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SHIFT: Ramses Trios Radiometer Above Water Measurements, Santa Barbara Sea, CA

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Documentation Revision Date: 2023-09-04

Dataset Version: 1

Summary

This dataset provides calculated remote sensing reflectance (Rrs) from measurements collected with a Ramses TriOS radiometer deployed on the Santa Barbara Museum of Natural History Sea Center at Stearns Wharf, Santa Barbara, California, U.S. All measurements were taken over a fixed position at (34.41037665, -119.68557147). Three sensors are used to collect solar downwelling irradiance (Ed), sky radiance (Ls) and water-leaving radiance (Lw). These data have been processed to Rrs at 10 second intervals and are either concurrent or taken within 2.5 hours of SHIFT campaign flights. The data collected by the three Ramses TriOS sensors for eight days during the period 2022-04-05 to 2022-05-29 are also included. The data were translated from the proprietary format output by the Ramses TriOS instrument and saved in comma-separated values (CSV) format.

There are four files in this dataset: one file in comma-separated values (CSV) format holding calculated reflectance values and three compressed zip archives holding raw sensor measurements in CSV format.
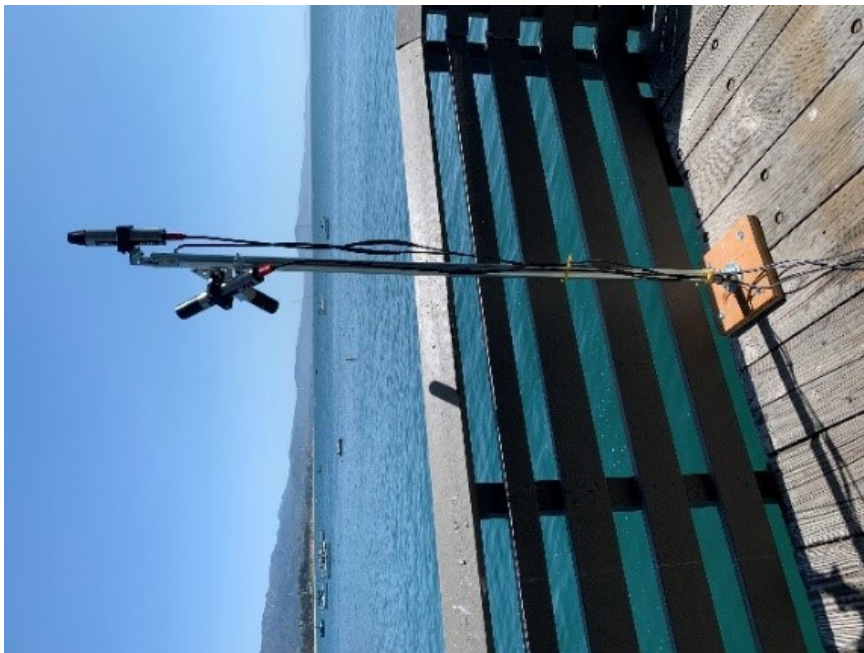

Figure 1. Ramses TriOS radiometer deployed on Stearns Wharf behind the Santa Barbara Museum of Natural History Sea Center. Three sensors are used to collect irradiance, downwelling radiance, and upwelling radiance measurements.

Citation

Ade, C., E.L. Hestir, D.M. Avouris, J. Burmistrova, C. Nickles, A.M. Lopez, B. Lopez Barreto, J. Vellanoweth, R. Smalldon, and C.M. Lee. 2023. SHIFT: Ramses Trios Radiometer Above Water Measurements, Santa Barbara Sea, CA. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2234

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1. Dataset Overview

This dataset provides calculated remote sensing reflectance (Rrs) from measurements collected with a Ramses TriOS radiometer deployed on the Santa Barbara Museum of Natural History Sea Center at Stearns Wharf, Santa Barbara, California, U.S. All measurements were taken over a fixed position at (34.41037665, -119.68557147). Three sensors are used to collect solar downwelling irradiance (E_d), sky radiance (L_s) and water-leaving radiance (L_w).

These data have been processed to Rrs at 10 second intervals and are either concurrent or taken within 2.5 hours of SHIFT campaign flights. The data collected by the three Ramses TriOS sensors for eight days during the period 2022-04-05 to 2022-05-29 are also included. The data were translated from the proprietary format output by the Ramses TriOS instrument and saved in comma-separated values (CSV) format.

Project: Surface Biology and Geology High-Frequency Time Series (SHIFT)

The Surface Biology and Geology (SBG) High Frequency Time Series (SHIFT) was an airborne and field campaign during February to May, 2022, with a follow up activity for one week in September, in support of NASA's SBG mission. Its study area included a 640-square-mile (1,656-square-kilometer) area in Santa Barbara County and the coastal Pacific waters. The primary goal of the SHIFT campaign was to collect a repeated dense time series of airborne Visible to ShortWave Infrared (VSWIR) airborne imaging spectroscopy data with coincident field measurements in both inland terrestrial and coastal aquatic areas, supported in part by a broad team of research collaborators at academic institutions. The SHIFT campaign leveraged NASA's Airborne Visible-Infrared Imaging Spectrometer-Next Generation (AVIRIS-NG) facility instrument to collect approximately weekly VSWIR imagery across the study area. The SHIFT campaign 1) enables the NASA SBG team to conduct traceability analyses related to the science value of VSWIR revisit without relying on multispectral proxies, 2) enables testing algorithms for consistent performance over seasonal time scales and end-to-end workflows including community distribution, and 3) provides early adoption test cases to SHIFT application users and incubate relationships with basic and applied science partners at the University of California Santa Barbara Sedgwick Reserve and The Nature Conservancy's Jack and Laura Dangermond Preserve.

Acknowledgement

SHIFT is jointly led by NASA's Jet Propulsion Laboratory, The Nature Conservancy, and the University of California, Santa Barbara (UCSB).

2. Data Characteristics

Spatial Coverage: Santa Barbara Museum of Natural History Sea Center at Stearns Wharf, Santa Barbara, California, U.S.

Spatial Resolution: Single location

Temporal Coverage: Measurements were made on the following eight days: 2022-04-05, 2022-04-12, 2022-04-20, 2022-04-29, 2022-05-03, 2022-05-11, 2022-05-17, 2022-05-29. Future updates will include data from 2022-09-15.

Temporal Resolution: Variable, but all dates are concurrent with SHIFT overpasses.

Study Area: Latitude and longitude are provided in decimal degrees.

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Santa Barbara Museum of Natural History Sea Center at Stearns Wharf, Santa Barbara, California, U.S.	-119.686	-119.6818	34.4106	34.41038

There are four files in this dataset: one file in comma-separated values (.csv) format holding calculated reflectance values and three compressed zip archives (.zip) holding raw sensor measurements in CSV format.

Ramses_SHIFT_Rrs.csv: holds with calculated remote sensing reflectances (R_{rs}) in 10 second intervals. Each row is an individual spectrum.

The three zip archives hold raw measurement data collected by the three Ramses TriOS sensors on eight dates.

- **Irrad_TriOS_SHIFTv2.zip**: measurments of solar downwelling irradiance (E_d)
- **Sky_TriOS_SHIFTv2.zip**: measurments of sky radiance (L_s)
- **Water_TriOS_SHIFTv2.zip**: measurments of water-leaving radiance (L_w)

Each zip archive has eight files that hold data translated from the proprietary format output by the Ramses TriOS instrument and saved in comma-separated values (CSV) format. Within each zip archive, the file naming convention is **mmddyy_variable_TriOS_SHIFTv2.csv**, where

- *mmddyy* = date of meaurement in month, day, and two-digit year: 040522, 041222, 042022, 042922, 050322, 051122, 051722, or 052922
- *variable* = measured variable**:** "Irrad" = solar downwelling irradiance (E_d), "Sky" = sky radiance (L_s), or "Water" = water-leaving radiance (L_w).

Example file name: *052922_Water_TriOS_SHIFTv2.csv* (in Water_TriOS_SHIFTv2.zip).

Variables in the data files

Table 1. Variables in the file **Ramses_SHIFT_Rrs.csv**. Several fields were included to maintain compatibility across several SHIFT spectral datasets. Each row represents a single remote sensing reflectance spectrum (unitless). Measurements from each date were taken in 10 second intervals.

Column Number	Column Name	Units/format	Description
1	unique_id	-	The unique id for that individual spectrum. The id is the date_utc value and the sample number on that given date separated by an underscore
2	date_utc	YYYY-MM-DD	Date of collection
3	time_local	hh:mm:ss	Time of collection in US/Pacific timezone

4	datetime_utc	YYYY-MM-DD hh:mm:ss	Date time of collection in UTC
5	instrument	-	The instrument used for in-situ field collection. All rows should read "ramses_trios "
6	latitude	degree north	Latitude coordinate for location in decimal degrees
7	longitude	degrees east	Longitude coordinate for location in decimal degrees
8	target_type	-	Type of surface measured. All should read "water"
9	measurement_type	-	Denotes the spectral type. All should read "remote_sensing_reflectance"
10	site_id	-	Site description as text. All should read "santa_barbara_pier"
11	light_source	-	The light source for spectral measurements. All should read "sun"
12	lab	0/1 (no/yes)	Indicates if the measurement was taken in a lab or not. All should read "0"
13- 203	320 – 951	sr^{-1}	Remote sensing reflectance values (R_{rs}); the numbers in the column names refer to the wavelengths in nanometers in 3-nm intervals

Sensor measurements: The 24 CSV files in the zip archives have a wavelength column folllowed by columns holding the measured solar downwelling irradiance (E_d), sky radiance (L_s), or water-leaving radiance (L_w). The name of each column holding measured values is the date and time of collection formatted as YYYY-MM-DD_hh-mm-ss.

The units for measured values are:

- solar (downwelling) irradiance (E_d): $W\ m^{-2}$
- sky radiance (L_s): $W\ m^{-2}\ sr^{-1}$
- water-leaving radiance (L_w): $W\ m^{-2}\ sr^{-1}$

Table 2. Example data from the file 052922_Water_TriOS_SHIFTv2.csv in Water_TriOS_SHIFTv2.zip.

Wavelength	2022-05-29_11-00-10	2022-05-29_11-00-20	2022-05-29_11-00-30
310	0	0	0
313	0	0	0
317	0	0	0
320	1.261890281	1.317099392	1.2714787
323	1.579225378	1.665510283	1.614270043
327	1.92706751	2.024282722	1.964082507

3. Application and Derivation

This dataset was collected to validate atmospheric correction procedures over water targets in the SHIFT flight box.

4. Quality Assessment

No uncertainty analysis was conducted, but measurements were screened for atmospheric noise, wave action, and glint. Measurements corresponding to atmospheric noise and clouds were discarded (those with low downwelling sky irradiance (Ed) at 524 nm < 50 $W\ m^{-2}$). Data contaminated by sun-glint and wave actions were removed (water-leaving radiance where (Lw) at 685 nm > Lw 709 nm).

5. Data Acquisition, Materials, and Methods

This dataset provides remote sensing reflectance (R_{rs}) measurements collected with a Ramses TriOS radiometer (Figure 1) deployed at the Santa Barbara Museum of Natural History Sea Center at Stearns Wharf, Santa Barbara, California, U.S. All measurements were taken over a fixed position at (34.41037665, -119.68557147). The TriOS collects a set of three measurements: solar (downwelling) irradiance (E_d) in $W\ m^{-2}$, sky radiance (L_s) in $W\ m^{-2}\ sr^{-1}$ and water-leaving radiance (L_w) in $W\ m^{-2}\ sr^{-1}$. The data have been processed to R_{rs} at 10 second intervals and screened for atmospheric noise and clouds. Processed R_{rs} measurements (Ramses_SHIFT_Rrs.csv**)** and the measurements from all three sensors (E_d, L_s, and L_w) are included as zip archives. All measurements are either concurrent or taken within 2.5 hours of SHIFT campaign overflights on 2022-04-05, 2022-04-20, 2022-04-29, 2022-05-03, 2022-05-11, 2022-05-17, and 2022-05-29

The data were processed following Simis and Olsson (2013). The measurements were screened for atmospheric noise and clouds: radiometer measurements that corresponded to a low downwelling sky irradiance (E_d at 524 nm < 50 $W\ m^{-2}$) were discarded. Next, data contaminated by sun glint and wave actions were screened by removing all measurements that corresponded to a measurement of water-leaving radiance where L_w at 685 nm > L_w 709 nm.

Remote sensing reflectance (R_{rs}) was then calculated from E_d, L_s, and L_w (eq 1):

$$Rrs = \frac{(L_w - \rho_s L_s)}{E_d}$$

Where ρs is a constant that accounts for sea surface roughness, sensor viewing geometry, and the direct and diffuse fractions of downwelling sky irradiance (Simis and Olsson, 2013). The ρs constant was set to 0.028, following Mobley (1999), who determined this as the optimal value for view angles between 30 and 40 degrees. This calculation removes the sky radiance contribution to the measured water-leaving radiance and normalizes it to the solar (downwelling) irradiance. Finally, R_{rs} data were screened for a second sunglint removal by removing all R_{rs} values where [R_{rs} at 582 nm / R_{rs} at 678 nm] > 200 Simis and Olsson (2013).

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

SHIFT: Ramses Trios Radiometer Above Water Measurements, Santa Barbara Sea, CA

Contact for Data Center Access Information:

- E-mail: uso@daac.ornl.gov
- Telephone: +1 (865) 241-3952

7. References

Mobley, C.D. 1999. Estimation of the remote-sensing reflectance from above-surface measurements. Applied Optics 38 **:**7442-7455 https://doi.org/10.1364/AO.38.007442

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