

## Deciphering microbial growth and intracellular energy flux from lipidomics

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Microorganisms have the metabolic and genetic capability to adapt to changing environmental conditions on very short time scales. However, the mechanisms that control the ecological dynamics of microbes at rapid time scales are not well understood. Cell membranes separate the inside of the cell from the outside environment and consequently represent the front line of microbes' response to external fluctuations of nutrients and mortality. Complementary to other 'omics', lipidomics thus provides a unique view on the immediate response of microbes to rapidly changing environments. We investigated the microbial lipidome at high temporal resolution over 8 day/night cycles in the oligotrophic North Pacific Subtropical Gyre (NPSG). We used a new lipidomics approach for the discovery, annotation, and putative identification of lipid biomarkers, which enables rapid and unambiguous identification of more than 1,000 individual lipids. Our data show that biosynthesis of energy-rich triacylglycerols (TAGs) by eukaryotic phytoplankton during the day and their subsequent consumption at night drives a large and previously uncharacterized daily carbon cycle. Diel oscillations in TAG concentration comprise  $23 \pm 11\%$  of primary production by phytoplankton representing a global flux of about  $2.7 \text{ Pg C yr}^{-1}$ .