Field Program: Three Areas

- Agriculture
- Surface Waters
- Coastal / Marine
1) Agriculture

**Biophysical Measurements:**
- Vegetation Fraction
- Leaf Area
- Pigment Type and Density
- Leaf-Water Content
- Primary Productivity / Biomass
- Absorbed Photosynthetically Active Radiation
CALMIT Field Facility

Note aircraft-calibration targets on concrete strip (above)
“Goliath”
Goliath Specifications

- All terrain (tracked wheels)
- Boom height = 10.5m (with full rotation)
- Boom length = 3.8m stowed; 12m extended
- Platform height = approx. 2m
- Platform width = 2.6 x 3m
- Passengers = driver + 4
- Wheel spacing for standard 76.2 cm (30-inch) rows
Goliath is Mobile
Spectroradiometers Available on Goliath

- Dual Spectron SE-590’s
- Dual Ocean Optics USB-2000’s
- ASD-FR
Spectroradiometers
Spectron SE-590 (2)

256 channels; 365-1114 nm
Spectroradiometers
ASD Field Spec - FR (2)

2150 channels; 350-2500 nm
Spectroradiometers
Ocean Optics USB2000 (4)

2048 Channels, 350-1000 nm

Dual systems allow simultaneous capture of downwelling (sky) irradiance and upwelling (target) radiance
Dual Fibers Facilitate Data Collection Under Rapidly Changing Illumination Conditions
Other Sensors on Goliath

- Canon digital-video camera
- Linear Laboratories infrared thermometer
- P-band Radar Scatterometer

- 104-1_194N-S
- 104-2_194N-S
- 104-3_194N-S
- 104-4_194N-S
- 104-5_194N-S

- 304-1_194N-S
- 304-2_194N-S
- 304-3_194N-S
- 304-4_194N-S
August 18, 2000.
Estimating Vegetation Fraction

Vegetation Fraction - Measured vs Vegetation Fraction - Estimated

$R^2 = 0.9016$

VARI
Other Systems on Goliath

- Real-time DGPS
- Wireless Internet
Other Field Instruments

UniSpec

256 Channels, 300-1100 nm

Leaf Clip

Operates with internal light source
University of Nebraska Carbon Sequestration Program

Project Study Teams:
- Micrometeorological (CO$_2$ and H$_2$O Vapor Fluxes)
- Soil Water Balance
- Soil C
- Plant C Assimilation
- NO$_2$ and CH$_4$ Flux
- Leaf Level Remote Sensing
- Canopy Level Remote Sensing
- Technology Design & Adoption
Seasonal VARI

Irrigated and Non-Irrigated Corn
June 6 through September 24 2001
Why Use Goliath?

July 3, 2001 - Carbon 3
Measurements from Goliath Platform
“Hercules” (2003 Field Season)
2) Surface Waters: Mesocosms
Spectral Reflectance with Varying SSC
(with clear water)

Reflectance Factor (%)
0 2 4 6 8 10 12 14 16 18 20 22 24

0 mg l⁻¹

500 mg l⁻¹

Wavelength (nm)
400 500 600 700 800 900
Surface Waters: Macrocosms
Underwater Light Fields
Okoboji Lakes (20 Sep 01)

West Okoboji

East Okoboji
Examples of Ancillary Data

- Sechi Disk
- Pigments
  - Chlorophyll
  - Carotenoids
  - Phycocyanin
- Phytoplankton Densities
- Turbidity
- Non-Organic Solids
Classified AISA Image

Fremont State Lakes
May 3rd, 2002

Chlorophyll (mg/m3)
<3  6  9  12  15 >18
The “Bob” Technology

- Ocean Optics SD-2000
  - 350-850nm range

- Fiber Optic
- Labsphere 50% Spectralon Panel

- Trimble GPS Antenna
- Sony Hi-8 Digital Video Camcorder
- Fiber Optic Cable To Boat
- Transducer
- Fiber Optic

- Digital Video IFOV
- Ocean Optics IFOV
Remote Sensing of Corals
Coral Spectra

SELECTED CLOSE RANGE SPECTRA
ROATAN ISLAND, HONDURAS

- 1 - Montastrea annularis
- 2 - Porites asteroides
- 3 - Acropora palmata
- 4 - Millepora complanta
- 5 - SAND BOTTOM

PERCENT REFLECTANCE

WAVELENGTH (nm)
Traditional Calibration
Dual Fibers

Collecting spectra on a coral reef: Roatan Island, Honduras (March, 2002)
Using Dual Spectoradiometers for Hyperspectral Data Collection

Land
Lakes
Underwater
Advantage

Allows for data collection under most irradiance conditions

Method is not valid if the irradiance changes during the scan time of the instruments (Usually 5 to 20 sec)
Hardware Requirements

Two similar spectroradiometers
Hardware Requirements

Two similar spectroradiometers

Hemispherical cosine corrected optic
Hardware Requirements

Two similar spectroradiometers

Hemispherical cosine corrected optic

Cables, power supplies, fibers, etc.
Hardware Requirements

Two similar spectroradiometers
Hemispherical cosine corrected optic
Cables, power supplies, fibers, etc.
Calibrated reflectance standard
Additional Requirements

Computer
Additional Requirements

Computer

Spectral calibration of instruments
Additional Requirements

Computer

Spectral calibration of instruments

Software for acquisition & processing
Additional Requirements

Computer

Spectral calibration of instruments

Software for acquisition & processing

Radiometric calibration optional

- Not necessary for reflectance
- Needed for radiance/irradiance
Method

Near simultaneous data acquisition from both instruments

- Downwelling and upwelling radiation
- Instruments have different integration times
Method

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Spectral channels of downwelling instrument interpolated
To match channels of upwelling instrument
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To match channels of upwelling instrument

Ratio of upwelling divided by downwelling is calculated
Method

Near simultaneous data acquisition from both instruments
- Downwelling and upwelling radiation
- Instruments have different integration times

Spectral channels of downwelling instrument interpolated
To match channels of upwelling instrument

Ratio of upwelling divided by downwelling is calculated

Use scans of calibration panel to correct all other scans
- Panel reflectance is known
- A correction factor (CF) is calculated for each channel
- CF applied to upwelling/downwelling ratio of each scan
Allows calibration scans to be compared
Correction factors calculated for each channel based on the median value of the calibration scans for that channel.
Correction factors applied to all scans
Radar Measurements of Wetlands
Radar in the Field: Wetlands

L-Band Scatterometer
24° Angle of Incidence

- Phragmites
- Typha

VV Polarization

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VH Polarization

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UBMAP CD
ARDC 1996
Field Program: One Part of System