生态学报 2006 26 (2006(12)): 3969～3979 ISSN: 1004-616x CN: 44-1063/R

研究论文

太湖梅梁湾水体悬浮颗粒物和CDOM的吸收特性

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收稿日期 2005-7-26 修回日期 2006-1-22 网络版发布日期: 2006-12-25

摘要 通过测定滤膜上悬浮颗粒物和过滤液中CDOM吸光度的方法计算得到太湖梅梁湾总颗粒物和CDOM的光谱吸收系数，并计算了各吸收组份的贡献份额以及吸收与PAR衰减的比值。总颗粒物的吸收系数从400 nm 到600 nm大致呈下降趋势，到675 nm附近由于叶绿素a的特征吸收会出现明显峰值，峰值高低随叶绿素a浓度的变化而变化，ap(440)在3.58～9.86 m^{-1} 间变化。非藻类颗粒物和CDOM的吸收随波长增加大致按指数规律下降，ad(440)和ag(440)的变化范围分别为2.23～7.07m^{-1} 和1.06～1.70 m^{-1} 。非藻类颗粒物在400～700 nm波段的指数函数斜率Sd的平均值为（10.91±0.62）μm^{-1} ; CDOM在280～500 nm波段指数函数斜率Sg的平均值为（15.52±0.49）μm^{-1} 。浮游藻类的光谱吸收表现为在440、675 nm附近存在两个明显的峰值，分别为（2.55±1.14）、（1.34±0.69） m^{-1} 。ap(440)与TSS、OSS、ISS均存在显著性正相关，而ad(440)则只与TSS、ISS有显著性相关，aph(440)只与OSS、Chla有显著性相关。CDOM吸收系数与DOC浓度没有显著正相关，但与Chla存在显著幂函数关系，浮游藻类降解产物是水体中CDOM的重要来源之一。水体中物质吸收主要以颗粒物为主，对总吸收的贡献率在70%以上，而颗粒物中又以非藻类颗粒物占主导，一般超过40%，总吸收对漫射衰减的贡献也在40%以上。

关键词 梅梁湾 _ 非藻类颗粒物 _ 浮游藻类 _ 有色可溶性有机物 _ 叶绿素a _ 吸收光谱

分类号 P343.3

Spectral absorption coefficients of particulate matter and chromophoric dissolved organic matter in Meiliang Bay of Lake Taihu

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Abstract Light absorption is an inherent optical property, which determines the transmission and distribution of underwater light.Knowledge about the inherent and apparent optical properties of water is very important for the development of bio-optical algorithms for remote sensing, and of bio-optical models for estimation of primary production as well as ecological restoration of eutrophic water bodies. In shallow eutrophic lakes, phytoplankton blooms and continuous sediment resuspension by benthivorous fish and wind lower the underwater light, which results in loss of submerged vegetation. The light absorption properties of an aquatic medium are characterized by the medium's absorption coefficient. The total absorption coefficient a(λ) includes the coefficients for total particulate matter (phytoplankton and nonalgal particulates) ap(λ), chromophoric dissolved organic matter (CDOM) ag(λ) and pure water aw(λ). Phytoplankton absorption influences the maximum photosynthetic rate as well as the rate of photosynthesis integrated over depth. CDOM limits the penetration of biologically damaging UV-B radiation (280320 nm) in the water column, thus shielding aquatic organisms by its strong absorption in the UV spectral range. Absorption of nonalgal particles and CDOM often disturb the remote sensing of the biomass and primary production of phytoplankton. The present study documents spectral absorption variations and relative contributions of the optically active constituents in water, and presents correlations between absorptio

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n coefficients and concentrations of these components.
Spectral absorption coefficients of the total particles ap(λ), nonalgal particles ad(λ), phytoplankton aph(λ), and CDOM ag(λ) as well as the relative contribution of each component's absorption to the total absorption coefficient integrated over the range of PAR (400700 nm) in Meiliang Bay of Lake Taihu were determined in summer 2004. CDOM absorption coefficients ag(λ) were obtained by measuring the optical density of filtered water. Particulate matter absorption coefficients ap(λ) were measured by applying the quantitative filter technique (QFT). Downward photosynthetically available irradiance (PAR, 400700 nm) at the water surface and at different depths was measured using an irradiance meter from Li-Cor (Lincoln, Nebraska, USA) equipped with a Li-192SA underwater cosine corrected sensor connected to a Li-1400 datalogger. Diffuse attenuation coefficients for downward irradiance were obtained from non-linear regression of the underwater irradiance profile.
The particulate matter absorption at 440 nm ap(440) ranged from 3.58 to 9.86 m^{-1} with an average of （7.56±1.74） m^{-1}. The absorption coefficients of nonalgal particles ad(440), phytoplankton aph(440) and CDOM ag(440) were in the range 2.237.07 m^{-1}, 0.684.76 m^{-1} and 1.061.70 m^{-1},respectively. The red absorption peak of phytoplankton aph(675) ranged from 0.58 to 2.84 m^{-1}. Absorption coefficients of nonalgal particles and CDOM decreased exponentially from short to long wavelength. The exponential spectral slope coefficients of nonalgal particles Sd over the 400～700 nm interval and of CDOM Sg over 280～500 nm were （10.91±0.62）, （15.52±0.49） μm^{-1}, respectively. In most cases, the absorption spectra of nonalgal particles were similar to those of the total particles, which demonstrated that the absorption of the total particulate matter was primarily due to the absorption of nonalgal particles.
Significant linear relationships were found between ap(440) and total suspended solids (TSS), organic suspended solids (OSS) and inorganic suspended solids (ISS). Significant linear relationships were also found between ad(440) and the suspended solid fractions, as was true as well for aph(440) with respect to OSS and chlorophyll a (Chla). Significant positive relationship was found between ag(440) and Chla, but not with dissolved organic carbon (DOC), which indicated that decomposition of phytoplankton was an important source of CDOM. Total particulate matter absorption dominated the total absorption. The relative contribution of ap to a integrated over the range of PAR (400700 nm) exceeded 70% and the relative contribution of ad to a generally exceeded 40% except for station M8, M9 and M13. Finally, the ratio of a to PAR diffuse attenuation Kd (PAR) also generally exceeded 40%.

Key words Meiliang Bay _ nonalgal particles _ phytoplankton _ chromophoric dissolved organic matter _ chlorophyll a _ absorption spectra

DOI

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