Growth deviation and environmental changes

CRA
CONSIGLIO PER LA RICERCA E LA SPERIMENTAZIONE IN AGRICOLTURA

CNR - Istituto per lo Studio degli Ecosistemi
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TerraData environmetrics

Rete Nazionale Integrata
CONECOFOR
Controllo Ecosistemi Forestali

Changes in management, climate and N deposition explain recent deviation from expected growth in mature Spruce and Beech forests in Italy

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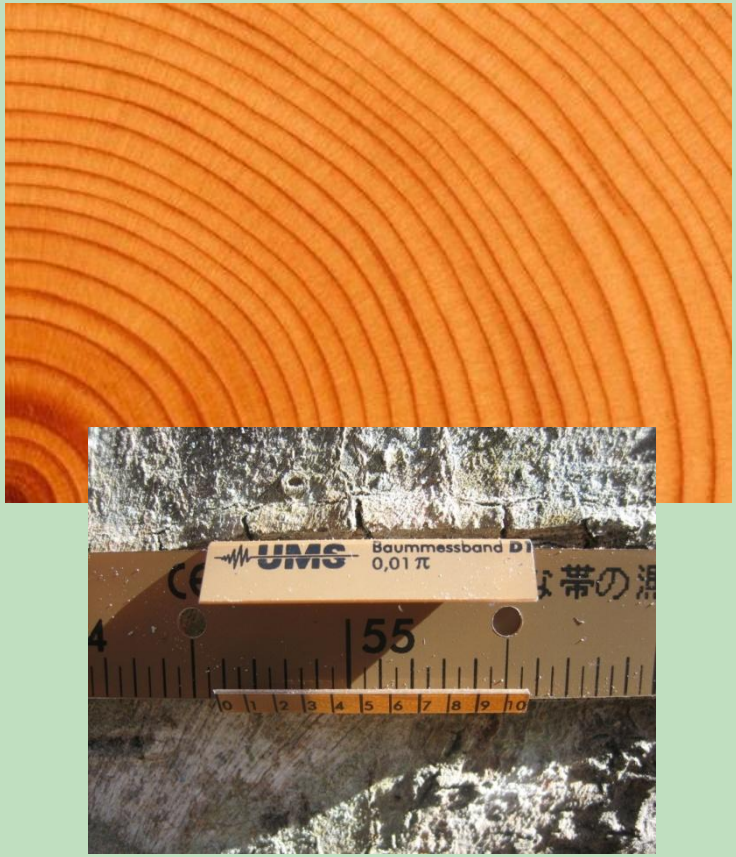
Growth deviation

A preliminary investigation on factors involved in recently measured growth deviation at selected CONECOFOR plots

- Reported changes in tree growth (Spieker et al.1996, Leuzinger et al.2005, Ciais et al. 2005)
- Possible reason: management, increasing AT, changes in precipitation pattern, raising CO_2 level, fertilization by N deposition, increasing O_3 concentration.
- Role of environmental drivers and management



Talk outline

A preliminary investigation on factors involved in recently measured growth deviation at selected CONECOFOR plots

- Concept and methods
- Variables used in the study
- Results and conclusions

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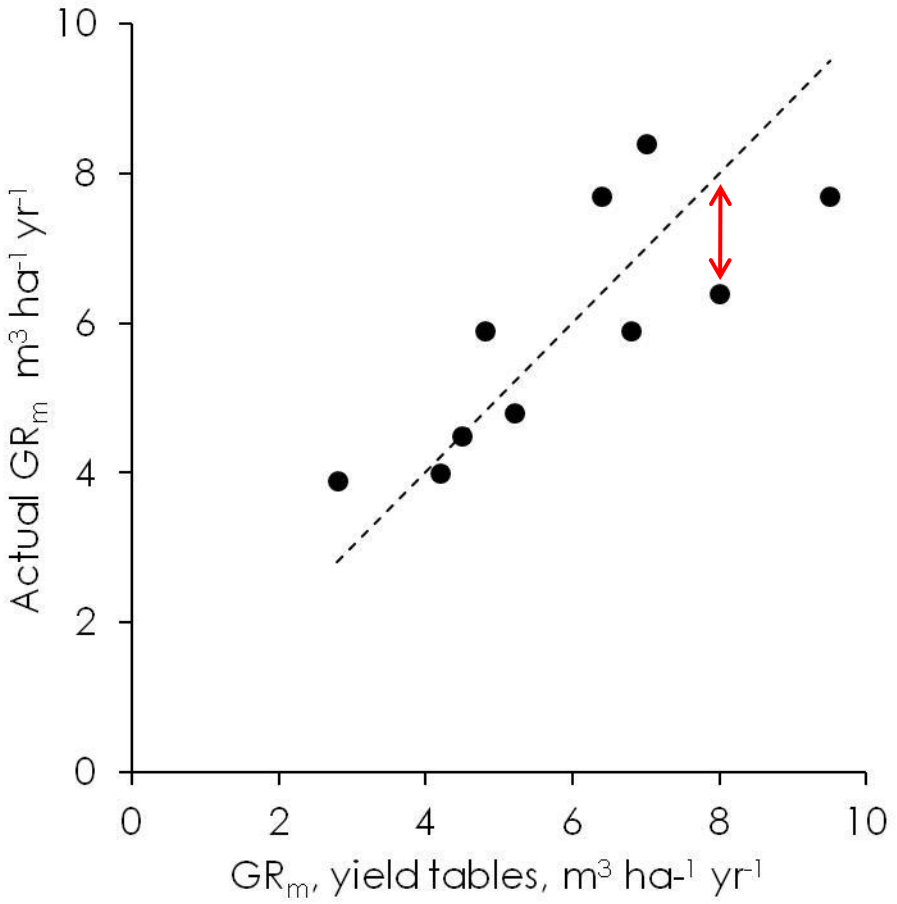
Concept and methods

A preliminary investigation on factors involved in recently measured growth deviation at selected CONECOFOR plots

- Concept: by comparing measured growth data and data from yield tables , investigate the role of environmental drivers in explaining recent growth deviation
- Data: measured growth on 10 CONECOFOR plots compared to yield tables for same or similar forests (1915-1974)
- Statistical methods: subsequent MLR models, starting from a reference model (only management related variables)



Predictor variables environmental changes

Differences between present and past condition

1. Meteorology

2. Management

3. Environmental pollution:

- O_3 concentration
- CO_2 level
- N deposition

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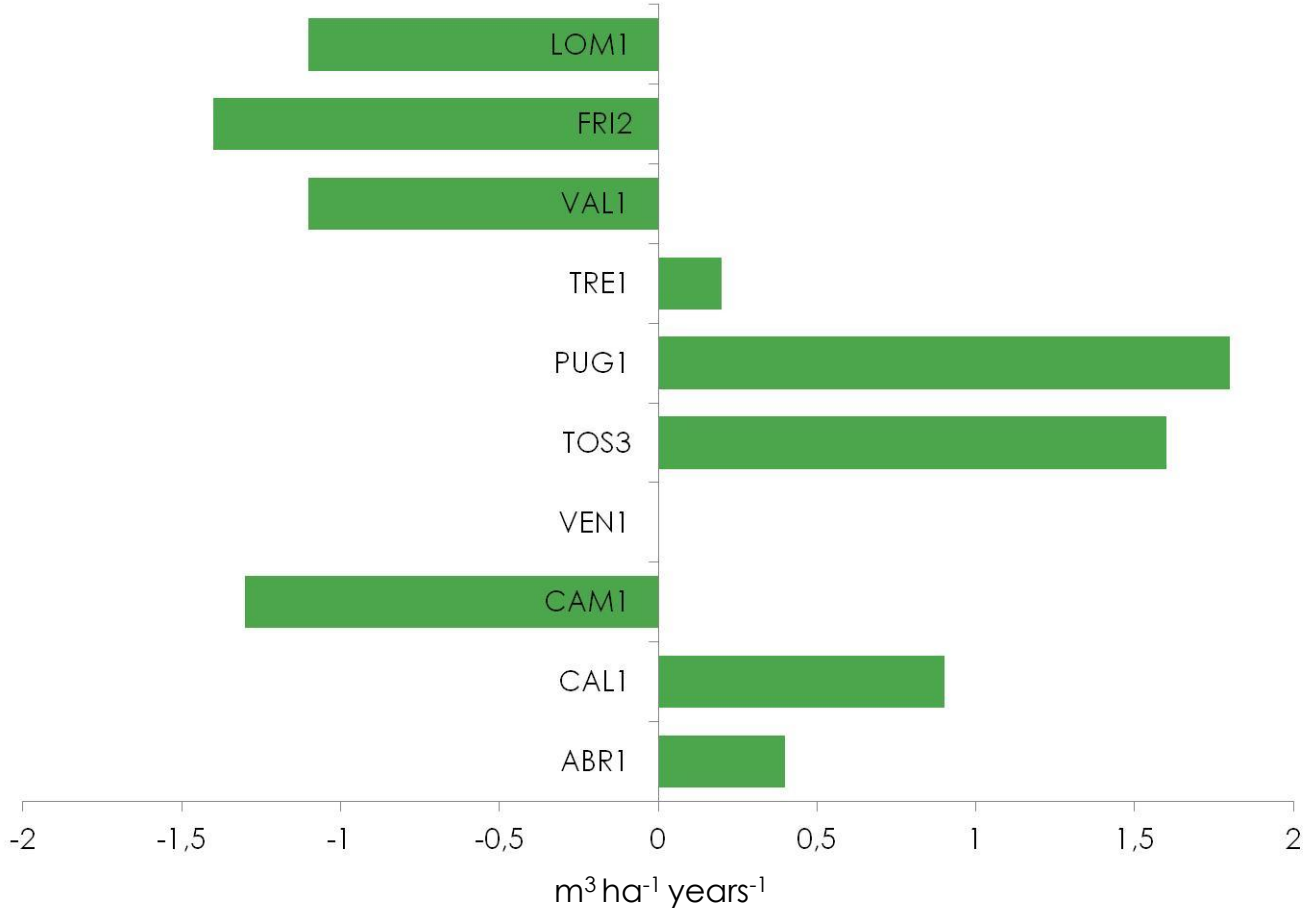
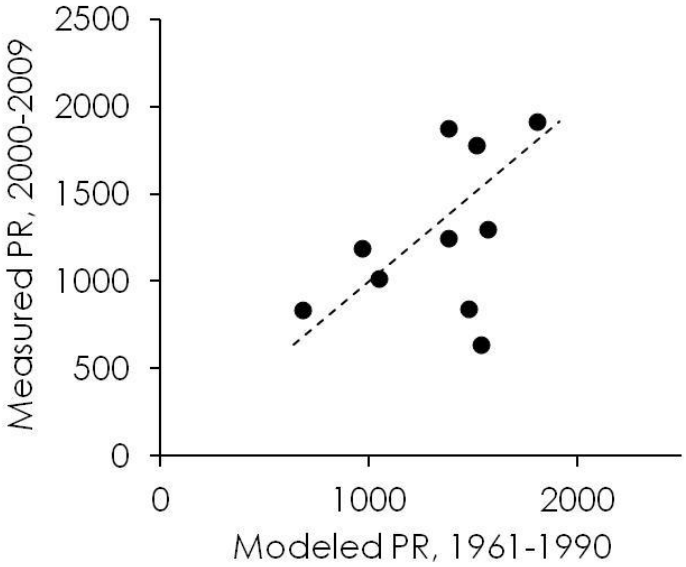
Response variable

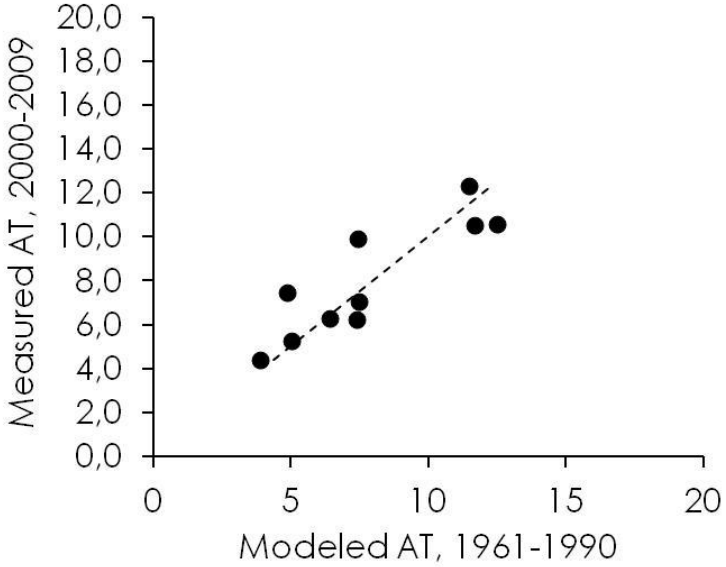
Difference between recently measured tree growth and growth from yield tables (1915-1974) in terms of mean volume increment ($m^3\ ha^{-1}\ years^{-1}$)



Predictor variables 1

Metereology: precipitation and air temperature



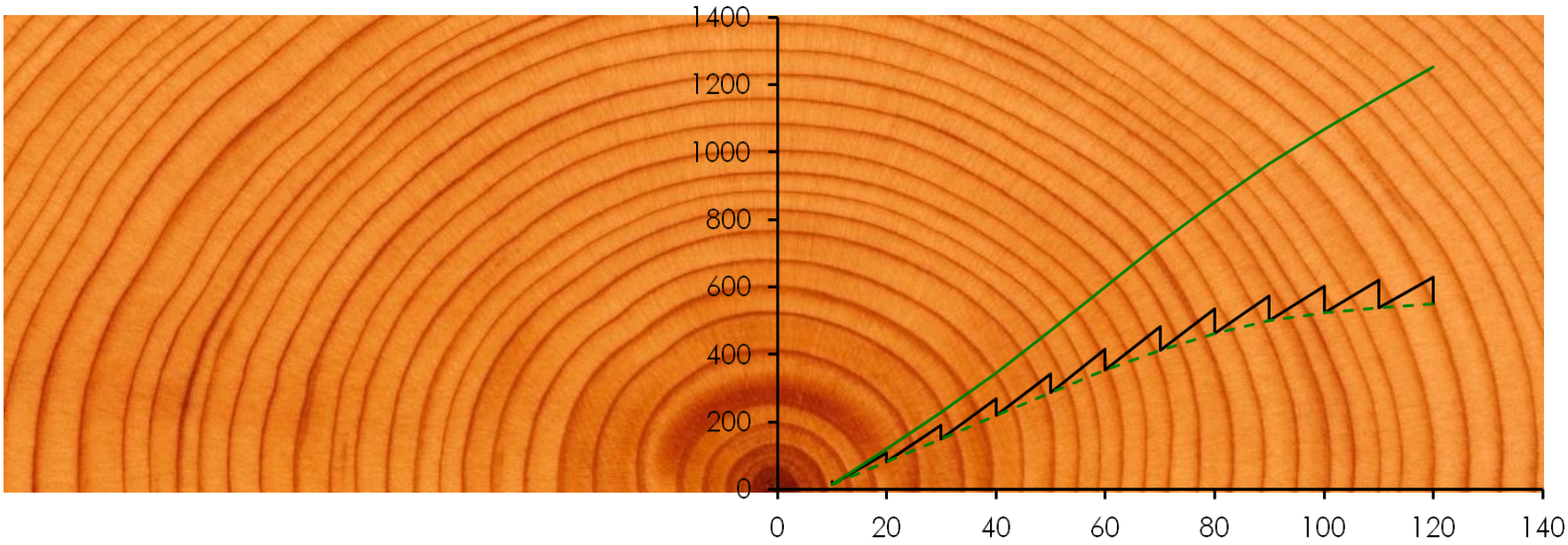


δ PR
differences between PR (annual, winter, spring, summer, autumn)measured 2000-2009 and modeled1961-1990 (Attorre et al. 2008)

δ AT
differences between AT (annual mean, maximum, minimum) measured 2000-2009 and modeled 1961-1990 (Attorre et al. 2008)

Predictor variables 2

Management

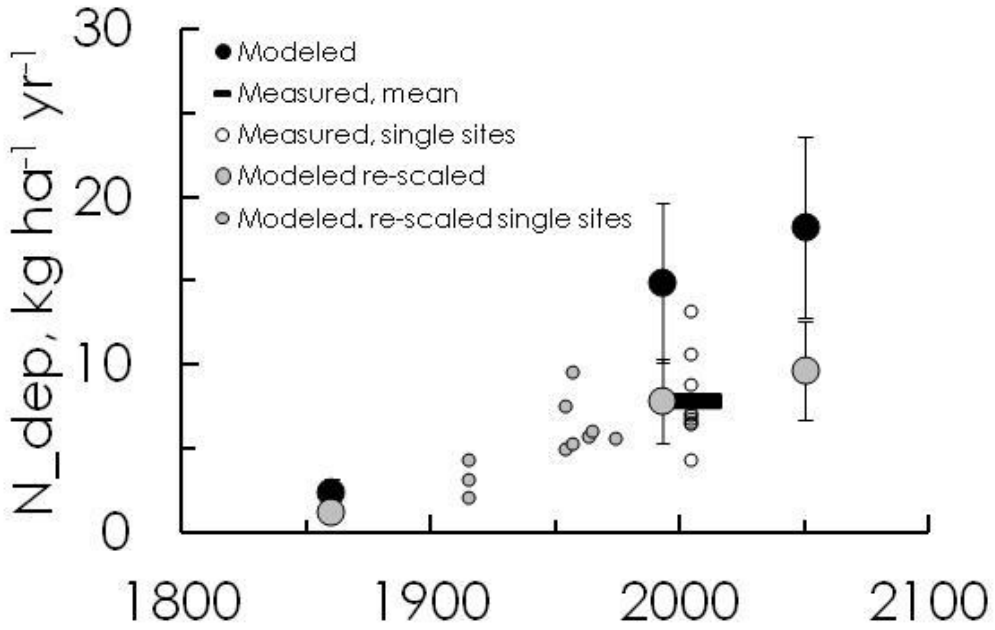


δ Age _Max_GR
differences between current ages of standing crops and ages of mean volume increment culmination of yield tables

δ Age _Max
differences between current ages of standing crops and maximum ages of yield tables

Predictor variable 3

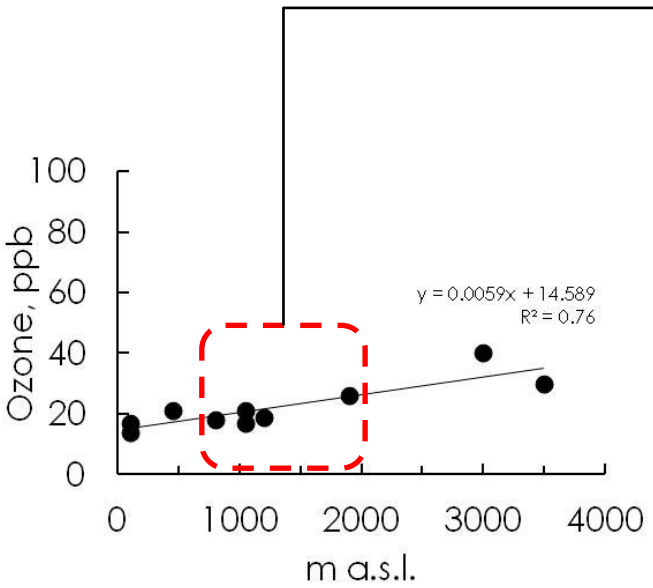
N deposition

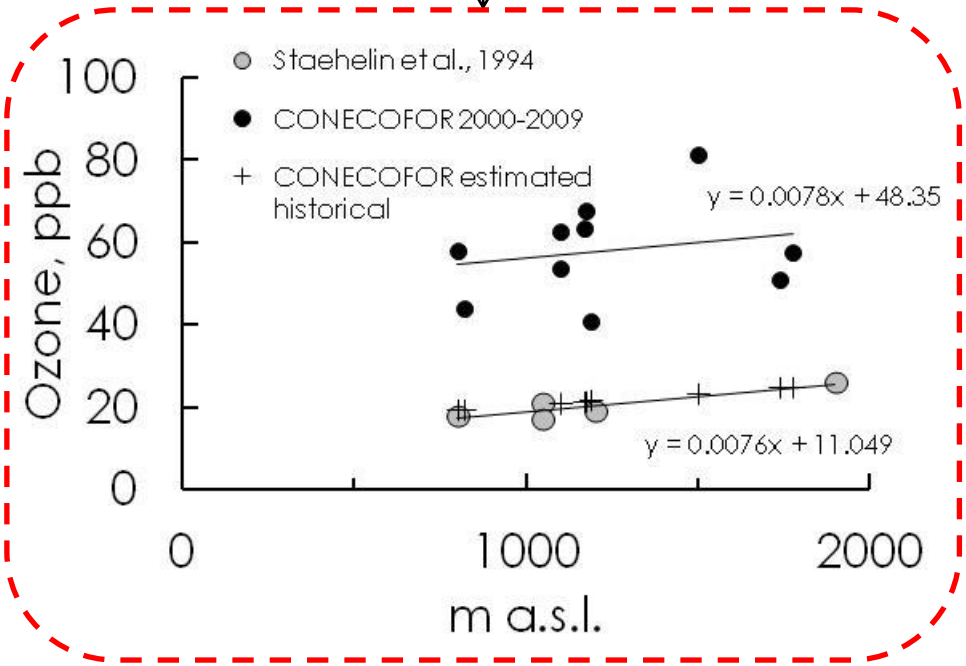


δ N_dep
differences between actual bulk N deposition (1998-2009)and potential N deposition estimated at the year of yield tables(Denter 2006)

Predictor variable 4

O_3 concentration





δ O_3
differences between actual O_3 concentration and O_3 concentration modeled for years ≤1950 by (Staehelin et al 1994)

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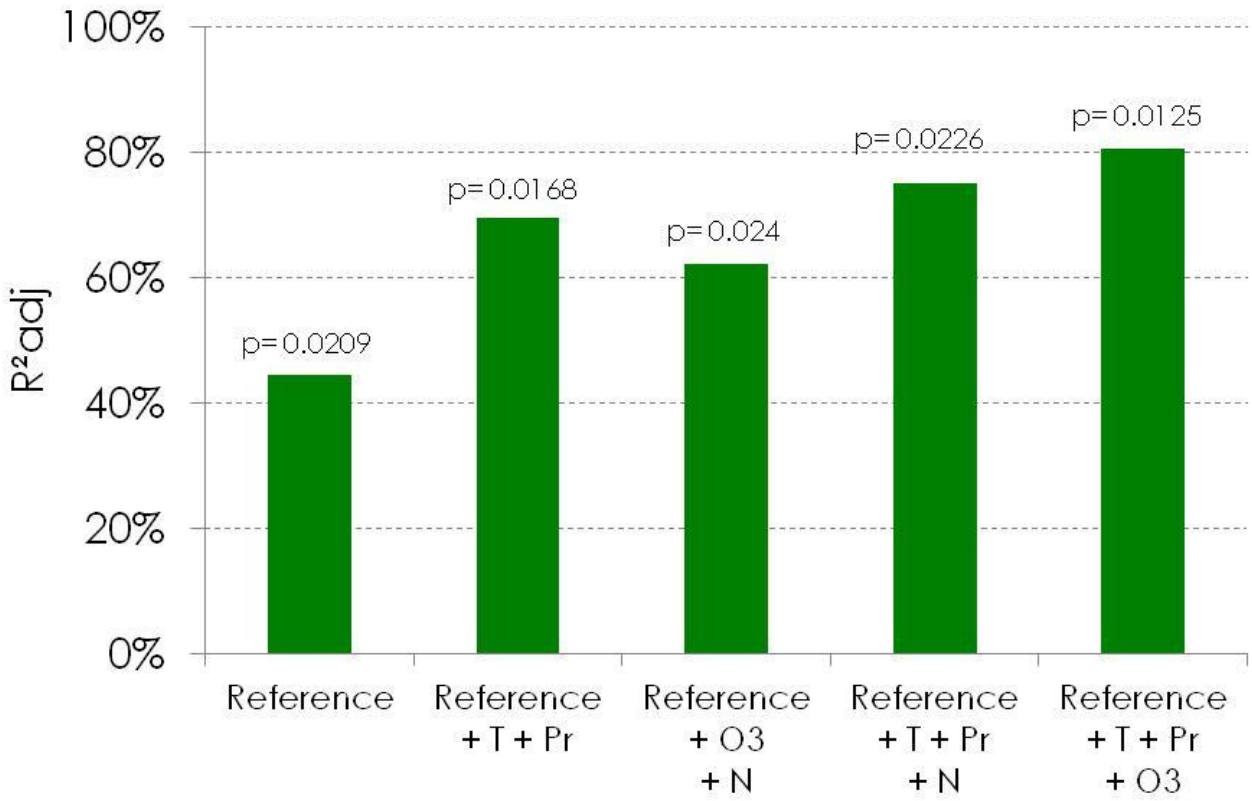
Variables and final models

Variables	
Metereology	δPR_winter
	δPR_spring
	δPR_summer
	δPR_aut
	δPR_tot
	δAT_min
	δAT_mean
	δAT_max
Environmental pollution	**δN_dep**
	δO_3
Management	δAge_Max
	δAge_Max_GR

Models
Reference
Reference + T +Pr
Reference + O3 +N
Reference + T+ Pr +N
Reference + T + Pr + O_3

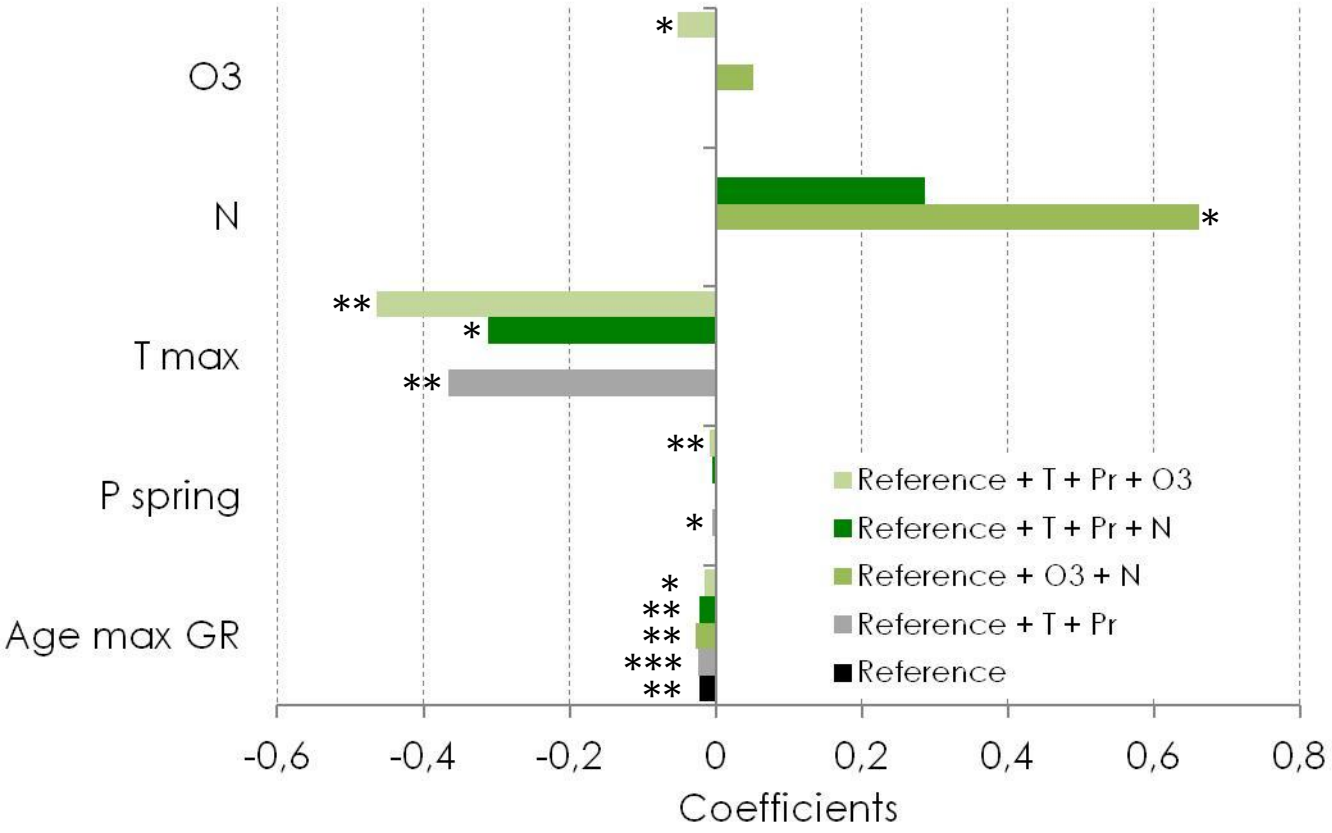
Models output

Explained variance

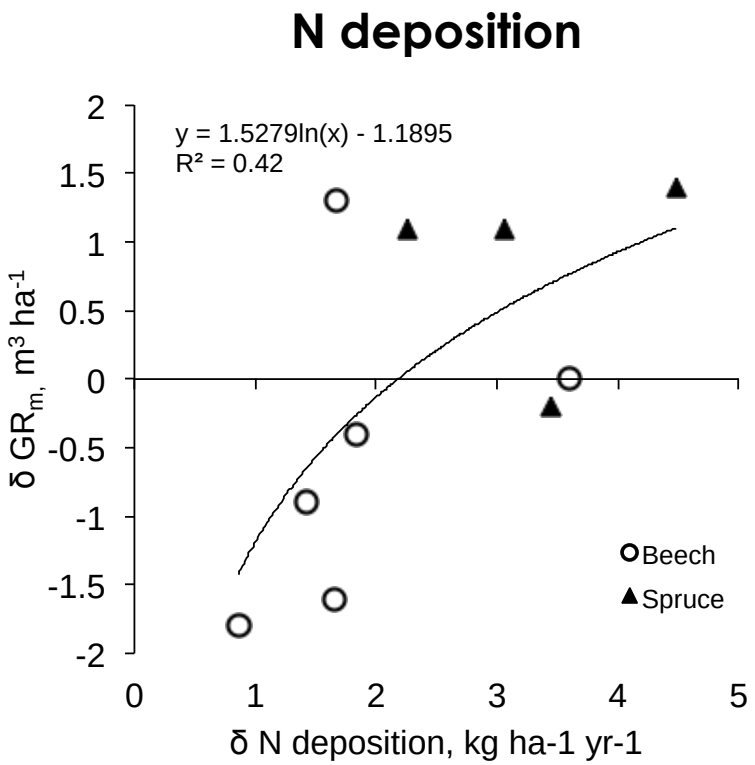


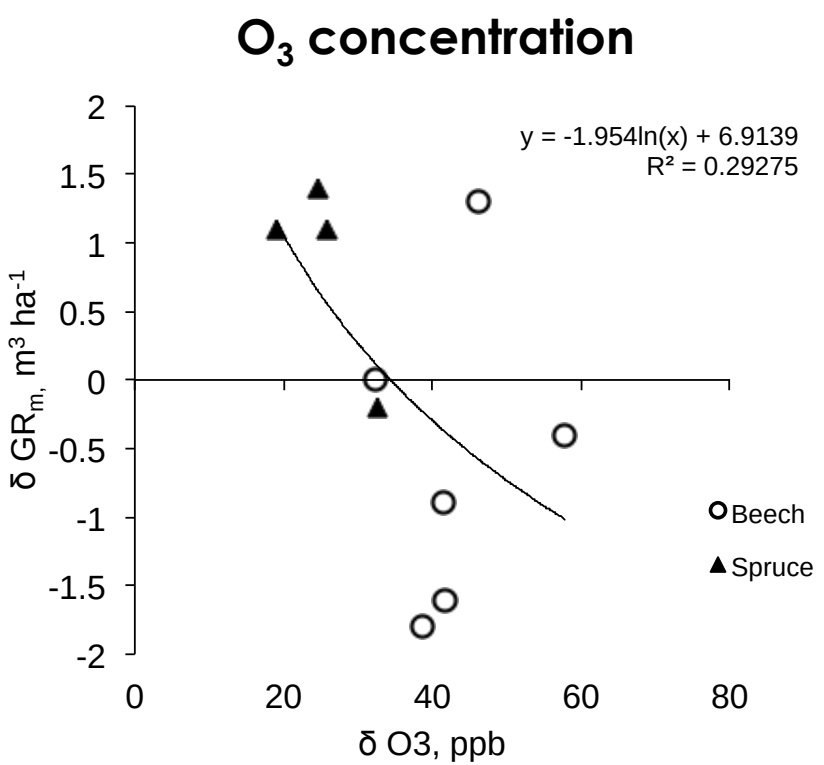
Models output

Estimated variable coeffiecients per model



Relationships between growth deviation and predictor variables





Conclusions

N deposition and growth deviation

- Past growth models explained ca. 64% of the average growth as recorded by current measurement
- Deviations from expected growth are explained by changes in several factors related to management (delayed rotation time, negative effect) and meteorology (T max, negative effect)
- Estimated changes in N deposition had a positive effect on reported growth deviation
- Tropospheric ozone, had a negative effect, something that was not obvious from investigation on current growth (Ferretti et al., 2014; 2003; Ferretti and Bussotti, 2009)
- These preliminary results are subject to several uncertainties and needs confirmation by further investigation

Thanks

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