Performance evaluation of an integrated eddy covariance system in a cold environment

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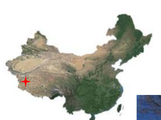
Introduction

- It is challenging to measure CO_2 flux with open-path eddy covariance in a cold environment. The difficulty arises from low flux signals and measurement artifacts.
- One such artifact is sensor self-heating, which is known to degrade the quality of the CO_2 flux. The problem arises from the density correction algorithm that uses the temperature fluctuations measured outside the optical-path of its gas analyzer.
- In this study, we compared an integrated open-path eddy covariance system (IRGASON, Campbell Scienti-fic Inc., USA.) with an separated open-path system consisting of a sonic anemometer (Gill Windmaster Pro, Gill Instruments Ltd., UK) and a gas analyzer (LI-7500A, LI-COR Inc., USA).

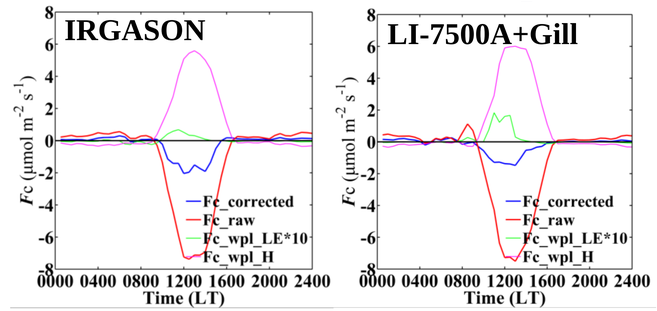
Site and Instrument

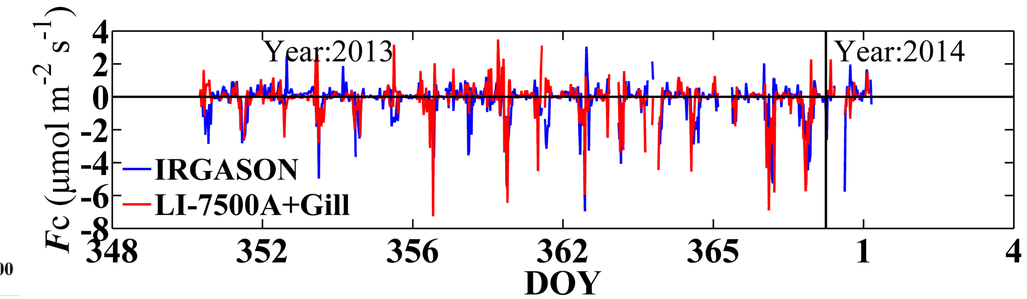
The experiment was conducted in a populus euphratica plantation forest in Yuli Country, Xinjiang Uygur Autonomous Region, China during the winter of 2013-2014.



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}
Vegetation	populus euphratica	Prevailing wind	NE, NW
Canopy height	10 m	Sunshine percentage	68%

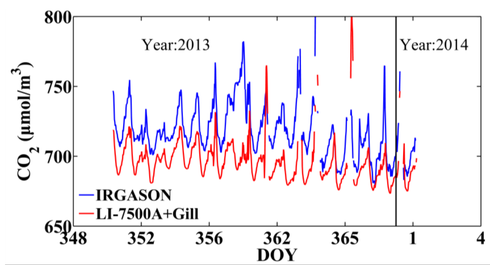
CO_2 Flux Diurnal Composite and Time Series

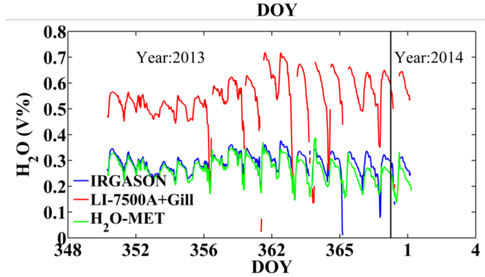


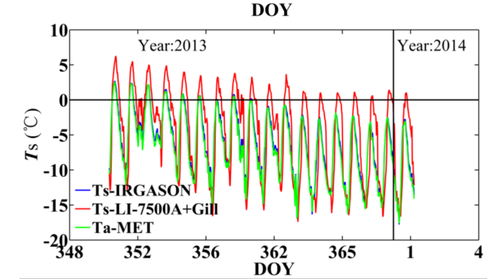


Even after WPL corrections, negative flux is apparent for both eddy covariance systems.

CO_2 , H_2O and T_s

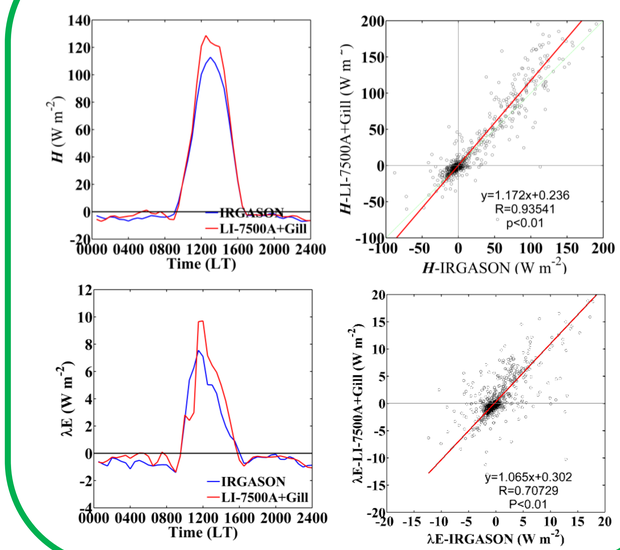




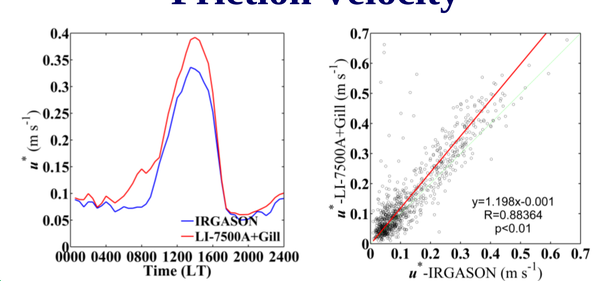


The temperature and vapor mixing ratio observed by IRGASON were in excellent agreement to those from the micrometeorological sensor.

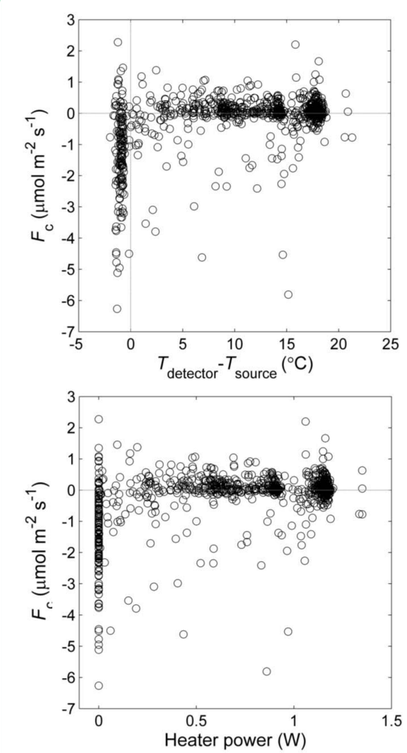
Sensible and Latent Heat



Friction Velocity



Self-Heating



More valid IRGASON measurements occurred when sensor heater was switched on, preventing condensation on its optical window.