Remote monitoring of orchards: possibilities and limitations

Laurent Tits – Geomatics Lab – KU Leuven
Laurent.tits@biw.kuleuven.be
Precision farming: remote sensing

Remote sensing → map spatial variability in plant properties

How does it work?
Remote sensing of vegetation
Remote sensing of vegetation

Near Infrared (NIR)  Short Wave Infrared (SWIR)
Remote sensing of vegetation

Pigments:
- Chlorophyll
- Carotenoids
- Anthocyanins
Remote sensing of vegetation

Variation in spectral properties = Proxy for variation in plant vigor
Remote monitoring of orchards
Remote monitoring of orchards

- Tree vigor
- Yield determination/forecasting
Remote monitoring of orchards

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

Struthers et al. (2015)
Struthers et al. (submitted)
Remote monitoring of orchards

• Tree vigor
• Yield determination/forecasting

• Pear trees - water stress
Remote monitoring of orchards

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

World view 2

Van Beek et al. (2013)
Remote monitoring of orchards

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

Soil service of Belgium

Research Station for fruit growing
Remote monitoring of orchards

- Tree vigor
- Yield determination/forecasting

Somers et al. (2010)
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?

Remote sensing $\rightarrow$ map spatial variability in plant properties

Relative $\rightarrow$ absolute
Remote monitoring of orchards

• What’s the problem?

Remote sensing → map spatial variability in plant properties

Symptoms vs causal factors
Remote monitoring of orchards

- What’s the problem?

Remote sensing $\rightarrow$ 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

Hank et al. (2014)
Remote monitoring of orchards

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

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Flowers per tree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>84</td>
</tr>
<tr>
<td>Stressed</td>
<td>140</td>
</tr>
</tbody>
</table>
Remote monitoring of orchards

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

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

\[ WI = \frac{R_{900\text{nm}}}{R_{970\text{nm}}} \]
Remote monitoring of orchards

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

![Images of data at different resolutions: 10 cm, 50 cm, 1 m, 1.5 m, 2 m]
Remote monitoring of orchards

• What’s the problem?
  • Remote sensing → map spatial variability in plant properties
  • Annuals VS perennial crops
  • The technology
    • 2m resolution
Remote monitoring of orchards

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

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?
  • Remote sensing → map spatial variability in plant properties
  • Annuals VS perennial crops
• The technology
  • 2m resolution
  • Viewing angles
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

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

Questions?

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