Détection et suivi du stress hydrique par proxidétection

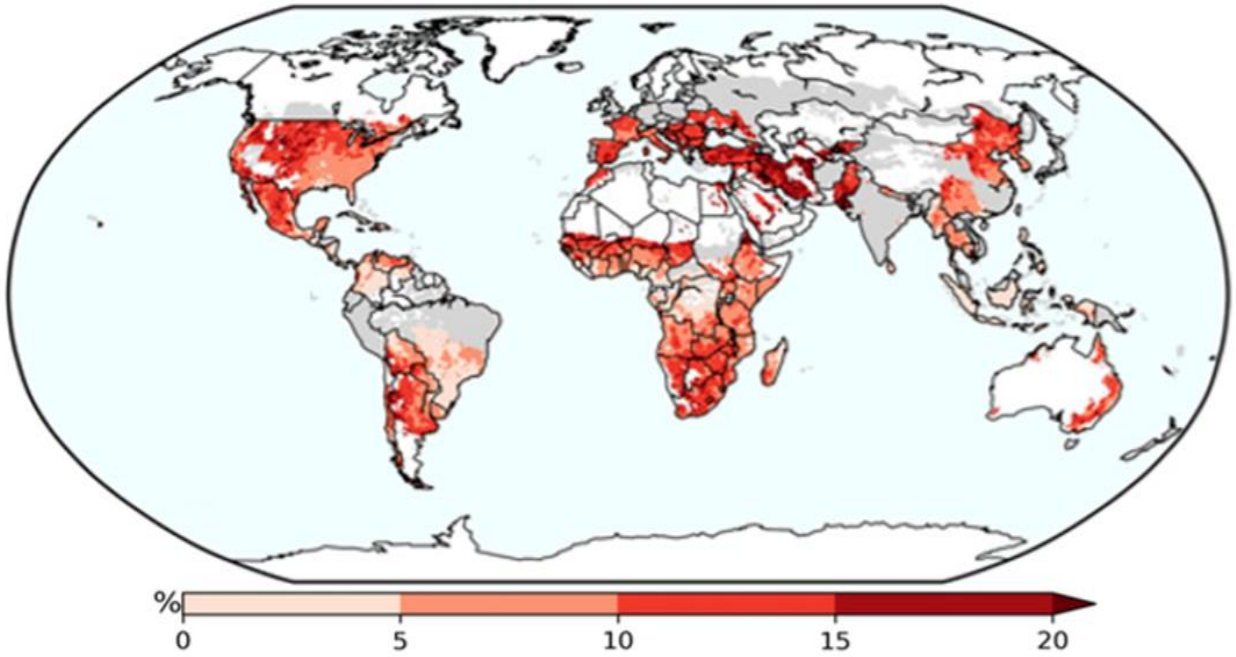
Colloque CHAAMS

4 juillet 2022

Contexte

- Major problem in agriculture

Average drought-induced yield loss between 1983 and 2006 (Kim et al., 2019)



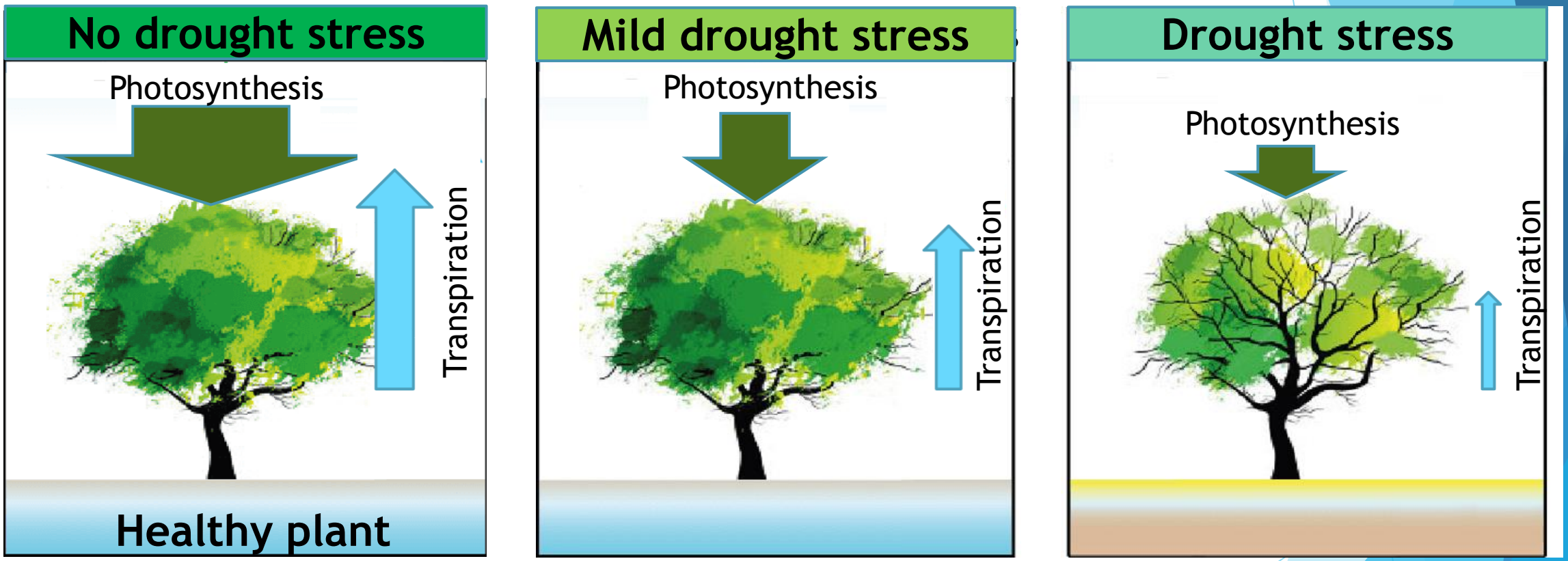
Percentage of yield loss

Need for early drought detection systems

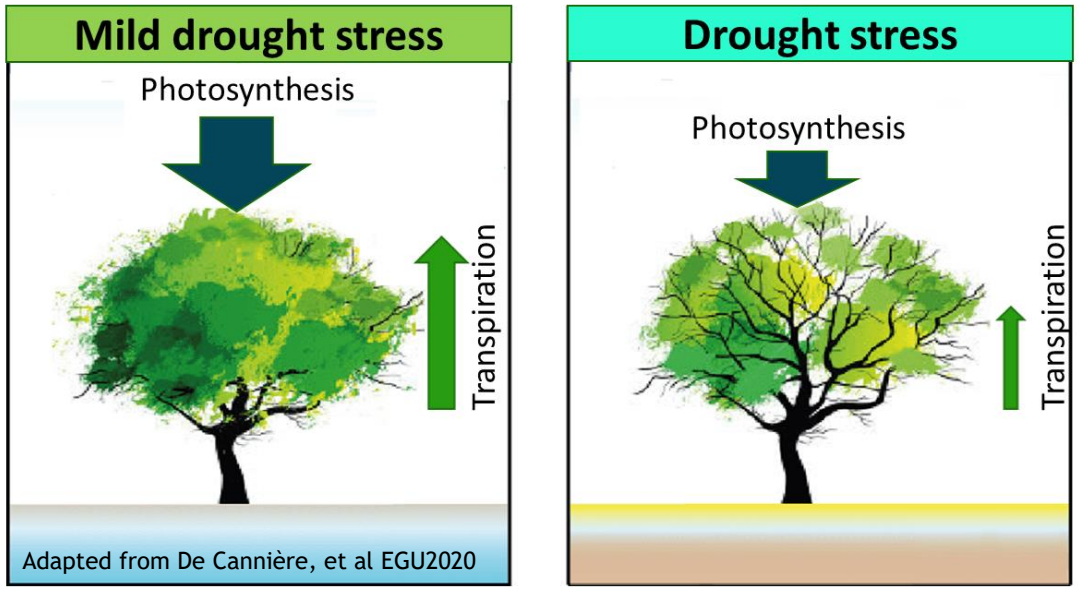
75% of global cropland affected
10% crop yield loss on average

Contexte

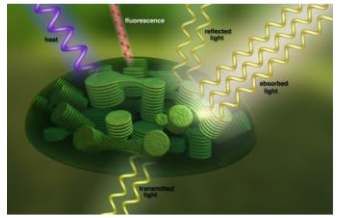
Figure from De Cannière, et al EGU2020



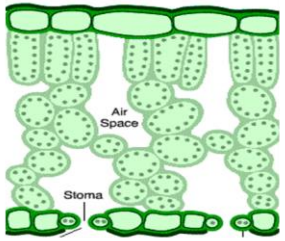
Contexte



Photosystem → Leaf → Canopy



Changes in photosynthesis process & foliar pigments



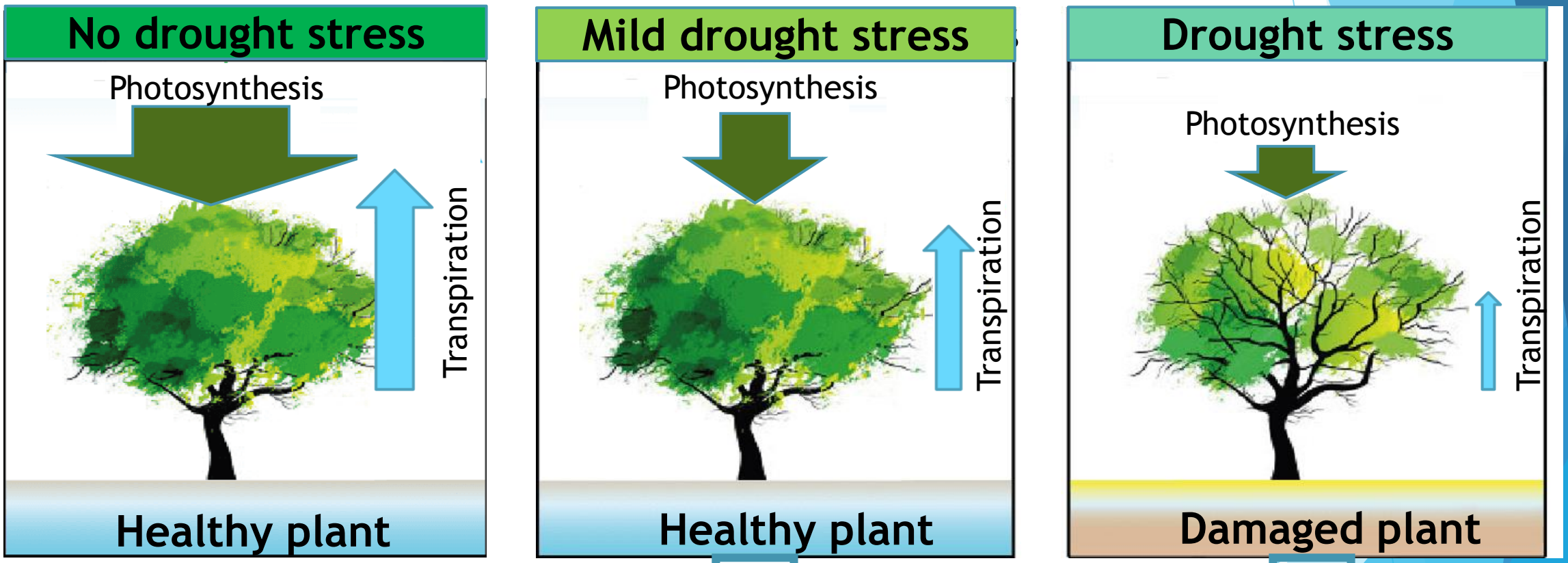
Loss in turgor pressure

Changes in canopy structure

observation par télédétection

Contexte

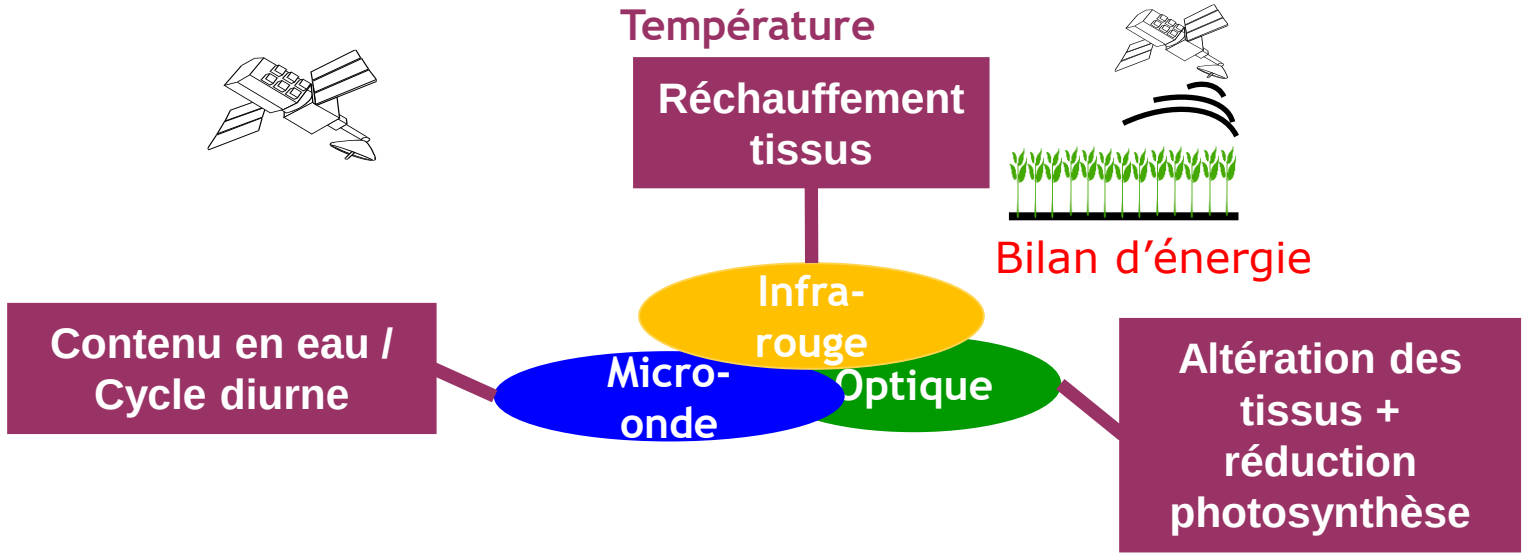
Figure from De Cannière, et al EGU2020



A explorer …

NDVI, indices T°surface

Objectifs



Potentialités des différents domaines spectraux pour détection de stress hydrique d'intensité variable?

Méthodes

Expérience *in situ* / Mesures sol et végétation

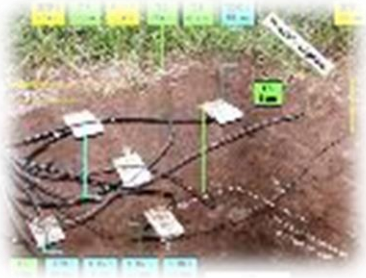
Mesures automatiques

Météo

Bilan d'énergie

Eddy-covariance

Sol



Profils T° et Hv

Physiologie

Flux de sève

Dendromètre

Proxidétection

Radiomètres & caméra IRT

Capteur PRI/NDVI

Antenne bande C

Mesures manuelles

Végétation

LAI / photos hémisphériques

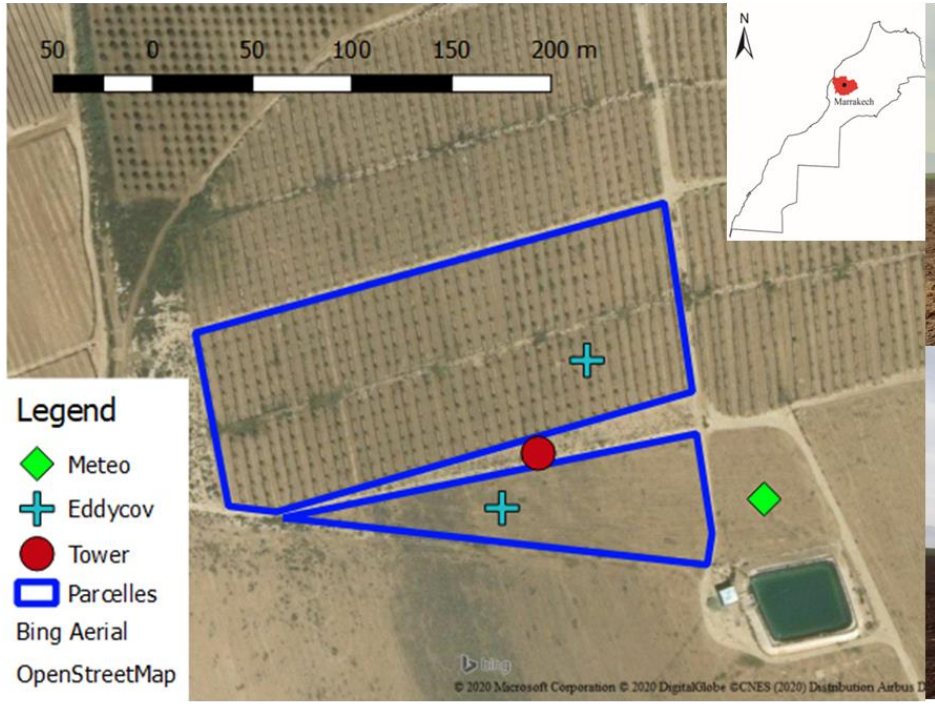
Biomasse / mesures destructives

Poromètre/fluorimètre

Sites

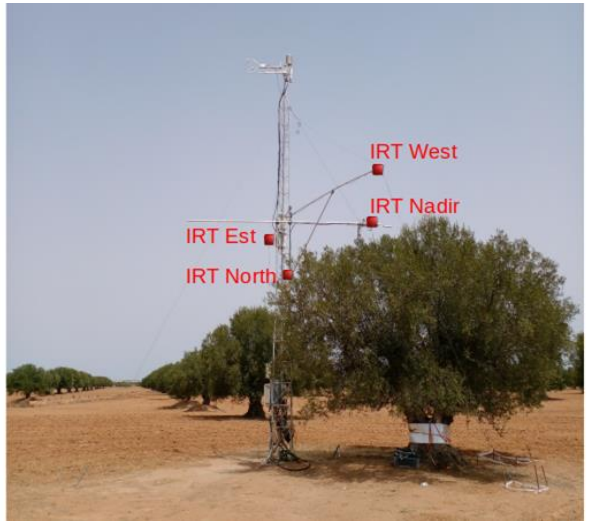
Taous en Tunisie (Merguellil)
pluvial

Chichaoua au Maroc (Tensift)
irrigué

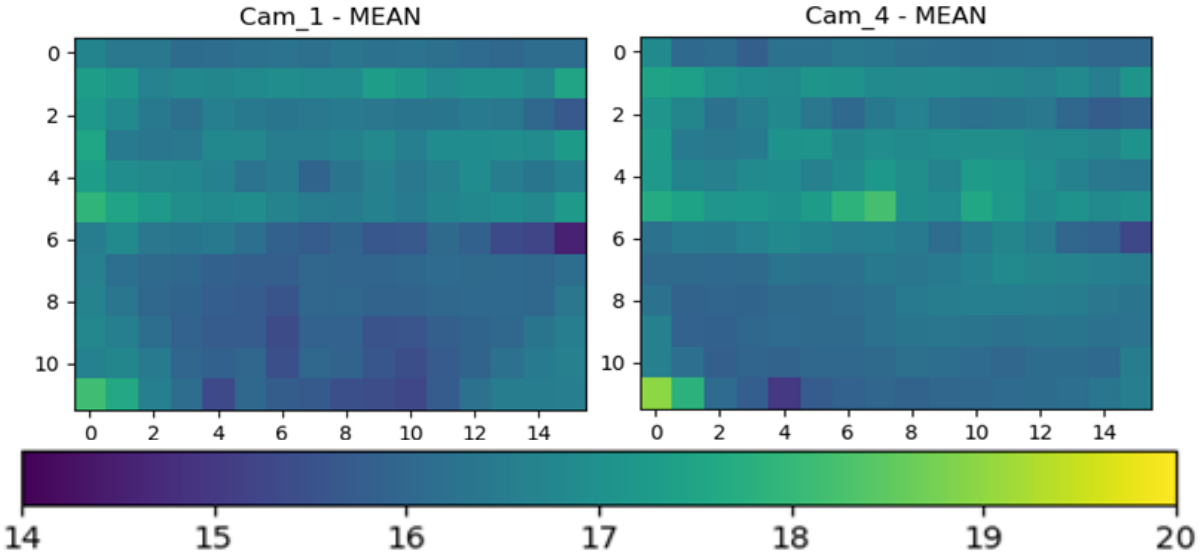


Study of leaf temperature evolution at Taous oliveyard

MAESPA model simulation Vs IRT cameras observation



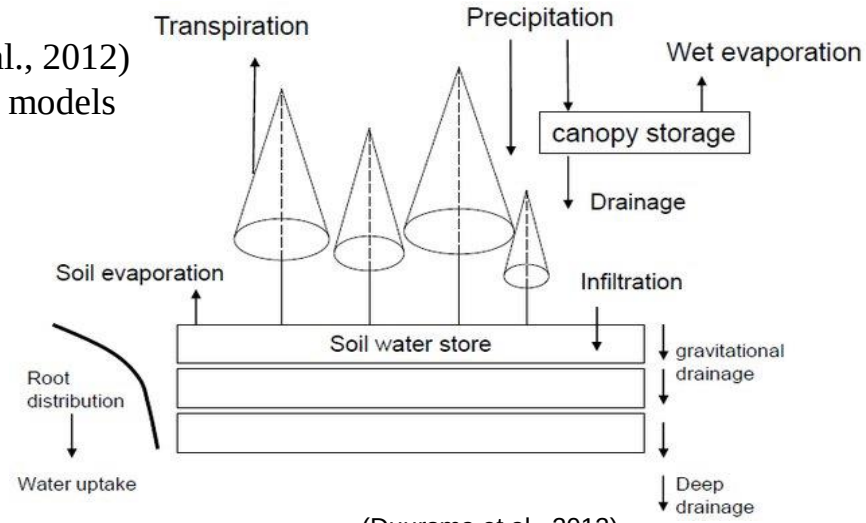
IRT cameras implementation
Taous (Tunisia)



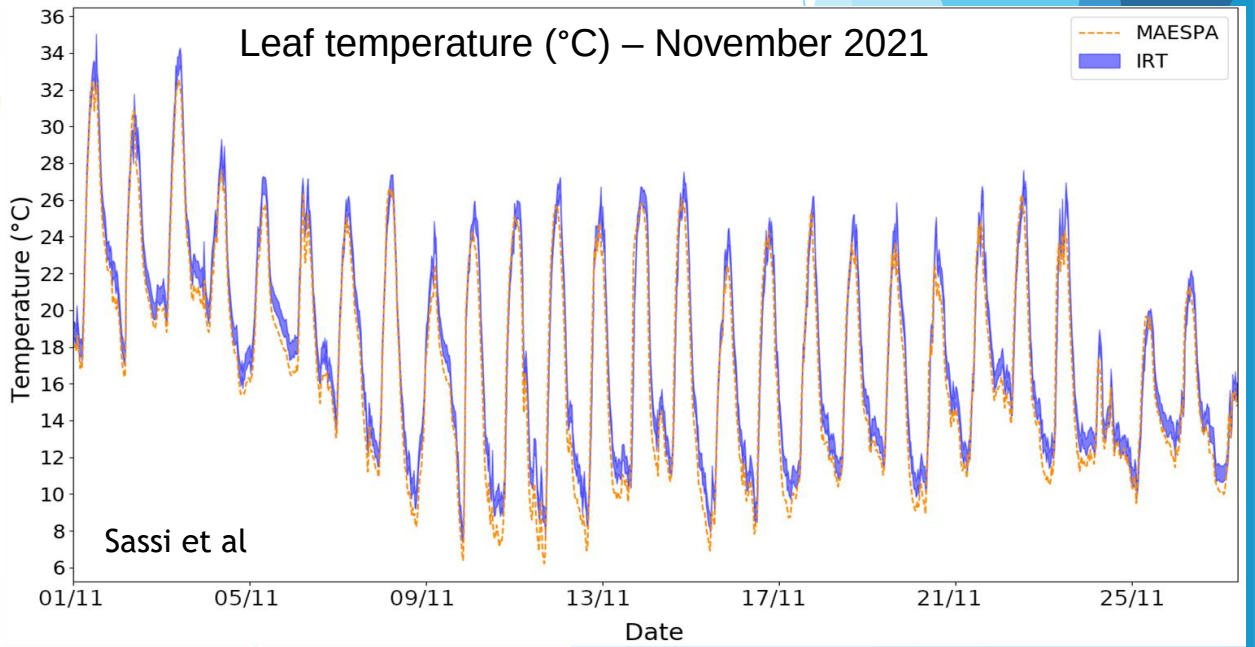
Nadir (left) and North (right) cameras mean pixel temperature (°C)

MAESPA (Duursma et al., 2012)

- Coupled soil and canopy models (SPA and MAESTRA)
- 3D canopy forest model
- 1D soil component



(Duursma et al., 2012)



Suivi du fonctionnement physiologique des cultures par télédétection radar bande C

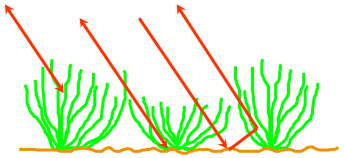
(Projet TOSCA/CNES MOCTAR)

Dispositif expérimental

- 6 antennes bande C-band sur une tour de 20 m de haut: mesure du coefficient de rétrodiffusion et de la coherence en configuration pleinement polarimétrique avec un pas de temps de 15 mns.

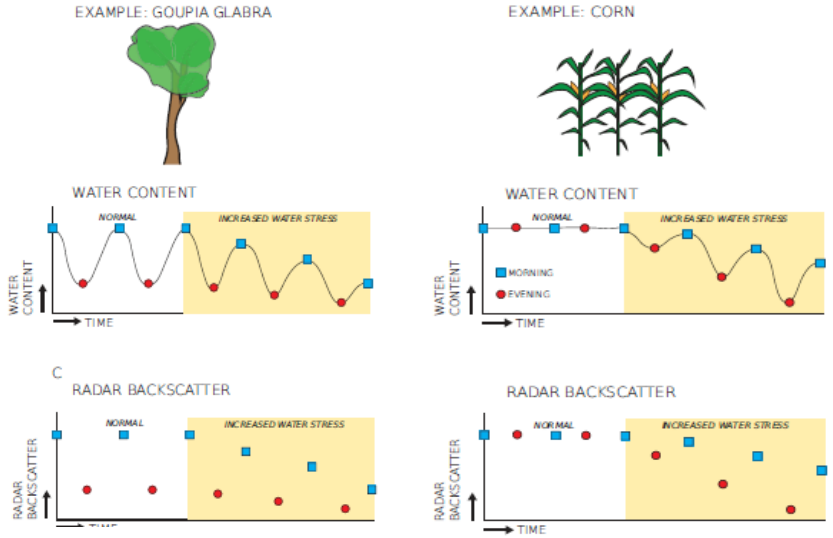
Objectif : Compréhension du signal

- Bande C: réponse mixte sol/végétation

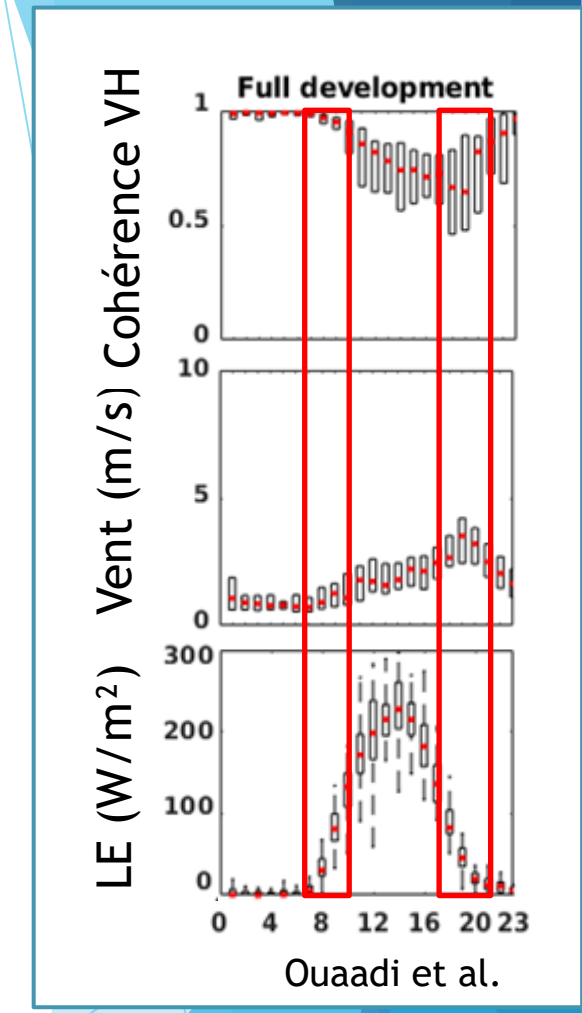


- Changements de géométrie

Objectif : Analyse du lien entre le cycle diurne de coefficient de rétrodiffusion et de la cohérence interférométrique et le fonctionnement physiologique des plantes



Thèse de Tim Van Emmerik, 2017 / Steele-Dune et al., 2011

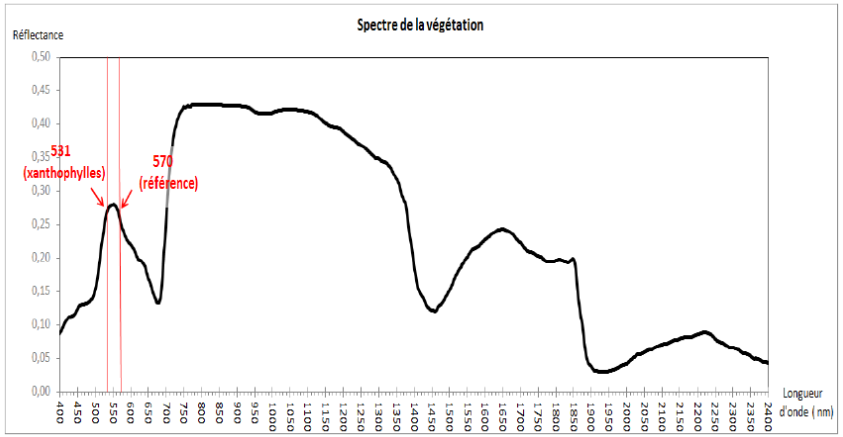


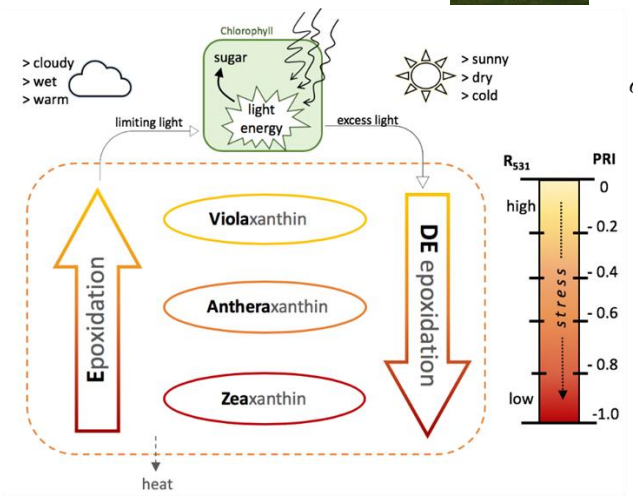
Cycle journalier de cohérence sur le blé

Suivi du fonctionnement physiologique des cultures par télédétection optique : PRI

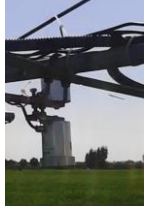
- ***The photochemical reflectance index (PRI)*** Gamon et al. (1992)

$$PRI = \frac{R_{570} - R_{531}}{R_{570} + R_{531}}$$



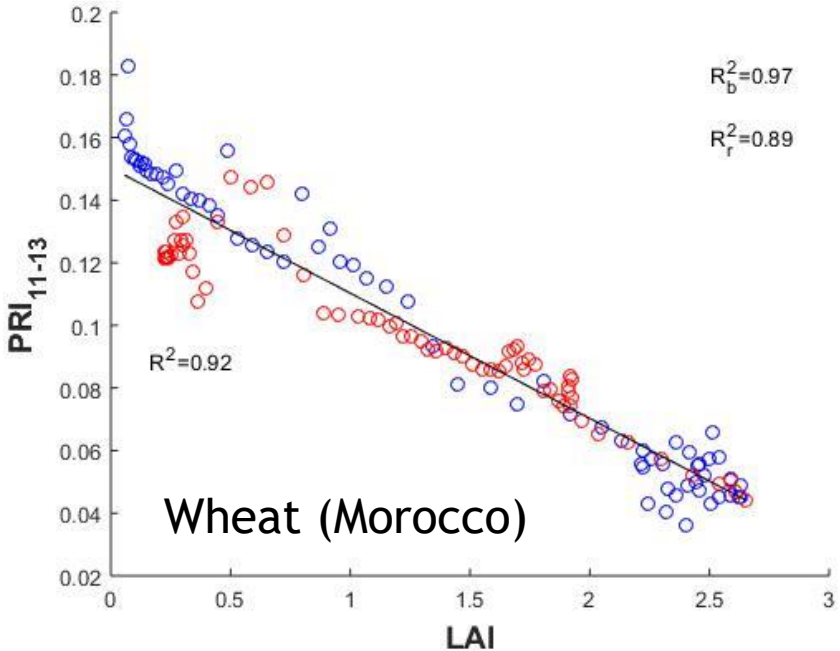


Yang, et al. 2019



Transpiration rate using sapflow sensors

Water content in trunk



Strong effect of seasonal dynamic of canopy structure

Z. Rafi, thesis (2020)

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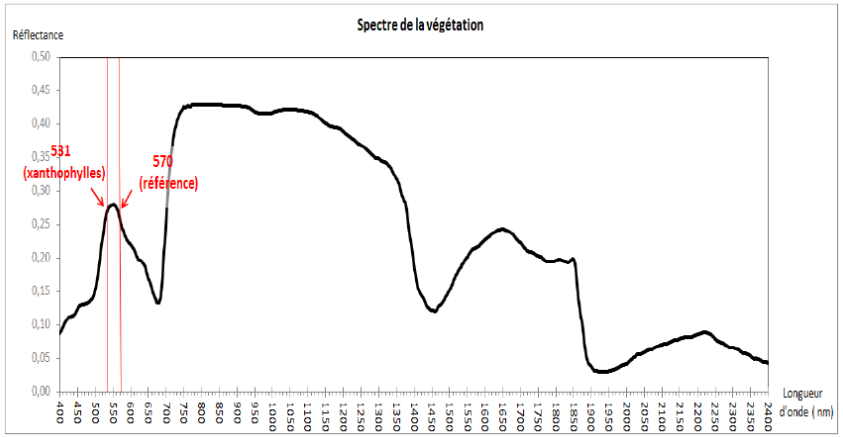
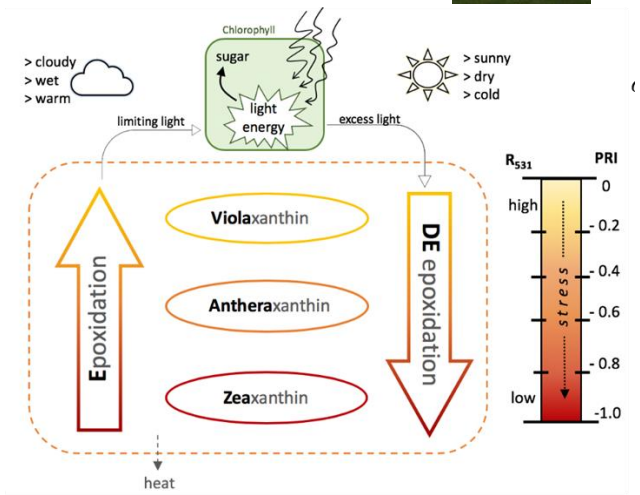


ΔPRI or PRIj = PRI_0 - PRI(11h-13h)



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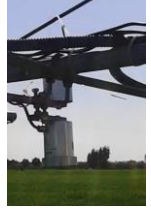

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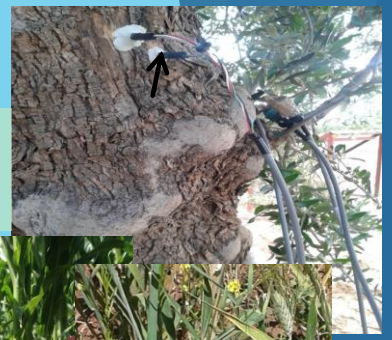
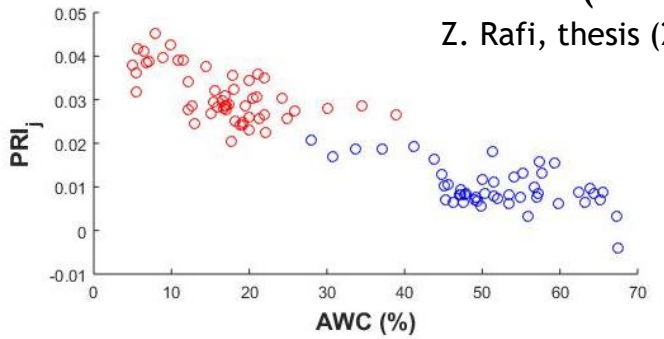
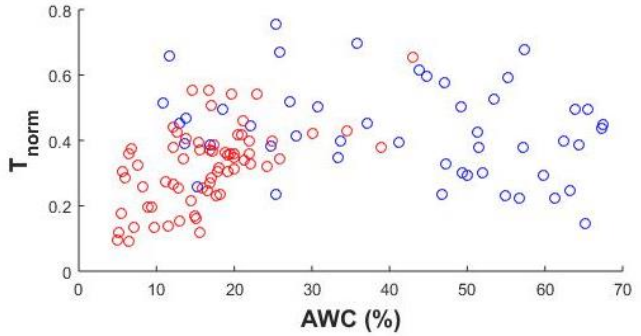


Water content in trunk

Wheat (Morocco)

Z. Rafi, thesis (2020)





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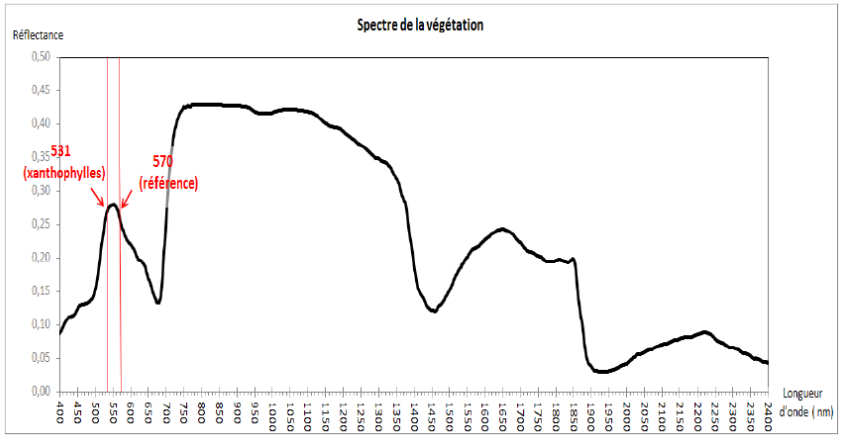

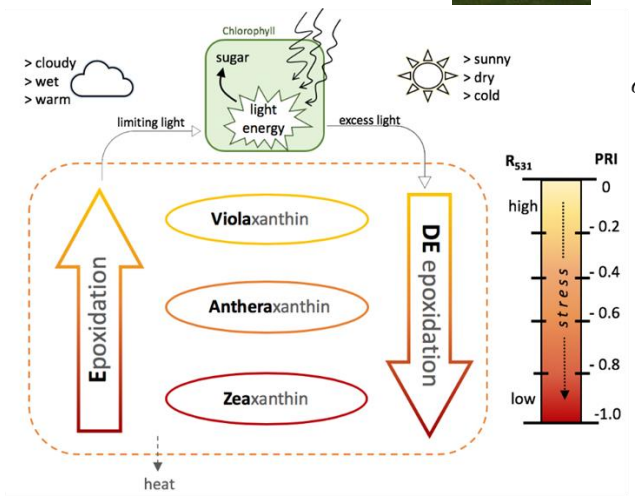

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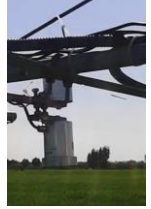

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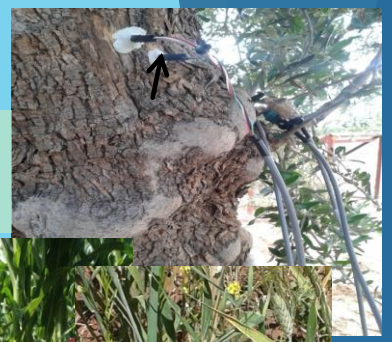
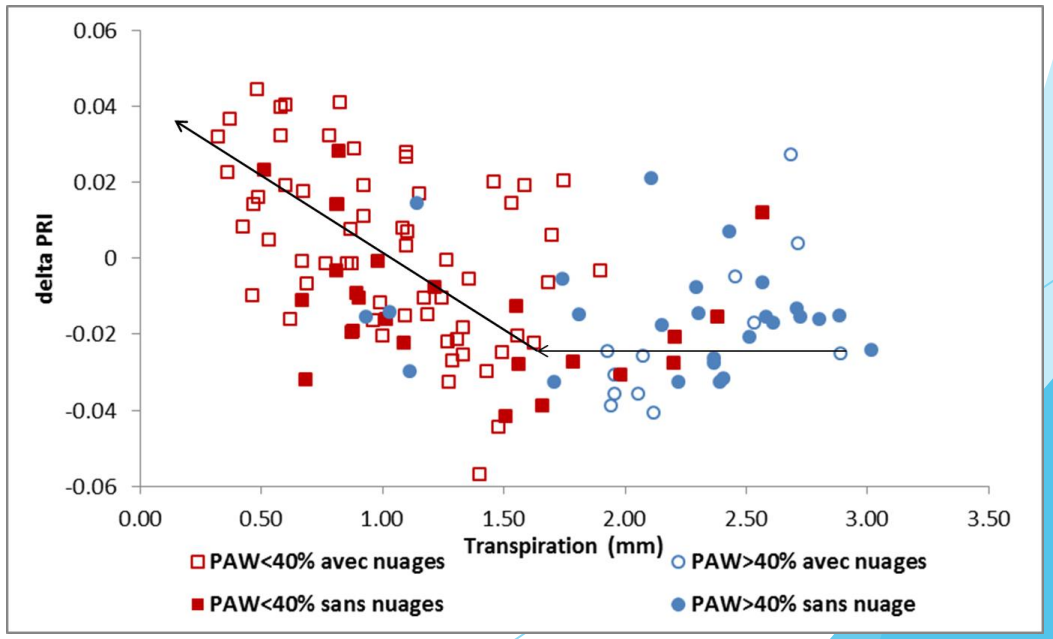


Olive orchard (Tunisia)

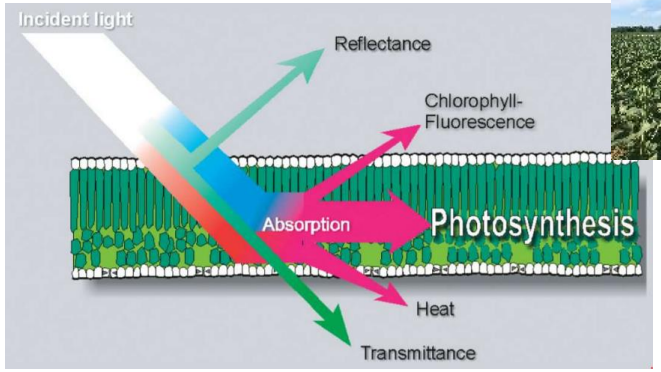
W. Chebbi , thesis (2019)

Water content in trunk



Conclusions & Perspectives

- ☞ **Approche novatrice : combinaison des longueurs d'onde**
- ☞ **Résultats prometteurs => à approfondir**
- ☞ **Ajouts d'autres types de mesure :**



Proxidétection : SIF

Automatique : zondes Zim (turgescence foliaire)