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# Atmospheric CO2 observation at the fumarolic area of Hakone volcano by use of TDLAS

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1. Introduction

Volcanic gas is the mixture of H2O vapor, CO2, SO2, H2S, HCl, etc. In general, CO2 is a dominated component in volcanic gases next to H2O vapor. H2O vapor can be condensed by cooling. H2O vapor is contained in normal ambient air with high concentration. On the other hand, CO2 cannot be condensed and the concentration in normal air is only 390 ppm. In terms of the flux determination, CO2 would be observed correctly relative to H2O vapor. Volcanic gases are discharged as fumarolic gas and diffusive gas through soil. Therefore, the flux observation is not straightforward even for CO2 gas. The practical observation of components in volcanic gas is possible for SO2 gas by use of COSPEC and DOAS. Those methods are not useful for the fumarolic gases at volcanoes the activity of which is dormant or quiescent, because the SO2 concentration in such a gas is limited. Recently the optical absorption measurement by use of tunable diode laser (TDLAS) became possible for atmospheric CO2 observation. TDLAS has advantages in terms of CO2 observation at fumarolic area, because, 1) it enable to measure CO2 concentration in open path the length of which extends up to 1 km, 2) the time resolution of measurement is the order of second, 3) it can be operated with battery therefore it is portable. In this study an example of TDLAS application at fumarolic area is reported.

2. Observation

Atmospheric CO2 observation was carried out at 13 to 14 PM on 6th Jan 2012 at Owakudani fumarolic area of Mt. Hakone, Japan. Within the fumarolic area a observation line (263m) was set in the direction of south to north. At the northern end, laser emitter (GasFinder, Boreal Laser Inc) was placed. In the box of emitter, a receiver of laser light was included. The laser light (1575 nm) was transmitted to a retroreflector which was placed at the southern end of observation line. GasFinder outputs CO2 concentration as ppm∗m which is the integrated CO2 concentration along the observation line. Dividing the value by the length of observation line, the averaged CO2 concentration was obtained. In parallel to the CO2 observation, climatic parameters (air temperature, wind speed, wind direction) were obtained on the northern end of observation line at the height 4m higher than surface.

3. Results

Thirty eight of values for the accumulated CO2 concentration were produced every minute. The averaged CO2 concentration was in the range of 500 to 515 ppm. The variation of the concentration looks as, short time variation was overlapped on a gradual base line change. The overall relationship between the concentration and climatic parameter was not clear. The wind direction was almost west over the whole duration of observation. In the middle of duration, the wind direction changed to west-south-west over only 3 minutes. In the short period, the CO2 concentration decreased quickly by 4 ppm and went back to the previous value after the period, which is a significant and short term correlation between CO2 concentration and wind direction.

Keywords: Laser, CO2, Volcanic gas, Mt. Hakone