Applications of the DMC Constellation in Agriculture

Gary Holmes
DMC International Imaging Ltd

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DMC International Imaging Ltd

- Established in 2004 to coordinate DMC constellation
- SSTL 100% shareholder
- Now an Airbus Defence and Space company
- 1st UK EO satellite operator
- 40+ Countries
- 5 Billion Km² Imagery
DMC 2\textsuperscript{nd} Generation Satellites

- UK-DMC2 and Deimos-1 launched 29\textsuperscript{th} July 2009
- Wide swath (650km)
- \textbf{22m} GSD
- Improved MTF, S:N, Stability
- Up to 2,100km along-track at full swath
- Faster X-Band downlink (replaces S-band)
- New operational modes, NRT Direct Downlink Service
DMC timeliness

DMC 600 x 560 km Image
- single image from UK-DMC
- Most of England captured within 1 minute
- Ideal for consistent classification approach
- Near real-time precision agriculture fully supported
- Reliable multi-temporal coverage per season
- Many fewer images to process than Landsat
Applications:
Crop statistics
USA Multitemporal Monitoring

- For US Department of Agriculture since 2011
- Satellites used: Deimos-1 and UK-DMC2
- Complete coverage of lower 48 States every 15-days
- 12 coverages April–October (average ~90% cloud-free)
- 150 Million km² of cloud-free imagery delivered per year

Image courtesy of Astrium / Deimos Imaging
### Improved Crop Classification Results through multitemporal DMC acquisitions: North Carolina Example

<table>
<thead>
<tr>
<th>CROPS</th>
<th>Producer</th>
<th>User</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL CROPS</td>
<td>81.7%</td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>94.3%</td>
<td>92.1%</td>
</tr>
<tr>
<td>Cotton</td>
<td>96.3%</td>
<td>94.4%</td>
</tr>
<tr>
<td>Soybeans</td>
<td>84.7%</td>
<td>84.0%</td>
</tr>
<tr>
<td>WW/Soy</td>
<td>93.9%</td>
<td>87.9%</td>
</tr>
<tr>
<td>Pasture</td>
<td>66.5%</td>
<td>68.1%</td>
</tr>
<tr>
<td>Peanuts</td>
<td>87.1%</td>
<td>92.8%</td>
</tr>
</tbody>
</table>

### Statistics courtesy of USDA

- 118 bands
- 73 bands
- 66 bands
Crop Classification in Emilia-Romagna, Italy

- Classification work performed by Regional Government
- For water balance, irrigation monitoring and statistics
- Small field parcels
- Multitemporal DMC-based classification (November-June)
- A fully operational system

Courtesy of ARPA Emilia-Romagna
Crop production mapping in Russia

Image Courtesy of Sovzond
Crop production mapping in Russia
Crop production mapping in Russia
Applications:
Precision Agriculture
Precision Agriculture: The Imagery Acquisition Challenge for Satellites

• **Highly demanding application for remote sensing:**
  – Very large areas to be covered for operational services
  – **Multitemporal** coverage needed
  – Timeliness is vital (cloud-free data at specific growth stages)
  – High enough resolution to map within-field variability
  – Rapid processing & delivery (for NRT services)
  – Must be low cost per acre

• **DMC constellation matches these demands well**
  – wide swath sensors on multiple small satellites

• **DMC imagery now used for Precision Ag in:**
  – USA, Canada, Argentina, Brazil, UK, France, Netherlands, Lithuania, Ukraine, Russia, Bulgaria, South Africa, Japan
Fieldlook

• Weekly updates using multiple data sources
• 10 quantitative parameters
• All crop types

Growth
• biomass production (kg/ha)
• CO2 intake (kg/ha)
• leaf area index LAI (m² leaf/m² ground)
• vegetation index NDVI

Moisture
• evaporation shortage (mm/week)
• current evaporation (mm/week)
• surplus rain (mm/2 weeks)
• reference evaporation

Minerals
• Nitrogen content in the top leaf layer (kg/ha)
• Nitrogen content in all leaves (kg/ha)

Yield
• Potatoes, Wheat, Maize, Sugar beet
• Dry matter content
• Sugar Yield
• Protein content
Regional and Field-Specific Intelligence

Weekly updates on:
• Water requirements
• Biomass production
• Water consumption
• Ground water abstraction

Irrigation recommendations:
• When to irrigate
• Where (variable rate or flat rate)
• How much
FarmStar (France)

• >15,000 farmers in N. France
  Covers cereals and oilseeds
  December-May

• Biophysical parameters estimated from DMC and SPOT data through canopy reflectance model inversion

• Integrate biophysical data with met, soil and crop variety info

• Apply national guidelines to deliver fertiliser/PGR recommendation maps
FarmStar: Final Map Product to Farmer

Préconisation azote fin montaison

Blé

M. CAPP

Parcelle : CHEMIN BALOSSIE

Sol : Limon argileux

Ilot : 120  Surface : 8.51 ha

Précédent : COLZA AVEC REPousse

Variété : BOREGAR

Semis : 22/10/2012  Densité (grains/m²) : 280

Carte de préconisation azote intra-parcellaire

<table>
<thead>
<tr>
<th>Dose (U)</th>
<th>% Surface</th>
<th>% Surface cumulée</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>30</td>
<td>1.4</td>
<td>21.4</td>
</tr>
<tr>
<td>40</td>
<td>4.2</td>
<td>25.6</td>
</tr>
<tr>
<td>50</td>
<td>70.4</td>
<td>100.0</td>
</tr>
<tr>
<td>60</td>
<td>10.0</td>
<td>100.0</td>
</tr>
<tr>
<td>70</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>80</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>&lt;100</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Dose recommandée

Dose recommandée sous réserve d'au moins 15mm de pluie dans les 20 jours suivant votre dernier apport d'engrais.

- Au delà de 40 U : fractionnement possible en 2 passages.
- De 30 à 40 U : apport possible à gomfler.
- 0 U : apport inutile pour le rendement.

Prochains stades:
- Dernière feuille étalée vers le 19/05/2013,
- Epiaison vers le 27/05/2013.

Origne des données climatologiques : METEORFRAINE
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Any questions?

g.holmes@dmcii.com

www.dmcii.com