

# 北海道沿岸域における海氷後退の時期の経年変動が植物プランクトンブルームに及ぼす影響

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## Influence of interannual variation in timing of sea ice retreat on phytoplankton bloom in the coastal water in the northeastern Hokkaido, the Okhotsk Sea

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Using a dataset of the oceanographic monitoring surveys at the observation station (the Okhotsk Tower; Figure 1), which were carried out by the City of Mombetsu, and sea ice concentration in the Okhotsk Sea, monitored by microwave sensor SSM/I on remote sensing satellite, influences of interannual variation in timing of sea ice retreat on initiation of phytoplankton bloom during late winter and early spring in the coastal water in the northeastern Hokkaido, the Okhotsk Sea, were analyzed. In the coastal water around the Okhotsk Tower, temperature and salinity in the surface layer showed a clear seasonality. In the climatology obtained from all data, the minimum ( $-1.36 \pm 0.30^\circ\text{C}$ ) and the maximum ( $19.82 \pm 1.56^\circ\text{C}$ ) of the temperature in the surface layer were observed in mid-February and late-August, respectively (Figure 2). Similarly, the minimum ( $31.60 \pm 0.42$ ) and the maximum ( $33.47 \pm 0.42$ ) of salinity in the surface layer were observed in early-January and mid-October, respectively. Chlorophyll *a* concentration at the sea surface increased climatologically in March, and reached to the maximum ( $3.1 \text{ mg m}^{-3}$ ) in April. After April, chlorophyll *a* concentration was kept in  $1\text{-}2 \text{ mg m}^{-3}$  until November. These trends in seasonal variations of the climatology observed around the Okhotsk Tower agreed generally with that observed in the coastal region in the southwestern Okhotsk Sea, suggesting that the oceanographic monitoring data in the Okhotsk Tower influenced the oceanographic conditions in coastal region along the northeastern Hokkaido, the Okhotsk Sea.

Seasonal change of sea ice concentration in the coastal water around Mombetsu, determined using microwave sensor, was varied interannually, the timing of sea ice retreat (defined as the date with decreased sea ice concentration  $<50\%$ ) varied with a range of 47 days between 2003-14. Since 2003, out of 10 years which monitoring was carried out during drifting sea ice stayed in shore, in nine years except 2010 chlorophyll *a* concentration at the sea surface increased to more than  $2 \text{ mg m}^{-3}$  until 16 days after sea ice retreat (Figure 3). These shows that sea ice retreat is the important factor to initiate phytoplankton bloom in the coastal water in the northeastern Hokkaido, the Okhotsk Sea.

北海道紋別市が観測施設（オホーツクタワー；Figure 1）で行っている沿岸域の海洋環境モニタリングデータ（1996-2014年）と、衛星搭載マイクロ波センサーSSM/Iで観測したオホーツク海の海氷密接度データを用いて、北海道オホーツク海沿岸域での海氷の後退時期の経年変動が晩冬～春季の植物プランクトンブルームの開始時期に及ぼす影響について解析した。オホーツクタワー周辺沿岸域では表層の水温および塩分は明瞭な季節変動を示し、全てのデータから得られた気候値での表層水温の最小値( $-1.36 \pm 0.30^\circ\text{C}$ )は2月中旬、最大値( $19.82 \pm 1.56^\circ\text{C}$ )は8月下旬に、表層塩分の最小値( $31.60 \pm 0.42$ )は1月上旬、最大値( $33.47 \pm 0.42$ )は10月中旬にみられた (Figure 2)。オホーツクタワー周辺域の流氷来遊期には表層水温は最低水準で維持されたが、表層塩分は水温と異なり上昇する傾向を示した。表層クロロフィル *a* 濃度は3月に増加し始め、4月に最大値( $3.1 \text{ mg m}^{-3}$ )を示し、それ以降は  $1\text{-}2 \text{ mg m}^{-3}$  の水準で11月まで維持された。これら気候値の季節変動はオホーツク海沿岸域のものと概ね一致し、オホーツクタワーでのモニタリングデータはオホーツク海沿岸域の海洋環境を反映したものであることが示された。

マイクロ波衛星データから求めた紋別沿岸域の海氷密接度の季節変動は年によって大きく異なり、海氷後退の時期（海氷密接度が50%以下になった日）は2003-2014年の期間で47日間の範囲で変動した。2003年以降、流氷接岸中もモニタリングを行った10年の内、2010年を除く9年で沿岸域での海氷の後退から16日後までに表層クロロフィル *a* 濃度は  $2 \text{ mg m}^{-3}$  以上に増加した (Figure 3)。このことから、北海道オホーツク海沿岸域では海氷の後退が植物プランクトンブルーム開始の重要な要因であることが示された。



Figure 1. Okhotsk Tower in Mombetsu, Hokkaido.

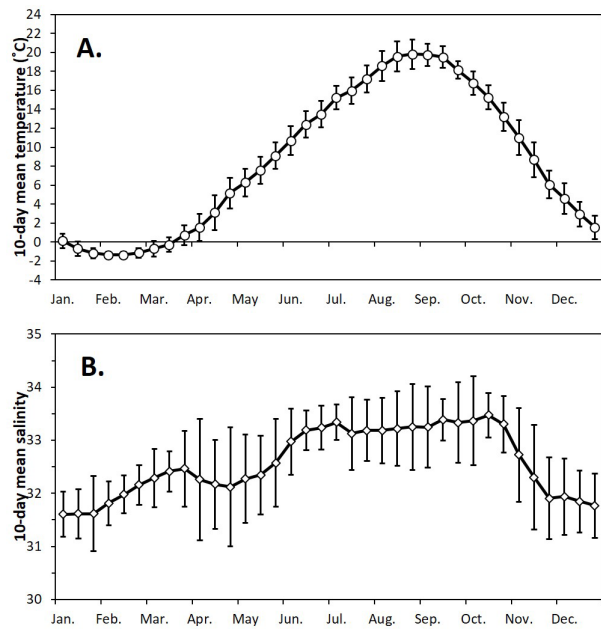


Figure 2. Seasonal change of climatology of 10-day mean of temperature (A) and salinity (B) in the surface layer around the Okhotsk Tower.

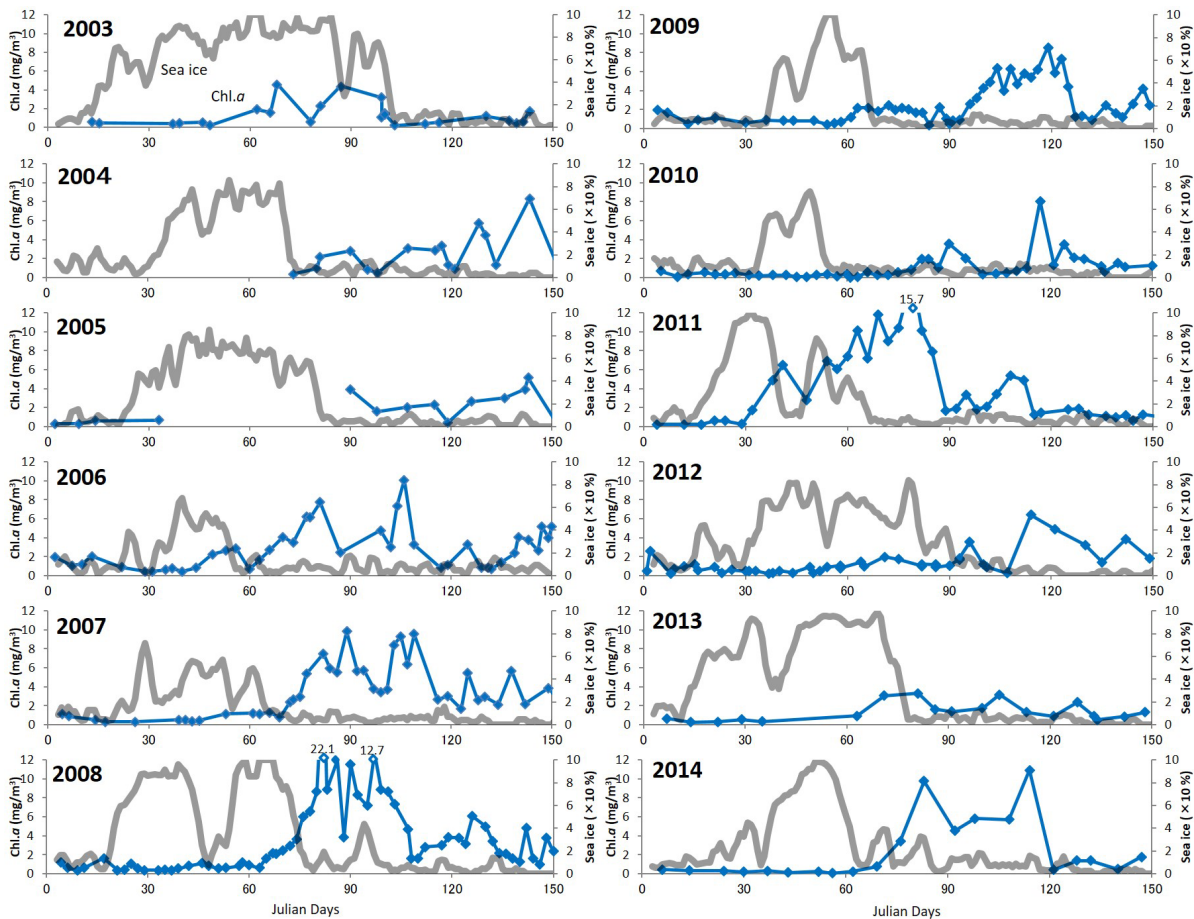


Figure 3. Temporal changes of sea-ice concentration (gray line) and chlorophyll *a* concentration (blue line) in the coastal water around the Okhotsk Tower from 2003 to 2014.

**References**

Kasai et al. (2017): Bull. Coast. Oceanogr., 54, in press (in Japanese with English abstract).