Yale 耶鲁大学-南京信息工程大学大气环境中心

Yale-NUIST Center on Atmospheric Environment

Temporal variations in atmospheric CO_2 concentration in Meiliang Bay of Lake Taihu

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Major: Applied Meteorology

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1 Background

- The mean CO_2 flux from lakes amounted to 61.5 ± 7.1 mg m^{-2} h^{-1} (Schrier-Uijl et al., 2011).

- Recently, researches on CO_2 flux on the water-air interface emerge in large numbers, and atmospheric CO_2 concentration is the component for flux caculation.

- Previous researches, with manual measurements leave much to be desired (Ji et al. 2006).

2 Research purpose

Investigate the temporal variations in atmospheric CO_2 concentration and the main influencing factors at MLW site.

3 Research contents

- Analyze diurnal and monthly variations in atmospheric CO_2 concentration at MLW.

- Investigate the main influencing factors on atmospheric CO_2 concentration.

- Compare the atmospheric CO_2 concentration data measured by WS-CRDS (Model G2301, Picarro Inc., CA, USA) and NDIR (LI-7500A, LI-COR, USA) and obtain the quantitative relationship.

4 Research progress

4.1 Temporal variations in atmospheric CO_2 concentration above the water surface

- Diurnal variation: The annual average diurnal variation acted as twin peaks at MLW (peak-7 am, 10 pm; valley-2 am, 2 pm) (Ji et al. 2006).
- Seasonal variation: Atmospheric CO_2 concentration has obvious seasonal features, namely, high in autumn and winter , low in spring and summer at coastal of The Bohai Sea (Kong et al. 2010).
- Interannual variability: Atmospheric CO_2 concentration grows 2.3% every year at MLW. (Ji et al. 2006).

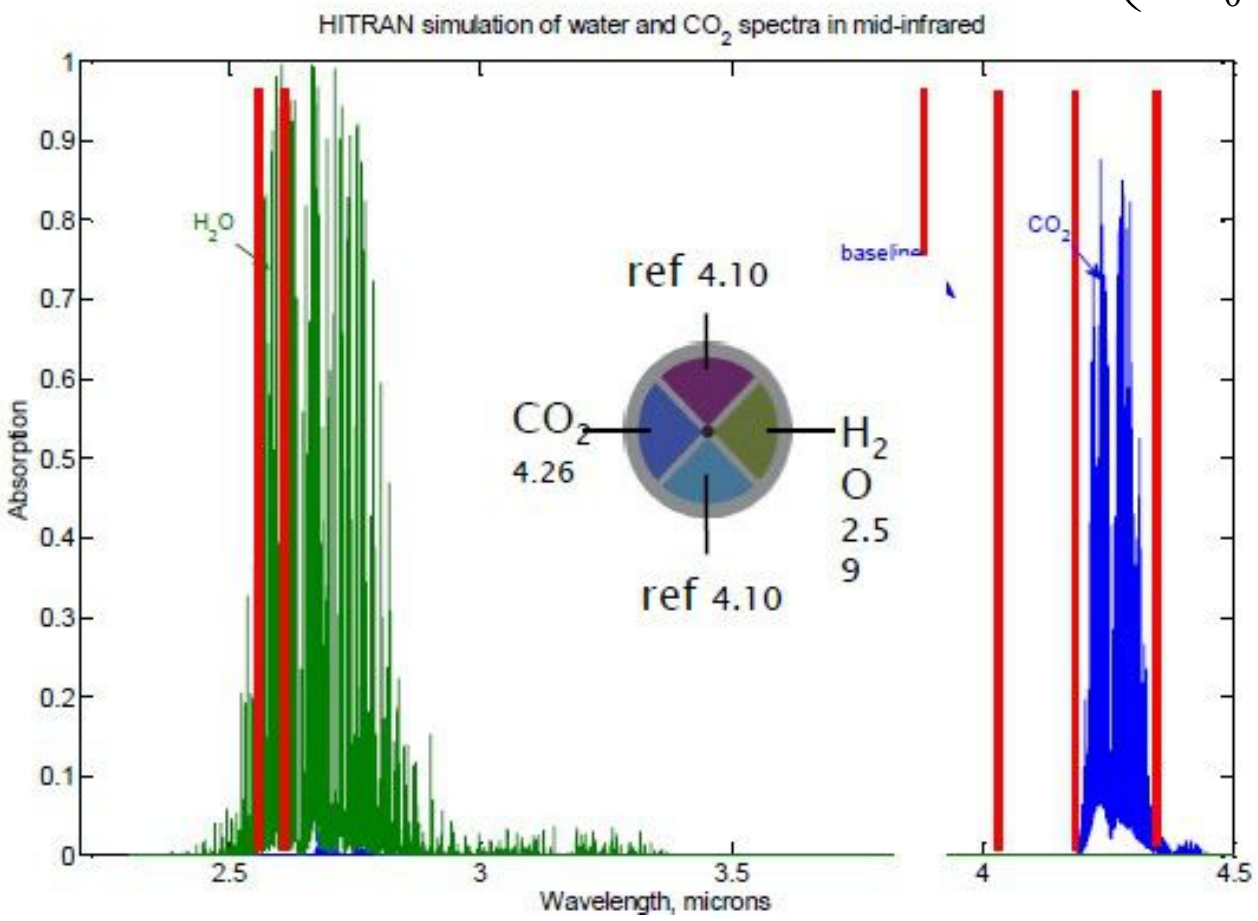
4.2 Influencing factors

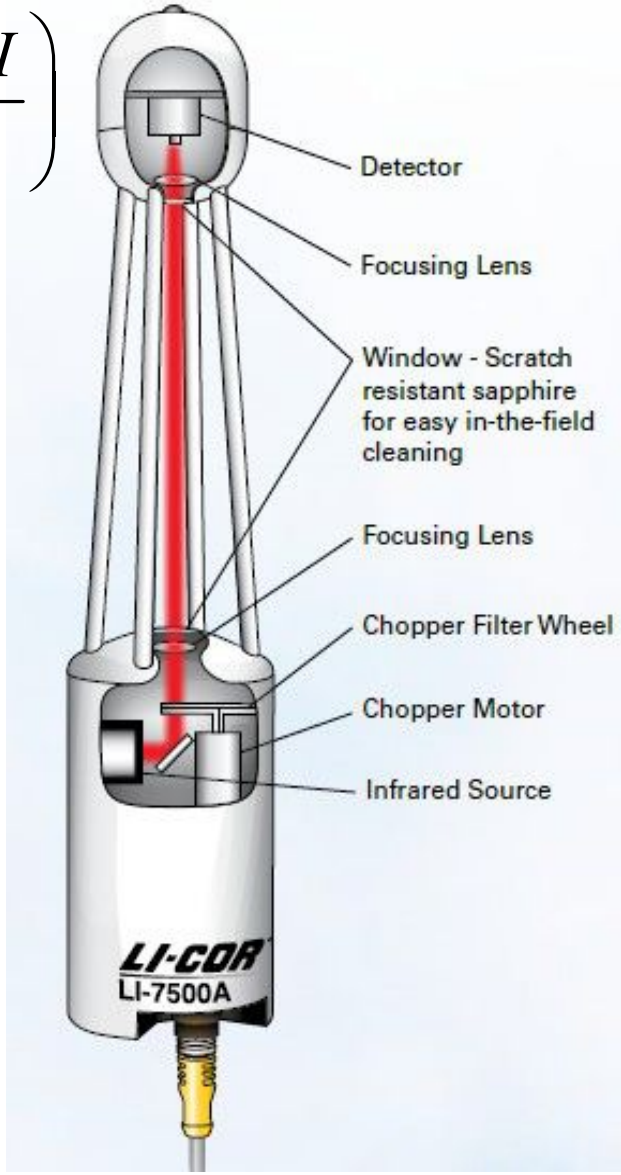
- Temperature: A research found that the diurnal CO_2 concentration was negatively correlated with temperature (R=-0.55~-0.64) (Zhao et al., 2011; Zhang et al., 2014).
- Wind: Results show that the correlation is weak between offshore wind speed and CO_2 concentration (r=0.17), while the correlation coefficients in Bohai Sea are 0.76 and 0.894 in January and July (Kong et al. 2010; Zhang et al. 2014).
- Humidity: The relationship between humidity and CO_2 concentration is strong in July (R=0.899) while weak in January (R=0.285) (Zhang et al. 2014).

4.3 Observation methods

4.3.1 NDIR

$$density \sim f\left(\frac{I_0 - I}{I_0}\right)$$



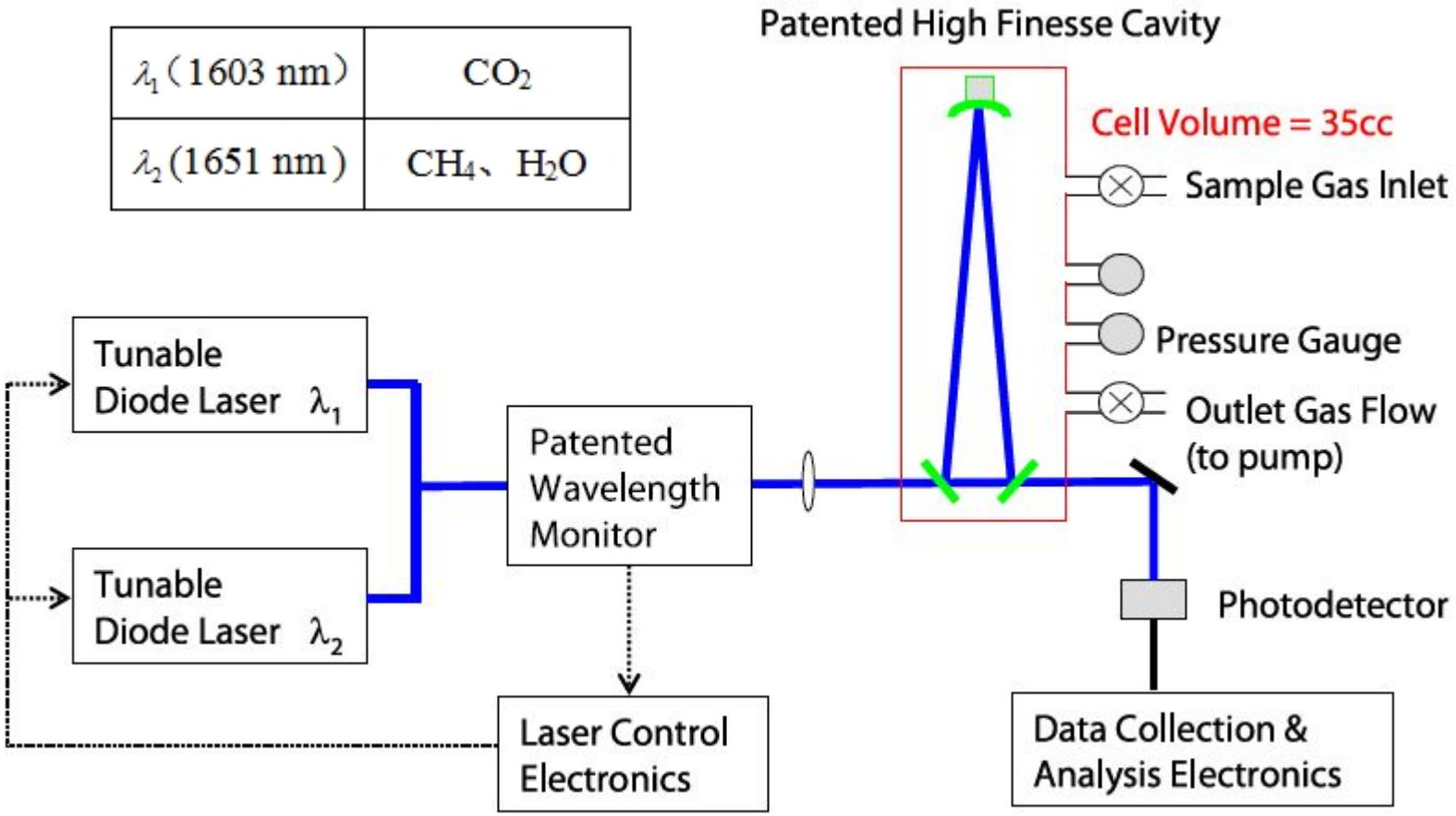


(Courtesy of Xu, 2013)

4.3 Observation methods

4.3.2 WS-CRDS

λ_1（1603 nm）	CO_2
λ_2（1651 nm）	CH_4、H_2O



(Picarro, Inc., 2008)

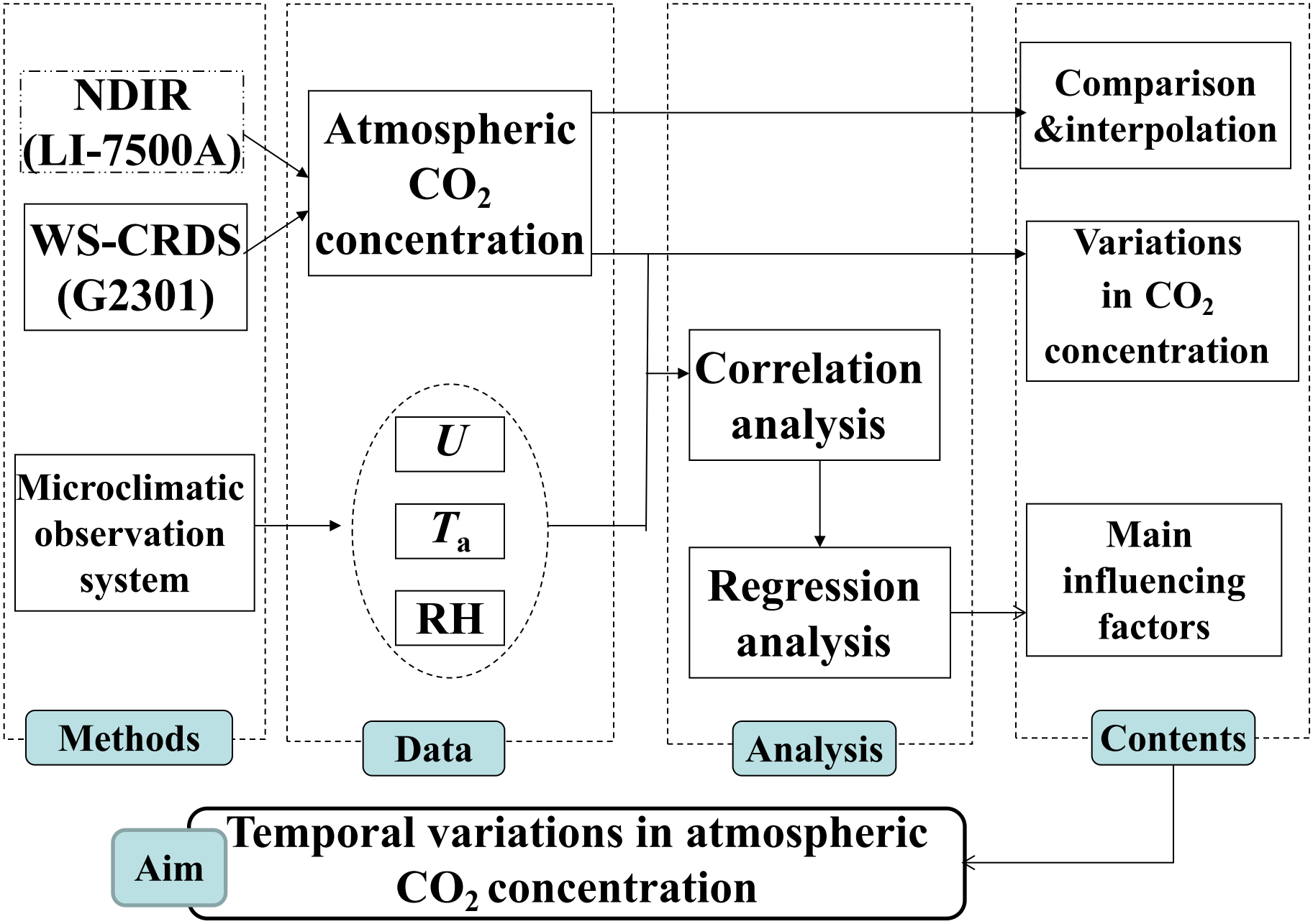
4.3 Observation methods

4.3.3 Comparison between NDIR and WS-CRDS

	NDIR	WS-CRDS
Instrument model	LI-7500A	G2301
Open-path/close-path	Open-path	Close-path
Measuring contents	ρ CO2、 ρ H2O	χ vCO2、 χ vCH4、 χ vH2O
Optical cavity length	0.125 m	0.2 m
Optical cavity volume	/	35 cm^3
Optical cavity pressure	/	187hPa
Measuring frequency	10Hz	1Hz
Maintenance demands	High	Low

(Courtesy of Jiayu Zhao, 2015)

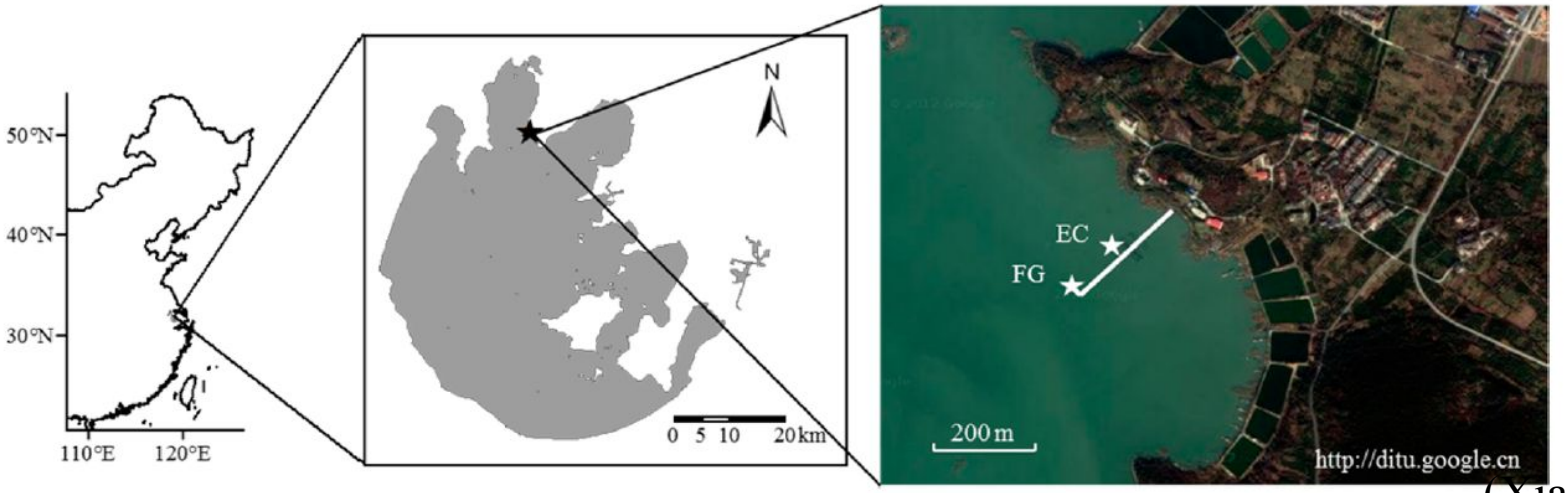
5 Route diagram



6 Experiments and methods

6.1 Site description

Name	Latitude and longitude	Average water depth	Area	Annual air temperature	Annual precipitation	Eutrophication
Taihu Lake	/	1.9 m	2400 km^2	/	/	Yes
MLW (Northern)	(31.4197°N, 120.2139°E)	2.0 m	132 km^2	16.2 ℃	1122 mm	Yes

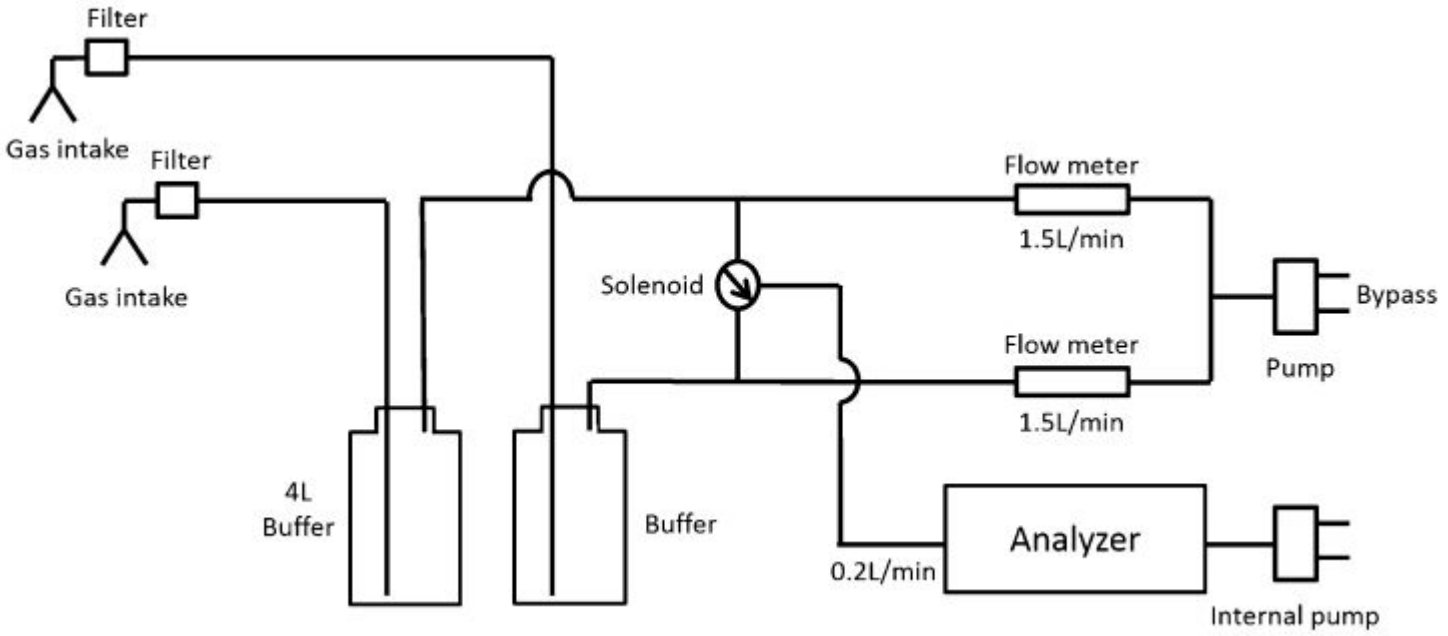


(Xiao et al., 2014)

6.2 Observation methods

6.2.1 Atmospheric CO_2 concentration data (WS-CRDS)

Air was drawn from two air intakes at the heights of 1.1 and 3.5 m above the water surface into the analyzer. Select the data measured at the height of 3.5 m.



(Xiao et al., 2014)

6.2.2 Atmospheric CO_2 concentration data (NDIR)

(Courtesy of Professor Lee et al., 2013)

6.2.3 Meteorological data

- Wind direction and speed

  An anemometer and wind vane (model 05103; R M Young Company, Traverse City, Michigan)

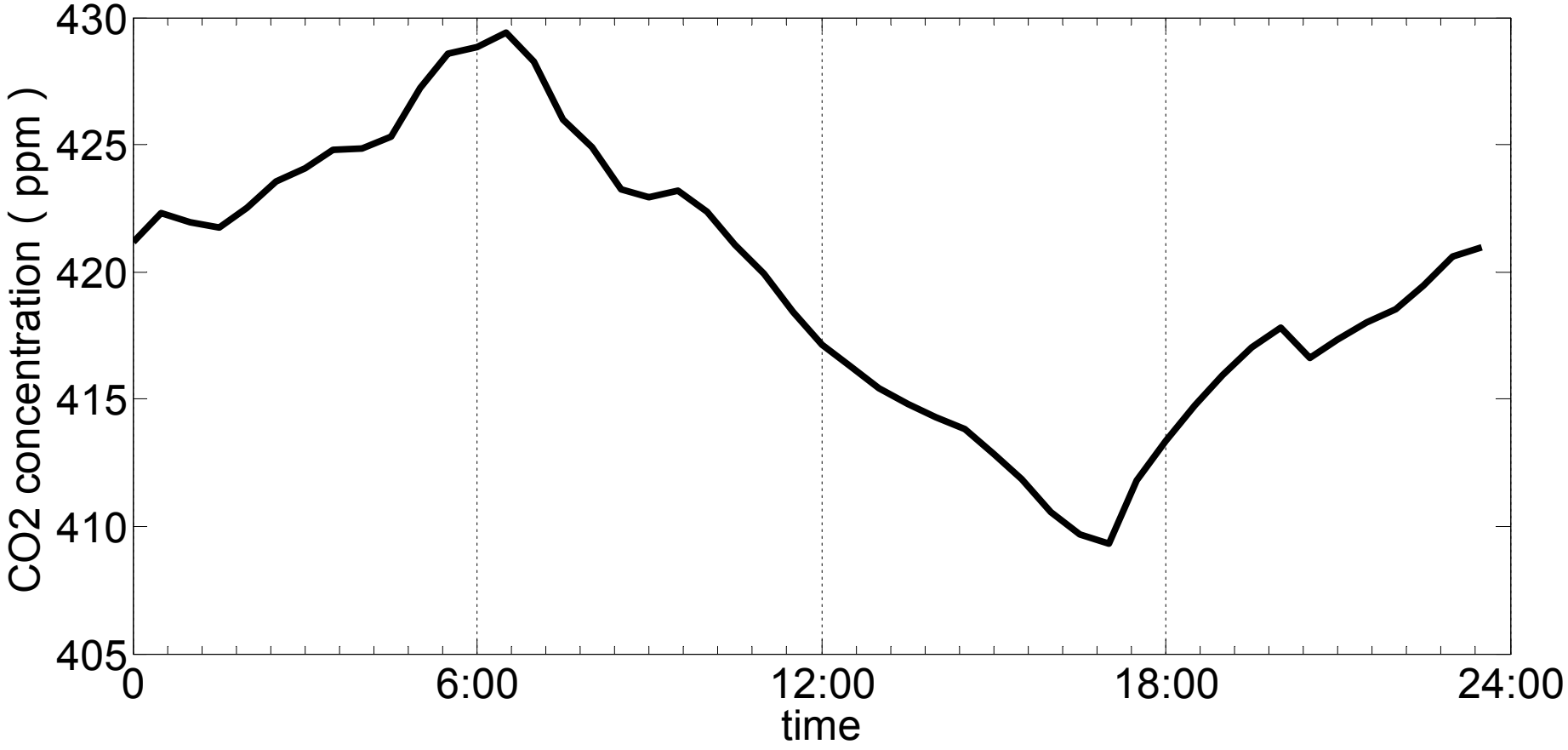
- Temperature and humidity

  An air temperature and humidity probe (model HMP155A; Vaisala, Inc., Helsinki, Finland)

(Xuhui Lee et al., 2014)

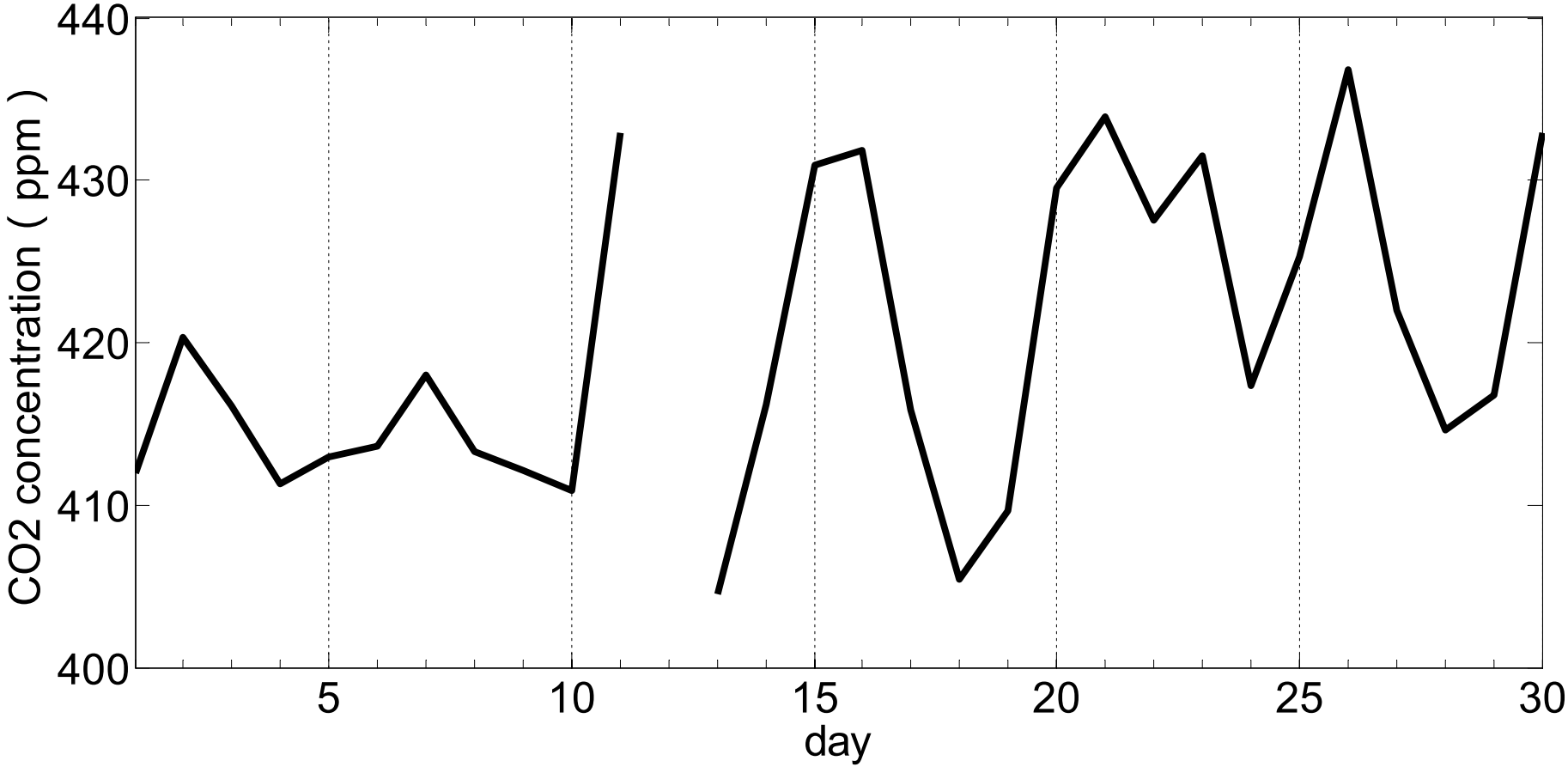
7 Data in October, 2015

7.1 Diurnal variation

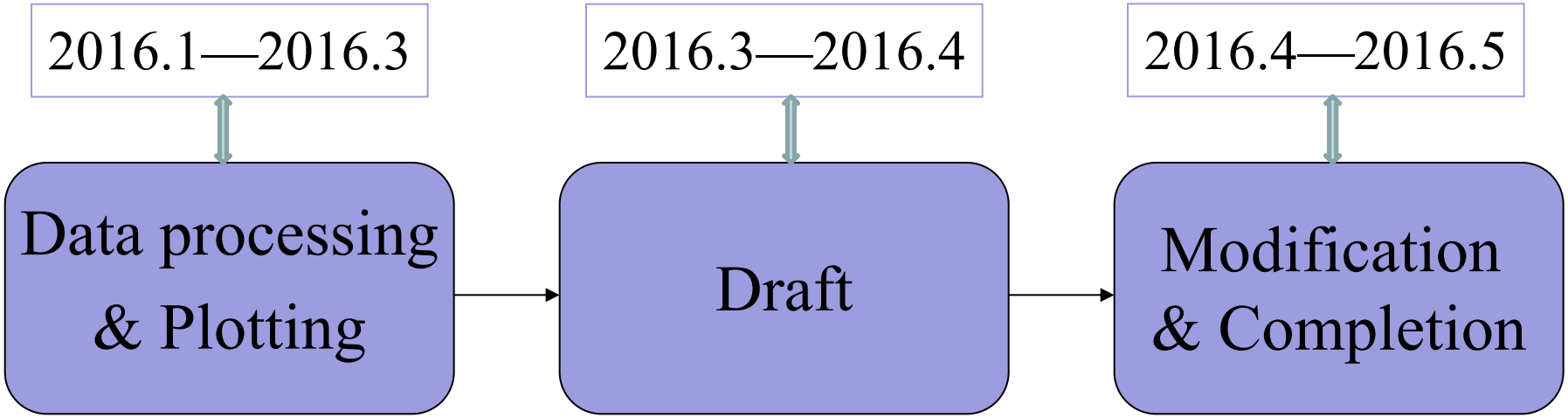


7 Data in October, 2015

7.2 Interday variation



8 Research schedule



9 Expected results

- ✓ Achieve the goals mentioned above
- ✓ Write a paper

Thank you!