Сирота А.М., Лебедев С.А., Медведев Д.П., Хлебникова С., Костяной А.Г., Гинзбург А.И., Шеремет Н.А, Кузьмина Е.В.

Геофизический центр РАН

Институт океанологии им. П.П. Ширшова РАН

Верификация данных спутниковой альтиметрии в прибрежной зоне европейских морей

Helen Snaith ,
Paolo Cipollini , Fabio Venuti

National Oceanography Centre,
Southampton, United Kingdom

Florent Lyard,
Jean François Cretaux,
Florence Birol,
Jérôme Bouffard

CNRS-LEGOS, Toulouse, France

Laurent Roblou

Noveltis, Ramonville-Saint-Agne, France

Sergey Lebedev,
Alexander Sirota,
Dmitry Medvedev,
Svetlana Khlebnikova

Geophysical Center, Russian Academy of Sciences, Moscow, Russia

Stefano Vignudelli

Istituto di Biofisica, Consiglio Nazionale delle Ricerche, Pisa, Italy

Andrey Kostianoy,
Anna Ginzburg, Nickolay Sheremet,
Elena Kuzmina

P. P. Shirshov Institute of Oceanology,
Moscow, Russia

Ramiz Mamedov,
Khasiyat Ismatova, Amir Alyev,
Tural Nabiyev

Institute of Geography, Center for Caspian Sea Problems, Baku, Azerbaijan

ALTImetry over COastal REgions

The original ALTICORE Project is funded by EU/INTAS and aims at providing high-resolution coastal altimetry from multiple missions over the European Seas

www.alticore.eu

Improving quality of data

- ✓ Backward reanalysis of official products
- ✓ New processing strategy

Making data more accessible

- ✓ Avoid duplication of efforts
- ✓ Data available at a mouse click

Exploiting data in the coastal context

- ✓ Comparison with in situ data (sea-truth)
- ✓ Use for circulation, coastal dynamics, coastal simulation

Building capacity in coastal altimetry

- ✓ Transferring know-how
- ✓ Improving cooperation between EU and Eastern European Countries

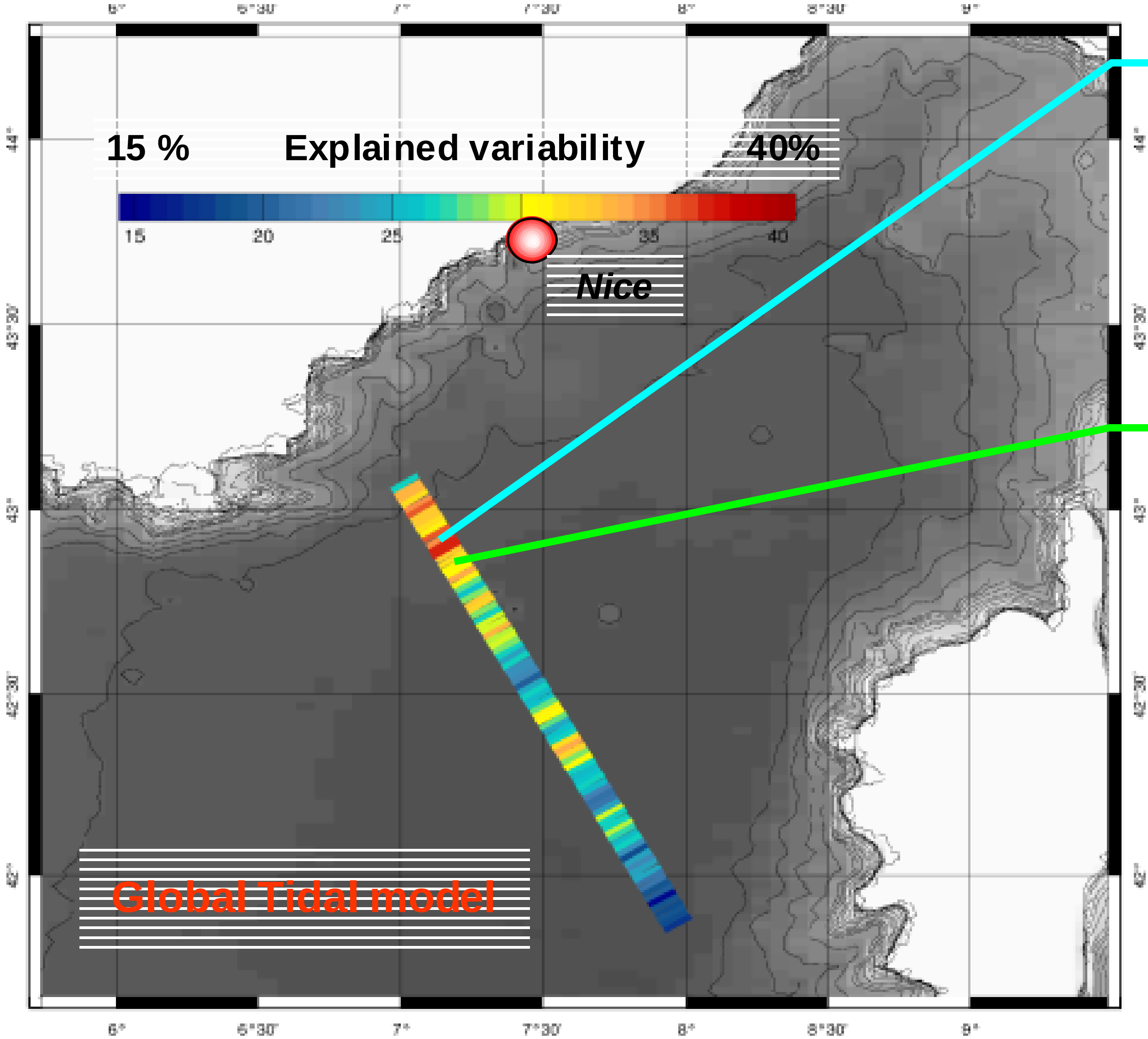
INTAS CORDIS

Three good things about ALTICORE

1. **Simple, pragmatic approach to recovering data in coastal environment, based on the reference RADS archive developed at DEOS Delft, and on recent research in coastal altimetry (ALBICOCCA Project, X-TRACK processing scheme)**
   - ✓ Uses higher-rate data but ***no retracking***
   - ✓ Aims at demonstrating that such a service can be operational
2. **Promotes an efficient paradigm for easy access to data, based on web services and the OPeNDAP protocol**
   - ✓ This makes data access straightforward also by automated procedures (models, forecasting services)
3. **Contributes to capacity building by drawing developing countries into the altimetric community**
   - ✓ They can bring to the consortium their local expertise (tidal modelling, in situ measurements for validation/calibration, etc.)
   - ✓ FSU countries participate in ALTICORE
   - ✓ Extension to India (ALTICORE-India) underway. Other regions to follow…

The Mediterranean Sea Tide Gauge

Impact of regional tidal corrections



STANDARD CORRECTION

Correlation: 0.75
Residual RMS: 4.1 cm
RMS explained: 33%

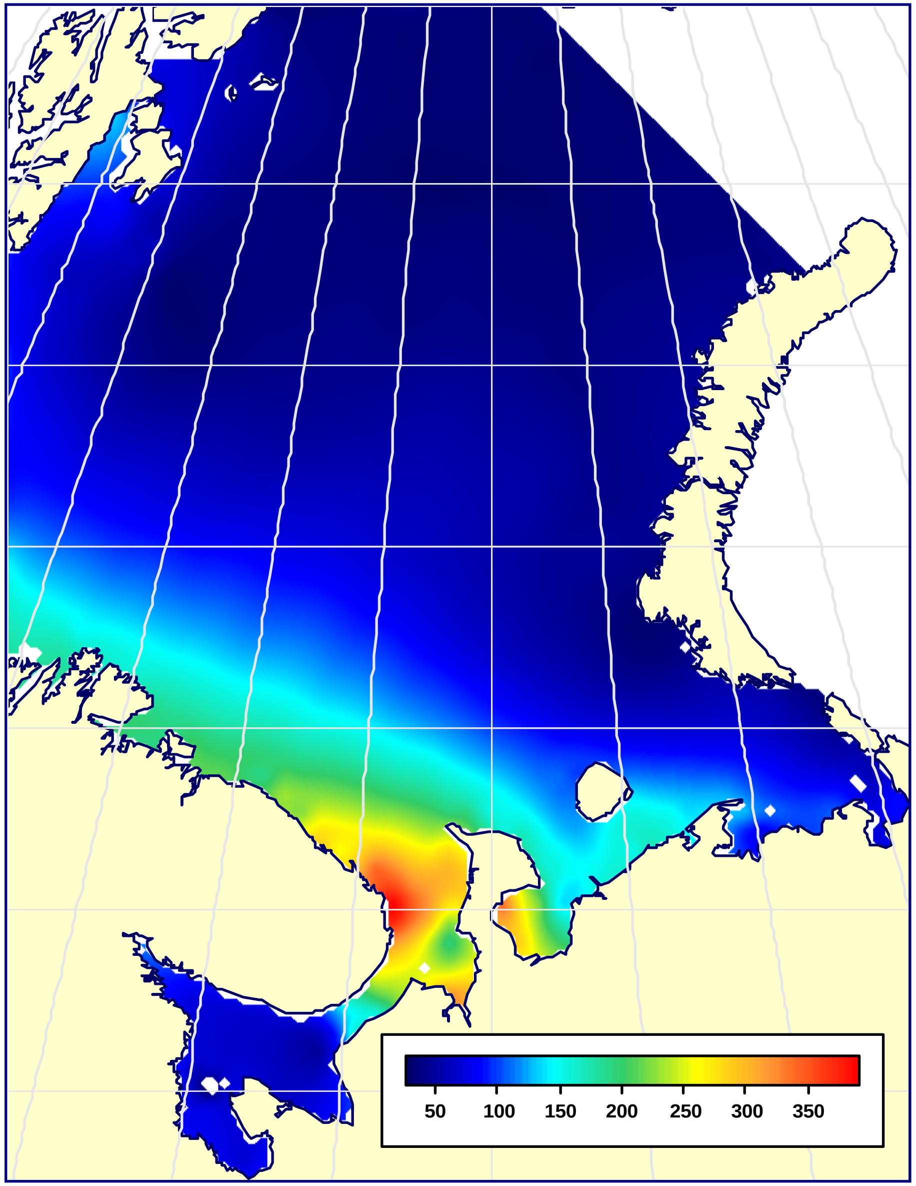
REGIONAL CORRECTION

Correlation: 0.78
Residual RMS: 3.9 cm
RMS explained: 37%

MOG2D Medsea (Regional configuration of MOG2D) improves the consistency between the altimeter and the Nice tide gauge time series.

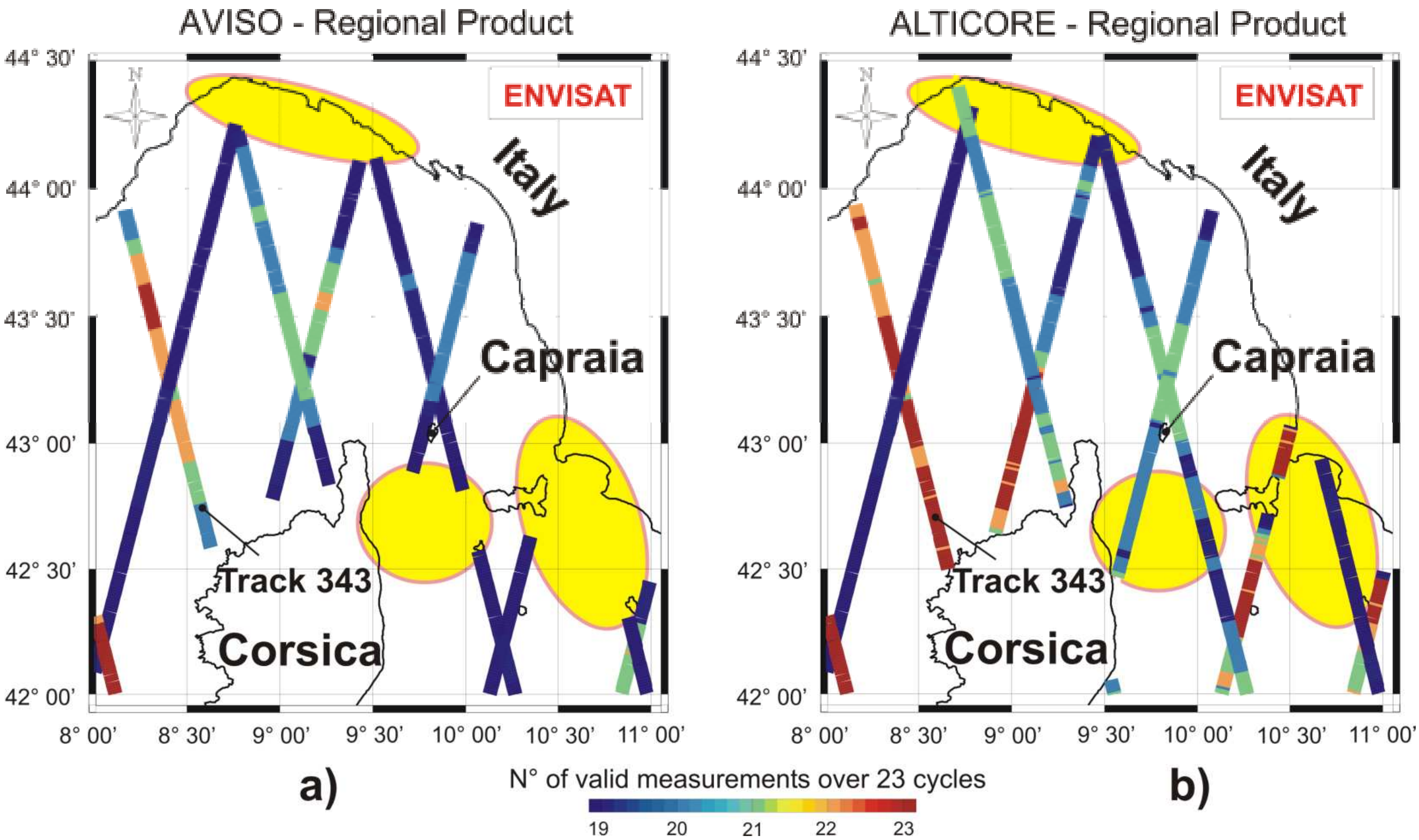
The White and Barents Seas Tide Gauge

For the Barents and the White Seas tide correction are taken. RADS have two values of this correction which calculated the next global ocean tide model FES99 and GOT00. Authors of RADS recommend to use tide height calculated on GOT00 model. Both model have spatial resolution 0.5° on latitude and longitude. For example this resolution for the White Sea is rough. For this region we propose regional tide model of Hydrometeorological Research Centre of the Russian Federation (HRCRF)



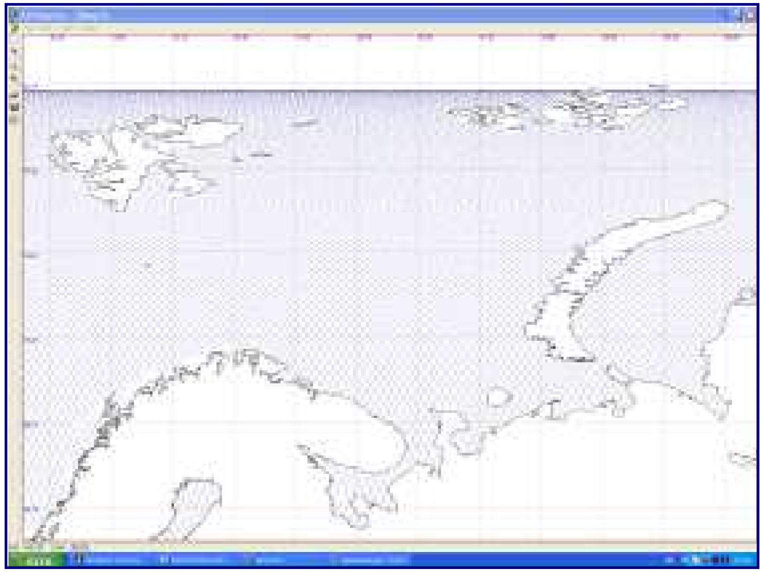
The comparison of results of calculation on the global model (GOT00) and on the Regional tide model HRCRF for Barents and White Seas. Maximal deviation of tide height (cm).

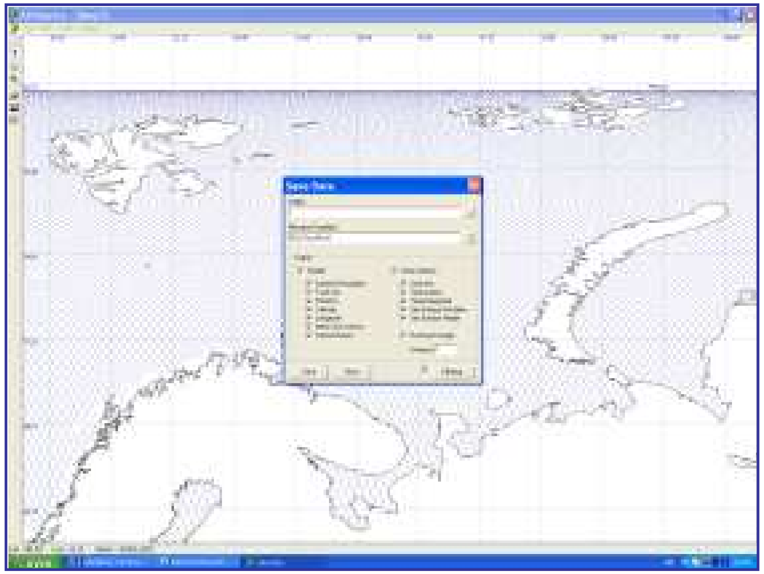
The Mediterranean Sea – ENVISAT



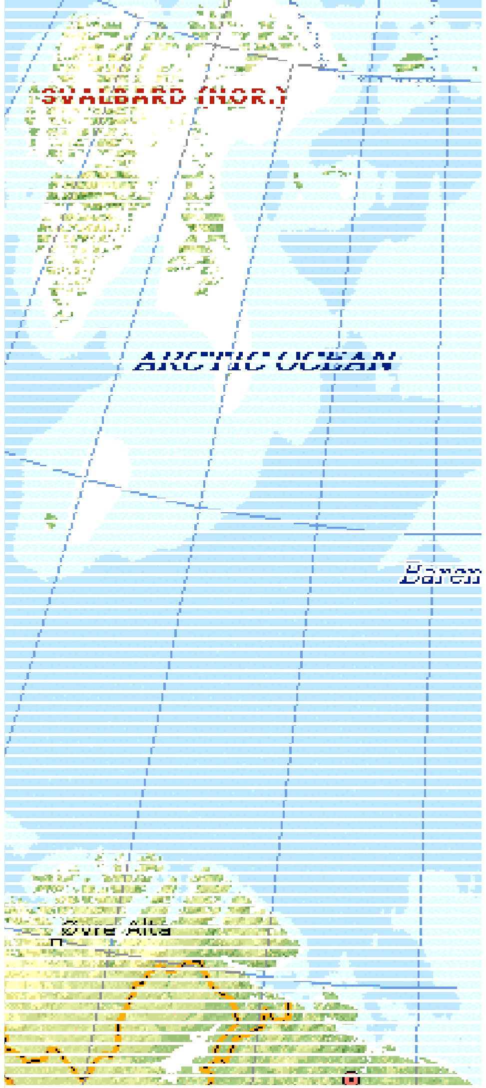
The Mediterranean Sea – ENVISAT

	AVISO			ALTICORE		
	Mean time-sampling	RMS difference	No. of tracks	Mean time-Sampling	RMS differenc e	No. of tracks
Genoa	16.6 days	5.1 cm (3.9 cm)	2	7.3 days	4.7 cm (3.5cm)	5
Capraia	14.6 days	4.2 cm (3.9 cm)	1	4.1 days	3.4 cm (2.4 cm)	6
Senetosa	10.9 days	4.6 cm (3.4 cm)	4	4.6 days	4.7 cm (2.9 cm)	9

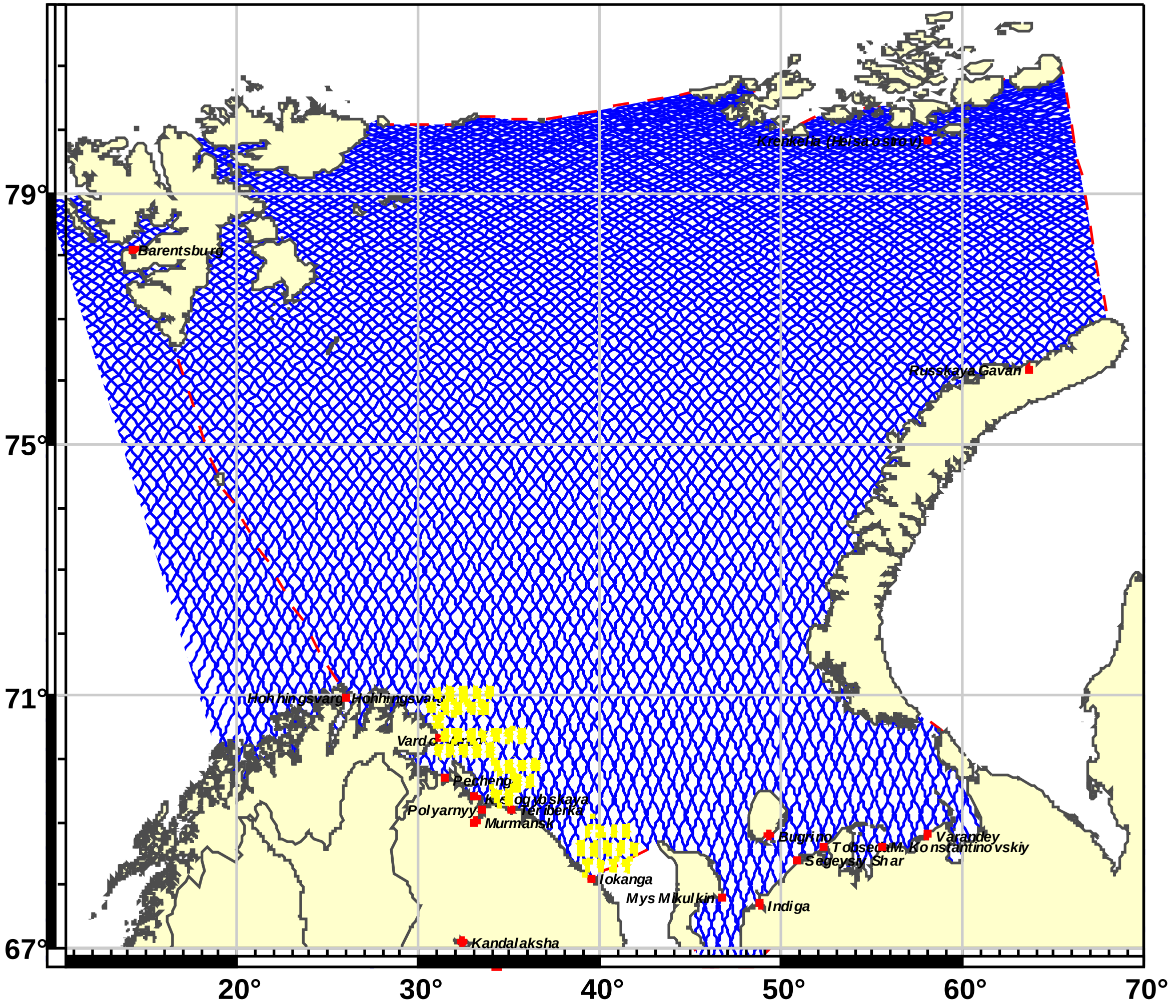




➲ **Program ALTIMITER for the RADS satellite altimetry data extraction (*Dmitry Medvedev*).**

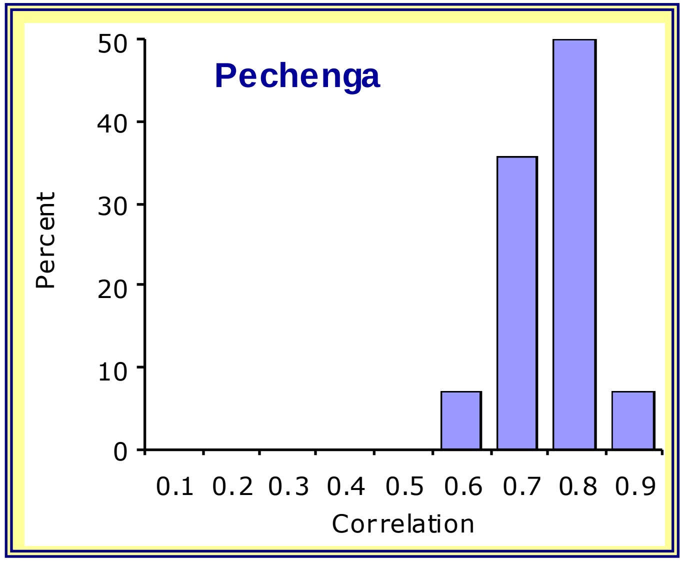


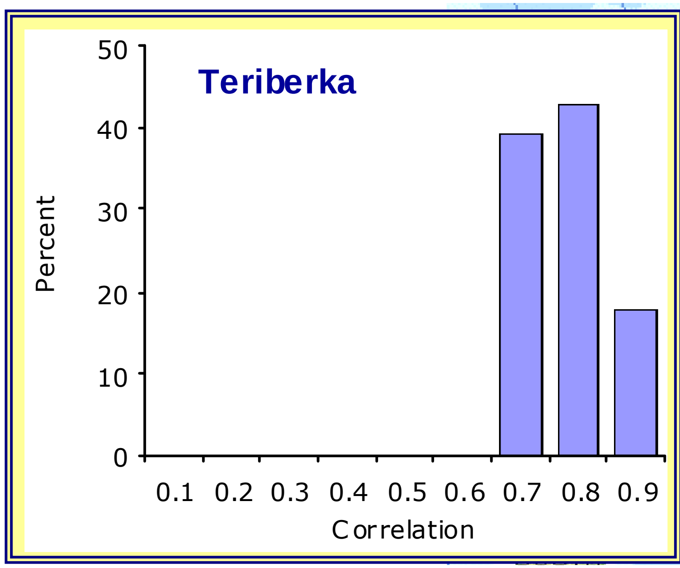
Barents Sea (ERS-1 & ERS-2)

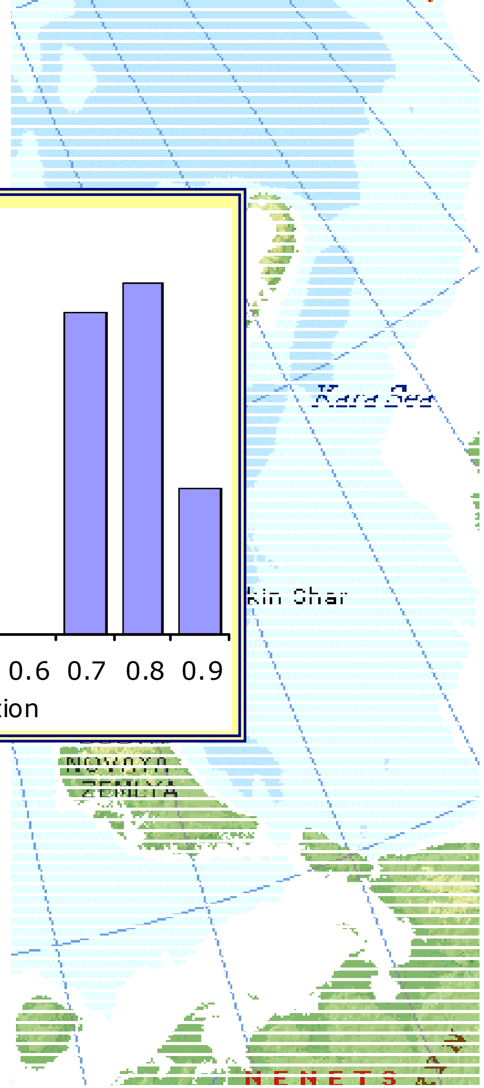


Blue lines – ERS-1(C, G) and ERS-2 groundtracks (1992-1993, 1995-1996)
Red circles – location of tide gauges
Yellow points – sample points from the groundtracks for data comparison

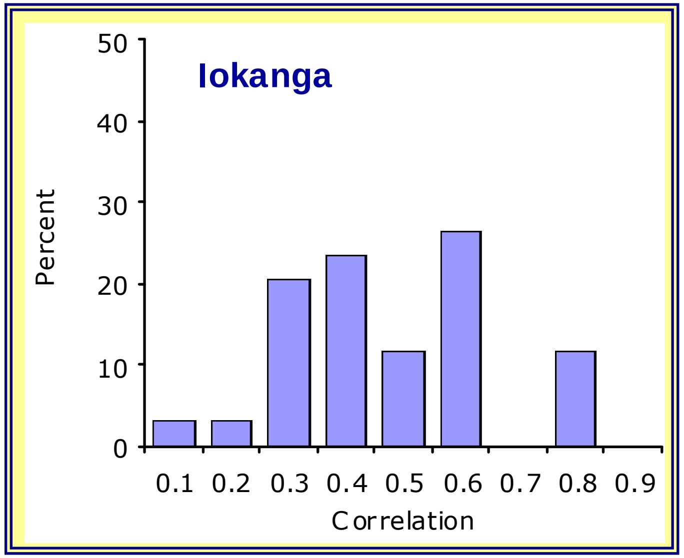
Barents Sea (ERS-1 & ERS-2)



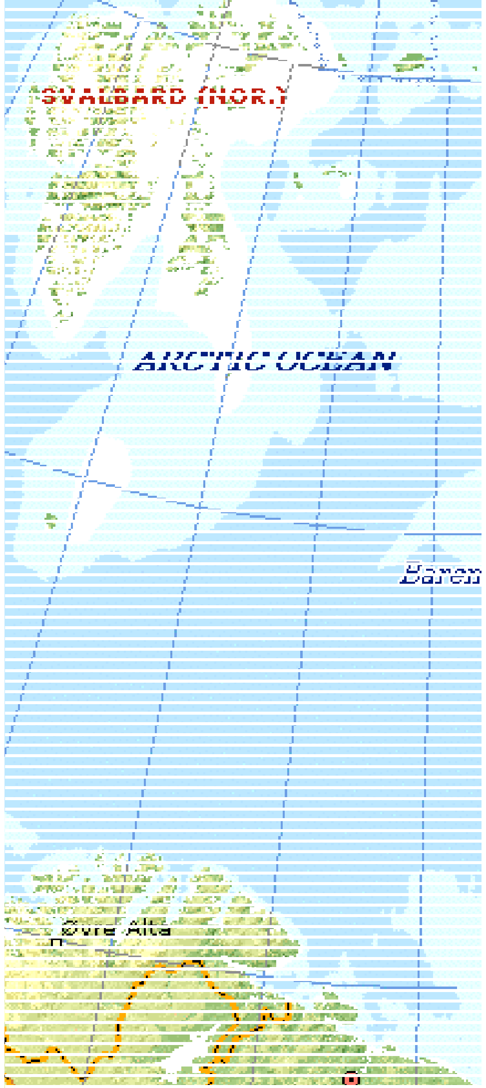


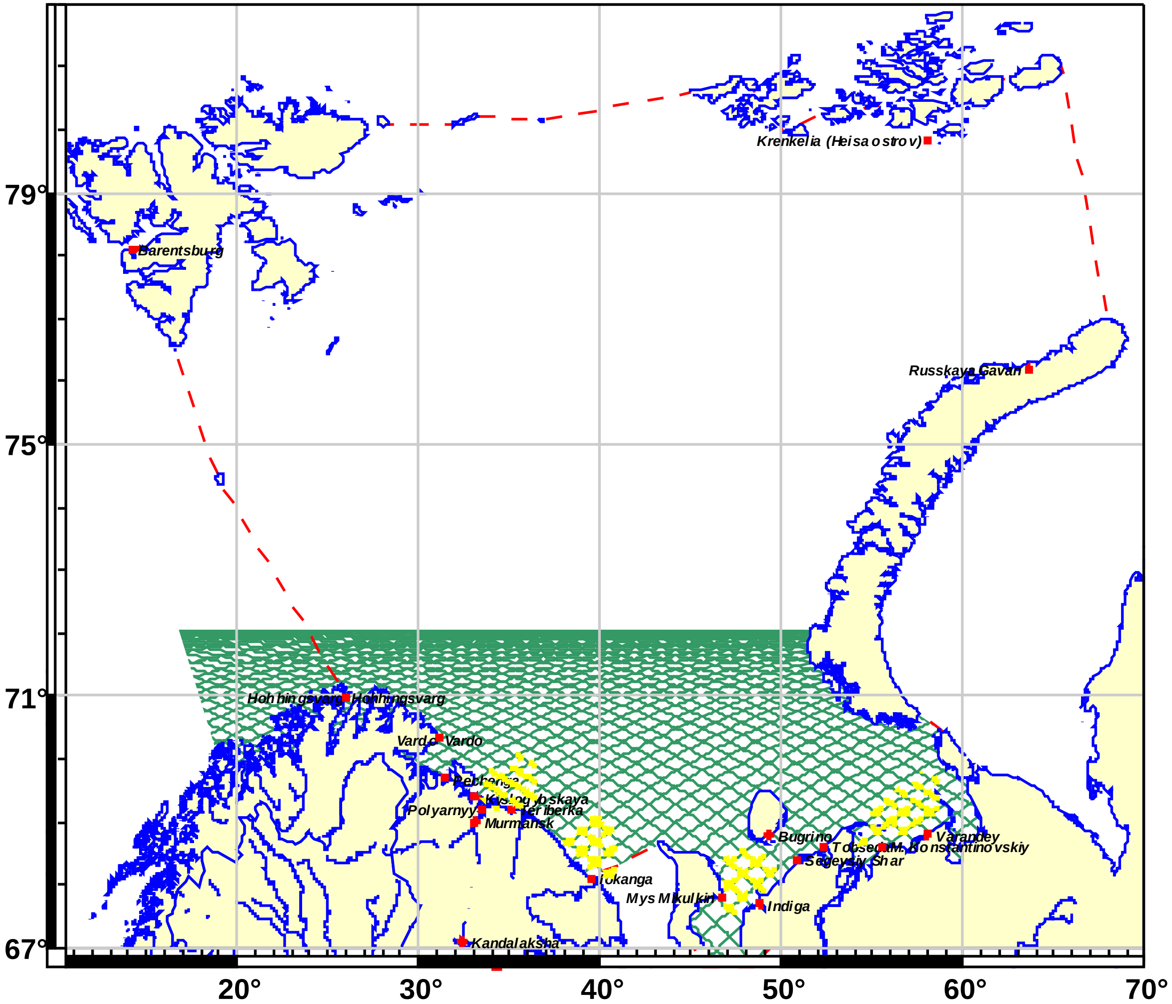


Statistical distribution of correlation between ERS-1 & ERS-2 SLAs and tide gauges SL in several locations at the Barents Sea in 1992-1993 and 1995-1996



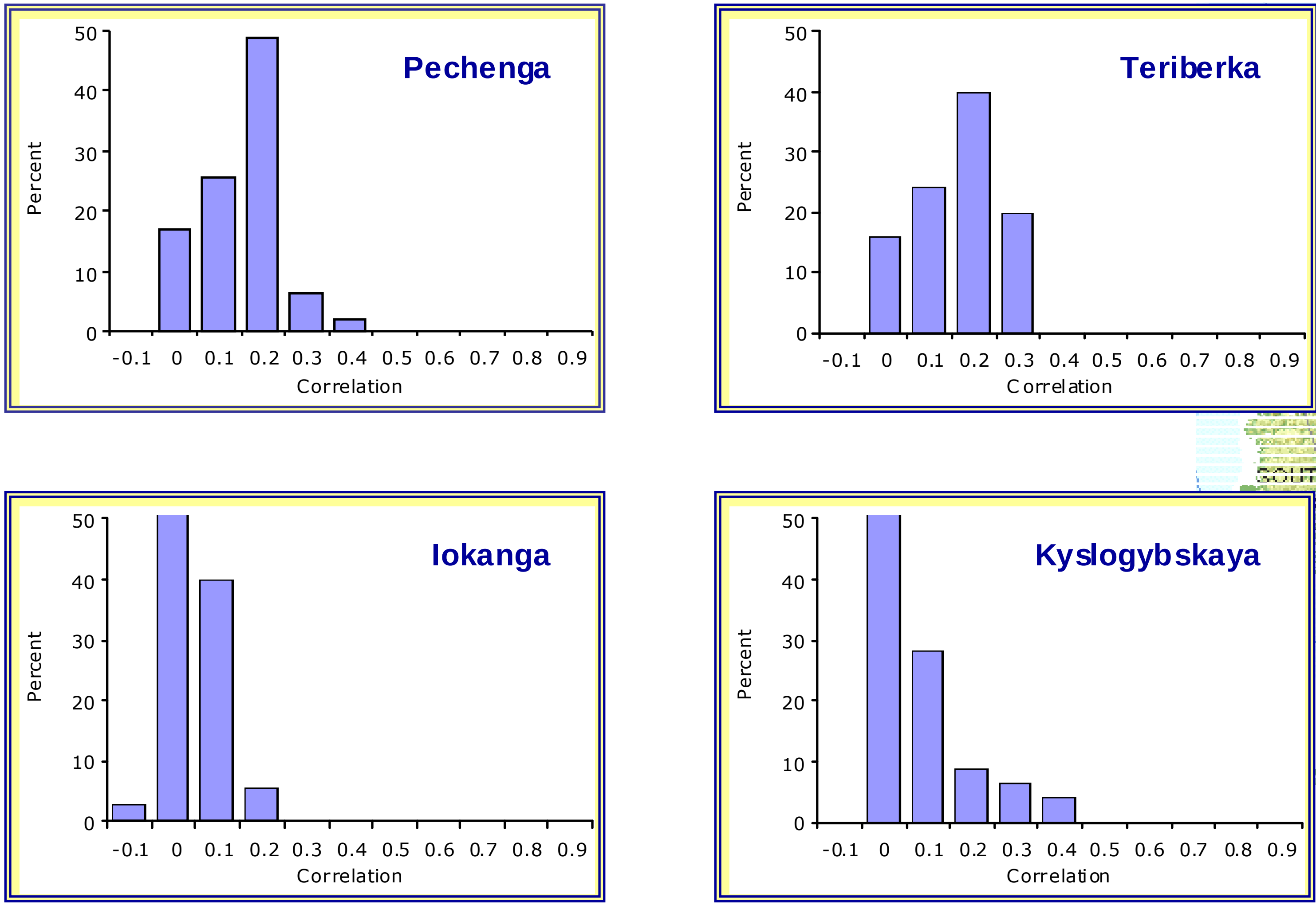
Barents Sea (GEOSAT)

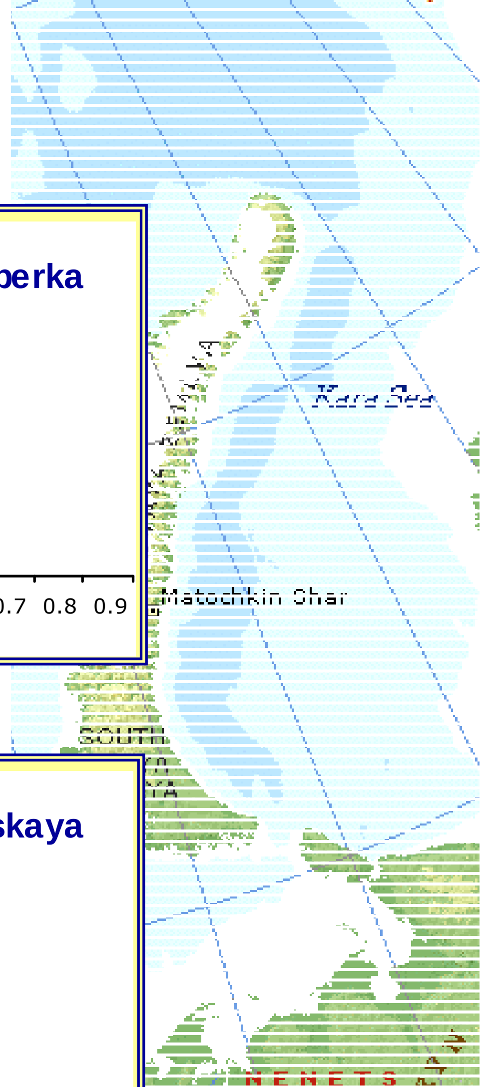




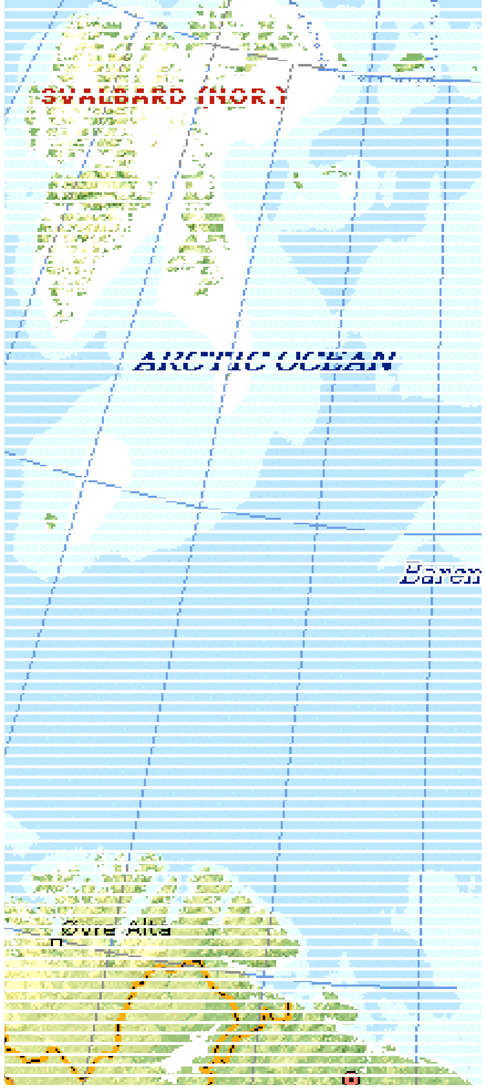
Green lines – GEOSAT (B) groundtracks (1987-1989)
Red circles – location of tide gauges
Yellow points – sample points from groundtracks for data comparison

Barents Sea (GEOSAT)

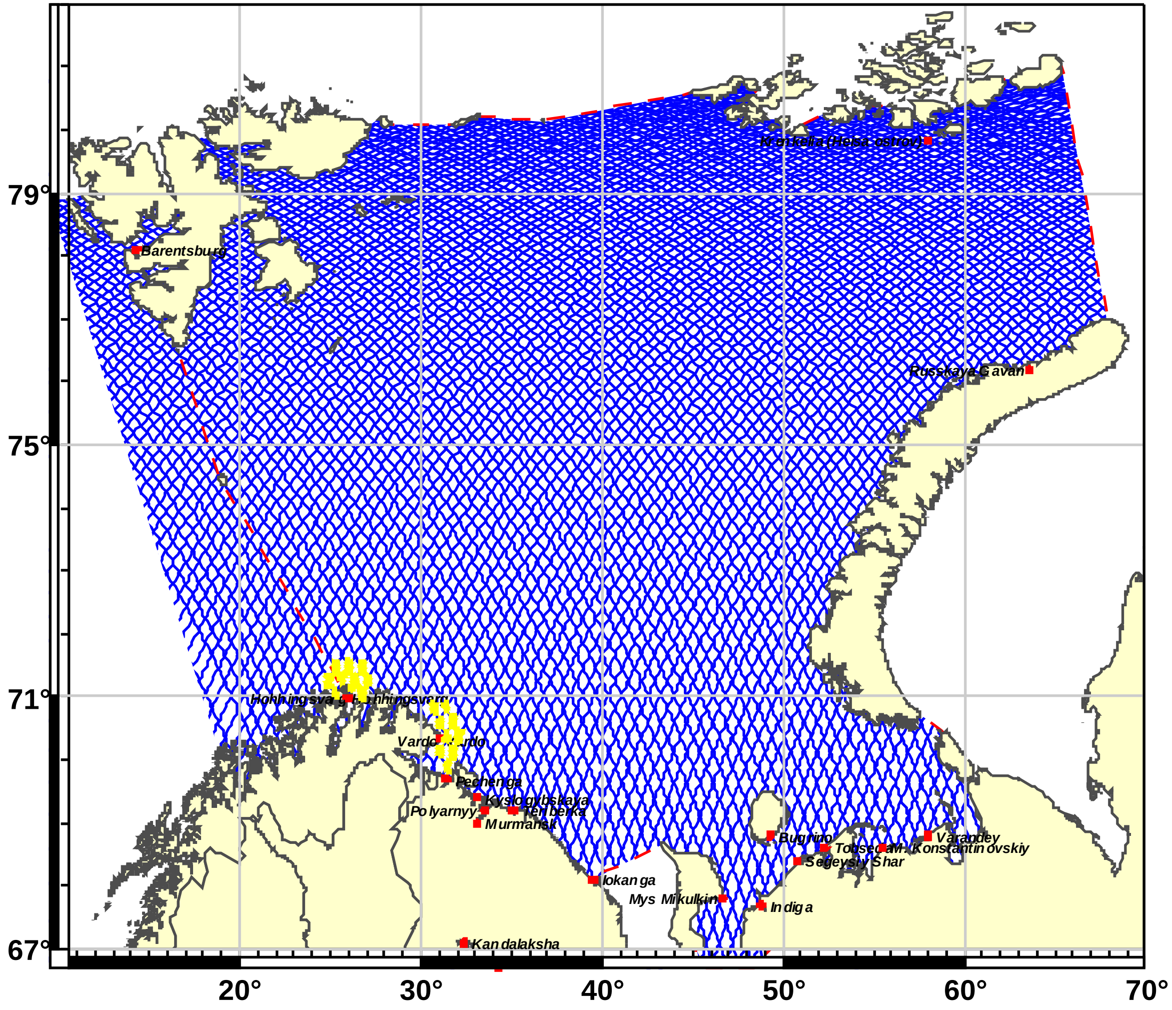




Statistical distribution of correlation between GEOSAT SLAs and tide gauges SL in several locations at the Barents Sea in 1987-1989



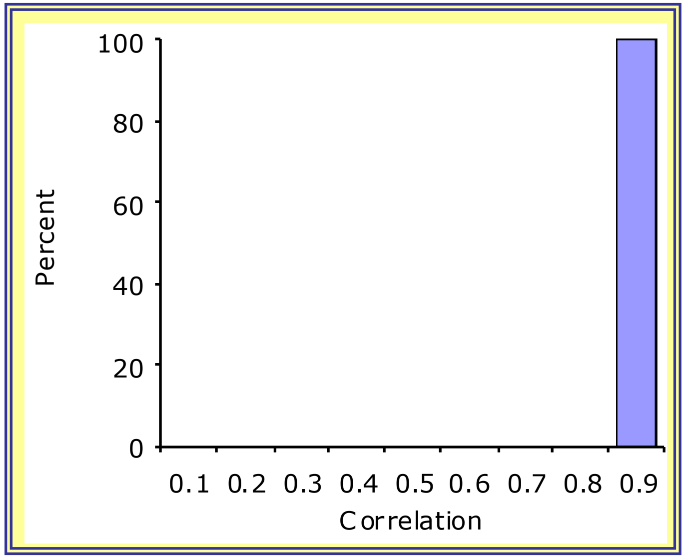
Barents Sea (ERS-2 & ENVISAT)

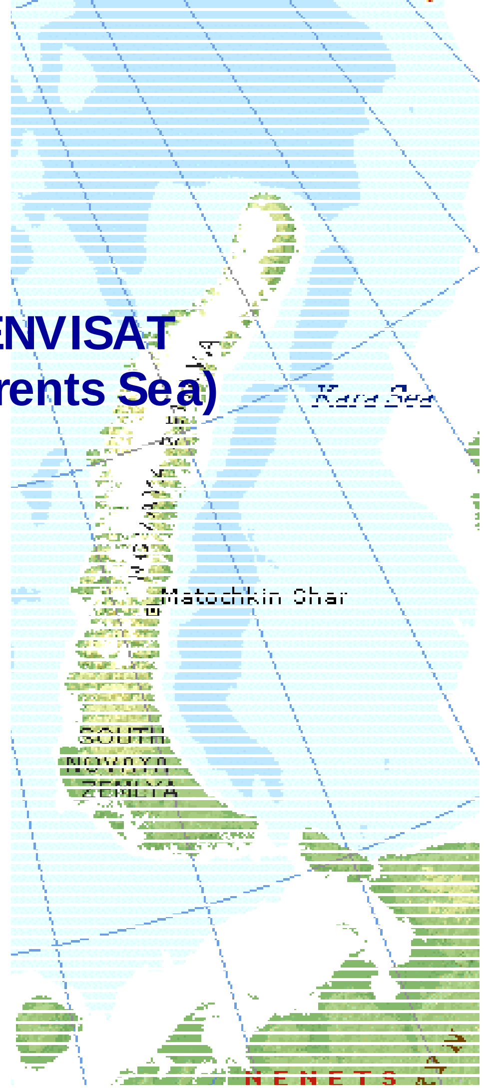


Blue lines – ERS-2 and ENVISAT groundtracks (2001-2007)
Red circles – location of tide gauges
Yellow points – sample points from the groundtracks for data comparison

Barents Sea (ERS-2 & ENVISAT)

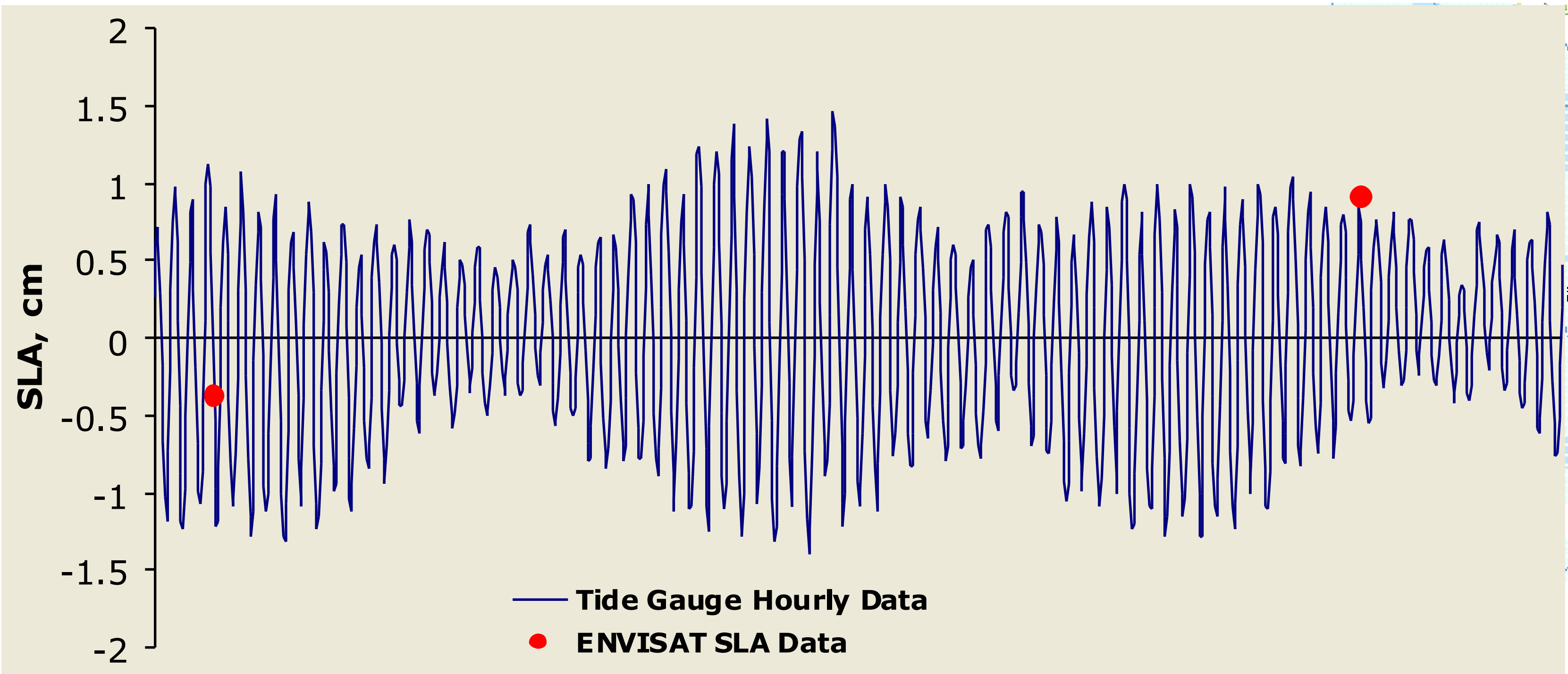
Statistical distribution of correlation between ERS-2 & ENVISAT SLAs and tide gauges SL in Vardo and Hohhingsvarg (Barents Sea) in 2001-2007

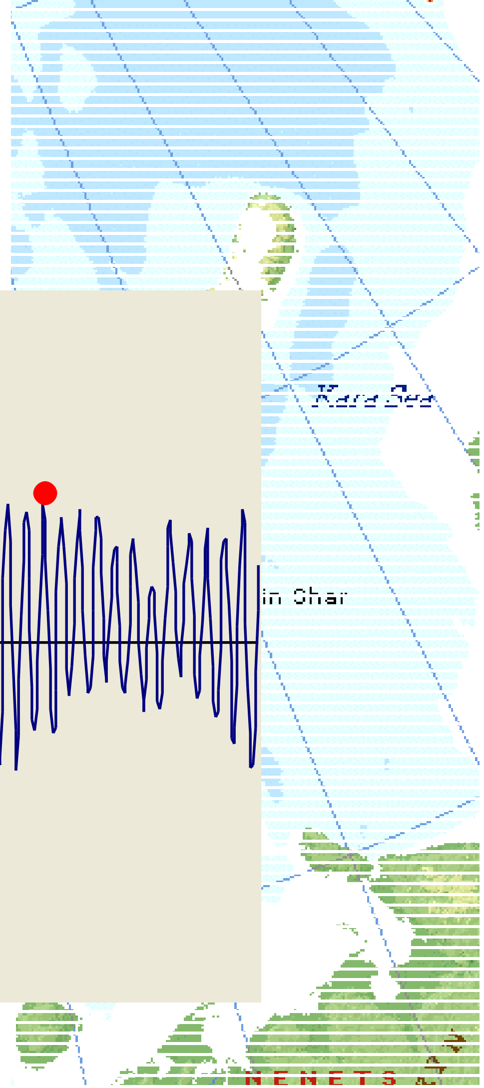




All the correlations between ERS-2 and tide gauges and ENVISAT and tide gauges are varied between 0.9 and 1.0. That is why the only one diagram is presented for all the comparisons.

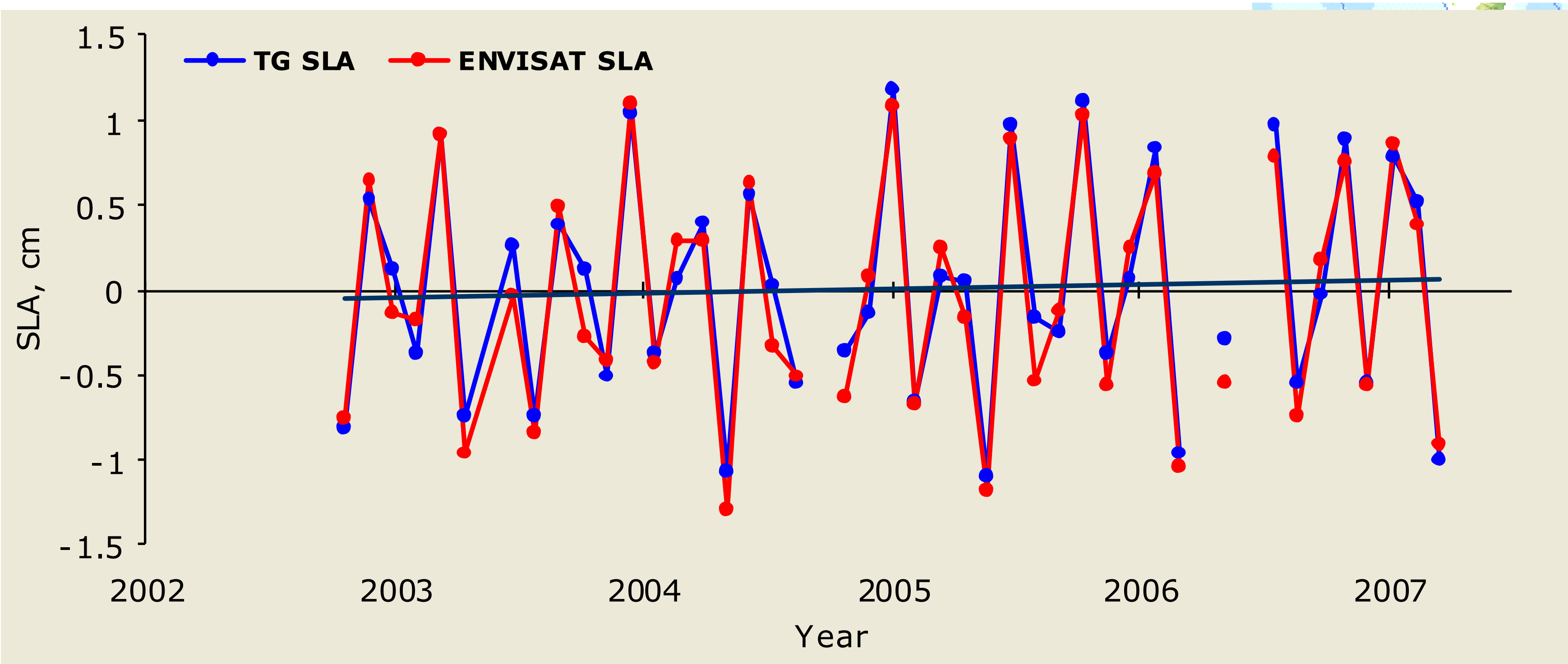
Barents Sea





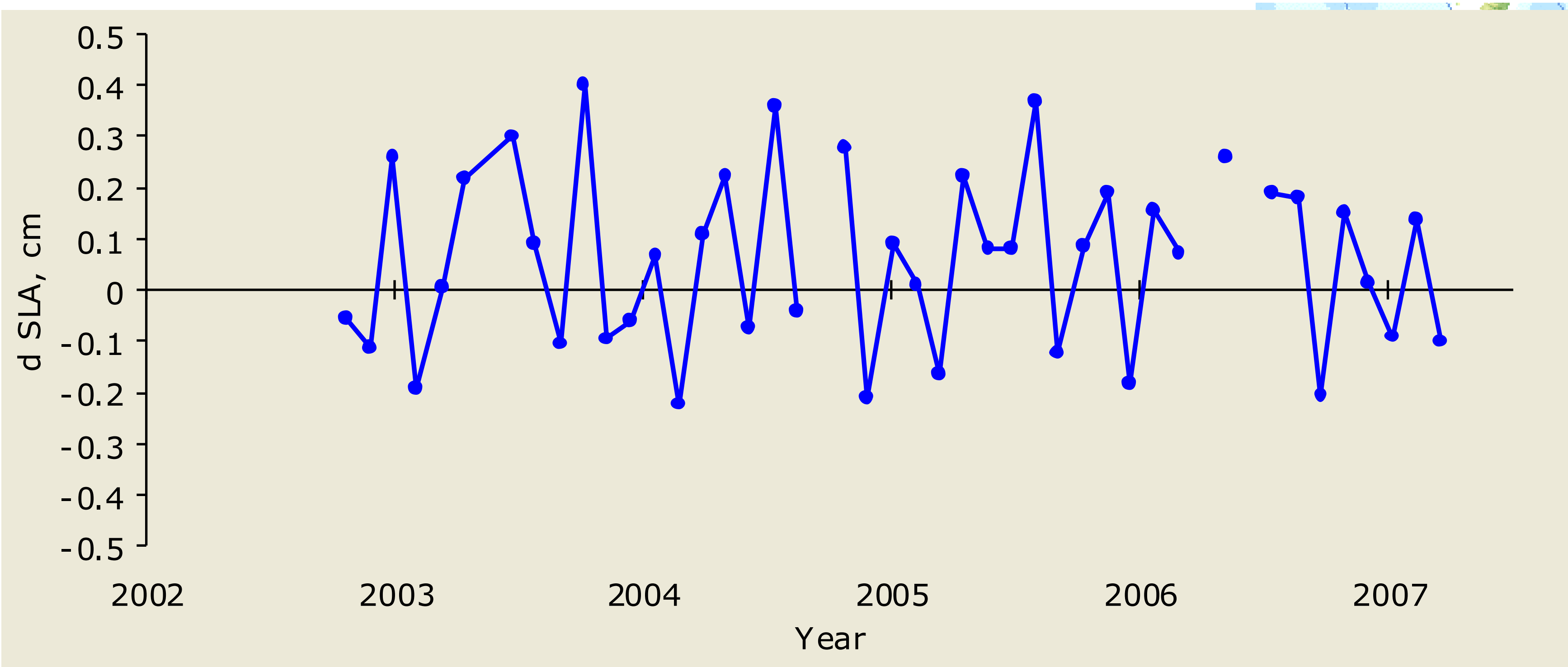
Sea level anomalies from the tide gauge (Hohhinsvarg) and ENVISAT for the two months: Feb-Mar 2003

Barents Sea

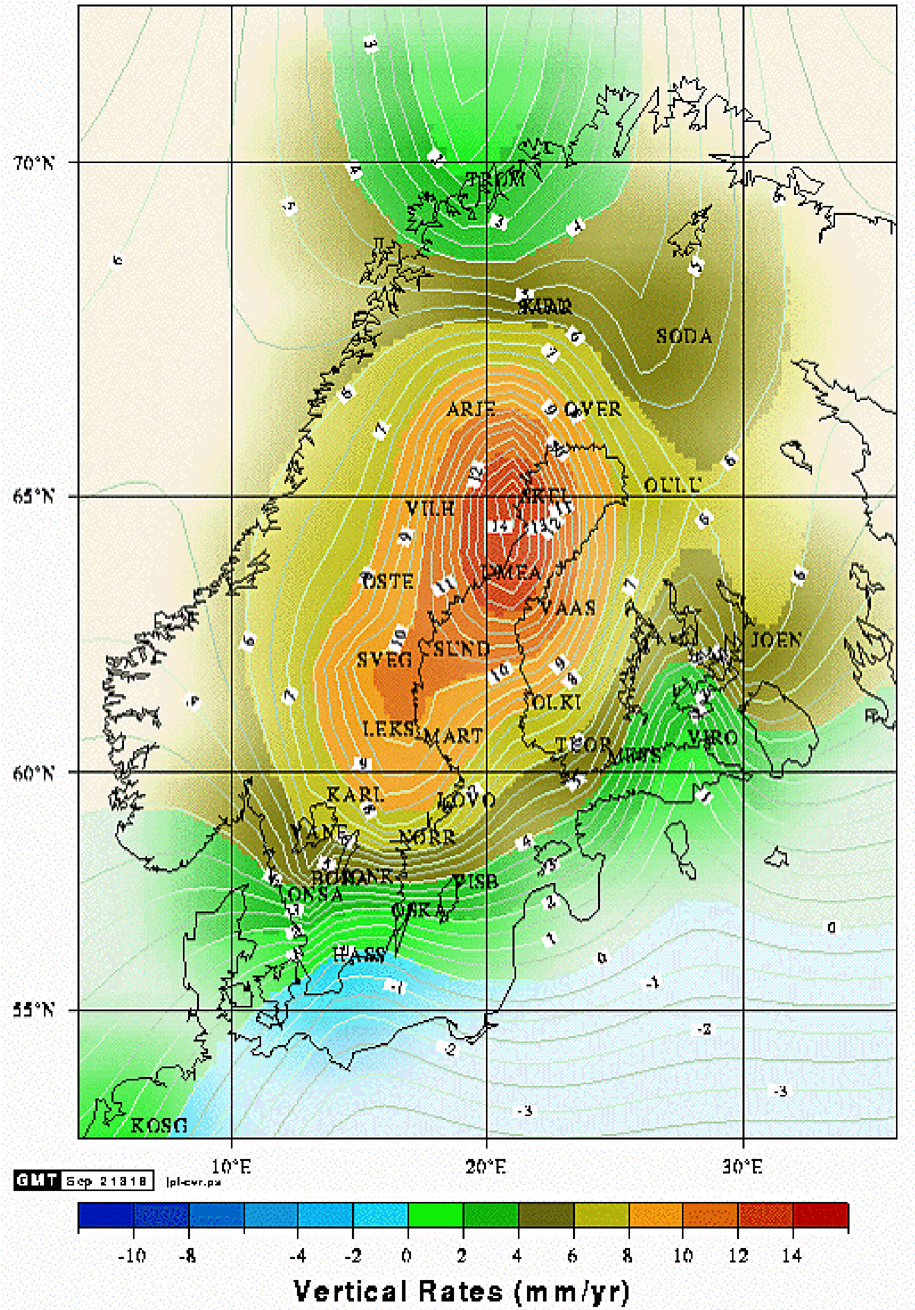


Sea level anomalies from the tide gauge (Hohhinsvarg) and ENVISAT (2002-2007)

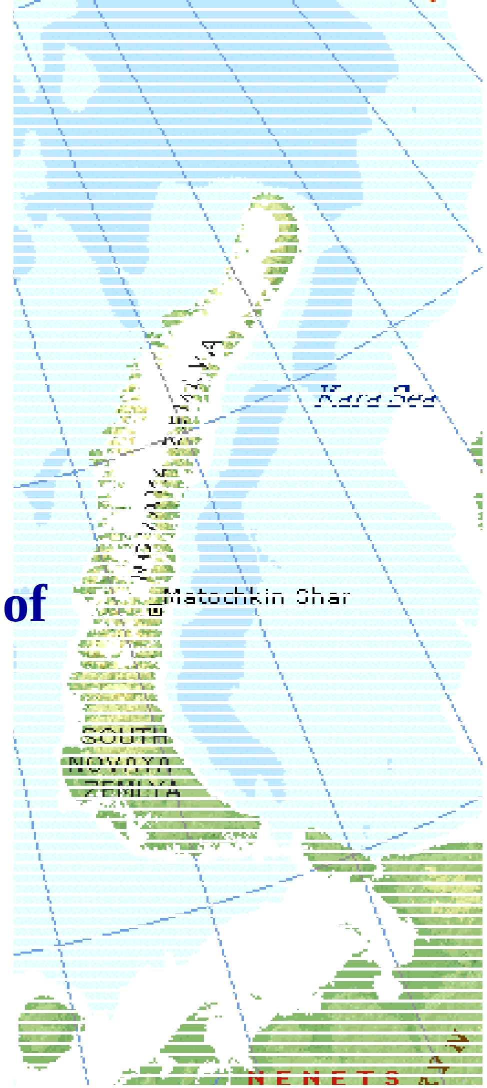
Barents Sea

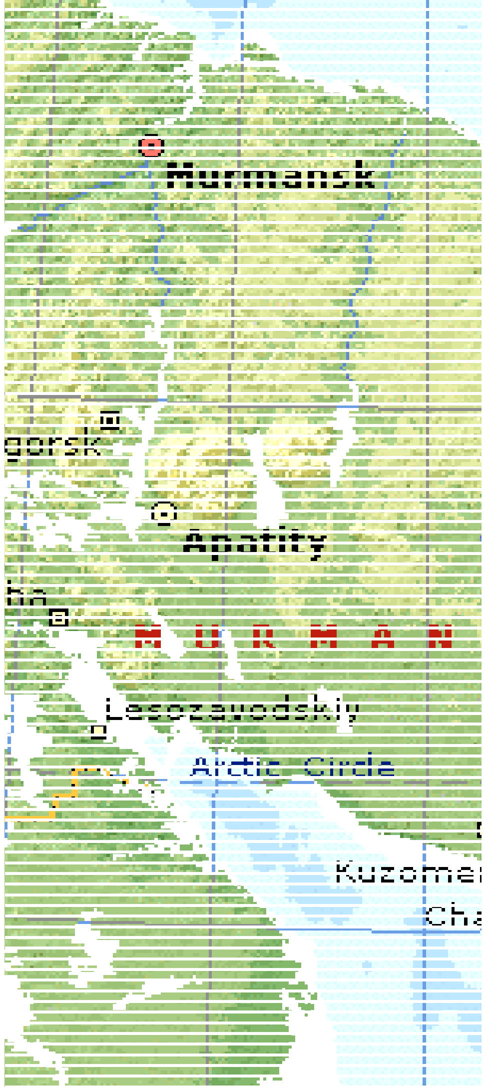


Difference between SLA from the tide gauge (Hohhinsvarg) and ENVISAT (2002-2007)

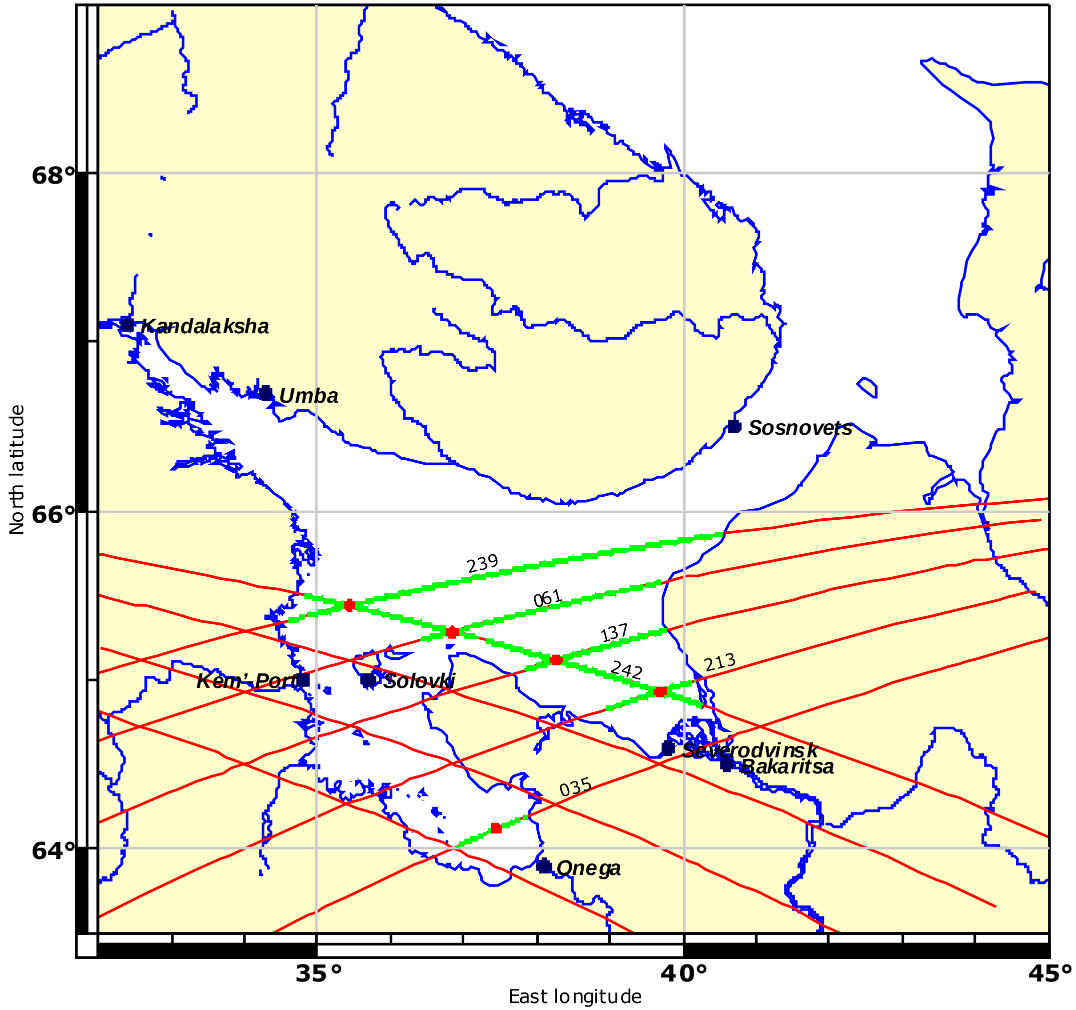


Vertical rates of the Earth's crust (from BIFROST Project, 1996)



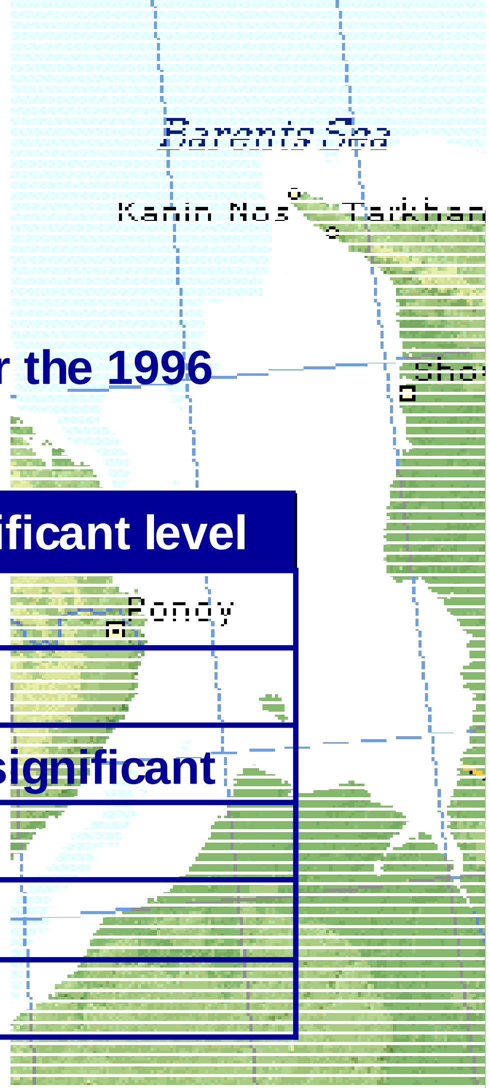


White Sea (TOPEX (A))



Red lines – TOPEX A groundtracks
Green lines – available data for 1996 (from RADS database)
Blue circles – location of tide gauges (data for 1996)
Red circles – sample points from groundtracks for data comparison

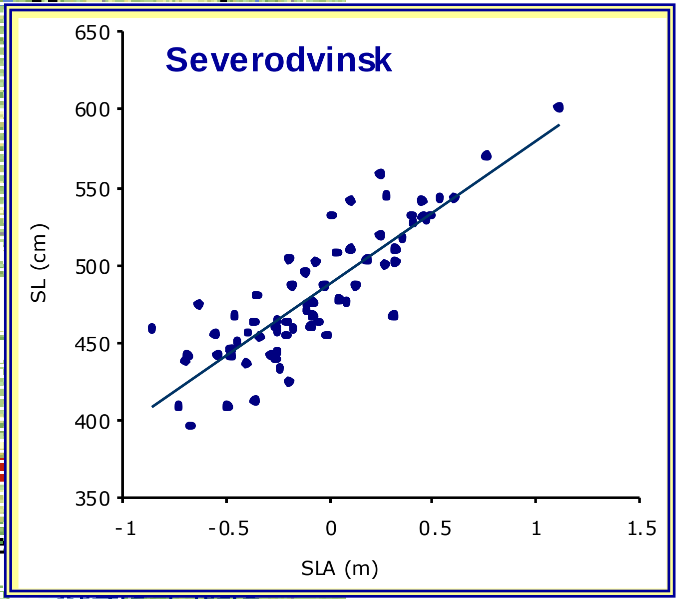
White Sea (TOPEX (A))

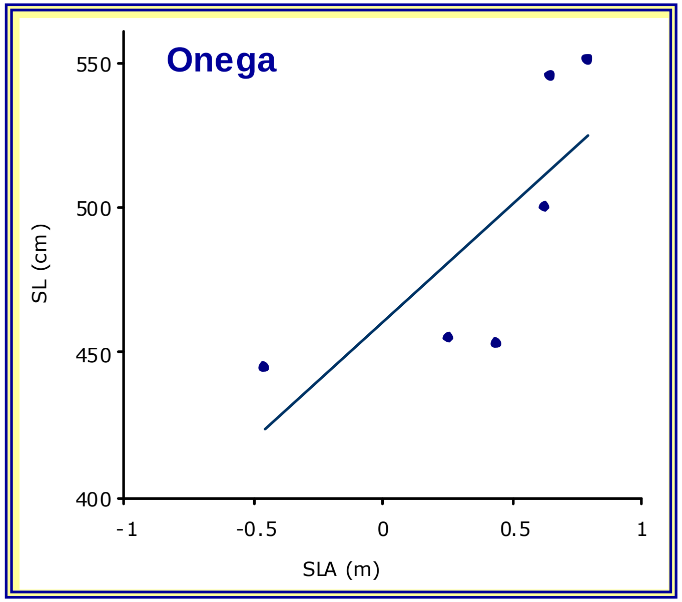


Correlation between tide gauges SL and TOPEX (A) SLAs for the 1996

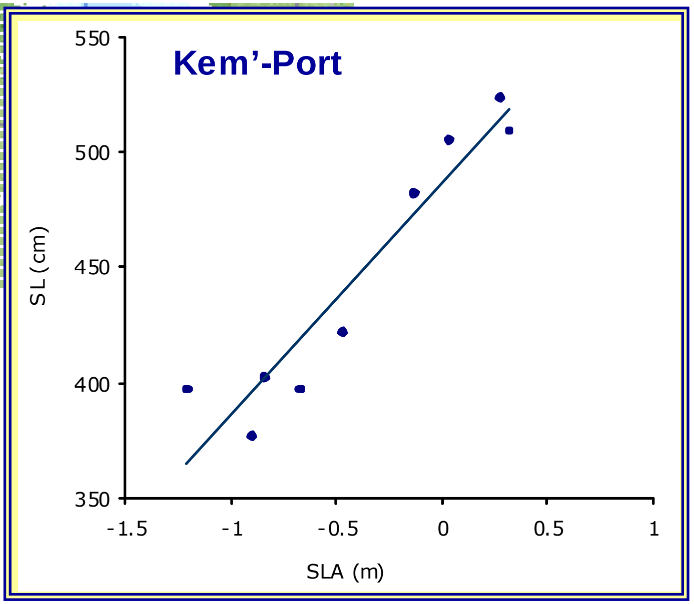
Tide Gauge	TOPEX Tracks	Correlation	Significant level
Severodvinsk	213/242	0.97	0.01
Severodvinsk	137/242	0.88	0.01
Onega	035	0.76	Not significant
Kem'-Port	239/242	0.66	0.05
Solovki	061/242	0.72	0.01
Solovki	239/242	0.76	0.01

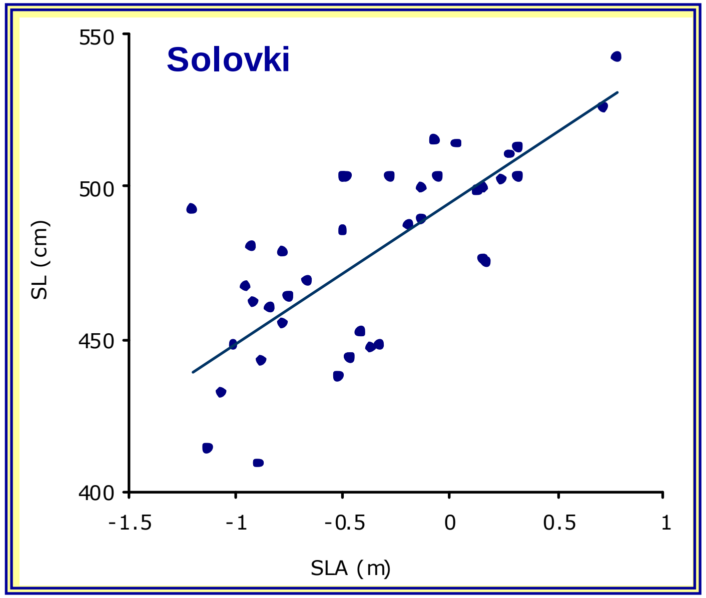
White Sea (TOPEX (A))





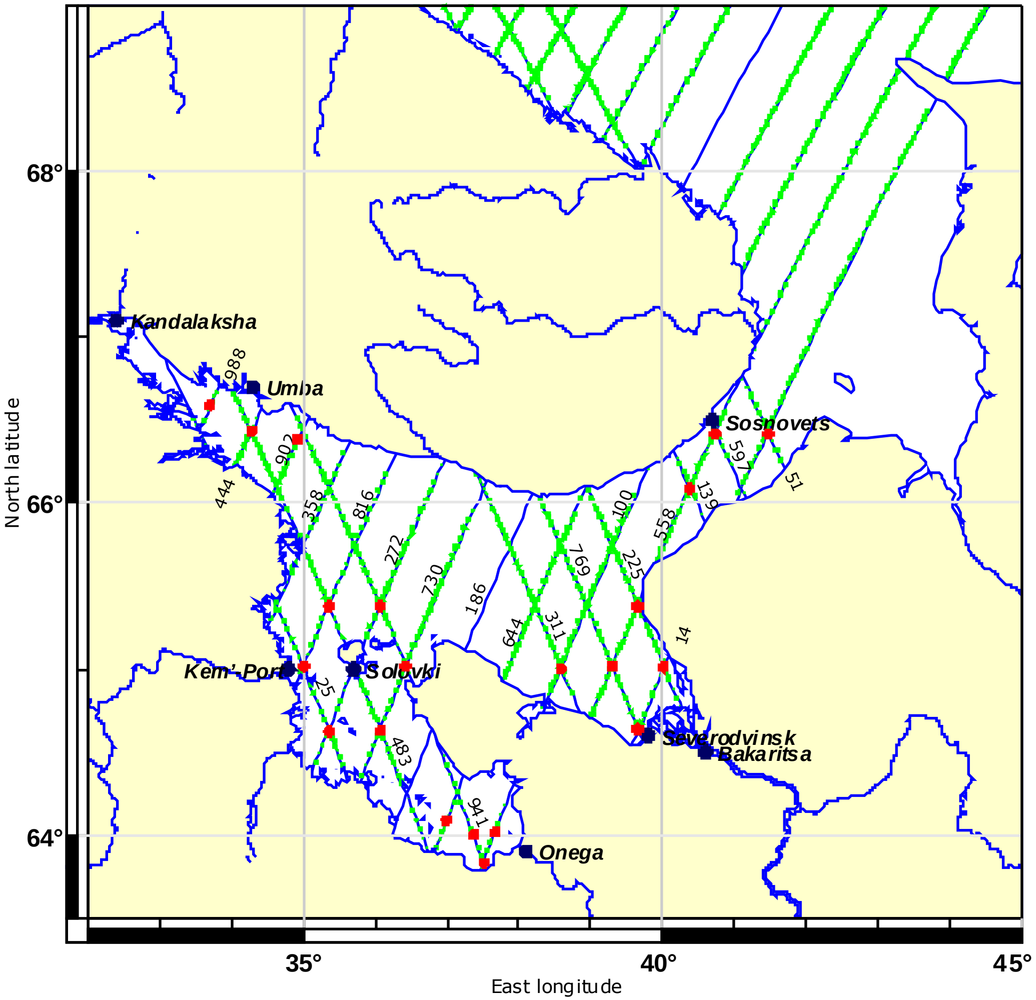
Sea level anomalies (SLA) from TOPEX-A and sea level (SL) from tide gauges for several locations in White Sea (1996)

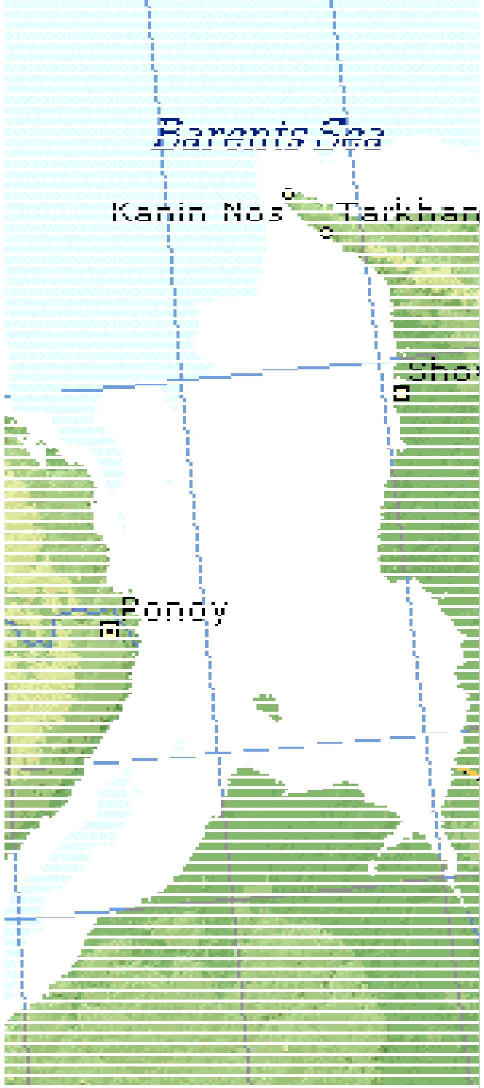




INTAS CORDIS

White Sea (ERS-2)



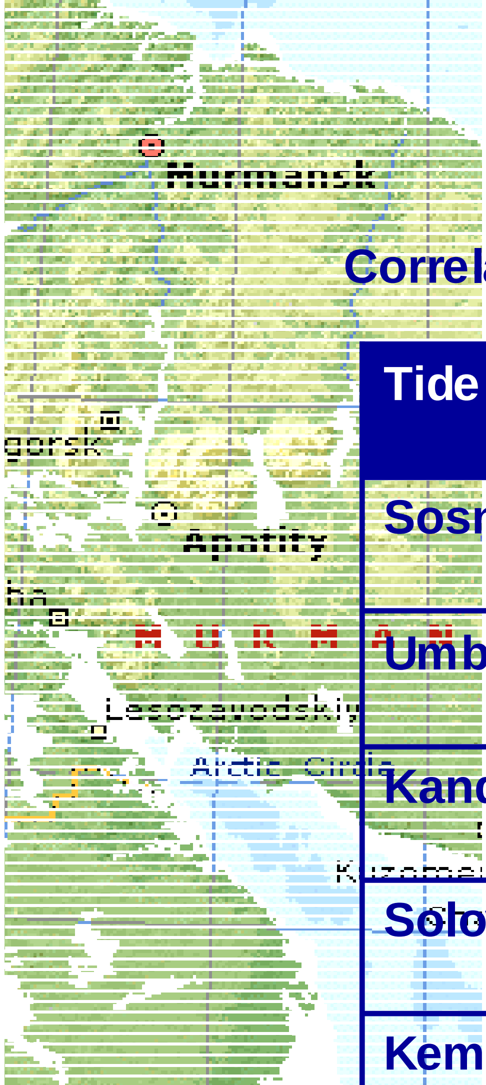


Blue lines – ERS-2 groundtracks

Green lines – available data for 1996 (from RADS database)

Blue circles – location of tide gauges (data for 1996)

Red circles – sample points from the groundtracks for data comparison



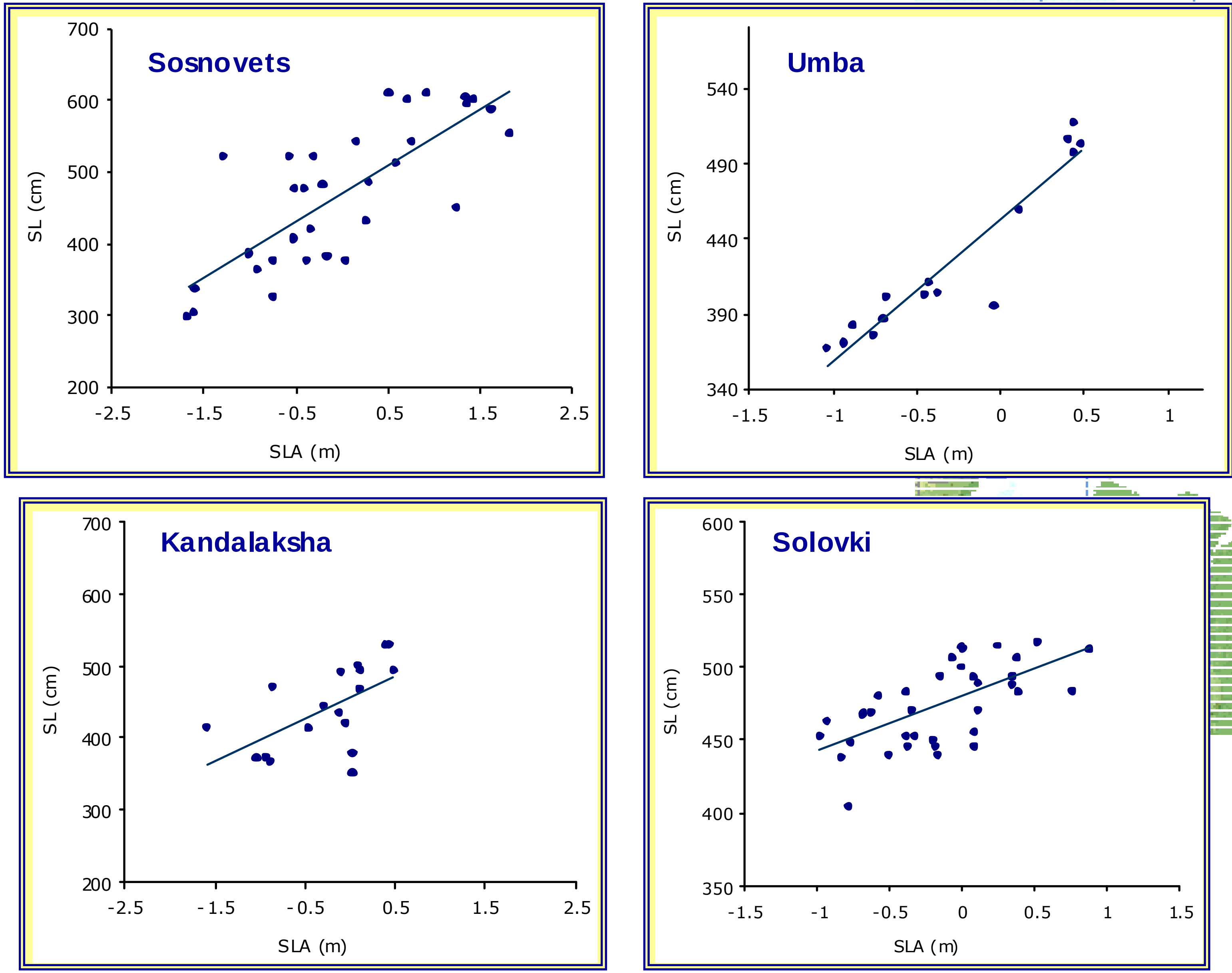
White Sea (ERS-2)

Correlation between tide gauges SL and ERS-2 SLAs for the 1996

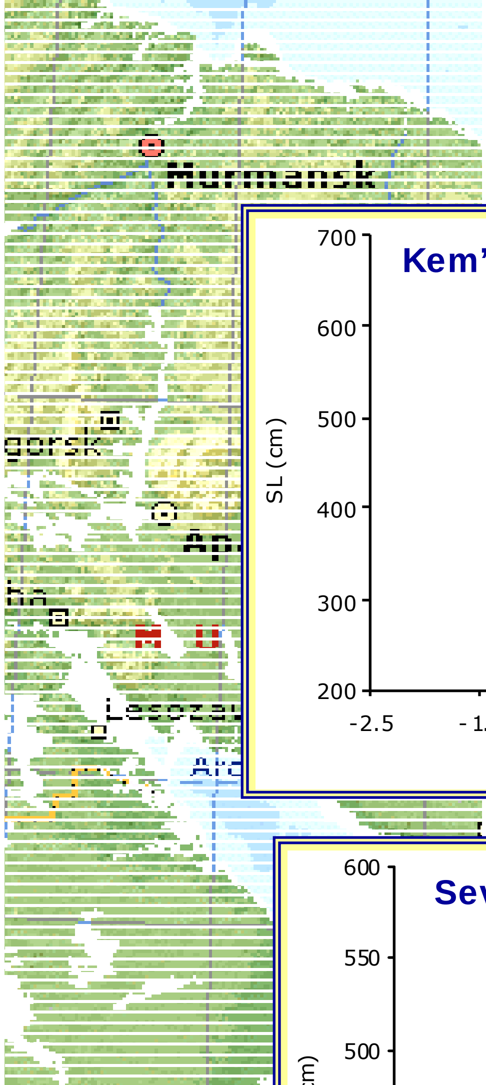
Tide Gauge	ERS-2 Tracks	Correlation	Significant level
Sosnovets	53/897/139 14/558	0.77	0.01
Umba	902/444/988 483	0.95	0.01
Kandalaksha	444/988 483	0.58	0.05
Solovki	730/272 483/941	0.65	0.01
Kem'-Port	272/816 25/483	-0.61	0.05
Onega	100/644 941	0.96	0.01
Severodvinsk	14/558/100 225/769/311	0.88	0.01

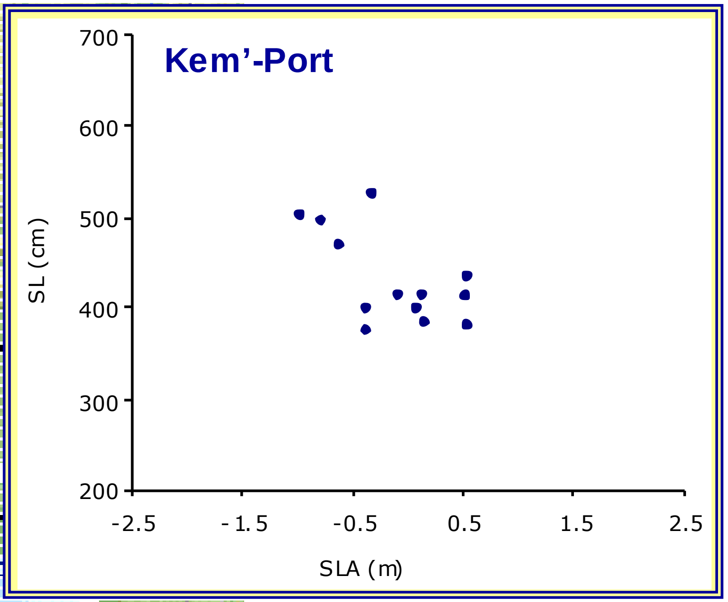
White Sea (ERS-2)

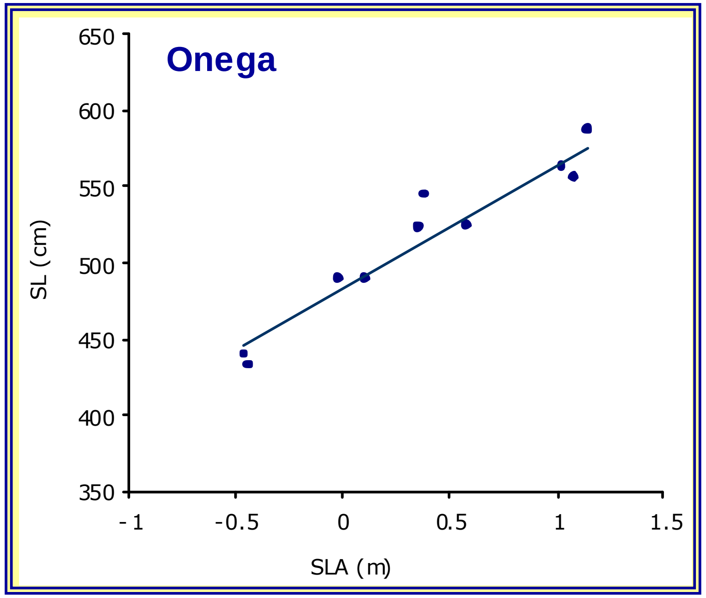
Sea level anomalies (SLA) from ERS-2 and sea level (SL) from tide gauges for several locations in White Sea (1996)

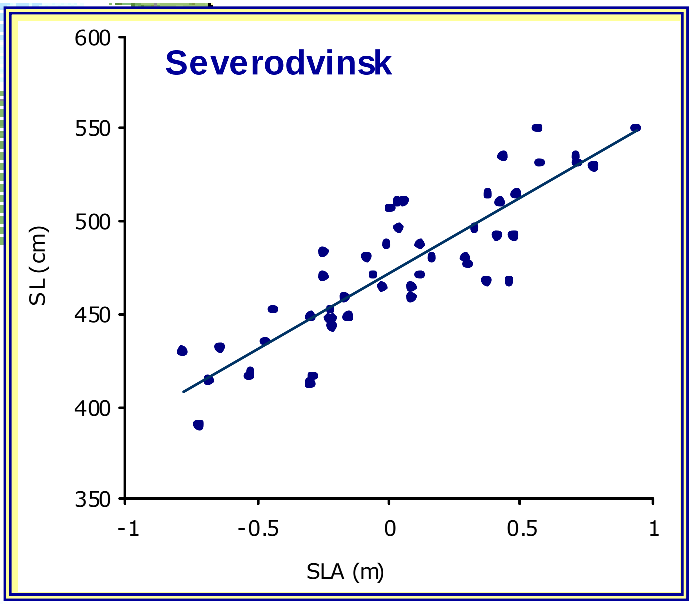


White Sea (ERS-2)



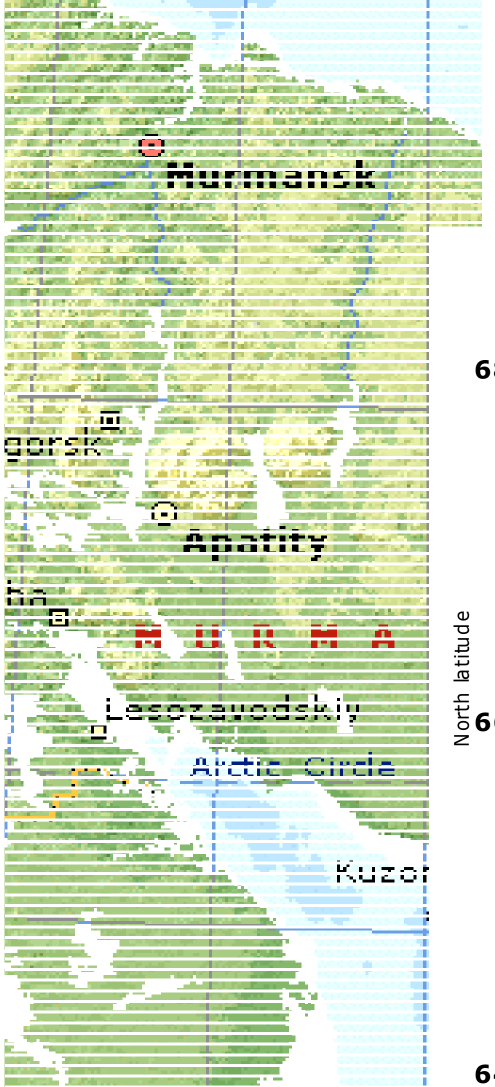


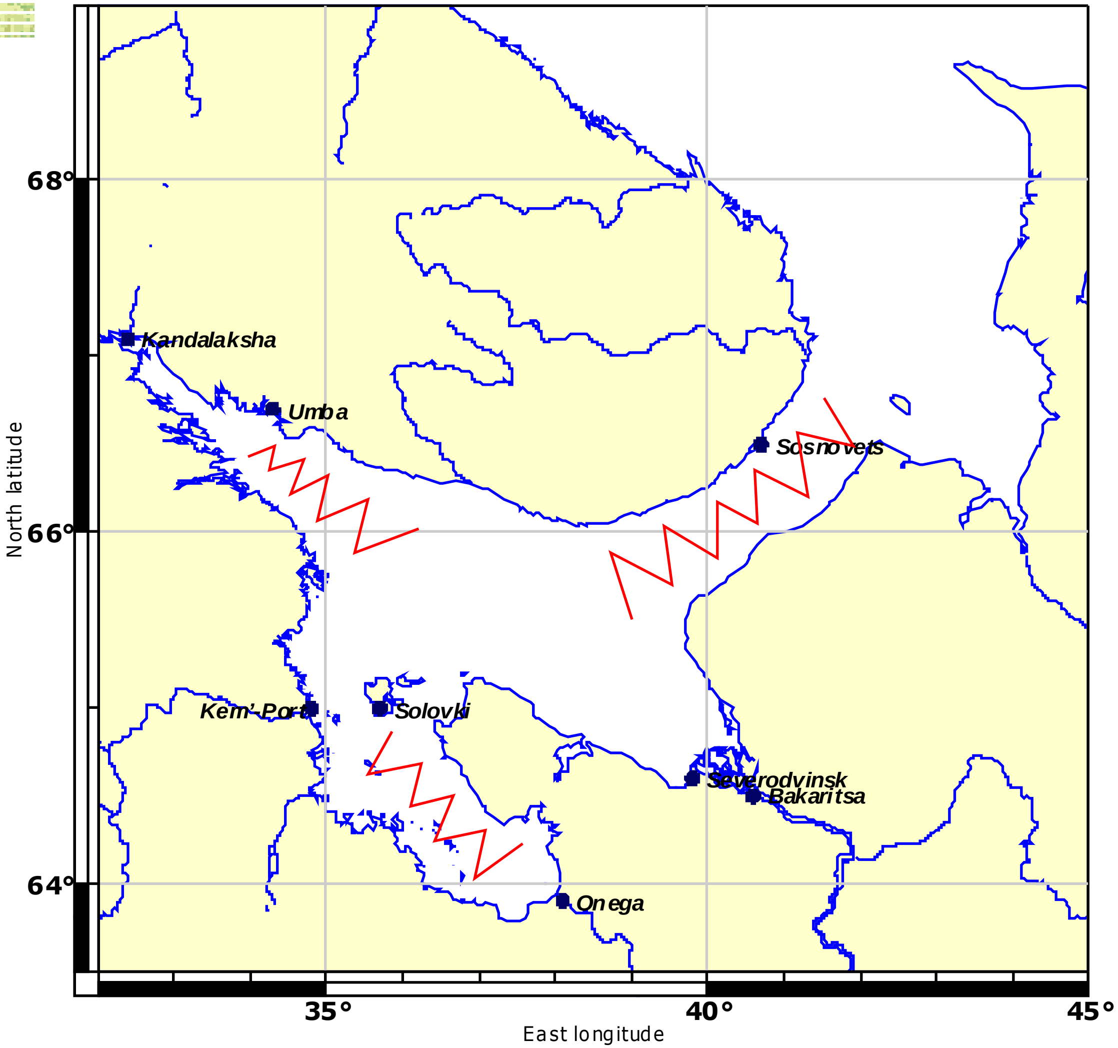




Sea level anomalies (SLA) from ERS-2 and sea level (SL) from tide gauges for several locations in White Sea (1996)

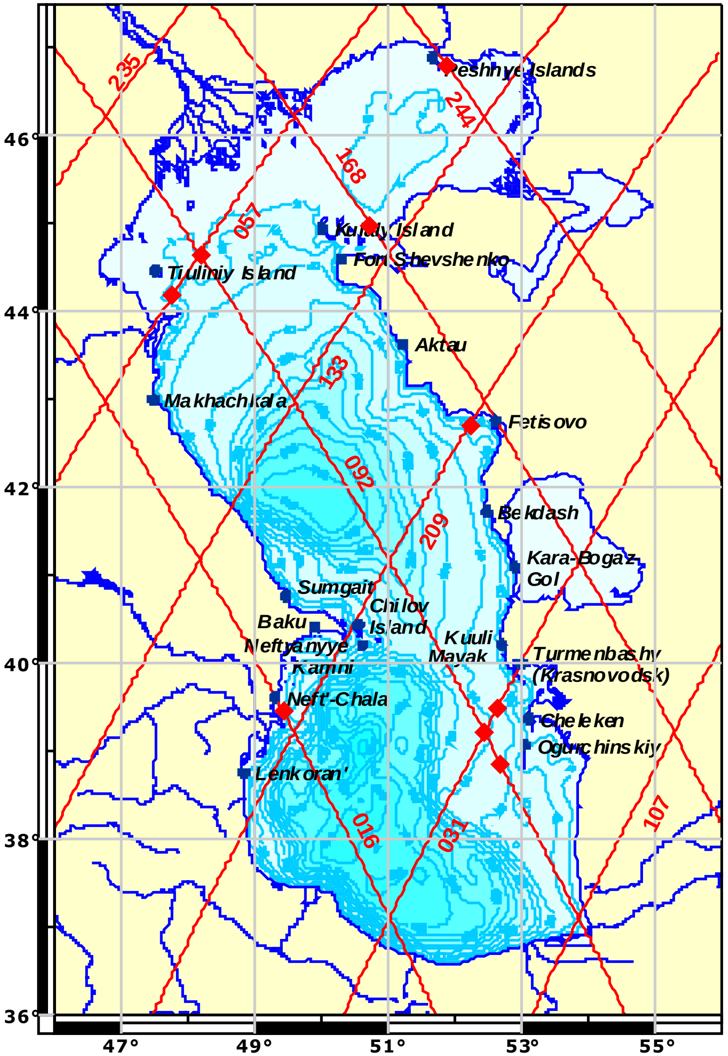
White Sea Tide Rips





The zones of frequent tide rips (red lines) in the White Sea according to marine observations (from Fedorov and Ginsburg, 1988)

Caspian Sea (Jason-1)

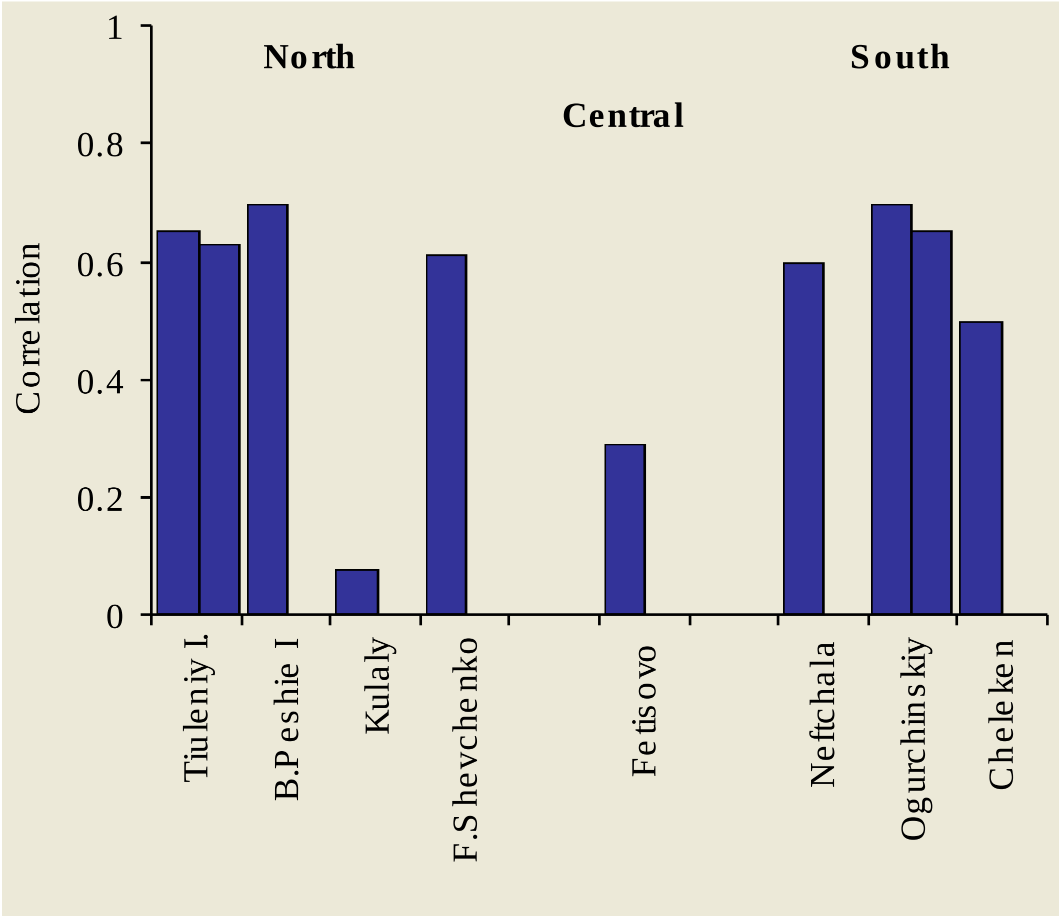


Red lines – Jason-1 groundtracks

Blue circles – location of tide gauges (data for 2005-2007)

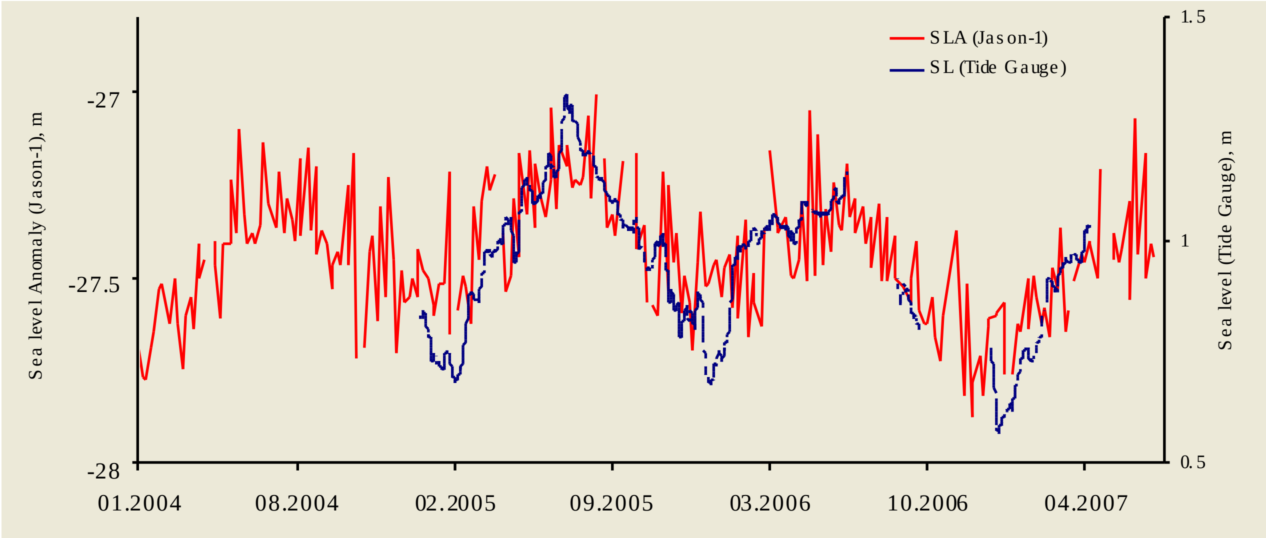
Red circles – sample points from the groundtracks for data comparison

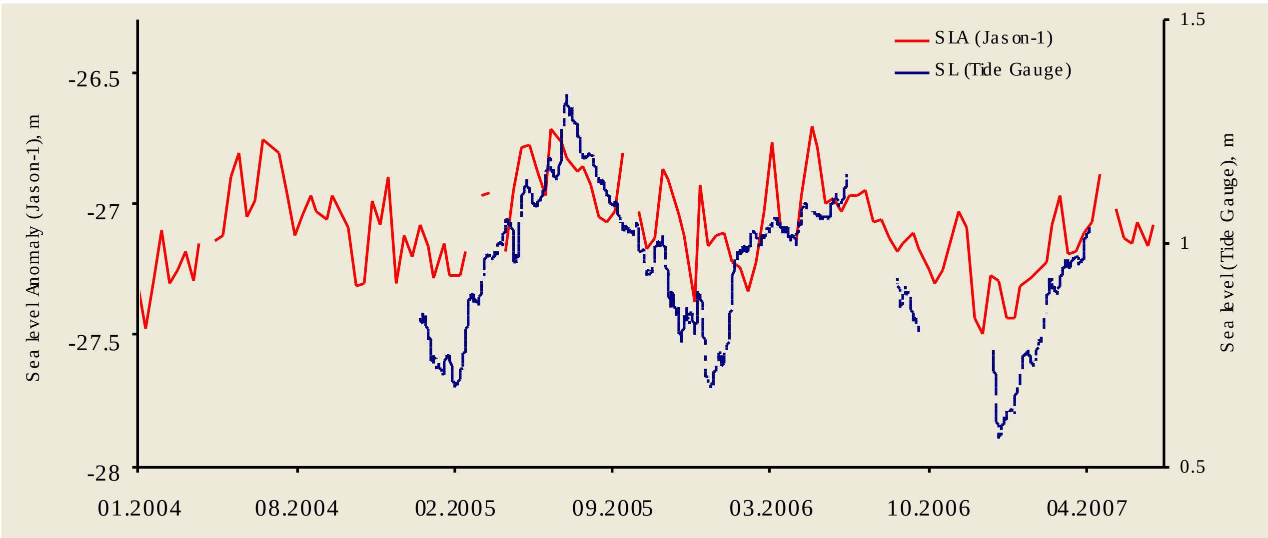
Caspian Sea (Jason-1)



Correlation between SLA from Jason-1 data and SL tide gauges data from several locations at the Caspian Sea coast.

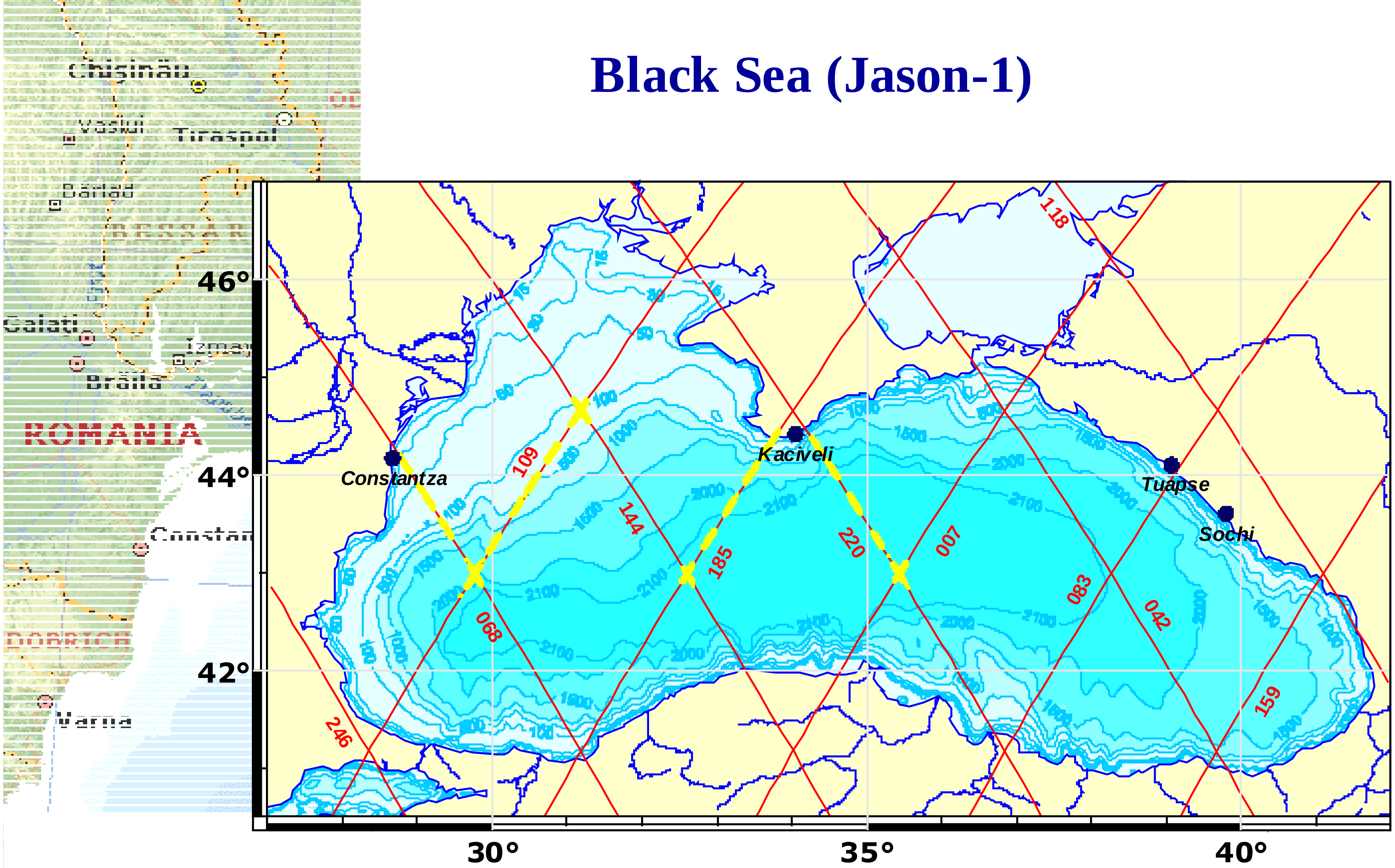
Caspian Sea (Jason-1)





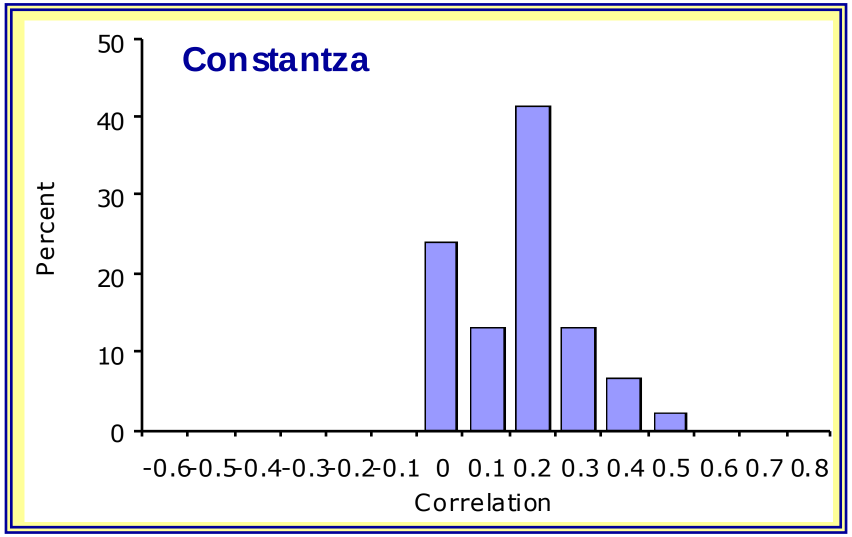
Variability of SLA from Jason-1 and SL from tide gauge at Ogurchinskiy point (smoothed by moved average over 10 days).

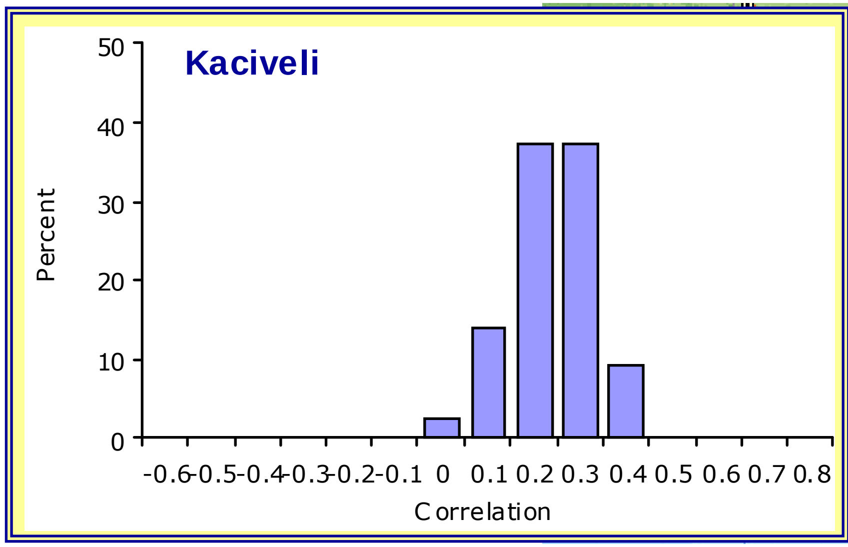
Black Sea (Jason-1)

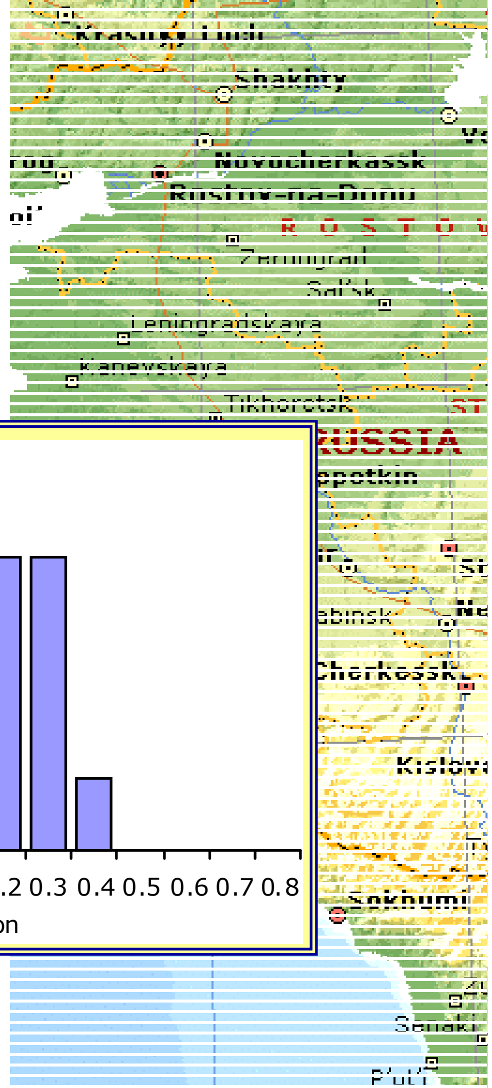


Red lines – Jason-1 groundtracks (2002-2007)
Blue circles – location of tide gauges
Yellow points – sample points from groundtracks for data comparison

Black Sea (Jason-1)

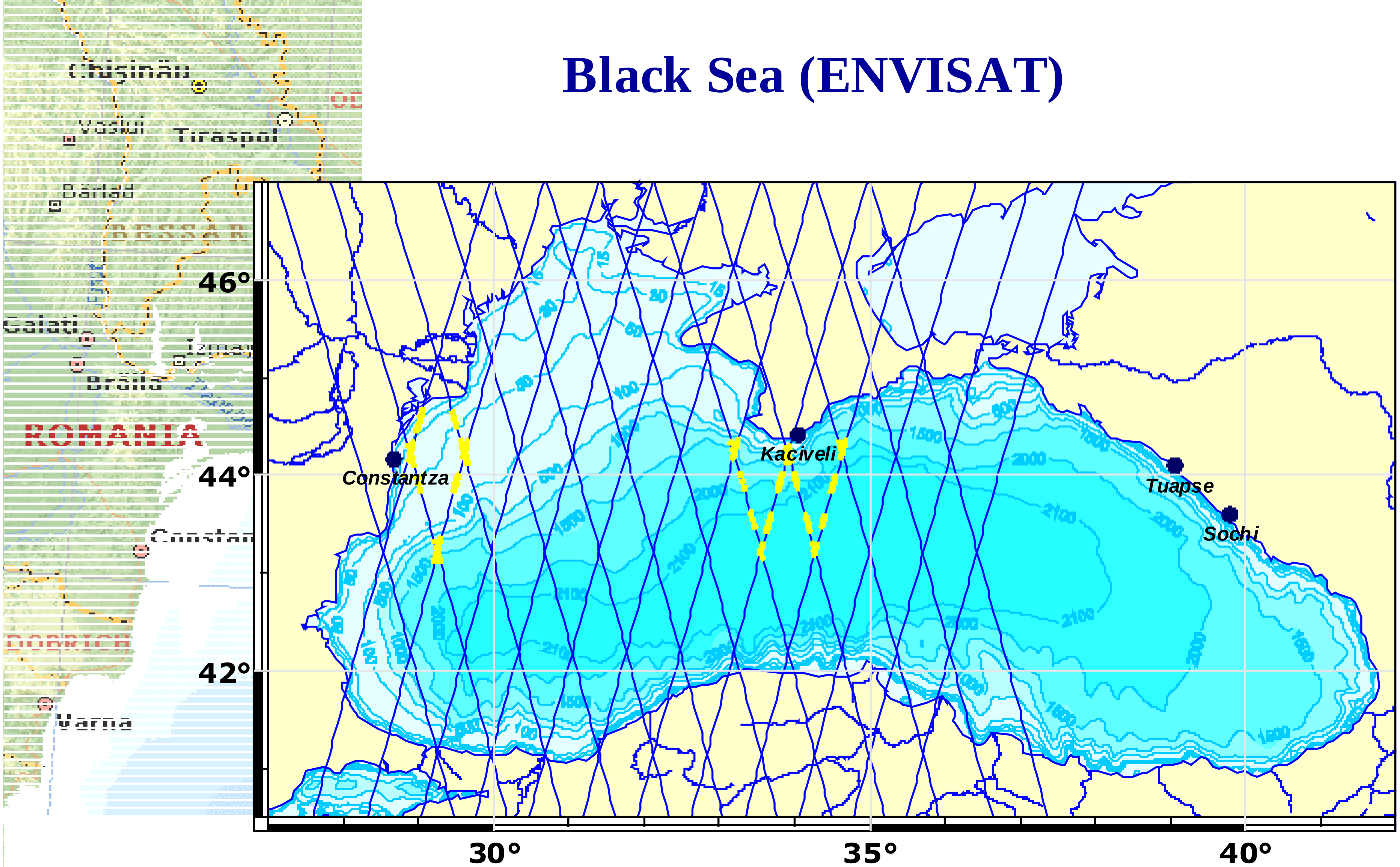






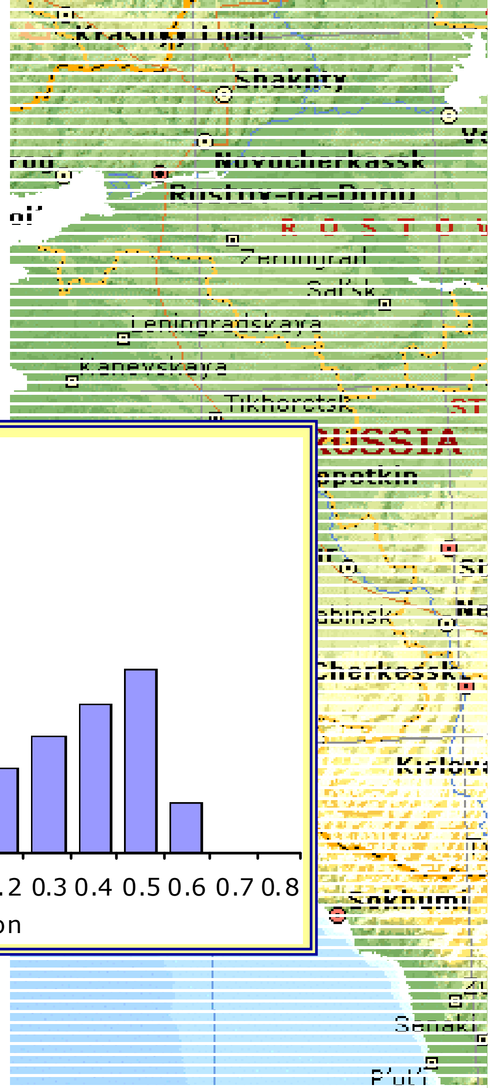
Statistical distribution of correlation between Jason-1 SLAs and tide gauges SL in two locations at the Black Sea in 2002-2007

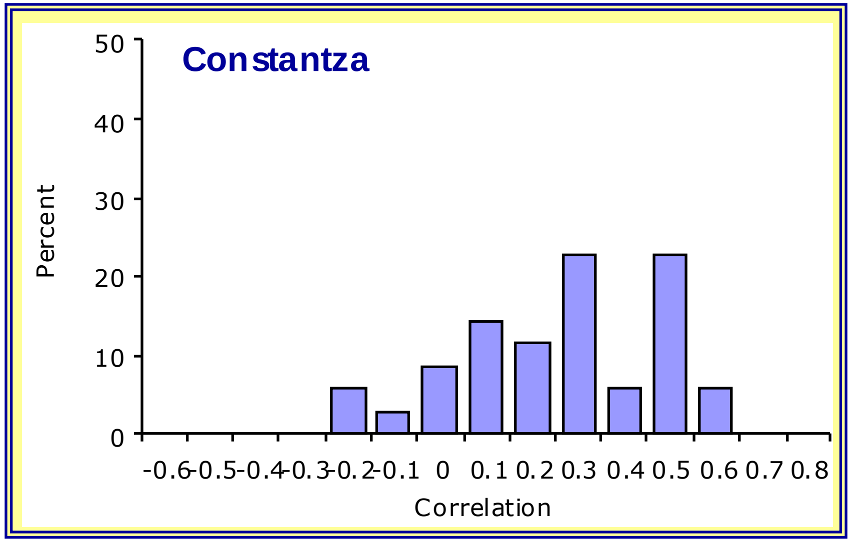
Black Sea (ENVISAT)

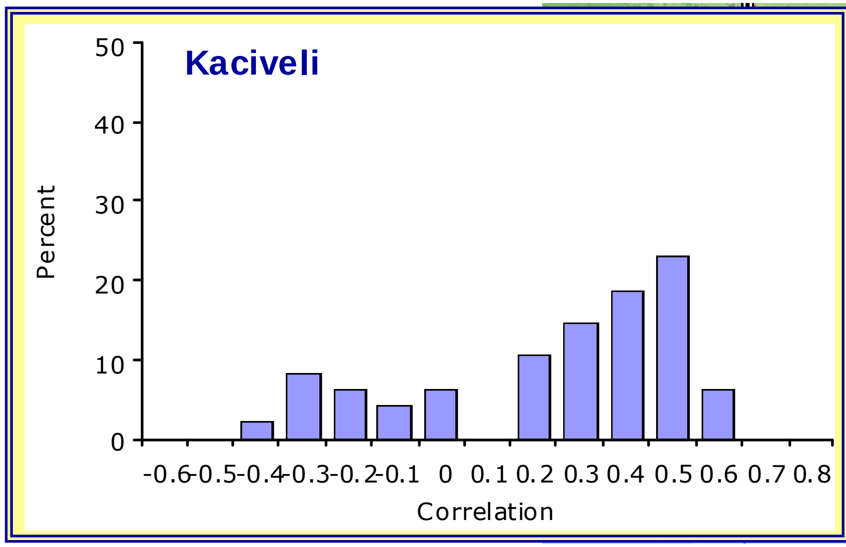


Blue lines – ENVISAT groundtracks (2002-2007)
Blue circles – location of tide gauges
Yellow points – sample points from the groundtracks for data comparison

Black Sea (ENVISAT)

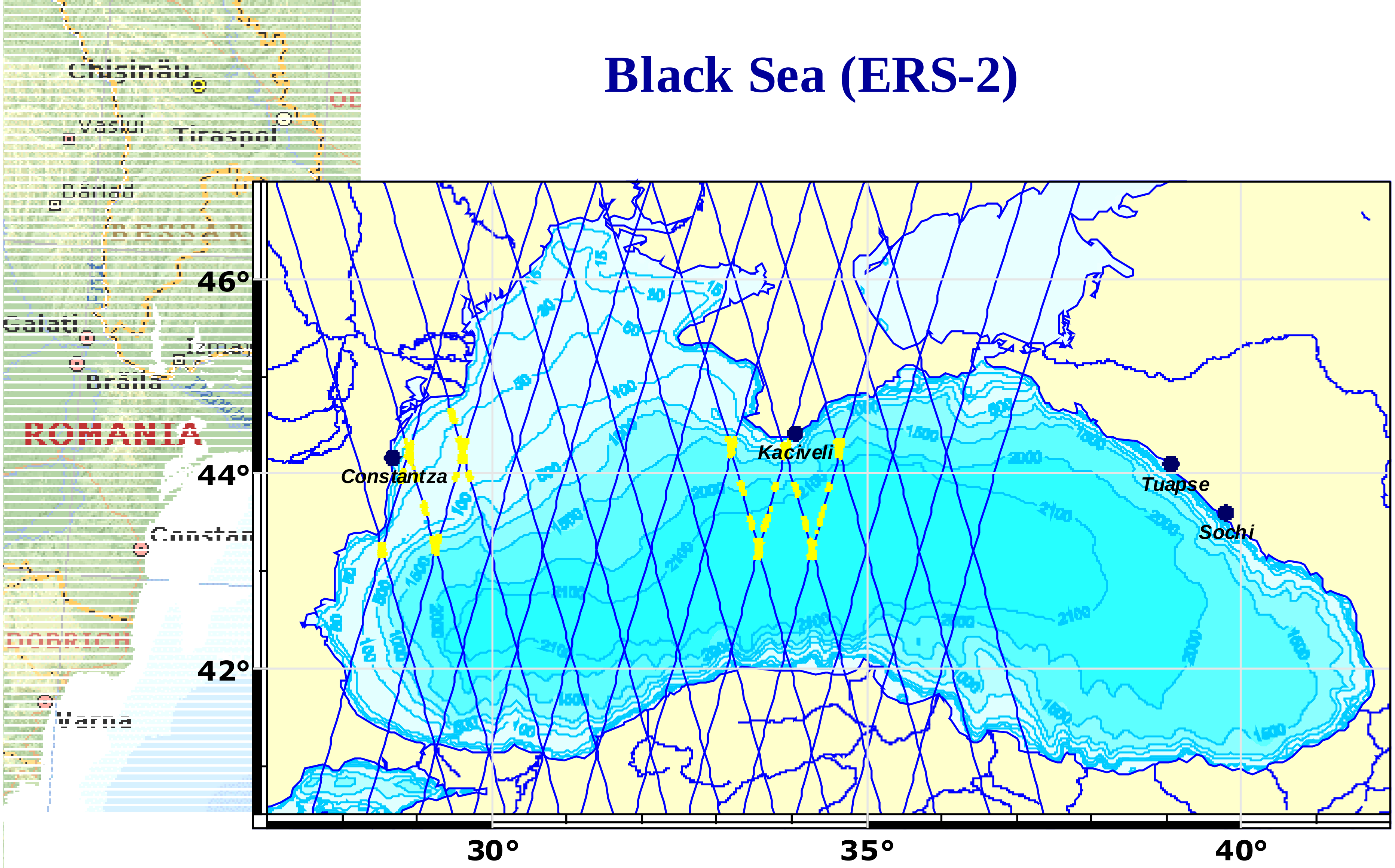






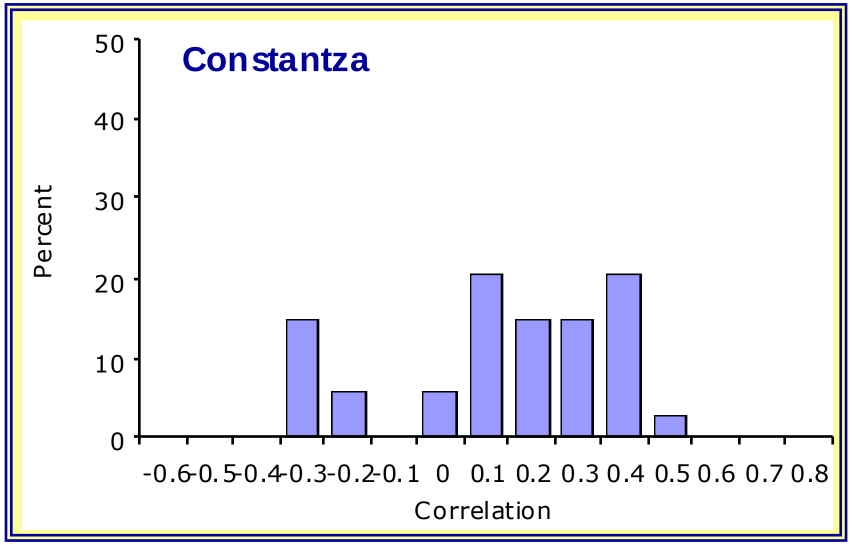
Statistical distribution of correlation between ENVISAT SLAs and tide gauges SL in two locations at the Black Sea in 2002-2007

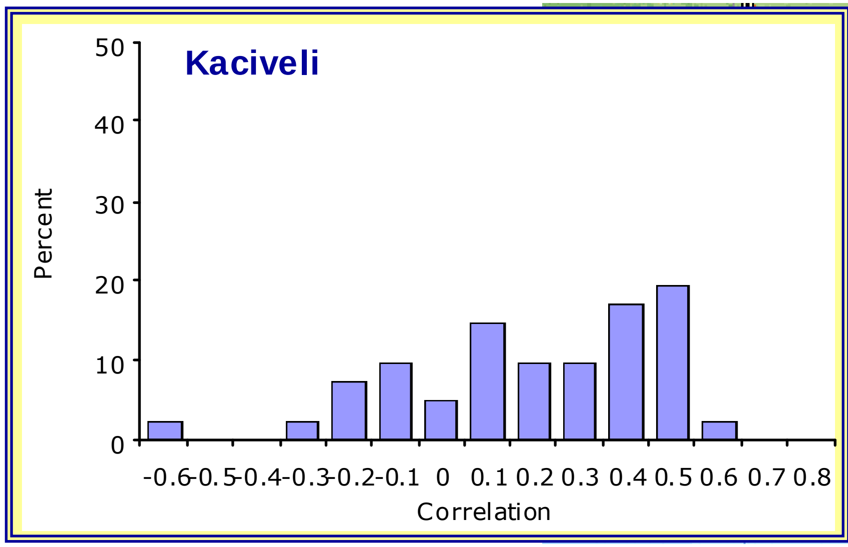
Black Sea (ERS-2)

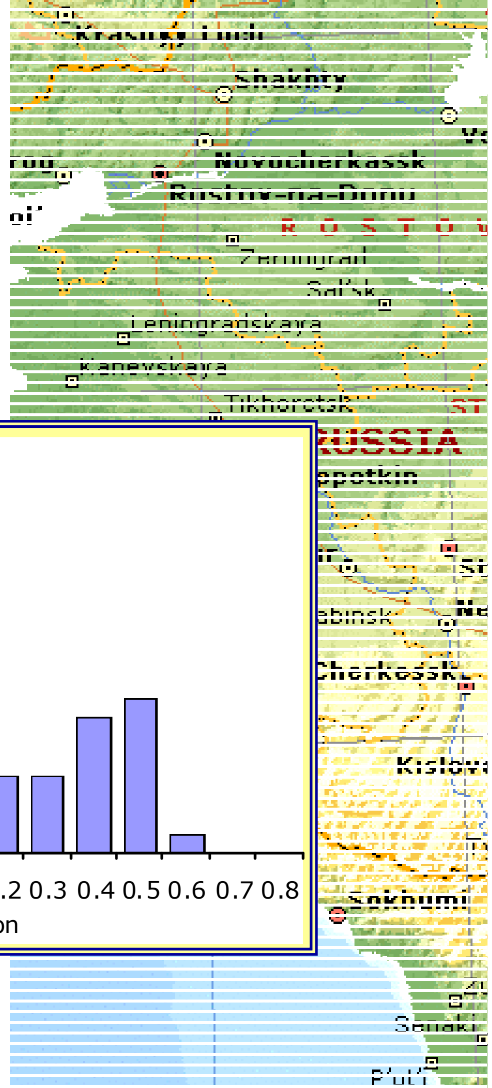


Blue lines – ERS-2 groundtracks (2002-2007)
Blue circles – location of tide gauges
Yellow points – sample points from the groundtracks for data comparison

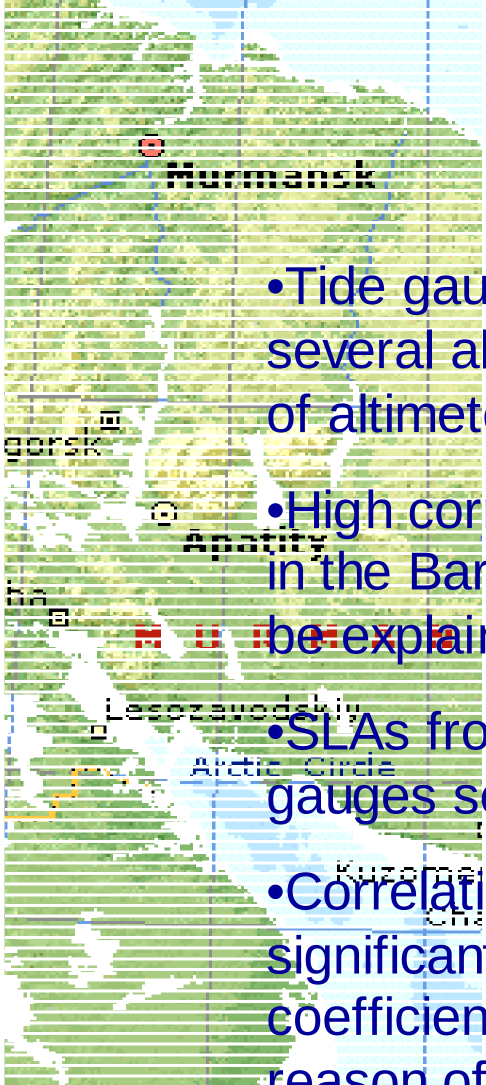
Black Sea (ENVISAT)







Statistical distribution of correlation between ERS-2 SLAs and tide gauges SL in two locations at the Black Sea in 2002-2007



Conclusions

•Tide gauges sea level (SL) data and sea level anomalies from several altimeters were compared in order to examine consistency of altimeters data.

•High correlation between the altimeters SLAs and tide gauges SL in the Barents and White seas was observed. This correlation might be explained by tides which are significant in that regions.

•SLAs from the Jason-1 altimeter are good correlated to the tide gauges sea level data in the Caspian Sea.

•Correlation between SLAs and SL in the Black Sea is statistically significant in the vicinity of coast but the value of the correlation coefficients is low. High mesoscale activity might be a possible reason of observed discrepancy.