

Comparing NDVI and observed stem growth and wood density in forests of northern Eurasia

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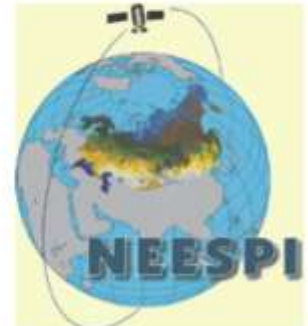
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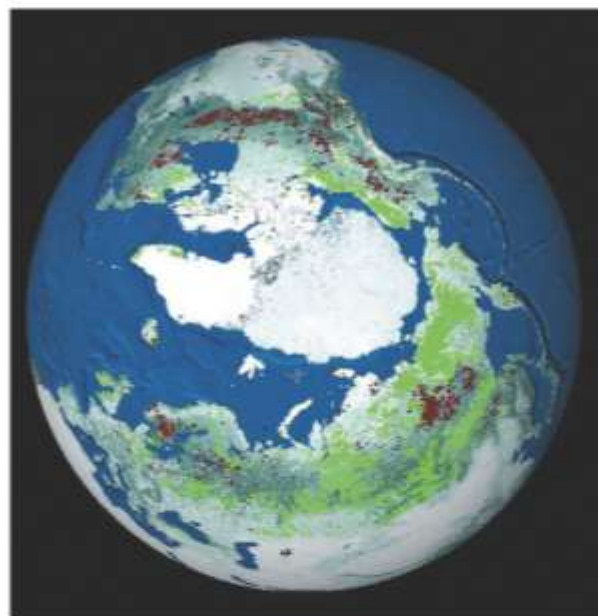
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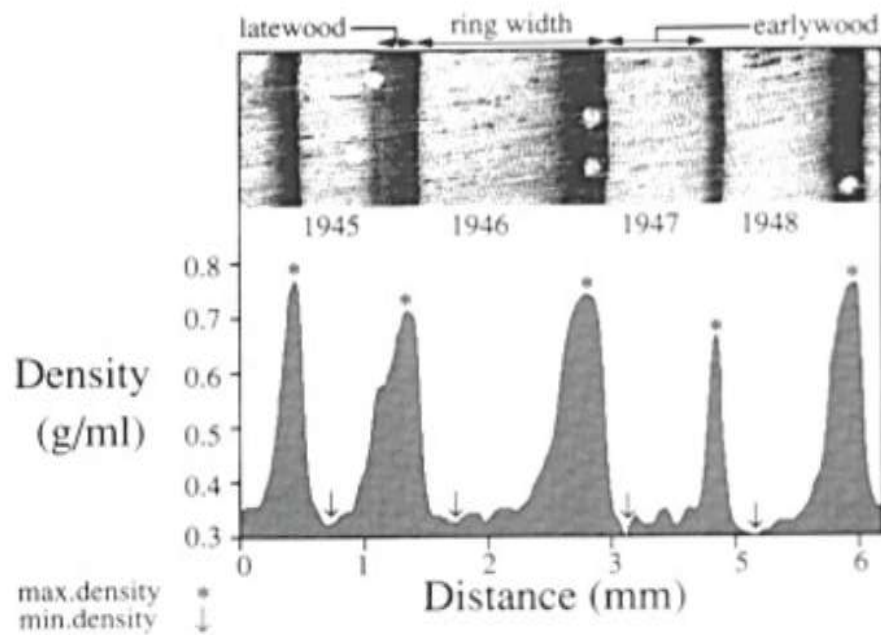
A contribution to:



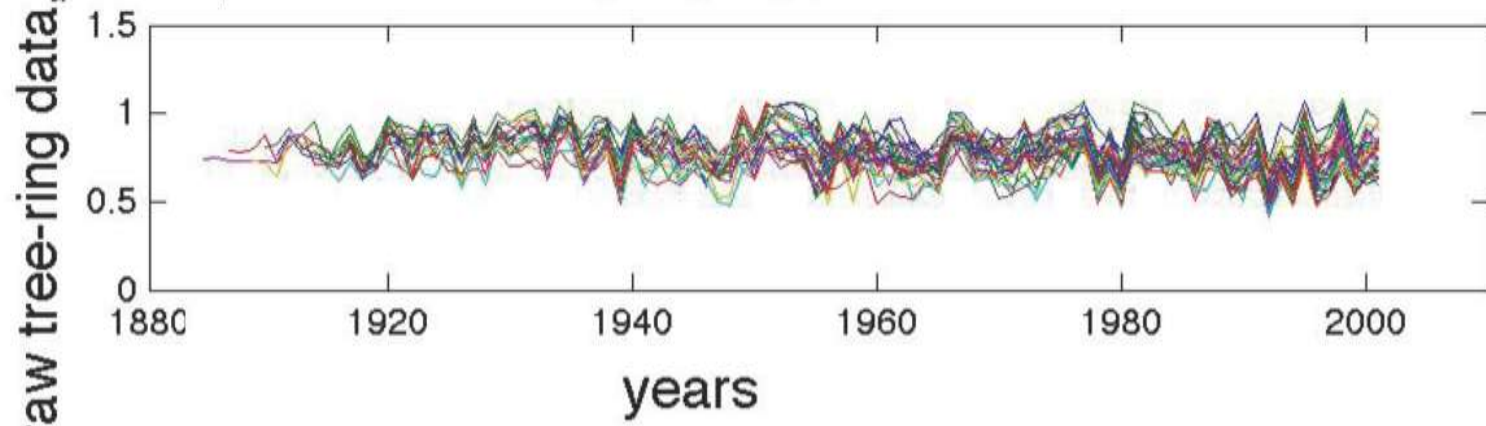
The question

- To what extent does NDVI (Normalized Difference Vegetation Index) observed from space co-vary with directly observed stem radial increment and maximum latewood density?





raw tree-ring data, g/ml Site SUR, *Picea obovata*, maximum latewood density, 31 specimens SURo2col

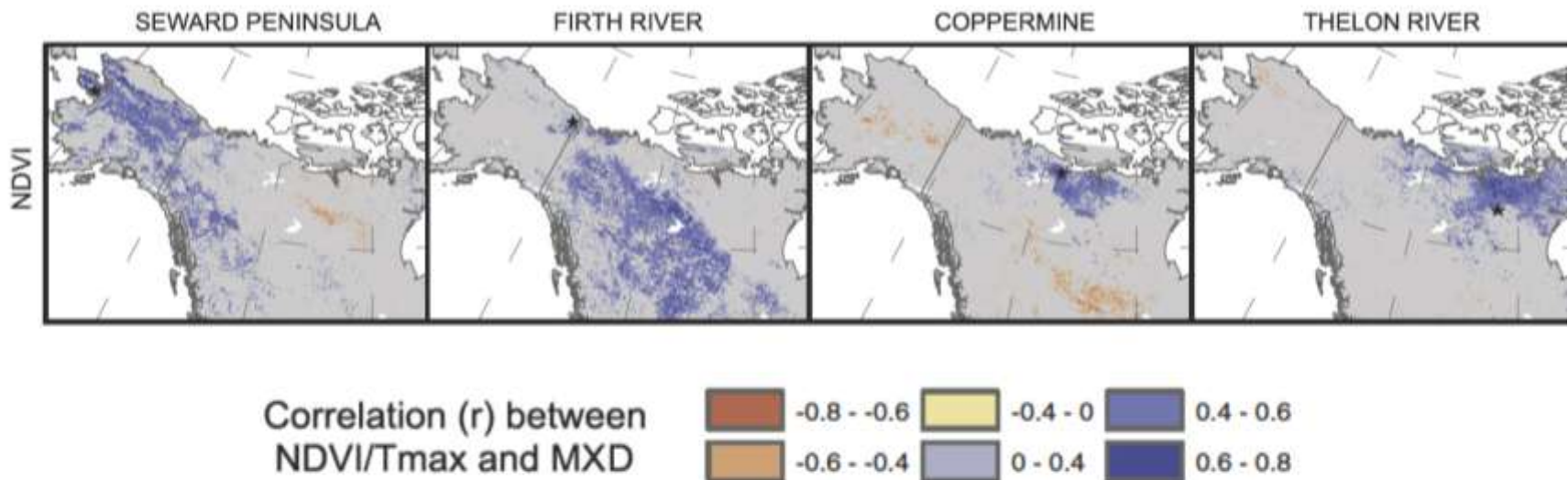




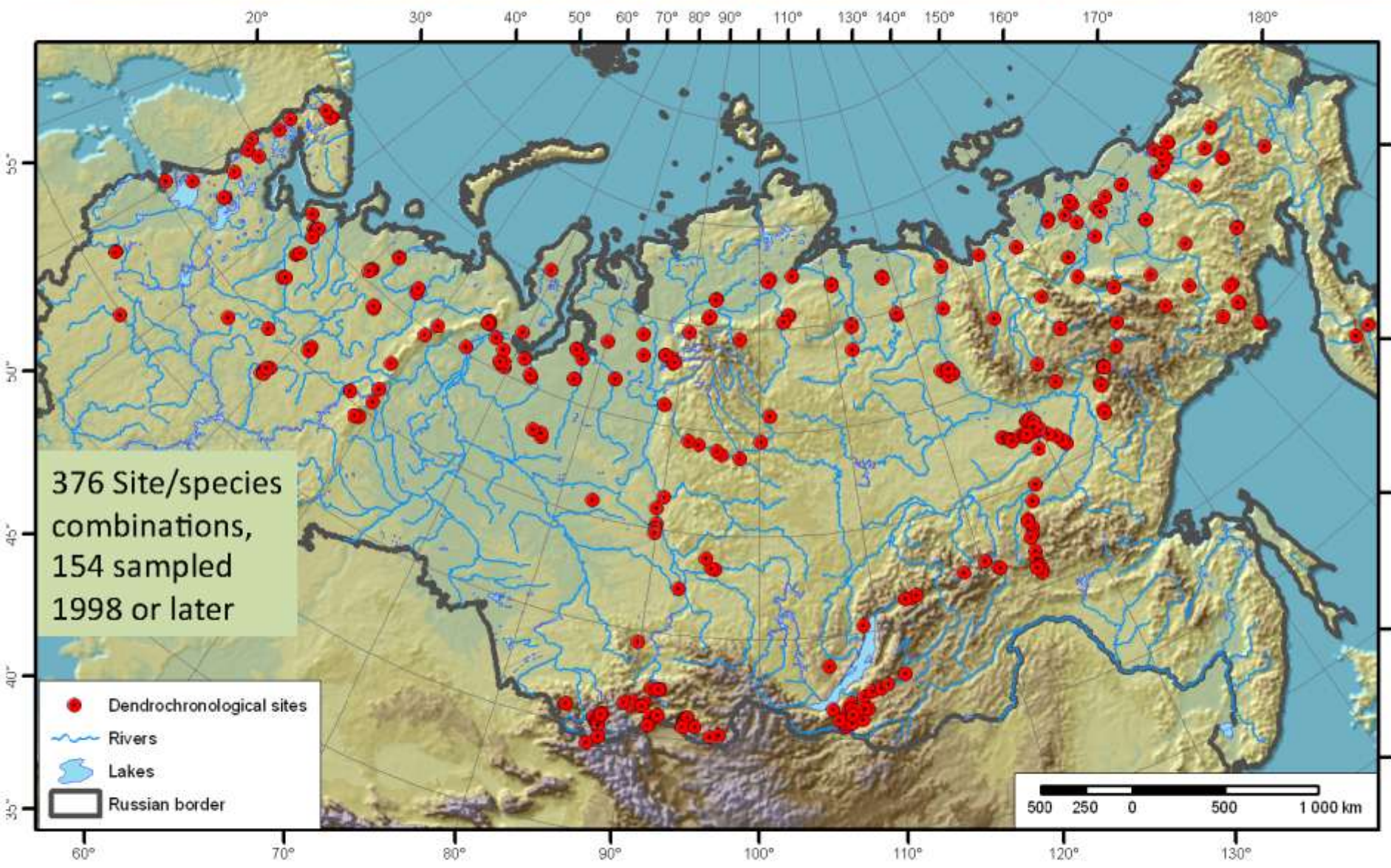
A large-scale coherent signal of canopy status in maximum latewood density of tree rings at arctic treeline in North America

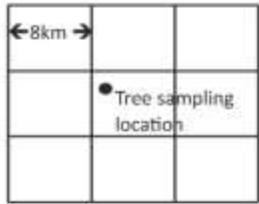
Pieter S.A. Beck ^{a,*}, Laia Andreu-Hayles ^{b,c}, Rosanne D'Arrigo ^b, Kevin J. Anchukaitis ^{b,d}, Compton J. Tucker ^e, Jorge E. Pinzón ^e, Scott J. Goetz ^a

Picea glauca ring width – no consistent relationship with NDVI,
but for maximum latewood density (MXD).....

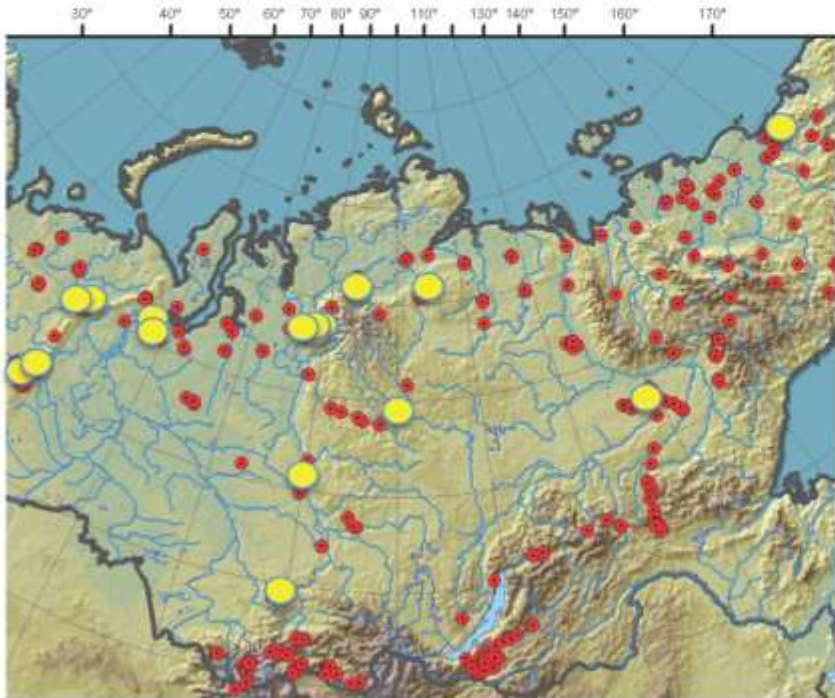


“Site-level MXD records reflect early growing season canopy status of large regions” (Beck et al highlights)

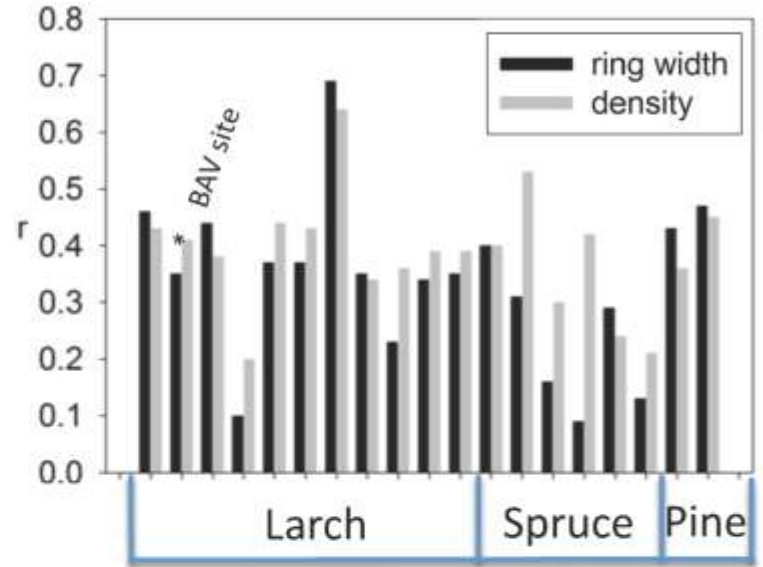




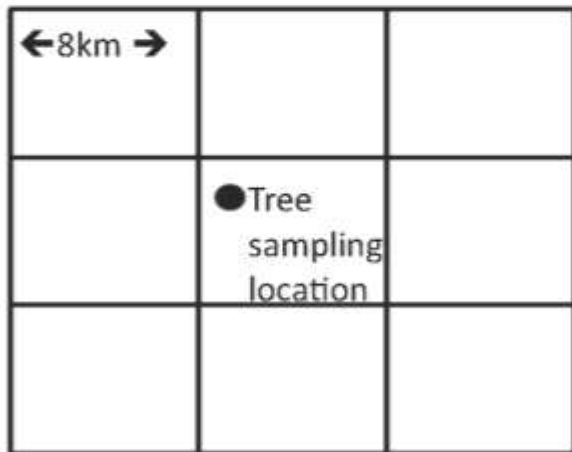
Some locations with ring width and maximum latewood density series ending in 1998 or later.



Maximum monthly correlation with local NDVI at 19 locations

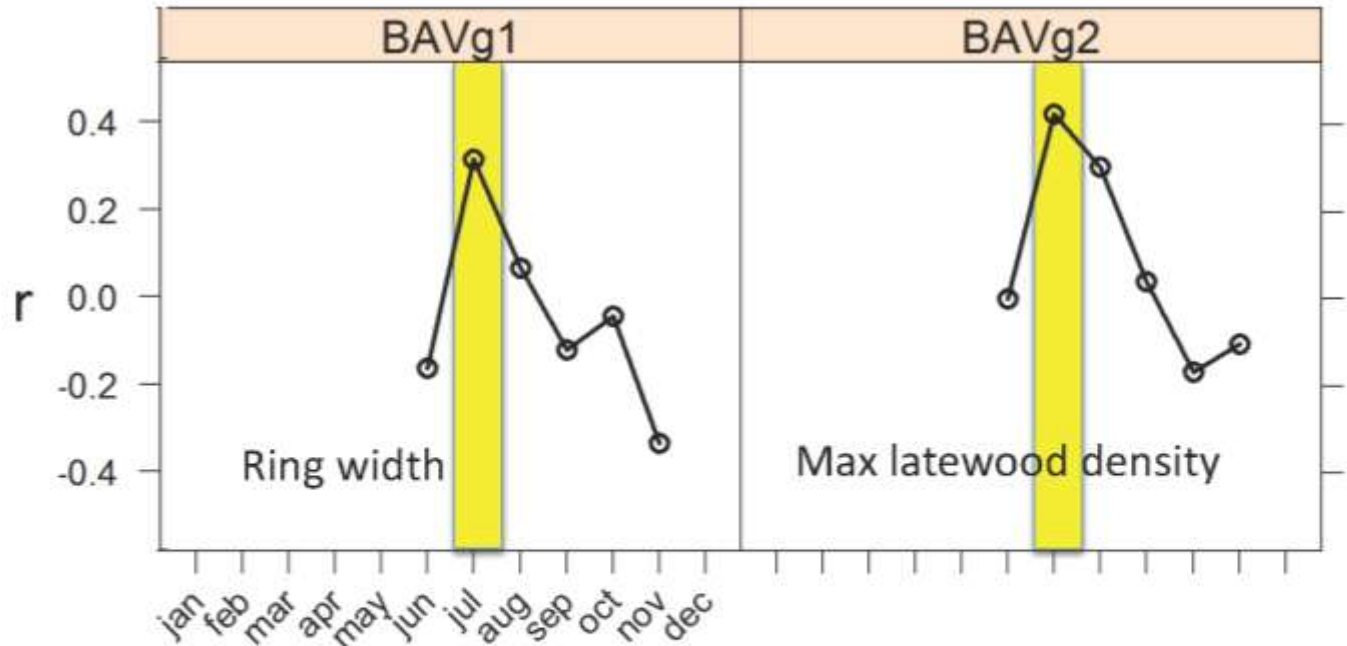
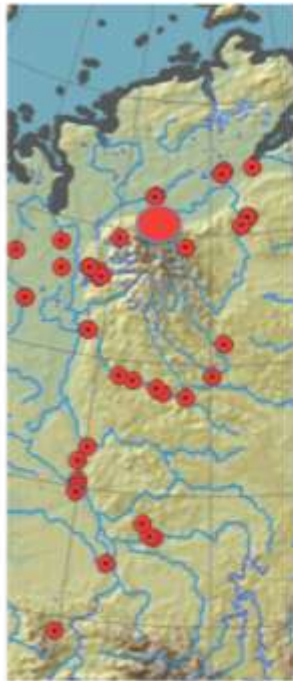


Moderate correlations at most locations for both ring width and maximum latewood density, often significant at $p < 0.05$ after taking account of autocorrelation. This differs from the Beck et al finding (prior slide).

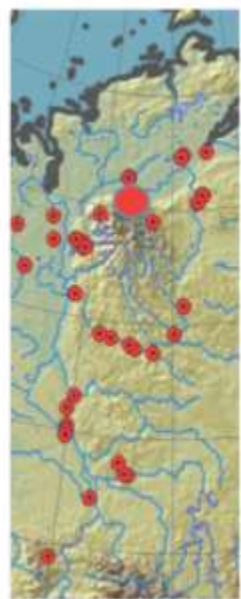
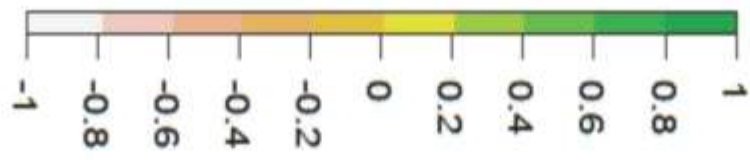
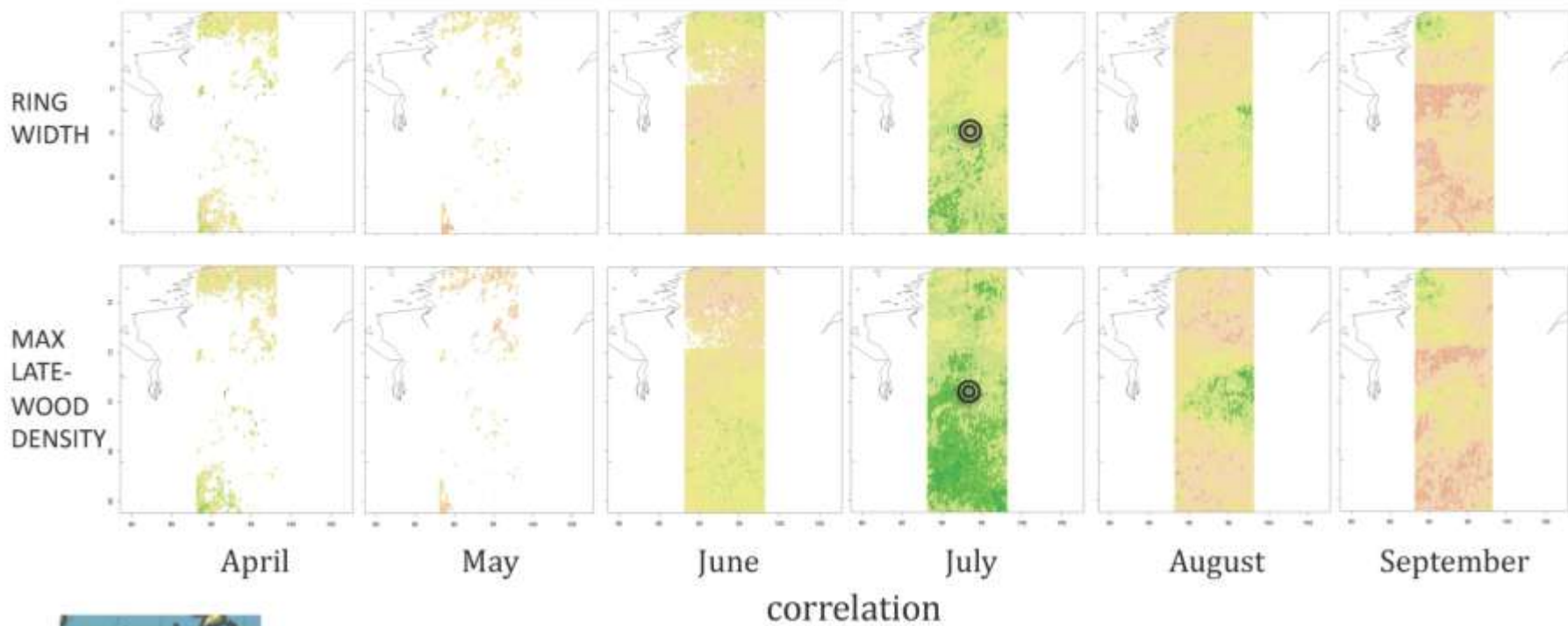


We examined correlations between NDVI* and a subset of the 154 local datasets (that end in 1998 or later). First we look at those with both maximum latewood density and ring width data. An example is shown here.

Correlation between NDVI (for ~24km box) and *Larix gmelinii* tree-ring series at the Bolshoi Avam (BAV) site on the Taimyr Peninsula (70.5 degrees North, 93.2 degrees East, 360 meters a.s.l.), 1982-2002.



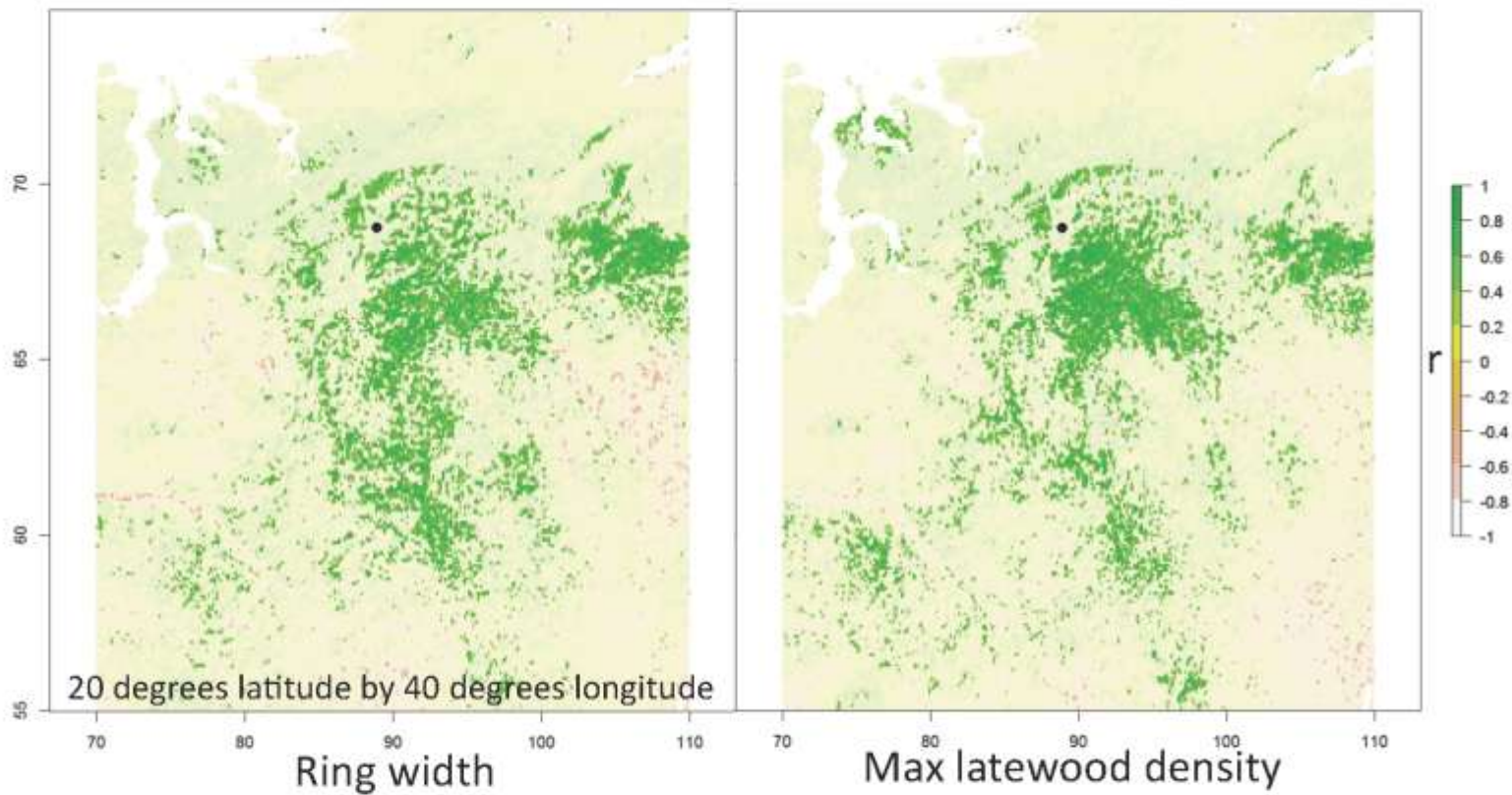
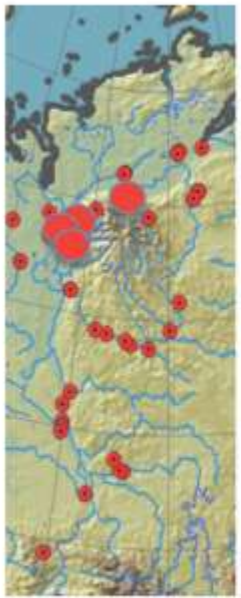
* GIMMs NDVI data computed monthly.



Same tree-ring data, larger area for NDVI: Correlation between NDVI (5 by 5 degree box) and *Larix gmelinii* tree-ring series at the Bolshoi Avam (BAV) site on the Taimyr Peninsula (70.5 degrees North, 93.2 degrees East, 360 meters a.s.l.), 1982-2002.

including BAV, 1982- 1998, $p \leq 0.05$

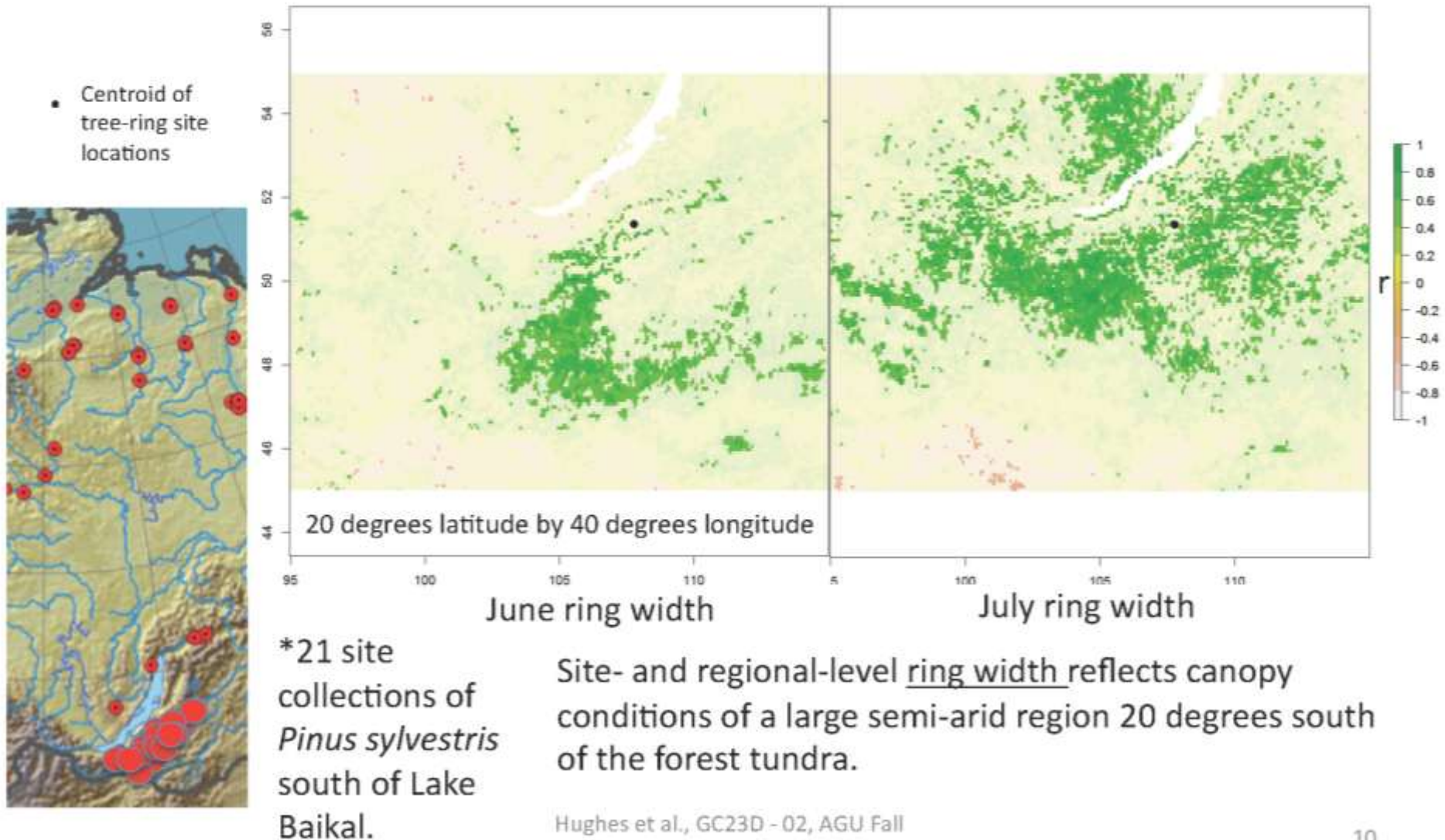
● Centroid of tree-ring site locations



Site- and regional-level maximum density AND ring width reflect canopy conditions of large regions. Why the difference with Beck et al, North America?

- a) Ring width and maximum latewood density remain strongly intercorrelated in Siberia (maybe a result of small rings), unlike Beck et al examples.
- b) Spruce in Siberia behave as other conifers there, not as in N. America.

Correlation of NDVI vs 1st PC of tree-ring width data*, 1982- 1998, $p \leq 0.05$



The question

- To what extent does NDVI (Normalized Difference Vegetation Index) observed from space co-vary with directly observed stem radial increment and maximum latewood density?

This week's answer

- At local level in Siberia, NDVI (usually July) covaries moderately but significantly well with both ring width (stem radial increment) and maximum latewood density.
- Regional tree-ring width and density data sets covary significantly and coherently with NDVI over large regions.

The next question

What does this mean?

Correlations in previous studies

- Malmström et al 1997
 - Alaska, one area, many trees 1982-1990, NDVI//TRW
 - Mixed spruce/birch 0.86
- D'Arrigo et al 2000
 - Siberia (1 site), Alaska (2 sites) 1982-1990, NPP from CASA/FASIR//MXD
 - *Larix gmelinii* 0.79; *Picea glauca* -0.19-0.79
- Lopatin et al 2006
 - Komi Rep., many trees 1982-2001, NDVI//TRW
 - *Pinus sylvestris* 0.27-0.57; *Picea obovata* 0.06-0.59
- Berner et al 2011
 - Siberia (12 sites), Canada (10 sites) 1982-2007/8, NDVI//TRW
 - *Larix gmelinii* 0.08-0.57; *Picea (abies, glauca/mariana)* 0.16-0.75; *Pinus banksiana* -0.58-0.15; *Pinus sylvestris* 0.36-0.82
- Beck et al 2013
 - Alaska/Canada (4 locations, very many trees) 1982-2001/4, NDVI//TRW/MXD
 - *Picea glauca* TRW – no consistent relationship; MXD – see slide 4.