DUE Coastcolour

Technical Note

CoastColour in-situ database

Version 1.4

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The Coastcolour Team

With

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Revision History

Version	Date	Change	Author
Draft 1	30.08.2010	Initial version	K. Poser E. Mota C. Sá
Draft 2	21.07.2011	Revision of all chapters	K. Poser
Draft 3	30.08.2011	Revision of the whole document	CoasctColour Core Team and Data Provider

Contents

1 SCOPE OF THIS DOCUMENT

This document is a Technical Note for the ESA DUE CoastColour project, aiming at characterising the in-situ data assembled for the CoastColour (CC) activities. The data were provided by different champion users and have been quality checked for their usability.

The Technical Note gives an overview of what has been provided by users to date, including measurement protocols/conditions adopted/encountered by the Data Providers (DPs) and details of how the individual datasets have been combined together. Further data is expected to be available but will not be accounted for in this document.

2 INTRODUCTION

The importance of the coastal zone for economic activities, and the anthropogenic stresses on the ecosystem, have been described and discussed widely throughout the past 20 years. Responding to this, ESA designed the MERIS instrument specifically to provide measurements most suitable for coastal zone management and research. In space for 8.5 years, MERIS has delivered a unique global dataset of coastal zones at 300m spatial resolution, which deserves dedicated processing with the most advanced algorithms, and provision of products targeted to specific user needs, properly documented and easily accessible.

The European Space Agency has launched the CC project to work towards these objectives by developing, demonstrating, validating and intercomparing different Case 2 algorithms over a global range of coastal water types, identifying best practices, and promoting discussion of the results in an open, public form. CC will fully exploit the potential of the MERIS instrument for remote sensing of coastal zone water. The product requirements have been derived from a user consultation process and have been translated into algorithm requirements.

Following the User Consultation Meeting 2 held in Frascati, between the 17-19 October 2010, many users decided to provide in-situ data from their site to the CoastColour team. In total, data has now been made available for 17 of the 27 CoastColour test sites, and contain information about water constituents, their concentrations, and in some cases also water radiometry. This data has been quality-checked and now provides a comprehensive, homogeneous set of data with more than 1,200,000 measurement records. A summary of the data will be made available on the CoastColour website soon.
These user-provided in-situ data are of major importance for the project, as they are used both for algorithm development or to build a basis for the regional algorithm calibration. The in situ data available for project activities will be described in this document.

3 AVAILABLE IN SITU DATA FOR 'LOOK FOR MATCHUPS' - OVERVIEW

Many users decided to support CoastColour with a set of in situ measured data. These build very diverse sets of data, which had to be quality checked and harmonised in a first step. Quality check was done by Vanda Brotas and collegues from the Centre of Oceanography of the University Lisbon (CO, Lisbon).
Depending on the application purpose, the data have to meet certain requirements. In-situ measurements are used within the Round Robin (RR) exercise, for algorithm development or for validation. While restrictions are less tight for algorithm development, they have to fullfill specific requirements to be a potential candidate for a matchup dataset used for algorithm validation. A look for matchups (LFM) list was created including all measurements from 2005 onwards taken at the surface, or at the lowest measurement depth to a maximum of 5m, with complete metadata information: date, time, latitude and longitude (DTLL).

A total of 1,280,203 records were assembled from various champion users, including ferry box data. The following Data Provider (DPs) contributed for this dataset:

- Australian Commonwealth Scientific and Research Organization (CSIRO)
- Council for Scientific and Industrial Research (CSIR)
- Center for Environment, Fisheries & Aquaculture Science (CEFAS)
- College of Oceanic and Atmospheric Sciences - Oregon State University (COAS-OSU)
- European Marine Ecosystem Observatory (EMECO)
- French Research Institute for Exploration of the Sea (IFREMER)
- Geographic Resource Analysis & Science Ltd (GRAS)
- Hellenic Centre for Marine Research (HCMR)
- Helmholtz-Zentrum Geesthacht, Centre for Materials and Coastal Research, Germany (HZG – GKSS - Forschungszentrum Geesthacht GmbH)
- Institute for Computational Earth System Science, University of California at Santa Barbara (ICESS UCSB)
- Instituto de Ciencias Marinas de Andalucia (CSIC)
- International Institute for Geo-Information Science and Earth Observation (ITC)
- Japan Aerospace Exploration Agency (JAXA)
- Korea Ocean Research and Development Institute (KORDI)
- Leibniz Institute for Baltic Sea Research Warnemünde (IOW)
- Marine Institute of Ireland (MII)
- Mississippi State University (MSU)
- National Aeronautics and Space Administration (NASA)
- Norwegian Institute for Water Research (NIVA)
- National Oceanic And Atmospheric Administration (NOAA)
- Plymouth Marine Laboratory (PML)
- University of Cantabria (UNICAN)

The data cover a time frame from 01.01.2005 (Site 1) to 31.10.2010 (Site 7) and spans over 17 of the 27 CC test sites in variable amounts (Table 1).

Table 1: Number of available data for 17 of the 27 CoastColour Site(s)

No	*Name of the site*	*Total No of measurements*
1	North Sea, English Channel, Bay of Biscay, Celtic Sea	1274686
2	Baltic	10
3	Eastern Mediterranean & Black Sea	483
4	Morocco (Atlantic and Mediterranean coasts of Morocco)	688
5	Acadia	76
6	Chesapeake Bay	81
7	Oregon and Washington	457
8	Plumes & Blooms	477
9	Puerto Rico	11
10	Benguela	136
11	China, Korea, Japan	626
12	Great Barrier Reef	78
14	Indonesian Waters	1583
17	Cape Verde	8

20	Central California	650
25	Tasmania	21
26	Gulf of Mexico	47

4 ACRONYMS AND UNITS OF AVAILABLE PARAMETERS

Chapter 4 contains the list of all available in-situ measured parameters present in LFM database, as well as its units. The variables are grouped into Metadata, Radiometric Data, IOPs and Biogeochemical optical data, and from now on we will mainly use the acronyms.

METADATA		
Wind_Speed	Wind Speed	[m/s]
Wind_Direction	Wind Direction	[degree]
Cloud_Cover	Cloud Cover	[%]
Secchi_Depth	Secchi Depth	[m]
Measurement_Depth	Measurement Depth	[m]
Water_Depth	Water Depth	[m]
Conductivity	Conductivity	[mS/cm]
Temperature	Temperature	[°C]
Light Transmission Chelsea 470nm	Light Transmission Chelsea 470nm	[%]
Light Transmission Chelsea 670nm	Light Transmission Chelsea 670nm	[%]
MLD	Mixed Layer Depth	[m]
RADIOMETRIC DATA		
kdXXX	Spectral downwelling irradiance Attenuation Coefficient at wavelength XXX	[1/m]
EdXXX	Downwelling irradiance at wavelength XXX	[uW/cm^2/µm]
LuXXX	Upwelling irradiance at wavelength XXX	[uW/cm^2/µm/sr]
LwXXX	Water Leaving Radiance at wavelength XXX	[uW/cm^2/µm/sr]
nlwXXX	Normalized water leaving radiance at wavelength XXX	[-]
Esxxx	Incident Irradiance at wavelength XXX	[uW/cm^2/µm]
RrsXXX	Remote Sensing Reflectance at wavelength XXX	[1/sr]
Color (mg Pt/l (a 460 nm m-1))	Color	[mg Pt/l (a 460 µm/m)]
IOPs (INERENT OPTICAL PROPERTIES)		
NAP	Non Algal Particulate Matter	[1/m]
apXXX	Particle Absorption Coefficient at wavelength XXX	[1/m]
aphXXX	Phytoplankton Absorption Coefficient at wavelength XXX	[1/m]
adXXX	Non-Pigmented Particle Absorption Coefficient at wavelength XXX	[1/m]

agXXX	Dissolved Material Absorption Coefficient at wavelength XXX [1/m]
a_NAP440	Non Algal Absorption Coefficient at wavelength XXX [1/m]
aXXX	Absorption Coefficient at wavelength XXX [1/m]
bXXX	Scattering Coefficient at wavelength XXX [1/m]
bpXXX	Particle Scattering Coefficient at wavelength XXX [1/m]
b_NAP555	Non Algal Scattering Coefficient at wavelength XXX [1/m]
bbXXX	Backscattering Coefficient at wavelength XXX (fit) [1/m]
bbpXXX	Particle Backscattering Coefficient at wavelength XXX (fit) [1/m]
bb_NAP555	Non Algal Backscattering Coefficient at wavelength XXX [1/m]
bbrXXX	Backscattering Coefficient at wavelength XXX (original) [1/m]
bb/bXXX	Backscattering ratio [-]
cp670	Particle Attenuation Coefficient at wavelength 670 [1/m]
cXXX	Beam Attenuation Coefficient at wavelength XXX [1/m]
BIOGEOCHEMICAL OPTICAL DATA	
Salinity	Salinity [psu]
Density	Density [sigma]
turbNTU	Turbidity: Nephelometric Turbidity Units
turbFNU	Turbidity: Formazine Nephelometric Units
turbFTU	Turbidity: Formazin Turbidity Unit
SPM/ss/ STM	Suspended Particulate Matter / Suspended solids / Total Suspended Matter [mg/l]
SIPM	Suspended Inorganic Particulate Matter [mg/l]
SOPM	Suspended Organic Particulate Matter [mg/l]
CDOM Flurescence	CDOM Flurescence
chl_a	Chlorofill a by Fluorometric Method [mg/m^3]
sig_t	sigma t (density of sea-water at a given T) [gc/m^3]
Si	Silicon [uM]
SiO4	Silicate [uM]
PO4	Phosphate [uM]
NO2	Nitrite [uM]
NO3	Nitrate [uM]
NH4	Ammonium [uM]
Cilicic acid	Cilicic acid
DissO2	Dissolved Oxygen [umol/kg]
DissOrgN	Dissolved Organic Nitrogen [umol/kg]

DissOrgC	Dissolved Organic Carbon	[umol/kg]
F(z)	Fluorescence Intensity in situ profile F(z)	arb. units
TOC	Total Organic Carbon	[mg/l]
POC	Particulate Organica Carbon	[mg/l]
kpar	Diffuse downwelling coefficient for PAR (Photosynthetically Available Radiation)	
z_YY	Depth of YY% light level of PAR [m]	[m^{-1}]
pDA	Particulate Domoic Acid	[ng/L]
O2.Conc	Oxygen Concentration	[mg/l]
High Performance Liquid Chromatography (HPLC)		
Phaeo	Phaeo pigments	[mg/m^3]
t_chl_a	total chlorophyll a of HPLC data products	[mg/m^3]
chlide_a	chlorophyllide a	[mg/m^3]
mv_chl_a	monovinyl chlorophyll a	[mg/m^3]
dv_chl_a	divinyl chlorophyll a	[mg/m^3]
chl_c3	chlorophyll c3	[mg/m^3]
chl_c2	chlorophyll c2	[mg/m^3]
chl_c1c2	chlorophyll c1 + chlorophyll c2	[mg/m^3]
chl_b	chlorophyll b	[mg/m^3]
pras	prasinoxanthin	[mg/m^3]
alpha-beta-car	alpha-carotene + beta-carotene	[mg/m^3]
Chl-a allomer total	Chl-a allomer total	[mg/m^3]
Chl-a epimer	Chl-a epimer	[mg/m^3]
Pigments PSC		
Perid	Peridinin	[mg/m^3]
But-fuco	Butfucoxanthin	[mg/m^3]
Fuco	Fucoxanthin	[mg/m^3]
Hex-fuco	Hexfucoxanthin	[mg/m^3]
Pigments PPC		
Viola	Violaxanthin	[mg/m^3]
Neox	Neoxanthin	[mg/m^3]
Diadin	Diadinoxanthin	[mg/m^3]
Allo	Alloxanthin	[mg/m^3]
Diato	Diatoxanthin	[mg/m^3]

Zea	Zeaxanthin	[mg/m^3]
BB Carot	beta-beta carotene	[mg/m^3]
Lut	Lutein	[mg/m^3]

PHYTOPLANKTON (Counts per mL at surface)	
Flagellates (Phyto)	Flagellates (Phyto)
Diatoms	Diatoms
Phaeocystis	Phaeocystis
Coccolithophorids	Coccolithophorids
Dinoflagellates	Dinoflagellates
Heterotroph-Dinophyceae	Heterotroph-Dinophyceae
Ciliates	Ciliates
Total phyto	Total phyto
PHYTOPLANKTON Contribution	
%Flagellates (Phyto)	% Flagellates (Phyto)
%Diatoms	% Diatoms
%Phaeocyst	% Phaeocyst
%Coccolith	% Coccolith
%Dinoflag	% Dinoflag
%Heterot Flagellates	% Heterot Flagellates

5 AVAILABLE DATA PER SITE

This chapter characterises all in situ data for potential matchups per site, besides some general information about user's equipments and measurements methodologies. LFM data statistics are described in the text (min, max, distribution, etc.) and some parameters are presented in detail in the figures of ANNEX 1: HISTOGRAMMS. The possibilities for algorithm validation purposes are also analysed in this chapter. This is done by checking the data for CC output parameter (biogeochemical optical parameters and AOPs, e.g. Chl_a, TSM, kd, a_443, bb_443) for which there is a contemporary radiometric measurement: Lw (water leaving radiance), nLw (normalised water leaving radiance) or Rrs (remote sensing reflectance).

5.1 Site 1: North Sea, English Channel, Bay of Biscay, Celtic Sea, Irish Sea, Southern Brittany

5.1.1 Overview

For Site 1 there are 1274686 possible available match-ups points (Figure 1), received from nine different users: EMECO, HZG, IFREMER, IOW, MII, NIVA, NOMAD, PML and UNICAN.

In this area LFM includes data collected between January 2005 and July 2010, although, there are some significant differences in measurements number and data periods between DPs. The months with more records are between May and August, inclusive, and October, each one with more than 100000 available DTLL points. The year with more available measurements is 2008 (373191 LFM points), which lies between 6941 LFM points, in September, and 130620 LFM points, in May [Table 2].

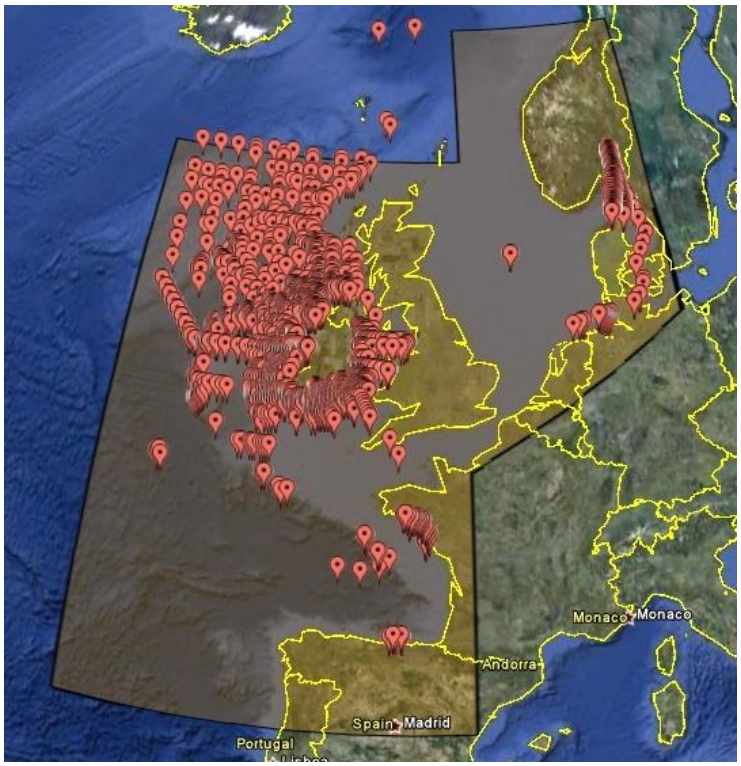


Figure 1: Site 1 - location of LFM points over Google Earth

Table 2: LFM Site 1 temporal availability

LFM Site1	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EMECO	9473	856	1250	610	696	1024	741	1016	944	546	720	663	407
GKSS	48				4	12	5	11		6	10		
IFREMER	2162	99	96	107	148	243	372	295	212	193	198	110	89
IOW	2								2				
MII	3133	482	473	71	211	451	441	195	158	176	309	148	18
NIVA	1259616	73062	73628	84009	84107	220896	113705	104046	112972	97826	107730	95722	91913
NOMAD	6										6		
PML	218	16	20	20	20	18	23	19	17	23	19	13	10
UNICAN	28							28					
2005	262770	375	476	257	13095	28893	35070	35274	30609	24999	29742	31492	32488
2006	337016	29418	25827	29898	27737	30140	33641	35029	27209	29628	29400	19748	19341
2007	300196	31504	21088	23249	20135	32754	28838	13498	25381	37121	31158	24947	10523
2008	373191	13108	27761	31359	24076	130620	17515	21695	31038	6941	18597	20417	30064
2009	1076	107	188	25	59	108	200	72	68	81	95	52	21
2010	437	3	127	29	84	129	23	42					
TOTAL	1274686	74515	75467	84817	85186	222644	115287	105610	114305	98770	108992	96656	92437

Site 1 has many available products and, like in date, they differ between DPs. Table 3 gives a summary of the key parameters available for this site, as well as the responsible institute which provided the data.

Among different parameters, there are also different measurements taken along the wavelength spectrum. Kd measurements are available at wavelengths 411, 443, 489, 510, 530, 555 and 590nm;

Lw and Es were measured at 411, 443, 489, 510, 530, 555, 590, 619, 665 and 683 nm; Rrs at each 2.5 nm intervals, between 350 and 850nm. Most of ap data are at wavelength 412, 442, 490, 510, 560, 620, 665, 681 and 705 nm, the same for aph, ad and ag; bp was measured at 412, 440, 488, 510, 532, 555, 650, 676 and 715 nm, and bbp at 470, 532 and 660 nm. The available bb for LFM are five records measured at 20 different wavelengths, among them eight corresponding to the first eight MERIS bands (411, 443, 489, 510, 560, 619, 665 and 683 nm); bbr was measured at fewer wavelengths, only eight, 420, 442, 470, 510, 550, 589, 620 and 671 nm.

Table 3: Site 1 – Data overview

Data Provider	Contact point	Key parameters	Notes
EMECO	Rodney Forster (CEFAS)	Chla	date are averaged hourly
HZG	Roland Doerffer and Friedhelm Schröder	Rrs, TSM, ISM, OSM and t_chl_a	
IFREMER	Francis Gohin	Chla, TurbNTU and turbFNU	
IOW	Herbert Siegel	ap, aph, ad, ag, TSM and chla	
MII	Guy Westbrook	N/A	
NIVA	Are Folkestad	T_chl_a, turbFNU and F(z)	All data have been quality controlled; F(z) can be used as a proxy of chla concentration.
NOMAD	P. Jeremy Werdell and Bryan Franz	Kd, Lw, ap, ad, bb, bbr, chla, t_chl_a,POC, z_37, z_10 and z_01	
PML	Victor Martinez	ag, ap, aph, ad, TSM, t_chl_a and F(z)	'11:00' is a default sampling time
UNICAN	Ana Silió-Calzada	Water and measurement depth, secchi depth, TSM, chla and Turbidity FTU (as FNU).	

Also important in data analysis, is the information of equipment used for taking the measurements and the methodologies applied for the collection and evaluation of data processing. Methodologies can be found in more detail in users publications, Table 4 gives a brief summary of the known methodologies used for the acquisition of chlorophyll a, radiometric parameters Lw and Rrs and absorption (ap, ad, aph and ag) in Site 1 area.

Table 4: Summary of essential aspects of measurements protocols of key parameters on Site 1

Data Provider	chla	lw	Rrs	abs
EMECO	Both laboratory fluorometric method and in vivo fluorescence	N/A	N/A	N/A
HZG	HPLC	N/A	Abovewater, z45° /a135° (Lu+, Lsky[1], Ed+) 1*TriOS RAMSES	N/A
IFREMER	Fluorometric method	N/A	N/A	N/A
IOW	Fluorometric method	N/A	N/A	ap, ad and aph: filter method, ß=2.0 (ESA-Validation Protocol), filtration on 0.25mm filters; ag: GF/F filtration on 2007 and 0.2µ filtration on 2009
MII	N/A	N/A	N/A	N/A
NIVA	HPLC	N/A	N/A	N/A
NOMAD	Fluorometry and HPLC measurements	Data collected by different users. Database includes radiometric dataquality checked according to [5]		Database only includes data collected following OBPG defined protocols [6]
PML	HPLC Extraction method: acetone containing an internal Standard (apo--carotenoate), sonification for 30 s and centrifugation for 5 min at 4000 rpm	N/A	N/A	WETLabs ac-9+
UNICAN	MET APHA 10200H	N/A	N/A	N/A

[1] Lsky – sky radiance

5.1.1.1 EMECO

Data were imported from site: http://www.emecodata.net/ (2010, December 15th), following the selections:

Date: 1-Jan-2000 to 30-Jun-2010,

Data Output Type: CSV (Comma Separated Value),

Average: Don't average,

Regions: all (three: EMECO Coarse rid, Charting Progress 2 – CP2 UK marine waters, and OSPAR Area II – Greater North Sea),

Parameters: Chlorophyll (µg/l), Fluorescence (arb. Units), Nitrate (µmol/l), Oxygen Concentration (mg/l), Salinity and Temperature (ºC),

Platforms: Research Vessel and SmartBuoy: calibrated archive data and near real-time data.

Data Processing: Research Vessel data source is ICES (International Council for the Exploration of the Seas) Oceanographic Data Centre, the data are averaged hourly for each station surveyed, have assessment quality and have been checked by a designated operator. SmartBuoy data source is CEFAS (Center for Environment, Fisheries & Aquaculture Science); the SmartBuoy calibrated archive have a daily temporal resolution of 0.5 hourly, but the data are daily averaged for each fixed buoy, although, they also have quality control (assessment quality and have been checked); on the other hand, SmartBuoy near real-time data, with 2 hours temporal resolution but also daily averaged, don't have assessment control [1]. From EMECO web page three files were created relating each one to the region selected: 'Emeco_CoarseGriddata_till30Jn10_15Dz10.csv', 'Emeco_CP2data_till30 Jn10_15Dz10.csv' and 'Emeco_OSPARdata_till30Jn10_15Dz10.csv'. Then, the files were compiled (using Matlab) to have a unique DTLL line with all measurements/variables. Geographic coordinates of these data were only provided with one decimal value and some measurements seem to be over land.This matter was already discussed with the user and there will be an update of the coordinates values to three decimal values. From EMECO data there are 9473 available DTLL points for LMF (2.66% of the total EMECO data).

5.1.1.2 HZG

Date: 20-04-2005 to 26-07-2006,

Region: North Sea,

Parameters: Rrs, TSM, ISM, OSM and t_chl_a,

Platform: Ferry cruises between Cuxhaven and Helgoland,

Data Processing: A TRIOS RAMSES radiometer system was used to determine the water leaving radiance reflectance spectrum, and the instruments were mounted at the bow of the ship to avoid the ship induced foam and to minimize shading/reflections by the ship's hull. One radiometer was pointing to the sea surface under an angle of 45 degrees with an azimuth angle of about 130-140 degrees with respect to the sun, the second radiometer pointed to the sky under the same angles and the third radiometer measured the downwelling irradiance. Rrs were then computed with this measurements, together with the specular reflectance of the water surface according to Fresnel law, using a wavelength dependent refractive index for the mean salinity along the transect. Some water samples were collected along the transect which were analysed in the laboratory of the Biologische Anstalt on Helgoland, for dry weight of suspended matter and chlorophyll a + degradation products concentration [2].

5.1.1.3 IFREMER

Date: 31-03-2003 to 15-02-2010,

Region: Armorican Shelf,

Parameters: Temperature, chla, turbNTU and turbFNU Units,

Platform: REPHY (REseau PHYtoplancton) surveillance network,

Data Processing: In situ data provided were extracted from the surveillance network: the REPHY (REseau PHYtoplancton). Chlorophyll data are mostly obtained from fluorimetry in laboratory and quality controlled. From IFREMER to CC project there are 2162 LFM points from 36 different locations.

5.1.1.4 IOW

Date: 13-08-2009 and 18-08-2009,

Region: Baltic Sea,

Parameters: Wind Speed, Wind Direction, Cloud Cover, Measurement Depth, Water Depth, ap, aph, ad, ag, TSM, chla and Phaeo,

Platform: Cruise campaigns,

Data Processing: IOW Absorption data (ap, ad, aph) were retrieved with the filter method, using ß=2.0 (ESA-Validation Protocol) and filtration on 0.25mm filters. For Cdom Absorption in 2007 Gf/F filters were used and in 2009 changed for 0.2µ filtration. Temperature and salinity were measured using CTD Sea Bird, validated data and Chlorophyll a determined by Fluometric method.

Radiometry profile data were provide by user but not extrapolated to surface, and therefore it was decided not to include these data in the database.

5.1.1.5 MII

Date: 12-01-2005 to 04-07-2010,

Region: between Slabes d'Olonne Canyon and Penmarc'h Canyon, North Sea, Faroe Islands and arround Ireland and North of Ireland,

Parameters: Temperature and Salinity,

Data Processing: MII only sent Temperature (2208676 records) and Salinity (1760901 records) data that were collected in two different ways: underway data (most of the measurements, about 99.85%) and topmost values from CTD casts. To LFM database only the latter ones were considered, although even with no other key parameters available. Salinity is of variable quality prior to 2008 [3].

5.1.1.6 NIVA

Date: 06-01-2003 to 30-12-2008

Region: Oslo fjord and the Skagerrak,

Parameters: Temperature, t_chl_a, salinity, turbFNU and F(z),

Platform: Ferrybox system operating on ships of opportunity (Color Festival, Prinsesse Ragnhild and Color Fantasy),

Data Processing: All parameters have been quality controlled by user, including sensor calibration and data cleansing. The Chlorophyll a fluorescence data were calibrated against water samples of Chlorophyll a concentration determined by the HPLC method, so it can therefore be used as a proxy for Chlorophyll a concentration [4].

5.1.1.7 NOMAD

Date: 23-04-2002 and 15to21-10-2005,

Region: between São Gabriel Valley and Vigo Seamount, North of Spain and English Channel,

Parameters: Temperature, Kd, Lw, Es, ap, ad, bb, bbr, chla, t_chl_a, kpar, POC, z_37, z_10 and z_01,

Platform: various (database),

Data Processing: Compiled by the NASA Ocean Biology Processing Group, the source data are available online via the SeaBASS Web site (http://seabass.gsfc.nasa.gov). Data were contributed by participants in the NASA SIMBIOS Program (NRA-96-MTPE-04 and NRA-99-OES-09) and by voluntary contributors (information on data file). Concerning the different study areas, this database provided information for 13 different sites. All the available information about NOMAD protocols are described in [5] and [6] (http://seabass.gsfc.nasa.gov/data/werdell_nomad_iop_qc.pdf).

5.1.1.8 PML

Date: 06-01-2003 to 26-10-2009,

Region: Celtic Sea, between Celtic Sea and Irish Sea and between English Channel and North Sea,

Parameters: Water depth, Temperature, MLD, ag, ap, aph, ad, bp, bbp, TSM, mv_chla, chlide_a, dv_chl_a, chl_c3, chl_c1+c2, chl_b, t_chl_a, allomer, epimer, F(z), PSC and PPC pigments and phytoplankton counts and contribution,

Platform: L4 monitorimg station, RV BELGICA (Biogeochemistry cruise and Bio-optics cruise) and RRS James Clark Ross (Biogeochemistry cruise)

Data Processing: data on LFM database include*data* obtained from weekly sampling at station L4 (508150N, 4813.020E, bottom depth 55 m), *where* discrete surface water samples were collected for IOPs analysis, SPM and biomass. Phytoplankton community structure was enumerated and Chl a was defined by the sum of chlorophyll a, divinyl-chlorophyll a, chlorophyll a isomer and epimer, and chlorophyllids a.Additional information about protocols procedures and analyses are available in [7] and [8].

5.1.1.9 UNICAN

Date: 07-08-2005 to 19-072010

Region: Bay of Biscay (South)

Parameters: Water and measurement depth, secchi depth, TSM, chla and TurbFTU (as turbFNU on xls data files)

Platform: Ship campaigns (REDCAL and EUFAR-VIGES)

Data Processing: We have no information about measurements equipment and/or protocols from EUFAR VIGES measurements, the one with available records for LFM collected in 2010, July 17th and 18th. REDCAL collected turbidiy information based on UNE-EN-27027 norm and chlorophyll a was measured with MET APHA 10200-H.

5.1.2 Data Statistics

Sampling stations in site 1 reach 66 with minimum depth of 4.3 m. Secchi depths varying from 4.3 to 13 m maximum. Water temperature shows a high variation between -1.34 °C and 27.55 C accounting for the entire test site 1. The values of kd, spectral downwelling irradiance attenuation coefficient, are generally very low. Minimum is measured at 489 nm (0.0486 m^{-1}) the maximum coefficient is measured at 590 nm (0.3569 m^{-1}). The particle absorption coefficient at ap442 and ap443 are predominantly small with most measurements below 0.06 m^{-1}, but reaching 0.3370 m^{-1} at 442 nm as maximum. The phytoplankton absorption coefficient aph442 shows a similar distribution but reaches significantly higher maximum values of up to 0.2742 m^{-1} (min: 0.0038 m^{-1}). For ad, the

non-particle absorption coefficient, most values are smaller than 0.02 m^{-1}, but at 442 nm they reach a maximum of 0.2271 m^{-1}. The dissolved material absorption coefficient (ag440) has mostly low to moderate values. Minimum is 0.0067 m^{-1} and maximum is 0.3329 m^{-1}, while most values vary between 0.04 m^{-1} and 0.08 m^{-1}. Scattering coefficient at 440 nm predominantly fluctuates between 0.25 m^{-1} and 0.75 m^{-1}, but shows extremer minimum and maximum values, the latter going up to 1.76167 m^{-1}. Fitted backscatter coefficient (bb443) stay significantly low with values from 0.0032 m^{-1} to 0.0048 m^{-1}, whilst the original backscattering coefficient reaches the highest value of 0.0053 m^{-1} at 440 nm. In test site 1 water density is relatively low and fluctuates between 4.825 and 7.475 sigma. The salinity varies strongly and covers a range of 0.529 to 36.9 psu. Measurements could detect total suspended matter (TSM) concentrations of mostly less than 5 mg/l but also reaching values of up to 31.24 mg/l. A significantly smaller number of measurements were realised for suspended inorganic particulate matter, but they can prove the same distribution: most concentrations are below 5 mg/l, but they also show concentrations of up to 24.04 mg/l. In contrast to this, the majority of suspended organic particulate matter is significantly lower and stays under 3.5 mg/l, though reaching values of up to 7.2 mg/l in some cases. For chlorophyll a, a relatively high maximum of 197.5 mg/m^3 could be measured, and a ninimum of 0.04 mg/m^3. In Formazin Turbidity Unit (turbFTN), turbidity values in Site 1 lies between 0.67 and 2.4, in Nephelometric Turbidity Units (turbNTU), the minimum is 0.2 and rises up to 195, in Formazin Nephelometric Units (turbFNU) the fluctuate is between 0 and 41.162.

5.1.3 Available Measurements for Algorithm Validation

The number of in-situ data provided for site 1 is rather big (including NOMAD measurement records) and therefor are hard to handle. For this reason the analysis of the complete site 1 data will be done after the onset of a database which facilitates quieries.

Leaving the NOMAD data unconsidered, the following data pairs are available. No normalised water leaving radiances (nLw) are available. Lw has been recorded for all wavelenghth between 412.5 nm and 681 nm (not at 709 nm). Contemporaneous records are available at all wavelength for kd at 411, 443, 489, 510, 530, 555 and 590 nm, for POC, bb at 443 nm, and for z (at 37, 01 and 10% light level of PAR).

5.2 Site 2: Baltic Sea

5.2.1 Overview

Site 2 has data from both IOW and NIVA users, however, due to area overlapping, NIVA data were included in Site1. For the Baltic Sea, therefore, LFM list includes therefore only IOW measurements (Figure 2 and Table 5).

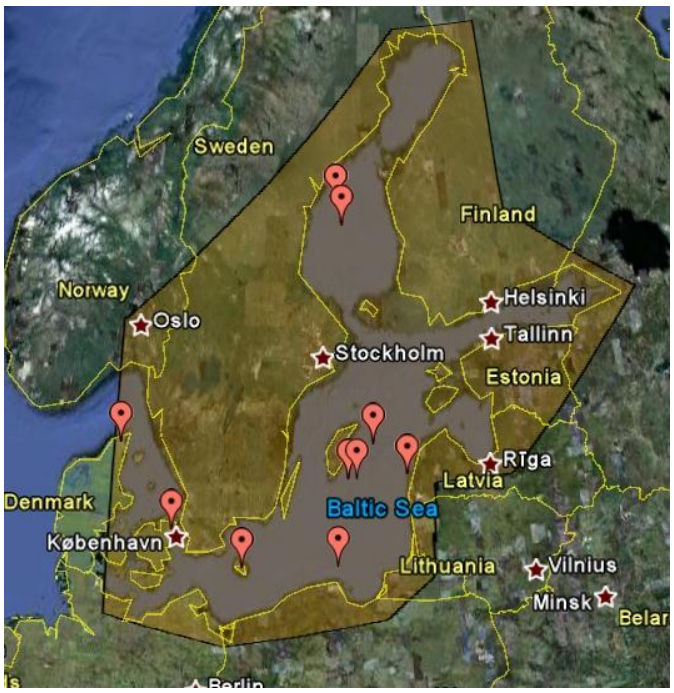


Figure 2: Site 2 – location of LFM points over Google Earth

Table 5: LFM Site 2 temporal availability

LFM Site2	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
IOW	10						4	4	2				
2007	1							1					
2009	9						4	3	2				
TOTAL	10						4	4	2				

5.2.1.1 IOW

IOW informations are reported in Table 3, Table 4 and 5.1.1.4.

5.2.2 Data Statistics

Sampling stations depth ranged from 24 to 190 m, with Secchi depth reaching 4.8m. Particle absorption coefficient at 443 nm (ap443) is low to moderate with a maximum of 0.2830 m^{-1}. Also moderate values are measured for phytoplankton absorption coefficient at 443 nm (aph443), which vary between 0.0457 m^{-1} and 0.1267 m^{-1}. Non-pigmented particle absorption coefficient at 443 nm (ad443) shows mostly low values but reaches 0.1797 m^{-1} in one case. Absorption coefficient by CDOM (ag443) has high values mostly between 0.23 m^{-1} and 0.35 m^{-1} but a maximum of 0.5010 $m^{-1}$and a minimum of 0.1205 m^{-1} can be observed. The concentrations of total suspended matter (TSM) are low to moderate reaching up to 10.7900 mg/l. Chlorophyll concentrations stay under 4 mg/m^3, which is the limit for definition of algal bloom in the Baltic Sea, except in the DTLL of 2007 when it reaches 4.2800 mg/m^3, Phaeo pigment concentrations are moderate with a maximum of 0.8835 mg/m^3.

5.2.3 Available Measurements for Algorithm Validation

For site 2 there are no contemporary radiometry data with IOPs or biogeochemical paramenters.

5.3 Site 3: Complete Mediterranean Sea, including Nile Delta and Black Sea

5.3.1 Overview

For Site 3 data are available from three different users: NIOF, HCMR and CSIC, totalising 30835 measurements. However, time information is missing in some cases, therefore only 1.6% (Figure 3) are considered for LFM. These include part of HCMR and CSIC data, spanning through time as descriminated in Table6.

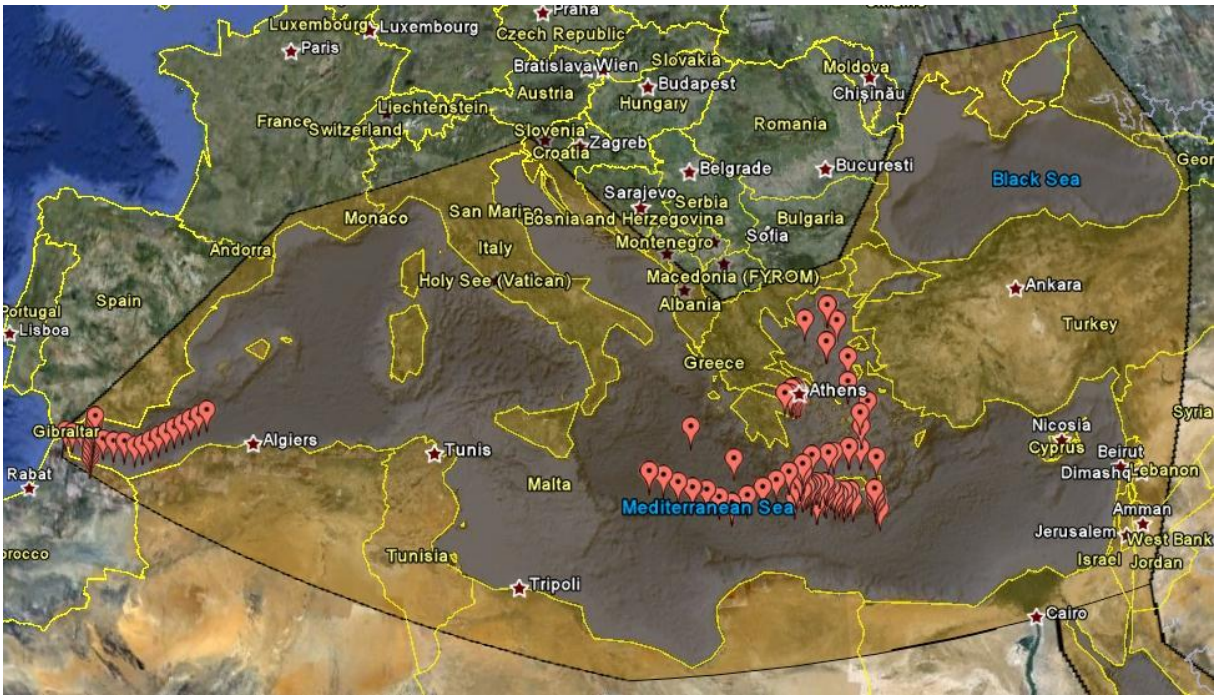


Figure 3: Site 3 - location of LFM points over Google Earth

Table6: LFM Site 3 temporal availability

LFM Site3	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HCMR	432	15	25	49	40	49	28	15	34	83	40	26	28
CSIC	51				26					25			
2005	72					24				14	20	6	8
2006	50	5	5	9	5	5	8	5		8			
2007	110	10	10	10	10	10	10	10		10	10	10	10
2008	181			20	41				24	66	10	10	10
2009	70		10	10	10	10	10		10	10			
TOTAL	483	15	25	49	66	49	28	15	34	108	40	26	28

Tables 7 and 8 give a summary of the key parameters included in the LFM, data contact point and generic information about measurements protocols.

Table 7: Site 3 – Data overview

Data Provider	Contact point	Key parameters	Notes
HCMR	Andrew Clive Banks	TSM, chla and CDOM Fluorescence	time in EET and EEST – updated to UTC; measurements depth between 2 and 5 m
CSIC	Isabel Caballero de Frutos	Chla, F(z) and turbFTU	collected at 5 m depth; quality controlled by user

Table 8: Summary of essential aspects of measurements protocols of key parameters on Site 3

Data Provider	chla	lw	Rrs	abs
HCMR	Fluorometric method	N/A	N/A	N/A
CSIC	Fluorometric method Whatman GF/F glassfiber filters (0.7 µm pore size), extracting in 90% acetone	N/A	N/A	N/A

5.3.1.1 HCMR

Date: 12-07-2002 to 21-09-2009,

Region: around Mediterranean Sea and Aegean Sea,

Parameters: Measurement and Water Depth, Light Transmission Chelsea at 470nm and 670nm, ag, a, cp670, c470, c660 and c670, TSM, CDOM fluorescence and Chla,

Platform: Cruise campaigns

Data Processing: Sampled chlorophyll-a concentration derived using Fluorometric method and provided from 2002 to 2009. For 2005 attenuation data were taken using a Chelsea Alphatracka II transmissometer, 25 cm path-length, and emitting at 670 nm (red). For 2008 the transmissometer data at 660nm (red) was from a Wetlabs C Star instrument and the data at 470nm was from the Chelsea Alphatracka MK II. For both years, bottle samples were analysed in the onboard laboratory using a membrane filter of 0.45µm pore size for particulate matter concentration.

5.3.1.2 CSIC

Date: 07-04-2008 to 26-09-2008,

Region: South Portugal and Spain,

Parameters: Measurement and Water Depth, Temperature, Conductivity, c660, chla, Phaeo, F(z), Salinity, turbFTU, O2.Conc, NO3, NO2, NH4, PO4, SiO4, DissO2, DissOrgN, DissOrgC,

Platform: Cruise campaigns,

Data Processing: Samples for inorganic nutrient analysis (30ml), total chlorophyll (500ml), chlorophyll in the size fraction above 20 µm (3l), and suspended matter (1l) were collected at each sam-

pling site in surface waters. Nutrients (nitrate, nitrite, ammonium, phosphate and silicate) were analyzed with a TRAAC800 autoanalyzer. Chlorophyll analysis (both total and fractioned) was conducted by filtering samples through Whatman GF/F glass fiber filters (0.7 µm pore size), extracting in 90% acetone, and measuring [Chla] by standard fluorometric methods using a Turner Designs Model 10. Further details on protocols can be found in [9].

5.3.2 Data Statistics

A number of 485 usable in situ measurements are available for the whole area of site 3. In the region of data acquisition water depth is 92 m minimum and 4101 m maximum. Temperature of water varies between 15.24 and 25.45º C. The Coefficient of Particle Attenuation cp670 is in 0.6250 and 0.6810 m^{-1} range, being 0.6393 the average and the median value. The Beam Attenuation coefficient has the less and higher values: the lowest at c660 = 0.098 m^{-1} and the highest at c470 = 0.8470m^{-1}. Salinity reaches maximum values of 37.7 psu and Turbidity varies around 0.065 units, although the maximum is 0.1390. Concentrations of TSM reaches values up to 0.85 mg/l and CDOM Fluorescence up to 0.552. For this area Chlorophyll a average is 0.4851 mg/m^{-3} but a 4.135 mg/m^{-3} value is reached and Phaeo goes up to 0.8381 mg/m^{-3}. Fluorescence Intensity in situ profile has values between 0.07 and 2.98 arb. units. Concerning nutrients, the Ammonium has the highest concentration, oscillating between 5.76 and 10.58 µM, and Phosphate has the lowest concentration reaching a maximum of 0.28 µM. With regards to the Dissolved Material, Dissolved Oxygen ranges between 204.04 and 249.23 µM/kg, Dissolved Nitrogen between 0.75 and 8.05 µM/l and Dissolved Organic Carbon varies between 22.96 and 97.33 µM/l.

5.3.3 Available Measurements for Validation

For site 3 there are no contemporary radiometry data with IOPs or biogeochemical paramenters.Site 4: Morocco (Atlantic and Mediterranean coasts of Morocco)

5.3.4 Overview

For Morocco area there are available data from NOMAD dataset (with only three records) and CSIC user (with 685 records) for the period between May 2005 and September 2008. Data were collected in the area presented in Figure 4 and measurement period is reported in Table 9.

Figure 4: Site 4 - location of LFM points over Google Earth

Table 9: LFM Site 4 temporal availability

LFM Site4	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NOMAD	3										3		
CSIC	685	45	69	56	71	82	47	55	30	64	55	60	51
2005	205					29	22	38		30	28	30	28
2006	324	15	40	27	28	30	25	17	30	29	30	30	23
2007	148	30	29	29	37	23							
2008	11				6					5			
TOTAL	688	45	69	56	71	82	47	55	30	64	58	60	51

Some records from Site 3 were considered in Site 4, although there are a flag reporting it ('out_4').

Table 10 and **Fehler! Verweisquelle konnte nicht gefunden werden.** give general information on data providers and parameters available for Site4.

Table 10: Site 4 – Data overview

Data Provider	Contact point	Key parameters	Notes
NOMAD	Werdell and Bryan Franz	Kd, Lw, Es, ap, ad, chla, t_chl_a, kpar, POC, z_37, z_10 and z_01	
CSIC	Isabel Caballero de Frutos	TSM, SIPM, SOPM, turbFTU, CDOM fluorescence, chla and F(z)	collected at 5 m depth; quality controlled by user

Table 11: Summary of essential aspects of measurements protocols of key parameters on Site 4

Data Provider	chla	lw	Rrs	abs
NOMAD	Fluorometry and HPLC measurements	Data collected by different users. Database includes radiometric dataquality checked according to [5]		Database only includes data collected following OBPG defined protocols [6]
CSIC	Fluorometric method Whatman GF/F glassfiber filters (0.7 µm pore size), extracting in 90% acetone	N/A	N/A	N/A

5.4.1.1 NOMAD

Date: 18to21-04-2002 and 27to29-10-2005,

Region: near Madeira and Canarias islands,

Platform: various (database),

Parameters: kd, Lw, Es, ap, ad, bb (fit), bbr (original), kpar, POC, z_01, z_10 and z_37,

Data Processing: Described in 5.1.1.7, [5] and [6] (http://seabass.gsfc.nasa.gov/data/werdell_nomad_iop_qc.pdf).

5.4.1.2 CSIC

Date: 23-05-2005 to 27-09-2008,

Region: South Portugal and Spain,

Parameters: Measurement and Water Depth, Temperature, Conductivity, c660, TSM, SIPM, SOPM, CDOM fluorescence, chla, Phaeo, F(z), Salinity, turbFTU,O2.Conc, NO3, NO2, NH4, PO4, SiO4, DissO2, DissOrgN and DissOrgC,

Platform: Cruise campaigns,

Data Processing: Total concentrations of suspended particulate matter were measured gravimetrically on preweighted Whatman GF/Ffilters after rinsing with distilled water. Organic matter lost on ignition was determined after drying the filters for 3h at 500 C, giving the concentration of mineral and, by subtraction, organic suspended matter. Further details can be found on protocols in 5.3.1.2 and [9].

5.3.5 Data Statistics

Only three measurements of radiometric products and absorption coefficients are clearly insufficient to characterise the study area, however, we can say that values of kd, the spectral downwelling irradiance attenuation coefficient, are very low in all measured wavelength (max. of 0.1702 m^{-1} in 590 nm). Also the values for the particle absorption coefficient at 443 nm (ap443) and non-pigmented particle absorption coefficient at 443 nm (ad443) are very low (maximum of 0.0127 and 0.0025 m^{-1}, respectively). Values for backscatter coefficient (fit) at 443 nm (bb443) vary between 0.0029 m^{-1} and 0.0031 m^{-1}. The original (not fitted) values for backscattering coefficient at 442 nm are only negligibly higher. The Beam Attenuation Coefficient at 660 (c660) has a maximum value of 0.6135. The Suspended Particulate Matter (or TSM) reaches in site 4 a value of 506.3 mg/l and chlorophyll a analysed by fluorometric method lies between 0.0090 and 10.8086 mg/m^3. Particulate Organic Carbon values show low to moderate concentrations (30.455-36.48 mg/l), but has only three records to evaluate, meanwhile, with more than 680 DTLL records, the nutrients concentration has some differences: there can be places/moments with no Nitrate, Nitrite or Silicate, or others that reach the value, respectively, of 78.770, 1.182 or 81.395 µM. Data for depth of 10/ 0.1/ 37 % light level of PAR all show a minimum of 48 m and a maximum of 60 m.

5.3.6 Available Measurements for Algorithm Validation

For site 4 there are no measurements available for nLw and Rrs, but data for water leaving radiance (Lw). In wavelengths corresponding to MERIS bands 1 – 8 a number of 3 measurements respectively were realised for Lw and simultaneously for the parameters POC, kd (kd411, kd443, kd489, kd510, kd530, kd555 and kd590), bb443, z_37, z_01 and z_10. There is no measurement for band 9, 709 nm.

5.4 Site 5: Acadia

5.4.1 Overview

The available data for Site 5 (Figure 5) are part of NOMADs database and were collected in some months on 2005, 2006 and 2007 (Table 12).

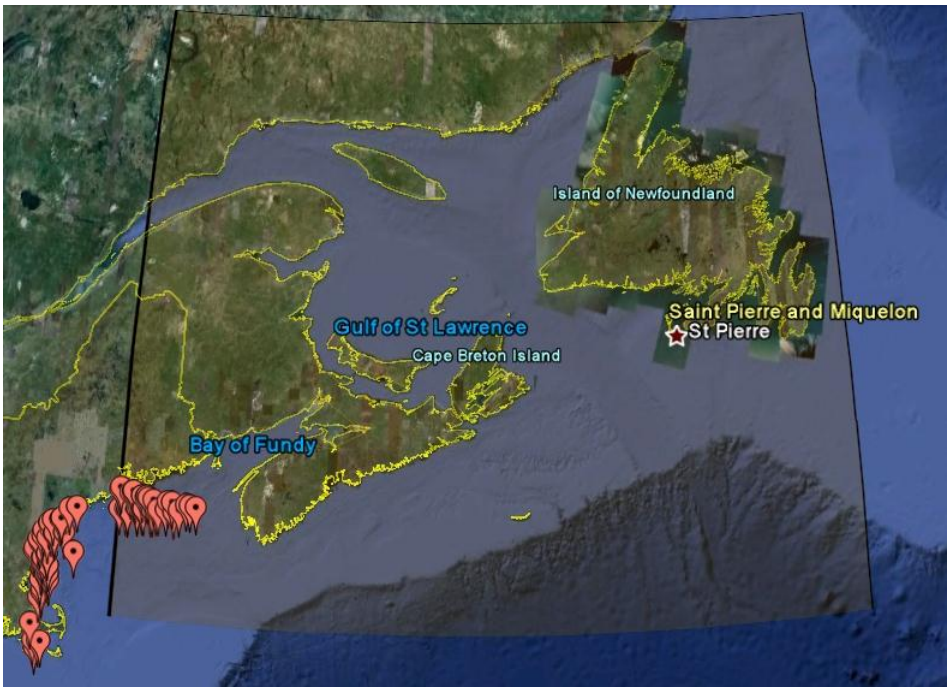


Figure 5: Site 5 - location of LFM points over Google Earth

Table 12: LFM Site 5 temporal availability

LFM Site5	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NOMAD	76		1	3	20	17	16	3	1	11	4		
2005	19				4		2	3		6	4		
2006	12		1		6		4		1				
2007	45			3	10	17	10			5			
TOTAL	76		1	3	20	17	16	3	1	11	4		

Table 13 and Table 14 give general information on data source and parameters provided.

Table 13: Site 5 - Data overview

Data Provider	Contact point	Key parameters	Notes
NOMAD	Werdell and Bryan Franz	Kd, Lw, Es, ag, chla, t_chl_a, kpar, POC, z_37, z_10 and z_01	

Table 14: Summary of essential aspects of measurements protocols of key parameters on Site 5

Data Provider	chla	lw	Rrs	abs
NOMAD	Fluorometry and HPLC measurements	Data collected by different users. Database includes radiometric dataquality checked according to [5]		Database only includes data collected following OBPG defined protocols [6]

5.5.1.1 NOMAD

Date: 11-05-2002 to 06-09-2007,

Region: Southwest Bay of Fundy

Platform: various (database),

Parameters: Water Depth, Temperature, Kd, Lw, Es, ag, bb, bbr, chla, t_chl_a, mv_chla, chlide_a, dv_chl_a, chl_c3, chl_c2, pras, PSC and PPC pigments (except Neoxanthin), kpar, POC, z_37, z_10 and z_01,

Data Processing: Described in 5.1.1.7, [5] and [6] (http://seabass.gsfc.nasa.gov/data/werdell_nomad_iop_qc.pdf).

5.4.2 Data Statistics

76-checked measurements for LFM in Site 5 show a 1.9299 m^{-1} maximum Spectral Downwelling Irradiance Attenuation Coefficient (kd) at 411 nm and at Lw443 a maximum of 0.7207 m^{-1}. Although with only four available records for each Dissolved Material Absorption Coefficient, ag443 lies between 0.1097 and 0.1742 and there is a low to moderate backscattering coefficient (fit) at 443 nm, with a maximum of 0.0110 m^{-1}. Chlorophyll concentrations are mostly low besides two exceptions of 6 mg/m^3 in June 2005 and March 2007.

5.4.3 Available Measurements for Algorithm Validation

Most of the Site 5 total backscattering coefficients (bb) only have 11 available records and, at the same time, for the same wavelengths corresponding to MERIS bands 1, 2, 3 and 4, are available data of Water Leaving Radiance (Lw).

5.5 Site 6: Chesapeake Bay

5.5.1 Overview

The only data information available for Site 6 is also part of NOMADs database. Figure 6 and Table 15 shows location and temporal information about the LFM data points.

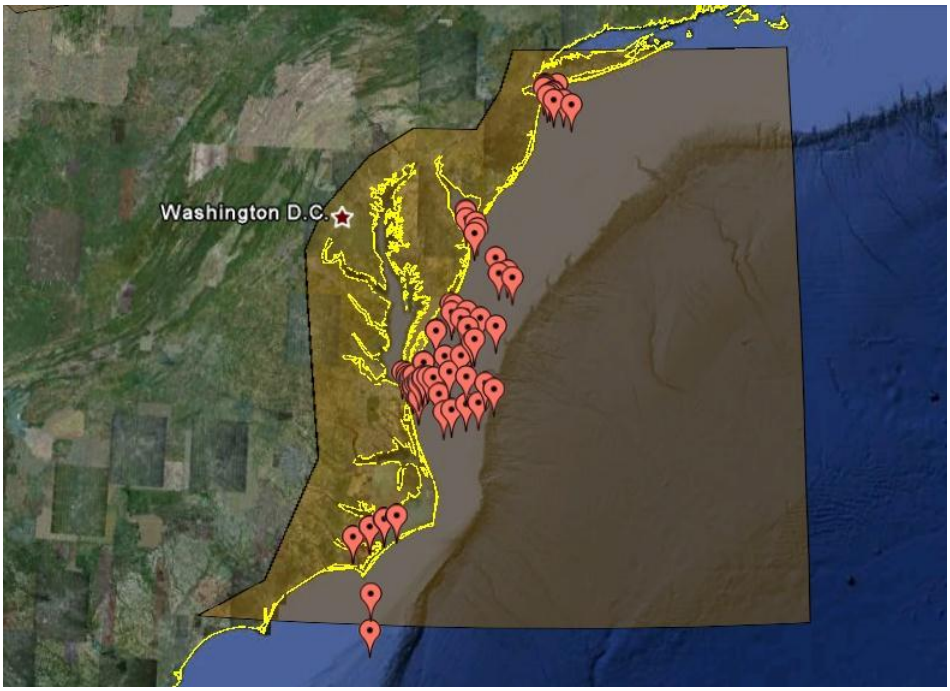


Figure 6: Site 6 - location of LFM points over Google Earth

Table 15: LFM Site 6 temporal availability

LFM Site6	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NOMAD	81			3	4	17		39	2		8	8	
2005	46			3	4	4		19	2		8	6	
2006	22							20				2	
2007	13					13							
TOTAL	81			3	4	17		39	2		8	8	

For LFM are available 59% of the total measured points in this area, that corresponds to 81 DTLL points. With the exception for the variable ag, the available parameters for this site are the same as described for Site 5 (Table 13 and 14).

5.5.2 Data Statistics

Of all test sites, this region shows the highest values of spectral downwelling attenuation coefficient (kd) at all measured wavelengths. The maximum value is 1.7625 m^{-1} at 411 nm, the minimum is 0.0411 m^{-1} at 489 nm. The total chlorophyll a values, 12 measurements, fluctuate between 0.3 mg/m^3 and 22.54 mg/m^3. Maximum depth for 37% light level of PAR is 9.2 m, 22.8 m for 10 % and 42.7 m for 1 % light level of PAR.

5.5.3 Available Measurements for Validation

For site 6 there are no data of nLw or Rrs available, but various measurements of Lw were done in wavelength between 411 nm and 683 nm (not for 709 nm). Between 80 and 171 measurements of Lw are contemporary of Chl_a, kd (kd411, kd433, kd489, kd510, kd530 and kd555), z_37, z_01 and z_10 in each MERIS band (Table 1616).

Table 16: Number of data for validation for Site 6

band n°	1	2	3	4	5	6	7	8	9
band nm	412.5	442.5	490	510	560	620	665	681.25	708.75
Parameters	lw411	lw443	lw489	lw510	lw560	lw619/lw625	lw665	lw683	-
Chl_a	12	12	12	12	12	12	12	12	0
t_chl_a	69	69	69	69	69	69	69	69	0
CDOM Fluoresc	0	0	0	0	0	0	0	0	0
ag440	0	0	0	0	0	0	0	0	0
POC	0	0	0	0	0	0	0	0	0
Kd411	69	69	69	69	69	69	69	69	0
kd443	69	69	69	69	69	69	69	69	0
kd489	69	69	69	69	69	69	69	69	0
kd510	69	69	69	69	69	69	69	69	0
kd530	69	69	69	69	69	69	69	69	0
kd555	69	69	69	69	69	69	69	69	0
kd590	69	69	69	69	69	69	69	69	0
kd665	68	68	68	68	68	68	68	68	0
kd683	68	68	68	68	68	68	68	68	0
a443	0	0	0	0	0	0	0	0	0
b440	0	0	0	0	0	0	0	0	0
bb443	0	0	0	0	0	0	0	0	0
z_37	69	69	69	69	69	69	69	69	0
z_10	66	66	66	66	66	66	66	66	0
z_01	61	61	61	61	61	61	61	61	0
turbNTU	0	0	0	0	0	0	0	0	0
turbFNU	0	0	0	0	0	0	0	0	0

5.6 Site 7: Oregon and Washington

5.6.1 Overview

For Site 4, CC project received data measurements from two different users: COAS_OSU and NOAA. These users were contact points for other in situ data contributors.

Figure 7: Site 7 - location of LFM points over Google Earth

Table 17: LFM Site 7 temporal availability

LFM Site7	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
COAS_OSU	478				29	48	51	201	114	16	19		
NOAA	137							8	109	20			
2006	64						10	37	17				
2007	104				16	16	24	18	23	7			
2008	272				5	16		98	109	25	19		
2009	17				6			11					
TOTAL	457				27	32	34	164	149	32	19		

Table 18: Site 7 – Data overview

Data Provider	Contact point	Key parameters	Notes
COAS_OSU	Jasmine Nahorniak (1) Tawnya Peterson (2) Marnie Jo Zirbel (3) Morgaine McKibben	Lw, Rrs, Es, t_chl_a and F(z)	time in PST and DPST – updated to UTC
NOAA	Dave Foley	Chl_a	

Table 19: Summary of essential aspects of measurements protocols of key parameters on Site 7

Data Provider	chla	lw	Rrs	abs
COAS_OSU	(1) and (3) Fluori-metric method (2) HPLC Extraction Methd: 90% Methanol		(2) Underwater profile (Lu^-, Ed^-, Ed^+) 3*Satlantic Hy-perPro	N/A
NOAA	Fluorimetric method	N/A	N/A	N/A

5.7.1.1 COAS_OSU

Date: Summer 2006, 2009 and 2010,

Region: Oregon and Washington coastal,

Platform: (1) CMOP campaigns, (2) Mi-LOCO campaigns and (3) MOCHA campaigns,

Parameters: Masurement and Water depth, Lw, Rrs, Es, chl_a, t_chl_a, phaeo, Pigments But-fuco, Fuco, Hex-fuco, Diadin, Allo, Zea and BB Carot, pras, salinity and F(z),

Data Processing: For CMOP data: Chl a = [(1/k) x (τ/(τ 1)) x (Fo-Fa) x (vol ext/vol filt)], where k and τ are constants, vol ext and vol filt are volume extracted [ml] and filtered [ml], respectively, and they used the COAS/ RML Turner AU10 Fluorometer (information on recieved data files). In Mi-LOCO campaignes water samples are collected within 60 minutes of the reflectance measurements, and are filtered onboard onto Whatman GF/F glass fiber filters (nominal pore size 0.7 µm) and stored at a temperature of -80°C for subsequent analysis. Filters are analysed for concentration of a suite of photosynthetic pigments including chlorophyll *a* using High Performance Liquid Chromatography (HPLC)

5.7.1.1 NOAA

Date: 30-07-2008 to 22-09-2008

Region: Oregon, Washington and California North coastal,

Platform: cruise campaigns,

Parameters: measurement and water depth, chla, NO3, PO4, Silicic acid, pDA and phaeo,

Data Processing: All measurements are based on in vitro fluorescence following dark 24-hour extractions in acetone.

5.6.2 Data Statistics

In total, for Oregon and Washington region, 549 measurements of different parameters are available. The depth of water column varies between 10 and 7000 m, and salinity between 25.72 and 34 psu. The maximum values of Water Leaving Radiance lie between 0.0174 and 1.9421 uW/cm^2/nm/sr, at Lw412.5. Most values of measured chl a concentrations are lower than 5 mg/m^3, but some measurements show concentrations of up to 33.819 mg/m^3. The same pattern can be remarked about Phaeo pigments, which mostly show concentrations lower than 0.2 mg/m^3, but reach values of 1.448 mg/m^3. For this site the fluorescence intensity in situ profile F(z) was measured in arab. units, and the maximum for this parameter is 4.3123. Maximum concentration of Nitrate in the area is 16.6995 µM, Cilicic acid lie between 0.9005 and 34.536 and Phosphate reaches 1.455 µM.

5.6.3 Available Measurements for Algorithm Validation

In site 7 parallel chlorophyll a and water leaving radiances measurements in wavelengths between 411 nm and 710 nm are available allowing algorithm performance assessment. About 55 measurement stations fullfill this requirement.

5.7 Site 8: Plumes & Blooms

5.7.1 Overview

Site 8 has data from January 2005 till March 2010, mainly 1 to 8 records per day, one day per month (with some gaps) and from three different users: UCSB, NOAA and NOMAD. Figure 8 shows location of the collected points in LFM database for Site 8 and Table 20 has the respective temporal availability.

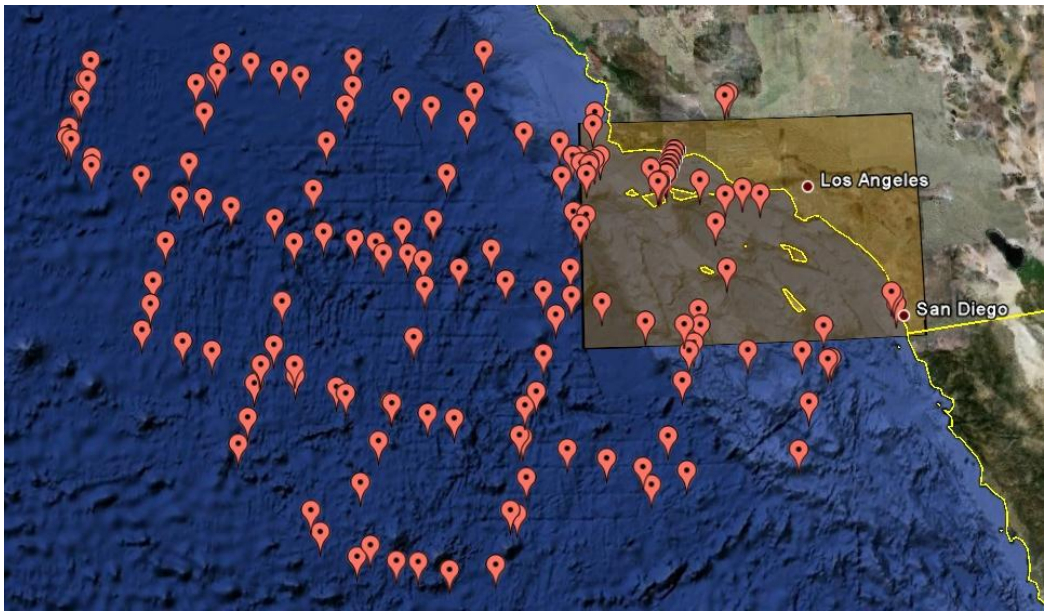


Figure 8: Site 8 - location of LFM points over Google Earth

Table 20: LFM Site 8 temporal availability

LFM Site8	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
UCSB	335	13	21	43	30	31	38	24	18	28	28	37	24
NOMAD	16				8	5	1		2				
NOAA	126									2	61	63	
2005	89	6	7	7	5	7	10		12	7	7	14	7
2006	65	7		11	7	12	8	6				7	7
2007	65			7	12	7	7	6	2	7	7	7	3
2008	185		7	7	7	4	7	6		9	68	63	7
2009	62			7	7	6	7	6	6	7	7	9	
2010	11		7	4									
TOTAL	477	13	21	43	38	36	39	24	20	30	89	100	24

Table 21 gives information about users contact points and about important available variables in Site 8. On the other hand, Table 22 shows some aspects about measurements equipments and methodologies.

Table 21: Site 8 - Data overview

Data Provider	Contact point	Key parameters	Notes
UCSB	Stephane Maritorena	Ed, Lw, Es, ap, ad, ag, chl_a and t_chl_a	
NOMAD	Werdell and Bryan Franz	Kd, Lw, Es, ag, bb, bbr, chla, t_chl_a, kpar, POC, z_37, z_10 and z_01	
NOAA	Dave Foley	Chl_a	

Table 22: Summary of essential aspects of measurements protocols of key parameters on Site 8

Data Provider	chla	lw	Rrs	abs
UCSB	Fluorometry and HPLC measurements	N/A	N/A	WetLabs AC-9
NOMAD	Fluorometry and HPLC measurements	Data collected by different users. Database includes radiometric dataquality checked according to [5]		Database only includes data collected following OBPG defined protocols [6]
NOAA	Fluorimetric method	N/A	N/A	N/A

5.8.1.1 UCSB

Date: 19-01-2005 to 24-03-2010,

Region: Santa Barbara Basin,

Platform: Monitoring station,

Parameters: Ed, Lw, Es, ap, ad, ag, bb, chl_a and t_chl_a

Data Processing: UCSB follows protocols from the manufacturers and those described in the NASA Technical Memoranda (http://oceancolor.gsfc.nasa.gov/DOCS/TechMemo/). The platform was equipped with a Biospherical PRR-600, a WetLabs AC-9, a Hobi-Labs Hydroscat-6, a Sequoia Scientific LISST 100-X, a Sea-Bird Electronics 911+ CTD (on a SBE32C carousel), a Shimadzu UV2401-PC (a Perkin-Elmer Lambda 2 before mid-2003) and a Turner Designs 10AU fluorometer.

5.8.1.2 NOMAD

Date: 10-01-2002 to 15-04-2003 and 11-05-2006 to 21-08-2007,

Region: around Los Angeles Coastal, mainly Santa Barbara region,

Platform: various (database),

Parameters: Temperature, kd, Lw, Es, ap, ad, ag, a, t_chl_a, PPC and PSC pigments (except Neox), kpar, z_01, z_10 and z_37,

Data Processing: Described in 5.1.1.7, [5] and [6] (http://seabass.gsfc.nasa.gov/data/werdell_nomad_iop_qc.pdf).

5.8.1.3 NOAA

Date: 27-09-2008 to 30-11-2008,

Region: Los Angeles and San Diego coast,

Platform: various (database),

Parameters: measurement and water depth, chl_a, NO3, PO4, Silicic acid, pDA and phaeo,

Data Processing: All measurements are based on in vitro fluorescence following dark 24-hour extractions in acetone.

5.7.2 Data Statistics

At Plumes & Blooms Temperature varied between 11.85 °C and 20.64 °C during data acquisition time. In each wavelength, the measurements of the spectral downwelling irradiance attenuation

coefficient are generally low. The minimum (0.0395 m^{-1}) was observed at 489 nm and the maximum (0.7162 m^{-1}) at 670 nm. The particle absorption coefficient at 443 nm (ap443) is mostly lower than 0.21, but it also goes up to 0.4908 m^{-1}, which is the highest value of all test sites. In contrast to this, the non-pigmented particle absorption coefficient at 443 nm (ad443) is very low with a maximum of 0.0555 m^{-1}. Also the values for the absorption coefficient and the dissolved material absorption coefficient are very low (a443: max=0.0936 m^{-1}; ag443: max=0.0366 m^{-1}). Very high measurement values show the backscattering coefficients at 442 nm (bb442), most values lie between 0.004 m^{-1} and 0.014 m^{-1}, but the maximum value is 0.0253 m^{-1}. Chlorophyll a concentrations are mostly below 5 mg/m^3 but on April 22nd 2008 have been observed concentrations of 22.7555 up to 28.685 mg/m^3. Phaeo pigment values are comparatively high, having the maximum concentration of 1.083 mg/m^3. Salinity is constantly around 33 psu. For the depth of x% light level of PAR moderate values have been measured.

5.7.3 Available Measurements for Algorithm Validation

For site 8 there are availableLw and Rrs data but no parallel records, only Lw to Kd. Besides MERIS band 9, that have no pairs, there are 3, but mostly 9 to 16 measurements in MERIS bands 1 – 8, for the parameter kd (kd411, kd433, kd489, kd510, kd530, kd555 and kd590), a_443, z_37, z_01 and z_10 (Table 23).

Table 23 Number of data for validation for Site 8

band n°	1	2	3	4	5	6	7	8	9
band µm	412.5	442.5	490	510	560	620	665	681.25	708.75
Parameters	lw411	lw443	lw489	lw510	lw555 / lw560	lw619 / lw625	lw665	lw683	-
Chl_a	0	0	0	0	0	0	0	0	0
t_chl_a	16	16	16	16	16	16	16	3	0
CDOM Fluoresc	0	0	0	0	0	0	0	0	0
ag440	0	0	0	0	0	0	0	0	0
POC	0	0	0	0	0	0	0	0	0
Kd411	15	15	15	15	15	15	15	3	0
kd443	15	15	15	15	15	15	15	3	0
kd489	16	16	16	16	16	16	16	16	0
kd510	16	16	16	16	16	16	16	16	0
kd530	16	16	16	16	16	16	16	16	0
kd555	16	16	16	16	16	16	16	16	0
kd590	13	13	13	13	13	13	13	0	0
kd665	3	3	3	3	3	3	3	3	0
kd683	3	3	3	3	3	3	3	3	0
a443	7	7	7	7	7	7	7	0	0
b440	0	0	0	0	0	0	0	0	0
bb443	0	0	0	0	0	0	0	0	0
z_37	16	16	16	16	16	16	16	3	0
z_10	15	15	15	15	15	15	15	2	0
z_01	11	11	11	11	11	11	11	0	0
turbNTU	0	0	0	0	0	0	0	0	0
turbFNU	0	0	0	0	0	0	0	0	0

5.8 Site 9: Puerto Rico

5.8.1 Overview

Data for this site is included in NOMAD database and it was collected at only one location: 10.5°N, -64.67°W (Figure 9), almost one measure per month on Date period (5.9.1.1 and **Fehler! Verweisquelle konnte nicht gefunden werden.**).

Figure 9: Site 9 - location of LFM points over Google Earth

Table 24: LFM Site 9 temporal availability

LFM Site9	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NOMAD	11	1	2	2	1		1	1		1		1	1
2006	9	1	1	1	1		1	1		1		1	1
2007	2		1	1									
TOTAL	11	1	2	2	1		1	1		1		1	1

Table 25: Site 9 - Data overview

Data Provider	Contact point	Key parameters	Notes
NOMAD	Werdell and Bryan Franz	Kd, Lw, Es, chla, t_chl_a, kpar, z_37, z_10 and z_01	

Table 26: Summary of essential aspects of measurements protocols of key parameters on Site 9

Data Provider	chla	lw	Rrs	abs
NOMAD	Fluorometry and HPLC measurements	Data collected by different users. Database includes radiometric dataquality checked according to [5]		Database only includes data collected following OBPG defined protocols [6]

5.9.1.1 NOMAD

Date: some measurements on 2002, 2003 and 2004 and 12-01-2006 to 06-03-2007,

Region: one point in Cariaco Basin (Venezuela),

Platform: cruise,

Parameters: Water Depth, Temperature, Kd, Lw, Es, ag, bb, bbr, chla, t_chl_a, mv_chla, chlide_a, dv_chl_a, chl_c3, chl_c2, pras, PSC and PPC pigments (except Neoxanthin), kpar, POC, z_37, z_10 and z_01,

Data Processing: Described in 5.1.1.7, [5] and [6] (http://seabass.gsfc.nasa.gov/data/werdell_nomad_iop_qc.pdf).

5.8.2 Data Statistics

Site 9, Puerto Rico, shows the highest water temperatures of all sites (22.58 – 28.44°C). In the measurements area we find the lowest spectral downwelling irradiance attenuation coefficients (kd411, kd443) of all test sites. The minimum is 0.0264 m^{-1} at 489 nm and the maximum is 0.3003 m^{-1} at 411 nm. Water Leaving Radiance (Lw) has its maximum at wavelength 443 nm - 0.8325 uW/cm^2/nm/sr. Salinity is stable at 36-37 psu and concentrations of chlorophyll were low at the time of measurements and do not exceed 4 mg/m^3. Depth of x% light level of PAR is moderate to high, for z_37 maximum is 22.3 m, for z_10 38 m and for z_01 64.3 m.

5.8.3 Available Measurements for Algorithm Validation

For site 9 there are no nLw or Rrs data available. Meanwhile, 11 measurements of water leaving radiance were done in wavelengths corresponding to MERIS bands 1-3, 5, 7 and 8. The parameters measured simultaneously are Chl a and all kd available wavelengths (11 records) and z_37, z_01 and z_10 (ten records together with chl_a).

5.9 Site 10: Benguela

5.9.1 Overview

Although there are two users with information for this region, CSIR and NOMAD, for LFM database in Benguela, only CSIR data are considered (because NOMAD Date is out off range) –Figure 10 and Table 27.

Figure 10: Site 10 - location of LFM points over Google Earth

Table 27: LFM Site 10 temporal availability

LFM Site10	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CSIR	136			116	20								
2005	34			25	9								
2006	22			22									
2007	21			10	11								
2008	18			18									
2009	41			41									
TOTAL	136			116	20								

Table 28: Site 10 – Data overview

Data Provider	SOURCE /Contact point	Paramenters	Notes
CSIR	Stewart Bernard	Rrs, Chla	Start and End Time of measurement; Rrs and chla quality checked

Table 29: Summary of essential aspects of measurements protocols of key parameters on Site 10

Data Provider	chla	lw	Rrs	abs
CSIR	Fluorometric method	N/A	Satlantic radiometers	N/A

5.10.1.1 CSIR

Date: March and (sometimes) April 2005 till 2009,

Region: Lamberts and Elands Bays,

Platform: Buoys monitoring stations,

Parameters: Rrs and chl_a,

Data Processing: CSIR data has Start Time and End Time, which can range between 16 minuts difference at a maximum of 1 hour difference. The radiometric data were collected with a Satlantic tethered radiometer and processed using the PROSOFT software package. From each sampling burst of 3 minutes, a median Lu(z) and Ed is chosen. Lu is measured at 0.66m below the surface. Data is processed to Rrs using a reflectance inversion algorithm optimised for local conditions (Bernard, 2005). This requires that the Lu(z) is extrapolated to the air-sea interface by means of the diffuse attenuation coefficient Ku (as described by Albert and Mobley 2003). Lu(0^+) is then normalised to Ed and the Rrs is then calculated from the reflectance approximation. See User publicationns for further details. Chlorophyll data all come from surface (bucket), and are produced using the standard fluorometric method (Parsons 1984), using a Turner 10-AU fluorometer.

5.9.2 Data Statistics

At Benguela site area chlorophyll concentrations reache very high values. Here a maximum of 496.5087 mg/m³ can be observed and 17.6 % of the records are above 50 mg/m³. Remote Sensing Reflectance reaches the maximum at Rrs560 with a value of 0.0084 1/sr.

5.9.3 Available Measurements for Validation

For MERIS bands 1 – 9 a number of 84 measurements of Rrs were done at the same time as measurements of Chl a.

5.10 Site 11: China, Korea, Japan

5.10.1 Overview

Site 11 has 626 points that can be possible matchups (Figure 11) and they were collected by Jaxa and Kordi (Table 30).

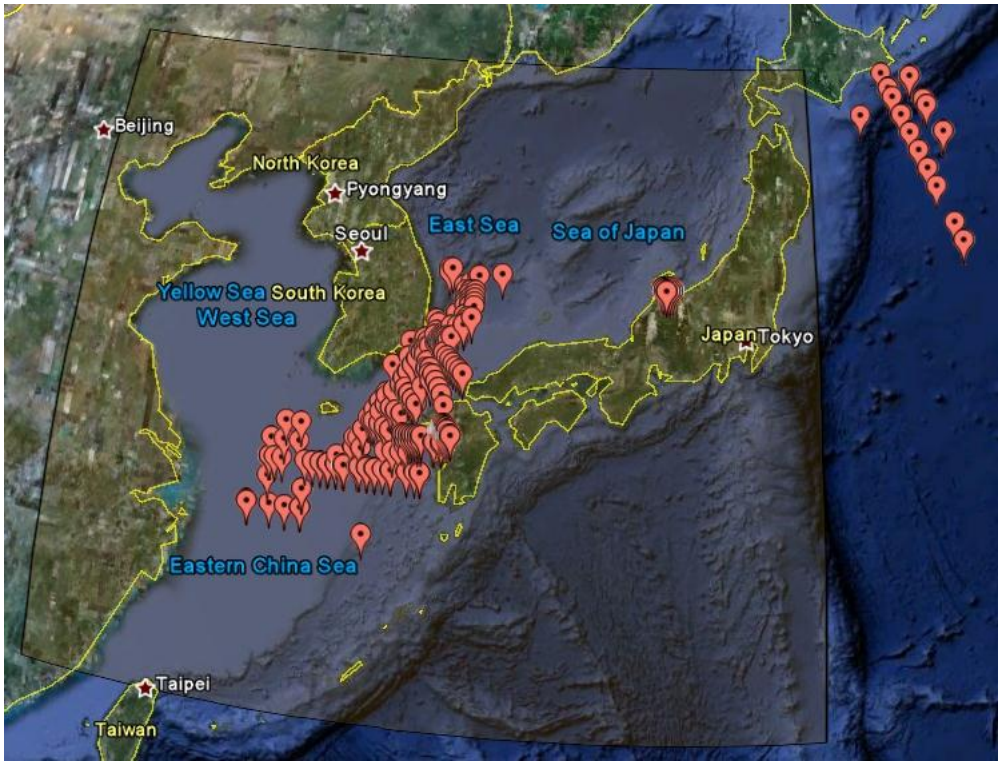


Figure 11: Site 11 - location of LFM points over Google Earth

Table 30: LFM Site 11 temporal availability

LFM Site11	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
JAXA	548	26	16	12	72	39	20	137	56	19	127	20	4
KORDI	78				32		15	31					
2005	388		3		46	19	4	116	56	19	101	20	4
2006	171	26	13	12	21	12	9	52			26		
2007	61				31	8	22						
2009	6				6								
TOTAL	626	26	16	12	104	39	35	168	56	19	127	20	4

Table 31 gives information about users contact points and about important available variables in Site 11. On the other hand, Table 32 shows some aspects about measurements equipments and methodologies.

Table 31: Site 11 – Data overview

Data Provider	Contact point	Key parameters	Notes
JAXA	Hiroshi Murakami	Kd, nlw, Rrs, ag, chl_a and TSM	
KORDI	Yu-Hwan Ahn	TSM, chl_a and POC	Start and End Time of measurement

Table 32: Summary of essential aspects of measurements protocols of key parameters on Site 11

Data Provider	chla	nlw	Rrs	abs
JAXA	fluorometer after extraction by N or acetone	Spectroradiometer Biospherical PRR-600, PRR-800, or MER-2040	$nLw(\lambda) = Rrs(\lambda) \times F0(\lambda)/\pi$	$ag(\lambda) = 2.303 \times ODy(\lambda)/L$
KORDI		N/A	N/A	N/A

11.1.1.1 JAXA

Date: 01-10-1998 to 12-06-2007,

Region: Between Eastern China Sea and Sea of Japan and Japan Northeast coast,

Platform: Cruise campaigns,

Parameters: water depth, Temperature, sechi depth, Kd, nlw, Rrs, ag440, chl_a, TSM, Salinity, Density, Si, PO4, NO2 and NO3,

Data Processing: To determine nLw(λ), JAXA used an underwater spectroradiometer (Biospherical PRR-600, PRR-800, or MER-2040) (Ishizaka et al., 2001) to determine the vertical profiles of Ed(λ) and Lu(λ). Rrs was calculated using the relation refered in Table 32 where Fo is the spectral solar irradiance at 1 AU (Thuillier et al., 2003). CHLA was determined by fluorometry using a fluorometer after extraction by N, NDimethylformamide (DMF) (Suzuki and Ishimaru, 1990) or acetone. Optical densities of the CDOM in water (ODy(λ)) were measured using the multi-purpose spectrophotometer (Shimadzu MPS-2400 etc.) and then ag was calculated as in Table 32, where L is the cuvette pathlength (m). TSM was derived as difference of weight of dried filter paper between before and after suction filtering and washing away sea salts on the filter. More information about JAXA protocols can be seen at **Fehler! Verweisquelle konnte nicht gefunden werden.**.

11.1.1.2 KORDI

Date: 12-07-20006 to 14-04-2009,

Region: Southeastern coast of South Korea,

Platform: Cruise campaigns,

Parameters: water and measurement depth, Temperature, TSM, chla, Salinity and POC,

Data Processing: KORDI data has Start Time and End Time, which can range between 16 minuts difference at a maximum of 20hours and 45 min, although most of times it doesn't go beyond 2h. There is no information about measurements protocols from KORDI campaigns.

5.10.2 Data Statistics

Measurements for test site 11 are available for regions with 48 to 2198 m water depth. Water temperature comprise the range between 1.9 °C and 23.1 °C. Both minimum and maximum of the spectral downwelling attenuation coefficient (kd) were measured at 490 nm (0.009 m^{-1} and 2.471 m^{-1}). Salinity varies between 21.15 and 34.75 psu, while the density is 25.32-26.91 sigma. The concentrations of TSM are generally below 5 mg/l but reach values of up to 22 mg/l in some cases. The same can be said about chlorophyll and POC. Chlorophyll shows higher concentrations than 5 mg/m^3 in exceptional cases, with 71.63 mg/m^3 registered as a maximum value. Particulate organic carbon exceeds the most frequent concentration of up to 5 mg/m^3 in some cases and then reaches very high values of 90.9 mg/l. CDOM varies between 0 and 0.517.

5.10.3 Available Measurements for Validation

For site 11 there is available nLw and Rrs for Chl, TSM and kd443. In each of MERIS bands 1-3, 5 and 6, 117 nLw measurements were performed. A number of 113 to 267 Rrs data is available for each of the MERIS bands 1-5 and 7 for Chl, CDOM, TSM and kd443.

5.11 Site 12: Great Barrier Reef

5.11.1 Overview

LFM database for Site 12 contains 59% of total CSIRO available data for CC project, and this is the only user with data for this site. Figure 12 shows the location of the available DTLL points for LFM and Table 33 gives an overview about the temporal availability of these data, mainly collected in April and September.

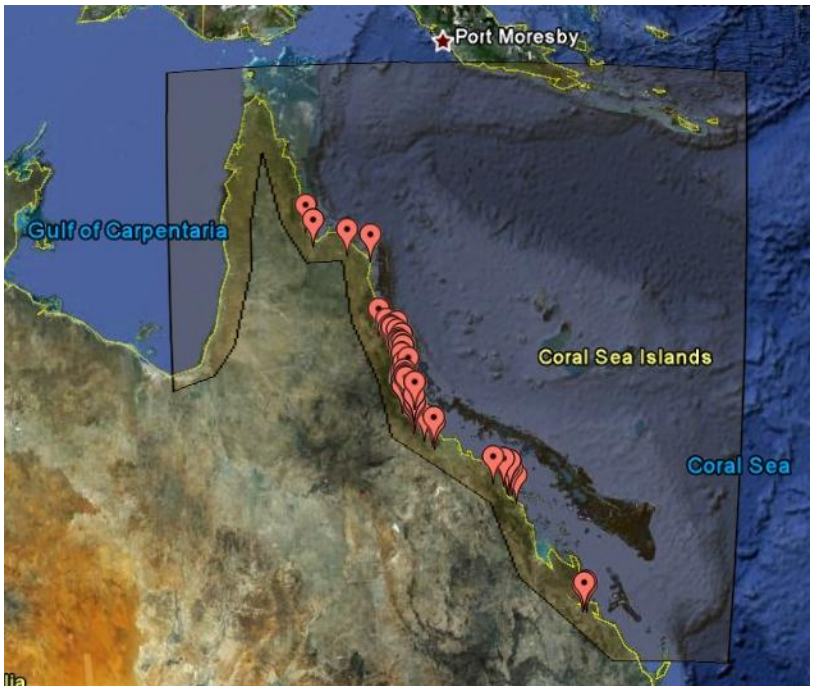


Figure 12: Site 12 - location of LFM points over Google Earth

Table 33: LFM Site 12 temporal availability

LFM Site12	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
CSIRO	78				24				12	36	4	2	
2005	25								12	13			
2006	6										4	2	
2007	23									23			
2008	24				24								
TOTAL	78				24				12	36	4	2	

User contact point, key parameters and main methodologies to collect the data are available in Table 34 and Table 35.

Table 34: Site 12 – Data overview

Data Provider	Contact point	Key parameters	Notes
CSIRO	Arnold Dekker	Rrs, aph, ag440, a_NAP, TSM and t_chl_a	

Table 35: Summary of essential aspects of measurements protocols of key parameters on Site 12

Data Provider	chla	lw	Rrs	abs
CSIRO	HPLC measurements Whatman 47 mm GF/F glass fiber filters (nominal pore size: 0.7 nm) stored in liquid nitrogen until nalysis	N/A		WetLabs AC-9

5.12.1.1 CSIRO

Date: 21-10-2002 to 23-04-2008,

Region: Coral Sea Islands,

Platform: Cruise campaign,

Parameters: Rrs, aph, ag440, a_NAP, b_NAP, bb_NAP, bb/b, TSM, t_chl_a and salinity,

Data Processing: To determine absorption coefficients water samples were filtered through Whatman 25 mm GF/F glass fiber filters (nominal pore size of 0.7 mm) and stored flat in liquid nitrogen. T_chl_a was analysed following the method described in Van Heukelem and Thomas [2001]. To get ag coefficients, some CSIRO water samples were filtered immediately after collection through a 0.22 mm polycarbonate filter (Millipore) and stored in glass bottles in cool and dark conditions. TSM were collected by filtering the surface water samples onto Whatman 47 mm diameter GF/F filters under low vacuum. More information about each method can be found in [11].

5.11.2 Data Statistics

At the Great Barrier Reef salinity fluctuates predominantly between 30 and 40 psu. TSM concentration is low to moderate with most values below 5 mg/l and a maximum concentration of 27.4 mg/l. The phytoplankton absorption coefficient is generally moderate but also reaches very high values. The minimum is observed at 443 nm (0.0355479 m^{-1}), the maximum at 440 nm (0.263237 m^{-1}). Also the dissolved material absorption coefficient (ag440) is generally low (0.0071-0.12 m^{-1}) but reaches

0.3954 m^{-1} maximum. The non-pigmented particle absorption coefficient at 440 nm rarely exceeds 0.06 m^{-1}.

5.11.3 Available Measurements for Validation

For site 12 there are no data available where measurements were done for AOP for MERIS bands and biochemical optical parameters simultaneously.

5.12 Site 14: Indonesian Waters

5.12.1 Overview

Indonesian Waters have data collected from three different users: NOMAD, ITC and GRAS. Figure 13 has the location of LFM points in this Site and Table 36 shows the time availability of this data.

Figure 13: Site 14 - location of LFM points over Google Earth

Table 36: LFM Site 14 temporal availability

LFM Site14	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NOMAD	8				8								
ITC	119					19			100				
GRAS	1456	141	123	75	142	163	149	140	126	121	120	65	91
2007	8				8								
2008	27					19			8				
2009	662	28	44	42	49	50	45	39	120	46	43	65	91
2010	886	113	79	33	93	113	104	101	98	75	77		
TOTAL	1583	141	123	75	150	182	149	140	226	121	120	65	91

Table 37 gives information about users contact points and about important available variables in Site 14. On the other hand, Table 38 shows some aspects about measurements equipments and methodologies.

Table 37: Site 14 – Data overview

Data Provider	Contact point	Key parameters	Notes
NOMAD	Werdell and Bryan Franz	Kd, Lw, Es, ag, chla, t_chl_a, kpar, z_37, z_10 and z_01	
ITC	Suhyb Salama	Rrs, TSM and chl_a	Start and End Time of measurement
GRASS	Lars Boye Hansen	TSM	

Table 38: Summary of essential aspects of measurements protocols of key parameters on Site 14

Data Provider	chla	lw	Rrs	abs
NOMAD	Fluorometry and HPLC measurements	Data collected by different users. Database includes radiometric dataquality checked according to [5]		Database only includes data collected following OBPG defined protocols [6]
ITC	spectrophotometric method	N/A	2 x TriOS-RAMSES hyperspectral spectroradiometers	N/A
GRASS	N/A	N/A	N/A	N/A

5.13.1.1 NOMAD

Date: 03to12-04-2007,

Region: along West Sumatra Island,

Platform: various (database),

Parameters: Temperature, Kd, Lw, Es, ag, chl_a, t_chl_a, chlide_a, dv_chl_a, chl_c3, chl_c2, pras, PSC and PPC pigments (except Neoxanthin), kpar, z_37, z_10 and z_01,

Data Processing: Described in 5.1.1.7, [5] and [6] (http://seabass.gsfc.nasa.gov/data/werdell_nomad_iop_qc.pdf).

5.13.1.2 ITC

Date: 03-05-2008 to 27-08-2009,

Region: Mahakam Delta,

Platform: cruise campaign,

Parameters: wind speed, cloud cover, secchi depth, measurement and water depth, Rrs, TSM and chl_a,

Data Processing: ITC data has Start Time and End Time, which can range between 8 minuts difference at a maximum of 1:30:00. Field measurements were carried out during wet (May) and dry (August) seasons in 2008 and during the dry season in August 2009, with total 119 stations. Chl-a concentrations were measured using a spectrophotometer after the water samples filtered through a 47

mm diameter filters (membrane filter, pore size of 0.45 µm) (Clesceri et al., 1998), and TSM concentrations were determined using the gravimetric method. CDOM fluorescence intensity (F(z) - recorded in quinine sulphate equivalent units – QSE) was measured with a MicroFlu-CDOM fluorometer. A TriOS RAMSES-ARC radiance sensor (7° field of view) was used to measure the water surface ($L_{sfc}(\lambda)$) and the sky radiance ($L_{sky}(\lambda)$) and a TriOS RAMSES-ACC-VIS irradiance sensor was used to measure down-welling irradiance ($E_d(\lambda)$) – with this measurements was possible to caltulate Rrs for 191 different wavelengths. More information about ITC measurements protocols and applied formulas can be found in [12].

5.13.1.3 GRASS

Date:01-01-2009 to 31-10-2010,

Region: Singapore waters,

Platform: N/A,

Parameters: TSM,

Data Processing: Optical based TSM concentrations are found through an Optical turbidity sensor (YSI®600) and measured values were average of measured data extracted with a +/- 20 minute time slot of the listed local time (SGT) (info in the user file).

NOTE: HZG data can not be used/shown in any publication or report and stations location may not be the exact ones.

5.12.2 Data Statistics

The region of measurements in the Indonesian Waters show very low water depth from 1 to 39.6 meters. Concentrations of TSM are frequently higher than 6 mg/l and show the highest concentrations of all test sites: up to 330 mg/l. Chlorophyll values are also high, reaching 48 mg/m^3. In contrast to this the dissolved material absorption coefficient at 443nm (ag440) stays very low (max: 0.00945 m^{-1}). Also the spectral downwelling irradiance attenuation coefficient (kd) is very low with minimum 0.02599 m^{-1} at 443 nm and maximum 0.08283 m^{-1} at 555 nm. Depth of x% light level of PAR is relatively high with 52 m maximum at 10%.

5.12.3 Available Measurements for Algorithm Validation

There are 118 measurements of Rrs and TSM and 91 of them also have chl_a information. In MERIS bands 1-5, and 6-7 there are respectively 5 measurements available for the parameters Chl a, kd411, z37, z_01 and z_10.

5.13 Site 17: Cape Verde

5.13.1 Overview

Cape Verde region data available is included in NOMAD database, and, although having a total of 13 different DTLL measurements, for LFM only 8 records are available and, even so, some only close to the site area (Figure 14).

Figure 14: Site 17 – location of LFM points over Google Earth

The data available for Site 17 was collected in 2005, October (2 records) and November (6 records). The available parameters are the same of Site 5 (5.1.1.7), except that site 17 has no data pigments, neither most of the HPLC products, just t_chl_a. More informations in [5] and [6] (http://seabass.gsfc.nasa.gov/data/werdell_nomad_iop_qc.pdf).

5.13.2 Data Statistics

The attenuation coefficient for spectral downwelling irradiance is very small in all measured wavelength and does not exceed 0.1883 m^{-1} (kd590) (min: 0.0303 at 489 nm). Particle and non-particle absorption coefficients at 443 nm are also very small (< 0.0213 m^{-1}). The fitted backscatter coefficient stays below 0.0050 m^{-1} like the highest original backscatter coefficient, at 420 nm, is 0.0043 m^{-1}. The particulate organic carbon concentrations fluctuate between 40 and 57 mg/l. Values for depth of x% light level of PAR are quite high with 100 m maximum for 10% and 1%.

5.13.3 Available Measurements for Validation

No in situ data are available for nLw or Rrs. In each of the 1-8 MERIS bands, 3 measurements were done for the parameters POC, kd (kd411, kd433, kd489, kd510, kd530 and kd555, kd 590) bb_443, z_37, z_01 and z_10.

5.14 Site 20: Central California

5.14.1 Overview

Site 20 has data from three users: NOAA, COAS_OSU and NOMAD. However NOMAD has only data previous to 2005 and therefore not suitable for LFM. Figure 15 shows the location of NOAA and COAS_OSU points with available information for LFM database and Table 39 has the temporal information.

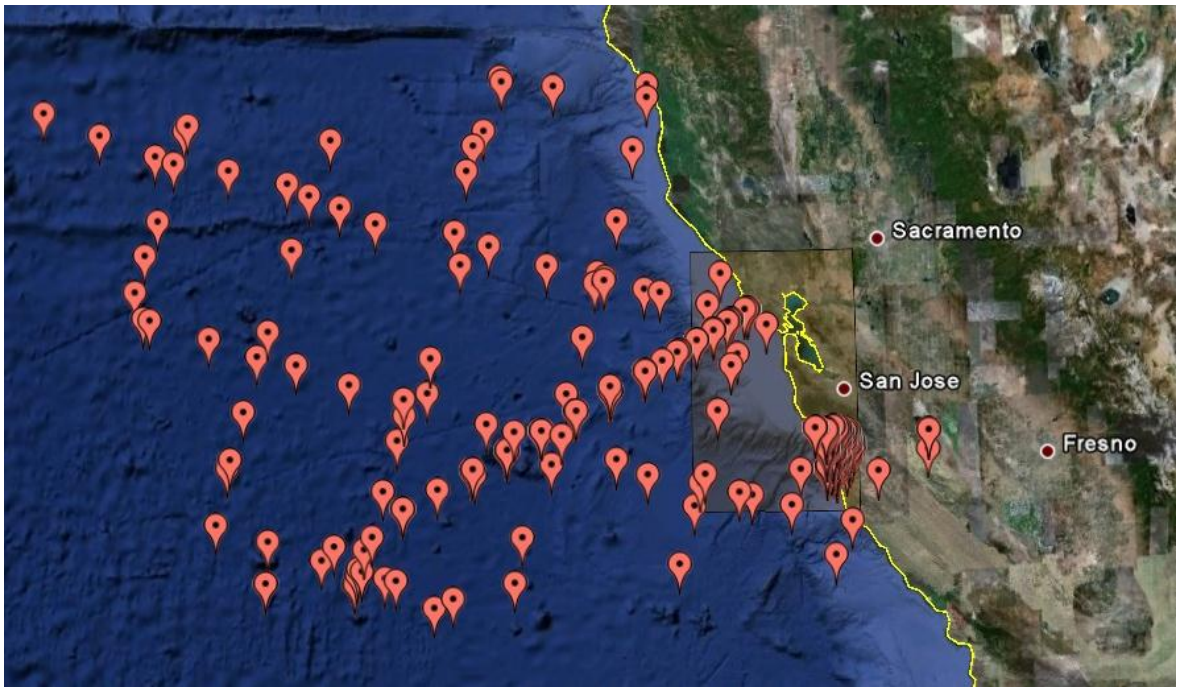


Figure 15: Site 20 - location of LFM points over Google Earth

Table 39: LFM Site 20 temporal availability

LFM Site20	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NOAA	648	59	15	23	17	35	51	67	43	126	143	55	14
COAS_OSU	2								2				
2005	144	21		11		11	8	28	11	11	32	11	
2006	161	9	3		2	11	14	23	11	42	28	14	4
2007	85	13	4	4	5	4	19	4	5	4	4	17	2
2008	175	6	4	4	5	4	6	5	4	64	62	8	3
2009	81	6	4	4	5	5	4	7	14	5	17	5	5
2010	4	4											
TOTAL	650	59	15	23	17	35	51	67	45	126	143	55	14

Table 40: Site 20 – Data overview

Data Provider	SOURCE /Contact point	Paramenters	Notes
NOAA	Dave Foley	Chl_a	
COAS_OSU	Jasmine Nahorniak (3) Morgaine McKibben	Chl_a	time in PST and DPST – updated to UTC

Table 41: Summary of essential aspects of measurements protocols of key parameters on Site 20

Data Provider	chla	lw	Rrs	abs
NOAA	NISKIN / GFF BUCKET / GFF GFoverF_Chl_a averages	N/A	N/A	N/A
COAS_OSU	Fluorimetric method	N/A	N/A	N/A

5.15.1.1 NOAA

Date: 03-03-1997 to 27-01-2010,

Region: San Francisco,

Platform: various (database),

Parameters: measurement depth, chla, phaeo, salinity, NO3, NO2, PO4, SiO4, Silicid acid, pDA, sig_t and O2.Conc,

Data Processing: All measurements are based on in vitro fluorescence following dark 24-hour extractions in acetone.

5.7.1.1 COAS_OSU

Date: 11-08-2009,

Region: San Francisco coastal,

Platform: (3) MOCHA campaign,

Parameters: Measurement and Water depth and chl_a,

Data Processing: See 5.7.1.1.

5.14.2 Data Statistics

In site 20 the depth of the water column at the measurement station is around 50 m. Water temperature fluctuates between 10 and 16°C at a salinity of 32-34 psu. Chlorophyll concentrations are extremely high in some exceptional cases overstepping 530 mg/m³. These values occured in a bloom situation and were verified and confirmed spectrometrically by the user. The concentration of Phaeo pigments is normally low but reaches values of 0.873 mg/m³.

5.14.3 Available Measurements for Validation

For site 20 there are no data available where measurements were done for AOP or biochemical optical parameters and radiance or reflectance in parallel.

5.15 Site 25: Tasmania

Tasmania site only counts with 21 measurements from CSIRO campaigns (Figure 16), undertaken during 2007, between May 21 and 29.

Informations about CSIRO contact and key parameters can be seen at Table 34.

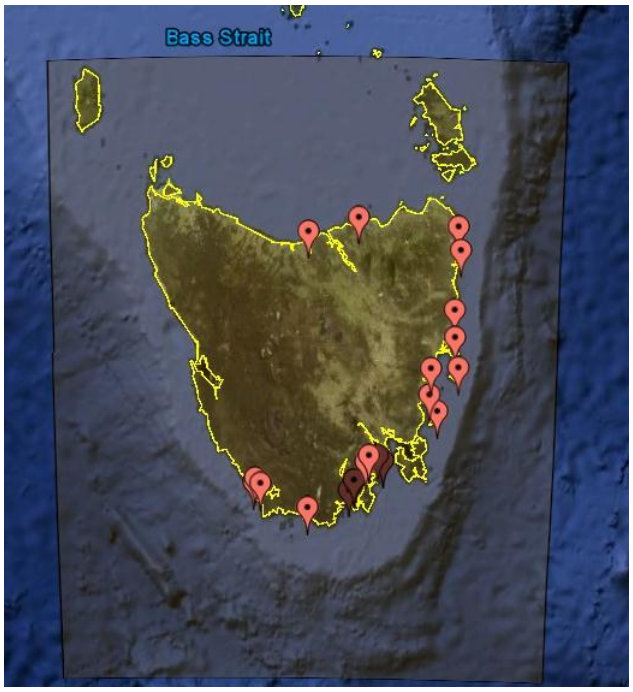


Figure 16: Site 25 - location of LFM points over Google Earth

5.16.1.1 CSIRO

Date: 21to29-05-2007,

Region: around Tasmania island, except Northwest quadrant,

Platform: Cruise campaign,

Parameters: aph, ag440, a_NAP, bb_NAP, bb/b, TSM, t_chl_a and salinity,

Data Processing: See Table 35 and 5.7.1.1.

5.15.2 Data Statistics

The salinity observed in test site Tasmania is caracteristic for oceanic waters, varying between 32 and 36 psu. TSM concentrations are very low and do not exceed 2 mg/l. In contrast, the dissolved material absorption coefficient at 443 nm shows values exceeding 5.38 m^{-1} maximum. Phytoplankton absorption coefficients are between 0.03 and 0.14 m^{-1} at different wavelengths but show the most frequent value around 0.065 m^{-1}.

5.15.3 Available Measurements for Validation

For site 25 there are no data available where measurements were done for AOP and biochemical optical parameters simultaneously.

5.16 Site 26: Gulf of Mexico

5.16.1 Overview

Site 26 has 47 records available (Figure 17) provided by NOMAD database and MSU user- Table 42 shows its dispersion on time measurements.

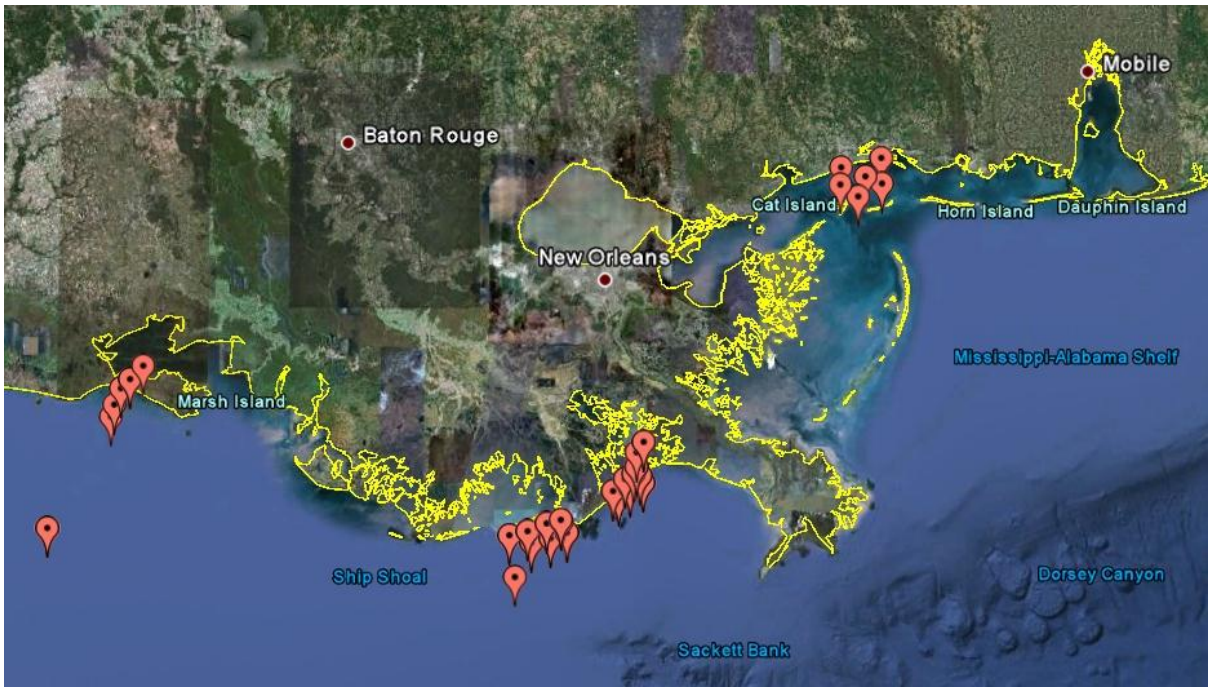


Figure 17: Site 26 - location of LFM points over Google Earth

Table 42: LFM Site 26 temporal availability

LFM Site26	TOTAL	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NOMAD	41					20		15	6				
MSU	6												6
2005	6												6
2007	41					20		15	6				
TOTAL	47					20		15	6				6

User contact point, key parameters and main methodologies to collect the data are available in Table 43 and Table 44.

Table 43: Site 26 - Data overview

Data Provider	Contact point	Key parameters	Notes
NOMAD	Werdell and Bryan Franz	Lw, Es, chla and t_chl_a	
MSU	ZhongPing Lee	Rrs, a, bp, TSM, SIPM and SOPM	

Table 44: Summary of essential aspects of measurements protocols of key parameters on Site 26

Data Provider	chla	lw	Rrs	abs
NOMAD	Fluorometry and HPLC measurements	Data collected by different users. Database includes radiometric dataquality checked according to [5]		Database only includes data collected following OBPG defined protocols [6]
MSU	N/A	N/A		N/A

5.17.1.1 NOMAD

Date: May, July and August 2007

Region: Barataria and Timbalier Bays, and between Vermilion Bay and Trinity Shoal,

Platform: various (database),

Parameters: water depth, Lw, Es, chl_a, t_chl_a, chlide_a, mv_chl_a, dv_chl_a, chla_c3, chla_c2, chl_c1c2, chl_b, pras and PPC and PSC pigments (except Neox),

Data Processing: Described in 5.1.1.7, [5] and [6] (http://seabass.gsfc.nasa.gov/data/werdell_nomad_iop_qc.pdf).

5.17.1.2 MSU

Date: 13-12-2005

Region: MS Sound (around Gulfport),

Platform: cruise,

Parameters: Rrs, a, bp, TSM, SIPM and SOPM,

Data Processing: We have no information about MSU measurements methodologies or processed data.

5.16.2 Data Statistics

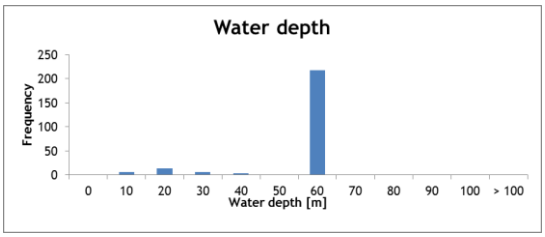
In the Gulf of Mexico the few measurements of Total Suspended Matter show concentrations between 3 and 15 mg/l, with one exception of 25.02 mg/l as maximum. The TSM splits in SIPM and SOPM. Suspended Inorganic Particulate Matter shows concentrations from 1 to 10 mg/l but also a value of 20.43 mg/l as maximum. SOPM concentrations fluctuate between 1.3 and 4.6 mg/l. The absorption coefficient (a440) has its minimum at 0.438 m^{-1} and its maximum at 1.73666191 m^{-1}. Minimum for the scatter coefficient at 440 nm (b440) is 2.15 m^{-1} and maximum is 15.65 m^{-1}.

5.16.3 Available Measurements for Validation

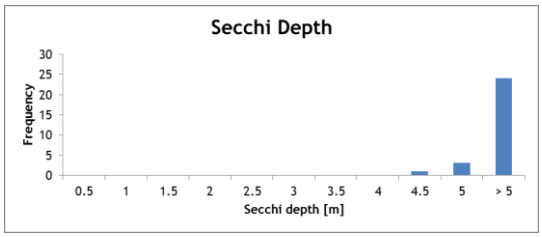
Site 26 has 6 LFM points with parallel information about Rrs and TSM (also with SIPM and SOPM).

6 ANNEX 1: HISTOGRAMMS

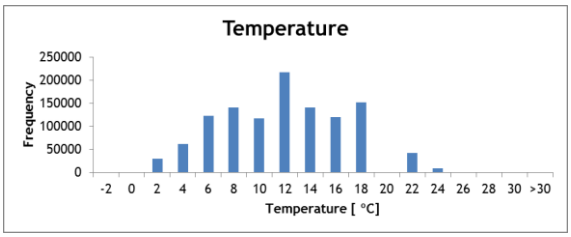
Site 1: North Sea, English Channel, Bay of Biscay, Celtic Sea



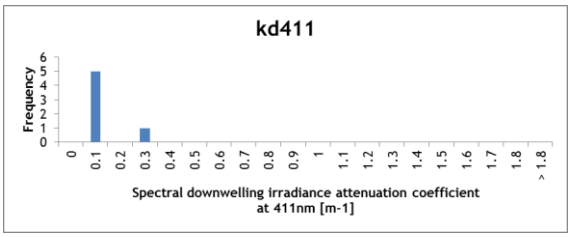
min: 4.3m; median: 55m; max: 85m



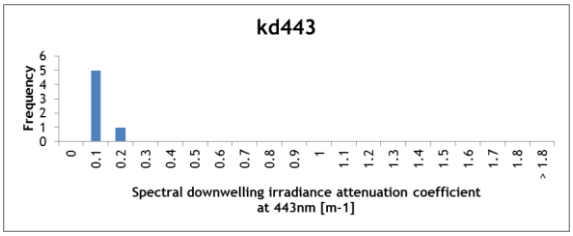
min: 4.3m; median: 8m; max: 13m



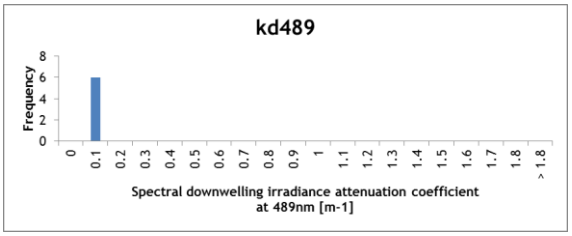
min: -1.34°C; median: 11.49°C; max: 27.55°C



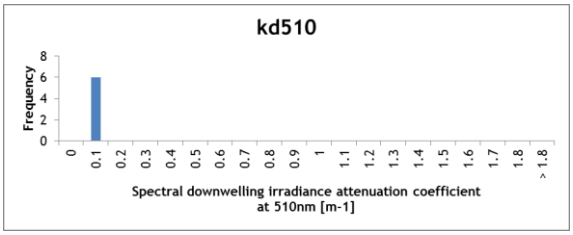
min: 0.069378m^{-1}; median: 0.08558345m^{-1}; max: 0.281456m^{-1}



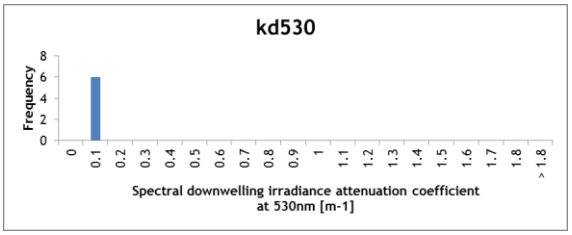
min: 0.0592166m^{-1}; median: 0.0707814 m^{-1}; max: 0.142078m^{-1}



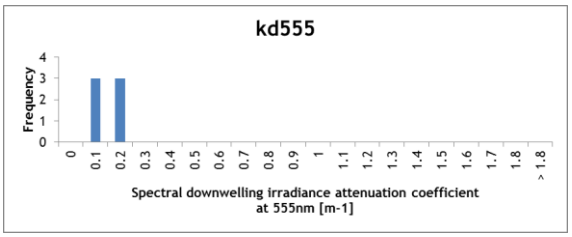
min: 0.0486076m^{-1}; median: 0.0578645 m^{-1}; max: 0.0821054m^{-1}



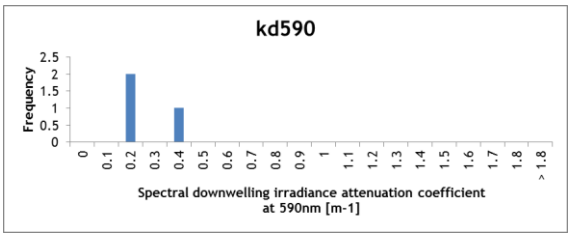
min: 0.0607511m^{-1}; median: 0.0709288 m^{-1}; max: 0.0900989m^{-1}



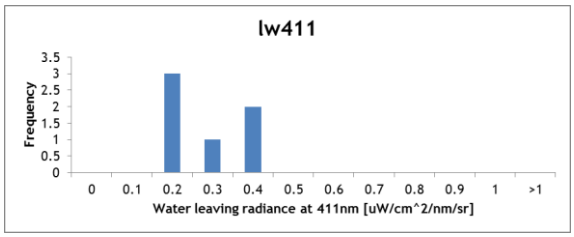
min: 0.0702109m^{-1}; median: 0.07554645 m^{-1}; max: 0.0960196m^{-1}



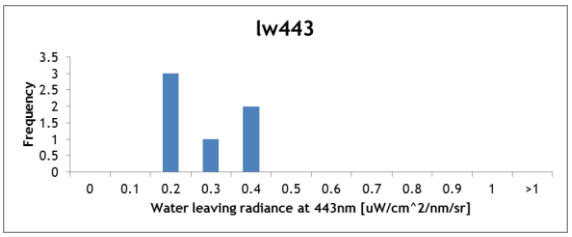
min: 0.0869017m^{-1}; median: 0.09450495 m^{-1}; max: 0.110214m^{-1}



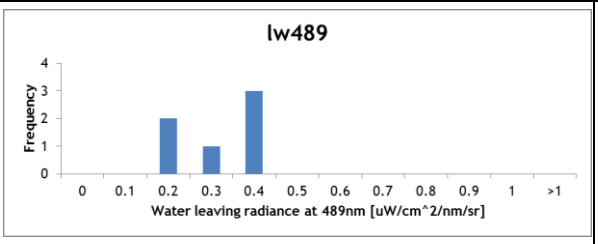
min: 0.147396m^{-1}; median: 0.171414 m^{-1}; max: 0.356875m^{-1}



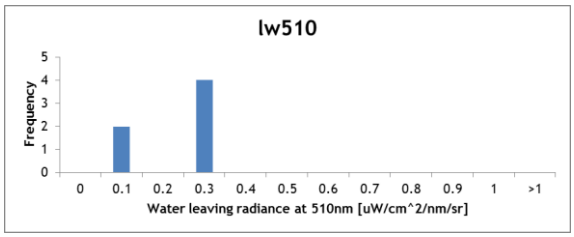
min: 0.108189 uW/cm²/nm/sr;
median: 0.1991635 uW/cm²/nm/sr;
max: 0.353948 uW/cm²/nm/sr



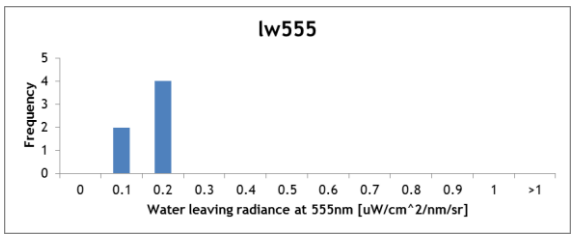
min: 0.103931 uW/cm²/nm/sr;
median: 0.2320215 uW/cm²/nm/sr;
max: 0.375013 uW/cm²/nm/sr



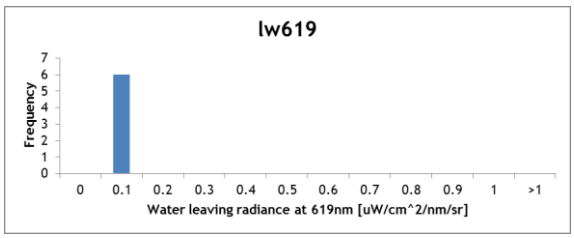
min: 0.106911 uW/cm²/nm/sr;
median: 0.2850385 uW/cm²/nm/sr ;
max: 0.390515 uW/cm²/nm/sr



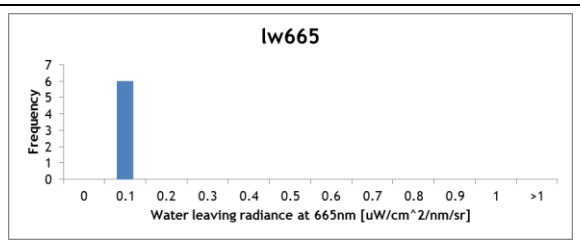
min: 0.084432 uW/cm²/nm/sr;
median: 0.227118 uW/cm²/nm/sr;
max: 0.280305 uW/cm²/nm/sr



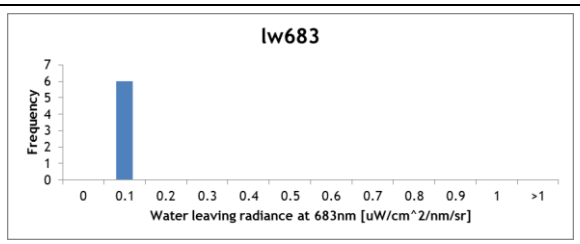
min: 0.042877 uW/cm²/nm/sr;
median: 0.129514 uW/cm²/nm/sr;
max: 0.137486 uW/cm²/nm/sr



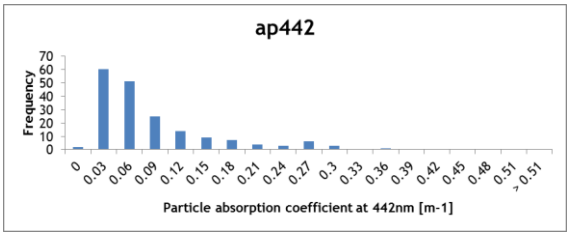
min: 0.003064 uW/cm²/nm/sr;
median: 0.009177 uW/cm²/nm/sr;
max: 0.022709 uW/cm²/nm/sr



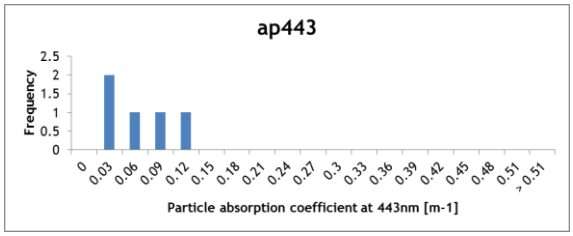
min: 0.001336 uW/cm²/nm/sr;
median: 0.003222 uW/cm²/nm/sr;
max: 0.009587 uW/cm²/nm/sr



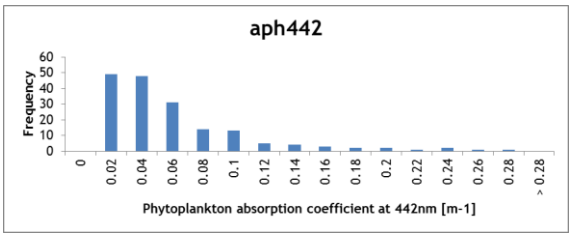
min: 0.002633 uW/cm²/nm/sr;
median: 0.005397 uW/cm²/nm/sr;
max: 0.013458 uW/cm²/nm/sr



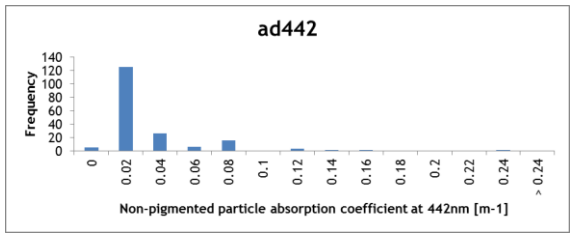
min: 0m^{-1}; median: 0.044763 m^{-1};
max: 0.336994m^{-1}



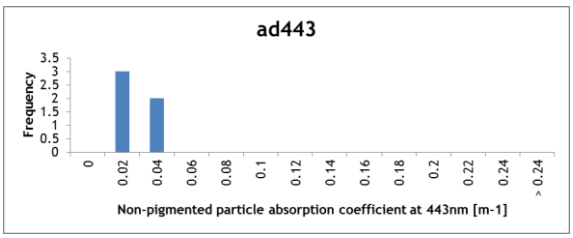
min: 0.01803m^{-1}; median: 0.0302m^{-1};
max: 0.119025m^{-1}



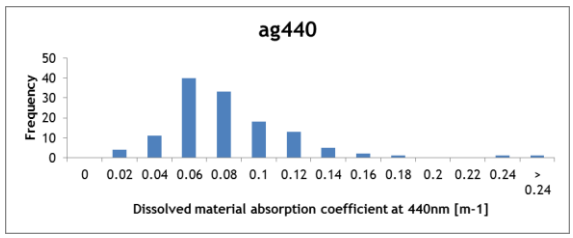
min: 0.003794m^{-1}; median: 0.034722 m^{-1};
max: 0.274209m^{-1}



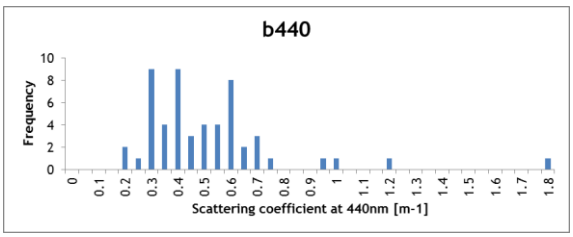
min: 0m^{-1}; median: 0.010968m^{-1};
max: 0.227126m^{-1}



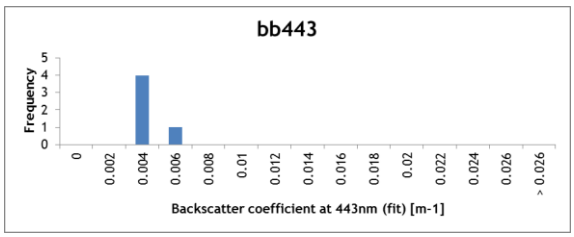
min: 0.00206m^{-1}; median: 0.00629 m^{-1};
max: 0.00629m^{-1}



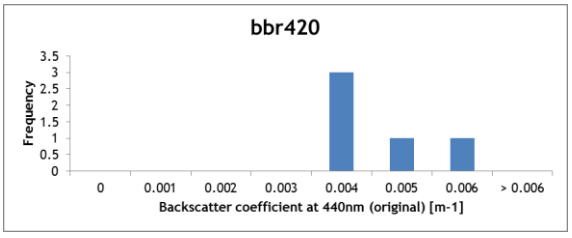
min: 0.00666m^{-1}; median: 0.065609m^{-1};
max: 0.33288801m^{-1}



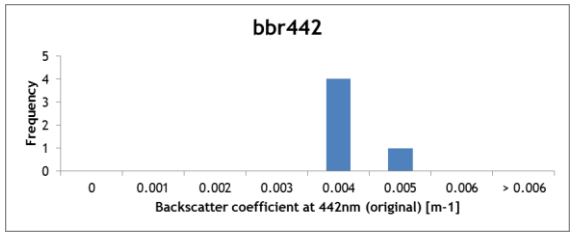
min: 0.167989m^{-1}; median: 0.424235m^{-1};
max: 1.76169m^{-1}



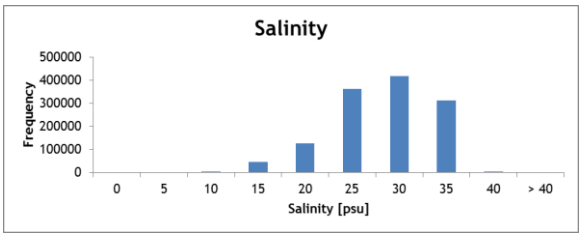
min: 0.00319667m^{-1}; median: 0.003323m^{-1};
max: 0.0047877m^{-1}



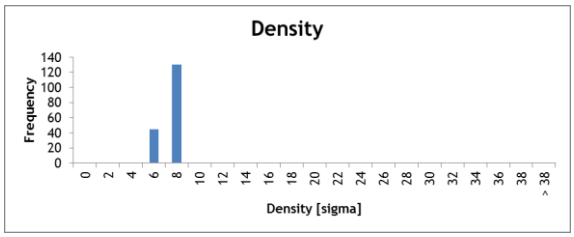
min: 0.00381m^{-1}; median: 0.00397m^{-1};
max: 0.00534m^{-1}



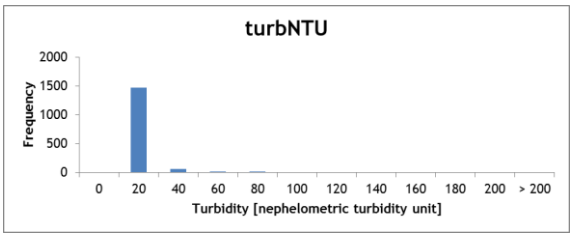
min: 0.00312m^{-1}; median: 0.00322m^{-1};
max: 0.00468m^{-1}



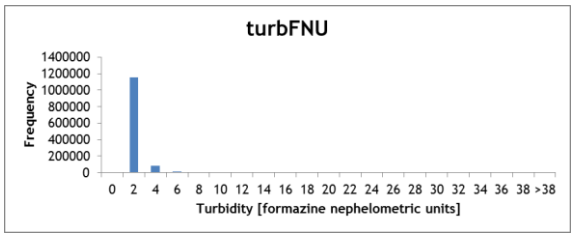
min: 0.529psu; median: 26.25psu;
max: 36.9psu



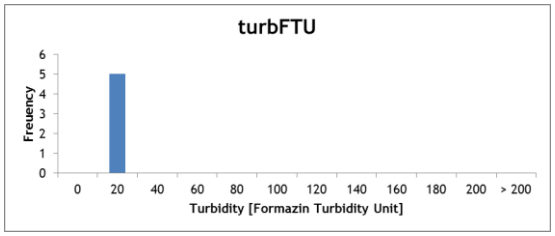
min: 4.8254sigma; median: 6.3693sigma;
max: 7.4752sigma



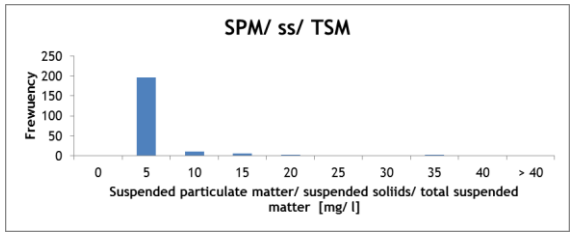
min: 0.2; median: 3; max: 195



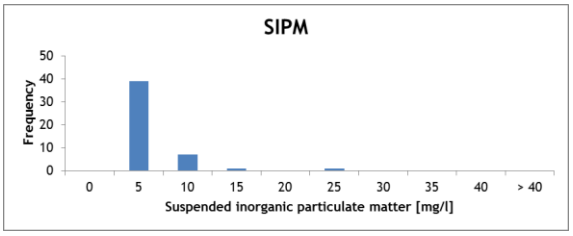
min: 0; median: 0.91; max: 41.162



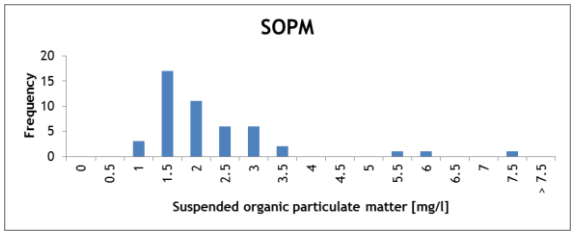
min: 0.67; median: 1.315; max: 2.4



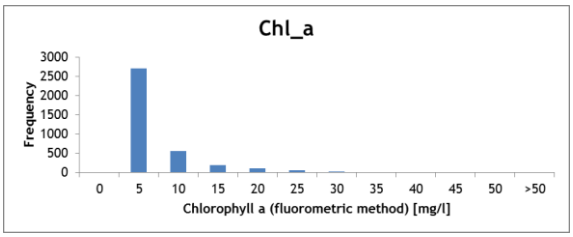
min: 0.17mg/l; median: 0.875mg/l;
max: 31.24mg/l



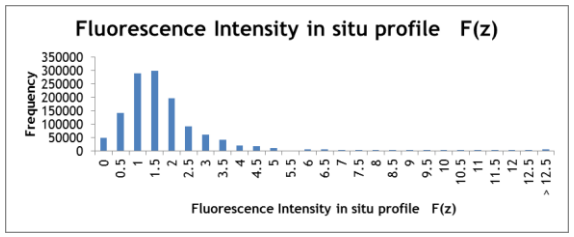
min: 0.03mg/l; median: 2.27mg/l;
max: 24.04mg/l



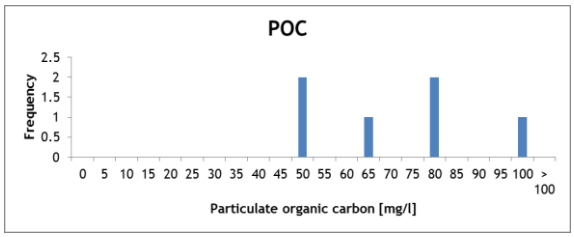
min: 0.94mg/l; median: 1.63mh/l;
max:7.2mg/l



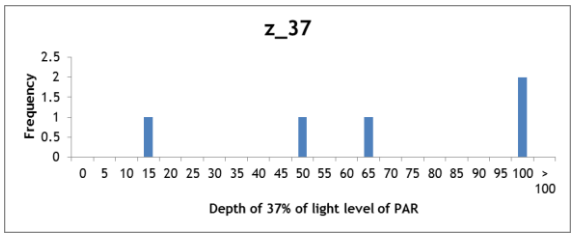
min: 0.04mg/m^3; median: 2.25mg/m^3;
max: 197.5mg/m^3



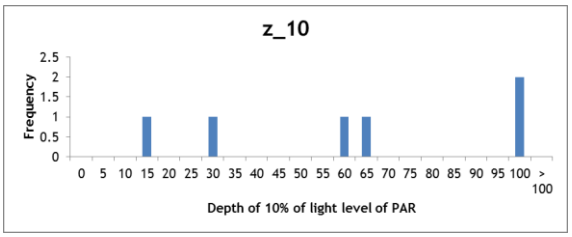
min: 0arb.units; median: 1.25arb.units;
max: 29.08arb.units



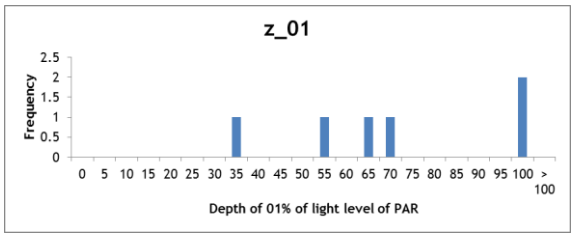
min: 47.885mg/l; median: 67.89mg/l; max: 98.019mg/l



min: 12.5m; median: 64m; max: 100m

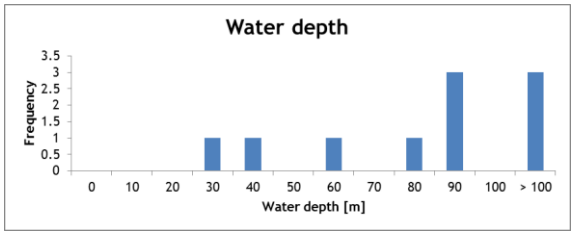


min: 12m; median: 61.25m; max: 100m

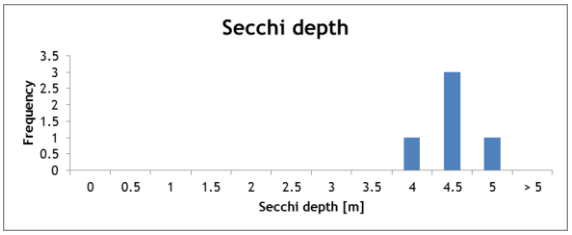


min: 34m; median: 65.75m; max: 100m

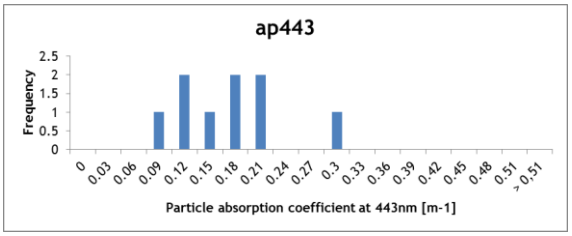
Site 2: Baltic Sea



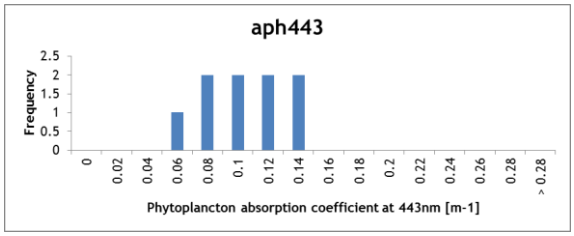
min: 24m; median: 96m; max: 190m



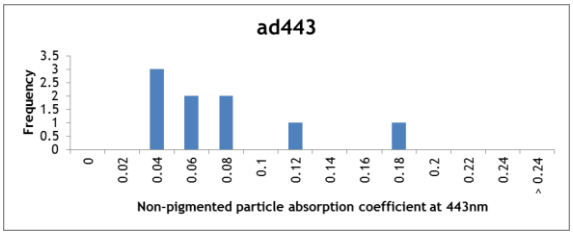
min: 4.0m; median: 4.5m; max: 4.8m



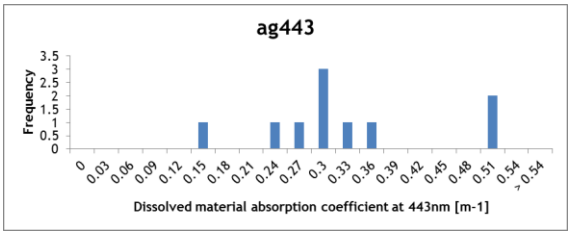
min: 0.07859m^{-1}; median: 0.15345m^{-1};
max: 0.283016m^{-1}



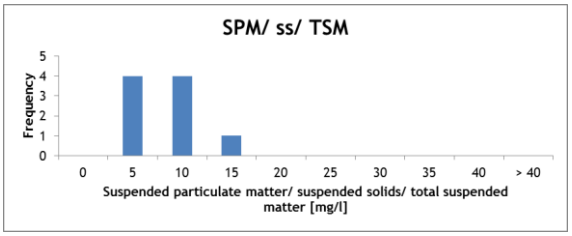
min: 0.045723 m^{-1}; median: 0.085m^{-1};
max: 0.126719m^{-1}



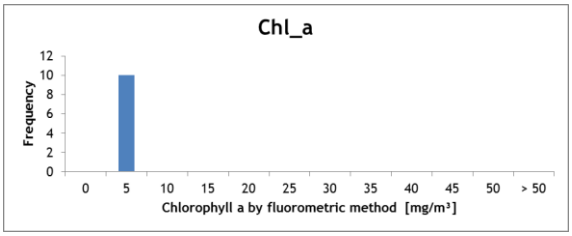
min: 0.032868m^{-1}; median: 0.04422m^{-1};
max: 0.179694m^{-1}



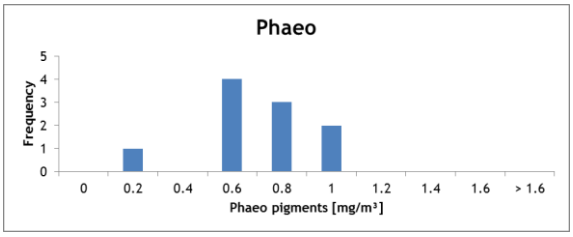
min: 0.12052m^{-1}; median: 0.27487m^{-1};
max: 0.50101m^{-1}



min: 0.14mg/l; median: 5.64mg/l;
max: 10.79mg/l



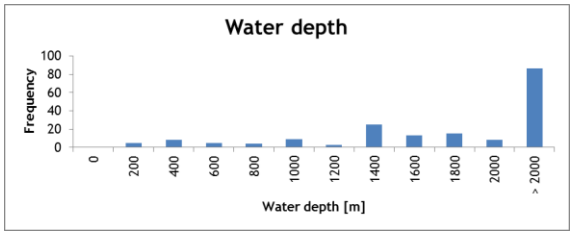
min: 0.57577mg/l; median: 2.39062m^{-1};
max: 4.28mg/l



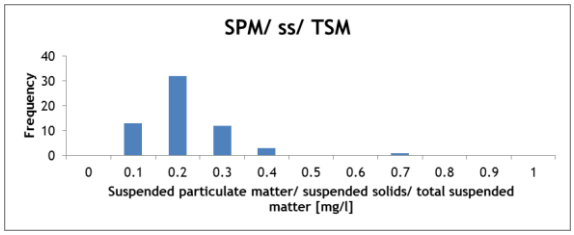
min: 0.17418mg/m^3; median: 0.6126mg/m^3;
max: 0.88mg/m^3

(x)

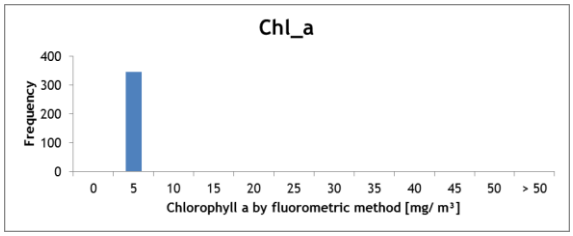
Site 3: Mediterranean Sea and Black Sea



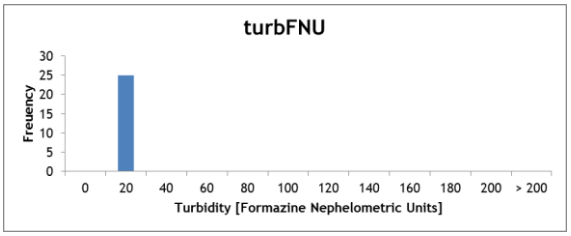
min: 92m; median: 1780m; max: 4101m



min: 0.01mg/l; median: 0.15mg/l; max: 0.85mg/l

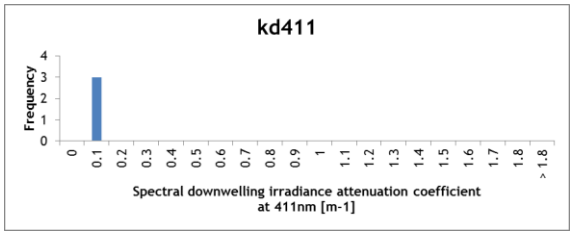


min: 0.006mg/m^3; median: 0.239mg/m^3; max: 4.135mg/m^3

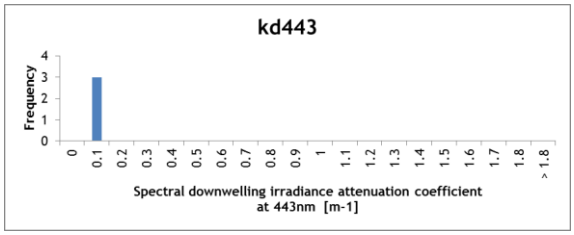


min: 0.031FNU; median: 0.053FNU; max: 0.139FNU

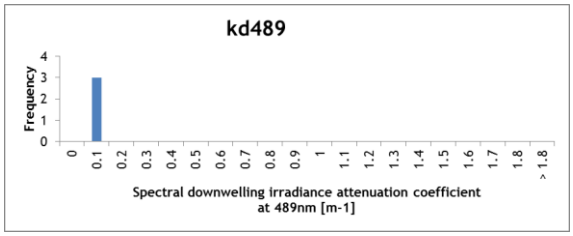
Site 4: Morocco



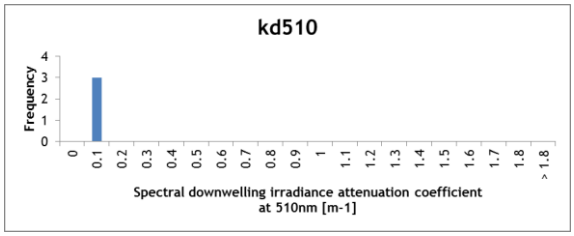
min:0.027543m^{-1}; median: 0.035057m^{-1}; max: 0.0350568m^{-1}



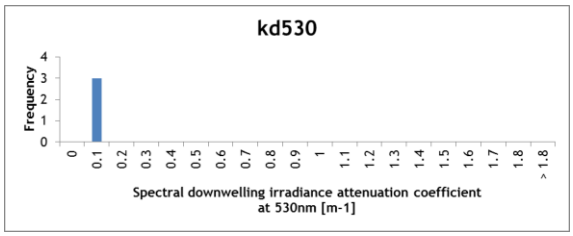
min: 0.0258149m^{-1}; median: 0.031486 m^{-1}; ax: 0.0326908m^{-1}



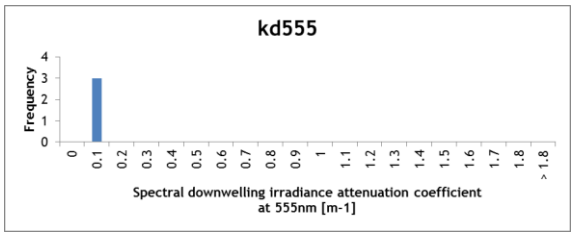
min: 0.0263261m^{-1}; median: 0.032142m^{-1}; max: 0.0324563m^{-1}



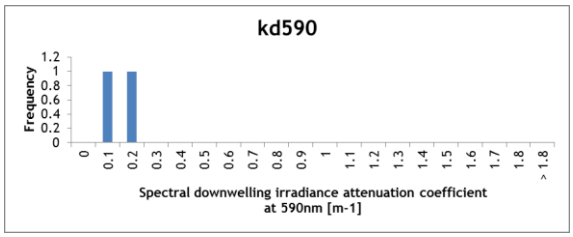
min: 0.0406158m^{-1}; median: 0.048513m^{-1}; max: 0.0531155m^{-1}



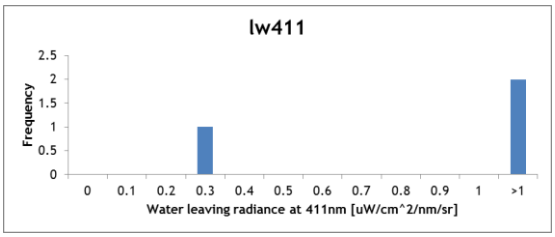
min: 0.0495025m^{-1}; median: 0.058455m^{-1}; max: 0.0653354m^{-1}



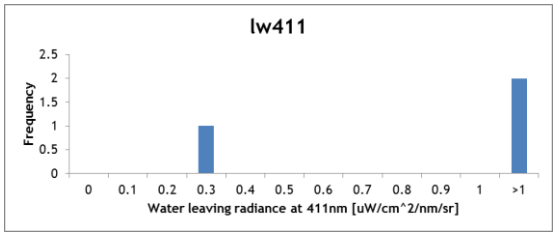
min: 0.0693563m^{-1}; median: 0.078867m^{-1}; max: 0.0994173m^{-1}



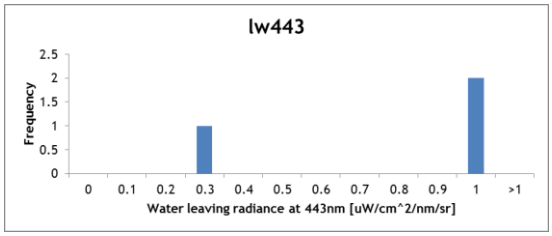
min: 0.0455834m^{-1}; median: 0.10791m^{-1}; max: 0.170237m^{-1}



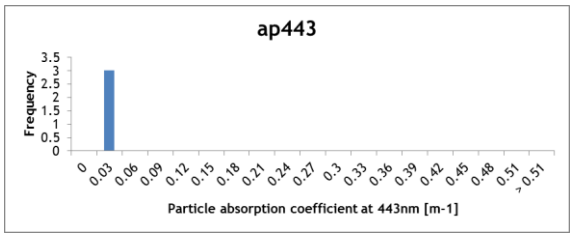
min: 0.233865 uW/cm²/nm/sr; median: 1.06678 uW/cm²/nm/sr; max: 1.08318 uW/cm²/nm/sr



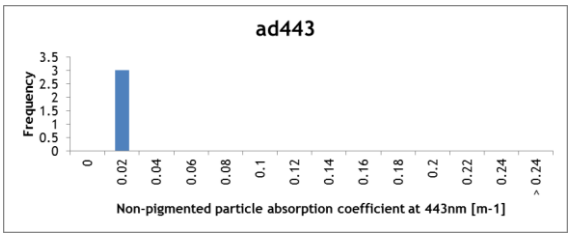
min: 0.207858 uW/cm²/nm/sr;
median: 0.944517 uW/cm²/nm/sr;
max: 0.96782 uW/cm²/nm/sr



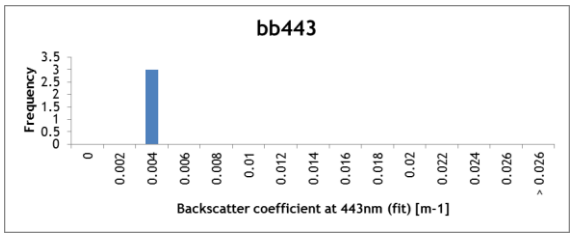
min: 0.160123 uW/cm²/nm/sr;
median: 0.744783 uW/cm²/nm/sr;
max: 0.753689 uW/cm²/nm/sr



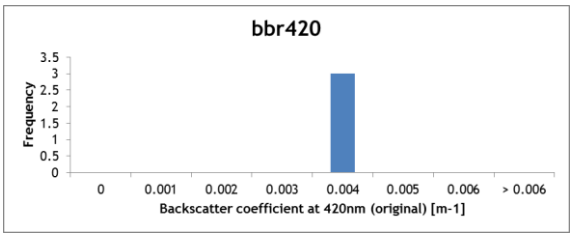
min: 0.01086m^{-1}; median: 0.01212m^{-1}
max: 0.01267m^{-1}



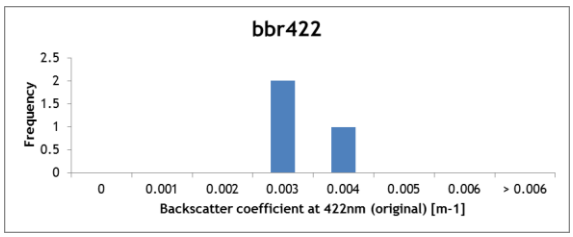
min: 0.00161m^{-1}; median: 0.00192m^{-1};
max: 0.00245m^{-1}



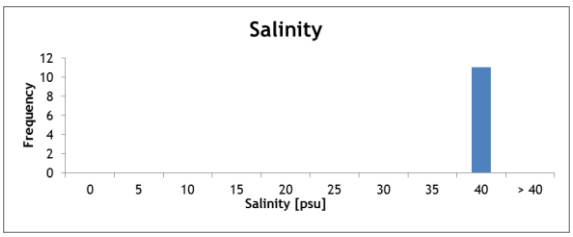
min: 0.002942m^{-1}; median: 0.003001m^{-1};
max: 0.0031375m^{-1}



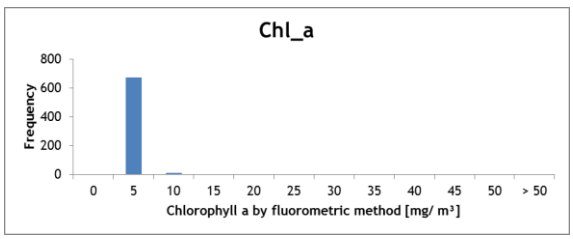
min: 0.00361m^{-1}; median: 0.00366m^{-1};
max: 0.00368m^{-1}



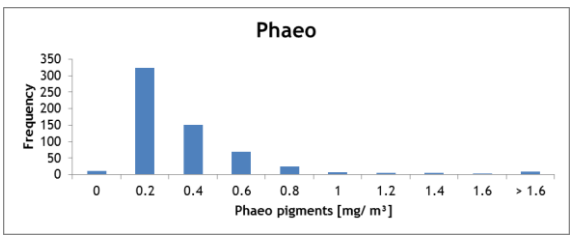
min: 0.00273m^{-1}; median: 0.0029m^{-1};
max: 0.00333m^{-1}



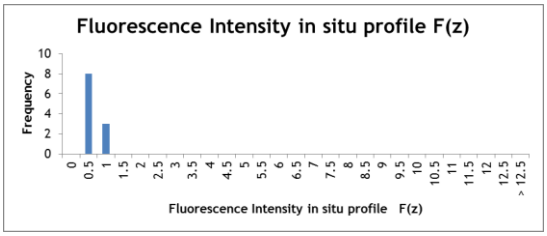
min: 36.3552psu; median: 36.5797psu;
max: 36.8448psu



min: 0.009mg/m^3; median: 0.457379mg/m^3;
max: 10.80858mg/m^3



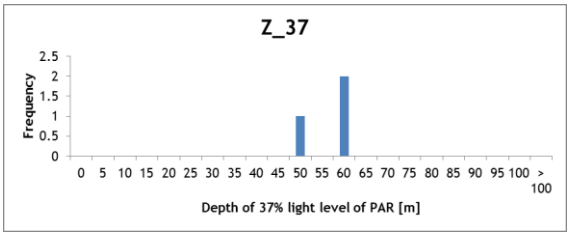
min: 0 mg/m^3; median: 0.17415mg/m^3;
max: 3.327903mg/m^3



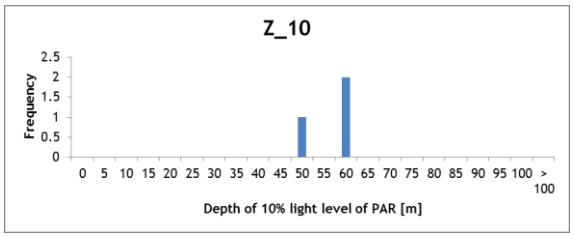
min: 0.26823 arb. units;

median: 0.41555 arb. units;

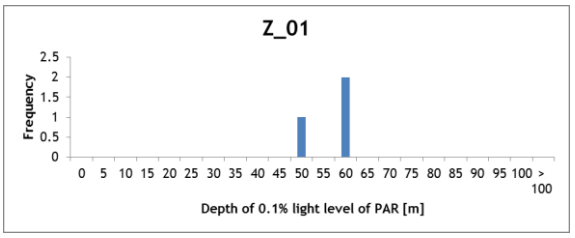
max: 0.78963 arb. units



min: 48m; median: 60m; max: 60m

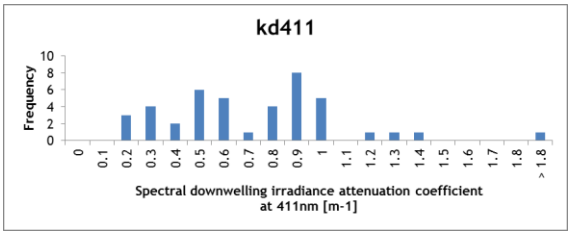


min: 48m; median: 60m; max: 60m

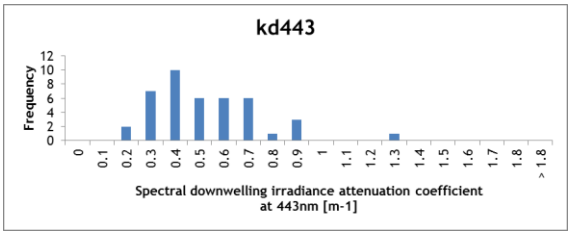


min: 48m; median: 60m; max: 60m

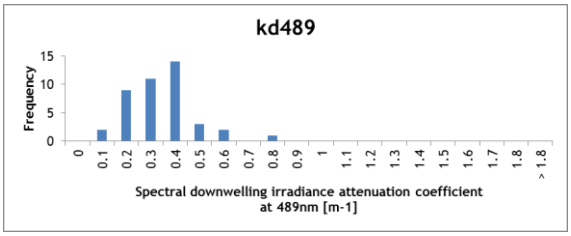
Site 5: Acadia



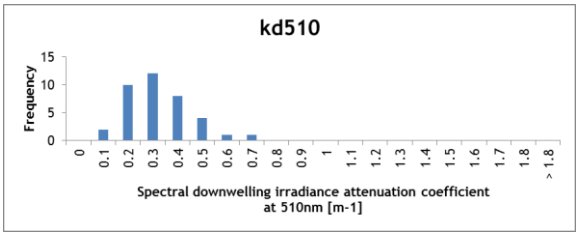
min: 0.12932m^{-1}; median: 0.68553m^{-1}; max: 1.92994m^{-1}



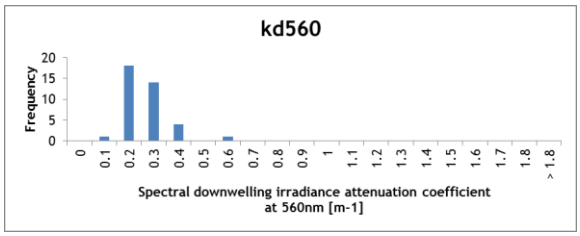
min: 0.12728m^{-1}; median: 0.4313m^{-1}; max: 1.27886m^{-1}



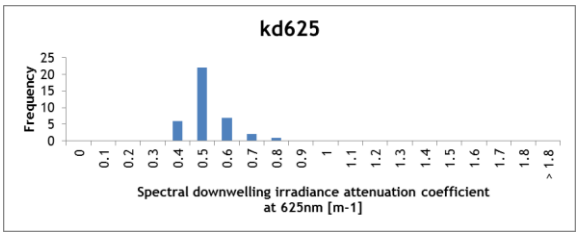
min: 0.08251m^{-1}; median: 0.29647m^{-1}; max: 0.73839m^{-1}



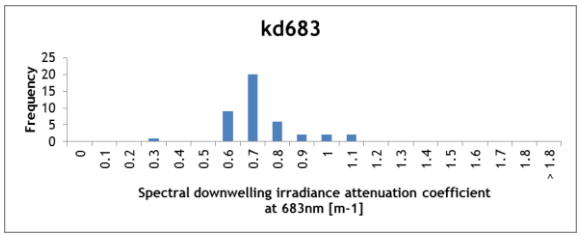
min: 0.08491m^{-1}; median: 0.26156m^{-1}; max: 0.51298m^{-1}



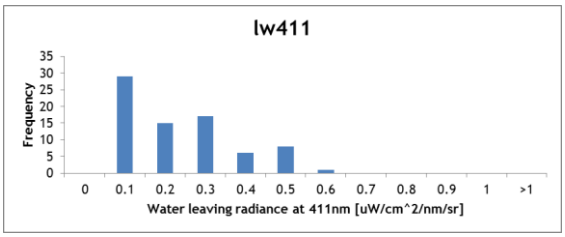
min: 0.09283m^{-1}; median: 0.21025m^{-1}; max: 0.50066m^{-1}



min: 0.32267m^{-1}; median: 0.47026m^{-1}; max: 0.76368m^{-1}



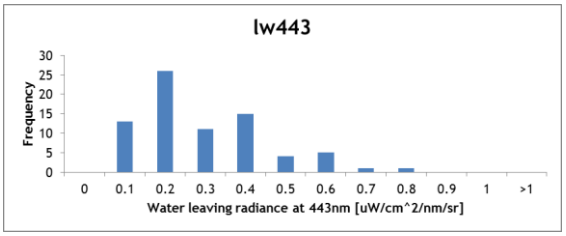
min: 0.28281m^{-1}; median: 0.66319m^{-1}; max: 1.09827m^{-1}



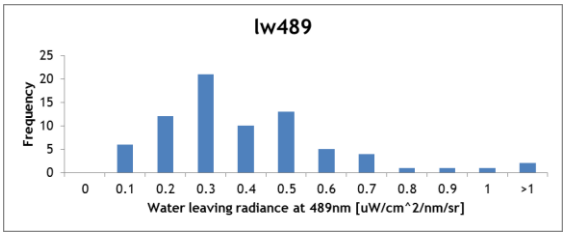
min: 0.00906 uW/cm²/nm/sr;

median: 0.1465 uW/cm²/nm/sr;

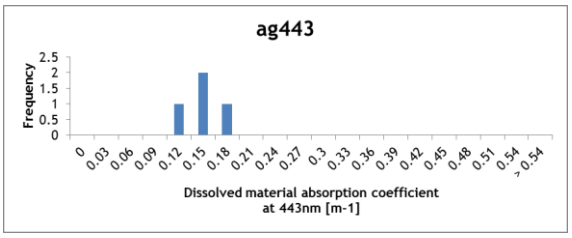
max: 0.5128 uW/cm²/nm/sr



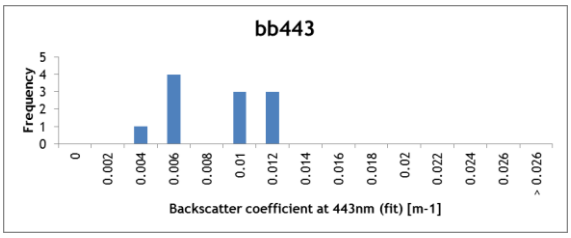
min: 0.01593 uW/cm²/nm/sr;
median: 0.19156 uW/cm²/nm/sr;
max: 0.72067 uW/cm²/nm/sr



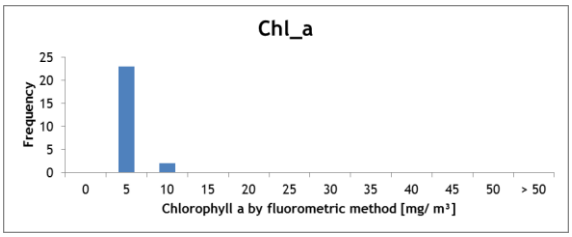
min: 0.02887 uW/cm²/nm/sr;
median: 0.29122 uW/cm²/nm/sr;
max: 1.21145 uW/cm²/nm/sr



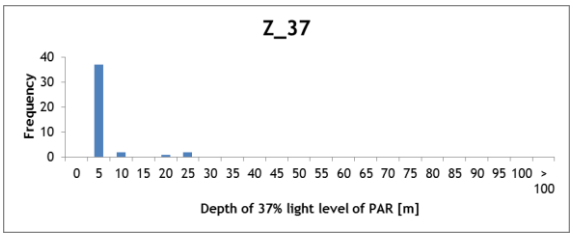
min: 0.10974m^{-1}; median: 0.13103m^{-1};
max: 0.17421m^{-1}



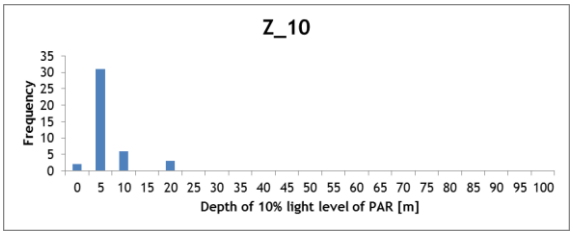
min: 0.002742m^{-1}; median: 0.00808m^{-1};
max: 0.011046m^{-1}



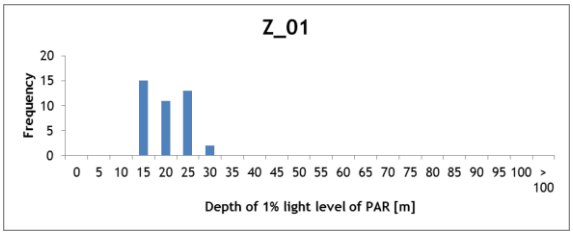
min: 0.24mg/m³; median: 1.1205mg/m³;
max: 6.12mg/m³



min: 1.5m; median: 2.95m; max: 24m

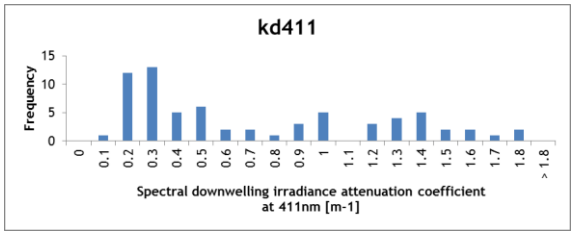


min: 4.3m; median: 7m; max: 24.8m

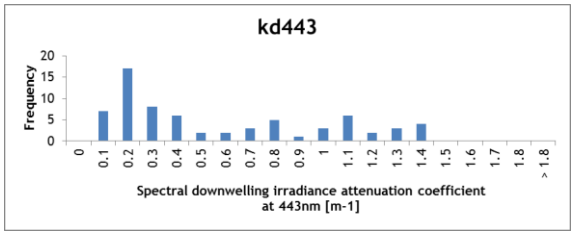


min: 10.2m; median: 16.8m; max: 27.2m

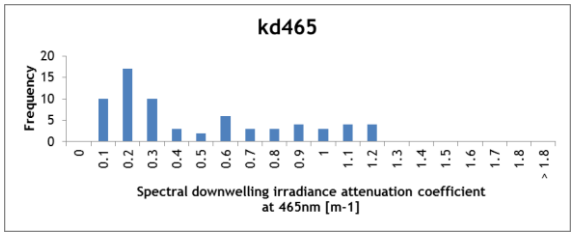
Site 6: Chesapeake Bay



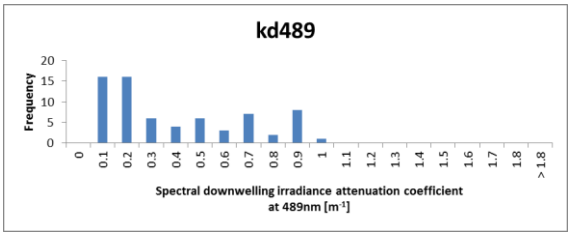
min: 0.091227m^{-1}; median: 0.442044m^{-1}; max: 1.76252m^{-1}



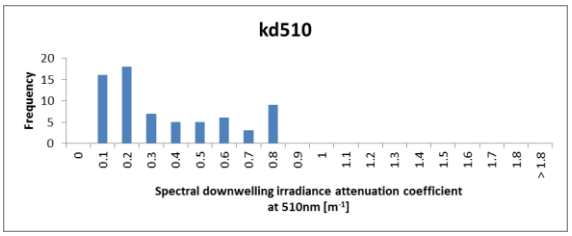
min: 0.062931m^{-1}; median: 0.329362m^{-1}; max: 1.36557m^{-1}



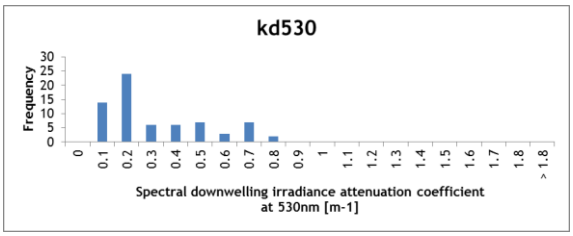
min: 0.050622m^{-1}; median: 0.267377m^{-1}; max: 1.12291m^{-1}



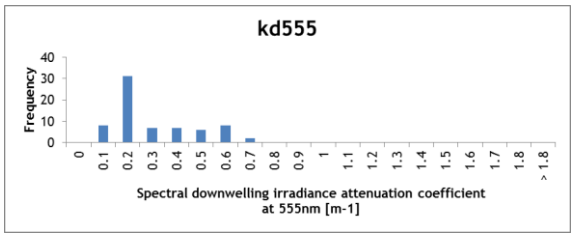
min: 0.041054m^{-1}; median: 0.218131m^{-1}; max: 0.911298m^{-1}



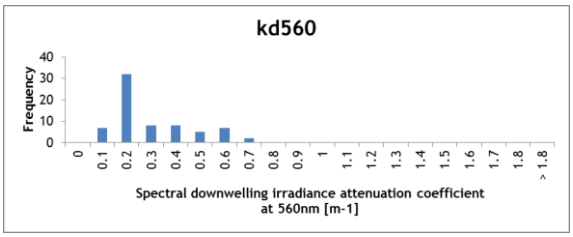
min: 0.050107m^{-1}; median: 0.203091m^{-1}; max: 0.789471m^{-1}



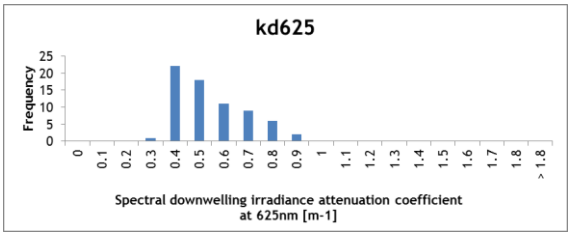
min: 0.059176m^{-1}; median: 0.177713m^{-1}; max: 0.704997m^{-1}



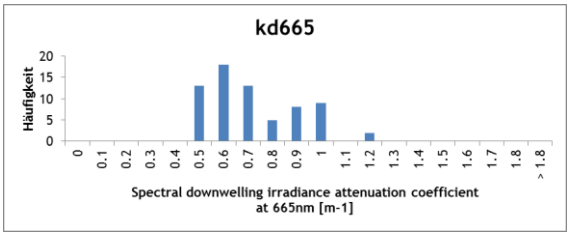
min: 0.067658m^{-1}; median: 0.168822m^{-1}; max: 0.642306m^{-1}



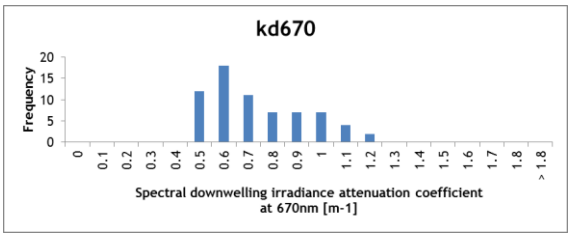
min: 0.068167m^{-1}; median: 0.168826m^{-1}; max: 0.62403m^{-1}



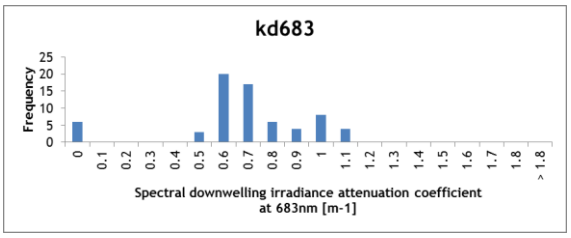
min: 0.272968m^{-1}; median: 0.460204m^{-1}; max: 0.868083m^{-1}



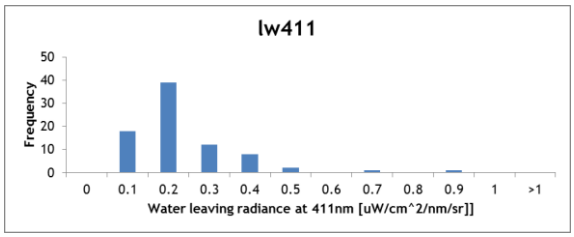
min: 0.414953m^{-1}; median: 0.607319m^{-1}; max: 1.12078m^{-1}



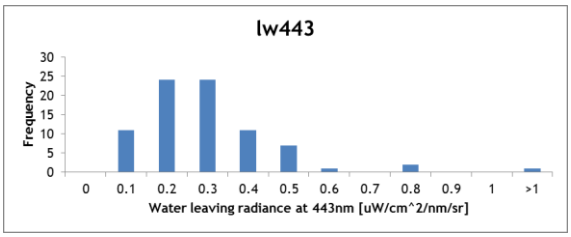
min: 0.422232m^{-1}; median: 0.618538m^{-1}; max: 1.16816m^{-1}



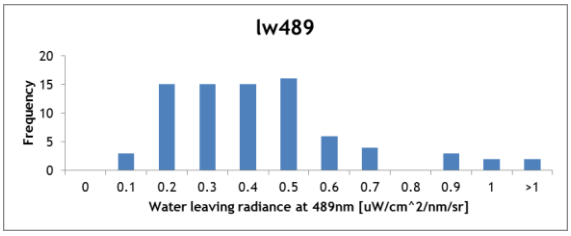
min: 0 m^{-1}; median: 0.617003m^{-1}; max: 1.05119m^{-1}



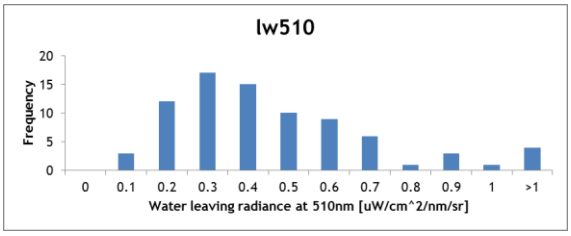
min: 0.034024 uW/cm²/nm/sr; median: 0.153286 uW/cm²/nm/sr; max: 0.8371 uW/cm²/nm/sr



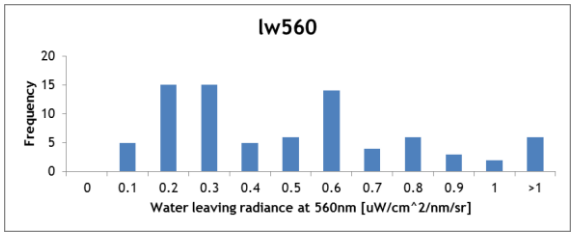
min: 0.043098 uW/cm²/nm/sr; median: 0.218736 uW/cm²/nm/sr; max: 1.0912 uW/cm²/nm/sr



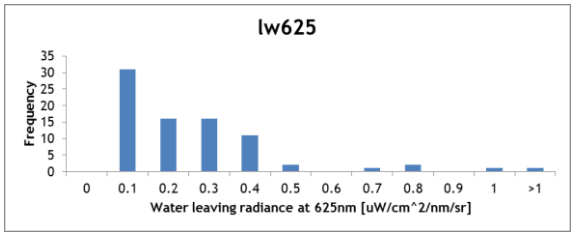
min: 0.053592 uW/cm²/nm/sr; median: 0.34296 uW/cm²/nm/sr; max: 1.4051 uW/cm²/nm/sr



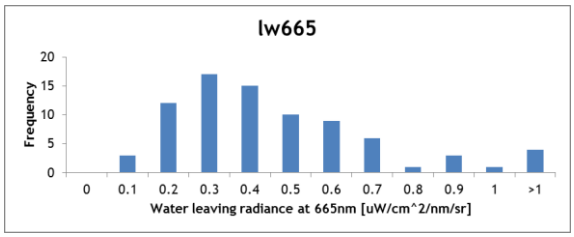
min: 0.045817 uW/cm²/nm/sr; median: 0.369948 uW/cm²/nm/sr; max: 1.4222 uW/cm²/nm/sr



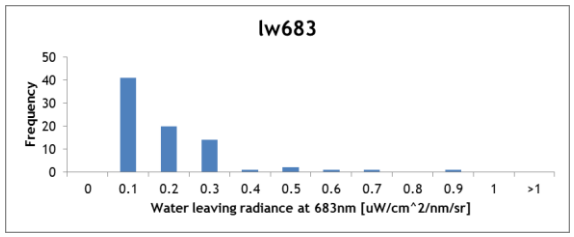
min: 0.027509 uW/cm²/nm/sr;
median: 0.417937 uW/cm²/nm/sr;
max: 1.67412 uW/cm²/nm/sr



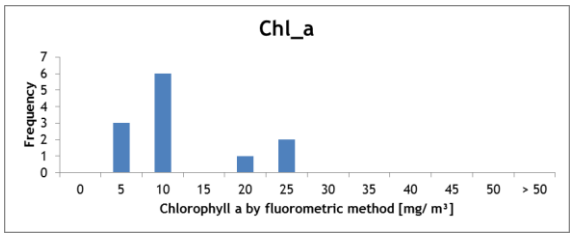
min: 0.004265 uW/cm²/nm/sr;
median: 0.140657 uW/cm²/nm/sr;
max: 1.0254 uW/cm²/nm/sr



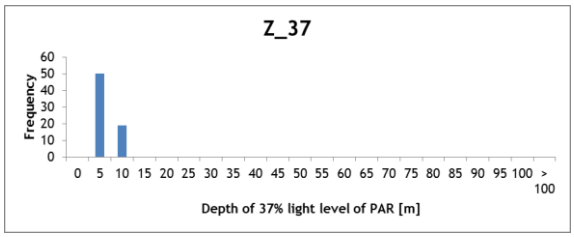
min: 0.002726 uW/cm²/nm/sr;
median: 0.094944 uW/cm²/nm/sr;
max: 0.8837 uW/cm²/nm/sr



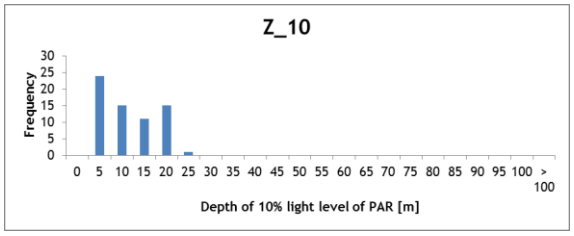
min: 0.002924 uW/cm²/nm/sr;
median: 0.097346 uW/cm²/nm/sr;
max: 0.8754 uW/cm²/nm/sr



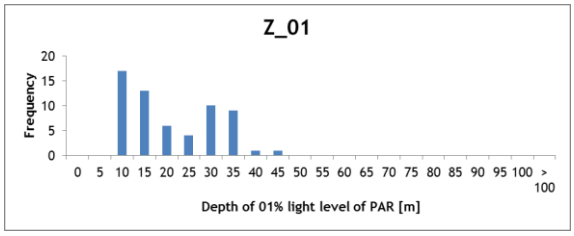
min: 0.3mg/m³;median: 6.4185mg/m³;
max: 22.54mg/m³



min: 1.1m; median: 3.3m; max: 9.2m

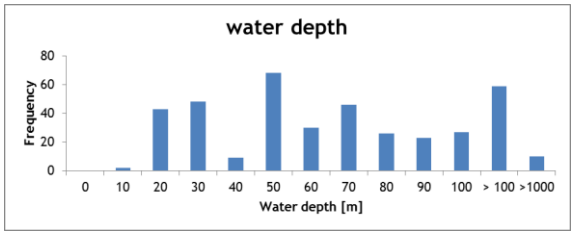


min: 1.9m; median: 8.2m; max: 22.8m

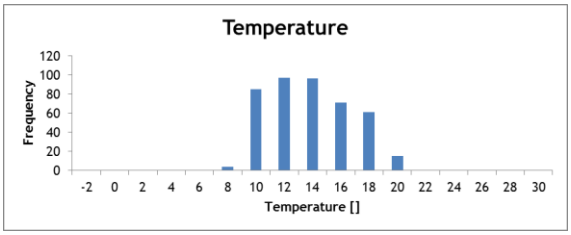


min: 5.3m; median: 16.1m; max: 42.7m

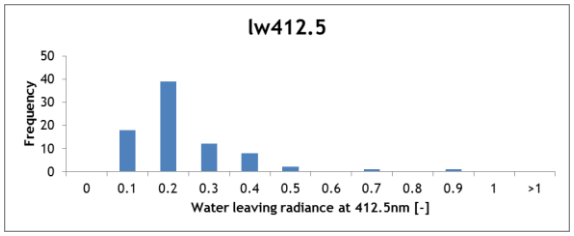
Site 7: Oregon and Washington



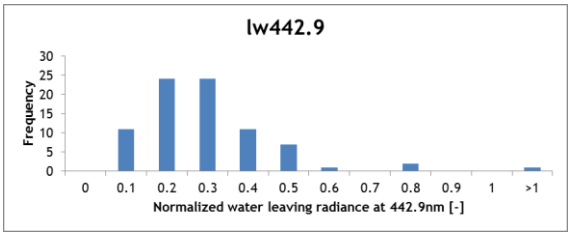
min: 10m; median: 60m; max: 7000m



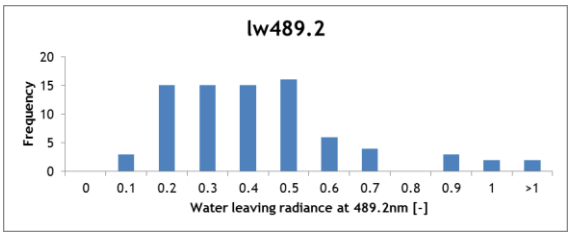
min: 7.451125ºC; median: 12.55418ºC; max: 19.09ºC



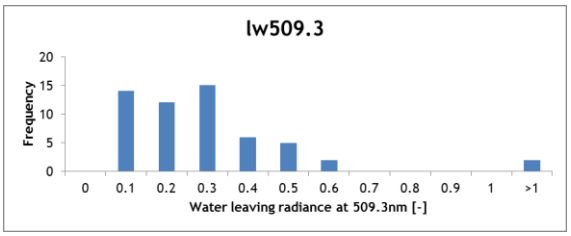
min: 0.000016 uW/cm²/nm/sr; median: 0.142368 uW/cm²/nm/sr; max: 1.94207 uW/cm²/nm/sr



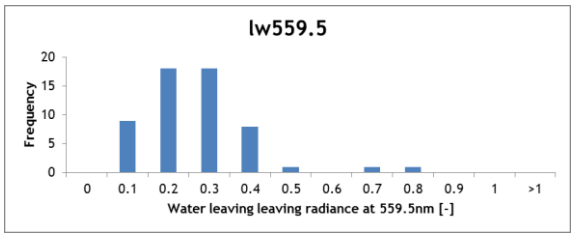
min: 0.000168 uW/cm²/nm/sr; median: 0.166554 uW/cm²/nm/sr; max: 1.7904 uW/cm²/nm/sr



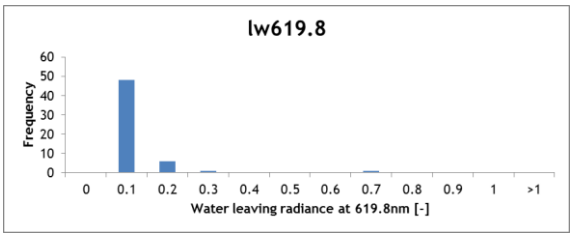
min: 0.002046 uW/cm²/nm/sr; median: 0.206363 uW/cm²/nm/sr; max: 1.43133 uW/cm²/nm/sr



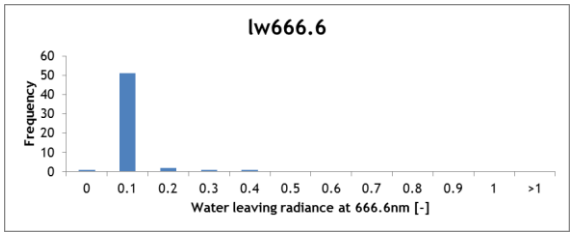
min: 0.002627 uW/cm²/nm/sr; median: 0.21713 uW/cm²/nm/sr; max: 1.31291 uW/cm²/nm/sr



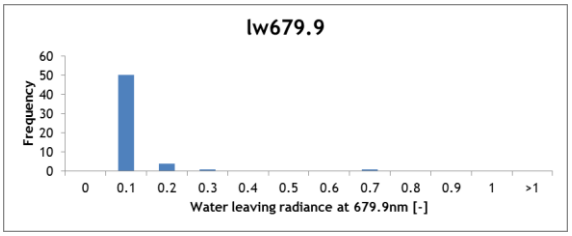
min: 0.010754 uW/cm²/nm/sr; median: 0.203041 uW/cm²/nm/sr; max: 0.701197 uW/cm²/nm/sr



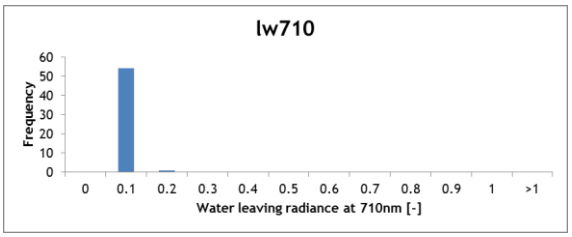
min: 0.004536 uW/cm²/nm/sr; median: 0.049866 uW/cm²/nm/sr; max: 0.660814 uW/cm²/nm/sr



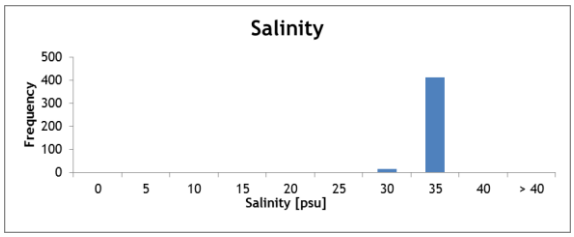
min: 0 uW/cm²/nm/sr;
median: 0.024224 uW/cm²/nm/sr;
max: 0.368641 uW/cm²/nm/sr



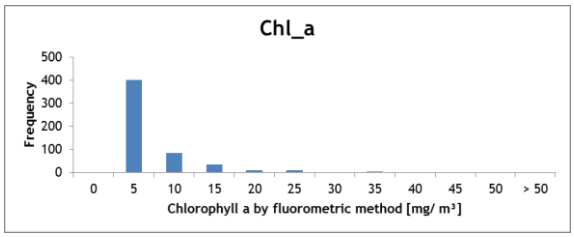
min: 0.000083 uW/cm²/nm/sr;
median: 0.027786 uW/cm²/nm/sr;
max: 0.62808 uW/cm²/nm/sr



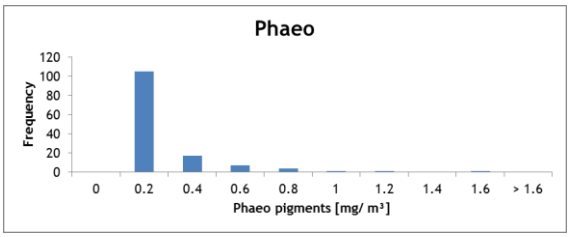
min: 0.000033 uW/cm²/nm/sr;
median: 0.006262 uW/cm²/nm/sr;
max: 0.110888 uW/cm²/nm/sr



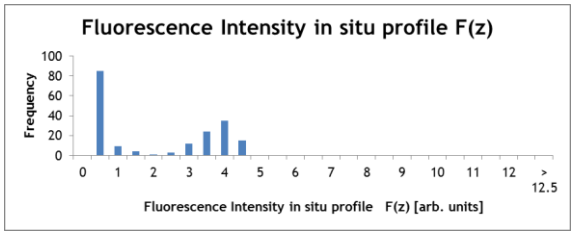
min: 25.719psu; median: 32.48psu;
max: 33.959psu



min:0.072mg/m³; median: 1.5525mg/m³;
max: 33.82mg/m³



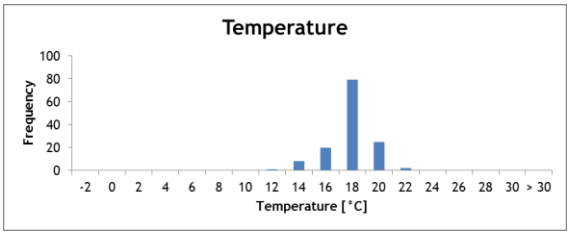
min: 0.015mg/m³; median: 0.072mg/m³;
max: 1.448mg/m³



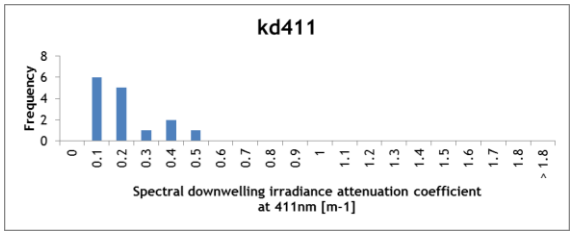
min: 0.021522 arb. units;
median: 1.00027 arb units;
max: 4.3123 arb. units

(x)

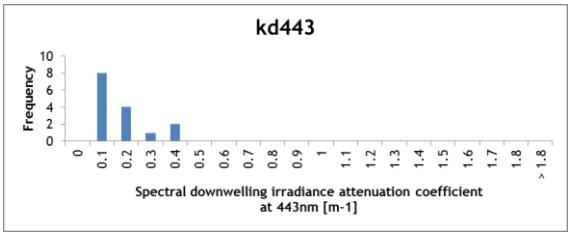
Site 8: Plumes & Blooms



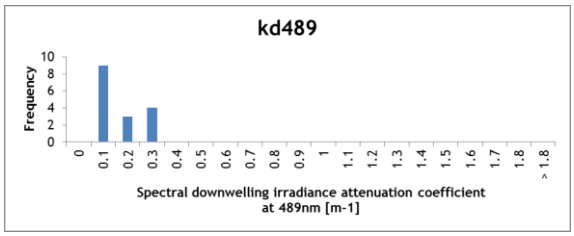
min: 11.85°C; median: 17°C; max: 20.64°C



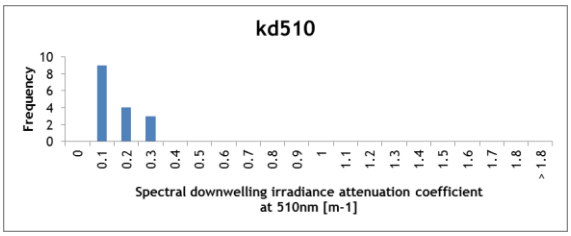
min: 0.0541m^{-1}; median: 0.11517 m^{-1}; max: 0.47486m^{-1}



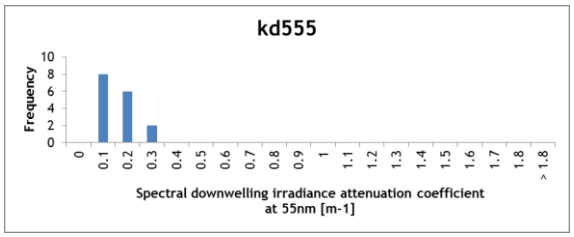
min: 0.04638m^{-1}; median: 0.09557m^{-1}; max: 0.37879m^{-1}



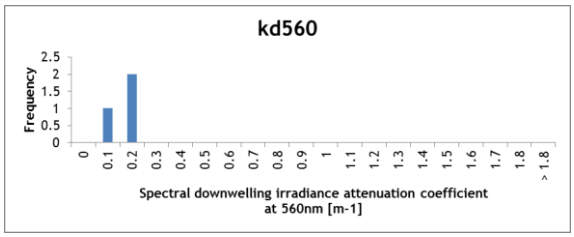
min: 0.03947m^{-1}; median: 0.07434m^{-1}; max: 0.28779m^{-1}



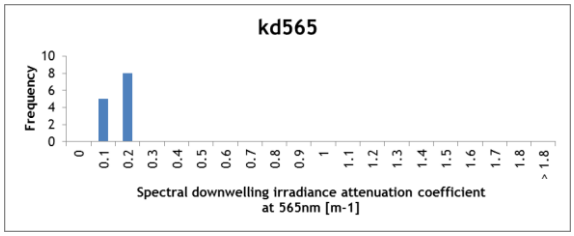
min: 0.0500m^{-1}; median: 0.0800 m^{-1}; max: 0.2600m^{-1}



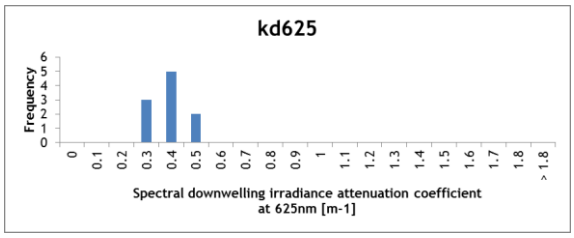
min: 0.06455m^{-1}; median: 0.10708m^{-1}; max: 0.20391m^{-1}



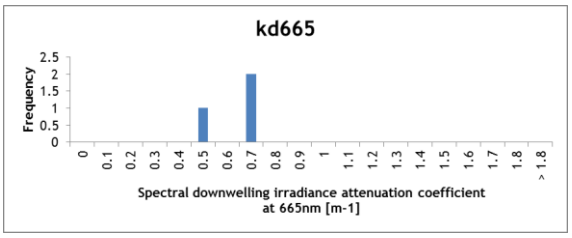
min: 0.064498m^{-1}; median: 0.11517 m^{-1}; max: 0.164019m^{-1}



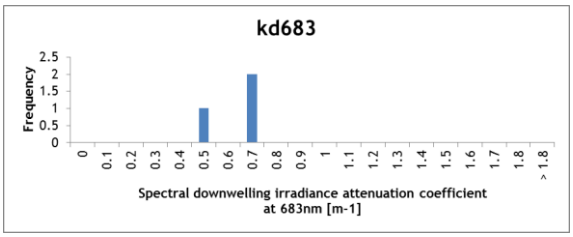
min: 0.07345m^{-1}; median: 0.10541m^{-1}; max: 0.19428m^{-1}



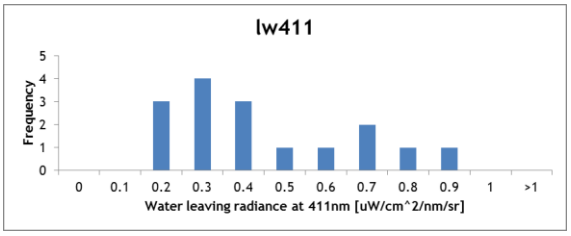
min: 0.22153m^{-1}; median: 0.32509m^{-1}; max: 0.49119m^{-1}



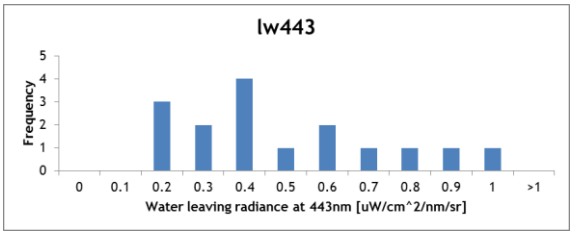
min: 0.45539m^{-1}; median: 0.63527m^{-1}; max: 0.67361m^{-1}



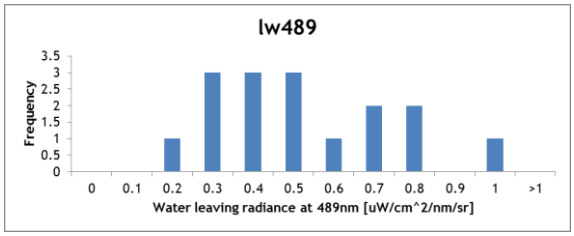
min: 0.48882m^{-1}; median: 0.63163m^{-1}; max: 0.68321m^{-1}



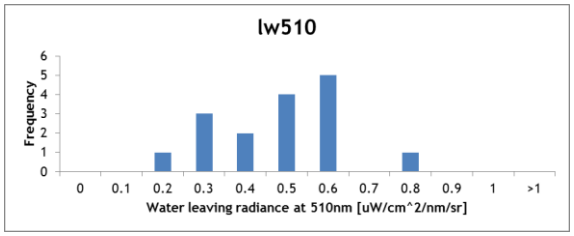
min: 0.11341 uW/cm²/nm/sr; median: 0.325145 uW/cm²/nm/sr; max: 0.89662 uW/cm²/nm/sr



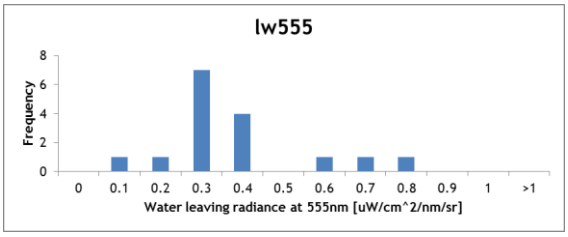
min: 0.12031 uW/cm²/nm/sr; median: 0.3453155 uW/cm²/nm/sr; max: 0.99831 uW/cm2/nm/sr



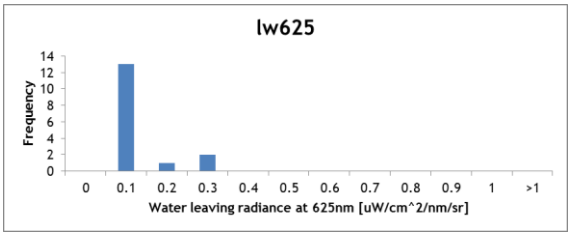
min: 0.14011 uW/cm²/nm/sr;
median: 0.4624355 uW/cm²/nm/sr;
max: 0.98816 uW/cm²/nm/sr



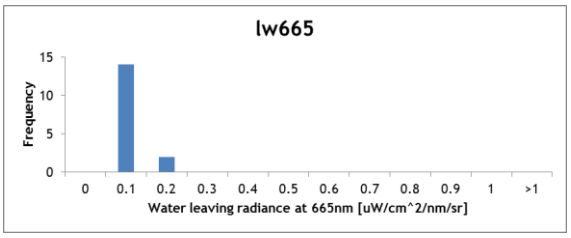
min: 0.12861 uW/cm²/nm/sr;
median: 0.436985 uW/cm²/nm/sr;
max: 0.72686 uW/cm²/nm/sr



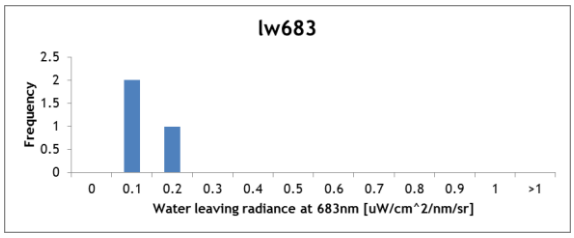
min: 0.07909 uW/cm²/nm/sr;
median: 0.293665 uW/cm²/nm/sr;
max: 0.753705 uW/cm²/nm/sr



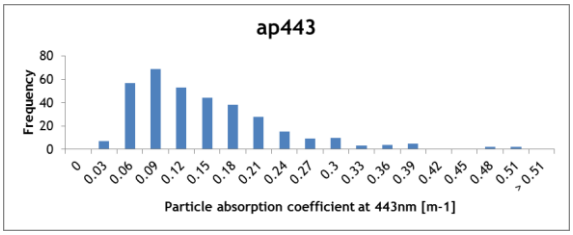
min: 0.0118 uW/cm²/nm/sr;
median: 0.050014 uW/cm²/nm/sr;
max: 0.21251 uW/cm²/nm/sr



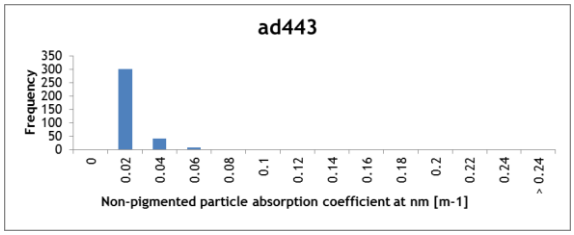
min: 0.00733 uW/cm²/nm/sr;
median: 0.029569 uW/cm²/nm/sr;
max: 0.13623 uW/cm²/nm/sr



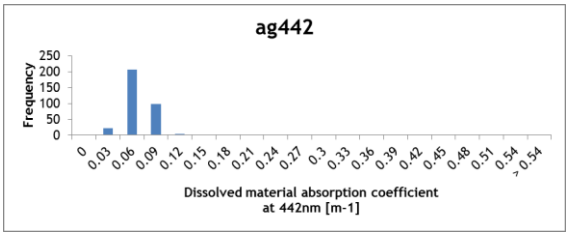
min: 0.032254 uW/cm²/nm/sr;
median: 0.039093 uW/cm²/nm/sr;
max: 0.15388 uW/cm²/nm/sr



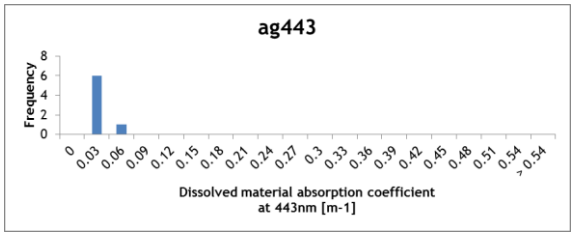
min: 0.0203355m^{-1}; median: 0.111115m^{-1};
max: 0.490837m^{-1}



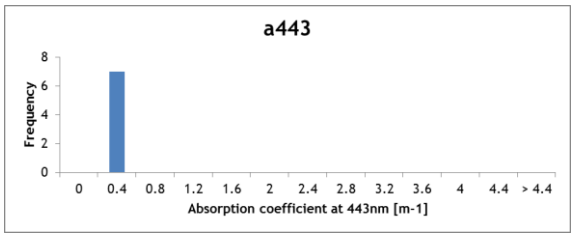
min: 0.00056m^{-1}; median: 0.01043m^{-1};
max: 0.05553m^{-1}



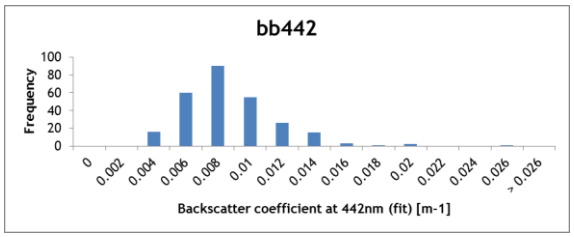
min: 0.0169m^{-1}; median: 0.0522m^{-1}; max: 0.208m^{-1}



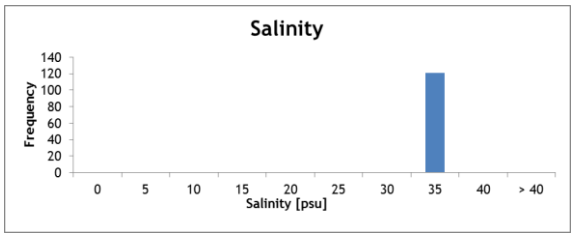
min: 0.00592m^{-1}; median: 0.01292m^{-1}; max: 0.03659m^{-1}



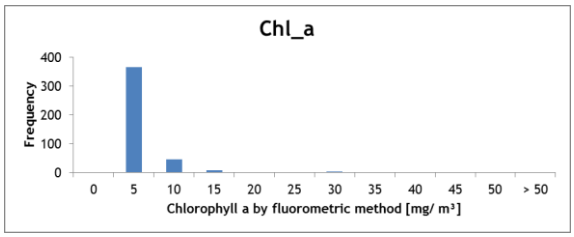
min: 0.03313m^{-1}; median: 0.07818m^{-1}; max: 0.09356m^{-1}



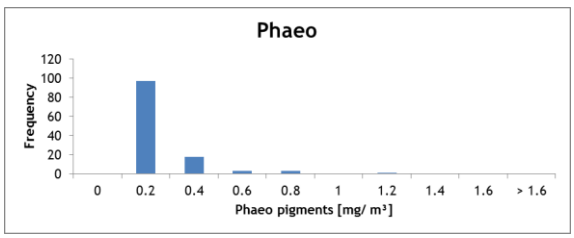
min: 0.00271m^{-1}; median: 0.0072m^{-1}; max: 0.0253m^{-1}



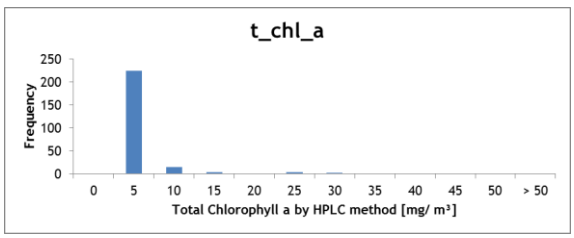
min: 32.74psu; median: 33.21psu; max: 33.54psu



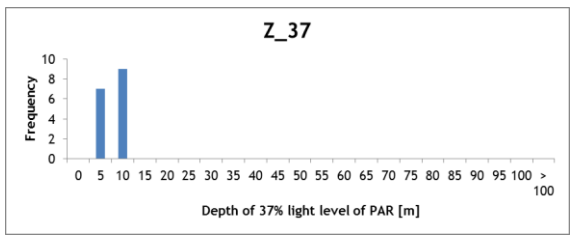
min: 0.075mg/m^3; median: 1.4525mg/m^3; max: 28.685mg/m^3



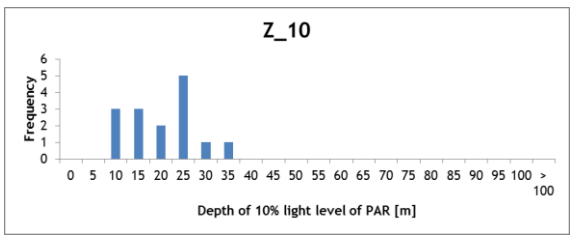
min: 0.02mg/m^3; median: 0.0815mg/m^3; max: 1.083mg/m^3



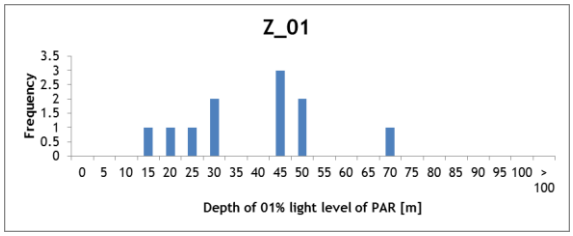
min: 0.092mg/m^3; median: 1.82mg/m^3; max: 28.319mg/m^3



min: 2m; median: 6m; max: 10m

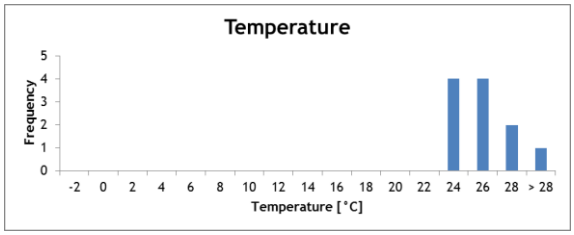


min: 8m; median: 20m; max: 31m

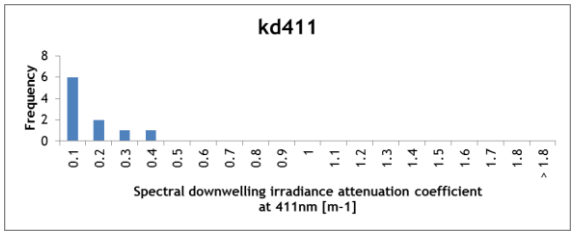


min: 14m; median: 43m; max: 68m

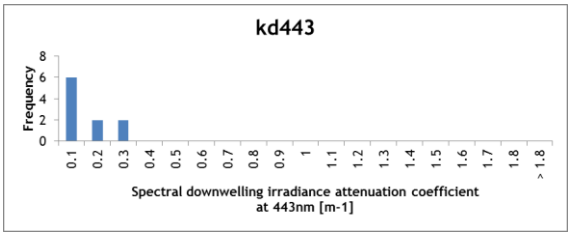
Site 9: Puerto Rico



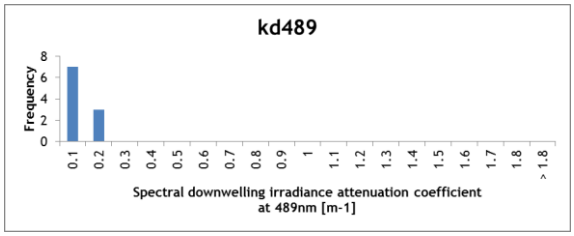
min: 22.58°C; median: 24.28°C;
max: 28.44°C



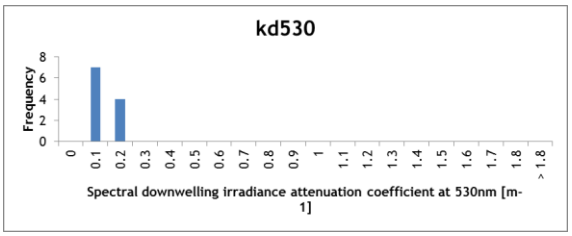
min: 0.036355m^{-1}; median: 0.09002m^{-1};
max: 0.300344m^{-1}



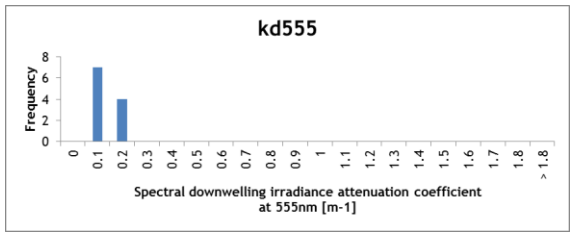
min: 0.0314185m^{-1}; median: 0.0718m^{-1};
max: 0.261203m^{-1}



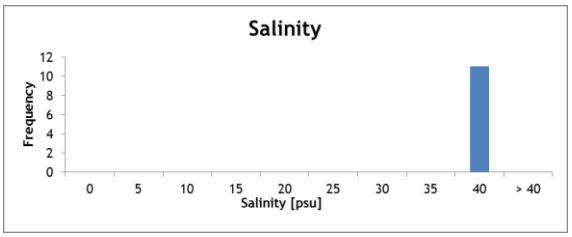
min: 0.0263677m^{-1} ; median: 0.05173m^{-1};
max: 0.151115m^{-1}



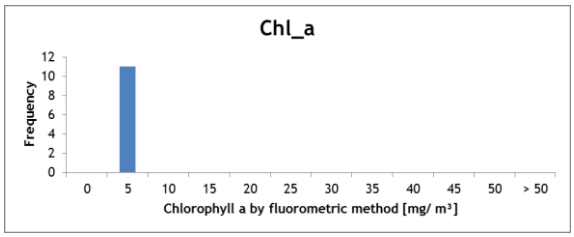
min: 0.0406313m^{-1}; median: 0.06672m^{-1};
max: 0.129189m^{-1}



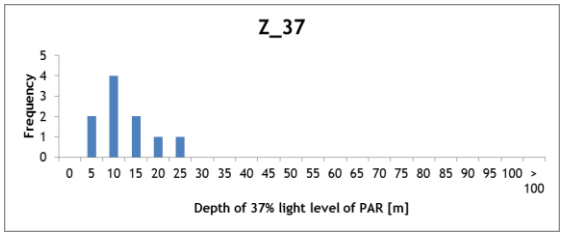
min: 0.0598069m^{-1}; median: 0.0803m^{-1};
max: 0.133647m^{-1}



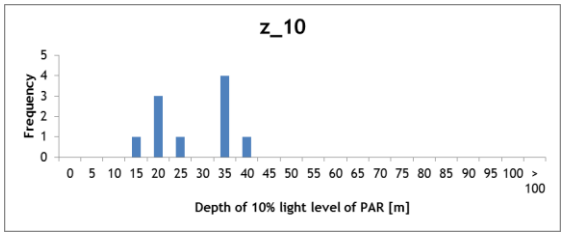
min: 36.17psu; median: 36.82psu;
max: 36.89psu



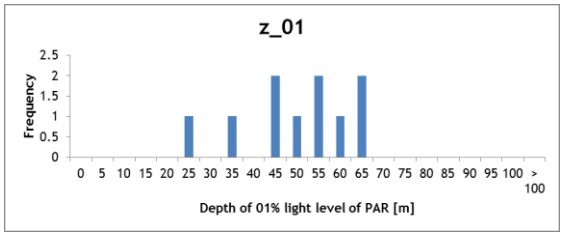
min: 0.098mg/m^3; median: 0.316 mg/m^3;
max:3.814mg/m^3



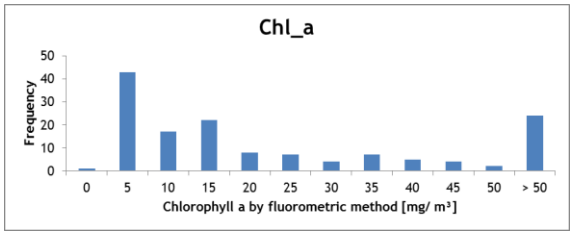
min: 4.2m; median: 8.8m; max: 22.3m



min: 11.6m; median: 26.9m; max: 38m

 min: 21.5m; median: 48.5m; max: 64.3m	(x)

Site 10: Benguela

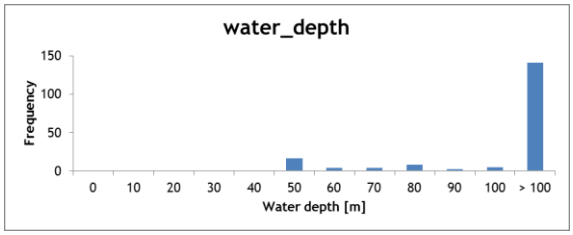


min: 0.3mg/m³; median: 11.754mg/m³;

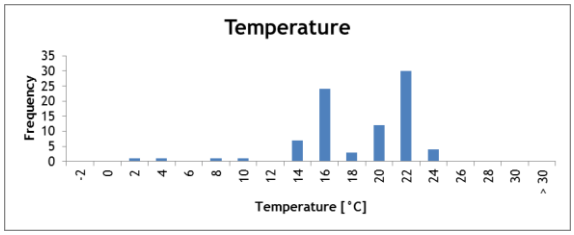
max: 496.509mg/m³

(x)

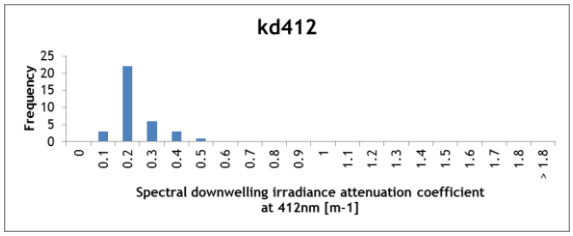
Site 11: China, Korea, Japan



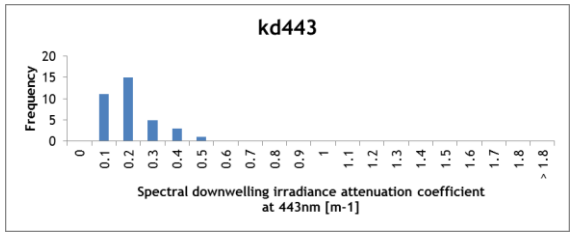
min: 48m ; median: 141.5m; max: 2198m



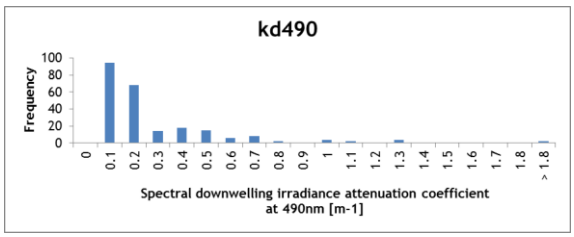
min: 1.9°C ; median: 19.61°C; max: 23.09°C



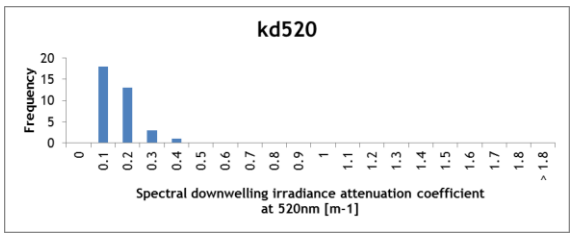
min: 0.095m^{-1}; median: 0.129 m^{-1}; max: 0.44m^{-1}



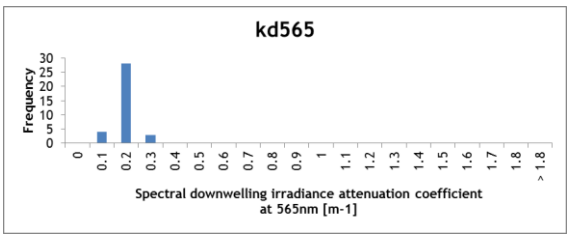
min: 0.068m^{-1}; median:0.114m^{-1}; max: 0.429m^{-1}



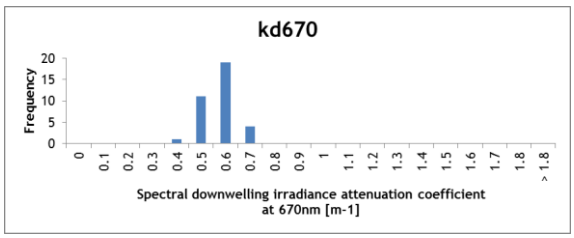
min: 0.009m^{-1}; median:0.118m^{-1}; max: 2.471m^{-1}



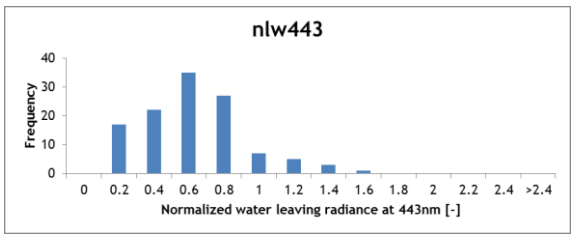
min: 0.056m^{-1}; median:0.097m^{-1}; max: 0.312m^{-1}



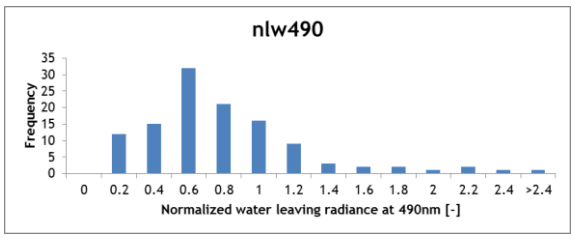
min: 0.082m^{-1}; median:0.118m^{-1}; max: 0.244m^{-1}



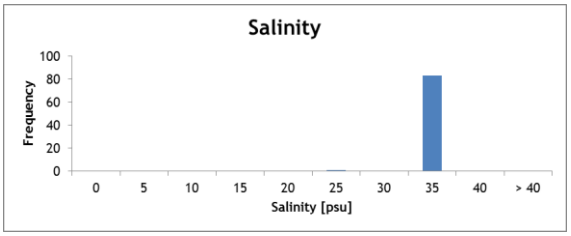
min: 0.358m^{-1}; median:0.518m^{-1}; max: 0.684m^{-1}



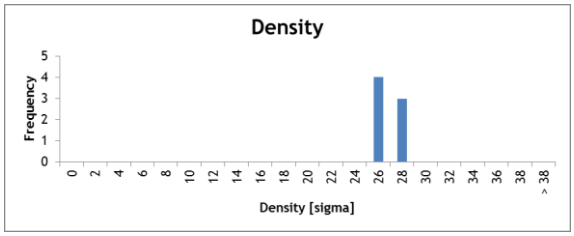
min: 0.0175; median: 0.5427; max: 0.1.4265



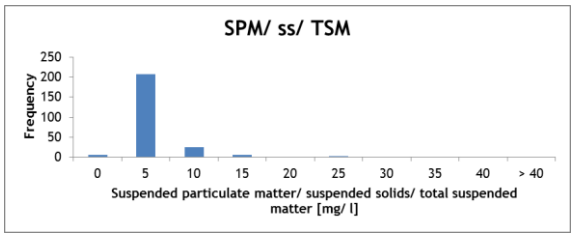
min: 0.018 ; median: 0.5986; max: 2.4725



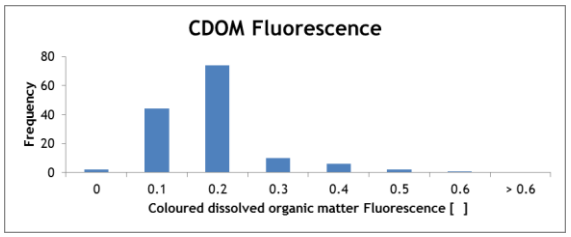
min: 21.146psu ; median: 33.933psu;
max: 34.747psu



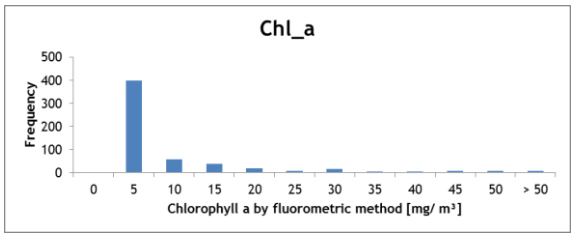
min: 25.317sigma; median: 25.822sigma;
max: 26.914sigma



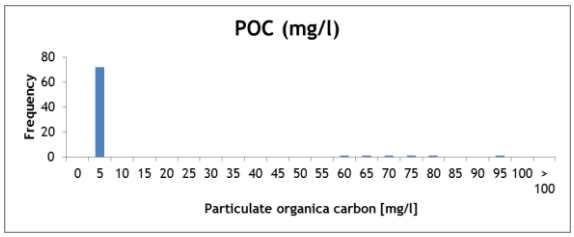
min: 0mg/l; median: 0.888mg/l;
max: 21.94mg/l



min: 0 []; median: 0.12 []; max: 0.517 []

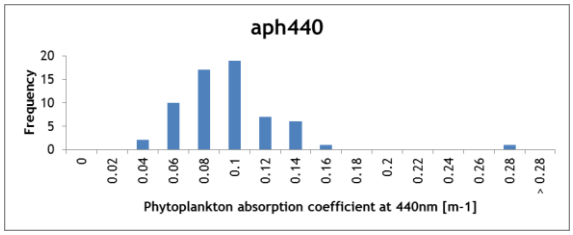


min: 0mg/m³; median: 1.292 mg/m³;
max: 71.625mg/m³

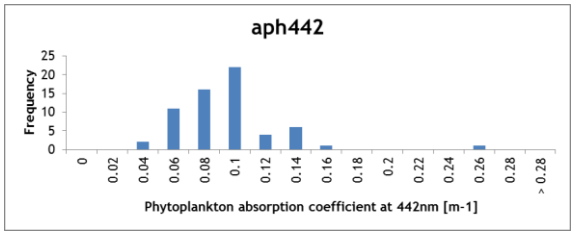


min: 0.034mg/l; median: 0.129mg/l;
max: 90.905mg/l

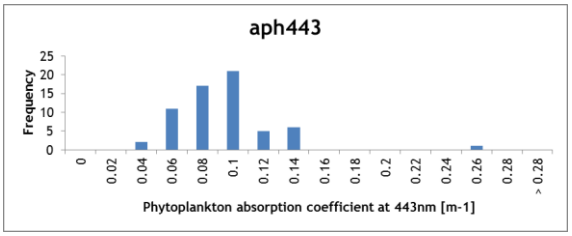
Site 12: Great Barrier Reef



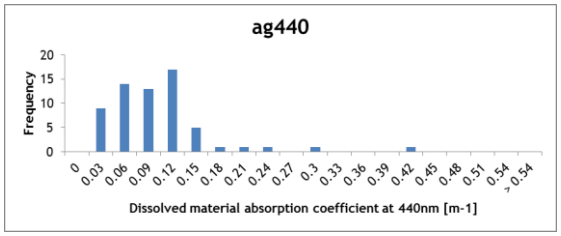
min: 0.037167m^{-1}; median: 0.084038m^{-1}; max: 0.263237m^{-1}



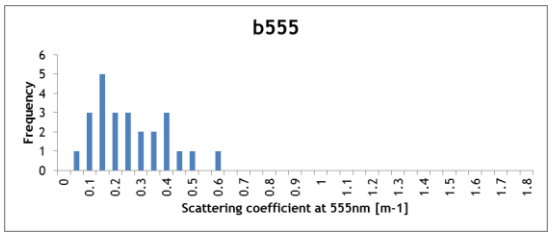
min: 0.036157m^{-1}; median: 0.082504m^{-1}; max: 0.254693m^{-1}



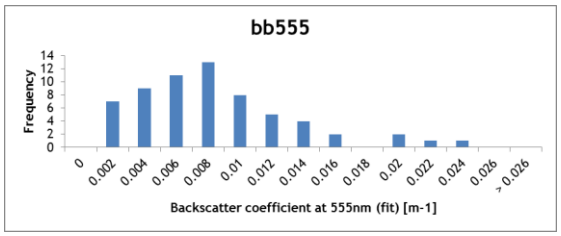
min: 0.035548m^{-1}; median: 0.081979m^{-1}; max: 0.250827m^{-1}



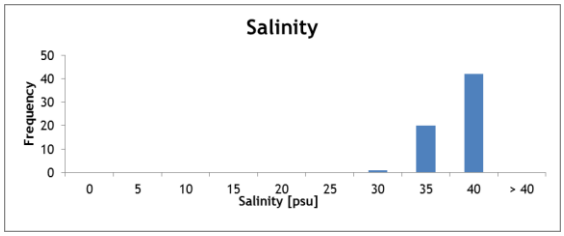
min: 0.00707m^{-1}; median: 0.07279m^{-1}; max: 0.3954m^{-1}



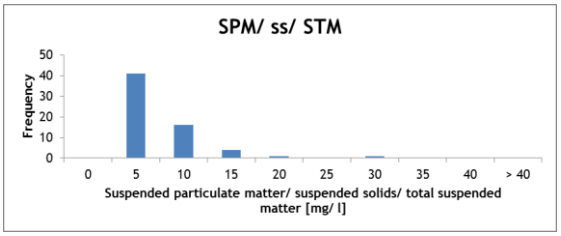
min: 0.037556m^{-1}; median: 0.215406m^{-1}; max: 0.586m^{-1}



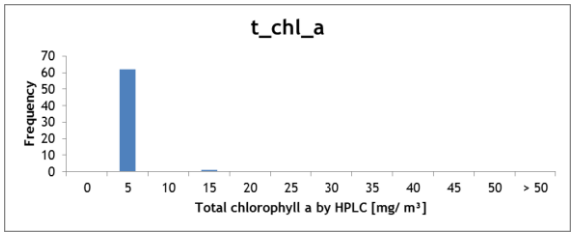
min: 0.00053m^{-1}; median: 0.007m^{-1}; max: 0.024m^{-1}



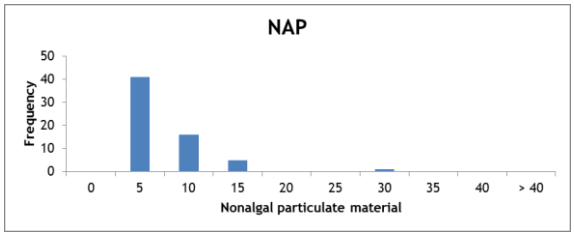
min: 27.96psu; median: 35.24psu; max: 35.94psu



min: 0.5714mg/l; median: 3.8mg/l; max: 27.4mg/l

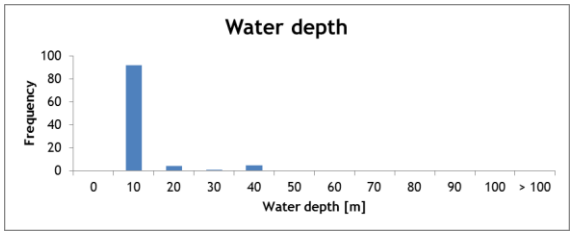


min: 0.106635mg/m^3; median: 0.3933mg/m^3; max: 12.7763mg/m^3

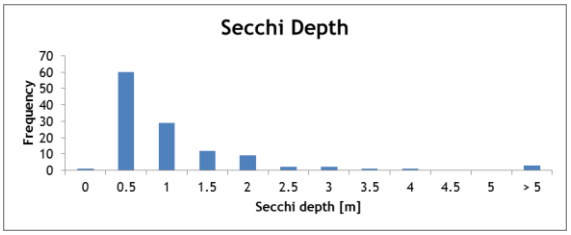


min: 0.5552m^{-1}; median: 0.3.7353m^{-1}; max: 27.3122m^{-1}

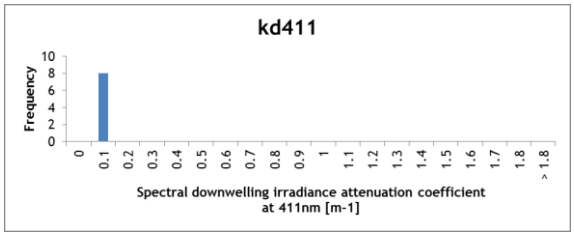
Site 14: Indonesian Waters



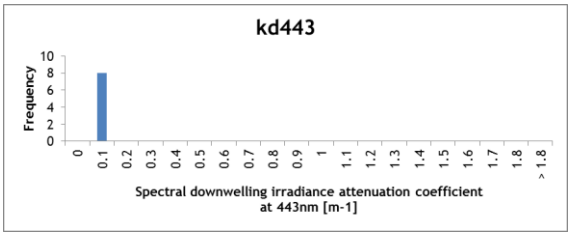
min: 1m; median: 4.05m; max: 39.6m



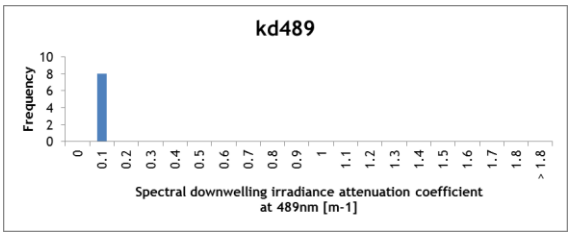
min: 0.1m; median: 0.5m; max: 13m



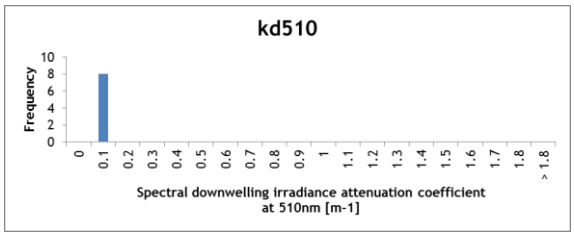
min: 0.02744m^{-1}; median: 0.0452m^{-1}; max: 0.0452m^{-1}



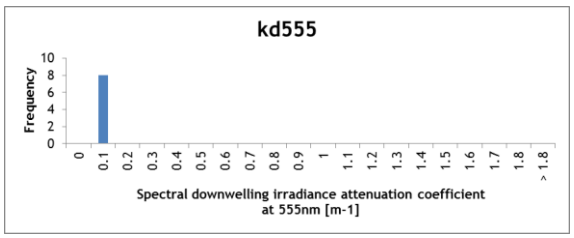
min: 0.02599m^{-1}; median: 0.029805m^{-1}; max: 0.04781m^{-1}



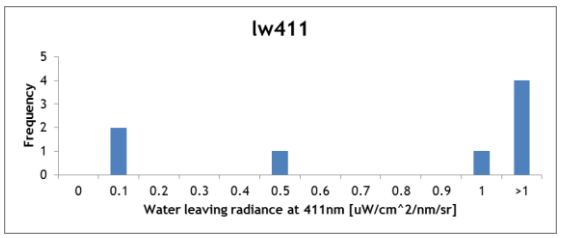
min: 0.02559m^{-1}; median: 0.029565m^{-1}; max: 0.0448m^{-1}



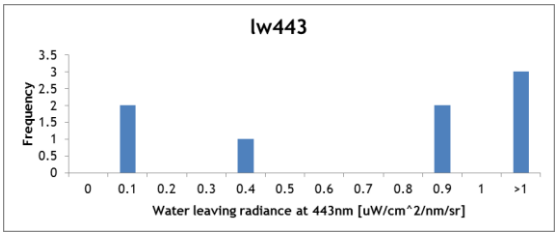
min: 0.03813m^{-1}; median: 0.043345m^{-1}; max: 0.0546m^{-1}



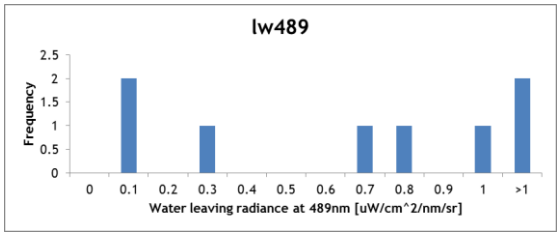
min: 0.05917m^{-1}; median: 0.07362m^{-1}; max: 0.08283m^{-1}



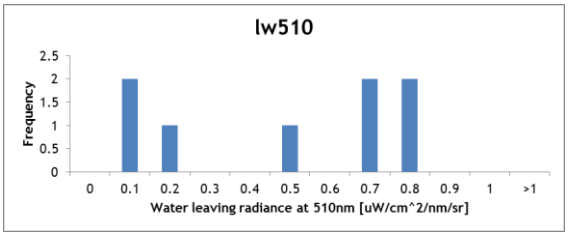
min: 0.035540 uW/cm²/nm/sr; median: 1.03038 uW/cm²/nm/sr; max: 1.697250 uW/cm²/nm/sr



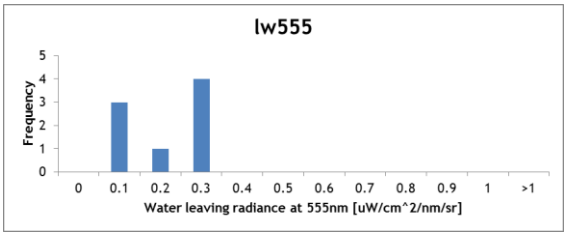
min: 0.02890 uW/cm²/nm/sr;
median: 0.862115 uW/cm²/nm/sr;
max: 1.468560 uW/cm²/nm/sr



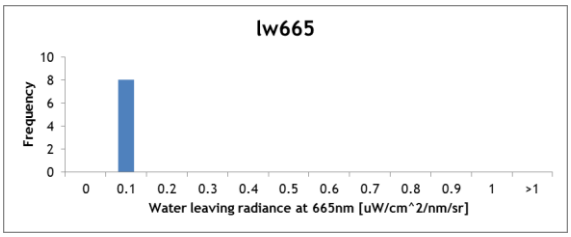
min: 0.023240 uW/cm²/nm/sr;
median: 0.729085 uW/cm²/nm/sr;
max: 1.144180 uW/cm²/nm/sr



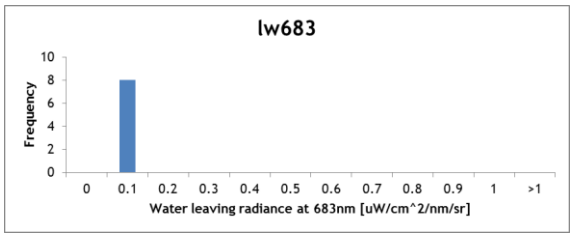
min: 0.013990 uW/cm²/nm/sr;
median: 0.510940 uW/cm²/nm/sr;
max: 0.730360 uW/cm²/nm/sr



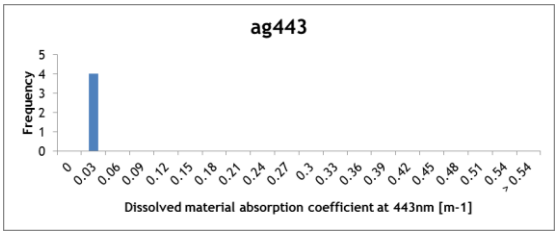
min: 0.005710 uW/cm²/nm/sr;
median: 0.217030 uW/cm²/nm/sr;
max: 0.293370 uW/cm²/nm/sr



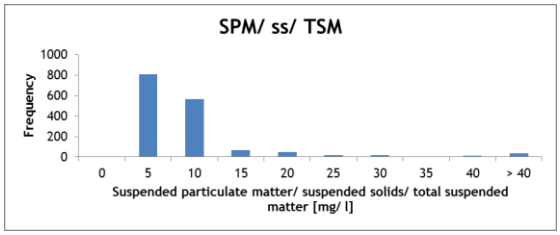
min: 0.0002 uW/cm²/nm/sr;
median: 0.006390 uW/cm²/nm/sr;
max: 0.01115 uW/cm²/nm/sr



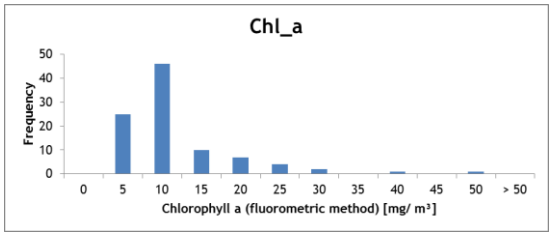
min: 0.00024 uW/cm²/nm/sr;
median: 0.0062 uW/cm²/nm/sr;
max: 0.01 uW/cm²/nm/sr



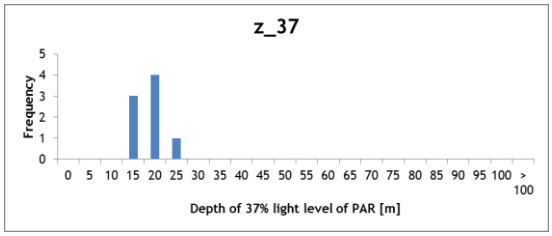
min: 0.00719m^{-1}; median: 0.009575m^{-1};
max: 0.009870m^{-1}



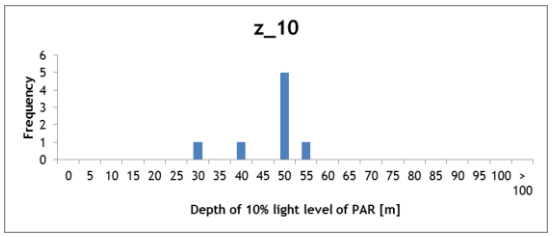
min: 0mg/l; median: 4.94mg/l;
max: 330mg/l



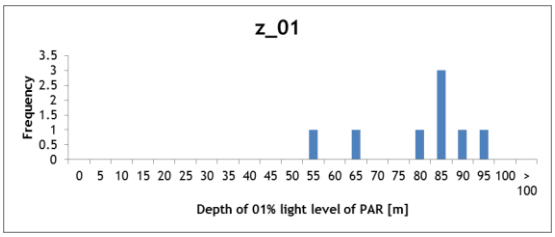
min: 0.072mg/m³; median: 7.0215mg/m³; max: 47.625mg/m³



min: 12m; median: 16m; max:24m

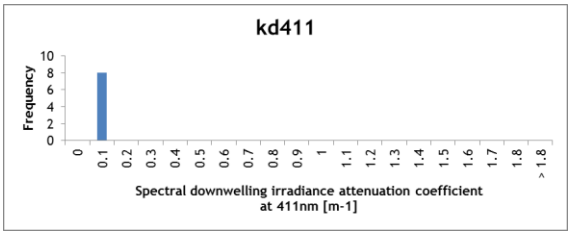


min: 26m; median: 47.5m; max: 52m

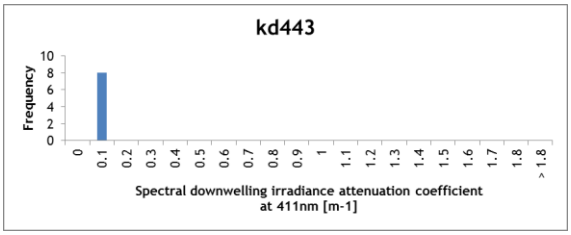


min: 55m; median: 47.5m; max: 91m

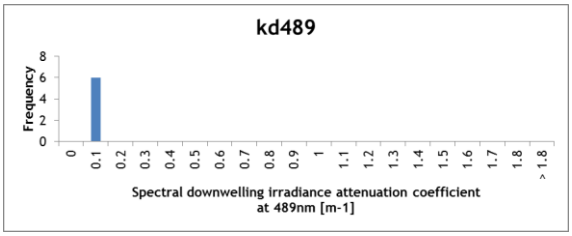
Site 17: Cape Verde



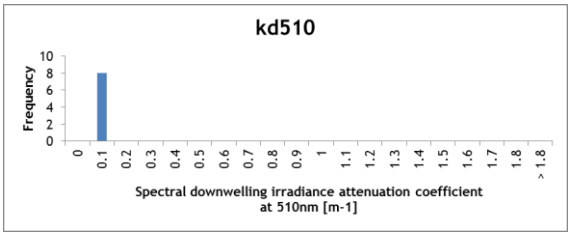
min: 0.031784m^{-1}; median: 0.046463m^{-1}; max: 0.059341m^{-1}



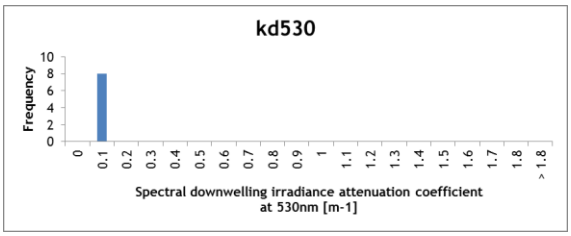
min: 0.031196m^{-1}; median: 0.041653m^{-1}; max: 0.055248m^{-1}



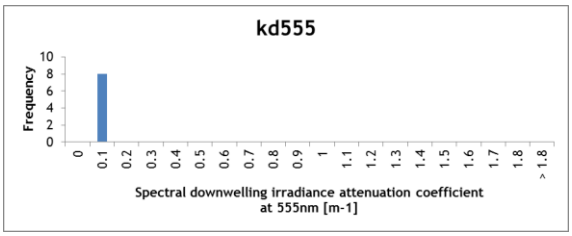
min: 0.030348m^{-1}; median: 0.036484m^{-1}; max: 0.049075m^{-1}



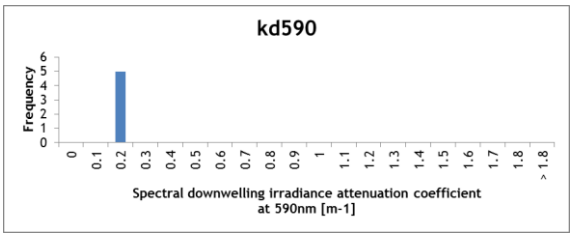
min: 0.043596m^{-1}; median: 0.052085m^{-1}; max: 0.064875m^{-1}



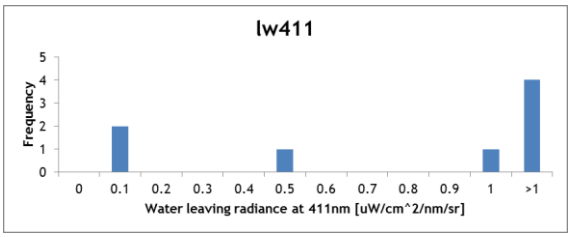
min: 0.055968m^{-1}; median: 0.059579m^{-1}; max: 0.071882m^{-1}



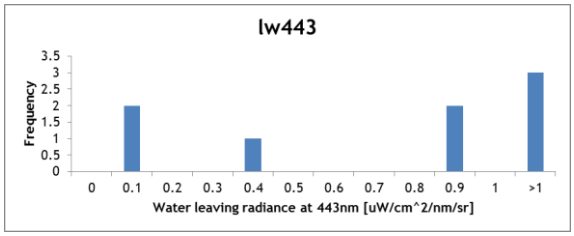
min: 0.068527m^{-1}; median: 0.076935m^{-1}; max: 0.0811517m^{-1}



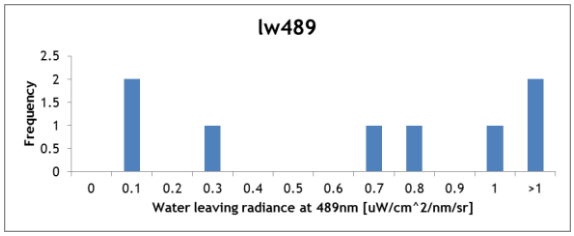
min: 0.152067m^{-1}; median: 0.170693m^{-1}; max: 0.188301m^{-1}



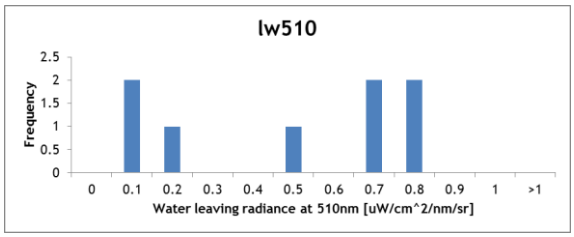
min: 0.532854 uW/cm^2/nm/sr; median: 0.94142 uW/cm^2/nm/sr; max: 1.49192 uW/cm^2/nm/sr



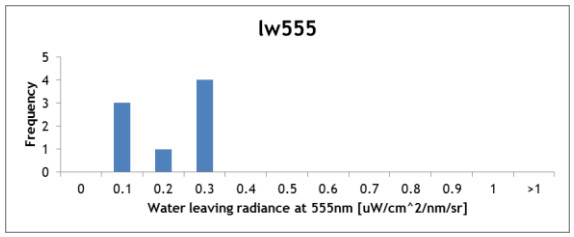
min: 0.439864 uW/cm²/nm/sr;
median: 0.850881 uW/cm²/nm/sr;
max: 1.27162 uW/cm²/nm/sr



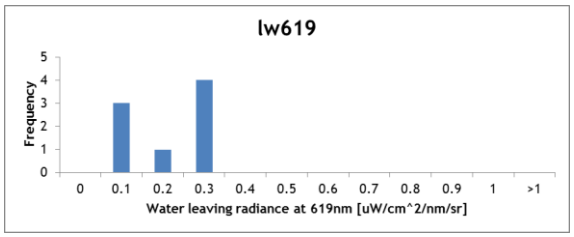
min: 0.377988 uW/cm²/nm/sr;
median: 0.7671075 uW/cm²/nm/sr;
max: 1.00671 uW/cm²/nm/sr



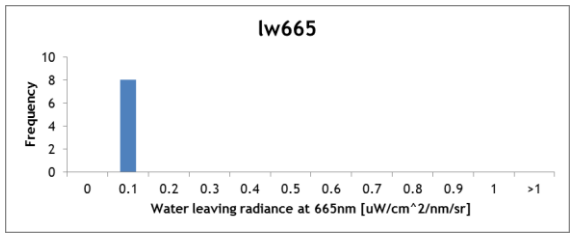
min: 0.239239 uW/cm²/nm/sr;
median: 0.4874385 uW/cm²/nm/sr;
max: 0.602626 uW/cm²/nm/sr



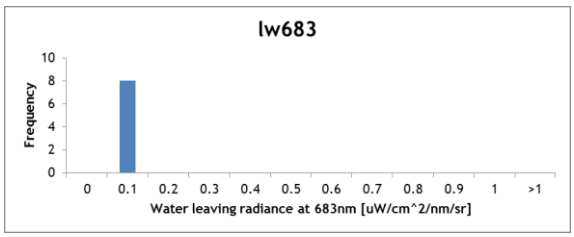
min: 0.110051 uW/cm²/nm/sr;
median: 0.222139 uW/cm²/nm/sr;
max: 0.283765 uW/cm²/nm/sr



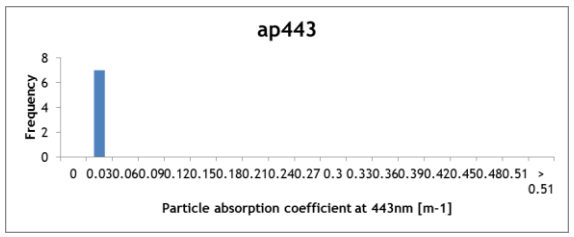
min: 0.007597 uW/cm²/nm/sr;
median: 0.01734 uW/cm²/nm/sr;
max: 0.023113 uW/cm²/nm/sr



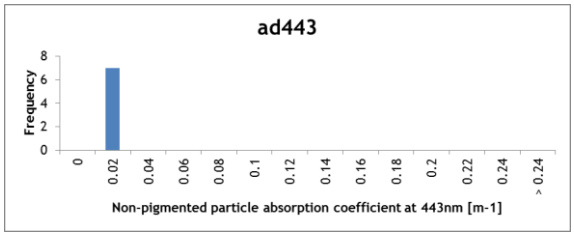
min: 0.002572 uW/cm²/nm/sr;
median: 0.006271 uW/cm²/nm/sr;
max: 0.008361 uW/cm²/nm/sr



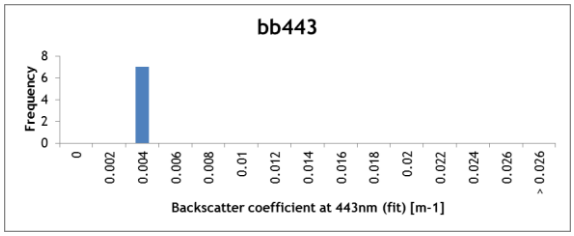
min: 0.005000 uW/cm²/nm/sr;
median: 0.009950 uW/cm²/nm/sr;
max: 0.013378 uW/cm²/nm/sr



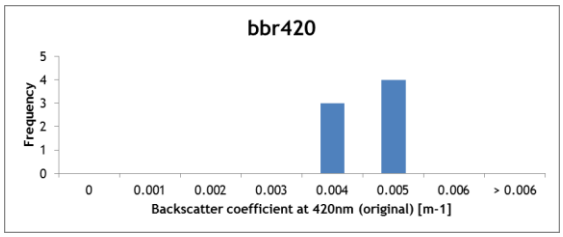
min: 0.0141m^{-1}; median: 0.01606m^{-1};
max: 0.01905m^{-1}



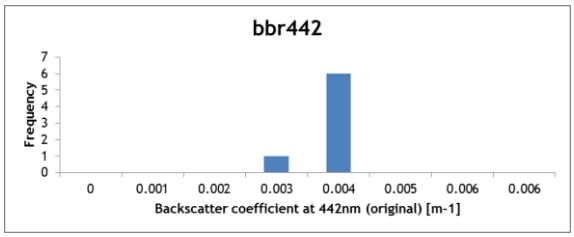
min: 0.00241m^{-1}; median: 0.00311m^{-1}; max: 0.00461m^{-1}



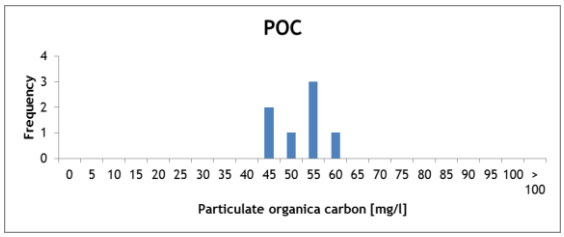
min: 0.003081m^{-1}; median: 0.003305m^{-1}; max: 0.003632m^{-1}



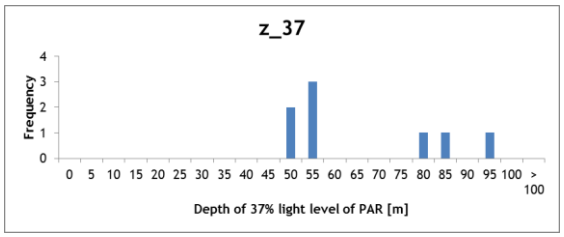
min: 0.00372m^{-1}; median: 0.00403m^{-1}; max: 0.00432m^{-1}



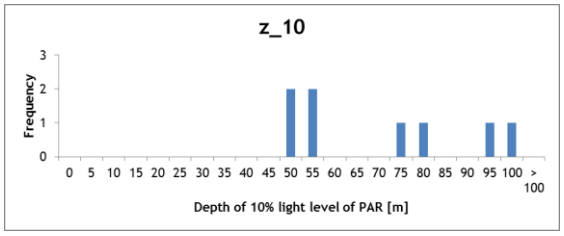
min: 0.00291m^{-1}; median: 0.00321m^{-1}; max: 0.00353m^{-1}



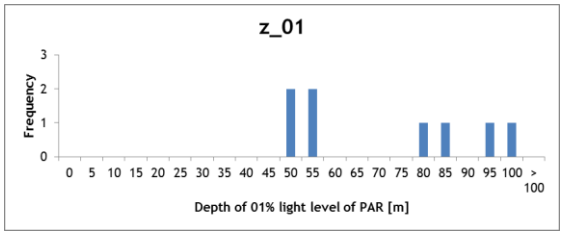
min: 40.477mg/l; median: 51.694mg/l; max: 56.497mg/l



min: 47m; median: 55m; max: 94m

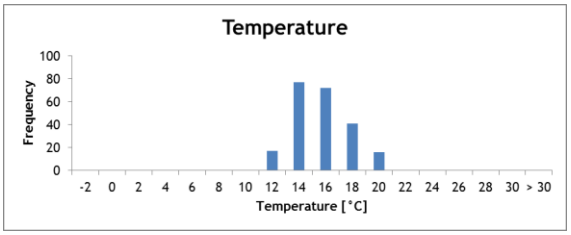


min: 47m; median: 65m; max: 100m

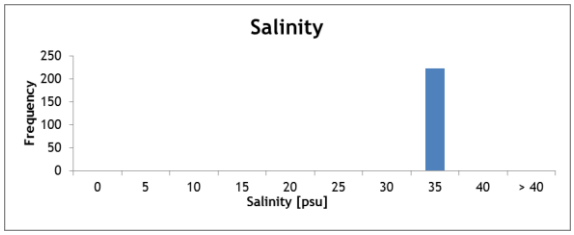


min:47m; median: 67m; max: 100m

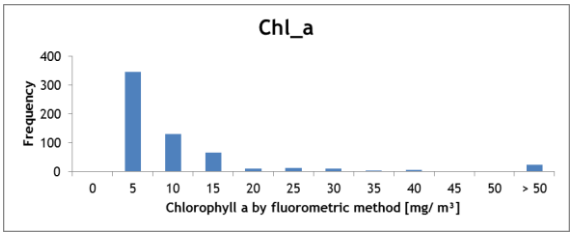
Site 20: Central California



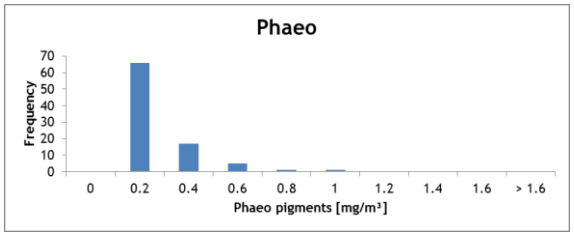
max:10.29°C; median: 14.48°C; max: 19.2°C



min: 32.24psu; median: 33.1 psu; max: 33.91psu

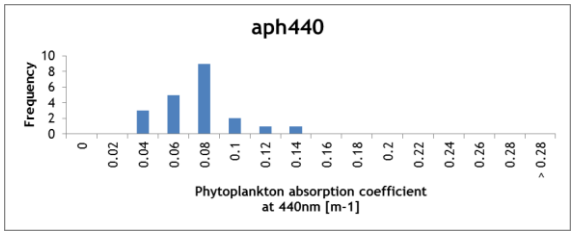


min: 0.071mg/m³; median: 3.68985mg/m³; max: 1169.728mg/m³

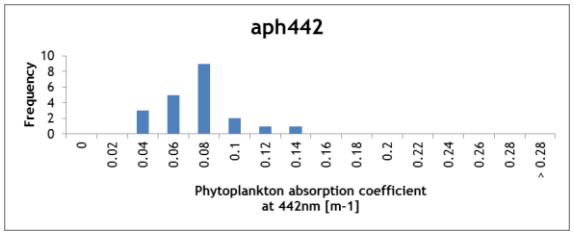


min: 0.017mg/m³; median: 0.0845 mg/m³; max: 0.873mg/m³

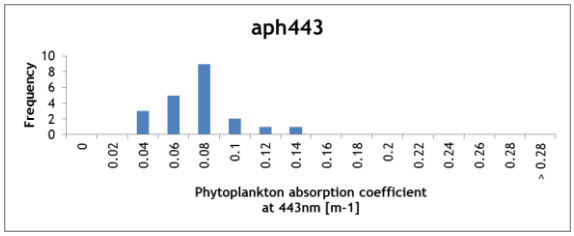
Site 25: Tasmania



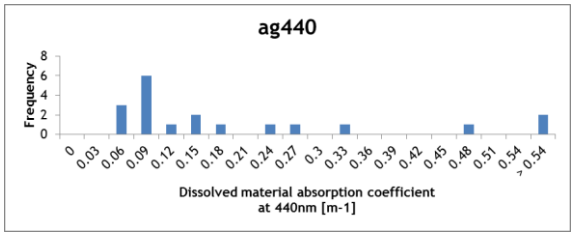
min: 0.031920m^{-1}; median: 0.068030m^{-1}; max: 0.137760m^{-1}



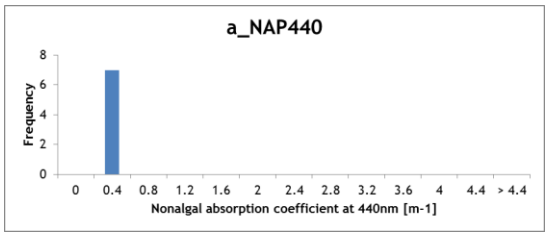
min: 0.031370m^{-1}; median: 0.066710m^{-1}; max: 0.134820m^{-1}



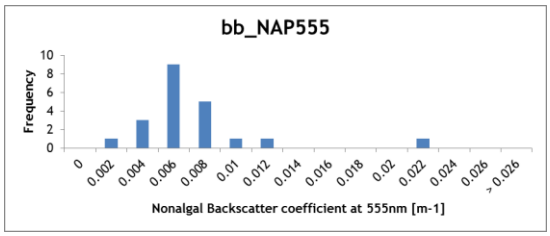
min: 0.031040m^{-1}; median: 0.065820m^{-1}; max: 0.133170m^{-1}



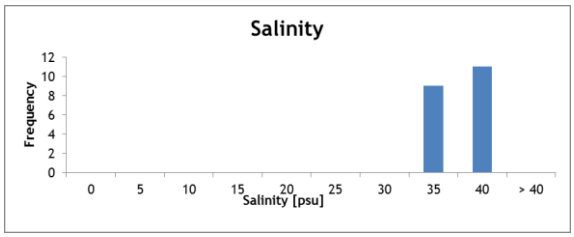
min: 0.034118m^{-1}; median: 0.0933m^{-1}; max: 5.387703m^{-1}



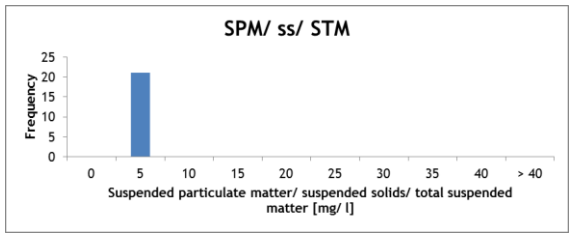
min: 0.00881m^{-1}; median: 0.04396m^{-1}; max: 0.2457m^{-1}



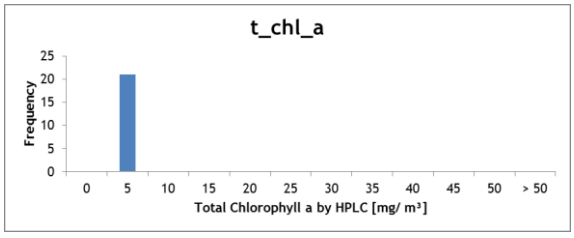
min: 0.0019m^{-1}; median: 0.0054m^{-1}; max: 0.0207m^{-1}



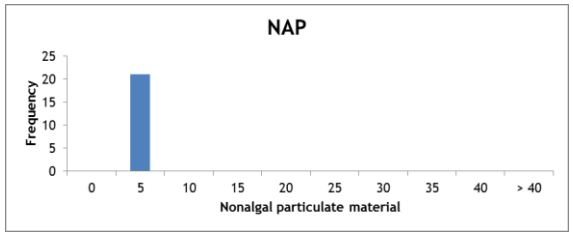
min: 32.312psu; median: 35.1395psu; max: 35.617psu



min: 0.2mg/l; median: 0.7mg/l; max: 1.67mg/l

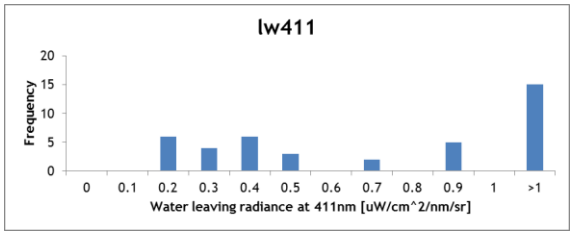


min:0.1708mg/m^3; median: 0.5641mg/m^3; max: 1.5269mg/m^3

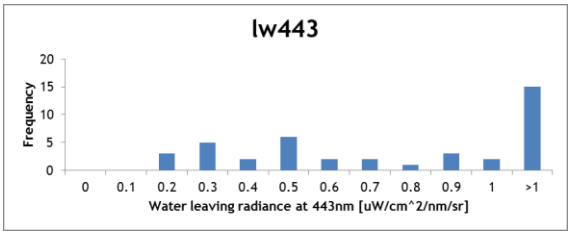


min: 0.1962m^{-1}; median: 0.6908m^{-1}; max: 1.6628m^{-1}

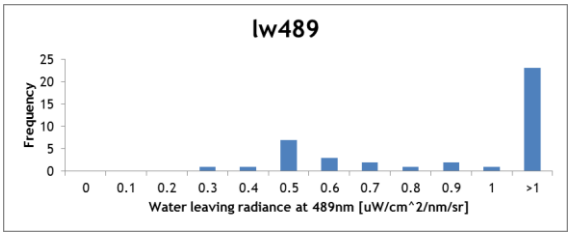
Site 26: Gulf of Mexico



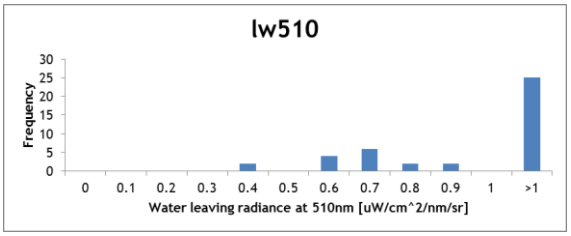
min: 0.1054 uW/cm²/nm/sr;
median: 0.6955 uW/cm²/nm/sr;
max: 1.8313 uW/cm²/nm/sr



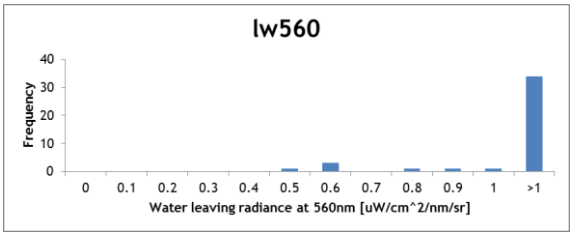
min: 0.1492 uW/cm²/nm/sr;
median: 0.7574 uW/cm²/nm/sr;
max: 2.3615 uW/cm²/nm/sr



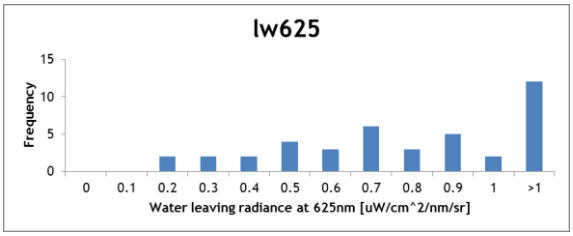
min: 0.2840 uW/cm²/nm/sr;
median: 1.08310 uW/cm²/nm/sr;
max: 3.56500 uW/cm²/nm/sr



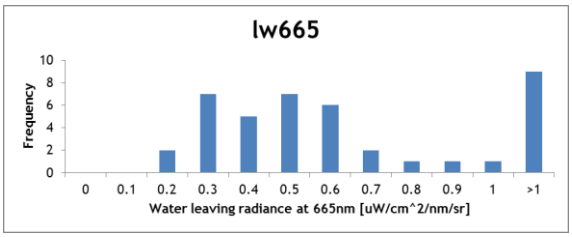
min: 0.36390 uW/cm²/nm/sr;
median: 1.1910 uW/cm²/nm/sr;
max: 4.39870 uW/cm²/nm/sr



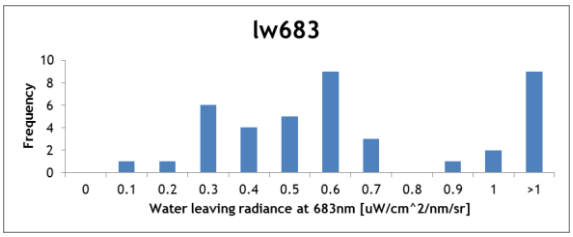
min: 0.49950 uW/cm²/nm/sr;
median: 1.43580 uW/cm²/nm/sr;
max: 6.47100 uW/cm²/nm/sr



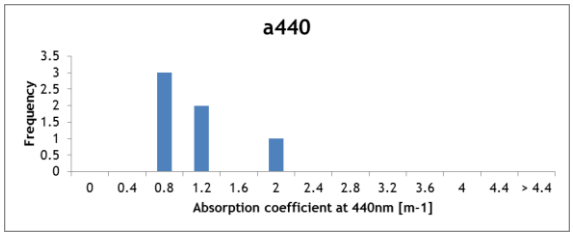
min: 0.1338 uW/cm²/nm/sr;
median: 0.758 uW/cm²/nm/sr;
max: 4.8289 uW/cm²/nm/sr



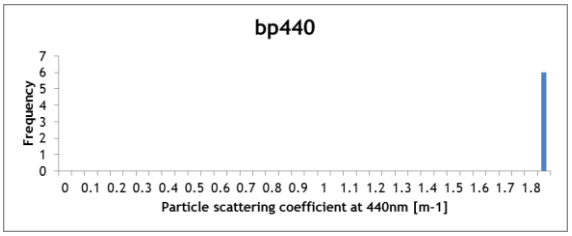
min: 0.1014 uW/cm²/nm/sr;
median: 0.4938 uW/cm²/nm/sr;
max: 3.2905 uW/cm²/nm/sr



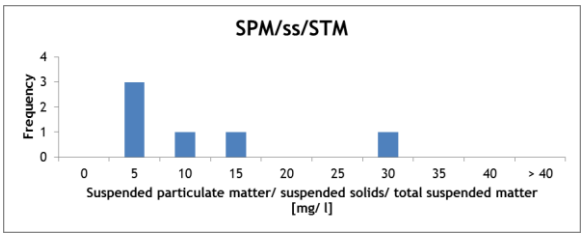
min: 0.0983 uW/cm²/nm/sr;
median: 0.5249 uW/cm²/nm/sr;
max: 3.7687 uW/cm²/nm/sr



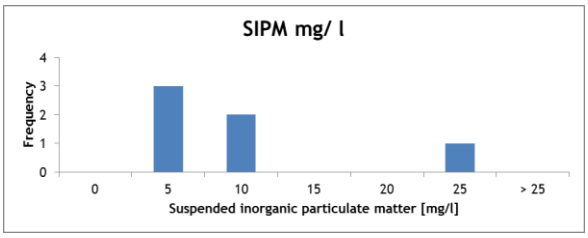
min: 0.438054m^{-1}; median: 0.73175m^{-1}; max: 1.7367m^{-1}



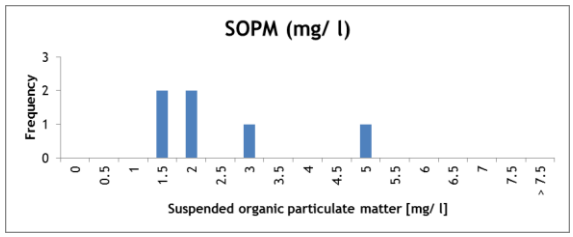
min: 2.148345m^{-1}; median: 0.73175m^{-1}; max: 15.6472m^{-1}



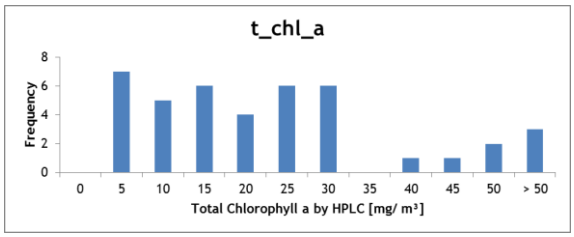
min: 3.03145mg/l; median: 6.6454mg/l; max: 25.02381mg/l



min: 1.512579mg/l; median: 5.06998mg/l; max: 20.42857mg/l



min: 1.318182mg/l; median: 1.658715mg/l; max: 4.595238mg/l



min: 0.46mg/m^3; median: 17.2294mg/ m^3; max: 77.2133mg/ m^3

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7 REFERENCES

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[2] (Technote_transectdata.pdf) *Validation Transect between Cuxhaven and Helgoland - Thechnical Note*;

[3] "README.txt", Marine Institute of Ireland ;

[4] (NIVA_VAMPDataDeliverables.pdf), *Deliverables - Project VAMP Validation of MERIS Products Project period 2000-2008 - ESA PRODEX Contract no 14849/00/NL/Sfe(IC)*;

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