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

Update on IRGASON Project

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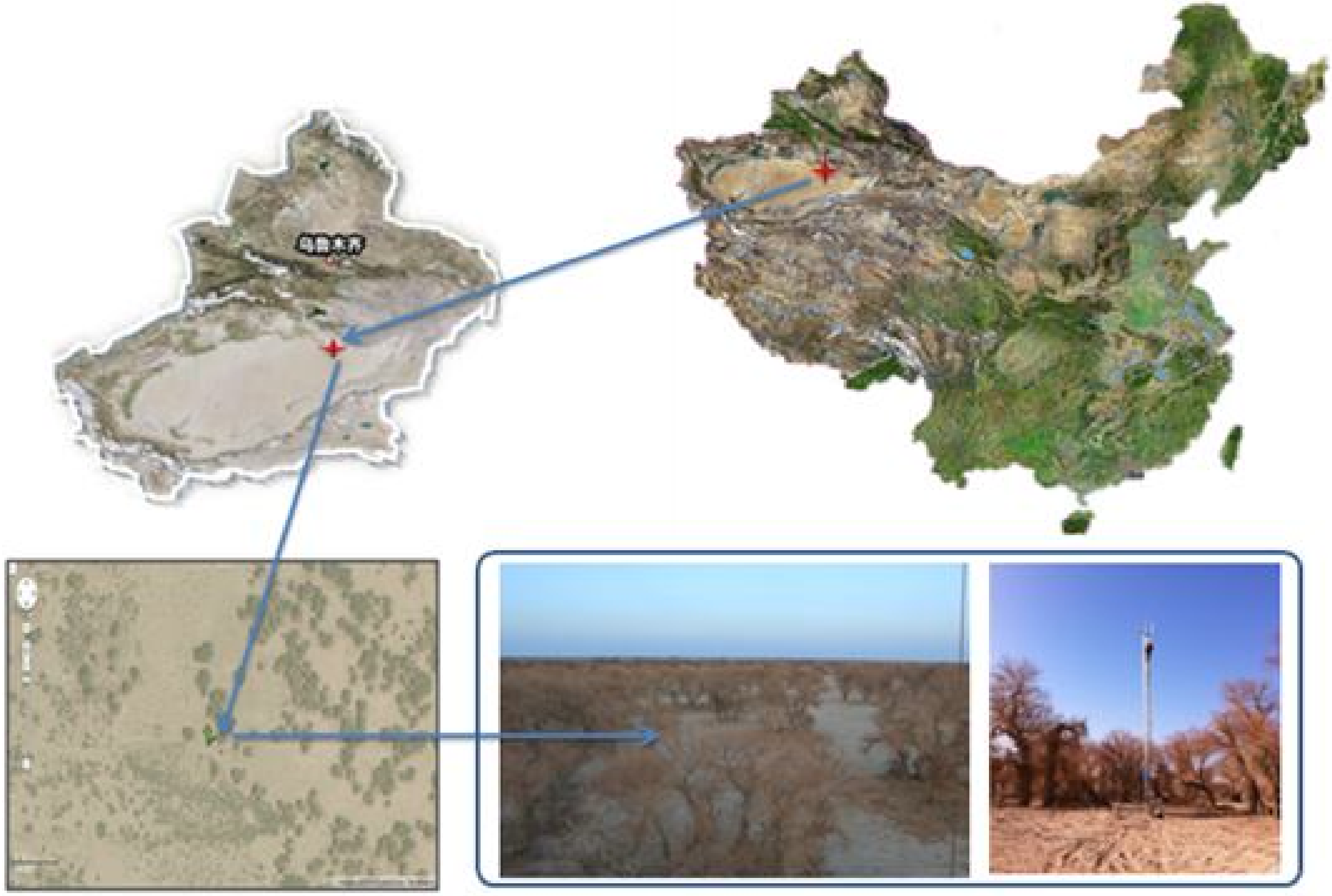
Nanjing, April 11, 2014

Outline

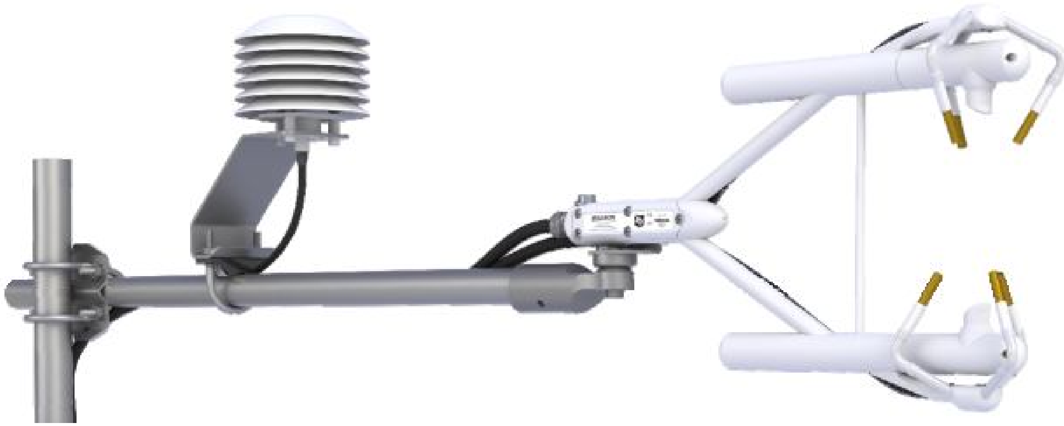
- 1. Background & Objective
- 2. updated results
- 3. Conclusions
- 4. Next work

1. Background & Objective



- In typical winter or desert, the flux is about of 0.2-0.5 mg $CO_2 \cdot m^{-2} \cdot s^{-1}$.

To evaluate the performance of IRGASON in low flux conditions and compare it with Gill+Li-7500A system.



IRGASON (Campbell Scientific Inc.)

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

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

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)

2. updated results

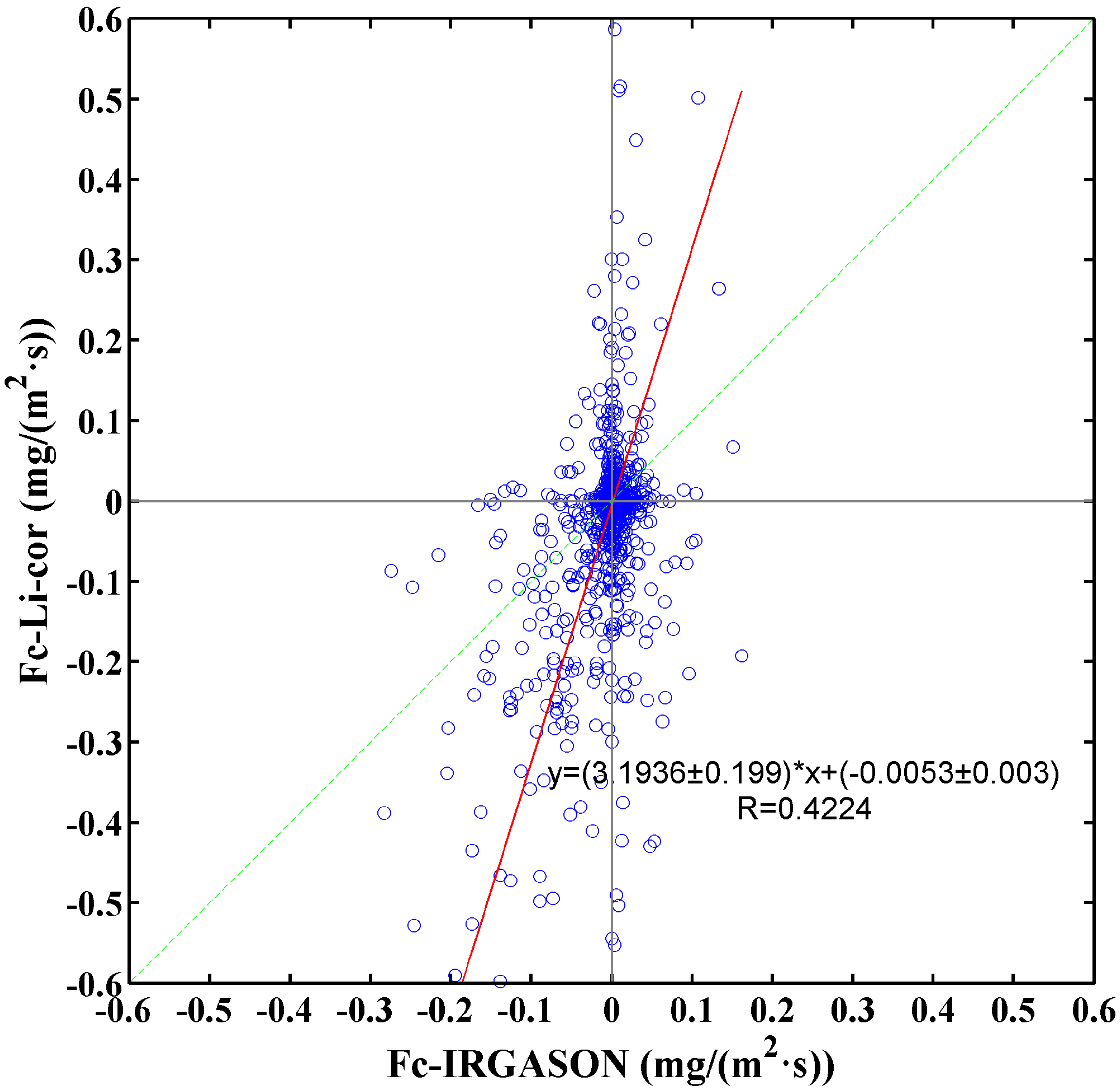


Fig. 1. Fc (IRGASON against Gill+Li-7500A) in Xinjiang.

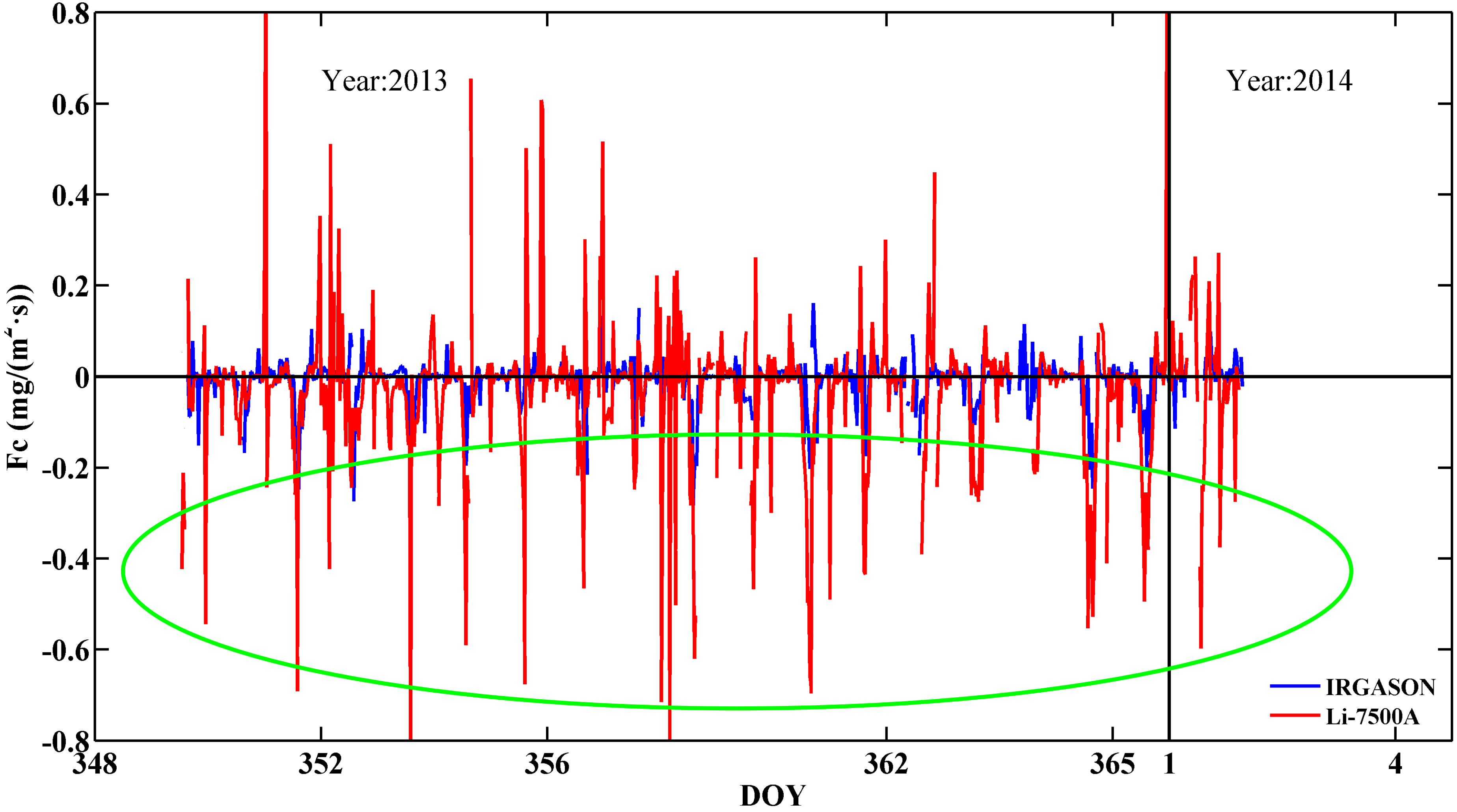


Fig. 2. The time series of Fc in Xinjiang.

Negative Fc could be found at noon with low wind speed.

$$\left.\begin{array}{l} \left.\begin{array}{l} u<u_{avg} \longrightarrow u'<0 \\ w'u'<0 \end{array}\right\} w'>0 \\ Ta\uparrow \longrightarrow CO_2'<0 \end{array}\right\} W'CO_2'<0$$

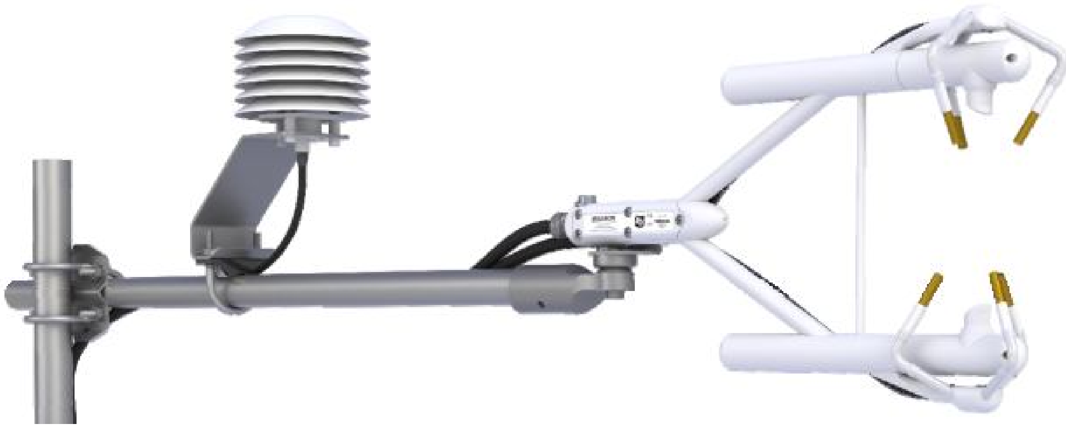


Table.1 Flux carbon in desert in winter.

	IRGASON	Gill+Li-7500A
C（mg/（$m^2 \cdot s$））	-0.516	- 1.734
C（g/（$m^2 \cdot yr$））	-92.49	- 310.70

$$Fc\_wpl = Fc\_raw + Fc\_wpl\_LE + Fc\_wpl\_H$$

Fc_wpl: Carbon dioxide flux after WPL correction, mg/ (m2·s）
Fc_raw: Raw carbon dioxide flux, mg/（m2·s）
Fc_wpl_LE: latent heat correction, mg/（m2·s）
Fc_wpl_H: Sensitive heat correction, mg/（m2·s）
*pressure and self-heating also will be considered in some cases.

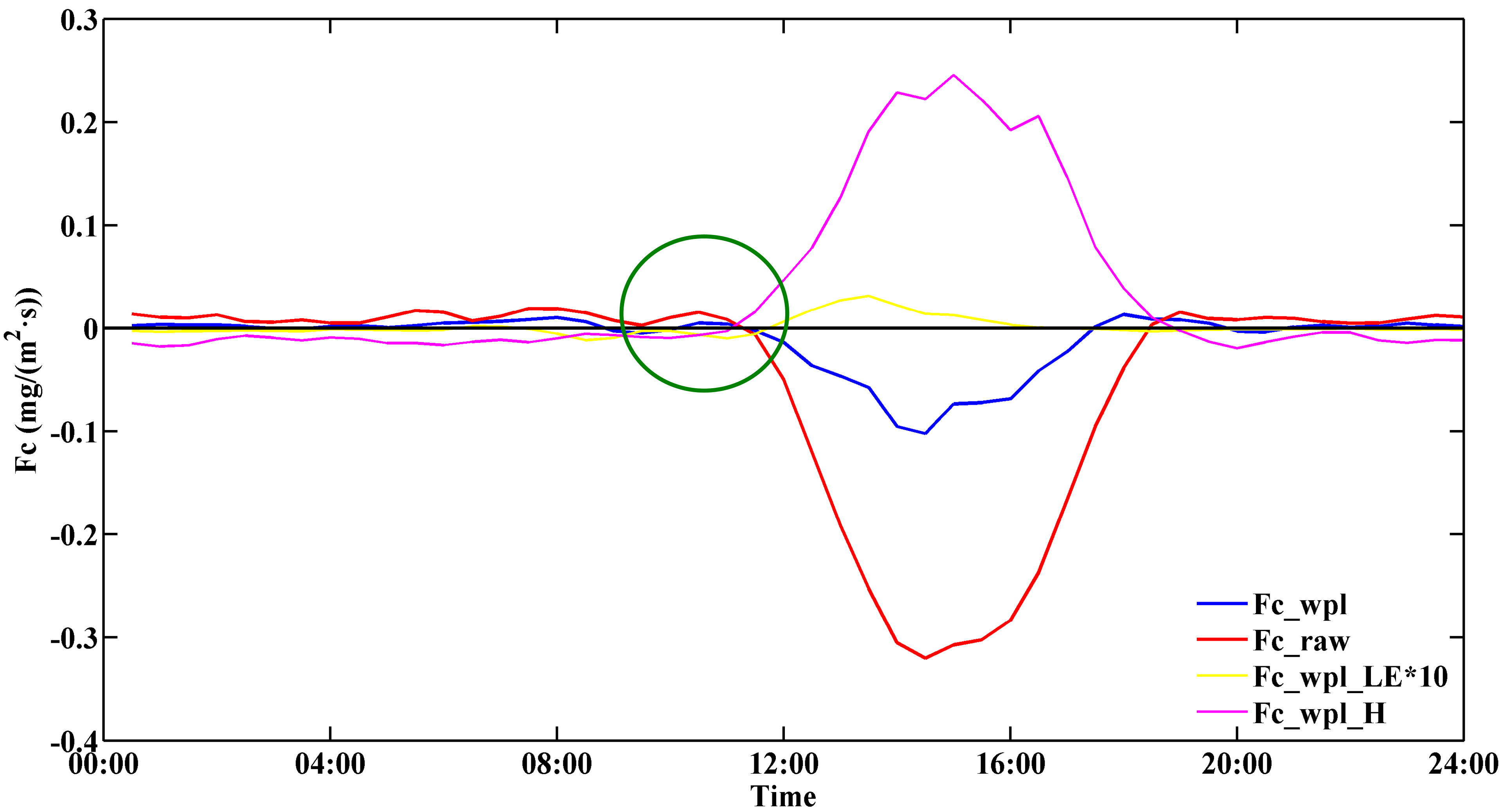


Fig.4. The diurnal composite of Fc_IRGASON in Xinjiang.

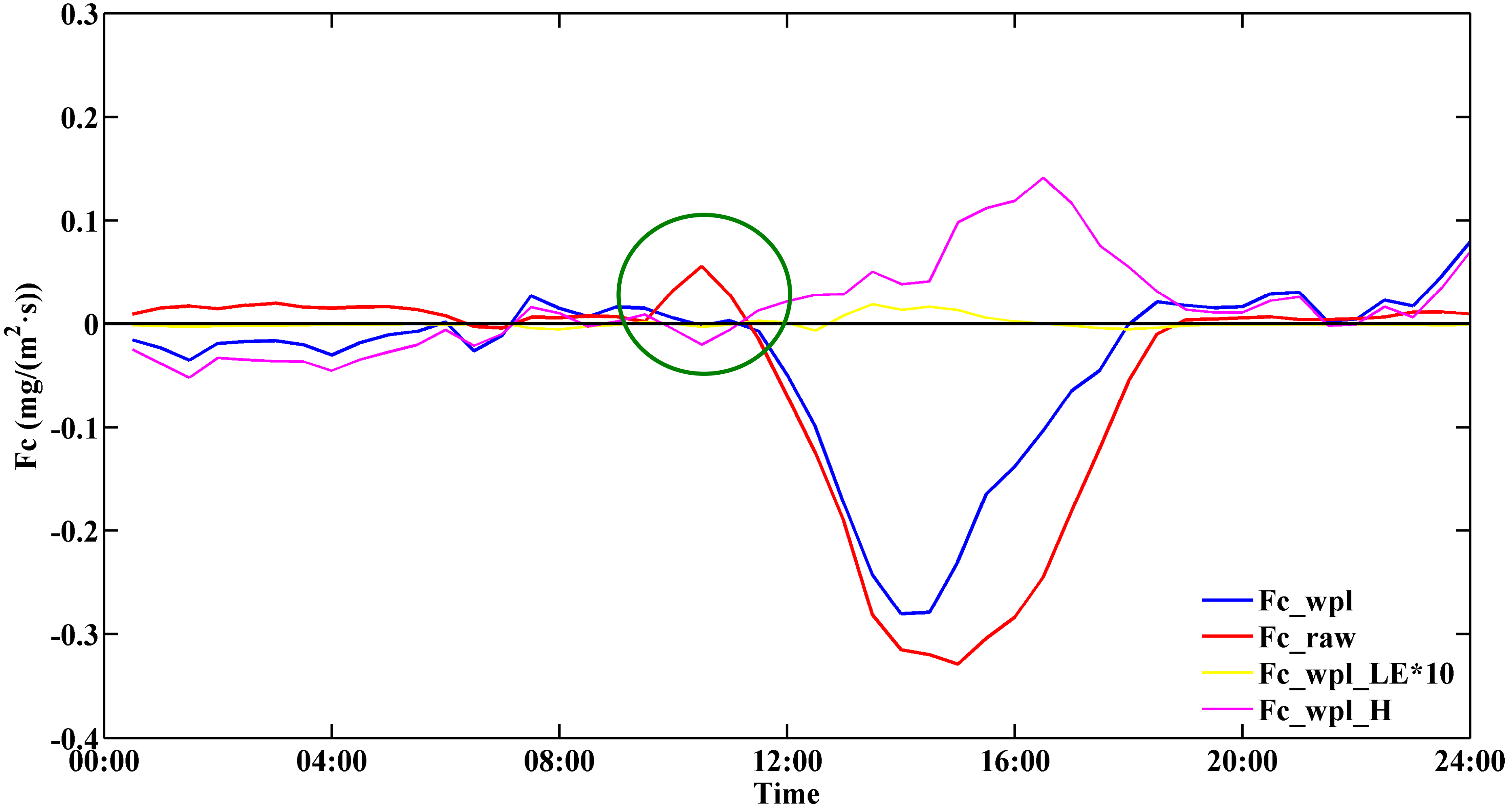


Fig. 5. The diurnal composite of Fc_Gill+Li-7500A in Xinjiang.

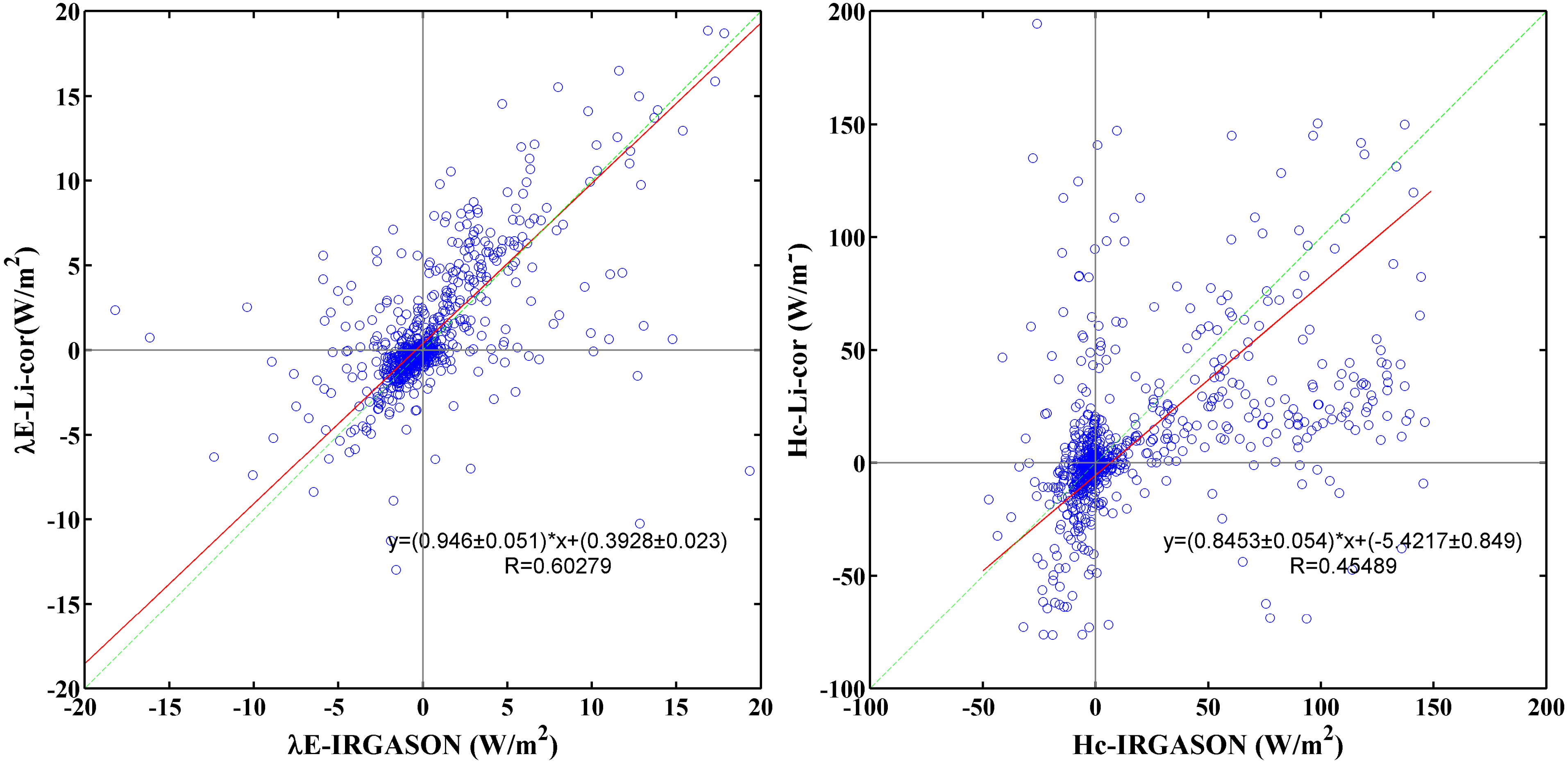


Fig. 6. λE and Hc (IRGASON against Gill+Li-7500A) in Xinjiang.

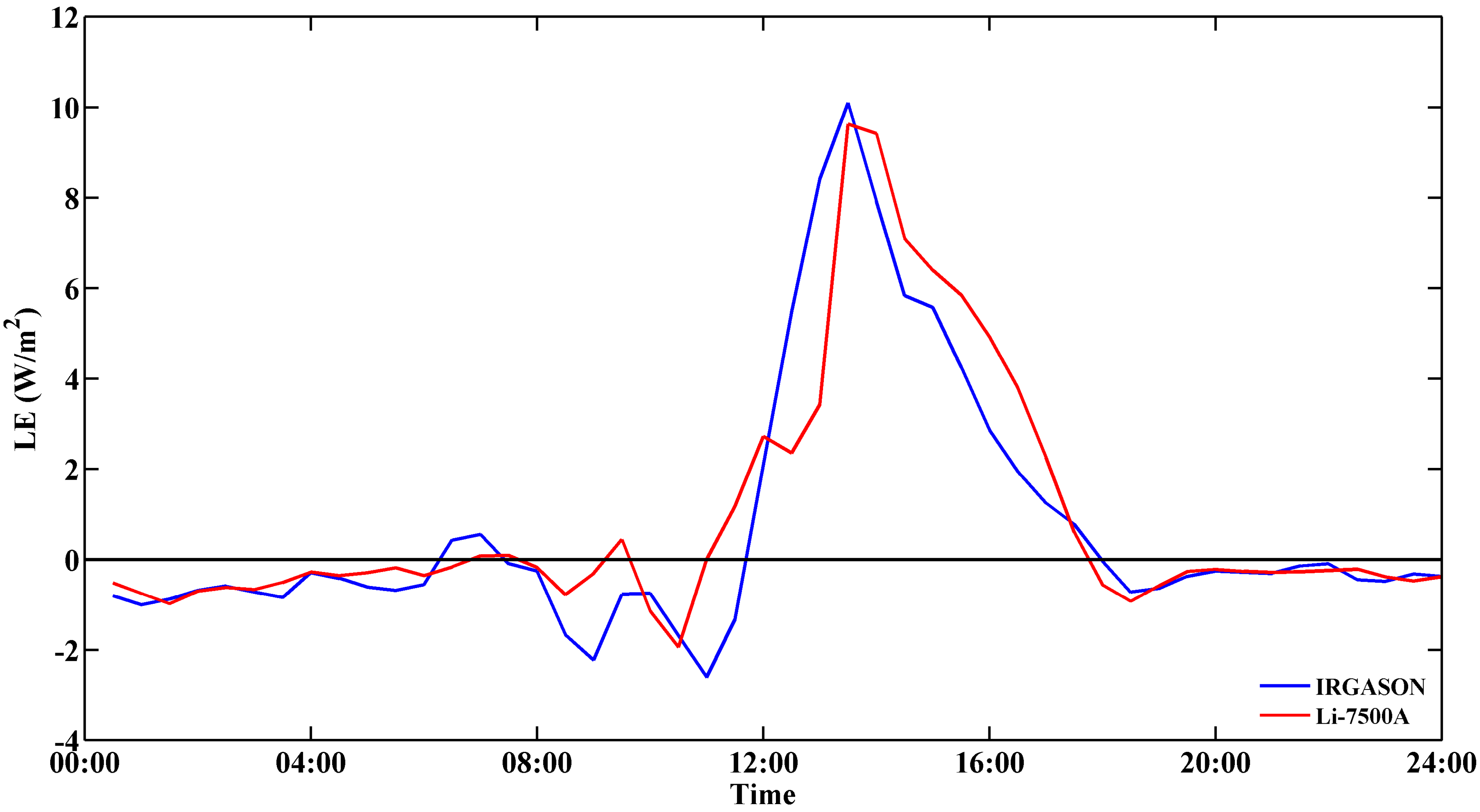


Fig. 7. The diurnal composite of λE in Xinjiang.

$$Fc\_wpl\_H=[(1+mu\cdot sigma)\cdot CO_2/(Ta+273.15)]\cdot[Hc\_wpl/(roua\cdot Cp)]$$

mu=1.6077; ratio of molecular weight of dry air to that of water vapor
Cp=1004.67; specific heat capacity of air, J/(kg.K)
sigma:H_2O density against dry air density
roua:wet air density , g/m^3
Roud: dry air density,g/m^3
Hc_wpl: sensitive heat after WPL correction, w/m^2

$$Hc\_wpl=(Hs\_wpl-roud\cdot Cp\cdot 0.514\cdot (287.058\cdot 0.001)\cdot(Ta+273.15)^2\cdot w'H_2O'/(press))\cdot(Ta/Ts)$$

$$Hs\_wpl=roua\cdot Cp\cdot w'Ts'$$

$$Ts=(1+0.51q)*Ta$$

First reason: Ts

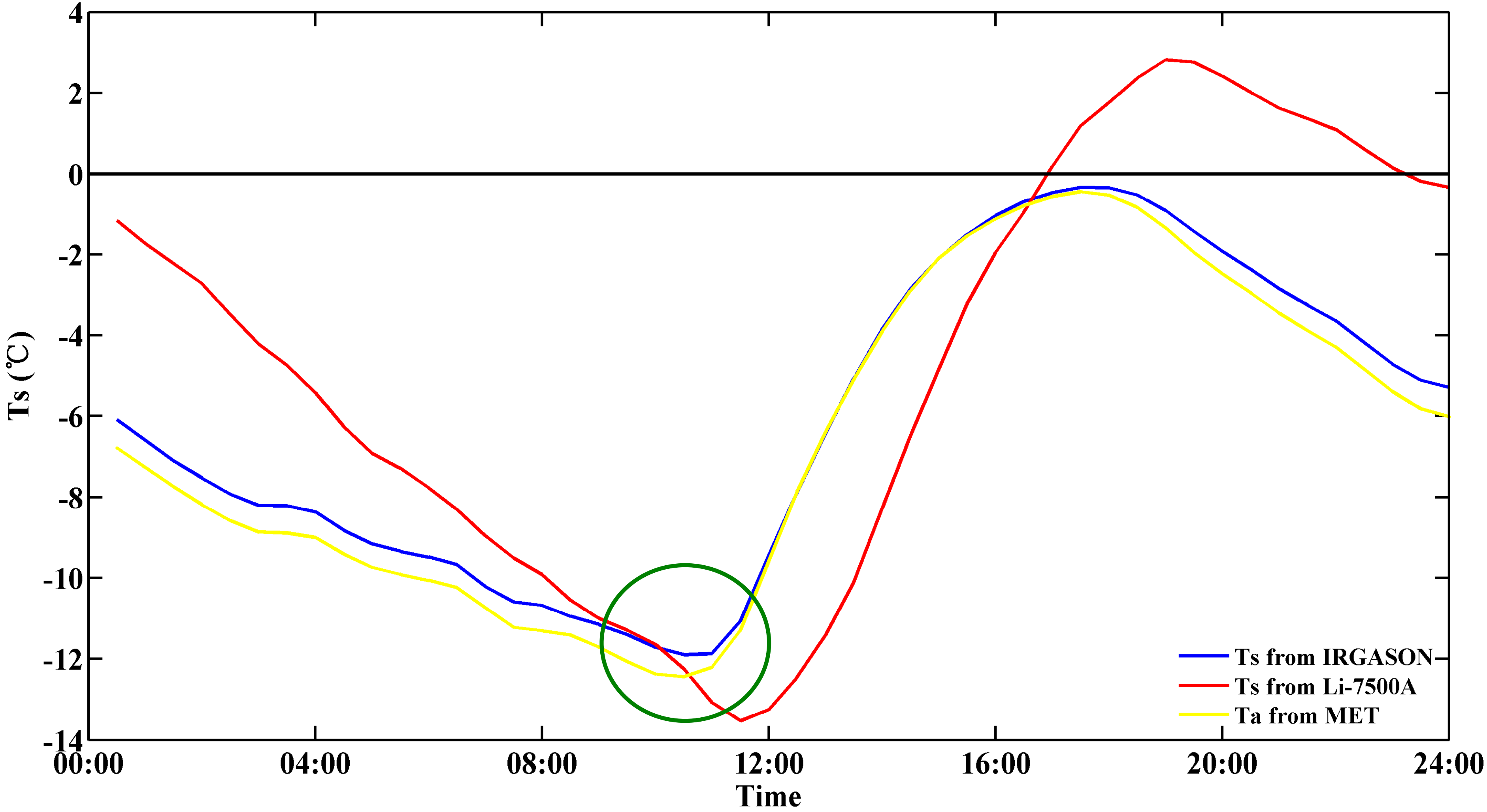


Fig. 8. The diurnal composite of Ts in Xinjiang.

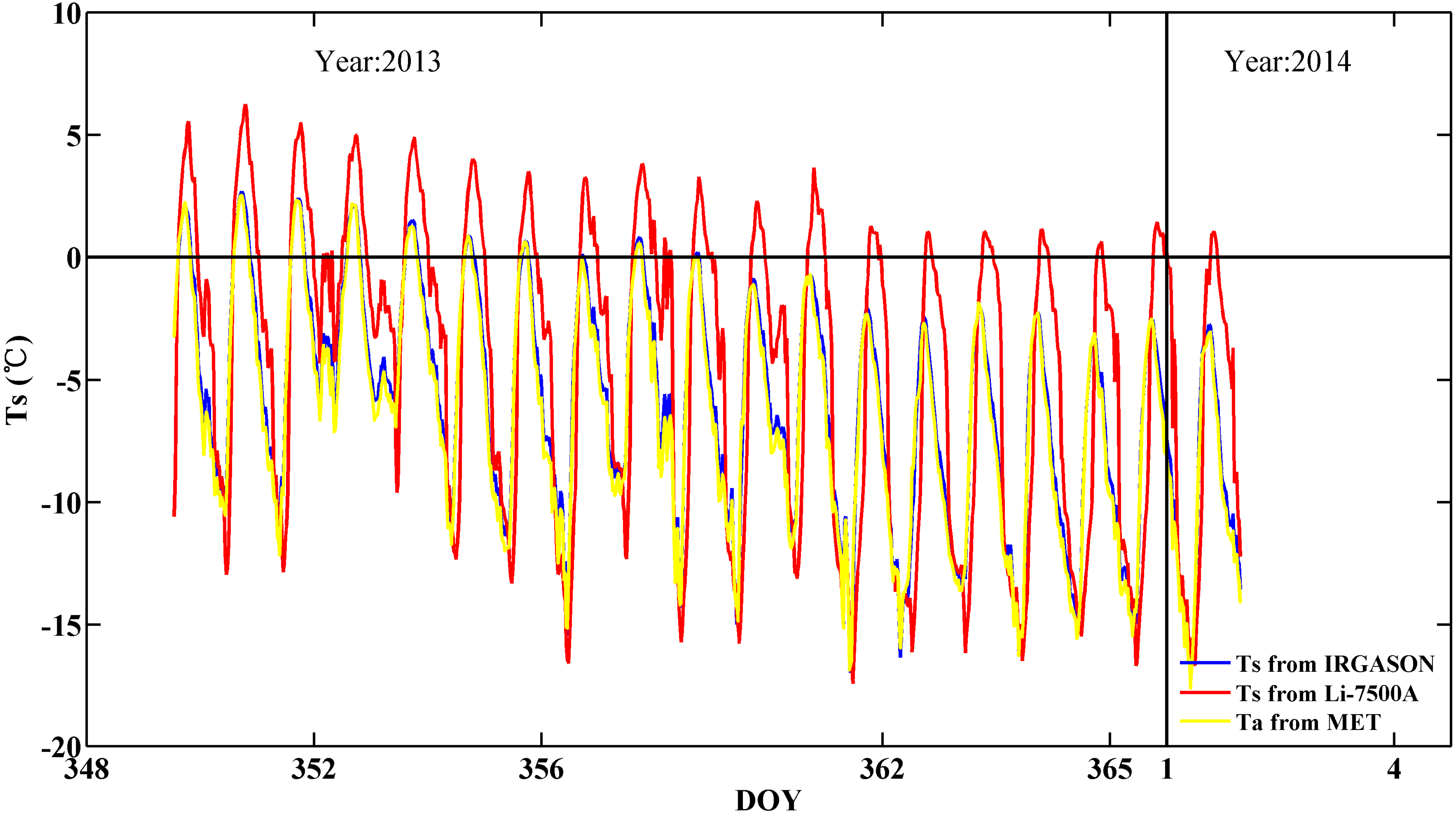


Fig. 9. The time series of Ts in Xinjiang.

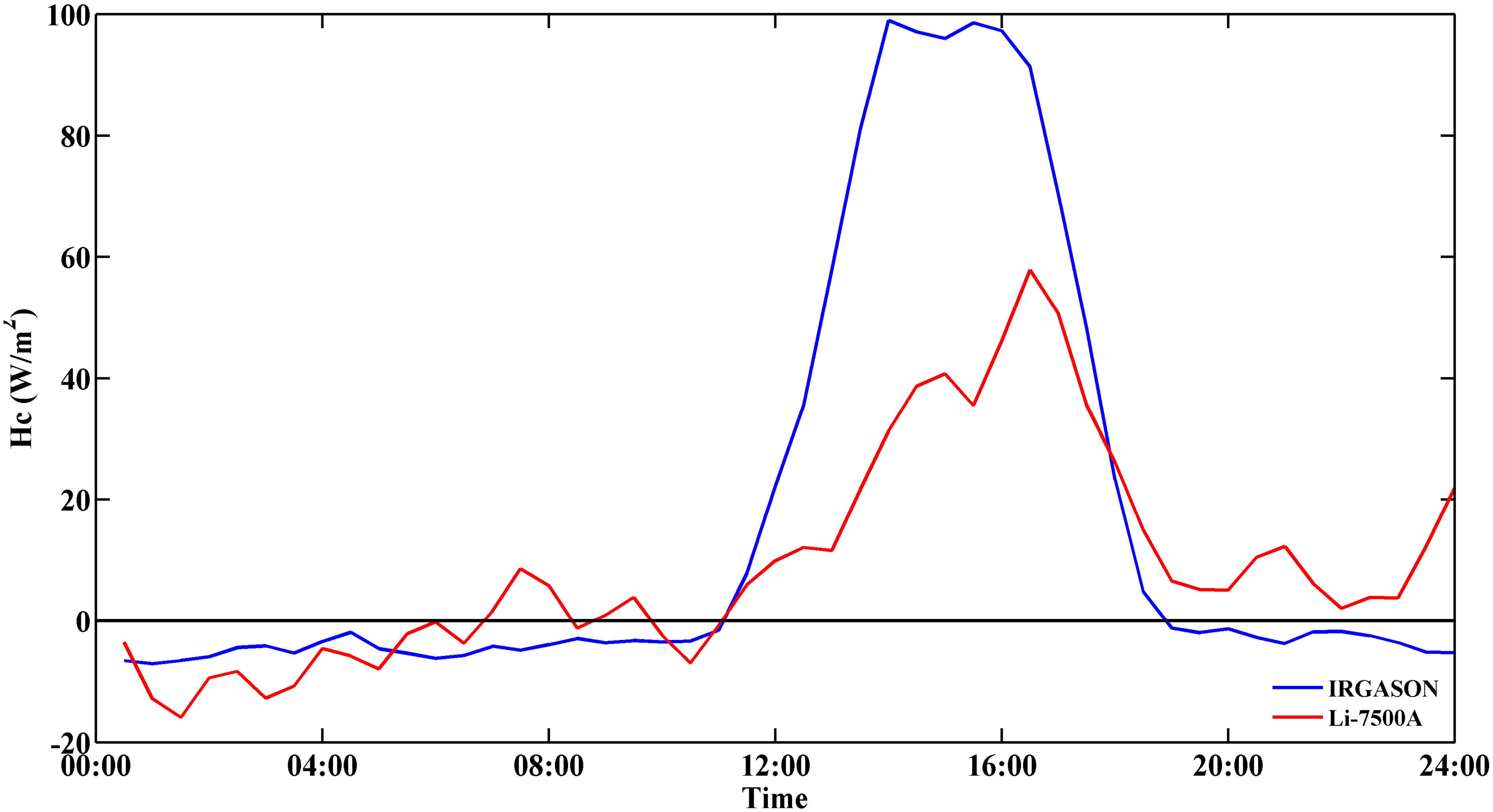
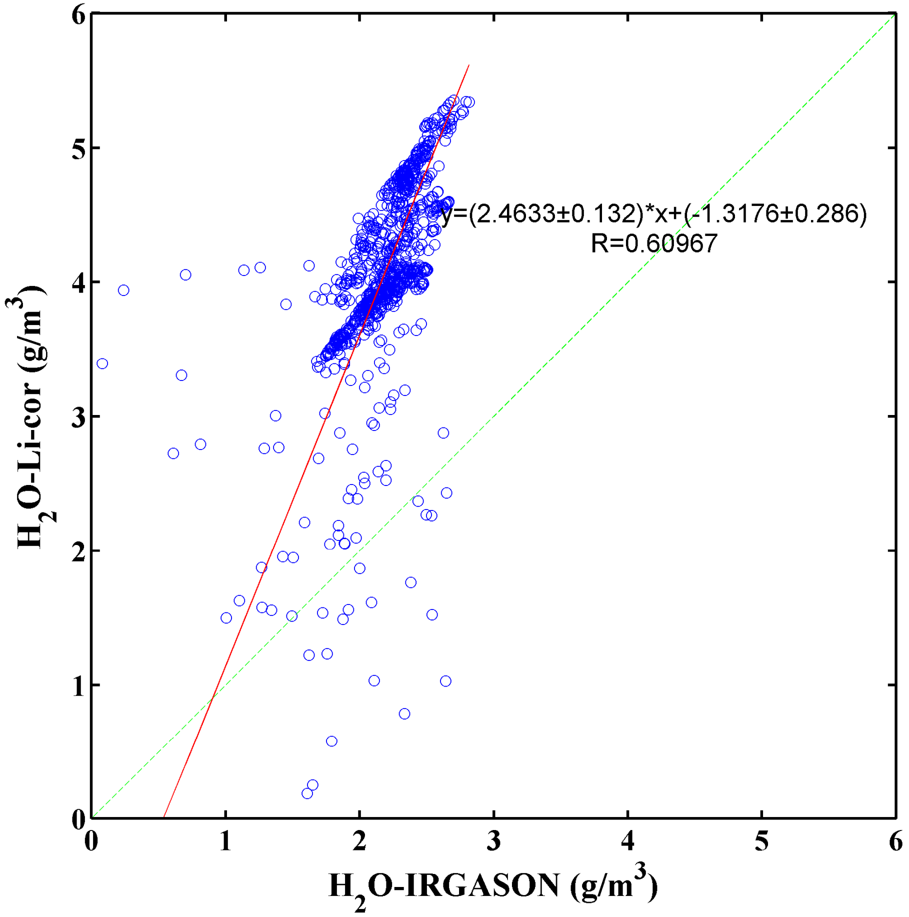


Fig. 10. The diurnal composite of Hc in Xinjiang.

Second reason: CO_2 and H_2O



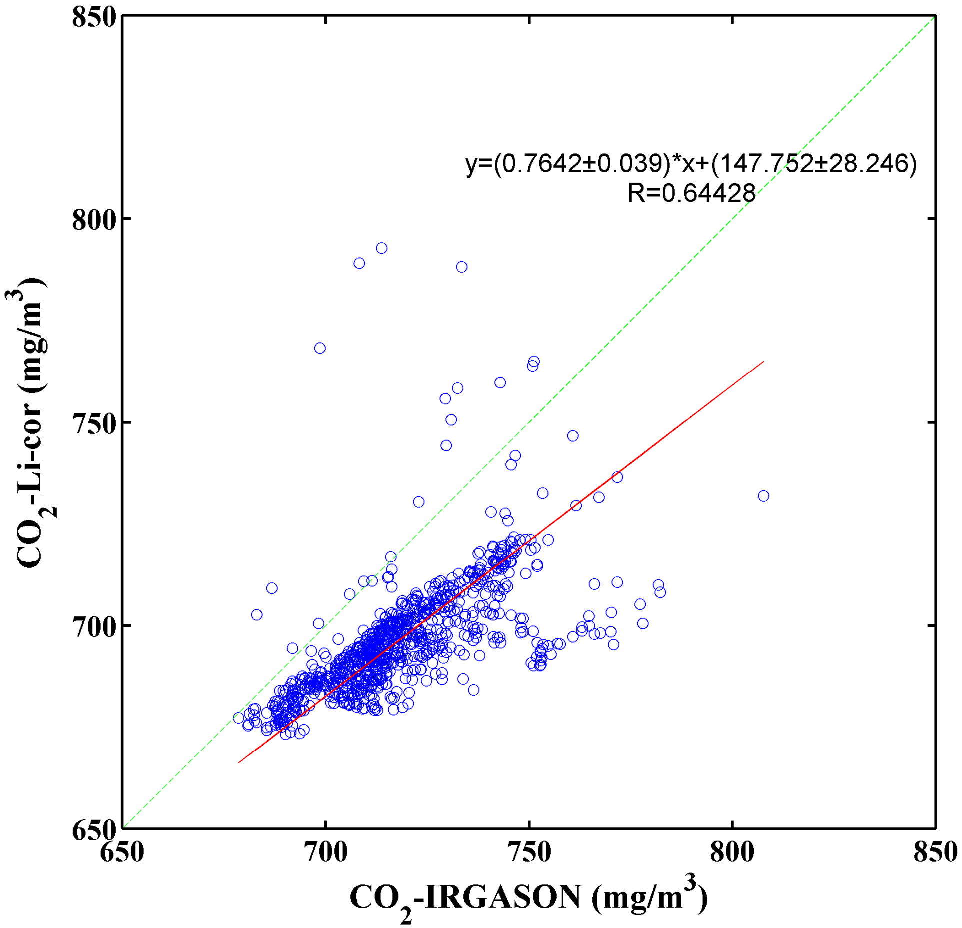


Fig. 8. H_2O and CO_2 (IRGASON against Gill+Li-7500A) in Xinjiang.

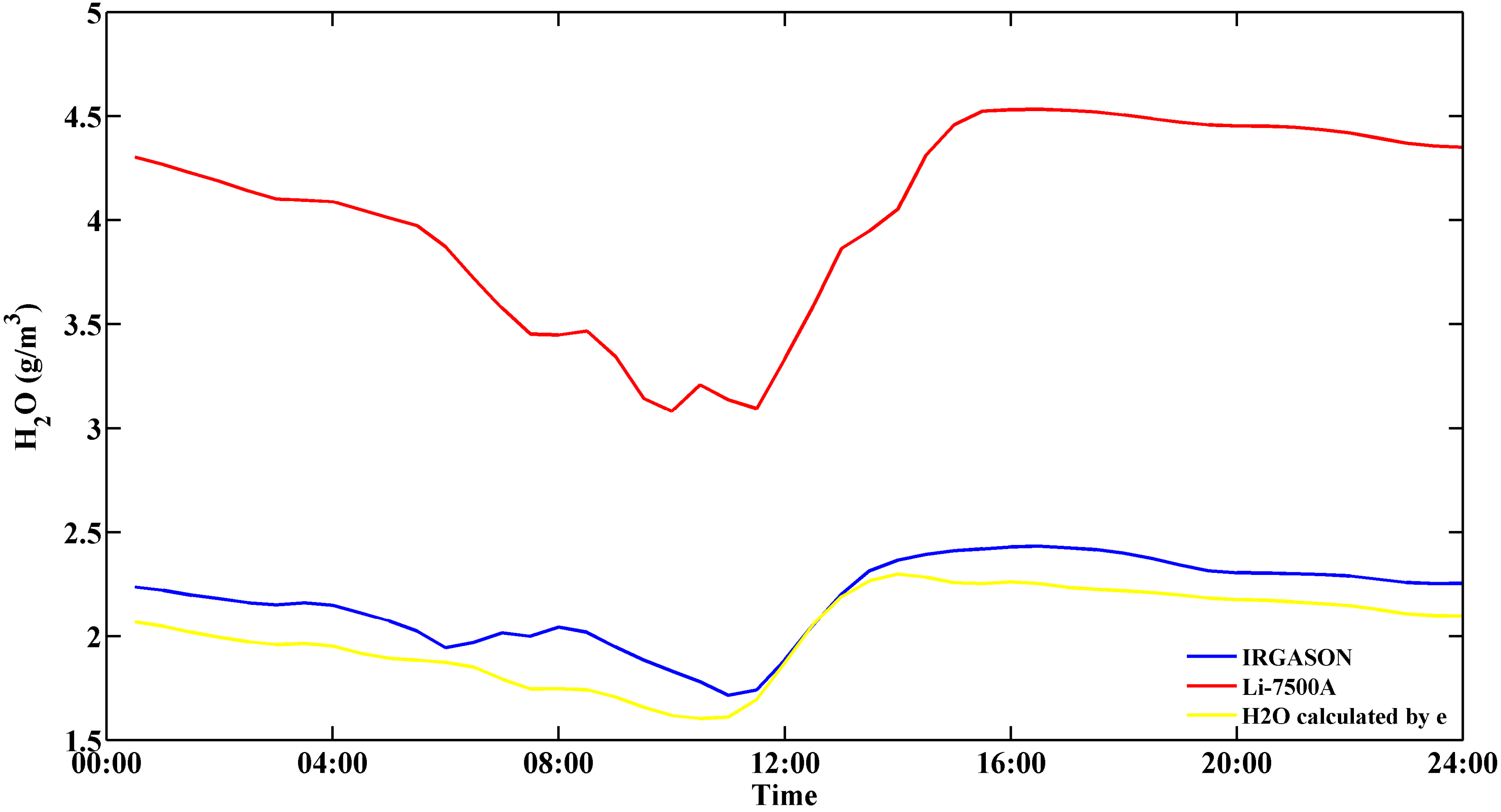


Fig. 15. The diurnal composite of H_2O in Xinjiang.

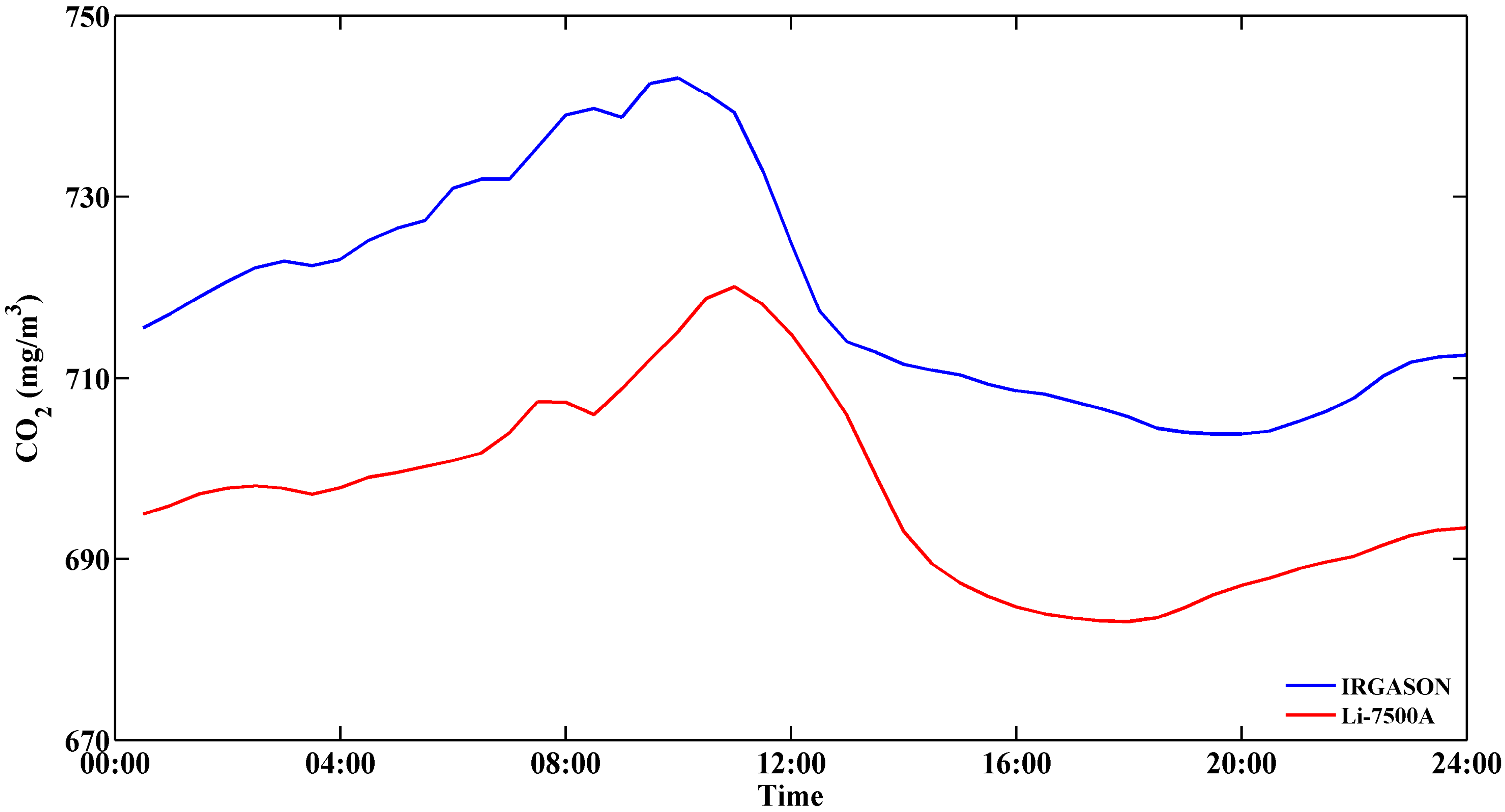


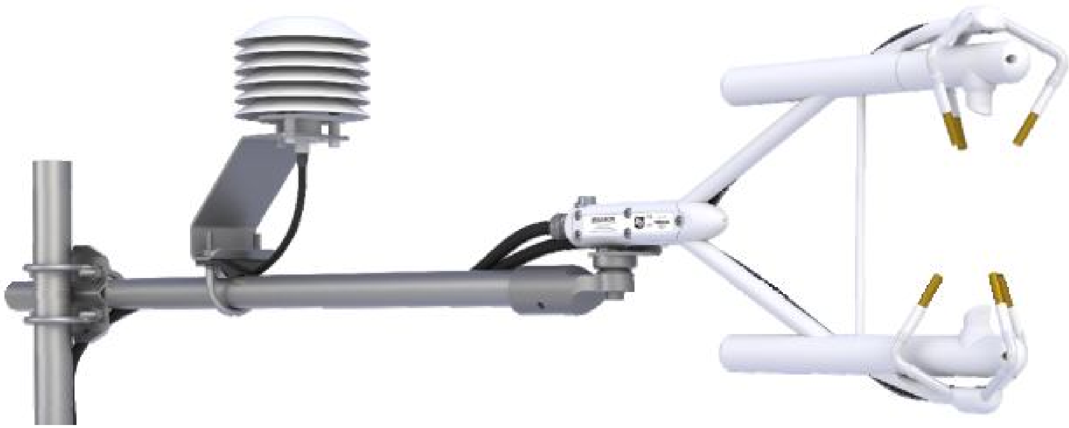
Fig. 16. The diurnal composite of CO_2 in Xinjiang.

3. Conclusion

- 1. According to Fc, the performance of IRGASON was better than Gill+Li-7500A.
- 2.The error results from Ts and H bias.

4. Next step

Self heating



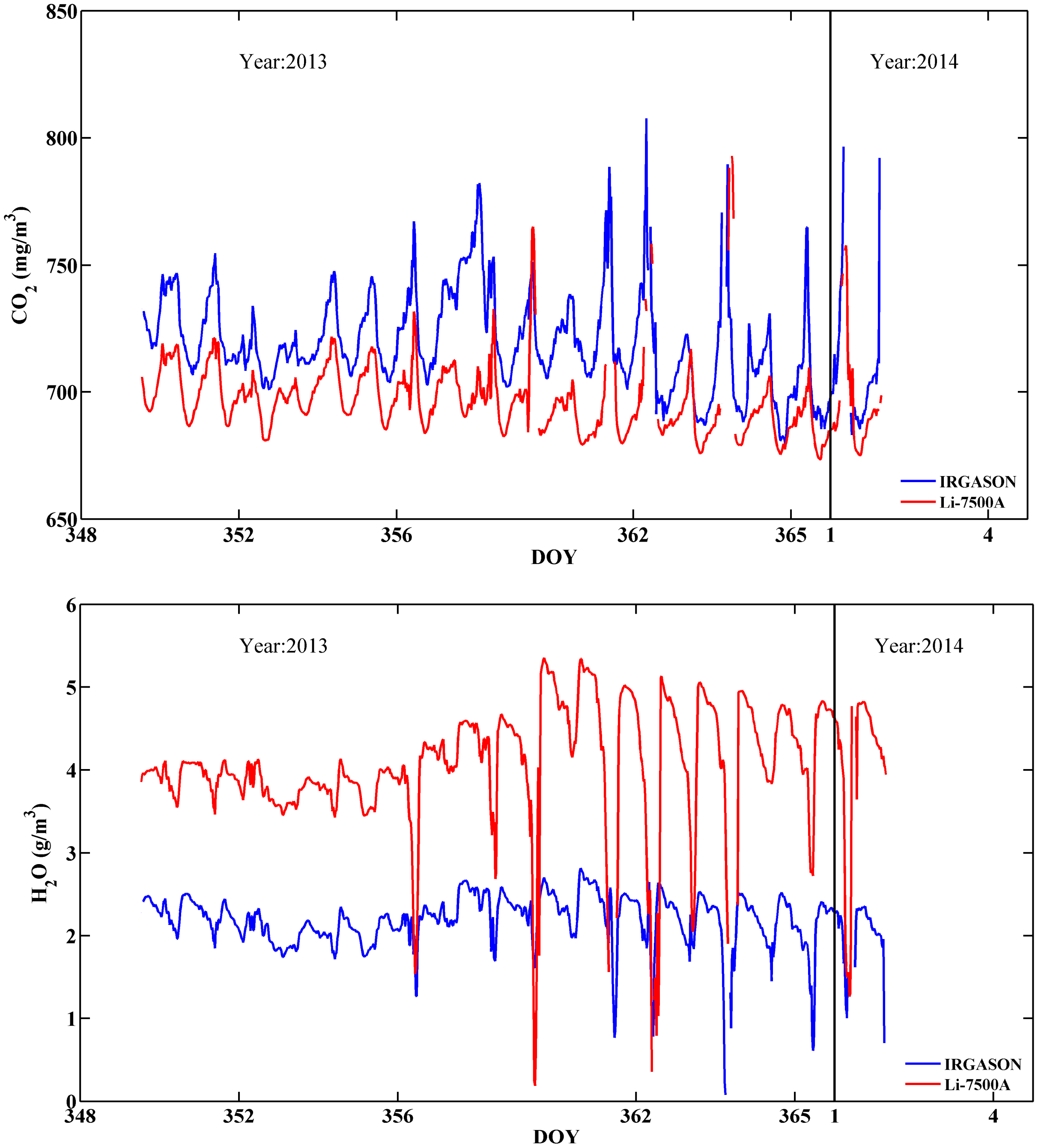
Same Ts, small radiation loading

Different Ts

The influence of self-heating will be explained by comparison data with and without self-heating.

Wet CO_2

The dry CO_2 can be calculated by WLG hourly data.



Thank You!

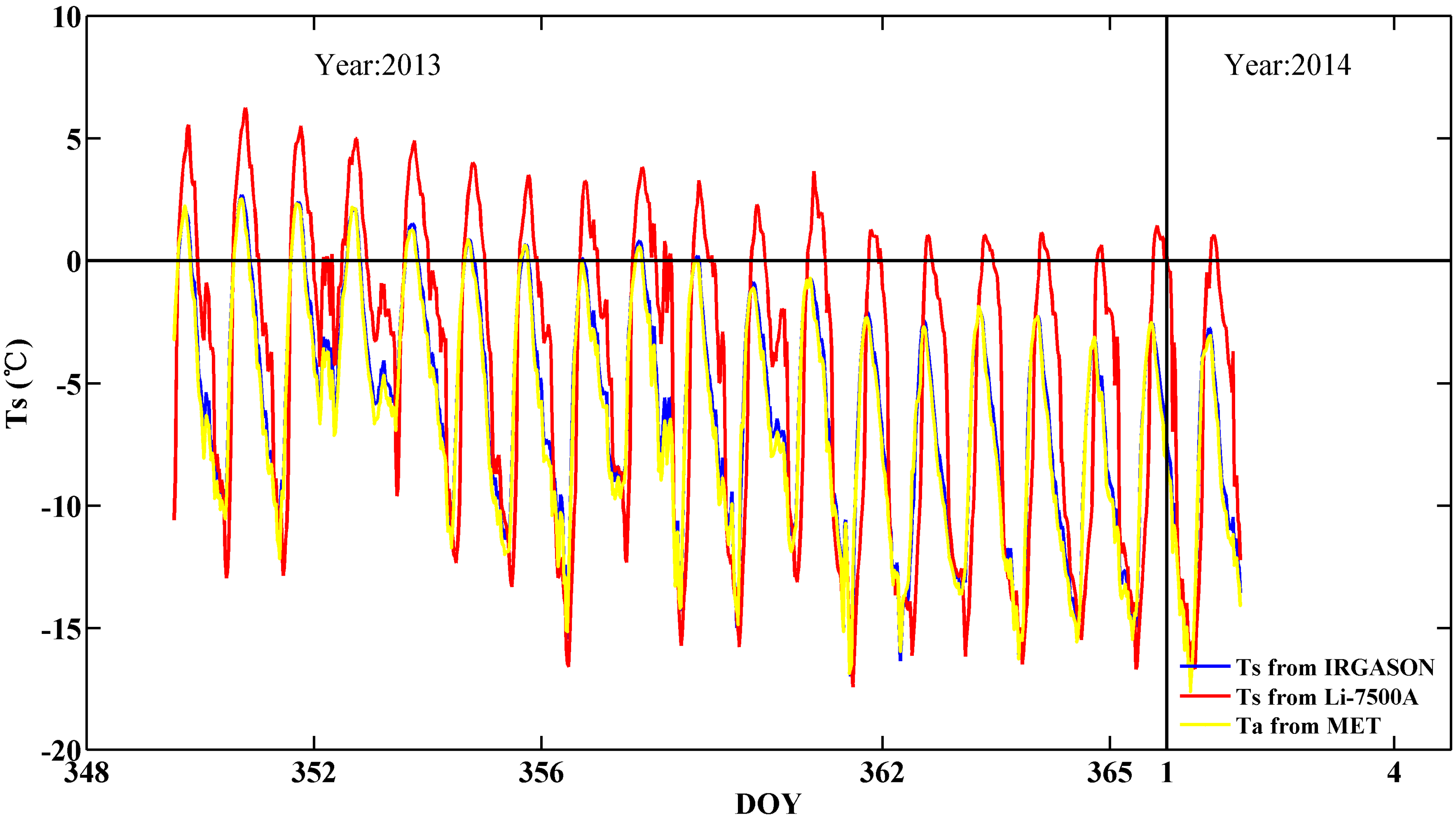


Fig. 1. The time series of Ts in Xinjiang.

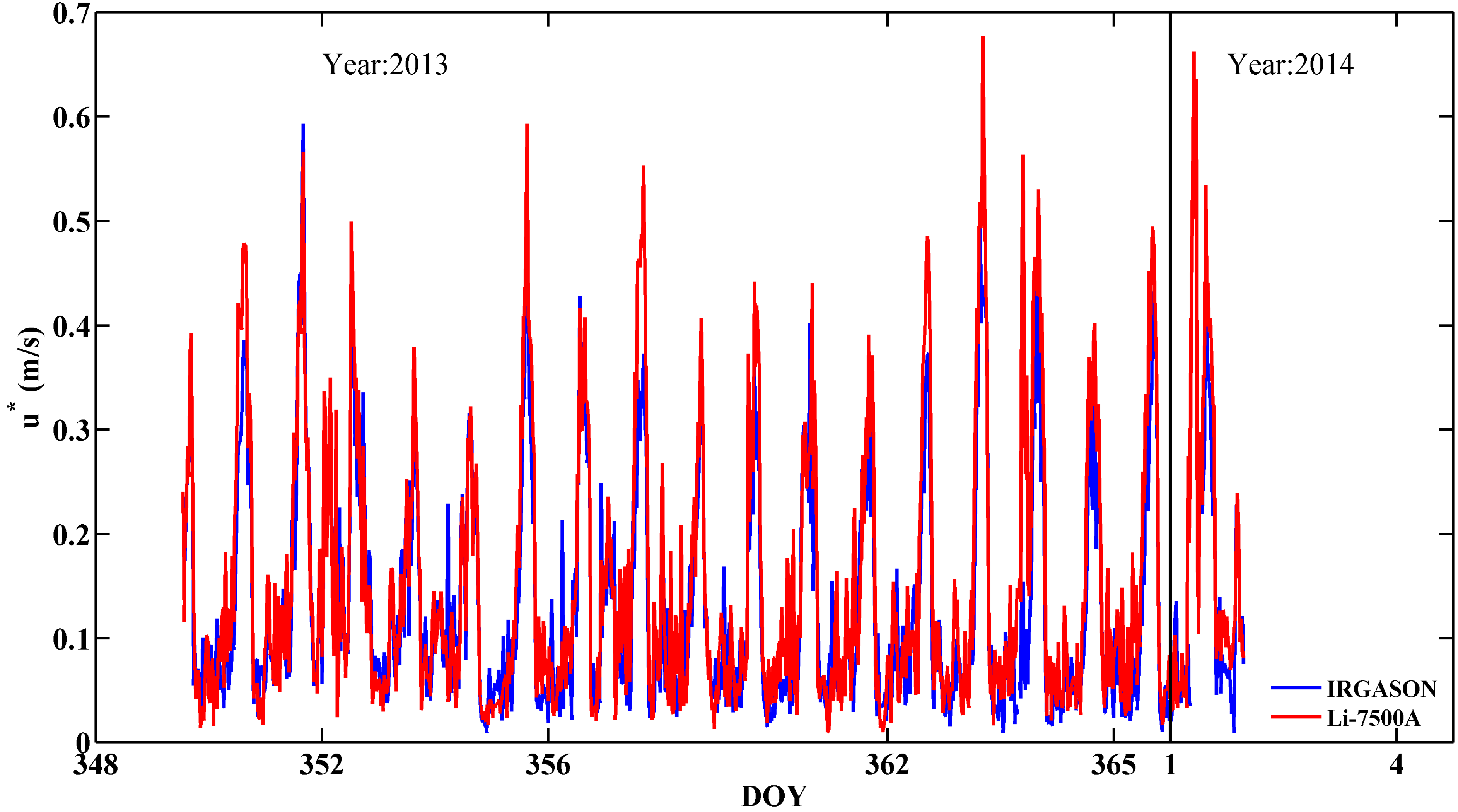


Fig. 2. The time series of u* in Xinjiang.

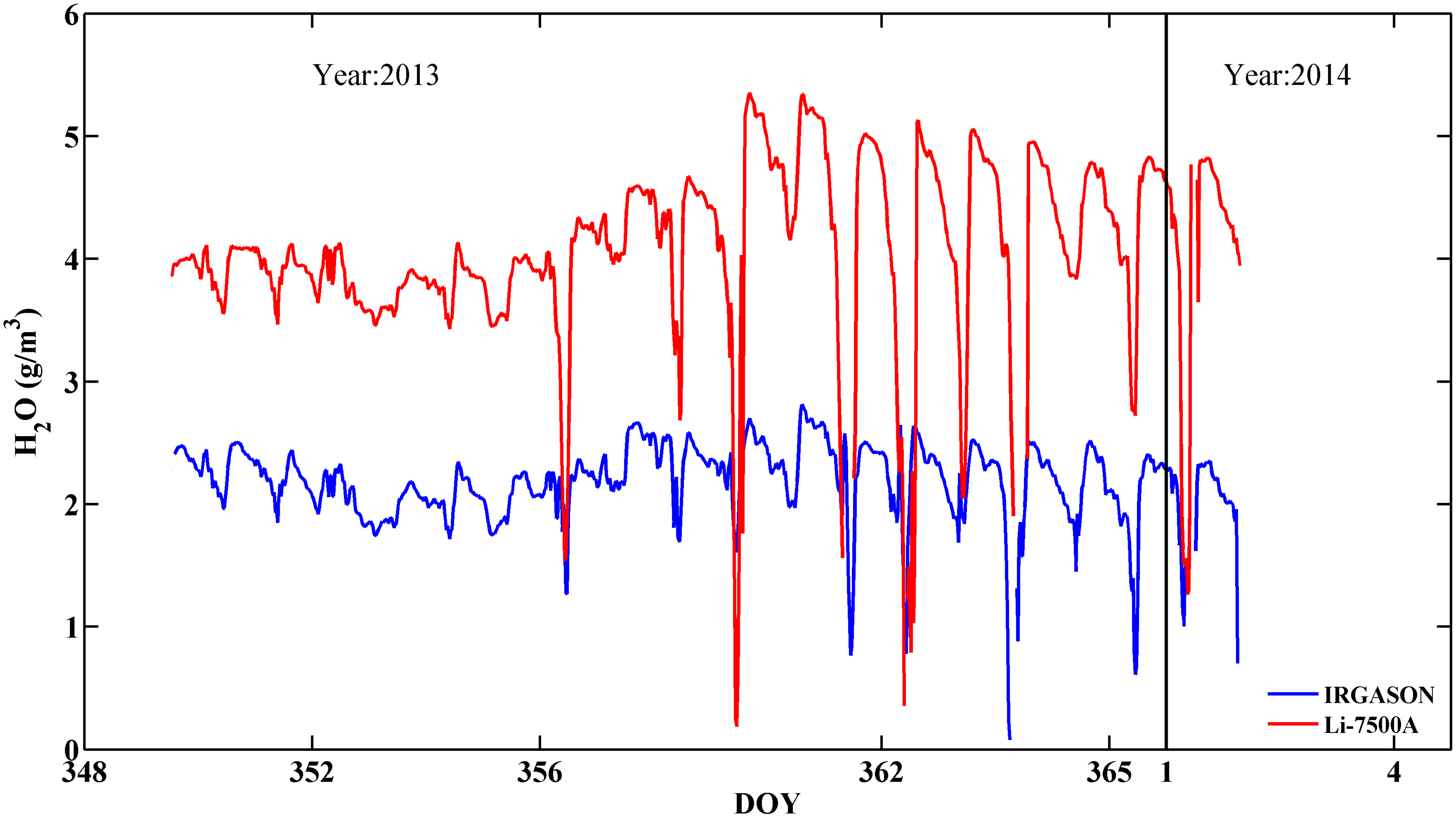


Fig. 3. The time series of H_2O in Xinjiang.

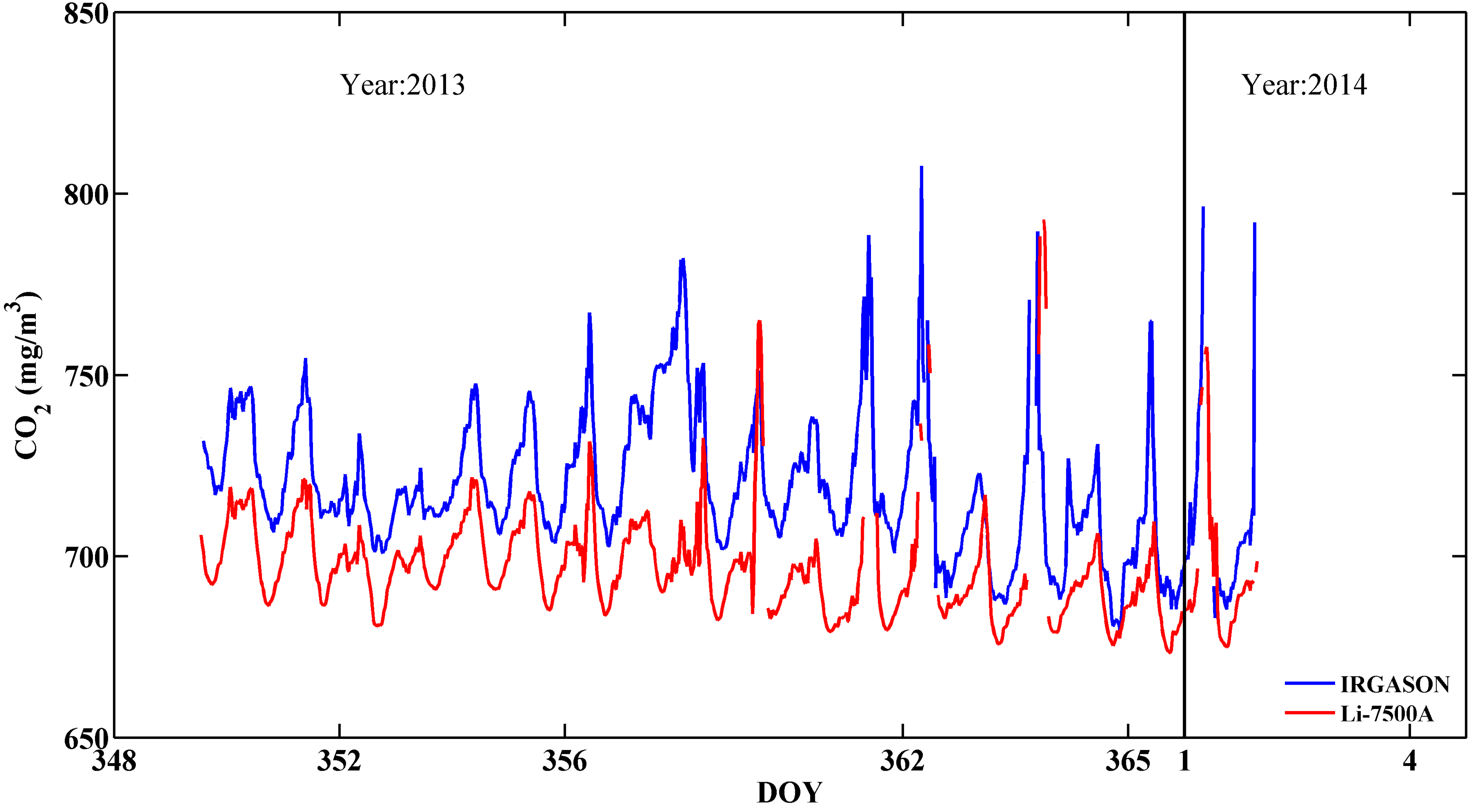


Fig. 4. The time series of CO_2 in Xinjiang.

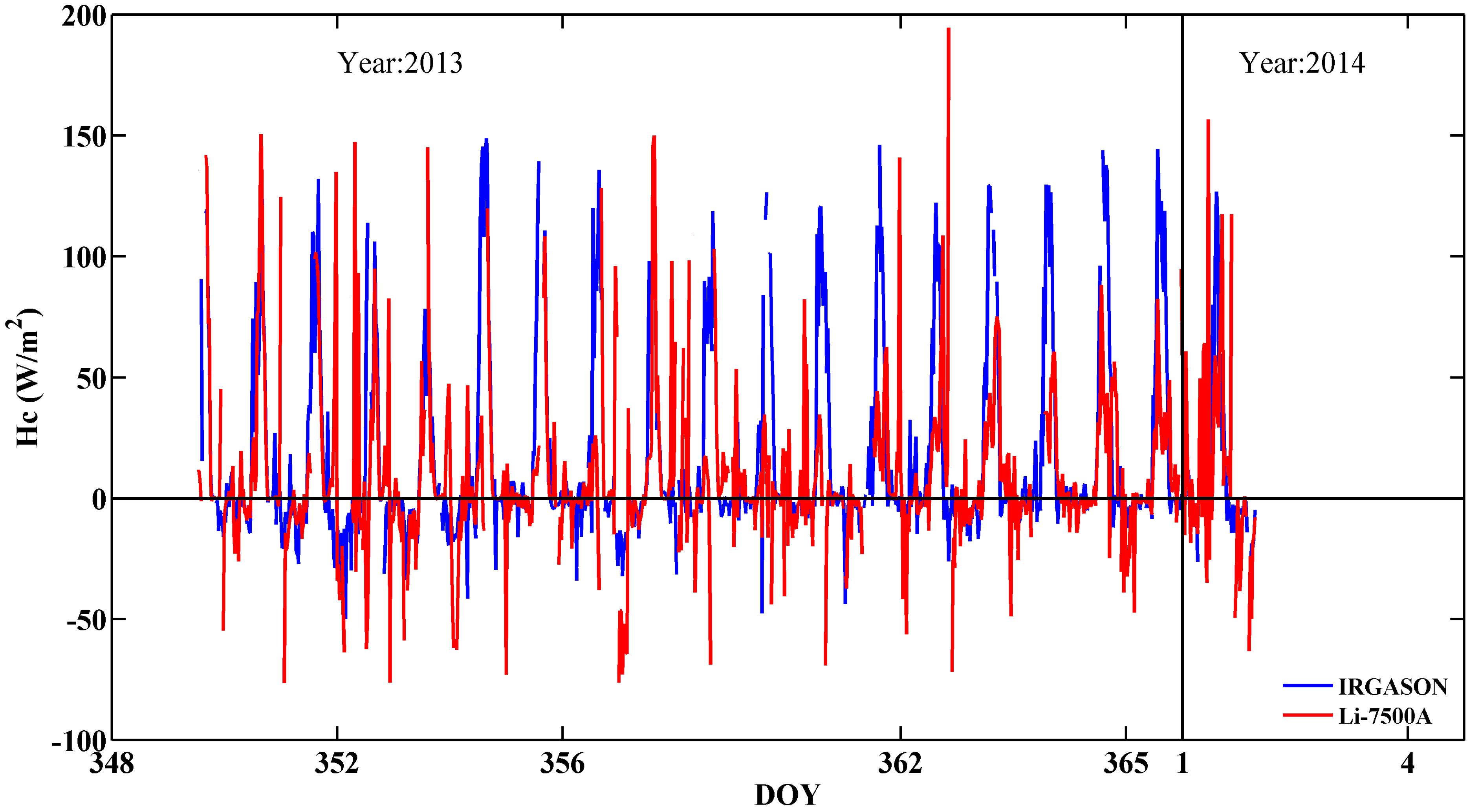


Fig. 5. The time series of Hc in Xinjiang.

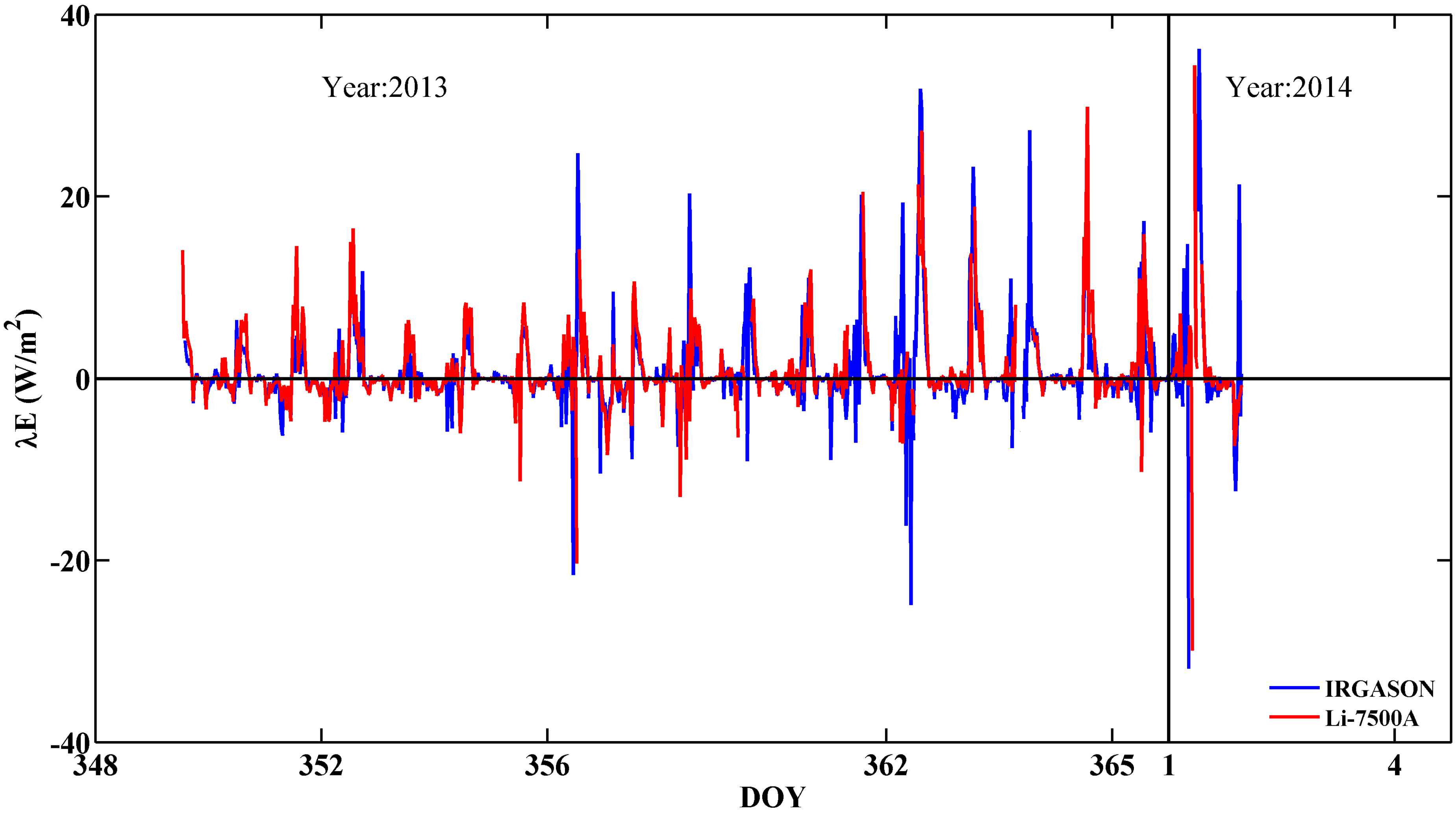


Fig. 6. The time series of λE in Xinjiang.

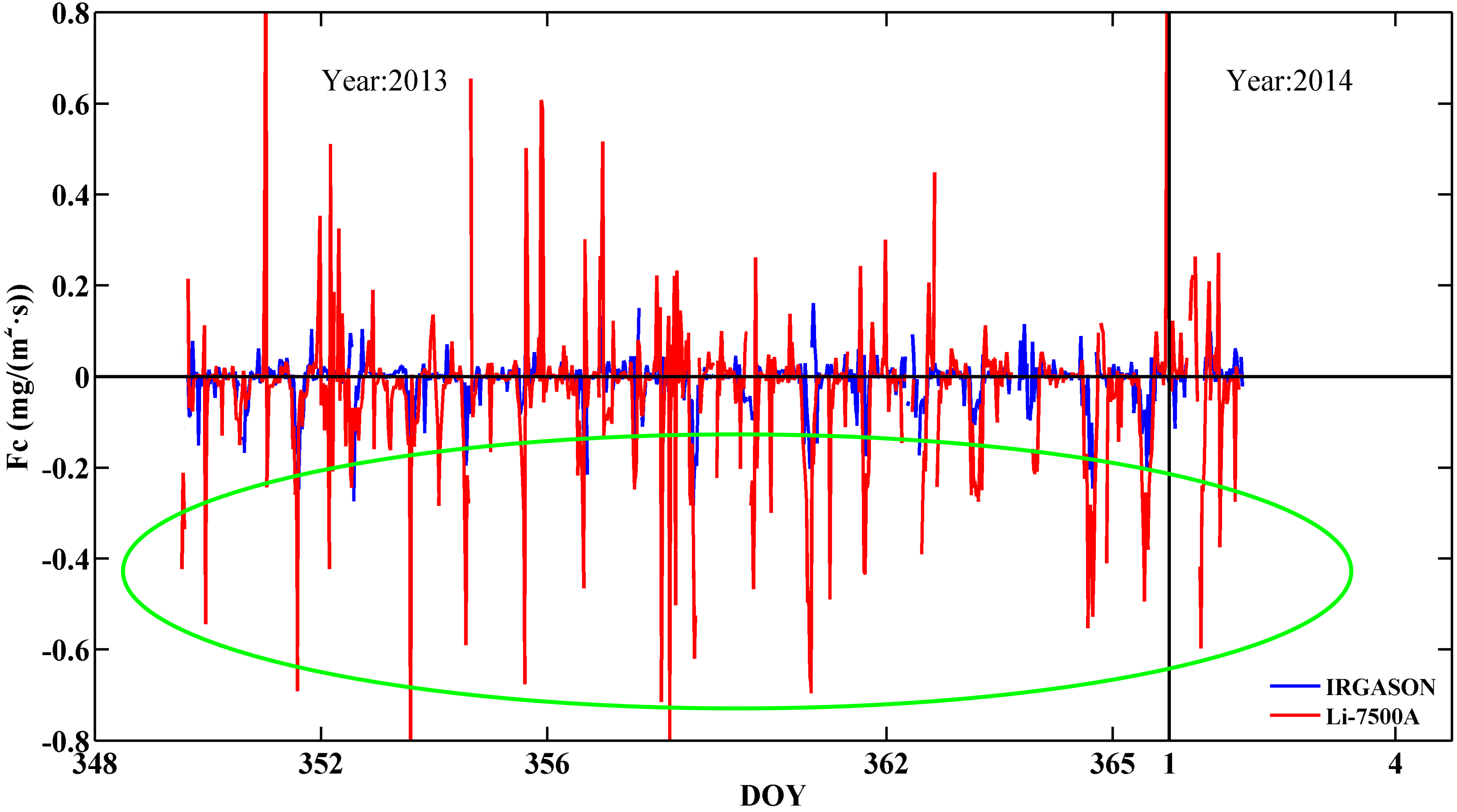


Fig. 7. The time series of Fc in Xinjiang.

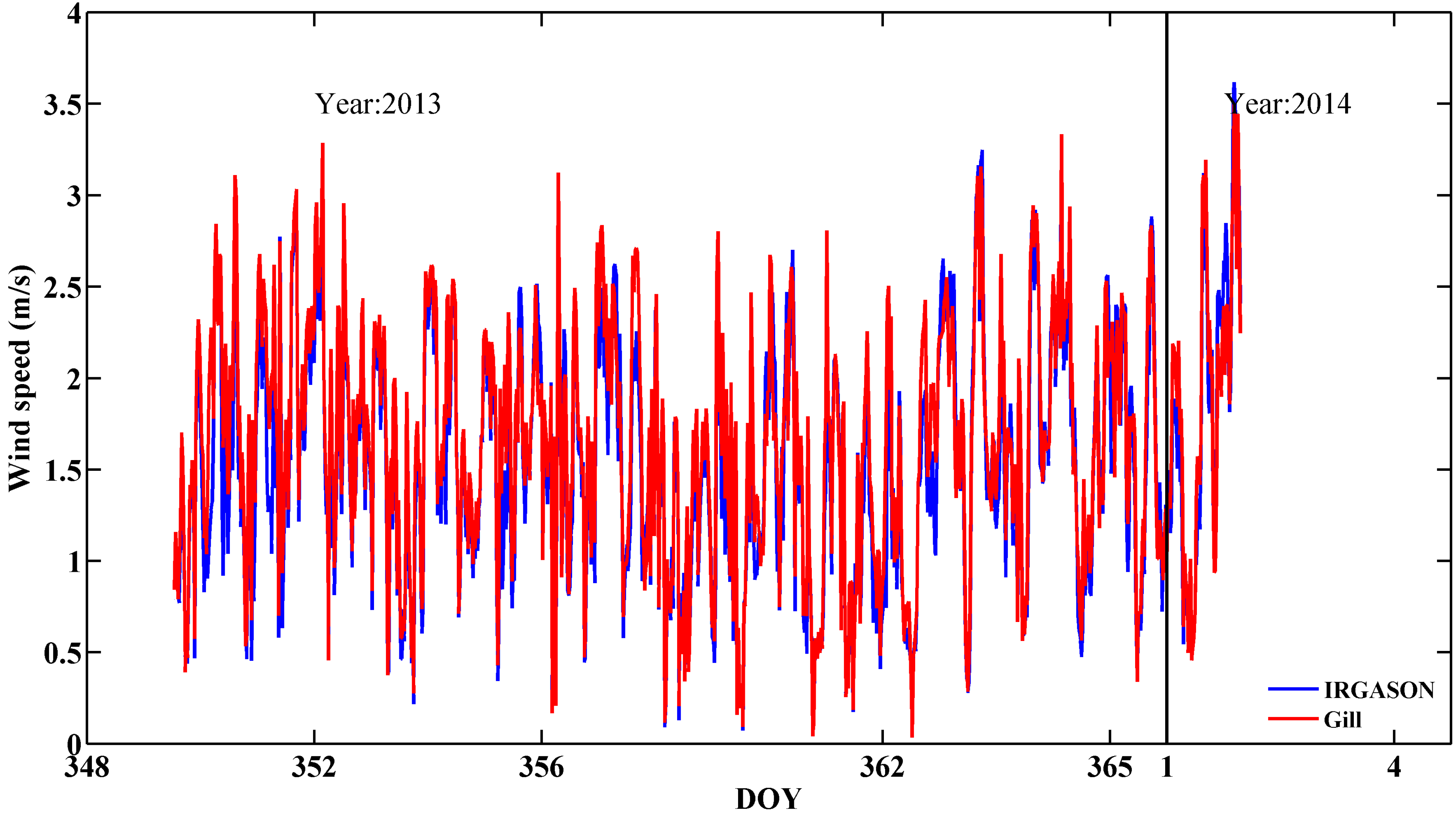


Fig. 8.The time series of wind speed in Xinjiang.

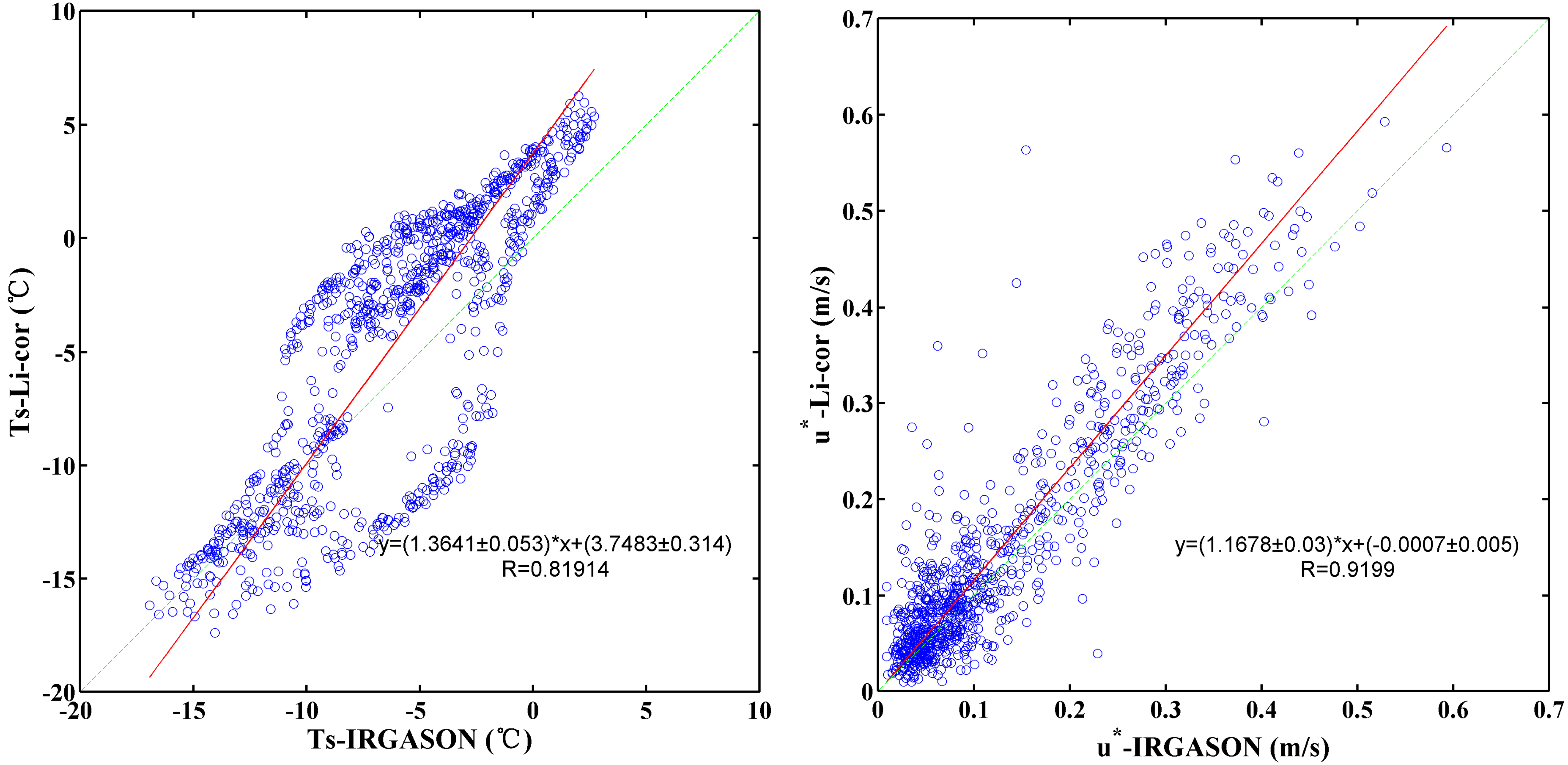


Fig. 9. Ts and u* (IRGASON against Gill+Li-7500A) in Xinjiang.

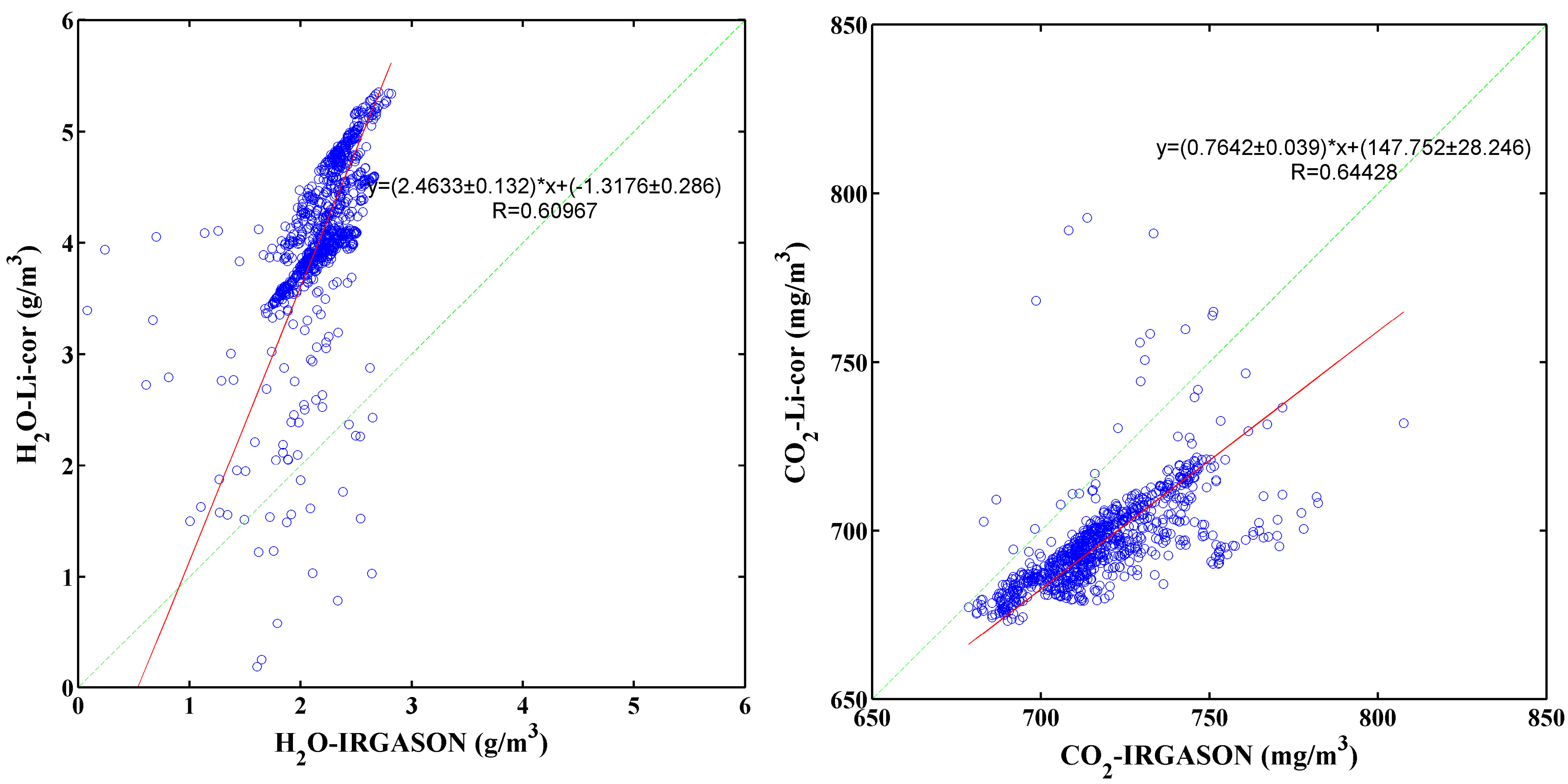


Fig. 10. H_2O and CO_2 (IRGASON against Gill+Li-7500A) in Xinjiang.

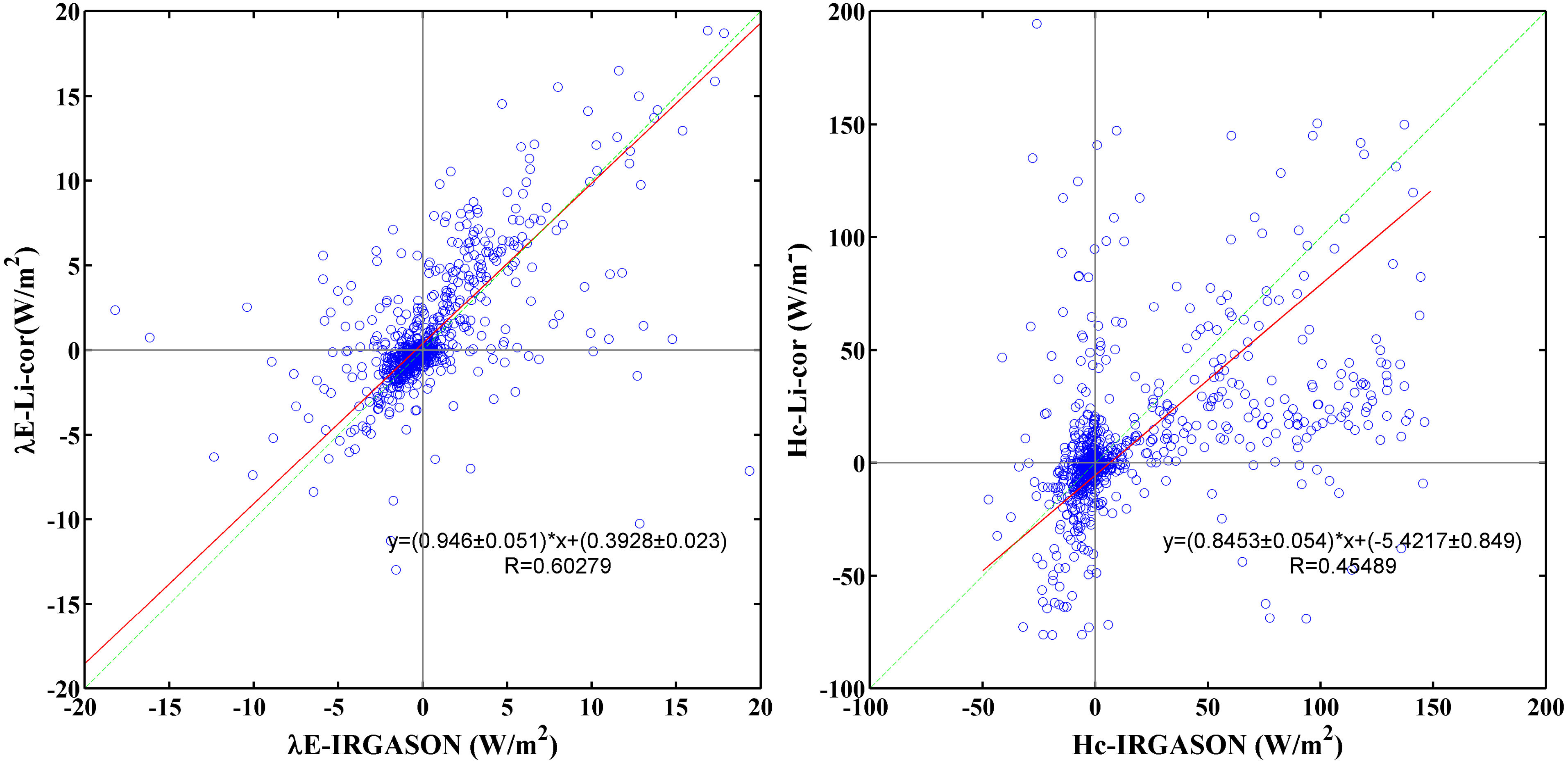


Fig. 11. λ E and Hc (IRGASON against Gill+Li-7500A) in Xinjiang.

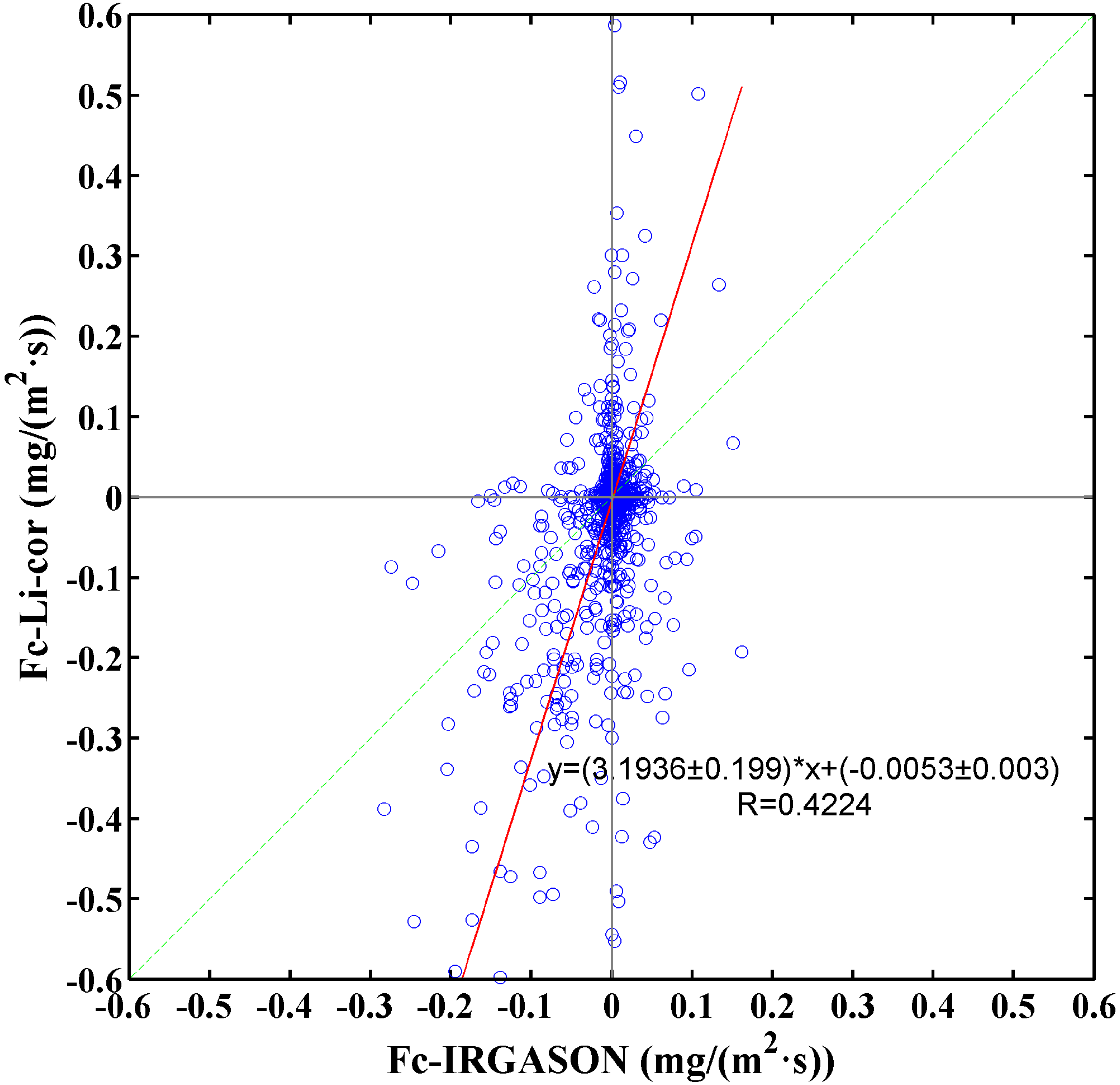


Fig. 12. Fc (IRGASON against Gill+Li-7500A) in Xinjiang.

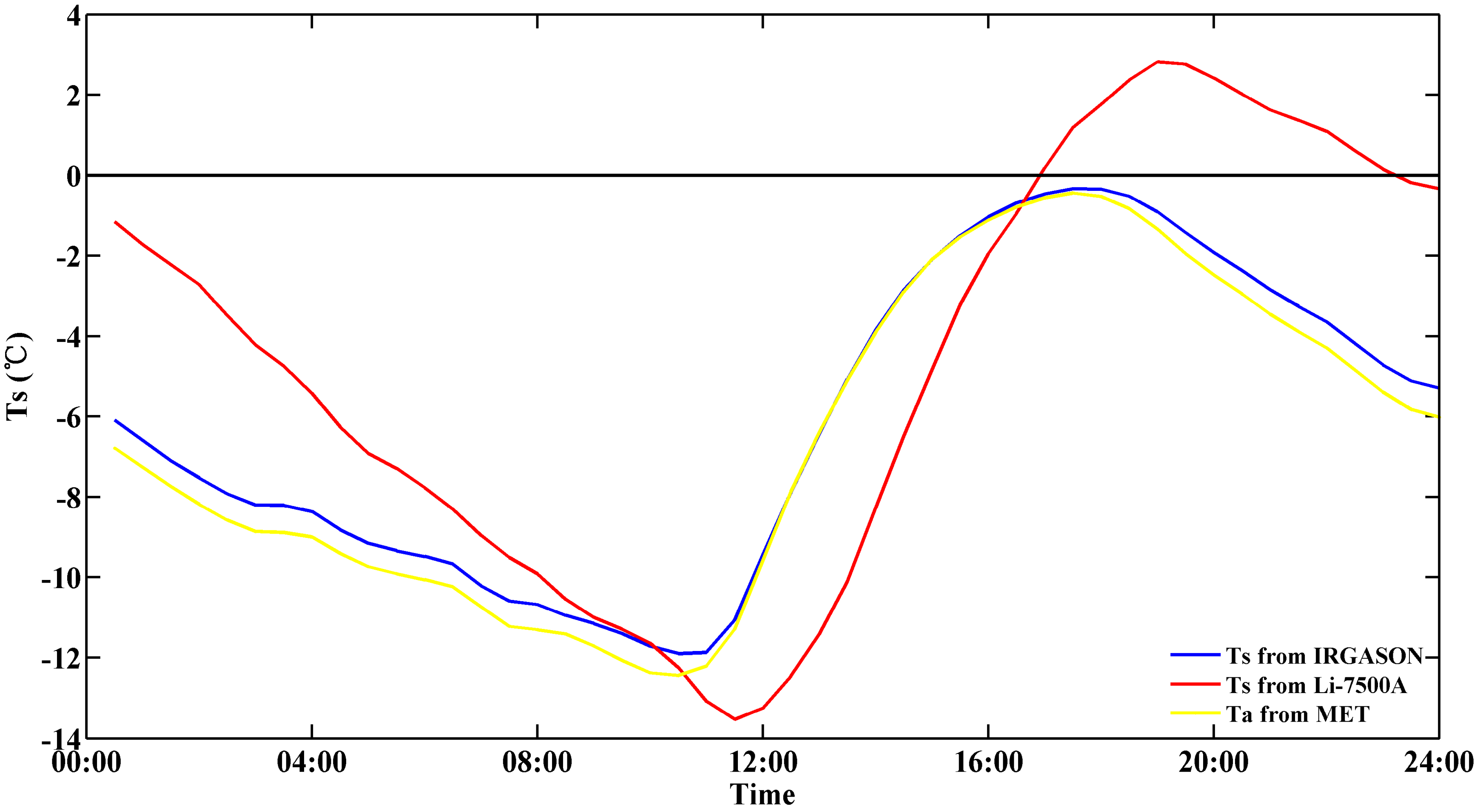


Fig. 13. The diurnal composite of Ts in Xinjiang.

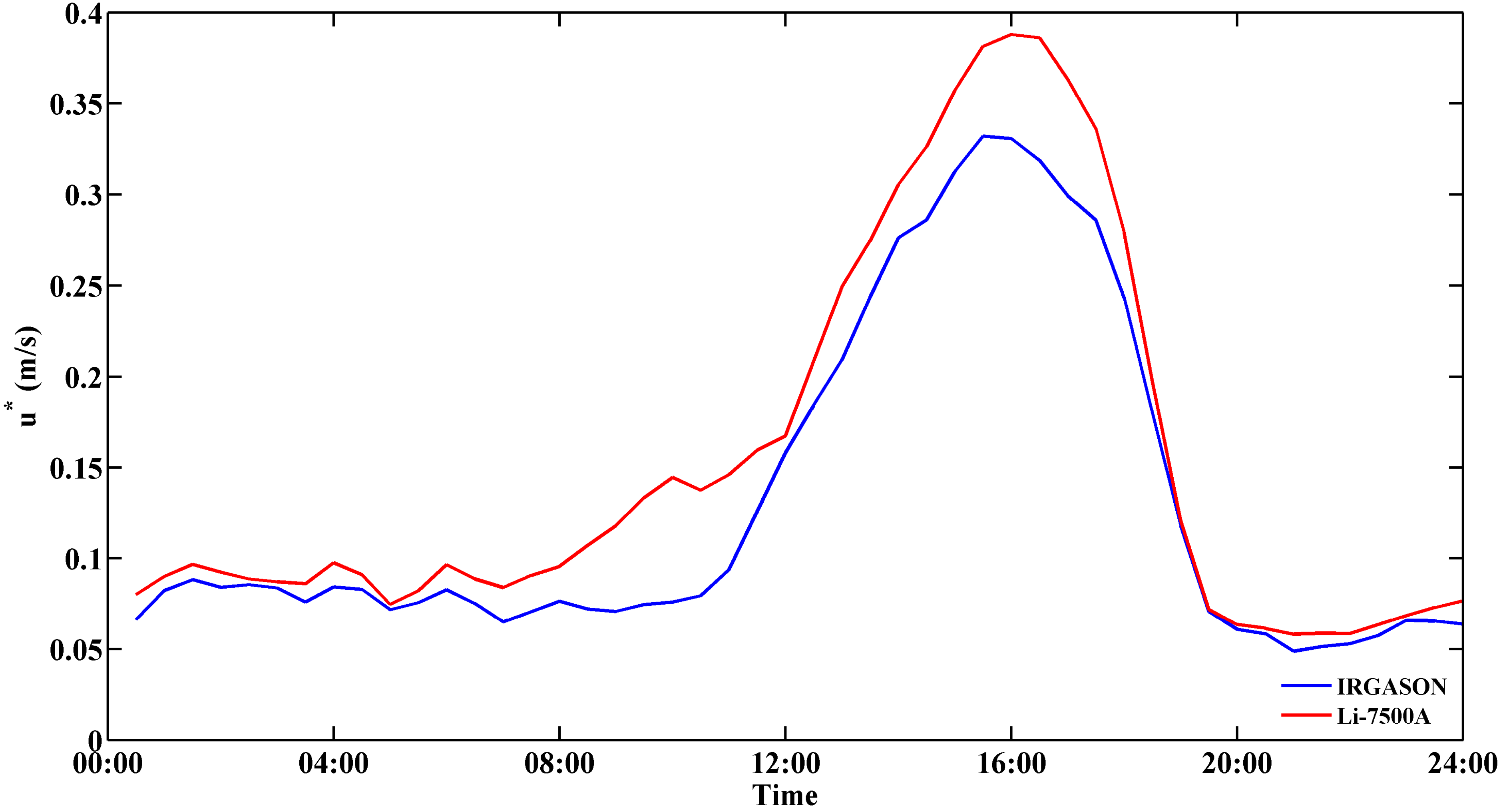


Fig. 14. The diurnal composite of u* in Xinjiang.

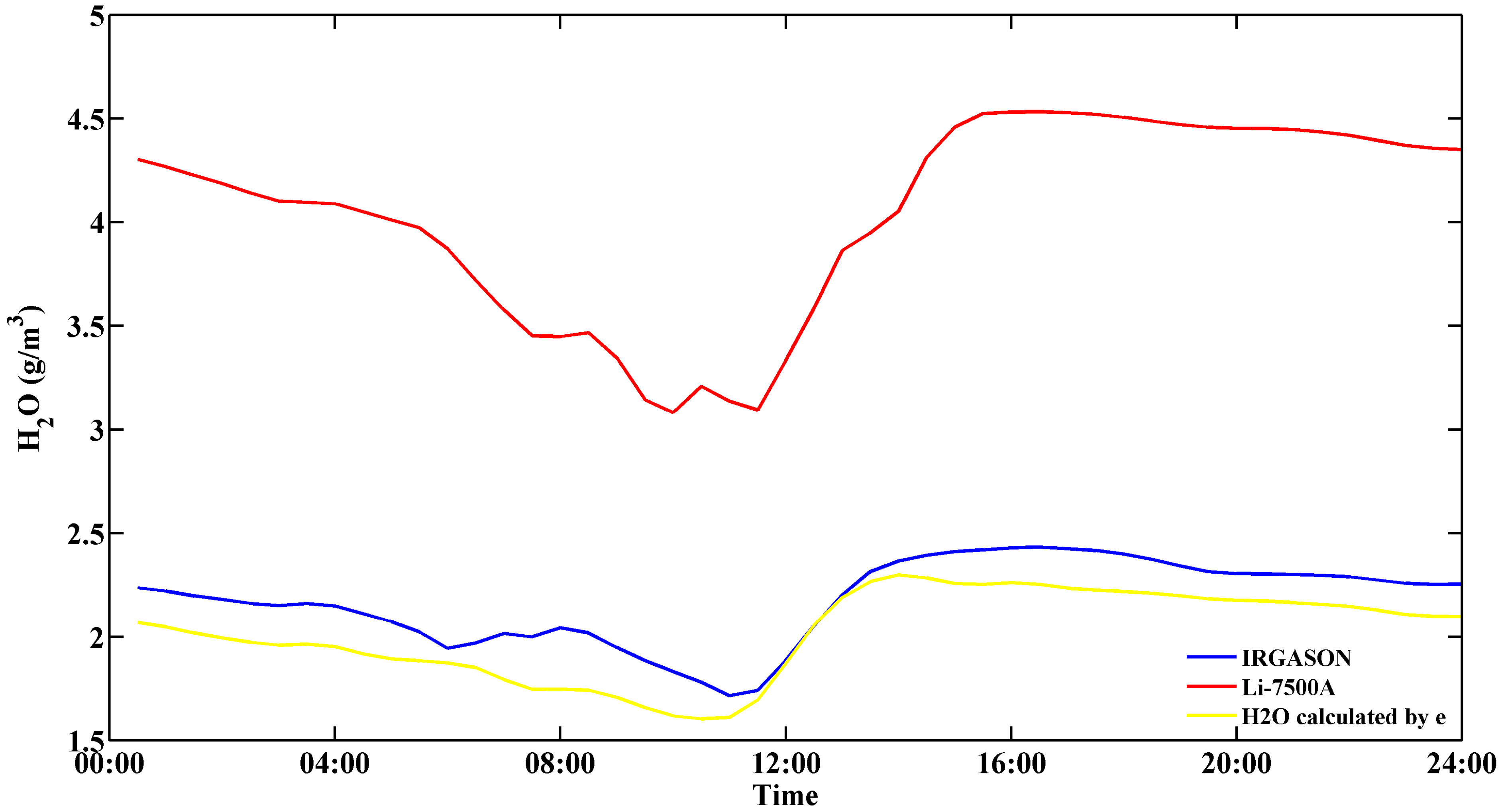


Fig. 15. The diurnal composite of H_2O in Xinjiang.

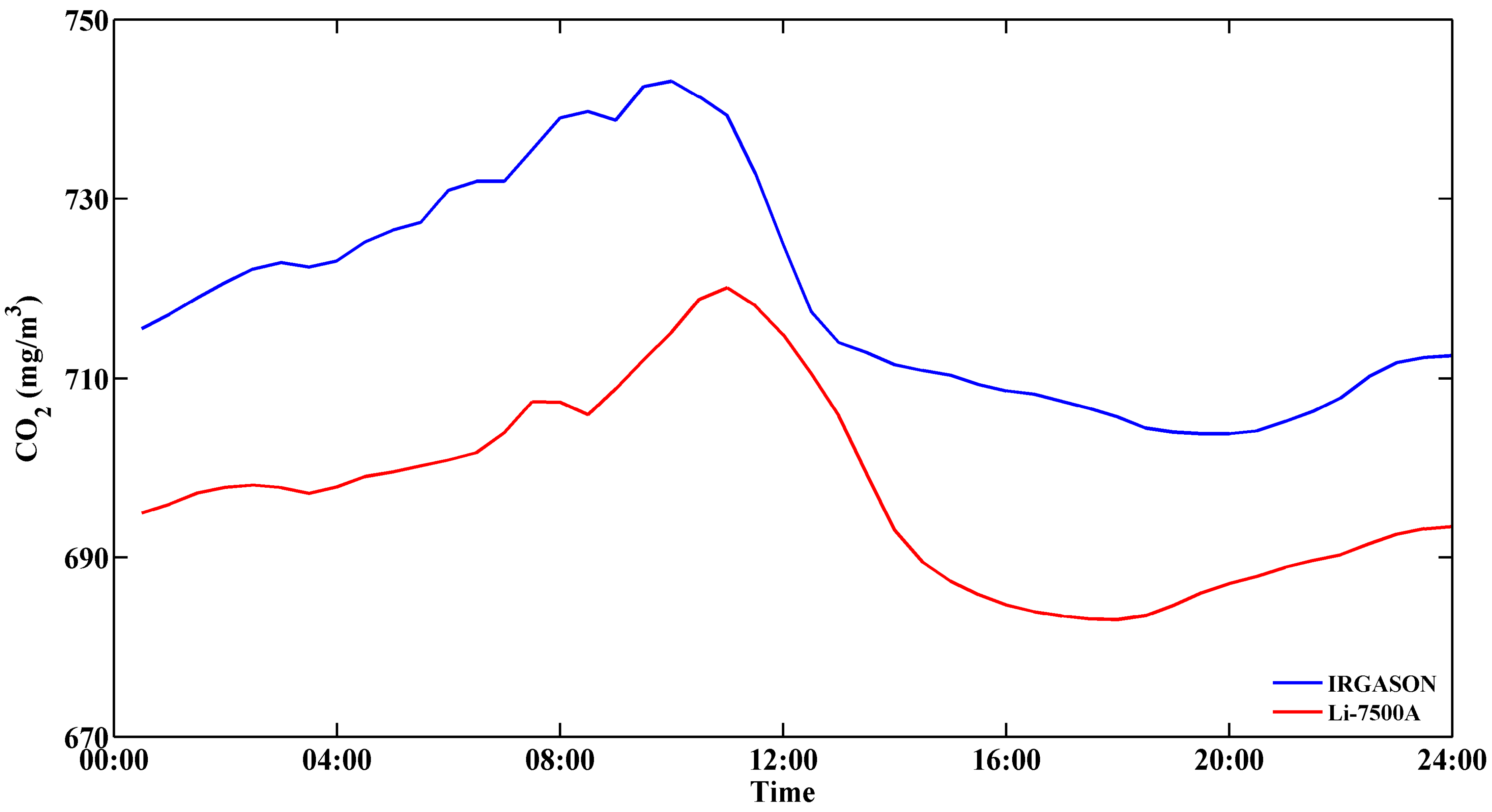


Fig. 16. The diurnal composite of CO_2 in Xinjiang.

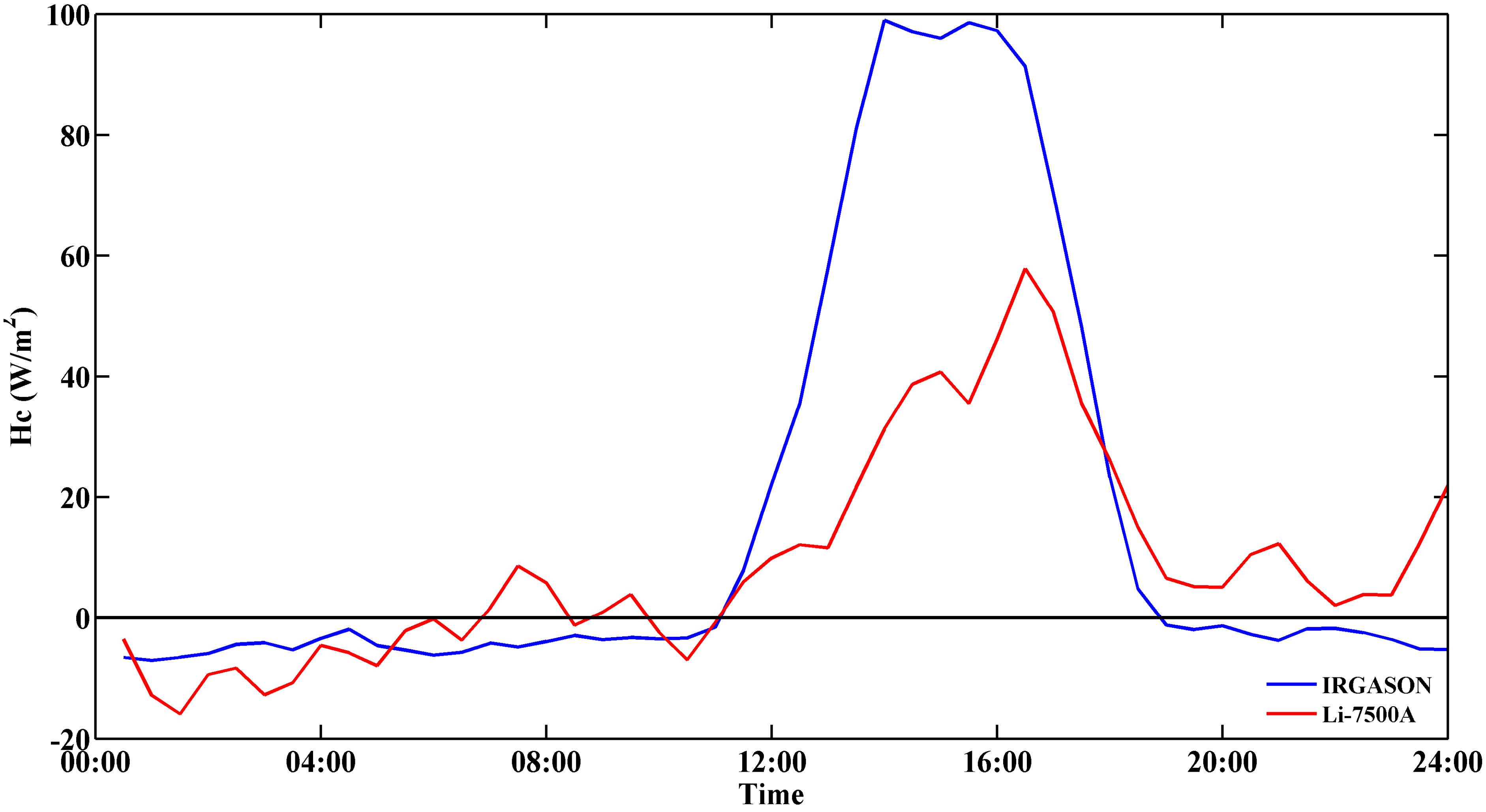


Fig. 17. The diurnal composite of Hc in Xinjiang.

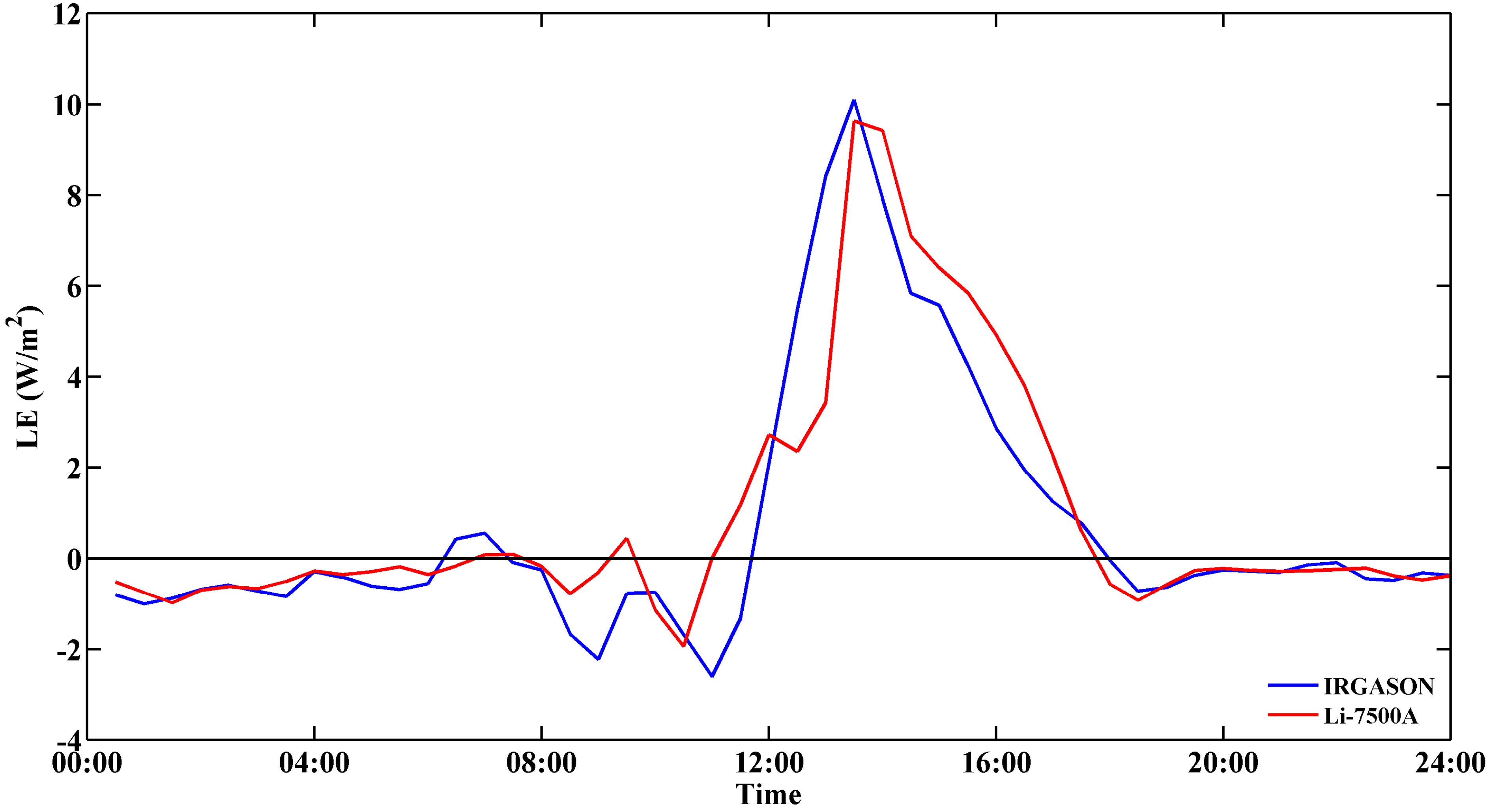


Fig. 18. The diurnal composite of λE in Xinjiang.

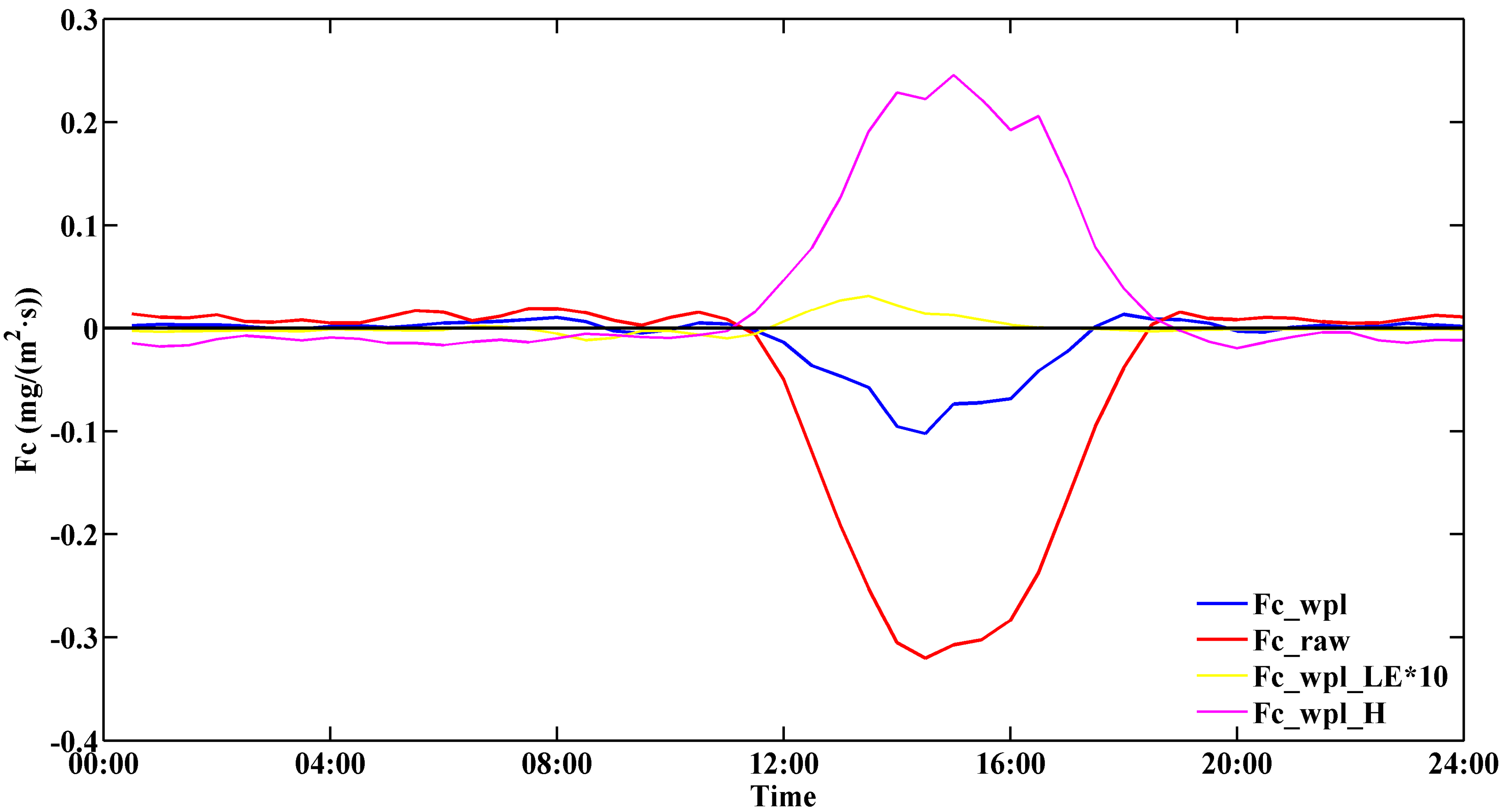


Fig. 19. The diurnal composite of Fc_IRGASON in Xinjiang.

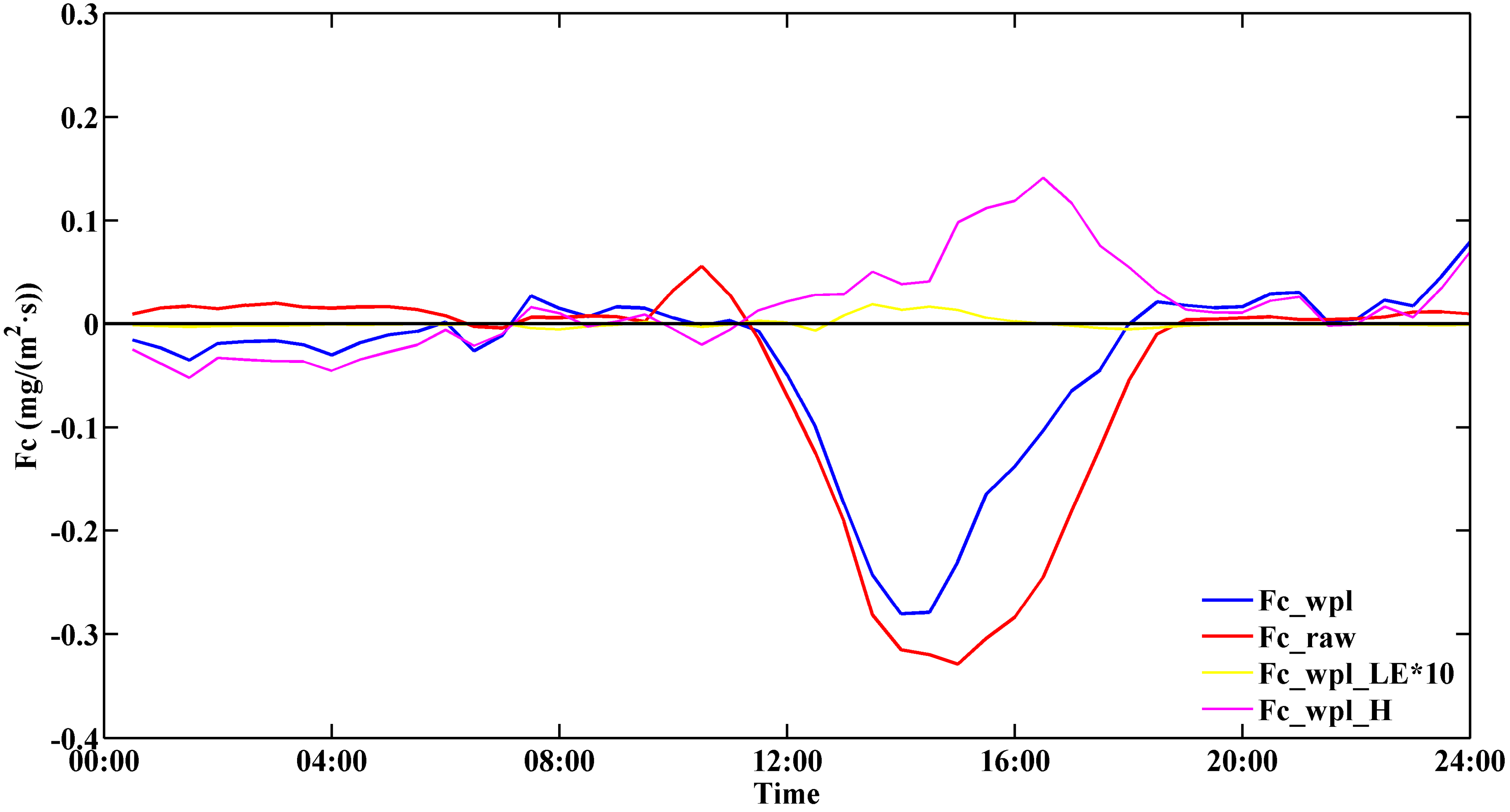


Fig. 20. The diurnal composite of Fc_Gill+Li-7500A in Xinjiang.

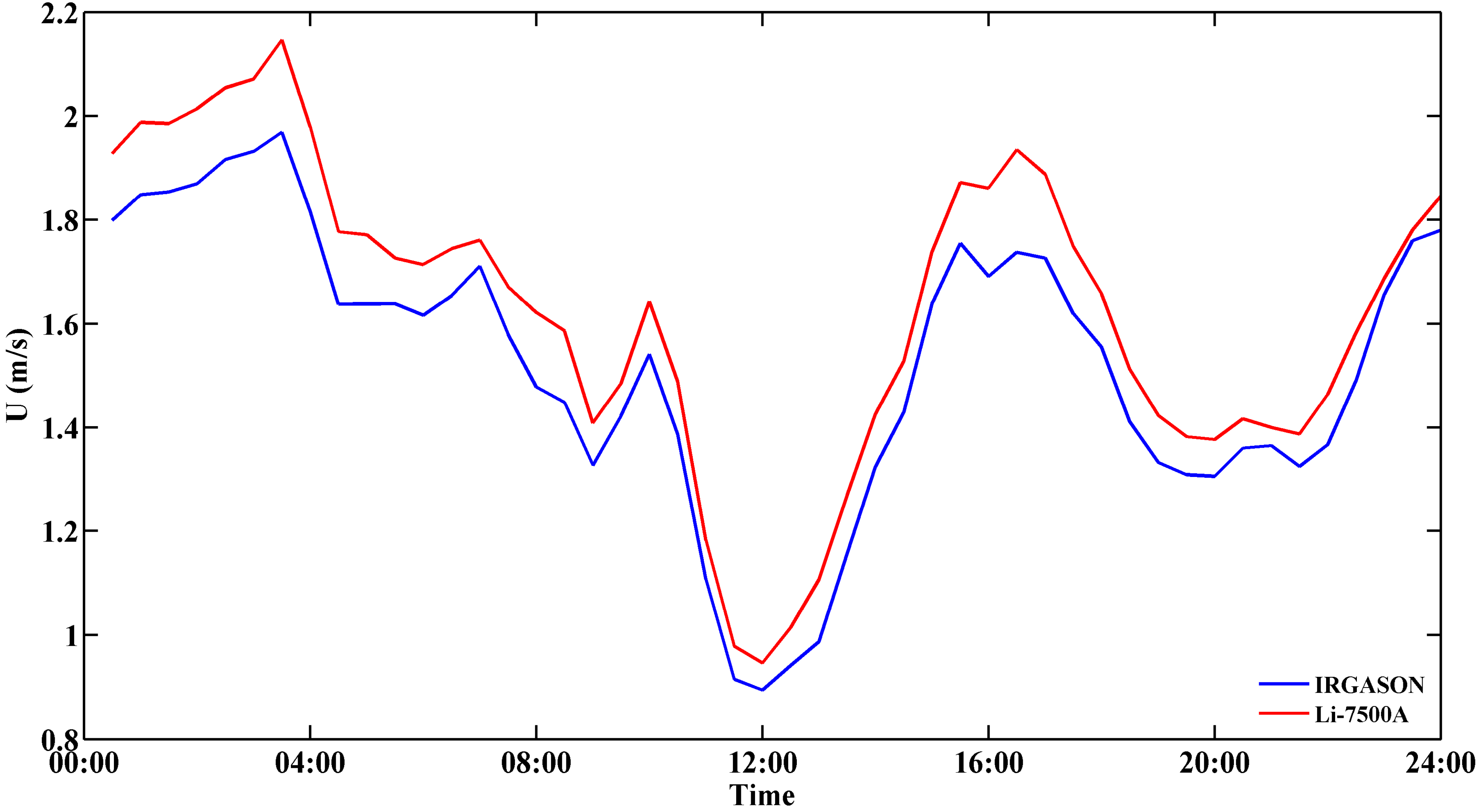


Fig. 21. The diurnal composite of wind speed in Xinjiang.