Remote sensing of instantaneous drought stress at canopy level using sun-induced chlorophyll fluorescence and canopy reflectance

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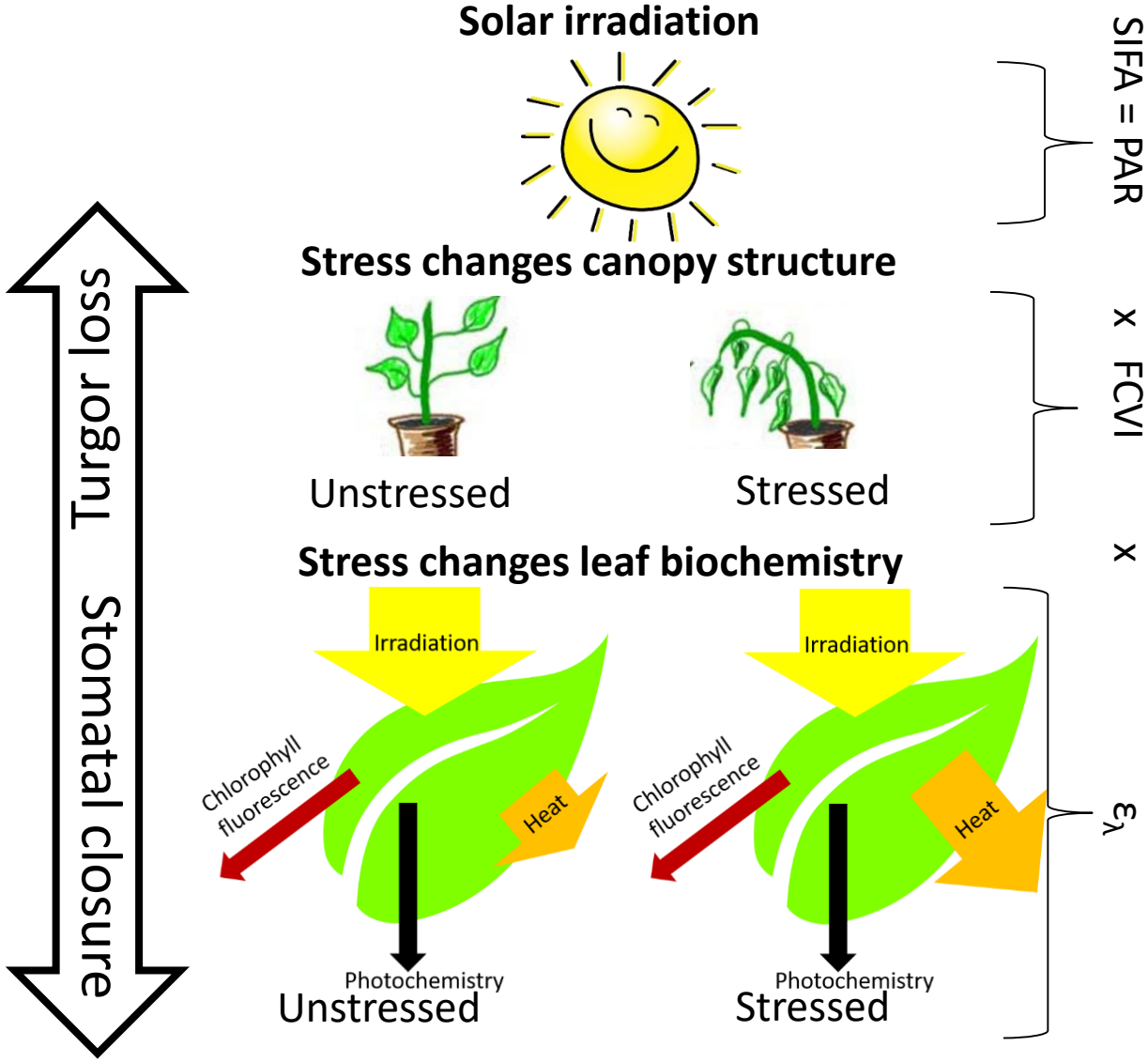
Stress effects on the SIF signal



SIF: sun-induced chlorophyll fluorescence
Linked to canopy-scale photosynthesis

PAR: photosynthetically active radiation
Sunlight intensity

FCVI: Fluorescence Correction Vegetation Index
Leaf area and leaf angle

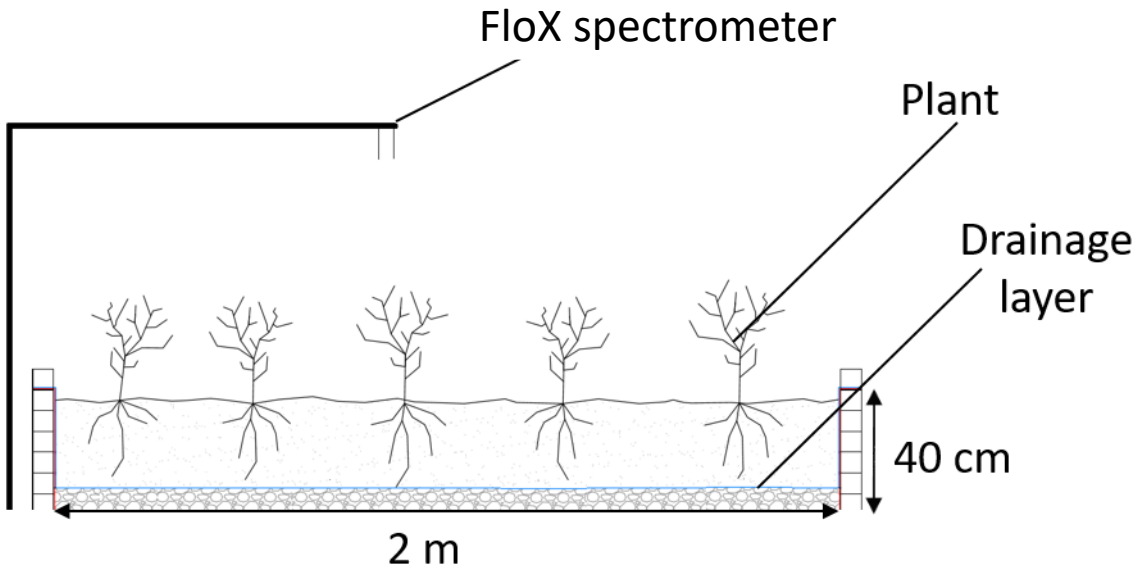
ε_λ: fluorescence emission efficiency
Efficiency of a chlorophyll molecule

Experiment to measure SIF stress reaction

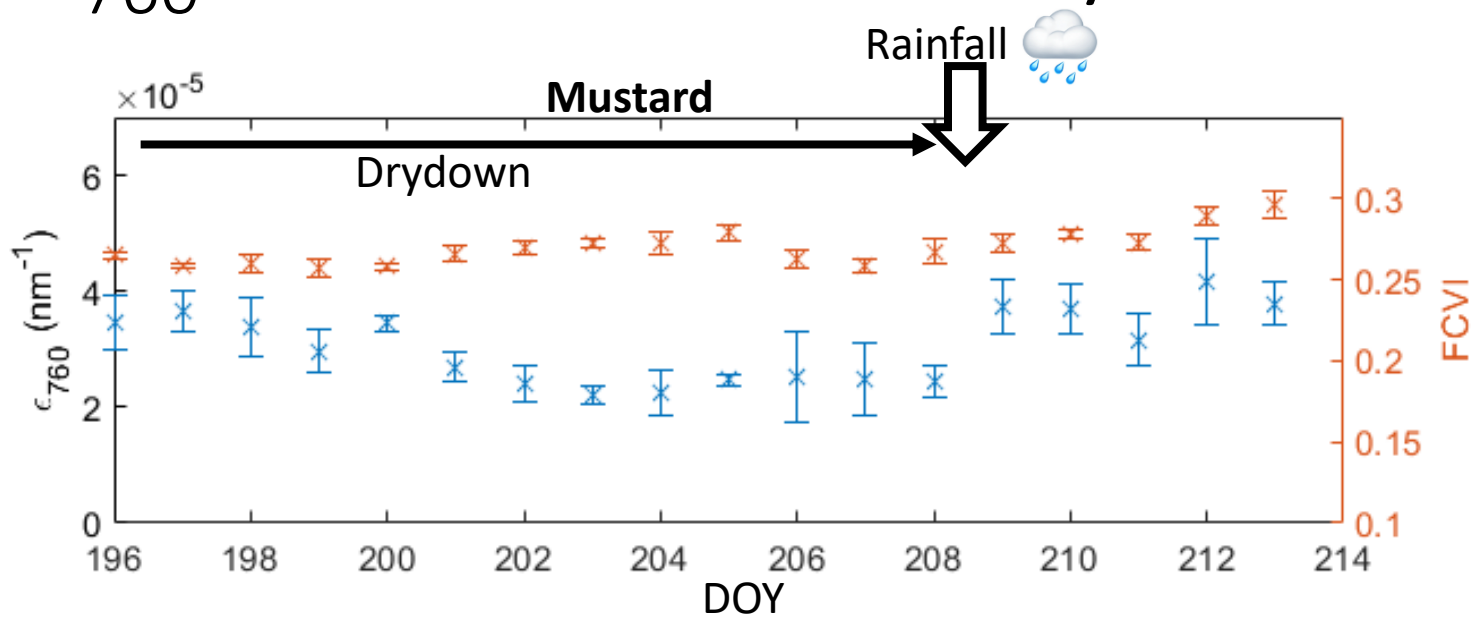
Continuous in-situ measurements of SIF and canopy reflectance over whole range of environmental conditions

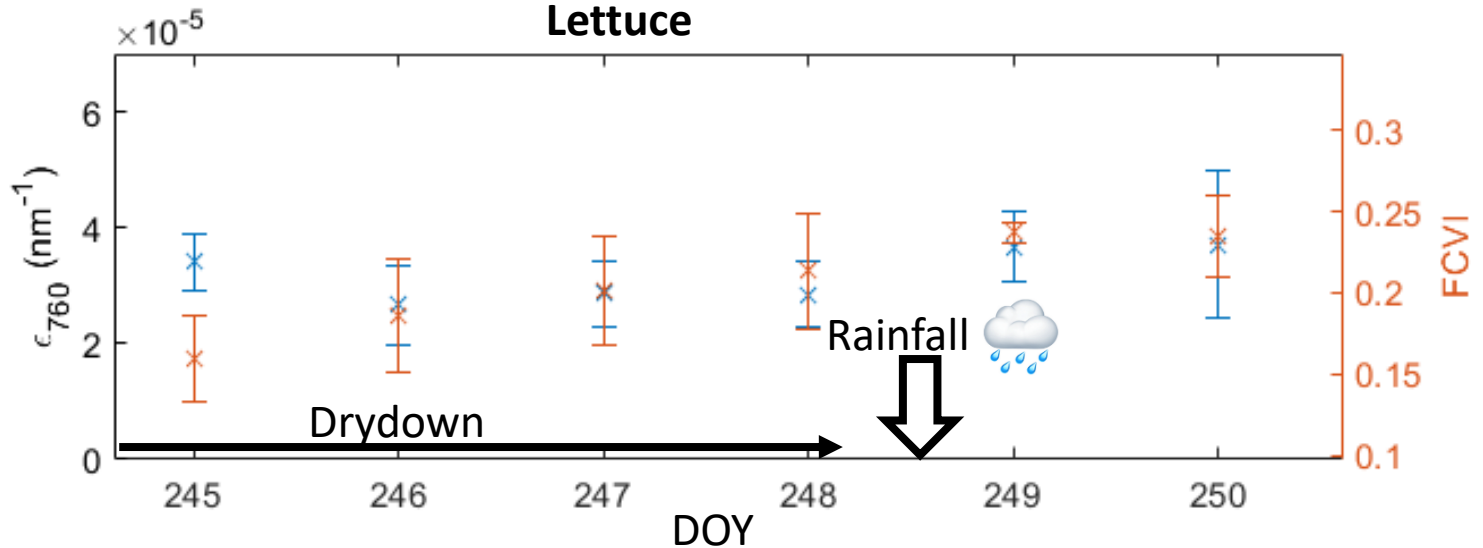
Experiment performed with lettuce and mustard canopy

Lettuce is known for anisohydric behaviour



ε_{760} reacts immediately to soil water status





Decrease in ε_{760} during drydown

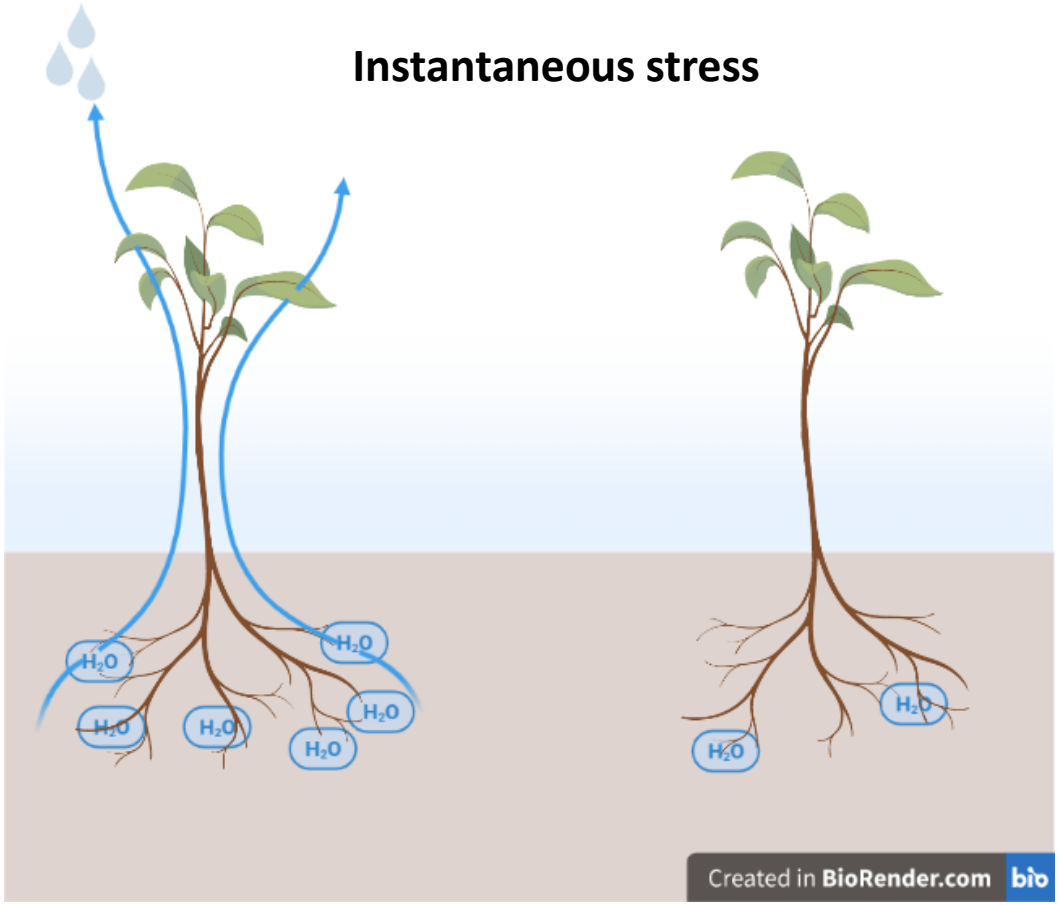
Prompt increase in ε_{760} after rainfall

Clearest ε_{760} reaction in mustard dataset

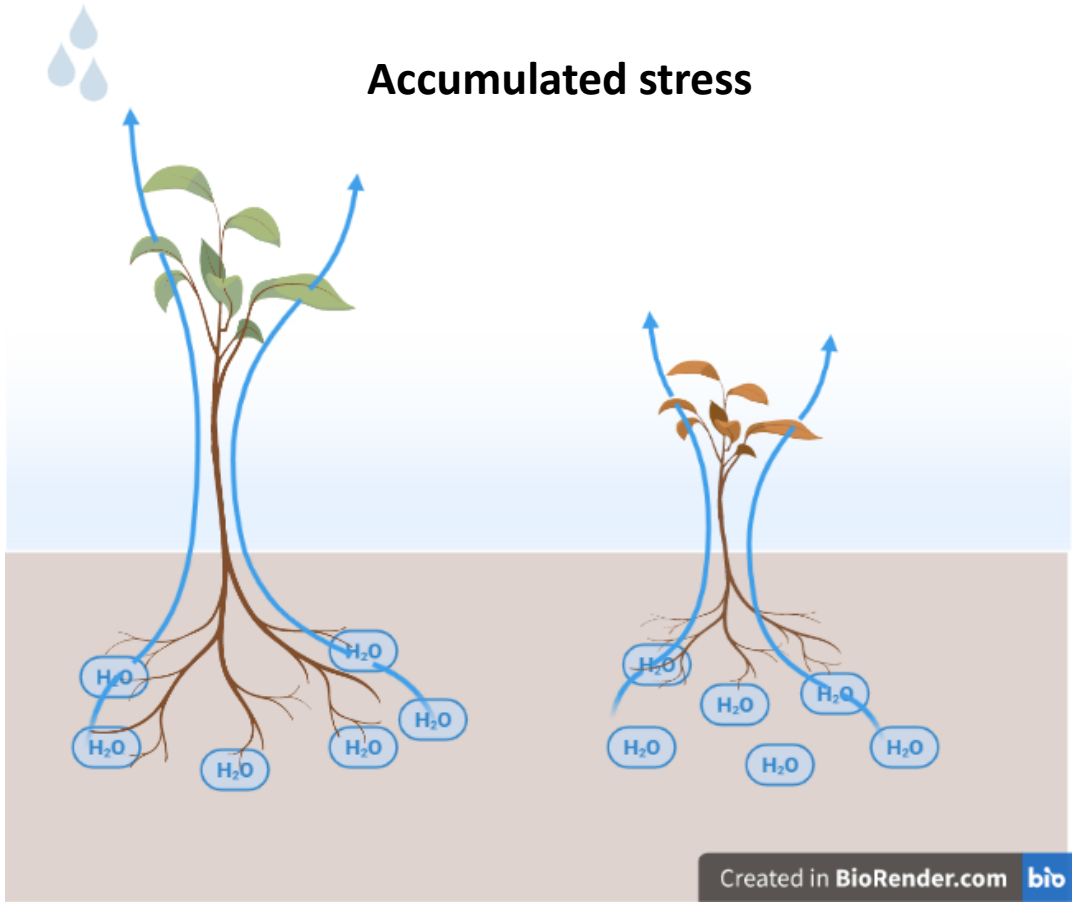
Large intra-daily variation in FCVI of lettuce dataset
=> leaf movement

Difference in isohydricity explains different crop reaction

Conclusion: SIF monitors instantaneous stress



Sensed with ε_{760} or short-term variation in FCVI



Classic methods (like NDVI) observe the damage caused by the stress