

## Working Group Reports to SCOR (2020)

### 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

We held a major full two-day meeting of our WG just prior to the AGU/ASLO Ocean Sciences conference in San Diego. The large majority of the WG was able to attend in person, with additional attendees participating for some of the discussion (subject to time zone constraints) via video conferencing. The meeting was highly productive, building on the week-long discussions and laboratory inter-comparison held at UBC in June, 2019. Other activities focused on the analysis and compilation of the data obtained at the June 2019 workshop, as well as recovery of new literature data used to update meta-analyses of C:ETR ratios. Finally, a number of WG members conducted their own field research, employing approaches and methodologies that were shaped by the Vancouver discussions. As part of this, a number of WG members exchanged / shared FRRF instruments (e.g. Suggett lent Bermman-Frank an instrument for use on a South Pacific cruise).

### 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

We have created a new shared Wiki page to organize the content of our SCOR WG activities (<http://scor156.com/>). The site is currently password protected, but we will make parts of it public-facing as we develop more shared resources (e.g. SOP documents and open-source software packages). We are currently working on the first publication from our SCOR working group. It will be based on the Frontiers in Marine Sciences paper outlining a prospectus for future FRRF measurements in oceanography. This article will be based on the example of Lomard et al. (2019) - <https://doi.org/10.3389/fmars.2019.00196>. We have also begun drafting a second high-profile perspective type publication on how fluorometry can transform understanding of marine primary productivity. New meta-data compiled for this publication may also contribute to other papers led by the WG ECR members.

### 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: Based on our results from the June, 2019 UBC workshop, we are now beginning to assemble a ‘standard operating procedures’ document as part of a best-practices guide for end-users. This will identify key sources of error / uncertainty, and approaches to improve inter-comparability among users / instruments. We are also working on drafting a review article for *Frontiers in Marine Sciences* (see above) that also summarizes the key aspects associated with this document.

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

- In progress. See above.

*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.*

- Significant Progress. One of our ERC members, Thomas Ryan-Keogh, has largely completed development work on Python scripts to process FRRF data from all major instrument manufacturers. At the San Diego meeting, Thomas had the opportunity to discuss the software with the manufacturers and resolve a few outstanding questions regarding data formats produced by different instruments.

*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.*

- Initiated and underway, but significantly slowed by limitations on summer field work associated with Covid-19. For example, several WG members had committed to attend the August 2020 Group for Aquatic Productivity Meeting (USA) to better resolve ETR-14C relationships for cyanobacterial dominated communities, but this has been postponed until 2021. However, we are currently analyzing preliminary data from the June, 2019 UBC workshop derived from a novel incubation technique (“simultaneous triple incubation” of 14C, O<sub>2</sub> and ETR). ECR Dave Hughes is leading the charge on this analysis / publication. Also, we have conducted a significant literature analysis to update the global 14C – ETR data set presented by Lawrenz et al. (2013), adding a significant number of new data points (more than double) to the existing information, including substantial new geographic coverage of previously under-represented areas (e.g. Indo-Pacific; sub-polar). Based on this updated data set, we are currently drafting a manuscript examining global patterns in the electron requirements of carbon fixation as a means of understanding ‘the reducing power of the oceans’ (above).

*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.*

- In progress. We had two representatives from NASA present for the full course of our San Diego meeting – Suzanne Craig (Project Scientist – PACE mission) and Zachary Johnson (PDF). Based

on our discussions, the NASA team is now exploring options for hosting a global FRRF data base on their servers (most likely through SeaBass). We expect more definitive information on this by summer or fall of this year, but this seems like a good possibility at this point. Discussions are on-going about required meta-data and formats, and the need to archive raw data files. A sub-group of WG members (e.g. Silsbe, Simmis, Craig et al.) with significant experience in this area will convene further discussions.

*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).*

- Not yet started. To be initiated in years 3-4.

*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 Working Group had a reasonably high profile at the Ocean Sciences meeting in San Diego, with a dedicated poster session (including submissions from non-WG members), and a well attended 30 min. tutorial presented by Suggett and Schuback (ECR).

Other on-going activities:

- Initiated a community voice of WG activities, outputs, interests and opportunities via Twitter (@SCOR\_WG156)
- We are still standing by for the next call for proposals for ship-time on the Falkor.
- Discussed with key instrument manufacturers possibility of providing some visibility to the WG activities via their existing web sites (similarly, amongst all WG members).
- Begun working with WG member Aurea Ciotti and collaborator Osvaldo Ulloa to develop proposals for new training workshops in South America, through collaboration with the Universidade de Sao Paolo (Brazil) and the Millennium Institute of Oceanography (Chile).
- Developing a training workshop on fluorometry practice for central American institutes (students and ECRs) via Universidad Nacional Autónoma de México (UNAM). The first workshop, led by Suggett, is scheduled to run February 2021, international travel restrictions dependent.

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

We have a series of Zoom conference calls coming up in early July (with multiple days / times to accommodate a wide range of time zones). These will be used to build momentum in conversations and writing initiated at our San Diego meeting, and to discuss planning (including contingencies) for future meetings and field work. Summer field work will proceed in a more limited fashion than anticipated. Some laboratories have limited activity resuming, but many are not at full capacity, and field work plans are largely on hold for the summer. We are still evaluating our plans for another face to face meeting, and will commit a venue/date once international travel restrictions begin to resolve. We will similarly revisit whether the GAP 2021 workshop will proceed to resolve cyanobacterial fluorometry (ETR-14C) signatures. If travel limitations persist, we will likely continue with virtual meetings.

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

As with many programs, our summer field work activities have been significantly impacted by Covid-19. A number of our group members had planned to attend the summer GAP meeting, looking at primary productivity (resolve cyanobacterial fluorometry (ETR-14C) signatures) in the Lake Erie ecosystem. This activity has now been postponed until 2021. There have also been some delays in the call for proposals on the Schmidt Ocean Institute's vessel Falkor. In summer, 2019, we had an excellent conversation with SOI representatives, who seemed enthusiastic about our work. But there have been no updates on the next round of applications. We are thus planning smaller-scale more distributed field sampling opportunities, as part of other existing sea-going programs in our various member nations.

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

We note that one of our active Early Career members, Nina Schuback, has applied to join the SCOR Executive Committee. We wholly endorse this, and Tortell has written a support letter. If Dr. Schuback is selected to join the SCOR Executive, it will be a significant contribution of WG 156 to the broader mandate of the organization.

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.