NACP, SAN DIEGO, CALIFORNIA

Observing and Modelling the Carbon Cycle of Northern Forests

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Université Laval (Quebec City)

Robert Grant
University of Alberta (Edmonton)

and

The Canadian Carbon Program Science Team

Canada's land mass is:

- 45% of North America
- Similar in size to Europe (10 M km^2 each)
- Contains 10% of the world's forests.

Canadian Carbon Program / Fluxnet-Canada

WHAT DO WE DO?

We Make High-Quality Field Measurements of the Carbon Cycle to Help Develop and Test Predictive Models of How Northern Forests and Peatlands Respond to Climate Variability and Disturbance

Canadian Carbon Program / Fluxnet-Canada

WHO ARE WE?

~40 Canadian University and Government Scientists
~50 Graduate Students and Postdocs

Funded for 2002-2010

Network Measurement Components:

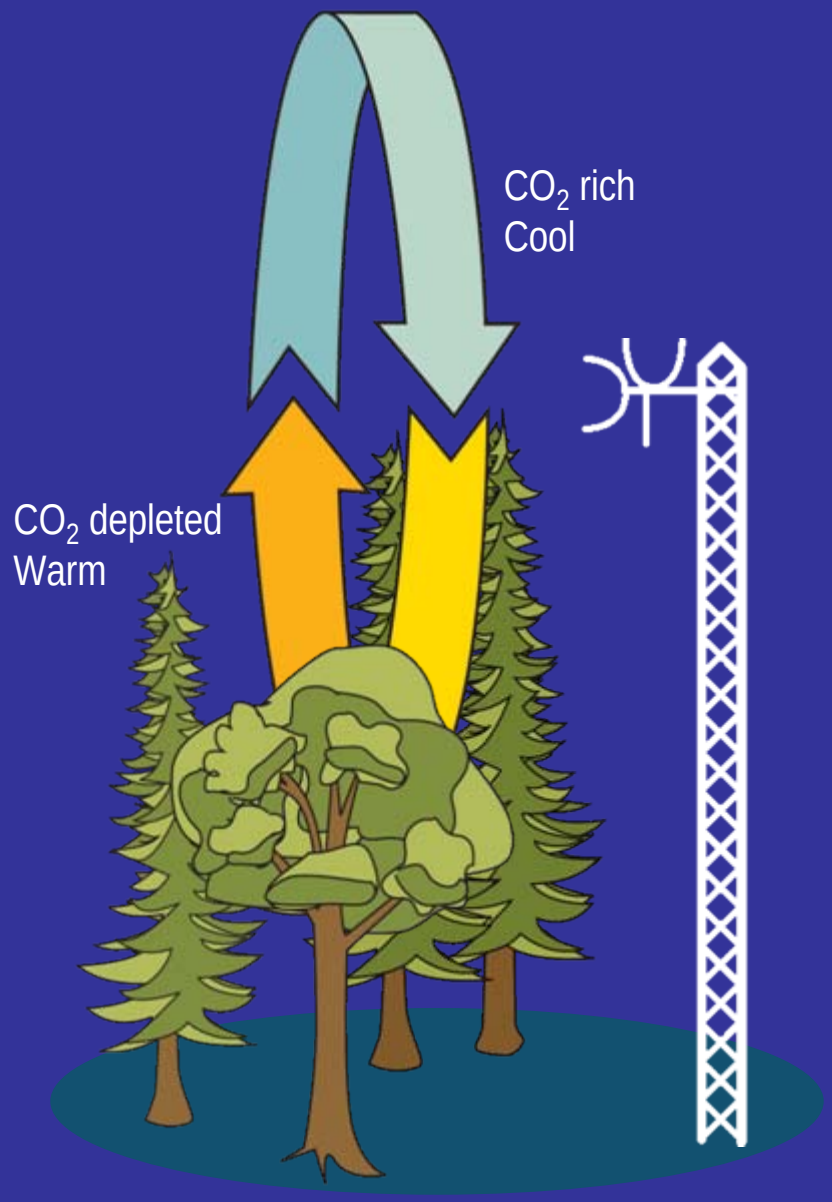
Ecosystem Fluxes: Impacts of Interannual Climate Variability and Disturbance

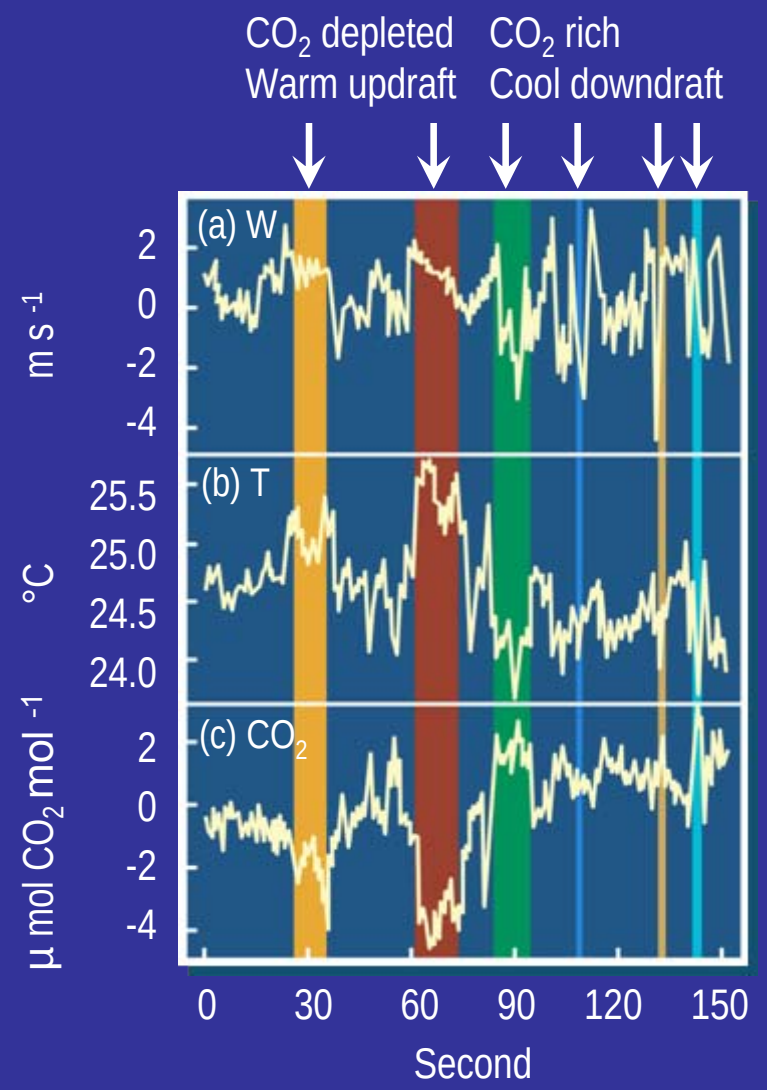
High-Precision Atmospheric Greenhouse Gas Concentrations & Related Isotopes

Network Modelling Components:

Regional, National, and Continental Scale Modelling of Carbon Sources and Sinks

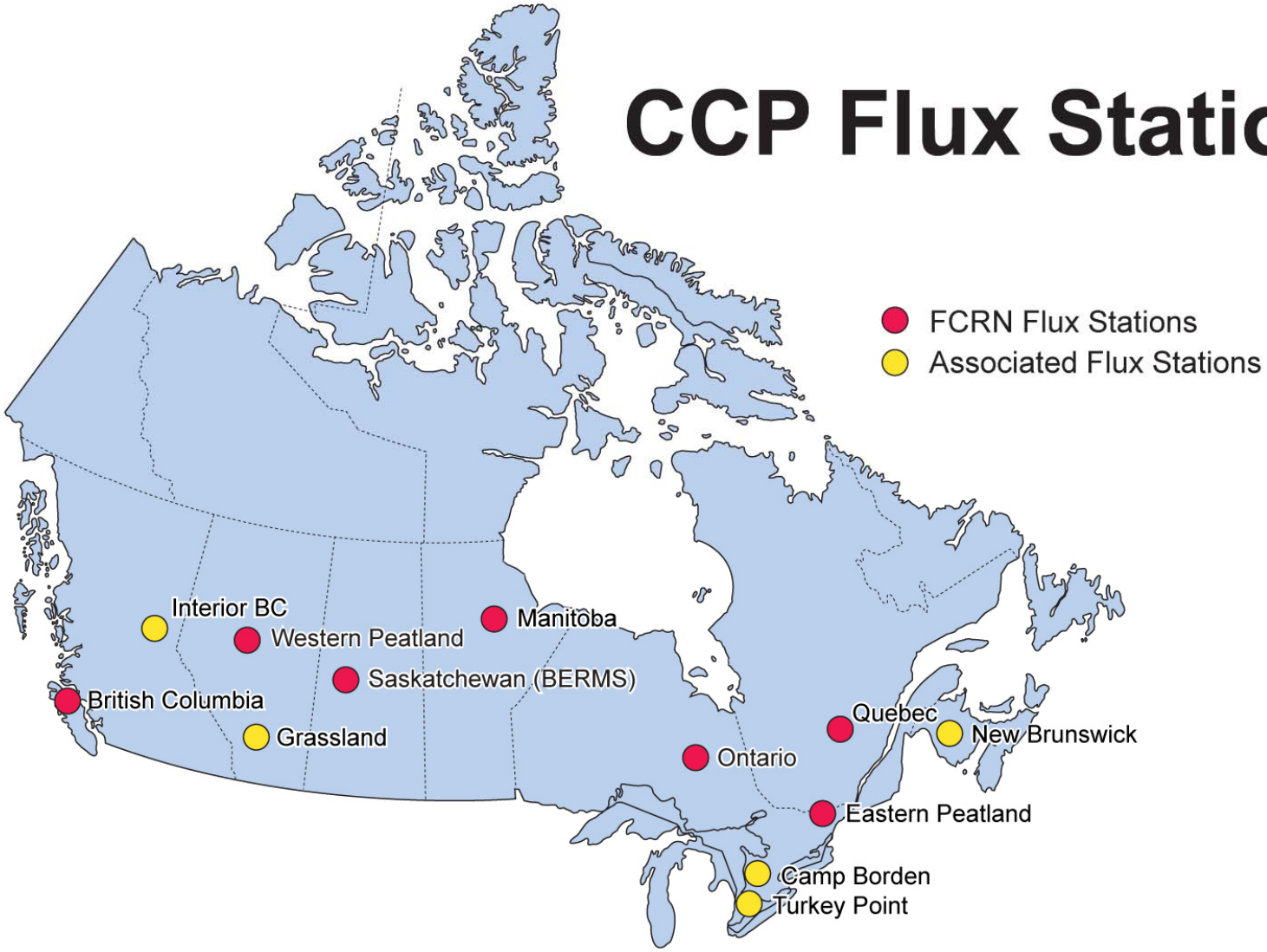
Bottom-Up Process Modelling to Support Forest Carbon Accounting System





$$F_{CO_2} = \overline{w'CO_2'}$$

CCP Flux Stations



Fluxnet-Canada: 2002-2007
Canadian Carbon Program (CCP): 2007-2010

Sample of Results and Interesting Activities

- Disturbance
- Forest Fertilization
- Autumn Warming Versus Autumn Cooling
- Process Modelling : Ecosystem Response to Changes in Temperature at Different Time Scales
- Assessing Forest C Stocks from Space

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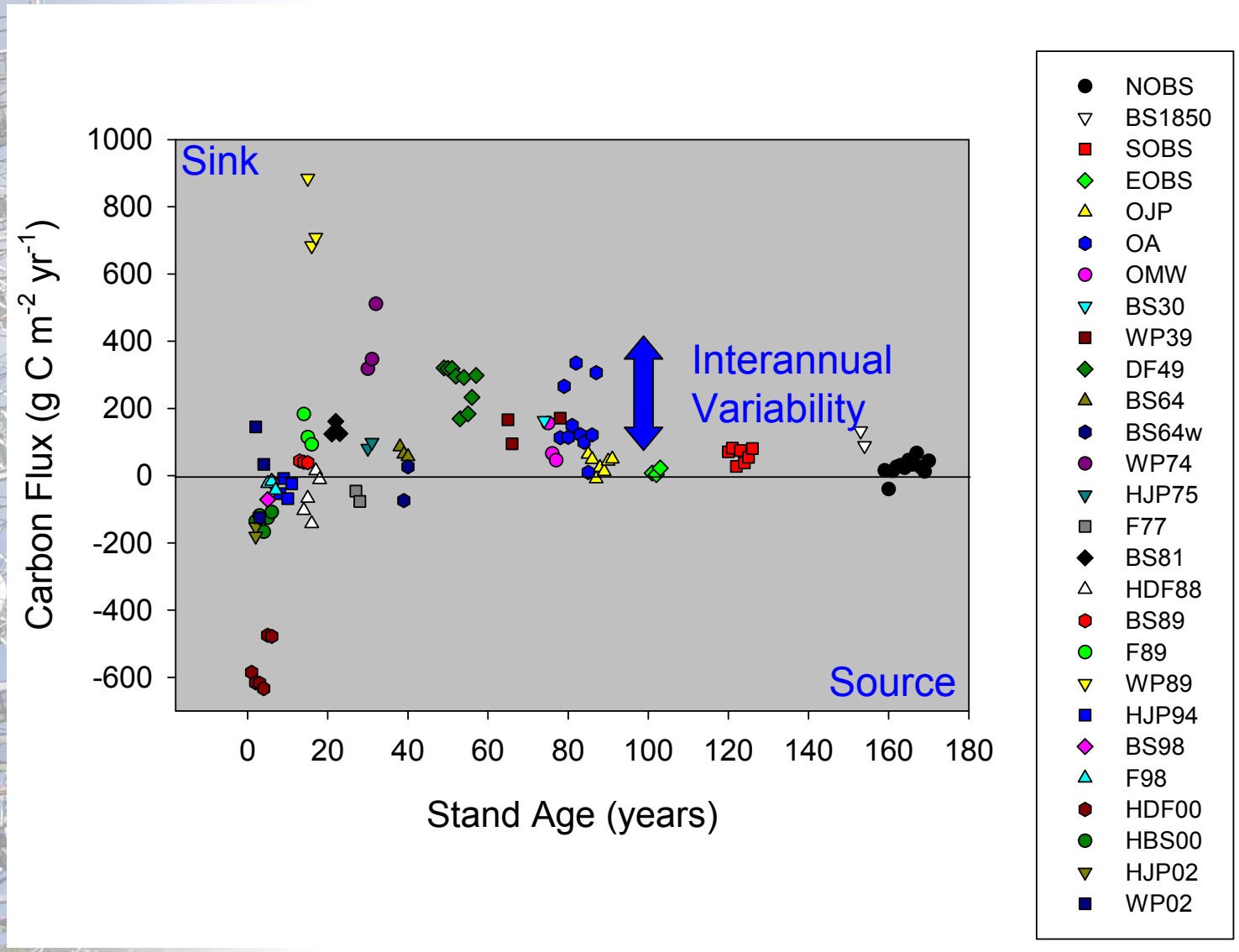
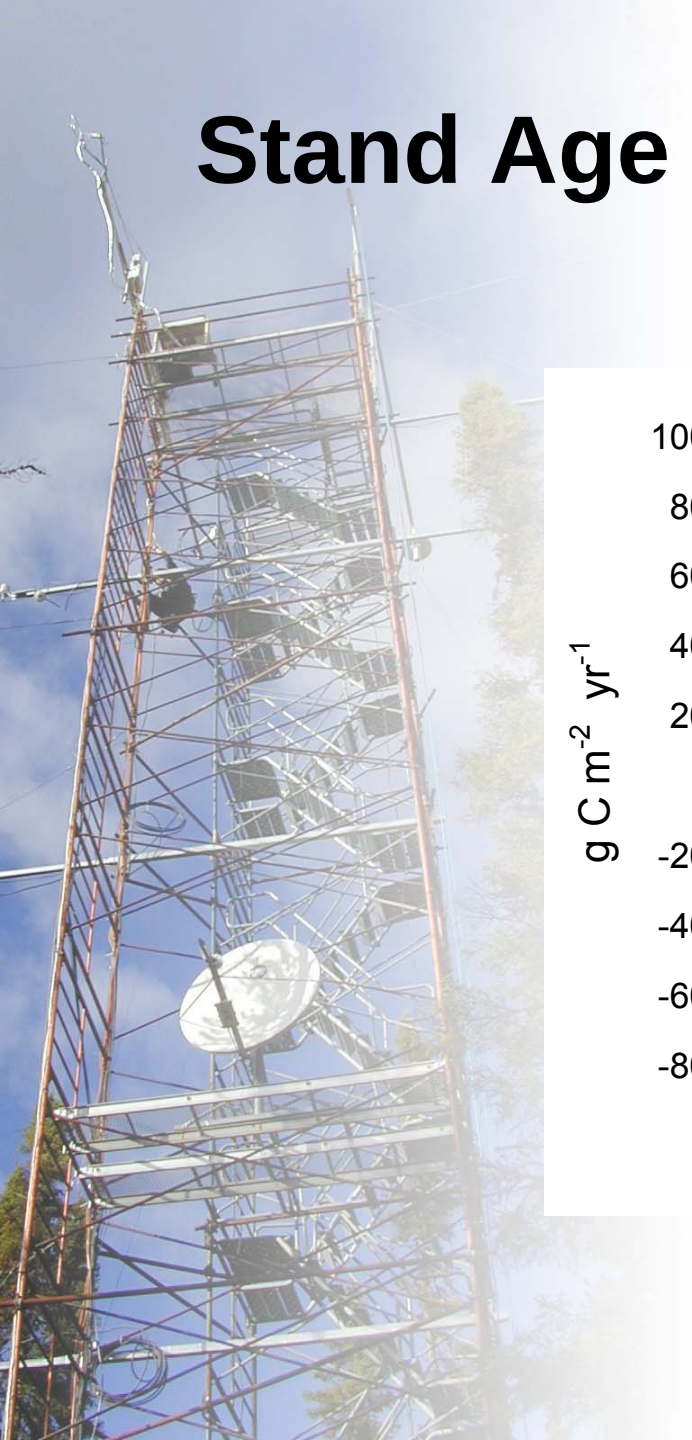
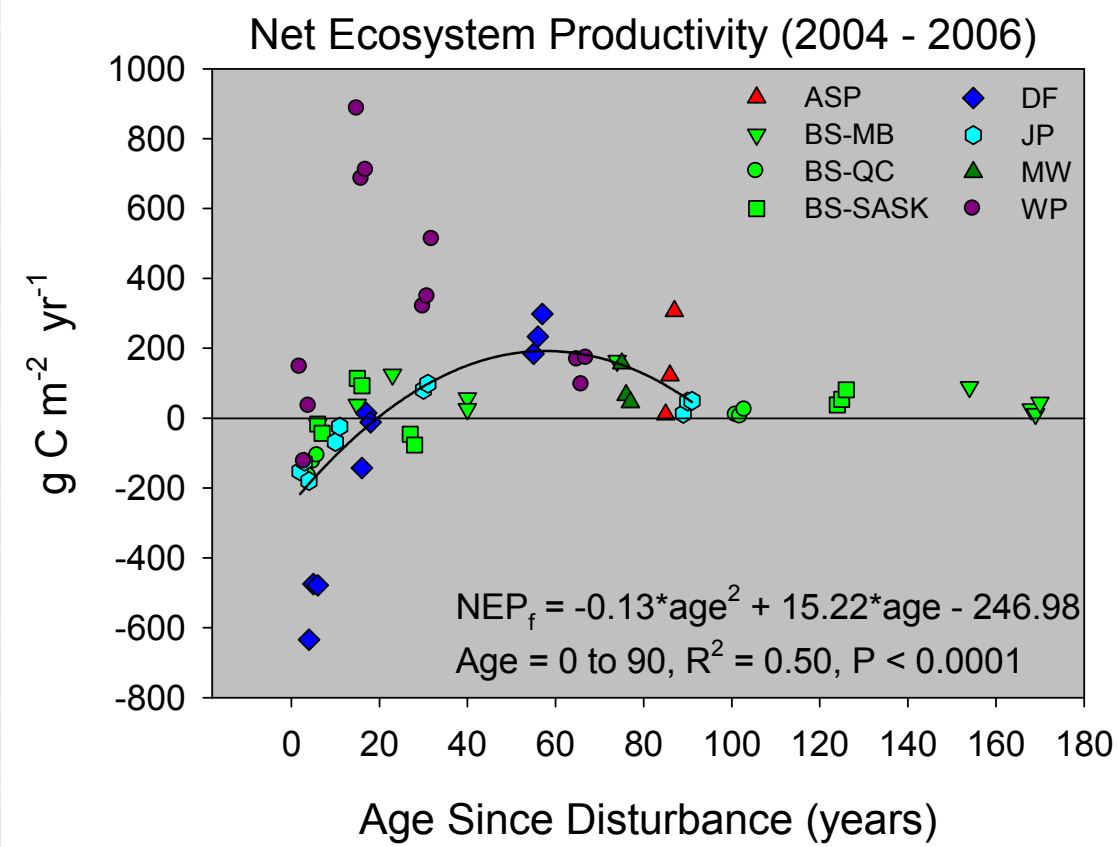
Annual Carbon Budgets



Stand Age & Carbon Sequestration





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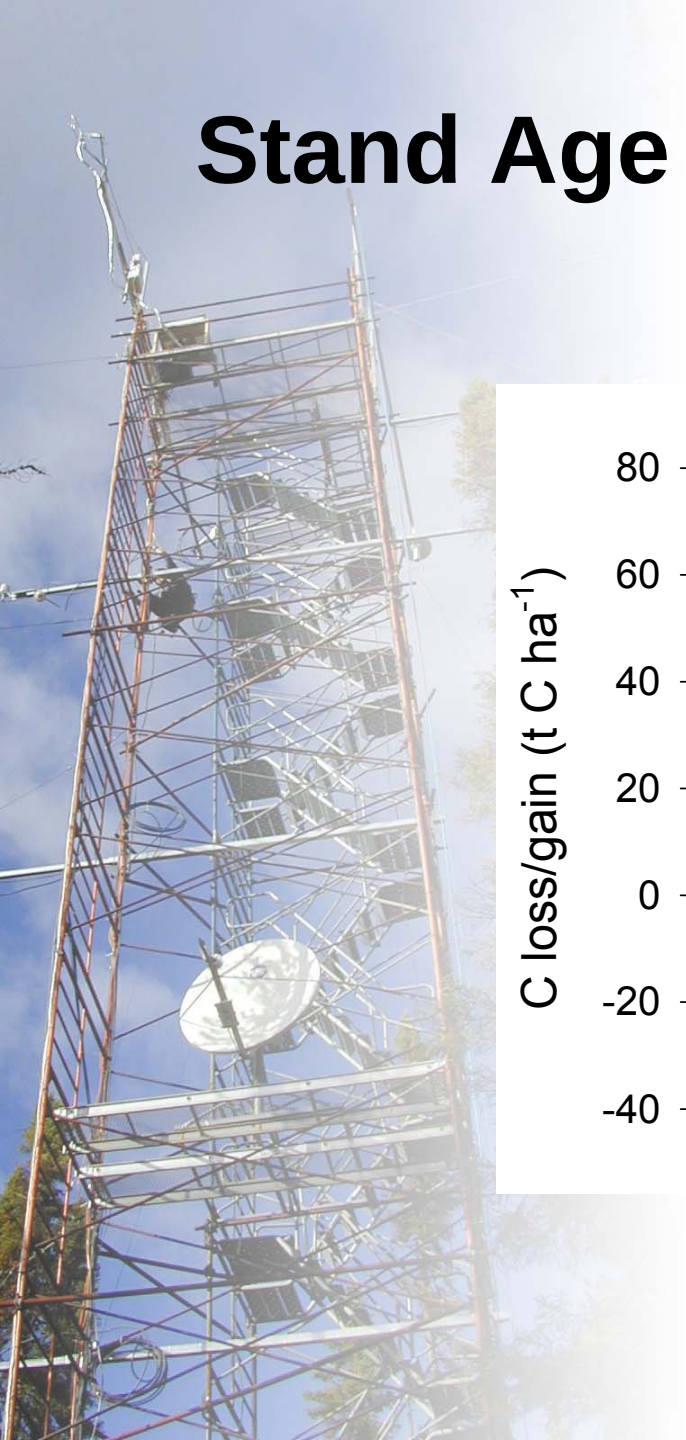
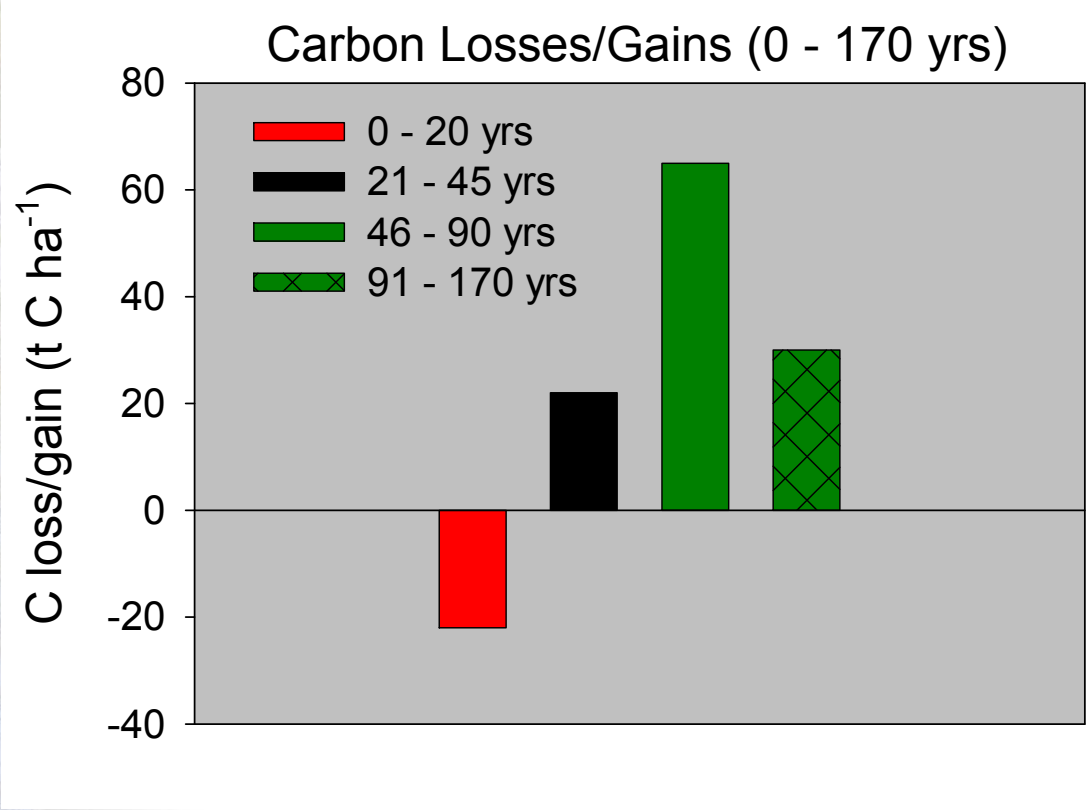
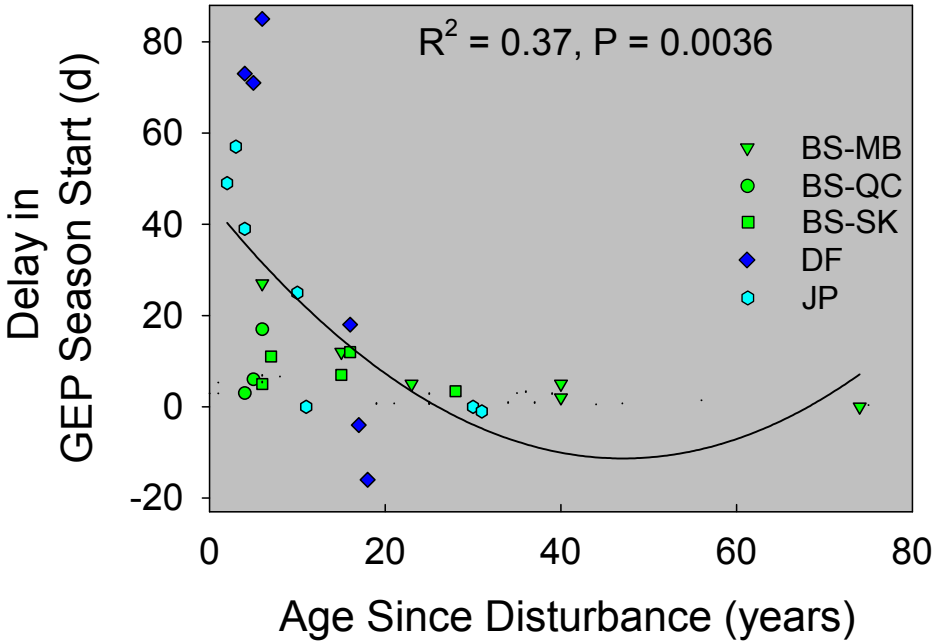




Stand Age & GEP Season Length



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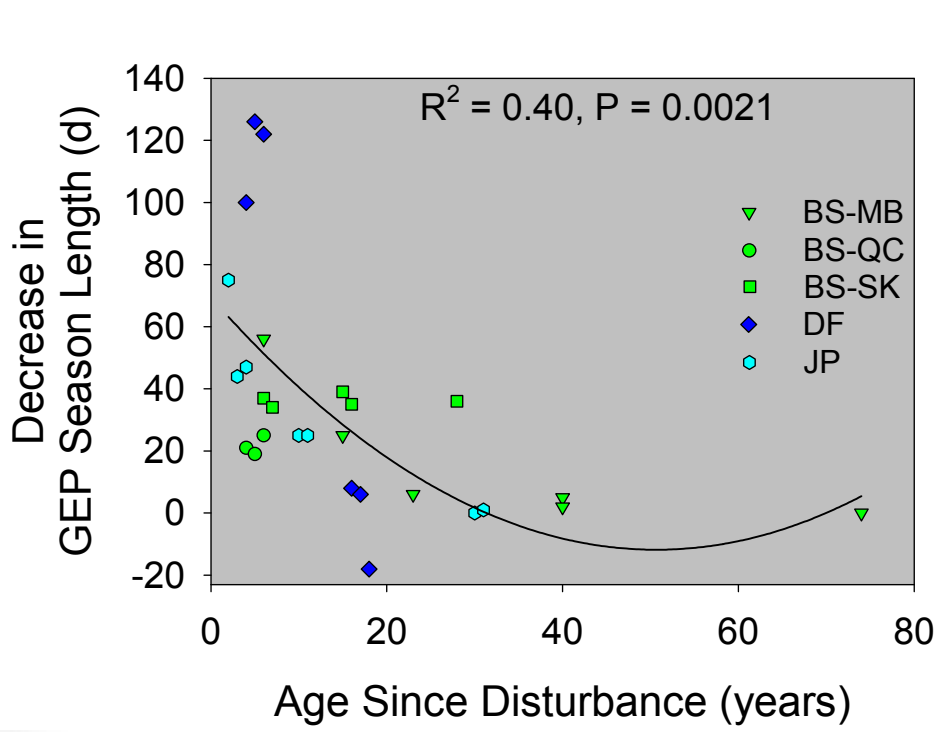
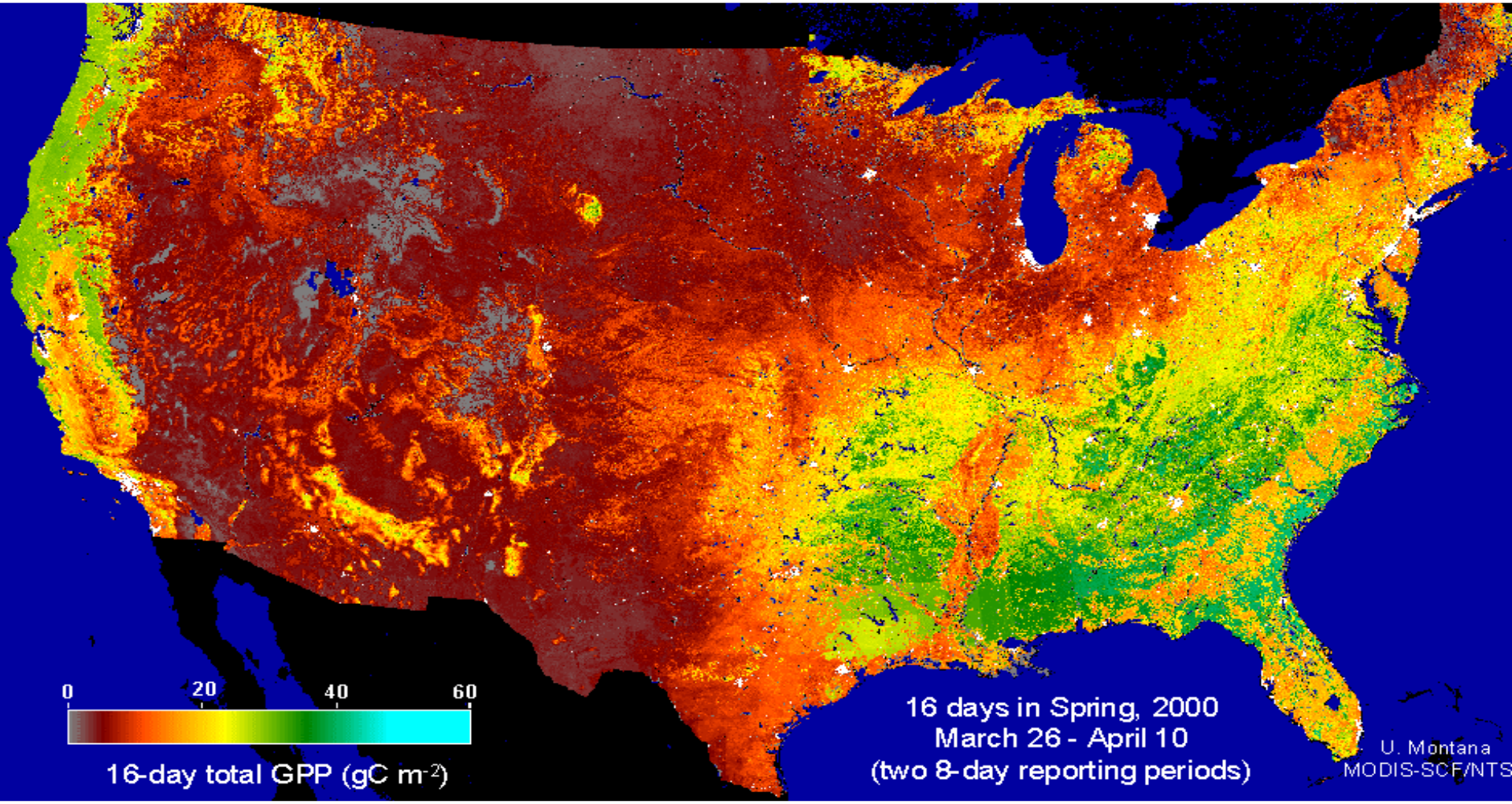


MOD17 GPP Product for the US for Spring 2000



Disturbance

FIRE

INSECTS

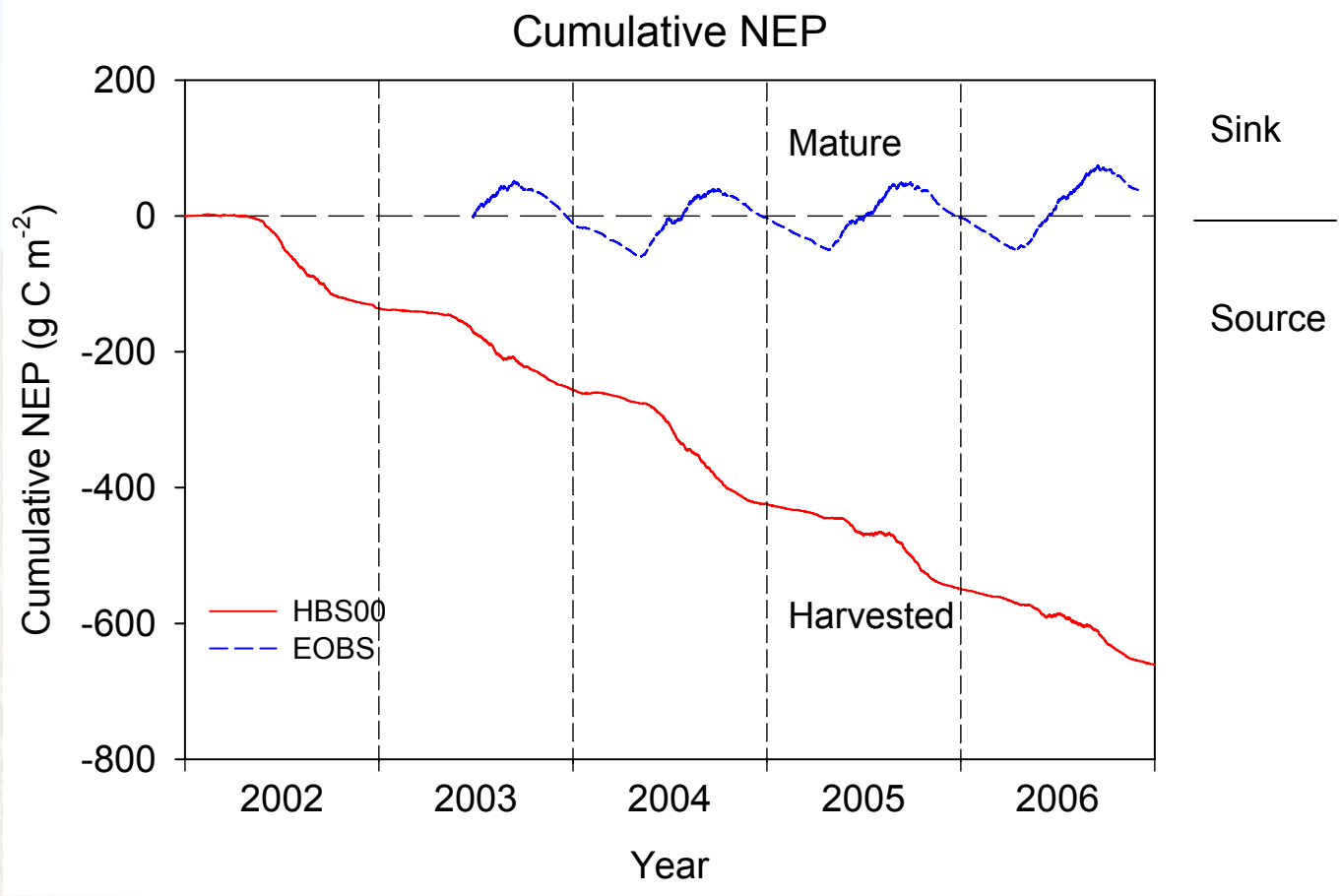
&DISEASE

HARVEST

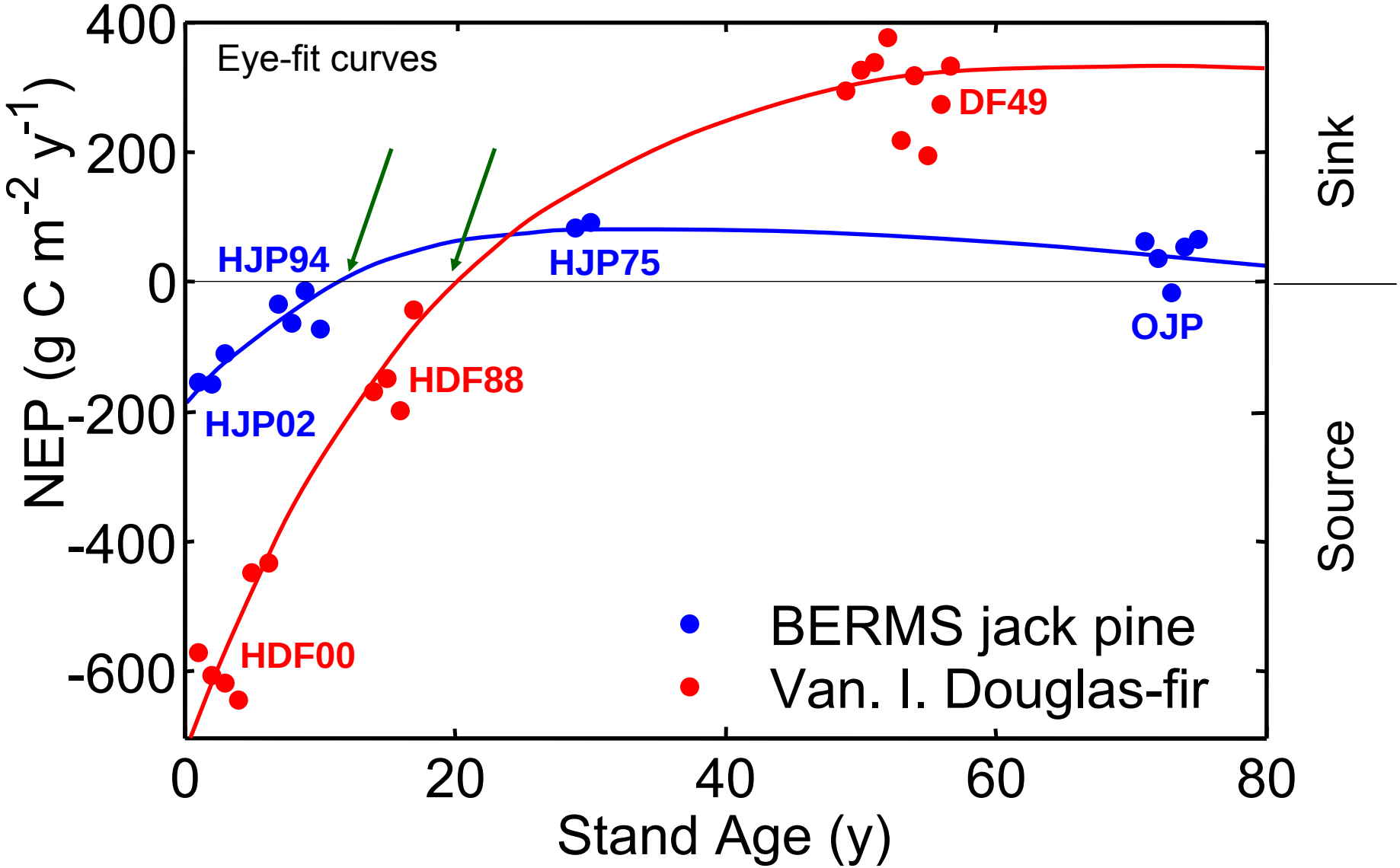
Photo : H. Margolis

Harvested vs Mature Black Spruce in Quebec

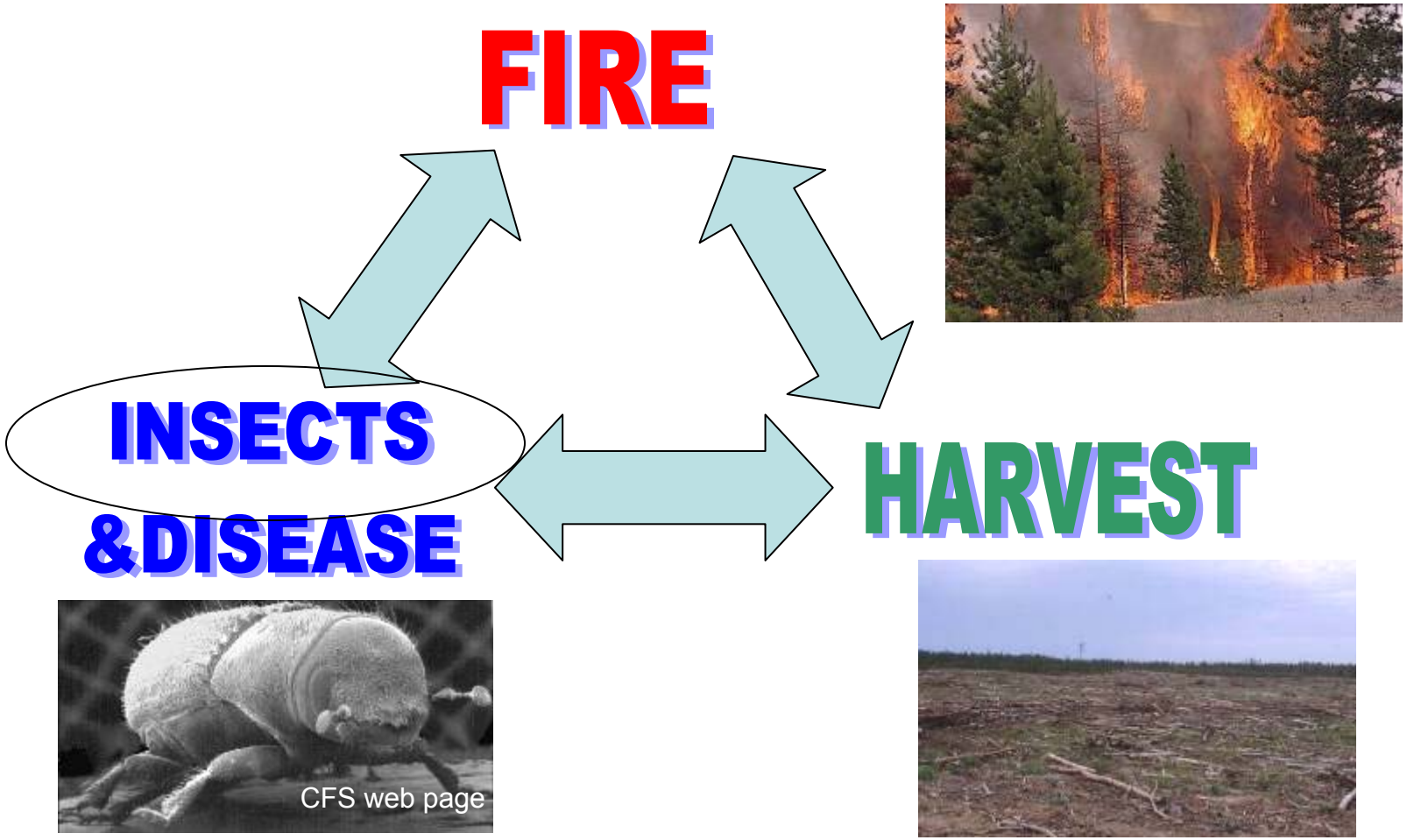
Cumulative NEP



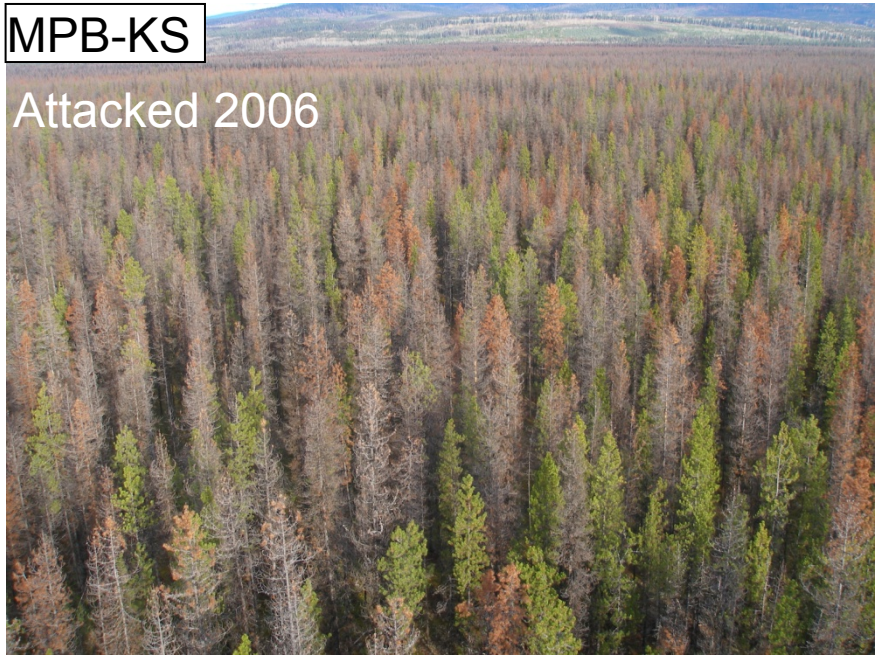
ANNUAL NEP FOR BERMS JP AND BC FLUX STATION DF CHRONOSEQUENCES

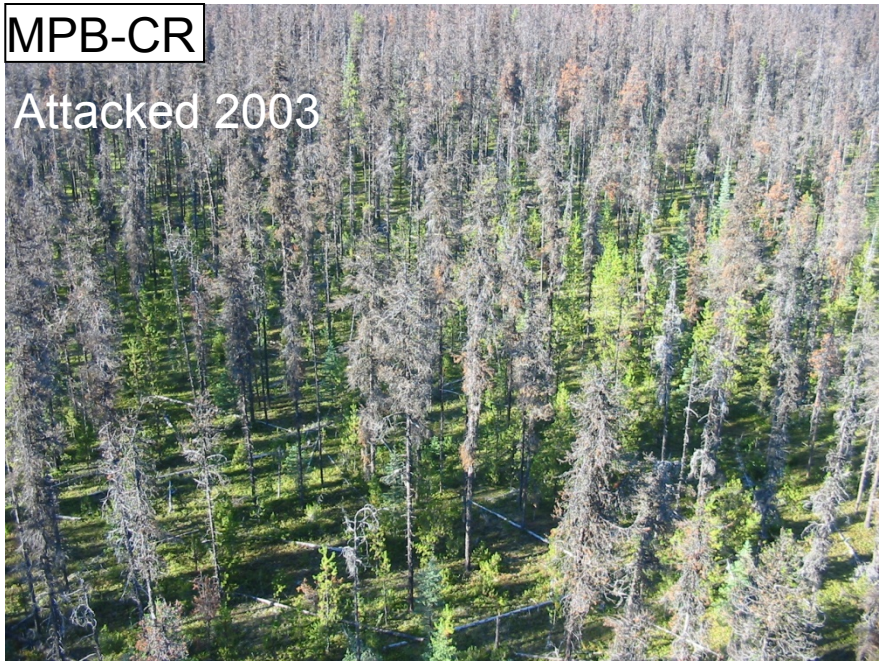


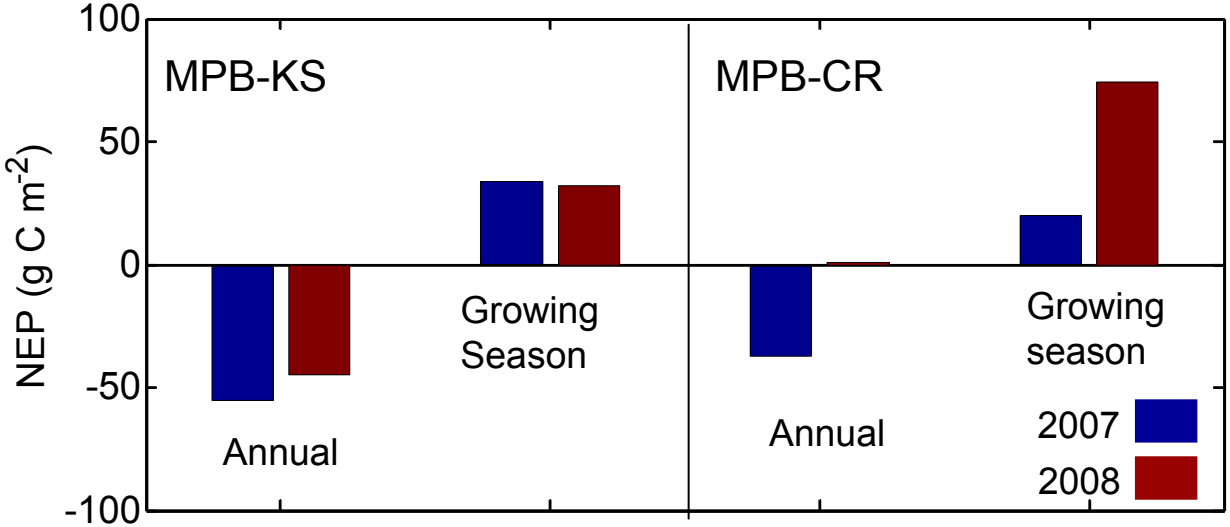
Disturbance



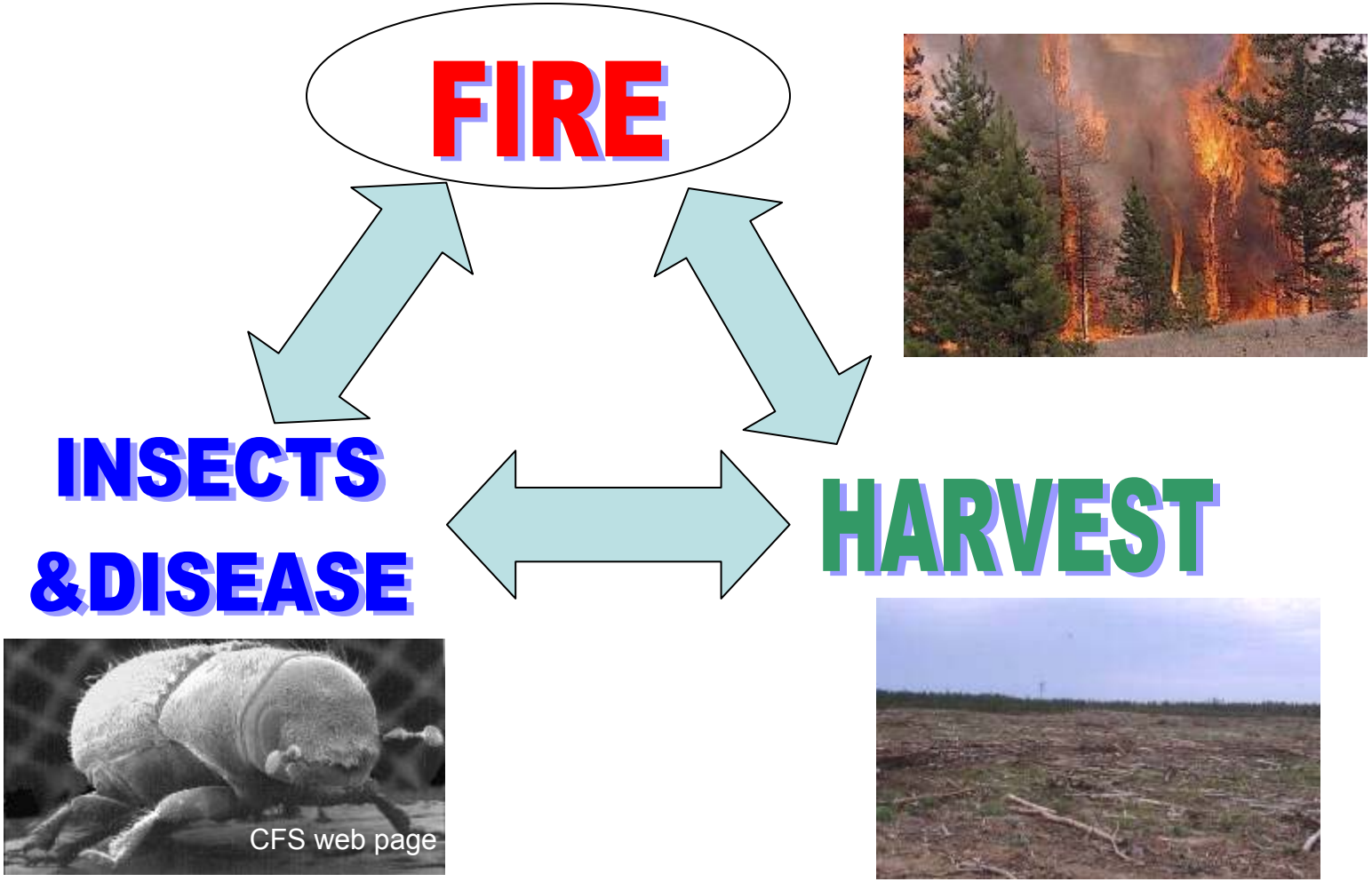
NEP of Mountain Pine Beetle Attacked Stands







Disturbance



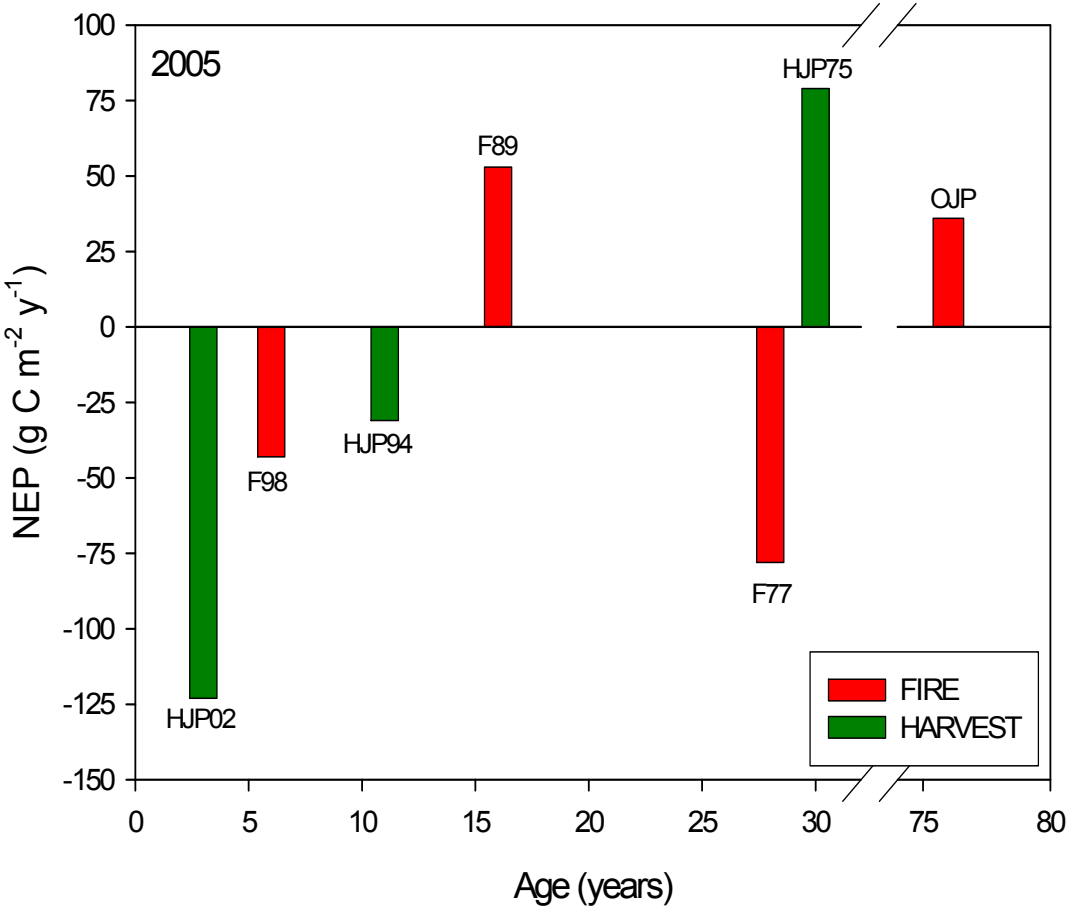
Fire!!!

Harvested (clearcut)
-2002
-1994
-1975

Burned (wildfire)
-1998
-1989
-1977
-1929 (OJP)

Annual Carbon balance

- HJP02 highest C source
- HJP75 highest C sink
- F77 remains a major C source, due to higher R_e than GEP
- OJP modest C sink



Brian Amiro

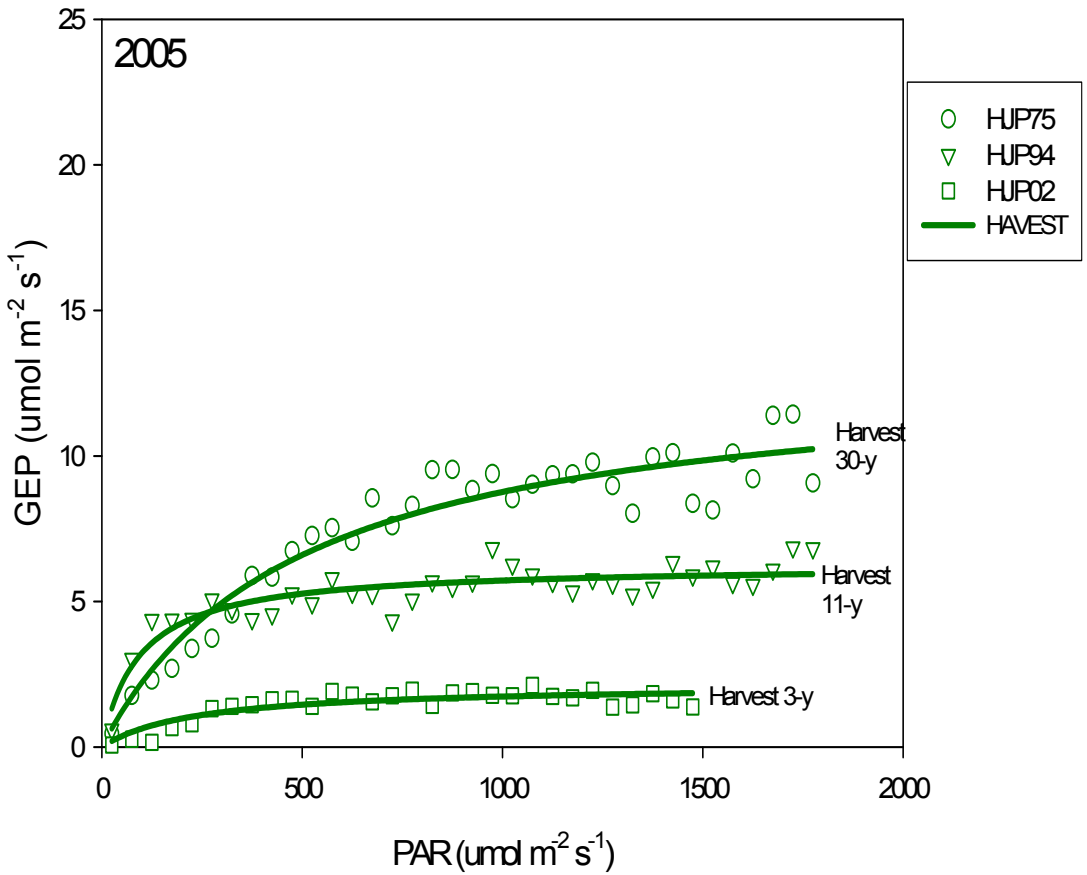
Harvest Versus Fire - Saskatchewan

- HJP75 highest C sink
- F77 remains a major C source:

- The "Dead Wood" problem.

Relationship between GEP and PAR (June – August)

- GEP increased with PAR up to PAR ~1400 µmol m^{-2} s^{-1}
- Strongest response at fire sites
- Lowest response at youngest harvest sites



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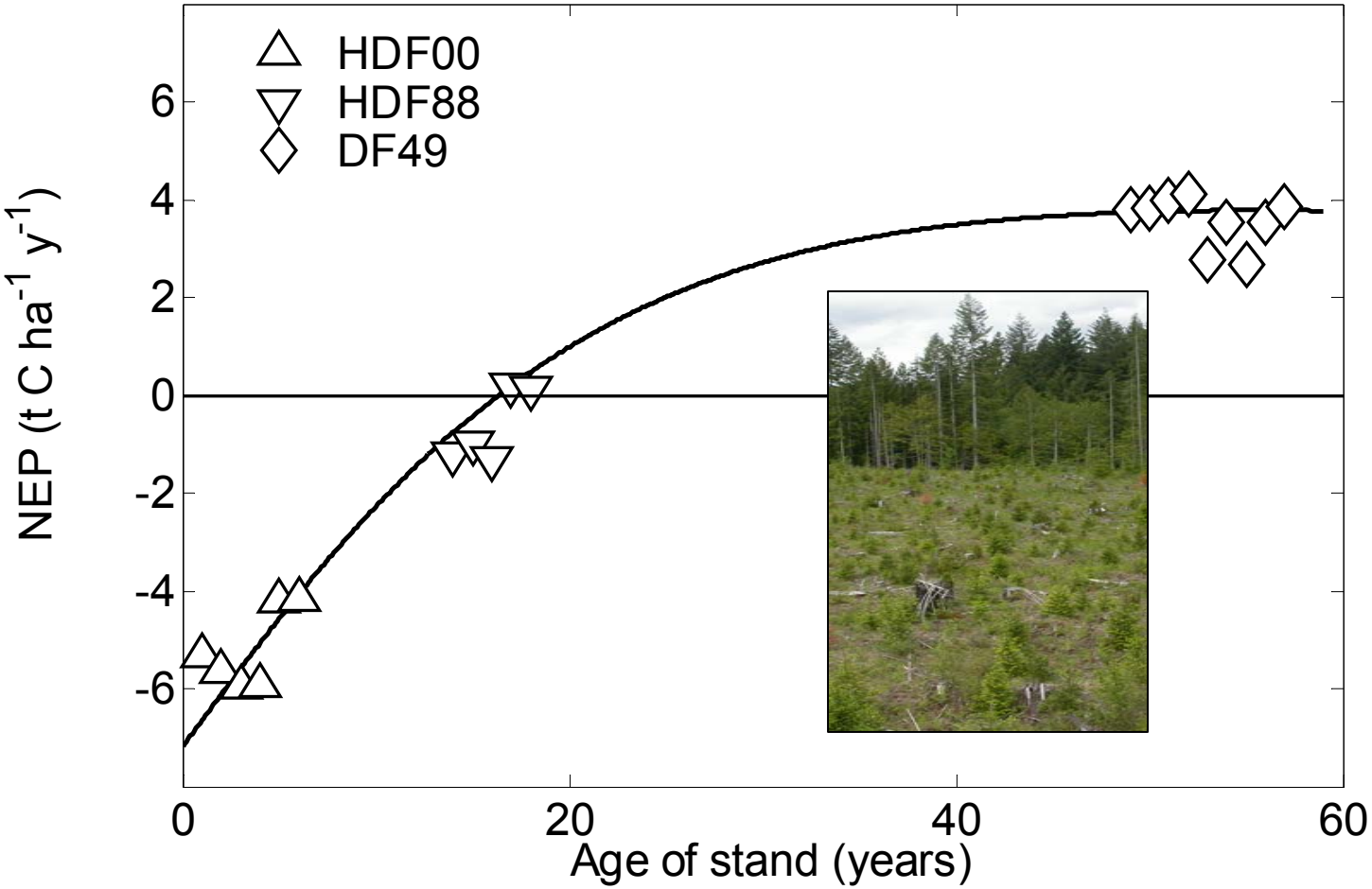
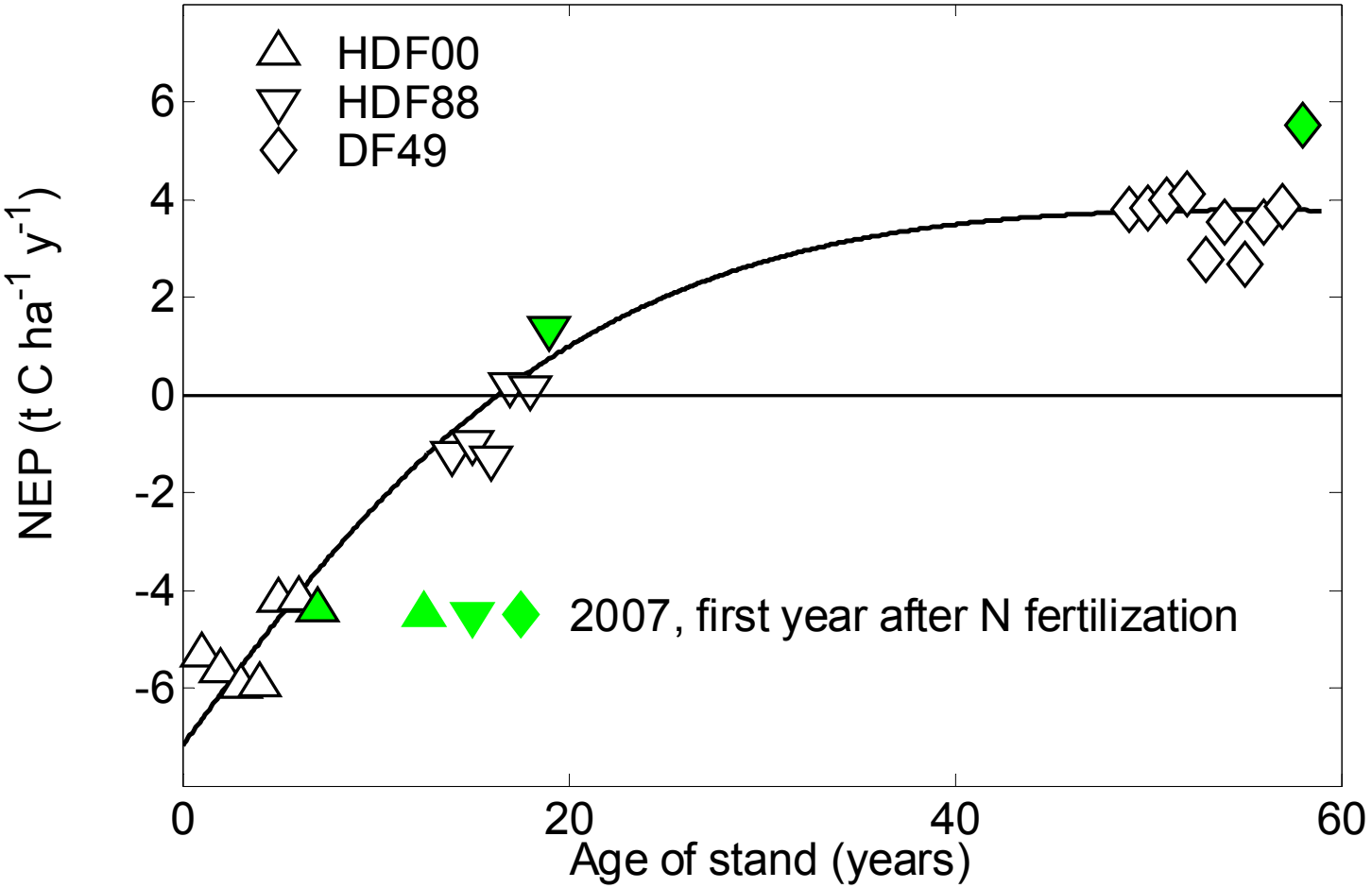
Impact of Forest Fertilization

Effect of N fertilization in a Douglas-fir chronosequence



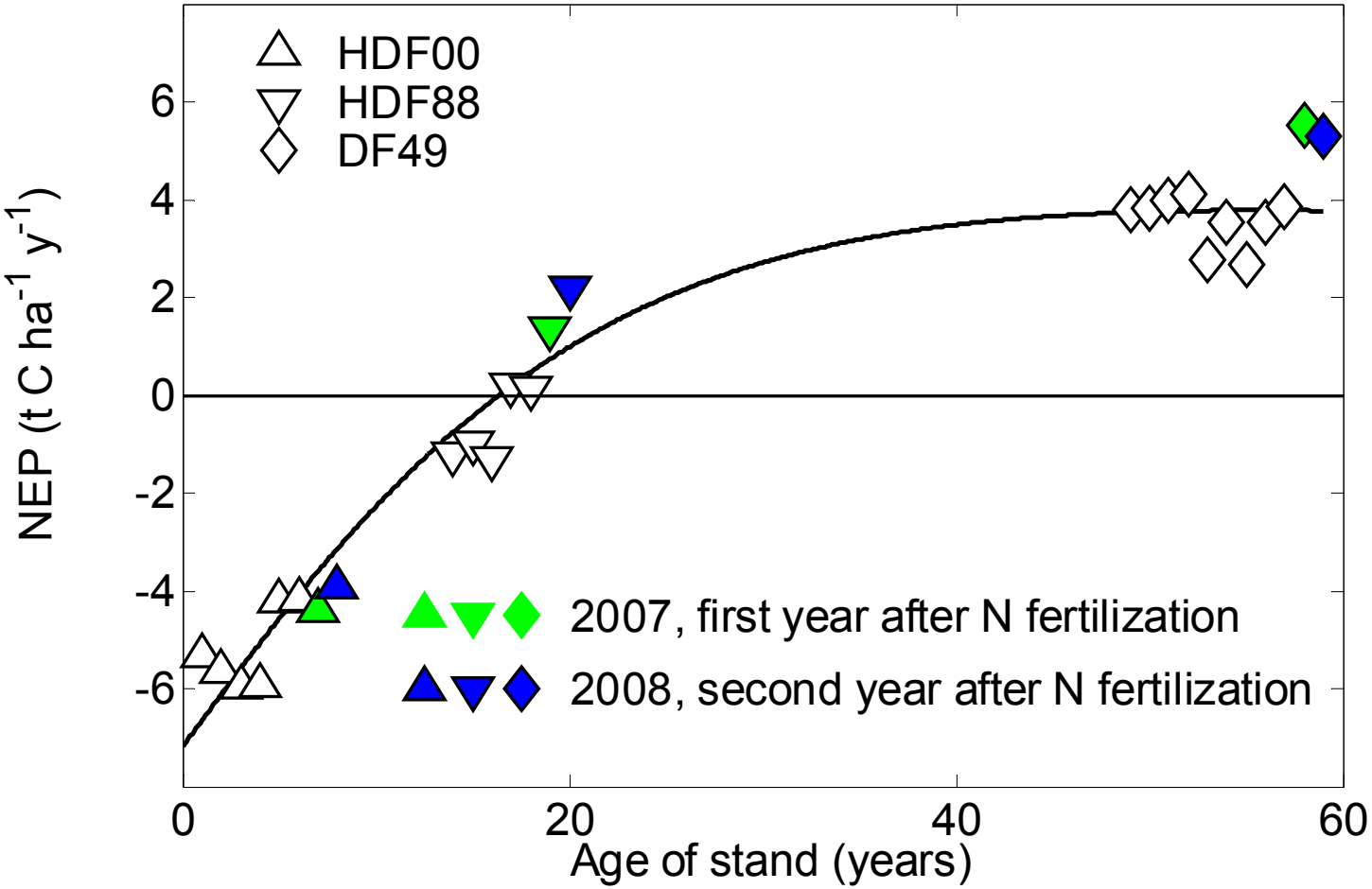
Andy Black *et al.*

Effect of N fertilization in a Douglas-fir chronosequence



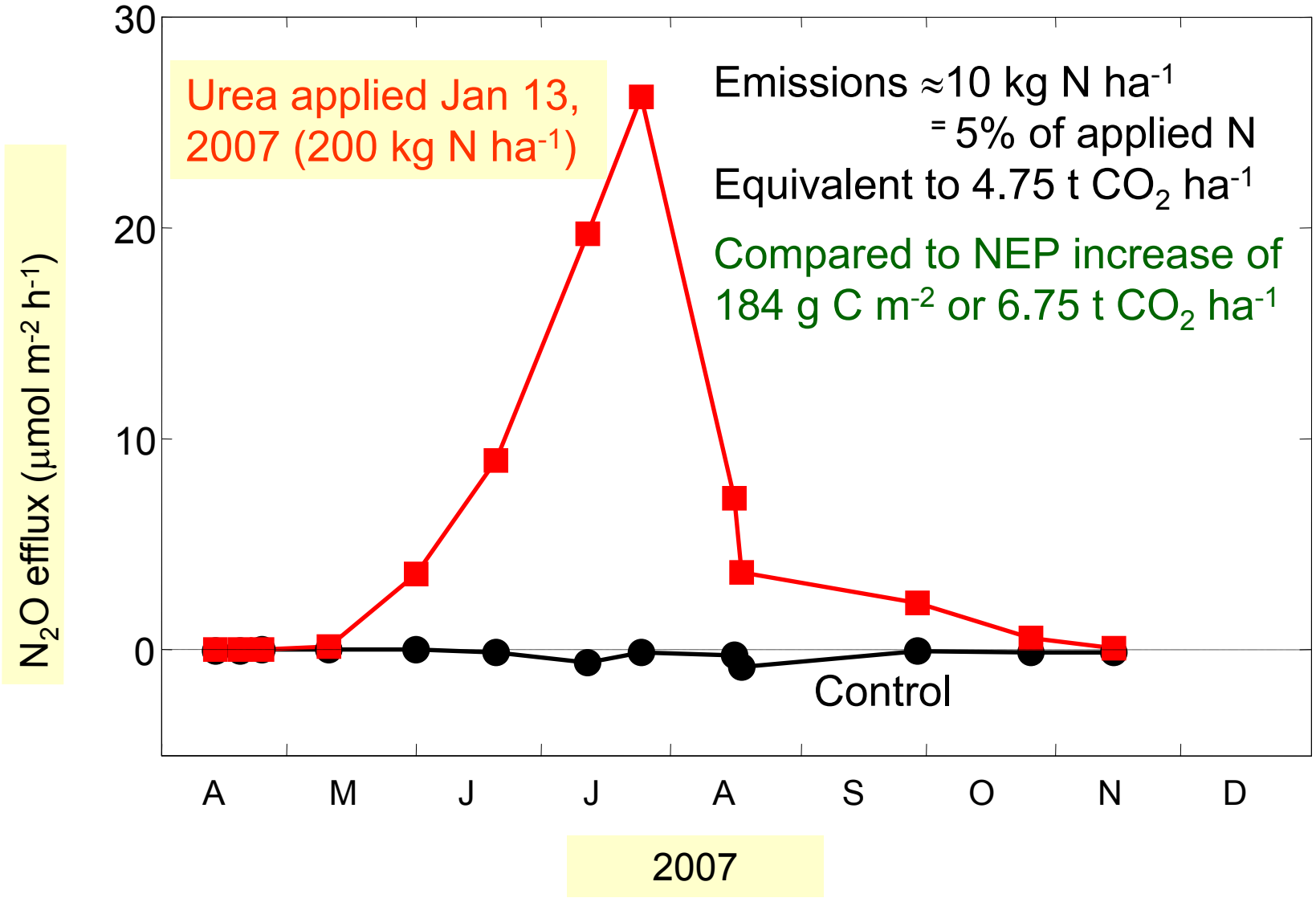
Jassal *et al.* (2008)

Effect of N fertilization in a Douglas-fir chronosequence



Black *et al.* (2008)

Impact of forest fertilization on N_2O emissions at DF49



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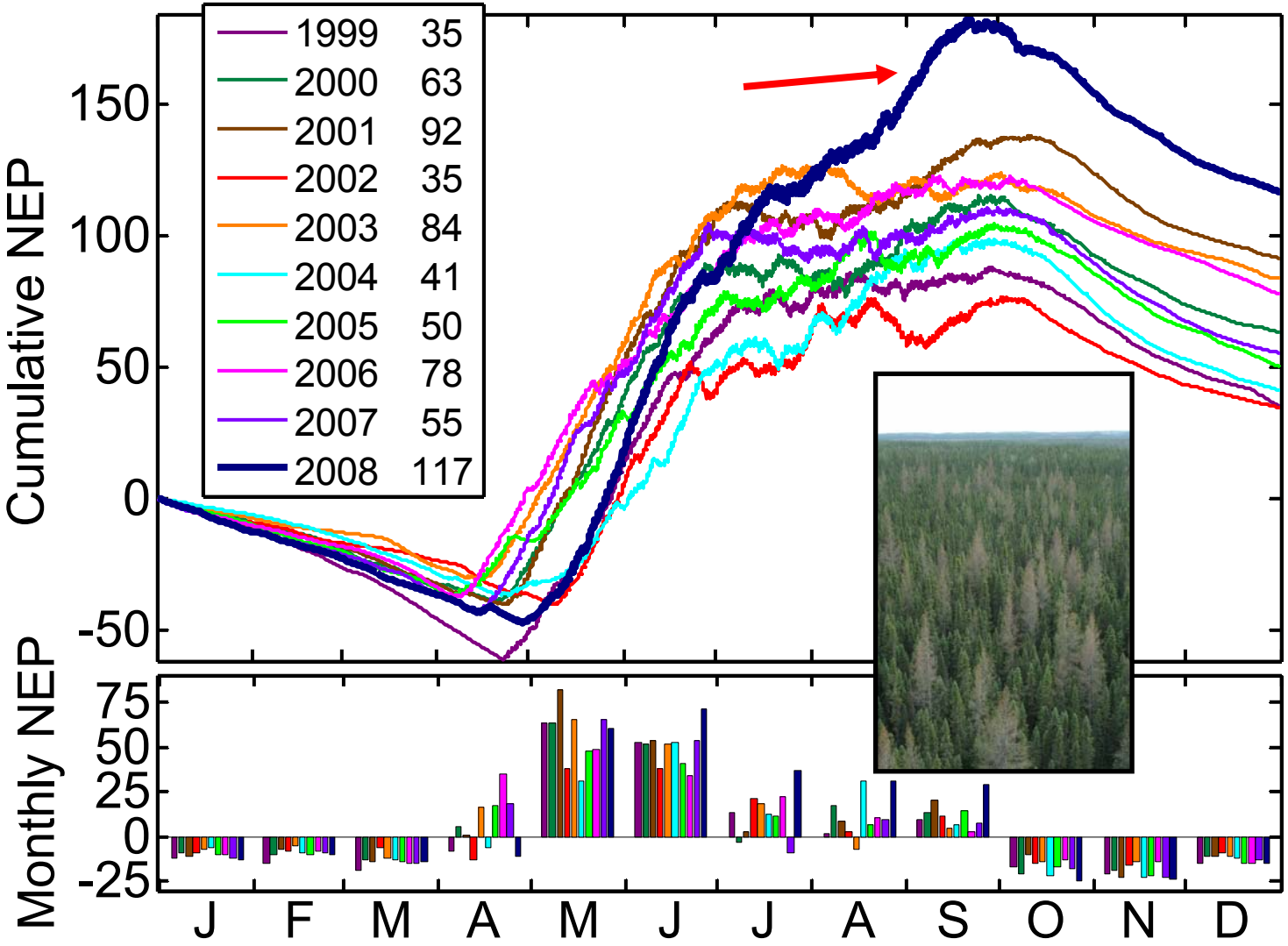
OBS 2008: Enhanced late growing season C sequestration (g C m^{-2})



Periods of below normal soil temperatures, and of enhanced PAR and diffuse PAR fraction, produced an exceptional year for C sequestration through their timing and influence on R and GEP, respectively (see Grant et al. poster for details).

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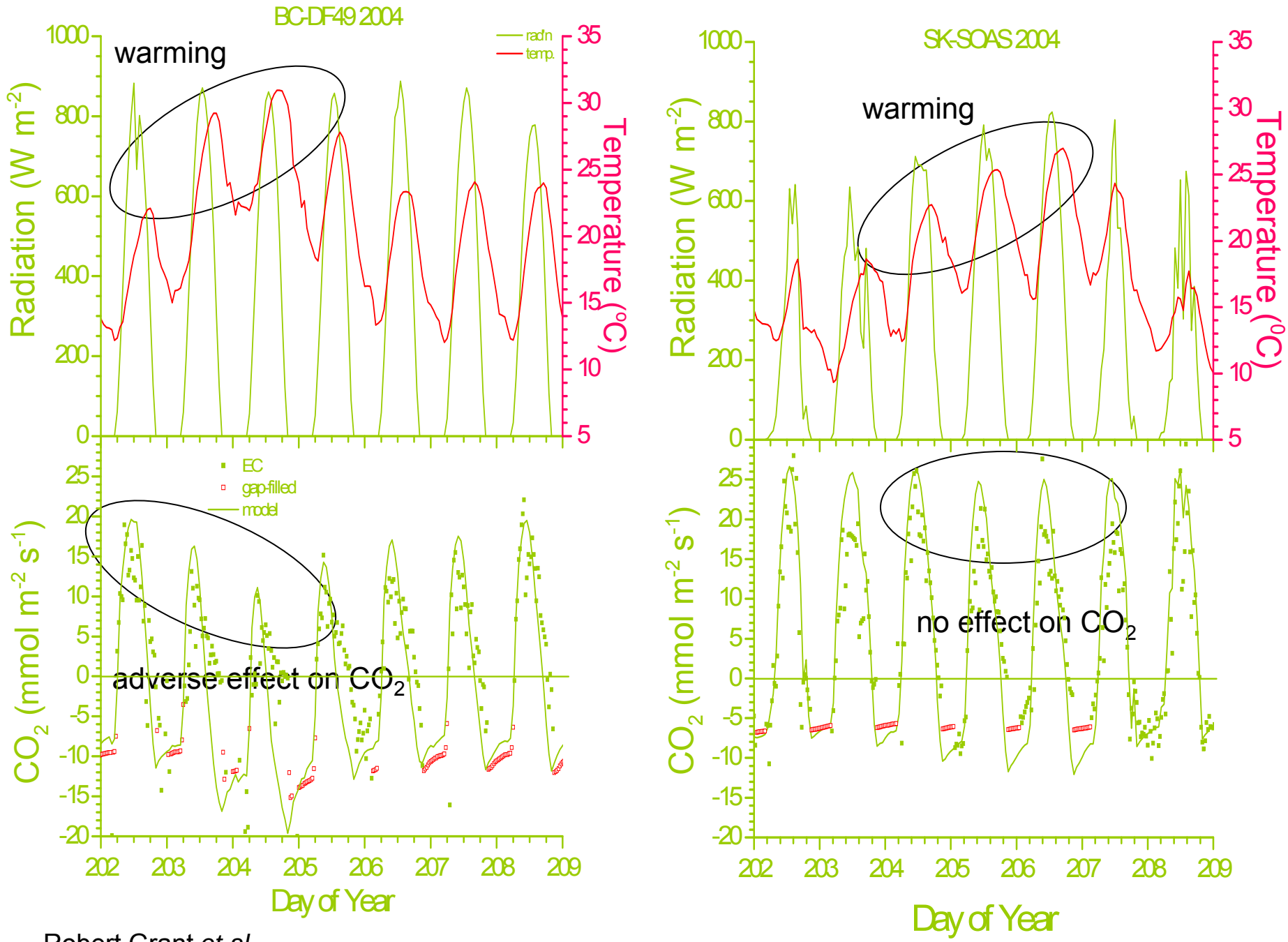

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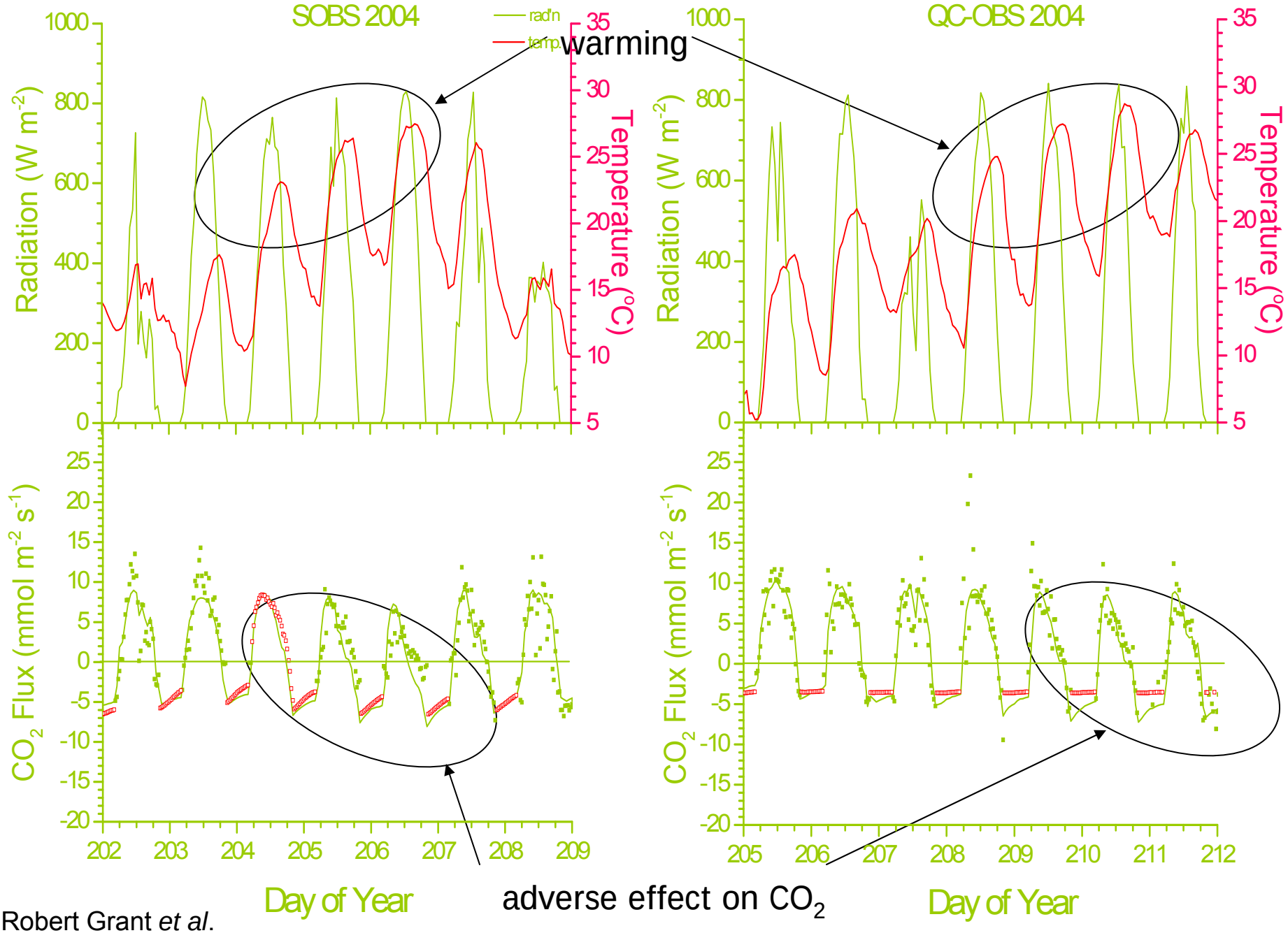

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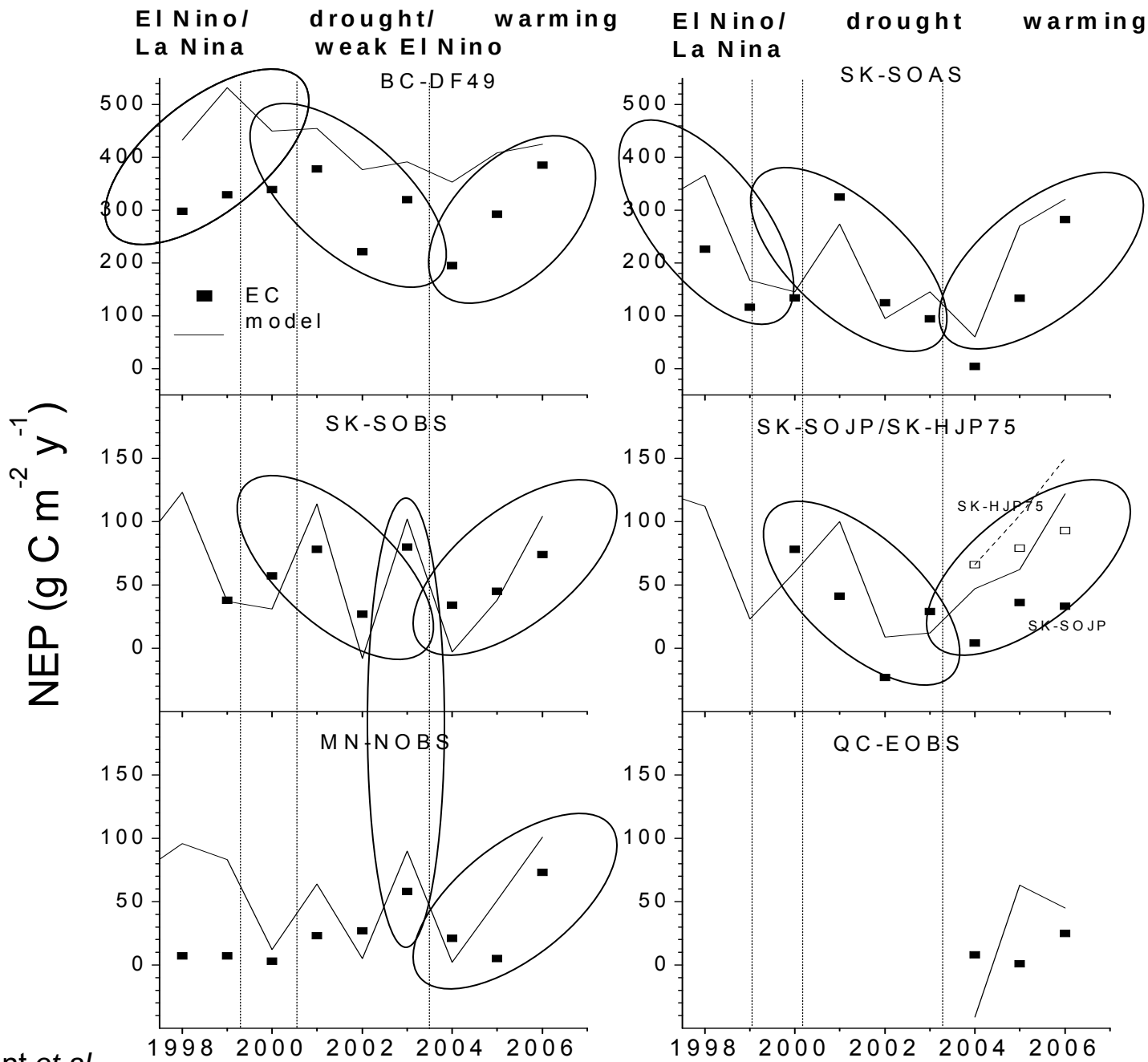

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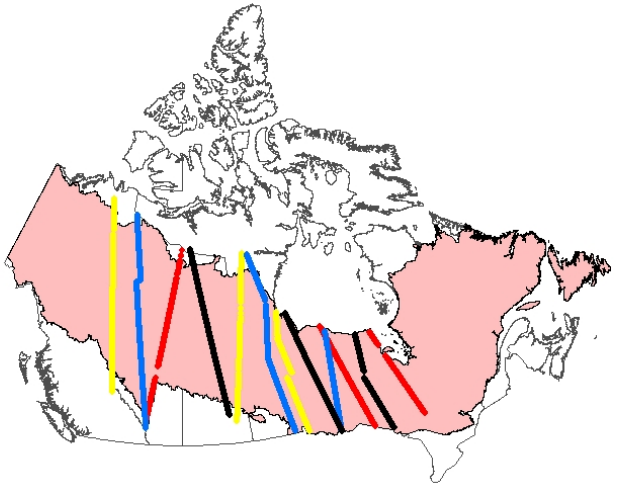
ICESat-1 Coverage

8 million “useable” pulses in boreal North America



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THANK YOU

AND THANK YOU TO ALL OUR SCIENTIFIC CONTRIBUTORS AND FUNDING SPONSORS