



KU LEUVEN

Remote monitoring of orchards: possibilities and limitations

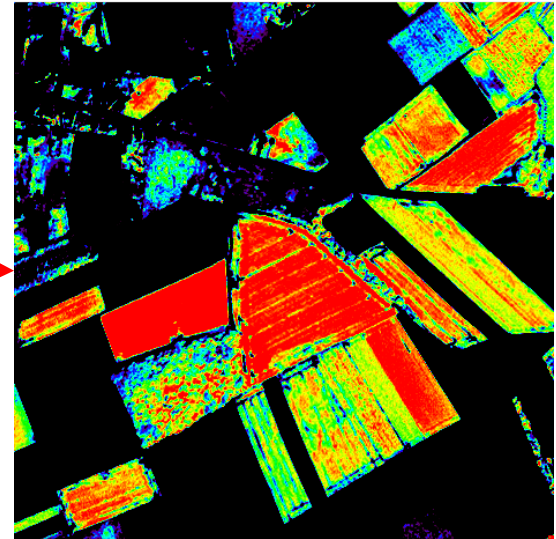
Laurent Tits – Geomatics Lab – KU Leuven

Laurent.tits@biw.kuleuven.be

Precision farming: remote sensing



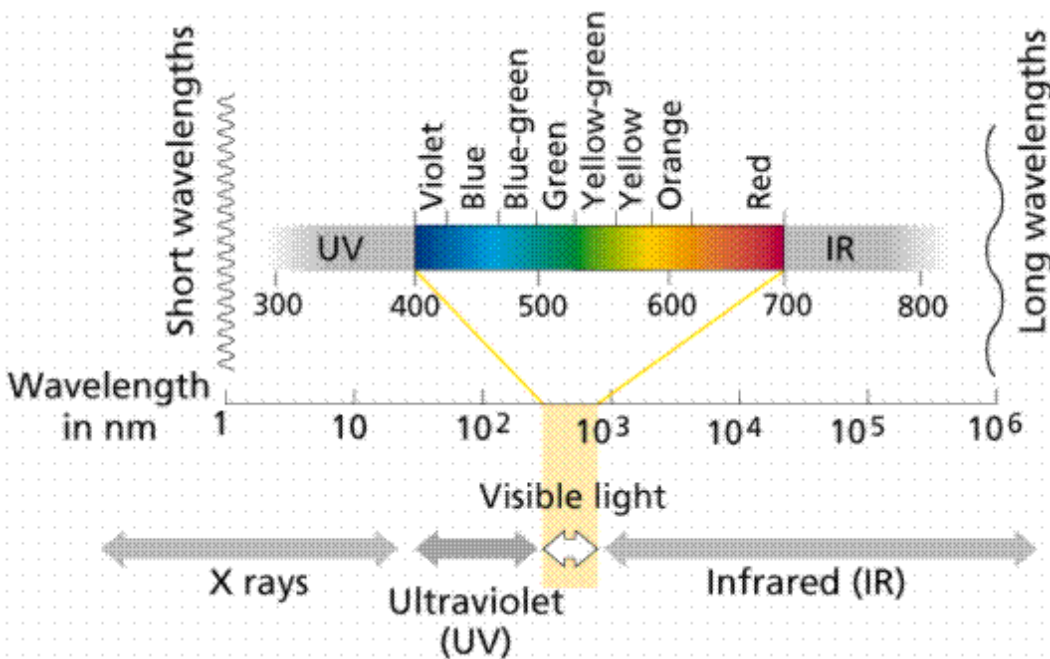
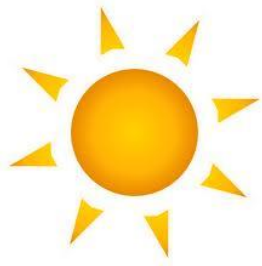
World view 2



Remote sensing → map spatial variability in plant properties

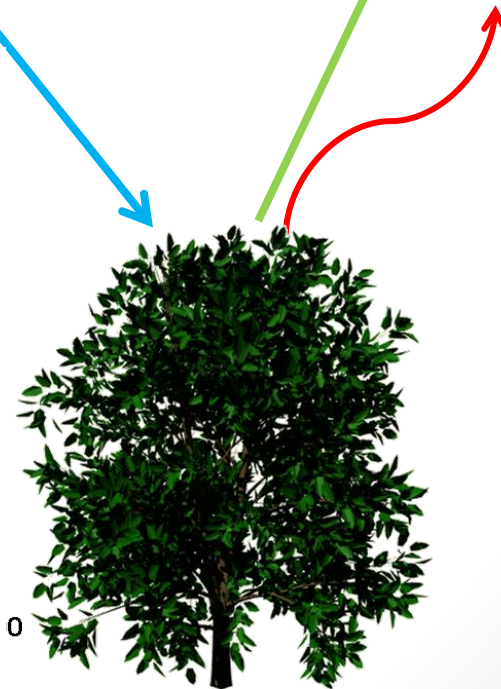
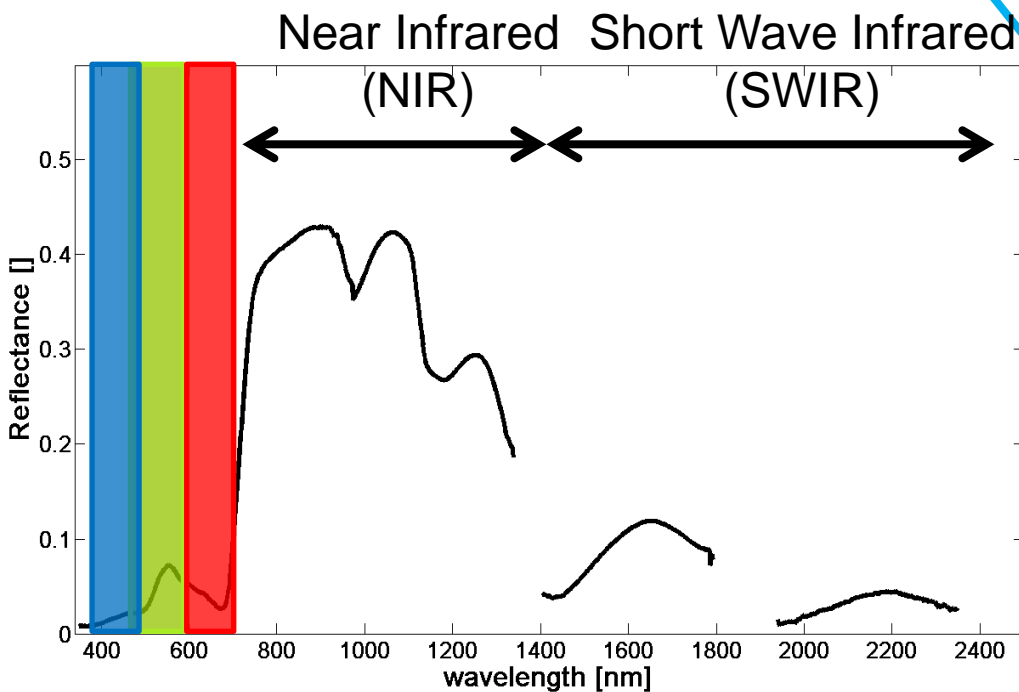
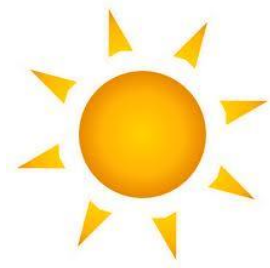
How does it work?

Remote sensing of vegetation



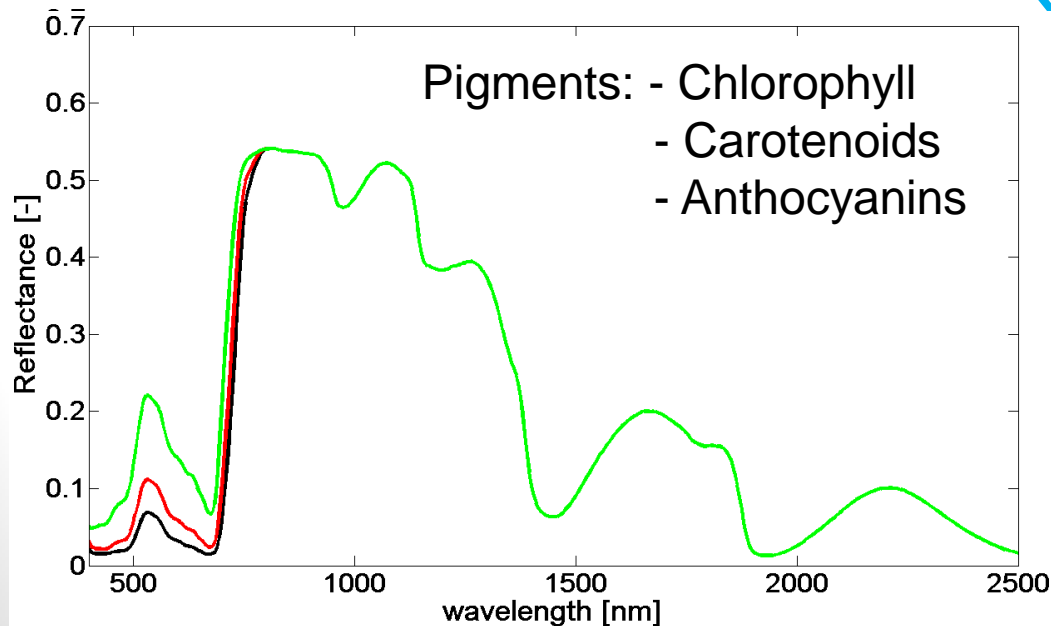
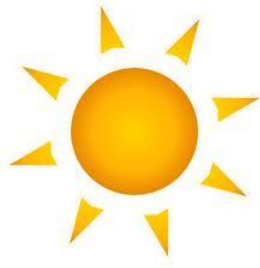
Remote sensing of vegetation

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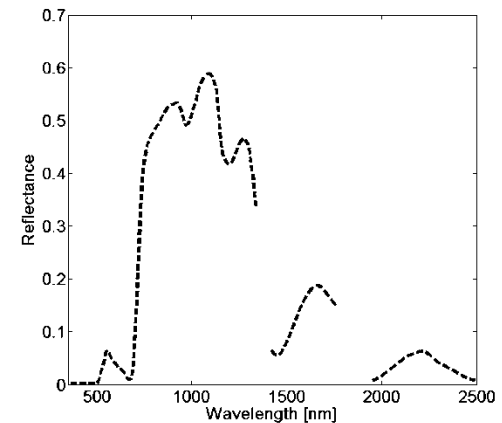
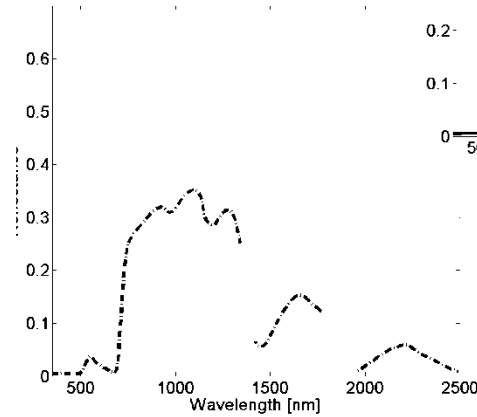
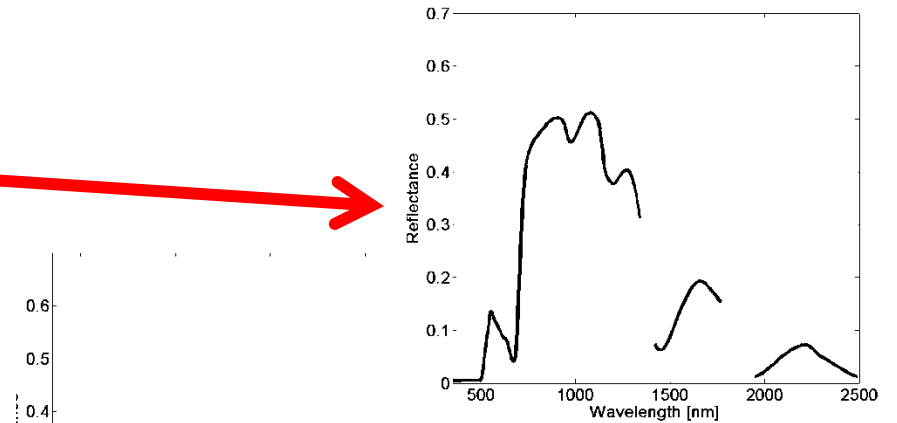


Remote sensing of vegetation

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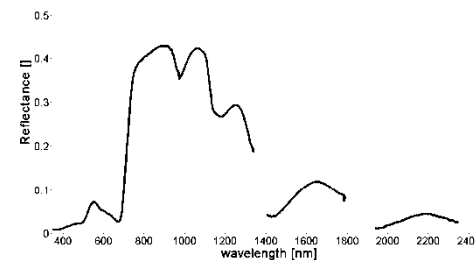
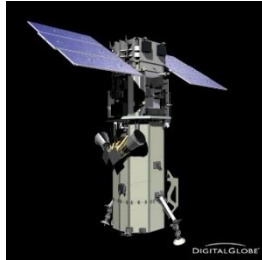
Remote sensing of vegetation



Variation in spectral properties
=
Proxy for variation in plant vigor

Remote monitoring of orchards

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Remote monitoring of orchards

- Tree vigor
- Yield determination/forecasting

Remote monitoring of orchards

- **Tree vigor**
- Yield determination/forecasting
- Pear trees - water stress



Hyperspectral (ASD)
Thermal (FLIR)



Remote monitoring of orchards

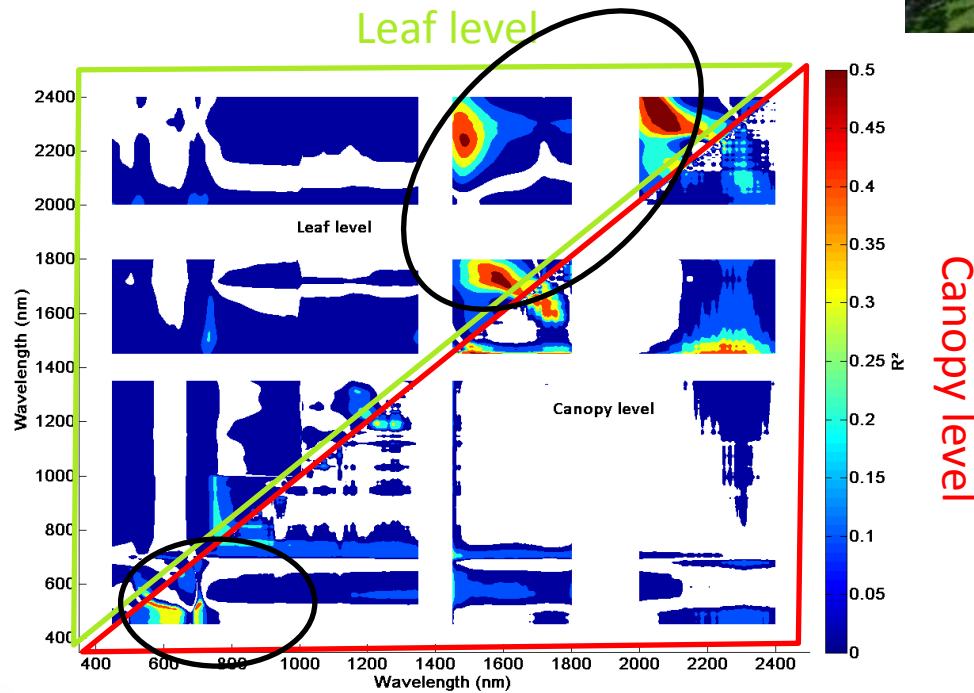


- **Tree vigor**
- Yield determination/forecasting
- Pear trees - water stress
- Tree response:
 - stomatal conductance ↘ (9DAS)
 - Leaf/canopy water content (Spectral - 1550-1750 nm range) ↘ (9DAS)
 - Canopy temperature ↗ (18DAS)

Remote monitoring of orchards

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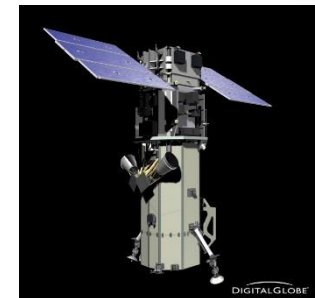
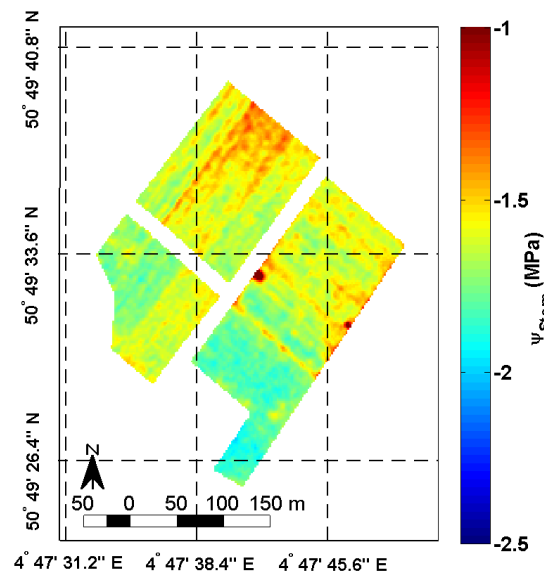
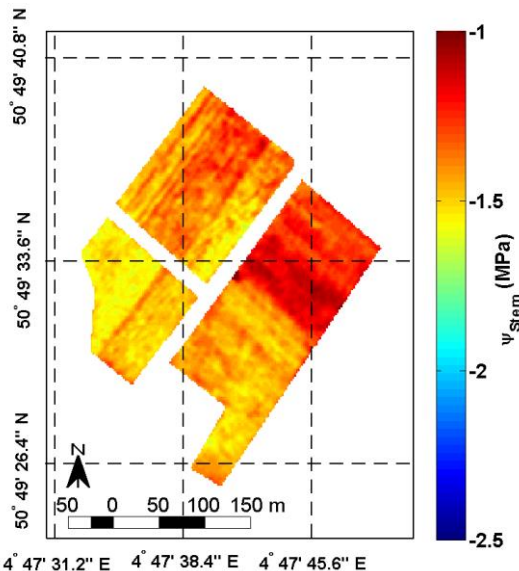
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Remote monitoring of orchards

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- **Tree vigor**
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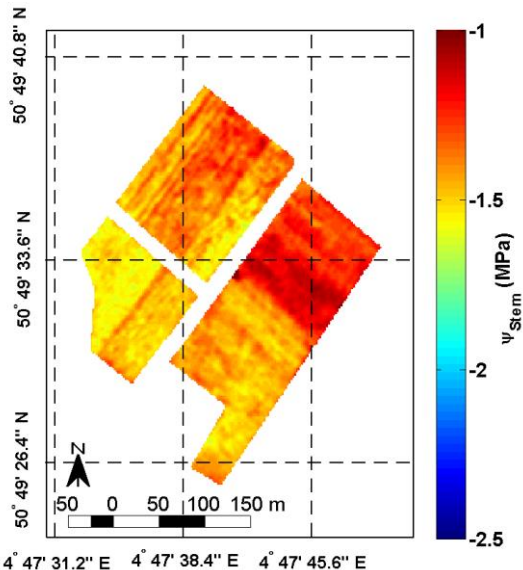
World view 2

Van Beek et al. (2013)

Remote monitoring of orchards

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- **Tree vigor**
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- Pear trees - water stress



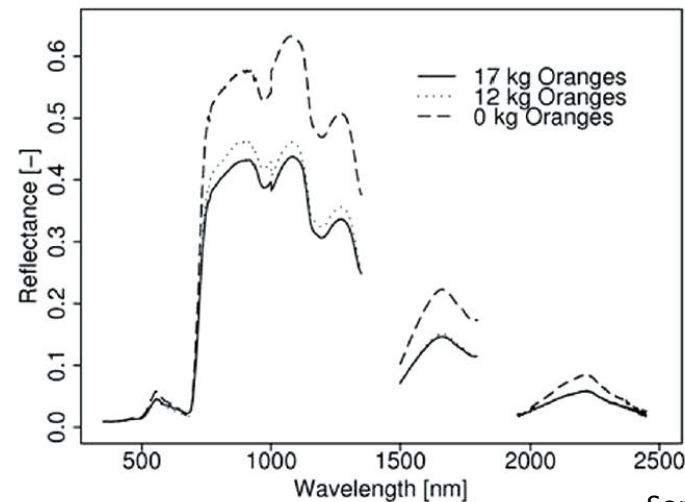
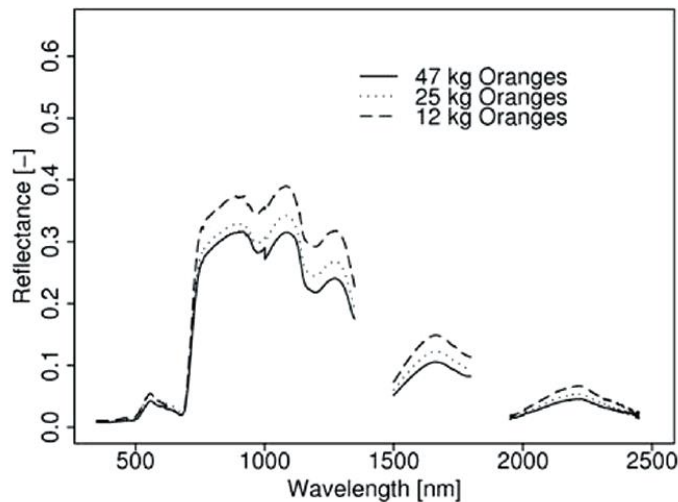
Soil service of Belgium



Research Station for fruit growing

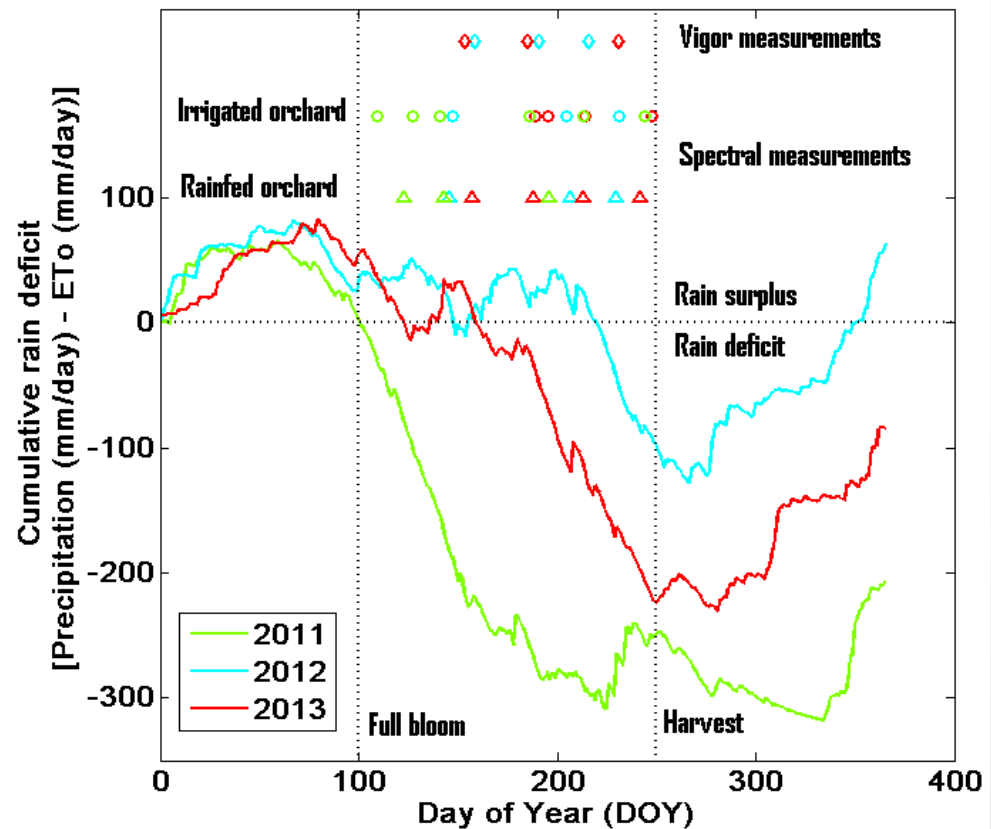
Remote monitoring of orchards

- Tree vigor
- **Yield determination/forecasting**



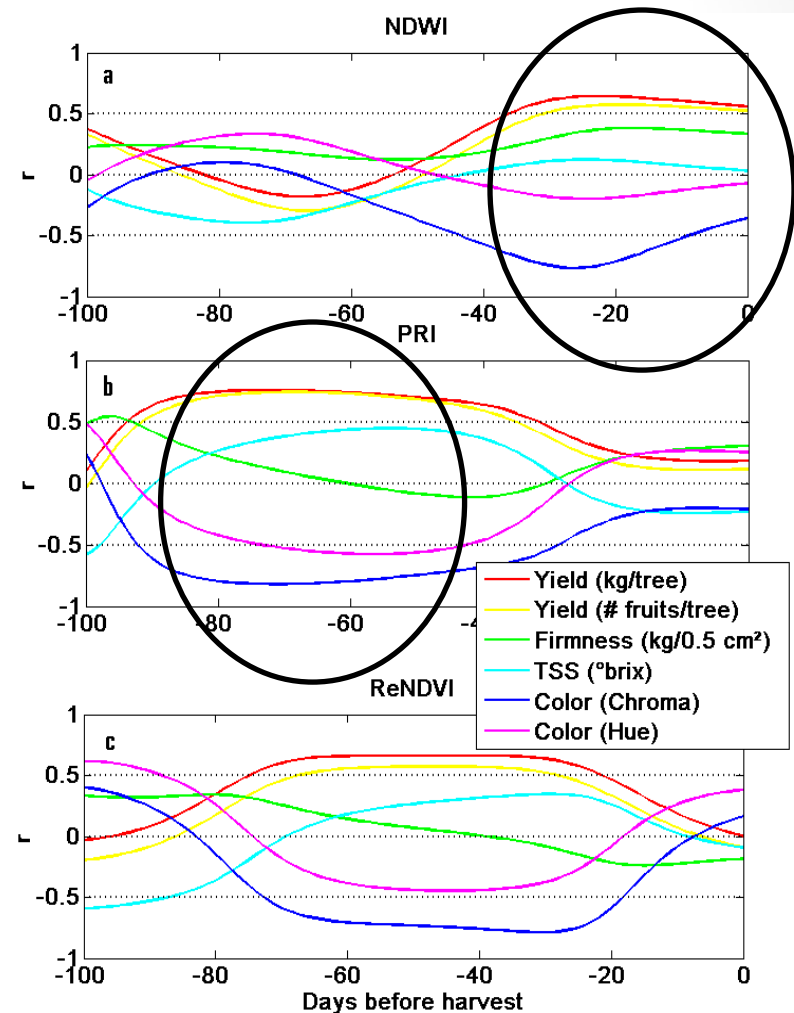
Remote monitoring of orchards

- Tree vigor
- Yield determination/forecasting



Remote monitoring of orchards

- Tree vigor
- Yield determination/forecasting

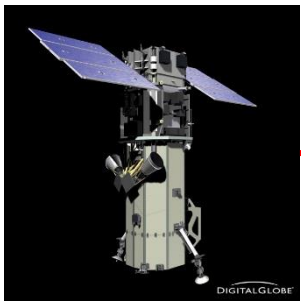


Remote monitoring of orchards

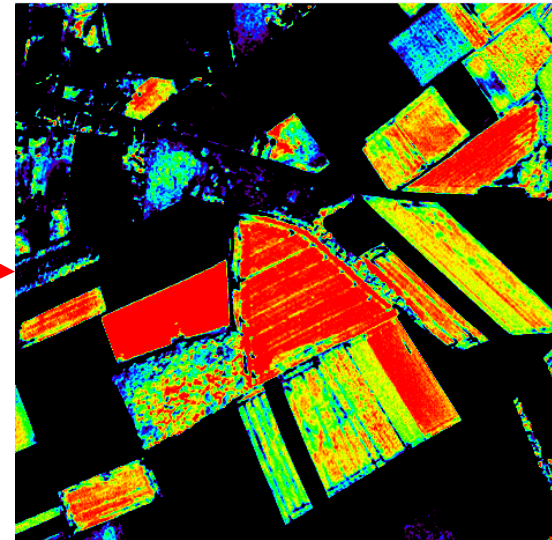
- What's possible:
 - Tree vigor
 - Yield determination/forecasting
- What's the problem?

Remote monitoring of orchards

- What's the problem?



World view 2

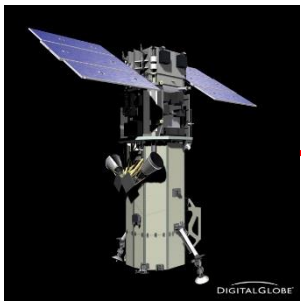


Remote sensing → map **spatial variability** in plant properties

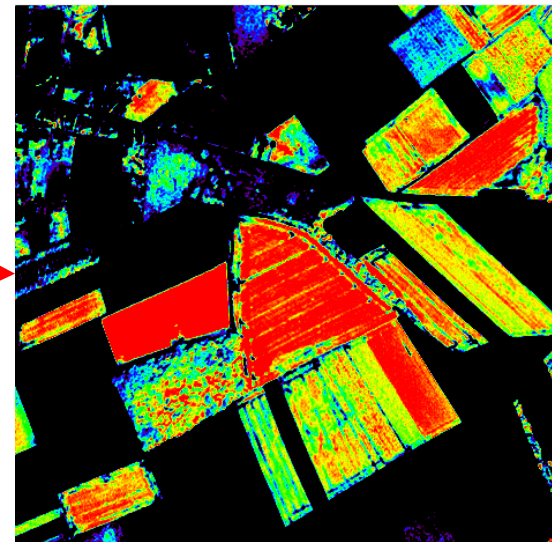
Relative → absolute

Remote monitoring of orchards

- What's the problem?



World view 2

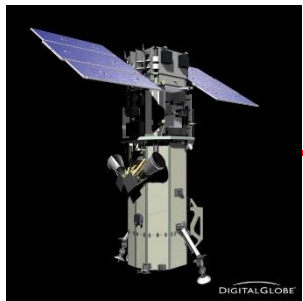


Remote sensing → map spatial variability in plant properties

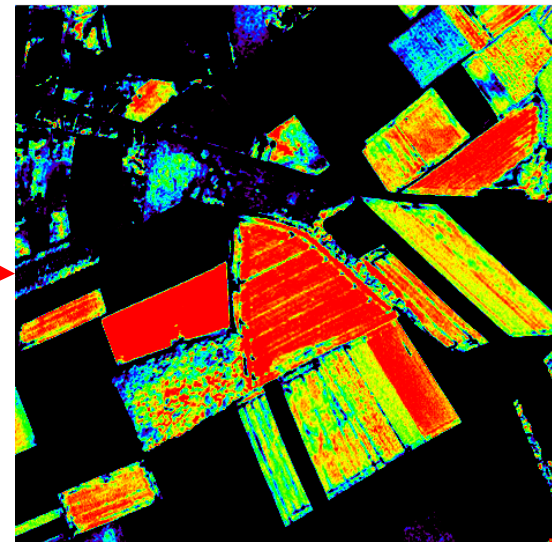
Symptoms vs causal factors

Remote monitoring of orchards

- What's the problem?



World view 2

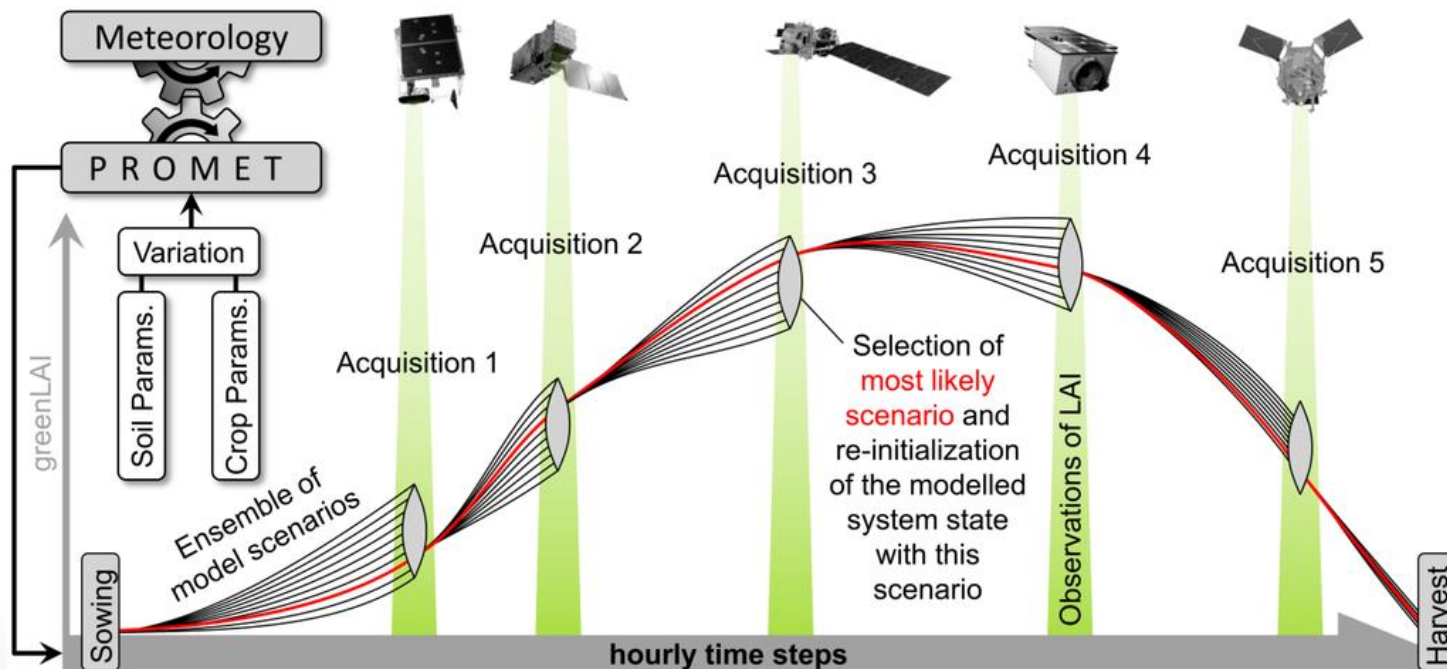


Remote sensing → map spatial variability in plant properties

Good communication with farmer (expert!) needed

Remote monitoring of orchards

- What's the problem?
 - Remote sensing → map spatial variability in plant properties
 - Annuals VS perennial crops



Remote monitoring of orchards

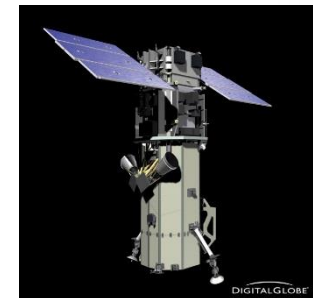
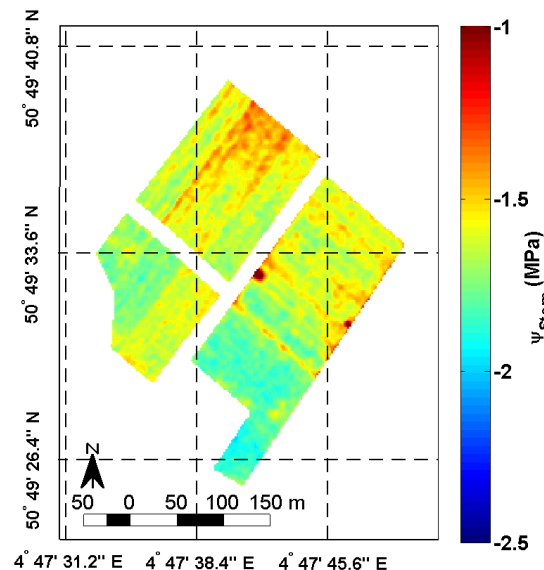
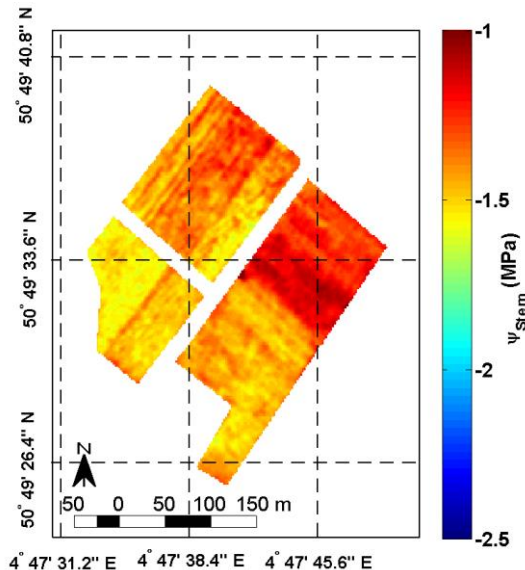
- What's the problem?
 - Remote sensing → map spatial variability in plant properties
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Treatment	Flowers per tree
Control	84
Stressed	140



Remote monitoring of orchards

- What's the problem?
 - Remote sensing → map spatial variability in plant properties
 - Annuals VS perennial crops
 - The technology

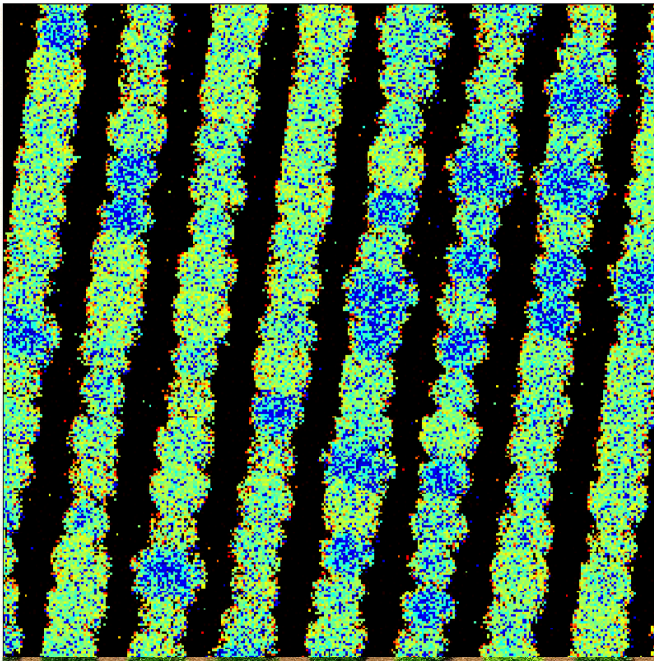


World view 2

Van Beek et al. (2013)

Remote monitoring of orchards

- What's the problem?
 - Remote sensing → map spatial variability in plant properties
 - Annuals VS perennial crops
 - The technology
 - 2m resolution

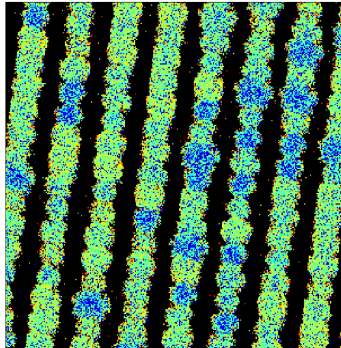


$$WI = \frac{R_{900nm}}{R_{970nm}}$$

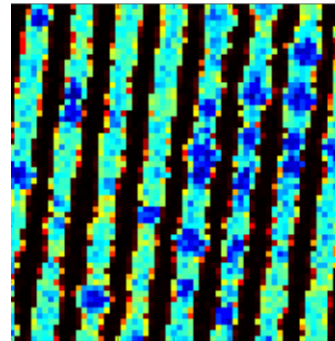
Remote monitoring of orchards

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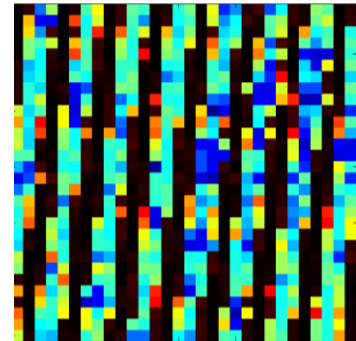
10 cm



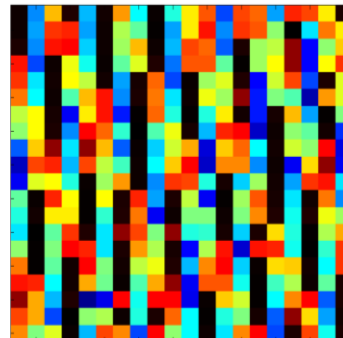
50 cm



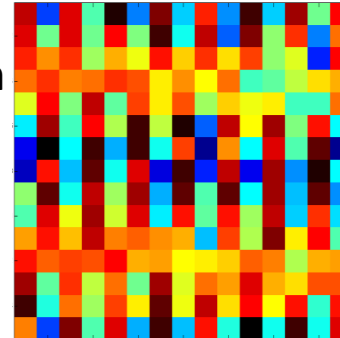
1 m



1.5 m

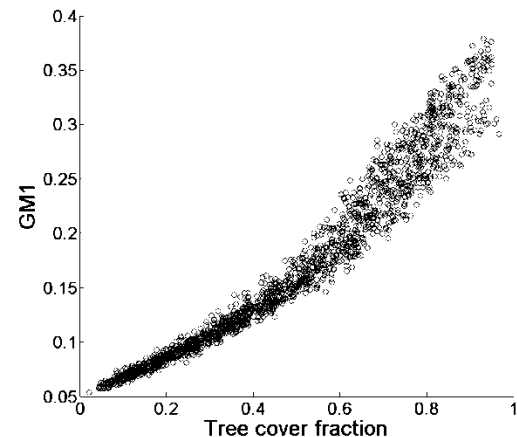
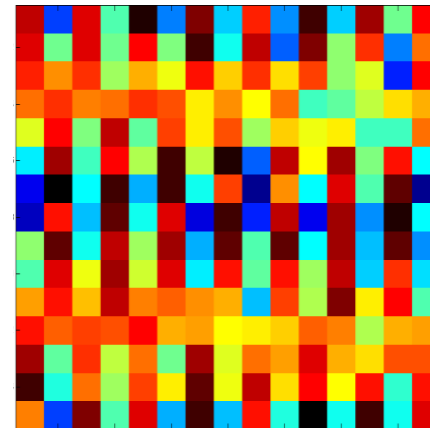
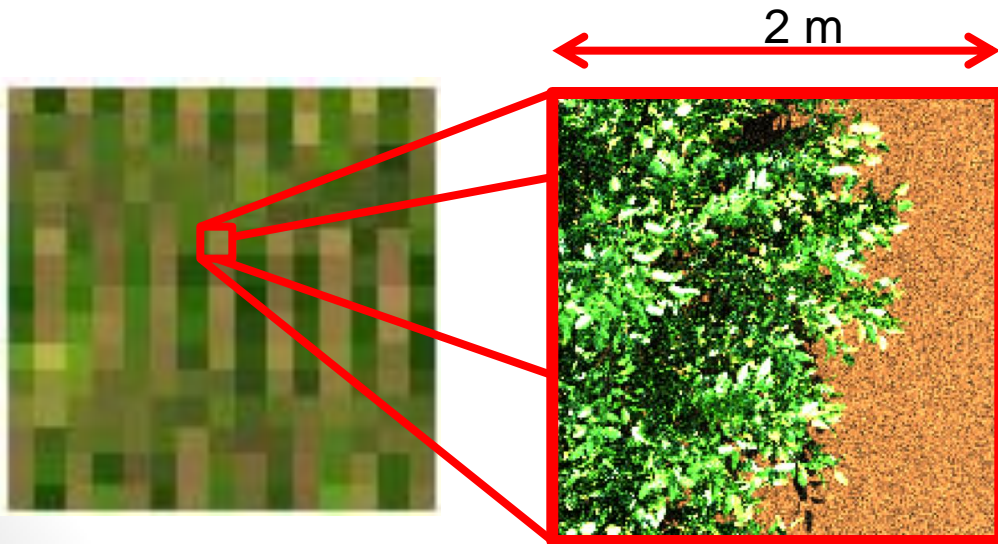


2 m



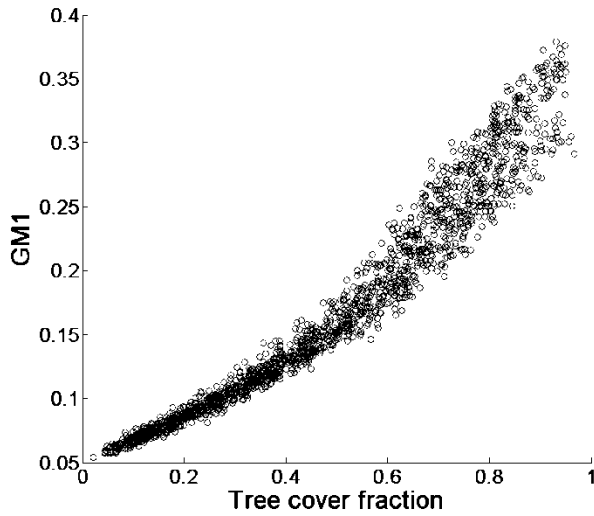
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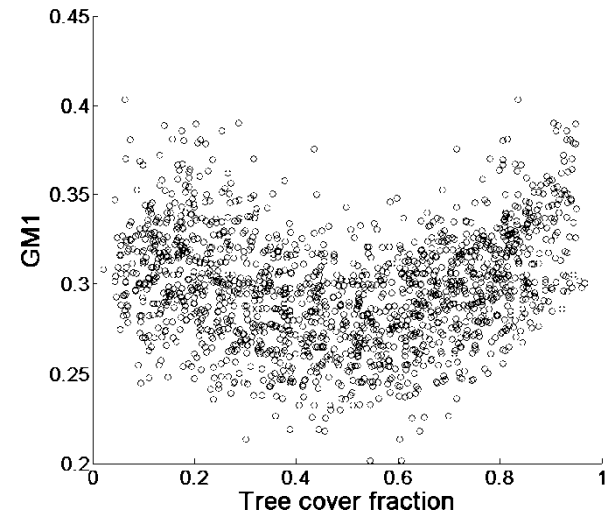


Remote monitoring of orchards

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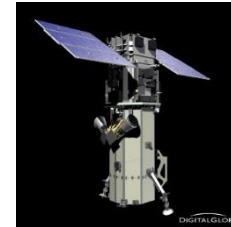
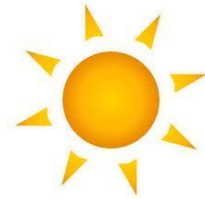
Before



After

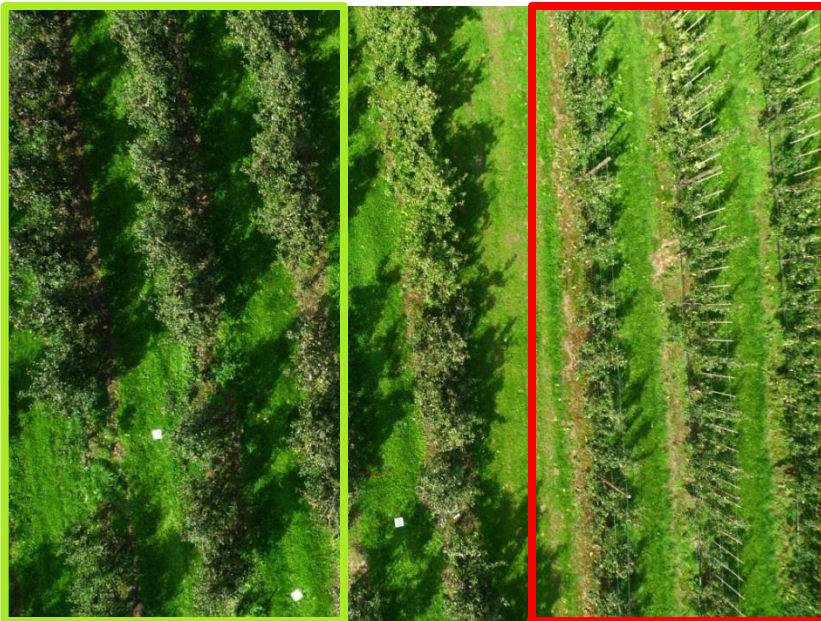
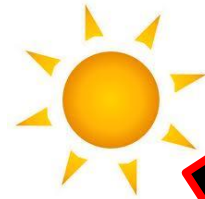
Remote monitoring of orchards

- What's the problem?
 - Remote sensing → map spatial variability in plant properties
 - Annuals VS perennial crops
 - The technology
 - 2m resolution
 - Viewing angles



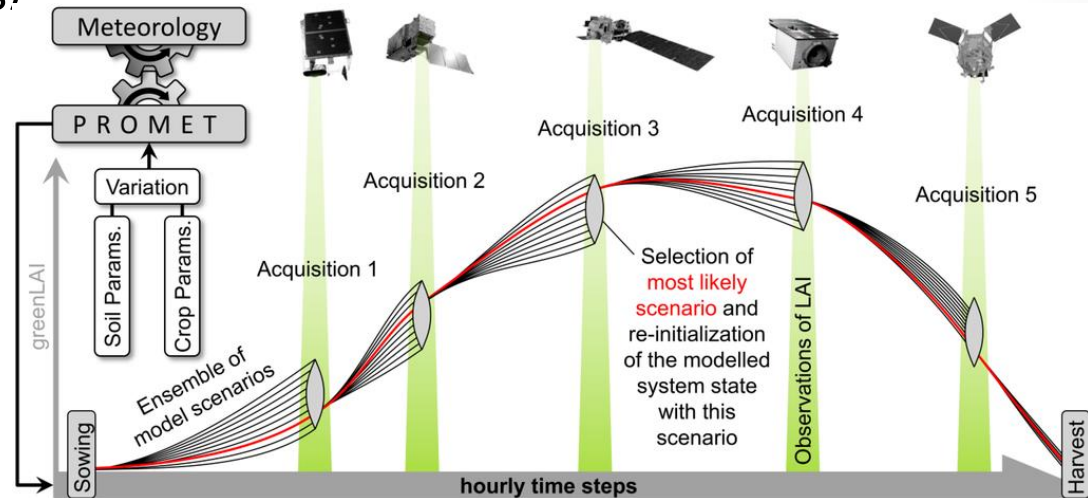
Remote monitoring of orchards

- What's the problem?
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Remote monitoring of orchards

- A way to go?
 - Combine any information source available (Remote sensing and non-remote sensing)

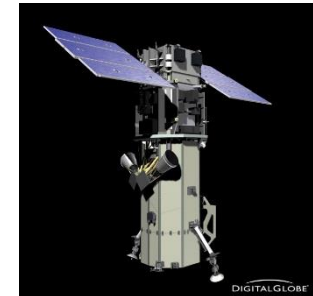
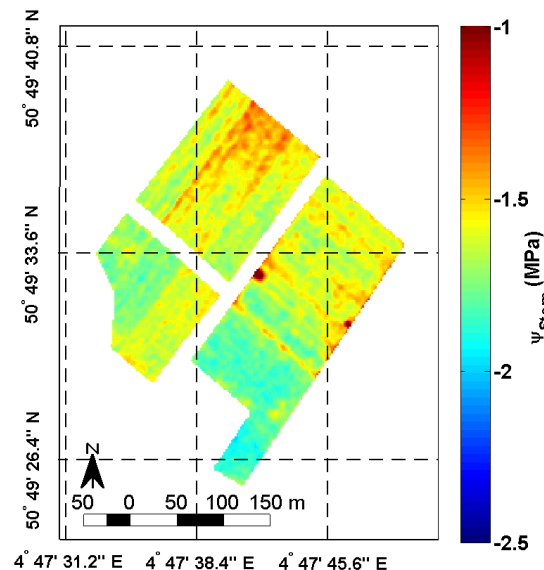
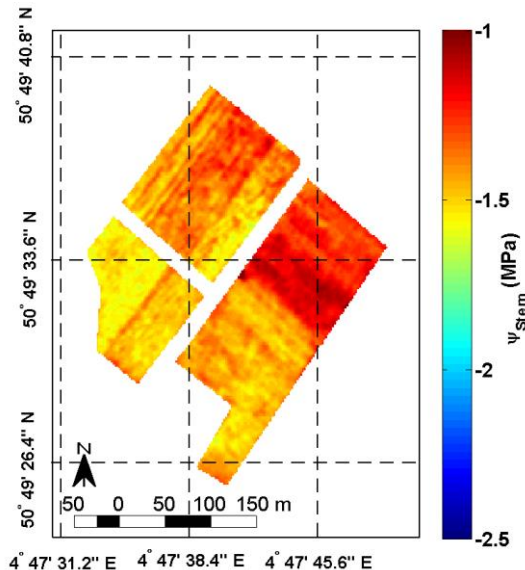


Hank et al. (2014)



Remote monitoring of orchards

- A way to go?
 - Combine any information source available (Remote sensing and non-remote sensing)



World view 2

Van Beek et al. (2013)

Remote monitoring of orchards

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- A new initiative: drone-port
 - Combine expertise of 3 partners in unique area
 - Centralize remote sensing (drones) research + data on fruit



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Remote monitoring of orchards

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Questions?

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