

# Impacts of extreme spring weather on temperate forest phenology and carbon cycling

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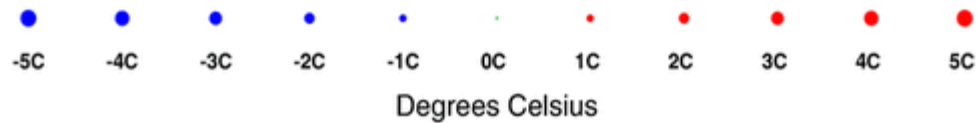
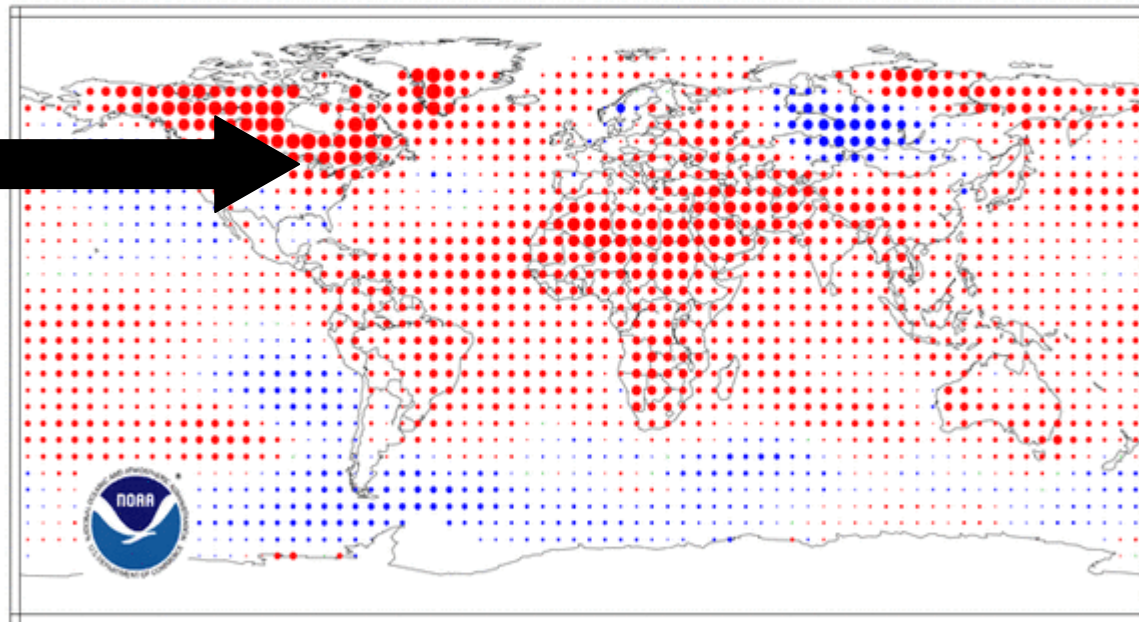
# Extreme warm spring of 2010...

## Temperature Anomalies Jan-Jul 2010

(with respect to a 1971-2000 base period)

National Climatic Data Center/NESDIS/NOAA

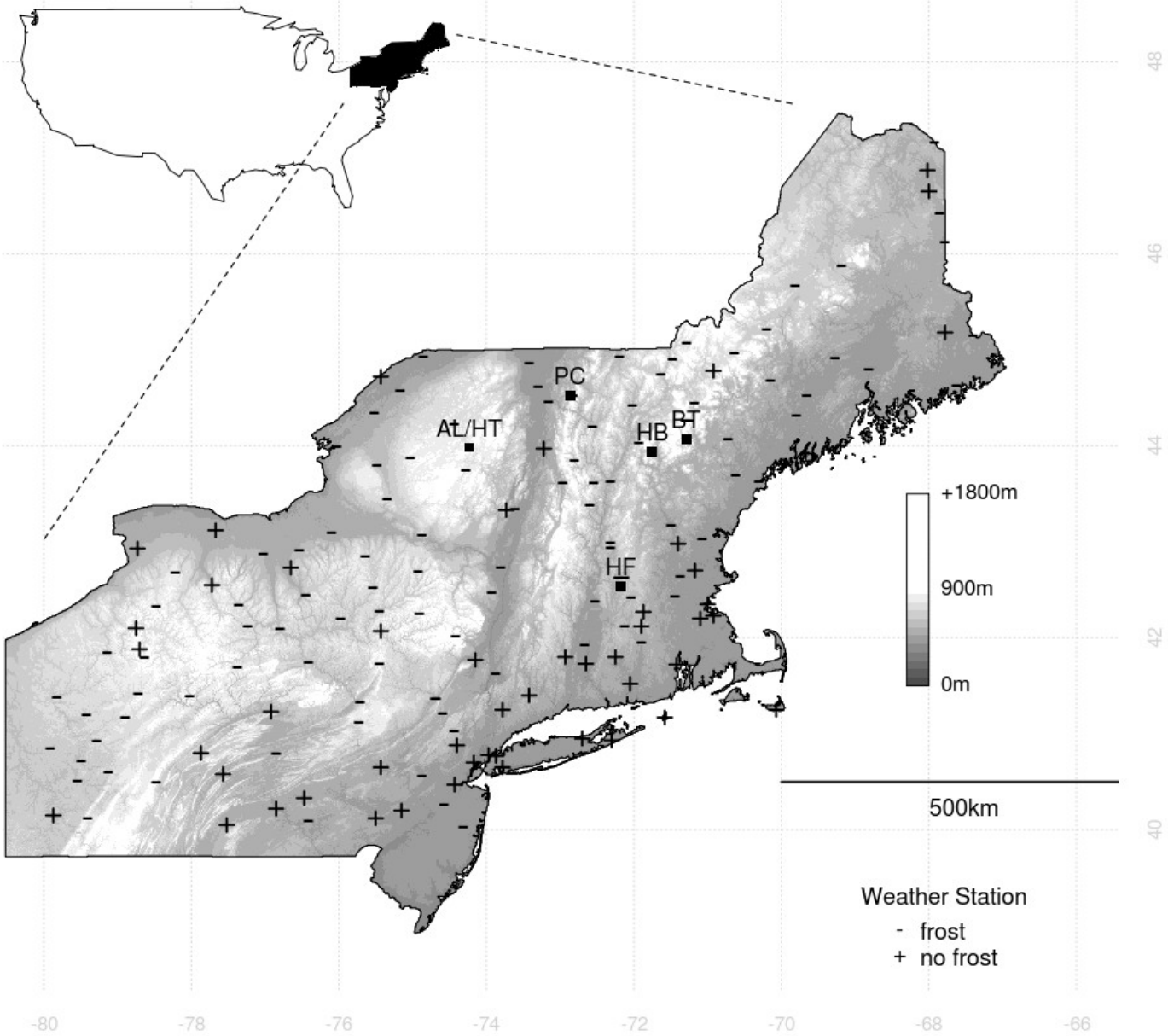
**HOT !!**



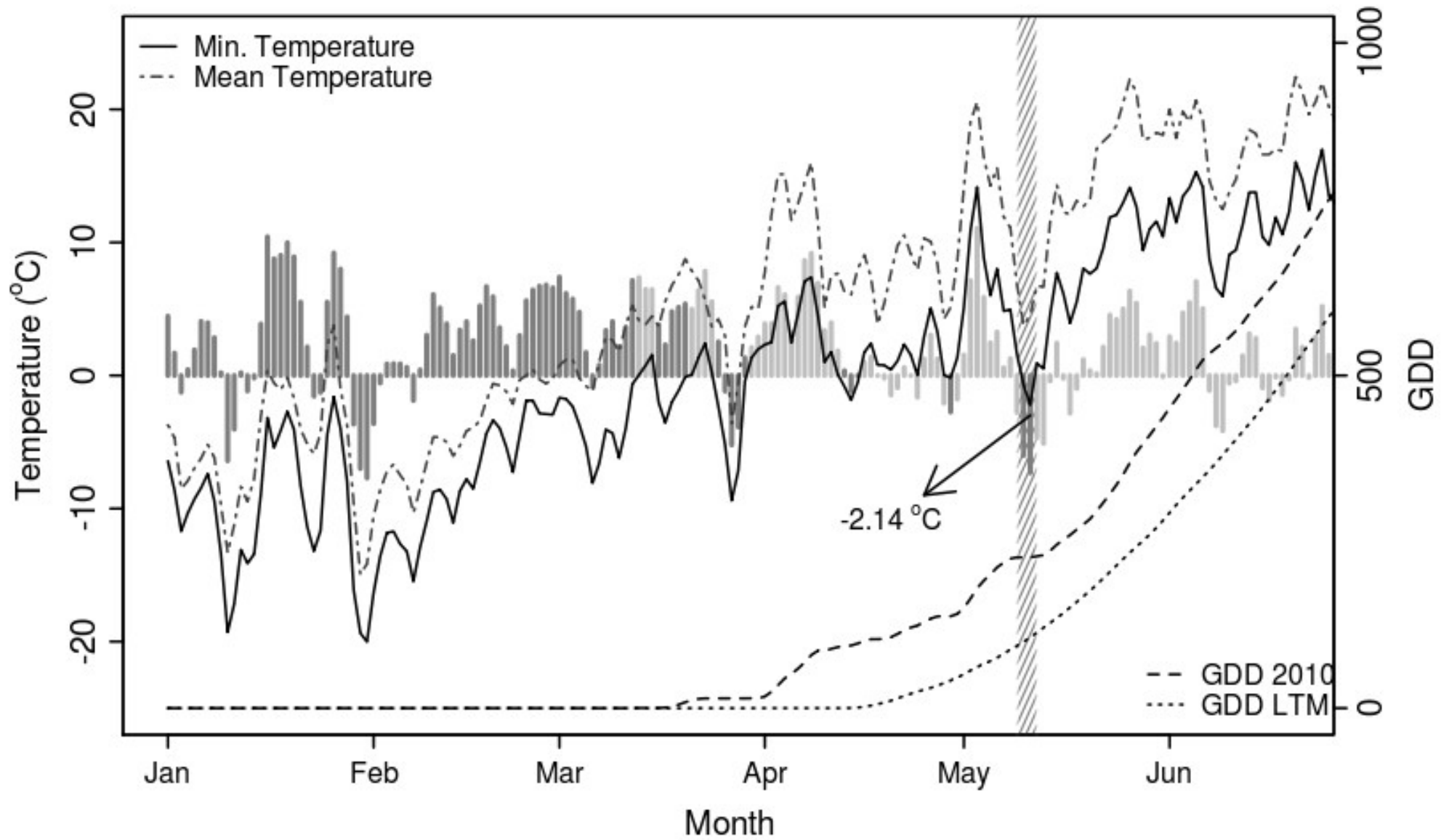
Frost hit late in spring...



# A widespread frost in the northeastern US...



# The spring weather summarized...

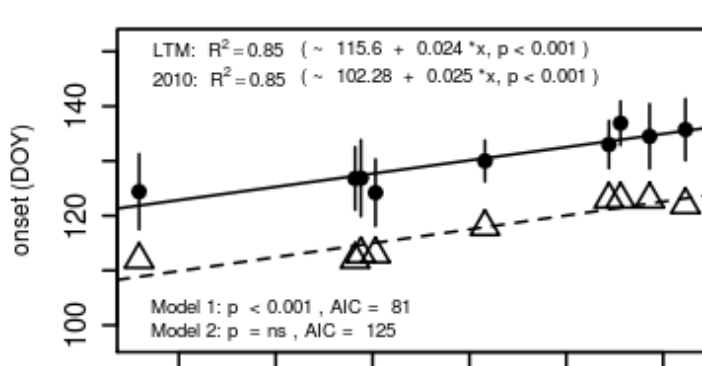


## How does...

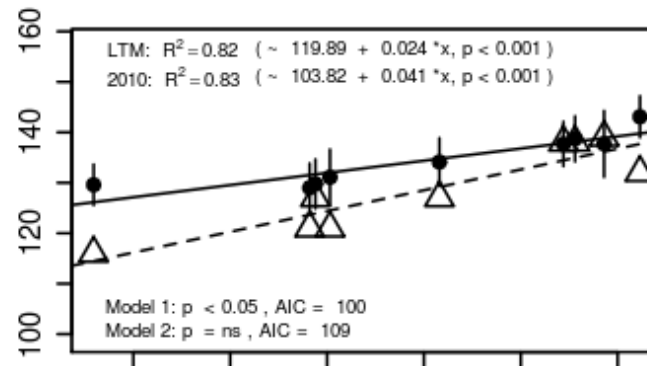
- \* a northern hardwood forest phenology respond to this changing climate and extremes in weather across an elevational gradient?
- \* a spring frost affect the carbon balance?
- \* /could a spring frost influence community ecology?

# Field observations along an elevational gradient...

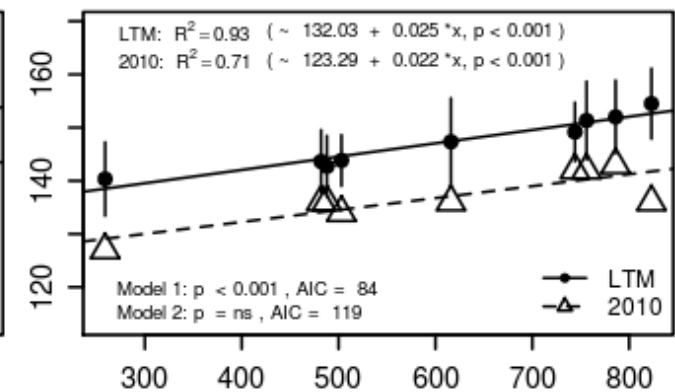
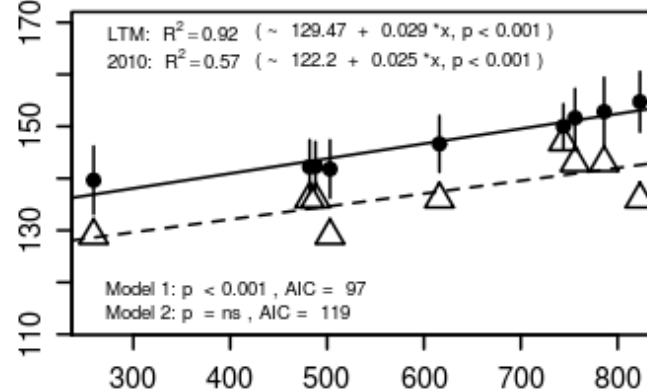
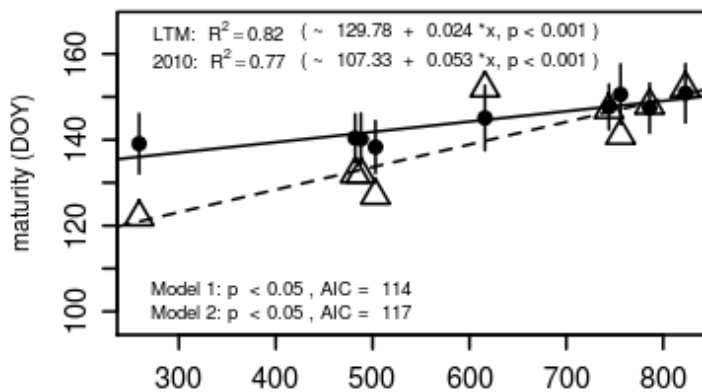
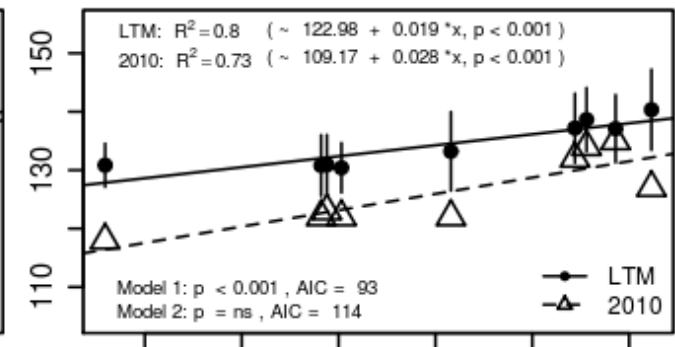
*Acer saccharum*



*Fagus grandifolia*

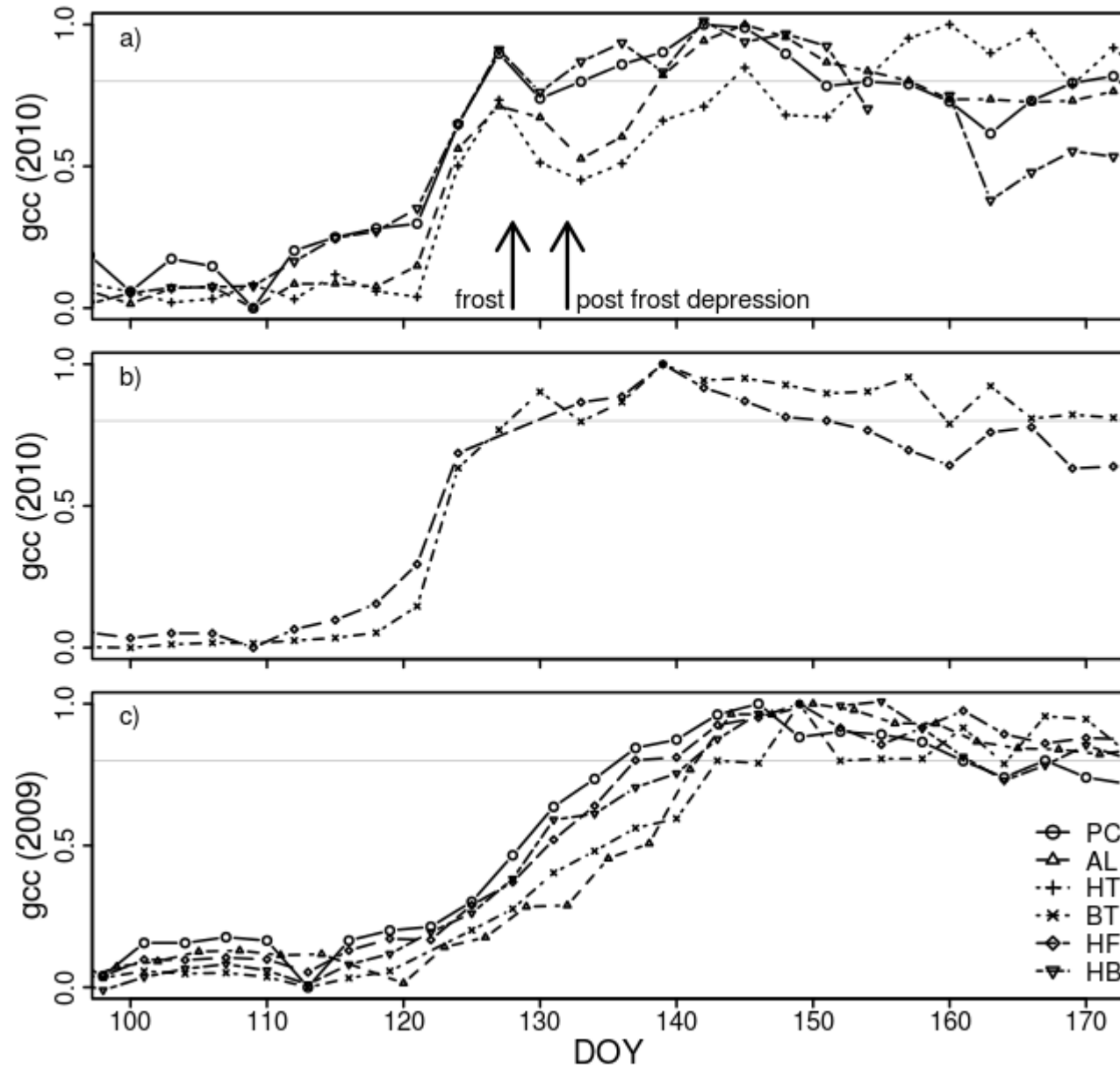


*Betula alleghaniensis*



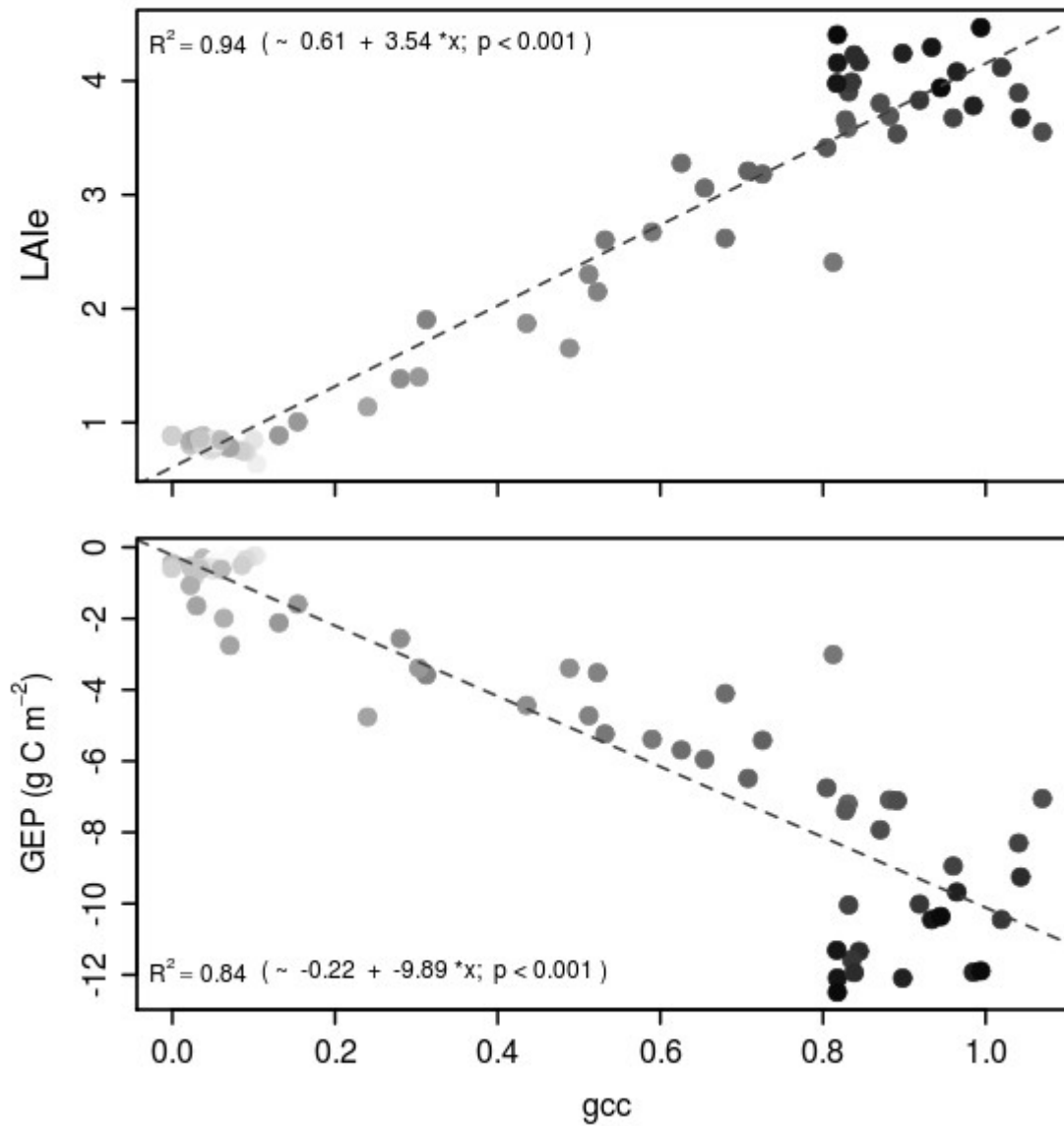
Altitude (m)

# Near-surface remote sensing data...





# Scaling GEP using near-surface remote sensing...

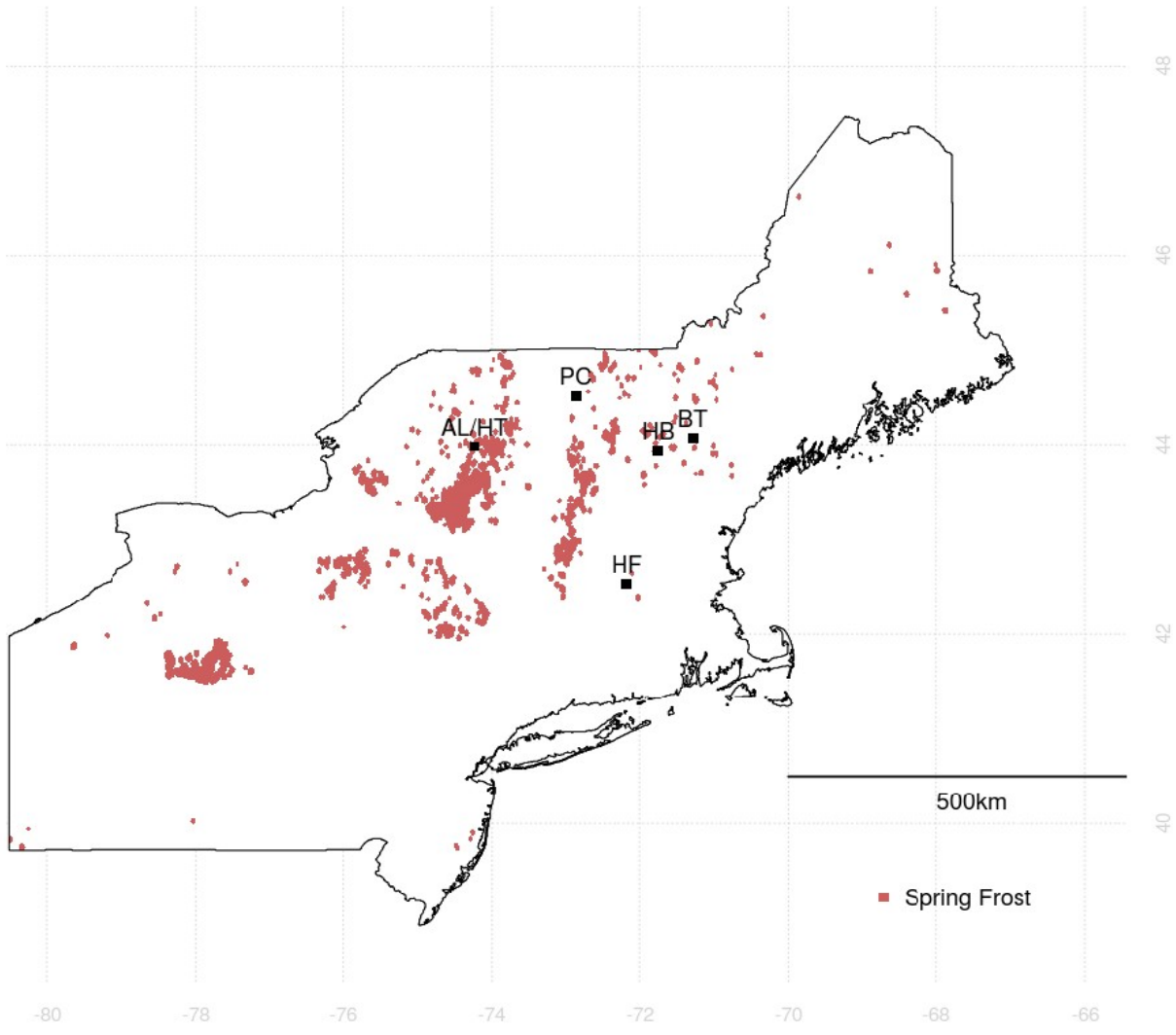


# Estimated lost GEP assimilation potential...

**Table 4.** Percentage decrease in excess green (gcc) and the associated loss of potential carbon gain (litterfall and assimilates) as a result of the late spring frost event calculated for Hubbard Brook Experimental Forest (HB), the Proctor Maple Research Center (PC), the Arbutus Lake (AL) and Huntington Forest (HF) national park sites. The total lost potential in carbon gain as a % of annual GEP is reported relative to an average of  $1060 \text{ g C m}^{-2} \text{ y}^{-1}$  (2004 -2009) as measured at the Barlett Experimental Forest.

Site	gcc decrease (%)	frost induced litterfall ( $\text{g C m}^{-2}$ )	lost potential carbon gain ( $\text{g C m}^{-2}$ )	total lost potential carbon gain ( $\text{g C m}^{-2}$ )	total lost potential carbon gain (% of annual GEP)
PC	16	52	1	53	5
AL	14	43	0	38	4
HB	24	75	16	91	9
HT	33	104	49	153	14

# Regional scale effects...



## Concluding remarks...

- \* Clear competitive advantage of American beech and yellow birch compared to sugar maples
- \* Short term influences on the carbon balance range from 4 - 14% of the annual gross ecosystem productivity of a northern hardwood forest
- \* Could alter community ecology if the chances on a late spring frost event do not decrease with increasing spring temperature with possible long term influences on the carbon balance due to shifts in community ecology