Carbon dioxide flux measurement in the central area of Tokyo

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Outline

- Introduction
- Measurement
- Diurnal variation of CO_2 flux
- Hourly emission inventory
- Flux vs. Inventory
- Summary

Introduction

CO_2 flux in Tokyo + Emission inventory

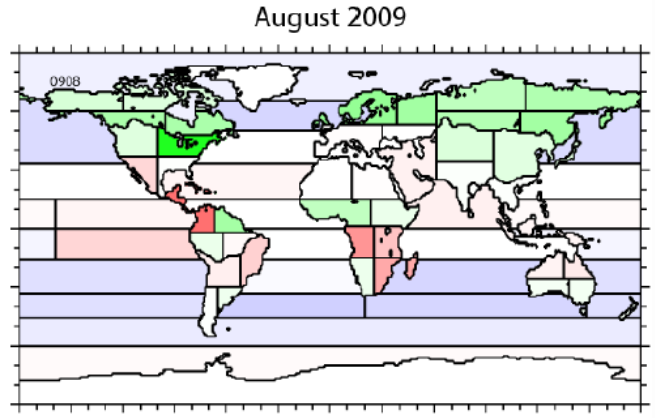
Purpose

- Clarify the diurnal variation of CO_2 flux.
- Estimate the hourly contribution of emission factor.

Introduction

Inversion analysis

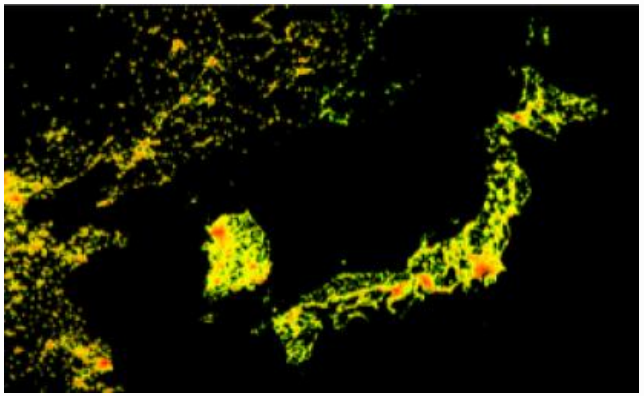
Global/Monthly scale emission



Maksyutov et al. 2013

In future

Regional/Hourly scale



For developing regional/ hourly scale inversion,

- Hourly emission inventories are required.

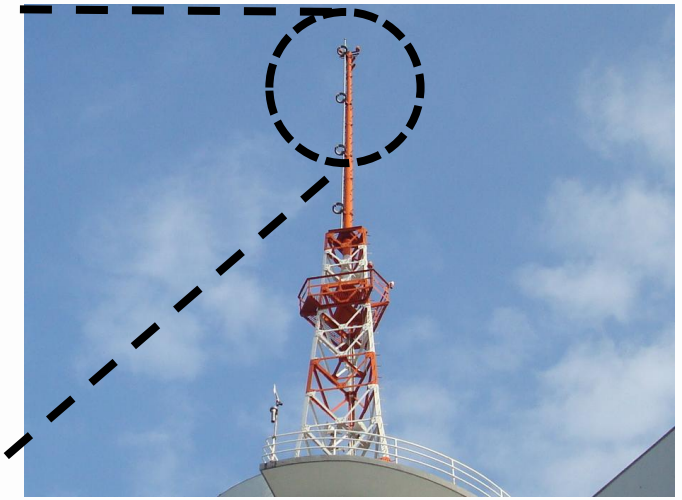
For validate the result of hourly scale inversion,

- Diurnal variation of measured flux is necessary.

Measurement

Nov. 2012 – Oct. 2013

Yoyogi site



Turbulence Sensor
52 m

Wind

Mean building height
9 m

Measurement

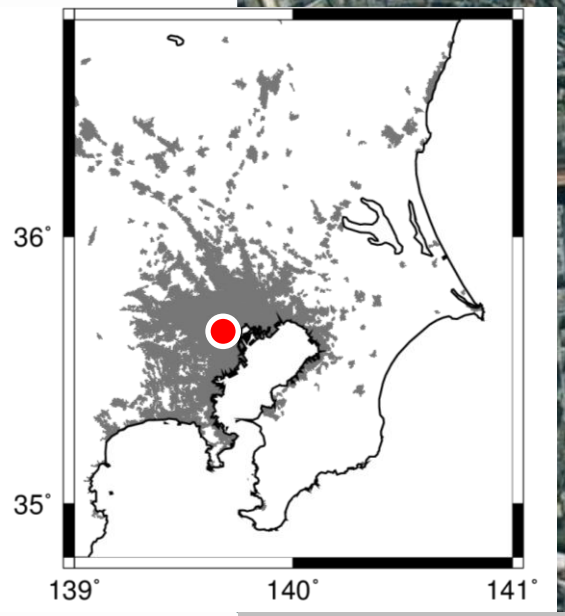
Focus on the winter flux

Arterial road

Winter (DJF)

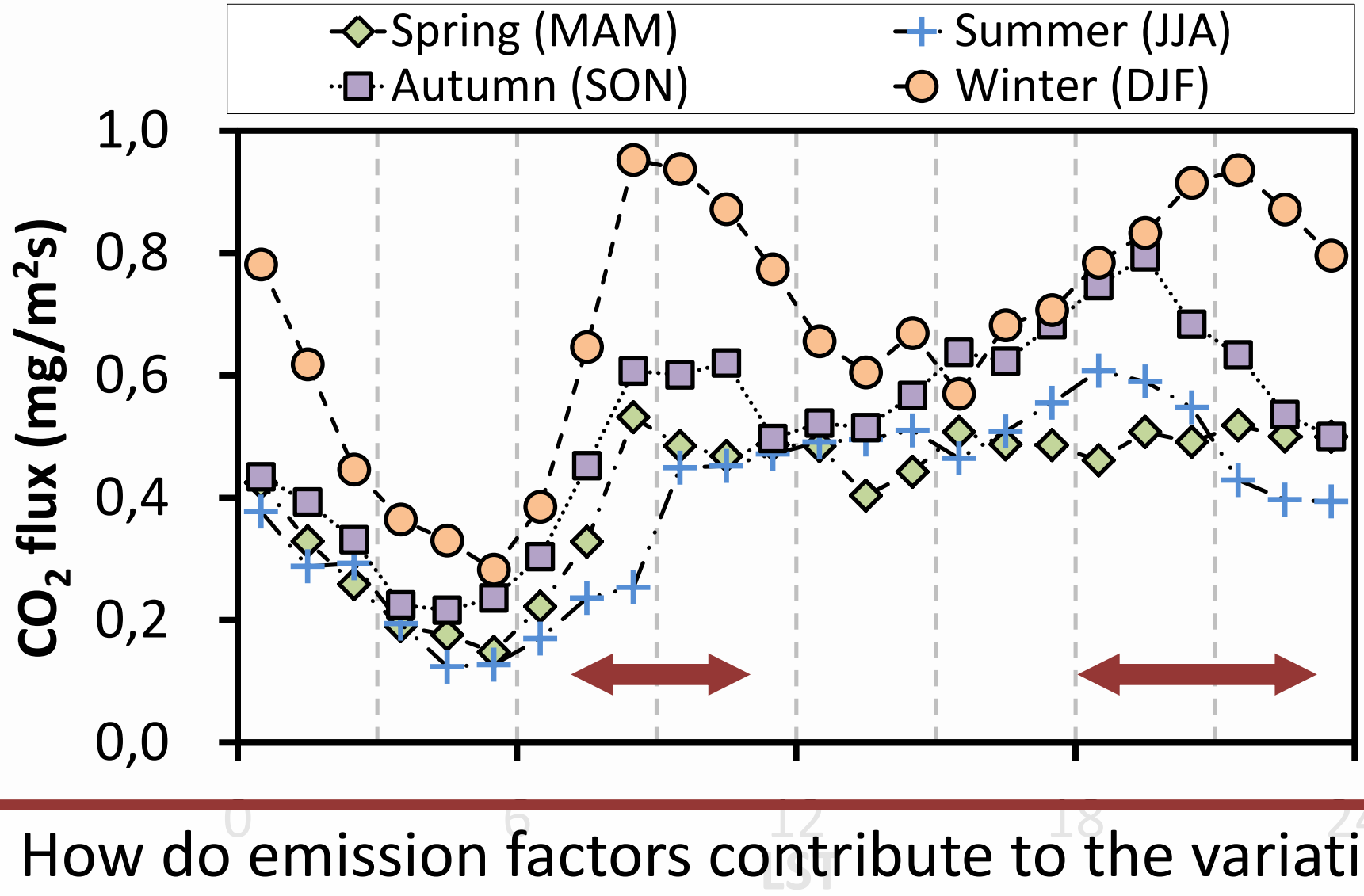
Summer(JJA)

500m



Result: Diurnal variation

Diurnal variation has 2 peaks.



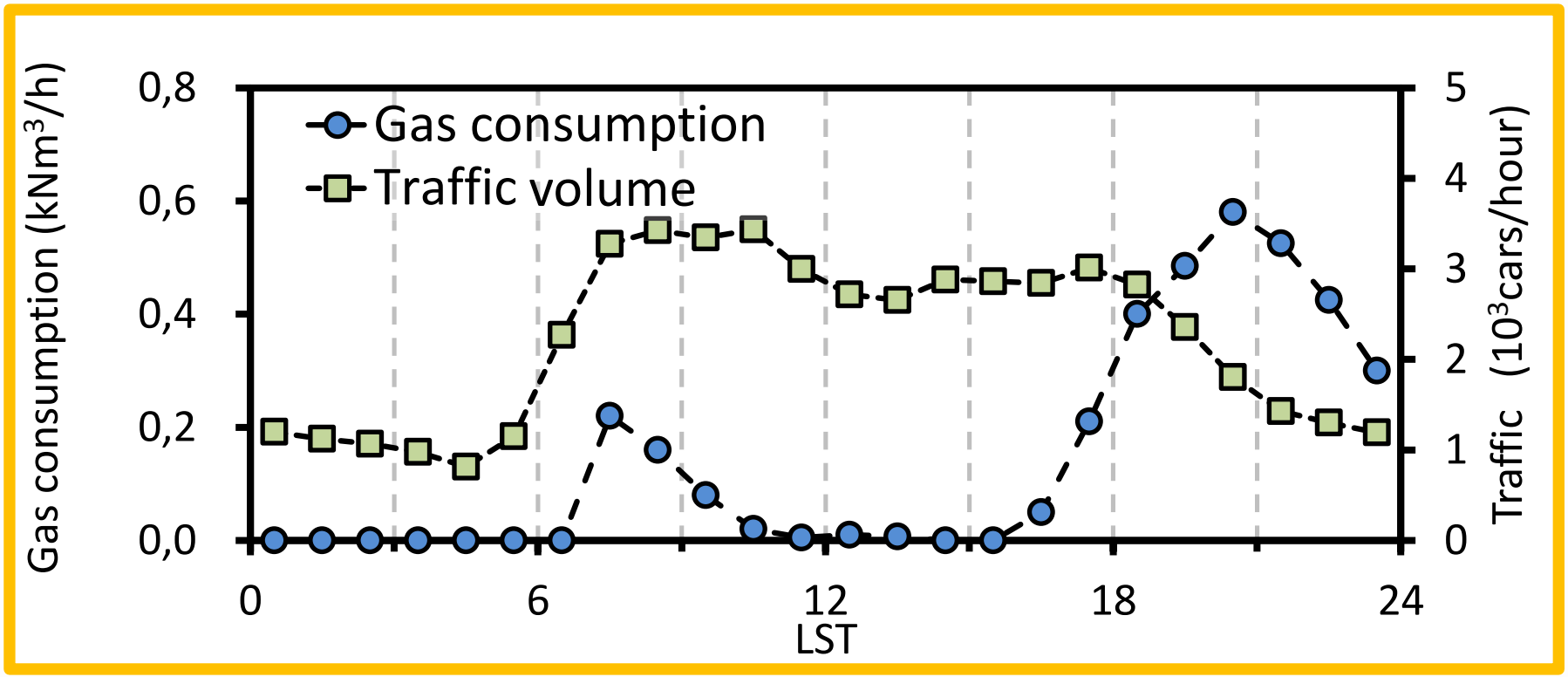
How do emission factors contribute to the variation?

Emission inventory

$$E_f(m,h) = C_f\ Q_f(m) P_f(h)$$

E : emission
m : month
h : hour
sub. f : emission factor (**Houses / Traffic**)

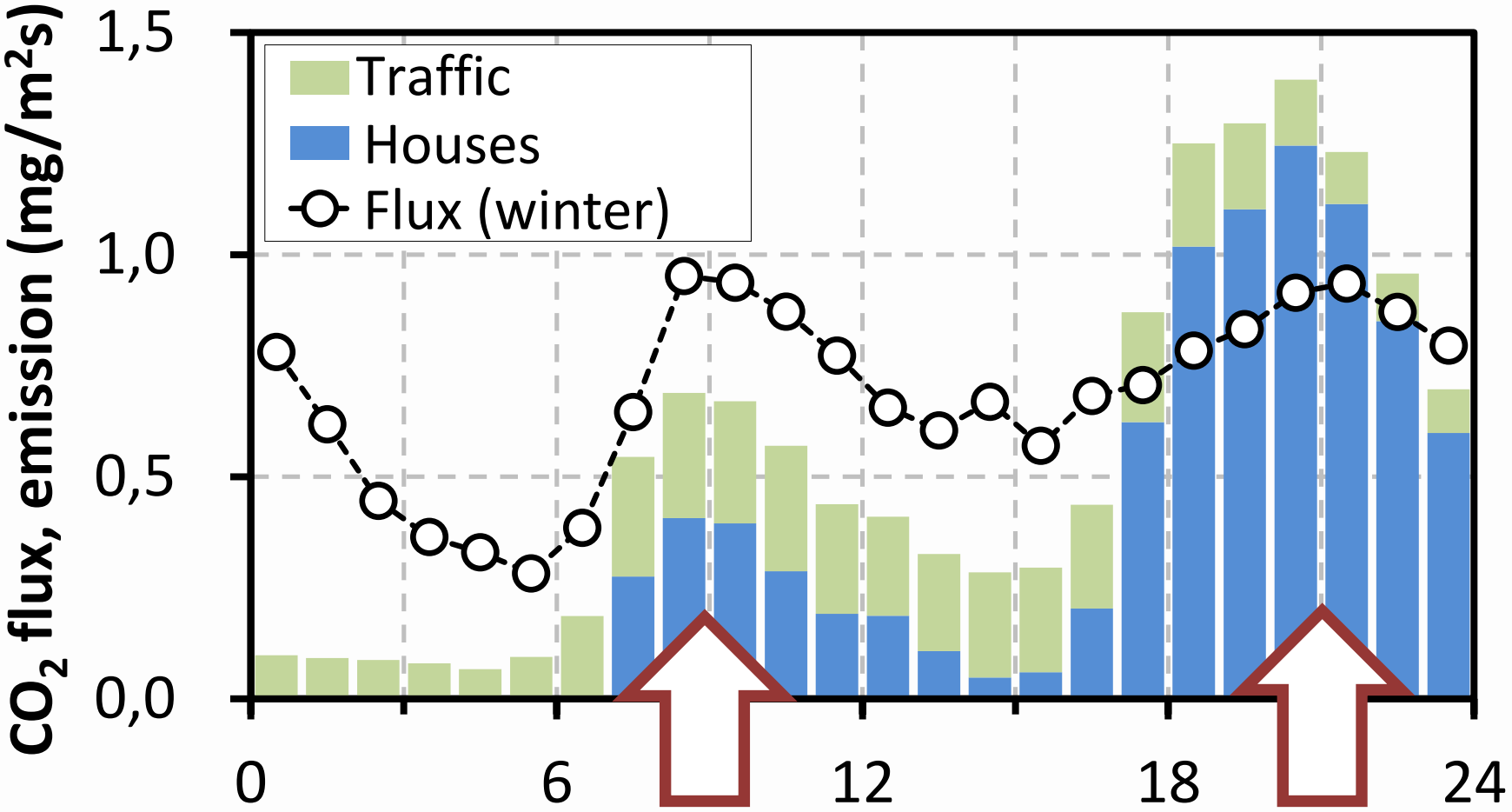
C : CO_2 emission rate
Q : daily average volume
P : rate to daily emission



Gas consumption: from Niurao et al. (2005), Hourly traffic volume: MLIT of Japan (2015)

Result: Flux vs. Emission inventory

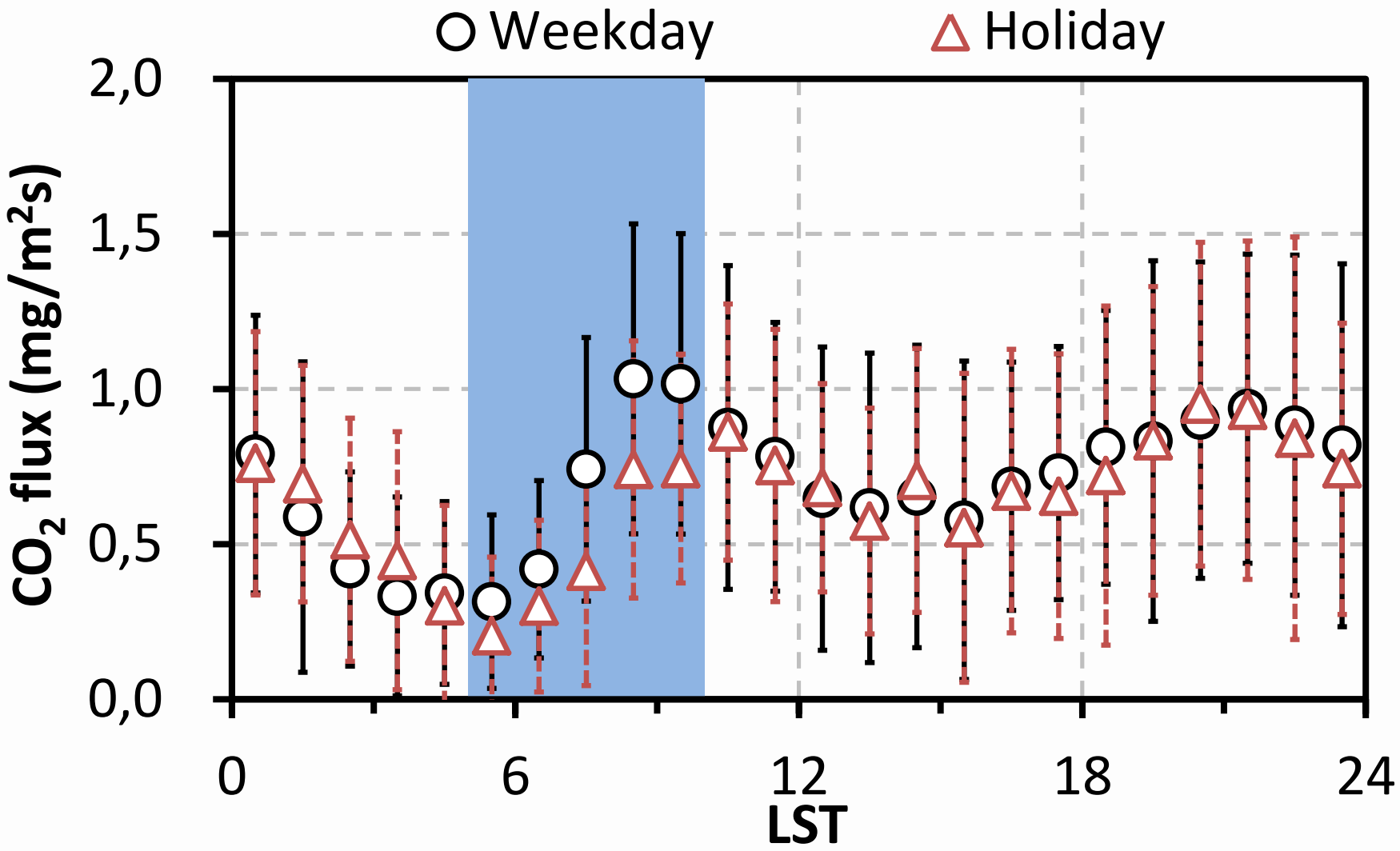
2 peaks are caused by different factors.



Are there weekday / holiday contrast in diurnal flux?

Result: Comparison of weekday & holiday flux

Significant difference was occurred in morning.



Summary

Measured CO_2 flux + Emission inventory

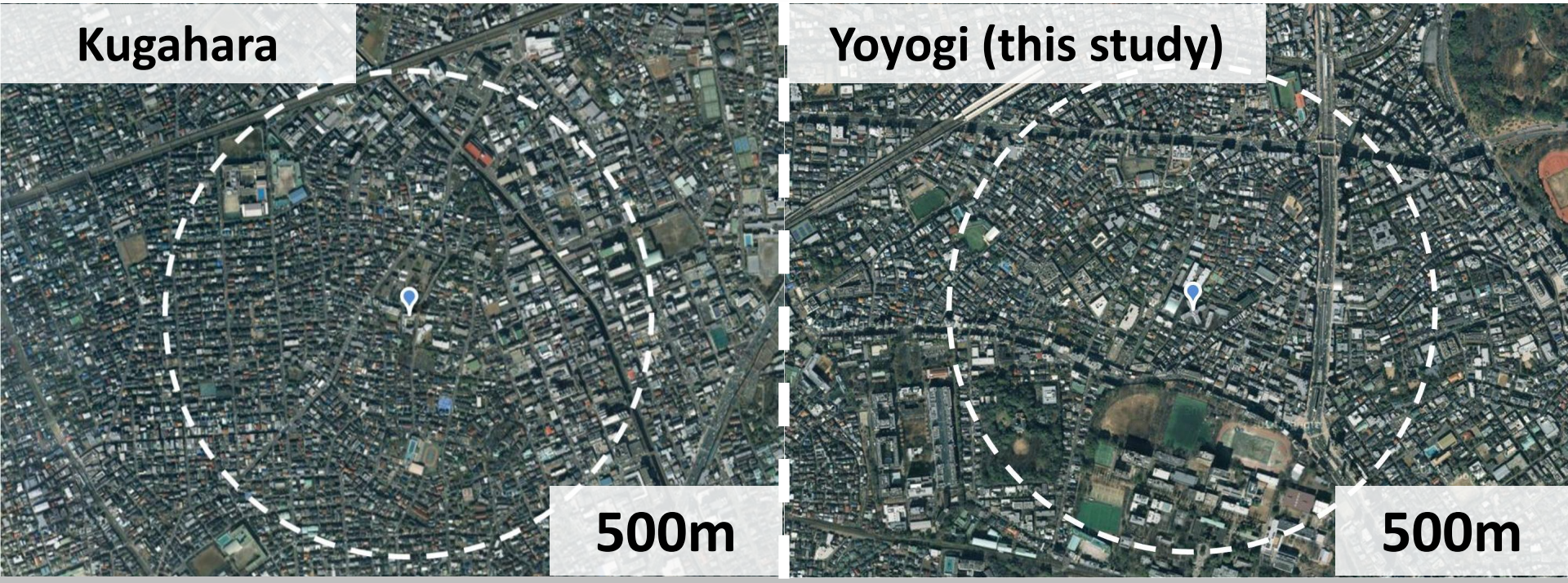
➢Conclusion

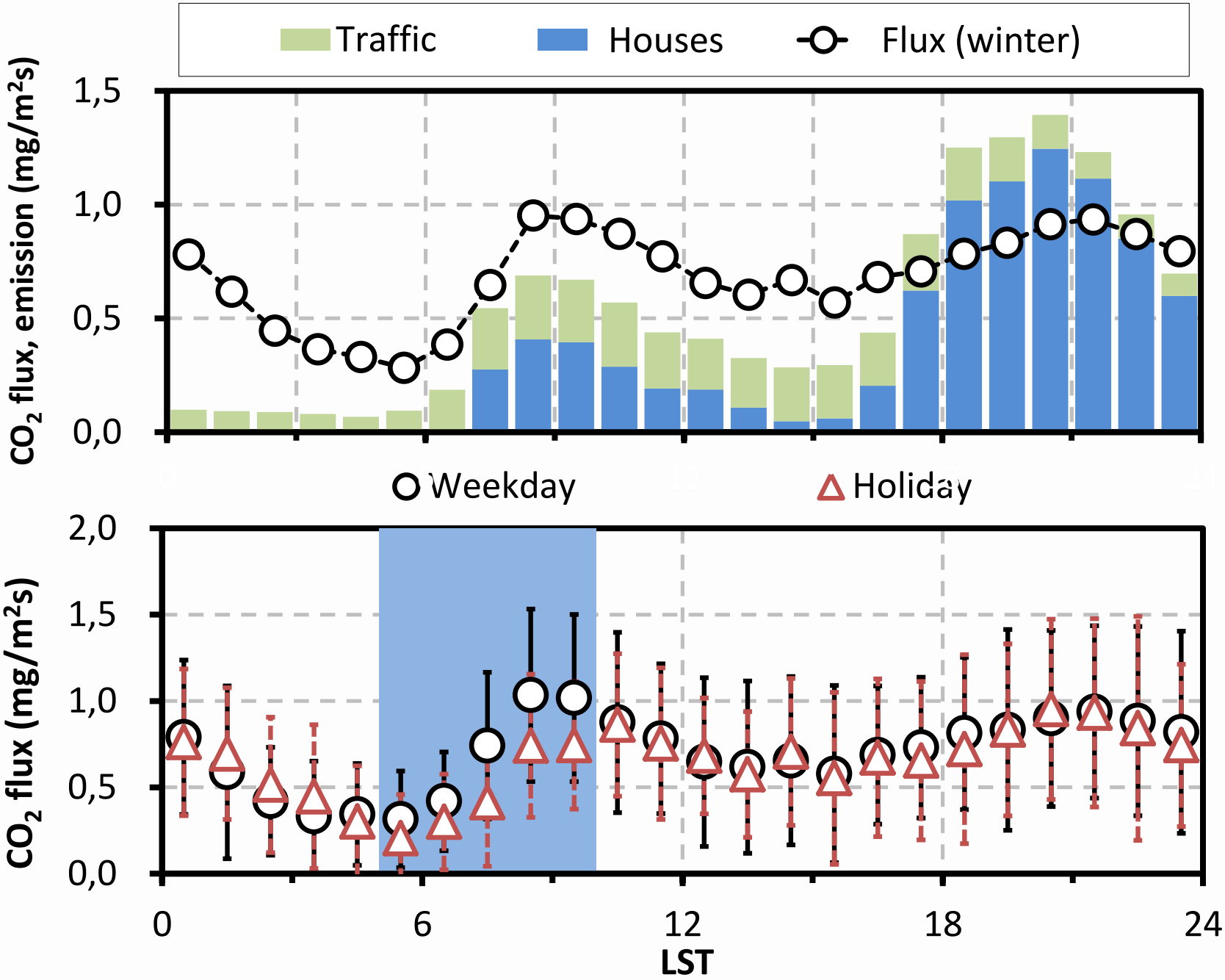
- Diurnal variation had 2 peaks: in morning and at evening.
- The 2 peaks are caused by different emission factors.
- The weekday/holiday contrast be attributed to traffic.

➢Moriwaki and Kanda (2004)

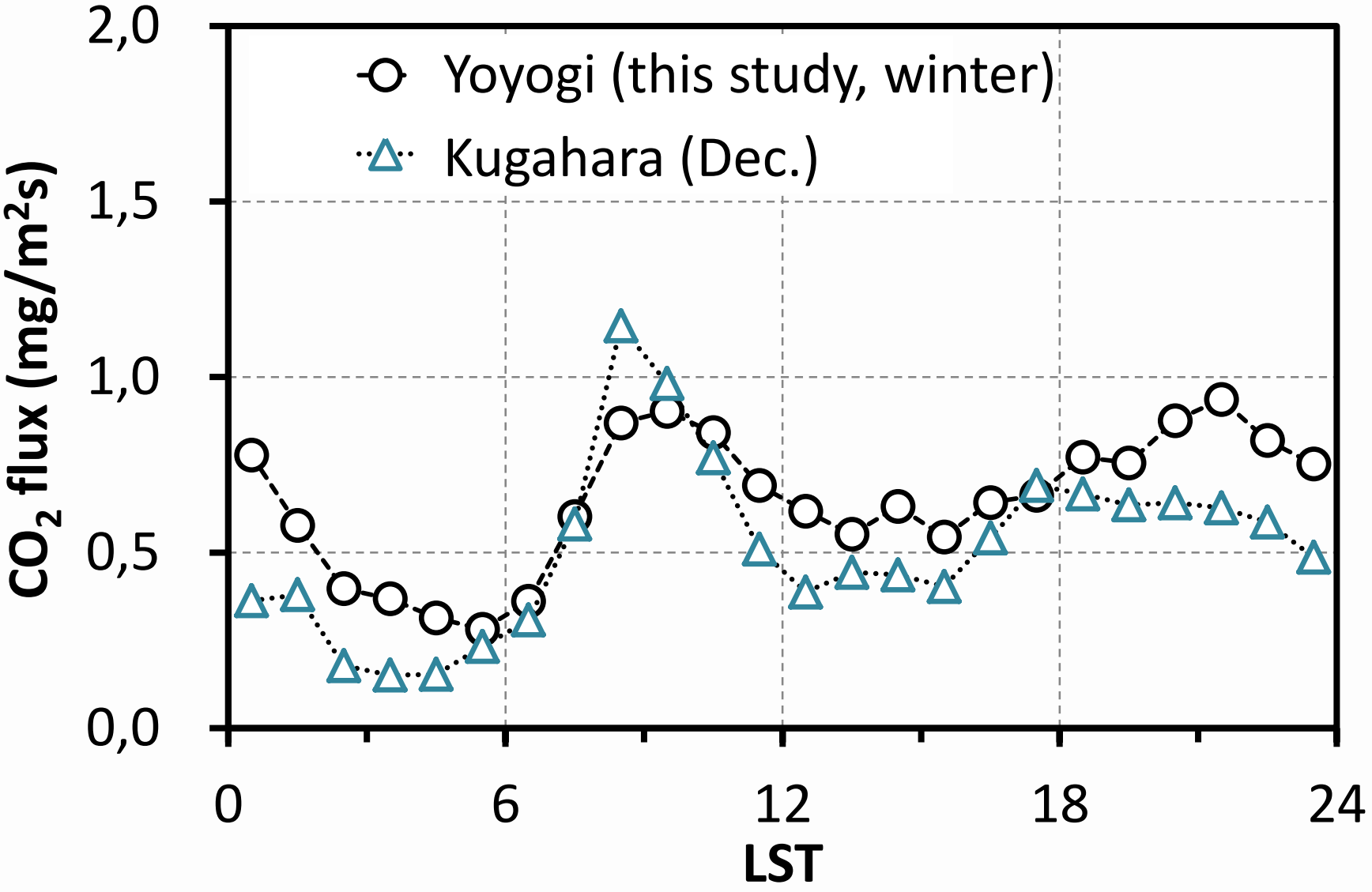
•Site: Kugahara, Tokyo, Japan.

•Measurement period: Apr. 2002 – May. 2003

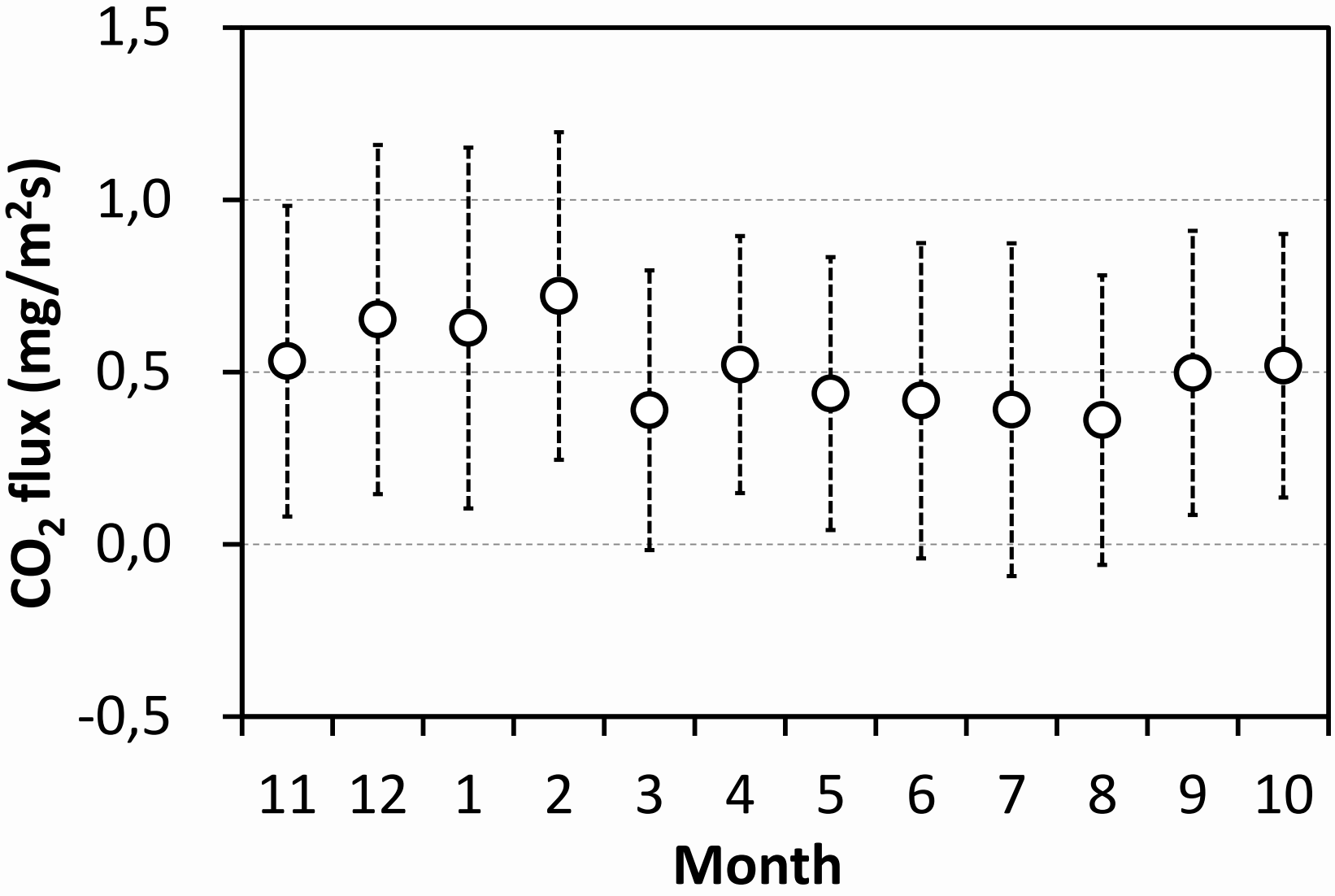



Traffic
Houses
Flux (winter)
1,5
1,0
0,5
0,0
CO_2 flux, emission (mg/m²s)
Weekday
Holiday
2,0
1,5
1,0
0,5
0,0
CO_2 flux (mg/m²s)
0
6
12
18
24
LST

Kugahara: Moriwaki and Kanda (2004)

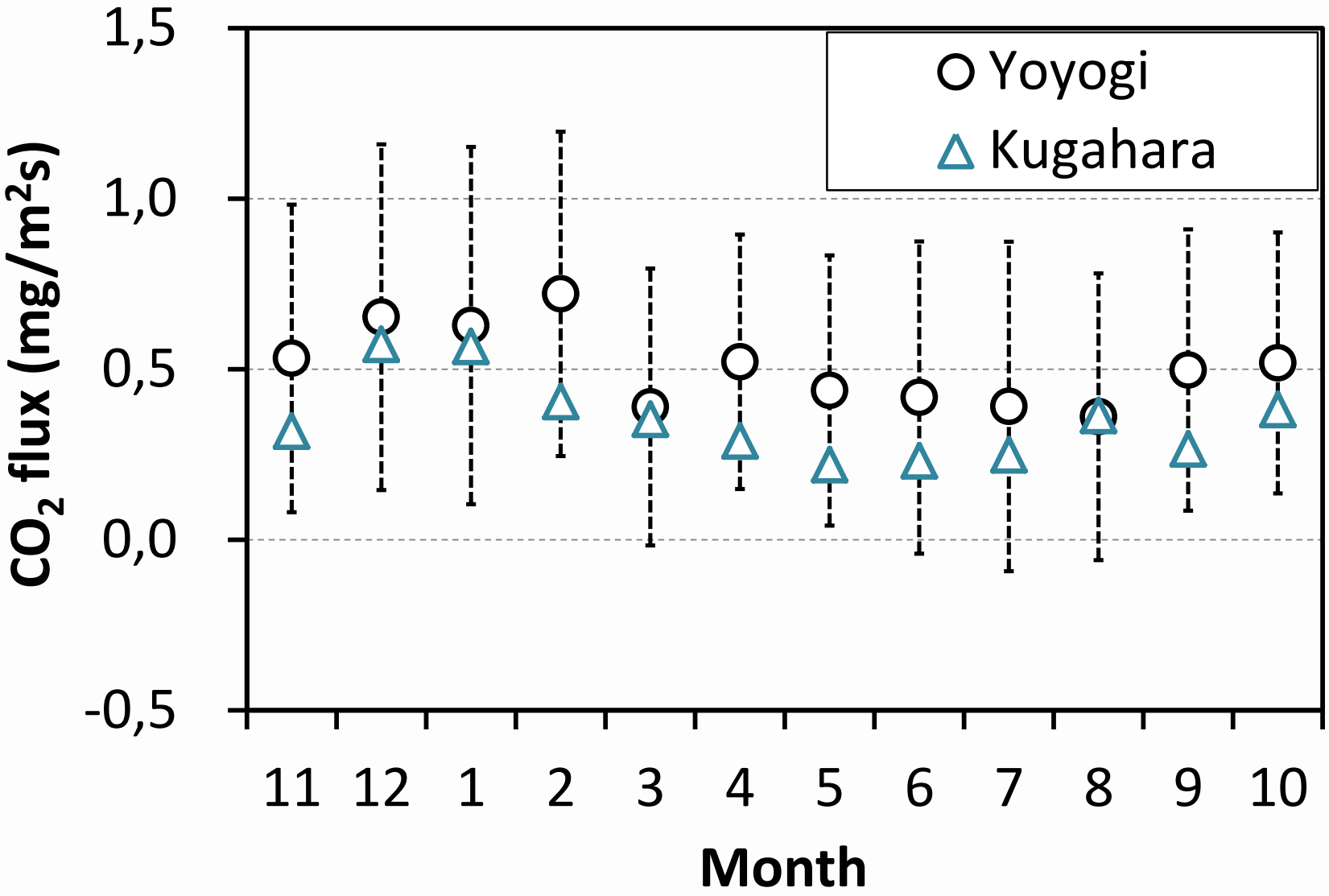


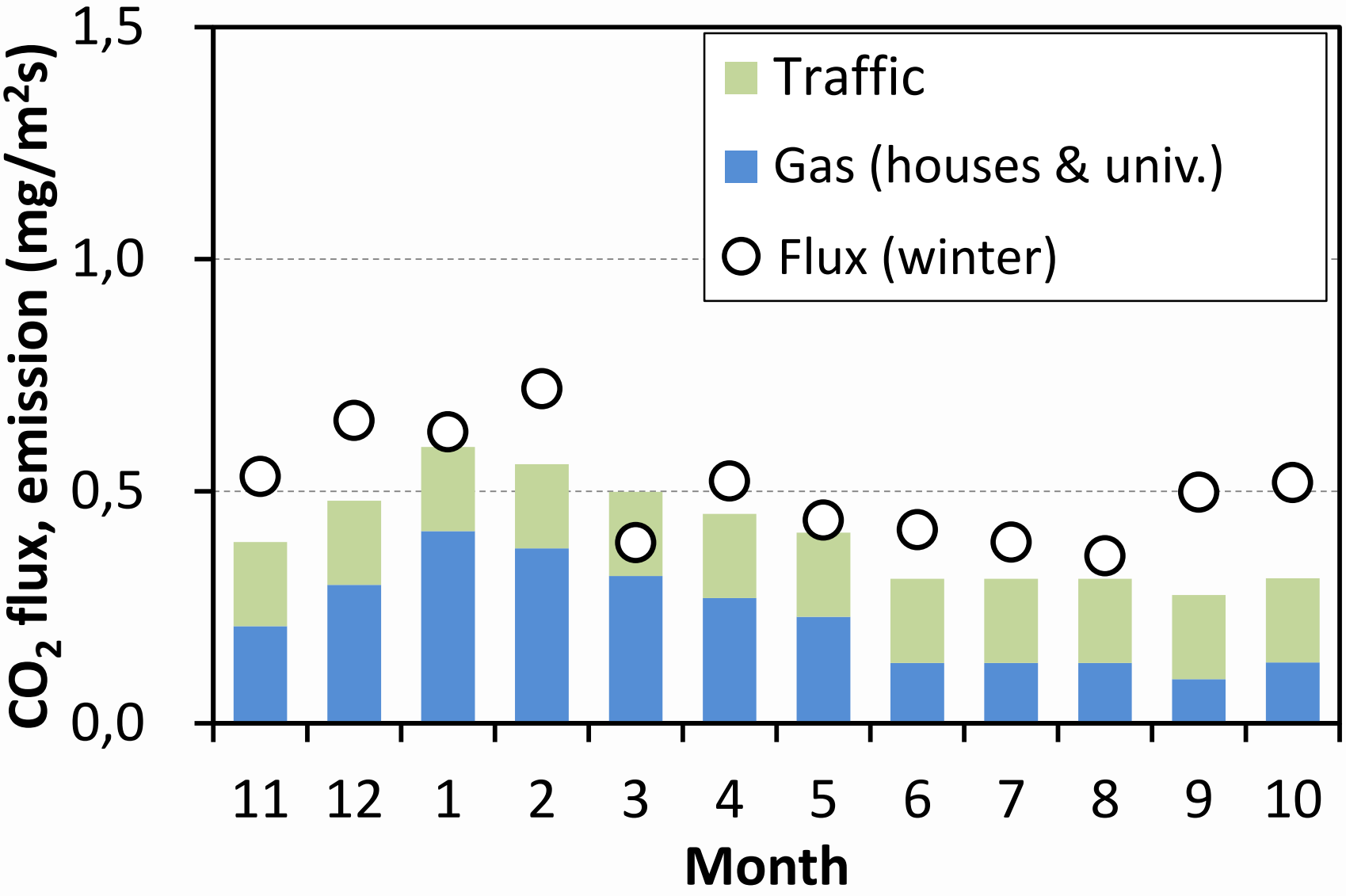
Nov. 2012 – Oct. 2013

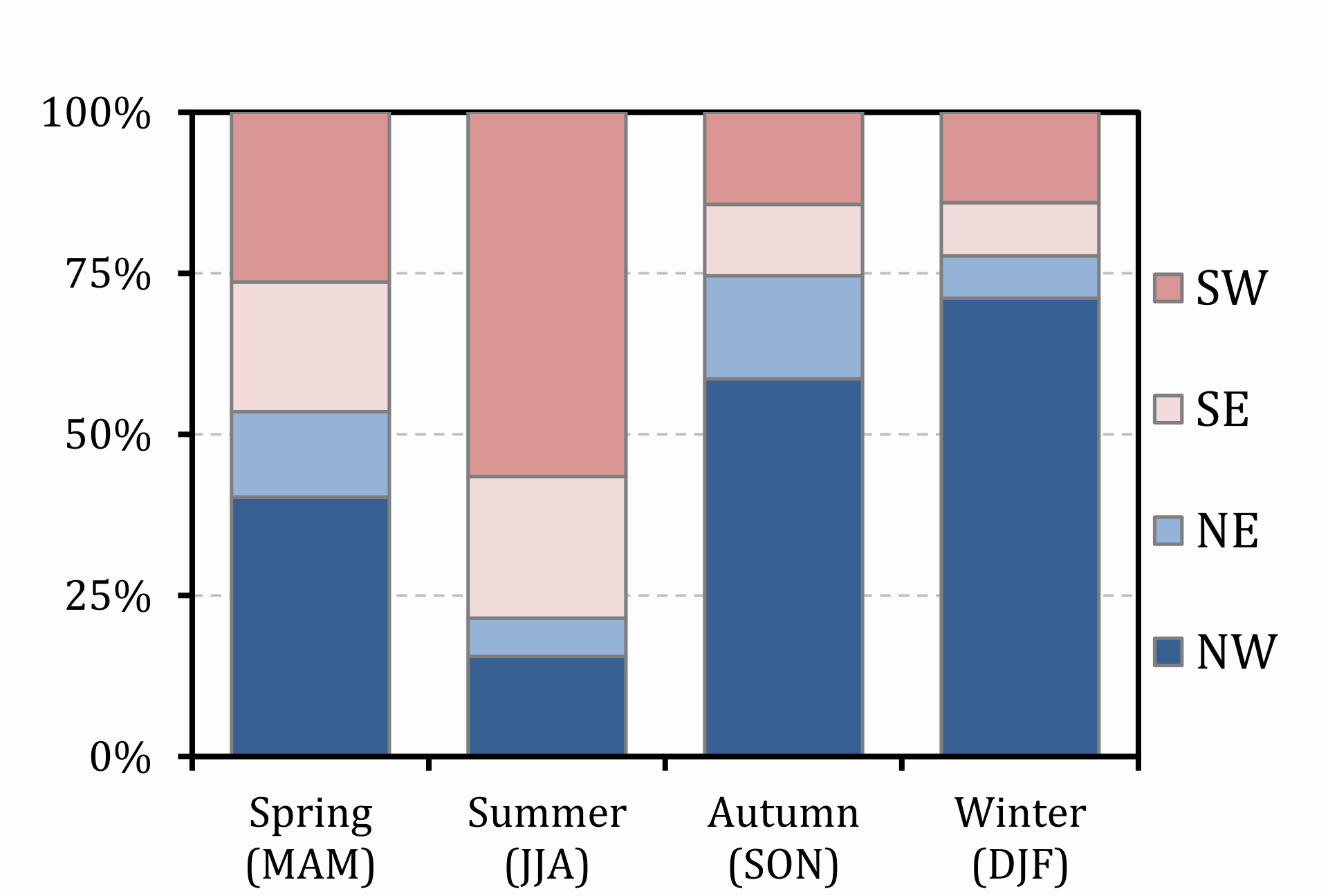


Yoyogi (this study): Nov. 2012 – Oct. 2013

Kugahara: Moriwaki et al. (2004), Apr. 2002 – May. 2003



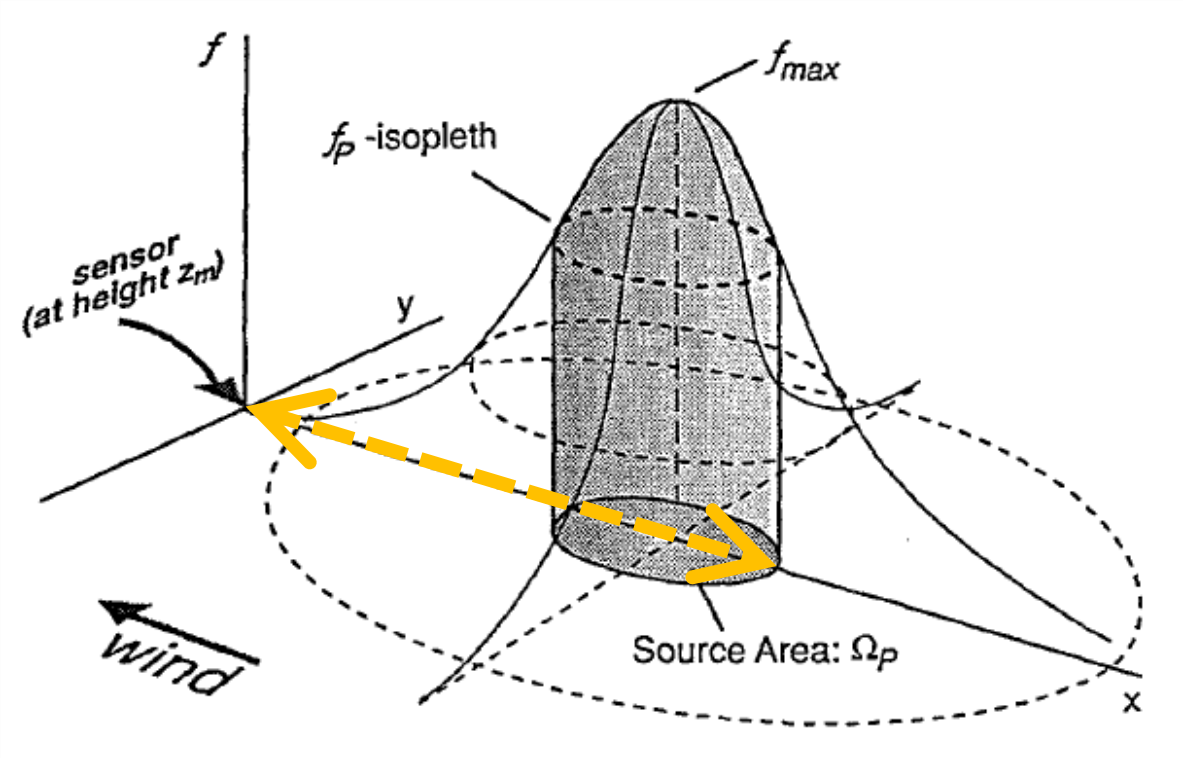

1,5
1,0
0,5
0,0
CO_2 flux, emission (mg/m²s)
Traffic
Gas (houses & univ.)
Flux (winter)
11
12
1
2
3
4
5
6
7
8
9
10
Month



Seasonally frequency distribution of wind direction in 30 min mean run.

The seasonally typical fetch length of source areas

Spring	Summer	Autumn	Winter
502 m	436 m	526 m	512 m



Conceptual diagram of the Source Area Model (Schmid, 1994).