Measuring evapotranspiration fluxes using a tunable diode laser-based open-path water vapor analyzer

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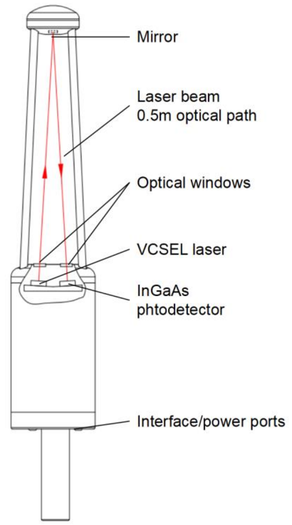
Introduction

- **Water vapor flux** is essential for drought monitoring and irrigation management. It is also a key parameter for environmental assessment and ecosystem modeling.
- We have earlier presented a **TDLAS-based** open-path water vapor analyzer (HT1800, HealthyPhoton Co., Ltd.), which is suitable for **eddy covariance (EC)** measurement of water vapor flux.
- Considering **spectroscopic effect correction** for EC measurement, we prepared two HT1800 water vapor analyzers for field experiments. One is equipped with an infrared laser operating near 1392 nm, and the other near 1877 nm.

Laser source and absorption line selection

- **Vertical cavity surface emitting laser (VCSEL)**: low-power consumption and cost-effective light source
- **1392nm**: one of the most used for TDLAS detection of water vapor
- **1877nm**: found to have less temperature-dependent absorption lineshape variations



Field deployment

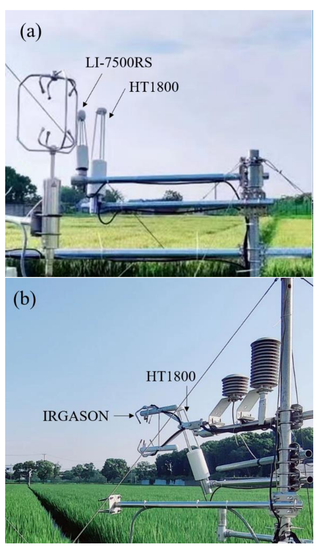
Site: Suzhou Academy of Agricultural Sciences of China. (31°27'09.205''N, 120°25'33.222‘’E)

Period 1 (figure a):

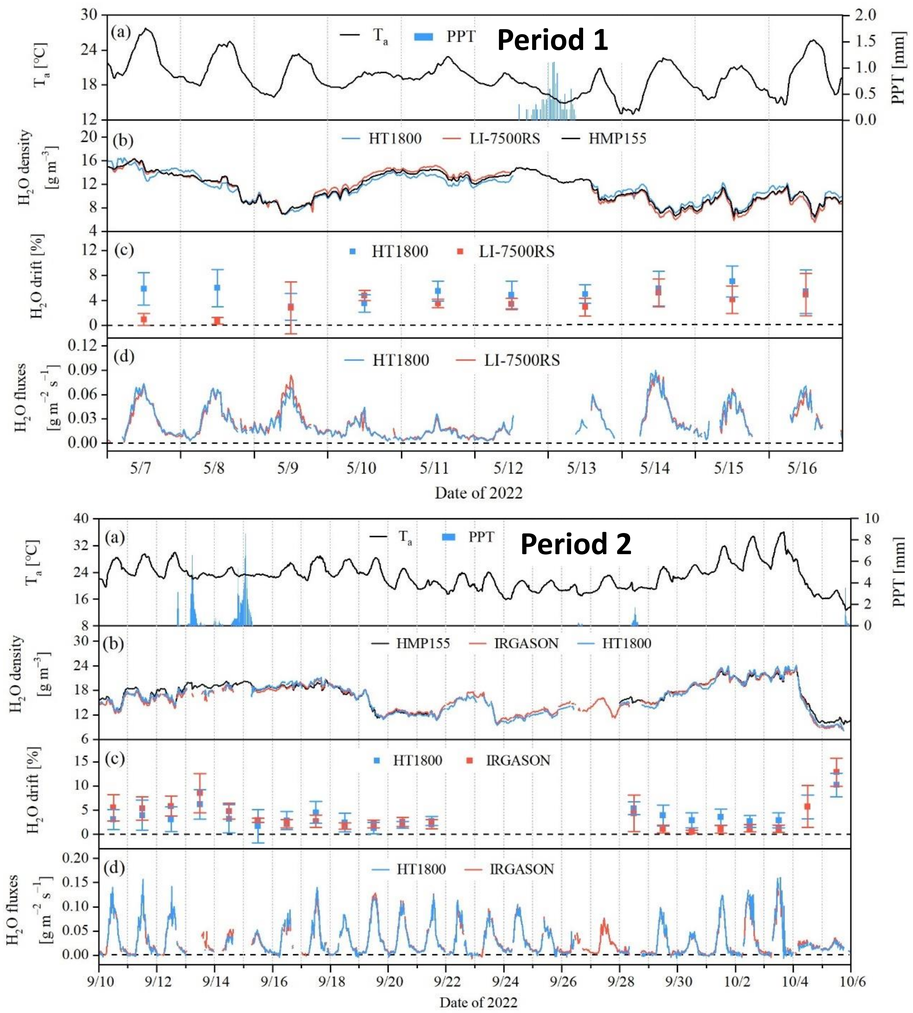
- Time: May 7–16, 2022
- Anemometer: METEK© u-Sonic3 Cage MP
- Analyzer 1: HT1800 (1877nm)
- Analyzer 2: LI-COR© LI-7500RS

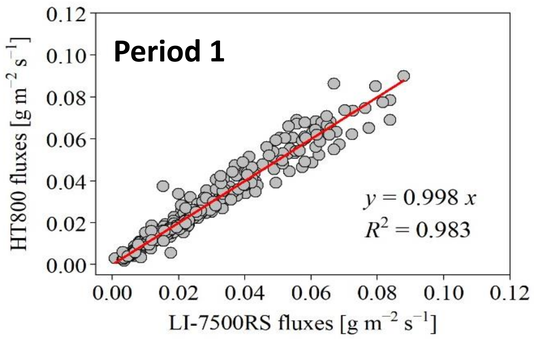
Period 2 (figure b):

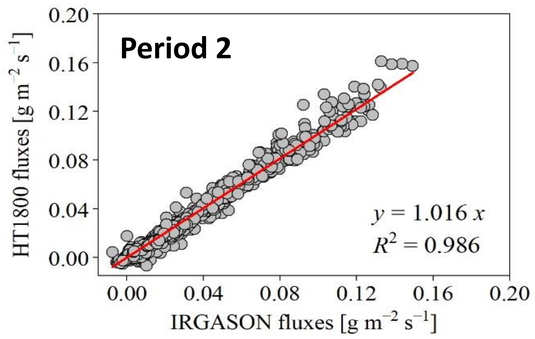
- Time: September 10–October 5, 2022
- Anemometer: Campbell© CSAT-3
- Analyzer 1: HT1800 (1392nm)
- Analyzer 2: Campbell© EC150

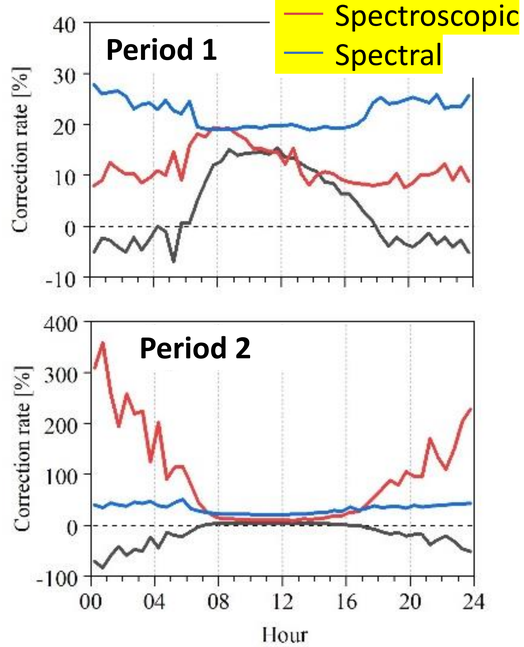


Experimental results









Conclusions

- We investigated the HT1800 performance of measuring water vapor flux through field deployment. The comparisons with another two commercial analyzers showed high consistency.
- The analyzer with a 1392nm laser source leads to a higher spectroscopic correction rate due to temperature drift. However, the corrected data showed a high degree of agreement with the measurements from a mature analyzer.
- Considering its convenient availability, this work demonstrated that a TDLAS-based analyzer with a 1392nm laser could be used as a cost-effective solution to measure water vapor flux precisely.

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