CONNECT Wireless Monitoring

Soil Moisture & Irrigation Systems

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System – Sensor to Desktop

Integration is done for you ....

...it is a system not just the individual components...
Complete CONNECT System

Field Stations ➔ Central Server ➔ End user

- Field Stations
- Central Server
- End user

- web based PC access
- Smart phones/Apps (Android, iPhone, etc)
- Tablets
- SMS/E-Mail warnings
- A2A ASCII export server
- addUPI XML based third-party application connectivity
Field Station Tool Box

- Communication options
- Full Integration - Ease of Use
Complete integration: each station integrates 5 components:
- Logger
- Radio
- Battery Pack
- Waterproof connectors & case
- Designed for solar panel operation

Advantages:
- Ease of installation
- Ease of maintenance
- Simple pole sufficient for mounting
- Very low risk of vandalism or theft
Common Wireless Communication Options

• Satellite
  - can be sited anywhere with view of horizon
  - $$$ cost of transmission

• Cellular
  - Requires cellular service provider
  - easy to site under coverage
  - $$ transmission costs

• Radio
  - point-to-multi point
  - short & long range
  - $ lowest transmission costs
  - create/maintain wireless infrastructure
Flexible Wireless Options

Stand Alone GPRS Stations

CPS/Crop CONNECT Hosting

Local UHF Network

Remote Radio Networks

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Wide Choice of Plug-N-Play Sensors

- High Quality & Professional Grade Lines
- Reputable Manufacturers

<table>
<thead>
<tr>
<th>McCrometer</th>
<th>Hukseflux</th>
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<tbody>
<tr>
<td>Adcon</td>
<td>Water Specialties</td>
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<td>Streat Instruments</td>
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<td>Keller Druck</td>
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<td>Nason</td>
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<td>Pronamic</td>
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<td>C-Probe</td>
<td>Vaisala</td>
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<tr>
<td>Kipp &amp; Zonen</td>
<td>and more …</td>
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</table>
Single Platform - Multiple Applications

» Weather / Evapotranspiration (ET)
» Disease Risk / IPM
» Frost Monitoring
» Soil Moisture Monitoring
» Irrigation System Monitoring
Weather Applications

- Site specific weather
- ETo (evapotranspiration)
- Disease Risk Monitoring
- Degree days / IPM
Reference Evapotranspiration

- Irrigation scheduling based upon calculating crop water use
- Penman-Monteith FAO Equation
- Crop coefficients are used to adjust crop water use for crop type and growth stage
- Growers use a “replacement” strategy and irrigate with the quantity of water used by the plant
Site Specific Weather

- Site specific weather
- Robust risk models
- Optimized control efforts

Maps courtesy of Crop Production Services Madera, CA
Degree Day & Chilling Hours

- 5 Degree day calculation methods
- Calculates daily and accumulated values
- Ready to work with most IPM DD pest models
- User set warnings & thresholds
Frost Monitoring

- Three measurement types
  Wet bulb, dry bulb & dew point
- User defined warning thresholds
- Warning Options
  SMS/text
  SIP (text to voice call)
Soil Moisture Sensors

- Brands & Models
- Types of Sensors
- Soil Moisture Display
- Additional Irrigation Sensors
Soil Moisture Sensors

- Wide range of soil moisture sensors on the market
- McCrometer telemetry compatible with 25+ brands/models

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Models</th>
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<tr>
<td>Sentek</td>
<td>EasyAg, EnviroSMART probes, Drill &amp; Drop (various lengths)</td>
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<tr>
<td>Adcon</td>
<td>SM-1 probe (various lengths)</td>
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<tr>
<td>Streat Instruments</td>
<td>Aquaflex</td>
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<tr>
<td>Decagon</td>
<td>5TM, 5TE, HS10, MPS1 &amp; 2, Echo 5/10/20</td>
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<tr>
<td>Irrrometer</td>
<td>Watermark &amp; tensiometers</td>
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<tr>
<td>ESI</td>
<td>GroPoint, GroPoint Lite</td>
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<tr>
<td>EnviroPro</td>
<td>Standard, Lite</td>
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<td>Campbell Scientific</td>
<td>655 TDR</td>
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<tr>
<td>C-Probe</td>
<td>various lengths</td>
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<tr>
<td>AquaSpy</td>
<td>various lengths</td>
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<tr>
<td>AquaCheck</td>
<td>various lengths</td>
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<tr>
<td>Stevens Water</td>
<td>Hydraperobe</td>
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</table>
Types of Sensors

- Single sensor/probe
  
  *single sensor for one depth*
  
  *usually requires a separate hole for each sensor*

- Multi-depth probe
  
  *Multiple sensors in a single probe*
  
  *access tube based*
  
  *sealed and non-sealed versions*

- Multi-parameter probe
  
  *moisture*
  
  *temperature*
  
  *salinity or conductivity*
Data Display – Separate Layer Graph

• Raw data
• Sort the lines
  no overlap
  Sorted by depth
• Zoom in to see detail
• Display like a soil profile
Data Display – Summed or Average Graph

- Single Curve
- Represents whole root zone
- Shape of summed and average curve is the same
• Viewing curves together is very useful

• Patterns in this example:
  - reaction to irrigation/rain event
  - depth of irrigation
  - infiltration rate
  - crop water use
  - implied “available” water

• Patterns/Trends are useful irrespective of engineering unit
Complementary Irrigation Measurement

• Highly recommend to quantify irrigation delivery

• Irrigation quantity or runtime

• Distinguish between rain and irrigation

• Gives consultants an edge when you do not have the grower’s irrigation schedule.
Multi-Depth Probe With Dual Pressure Sensors

Sprinkler Pressure Sensor

Drip Pressure Sensor
Irrigation System Monitoring

- Pump/Flow Monitoring
- Pressure
- Well Water Level
- Fertigation
Types of Flow Meters

- Mechanical propeller meters
- "Insertion" meters
- Digital propeller meters
- Battery operated mag meters
- Full bore mag meters
Pulse outputs

- Wide range of flow meters provide pulse outputs for loggers/recorders

- Typically provide a pulse per unit volume
  example: 1 pulse = 100 gallons

- Pulses are accumulated for every time slot then the sum is reported

- Mechanical meters require a transmitter to create the incremental pulse output
Other Meter Outputs

• Some meters can provide digital pulse outputs
  - Example is McCrometer FlowCom register
  - Pulse rates and widths need to match field station capability

• Flow Converters/Computers on mag meters etc often of 4-20mA outputs
  - 4-20mA outputs typically used to read instantaneous flow rate.
Volume vs. Flow

- In most cases only volume is monitored
- Flow rate is for database purposes is typically calculated
- Lower sampling rate
- Higher water use accuracy
- Typical sampling period in agriculture is 15 minutes
Other AMR/Pump Monitoring Sensors

- Pressure Sensor
  - 1/2” NPT fitting
  - 0-145 PSI range
  - 1.0% accuracy FS

- Pressure Switch
  - 1/2” NPT fitting
  - Various threshold (% PSI and up)
  - Indicates on/off status

- Excellent complementary sensor to flow meter
  - Can indicate flow if meter is broken
Maintenance

- Minimal maintenance on AMR / BPM stations
  - clean solar panel & field station
  - check cables
  - normal flow meter maintenance
AMR – Automatic Meter Reading

- Typically “record keeping in nature”
- Daily, monthly, seasonal usage etc.
Allocations

• Running totals / seasonal water use easy to set up
• Easy to track relative to seasonal allocation
Basic Pump Monitoring

- AMR with addition of pressure sensor
- Can now compare flow rates and operational pressure
- Identify problems before they become serious
Basic Pump Monitoring

Problem & Correction
Pump and Well Management

- Water level
  - Canals
  - Reservoirs / ponds
  - Wells
  - Deep well

- Water Meters

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Fertigation and Small Line Size Meters

- **Flow meters for smaller lines**
  Monitoring individual irrigation blocks
  Typically ¾” to 3”

- **Ultra small line size**
  - fertiligation systems
  - 1/8” to ¼” lines
  - combine with pump data to monitoring injections rates and quantities
Water Use & Reference ET

- Water use data from flow meter compared against ETo/ETc
- Irrigation by block
- Inches actually applied can now be compared with ET
- Can be done daily, weekly etc.
Thanks!!!