

Atmospheric greenhouse gas concentrations for five years over a tropical forest in Borneo Island.

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We collected the air samples once a week at the top of the tower of 100 m at GAW station at Danum valley (DMV) (4.98°_N, 117.84°_E, 426 m a.s.l) in the tropical forest of Borneo Island, Malaysia since 2010 by using an automatic flask sampling unit and then we shipped the samples to our institute for analysis for CO₂, CH₄, CO, H₂, N₂O and SF₆ concentration, and isotopic ratios ($\delta^{13}\text{C}$ and $\delta^{18}\text{O}$) of CO₂. We also collected the air samples using Volunteer Observing Ships (VOSs) over South China Sea (SCS) (2-9°_N, 110°-117°_E) and Western Pacific Ocean (WPO) (2-9°_N, 144-151°_E) at 3 or 4-week intervals, and analysed the same component as DMV. In this study, we compared the data of DMV with the data of SCS and WPO to show the characteristics of the greenhouse gas concentrations in the tropical forest in Borneo Island.

CO₂ at DMV and SCS in winter were approximately 3 ppm higher than that at WPO because DMV and SCS were received the air mass of high CO₂ concentration from Asian continent. While CO₂ at DMV in summer was approximately 3 ppm lower than those at SCS and WPO even though the air of DMV was collected at night (10 pm). It was suggested that the CO₂ concentration of air mass of DMV region that pass through over Borneo Island was decreased due to CO₂ absorption by the photosynthesis of the forest. Seasonal variation and long-term trend of $\delta^{13}\text{C}$ showed opposite to those of CO₂. $\delta^{18}\text{O}$ at DMV and WPO showed a tendency to become heavier in recent years.

CH₄ at DMV, SCS and WPO showed a seasonal variation that it was same as a representative variation in the northern hemisphere. However, CH₄ at DMV was always 10-30 and 30-60 ppb higher than that at SCS and WPO, respectively. It is considered that DMV region has large CH₄ source.

CO at DMV and SCS were 20-100 ppb higher than the data at WPO. CO at DMV and SCS also had two peaks in a year. The peaks in Mar and Oct were occurred due to the transportation of the air mass of high CO concentration from Asian continent, and the influence of the forest fire in Indonesia, respectively. H₂ at DMV also showed two peaks in Mar and Oct, and almost same as those at SCS and WPO except for Oct when the severe forest fire in 2015 occurred.

N₂O and SF₆ at DMV had a seasonal variation that the concentration increased from Nov to Mar, and decreased from Jun to Oct because DMV was received air mass with high concentration from Asian continent in winter, and air mass with low concentration from Southern Hemisphere in summer. The values of N₂O and SF₆ at DMV was almost same as those at SCS and WPO. But the variation of measured values at DMV and SCS were larger than that at WPO.

Thus, it was clearly found that Borneo Island has CO₂ sink, and strong CH₄ and CO source.