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# Boreal Ecosystem Research and Monitoring Sites (BERMS)

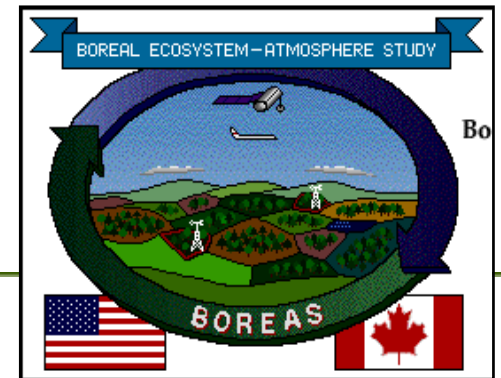
**Anne Walker**

**Climate Research Division, Environment Canada**

**Second Canadian SMAP Workshop  
November 16-17, 2010**



# The Boreal Ecosystem- Atmosphere Study (BOREAS)



## What BOREAS Was

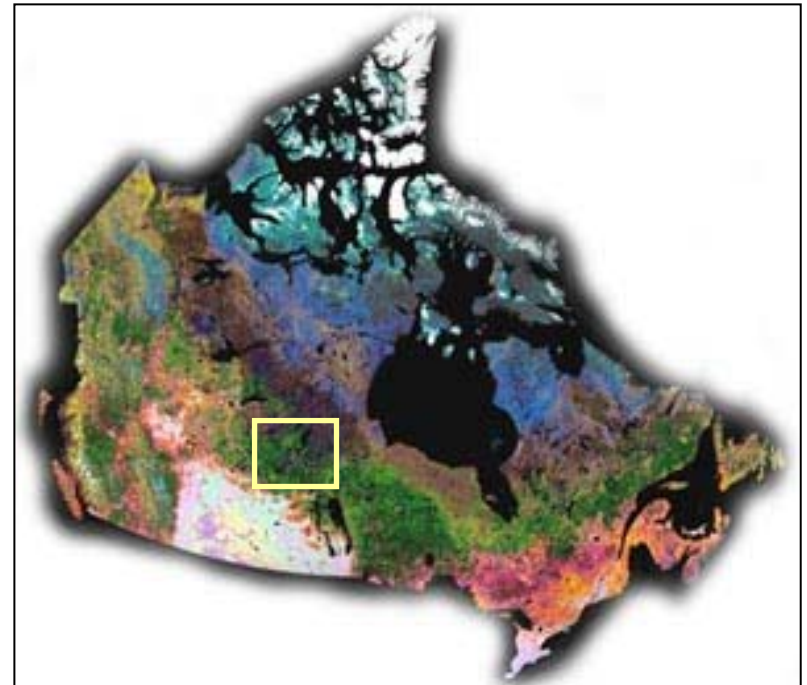
USA-Canada collaborative study of the role of boreal forest in global carbon budget and climate system, 1994 and 1996

## What BOREAS Found

- Modest carbon sink
- Sensitive to climate

## What BOREAS Missed

- Complete annual cycles
- Inter-annual variability
- Role of disturbance



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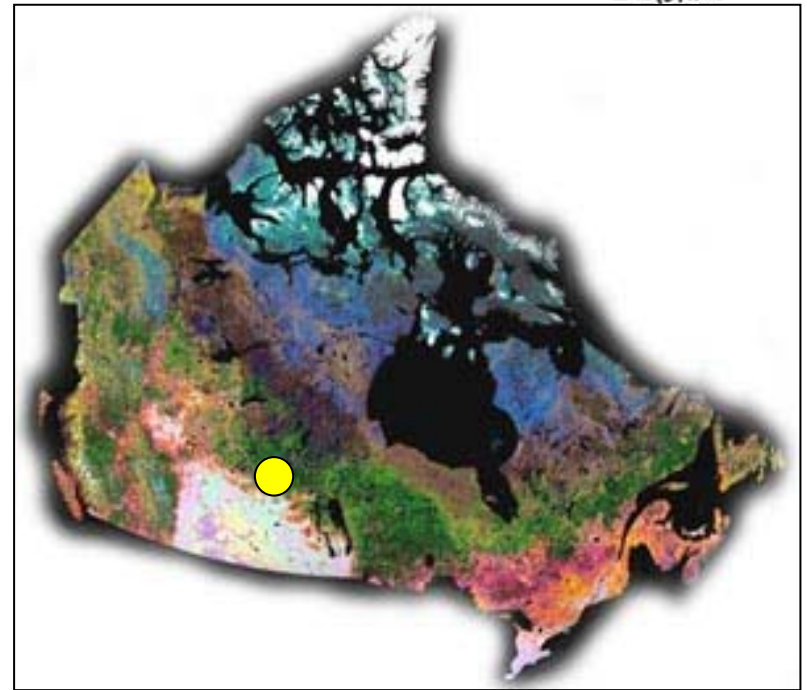
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# The Boreal Ecosystem Research and Monitoring Sites (BERMS)

A collaborative venture of Environment, Natural Resources and Parks Canada and university partners, 1997 to present

- BOREAS southern study area
- complete annual cycles
- inter-annual variability, climatic controls
- role of disturbance
- Fluxnet-Canada/  
Canadian Carbon Program  
flagship flux station since 2002



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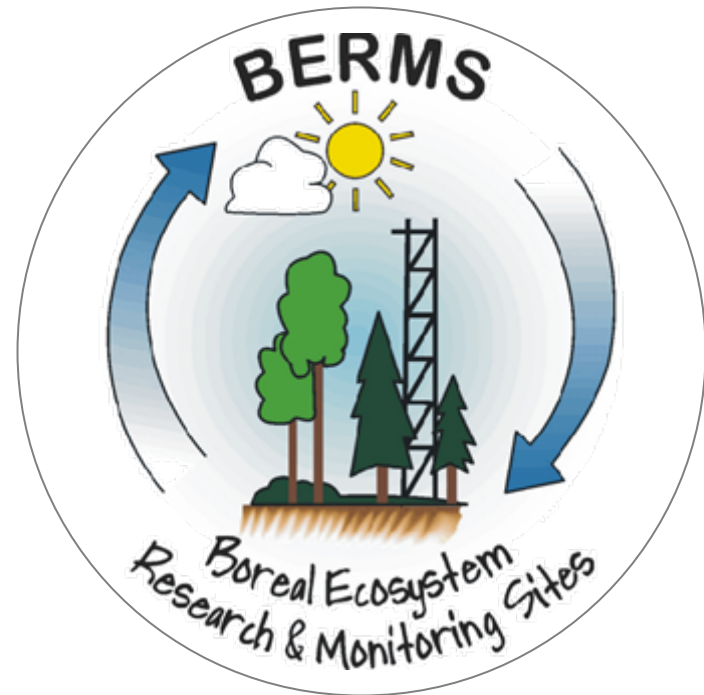
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# Objective

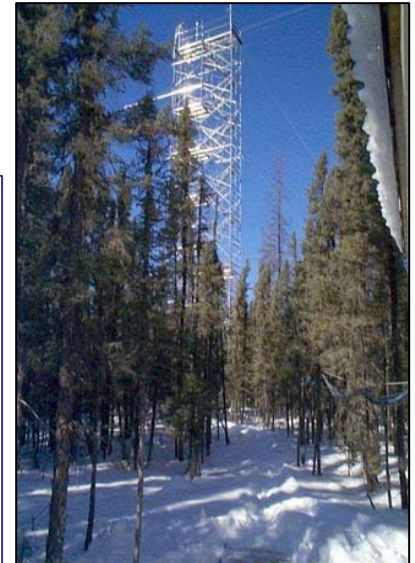
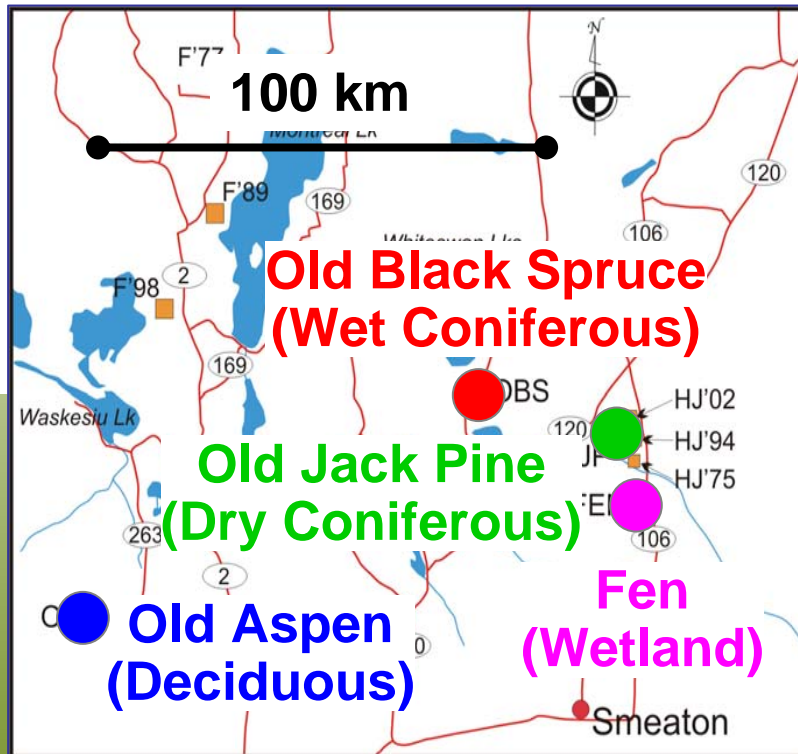
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**Understanding the influences of climate variability and disturbance on the carbon, water and energy cycles of the southern boreal forest**





# BERMS Mature Sites

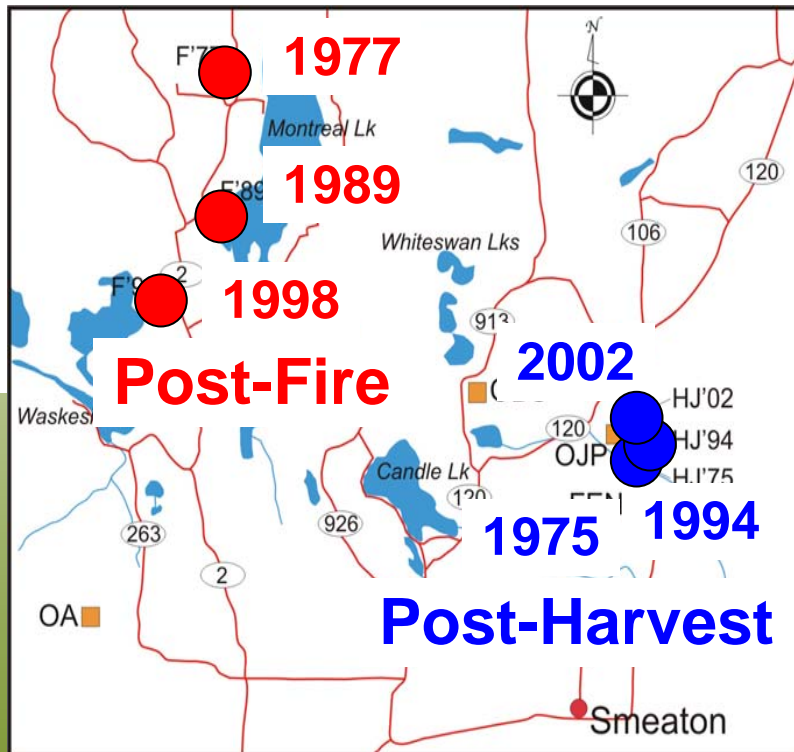


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# BERMS Disturbed Sites





# Flux and Climate Measurements at the BERMS Flux Tower Sites

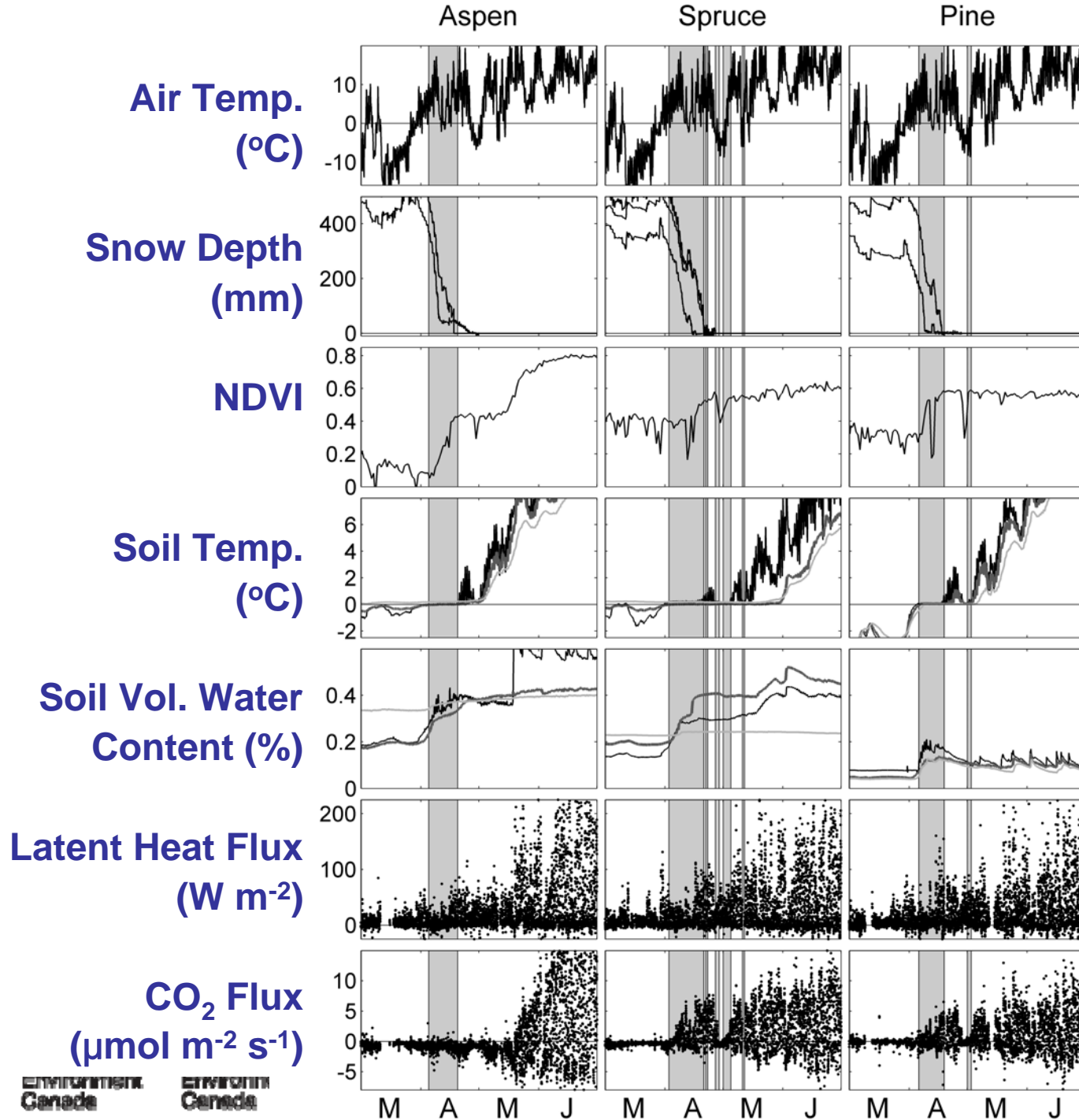
## Fluxes:

- Radiation balance (net, up and down: shortwave, longwave, and photosynthetically-active)
- Sensible and latent heat fluxes, CO<sub>2</sub> flux, momentum flux
- Soil heat flux, soil CO<sub>2</sub> efflux

## Climate:

- Air temperature, humidity & CO<sub>2</sub> profiles, wind speed, atmospheric pressure,
- Precipitation, snow depth
- Soil temperature profile, soil moisture profile, water table depth





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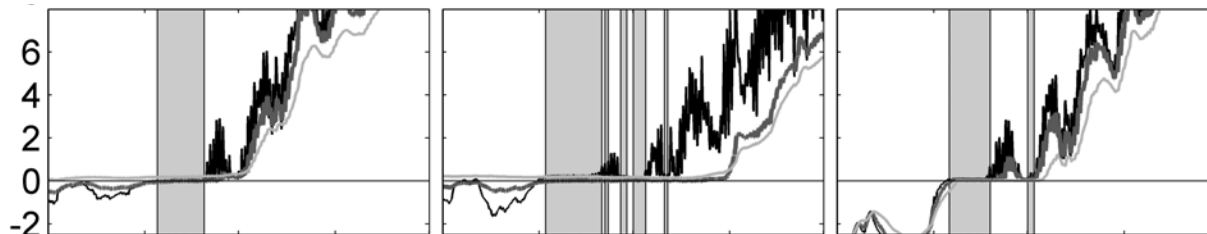


Aspen

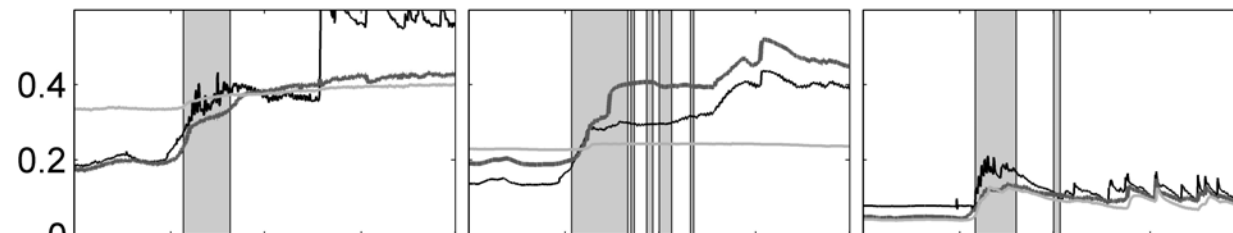
Spruce

Pine

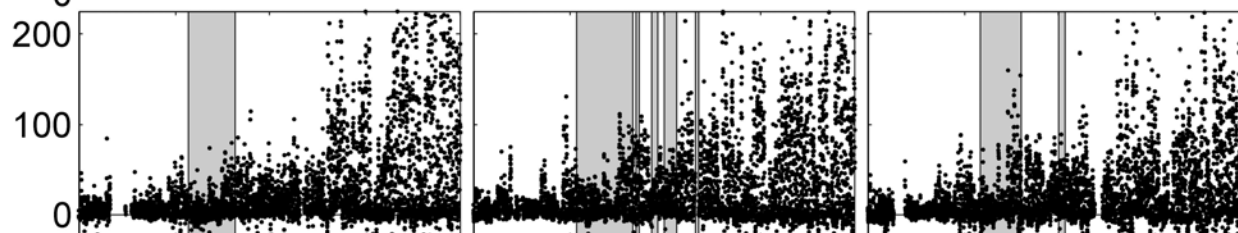
Soil Temp.  
(°C)



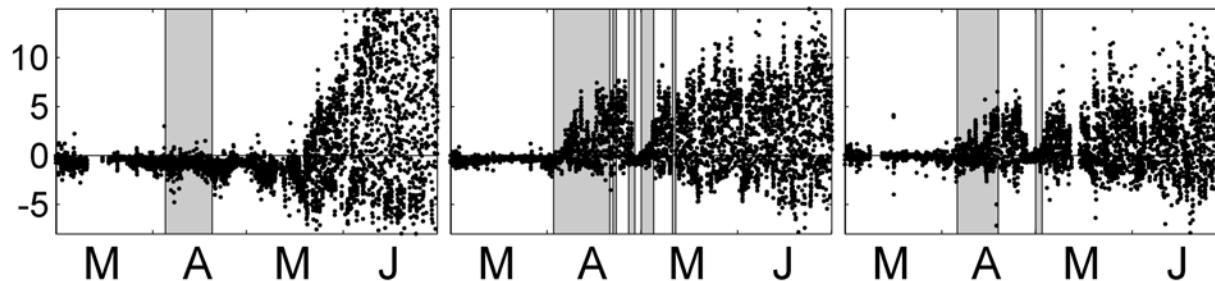
Soil Vol. Water  
Content (%)



Latent Heat  
Flux ( $\text{W m}^{-2}$ )



CO<sub>2</sub> Flux  
( $\mu\text{mol m}^{-2} \text{s}^{-1}$ )



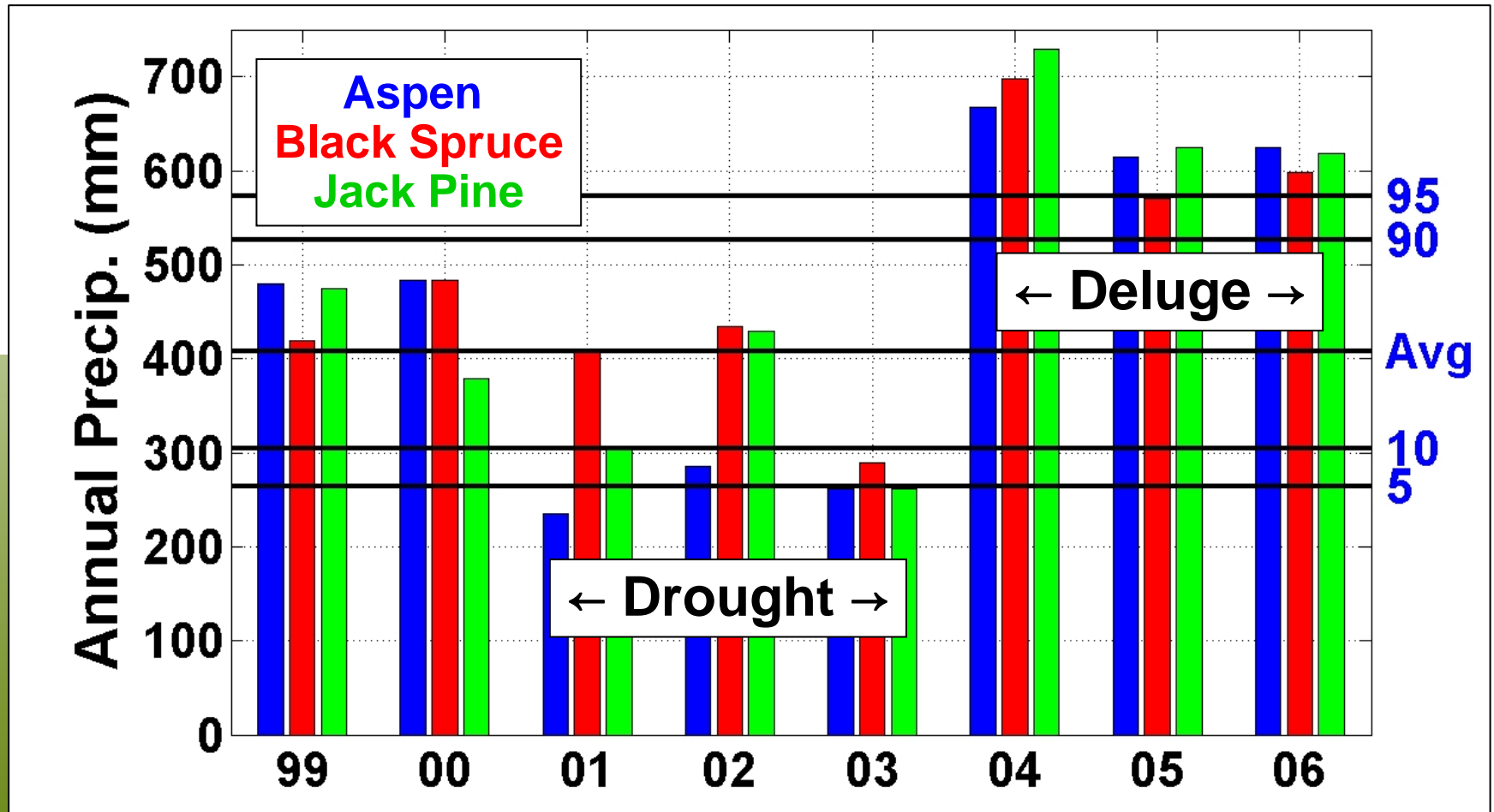
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# Annual Precipitation 1999 to 2006

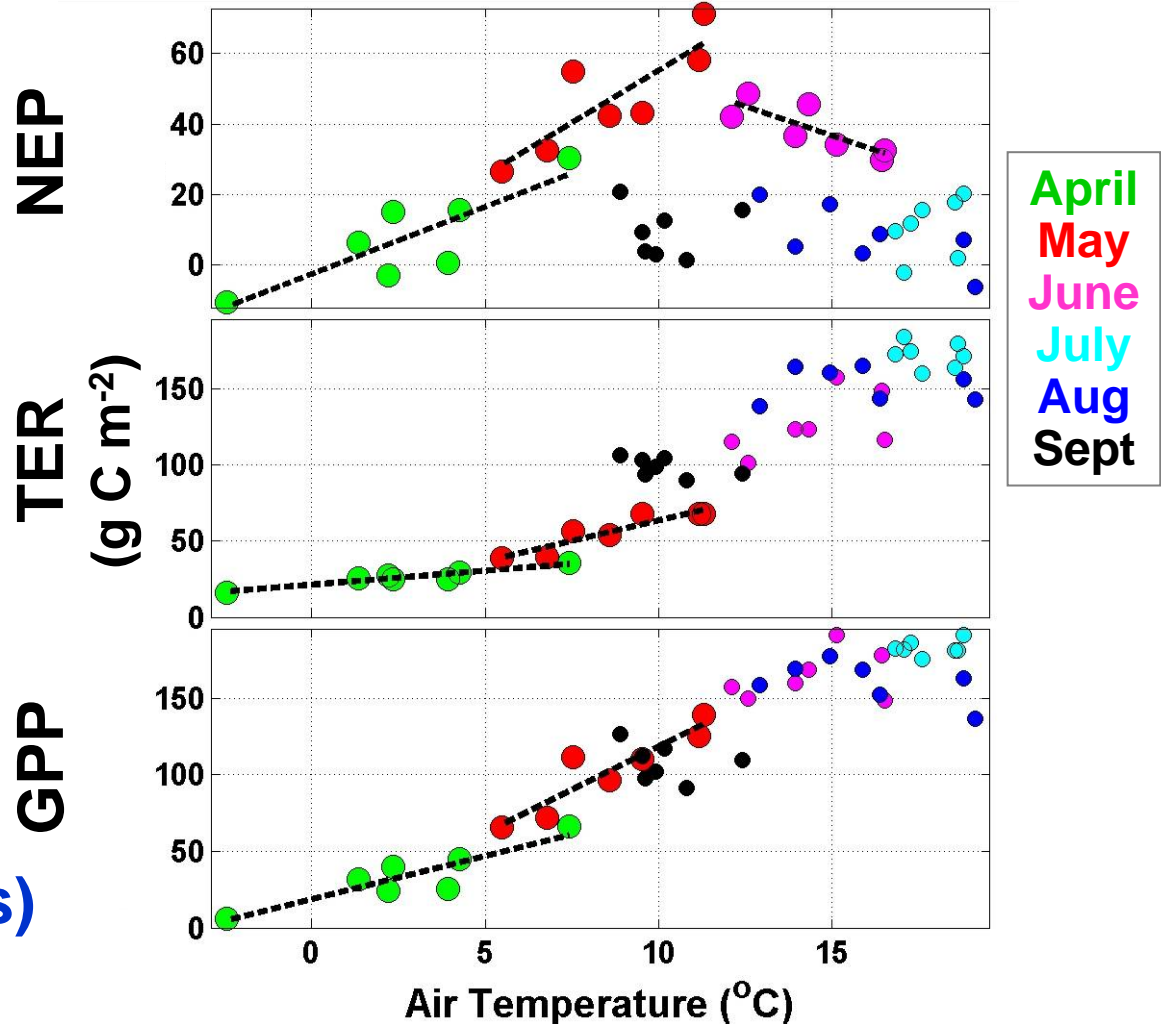
(The horizontal lines show percentiles  
from Prince Albert, 1900-2000)



# Monthly Carbon Fluxes vs. Monthly Mean Air Temperature, Old Black Spruce 2000-2006

(Dashed lines are plotted when linear-regression  $p \leq 5\%$ )

$$\begin{array}{l} \text{NEP Net} \\ \text{Ecosystem} \\ \text{Production} \\ = \\ - \text{TER Total} \\ \text{Ecosystem} \\ \text{Respiration} \\ + \\ \text{GPP Gross} \\ \text{Primary} \\ \text{Production} \\ \text{(Photosynthesis)} \end{array}$$



# Access to BERMS data

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- BERMS database of flux and meteorological measurements is maintained at Environment Canada
  - Contact: Erin Thompson ([erin.thompson@ec.gc.ca](mailto:erin.thompson@ec.gc.ca))
- BERMS data have been submitted to Fluxnet-Canada/CCP Data Information System since 2002 ([www.fluxnet-canada.ca](http://www.fluxnet-canada.ca))
  - CCP DIS operated by Environment Canada; Contact: Alan Barr ([alan.barr@ec.gc.ca](mailto:alan.barr@ec.gc.ca))
- BERMS data also submitted to international databases:
  - FLUXNET([www.fluxnet.ornl.gov](http://www.fluxnet.ornl.gov))
  - WCRP/GEWEX CEOP (Coordinated Energy and Water Cycle Observations Project – [www.ceop.net](http://www.ceop.net)); BERMS is a CEOP Reference Site





# Status of BERMS after March 2011?

- Fluxnet-Canada/CCP funding to university partners has supported flux measurements at BERMS since 2002
- CCP funding was due to end in March 2010 but Natural Resources Canada provided bridge-funding for 1 additional year
- Reduced operating budgets at Environment Canada
- Unlikely to be able to operate all 7 flux tower sites after March 2011
- Natural Resources Canada (CFS) taking the active lead to find support for the continuation of Canadian flux tower networks beyond 2010/11.
  - Initiated development of a 10-year Forest C Cycle Science Plan
- Future of BERMS is uncertain

