Satellite Imagery

New Table Stake for Crop Condition Information?

Damien Lepoutre

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Satellite Remote Sensing: Old or New?
Corona program: Discoverer satellites - 1959

The CORONA Program 1959-1972

OBJECTIVES
- ANNUAL AND SEMI-ANNUAL SEARCH
- PRIORITY TARGETS
- MAPPING, CHARTING AND GEODESY

PAYLOAD DATA
- TWO CONVERGENT, F/3.5, 24. IN. FL PAN CAMERAS
- STELLAR-TERRAIN CAMERA
- 1,500 FT x 70mm FILM
- FRAME SIZE 7.4 x 119 NM
- RESOLUTION 6-10 FT
- COVERAGE 7 MILLION SQ NM/MISSION
- TWO RECOVERY VEHICLES

ORBITAL DATA
- INCLINATION 60-110 DEG
- AVERAGE PERIGEE 100 NM
- AVERAGE APOGEE 150 NM
- MISSION LIFE: 19 DAYS
- BOOSTER
  - THOR/AOGA
Corona: first successful image - 1960

18 AUGUST 1960 IMAGERY

PARKING APRON

RUNWAY
Landsat: To study and monitor - 1972
NOAA AVHRR: Daily monitoring - 1978
First uses in agriculture

Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing (AgRISTARS) ended in the early 1980’s

- Domestic and global commodities
- Early warning of changes on production + quality of commodities + renewable resources
- Predicting commodity production
- Land use classification and quantification
- Inventories and assessments of renewable resources
- Land productivity measurements
- Assessment of conservation practices
- Pollution detection and impact evaluation

Used both Landsat and AVHRR data

⇒ No “crop signature”
⇒ Methods to monitor crop conditions and estimate crop areas
Landsat TM and SPOT

First results exceeded expectations
Drove to investments, commercial ventures, higher resolution:
- 30m with better radiometric quality in 1982 (Landsat TM)
- 20m / 10m in 1986 with lower frequency / targeting potential (Spot)

Not the expected growth
Defense remained center of business for high resolution
Market

Commercial developments before 2010:

• Agricultural policies including control of area based subsidies in Europe
• Traders to monitor crop conditions
• Insurers and/or banks to monitor real impact of weather events
• Some inroads on variable rate application based on variability as measured by satellites

Very slow adoption with mostly innovators and/or leader’s market:

• Customers asked for proof of RoI before start
• Customers challenged the usefulness of the information

⇒ Convincing customer that satellite remote sensed images provided useful information

Now all farmer or distributors decision support systems make use / provide access to satellite imagery
The road to adoption
What did not change?

30+ years

Same measures:

- Reflectance of sun light that interacts with plants
- Different indexes (ratios of energy in different wavelengths: NDVI)
- Systematic measures every few meters
- Every few days/weeks for mid resolution, every day for low resolution

Reflectance

Solar spectrum wavelengths

“Healthy” vegetation

Stressed, dry or mature vegetation

NDVI > NDVI

Reflectance
What changed?

More precise (Human eye vs. digital maps)
Better calibrated (Digital processing and change detection vs. human eye)
Better frequency (real vs. tasked, guarantee and monitoring):
  • First uses were for monitoring with AVHRR then Vegetation/ProbaV and Modis
  • 10 days updates vs. 7 days
  • For mid resolution… more satellites
Central download/depositories and easy / fast cloud access for scalability
More easily available (on the shelf vs. project based and open to less specialized companies)

Pricing

Convergence of technologies:
  • GIS ubiquitous, cost of storage and processing

Google maps
New needs

More information needed to bridge the gap between genetics potential and average yield.

1960-1995:
1.5+bu/yr

1995-2007:
+3.5 bu./yr.

Illinois Corn Yields, 1960-2030:

- Genetics
- Biotech

Insights

Source: Dr. Fred Below, University of Illinois
Technology meets the needs?

More information needed / bridge the gap between genetics potential and average yield

More local and precise / at least zones inside the fields even if not per pixel

Need to monitor the investment to act as soon as necessary:
  • Monitoring is “observe and check the progress or quality of something over a period of time; keep under systematic review”
  • Daily, “real-time”, comparison to detect problems

Scale of needs and images availability allowed to move from projects to on-the-shelf products

Big Data talks together with ML/AI made RS images accepted as core data source and hope/promise of extracting all that is needed

Drones promises and deceptions brought back to fundamentals
Leading movers

Governments and international organizations moved in the 1990’s

Businesses who work on commodities markets and manage risks related to crop conditions moved in the 2000’s

Other agribusinesses moved in the 2010’s

WinField United was first at scale mover
WinField United R7

WinField United did the first real strategic move to use remote sensing as part of its core business
WinField United is part of Land O’Lakes, a farmer’s owned cooperative
We operate in four diversified agribusinesses, driven by insights and innovation

Crop Inputs & Insights
Agricultural products, data, technology tools and services

Animal Nutrition
Solutions that enhance performance and well-being

Dairy Foods
Milk-based products and ingredients

Sustainability
Environmental sustainability solutions
We help independently owned and operated agricultural retailers by providing products, data, tools and services to help unlock the greatest potential of every acre. Through intelligent insights, we’re helping farmers responsibly produce more from each input to support our growing population.
1/2
the harvested acres in the United States
R7® TOOL HISTORY

2011
August: Web-based tool launched to retailers and co-ops
Sept-Dec: Seller training (3000+)

2013
September: iPad App released to retailers and co-ops

2013
Over 12.6 million acres mapped in the R7® Tool
WinField United R7

A tool to be used by all sales team
Help farmer select the best genetics
Capacity to develop the tool because of agronomic data and insights
Nationwide roll-out

It was about looking at the plants everywhere and all the time instead of trying to model it

Today it is:

• Field Monitoring Tool that uses daily imagery to benchmark fields and detect anomalies and define priorities
• R7 to zoom in each field with 10-30m resolution images and 18 images per growing season per field to map, define zones, define tissue and/or soil sampling, write prescription maps
Helping Growers with Key **In-Season** Decisions

- **Right Genetics @ Right Population**
- **In Season Crop Protection**
- **In Season Plant Nutrition**
- **In Season Adjustments**

**R7® Tool**

**R7® Field Monitoring**

**NutriSolutions®**

**R7® Field Forecasting**
The future
Exhaustive and scalable

A picture is worth a thousand words

Farm management systems and Agronomic decision support tools all (almost) have satellite image background.

From asking and waiting for actionable information from Remote Sensing specialists, to making it possible for anyone to extract its own information with some automatic processing.

Meaningful information is unique as it requires specific agronomic expertise and must be imbedded in operations and decision processes: agronomic value and solutions will stay local.

Satellite image acquisition and processing is the scalable and global part of the technologies for agriculture.

Professionals are getting used to satellite image information as baseline to analyze changes and potential anomalies.

The plants and the environment are complex, the imagery and satellite technologies are just complicated and a synthesis of environment interactions.

Speaking of IoT: plant is the best sensor of environment and it provides information everywhere through its interaction with light.

We will have guaranteed and secured access to on-the-shelf full detailed (a few meters resolution) maps of each and every field in the world every day or week (as we already have for 250 meters today).

Crop scouting will be made more efficient for all farmers in the world.
Thank you