OceanPredict OS-Eval Task Team
The 13th web meeting

(Jan 24th, 2022, 13:00 UTC)

Agenda

00:00-00:02: Introduction

00:02-00:20: Report and Discussion on the preparation of SynObs

00:20-00:50: Presentation on the OSEs for Argo fast salinity drift (Yosuke Fujii, JMA/MRI) (including discussion)

00:50-01:00: Communications, Wrap-up

★ Preparation for SynObs

- SynObs application form have been submitted to the UN Decade Second Call
  - ✓ The official name is changed (because only 50 characters are allowed)

    "Synergistic Observing Network for Ocean Prediction"
  - ✓ Partner Institutions: MRI/JMA, MOI, UKMO, NOAA Quantitative Observing System Assessment Program, ECMWF, CNR ISMAR, NERSC, Ocean Data Network, CNRS, UFBA
- Selection of the steering team member
  - ✓ We would like start the team from the minimum number, and are now inviting members.
  - ✓ Y. Fujii, E. Remy, P. Oke, F. TBD (ObsCoDe), Davidoson (OPST&ForeSea), P. DeMey (COSS-TT&CoastPredict), A. Moore (DA-TT), TBD (MEAP-TT). (Request for additional members?)
  - ✓ We will start the discussion on the SynObs implementation plan at the team. (Any request?)
- Discussion on SynObs Coast (Need to submit politically as a project under CoastPredict?)
  - ✓ Just for showing the presence of SynObs in the CoastPredict community. (Maybe good for promoting coastal system evaluation study.)
  - ✓ Even if SynObs Coast is launched we would like to manage it together with SynObs.
  - ✓ Cons: Increase of management costs. Possibility of separation of it from the SynObs main body.

13th OS-Eval TT Web Meeting
Jan 24th, 2022, Online

Observing System Experiments for the Argo Fast Salinity Drift

Y. Fujii (MRI/JMA)

1. What is the Fast Salinity Drift?
2. Planned collaborative OSE
3. Results of OSEs with the JMAs system
4. Summary

1. What is the fast salinity drift?

★ What is the Fast Salinity Drift

- ✓ The number of SeaBird Argo floats showing Fast (sudden or abrupt) Salinity Drift (FSD) increases after 2016.
- ✓ FSD is defined as drift of salinity more than 0.05 psu in the life span of a float
- ✓ The abrupt drift is supposed to happen when the instrument get cracks and the distance between the two electrodes in the conductivity sensor shrinks.
- ✓ Once FSD occurs, the sensor cannot be recovered.
- ✓ SeaBird changed the manufacturing process in order to resolve the problem recently. However, scientists still found several floats suffering FSD although they are produced after the change of the manufacturing process.

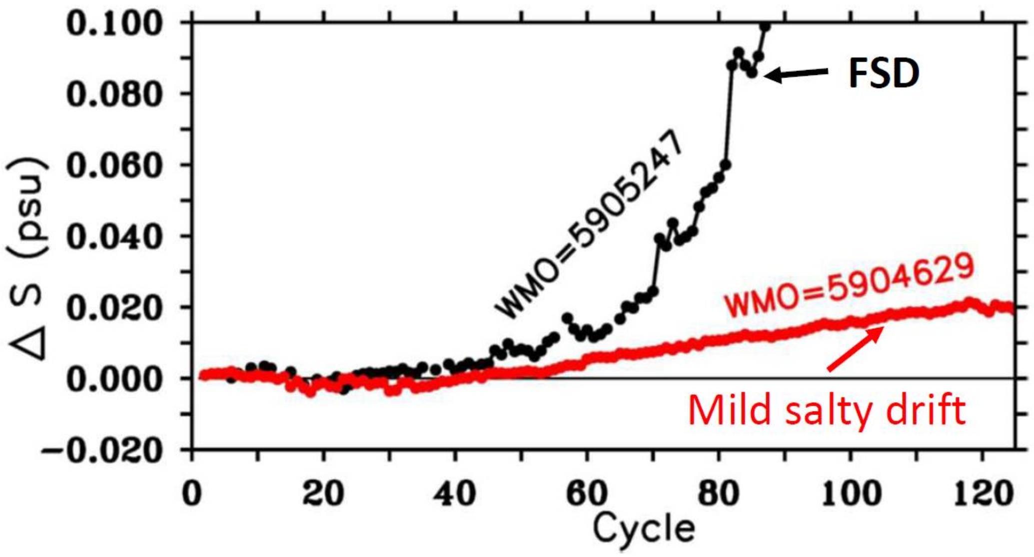


Fig.1: Two examples of SBE CTDs that showed salty sensor drift: a "slow" drift (WMO ID 5904629, in red), and a "fast" drift (WMO ID 5905247, in black). (Fig.11 in Wong et al. 2020)

★ Impact of the fast salinity drift

- ✓ About 15% of Argo floats suffer from this problem

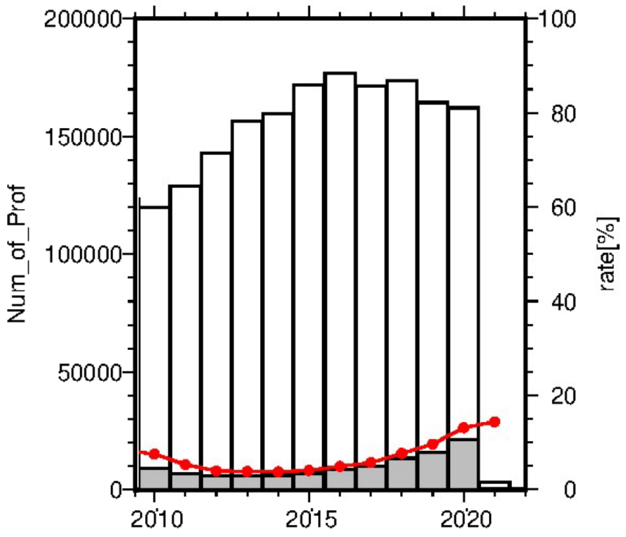


Fig.2: (bar) histogram of num of S profile; gray means num of S profile with 'bad' flag to all years, and white means num of S profile other than that. (red line) time series of ratio of the number of S profile with the 'bad' flag to all layers to the num of global S profiles.

- ✓ The problematic data tend to produce high salinity bias.

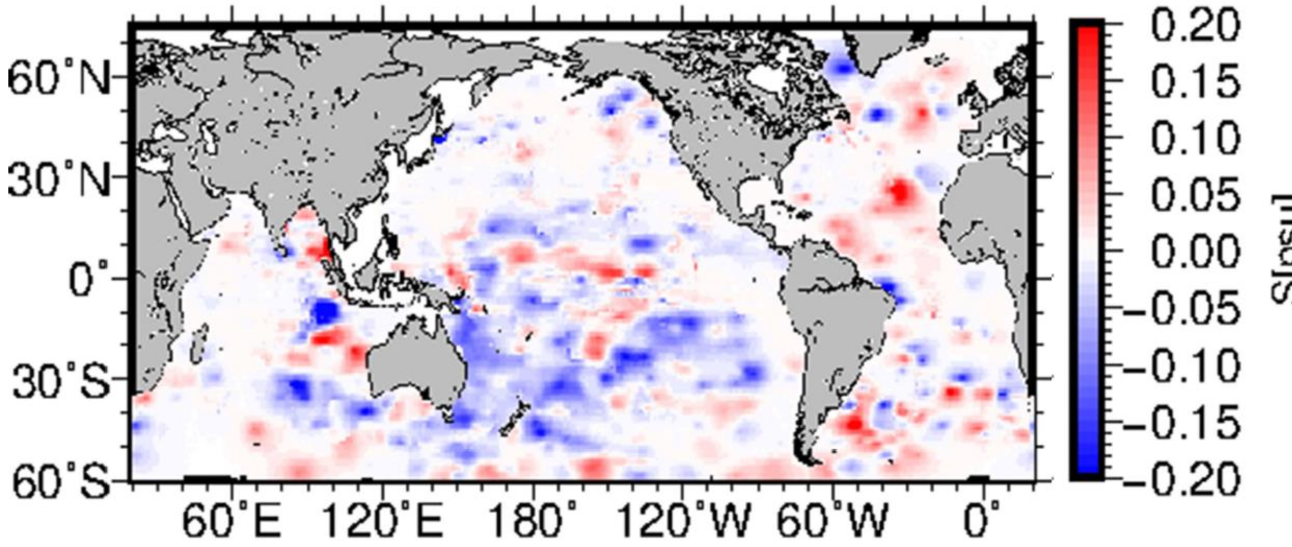


Fig.4:map of ΔS (revised-S minus previous-S) in December 2016 at 100-dbar.(Tentative result)

(Form the presentation by K. Sato at the 9th OS-Eval web meeting)

★ How the error data are handled?

- ✓ Argo floats suffering from the fast salinity drift are add to the Argo gray list when the problem is detected. The gray list is open at the web page of the Argo database.
- ✓ The data observed by the floats problematic floats are cautioned by the error flags in the real-time Argo database and GTS.
- ✓ As far as the data on GTS are concerned, the data observed by the floats from which FSD have already been detected are cautioned by the error flag, but the data without the error flag includes the data influenced by FSD which have not been detected yet.
- ✓ On the delayed-mode data in the Argo database, I hope all data influenced by the FSD are cautioned by the error flag.
- ✓ It should be noted that the delayed-mode data are generated typically after a float ends its life. I found several profiles observed in 2015 still not have delayed-mode data.

2. Planned collaborative OSE

★ Collaborated OSEs in the OS-Eval TT

☐ Purposes

- ✓ Evaluate the possible impacts of Argo fast salinity drift on the operational systems
- ✓ Examine the effects of using the gray list and the delayed-mode data
- ✓ Examine the effects of automated QC systems incorporated in ocean prediction systems.

☐ System participating in the OSE study (also collaborating with CLIVAR-GSOP)

- ✓ JMA 1x1/2˚ Global System, MOVE-G3A-3DVAR (Y. Fujii)
- ✓ CSIRO 1/10˚ Global System, Global Blue Maps (P. Oke)
- ✓ ECMWF 1/4˚ Global System, OCEAN5 (H. Zuo)
- ✓ NERSC 1˚ Global System, NorCPM (Y. Wang)
- ✓ IAP/CAS 1˚ Global objective analysis system (L. Cheng)

☐ Experimental Period (mandatory) : 2016-2020

★ Observing System Experiments (OSEs)

☐ Mandatory

- ✓ **OSE 1.** Assimilation run with real-time obs data which are actually used in operation (or its proxy). The data with error flags will not be used if the data are actually not used in operation.
- ✓ **OSE 2.** Same as OSE 1 but the data included in the Argo gray list is discarded.

☐ Optional

- ✓ **OSE 3.** Same as OSE 2 but the Argo profile data are replaced by their delayed-mode data when the delayed-mode data have already been created.
- ✓ **OSE 4.** Same as OSE 1 but the gray list is applied. But the error flags of Argo data are ignored. (Only the data out of the rages of -5°C < T < 40°C and 0 psu < S < 50 psu are discarded.)

☐ Additional OSEs in JMA

- ✓ **OSE 0.** Assimilating no data. (Climatology nudging and bias correction are applied.)
- ✓ **OSE 10.** Model free run.
- ✓ OSEs 1-4 are also conducted the system from which most QC procedures are turned off.
  ⇒ **OSEs 1b, 2b, 3b, 4b.**

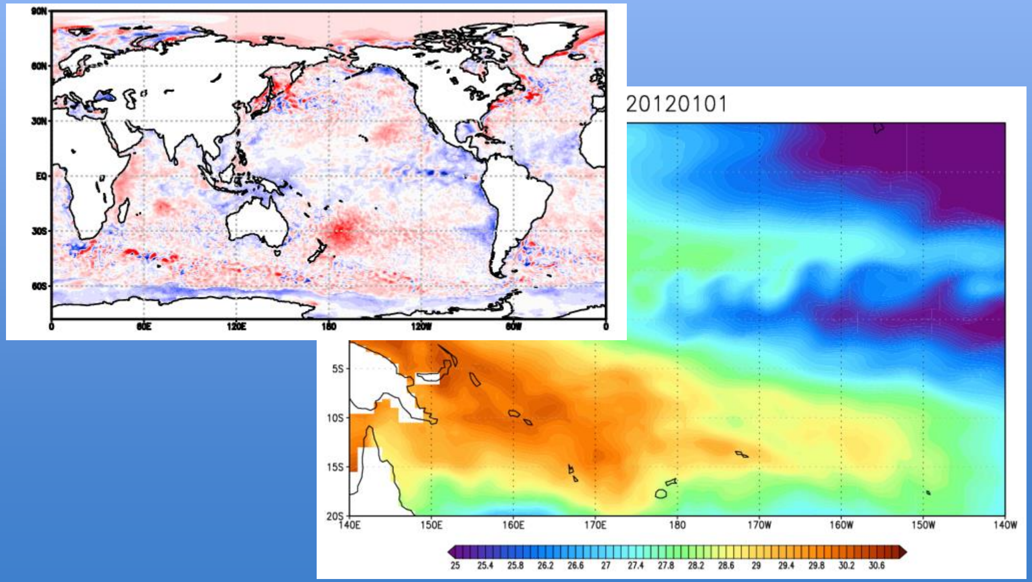
3. Results of OSEs with the JMAs system

★ JMA's New Global Ocean DA System for coupled predictions

➢ A new system based on 4DVAR are planed to be introduced in operation from Feb. 2022.

MOVE-G3A (4DVAR)

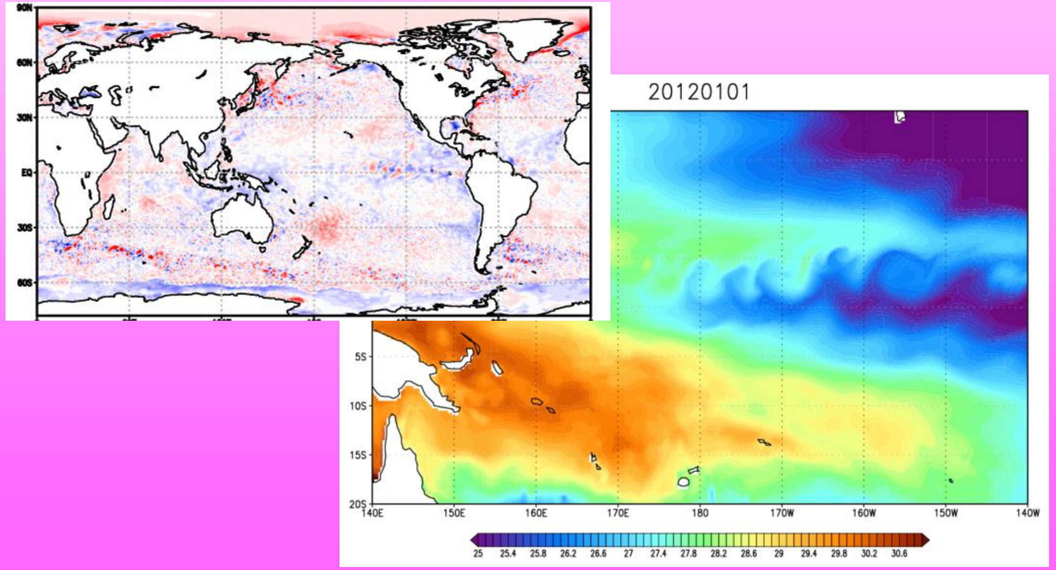
- Global (Tripolar)
- Resolution: 1˚ x ½˚
- 4DVAR (5-day interval)



Down Scaling

MOVE-G3F (Forecast Model)

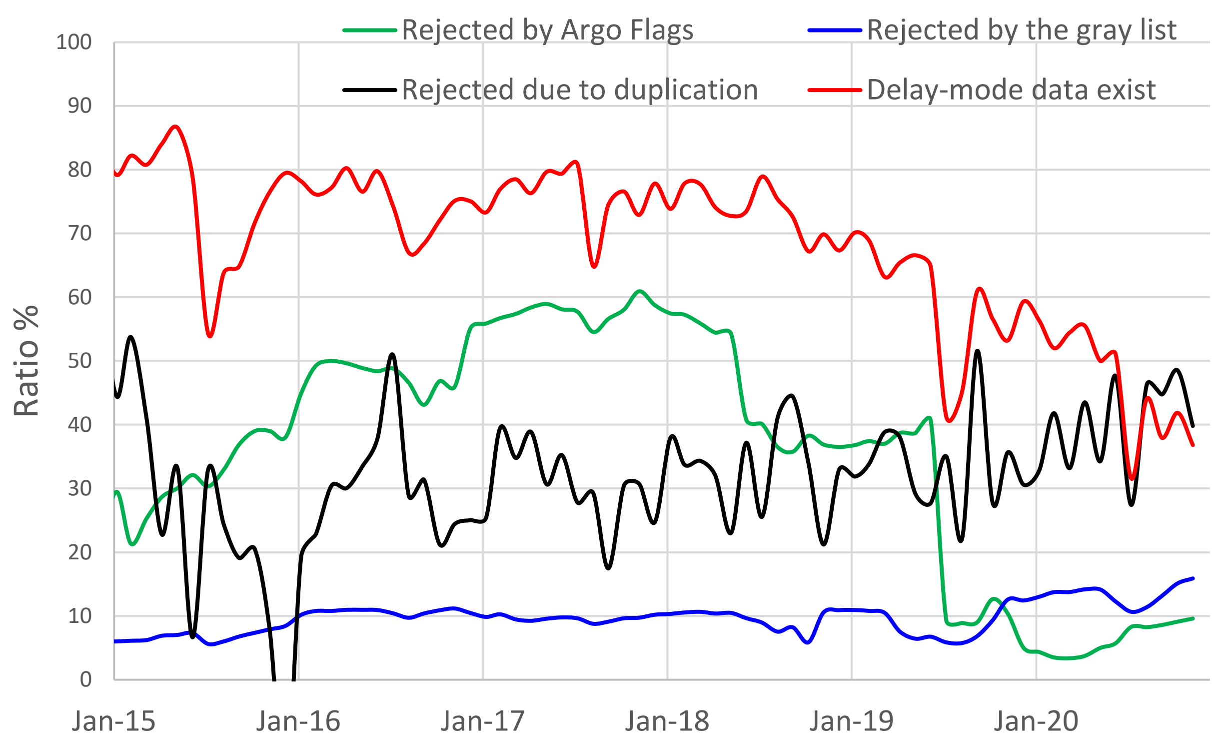
- Global (Tripolar)
- Resolution: 1/4˚ x 1/4˚
- Assimilation fields are downscaled from G3A by IAU



➢ However, we use the low resolution system (MOVE-G3A) in the 3DVAR mode in the OSEs in order to reduce the computational burden.

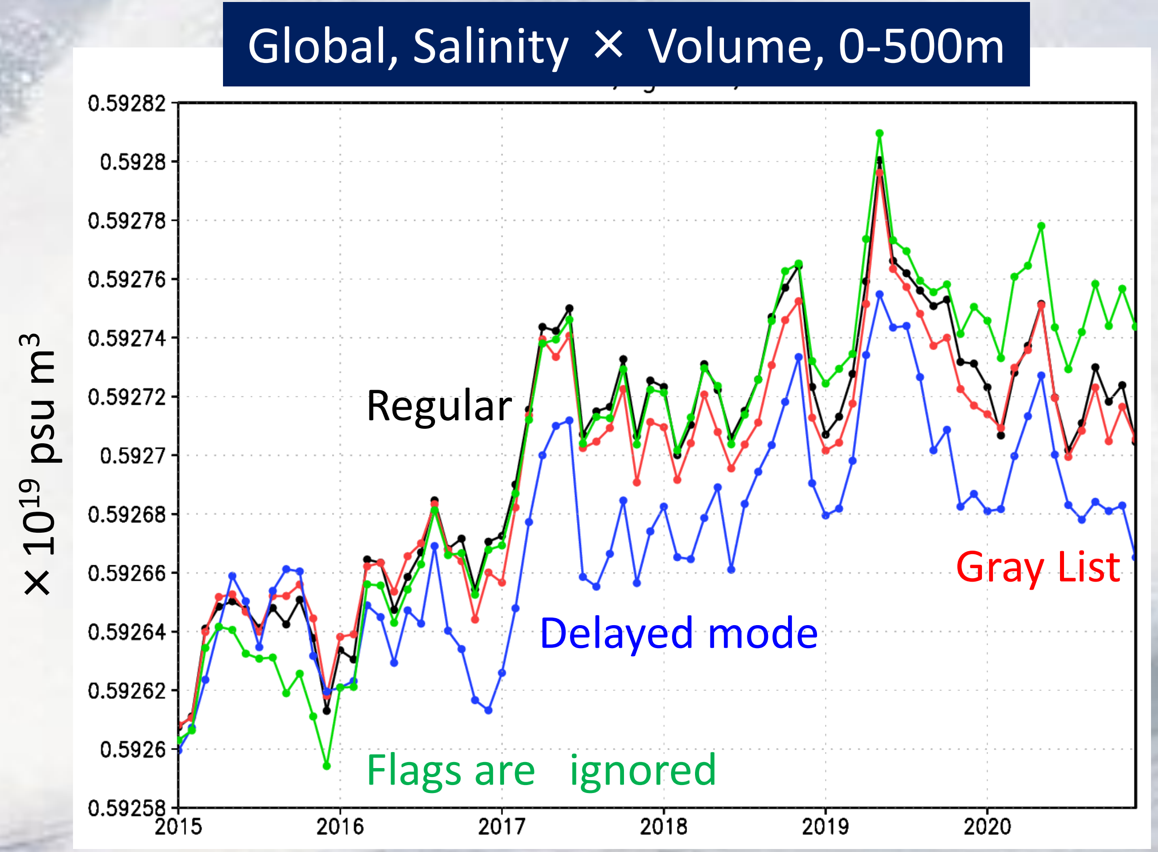
★ Ratios of rejection and replacement by delayed mode data

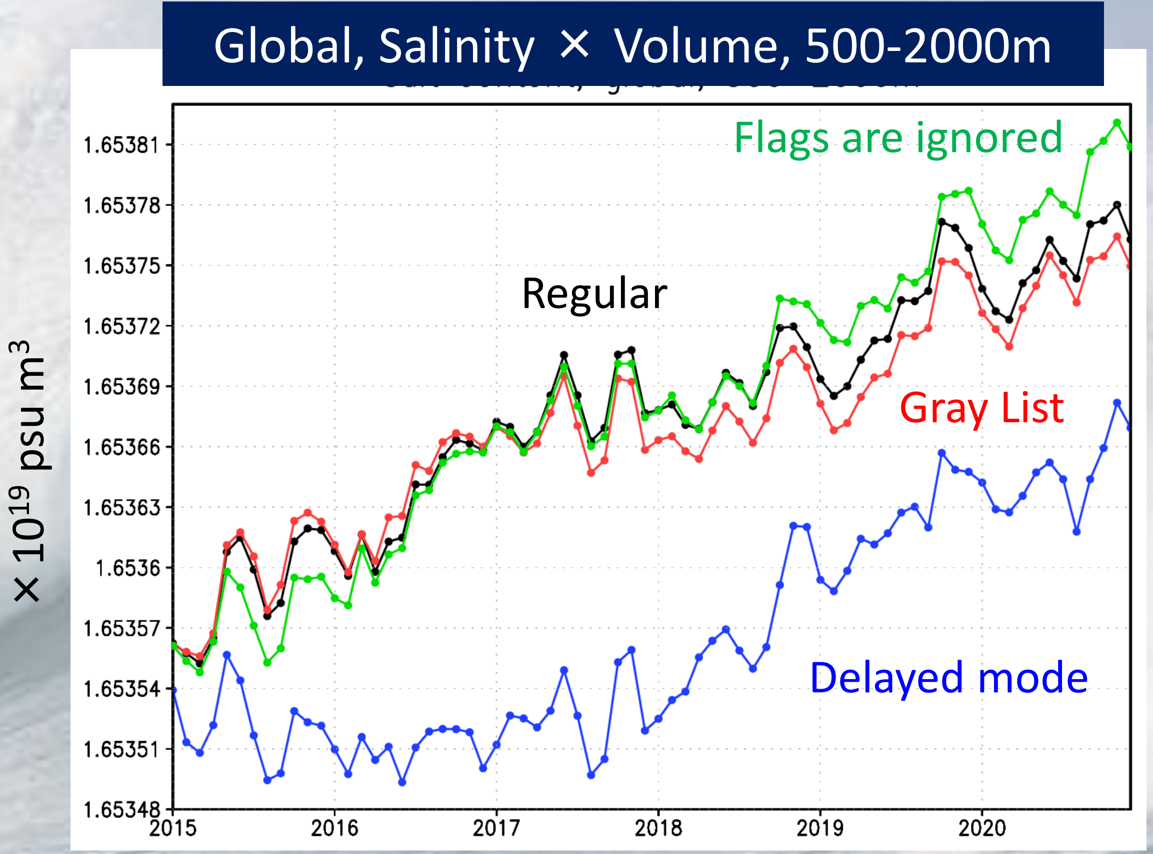
- ✓ We use the data on GTS reported less than 3 days after they observed.
- ✓ The ratio of profiles rejected due to the bad flags (green) are around 40% before the summer of 2019. The ratio is much reduced to less than 10% after that.
- ✓ The ratio of profiles rejected by the gray list (blue) is about 10%.
- ✓ The number of profiles are reduced about 30% (black) when the delayed-mode profiles are added and duplicated real-time data are removed (some profiles are reported several times?).



- ✓ About 70% of profiles have the delayed mode data (red) until 2018. The ratio gradually decreases after that.

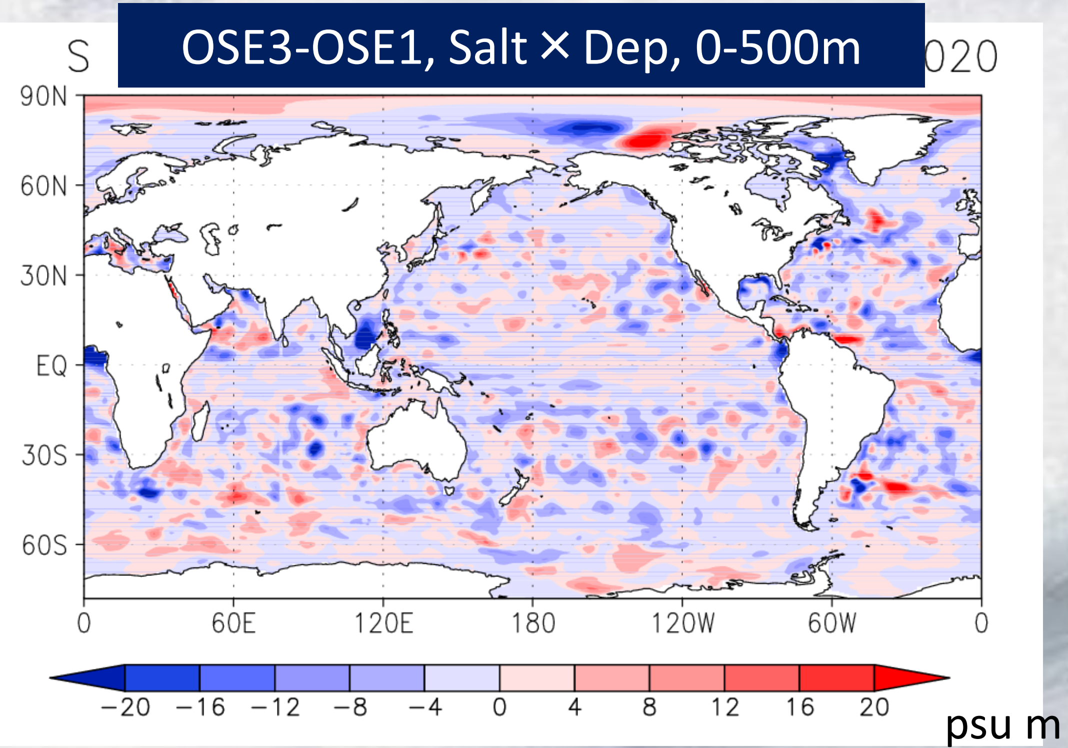
★ Impacts on the global salinity contents

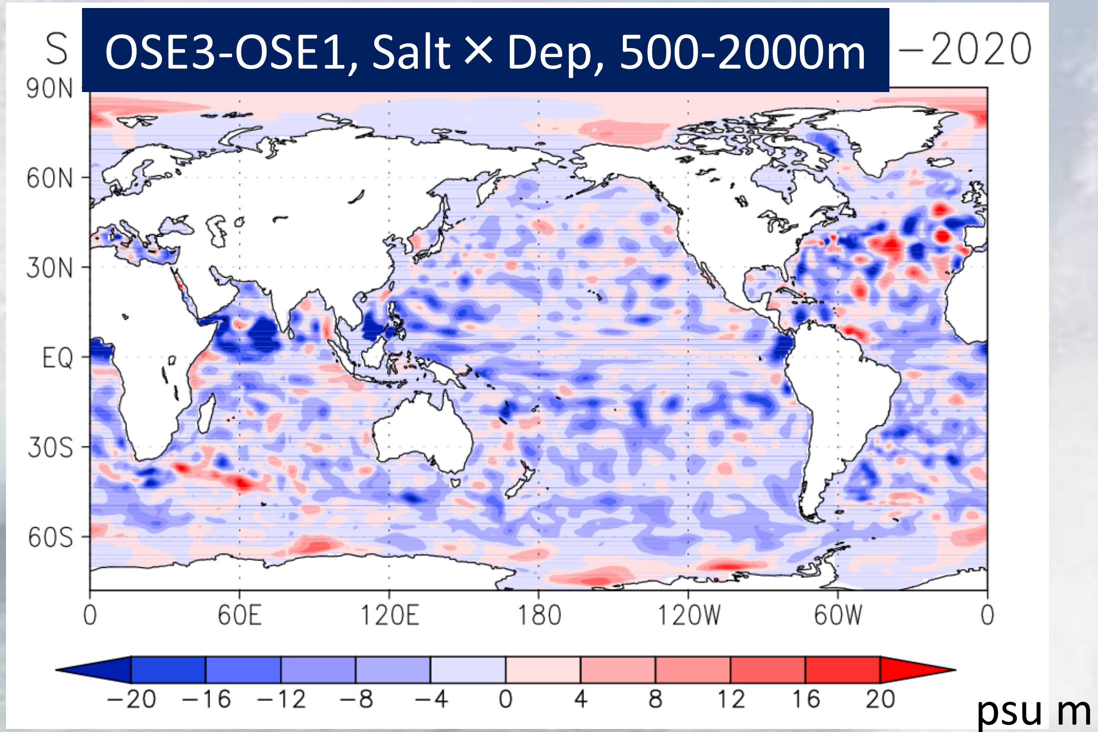




- Using Delayed-mode data tends to reduce the global salt content.
- Both Considering flags and applying the gray list also reduce the salt content after 2017, although they are not likely to remove the influence of the salinity drift completely.
- It has a increasing trend (as in the ECMWF result), especially in 500-2000 m after 2018.

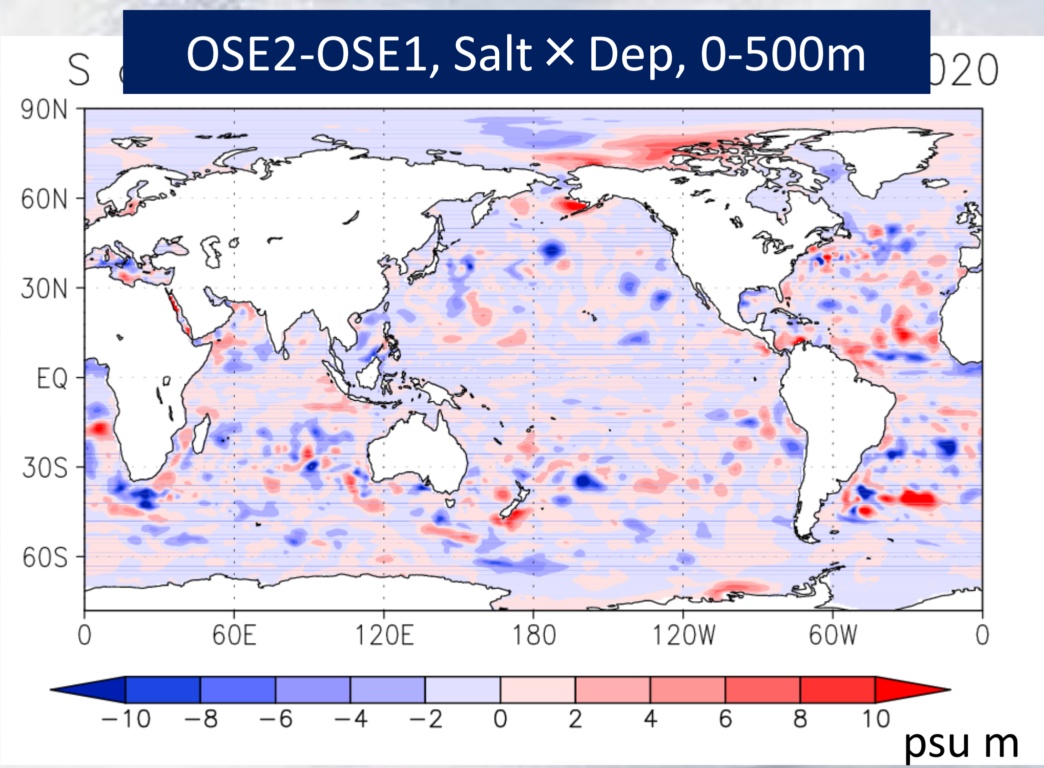
★ Salt content difference between OSE3 and OSE1 (2019-2020)

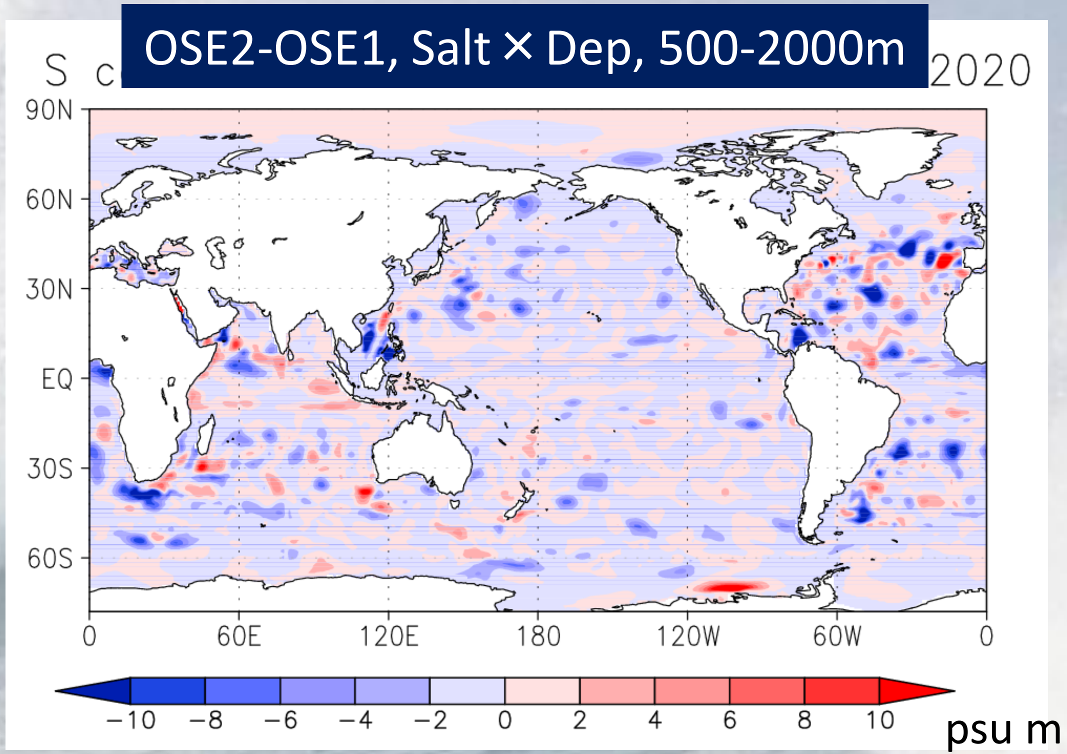




- The salt content decreases in the 500-2000-m layer in almost the entire ocean area by using delayed-mode data in OSE 3.
- The difference is equivalent to ~0.03 salinity anomaly.
- There is no specific area where the decrease of the salt content is especially large.

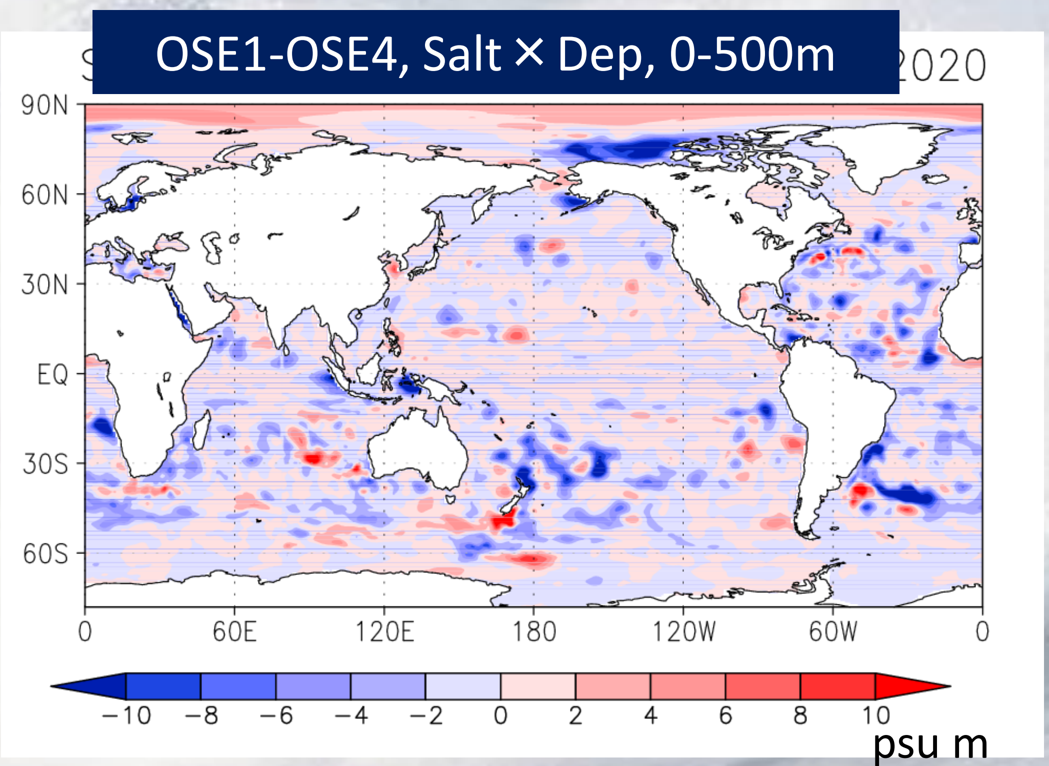
★ Salt content difference between OSE2 and OSE1 (2019-2020)

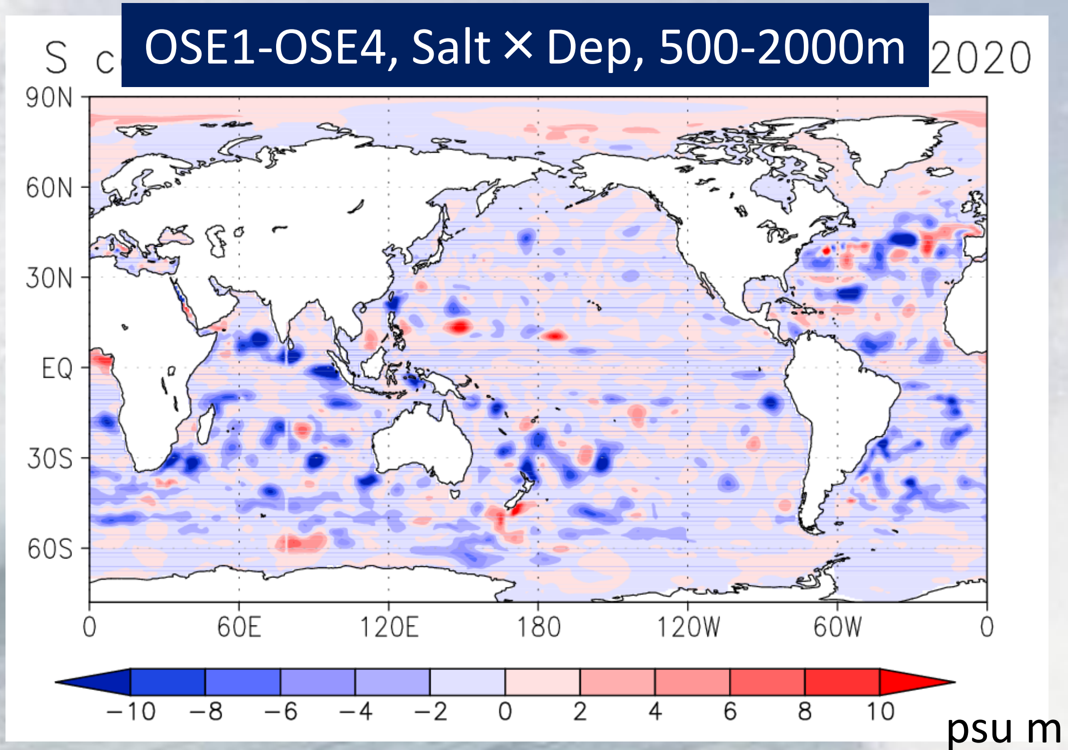




- Applying the gray list (OSE 2) reduces the salt content in the 500-2000-m layer, as in OSE 3 in which delayed-mode data are assimilated. But the decrease is smaller.
- The smaller decrease indicates applying the gray list is not enough to remove the influence of the fast salinity bias completely.

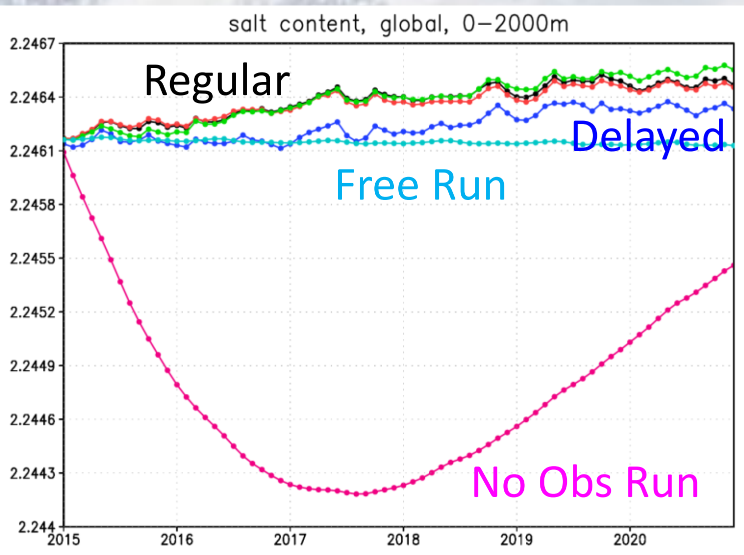
★ Salt Content difference between OSE4 and OSE1 (2019-2020)





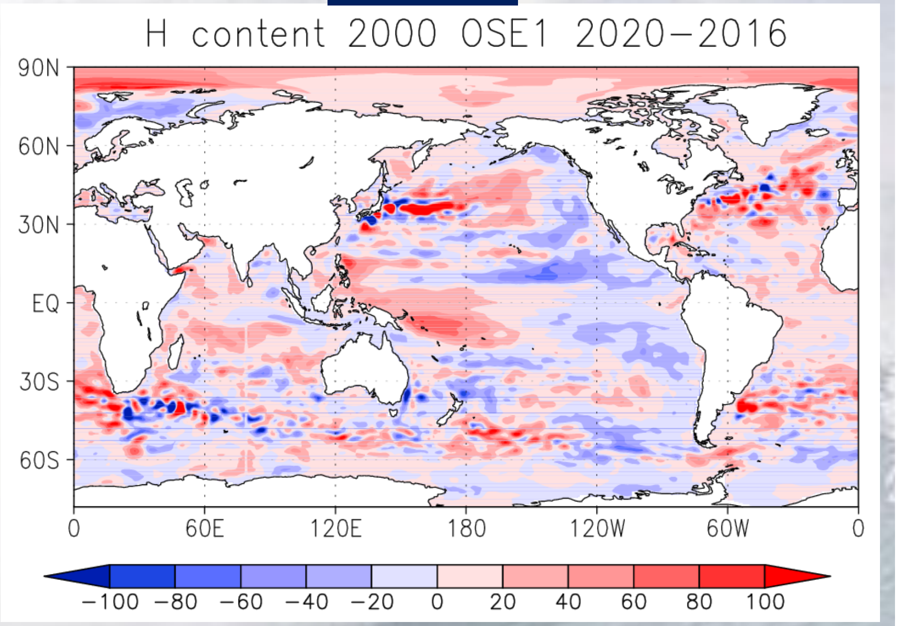
- Applying the Argo error flags (OSE 4) also reduces the salt content in the 500-2000-m layer.
- The decrease is a little large compared with the decreasing by applying the gray list.

★ On the increasing trend of the salt content

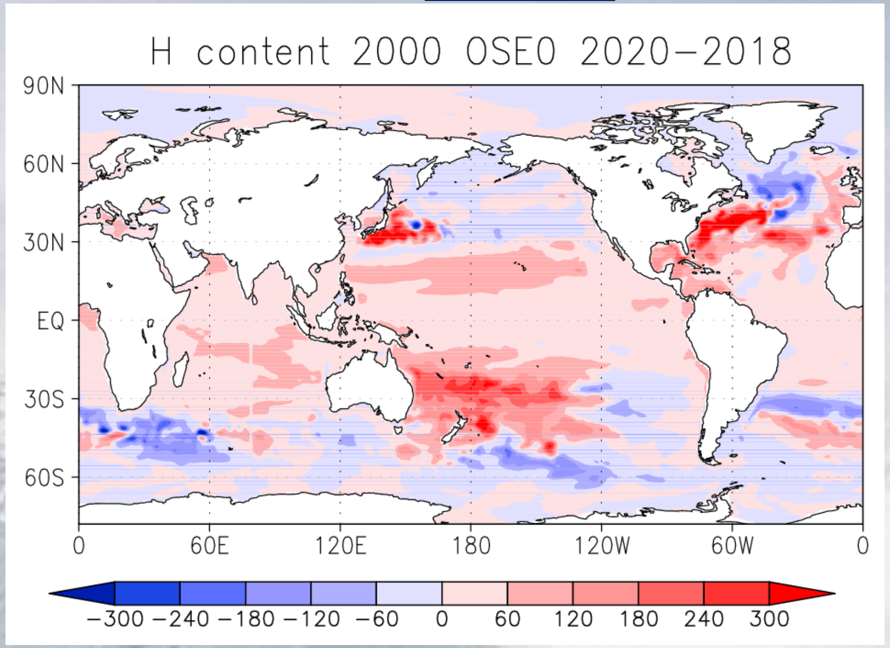


(Salinity × Volume)

Regular



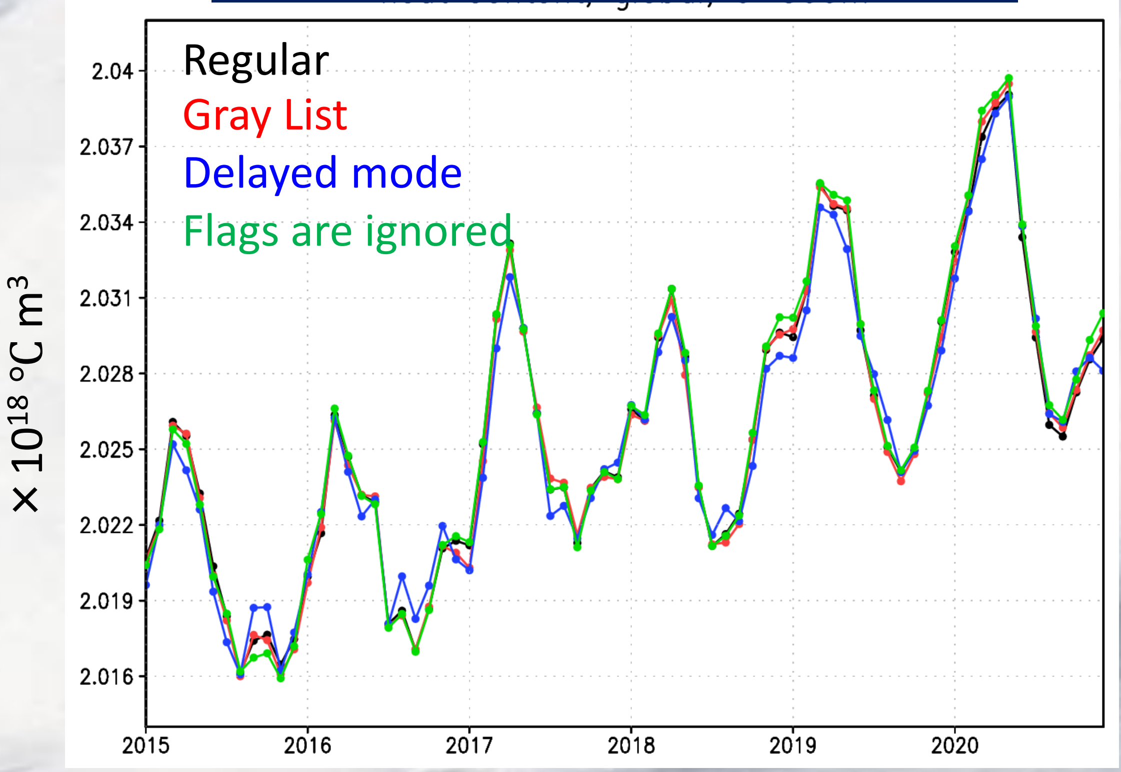
No Obs



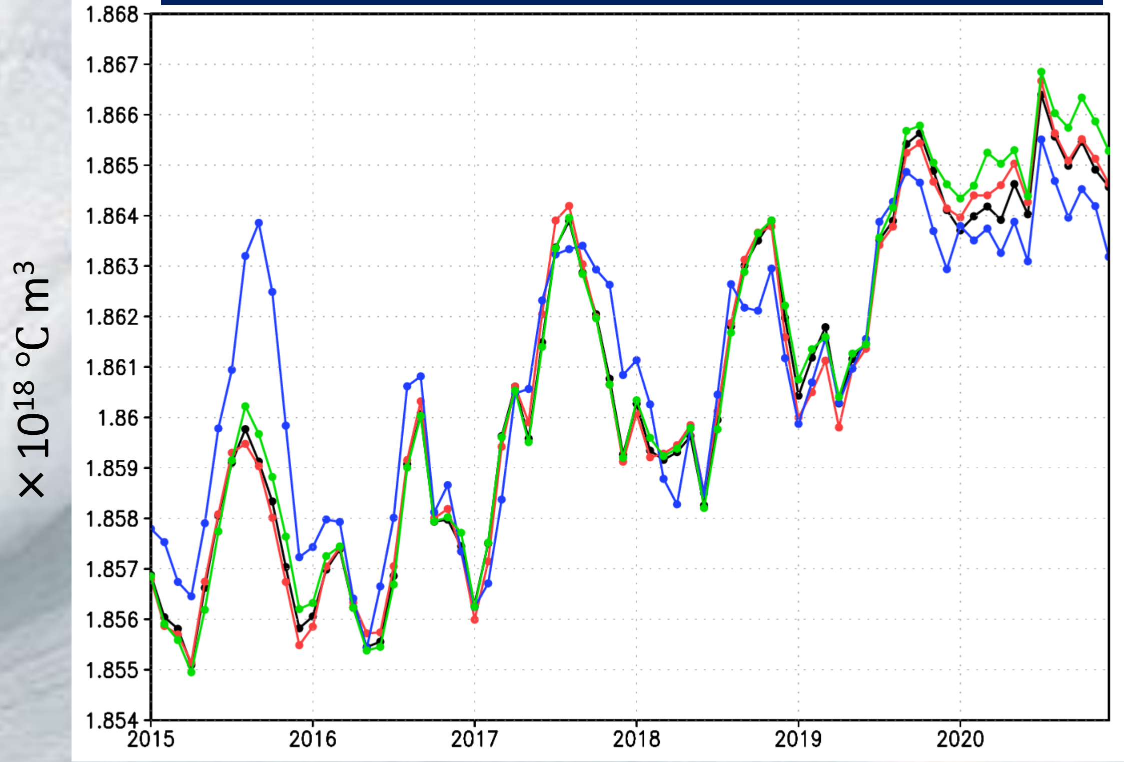
- In the real world, there should be no effective salinity source.
- The trend is noy found in the free run (OSE 10), but found in the No-Obs run (OSE 0), in which no observation data are directly assimilated but the weak climatological nudging and bias correction are applied after a three-year adjustment is finished(?).
- A increasing trend is notable in the whole Atlantic and Indian Ocean in the regular run (OSE 1), and this trend is common with the No-Obs run (OSE 0).

★ Impacts on the heat content

Global, Temp. × Volume, 0-500m

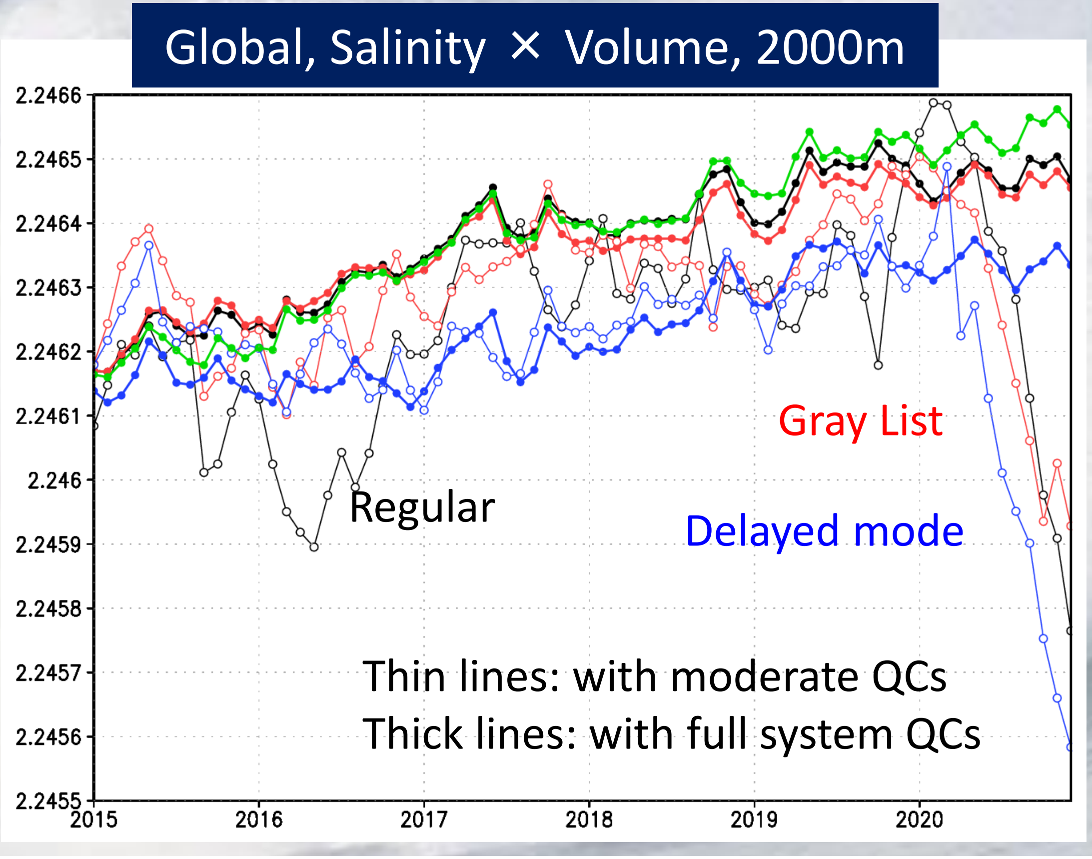


Global, Temp. × Volume, 500-2000m



- ➢ The impact of the fast salinity drift is mostly negligible in comparison with the seasonal variation and the trend of the heat content.
- ➢ Impact by replacing the real-time data to the delayed-mode one is relatively large in the 500-2000-m layer.

★ Salt trend changes with the moderate QC procedure



- ➢ The salt content decreases in all the cases. The decrease is rather large when the Argo flags are ignored.
- ➢ High frequency variations becomes larger with the moderate QC.
- ➢ Salt content is rapidly reduced in 2020 with the moderate QC.
- ➢ The system QC procedure reduces the inconsistent changes of the global salt content.

4. Summary

★ Summary

- Replacing the real-time Argo data by the delayed-mode data decreases salt content especially in 500-2000-m layer in the entire global ocean by ~0.03 psu.
- Appling the gray list and using the Argo flags have a similar effect but they do not remove the influence of the fast salinity drift completely.
- QC activities by the Argo data providers are essential for analyzing accurate salinity fields even if DA systems have their own QC procedures.
- The impact on the heat content is almost negligible compared with its seasonal variation and the increasing trend.
- The system QC procedures effectively reduce inconsistent changes of salt content.
- The regular run has a increasing trend of the global salt content. The trend does not exist in the free run, but is reproduced in the run in which observations are not assimilated but weak climatology nudging and bias correction are applied.

- We plan to compare the OSE results among participating systems.
- If you can participate the collaborative OSEs, please inform to Yosuke Fujii.

End of the Presentation

★ ➢ Communications

◆ Table on the use of observations in OceanPredict System

- ➢ Updated every three months. (Next update is April?)

  Use following address for the edit!

  https://docs.google.com/spreadsheets/d/17pztRAwDztIoyNn5gJbNFt5Ln6nq9F75kPlxAkQUvMQ/edit#gid=2043505062

◆ Next Meeting

- ➢ In March?
- ➢ Presentation on the Southern Ocean Observing System (SOOS)
- ➢ SynObs implementation plan?