

# **Activity during the 8 months**

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# International Polar Year Database: 2007-2010

Oregon Home | HFR Adjoint

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CTD/xCTD/XBT/XSV contributions as of 2014-11-13:

Norway	6758
Russia	2222
USA	1085
Canada	879
Germany	691
Poland	572
Japan	539
Sweden	133
China	120
<b>TOTAL</b>	<b>12999</b>

IIP records as of 2012-11-01: 18287

Glider/AUV records as of 2013-06-21: [redacted]

[See the list of contributing nations and organizations](#)

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These maps were distilled by SeaWiFS

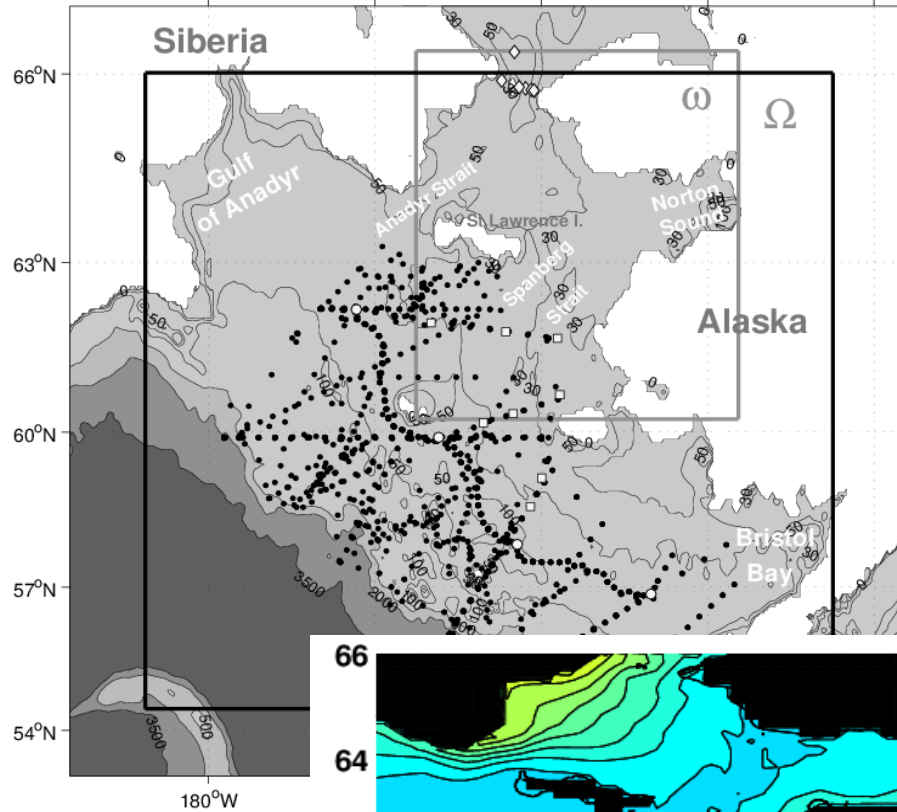
[Temperature Maps](#)

[Salinity Maps](#)

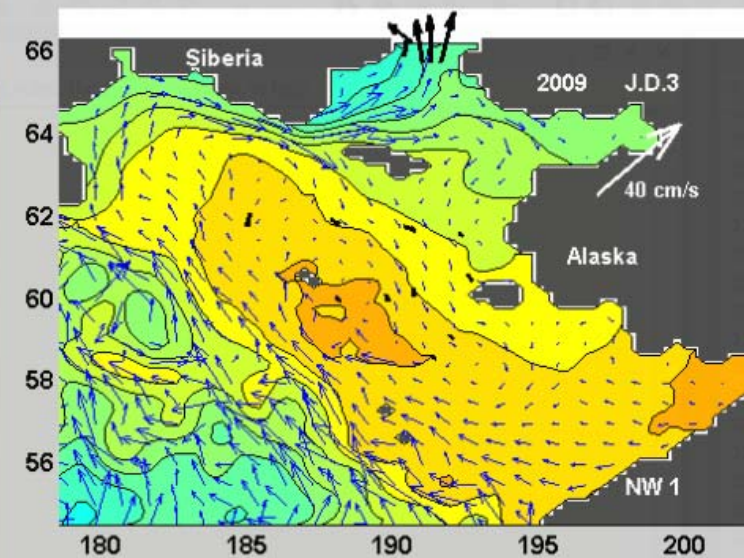
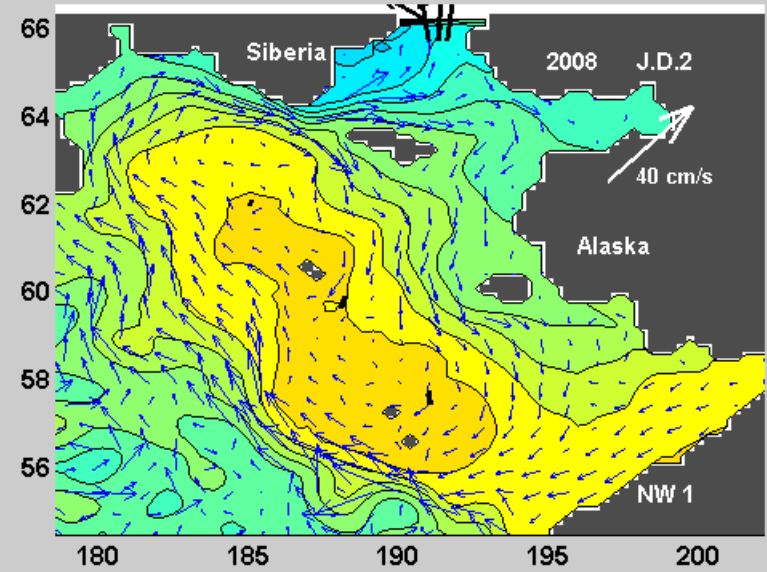
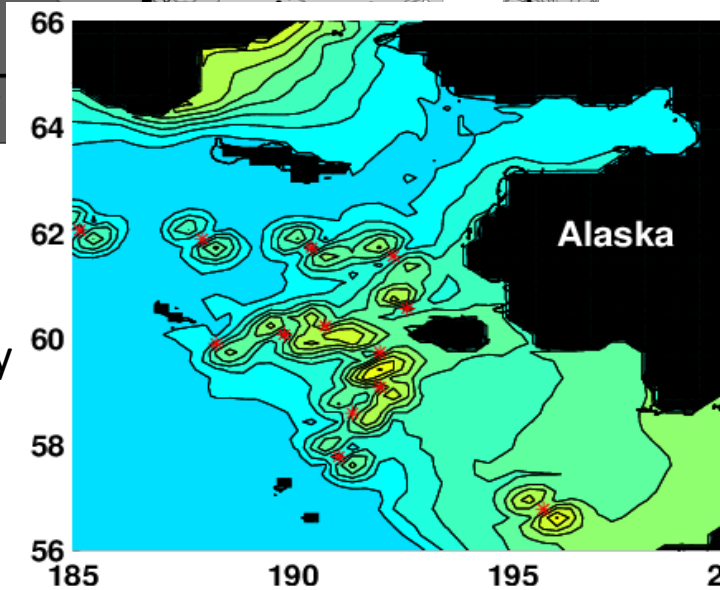
- 34.8 isohaline depth
- 34.8 isohaline depth and salinity
- AW core depth
- AW core depth anomaly
- AW core temperature
- AW core temperature anomaly
- AW heat content
- AW heat content anomaly
- AW lower boundary
- AW lower boundary anomaly
- AW upper boundary
- AW upper boundary anomaly
- Freshwater content
- Freshwater content anomaly
- SPW Tmax
- SPW Tmax anomaly
- SPW depth of Tmax
- SPW depth of Tmax anomaly
- SPW depth of lower boundary
- SPW depth of lower boundary anomaly
- SPW depth of upper boundary
- SPW depth of upper boundary anomaly

# 4 year reanalysis of the Bering Sea: 2007-2010

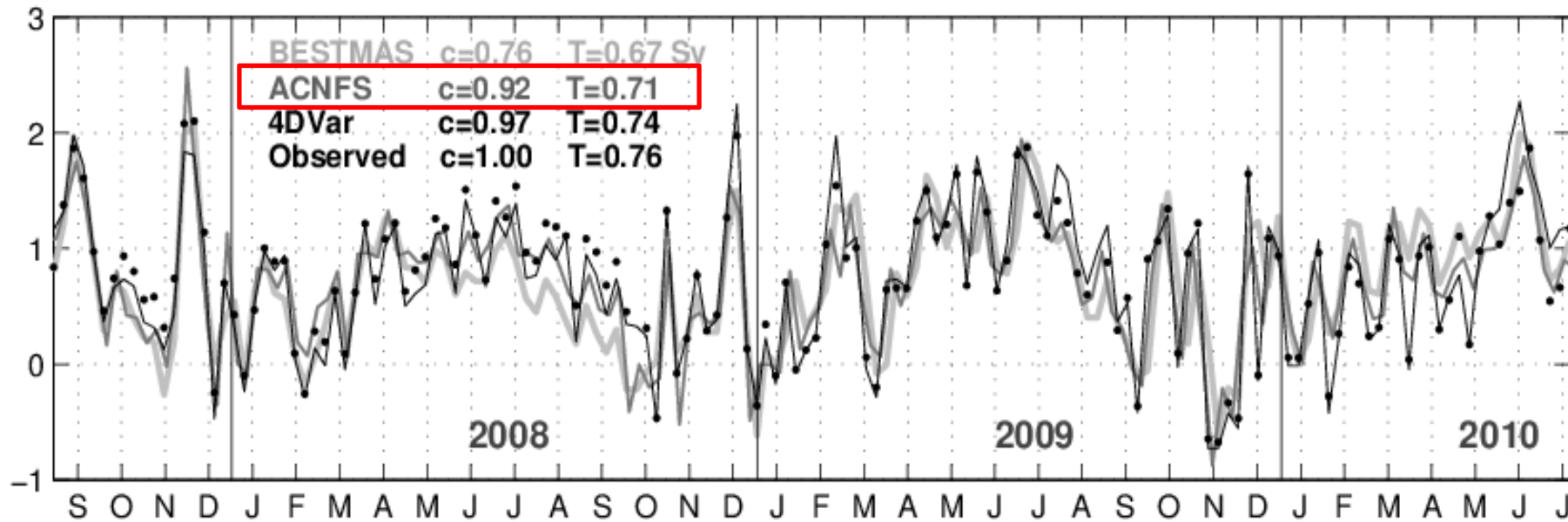
Manuscript in preparation: Pantelev, Yaremchuk, Francis, Stabeno, 2015.



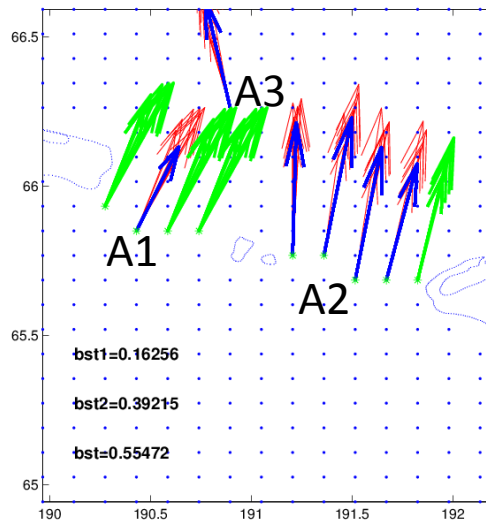
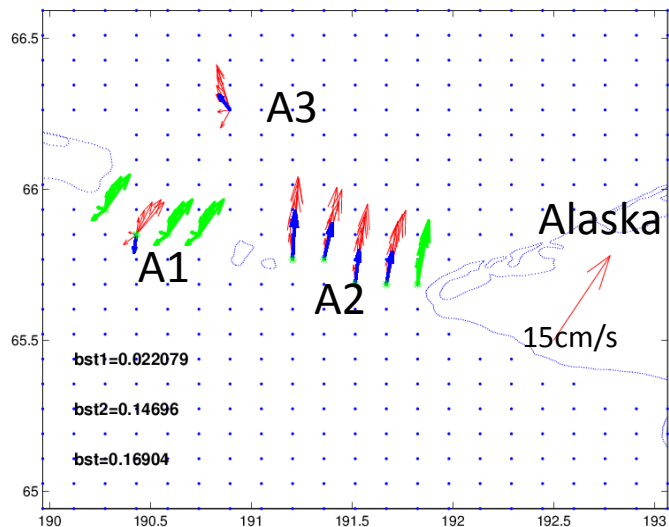
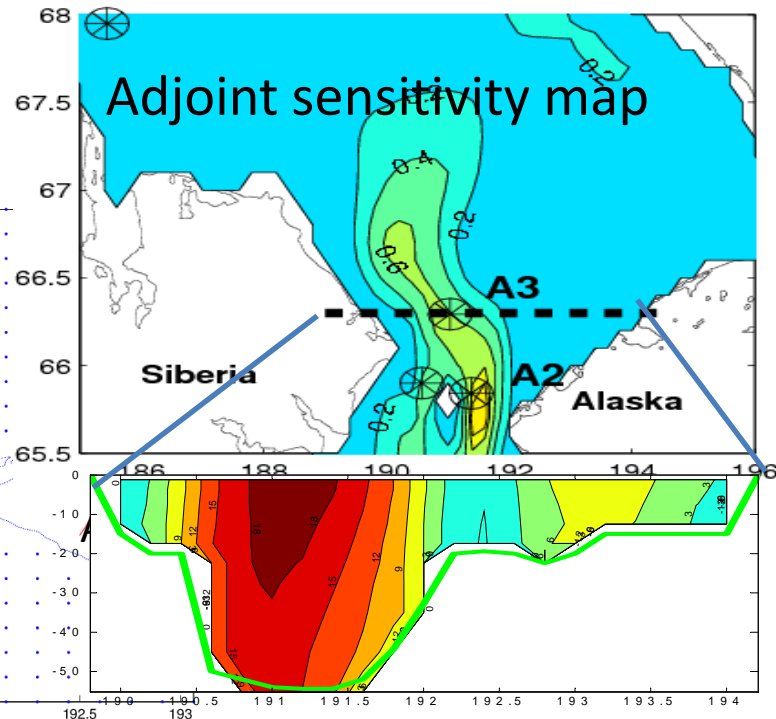
Adjoint  
Sensitivity  
analysis



# Bering Strait transport:



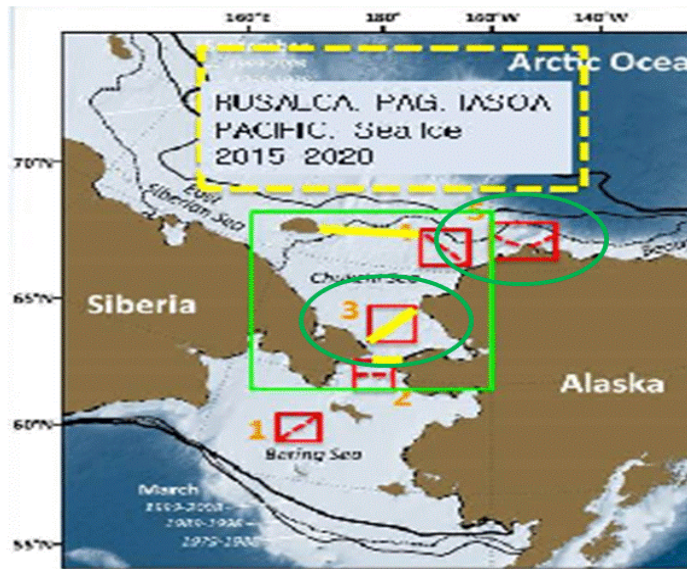
Weekly averaged Correlation( $V_{A3}$ , BST) = 0.96-0.98;  
 Weekly averaged Correlation( $V_{A2}$ , BST) = 0.98-0.99;



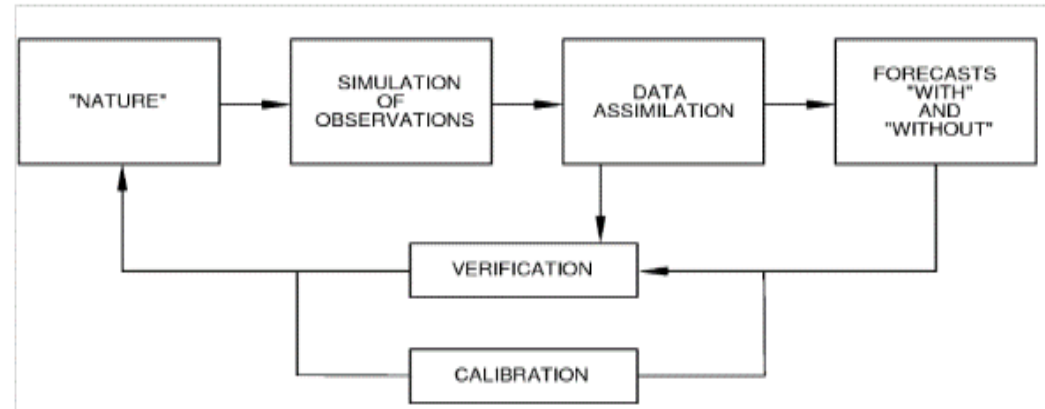


# Passive tracer (biological) sampling

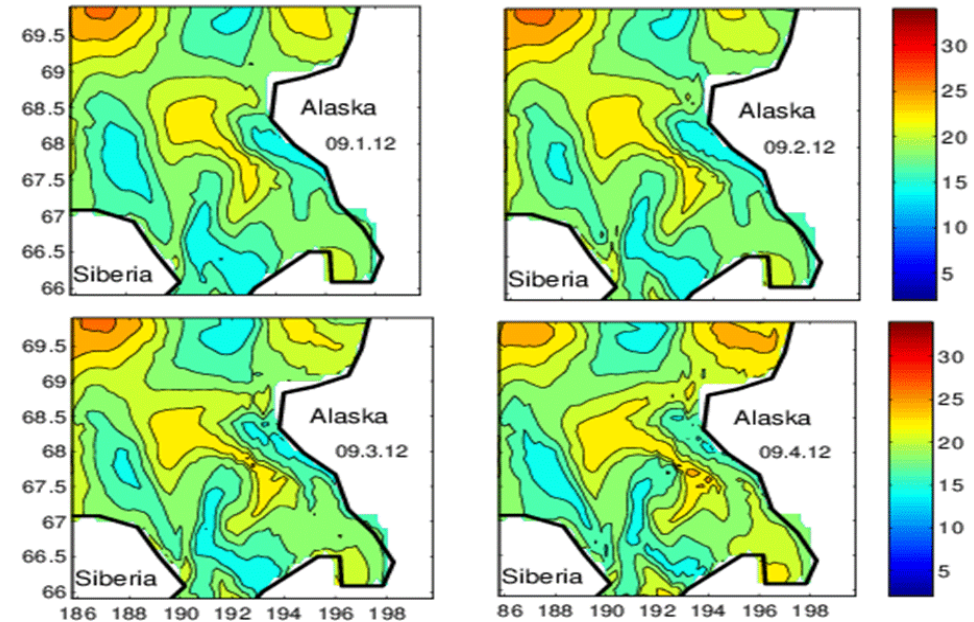
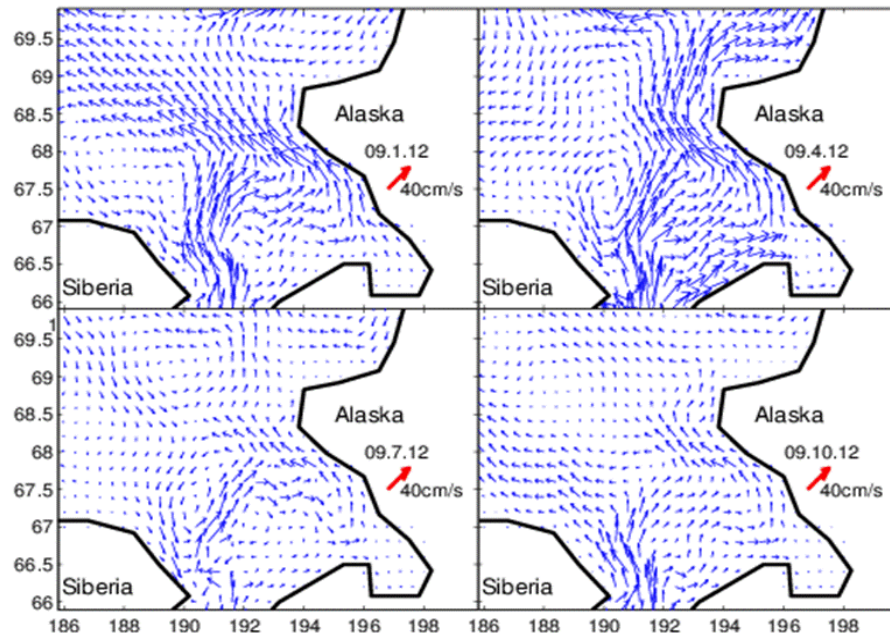
## Area of interest

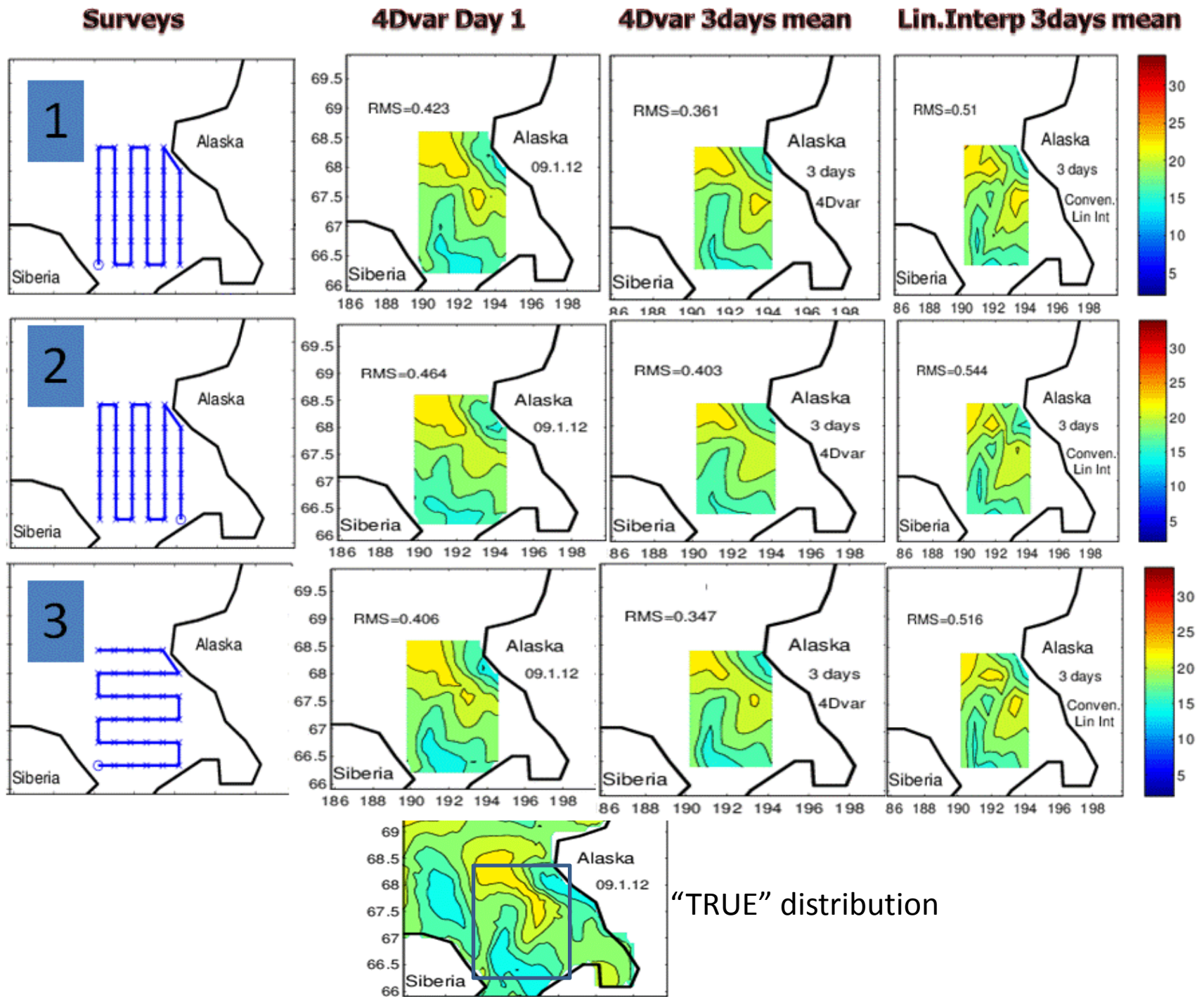


## Observing System Simulation Experiments



Velocity field was derived through the assimilation HFR's and mooring data:







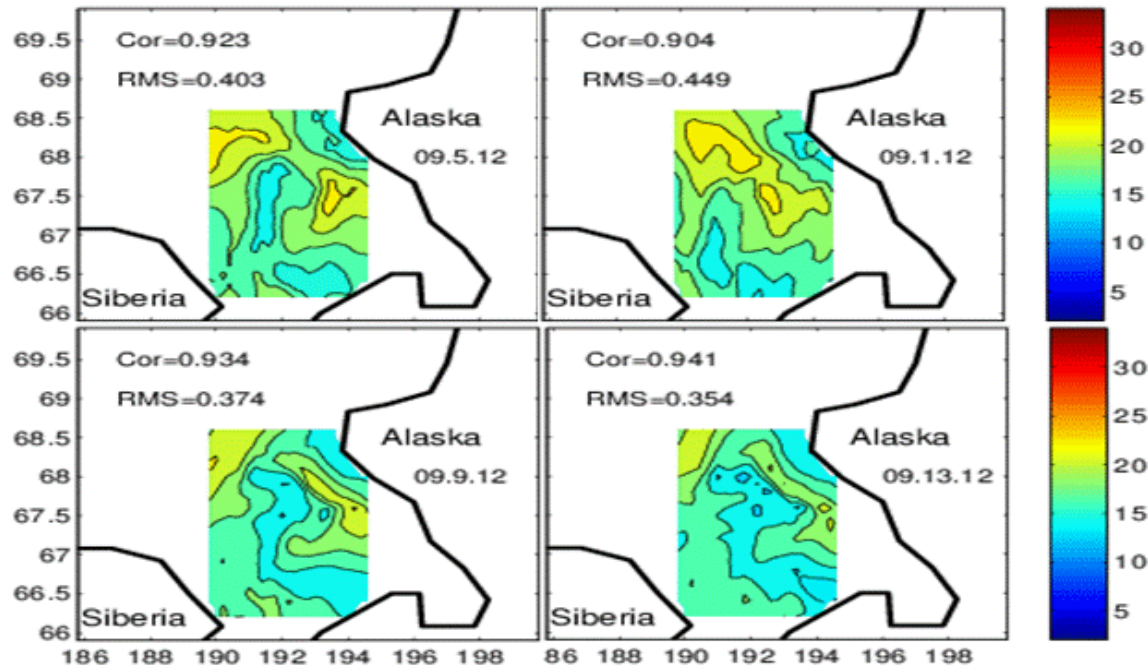
## The 4Dvar advection-diffusion model

The *Advection-Diffusion Biological Tracer Model (ADBTM)* is based on modified advection-diffusion equations which are the part of SIOM. Currently ADBTM includes exponential mortality/growth ( $m$ ) and biological tracer horizontal and vertical (sinking) velocity ( $u_B, v_B, w_B$ ) and fluxes  $F_{B0}, F_{BH}$  at the surface and at the bottom:

$$\frac{\partial B}{\partial t} + (u+u_b)\frac{\partial B}{\partial x} + (v+v_b)\frac{\partial B}{\partial y} + (w+w_b)\frac{\partial B}{\partial z} = \Delta B + \frac{\partial^2 B}{\partial z^2} - mB$$

$$\frac{\partial B}{\partial z} = F_{B0}, z = 0; \quad \frac{\partial B}{\partial z} = F_{BH}, z = H$$

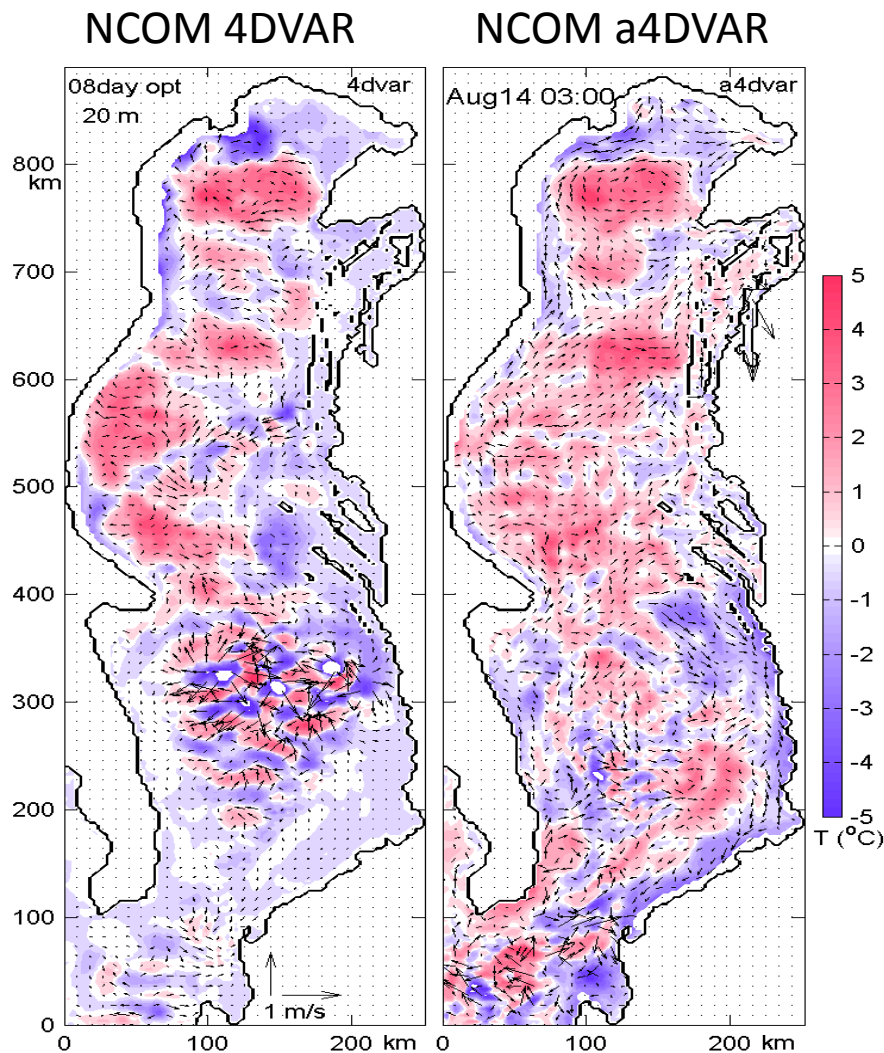
## Estimation of the mortality coefficient



Formally mortality coefficient can be defined from two surveys separated by 1-2 week periods. Survey configuration 1, 3 and 4 were tested with respect of possibility to determine mortality coefficient ( $m$ ) from 2 surveys separated by 7 day period and provided respectively  $m_{\text{optimized}} = -1.29e-7$ ,  $-1.33e-7$ , and  $-1.4e-7$ . The conventional approach (fitting to exponent) provides  $m_{\text{exp}} = -1.53 - 1.57e-7$ . Figure below shows the reconstructed passive tracer evolution with  $m_{\text{optimized}} = -1.29e-7$  for the survey configuration #1.



# Adjointless 4Dvar NCOM: extention to the ICE-HYCOM and ICE-ROMS



## Observations

### Velocity

18 ADCP  
moorings:  
9 GS moorings  
4 HR&ITH moorings  
5 SEPTR moorings

Duration:  
Range: 3.5 – 14.5 days  
Average: 12.7 days  
Depth: 2 – 150 m

$N_{obs} = 13,856$

### Temp/Salinity

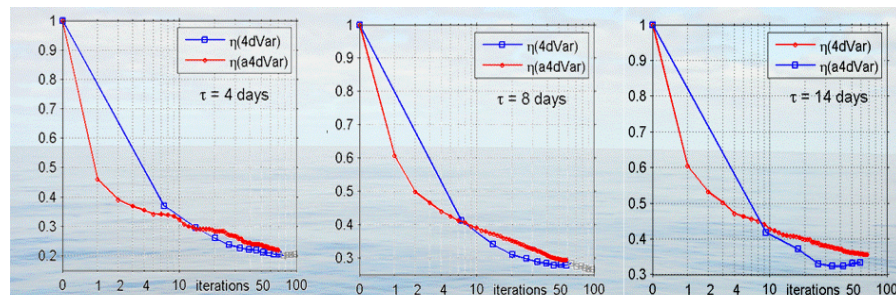
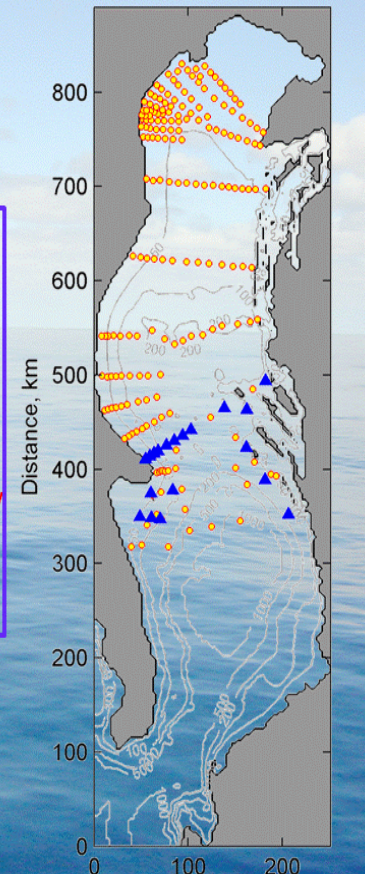
219 CTD casts  
4 HR&ITH moorings  
4 SEPTR moorings

Duration:  
Range: 8/15 – 8/29  
Average: 15 casts/day  
Depth: 8 – 1054 m

$N_{obs} = 9,650$

Assimilation interval:  
14 – 28 Aug, 2006

Total obs: 23,506  
dim(M) = 1,493,570



Horizontal axis: one unit is the total CPU time  
required by a4dVar iteration

Vertical axis: cost function normalized  
by the initial value



## Conclusions:

1. SAON/NOAA International data base provide the one stop for CTD observations in the AO during 2008-2010. There is a strong need to continue this activity and develop PAG database.
2. 2007-2010 Northern Bering Sea reanalysis has been accomplished. The lessons from this study are:
  - a) preliminary adjoint sensitivity analysis and OSSE help to increase the information content of the observation. That will result to the more accurate estimates of the ocean state
  - b) HYCOM ACNFS (3Dvar) provides very good estimates of the Bering Strait transport and near surface circulation. It can be used as a first guess for the incoming Adjointless ROMS-HYCOM DAS'es
3. A4Dvar NCOM has been tested. A4Dvar ROMS-ICE, HYCOM-ICE is the next step.
4. Variational inversion of the biological observations using the passive traces allows to increase accuracy of the estimates of the biological parameters and mortality coefficient.