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General conclusions and recommendations of the 2nd Pri-Pro-Workshop 1998 at Buesum

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As a general conclusion of this workshop we would like to emphasise that the main topic has been shifted from the traditional estimation of primary production by conventional O_2- and ^{14}C-methods to the innovative saturation pulse fluorescence measurements. This was due to the fact that fluorescence techniques get increasing relevance in the estimation of photosynthetic parameters and primary production of phytoplankton over the last years. The main advantages of the saturation pulse fluorescence measurements are the rapid and non-invasive study of the photosynthetic efficiency of phytoplankton. However, regarding this method a number of questions remain open as was shown in the contributions by Mueller (1999; this issue), Hintze et al. (1999; this volume) and Hartig et al. (1999; this volume) as well as in the last PRI-PRO report 1998 (Domin et al., 1998; Hartig and Lippemeier, 1998).

A subgroup of the current workshop showed that the common PAM-devices (LED-PAM, Xenon-PAM and PAM-2000) all provide a very similar estimate of photochemical efficiency under standardised conditions. Regarding the sensitivity, the Xenon-PAM proved to be most appropriate for measuring the photosynthetic efficiency of phytoplankton samples. However, because of the intensity of the measuring pulse of the Xenon-PAM, one has to be consider up to which extent the F_0-estimate influences the measurement of F_v/F_m and relative electron transport rates if flashes are repeated in a short time interval. One of the main problems, the estimation of the PSII absorption cross section, could not be investigated in this workshop due to a time lack. Because of the great importance of this parameter for the estimation of primary productivity, we recommend that it's determination should definitely be a topic for future workshops.

Another subgroup of this workshop investigated for the first time the performance of saturation pulse fluorometers that are capable of algal group detection (see contribution of Ruser et al., 1999, this issue). The comparison of two of the fluorometers showed that these devices provide qualitative identifications and quantitative estimates of different algal groups. Because this method offers a promising new approach in phytoplankton detection, we recommend to further study the potential application of this technique in a future workshop.

In another part of this workshop we mainly focused on one parameter, the incident irradiance, which has basic relevance for the calculation of the relative electron transport rates (rETRs) and for other photosynthetic parameters (I_K, α, P_{max}-values). The main result was that there is a strong need for precise measurements of actinic irradiances in PAM cuvettes, because the glass-fibre bundle and the geometry of the cuvettes do not provide a homogeneous light distribution. Light measurements inside the PAM-cuvettes can be done very effectively by the Zemoko light sensors (see Meyercordt et al., 1999a, this volume). The main advantages of this nice equipment is that they are relatively cheap compared to other light sensors (around 300 $) and that the Zemoko-sensors measured similar values as the higher-prised ones. Regarding the reflectance angle they provided an even better performance than other light sensors. Another main outcome was that the light measurements are reliable even if the sensors have not been calibrated over several years. But one should be aware that due to construction differences between sensors and due to methodological uncertainties during the measuring process the error can amount up to 10 to 15% (see Meyercordt et al., 1999b, this volume).

We recommend to address a series of other parameters, which have basic relevance for productivity measurements in the next workshop. One parameter to reconsider is the estimation of chlorophyll. It could be shown that the chlorophyll values measured by different methods vary to a large extent (see Ruser et al., 1999, this volume). The comparison between O_2- and ^{14}C-data shows remarkable differences between both methods. Results of fluorescence data are therefore difficult to relate to either of the traditional methods because their relation to primary productivity is obviously not clear. It became clear that under different light regimes the sinks for the electrons must be different, because the slope between the O_2 and ^{14}C-based photosynthetic rates varies between 1 to 3 times within the applied light regime. We recommend that the question how the allocation of electrons produced during photosynthesis is influenced or regulated by environmental factors like irradiance, nutrient limitation etc., is taken as a further topic for the next workshop.

One of the biggest advantages of this workshop was that the present network could be further extended leading to intensive contacts and exchange of ideas between the groups working on primary productivity measurements in Germany.

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