

Compare of UV radiation and CDOM in the Chukchi Sea and East Siberian, Arctic

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Abstract

We investigated the penetration of solar radiation on the Chukchi Sea and East Siberian, Arctic from 6 to 19 August 2016 using IBRV ARAON. We measured the intensity of UV radiation, CDOM and UV-absorbing compounds (mycosporine-like amino acids) in the 14 stations. The penetration depth (Z: 1%) of UV-B, UV-A, and PAR on the middle Chukchi Sea relatively deeper than East Siberian stations. The CDOM concentration on East Siberian was relatively higher than middle Chukchi Sea due to influenced organic matter by river off or melting water of permanence frozen zone from East Siberia. Especially, the penetration depth of UV-B showed the average around 5 m at East Siberian and around 15 m at middle Chukchi Sea. Also the CDOM concentration on the Siberian presented higher 0.02 m^{-1} than middle Chukchi Sea (0.01 m^{-1}). The CDOM was affected the transmission of UV-B radiation to compare of UV-A and PAR. We suggest that global warming accelerated the melt of permanence frozen zone in the Siberia to supply the CDOM concentration in the sea water. According CDOM protected the penetration of UV-B on the sea water; the limited UV transmission influenced the phytoplankton communities and primary production.

Material and Methods

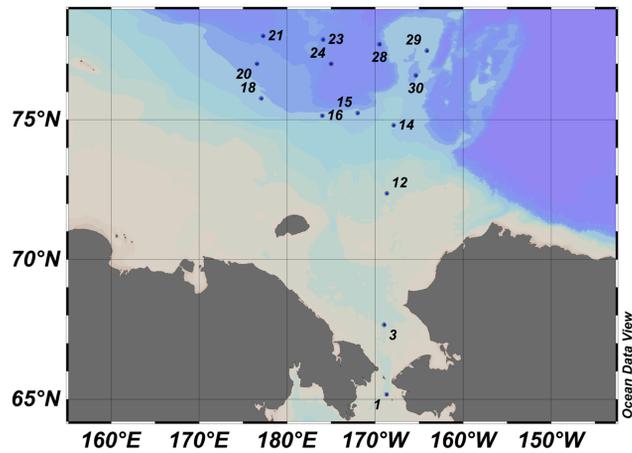


Fig. 1. Sampling stations on the Chukchi Sea and East Siberian Sea, Arctic

➤ To measure for UV radiation on the IBRV ARAON



TriOS RAMSES
(Hyperspectral Radiance and Irradiance
Sensors for the UV, VIS or UV/VIS
range)



➤ To analysis for stable isotope and mycosporine-like amino acids



EA-irMS (EuroEA-Isoprime IRMS,
GV Instruments, UK)



HPLC system – Agilent Technologies 1200 series
Mobile phase – Water with 0.1% acetic acid
Column – Waters 120DS-AP (5µm) 250mm x 4.6
Detector – Agilent DAD (G1315D) 310nm (250–750nm Scan)
Fraction collector – Agilent analyst FC (G1364C)

Results and Discussion

❖ Arctic Ozone Watch

Yearly maps
Missing years are indicated with a plain gray globe.

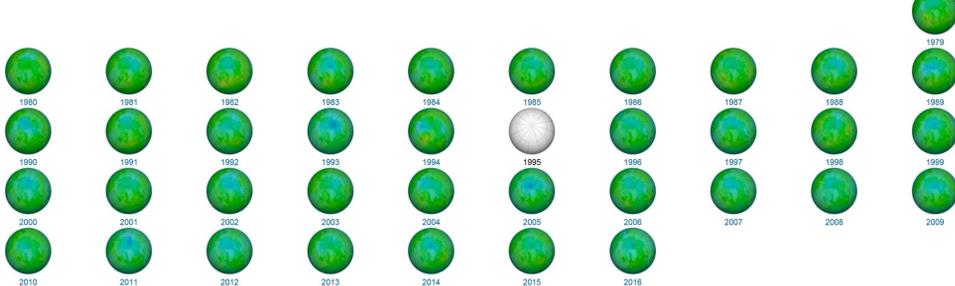


Fig. 2. Images of the yearly Arctic Hemisphere maps of total ozone for August from 1979 to 2016. (From: <https://ozonewatch.gsfc.nasa.gov/>)

✓ Data sources

The data for 1979–1992 are from the TOMS instrument on the NASA/NOAA Nimbus-7 satellite.
The data for 1993–1994 are from the TOMS instrument on the Soviet-built Meteor-3 satellite.
The data for 1996–2004 are from the NASA Earth Probe TOMS satellite.
The data for 2005–2016 from the OMI instrument (KNMI / NASA) onboard the Aura satellite. They are the OMTO3d that have been processed in a manner similar to the TOMS data from earlier years.

❖ Compared to CDOM concentration and UVR penetration depth

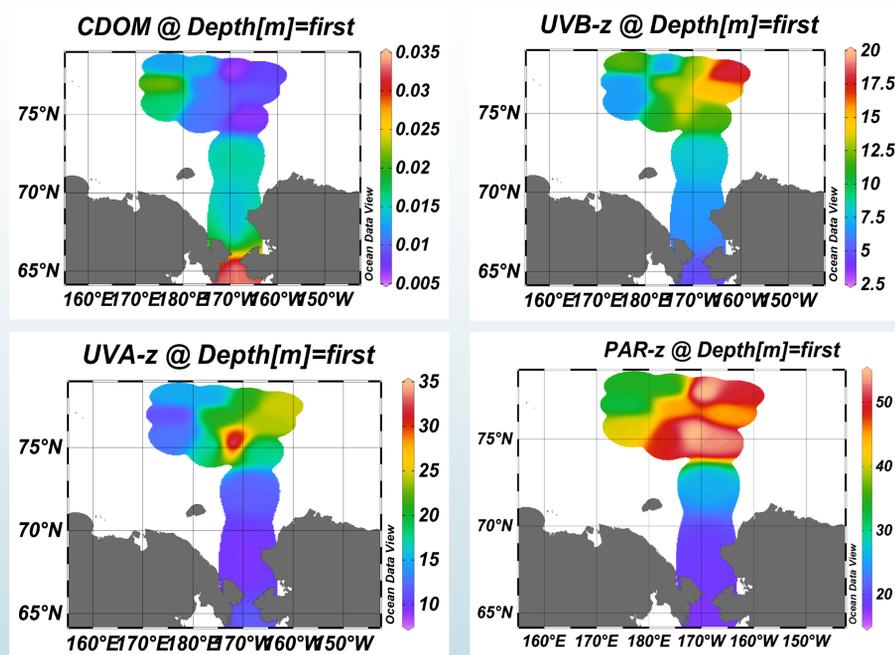


Fig. 3. Compare of relative CDOM concentration and penetration depth (Z:1%) of PAR, UV-A, and UV-B in the Chukchi Sea and East Siberian

The CDOM concentration at coastal area showed the higher than open sea. In particularly, the concentration of CDOM on the East Siberian Sea presented higher than Chukchi Sea. The penetration depth (Z:1%) of UV-B radiation on the Chukchi Sea which had less CDOM concentration was deeper than on the East Siberian Sea. The transmission of PAR and UV-A radiation also appeared deeper in the Chukchi Sea than East Siberian Sea.

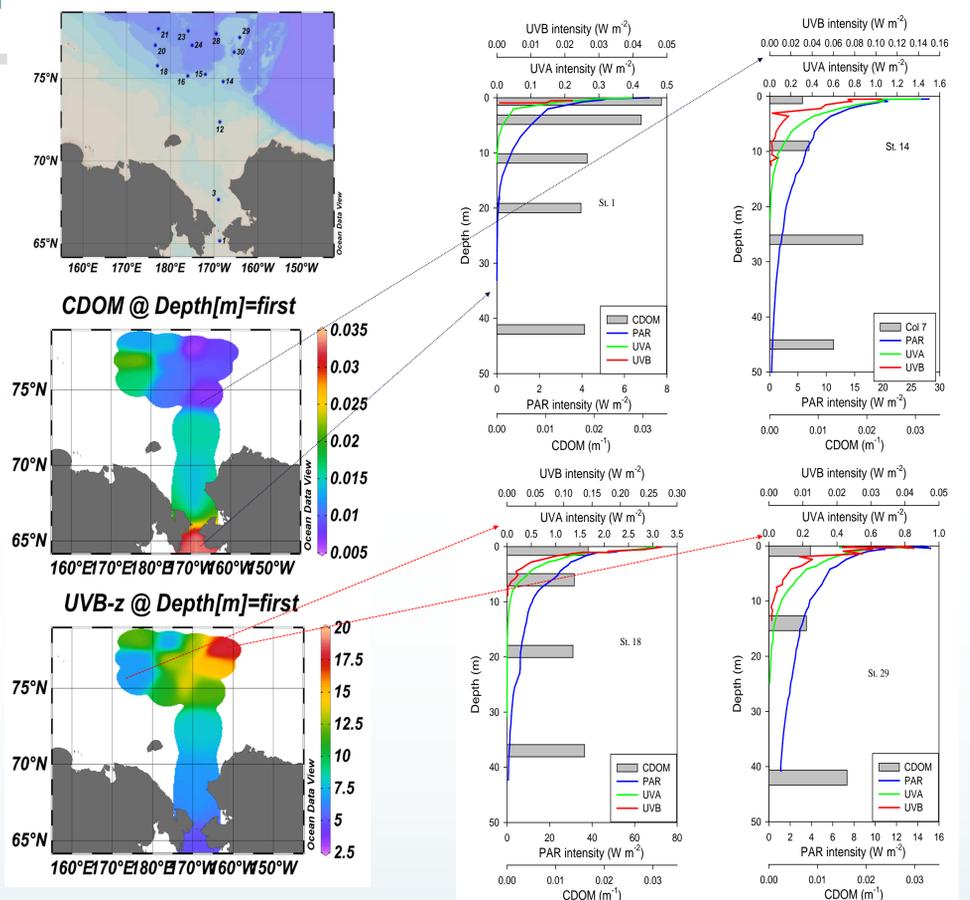


Fig. 4. Vertical profile of relative CDOM concentration and penetration depth (Z:1%) of UV-B in the Chukchi Sea and East Siberian

The distribution of CDOM concentration appeared difference between site 1 and site 14. The penetration depth of UV-B radiation were a clear difference depending on latitude. East Siberian Sea and Chukchi Sea were showed the difference the penetration of UV-B radiation and CDOM concentration, relatively.

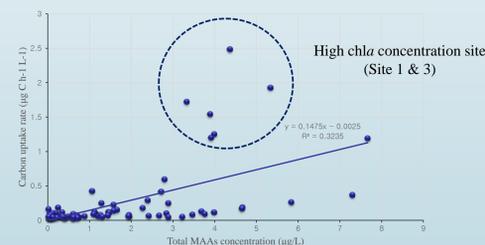


Fig. 5. Plots of carbon uptake and total MAAs concentration of POM in the Chukchi Sea and East Siberian

The phytoplankton that have the relative abundant concentration of UV-absorbing compounds (mycosporine-like amino acids) was shown the relatively high carbon uptake rate due to protect from the harmful radiation. However, the phytoplankton with a high carbon uptake rate at site 1 and site 3 had a constant concentration of total MAAs.