Evolution of dissolved organic matter composition along the upper Mekong River

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The Mekong River is an important trans-boundary river flowing through multiple climate zones. Dissolved organic matter (DOM) is a key constituent in riverine waters, which affects metal/pollutant transformation and bioavailability and influences global carbon cycle as a bridge along the soil-ocean continuum. However, DOM composition in the Mekong River remains relatively poorly investigated due to natural and political complexities associated with this fluvial system. Here, we examined the evolution of DOM characteristics in the upper Mekong (also known as the Lancang in China) River spanning ~2200 km from alpine regions of Tibetan Plateau to the tropical forests at the Chinese border. We employed multiple techniques including excitation emission matrix fluorescence spectroscopy with parallel factor analysis (EEM-PARAFAC), ultrahigh resolution mass spectrometry (FTICR-MS) and lignin biomarker analysis to reveal changes in the molecular composition of DOM along its transport. While water chemistry (i.e., pH value and conductivity) and dissolved organic carbon (DOC) concentration showed seasonal variations from the headwater to the upstream of Gonguoqiao Dam in Yunnan Province, they only had slight seasonal fluctuations within the reservoir area inside Yunnan, indicating a reservoir effect on water chemistry. Both EEM-PARAFAC and FTICR-MS data suggest a disappearance of terrigenous organic matter from the upper to lower reaches of Lancang River, indicating decomposition processes during fluvial transport. This is further proved by the quantification of lignin phenols, which also shows a decreasing pattern along the Lancang River. As the biodegradability of bulk DOC showed no relationship with lignin phenol concentrations, we deduce that photo-degradation, rather than biodegradation, was the major process responsible for lignin removal during fluvial transport. Overall, our study provides novel information on the evolution of dissolved molecular components along the upper Mekong River.