



Fig. 2. Absorption coefficients of phytoplankton pigment ($a_{\text{ph}443}$, m^{-1}) and CDOM ($a_{\text{g}443}$, m^{-1}) for the oligotrophic surface ocean at 27.5°N 65°W (Fig. 1), derived from high-resolution (1-km) daily SeaWiFS data between 1998 and 2003 with a quasi-analytical algorithm [16]. Also shown are the $a_{\text{g}443}/a_{\text{ph}443}$ ratio, as well as the ratio between chlorophyll concentration estimated from the band-ratio OC4v4 algorithm [Chl(OC4)] and $a_{\text{ph}443}$.

high-quality satellite observations of the VSSR and increasingly sophisticated algorithms allow us to revisit this basic hypothesis.

II. DATA AND METHODS

To minimize the impact of lateral exchanges and terrigenous inputs of colored organic and other materials on our conclusions, our study was conducted in the southern Sargasso Sea, at 27.5°N 65°W . This is in the western portion of the North Atlantic subtropical gyre, where waters exhibit homogeneous optical properties over horizontal distances exceeding hundreds of kilometers (Fig. 1). This region features some of the clearest water in the world.

Data from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) collected during 1998–2003 were processed with the SeaDAS4.6 software released by NASA’s Goddard Space Flight Center. The derived remote sensing spectral reflectance data ($R_{\text{rs}}(\lambda)$, sr^{-1}), after a rigorous quality control process (e.g., pixels with suspicious flags were removed, and a 15×15 box centered at the location was used to remove sensor/algorithm noise [14]), were then used as input to a quasi-analytical algorithm [16] to estimate $a_{\text{ph}443}$ and $a_{\text{g}443}$ (where 443 is the band center wavelength in nanometers). Briefly, total absorption and backscattering coefficients at 555 nm were first estimated empirically and analytically. The coefficients at other wavelengths were then derived using an empirical estimate of particle backscattering spectral shape. $a_{\text{ph}443}$ and $a_{\text{g}443}$ were analytically derived from the total absorption coefficients at 412 and 443 nm. In this last step, a specific CDOM absorption spectral

slope, S , was assumed to be constant and equal to 0.02nm^{-1} . A sensitivity analysis was conducted to test this assumption, and the results are discussed below. Chlorophyll-*a* concentration (Chl) was derived using the OC4v4 algorithm [28].

III. RESULTS AND DISCUSSION

Fig. 2 shows the SeaWiFS time series of $a_{\text{g}443}$, $a_{\text{ph}443}$, $a_{\text{g}443}/a_{\text{ph}443}$, and the Chl/ $a_{\text{ph}443}$ ratio for our Sargasso Sea location. A seasonal cycle is evident in all parameters, with winter maxima and late summer minima. There is little interannual variation, suggesting that the oligotrophic ocean gyre may be used to monitor long-term stability of future satellite sensors.

The high temporal resolution and the length of the series reveal a lag in $a_{\text{g}443}$ relative to $a_{\text{ph}443}$. The lag is more manifest when all data of 1998–2003 are averaged to produce a weekly climatology [Fig. 3(a)]. Correlation analysis based on the weekly climatology shows that $a_{\text{g}443}$ maxima lagged $a_{\text{ph}443}$ maxima by about two weeks during winter-spring (week 49–19). The minimum $a_{\text{g}443}$ lags $a_{\text{ph}443}$ by about 4–5 weeks during summer-fall (week 26–48) (Fig. 4). The lag, or phase shift, between $a_{\text{g}443}$ and $a_{\text{ph}443}$ is more manifest when summer-fall (week 26–48) lows and winter-spring (week 49–19) highs are treated separately, because of the various processes that drive these temporal changes (see below). The horizontal lines in Fig. 4 correspond to the 95% significance levels calculated using a “phase randomization” method [8]. Correlation coefficients above these lines indicate that the two time-series are significantly correlated. The same analysis