Automated systems for monitoring weather and soil moisture

Brenna Aegerter
UCCE San Joaquin County
VARIOUS SENSORS

PERSONAL COMPUTER

COMMUNICATION

- direct connection
- telephone modem
- data “shuttle”

DATALOGGER

AUTOMATED WEATHER STATION

Wireless connection
- radio telemetry
- cellular modem
- satellite
What are your needs?

• What do you want to measure?

• Do you need real-time data or historical data?
  – At end of season only? Once a week? Daily?
Pros:

- Flexibility (sensors, communication options)
- High quality, durable
- Good product support
Pros:
• Flexibility (sensors, communication options)
• High quality, durable
• Good product support

Cons:
• Somewhat less user-friendly (though improving)

Support and service:
Western Weather Group in Chico
California Coverage

60 receivers at WFS offices or large growers’ offices

- Central Valley
- Coastal
- Southwest
- Temecula/Riverside
- Napa/Sonoma
- North Sacramento Valley

Not reliant on cellular coverage, but does depend on base station, another weather station, or a repeater being within 12-15 miles.
Adcon sensors

- Leaf Wetness
- Wind Speed & Direction
- Solar Radiation
- Rain Gauge
- Temperature & Humidity
- C-Probe Soil Moisture
- Watermark Soil Moisture
- Soil Temperature
Adcon software disease models

- Vine Powdery Mildew
- Vine Botrytis Bunch Rot
- Potato Blight
- Walnut Blight
- DSV – TomCAST
- Apple Scab
- Strawberry Botrytis/Powdery Mildew
- Pistachio Blight
Leaf Wetness Sensors

- Datalogger reads a resistance measurement
  - recorded as between 0 and 6999 (Campbell)
  - or between 0 and 10 (Adcon)

- You must decide what resistance measurement correlates with wet leaves in your location
Measuring soil water status

• Soil Water Potential (Centibars suction – measurement of soil moisture tension)
  ✓ Tensiometer (with pressure transducer)
  ✓ Gypsum or granular matrix (Watermark™) blocks

• Volumetric Water content (%; in/ft)
  ✖ Volumetric soil sampling
  ✖ Neutron probe
  ✓ Dielectric sensors

✓ Capable of being automated
  ✖ Cannot be automated
Dielectric soil moisture sensors

- Use an oscillating voltage to measure the capacity of a non-conducting material to transmit electromagnetic waves or pulses

- Mostly affected by water content, though also by other factors, soil-specific calibration required
Dielectric soil moisture sensors must be calibrated to your soil.
8 sensors capacity:

Watermark soil moisture sensors
RSU-equipped irrometer tensiometers
Irrometer soil temperature sensors
On/Off Switches – irrigation events

Communications options
## Communications Options

<table>
<thead>
<tr>
<th></th>
<th>Campbell Scientific</th>
<th>Adcon Telemetry</th>
<th>Spectrum/Watchdog</th>
<th>Onset/Hobos</th>
<th>Hansen</th>
<th>Watermark monitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN-FIELD DISPLAY</td>
<td>X opt</td>
<td></td>
<td>+/-</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DIRECT CONNECTION</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>PDA CONNECTION</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>RF TELEMETRY (distance)</td>
<td>various, up to 60 miles</td>
<td>1 mile or 12-15 miles</td>
<td>1,000 ft or 2 miles</td>
<td>5 miles</td>
<td>---</td>
<td>14 miles</td>
</tr>
<tr>
<td>unlicensed radio modems</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>900 MHz</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4 GHz</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>licensed radio modems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(UHF/VHF)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CELLULAR MODEMS</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>SATELLITE MODEMS</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TELEPHONE MODEM</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHORT-HAUL MODEM</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ETHERNET</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Things to consider…

- Logging interval
- Sensor placement
- Set-up (wiring, programming, initial sensor calibration)
- Maintenance (sensor manufacturer calibration, battery replacement)*