Recent growth trends of coniferous species in the Central European Alps indicate decreasing sensitivity to climate warming

W Oberhuber, U Bendler, V Gamper, J Geier, A Hölzl, H Krismer, W Kofler, B Waldboth, G Wieser

universität innsbruck

BFW.

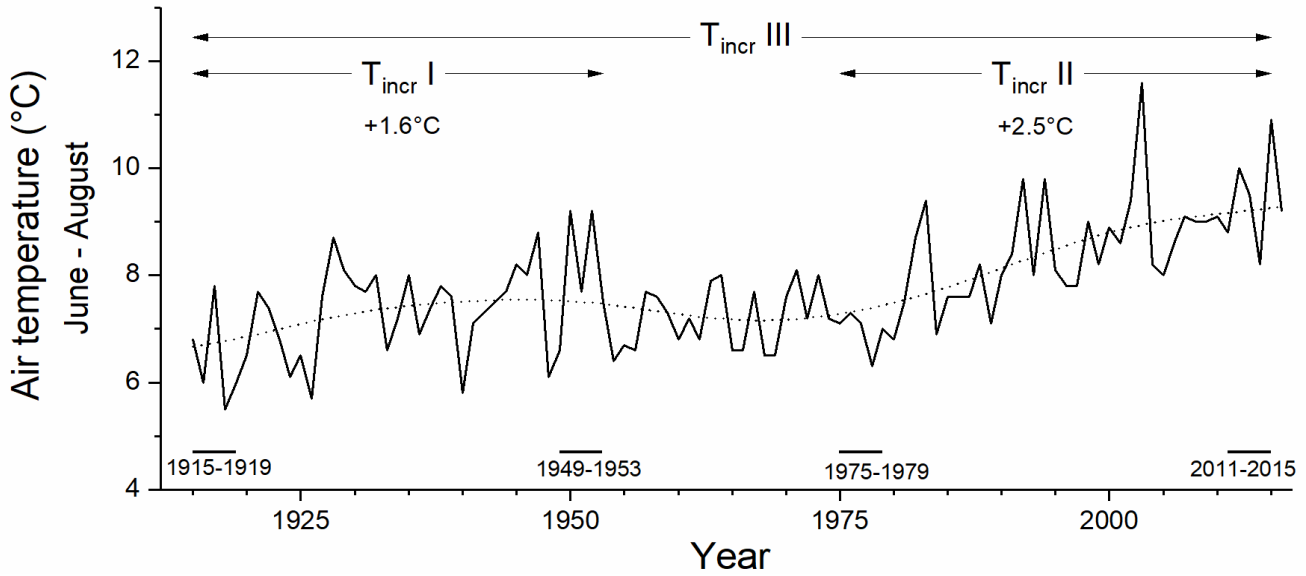
IMC Innsbruck 2019 International Mountain Conference

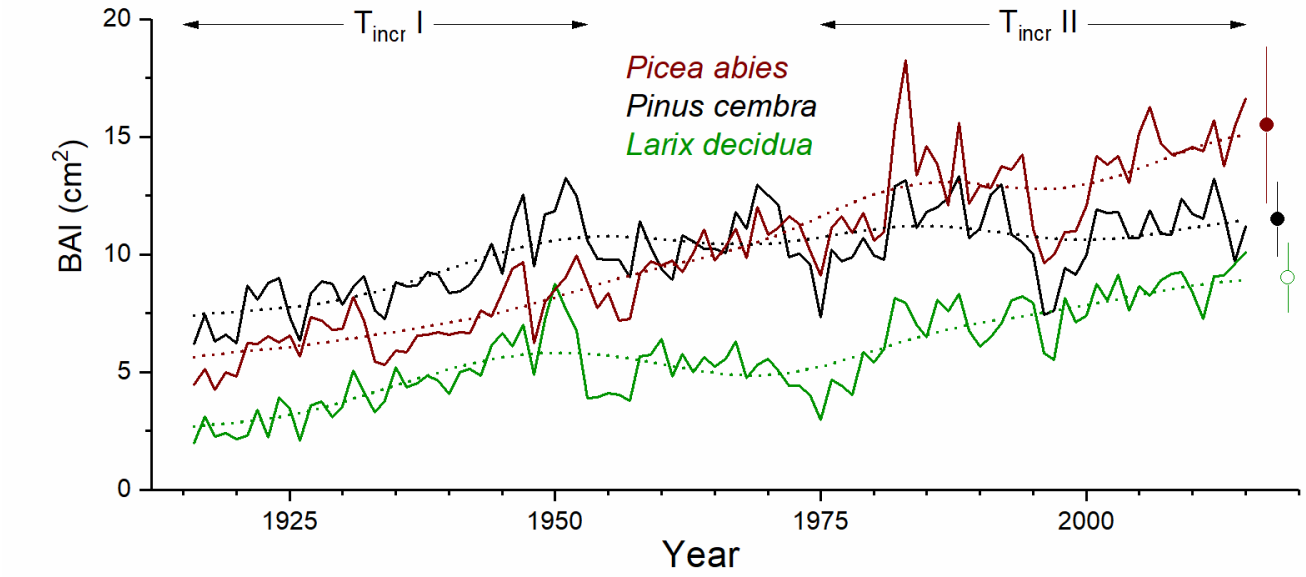
8-12 Sep 2019, Innsbruck, Austria

Picea abies: 131±29 yrs / n=74

Pinus cembra: 199±42 yrs / n=50

Larix decidua: 133±32 yrs / n=70





Increase in BAI (cm^2) during phases of climate warming

Species	$T_{incr}I$	$T_{incr}II$	1915-2015
Pinus cembra	5.35 ± 0.84^a	1.89 ± 1.78^b	4.84 ± 1.33^a
Larix decidua	4.49 ± 1.91^a	4.65 ± 0.54^a	6.66 ± 1.05^b
Picea abies	4.24 ± 0.82^a	4.28 ± 1.23^a	10.57 ± 1.22^c

Conclusions

We explain missing adequate growth response to recent climate warming by:

- intensified competition for resources (nutrients, light, water) in increasingly denser stands,

- species-specific sensitivity to climate variables beyond the growing season.

Recent growth trends of coniferous species in the Central European Alps indicate decreasing sensitivity to climate warming

W Oberhuber[1], U Bendler[1], V Gamper[1], J Geier[1], A Hölzl[1], H Krismer[1], W Kofler[1], B Waldboth[1], G Wieser[2]
[1]Department of Botany, University of Innsbruck, Austria; [2]Department of Alpine Timberline Ecophysiology, BFW, Innsbruck, Austria

universität innsbruck
Institut für Botanik

Background

Climate observations reveal a pronounced rise of air temperature in the Central European Alps (CEA) in recent decades (Gobiet et al. 2014) and it is also well established that tree growth at high altitude is mainly limited by low temperature during the growing season (Körner & Paulsen 2004; Wieser et al. 2019).

Aim and Method

We developed tree ring series of coniferous species at subalpine sites (n=194 trees) and evaluated whether trends in basal area increment (BAI) are in line with two phases of climate warming. Differences in temperature and BAI during 5-yr long periods at the start and end of these warming phases were compared.

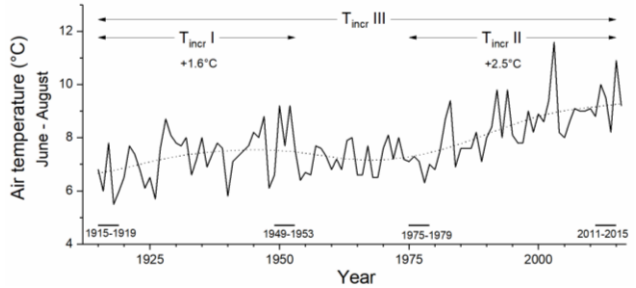


Fig. 1 Two phases of climate warming (T_{incr}I and II) in the Alpine region in the period 1915–2015 (data from Auer et al. 2007).

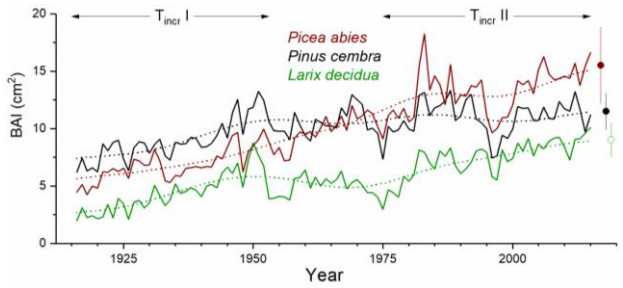


Fig. 2 Trend in basal area increment (BAI) from 1915–2015 in dominant conifers in CEA (n>50 trees per species).

Species	T_{incr}I	T_{incr}II	T_{incr}III
Pinus cembra	5.35±0.84[a]	1.89±1.78[b]	4.84±1.33[a]
Larix decidua	4.49±1.91[a]	4.65±0.54[a]	6.66±1.05[b]
Picea abies	4.24±0.82[a]	4.28±1.23[a]	10.57±1.22[c]

Table 1 Increase in BAI (cm^2) during phases of climate warming (T_{incr}I and II) and the whole study period (T_{incr}III). Different letters indicate significant differences at $P < 0.05$.

Results

Although enhanced tree growth occurred at high altitude in response to climate warming, results revealed that growth increase has declined in *Pinus cembra* and remained constant in *Picea abies* and *Larix decidua* despite the more intensified warming taking place since late 1970s (**Fig. 1, Table 1**).
Pinus cembra dominates at high altitude in the CEA and therefore was expected to mainly benefit from climate warming. However, increase in air temperature during the growing season primarily favored growth of *Larix decidua* and *Picea abies* (**Fig. 2, Table 1**).

Conclusions

We explain missing adequate growth response to recent climate warming by

(i) intensified competition for resources (nutrients, light, water) in increasingly denser stands leading to changes in carbon allocation among tree organs, and

(ii) species-specific sensitivity to climate variables beyond the growing season.

References
Auer I et al. (2007) Int J Climatol; Gobiet et al. (2014) Sci Total Environ; Körner & Paulsen (2004) J Biogeogr; Wieser et al. (2019) Forests.