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Photochemical transformations of fatty acids in atmospheric waters

Subba Rao Devineni (1), Chandra Mouli Pavuluri (1), Zhanjie Xu (1), Yan-Lin Zhang (2), Pingqing Fu (1), and Cong-Qiang Liu (1)

(1) Institute of Surface-Earth System Science, Tianjin University, Tianjin, China (cmpavuluri@tju.edu.cn), (2) Yale-NUIST Center on Atmospheric Environment, Nanjing University of Information Science and Technology, Nanjing, China

Secondary organic aerosols (SOA), which account for a substantial and often a dominant fraction of total OA mass, are formed by photooxidation of various precursors emitted from anthropogenic and biogenic sources in the atmosphere. They have serious impacts on the Earth's climate system by absorbing solar radiation and acting as cloud condensation nuclei and adverse effects on human health. In recent times, a considerable attention has been paid on laboratory studies, preferably in gas-phase, in order to understand the SOA formation chemistry. However, the laboratory studies, particularly on fatty acids, in aqueous phase are very limited. Fatty acids are believed to be photochemically inert in the actinic region but in fact, they can produce SOA during illumination of an air-water interface coated solely with a monolayer of carboxylic acid and such processes have not been fully understood yet. To better understand the air-water interface photochemistry of fatty acids and their transformations to lower homologues and/or more oxygenated species in atmospheric waters (fog, cloud and aqueous aerosol), we conducted batch UV irradiation experiments on fatty acids ($C_{18}H_{36}O_2$ and $C_{18}H_{32}O_2$) in aqueous-phase for different time periods (age) up to 120 h. All the irradiated samples were analyzed for the measurements of mono- and di-acids, oxoacids and α-dicarbonyls. We found high abundances of C_{11} diacid followed by pyruvic acid and α-dicarbonyls in less aged (irradiated up to 24 h) samples whereas C_3 and C_4 diacids in the more aged (irradiated for 48-120 h) samples. Our results revealed that the photochemical transformations of fatty acids in the aqueous phase are significant and result in more oxygenated SOA with aging in the atmosphere.