences arising from accidental oil spill events, it is suggested that stochastic modelling for selected targeted scenarios using time-series of variable wind and current data be undertaken.

6.0 REFERENCES

BMT Argoss, 2015. Metocean Criteria – Kavala, Greece. Report prepared for Energean Oil & Gas. Report reference RP_A15183_P1r1

ITOPF, 2012. The International Tanker Owners Pollution Federation Limited. Response to marine Oil Spills. 2nd Edition.

Walker, M. (1995). The oil spill information system (OSIS) and Eurospill models: background documentation. ASMO International Workshop, The Hague, 15-17 November 1995. Modelling of Accidental Spills & Other Calamities at Sea. 13pp.

APPENDIX A:
MODELLING INPUT DATA

Scenario	Location (Lat/Long)	Start Date	Oil Type	Sea Temp (°C)	Air Temp (°C)	Wind Characteristics			Spill Characteristics		
						Speed (m/s)	Direction	Bearing (°)	Total Quantity Released (m^3)	Release Rate (m^3/hr)	Release Duration (hrs)
Well blow-out: Winter scenarios											
Well blow-out 1A	24° 27' 12.97"E 40° 48' 33.55"N	01/02	Epsilon Fluid	12	7.5	3.95	From S	180	475	19.8	24
Well blow-out 1B	24° 27' 12.97"E 40° 48' 33.55"N	01/02	Epsilon Fluid	12	7.5	10 for 7.5h then 3.95	From S	180	475	19.8	24
Well blow-out 1C	24° 27' 12.97"E 40° 48' 33.55"N	01/02	Epsilon Fluid	12	7.5	3.38	From SW	225	475	19.8	24
Well blow- out 1D	24° 27' 12.97"E 40° 48' 33.55"N	01/02	Epsilon Fluid	12	7.5	10 for 3.5h then 3.38	From SW	225	475	19.8	24
Well blow-out 1E	24° 27' 12.97"E 40° 48' 33.55"N	01/02	Epsilon Fluid	12	7.5	2.1	From NW	315	475	19.8	24
Well blow-out 1F	24° 27' 12.97"E 40° 48' 33.55"N	01/02	Epsilon Fluid	12	7.5	7.5	From NE	45	475	19.8	24
Well blow-out 1G	24° 27' 12.97"E 40° 48' 33.55"N	01/02	Epsilon Fluid	12	7.5	13 for 48h then 7.52	From NE	45	475	19.8	24

Scenario	Location (Lat/Long)	Start Date	Oil Type	Sea Temp (°C)	Air Temp (°C)	Wind Characteristics			Spill Characteristics		
						Speed (m/s)	Direction	Bearing (°)	Total Quantity Released (m^3)	Release Rate (m^3/hr)	Release Duration (hrs)
Well blow-out: Summer scenarios											
Well blow-out 2A	24° 27' 12.97"E 40° 48' 33.55"N	01/07	Epsilon Fluid	24	25.2	2.7	From S	180	475	19.8	24
Well blow-out 2B	24° 27' 12.97"E 40° 48' 33.55"N	01/07	Epsilon Fluid	24	25.2	3.4	From SW	225	475	19.8	24
Well blow-out 2C	24° 27' 12.97"E 40° 48' 33.55"N	01/07	Epsilon Fluid	24	25.2	2.4	From NW	315	475	19.8	24
Well blow-out 2D	24° 27' 12.97"E 40° 48' 33.55"N	01/07	Epsilon Fluid	24	25.2	5.0	From NE	45	475	19.8	24
Well blow-out 2E	24° 27' 12.97"E 40° 48' 33.55"N	01/07	Epsilon Fluid	24	25.2	10 for 7h then 5.0	From NE	45	475	19.8	24

Scenario	Location (Lat/Long)	Start Date	Oil Type	Sea Temp (°C)	Air Temp (°C)	Wind Characteristics			Spill Characteristics		
						Speed (m/s)	Direction	Bearing (°)	Total Quantity Released (m^3)	Release Rate (m^3/hr)	Release Duration (hrs)
Pipeline release: Winter scenarios											
Pipeline 1A	24° 31' 02.02"E 40° 52' 01.09"N	01/02	Export Fluid	12	7.5	3.95	From S	180	410	48.2	8.5
Pipeline 1B	24° 31' 02.02"E 40° 52' 01.09"N	01/02	Export Fluid	12	7.5	10 for 7.5h then 3.95	From S	180	410	48.2	8.5
Pipeline 1C	24° 31' 02.02"E 40° 52' 01.09"N	01/02	Export Fluid	12	7.5	3.38	From SW	225	410	48.2	8.5
Pipeline 1D	24° 31' 02.02"E 40° 52' 01.09"N	01/02	Export Fluid	12	7.5	10 for 3.5h then 3.38	From SW	225	410	48.2	8.5
Pipeline 1E	24° 31' 02.02"E 40° 52' 01.09"N	01/02	Export Fluid	12	7.5	2.1	From NW	315	410	48.2	8.5
Pipeline 1F	24° 31' 02.02"E 40° 52' 01.09"N	01/02	Export Fluid	12	7.5	7.5	From NE	45	410	48.2	8.5
Pipeline 1G	24° 31' 02.02"E 40° 52' 01.09"N	01/02	Export Fluid	12	7.5	13 for 48h then 7.52	From NE	45	410	48.2	8.5

Scenario	Location (Lat/Long)	Start Date	Oil Type	Sea Temp (°C)	Air Temp (°C)	Wind Characteristics			Spill Characteristics		
						Speed (m/s)	Direction	Bearing (˚)	Total Quantity Released (m^3)	Release Rate (m^3/hr)	Release Duration (hrs)
Pipeline release: Summer scenarios											
Pipeline 2A	24° 31' 02.02"E 40° 52' 01.09"N	01/07	Export Fluid	24	25.2	2.7	From S	180	410	48.2	8.5
Pipeline 2B	24° 31' 02.02"E 40° 52' 01.09"N	01/07	Export Fluid	24	25.2	3.4	From SW	225	410	48.2	8.5
Pipeline 2C	24° 31' 02.02"E 40° 52' 01.09"N	01/07	Export Fluid	24	25.2	2.4	From NW	315	410	48.2	8.5
Pipeline 2D	24° 31' 02.02"E 40° 52' 01.09"N	01/07	Export Fluid	24	25.2	5.0	From NE	45	410	48.2	8.5
Pipeline 2E	24° 31' 02.02"E 40° 52' 01.09"N	01/07	Export Fluid	24	25.2	10 for 7h then 5.0	From NE	45	410	48.2	8.5

Scenario	Location (Lat/Long)	Start Date	Oil Type	Sea Temp (°C)	Air Temp (°C)	Wind Characteristics			Spill Characteristics		
						Speed (m/s)	Direction	Bearing (˚)	Total Quantity Released (m^3)	Release Rate (m^3/hr)	Release Duration (hrs)
Loading buoy: Summer scenario											
Loading buoy	24°31'32.79"E 40°56'2.16"N	01/07	Export Fluid	24	25.2	2.7	From S	180	60	1800	0.033 (2 min)