



Re-calculating derived BGC parameters: metadata that is perfect, inconsistently formatted or missing

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Why were BODC looking at BGC metadata

Whilst writing a BGC infrastructure agnostic derivation equations – a toolbox to share when done...

But as BODC is not yet releasing B-files, decided to test on other DAC's netCDFs...

But progress seriously impinged by availability of metadata to re-derive variables from raw counts:

- Focus on:
 - PREDEPLOYMENT_CALIB_EQUATION
 - PREDEPLOYMENT_CALIB_COEFFICIENT
- High-level of inconsistency in formatting – creating parsing issues
- Sometimes completely absent!



pH inputs and metadata – few examples

The pH cookbook does not include a specification for the `PREDEPLOYMENT_CALIB_COEFFICIENT`. However, based on other BGC cookbooks the text string (using the example coefficients in the cookbook table 7) should look like:

$K0 = -1.372714$, $K2 = -0.001063$, $F1 = 4.15927E-06$, $F2 = -2.53737E-08$, $F3 = 2.87941E-11$, $F4 = -1.33263E-14$, $F5 = 2.23781E-18$

No metadata was present in any of the AOML files examined.



Chlorophyll-a inputs

Variable	Example	File	netCDF variable	Equation variable
Manufacturer dark count	DARK_CHLA	meta	PREDEPLOYMENT_CALIB_COEFFICIENTS: DARK_CHLA	dark
Pre-deployment operator dark count	DARK_CHLA_O	meta	PREDEPLOYMENT_CALIB_COEFFICIENTS: DARK_CHLA_O	dark
Raw count of chlorophyll-a fluorescence	FLUORESCENCE_CHLA	profile	FLUORESCENCE_CHLA	raw
Scale factor from instrument manufacturer characterisation	SCALE_CHLA	meta	PREDEPLOYMENT_CALIB_COEFFICIENTS: SCALE_CHLA	scale



Cholorphyll-a metadata

DAC	WMO	PREDEPLOYMENT_CALIB_EQUATION	PREDEPLOYMENT_CALIB_COEFFICIENT
AOML	5904180	n/a	n/a
Coriolis	6903697	$CHLA = (FLUORESCENCE_CHLA - DARK_CHLA) * SCALE_CHLA$	SCALE_CHLA=0.0072, DARK_CHLA=44
INCOIS	2902156	$CHLA = FLBBCHLscale * (Fsig - FLBBCHLdc)$	ser# = 0 FLBB CHLA coeffs: Scale = 0.0073 Dark Counts = 43.0000
CSIO	2902784	$CHLA = (FLUORESCENCE_CHLA - DARK_CHLA) * SCALE_CHLA$;	SCALE_CHLA=0.0073;DARK_CHLA=46;
CSIRO	5905397	$CHLA = FLBBCHLscale * (Fsig - FLBBCHLdc)$	ser# = 125 FLBB CHLA coeffs: Scale = 0.0020 Dark Counts = 49.0000



Radiometry inputs

Variable	Example	File	netCDF variable	Equation variable
Raw downwelling irradiance at xxx wavelength	RAW_DOWNWELLING_IRRADIANCE380	profile	RAW_DOWNWELLING_IRRADIANCExxx	raw
Raw upwelling radiance at xxx wavelength	RAW_UPWELLING_RADIANCE380	profile	RAW_UPWELLING_RADIANCExxx	raw
Raw Photo-synthetically Active Radiation (PAR)	RAW_DOWNWELLING_PAR	profile	RAW_DOWNWELLING_PAR	raw
Calibration coefficient A0 at given wavelength/PAR	A0_380	meta	PREDEPLOYMENT_CALIB_COEFFICIENTS: A0_xxx	a0
Calibration coefficient A1 at given wavelength/PAR	A1_380	meta	PREDEPLOYMENT_CALIB_COEFFICIENTS: A1_xxx	a1
Calibration coefficient Im at given wavelength/PAR	Im_380	meta	PREDEPLOYMENT_CALIB_COEFFICIENTS: Im_xxx	Im



Radiometry metadata:

PREDEPLOYMENT_CALIB_COEFFICIENT

Variable	WMO	PREDEPLOYMENT_CALIB_EQUATION	PREDEPLOYMENT_CALIB_COEFFICIENT
AOML	5904179	n/a	n/a
Coriolis	6902828	DOWN_IRRADIANCE380=0.01*A1_380*(RAW_DOWNWELLING_IRRADIANCE380 -A0_380)*Im_380	A1_380=1.56391e-07, A0_380=2.14783e+09, Im_380=1.161
INCOIS	2902241	No entry	No entry
CSIO	2902750	DOWN_IRRADIANCE490=0.01*A1_490*(RAW_DOWNWELLING_IRRADIANCE490 -A0_490)*Im_490;	A1_490=1.96985133712e- 007;A0_490=2148569513.5;Im_490=1.365;
CSIRO	2902750	n/a	n/a



Particle backscatter inputs

Variable	Example	File	netCDF variable	Equation variable
Conversion factor from table in manual	χ	meta	PREDEPLOYMENT_CALIB_COEFFICIENT: khi	chi
In-situ temperature	TEMP	profile	TEMP	Tc
Salinity	PSAL	profile	PSAL	S
Raw count from backscattering meter	BETA_BACKSCATTERING700	B-profile	BETA_BACKSCATTERINGxxx	beta
Raw count from backscattering meter dark count test	DARK_BACKSCATTERING700	meta	PREDEPLOYMENT_CALIB_COEFFICIENT: DARK_BACKSCATTERINGxxx	dark
Scale factor	SCALE_BACKSCATTERING700	meta	PREDEPLOYMENT_CALIB_COEFFICIENT: SCALE_BACKSCATTERINGxxx	scale
Seawater contribution to backscattering	BETASW700	meta	PREDEPLOYMENT_CALIB_COEFFICIENT: BETASWxxx	betasw



Particle backscatter metadata

Variable	AOML	PREDEPLOYMENT_CALIB_EQUATION	PREDEPLOYMENT_CALIB_COEFFICIENT
AOML	5904179	n/a	n/a
Coriolis	6903697	BBP700=2*pi*khi*((BETA_BACKSCATTERING700-DARK_BACKSCATTERING700)*SCALE_BACKSCATTERING700-BETASW700)	DARK_BACKSCATTERING700=41, SCALE_BACKSCATTERING700=1.599e-06, khi=1.097, BETASW700 (contribution of pure sea water) is calculated at 142 angularDeg
INCOIS	2902245	BBP700=2*pi*khi*((BETA_BACKSCATTERING700-DARK_BACKSCATTERING700)*SCALE_BACKSCATTERING700-BETASW700)	DARK_BACKSCATTERING700=40, SCALE_BACKSCATTERING700=1.645e-06, khi=1.097, BETASW700 (contribution of pure sea water) is calculated at 142 angularDeg
CSIO	2902750	BBP700=2*pi*khi*((BETA_BACKSCATTERING700-DARK_BACKSCATTERING700)*SCALE_BACKSCATTERING700-BETASW700);	DARK_BACKSCATTERING700=46;SCALE_BACKSCATTERING700=1.897E-06;khi=1.076;BETASW700 (contribution of pure sea water) is calculated at 124 deg;
CSIRO	5905397	totalBBP = FLBB700scale*(Bbsig - FLBB700dc); [betasw,beta90sw,bsw] = betasw_ZHH2009(700,t_oxygen,FLBB700angle,s_oxygen) cf betasw_ZHH2009; BBP700 = 2*pi*FLBBChi*(totalBBP-betasw)	ser# = 125 FLBB 700 BBP coeffs: Scale = 0.0000 Dark Counts = 48.0000 FLBBangle = 150.0000 FLBBChi = 1.1400

Nitrate inputs

Variable	Example	File	netCDF variable	Equation variable
Pressure from CTD	PRES	profile/B-profile	PRES	PRES
Temperature of seawater from CTD	TEMP	profile	TEMP	TEMP
Salinity of seawater from CTD	PSAL	profile	PSAL	PSAL
Potential density of seawater derived from CTD	rho	n/a	n/a - derived intermediate variable	rho
Intensity of ultra violet flux from nitrate sensor	UV_INTENSITY_NITRATE	B-profile	UV_INTENSITY_NITRATE	UV_INTENSITY_NITRATE
Intensity of ultra violet flux dark measurement from nitrate sensor	UV_INTENSITY_DARK_NITRATE	B-profile	UV_INTENSITY_DARK_NITRATE	UV_INTENSITY_DARK_NITRATE
Nitrate	MOLAR_NITRATE	B-profile	MOLAR_NITRATE	MOLAR_NITRATE
Nitrate fit error	FIT_ERROR_NITRATE	B-profile	FIT_ERROR_NITRATE	n/a - not used
Relative humidity inside the SUNA sensor (If > 50% There is a leak)	HUMIDITY_NITRATE	B-profile	HUMIDITY_NITRATE	n/a - not used
Internal temperature of the SUNA sensor	TEMP_NITRATE	B-profile	TEMP_NITRATE	n/a - not used
Temperature of the spectrometer	TEMP_SPECTROPHOTOMETER_NITRATE	B-profile	TEMP_SPECTROPHOTOMETER_NITRATE	n/a - not used
Sea water absorptivity	E_NITRATE	meta	PREDEPLOYMENT_CALIB_COEFFICIENT: E_NITRATE	E_NITRATE
Molar absorptivity of nitrate	E_SWA_NITRATE	meta	PREDEPLOYMENT_CALIB_COEFFICIENT: E_SWA_NITRATE	E_SWA_NITRATE
Wavelength	OPTICAL_WAVELENGTH_UV	meta	PREDEPLOYMENT_CALIB_COEFFICIENT: OPTICAL_WAVELENGTH_UV	OPTICAL_WAVELENGTH_UV
Calibration temperature	TEMP_CAL_NITRATE	meta	PREDEPLOYMENT_CALIB_COEFFICIENT: TEMP_CAL_NITRATE	TEMP_CAL_NITRATE
Ultraviolet intensity of reference nitrate	UV_INTENSITY_REF_NITRATE	meta	PREDEPLOYMENT_CALIB_COEFFICIENT: UV_INTENSITY_REF_NITRATE	UV_INTENSITY_REF_NITRATE



Nitrate metadata

NO GO



Oxygen inputs

Sensor model	Variable	Description	Sensor units	netCDF variable
SBE63	Phase Delay		usec	PHASE_DELAY_DOXY
	DO	Dissolved oxygen concentration at zero pressure and in fresh water or at a reference pressure and reference salinity	ml/L	MLPL_DOXY
	Temp	Sea temperature measured by the optode	degC	TEMP_DOXY
	Voltage	To be converted in sea temperature	volts	TEMP_VOLTAGE_DOXY
Aanderaa 3830	RPhase	Phase measurement with red excitation light	deg	RPHASE_DOXY
	BPhase	Phase measurement with blue excitation light	deg	BPHASE_DOXY
	DPhase	Calibrated phase measurement	deg	DPHASE_DOXY
	DO	Dissolved oxygen concentration at zero pressure and in fresh water or at a reference salinity	umol/L	MOLAR_DOXY
	Temp	Sea temperature measured by the optode	degC	TEMP_DOXY
Aanderaa 4330	TCPhase	Temperature compensated phase	deg	TPHASE_DOXY
	C1RPhase	Phase measurement with blue excitation light	deg	C1PHASE_DOXY
	C2RPhase	Phase measurement with red excitation light	deg	C2PHASE_DOXY
	DO	Dissolved oxygen concentration at zero pressure and in fresh water or at a reference salinity	umol/L	MOLAR_DOXY
	Temp	Sea temperature measured by the optode	degC	TEMP_DOXY

ETC...



Oxygen metadata

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Tentative Conclusions

- Inconsistency in encoding BGC metadata in the Argo data system
- Effects a range of programmes
- Hindrance to software testing
- Future issue for recalculation/reconsideration of:
 - real-time mode data
 - adjusted-mode data
 - delayed-mode
- Barrier to effective reuse?
- Issue of accessibility and/or confidence for users?

