06/10/2021
JAMSTEC RIGC GOORC GOERG

Release of the recalculated MOAA GPV

1. Background

According to a manufacturing problem that occurred a few years ago, high salinity drift of the Sea Bird Scientific CTD sensor, whose S/Ns are within 6000-7000 and within 8100-9200, occurs more frequently than usual (see Argo Program Office homepage; https://argo.ucsd.edu/argo-salty-drift-salinity-data-issue-notice-2021/). Many floats equipped with CTD sensors in the above serial number range are in operation, and as a result, there is a salty bias error exceeding the target salinity accuracy of 0.01 in the real-time data. It is estimated that about 25% of real-time profile data can be affected by this bias.

Recently, it became clear that this salty bias affected Argo products that mainly used Argo profile data in real-time mode (Barnoud et al. (2021)). Since MOAA GPV emphasizes immediacy and mainly uses Argo profile data in Real-time mode, MOAA GPV is recalculated using the Argo profile data in the latest quality control stage.

2. The target period of recalculation

From January 2015 to December 2020

3. Argo profile data used for recalculation

We downloaded the Core Argo profiles from 2015 to 2018 from Global Data Assembly Center (hereafter, GDAC) on 10th March 2021 and those from 2019 to 2020 from GDAC on 16th July 2021. We used the profiles of which pressure, temperature, and salinity QC flags are all 1, i.e., good data, and which satisfy the condition in Table 2 of the document "MOAA GPV quick instruction ver. March 28th 2017". The number of profiles from 10 to 1000dbar is about the same, and the number of profiles decreases as the depth increases (Figure 1). This is because the profile depth of the Argo floats are not uniformly 2000dbar. In addition, the number of profiles for recalculation is larger than those before recalculation, and it has increased especially from around 2017. In 2018, the number of profiles for recalculation increased by more than 5000 profiles at 10 to 1000dbar and about 4000 profiles at 2000dbar. This is due to the correction of the bug in the profile data input part of the program.

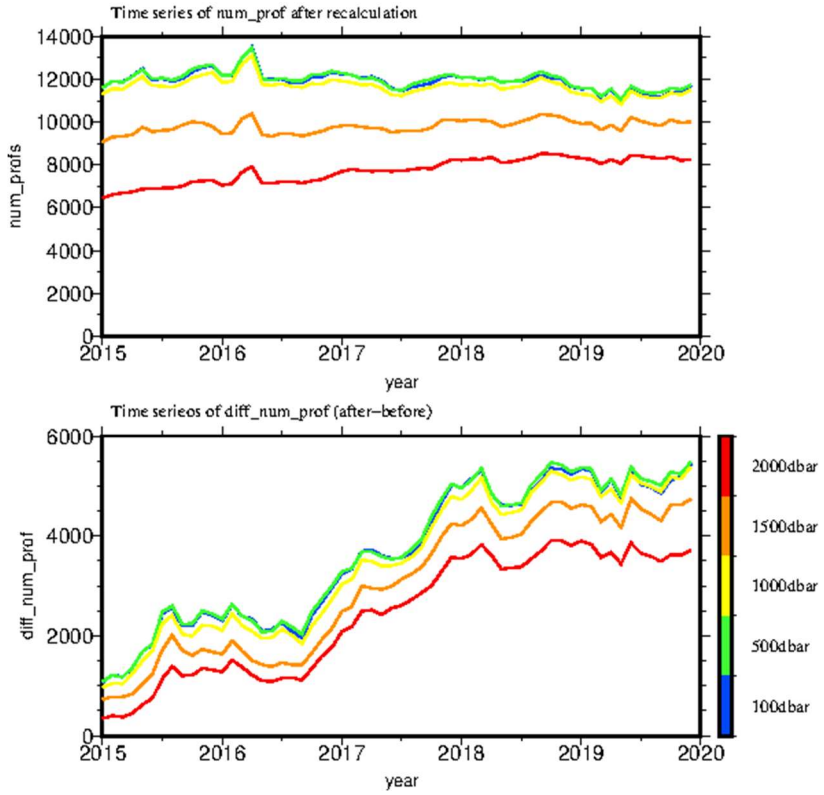

Figure 1. (Upper) the number of profiles by depth used for MOAA GPV recalculation for each month. (Lower) the deviation of the number of profiles used for recalculation from those for previous version of MOAA GPV. Colors indicate the depth of MOAA GPV.

Regarding the Argo quality control procedure, Core Argo profile data is classified into three modes according to the stage of quality control as follows: Real-time mode, Adjusted mode, and Delayed mode. We used the pressure, temperature and salinity values with the highest quality control stage in each profile for recalculation. Figure 2 shows the percentages of the quality control mode of Argo profile data of each month for the recalculation. Although MOAA GPV had hardly included Delayed mode profile, Delayed mode profiles accounted for about 70% from 2015 to the middle of 2018 for recalculation.

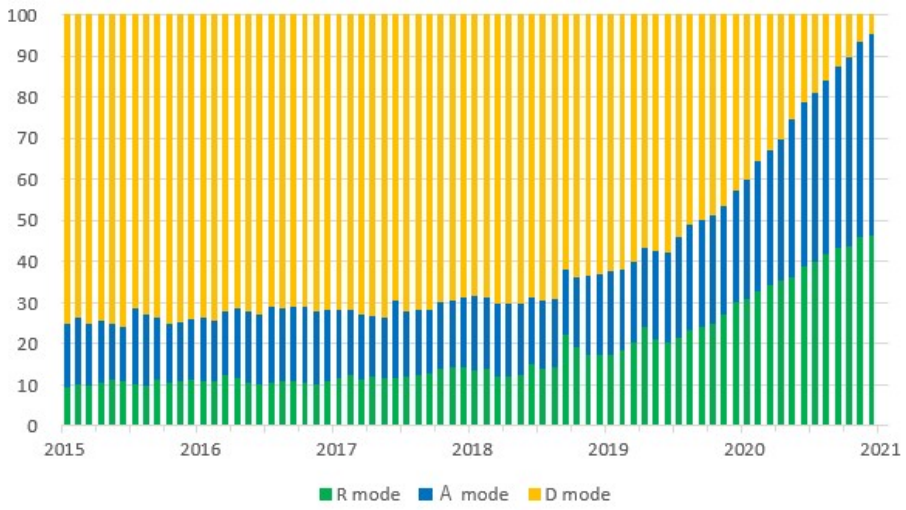

Figure 2. Time series of the ratio of Argo profile quality control mode for recalculation

4. Comparison the recalculation result with pre-recalculation one

As described above, the dataset before recalculation is the result with the bug in the profile data input part. On the other hand, we recalculated MOAA GPV after fixing the bug. Therefore, it is noted that the recalculation result includes not only the effect of the use of corrected salinity but also effect of bug correction.

We checked the temporal change of the difference between before and after recalculation. Salinity of recalculation in deeper than 1000 dbar is lower than that of pre-recalculation, the difference is about 0.001 to 0.002 for the whole period. Salinity of recalculation in the layer shallower than 1000dbar is also lower than that of pre-recalculation about the same, although its variation is larger than that deeper below 1000 dbar. However, since the standard deviation of the global mean of salinity difference is large in the all layers, the salinity difference is considered to vary considerably from place to place. On the other hand, temperature shallower than 400 dbar has increased since 2016, indicating that temperature has increased globally. This is caused by the bug fix in the profile data input part of the program.

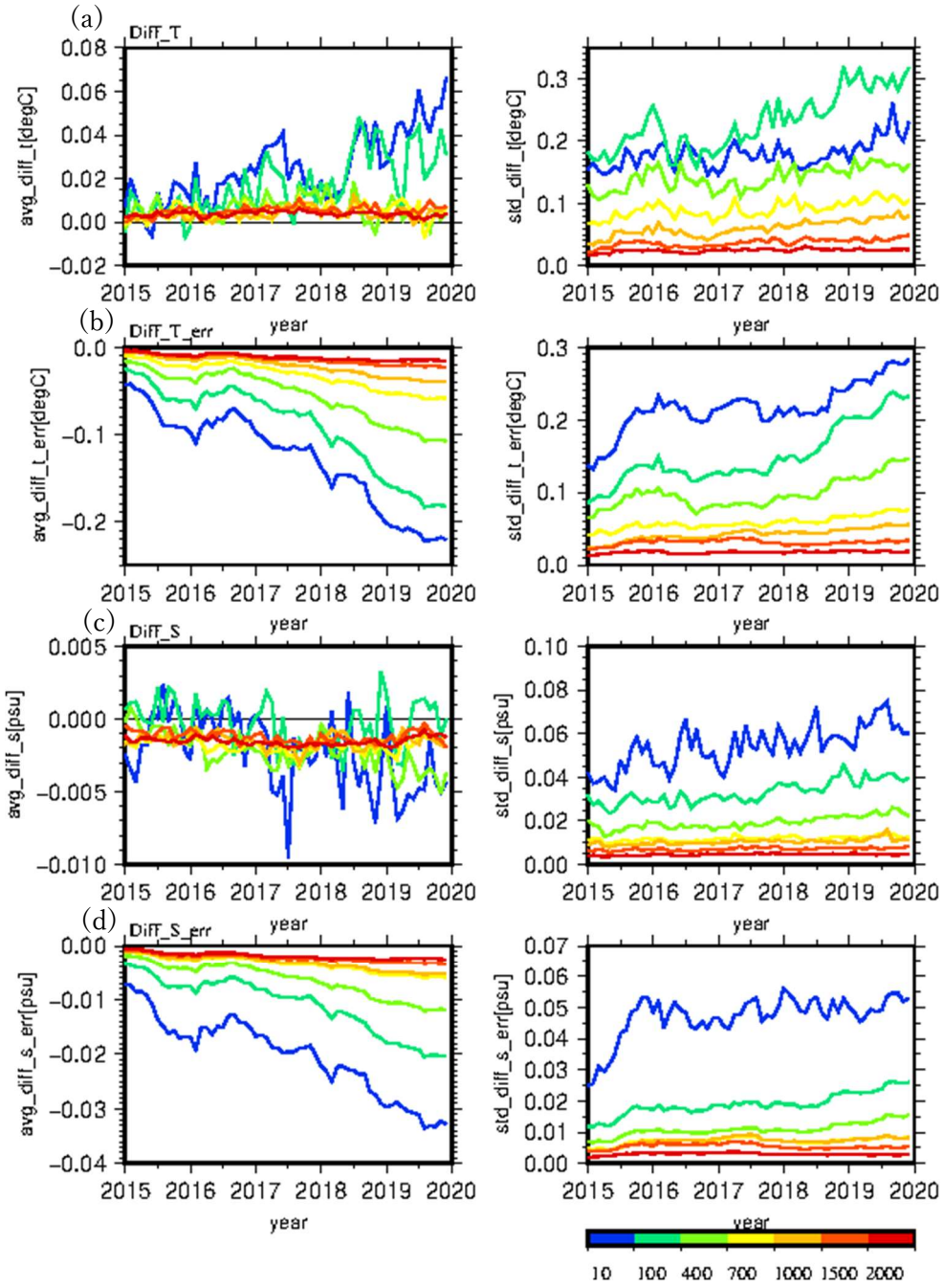

Figure 3. Time series of global mean (left) and standard deviation (right) of the difference of temperature (a), temperature estimation error (b), salinity (c), and salinity estimation error (d) between recalculation and pre-recalculation. Colors mean the depth of MOAA GPV.

Figure 4 shows the distribution of salinity difference before and after recalculation at some pressure levels in June 2016, when the difference of the number of profiles between recalculation and previous version is relatively small. Figure 4 is considered to

show the effect of using corrected salinity.

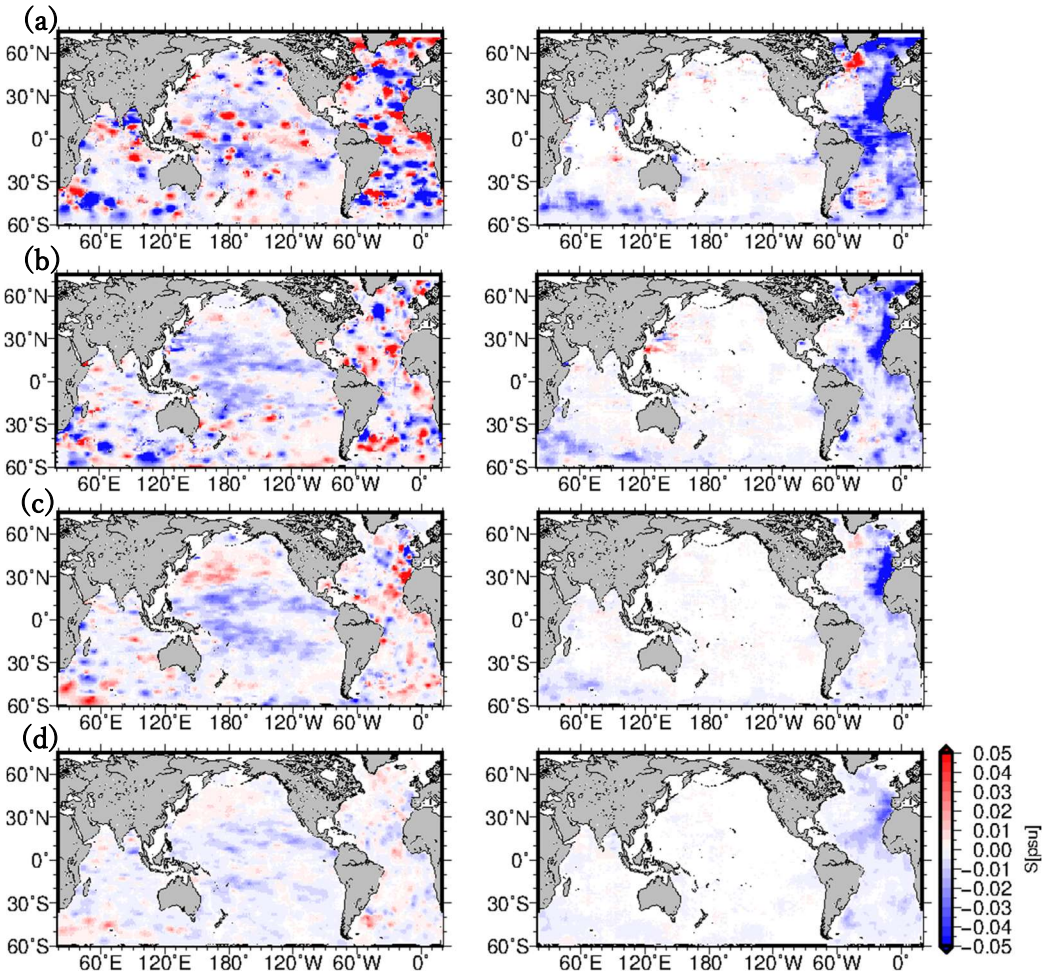

Figure 4. The map of deviation of salinity (left) and salinity estimation error (right) of recalculation from pre-recalculation at 100dbar (a), 400dbar (b), 1000dbar(c), and 2000dbar(d) in June 2016.

Salinity of recalculation is lower than 0.01 in the tropical and subtropical Pacific Ocean below 400dbar, while it is higher than 0.01 in the subarctic region of the North Pacific. Those salinity changes suggest the influence of the salinity drift correction. Also, the salinity estimation error has been reduced by recalculation, which is the results of increase of Argo profile data due to the effect of fixing bugs.

Figure 5 shows the maps of salinity and salinity estimation error, which is the same as Figure 4, except in June 2019 when there is a large difference in the number of profiles before and after recalculation. It is considered that this includes the effect of fixing bugs in addition to the effect of using the corrected salinity.

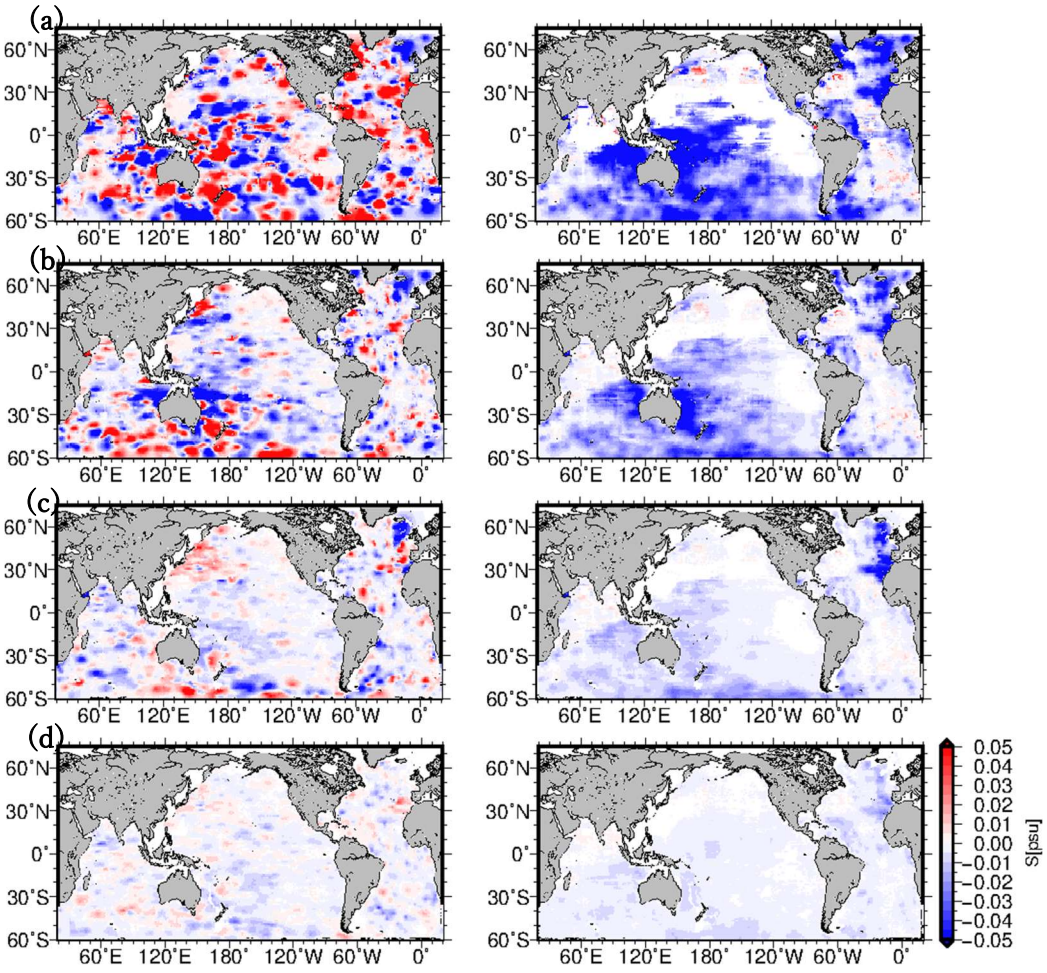

Figure 5. Same as Figure4, but in June 2019.

In June 2019, the reginal characteristics of deviations as seen in June 2016 are small, and positive and negative values are patchy distributed. Moreover, the salinity estimation errors have reduced in the South Pacific and the Indian Ocean as well as the North Atlantic Ocean.

5. Format of dataset

（1）Format

There is no change of format and variable names in data files (see the MOAA GPV manual).

（2）Notes

The target period of the recalculation id as described above, before 2015, it is not subject to this recalculation. The recalculation history of the dataset before 2015 is as follows.

【Previous recalculation data】

June 25th, 2015
【The target period of the previous recalculation】
From January 2001 to December 2014

6. Future plan

The dataset will be released in the following two types.

Table 1. the type of MOAA GPV

Type	Contents	Creation frequency	Update frequency
Near-Real-Time (NRT)	Created using Argo profile data for one month two months before the creation date.	monthly	None
Delayed-Mode (DM)	Recalculated using the Argo profile data in the latest quality control stage.	Once a year	Once a year

The NRT type emphasizes immediacy and is only open for the last year. The DM type is the recalculation data set using the Argo profile data in the latest quality control stage for the entire period. As shown in Fig. 2, about 70% of the profiles are delayed mode before about 3 years from now. Therefore, the DM type of MOAA GPV is better data set using the Argo profile.

【Reference】

Barnoud, A., Pfeffer, J., Guerou, A., Frery, M.-L., Simeon, M., Cazenave,A., et al. (2021), Contributions of altimetry and Argo to non-closure of the global mean sea level budget since 2016. *Geophysical Research Letters*, *48*, e2021GL092824. https://doi.org/10.1029/2021GL092824

Hosoda, S., Ohira, T., and Nakamura, T. (2008), A monthly mean dataset of global oceanic temperature and salinity derived from Argo float observations. *JAMSTEC Rep. Res. Dev.*, 8, 47-59.

【Appendix】The distribution of temperature difference before and after recalculation

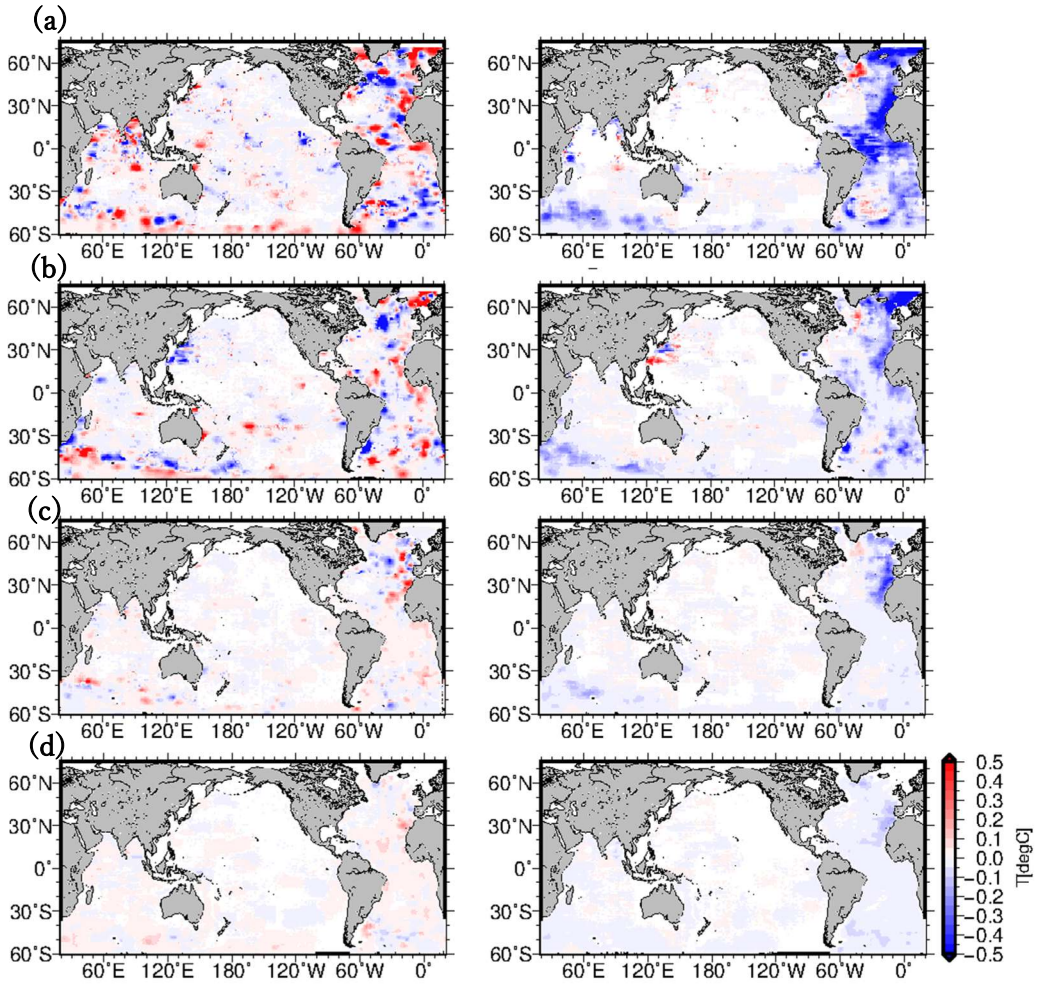

Figure 6. The map of deviation of temperature (left) and temperature estimation error (right) of recalculation from pre-recalculation at 100dbar (a), 400dbar (b), 1000dbar(c), and 2000dbar(d) in June 2016.

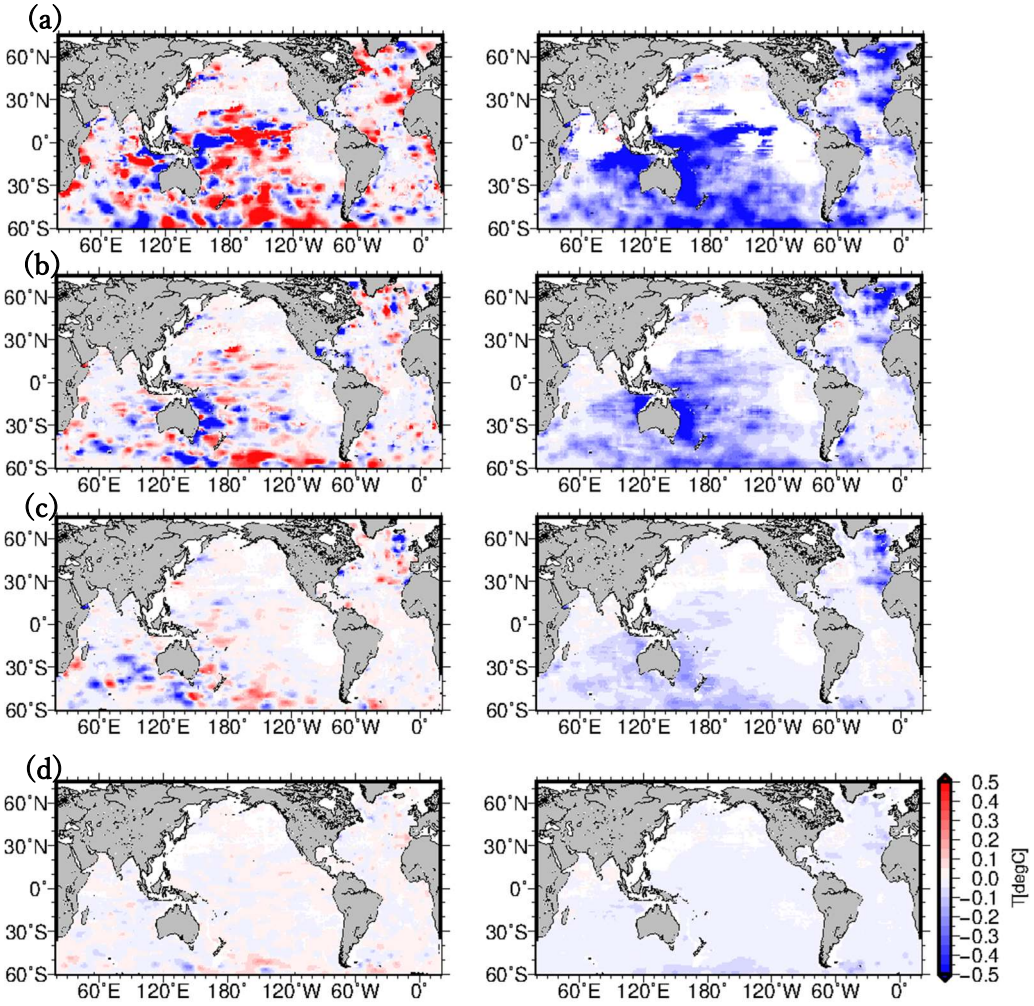

Figure 7. Same as Figure 6, but in June 2019.