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Contrasting Marine Carbon Monoxide Budget in the North Pacific and the Amundsen Sea

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Carbon monoxide (CO) is a trace gas that affects the global climate indirectly by participating in the atmospheric chemistry. Although in many studies it is estimated to be produced fast in the surface ocean from the photolysis of chromophoric dissolved organic carbon (CDOM), also it decreases considerably by the microbial oxidation and the vertical mixing in water column. Therefore, the strength of oceanic source to the atmosphere is not so considerable. To investigate how the CO budget in the mixed layer governs the CO emission from sea to air, we conducted the underway measurements of CO, the dark incubation experiments, and the measurements of CDOM absorbance during two expeditions in the Amundsen Sea and the North Pacific in summer season of 2012. Dark incubation experiments revealed that microbial consumption rate in the North Pacific was 2.7 nM d^{-1}whilst 1.2 nM d^{-1} in the Amundsen Sea, which is ca. 2.3 times smaller. However, CO production rate was as much as about 40 times higher in the North Pacific (1 nM d^{-1}) due mainly to sea-ice albedo in the Amundsen Sea. It seems that this different CO budget between the two regions causes different amplitude of diurnal variation of dissolved CO. That is, compared to the Amundsen Sea, CO is produced faster in daytime and removed faster all day in the North Pacific where the sinusoidal amplitude of CO is larger. In both regions, $\sim$97% of CO is estimated to be consumed by microbes, and sea-to-air flux density calculated from the underway measurements was insignificant in terms of the total atmospheric reservoir. Our observations indicate that the source strength of the ocean was evenly weak regardless of the scale of CO budget in the ocean. That is, marine biota can be thought as a main control of CO in the atmosphere, the important trace gas for the global climate change.