

Marine monitoring in the Black Sea using satellite data

GMES activities related to climate and marine environment

by
Stein Sandven

Nansen Environmental and Remote Sensing Center (NERSC)
Bergen, Norway





Goal of MyOcean

MyOcean overall objectives are to

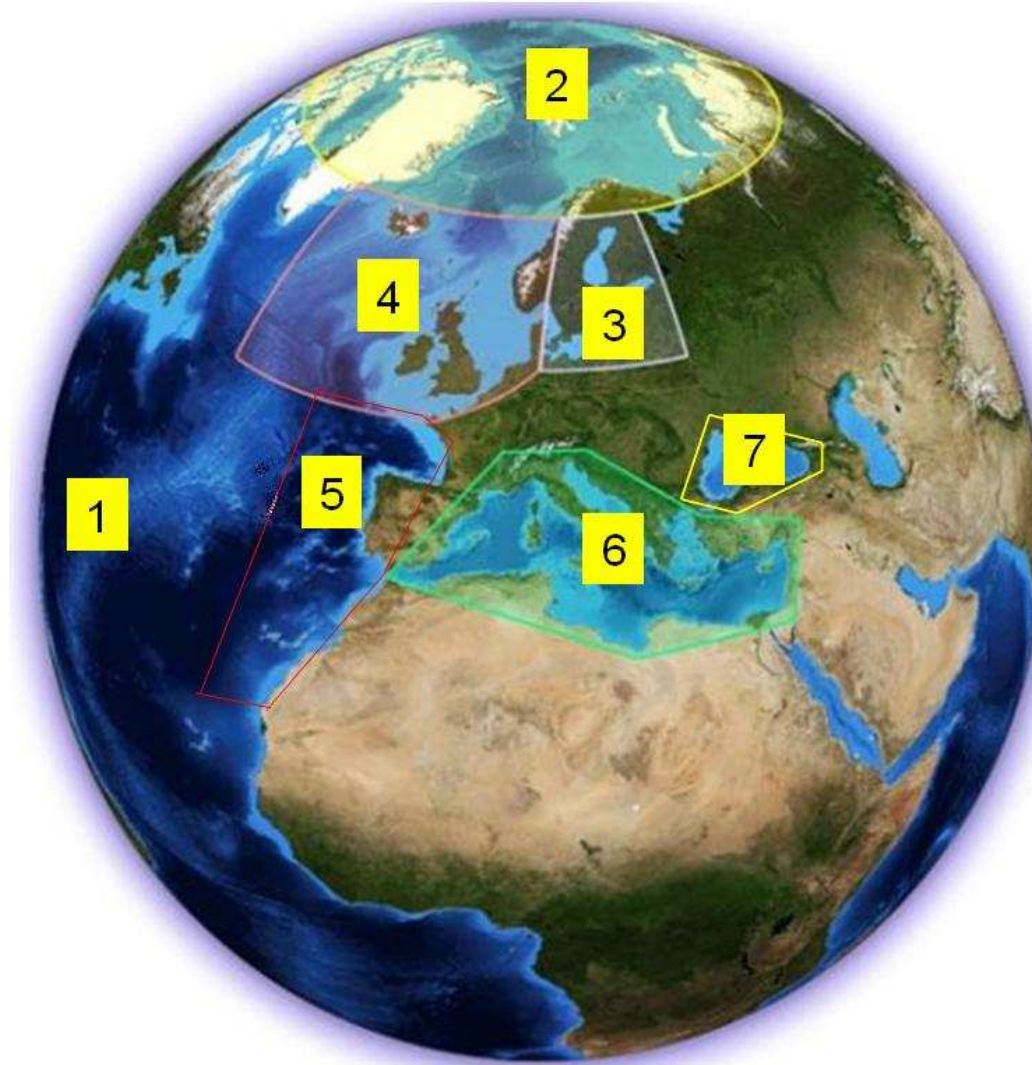
- set up a concerted and integrated **pan-European capacity** for ocean monitoring and forecasting, using nationally-available skills and resources.
- demonstrate the **operationality** of the system, based on a « service oriented » organization, according to the European quality standards, and to achieve operational qualification and eventually qualification of Service.
- bring a new pan-european value for the benefit of the **marine service providers** on duty at national or european levels.
- contribute to the long-term **sustainability** of this pan-European capacity.





MyOcean regions

6 European Seas + Global Ocean



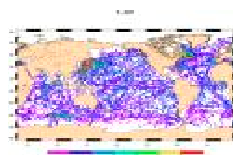
- 1. Global
- 2. Arctic
- 3. Baltic
- 4. NWS
- 5. IBI
- 6. Med Sea
- 7. Black Sea



Black Sea

Observations

INSITU_GLO_TS_RAN_OBSERVATION
S_013_001_b

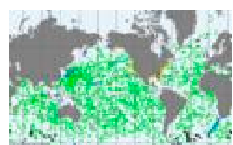


Global Ocean- In-situ Observations Yearly Delivery in Delayed Mode

For the Global Ocean- Coriolis global in-situ observation yearly delivery in delayed mode. The Coriolis delayed mode product designed for reanalysis purposes integrates the best available version of in situ data for temperature and salinity measurements. These data are collected from main global networks (Argo, GoSUD, OceanSites, WOD) completed by European data provided by EuroGOOS regional systems. It is updated on a yearly basis. It is the In Situ data nominal product for the Global Ocean.

[INFO](#)
[DATA ACCESS](#)

INSITU_GLO_TS_NRT_OBSERVATION
S_013_001_a

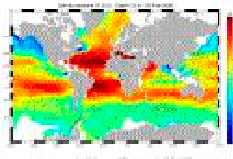


Global Ocean- In-situ Observations Daily Delivery

For the Global Ocean- Coriolis global in-situ observations daily delivery. The Coriolis real-time product integrates the real-time in situ data for temperature and salinity measurements. These data are collected from main global networks (Argo, GoSUD, OceanSites, GTS) completed by European data provided by EuroGOOS regional systems. The data are quality controlled using automated procedures and statistical analysis residuals. It is updated daily. It is the In Situ data operational nominal product for the Global Ocean.

[INFO](#)
[DATA ACCESS](#)

INSITU_GLO_TS_OA_NRT_OBSERVATION
IONS_013_002_a

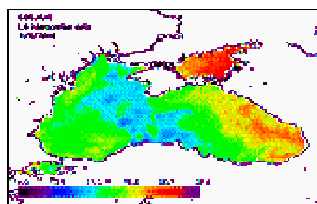


Global Ocean- Real Time In-situ Observations Objective Analysis

For the Global Ocean- Coriolis Global Real Time Objective Analysis. Gridded objective analysis fields of temperature and salinity using profiles from the in-situ near real time database are produced every week. Objective analysis is based on a statistical estimation method allows to present a synthesis and a validation of the dataset, provide a support for localized experience (cruises), provide a validation source for operational models, observe seasonal cycle and interannual variability. It is the In Situ Objective analysis operational nominal product for the Global Ocean.

[INFO](#)
[DATA ACCESS](#)

SST_BS_SST_L4_NRT_OBSERVATION
S_010_006_a



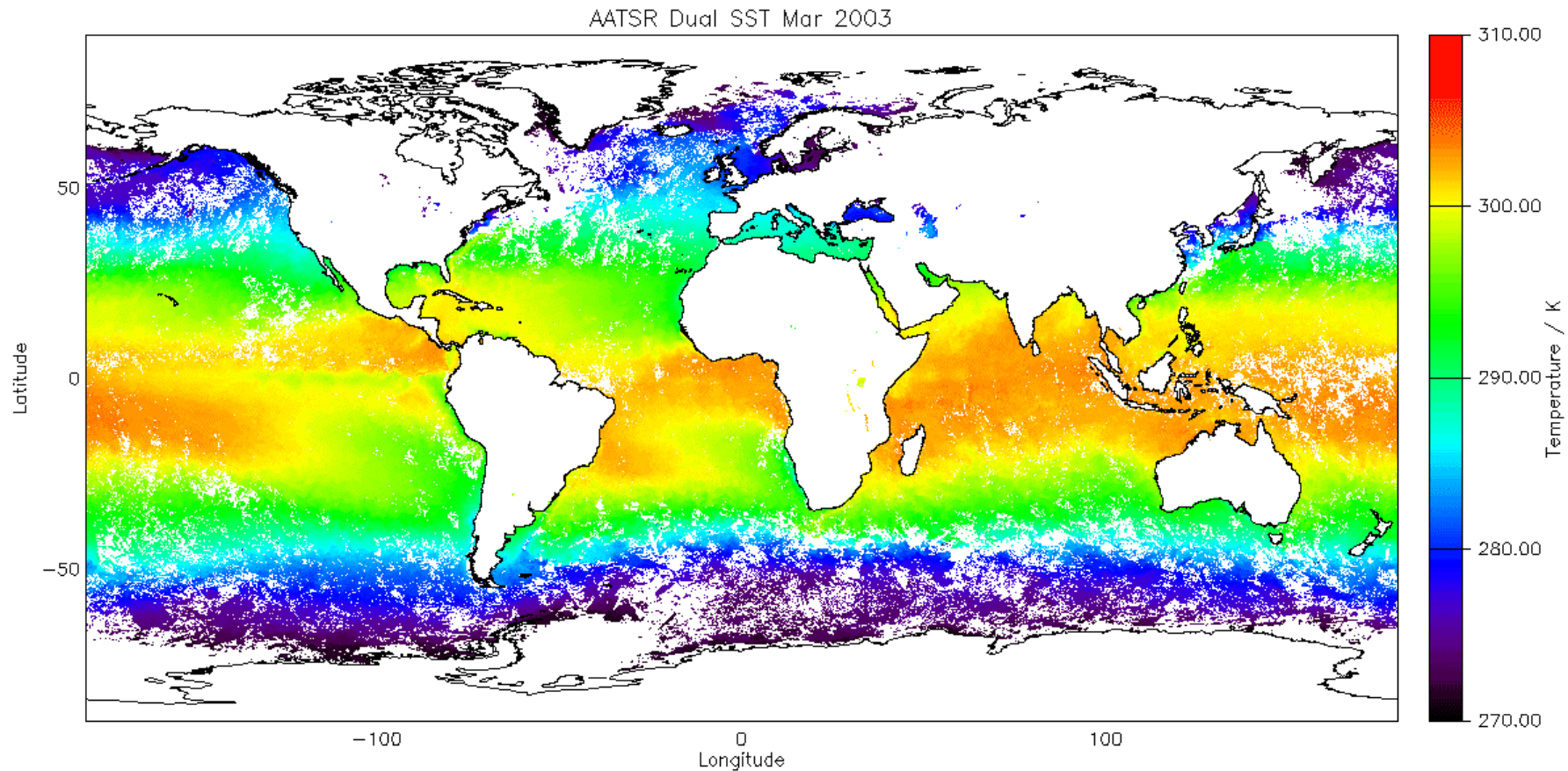
Black Sea Sea Surface Temperature Analysis

For the Black Sea- The CNR BLS Sea Surface Temperature analysis provides daily gap-free maps of sea surface temperature, referred as L4 product, at 0.0625° x 0.0625° horizontal resolution, using satellite data from infra-red radiometers. It is the sea surface temperature operational nominal product for the Black Sea.

[INFO](#)
[DATA ACCESS](#)



Global Sea Surface Temperature from infrared radiometers

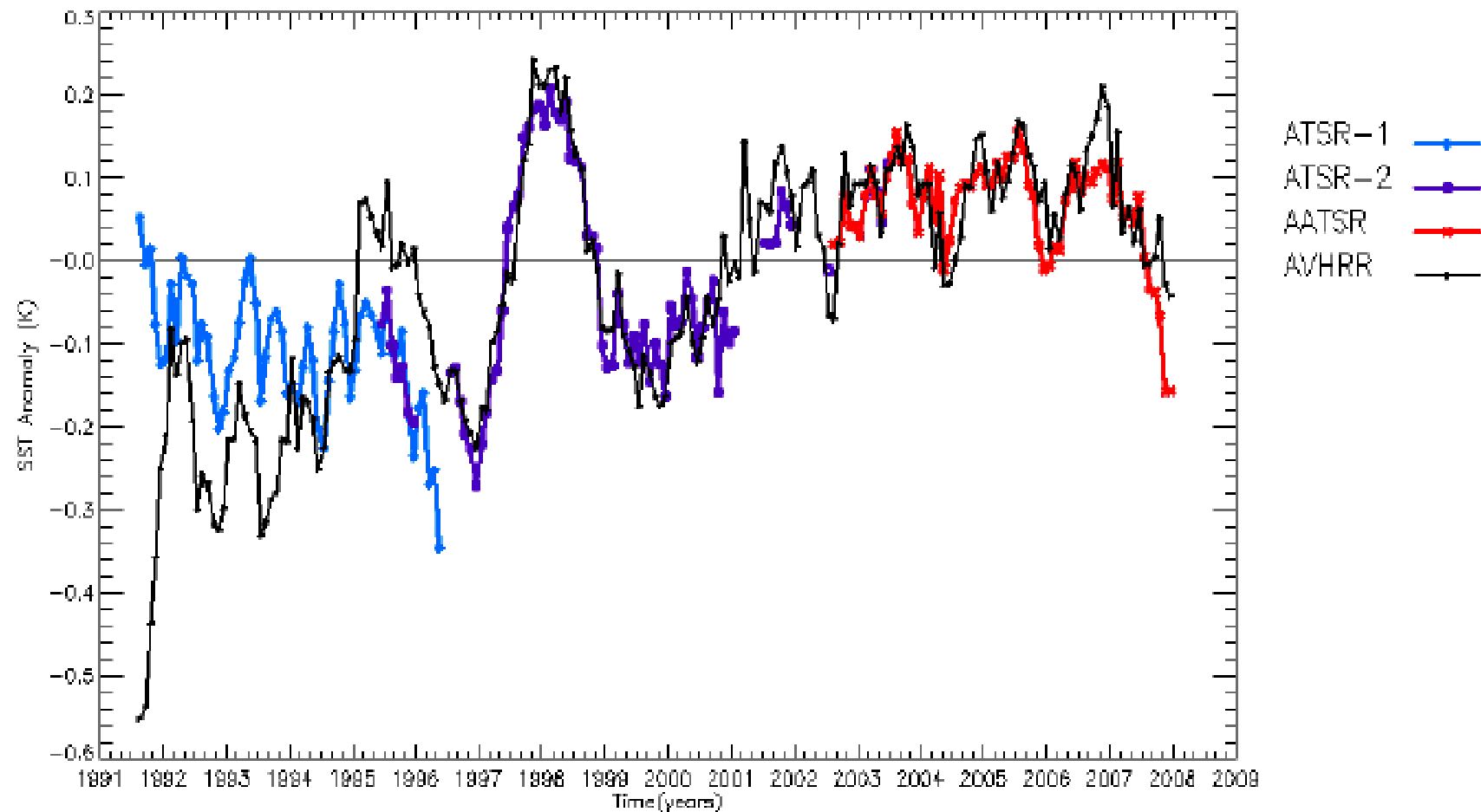


Courtesy of David Llewellyn Jones, Univ. Leicester, UK

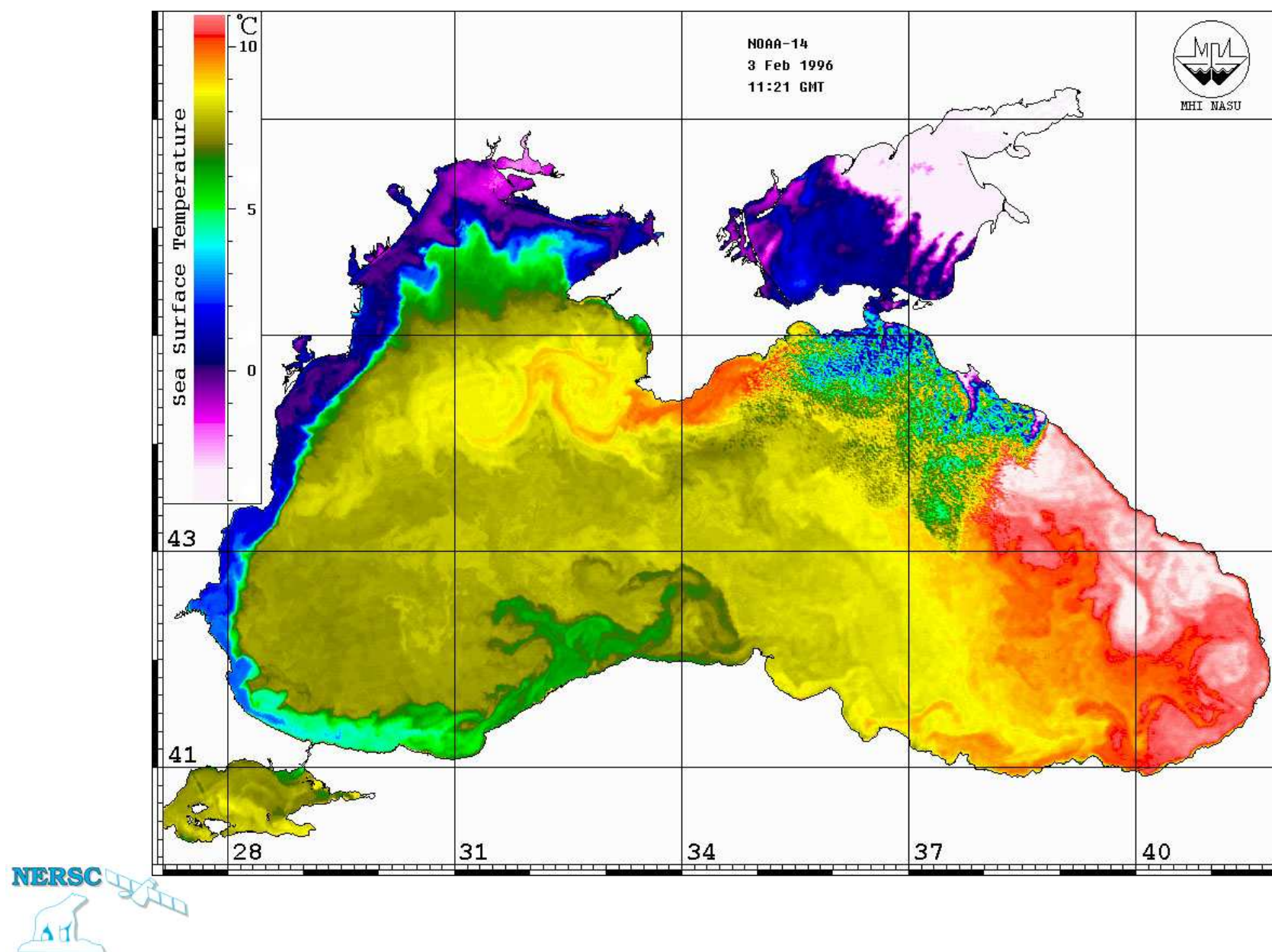
ERS & ENVISAT measurements
Trend $0.13 \pm 0.03^\circ\text{C/decade}$



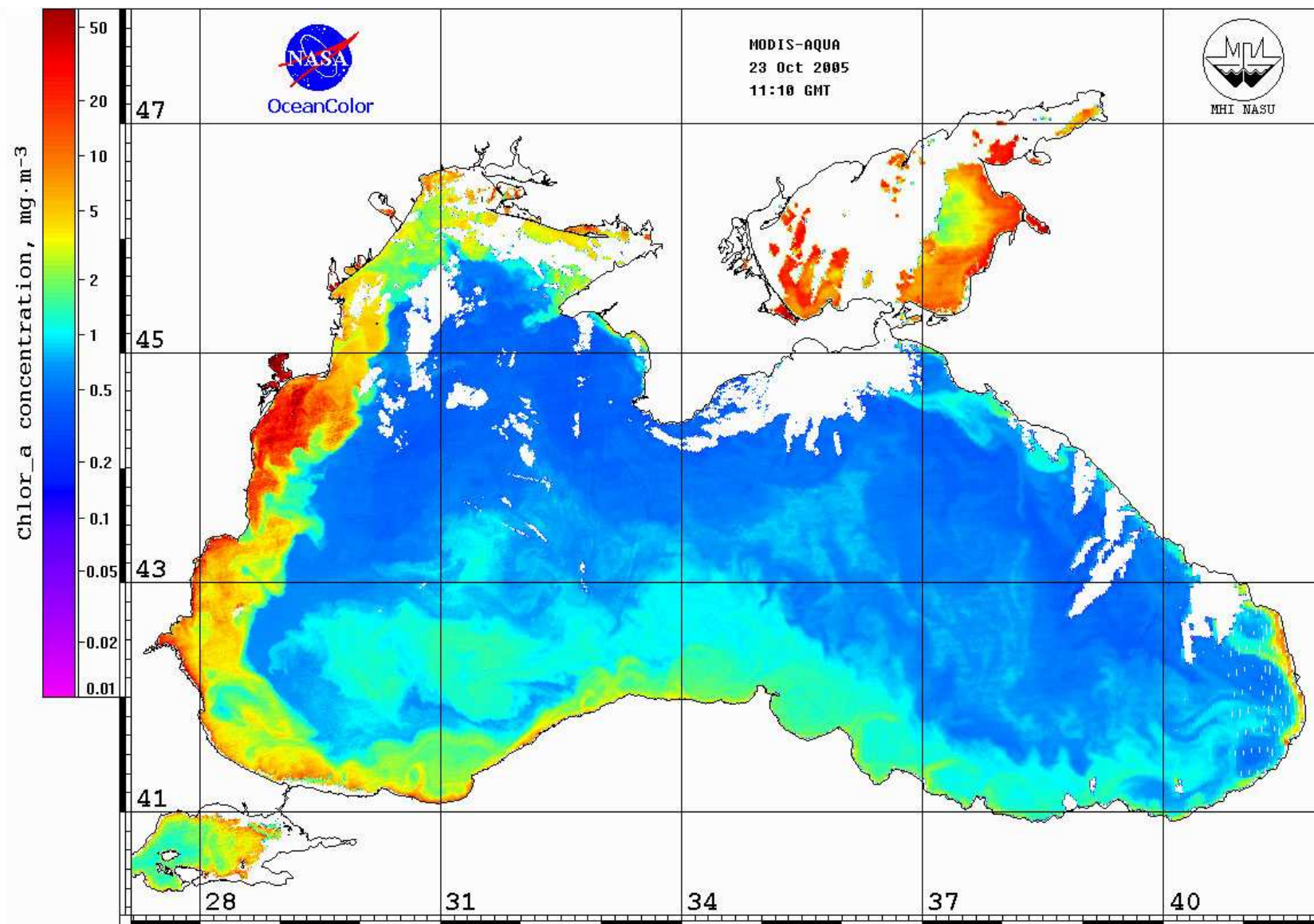
Global Sea Surface Temperature anomaly time series from merged data sets



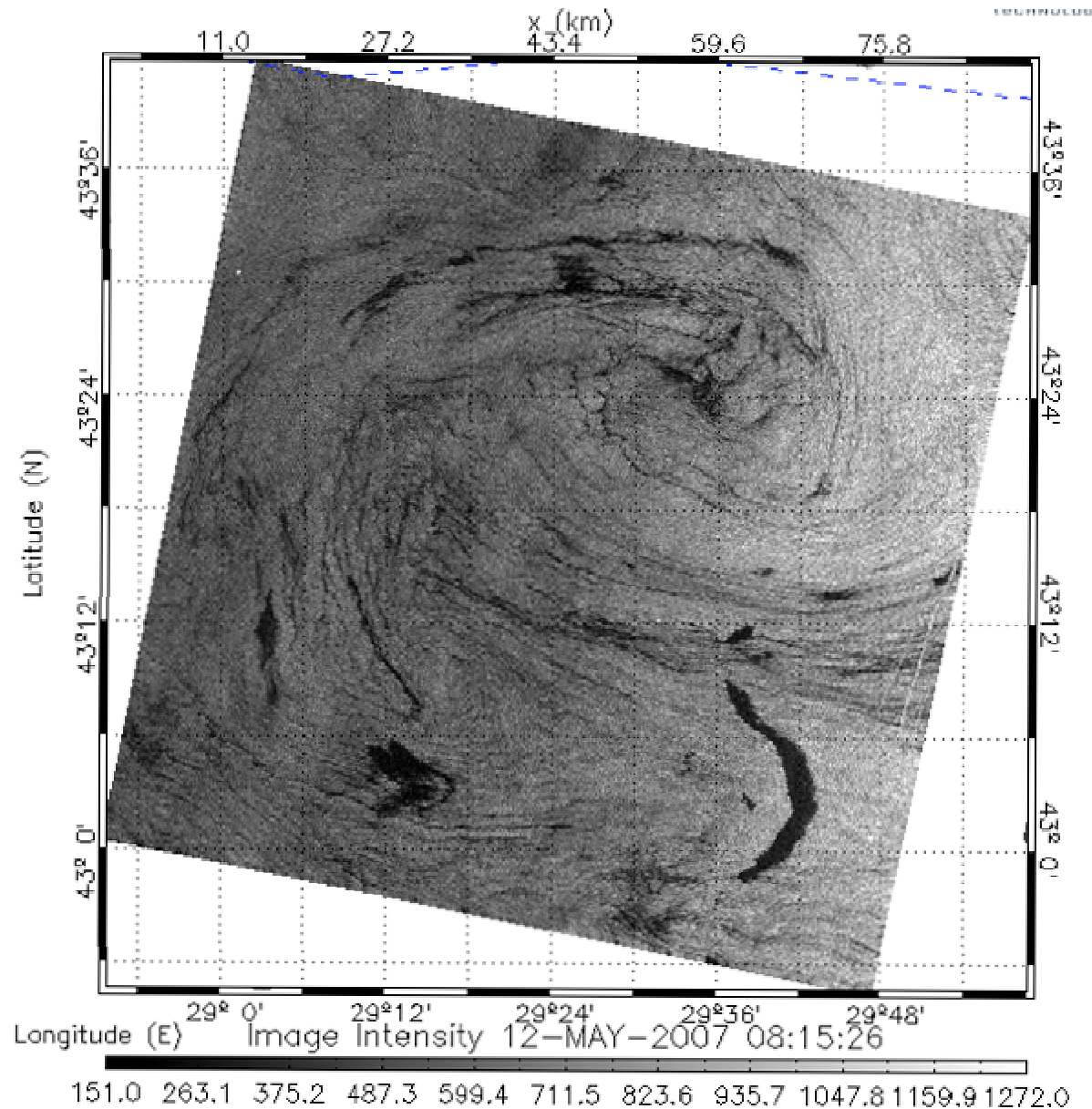
SST maps produced by Marine Hydrophysical Institute in Sevastopol



Ocean colour maps from MODIS data

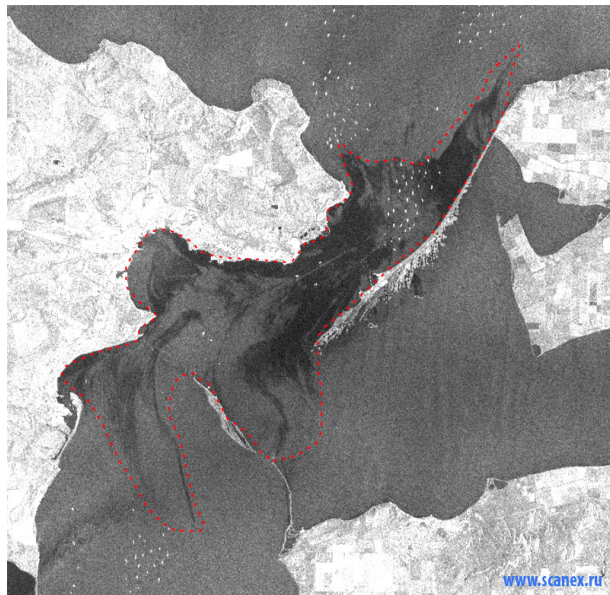


Synthetic Aperture Radar (SAR) monitoring of the sea surface



Oil spill event Kerch Strait 11 November 2007

C-band: RADARSAT



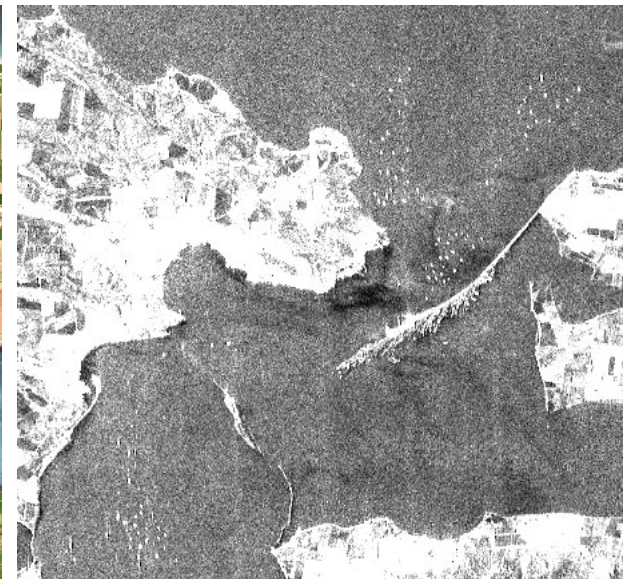
Courtesy: Scanex

X-band: TerraSAR



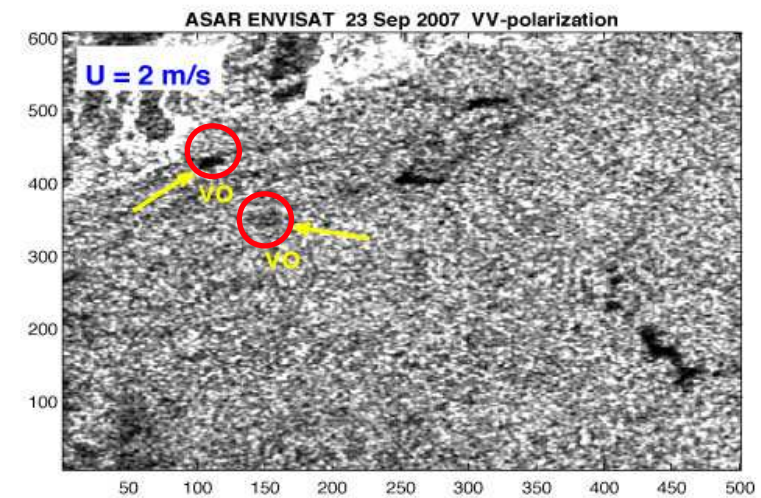
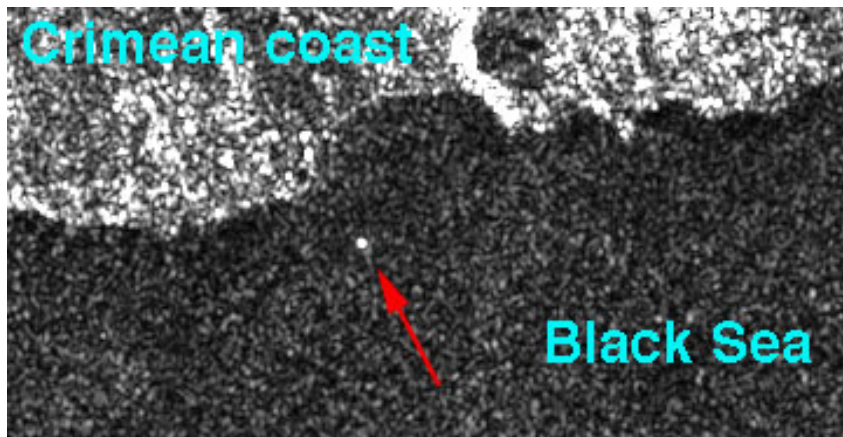
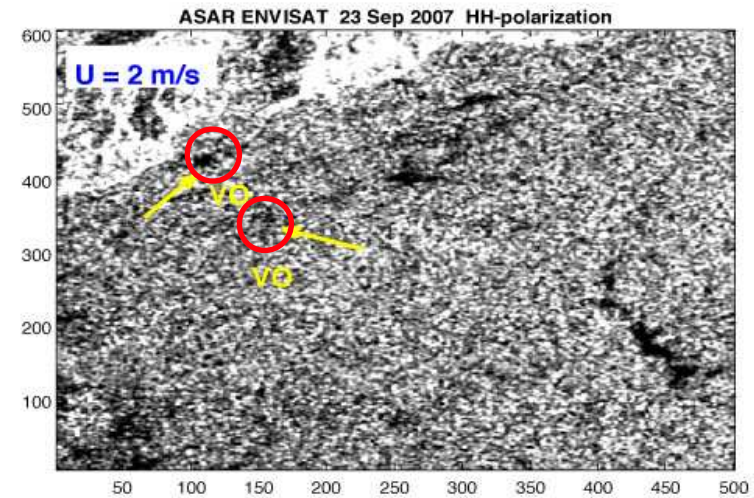
Courtesy: DLR

L-band: ALOS

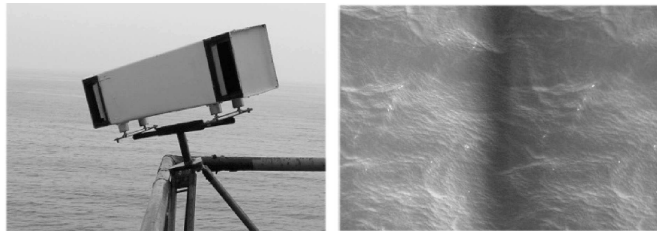
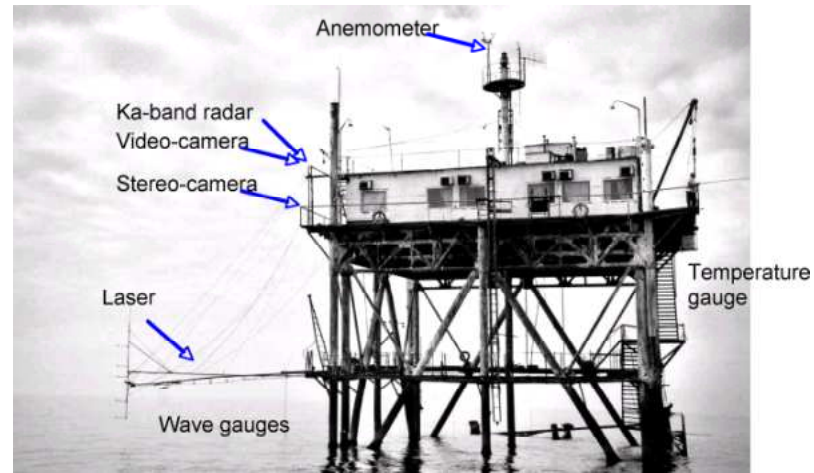


Images obtained 16 November - > case study for model comparison

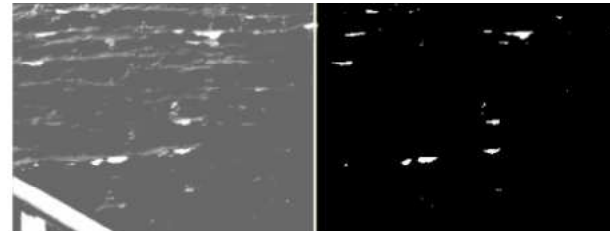
SAR observation of experimental oil spills



Field experiment from an offshore tower in the Black Sea



Optical system to measure short wave spectrum and surface mean slope

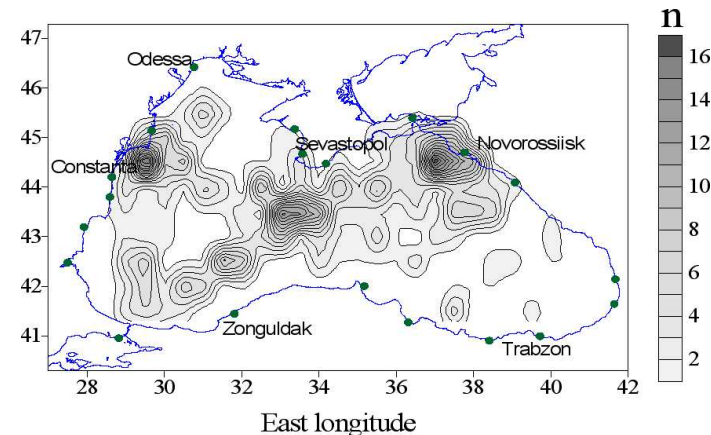
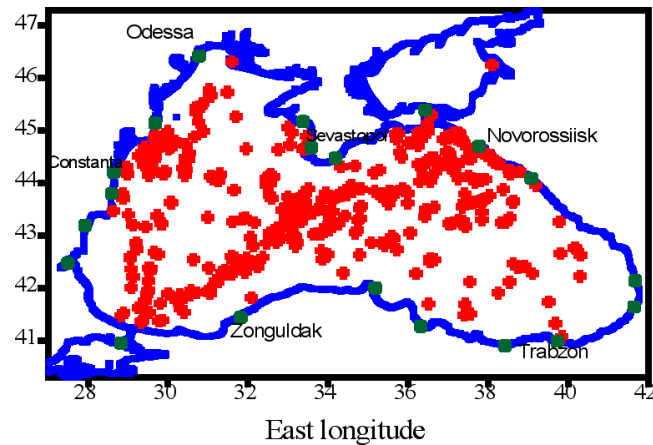


Video system to measure wave breaking characteristics

Field experiment with X-band og Ku-band radar



Distribution of oil spills in the Black Sea from studies 2001 - 2004



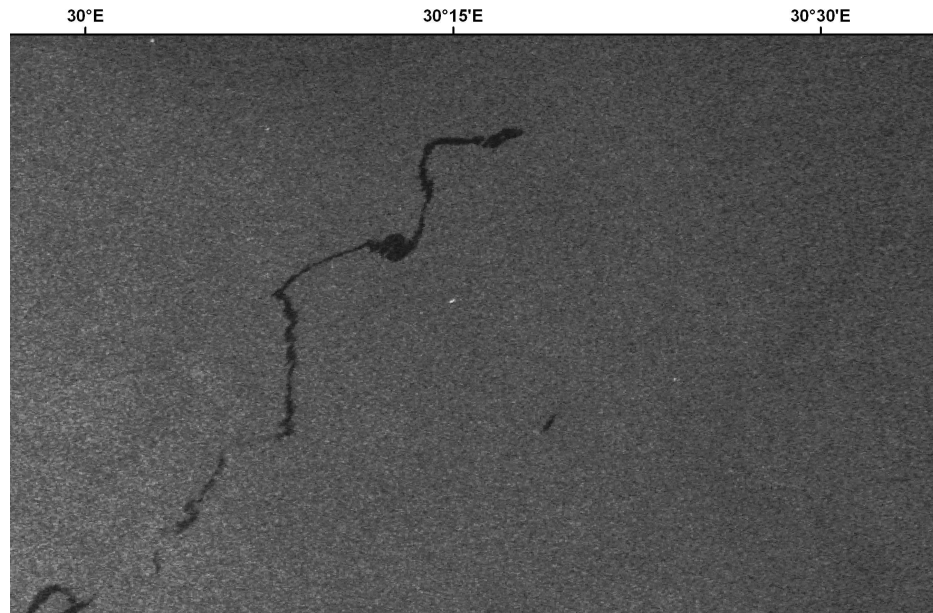
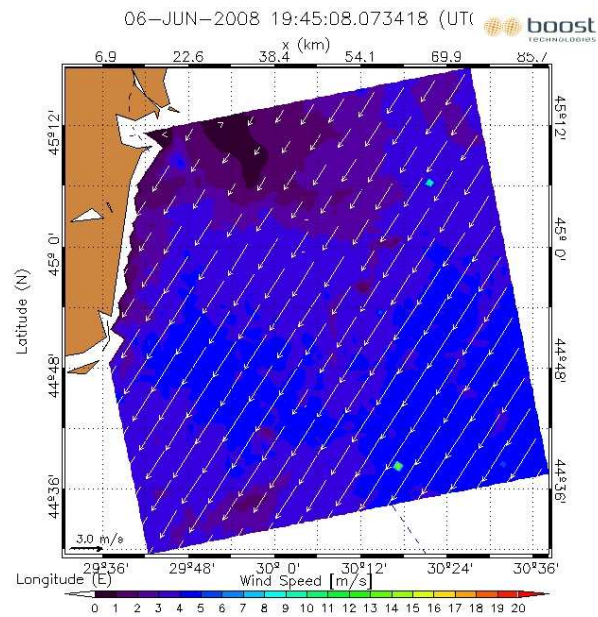
SAR images from ERS-2 and ENVISAT were analyzed for a period of three years (2001 - 2004), resulting in 68 images with 424 likely oil spill events.

The distribution of the spills are concentrated along the main shipping lanes and in the offshore drilling area in the western Black Sea

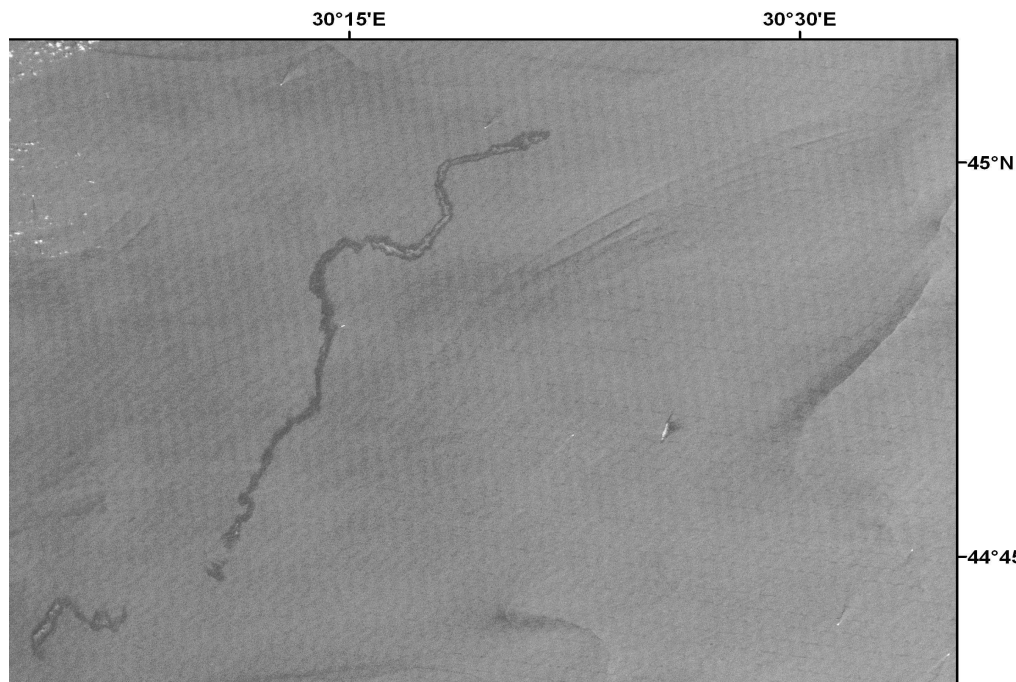
[OSCSAR Final Report, 2006]



Comparison of oil spills in SAR and optical images



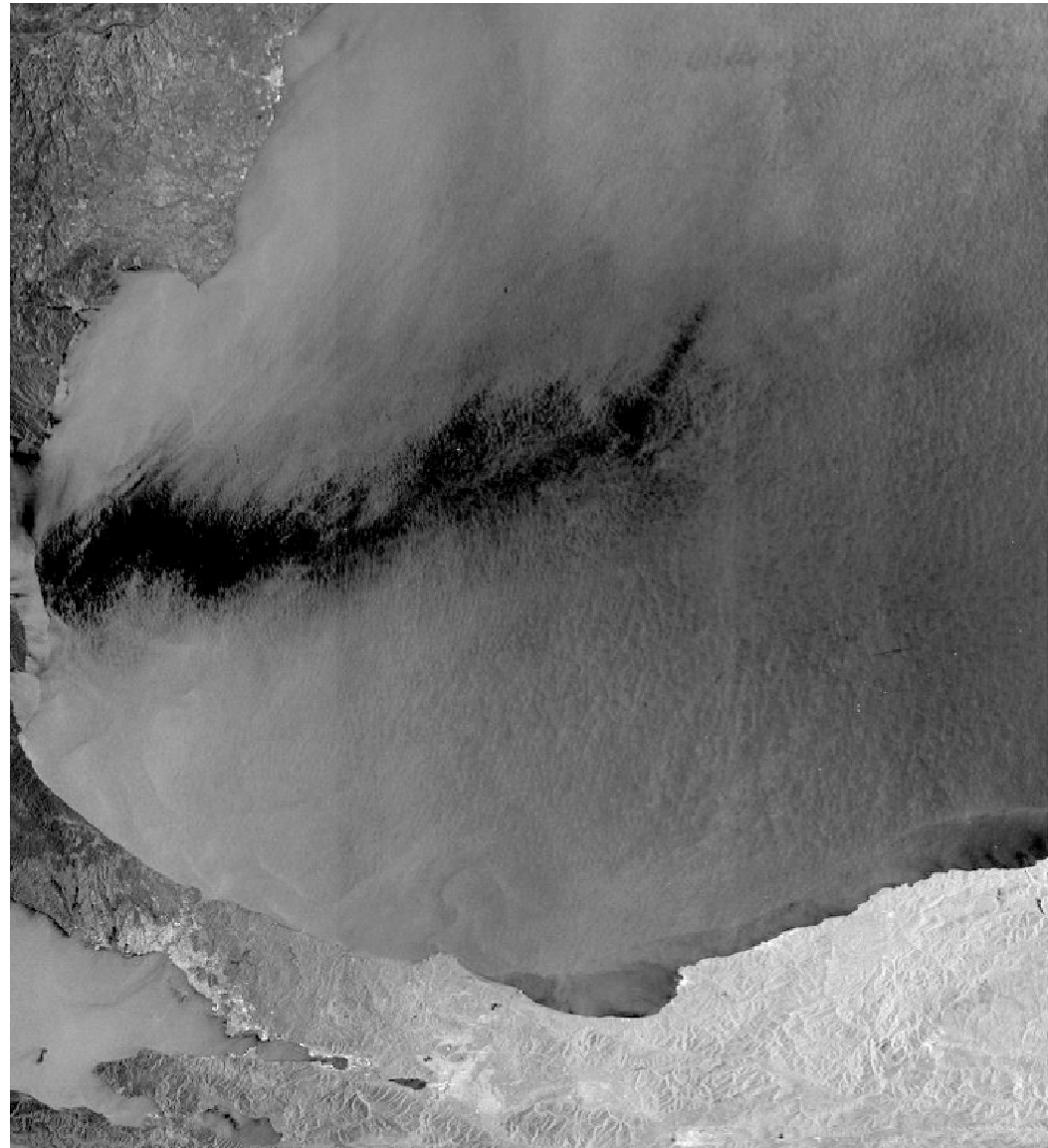
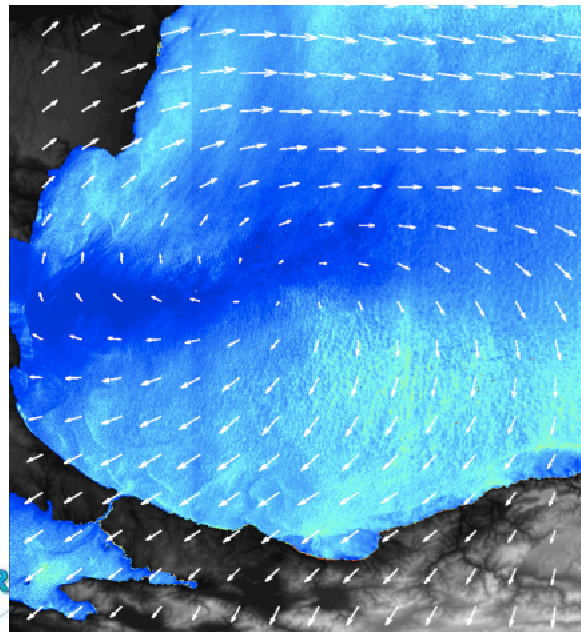
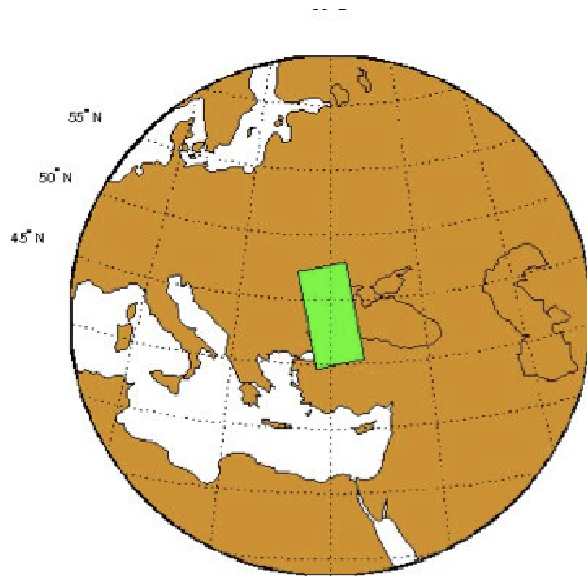
ASAR 06
June 2008



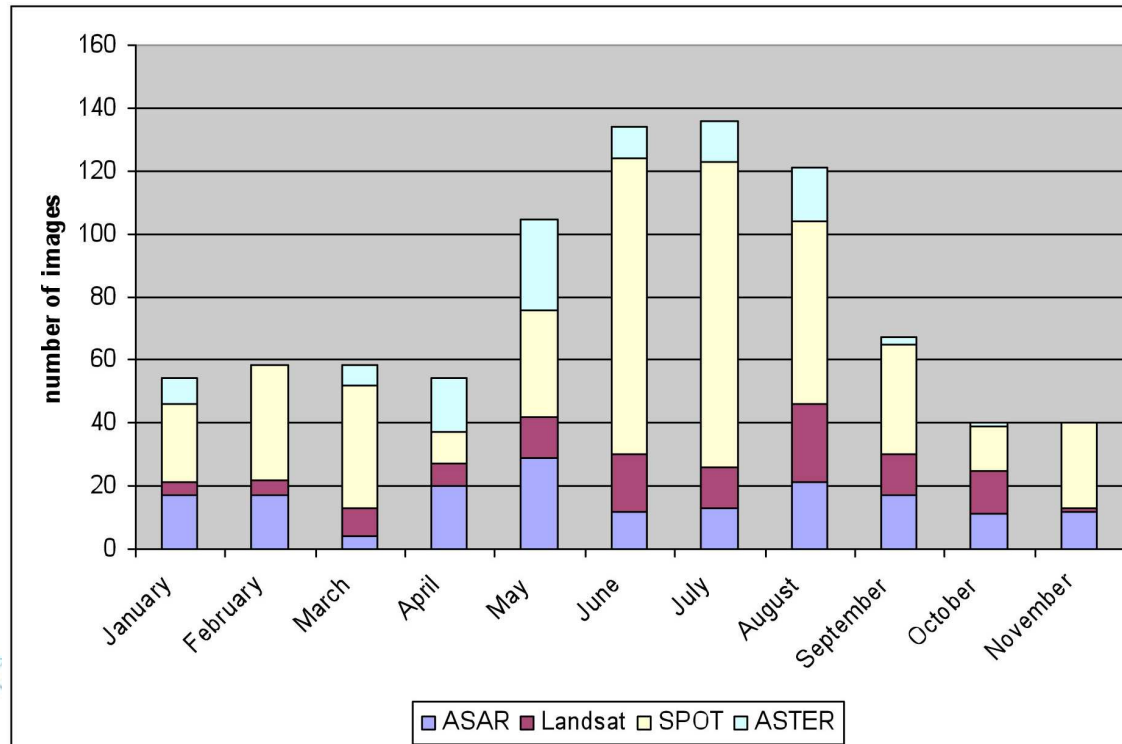
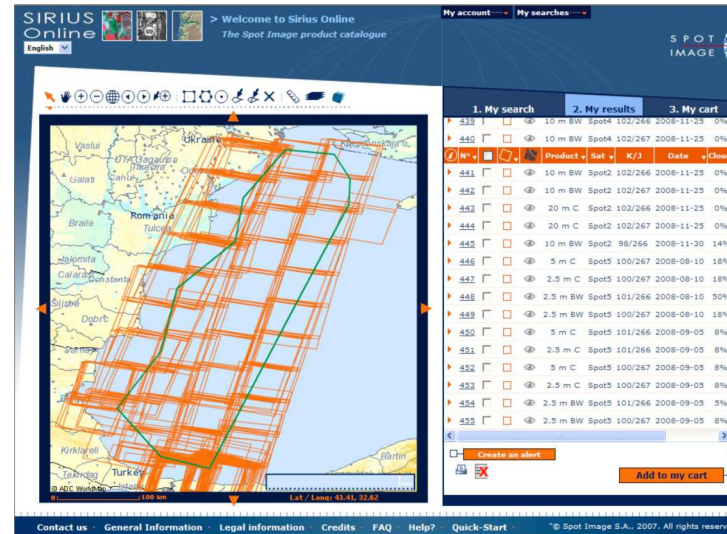
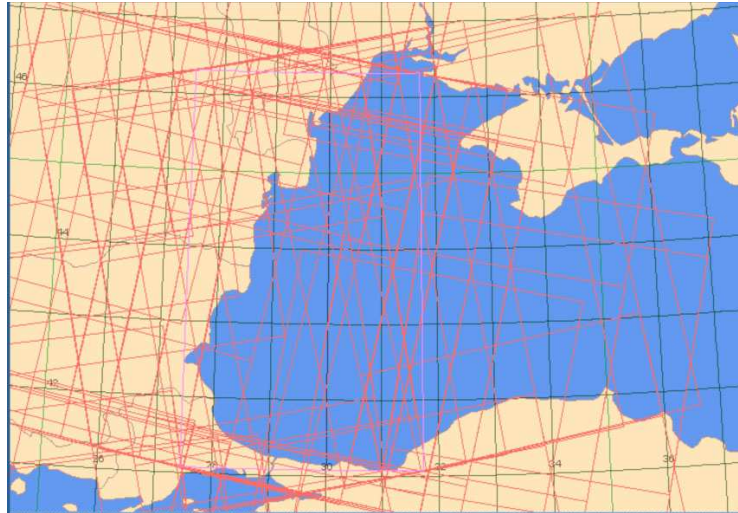
Landsat 06
June 2008
(band 3)

ENVISAT ASAR monitoring system

Western Black Sea 10 March 2010



Data coverage in western Black Sea in 2008

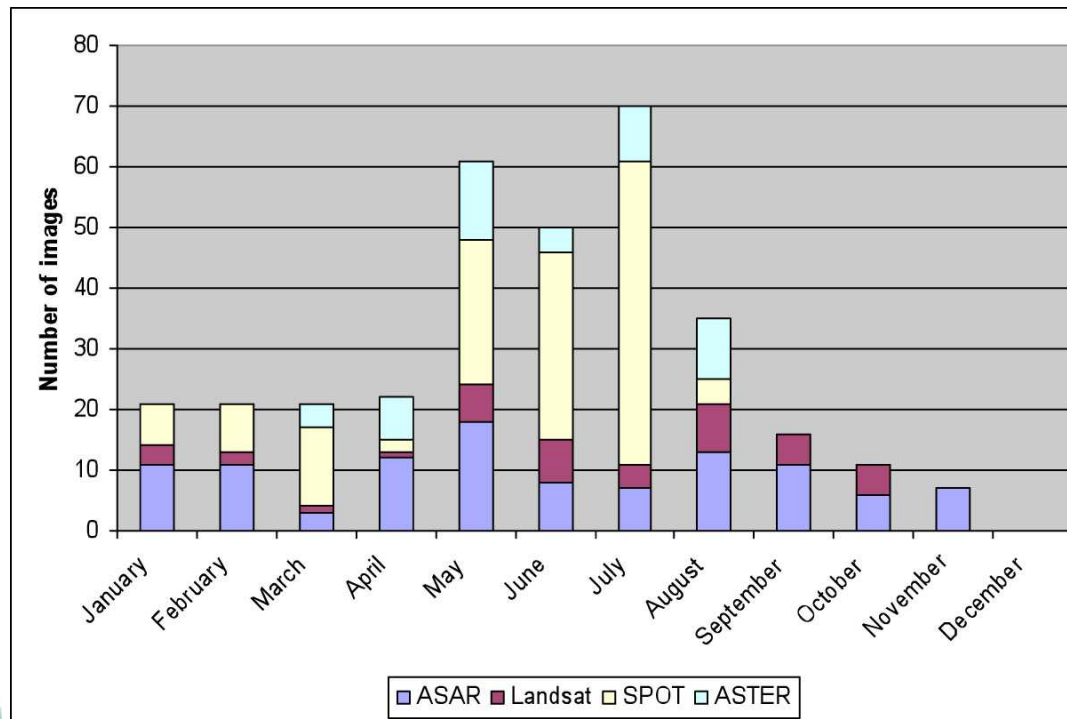
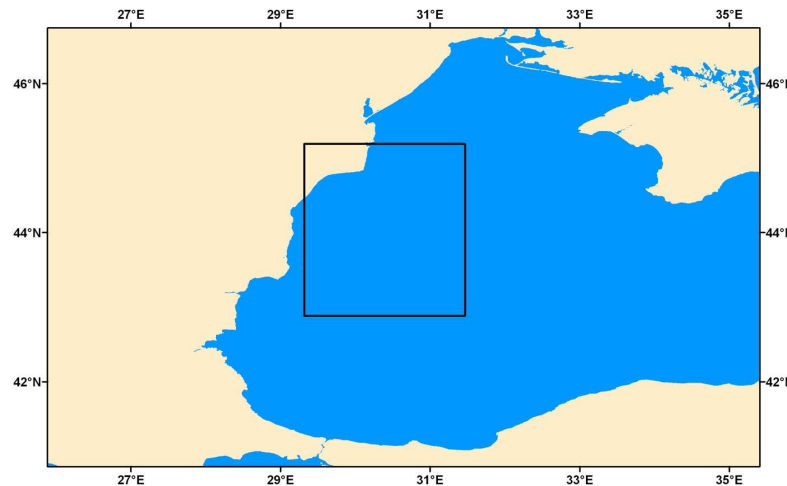


2008 (end Nov)
 ASAR WS: 173
 Landsat: 122*
 SPOT: 455*
 ASTER: $\approx$ 130

*images with < 20 % clouds



Data coverage in western Black Sea in 2008 – smaller area



2008 (end Nov)
ASAR WS: 108
Landsat: 42*
SPOT: 135*
ASTER: ≈ 47

*images with < 20 % clouds



Summary and further work

- Several types of satellite data are used to observe the sea surface of the Black Sea: infrared, optical, scatterometer, SAR, etc.
- SAR data are particularly useful for oil spill detection, ship detection and surface wind mapping
- SAR data can also be used in combination with optical images to detect oil spills and natural films
- Field experiments from the tower in off Crimea have been used to measure wave damping from spills coincident with SAR images
- Goal: Establish monitoring scheme using satellite data, both SAR and optical, in combination with radar scattering models and in situ data for validation



Acknowledgement

- The SAR data for the study are provided by ESA through AOB E-2780
- The research is supported by INTAS (contract no. 06-1000025-9264), EU FP6 (contract no. 031001- MONRUK), and national projects in Ukraine and Russia
- Several colleagues at NERSC, NIERSC (Russia), MHI (Ukraine) and API (Russia) have contributed to the work

