Assessing different levels of ecophysiological response during seasonal heatwaves using SIF and COS measurements

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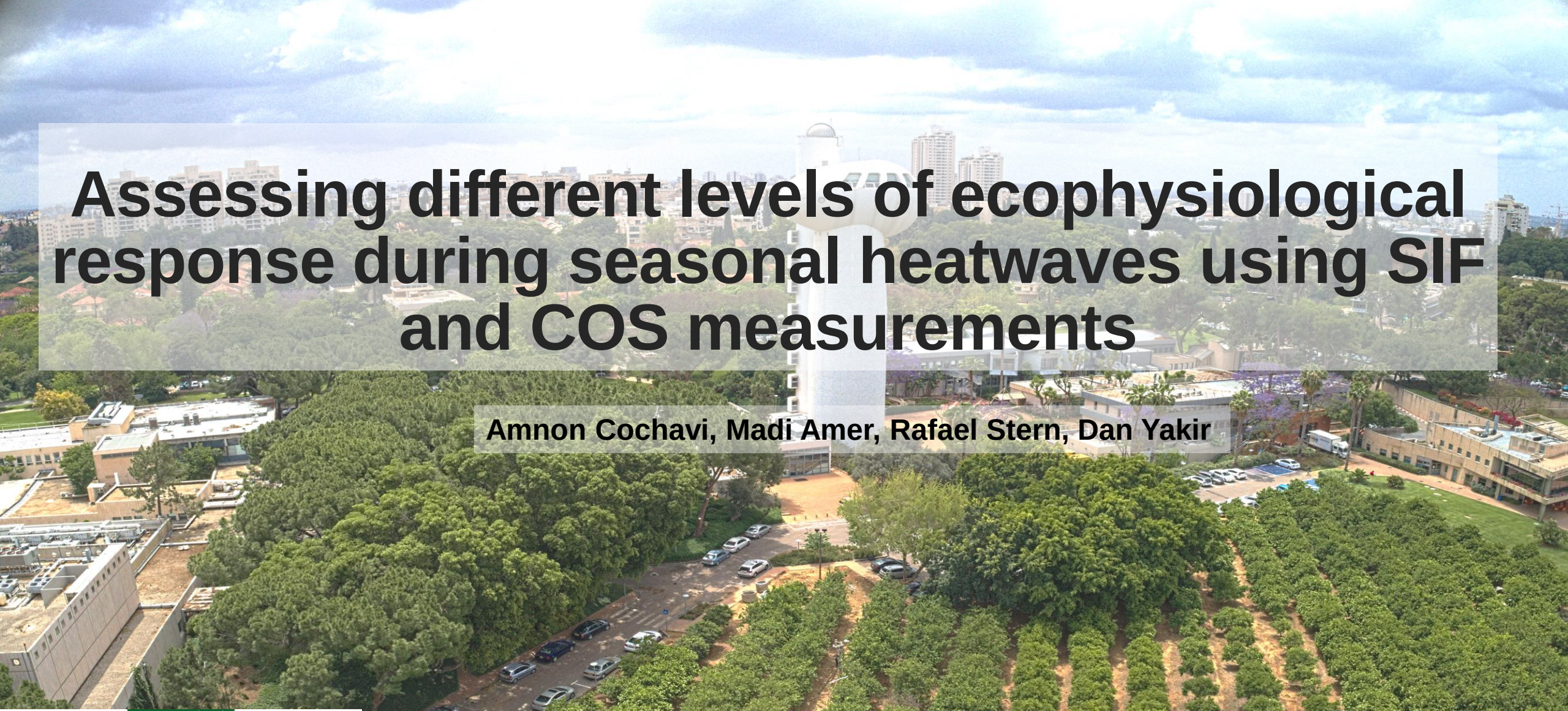

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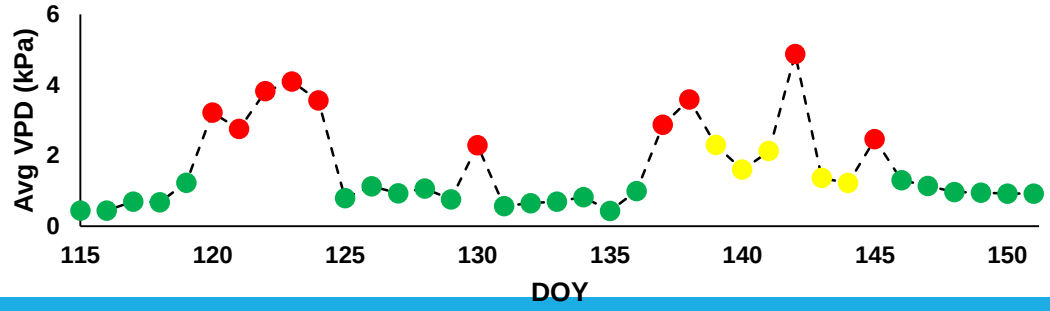
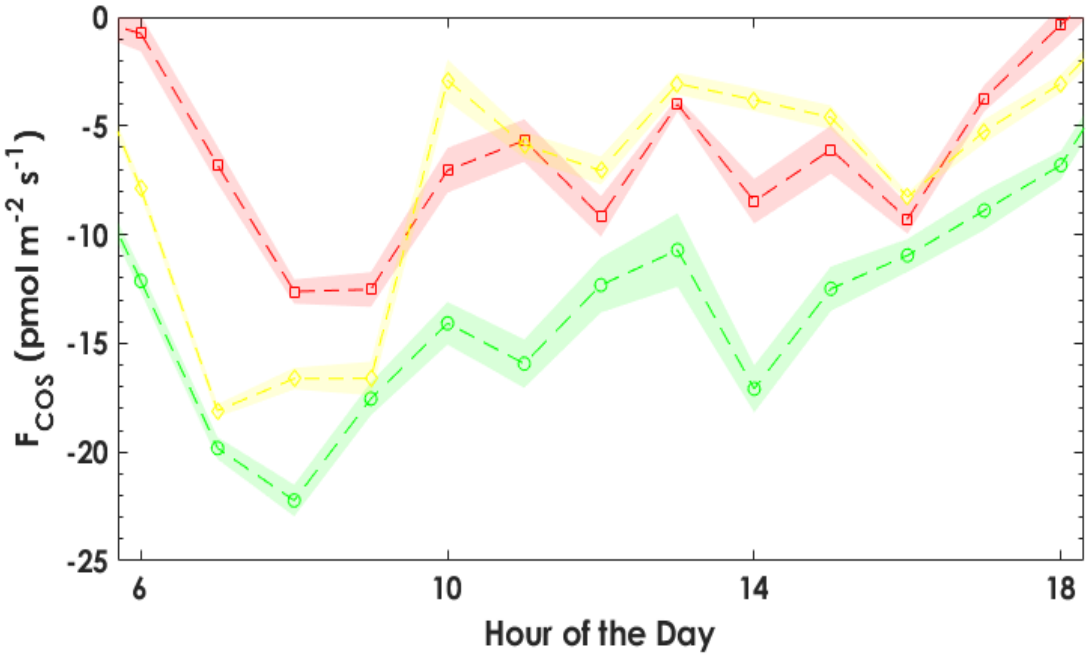
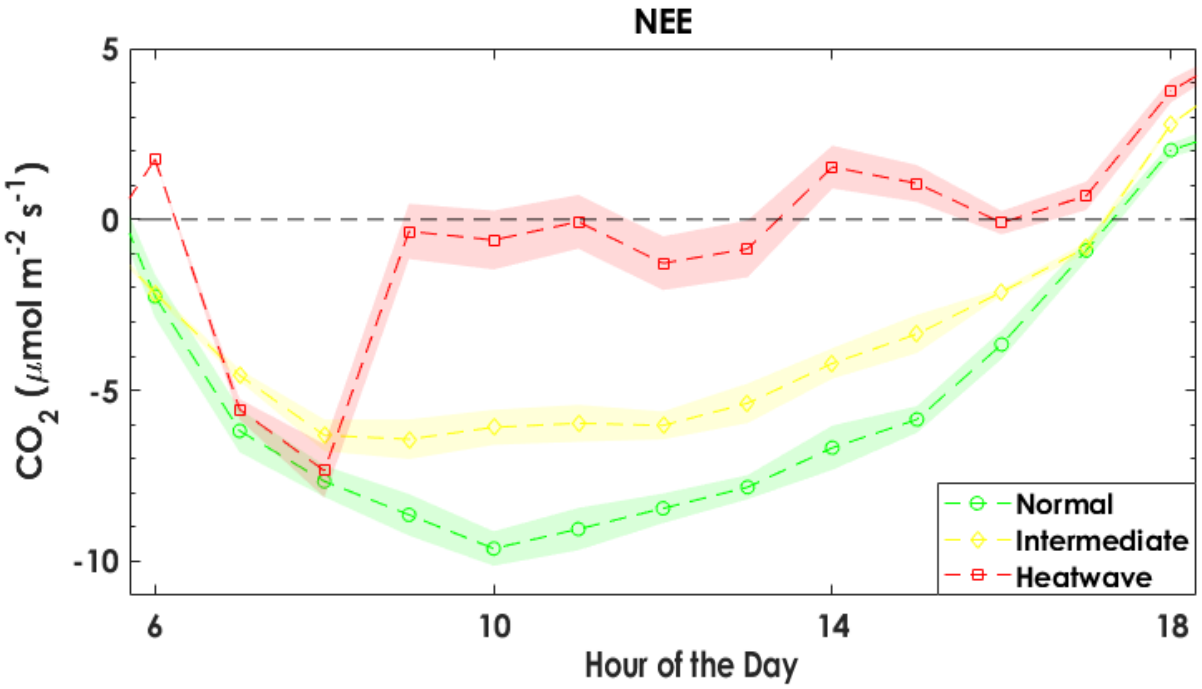
Heat waves in the Mediterranean

- A common phenomena, mostly during spring time.
- These events include dramatic rise in vapor pressure deficit (VPD), and end with a sharp drop back to normal values.
- Heatwave event on an irrigated plot allows to test the effect of increasing VPD on the environment, without other variables (light, LAI, SWC, etc.).
- During the experiment, beside the normal days (N, •),we detected five heatwave events (HW, •). We also detected two events where temperature and VPD values did not return to normal level, but to intermediate level (IN, •).



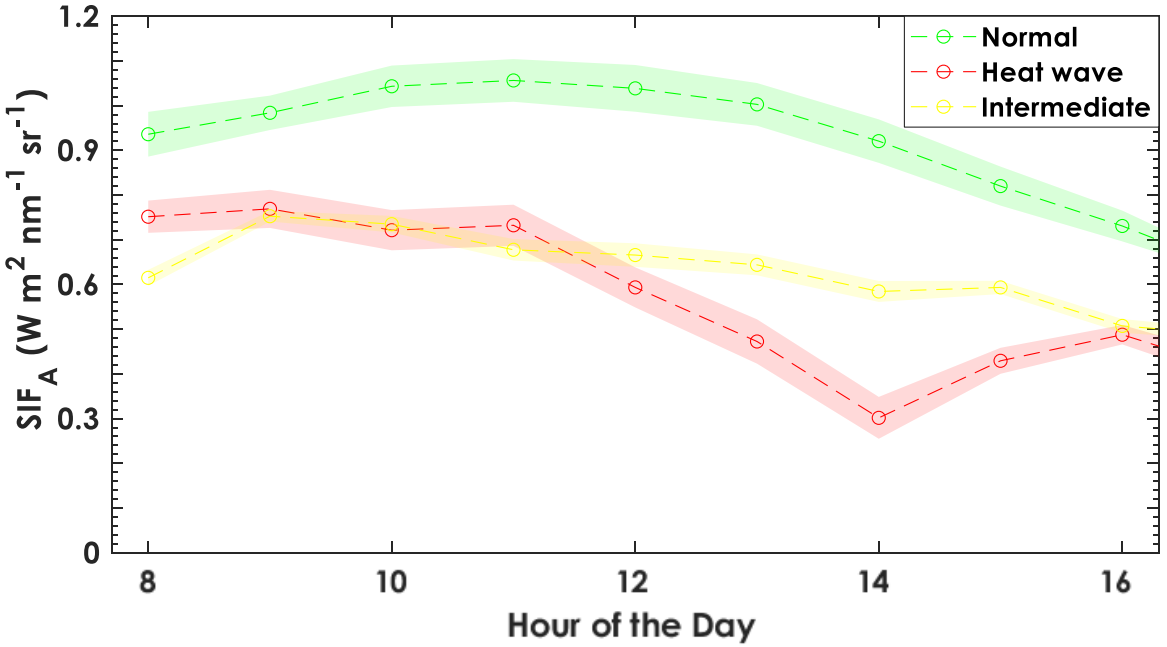
COS and CO_2 flux during the experiment

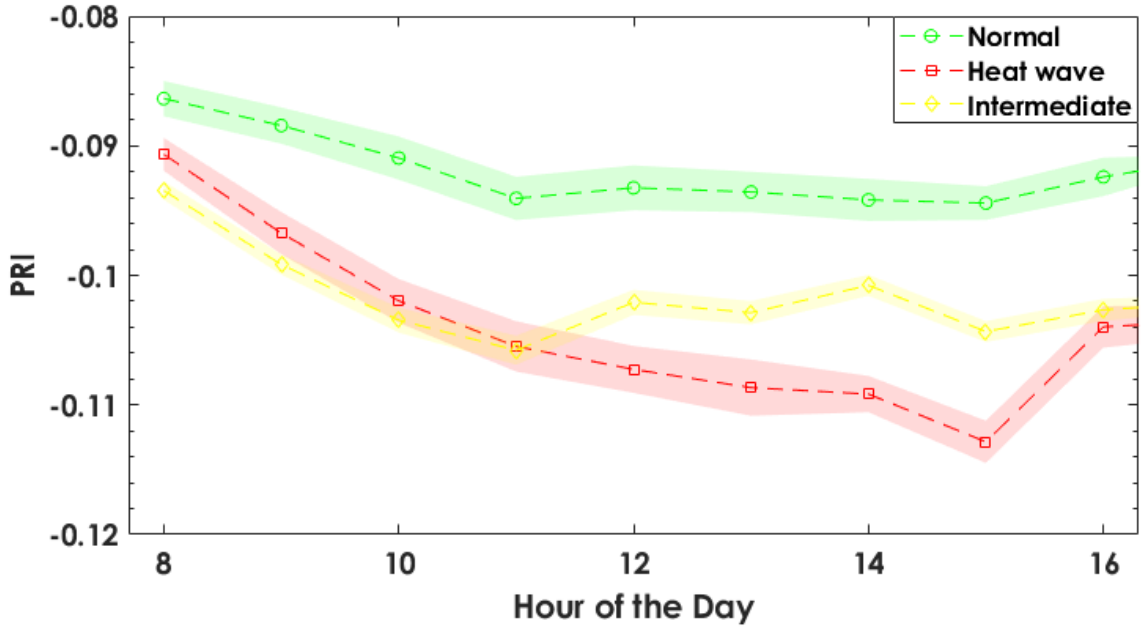




The COS flux, which controls predominantly by the stomata, was higher in the **N** days then in the **HW** and **IN** days. However, the CO_2 flux in the **IN** days was higher than the **HW**, and closer to the normal days flux.
These results indicate that other physiological aspects, beside the stomata, play a role in the trees response to heatwaves.

Spectral measurements



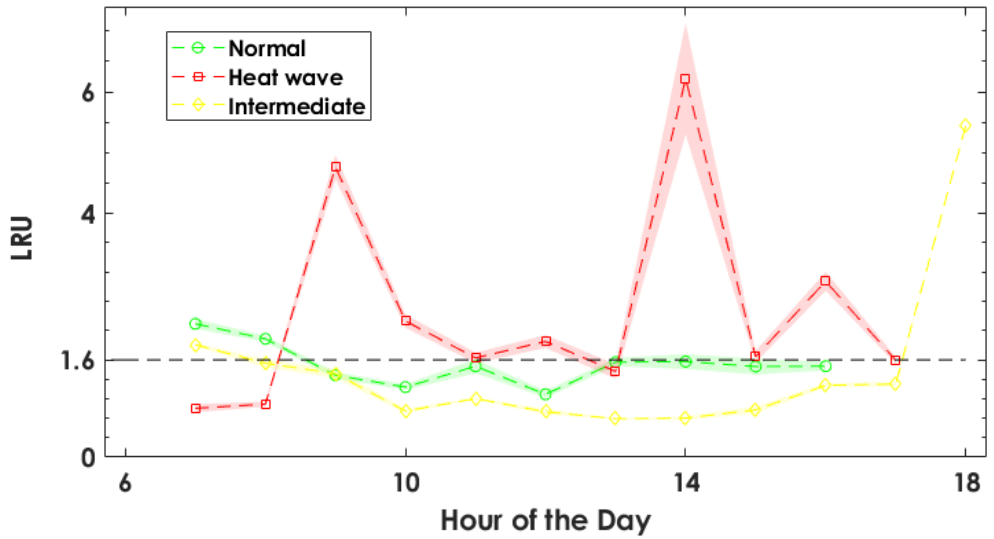


Both SIF_A and Photochemical reflectance index (PRI) were different between the **IN** and **HW** days. The difference became significant during midday, when temperature and VPD increased rapidly in the **HW** days. In addition, PAM measurements demonstrate difference in non-photochemical quenching (NPQ), and electron transport rate (*J*) between the **IN** and **HW** days.

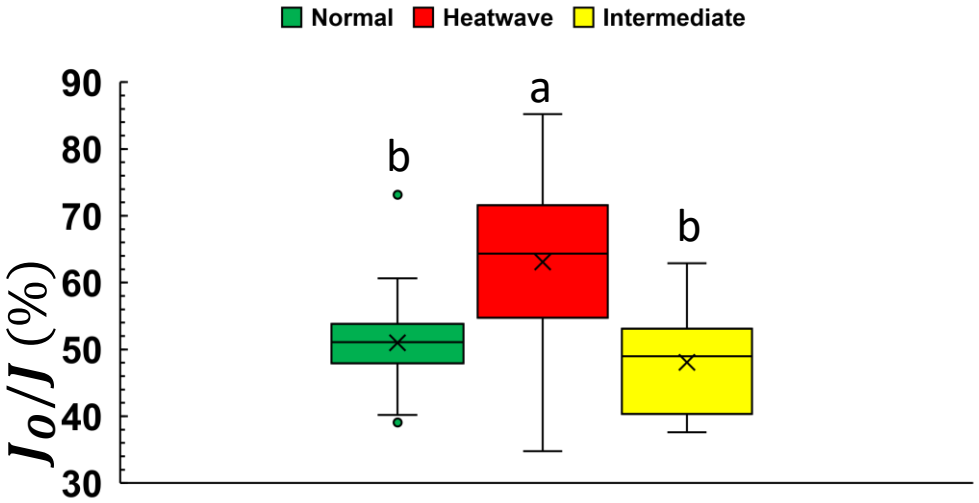
These results indicate that the photosystem activity and energy partitioning were different between the HW and IM days.

Energy partitioning is changing under stress conditions

$$LRU = \frac{F_{COS}}{GPP} * \frac{[CO_2]}{[COS]}$$



$$J_o = \frac{2}{3} * \left(J - 4 * (A_n + R_d)\right)$$



The leaf relative uptake (LRU), represents the relation between COS and CO_2 uptake. In many works this ratio is around 1.6, and remains stable during day time.
Here we can see that in the **N** and **IN** days this value remains stable, and is noisy in the **HW** days. The photorespiratory pathway (which is represented by Jo), another protective mechanism, is also highly activated in **HW** and not in **IN** days.

Conclusions

- The first response to high atmospheric VPD in both IN and HW days was stomatal closure (as reflected in the decrease in COS flux).
- Due to the higher stress level in the HW event, another protective mechanisms were activated.
- Decrease in the electron transport rate (and SIF_A) and increase in the activity of non-photochemical quenching(NPQ, PRI), another protective mechanisms, was activated gradually in the different stress levels.
- In addition, increase in the photorespiration, was active only in the highest stress level (HW).
- This work demonstrates that the combination of SIF and COS measurements, allow to determine different stress levels in the ecosystem.