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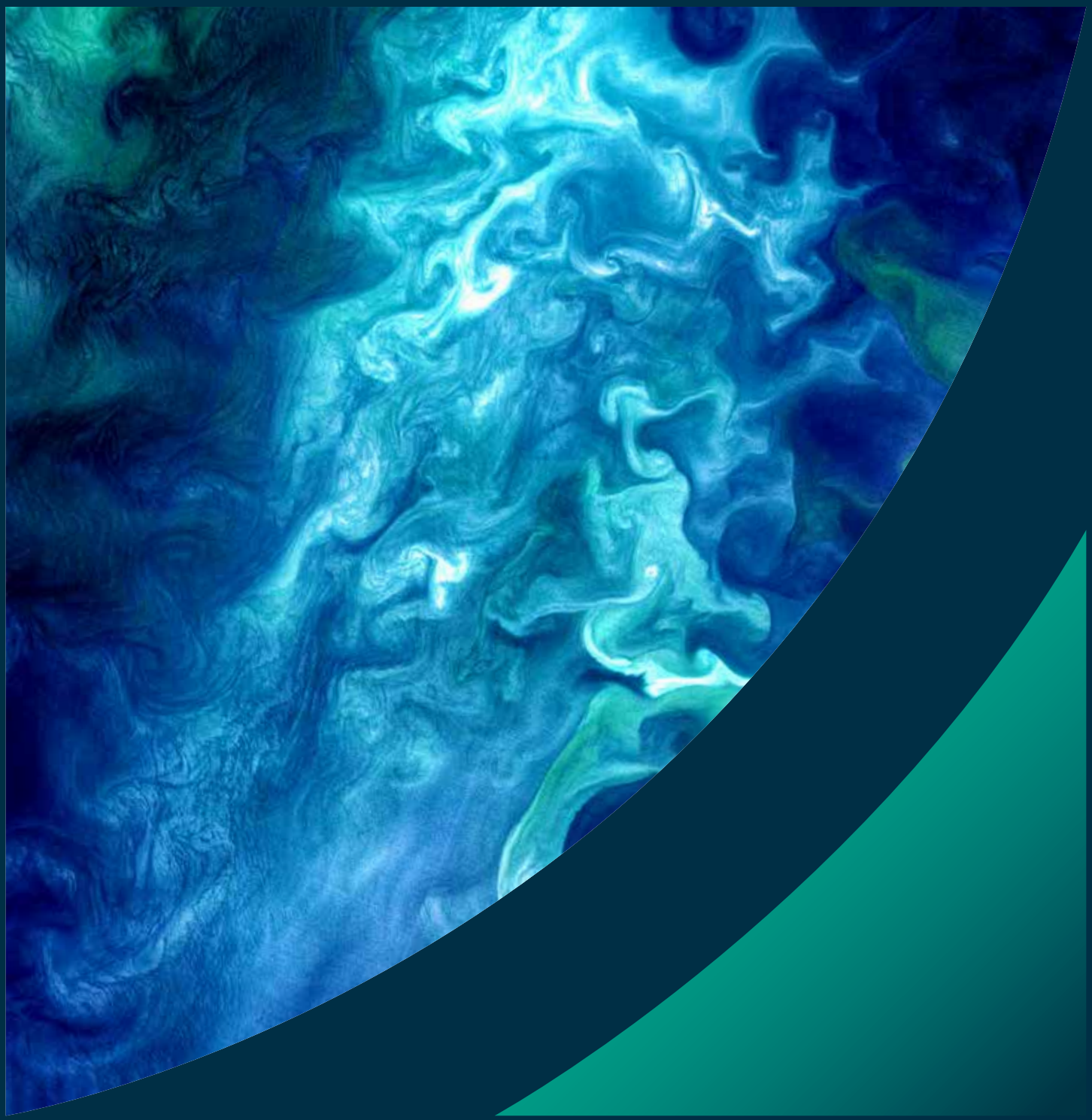
AutoSTAF

Single Turnover Active Fluorometer

Deployable STAF-based system for the in-situ, automated assessment of primary productivity



AutoSTAF Single Turnover Active Fluorometer

Single Turnover Active Fluorometry (STAF) is already well established as a method for the non-invasive assessment of phytoplankton photosynthesis. AutoSTAF is the deployable equivalent of Chelsea's existing LabSTAF system, incorporating fully automated spectral analysis, dual waveband package effect correction and Fluorescence Light Curves (FLCs). This combination of features makes AutoSTAF ideal for the in-situ assessment of primary productivity.

Chelsea's AutoSTAF combines unparalleled sensitivity with a wide dynamic range, allowing for measurements in extreme oligotrophic waters, open oceans, coastal waters and lakes.

"Ground breaking deployable and automated system for monitoring phytoplankton primary productivity from submerged platforms to depths of up to 600m"

The combination of AutoSTAF and Deployable Control Unit (DCU) provides a compact, robust system for deploying on moorings and other submerged platforms. A number of features have been specifically incorporated to minimise errors associated with the quantitative evaluation of PSII photochemistry per unit volume, per unit time. This list includes seven waveband excitation, for spectral evaluation, and dual waveband fluorescence measurement for package effect correction. Along with the ability to run FLCs, with automated protocol adjustment, these features greatly increases the value of AutoSTAF for primary productivity assessment.

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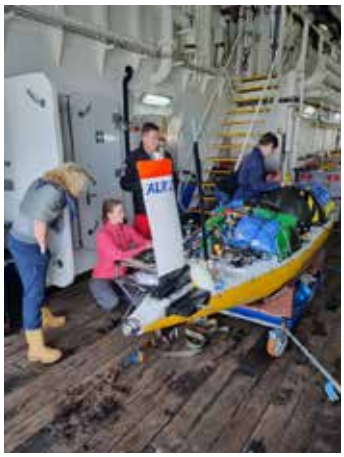
Key Features

- **In water assessment of phytoplankton photosynthesis** using latest STAF technology
- **Unparalleled sensitivity** allowing for measurements in extreme oligotrophic water
- **Fully automated system** includes an optional Spectral PAR (SPAR) sensor for ambient light assessment
- **Wide dynamic range** providing reliable measurements in open oceans and lakes
- **Greatly improved accuracy** when compared with satellite data
- **Greatly improved spatial and temporal resolution** when compared with ^{14}C-fixation
- **Advanced spectral evaluation** using seven waveband excitation
- **Package effect correction** using dual waveband fluorescence measurement
- **Deployable to 600m** on a variety of platforms

Applications

- Measurement of PSII photochemical flux per unit volume (JVPII) to provide an upper limit to primary productivity at high spatial and temporal scales
- Carbon cycle assessment
- Analysis of the biochemistry and ecology of aquatic systems
- Verification of satellite data
- Climate change research and modelling
- Monitoring of algal bloom development and community structure
- Ecological monitoring to manage water catchments
- Identify and mitigate sources affecting water quality in catchments



CURRENT METHODS

Traditional methods of measuring primary productivity involve a compromise between the accuracy of the data and the temporal and spatial resolution

- Satellite remote sensing methodology is the broadest large-scale method, but produces large errors, requires validation and is unable to probe below the surface
- Traditional methods such as ^{14}C fixation are slow, expensive laboratory-based processes requiring handling and training protocols for radioisotopes

THE CHELSEA SOLUTION

AutoSTAF builds on the LabSTAF lab-based instrument from Chelsea Technologies enabling in-situ automated analysis. The combination of AutoSTAF and DCU provides a deployable platform for measurements that have historically been restricted to the laboratory environment.

- Monitoring phytoplankton primary productivity using latest technology
- Deployable to 600m
- Ideal for use on moorings, large AUVs and similar
- Unparalleled sensitivity allowing for measurements in extreme oligotrophic water
- Fully automated acquisition for continuous measurements
- Wide dynamic range providing reliable measurements in open oceans and lakes
- Advanced corrections as standard: seven waveband excitation, dual fluorescence waveband measurement and baseline subtraction

AutoSTAF Single Turnover Active Fluorometer

Technical Features

- Integration of the absorption method for the assessment of photosynthesis and primary productivity per unit volume, per unit time (Oxborough et al. 2012)
- Seven measurement wavebands to allow for routine spectral correction based on variable fluorescence (F_v)
- Comparison of F_v-based and σ_{PII}-based spectral data provides valuable qualitative information on community structure
- Dual narrow waveband fluorescence measurement for automated package effect correction (Boatman et al. 2019)
- Dual Single Turnover pulse method for the measurement of relaxation phase kinetics
- Full spectrum blue-enhanced actinic illumination providing > 1600 μmol photons m^{-2} s^{-1}
- Circulating sample chamber water jacket which avoids intersection with all optical paths
- Potential replacement for ^{14}C-based photosynthetron measurements

Further Reading:

Reference 1:

Boatman, T.G., Geider R.J. and Oxborough, K. (2019) Improving the accuracy of single turnover active fluorometry (STAF) for the estimation of phytoplankton primary productivity (PhytoPP)

https://doi.org/10.1101/583591

Reference 2:

Oxborough, K., Moore, C.M., Suggett, D.J., Lawson, T., Chan, H.G and Geider, R.J. (2012) Direct estimation of functional PSII reaction centre concentration and PSII electron flux on a volume basis: a new approach to the analysis of Fast Repetition Rate fluorometry (FRRf) data.

https://doi.org/10.4319/lom.2012.10.142

Why use Single Turnover Active Fluorometry (STAF)?

The application of STAF has revolutionized our general understanding of phytoplankton physiology in oceanic systems over more than twenty years and, with recent technological and theoretical developments, has become recognized as an enabling technology from non-destructive in situ measurements of Phytoplankton Primary Productivity.

Photochemistry by Photosystem II (PSII) is the ultimate source of energy for PhytoPP. STAF can be used to measure PSII photochemical flux per unit volume (JV_{PII}). This parameter is strongly correlated with oxygen evolution by PSII and provides an upper limit to PhytoPP. AutoSTAF can be used on much wider spatiotemporal scales and either ^{14}C fixation or O_2 evolution and at much lower biomass.

- Deployable to 600m
- Fully automated system including control unit and spectral PAR sensor
- Suitable for deployment on moorings, large AUVs and similar platforms

Specifications

Power requirements	140 - 400 mA, 24 V, 3.4 - 9.7 W
Excitation wavebands (wavelength)	452, 472, 505, 417, 534, 594, 622 nm
Actinic light source	Collimated output f rom 10 - 2000 µmol photons m^{-2} s^{-1} at 12 bit resolution
Detection limit	Can resolve Fv with an amplitude equivalent to 0.001 mg m^{-3} of chlorophyll a
Depth rating	600m

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**In view of our continual improvements, the designs and specifications of our products may vary from those described.*

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