

Manipulative experiments - overview

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October 21, 2013



INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

What are the aims of this presentation?

- be familiar with database of manipulative experiments „Climmani“
- show how to navigate in it and search
- present specific examples of experiments in Europe and CR

What are the benefits for you?

- when writing an article
- when preparing and writing a project
- when creating meta-analyzes
- to establish contacts with persons engaged in similar issues



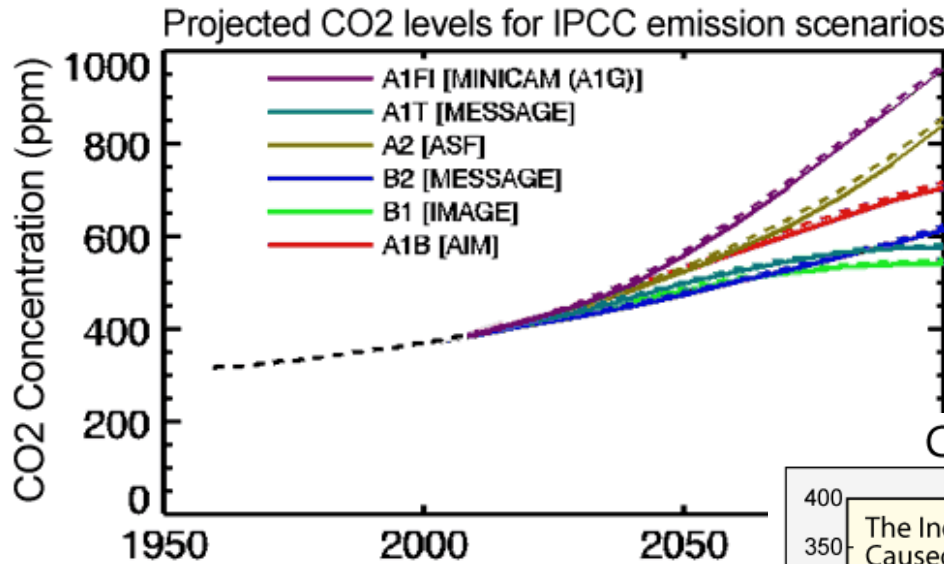
Outline of the presentation

- Introduction to the topic of climate change
- Climmani – project ESF and database of manipulative experiments
- Examples of various types of experiments from Europe
- Examples of manipulative experiments from CR
- Options for the future



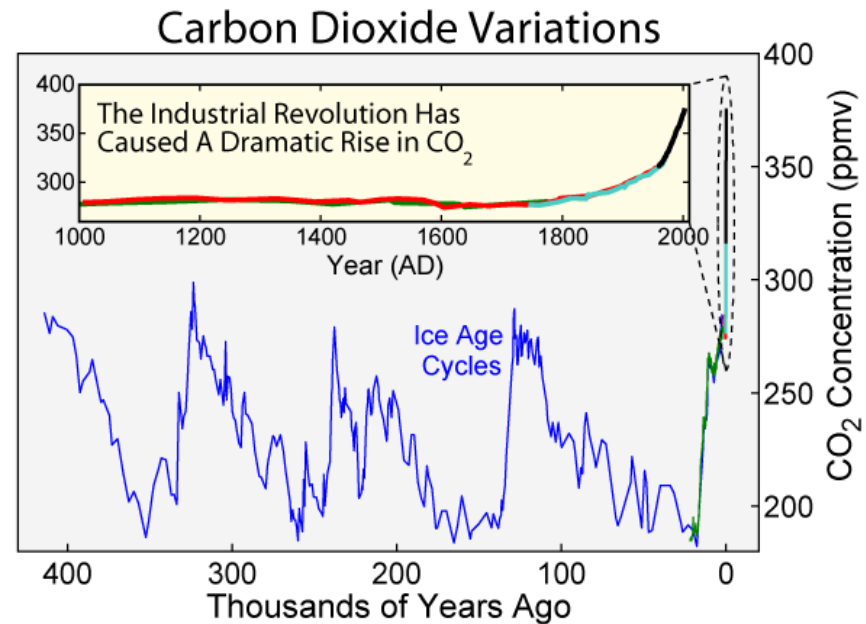
INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

1. Introduction to the topic of climate change



Scenarios of CO₂ concentrations

Source: www.skepticalscience.com



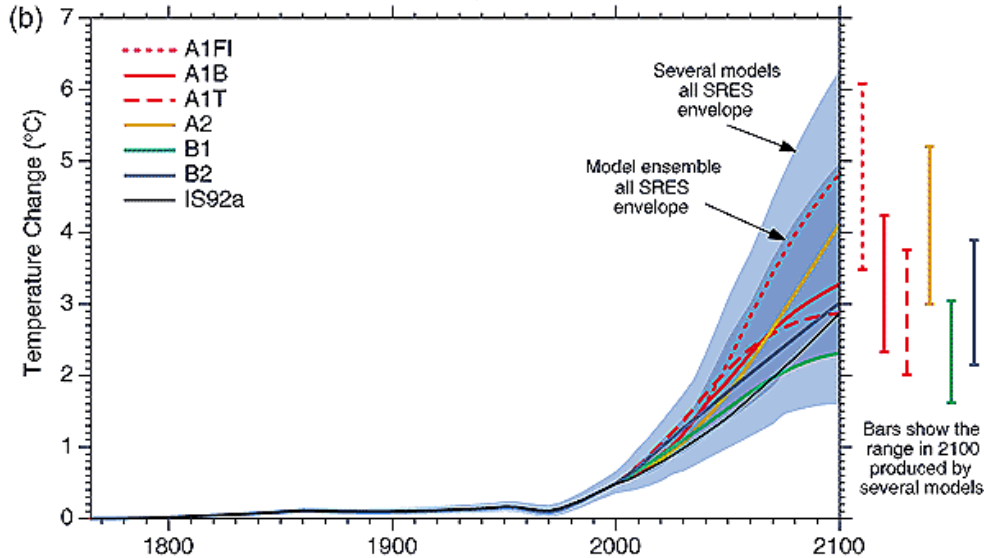
(Wikipedie, various sources)



1. Introduction to the topic of climate change

Temperature projections to 2100

(according IPCC)

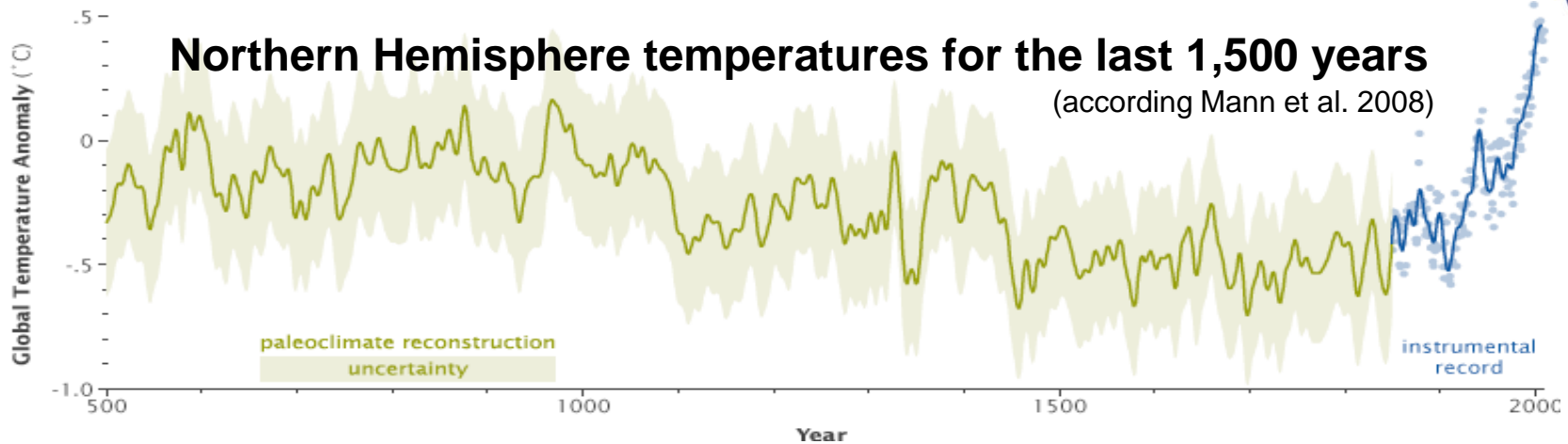


Air temperature scenarios



Northern Hemisphere temperatures for the last 1,500 years

(according Mann et al. 2008)



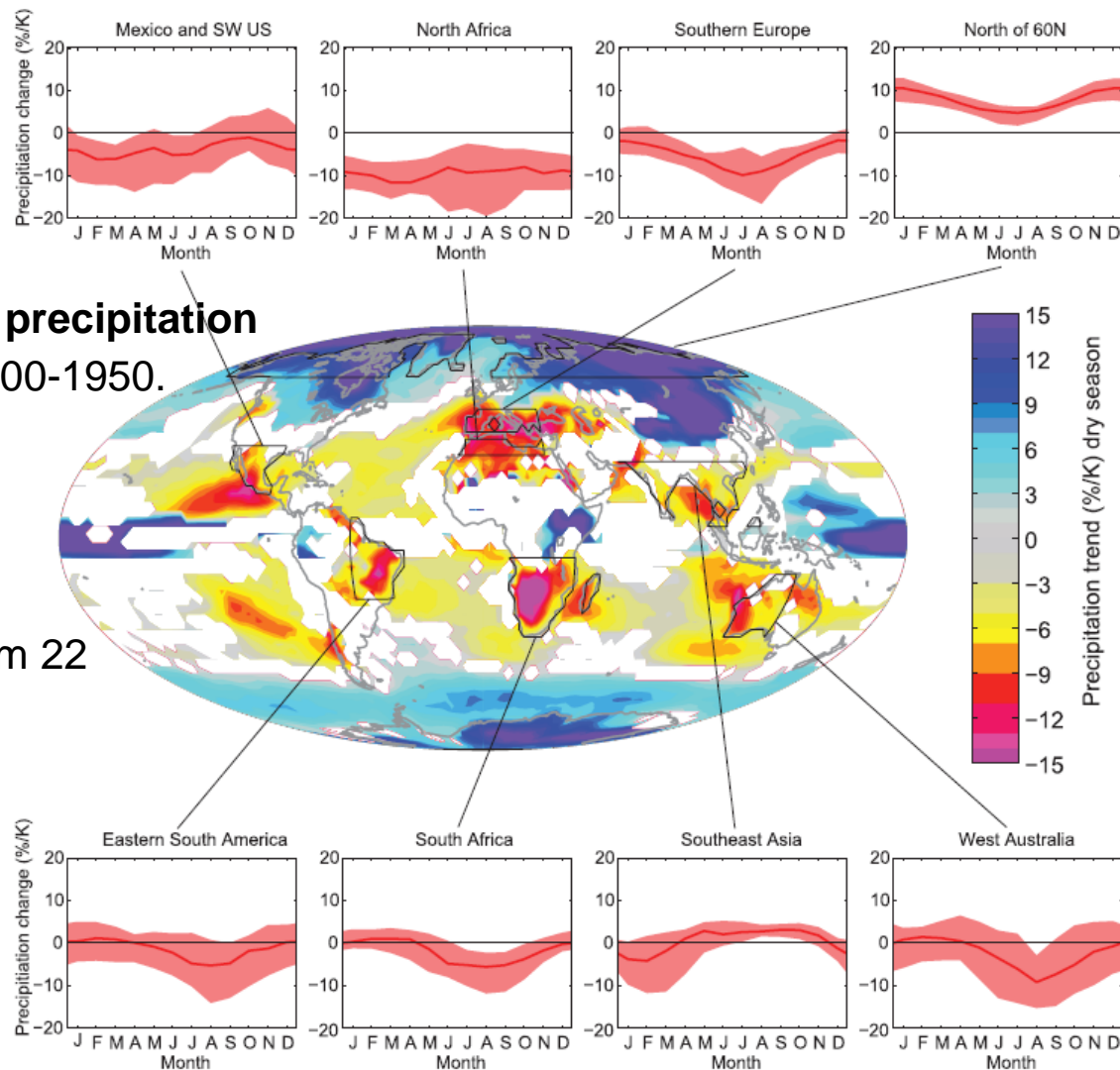
1. Introduction to the topic of climate change

Precipitation scenarios

Percentage change in precipitation relative to the period 1900-1950.

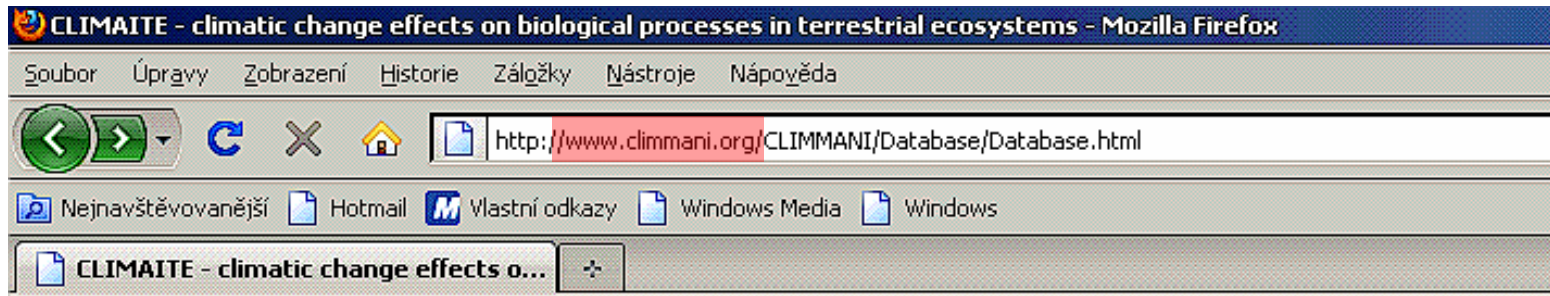
(Solomon et al. 2009)

White is used where less than 16 models from 22 was consistent.



Project ESF (2008-2013)

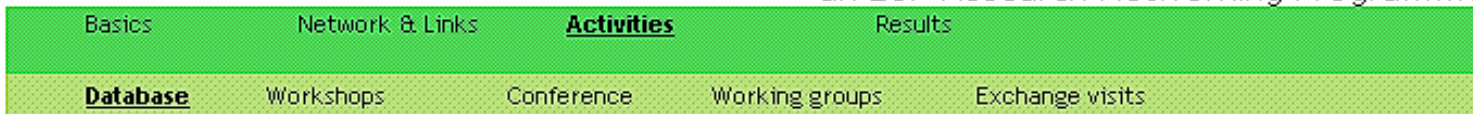
www.climmani.org



ClimMani

Climate Change - Manipulation experiments in terrestrial ecosystems

- an ESF Research Networking Programme



Database

ClimMani will engage with existing projects and provide a platform for gathering data into a common database, which will be available to research communities and modellers on request.

A new web-based metadatabase has been developed - see [here](#).



ClimMani

Climate Change - Manipulation experiments in terrestrial ecosystems

- an ESF Research Networking Programme

Basics Network & Links **Activities** Results

Aim and objectives Description Steering committee Contact

The ClimMani project

ClimMani is a Research Networking Programme under the European Science Foundation (ESF). ClimMani involves at present 14 European countries and links more than 50 climate change related field scale experiments. ClimMani is networking with similar experiments and activities in US and Australia.

ClimMani aims to provide an umbrella for coordinated activities bringing together researchers, data and knowledge from past and ongoing European climate manipulation research projects in order to synthesise the knowledge and improve ecosystem models.

CLIMMANI/INTERFACE Workshop on "Nutrient constraints on the net carbon balance" June 15-17th 2011 in Keflavik, Iceland

[Programme and student/postdoc application procedure here.](#)

Young scientists Workshop on "terrestrial ecosystem responses to climate change" - September 2011. Apply to participate:

CLIMMANI will sponsor a two-week workshop focused on analyzing responses of terrestrial ecosystems to climate manipulation (week 1) and on writing a review based on these findings (week 2). This workshop will be held in Belgium in September 2011 and will be organized by Ivan Janssens. To foster knowledge transfer to younger generations, 5-10 early-career researchers will be invited to participate in this writing workshop. CLIMMANI is offering support in the form of travel grants. If you are interested in participating please send a one-page letter of interest and CV to Ivan Janssens (ivan.janssens@ua.ac.be) before May 1st 2011. Read more [here](#).

New climate change experiments META-database:

A new meta database for climate change experiments are available [here](#) - please register your experiment. Site, project, treatments, response measurements, data status, site characteristics, key reference, contacts person etc. [here](#)

New call for short exchange grants:

Will come in the spring of 2011

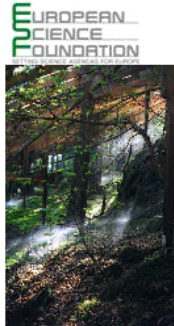


Photo: Filip Moldan (IVL SE)

Quick links

[Iceland Workshop](#)

[Meta database](#)

[Young scientist workshop](#)

www.climmani.org



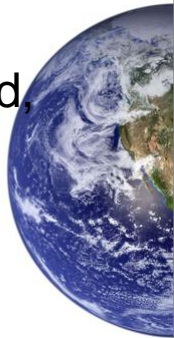
Project: 2008-2013.

The participating countries:

Austria, Belgium, Croatia, CR, Denmark, Finland, Italy, Netherland, Norway, Poland, Romania, Spain, Sweden, Switzerland, United Kingdom.

The main objectives:

Workshops, exchanges for students, **databases of projects** creation of meta-analyses



ClimMani

Climate Change - Manipulation experiments in terrestrial ecosystems

- an ESF Research Networking Programme

Basics	Network & Links	Activities	Results
Database	Workshops	Conference	Working groups Exchange visits

Main activities

ClimMani will initiate a series of activities to obtain its goals. These are:

Database

ClimMani has developed a META DATABASE providing registration and search facilities for ecosystem experiments globally. You can register your experiment in the database in order for others to know your experiment and potentially to get access to your data for publications. Go to the data base, register your experiment and fill in the information about the experiment, the responses measured and references to your work. [DATABASE here](#)

ClimMani will further establish a comprehensive integrated database that contains data on all manipulation experiments and from both ongoing and past EU research projects as well as from existing national databases. This will be conducted in close collaboration with major existing climate change-related projects and provide links to other databases. The database will be available to research communities and modellers on request.

Workshops

In order to analyse our present understanding of ecosystem processes and modelling ecosystem functioning under atmospheric and climatic changes, a series of workshops will be organised. Key researchers and working groups from different disciplines with experimental as well as modelling backgrounds will be invited to assess results from manipulation experiments, evaluate existing literature and databases and identify and discuss progress and developments within climate change research. Workshops will include collaborative meetings with the US networks TERACC and INTERFACE.

Conference

A conference on "Climate-Nutrient interactions – role of resources in controlling climate change responses in ecosystems. Experiments and modelling" in June 2011 held together with the American network TERACC/INTERFACE. If you want to participate or contribute, please contact us.

Working groups

A series of working groups may be initiated according to identified

EUROPEAN SCIENCE FOUNDATION
GETTING SCIENCE WORKING FOR EUROPE



Photo: Claus Beier

Quick links

[Meta database](#)

www.climmani.org

Database of projects



ClimMani Meta-database

- Search experiment
- Update experiment
- Add experiment
- Information
- Frontpage
- ClimMani

CLIMMANI Meta database

- a Climate Change Experiments overview database

This meta database provides a global overview of climate change experiments. The database focuses on manipulations of global climate change.

- Which experiments exist, where are they carried out?
- which treatments have been carried out?
- which responses were measured?
- how can you get access to the data?
- which key references exist?
- who should you contact to get data?

You can use the database to:

- Add your experiment to the database ("Add experiment")
- Modify or update your previously added experiment ("Update experiment")
- Search the database to find out about previous experiments ("Search experiment")

What is CLIMMANI

CLIMMANI is an integrated network among European researchers. CLIMMANI will provide a framework for networking and collaboration. CLIMMANI will:

- bring together key researchers within climate change research
- build coherent interdisciplinary databases
- coordinate research activities in climate change research

CLIMMANI aims to improve our capacity for understanding and managing climate change. CLIMMANI is supported by ESF (The European Social Fund). Learn more at the CLIMMANI website (www.climmani.eu)

What experiments are there?

Which factors have been manipulated?

Which parameters were monitored?

Which main publications exist?

Who is a contact person?

Any Treatment

Information
Frontpage
ClimMani

- Air pollutants
- Clear cut - forest
- CO2 increase
- Control
- Fire
- Girdling
- Grazing
- Litter addition
- Moving
- N addition
- N removal
- Nutrients +/-
- Ozone
- Shading
- Snow removal
- Soil management
- Temperature
- Thinning - forest
- tillage
- UVB

provide information on contacts persons and data availability on all available warming projects that measured soil respiration.

person. Select the combination of search criteria from the drop down boxes.

number of specific responses (0 - 5)

Specific treatments:	Select responses (You may leave these fields empty if you are not looking for specific responses):				Leaving both Treatment and <input type="button" value="Search"/>
Response 1	Any Response	▼			
Response 2	Any Response	▼			
Response 3	Any Response	▼			
Response 4	Any Response	▼			
Response 5	Any Response	▼			

2. Climmani – database of manipulative experiments

ClimMani Meta-database

Search for experiment - treatments - responses

Here you can search for certain experiments/treatments and responses

Example
 You want to synthesise soil respiration data from warming experiments
 - make a search for "warming experiments" and "soil respiration". The database will provide it

You can further finetune the search by country, project, site, treatment and contact person. Select

Search for projects employing a number of specific treatments (0 - 5) and providing a number of

Select treatments (You may leave these fields empty if you are not looking for specific treatments)

Treatment 1:

Treatment 2:

Treatment 3:

Treatment 4:

Treatment 5:

Search for site / projects combinations:

Search for projects connected with a given site:

Search for sites connected with a given project:

Search for sites/projects managed by a given person:

Search for sites in a given country:

- Atmospheric components
- Basic climate variables
- Biomass
- Burried bag soil processes
- C mineralisation
- CH4
- CH4 exchange
- Denitrification
- Deposition
- drainage and lysimeter water characteristics
- Ecophysiology**
- General soil characteristics
- Genetics
- Herbivory
- Hydrology
- LAI
- Litter decomposition
- Litter production
- Management timing
- Management type

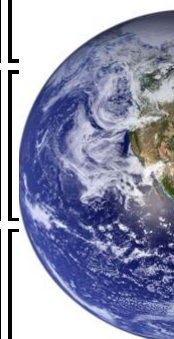
both Treatment and Response

3. Examples of various types of experiments from Europe

Site name	Project name	Country	
Brandbjerg	CLIMAITE	DENMARK	Show details
Flakaliden	Flakaliden	SWEDEN	Show details
Risdalsheia	CLIMEX	NORWAY	Show details

Site name	Project name
Brandbjerg	CLIMAITE
Flakaliden	Flakaliden
Risdalsheia	CLIMEX

Czech_Multi	CzechTerra	CZECH REPUBLIC	Show details
Linden	GIFACE	GERMANY	Show details
Braunschweig	Braunschweig	GERMANY	Show details
Munich	Munich CO2	GERMANY	Show details
Hohenheim	MiniFACE	GERMANY	Show details



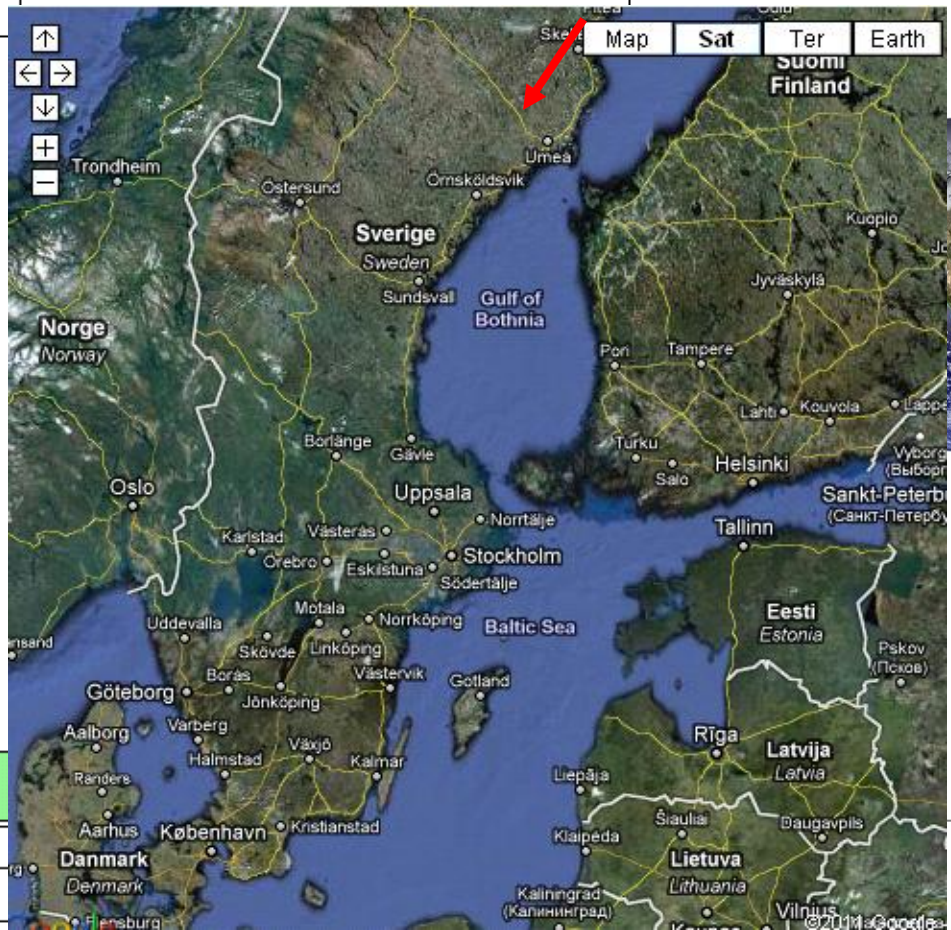
3. Examples of various types of experiments from Europe

ClimMani Meta-database

Flakaliden, Sweden (S. Linder)

Search experiment	Update experiment	Add experiment	Information
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Site name	Project name	Country	Location	Altitude
Flakaliden	Flakaliden	SWEDEN	64o07'N 19o27'E	320
Site Description	Project Description	Landuse		
1	0	Forest		
Treatments				
CO2 increase				
Control				
Girdling				
N addition				
Nutrients +/-				
Temperature				
Thinning - forest				
Water addition				
Response name	response type			
Basic climate variables	site			
Additional Information:				
Data Status:	Spreadsheets			
Key References:				
Web Link:				
Person name	Contact detail	Institute		
Sune Linder	sune.linder@ess.slu.se	SLU		
Additional Persons:				



3. Examples of various types of experiments from Europe

Flakalic

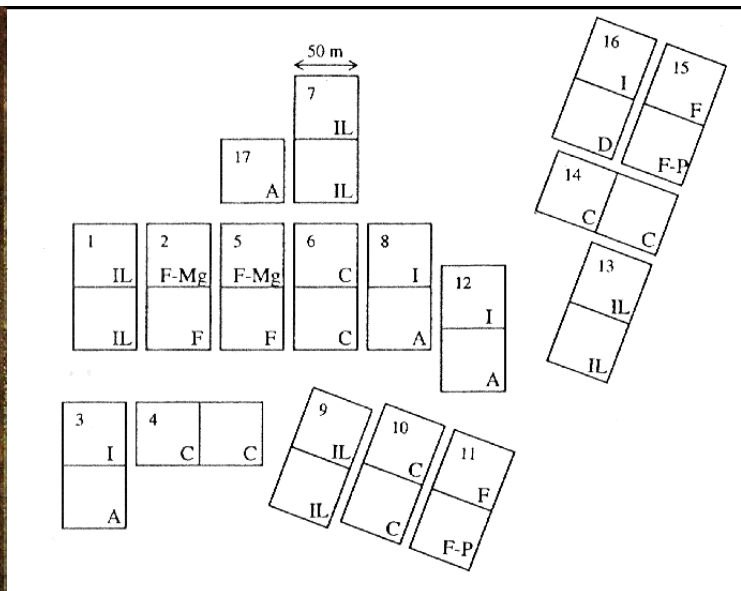
Experiment of
(Photo 1996)



3. Examples of various types of experiments from Europe



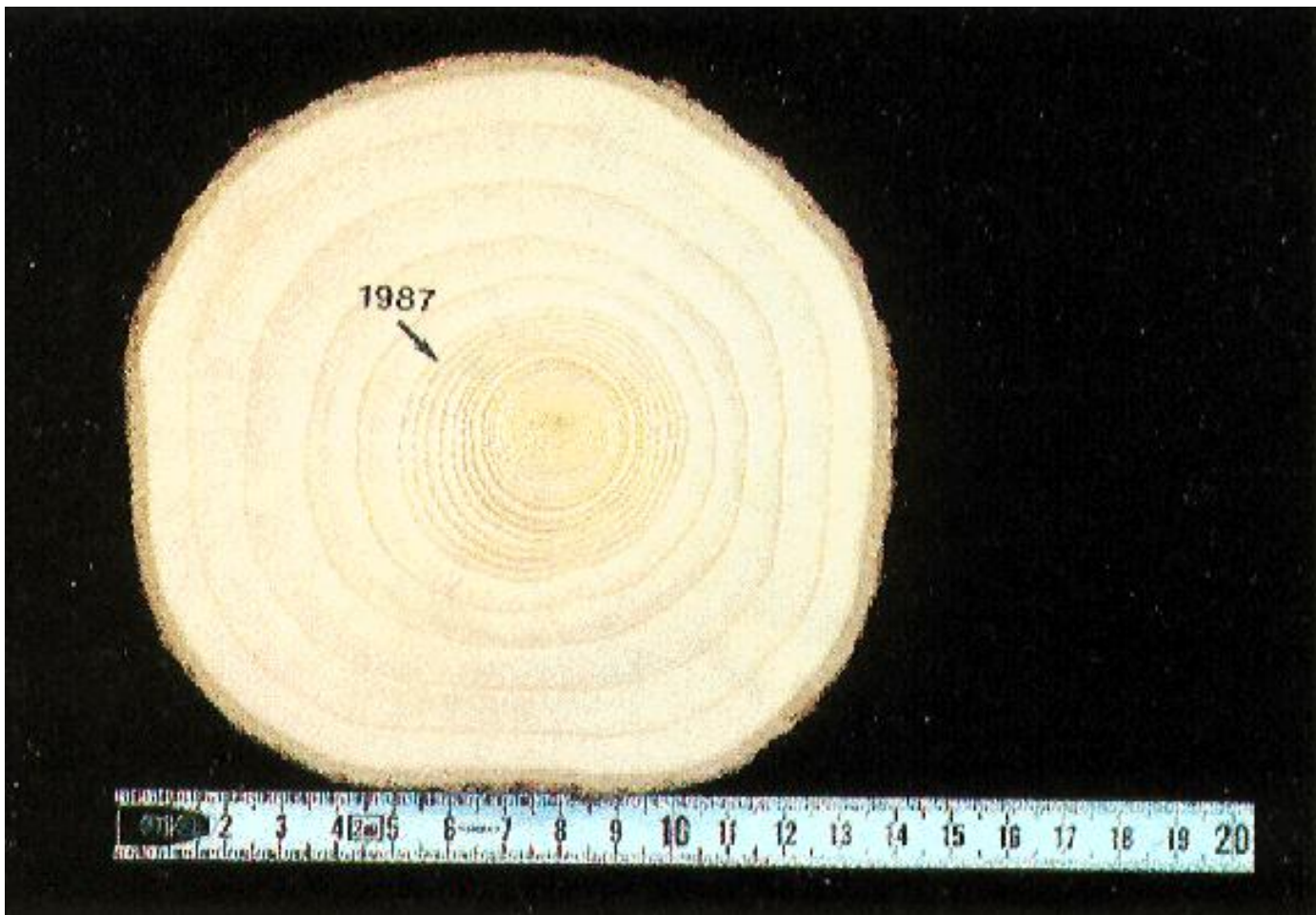
4 years after the establishing of the experiment
(fertilized areas are darker, photo 1990)



Schematic design: control plots (C), irrigated plots (I), fertilized plots (F), irrigated and fertilized plots (IL) (n = 4).
Other experimental plots:
Fertilized plots complemented by forest ashes (A), fertilized plots with all essential elements except phosphorus (F-P) or magnesium (F-Mg), variant where summer precipitation were reduced to 65% (D)

See Bergh (1997) and Bergh et al. (1998) for further details.



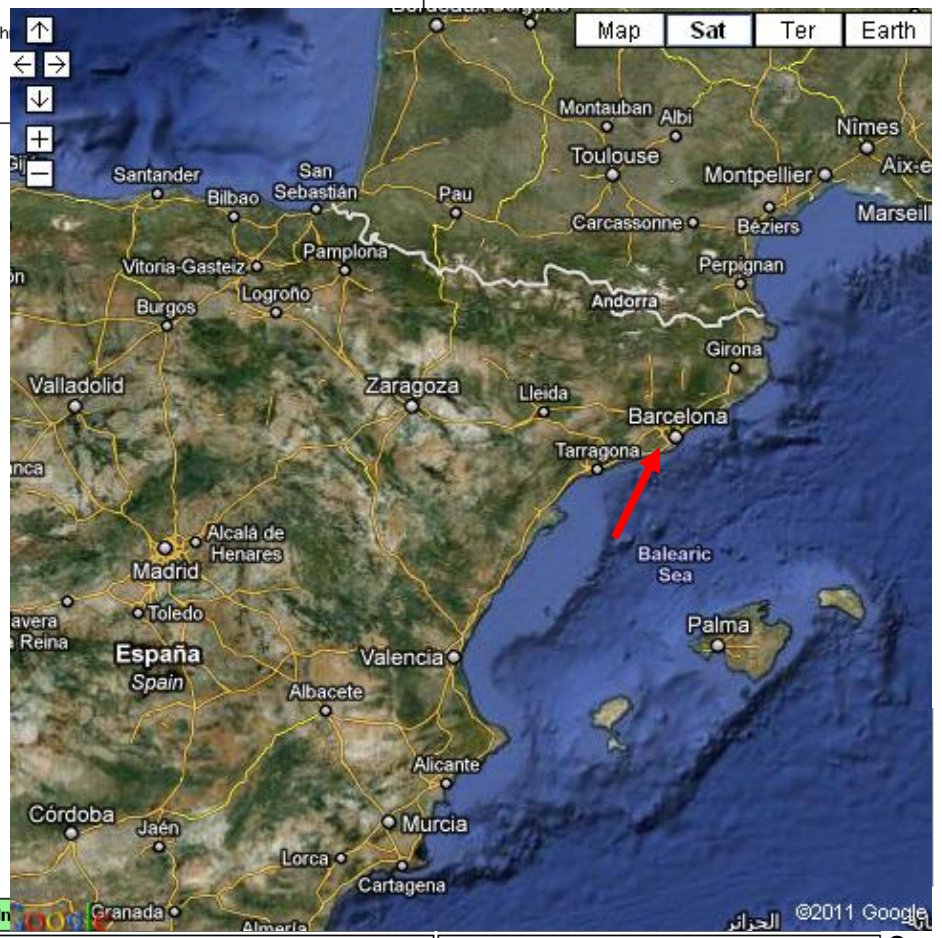


**Growth rings *Picea abies* from irrigated and fertilized plots (IL)
(significant expansion of rings after the experiment began in 1987)
Photo 1992**

3. Examples of various types of experiments from Europe

Garraf, Spain (CLIMOOR-VULCAN)

Site name	Project name	Country	Location	Altitude
Garraf	CLIMOOR-VULCAN	SPAIN	41.18N, 1.49E	210
Site Description	Project Description	Landuse		
MAT: 15.6; MAP: 580; N deposition 0.5 gNm ² /yr; Soil: Petrocalcic Calcixerepts 3.1 kgC/m ² ; vegetation: Erica multiflora, Globularia alypum	Project to investigate ecosystem responses (productivity, biogeochemical cycling, species change) to realistic changes in climatic variables (increased temperature and extended drought) in the long term using a newly developed and tested experimental approach. To investigate the interaction between climate change and other stress factors such as N pollution, management and land use practices in shrublands.			
Treatments				
Control				
Temperature				
Water removal				
Response name	response type			
Biomass	plant			
Ecophysiology	plant			
LAI	plant			
Litter production	plant			
Phenology	plant			
Plant C pools	plant			
Plant chemistry	plant			
Plant N pools	plant			
Root biomass	plant			
Species composition	plant			
Basic climate variables	site			
Key References:	Sirca, C.; Sowerby, A.; Spano, D. and Tietema, A. (2007) Response of plant species richness and primary productivity in shrublands along a north-south gradient in Europe to seven years of experimental warming and drought. Reductions in primary productivity in the heat and drought year of 2003. Global Change Biology, 13, 2563-2581.			
Web Link:	http://www.creaf.uab.es			
Person name	Contact detail			
Josep Penuelas	josep.penuelas@uab.cat			
Additional Persons:				



Garraf, Spain

Experiment on the effects of increased temperature

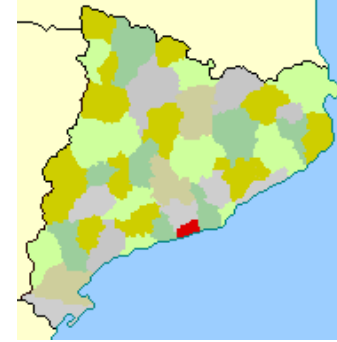


3. Examples of various types of experiments from Europe



GARRAF EXPERIMENTAL STUDY AREA

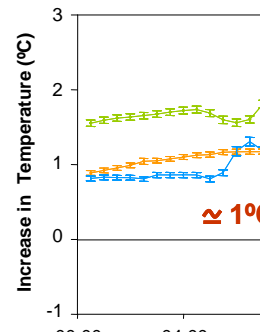
Shrubland



- 3 Control plots
- 3 Warming treatment plots



WARMING TREATMENT



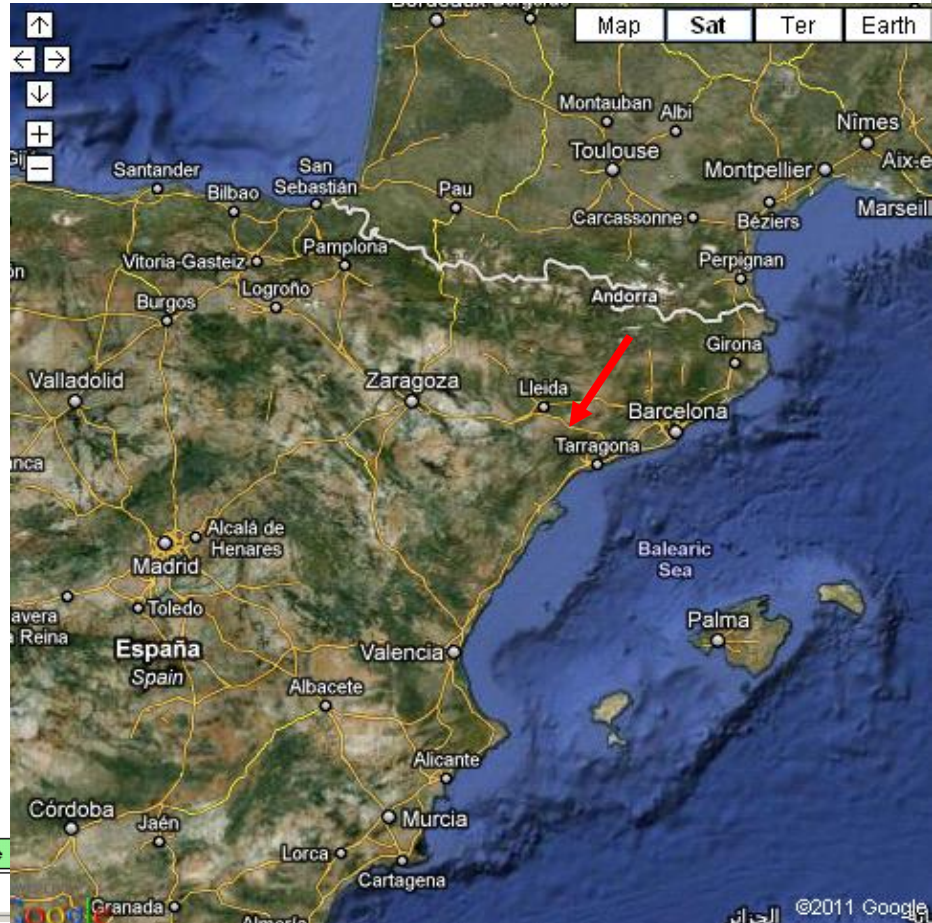
Passive warming (capture of infrared radiation during the night)

3. Examples of various types of experiments from Europe

Prades, Spain (J. Penuelas)

[Search experiment](#)
[Update experiment](#)
[Add experiment](#)
[Information](#)
[Frontpage](#)

Site name	Project name	Country	Location	Altitude
Prades	Prades	SPAIN	1	950
Site Description	Project Description	Landuse		
Mediterranean evergreen forest	Experimental drought simulating future water availability for Mediterranean forests induced by climate change	Not Yet Assigned		
Treatments		Not assigned, select a Landuse from the list to assign it to a site		
Control				
Water removal				
Response name	response type			
Biomass	plant			
Ecophysiology	plant			
LAI	plant			
Litter production	plant			
Phenology	plant			
Plant chemistry	plant			
Species composition	plant			
Basic climate variables	site			
General soil characteristics	site			
Plant productivity	site			
Plant species composition	site			
Soil respiration	soil			
Soil moisture content	soil			
Soil respiration	soil			
Stable isotope studies	soil			
Additional Information:				
Data Status:				
Key References:				
Web Link:	http://www.creaf.uab.es/ecophysiology/sites/experimental_sites.htm			
Person name	Contact detail	Institute		
Josep Penuelas	josep.penuelas@uab.cat	CREAF		



Prades (Mediterranean forest, Spain)

Experiment on the effects of drought



Acta Physiol Plant (2010) 32:387–394

DOI 10.1007/s11738-009-0416-y

ORIGINAL PAPER

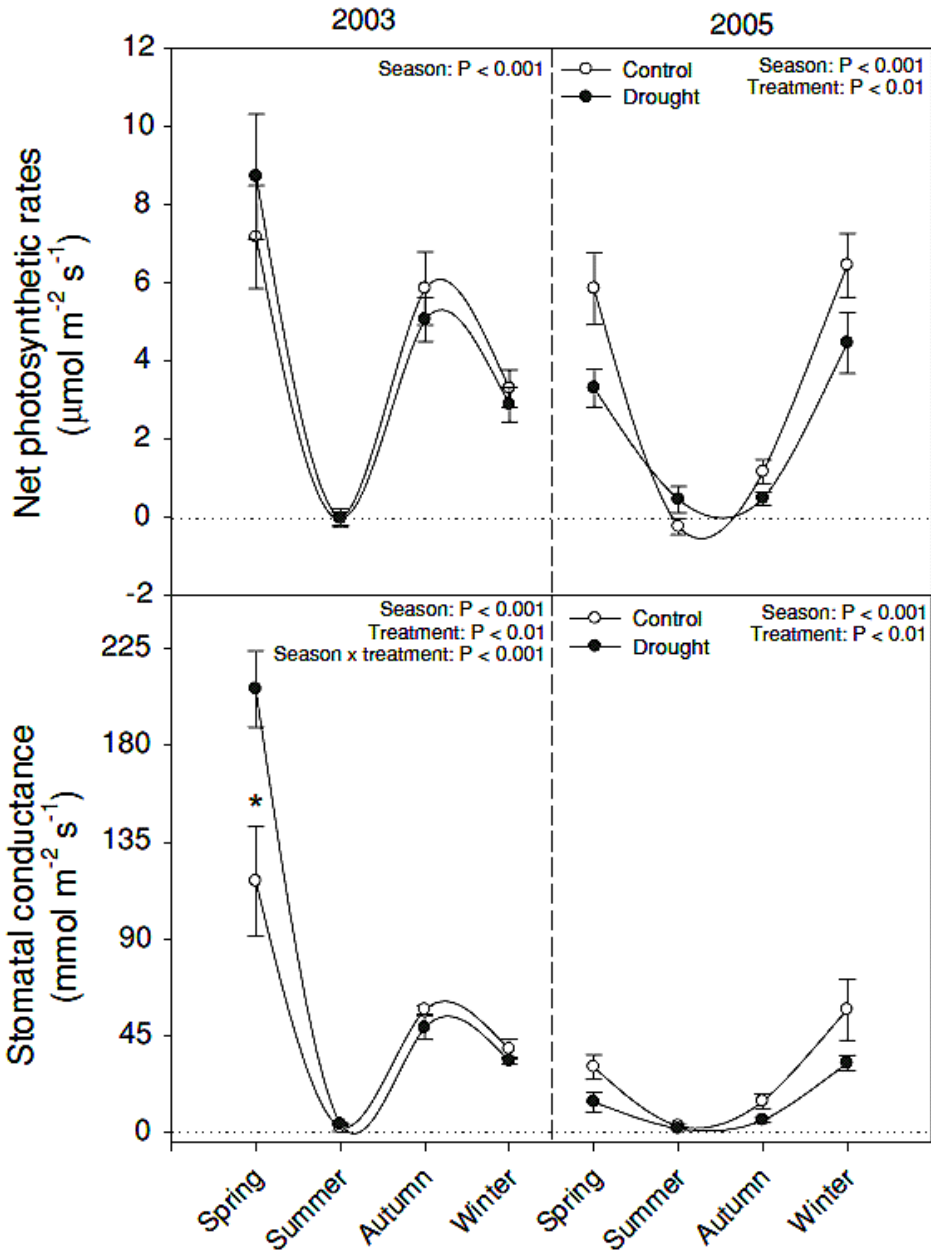
Annual and seasonal changes in foliar terpene content and emission rates in *Cistus albidus* L. submitted to soil drought in Prades forest (Catalonia, NE Spain)

**Joan Llusà · Josep Peñuelas ·
Giorgio Alessio**

Received: 5 October 2009 / Revised: 8
© Franciszek Górski Institute of Plant Physiology



3. Examples of various types of experiments from Europe



Precipitation 2003: 900 mm
vs. 2005: 500 mm
(drought: 20% reduction)

Cistus albidus (cist vlnatý)

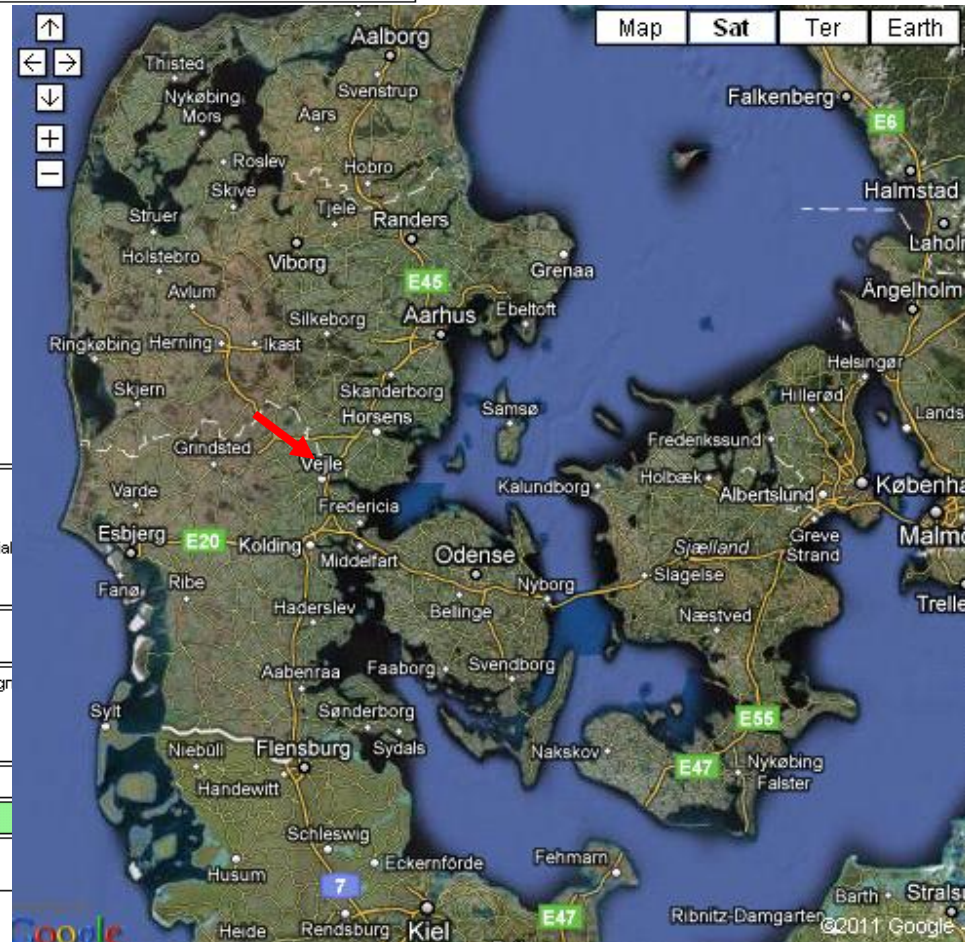


3. Examples of various types of experiments from Europe

Brandbjerg, Denmark (CLIMAITE)

Search experiment	Update experiment	Add experiment	Information	Frontpage
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Site name	Project name	Country	Location	Altitude
Brandbjerg	CLIMAITE	DENMARK	55.53N 11.58E	25
Site Description	Project Description	Landuse		
Sandy soil, calluna shrubland/deschampsia grassland, no management	Multifactorial climate change experiment (elevated CO2 (FACE), T (passive night time warming) and H2O (summer drought)). Measurements of responses at the species, community and ecosystem level.	Shrubland		
Treatments				
CO2 increase				
Control				
Temperature				
Water removal				
Response name	response type			
Biomass	plant			
Ecophysiology	plant			
Herbivory	plant			
LAI	plant			
Litter production	plant			
NEE	plant			
Phenology	plant			
Additional Information:	CO2 increase to 510 ppm by FACE (only daytime, year round) Temperature increase 1 oC by passive night time warming Water removal (extended summer drought) by automatic rain out shelters Treatments include full factorial approach. 6 replicates. Started treatments in 2005 - ongoing.			
Data Status:	Driving variables (meteorology etc) in database, some responses in database and some in spreadsheets			
Key References:	Mikkelsen, T.N.; Beier, C.; et al. (2008) Experimental design of multifactor climate change experiments with elevated CO2, warming and drought – the CLIMAITE project. Functional Ecology, 22, 185-195.			
Web Link:	www.climaite.dk			
Person name	Contact detail			
Claus Beier	clbe@risoe.dtu.dk			
Additional Persons: Teis Mikkelsen (site & ecophysiology) Leon G Linden (modelling)				

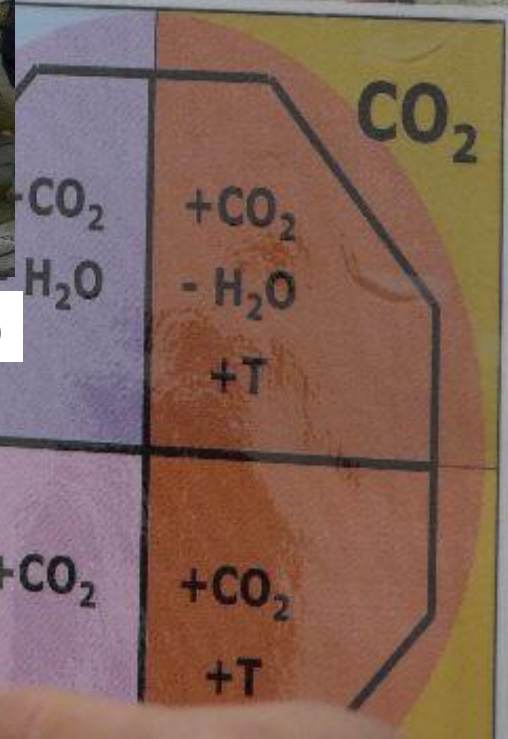
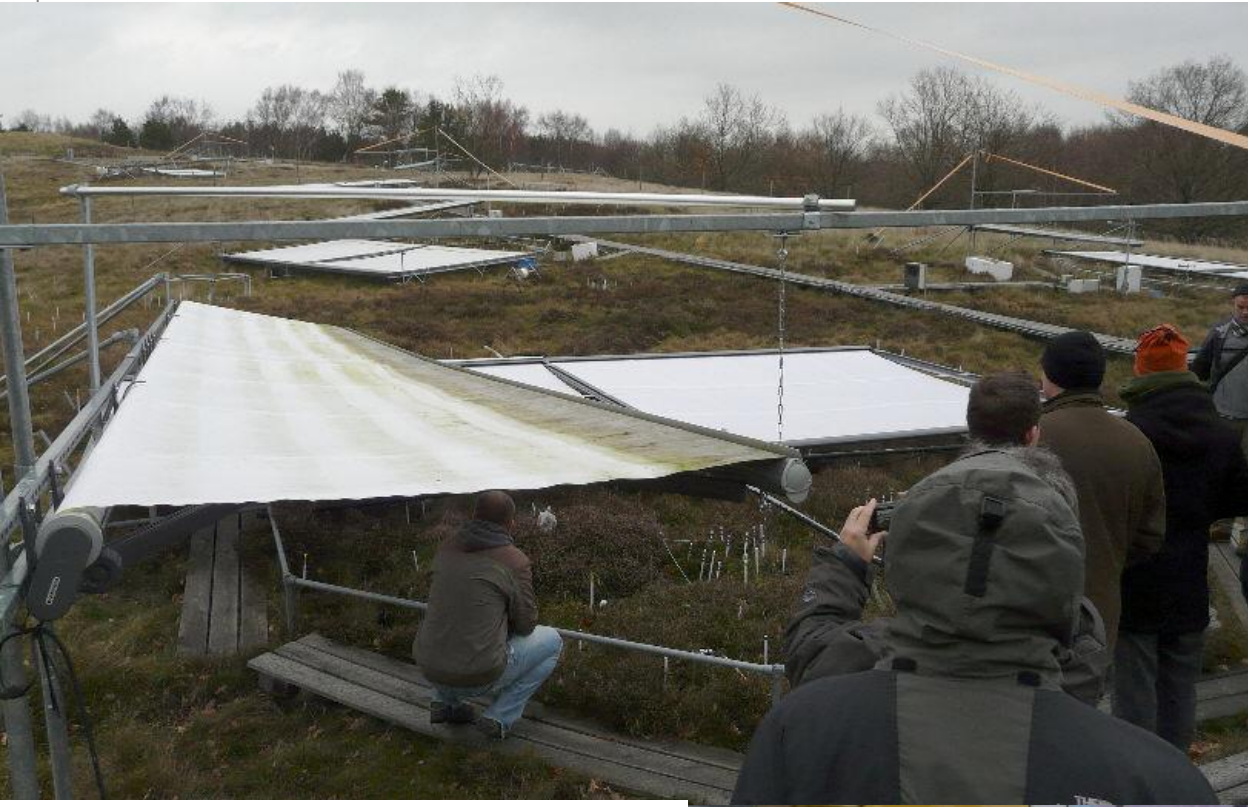


Brandbjerg, Denmark

Experiment on the combined effects of temperature, drought and elevated CO₂ (CLIMAITE)



3. Examples of various types of experiments from Europe



Shielding of precipitation (blind) + reduced radiation during the night)



Global Change Biology

Global Change Biology (2011) 17, 1884–1899, doi: 10.1111/j.1365-2486.2010.02351.x

Reduced N cycling in response to elevated CO₂, warming, and drought in a Danish heathland: Synthesizing results of the CLIMAITE project after two years of treatments

KLAUS S. LARSEN*, LOUISE C. ANDRESEN†¹, **CLAUS BEIER***, SVEN JONASSON†, KRISTIAN R. ALBERT*, PER AMBUS*, MARIE F. ARNDAL‡, METTE S. CARTER*, SØREN CHRISTENSEN†, MARTIN HOLMSTRIIPS, ANDREAS IBROM* JANE KONGSTAD‡, LEON VAN DER ANDERS MICHELSEN†, TEIS N. M. HELGE RO-POULSEN†, INGER K. KAREN STEVNBAK†

*Risø DTU, Biosystems Division, Technical University of Denmark, Roskilde, Denmark
 †Department of Biology, University of Copenhagen, Øster Farimagsgade 2, Copenhagen, Denmark
 ‡University of Copenhagen, Hørsholm Kongevej 11, Hørsholm, Denmark
 §Environmental Research Institute, Aarhus University, Aarhus, Denmark

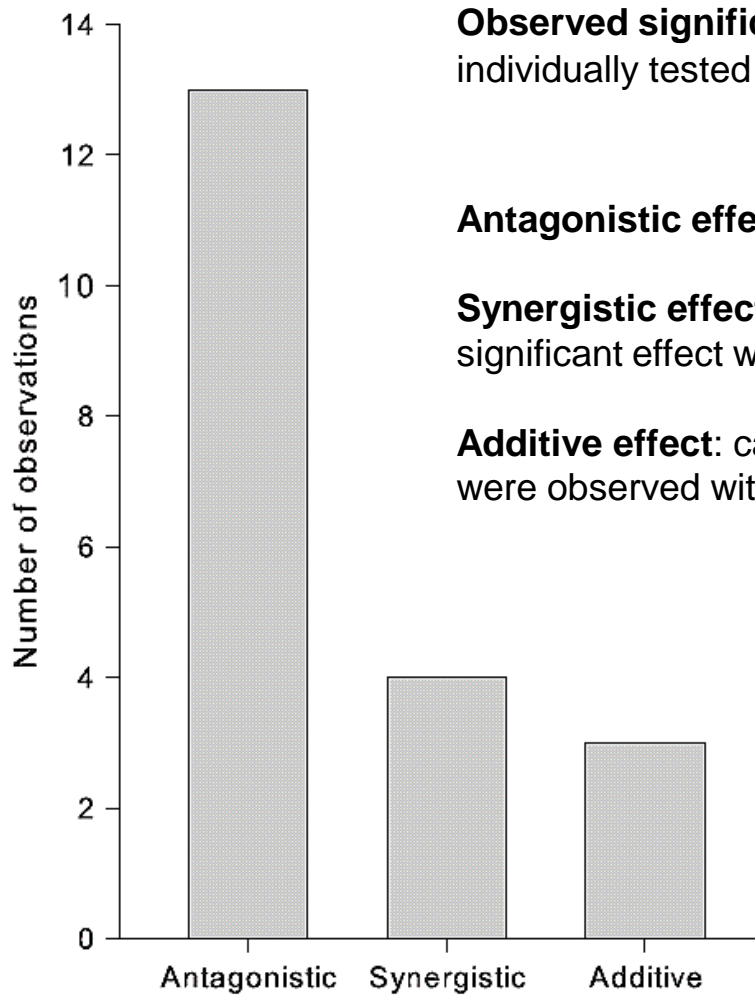
Abstract

Field-scale experiments simulating realistic future current and future climate changes on ecosystem



Claus Beier (coordinator of project CLIMAITE)

3. Examples of various types of experiments from Europe



Observed significant interactions ($P \leq 0,05$) from the analysis of 47 individually tested response variables

Antagonistic effect: combination lead to reduction of effects.

Synergistic effect: combination lead to extension of single effects or significant effect was only observed in combination.

Additive effect: cases where two significant individual effects were observed without significant interaction.



Larsen et al. 2011 Global Change Biology

3. Examples of various types of experiments from Europe

Basel, Switzerland (Swiss Canopy Crane)

Search experiment Update experiment Add experiment

Site name	Project name	Country
Basel	Swiss canopy crane	SWITZERLAND
Site Description	Project Description	
1	0	
Treatments		
CO2 increase		
Control		
Response name	Response type	
Additional Information:		
Data Status:		
Key References:		
Web Link:		
Person name	Contact detail	
Christian Koerner	christian.koerner@unibas.ch	
Additional Persons:		



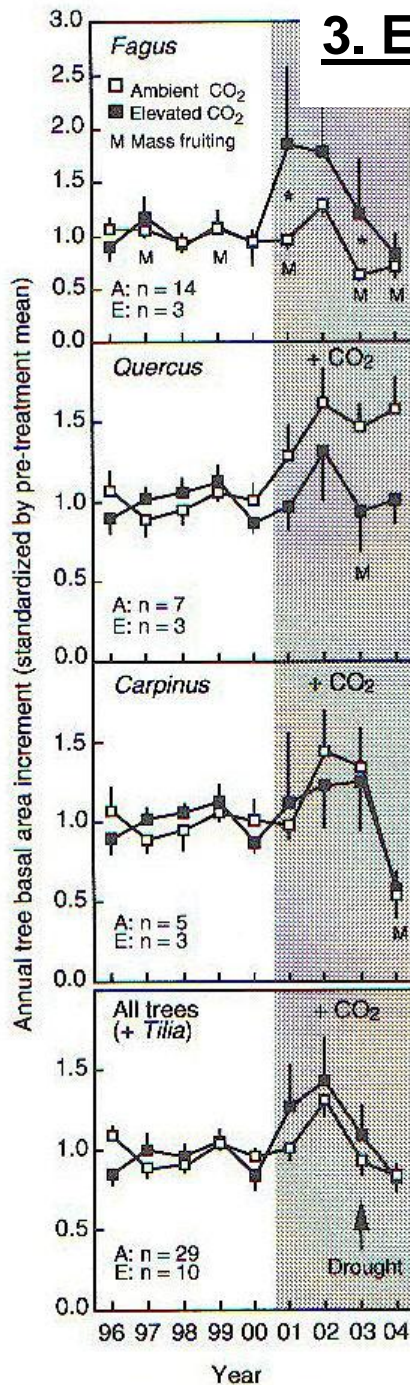
3. Examples of various types of experiments from Europe



3. Examples of various types of experiments from Europe

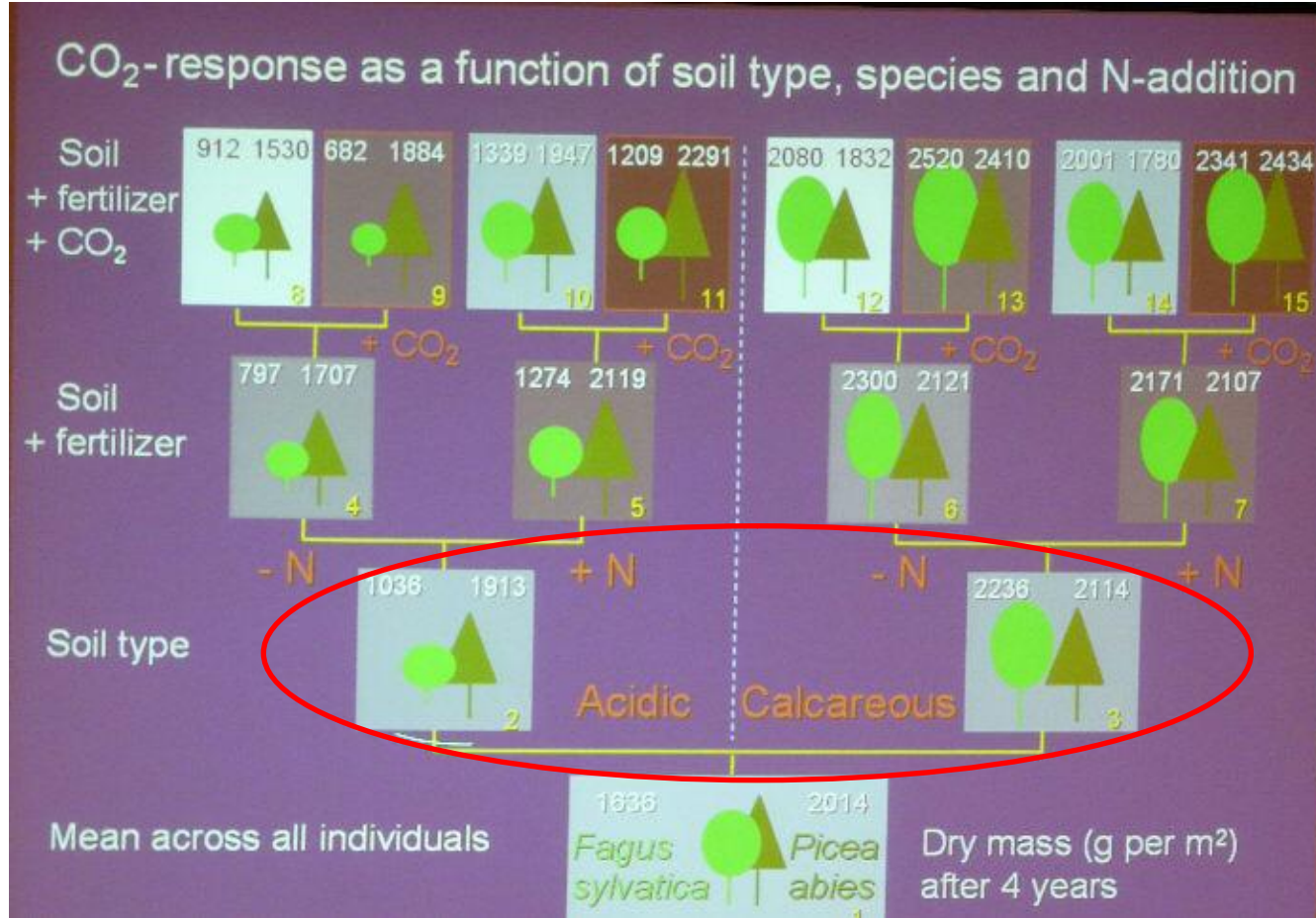
Carbon Flux and Growth in Mature Deciduous Forest Trees Exposed to Elevated CO₂

Christian Körner,^{1*} Roman Asshoff,¹ Olivier Bignucolo,¹
 Stephan Hättenschwiler,^{1,2} Sonja G. Keel,³ Susanna Peláez-Riedl,¹
 Steeve Pepin,^{1,4} Rolf T. W. Siegwolf,³ Gerhard Zotz¹



Whether rising atmospheric carbon dioxide (CO₂) concentrations will cause forests to grow faster and store more carbon is an open question. Using free air CO₂ release in combination with a canopy crane, we found an immediate and sustained enhancement of carbon flux through 35-meter-tall temperate forest trees when exposed to elevated CO₂. However, there was no overall stimulation in stem growth and leaf litter production after 4 years. Photosynthetic capacity was not reduced, leaf chemistry changes were minor, and tree species differed in their responses. Although growing vigorously, these trees did not accrete more biomass carbon in stems in response to elevated CO₂, thus challenging projections of growth responses derived from tests with smaller trees.

The importance of monitoring a combination of several factors



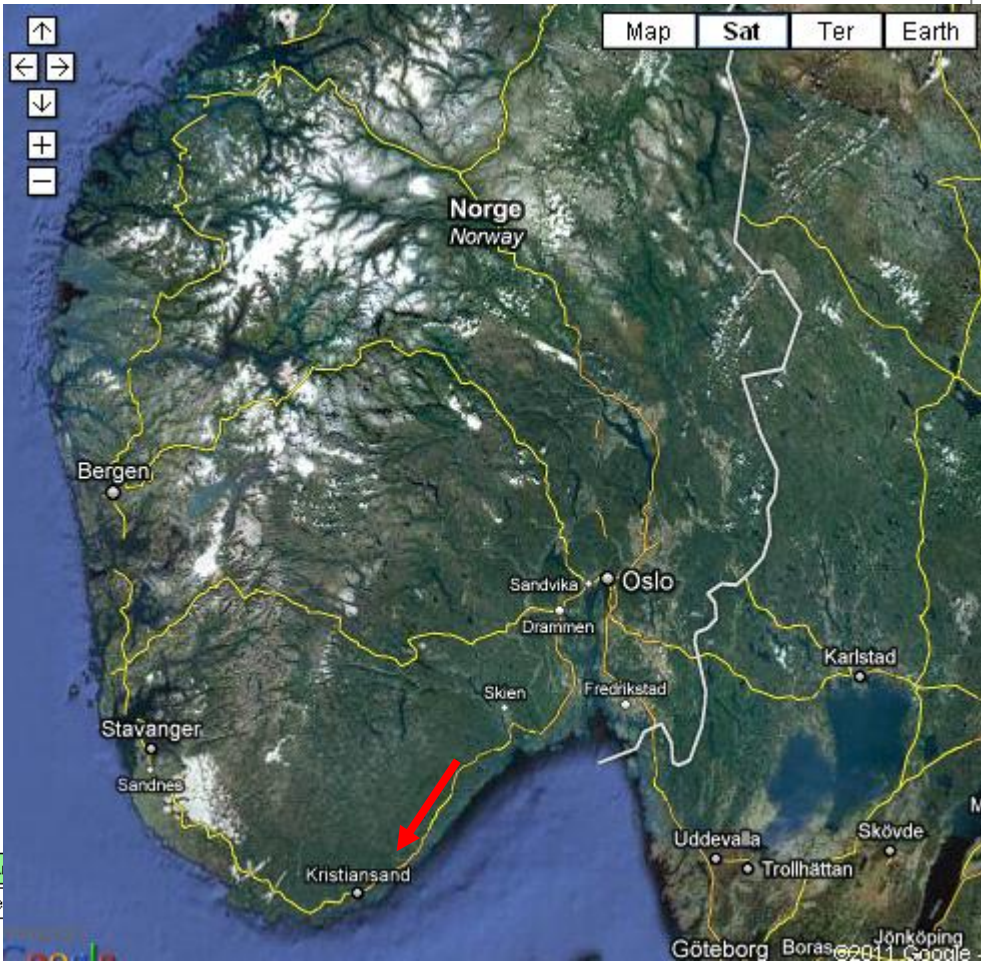
Source: Ch. Körner (conference Lipsko)

3. Examples of various types of experiments from Europe

ClimMani Meta-database

Risdalsheia, Norway (CLIMEX, 1994-2000)

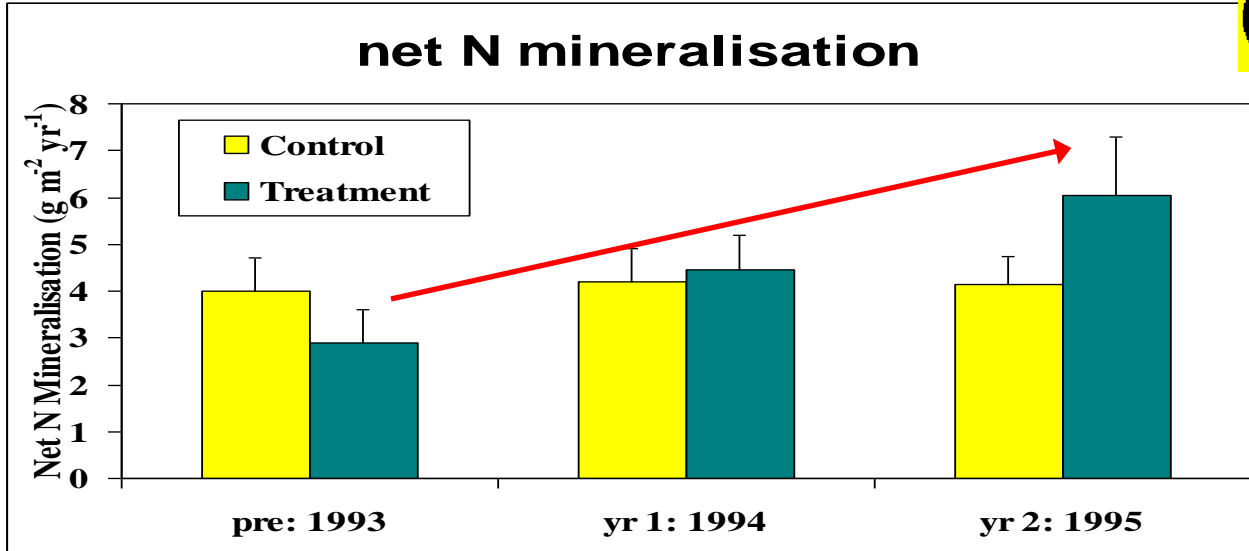
Site name	Project name	Country	Location	Altitude
Risdalsheia	CLIMEX	NORWAY	58.23N, 8.19E	300
Site Description	Project Description	Landuse		
1	0	Forest		
Treatments				
CO2 increase				
Control				
Temperature				
Response name	response type			
Biomass	plant			
Litter production	plant			
Phenology	plant			
Plant C pools	plant			
Plant chemistry	plant			
Plant N pools	plant			
Yield	plant			
Basic climate variables	site			
Deposition	site			
General soil characteristics	site			
Hydrology	site			
C mineralisation	soil			
Soil water chemistry	soil			
Water drainage	soil			
Additional Information:	Extension of the Norwegian acid removal project RAIN. Started in 1995 - ended in 1999. Full catchment "roof" project with "elevated CO2" (as chamber) combined with elevated temperature (air +5/+3), and compared with elevated soil temperature (soil cables) and 3 paired untreated control catchments.			
Data Status:	Spreadsheets Vol.1, No.2, pp.216-225.			
Web Link:	http://www.macaulay.ac.uk/dynamo/climex.htm			
Person name	Contact detail	Institu		
Richard Wright	richard.wright@niva.no	Norwe		
Additional Persons:				



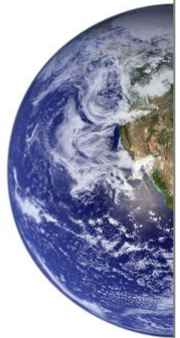
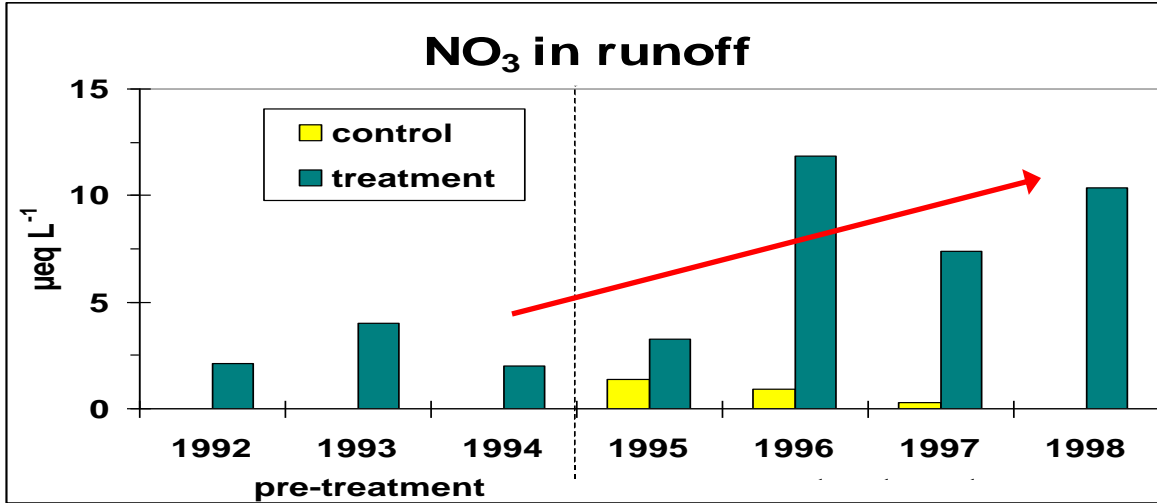
**Experiment on the effect of increased CO₂ (560 ppm)
in combination with increased temperature (+3,5 °C)
- at the ecosystem level (1000 m²)**

CLIMEX

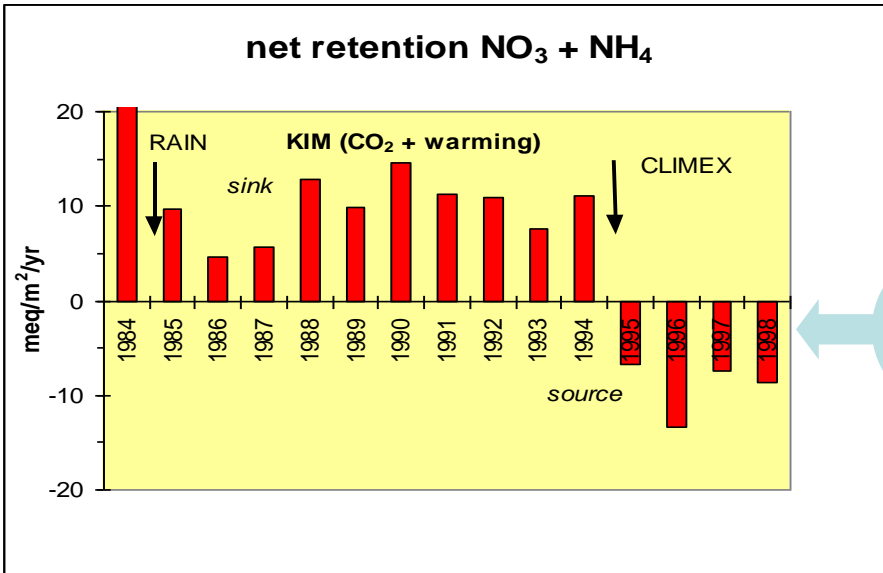




3. Examples of various types of experiments from Europe



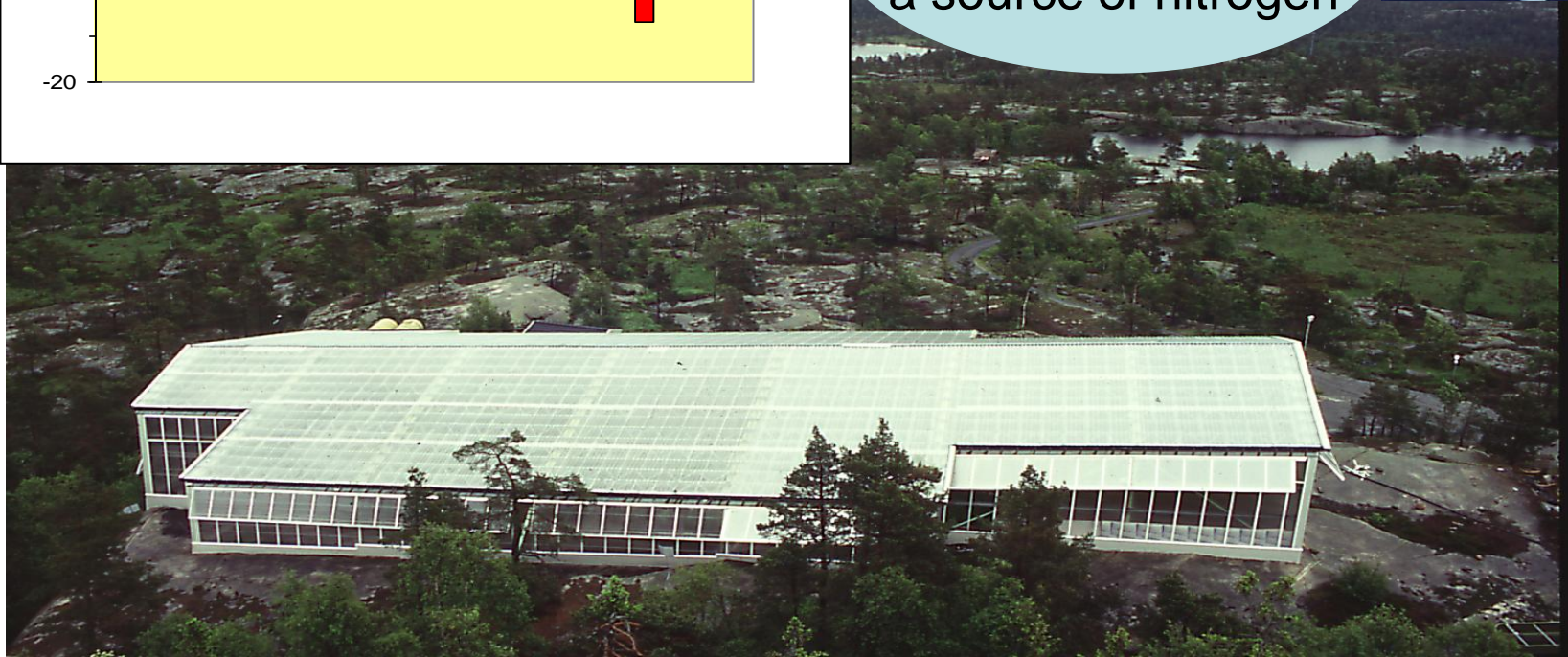
3. Examples of various types of experiments from Europe



Richard Wright
(coordinator)



The ecosystem is becoming a source of nitrogen

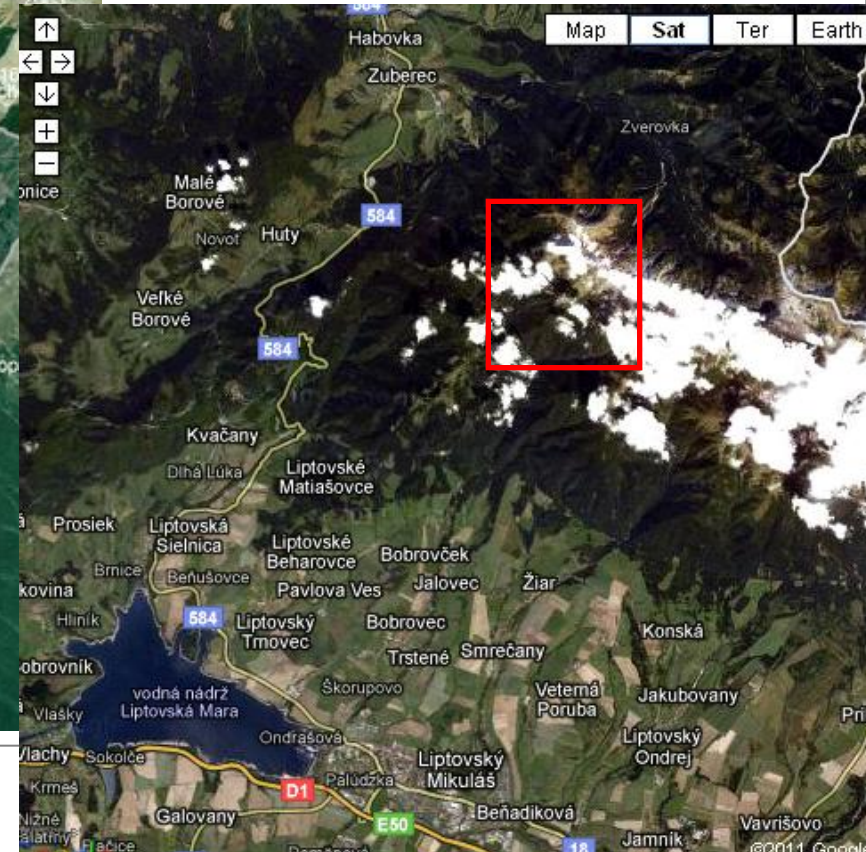


3. Examples of various types of experiments from Europe

Salatín, Slovakia (L. Halada)



Altitude 1900 m a.s.l.



3. Examples of various types of experiments from Europe



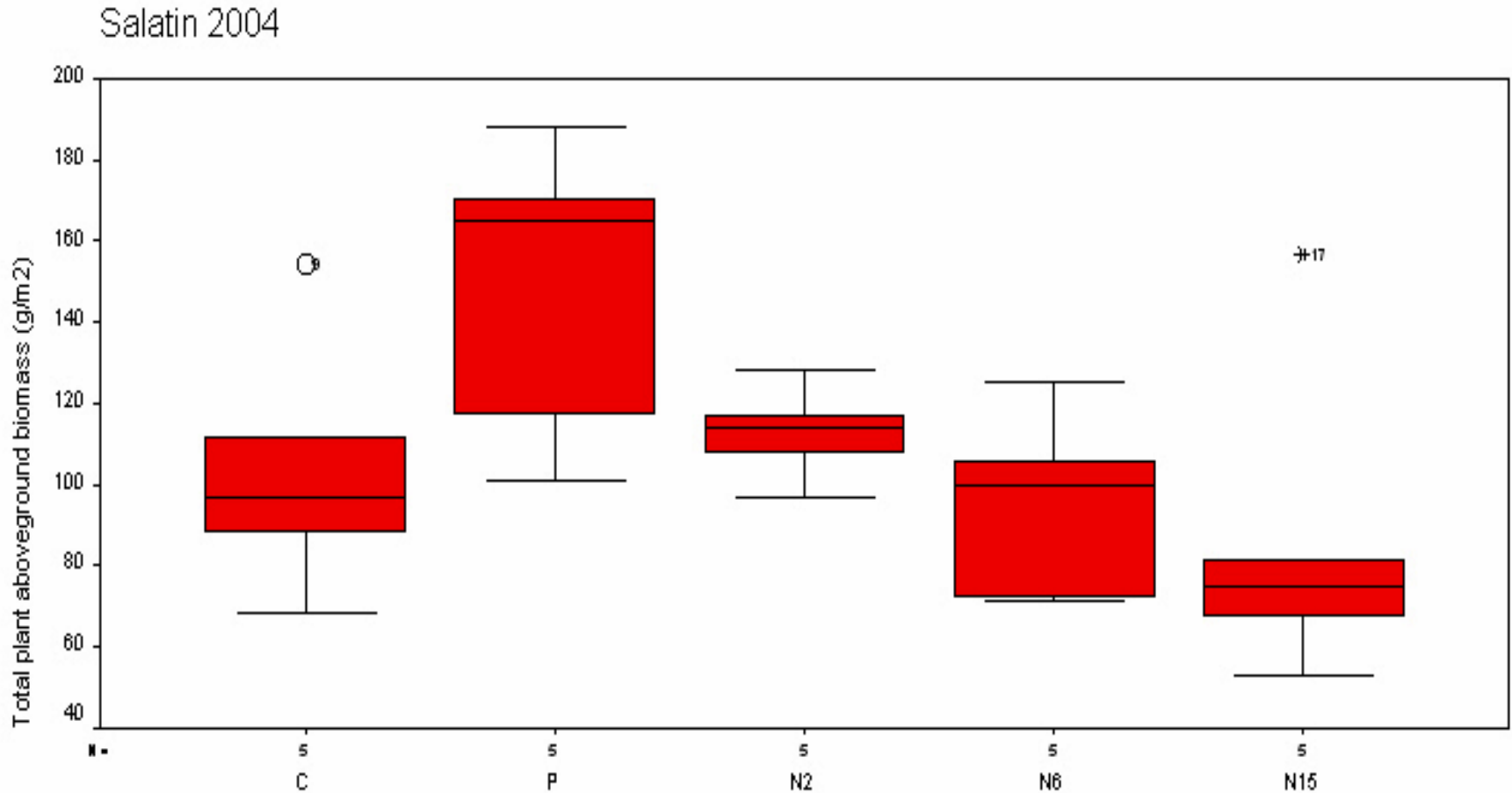
Treatments:
N2 (2 g N m⁻² year⁻¹)
N6, N15,
P (5 g P m⁻² year⁻¹),
K (control)

Monitoring of plant species diversity
Microlyzimeters
Soil analyses
Biomass (nutrients)
Atmospheric depositions
Climatic data



Salatín, Slovakia

Experiment on the effects of nitrogen deposition on alpine grass vegetation



TREATMENT

3. Examples of various types of experiments from Europe

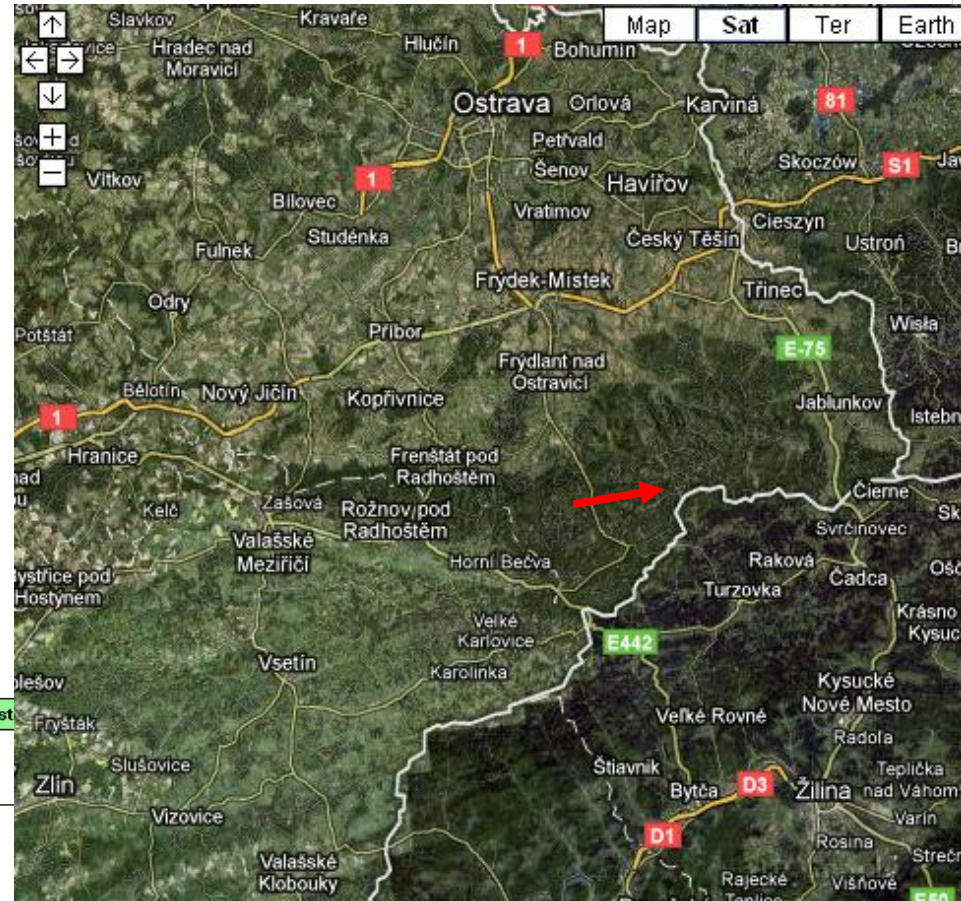


Luboš Halada – Coordinator of the project

4. Examples of manipulative experiments from CR

Search experiment	Update experiment	Add experiment	Information	Frontpage	ClimMani
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Site name	Project name	Country	Location	Altitude
ILE	ECOCRAFT	CZECH REPUBLIC	49.30N, 18.32E	908
Site Description	Project Description	Landuse		
Bílý Kríž (Moravia-Silesian Beskydy Mts.)	Climate change experiment (elevated CO2)- glassdomes. Measurements of responses at the species level.	Forest		
Treatments				
CO2 increase				
Control				
Response name	response type			
Biomass	plant			
Ecophysiology	plant			
LAI	plant			
NEE	plant			
Plant C pools	plant			
Plant chemistry	plant			
Root biomass	plant			
Basic climate variables	site			
General soil characteristics	site			
Soil respiration	site			
Additional Information:				
Data Status:				
Key References:	Marek M V, Kalina J, Matoušková M (1995) Responses of photosynthetic carbon assimilation of Norway spruce exposed to long-term elevation of CO2 concentration. Photosynthetica 31: 209-220.			
Web Link:				
Person name	Contact detail	Inst		
Michael Marek	emarek@usbe.cas.cz			
Additional Persons:				



4. Examples of manipulative experiments from CR

Main projects associated with this infrastructure:

AnaEE – Analysis and Experimentation on Ecosystems (2012-2018)

CzechGlobe – Center for Global Climate Change Impacts Studies (2010-2014)

Czech Terra - adaptation of landscape carbon sinks in the context of global change (2007-2011)

CzechCarbo - Carbon cycle study focused on the terrestrial ecosystems in the Czech republic in connection on the CARBOEUROPE project (2003-2007)

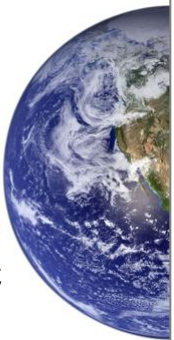
EUROFACE - An integrated European scientific infrastructure for GC studies on forest and agroforest ecosystems utilising FACE technology (2003-2005)

MERCI - Methodological and Experimental Research Centre and Infrastructure for Studies of GCC Impacts on Forests (2003-2004)

CARBOMONT - Effects of land-use changes on sources, sinks and fluxes of carbon in European mountain areas (2002-2004)

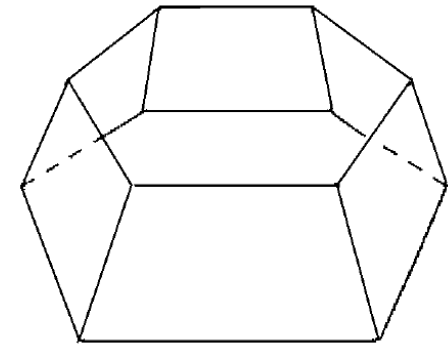
ECOCRAFT II - (1996-1999)

Another national projects

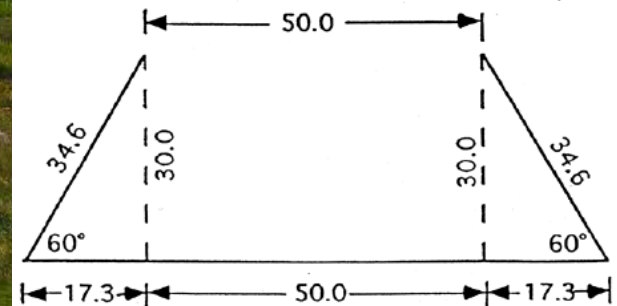


Project Ministry of Education 2007-2011

Changes in alpine ecosystems in the KRNAP, NPR Kralický Sněžník and CHKO Jeseníky in the context of global change (*M. Banaš, M. Zeidler*)



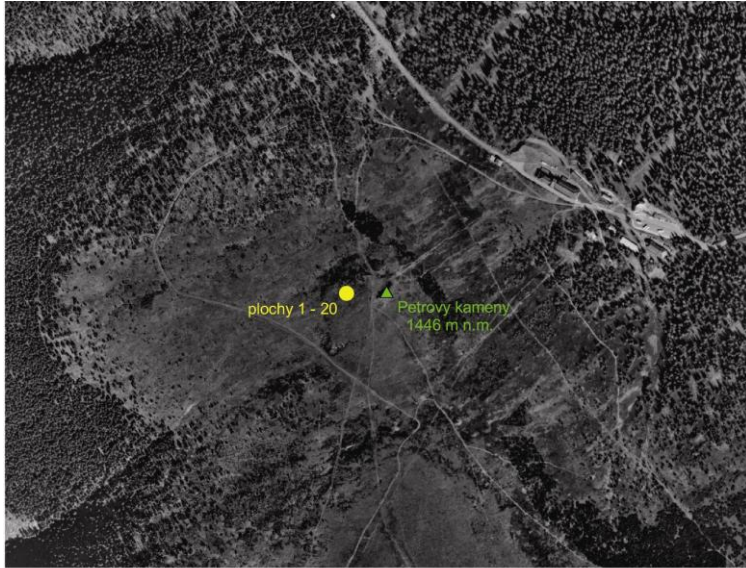
hexagonal OTC's according ITEX (Molau *et* Mølgaard 1996).



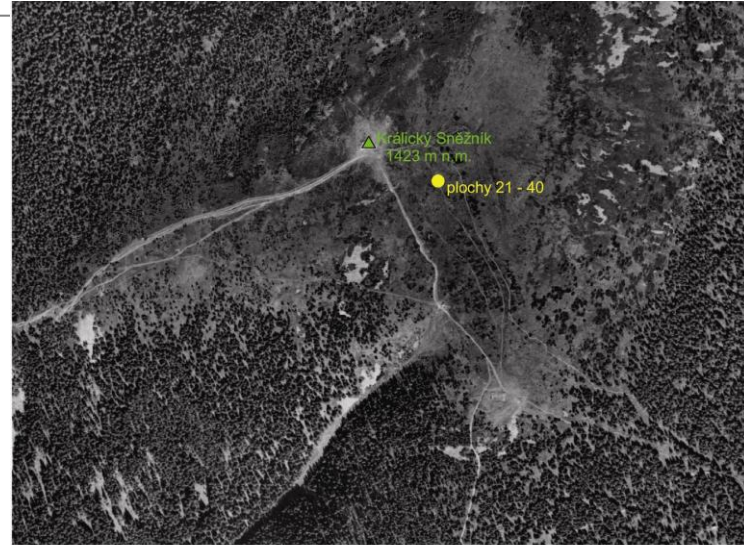
increase of the temperature by 1-3 °C (Henry and Molau 1997).

4. Examples of manipulative experiments from CR

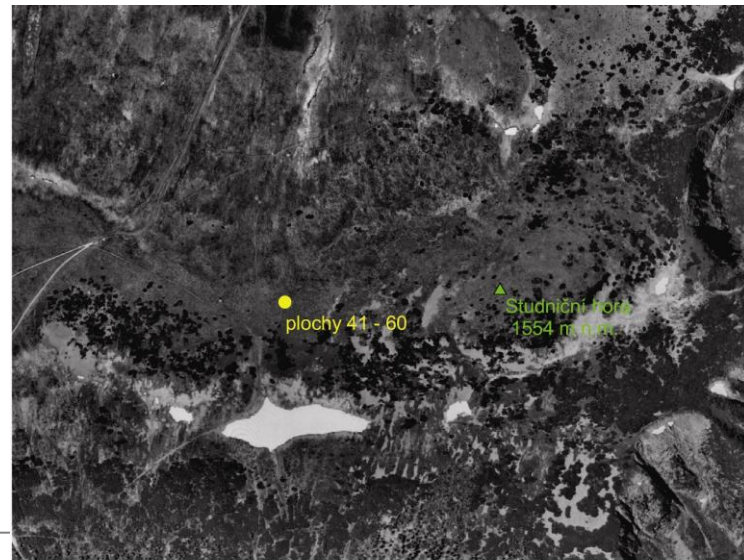
Localities:



(1) Petrovy kameny (Jeseníky)



(2) Kralický Sněžník (SE from the top)



(3) Modré sedlo (Krkonoše)



4. Examples of manipulative experiments from CR

Design of the experiment:

Treatments:

warming (OTC),
warming + irrigation (50% of ambient precipitation),
warming + fertilization ($2 \text{ g N m}^{-2} \text{ year}^{-1}$ - NH_4NO_3)
control



Monitoring of plant species diversity

Phenology

Soil analyses

Biomass (nutrients)

Climatic data

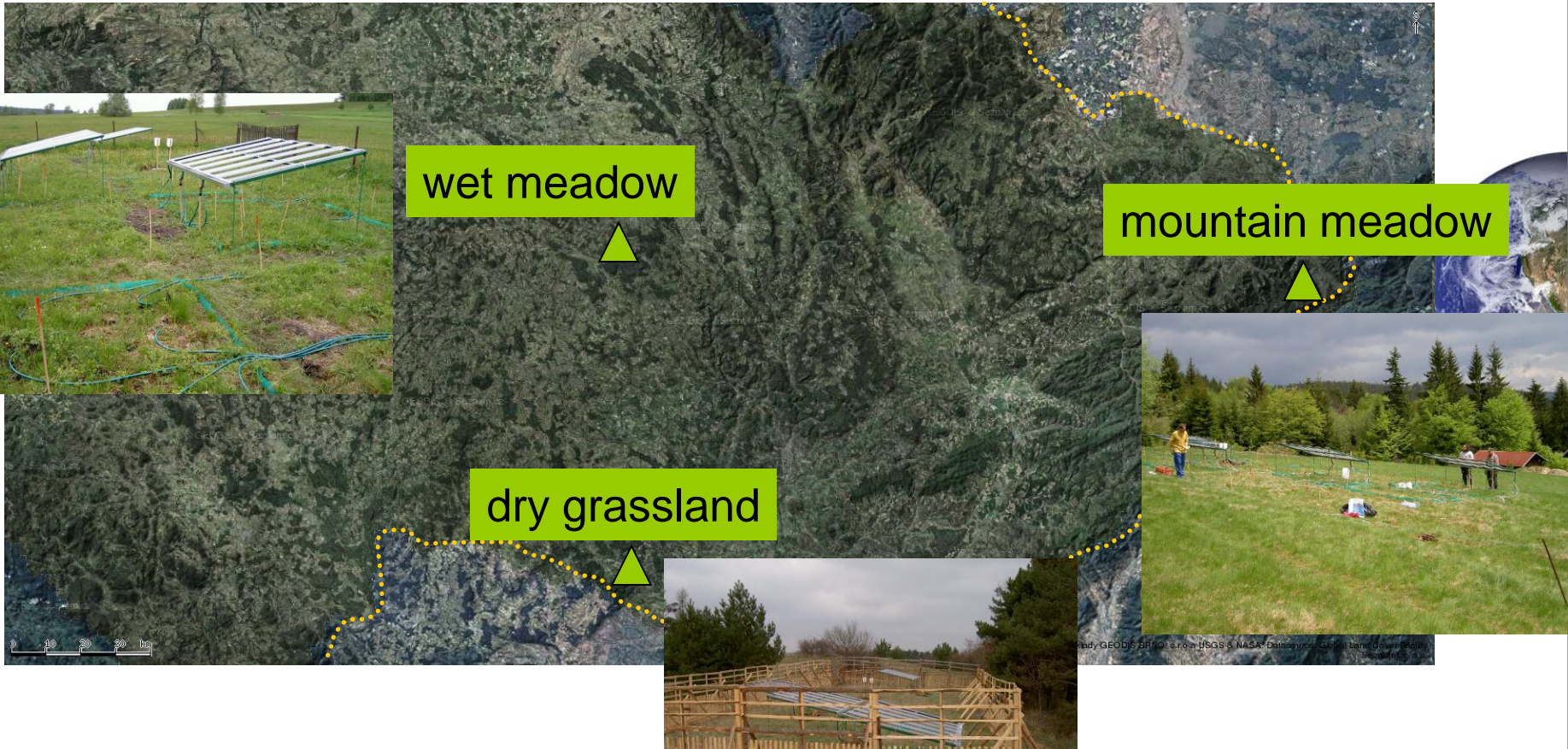
Long-term changes in vegetation



4. Examples of manipulative experiments from CR

Project GA CR 2006-2008

Impact of precipitation changes on plant and soil processes in different grassland ecosystems (*K. Fiala*)



4. Examples of manipulative experiments from CR

elevation gradient

Lowland site:



Highland site:



Mountain site:



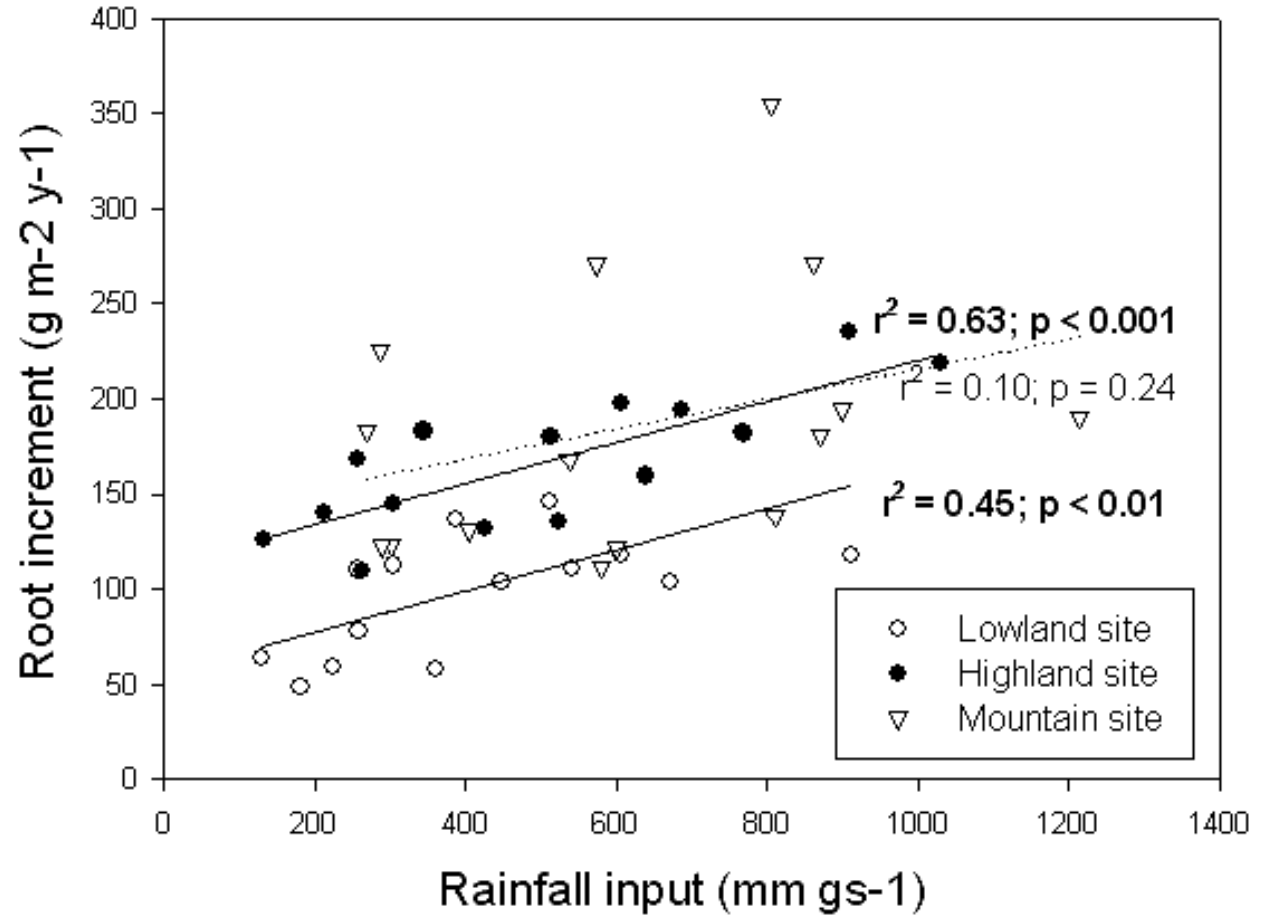
precipitation gradient

4. Examples of manipulative experiments from CR



ECOSYSTEMS

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4. Examples of manipulative experiments from CR

Experiment on the combined effect of drought and UV radiation in mountain grassland (2010-2015)

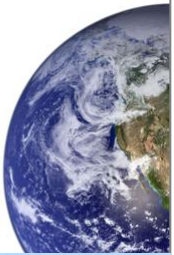
Hypotheses:

Effects of drought and UV has a similar effect on the induction of protective mechanisms of plants. The combined effect of drought and UV has a significant impact in comparison with the effects of individual factors.

Design of the experiment:

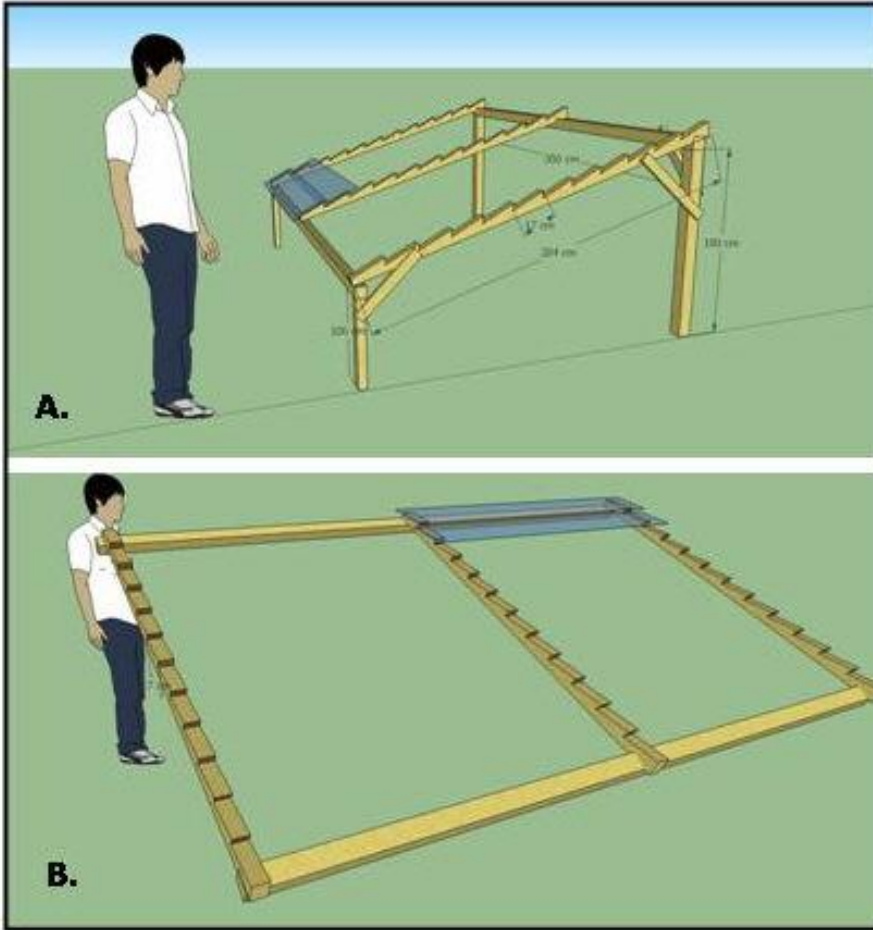
Treatments changing precipitations: drought (4-6 weeks)
control with ambient precipitation

Treatments changing UV radiation: filtered UV (acrylic with filter of UV radiation)
ambient UV (acrylic without filter)



4. Examples of manipulative experiments from CR

Experiment on the combined effect of drought and UV radiation in mountain grassland (2010-2015)



control treatment with ambient precipitation

drought treatment for 4-6 weeks

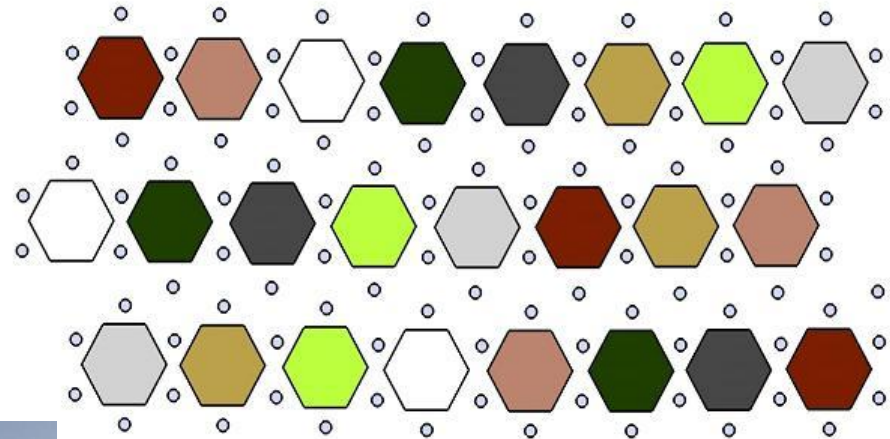


4. Examples of manipulative experiments from CR

New infrastructure Domanínek - Experimental station of Plant Ecophysiology in the frame of project CzechGlobe (monitoring of multiple factors simultaneously)

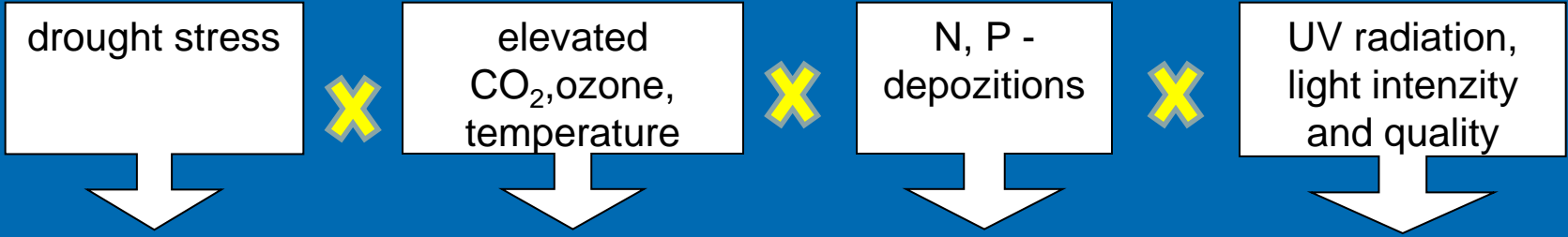
24 Open top chambers (OTC)

Infrastructure allows to monitor the influence of three factors in two levels and their combinations in three replications

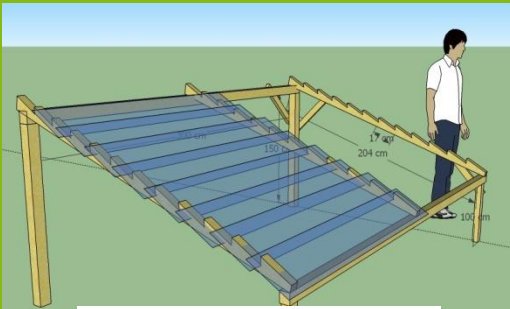


treatment	elevated CO2		nitrogen		drought	
	-	+	-	+	-	+
1 (---)	✓		✓		✓	
2 (+++)		✓		✓		✓
3 (--+)	✓		✓			✓
4 (-+-)	✓			✓	✓	
5 (+--)		✓	✓		✓	
6 (-++)	✓			✓		✓
7 (++-)		✓		✓	✓	
8 (+-+)		✓	✓			✓

Environmental factors in the global climatic changes and their interaction



Manipulative experiments



experimental roofs



„glass domes“



units with modulated UV



open-top chambers



pot and field experiments



growth chambers

Thank you for your attention...