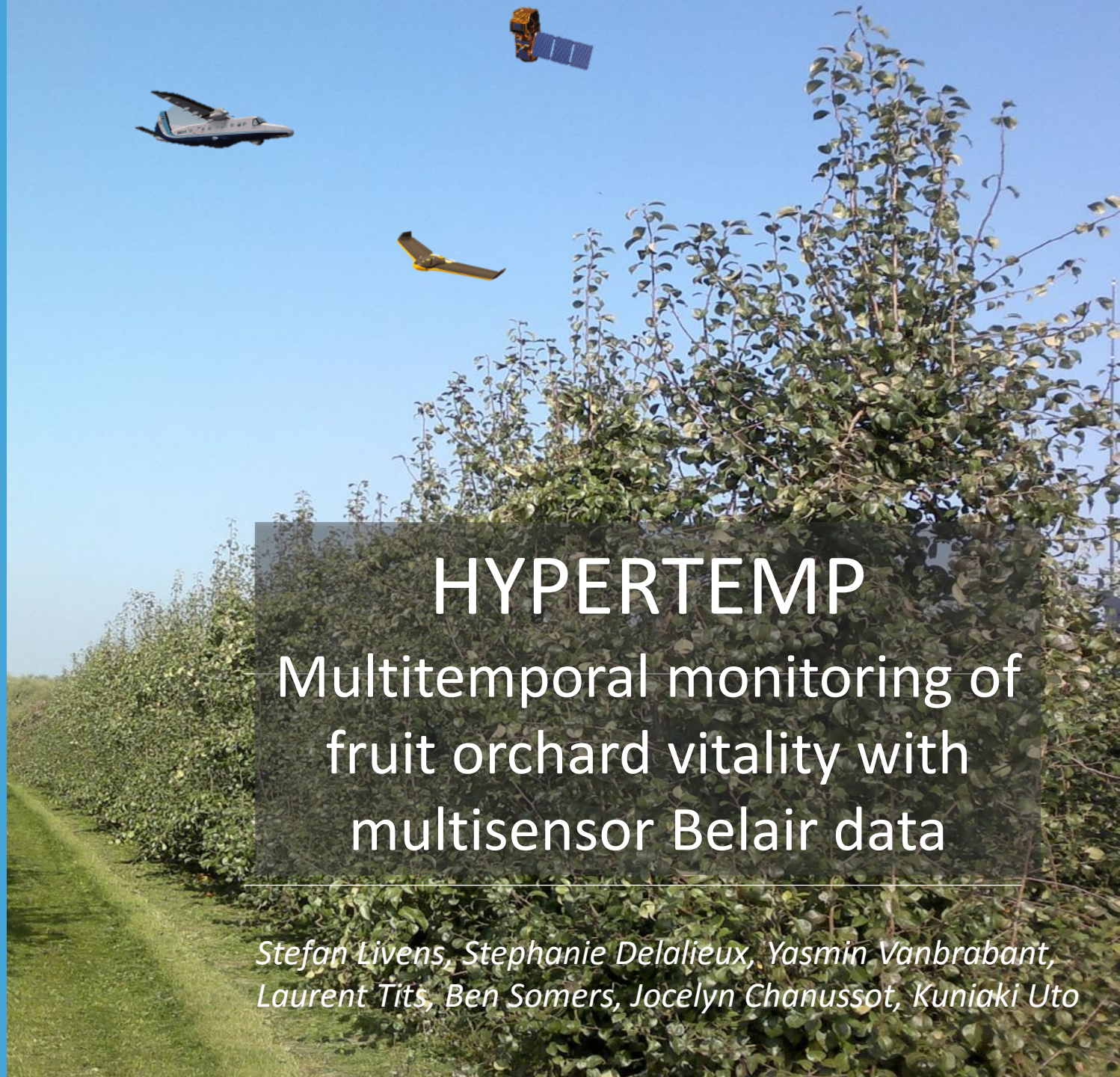
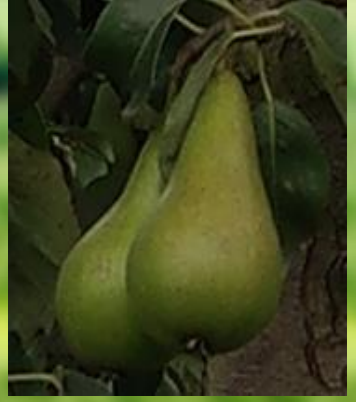


HYPERTEMP

Multitemporal monitoring of fruit orchard vitality with multisensor Belair data

Stefan Livens, Stephanie Delalieux, Yasmin Vanbrabant, Laurent Tits, Ben Somers, Jocelyn Chanussot, Kuniaki Uto

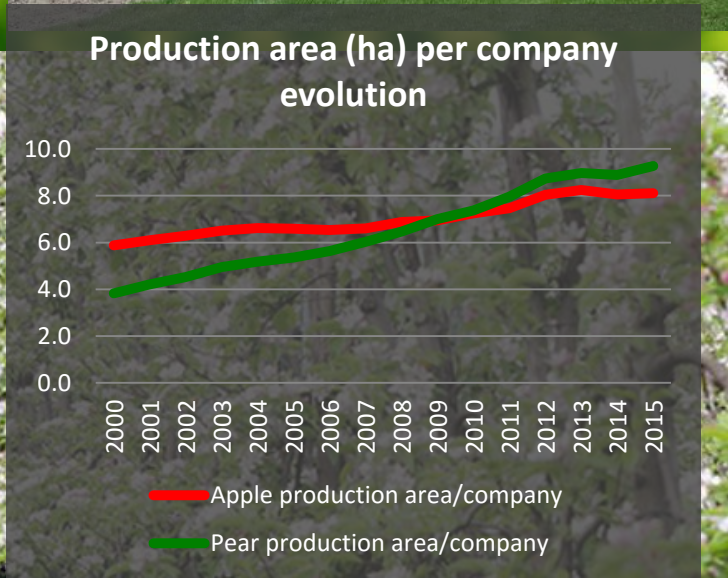
What to do *when* and, *where*?



Why ?
understand orchard performance

Increase profitability

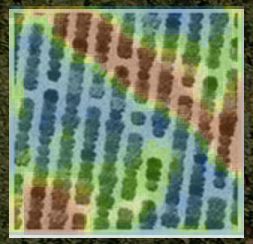
Reduce environmental effects



Every tree counts

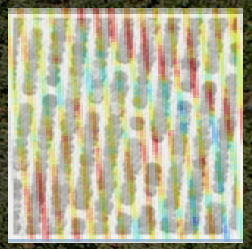
Canopy vigor

+



Yield potential

=



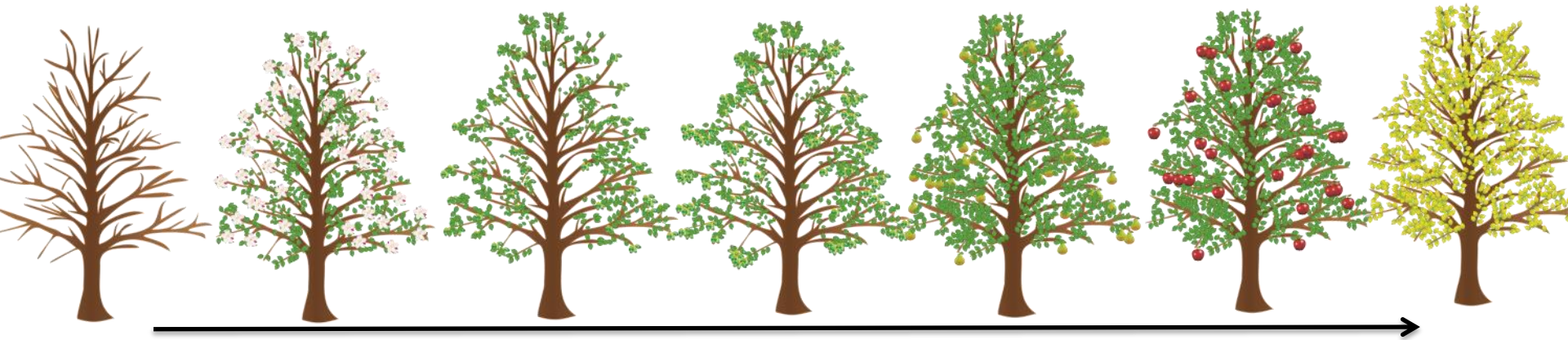
Site specific Management

… Management zones

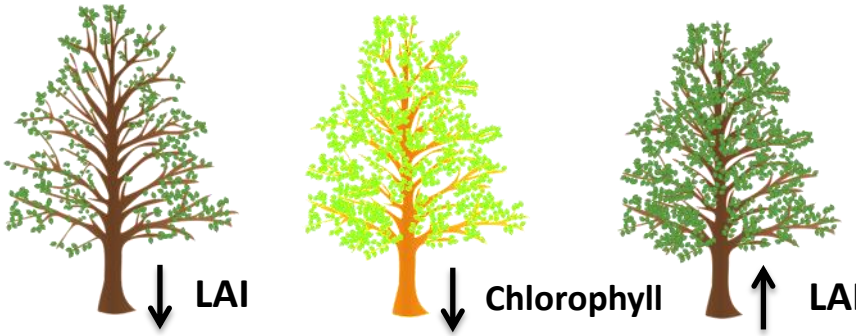
local variations call for locally adapted treatment


One snapshot does not tell the whole story
Evolution throughout season
Correspondence & changes over years
Multitemporal data is needed

Evolution over time

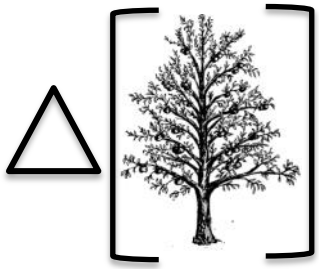


Phenological changes (= normal evolution) (leaf, flower buds, flowers, fruit,…)



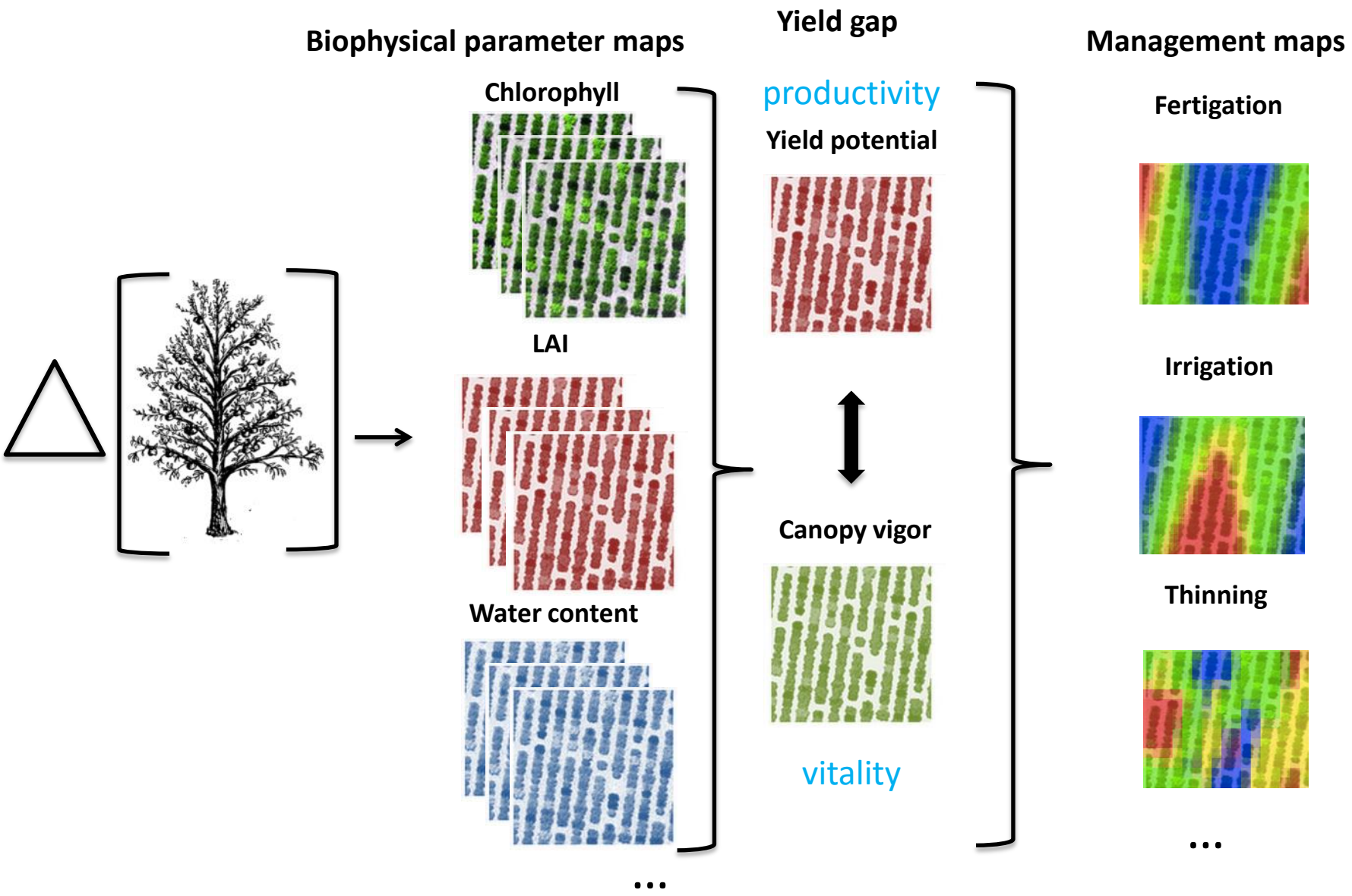
?

Stress responses (= anomalies) (Altered growth, stomatal closure, freezing, increased respiration, altered pigments, photosynthetic inhibiiton, altered leaf angle, …)



Total tree response

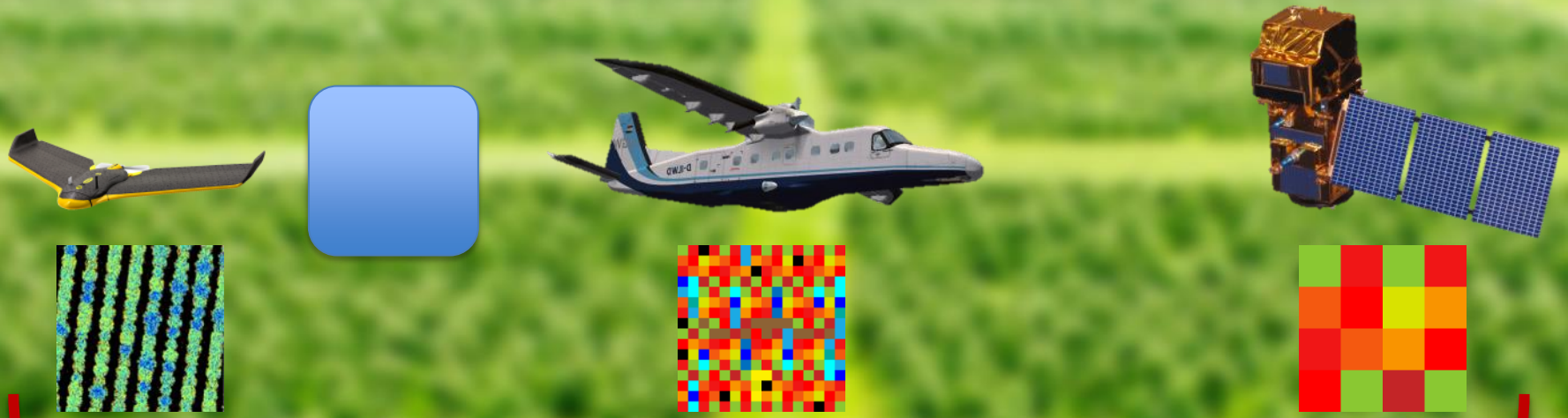
Farmers need to know *what* to do *when* and, *where*



How to create temporal vitality & productivity maps ?

NEEDED	PRESENT	HYPERTEMP CONTRIBUTIONS
Good quality input data	Belair data	Additional data for validation, Hyperspectral UAV data
Image preprocessing	Standard	Accurate geometric cand radiometric correction
Single image processing	OBIA RGB, unmixing, segmentation	OBIA hyperspectral, improved signal unmixing
Multi-date, multi-sensor image processing	Classification, fusion	Multimodal segmentation, temporal VI, fusion
Prediction of tree vitality		Regression vitality maps and yield data

Combine the best of multiple aquisitions

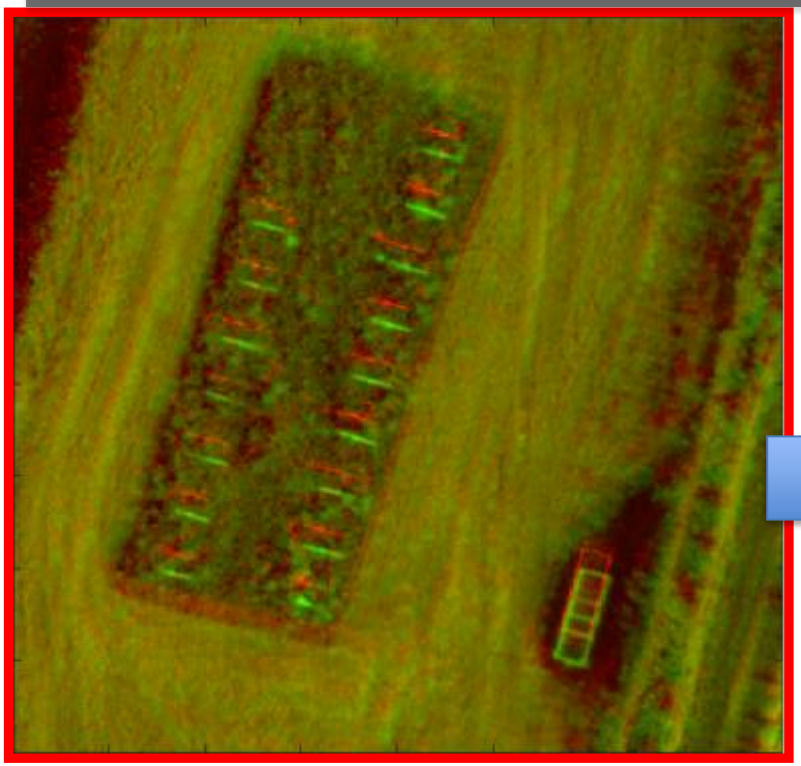


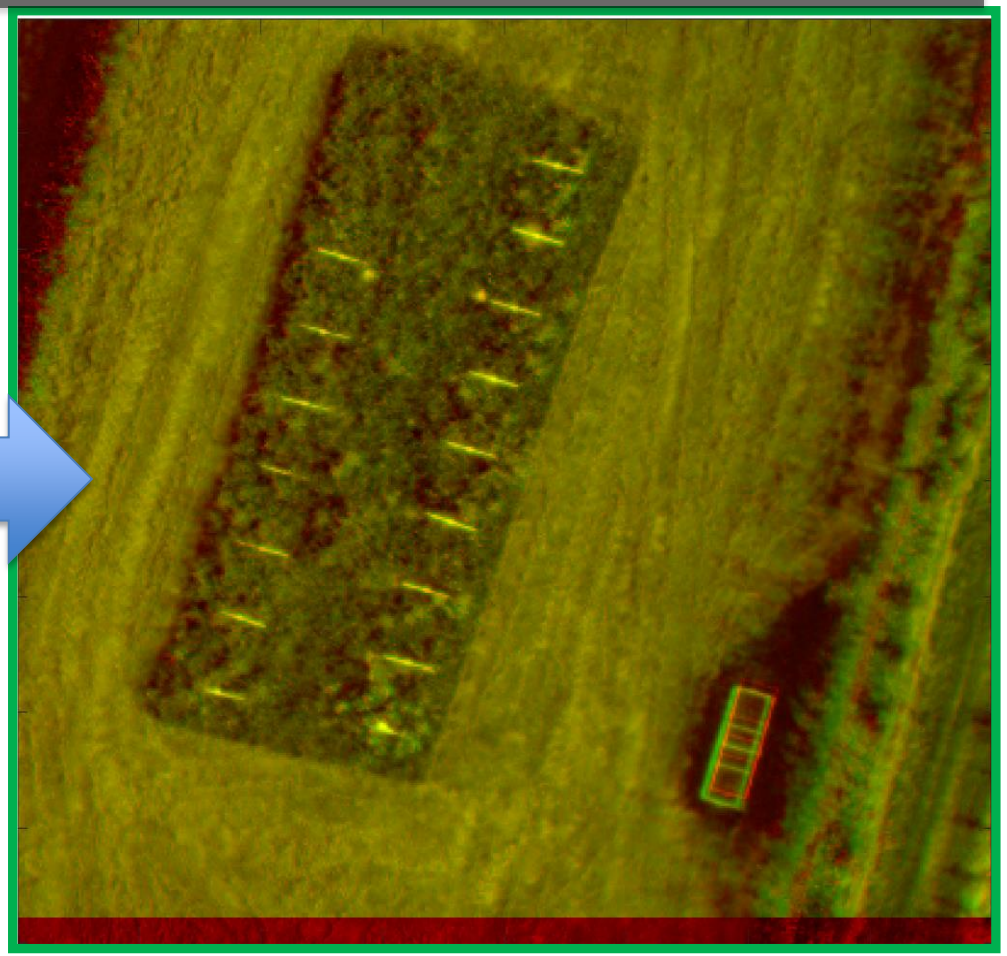
Data fusion

High spatial resolution	High spectral resolution	High temporal resolution
Low spectral resolution	Low temporal resolution	Low spatial resolution
Leaf canopy (cm) Flowers and fruits	Canopy (m) Flowers and fruits	Orchard zones Crop load

Coregistration

Generic coregistration tool based on local matching:
- Combine spectral bands,

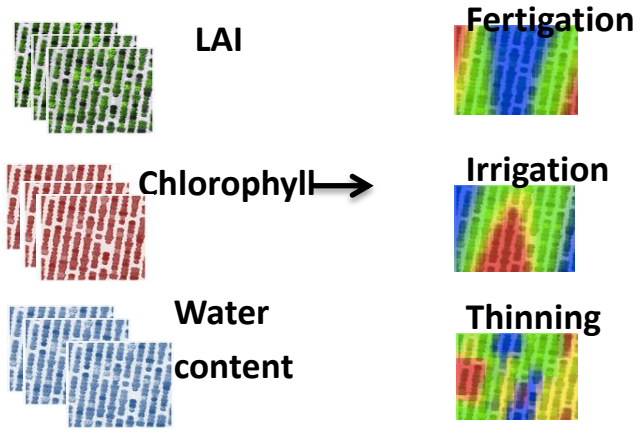




False color:
green : reference image
red: image to be coregistered

HYPERTEMP

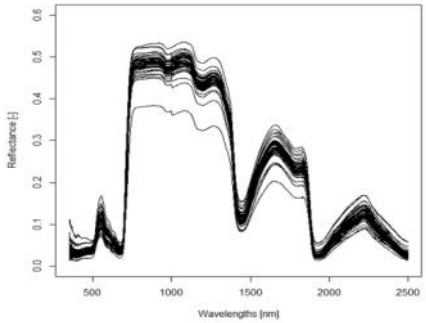
Highly detailed spatio-temporal monitoring of fruit orchards

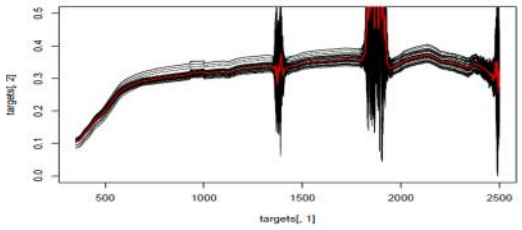


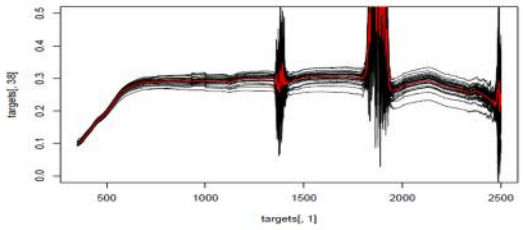
Extra slides

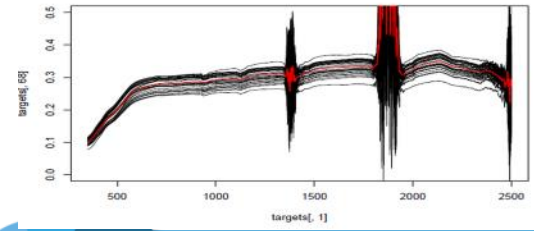
IN-SITU CAMPAIGNS

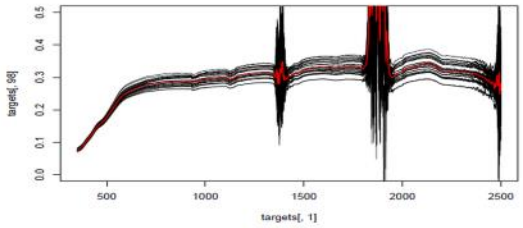
- In-situ:
  - Physiological measurements
  - Chlorophyll fluorescence
  - Hyperspectral measurements
  - FLIR
  - Sunphotometer
  - Yield data collection
  - Leaf samples - biochemical parameters











AIRBORNE AND SPACEBORNE CAMPAIGNS

Airborne:

- UAV ebee: RGB, MS, RE
  - Acquisition dates: 21/05, 12/6, 1/7, 13/8, 9/9
- UAV octocopter: Cosicam (internal VITO funding)
  - Acquisition dates: 11/5,21/5,12/6
- Manned aircraft - APEX : 1/7
  - Quicklooks available on:

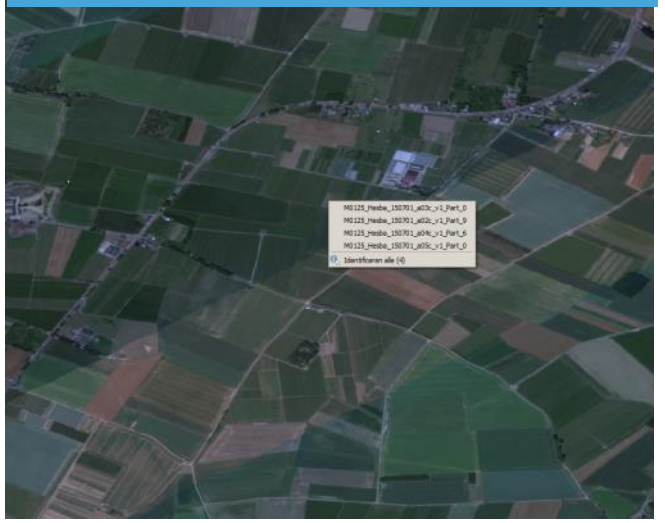
http://www.apex-esa.org/content/quicklooks.

Spaceborne:

- DMC/Deimos
  - Acquisition dates: 4/6,11/6,14/6,1/7,11/7,1/8,7/8,21/8,31/8,10/9
- RapidEye
  - Acquisition dates: 13/5,30/6,17/7,31/8,11/9
- Sentinel 2
  - Acquisition dates: 05/08, 22/8, 03/12

OCTOCOPTER WITH COSICAM

GEOREFERENCED QUICKLOOK APEX



SENTINEL 2

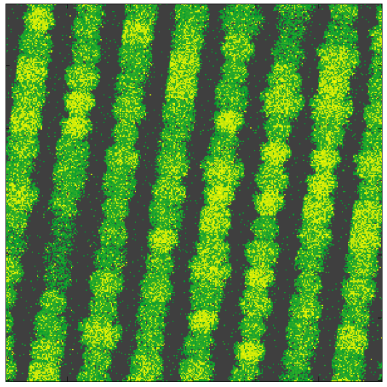
OBJECTIVE: ESTABLISH ACCURATE VITALITY MONITORING FOR FRUIT ORCHARD MANAGEMENT

HOW to obtain required insights ?

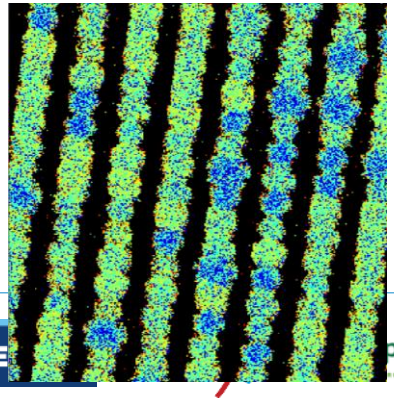
Map the variability in tree vitality

- Vegetative growth
- Chlorophyll
- Water
- Photosynthetic efficiency

RGB



$$GM1 = \frac{R_{550nm}}{R_{750nm}}$$



$$WI = \frac{R_{900nm}}{R_{970nm}}$$