The Automated Satellite Data Processing System

SeaWiFS Processing

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Chapter 1. Introduction

The SeaWiFS sensor was launched in 1997 and has collected ocean color data for over 10 years. The satellite is owned and operated by GeoEye with NASA procuring the majority of the data.

Spacecraft Descrition

The SeaStar spacecraft, developed by OSC, carries the SeaWiFS instrument and was launched to low Earth orbit on board an extended Pegasus launch vehicle on August 1, 1997. The SeaWiFS instrument will be the only scientific payload on the SeaStar spacecraft. OSC has the sole responsibility for the development, launch, and command and control of the satellite. The development of the SeaWiFS instrument was subcontracted to Hughes/SBRC, but OSC maintains ultimate responsibility for the instrument.

Currently, the Pegasus is flown aloft under the body of a modified Lockheed L\-1011 aircraft and released at an altitude of about 39,000 ft, whereupon the launch vehicle engages and lifts the spacecraft to a low Earth, circular, parking orbit of 278 km with an inclination of 98 degree 20 minute. The solar panels are deployed at this time which along with the batteries, are the sensor's power source.

The SeaStar spacecraft has an onboard hydrazine propulsion system that is then used to raise the satellite to its final 705 km circular, noon, sun-synchronous orbit. The final orbit is reached approximately 20 days following launch. The launch is presently planned to occur from the U.S. West Coast during daylight hours, although launch from the East Coast is under consideration. At 25 days after launch, the SeaWiFS instrument is powered up and checked out. At launch plus 30 days, data collection operations commence.

The attitude control system (ACS) must be capable of maintaining the 705 km noon, sun-synchronous orbit, performing lunar and solar calibration maneuvers, and providing attitude knowledge within one SeaWiFS pixel. The three-axis stabilized system consists of orthogonal magnetic torque rods for roll and yaw control and two momentum wheels for pitch stabilization. Sensors include redundant sun sensors, horizon sensors, and magnetometers.

The propulsion system consists of two subsystems, a reaction control system, band a hydrazine propulsion system. The reaction control system uses nitrogen and provides third stage stabilization during the launch. The hydrazine propulsion system is used for raising the orbit from the nominal 278 km parking orbit to the 705 km sun-synchronous operational orbit. In addition, it is used for orbit trim requirements over the life of the mission. Four Hamilton Standard one pound thrusters are being used.

Two telemetry streams are transmitted. The first is real-time LAC data merged with spacecraft health and instrument telemetry at 665.4 kbps. This is transmitted at L-band with a frequency of 1702.56 MHz. The other telemetry stream consists of stored GAC and selected LAC, along with spacecraft health and instrument telemetry, at 2.0 Mbps. This is transmitted at S-band with a frequency of 2272.5 MHz. The command system uses S-band with an uplink of 19.2 kbaud at 2092.59 MHz.

Redundant global positioning system (GPS) receivers will be used for orbit determination. The orbit state derived from this is included in the spacecraft health telemetry.

Sensor Description

The SeaWiFS instrument has been modified to produce a bilinear response; the original sensitivity is maintained up to about 80% of the digital output range, and then changed discontinuously to extend the dynamic range substantially; the net result is no expected saturation over clouds (or bright sand, ice, etc.). For example, in the original design, Band 1 saturation (1023 counts) corresponded to an input radiance of about 13.6 mW per (cm um sr), with a linear response; now the response is linear up to radiance about

10.9 (about 817 counts), and changes slope above that point so that saturation is reached at about 60.1. The complete set of gain responses has been published in the SeaWiFS Prelaunch Radiometric Calibration and Spectral Characterization Report in the SeaWiFS Project Technical Report Series.

The instrument has scanning mechanisms to drive an off-axis folded telescope and a rotating half-angle mirror that is phase-synchronized with, and rotating at half the speed of, the folded telescope. The rotating scanning telescope, coupled with the half-angle scan mirror arrangement, provides a design configuration that permits a minimum level of polarization to be achieved, without field-of-view rotation, over the maximum scan angle requirement of 58.3 degrees. The absence of field-of-view rotation permits the use of a multichannel, time-delay and integration (TDI) processing in each of the eight spectral bands to achieve the required SNR. This capability, in turn, allows a relatively small sensor collecting aperture and, therefore, results in a smaller and lighter instrument than would otherwise be required. Incoming scene radiation is collected by the folded telescope and reflected onto the rotating half-angle mirror. The collected radiation is then relayed through dichroic beam splitters to separate the radiation into four wavelength intervals - each wavelength interval encompassing two each of the eight SeaWiFS spectral bands. The radiation in the four separate wavelength intervals is directed by four corresponding aft-optics assemblies through two separate spectral bandpass filters that further separate the radiation into the eight required SeaWiFS spectral bands. The aft-optics assemblies also image each of the resultant defined bands of radiation onto four detectors that are aligned in the scan direction. The detected radiation signals are then amplified by preamplifiers for TDI processing in the electronics module. The off-axis scanning telescope rotates at six revolutions per second in the cross-track direction, for HRPT format compatibility, to provide contiguous scan coverage at nadir from a 705 km (380 nmi) orbital altitude with the SeaWiFS spatial resolution of 1.6 mrads (1.13 km or 0.6 nmi at nadir). A scanner tilt mechanism enables the instrument to be oriented in the along-track direction to +20, 0 -20 degrees to avoid sun glint from the sea surface. Tilting the entire scanner, rather than only a section of the optical train, assures that the SeaWiFS calibration, polarization, and angular scanning characteristics will be identical for all tilt positions and, thereby, simplifies the ground processing of in-flight data. Monitoring of sensor calibration over periods of a few orbits, to several months or years, is accomplished using solar calibration for the former and lunar calibration for the latter. Solar calibration uses a solar radiation diffuser and an input port located in a fixed position outside of the 58.3 degrees SeaWiFS scene-scan interval. The diffuser is located on the inside of a baffle pointed in the +y (minus velocity vector) direction. The diffuser will be covered with an aperture plate with numerous small holes that will adjust the diffuser system output to the required level and minimize diffuser surface degradation from contamination or ultraviolet exposure. The diffuser is located so calibration will take place near the southern terminator. Lunar calibration is accomplished by a spacecraft maneuver to view the moon when the spacecraft is in the nighttime part of the orbit. The spacecraft is oriented such that the SeaWiFS scene-scan interval is 180 degrees from the normal Earth oriented position, i.e., looking outward. The lunar observation can, therefore, be accomplished under nearly full moon conditions through the identical SeaWiFS optical path as that for Earth scenes. The detected and amplified signals are routed from the scanner to the electronics module where they are further amplified and then filtered to limit the noise bandwidth. The filtered signals are digitized by a 12 bit analog-to-digital converter and the digitized signals directed to a commandable processor where the TDI operation is performed in real time as data are generated. The resultant summed signals are divided by four and rounded to 10 bit numbers, and then sent from the processor to the spacecraft data system at 1.885 Mbps during the data acquisition period of each scan line. The instrument angular momentum will be compensated by the angular momentum wheel. This is necessary to avoid nutation coupling when the instrument is tilted. Implementation will consist of a brushless DC motor driven synchronously at approximately 2,000 rpm. The accurately controlled frequency derived from the instrument clock will ensure compliance to the 1 oz-in-sec uncompensated angular momentum requirement for the spacecraft attitude control system.

Sensor Response

The SeaWiFS instrument consists of an optical scanner and an electronics module. Below is a listing of the central wavelengths and bandwidths for SeaWiFS.

Figure 1.1. SeaWiFS Sensor Response

Chapter 2. Products

Top-of-Atmosphere Products

The top-of-atmosphere products include the atmospheric properties of the total radiance at the sensor. Here, *nnn* may be one of: 412, 443, 490, 510, 555, 670, 765, 865.

Product	**Description**
Lt_*nnn*	calibrated TOA radiance at *nnn* nm
rhot_*nnn*	TOA reflectance at *nnn* nm
TLg_*nnn*	TOA glint radiance at *nnn* nm
glint_coeff	glint radiance normalized by solar irradiance
tLf_*nnn*	foam (white-cap) radiance at *nnn* nm
Lr_*nnn*	Rayleigh radiance at *nnn* nm
t_sol_*nnn*	Rayleigh-aerosol transmittance,sun to ground at *nnn* nm
t_sen_*nnn*	Rayleigh-aerosol transmittance,ground to sensor at *nnn* nm
t_oz_sol_*nnn*	ozone transmittance,sun to ground at *nnn* nm
t_oz_sen_*nnn*	ozone transmittance,ground to sensor at *nnn* nm
t_o2_*nnn*	total oxygen transmittance at *nnn* nm
t_h2o*nnn*	total water vaport transmittance at *nnn* nm
taua_*nnn*	aerosol optical depth at *nnn* nm
tau_*nnn*	same as taua_*nnn*
brdf_*nnn*	BRDF coefficient at *nnn* nm
La_*nnn*	aerosol radiance at *nnn* nm
Es_*nnn*	extra-terestrial surface irradiance at *nnn* nm
cloud_albedo	cloud albedo at 865 nm
foq_*nnn*	f/Q correction to nadir at *nnn* nm

Atmospheric Correction Products

These are derived during the atmospheric correction. Here, *nnn* may be one of: 412, 443, 490, 510, 555, 670, 765, 865.

Product	**Description**
La_*nnn*	aerosol radiance at *nnn* nm
aerindex	aerosol index
aer_model_min	minimum bounding aerosol model #
aer_model_max	maximum bounding aerosol model #
aer_model_ratio	model mixing ratio

Product	Description
aer_num_iter	number of aerosol iterations, NIR correction
epsilon	retreived epsilon used for model selection
eps_78	same as epsilon
angstrom_*nnn*	aerosol angstrom coefficents (*nnn*,865) nm
eps_*nnn*_*lll*	ratio of *nnn* to *lll* single-scattering aerosol radiances
rhom_*nnn*	water + aeorsol reflectance at *nnn* nm (MUMM)

Water-leaving Products

These are derived during the atmospheric correction. Here, *nnn* may be one of: 412, 443, 490, 510, 555, 670, 765, 865.

Product	Description
rrs_*nnn*	remote sensing reflectance at *nnn* nm
nLw_*nnn*	normalized water-leaving radiance at *nnn* nm
Lw_*nnn*	water-leaving radiance at *nnn* nm
rhos_*nnn*	surface reflectance at *nnn* nm

Geometry Products

These products include the viewing angles, location, and sensor information.

Product	Description
pixnum	pixel number
detnum	detector number
latitudes	latitudes (-90.0 to 90.0)
longitudes	longitudes (-180.0 to 180.0)
solz	solar zenith angle
sola	solar azimuth angle
senz	satellite zenith angle
sena	satellite azimuth angle

Ancillary Data Properties

The following are ancillary data properties used during the atmospheric correction.

Product	Description
windspeed	magnitude of wind at 10 meters
zwind	zonal wind speed at 10 meters
mwind	meridional wind speed at 10 meters

Product	Description
windangle	wind direction at 10 meters
water_vapor	precipital water concentration
humidity	relative humidity
pressure	barometric pressure
ozone	ozone concentration
no2_tropo	tropospheric NO2
no2_strat	stratospheric NO2

Chlorophll-a Products

Since the algorithms are general in nature, the user may modify the algorithms by defining the follow parameters for each number of band ratios. These parameters are used by **n2gen**. See the APS Ocean Color User's Guide for more information about **n2gen**.

chloc2_coeff The coefficients for the 2-band chlorophyll-a algorithm. Defaults are [0.237200,-2.45410, 1.71140,-0.339900,-2.78800].

chloc2_wave The sensor specific wavelengths for 2-band chlorophyll-a algorithm. Defaults are [489,555].

chloc3_coeff The coefficients for the 3-band chlorophyll-a algorithm. Defaults are [0.240900,-2.47680, 1.52960, 0.106100,-1.10770].

chloc3_wave The sensor specific wavelengths for 3-band chlorophyll-a algorithm. Defaults are [443,489,555]

chloc4_coeff The coefficients for the 4-band chlorophyll-a algorithm. Defaults are [0.366,-3.067, 1.930, 0.649,-1.532].

chloc2_wave The sensor specific wavelengths for 4-band chlorophyll-a algorithm. Defaults are [443,489,510,555].

Product	Description
chl_oc2	chlorophyll-a concentration using OC2 algorithm
chl_oc3	chlorophyll-a concentration using OC3 algorithm
chl_oc4	chlorophyll-a concentration using OC4 algorithm
chlor_a	chlorophyll-a concentration using OC4 algorithm
chl_stumpf	chlorophyll-a concentration using Stumpf's algorithm
chl_carder	chlorophyll-a concentration using Carder's algorithm

Diffuse Attenuation Properties

The following diffuse attenuation products are available. Here, *nnn* may be one of: 412, 443, 490, 510, 555, 670.

Product	Description
Kd_532	diffuse attenuation at 532 nm using 490/555 ratio
K_length_532	diffuse attenuation at 532 nm using 443/555 ratio
Kd_*nnn*_lee	diffuse attenuation at *nnn* nm using Lee algorithm
Kd_490_morel	diffuse attenuation at 490 nm using Morel Eq8
Kd_490_morel_ok2	diffuse attenuation at 490 nm using Morel OK2
Kd_490_mueller	diffuse attenuation at 490 nm using Mueller
Kd_490_obpg	diffuse attenuation at 490 nm using OBPG
Kd_PAR_morel	diffuse attenuation (PAR) using Morel algorithm (1st optical depth)
Kd_PAR_lee	diffuse attenuation (PAR) using Lee algorithm (1st optical depth)

Euphotic Properties

The following euphotic products are available. Here *ddd* is the percent depth from 0 to 100.

Product	Description
Zeu_lee	euphotic depth, Lee algorithm
Zeu_morel	euphotic depth, Morel algorithm
Zhd_morel	Heated layer depth, Morel algorithm
Zp_*ddd*_lee	Photic depth at *ddd*, Lee algorithm
Zsd_lee	Secchi depth, Lee algorithm
Zsd_morel	Secchi depth, Morel algorithm

SeaWiFS IOP Products

For the QAA product suite, the available wavelengths *nnn* are 414, 442, 489, 512, 557, and 670.

qaa_adg_s Define the spectral slope parameter, s, to use in the QAA algorithm. Default is 0.015.

qaa_wave The sensor specific wavelengths for QAA. For SeaWiFS, these are defined as [412,443,490,555,-1].

Product	Description
a_*nnn*_carder	total absorption at *nnn* nm using Carder algorithm
aph_*nnn*_carder	phytoplankton absorption at *nnn* nm using Carder algorithm
adg_*nnn*_carder	detris/gelbstuff absorption at *nnn* nm using Carder algorithm
bb_*nnn*_carder	backscatter at *nnn* nm using Carder algorithm
b_*nnn*_carder	total scattering at *nnn* nm using Carder algorithm
c_*nnn*_carder	beam attenuation at *nnn* nm using Carder algorithm

Product	Description
a_*nnn*_gsm01	total absorption at *nnn* nm using GSM01 algorithm
aph_*nnn*_gsm01	phytoplankton absorption at *nnn* nm using GSM01 algorithm
adg_*nnn*_gsm01	detris/gelbstuff absorption at *nnn* nm using GSM01 algorithm
bb_*nnn*_gsm01	backscatter at *nnn* nm using GSM01 algorithm
b_*nnn*_gsm01	total scattering at *nnn* nm using GSM01 algorithm
c_*nnn*_gsm01	beam attenuation at *nnn* nm using GSM01 algorithm
a_*nnn*_qaa	total absorption at *nnn* nm using QAA algorithm
aph_*nnn*_qaa	phytoplankton absorption at *nnn* nm using QAA algorithm
adg_*nnn*_qaa	detris/gelbstuff absorption at *nnn* nm using QAA algorithm
bb_*nnn*_qaa	backscatter at *nnn* nm using QAA algorithm
b_*nnn*_qaa	total scattering at *nnn* nm using QAA algorithm
c_*nnn*_qaa	beam attenuation at *nnn* nm using QAA algorithm
flag_qaa	quality flags from QAA algorithm
mod_rrs_qaa	modeled rrs at 640 nm from QAA algorithm

SeaWiFS Water Mass Classification Products

These products are used for water mass classification. In the case of these algorithms the wavelengths available are for *nnn* are 412 or 443.

The following **n2gen** parameter controls the version of the algorithm to use for output.

wmc_version The available options are **`200702`** or **`200711`**. The default is **`200711`**.

Product	Description
wmass	water mass classification using Gould algorithm
water_mass	water mass classification image using Gould algorithm
PIM_gould	particulate inorganic matter using Gould algorithm
POM_gould	particulate organic matter using Gould algorithm
TSS_gould	total suspened particles using Gould algorithm
aph_*nnn*_gould	phytoplankton absorption at *nnn* nm using Gould algorithm
asd_*nnn*_gould	sediment and detrital absorption at *nnn* nm using Gould algorithm
asd_*nnn*_gould	sediment and detrital absorption at *nnn* nm using Gould algorithm
ag_*nnn*_gould	gelbstuff absorption at *nnn* nm using Gould algorithm

Product	Description
ap_*nnn*_gould	particulate absorption at *nnn* nm using Gould algorithm
as_*nnn*_gould	sediment absorption at *nnn* nm using Gould algorithm

Chapter 3. R_{rs} Matchup

Remote sensing reflectance, R_{rs} derived from the SeaWiFS sensor are each compared with NRL's *in situ* data base of remote sensing reflectance measurements collected by hand-held spectroradiometer(s).

The results show that the blue region of the spectrum has the least correlation with the *in situ* reflectance data. As one moves toward the red portion of the spectrum, the data has a greater correlation. These differences can be associated with the residual reflectance (glint) in the *in situ* data and the atmospheric correction in the remote sensing data.

Remote Sensing Reflectance

The SeaWiFS-derived remote sensing reflectance is compared with *in situ* R_{rs} measurements processed with NRL's *in situ* data processing system.

In-situ data collection

For well over ten years, the Naval Research Laboratory collected in-situ measurements in water properties, including data from the Arabian Gulf, Mediterranean Sea, Pacific Ocean off of the Hawaiian Islands, Monterey Bay, New York Bight, and Gulf of Mexico. Due to the proximity of the Gulf of Mexico to the laboratory, the majority of the data was from this region. Since the laboratory's emphasis was the coastal ocean, much of that in-situ data collection was in the very complex Case 2 water columns.

The Naval Research Laboratory used several instruments to derive the remote sensing reflectance. This reflectance, known as "ocean color", related to the inherent optical products of the water column from which estimates of diver visibility and mine detection were derived. Thus, the remote sensing reflectance was a very important product to estimate and the primary focus of this matchup.

The instruments to collect this remote sensing reflectance were known as field spectrometers. The radiometers had spectrally high-resolution but very low spatial resolution since data collection was labor intensive. The collection required the personnel to obtain reads from the sky, water, and reference; usually a grey card. The collection had a rigorous protocol sequence, which included dark current, angle, and sea state as conditions considered and recorded by the personnel.

Once the data was collected, it was processed by Naval Research Laboratory software which implemented the equations of the NASA Ocean Color Protocols to derive the remote sensing reflectance. For each station, the plotted data (see Figure 1: Don't know) showed the three input targets (sky, water, reference) and the derived remote sensing reflectance. The resulting reflectance was written to a SIMBIOS formatted in-situ file and contained the time and location of collection as well as other metadata like the cruise, experiment, investigators, etc.

In-situ Data Base

After each cruise, all the in-situ data processed by Navy personnel was placed into a simple file-system data base stored under /projects/insitu. The database was organized by region, cruise, and instrument. It included data collected from other instruments and from laboratory work as well as the field spectrometers' data. Even though some cruises did not collect spectrometer data, more than 20 gigabytes of data was gathered in this directory of over 50 cruises and data collects.

Atmospheric Correction

The basis for the atmospheric correction used by the Automated Processing System came from the work of Gordon and Wang (1994) where they proposed computing a model of the aerosol distribution by using two bands in the near infrared. Based on the “black water pixel” assumption, the reflectance from the water column was totally absorbed and, therefore, the contribution to the total signal at the sensor was zero.

However, in the coastal regime, the introduction of more constituents into the watermass caused that assumption to be invalid. The deficiency noted early in the life span of the SeaWiFS (Sea-viewing Wide Field-of-View Sensor) introduced several attempts to correct this. The best approach identified a reflectance based method which originated out of the Naval Research Laboratory. With this approach, the “black water pixel” assumption was discarded and instead, used an iterative attempt to estimate the true water reflectance. The “Near infra-red iteration” (NIR) used the relationship between the remote sensing reflectance and the inherent-optical properties of water. Furthermore, the algorithm iteratively estimated the true water contribution. Once the water contribution was known, it was removed from the NIR bands used in the Gordon/Wang aerosol prediction.

On the other hand, based on the aerosol model suite used, the Gordon/Wang atmospheric correction was unable to distinguish absorbing aerosols from non-absorbing aerosols. Thus, following the work of Rick Stump, a correction which attempted to estimate the reflectance in the blue band (412 nm) was implemented and run on each pixel. Each pixel whose Gordon/Wang derived reflectance was lower than the estimate was assumed to have been a product of an absorbing aerosol. The over compensation by the Gordon/Wang algorithm was then backed out of the remote sensing reflectance.

Match up system

To accomplish this comparison, the developers took several steps. To begin, they examined the in-situ data base for all cruises that contained field spectrometer data which was collected during the life span of each satellite. The NRL in situ data base contained data collected several years prior to the launch of the MERIS instrument. For this report, over 30 cruises were examined but only 22 used.

As each cruise was examined, the locations of each in-situ collection were entered into an ASCII file used by imgBrowse. These “points” files were placed into the match up system in data/rs/points. Once this file wascreated, the remote sensing database was examined for all scenes that were collected during that time frame. Each satellite pass was processed and four quick look browse images were created. Using these files, the satellite data was visually examined for a match.

Complete Reflectance Data base

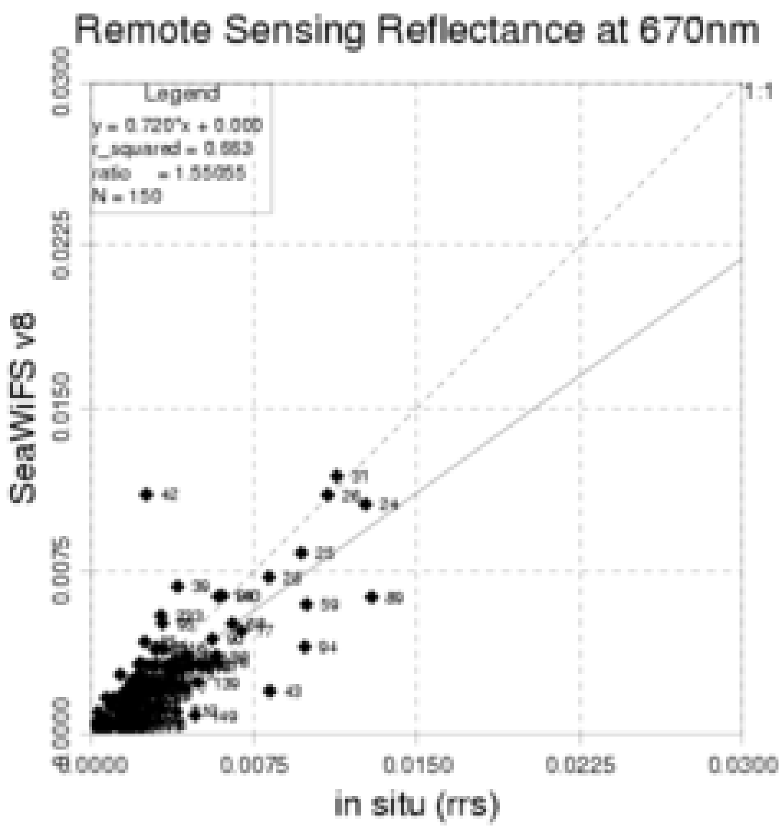
The table below shows the number of stations for each area processed.

Table 3.1. Cruise Count Chart

Cruise	Date	SeaWiFS	
Dauphin Island	November 1997	2	
SeaWiFS Verification	December 1997	4	
Tampa ECHOHAB	May 1998	8	
Biloxi	June 1999	1	
NGLI	June 1999	2	
CoJet 3	June 1999	3	
CoJet 4	June 1999	3	
NGLI	September 2001	7	
CoJet 5	March 2002	1	
CoJet 6	March 2002	6	

Cruise	Date	SeaWiFS	
CoJet 7	May 2002	7	
Horn Island	May 2005	1	
SEED	May 2005	29	
RV/Ocolor	December 2005	2	
EPA Bold	September 2006	6	
RV/Ocolor	February 2007	6	
EPA	July 2007	3	
EPA Bold	August 2007	3	
BioSpace	October 2008	10	
Leo15	July 2001	22	

Figure 3.2. SeaWiFS derived R_{rs} vs *in situ* R_{rs}



Chapter 4. Command Line Reference

Name

swfArea — determine file extents of geographical area

Synopsis

`swfArea` [-M *`mapFile`*] *`mapName`* *`ifile`*

Description

Determine the file extents (start/stop pixel/line) of a SeaWiFS file (still in sensor projection, i.e. L1A, L2, etc.) that covers a map.

SwfArea begins by reading in the map from the mapFile. If the file can not be opened or the named map is not in the file, a diagnostic is printed and the program will exit.

Next, the SeaWiFS file is opened and the navigation information initialized. If unable to open the SeaWiFS file or retrieve the navigation information from it, the program will print a diagnostic and exit. The navigation to be read includes the data sets “orb_vec”, “scan_ell”, “sen_mat”, and “tilt”.

Once the navigation has been set, **swfArea** reads in every 64th scan line, and using every 64th sample, determines if that point falls within the desired map. From this, the smallest box (modulo 64) that will cover the box will be determined. These file extents will be printed to the screen.

If the 64-sided box fails or the user has selected a refined coverage, **swfArea** will rescan the entire image (if 64-sides failed) or the box determined previously (if user selected refined coverage) using a small 5-sided box. If the file extents are found they are printed or the message “No coverage”. If the file extents are the original input file, then the message will be “Complete coverage”.

A third pass, which may be quite computer intensive, uses a reverse mapping to determine the file extents. It scans through the entire map image to determine where that pixel lies in the SeaWiFS file. For large map areas this computation can require large resources (i.e. memory and CPU time). The user can select this pass directly by using the exact option (-e) or allow it to be used after the first two passes have failed (-3).

Options

-a angle	if *angle* is defined then it is used to reduce the swath of the input image. It will reduce the image during calculation of file extents. It can be used to prevent the large pixels from the edge of the swath to be output. If angle is less than 1.1, then it is assumed to be given in radians. Otherwise it is give in degrees. A negative angle will be converted to a positive one.
-e	Do a reverse mapping from the map to the SeaWiFS file to determine its file extents. May be more computer intensive depending on the selected map.
-l	Don't output start/stop line locations
-M mapFile	Use the given map file to find mapName. Defaults to $APS_DATA/maps.hdf
-o format	output locations in desired format. Valid format is “l2gen”
-p	Don't output start/stop pixel locations
-r	Refine search to within plus or minus 5 samples/lines.
-v	Make output verbose.

-3 If passes one and two fail, use pass 3. This is mainly useful for maps that are smaller than the 5-sided box. (Why use SeaWiFS, then?)

--version Print out version and exit.

Environmental Variables

APS_DATA The location of the aps data directory.

Examples

Example of usage:

```
$ swfArea -M maps.hdf MissBight S2000144175835.L1A_HNAV
257 835 1793 2177
$ swfArea -M maps.hdf EastSea S2000144175835.L1A_HNAV
No coverage
$ export APS_DATA=/usr/local/aps/data
$ swfArea MissBight S2000144175835.L1A_HNAV
257 835 1793 2177
$ swfArea -r MissBight S2000144175835.L1A_HNAV
301 783 1849 2177
$ swfArea -o l2gen MissBight S2007259190328.L1A_HNAV
spixl=322
epixl=835
dpixl=1
sline=1729
eline=2113
dline=1
```

Name

swfInfo — query information about a SeaWiFS Level-1A file

Synopsis

`swfInfo` [*`option`*] *`swfFile`*

Description

This program is used to dump information about a SeaWiFS data file. With no options the program will print out a series of parameters. A single parameter can be single with the option. The options are succint as they were designed with shell scripting in mind.

Options

-year	4-digit year of input file.
-doy	3-digit day of year of input file.
-month	3-character month of input file. Months are `jan', `feb', `mar', `apr', `may', `jun', `jul', `aug', `sep', `oct', `nov', `dec'
-time	6-digit time (HHMMSS) of input file.
-hour	2-digit hour (HHMMSS) of input file.
-min	2-digit min (MM) of input file.
-sec	2-digit second (SS) of input file.
-start_time	start time of input file.
-end_time	end time of input file.
-name	Generate a file name in the following format as swf.YYYY.MMDD.HHMM. This is a short cut version of using -sat, -year, -doy, and -time.
-sat	3-character satellite name. Names is "swf".
-type	Character code for datatype: "LAC", "GAC", "HRPT"
--version	Print out version and exit.

Examples

Executing **swfInfo** with no options.

```
$ swfInfo S1998291133955.L1A_GAC
Filename:         S1998291133955.L1A_GAC
Starting Time:    10/18/1998 13:39, 291
Ending Time:      10/18/1998 14:19, 291
Satellite:        swf
Datatype:         GAC
```

```
Total Scans:
```

Executing **swfInfo** with a option.

```
$ swfInfo -year S1998291133955.L1A_GAC
1998
$
```

Here is how a Bourne shell script function might use **swfInfo** to set the name of the output files from the input file:

```
set_name()
{
    sat=`swfInfo -sat $1`
    yr=`swfInfo -year $1`
    jday=`swfInfo -doy $1`
    time=`swfInfo -time $1`
    file=S$yr$jday$time.L1A_HNAV
}
```