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

The IRGASON Project: preliminary results from the winter field campaign in Northwest China

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2. Site description & Instrumentation
3. Data processing
4. Preliminary results
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   - Time series and scatter plot (CO_2, H_2O, H, λE, F_c, u^*)
   - Diurnal composite (CO_2, H_2O, H, λE, F_c, u^*)
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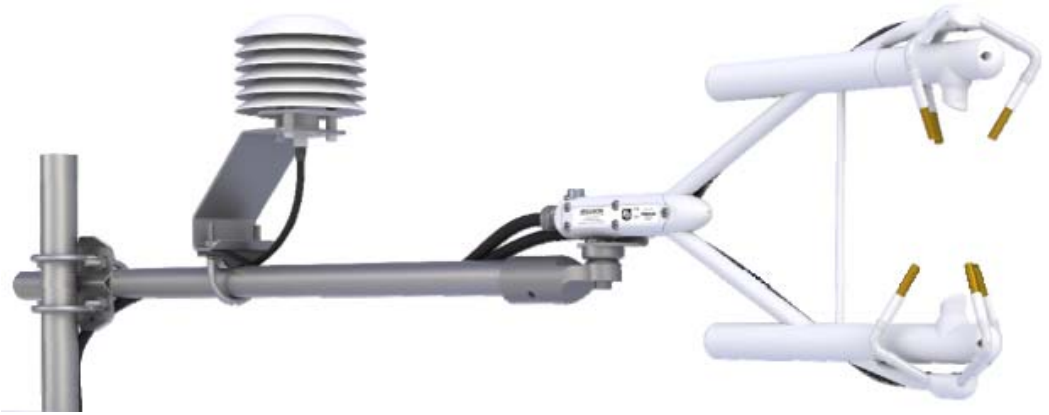
1. Background & Objective

Gill & Li-7500A (Li-Cor Inc.)

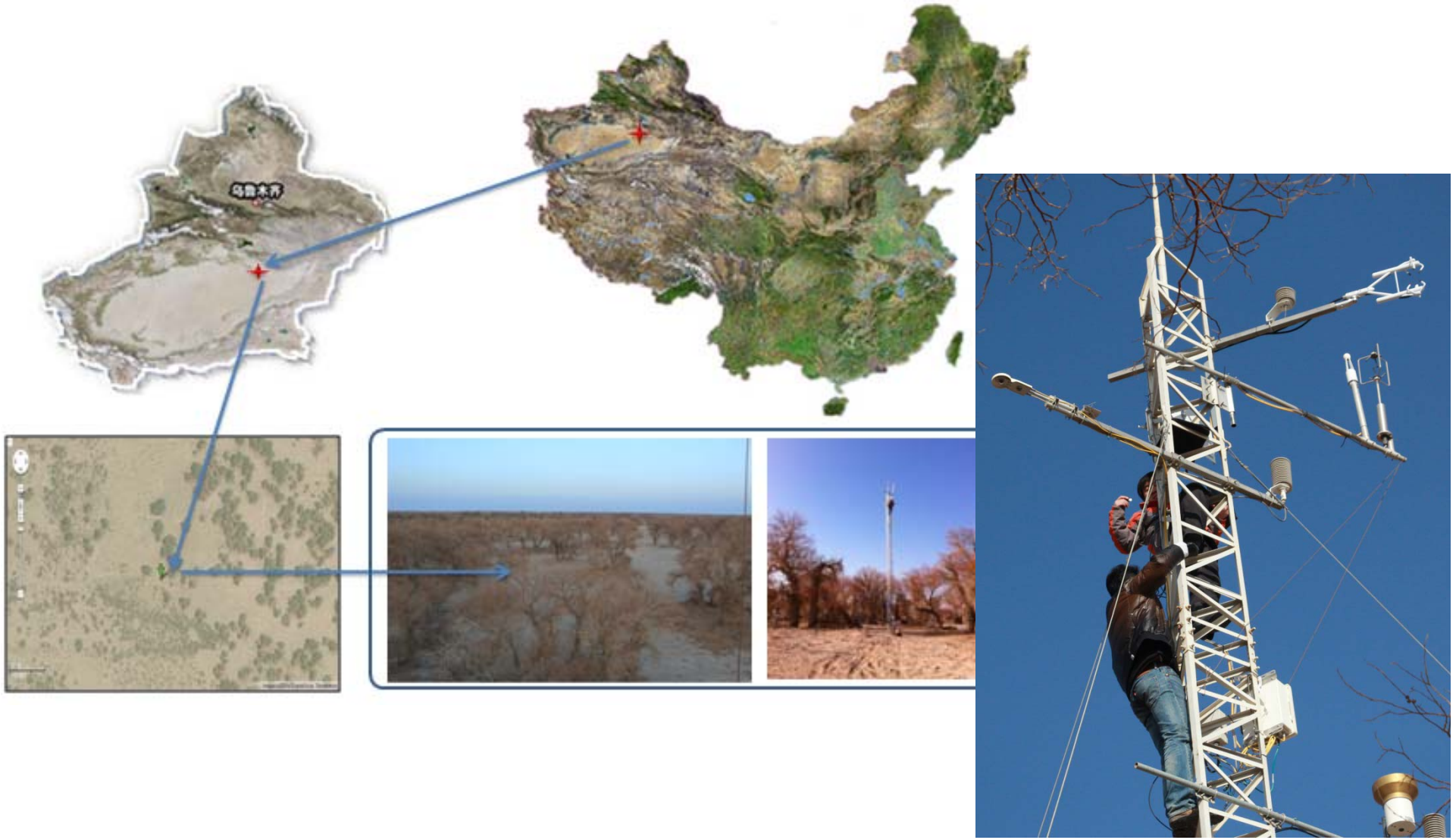


IRGASON (Campbell Scientific Inc.)

IRGASON's advantages in geometry (colocation, synchronicity and aerodynamics) and low power consumption.

To evaluate the performance of IRGASON in low flux conditions and compare it with classic open-path EC systems.

2. Site description



Site and climate

Geography		Climatology	
Latitude	40º26'02.27" N	Air temperature	12 ºC
Longitude	88º01'36.20" E	Annual precipitation	37.2 mm
Elevation	843 m	Wind speed	2.4 m s^{-1}
Landscape	populus euphratica forest	Prevailing wind	NE, NW
Canopy height	10 m	Sunshine percentage	68%

Instrumentation

Instruments	Sensors	Height/Depth(m)	Variables	Operation period
EC	EC150+CSAT3	15	H, λE, F_c, u^*, CO_2, H_2O, U, wind direction	Jun.2013-Dec.2013
	Li-7500A+Gill	15		Jun.2013-now
	IRGASON	15		Dec.16,2013-Jan.13,2014, Mar.3,2014-now
Radiation	CNR4	14	$K_\downarrow$, $K_\uparrow$, $L_\downarrow$, $L_\uparrow$, R_n	Jun.2013-now
	PAR LITE	14	PAR	Jun.2013-now
MET	HMP155A	11, 14	T_a, RH	Jun.2013-now
	SI111	11	T_{skin}	Jun.2013-now
	TE525MM	11	Precipitation	Jun.2013-now
Soil	Hukseflux HFP01	0.08, 0.2, 0.5	Soil heat flux	Jun.2013-now

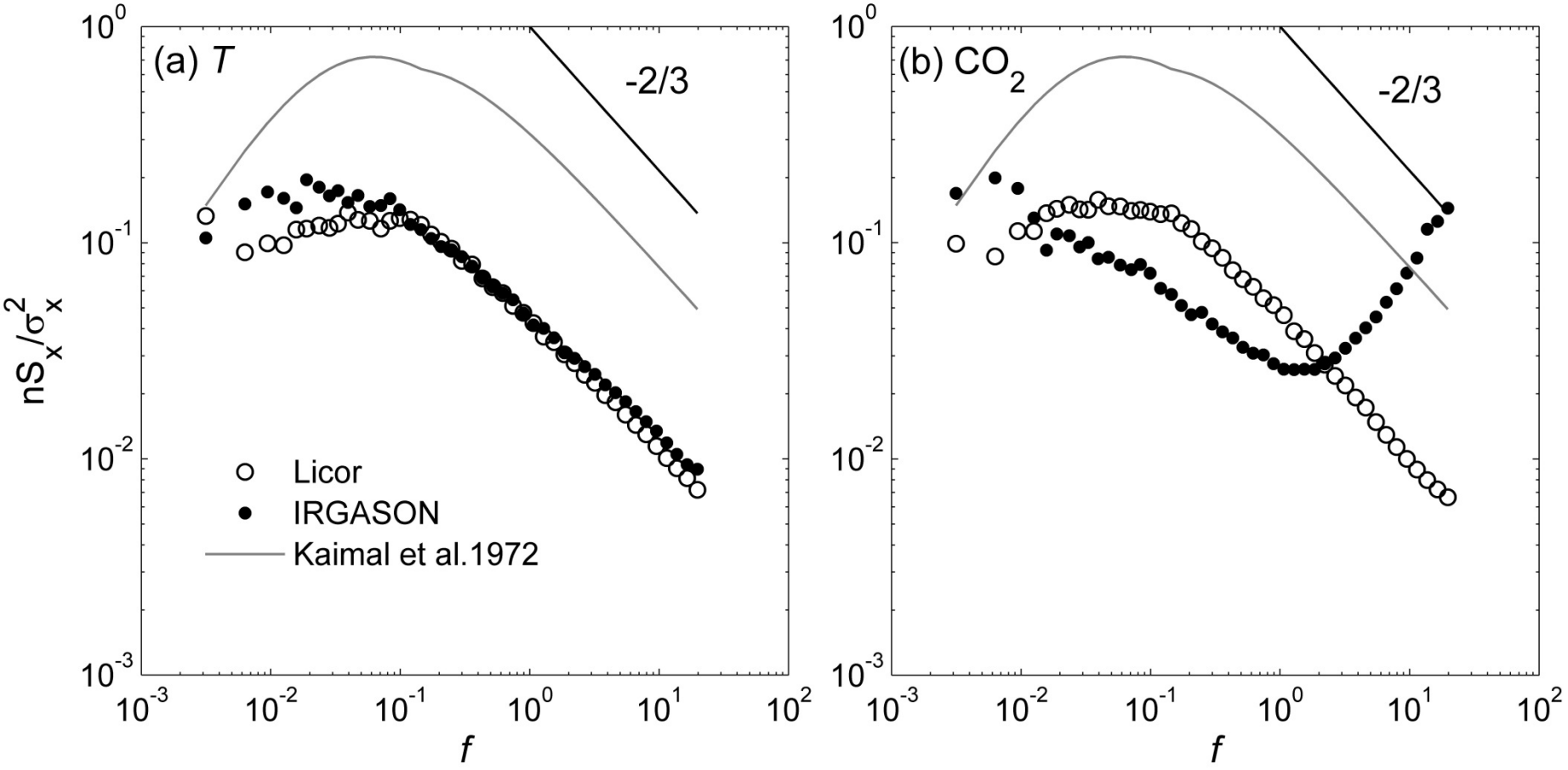
Evaluation and comparison period: **Dec.24, 2013—Jan.4, 2014**

3. Data processing

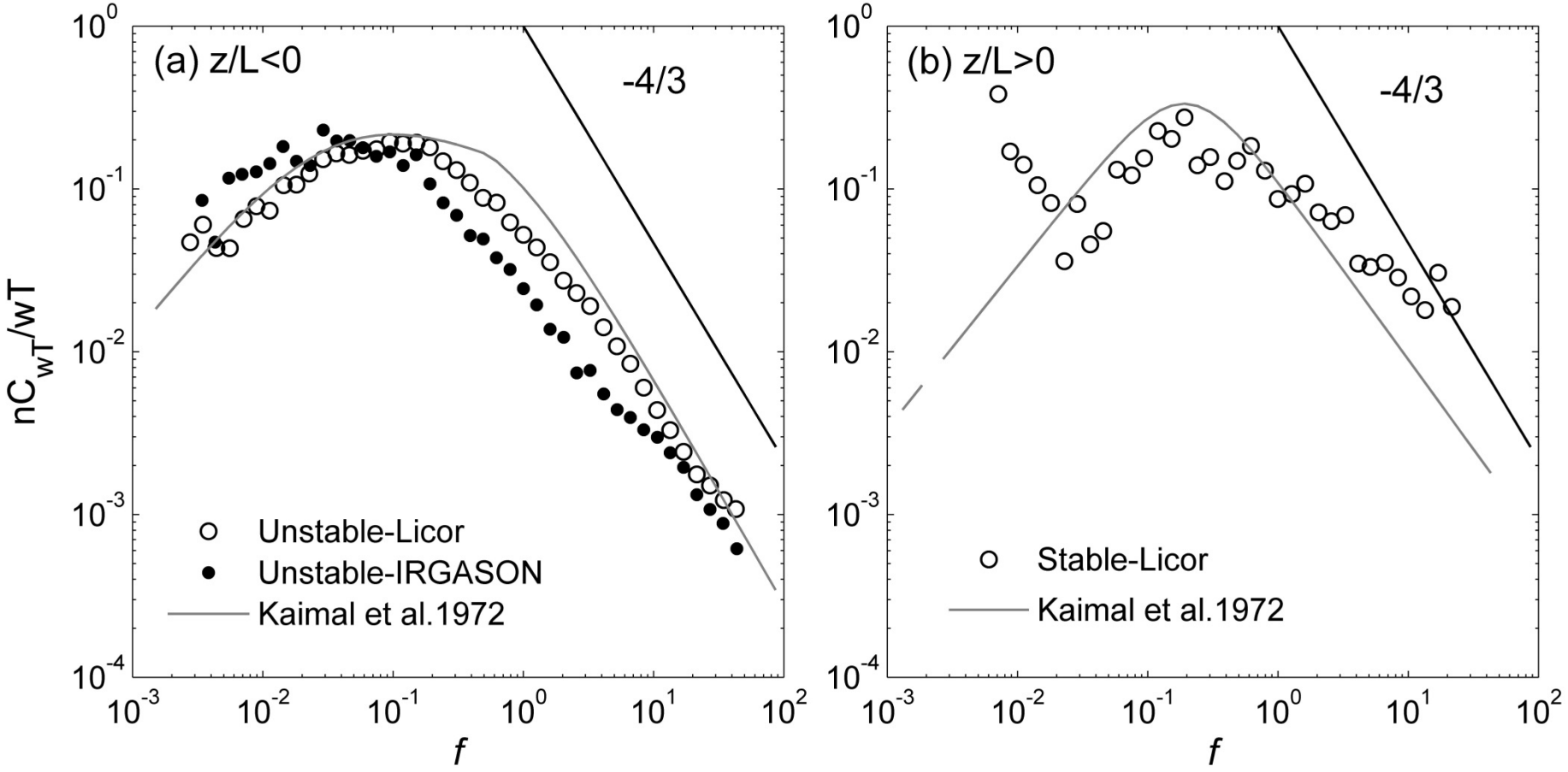
- EddyPro 5.0 (from 10 Hz to 30 min)
- Tilt correction: double rotation
- Detrend: block average
- Time lag detection: covariance maximization
- Compensate density fluctuation: WPL correction
- FFT: Hamming (50)
- Spectra correction: low frequency (Moncrieff et al., 2004), high frequency (Moncrieff et al., 1997)

4. Preliminary results

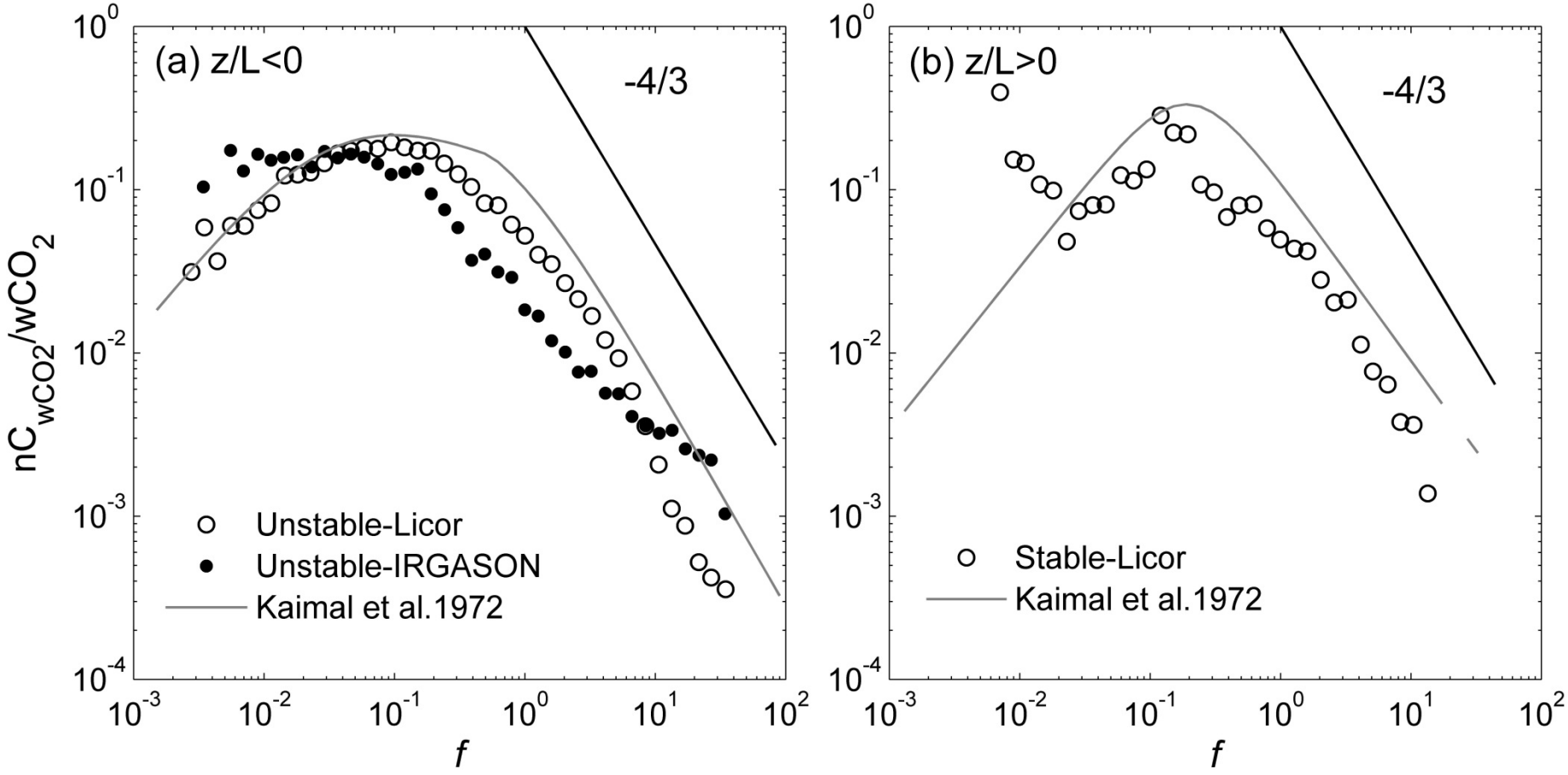
Spectra of T and CO_2



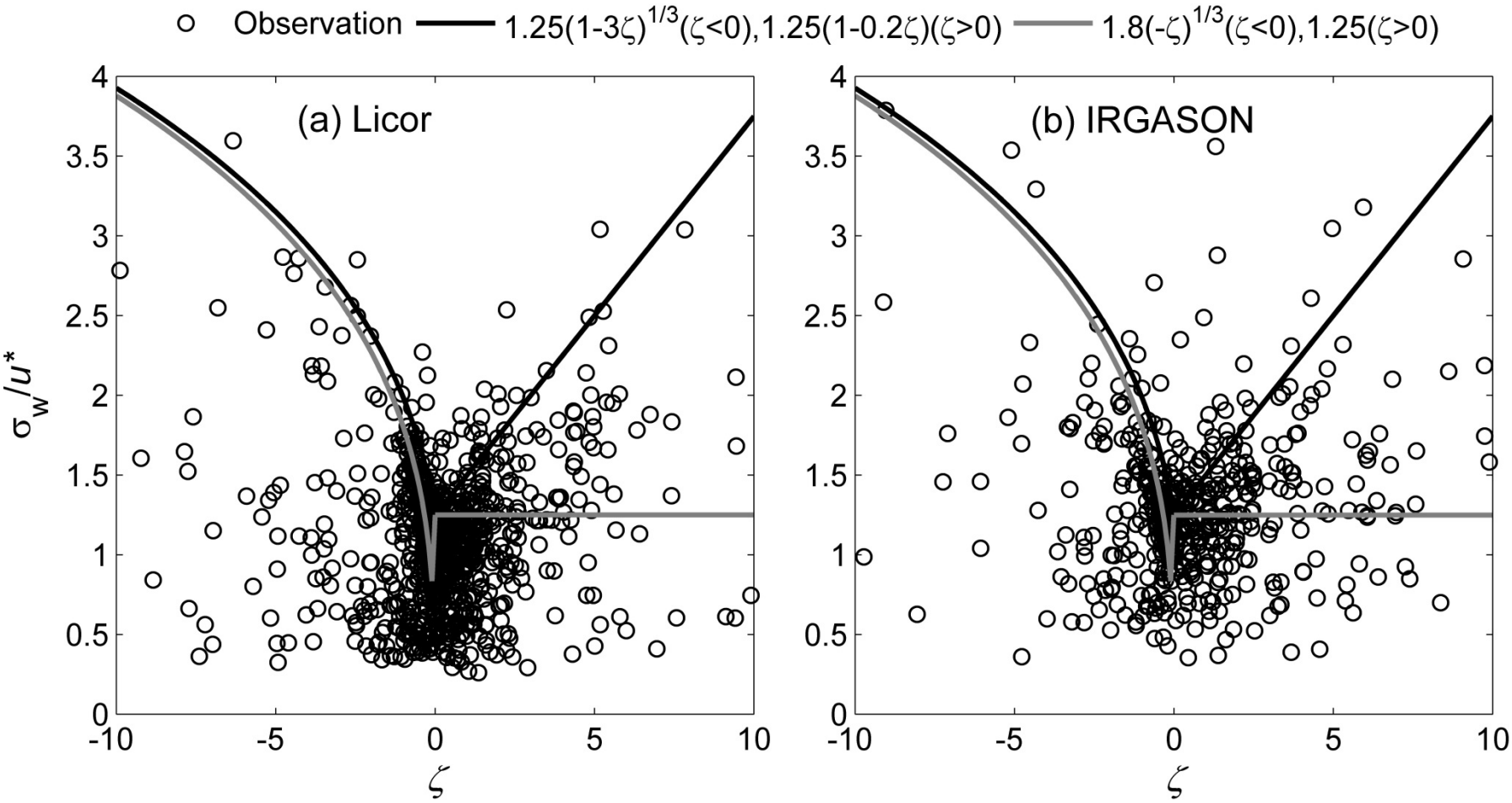
Cospectra of *wT*



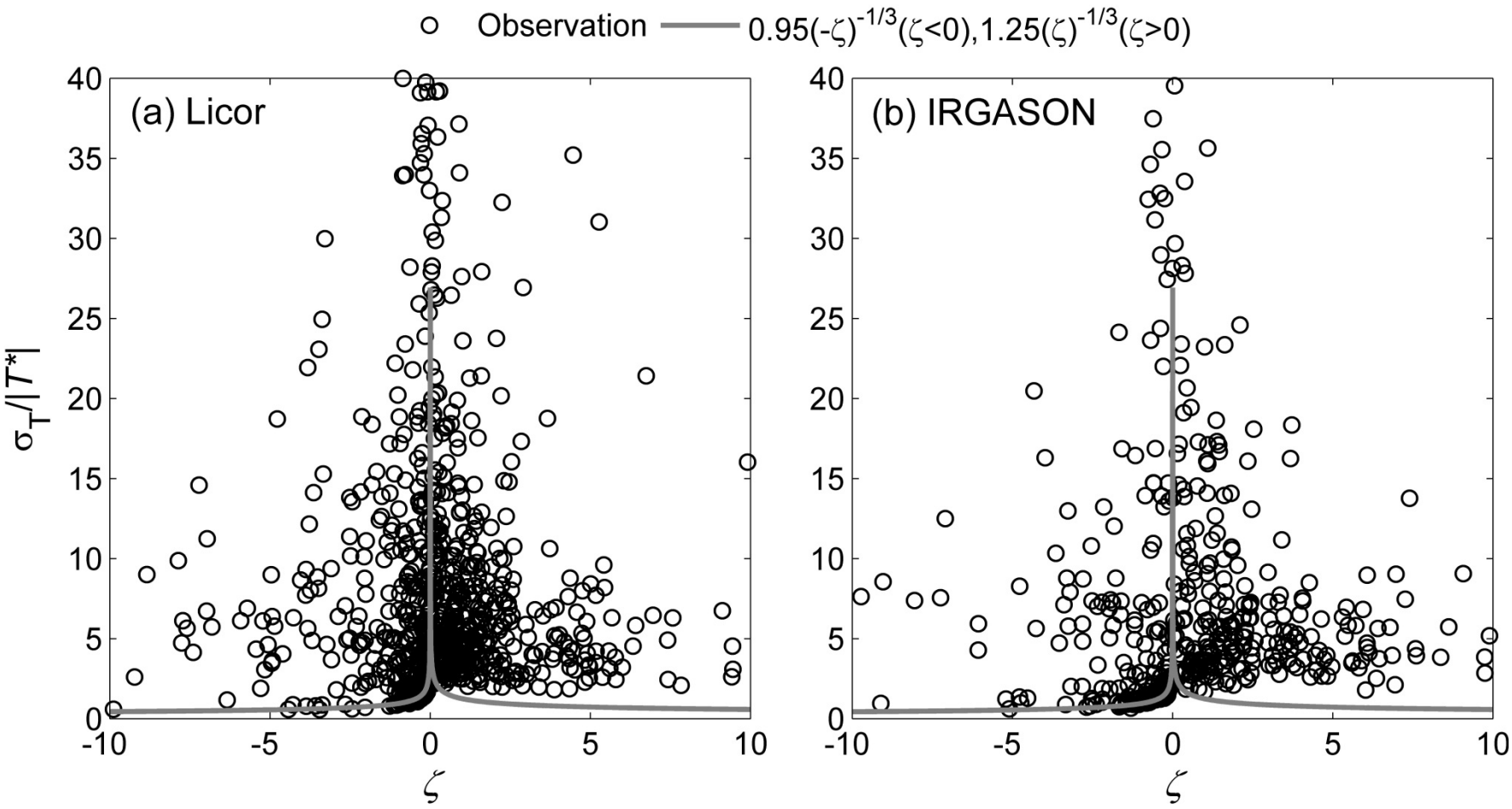
Cospectra of wCO_2



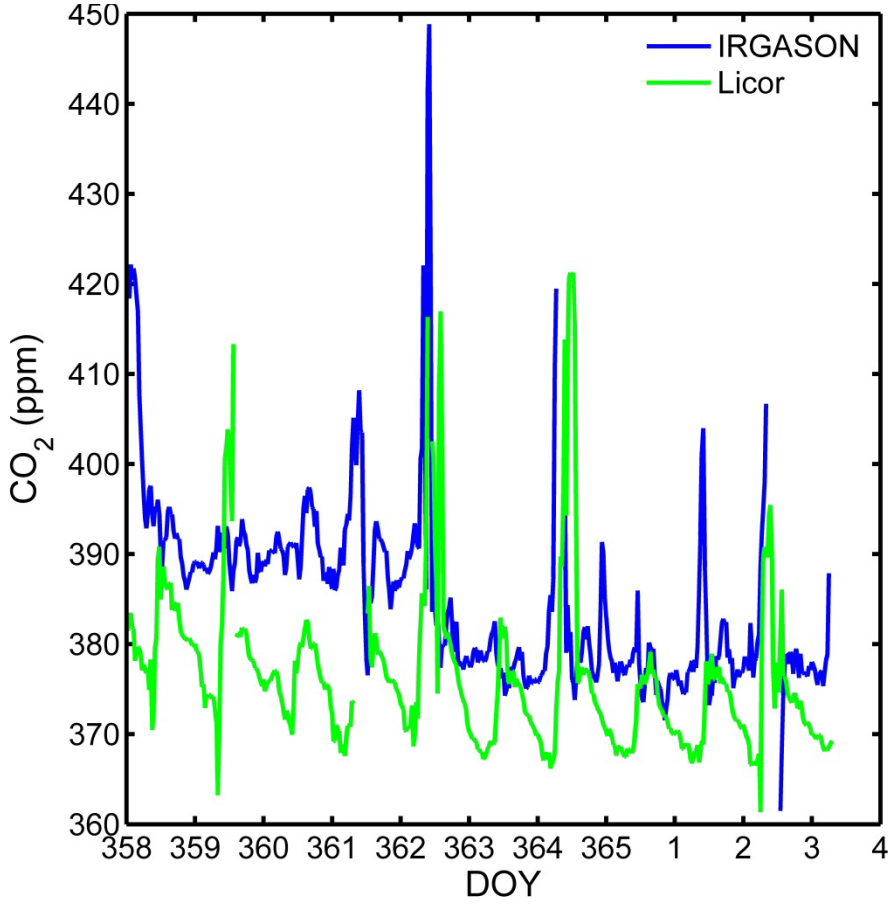
Similarity for σ_w/u^*

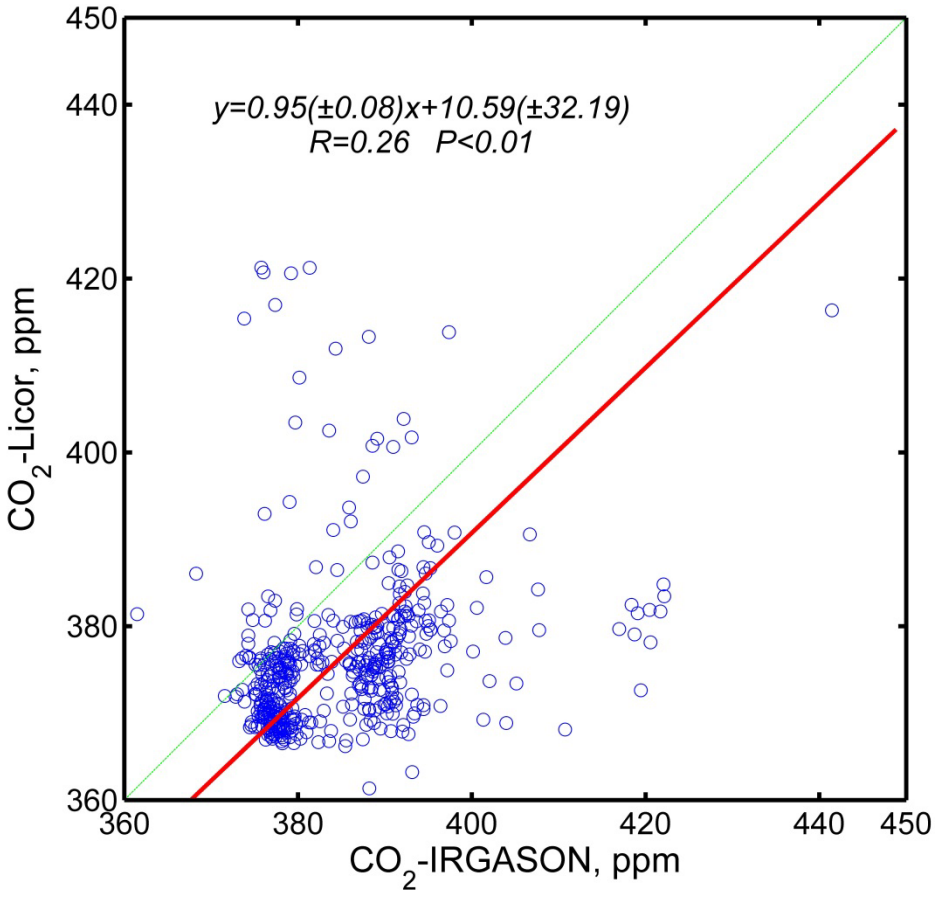


Similarity for $\sigma_T/|T^*|$

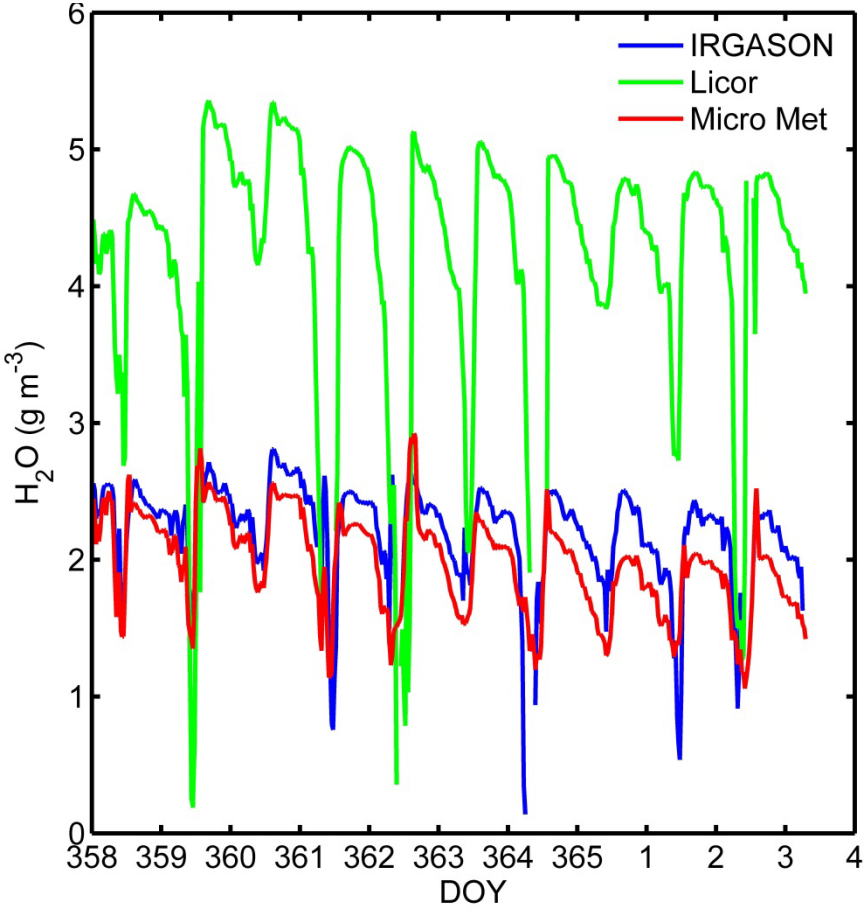


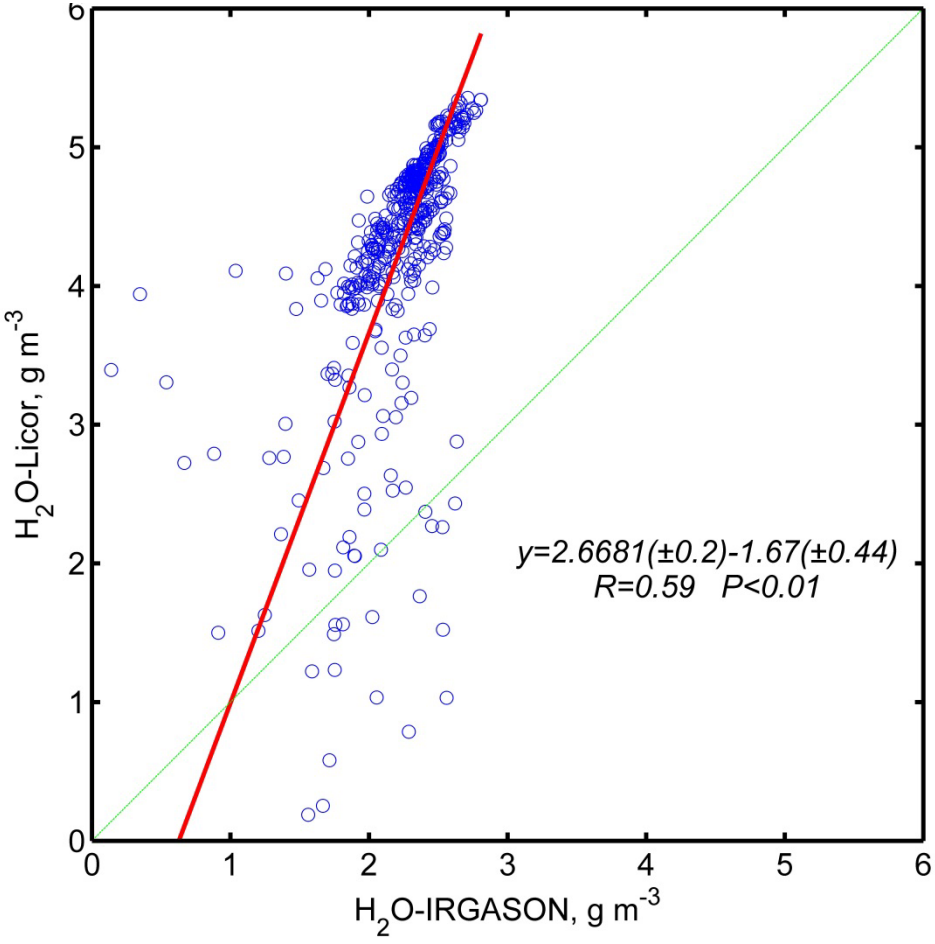
Time series and scatter plot for CO_2



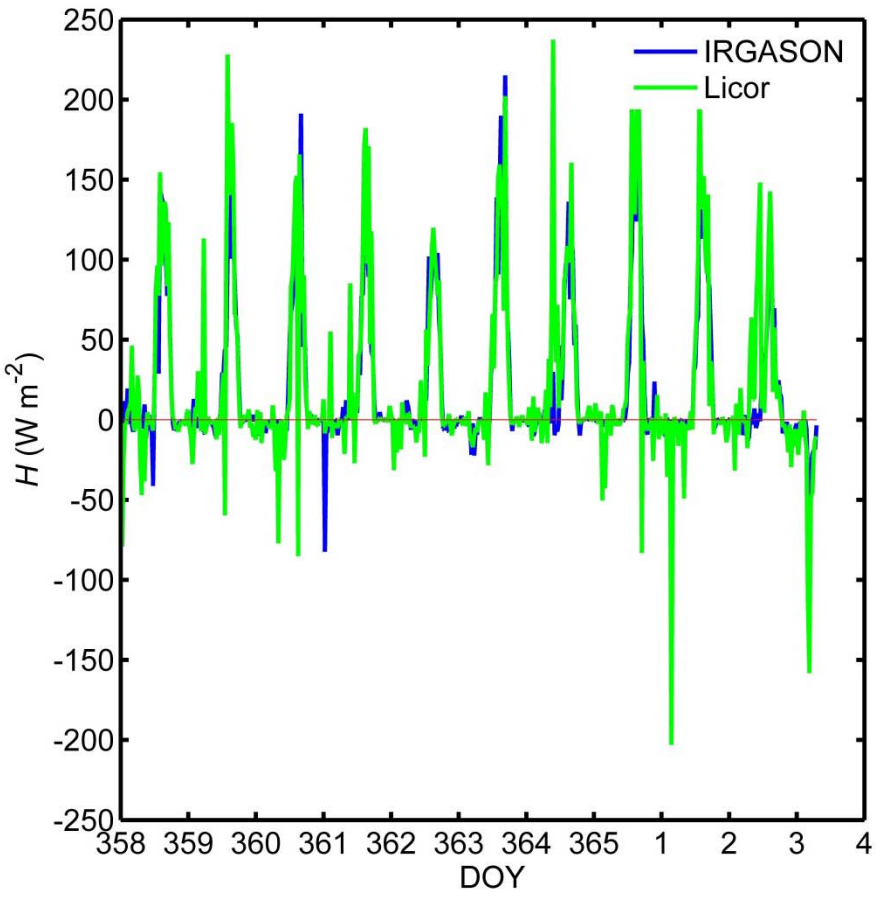


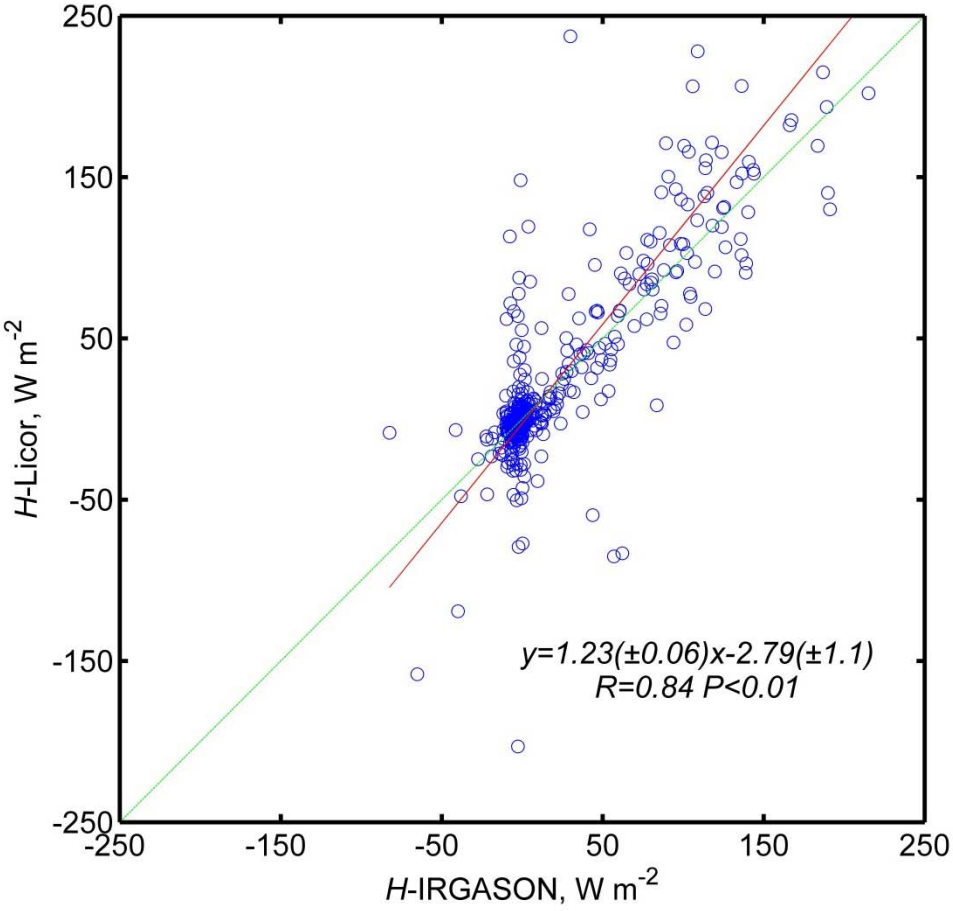
Time series and scatter plot for H_2O



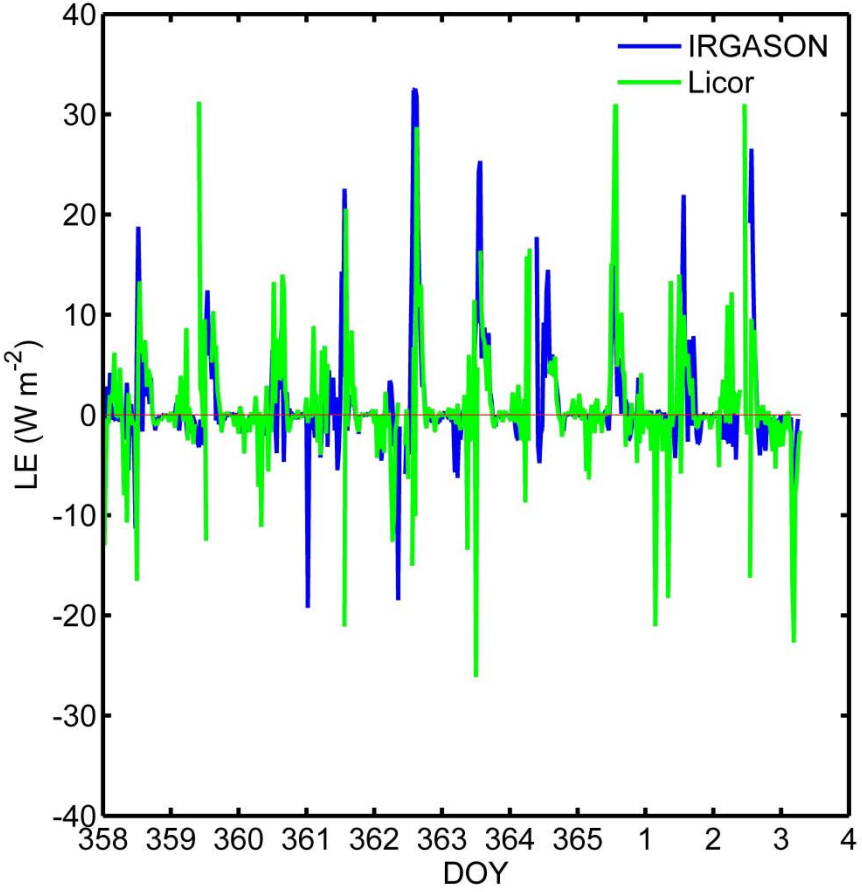


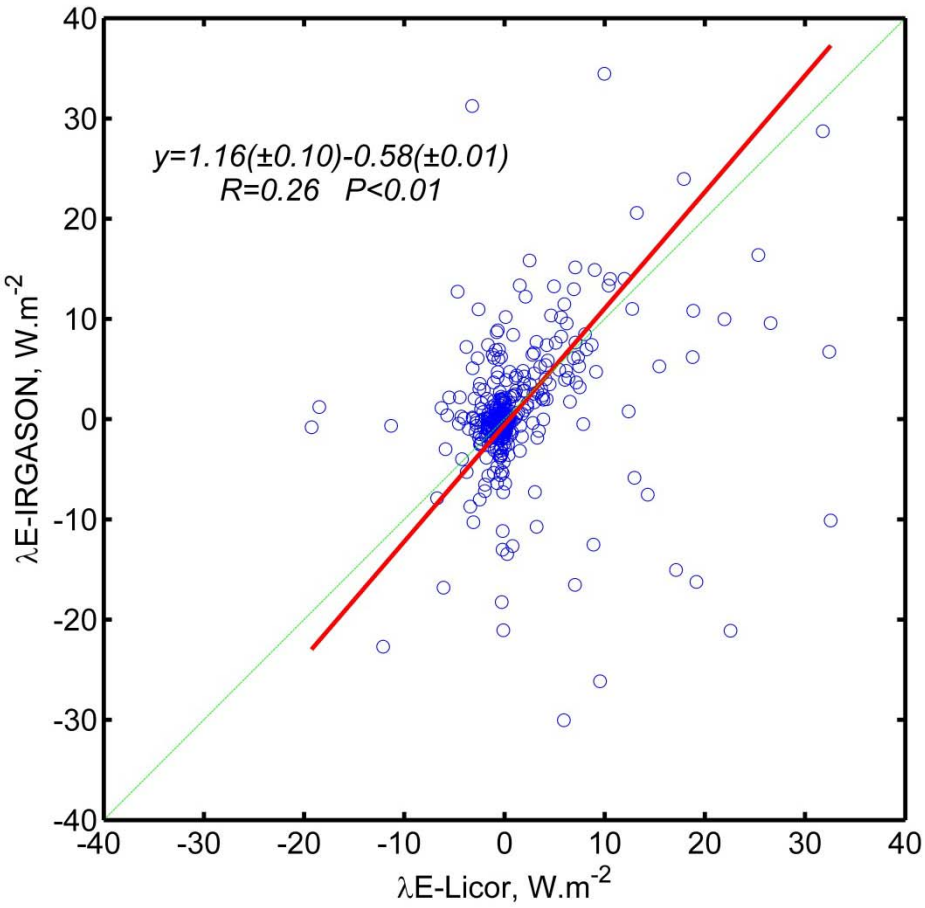
Time series and scatter plot for *H*



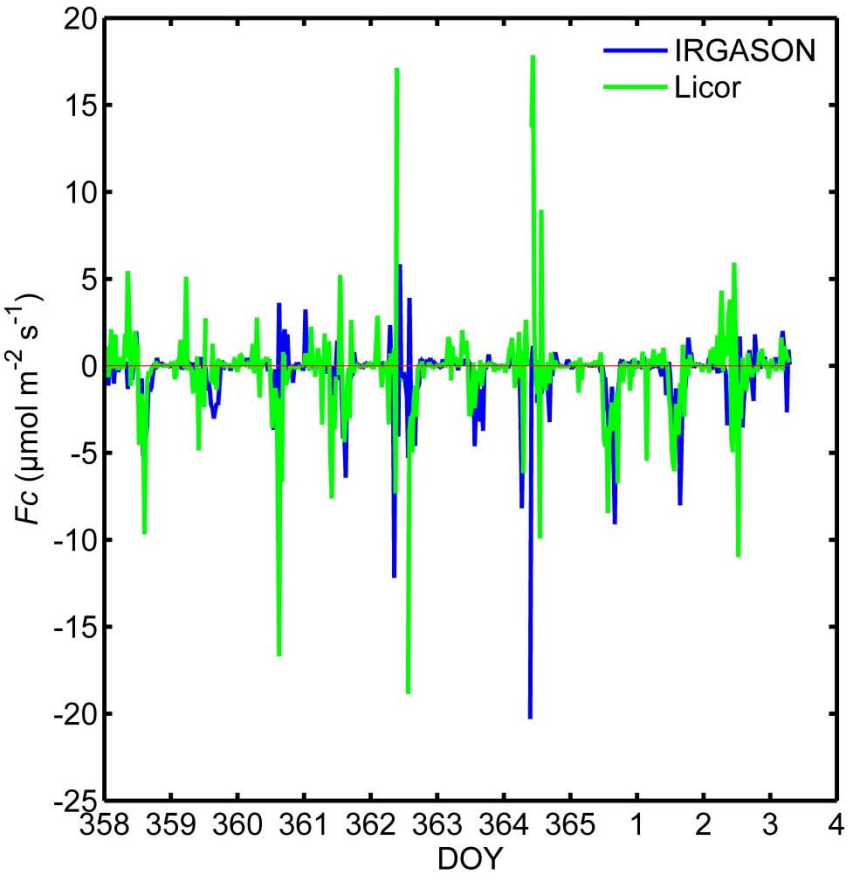


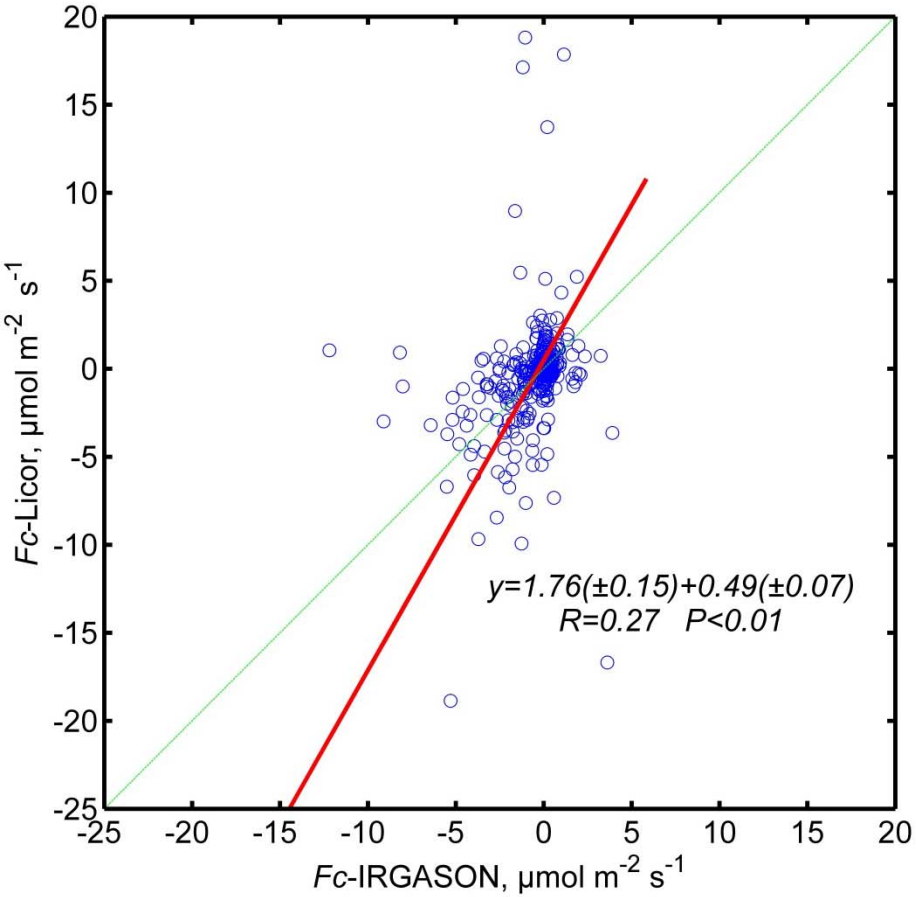
Time series and scatter plot for λE



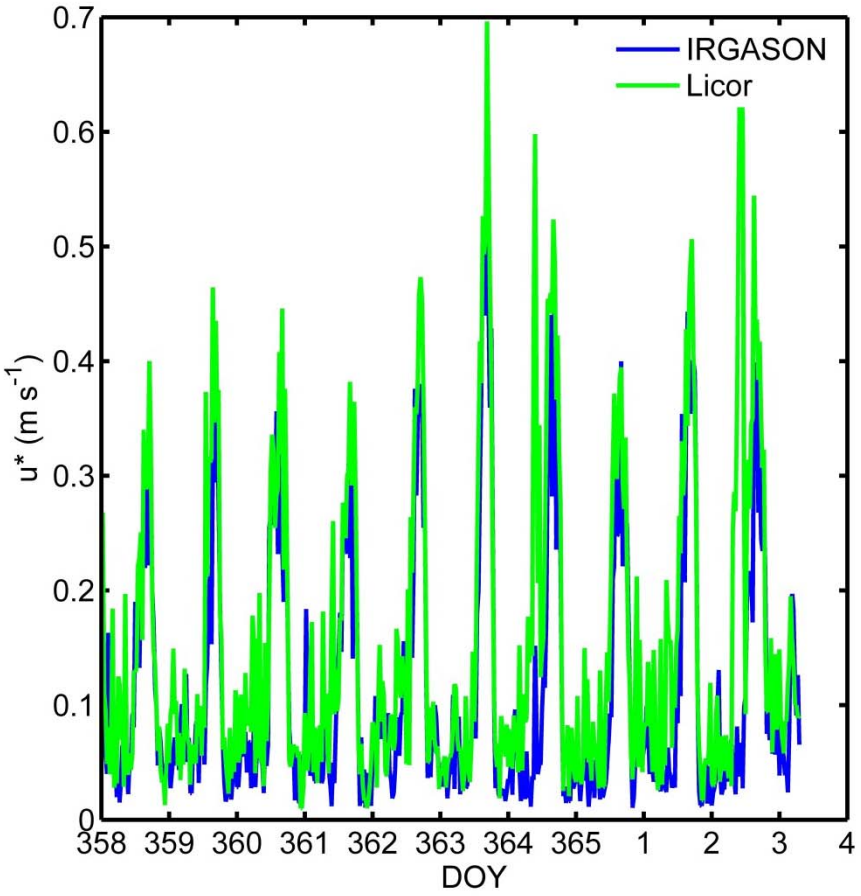


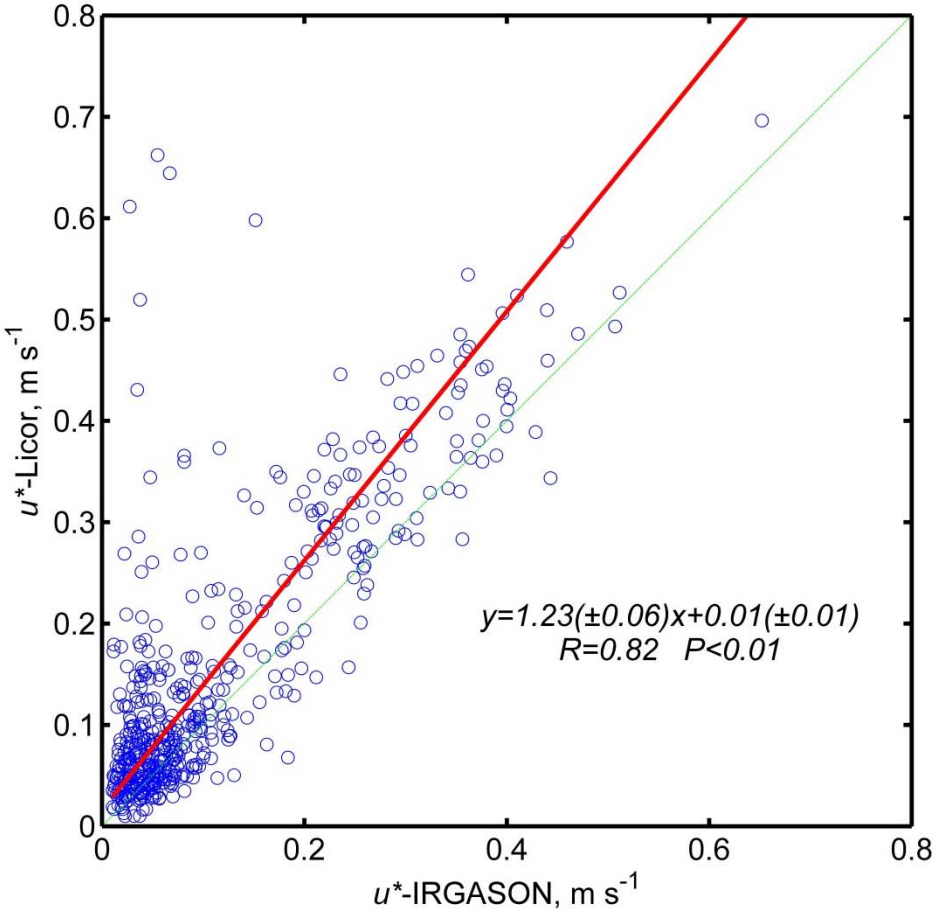
Time series and scatter plot for F_c



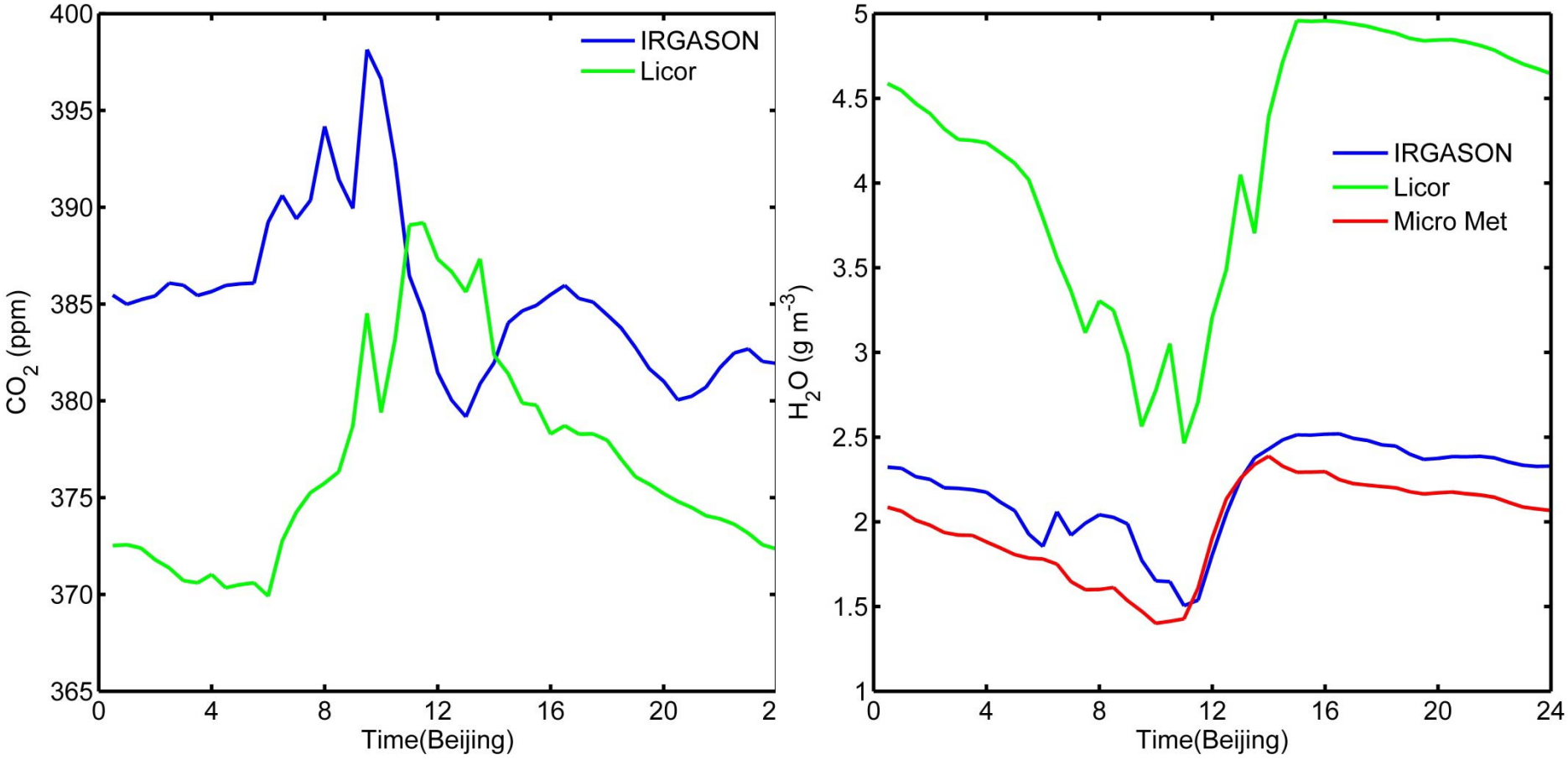


Time series and scatter plot for *u**

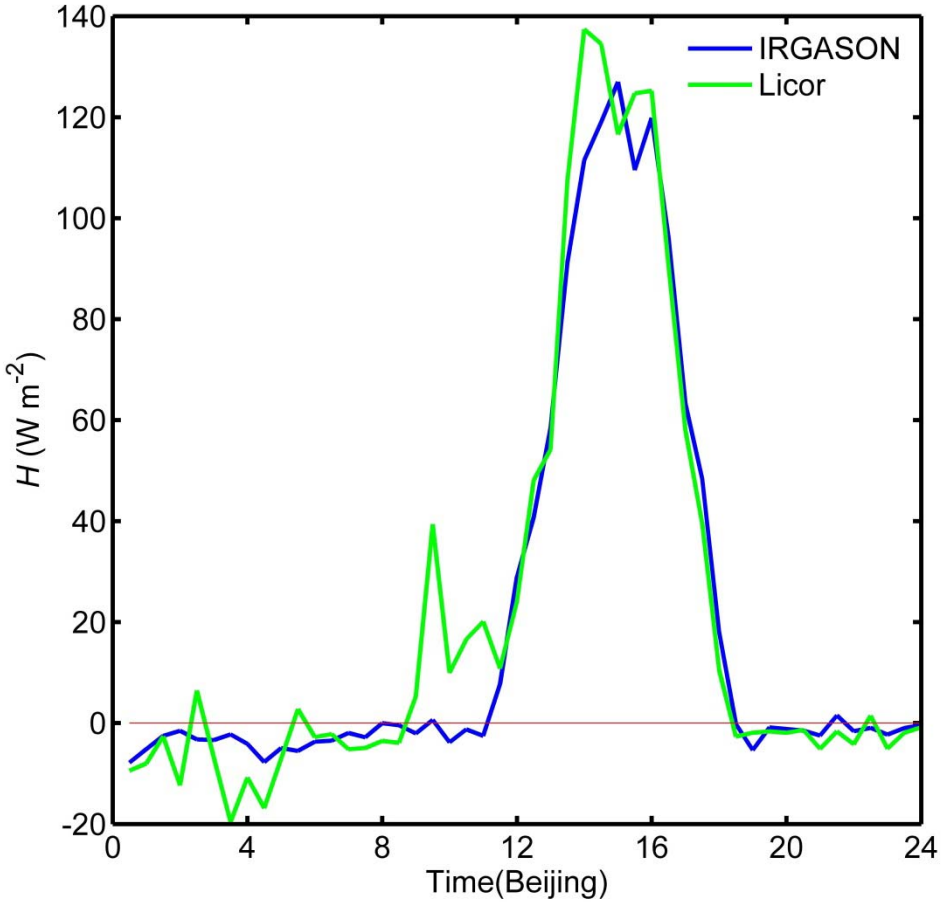


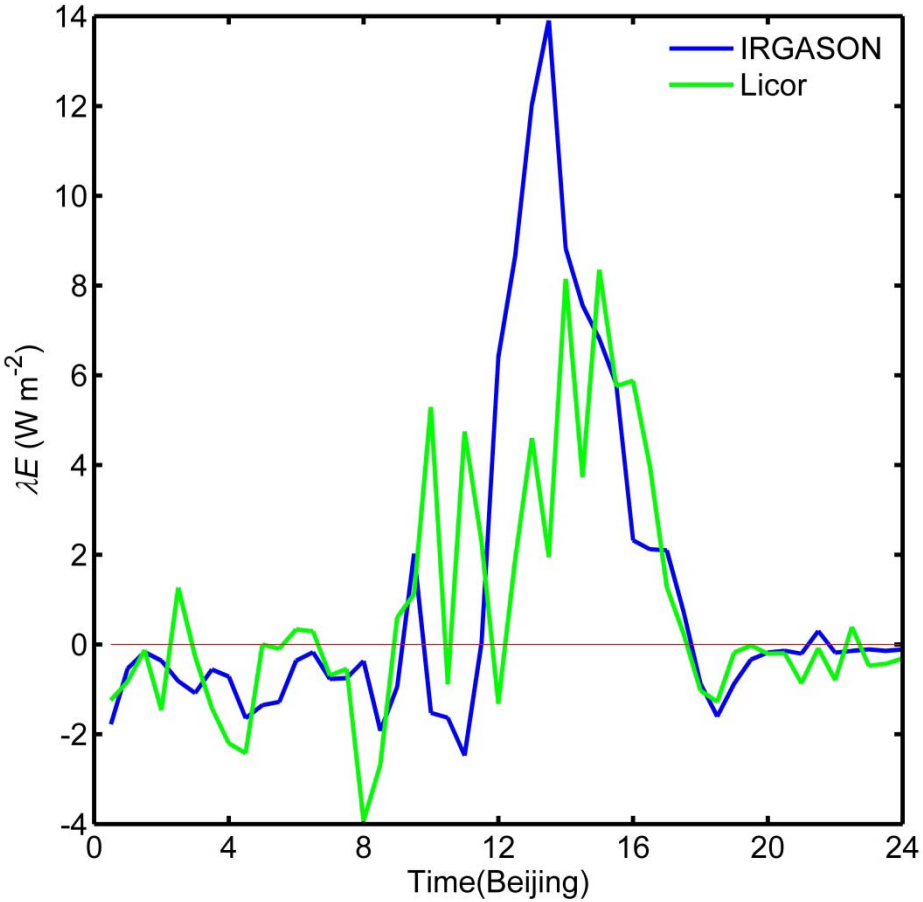


Diurnal composite of CO_2 and H_2O

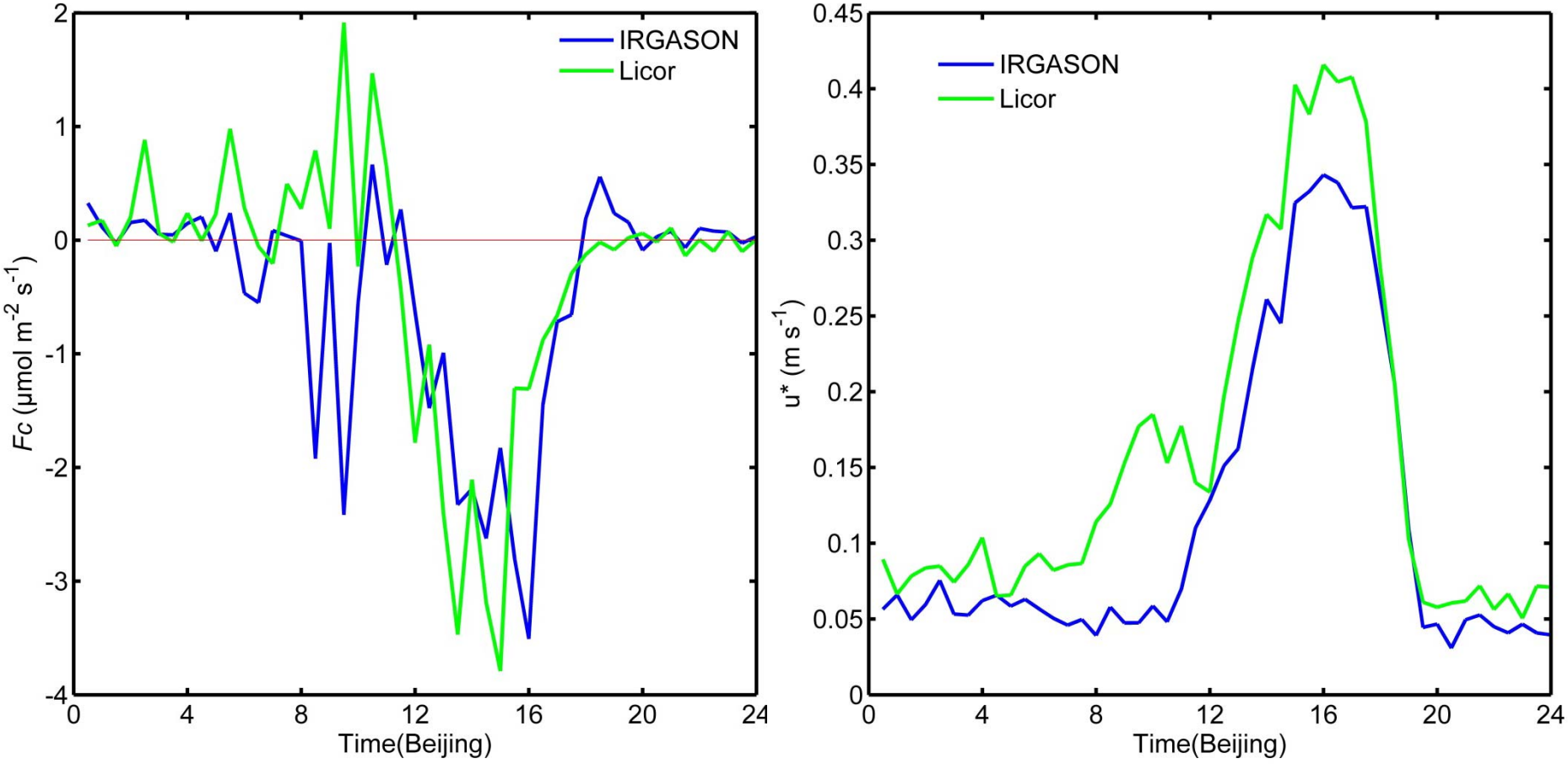


Diurnal composite of H and λE





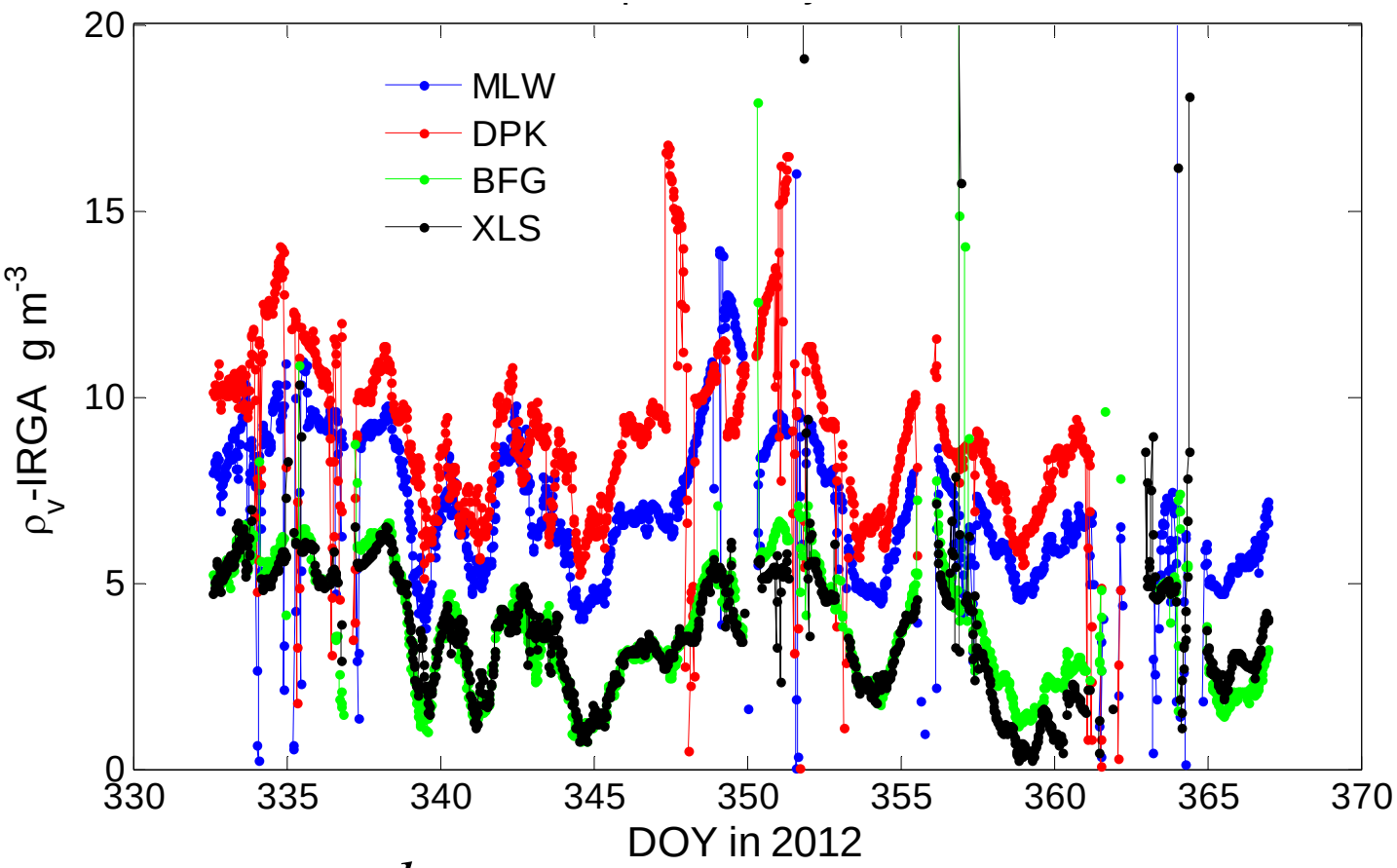
Diurnal composite of F_c and u^*



Valid daily mean (IRGASON/Licor)

doy	***H***	***λE***	F_c		**CO_2**	**H_2O**	***u****
	W m^{-2}	W m^{-2}	μmol m^{-2} s^{-1}		ppm	g m^{-3}	m s^{-1}
358	20.9 /21.2	0.71 /0.27	-0.51	-0.18	397.3 /381.5	2.3 /4.2	0.11 /0.12
359	19.3 /24.5	0.8 /0.8	-0.4	-0.14	389.6 /380.9	2.34 /4.0	0.10 /0.13
360	20.7 /17.2	0.27 /0.74	-0.13	-0.77	390.9 /376.4	2.4 /4.9	0.11 /0.14
361	16.3 /24.4	0.53 /NaN	-0.4	-0.46	390.9 /NaN	2.2 /NaN	0.1 /0.13
362	17.5 /15.5	2.78 /0.01	-0.51	-0.24	389.2 /381.0	2.3 /3.7	0.12 /0.14
363	26.5 /25.2	1.84 /0.64	-0.37	-0.07	377.7 /372.7	2.3 /4.2	0.13 /0.15
364	18.6 /30.9	1.48 /NaN	-0.98	0.62	382 /381.0	2.3 /NaN	0.11 /0.20
365	26.1 /25.3	1.07 /2.35	-0.73	-1.01	377 /371.8	2.3 /4.3	0.1 /0.14
1	24.8 /18.0	1.59 /-0.16	-0.71	-0.73	379.2 /372.1	2.3 /4.3	0.12 /0.16
2	11.5 /22.3	0.91 /1.31	-0.25	0.03	NaN /375.3	2.3 /4.0	0.12 /0.22
Average	**20.2 /22.5**	**1.2 /0.74**	**-0.5**	**-0.29**	**386 /377.0**	**2.3 /4.2**	**0.11 /0.15**

Vapor density observation at Taihu



$$\rho_{vRH} = a\rho_{vIRGA} + b$$

$$\overline{w'\rho'_{vRH}} = \overline{w'(a\rho_{vIRGA} + b)'} = a\overline{w'\rho'_{vIRGA}}$$

5. Next step

Sites	Time	Note
Xinjiang	Dec.16, 2013-Jan.13, 2014, Mar.7, 2014-Mar.11, 2014	With self-heating
Xinjiang	Mar.12, 2014-Apr.12, 2014	Without self-heating
MLW	Apr.15,2014-Jun.15,2014	2 months
XLS	Jun.18, 2014- Aug.18,2014	2 months, supports in design