The future for satellites in agriculture

European Space Solutions

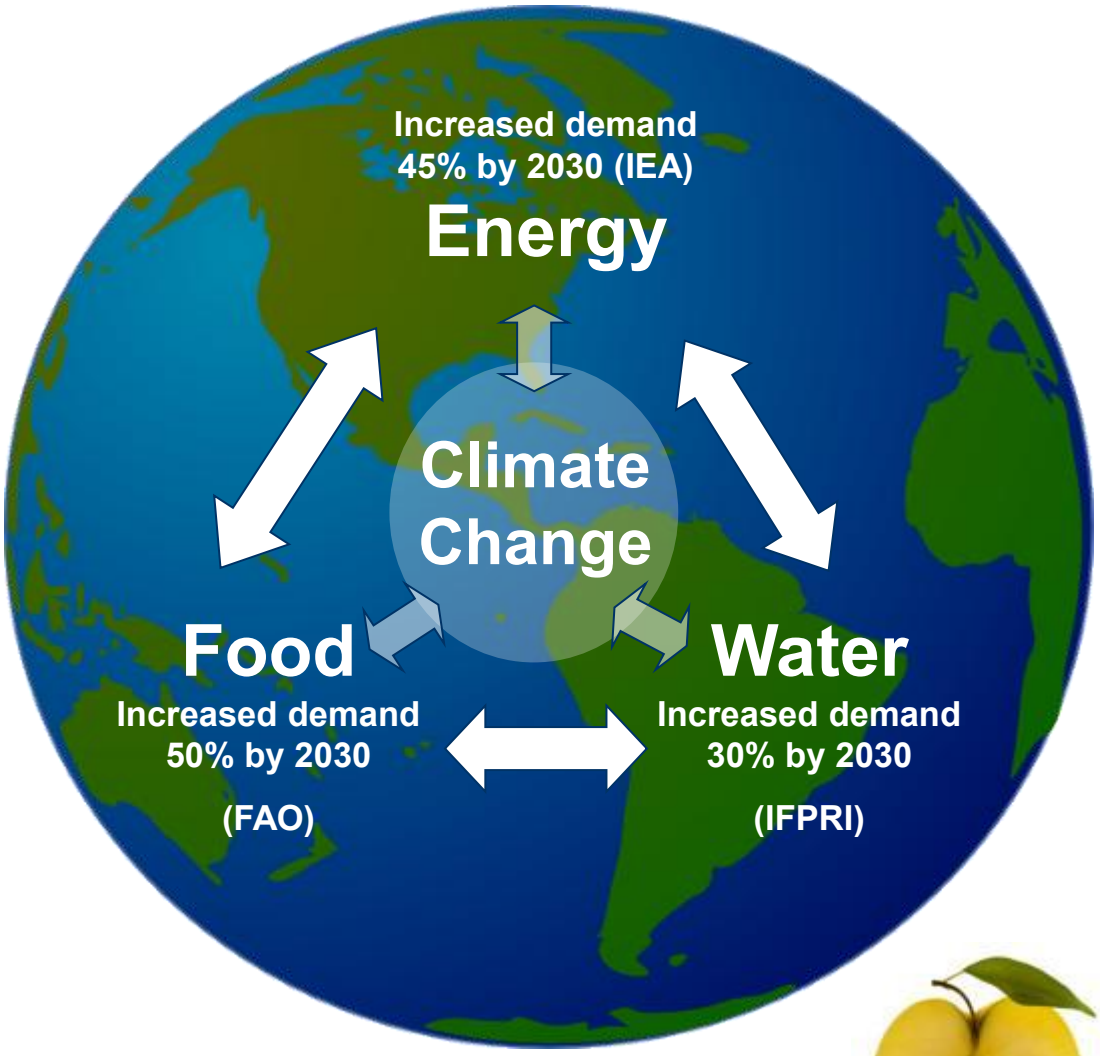
Dec 2012

Global Food supply

Diet	Western diets are being copied as countries become more affluent but are fundamentally less healthy and less resource efficient.
Population increase	Global food production needs to rise by 80% by 2050 to meet demand of approx 9 billion people
Environment	Impact of water shortages (by 2020 2/3 of population will be in water stressed countries) and focus on reducing greenhouse gas emissions
Climate change	Southern Europe getting hotter & drier, north getting wetter & warmer Increase in natural disasters and diseases thriving in warmer climates
Energy	Agriculture oil dependent for fertilisers, farming, storage or transport. Shortage of phosphates. Bio-fuel demand reducing food area
World markets	Ownership, particularly in Africa, of land by foreign powers Price volatility inevitable as a result of shortages and protectionism

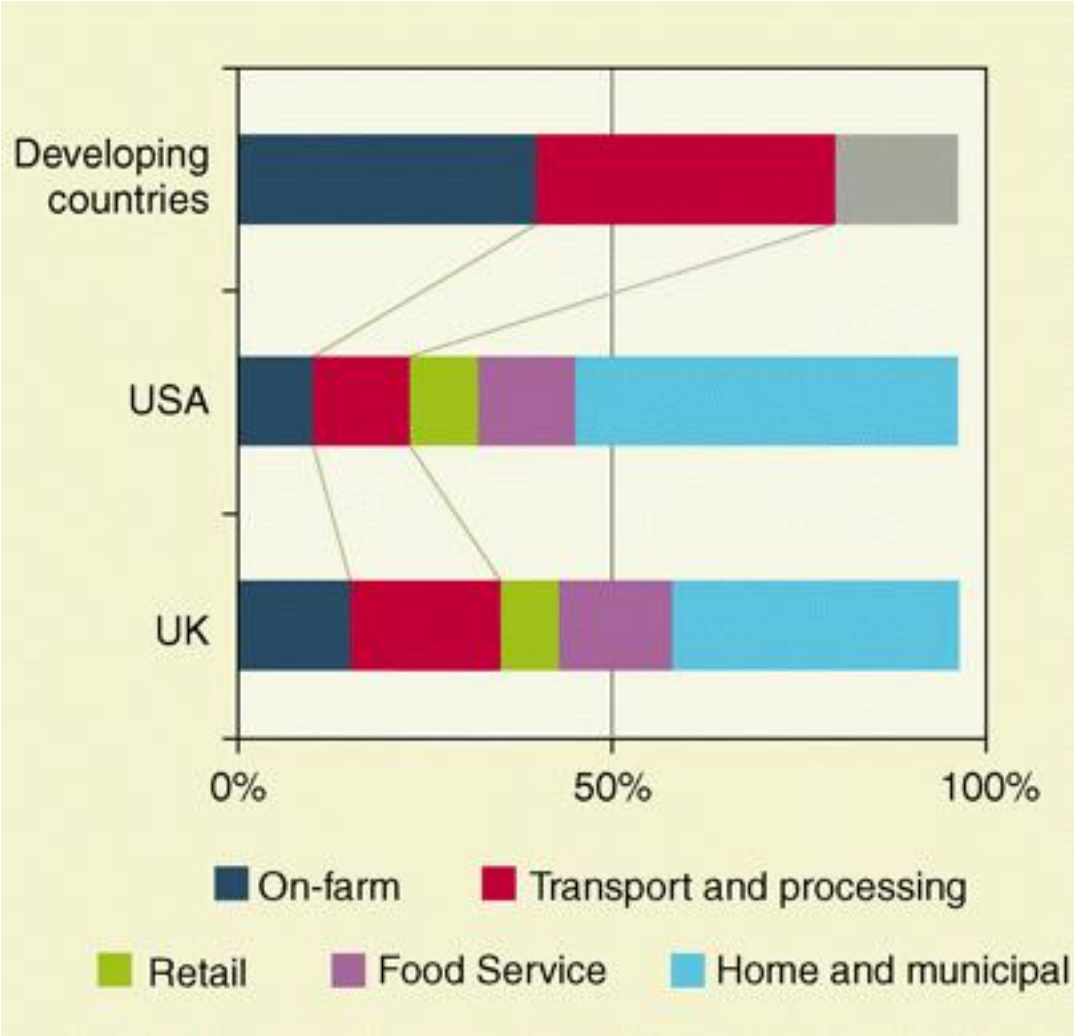
Perfect Storm

1. Increasing population
2. Changing diets
3. Losing land to urbanisation and rising sea levels



Prof Sir John Beddington, UK Government's Chief Scientist

Food waste


Developing countries
USA
UK
0%
50%
100%
On-farm
Transport and processing
Retail
Food Service
Home and municipal

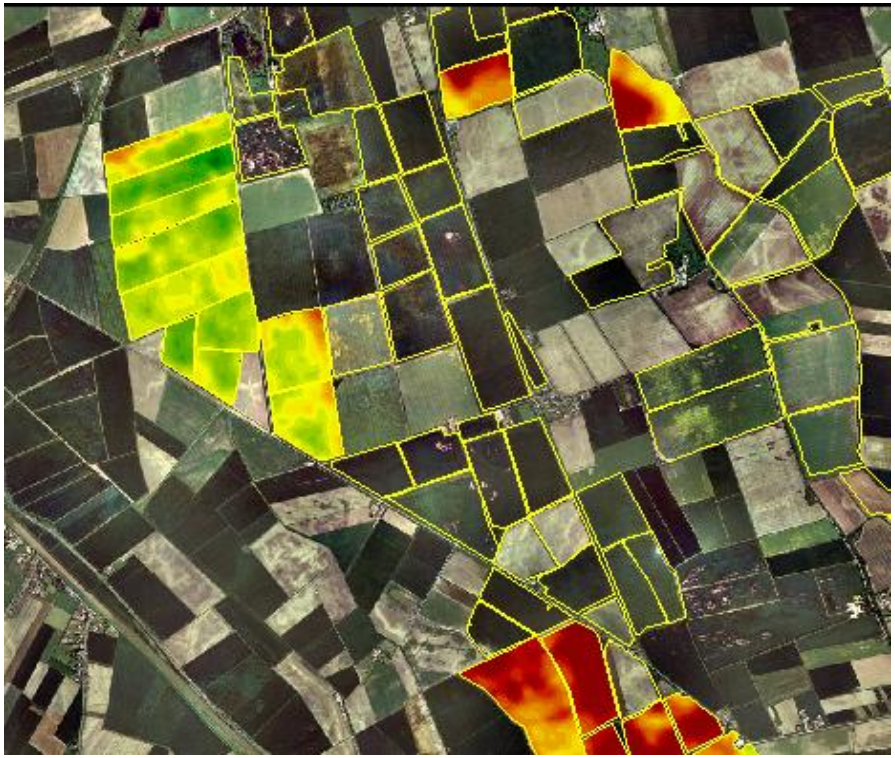
Sustainable intensification

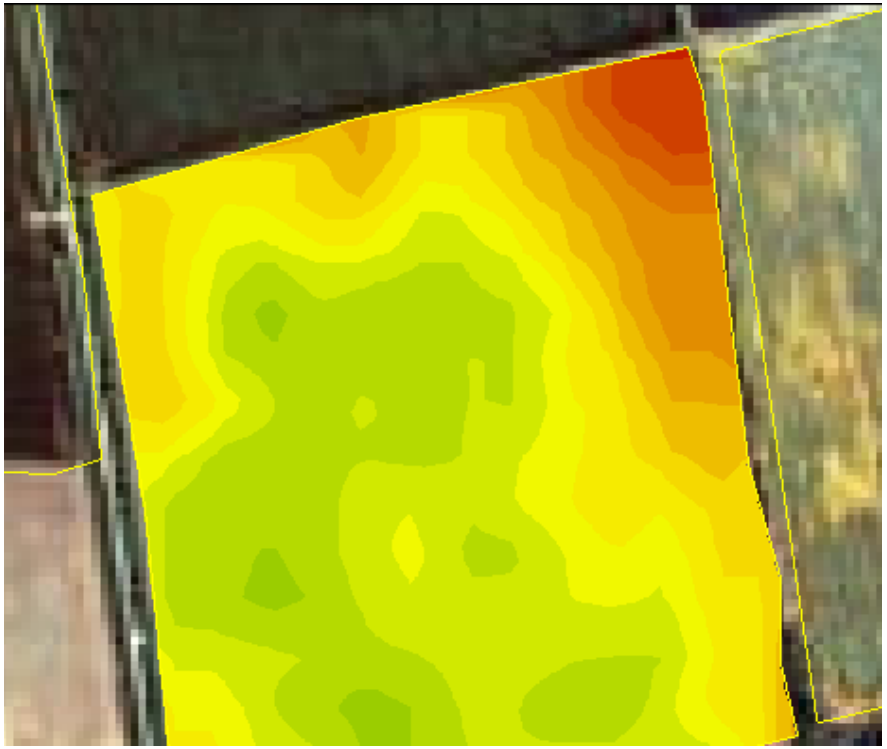
- Reduce inputs (ag chems, fertiliser)
- Reduce compaction
- Reduce water use
- Reduce waste
- Increase crop yields
- Increase resilience to climate variations
- Increase understanding and actions for wildlife

Current best practice

- Auto-steer and position guidance
- Use of N sensors
- Improving understanding of soils
  - Controlled traffic farming
  - Zoning
  - Reduced pressure of equipment ??

OSR leaf cover Coldham, UK



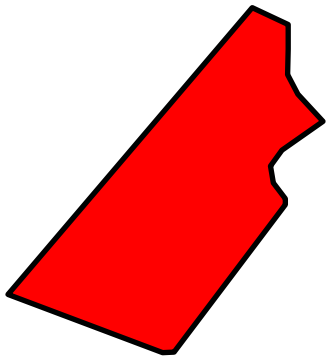


Management units reduction of scale

- Conventional or Traditional Farming

  Field

  One rate

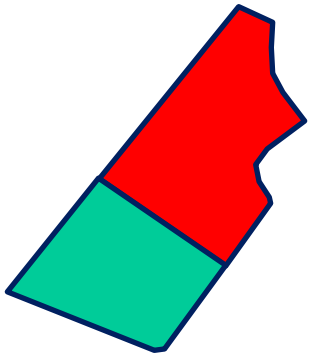


- Precision Farming

  Sub-Field

  Variable dose rate

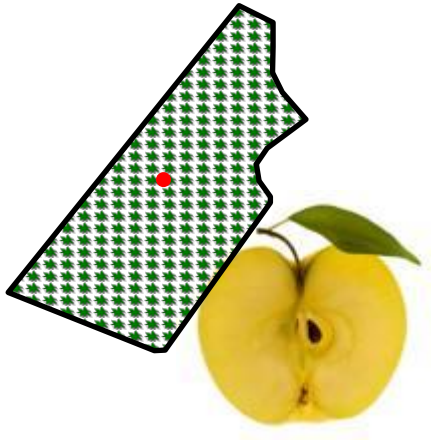
  Patch application



- Single-Plant-Care or Plant Level Husbandry ‘Phytotechnology’

  Single Plant

  Individual dose rate



Autonomous crop scouting

- Low power, non contact assessment of crop
  - Nutrient stress (multispectral camera)
  - Diseases (visible camera, biosensors)
  - Crop height/growth (ultrasonic rangefinder)
  - Weeds (visible camera)

What satellites can provide

- Use of visible light, other electromagnetic radiation and the electromagnetic spectrum
  - collecting the radiation that is reflected, emitted or scattered by a target (*passive systems*)
  - illuminating a target with a pulse or beam of radiation and collecting the signal that is reflected or diffracted back to the sensor *(active systems).*
- From 2013 satellite data will be available day and night over all EU

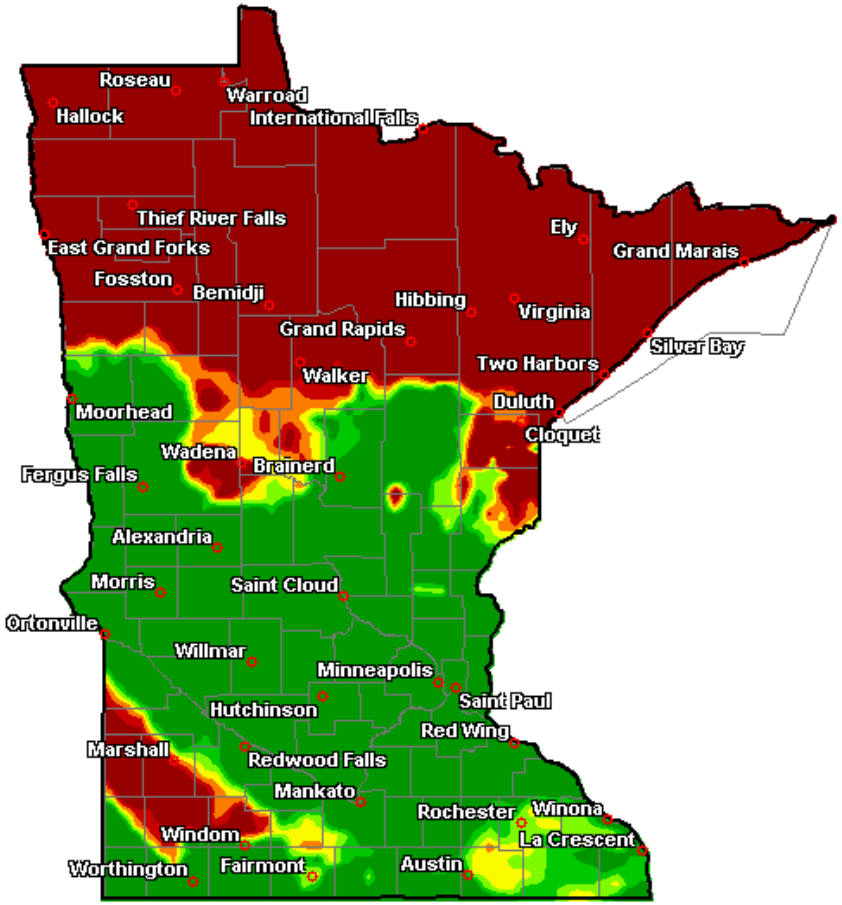
How satellites can help in future

- Short term
  - “Automated” agronomist looking at crops
  - Disease prediction affecting chemical requirement
  - Stressed crops showing irrigation/fertiliser requirement
  - Yield predictions, market signals
  - Ecosystem assessments: eg tree health, soil quality, habitat
- Medium term
  - Ag chem businesses sell “healthy crop” not chemicals
  - Fertiliser businesses selling yield

Nitrogen variation

Hyperspectral sensing detecting chlorophyll

Leaf rust risk prediction

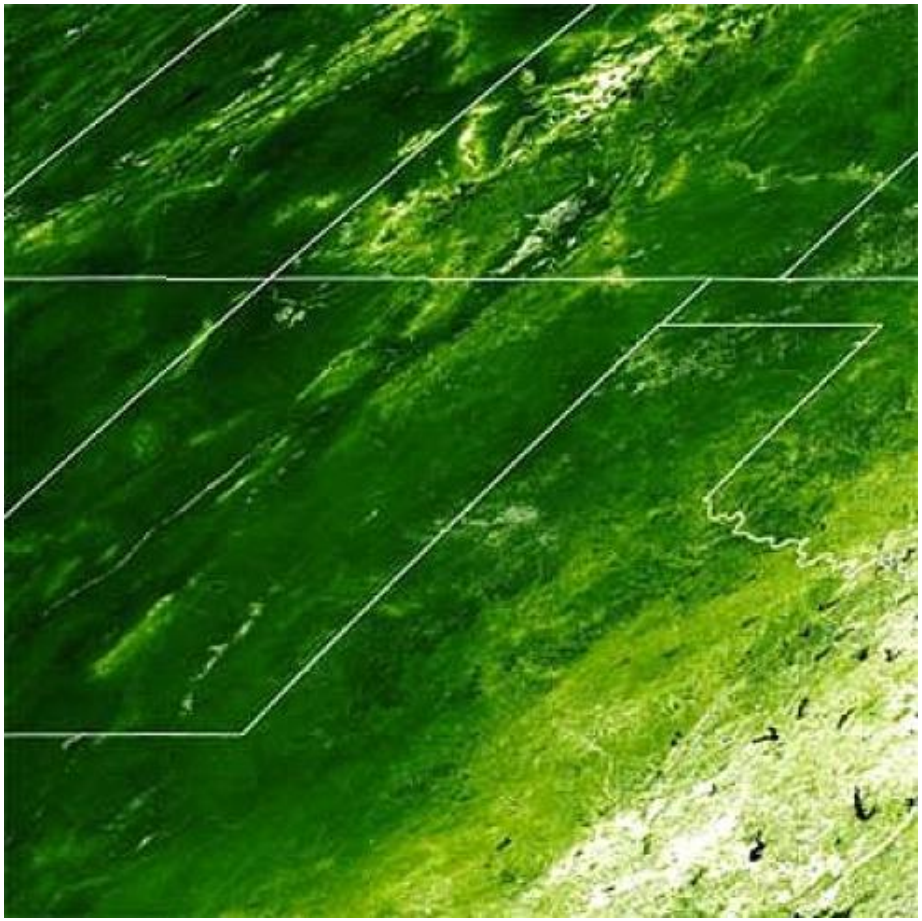


Minnesota

Fungal infestation

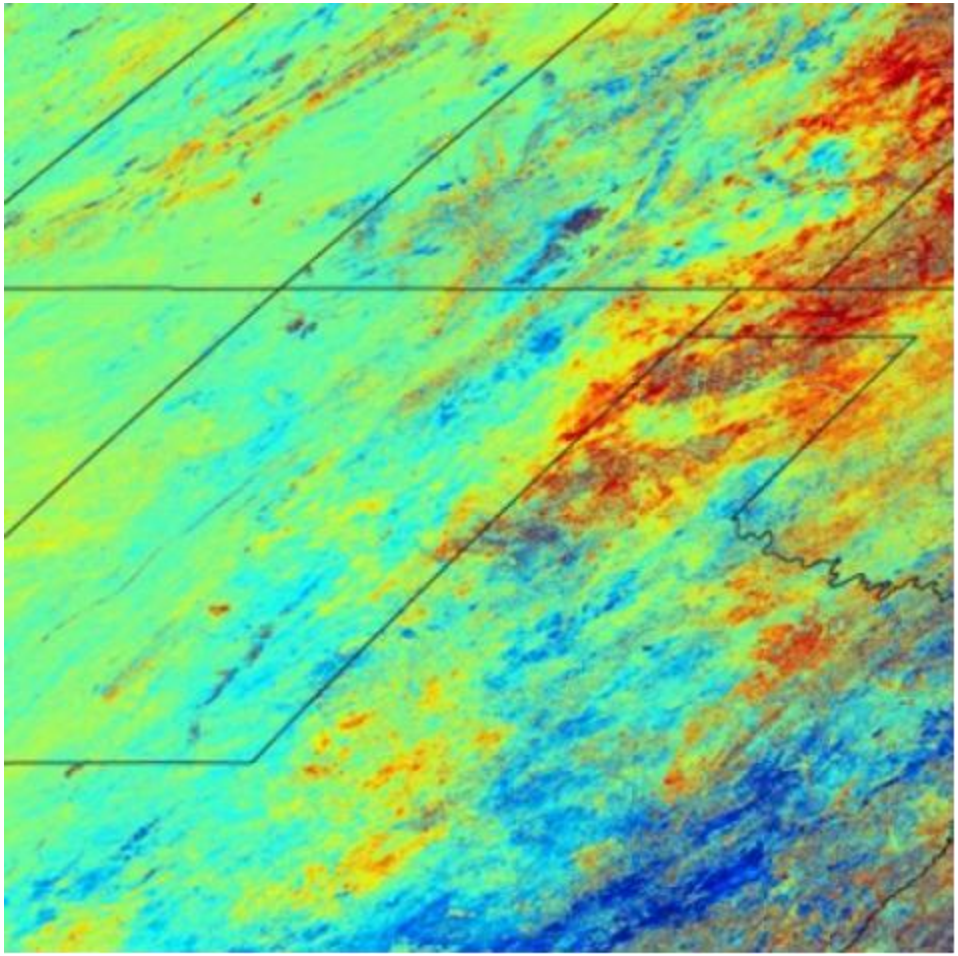
Very High Resolution Remote Sensing

Predicting disease outbreaks



Increased leaf cover leads to increased hantavirus in humans

Year on year change in plant cover



Limitations of satellites

- Lack of precision will require local follow up
  - Farmer
  - Drone
  - Third party
- Compete with individual plant monitoring
- Lack of common data sets

A systems approach

- Develop new generation of machinery based on plant needs
  - Allow us to do operations we cannot do now, find too expensive or time consuming
  - Low energy, intelligently targeted inputs
  - Plant scale operations
  - Very low compaction
  - Modular and scalable
  - Integrated

System implications

- Environment
  - Reduced inputs
  - Allows controlled biodiversity (retain non-competitive weeds)
- Economics
  - Reduced costs and increased affordability of agronomist skills
  - Market signals
- Social
  - Public perception of agriculture improved
- Opportunity
  - Sustainable intensification