# Evapotranspiration Monitoring at a Wetland Site in the New Jersey Pinelands

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***U.S. Geological Survey***

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# Kirkwood-Cohansey Project

## *A hydrologic/ecological investigation in the New Jersey Pinelands*


New Jersey Pinelands Commission
U.S. Geological Survey
Rutgers University
U.S. Fish and Wildlife Service
New Jersey Department of Environmental Protection

# Why Monitor Evapotranspiration?

## Applications of ET Monitoring Data

- Water budget evaluations
- Quantifying seasonal water availability
  - Water used by vegetation types
  - Water available for aquifer recharge
- Drought management
  - Tracking and anticipating conditions

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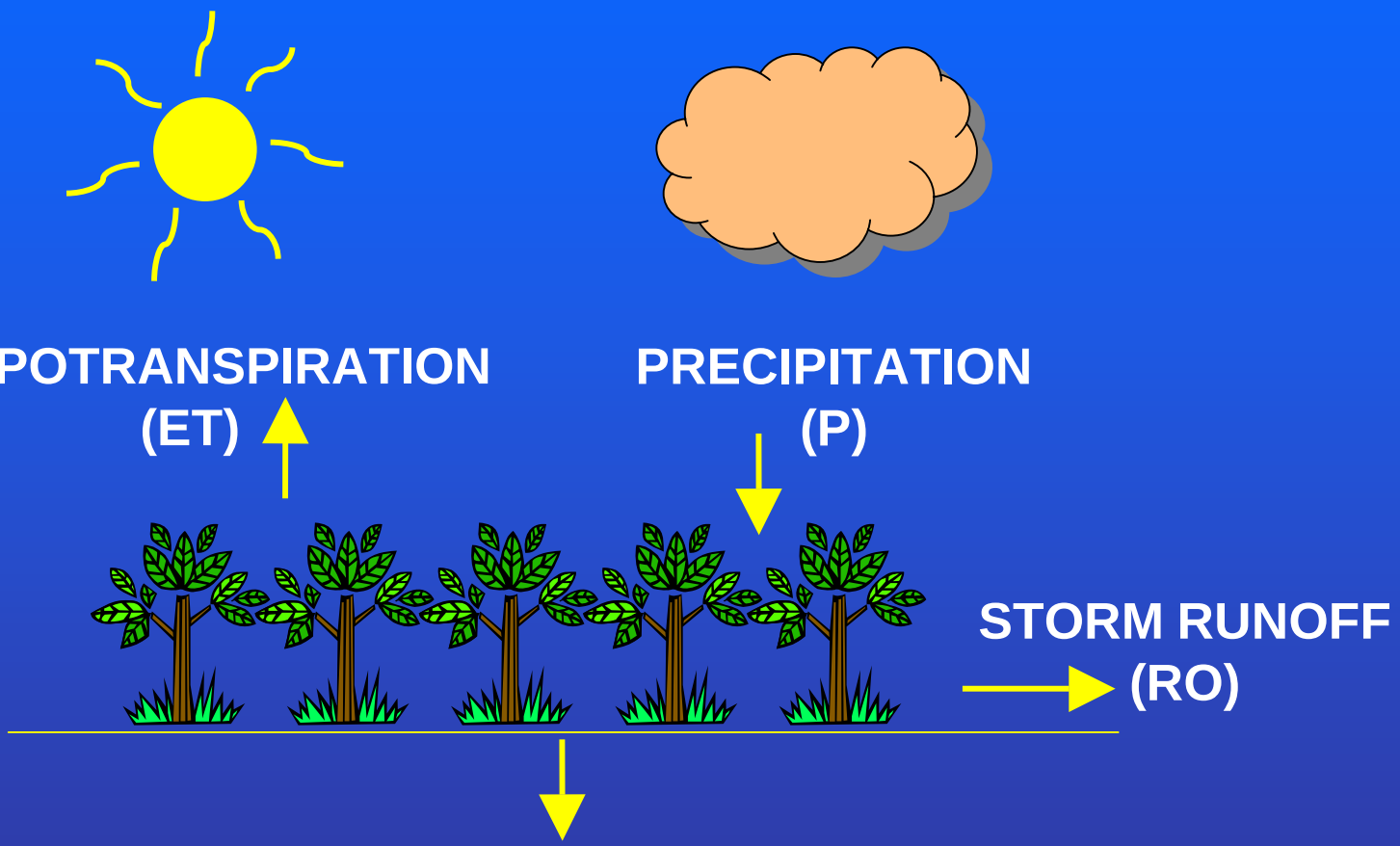
# Land Surface Water Budget




$$P = ET + RO + R$$

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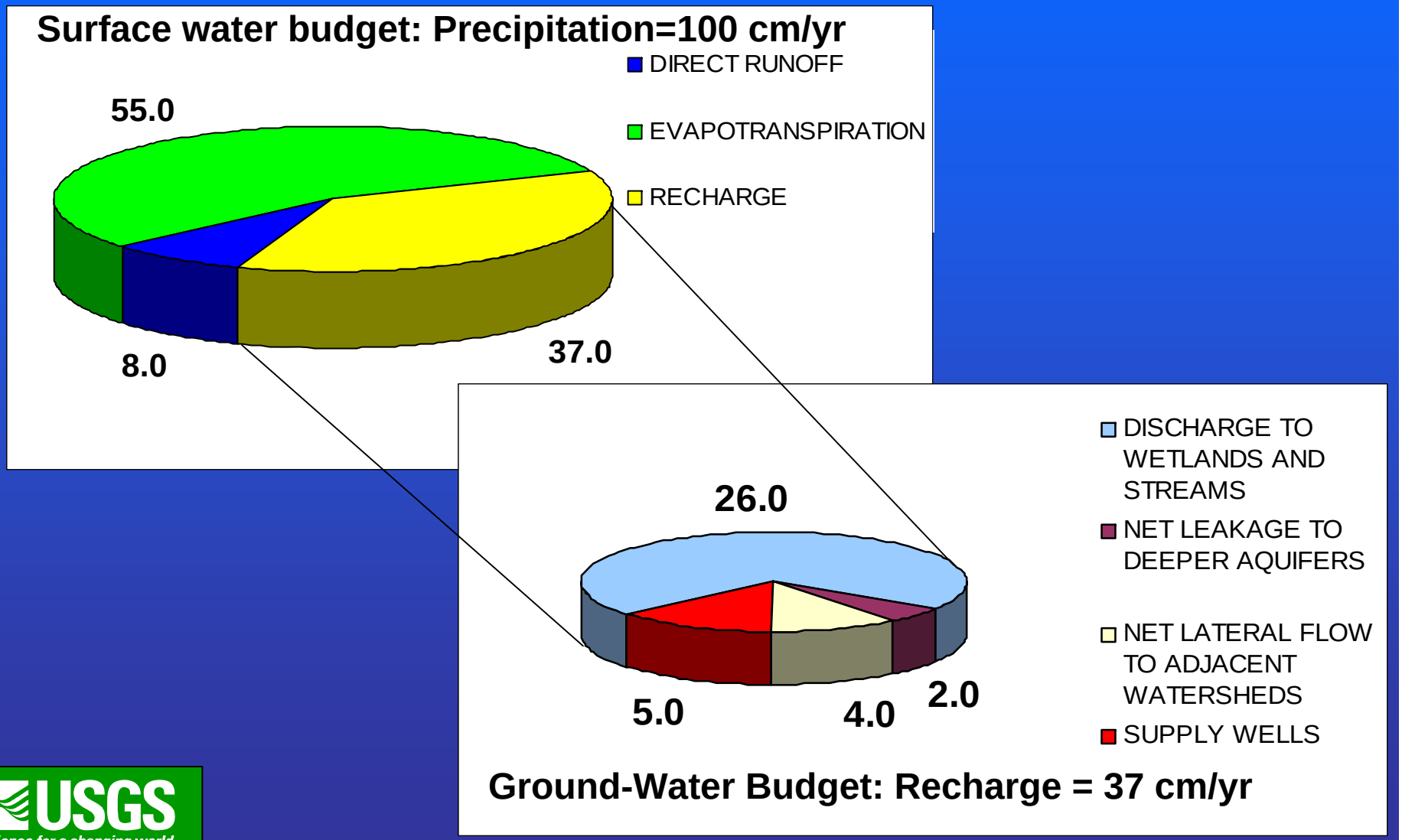
# Water Budget Example

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# Methods of ET Estimation

- Empirical (Thornthwaite - rough estimate for a region)
- Physically-Based Models (Penman-Monteith, Priestly-Taylor)
- Chamber methods
  - Surround all or part of individual plant; measure flux; extrapolate to larger area
- Micrometeorological methods
  - Profile method
  - Bowen ratio – energy budget
  - Eddy correlation

  methods allow:
  - high temporal resolution
  - spatial averaging

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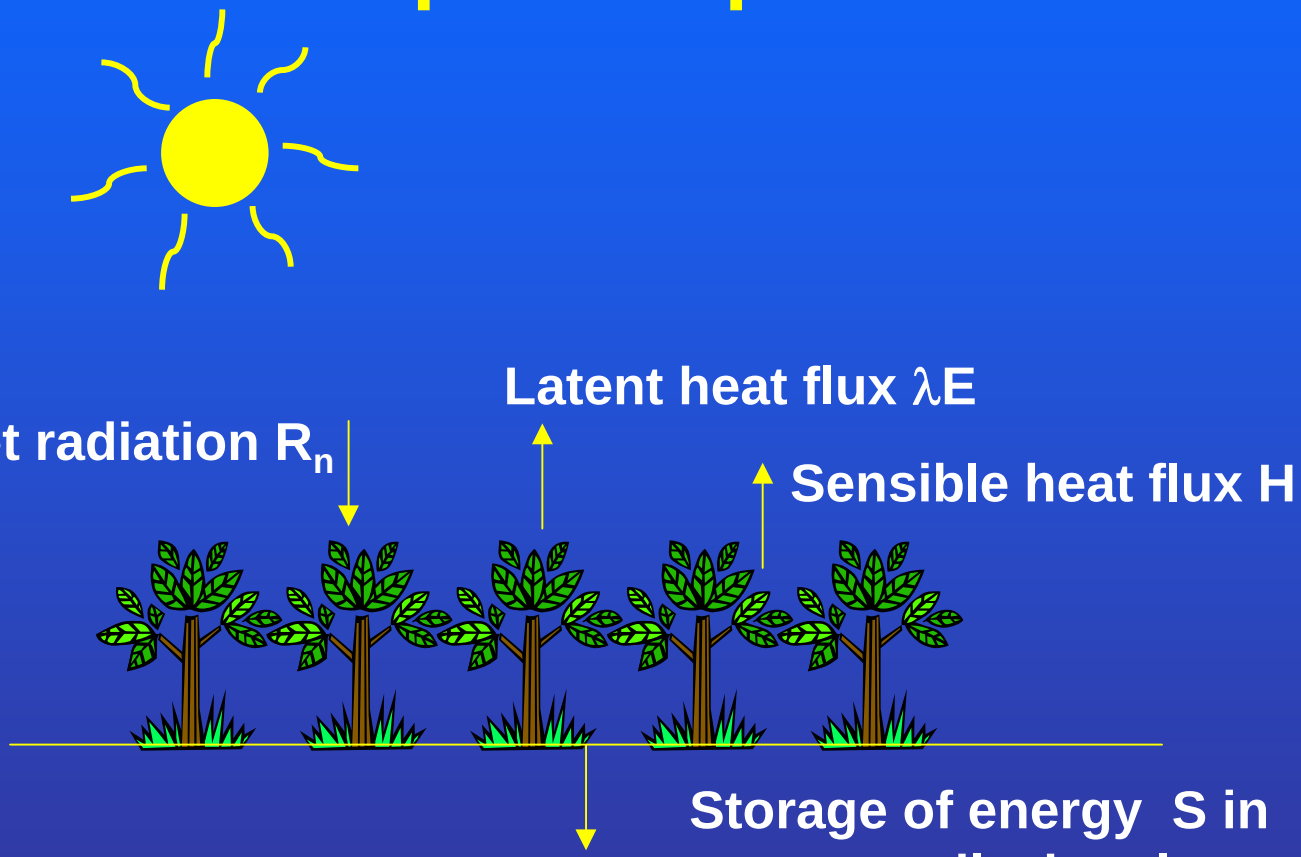
# Available energy driving evapotranspiration

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# Bowen ratio method

$$R_n - S = \lambda E + H$$

$$B = \frac{H}{\lambda E} = \frac{\gamma\, \Delta\text{temperature}}{\Delta\text{vapor pressure}}$$

$$\lambda E = \frac{R_n - S}{1 + B}$$

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# Eddy correlation method

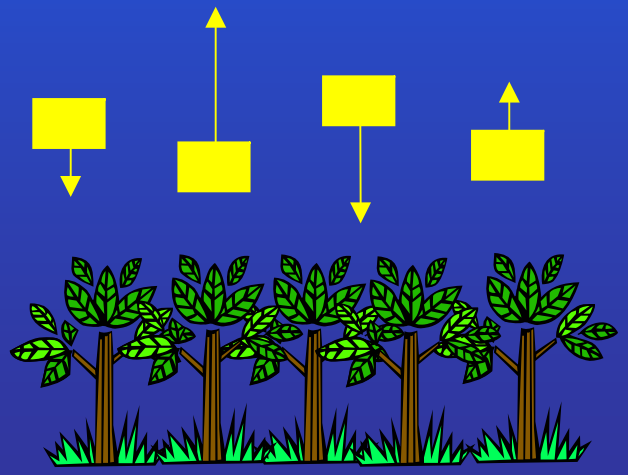
$$\overline{ET} = \overline{\rho_v w} = \mathrm{cov}(\rho_v, w)$$

$\rho_v$ = vapor density

w = vertical wind speed

…. and similarly for H

Use as “direct” ET measurement or use results in an energy balance variant method



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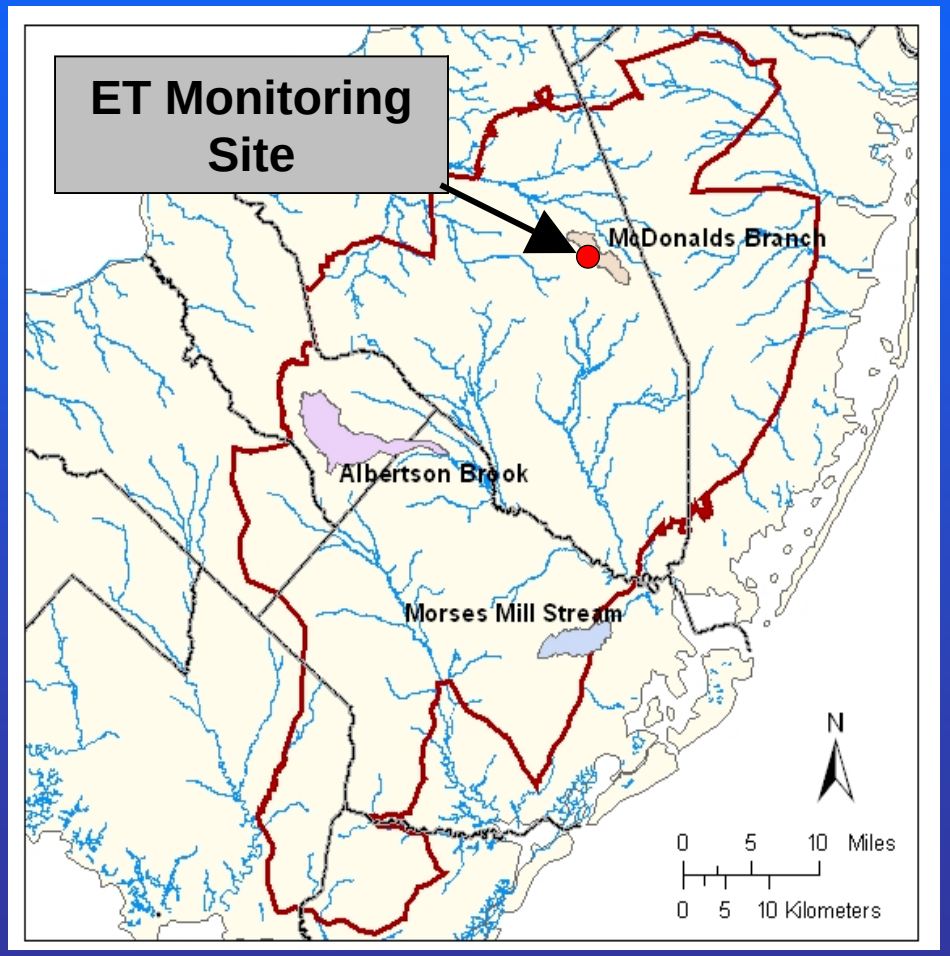
# Evapotranspiration Objectives

## Subseasonal ET estimates

## Relations between ET and

- Soil Moisture
- Depth to water
- Radiation

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# McDonalds Branch Tower Site Wetlands Vegetation


**Predominantly**

**pitch pine lowlands**

**Atlantic white cedar**

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# 80-ft Flux Tower at McDonalds Branch Site

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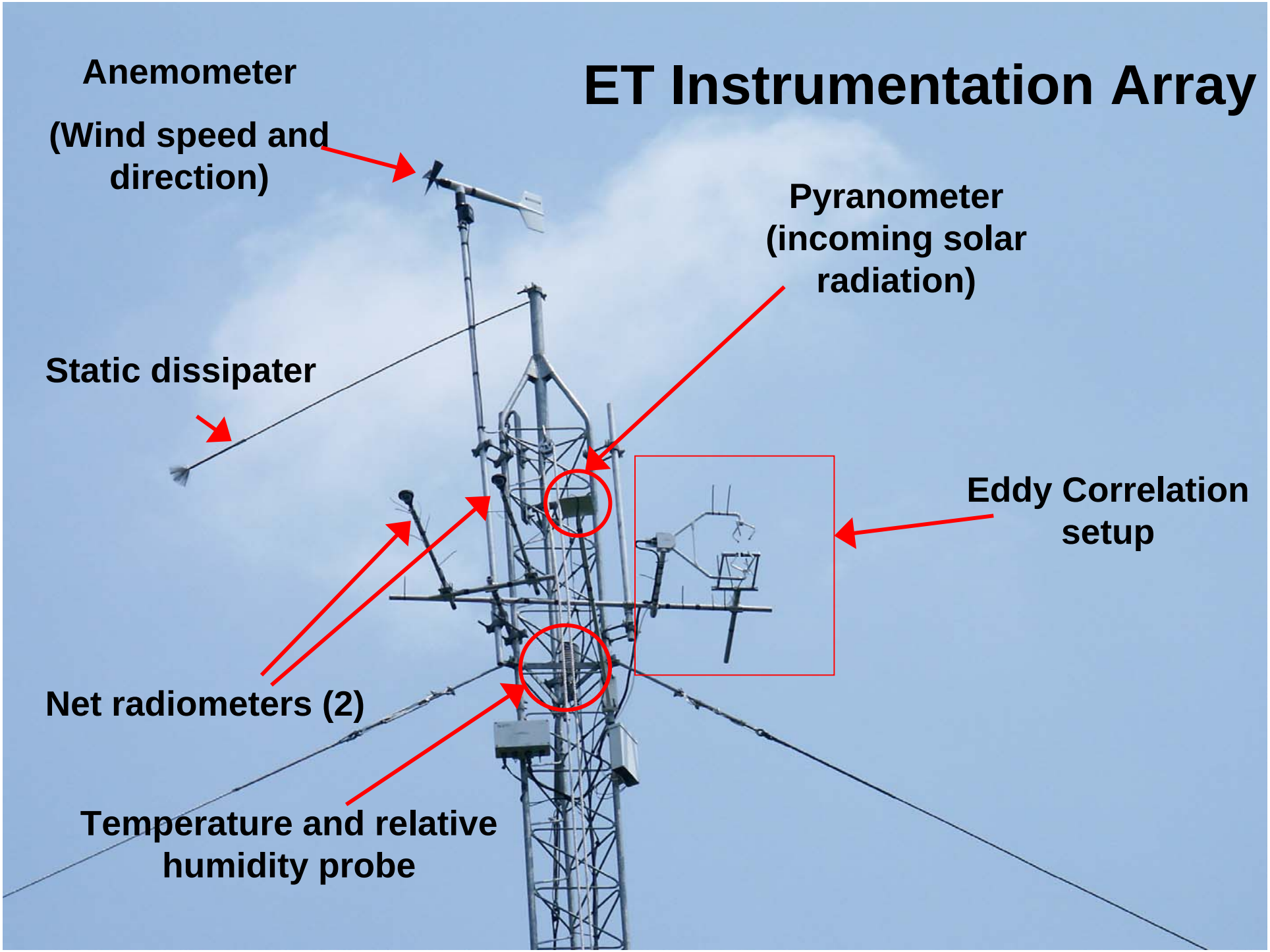
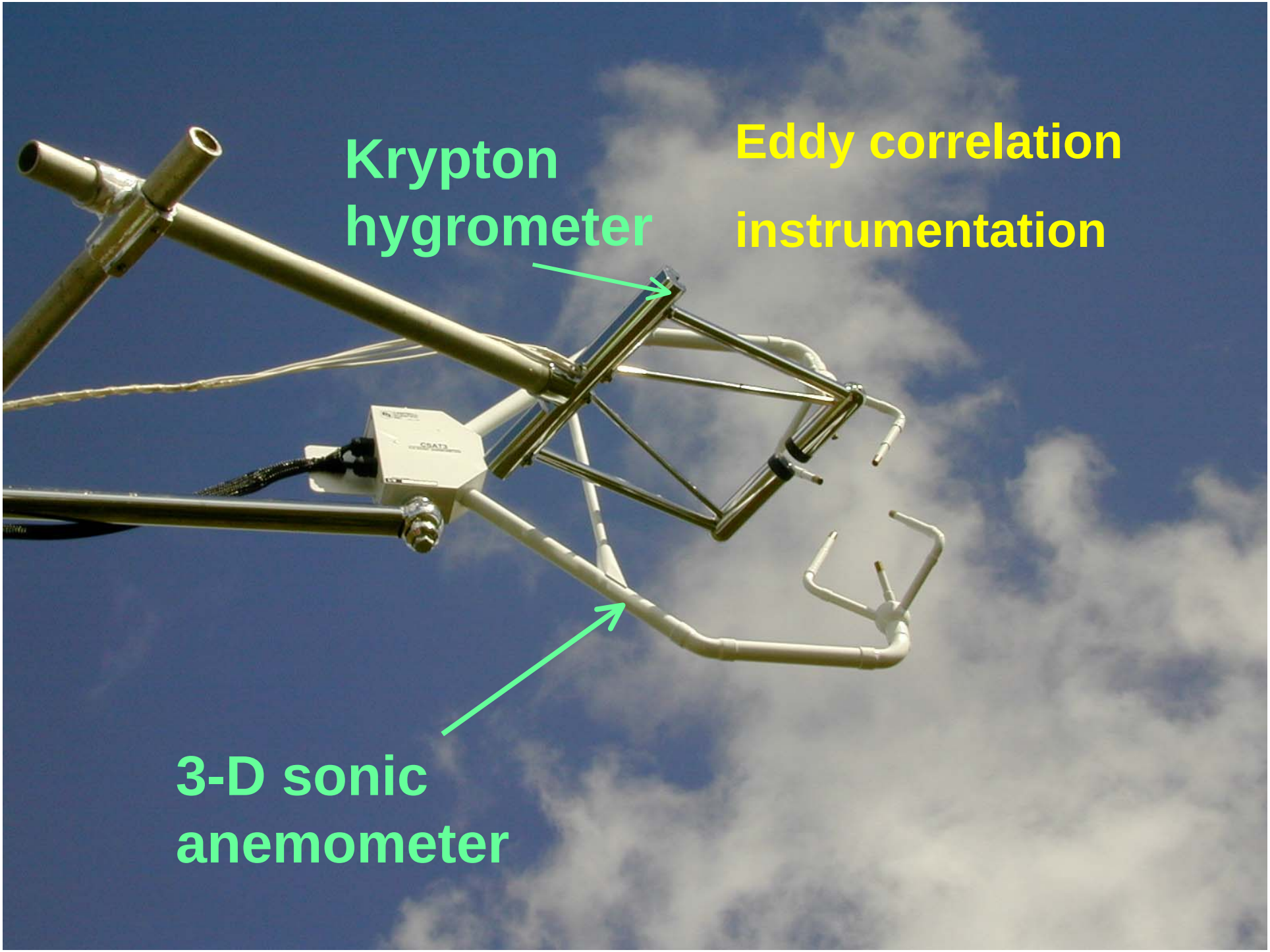
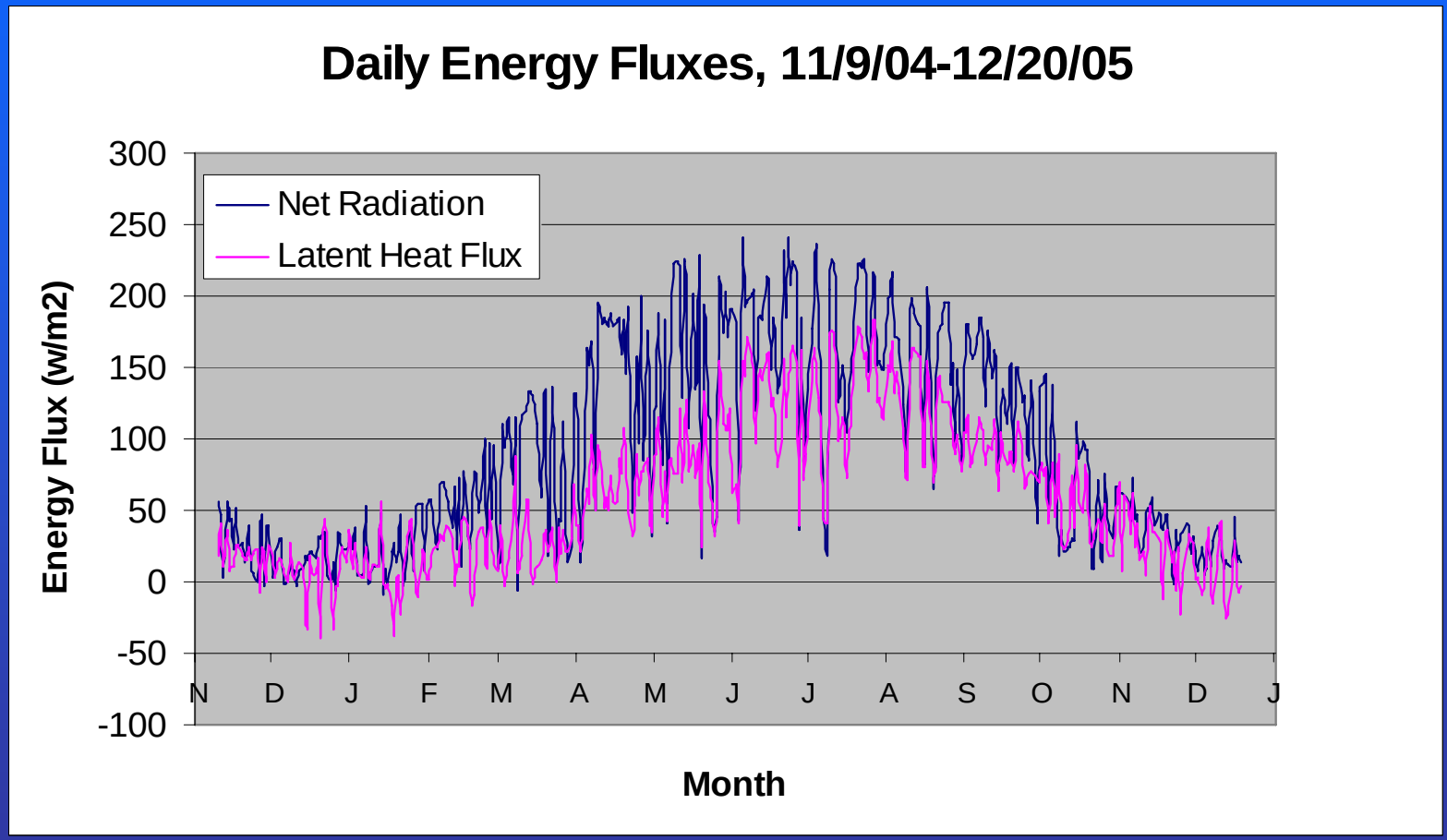

ET Instrumentation Array
Anemometer
(Wind speed and direction)
Pyranometer (incoming solar radiation)
Static dissipater
Eddy Correlation setup
Net radiometers (2)
Temperature and relative humidity probe


Krypton
hygrometer
Eddy correlation
instrumentation
3-D sonic
anemometer


DANGER
KEEP OFF


Atlantic Solar
12V110AH
Maintenance-free Sealed Lead-acid Battery
Pb.
Master

# Year 1 ET Monitoring Results

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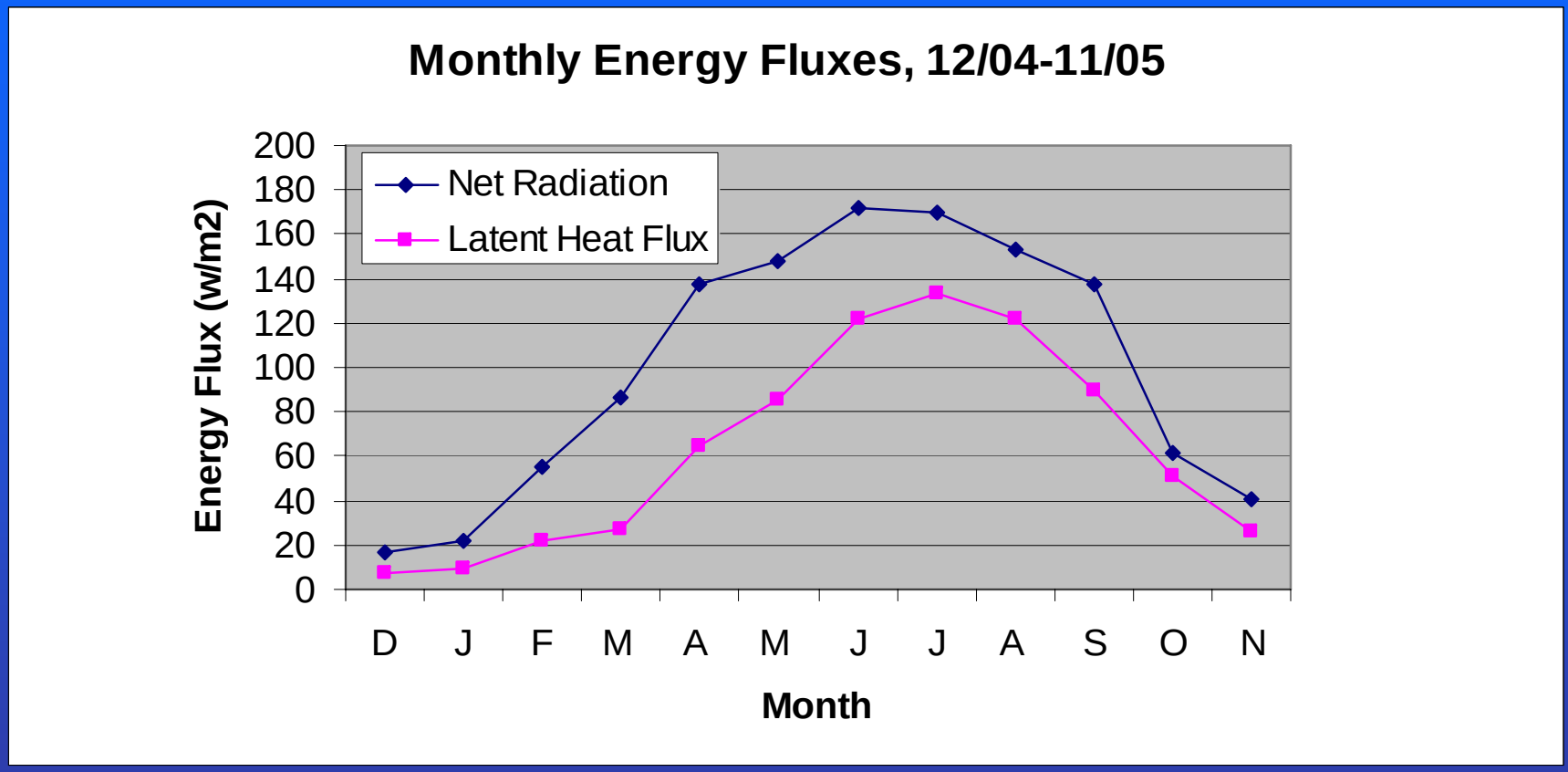
# Year 1 ET Monitoring Results




**1 w/m2 LE ~ 1.07 mm ET (depends on temperature)**

**Total ET for 12-month period was 81.4 cm, or about 32 “**

**Total precipitation was 120.8 cm, or about 48”**

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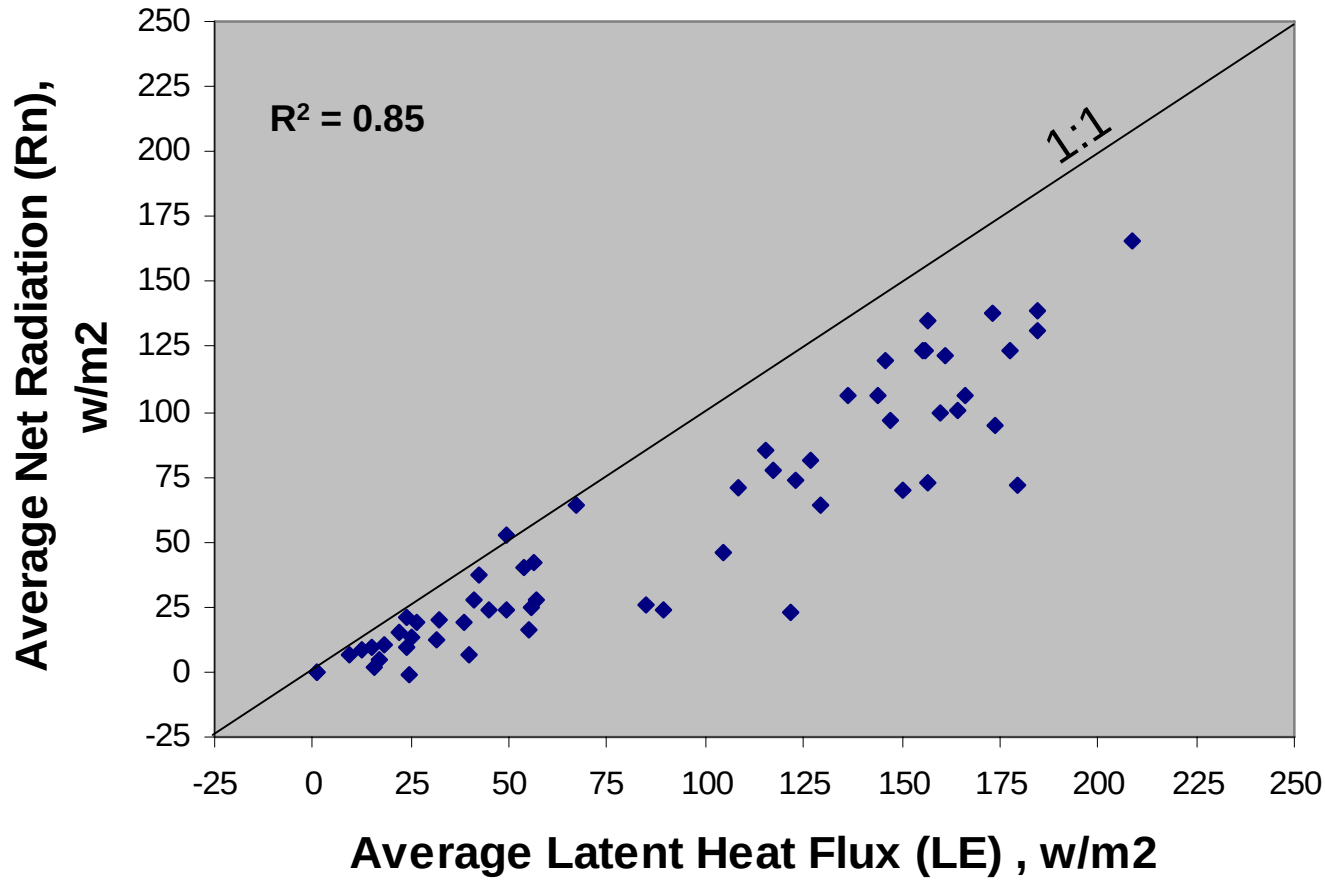
# Relation Between Weekly LE and Rn Measurements

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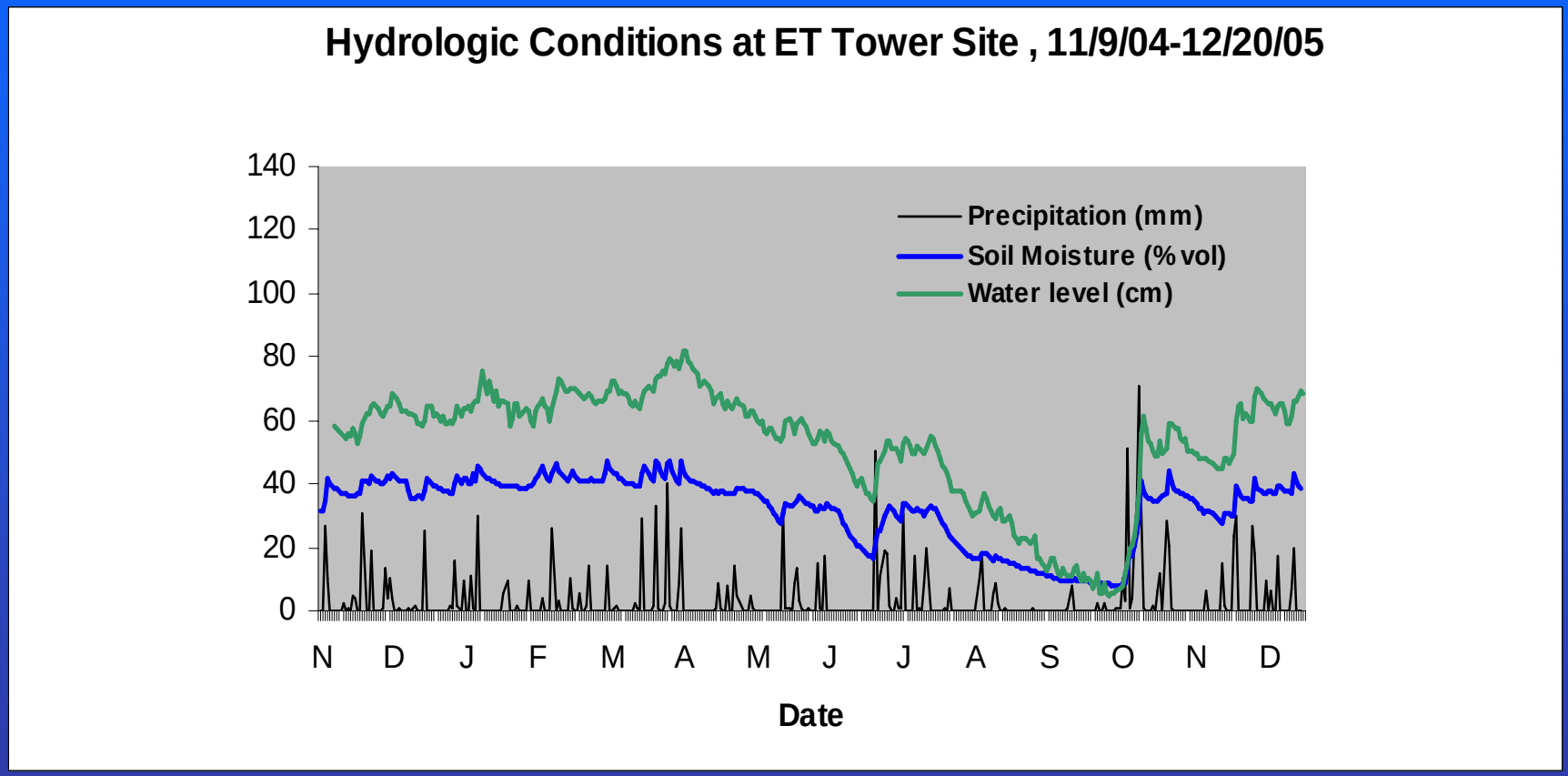
# Year 1 ET Monitoring Results

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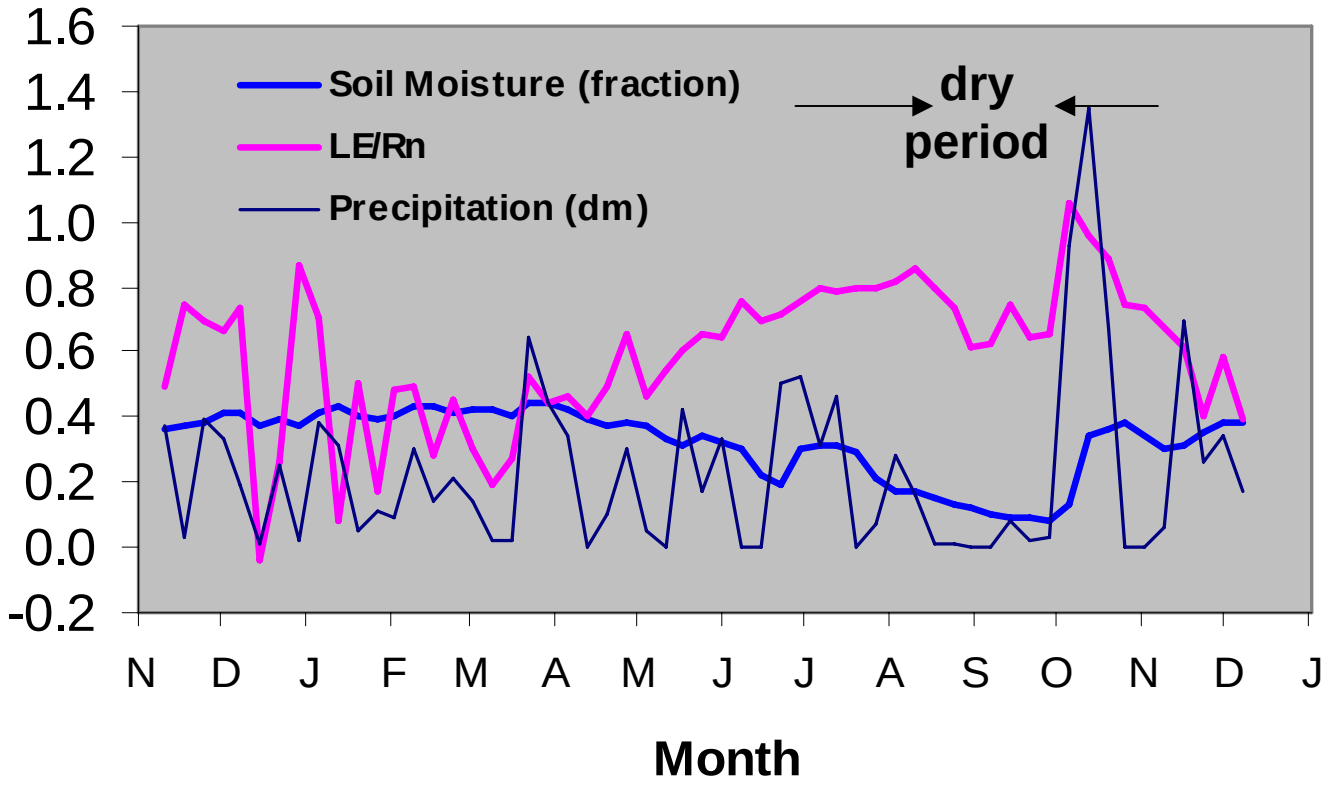
# Year 1 ET Monitoring Results

**Weekly Measurements Showing Lower LE during dry period**

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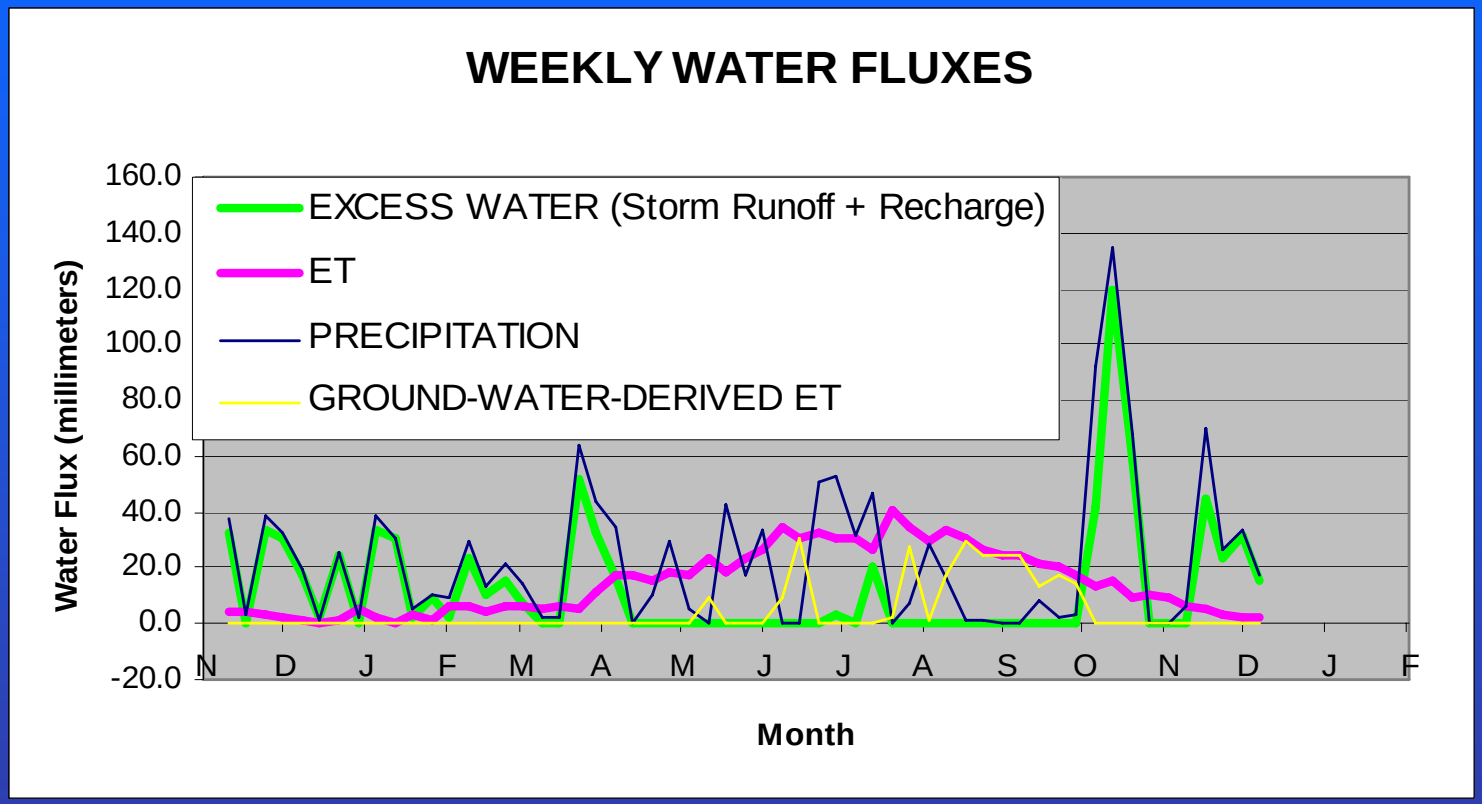
LE = Latent Heat Flux  Rn = Net Radiation

# ET Results in Water Budget

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# SUMMARY

## Evapotranspiration…

- is a large part of the water budget
- can be measured directly
  - ✓ Quantified on a daily basis
  - ✓ Spatially averaged
  - ✓ Related to other conditions
- monitoring can provide an improvement in quantitative analysis of water availability and drought conditions

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