Measurement needs for automated site characterization

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Landnet approach

Automated ground measurement approaches are a useful means for radiometric calibration

- Many success stories
  - MOBY and Boussole
  - Stennis Space Center facility
  - JPL facility at Lake Tahoe and Frenchman Flat
  - UofA at RRV Playa
- Allows data to be collected at the convenience of the sensor scheduler
- Allows intercomparisons between sensors without need for coincident data collections

Background

Justifications for automated measurements are well established

- Automated sites can combine accuracy of in situ with flexibility of invariant scene
- Automated ground systems are always collecting so results are available when the on-orbit sensor needs them
- Questions that still exist are
  - What are the measurements needed?
  - What is the trade between cost and accuracy?
  - Are a few highly-instrumented sites better than more sites with less instrumentation?

Protocol development

A key portion of automated processing is development of protocols

- Not just a measurement
  - No commercially-available radiometers will currently satisfy a Landnet
  - Not feasible to outfit multiple sites with identical instrumentation
- Develop basic measurement scenarios
  - Surface parameterization
    - Spatial sampling
    - Spectral sampling
    - BRDF
  - Atmospheric parameterization
- Site Selection

Data product

Propose that goal should be to develop a model image of the site

- At-sensor radiance for a given sun-sensor geometry
  - Hyperspectral at 10-nm intervals from 350-2500 nm
  - 20-m spatial resolution
  - Cover the full test site area (several km in size)
- Standard and on-demand product
  - Standard image produced for five preselected times during the day
  - On-demand product based on user preference for sun- sensor geometry
- Includes accuracy assessment for data product

Landnet accuracy

Accuracy from automated instrumentation is no different than for other in-situ measurements

- Landnet would use similar processing schemes to methods already in place
- Landnet would make similar measurements
- Lack of on-site personnel means quality assessment is more difficult
  - Similar to issues with PIC sites
  - Develop techniques for quality assessment
- Differences between on-site versus automated
  - Hyperspectral versus multispectral
  - Mobile instrumentation versus stationary
  - Atmospheric characterization data

Landnet accuracies

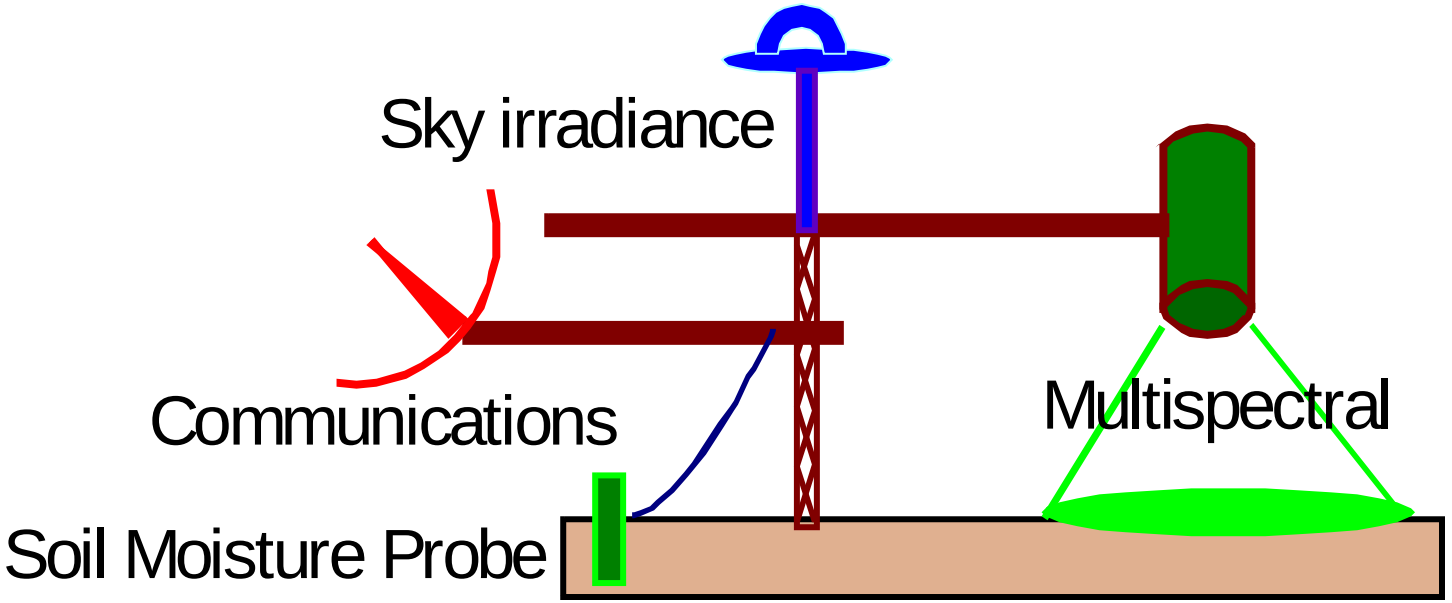
Minimum set of measurements needed for a reflectance-based approach

- Impact of assumptions on uncertainties must be evaluated
- Numbers of data collections is key factor
- Sites with reflectance > 0.2
  - Site reflectance is most important
    - BRDF
    - Spectral
    - Spatial
    - Temporal
  - Aerosol effects can be viewed as random
    - Aerosol absorption changes with time

Minimum measurements

Most sites would be high enough reflectance to omit atmospheric aerosol measurements

- Sky irradiance still desired for reflectance retrieval
- Soil moisture probe to monitor surface conditions
- Multispectral systems tend to be more robust and easier to characterize



Minimal budget

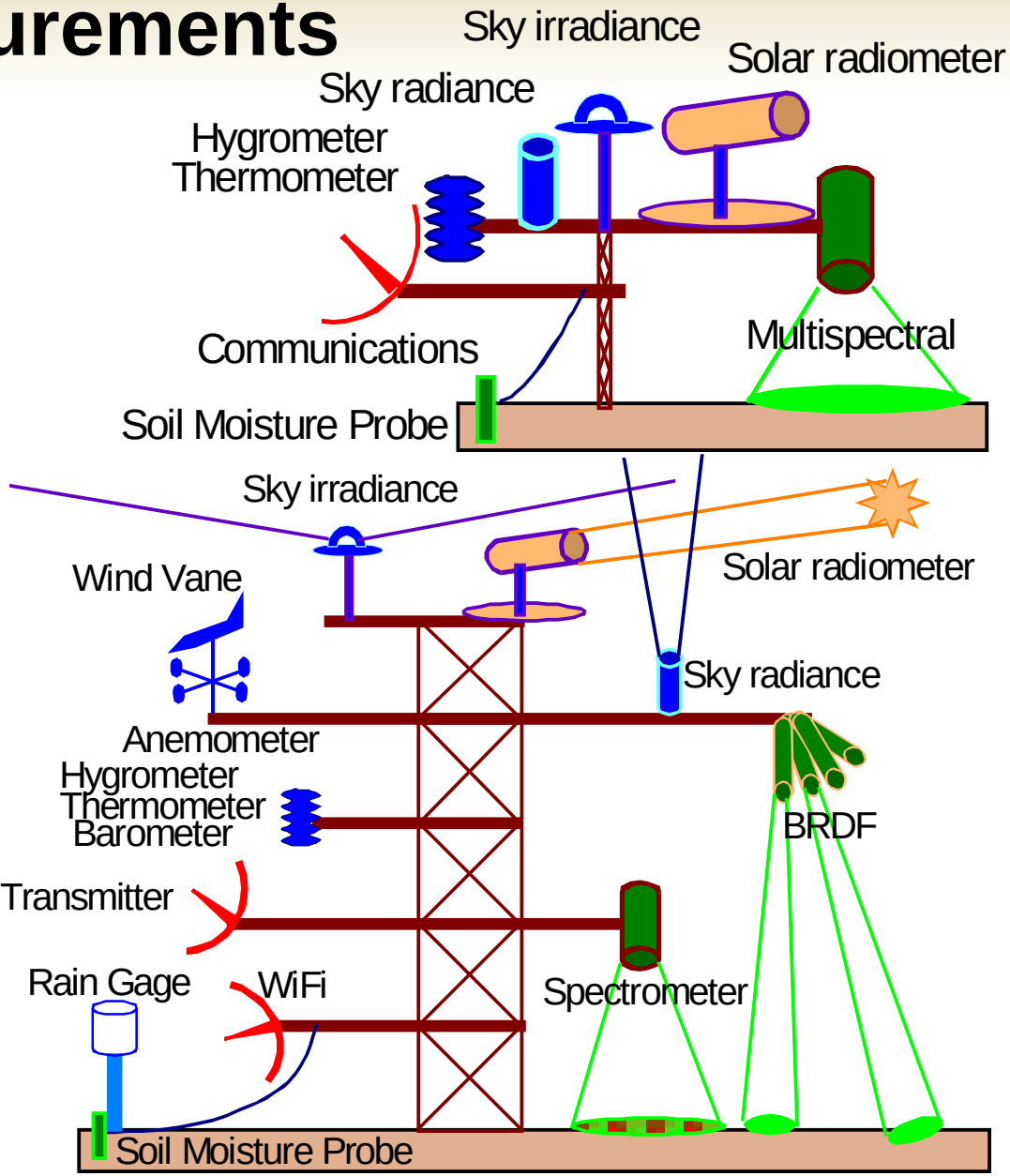
Costs for minimum set of measurements would be $50K

- Portable tower for deployment including costs to incorporate equipment ($5K)
- 1 Multispectral, sky irradiance monitor ($15K)
- 1 Multispectral ground monitor radiometer ($15K)
- Soil moisture probe and data logger ($5K)
- Power generation ($5K)

- Irradiance and ground monitor costs are optimistic based on custom builds – no commercial product is currently available
- 2 Digital camera systems for sky and ground monitoring could be included ($5K)
- **Data connectivity and year-to-year maintenance not included**

More detailed measurements

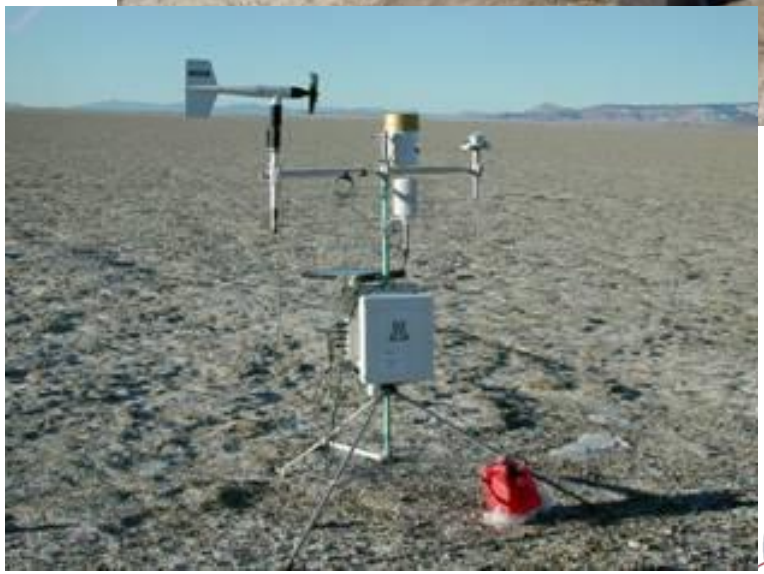
- More detail means higher costs
- Benefits are improved atmospheric characterization and spectral reflectance
- Minimal improvement in overall accuracy for >5 calibrations of a single sensor



Current instrumentation

Currently a suite of instruments to obtain atmospheric and surface information

- Atmospheric data from Cimel sun photometer
  - Atmospheric optical depth
  - Angstrom exponent
  - Water vapor
- Weather information from meteorological station
  - Temperature
  - Pressure
  - Precipitation



Way forward

Many options exist as to next steps with trades on cost, accuracy, and time to implement

- Test sites
  - New site
  - Previously-used
- Equipment
  - Already-existing
  - Obtain new equipment
- Processing schemes and data distribution
  - Coordinated processing effort
  - Independent developments

Way forward

Propose the following minimum approach for discussion purposes

- Goal should be to work for IVOS-approved result in place for Sentinel 2 launch
  - Inter comparison opportunity with Landsat 8
  - Moderate resolution makes site selection less difficult
- Two independent sites should be developed
  - Demonstrates "net" part of Landnet
  - One site should be an already-existing site to leverage past knowledge
- Coordinated processing scheme
  - CEOS-led distribution
  - Emphasis on processing and data quality protocols