Effect of elevated CO_2 on the physiological adjustment and xylem structure of northern Japanese deciduous trees grown in a Free Air CO_2 Enrichment (FACE) system

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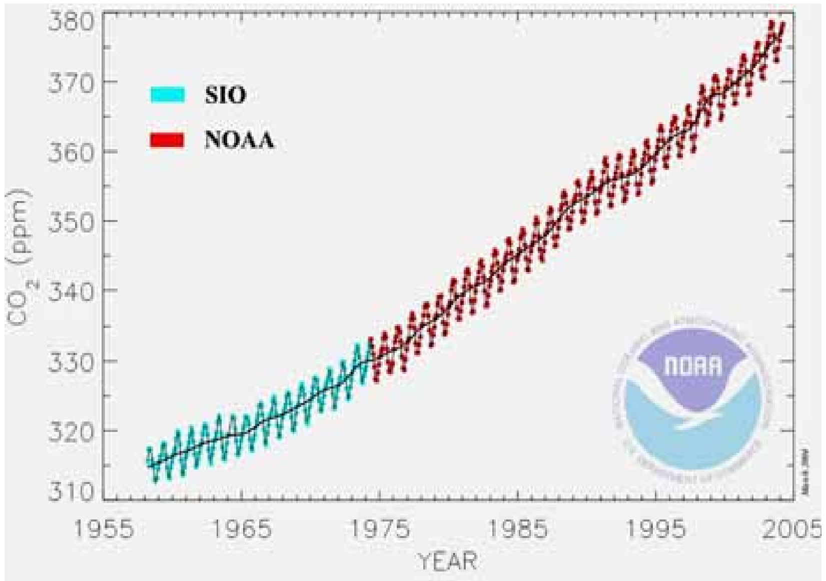
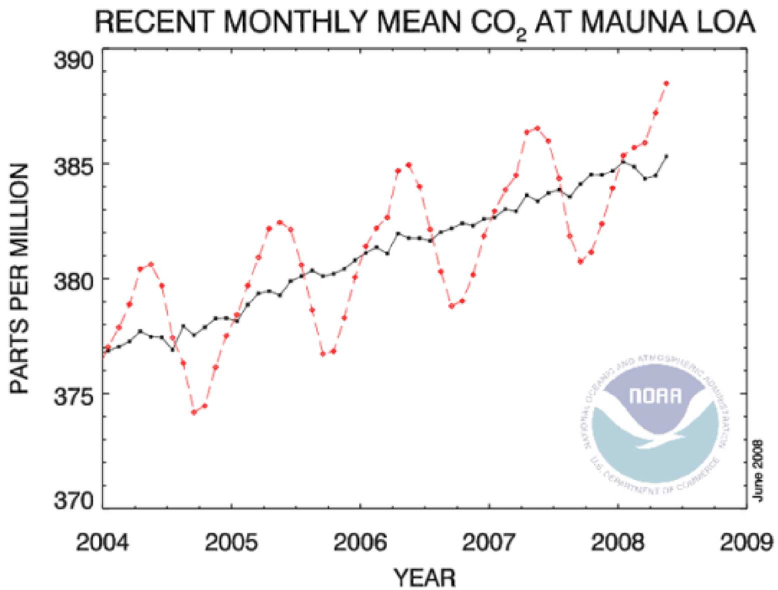
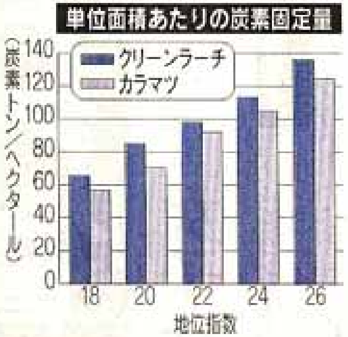




http://www.esrl.noaa.gov/gmd/ccgg/trends/

科学

CO2 may be reduced by breeding Technique in larch species! July 1st



40年生のクリーンラーチとカラマツで、単位面積あたりの炭素固定量を比較した。地位指数とは植栽場所が成長に適しているかを表す指標。数値が大きいほど成長に適している。いずれもクリーンラーチの炭素固定量が大きいことが分かる

CO₂吸収量多い新種

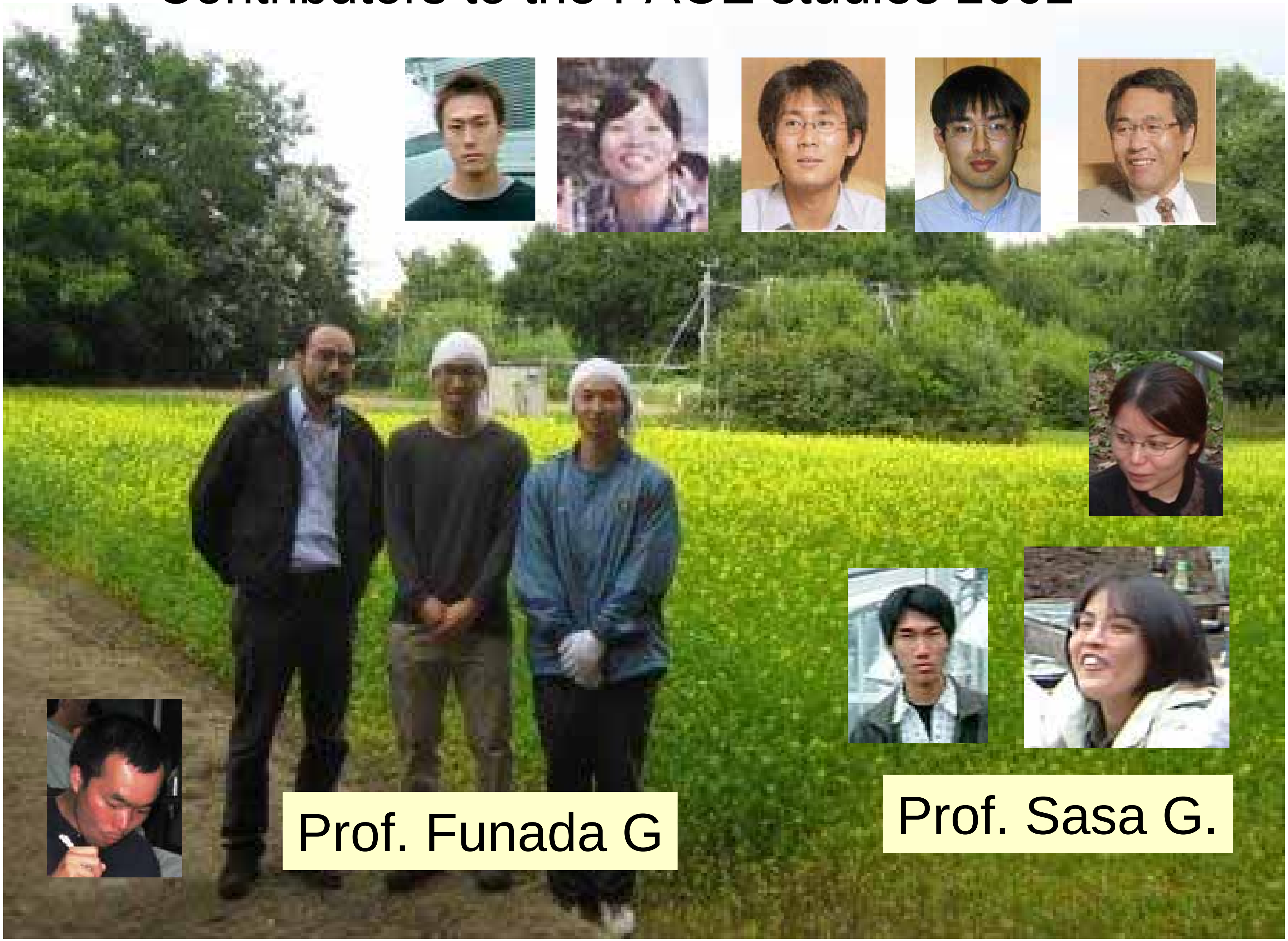
北海道の森林

林木育種と温暖化対策

Trees have big stem, and store fixed CO_2 for longtime.

But, Can we expect the carbon sink capacity of trees in changing environment?

Contributors to the FACE studies 2002~



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First goal:

2. Down regulation in photosynthesis

3. Introduction of FACE

Second goal

4. Stomatal regulation at high CO_2

5. Xylem formation in broadleaf trees

6. Conclusion and proposal

Photosynthetic rate was the same determined at growth CO_2 concentration.

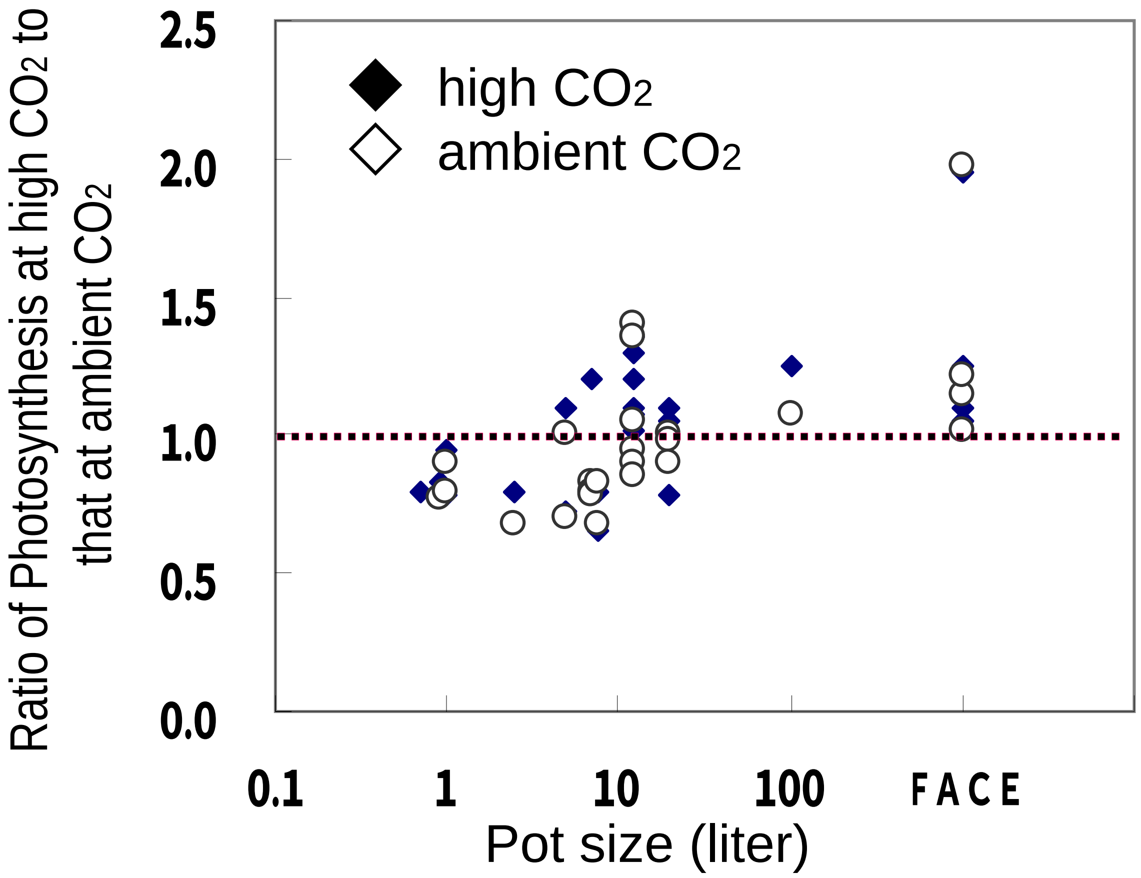
Photosynthetic response → adjustment

Down regulation

Why did photosynthetic adjustment occur?

1) Dilution of nitrogen in plant body
2) Extra-accumulation of starch
3) Depression of enzyme activity of amount

All "physiological adjustment" were artifacts!



Arp WJ (1991)
Plant, Cell & Environment
13: 135-145

Root growth is restricted by pot !, which brought imbalance in sink-source

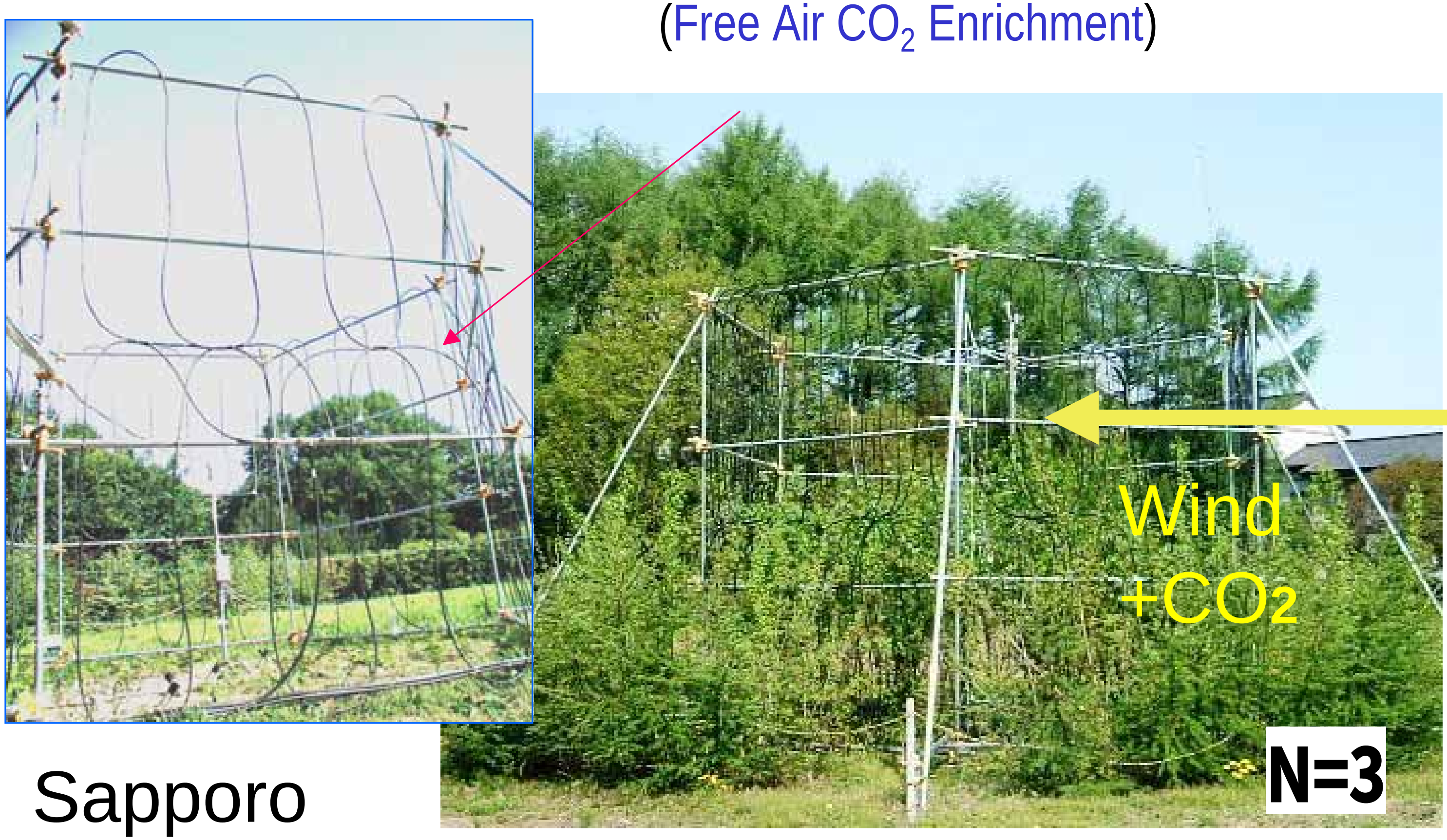
Effects of source-sink relations on photosynthetic acclimation to elevated CO2.

FACE (Free Air CO_2 Enrichment)

11 deciduous tree species native to temperate region

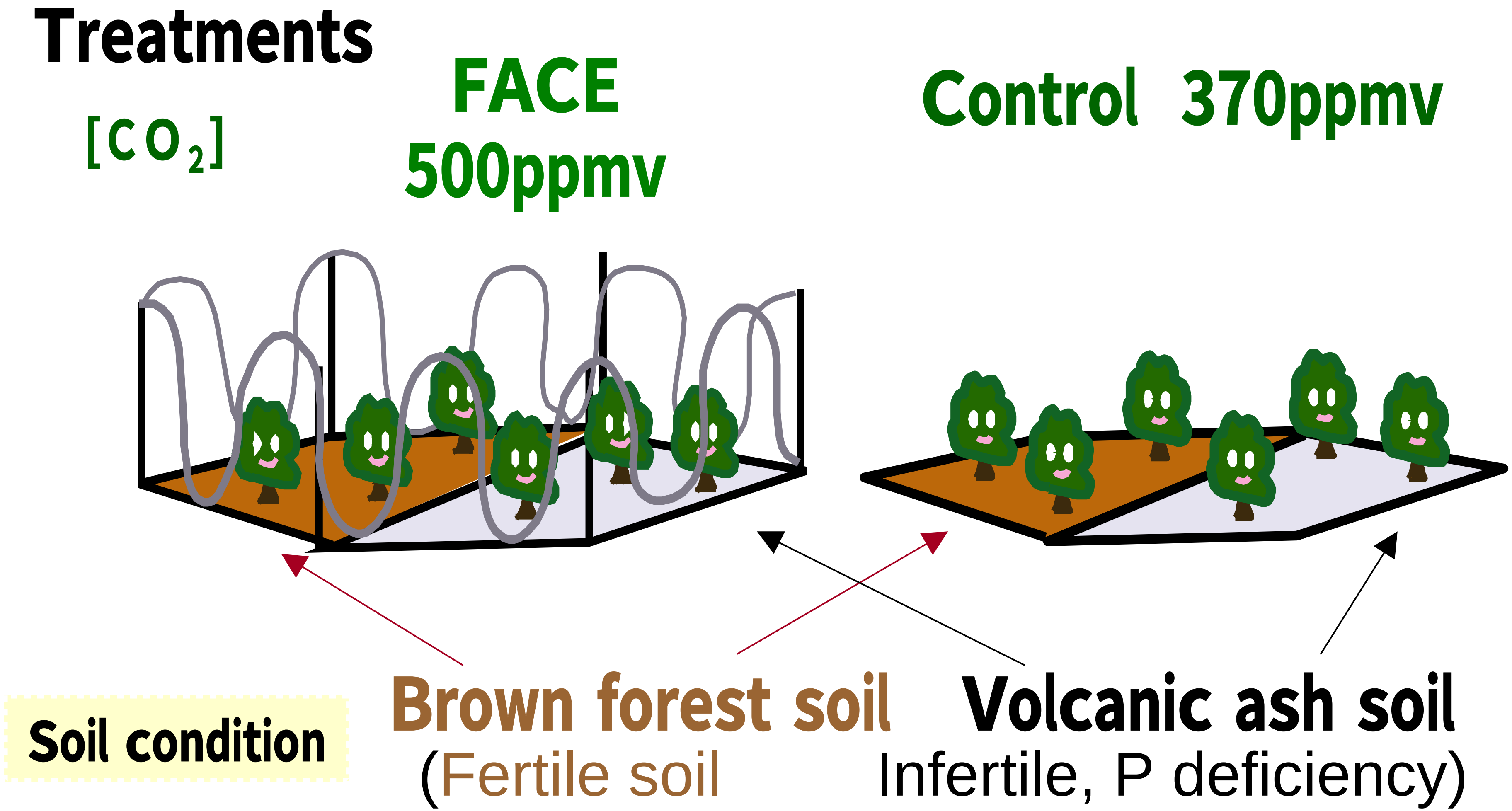
RR2002

Mini-FACE
(Free Air CO_2 Enrichment)



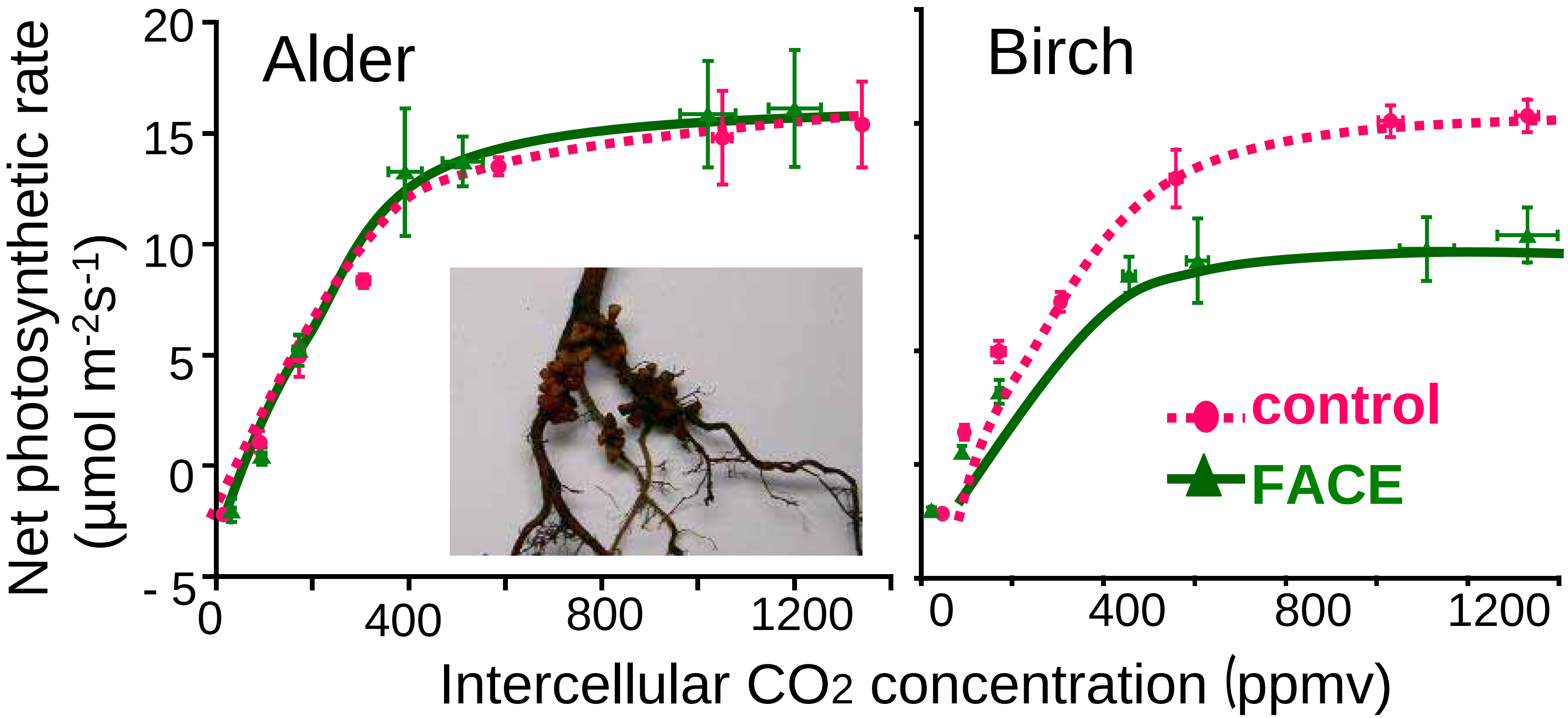
Sapporo
Experimental Forest

(Eguchi et al.. 2004)



We prepared two soil conditions because the effects of high [CO_2] on plants depend on soil nutrient conditions.

Volcanic ash soil



Even in FACE, birch showed clear down regulation,

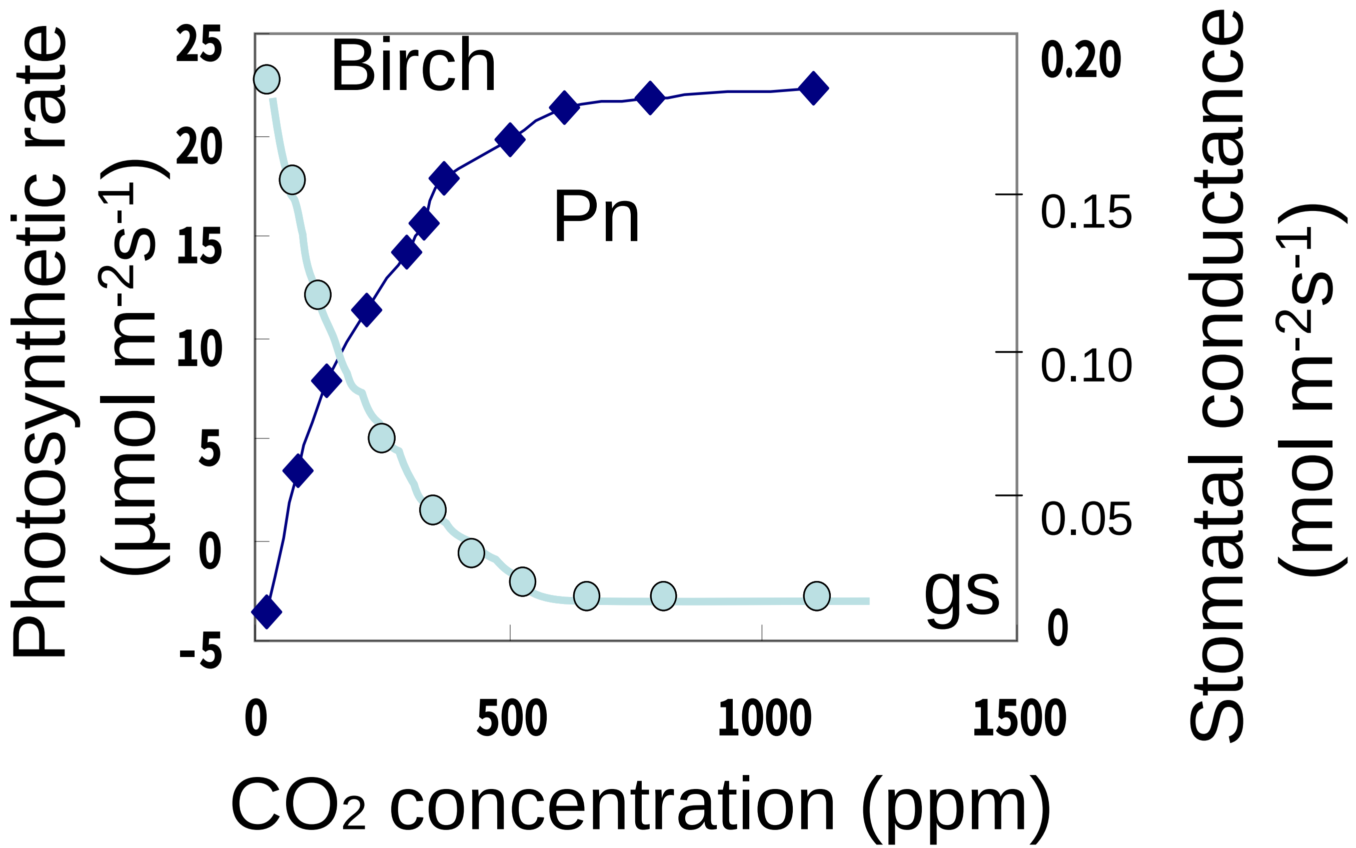
Photosynthetic down regulation

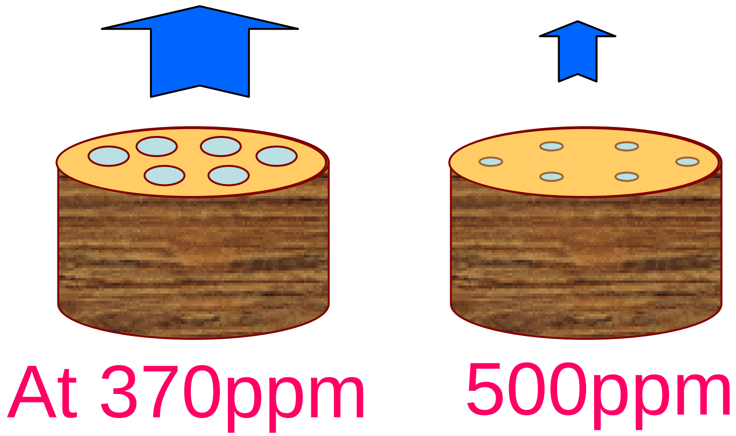
Even in
without any restriction of root growth at FACE, photosynthetic down regulation was found in Birch grown at nutrient poor soil.

However, no down regulation was found in Alder, which may be attributed to the activity of symbiotic microorganisms, *Frankia* sp.

Frankia sp. may provide nitrogen to the root.

(Feed-forward regulation?!)





With increasing CO_2, stomatal conductance (gs) decreases.

It is expected that transpiration rate may decrease at high CO_2.

CO_2 affected only at sunny crown and reduced Transpiration rate in both species and soils.

(Eguchi et al. 2008 Trees)

It is expected that specific gravity of xylem at high CO_2 may increase because
the proportion of “air” of vessel decreased.

Vessel diameter at 500ppm was smaller!

Stem mass increased only at fertile soil condition (brown forest soil).

No clear increase was found in specific gravity of stem

Water relations may be changed by CO_2.

With increasing CO_2, stomatal conductance Decreased, which may change the xylem structure through the change in vessel diameter.

Decrease in vessel diameter was found at petiole and shoot level but not at stem level because an increase of leaves at high CO_2.

Increase of biomass of stem and branches was only observed at fertile soil conditions.

Thank you for kind attention !

Physiology of larch

Grazing Damages by Insects?

Decomposition by macro-Fauna?

On going studies