Applying Novel, Cross-Disciplinary Technology to Improve Measurements at Sea on Ships of Opportunity

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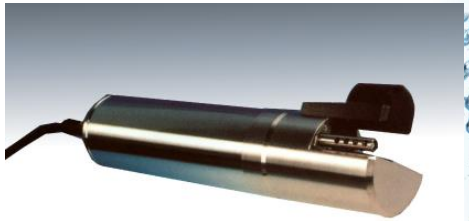
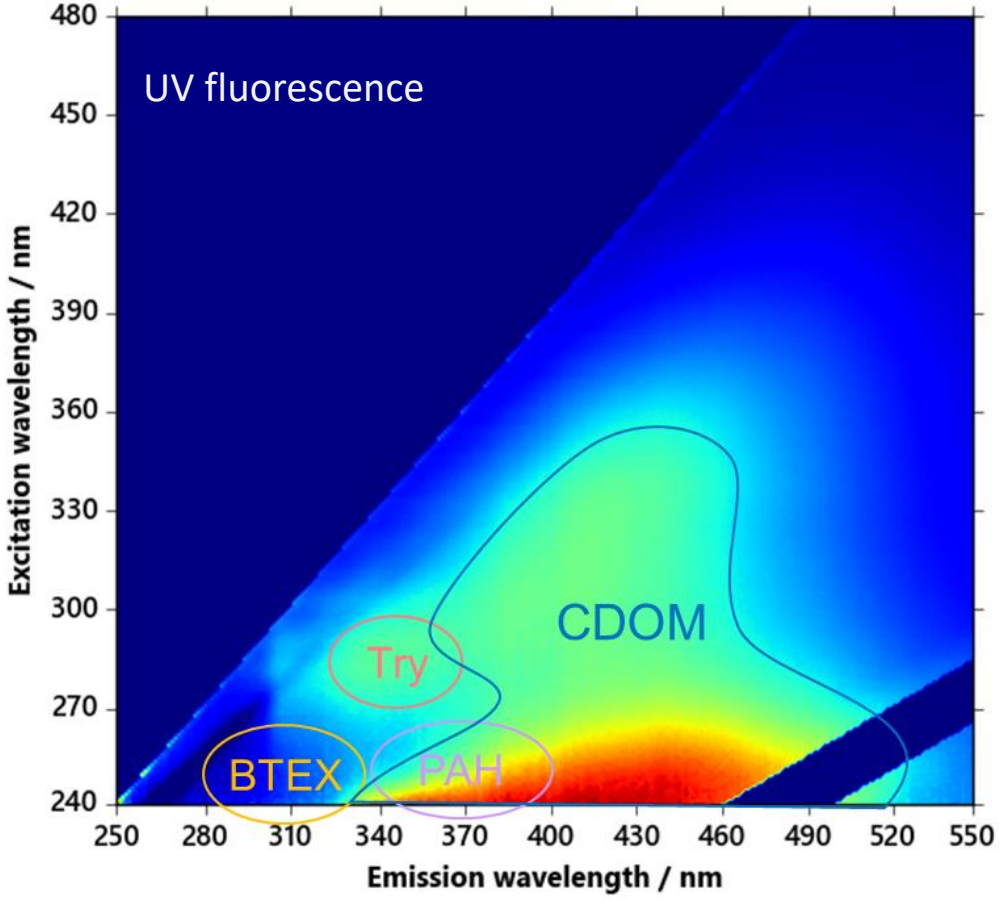
9th Ferrybox Workshop, Genoa

CTG's current range of fluorometers

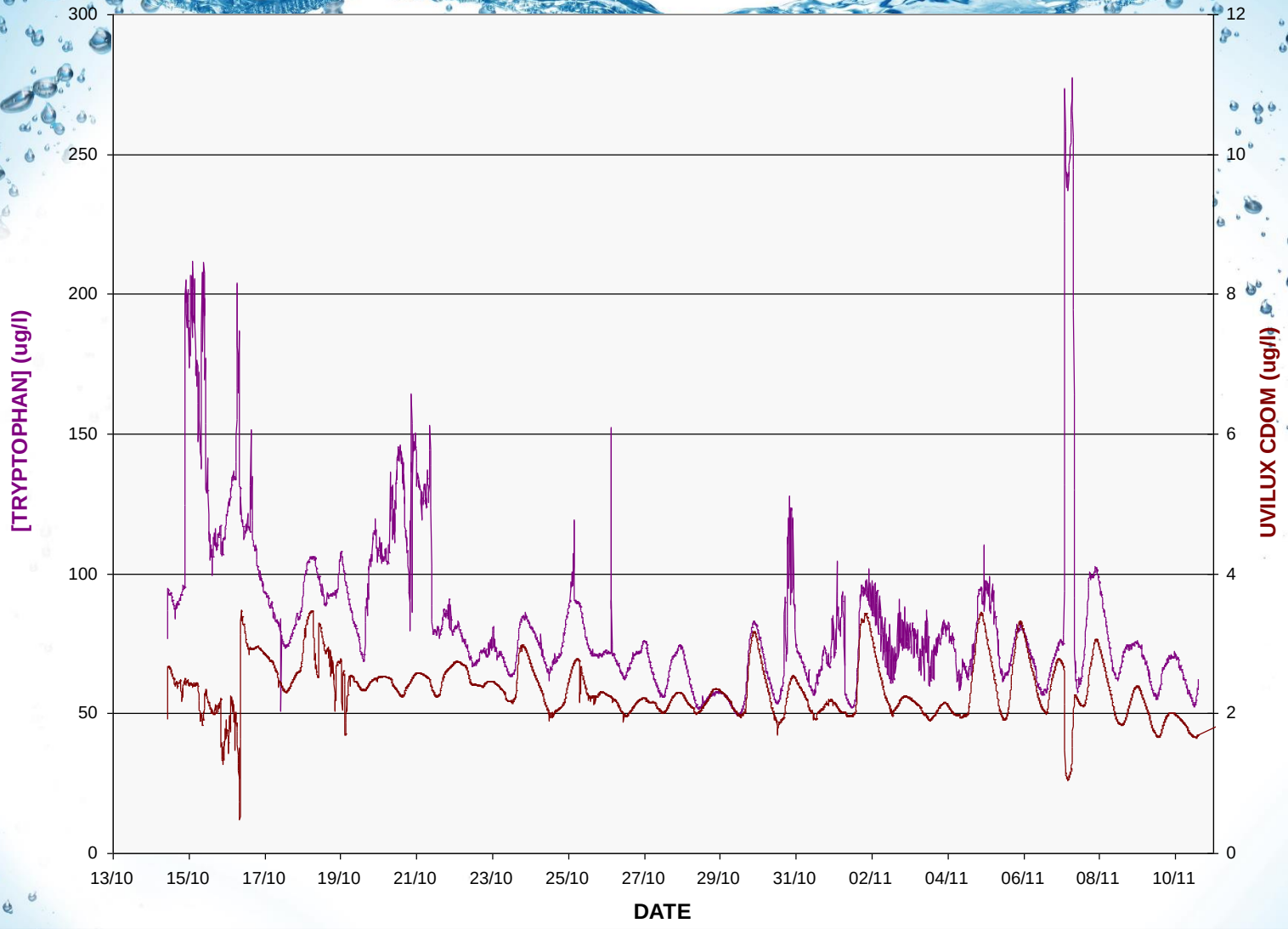
- Visible
  - Algae
  - Dye tracing
- UV
  - Tryptophan
  - CDOM
  - Aromatic Hydrocarbons
  - Optical Brighteners
- Active
  - Photosynthesis analysis



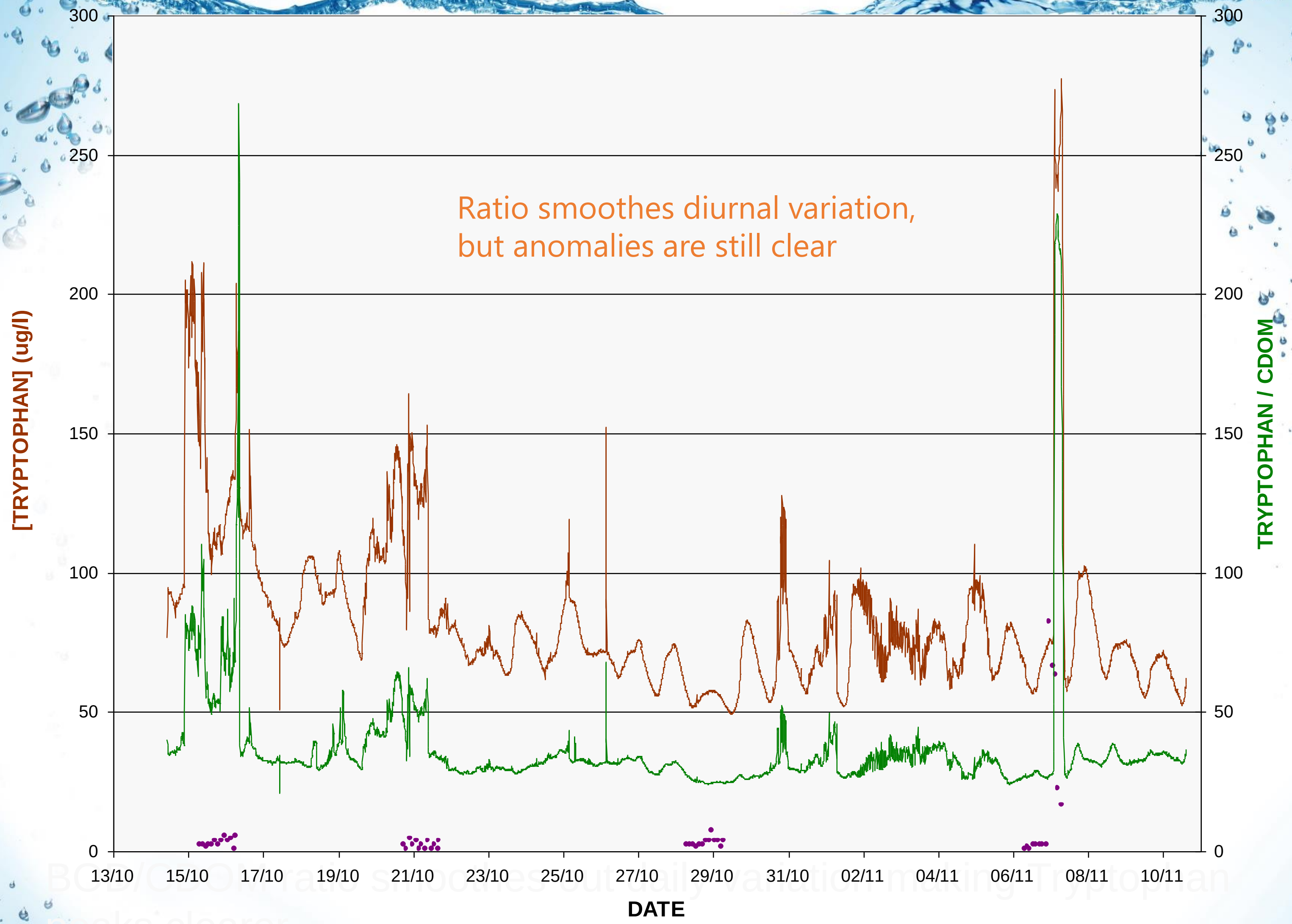
Measurement specificity



Spectral cross-talk

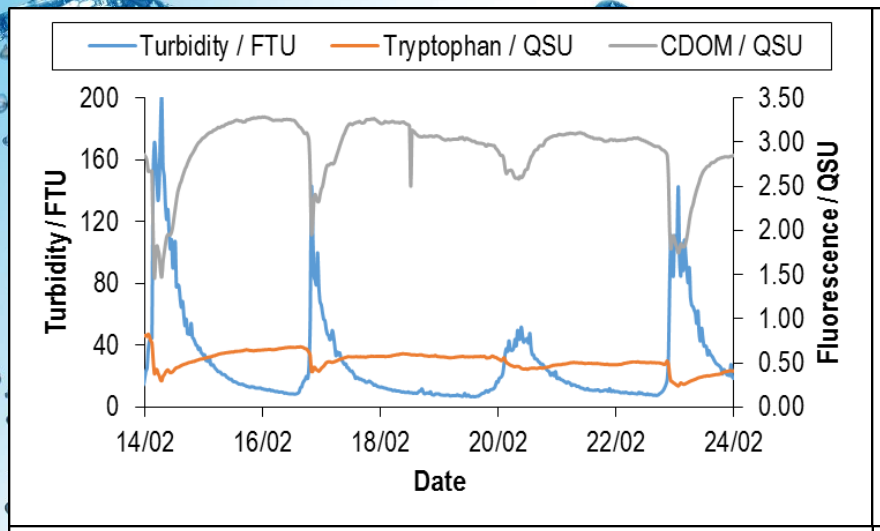


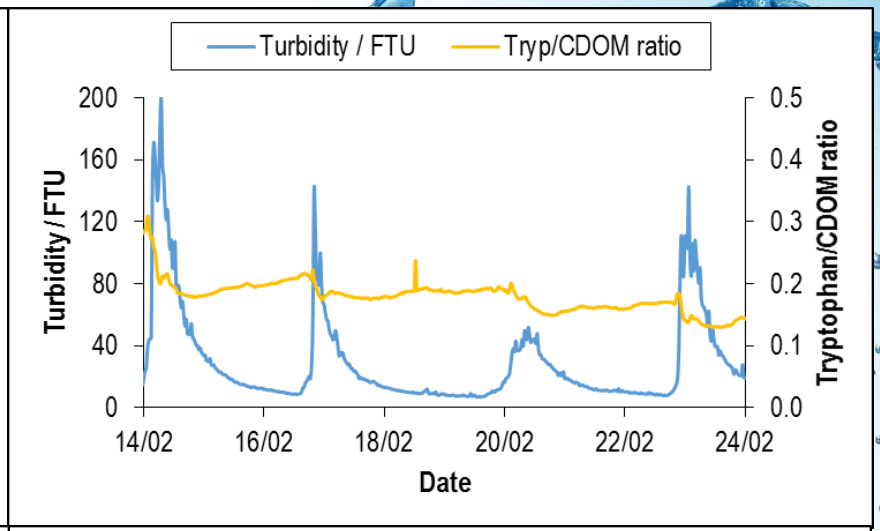
Tryptophan/CDOM ratio

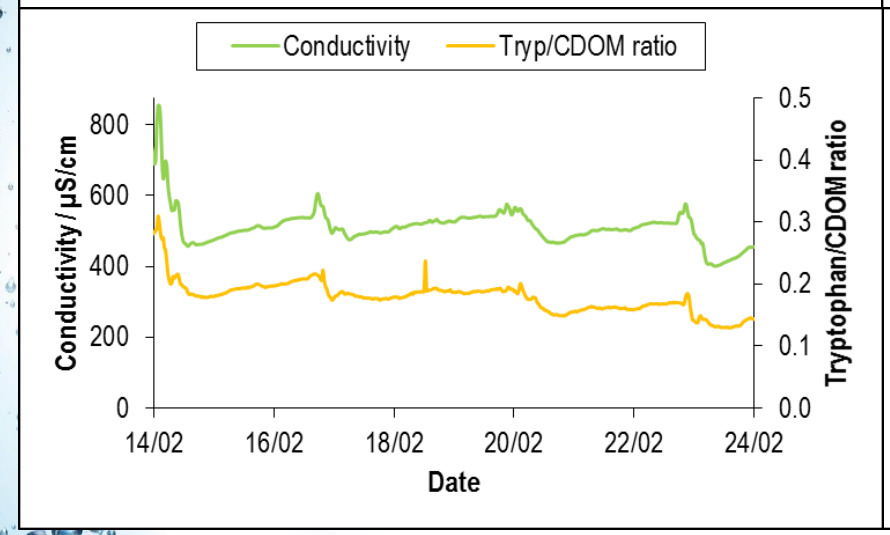


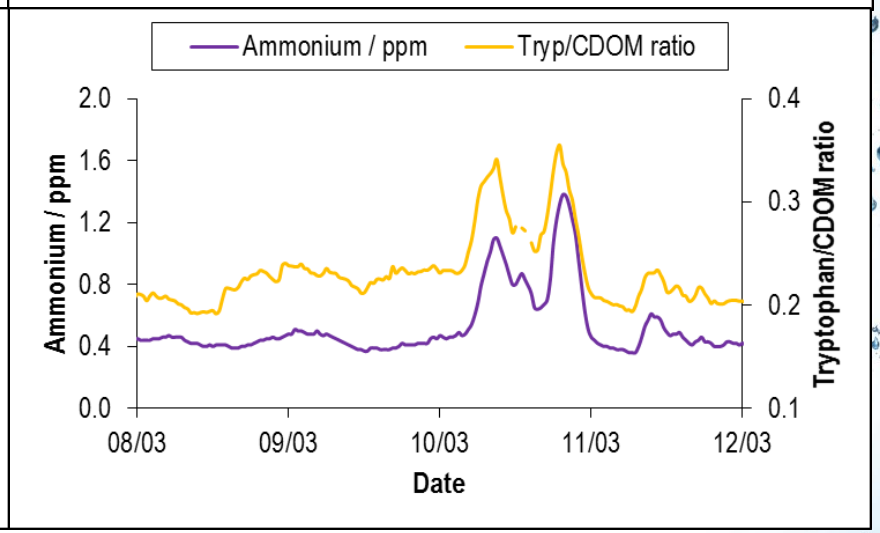
BOD/CDOM ratio smoothes out daily variation making Tryptophan peaks clearer

Example of deployment data





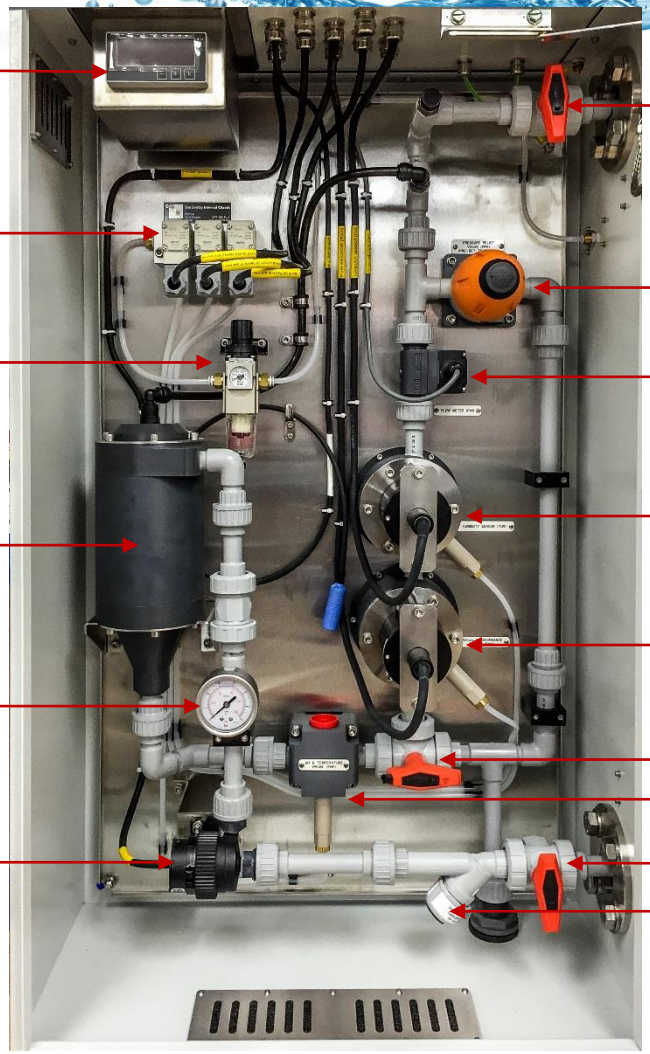




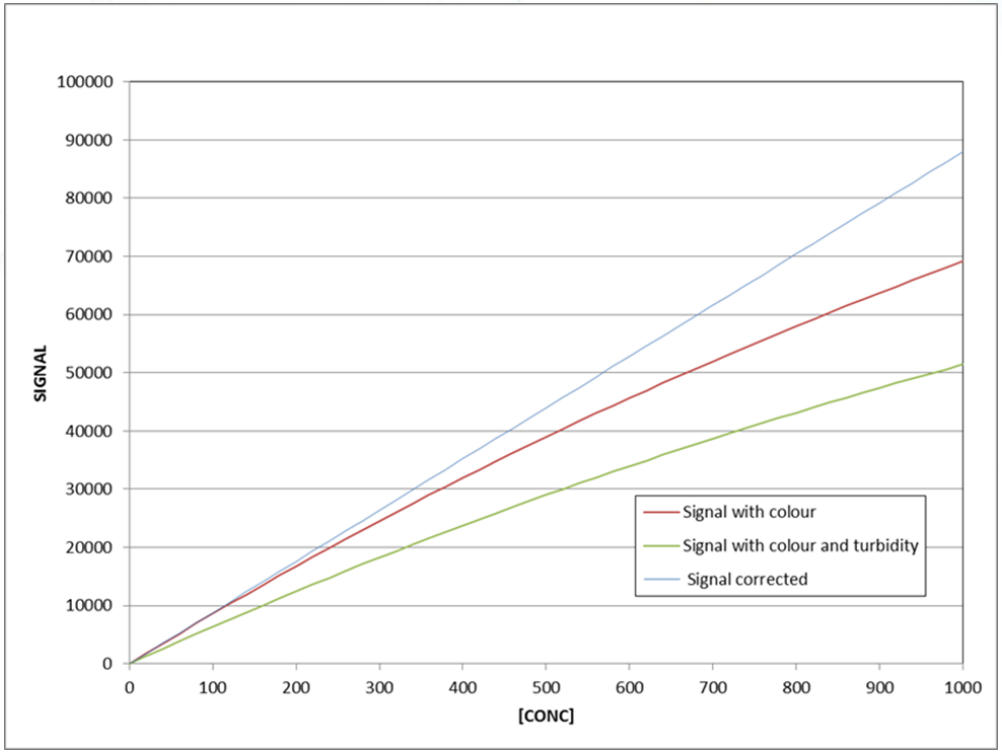
Turbidity interference after heavy rainfall

Sea Sentry - integrated cabinet solution

Fluidics

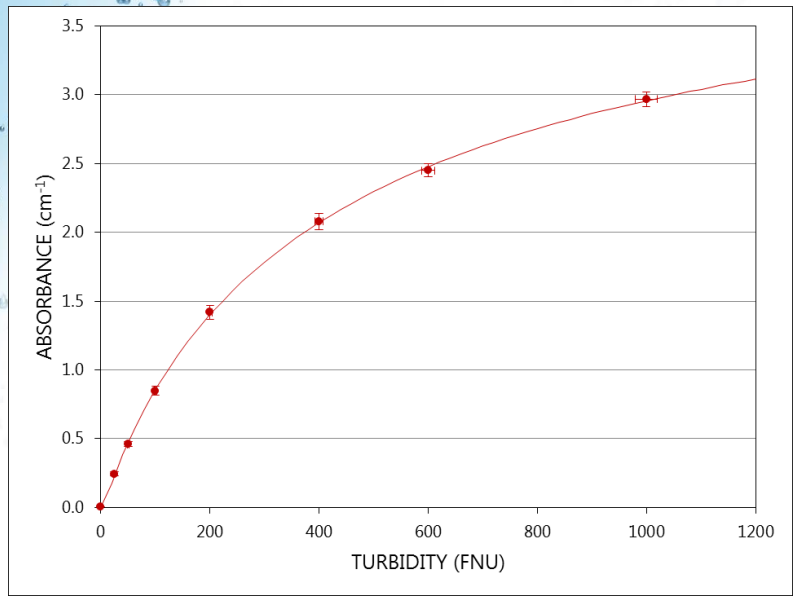

pH sensor controller
pneumatic solenoid valves
pneumatic regulator
de-aerator
pressure gauge
pump
outlet isolation valve
pressure relief valve
flow meter
turbidity sensor
$PAH_{phe\ eq}$ sensor
drain valve
pH sensor mount
inlet isolation valve
strainer

Turbidity & ‘colour’ interference

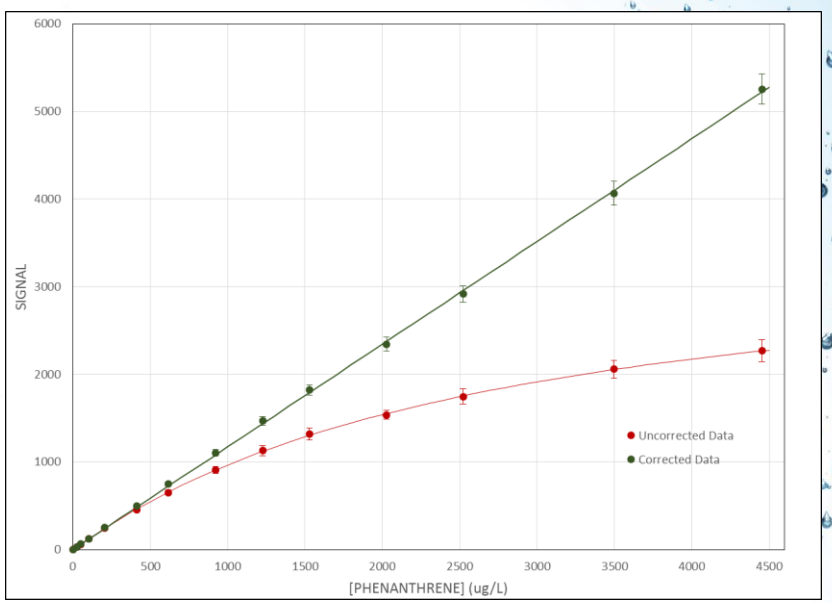


Fluorescence signal is attenuated by both sample absorbance (‘colour’) and turbidity - measurement corrections must be applied to take account of *both* effects.

Turbidity & ‘colour’ correction

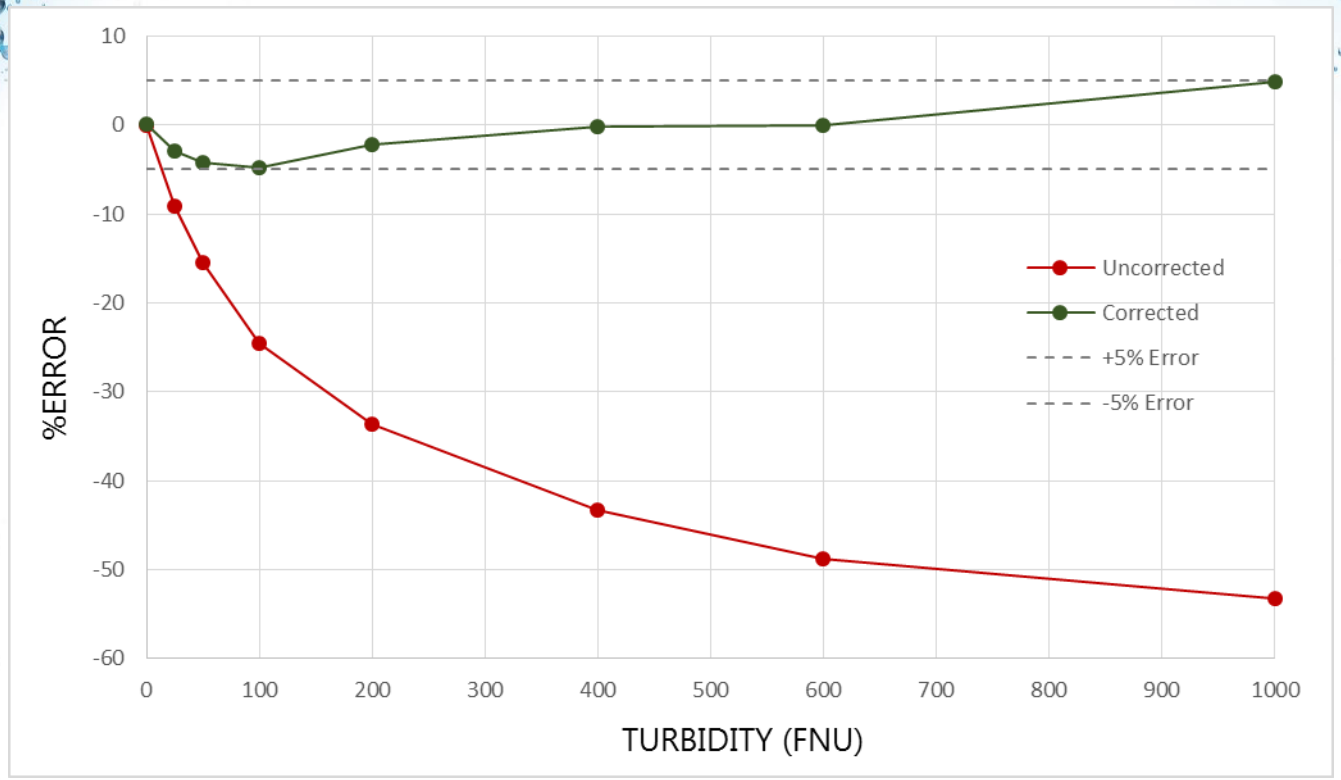


Turbidity correction is derived from measured effect on absorbance



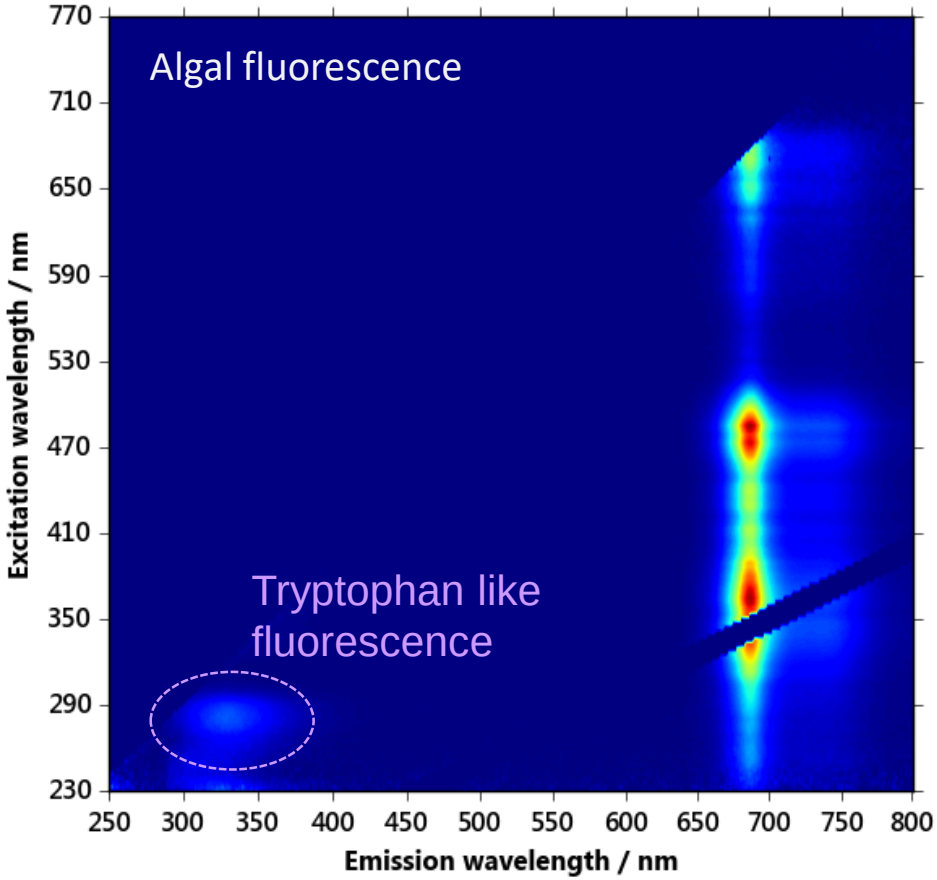
‘Colour’ correction is applied after taking account of turbidity

Turbidity & ‘colour’ correction



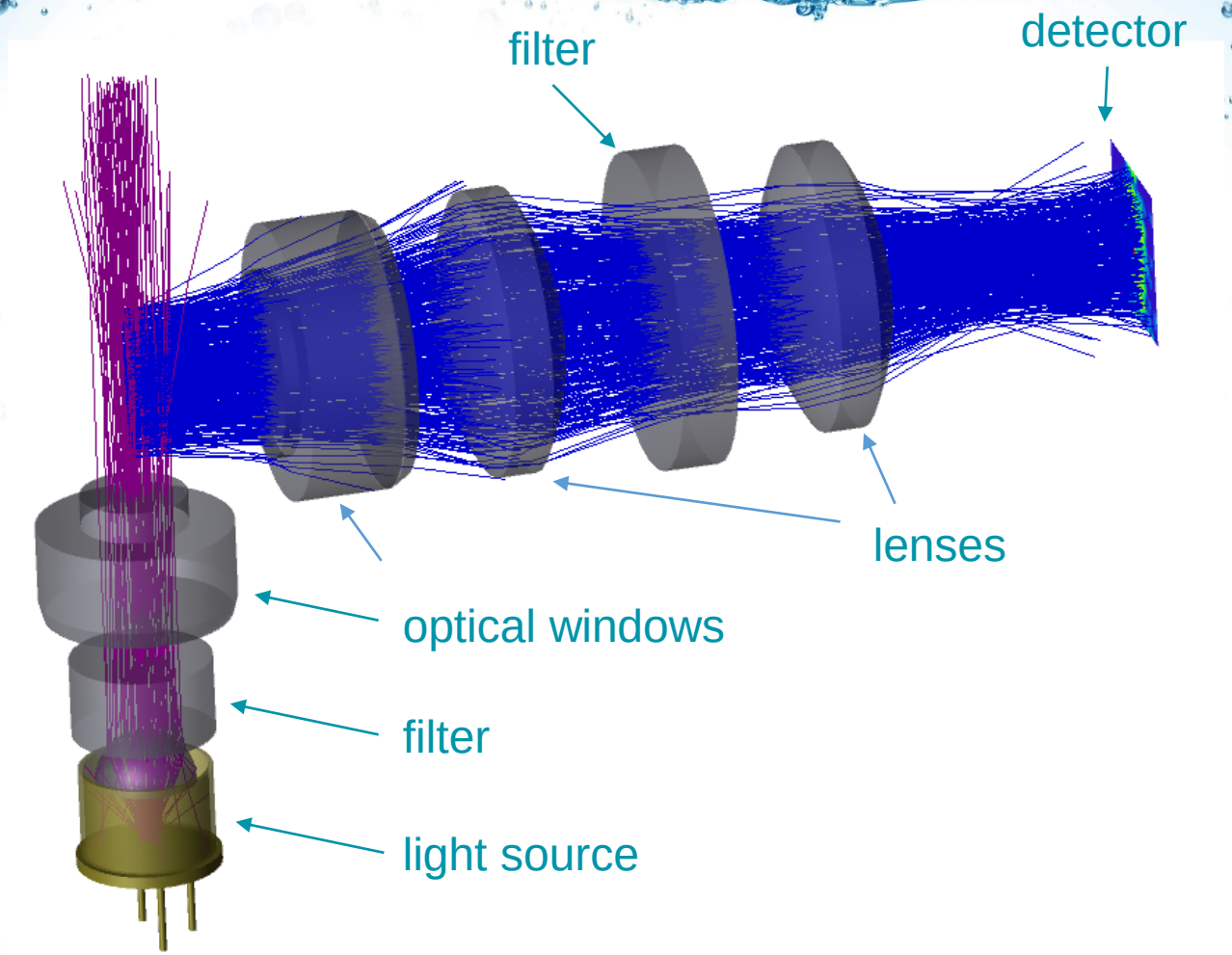
Effect of Turbidity correction for 270 ug/l phenanthrene - corrected result is within ±5% from 0-1000 FNU

Potential algal interference

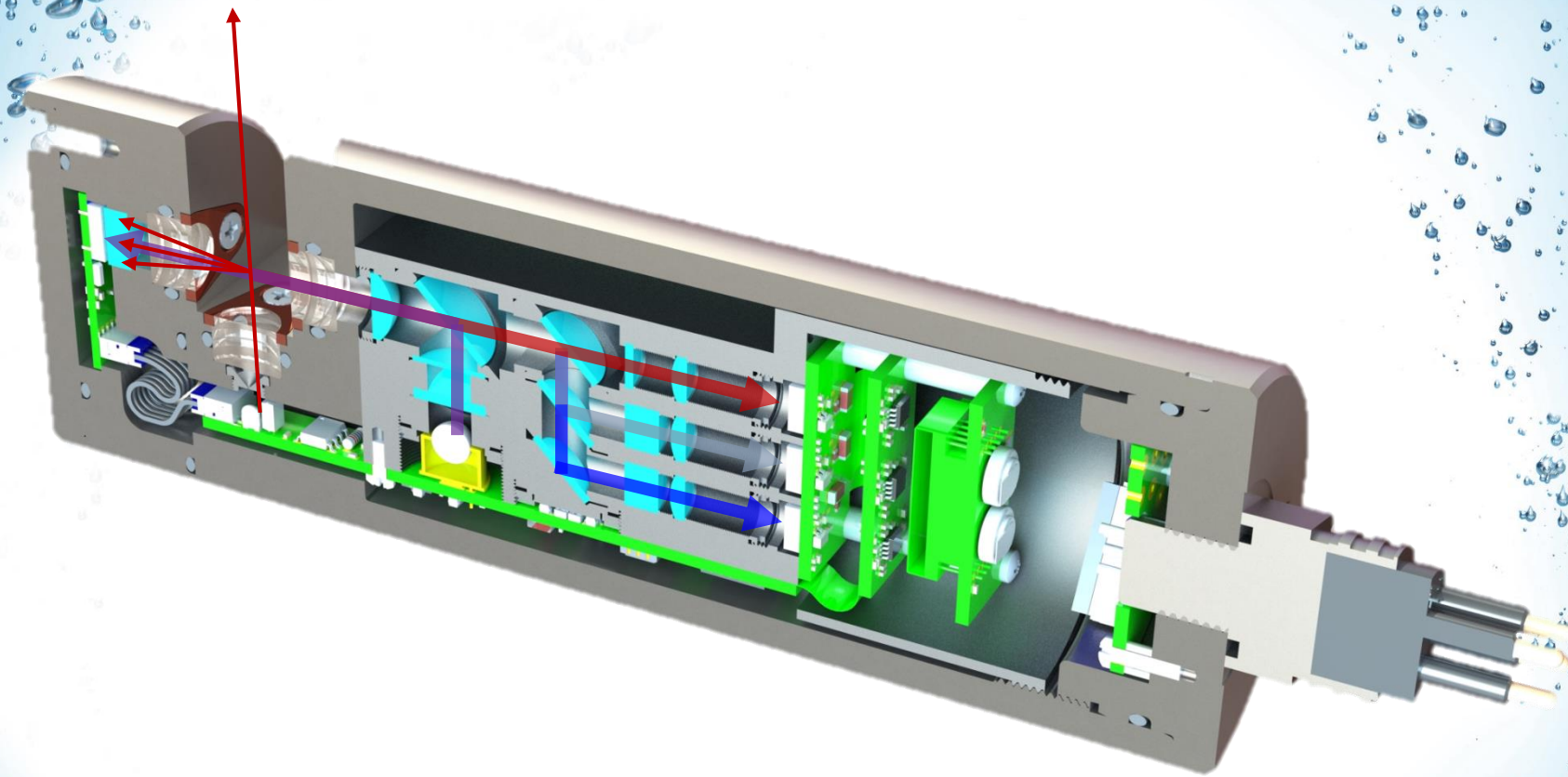


Algal fluorescence could interfere with hydrocarbon detection

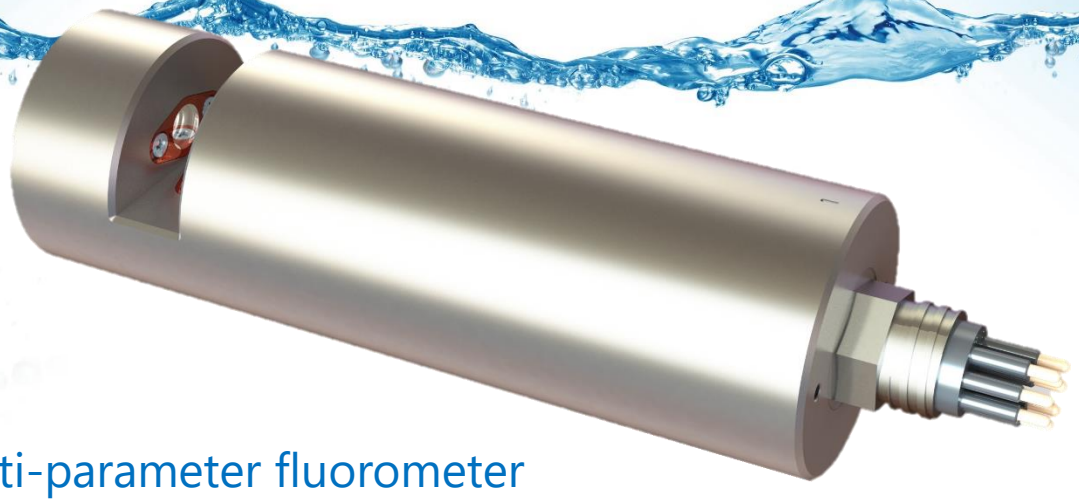
Typical fluorimeter design



V-Lux UV Design



V-Lux multiparameter sensor

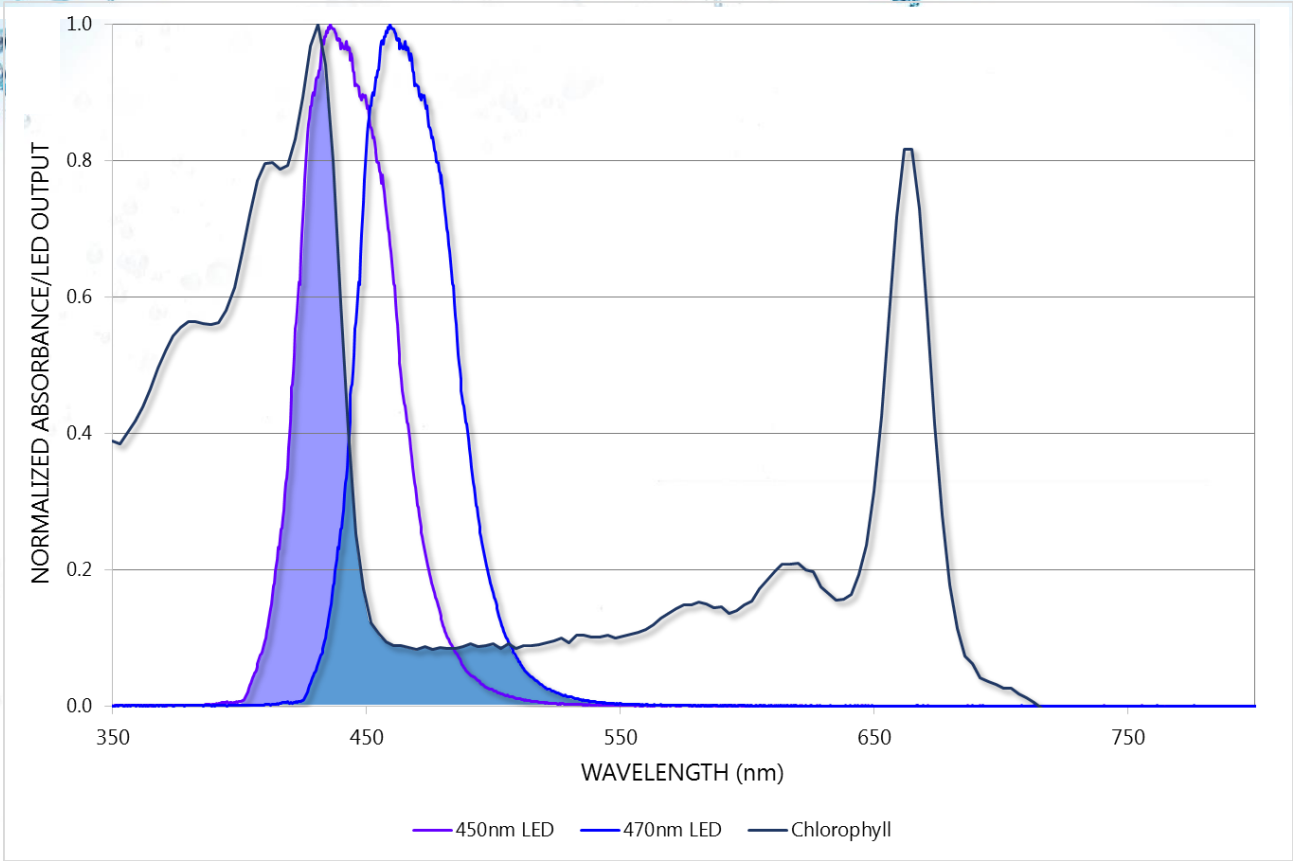


- New multi-parameter fluorometer
  - 3 fluorescence, absorbance, turbidity and temperature channels
  - Fluorescence corrected for turbidity, absorbance and temperature
  - Linear dynamic range extended (x20)
  - Turbidity measurement ISO 7027-1:2016 compliant
- Reference light source for long term calibration stability
- 6000m depth rating
- Traceable output in relative fluorescence units (QSU)
- Internal logging, range of data output options
- Integrated biofouling protection

V-Lux variants

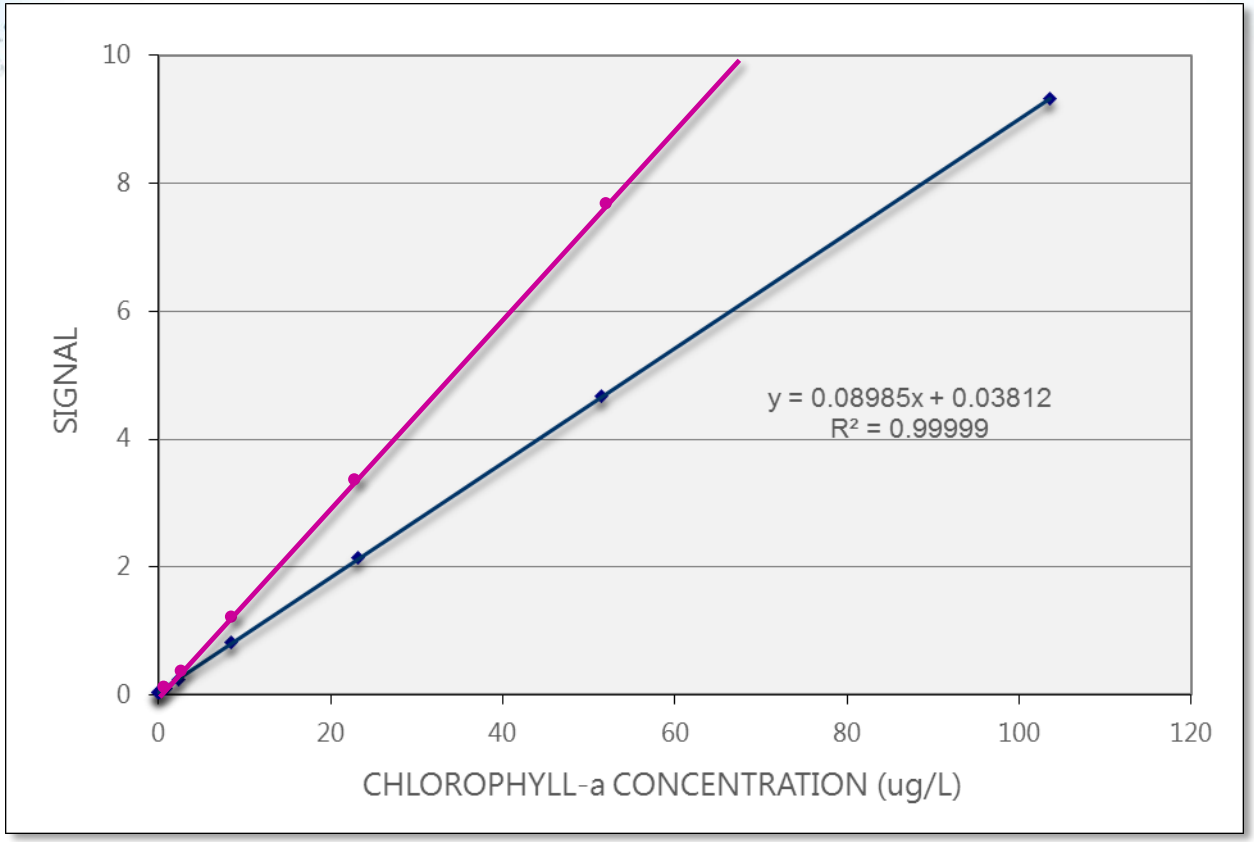
Parameter	V-Lux (BTEX)	V-Lux (Crude)	V-Lux (Tryptophan)	V-Lux (Algae)
BTEX	✓			
PAH		✓		
Tryptophan			✓	
CDOM	✓	✓	✓	
Chlorophyll-a & -c	✓	✓	✓	✓
Chlorophyll-b & -c				✓
Phycoerythrin				✓
Phycocyanin				✓
Absorbance	✓	✓	✓	✓
Turbidity	✓	✓	✓	✓

Calibration sensitive to configuration



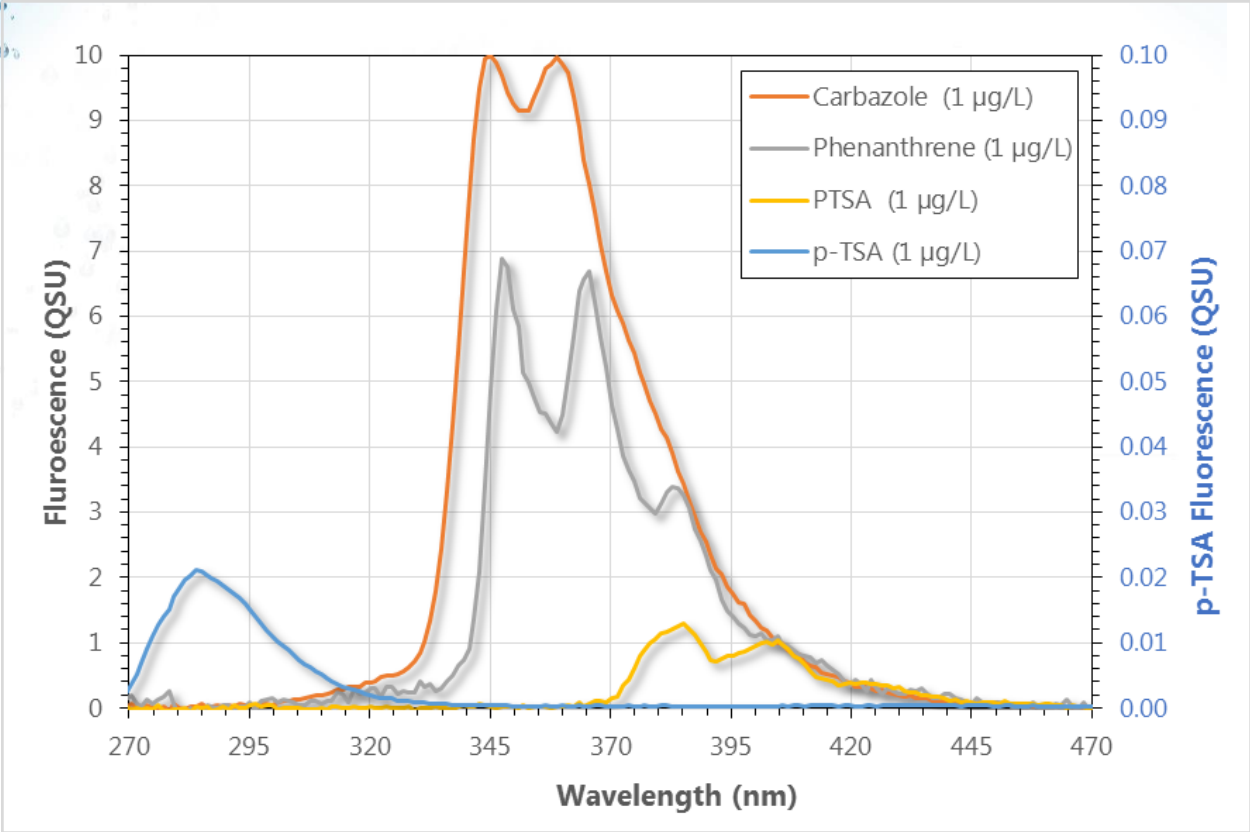
Sensors from various manufacturers will report differently, depending on excitation wavelength and calibration method

Calibration dose response



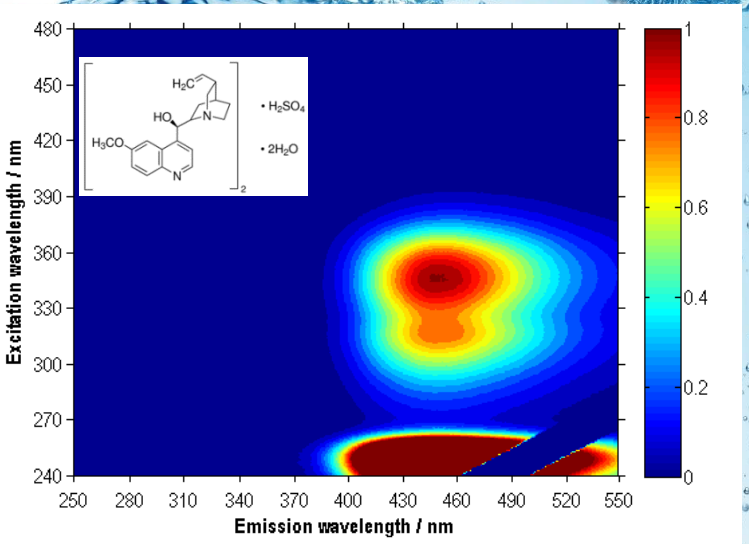
Different configurations will correlate for a given calibrator

Response dependent on calibrator

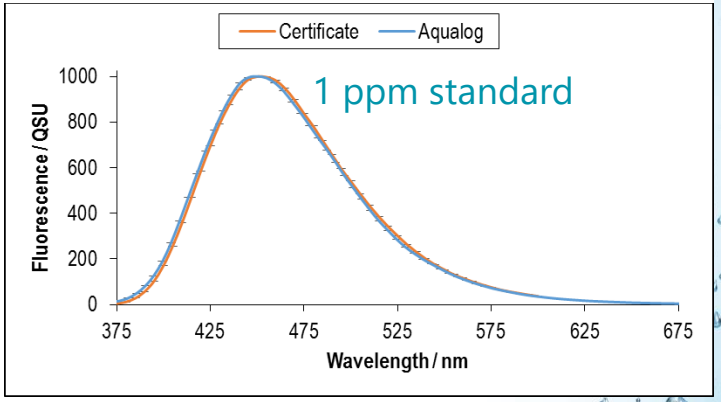


Problem compounded by choice of calibrator

Fluorometer standardisation



- Quinine Sulphate: NIST-traceable, certified reference material
- Aqualog normalises spectral response for source intensity and detector sensitivity to cross correlate different calibration solutions
- QSU calibration provides an absolute measurement of fluorescence allowing direct comparison between different sensor configurations



Example of QSU calibration

	AquaTracka III (µg/L Chl a)	UniLux (µg/L Chl a)	AquaTracka III (QSU)	UniLux (QSU)
50 µg/L chlorophyll a in acetone	57.98	48.63	13.25	2.00
100 µg/L chlorophyll a in acetone	112.81	103.30	25.79	4.26
River sample 1	0.80	7.94	0.18	0.33
River sample 2	0.68	4.20	0.16	0.17
Tank sample	10.34	97.67	2.36	4.02

AquaTracka III
λ_{ex}: 430 / 115 nm
λ_{em}:685 / 30 nm

UniLux
λ_{ex}: 470 / 30 nm
λ_{em}:682 / 30 nm

QSU calibration enables a direct comparison to be made between different sensor configurations

Thank You

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