

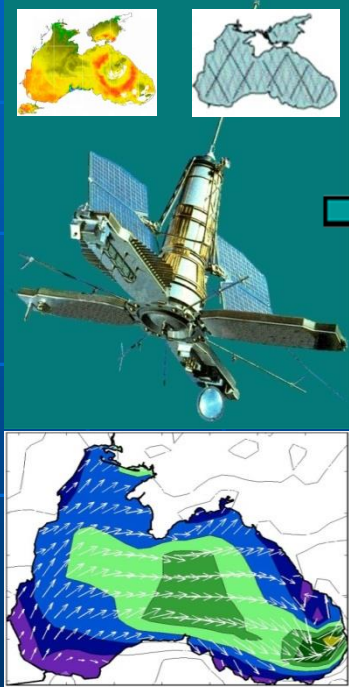


**A.V. Grigoriev**

**The system of monitoring of the regions of  
Black Sea of N.N. Zubov's State  
Oceanographic Institute**

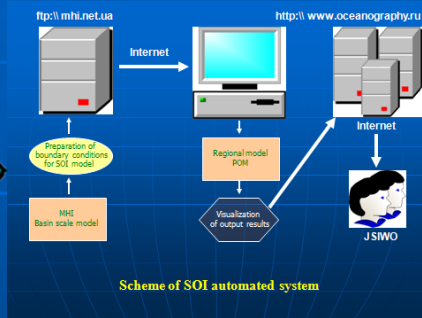
# Modelling of currents and water structure of Black Sea (POM) (general scheme)

Satellite data



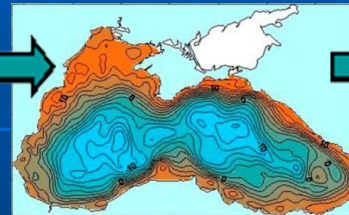
Atmospheric forcing

Automated system for the exchange of information

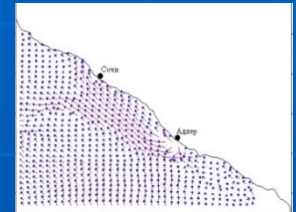


Scheme of SOI automated system

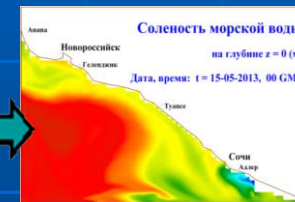
Black Sea



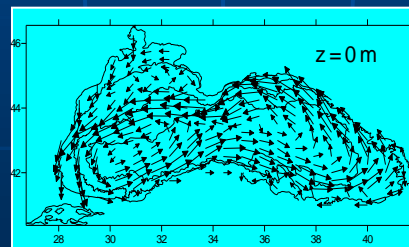
Regions of Black Sea



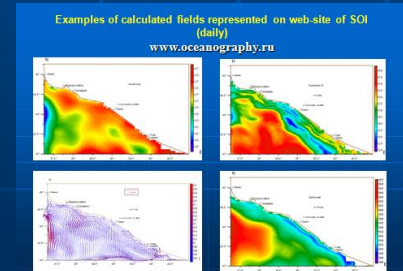
Russian zone



Great Sochi region



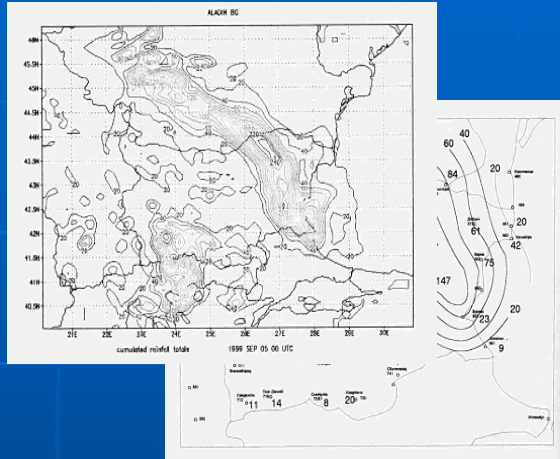
Electronic atlas of currents (JSIWO Project, Russia)



Web-site of SOI

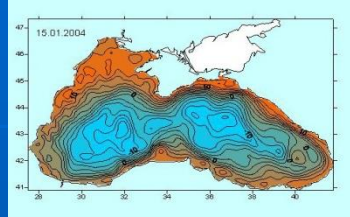
# Nowcasting/Forecasting System of the Black Sea Circulation

## Regional Atmospheric Model

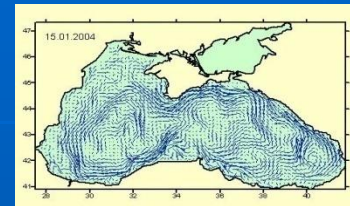


## Basin-Scale Circulation Model

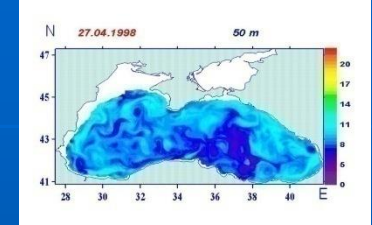
Sea Surface Elevation



Current Velocity



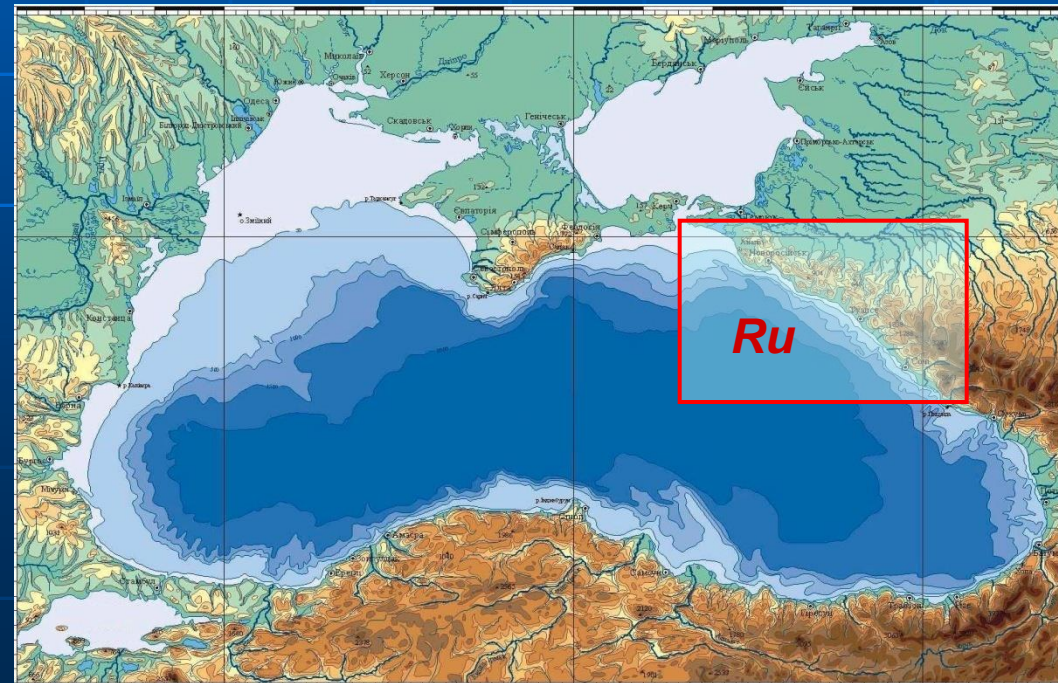
Sea Water Temperature and Salinity



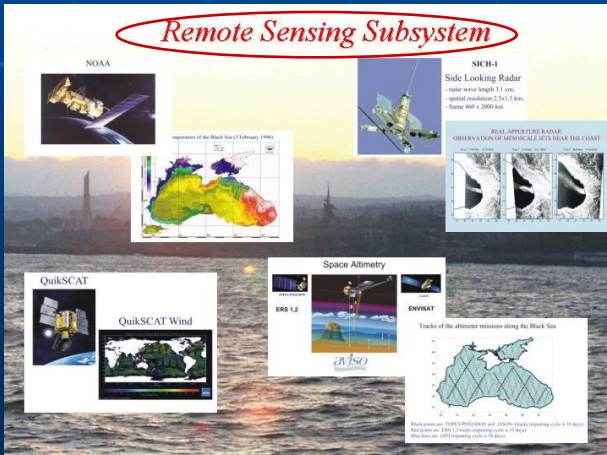
## MHI Ukraine

## Regional Model POM

## SOI Russia



## Remote Sensing Subsystem

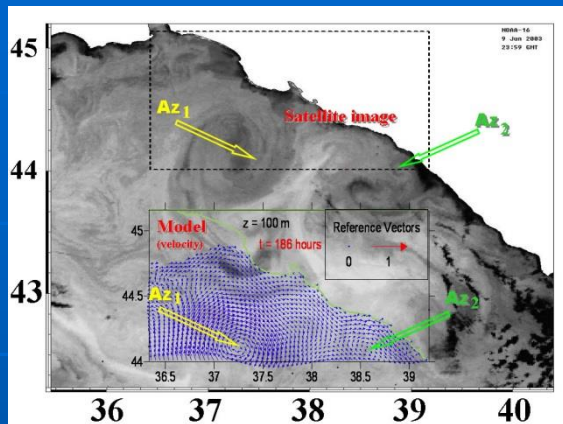


# Main features of global model and regional models

(Black Sea)

Main features Model	Type	Vertical coordinates	Grid size	Number of grid points	Time step
<b>Basin scale model (MHI)</b>	<b>MHI-model with remote sensing data assimilation</b>	<b>Fixed levels in the vertical z-direction</b>	<b>~ 4900 m</b>	<b>237 x 131 x 35</b>	<b>600 s</b>
<b>Northeastern Russian Coastal Zone Regional Model</b>	<b>POM-model</b>	<b>Terrain following <math>\sigma</math>-coordinates</b>	<b>~ 1000 m</b>	<b>304 x 254 x 18</b>	<b>120 s (baroclinic mode) 3 s (barotropic mode)</b>

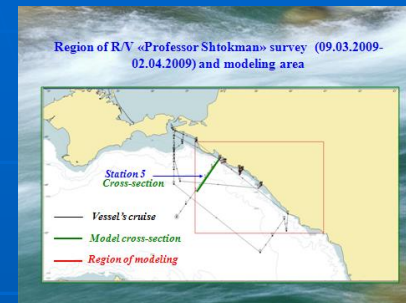
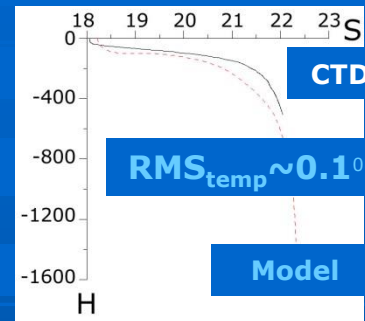
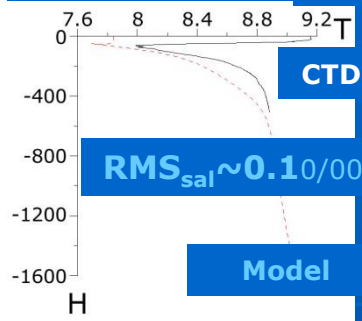
# Model validation by remote and contact data



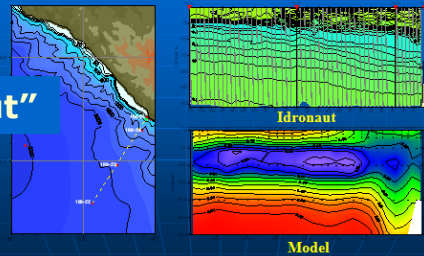
Satellite data

$Az_1 \sim 70 \text{ km}$   $Az_2 \sim 15 \text{ km}$

## Contact observation

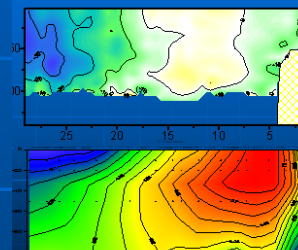


Comparison with "Idronaut" data (18.03.2009, temperature)



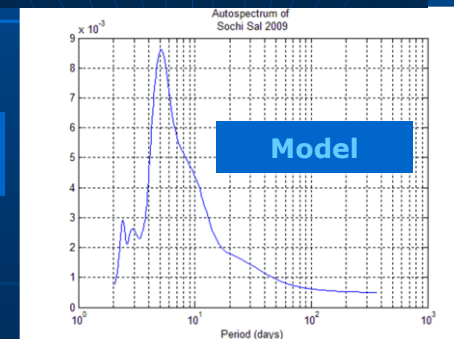
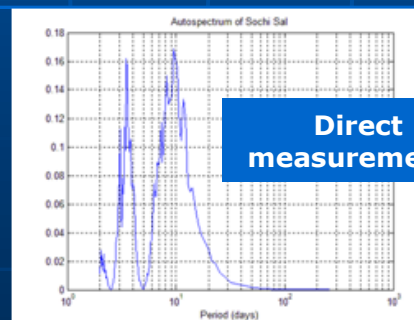
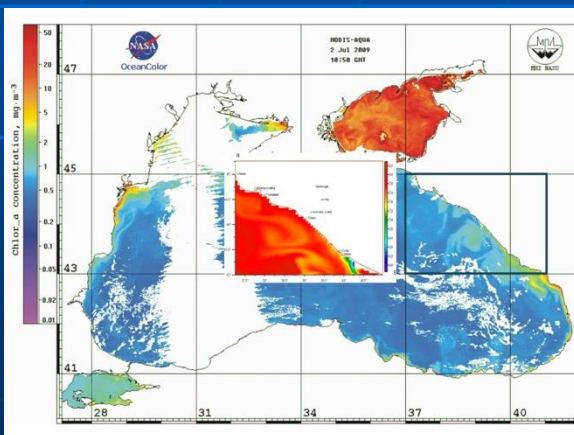
"Idronaut"

Comparison with ADC data (horizontal velocity)



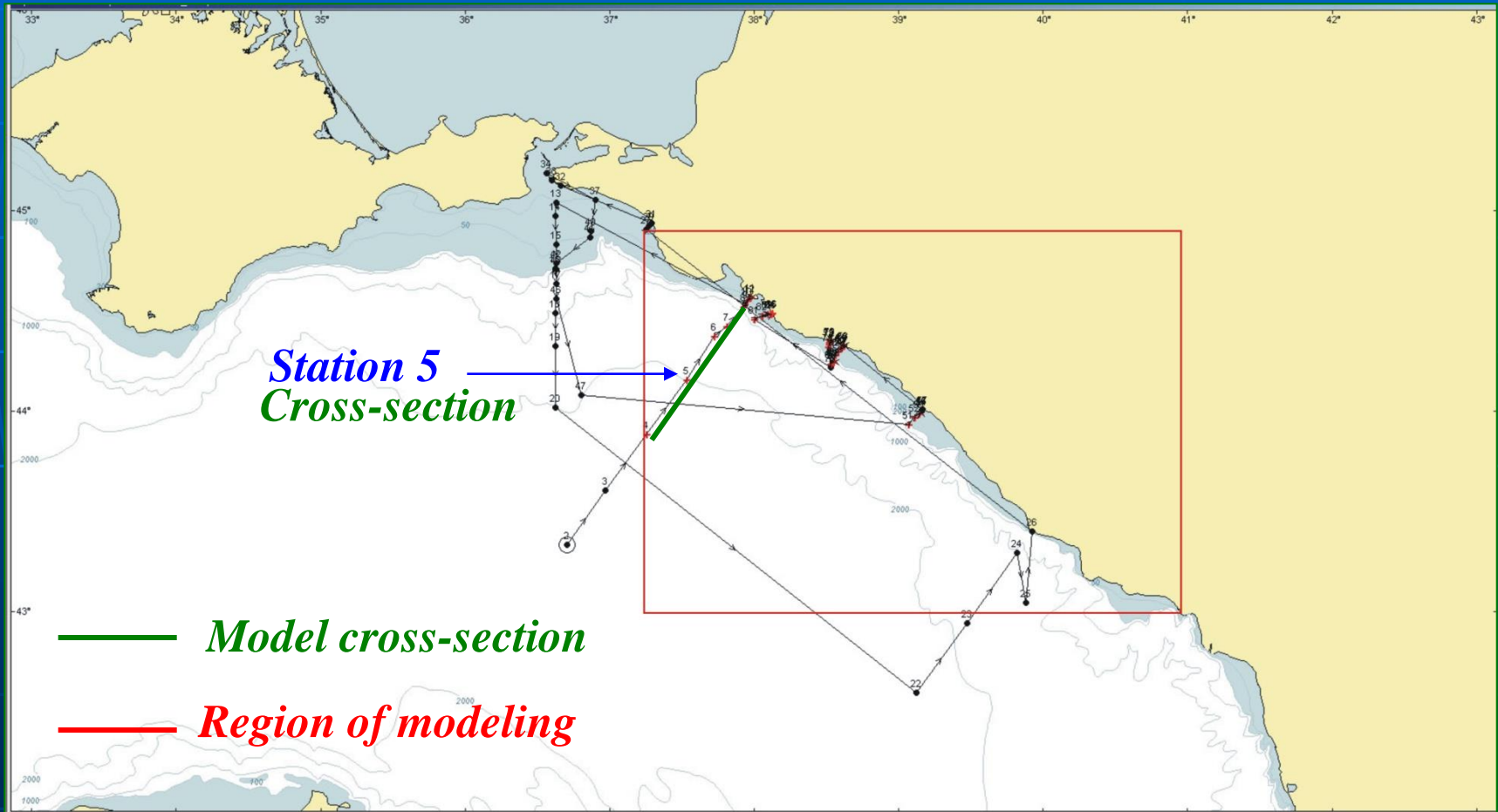
Idronaut

ADCP

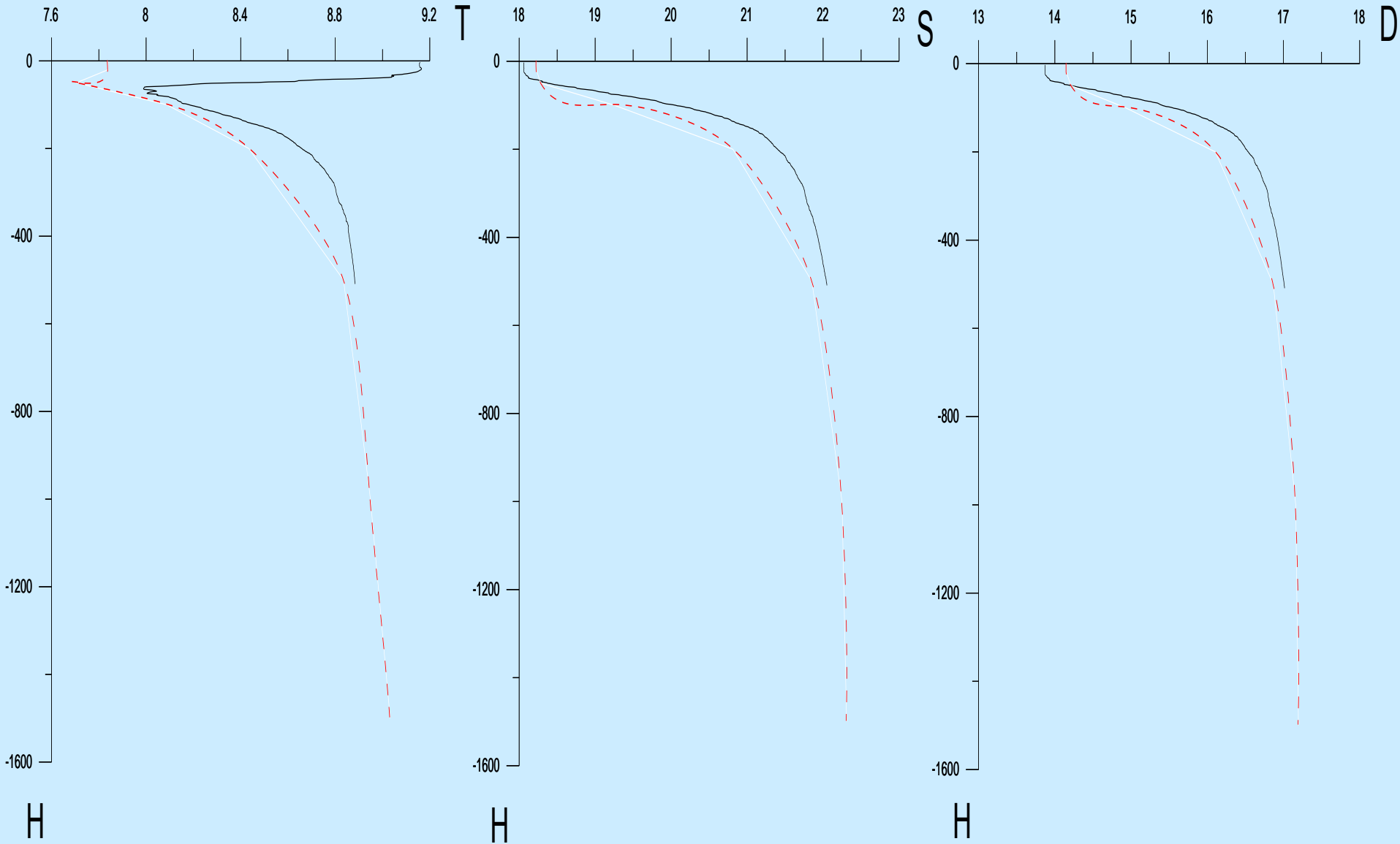


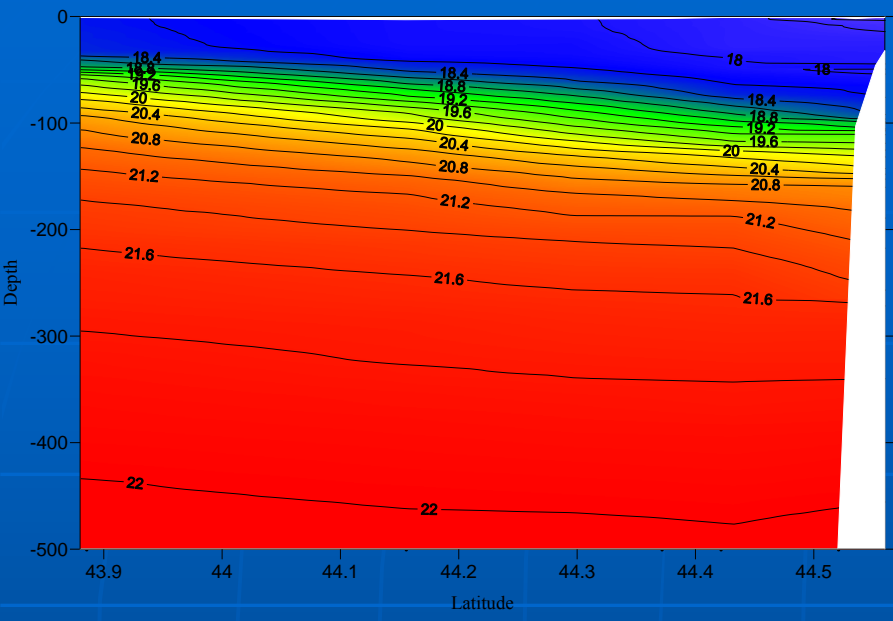
Autospectrums of salinity's variability

# Region of R/V «Professor Shtokman» survey (09.03.2009-02.04.2009) and modeling area

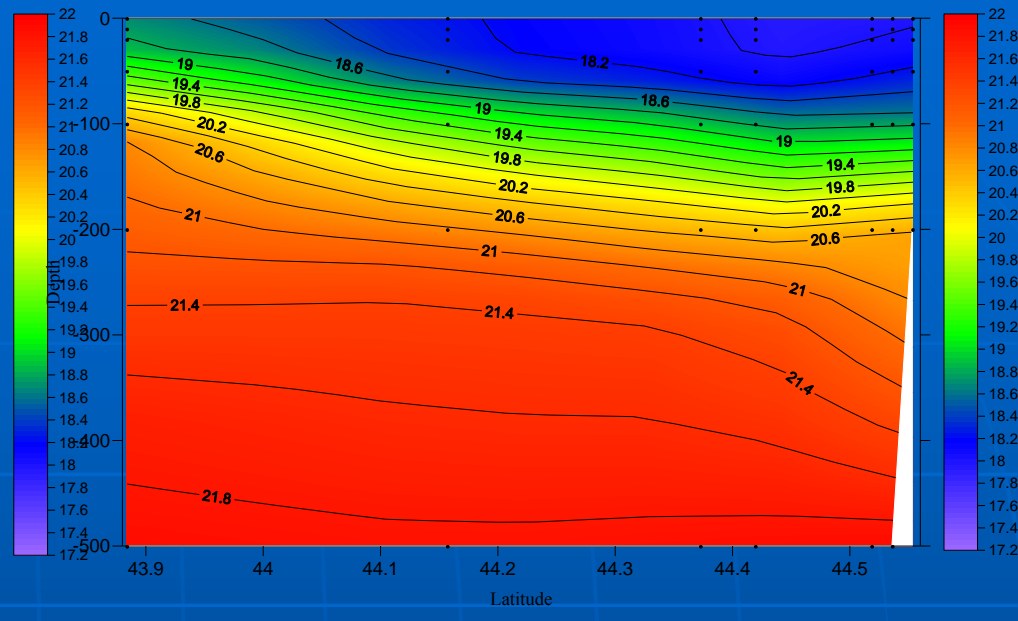


# Vertical profiles of temperature (T), salinity (S) and density (D) for Station №5 from CTD data (black) and modeling (red)

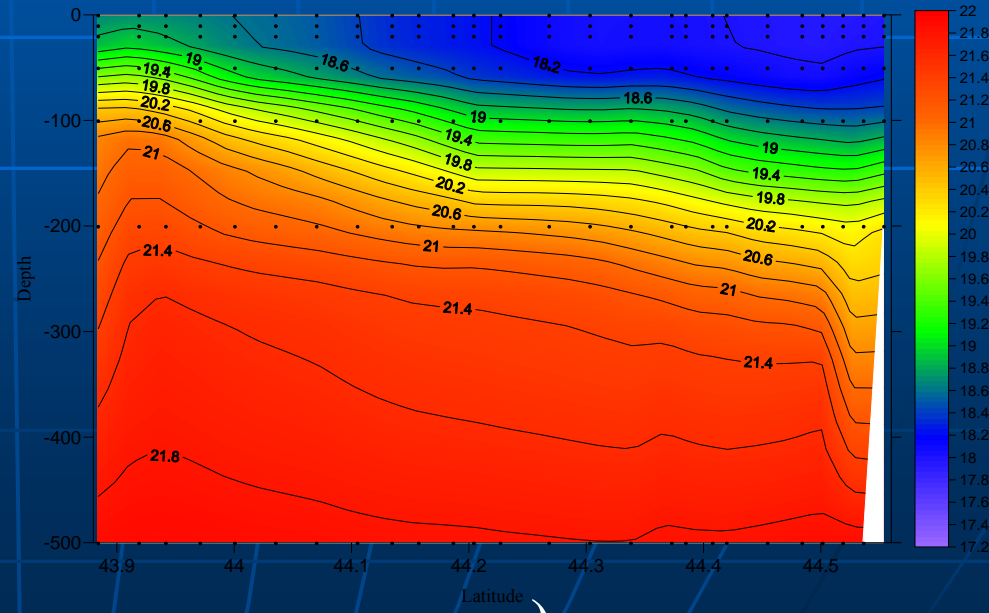




a)



b)

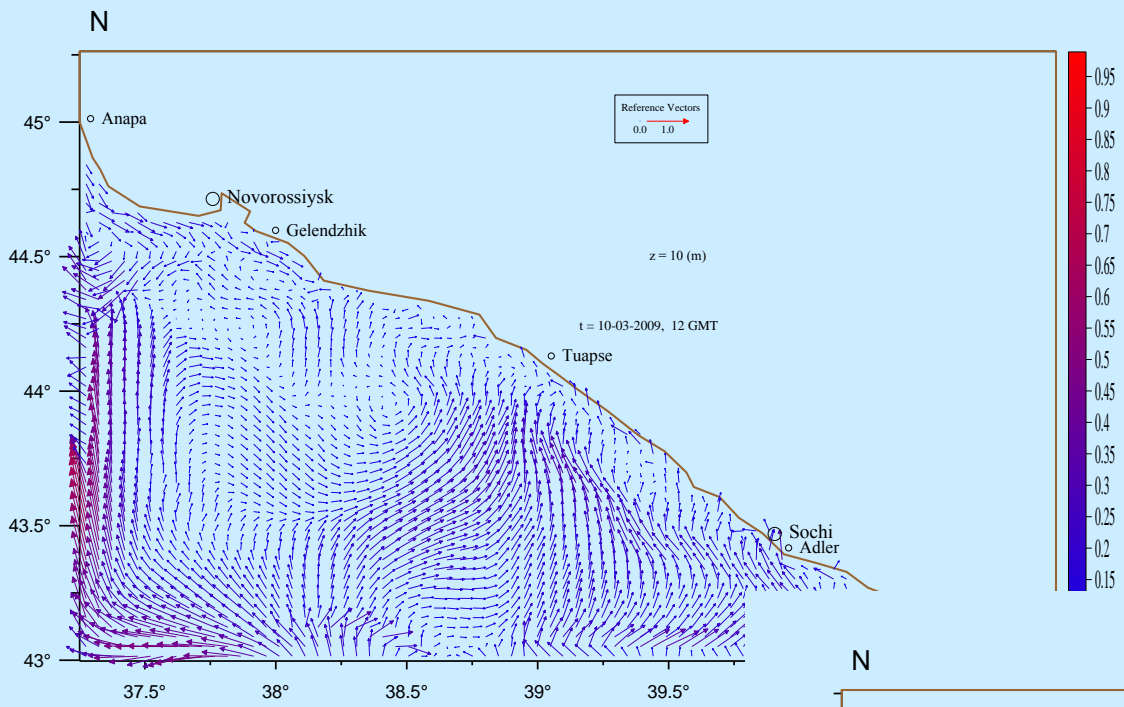


c)

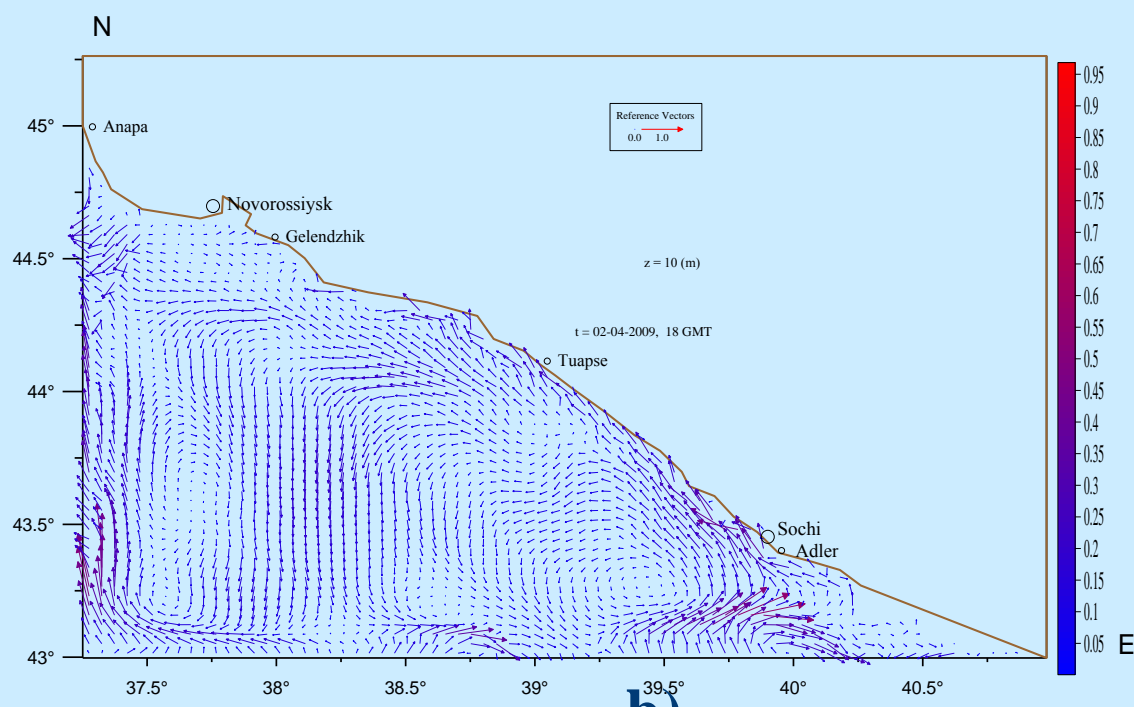
**Distribution of salinity on a cross-section, obtained from CTD data (a) and model data (b, c)**



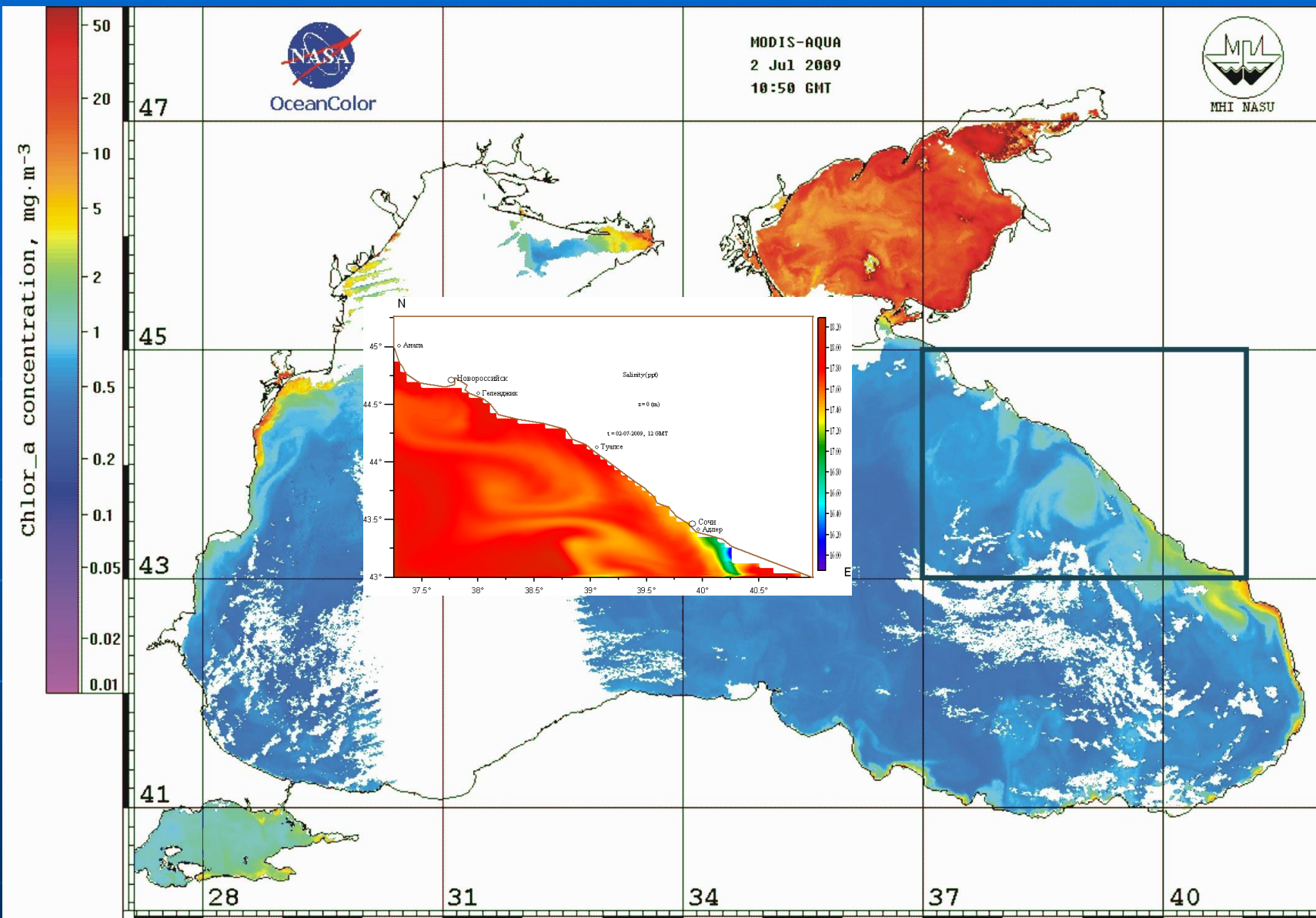
# Model fields of sea currents at depth of 10 m 10.03.2009 (a) and 02.04.2009 (b)



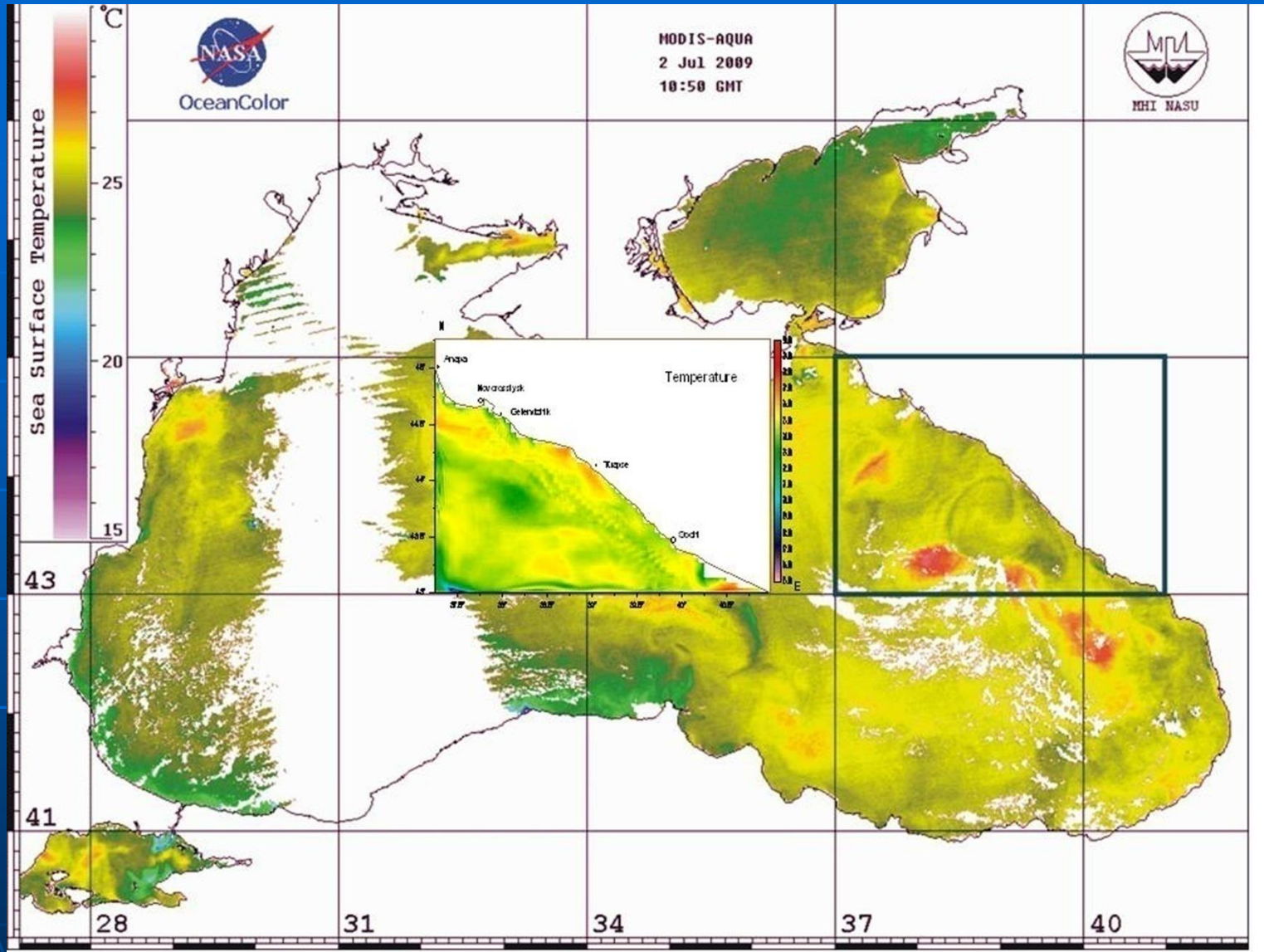
a)



b)



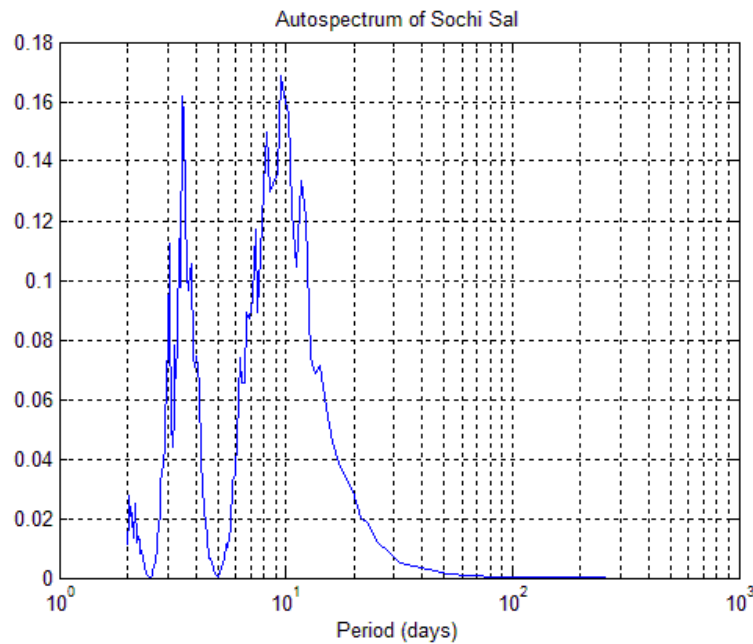
**Satellite image (Chlorophyll concentration) and modeled sea surface salinity at 2 July, 2009**



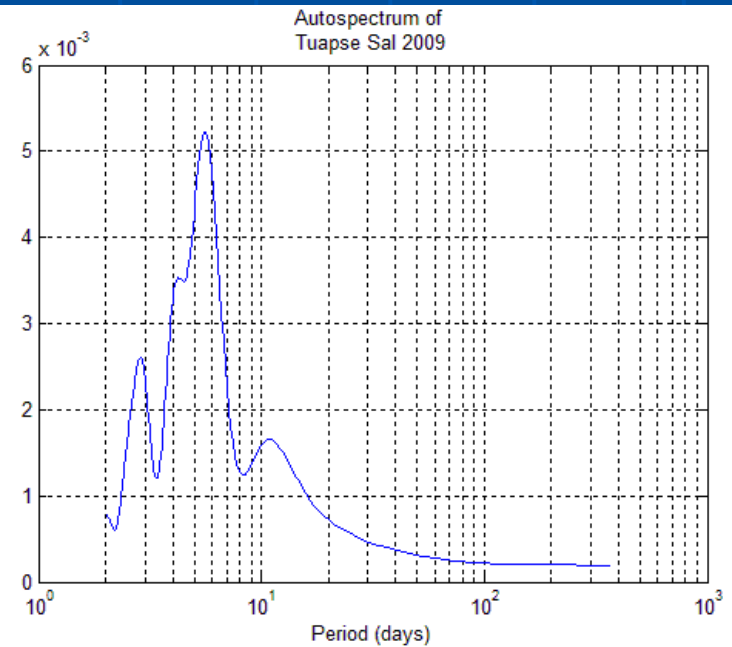
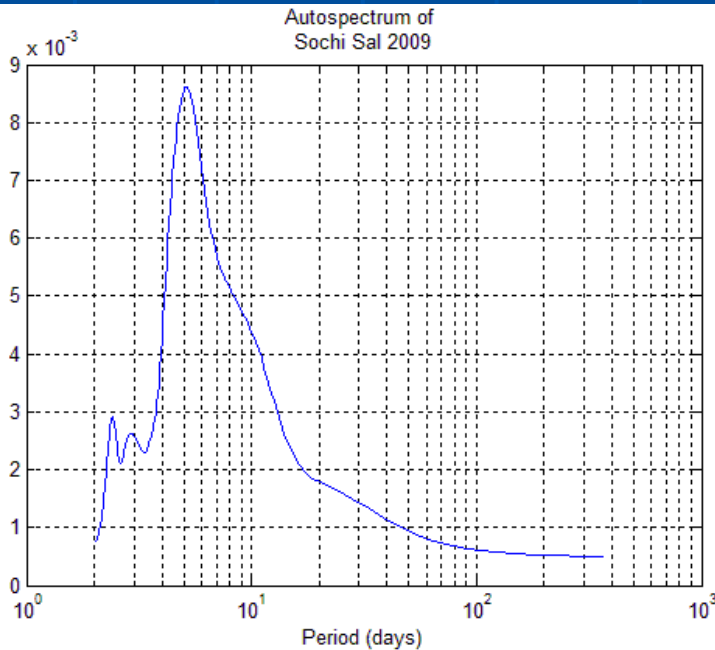
**Satellite image (SST) and modeled sea surface temperature at  
2 July, 2009**

# Autospectrums of salinity

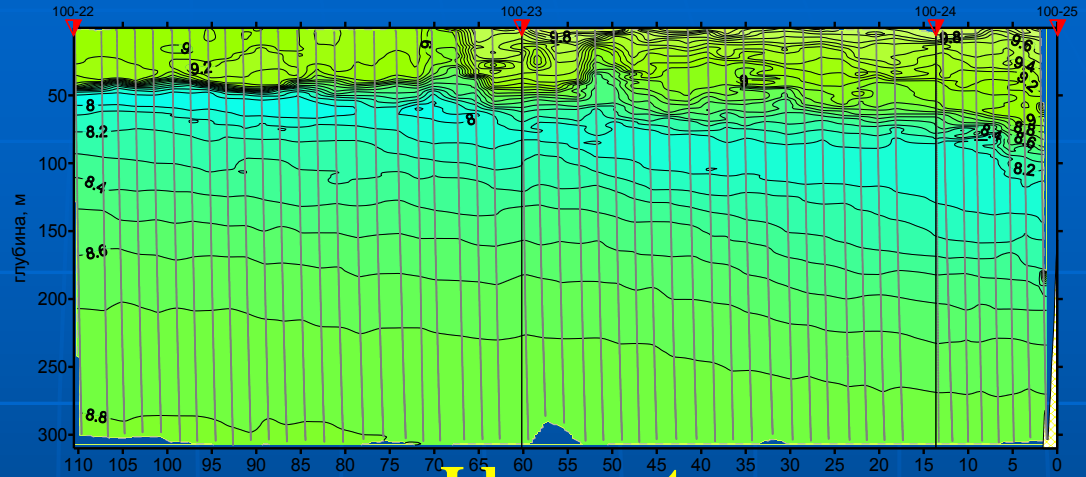
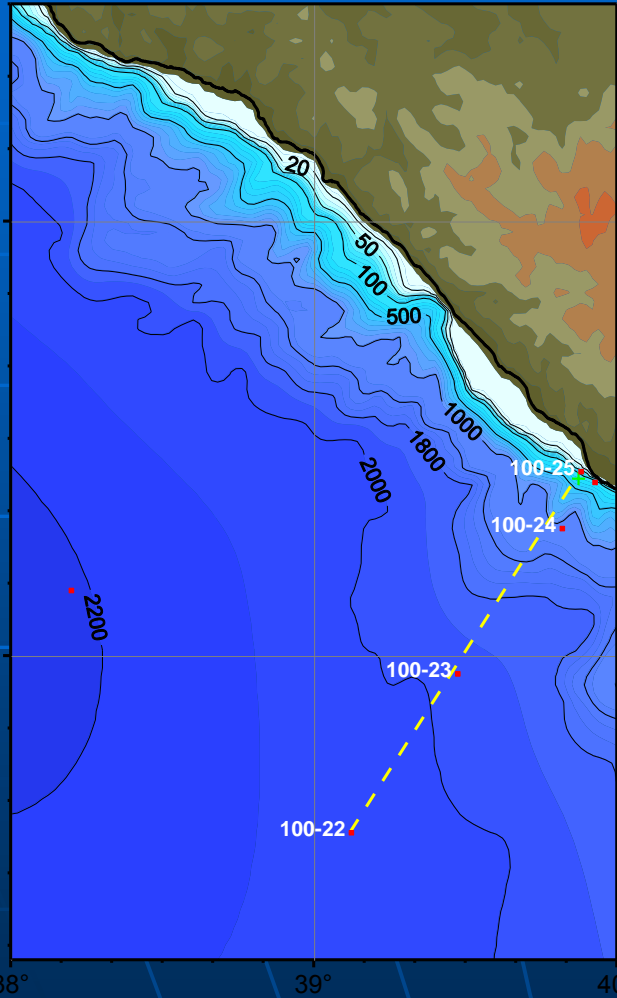
Real data (1991-2005)



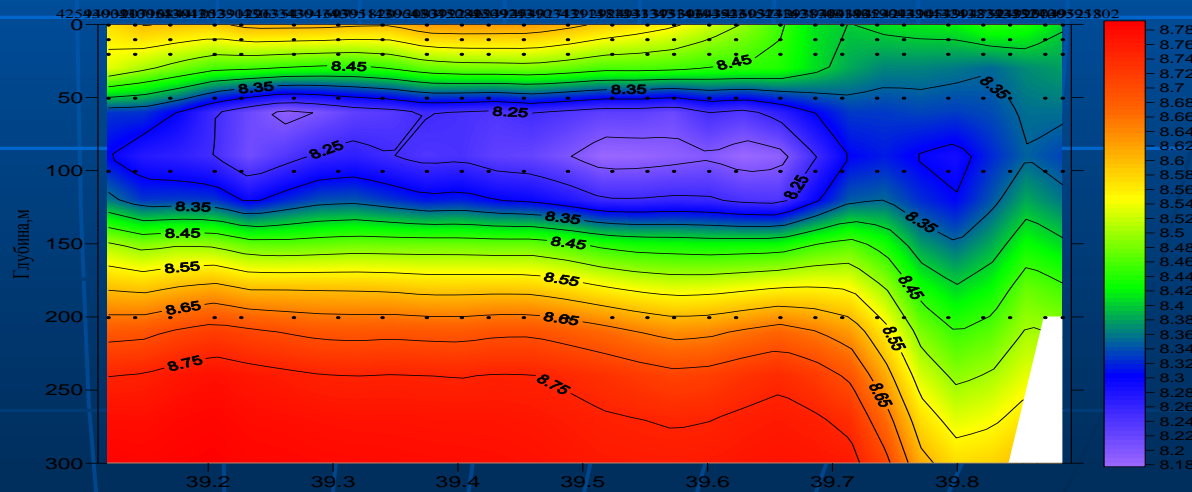
Model data (2009)



# Comparison with "Idronaut" data (18.03.2009, temperature)



**Idronaut**

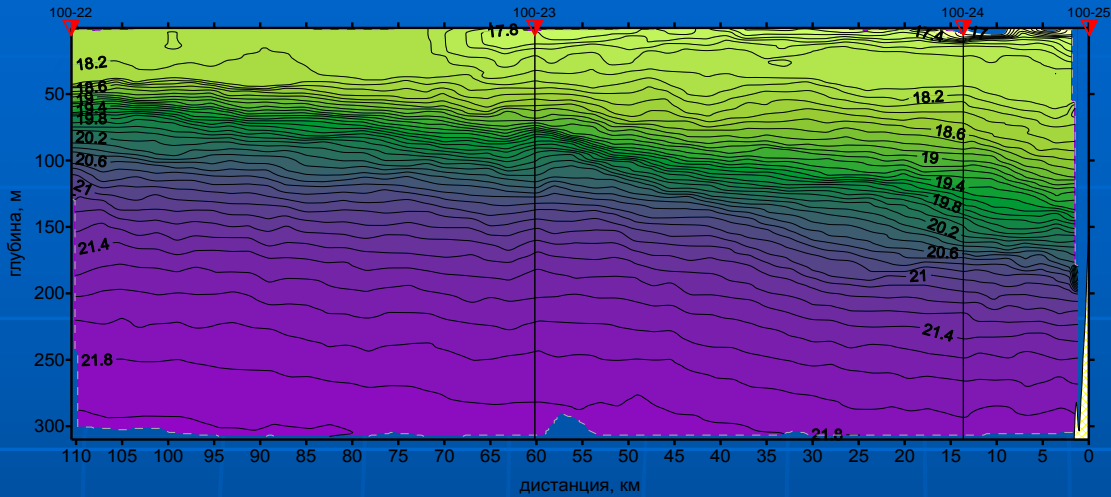


**Model**

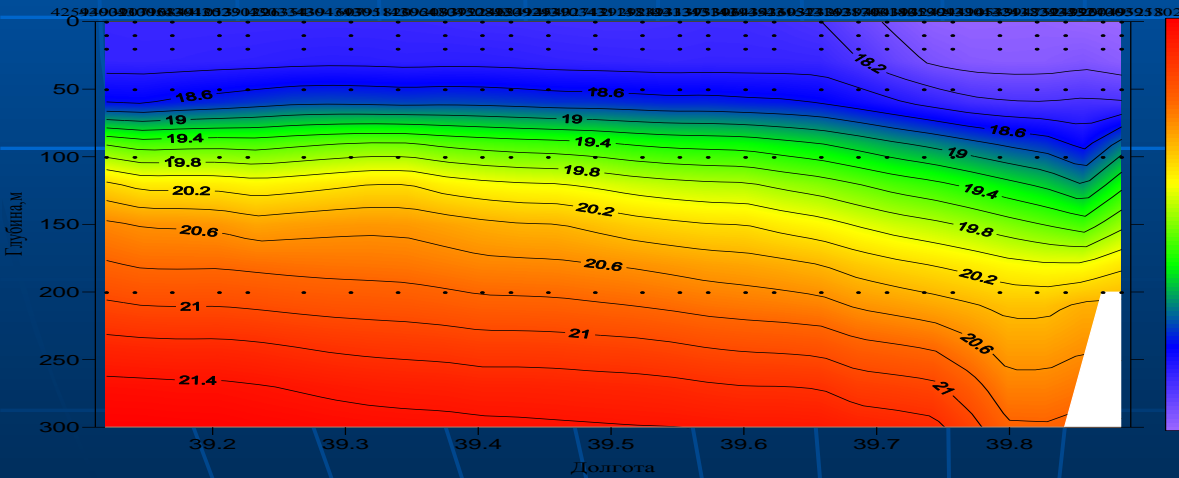
Температура. Разрез по 42.991 - 43.400 с.ш. (21-21 июня 1984 г.)

# Comparison with “Idronaut” data (salinity)

**Idronaut**

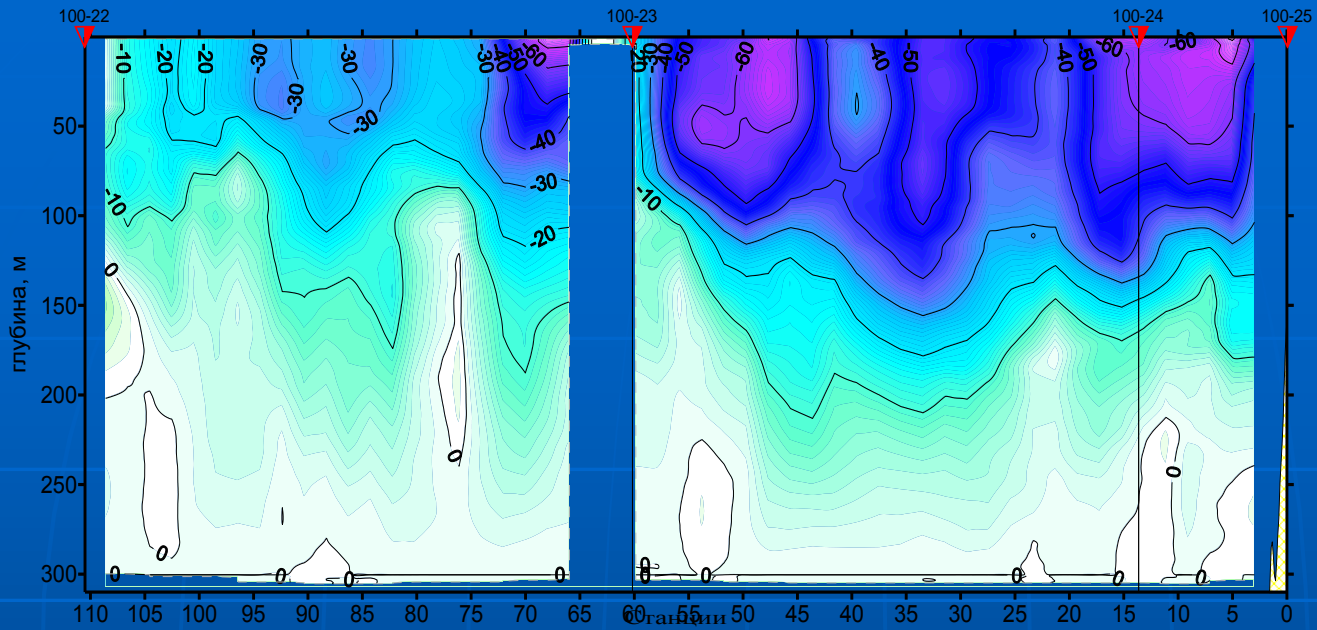


Станции



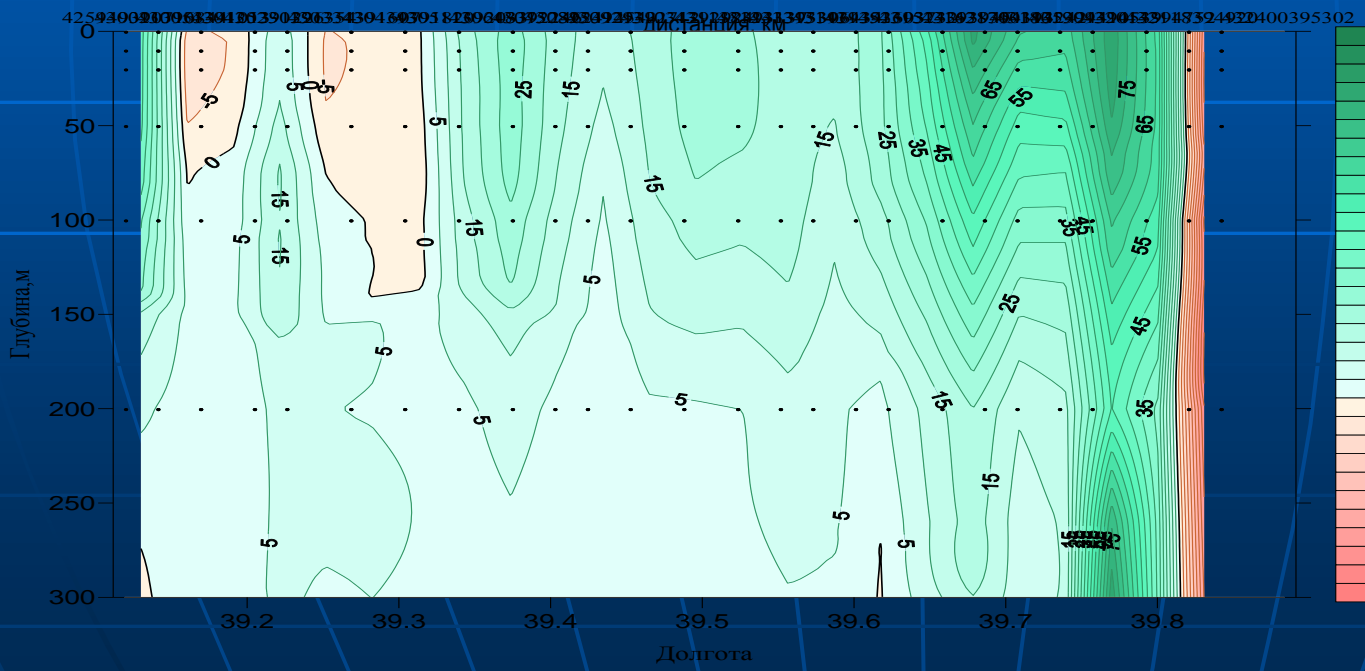
**Model**

Соленость. Разрез по 42.991 - 43.400 с.ш. (21-21 июня 1984 г.)



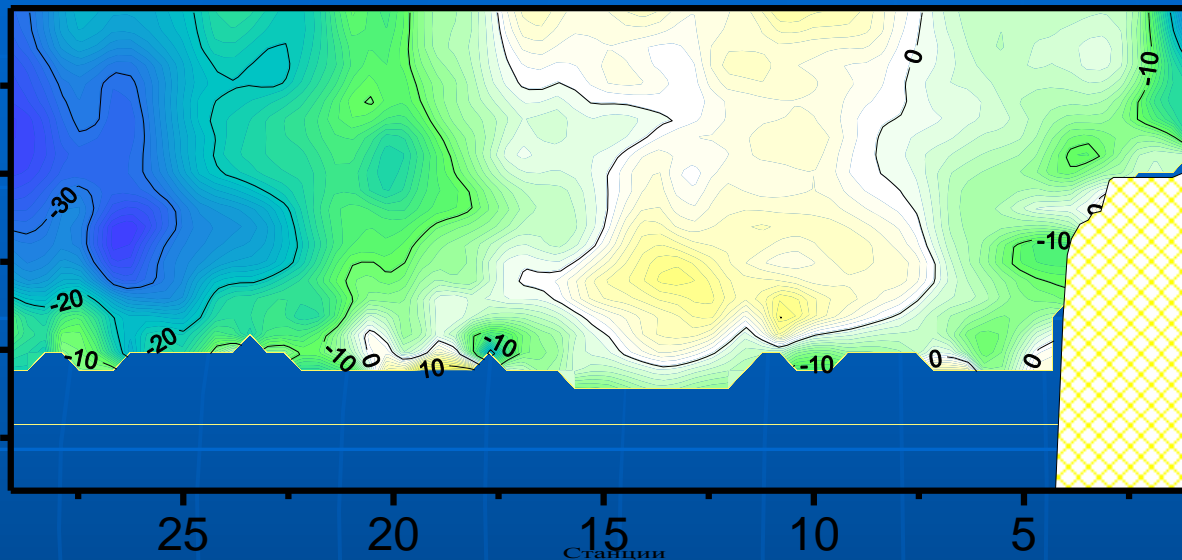
**Comparison with  
“Idronaut” data  
(geostrophical  
velocity)**

**Idronaut**

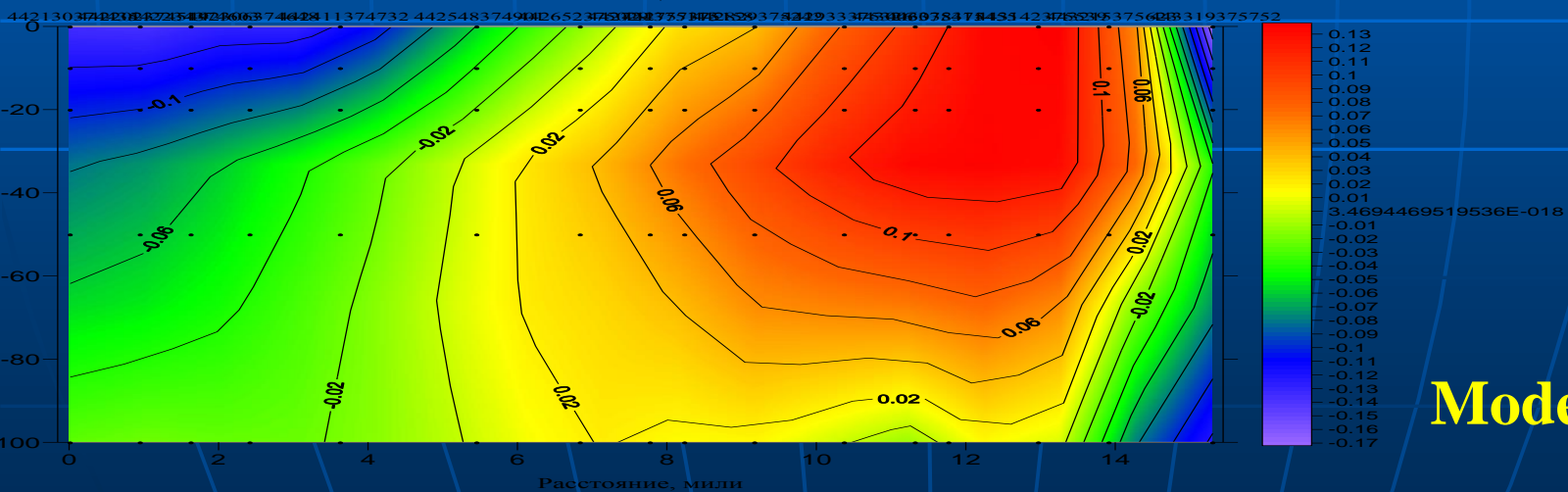


**Model**

# Comparison with ADCP data (horizontal velocity)



**Idronaut**

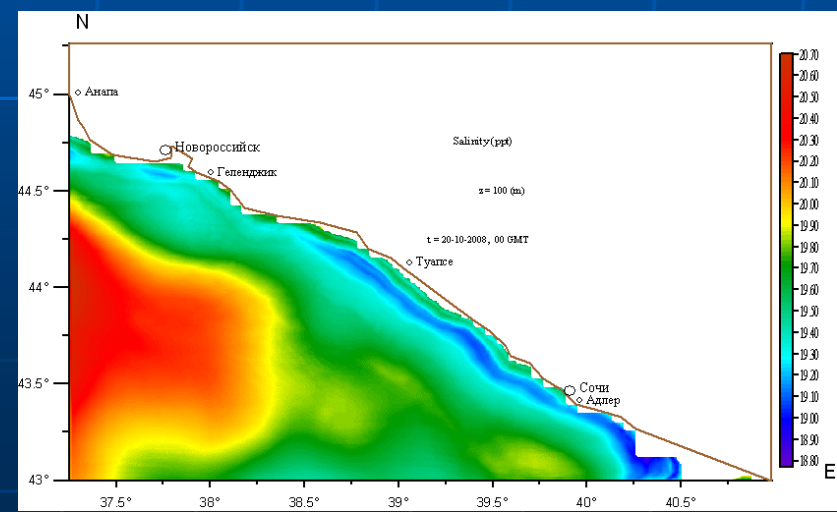
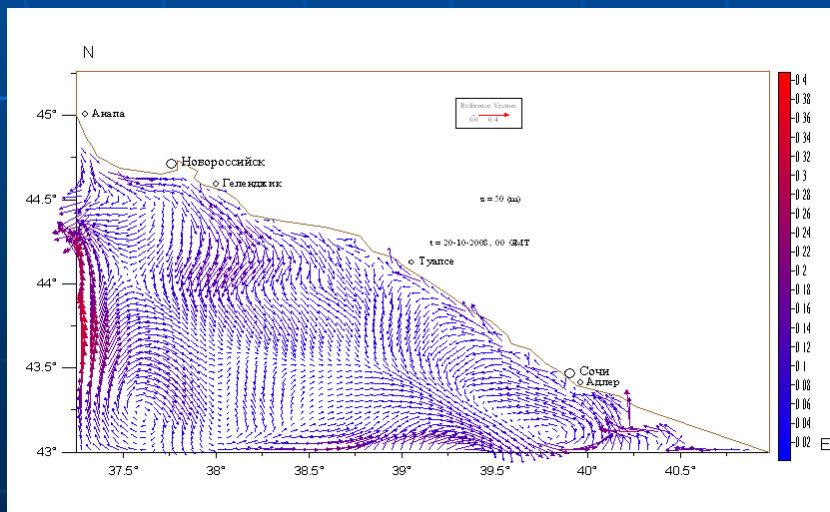
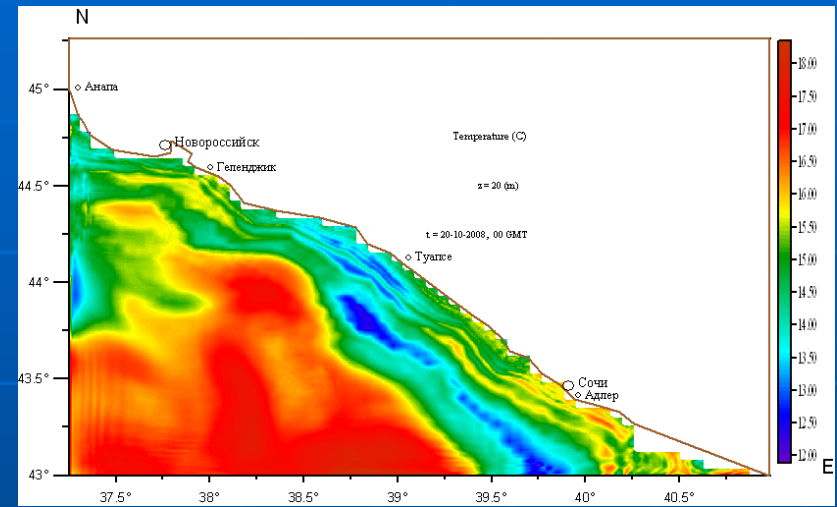
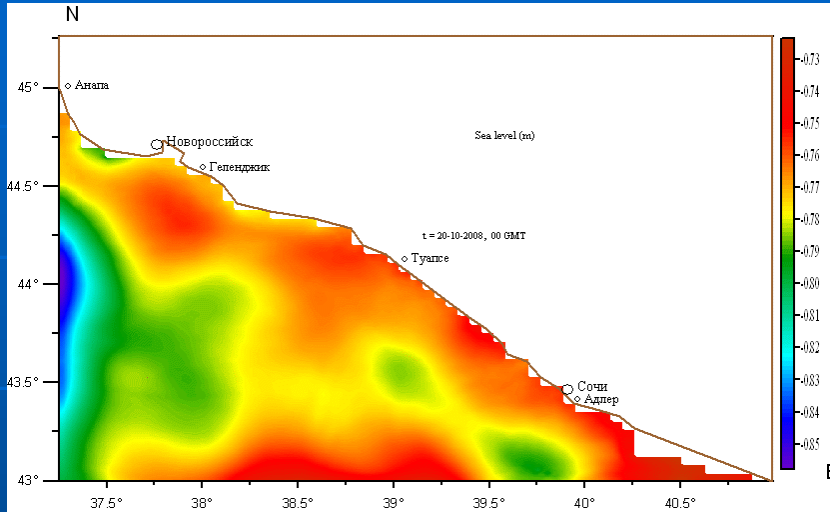


**Model**



# Examples of calculated fields represented on web-site of SOI (daily)


[www.oceanography.ru](http://www.oceanography.ru), [modelling.oceanography.ru](http://modelling.oceanography.ru)



# Подготовка материалов для сайта ГОИН

Результаты расчета Скорос

← → ↻ 🏠 [modelling.oceanography.ru/bs/2011-02-05-20-28-46](http://modelling.oceanography.ru/bs/2011-02-05-20-28-46) ☆ 🌐 🔍



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- Направление исследований
- Издания и публикации
- Учебная работа
- Международная деятельность
- Чёрное море**
  - Результаты расчета Скорости течений**
  - Результаты расчета Солёности
  - Результаты расчета Температуры
  - Результаты расчета Уровня
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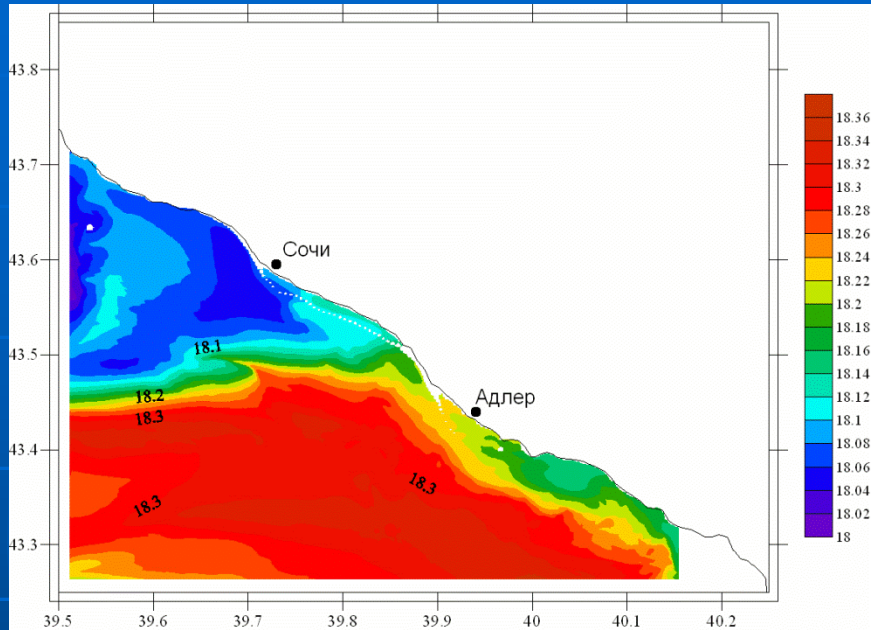
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# Great Sochi Region

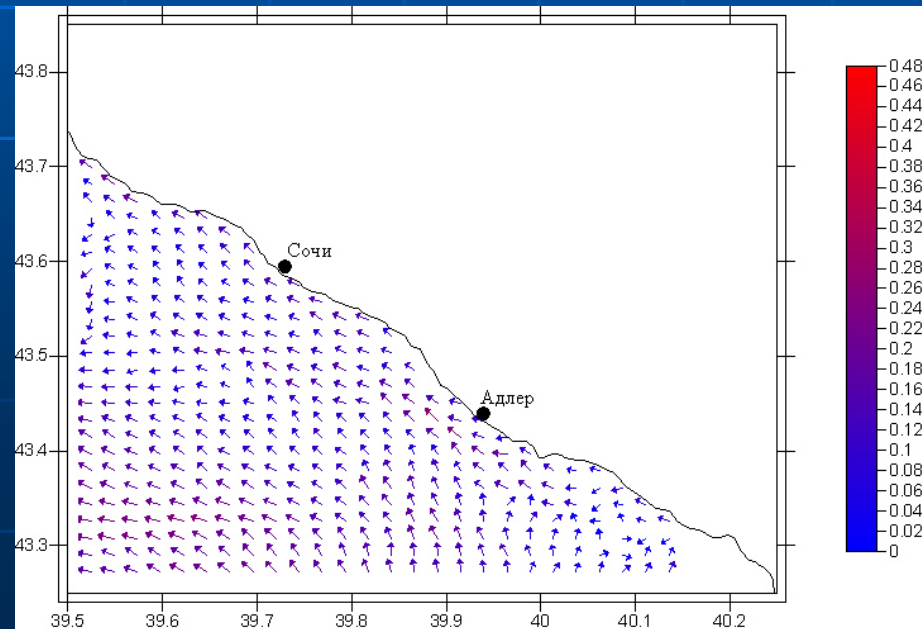


# Great Sochi Region

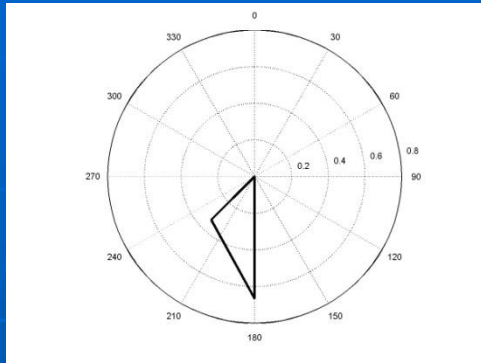


Salinity, 0 m

Currents, 0 m

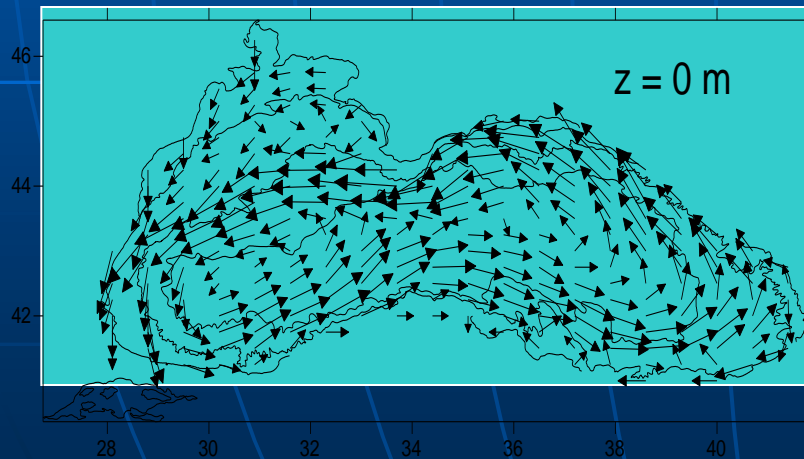


# Electronic atlas of climatic Black Sea currents (JSIWO Project, Russia)



“Rose” of currents

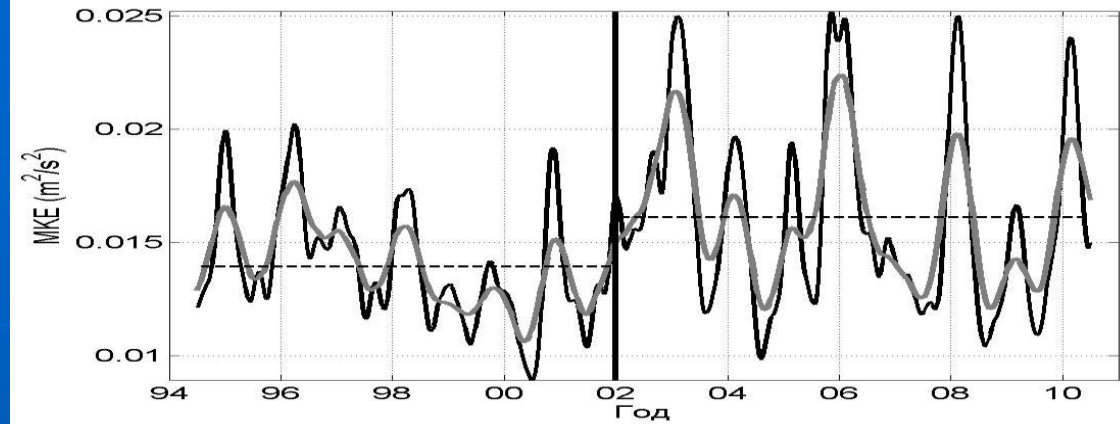
41.8125 lat, 28.3 lon



Example of current's field, climate

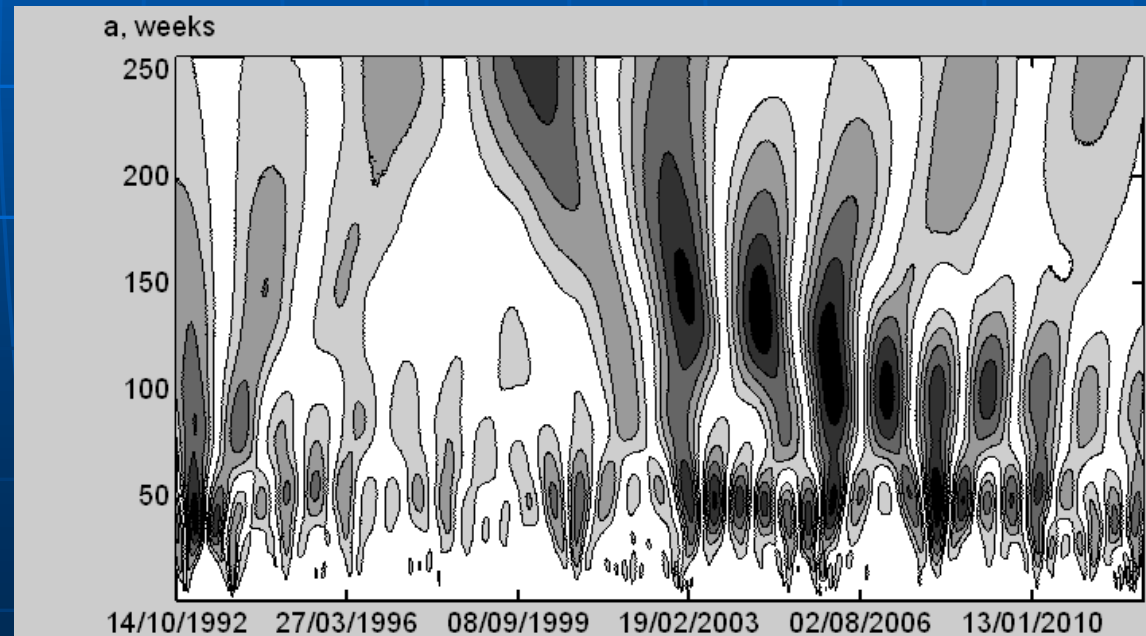
March

# Black Sea

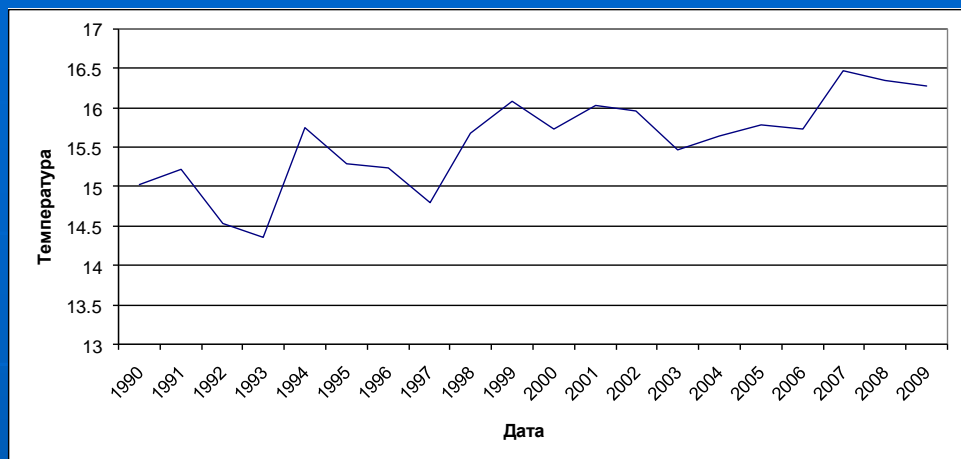


**Kinetic energy ( $\text{m}^2/\text{sec}^2$ )  
(Stanichny, Kubryakov, Zatsepin)**

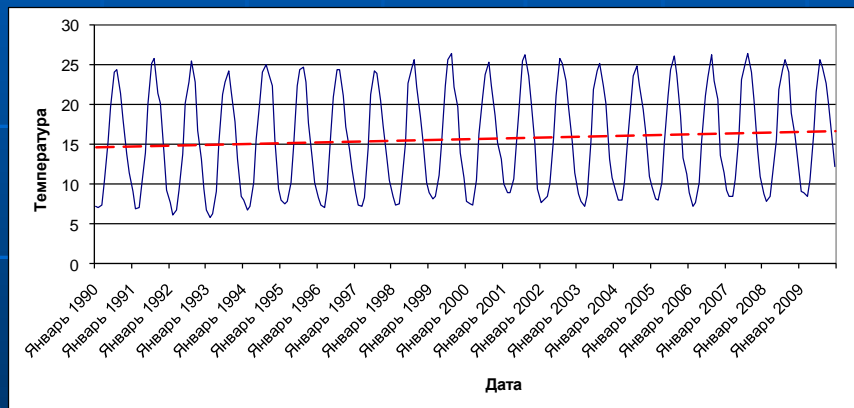
# Wavelet analysis



# Black Sea SST



**Annual data (1990-2009).**



**Month data.  
Linear trend: 2.1 degree  
(14.5-16.6).**

*Thanks for Your's attention*