8.2 Gas measurements

(1) Personnel

Shungo KATO, Jun Matsumoto, Yoshizumi Kajii (Research Center for Advanced Science and Technology, The University of Tokyo)

(2) Objectives

The polluted air emitted in East Asia is transported to the Pacific and would be affect the air quality in a remote place. The gas measurements on a ship in the western Pacific would contribute to elucidate of the long-range transport of polluted air from East Asia. Also, some gases emitted from the ocean were measured.

(3) Measured parameters

Carbon monoxide (CO), Ozone (O_3), Sulfur dioxide (SO_2), Nitric oxide (NO), Nitrogen oxides (NO_x), Hydrocarbons (HC).

(4) Method

CO was measured by an IR-Gas filter correlation analyzer (Thermo Environmental Instruments, Model 48C). O_3 was measured by an UV absorption analyzer (Thermo Environmental Instruments, Model 49C). SO_2 was measured by an UV-Fluorescence analyzer (Thermo Environmental Instruments, Model 43C Trace Level). NO and NO_x were measured by an Ozone-Chemiluminescence analyzer (Thermo Environmental Instruments, Model 42S). These gases were analyzed continuously on the ship and minutely average data was logged by a personal computer. The detection limits were estimated 10 ppbv, 1.0 ppbv, 0.1 ppbv, 0.05 ppbv, 0.05 ppbv for CO, O_3, SO_2, NO and NO_x, respectively. Zero gas was automatically injected for 15 minutes every hour for CO and SO_2, and manually injected twice times in a day for NO and NO_x. The air was taken through a 1/4 PFA tube from the side of the compass deck for these measurements. The air for hydrocarbon measurements was sampled into Silcosteel canisters (Restek) using a bellows pump and was analyzed by Pre-concentrator (Entech7000) and GC-FID (Hewlett Packard, HP6890) in the laboratory in The University of Tokyo.

(5) Results

In Figure 8.2-1, the results of CO, O_3, SO_2, NO and NO_x are shown against date. Before leaving Yokosuka (before May 14 morning), high concentrations of CO and SO_2 were observed. NO and NO_x were not measured when the ship was stayed at Yokosuka to keep clean condition in the analyzer, but very high concentration was expected there. O_3 concentration was high in daytime since photochemical production was enhanced in polluted urban atmosphere. But O_3 concentration decreased during night since O_3 decreased by the reaction with NO and no production

reaction occurred without sunlight. After leaving Yokosuka, the air become clean gradually and CO, SO_2, NO and NO_x concentrations decreased. On May 15, only the concentration of SO_2 become increased, but the reason is unknown. In the afternoon on May 16, the air was affected by the exhaust form the ship itself, and high concentrations of SO_2, NO and NO_x were observed. O_3 was reacted with NO and decreased when the exhaust affected. On May 17, a low pressure passed and clean maritime air with low CO and O_3 concentrations were observed. During May 18 - 21, the air condition seems stable. After May 22, there are many peaks of NO, NO_x and SO_2. These spikes were caused by the exhaust from the ship itself. On May 24, low pressure passed and very clean maritime air were observed. O_3 decreased to about 10 ppbv, and CO also decreased. On May 27, polluted air from Japan transported and high O_3, SO_2, and NO_x were observed. High concentration of NO_x without involving high NO would be old air-mass: long-range transported polluted air. Because the lifetime of NO is short. And when high NO is observed, the air is freshly polluted and the pollutants emitted from near place.

The concentrations of hydrocarbons which mainly originated from human activity (ethane, propane, butane, pentane, acetylene, benzene etc.) changed similar as O_3 concentration, rather than CO. Low concentration appeared in May 17 and May 24. In the cases of ground-base measurements at other places, these hydrocarbons have good correlation with CO, but not with O_3. Ethane concentration is shown in Figure 8.2-2 compared with CO and O_3 concentrations. This difference is interesting, but there is no suitable explanation at this moment.

Some biogenic hydrocarbons were also measured. Ethylene (C_2H_4), which is originated from both anthropogenic and biogenic activity, show different trend from the anthropogenic hydrocarbons. There should be a parameter which control the concentration of ethylene, if it mainly produced from biogenic activity in the Ocean, but the parameter is not identified at a moment. Isoprene is mainly emitted from the plants on land. But the life time of isoprene in the atmosphere is only a few hour and it is not probable to transport from the land to the ocean. It is suggested ocean also produce isoprene by biogenic activity. In this cruise observed isoprene concentration is almost lower than the detection limit , but high concentration were observed on May 19. The area where the ship traveled on May 19 would be a high biogenic activity, or the weather would be a favorable to biogenic activity (May 19 was sunny day).

(6) Data archives

The original data will be archived at RCAST, The University of Tokyo (Contact

Shungo KATO; shungo@atmchem.rcast.u-tokyo.ac.jp).

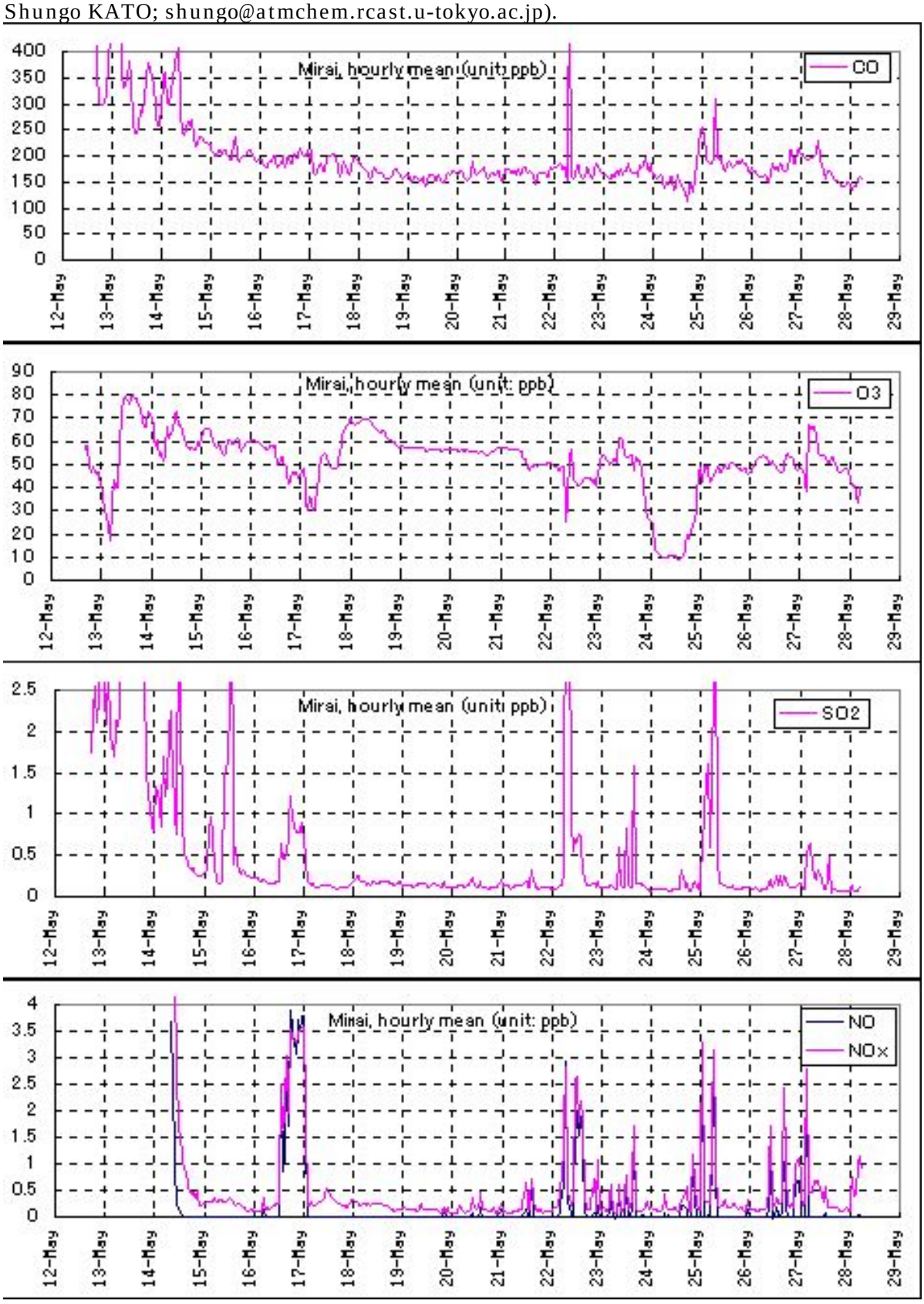

Figure 8.2-1 Concentrations of CO, O_3, SO_2, NO and NO_x.

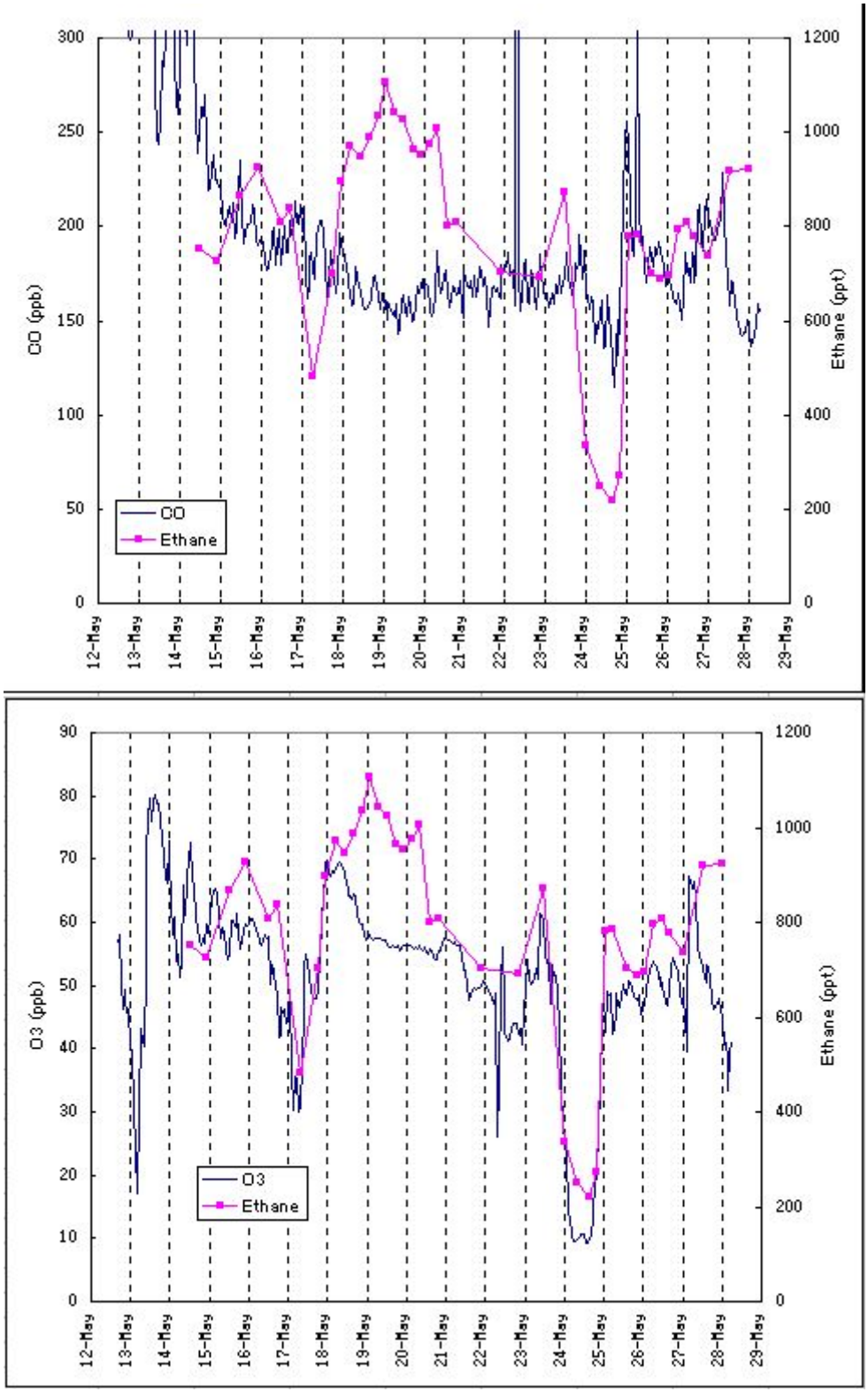

Figure 8.2-2 Comparison with ethane and CO, O_3 concentrations.