

Carbon isotopes in Tree Rings of Norway Spruce Exposed to Atmospheric Pollution

Mountain spruce forest story in the Bohemian Forest continues...

Players:

Norway spruce (*Picea abies*)
Bark beetle (*Ips typographus*)

Environmental conditions:

Climate
Atmospheric pollution
Soil conditions

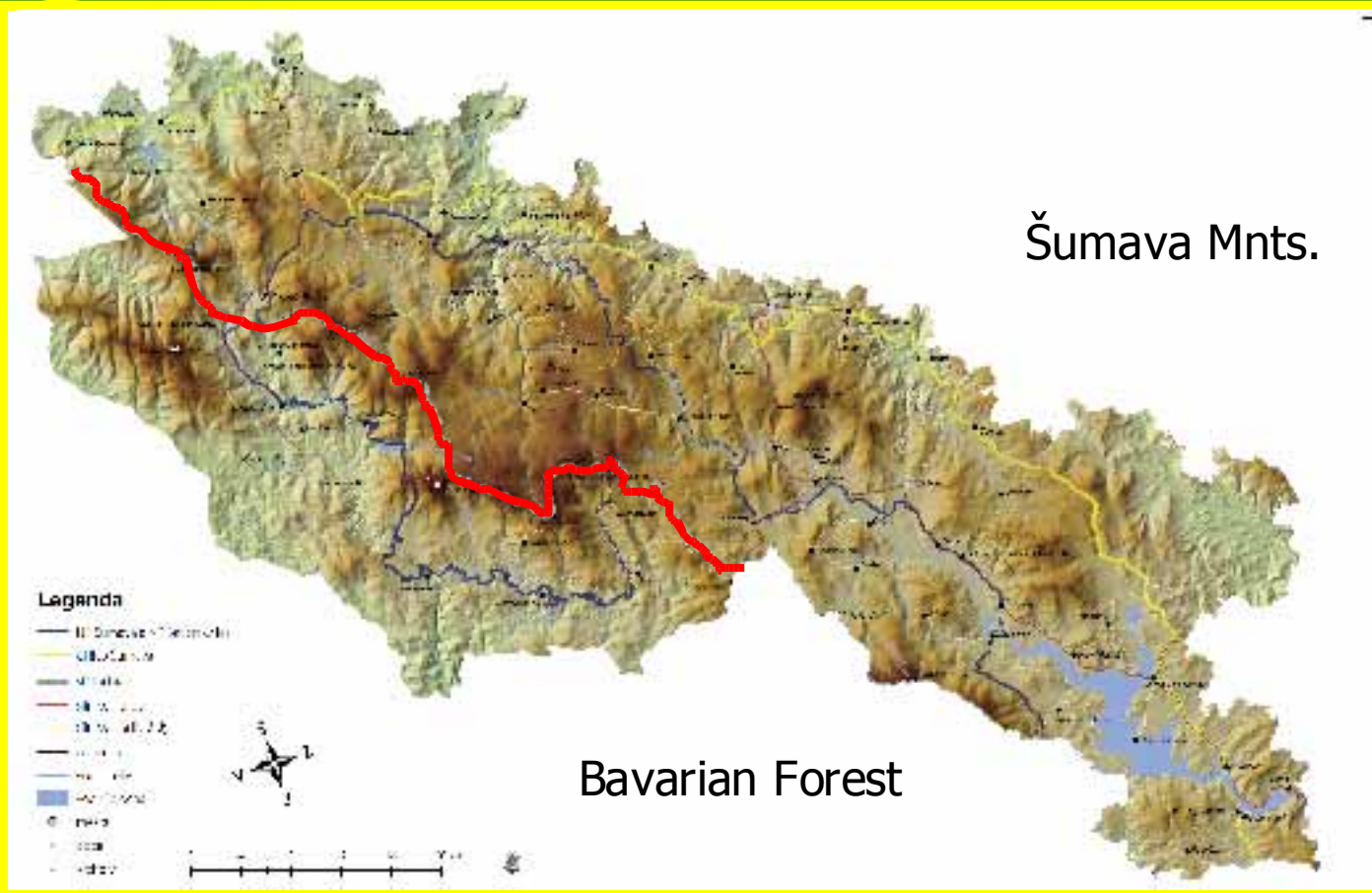


Hana Šantrůčková *et al.*

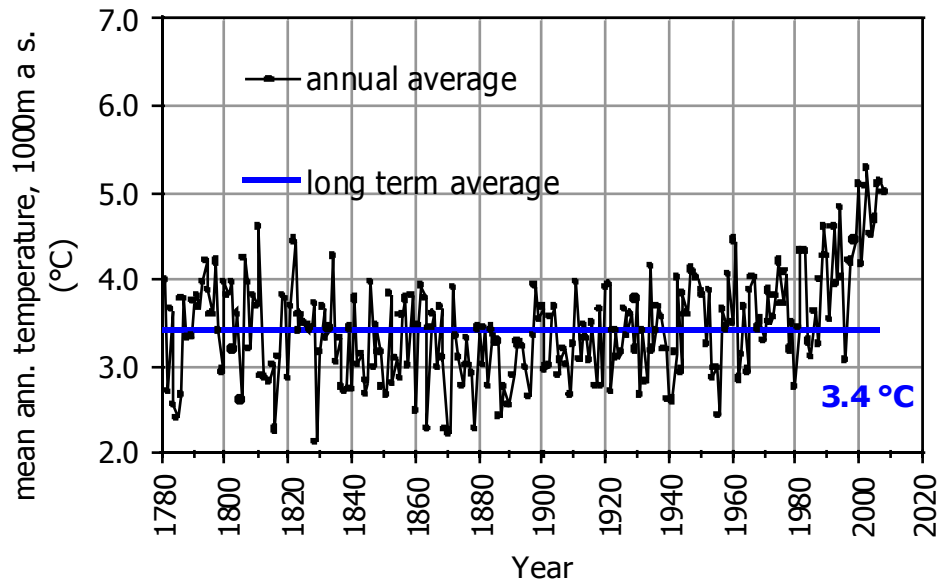
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České Budějovice*

Place of storyline:

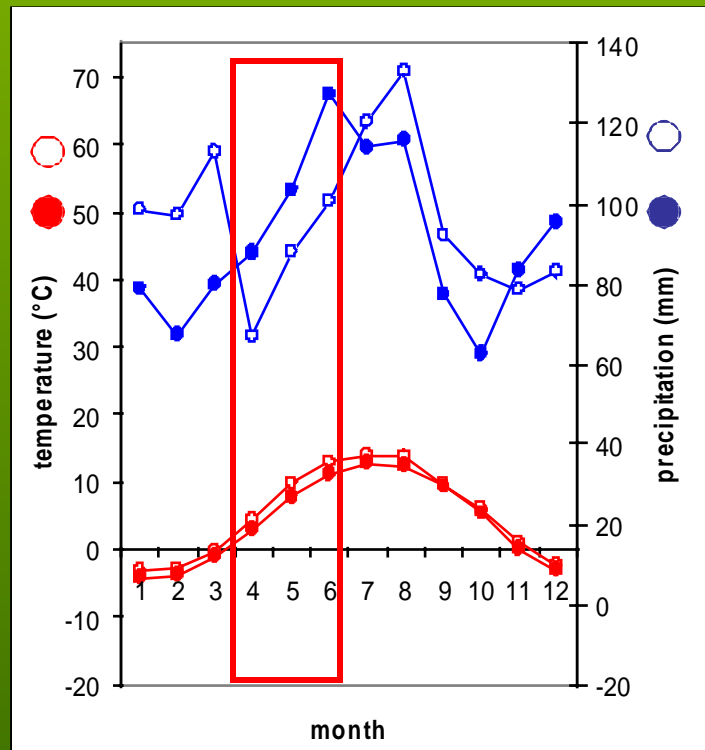
Bohemian Forest



Climate: mean temperature increases



and a shift in rainfall distribution over the year brings drought in the spring

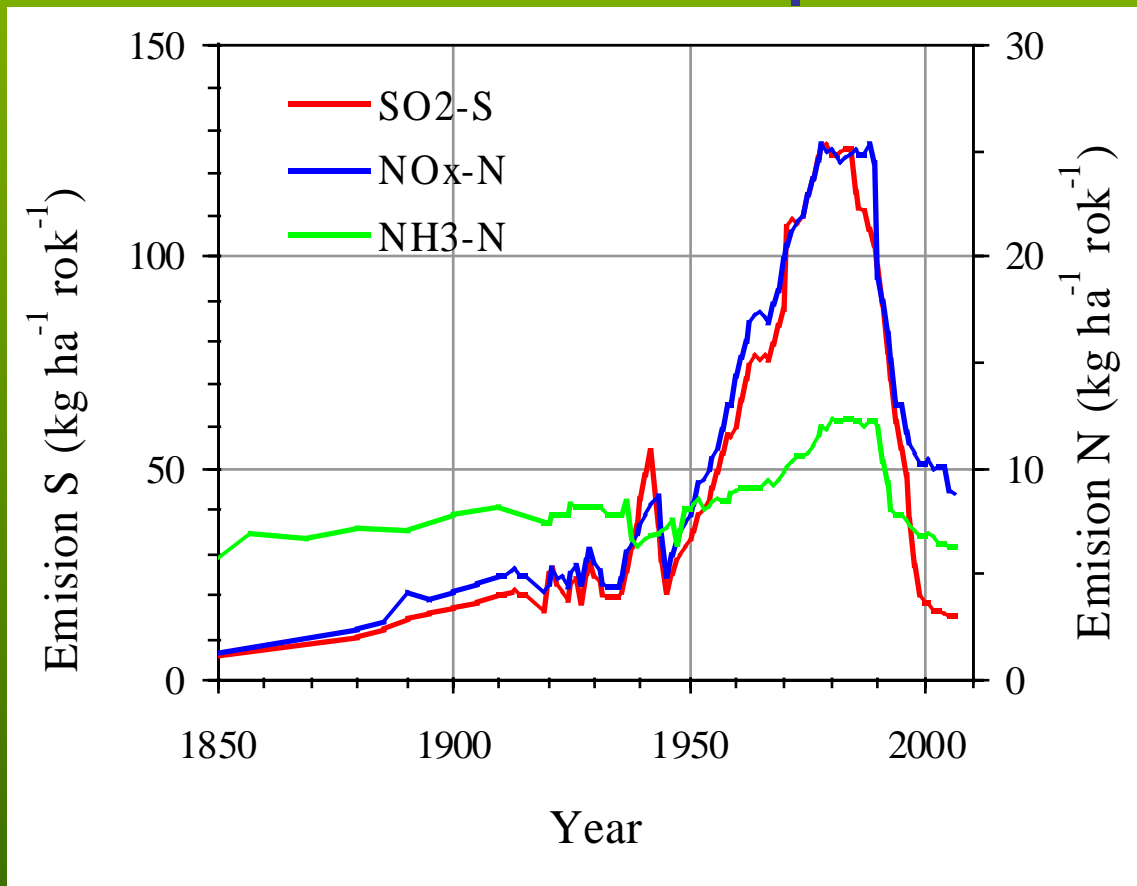


Full symbols – 1960 to 1990

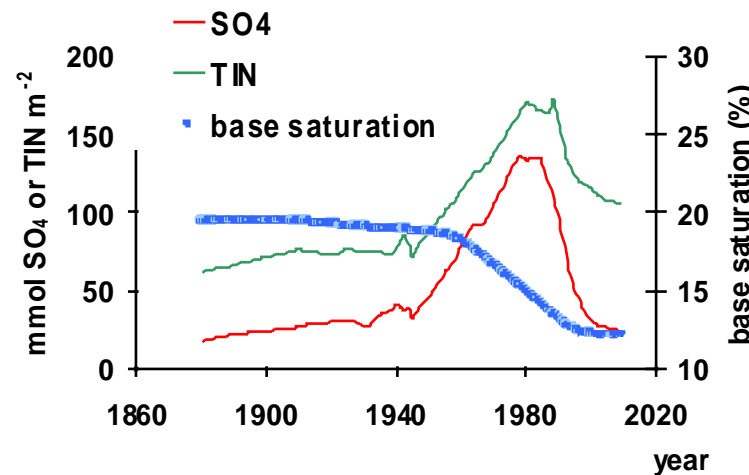
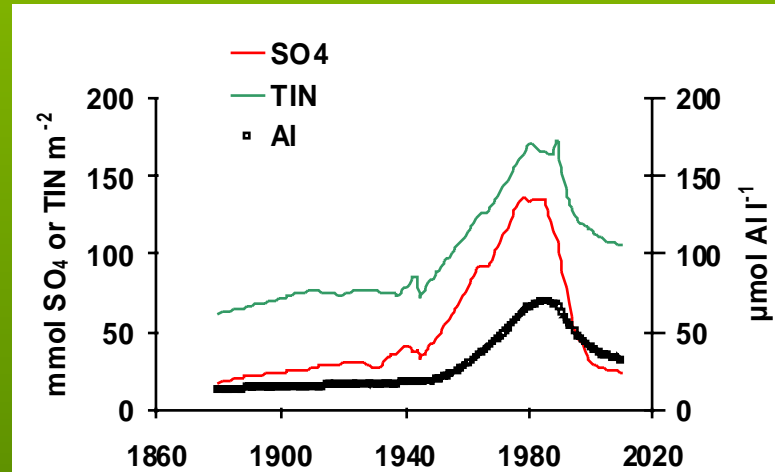
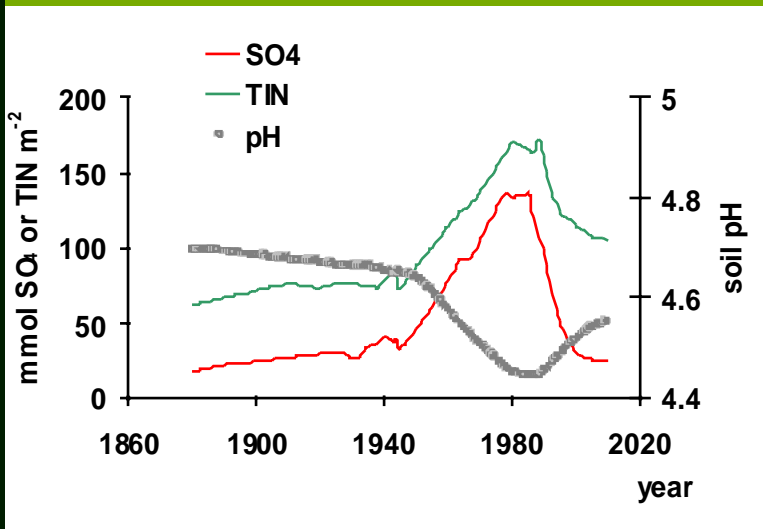
Open symbols – 1991 to 2008



The Bohemian Forest was exposed to **heavy atmospheric pollution** during the last century. Total emissions of S and N compounds increased slowly until 1950s, then rapidly in the 1950-1980 period, peaked in the 1980s, and declined markedly between the middle 1980s and 2000



The changes in acid deposition caused significant changes in the soil chemistry. MAGIC modeling showed a rapid **decline in pH and nutrient availability, and increase in Al concentration of soil solutions** after the 1950s



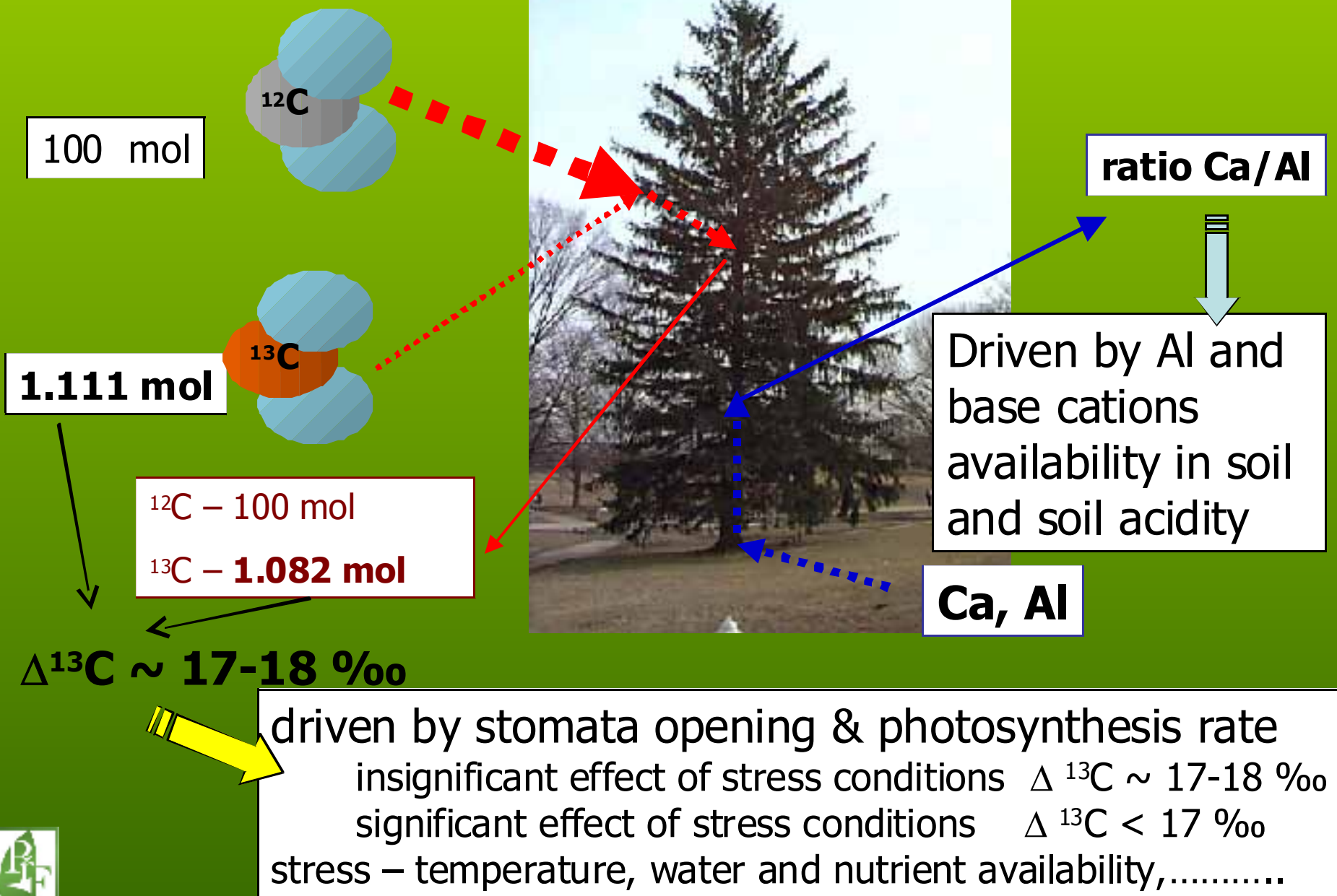
(according to MAGIC modeling; Majer et al. 2003, Hydrol.Earth Syst.Sci.)



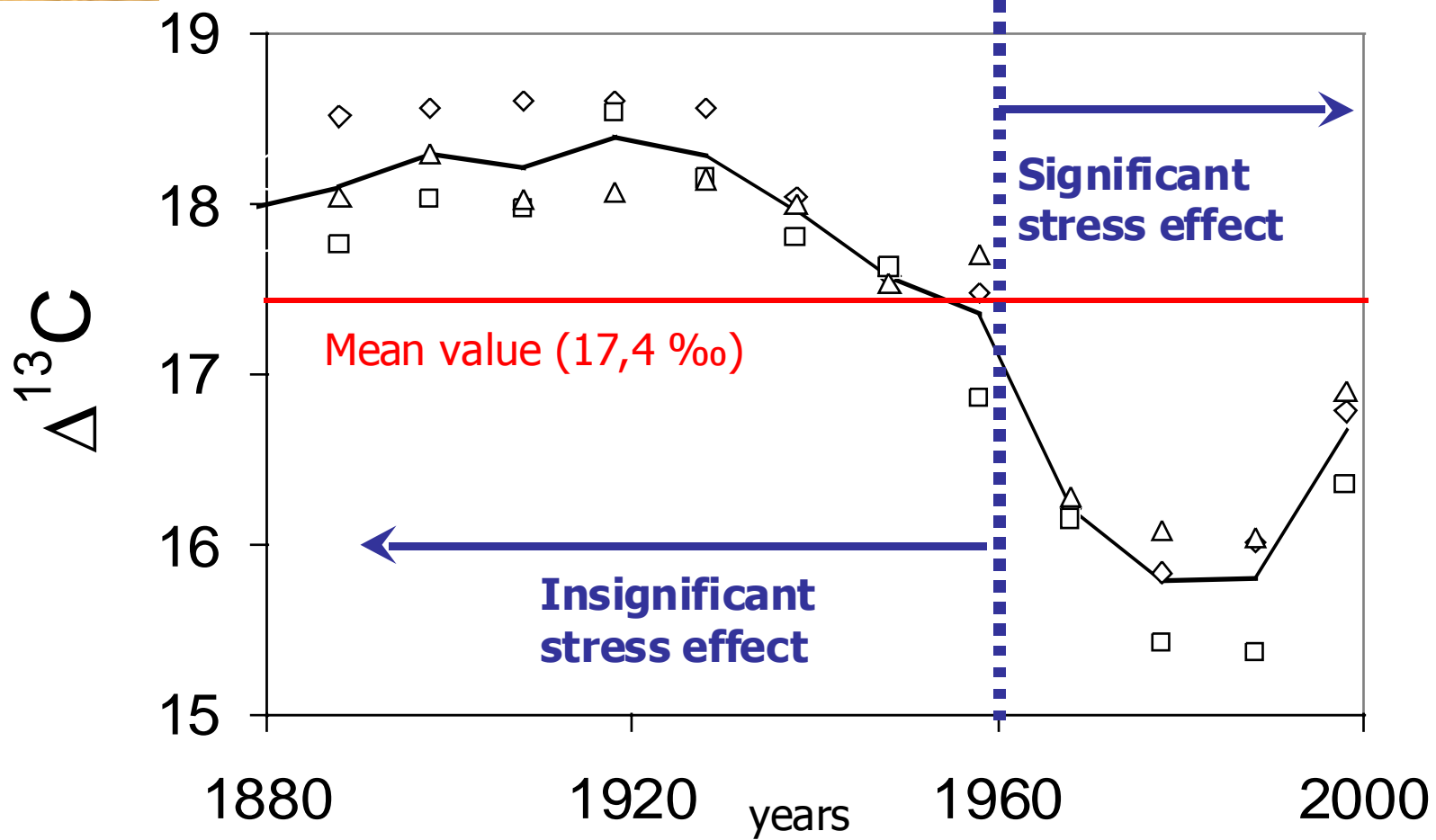
Did spruce trees reply to the changes in environmental conditions ?



The least bit of theory.....



Isotope composition of tree rings

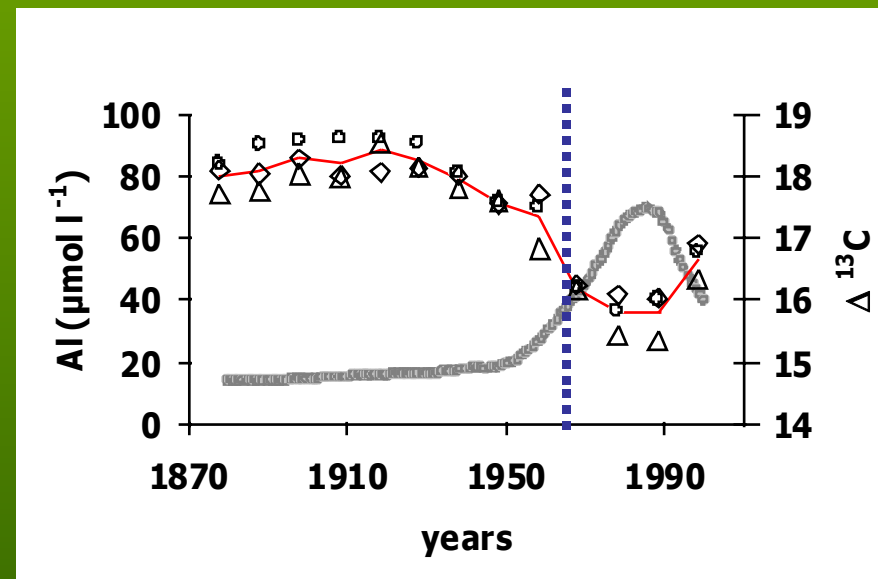
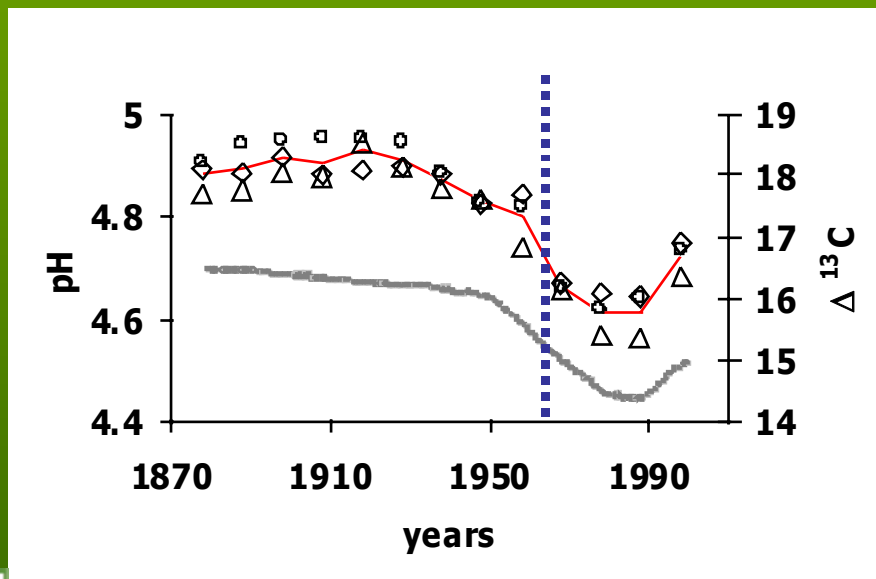
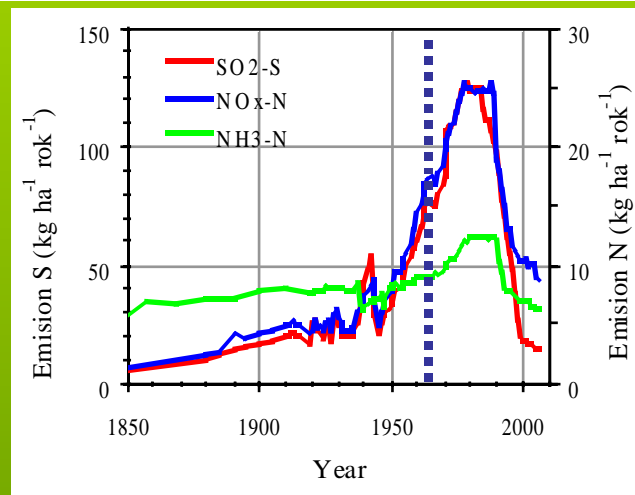


Tree physiology was negatively affected from 1960s



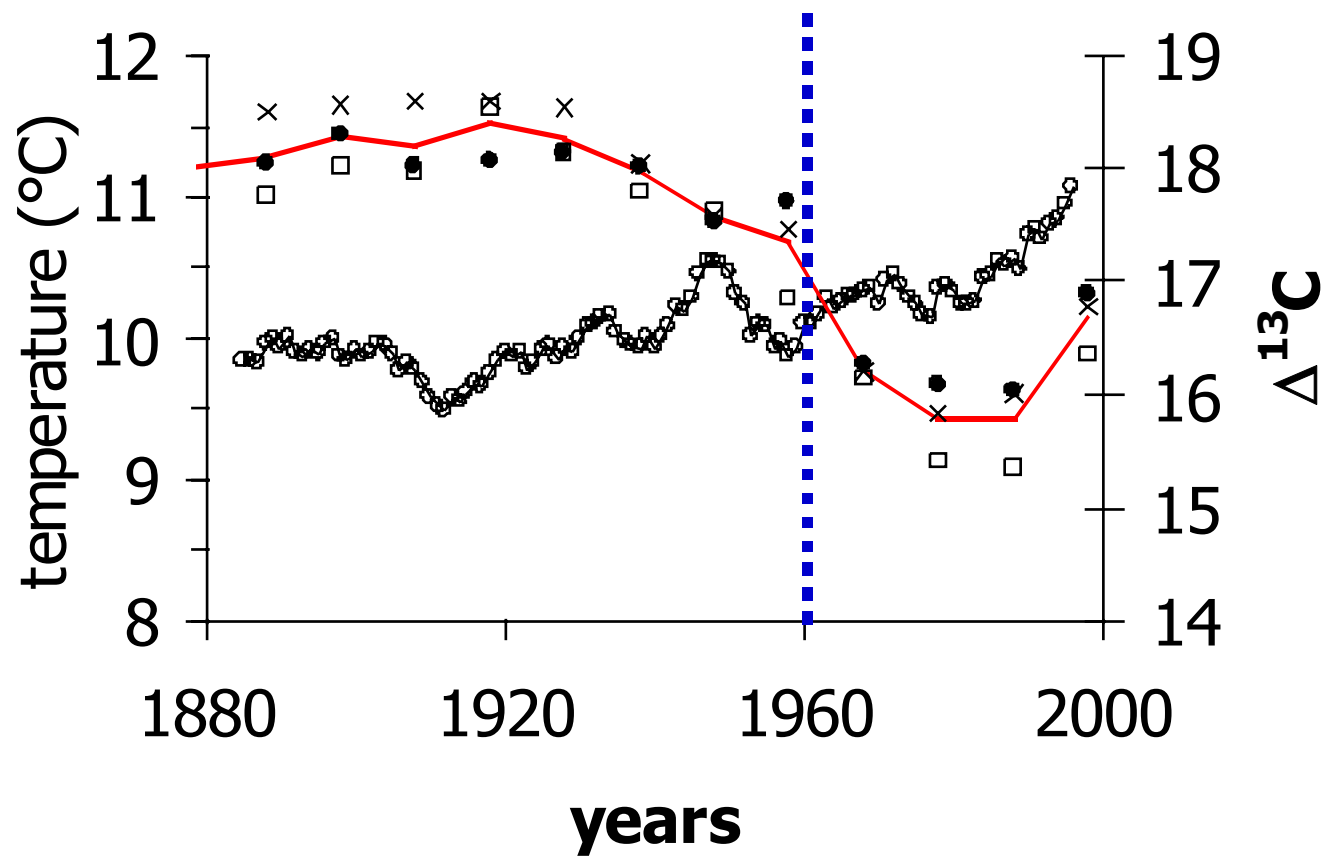


Isotope composition of tree rings followed changes in atmospheric depositions and soil chemistry



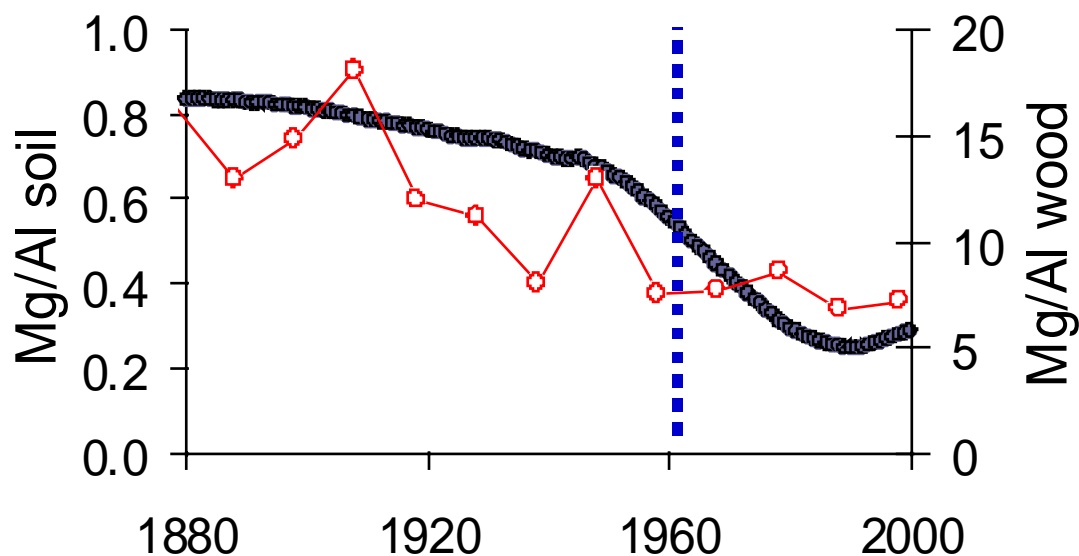
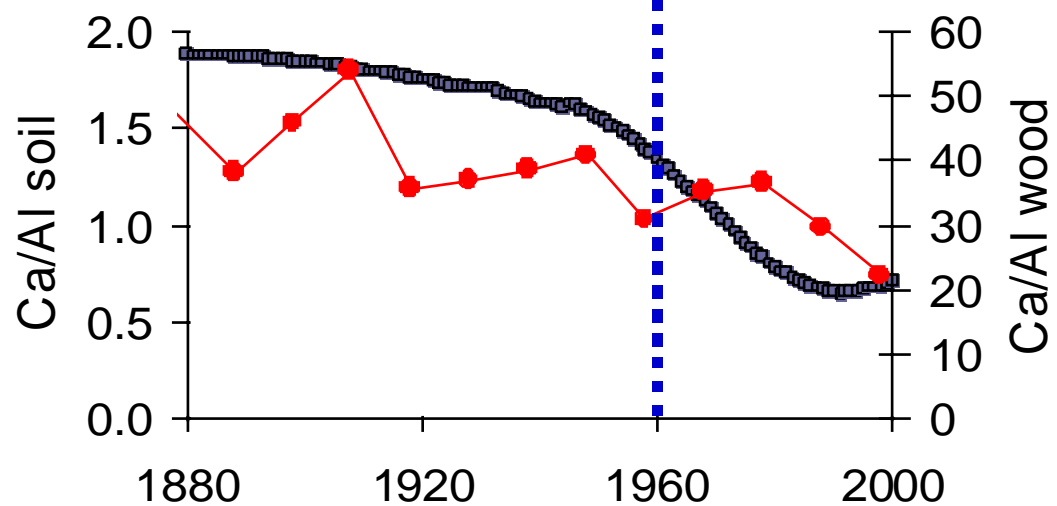


Correlation with climate change is not so tight





Molar ratios Ca/Al and Mg/Al decrease in both the soil and wood and indicate decreasing availability of base cations and increasing Al toxicity



Spruce trees in the Bohemian Forest are negatively affected by the change in environmental conditions.



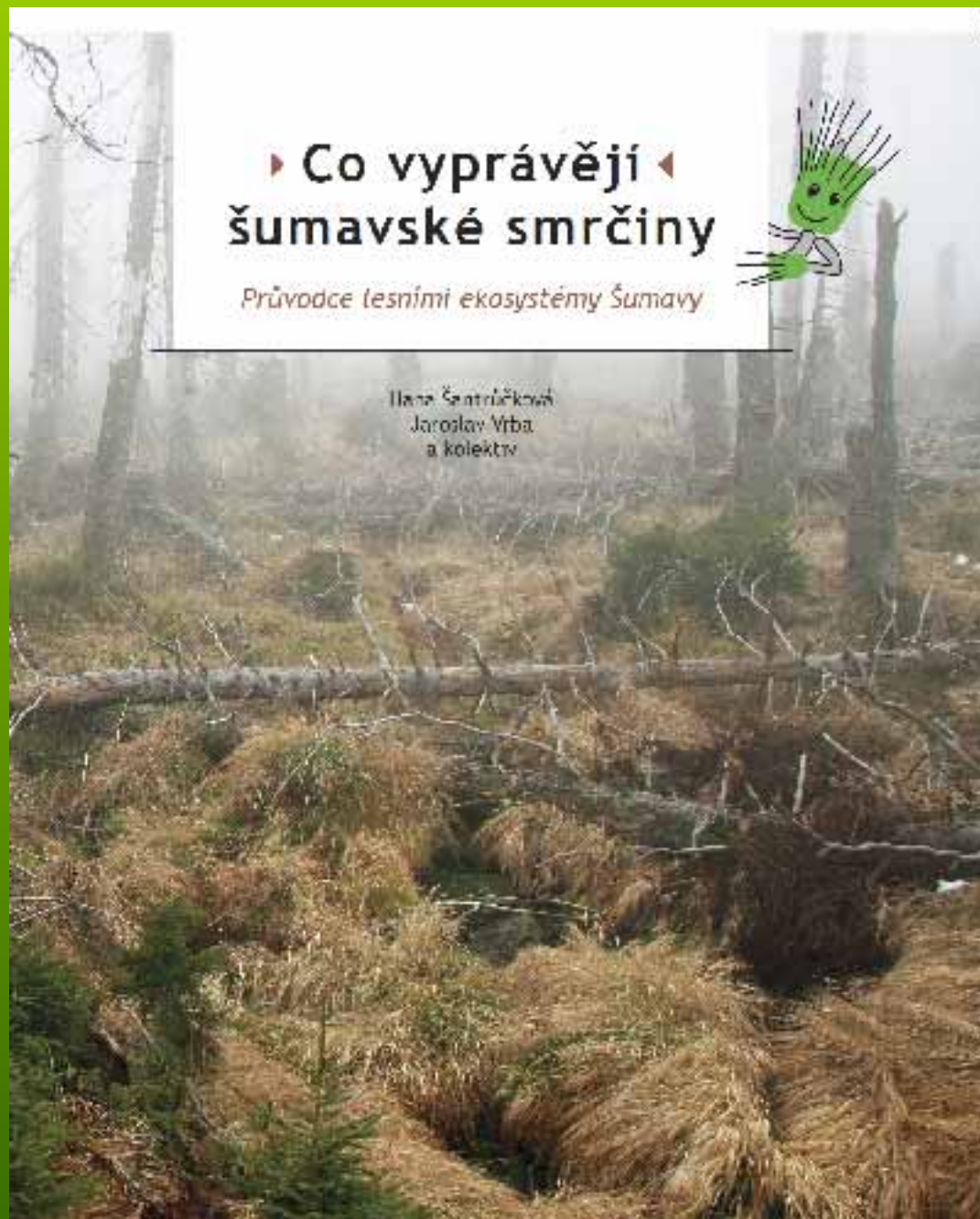
?? Were consequences of Kyrill windstorm worse because of it??



Foto – Zdenka Křenová

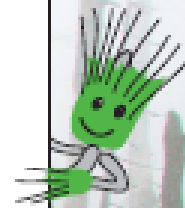
?? Did it support bark beetle attack??





► Co vyprávějí ◄ šumavské smrčiny

Průvodce lesními ekosystémy Šumavy

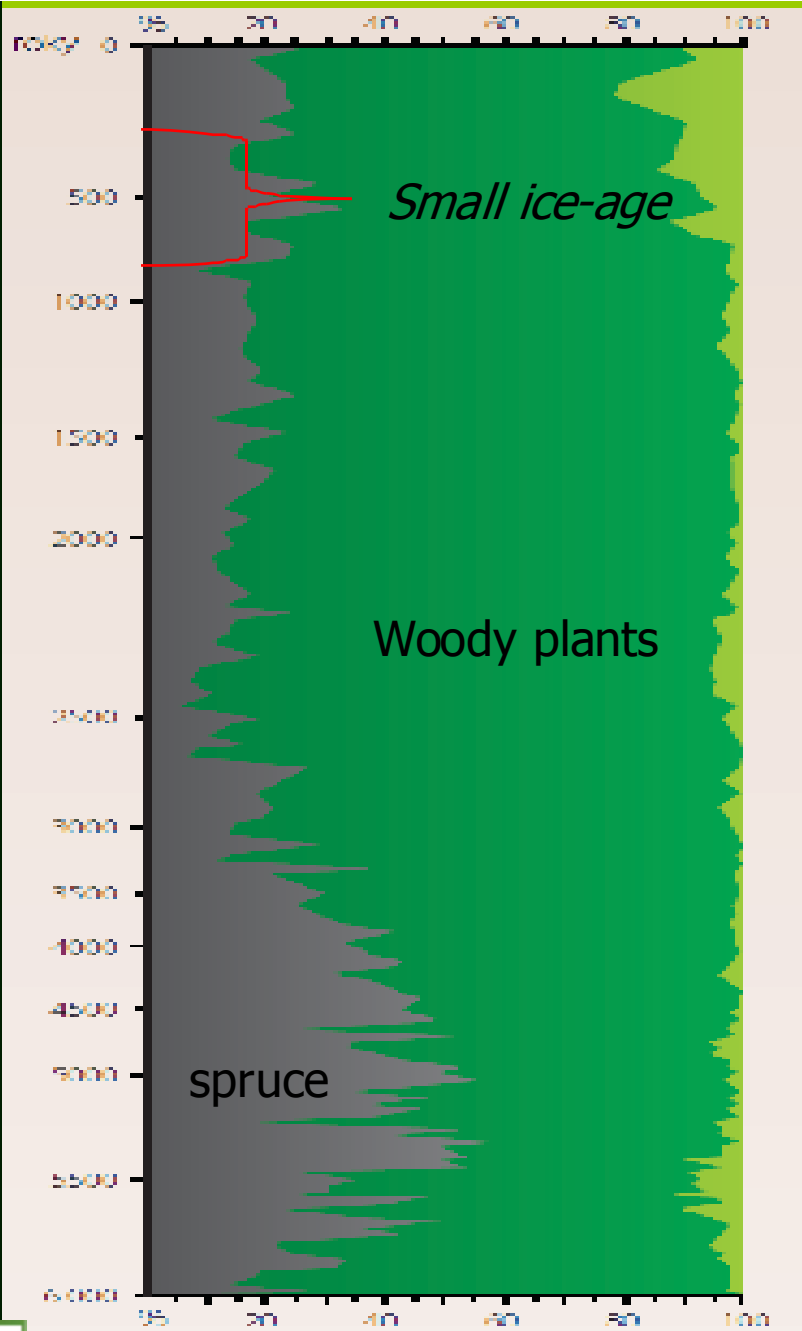


Hana Šantrůčková
Jaroslav Vrba
a kolektiv



Co vyprávějí šumavské





We know that spruce abundance regularly decreased in the past, with a period of about 200 years

why?

Settlement and larger impact of human activity is not documented until Middle Ages (since before 1400 years)

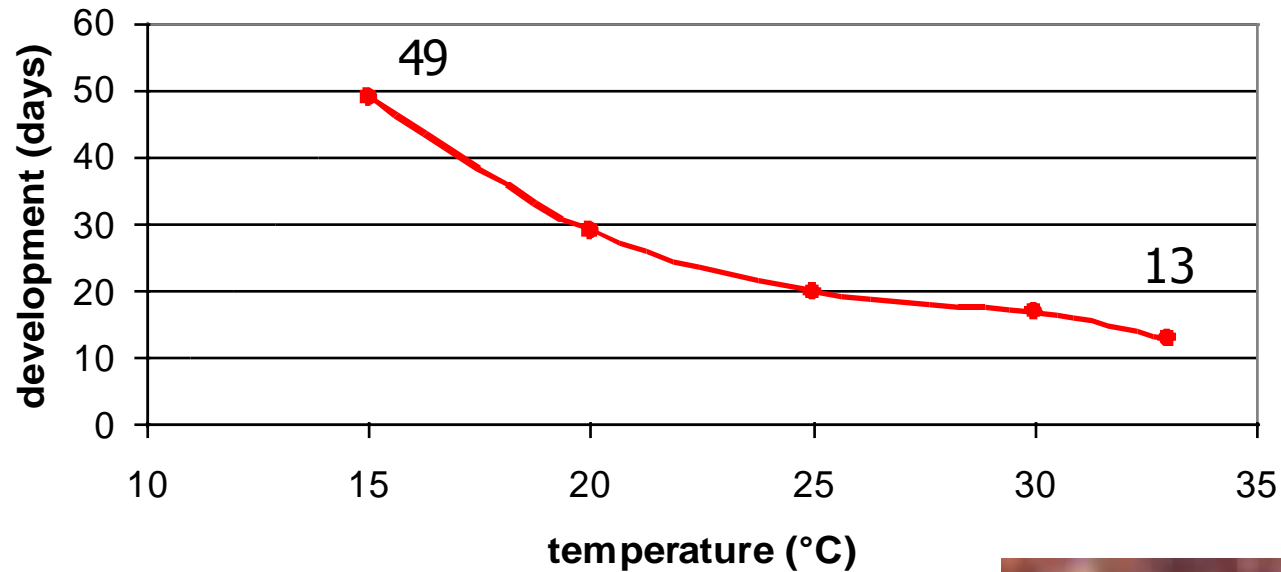


Effect of bark beetle attack is likely explanation



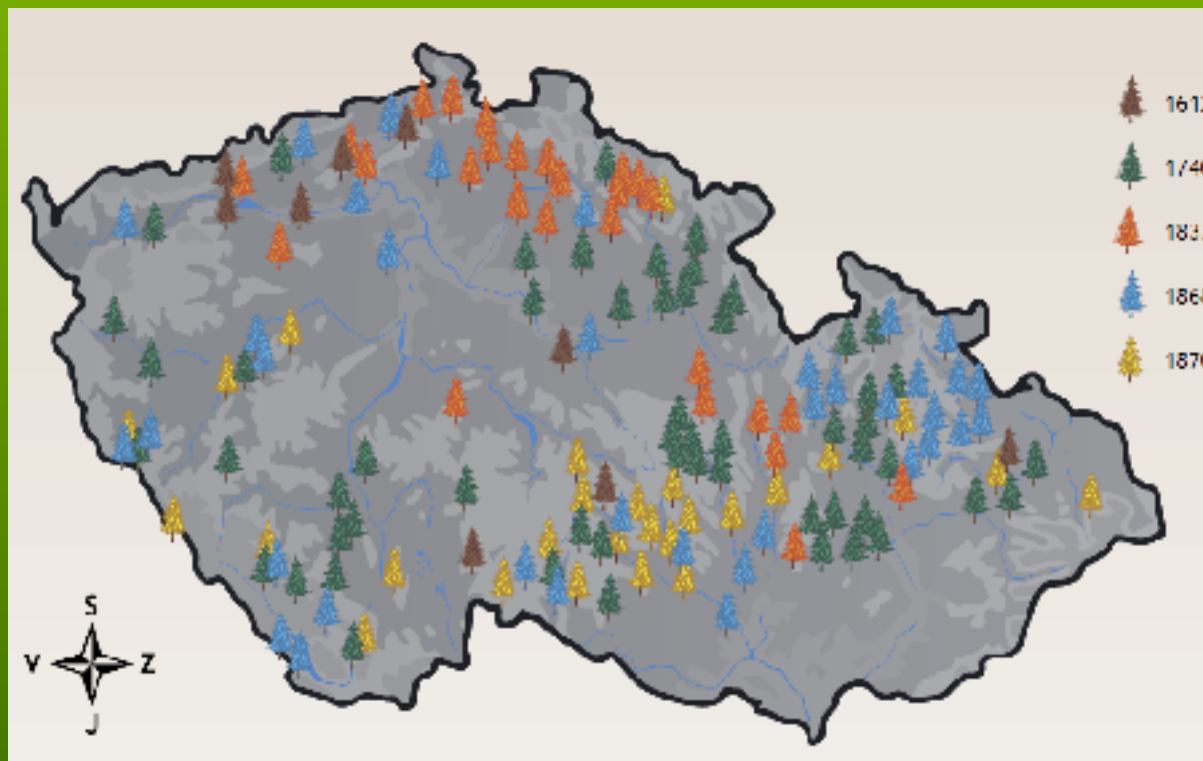
We know that bark beetle is an integral component of mountain spruce forests

The warmer the climate, the faster his development



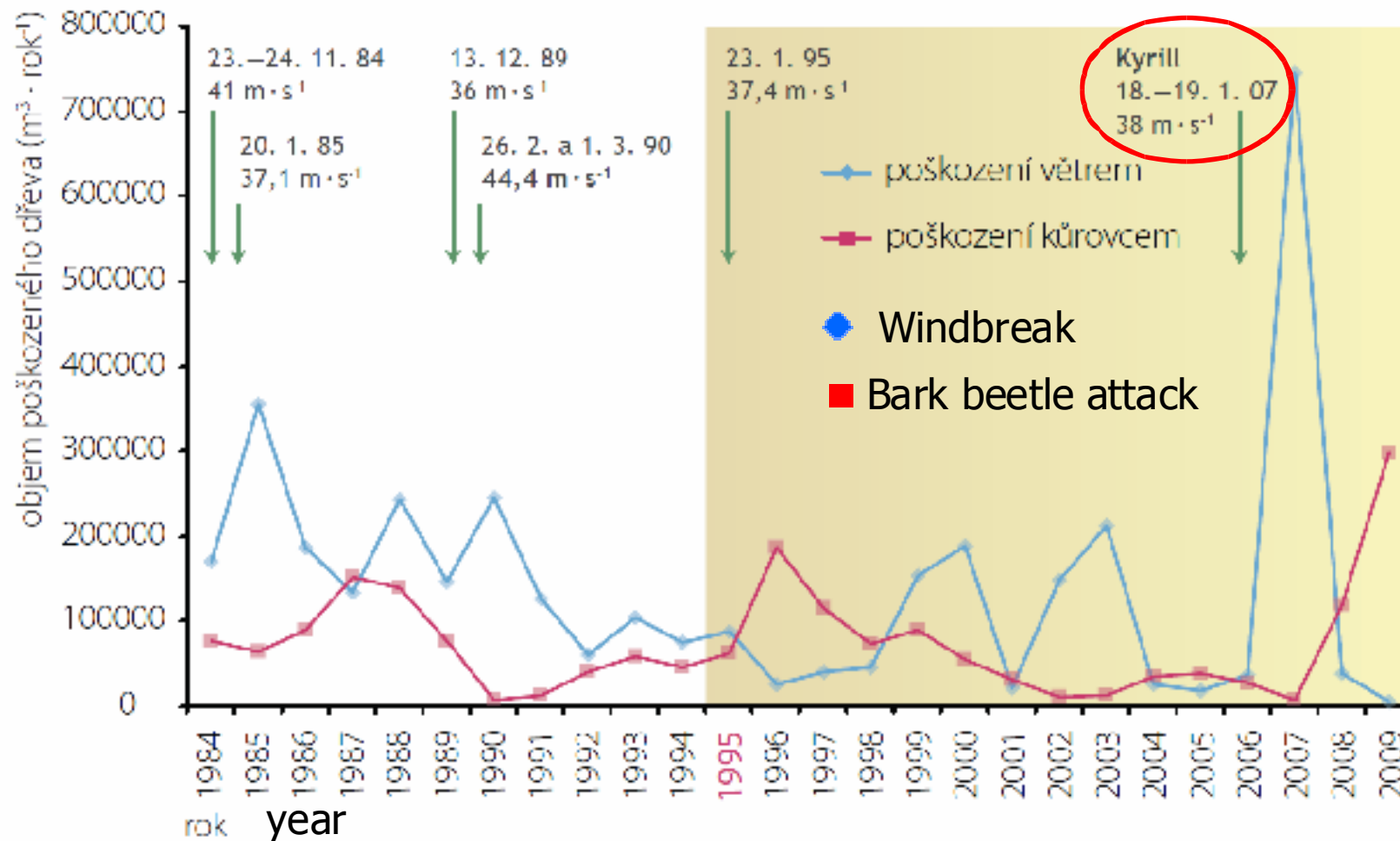
Windstorm is an attribute of climate in Central Europe.

History file revealed that windstorm came through Czechia each century during last 500 years and it always resulted in windbreaks.

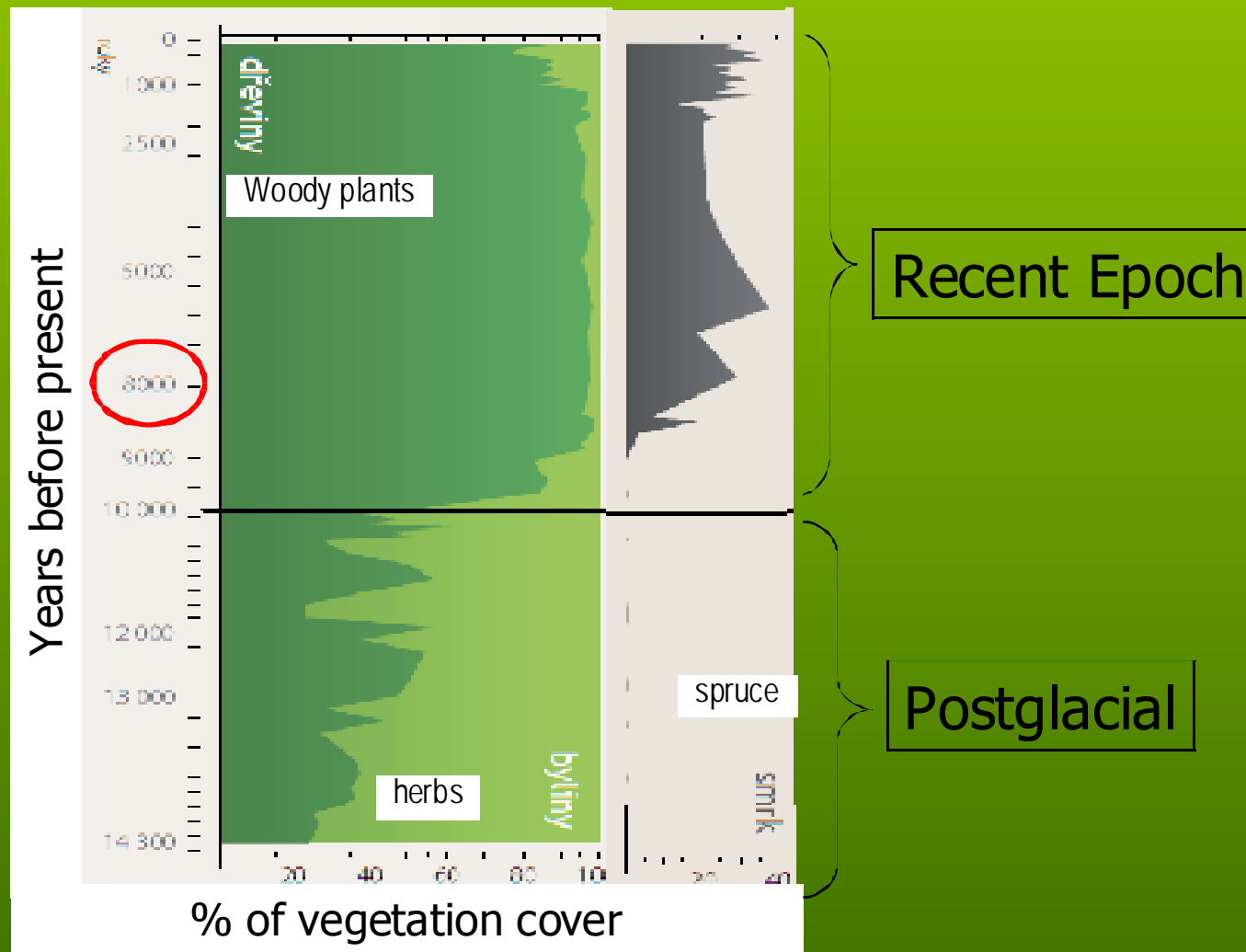


Recent data show that windstorm came through the Bohemian Forest six times since 1984

volume of destroyed wood



Spruce trees have occurred in these mountains already 8 000 years ago.



Pollen diagram from sediment of the Plešné lake - one of five glacial lakes (depth of the sediment - 5,5 m, Jankovská 2006)

