

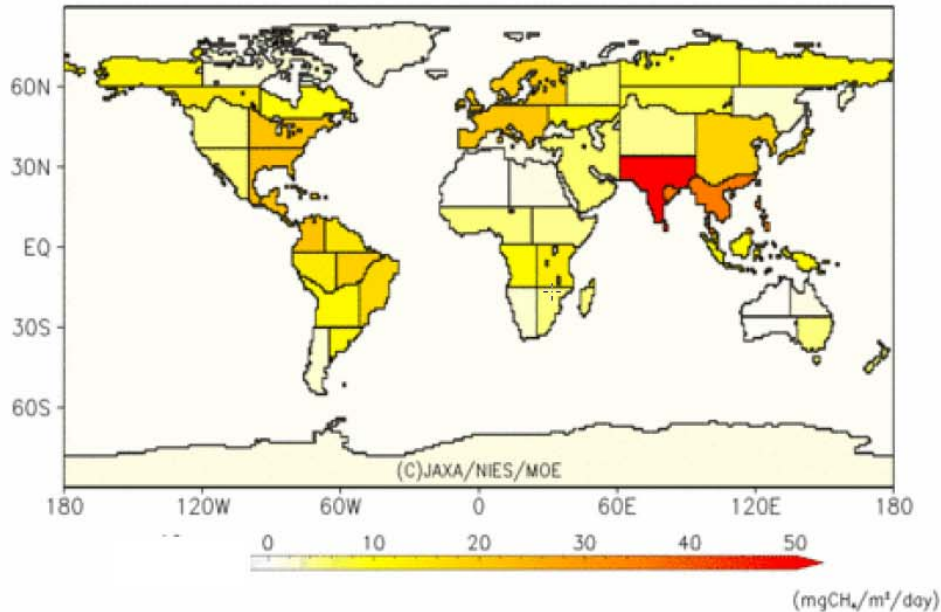
Continuous in-situ observation of methane at a paddy field in India

T. Hidemori¹, M. Izuhara¹, M. Kawasaki¹, T. Nakayama¹,
Y. Matsumi¹, Y. Terao², T. Machida², S. Nomura², K. Takahashi³,
S. K. Dhaka⁴, Jagmohan Singh⁴, and R. Imasu⁵

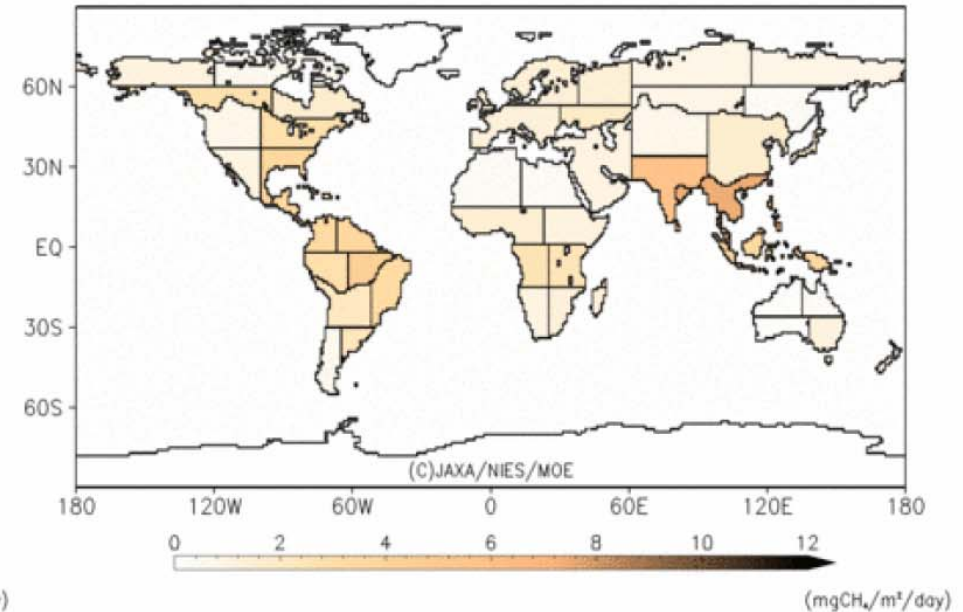
- (1) Institute for Space-Earth Environmental Research,
Nagoya University
- (2) National Institute for Environmental Studies
- (3) Research Institute for Sustainable Humanosphere,
Kyoto University
- (4) Rajdhani College, University of Delhi, India
- (5) Atmosphere and Ocean Research Institute,
University of Tokyo

CH₄ Fluxes and their uncertainties (GOSAT L4A data)

GOSAT L4A V01.01 CH₄ Fluxes (2010/07)



GOSAT L4A V01.01 CH₄ Flux Uncertainties (2010/07)



In southeast and south Asia, the satellite observations suggest that the biogenic emission such as rice paddies is significant and important source of CH₄ during rainy season. There are large uncertainties in quantitative estimation of methane emission in these areas and detailed comparisons between satellite and ground based measurements will be required. However, there are only few in-situ, ground-based measurements of CH₄ in these areas.

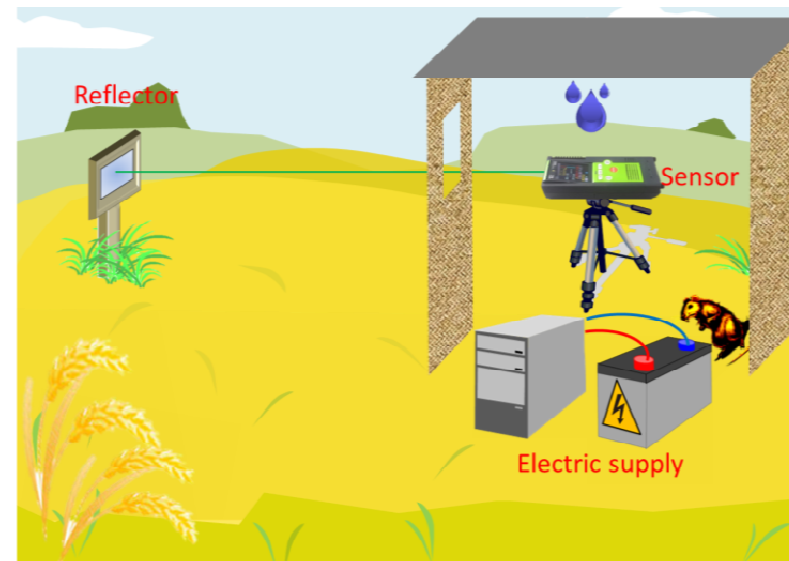
Methane measurements in south and southeast Asia

There are a lots of **hard conditions** for the measurements of methane **in rural areas in south and southeast Asia**

- Poor electricity supply
- Poor data transmission network
- Hard access for maintenance
- Dust, wind, and rain leaks
- Animals, insects, safety etc.

Expensive and delicate instruments are not suitable for the measurements under these hard conditions.

We have developed a low-cost, heavy-duty measurement system for CH₄ concentration measurement system which can perform a continuous in-situ observation. We have operated the system at a rice paddy field in North India.



Observation site in North India

Ganges
granary



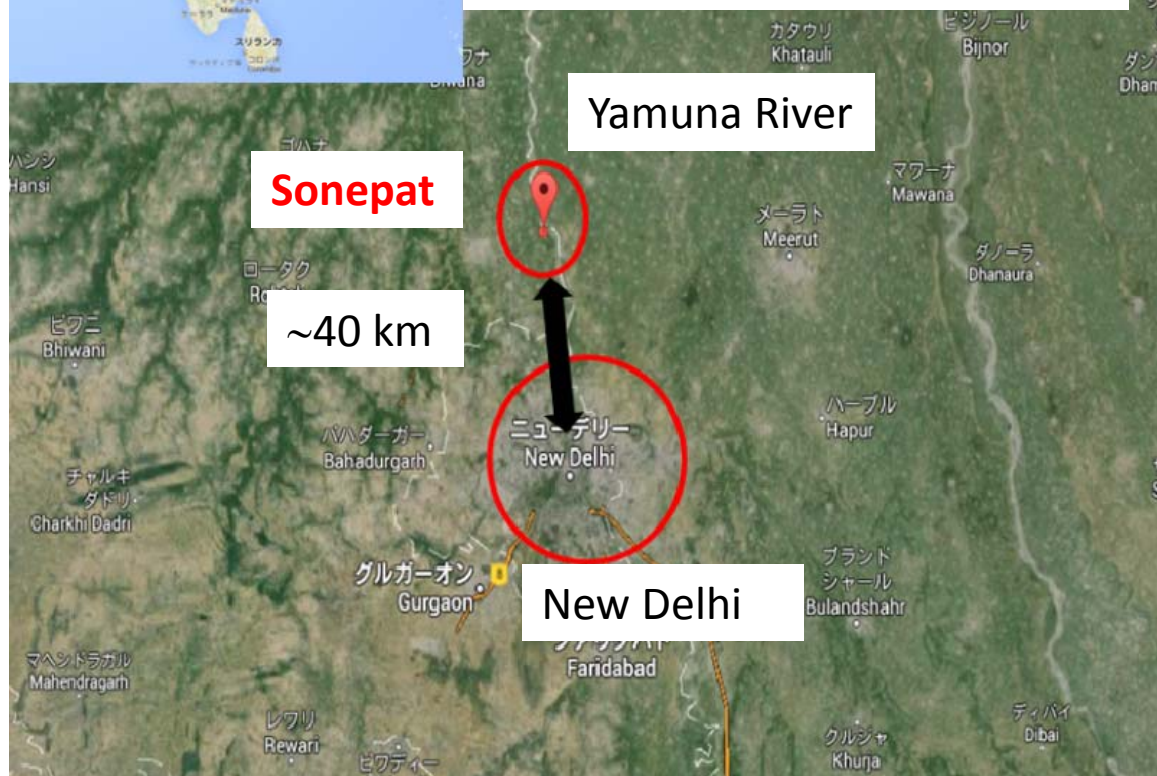
North India

Sonepat, Haryana

29.0181° N

77.1684° E

North of Delhi ~40 km



Yamuna River

Sonepat

~40 km

ニューデリー
New Delhi

New Delhi

Observation site in Sonapat, India

In an old barn in the rice paddy field

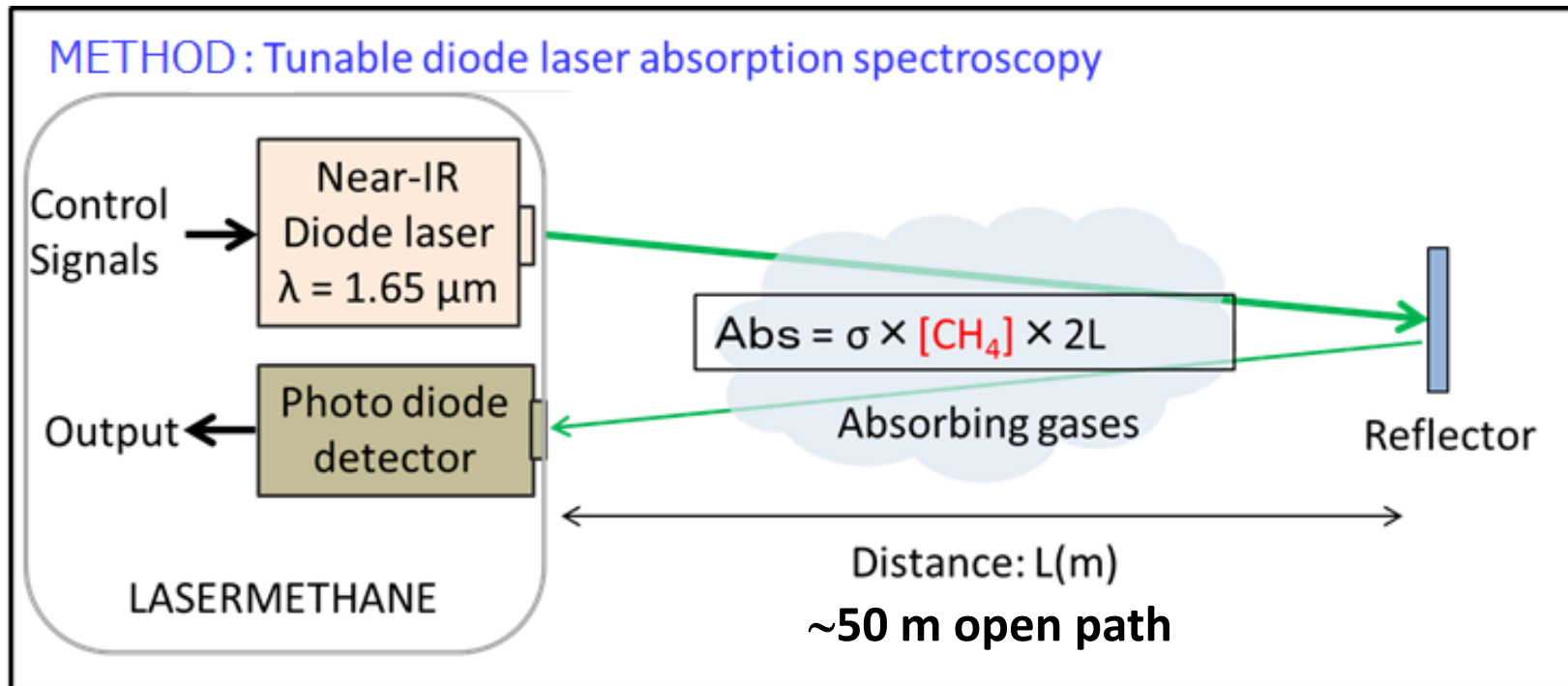
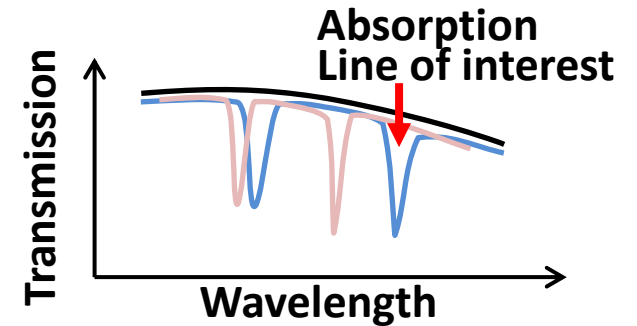


CH₄ sensor – open path tunable diode laser spectrometer

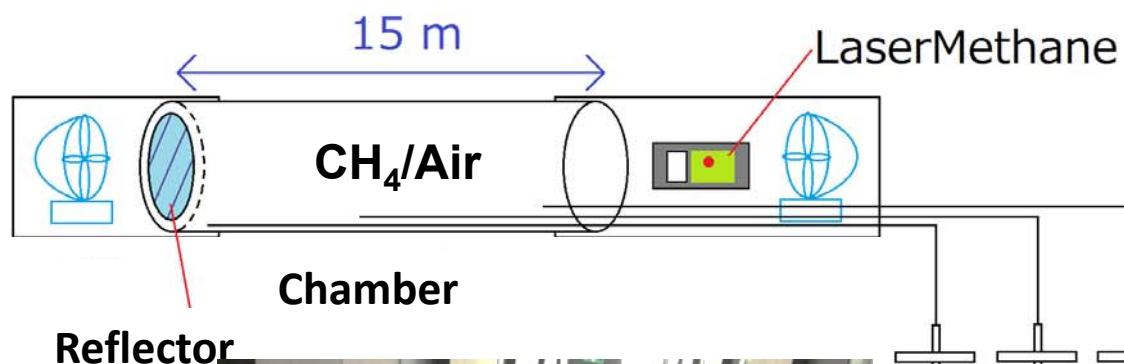


“LaserMethane mini G”
Tokyo Gas and Anritsu Corp.
Developed for Gas Leak Detection

- Low cost
- Heavy duty
- Fast response
- Continuous measurement

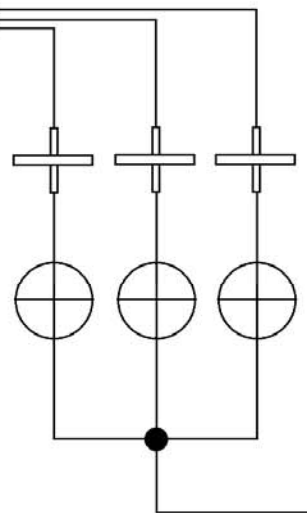


CH₄ instrument calibration in Japan



Calibration with standard gas

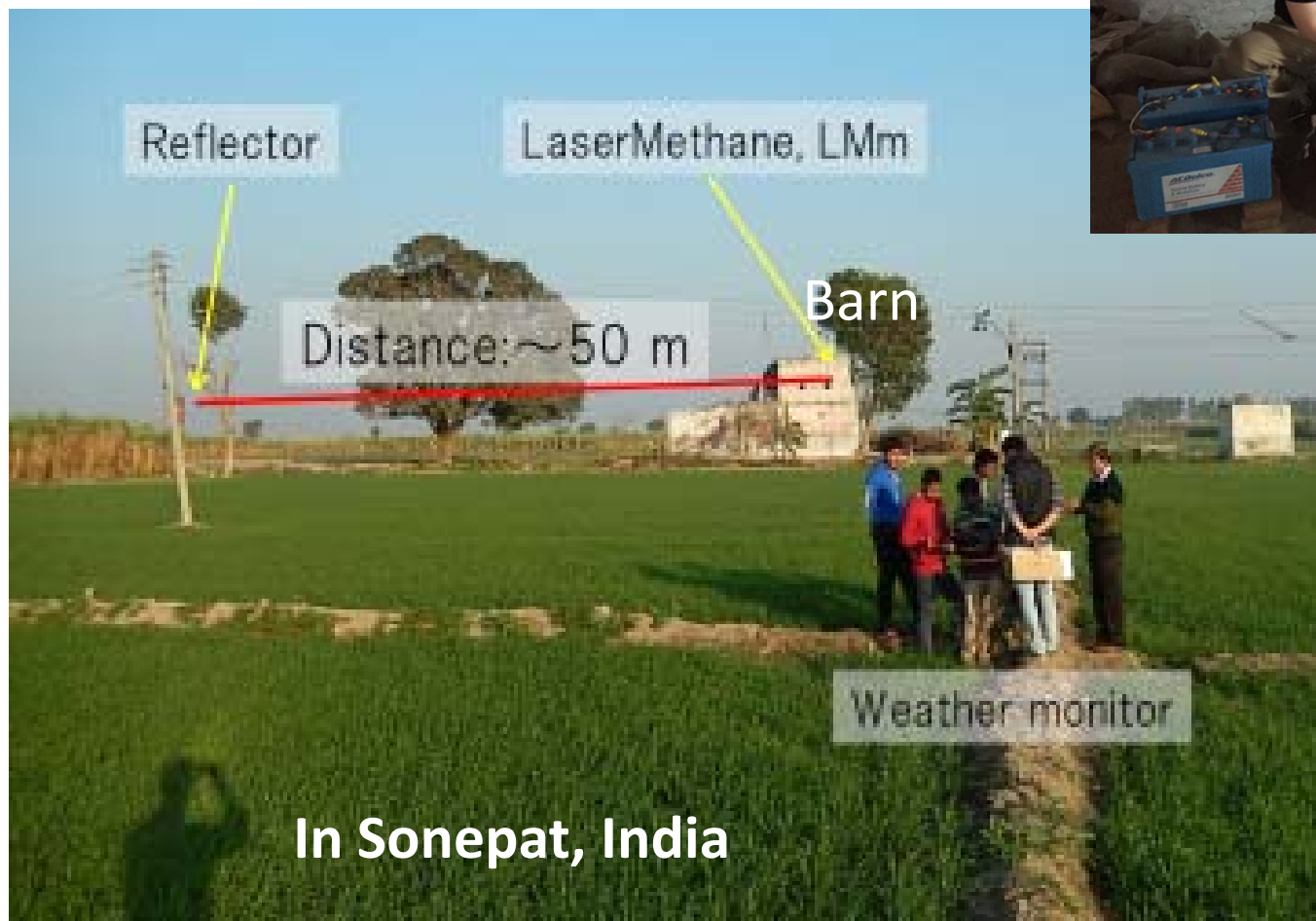
- Thermo, DFG-TDLAS 3.5 μm
- LGR, Off-axis ICOS 1.6 μm



In the institute
building in Japan

Also simultaneous measurements of
ambient air were performed.

Installation of the measurement system in the barn



Flask sampling measurements in Sonapat, India

Sampling interval: Once in 1-3 weeks



1.5L Pyrex glass vessel at $\sim 0.12\text{MPa}$



Sent to NIES, Japan

Analysis: GC-FID

CH_4 , CO_2 , CO etc.

Accuracy: $\pm 2\text{ppb}$

NIES 94 CH_4 scale

(Terao et al., JGR, 2011)

Vegetation in Sonapat, India

MODIS data analysis
Sonapat spatial range 1 km

Vegetation
camera



Feb. 1st



Oct. 1st



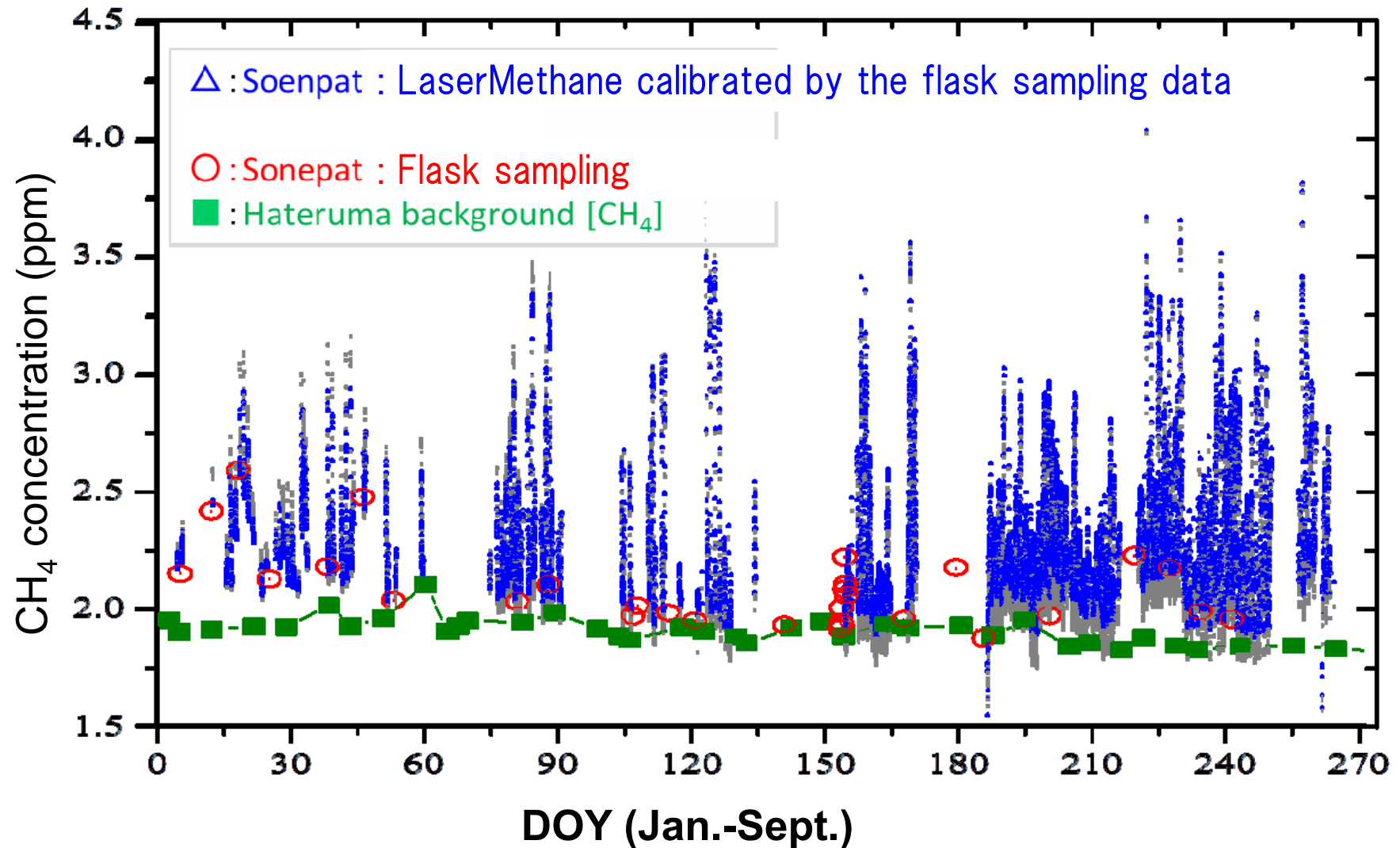
Crops

Summer-autumn: rice, vegetable

Winter-spring: wheat, sugarcane

Off-season: Apr-Jun, Nov-Dec

Observation results of CH₄ in 2015



CH₄ concentrations at Sonepat were higher than that of Hateruma NIES station that is located at the similar latitude in the Pacific ocean.

Summary

- **The open-path CH₄ measurement system is very convenient to use at rural areas and can provide continuous CH₄ concentration.**
- **The system has performed CH₄ measurement at a rice paddy field in North India.**
- **Monthly mean CH₄ concentrations increased in winter and monsoon season at Sonapat site.**
- **The vegetation phenology using MODIS indicates the increase of the both LAI and LSWC during Monsoon, suggesting that the increase of CH₄ is influenced by the rice cultivation.**
- **The increase of $\Delta\text{CH}_4/\Delta\text{CO}$ ratio using the flask data also supports that the rice cultivation leads to the increase of CH₄ in July and August.**

This research was partly conducted under the framework of the GOSAT RA, and partly supported by GRENE-ei program (Monbusho).

END