CRUISE REPORT

Experiment: Tampa_Bay
Cruise: T1205
Investigator: Chuanmin Hu
Affiliation: University of South Florida, College of Marine Science
Contact: hu@marine.usf.edu
Vessel: R/V Ashton operated by FDEP
Site: Tampa Bay (Florida, USA)
Dates: May 7, 2012

Data Collected: $R_{rs}(\lambda)$, $a_p(\lambda)$, $a_d(\lambda)$, $a_g(\lambda)$, and CHL

METHODS:

a. Remote sensing reflectance spectra, $R_{rs}(\lambda)$

$R_{rs}(\lambda)$ was determined according to the methods of Lee et al. (1997) using a custom-built, handheld SPECTRIX spectrometer equipped with an extension tube permitting a 10° field-of-view. Briefly, multiple spectra of upwelling radiance, $L_u(\lambda)$, and downwelling sky radiance, $L_{sky}(\lambda)$, were collected at 30° from nadir and 30° from zenith, respectively. Both $L_u(\lambda)$ and $L_{sky}(\lambda)$ were collected 90° from the solar plane. Spectral "gray card" radiance, $L_G(\lambda)$, was also obtained by measuring the radiance normal to a standard diffuse reflector (Spectralon®). A typical scan set consisted of five individual scans made sequentially in the following order: $L_G(\lambda)$, $L_u(\lambda)$*3, $L_{sky}(\lambda)$. A minimum of three scan sets was collected at each station.

For each scan set, the total remote-sensing reflectance, $T_{rs}(\lambda)$, and sky remote sensing reflectance, $S_{rs}(\lambda)$, were derived through

$$T_{rs}(\lambda) = \frac{L_u(\lambda)}{E_d(\lambda)} \quad , \quad S_{rs}(\lambda) = \frac{L_{sky}(\lambda)}{E_d(\lambda)}$$

where the downwelling irradiance, $E_d(\lambda)$, was obtained from $L_G(\lambda)*\pi/R_G$ and R_G is the reflectance from the standard diffuse reflector (~10%). Average $T_{rs}(\lambda)$ and $S_{rs}(\lambda)$ for all scan sets were used after discarding obvious outliers caused by solar glint, sea surface roughness, variable sky conditions, etc.

$R_{rs}(\lambda)$ was then derived by subtracting from $T_{rs}(\lambda)$ the portion of the skylight that was reflected into the sensor along with any solar glint as follows:

$$R_{rs}(\lambda) = T_{rs}(\lambda) - F(\theta)S_{rs}(\lambda) + \Delta$$

where $F(\theta) = 0.022$ is the surface Fresnel reflectance for the zenith angle (θ) at 30° and Δ is a spectrally constant solar glint correction. Δ was estimated by assuming $R_{rs}(750) = 0$ in open ocean waters. For coastal waters, Δ was estimated iteratively (Lee et al., 1999) without assuming $R_{rs}(750) = 0$.

b. Particulate and detrital absorption spectra

Spectral absorption coefficients of total particulates, $a_p(\lambda)$, and non-algal detrital matter, $a_d(\lambda)$, were determined using the quantitative filter technique (Yentsch, 1962; Kiefer and SooHoo, 1982).

Seawater was collected at each station from the surface. Samples were stored on ice until return to shore when they were filtered through 2.5cm diameter Whatman GF/F filters using ~5-

7 in Hg vacuum pressure. Next, filters were carefully placed flat in individual Fisher™ Histoprep tissue capsules which were wrapped in aluminum foil, stored in liquid nitrogen for ~1-2 days, and then transferred to a -80^{o} freezer upon return to the lab.

Prior to being processed, filters were allowed to thaw at room temperature for ~5 minutes. Then, they were re-saturated on a drop or two of Milli Q water inside a darkened petri dish. Next, the sample filter and a blank reference filter (wetted with Milli Q water) were placed side-by-side on individual glass plates inside a custom-built Pad Transmissometer box. Before each scan was collected, the filters were slid one at a time over a tungsten-halogen light source that passed through a blue optical filter (Schott BG-34) and a quartz glass diffuser. Light transmission of the reference filter, $T_{reference}(\lambda)$, followed by the sample filter, $T_{sample}(\lambda)$, were measured three times each using a SPECTRIX spectrometer.

Phytoplankton pigments (e.g., chlorophylls, carotenoids) were extracted from the sample filter for 15-20 minutes in the dark using ~50ml of hot 100% methanol (Kishino et al., 1985). Afterward, the sample filter was rinsed with ~5-10ml of Milli Q water to remove the excess methanol and re-wet the filter. Light transmission was measured, once again, for this sample filter and the same reference filter to obtain the absorption spectra due to detrital particles, $a_d(\lambda)$.

Optical density spectra, $OD(\lambda)$, were calculated for each scan set as

$$OD(\lambda) = log_{10}\left(\frac{T_{reference}(\lambda)}{T_{sample}(\lambda)}\right)$$

$a_p(\lambda)$ and $a_d(\lambda)$ were then calculated from the mean $OD_p(\lambda)$ and $OD_d(\lambda)$, respectively, obtained for all three scan sets as

$$a_{p,d}(\lambda) = \frac{2.303 \times OD_{p,d}(\lambda)}{l \times \beta}$$

where l is the geometric pathlength equal to the volume of seawater filtered divided by the effective filtration area of the filter and β is the pathlength amplification or "beta factor" (Butler, 1962). An average of two published beta factor formulations (Bricaud and Stramski, 1990; Nelson and Robertson, 1993) was chosen

$$\beta = 1.0 + 0.6\, OD_{p,d}(\lambda)^{-0.5}$$

to correct for pathlength amplification. The average absorption from 740-760nm was subtracted from the entire spectra to correct for residual scattering and the spectra were smoothed. For highly absorption samples in which absorption continued to decline beyond ~750nm, the average absorption from 780-800nm was used for the null-point correction. The absorption spectra due to phytoplankton pigments, $a_{ph}(\lambda)$, was then calculated as

$$a_{ph}(\lambda) = a_p(\lambda) - a_d(\lambda)$$

c. Gelbstoff (or colored dissolved organic matter) absorption spectra

Gelbstoff absorption spectra, $a_g(\lambda)$, was measured on filtered seawater samples. Seawater was first filtered through GF/F filters (nominal pore size = 0.7μm) to remove larger particles that tend to clog smaller pore size filters. GF/F filtrates were then filtered through pre-rinsed 0.2μm nylon membrane filters. Samples were stored in clean 4oz amber borosilicate bottles in a refrigerator (~0-5^{o}C) and processed typically within 1-2 days.

Samples were allowed to warm up slowly to room temperature prior to being scanned. Duplicate scans of gelbstoff absorbance spectra, $Ag(\lambda)$, were measured from 200-800nm using 10cm quartz cells with Milli Q water as a reference. Raw individual scans were smoothed (7-point boxcar average) and averaged prior to being converted to $a_g(\lambda)$ as follows:

$$a_g(\lambda) = \frac{2.3\, A_g(\lambda)}{l}$$

where l is the cell pathlength. The average absorption from 690-710nm was then subtracted from the entire spectra to correct for residual scattering.

Reporting Notation:
abs_ag = absorbance coefficient (raw duplicate scans smoothed and averaged)
ag = absorption coefficient (null point corrected)

d. Fluorometric chlorophyll a concentrations, CHL

Chlorophyll *a* and pheopigment concentrations were determined fluorometrically using the traditional acidification technique (Holm-Hansen et al., 1965; Holm-Hansen and Riemann, 1978). Seawater samples were filtered through 2.5cm diameter Whatman GF/F filters using ~5-7 in Hg vacuum pressure. Filters were stored in liquid nitrogen for < 2 weeks, and then transferred to a -80^o freezer upon return to the lab. Sample processing occurred within 6 months of collection.

Pigments were extracted for 15-20 minutes in the dark using ~50ml of hot 100% methanol (Kishino et al., 1985), and concentrations were measured using a Turner-Designs 10-AU-005 field fluorometer. The fluorometer was configured using the standard 10-037R optical kit as follows:

Excitation filter: 340-500nm
Emission filter: >665nm
Neutral density filter: 1ND
Daylight white lamp

The instrument was calibrated using pure chlorophyll a from *A. nidulans* (Sigma Chemical). A secondary solid standard was used to correct for instrument drift (<5%).

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