



## **Origin and applicability of tetraether membrane lipids as temperature proxies in French peri-urban lakes**

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The Ile-de-France region is the most populated area in France, with ca. 12 million inhabitants, i.e. about 20 % of French population. The peri-urban aquatic ecosystems of this region are impacted by a large variety of environmental stressors, and especially high anthropogenic pressures (agricultural, industrial and urban pollutants), leading to the increased eutrophication of these water systems. The Ile-de-France lakes are therefore highly vulnerable ecosystems. Over the last years, several environmental markers have been developed to better understand the functioning of aquatic ecosystems, including the so-called GDGTs (glycerol dialkyl glycerol tetraethers). GDGTs are membrane lipids produced by archaea and some unknown bacteria, which are increasingly used to reconstruct mean annual air and surface water temperature as well as pH. These compounds are ubiquitous in terrestrial and aquatic environments, but their origin and applicability as temperature and pH proxies in lakes, especially highly polluted ones, need further investigation. In this study, GDGTs were analysed in 33 lakes from the Ile-de-France region, representing the diversity of the regional landscape and characterised by different levels of eutrophication.

The abundance and distribution of GDGTs in lacustrine sediments and surrounding soils were compared. Bacterial GDGTs were systematically much more abundant in sediments than in soils and displayed different distributions in the two types of environments, showing that they are mainly produced in situ in lakes, in the water column and/or sediment. Similarly, the concentration in archaeal GDGTs was much higher in sediments than in soils and the distribution of these compounds differed between soils and sediments, implying that the predominant archaeal communities are not the same in the two environments.

When the lakes are distinguished by their eutrophication level, the latter was shown for the first time to have an impact on the microorganisms producing GDGTs. Indeed, bacterial and archaeal GDGTs were observed to be significantly less abundant in sediments from oligotrophic lakes than in those from hypertrophic lakes. Nevertheless, the applicability of bacterial GDGTs as temperature proxies was not affected by the eutrophic status of the lakes, since temperature estimates derived from these compounds were consistent with both mean annual air temperature (11 °C) and mean summer air temperature (19 °C) recorded in the Ile-de-France region.