OPTICAL AND ANCILLARY MEASUREMENTS AT HIGH LATITUDES IN SUPPORT OF THE MODIS OCEAN VALIDATION PROGRAM

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In collaboration with the
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MAJOR RESULTS

data base from in-situ measurements in the Greenland and Norwegian Seas

quantification of the accuracy of atmospheric correction and in-water Case 1 and Case algorithms and data products

proposal of improvements to the MODIS algorithms for the investigated region
OTHER MEASUREMENTS AND OBSERVATIONS

Concentration and size distribution of gas bubbles
Sea surface state and whitecap coverage
Wind horizontal velocity
Air temperature and relative humidity
Atmospheric pressure
Total aerosol and sea salt particle concentration and size distribution
Sky state photographs
Sea ice conditions
Water Temperature and conductivity profiles
Horizontal current components
WATER SAMPLE ANALYSES

ap (λ) Particulate absorption spectrum
ad (λ) Detrital particle absorption spectrum
ag (λ) Colored dissolved absorption spectrum

Discrete phytoplankton pigments
Total suspended matter
Particulate organic carbon
Dissolved organic carbon
Particle size distribution
Phytoplankton taxonomy
OPTICAL MEASUREMENTS

\( E_d (0+, \lambda) \) Incident spectral downwelling irradiance
\( L_u (0+, \lambda) \) Above-water spectral upwelling radiance

\( L_{\text{sky}} \) Spectral sky radiance
\( t_s (\lambda) \) Spectral solar atmospheric transmission

\( E_d (z, \lambda) \) En-water spectral downwelling irradiance
\( L_u (z, \lambda) \) In-water spectral upwelling radiance
\( E_u (z, \lambda) \) In-water spectral upwelling irradiance
\( \text{PAR}(z) \) Photosynthetically available scalar irradiance (400-700 nm)

\( a (z, \lambda) \) Spectral absorption coefficient
\( c (z, \lambda) \) Spectral beam attenuation coefficient
\( b_b (z, \lambda) \) Spectral backscattering coefficient
\( c(z,660) \) Red beam attenuation at 660 nm
\( c(z,488) \) Blue beam attenuation at 488 nm
\( \text{Chl-fl} (z) \) Chlorophyll fluorescence
Figure 2. CZCS imagery of the Barents, Norwegian, and Greenland Seas (Mitchell et al. 1992). As indicated panel (a) is for July 10, 1979 and panel (b) is for June 28-30, 1980. Although the image is for early summer each year, significant interannual variability is evident. The land mask is indicated by the white borders; a cloud/ice algorithm generated a mask resulting in regions reported that are obscured in the imagery.
RESEARCH VESSEL
OCEANIA™

displacement - 370 T
length - 48.93 m
breadth - 8.99 m
draught - 3.80 m
sails - 700 m²
engine - 310 HP
unlimited cruising range
2 months endurance
ecological clean
14 person scientific crew
SPECIFIC OBJECTIVES

- conduct optical and ancillary measurements in the Greenland and Norwegian Seas

- quantify errors in MODIS-derived water-leaving radiance, Case 1, and Case 2 algorithm products

- develop understanding of the error budgets in Case 1 and Case 2 bio-optical algorithms (effects of particles, dissolved matter, submerged bubbles)

- examine errors in the in-situ determinations of water-leaving radiance and wind-dependent parameterization of whitecap coverage
OVERALL GOALS

- identify regional biases and characterize error budgets for the Level-2 MODIS ocean data products in the Arctic
- develop understanding of these errors
- improve algorithms
The graph shows two power law relationships:

- \( F(D) = 5.1158 \times 10^{11} D^{-4} \)
- \( F(D) = 2.0463 \times 10^{10} D^{-4} \)

The y-axis represents \( F(D) \) in units of \( \text{m}^{-3} \text{mum}^{-1} \), and the x-axis represents the Diameter \( D \) in units of \( \text{mum} \).
STATEMENT OF THE PROBLEM

- need for validation activities at high latitudes
- differences in bio-optical algorithms between polar and temperate/tropical waters
- wind-dependent effects of near-surface bubble clouds