Recovery of CO_2 emissions from China after COVID-19 lockdown estimated from the atmospheric observation at Yaeyama Islands

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Explosive spread of the new coronavirus infection (COVID-19) in China, through a nationwide lockdown, resulted in substantial reduction of fossil fuel-derived CO_2 emissions from China. Although about 20% reduction in February 2020 was estimated by compiling variety of economic indices, it is crucially important to validate the CO_2 emission changes by using independent and scientific approaches. In previous studies, we revealed that the synoptic-scale variability ratio between atmospheric CO_2 and CH_4 ($\Delta CO_2/\Delta CH_4$) observed at Hateruma Island (HAT; lat. 24.1˚N, long. 123.8˚E) and Yonaguni Island (YON, 24.5˚N, 123.0˚E) during January to March were useful to detect the change in the relative emissions from China. The $\Delta CO_2/\Delta CH_4$ ratios for HAT and YON showed marked decreases in February 2020 in association with the COVID-19 lockdown in China. In this presentation, we estimate the recent change in the CO_2 emissions from China after COVID-19 lockdown based on the $\Delta CO_2/\Delta CH_4$ ratios observed at HAT and YON.

In accordance with the previous studies, the monthly $\Delta CO_2/\Delta CH_4$ ratio was computed as an average of slopes of the scatter plots for the data within a certain time window (24-hour for HAT and 84-hour for YON), which was repeatedly shifted by one hour for the entire data set. Note that in addition to rather longer time window only night-time data (20-6 LST) were used to calculate the $\Delta CO_2/\Delta CH_4$ ratios for YON to suppress the local influences on the variability ratios.

The monthly $\Delta CO_2/\Delta CH_4$ ratios for HAT (YON) in January, February, and March during 9-year period (2011-2019) showed relatively stable values, of which average was 131 ±10 (130 ±11) mol/mol, whereas the ratio decreased to the value of 100 (97) mol/mol in February 2020. In 2021, the ratios for both sites became almost equal to or a little larger than those for the preceding 9-year period before the COVID-19 lockdown: 146 (149), 126 (126), and 147 (170) for January, February, and March, respectively, for HAT (YON). Assuming that the CH_4 emissions from China were stable after 2019, the CO_2 emissions from China during January to March in 2021 corresponded to about 119 ±22% of the emission in 2019. This result is consistent with the recovery of China’s economy after COVID-19 lockdown: China’s GDP returned growth as early as in the second quarter in 2020 and its year-on-year growth rate reached more than 18% in the first quarter in 2021.

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