We really appreciate the anonymous referee #1 for your very positive and constructive comments. Almost all suggestions were accepted and the manuscript has revised as below.
RC = Referee's comments; AR = Authors' Response (written in blue); RS=reconstructed sentences (written in green)

First of all we changed the manuscript title from "Influence of timing of sea ice retreat on phytoplankton size during marginal ice zone bloom period **in** the Chukchi and Bering shelves" to "Influence of timing of sea ice retreat on phytoplankton size during marginal ice zone bloom period **on** the Chukchi and Bering shelves".

RC1: Page 12613, Line 1-4: This sentence needs to be revised. How TSR plays crucial roles under seasonally ice-covered environments? You clearly have to mention one of expectable reasons. For example, TSR plays crucial roles in controlling distribution of phytoplankton community size structure in the seasonally ice-covered marine ecosystem (or) in affecting food-web structure (You mentioned that TSR is crucial to understand to evaluate bottom-up effects of PP on the food web: in line 13-15, page 12616).
AR: Thank you for pointing it out. I reconstructed the first two sentences as below adding a sentence.
RS: The size structure and biomass of a phytoplankton community during the spring bloom period can affect the energy use of higher-trophic-level organisms through the predator-prey body size relationships. The timing of the sea ice retreat (TSR) also plays crucial roles in seasonally ice-covered marine ecosystem, because it is tightly coupled with the timing of the spring bloom. Thus, it is important to monitor the temporal and spatial distributions of a phytoplankton community size structure.

RC2: Page 12615-12616, Line 29-Line 1-2: Change "ecosystem changes" to "phytoplankton community changes". Application of these regional ocean color algorithms is expected to contribute to comprehension of phytoplankton community changes (not ecosystem changes) in Arctic ecosystems.
AR: Thank you for pointing out. I revised the sentence as below.
RS: The application of these regional ocean colour algorithms to long-time-series satellite data is expected to contribute to our comprehension of phytoplankton community changes.

RC3: Page 12617, Line 19-20: I agree that the development of thermal stratification is an important controlling factor of nutrient supply into the upper layer. In the section 4.3, you supposed that the nutrient conditions in the surface are mainly related to the thermal stratification. However, the local wind filed could be important for affecting the nutrient vertical distribution as well as horizontal distribution in the Bering and Chukchi Sea.

AR: Thank you for the very valuable comment. I agree with you that local wind is important to determine nutrient conditions as several studies have already reported. I wish I could analyze wind data in this study, too. But unfortunately there is no time to obtain and analyze 16-year time series wind dataset. However, I added several sentences to the top of last paragraph of discussion 4.3 to describe about the importance of taking into account of local wind field for spring bloom as below.

RS: There are several studies that referred to the importance of the local wind field to determine nutrient conditions and chla concentration near the ice edge instead of TSR. For example, Niebauer et al. (1995) showed the effect of the wind velocity on the initiation and duration of the ice-edge bloom in the southern Bering shelf. Arrigo et al. (2014) also reported the wind direction in the northern Chukchi shelf has large impact on the upwelling of nutrients from shelf break. Although inter-annual variability of such wind field can also affect the phytoplankton community size structure during the MIZ bloom period in the local scale, our spatial statistical analysis revealed a general trend of the bloom time F_L toward TSR. It has been reported that the sea ice retreat timing can alter the seasonal succession of phytoplankton in Svalbard (Leu et al., 2011) and the northern Chukchi Sea (Fujiwara et al., 2014). Our results also suggest that the phytoplankton community size composition can change with the timing of the sea ice retreat in the shelf region of the Bering and Chukchi Seas during the MIZ bloom. These results provide important information to help understand the efficiency of energy transfer for organisms that depend on the MIZ blooms as a food source. However, it should be noted that the relationships between the TSR and phytoplankton size might not be applicable to the entire Arctic, because our region of focus is characterized by a shallow bathymetry, sea ice retreat near the summer solstice (Fig. 4a), and the dominance of thin first-year ice. These unique environmental characteristics can tightly couple the phytoplankton bloom and sea ice dynamics.

RC4: Page 12622, Line 6-7: How did you measure in situ primary production? Using 13C or 14C? You have to mention the used method at the end of the sentence.

AR: I should provide the information about primary productivity measurement. We measured PP using 13C method. The sentence was reconstructed as below with an additional citation.

RS: PP was measured using the stable ^{13}C isotope method (Hama et al., 1983) for several optical depths, and then PP_{eu} was calculated by integrating the PP values from the surface to Z_{eu} (see Hirawake et al., 2012 for more details of the sampling and analysis).

RC5: Page 12622, Line 18-20: Based on relationships between in situ FL and satellite FL, you found a slight overestimation in the low FL and underestimation in the high FL range. Could you explain the reason for it?

AR: Thank you very much for pointing out such an important point. I tried to explain why the slope differed from 1:1 line, and I concluded that it is because of underestimation of Rrs from MODIS. Fortunately, we were able to obtain the 13 match-ups between in situ and MODIS-measured Rrs during the cruise of 2013. Figure R1b (same as Figure 2b in revised manuscript) indicates the relationship between in situ and MODIS-Rrs. Although there are linear relationships between the Rrs, we found that MODIS underestimated Rrs for every band I compared (412, 443, 469, 488, 555 and 667 nm). The slopes and intercepts between them are listed in Table R1 (same as Table 2 in revised manuscript). Using these relationships, we converted in situ Rrs to MODIS-Rrs using the dataset used in appendix B. Then, we compared the FL derived from original in situ Rrs and in situ Rrs converted to MODIS-Rrs (Figure R2b and Fig. 3b of revised manuscript). F_L calculated from MODIS-converted Rrs also showed significant underestimation compared to F_L calculated from in situ Rrs (the slopes ranged from ~0.33 to ~0.46), which is very similar to middle to high range of F_L of Figure R2a. Although we understand that the number of dataset is not enough to illustrate the characteristic of MODIS-Rrs and the relationship may vary with seasons and regions, such underestimation of Rrs significantly caused the underestimation of F_L via the calculation steps (i.e. QAA and SDM), at least during summer of 2013. The description about this point has added to result 3.1 as follows.

RS: The accuracy of the SDM-derived F_L was evaluated by comparing the F_L values from the in situ measurements and daily matched MODIS level-2 dataset. Twenty-five data points were available for this examination, which were collected over a wide area of the Bering and Chukchi Seas during different seasons (Fig. 1). Fig. 2a compares the satellite-derived F_L and in situ F_L. The SDM successfully retrieved the F_L values for 17 of the 25 data points (68% of the data) within a ±20 % F_L range (Fig. 2a). The RMSE was 25%. The satellite validation was very similar to the results of Fujiwara et al. (2011), who showed that the F_L derived using the in situ measured $R_{rs}(\lambda)$ had a 69% accuracy and an RMSE of 22.7%. However, it should be taken into account that there was a slight overestimation in the low F_L range and relatively large underestimation in the high F_L range (slope = 0.48 and intercept = 0.18). We also evaluated the performance of $R_{rs}(\lambda)$ retrieval of MODIS comparing with in situ-measured $R_{rs}(\lambda)$ at 13 data points during the GRENE cruise of 2013. Fig. 2b shows the comparison of in situ- and satellite-derived $R_{rs}(\lambda)$, and we found that the MODIS significantly underestimates $R_{rs}(\lambda)$ at every wavelength (the slopes ranged from to ~0.34 to ~0.46). The slopes and intercepts between the two $R_{rs}(\lambda)$ are listed in Table 2, which was used as the factors to convert in situ $R_{rs}(\lambda)$ to MODIS-$R_{rs}(\lambda)$. The conversion factors were applied to the $R_{rs}(\lambda)$ dataset used in appendix B, and then, we compared the SDM performance between in situ $R_{rs}(\lambda)$ and $R_{rs}(\lambda)$ converted to MODIS-$R_{rs}(\lambda)$ to assess how the retrieval errors in the MODIS-$R_{rs}(\lambda)$ affect estimation accuracy of the F_L. The relationship between the two derived F_L is shown in Fig. 2c, and we found similar relationship with Fig. 2a. It can be said that the underestimations of $R_{rs}(\lambda)$ significantly caused the underestimation of F_L especially in the middle to high range of F_L. Although we conducted the optimization of the QAA to derive more accurate input parameters of the SDM (appendix B), retrieval error in the $R_{rs}(\lambda)$ significantly affected the SDM accuracy in the study region. Nevertheless, the high determination coefficient indicated that the correlation was sufficient to address the spatio- and temporal variability of F_L. Here, we conclude that the SDM is applicable to satellite remote sensing in the Bering and Chukchi Seas, and is effectively optimized for what is known as optically complex water (Matsuoka et al. 2007, Naik et al. 2013).

RC6: Page 12624, Line 17: How did you determine the open water period? Is this meant SIC reach zero? Define the open water period in the materials and methods section.

AR: I should provide the information. I defined the period as the number of day of SIC < 10%. The sentence was added describing the definition as below in materials and methods section.

RS: The length of the open-water period for each pixel was defined as the number of days where the SIC was less than 10%.

RC7: Page 12626, Line 19-25: You found that the timing of the MIZ bloom occurrence was not tightly coupled with the TSR in the western side of the Bering Strait and coastal Alaska. Plausible reasons (nutrient conditions or CDOM effects) are suggested for explaining it.

However, the coastal Alaska is the region affecting by nutrient-poor Alaska Coastal Waters not nutrient-rich Anadyr Water.

AR: Thank you for the comment. I should explain separately about Bering Strait and coastal Alaskan area. The related sentences were reconstructed as below.

RS: However, our results also indicated that the CMAX date is delayed in the Bering Strait and along the coast of Alaska (Fig. 4c). This suggests that the timing of the annual maximum phytoplankton biomass does not fully depend on the sea ice retreat timing and the subsequent nutrient conditions in these areas. In the Bering Strait, the CMAX delay would be because the large nutrient supply continues even in summer as a result of the inflow of nutrient-rich Anadyr Water (Springer and McRoy, 1993, Springer et al., 1996). On the other hand, in coastal Alaska, optical contamination of the CDOM during the chla retrieval can also affect the CMAX values, especially in the area where the Alaskan Coastal Water (ACW) flows. Matsuoka et al. (2011) suggested that the ACW contributes to the high value of CDOM absorption ($a_y(\lambda)$), which can cause an overestimation of satellite chla values, because the CDOM absorbs light at some of the same wavelengths as chla (Matsuoka et al., 2007; Naik et al., 2013).

RC8: Page 12629, Line 5: Change "phytoplankton cell size composition" to "phytoplankton community size composition"

AR: Thank you for pointing out. I revised the sentence as below.

RS: Our results also suggest that the phytoplankton community size composition can change with the timing of the sea ice retreat in the shelf region of the Bering and Chukchi Seas during the MIZ bloom.

RC9: Page 12629, Line 7-9: Could be different food quality depending on phytoplankton size composition? If so, you have to mention reference. For example, since the food quality as food source could be related to phytoplankton size composition (reference), these results provide important information to help understand food quality. I think that the changes in phytoplankton species composition might be related to food quality change.

AR: Thank you for pointing out. It was wrong sentence. I would like to use "food quality" same as meaning of "efficiency of energy transfer".

RS: These results provide important information to help understand the efficiency of energy transfer for organisms that depend on the MIZ blooms as a food source.

Table R1. Slope and intercept between MODIS and in situ measured Rrs.

λ	412	443	488	555	667
Slope	0.36185	0.33849	0.34321	0.42559	0.46137
Intercept	0.00106	0.00154	0.00163	0.00048	0.00019
r^2	0.34	0.48	0.59	0.75	0.73
N	13	13	13	13	13

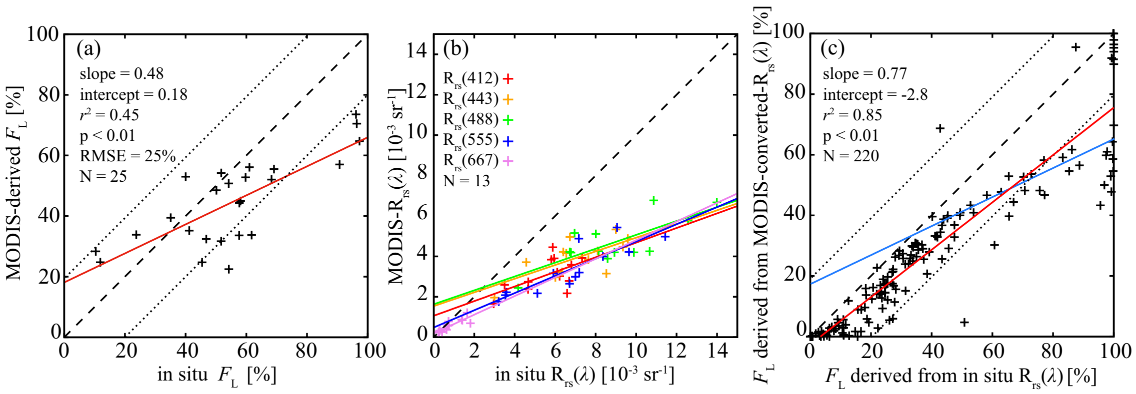

Figure R1. Scatter plots of (a) satellite-derived F_L vs. in situ observed surface F_L ($r^2 = 0.45$, $p < 0.01$, N = 25, RMSE = 25%), (b) satellite-derived $R_{rs}(\lambda)$ vs. in situ measured $R_{rs}(\lambda)$ (N = 13, slopes and intercepts for each λ are listed in Table R1), and (c) F_L derived from MODIS-converted-$R_{rs}(\lambda)$ vs. F_L derived from in situ $R_{rs}(\lambda)$ ($r^2 = 0.85$, $p < 0.01$, N = 220). Dashed lines are 1:1 lines, doted lines indicate ±20% from 1:1 (Fig. R1a and c), and coloured solid lines represent regression line, respectively. The regression line of Fig. R1a is also shown in Fig. R1c with the blue solid line for comparison.