Is photosynthetic efficiency in microbial mats affected by tidal state?

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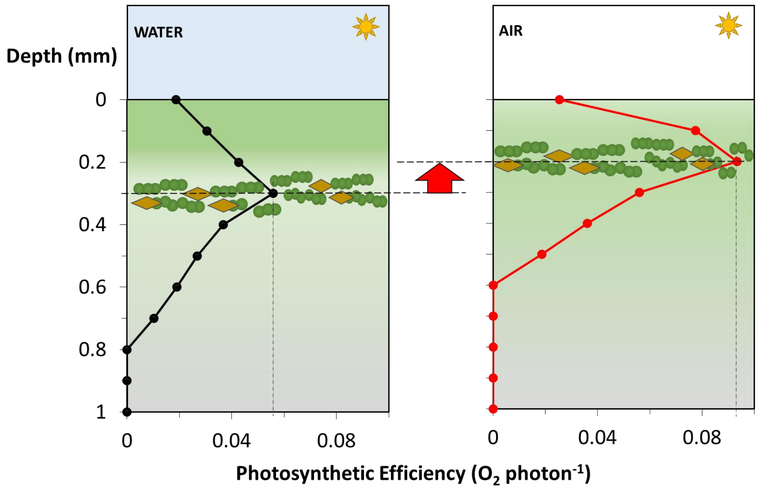
Yes, but it depends on the irradiance level

Spatial distribution of the photosynthethic efficiency within the euphotic zone of a microbial mat was different **under immersion or emersion**.

Maximum photosynthetic efficiency was found **at different depths** during immersion and emersion depending on the incident irradiance.

Low irradiance

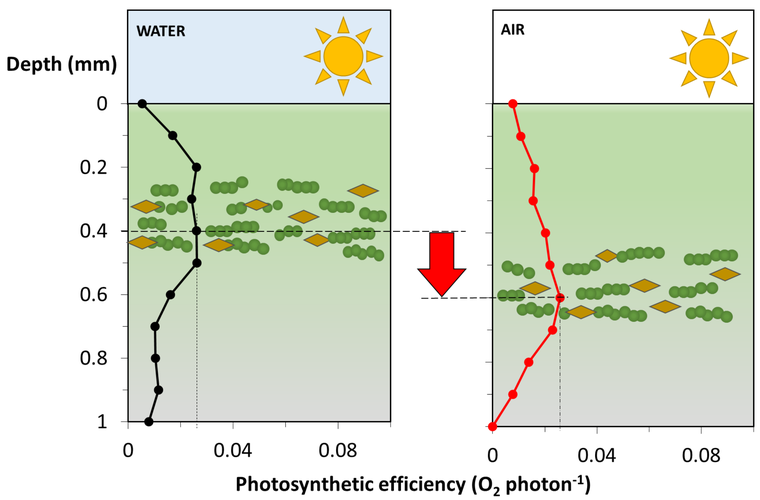
from **immersion** to **emersion**



- Phototrophic cells **migrate upwards** in search of **optimal light conditions.**
- **Photosynthetic efficiency increases** 1.7 times in emersion compared to immersion.

High Irradiance

from **immersion** to **emersion**

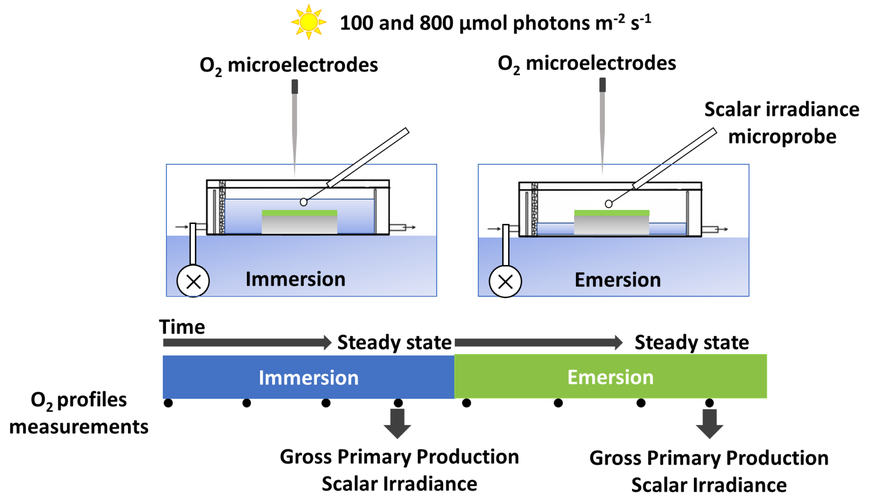


- Phototrophic **cells migrate downwards** and disperse within the euphotic zone to **avoid excess light energy** (photoprotection mechanism).

Background and Experimental set-up

Irradiance and **tidal state** affect **microphytobenthic primary production. Vertical migration** of cells within the sediment can induce changes in the **local photosynthetic efficiency**.

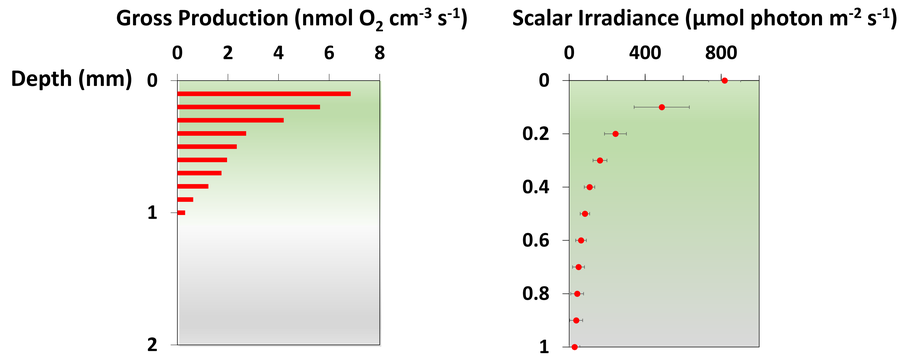
Generally, **photosynthetic efficiency** decreases with **increasing irradiance.** However, it is unknown **how** local photosynthetic efficiency is affected **during tidal cycles.**



We studied the **photosynthetic efficiency profiles** in a **microbial mat** during **immersion and emersion** under **increasing irradiance** using combined **microsensor** measurements of oxygen (O_2) and scalar irradiance.

Photosynthetic efficiency was calculated according to Al-Najjar et al., 2010**.**

$$\eta(z) = \frac{2GPP(z)}{K\, E_S(z)}$$



e.g. emersion at 800 µmol photon m^{-2} s^{-1}

$\eta\,(z)$: Local photosynthetic quantum efficiency (O_2 photon^{-1})
GPP : Gross primary production (nmol O_2 m^{-3} s^{-1})
$E_S\,(z)$: Scalar irradiance measured at depth z (µmol photons m^{-2} s^{-1})

K : Light absorption coefficient (m^{-1}); K = α (1-R)/(1+R);
α = light attenuation coefficient (m^{-1})
R = reflected light (%)

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