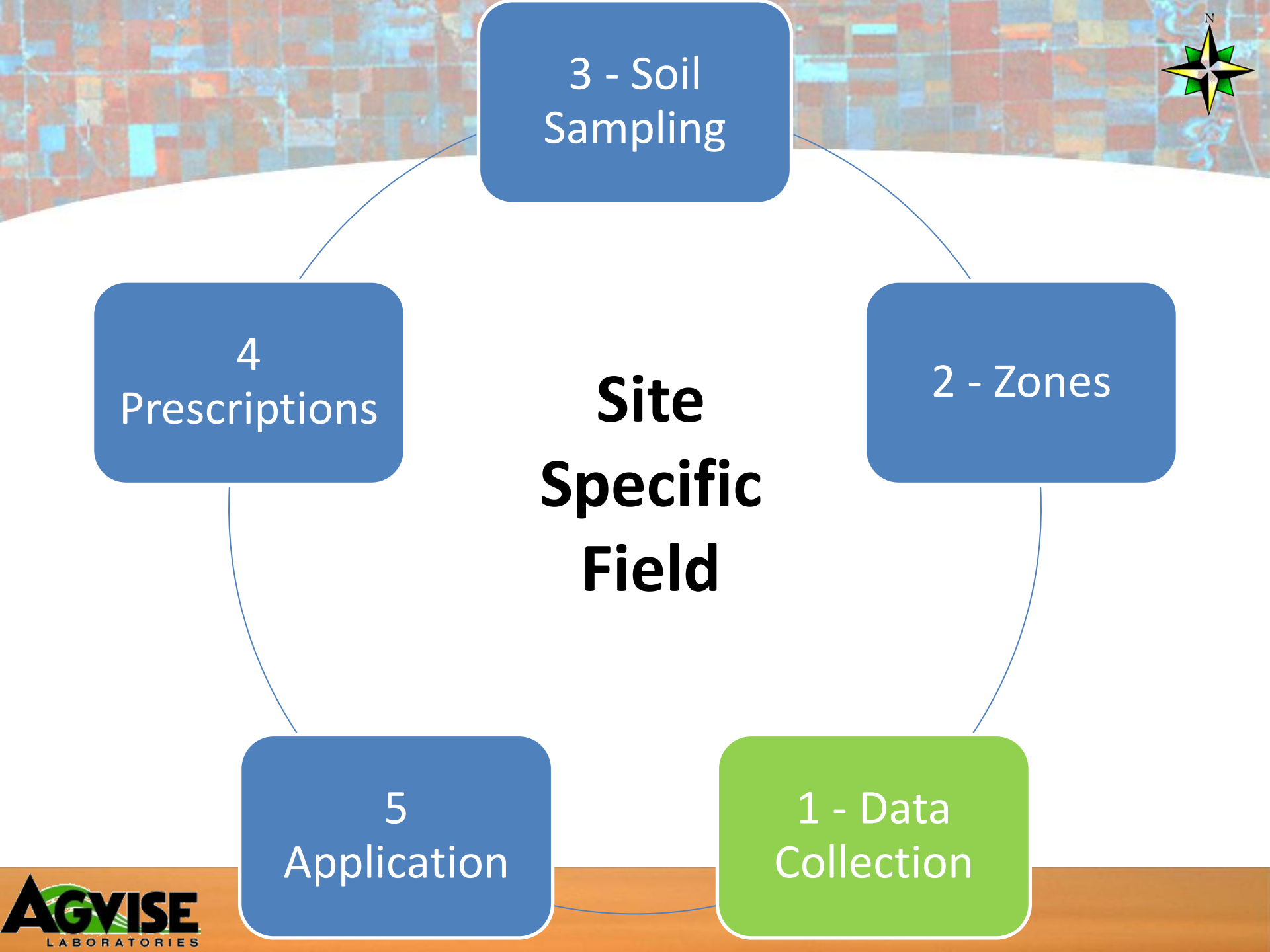
2009 Site Specific Agriculture Update

AGVISE LABORATORIES

Darin Johnson **Kelly Sharpe**


3 - Soil Sampling
2 - Zones
1 - Data Collection
5 Application
4 Prescriptions
Site Specific Field
N
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Data Collection – Data Sources

- Crop Yield
- Satellite / Aerial Imagery
- Soil EC (Electrical Conductivity)
- Topography
- Crop Quality
- Soil Type
- Soil Permeability (compaction)
- On the go Sensing

Data Collection – Satellite Imagery

Source	Resolutions	Orbit	Raw Image Cost
Ikonos	½ to 1 meter	Tasked	$2,200/Township
QuickBird	½ to 1 meter	Tasked	$2,200/Township
Rapid Eye	**5 meter**	**Tasked**	**$ Don't know**
EROS	1.8 meter	Tasked	$ Don't know
Spot-5	5 to 10 meter	Tasked	$430/Township
Spot	20 meter	Tasked	$70/Township
IRS LISS	20 meter (5 m opt.)	24 day	$ Don't know
AgCam	**20 meter**	**Nonsync**	**$ Don't Know**
Terra (Aster)	15 meter	16 day	$4/Twp - Free
Landsat 5	30 meter	16 day	$2/Twp - Free
Landsat 7	30 meter	(2000 – 03)Dead	$ Free

Data Collection - Rapid Eye

- Launched Aug 28, 2008
- Rapid Eye constellation (5 satellites)
- First commercial satellite constellation worldwide
- Supplying 5 meter resolution
- Able to collect 4 million sq kilometers per day

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No Muddy Boots Allowed

The five RapidEye satellites in a clean room waiting for launch.

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Data Collection – Aero Cam

- Aerial Imagery
- Available upon request (request by April 15)
- ½ meter to 2 meter resolution
- Cost Free (first come)
- www.umac.org

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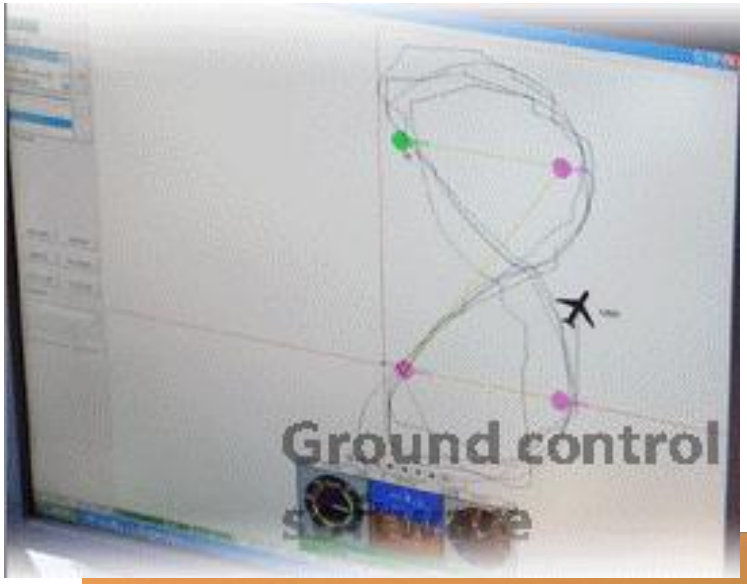
Data Collection – Unmanned Aerial Imagery

- ½ meter to 2 meter imagery
- Purchase the plane & fly anytime
- Preplan flight
  - plane will fly the pattern
  - land where it started
- Plane flies using GPS
- Produces geo-referenced .tif files
- Not aware of any local suppliers of this service.?.
- Expensive initial setup (Plane/Cam/Software)
- www.cropcam.com



CropCam

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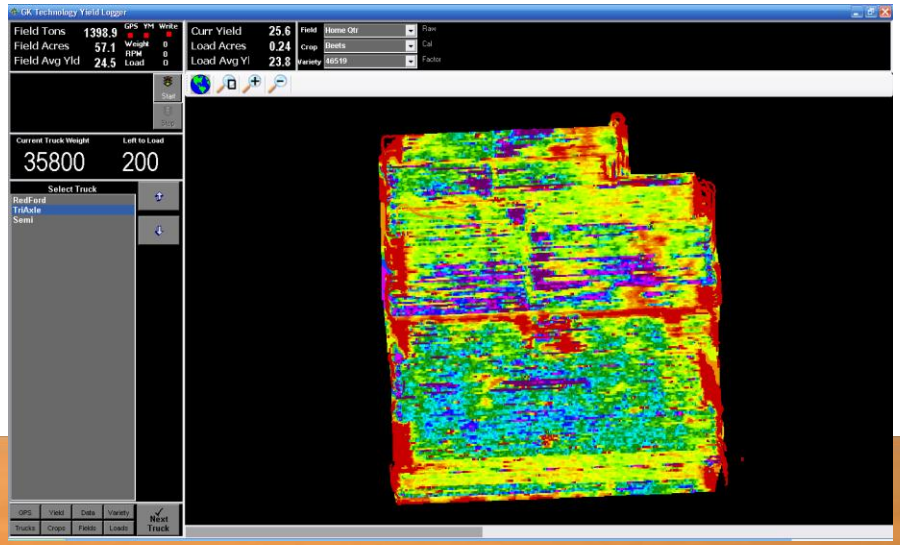
Data Collection – Yield Mapping

- Yield & Moisture Mapping for Grain Combines
  - Agleader www.agleader.com
  - CNH www.cnh.com
  - John Deere www.deere.com
  - Agco www.fieldstar.agcocorp.com
  - Cat/Lexion www.claas.com
- Yield Mapping for Sugarbeets/Potatoes/Edible Bean Harvesters
  - KB Manufacturing & GK Technology Inc.
    - www.rrv.net/kbmfg
    - www.geektechforag.com



Data Collection – Protein Sensor

- **Zeltex – AccuHarvest**
  Collects on the go
  - Protein
  - Oil Content
  - Moisture
- Processes 1 sample every 12 seconds.
- www.zeltex.com

Zeltex Inc.

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Data Collection – Australian Style

Figure 1. *The Multi-sensor platform at The University of Sydney. This system is capable of measuring EC_a at 0-30cm, 0-90cm and 30-90cm using the Veris 3100, EC_a to 1.5 m using the Geonics EM38 (vertical mode), EC_a to ~5m using the Geonics EM31, topsoil pH with the Veris pH sensor, elevation with the Omnistar Carrier-phase GPS and several regions of interest in the gamma radiometer spectra in one pass over the field.*

Dr James Taylor, *The Australian Centre for Precision Agriculture*

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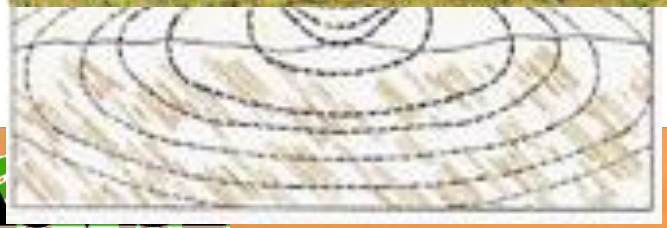
http://spaa.com.au/files/catalog/March%2008(On-the%20go%20soil%20surveying).pdf

Data Collection – Soil Properties

- **Soil EC 3150** – Maps soil electrical conductivity using small electrical currents between coulters.
- **pH Mapping** – While collecting EC data a small shoe goes into the soil processing pH samples (8 to 10 samples / acre)



Veris technologies

www.veristech.com

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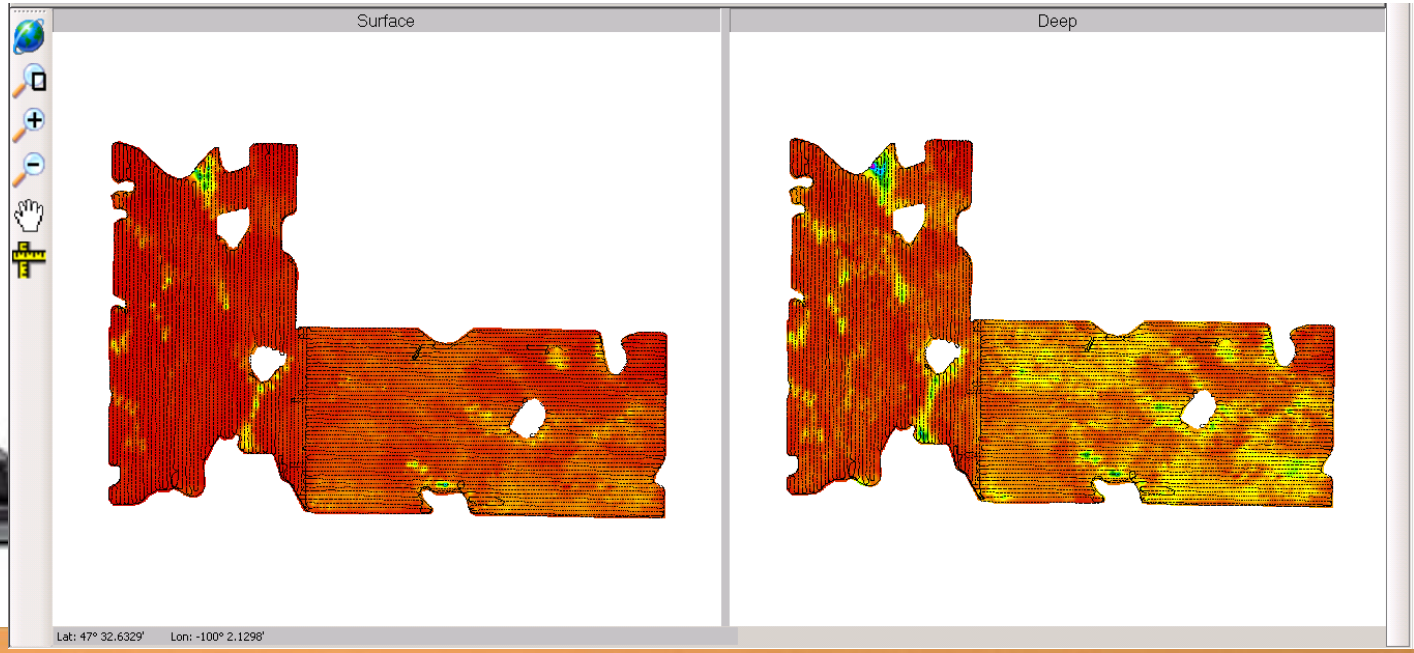
Data Collection – Veris Logging

- Produces an on the go COLOR Veris Log file
- Saves time (wiring / soil moisture problems)
- Requires a PC with 2 – 9 pin serial ports
- www.geektechforag.com



Data Collection – Soil Properties

- **EM38** – Maps soil conductivity using a electromagnetic inductive technique. No moving parts.
- www.geonics.com

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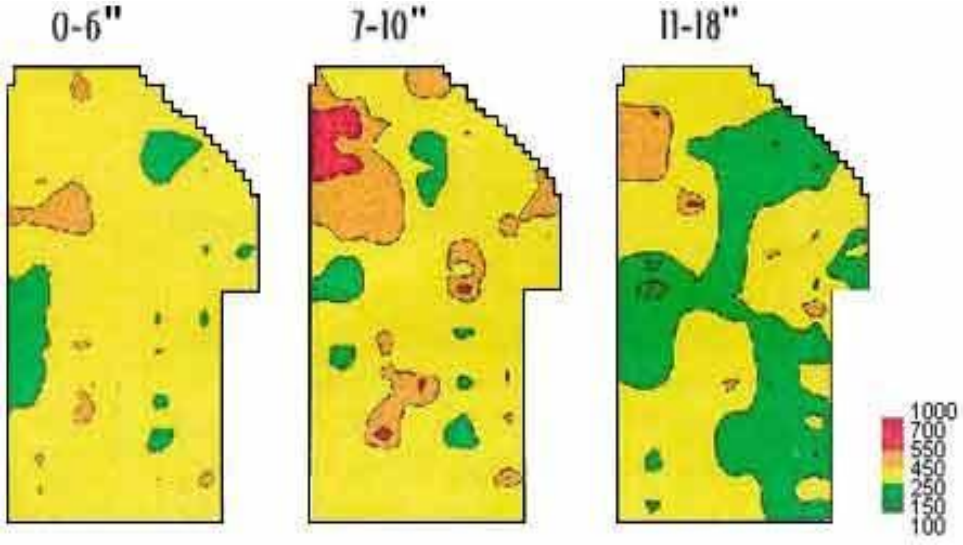
GEONICS LIMITED

Data Collection – Soil Penetrometer

- Compaction Detector
- Amity Technology
- Data collected on an iPaq
- Up to 120 probes / hour
- www.amitytech.com



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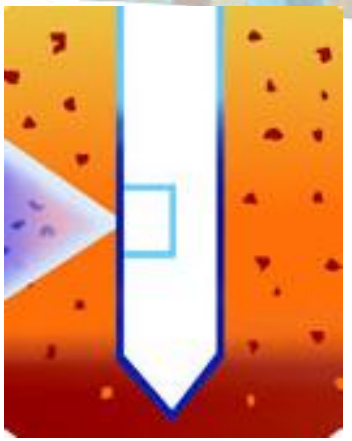
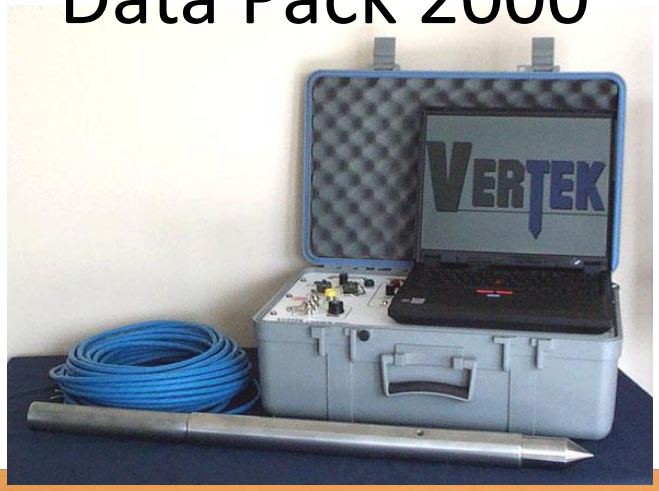
Amity TECHNOLOGY

Data Collection – Soil Properties

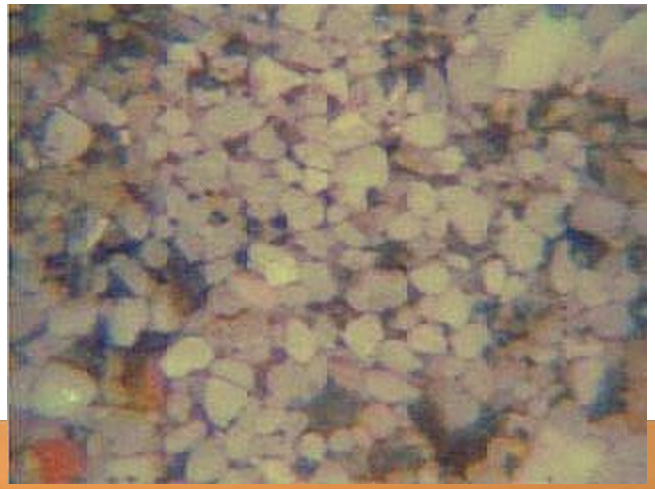
- Soil Penetrometer with Camera
  - Collect Soil Compaction Values
  - Capture pictures of the soil profile
  - Not a “soil sampling” probe
- www.vertek.ara.com



Data Pack 2000



Course Sand



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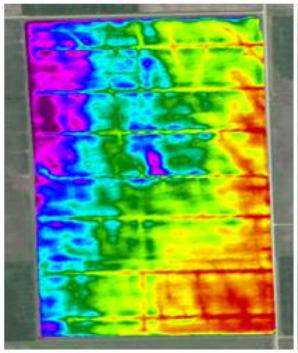
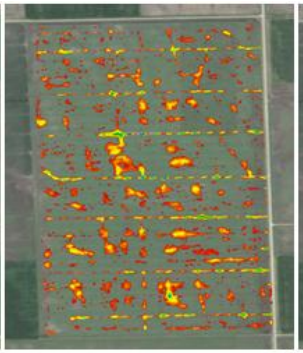
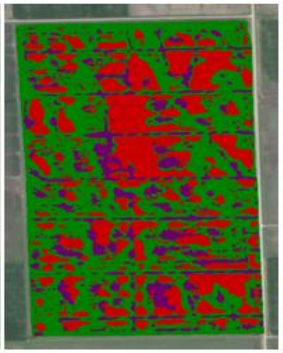
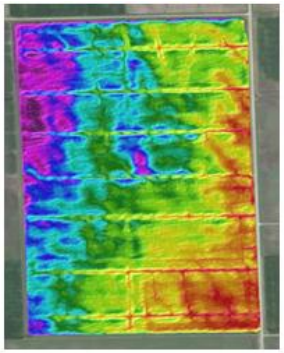
Data Collection - Topography

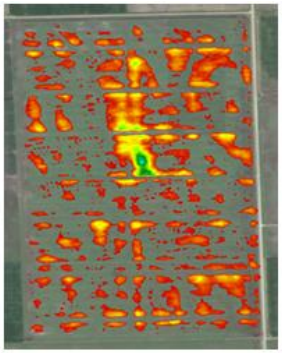
- Flat land – Need RTK for drainage
- Hills – High quality correction (not for drainage) (HP/XP/Omnistar/SF2)
- Most GPS systems collect quality data
- Most software will process topography data


Topography Image


Depressions


Topography Features


Topo & Slope Transparency


Areas Shedding Water


Watersheds & Flow Accumulations

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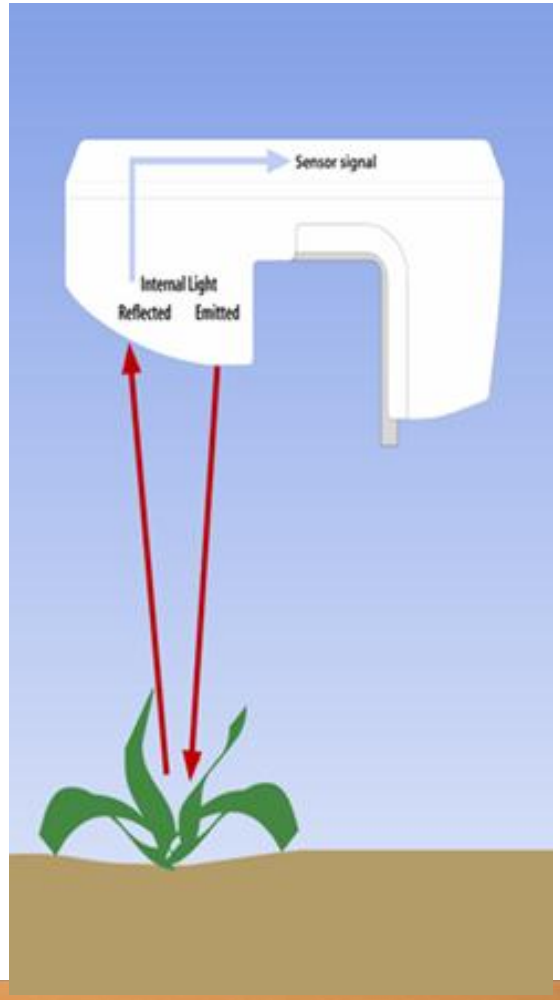
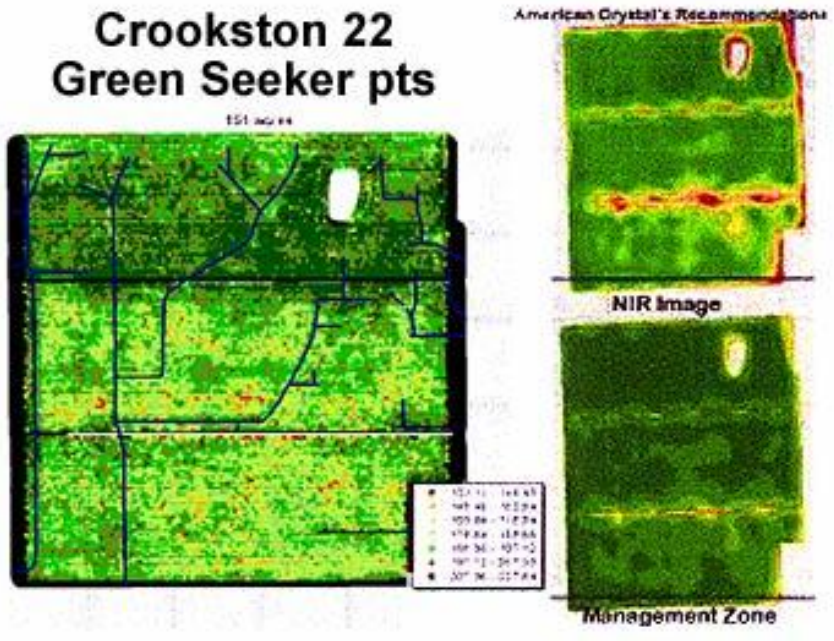
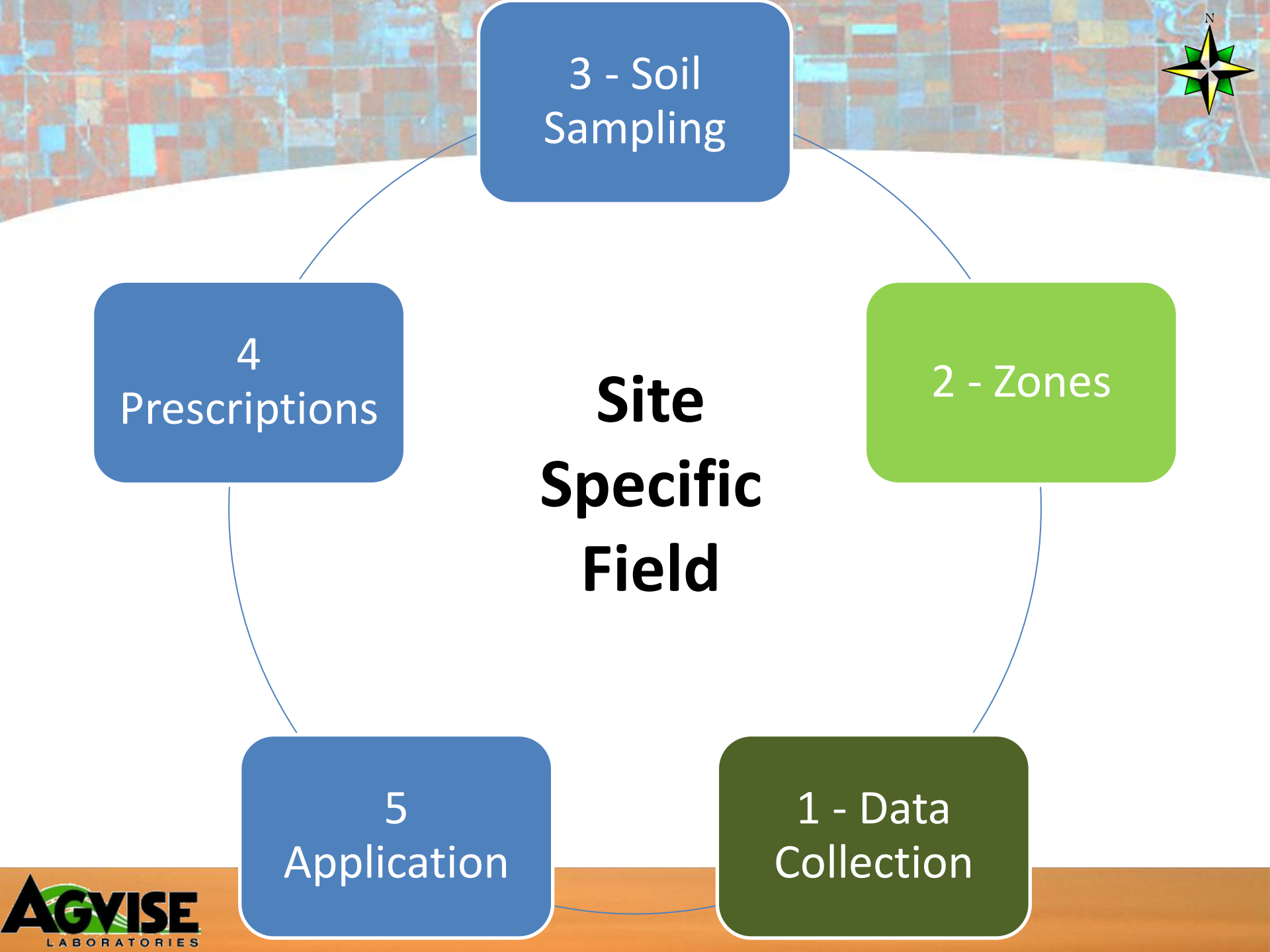
Data Collection – Green Seeker

- Real time vegetative index
- Collect data
- Real time Variable Rate
- 2010 RT Commander Pro
  - Delineated VR application
- www.ntechindustries.com



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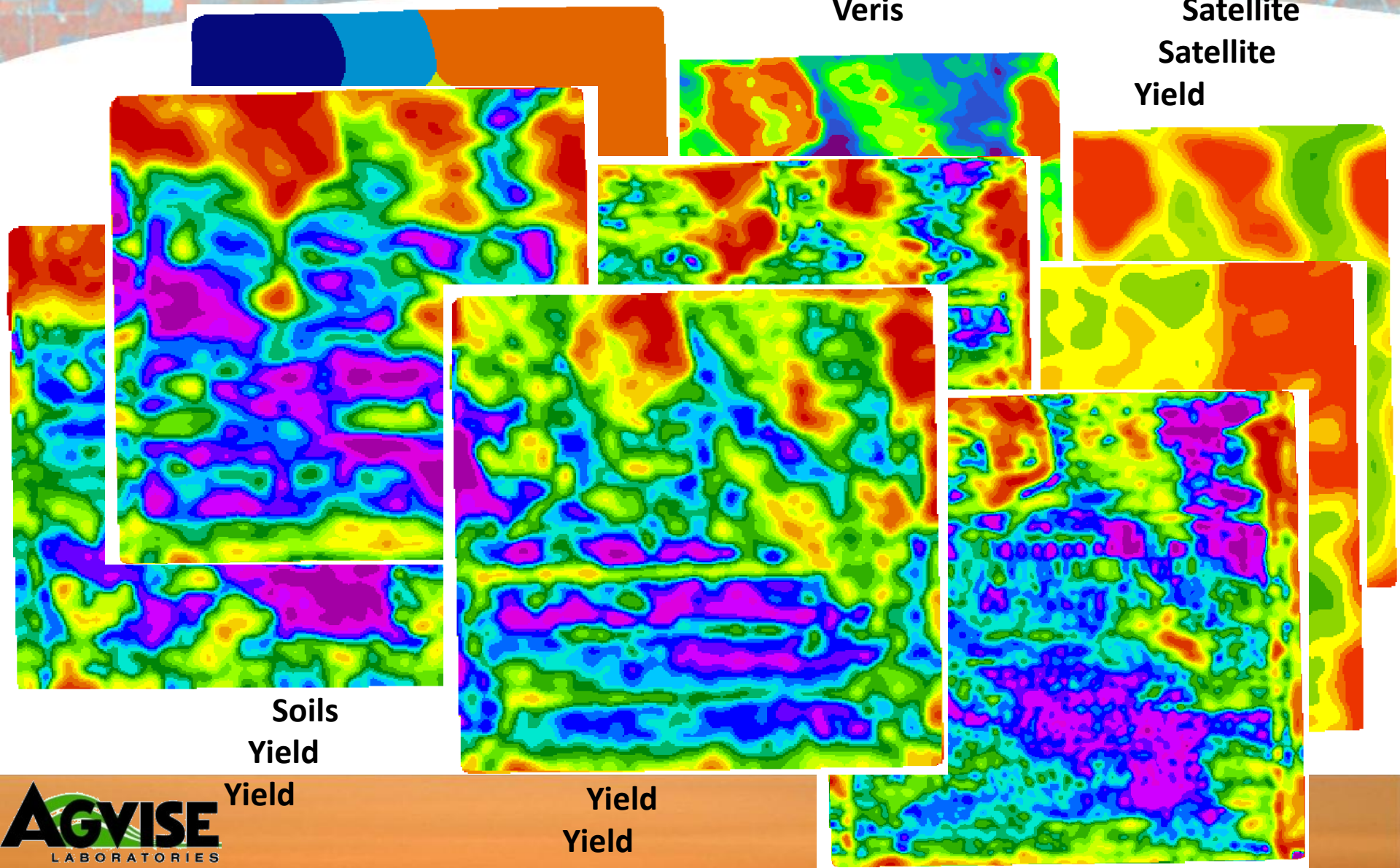
Site Specific Field

Zones – Converting Data to Zones

- What data to use?
  - Options - Imagery / Yield / Quality / EC / Compaction / Topography / Years
- Use 1 data source.
- Merge data.
- What layers can be merged?
- Grower input & Field knowledge!!

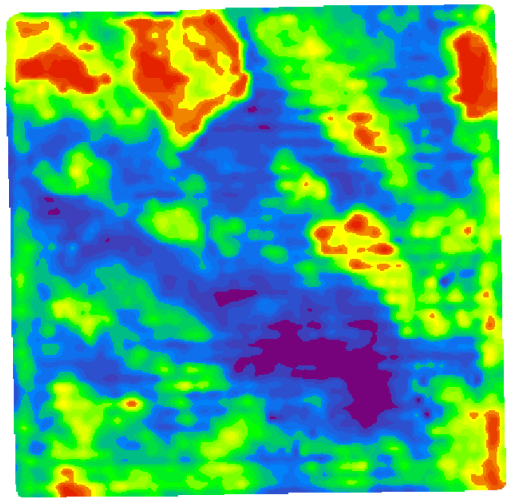
Zones - Single Data Source



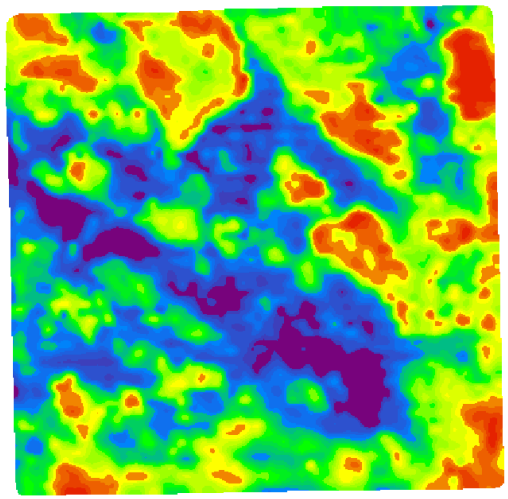
Zones – Multiple Map Merge

- Taking a look at components of Veris Data

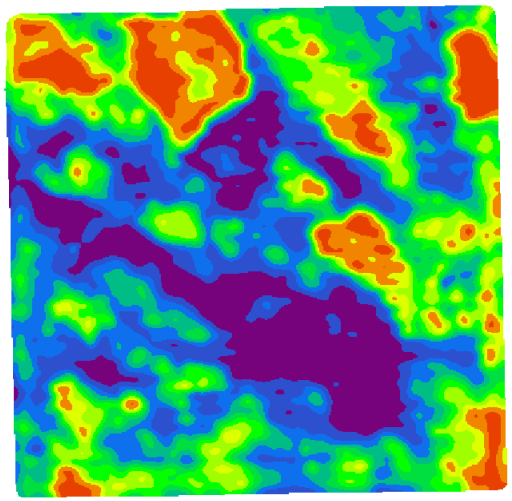
Surface Data + Deep Data = **Veris Merged**



0 - 12”

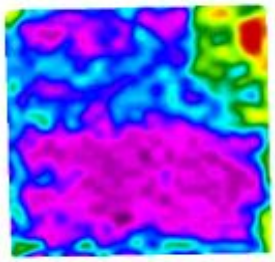


12”- 36”

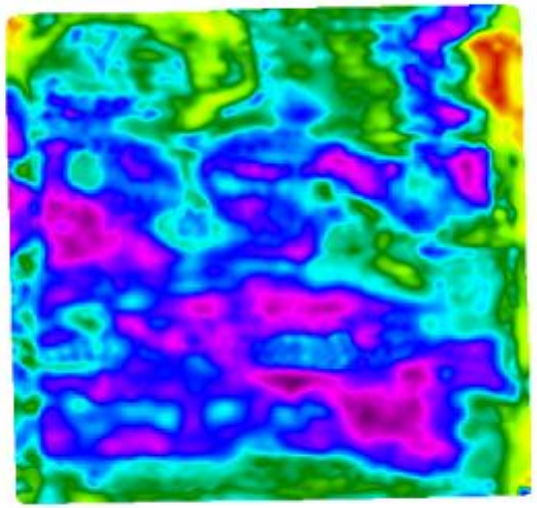


0 - 36”

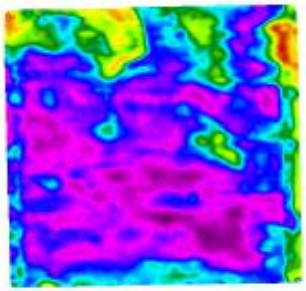
Input #1



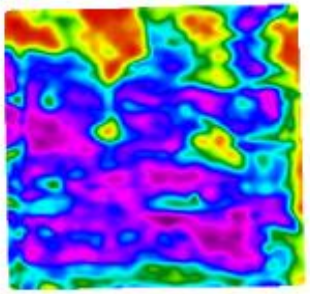
Maximum Productivity



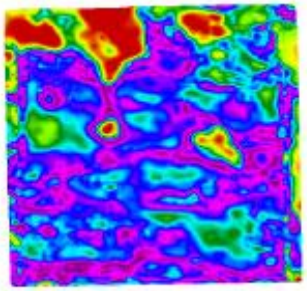
Average



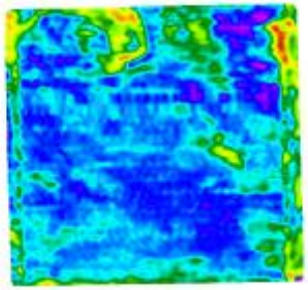
Input #2

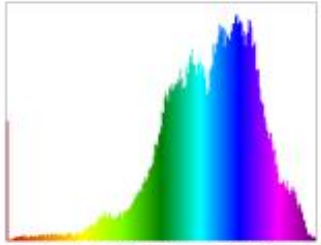


Confidence Map



Input #3





Grower Defined Settings:

Minimum Yield_____ Maximum Yield_____

Starter Fert_____ Zone Soil Test(Y/N)_____

Precision With 'Confidence'

Grower: Yield Freq
Field: Yield_Feq_Meeting

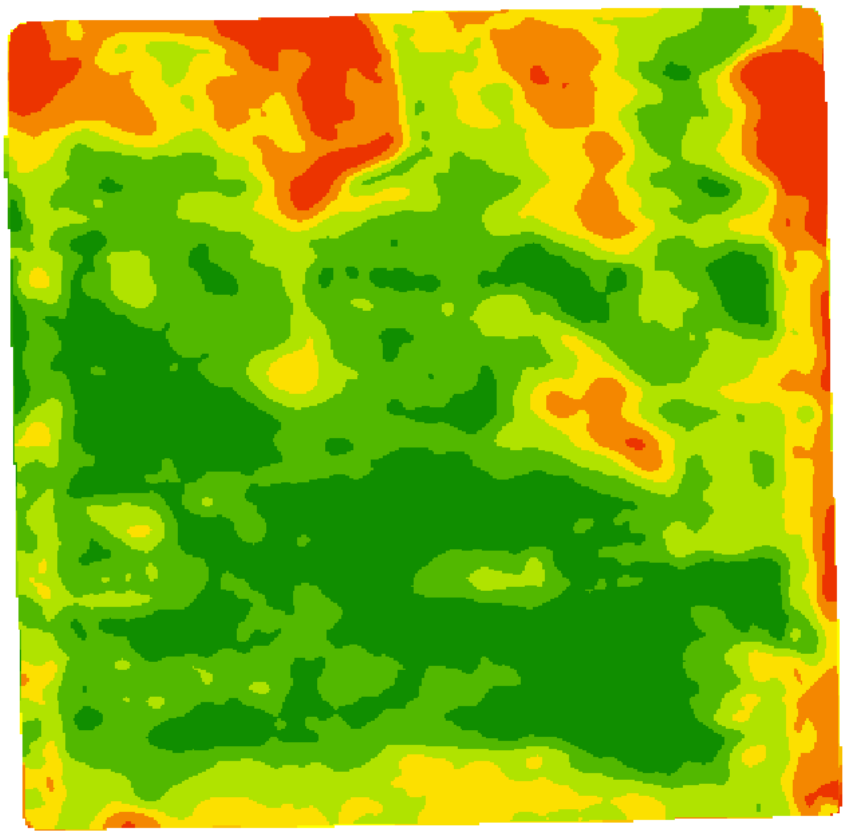
Build Settings:

Input 1: 2007_SEP05_NDVIR LT: 51.7 UT: 81.4
Input 2: 2004 Corn Yield LT: 11.1 UT: 133.1
Input 3: 2002-CornYield LT: 21.3 UT: 201.7

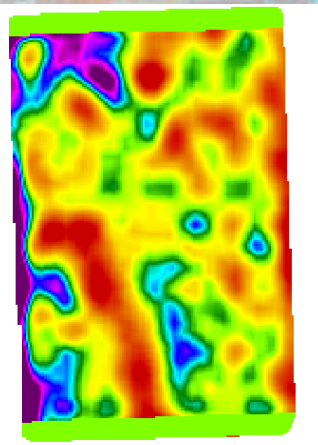
GK Technology For Agriculture

Zones – Field Ready

- Using “Avg Production” map converted to 5 Zones
- Confirm Zones grower
- Send Zones to sampler
- Know the formats your software handles !!!

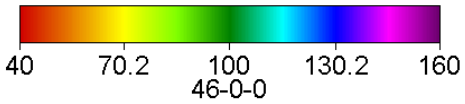


Zones – Specialty Areas

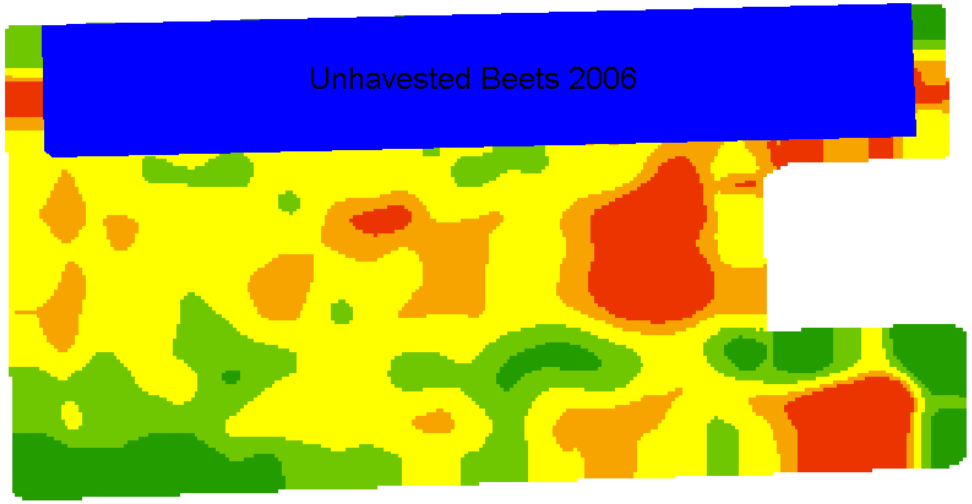


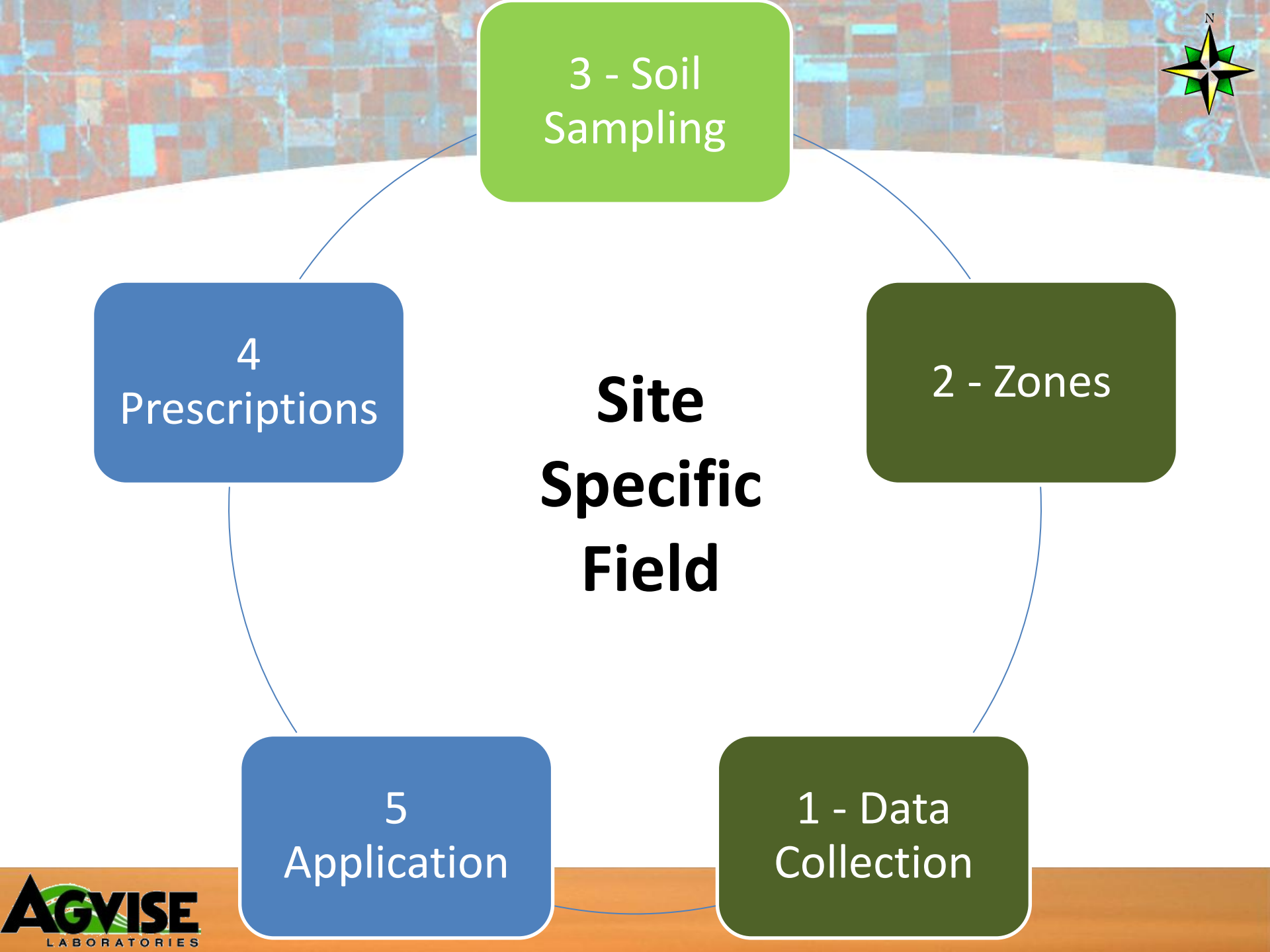
- Headlands
  - Reduced rates for fewer plants

    or crop rotation



- Areas where crop was left (destroyed beets)
  - Increased N rates year following
  - Increased organic matter as beets break down

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Soil Sampling – Zone Tools

- Going to the field with zones
- New Hardware & Prices

iPaq

Tablet PC

Touch Screen PC

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Soil Sampling – iPaq's

- Cheapest – Most rugged
- Screen Size 3.5"
- Best Fit ATV applications
- Hardware Cost Est. - $600 – 2,500
  - HP 2495
  - Ram Mount Cradle & Arm
  - Compact Flash GPS with WASS or
  - Garmin GPS with WA

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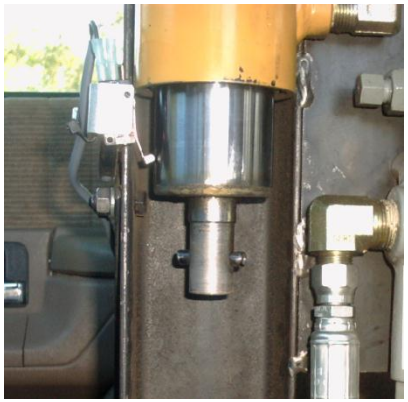
Soil Sampling – Tablet PC

- Least Rugged
- Screen Size 12.1”
- Best Fit Pickup Mount & mobile with USB GPS
- Hardware Cost est. $1,400-4,000
  - HP tx2000 series
  - RAM Mount Stand & Arm
  - GlobalSat USB GPS with WAAS

Soil Sampling – Touch Screen PC

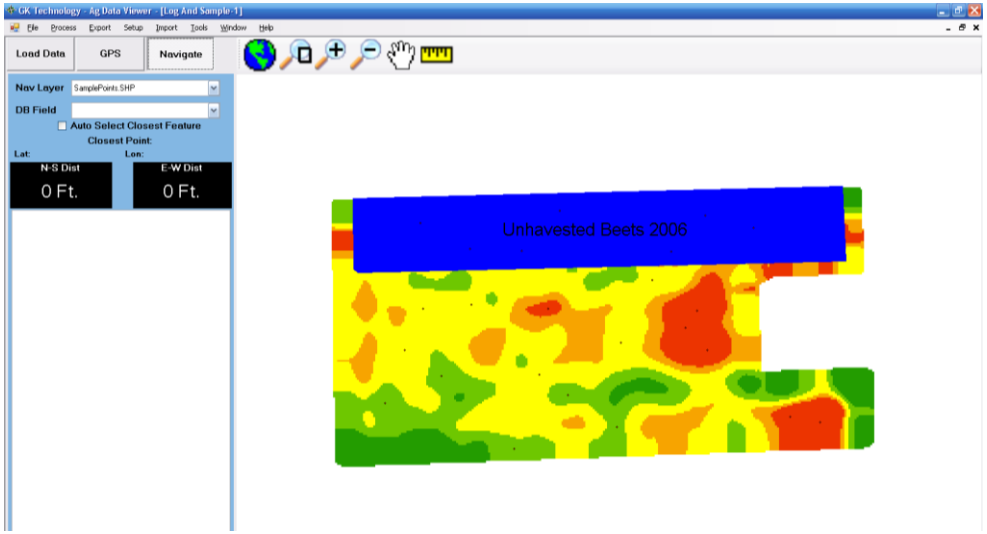
- Moderately Rugged
- Screen Size 12”
- Best Fit Pickup Mount
- Hardware Cost Est. $2,200-5,000
  - 12” Touch Screen PC
  - RAM Mount Arm
  - Garmin 5 mhz GSP / WA

Soil Sampling – Software Tools



- Automated Sample Point marking
- Navigate to Point –
  - Option in some software packages

www.geektechforag.com



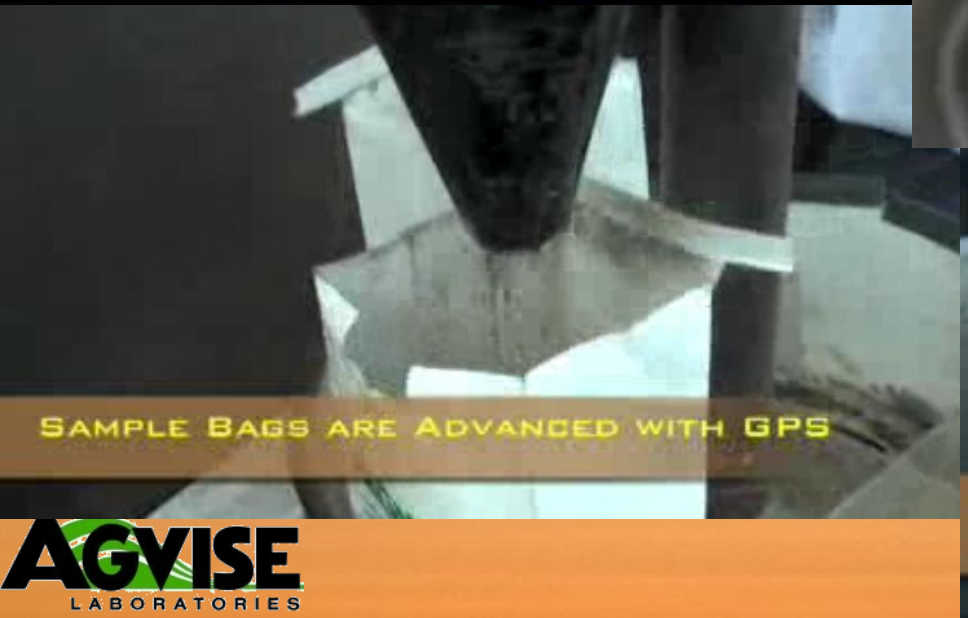
Soil Sampling – AutoProbe

- Soil sample 6” – 8” deep @ 5-8mph
- Pulling cores every 16.5’ (roughly 20 cores / 2.5ac grid)
- Vacuum system move soil to the cab – directly to the sample bag
- Automated label system
- Great for GRIDS
- www.agrobotics.com

AgRobotics
FARMING INNOVATIONS

AgVise Laboratories

Soil Sampling - AutoProbe



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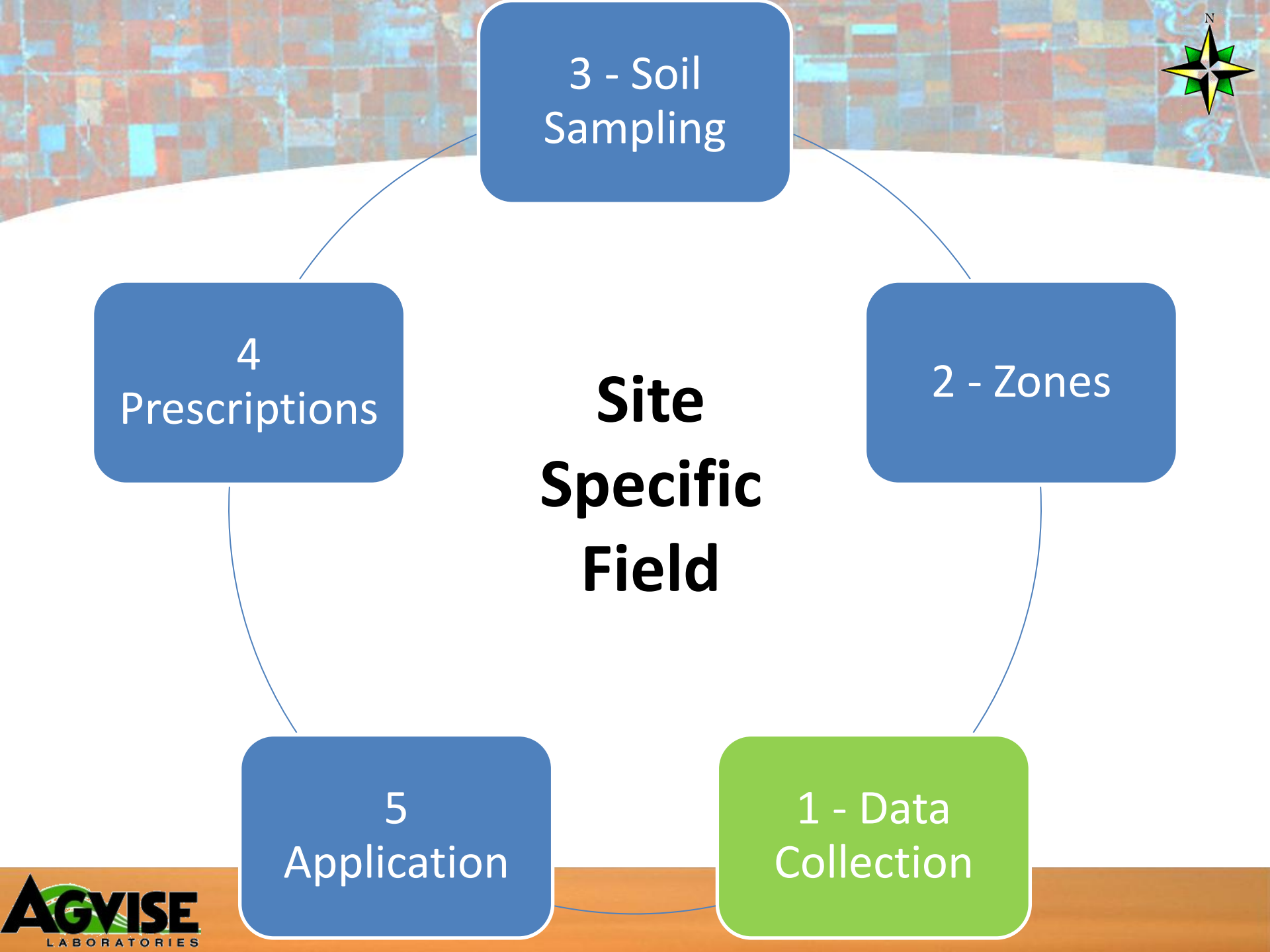
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Ag Cam

- UND Ag Cam on the International Space Station
  - What is it?
  - How will it work?
  - How do you participate

UMAC-NASA Ag Cam

- On Nov 14th 2008 a 8 year long project at UMAC took another step.
- A camera system designed and built by students was launched on the shuttle Endeavour.
- This system will be mounted in an ultra clear window on the Space Station.
- Imagery of the UMAC region will be collected, with that system starting this spring.

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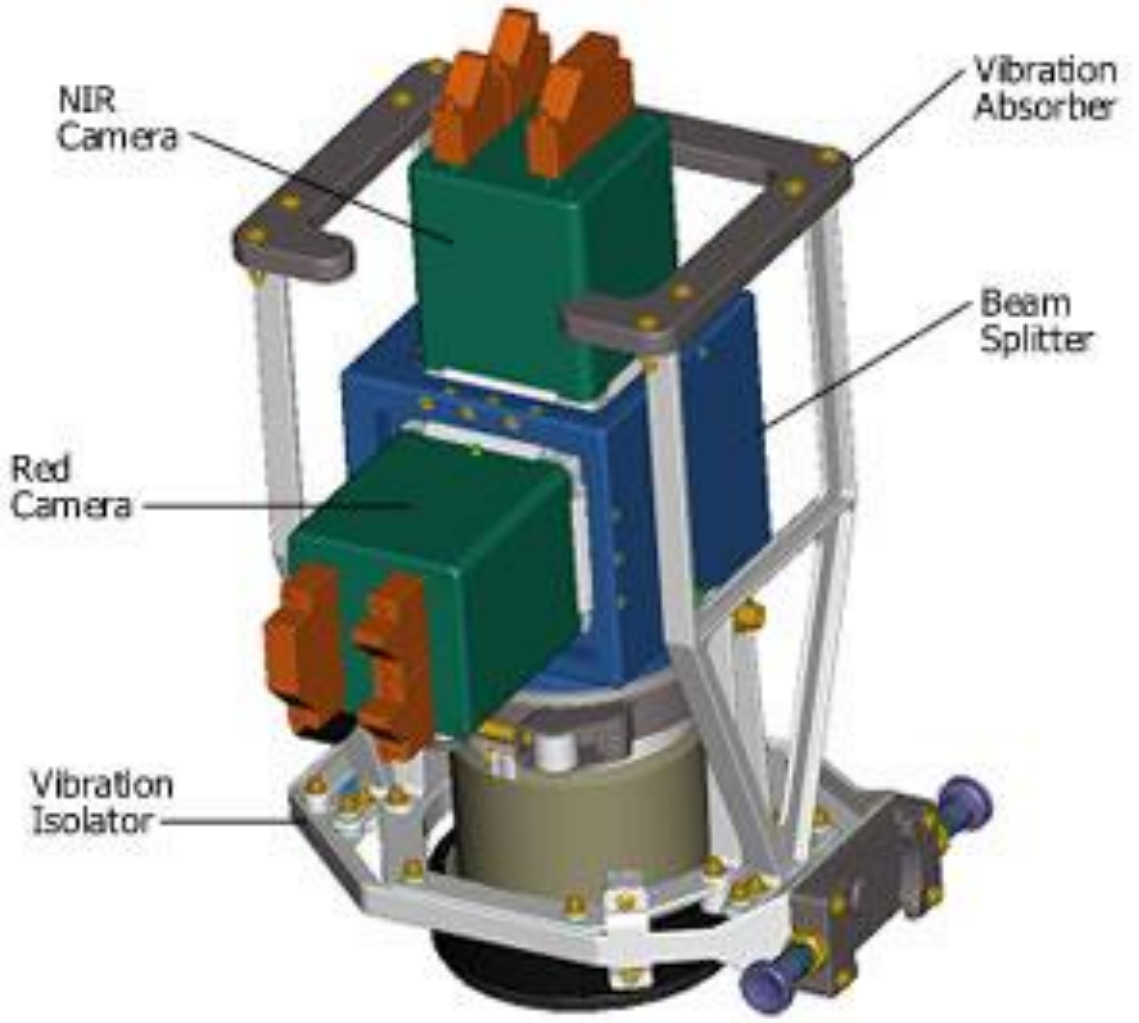
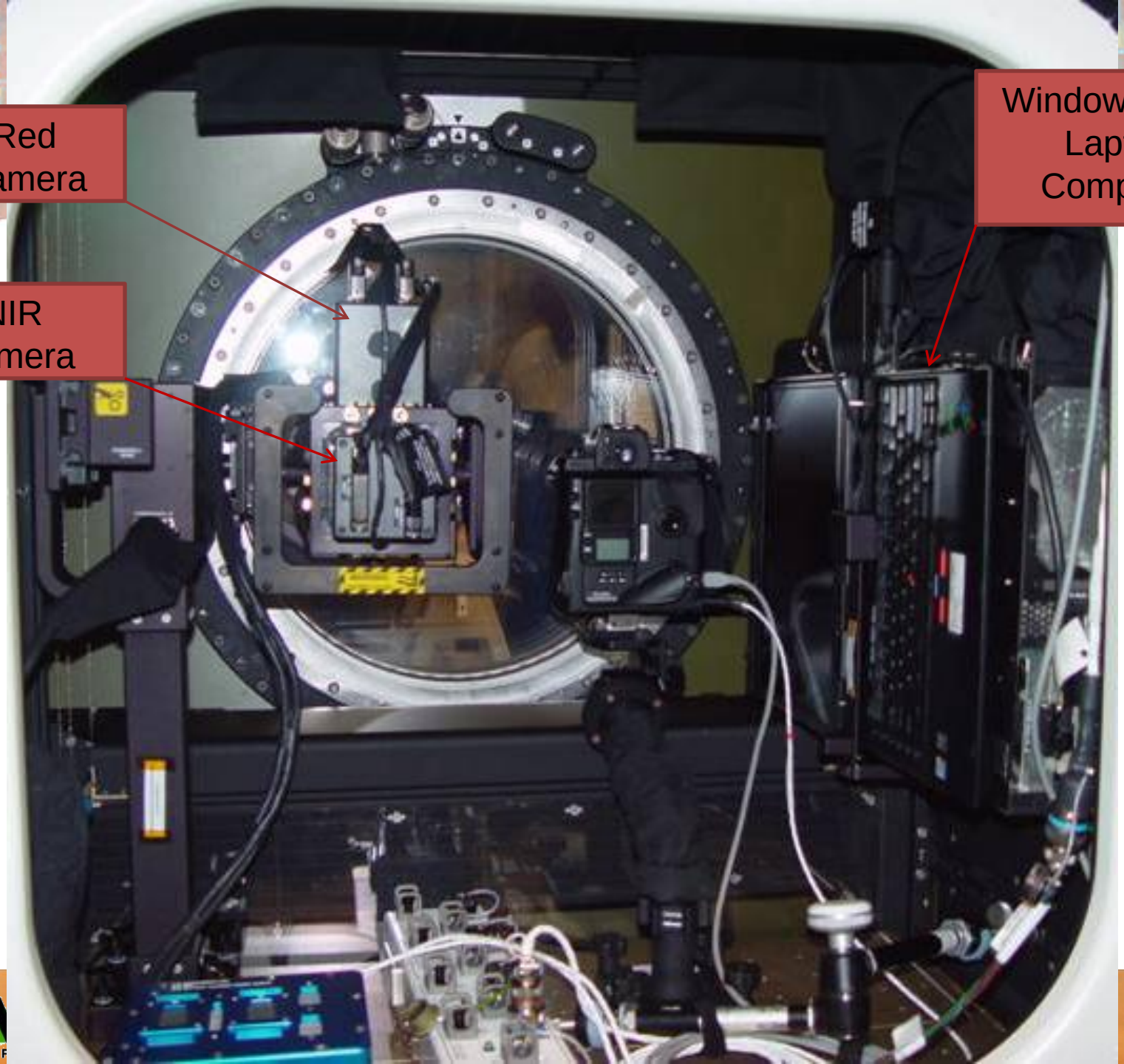
UND AgCam team
University of North Dakota

Ag Cam - Details

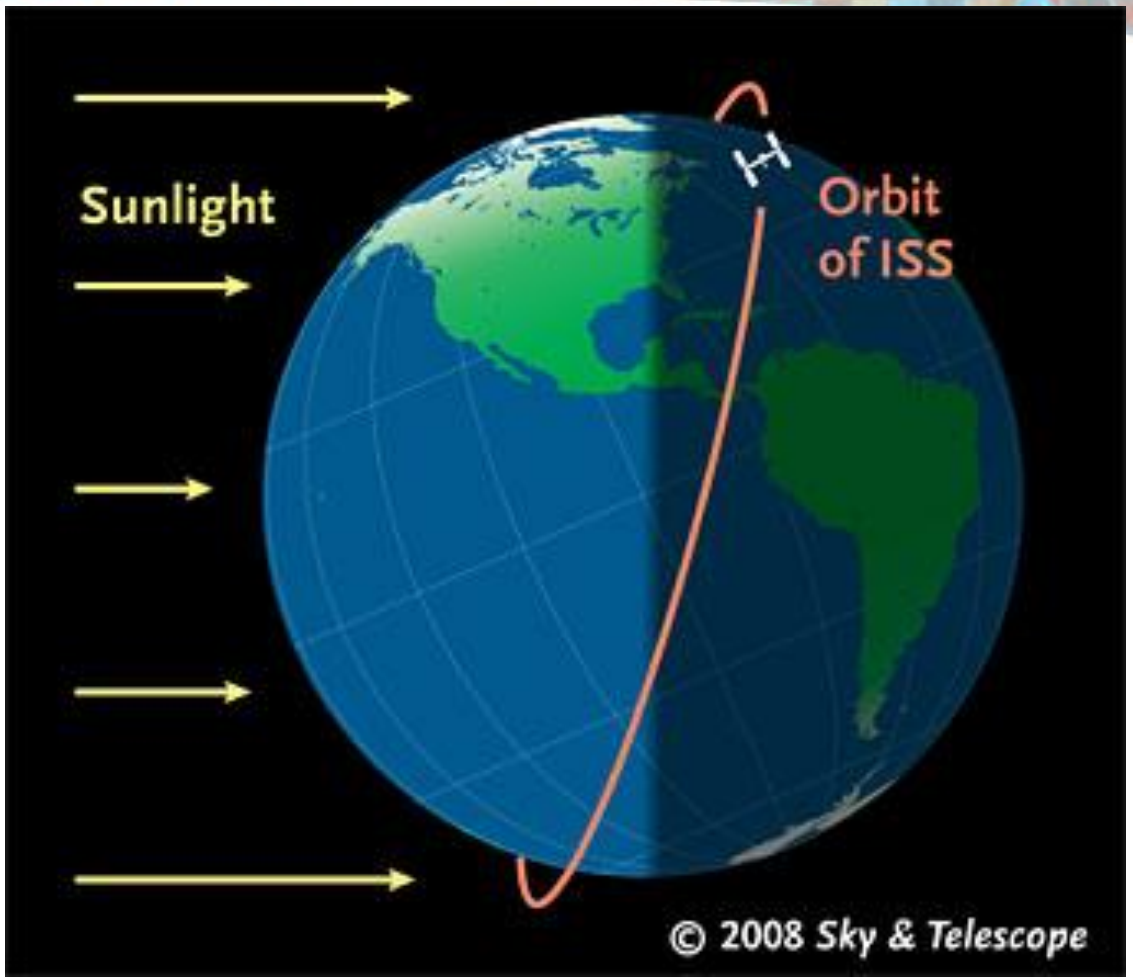
- 300 mm lens
- Into a Beam Splitter and Filters
- Dual Cameras
- One NIR band
- One Red band
- A laptop computer collects, stores, and transmits data to UND.



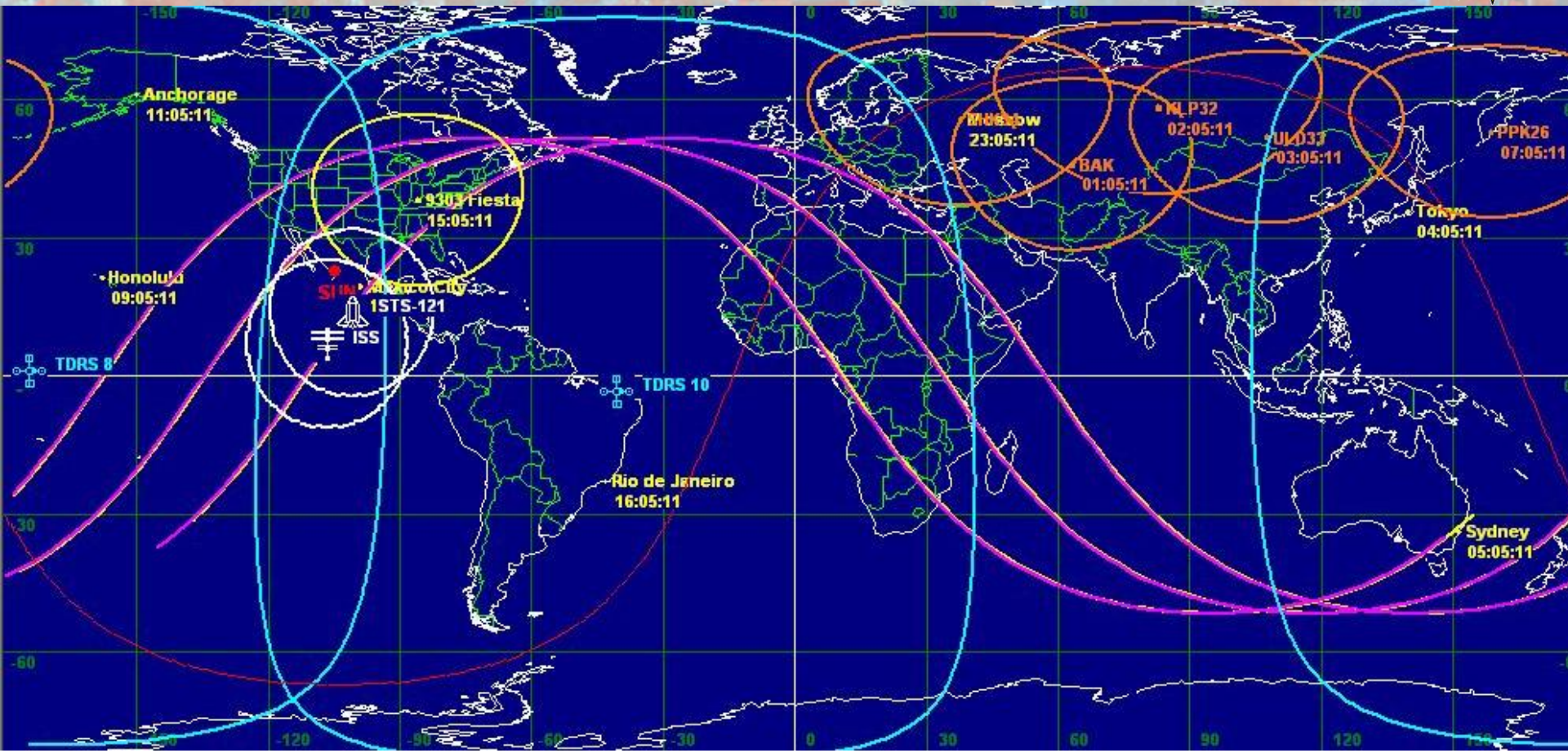

Red Camera
NIR Camera
Windows 2000 Laptop Computer

Space Station Orbit

- The orbit of the space station never passes over the poles.
- With this orbit the space station never passes above or below 52 deg Latitude.
- With each orbit the ground beneath the station moves by 22.5 degrees or about 1550 miles.



3 Passes of the Space Station



In the weird world of orbital mechanics the space station appears to “turn around” just north of us.

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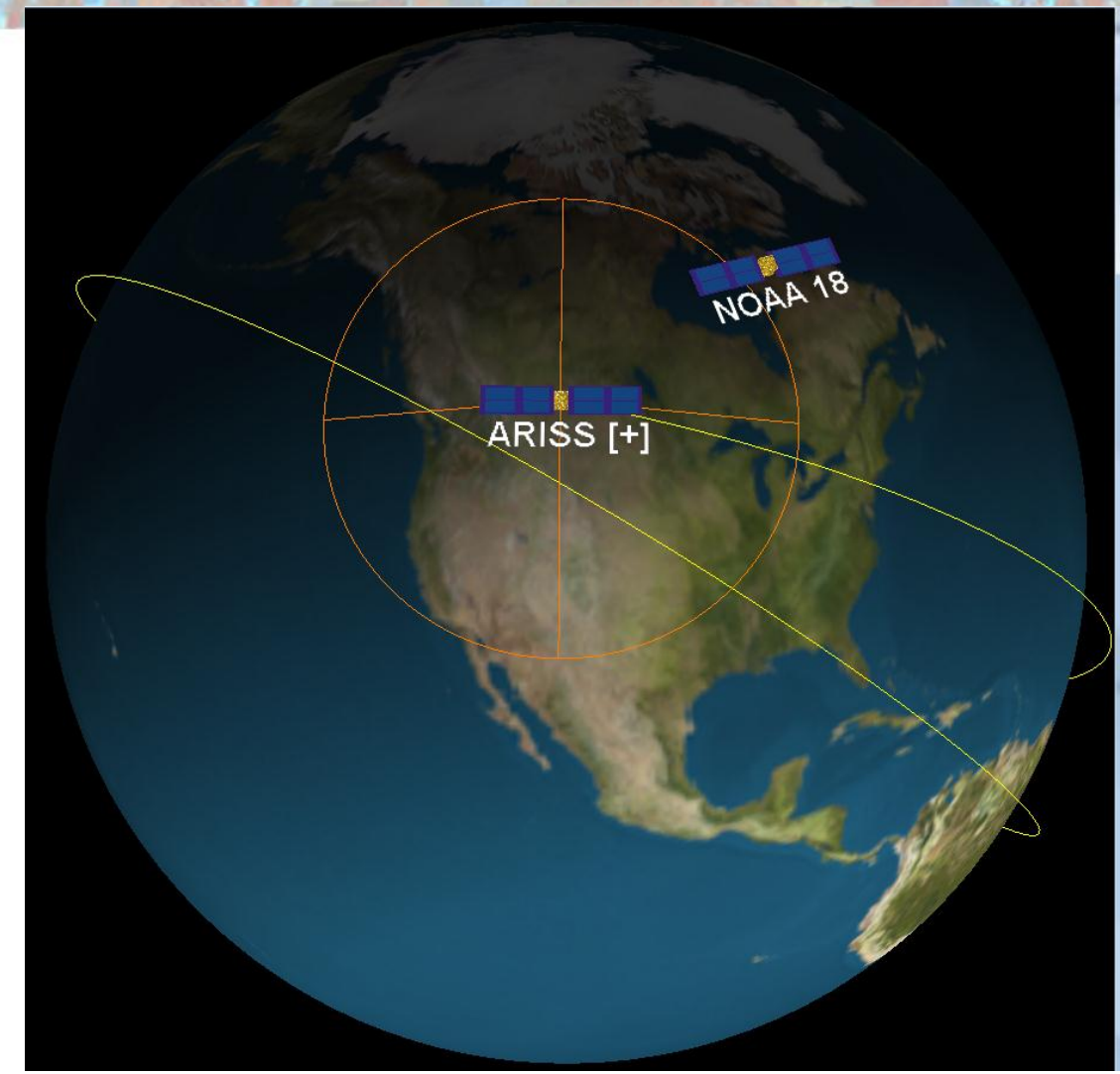
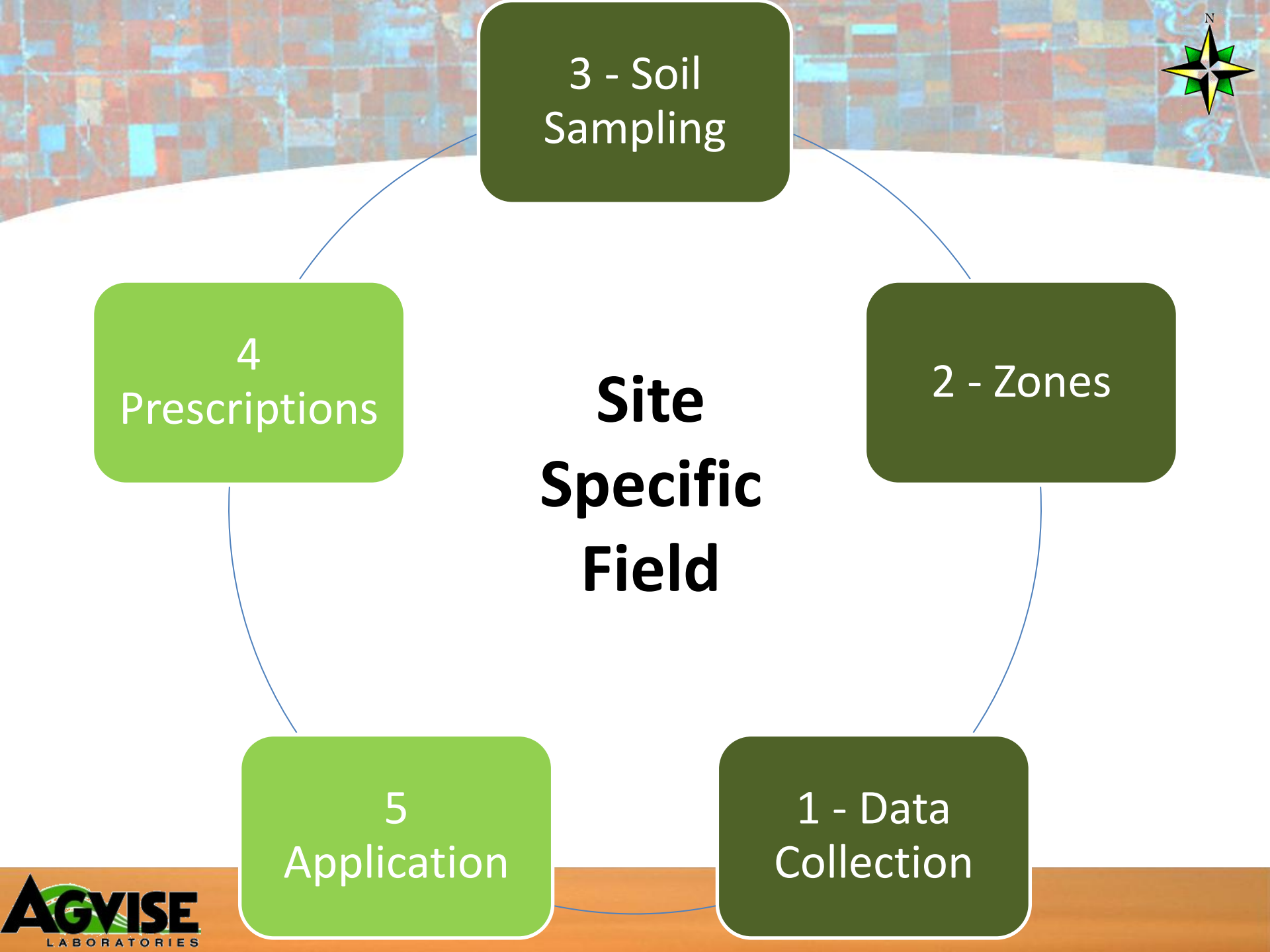
Tracking Packages

- Many applications available for tracking the ISS.
- I like one called Satscape.
- You can enter your Lat-Lon and have it posted on the 3D Globe.
- Allows for pass prediction dates and times.
- 2D, 3D and Tabular data output.
- Donation Ware



What can we expect from Ag Cam?

- Imagery is estimated to have a pixel ground resolution of about 20 Meters.
- 8 Bit data (0-255) for vegetative measurements.
- Projected swath width of 35 miles.
- Some of the data may be imaged at up to 35 degrees off center.
- May make geo-referencing more of a challenge.
- Since its orbit is not sun-synchronous, there may be periods of up to 3 weeks where every time the ISS passes over us, that it will be night time.


3 - Soil Sampling
2 - Zones
1 - Data Collection
5 Application
4 Prescriptions
Site Specific Field

ISOBUS

- ISOBUS
  - What is it?
  - How does it affect precision providers

Site Specific Agriculture Delivery

- What is one of our biggest challenges?
  - Creating Prescriptions for many different manufacturers controllers.
  - Did they learn anything from 30 years of different hydraulic tips.
  - Looks like they might have.
  - All major manufacturers are involved with a standard known as the North American ISOBUS.

The Dream Scenario

Hook any implement, To any tractor

Without changing any wiring harnesses or displays.

Definition of ISOBUS?

ISO + BUS

International Organization for Standardization, which oversees the ISO11783 standard

BUS is a generic term to describe the physical connection between a set of electronic components.

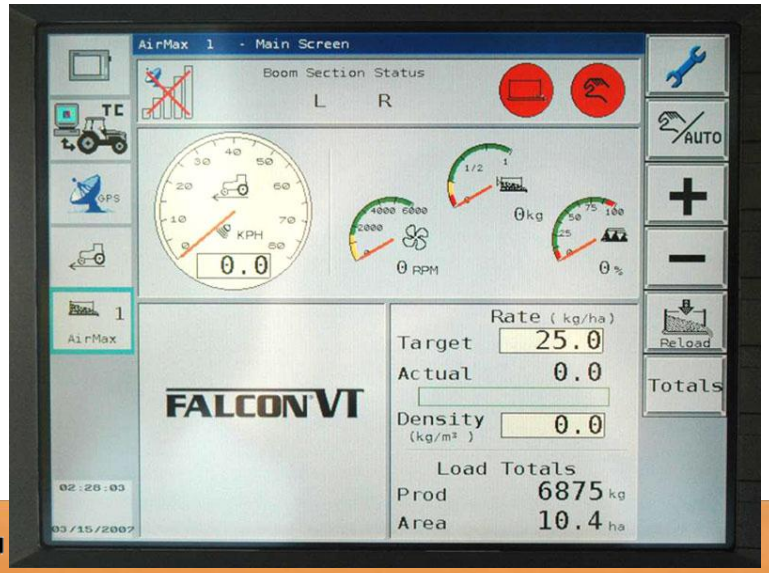
The network is based on a system called Controller Area Network or CAN

Beyond the Definition

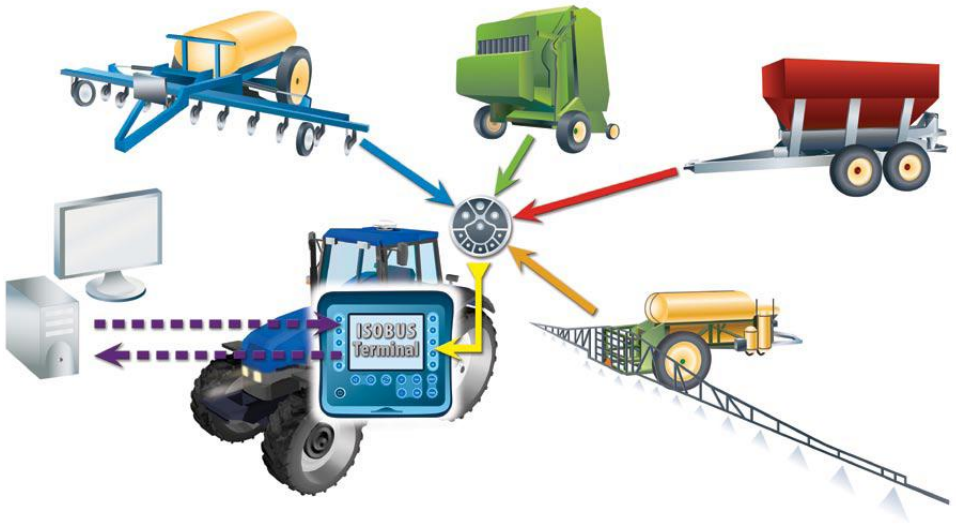
- ISOBUS Defines standards for:
  - The base network that provides communication between computers.
  - The language or protocol that is used to send messages between computers on the network.
  - Standards for Storing data, creating site specific prescriptions.
  - The methods of storing data in a File Server for use by task controllers.
  - Data display and Operator input.

ISOBUS Component Terms

- VT (Virtual Terminal)
  - Provides for User input and displays data to the operator.
  - All computing power for the task is on the implement.
  - The VT is just the display.



ISOBUS Component Terms



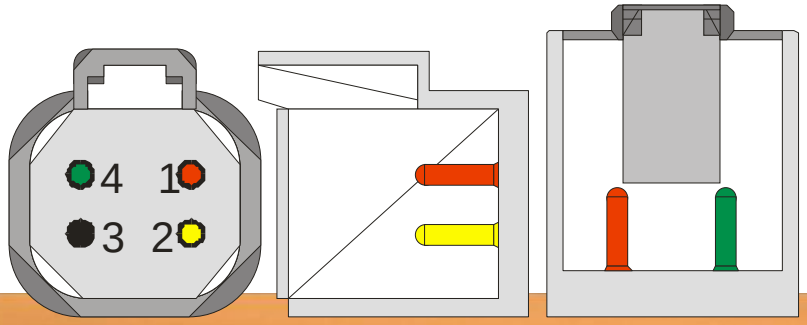
- **ECU**
  - Equipment Control Unit on many different devices will display their data on a VT.
  - You can plug a Case New Holland Baler into your Falcon VT from a Terra-Gator and be ready to make hay!
  - Air Seeders, sprayers, balers, spreaders, even depth control systems for cultivators will all be ISOBUS and are going to work regardless of manufacturer.
  - The VT in your tractor died, not a problem, borrow the one from the Terra-Gator.

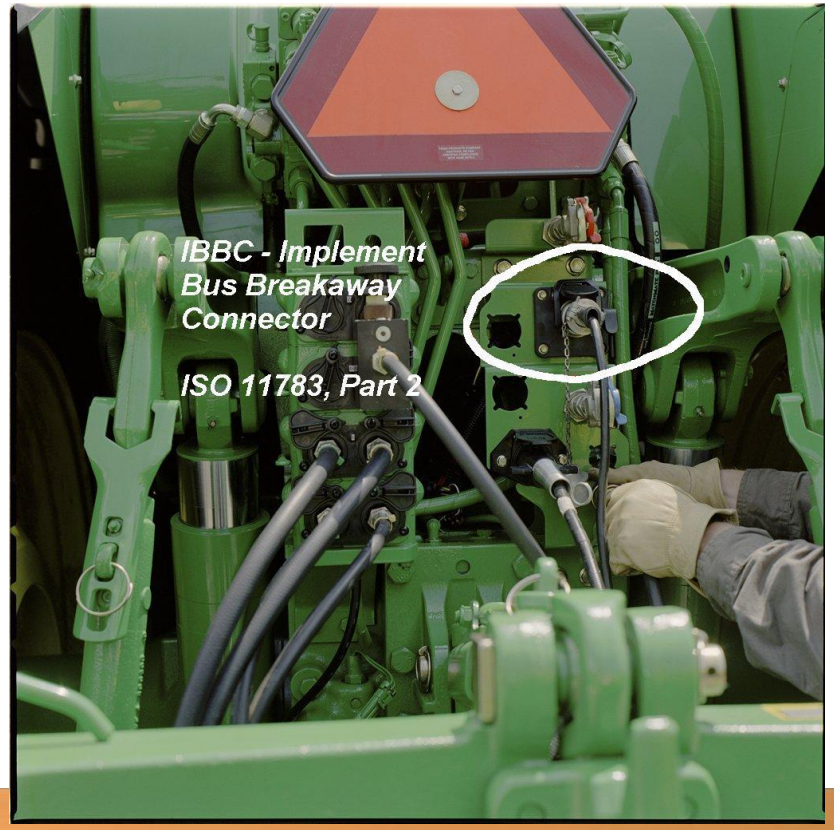
ISOBUS Component Terms

- **Task Controller**
  - Controls application rates on a sprayer or Air Seeder.
  - May control the bale tying operation and tension on a baler.
  - Reads input from all sensors related to the operation and watches for trouble.
  - Takes setup information from the Virtual Terminal and creates the screens and setup information that is displayed on the Virtual Terminal.
  - Weather proof-lives on the implement.

ISOBUS Component Terms

- **CAN BUS**
  - The network that broadcasts data to and from ECU's and sensors on the network to other ECU's, or task controllers.





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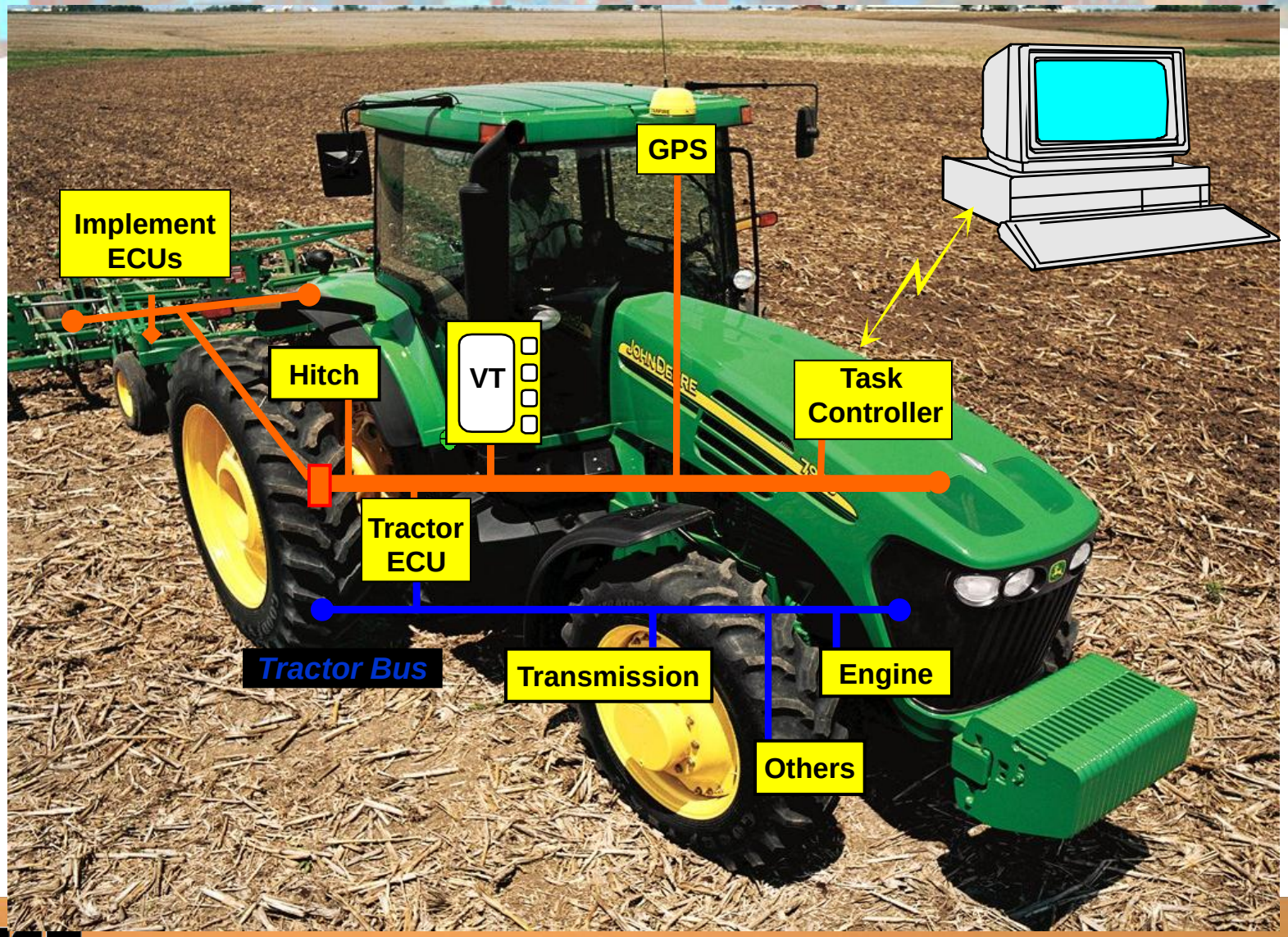
Two Independent Networks



Why Two Networks?

- Network traffic capacity is limited.
  - Not all of the information on the Tractor ISOBUS is pertinent to the Implement ISOBUS, but some is.
  - Does the implement task controller need to know the engine oil pressure or fuel flow? Probably not.
  - But the implement task controller needs to know the current ground speed from the radar, GPS, or transmission speed sensors. Absolutely!!
  - The Tractor ECU takes care of running the tractor, and puts messages that may be of interest to others on to the CAN Bus.
  - Other Task controllers or ECU's can grab this data from the bus and use it, or just ignore the message.

ISOBUS – Connected Networks

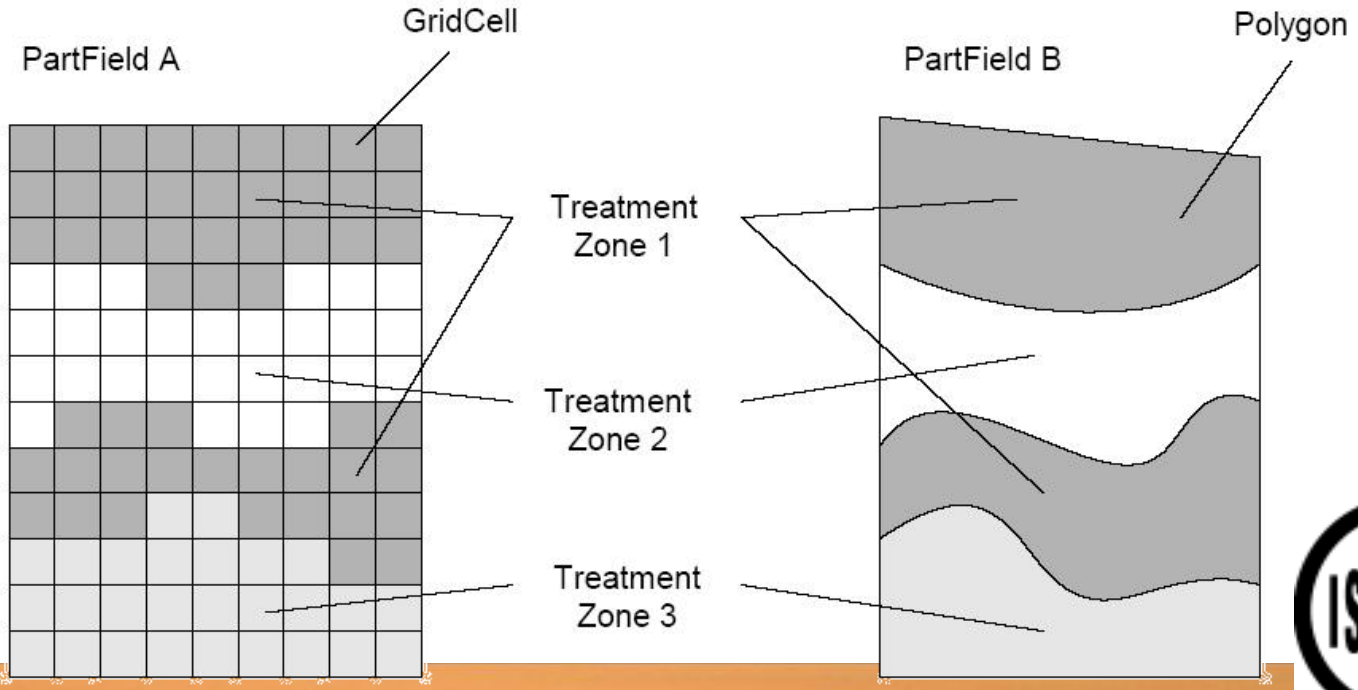
- Air Seeder Example:
  - Fan Speed Sensor — 3 Wires — 3
  - 2 Bins, each with:
    - Control Valve — 3 wires — 9
    - Shaft Speed Sensor — 3 wires — 15
    - Bin Level Sensors — 6 wires — 27
    - Product Flow — 3 wires — 33
- Total: 33 wires in a harness going forward 80 ft to the tractor.
- ISOBUS could control this and much more with 6 wires.
- Troubleshooting is easier because the Task controller is designed specifically for that implement.
- If you have to replace a 6 wire cable because you forgot to unhook it, it's much cheaper than a 33 wire cable.
- On just this one Air Seeder it saves about 1500 feet of wire.

What's Cool about ISOBUS

- But what's in it for us?
  - Every air seeder, spreader, or sprayer could have the same VT interface.
  - The screens on the VT will change, but the same computer can be in every vehicle.
  - For OEM equipment the task controller will have the dimensions of the equipment, making setup easier.
    - The task controller can "describe" the implement to the system.
    - It knows how many booms or rows, their width, spacing, offset from the GPS receiver and calibration settings.
  - Less mistakes to be made setting up new equipment.

What's in it for Precision Providers?

- One prescription format for every implement, regardless of the color of the equipment.
- Logged data is in a common published format.
- Supports both Polygon and Grid based prescription formats.



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ISOBUS inside

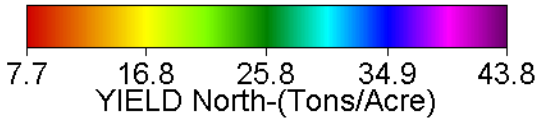
ISOBUS Summary

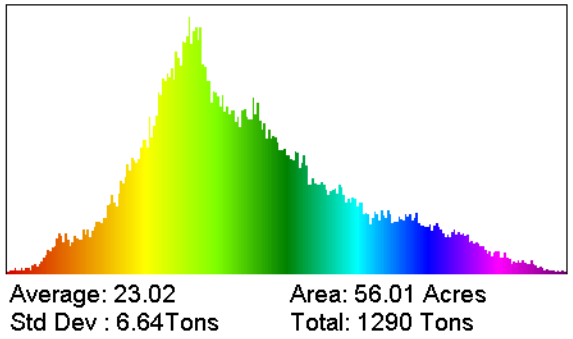
- ISOBUS shows promise to be:
  - Good for Growers
  - Good for Custom Applicators
  - Good for Site Specific Providers
  - Good for Equipment Manufacturers.
- Still a couple of years from achieving the dream.
  - OEM's meet twice a year to plug their equipment into other OEM's Virtual Terminals and test.
  - These meetings are called a "Plug Fest".
  - Still a lot of work to do.

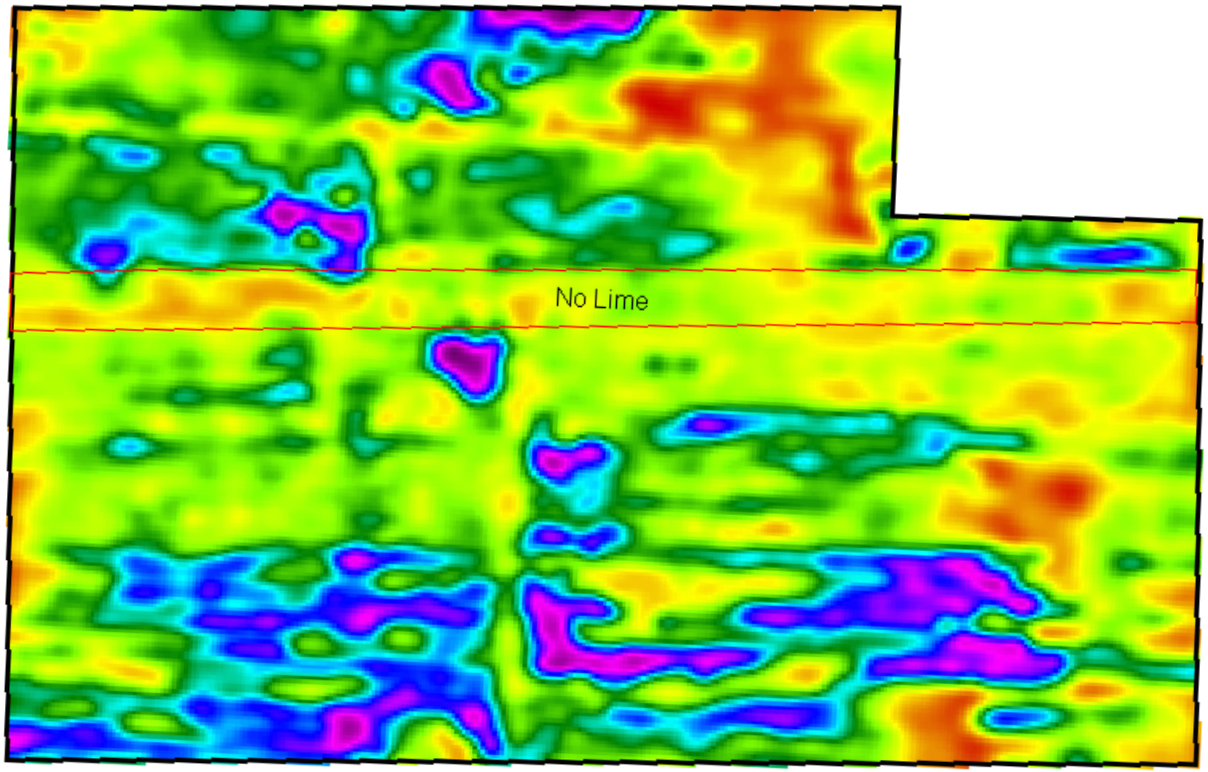
- We are in the startup phases of forming a new industry alliance for what Agvise refers to as “Precision Helpers”
- The new organization is a called:
  - Alliance of Site Specific Providers
  - Web Site http://www.allsitespecific.org
  - Formed to promote responsible, site specific agriculture.
  - A user forum for members is available on the web site.
  - We hope it will become a valuable resource to this relatively new industry.

Beet Lime Treatment

- Field treated with Beet Lime
- Check Strip “No Lime” LOST - 5 Tons / Acre







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Questions???

GK Technology For Agriculture

Innovative Technological Solutions for Agricultures Challenges

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Trimble Acquisitions

- Tru Count –Oct 31, 2008
  - Tru count makes the clutches for shutting of individual rows of a planter on headlands.

- Rawson – acquired Dec 2, 2008
  - Rawson makes variable rate hydraulic drives for seeding.

- Both hold patents for seeding technology that have been largely ignored by the rest of the industry.
- By these acquisitions does Trimble intend to try to corner the market on planter controls?

Prescription

- JD Rx Converter
- EIC 3.0 which allow