Carbon Sequestration in Dryland & Irrigated Agroecosystems

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Overall Goals

- Investigate the C sequestration potential of major rainfed and irrigated agroecosystems in the north-central USA

- Understand the biophysical controls on C sequestration

Flux Tower Facility

at the University of Nebraska
Agricultural Research and Development Center, Mead

- **Three major cropping systems**
  - Dryland maize-soybean rotation
  - Irrigated maize-soybean rotation
  - Irrigated continuous maize

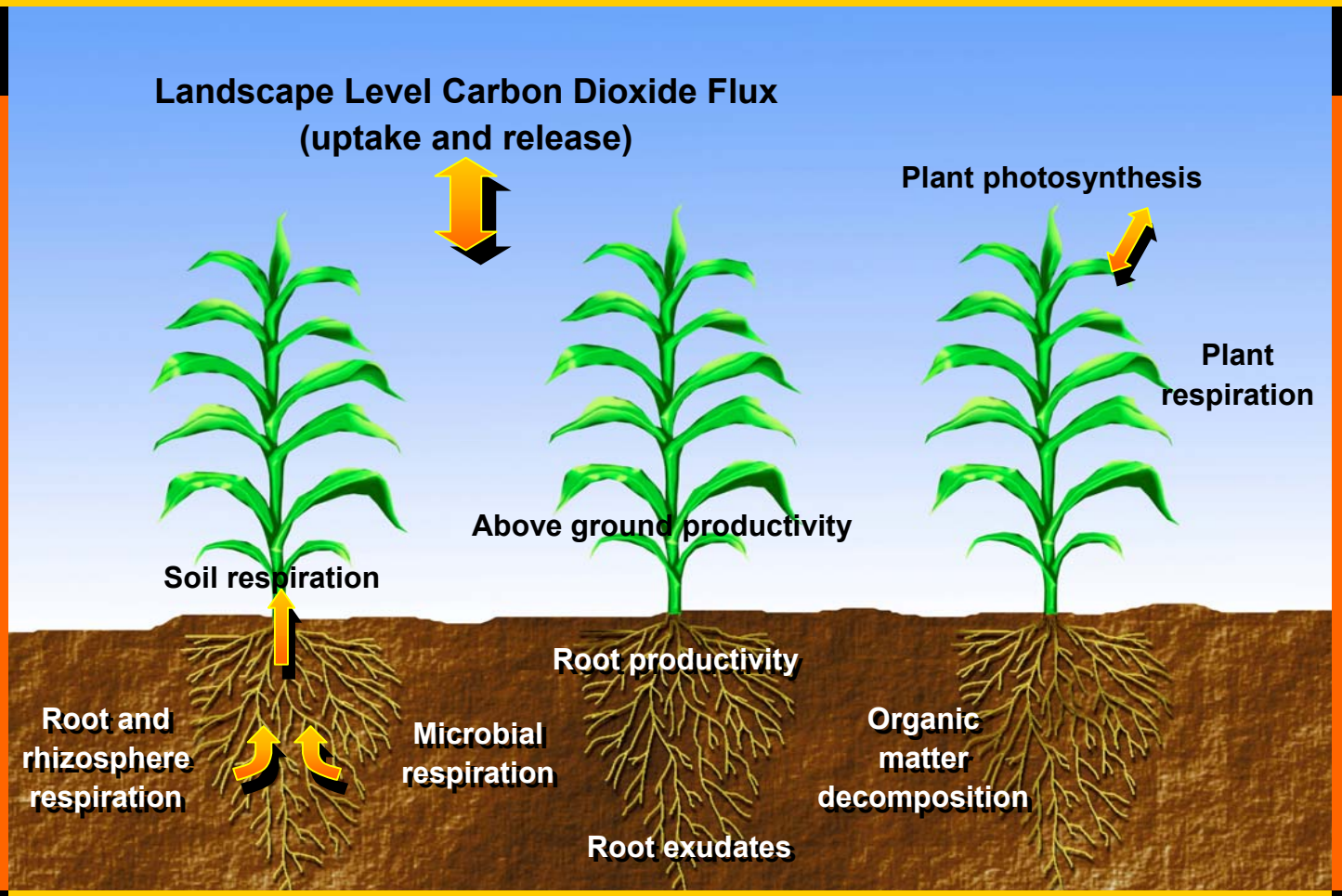
- **Large production fields (about ¼ section)**
  - Sufficient field size needed for measuring landscape level fluxes
  - Center pivot irrigation

- **Within each large production field**
  - Several small plot areas (Intensive Measurement Zones) for process level plant & soil studies

Subprojects/Methods

Subproject	Method
Landscape-level CO_2 Flux	Eddy Covariance (3 Flux Towers)
Plant photosynthesis & soil CO_2 flux	Portable gas exchange systems
Improved estimation of soil C changes in relation to spatial variability	Destructive sampling, multivariate geostatistics & modeling
N_2O & CH_4 Fluxes	Surface Chambers
Belowground Processes	Stable carbon isotope ratios
“C costs” of crop management practices (e.g., fertilizer, irrigation, grain drying	Inventory of all inputs

Partitioning of Carbon in Agroecosystems



Atmospheric CO_2 Flux Studies

Landscape-level (Eddy Covariance) Measurement of CO_2 and Other Fluxes

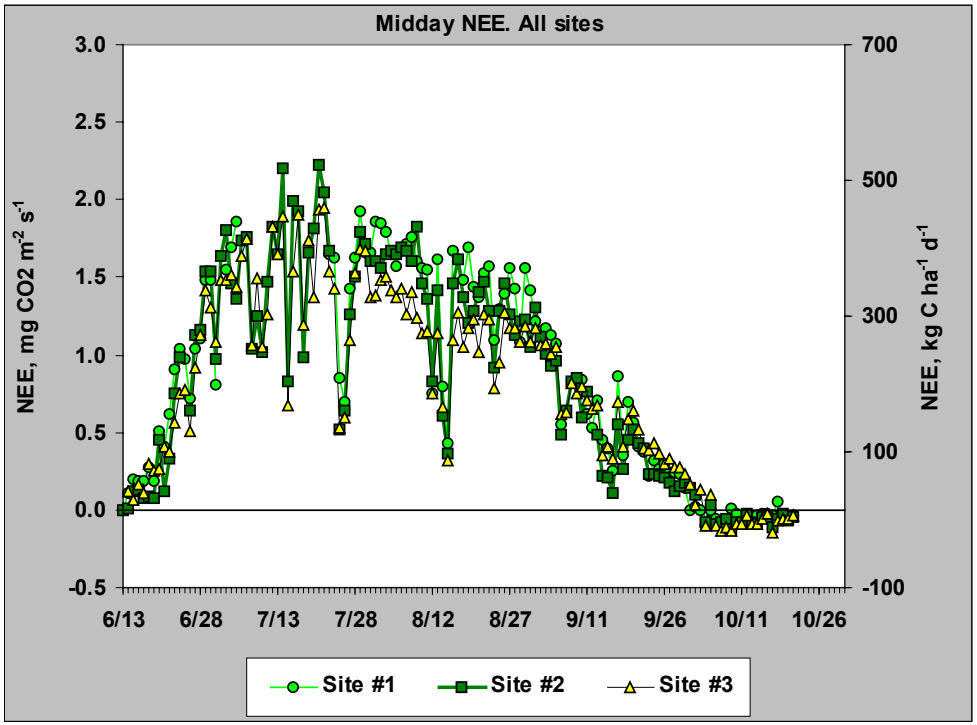
Measuring Components of Solar Radiation

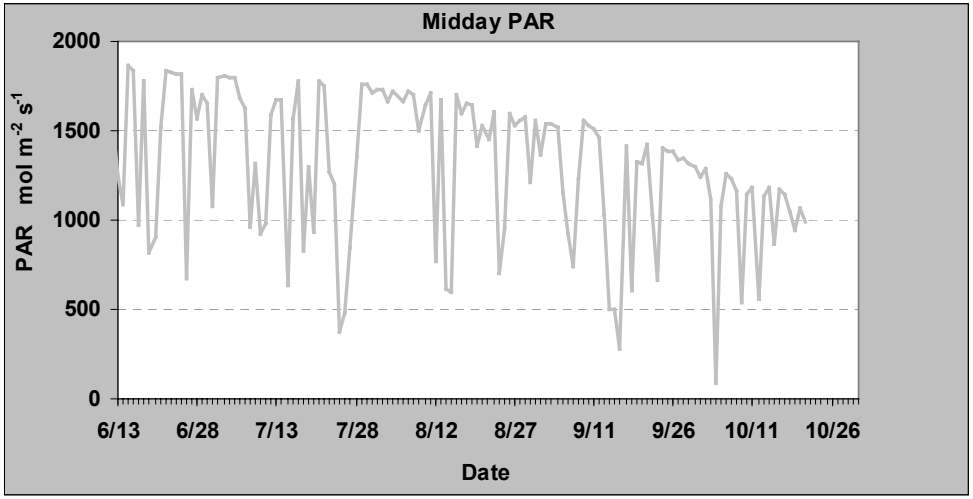
Close Up of Eddy Covariance Flux Sensors

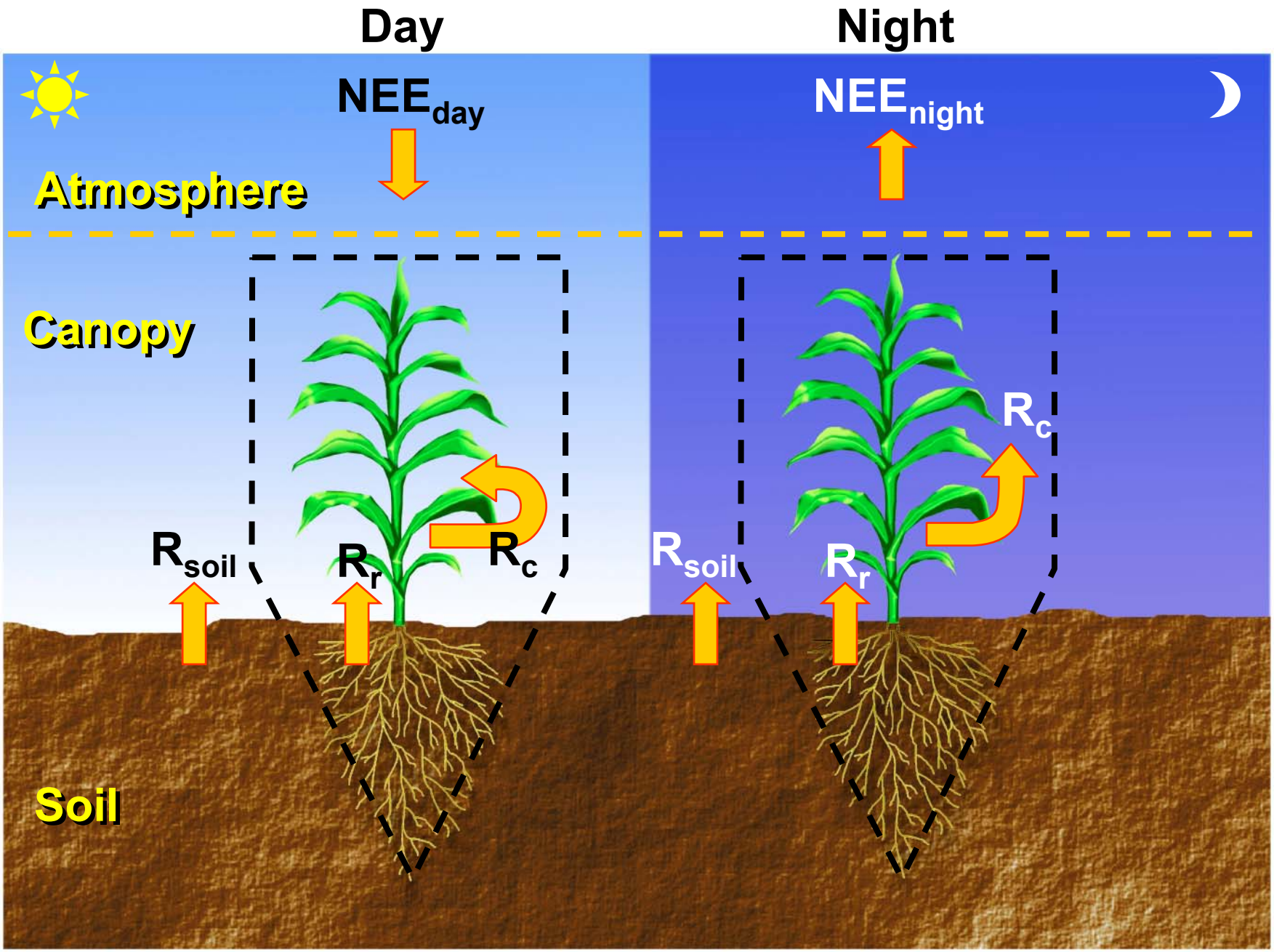
Measurements

- Primary Measurements
  - Fluxes of CO_2, water vapor, sensible heat & momentum
  - Mean wind speed, air temperature, humidity and CO_2 concentration
  - Wind direction
  - Soil heat flux & soil temperature
  - Radiation:
    - ❖ Net radiation
    - ❖ Short wave radiation (incoming & reflected)
    - ❖ P A R (incoming & reflected)
  - Light interception
  - Atmospheric pressure
  - Precipitation

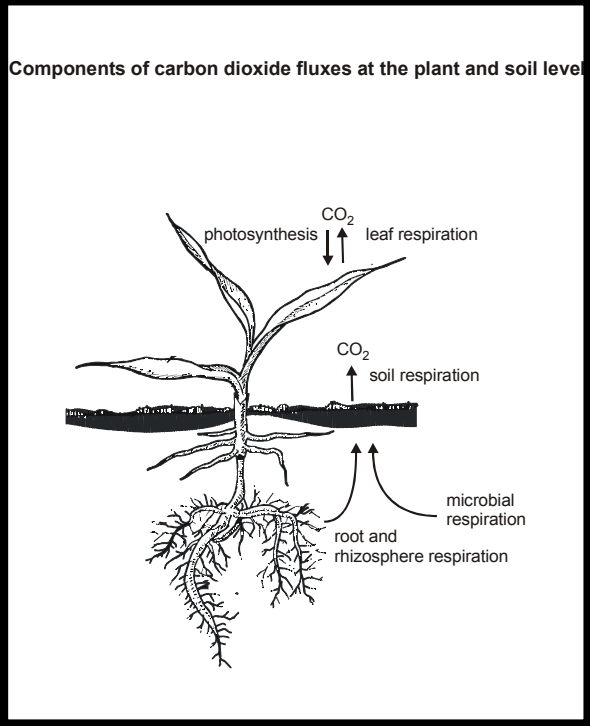
- Supporting Measurements
  - Soil moisture
  - Leaf area index
  - Canopy height
  - Biomass
  - Leaf nitrogen content


Midday NEE. All sites
NEE, mg CO2 m-2 s-1
NEE, kg C ha-1 d-1
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
700
500
300
100
-100
6/13
6/28
7/13
7/28
8/12
8/27
9/11
9/26
10/11
10/26
Site #1
Site #2
Site #3

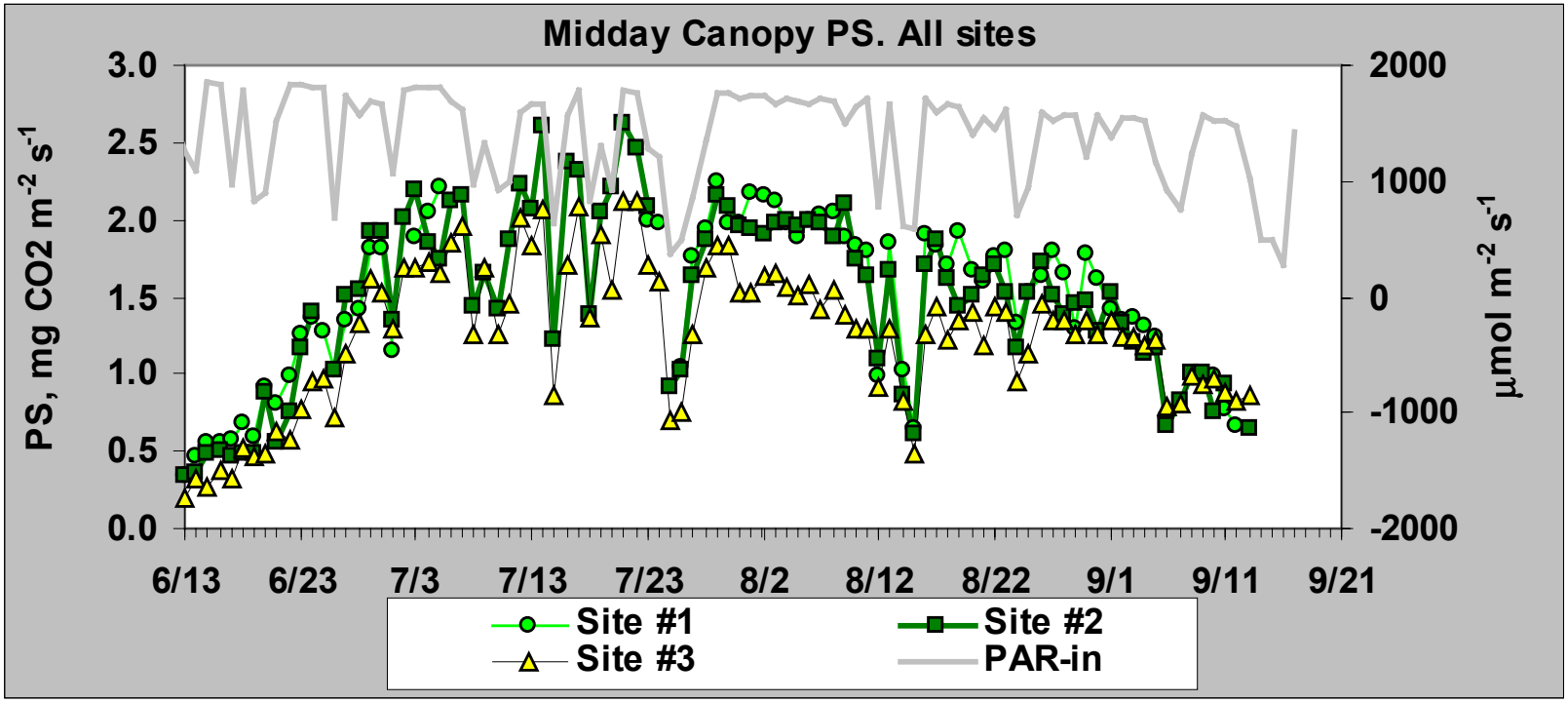

Midday PAR
PAR mol m-2 s-1
2000
1500
1000
500
0
6/13
6/28
7/13
7/28
8/12
8/27
9/11
9/26
10/11
10/26
Date


Day
Night
NEEday
NEEnight
Atmosphere
Canopy
Rsoil
Rr
Rc
Rsoil
Rr
Rc
Soil

Measurements of Leaf and Soil Surface Carbon Dioxide Exchange



- Annual and interannual C dynamics
- Environmental and biological controlling factors
- C sequestration


Midday Canopy PS. All sites
PS, mg CO2 m-2 s-1
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2000
1000
0
-1000
-2000
µmol m-2 s-1
6/13
6/23
7/3
7/13
7/23
8/2
8/12
8/22
9/1
9/11
9/21
Site #1
Site #2
Site #3
PAR-in