

Template for Annual SCOR Working Group Reports to SCOR

1. Name of group

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 2020), our major focus for year 2 has been on working towards completion of the “Best Practice” document and a related manuscript in *Frontiers of Marine Science*. These activities specifically address terms of reference i-iii and v-vii. We have been successful in publishing our group’s first peer reviewed article, and we have made significant progress on the Best Practice Guide, with a working framework document uploaded to the Ocean Best Practices site (see below for further details). 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 three virtual teleconferences of the whole group (sometimes grouped into 2 sessions to accommodate all time-zones), as well as a number of additional smaller meetings of various working-groups. Most meetings have focused on the development of our documents.

Working Group Meetings:

1. October 5 / 6, 2020
2. December 14 / 15, 2020
3. April 20 / 21, 2021

New research activities from WG networking: A highlight of our working group has been the development of a number of new collaborative research projects among groups that had not previously worked together. Some examples are given below:

1. Berman-Frank, Suggestt, Hughes: Analyzing novel data sets on underway chlorophyll fluorescence data collected in early 2020 in the south Pacific
2. Campbell and Kolber: Development of a prototype temperature control unit for SoliSense LIFT fluorometer. Calibration of SoliSense LIFT fluorometer for fluorometric estimation of ETR PSII
3. Moore, Oxborough and Schuback: Upcoming research cruise out of NOC (Southampton) to test new Chelsea STAF instrument.
4. Tortell, Suggestt, Kolber and Gorbunov: Comparative analysis of different ETR algorithms in a 2019 Arctic data set (paper in prep – details below).

Conference presentations:

Schuback et al. (2021). SCOR WG #156: Active chlorophyll fluorescence as a tool for assessing phytoplankton photosynthesis and primary productivity. OCB summer workshop. June 2021.

Yayla Sezginer, David J. Suggett, Maxim Gorbunov, Robert W. Izett, and Philippe D. Tortell, Light and nutrient-dependent effects on chlorophyll fluorescence-based estimates of electron transport rates in Arctic phytoplankton assemblages. 2021, ASLO Aquatic Sciences 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 WG activities and which acknowledge SCOR support

Papers and reports (with DOI):

1. Schuback et al. Single-turnover variable chlorophyll fluorescence as a tool for assessing phytoplankton photosynthesis and primary productivity: Opportunities, caveats and recommendations. *Frontiers in Marine Science* 8, 895. doi:10.3389/FMARS.2021.690607
2. Tortell & Suggett (Eds.). 2021. A User Guide for the Application of Single Turnover Active Chlorophyll Fluorescence for Phytoplankton Productivity Measurements. Version 1. Scientific Committee on Oceanic Research Working Group 156, 20pp.
<https://repository.oceanbestpractices.org/handle/11329/1585>

4. Progress toward achieving group'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 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 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.

In progress. Details are being developed as part of version 2 of our User Guide Document. We currently have draft document that is ~ 100 pages long. 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. We are in discussions about how to hire a part-time student to push this work along.

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 has been largely curtailed during 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 “Best Practice” document is progressing (including posting of “placeholder” consisting of section abstracts – see section 3; Tortell & Suggett 2021), and we have published a new open access review paper (Schuback et al. in press) that similarly summarizes the best practice elements for broad knowledge transfer. The reviewers were very supportive of the paper, which was accepted with only minor revisions. One reviewer wrote: ‘I thank the authors for taking on a task like this. As a frequent user of instruments to measure photo-physiological responses in phytoplankton I certainly welcome a roadmap and a guide like this.’

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

Our main activities are as follows:

1. **Best Practice working document completion deadline end of 2021.** Note that we are working closely with individual members of the WG to complete sections to ensure all are drafted by the final quarter 2021 for editing. Our goal is to launch the first version of the complete document in advance of the Ocean Science Meeting in Hawaii (Feb., 2022)
2. **Continuation of fully compiling 14C-ETR database for high level paper production.** We have already begun conceptualizing a high-level paper on our topic, and WG group members will be assigned tasks within this activity end 2021-start 2022 (once activity 1 is complete) to being executing this activity.

3. **New field activities are now planned.** Many field campaigns are now resuming, enabling additional activities to address critical data gaps.
4. **ASLO / AGU Ocean meeting 2021 (Hawaii).** We have proposed that our SCOR working group will meet as part of ASLO, February 2021, in Hawaii. The focus of the meeting will be to resume activities to progress terms of reference v-vi, and also to launch our User Guide in a Town Hall session.

6. Is the group 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

A major impact on our WG activities has been the loss of Dr Jacco Kromkamp, who sadly passed away in October 2020 – Jacco was a pioneer for the field and a major contributor to the WG, energetically championing several of the goals/terms of reference. Like many, we have been significantly burdened by the COVID-19 pandemic, which has curtailed laboratory and field work. In addition, three WG members (Tortell, Moore and Berman-Frank) are department Head's and were thus forced to take on even higher administrative loads associated with COVID-19 safety planning.

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

We are working on a request to use SCOR funds to support a part-time student to help with the development of open-source software for the processing and analysis of FRRf data. A detailed proposal regarding scope of work and requested funding is being developed.

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.