Contribution of dissolved organic carbon to submicron water-soluble organic aerosols in the marine boundary layer over the eastern equatorial Pacific

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Stable carbon isotopic compositions of water-soluble organic carbon (WSOC) and organic molecular markers were measured to investigate the relative contributions of the sea-surface sources to the water-soluble fraction of submicron organic aerosols (OAs) collected over the eastern equatorial Pacific during the Tropical Ocean tRoposphere Exchange of Reactive halogens and Oxygenated VOCs (TORERO)/KA-12-01 cruise. The average stable carbon isotope ratio of WSOC ($\delta^{13}C_{WSOC}$) was –19.8 ± 2.0‰, which was systematically higher than that of TC ($\delta^{13}C_{TC}$) (–21.8 ± 1.4‰). We found that in both coastal and open oceans, the $\delta^{13}C_{WSOC}$ was close to the typical values of $\delta^{13}C$ for dissolved organic carbon (DOC) in surface seawater of tropical Pacific oceans. This suggests an enrichment of marine biological products in WSOC aerosols in the study region regardless of the oceanic area. In particular, enhanced levels of WSOC and biogenic organic marker compounds together with high values of WSOC/TC (~60%) and $\delta^{13}C_{WSOC}$ were observed over upwelling areas and phytoplankton blooms, which was attributed to planktonic tissues being more enriched in $\delta^{13}C$. The $\delta^{13}C$ analysis estimated that on average, marine sources contribute ~90 ± 25% of the aerosol carbon, indicating the predominance of marine-derived carbon in the submicron WSOC. This is supported by Lagrangian trajectory analysis, which suggests that the majority of the sampling points on the ship had been exposed to MBL air for more than 80% of the time during the previous 7 days. The combined analysis of the $\delta^{13}C$ and monosaccharides, such as glucose and fructose, indicated that DOC is likely the dominant control on submicron WSOC and implies that it may characterize background OA in the MBL regardless of the oceanic areas over the study region.