22nd Session of NEAR-GOOS-CC, March 10, 2025, Tokyo, Japan

NEAR-GOOS Climate Monitoring Section

A pilot project of JMA and POI since 2011

Vyacheslav Lobanov[1], Daisuke Sasano [2]

1 V.I.Il'ichev Pacific Oceanological Institute, Far Eastern Branch, Russian Academy of Sciences
2 Marine Division, Japan Meteorological Agency

国土交通省 気象庁 Japan Meteorological Agency

Motivation

* Global warming may slow down deep-ocean water production & circulations that are driven by sea surface cooling. This may affect climate pattern.
* Changes in deep-sea water & circulations are expected to appear earlier in isolated seas.
* WG-I Report of IPCC's 4th Assessment Report:
  * "Because of this sea's limited size, it responds quickly through its entire depth to surface forcing changes."
  * "The warming … is clearly apparent in this isolated basin, which warmed by 0.1°C at 1,000m and 0.05°C below 2,500m since 1960s."
  * "Deep water production in the Japan Sea slowed for many decades, with a marked decrease in dissolved oxygen from the 1930s to 2000 at a rate of about 0.8μmol/kg/yr."

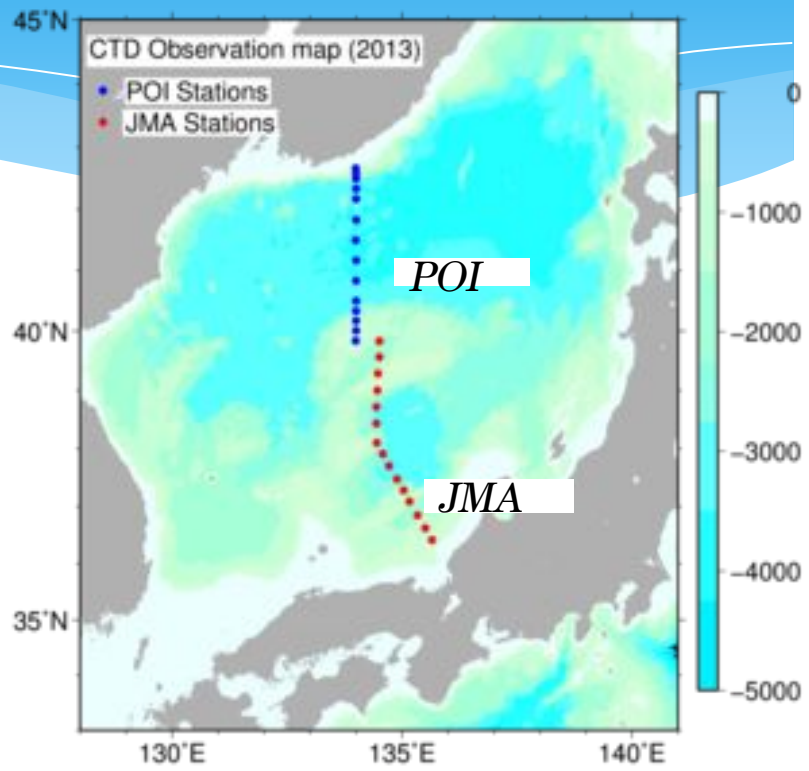
JMA-POI Synchronized Survey

1. Complete cross-basin sections were hardly carried out, partly due to national EEZ borders.
2. Thus JMA & POI suggested to make observations along a line connecting Japan & Russia in a synchronized manner.
3. Observation data will be exchanged between JMA & POI. Results will be available through Regional Data Bases for all NEAR-GOOS participants.
4. Observations along the same line will be continued in the following years, producing long-term dataset.
5. The project was approved by NEAR-GOOS CC meeting in 2011 and started the same year.

Observation details

* Observation period 2011-2021:
  * Late October-early December

* Observed elements:
  * CTD & water sampling down to the bottom
  * Parameters observed:
    * Temperature, Salinity,
    * Oxygen, Nitrate, Nitrite, Silicate, pH,
    * Total inorganic carbon, Alkalinity



Climate Monitoring Section Implementation

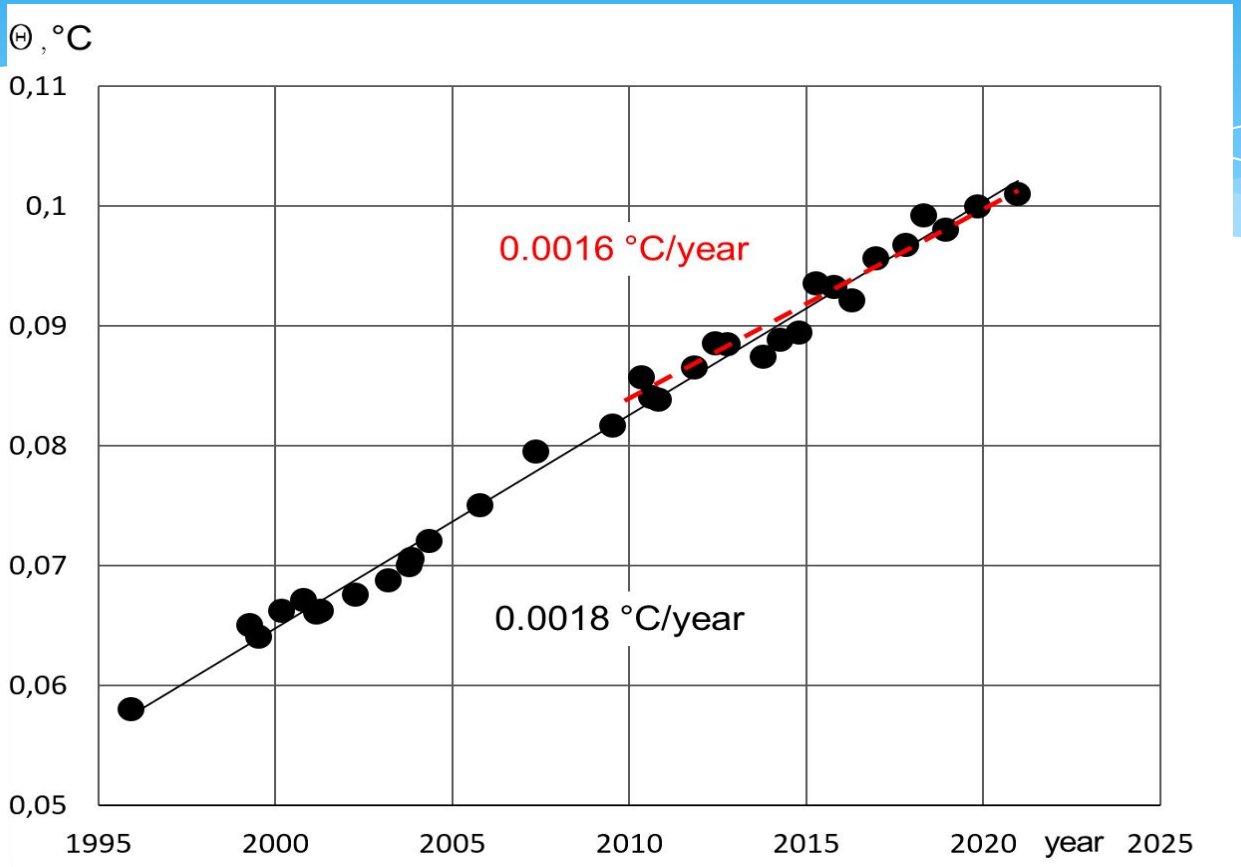
r/v Akademik M.A.Lavrentyev
Akademik Oparin, Prof. Gagarinskiy

r/v Keifu-maru

<u>Synchronised observations:</u>

2011 Oct-Nov
2012 Oct-Nov
2013 Oct
2014 Oct
2015 Oct
2016 Nov-Dec
2017 Oct-Nov
2018 Oct-Dec
2019 Oct-Nov
2020 Oct-Dec
2021 Dec

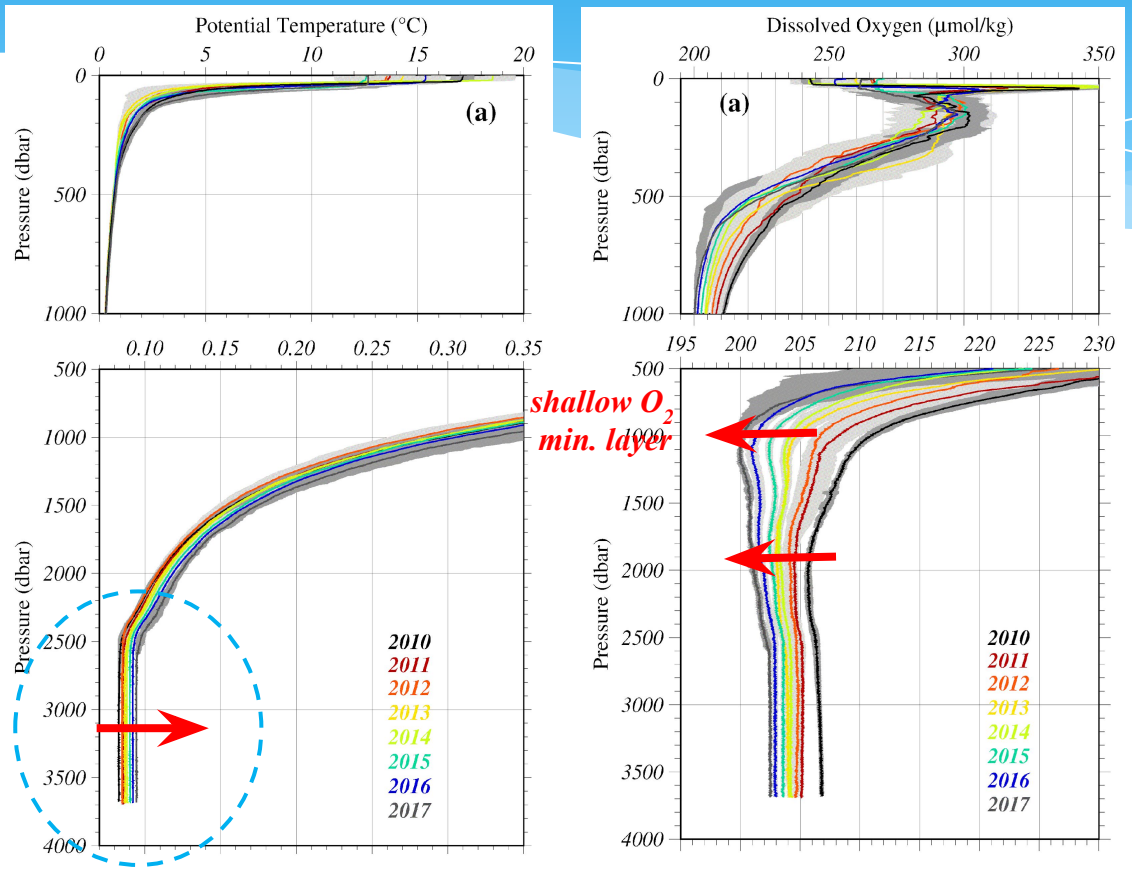
New Finding 1: Warming trend continues and slows down



Lobanov et al., 2022

* Warming trend of bottom water and its recent slowdown

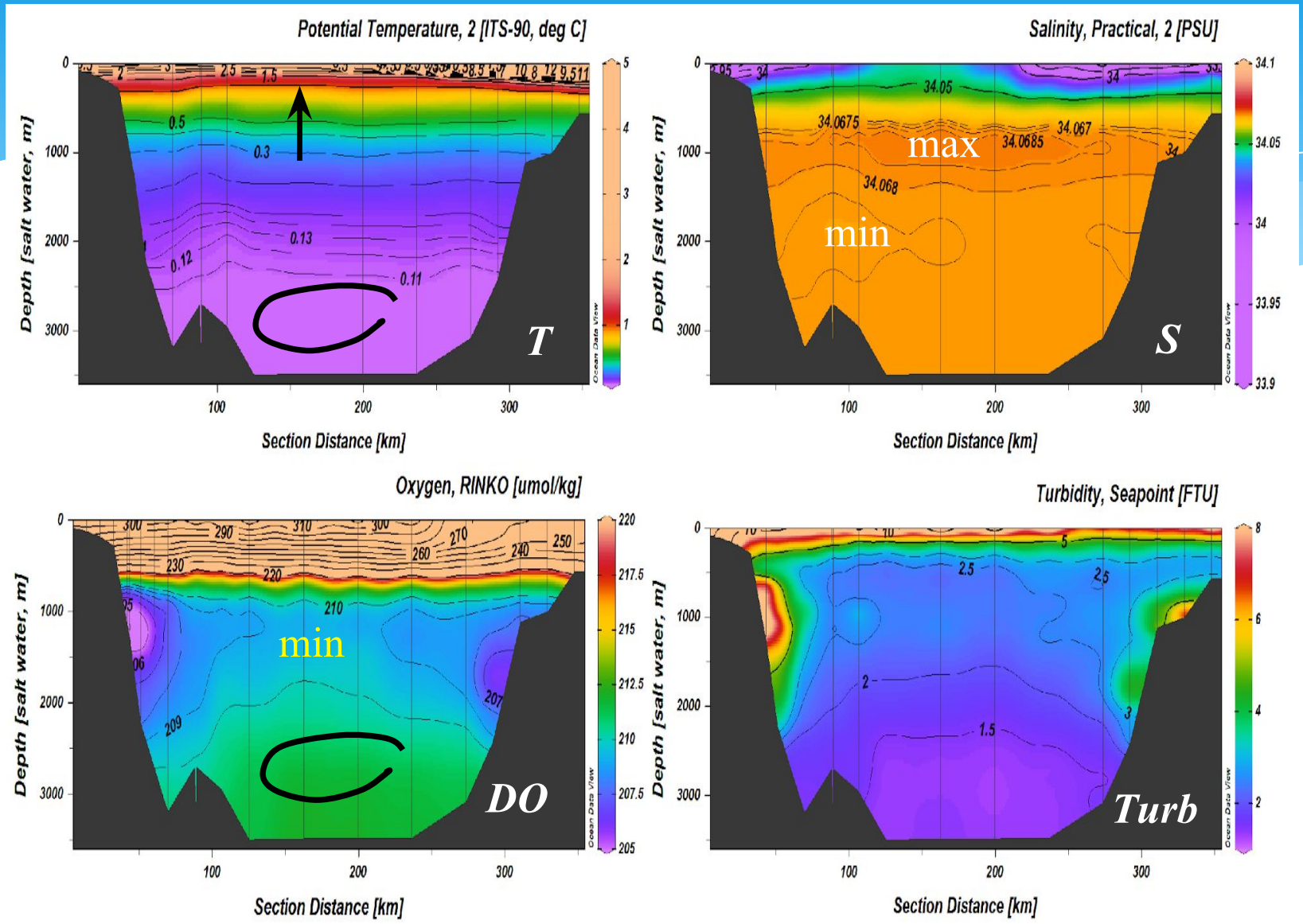
New Finding 2: Structural changes of DO vertical profile



Nakano et al., 2019

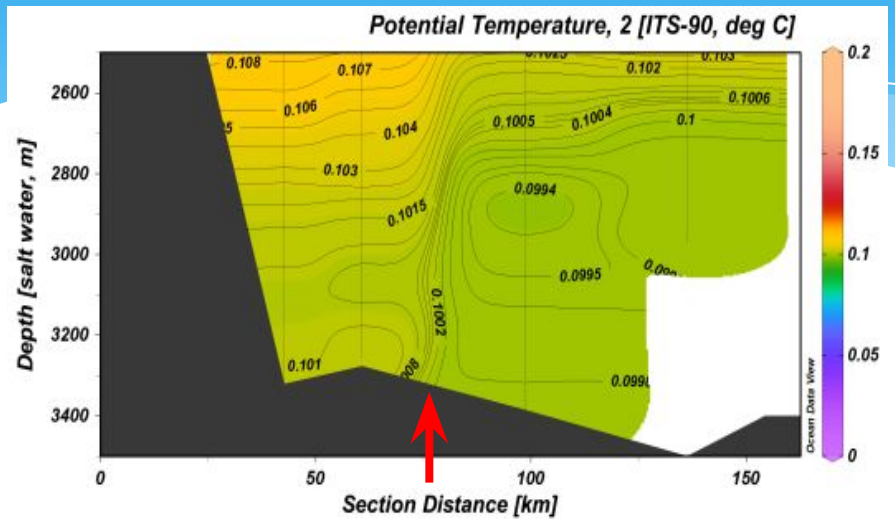
* Changes in vertical profiles of DO

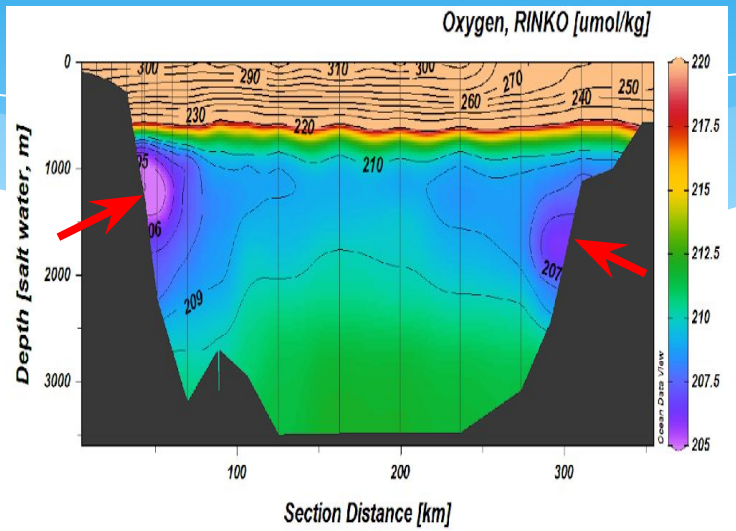
New Finding 3: Water mass structure of cyclonic gyre



Sergeev et al., 2022

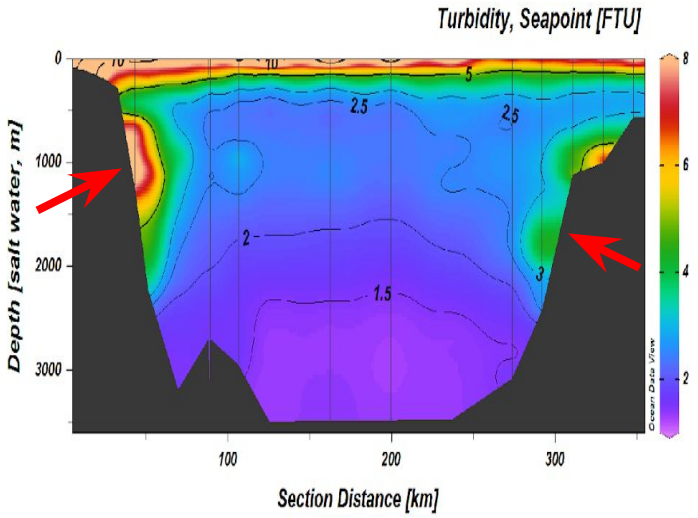
New Finding 4: Marginal benthic fronts



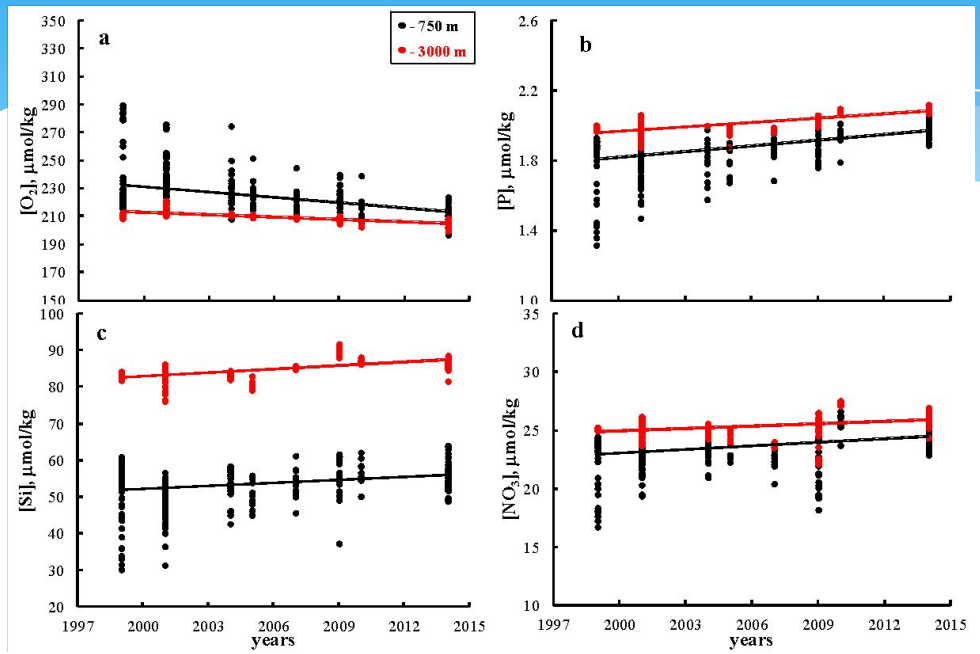


* T,S marginal benthic fronts

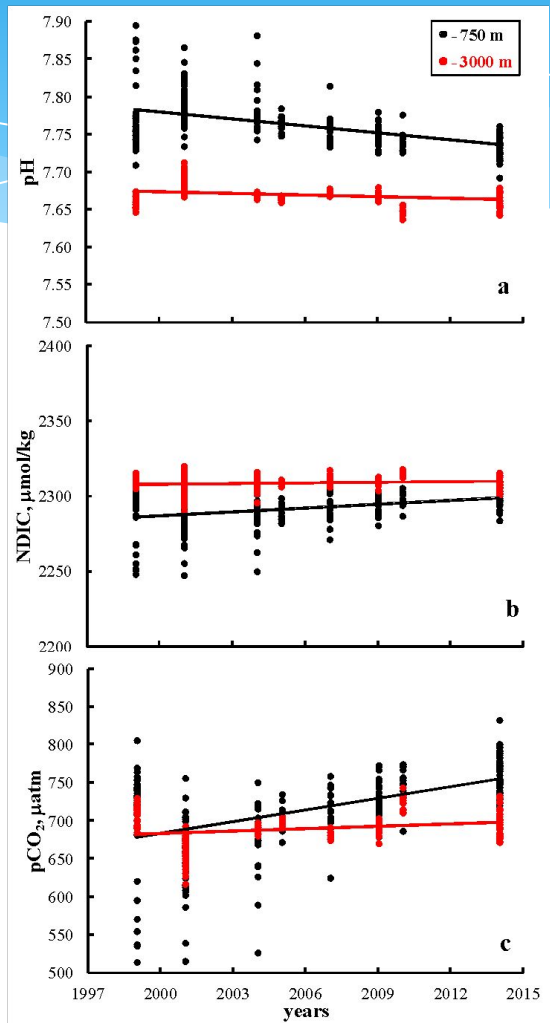
* DO min zones at the slopes and their evolution



New Finding 5: Acidification, eutrophication and deoxygenation of the northern part of the sea



Temporal variability of the hydrochemical parameters at 750 m (black) and 3000 m (red) depths. (**a**) DO concentrations (µmol/kg); (**b**) phosphorus concentrations (µmol/kg); (**c**) silica concentrations (µmol/kg); (**d**) nitrate concentrations (µmol/kg).



Temporal variability of the carbonate system parameters in the at 750 m (black) and 3000 m (red) depths. (**a**) pH (in situ); (**b**) Normalized Dissolved Inorganic Carbon (NDIC = DIC·35/S); (**c**) carbon dioxide partial pressure.

Tishchenko et al., 2021

New Finding 6: Changes in Intermediate Water Formation

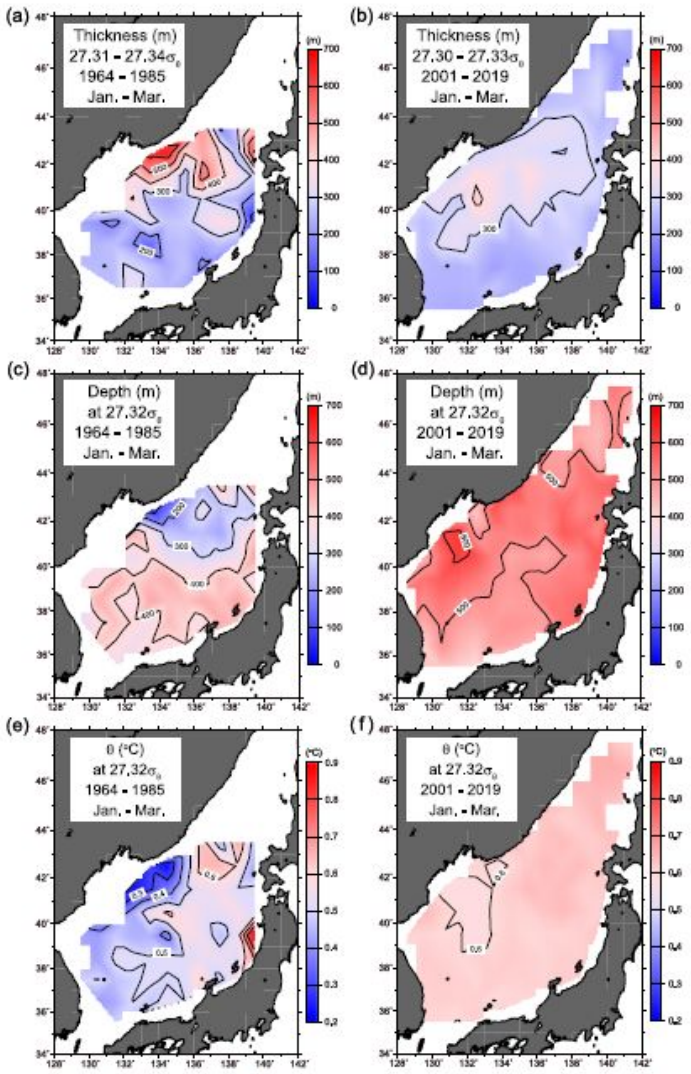


Figure 8. Horizontal distributions of the UJSPW thickness (a) and (b), depth (c) and (d), and θ (e) and (f) on the 27.32 σ_θ surface. The left and right panels are Period I (1964–1985) and Period II (2001–2019), respectively. The upper portion of the Japan Sea Proper Water thickness in (a) is for the 27.31–27.34 σ_θ surfaces, whereas that in (b) is for the 27.30–27.33 σ_θ surfaces.

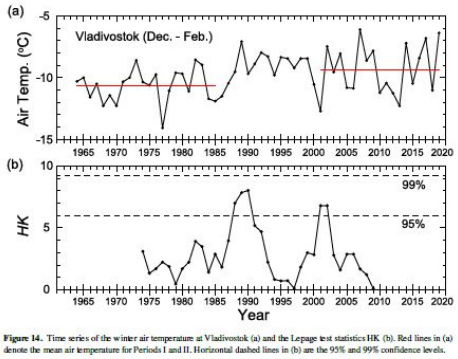


Figure 14. Time series of the winter air temperature at Vladivostok (a) and the Lepage test statistics HK (b). Red lines in (a) denote the mean air temperature for Periods I and II. Horizontal dashed lines in (b) are the 95% and 99% confidence levels.

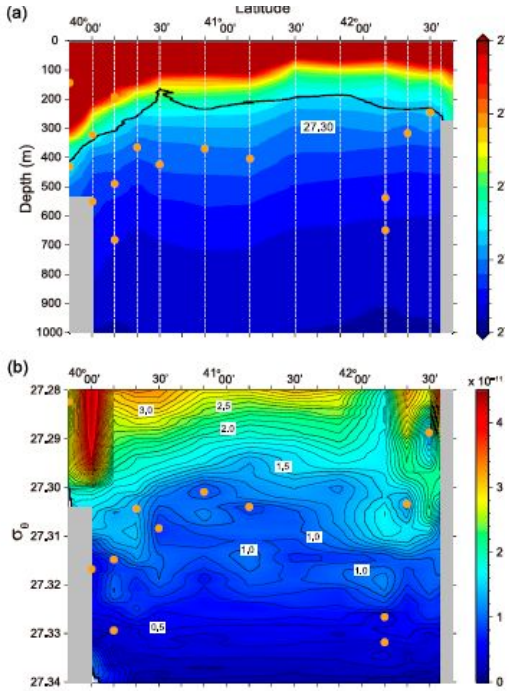


Figure 5. Vertical sections along the 134°E line in October 2013 (Figure 3c): (a) σ_θ and (b) PV with the vertical axis of σ_θ. Notable PV minima are indicated by orange circles. Black line in (a) is the 1.0°C isotherm which indicates the top of the upper portion of the Japan Sea Proper Water. White broken lines in (a) indicate the location of stations.

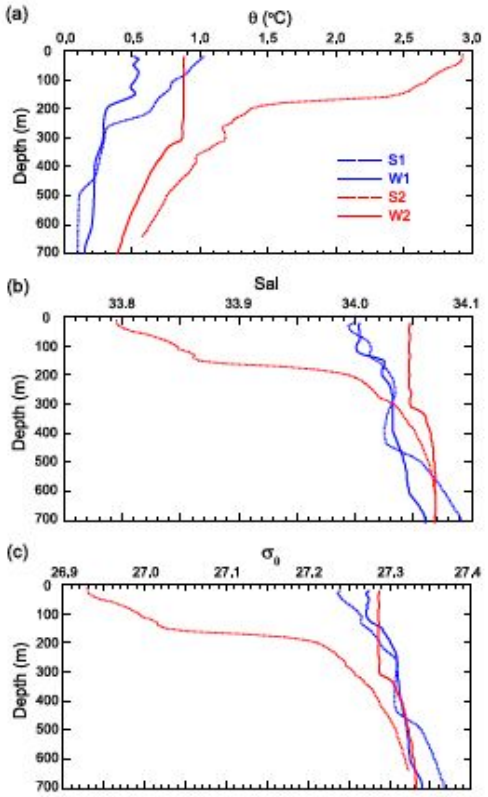
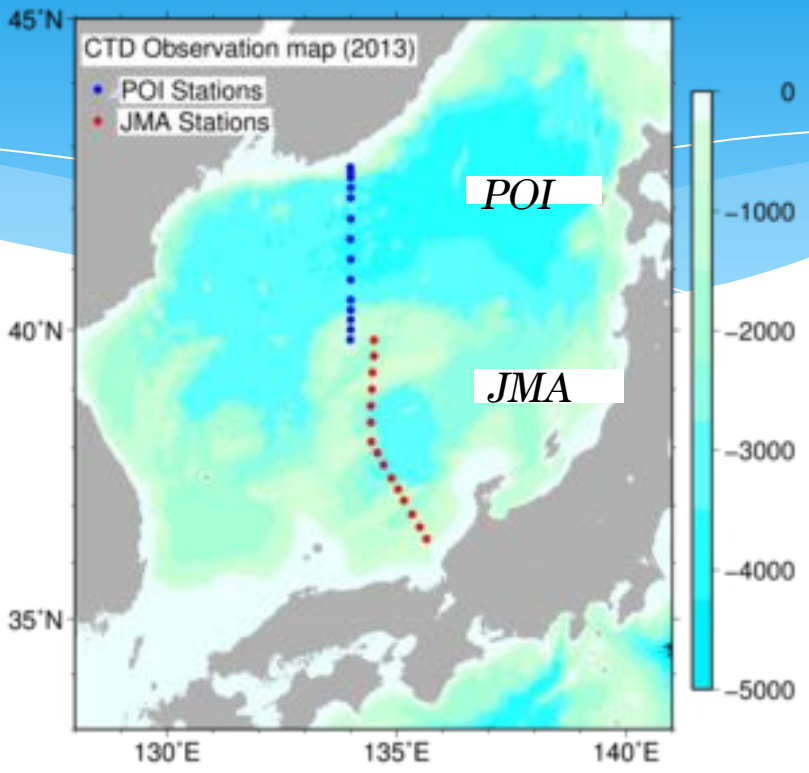


Figure 12. Profiles with weak (solid line) and strong (dashed line) stratifications in the upper portion of the Japan Sea Proper Water formation area in winter: (a) θ, (b) S, and (c) σ_θ. Blue and red colors are Periods I and II, respectively. Locations of each profile are shown in Figure 10.

Senjyu and Shiota, 2023

Future work

* Further data analysis and preparation of papers based on 11 surveys
* POI had a break in observations since 2022
* JMA had conducted observations to 2023 and is planning observations in 2024 as well
* However because of lack of observations from POI side the project will be stopped temporarily and may be continued in the future



Thank you !

Twenty fours session, online, 12 Oct, 2023
Twenty third session, online, 11 April, 2022
Twenty second session, online, 4 Nov, 2021
Twenty first session, online, 19 Oct, 2020
Twentieth session, Gangneung, Korea, 21-22 Nov, 2019
Nineteenth Session, Bangkok, Thailand, 13-15 Nov, 2018
Eighteenth Session, Fuzhou, China, 20-22 Nov, 2017
Seventeenth Session, Vladivostok, Russia, 14-16 Dec, 2016
Sixteenth Session, Tokyo, Japan, 8-9 December 2015
Fifteenth Session, Busan, Republic of Korea, 10-11 October 2013
Fourteenth Session, Tianjin, China, 8-9 September 2011
Thirteenth Session, Vladivostok, Russia, 8-10 April 2010
Twelfth session, Kota Kinabalu, Malaysia, 24 May 2008
Eleventh session, Bangkok, Thailand, 18-19 January 2007
Tenth session, Busan, Republic of Korea, 16-18 January 2006
Ninth session, Sendai, Japan, 3-5 November 2004
Eighth session, Beijing, China, 8-10 December 2003
Seventh session, Vladivostok, Russia, 2-4 October 2002
Sixth session, Seoul, Republic of Korea, 31 August 2001
Fifth session, Seoul, Republic of Korea, 7-8 December 2000
Fourth session, Tokyo, Japan, 28 September - 1 October 1999
Third session, Beijing, China, 3-6 August 1998
Second session, Bangkok, Thailand 14-16 May 1997
First session, Bangkok, Thailand, 4-6 September 1996

Operational manual version 1.0 for NEAR-GOOS Data Exchange; May 1997

Draft pilot implementation plan for North-East Asian Regional - Global Ocean Observing System (NEARGOOS); Tokyo; 26 February - 1 March 1996