Ag Outlook

February 2014

Vision For Data Driven U.S. Agriculture

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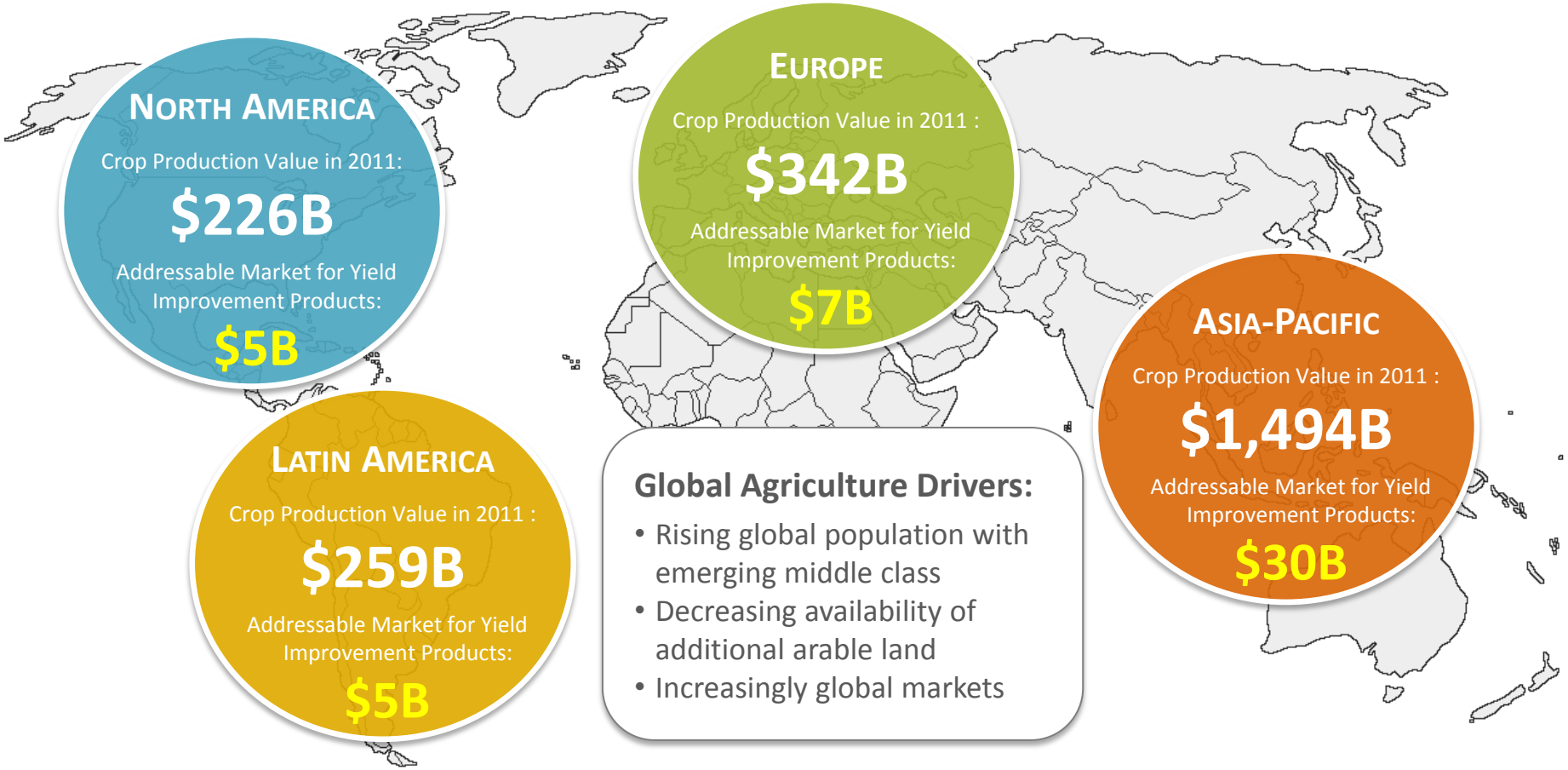
Agriculture must increase efficiency

Crop production must increase 100% by 2050 to feed growing world demand primarily by increasing yield per acre



Global Agriculture Drivers:

- Rising global population with emerging middle class
- Decreasing availability of additional arable land
- Increasingly global markets

Global Annual Market for Yield Improvement Products = $47B

(Source of crop production values = FAOSTAT; addressable market assumes 50% irrigated crop value, 20% yield improvement, 20% recoupment)

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…while carefully managing key crop inputs

Rising input costs including land, water, fertilizer, pesticides, herbicides and power

- USDA fertilizer price index increase from 108 in 2002 to 326 in 2012

Constant threat of catastrophic crop loss due to climate change, drought and disease/pests

- U.S. average of $27B per year in crop damage due to disease, weeds and pests

Water supply, management and quality issues

- Chronic over-irrigation Increases costs, harms soil health (rising salinity), impacts crop yield and accelerates ground-water pollution

Increasing regulation to control agricultural pollution in rivers, lakes and groundwater

- Probability of government imposed limits on nitrate application in California and other high pollution areas

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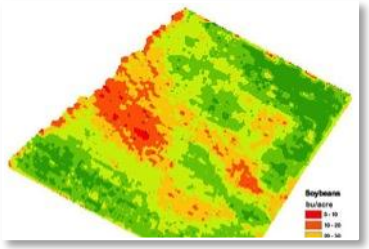
New technologies are having an impact

Genetically Modified Crops

Variable Rate Irrigation

Multispectral Imagery (satellite and aircraft)



Drip Irrigation

Precision Input Application (e.g., planting, fertilizer)

Wireless Soil Sensors

…but each provides only part of the solution.

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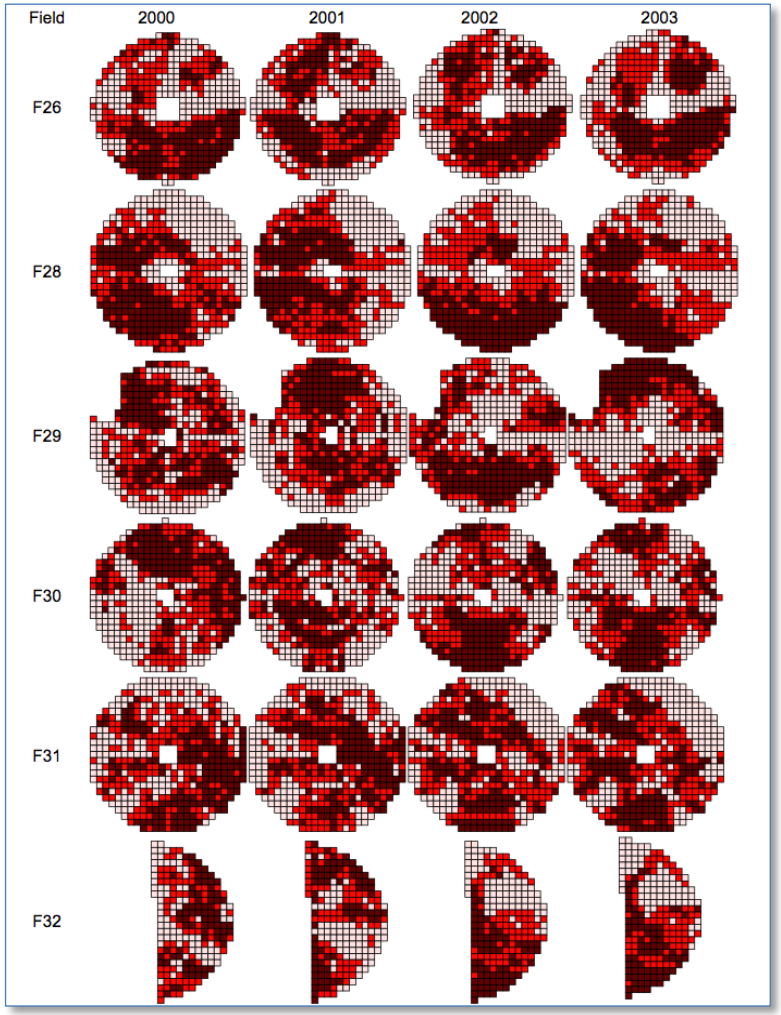
Precise high-resolution soil data is critical

Yield Variation in 6 Fields Over 4 Years (Cotton in Texas)



1 Pixel = 30m x 30m area; total field = 120 acres; dark red = highest yield
Source: Spatial and Temporal Variability in Cotton Field, Wenxuan Guo

- Crop yield can vary substantially within a field and from year-to-year due to many factors, e.g.,
- Conventional practices manage fields uniformly resulting in over- or under-application of inputs in specific locations within a field
- High resolution real-time field data is critical to increasing yield

Yield (kg/ha)

197 - 533
533 - 734
734 - 903
903 - 1076
1076 - 1515

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California Central Valley Case Example

$2800: Market value of crop products per acre

$140: Fertilizer cost per acre plus pending nitrate regulation cap

$70: Energy usage per acre-foot in California

$175+: Water cost per acre-foot

$0.17-$0.41: Cost of energy per kWh for PG&E farmer

30%+: Percentage less water farmers are getting because of low rainfall this season

High crop values with intense pressure to improve yield, control input costs and address regulations drives adoption

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Precision Field Monitoring

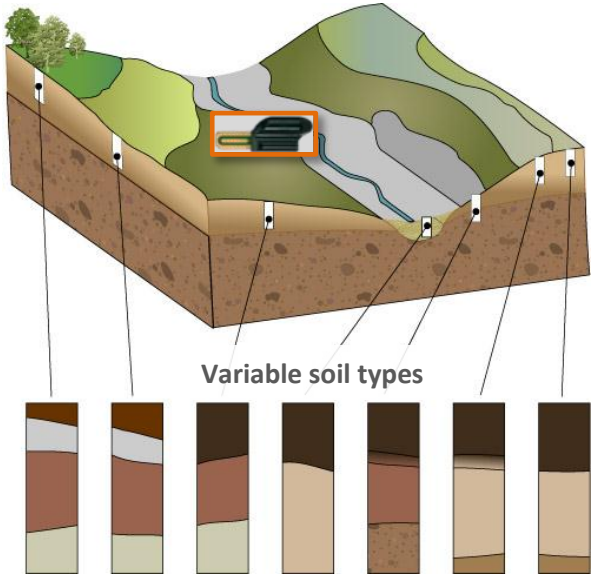
Current practice:

- ET estimates, visual condition of crop and feel of soil to determine irrigation application
- 1 Sensor per field used in small percentage of farms..

Data Collection Solution:

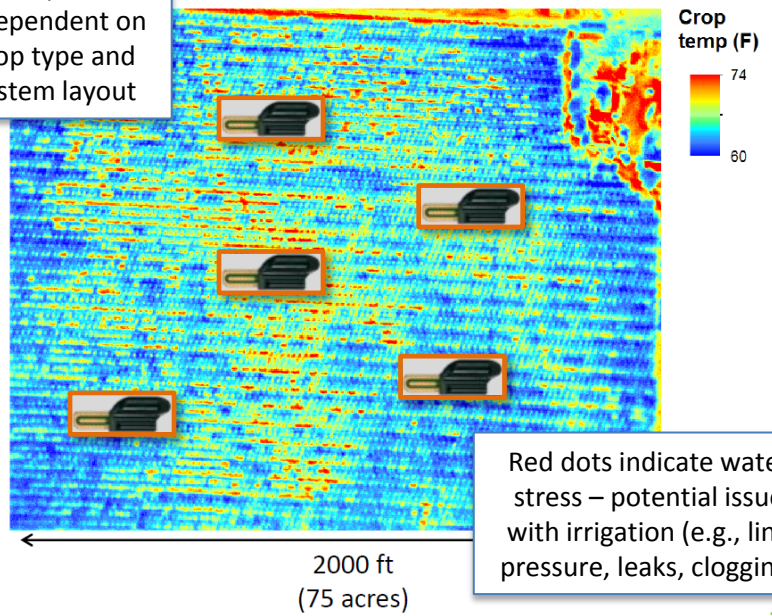
- High density of low cost and low power wireless sensors
- Combined with low cost imaging information

1 sensor per field (80-200 acres)



4-6 sensors per field

Sensor density and placement dependent on soil type; crop type and irrigation system layout



Red dots indicate water stress – potential issue with irrigation (e.g., line pressure, leaks, clogging)

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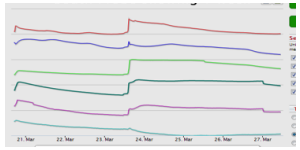
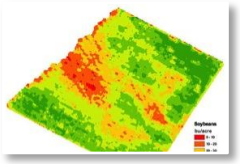
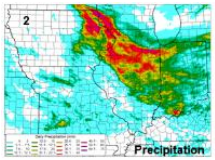
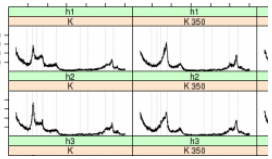
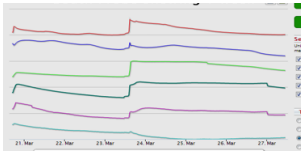
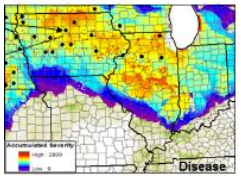
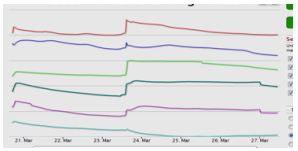
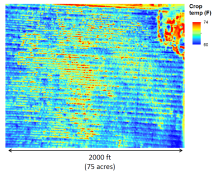
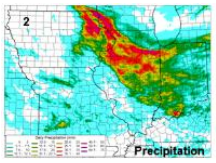
Resulting in actionable information

Measurement & Analysis Examples	Action	Result
IrrigationVu (irrigation scheduler) Soil Moisture & Salinity  Plant Imagery  Weather Prediction 	• Precise application of water for each zone	• Increase yield • Reduce inputs • Improve irrigation system performance
PestVu (pesticide/herbicide scheduler) Soil Temperature  Soil Moisture  Regional Pest Maps 	• Timing and type of herbicide/pesticide application	• Optimize timing of chemical applications • Reduce input costs • Reduce risk of crop loss
NutrientVu (fertilizer scheduler and compliance tool) Soil Moisture  Plant Imagery  Weather Prediction 	• Apply when root moisture indicates optimal absorption • Vary rate by management zone	• Increase crop yield • Reduce waste • Less environmental impact

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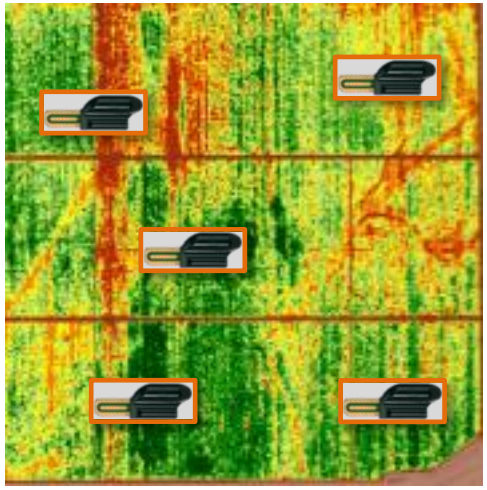
Case Study: Family Owned Farm



Background:

- 20,000 acre family owned farm in Central Valley of California
- High value crops (almonds, pistachios, tomatoes) up to $6,000/acre
- 50% reduction in water availability
- High efficiency drip irrigation system installed
- High electric costs from deep well water extraction
- Increased soil salinity impacting plant health

Solution:

- Soil and Irrigation Scheduling: Sensing locations every 20 acres
- Image Analysis: Approximately 12 multispectral images per field

Net Economic Impact: *(based on 20K acre deployment)*

- Avg. input cost reduction over 5 years of 9.7% per year
  - ($900K per year or $45/acre)
- Avg. crop yield improvement over 5 years of 8.8% per year
  - ($4.7M per year or $250/acre)

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Community Economic Impact At Scale

Empower farmer with better data on yield, planting decisions, water, fertilizer, and energy savings opportunities

Deliver tools to enable immediate and predictive decision making

Community benefits for water resources, new jobs, and environment

$945 million

Net Present Value of potential economic value to farmers unlocked through roll out of system in San Joaquin Valley alone

* Assumes 10 year NPV, 30% market penetration of all farms in SJV

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