## Continuous in-situ measurements of CO and CO<sub>2</sub> concentrations and CO<sub>2</sub> isotope ratios ( $\delta^{13}$ C, $\delta^{18}$ O) in Nagoya city: towards CO and CO<sub>2</sub> simultaneous measu rements by GOSAT-2

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The GOSAT-2 satellite is planned to observe CO and  $CO_2$  column concentrations simultaneously from the space.

The simultaneous measurements of CO and CO<sub>2</sub> column concentrations may enable to identify the contributions of the anthropogenic and biogenic processes.

In this presentation:

- Results of the ground-based in-situ measurements of CO and CO<sub>2</sub> concentrations in the summer and winter in the urban area of Nagoya city.
- > Estimation of the sources of CO<sub>2</sub> and CO from the simultaneous observation with the aids of the measurements of CO<sub>2</sub> stable isotope ratios ( $\delta^{13}$ C,  $\delta^{18}$ O).

Research purposes:

- What can be derived from the simultaneous observation of CO and CO<sub>2</sub>.
- How in-situ observations can support the analyses of the satellite data.

### Observation site and periods



#### **Observation site**

Nagoya urban area

: Forth largest city in Japan with a population of 2.3 million

#### **Observation periods**

(1) August 16-24, 2011, (2) January 6-31, 2012

### Measurement species and instruments

Measurement species	Instruments
CO <sub>2</sub>	Li-Cor 820, NDIR
$CO_2$ Isotope $\delta^{13}C$ , $\delta^{18}O$	Aerodyne, Laser absorption spectrometer
H <sub>2</sub> O Isotope δD, δ <sup>18</sup> O	LGR, water vapor isotope ratio analyzer
СО	Thermo, NDIR, CO analyzer
NO, NO <sub>2</sub>	Horiba, NO <sub>x</sub> analyzer

# Temporal variations of CO<sub>2</sub> and CO concentration in the summer and winter



The contribution of anthropogenic combustion, and biogenic activity.

\* CO<sub>2</sub> and CO concentrations became high in the nighttime.

those of CO concentration

In the winter, the air pollution was stayed inside the inversion layer.

## Relationship between CO<sub>2</sub> and CO concentration



Winter

 $CO/CO_2$  is around 9.

No difference between night and day.

Summer

 $CO/CO_2$  is ranged from 2 to 7.

 $CO/CO_2$  in the nighttime are lower than those in the daytime.

#### $CO/\Delta CO_2$ in summer

 $CO/\Delta CO_2$  shows the contribution of  $CO_2$  emission source.



 $CO/\Delta CO_2$  ratio :Power plant, biogenic $\sim 0$ Car exhaust $\sim 5$ Residential energy use $10 \sim 15$ 

## Temporal variation of $CO/\Delta CO_2$



#### Temporal variations of CO<sub>2</sub> isotopic ratios in the summer and winter



Keeling plot analysis





# Identification of CO<sub>2</sub> emission sources from the isotope ratios



Pataki et al. (2006)

#### Keeling plot analysis: $\delta^{13}$ C and CO/ $\Delta$ CO<sub>2</sub>



#### Keeling plot analysis: $\delta^{18}$ O and CO/ $\Delta$ CO<sub>2</sub>



According to Keeling plot analysis of  $\delta^{18}$ O, CO<sub>2</sub> concentrations in the winter were partly influenced by CO<sub>2</sub> emission from the biogenic respiration.

# conclusion

- We report that the ground based measurement of CO, CO<sub>2</sub> concentration and CO<sub>2</sub> isotopic ratios ( $\delta^{13}$ C and  $\delta^{18}$ O) at Nagoya, in 2011 winter and 2012 summer.
- The variation of CO and CO<sub>2</sub> concentration was different in the summer and winter.
  - CO and CO<sub>2</sub> concentrations were varied synchronously.
  - CO<sub>2</sub> concentration in the summer shows the clear diurnal variation.
- The contributions of emission from combustion and biogenic process were shown from the analysis of CO/ $\Delta$ CO<sub>2</sub> and Keeling plot analysis.

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## Thank you for attention.

CO2 and CO emission and absorption in the4%rb2%n 7%ea

- CO<sub>2</sub> concentration in urban area is influenced by...
  - the emission or absorption based on the biogenic respiration and photosynthesis.
  - the emission from fossil fuel combustion.
- CO concentration in urban area is changed with the emission from vehicles and biomass burning. (mainly from vehicles).

