Table 2. Empirical Algorithms

Algorithm	Type	Result Equation(s)	Band Ratio (R), Coefficients (a)	Reference
Global processing (GPs)	power	$C_{13} = 10^{(a0+a1*R1)}$ $C_{23} = 10^{(a2+a3*R2)}$ $[C + P] = C_{13}$; if C_{13} and $C_{23} > 1.5$ μg L^{-1} then $[C + P] = C_{23}$	$R1 = \log(Lwn443/Lwn550)$ $R2 = \log(Lwn520/Lwn550)$ $a = [0.053, -1.705, 0.522, -2.440]$	1
Clark three-band (C3b)	power	$[C + P] = 10^{(a0+a1*R)}$	$R = \log((Lwn443 + Lwn520)/Lwn550)$ $a = [0.745, -2.252]$	2
Aiken-C	hyperbolic + power	$C_{21} = \exp(a0 + a1*\ln(R))$ $C_{23} = (R + a2)/(a3 + a4*R)$ $C = C_{21}$; if $C < 2.0$ μg L^{-1} then $C = C_{23}$	$R = Lwn490/Lwn555$ $a = [0.464, -1.989, -5.29, 0.719, -4.23]$	3
Aiken-P	hyperbolic + power	$C_{22} = \exp(a0 + a1*\ln(R))$ $C_{24} = (R + a2)/(a3 + a4*R)$ $[C + P] = C_{22}$; if $[C + P] < 2.0$ μg L^{-1} then $[C + P] = C_{24}$	$R = Lwn490/Lwn555$ $a = [0.696, -2.085, -5.29, 0.592, -3.48]$	3
OCTS-C	power	$C = 10^{(a0+a1*R)}$	$R = \log((Lwn520 + Lwn565)/Lwn490)$ $a = [-0.55006, 3.497]$	4
OCTS-P	multiple regression	$[C + P] = 10^{(a0+a1*R1+a2*R2)}$	$R1 = \log(Lwn443/Lwn520)$ $R2 = \log(Lwn490/Lwn520)$ $a = [0.19535, -2.079, -3.497]$	5
POLDER	cubic	$C = 10^{(a0+a1*R+a2*R^2+a3*R^3)}$	$R = \log(Rrs443/Rrs565)$ $a = [0.438, -2.114, 0.916, -0.851]$	6
CalCOFI two-band linear	power	$C = 10^{(a0+a1*R)}$	$R = \log(Rrs490/Rrs555)$ $a = [0.444, -2.431]$	7
CalCOFI two-band cubic	cubic	$C = 10^{(a0+a1*R+a2*R^2+a3*R^3)}$	$R = \log(Rrs490/Rrs555)$ $a = [0.450, -2.860, 0.996, -0.3674]$	7
CalCOFI three-band	multiple regression	$C = \exp(a0 + a1*R1 + a2*R2)$	$R1 = \ln(Rrs490/Rrs555)$ $R2 = \ln(Rrs510/Rrs555)$ $a = [1.025, -1.622, -1.238]$	7
CalCOFI four-band	multiple regression	$C = \exp(a0 + a1*R1 + a2*R2)$	$R1 = \ln(Rrs443/Rrs555)$ $R2 = \ln(Rrs412/Rrs510)$ $a = [0.753, -2.583, 1.389]$	7
Morel-1	power	$C = 10^{(a0+a1*R)}$	$R = \log(Rrs443/Rrs555)$ $a = [0.2492, -1.768]$	8
Morel-2	power	$C = \exp(a0 + a1*R)$	$R = \ln(Rrs490/Rrs555)$ $a = [1.077835, -2.542605]$	9
Morel-3	cubic	$C = 10^{(a0+a1*R+a2*R^2+a3*R^3)}$	$R = \log(Rrs443/Rrs555)$ $a = [0.20766, -1.82878, 0.75885, -0.73979]$	9
Morel-4	cubic	$C = 10^{(a0+a1*R+a2*R^2+a3*R^3)}$	$R = \log(Rrs490/Rrs555)$ $a = [1.03117, -2.40134, 0.3219897, -0.291066]$	9

References: 1, *Evans and Gordon* [1994]; 2, *Muller-Karger et al.* [1990]; D. Clark; *McClain and Yeh* [1994]; 3, *Aiken et al.* [1995]; 4, Science on the GLI Mission, p. 16; Ocean Optics XIII, Halifax, October 1996; 5, Ocean Optics XIII, Halifax, October 1996; personal communication to C. McClain, NASA; 6, A. Bricaud, personal communication to S. Maritorena; 7, *Mitchell and Kahru* [1998]; 8, Ocean Optics XIII, Halifax, October 1996; 9, A. Morel, personal communication to S. Maritorena.

Sargasso Sea [*Garver and Siegel*, 1997]. Recent developments included the use of $a_w(\lambda)$ values from *Pope and Fry* [1997] instead of *Smith and Baker*'s [1981], the chlorophyll-specific phytoplankton absorption spectra of *Morel* [1988] instead of that from *Bricaud et al.* [1995], and a different value for the exponential decay constant of the detrital and dissolved absorption. Details of adjustments made to the model for the SeaBAM intercomparisons are provided by *Garver* [1997].

2.2. Empirical Models

Most CZCS-pigment estimates have been made using the global processing switching (GPs) algorithm [*Gordon et al.*, 1983; *Feldman et al.*, 1989; *Evans and Gordon*, 1994] which uses Lwn443/Lwn550 at concentrations below ~1.5 μg L^{-1} and switches to Lwn520/Lwn550 above 1.5 μg L^{-1}, when the former band ratio gets too low (Table 2). The Clark three-band (C3b) [*Muller-Karger et al.*, 1990] uses the same bands as the GPs but avoids band switching by summing the 443 and 520 channels, thereby compensating for the weakness of the 443 nm band at high pigment concentrations. The Aiken hyperbolic models estimate C and [C + P] by the combination of a hyperbolic function up to 2 μg L^{-1} with a power function at higher concentrations [*Aiken et al.*, 1995]. The OCTS-C model is a power-law formulation which uses the sum of Lwn520 and Lwn565 over Lwn490 to estimate C, whereas the OCTS [C + P] model (OCTS-P) uses two-band ratios, Lwn443/Lwn520 and Lwn490/Lwn520, in a multiple regression function. The POLDER algorithm is considered empirical because it is based on a simple equation relating C to a band ratio, although the equation was actually derived from the use of a modified version of the semianalytic model of *Morel* [1988], parameterized for absorption instead of diffuse attenuation coefficient (A. Bricaud, personal communication, 1997).

The CalCOFI algorithms are derived from CalCOFI data [*Mitchell and Kahru*, 1998]. The CalCOFI two-band relates C to Rrs490/Rrs555 using a power equation. The CalCOFI two-band cubic is a third-order polynomial equation using Rrs490/Rrs555. The CalCOFI three-band, a multiple regression equation, has similarities with the OCTS-P algorithm and uses the Rrs490/Rrs555 and Rrs510/Rrs555 band ratios. The functional form of the CalCOFI four-band equation is similar to CalCOFI three-band except that it uses Rrs443/Rrs555 and Rrs412/Rrs510 (Table 2). The Morel-1 equation was presented at the Ocean Optics XIII meeting [*Morel*, 1997] and relates C to Rrs443/Rrs555 using a power equation (Table 2). Morel-2 is