Ground-based Remote Sensing

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Measurement Function

- Calibrate airborne and orbital sensors
- Supply parameters for growth/physical models
- Direct input for management decisions

Platforms

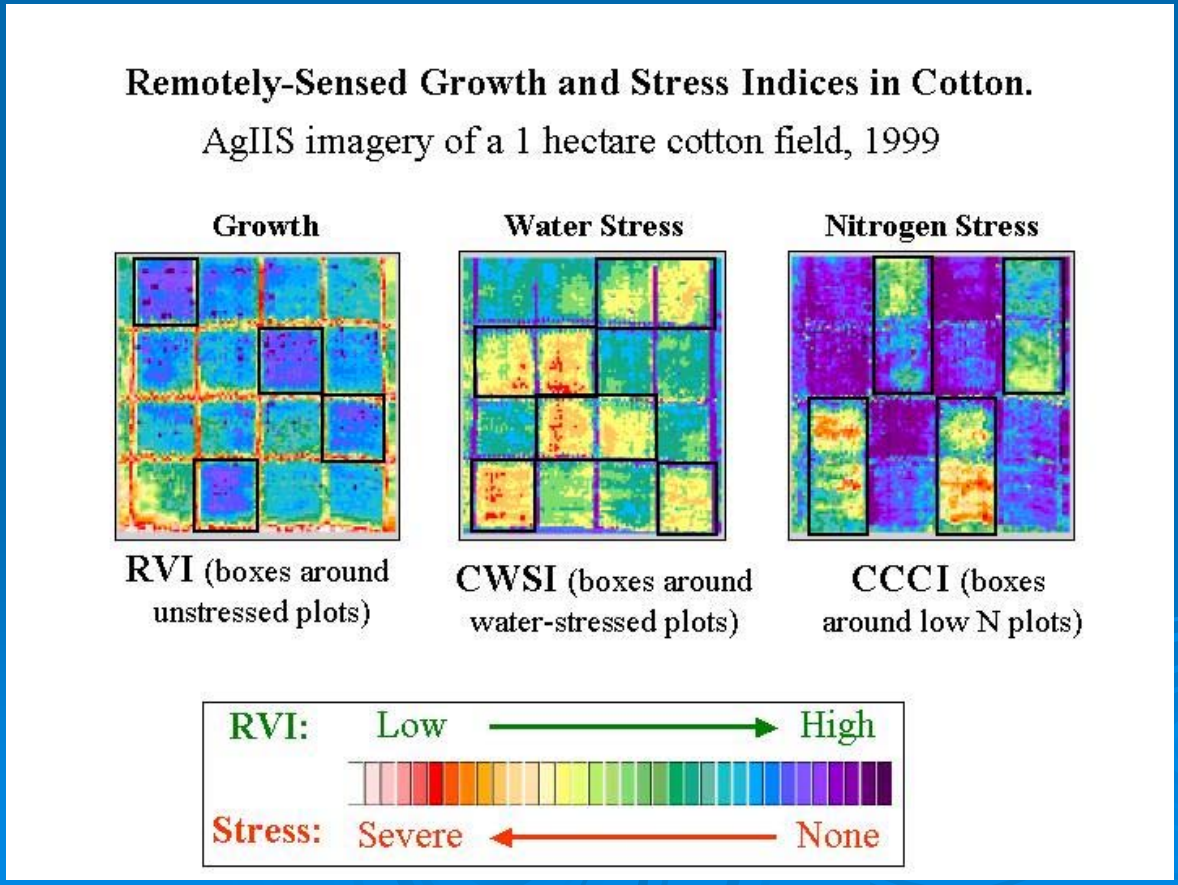
- Fixed (infrared thermometers)
- Hand-held

Platforms

- Vehicle Mount
- Overhead Irrigation Mount

Platforms

- Vehicle and Overhead Irrigation Mount allow high resolution field imagery with minimal operation cost.



Basic sensor categories

- Active – supply own light source
  - CropCircle, Green Seeker
  - LIDAR, Microwave

- Passive
  - Visible/Near Infrared
  - Thermal

Active Sensors

- Benefits
  - Never a shadow, so doesn't change with sun angle.
  - Does not require reference panel.
  - Easy to use, hand-held or tractor mount.

- Drawbacks
  - Cannot be used in conjunction with passive sensors or to calibrate orbital/airborne platforms.
  - Cannot be used for individual band reflectance: Band comparison (i.e. vegetation indices) only.
  - No more than three visible/NIR bands per instrument.
  - Must be within 2 meters of target.

Accuracy

" How good is good enough?"

- Dependent on Function
  - Absolute Measurements
    - Airborne/Orbital Calibration
    - Physical Models
  - Relative Measurements
    - Growth Models
    - Management Decisions

Accuracy

Absolute Measurement

- Visible, Near IR
  - Frequent measurement of a standard reflectance reference panel (e.g. Labsphere Spectralon) with bidirectional reflectance corrections applied.

- Thermal
  - Sensors should be carefully calibrated at beginning and end of season using an extended area blackbody and a wide range of ambient and target temperatures.
  - Reference target (e.g. Everest 1000) checked before and after each measurement set

Measurement Concerns

- Frequency of sensor calibration/checks
  - For visible/NIR, increase frequency when solar angle is changing rapidly.
- Shadow avoidance for passive visible/NIR measurements
  - Extend sensor to the south.
  - Avoid mid-day measurements if possible in summer. Otherwise calculate sun angle - instrument field of view geometry do make sure shadow does not interfere.

Measurement Concerns

- Nadir vs. off-nadir viewing, Fields of View
  - For thermal measurement of canopy temperature, IRT must be angled enough to remove soil background (very hot!) from the f.o.v., but not so much that the horizon sky (very cold!) enters the field of view.
  - Visible/NIR reflectance normally should be taken looking nadir, at a constant solar zenith angle through the season.

Measurement Concerns

- Relationship of row width, field of view (f.o.v.), Sensor height, and crop height
  - Widening instrument f.o.v. causes over-estimation of plant cover.

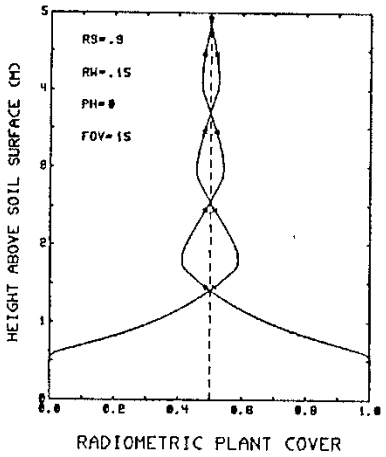


Figure 13.--Radiometric plant cover as a function of height above soil surface for a radiometer held over the plant row (circles) and over the exposed soil (crosses), for a 15° FOV instrument, plant height/width ratio is zero.

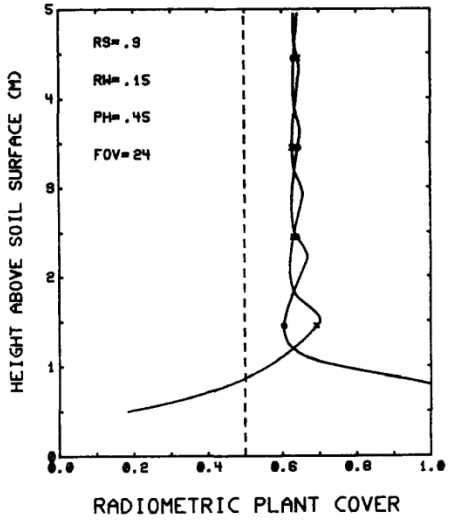


Figure 19.--Same as figure 13 except 24° FOV, plant height/width ratio is 3.