Comparison of seasonal variations in Chlorophyll a concentration and oceanographic conditions between Oyashio and Ocean Weather Station P

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Oyashio: Massive spring blooming
ST. P: HNLC
Outline

1: Area & Data
2: Physical condition
3: Chl-a & Phosphate
4: Iron
5: Summary
Observation areas

N:6463

Oyashio: < 5° C at 100m

ST. P: < 34 psu at surface
### Dataset

<table>
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<tr>
<th>Sources</th>
<th>Periods</th>
<th>N of stations</th>
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<td><strong>Oyashio</strong></td>
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<td>Oceanographic</td>
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<td>Japan Ocean Data Center online data</td>
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<td>Saito et al. (1998)</td>
<td>1990-1994</td>
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<td>Meteorological</td>
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Oceanographic data: temperature, salinity, PO4, chl-a, and Secchi Disc depth
Meteorological data: wind speed, solar radiation
*: Total grid number
Physical conditions: Temp. & Sal.

Oyashio

High fluctuation

ST P

Moderate fluctuation

Strong halocline

Temperature (°C)

Salinity +30 (psu)
Physical conditions: MLD

(a) Oyashio  Deep mixing

(b) ST P  Shallow mixing
Physical conditions: Cause of seasonal pycnocline

\[
\text{TEMP} = \frac{\Delta t \times 100}{\Delta t + \Delta s} \quad \ldots (1)
\]

\[
\text{SAL} = 100 - \text{TEMP} \quad \ldots (2)
\]

\[
\Delta t = \sigma_i - \sigma_s \quad \ldots \ldots \ldots \ldots \ldots (3)
\]

\[
\Delta s = \sigma_{ij} - \sigma_{ts} \quad \ldots \ldots \ldots \ldots \ldots (4)
\]

TEMP : contribution rate (%) of temp.
SAL : contribution rate (%) of sal.

\(\sigma_i: \sigma_t\) calculated by sal. at MLD and temp. at surface
\(\sigma_{ts}: \sigma_t\) calculated by sal. and temp. at surface
\(\sigma_{ij}: \sigma_t\) calculated by sal. at surface and temp. at MLD

Contribution rate (%) of temperature and salinity change for formation of the upper pycnocline (less than 50m). TEMP and SAL were calculated using equations of (1) and (2).
Physical conditions: Domains and current systems

Favorite et al. (1976)

Discharge:
- Strong halocline

Melting sea ice:
- Weak seasonal pycnocline

Oyashio
Chl-a & Phosphate

**Oyashio**
- **Spring bloom**
- **Autumn bloom**

**ST P**
- Decrease but not depletion

**Chl-a concentration (mg/m³)**

**Phosphate concentration (mol)**
Fe concentration at pre-stratification period.

**STP:** 0.19 nM

**Oyashio:** 0.71 nM

Significant chl-a increase observed when 1 n mol added! eg. Martin & Fitzwater (1988)

**STP:** Nishioka et al. (1998), sampling period June 1998

**Oyashio:** Nishioka et al. (2003), sampling period May 2001
Summary: Oyashio

- Wind stress
- Solar radiation
- Iron concentration

- Deep convection
- MLD

Months: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
Summary: ST.P

Wind stress

solar radiation

Iron concentration
Summary: Geographicl variation in Chl-a

Oyashio: entrainment of iron from mesopelagic layer.

Bering shelf, coastal area: iron form sea floor is important?

SeaWiFS average Chl-a, Oct 1997 - April 2002

Iron from sea floor is important. 
(Johnson et al. 1999)