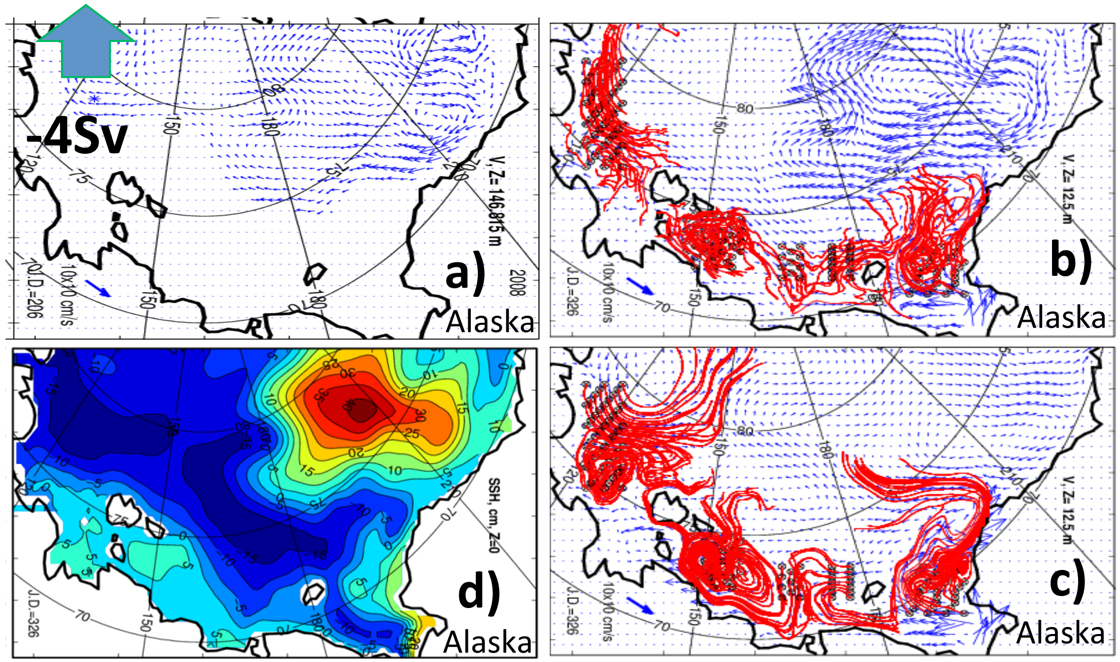
Analysis of the climate variability of the circulation in the Pacific AO

Analysis reveals anomalous circulation in PSAO during 2008-2009:

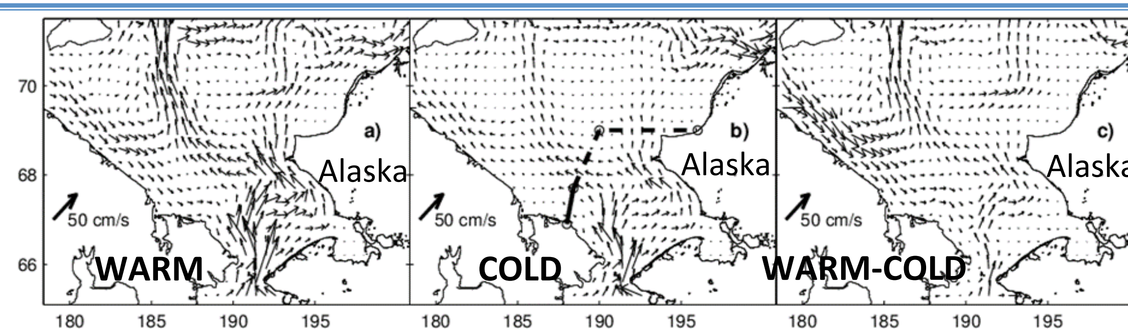
a) Westward flow of the Atlantic Water: decrease of the Atlantic water flow

b)-c) Intense off-shore flow from ESS: biology and methane off shore transport

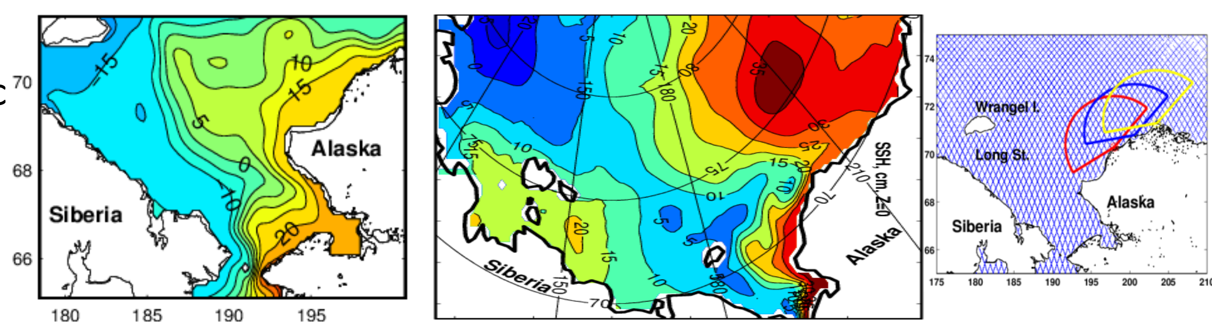
d) Depression of the Sea Surface Height in the western part and maximum in the Beaufort Sea: accumulation of the freshwater storage in the Beaufort Sea



EOF analysis of the T/S observations in the Chukchi Sea during 1948-2008 reveals strong difference of Pacific water flow during the “warm” and “cold” years: Strong impact on biology and chemistry

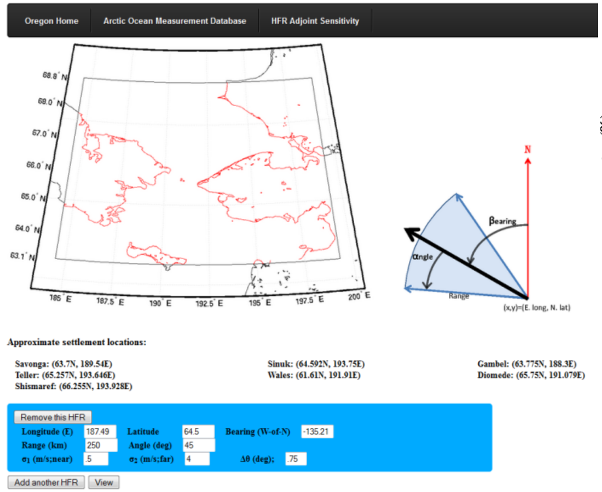


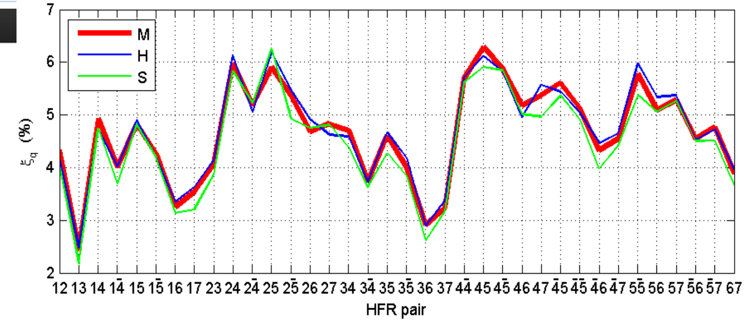
As an additional result of these studies we obtained two MDOTs for the Pacific AO (a,b), which may be used as a reference SSH for assimilation of satellite altimetry observations (c)



Towards operational hind cast/forecast of the circulation in the Pacific AO

Locations of the High Frequency Radars (HFRs) were optimized with respect to the accuracy in estimating the Bering Strait transport



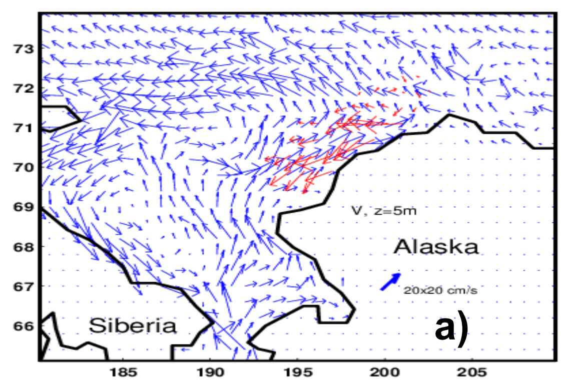


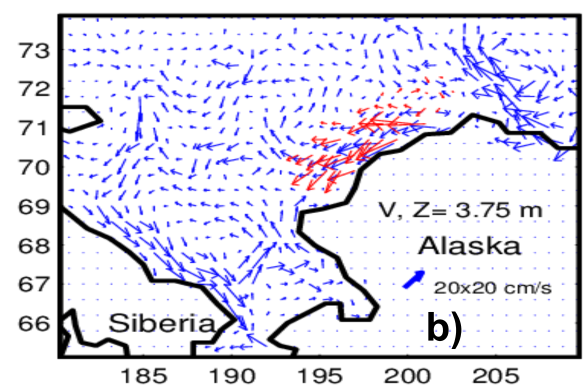
Relative reduction of the errors in estimation of the mass (M), Heat (H) and salt (S) transports for various pairs of the HFRs. Number labeling HFR pairs correspond to location HFR.

Reconstruction of the circulation in the Chukchi Sea through the assimilation of HFR velocities :

a) First guess HYCOM solution: after SODA data assimilation

b) Circulation after 4Dvar assimilation HFR observations



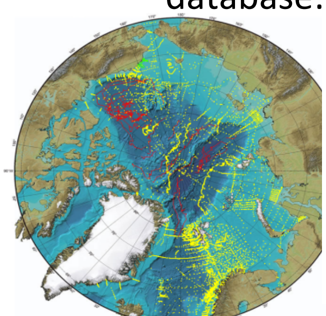


Validation of the available wind using WAM (wave) model:

Regions	NCEP	ERA-I	MERRA	NARR	OWI	CBSHR
Pacific Arctic Ocean (PAO)	0.59	0.51	0.50	X	X	X
Chukchi Sea (CS)	0.94	0.75	0.72	0.81	0.79	0.76
Bering Sea (BS)	0.70	0.68	0.71	0.76	0.63	X

RMS between surface waves from WAM (wave) model forced by different reanalysis and satellite observations

Validation of the available SST products using IPY database:

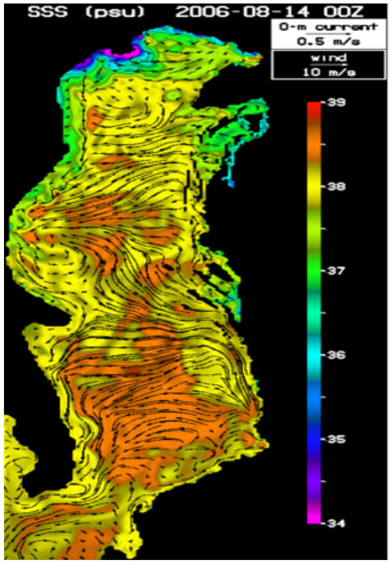


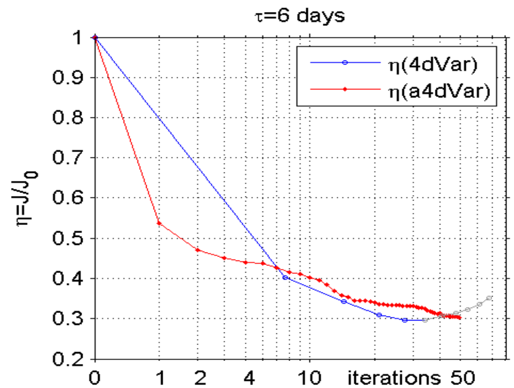
	Bias			RMSE		
	IPY	p-IPY	All	IPY	p-IPY	All
OISSTv2	-0.11	-0.39	-0.16	1.10	1.68	1.22
OSTIA	-0.26	-0.55	-0.30	0.89	1.47	1.00
RTGSST	-0.18	-0.36	-0.21	1.13	1.81	1.26
ECCO2	-0.42	-0.99	-0.48	1.81	2.23	1.87
salt	-0.73	-0.58	-0.71	2.12	2.51	2.17
HYCOM	-0.09	+0.02	-0.05	0.99	1.13	1.04
salt	+0.64	+1.27	+0.87	1.67	2.79	2.17

New approaches: 1) Adjoit-Free Variational Data Assimilation into Regional Models (Panteleev and Yaremchuk)

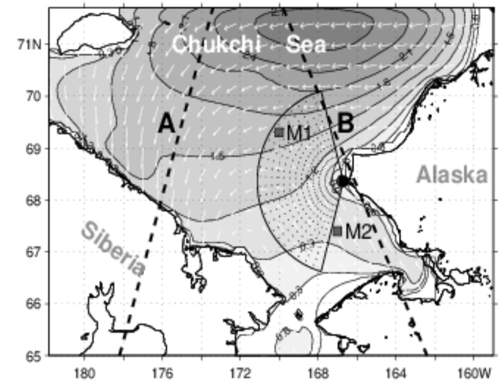
Right: Performance of the WAM a4Dvar (under review in JTech)

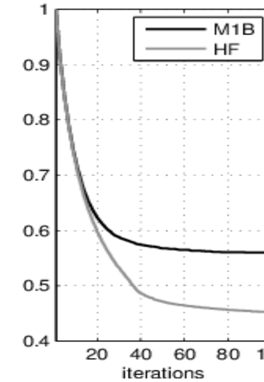
Below:
Performance of the NCOM a4Dvar: experiment in the Adriatic Sea





Comparison of 4Dvar (blue curve) and a4Dvar (red) performance, in terms of the cost function reduction η.

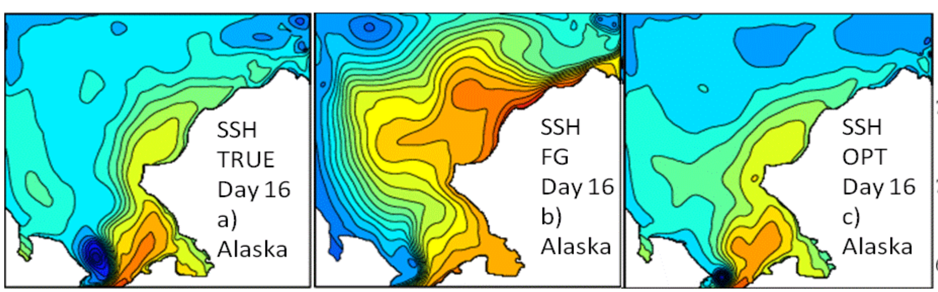


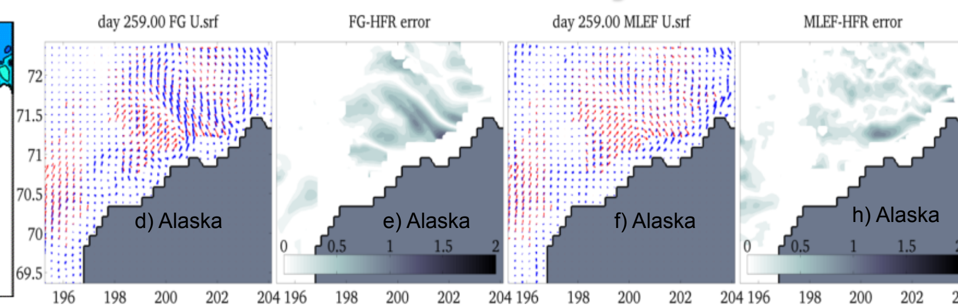


a4Dvar WAM DAS and a4Dvar NCOM are proposed. a4Dvar provides a pathway to bypass the burden of development and maintenance of the tangent linear and adjoint code. It can be adopted for any kind of model: atmospheric, ice, biological, and etc.

Incoming: adopt a4Dvar for ROMS-ICE model

New approaches: 2) Maximum Likelihood Ensemble Filter ROMS-ICE ~ Adjoint-free 3Dvar





A-C: Results of assimilation of simulated SSH observations into the MLEF ROMS model: (a) true solution after 16 days of integration; (b) first guess; (c) optimized solution after assimilation.

D-G: Preliminary results of HFR velocity assimilation : velocity observations (red arrows) and first quess surface velocity field (d); normalized model-data errors (e); (f-h) same after 10-day assimilation of the HFR velocities.