Supplementary Information

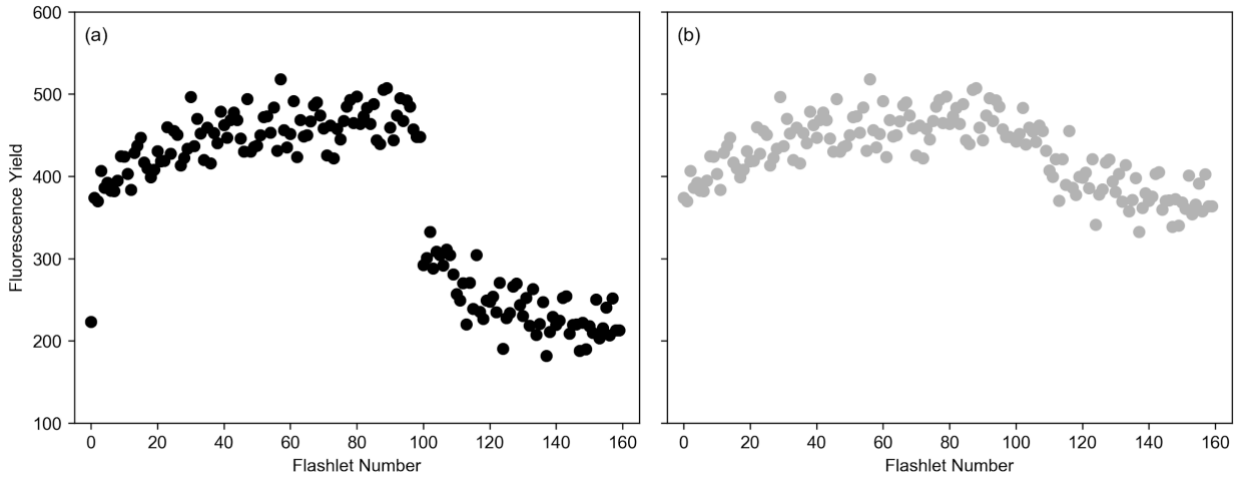

Figure S1: (a) Example induction curves from the FIRe instrument collected during the ACE voyage demonstrating the bias in the saturation and relaxation phases as a result of mismatch between the LED excitation power and reference excitation file. Figure (b) demonstrates 'bias' corrected induction curve after application of the skip option in *saturation.fit_saturation* and *tools.correct_fire_instrument_bias*..

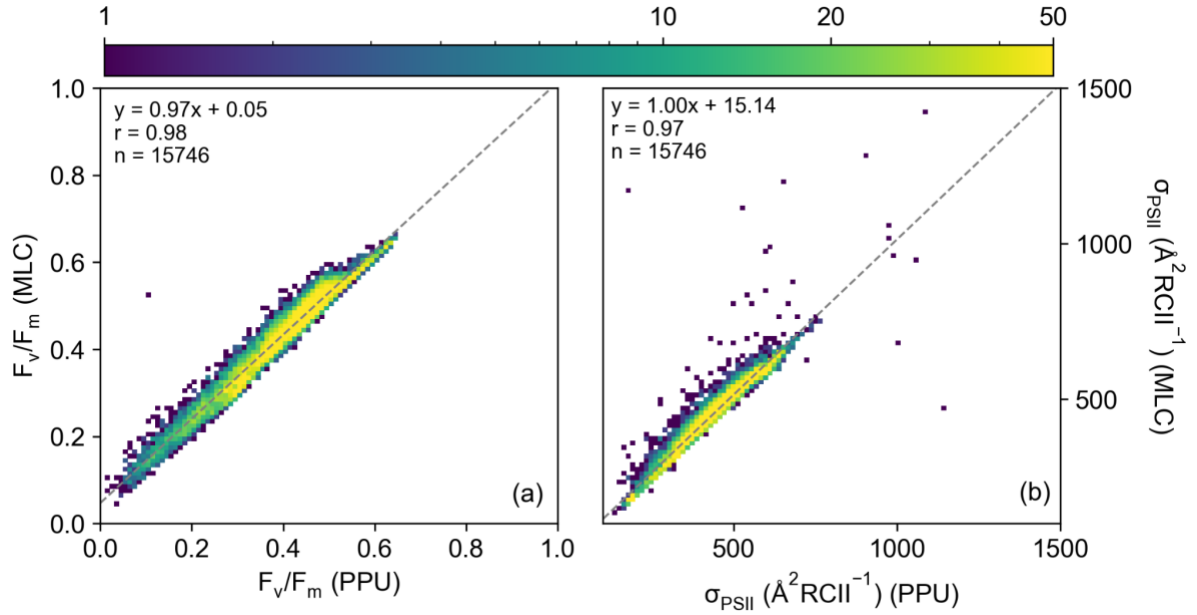

Figure S2: 2D histograms of F_v/F_m (a) and σ_{PSII} (b) from the modified Laney code (y-axis; Moore et al., 2007) versus PPU (x-axis) derived from the FastTracka I D350 (North Atlantic) dataset fit with the 'ρ' model fitting routine.

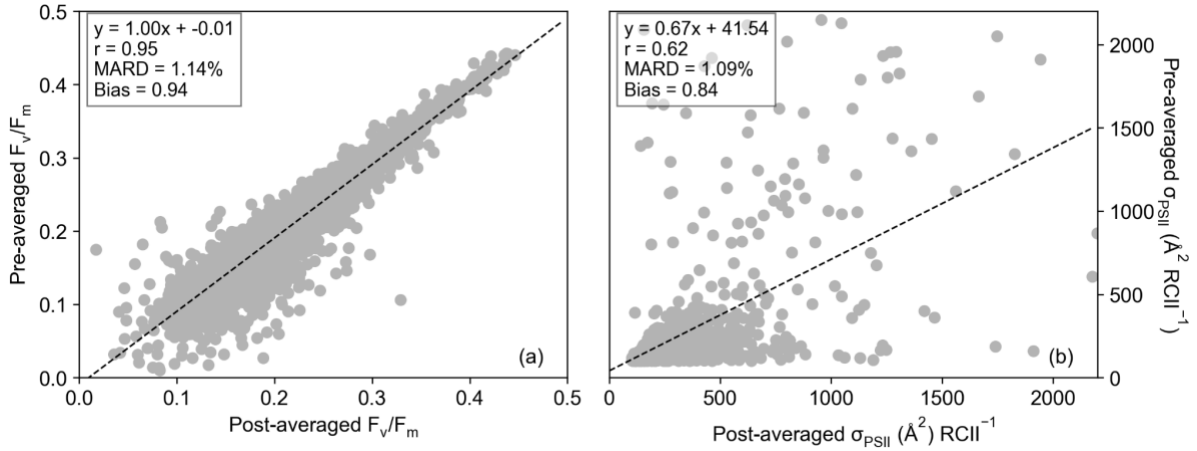

Figure S3: Plot of post-averaged (x-axis) vs pre-averaged (y-axis) F_v/F_m (a) and σ_{PSII} (b) from the FIRe instrument with the 'ρ' model fitting routine.

Table S1: Options available for different fitting options and provided statistical metrics on the fit.

	R^2	**p-value**	**χ^2**	**RMSE**	**nRMSE**	**Bias**	**Parameter Error (i.e. F_0 error)**
PPU				✓	✓	✓	✓
Laney			✓				
FIRePro							
FIReCom				✓			
FIREWORX	✓	✓					✓
FastPro							
FastPro8							
LIFT-FRR			✓				
RunSTAF							

Table 2: Functions available in *Phytoplankton Photophysiology Utilities*.

Function	**Description**
calculate_blank_FIRe	Calculates the blank from a discrete SAtlantic FIRe file
calculate_blank_FastOcean	Calculates the blank value from a CTG FASTast^{Ocean} data output. This function can also calculate blanks from the CTG FAST^{Tracka} II files as well.
calculate_chl_specific_absorption	Calculates either the chlorophyll specific or phytoplankton specific from raw absorbance
calculate_amplitude_etr	Calculates irradiance dependent and independent electron transport rates
calculate_instrument_led_correction	Calculates the instrument spectral correction factor
calculate_npq	Calculates non-photochemical quenching using either the Stern-Volner or normalised Stern-Volner derivation
correct_fire_instrument_bias	Corrects the large gap in the fluorescence yield between the end of the saturation phase and start of the relaxation phase
fit_saturation	Fits the saturation model of Kolber et al. (1998) with either no connectivity coefficient, a fixed value of the connectivity coefficient or an estimated connectivity coefficient.
fit_relaxation	Fits either the single or triple decay relaxation model of Kolber et al. (1998)
load_FASTTrackaI_files	Loads files from a CTG FAST^{Tracka} I that have

	been converted from binary format to txt format
load_FIRe_files	Loads files from a SAtlantic benchtop FIRe with file format .000
load_FastOcean_files	Loads files from a CTG FAST^{Ocean} that have been copied (CTRL+U) into a .csv file. Additional options allow the user to load in a single acquisition and calculate the fits on each transient as opposed to the instrument averaged transient. This function can also handle FAST^{Tracka} II files that have undergone conversion within FastPro8^{TM}.
load_LIFT_FRR_files	Loads excel files from a Soliense LIFT FRR
plot_fluorescence_light_curve	Plots the fluorescence light curve data
plot_relaxation_data	Plots the relaxation phase data
plot_saturation	Plots the saturation phase data
remove_outlier_from_time_average	Averages acquisitions together using time windows whilst removing outliers

Table S3: Suggested upper and lower bounds for input into PhytoPhotoUtils saturation and relaxation fitting routines.

Parameter	Definition	Lower Bound	Upper Bound	Reference
σ_{PSII} (Å^2 RCII^{-1})	Functional absorption cross section of PSII	100	2000	Kolber et al. 1998, Behrenfeld & Kolber 1999, Moore et al. 2003, Suggett et al. 2004, Moore et al. 2005, Moore et al. 2006b, Suggett et al. 2006a, Suggett et al. 2006b, Suggett et al. 2009
ρ	Connectivity coefficient; probability of energy transfer between individual photosystems	0.001	1	Babin et al. 2008, Suggett et al. 2001, Suggett et al. 2004
τ_1(µs)	Time constants of the re-oxidation of PSII, equivalent to electron transport between Q_A to Q_B	100	800	Kolber & Falkowski 1993, Kolber et al. 1998, Suggett et al. 2009

τ_2(μs)	Time constant of the re-oxidation of PSII equivalent to electron transport between Q_B to PQ pool	800	2000	Kolber et al. 1998
τ_3(ms)	Time constant of the re-oxidation of PSII equivalent to electron transport between PQ pool to PSI	2	50	Kolber & Falkowski 1993, Kolber et al. 1998, Behrenfeld et al. 2006
α	Amplitude of the decay phase of the fluorescence transient	0	1	Kolber et al. 1998

Table S4: Upper and lower limits and initial estimates (where set) for derived parameters as preset in Laney V6, modified Laney V6 and FastPro8 v1.0.55. See Table S3 for parameter definitions.

Parameter	Laney V6	Modified Laney V6	FastPro8 v1.0.55
F_o	Initial: Mean first 3 saturation flashlets Bounds: ± 50 % If < 0 = 0.01	Initial: Mean first 3 saturation flashlets Bounds: None	Initial: Intercept of the linear regression through first 8 saturation flashlets Bounds: None
F_m	Initial: Mean last 9 saturation flashlets Bounds: ± 50 %	Initial: Mean last 9 saturation flashlets Bounds: None	Initial: Linear regression through last 24 saturation flashlets Bounds: None
σ_{PSII} (Å quanta^{-1})	Bounds: 0-3000 Initial: 1	Initial: 500 Bounds: None	
ρ	Initial: 0.0001 Bounds: None	Initial: 0.2 Bounds: None	Bounds: 0-0.4

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