

Template for Annual SCOR Project Reports to SCOR

Summary:

Working Group 156 has largely focused the past year towards completion of the “Best Practice” document – a key deliverable for many of our terms of reference – intended as a new central resource for existing and new ocean-based users of active chlorophyll fluorometry. A soft launch was held through a Town Hall event at ASLO Ocean Sciences 2022, and final edits are underway for a final community consult. Field work has begun to resume after lengthy delays and challenges from the global pandemic, where activities have centred on evaluating further improved practices in accurate retrieval of active chlorophyll fluorescence-based primary productivity across diverse environmental gradients. A major new review article was published to synthesise how further developments in our field are transforming capacity to use active chlorophyll fluorescence as a measure of ocean health and productivity over space and time (Gorbunov & Falkowski. 2022. Annual Review of Marine Science.)

1. Name of project

WG156: Active Chlorophyll fluorescence for autonomous measurements of global marine primary productivity

2. Activities since previous report to SCOR (e.g., virtual or in-person meetings, email discussions, special sessions). Limit 1000 words

Since the last SCOR report (July 2021), our major focus has been on working towards completion of the “Best Practice” document. These activities specifically address terms of reference i-iii and v-vii. We have been successful in publishing a new peer reviewed article, and we have made significant progress towards finalizing Best Practice Guide, including a soft launch via a Town Hall meeting for the recent ASLO virtual meeting (March 2022). We have also continued to make progress (though perhaps slower than would be desired) in the development of open-source Jupyter notebooks for processing FRRF data. We have continued smaller meetings of various working-groups to focus on completion of the Best Practice document. Field work has begun to resume after the hiatus at the start of the global pandemic, but both COVID19 and other factors (see section 6) has continued to majorly slow progress.

Working Group Meetings were conducted throughout this reporting period via numerous smaller groups on-line for focused discussions towards completion of the Best Practice Guide, but notably December 2021 and March 2022.

New research activities from WG networking: A highlight of our working group continues to be a new research activity that directly targets our terms of reference; these include for the current reporting

period new relevant fluorescence-14C data sets in the North Atlantic (March 2022) and Crete (May 2022) (Schuback, Oxborough, Moore).

Conference presentations:

Tortell PT. 2022. ASLO 2022 Ocean Sciences Meeting. Town Hall presentation on the Best Practice Guide “A User Guide for the Application of Single Turnover Active Chlorophyll Fluorescence for Phytoplankton Productivity Measurements” (virtual meeting)

3. Documents published since previous report to SCOR (e.g., peer-reviewed journal articles, reports, Web pages) and should be limited to publications that resulted directly from project activities and which acknowledge SCOR support.

Gorbunov MY, Falkowski PG. 2022. Using Chlorophyll Fluorescence to Determine the Fate of Photons Absorbed by Phytoplankton in the World's Oceans. Annual Review of Marine Science 14: 213-238. doi: <https://doi.org/10.1146/annurev-marine-032621-122346>

4. Progress toward achieving project’s terms of reference. List each term of reference separately and describe progress on each one. Limit 1000 words

i. To inter-compare active Chla induction measurements across instruments and approaches, identifying key aspects of instrument configuration, deployment and parameter acquisition that may introduce variability in retrieved data.

Significant progress. Much of the work for this was conducted during the initial WG156 workshop (Vancouver, June 2019) and was been captured in the “Best Practices document” through subsequent meetings and writing assignments across the WG.

ii. To develop, implement and document internationally-agreed best practice for data acquisition, standardised output formats and archiving approaches.

Significantly completed. As above, most of the work for this was been conducted during the initial WG156 workshop (Vancouver, June 2019) and has been captured in the “Best Practices document” through subsequent meetings and writing assignments across the WG.

iii. To develop, implement and document internationally-agreed best practice for processing raw fluorescence data to retrieve photosynthetic parameters and primary productivity estimates, taking into account taxonomic and environment factors driving diversity in chlorophyll fluorescence signals in the oceans. From this work we will develop freely available software and documentation to allow non-specialist users to process fluorescence data according to these best practices.

Our document is now largely complete and we anticipate release for public feedback towards the end of 2022. We are also making progress on the development of Jupyter notebooks for data processing, including the inclusion of new fitting routines for different ETR algorithms; however, this activity has slowed because of COVID and time availability of relevant expertise within the WG.

iv. To produce a new synthesis of parallel 14C and active Chla induction measurements that can be used to examine the relationship between these two productivity metrics under a range of field conditions. We will also consider other metrics of Net Primary Production alongside 14C.

Although field work is now only just resuming post the COVID-19 pandemic, a new (high level) database has been compiled (Suggett et al.) that builds on the previous 2012 database (Lawrenz et al.). The new meta-analysis more than doubles the amount of data collected and significantly expands data coverage into previously under-represented ocean regions. The high-level database will need to be revisited to add further ancillary data for trend analysis. New field activities are now planned to address some critical data gaps (e.g. field-based comparisons of new ETR algorithms and gross O₂; Tortell).

v. To develop a global database structure for hosting quality-controlled active Chla induction measurements, creating standards for data and meta-data collection, submission and archiving.

No further progress since last reporting period and discussions with NASA (except for detailing these proposed standards in the “Best Practices” document).

vi. To build a framework through which in situ active Chla induction data can be used to validate and refine relevant remote sensing measurements (e.g. sun-induced fluorescence yields).

No further progress since last reporting period and discussions with NASA (except for detailing these proposed standards in the “Best Practices” document).

vii. To share knowledge and transfer skills in instrumentation, best practice, quality control and data stewardship with the rapidly expanding user community in developing nations.

Our dissemination activities for 2022 were via a peer reviewed paper (see section 3) and importantly a Town Hall meeting (ALSO 2022) for an initial soft public release of the Best Practice Guide.

5. Project activities planned for the coming year. Limit 500 words

i. Best Practice working document completion deadline end of 2022. Note that we are working closely with individual members of the WG to complete sections as soon as possible for an anticipated release by the end of 2022.

ii. Continuation of fully compiling 14C-ETR database for high level analysis. As field activity resumes, we will continue to build this novel database and begin analysing sometime 2023.

iii. New field activities. Field campaigns are now resuming, enabling additional activities to address critical data gaps throughout the next reporting period. As part of this, WG members Schuback and Ciotti are exploring submission of a proposal to the “Exceptional” Call for SCOR Project and Working Groups Scholars, to undertake novel ToR-related activities in Brazil.

iv. Meetings. We will begin planning an in-person WG meeting for 2023 to reconnect on key activities. In addition, it is anticipated some WG representatives (Oxborough, Schuback) will attend Ocean Optics XXV (Vietnam) in October 2022, in part to advance discussions of aligning active fluorometry measurements to remote sensing (and other optical) platforms.

6. Is the project having difficulties expected in achieving terms of reference or meeting original time schedule? If so, why, and what is being done to address the difficulties Limit 200 words

Several major factors have limited significant progress since the previous reporting period:

- WG members (Moore and Berman-Frank) are Department Head and thus forced to take on continually higher administrative loads associated with COVID-19 safety planning.

- The war in Ukraine has significantly impacts some WG members who have strong ties to this region, and therefore have placed their working activities on hold throughout 2022.
- One WG member (Suggett) has begun transitioning into a private sector role in a new field, and therefore has had limited time and resources (staff, instrumentation etc) to support WG activities.

7. Any special comments or requests to SCOR. Limit 100 words.

None

Additional information can be submitted and will be included in the background book for the SCOR meeting at the discretion of the SCOR Executive Committee Reporter for the WG and the SCOR Secretariat.