

Bilateral seminar of the young space scientists  
“Future perspectives of Space Science and Space exploration”

**“Study of hydrophysical processes in the coastal zone  
on the basis of satellite measurements  
and ground truth measurements”**

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Russisches Haus der Wissenschaft und Kultur  
Germany, Berlin, 1 – 3 June 2016

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- Our goals

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- Validation

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# Motivation

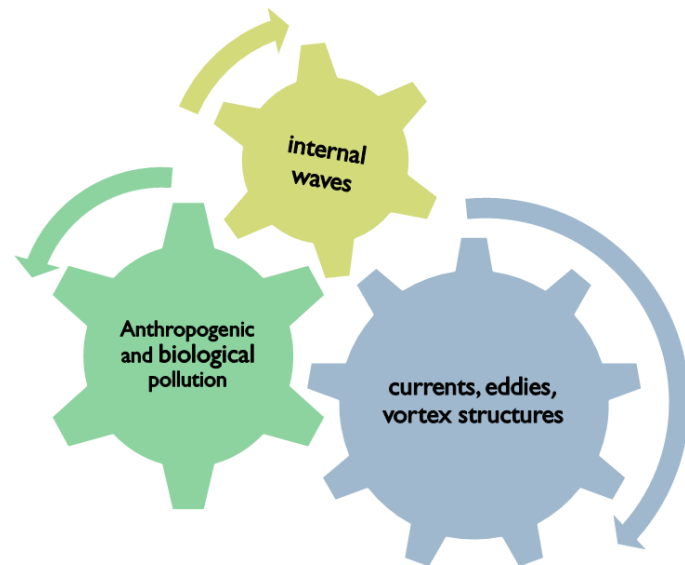
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# Motivation

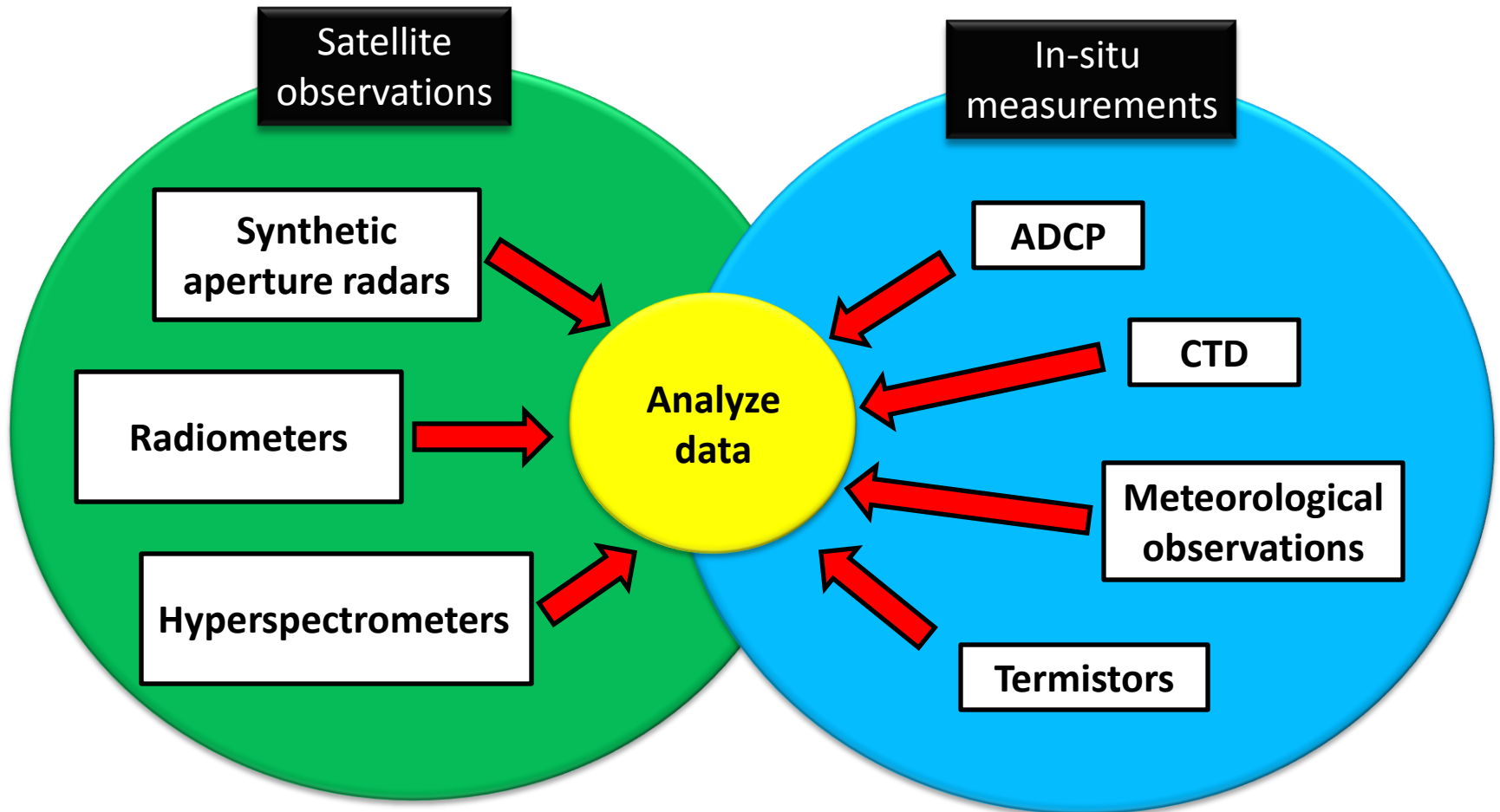


Object of our research is OCEAN!

What interesting for us?

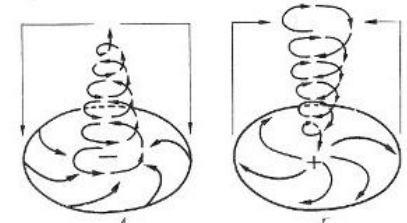


## What we actually do?



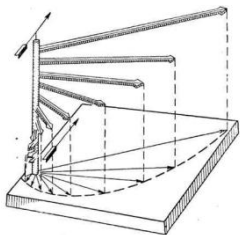
## History:

1. From **1970** – first steps in detection on satellite images small vortex structures
2. In **1980** – first radiolocation satellite data
  - no a doubt that sea surface reach of vortex structures  
(Stevenson “Oceanography from Space Shuttle” 1989)
3. In **2000** – new research area in oceanology – sub-mesoscale oceanography

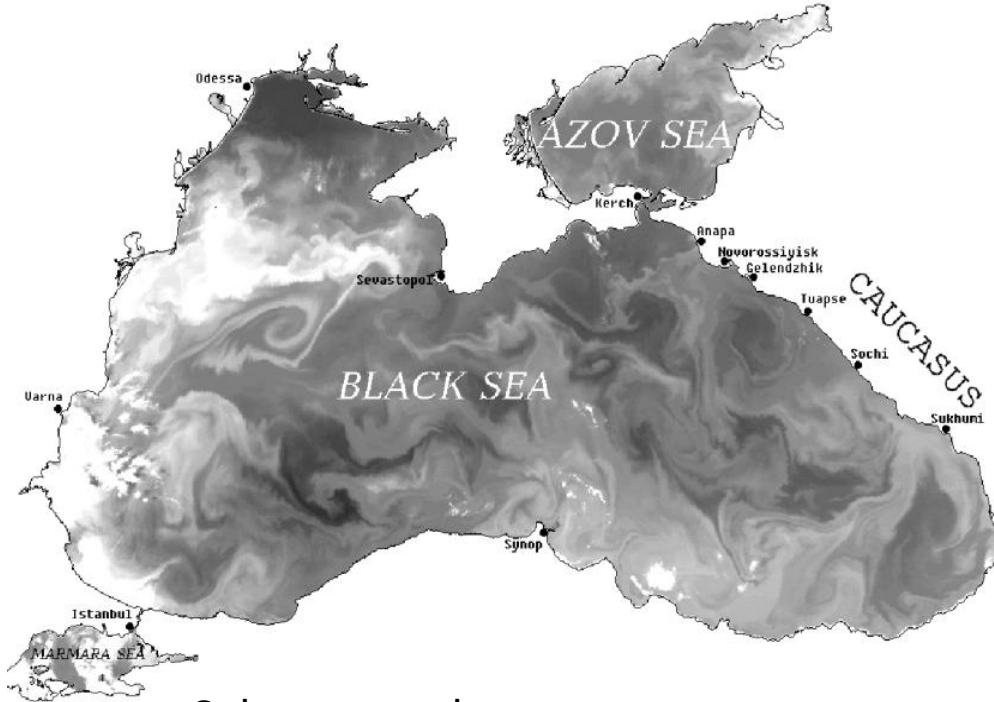


*“Spiral eddies are a manifestation of a sub-mesoscale oceanography which may constitute an important link in the balance of generating and dissipating ocean processes”.*

*Munk et al. “Spirals on the sea”*

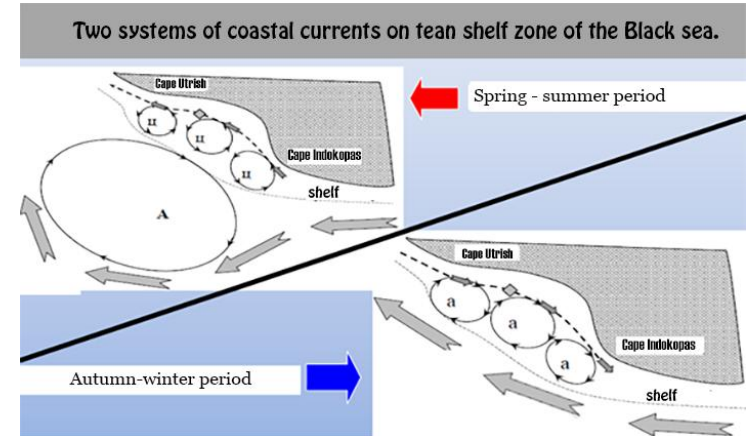
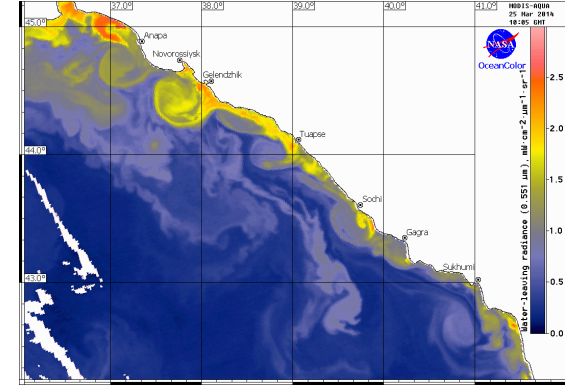


# Background



## Submesoscale structures:

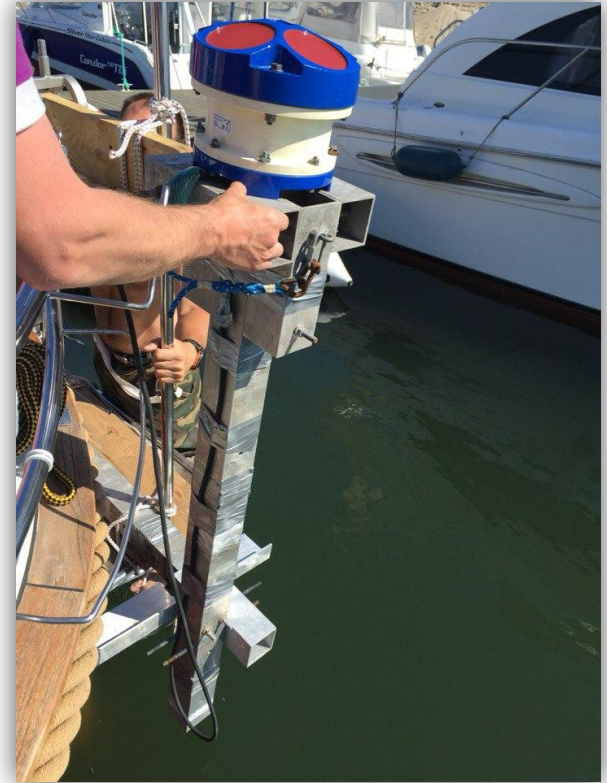
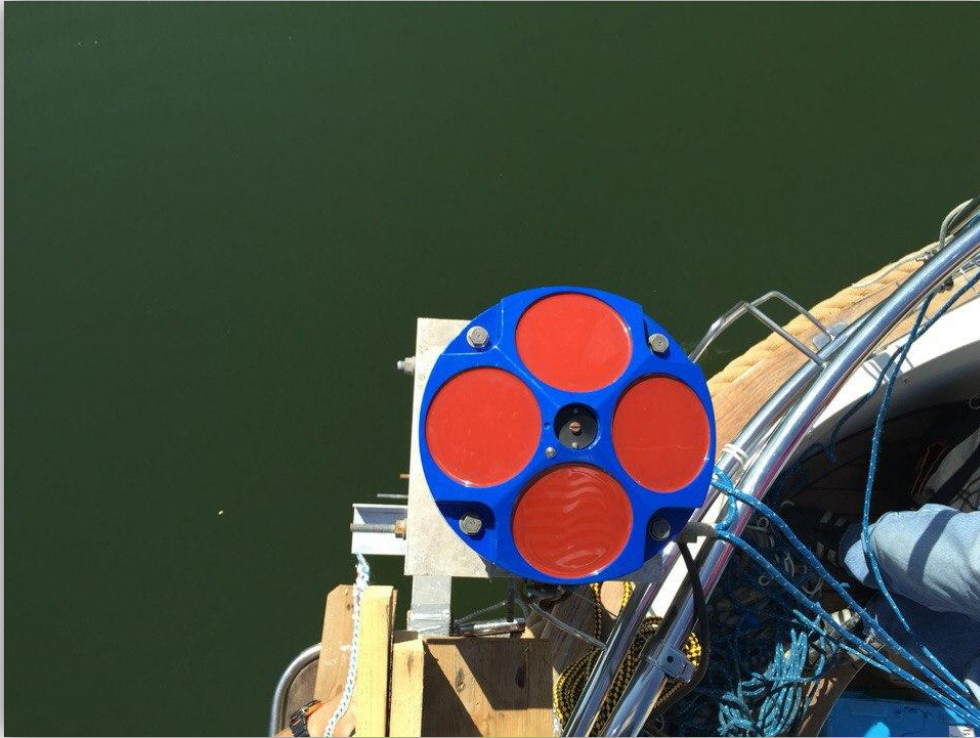
- Small size < 10 km
- Period of “life” – 2-3 days??
- Reasons of generation – not clear



One of the biggest problem are no sub-satellite measurements near coast line!

# Measurements in-situ





Acoustic Doppler current profiler (**ADCP**) WorkHorse Sentinel 300 kHz



**CTD** probe was used to determine conductivity, temperature and pressure for further depth calculation. And also turbidity sensor.





**Star Oddi Centi**  
temperature and depth sensors.

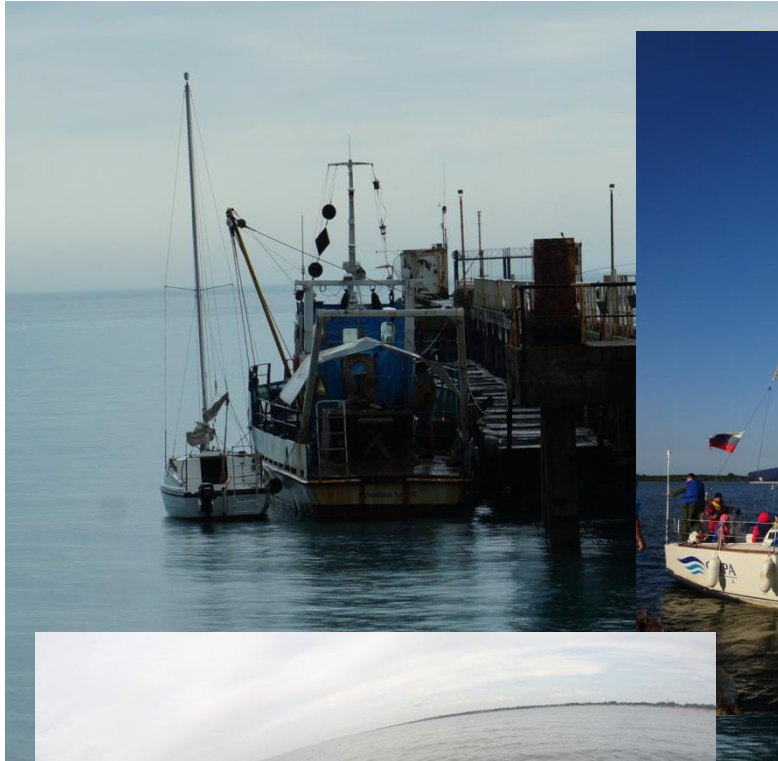


**Weather station:**

- Wind direction
- Wind speed
- Temperature
- Pressure
- GPS



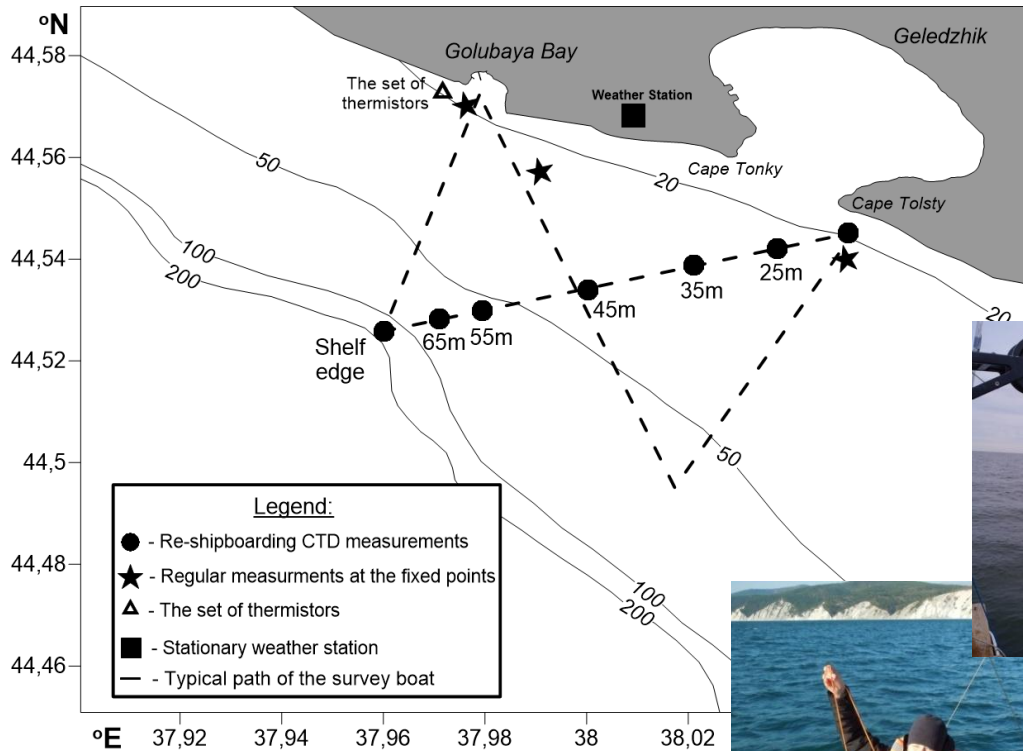
# Instrumentation



Different kind of boats.

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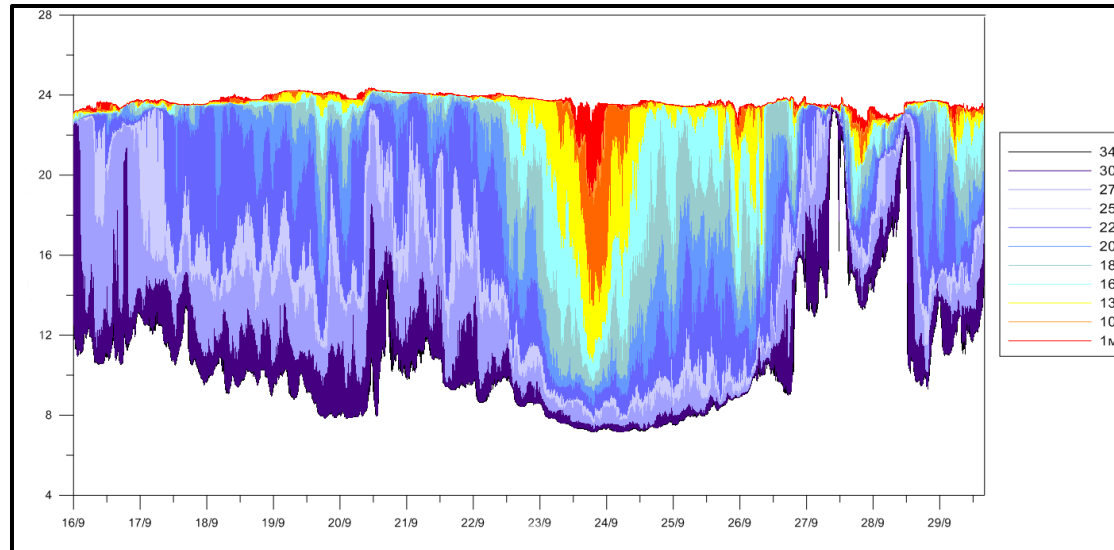
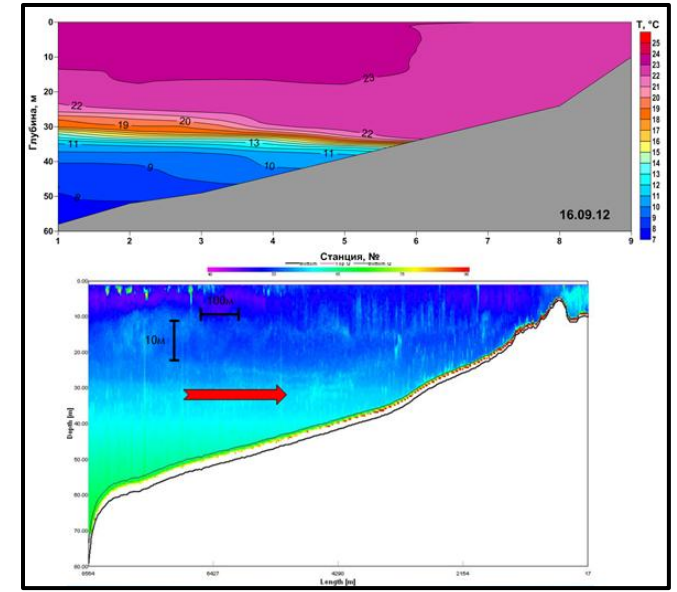
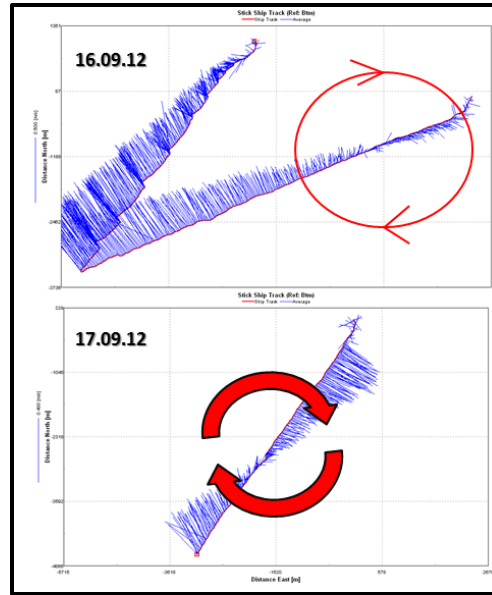
# Methods



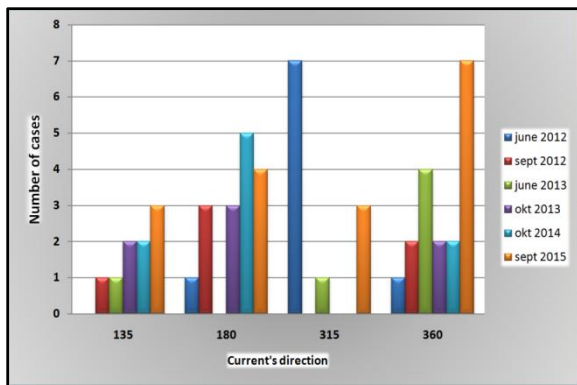
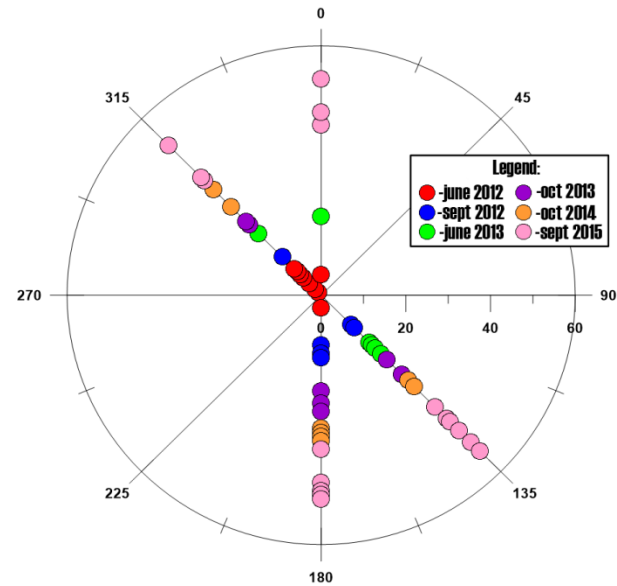
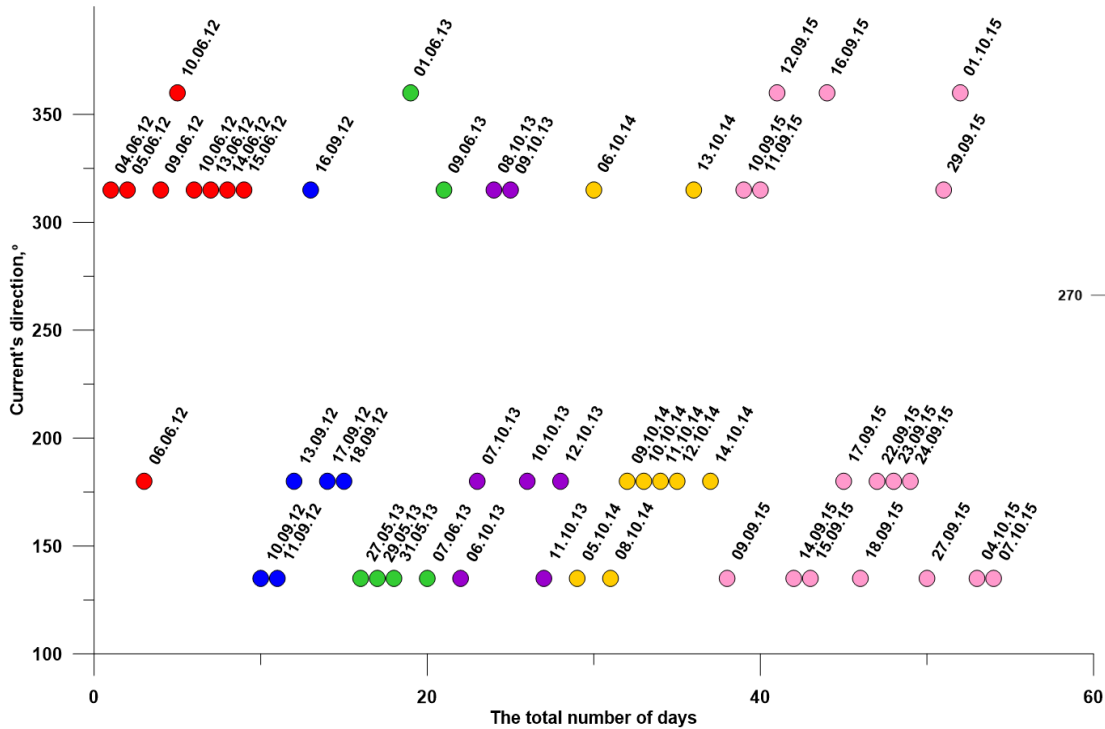
Black sea poligon.



**CTD**  
**+**  
**ADCP**  
**+**  
**thermistors**



# Results. Data visualization.



|  | Autumn-winter system     | Spring-summer system |
|--|--------------------------|----------------------|
| The main direction of currents                         | South-eastward (SE=135°) | Northwest (NW=315°)  |
| Average speeds (m/s)                                   | 0,45                     | 0,25                 |
| Maximum speed (m/s)<br>(direction of currents)         | 0,9 (NW)                 | 0,4 (SE)             |
| The number of cyclones<br>(flowrate in the vortex)     | 2 (0,3 m/s)              | 2 (0.15-0,3 m/s)     |
| The number of anticyclones<br>(flowrate in the vortex) | 9 (0,4-0,6 m/s)          | 3 (0,3-0,4 m/s)      |



# Satellite data

## Synthetic aperture radars

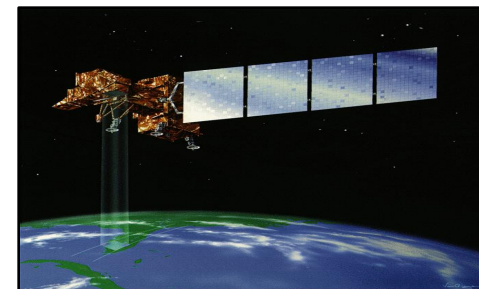
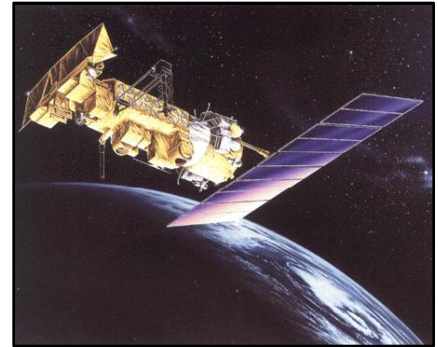
Envisat ASAR, ERS-2 SAR, RADARSAT, 1\2, TerraSAR-X,  
TanDem-X, Sentinel-1, 2, 3!

## Radiometers

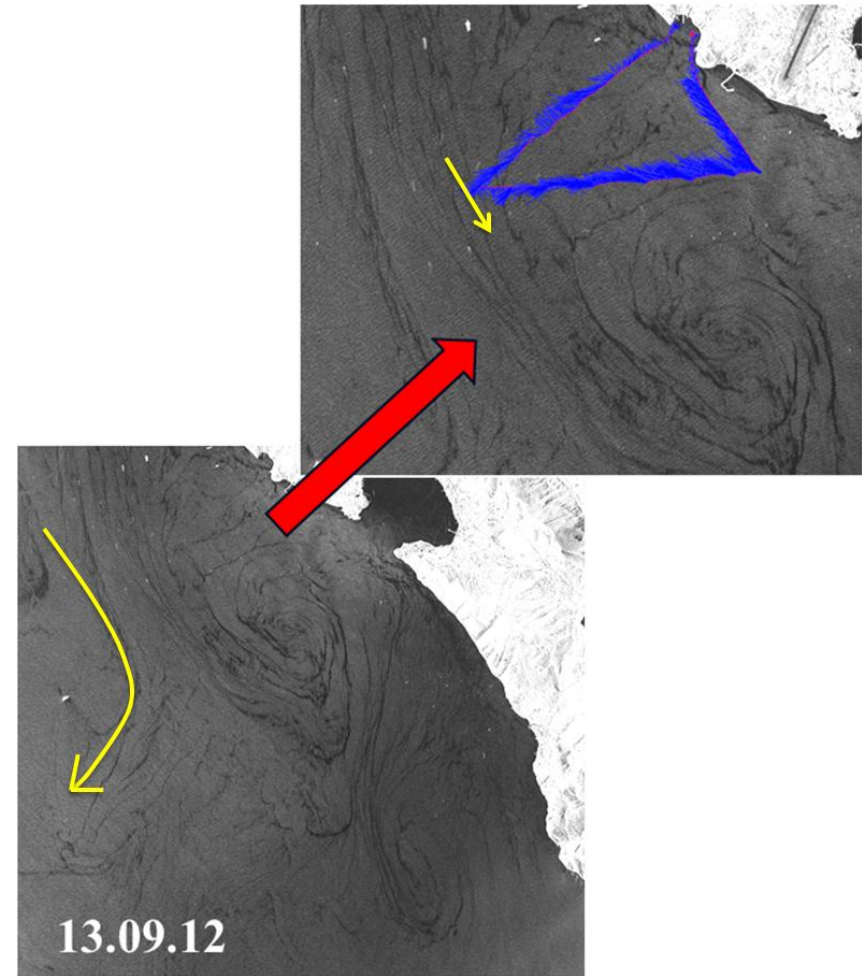
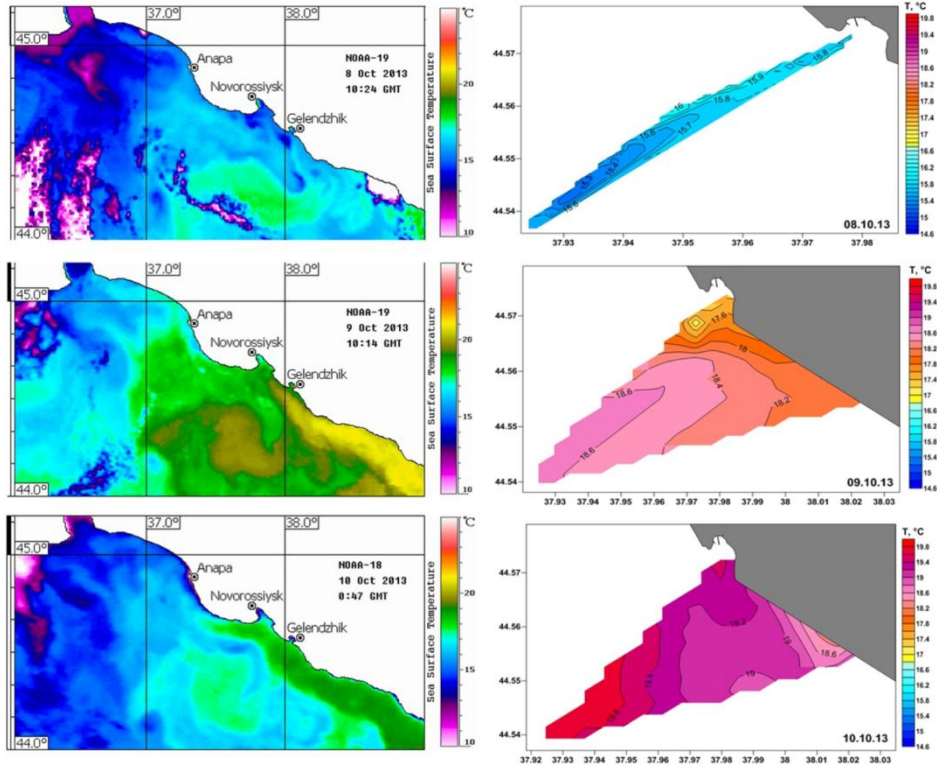
Envisat MERIS; Landsat 8 OLI, Landsat 7 ETM+, Landsat-5 TM,  
MODIS Terra/Aqua, NOAA AVHRR

## Hyperspectrometers

HICO and Hyperion

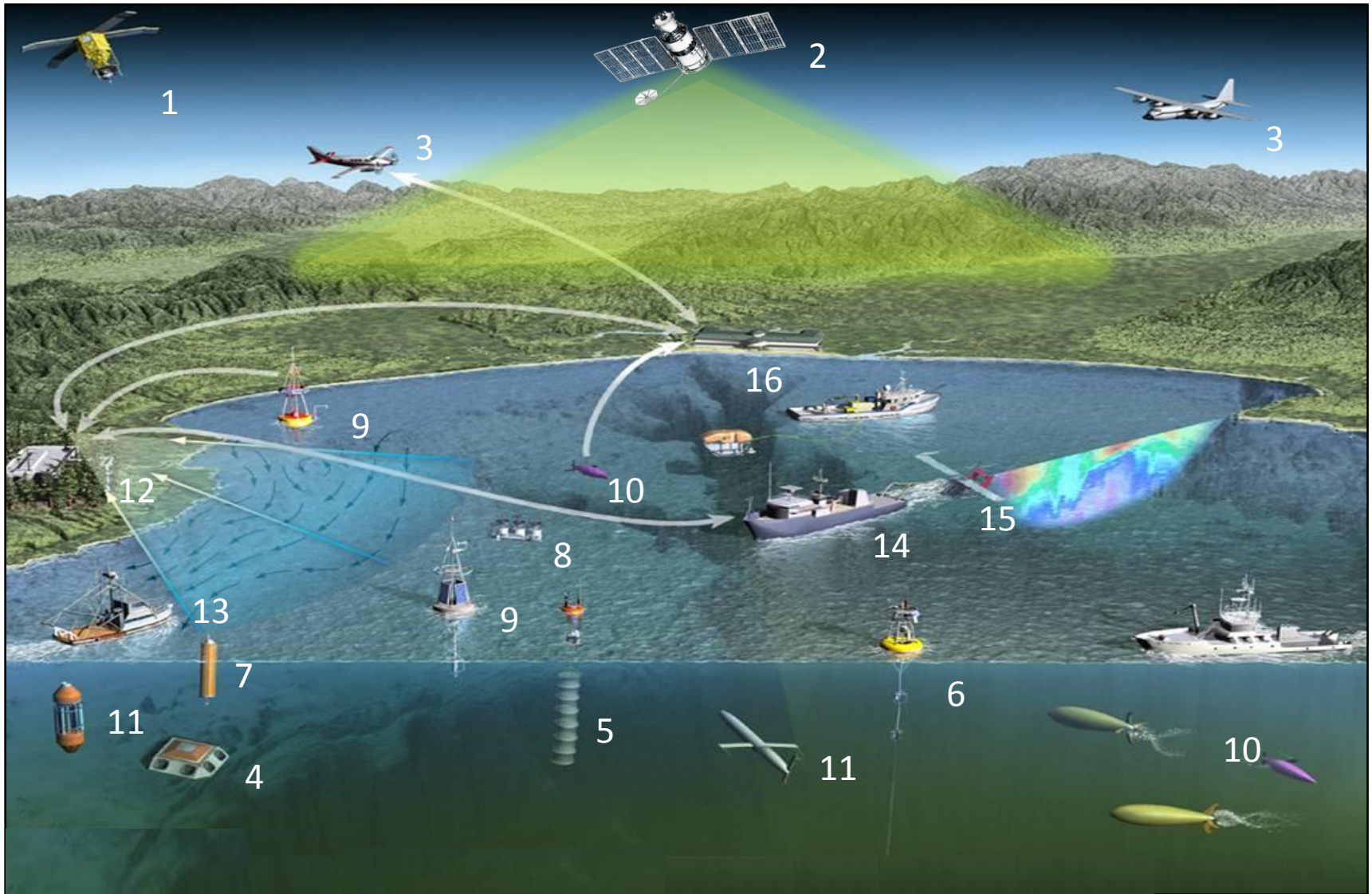


# Validation



# Conclusion

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**Thank you**

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