NIKOLA VAPTSAROV NAVAL ACADEMY

SCIENTIFIC DEPARTMENT

"How to determine the different pollution sources in the Black Sea?"

Prof. Ph.D. Eng. Miroslav Tsvetkov

"How to determine the different pollution sources in the Black Sea?"

Sources of public available information and technologies for data gathering and monitoring of:

- Sea-surface floating objects (waste and oil pollutions)
- Underwater noise pollution
- Waste on beaches
- Data fusion for modeling, simulations and visualization
- Future work

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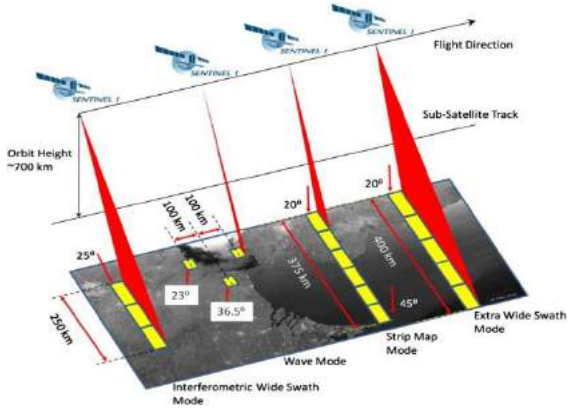
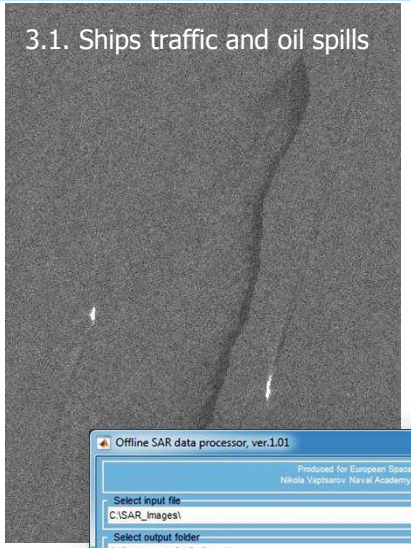
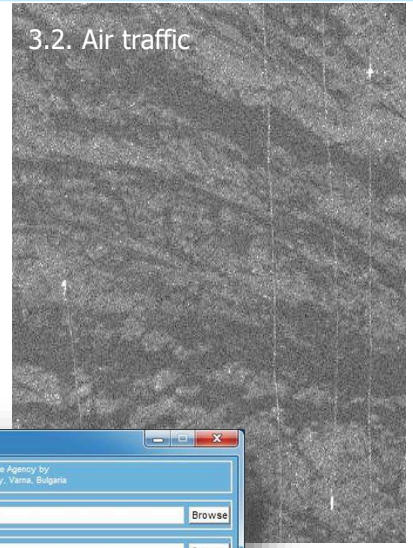
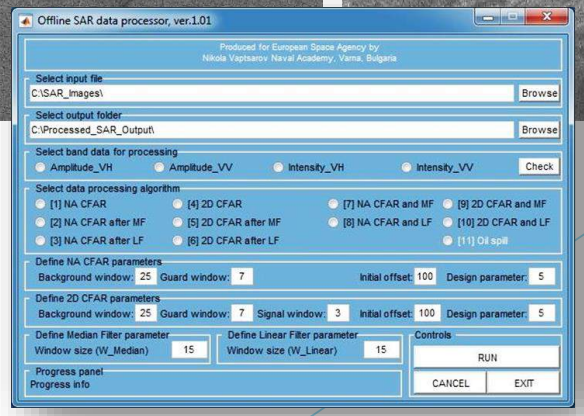
"How to determine the different pollution sources in the Black Sea?"

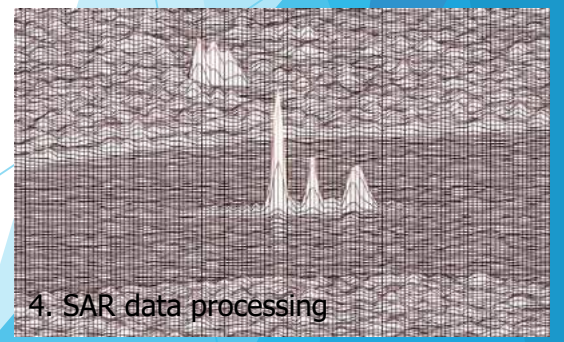
ESA Contract No. 4000122601/17/NL/SC for development of research project "EXpanded TRAffic Surveillance and Deep Sea Oil Pollution Observation" (ExTra S-D-S-O-P-O) for creating of algorithms and software packages for processing of radar data from the Sentinel-1 satellites, part of EU Copernicus Program.











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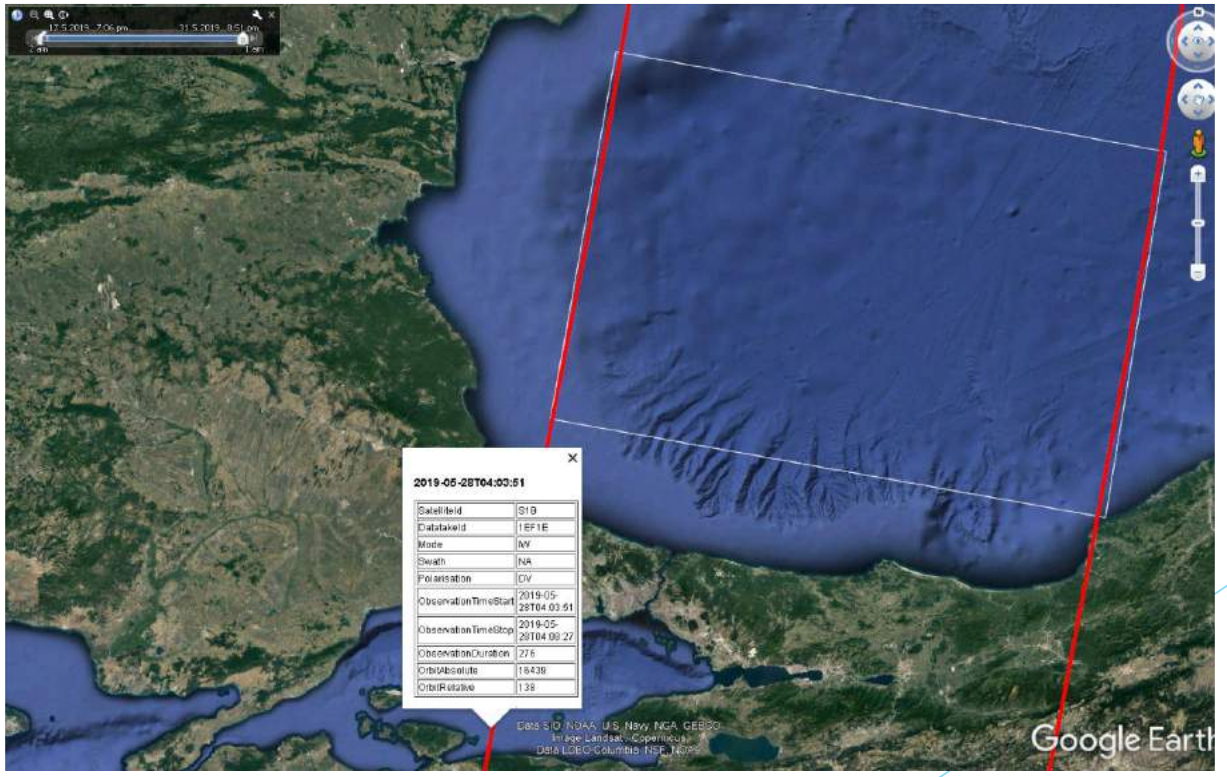

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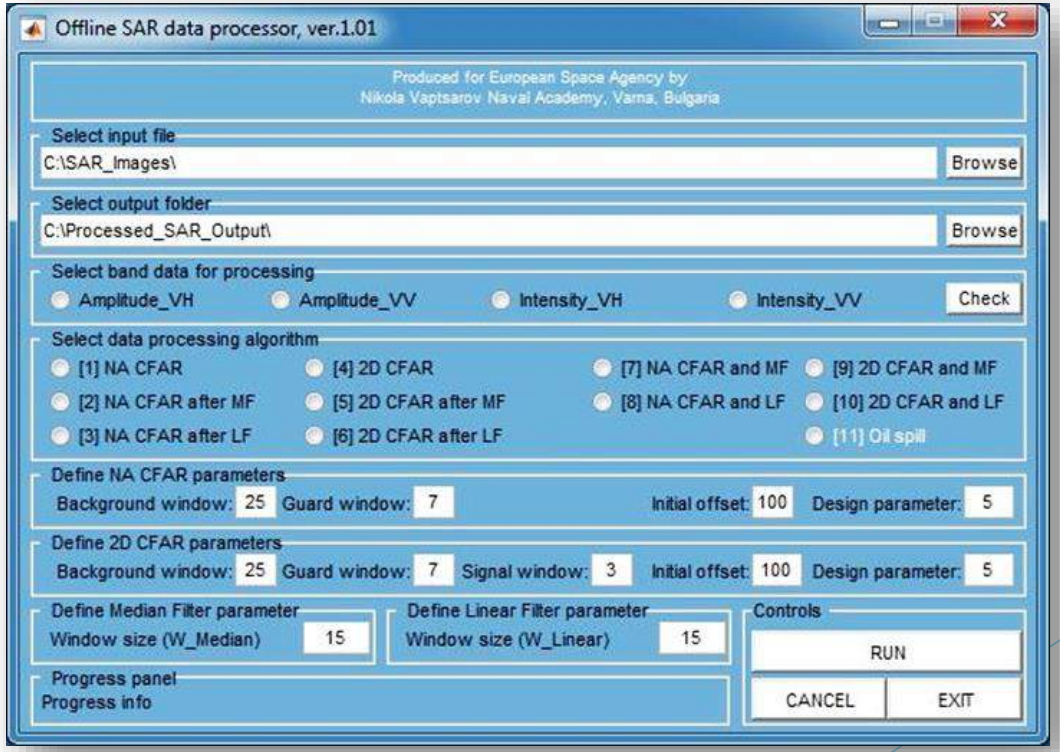

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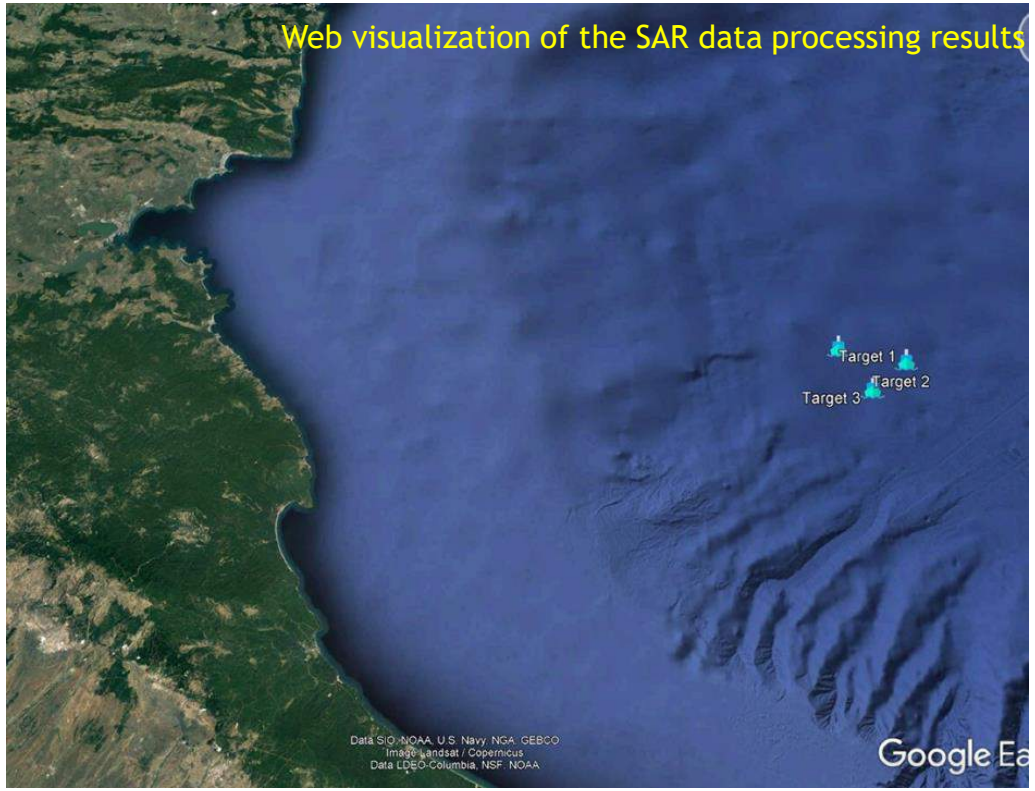

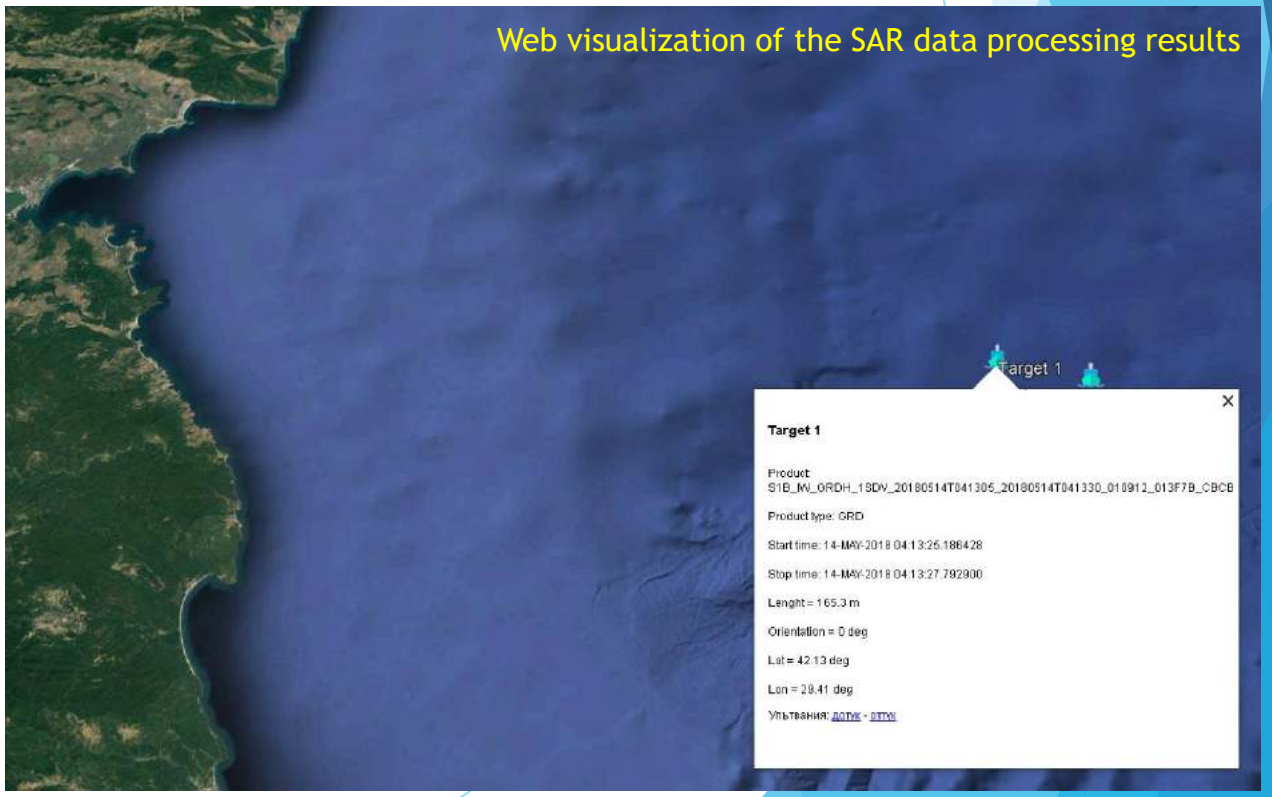

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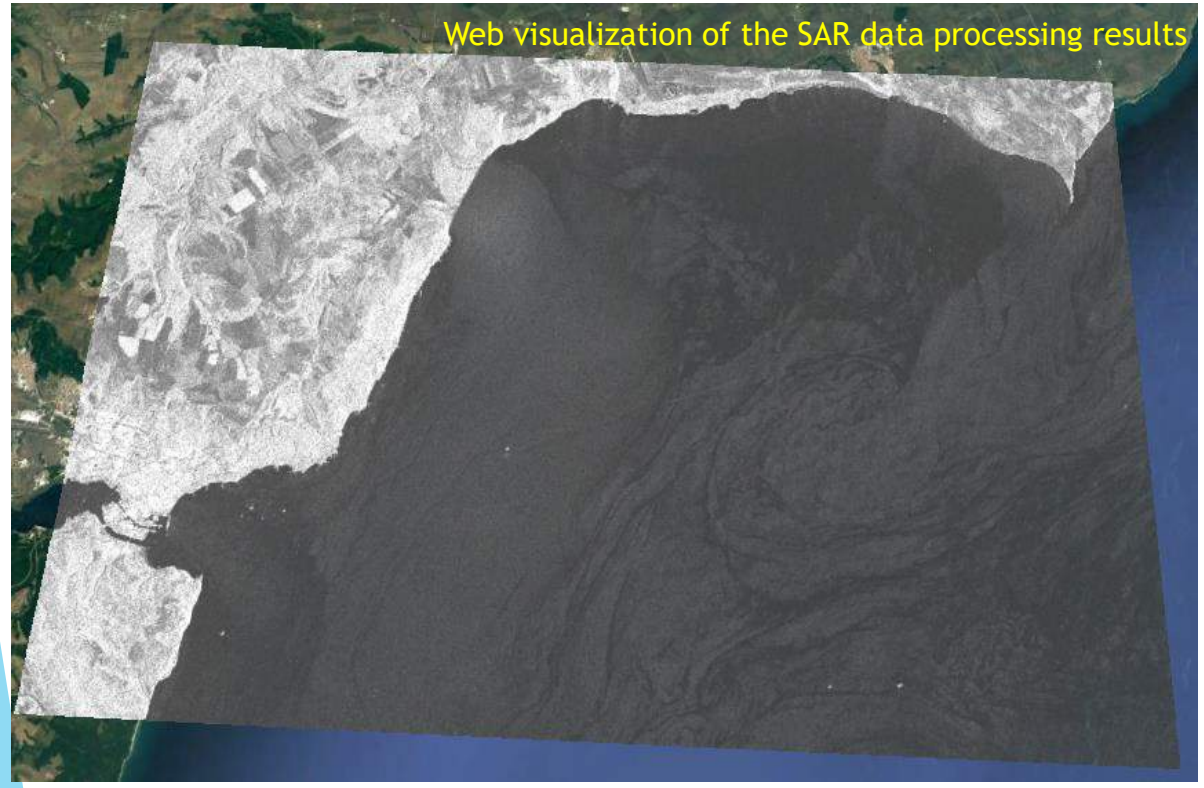

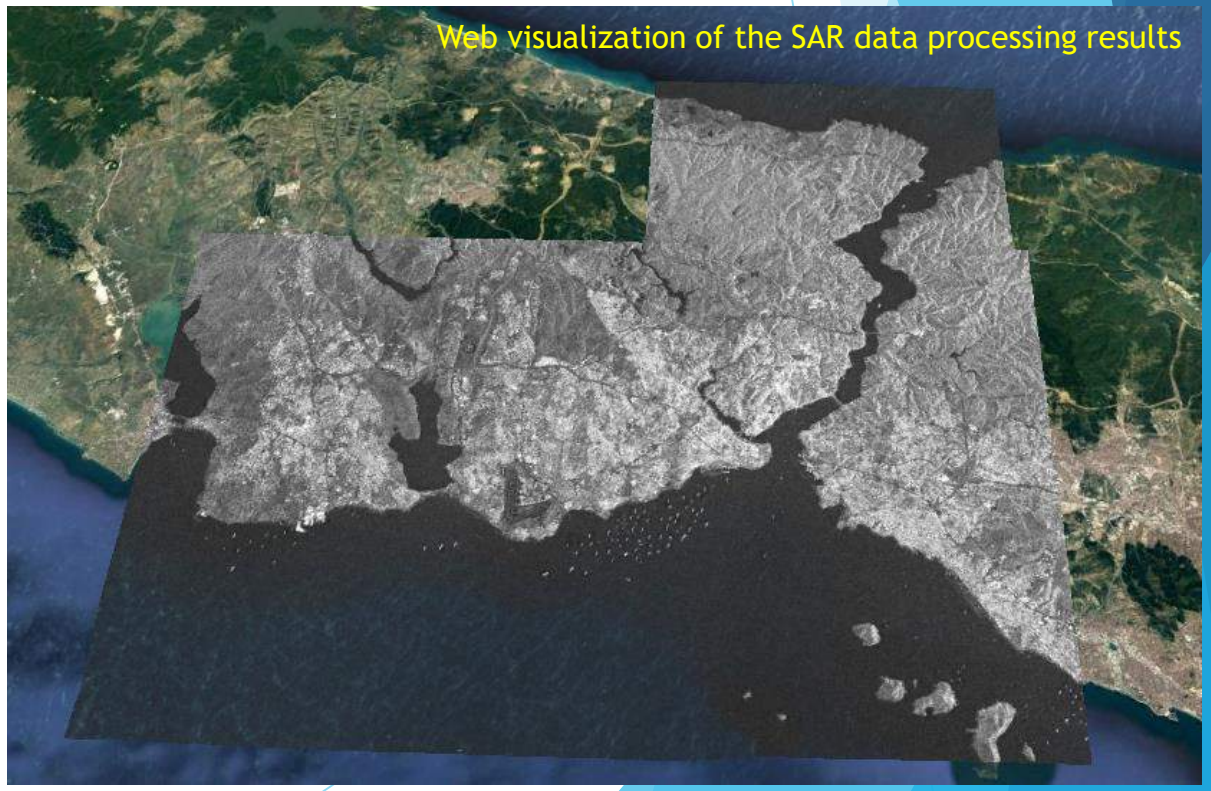

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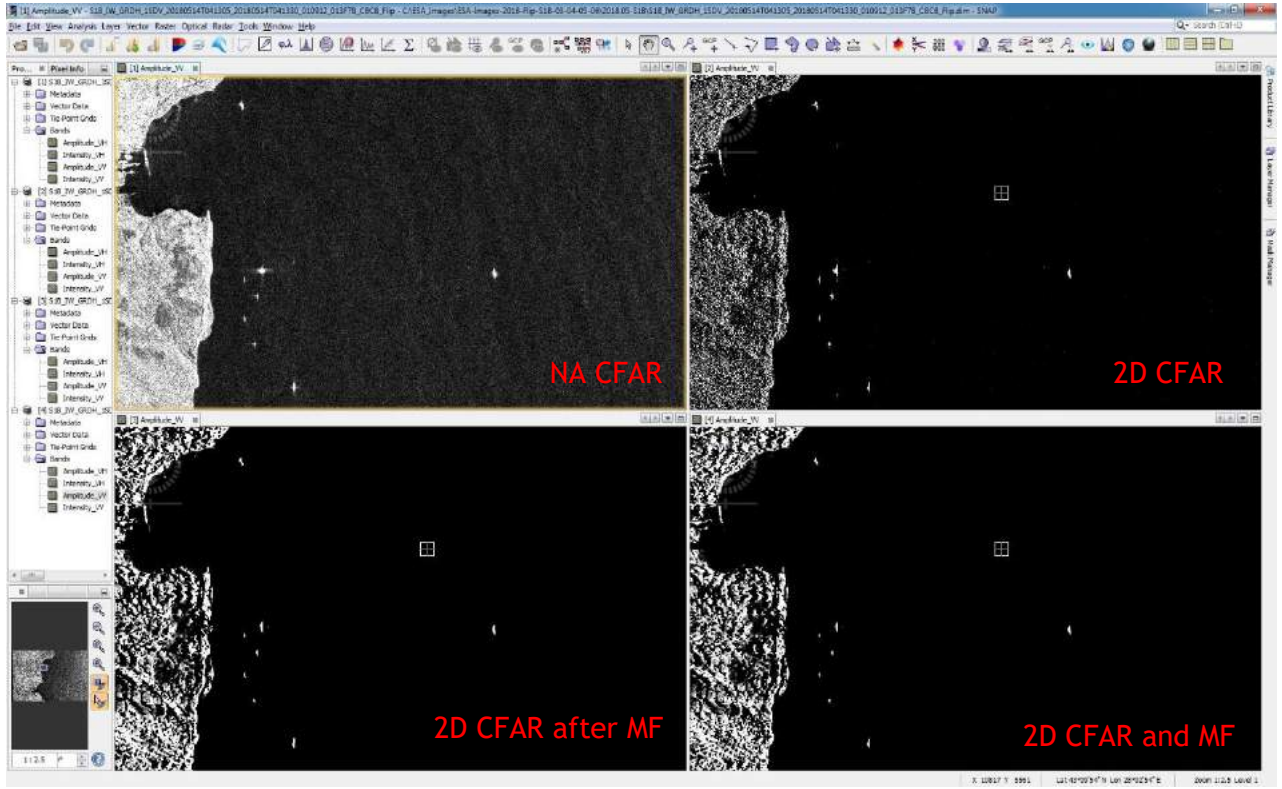
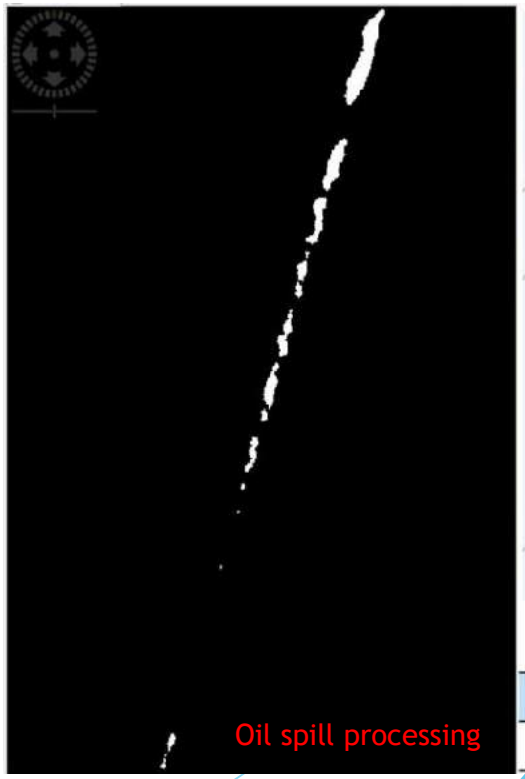
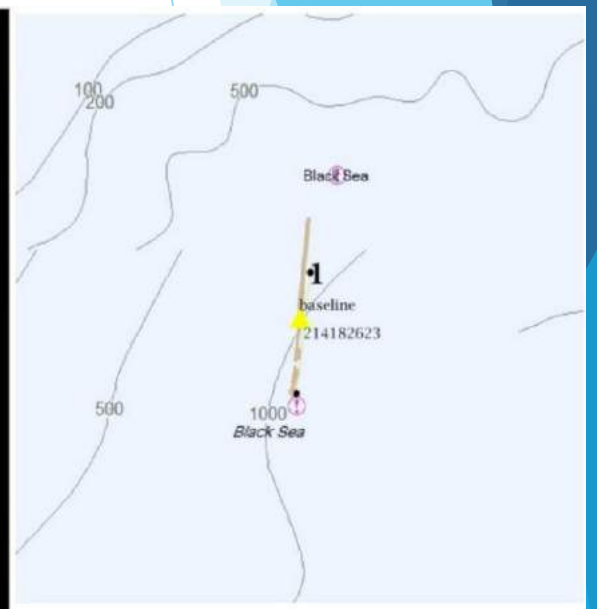


Verified with AIS and shore radar surveillance systems





Possible source information

IMO	Name	MMSI	C/S
N/A	N/A	214182623	N/A

Verified with EMSA CleanSeaNet reports

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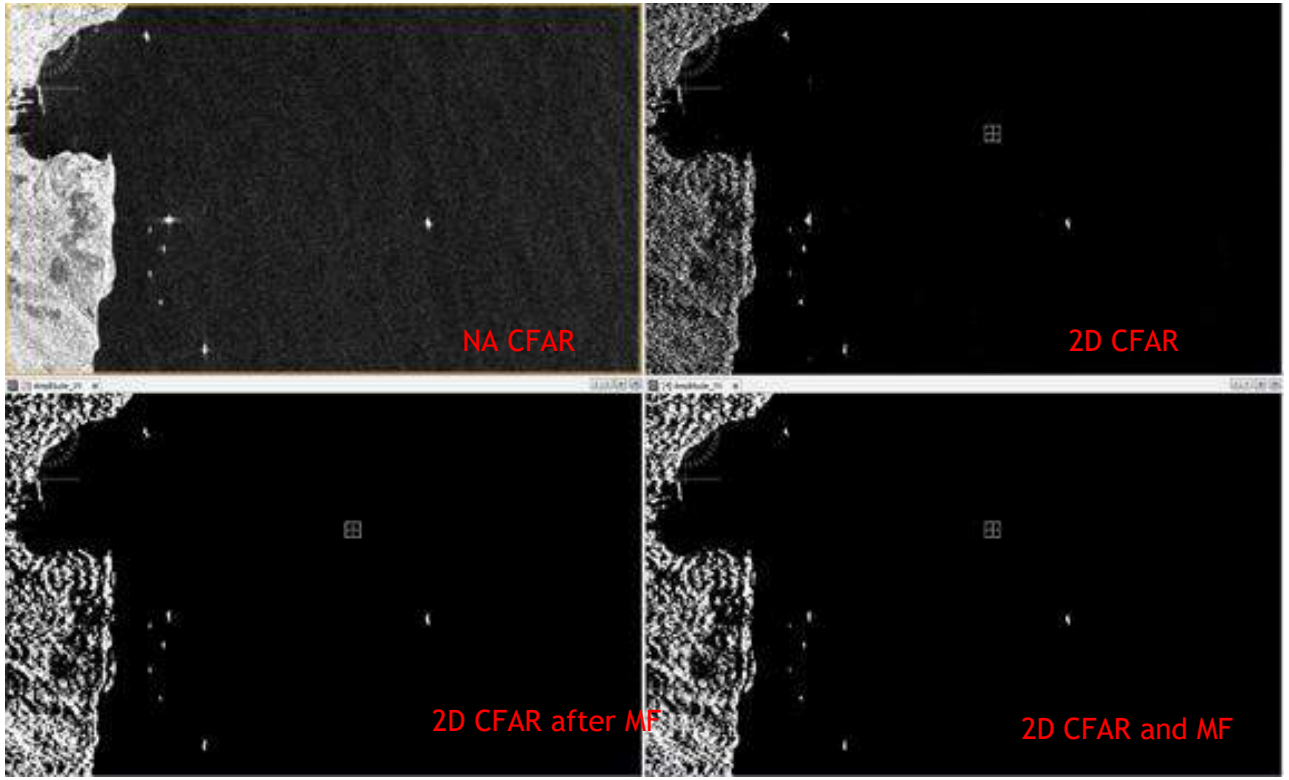

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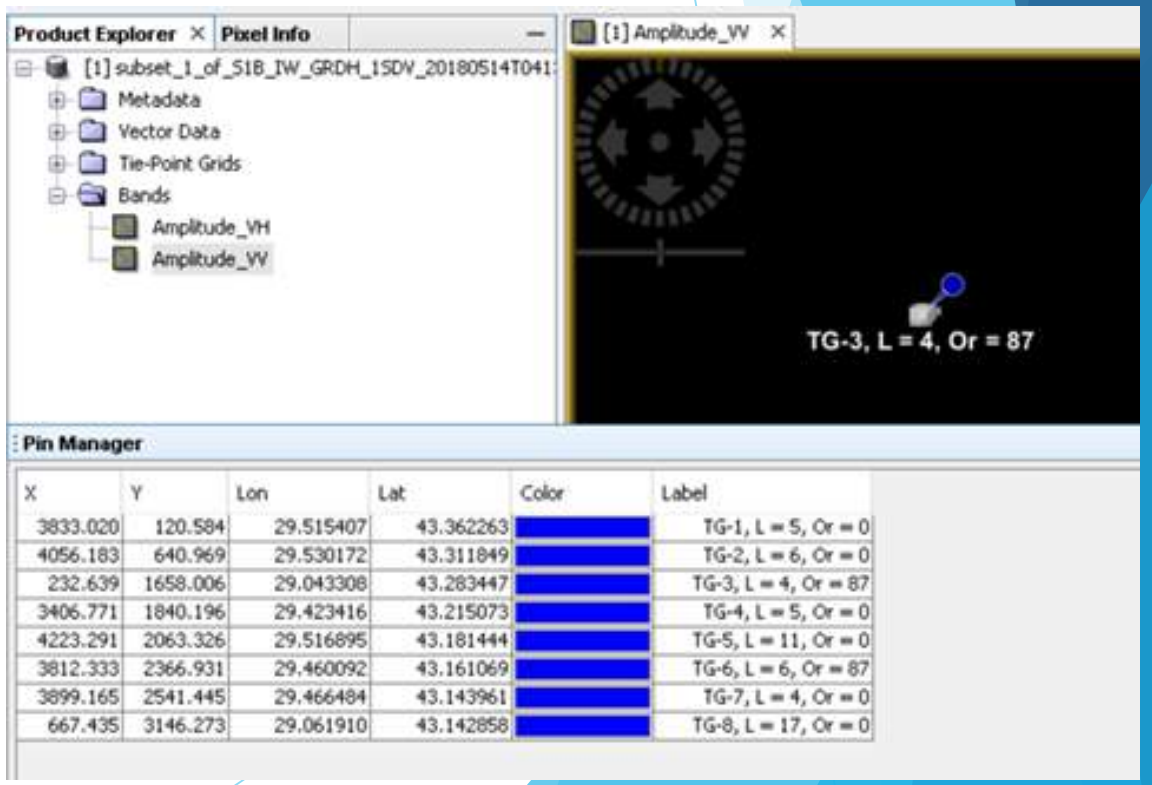

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4056.183	640.969	29.530172	43.311849		TG-2, L = 6, Or = 0
232.639	1658.006	29.043308	43.283447		TG-3, L = 4, Or = 87
3406.771	1840.196	29.423416	43.215073		TG-4, L = 5, Or = 0
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3812.333	2366.931	29.460092	43.161069		TG-6, L = 6, Or = 87
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667.435	3146.273	29.061910	43.142658		TG-8, L = 17, Or = 0

Visualization of the SAR data processing results in different soft app’s

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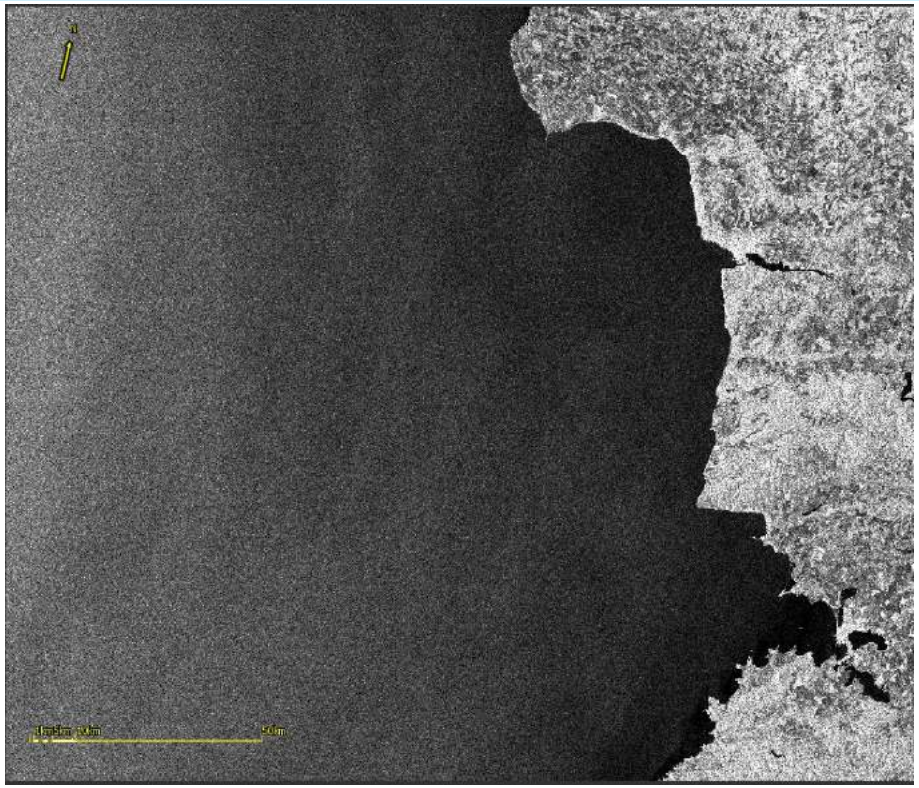
"How to determine the different pollution sources in the Black Sea?"

Level-2 Sentinel-1 SAR data for wind, wave and currents applications



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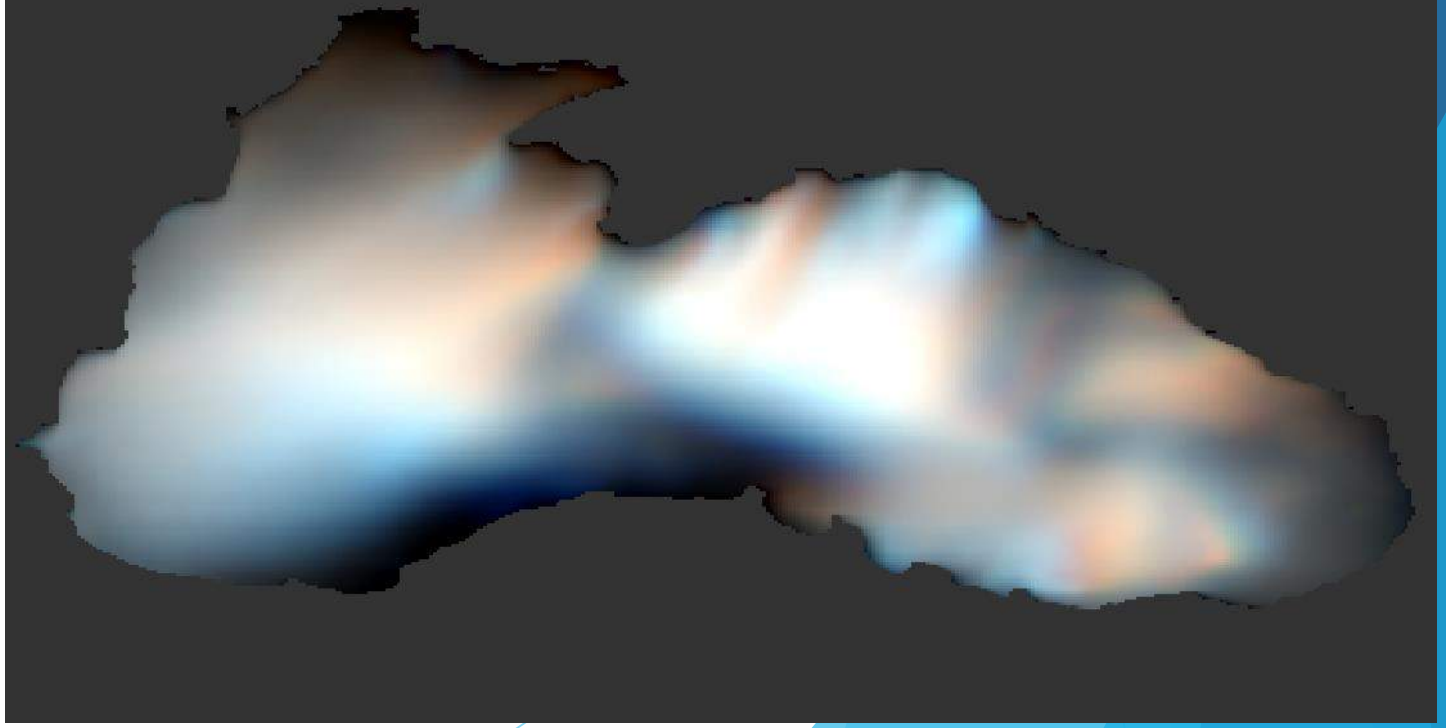
"How to determine the different pollution sources in the Black Sea?"

Copernicus CMEMS data access

- Temperature
- Salinity
- Sea surface height
- Current Velocity
- Mixed layer thickness
- Sea Ice
- Wind
- Wave
- Plankton
- Oxygen
- Nutrients
- Primary production
- Reflectance

CMEMS RAW DATA



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"How to determine the different pollution sources in the Black Sea?"

Copernicus CMEMS data processing

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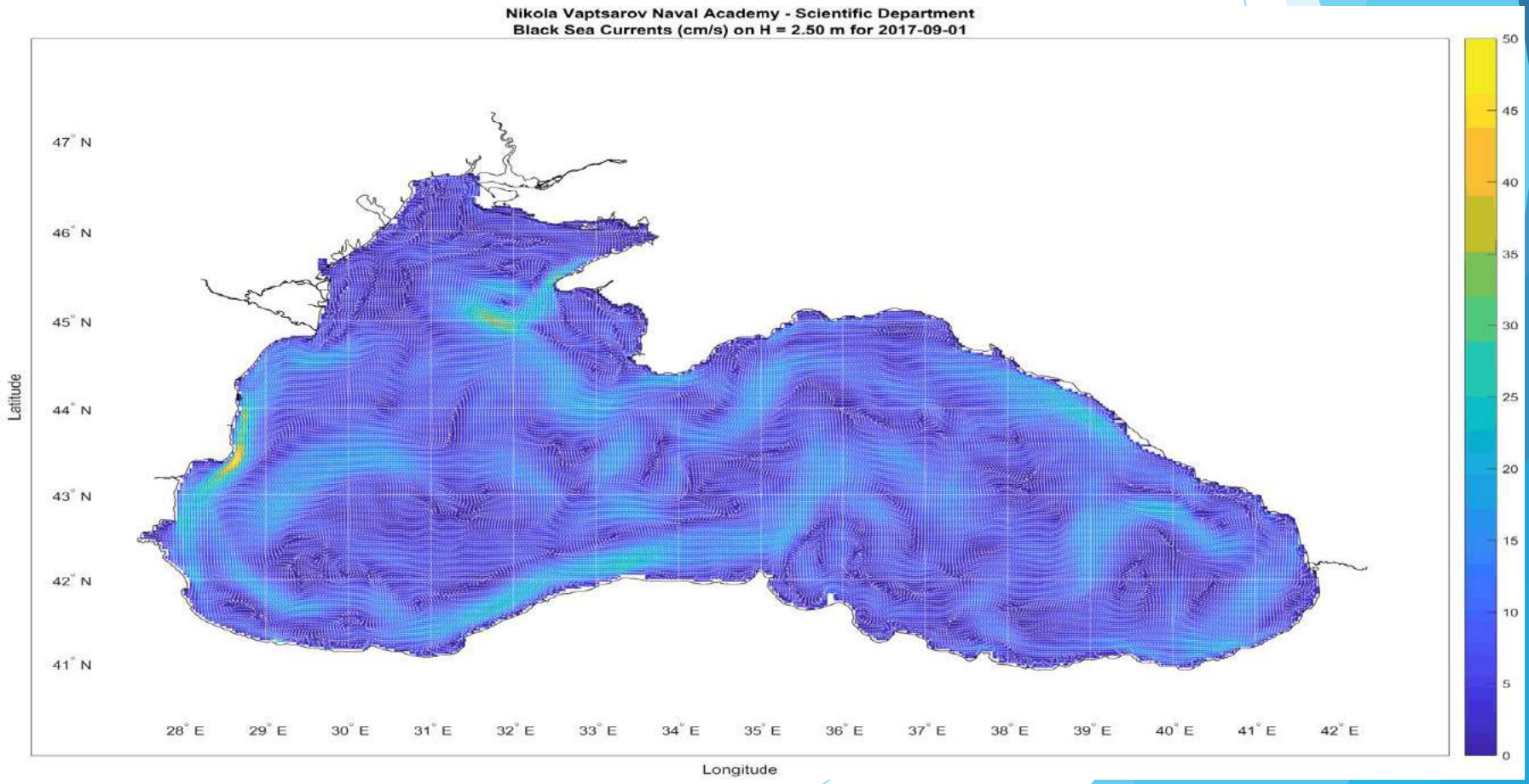

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"How to determine the different pollution sources in the Black Sea?"

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Temperature
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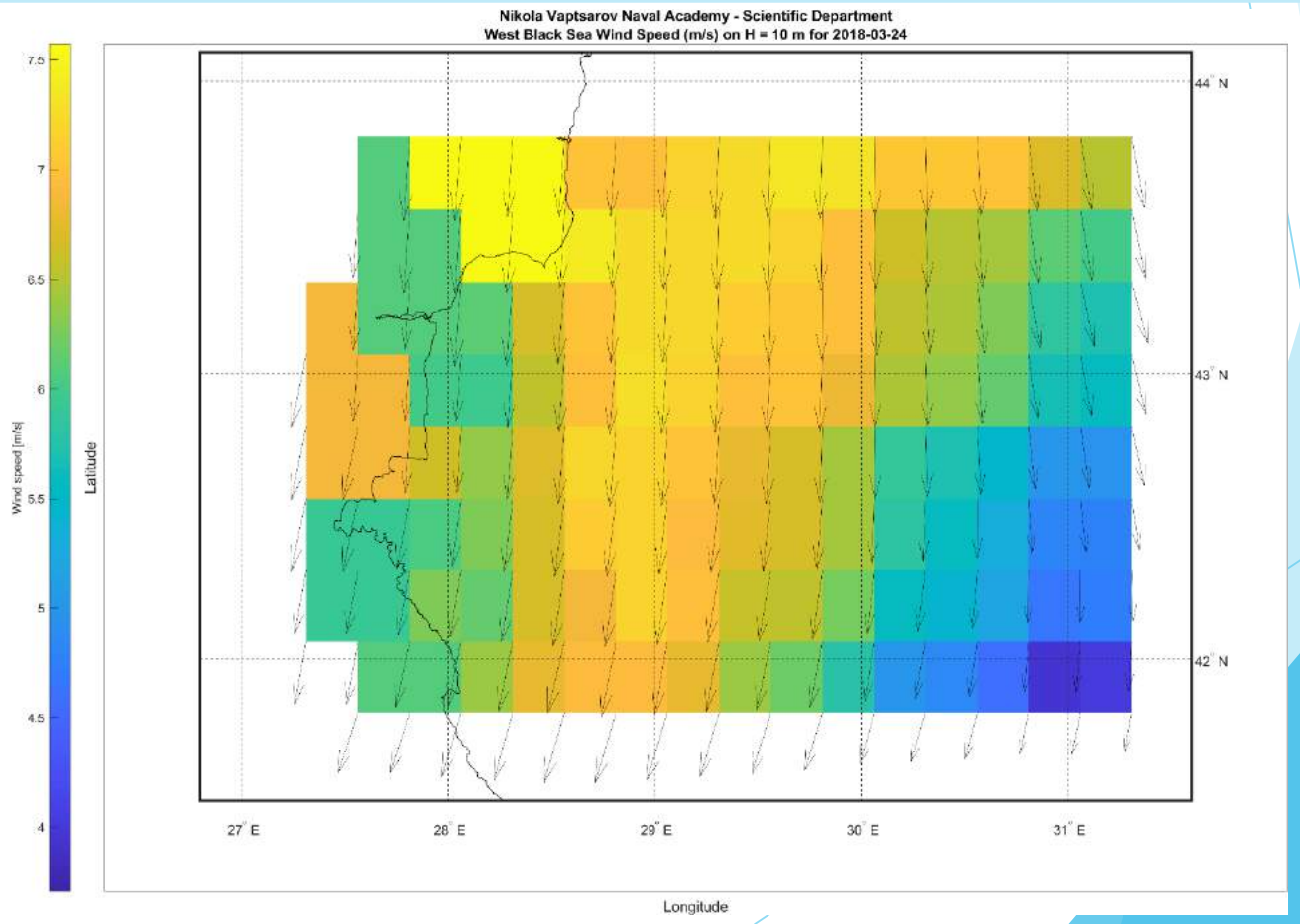

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Copernicus CMEMS data processing

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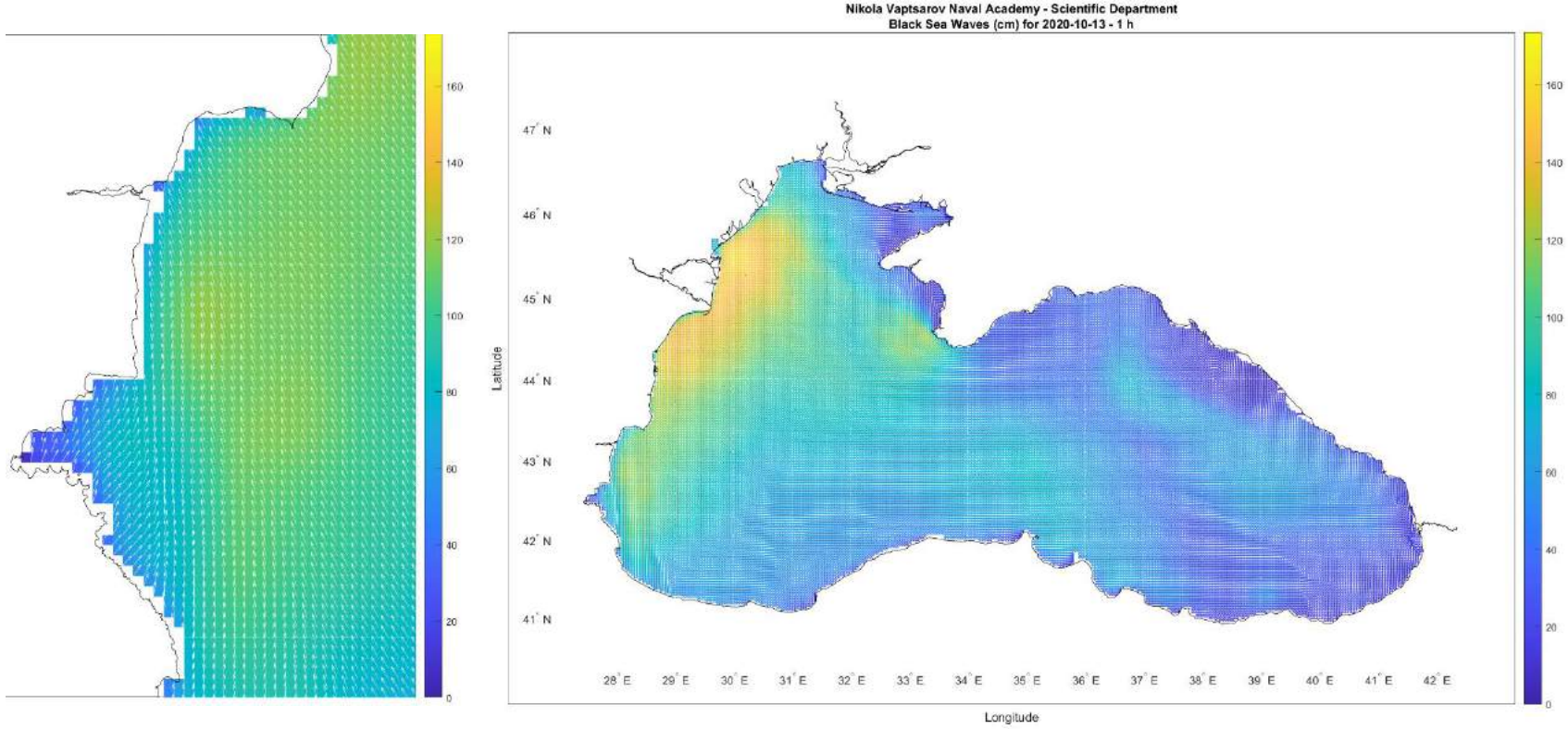

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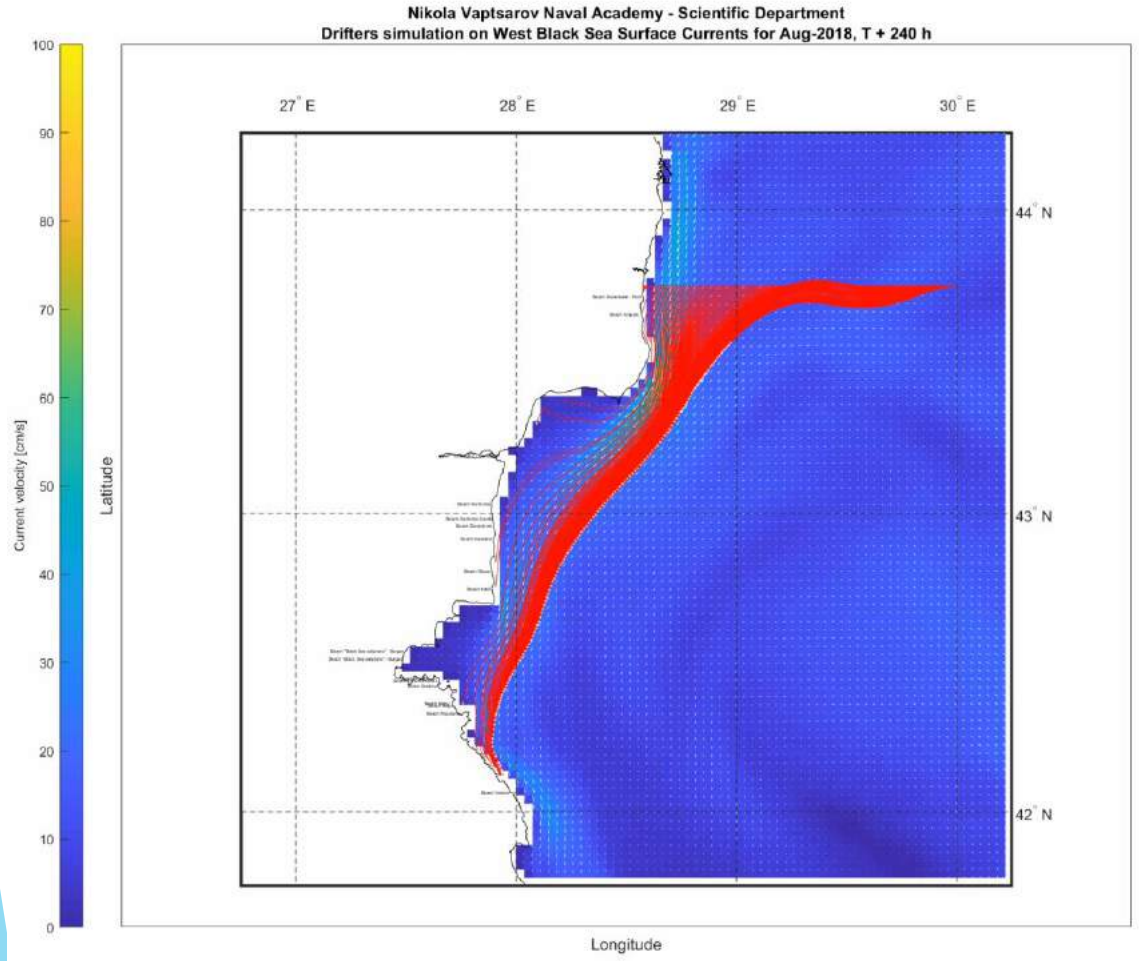
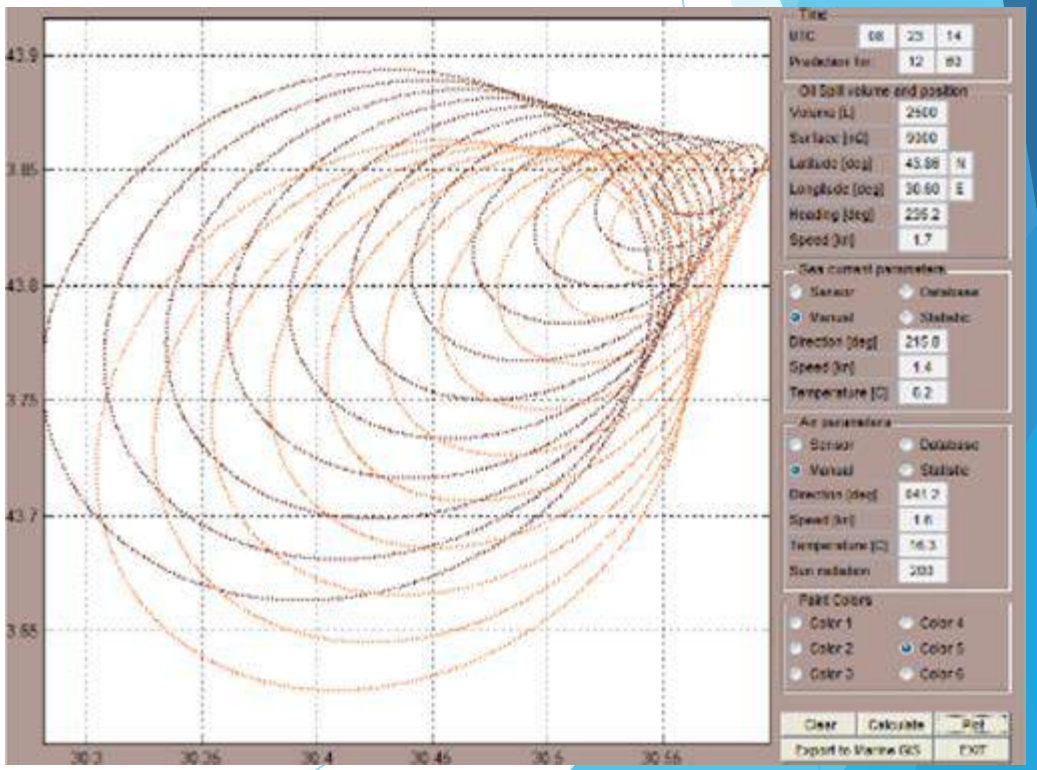
"How to determine the different pollution sources in the Black Sea?"

Numerical modelling and simulation of sea surface floating objects



Numerical modelling and simulation of oil spill movement and distribution



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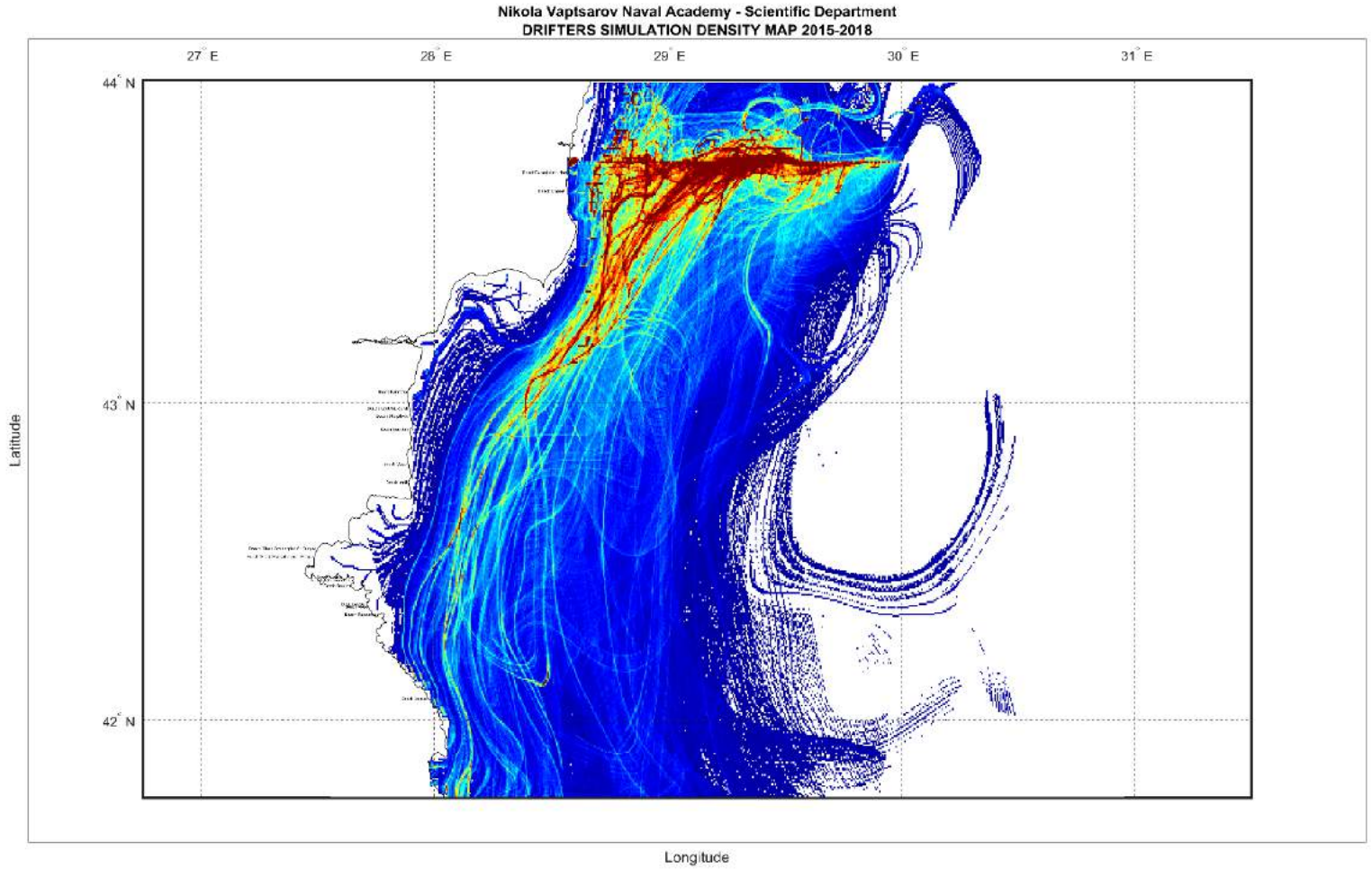

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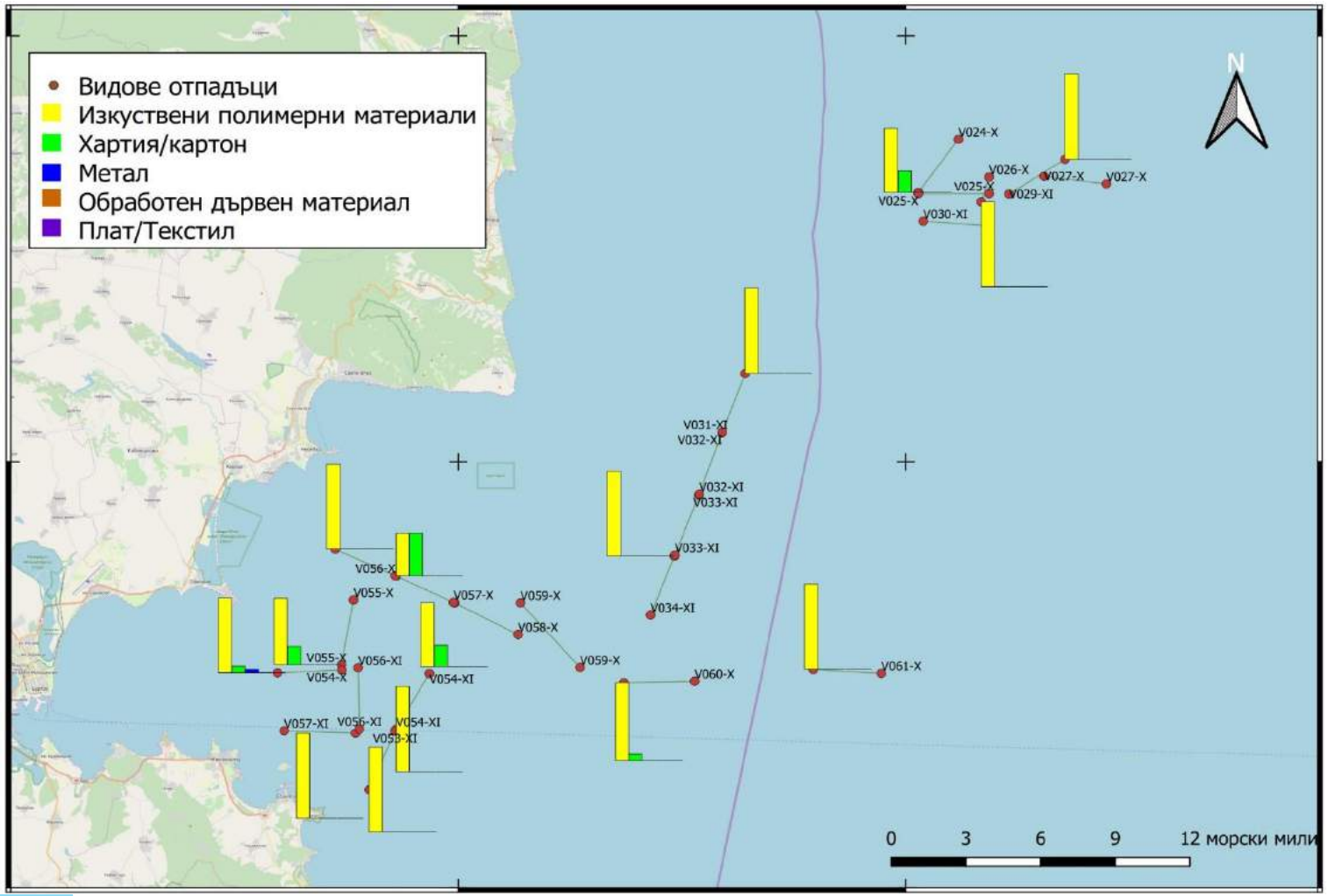
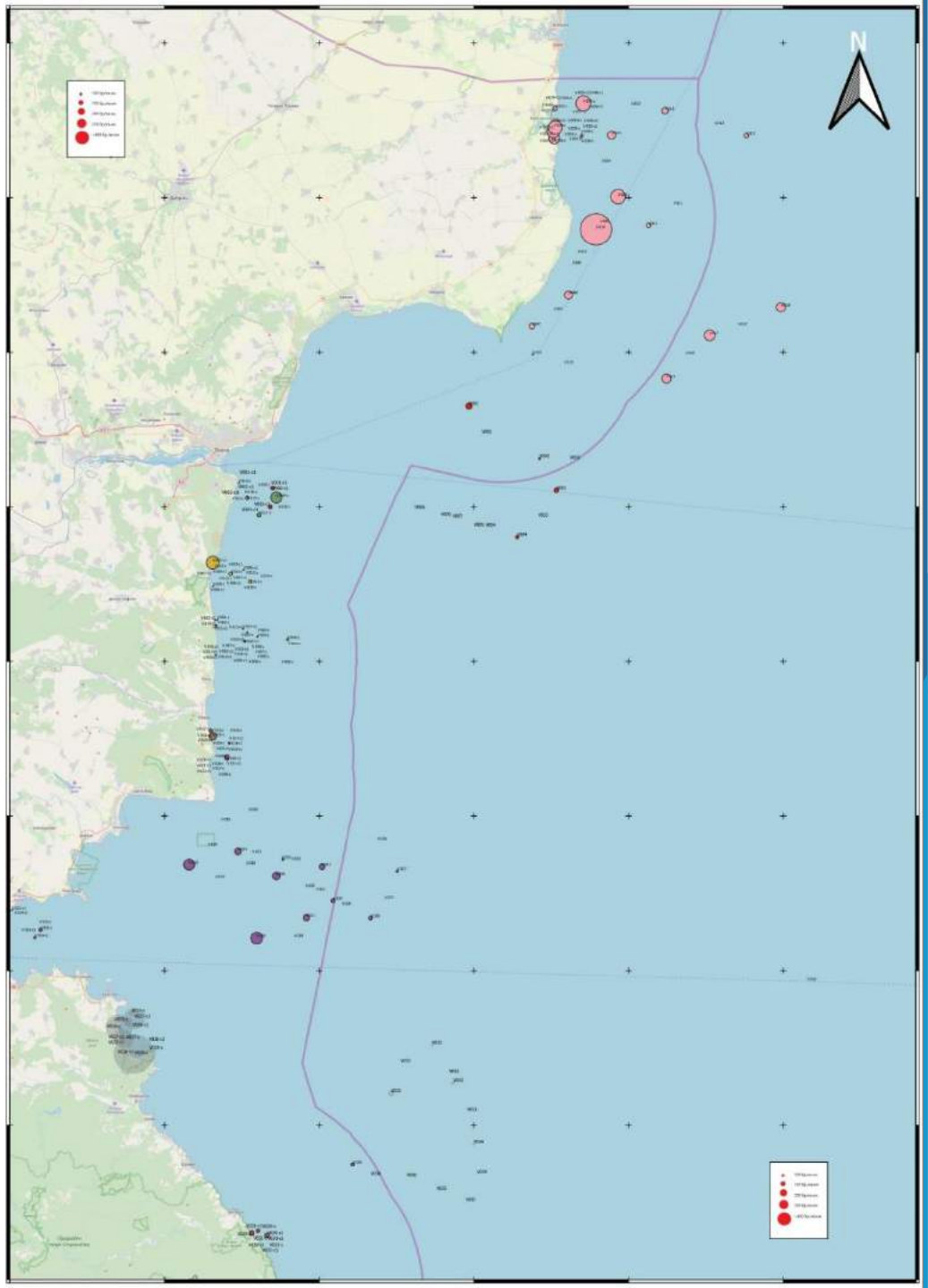
Mapping of sea surface floating waste





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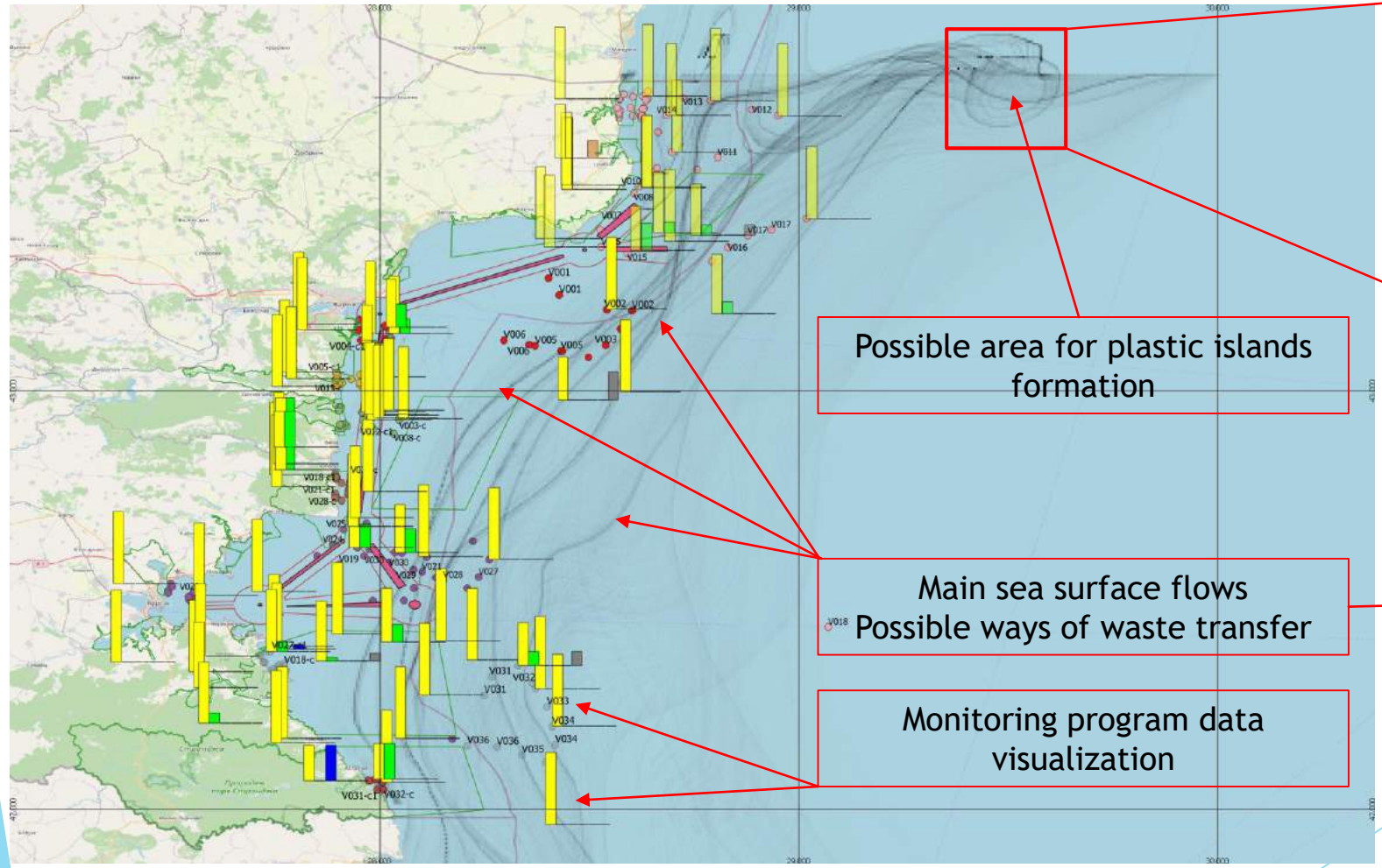
"How to determine the different pollution sources in the Black Sea?"

Mapping and analyses of sea surface floating waste (data fusion and mixed layers)



Possible area for plastic islands formation

Main sea surface flows
Possible ways of waste transfer

Monitoring program data visualization

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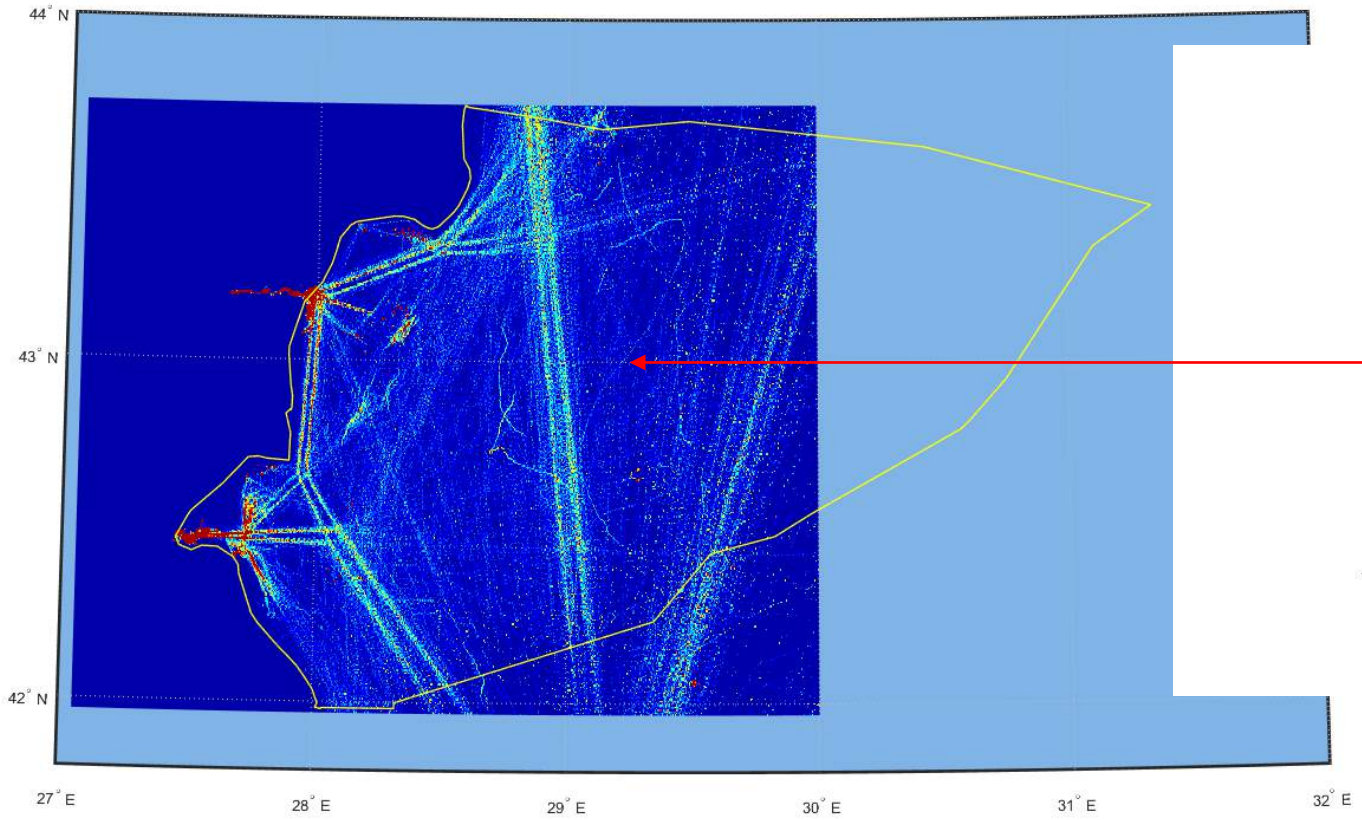
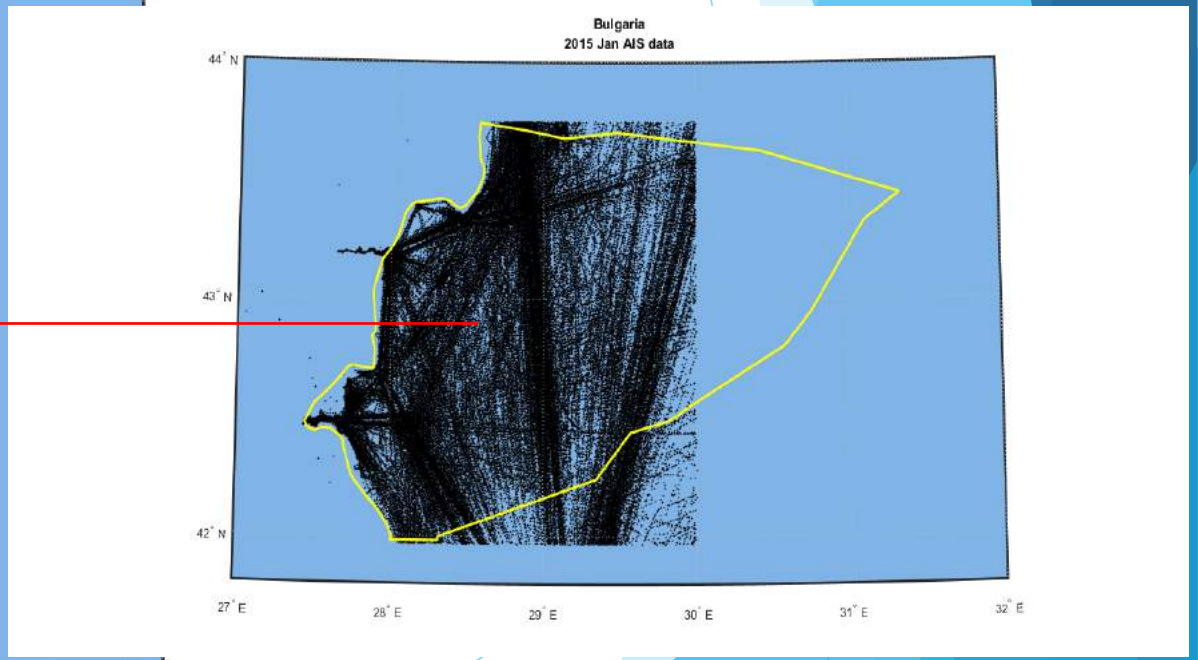
"How to determine the different pollution sources in the Black Sea?"

Ship's traffic – Density map based on raw AIS data





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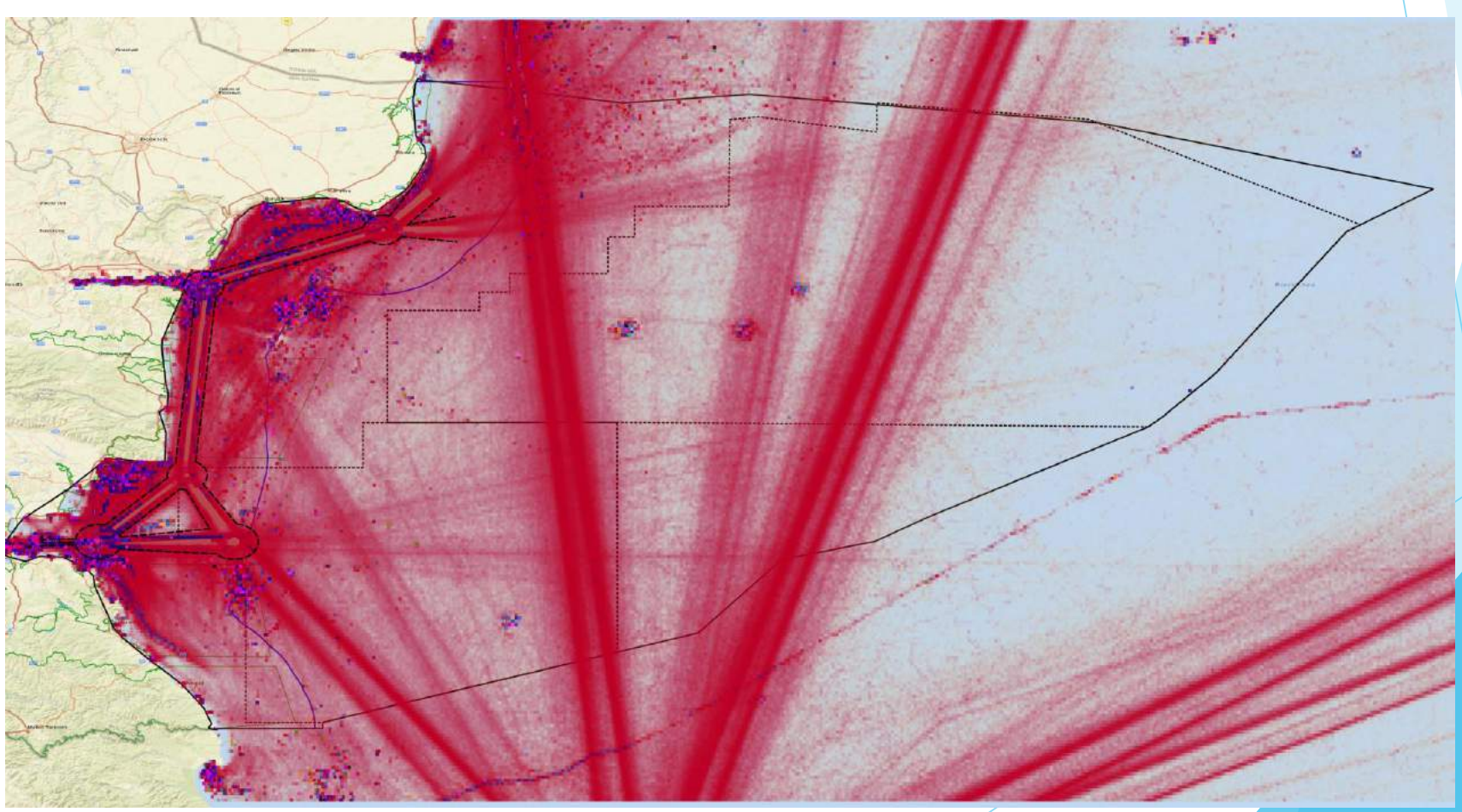
"How to determine the different pollution sources in the Black Sea?"

Ship's traffic – Density map based on raw AIS data (from 2014 to 2019)



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"How to determine the different pollution sources in the Black Sea?"

The NVNA drone fleet

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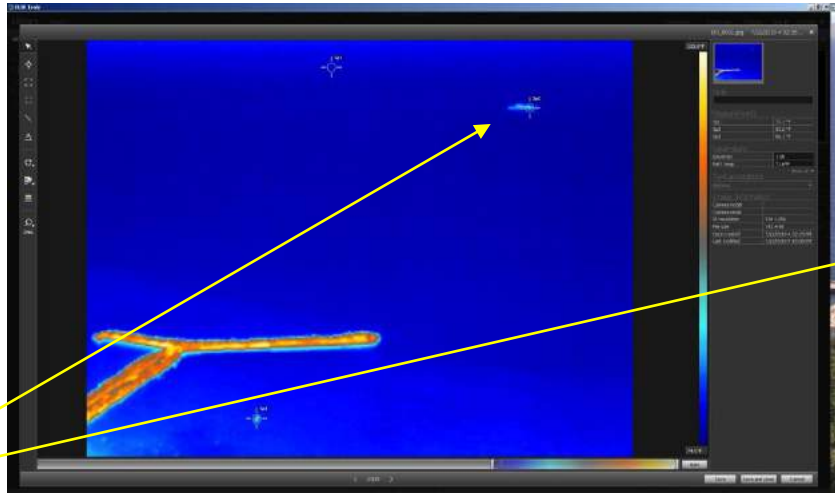
"How to determine the different pollution sources in the Black Sea?"

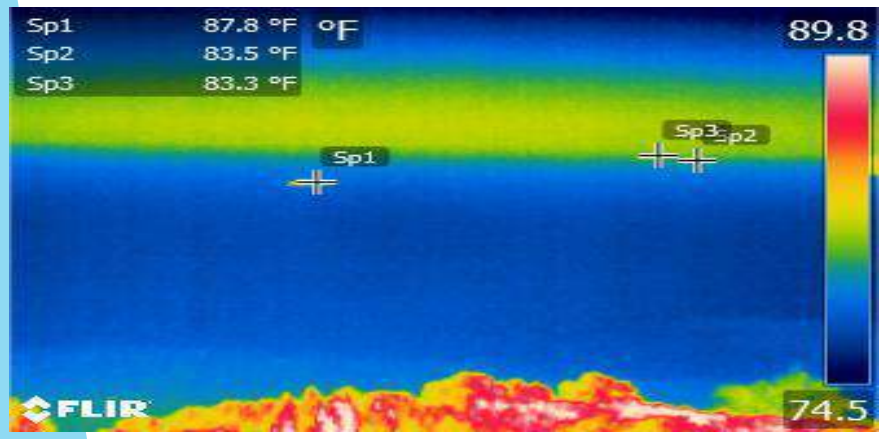
Drone DJI Matrice 600

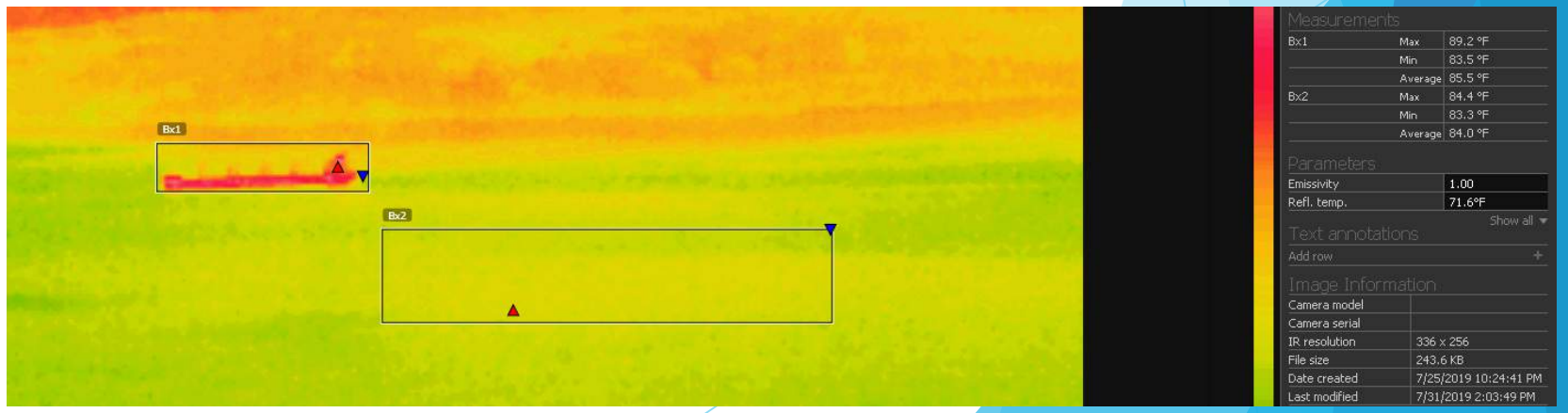
Drone thermal channel (thermal camera)

Drone visual channel (4K res. camera)

Parallel monitoring with different sensors







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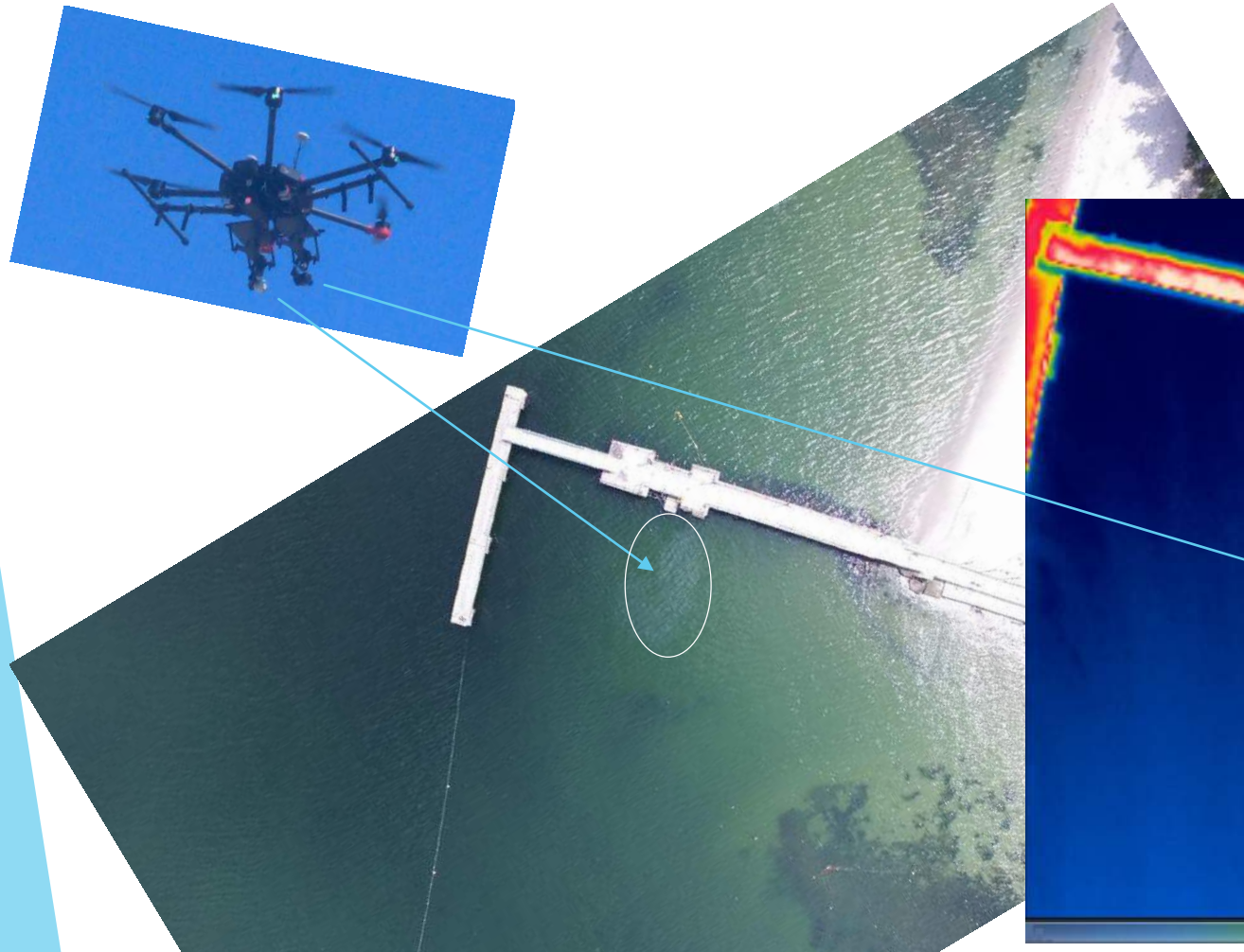
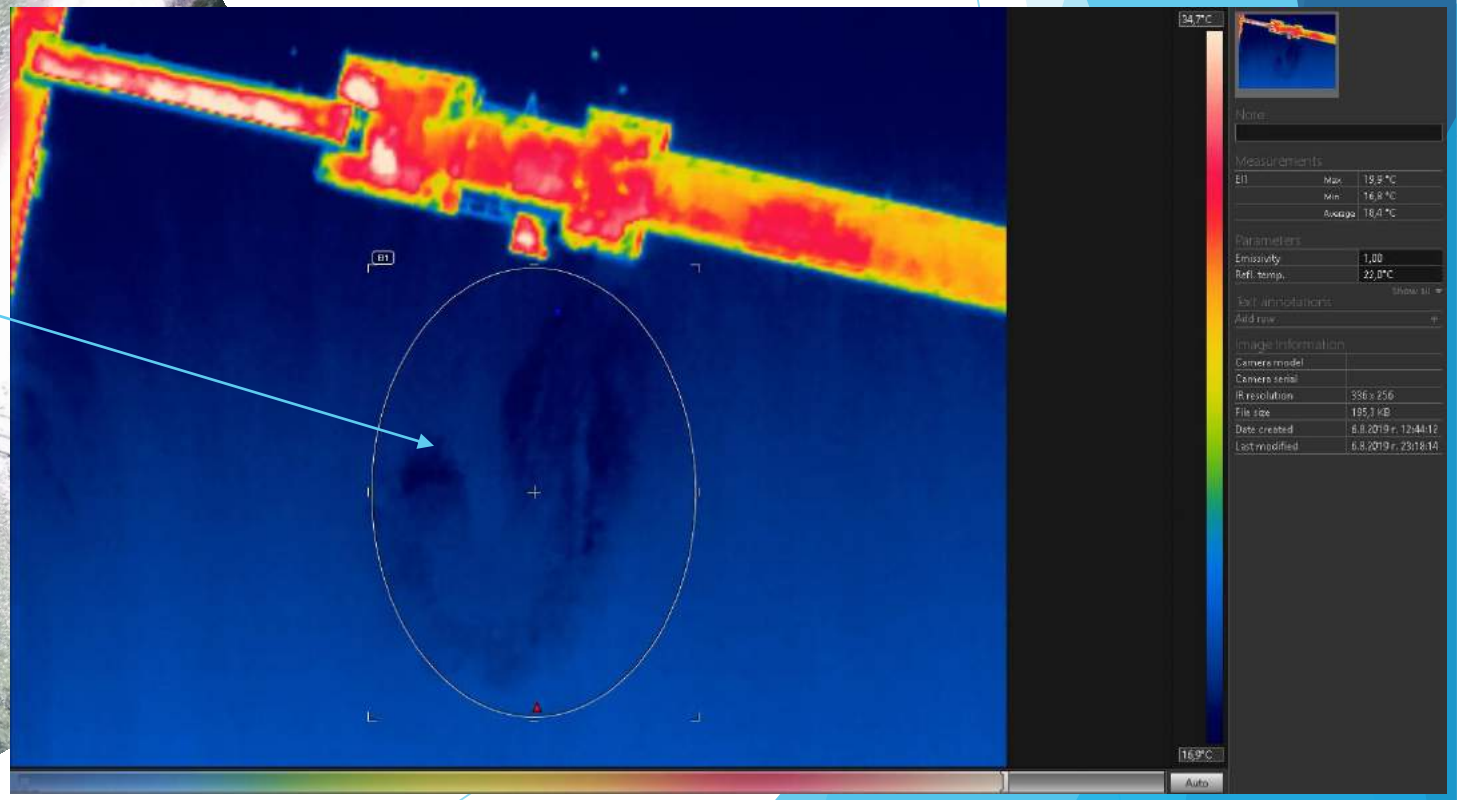
"How to determine the different pollution sources in the Black Sea?"

Controlled oil spill

- 3 liters of cooking oil
- drone altitude = 100 meters
- remotely measured temperature difference between oil and sea water = 3 degrees [C]





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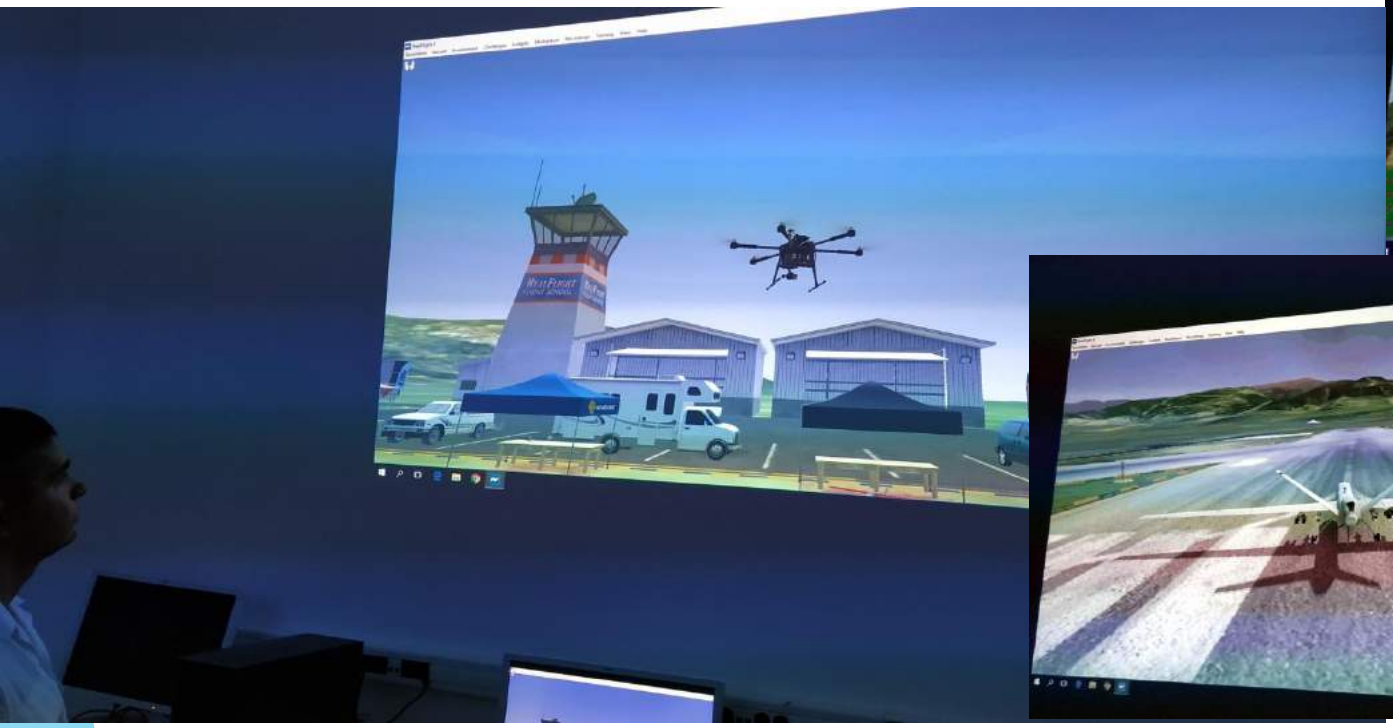
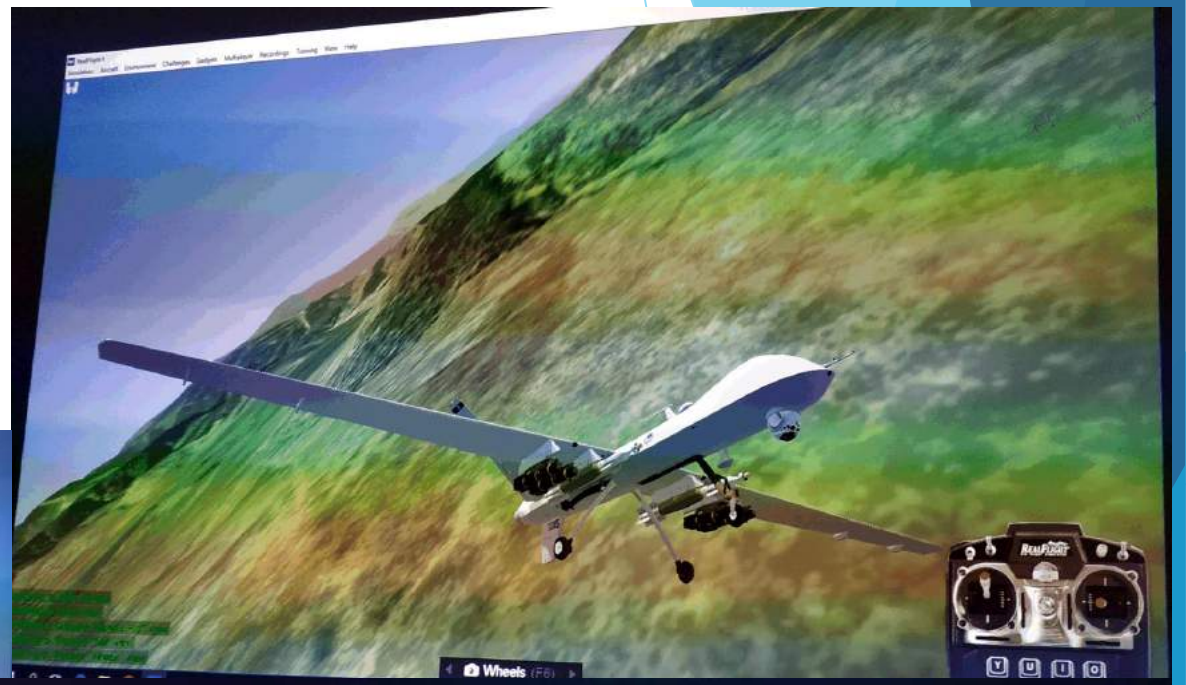
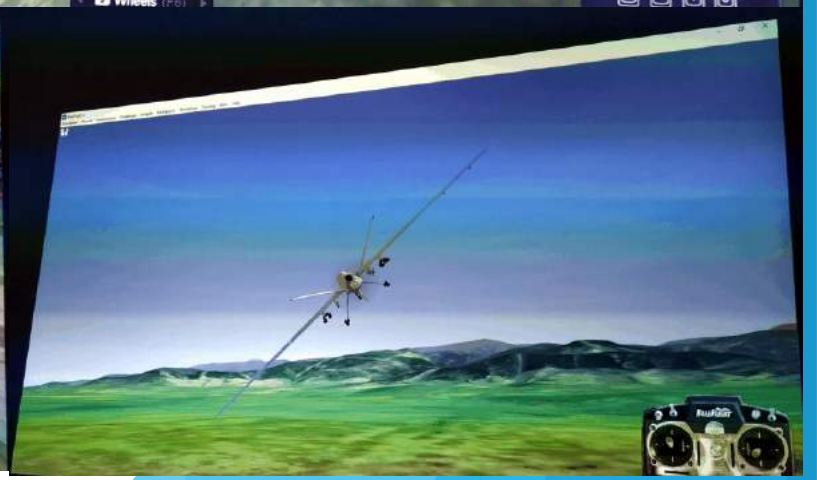
"How to determine the different pollution sources in the Black Sea?"

NVNA Drone Academy

- *Drone simulator DJI*
- *Drone simulator Real Flight 8*







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"How to determine the different pollution sources in the Black Sea?"

Drone ortho-photogrammetry

Digital ortho-photogrammetry of „Nos Foros" beach
Drone altitude - 30 meters

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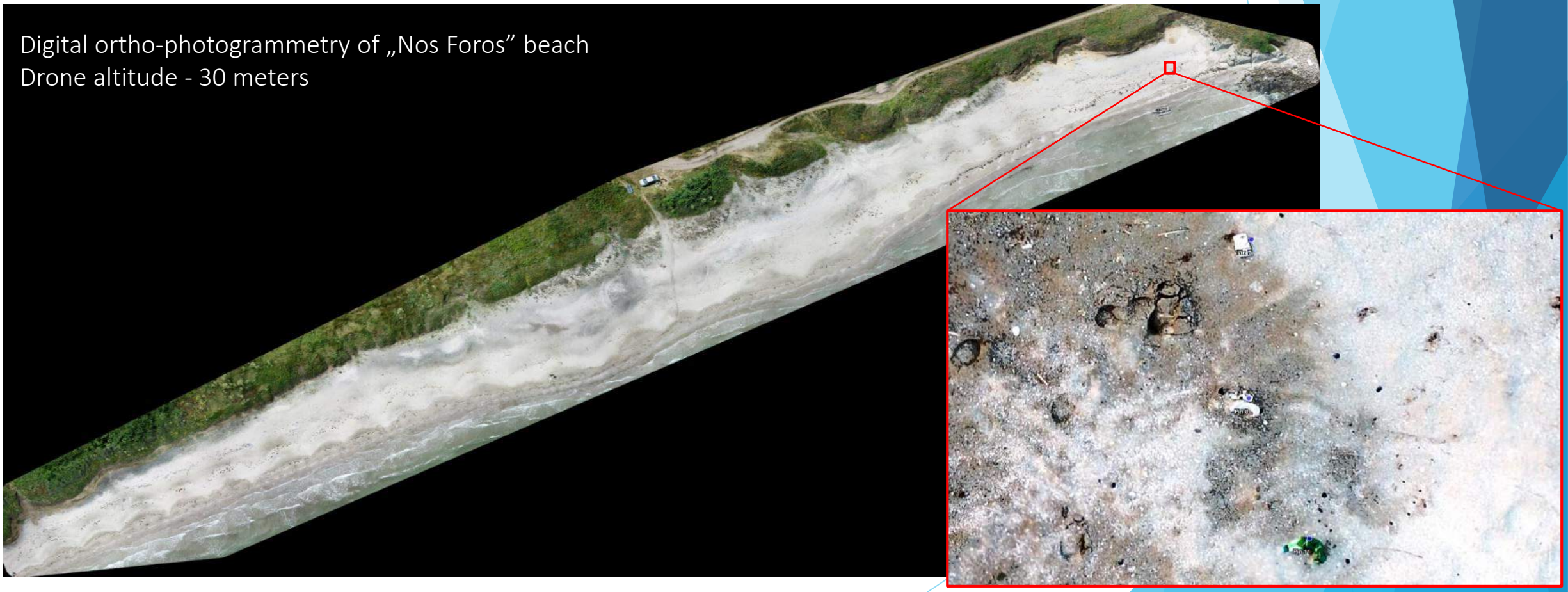
"How to determine the different pollution sources in the Black Sea?"

Drone ortho-photogrammetry

Digital ortho-photogrammetry of „Nos Foros" beach
Drone altitude - 30 meters



NIKOLA VAPTSAROV NAVAL ACADEMY

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"How to determine the different pollution sources in the Black Sea?"

Drone ortho-photogrammetry (edge detection over ortho-photo image)

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"How to determine the different pollution sources in the Black Sea?"

Drone ortho-photogrammetry

(elaboration of measurement and labeling tools)

NIKOLA VAPTSAROV NAVAL ACADEMY

SCIENTIFIC DEPARTMENT

"How to determine the different pollution sources in the Black Sea?"

Drone ortho-photogrammetry (video records mixed with drone flight details additional information layer)

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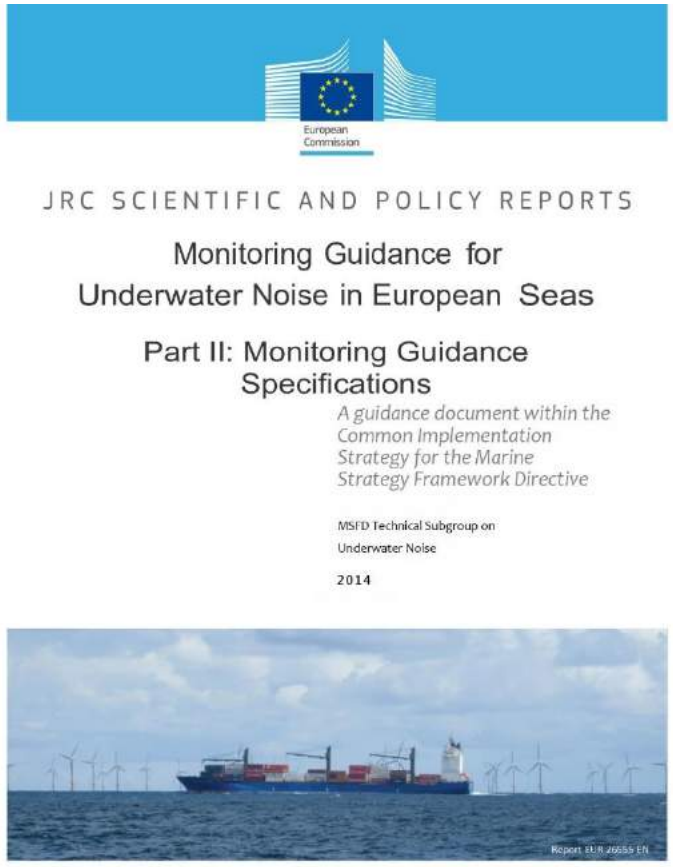
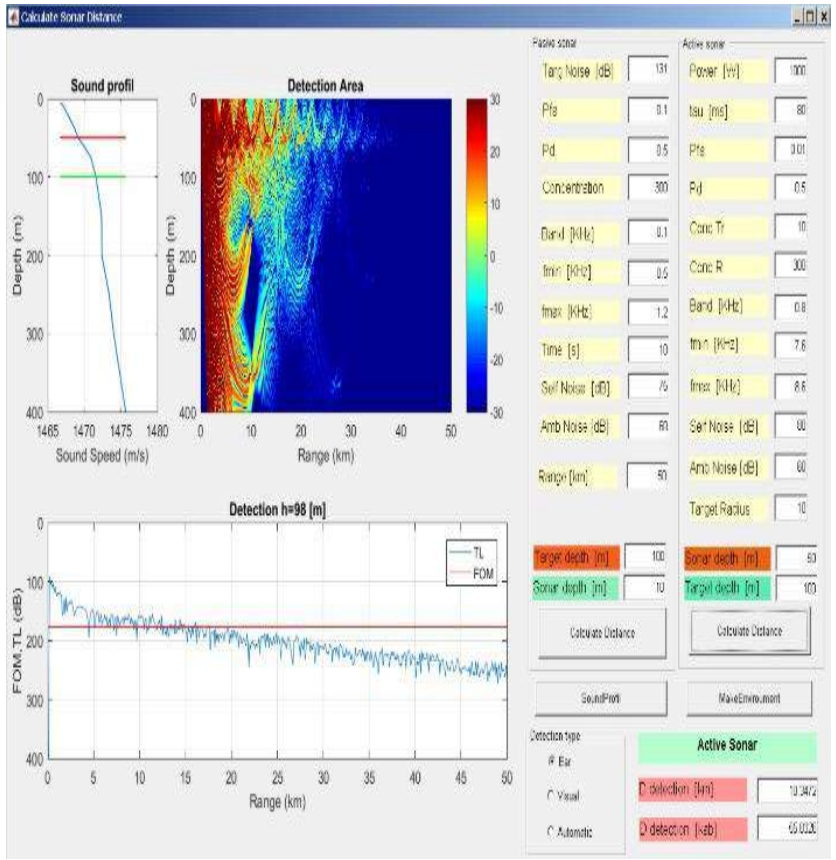
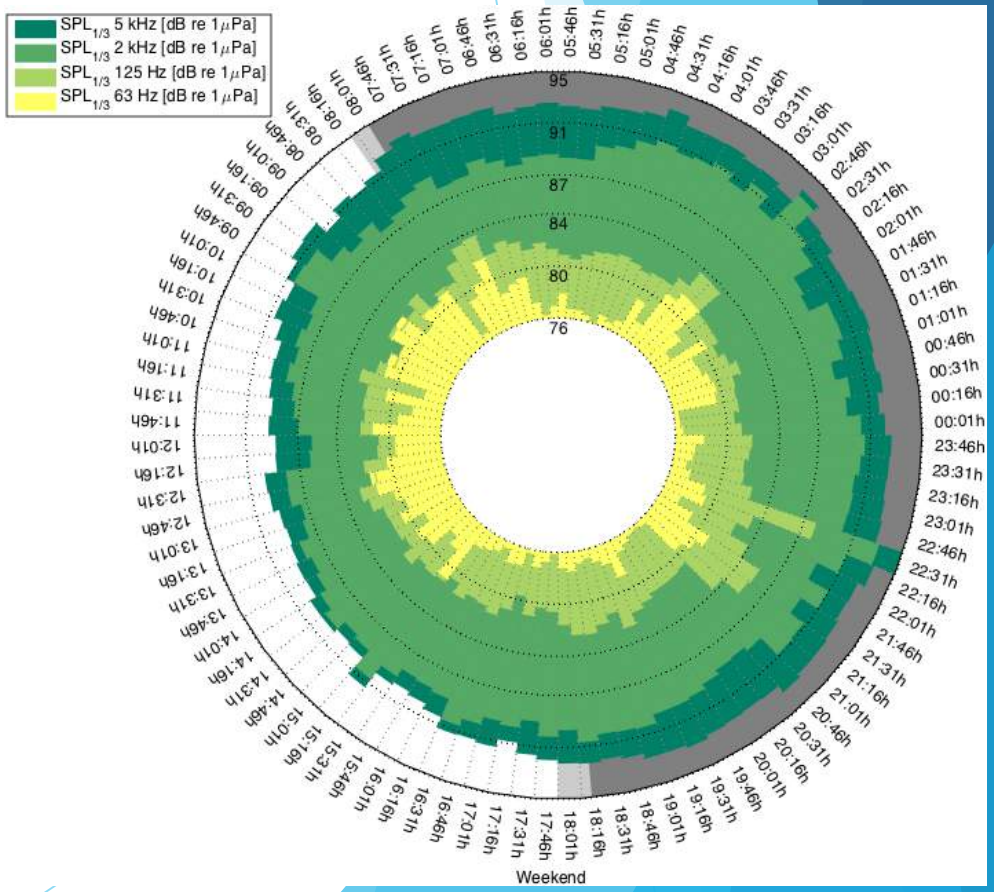
Underwater noise pollution







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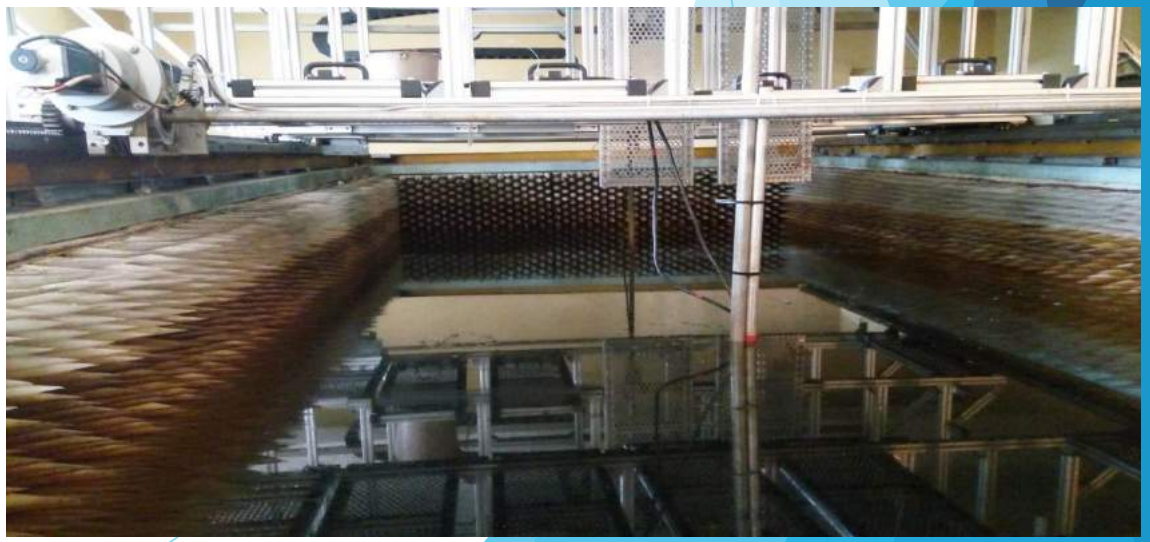
Hydrophones, recorders and software for underwater noise registration and analyses



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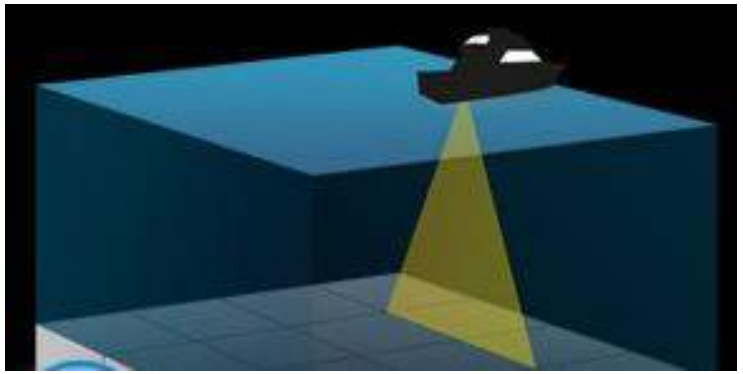
"How to determine the different pollution sources in the Black Sea?"

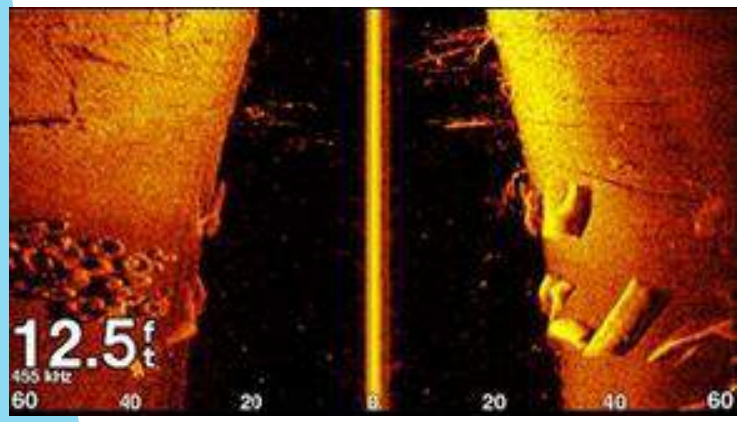
Bathymetry and deep water physicochemical measurement systems

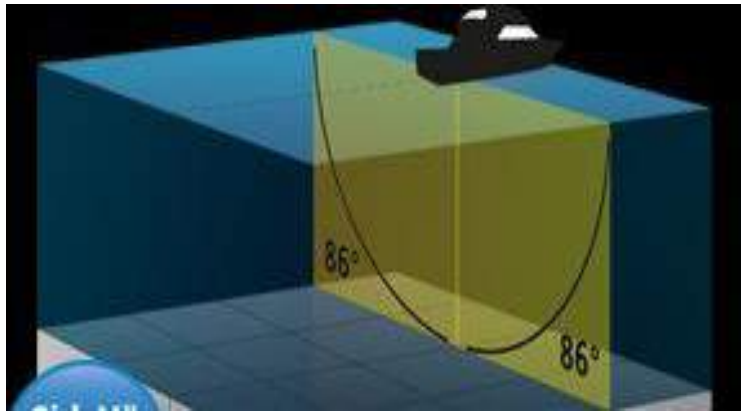
GARMIN

SEASAM

MAVS3







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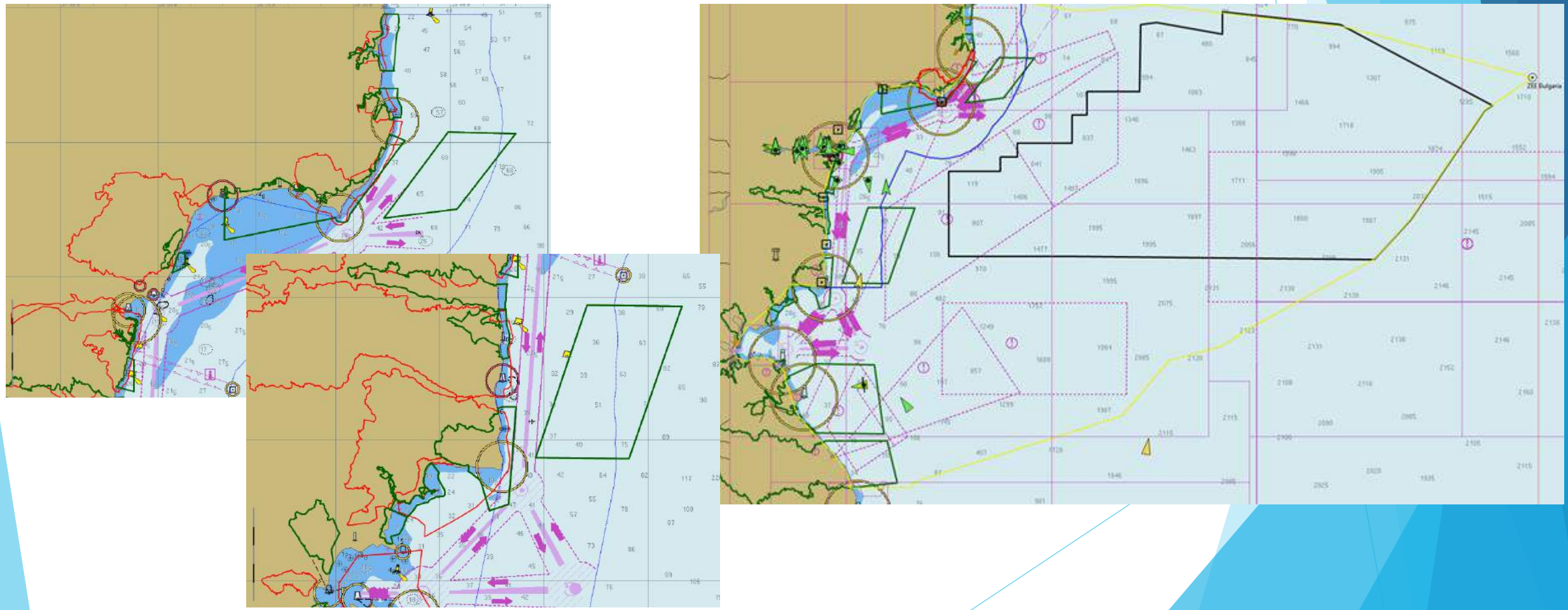
Visualization in maritime oriented GIS (static and dynamic layers)



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Thank you for your kind attention !