

Role of river inflows from the Kamchatka Peninsula in the Okhotsk Sea

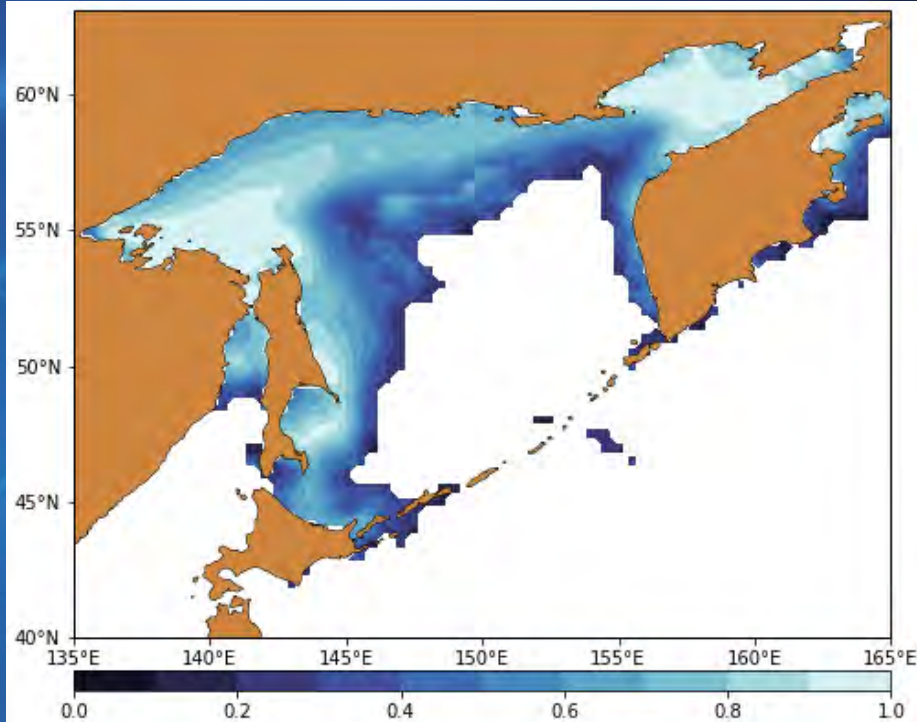
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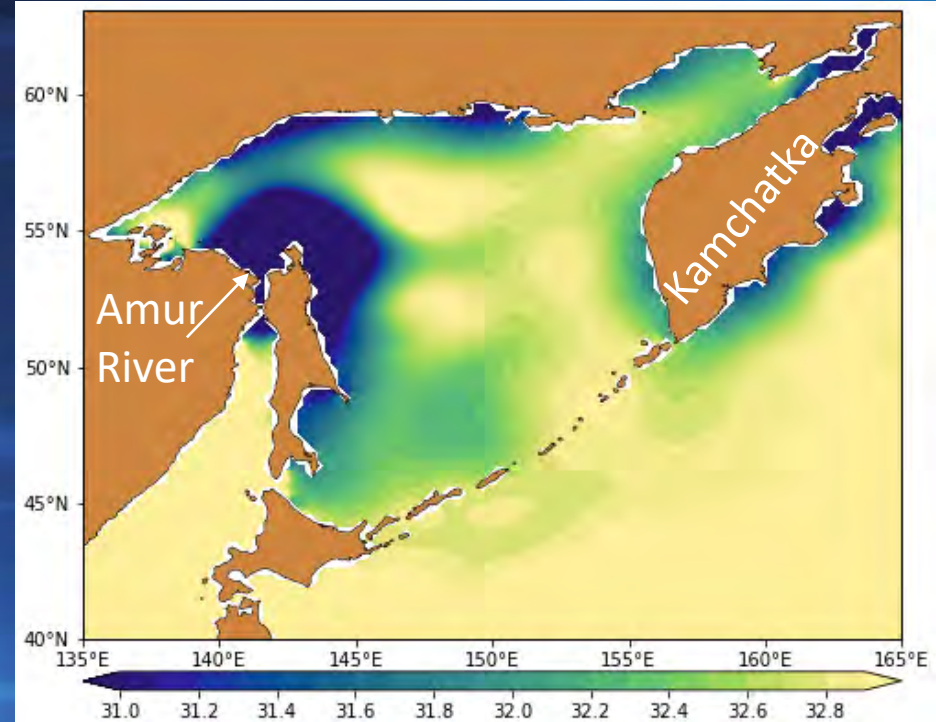
Okhotsk Sea

Sea Ice



Feb 2011
NOAA OISST

Sea Surface Salinity



July Climatology
World Ocean Atlas 2013

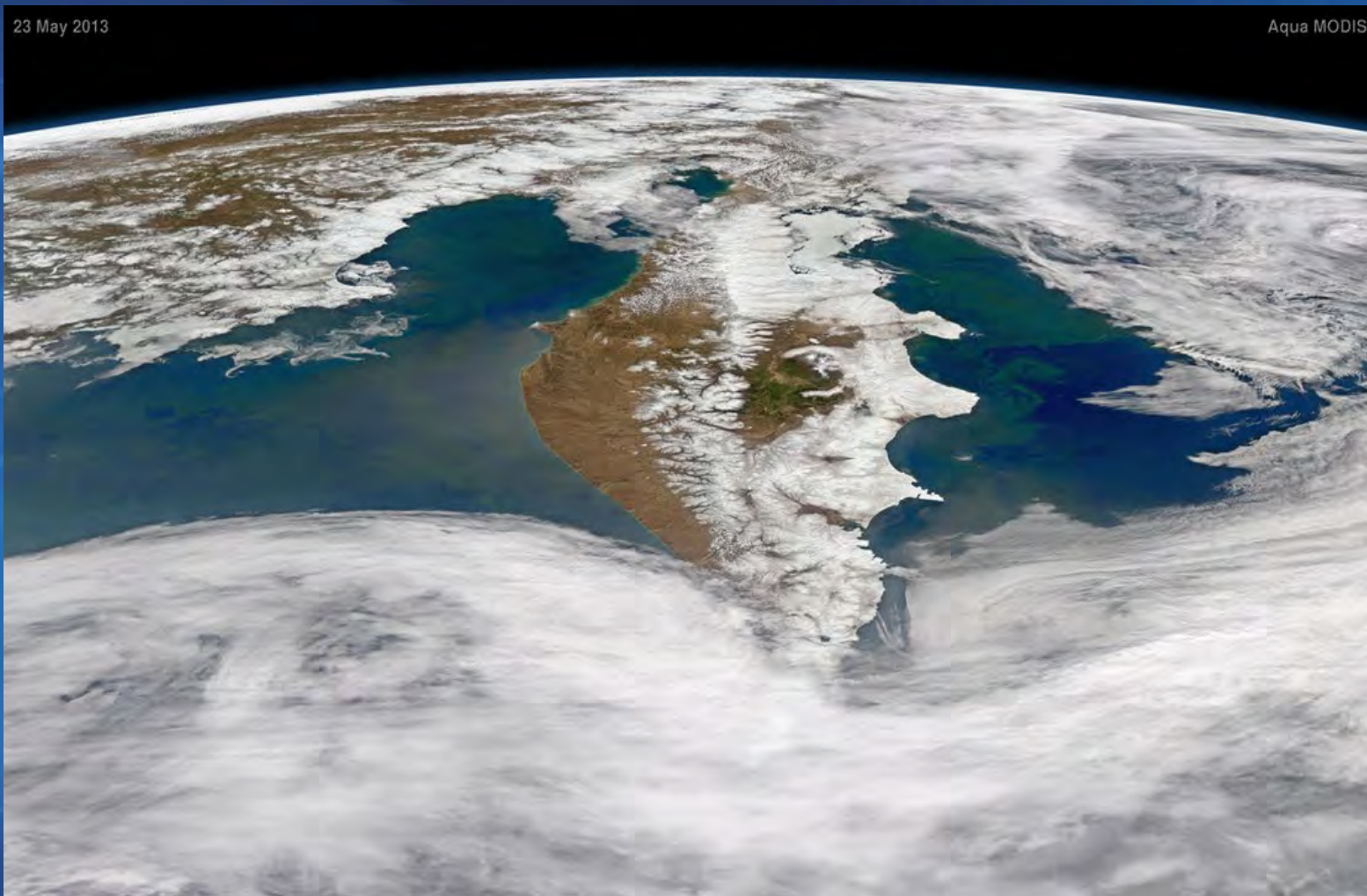
Ocean Color images from Sentinel2



Courtesy of
Dr. Nakata (NIES)

NASA: Image of the day

Kamchatka Surrounded by Blooms (May 23, 2013)



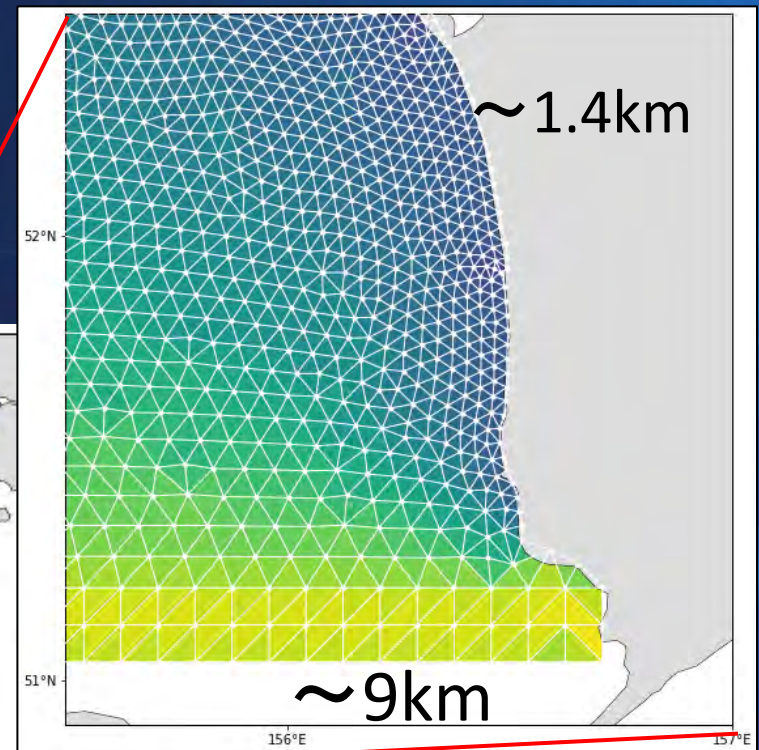
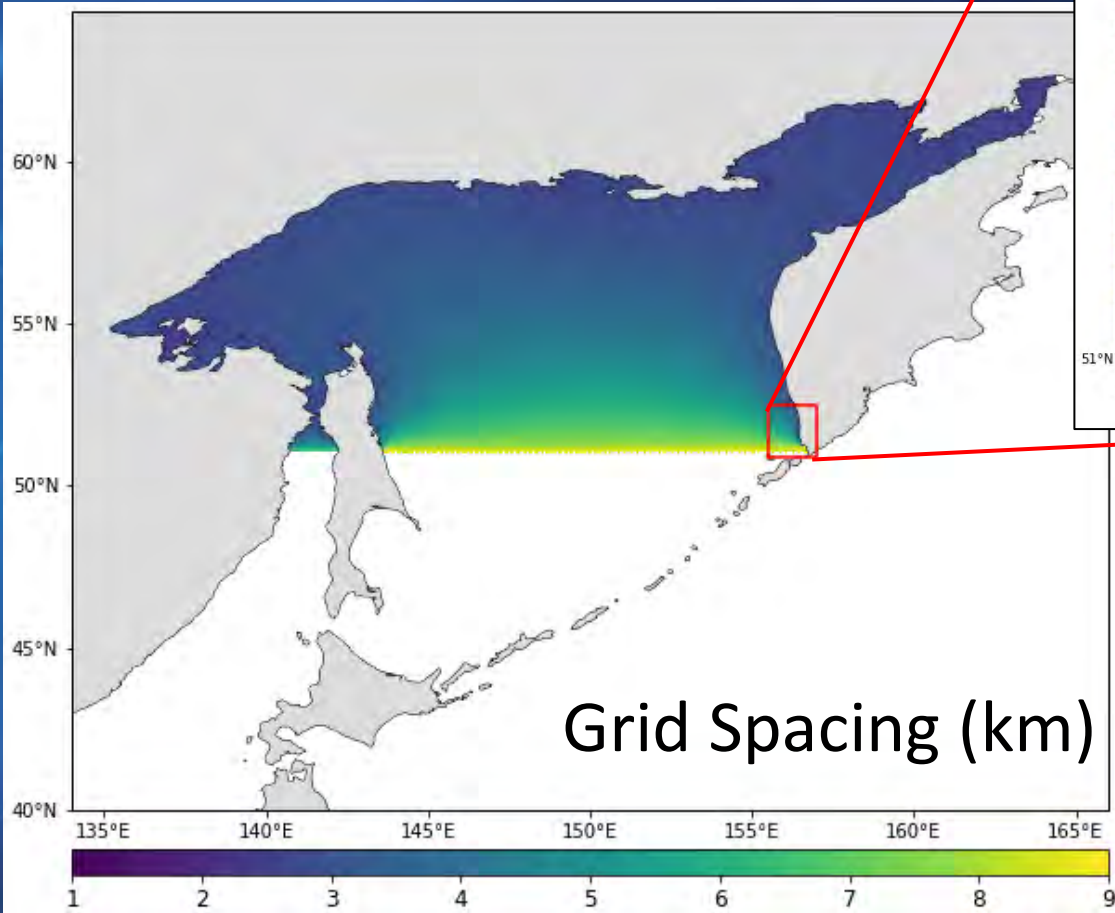
<https://earthobservatory.nasa.gov/images/81258/kamchatka-surrounded-by-blooms>

This study

- Simulate the northern Okhotsk Sea
- Compare the run with and without river inflows from Kamchatka Peninsula
- Clarify the roles of the river inflows

FVCOM

Finite-Volume, Primitive equation
Community Ocean Model
(Chen et al. 2003)



32 generalized
sigma levels

Forcings

- Atmospheric forcings
 - **JRA55-do** (Tsujino et al. 2018)
 - New standard forcing for Ocean Model Intercomparison Project
 - TL319 (0.5625°)
 - 3hourly
- Lateral boundary condition
 - Sea level
 - Observed 6 tidal components from **TPX09**
 - + daily sea level from **FRA-JCOPE2 reanalysis**
(c.f. Nakanowatari and Ohshima 2014, Arrested topographic wave)
 - Temperature, salinity, velocity
 - Restored to **FRA-JCOPE2 reanalysis**

Data for River inflows

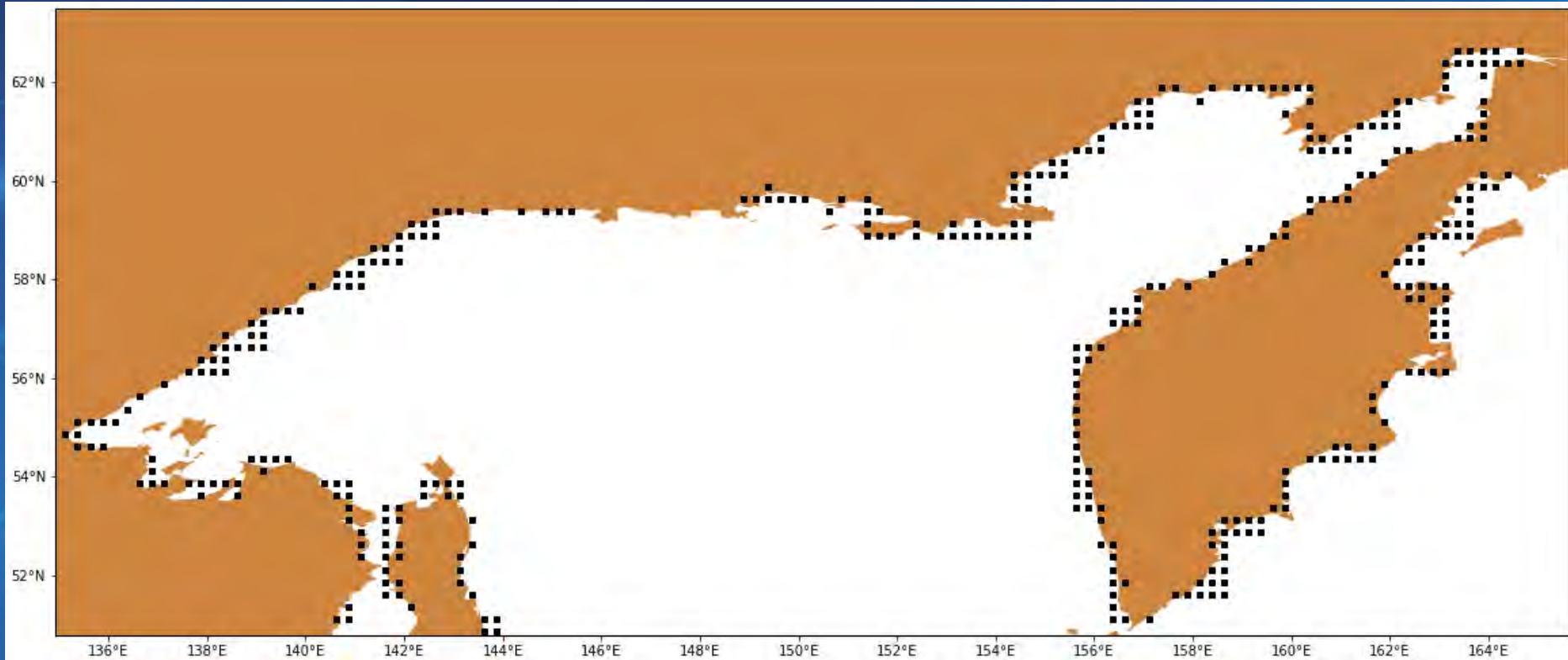
JRA55-do (from Suzuki et al. 2017)

- Based on model calculation
 - River runoff field, including runoff from ice-sheet melting
 - CaMa-Flood global river routing model and adjusted runoff from the land component of JRA-55.
- 0.25 x 0.25 horizontal resolution
 - → Converted to river inflow at the closest costal point
- Daily time resolution

Temperature and salinity

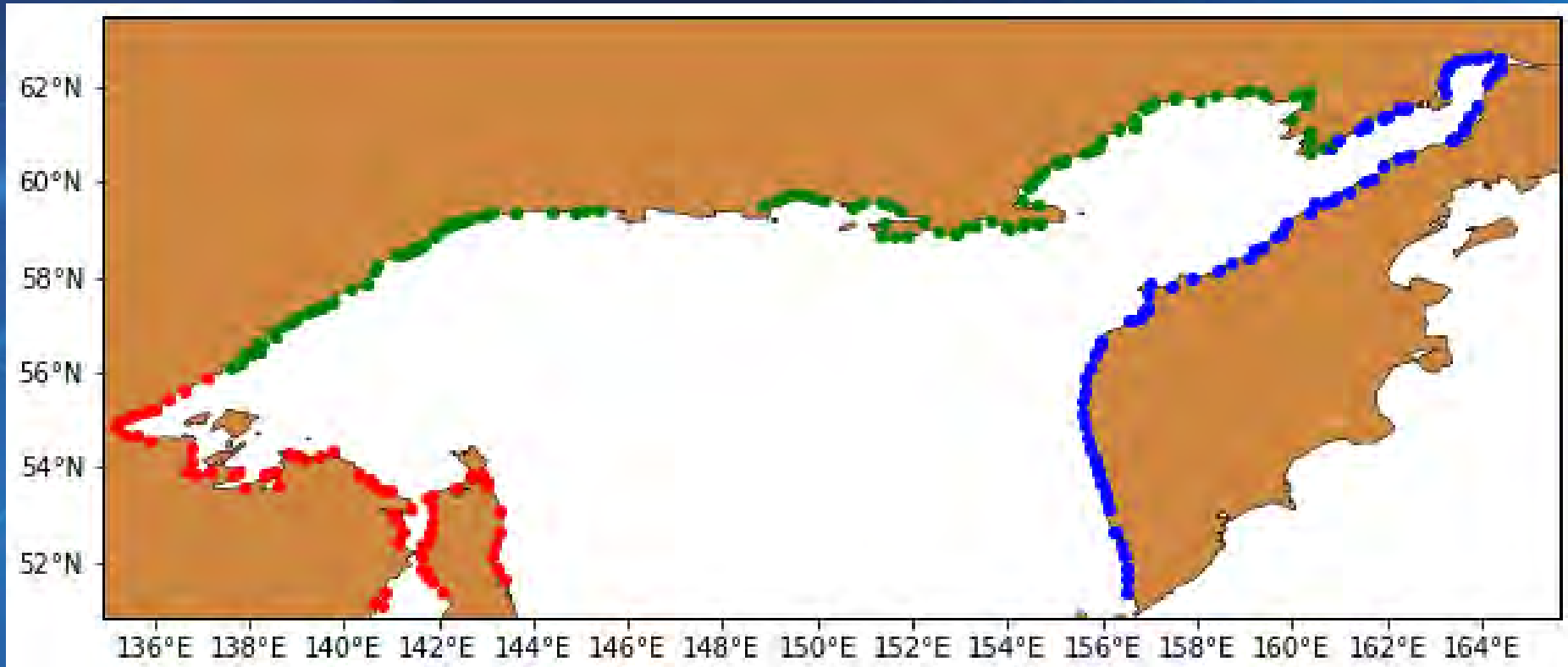
- Salinity: zero
- Temperature:
 - Surface air temperature (more than 0)
 - (Same treatment as JAMSTEC JCOPE-T)

River mouths for the FVCOM



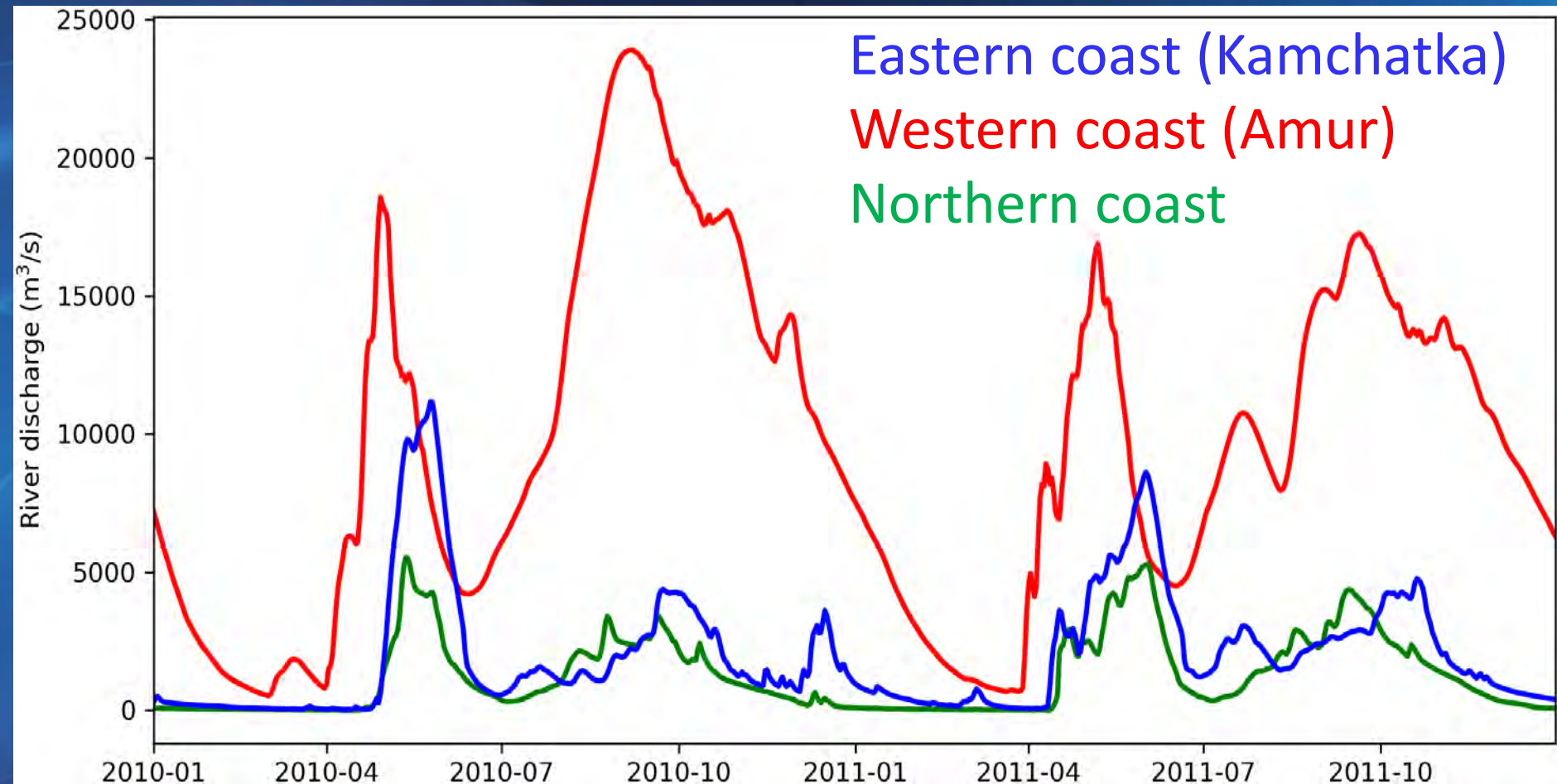
JRA55-do 0.25x0.25 deg

River mouths



Compare the run **with and without river inflows**

River inflow volumes



Spin up

- Integration

- Repeated integration for 10 years
- forced by the data from **June 1, 2010 to June 1, 2011**
- **Results in 10th year are presented.**

Results

Control run

Sea Surface Salinity

Animation From 0 UTC, **April 10** to 0 UTC, **May 10**, 2011 (every 1 hour)

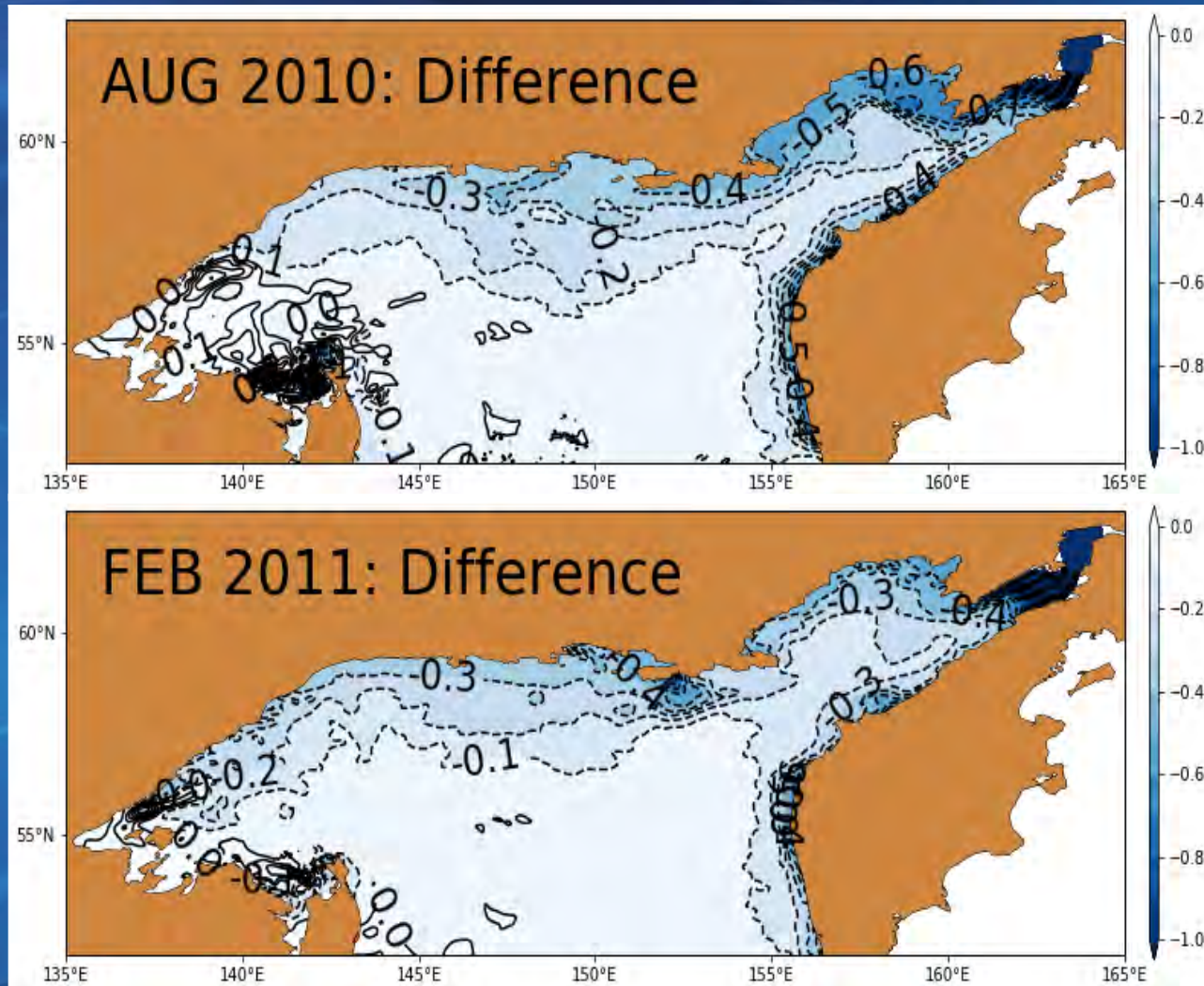


Results

With – Without River

Sea Surface Salinity

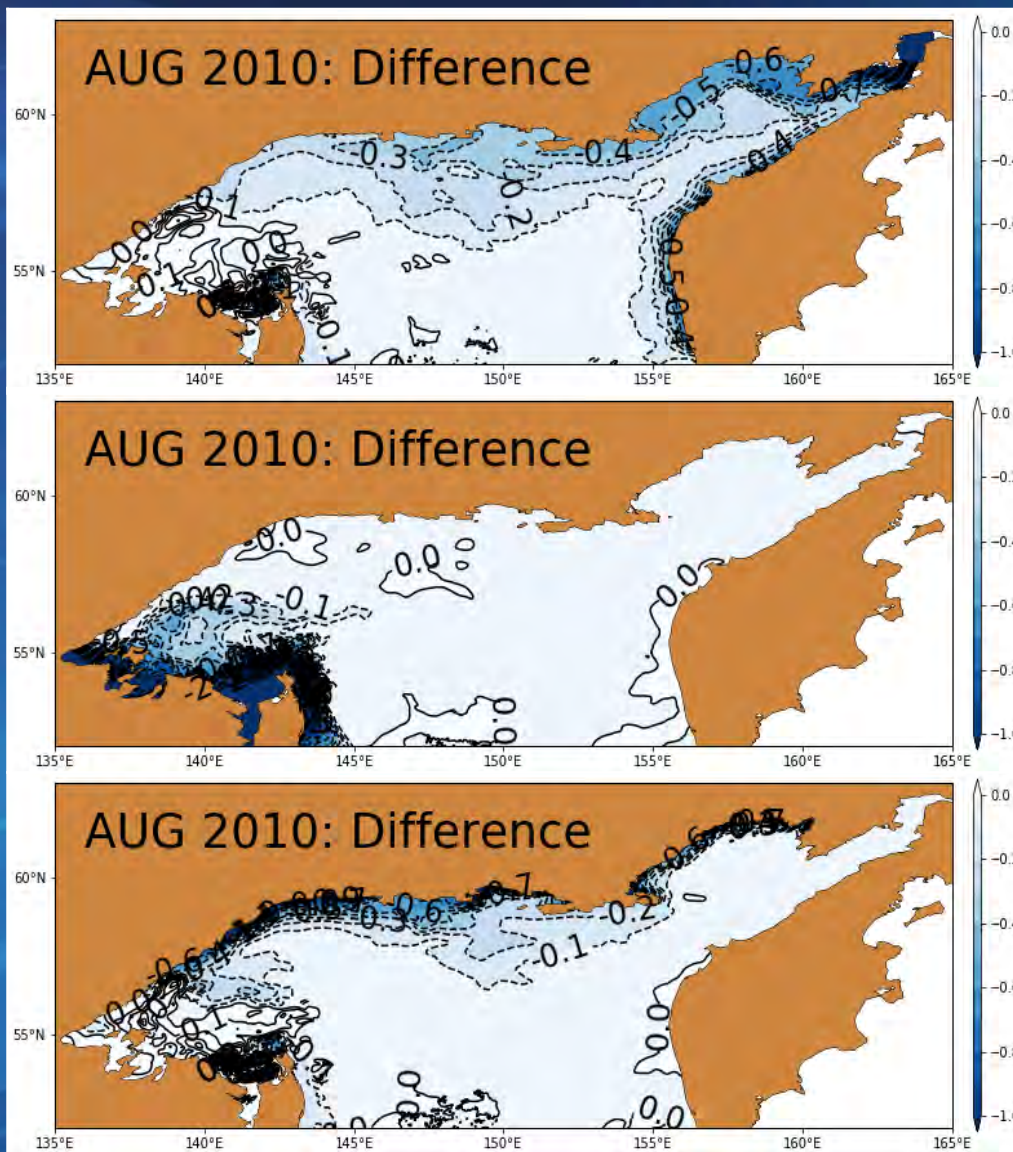
With all rivers – Without the eastern (Kamchatka) rivers



Sea Surface Salinity

With the rivers – Without the rivers

August

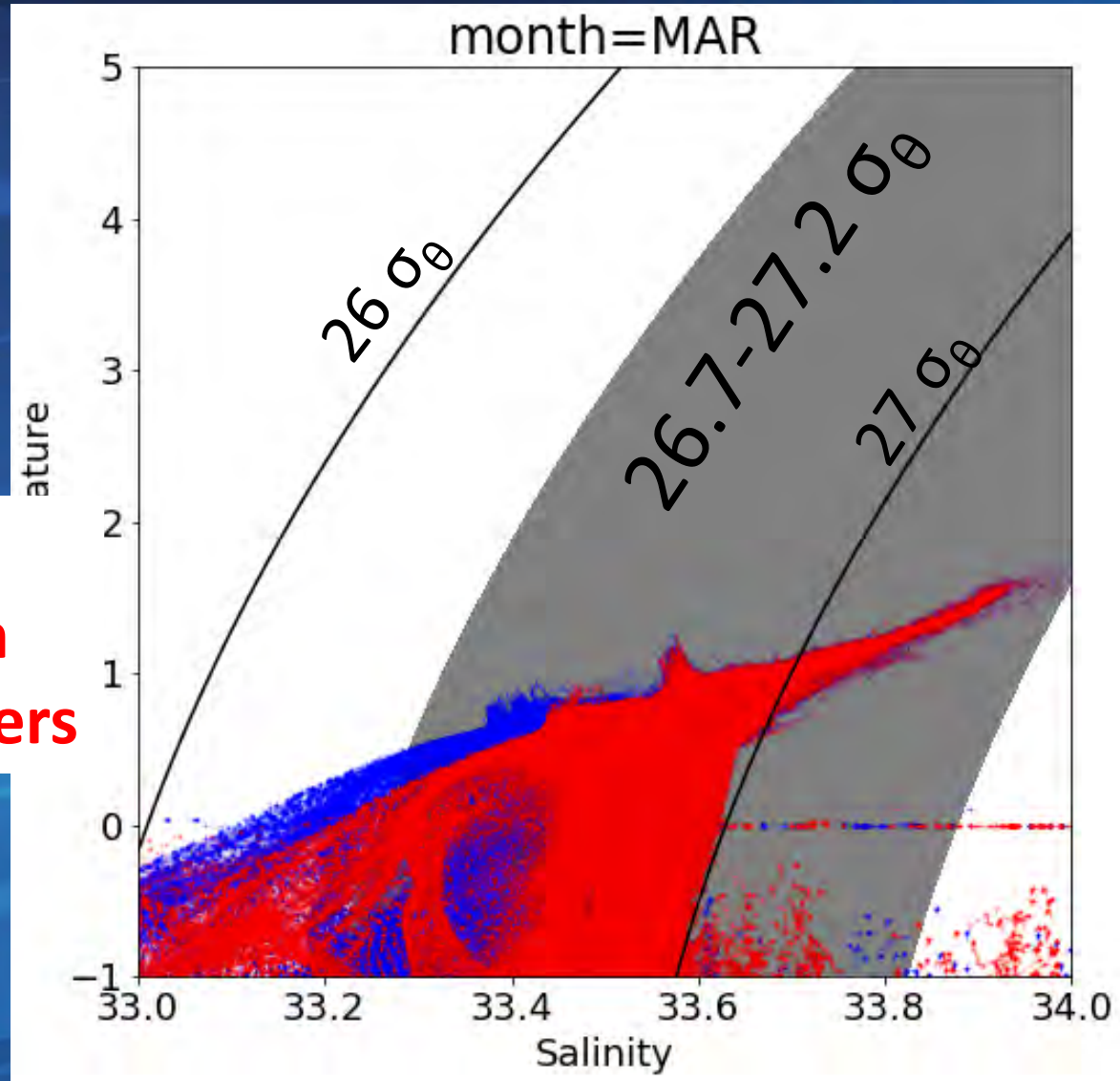


Eastern rivers
(Kamchatka)

Eastern rivers
(Amur)

Northern rivers

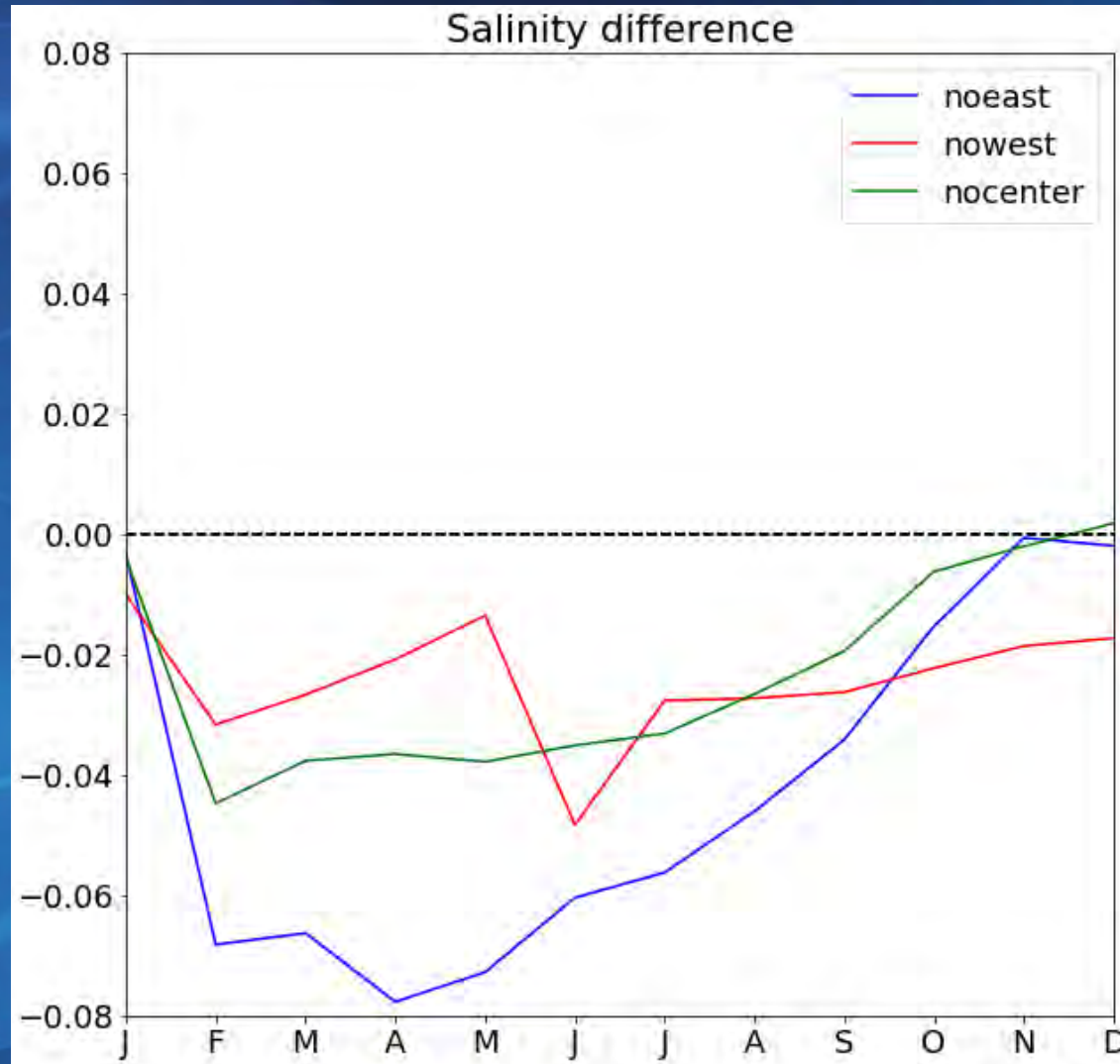
T-S diagram



With all rivers

Without eastern
(Kamchatka) rivers

Difference on $26.7 - 27.2 \sigma_{\theta}$ With minus Without River

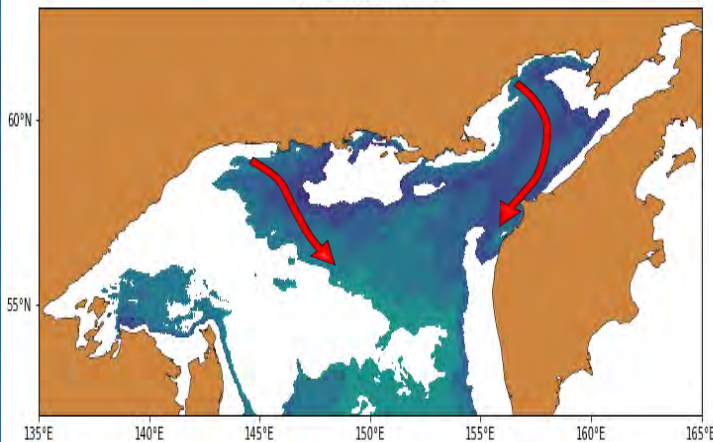


Salinity on density surface (Mar)

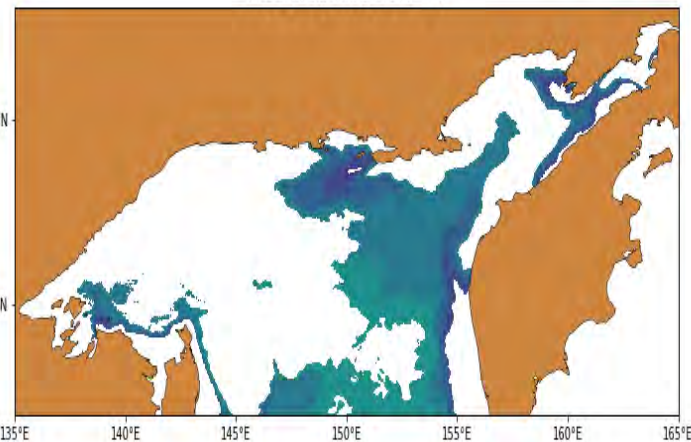
Without eastern
(Kamchatka) rivers

All Rivers included

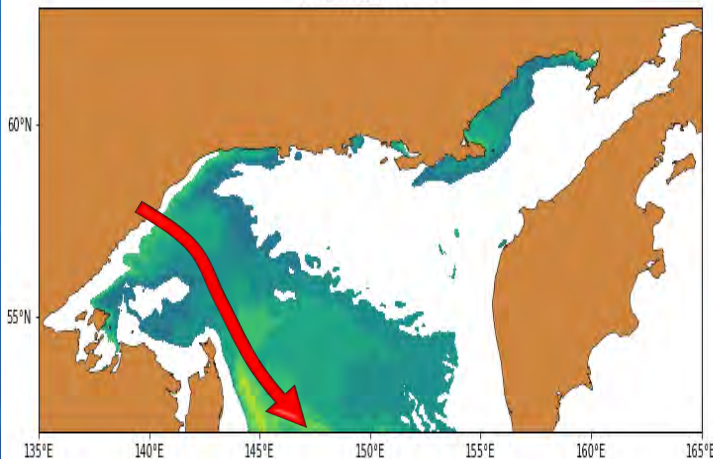
all month=3



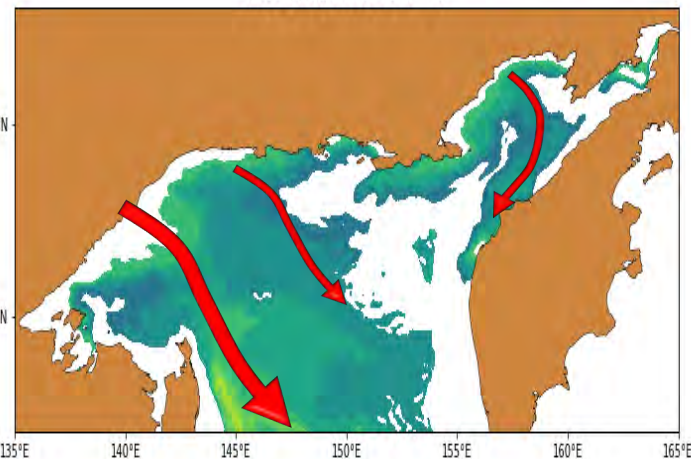
noeast month=3



all month=3



noeast month=3



26.7
-26.9
 σ_θ

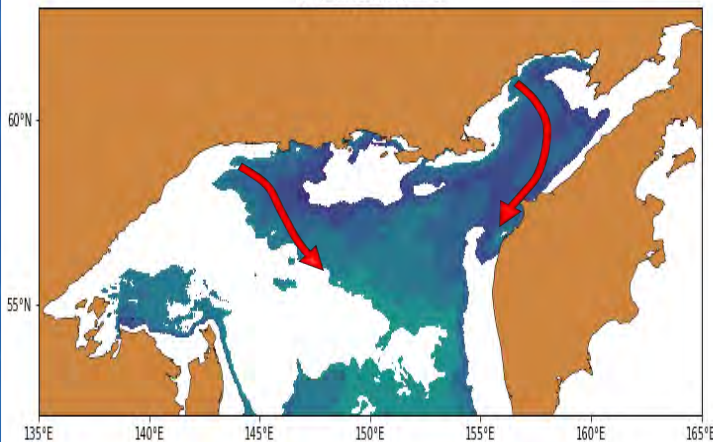
26.9
-27.2
 σ_θ

Salinity on density surface (Mar)

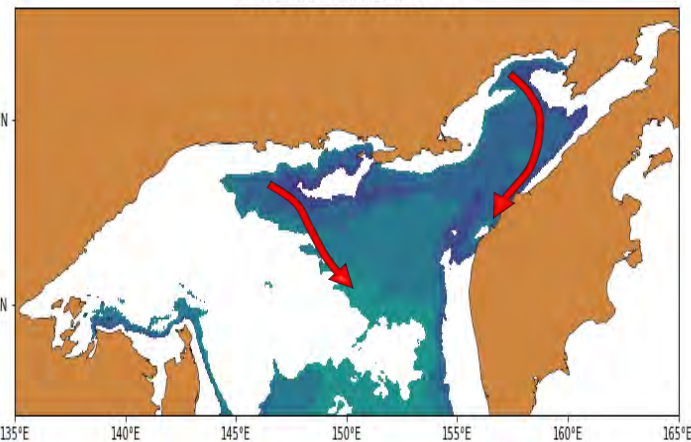
Without central rivers

All Rivers included

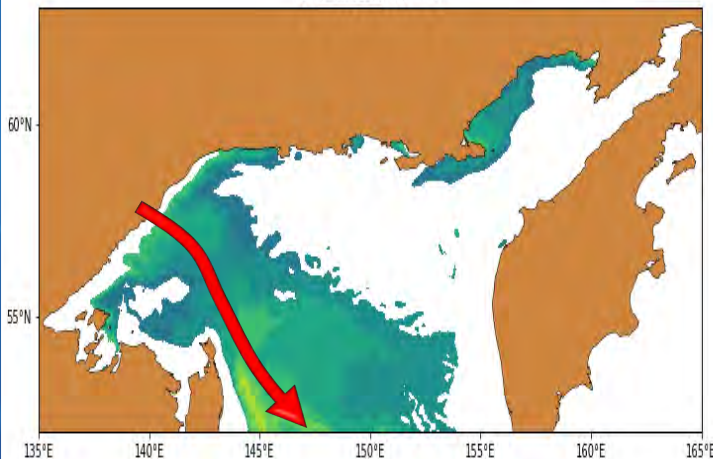
all month=3



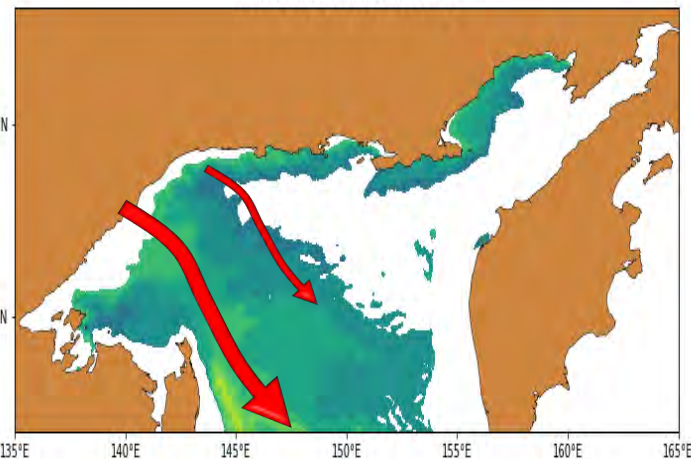
nocenter month=3



all month=3



nocenter month=3



26.7
-27.2
 σ_θ

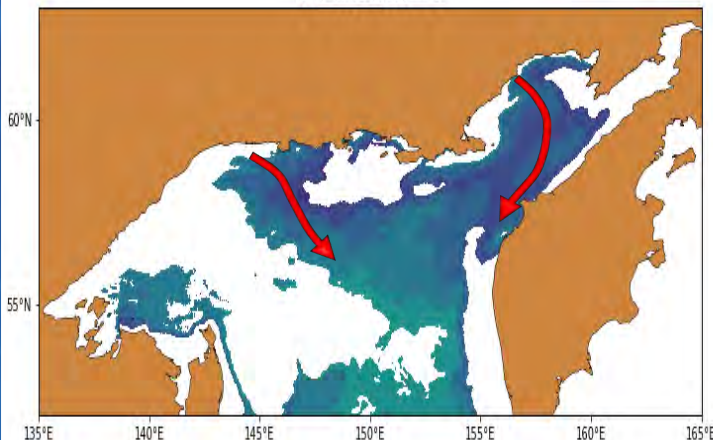
26.7
-27.2
 σ_θ

Salinity on density surface (Mar)

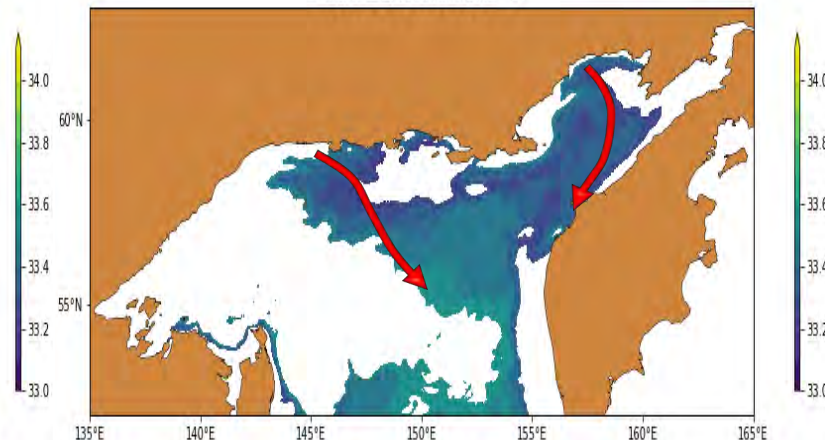
Without western
(Amur) rivers

All Rivers included

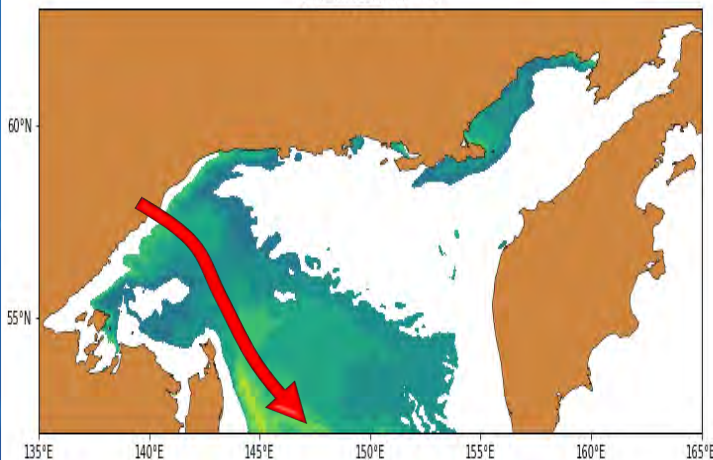
all month=3



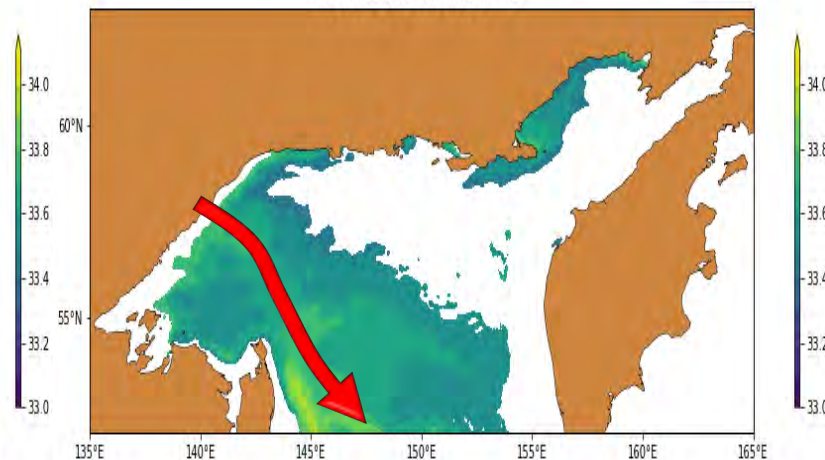
nowest month=3



all month=3



nowest month=3



26.7
-27.2
 σ_{θ}

26.7
-27.2
 σ_{θ}

Summary

- As a part of the project in the Okhotsk Sea, the northern Okhotsk Sea was simulated with FVCOM.
- The comparison with and without the river inflows shows that the inflows lower the salinity more than 1 unit at a maximum. The effect of river inflows from Kamchatka Peninsula also spreads toward the western Okhotsk Sea.
- Freshening (warming on the same density) reaches deeper levels through the dense shelf water formation.