Evapotranspiration and photosynthetic parameters in a drip-irrigated olive grove on western coastal South America

Extended presentation

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ProCIENCIA

Study area

- Olive cultivation in land claimed by irrigation from Pacific coastal desert.
- Yearly precipitation 26 mm
- Temperature regime between 15 and 28 C

- Grove located 2 Km from the Pacific Ocean.
- 6 hectares on mild incline of sandy soil
- Frantoio and Manzanilla olive varieties interspersed in a 3 to 1 ratio
- Grove is 8 years old

Irrigation

- Crop density: 380 trees ha^{-1} , 60% canopy coverage, rest is exposed sandy soil
- **Growing season:** 57 $m^3ha^{-1}day^{-1}$ or 130 L day^{-1} per tree (September- April).
- **Winter:** 21 $m^3ha^{-1}day^{-1}$ or 60 L day^{-1} per tree (May - August)

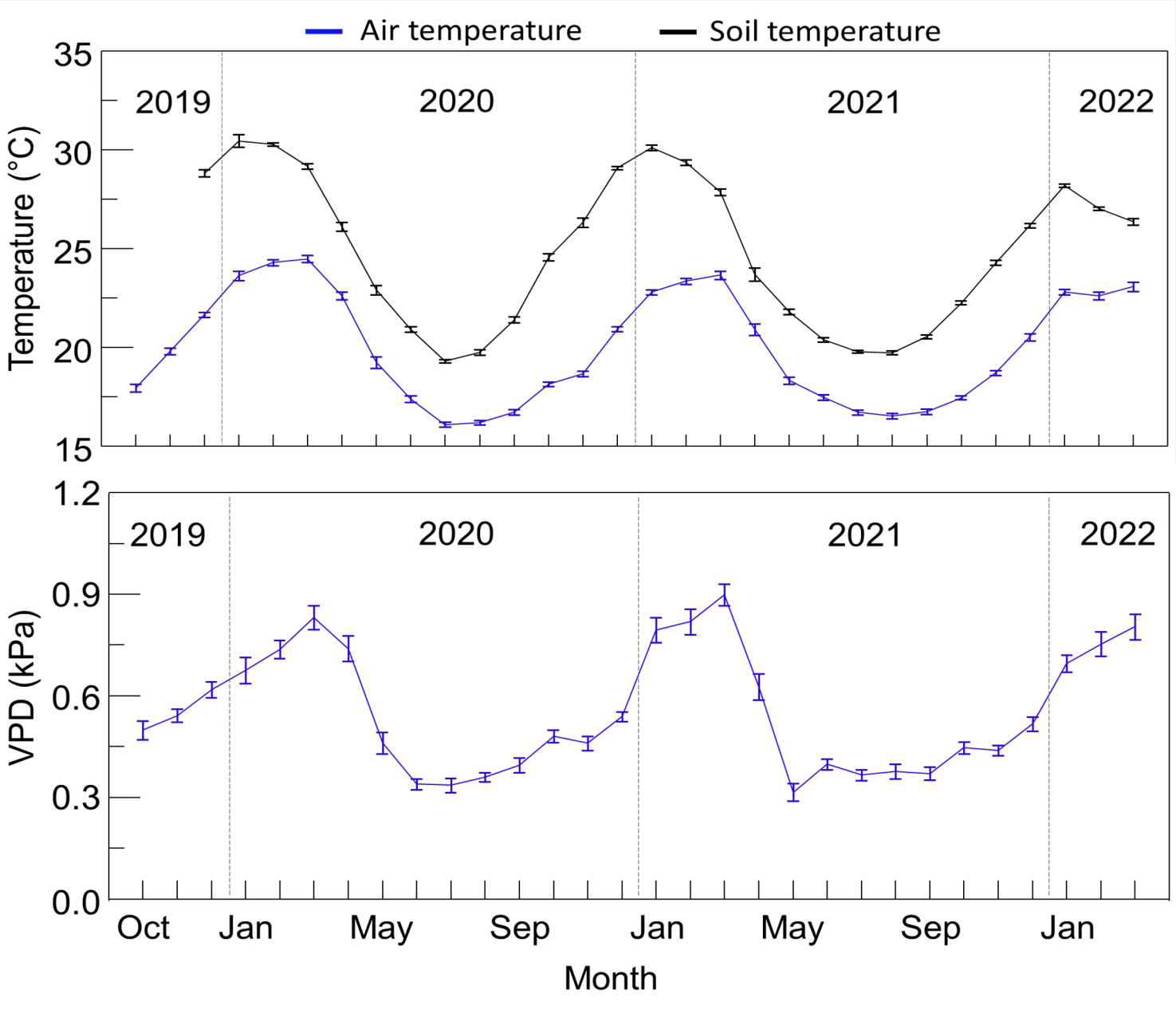
Weekly averages for temperature and VPD

Eddy Flux
9 m tower with systems installed at 7 m height:

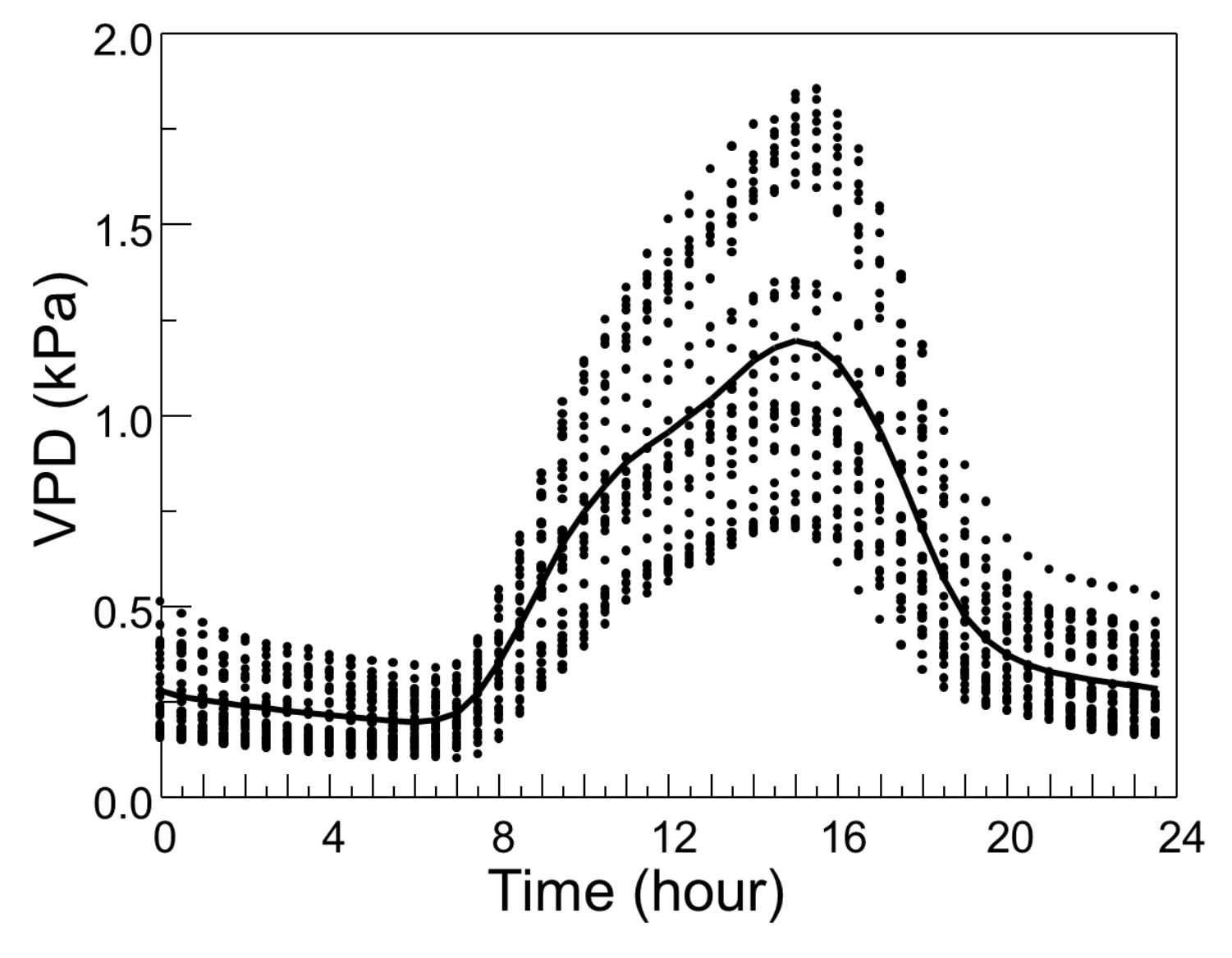
- Campbell Irgason, open path
- Kipp & Zonen radiometers
- LiCor PAR sensor
- Vaisala T and RH sensor
- Hukseflux soil heat flux plates

In 6 trees within the flux footprint of the tower:

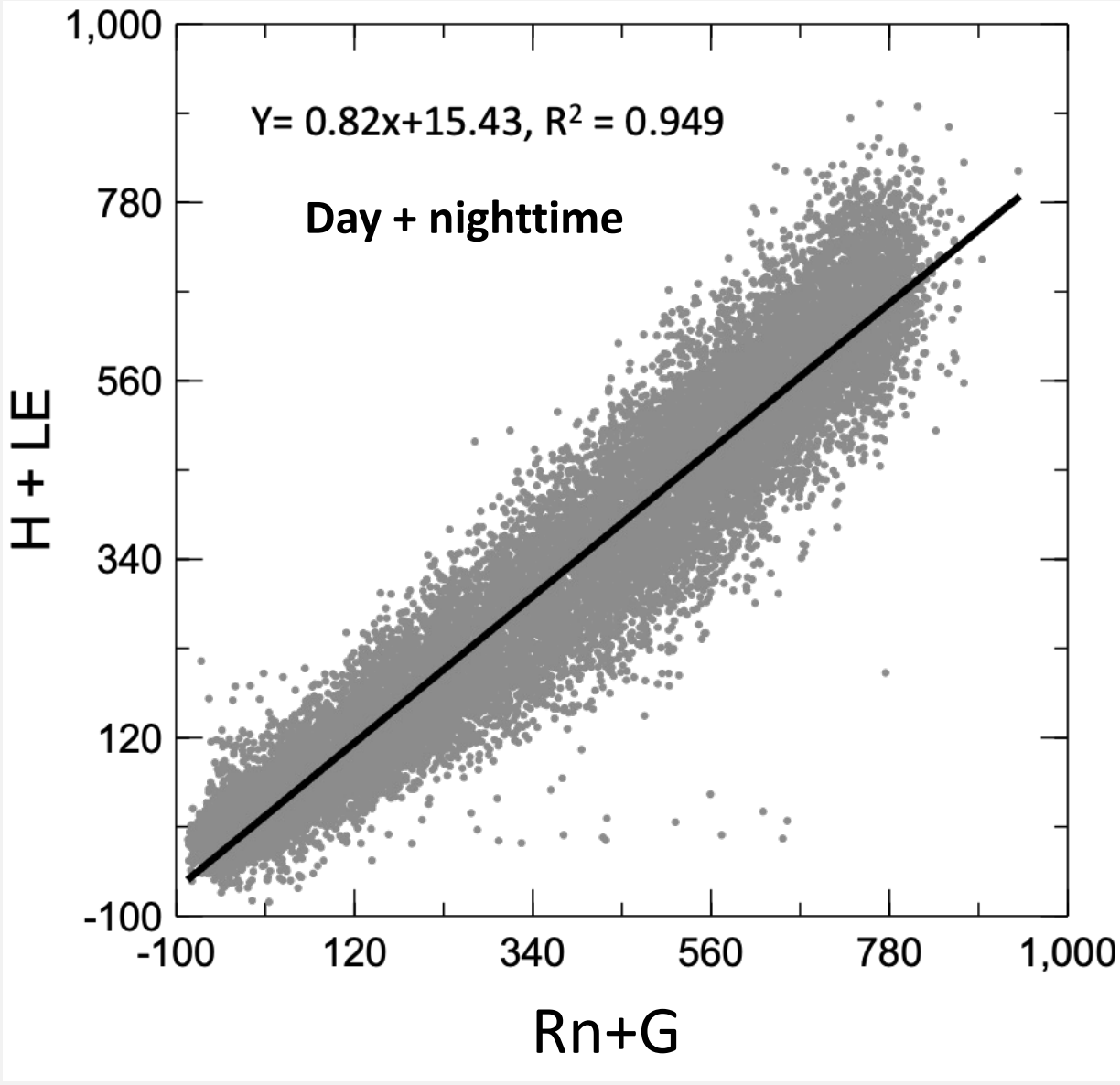
- Ekomatic dendrometers
- LiCor TDR soil water content and temperature probes

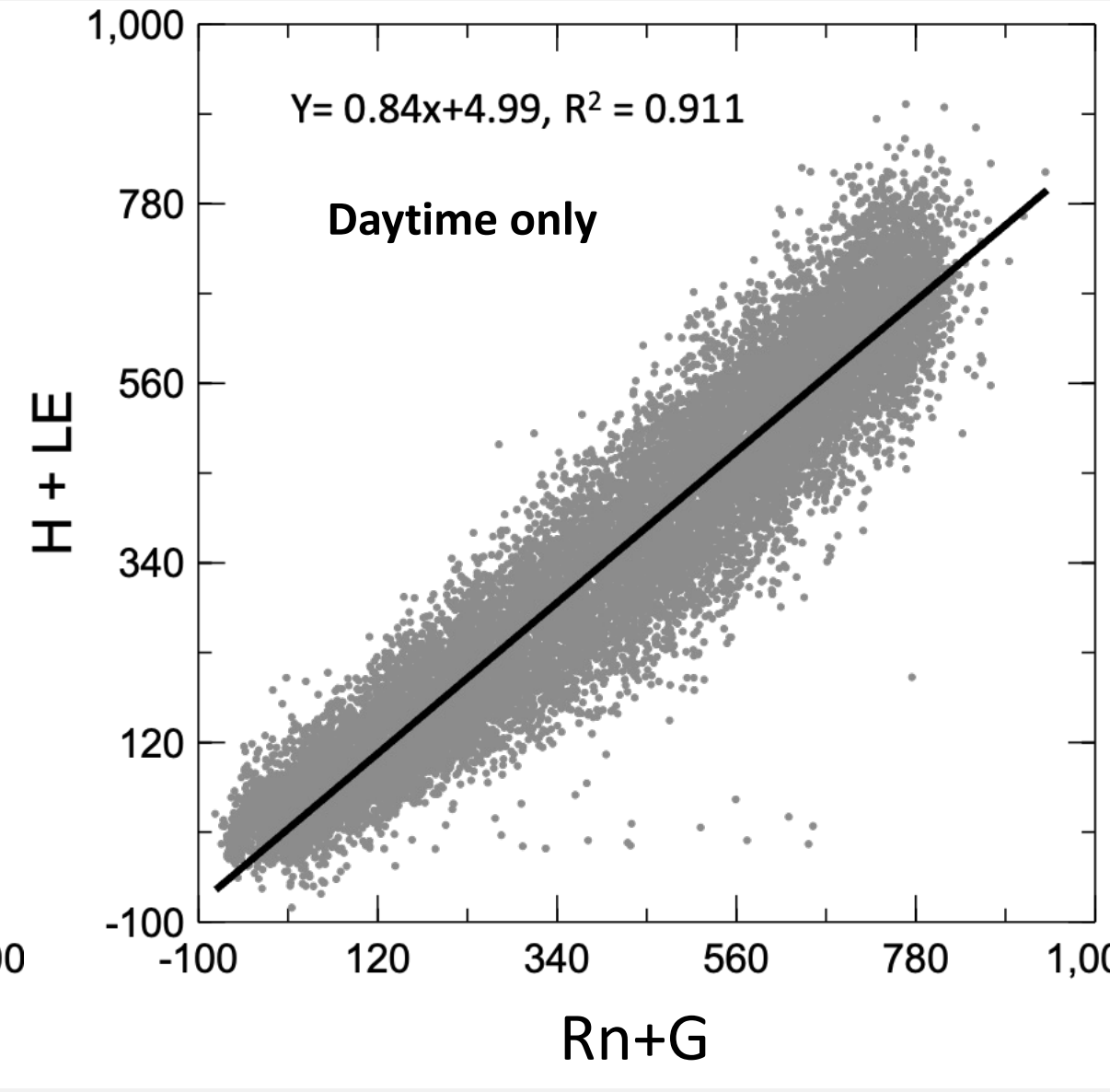


Average half-hourly VPD for all seasons

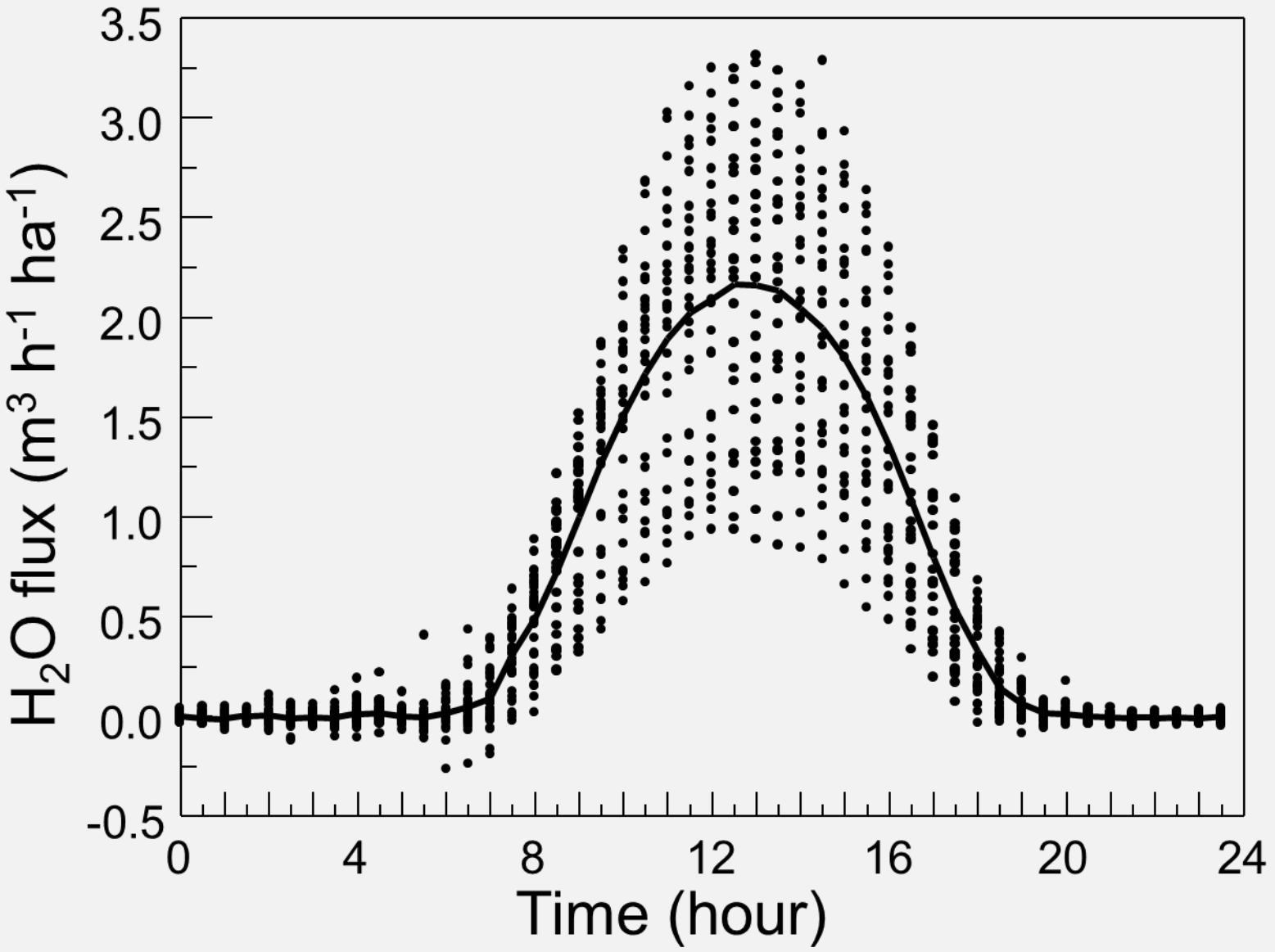


Energy balance

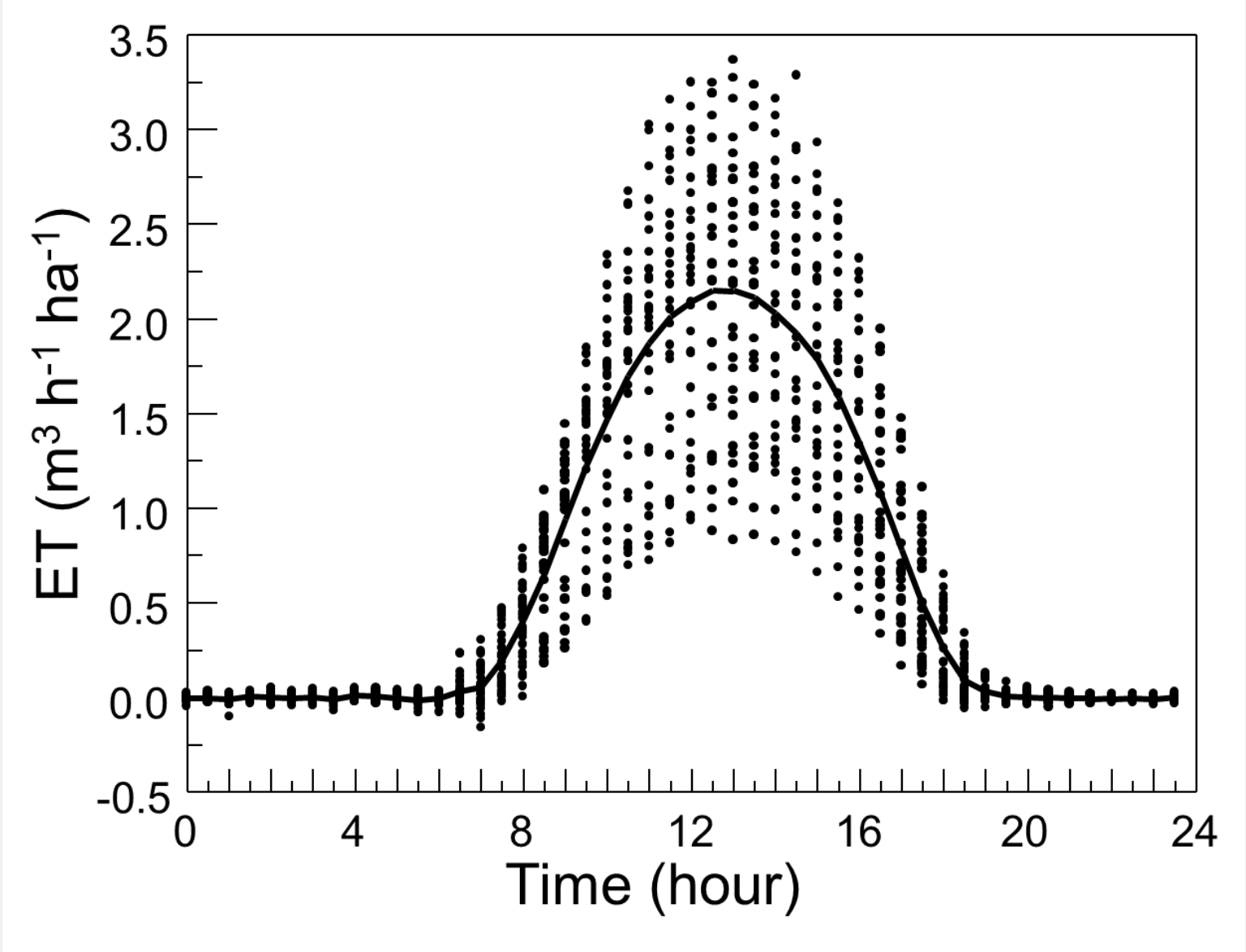




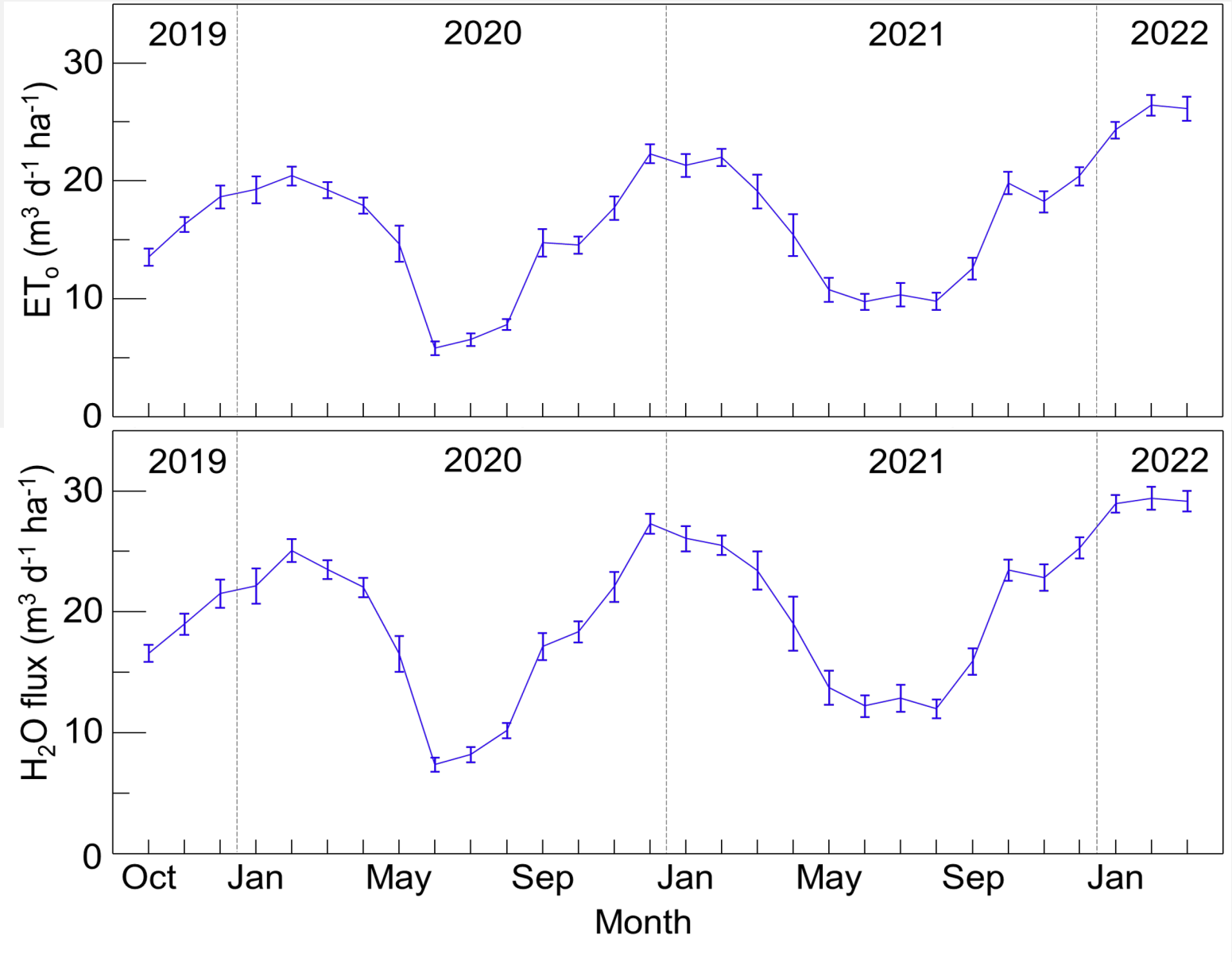
Average half-hourly H2O fluxes for boths seasons



Average half-hourly ET for all seasons

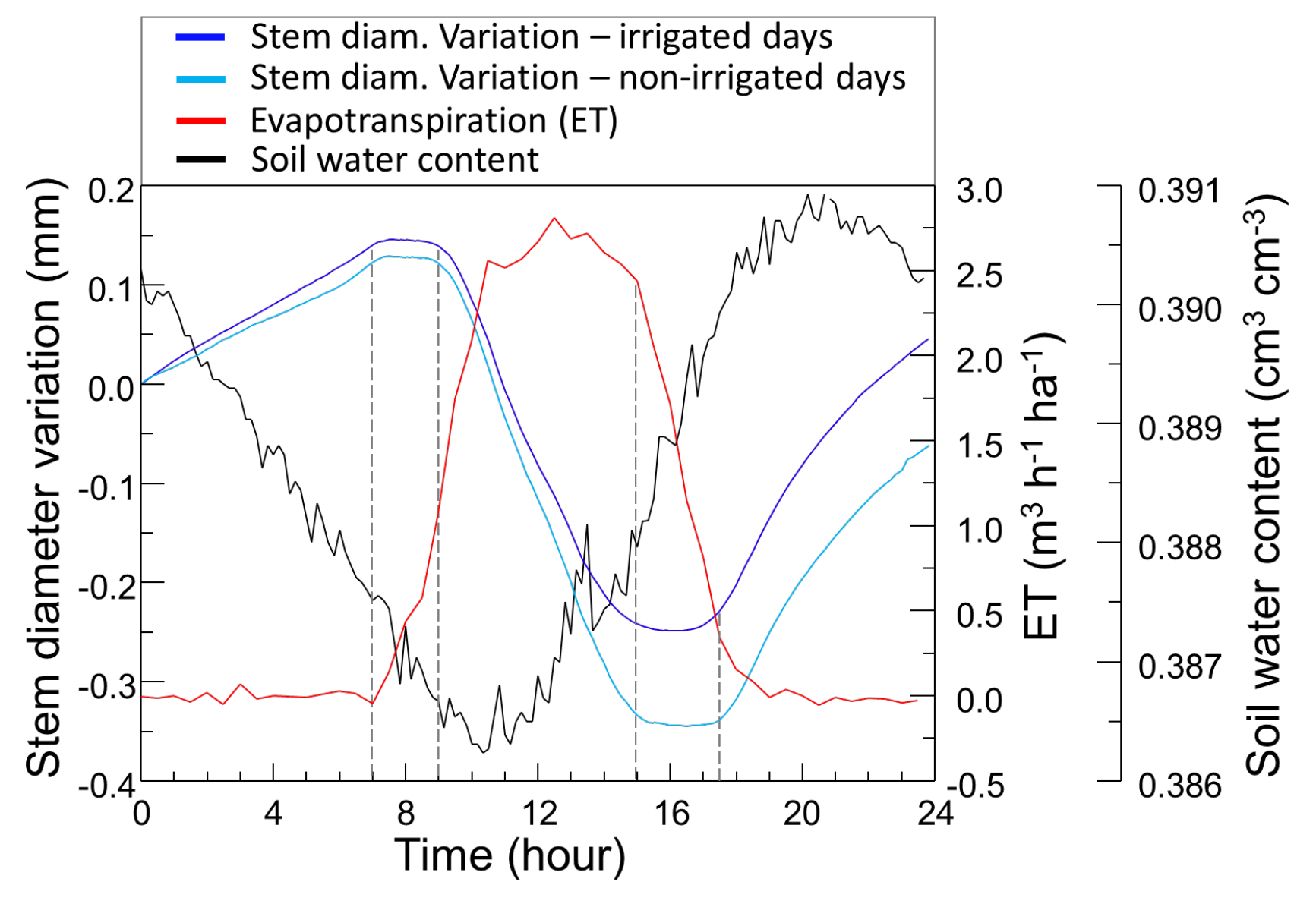


Monthly average H_2O flux and ET



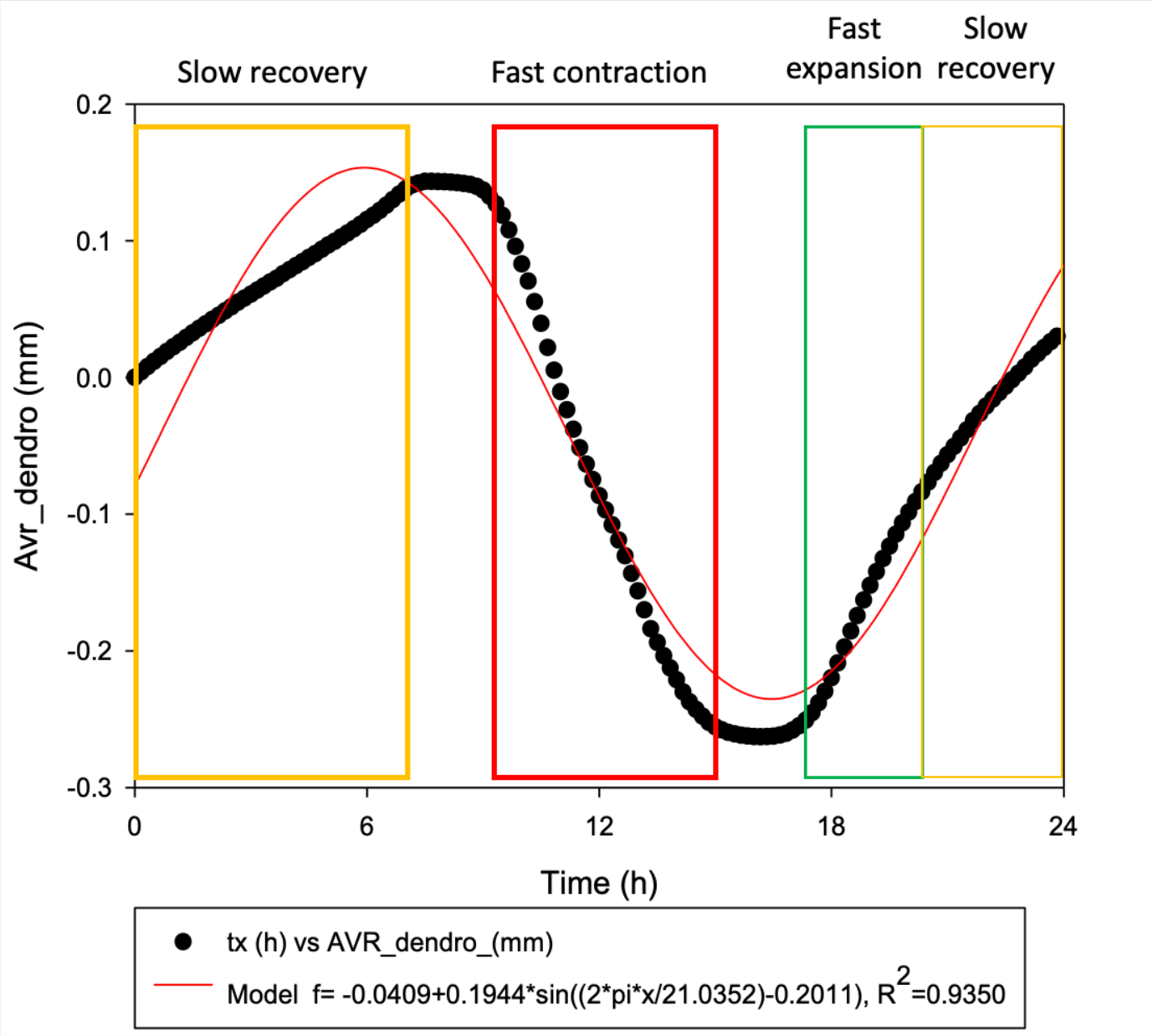
ET, stem diameter and soil water content relationships

- ET starts while stem diameter (SD) is at its peak and continues during its plateau for 2 hours.
- When ET reaches half maximal value, fast SD contraction start
- SD reaches minimal value while ET is still close to its maximum.
- SD recovery starts when ET reaches a minimum and appears to be biphasic process



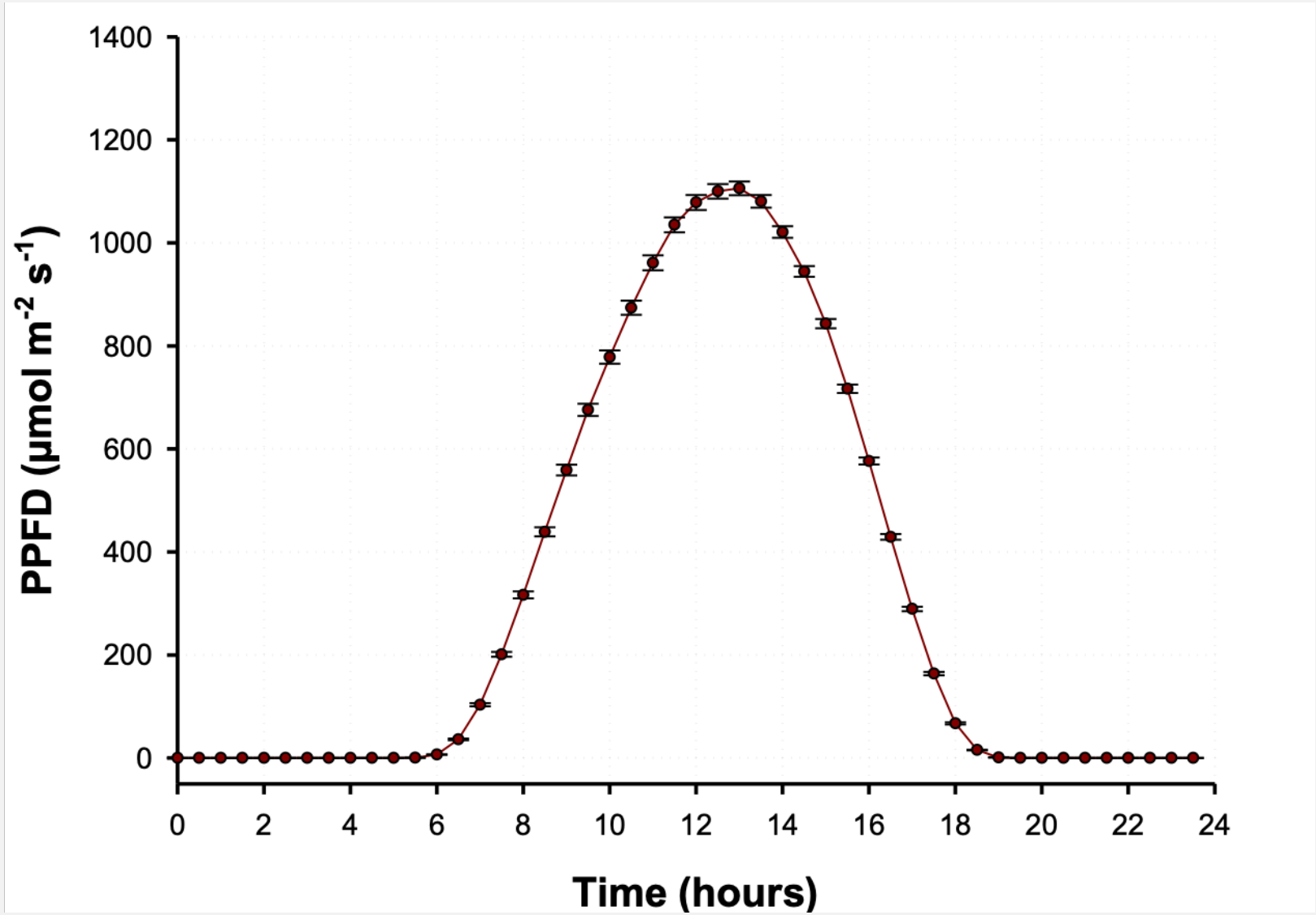
Pattern of stem diameter fluctuations suggest storage component

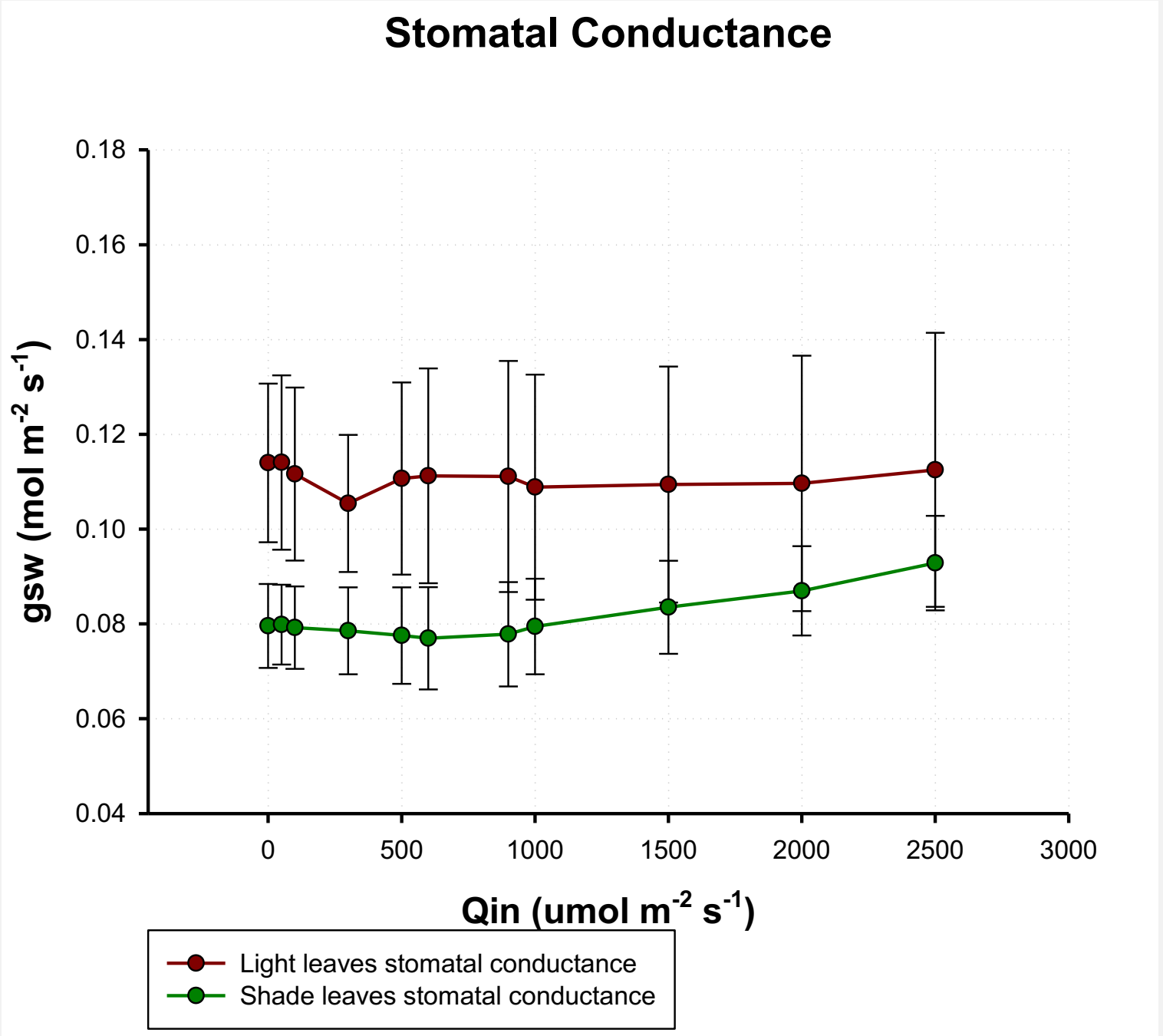
- Stem contraction follows a linear pattern at 67 µm h^{-1} for 6 h (6 am - 5 pm).
- Recovery is biphasic, an initial fast phase at 45 µm h^{-1} lasts 3 h (5 – 9 pm)
- A slow recovery follows that lasts 10h at 17 µm h^{-1}.
- The rise in ET to half-maximal values while SD remains constant at the start of the day suggests a significant water storage component accumulated during overnight uptake.

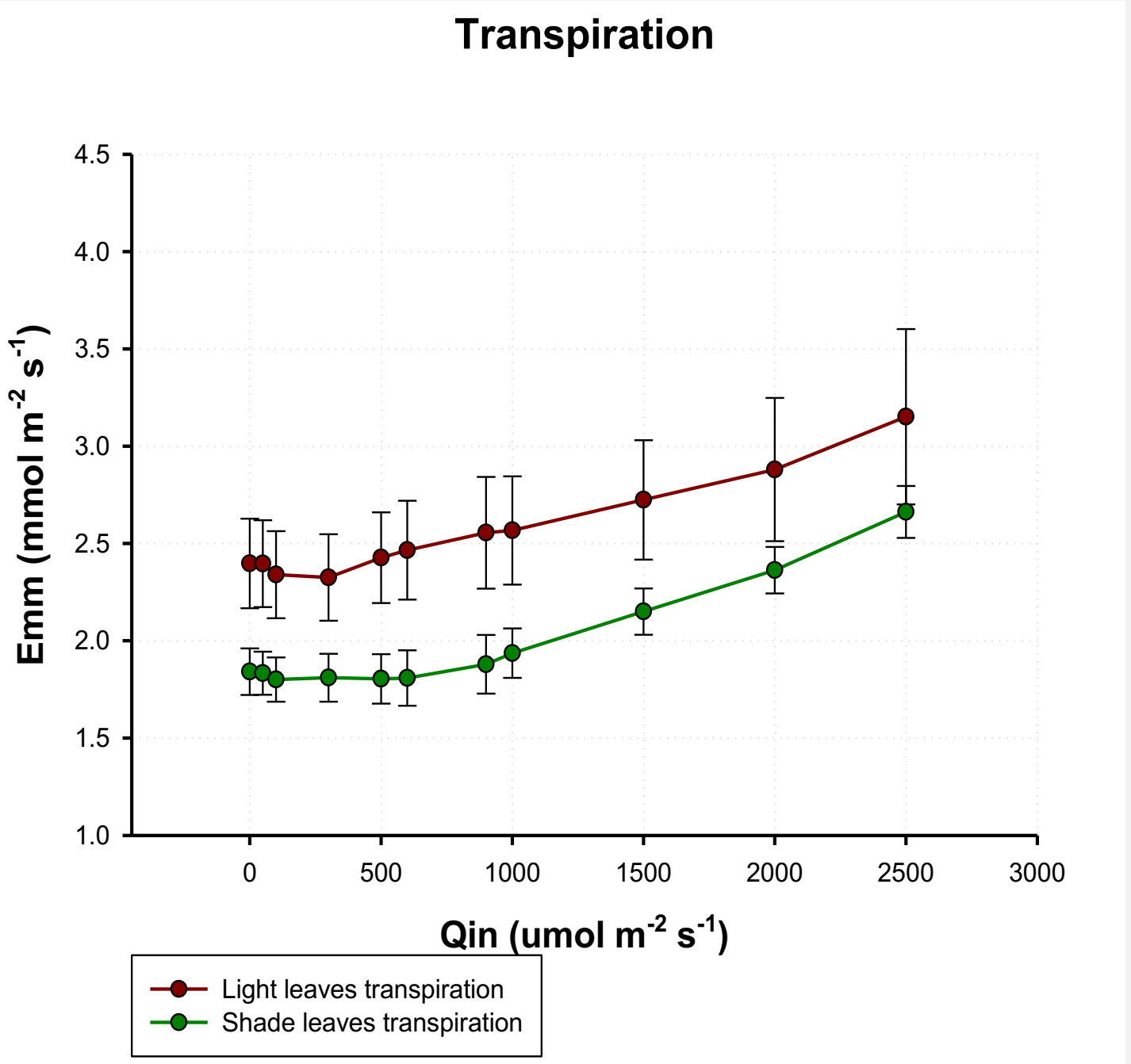


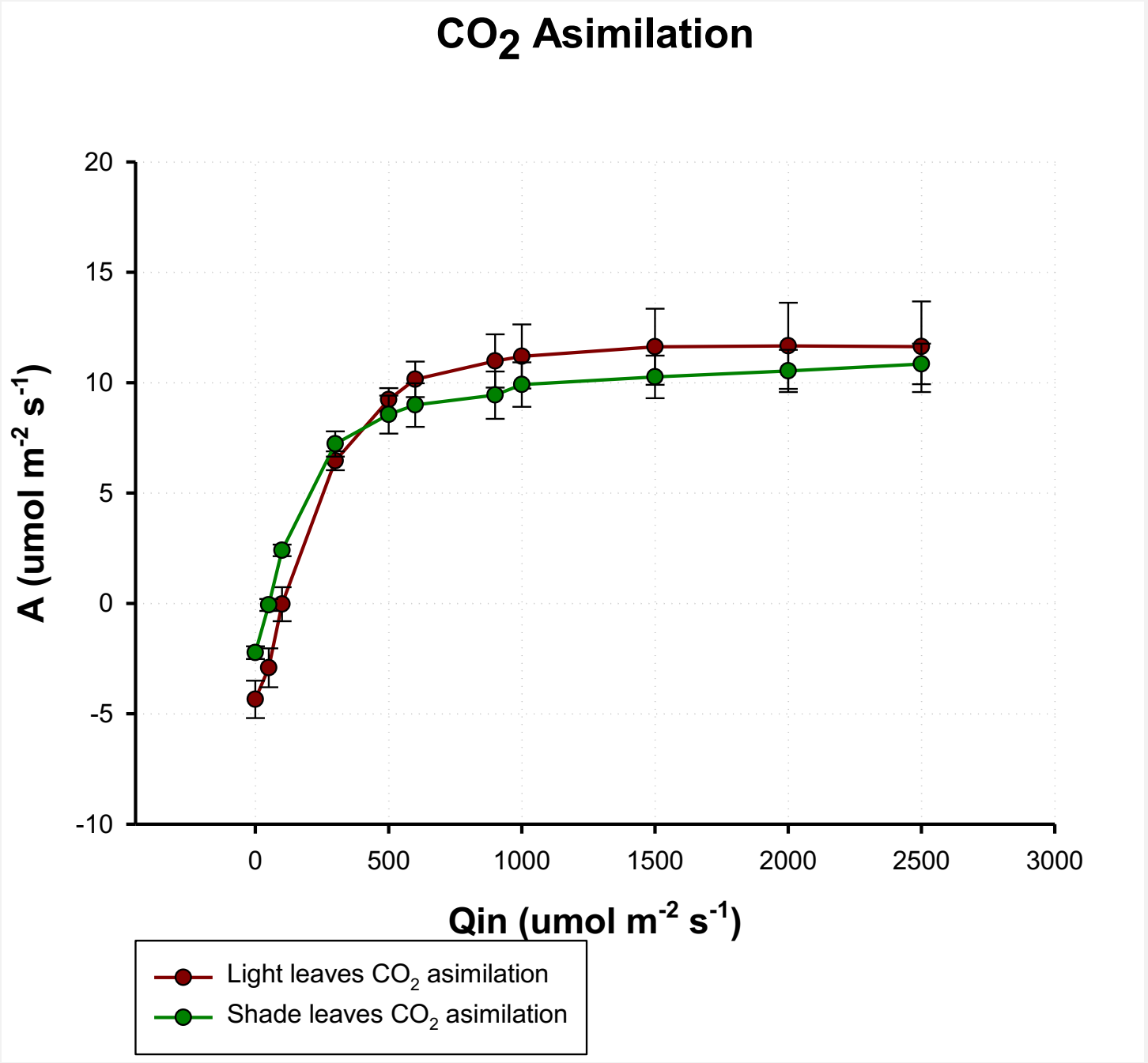
Photosynthetic parameters of olive sun and shade leaves

Average photosynthetic photon flux density during growing season




Stomatal Conductance
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
gsw (mol m-2 s-1)
0
500
1000
1500
2000
2500
3000
Qin (umol m-2 s-1)
Light leaves stomatal conductance
Shade leaves stomatal conductance


Transpiration
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
Emm (mmol m-2 s-1)
0
500
1000
1500
2000
2500
3000
Qin (umol m-2 s-1)
Light leaves transpiration
Shade leaves transpiration


CO_2 Asimilation
20
15
10
5
0
-5
-10
A (umol m^{-2} s^{-1})
0
500
1000
1500
2000
2500
3000
Qin (umol m^{-2} s^{-1})
Light leaves CO_2 asimilation
Shade leaves CO_2 asimilation

Thank you!