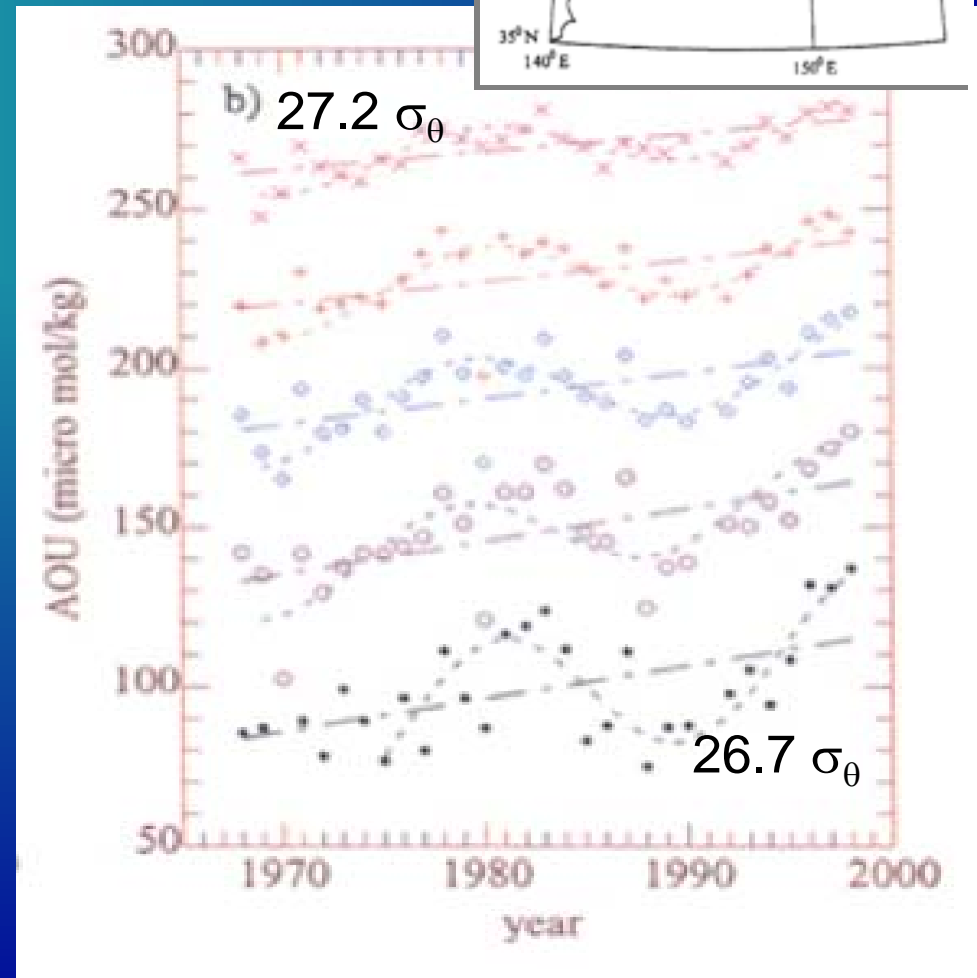
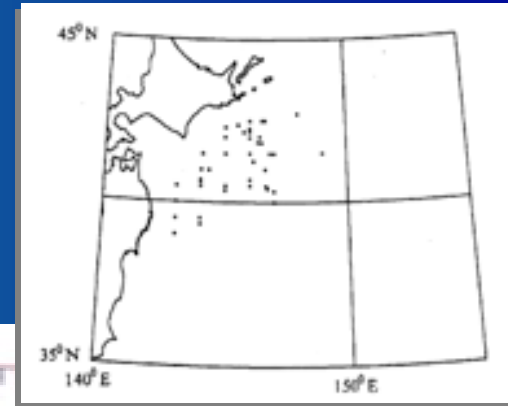


Bidecadal variability in the intermediate waters of the northwestern subarctic Pacific and the Okhotsk Sea in relation to the 18.6-year nodal tidal cycle

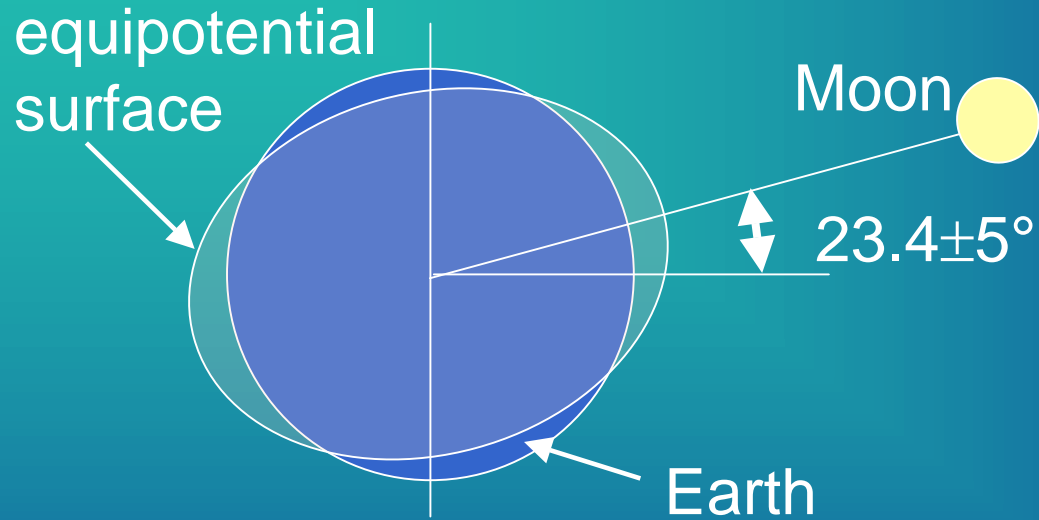
Satoshi Osafune & Ichiro Yasuda
(Ocean Research Institute,
University of Tokyo, Japan)

Introduction

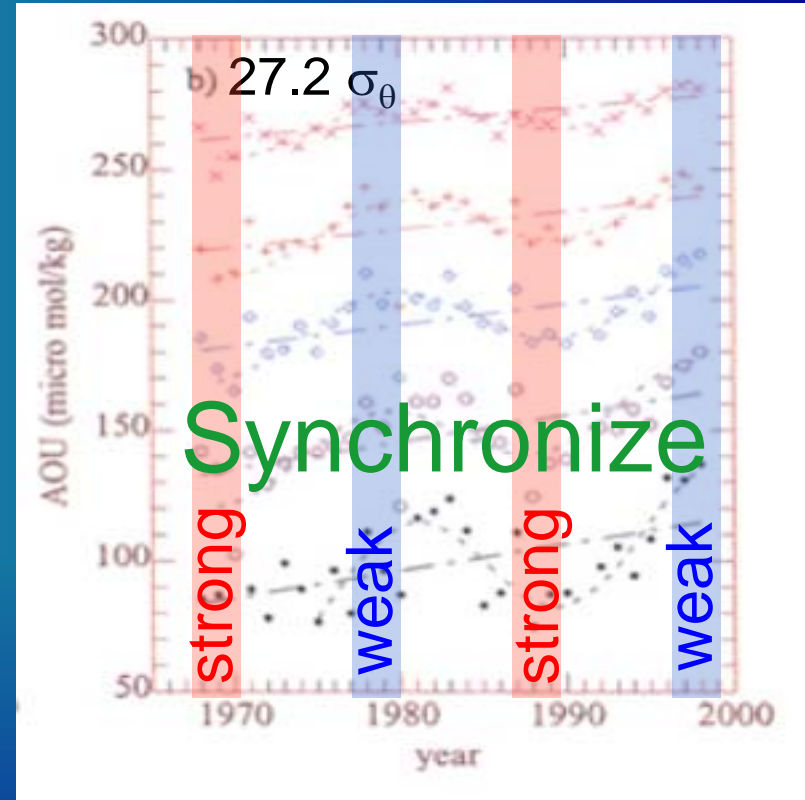
- Bidecadal oscillation of AOU (apparent oxygen utilization) in the intermediate layer in Oyashio area (Ono et al., 2001)
- Correlated with NPI
...Atmospheric forcing?
...not outcrop



The 18.6-year period nodal tide



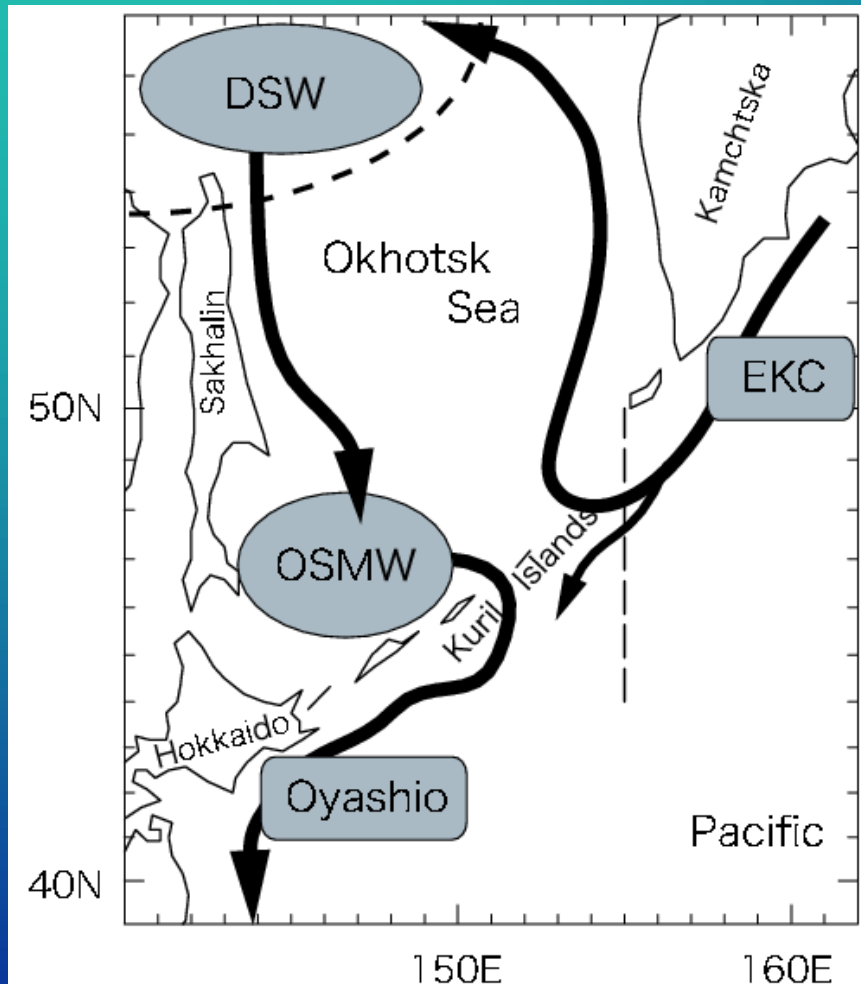
- The 18.6-year period nodal tidal cycle
... diurnal tide amplitude is modulated 20 %



(Ono et al., 2001)

➔ Investigate the relation between the intermediate water variation and the nodal tide

The intermediate water formation and tidal mixing



- East Kamchatska Current
- Dense Shelf Water
- Okhotsk Sea Mode Water

Vertical mixing induced by the diurnal tide around the Kuril Islands is important

--- direct effect

& upward salt flux

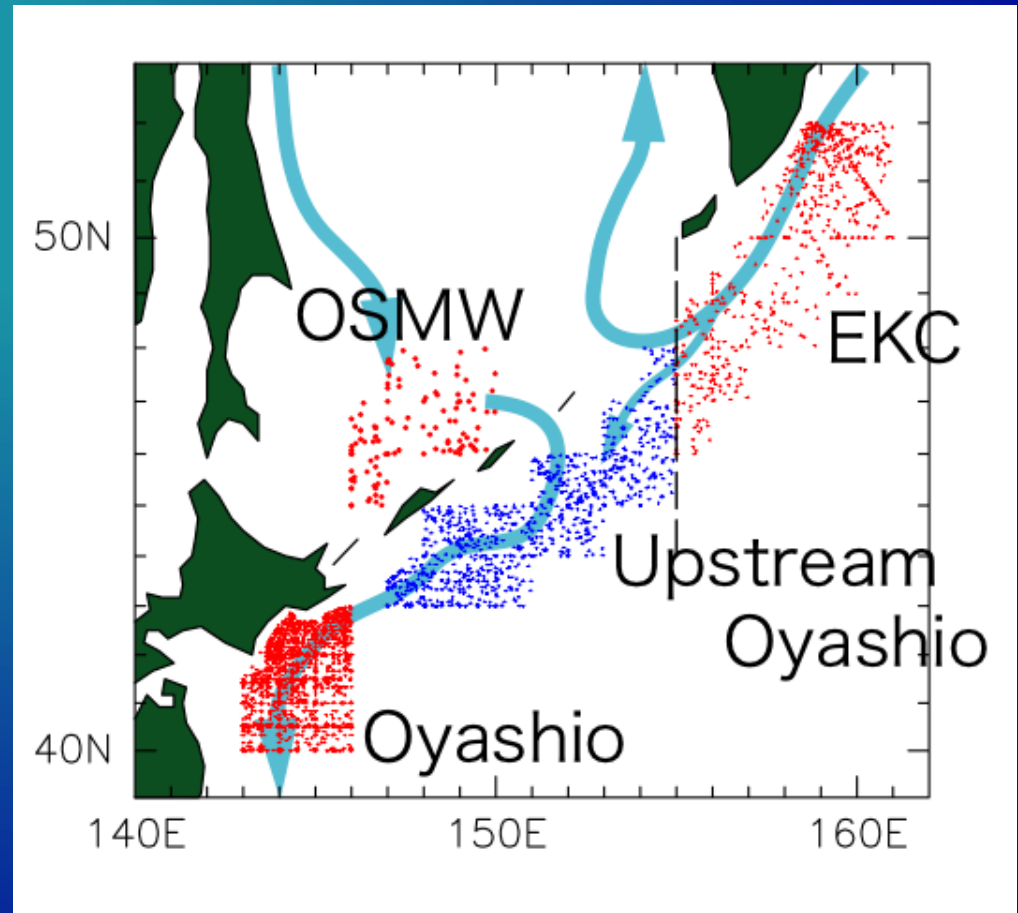
(Nakamura et al., 2004)



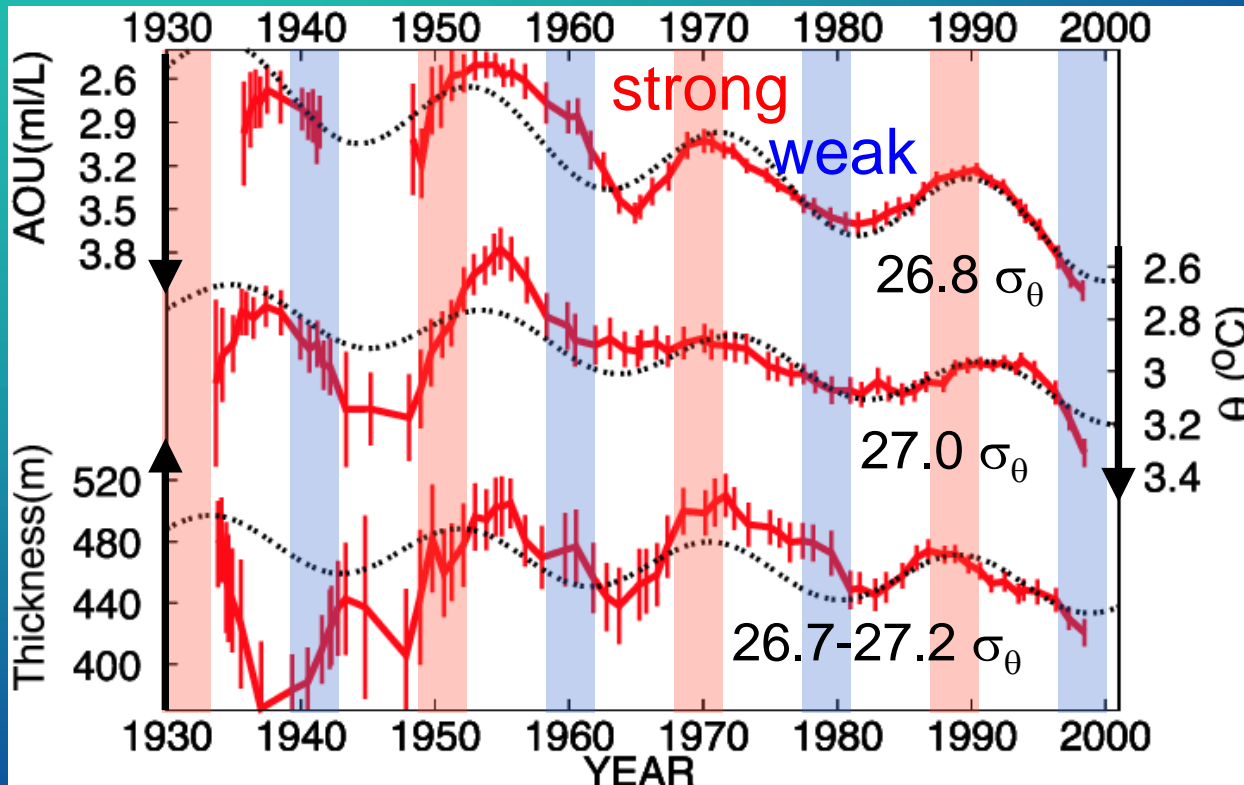
The nodal tide may influence the intermediate waters around this area

Data and Method

- World Ocean Database 2001
- Standard level data
- Linearly interpolated to the density surfaces
- Average in 5 years (between 2 years before and after)



Oyashio

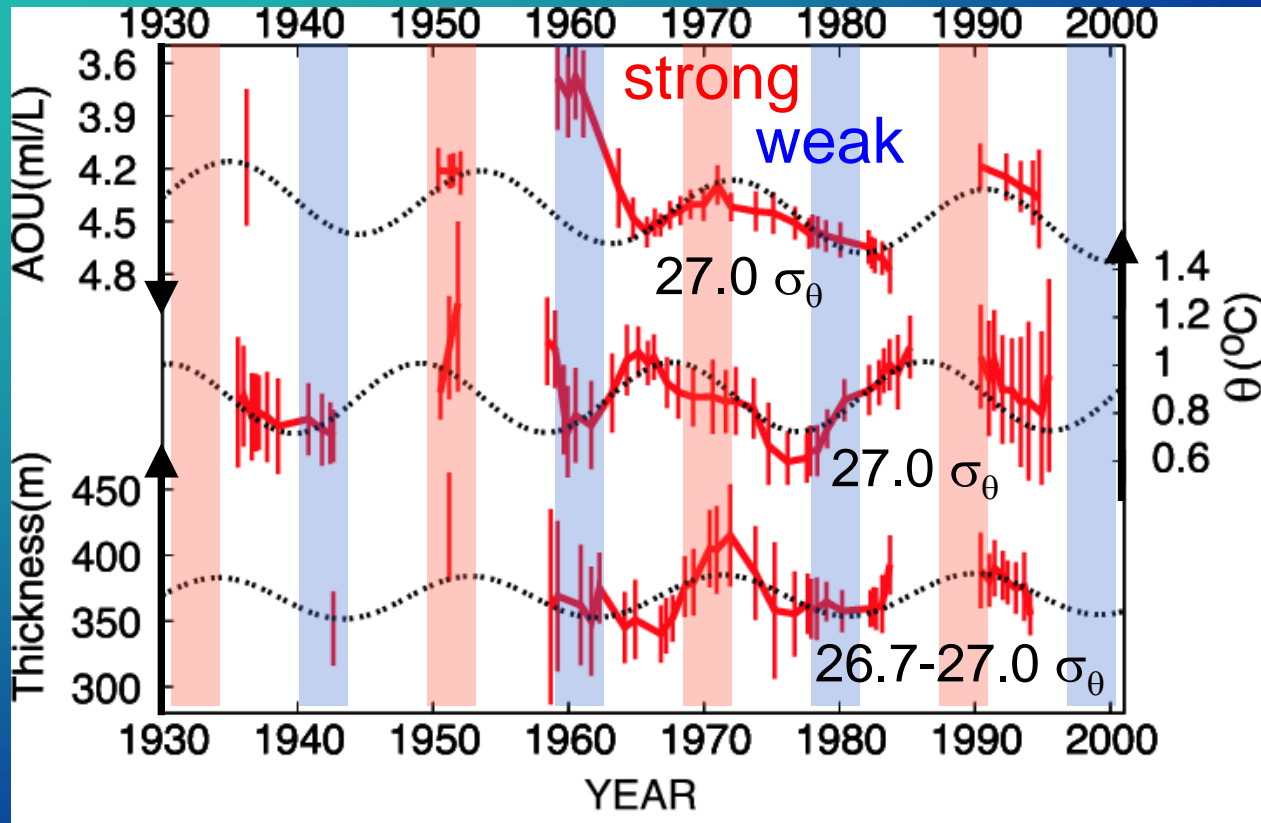


black curves:
<18.6-y curve + trend>
... fitted by weighted
least square

When the diurnal tide is strong, in the intermediate layer ...

- AOU is low (water is young)
- Potential temperature is low
- Thickness is large

Okhotsk Sea Mode Water



When the diurnal tide is strong, in the intermediate layer ...

- AOU is low (water is young)
- Potential temperature is high
- Thickness is large

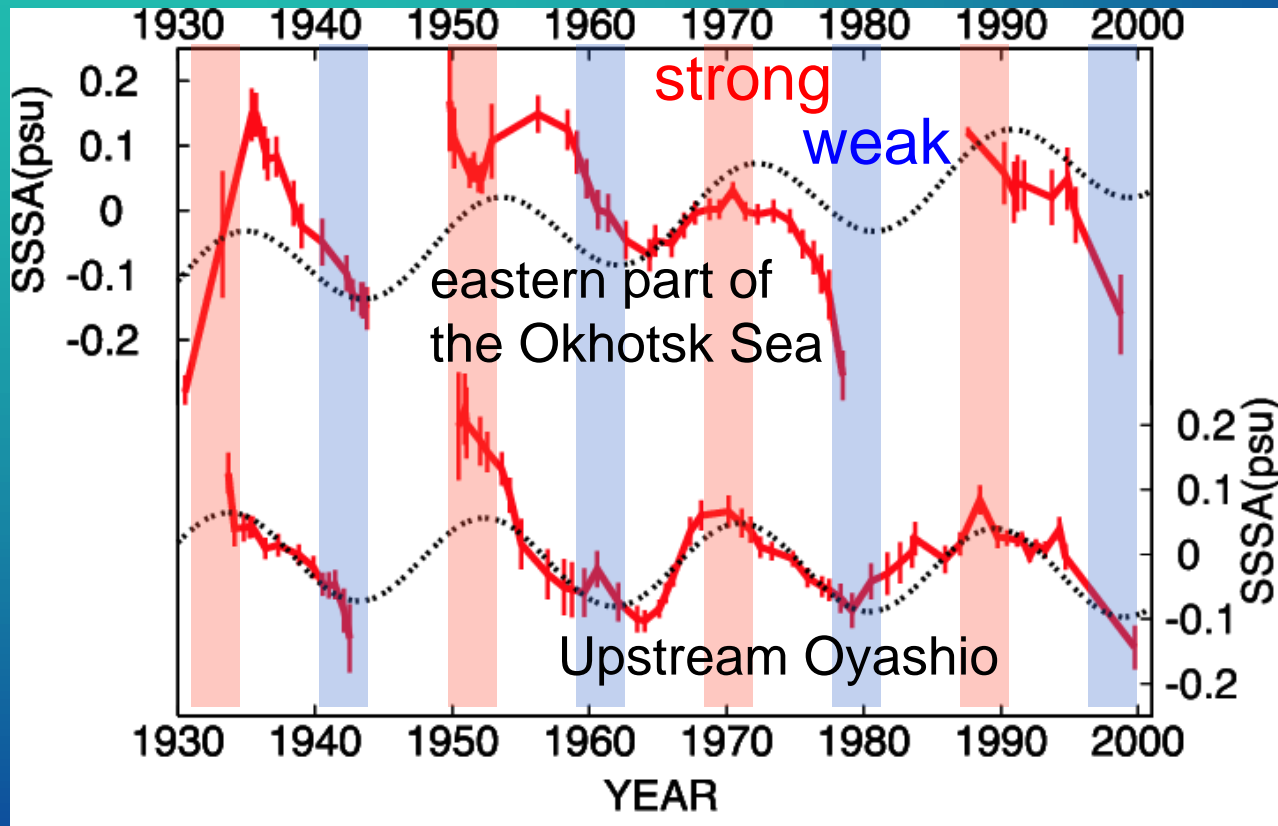
Midterm Summary

When the diurnal tide is strong,
in the intermediate waters...

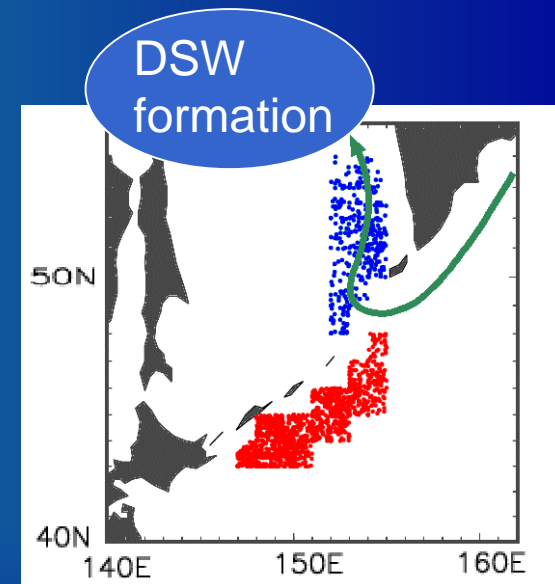
| | Oyashio | Upstream Oyashio | OSMW |
|-----------|---------|---------------------|-------|
| AOU | low | (not clear) | low |
| T | cool | cool | warm |
| Thickness | thick | thick | thick |

- AOU and thickness variations indicate that the intermediate water formation rate is increased.
- Why temperature variations are opposite between Pacific side and the Okhotsk Sea?

Sea Surface Salinity Anomaly



average of anomalies from long term monthly mean



When the diurnal tide is strong, SSS is high.
This possibly change the DSW formation.

- High S = High T, on an isopycnal surface
- Need less cooling to sink > volume ↑

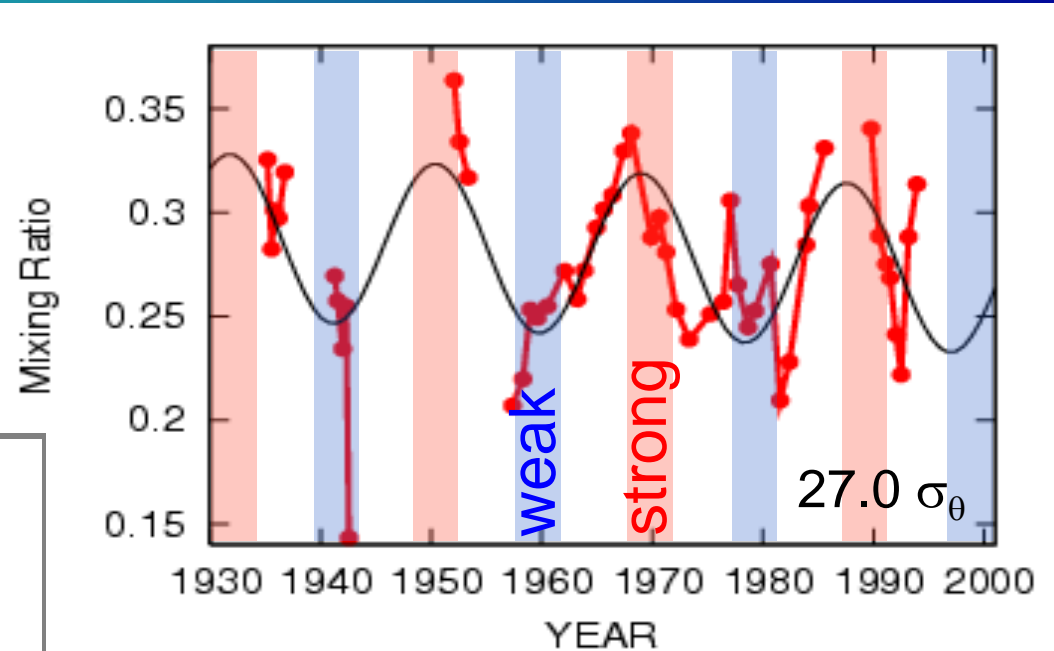
Mixing Ratio of OSMW in the Upstream Oyashio water

Assumption:

U-OY water is produced
by the isopycnal mixing
between EKC and OSMW

Mixing
Ratio

$$R = \frac{\theta_{EKC} - \theta_{U-OY}}{\theta_{EKC} - \theta_{OSMW}}$$



When the diurnal tide is strong, the Mixing Ratio is high.

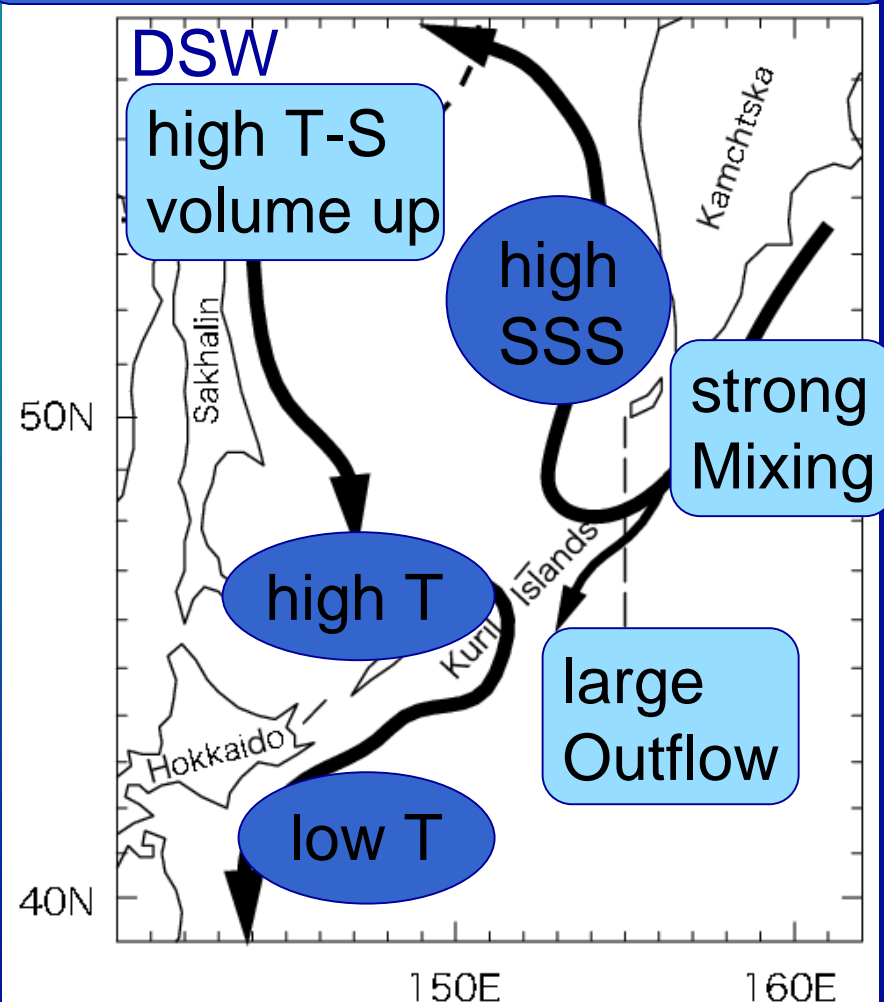
Large outflow of OSMW cool the Pacific water.

<== OSMW is colder than the Pacific water
even in strong tide / warm OSMW period

Summary & Possible Mechanism

- We found bidecadal water variations in the northwestern subarctic Pacific and the Okhotsk Sea.
- These temporal variations are synchronized with the 18.6-year period nodal tidal cycle.
- This could be explained by the nodal modification of the vertical mixing around the Kuril Straits.

All Areas : low AOU
thick intermediate layer



END