First MAX-DOAS observation of glyoxal and formaldehyde in Southeast Asia and South Asia.

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We present the Multi-Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) measurements of formaldehyde (HCHO) and glyoxal (CHOCHO) performed at Phimai in Thailand (15.18˚ N,102.56˚ E) and at Pantnagar in India (29.03˚ N,79.47˚ E). Our MAX-DOAS instruments have been operating in Phimai and Pantnagar since September 2014 and January 2017, respectively. Vertical profiles of eight components were retrieved separately using the Japanese MAX-DOAS profile retrieval algorithm, version 2. Here we focus on formaldehyde (HCHO) and glyoxal (CHOCHO) and study their volume mixing ratios (VMRs) in the lowest layer (0-1 km) of the retrieved vertical profiles. We estimated the ratio of CHOCHO to HCHO concentrations (R_{GF}), which is suggested to be an important tracer indicating changes in volatile organic compound (VOC) emissions. In Phimai, higher concentrations of HCHO and CHOCHO were observed during the dry season, reflecting the influence of biomass burning. The annual mean R_{GF} for the Phimai site was estimated to be 0.032 ±0.008. The estimated R_{GF} for the dry season (0.028 ±0.007) was lower than that of the wet season (0.040 ±0.010). This change in the R_{GF} is consistent with results reported from satellite retrievals, suggesting a higher R_{GF} for strong biogenic emissions. Similarly, in Pantnagar, biomass burning influence during spring and autumn led to higher concentrations of HCHO and CHOCHO. R_{GF} estimated for the spring (0.030 ±0.007) and autumn (0.026 ±0.006) season in Pantnagar was lower, consistent with the R_{GF} response observed in Phimai in the dry season. The R_{GF} response observed in Phimai and Pantnagar was in contrast to some field studies suggesting higher R_{GF} during biomass burning activities. Such discrepancies might be due to the differences in the emission from a biomass burning event. The overall discrepancies observed among satellite measurements and field studies are yet under discussion. Findings of such studies are expected to be used to reduce model uncertainties related to VOC chemistry in study regions.

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