

# Дистанционный мониторинг процессов и явлений в морских экосистемах

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Станичная Р.Р., Кубряков А.А., Антонюк А.Ю.

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**Экосистема, или экологическая система** (от [др.-греч.](#) οἶκος — жилище, местопробывание и σύστημα — система) — биологическая система, состоящая из сообщества живых организмов ([биоценоз](#)), среды их обитания ([биотоп](#)), системы связей, осуществляющей обмен веществом и энергией между ними

- **Определения**

- Любое единство, включающее все организмы на данном участке и взаимодействующее с физической средой таким образом, что поток энергии создаёт чётко определённую трофическую структуру, видовое разнообразие и круговорот веществ (обмен веществами и энергией между биотической и абиотической частями) внутри системы, представляет собой экологическую систему, или экосистему ([Ю. Одум](#), 1971)[\[2\]\[4\]](#).
- Экосистема — система физико-химико-биологических процессов (А. Тенсли, 1935 год).
- Сообщество живых организмов вместе с неживой частью среды, в которой оно находится, и всеми разнообразными взаимодействиями называют экосистемой (Д. Ф. Оуэн.)[\[5\]](#).
- Любую совокупность организмов и неорганических компонентов окружающей их среды, в которой может осуществляться круговорот веществ, называют экологической системой или экосистемой (В. В. Денисов.)[\[5\]](#).
- Биогеноценоз (В. Н. Сукачёв, 1944) — взаимообусловленный комплекс живых и косных компонентов, связанных между собой обменом веществ и энергии[\[6\]](#).
- Иногда особо подчёркивается, что экосистема — это исторически сложившаяся система (см. [Биоценоз](#)).

MHI NASU Remote Sensing Department - Microsoft Internet Explorer

Файл Правка Вид Избранное Сервис Справка

Назад Поиск Избранное

Адрес: <http://dvs.net.ua/> Ссылки >>

## Marine Hydrophysical Institute National Academy of Sciences of Ukraine

# Remote Sensing Department

Eng  
Rus

- Main
- Projects >>
- Desertification in the Aral Sea Region
- Aegean-Black Sea Exchange
- EC 5 FP MFSTEP, Task 13400
- Barents Sea Currents
- Monitoring of Oil Pollution
- Kerch Strait Aquatory Investigation
- My Ocean-WP10-BS
- Marine Portal NSAU
- Staff
- Publications
- Site Map

*Remote Sensing Department of Marine Hydrophysical Institute* is the leading Ukrainian subdivision in the field of the environmental remote sensing. The department consists of the high level specialists in oceanography and data processing. Marine Hydrophysical Institute has HRPT satellite receiving station, software for data processing and a data archive. During the last five years the department was involved in the study of the Black, Aral and Caspian Seas and performed in the frame of a number of national and international programs and gathered experience in the analysis of long series of satellite data and imagery. Scientists of the department were involved in international projects and programs of NASA, EU INCO COPERNICUS, NATO SFP, CRDF.

**Contact information:**

Remote Sensing Department, Marine Hydrophysical Institute  
 Postal address: 2, Kapitanskaya St., Sevastopol, 99011, Ukraine  
 Phone: (38)-0692-545065

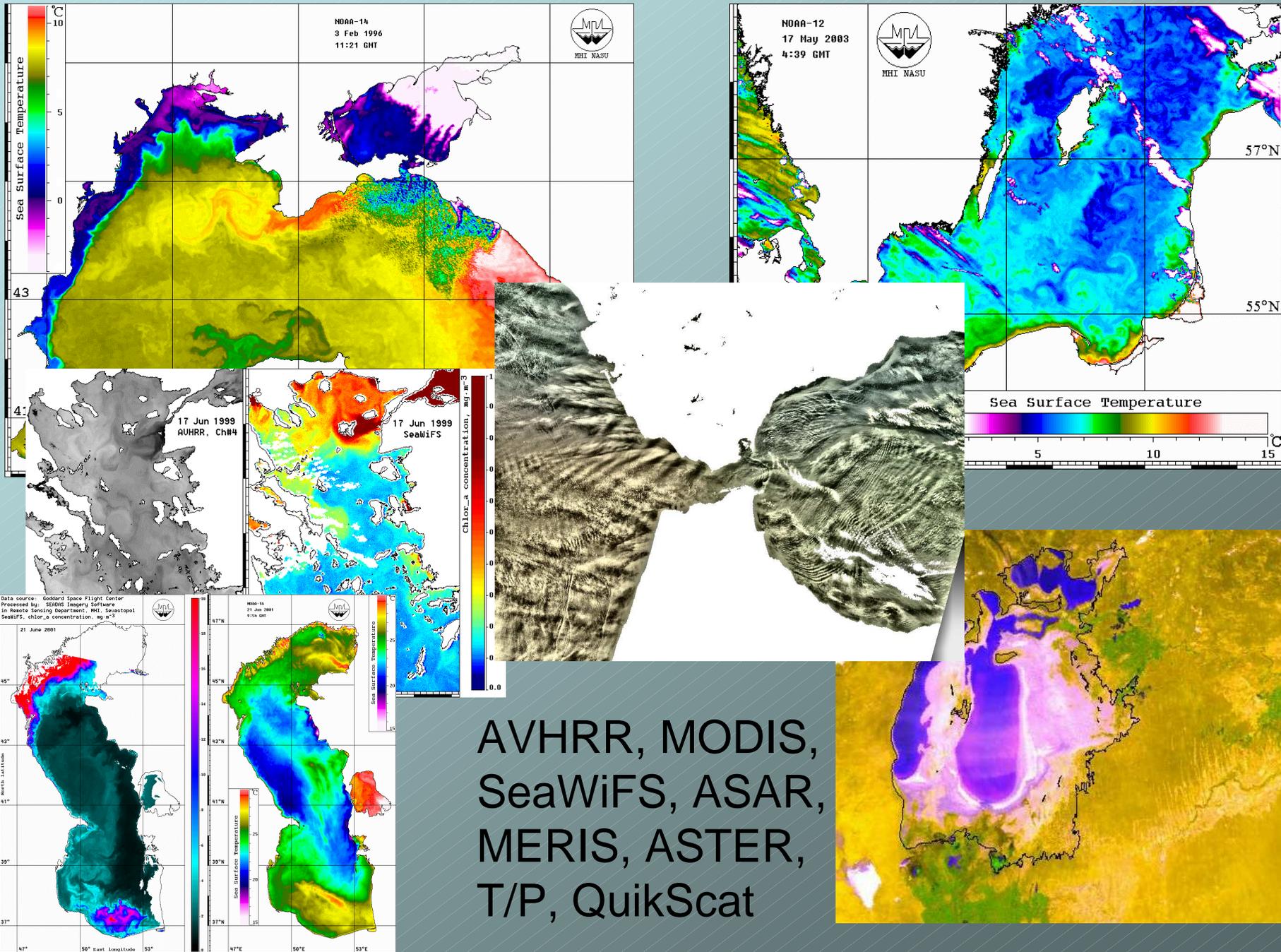
If you have a questions or comments about this site, please send mail to [webmaster](mailto:webmaster)

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<http://dvs.net.ua/proj.shtml>

Total Comma... Adobe Acrob... Ломоносовск... LAADS Web ... http://wifi.sla... Выполнено: ... Все о фидер... MHI NASU R... 23:22

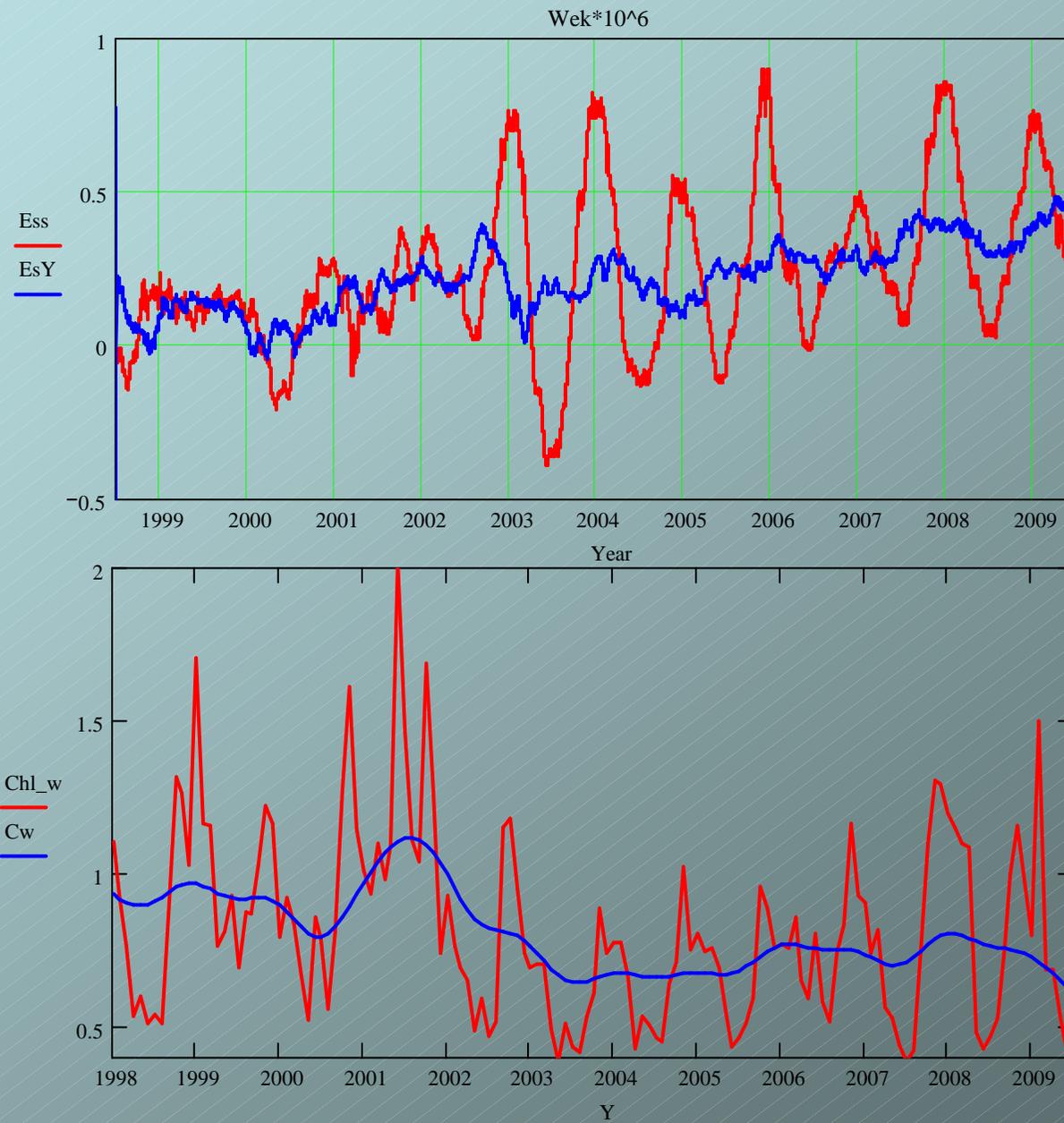
# REGIONAL SATELLITE MONITORING



AVHRR, MODIS,  
SeaWiFS, ASAR,  
MERIS, ASTER,  
T/P, QuikScat

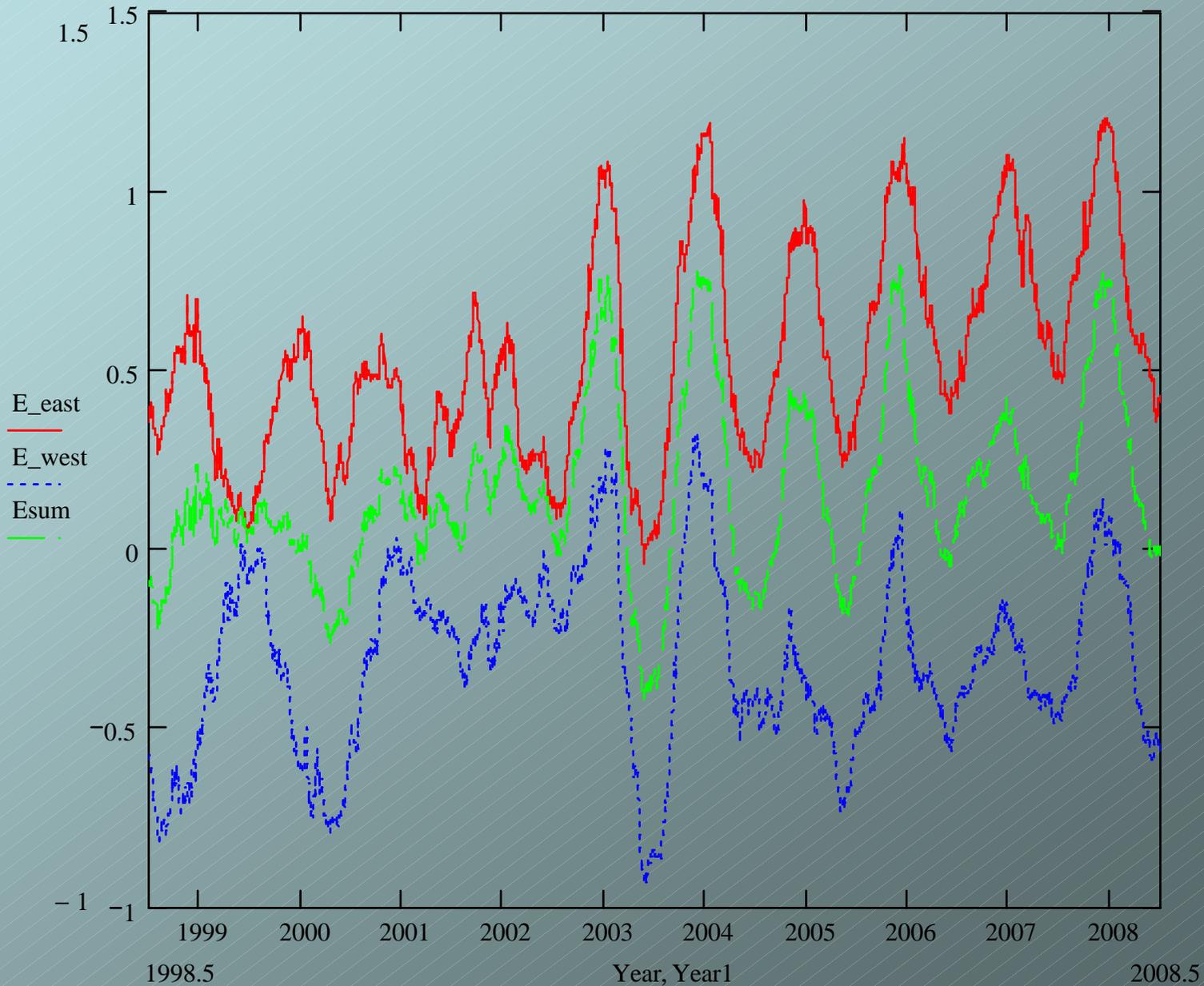
# **СДВИГИ В АТМОСФЕРНЫХ ПРОЦЕССАХ**

# Wind stress curl NCEP and SeaWiFS chl\_a concentration

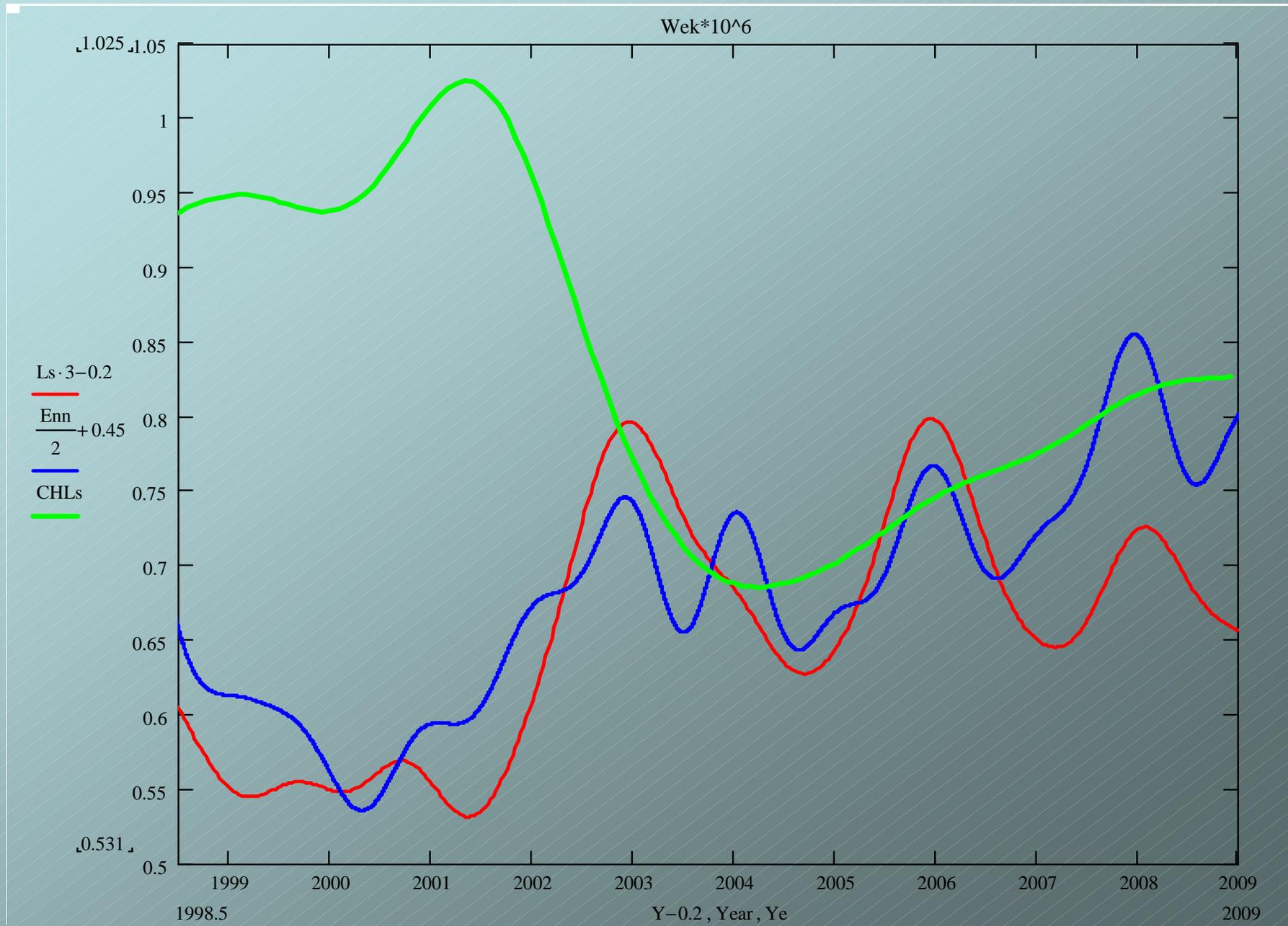


# EAST – WEST parts 34E, Wekm

$E_{\text{east}} > E_{\text{west}}$

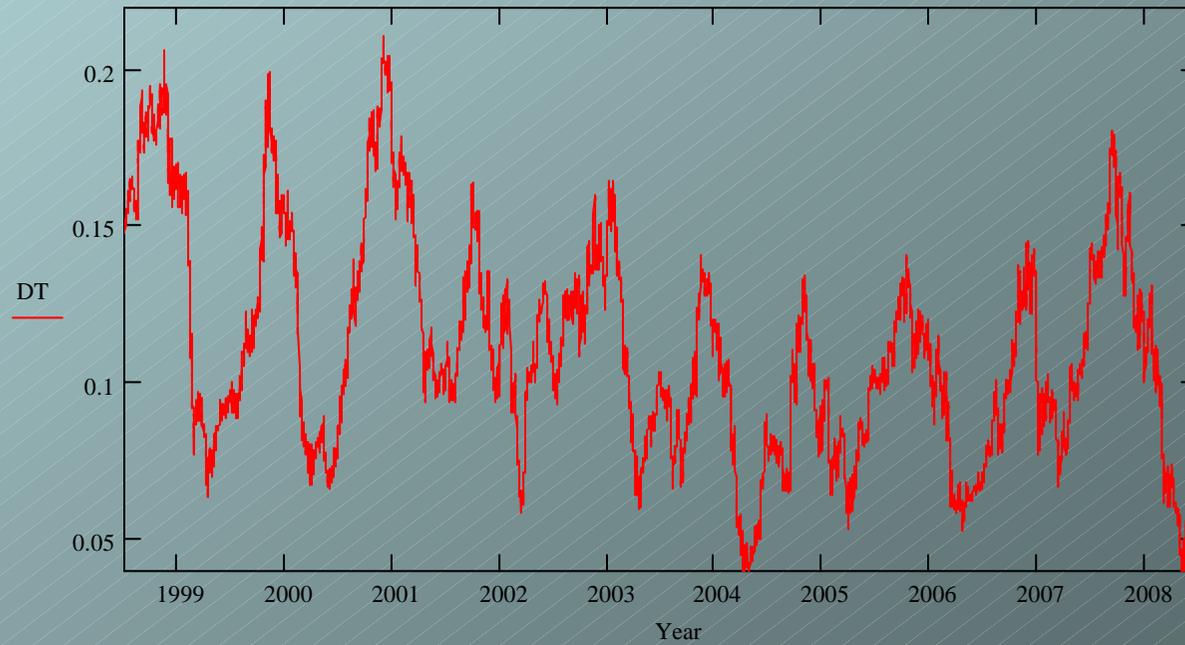
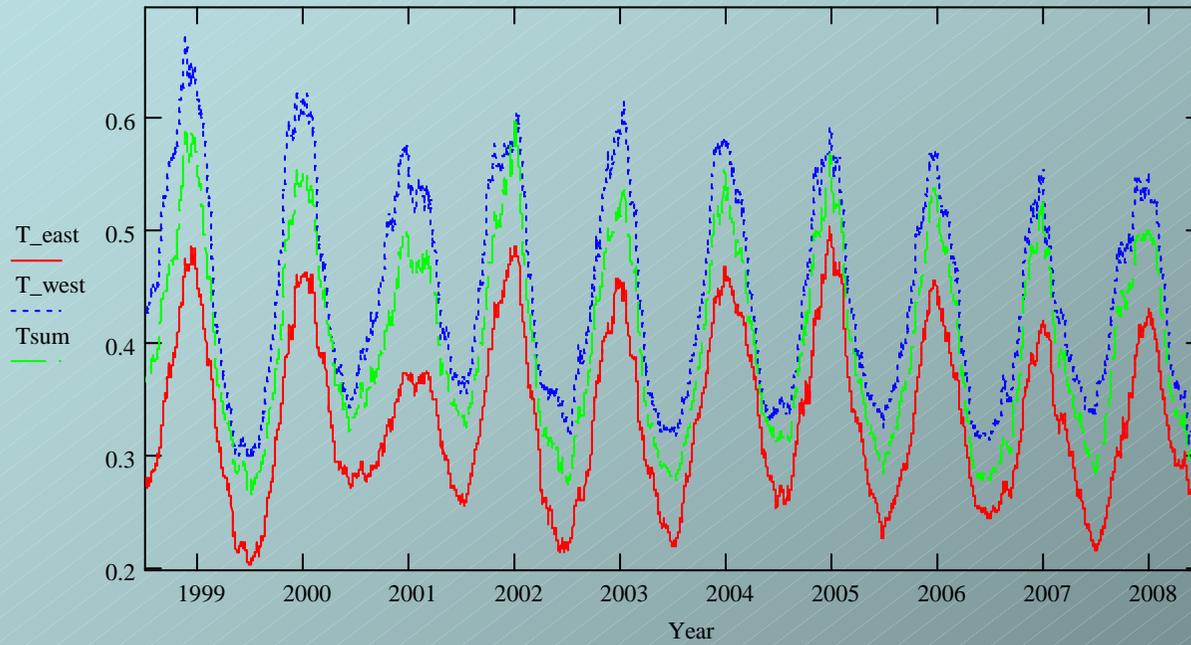


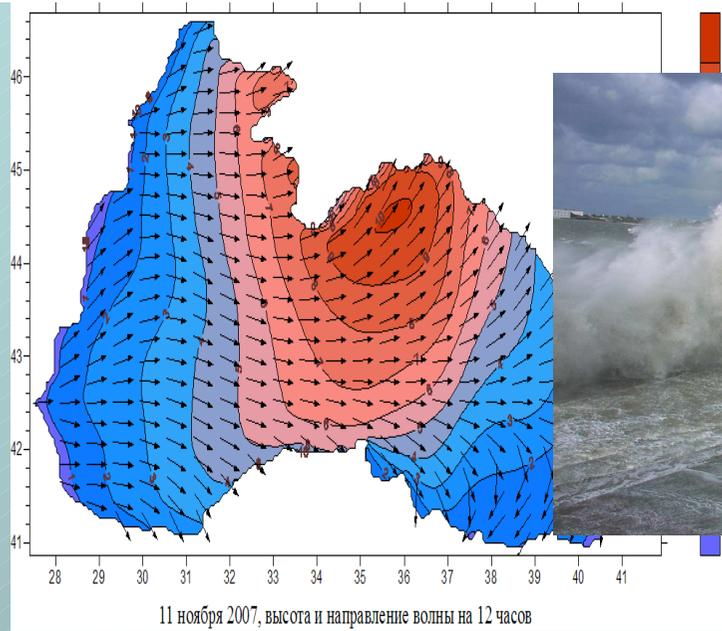
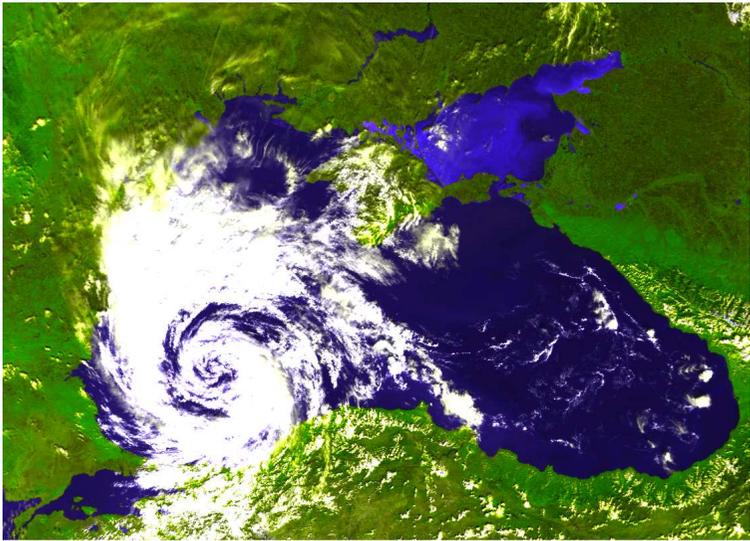
# Altimetry derived kinetic energy $E_V$ , $\tau$ , $W_{ekm}$



WIND\_STRESS - decreasing

$\text{Tau}_{\text{east}} < \text{Tau}_{\text{west}}$



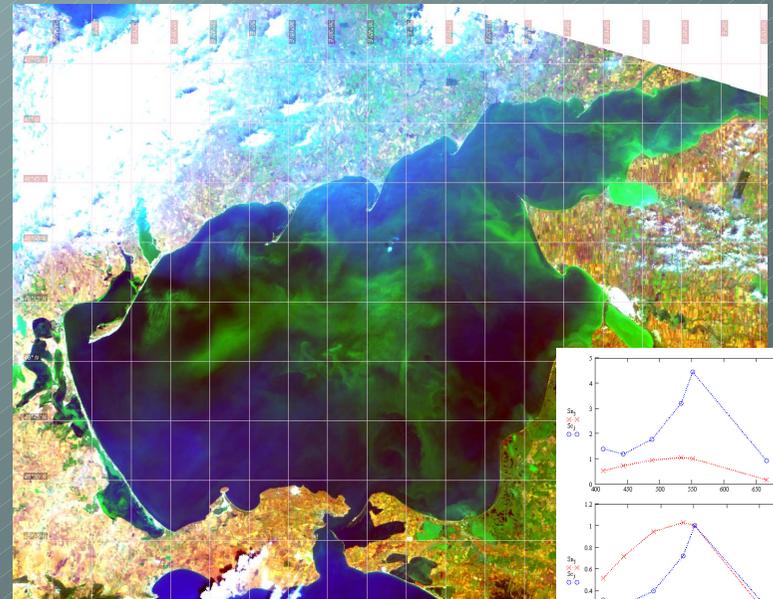
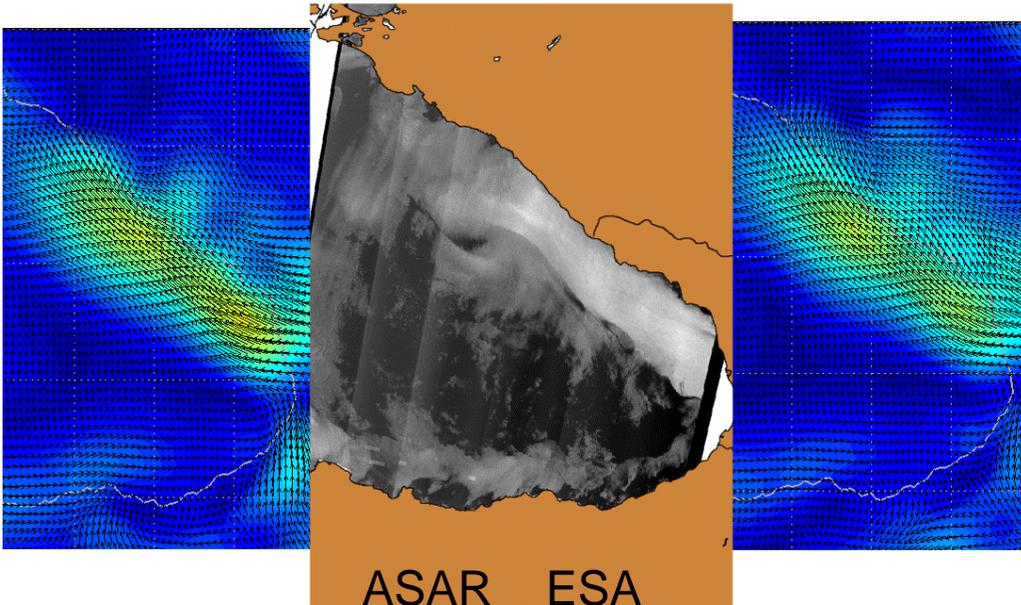


01 nov 2008 **drainage flow**

07:00

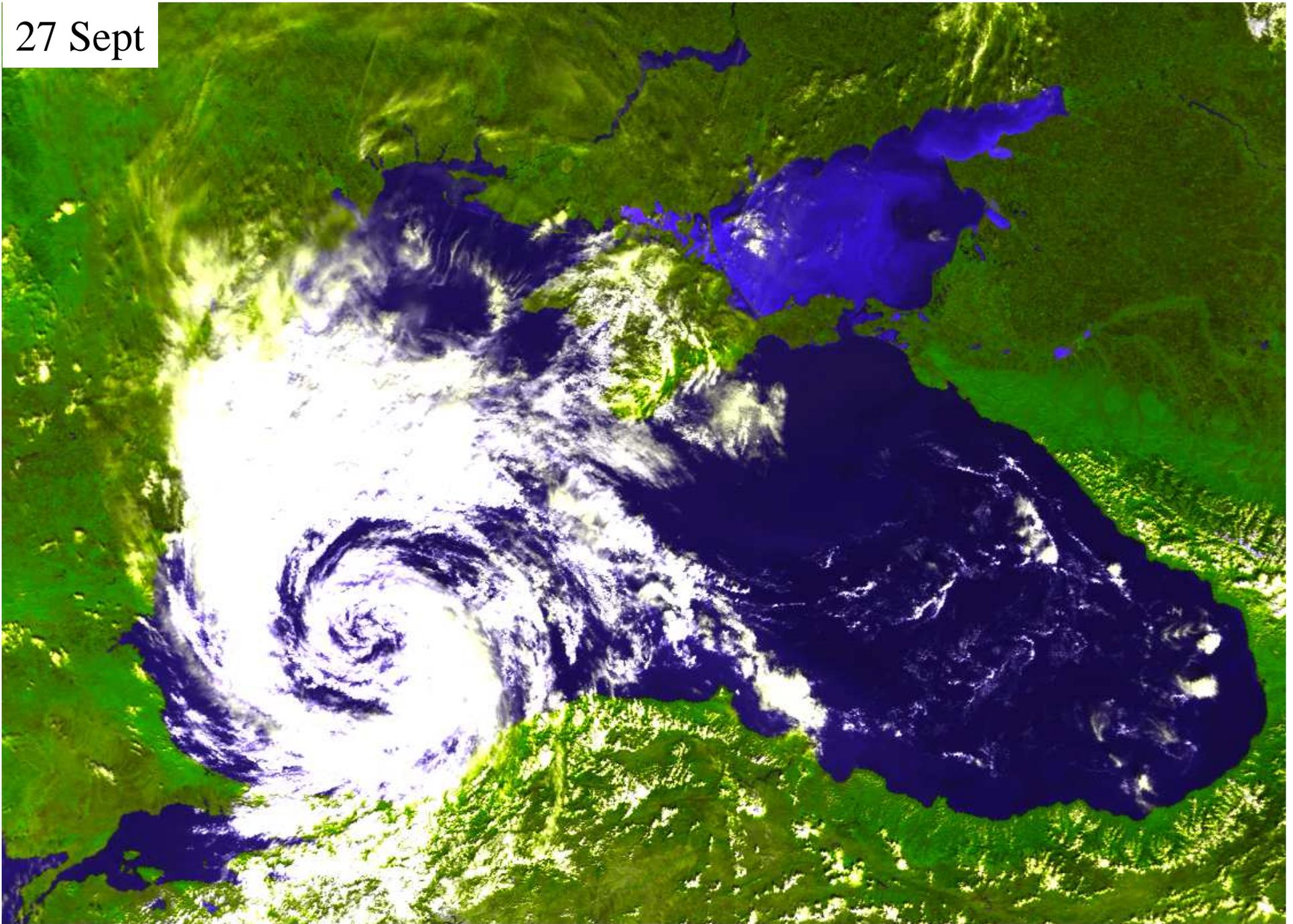
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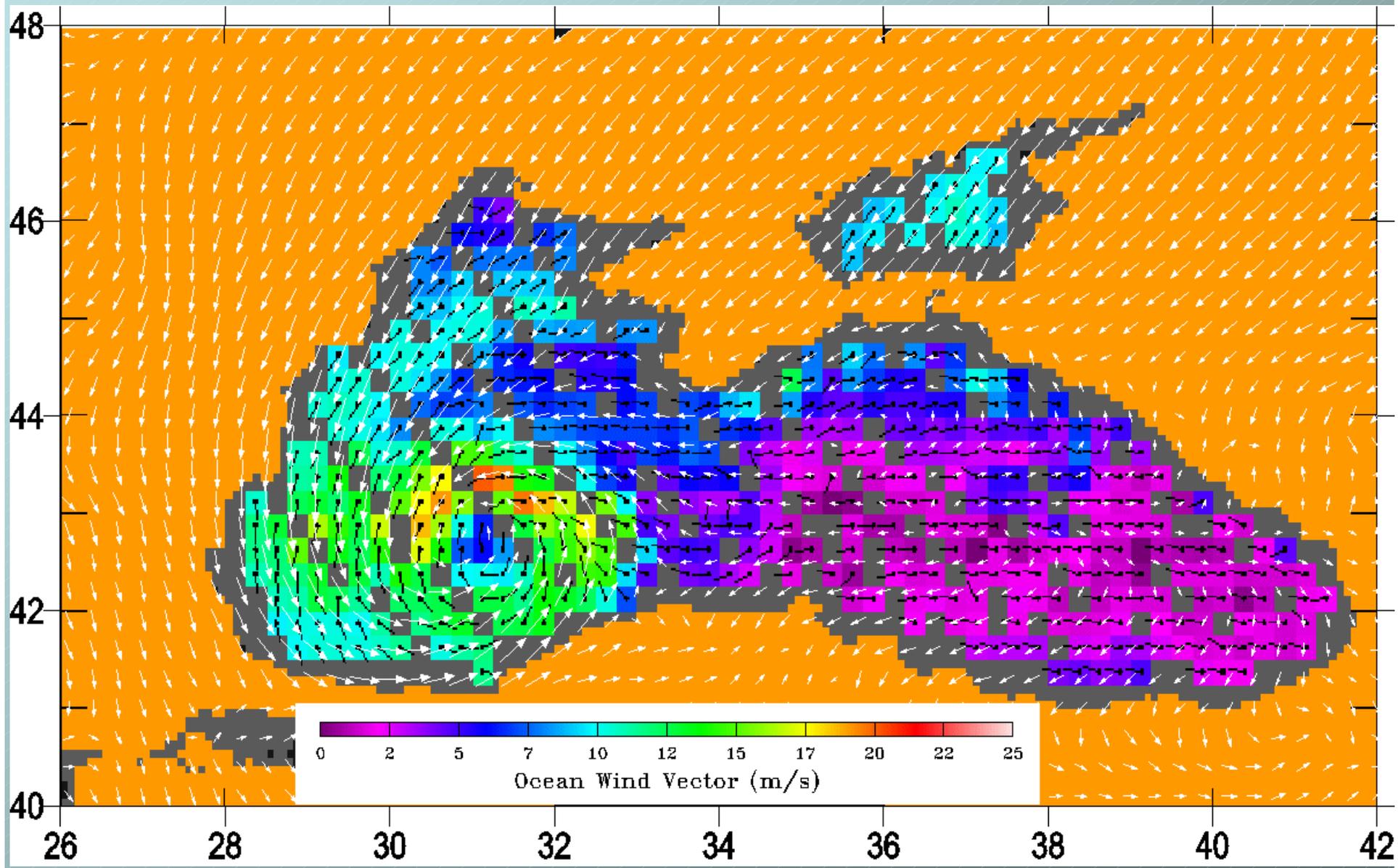
08:00

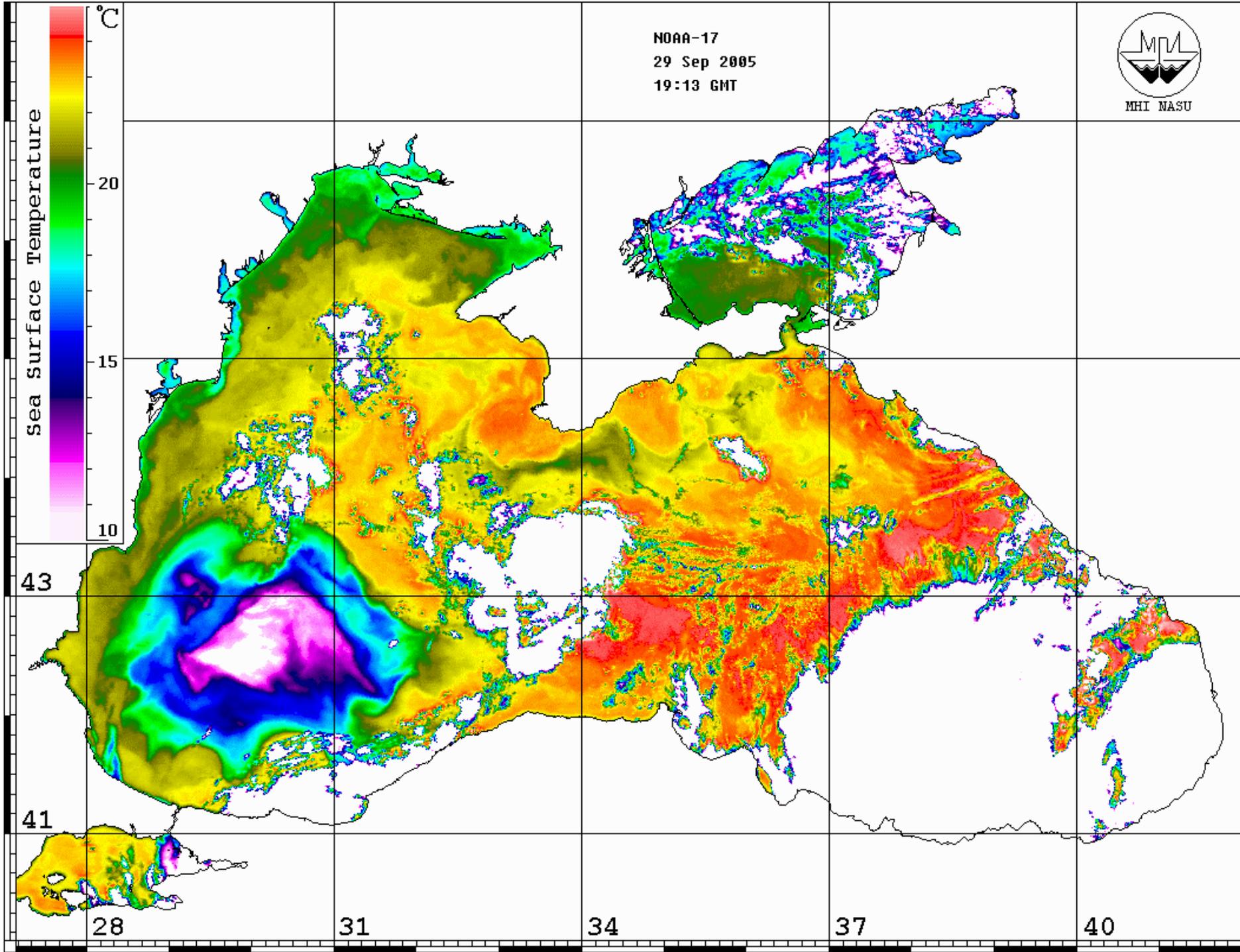


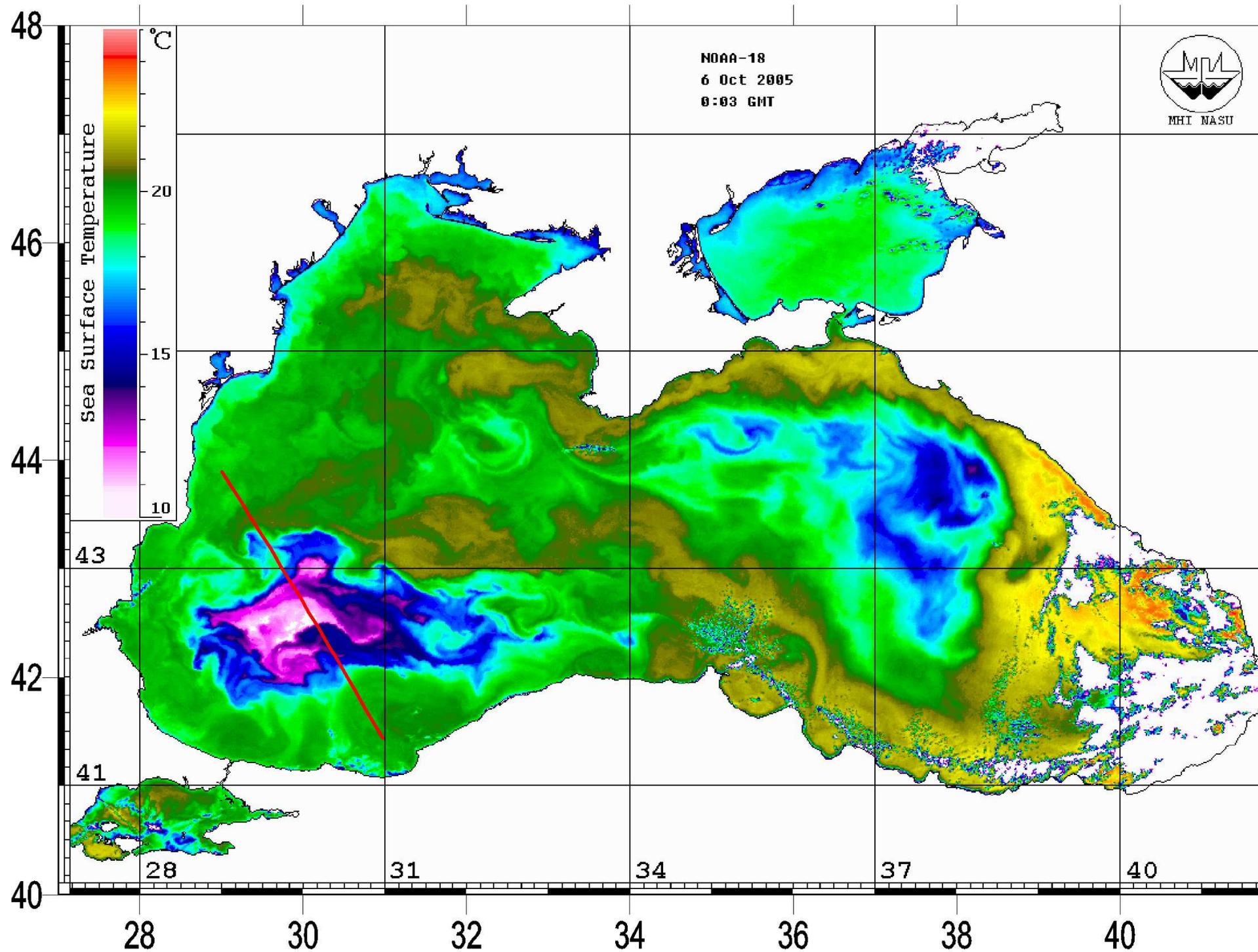
<http://vao.hydrophys.org/>

27 Sept





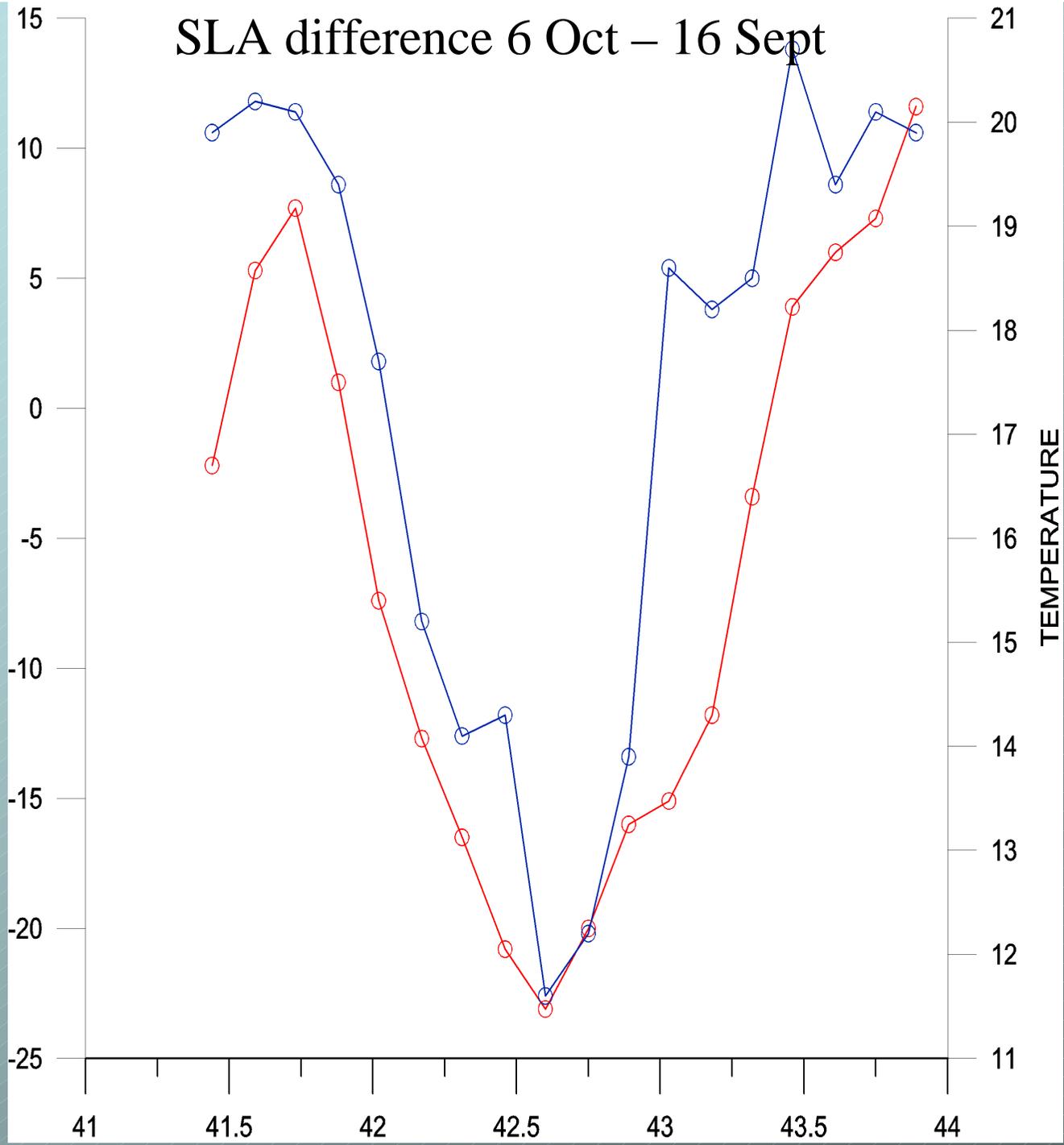




# SLA difference 6 Oct – 16 Sept

Sea level  
Difference,  
cm

TEMPERATURE



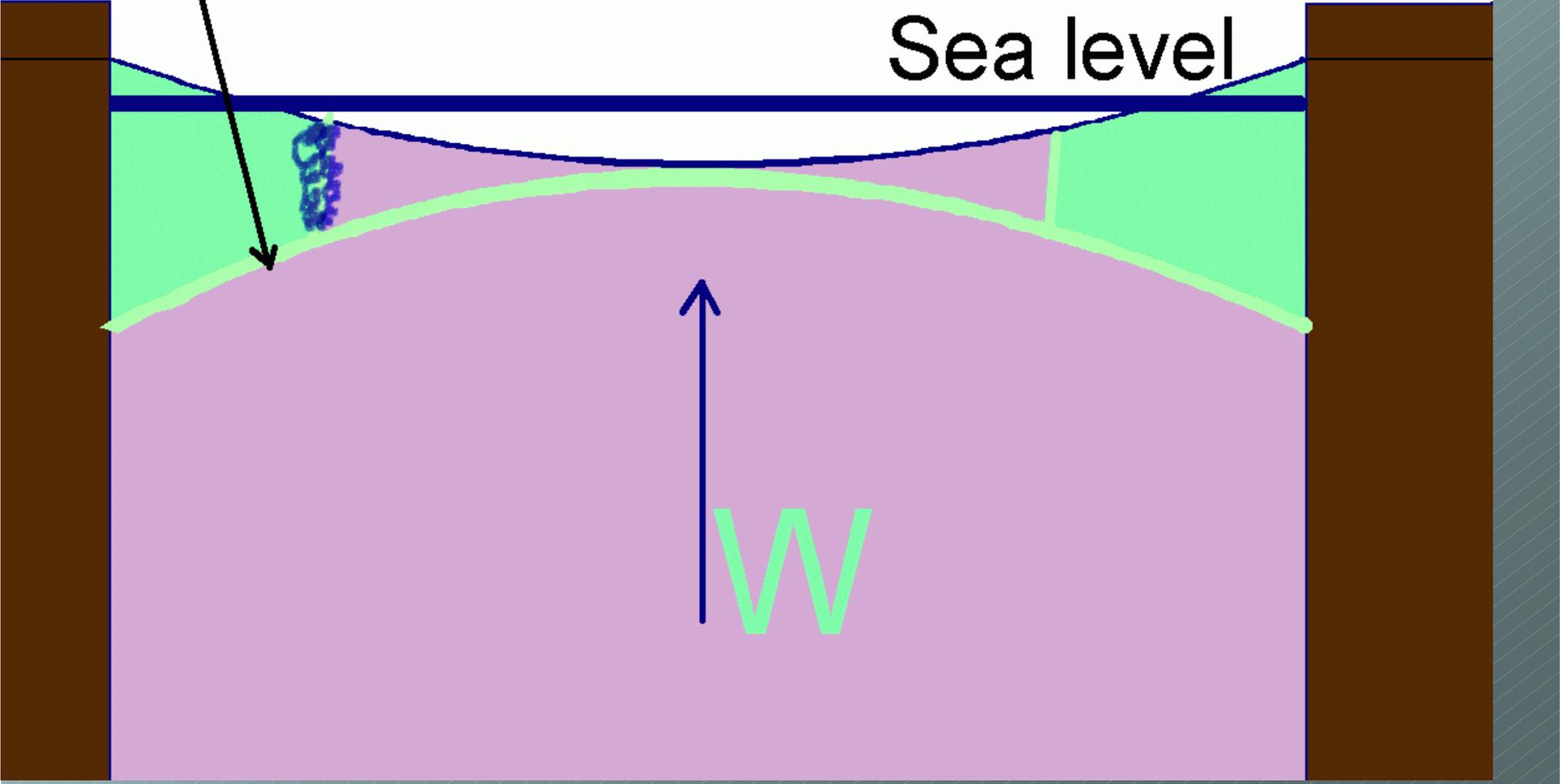


ветер

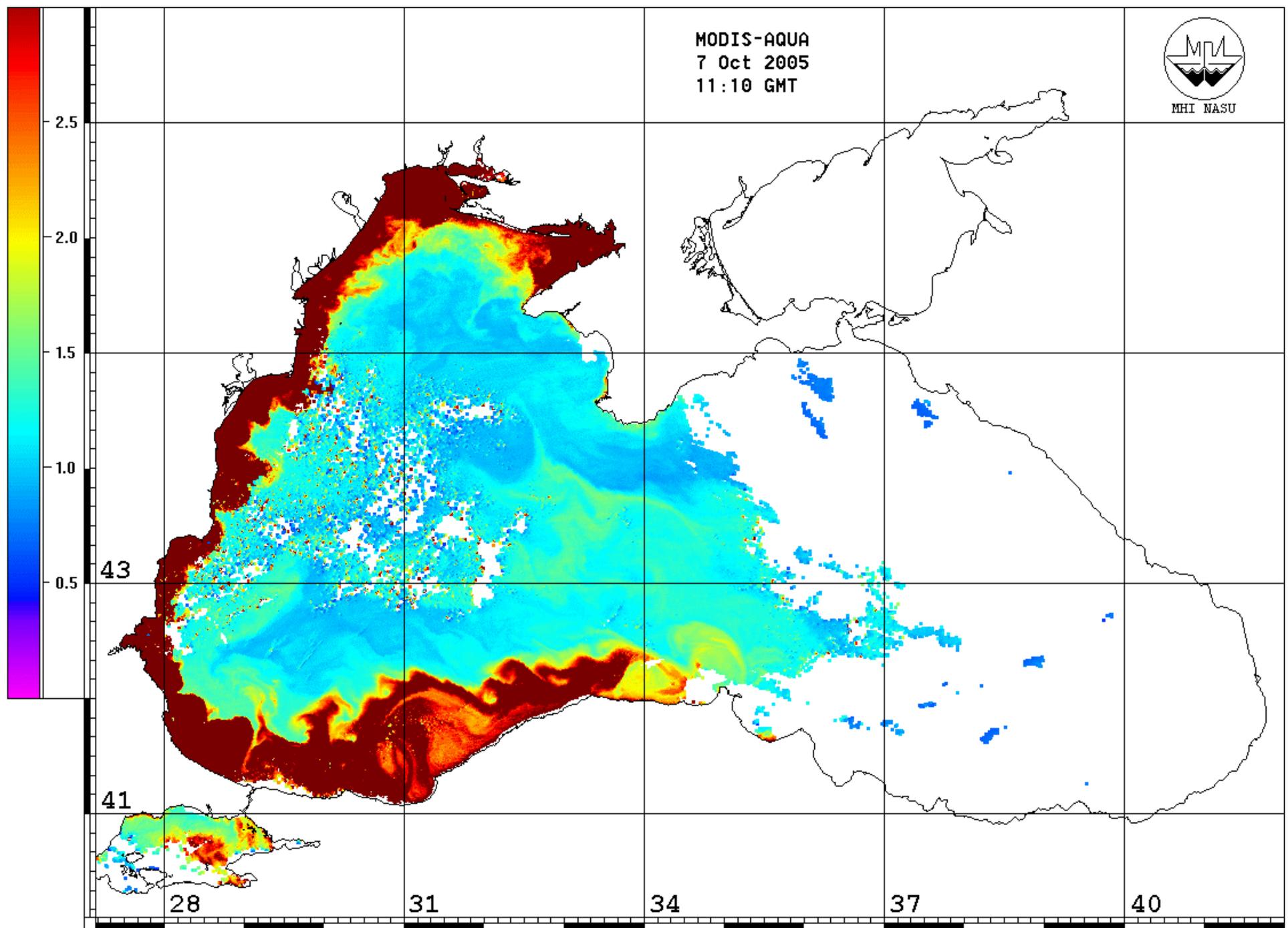


ПИКНОКЛИН

Sea level



MODIS-AQUA  
7 Oct 2005  
11:10 GMT



2.5  
2.0  
1.5  
1.0  
0.5

43

41

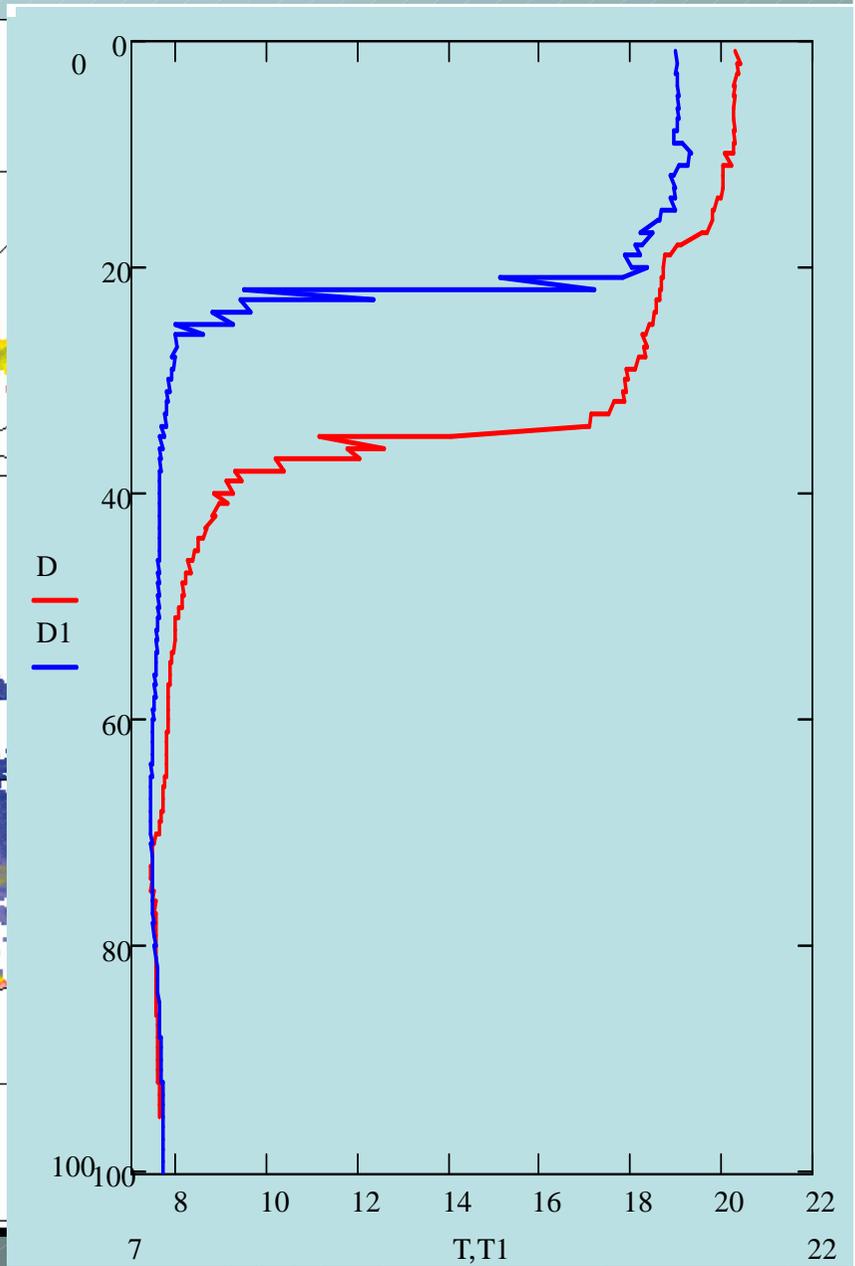
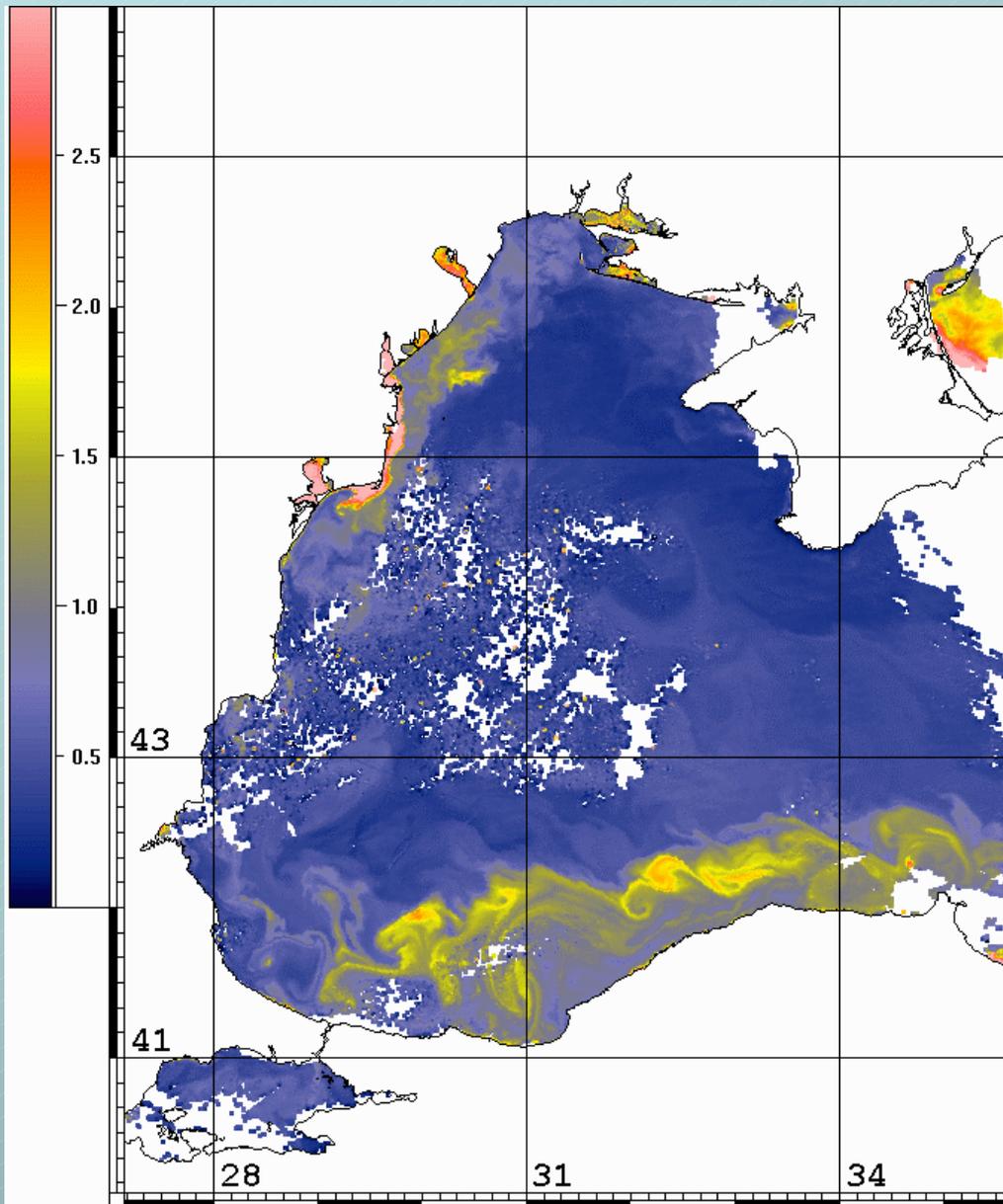
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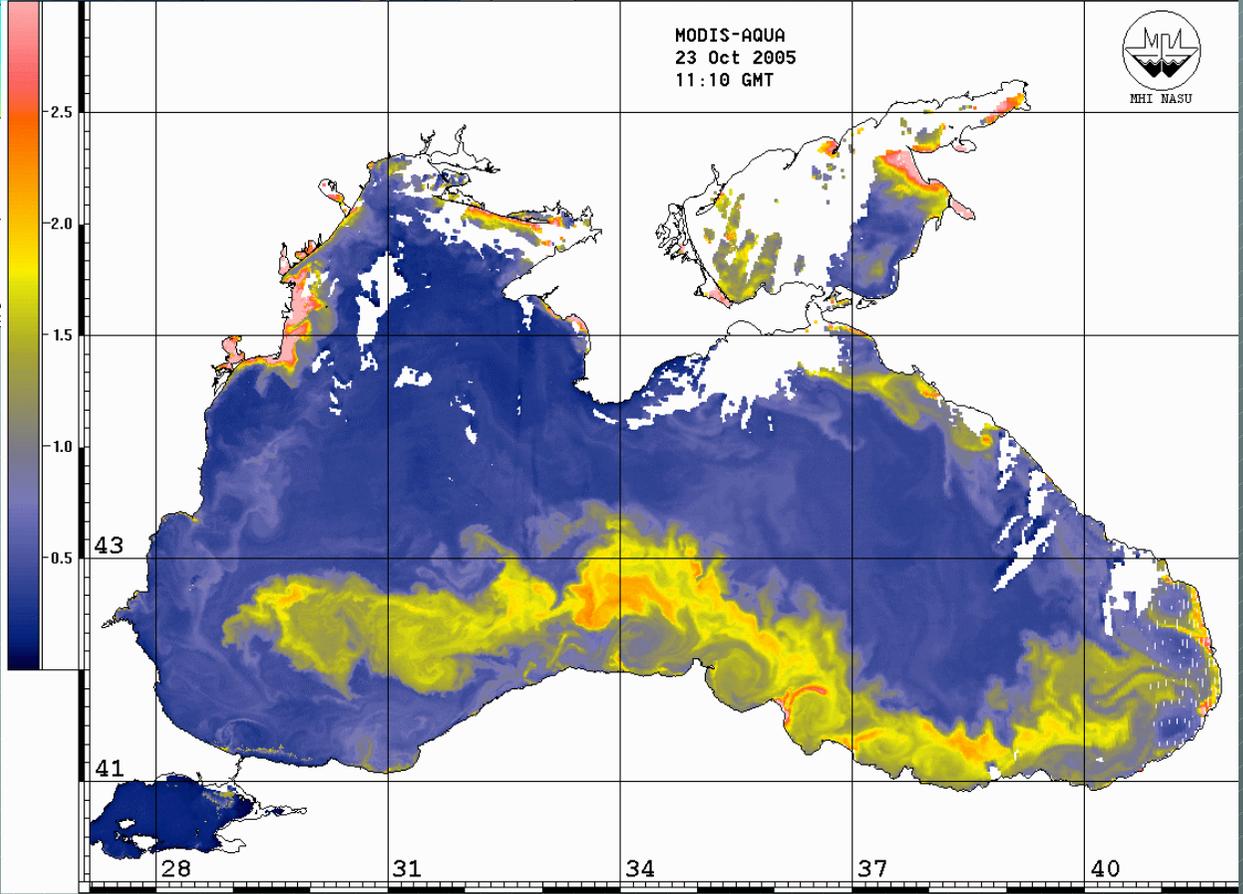
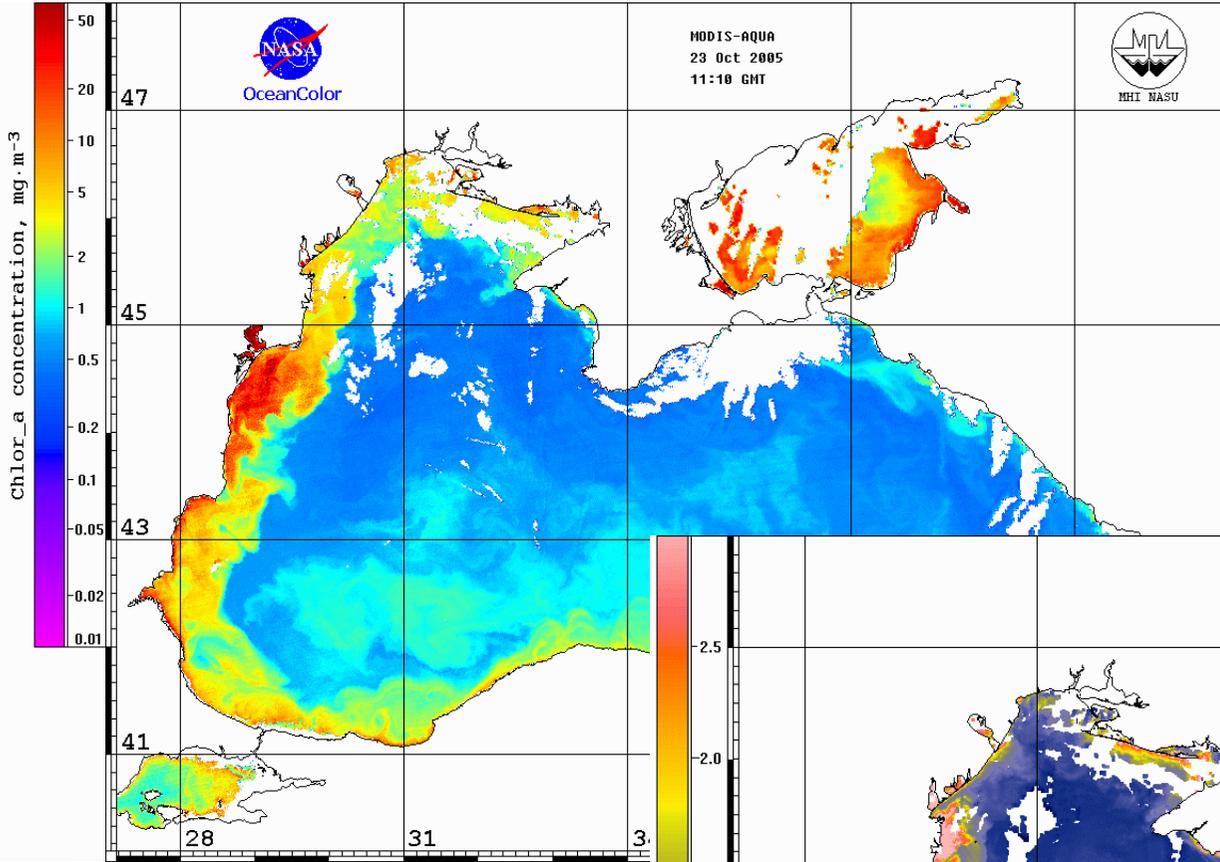
31

34

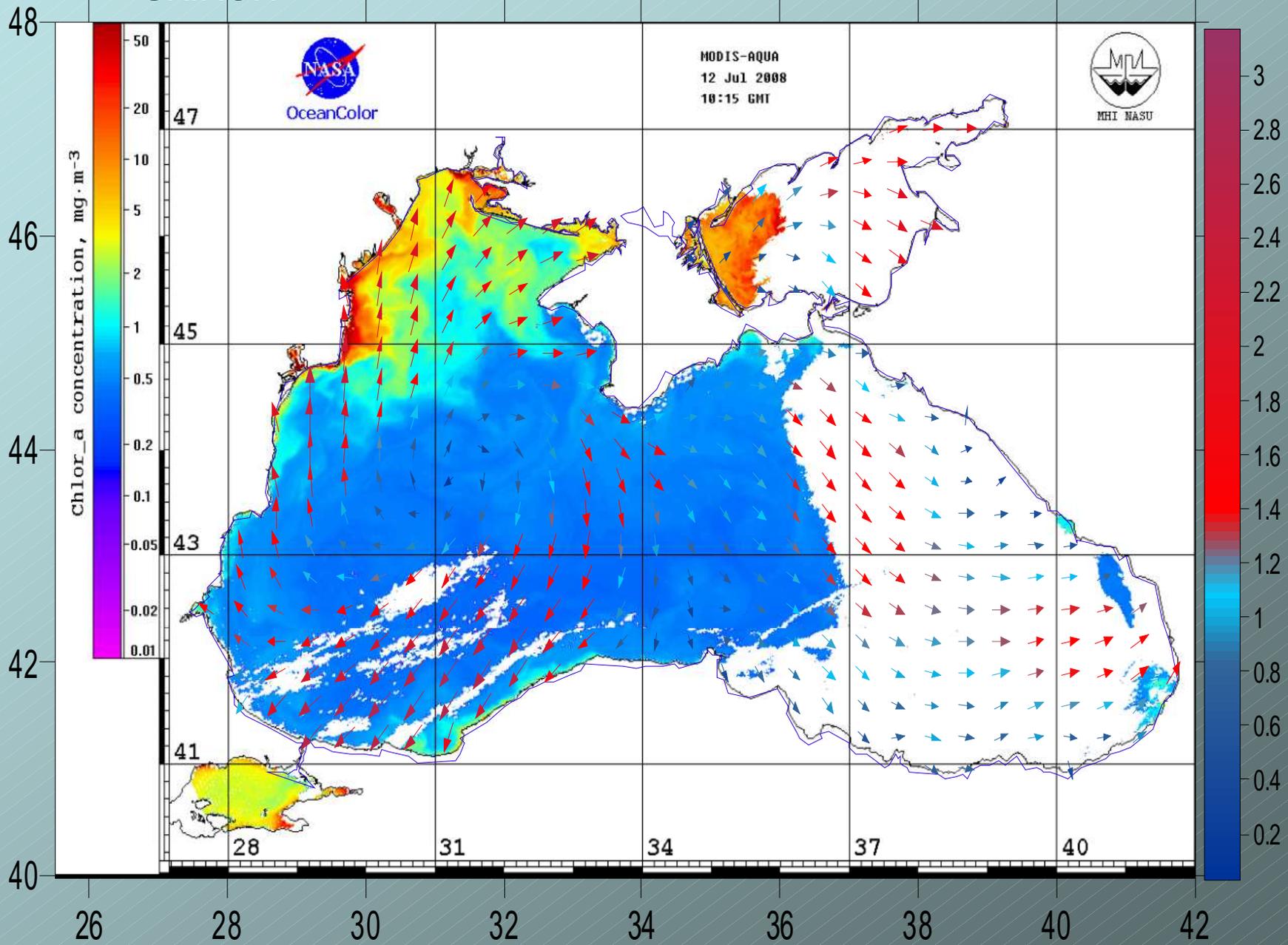
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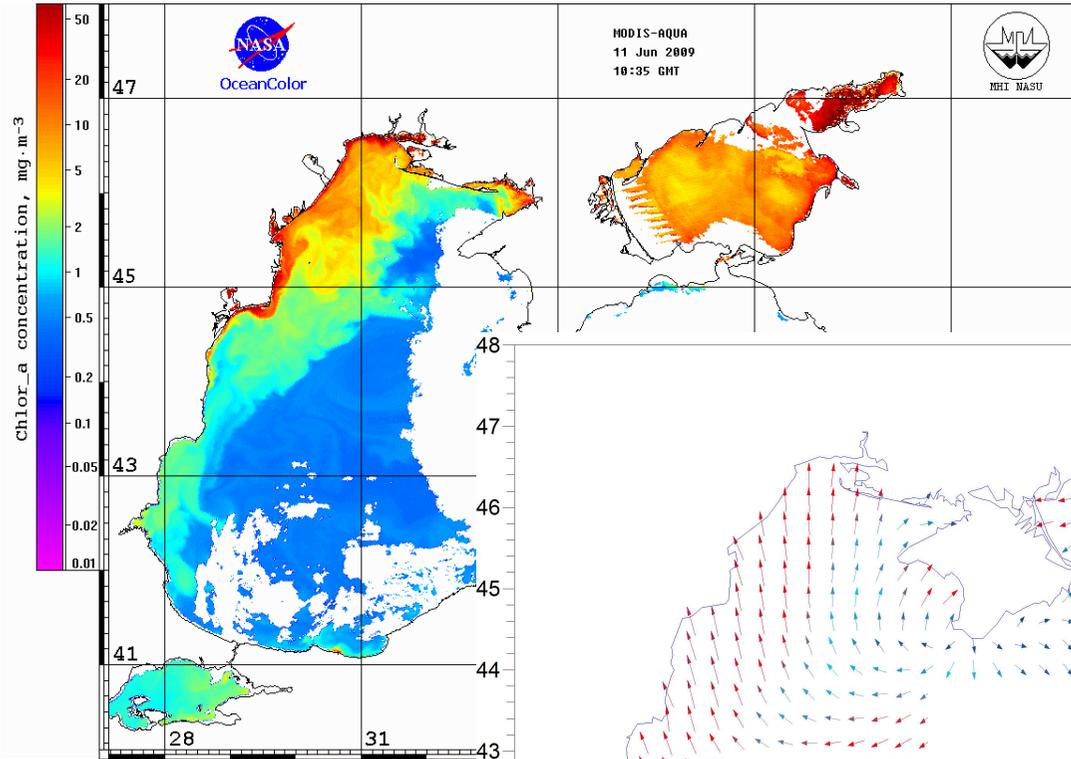
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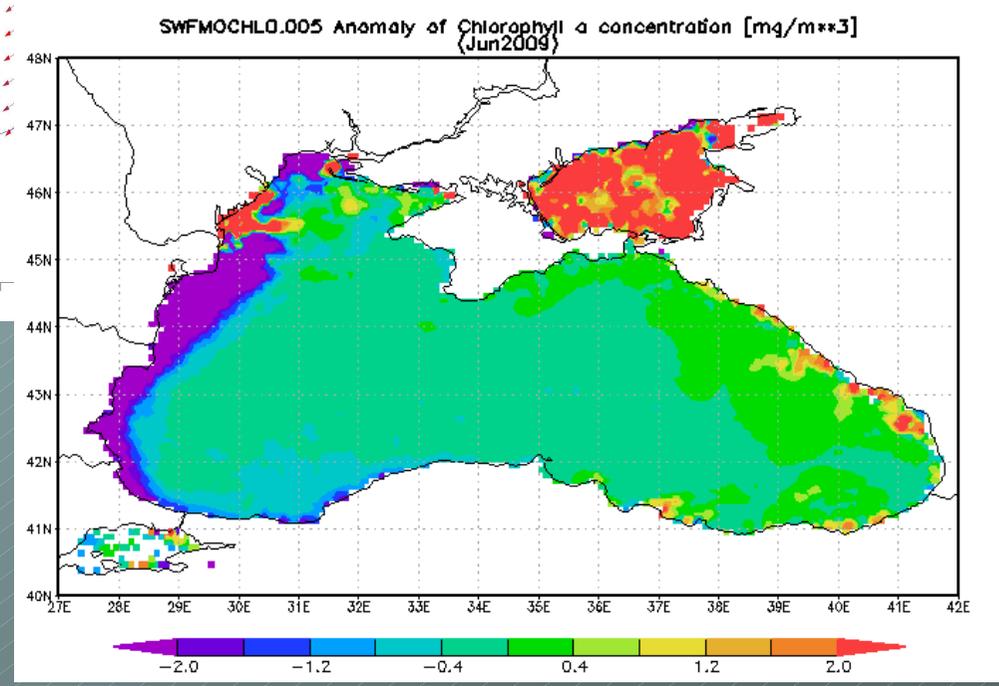
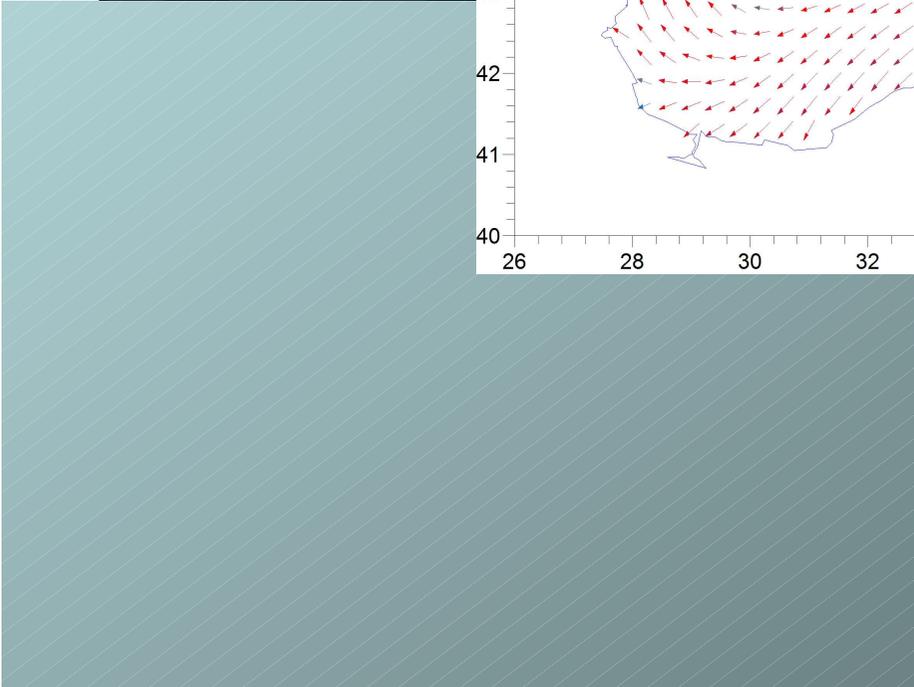
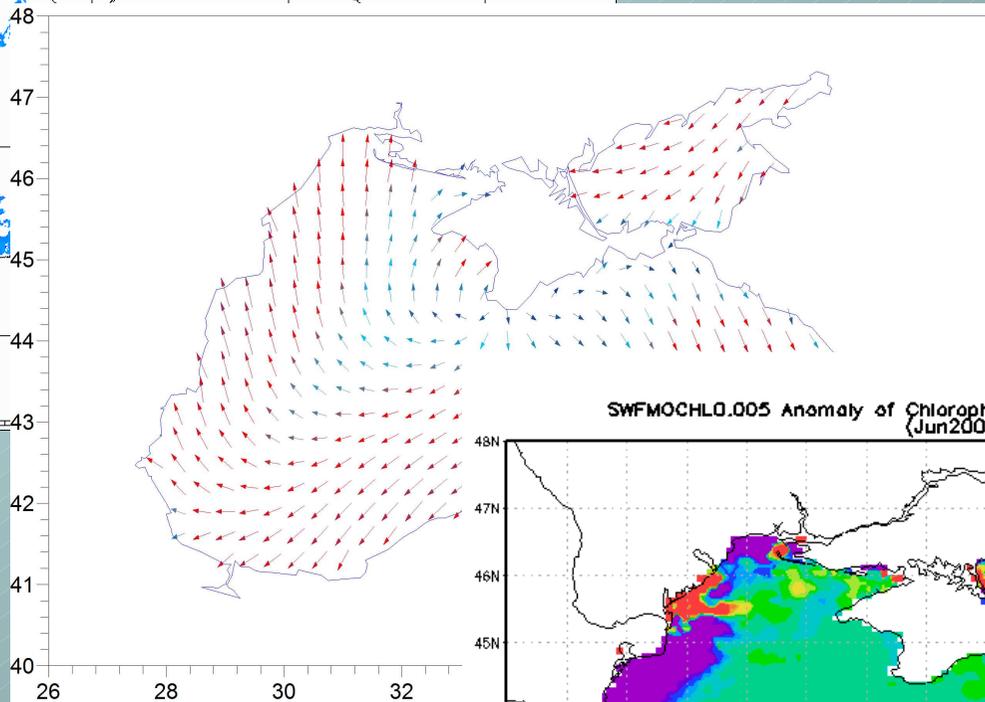


# SKIRON





Июнь 2009,



# Цветение сине-зеленых водорослей

*Nodularia spumigena*

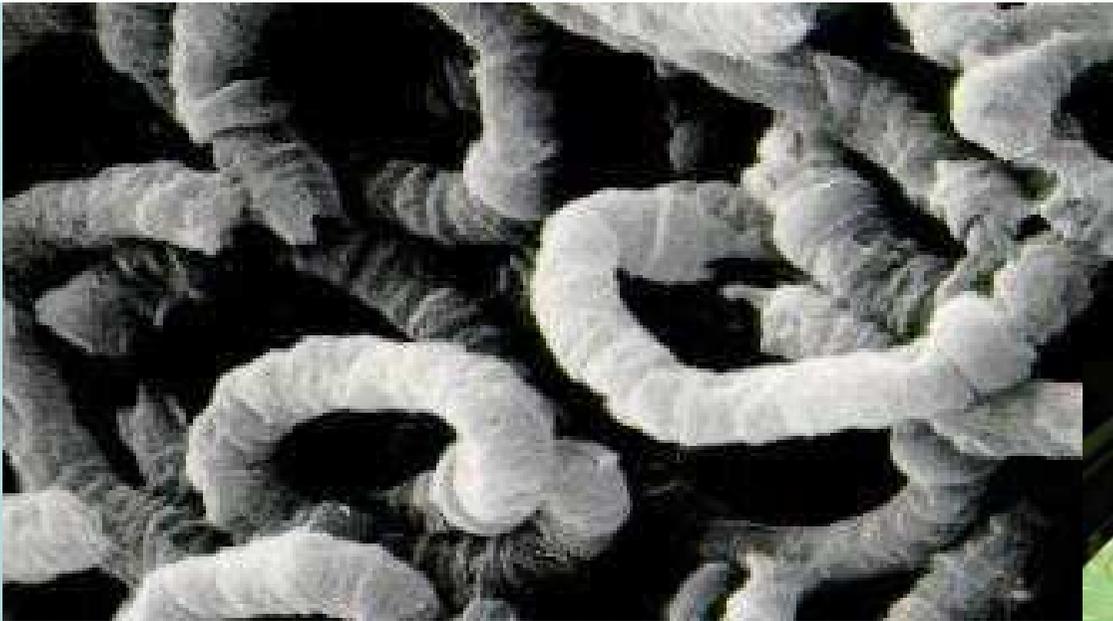
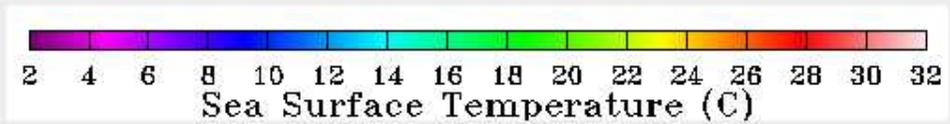
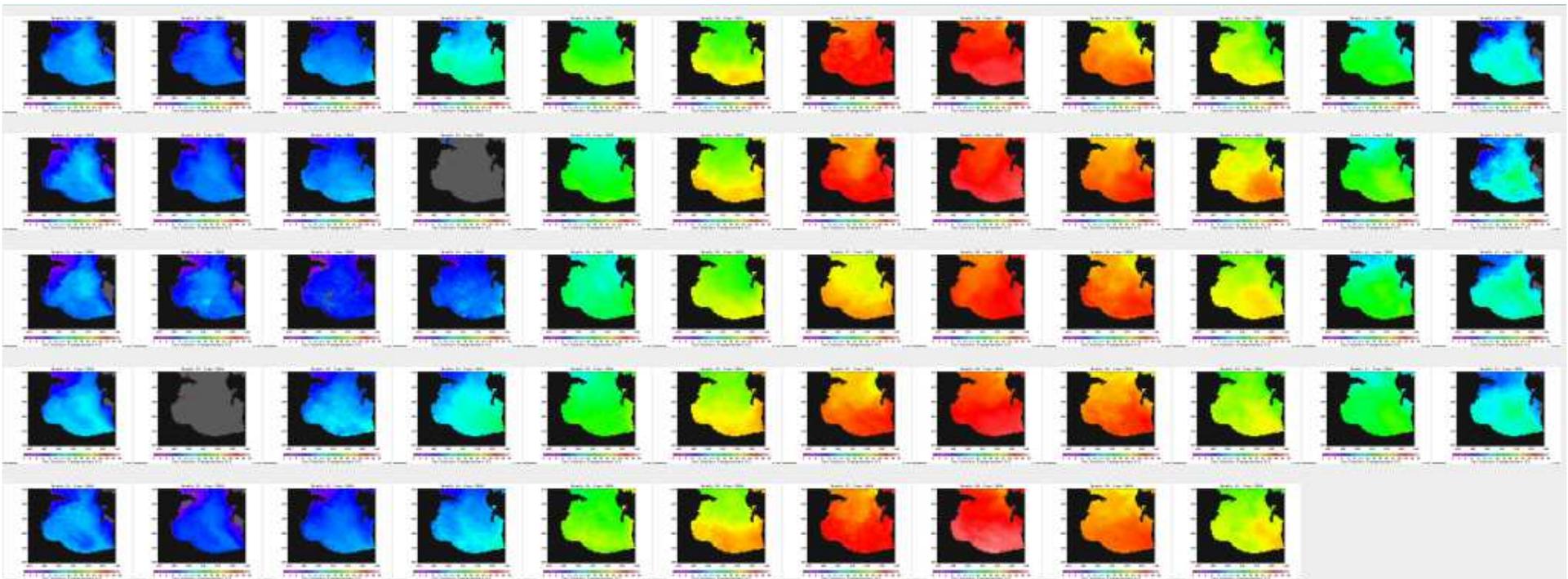


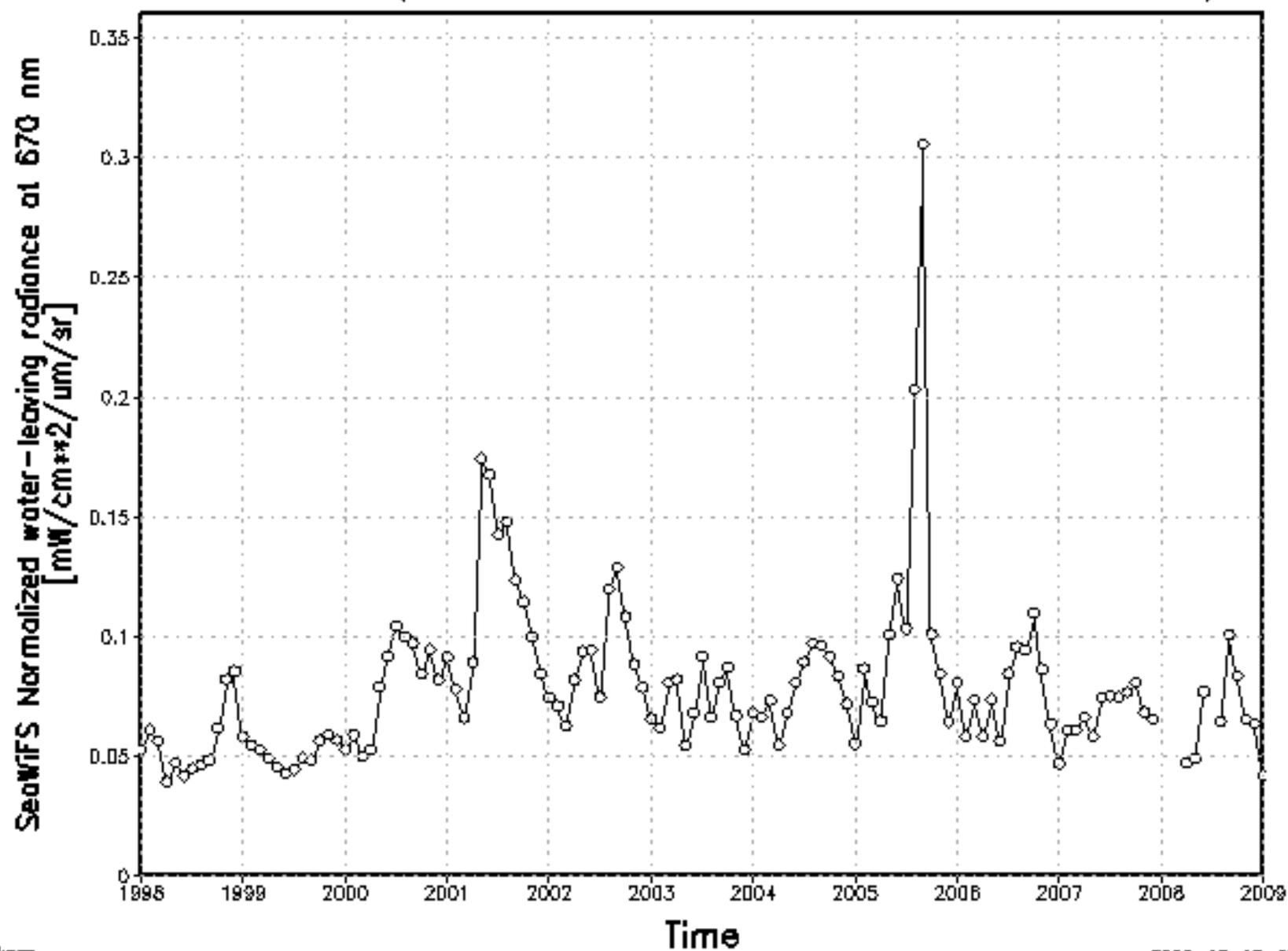
Photo: Pia Moisander



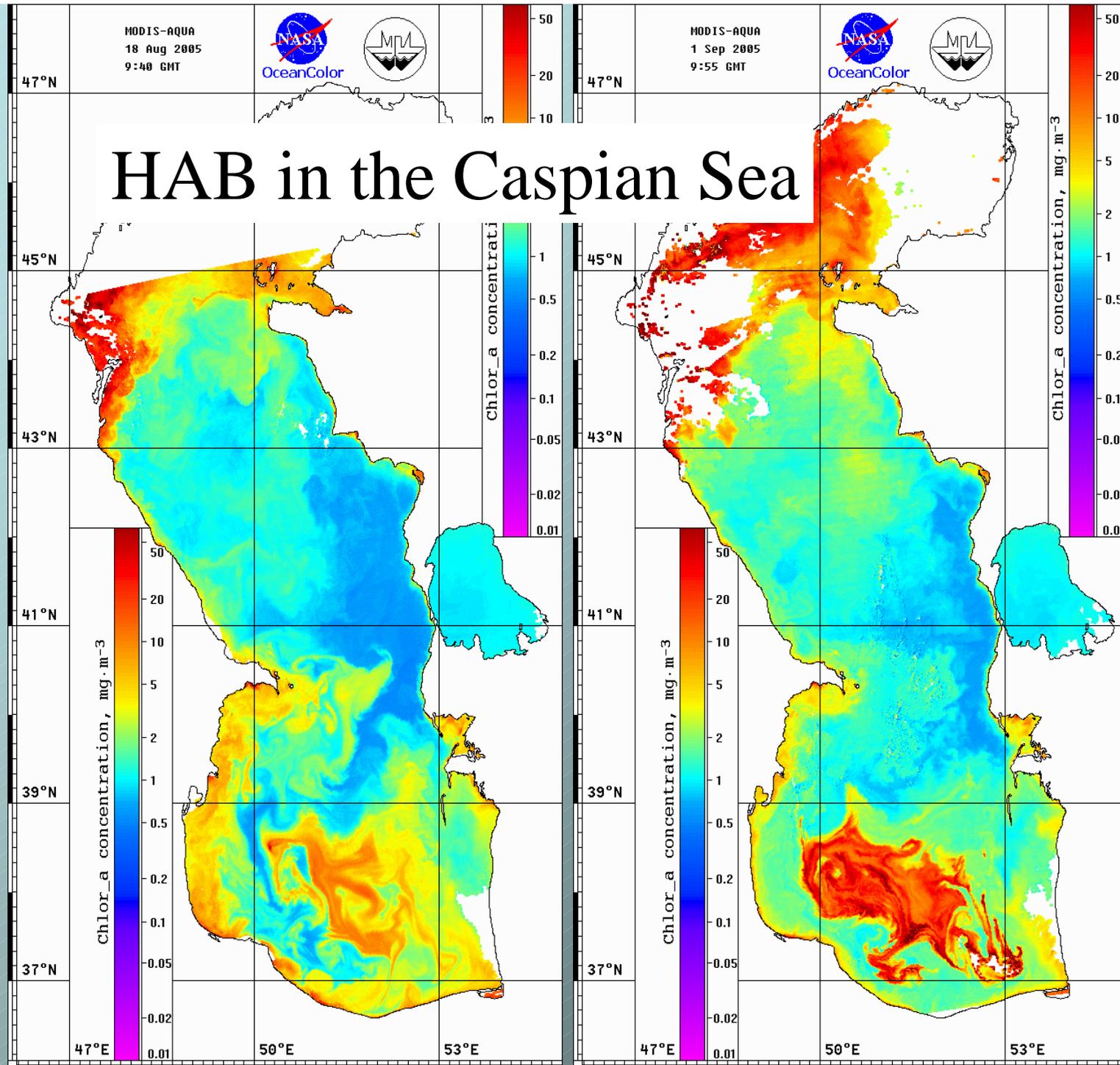


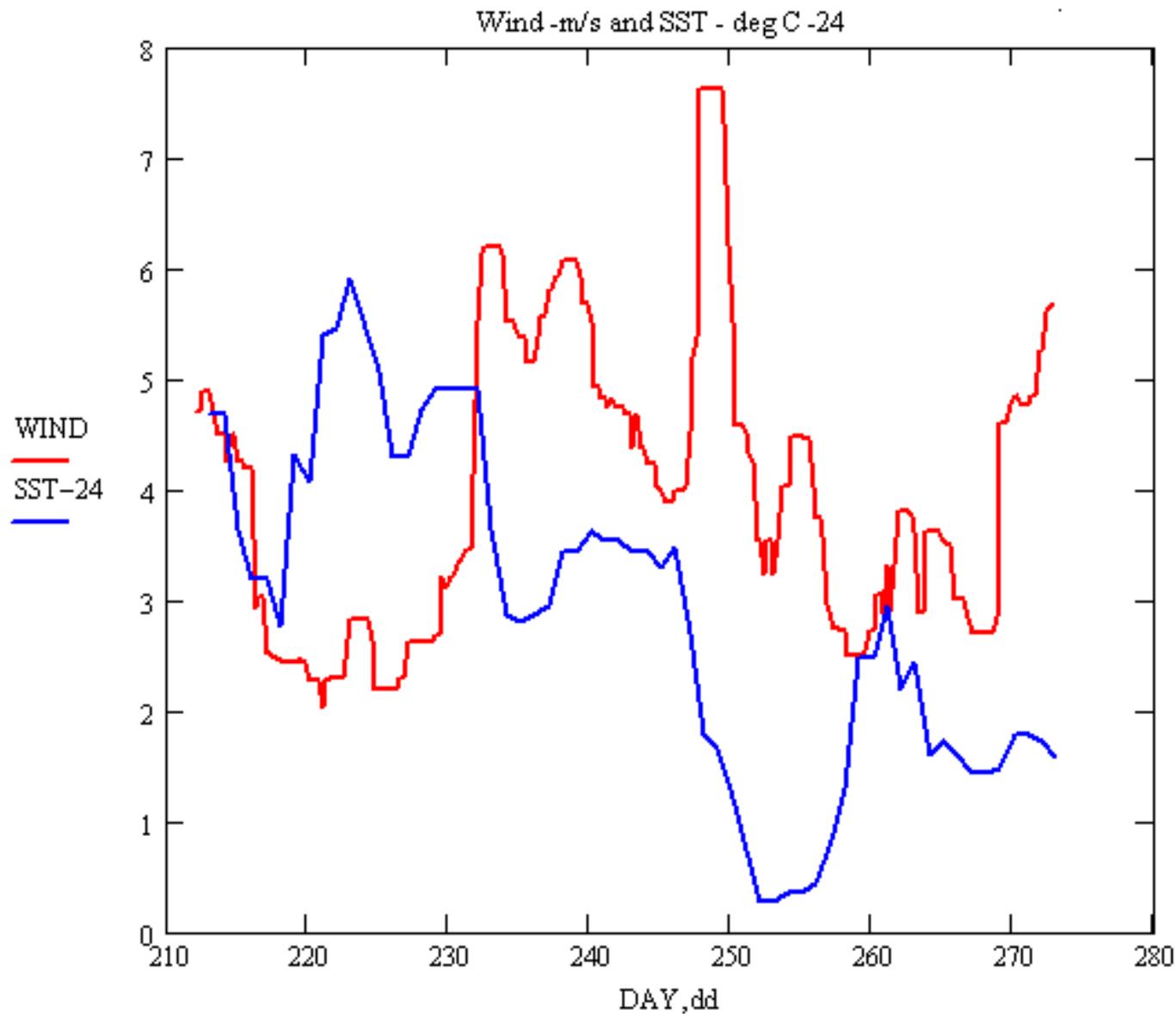
MONTHLY MEAN DAYTIME MODIS SST FROM PODAAC JPL  
COLUMNS – MONTHS JANUARY – DECEMBER  
ROWS - YEARS 2001-2005

For area (Lat: 37.0N–38.0N, Lon: 51.0E–52.0E)

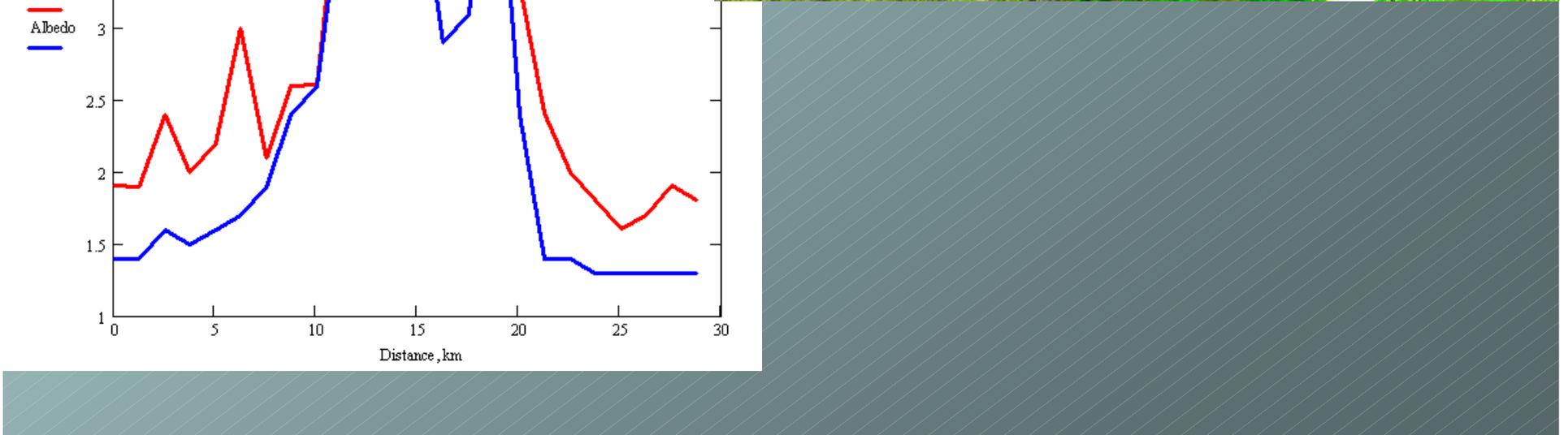
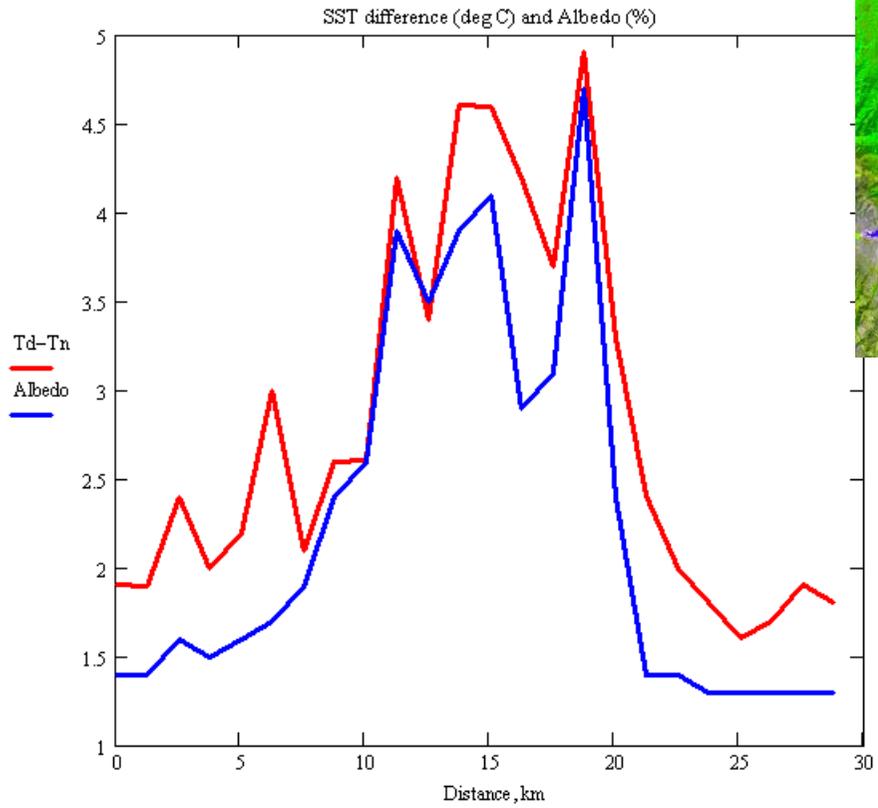
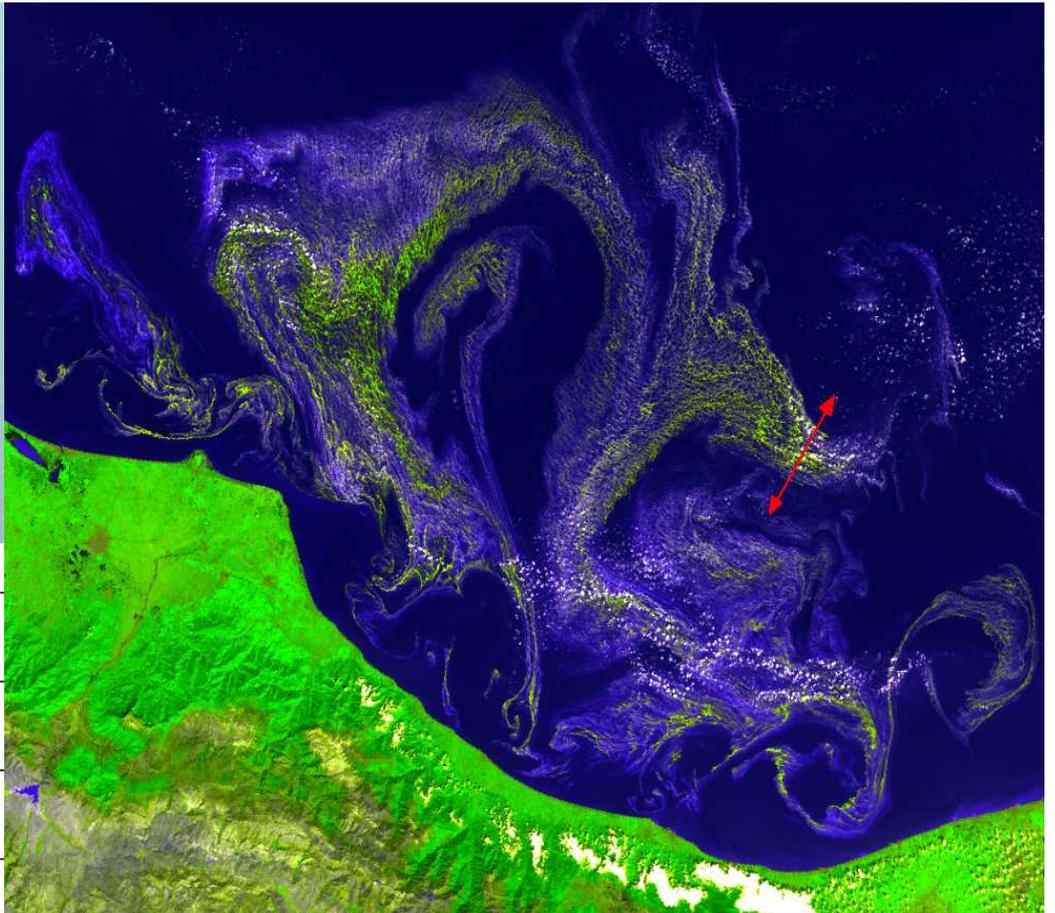


# HAB in the Caspian Sea



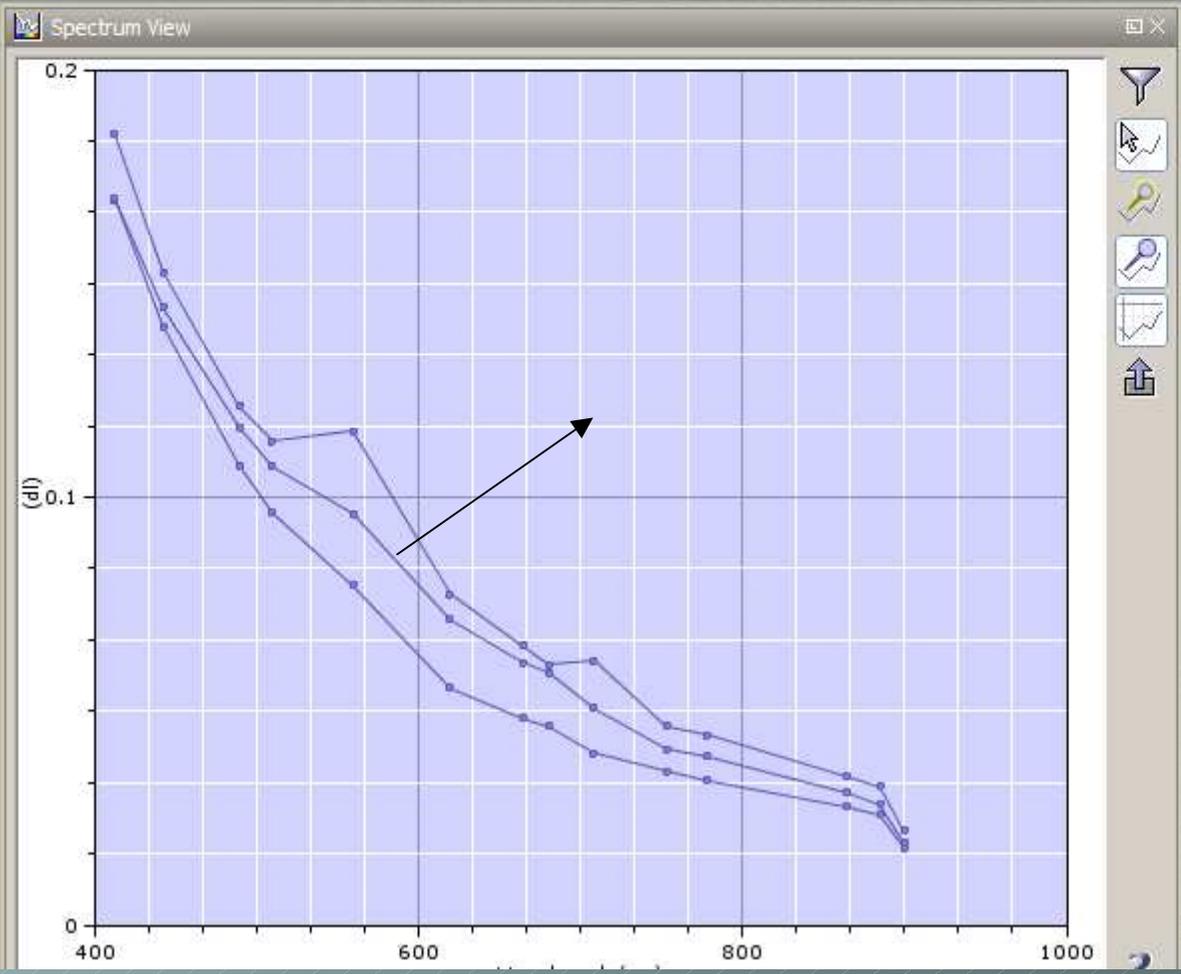
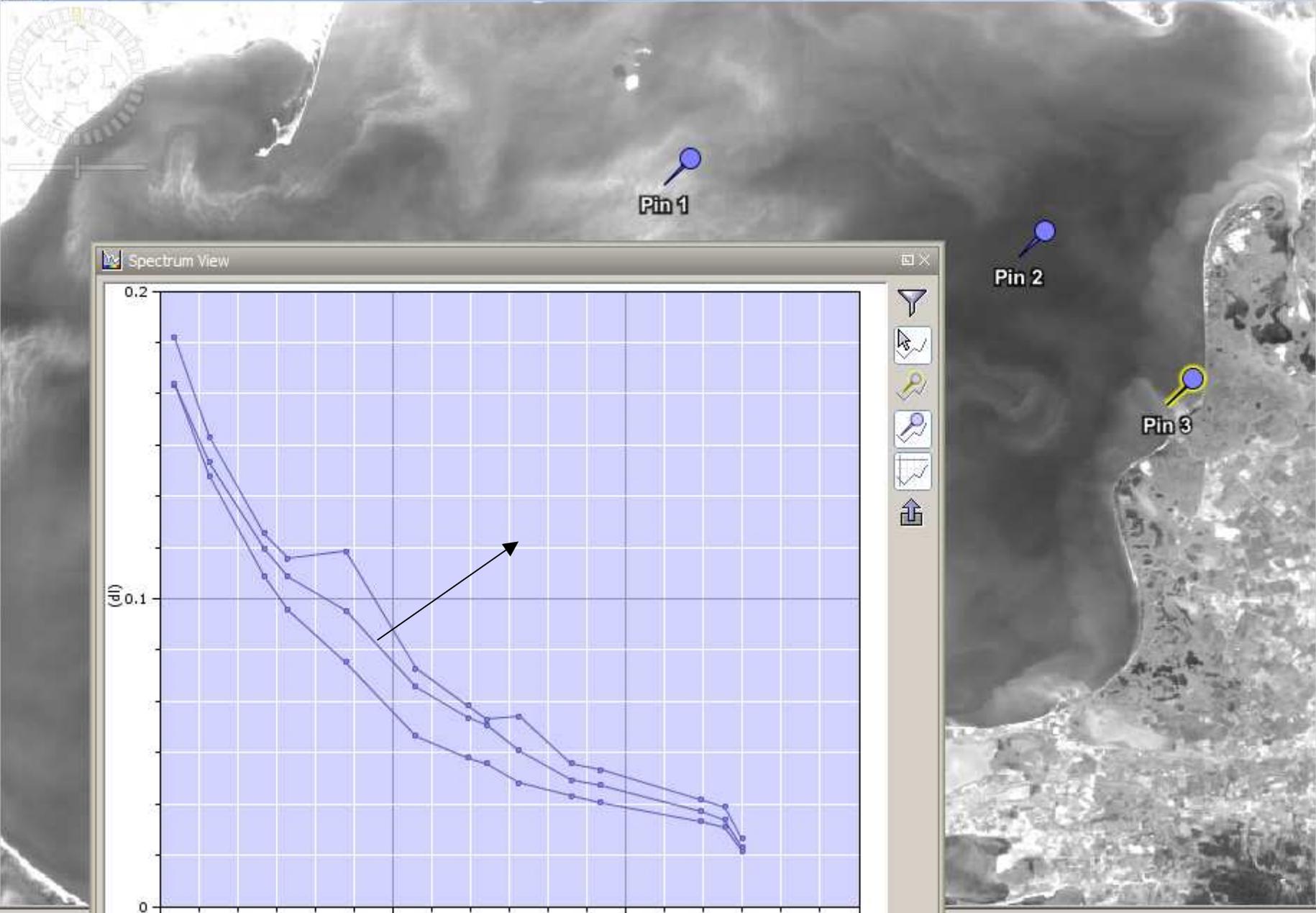


NCEP wind (m/s) and AVHRR SST (deg C – 24) variability for August – September 2005 for the point (51°E, 38°N) versus Julian day of year

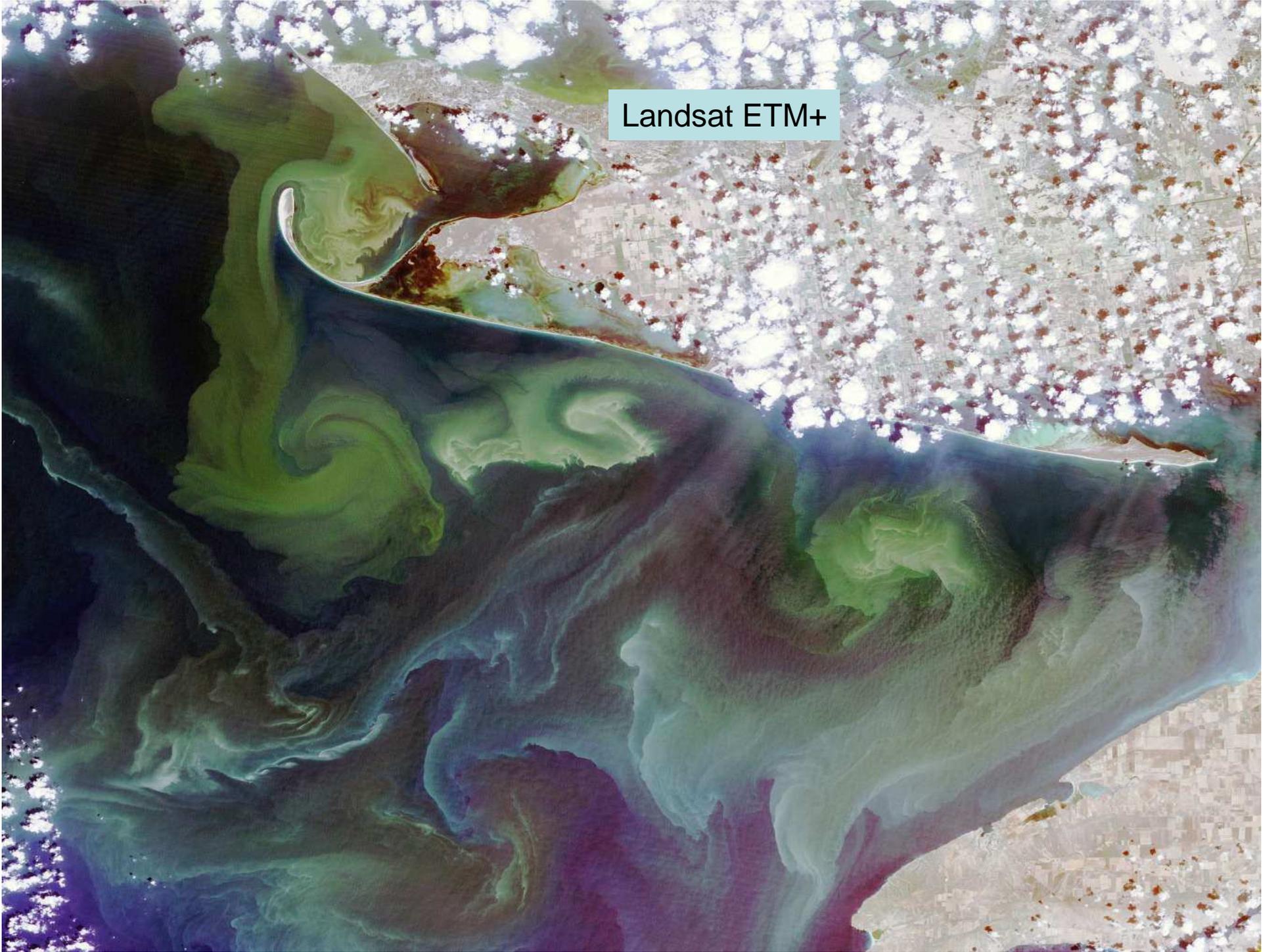


25 июля 2009 Цветение сине-зеленых водорослей



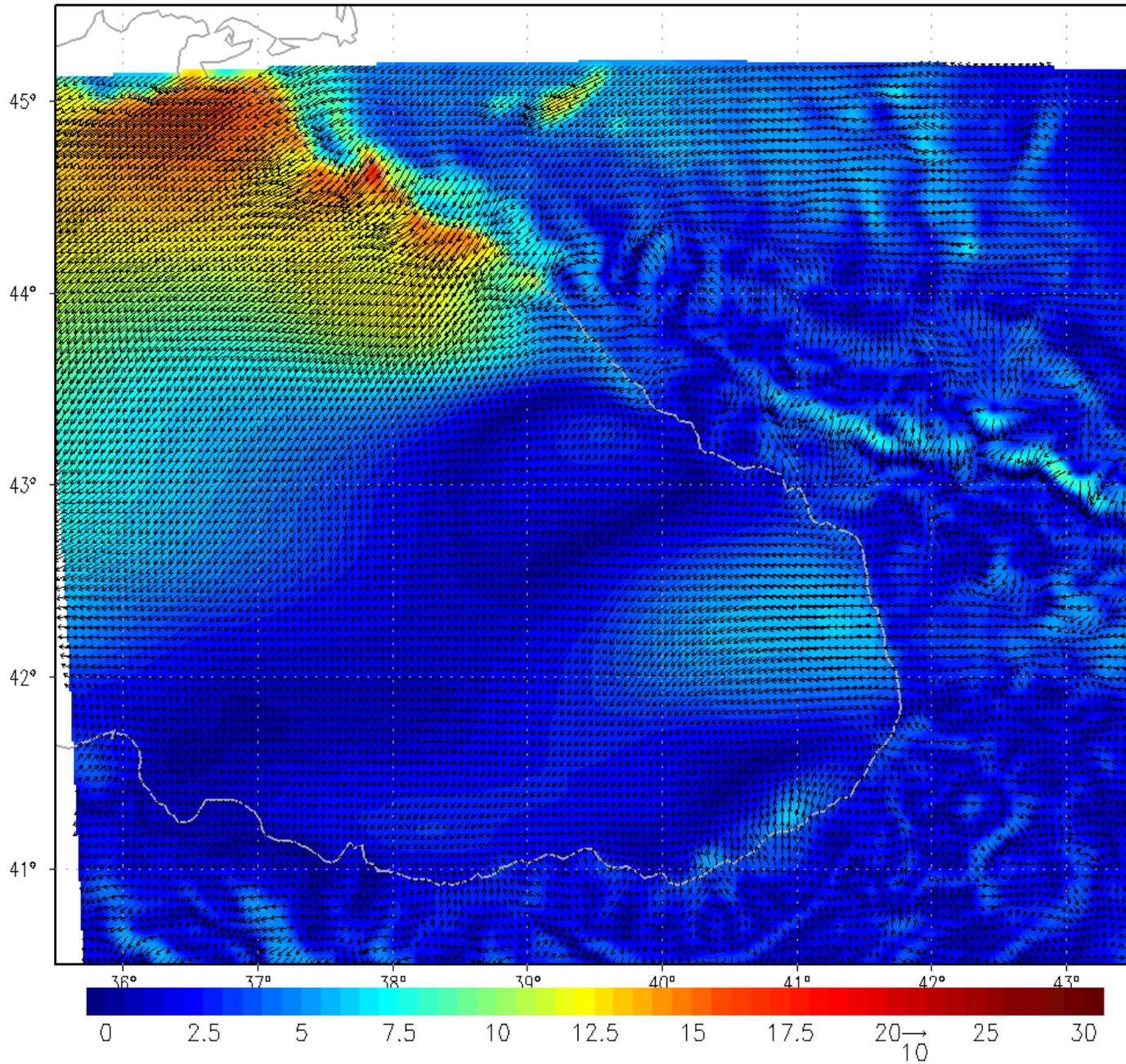


Landsat ETM+



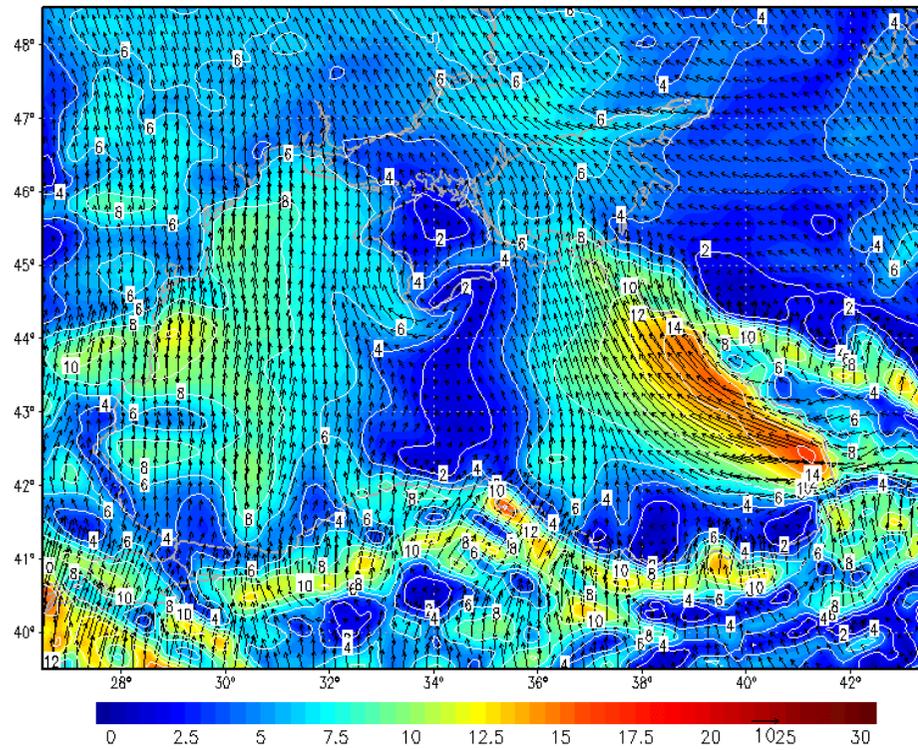


01Z09NOV2008



00Z10JAN2010

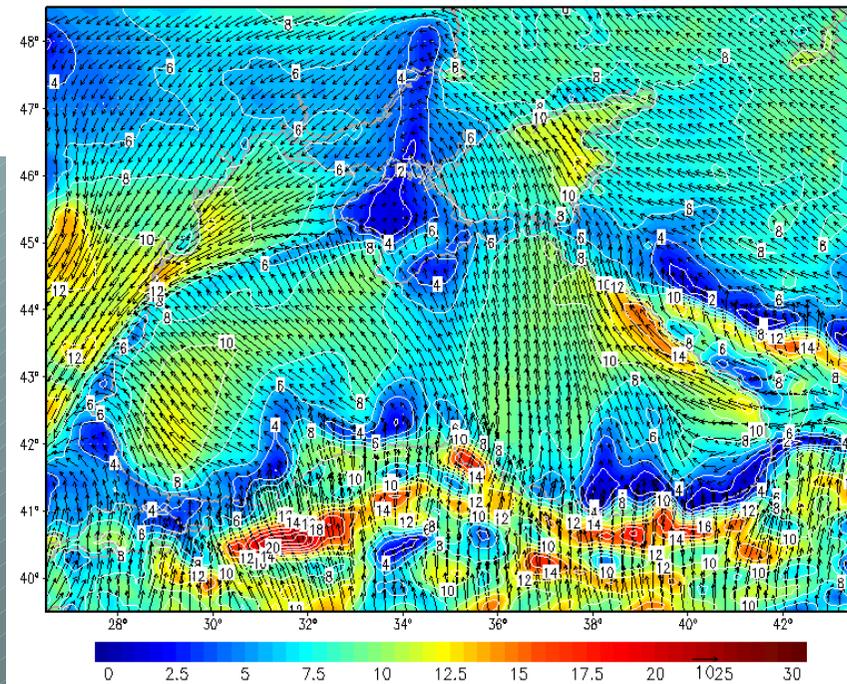
10m wind, m/s

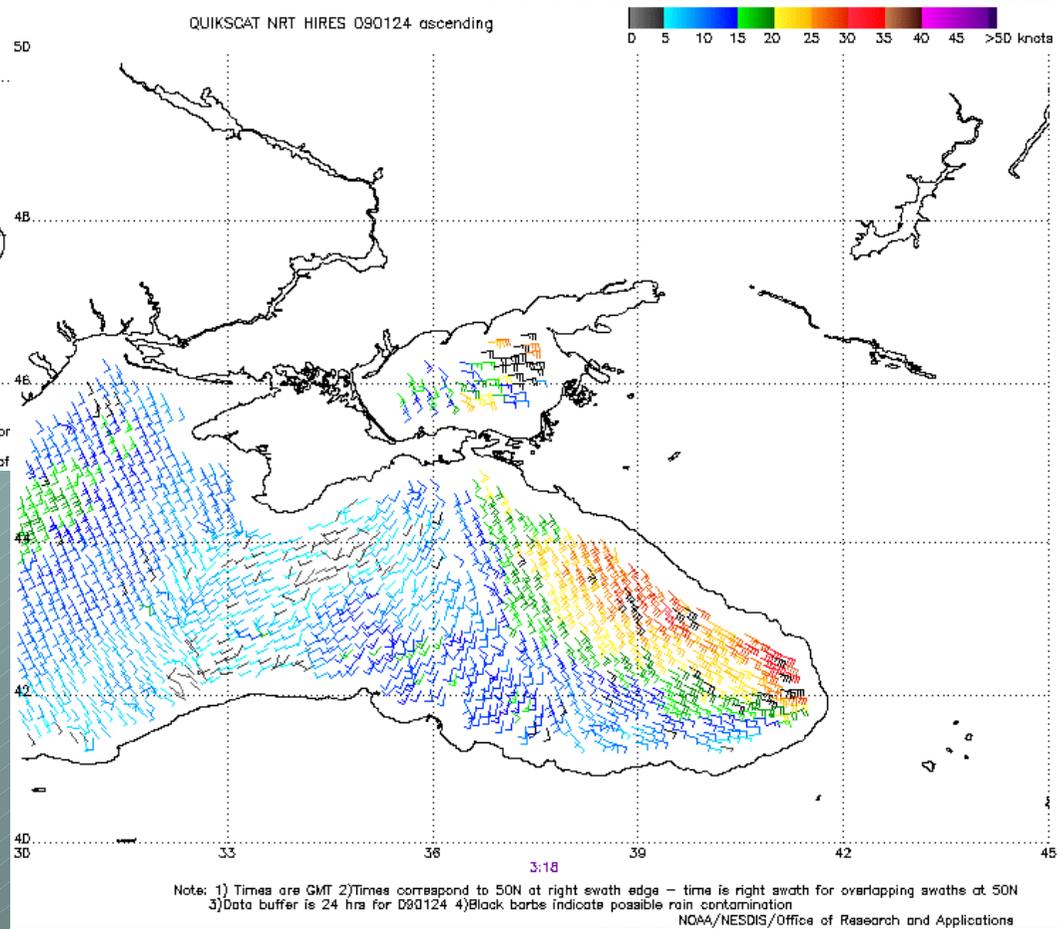
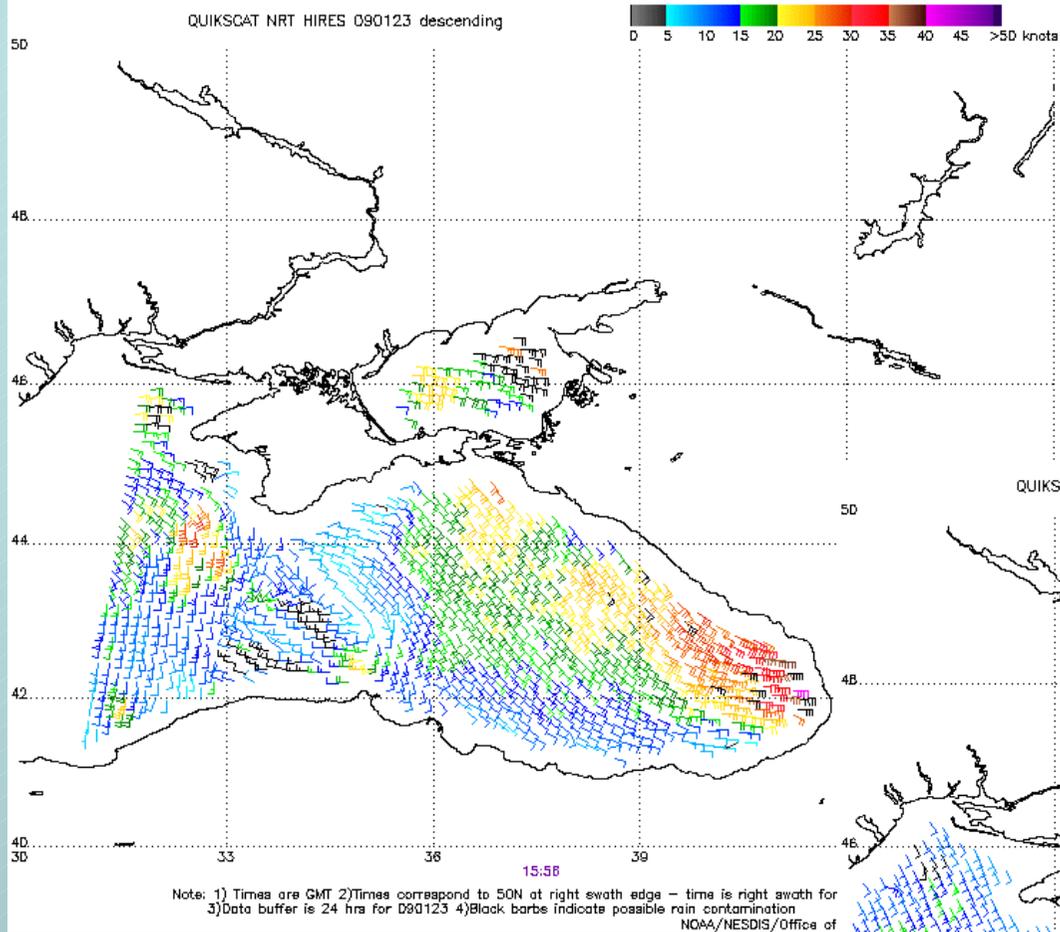


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06Z08FEB2010

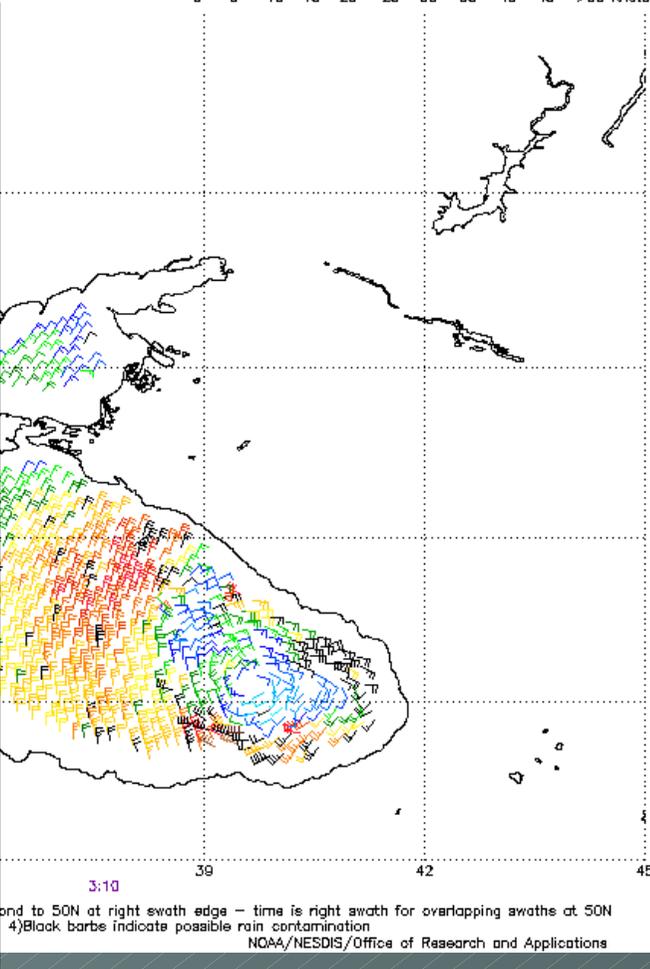
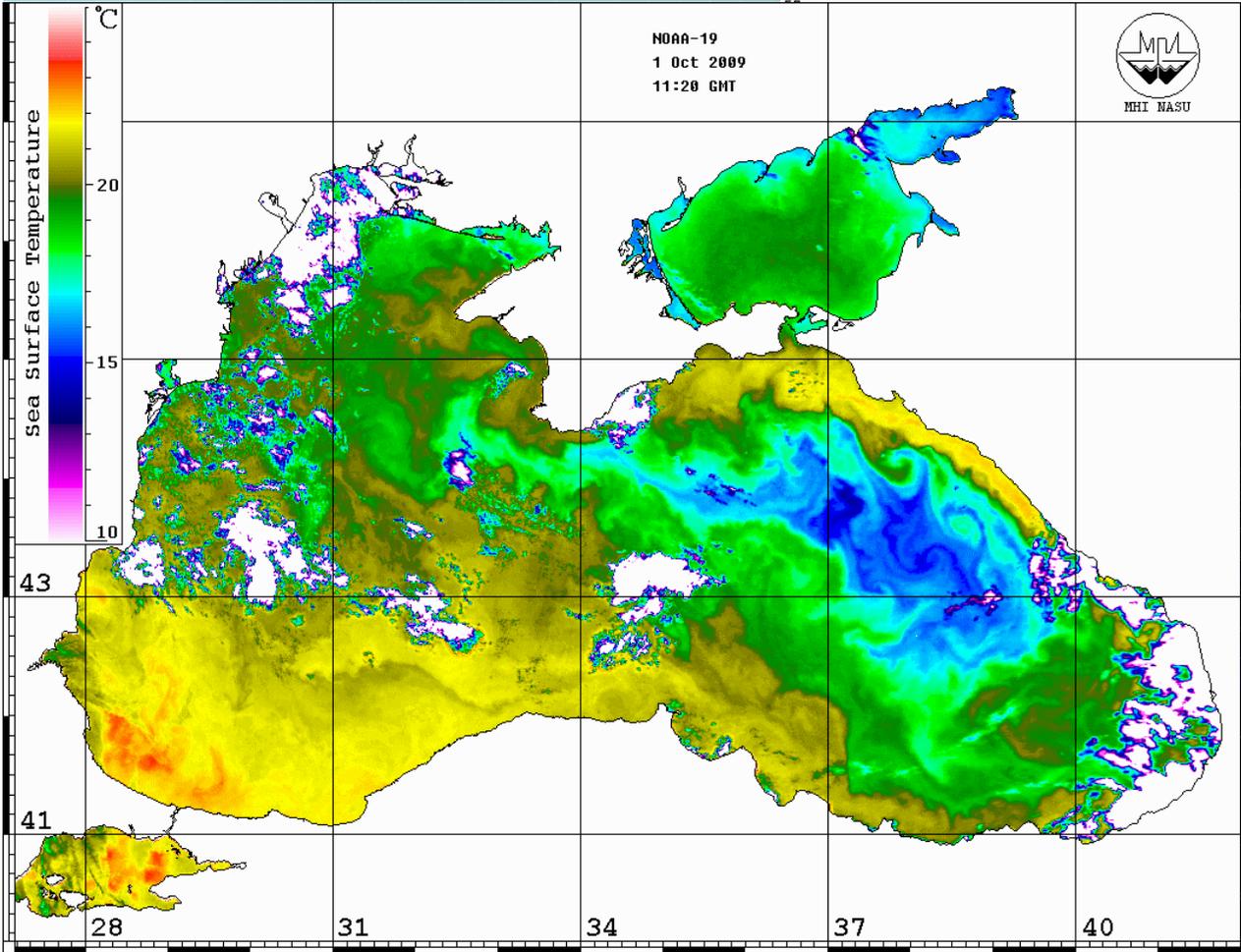
10m wind, m/s



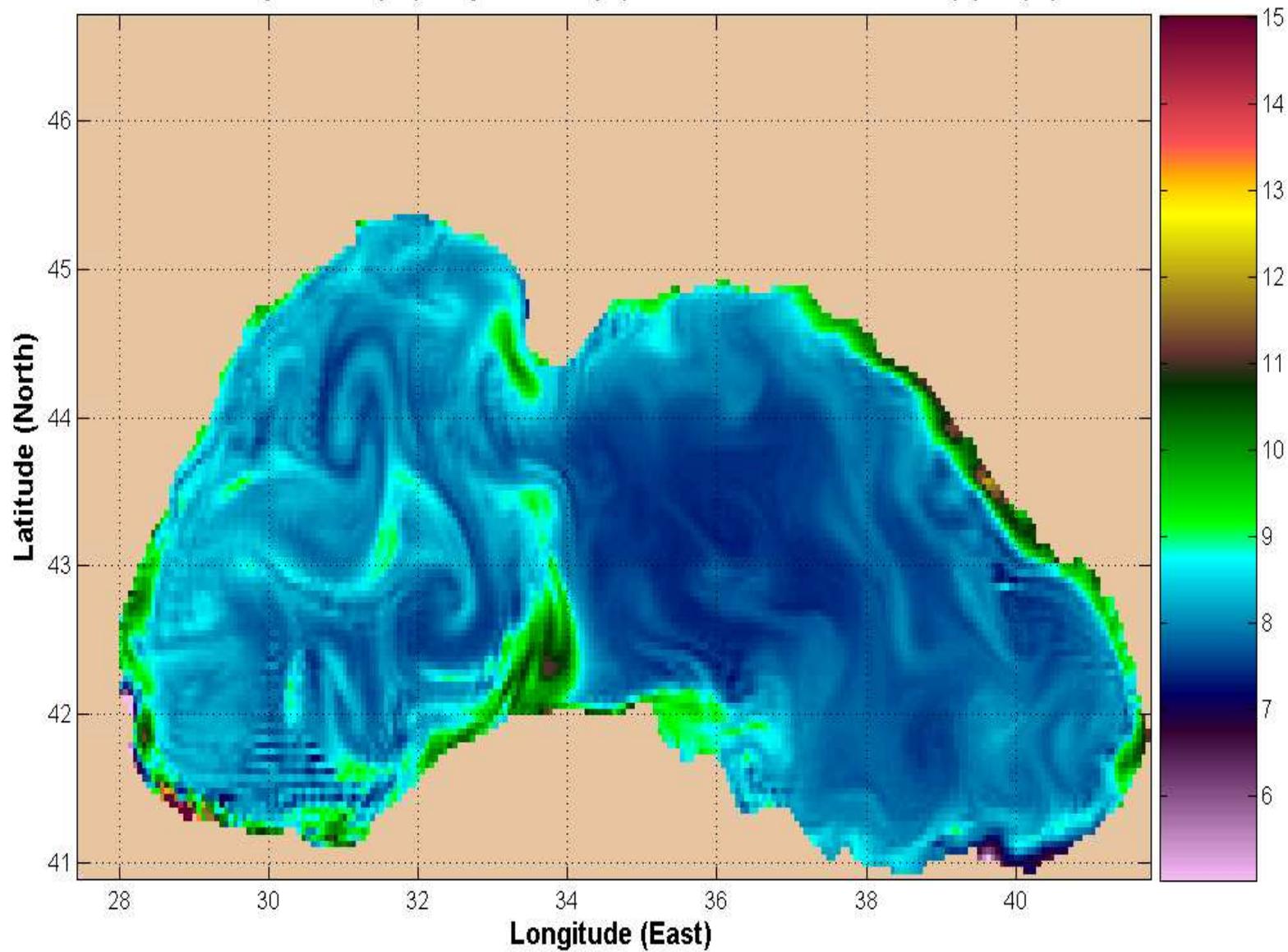


# 2009 September

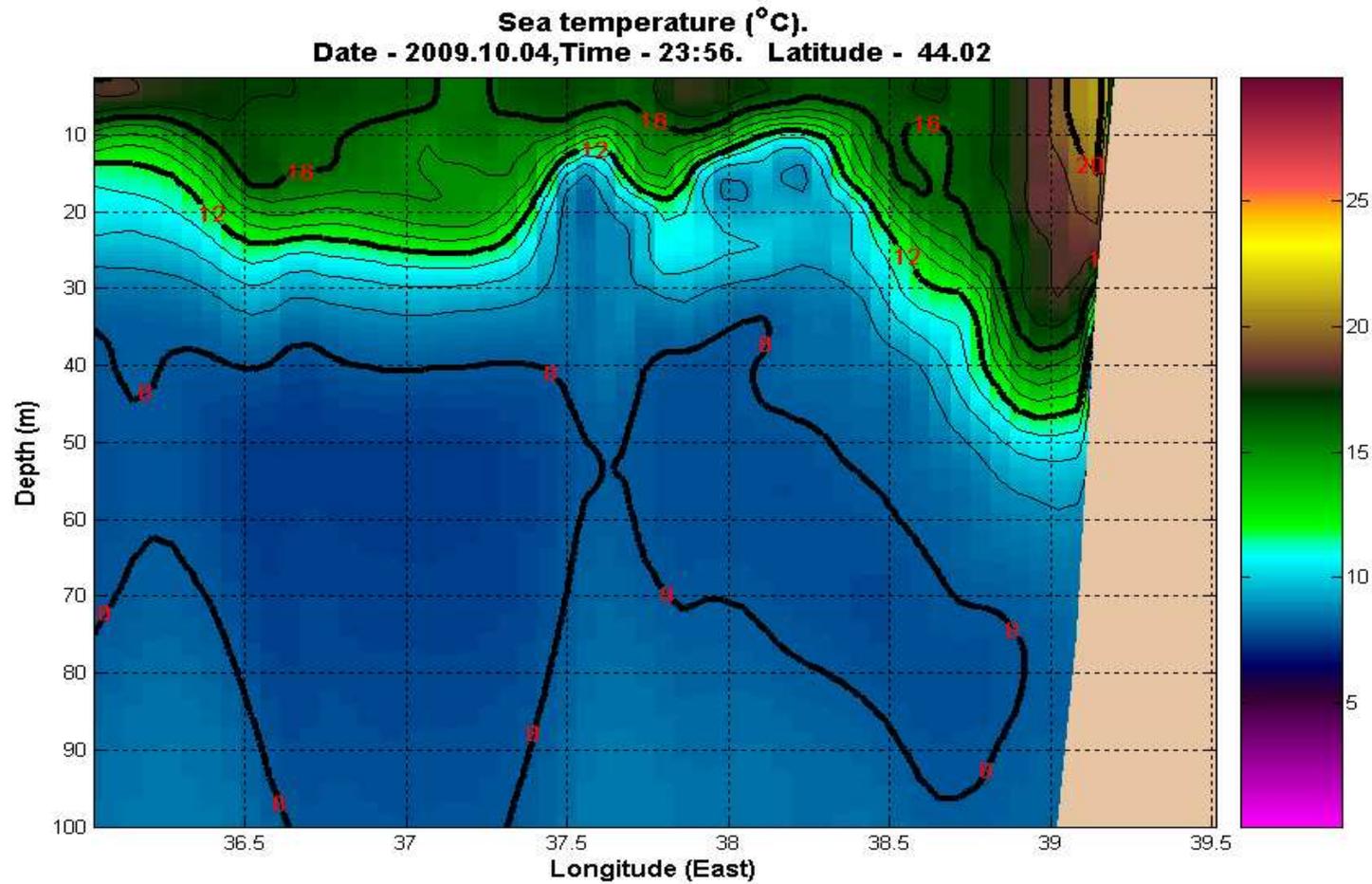
QUIKSCAT NRT HIRES 090928 ascending



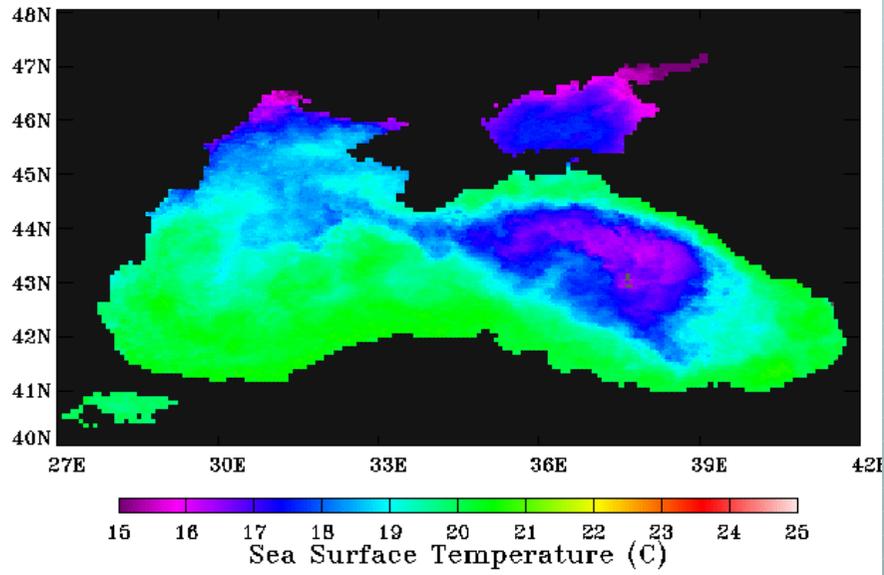
Sea temperature (°C). Depth= 50.0 (m). Date 2009.10.04. Time 00(h):00(m)



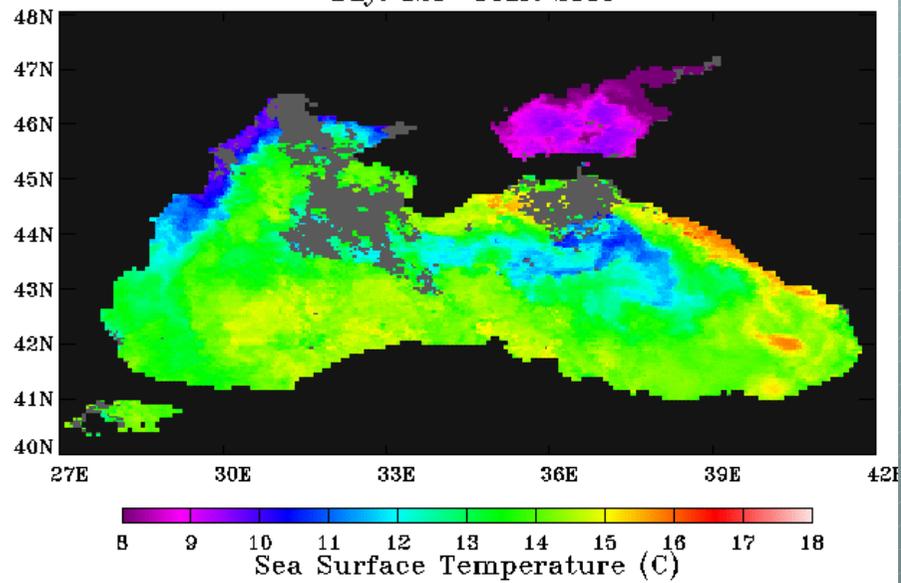
# Temperature cross section 44N, MODEL MHI



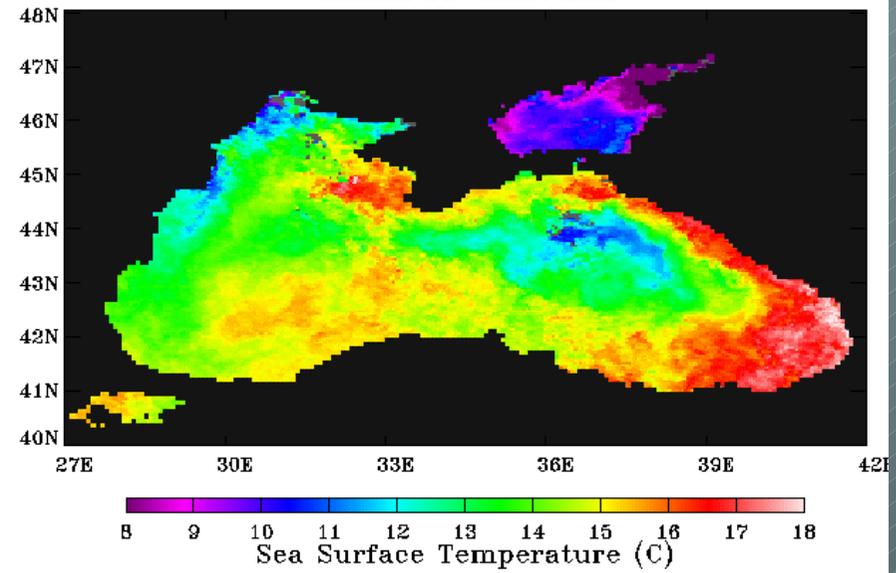
Month: 10 Year: 2009

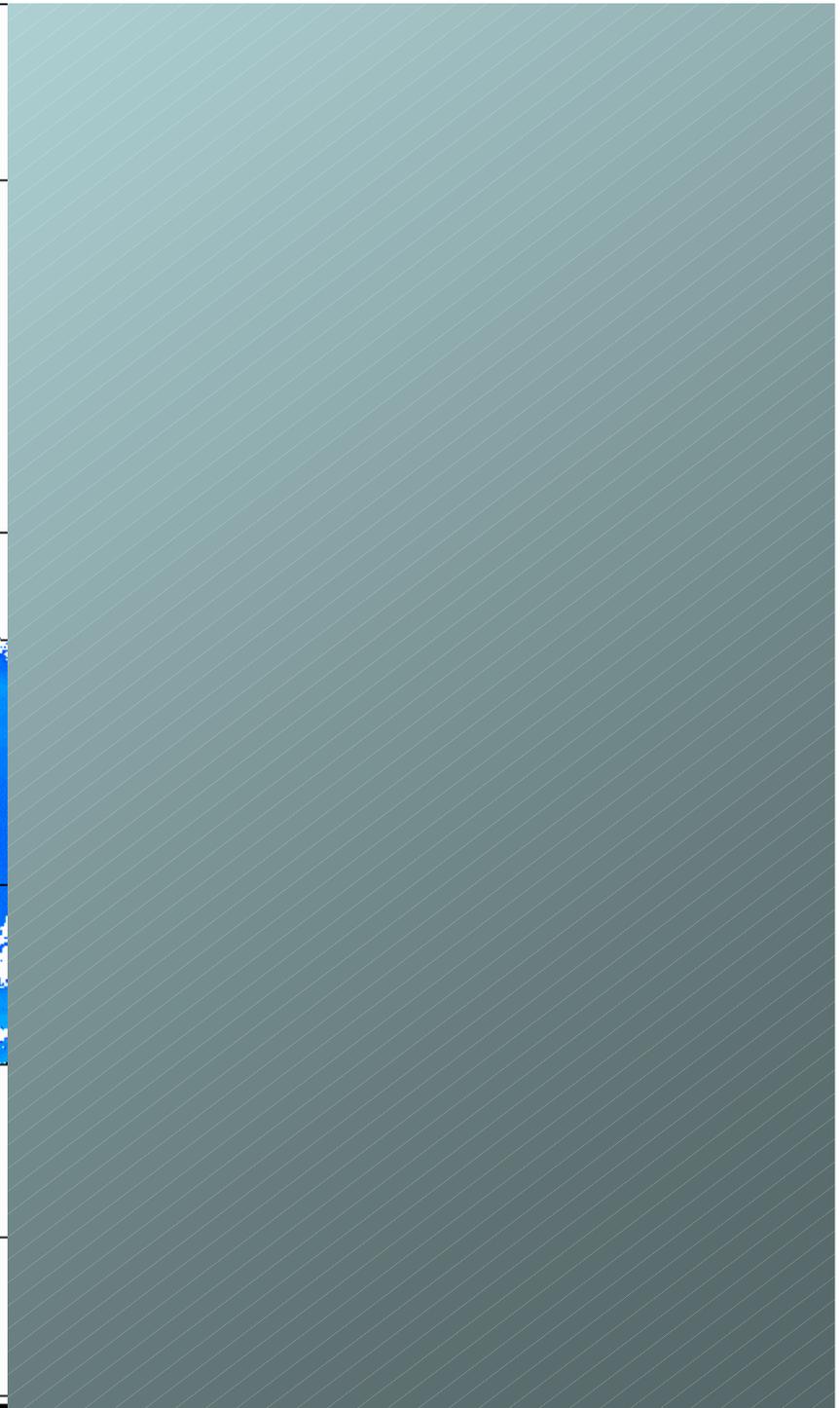
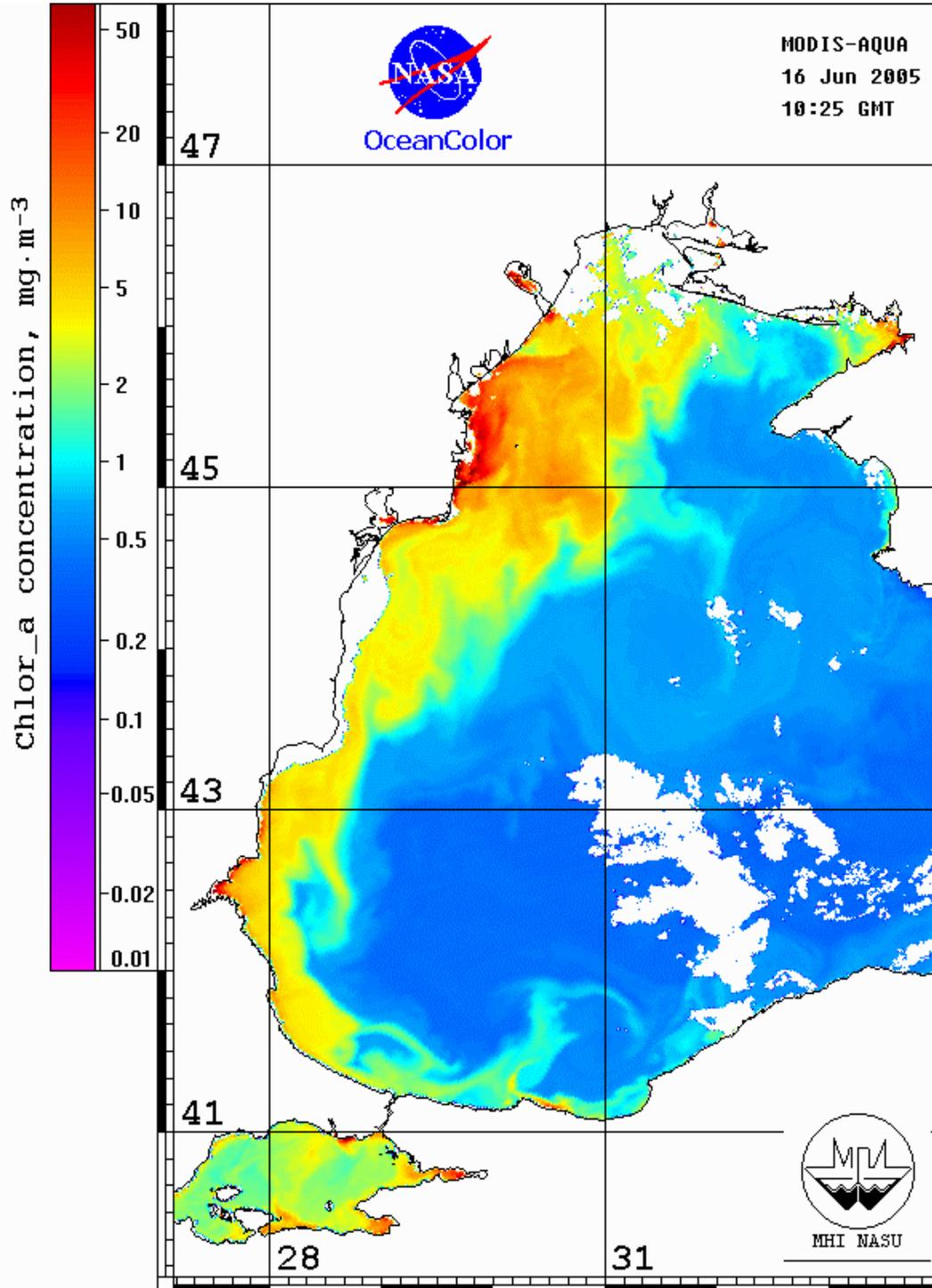


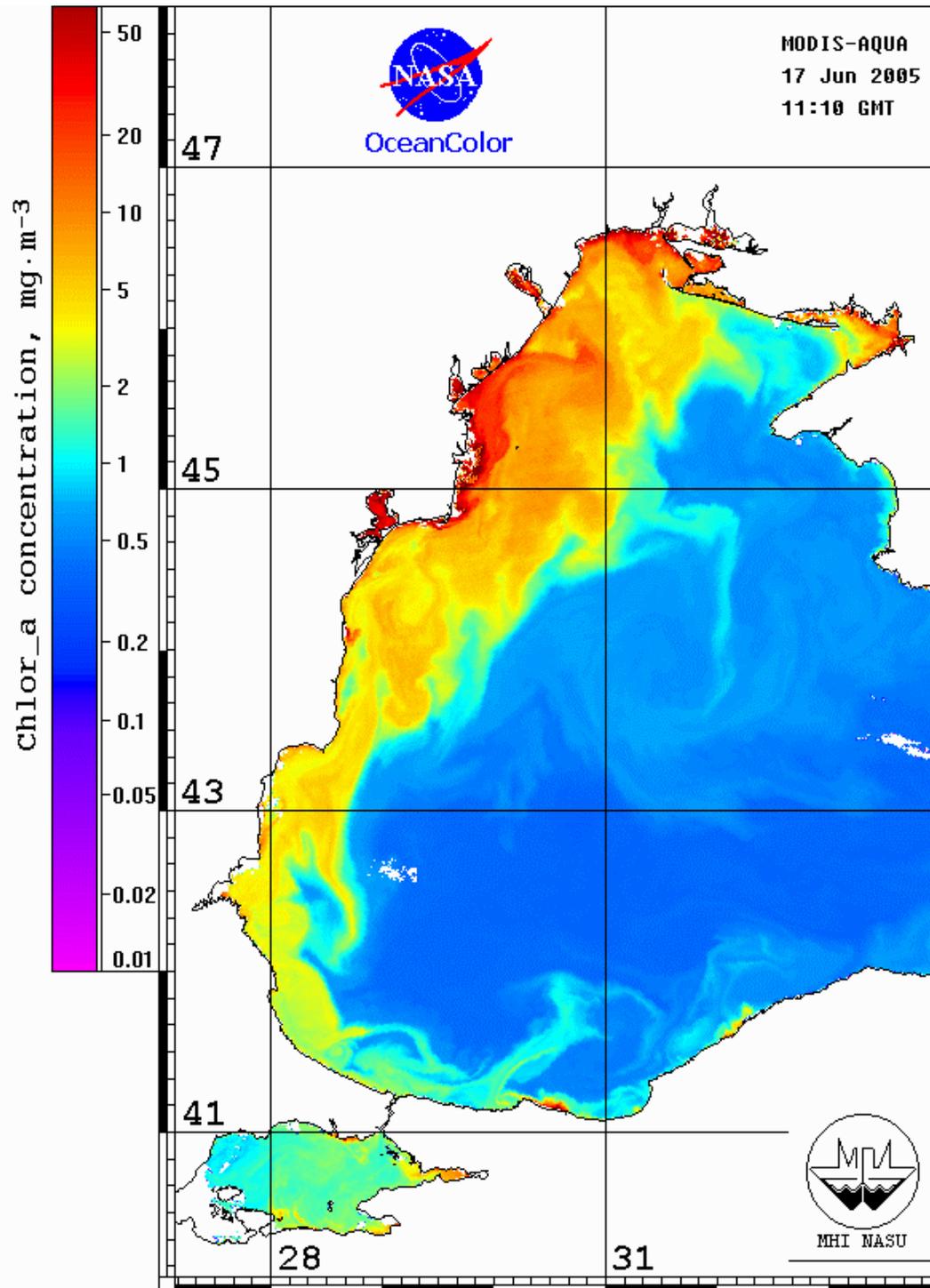
Day: 329 Year: 2009



Month: 11 Year: 2009







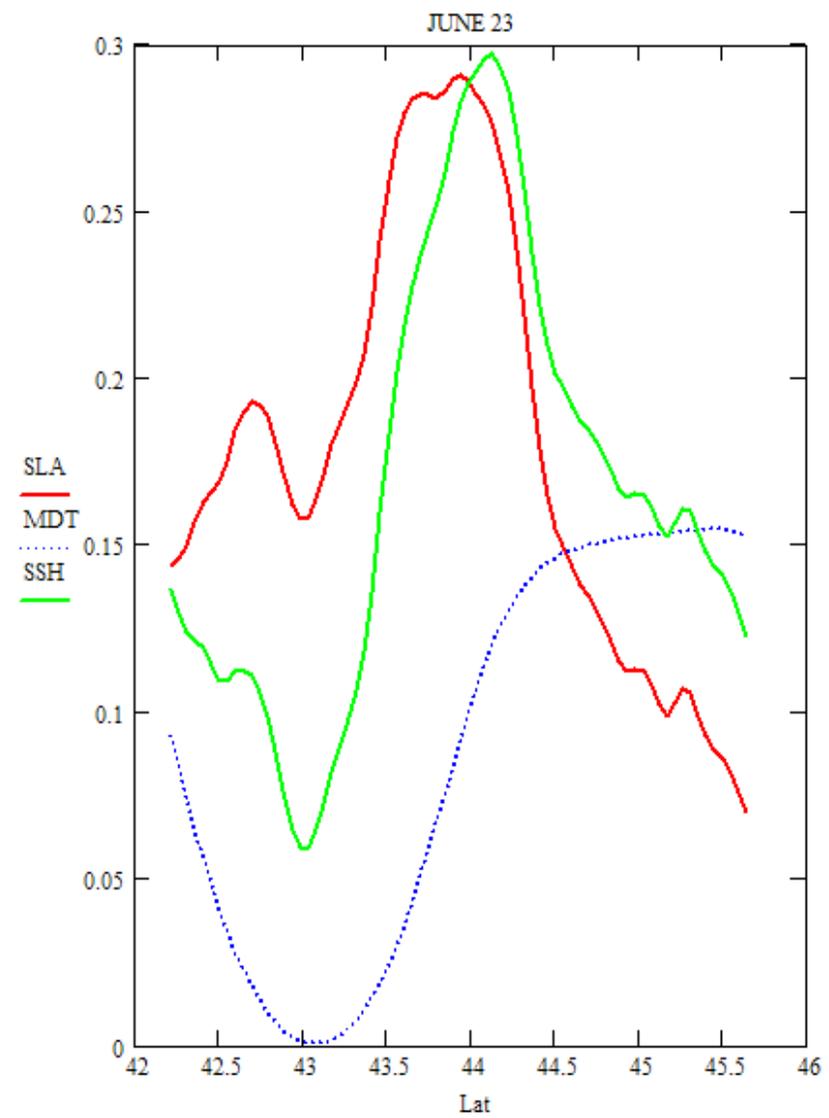
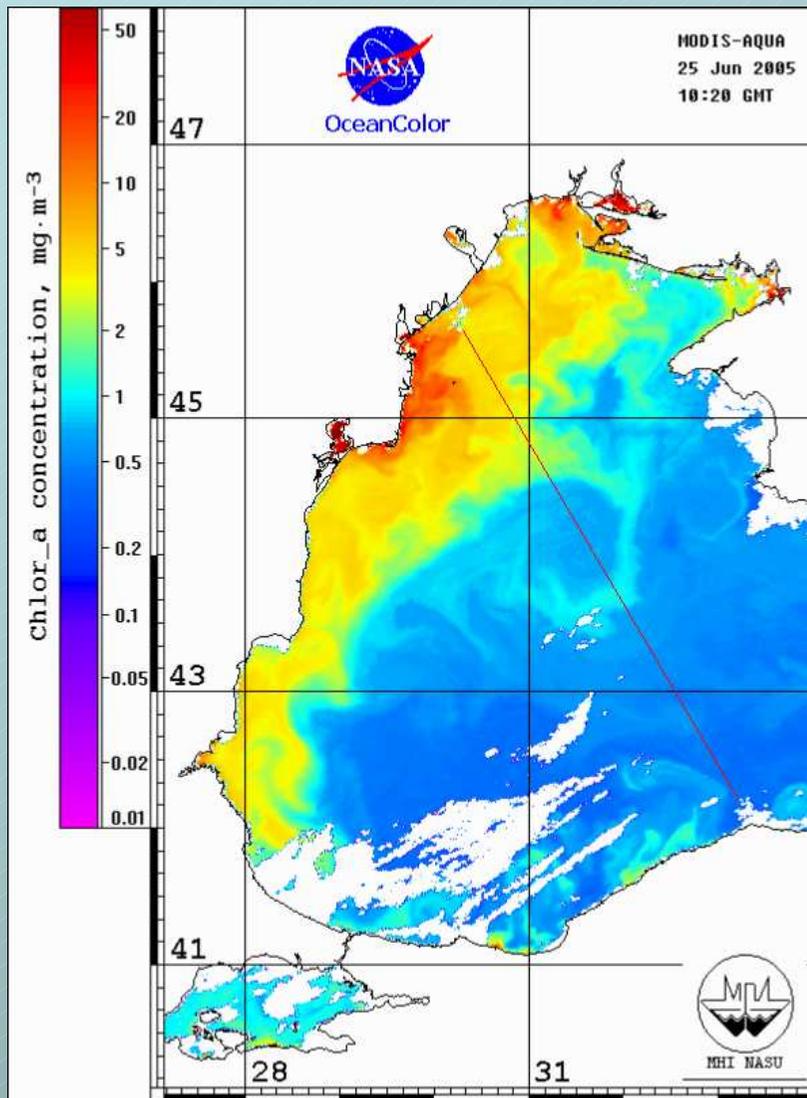
$$F=W*D*N$$

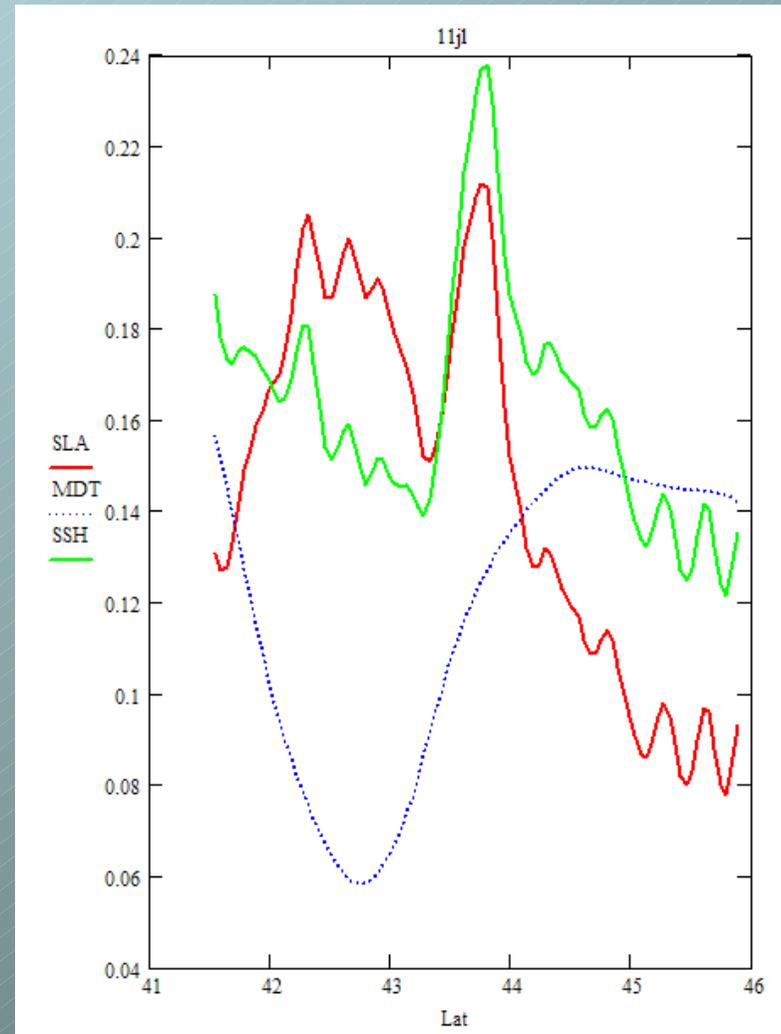
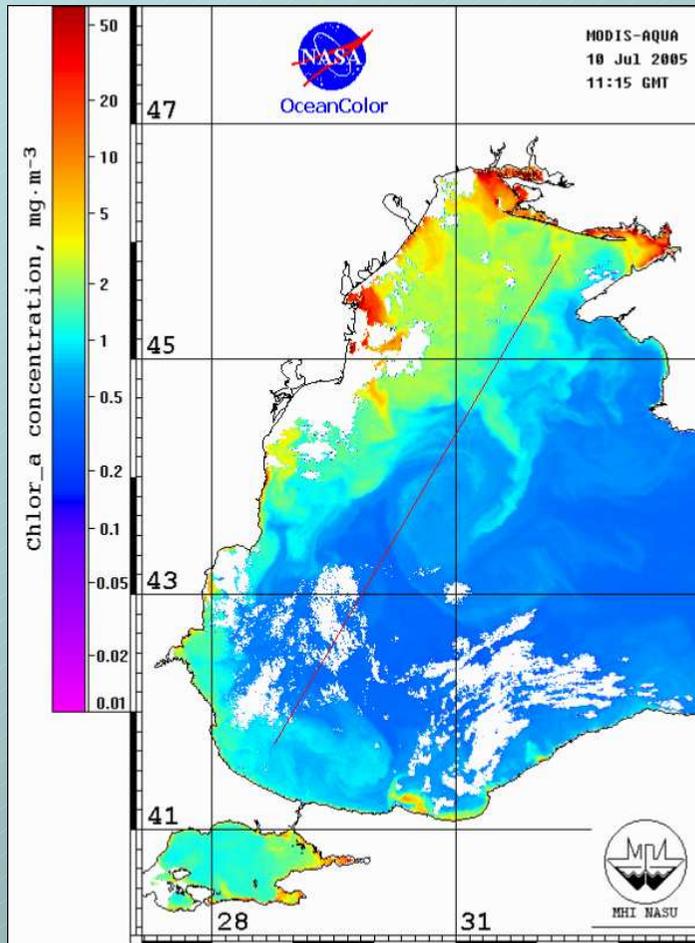
F-поток

D-ширина струи

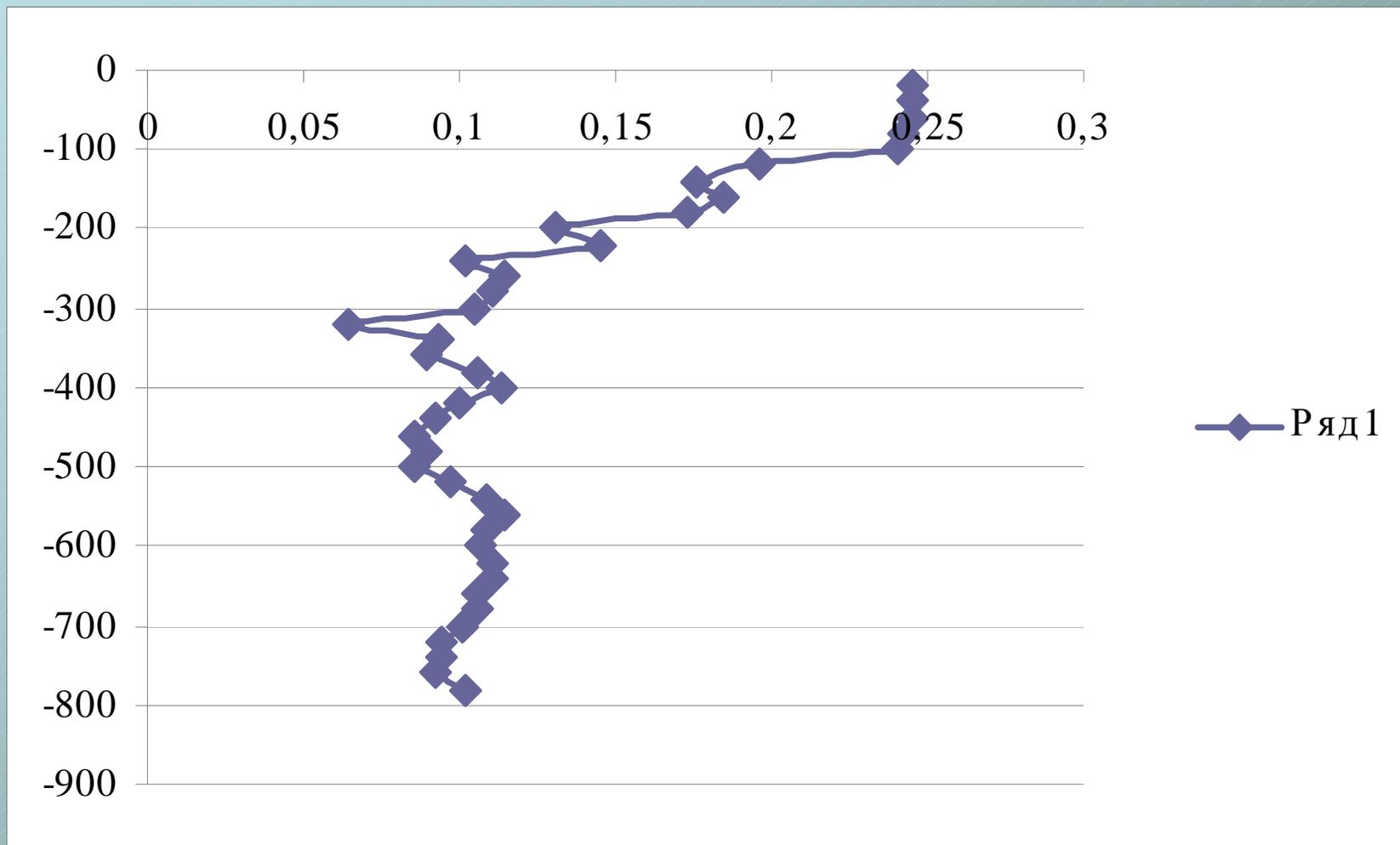
W- скорость

N – глубина





# Вертикальный профиль скорости течения ADCP



$$D=20000 \text{ m}$$

$$W=0.15 \text{ m/s and}$$

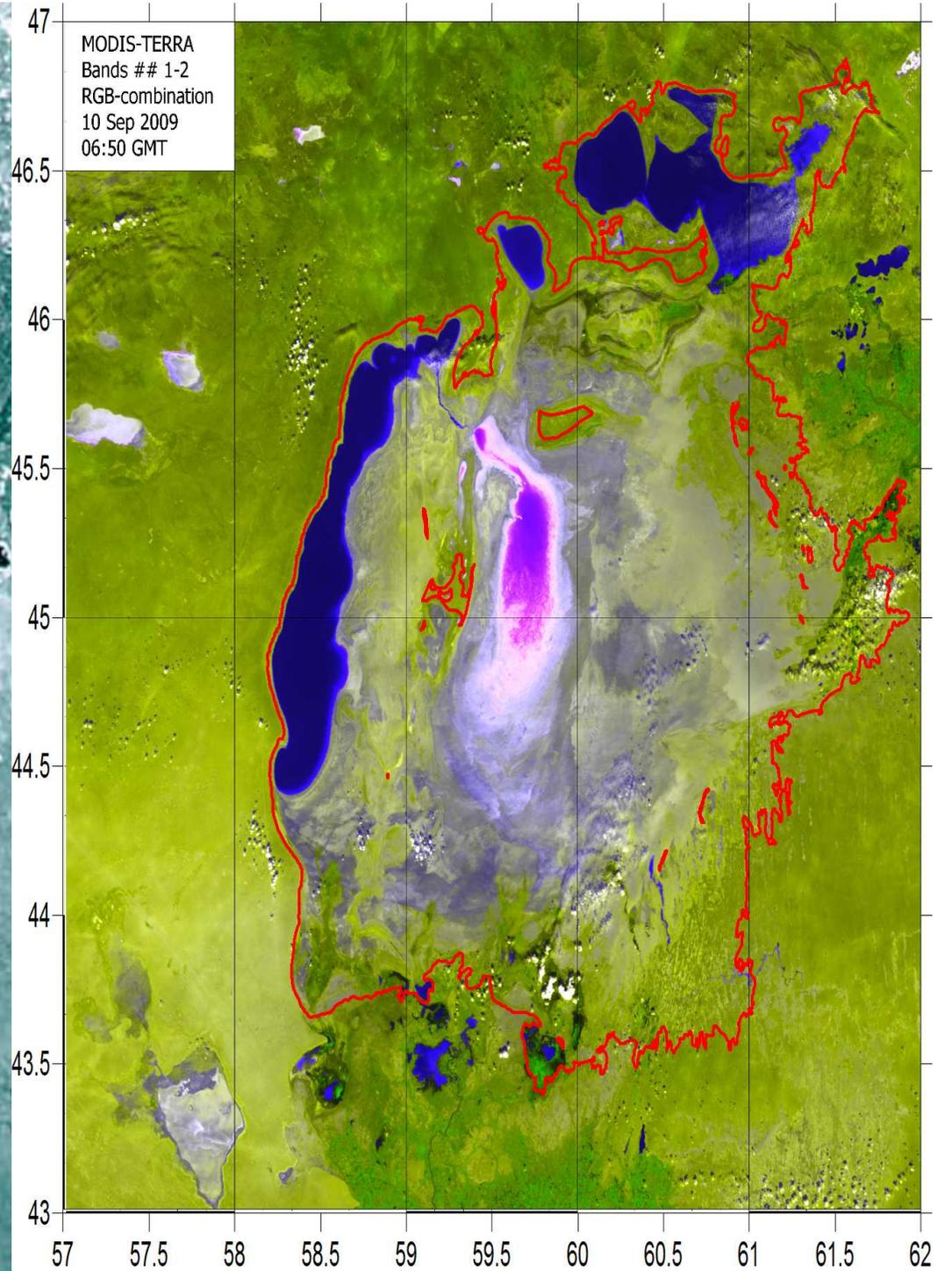
$$H=100 \text{ m}$$

$$F= 3 \cdot 10^5 \text{ m}^3/\text{c}$$

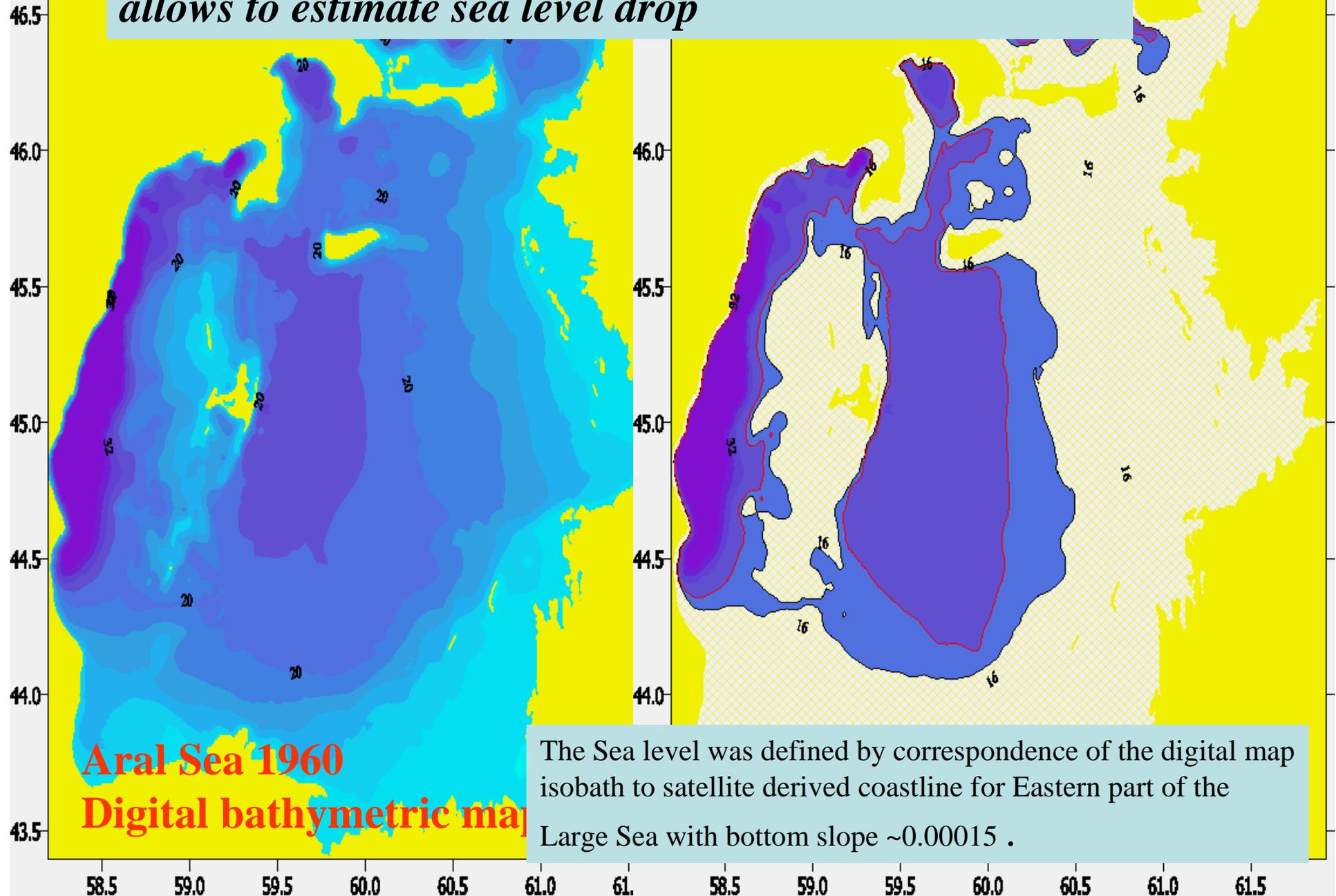
$$\text{ДУНАЙ- } 6.5 \cdot 10^3 \text{ m}^3/\text{c}$$

За 40 дней вихрь перекачал объем  
равный  $-1 \cdot 10^{12} \text{ m}^3$

Для примера весь объем шельфа севернее  
43.5 N до 100 метровой изобаты  
 $-2.5 \cdot 10^{12} \text{ m}^3$   
те вихрь провентилировал 40% вод шельфа



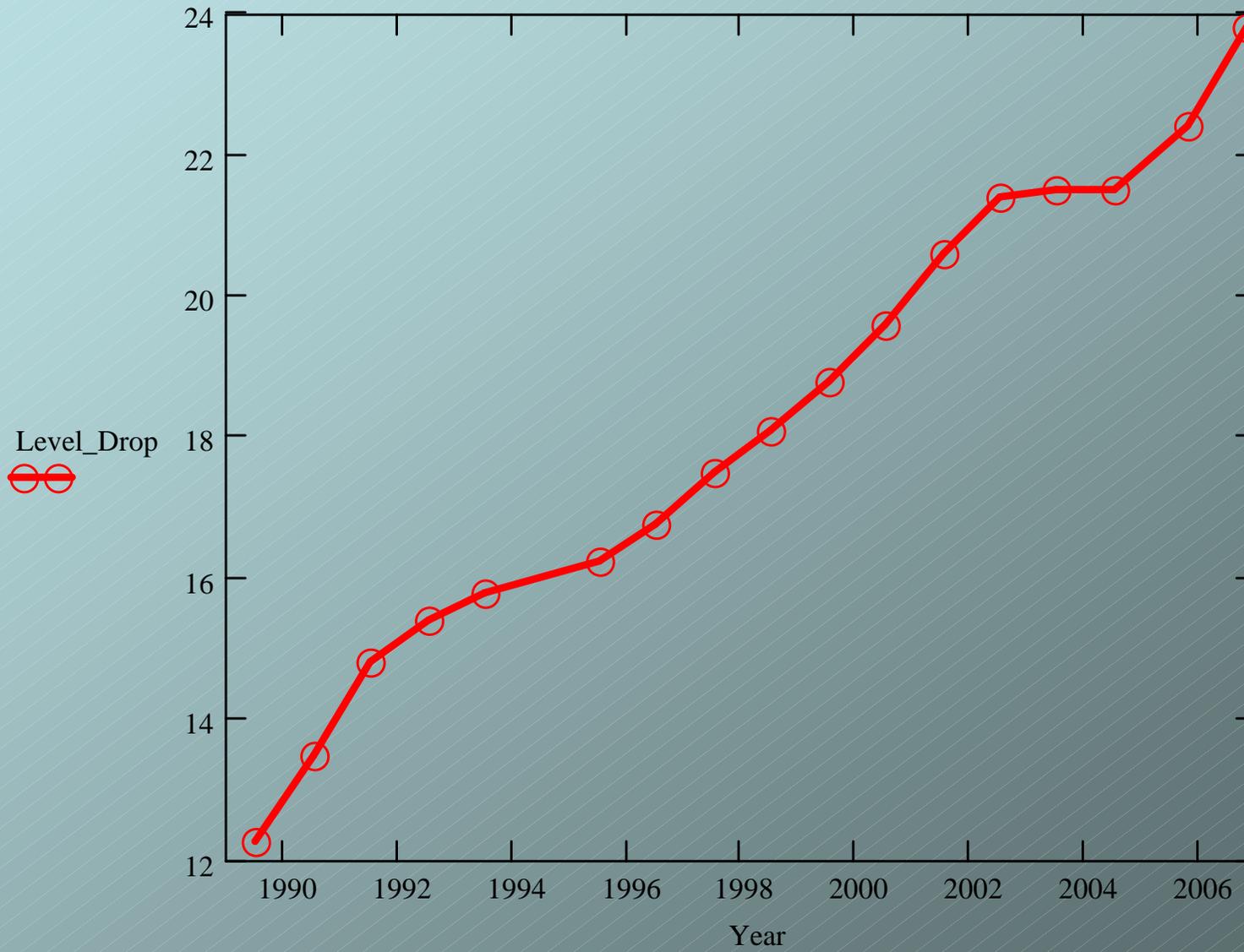
*Combination of the digital depth map and satellite data allows to estimate sea level drop*

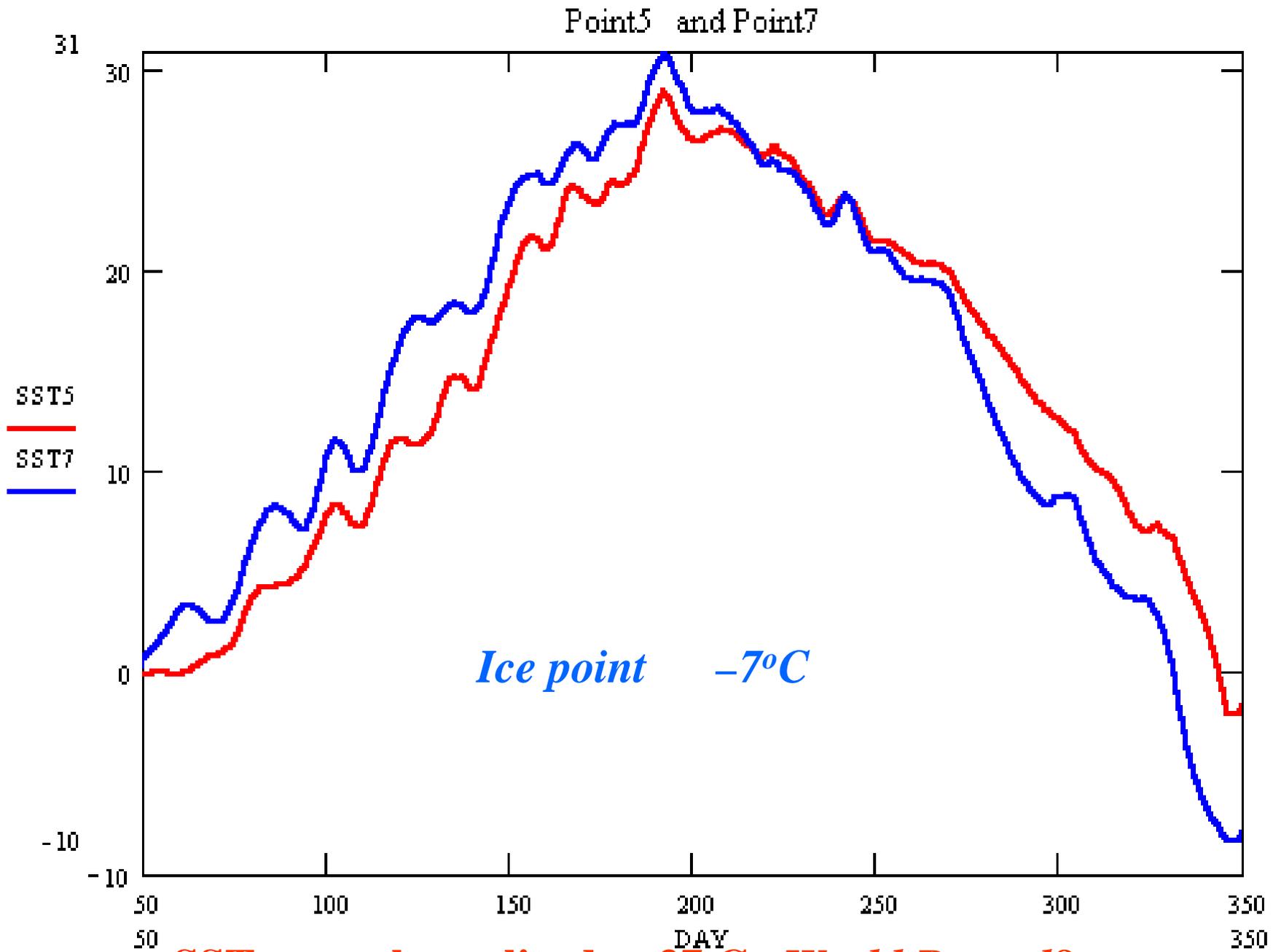


**Aral Sea 1960**  
**Digital bathymetric map**

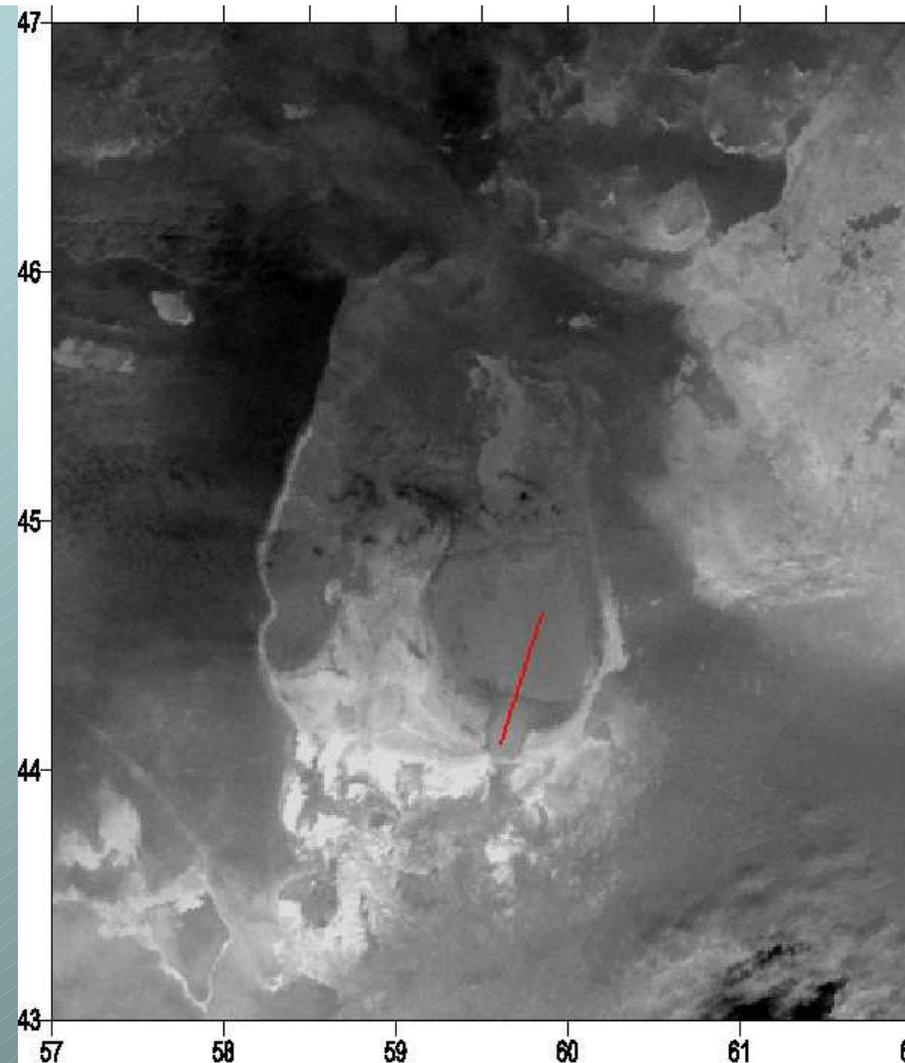
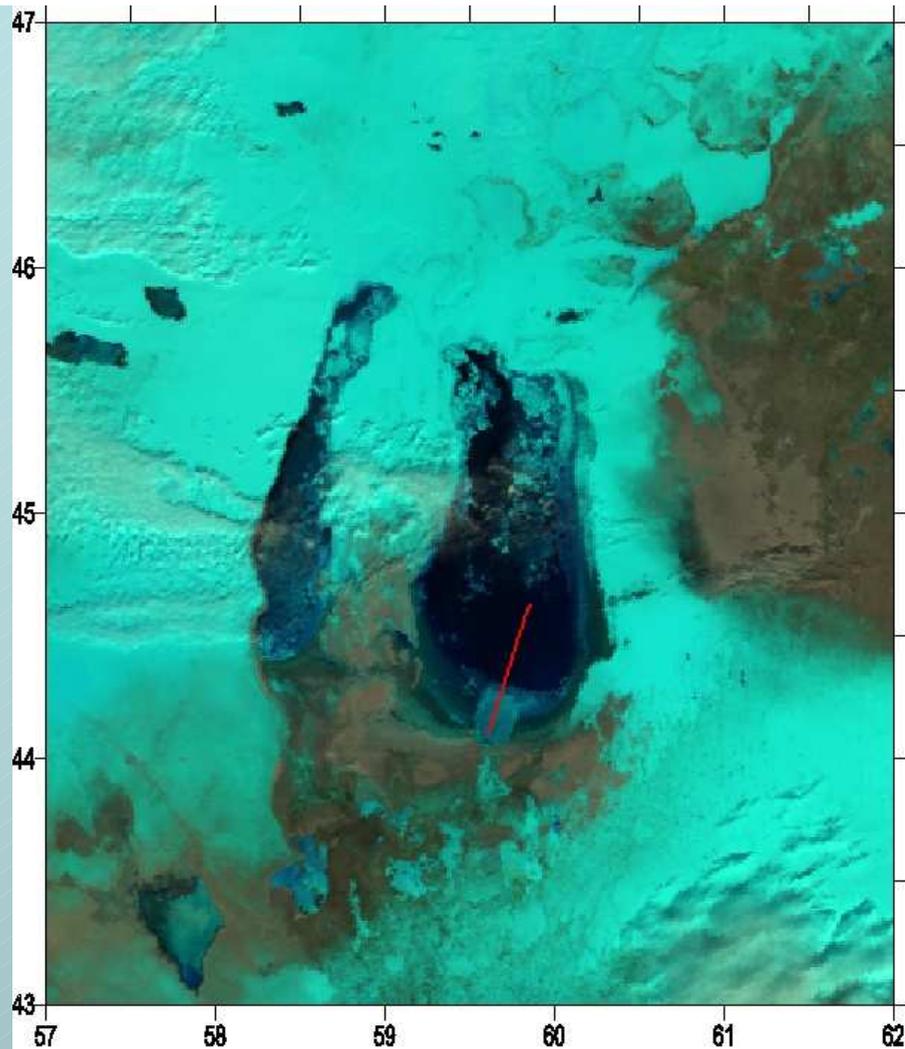
The Sea level was defined by correspondence of the digital map isobath to satellite derived coastline for Eastern part of the Large Sea with bottom slope  $\sim 0.00015$ .

*Additional river discharge after 2002 ~15-20km<sup>3</sup>/year*



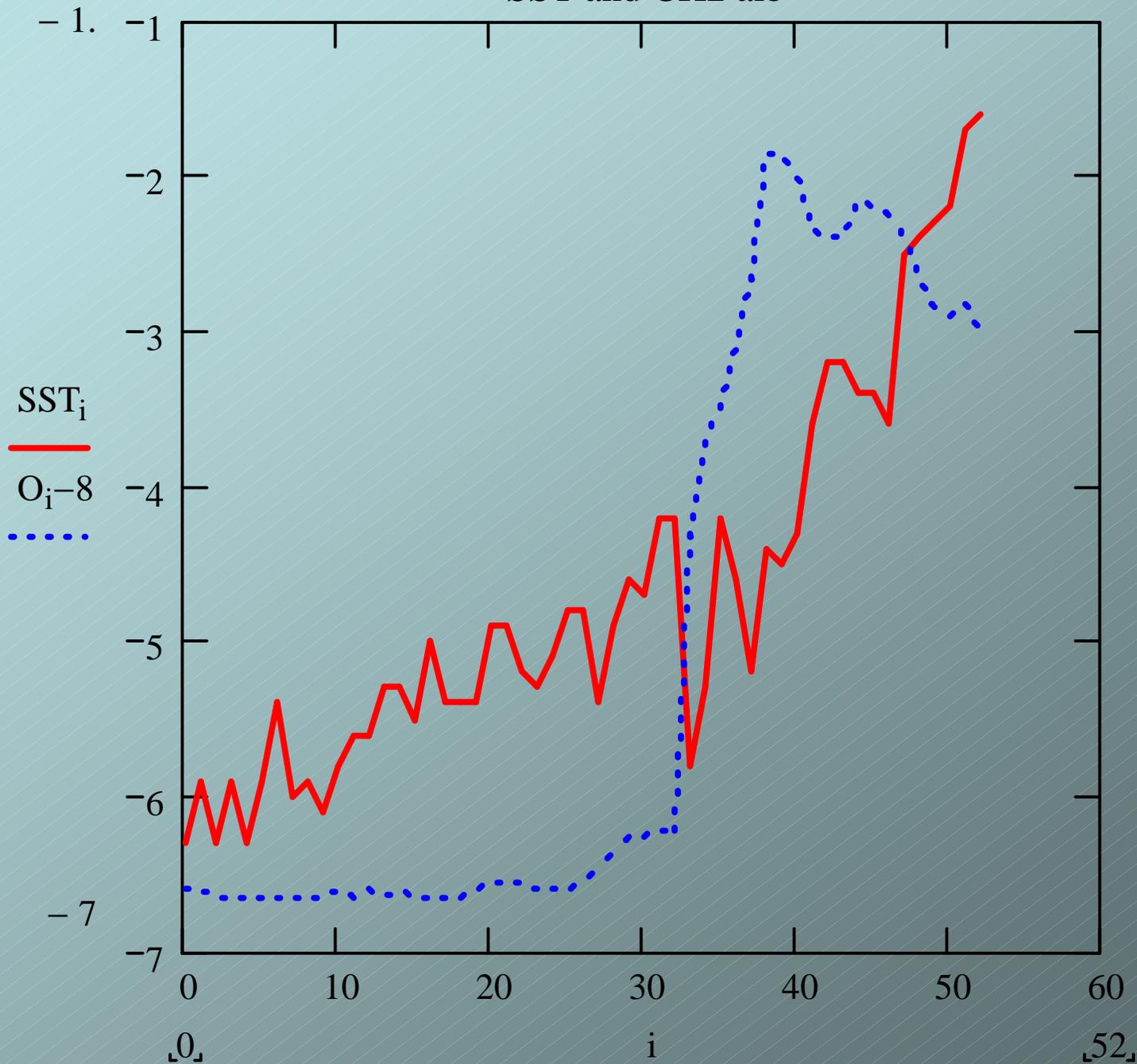


**SST annual amplitude - 37 C, World Record?**

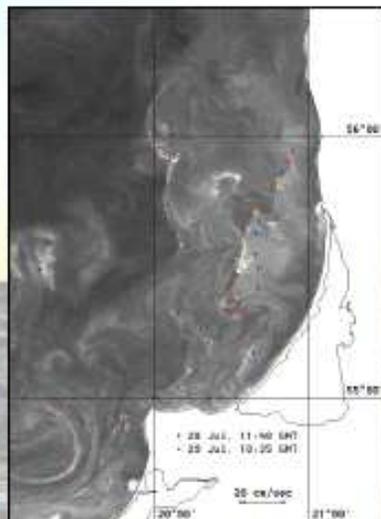


ТЕПЛЫЙ ЛЁД

SST and CH2 alb

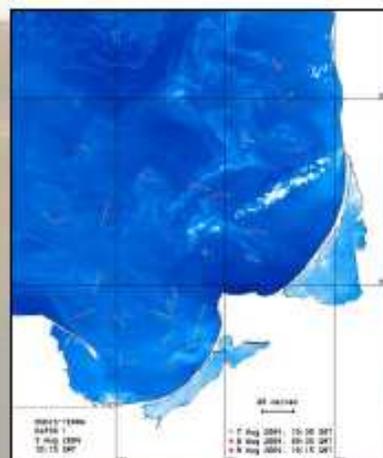
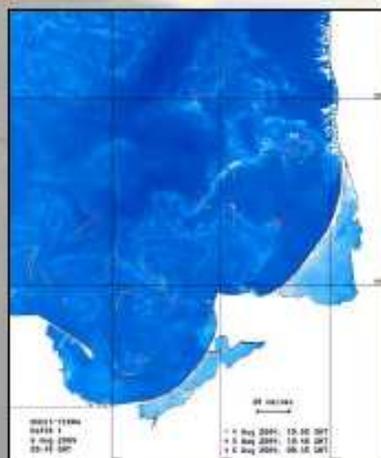


### Reconstruction of the Currents Field from a Sequence of Daily MODIS Imagery Восстановление полей течений по последовательности ежедневных изображений MODIS

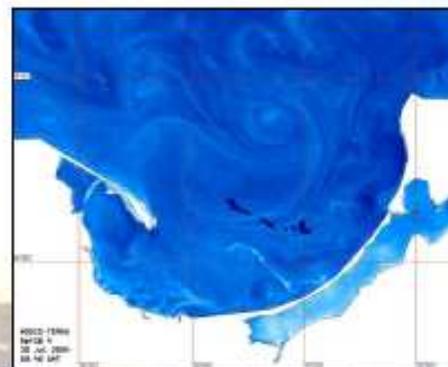
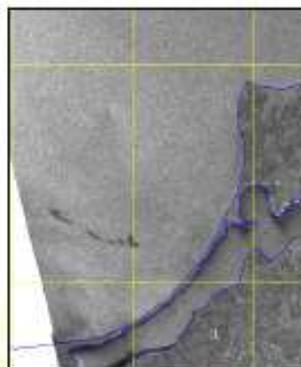


Sequence of daily MODIS IR and VIS imagery allows to reconstruct a real field of surface currents (direction and velocity of currents) with 250 m resolution which is very important for a forecast of a direction and velocity of potential pollution drift including oil spills. Images and current fields show an upwelling zone along the Curonian Spit induced by a steady wind from the north. Upwelled waters move to the west with a velocity of 16 cm/s. A number of dipole structures is located in the Odenskaya Bay and offshore. Red square is D-6 oil platform.

Последовательность ежедневных спутниковых изображений MODIS в оптическом и инфракрасном диапазонах позволяет восстанавливать реальные поля течений (направление и скорость течений) с пространственным разрешением 250 м, что необходимо для прогноза направления и скорости дрейфа потенциальных загрязнений, в том числе, нефтяных пятен. На изображениях отмечено явление апвеллинговой зоны, расположенной вдоль Куршского косы. К северу от платформы Д-6 (красный квадрат) наблюдается наибольшая скорость (до 16 см/с) оттока прибрежных вод на запад. Вдоль южной части косы и Салбишского полуострова преобладают течения со скоростями до 10 см/с, направленные в противоположную сторону (от юга-запада, запада), чем объясняется, что связано с утолщением северным ветром. Передний фронт дипольной структуры в Гданьском заливе продвигается вперед со скоростью 5-8 см/с.

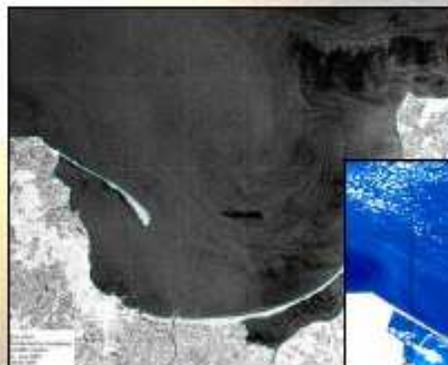


### Combined Analysis of ASAR ENVISAT and MODIS Imagery Совместный анализ радиолокационных изображений ENVISAT и оптических изображений MODIS

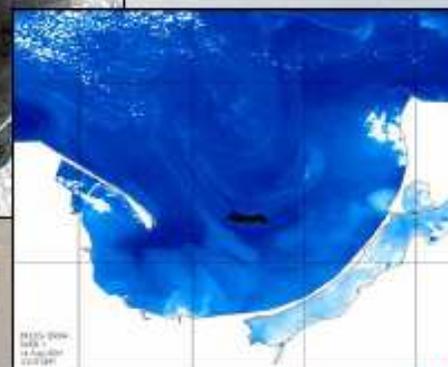


Oil spill chain (length – 26 km, total surface – 20.3 km<sup>2</sup>) detected on ASAR ENVISAT image on 30 July 2004 (20:08 GMT) was combined with an appropriate MODIS-Terra optical image (09:40 GMT), which shows water dynamics in the Odenskaya Bay in detail, in order to forecast the drift direction of oil spills.

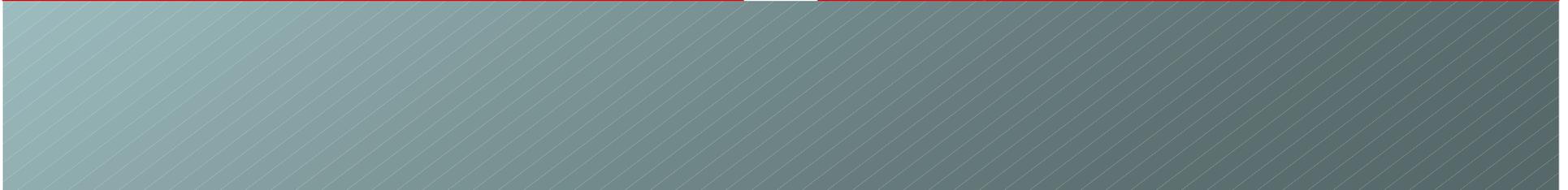
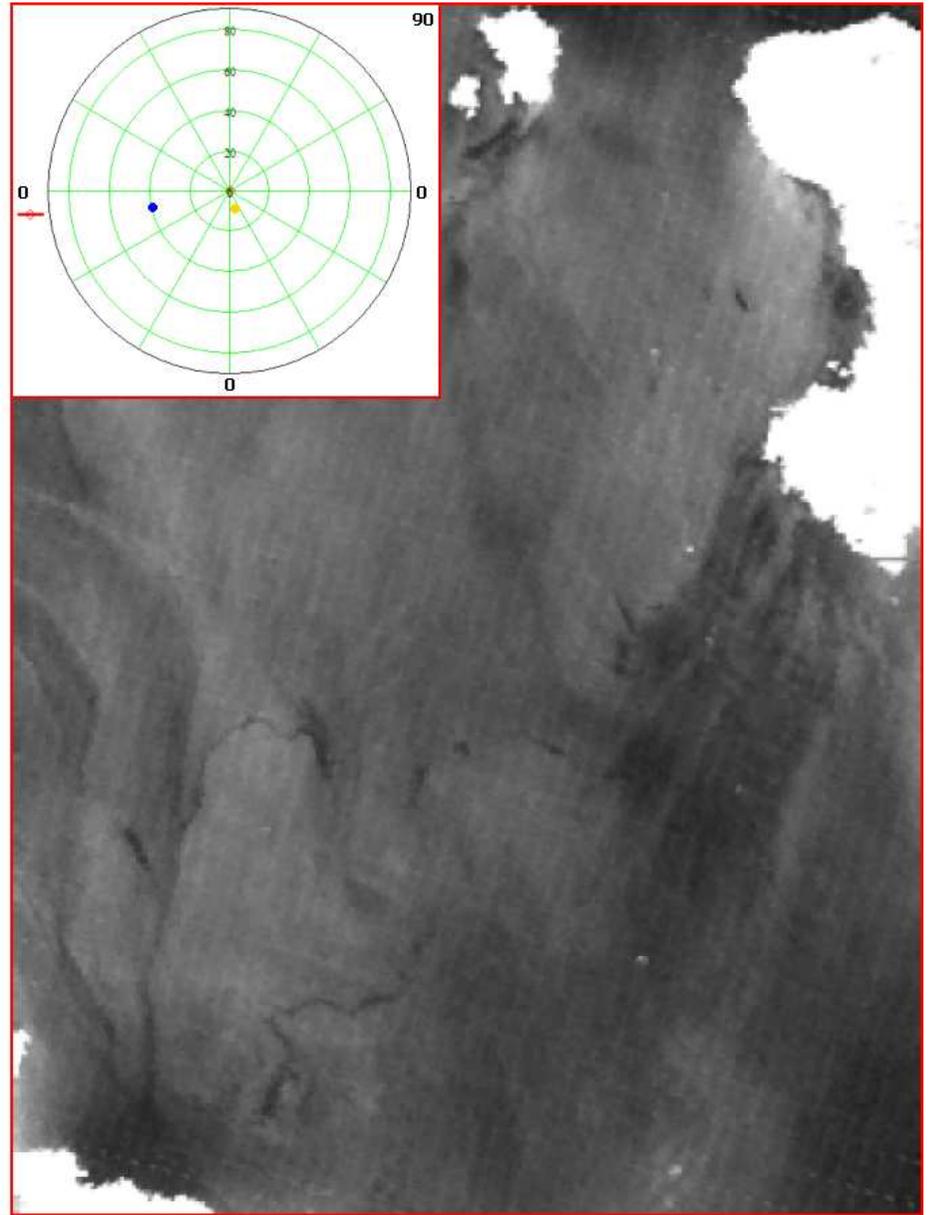
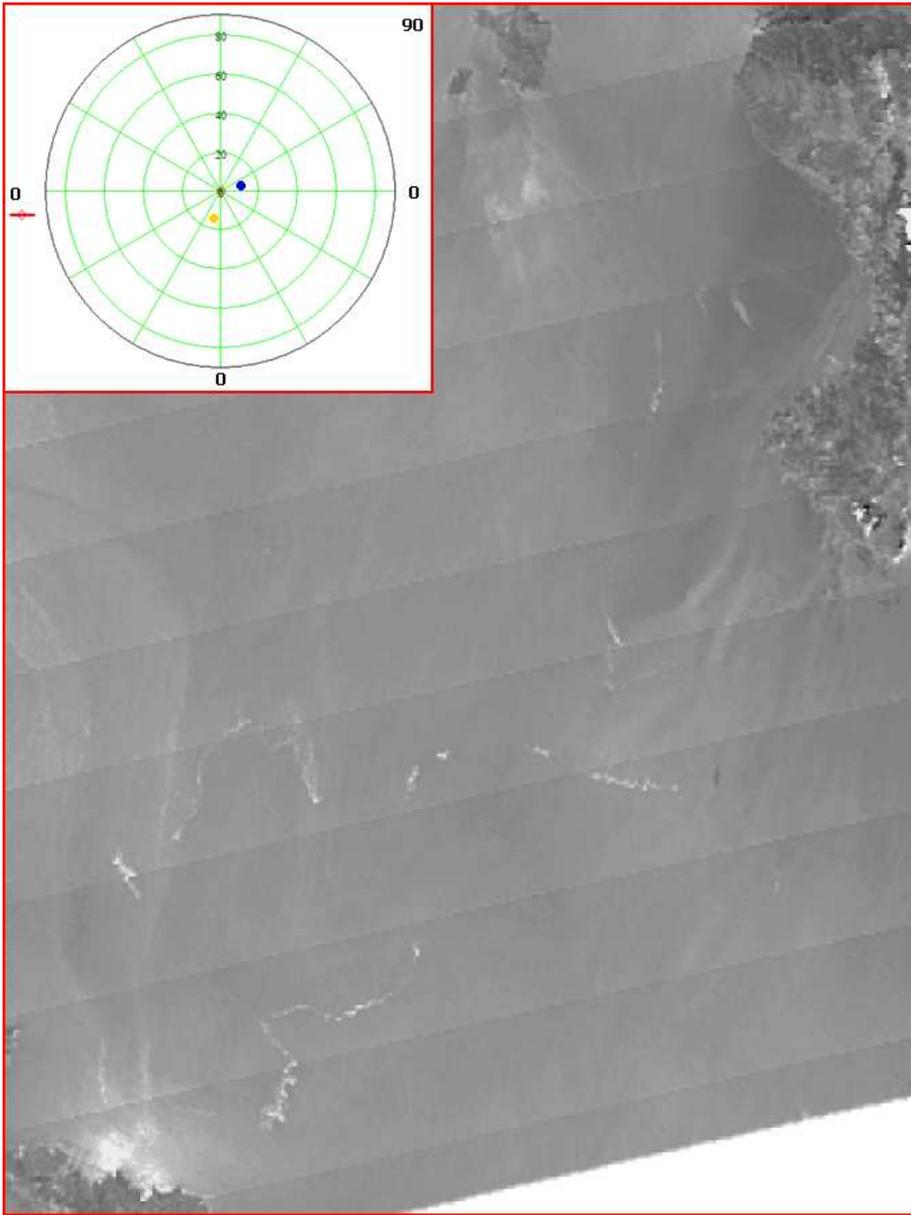
Цепочка нефтяных пятен (длина – 26 км, общая площадь – 20,3 км<sup>2</sup>), обнаруженная 30 июля 2004 (20:08 GMT) на радиолокационном изображении ASAR ENVISAT, была заложена на соответствующее оптическое изображение MODIS-Terra (09:40 GMT), которое показывает в деталях динамику вод в Гданьском заливе, для прогноза направления дрейфа нефтяных пятен.



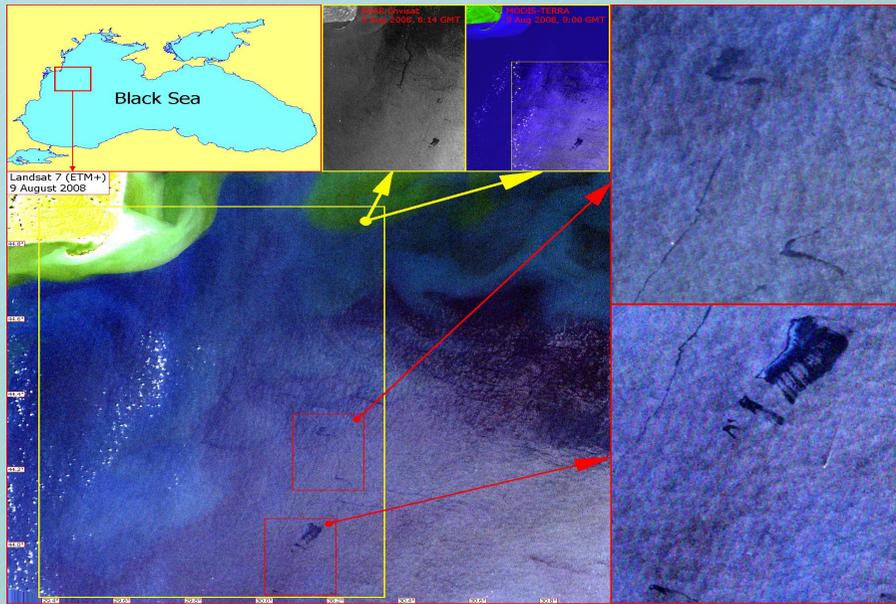
Совместный анализ изображения нефтяного пятна, обнаруженного 11 августа 2004 (09:06 GMT) на радиолокационном изображении ASAR ENVISAT, с соответствующим оптическим изображением MODIS-Terra (10:05 GMT).



Combined analysis of an oil spill detected on ASAR ENVISAT image on 11 August 2004 (09:06 GMT) with an appropriate MODIS-Terra optical image (10:05 GMT).



## Oil spill appearance in optical data

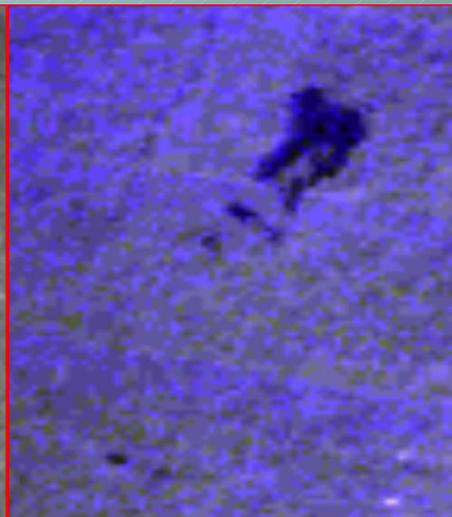


На данных Landsat  
видна область толстой пленки  
с увеличенным отражением

ASAR

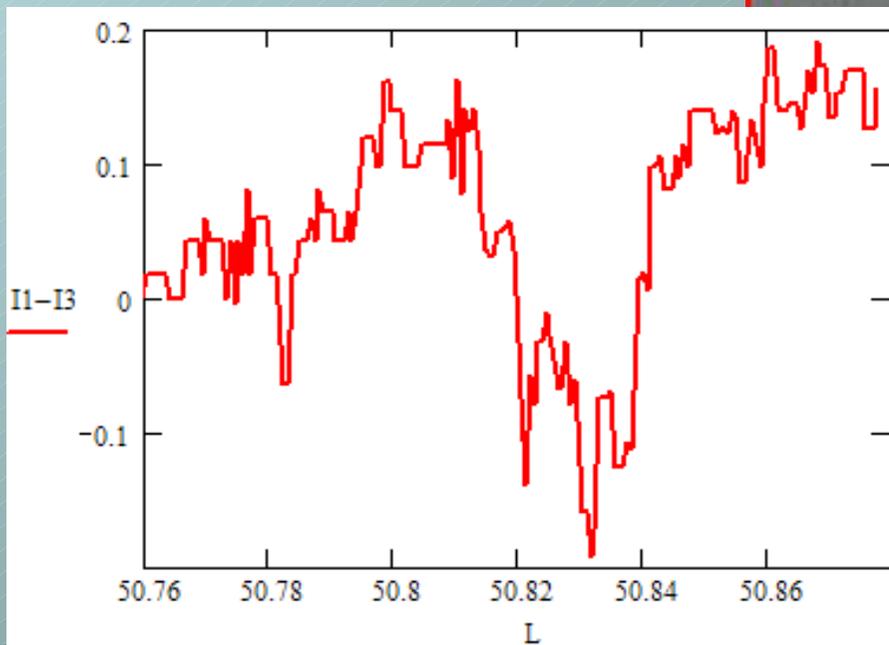
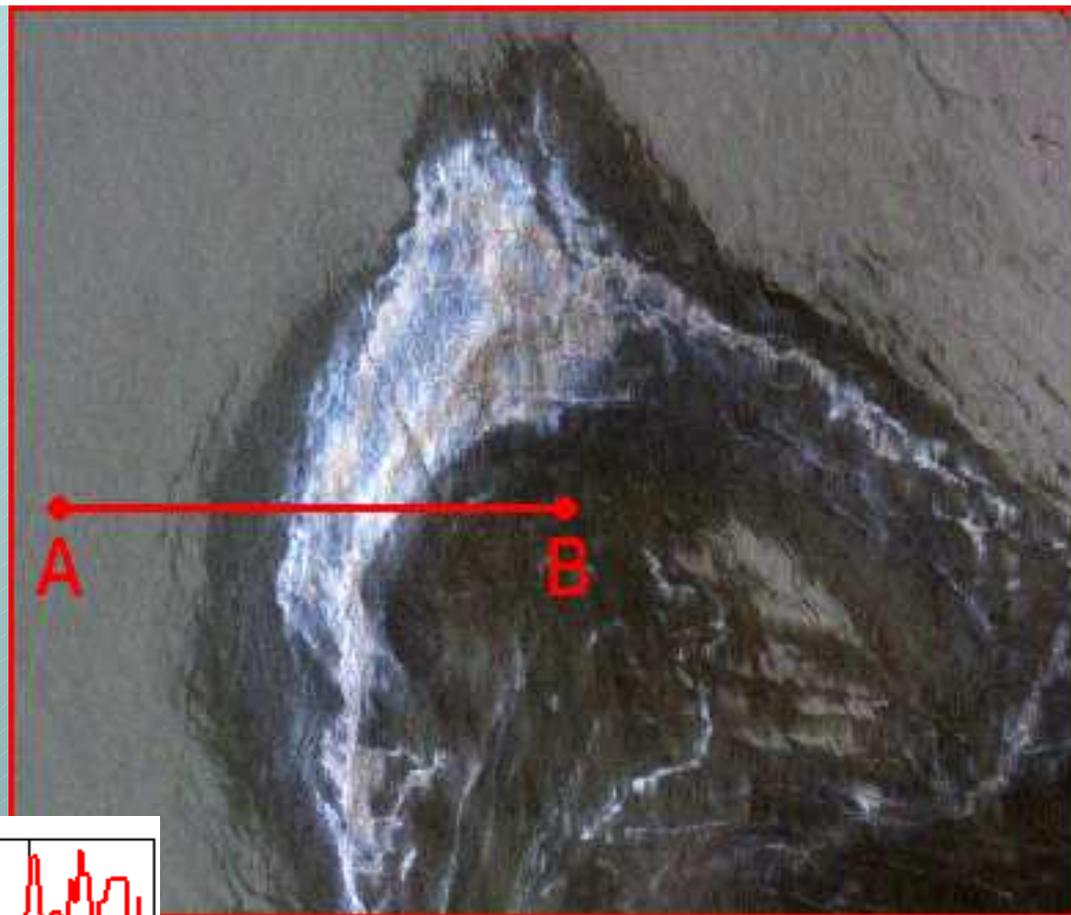
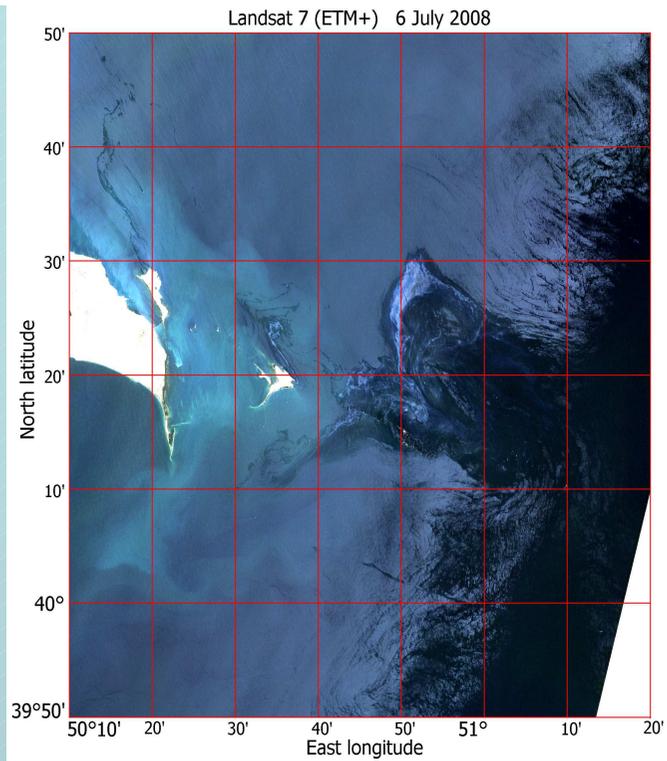


MODIS



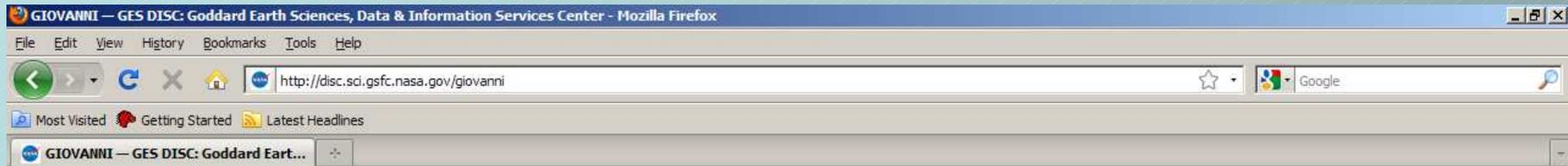
Landsat





Разность спектральных контрастов  
 В 1 и 3м каналах сканера  
 0.45-0.51мкм  
 0.63-0.69 мкм

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- **Environmental Instances:** Agriculture; Air Quality; Monsoon Asia Integrated Regional Study (MAIRS) *Monthly*; Northern Eurasia Earth Science Partnership Initiative (NEESPI) *Daily* and *Monthly*.
- **Ocean Instances:** Ocean Color Radiometry (SeaWiFS, MODIS, and derived and model products); Ocean Model *Daily* and *Monthly*.
- **Hydrology Instances:** Modern Era Retrospective-Analysis for Research and Applications (MERRA) *3D Monthly* and *2D Monthly*; MODIS Terra and Aqua *Daily* and *Monthly*; Northern Eurasia Earth Science Partnership Initiative (NEESPI) *Daily* and *Monthly*; TRMM Online Visualization and Analysis System (TOVAS); Global Land Data Assimilation System (GLDAS) *Monthly*.

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<a href="#">Aqua/AIRS Daily</a>	<a href="#">Aqua/AIRS Monthly</a>	<a href="#">Aura HIRDLS</a>	<a href="#">Aura MLS</a>	<a href="#">Aura OMI L3</a>
<a href="#">Aura OMI L2G</a>	<a href="#">CERES (FM4)</a>	<a href="#">GLDAS Monthly</a>	<a href="#">MAIRS Monthly</a>	<a href="#">MERRA 2D</a>
<a href="#">MERRA 3D</a>	<a href="#">MISR Daily</a>	<a href="#">MISR Monthly</a>	<a href="#">MODIS Daily</a>	<a href="#">MODIS Monthly</a>
<a href="#">NEESPI Daily</a>	<a href="#">NEESPI Monthly</a>	<a href="#">Ocean Color Radiometry</a>	<a href="#">Ocean Model Daily</a>	<a href="#">Ocean Model Monthly</a>
<a href="#">TOMS</a>	<a href="#">TRMM/TOVAS</a>	<a href="#">TES</a>	<a href="#">UARS HALOE</a>	

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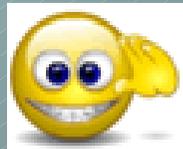
- STRONG TEAM
- OPERATIVE MONITORING SYSTEM FOR THE BLACK SEA
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