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OS4.9 : Marine Monitoring Predictions and Risk Mapping

Evaluation of the Leviathan offshore platform environmental studies in the Eastern Mediterranean Sea

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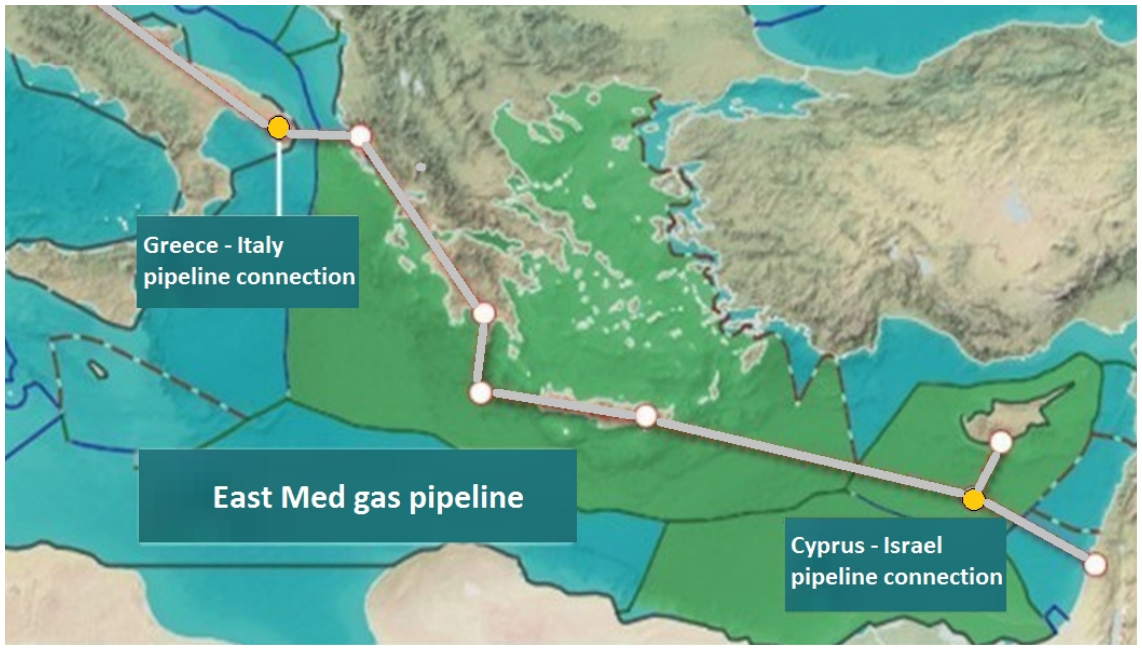
Outline

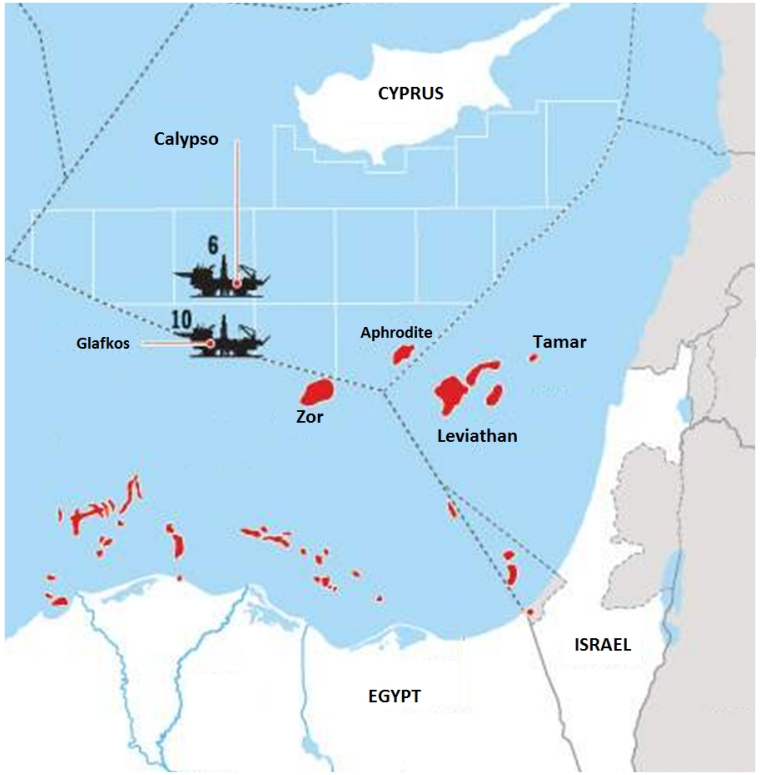
- ✓ Why the necessity for RA of the Leviathan OP
- ✓ The spillage simulation approach
- ✓ The oil spillage scenarios
- ✓ The derived conclusion from each scenario
- ✓ Overall conclusions from the spillage scenarios

Increase exploration and exploitation of hydrocarbons in the Eastern Med Sea-Levantine.

The East Med gas pipeline plans



Existing/planned offshore platforms



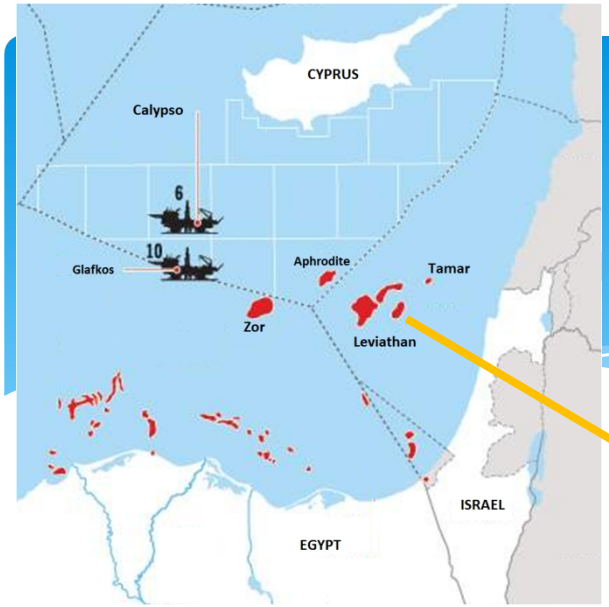
The Barcelona Convention: Protocol on offshore platforms and RAOP

- The risks associated with the installation of offshore platforms in the Med Sea have led to the adoption of the Protocol for the protection of the Med Sea from pollution, from the *Exploration* and *Exploitation* of the seabed, known as the **Offshore Protocol**, which **is one** of the **7 Protocols** to the Barcelona Convention.

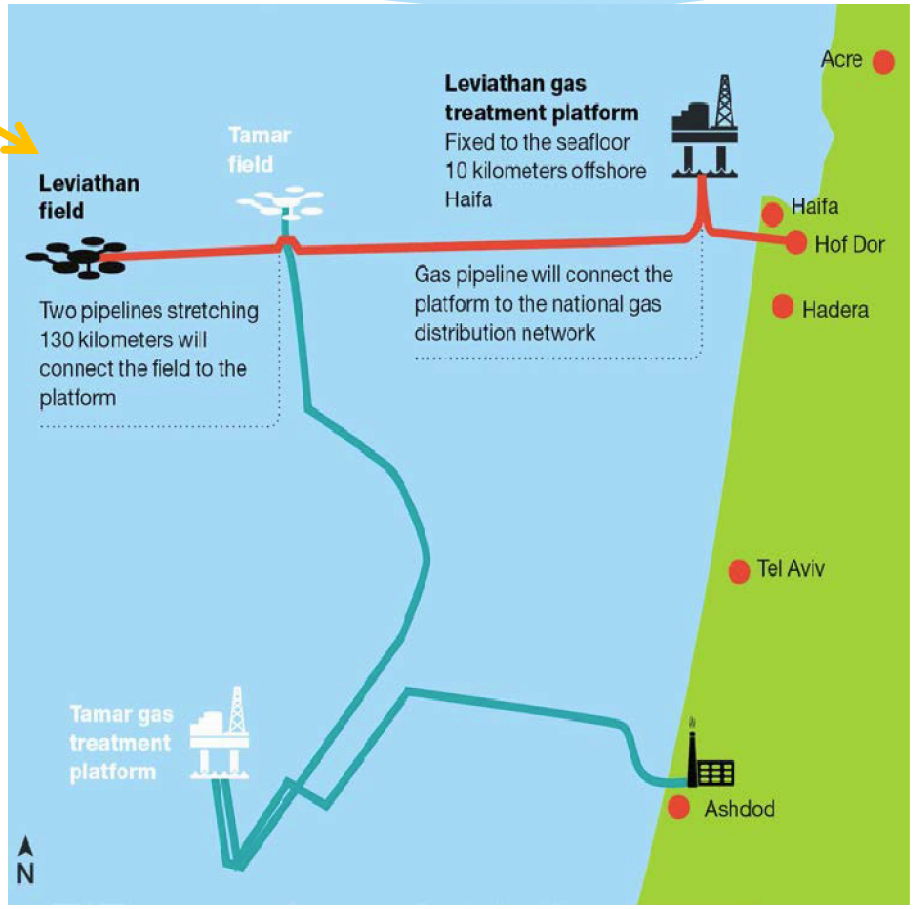
- The **Offshore Protocol** encourages the parties to develop ***Impact Damage Assessments*** taking into account all the elements that can affect the marine and coastal environment, due to the deployment of offshore platforms.

- In order to **assess the consequences of oil spill leakage** from existing/planned offshore platforms, the authorities are requesting studies on **Impact Damage Assessment**, which should based on ***OIL SPILL SIMULATIONS***.

Why RAOP for the Leviathan offshore platform



One of the largest discoveries of hydrocarbons in the Eastern Mediterranean is the Leviathan field. Gas and condensate from the Leviathan well are transferred via pipeline to an offshore platform 10 km from the shoreline, and from there via a pipeline to the coastal Leviathan energy installation in Israel. The local communities, led by Zichron-Ya'akov Local-Council, concern about possible accident.



The Leviathan offshore platform risk assessments

The Zichron-Ya'akov Local-Council in the framework of the Leviathan RAOP requested among other tasks to:

- Perform spillage simulations for condensate, diesel and grey water from the Leviathan platform located at 10km from the shoreline,
- Perform spillage simulations for condensate from a pipe rupture located 1 km from the shoreline,
- Examine the impact to the desalination and other sensitive facilities along the Med Sea coast of Israel from the spillage scenarios,
- Review the previous spillage simulations regarding the Leviathan platform,
- Perform evaporation simulations resulting from the condensate spillage vapor cloud.

Why the need to use oil spill models for risk assessment for offshore platforms

To provide answers to the following questions :

- Where the oil spill will move
- How soon it will get there – first impact on the coast
- Which resources are threatened
- What will be its state when it arrives

The first 3 questions are the more critical for effective support of the response agencies to combat the spills, and **depend completely on reliable sea currents, winds, waves data.**

For the 4th question a reliable fate algorithm is required.

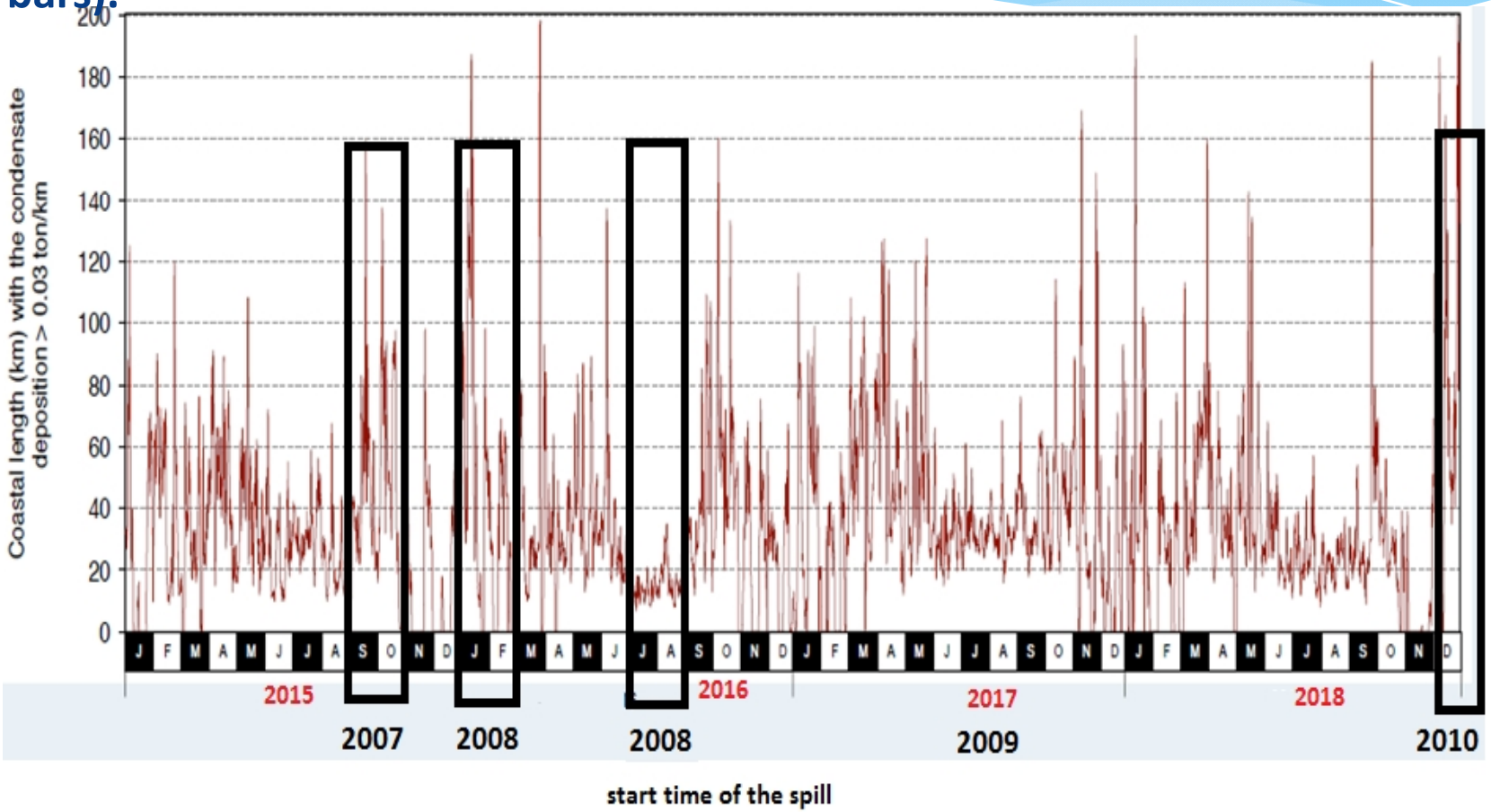
The MEDSLIK/MEDSLIK II models used to provide the spillages fate and transport

Overall **5844** simulations were produced for **condensate** and **diesel** spillages from the Leviathan offshore platform located 10 km from the Israel shore. Each simulation initiated every 6 hours for 10 days ahead during 2015-2018, using the **CMEMS Med MFC** hind-cast data.

Moreover, **104** simulations were produced for the **grey water** from the Leviathan offshore platform and another **104** simulations were produced for the **condensate** pipe rupture located 1 km from the Israel shore. Each simulation initiated every 15 days for 20 days ahead during 2015-2018 using the **CYCOFOS** flow and wave data and **SKIRON** winds.

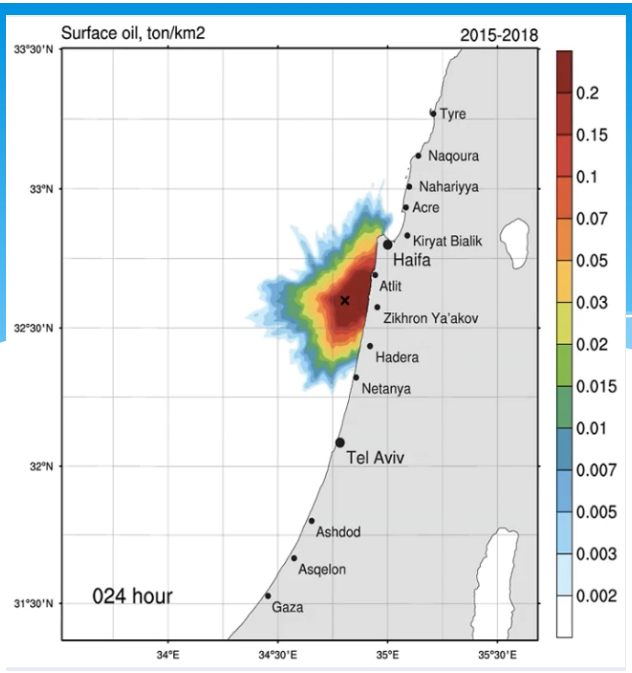
The importance of the ensemble predictions

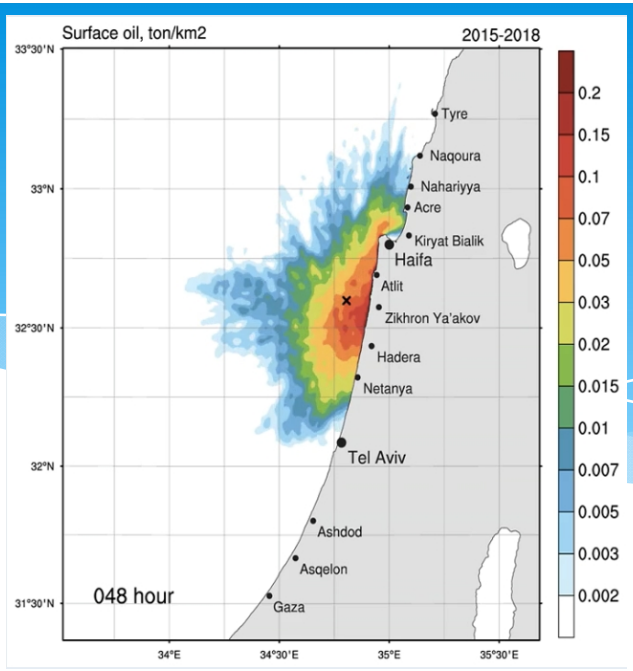
Time series of the impacted coastal length from the current condensate spillage simulations for the period 2015-2018 (red color line), superimposed with the time windows of previous studies with 12 OSCAR and MEDSLIK by Brenner predictions for the period 2007-2010 (black color bars).

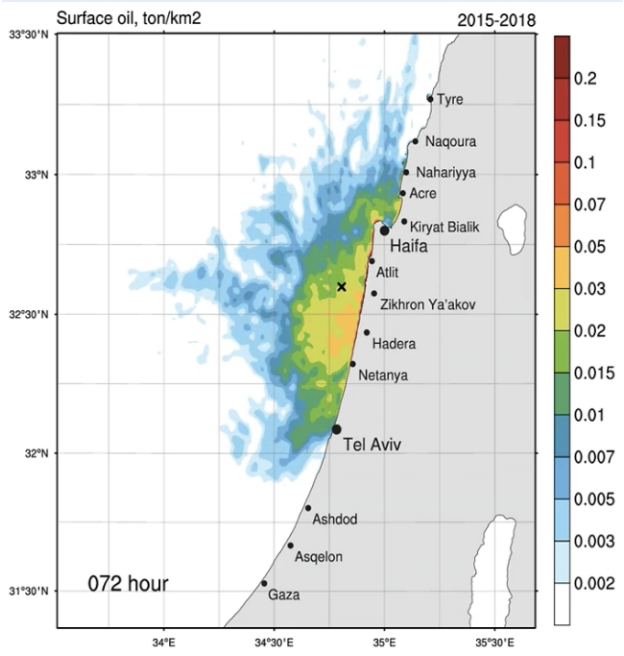


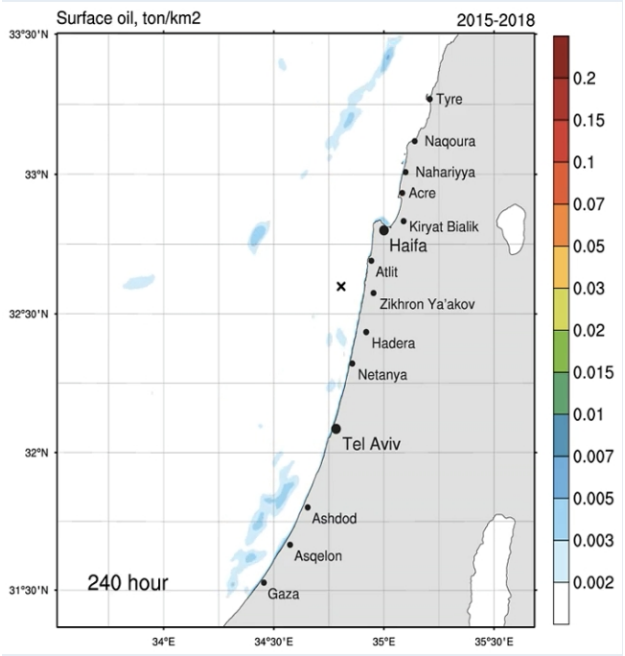
The condensate spill simulations setup

Parameter	Value
Leviathan platform coordinates	32° 35’ 55.76’’ N 34° 48’ 21.55’’ E
Oil type : **Condensate**	Condensate with API=43.2 and SG=809.9 kg/m^3
Spilled volume	5300 bbls
Spill duration	Near instantaneous : 24 hrs
Simulation length	240 h
Hydrodynamic fields	Hourly, CMEMS, 1/16 degree (~6.5 km)
Wind fields	6-hourly, ECMWF, 0.125 degree (~12.5 km)
Number of parcel used	90,000



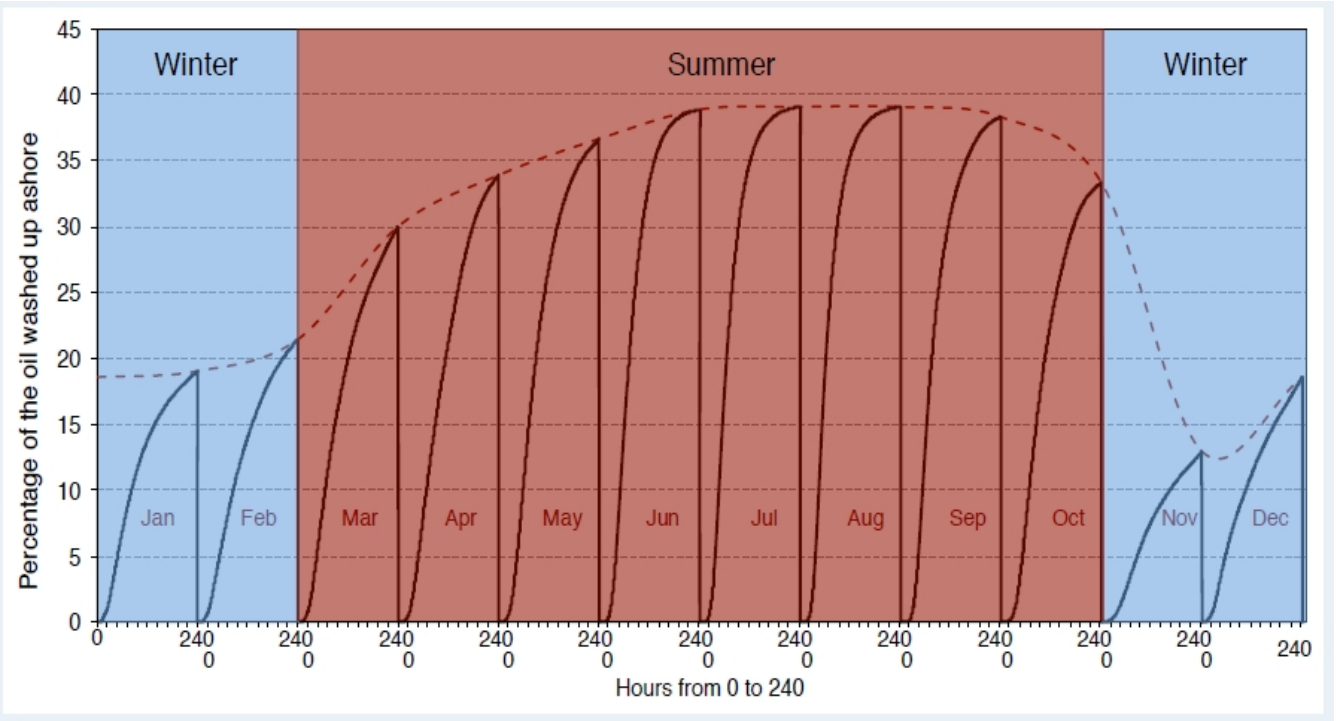






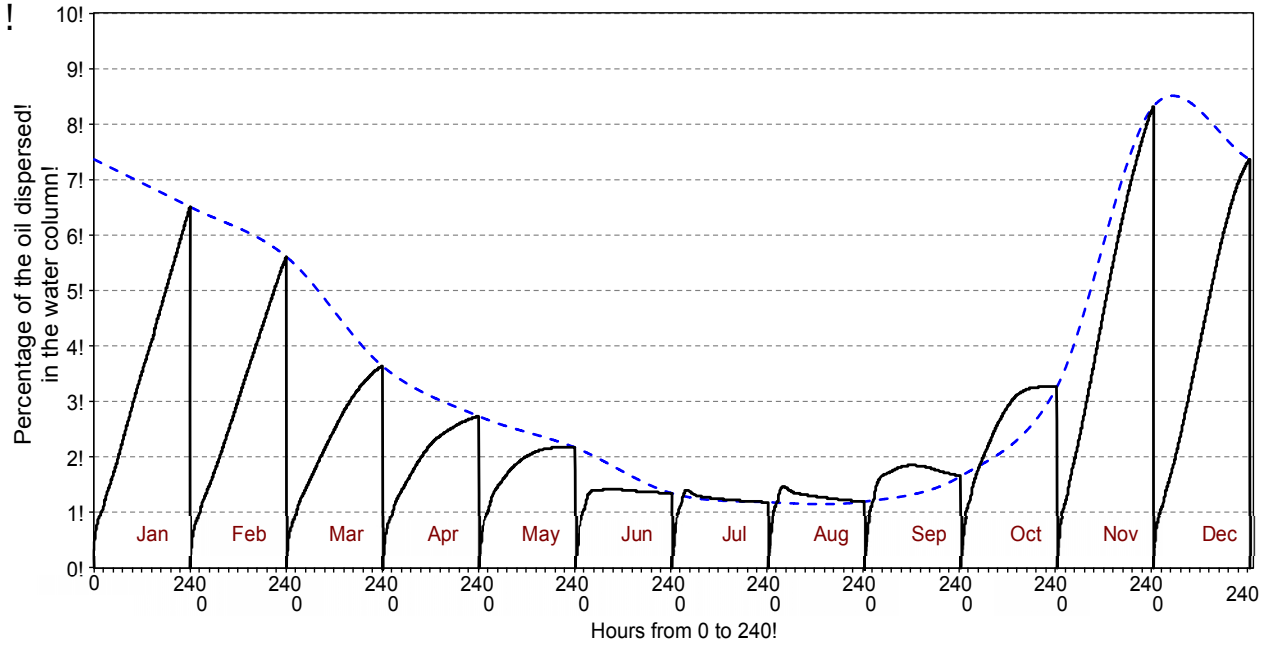
Surface average condensate concentrations (in tons/km) after: 24h, 48h, 72h and 240h, after the spillage.

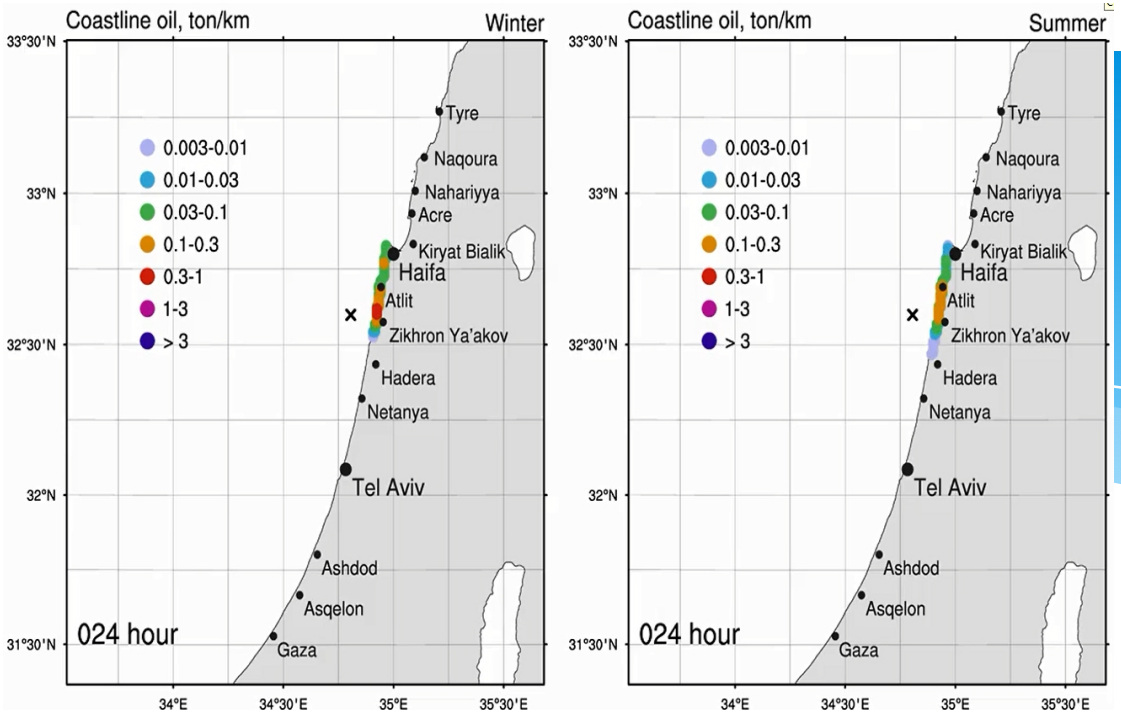
Monthly mean variations of condensate spill washed up ashore

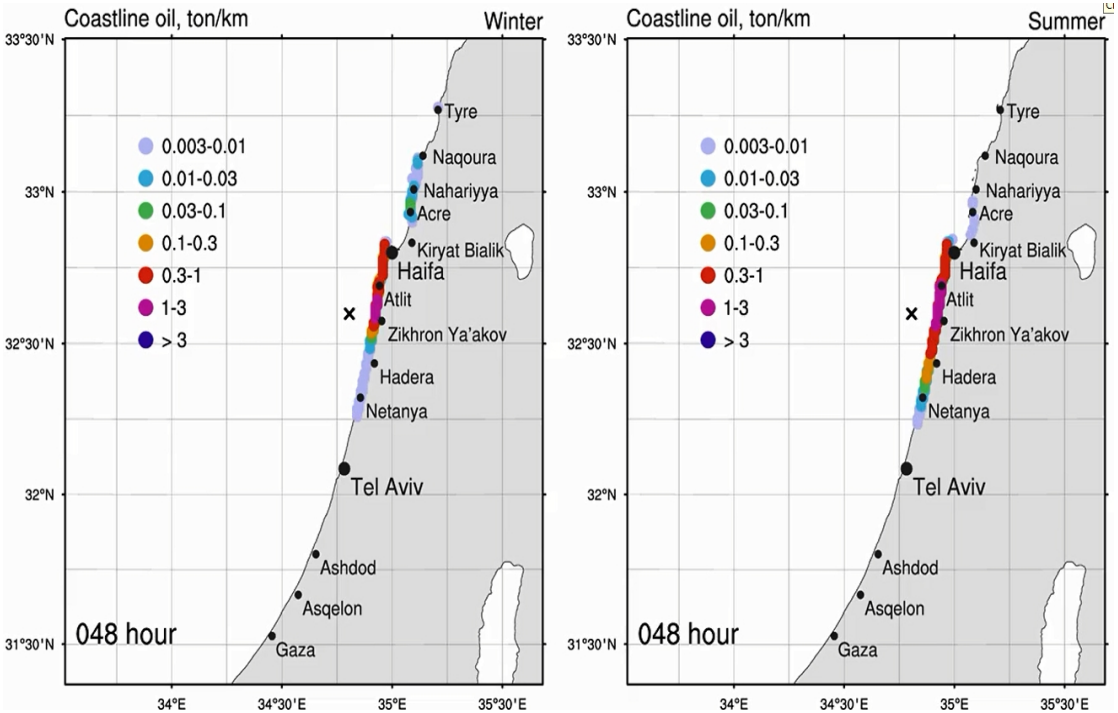


From the Leviathan offshore platform condensate spillage

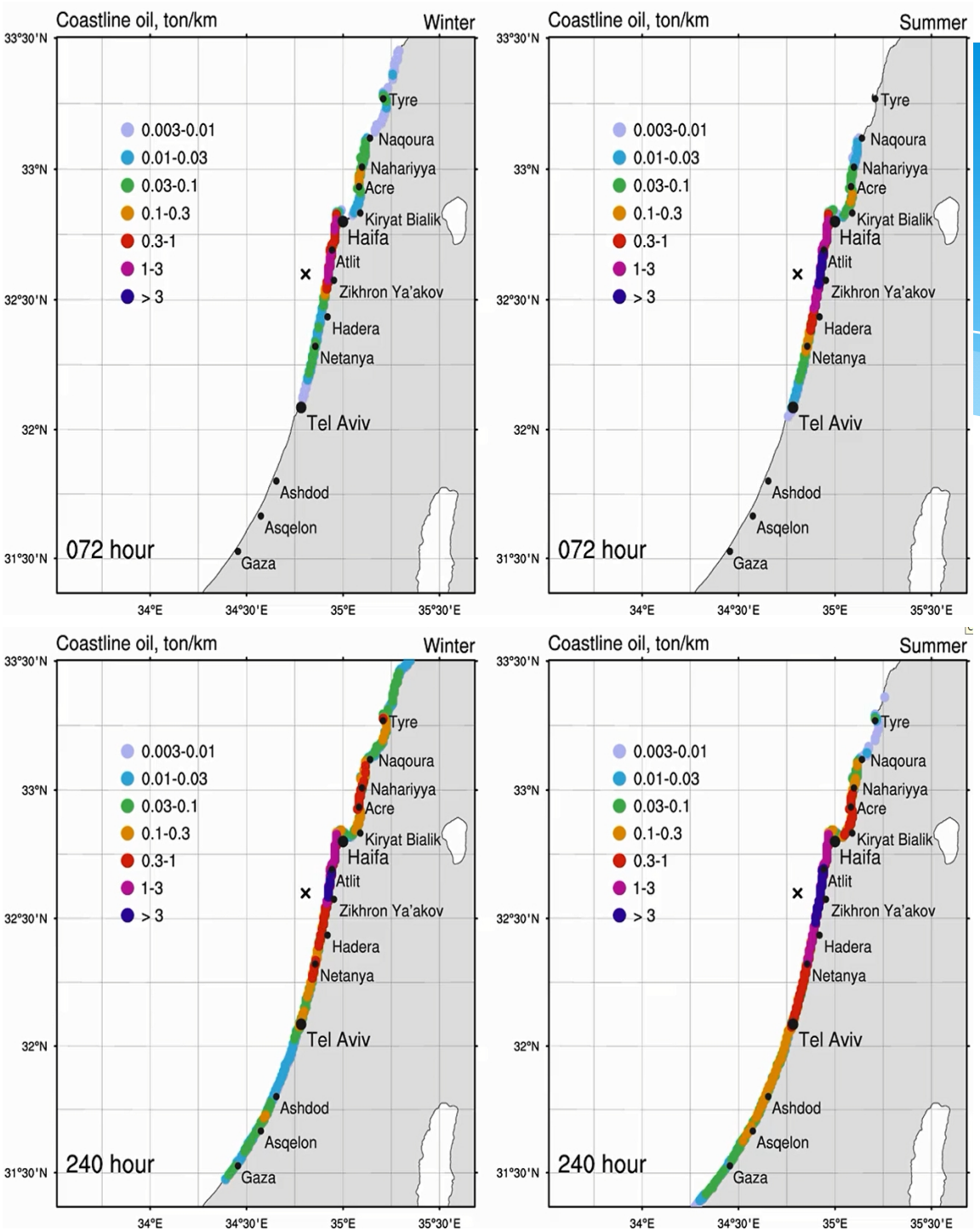
Monthly mean variations of the dispersed condensate in the water column





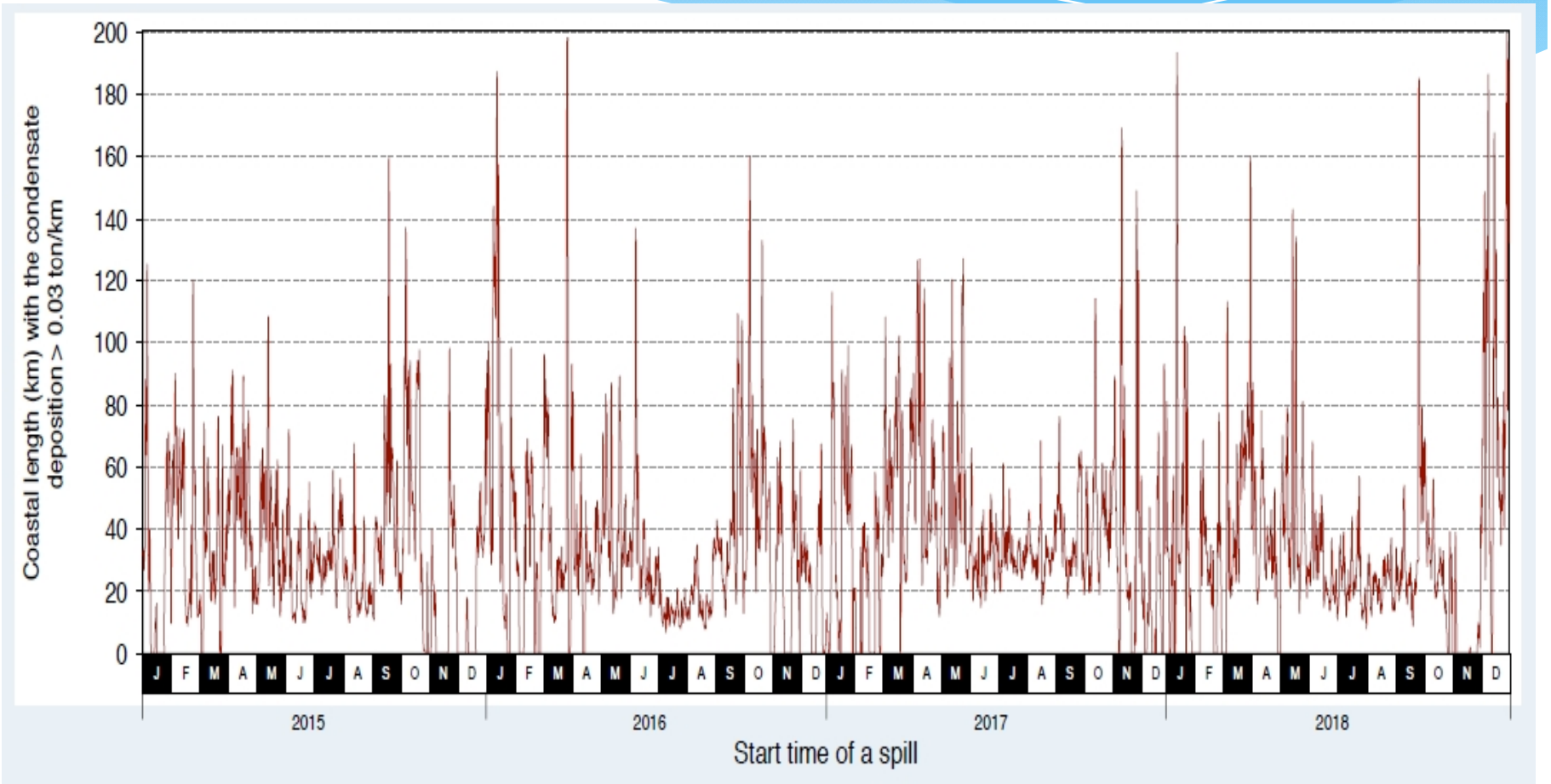


Winter and summer spatial-temporal evolution of ensemble average concentrations (tons/km) of beached condensate after: 24h and 48h from the spillage.

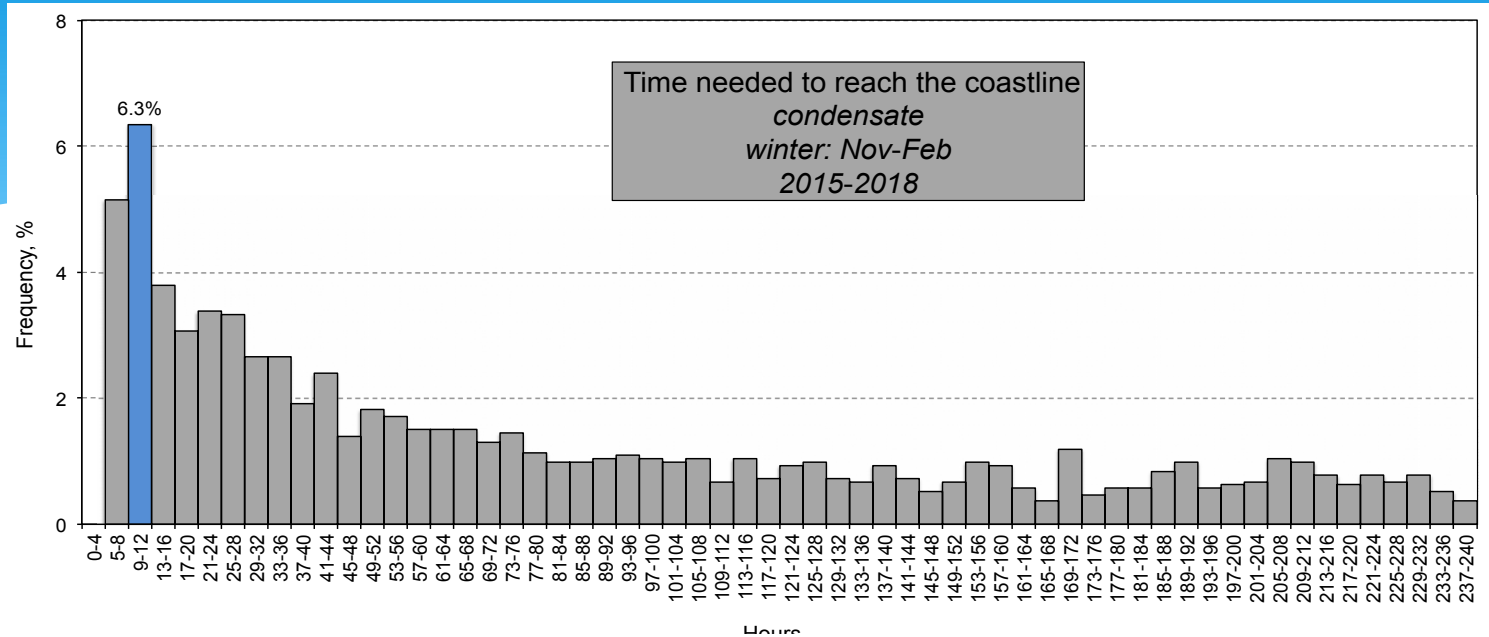


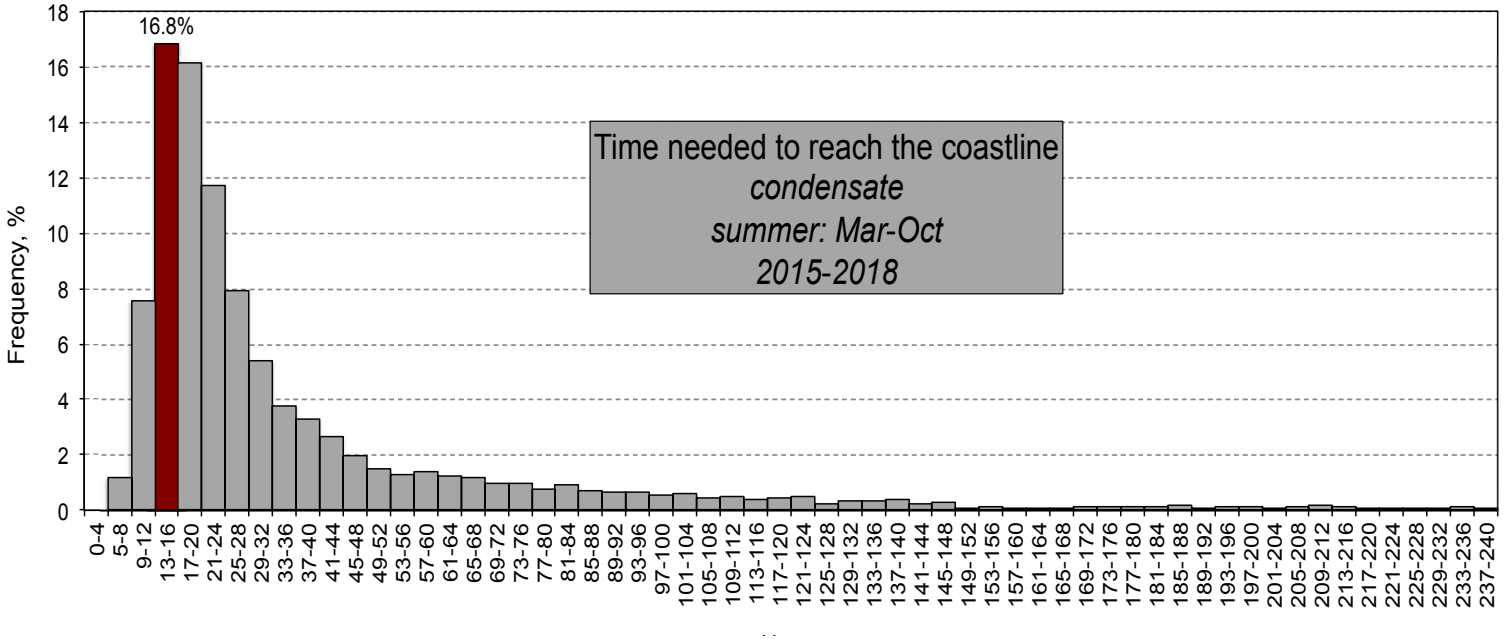
Winter and summer spatial-temporal evolution of ensemble average concentrations (tons/km) of beached condensate after: 72h and 240h from the spillage.

Length of the coastline where the **condensate** spill **deposition** exceeds 0.03 ton/km



Histograms: time needed for **condensate** spill to reach the coast



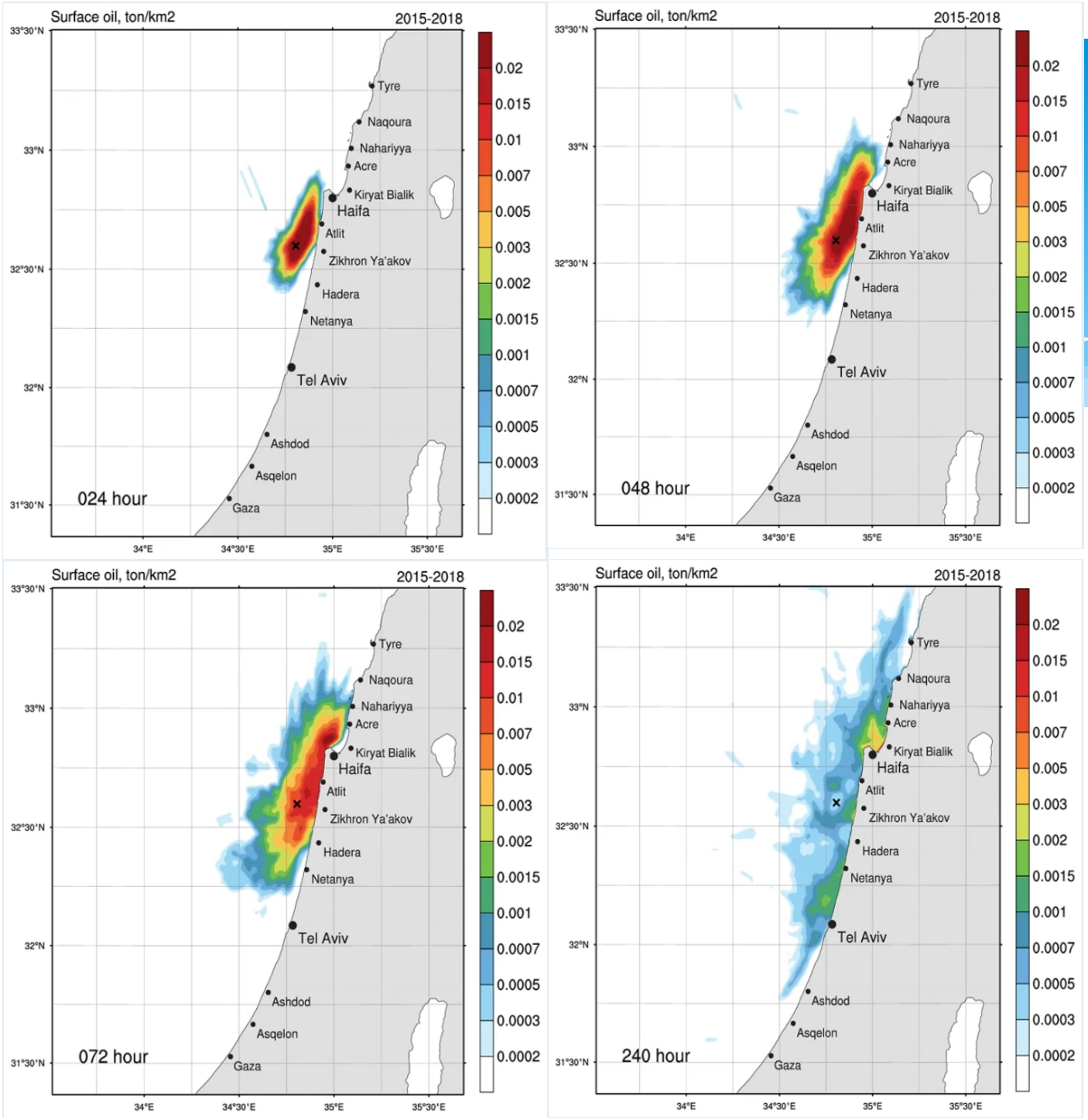


Major results from condensate spillage simulation from the Leviathan platform

- ✓ First impact on the coast is predicted to be 8 hrs in winter and at 11 hrs in summer. The first impacted area is the coastline between Zichron/Dor and Atlit.
- ✓ In winter it is predicted that 17% of the spillage is beached, while in summer twice as higher, i.e. up to 35%.due to the prevailing SW winds.
- ✓ Most affected area with maximum spill concentrations (> 3 ton/km) is the coastlines of Zichron/Dor and Atlit and from Atlit to Haifa (Shikmona) and the coastline between Zichron/Dor and Hadera, regardless of the season.
- ✓ Deposition of the condensate spills in the Hadera desalination plant is estimated to be the highest among the 5 desalination plants examined.
- ✓ During winter seasons the condensate depositions on the coastline extend northern than Tyre in Lebanon, while during summers seasons extend southern than Gaza, both with concentrations above the TH.

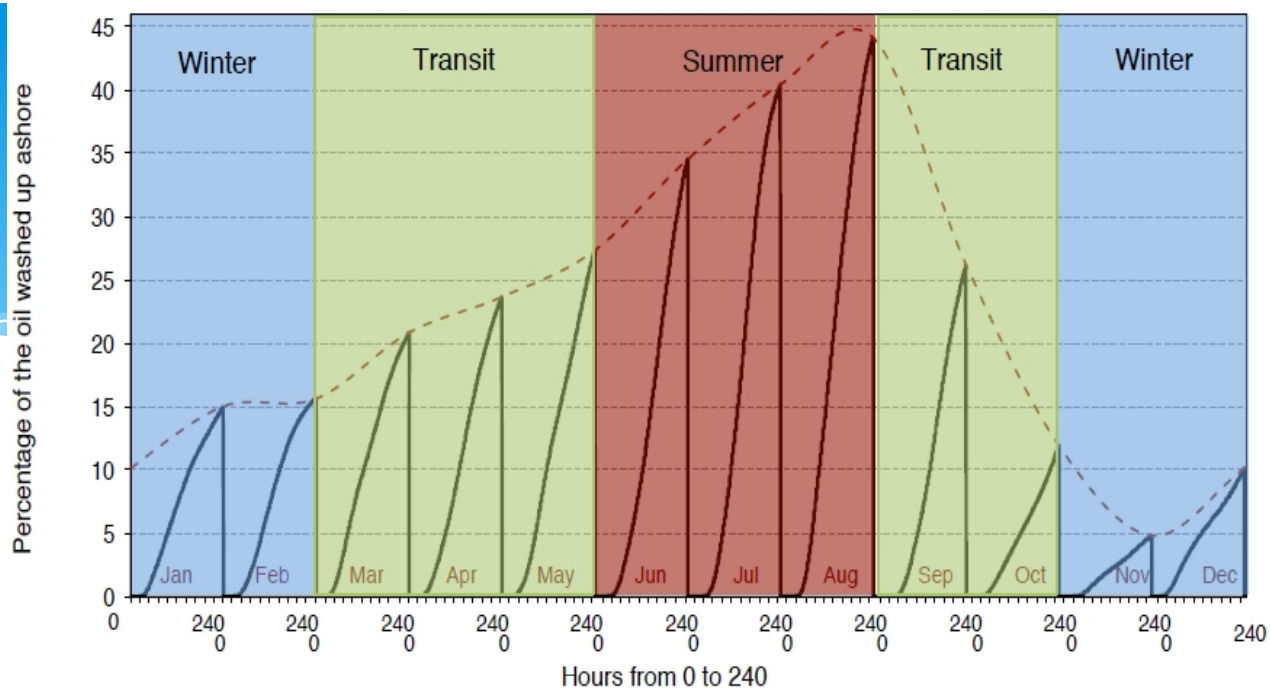
The diesel spill simulations setup

Parameter	Value
Leviathan platform coordinates	32° 35’ 55.76’’ N 34° 48’ 21.55’’ E
Oil type: **Diesel**	Diesel with API=36.4 and SG=843 kg/m^3
Spilled volume	250 bbls
Spill duration	Near instantaneous : 24 hrs
Simulation length	240 h
Hydrodynamic fields	Hourly, CMEMS, 1/16 degree (~6.5 km)
Wind fields	6-hourly, ECMWF, 0.125 degree (~12.5 km)
Number of parcel used	90,000



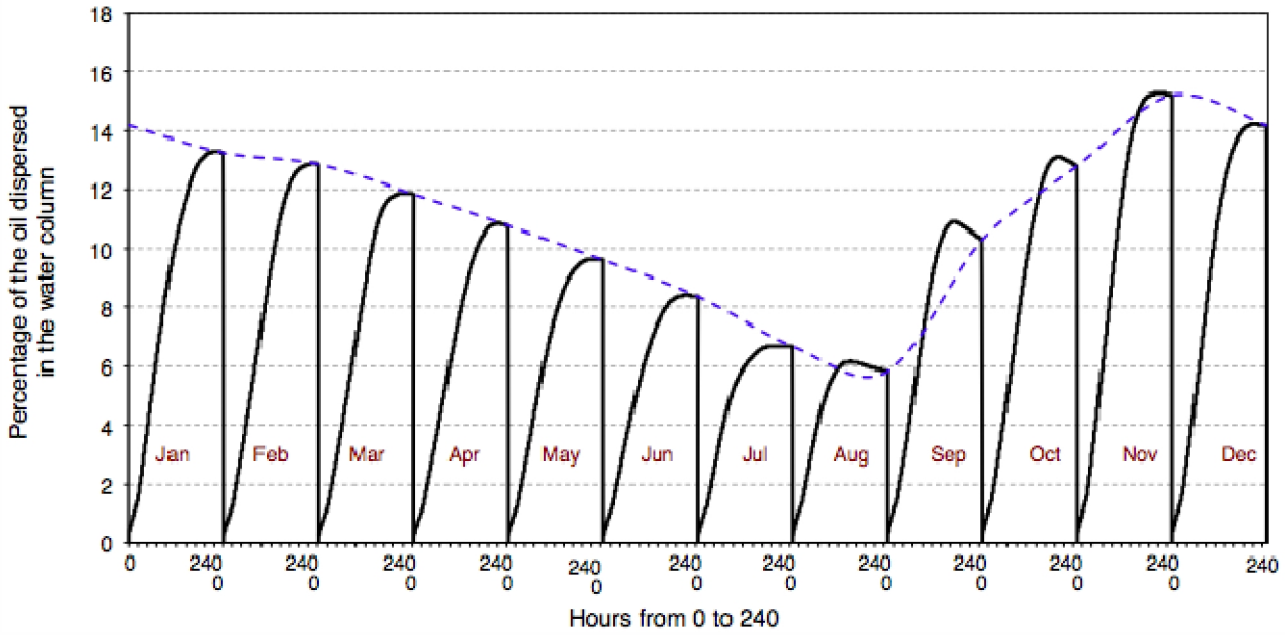
Ensemble surface average diesel concentrations (in tons/km) after: 24h, 48h, 72h and 240h after the spillage.

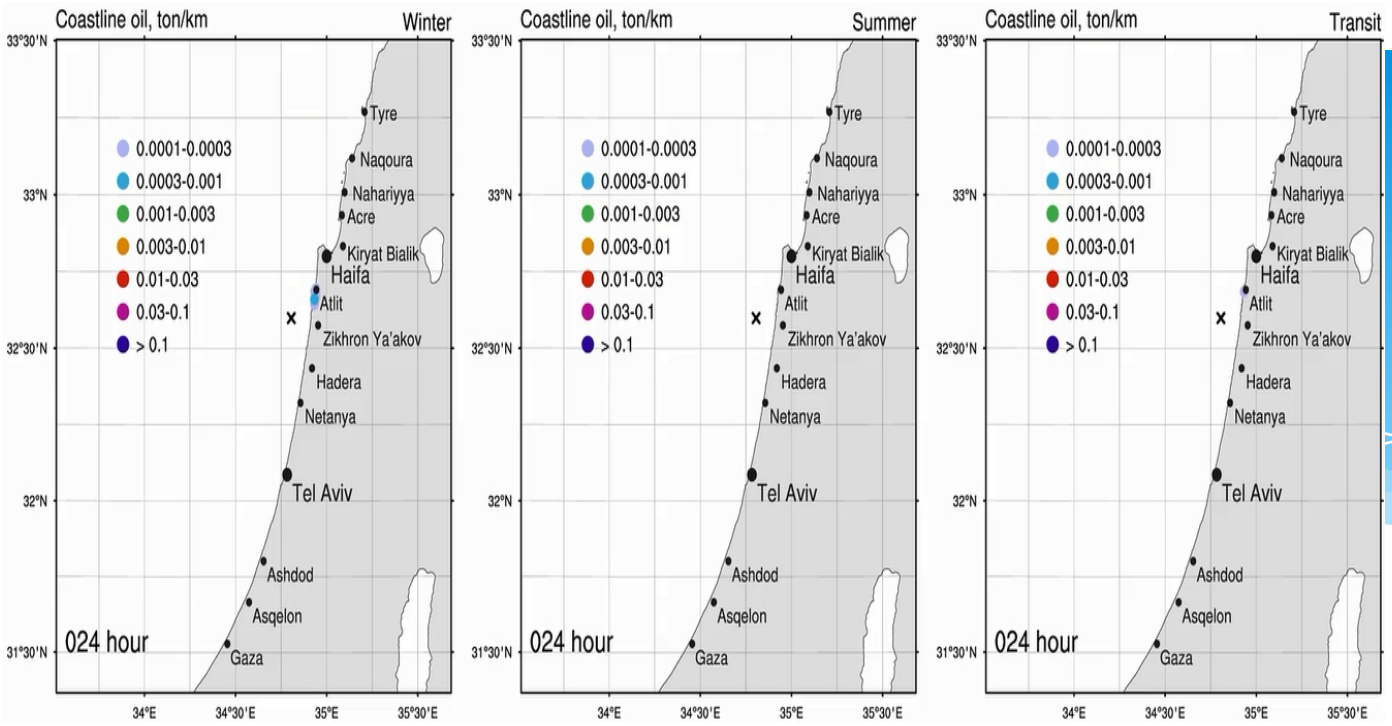
Monthly mean variations of diesel spill washed up ashore

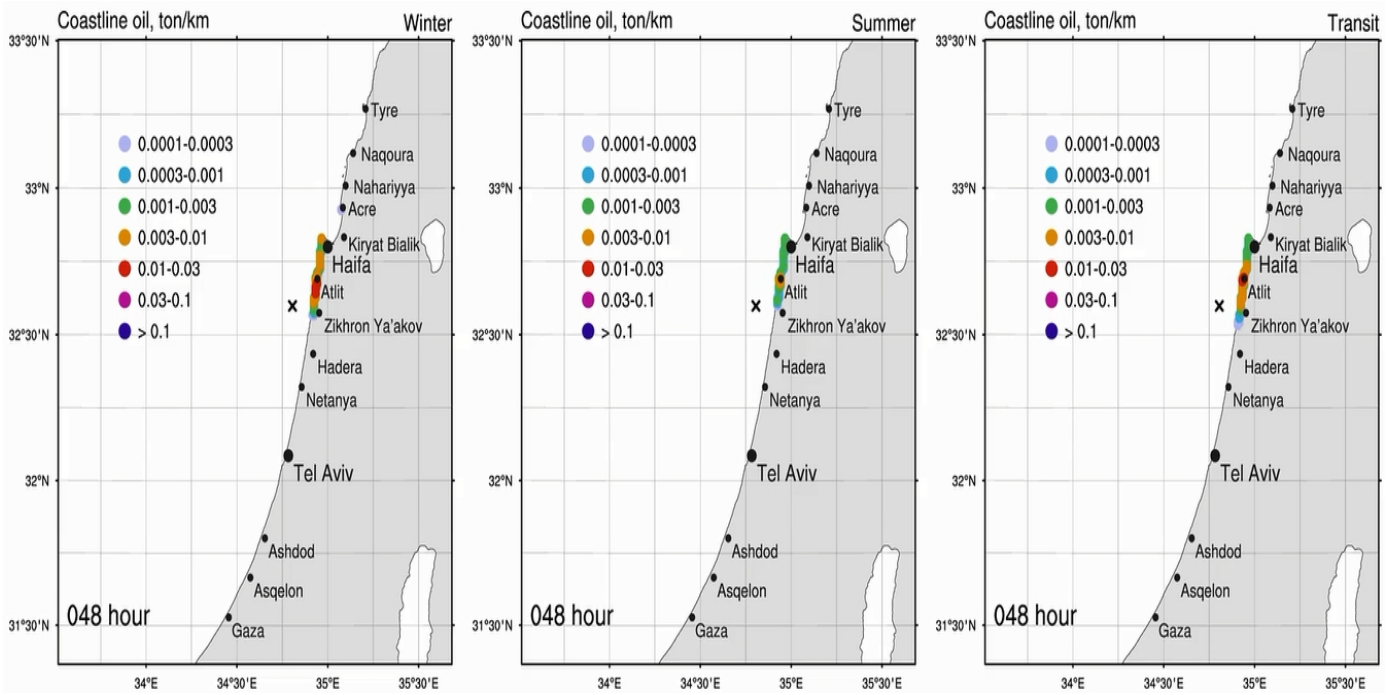


From the Leviathan offshore platform diesel spillage

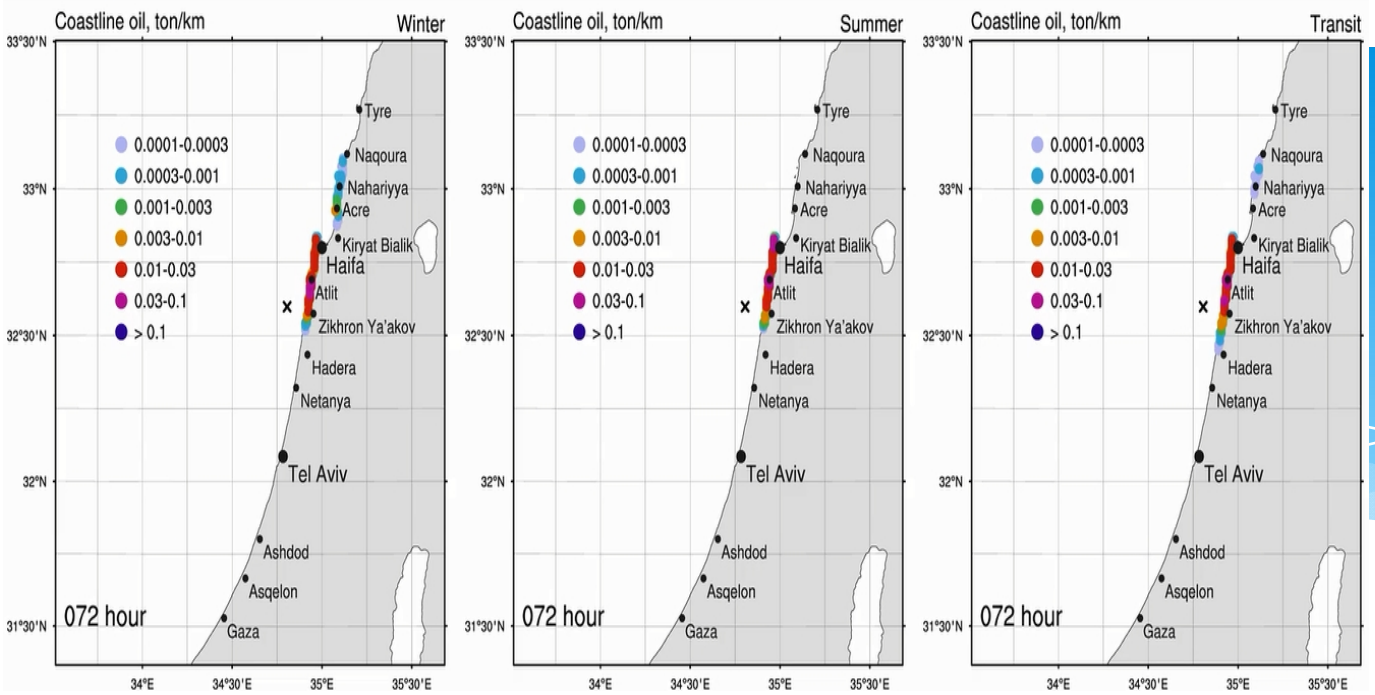
Monthly mean variations of the diesel spill in the water column

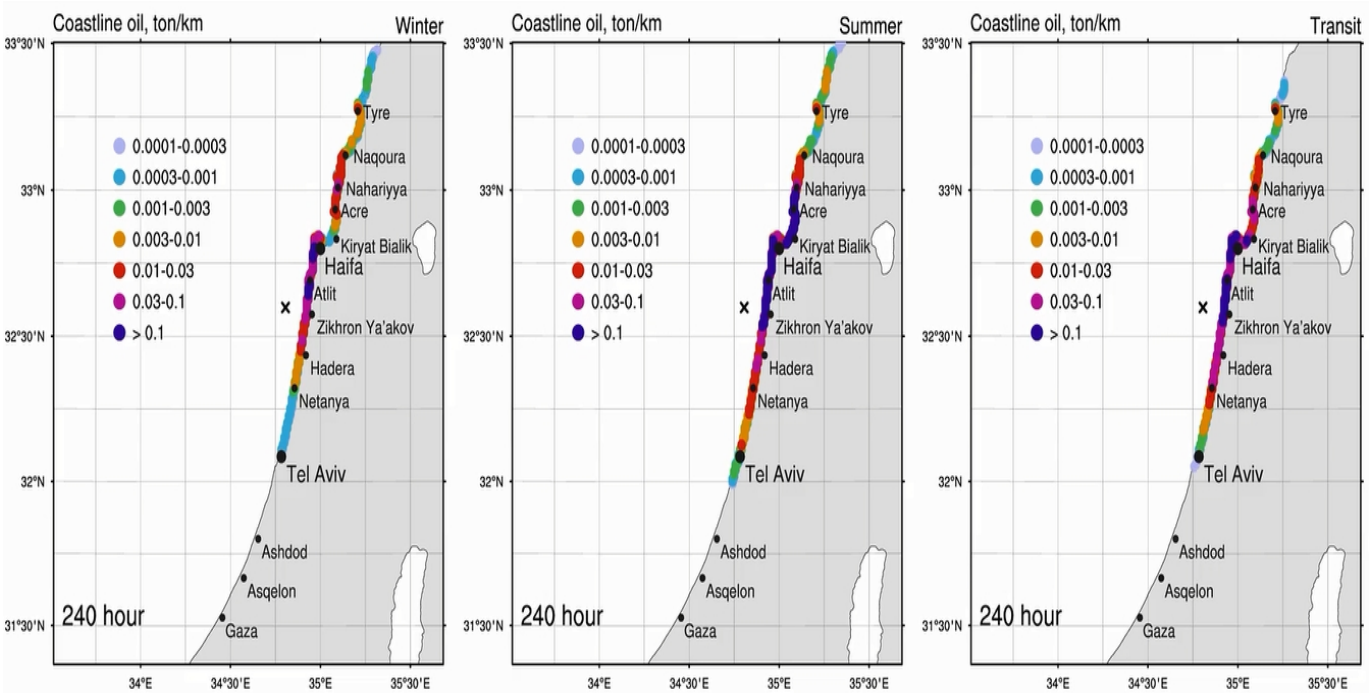






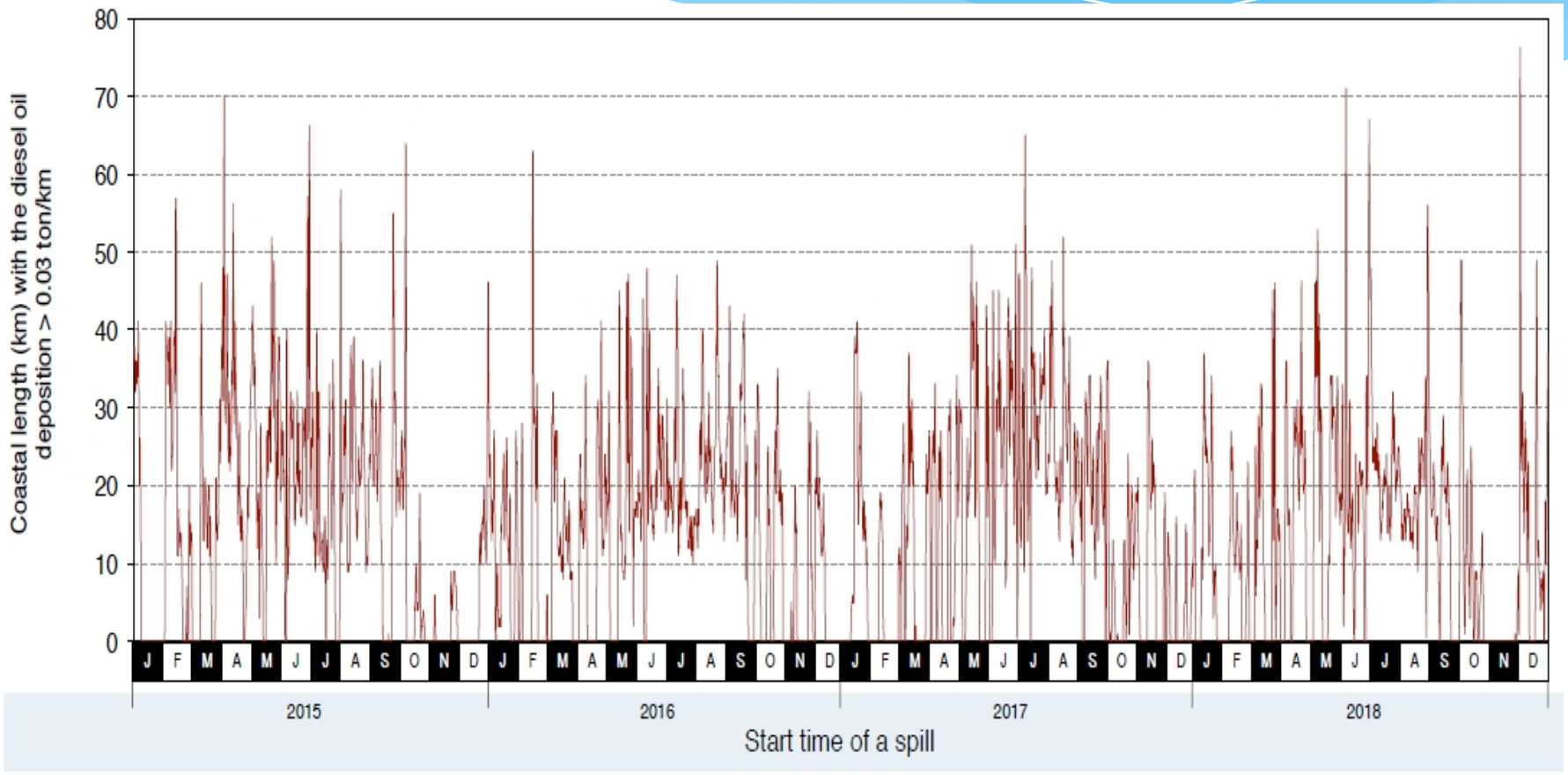
Winter, Summer and Transit seasonal spatial-temporal evolution of ensemble average concentrations (tons/km) of beached diesel after: 24h and 48 h of simulation.





Winter, Summer and Transit seasonal spatial-temporal evolution of ensemble average concentrations (tons/km) of beached diesel after: 72h and 240 h of simulation.

Length of the coastline where the diesel spill deposition exceeds 0.03 ton/km

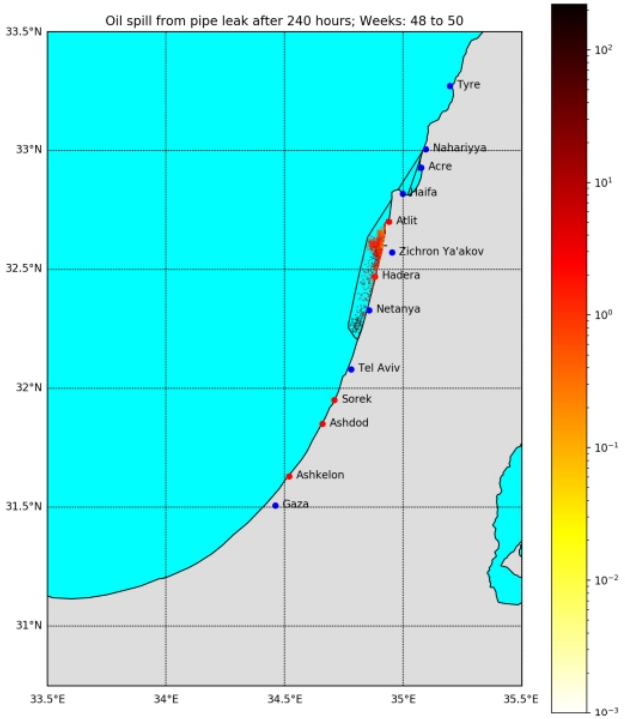


Major results from diesel spillage simulation from the Leviathan platform

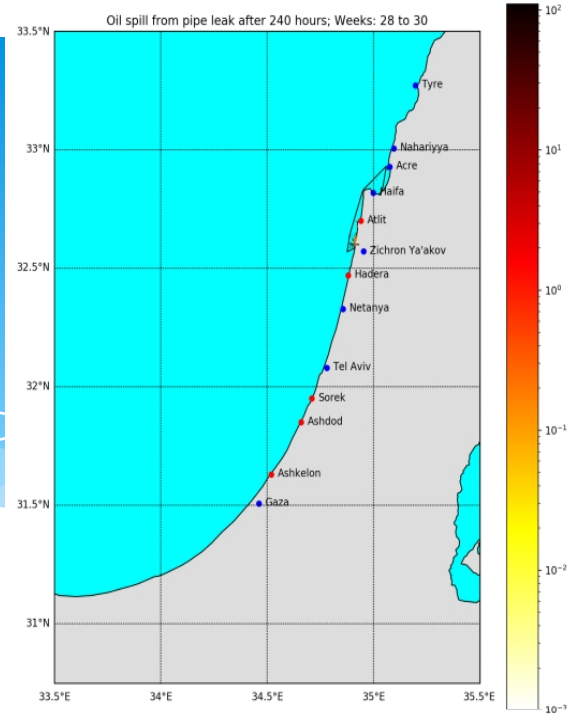
- First impact on the coast is predicted at 21 hrs but not earlier than 16hrs, in winter, at 24 hrs in transit seasons but not earlier than 20 hrs and at 33 hrs during summer seasons but not earlier than 24.
- The first impacted area is the coastline of Atlit.
- In winter on average, is predicted that 15% of the spillage is beached, while in summer as high as up to 45%.
- Most affected area with maximum spill concentrations (> 0.1 ton/km) is the coastlines between Zichron/Dor - Atlit, and between Atlit and Haifa (Shikmona) and between Zichron/Dor - Hadera.
- Deposition of the diesel spill in the Hadera desalination plant is estimated to be the highest among the 5 desalination plants examined.

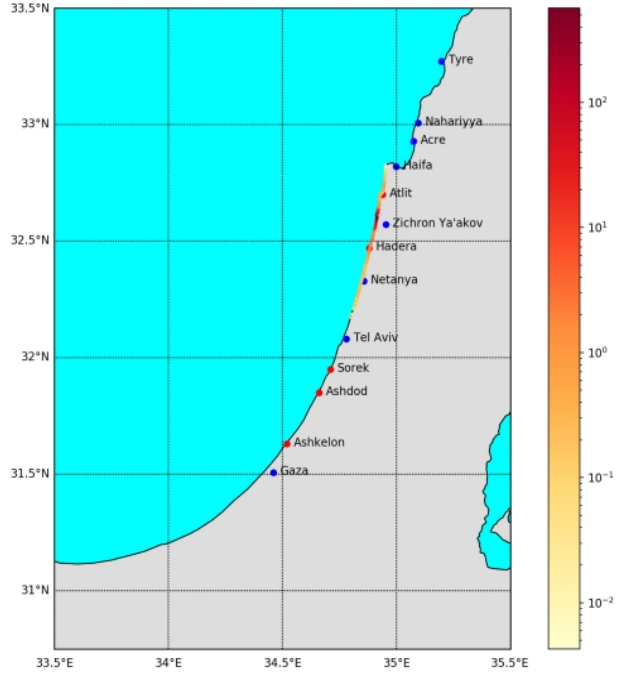
The condensate spill simulations setup

Parameter	Value
Pipe rupture located 1 km from the coast	32° 36’ 02.7’’ N and 34°54’18.8’’ E
Oil type : **Condensate**	Condensate with API=43.2 and SG=809.9 kg/m^3
Spilled volume	3000 bbls
Spill duration	Near instantaneous : 24 hrs
Simulation length	480 hours
Hydrodynamic fields	6- hourly CYCOFOS downscaled from CMEMS MFC Med at a horizontal resolution of 1.8 km
Wind fields	hourly, SKIRON at a horizontal resolution of 10 km
Wave fields	3-hourly, CYCOFOS at a horizontal resolution of 10 km

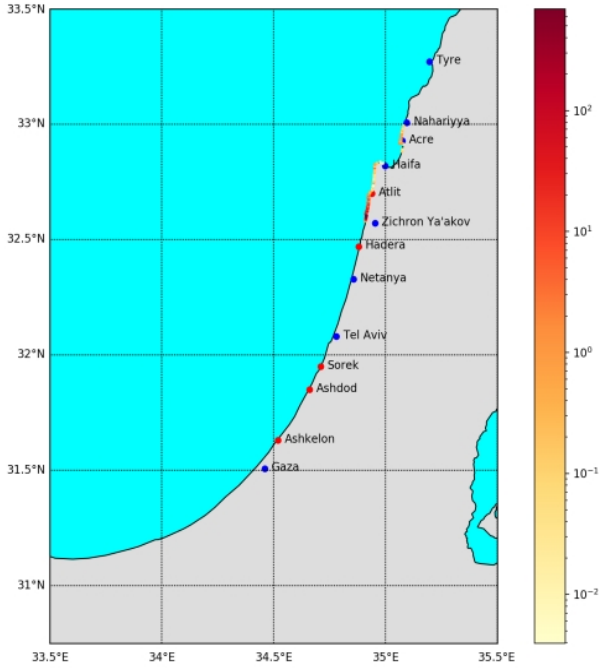


Winter (left) and Summer ensemble condensate concentration (bbls) at sea surface from the pipe rupture spillage after 240 h.

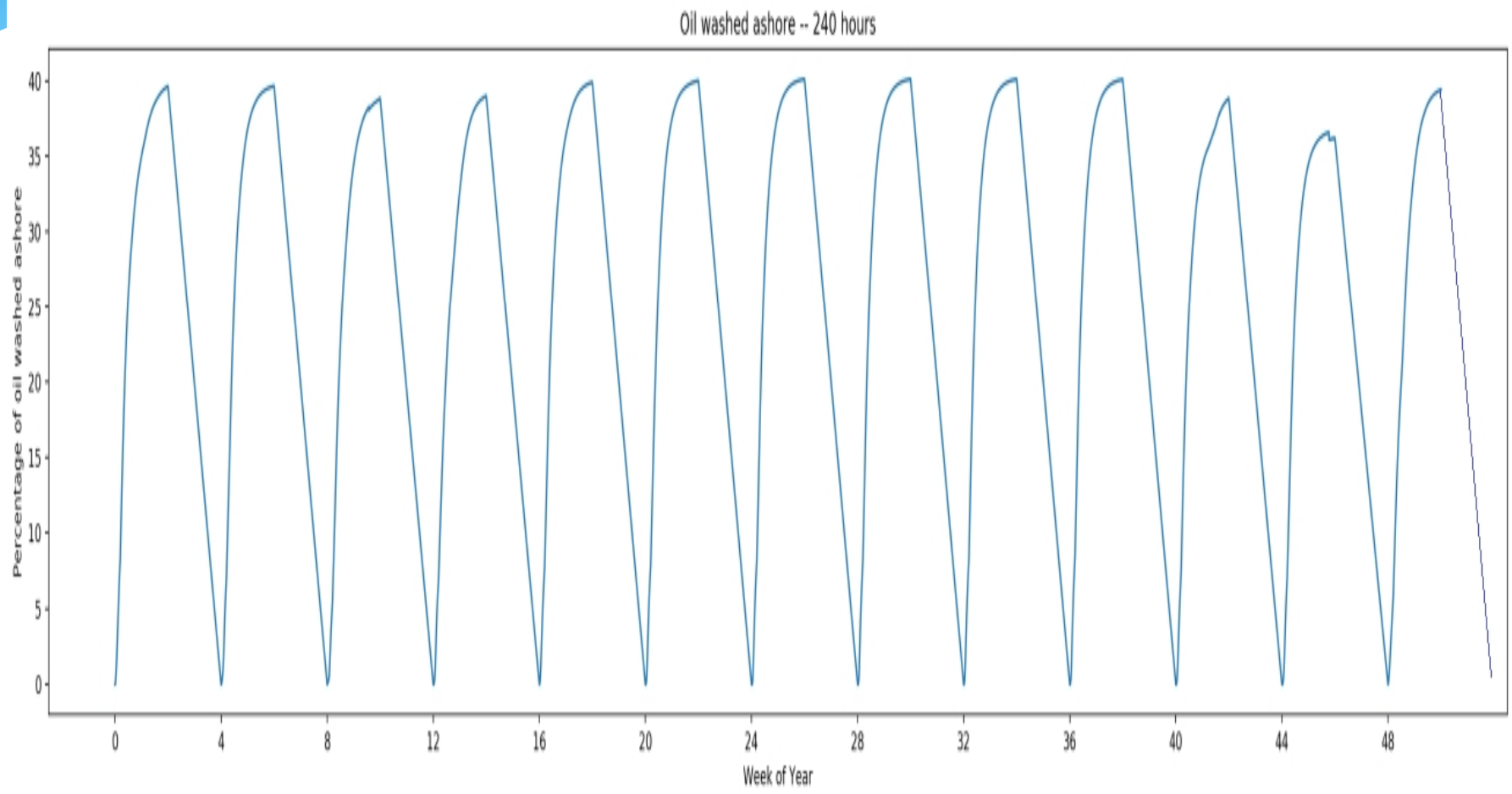


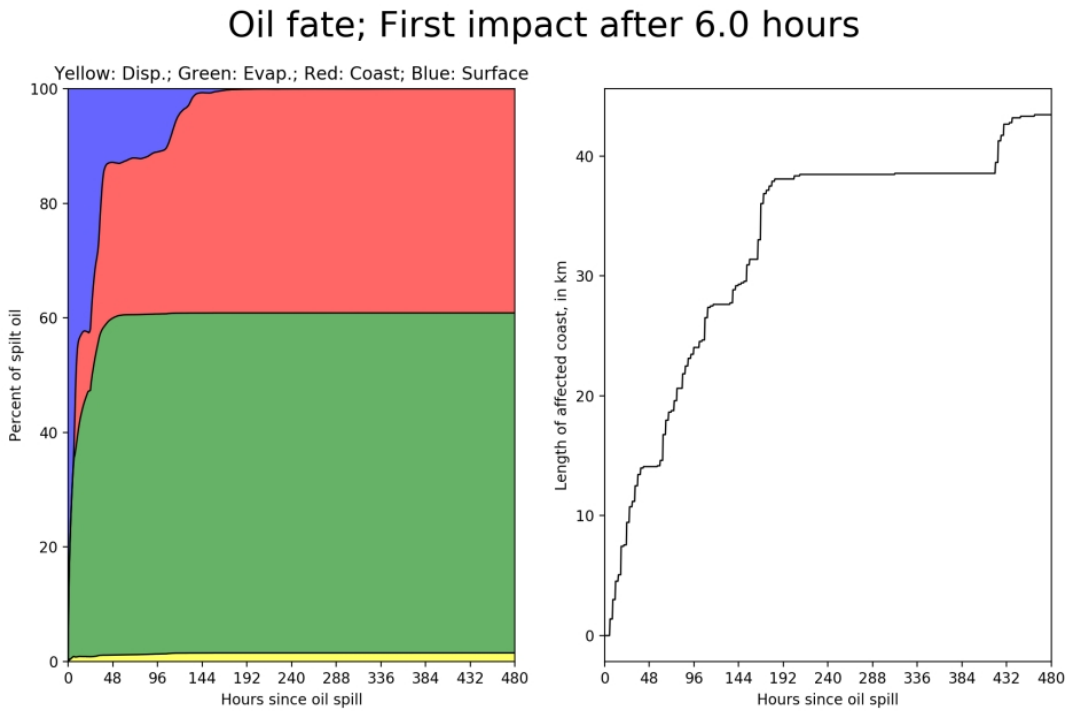


Winter (left) and Summer ensemble condensate concentration (bbls) washed up to the shoreline from the pipe rupture spillage after 240 hours.

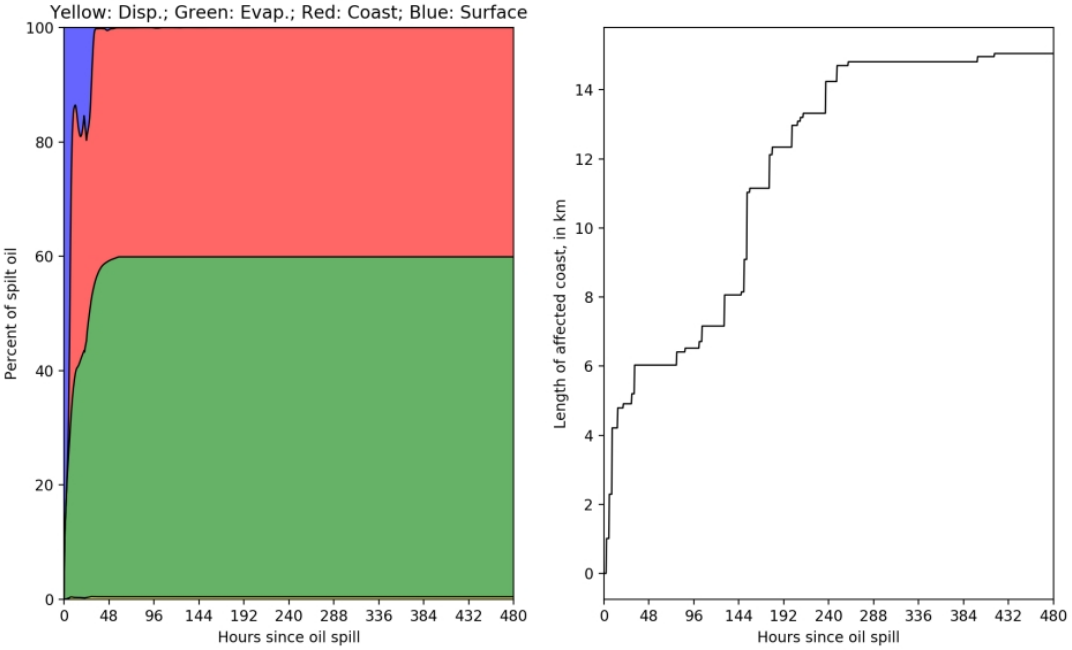


Monthly climatological variations of condensate spill washed up ashore (%), after 240 hours.





Winter/December, period condensate fate parameters (%) for evaporation (in green), for beached (in red), at sea surface (in blue), for dispersed (in yellow) and the impacted length (km) of shore.



Summer/August period condensate fate parameters (%) for evaporation (in green), for beached (in red), at sea surface (in blue), for dispersed (in yellow) and the impacted length (km) of shore.

Major results from condensate spillage simulation from the 1Km pipe rupture

- First impact on coast is predicted to be between 3-4 hrs in summer and 5-6 hrs in winter, with the worst case scenario to be at half hour after the spillage.
- The first impacted area is the coastline between Zichron-Atlit. The coastline of Zichron is predicted to be the epicenter of condensate deposition up to 15 tons/km, regardless the season.
- Due to the proximity of the pipe rupture to the shore, 38-40% of the condensate spillage washed up the shore, without seasonal or monthly variability. Moreover, in summer, the extend of the impacted coastline is mostly northward from the epicenter toward Acre, while in winter the condensate depositions extended far south to Netanyya and far north to Type with insignificant levels of depositions.
- The condensate spillage will affect the Hadera Desalination coastline but not the shoreline of the Palmachim, Ashdod, Ashkelon and Sorek desalination plans, neither within a period of 10 and 20 days of predictions.

Overall Conclusions

- ✓ Long term ensemble spillage simulation from existing/planned offshore platforms is important to identify vulnerable coastal areas may affected.
- ✓ First impacted area from the Leviathan platform is the coastline between Zichron-Ya'akov/Dor and Atlit within 8 hrs in winter, and 11 hrs in summer. In winter 17% of the spillage is beached, while in summer, twice as higher.
- ✓ In case of the pipe rupture the coastline of Zichron-Ya'akov is predicted to be the epicenter of the condensate deposition up to 15 tons/km, while 38–40% of the condensate washed up the shore nearby, regardless the season.
- ✓ Deposition of spilled condensate in the Hadera desalination plant is estimated to be the highest among the 5 desalination plants examined.
- ✓ The previous spillage scenarios had underestimated by an order of magnitude the content per design itself (1000bbls vs. ~6000bbls) and documentation of permits. Similarly, the pipe rupture spillage scenarios underestimated by half order of magnitude (1200bbls vs. ~3000bbls). Therefore, the current simulations predicted larger spillage quantities, compared to previous simulations.

References

- Dor Leviathan Offshore Platform Environmental Report Review and Simulation ORION-Joint Research and Development Center
  Date of Issue: 04/August/2019

  Doc: LSR-OR-ZY-04-08-2019-R-A
- Dor Leviathan Offshore Platform Environmental Report Review and Simulation Supplementary Report ORION-Joint Research and Development Center
  Date of Issue: 22/November/2019

  Doc: LPR-OR-ZY-22-11-2019-R-A
- White Paper: Dor Leviathan offshore platform Environmental Report Review and Simulation ORION-Joint Research and Development Center

  Date of Issue: 18/January/2020

  Doc: WPR-OR-ZY-18-01-2020-R-A