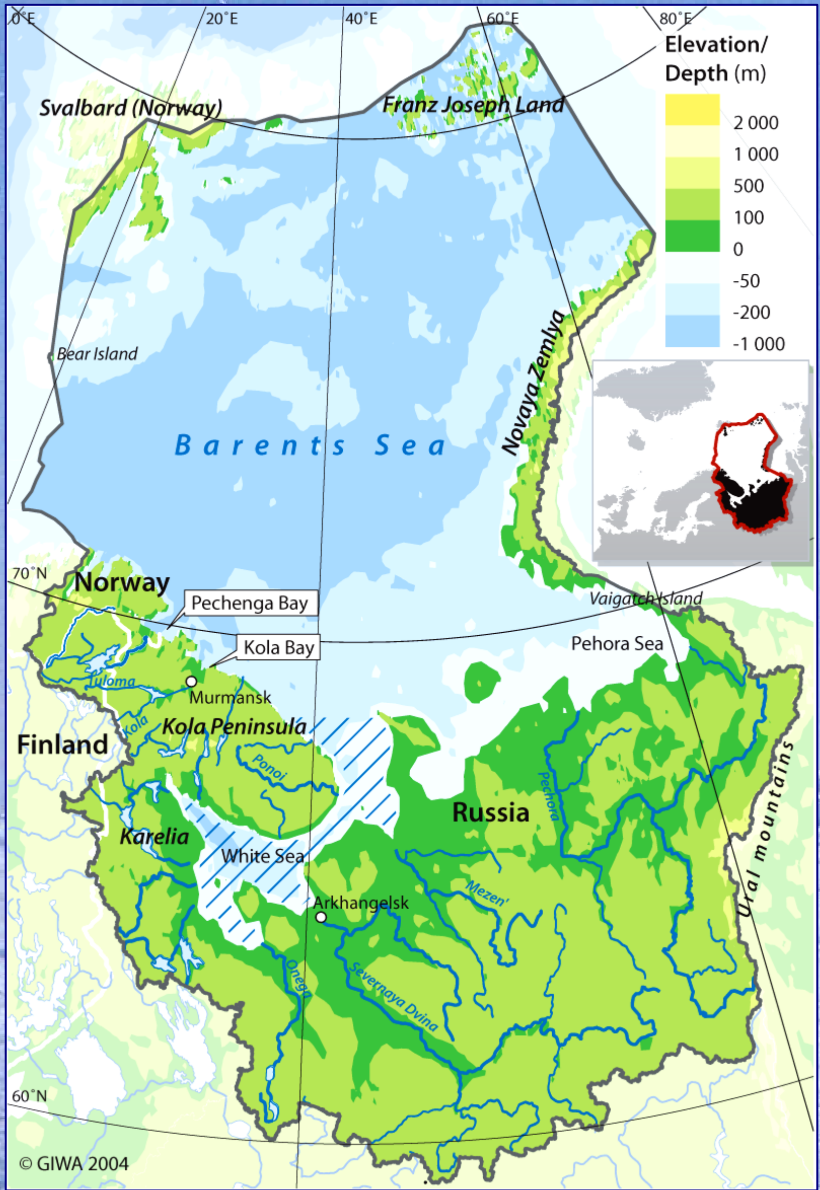
Coastal zone meteorology in the Barents and White seas as derived from in-situ and satellite altimetry data in 1992-2007

Prof. Andrey Kostianoy[1]
Dr. Nickolay Sheremet[1]
Dr. Anna Ginzburg[1]
Dr. Alexander Sirota[1]
Dr. Sergey Lebedev[2]
Dr. Stefano Vignudelli[3]

(1) P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow, Russia

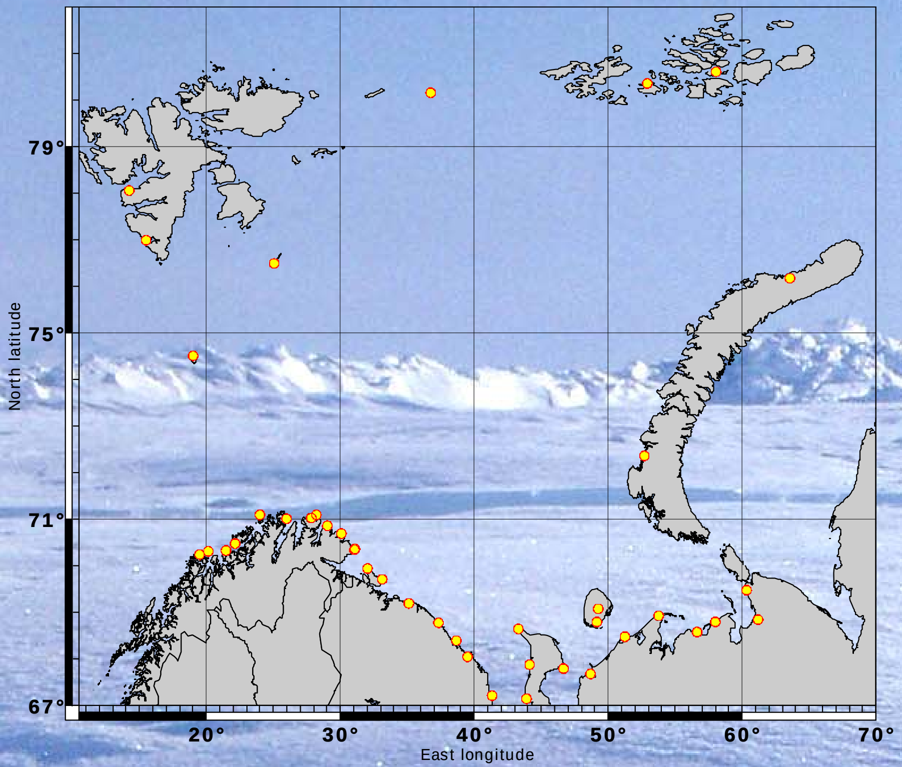
(2) Geophysical Center, RAS, Moscow, Russia

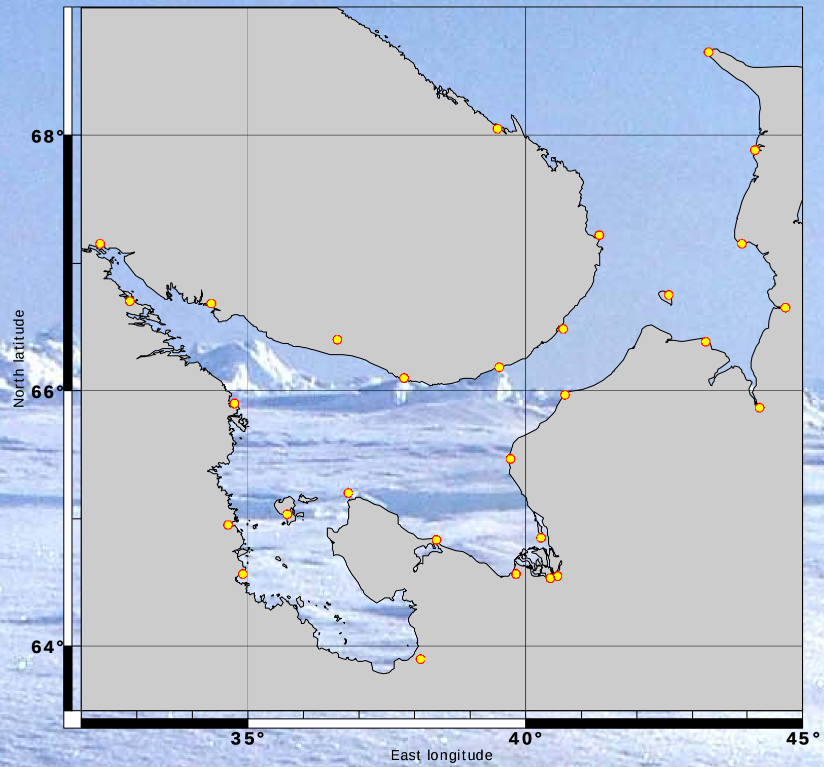
(3) Istituto di Biofisica, CNR, Pisa, Italy



Significant changes in the regional climate have happened in different parts of the Arctic Ocean and the Subarctic seas. In order to investigate interannual variability of key meteorological parameters in the Barents and White seas and their trends during last 16 years we used the global surface summary of day data produced by the National Climatic Data Center (NCDC) in Asheville, NC (http://www.ncdc.noaa.gov/cgi-bin/res40.pl). The data used in building these daily summaries are obtained from the USAF Climatology Center, located in the Federal Climate Complex with NCDC. Over 9000 stations' data are included currently in the database. Global summary of day data for 18 surface meteorological elements are derived from the synoptic/hourly observations contained in USAF DATSAV3 Surface data and Federal Climate Complex Integrated Surface Data (ISD).

From this database we selected 41 meteo stations located at the coasts of the Barents Sea and 29 meteo stations located at the coasts of the White Sea. This set also includes meteo stations located at Bear Island, Svalbard, Franz Josef Land, and Novaya Zemlya.





We restircted our analysis by the following five meteo elements:

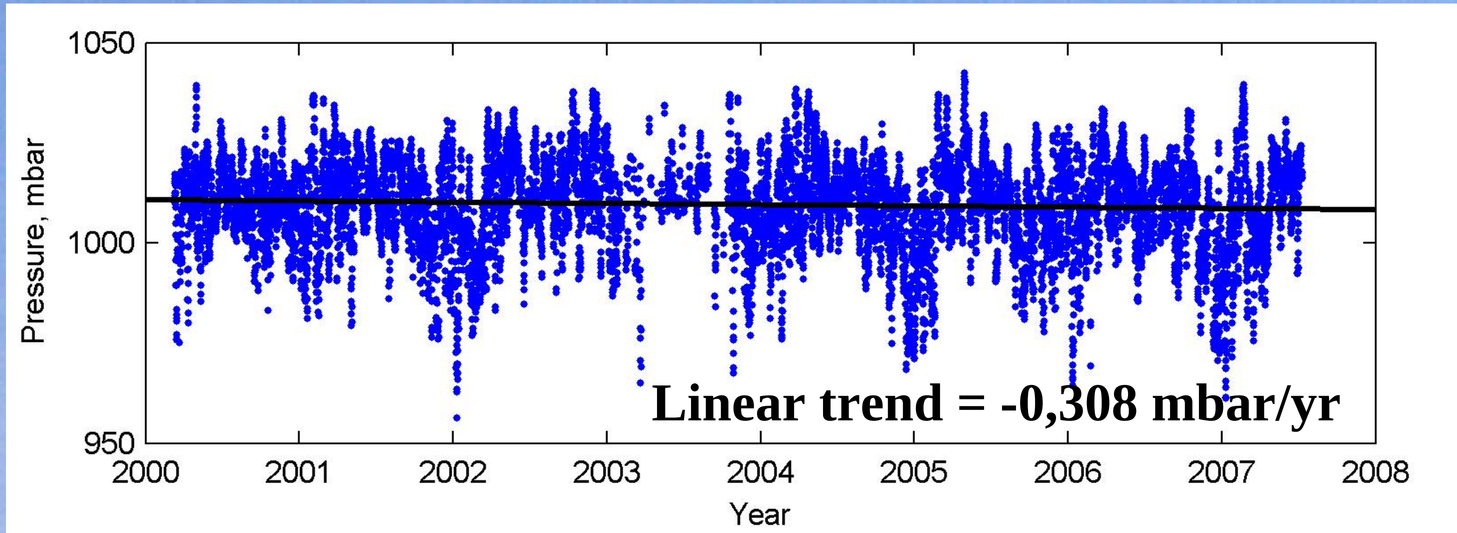
mean air temperature,
mean sea level pressure,
mean wind speed,
precipitation amount,
snow depth,

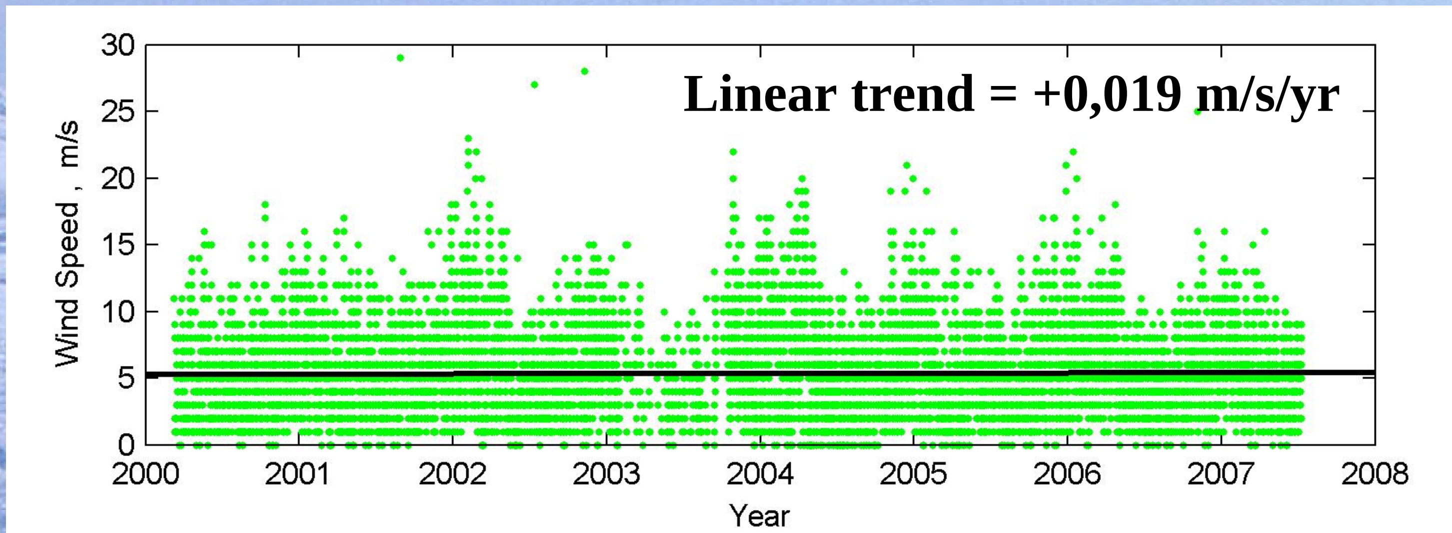
derived in the period between 1992 and 2007.

We are studying seasonal and interannual variability of these parameters, general statistics, and geographical distinctions.

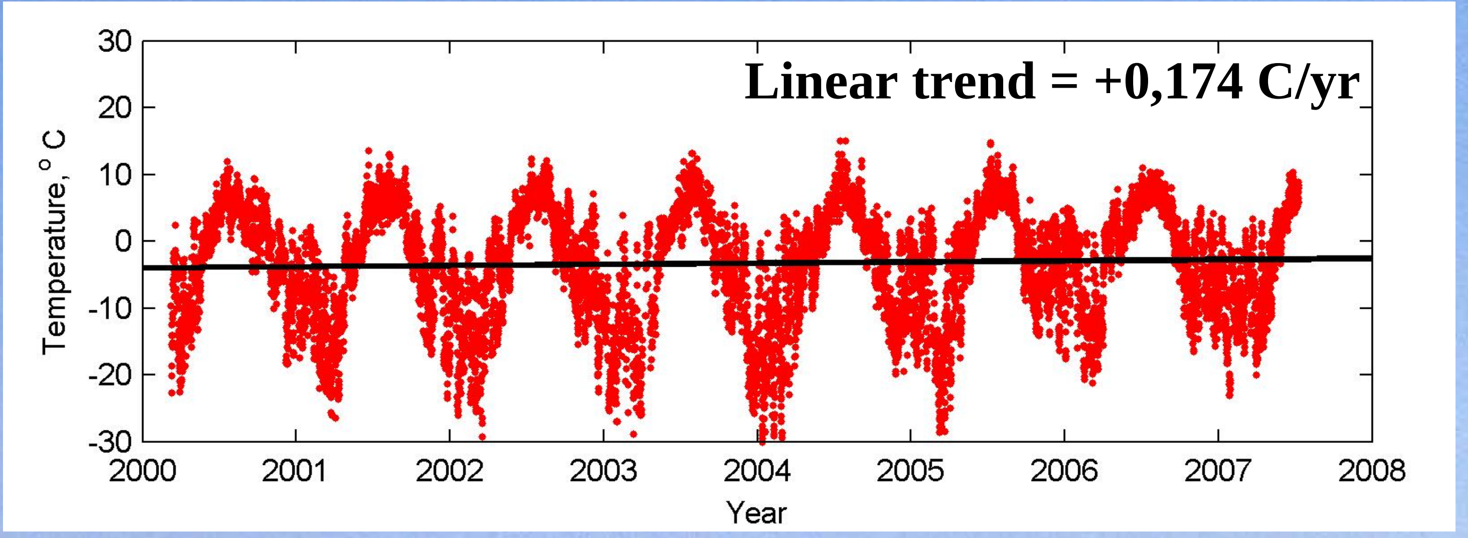
In this presentation we used 6-hours meteo data from Russian's Weather Server: http://meteo.infospace.ru/main.htm

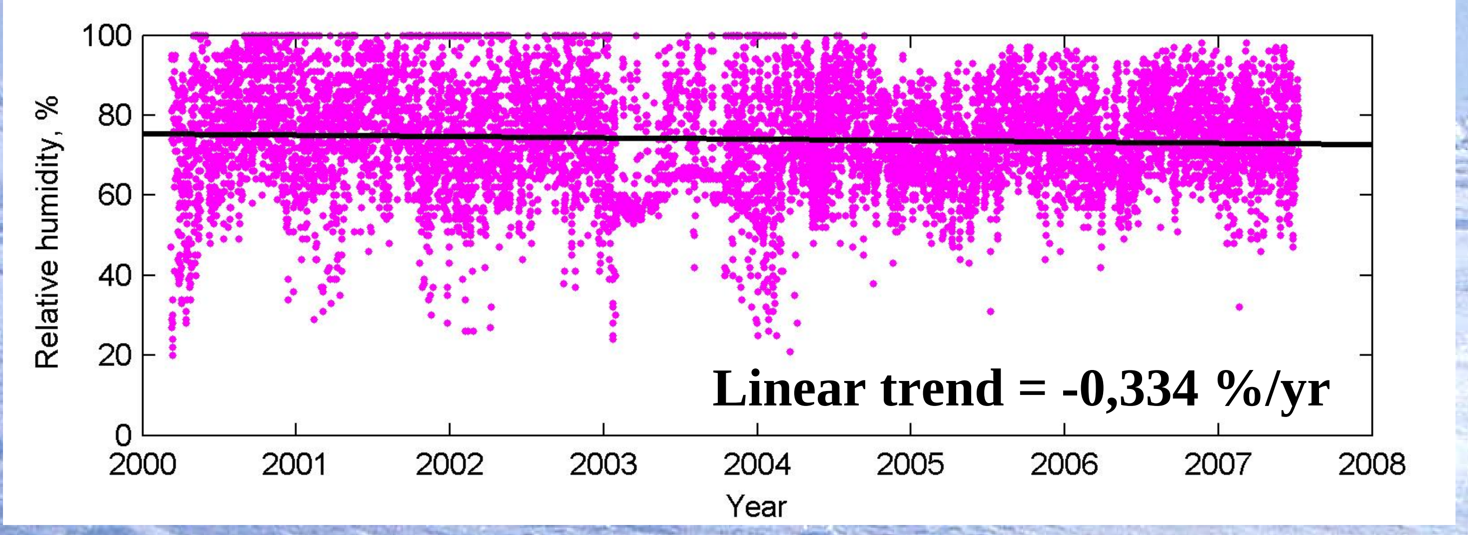
Svalbard Lufthavn (WMO code #1008)



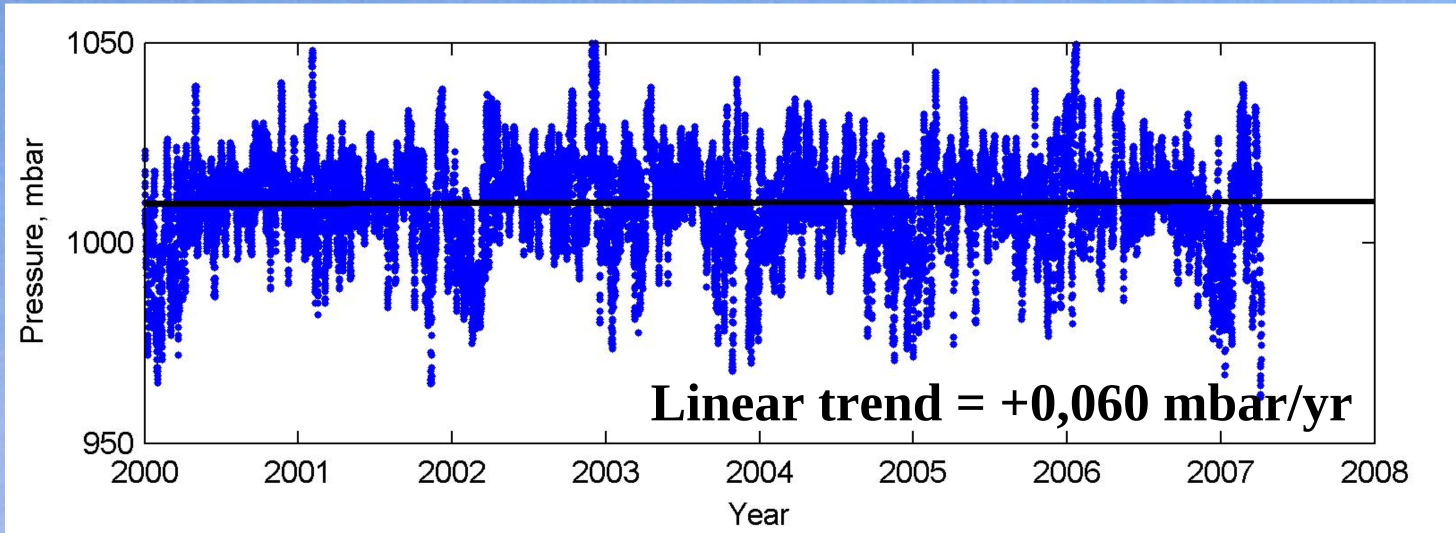


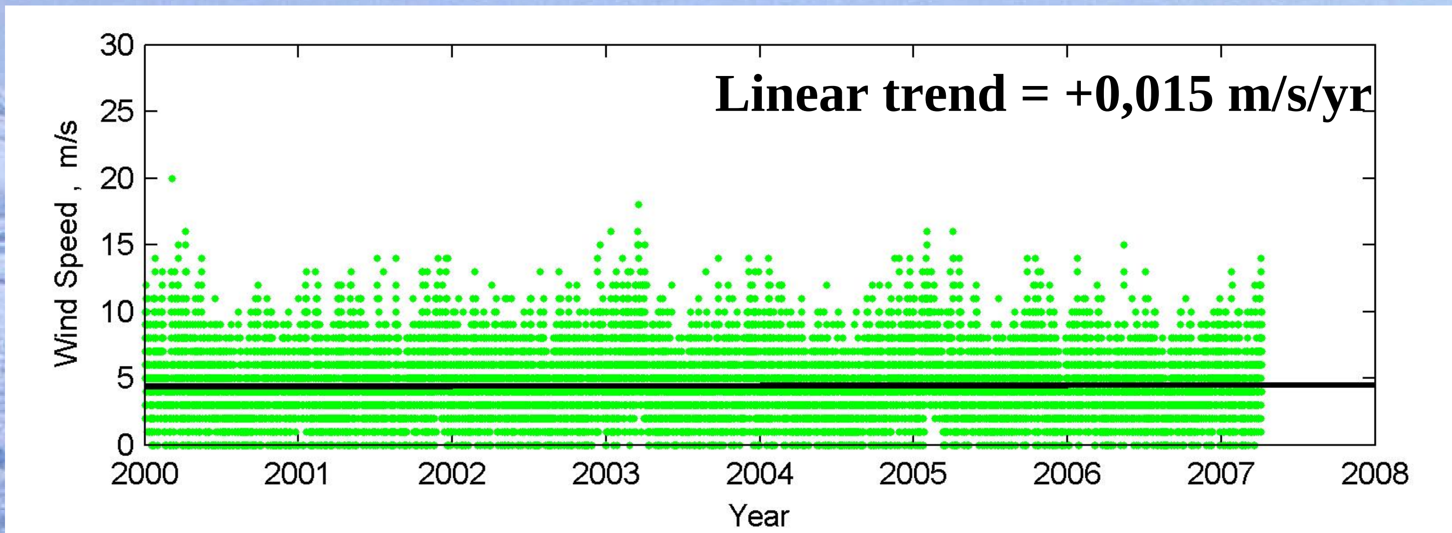
Svalbard Lufthavn (WMO code #1008)





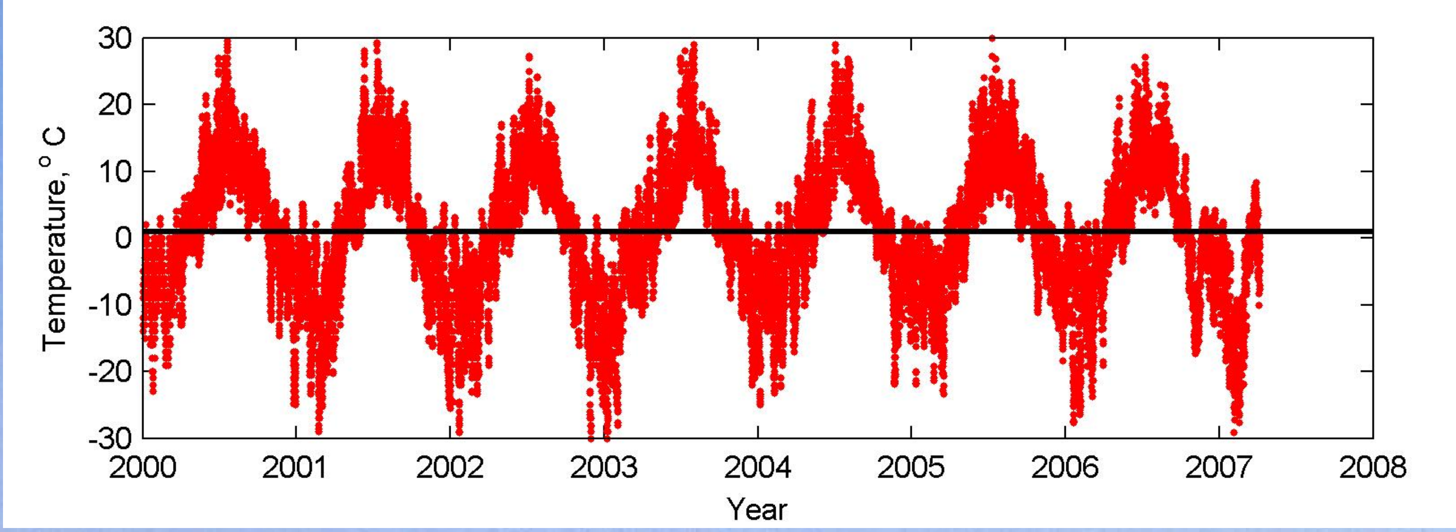
Murmansk (WMO code #22113), the Southwestern Barents Sea

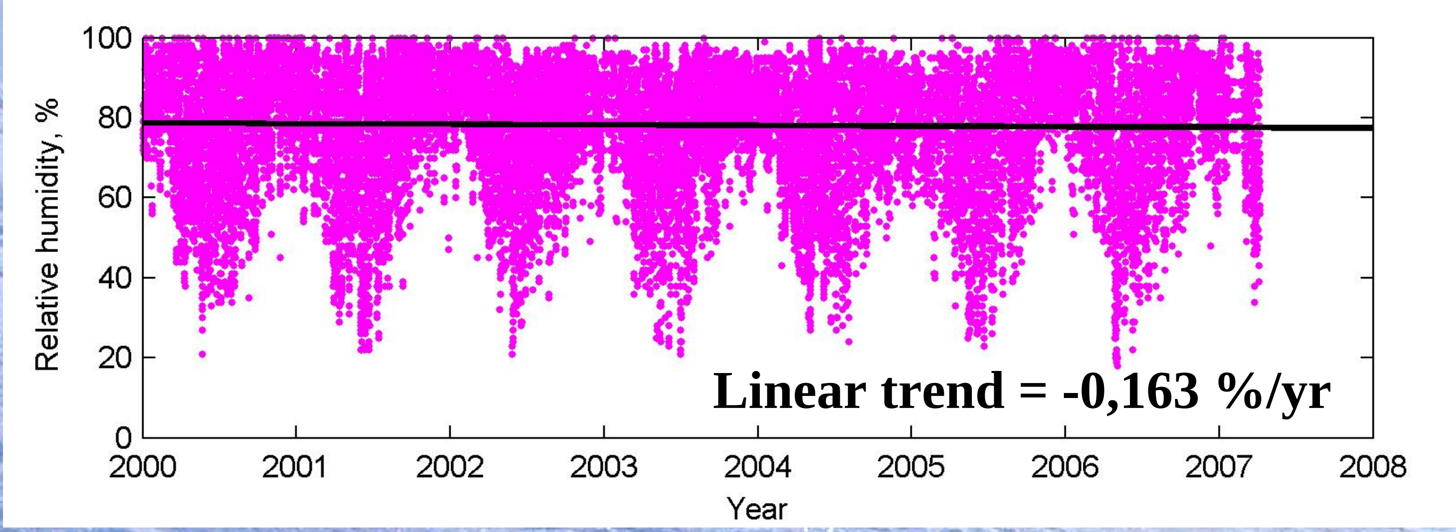




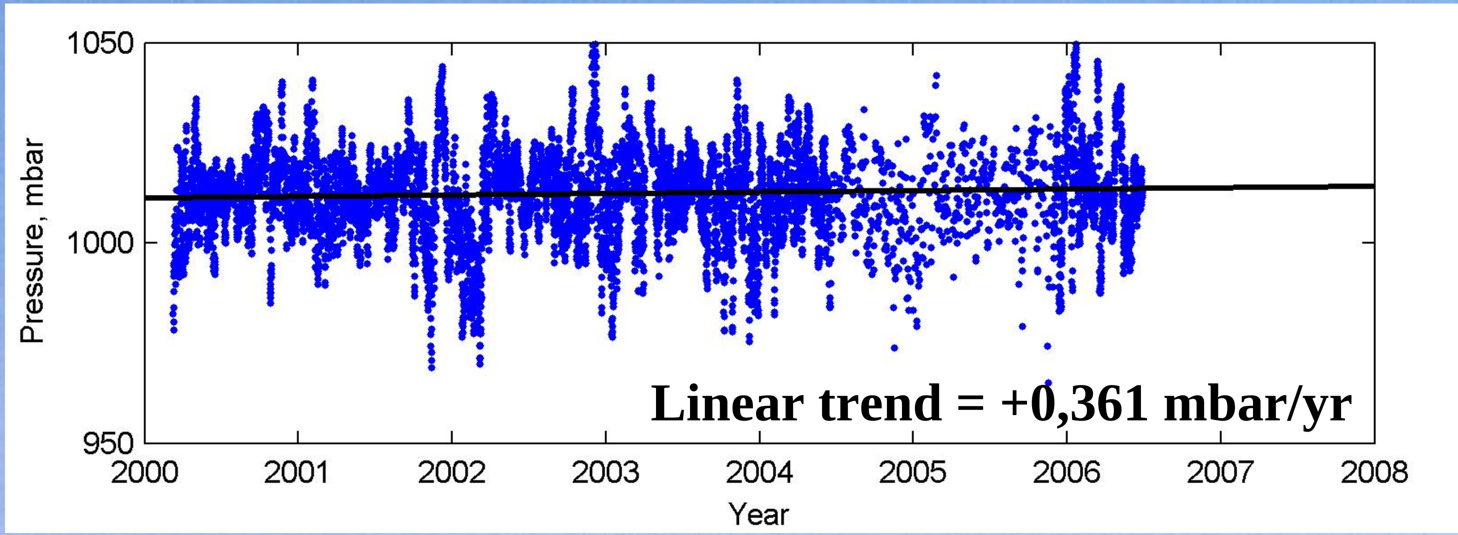
Murmansk (WMO code #22113), the Southwestern Barents Sea

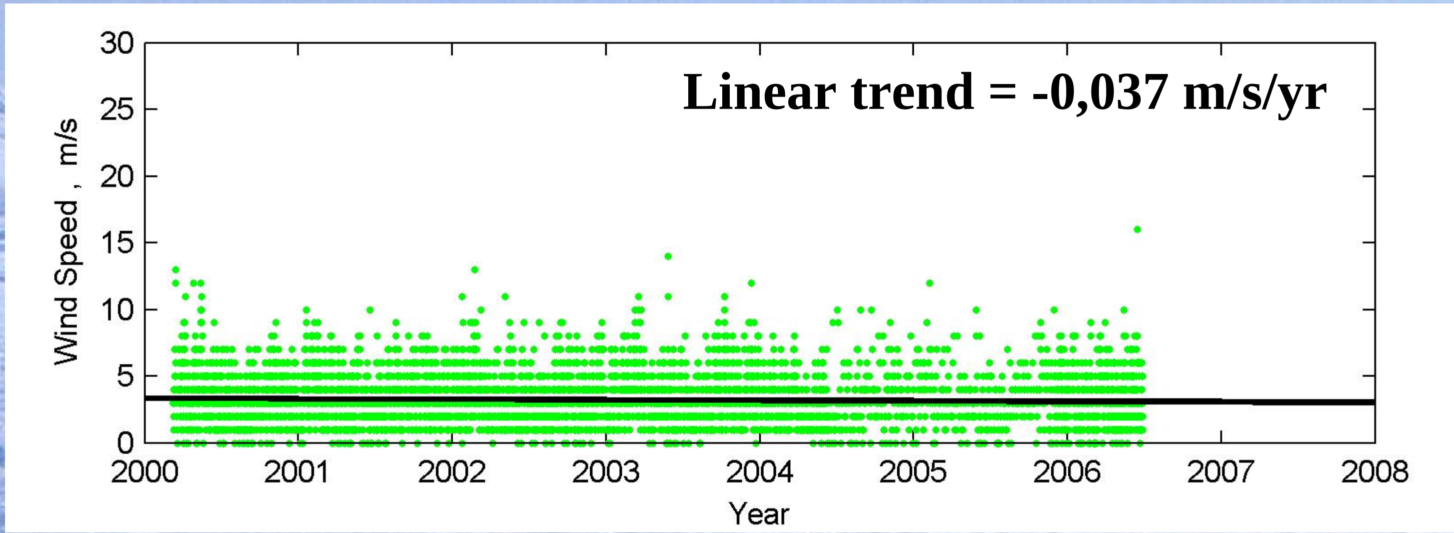
Linear trend = -0,001 C/yr



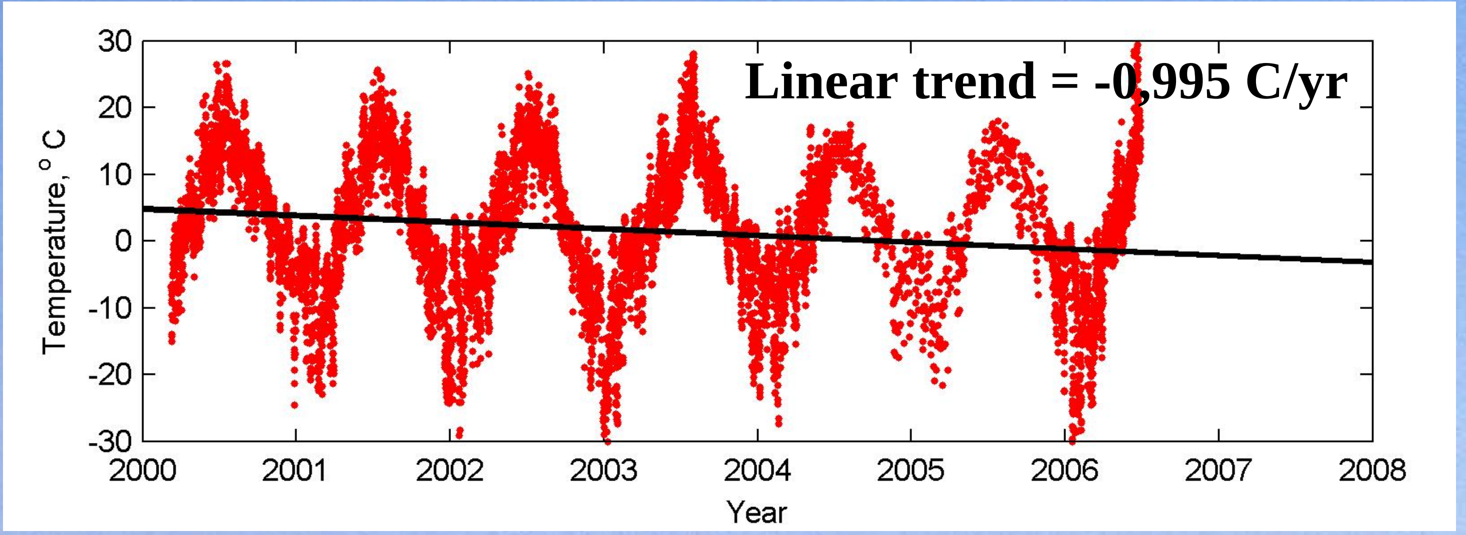


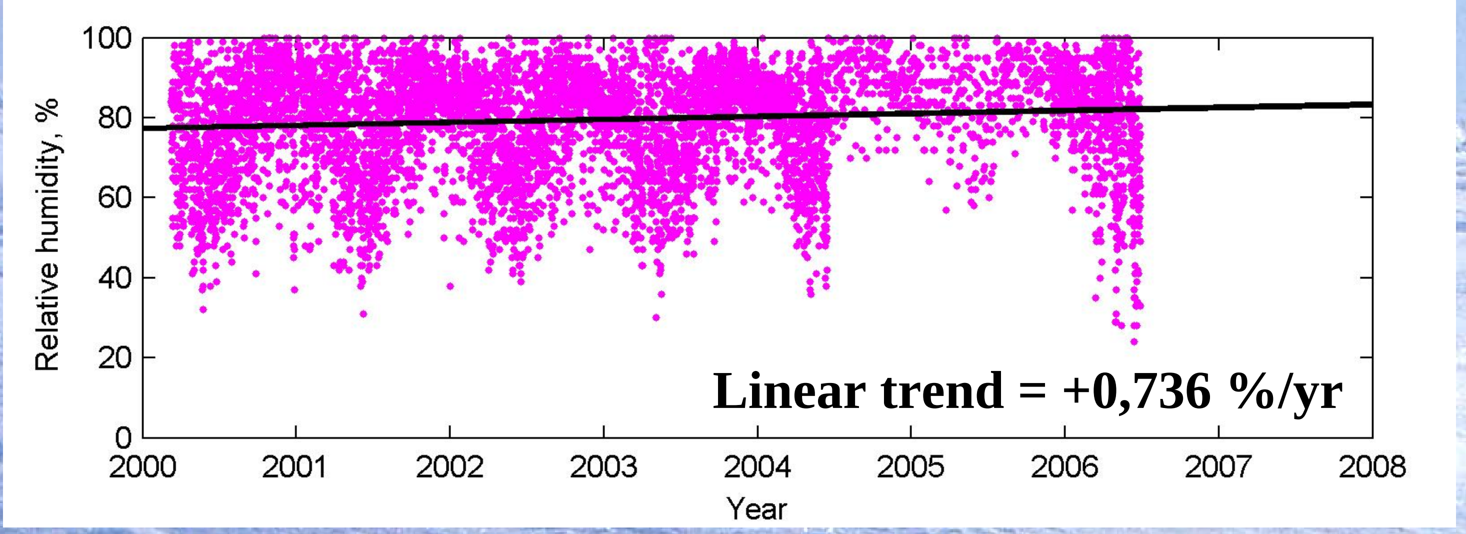
Kem' Port (WMO code #22522), the White Sea



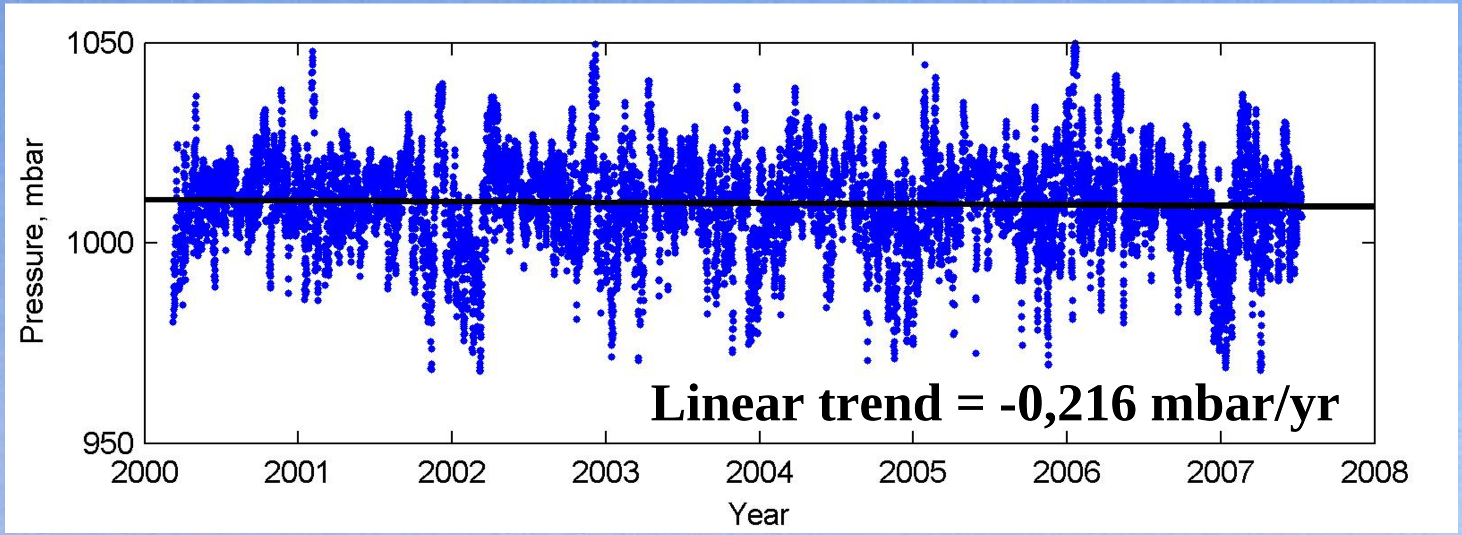


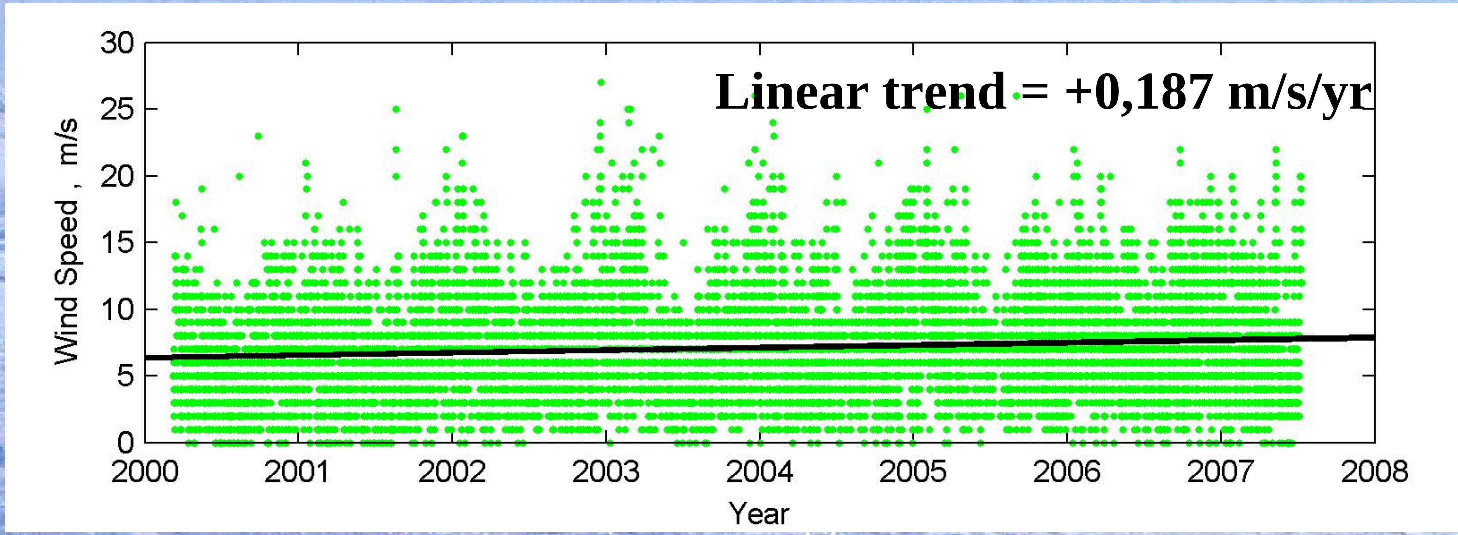
Kem' Port (WMO code #22522), the White Sea



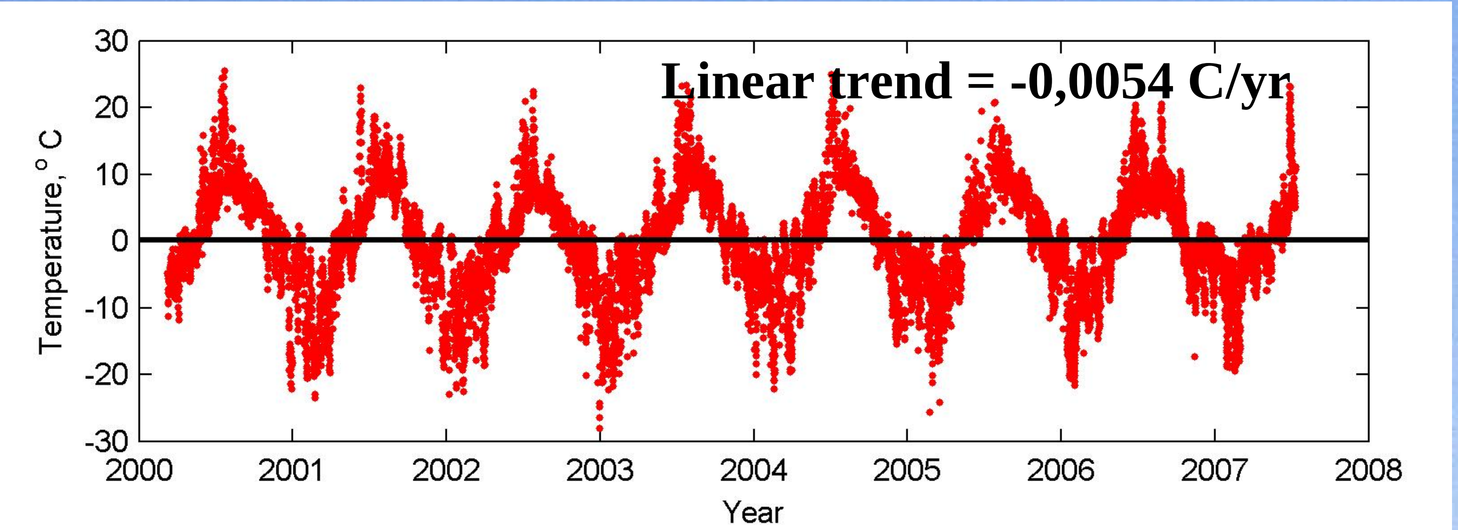


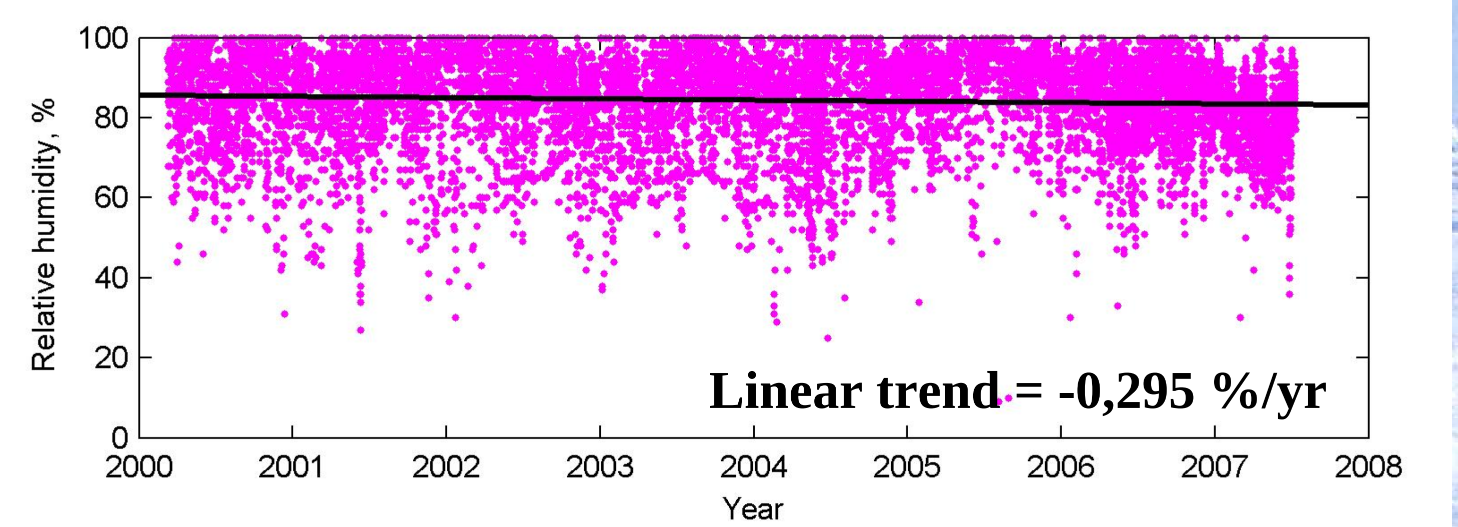
Kanin Nos (WMO code #22165), the Southern Barents Sea



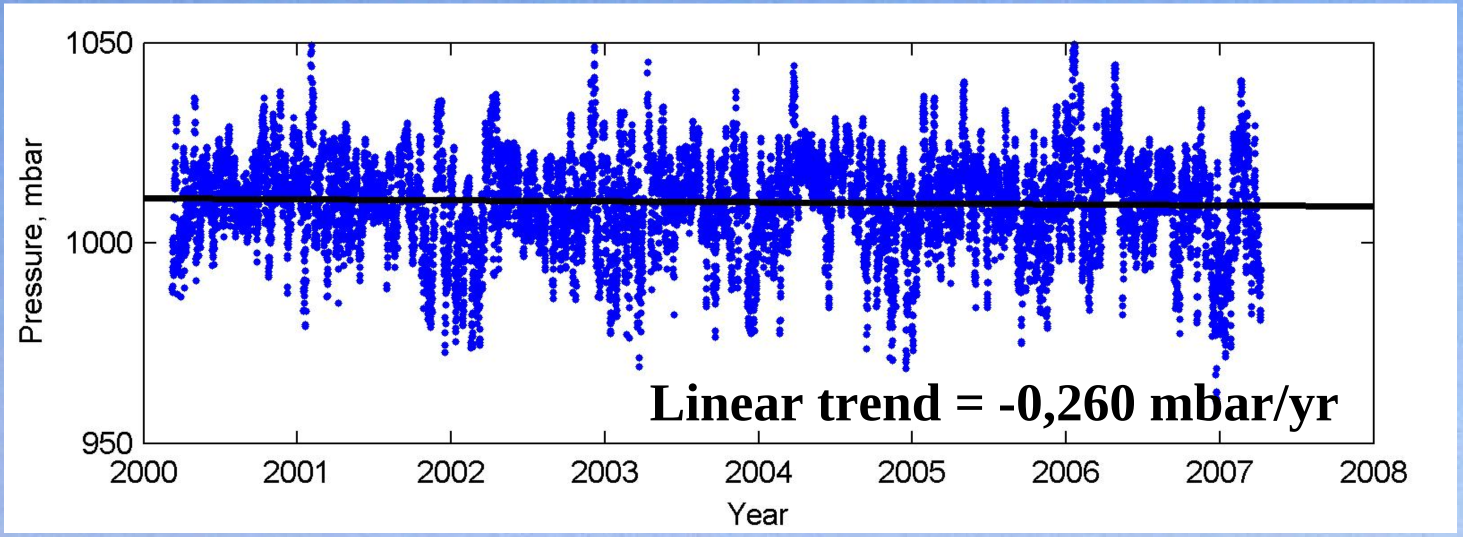


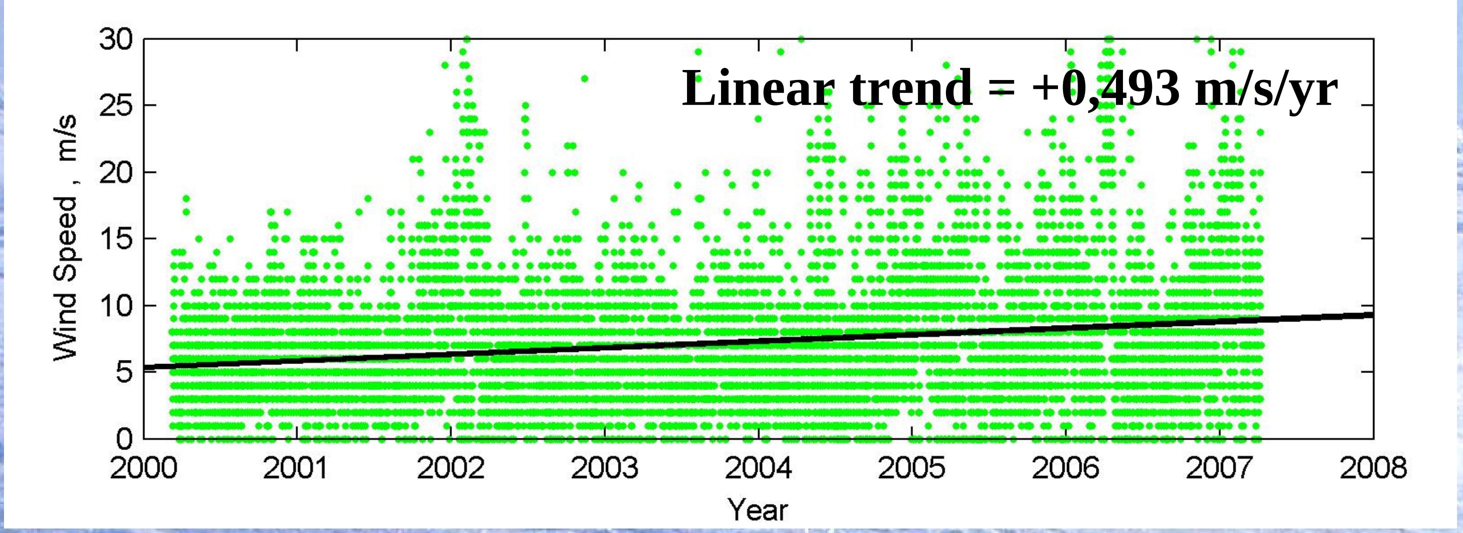
Kanin Nos (WMO code #22165), the Southern Barents Sea



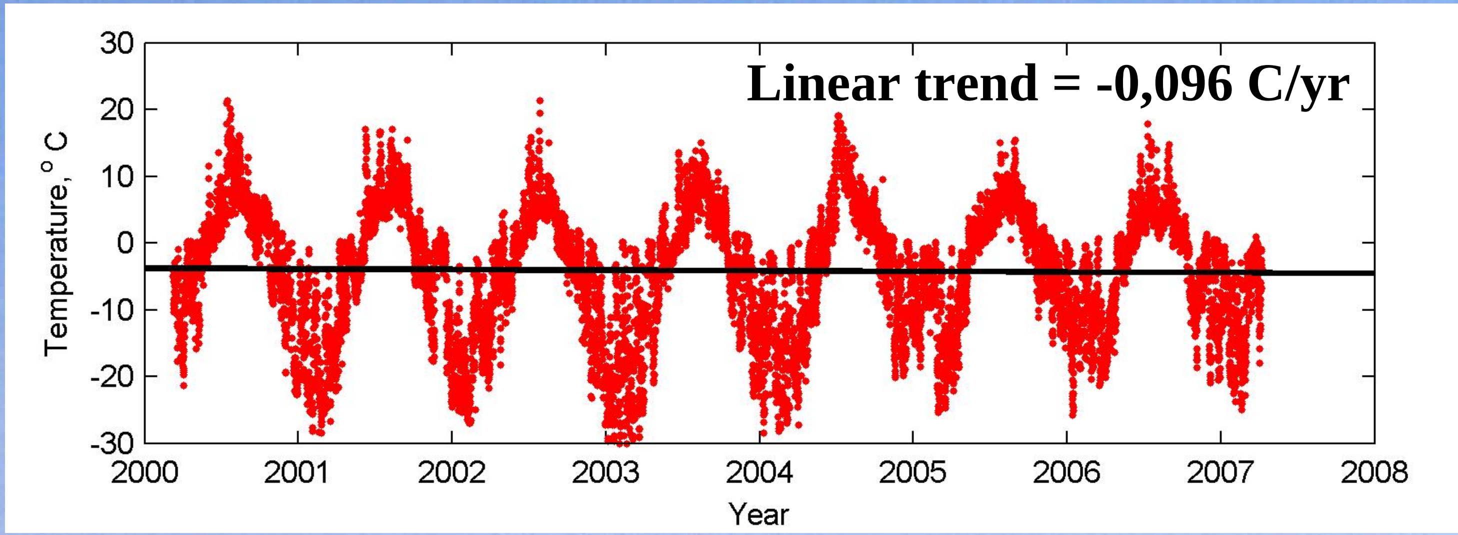


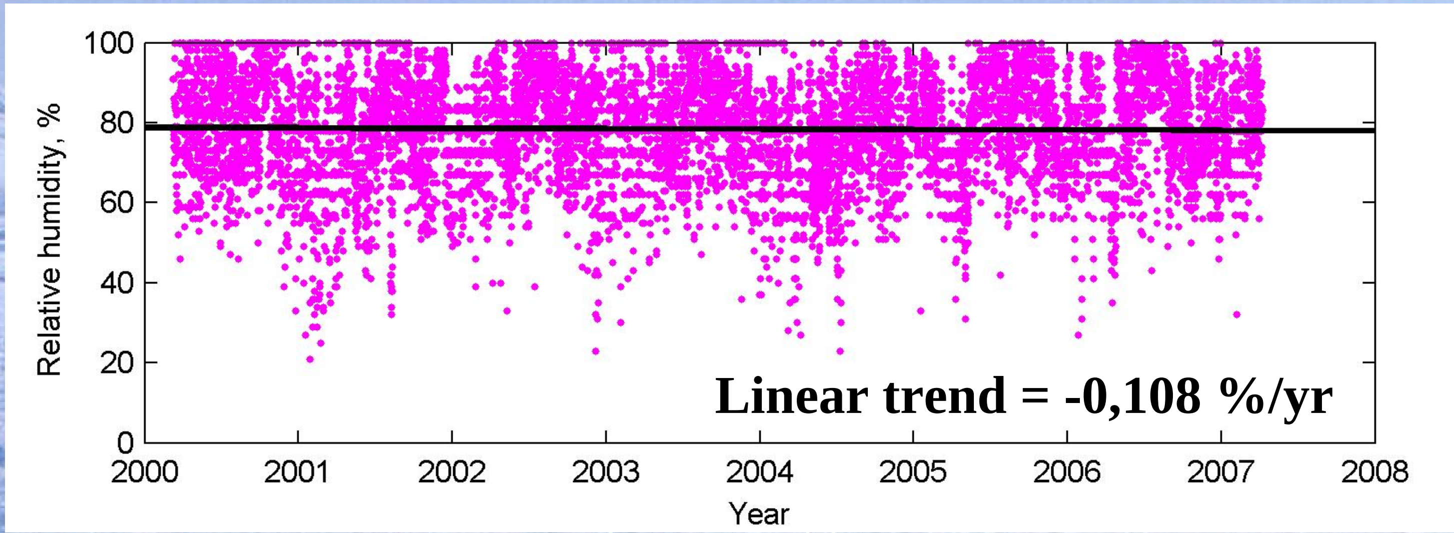
Malye Karmakuly (WMO code #20744), Novaya Zemlya



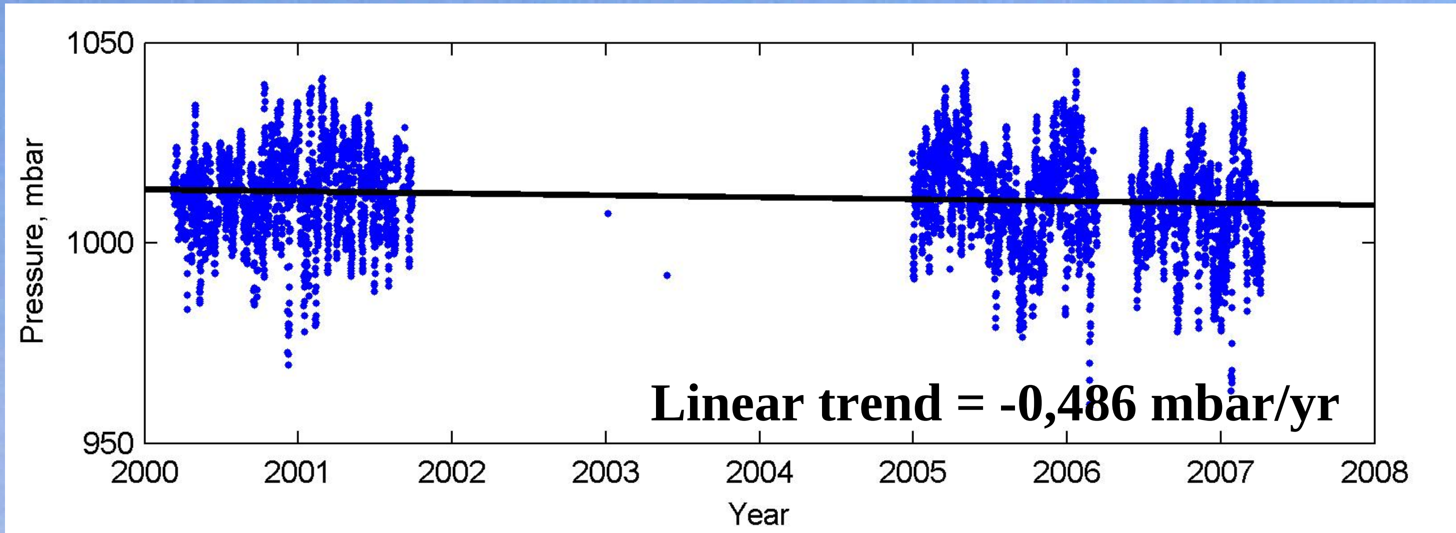


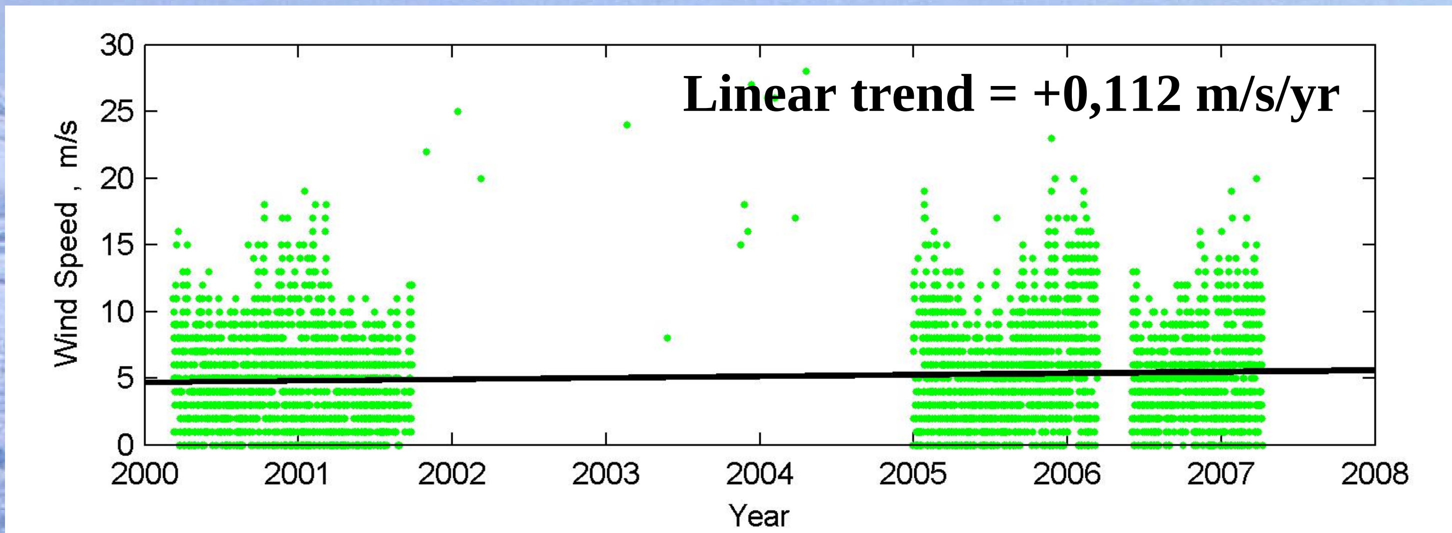
Malye Karmakuly (WMO code #20744), Novaya Zemlya



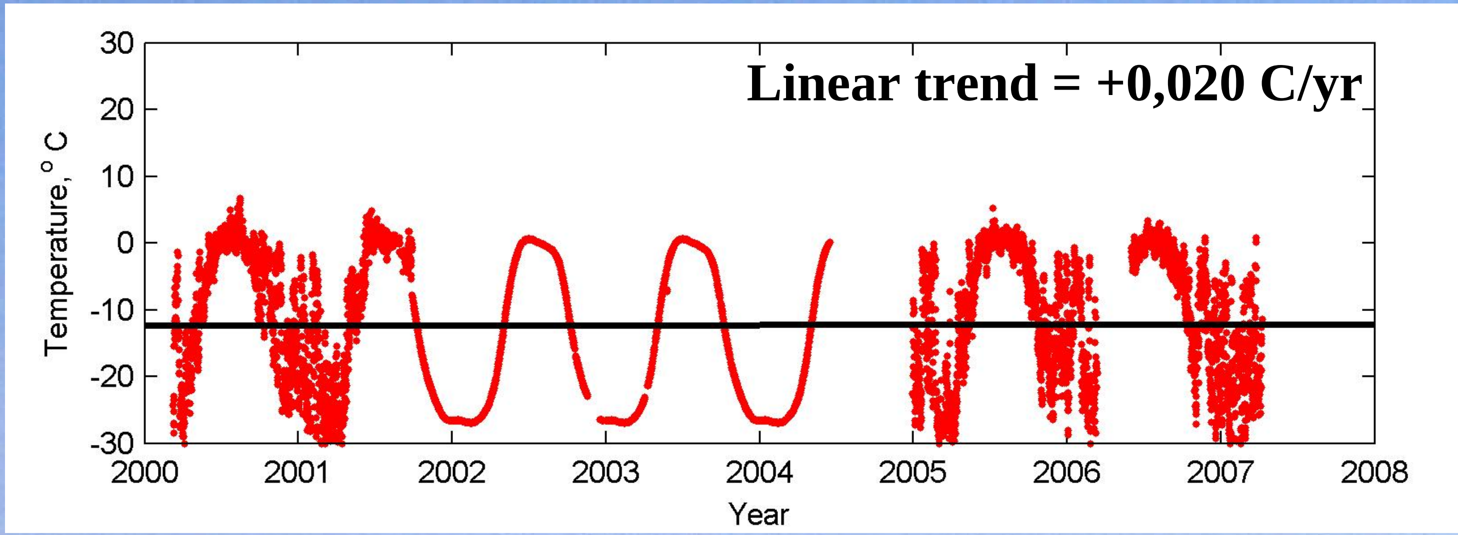


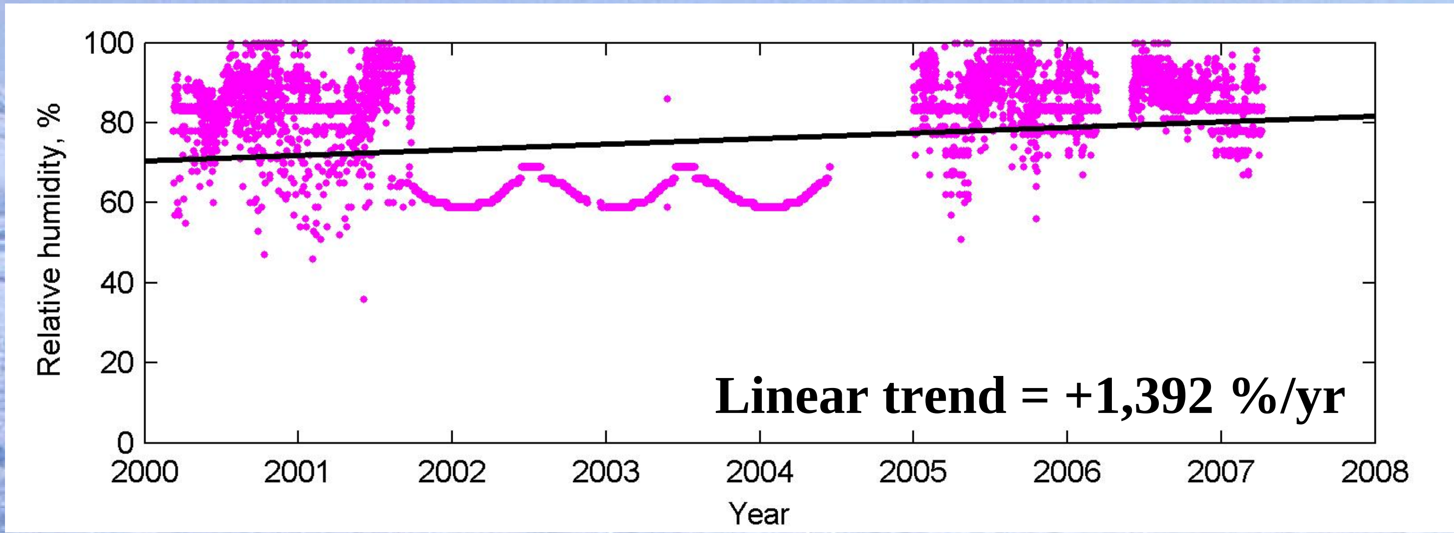
Polar GMO im. E.T.Krenkelja (WMO code #20046), Franz Josef Land



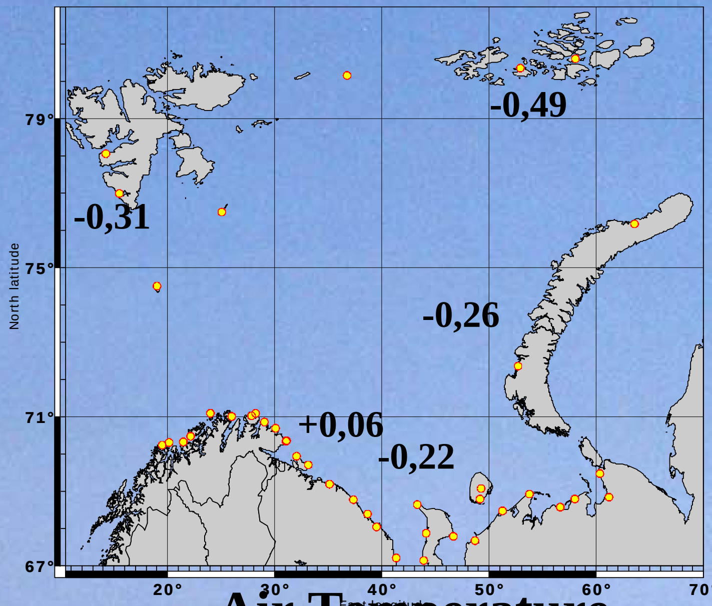


Polar GMO im. E.T.Krenkelja (WMO code #20046), Franz Josef Land

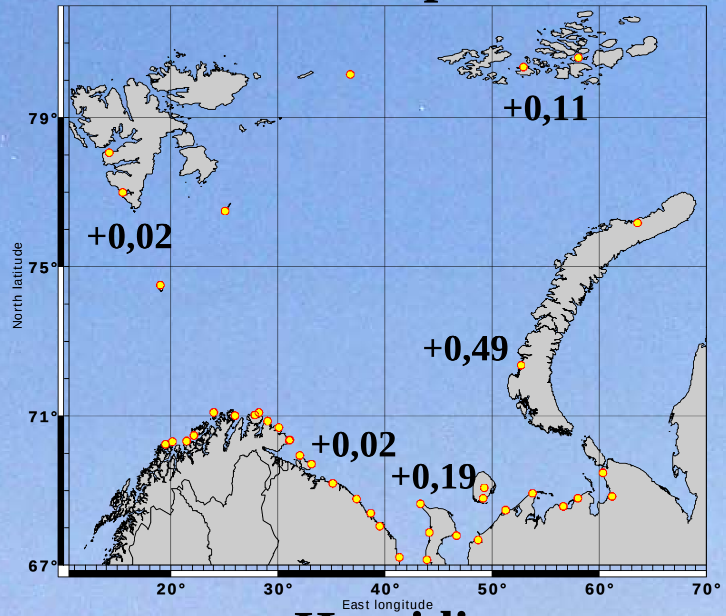




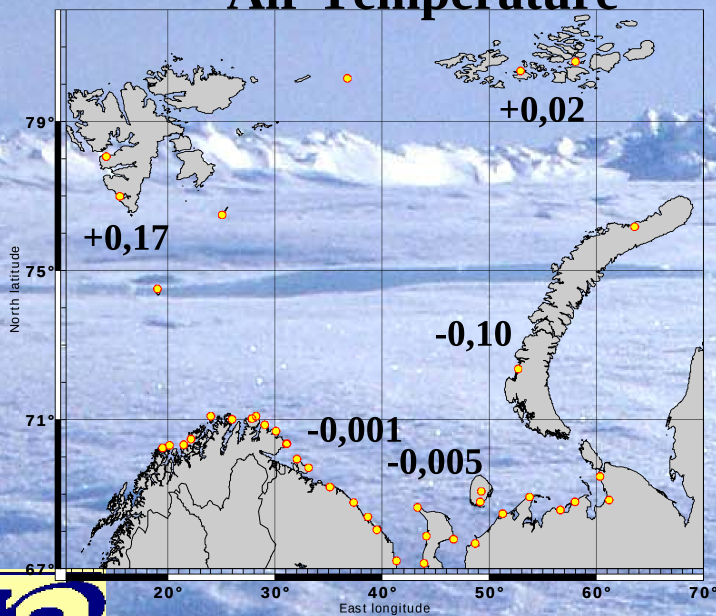
Pressure



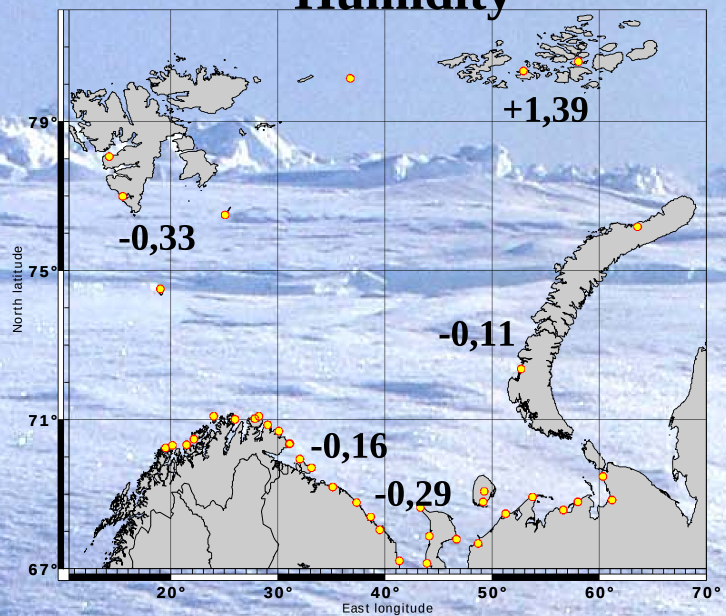
Wind speed



Air Temperature



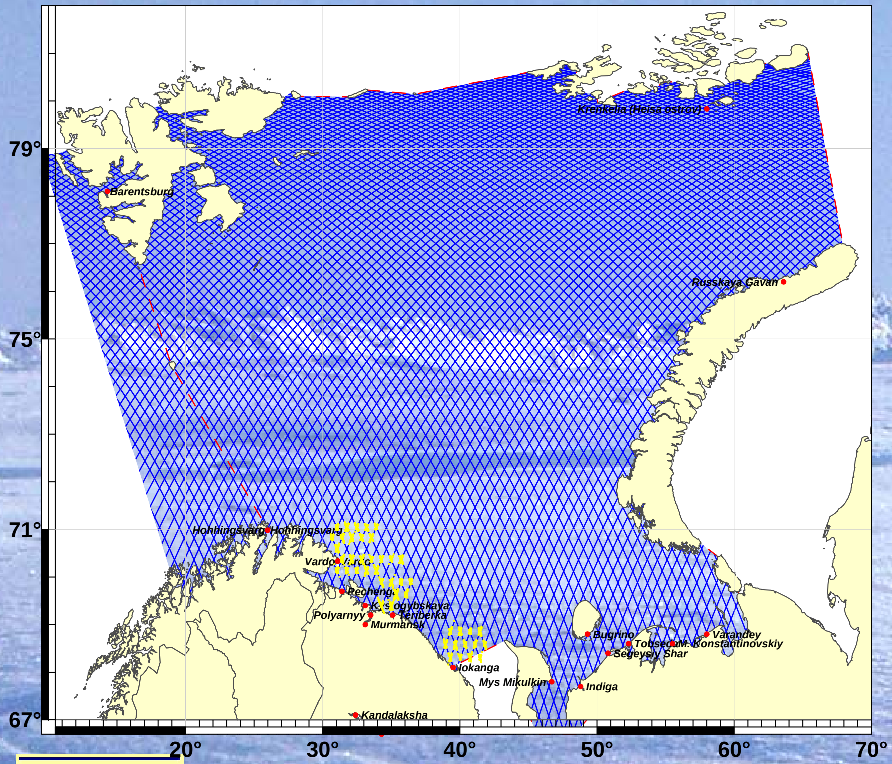
Humidity



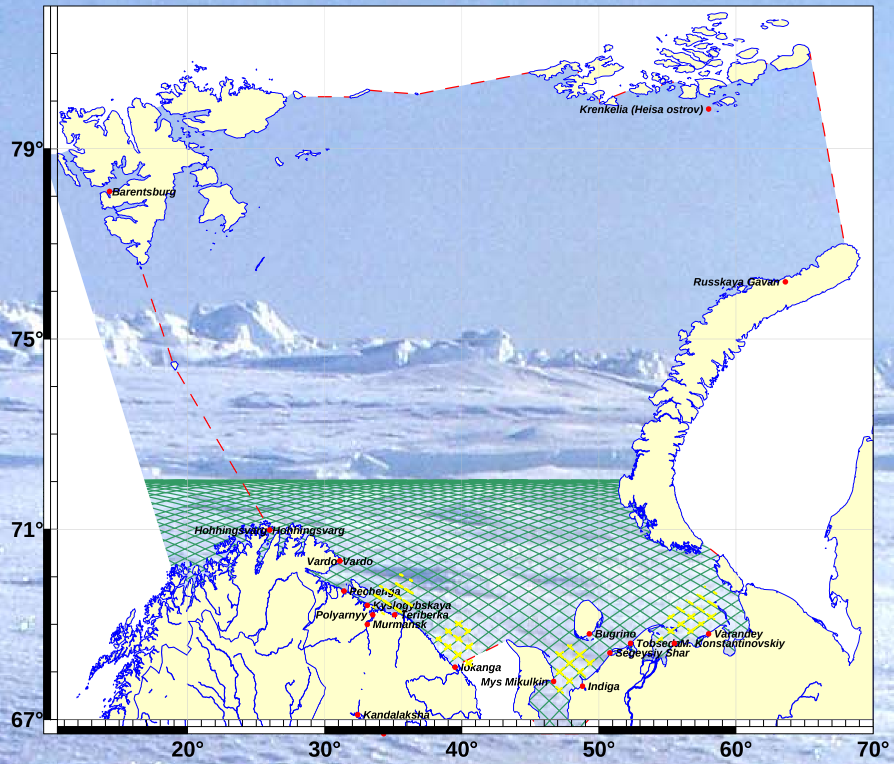
The analysis of in-situ meteo data was coupled with the analysis of satellite observations, which are a unique source of information about the coastal ocean. Radar altimetry is an important remote technique for directly sensing sea state from space, providing along-track measurements of sea surface height, wave height and wind speed. While it provides favourable results in the open ocean conditions, in coastal zones it lacks accuracy due to a number of problems that need to be assessed and solved. A 15-yr long data record from a variety of radar altimeters over costal regions is currently available globally. Under the umbrella of European Union within the INTAS cooperation program, the ALTICORE project (www.alticore.eu) has been running since December 2006 aiming at determining the extent to which this unprecedented data set can be improved and usefully exploited along the European coasts, specifically over selected validation sites in the Mediterranean, Black, Caspian, White and Barents seas. A comparison of satellite and in-situ sea surface height and wind speed data was made for the Barents and White seas, in particular, which showed distinctions between different parts of the coastal zone, derived from the correlation analysis.

The Barents Sea

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

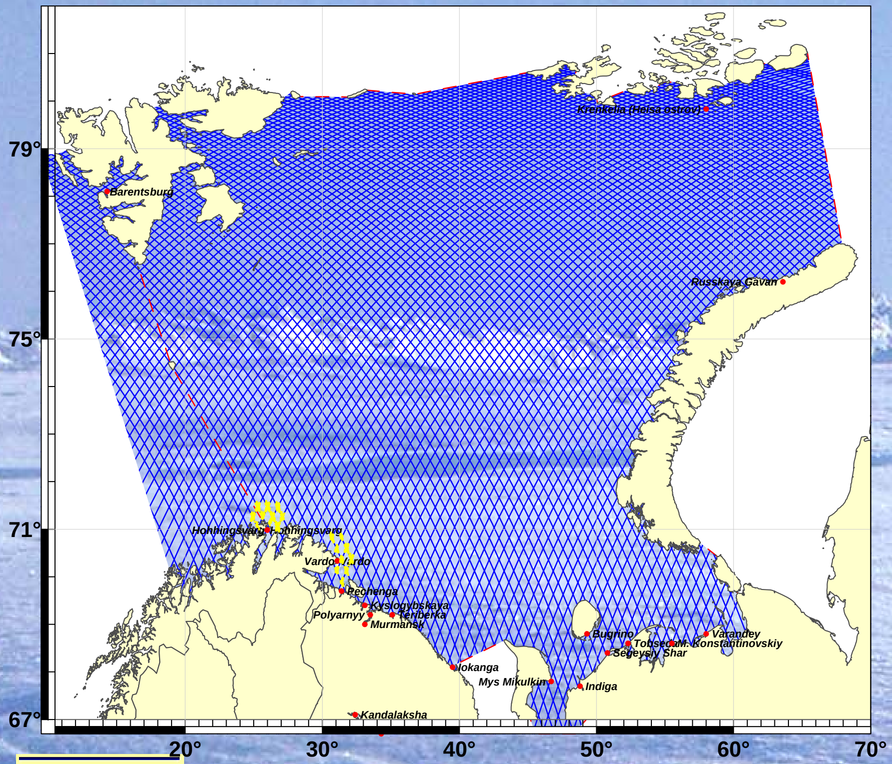


Green lines – GEOSAT (B) groundtracks (1987-1989)
Red circles – location of tide gauges
Yellow points – sample points from groundtracks for data comparison

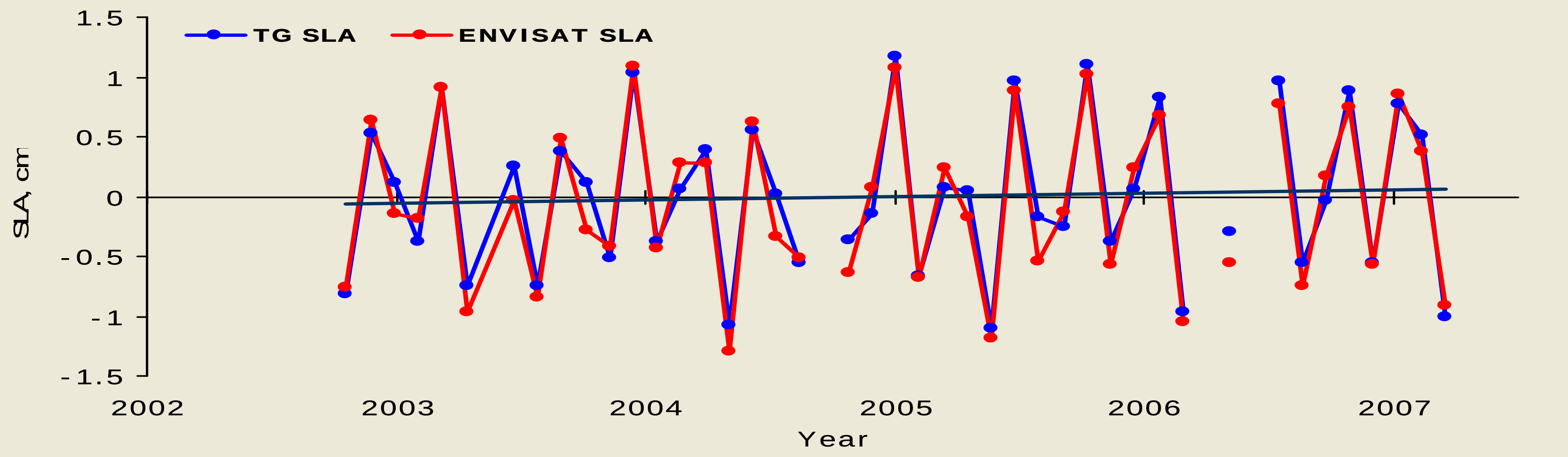


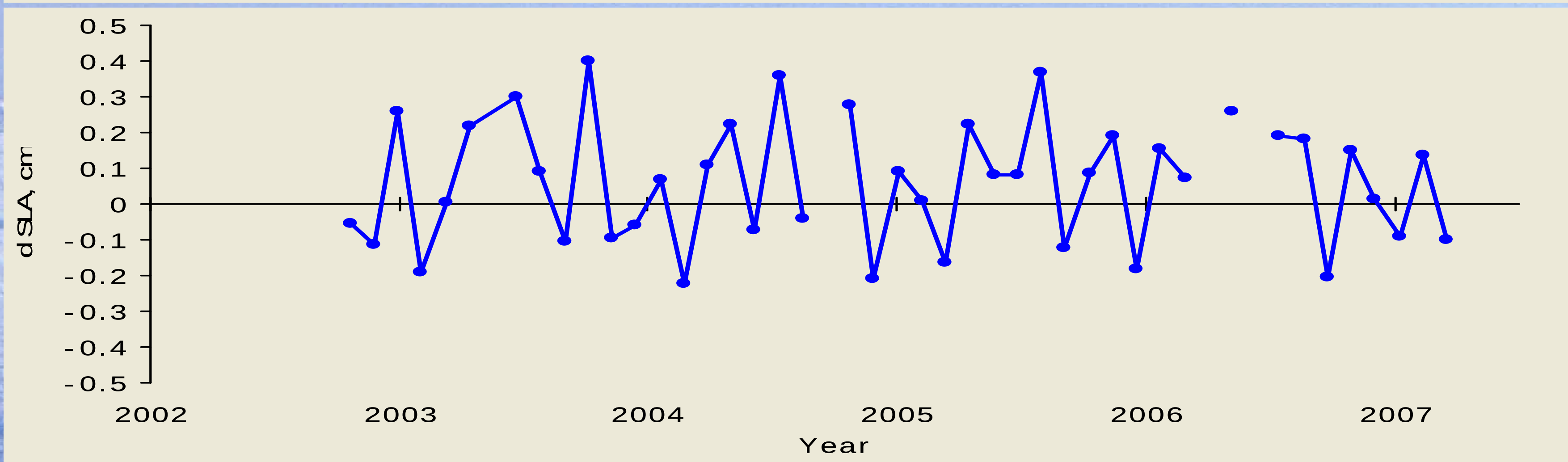
The Barents Sea

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

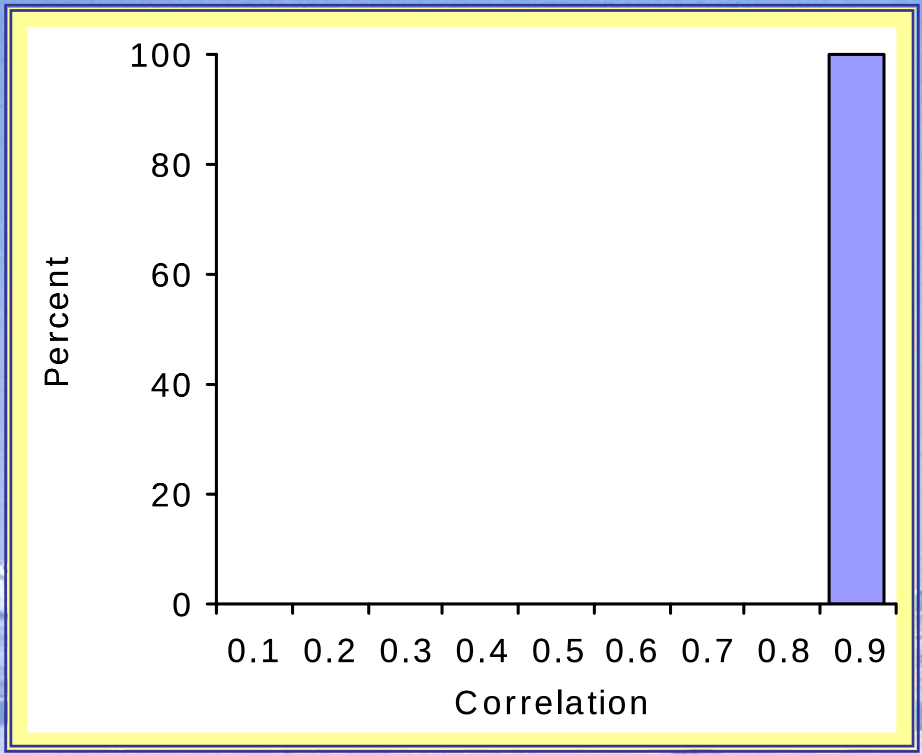


Sea level anomalies from the tide gauge (Hohhinsvarg) and ENVISAT data (2002-2007)

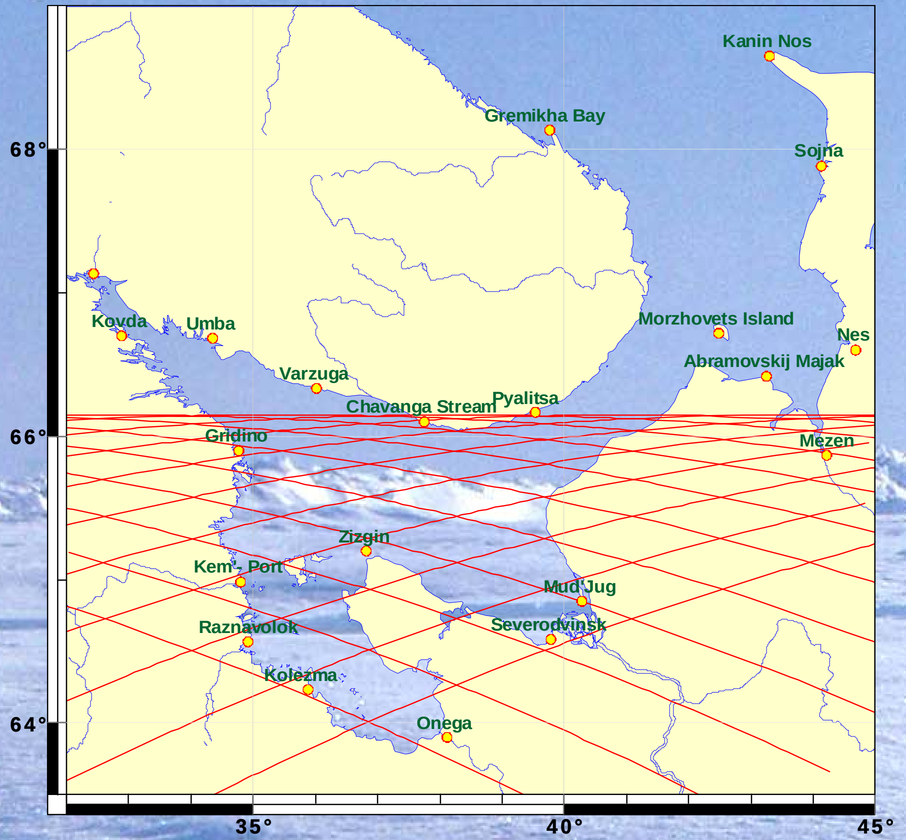




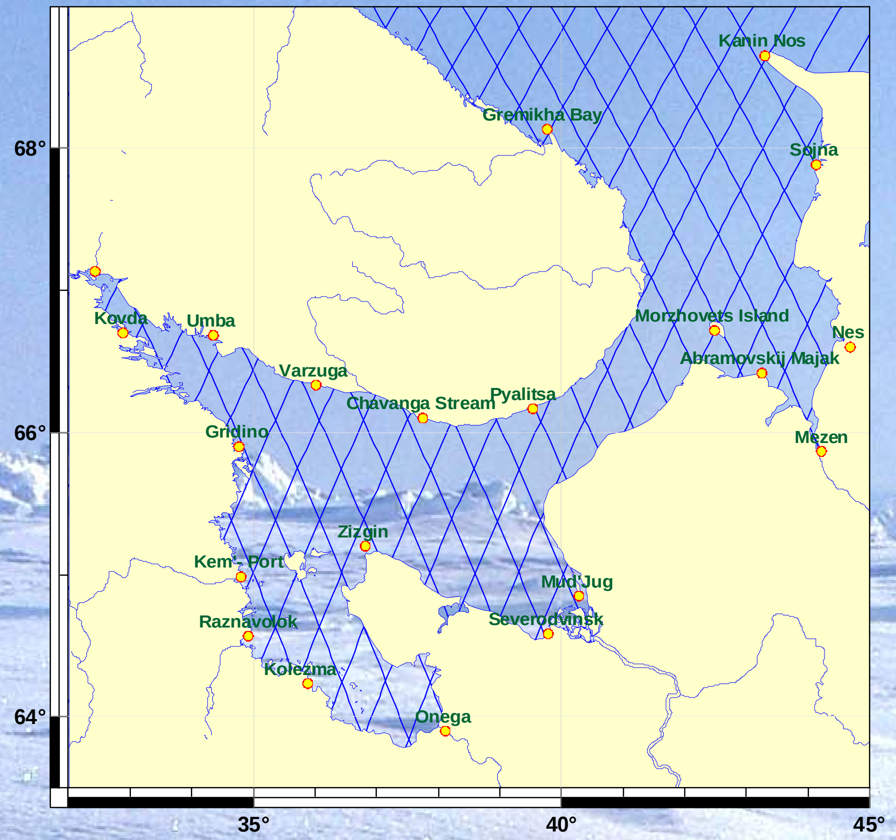
Statistical distribution of correlation between ERS-2 & ENVISAT SLAs and tide gauges SL in Vardo and Hohhingsvarg (Barents Sea) in 2001-2007



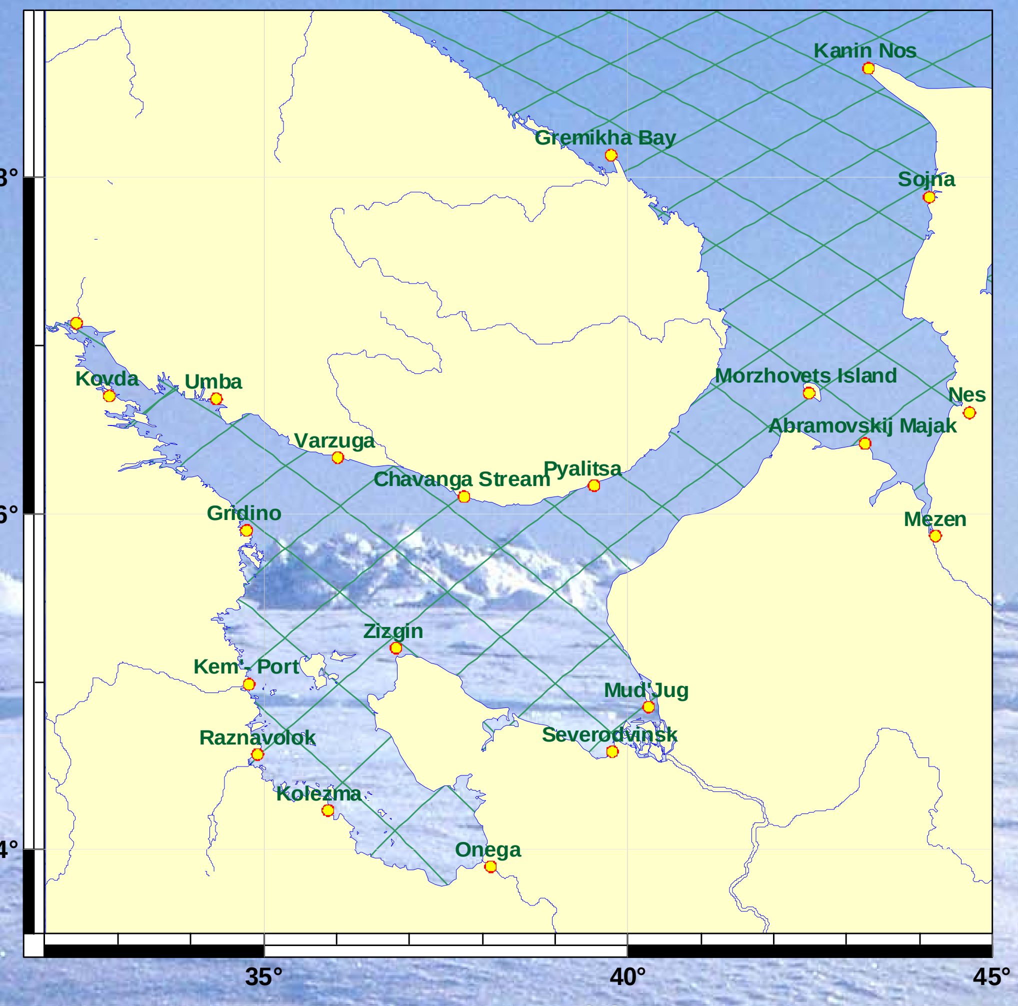
Location of the meteo stations and TOPEX/Poseidon & Jason-1 groundtracks



Location of the meteo stations and ERS & Envisat groundtracks

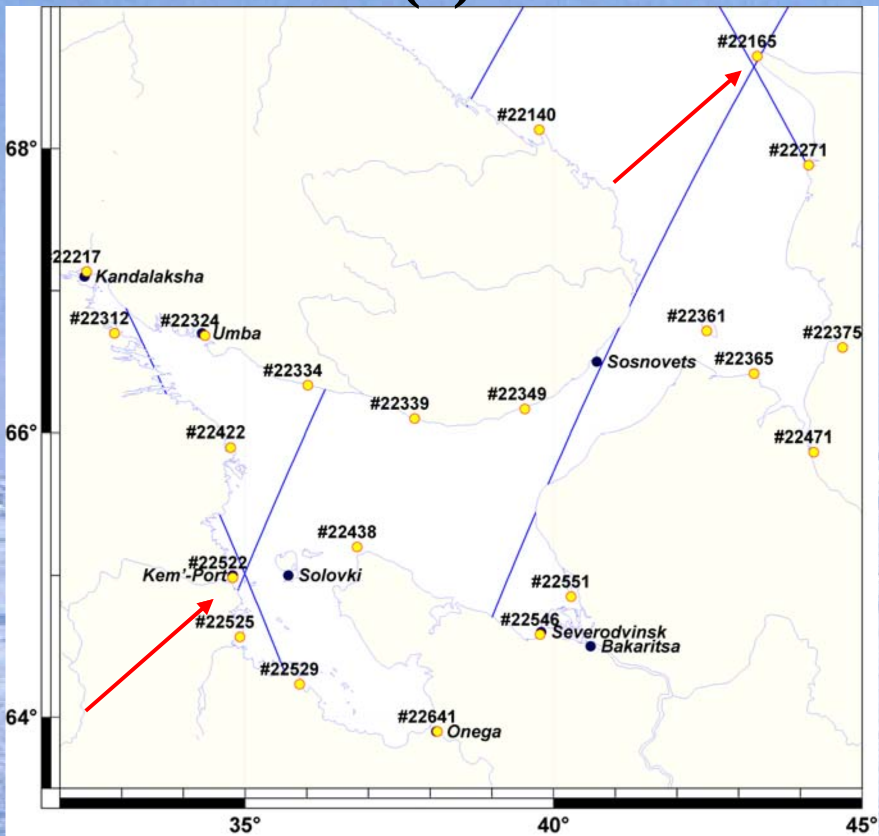


Location of the meteo stations and GFO groundtracks

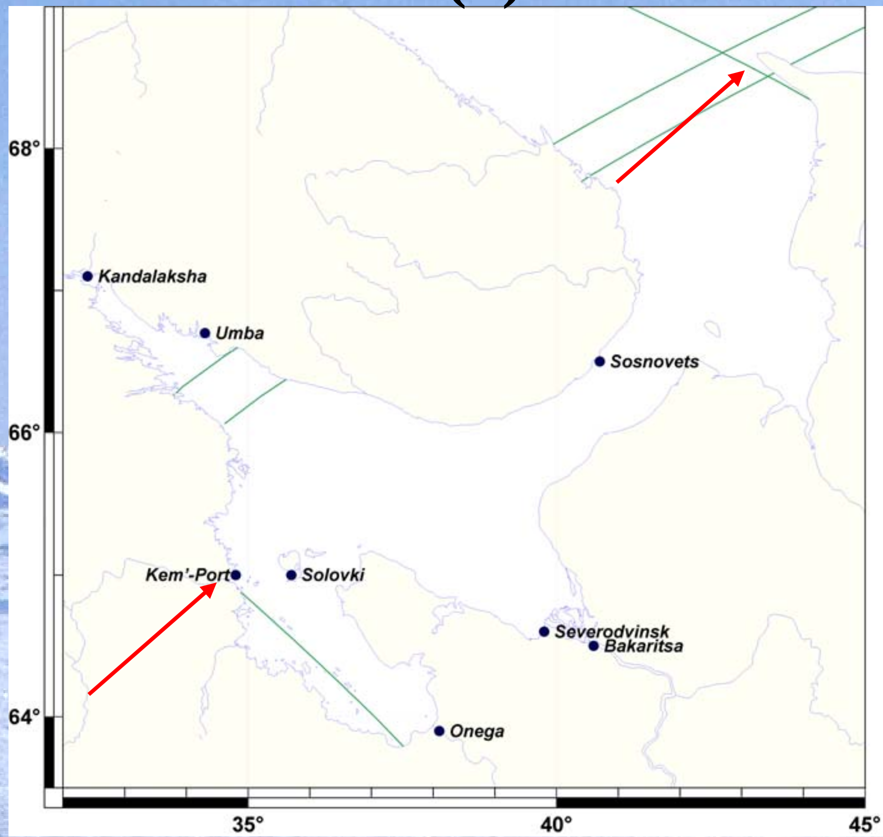


Location of the ERS/ENVISAT (a) and GFO (b) groundtracks over the White and Barents seas which were used for the analysis

(a)

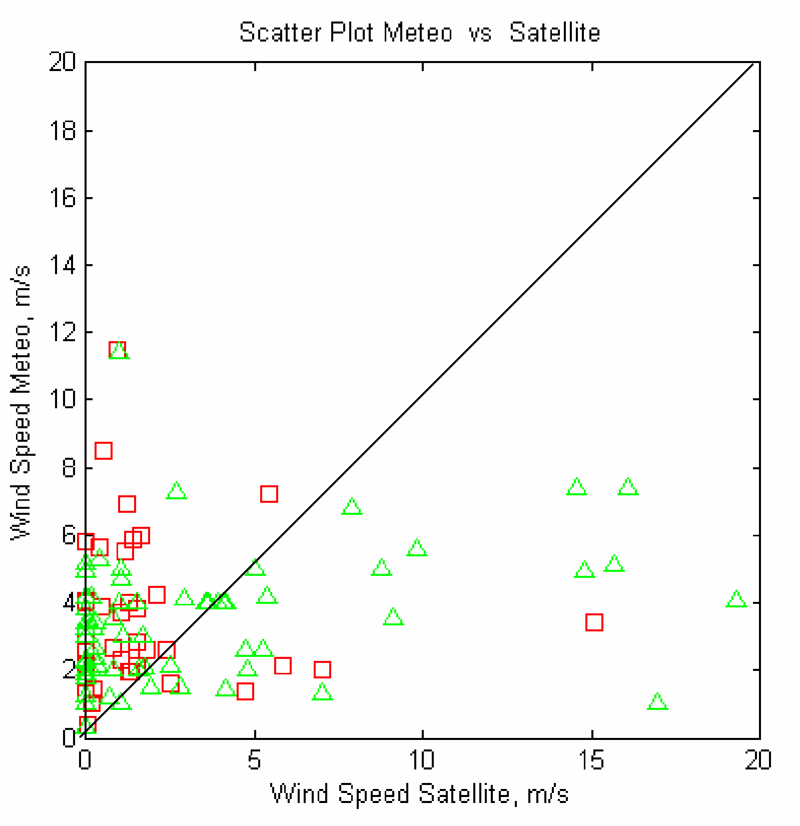


(b)

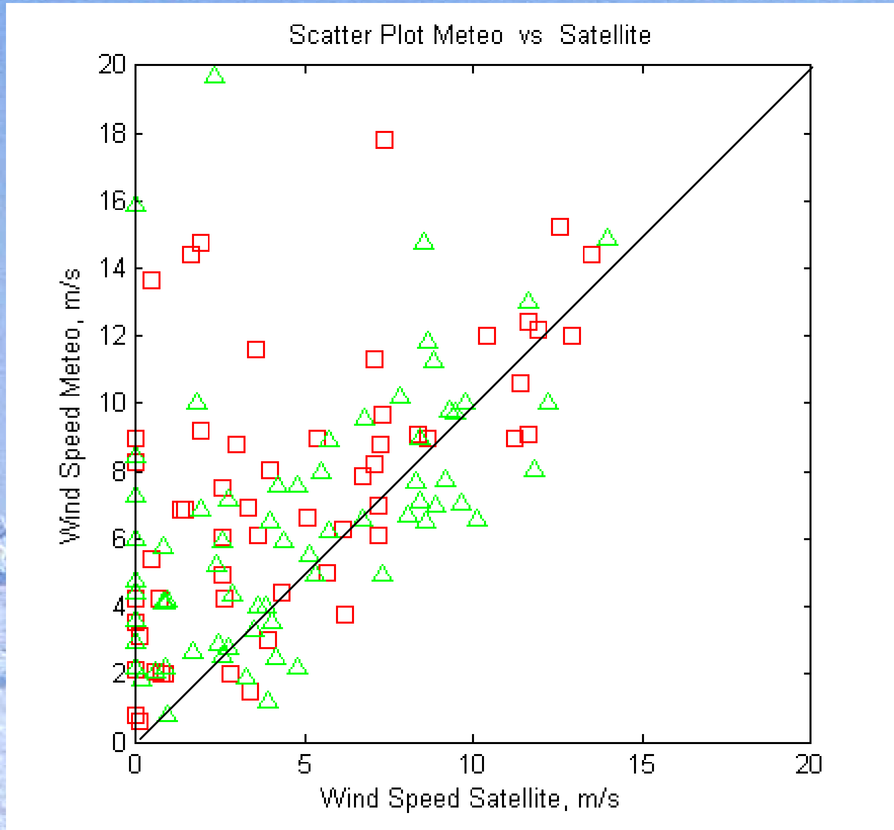


Wind Speed: Altimeter vs Meteo

Kem Port (White Sea)



Kanin Nos (Barents Sea)



Conclusions

Significant spatial variability of several meteo parameters in the Barents Sea.
Decrease of atmospheric pressure in the Barents Sea.
Increase of wind speed in the Barents Sea. Significant one at Novaya Zemlya.
A notable incease of air temperature at Svalbard.
A significant increase of humidity at Franz Josef Land.

The comparison carried out between satellite-derived and meteo data on wind speed has shown their poor correlation, except only for some meteostations (e.g., Kanin Nos). Possible reasons of such discrepancy, provided trustworthy measurements with altimeter, may be position of a satellite pass relative to a coastal meteostation and influence of land on the results of satellite measurements, as well as lack of coincidence in time of these measurements.

To improve the correlation, some additional techniques must be used (e.g., calibration of measurement devices, a correct choice of the distance between coordinates of satellite track point of measurement and meteostation position so that to exclude a possible influence of land, choosing several track points data and compose them, as well as decomposition of the wind speed on four main directions - from the sea, from the land, and two directions along the coast). These are present tasks for ALTICORE project.