Manipulative experiments - overview

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Academy of Science of the Czech Republic

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esf evropský sociální fond v ČR
EVROPSKÁ UNIE
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY
OP Vzdělávání pro konkurenceschopnost
INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Tato akce se koná v rámci realizace projektu COPPICE - Výmladkové lesy jako produkční a biologická alternativa budoucnosti – CZ.1.07/2.3.00/20.0267. Tento projekt je spolufinancován Evropským sociálním fondem a Státním rozpočtem ČR.

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

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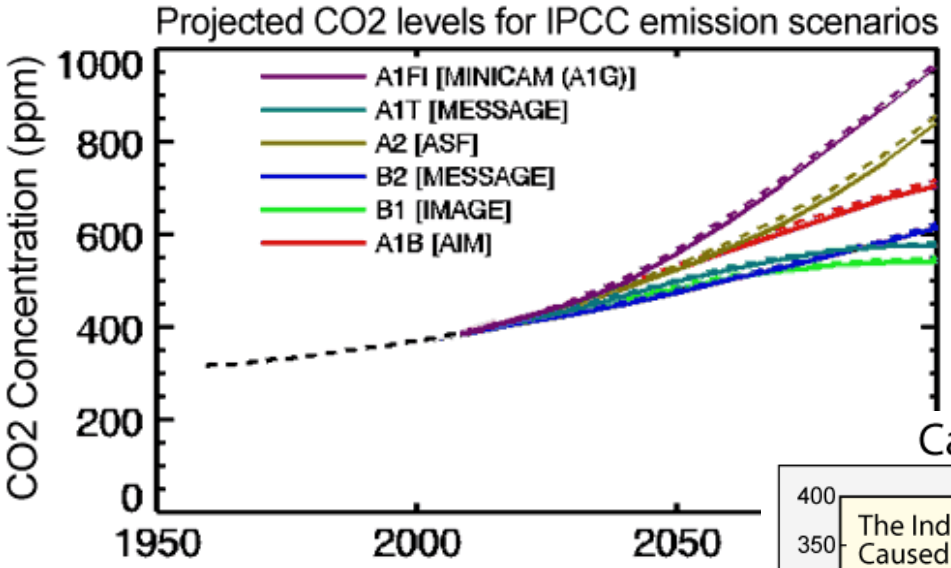
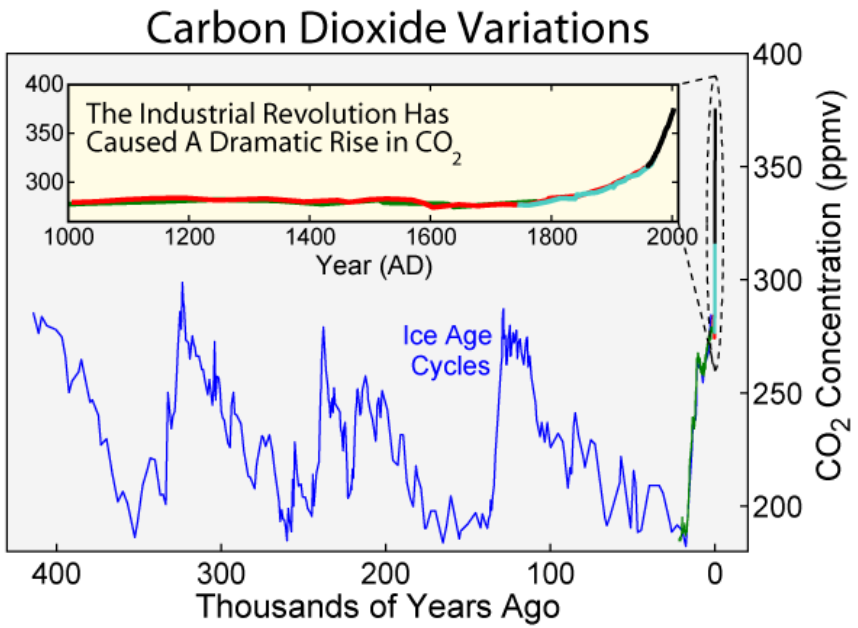
1. Introduction to the topic of climate change



Source: www.skepticalscience.com

Scenarios of CO_2 concentrations

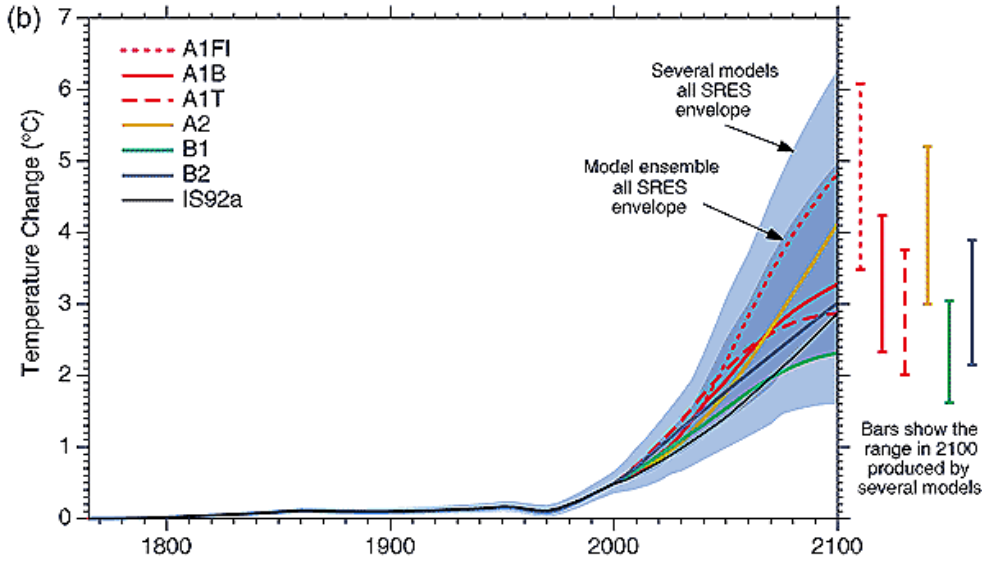


(Wikipedie, various sources)

1. Introduction to the topic of climate change

Temperature projections to 2100

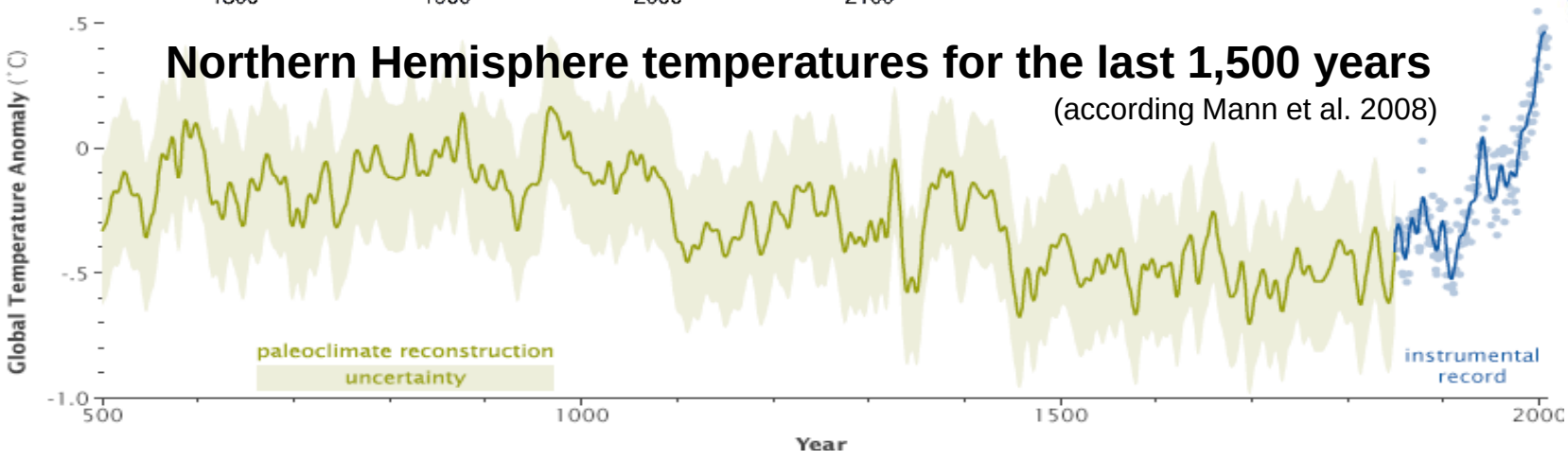
(according IPCC)



Air temperature scenarios

Northern Hemisphere temperatures for the last 1,500 years

(according Mann et al. 2008)

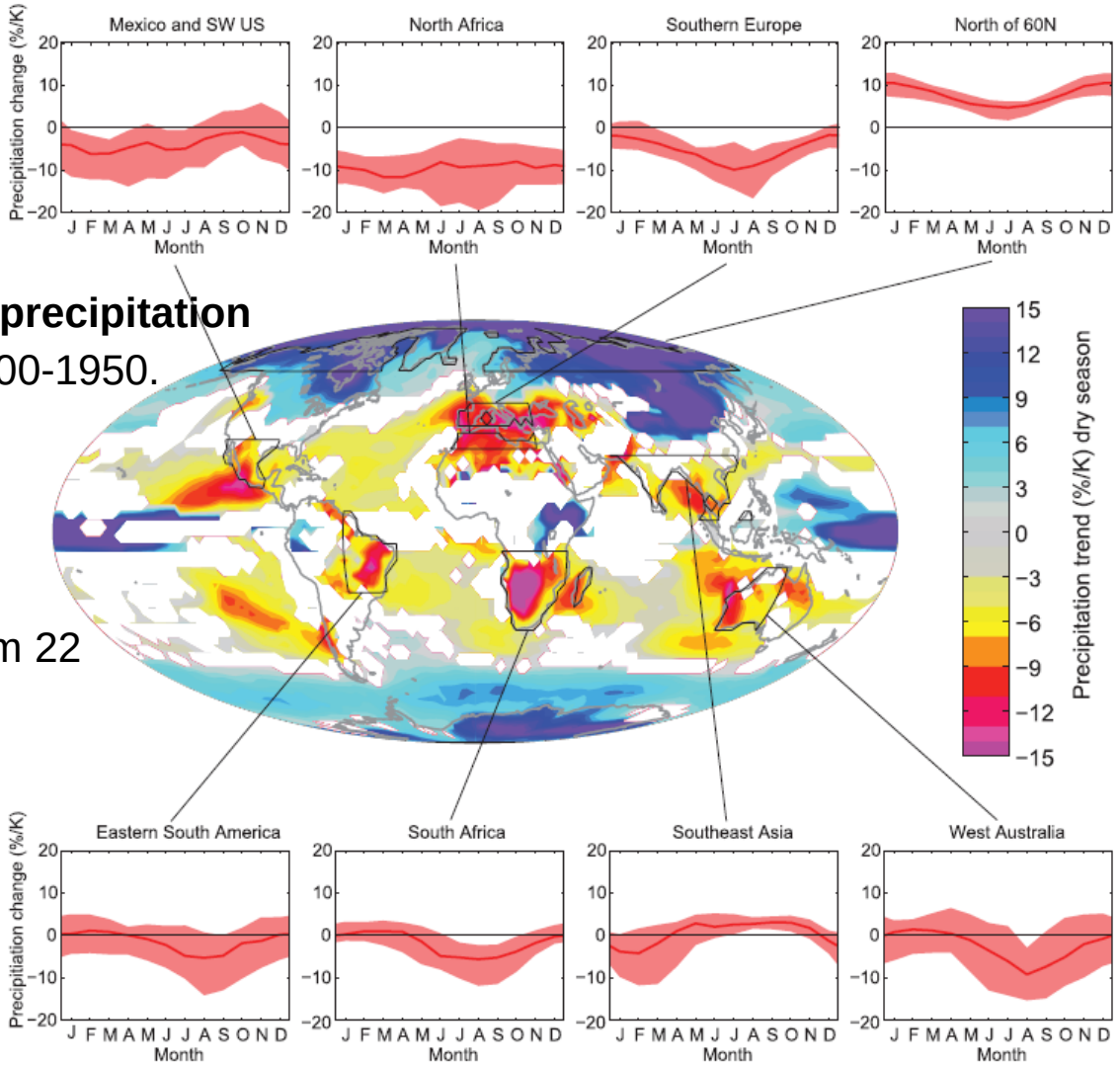


Precipitation scenarios

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

(Solomon et al. 2009)

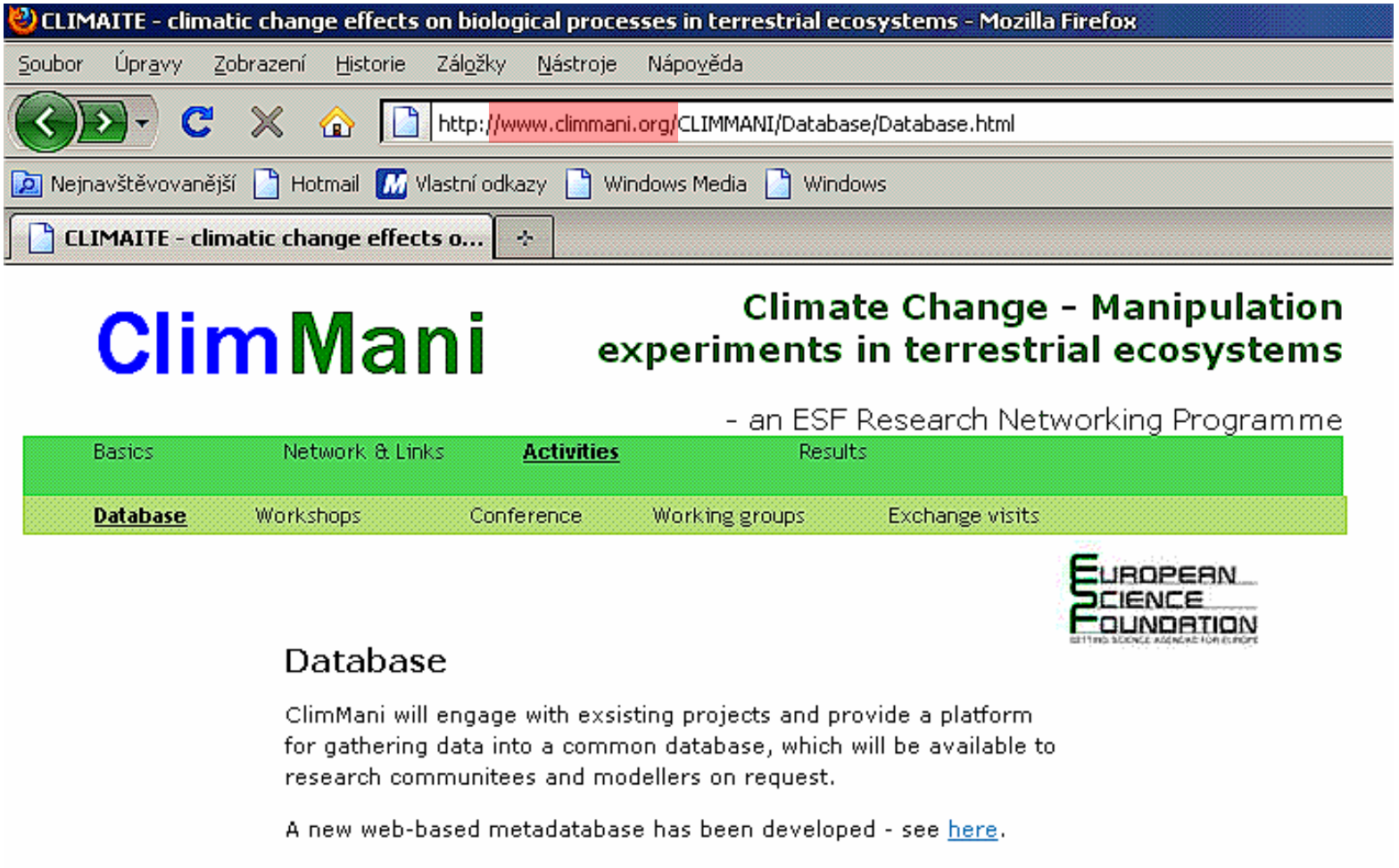
White is used where less than 16 models from 22 was consistent.



2. Climmani – database of manipulative experiments

Project ESF (2008-2013)

www.climmani.org



2. Climmani – database of manipulative experiments

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

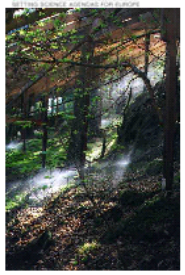


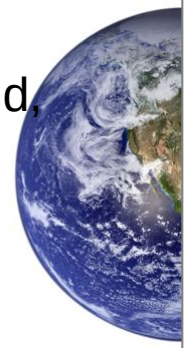
Photo: Filip Moldan (IVL, SE)

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

2. Climmani – database of manipulative experiments

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

EUROPEAN SCIENCE FOUNDATION

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 exsisting 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

Photo: Claus Beier

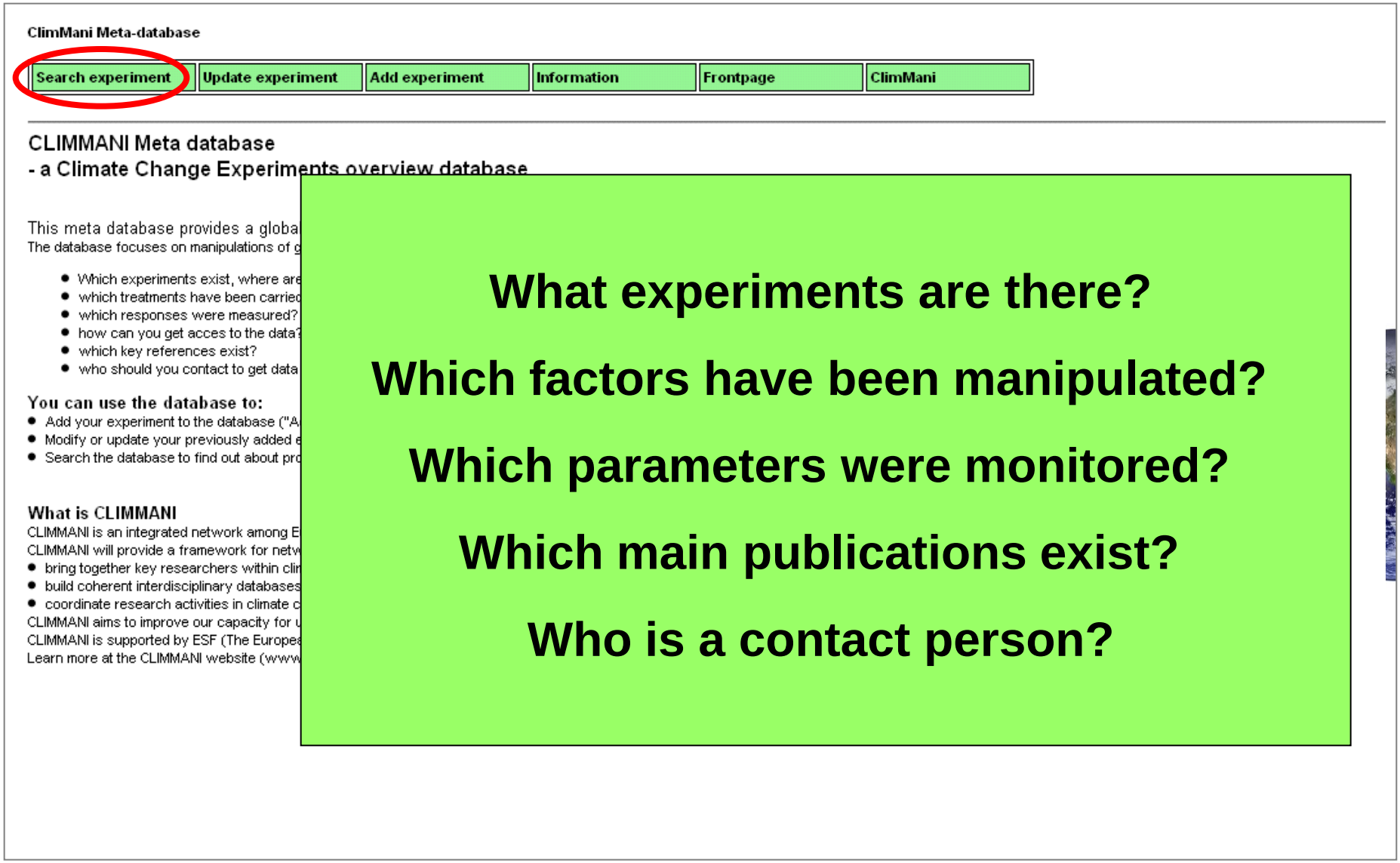
Quick links

Meta database

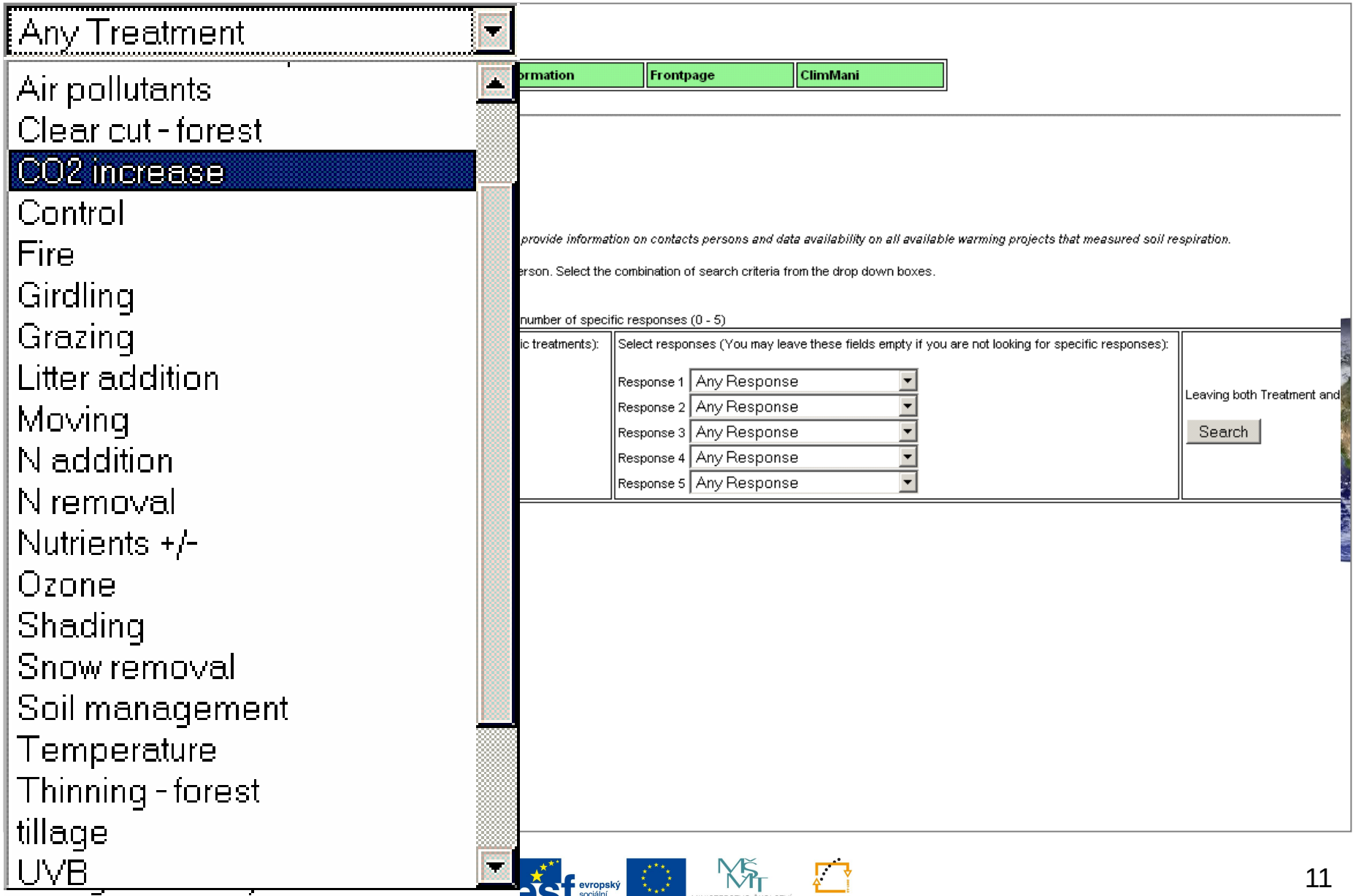
www.climmani.org

Database of projects

2. Climmani – database of manipulative experiments

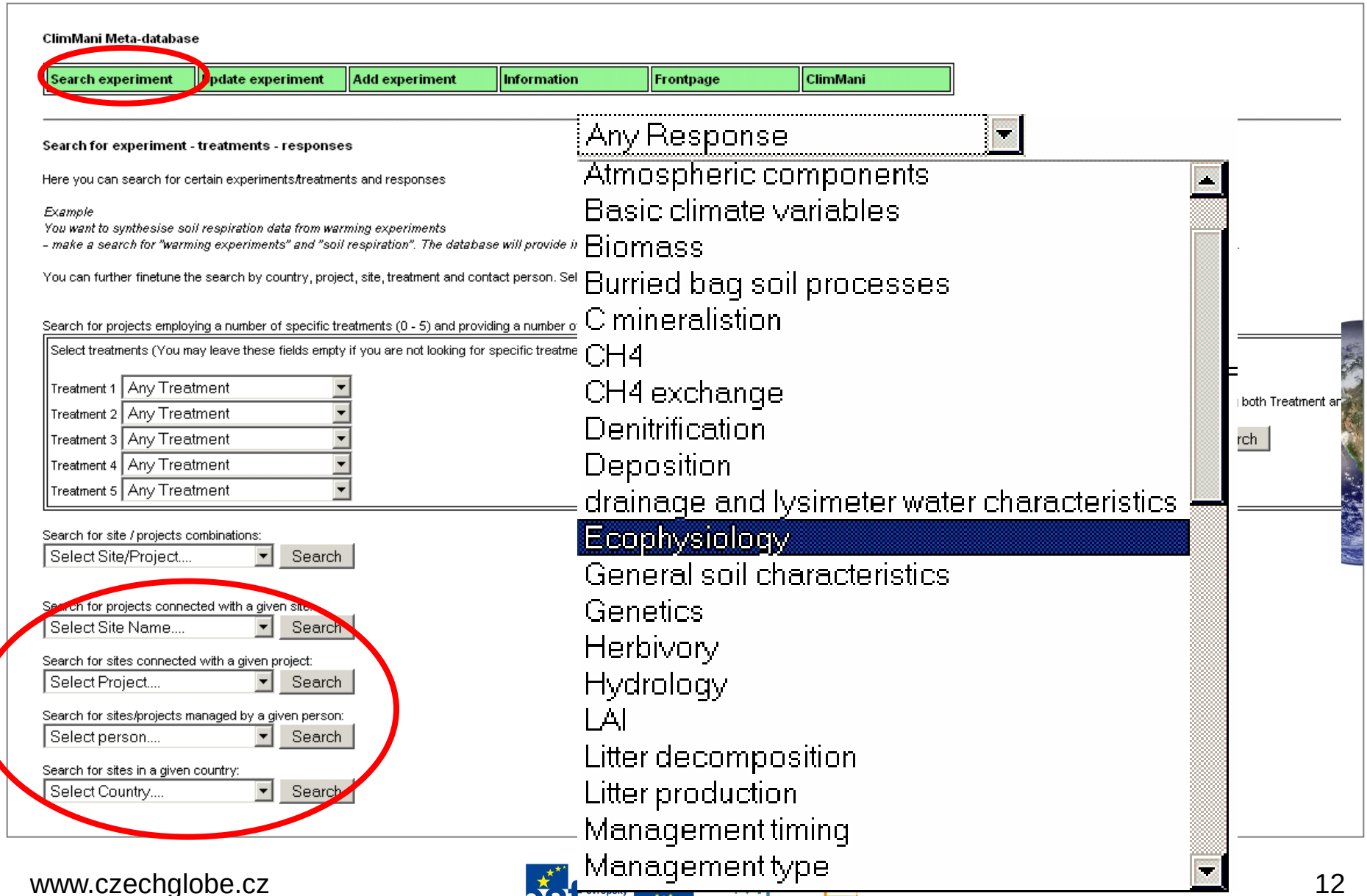


2. Climmani – database of manipulative experiments



INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

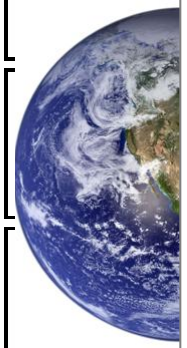
2. Climmani – database of manipulative experiments



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
Antwe			
Furka			
Eschik			
Davos			
Basel			
Hofste			
Stillber			
Swiss			
Birmer			
Besky			
ILE			
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

Site name	Project name
Brandbjerg	CLIMAITE
Flakaliden	Flakaliden
Risdalsheia	CLIMEX



3. Examples of various types of experiments from Europe

ClimMani Meta-database

Search experiment	Update experiment	Add experiment	Information

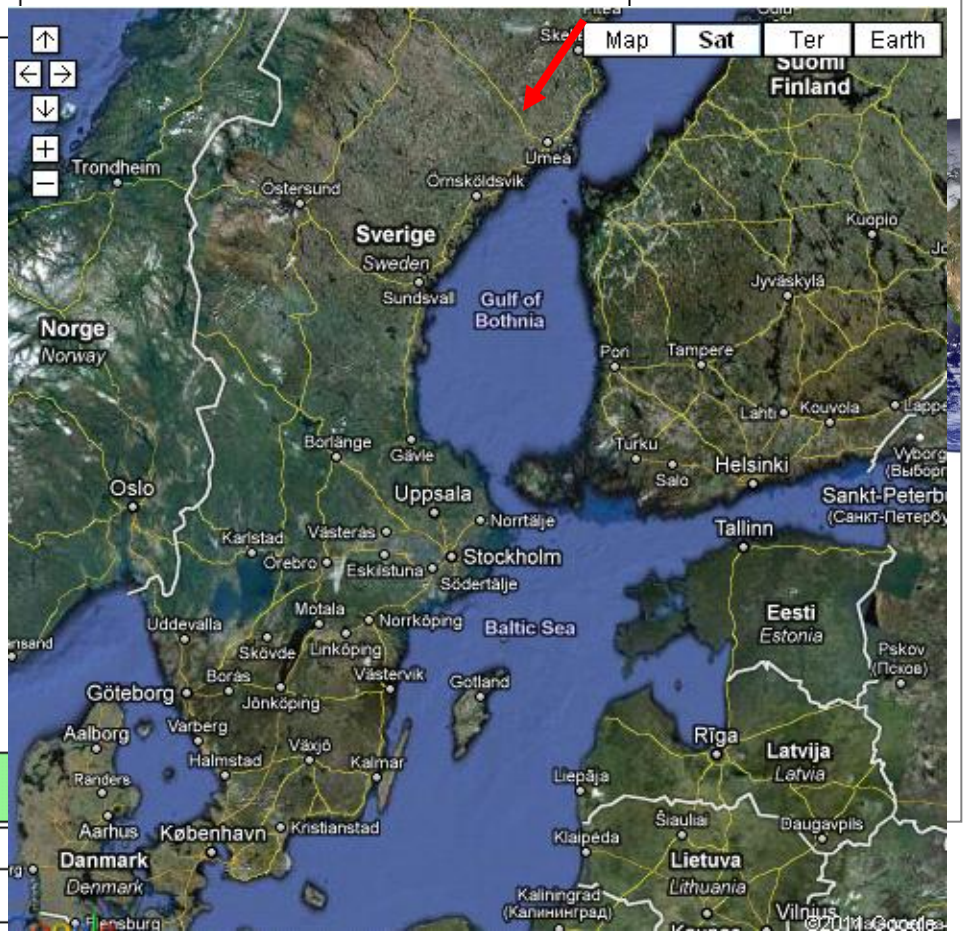
Flakaliden, Sweden (S. Linder)

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

Flakalid

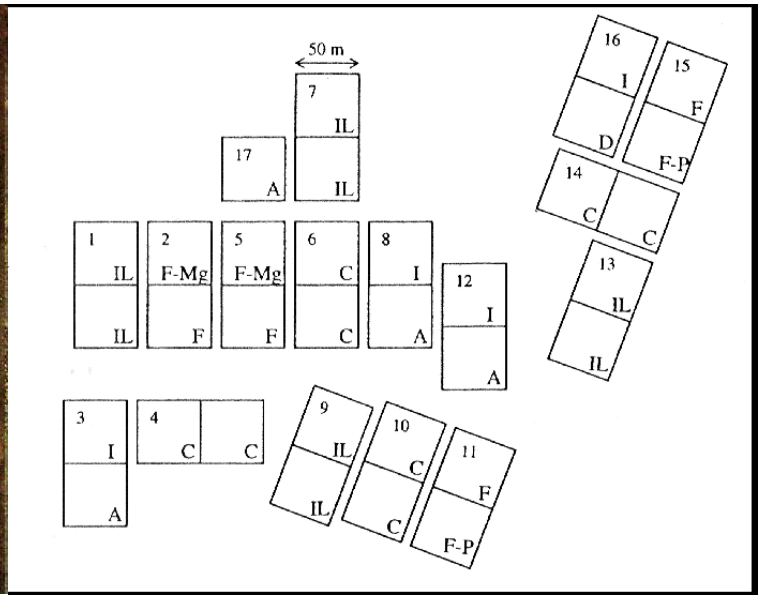
Experiment c

(Photo 1996)

www.czechglo

3. Examples of various types of experiments from Europe

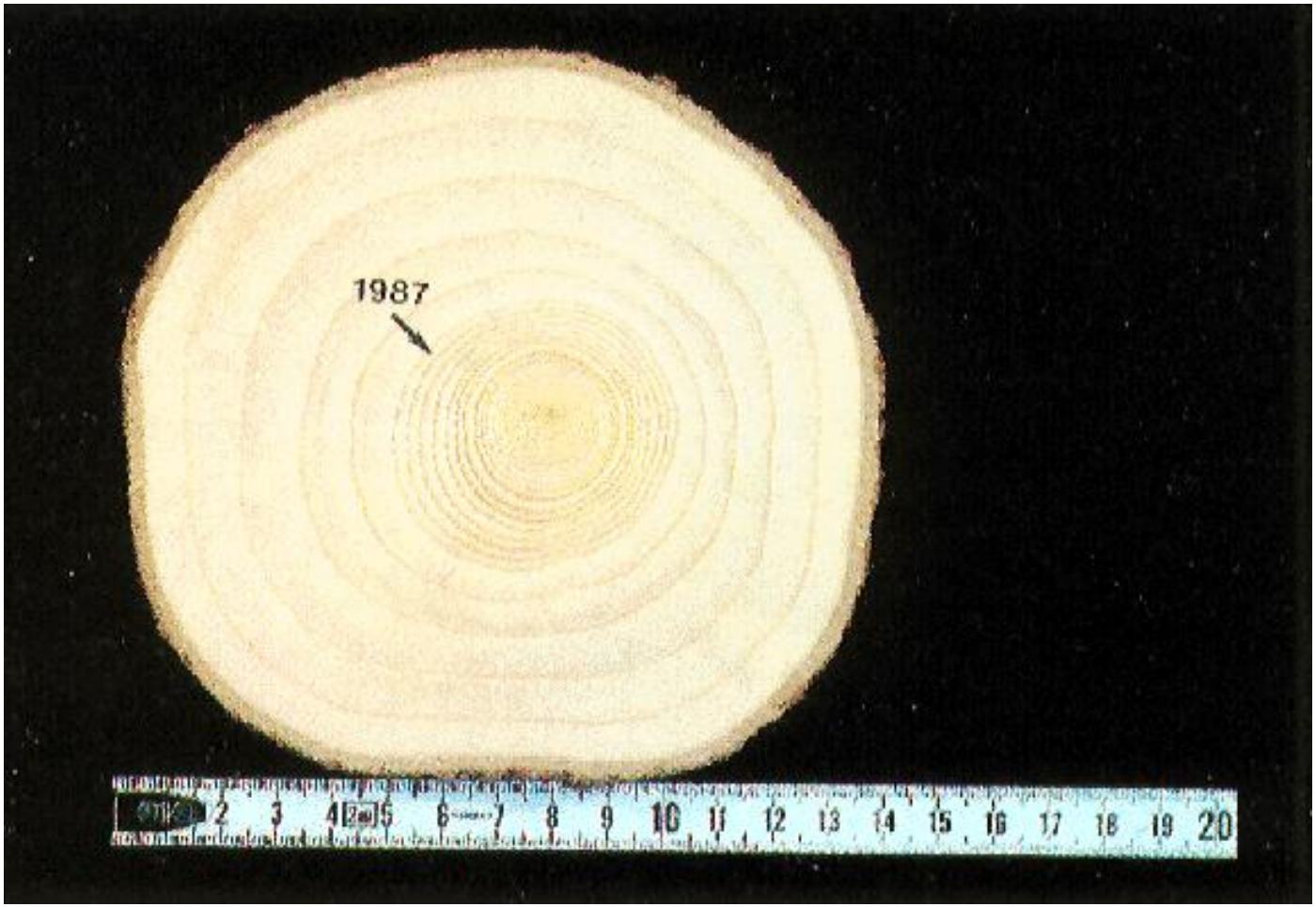
4 years after the establishing of the experiment
(fertilized areas are darker, photo 1990)



Schematic design: control plots (C), irrigated plots (I), fertlized plots (F), irrigated and fertilized plots (IL) (n = 4).
Other experimental plots:
Fertlized 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.

3. Examples of various types of experiments from Europe



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)

Search experiment	Update experiment	Add experiment	Information	Frontp

Site name	Project name	Country	Location	Altitude
Garraf	CLIMOOR-VULCAN	SPAIN	41.18N, 1.49E	210

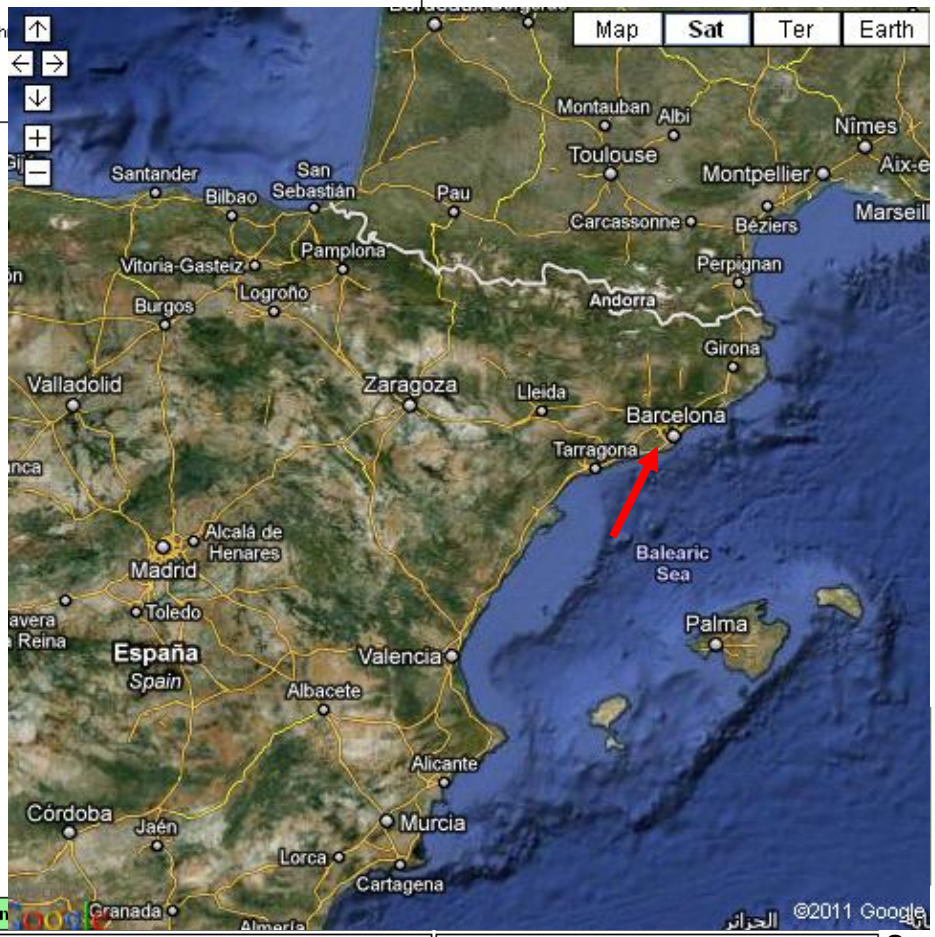
Site Description	Project Description	Landuse
MAT: 15.6; MAP: 580; N deposition 0.5 gN/m2/yr; Soil: Petrocalcic Calcixerepts 3.1 kgC/m2; vegetation: Erica multiflora, Globularia alypum	Project to investigate ecosystem responses (productivity, biogeochemical cycling, species change) to realistic changes 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
Phenlogy	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	In		
Josep Penuelas	josep.penuelas@uab.cat	CREAF	Universitat Autònoma de Barcelona Edifici C 08193 BELLATERRA (Barcelona) SPAIN www.creaf.uab.es	
Additional Persons:				

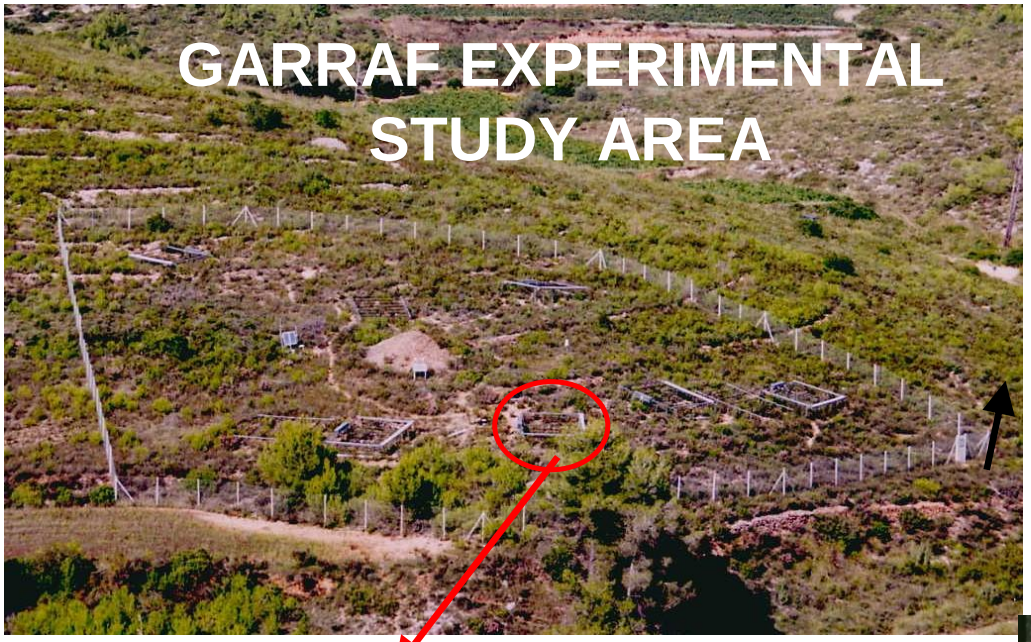


3. Examples of various types of experiments from Europe

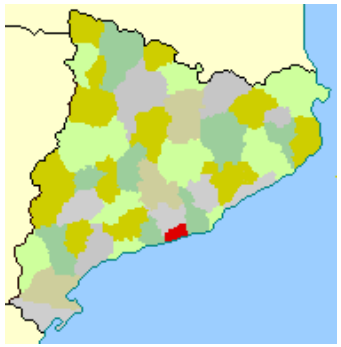
Garraf, Spain

Experiment on the effects of increased temperature

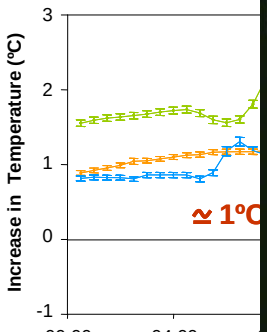
3. Examples of various types of experiments from Europe



Shrubland



· 3 Control plots
· 3 Warming treatment plots



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

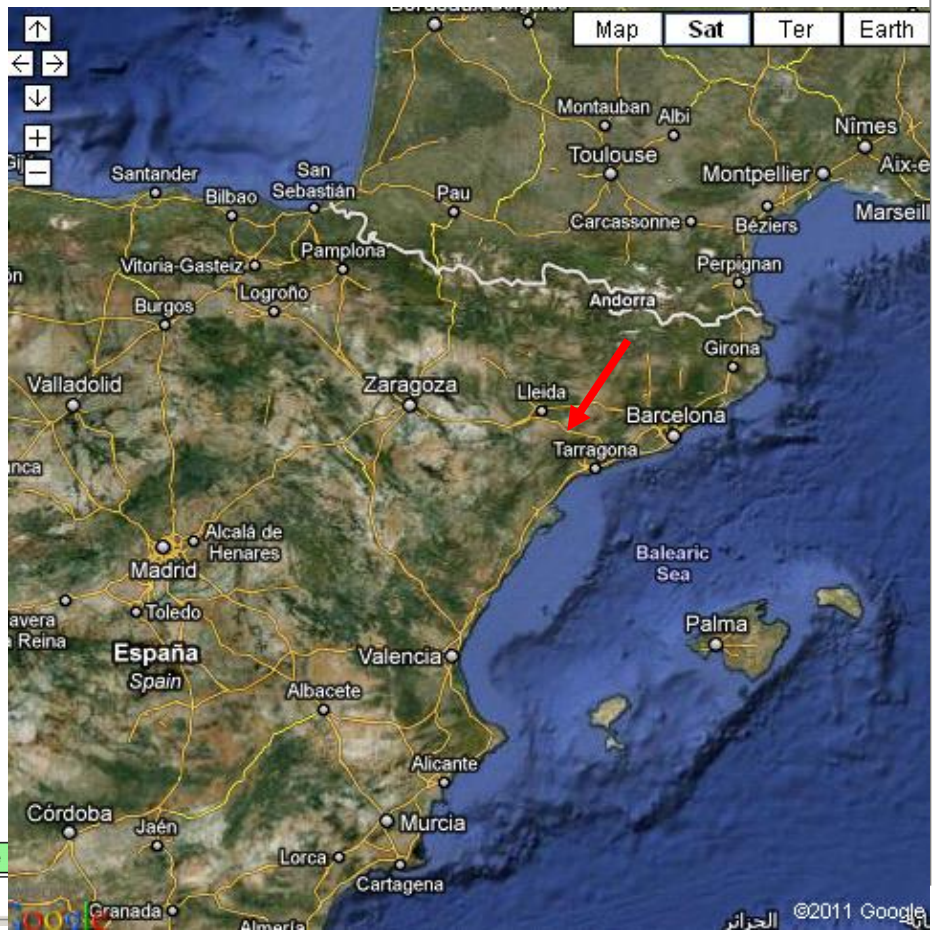
Site name	Project name	Country	Location	Altitude
Prades	Prades	SPAIN	1	950

Site Description	Project Description	Landuse	
Mediterranean evergreen forest	Experimental drought simulating future water availability for Mediterranean forests induced by climate change	Not Yet Assigned	Not assigned, select a Landuse from the list to assign it to a site

Treatments
Control
Water removal

Response name	response type
Biomass	plant
Ecophysiology	plant
LAI	plant
Litter production	plant
Phenlogy	plant
Plant chemistry	plant
Species composition	plant
Basic climate variables	site
General soil characteristics	site
Plant productivity	site
Plant species composition	site
Soil respiration	site
Microbial genetics	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/experimetal_sites.htm

Person name	Contact detail	Institute
Josep Penuelas	josep.penuelas@uab.cat	CREAF



3. Examples of various types of experiments from Europe

Prades (Mediterranean forest, Spain)

Experiment on the effects of drought

3. Examples of various types of experiments from Europe

Acta Physiol Plant (2010) 32:387–394
DOI 10.1007/s11738-009-0416-y

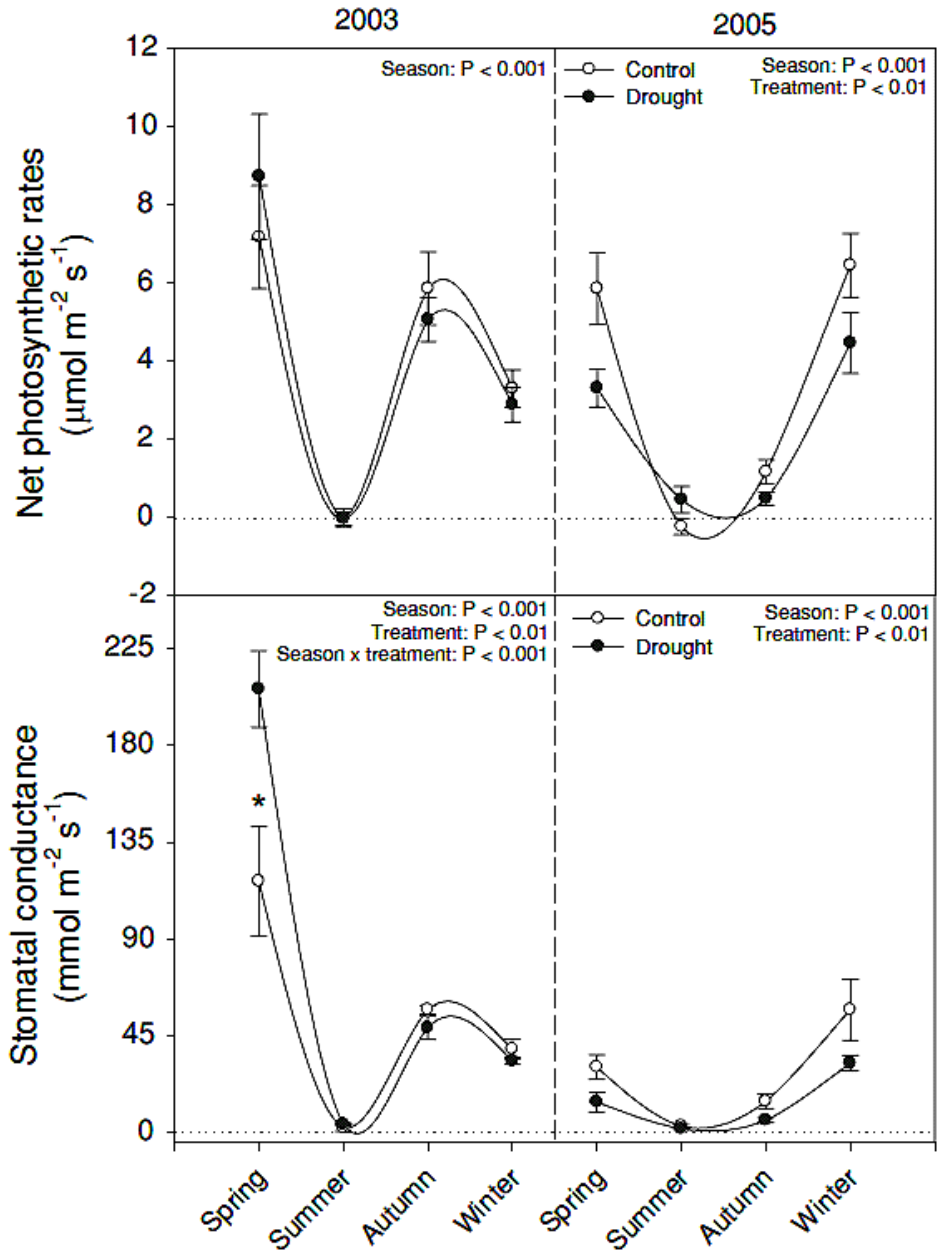
ORIGINAL PAPER

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 Llusià · Josep Peñuelas ·
Giorgio Alessio

Received: 5 October 2009 / Revised: 8

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

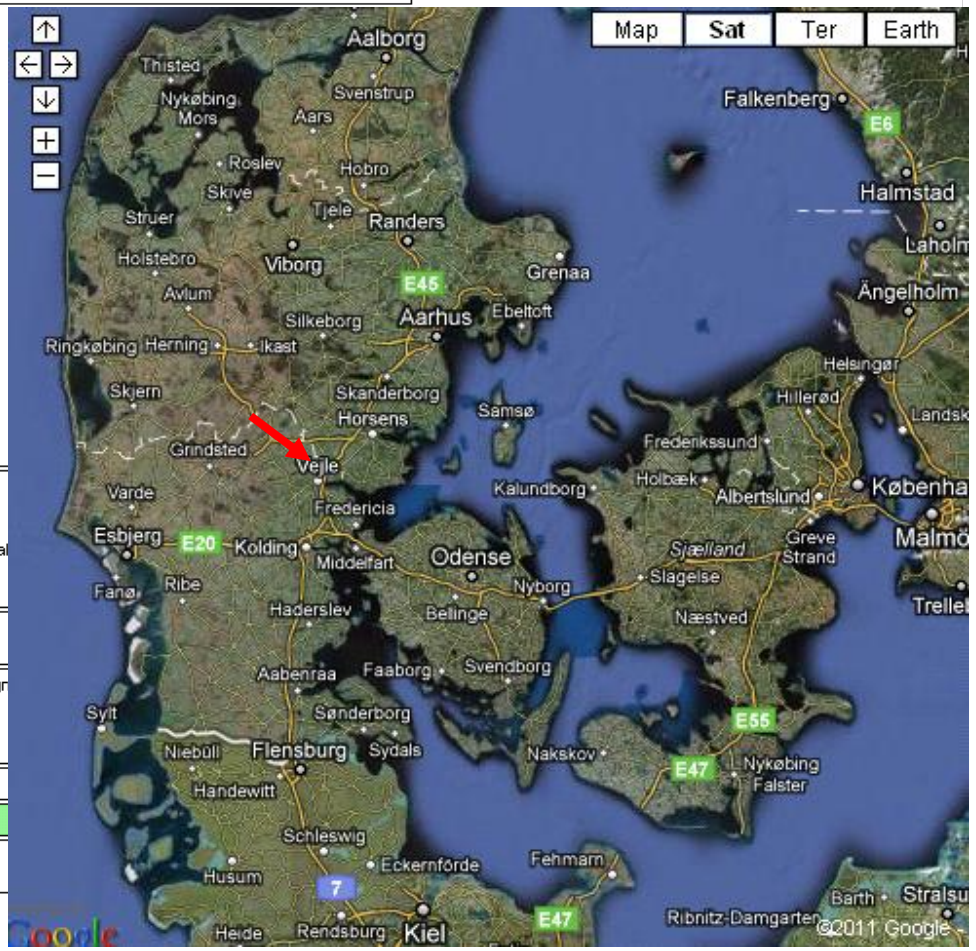
Site name	Project name	Country	Location	Altitude
Brandbjerg	CLIMAITE	DENMARK	55.53N 11.58E	25

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
Phenlogy	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)	



3. Examples of various types of experiments from Europe

Brandbjerg, Denmark

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

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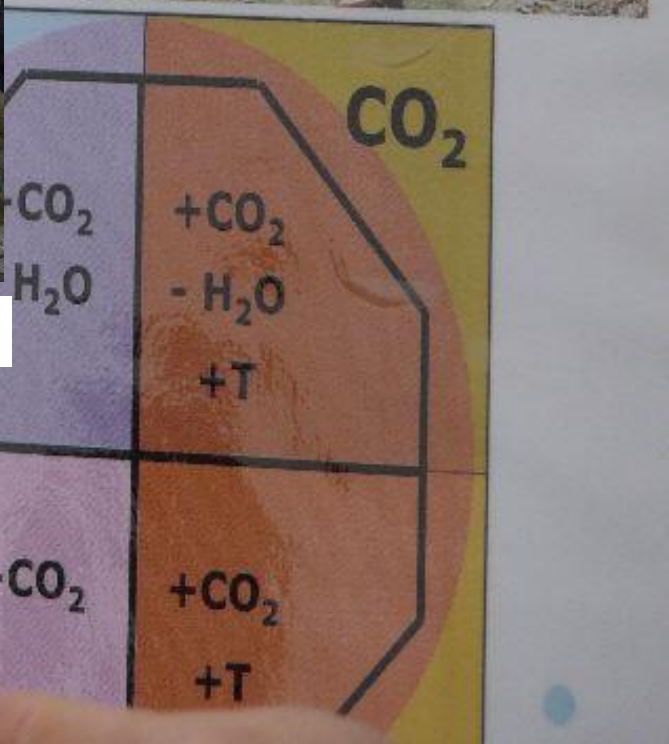
3. Examples of various types of experiments from Europe



Shielding of precipitation (blind)

ared radiation during the night)

www.czechglobe.cz

3. Examples of various types of experiments from Europe

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 CO_2, 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 HOLMSTRUPS, ANDREAS IBROM*, JANE KONGSTAD‡, LEON VAN DER ANDERS MICHELSEN†, TEIS N. M HELGE RO-POULSEN†, INGER K. KAREN STEVNBAK†

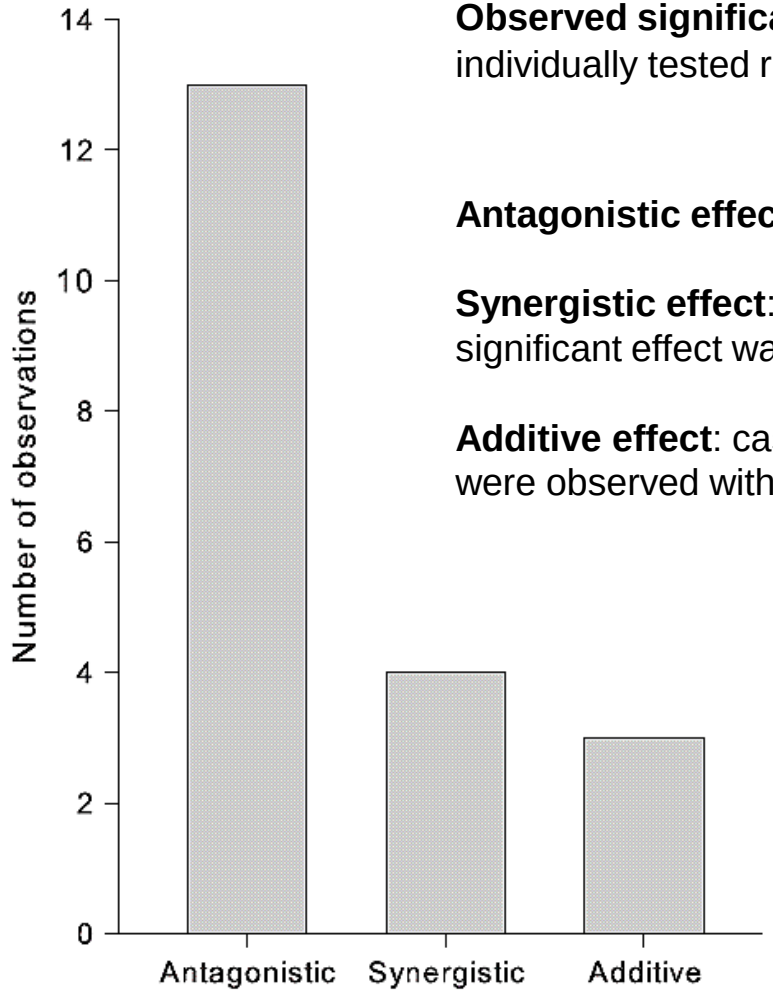
*Risø DTU, Biosystems Division, Technical Univer of Biology, University of Copenhagen, Øster Farim University of Copenhagen, Hørsholm Kongevej 11, Environmental Research Institute, Aarhus Univers

Abstract

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

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

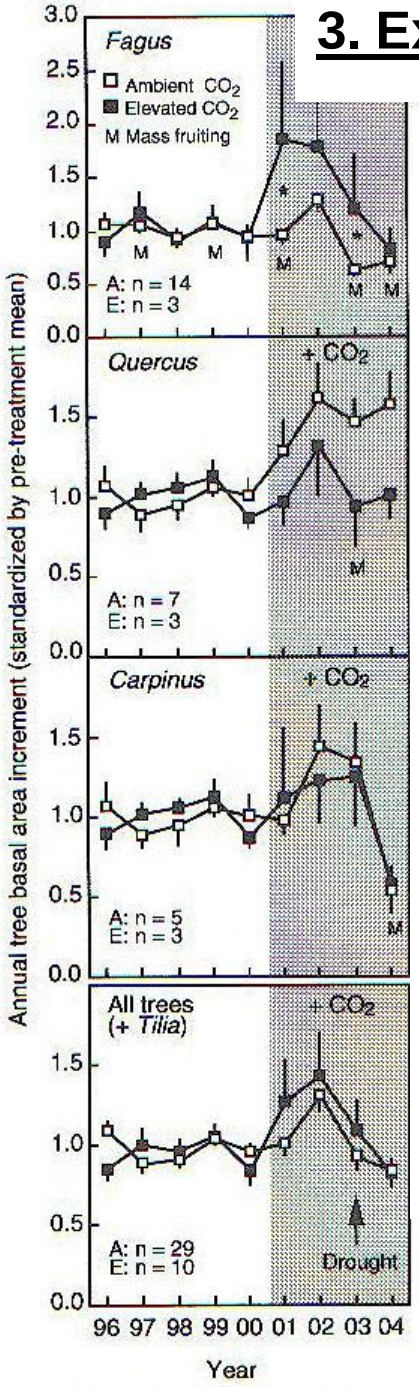
Basel, Switzerland (Swiss Canopy Crane)

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.c	
Additional Persons:		

3. Examples of various types of experiments from Europe

3. Examples of various types of experiments from Europe



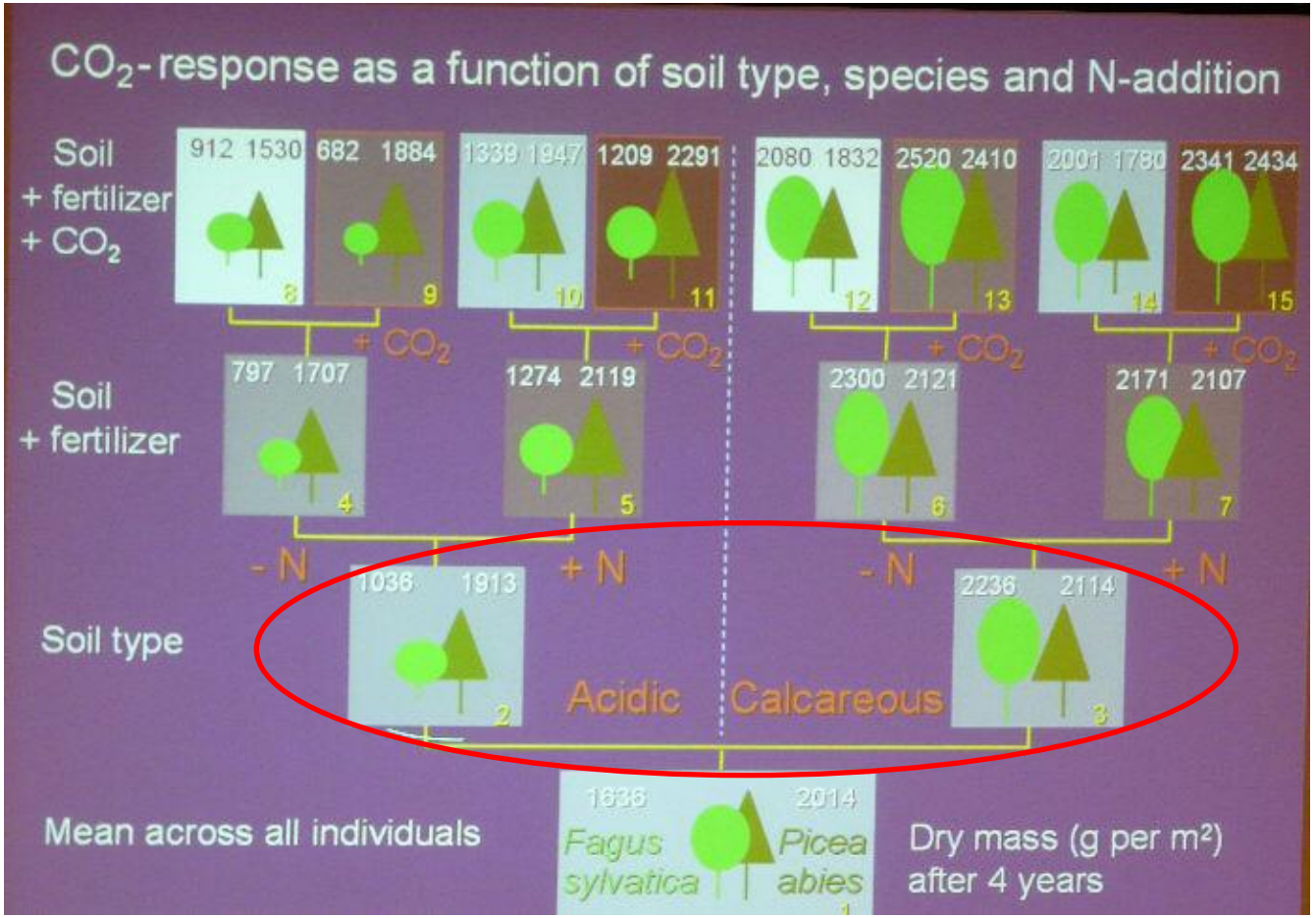
Carbon Flux and Growth in Mature Deciduous Forest Trees Exposed to Elevated CO_2

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 Zotz[1]

Whether rising atmospheric carbon dioxide (CO_2) concentrations will cause forests to grow faster and store more carbon is an open question. Using free air CO_2 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 CO_2. 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 CO_2, thus challenging projections of growth responses derived from tests with smaller trees.

3. Examples of various types of experiments from Europe

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

Search experiment	Update experiment	Add experiment	Information	Frontpage

Risdalsheia, Norway (CLIMEX, 1994-2000)

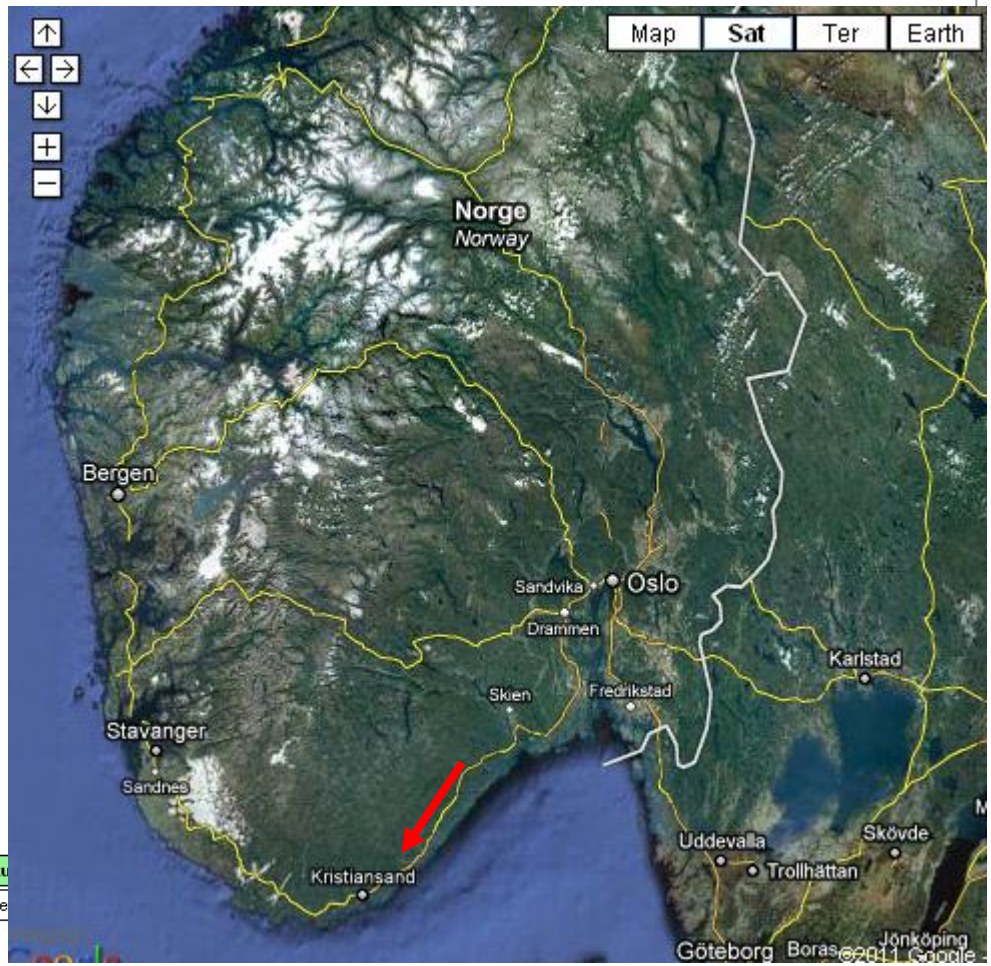
Site name	Project name	Country	Location	Altitude
Risdalsheia	CLIMEX	NORWAY	58.23N, 8.19E	300

Site Description	Project Description	Landuse
1	0	Forest

Treatments
CO2 increase
Control
Temperature

Response name	response type
Biomass	plant
Litter production	plant
Phenlogy	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 mineralistion	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:		

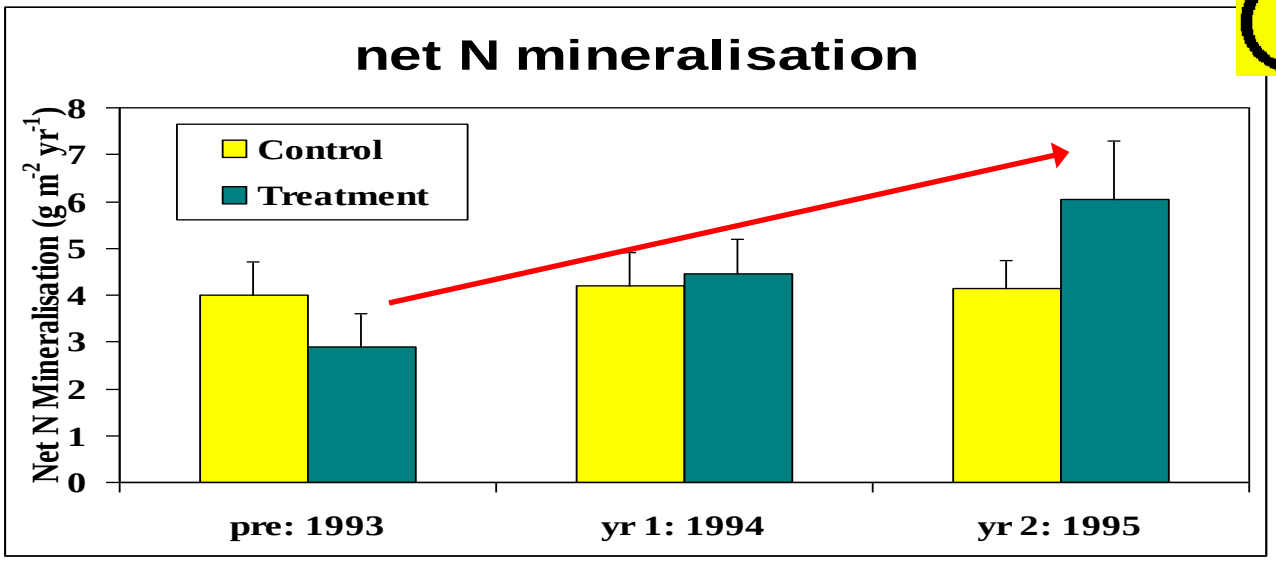


3. Examples of various types of experiments from Europe

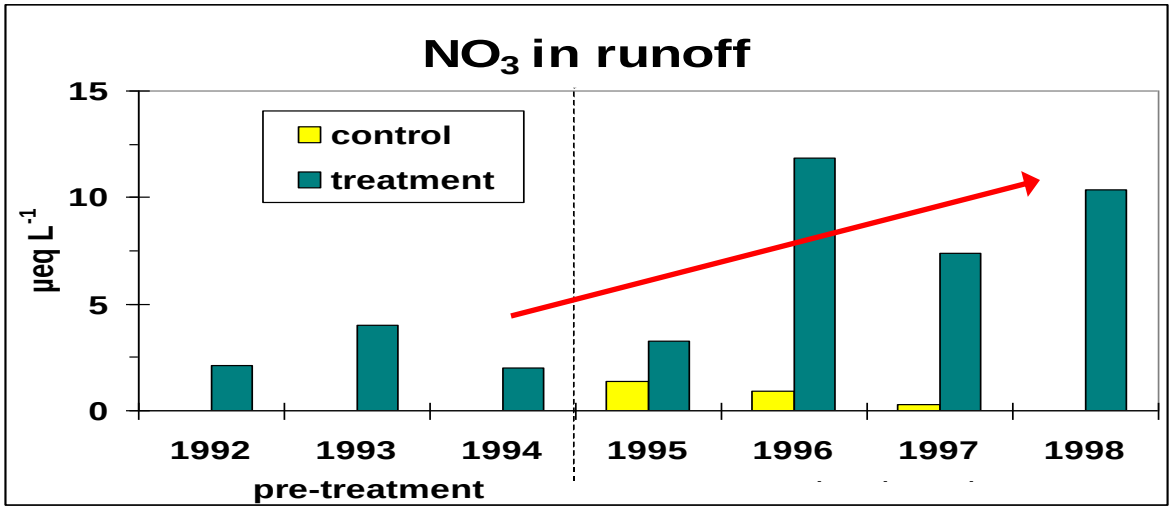
Experiment on the effect of increased CO2 (560 ppm)
in combination with increased temperature (+3,5 ºC)
- at the ecosystem level (1000 m²)

3. Examples of various types of experiments from Europe

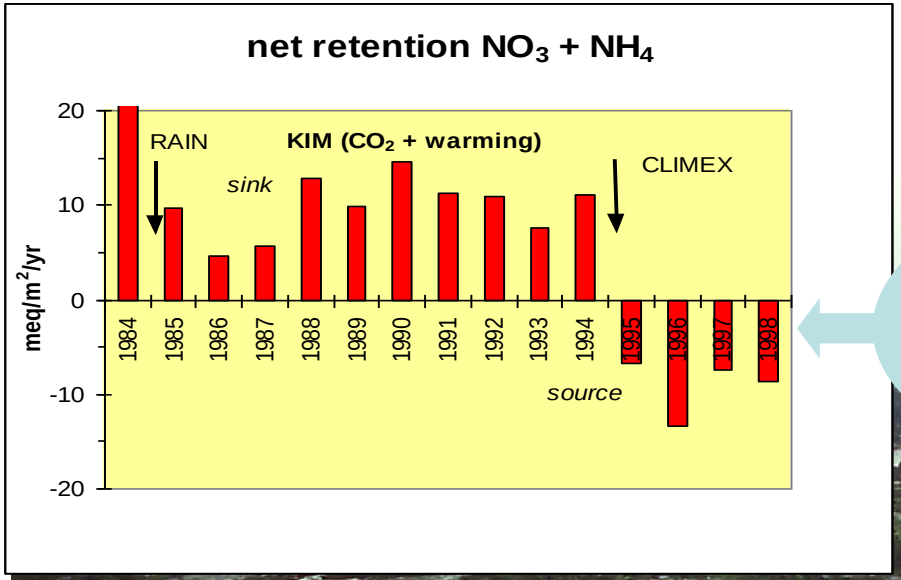
CLIMEX



3. Examples of various types of experiments from Europe

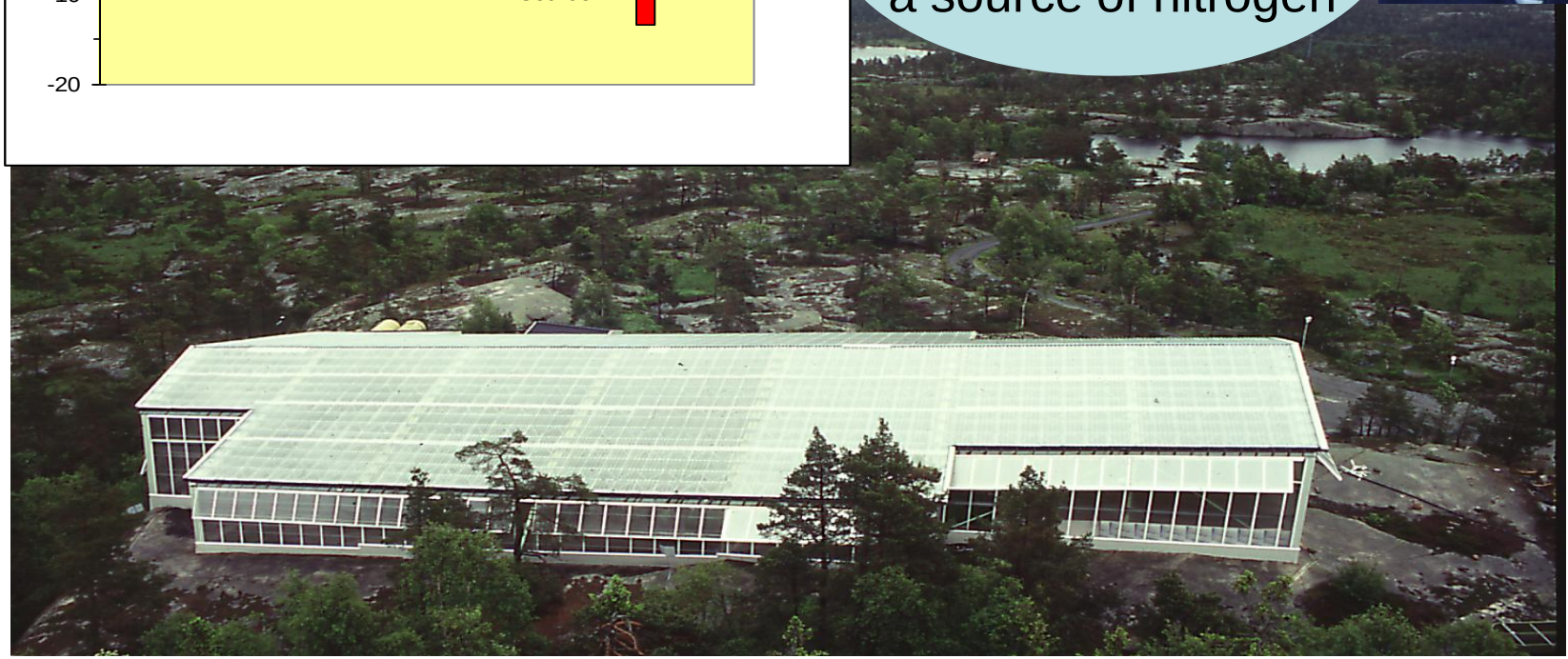


3. Examples of various types of experiments from Europe



Richard Wright
(coordinator)

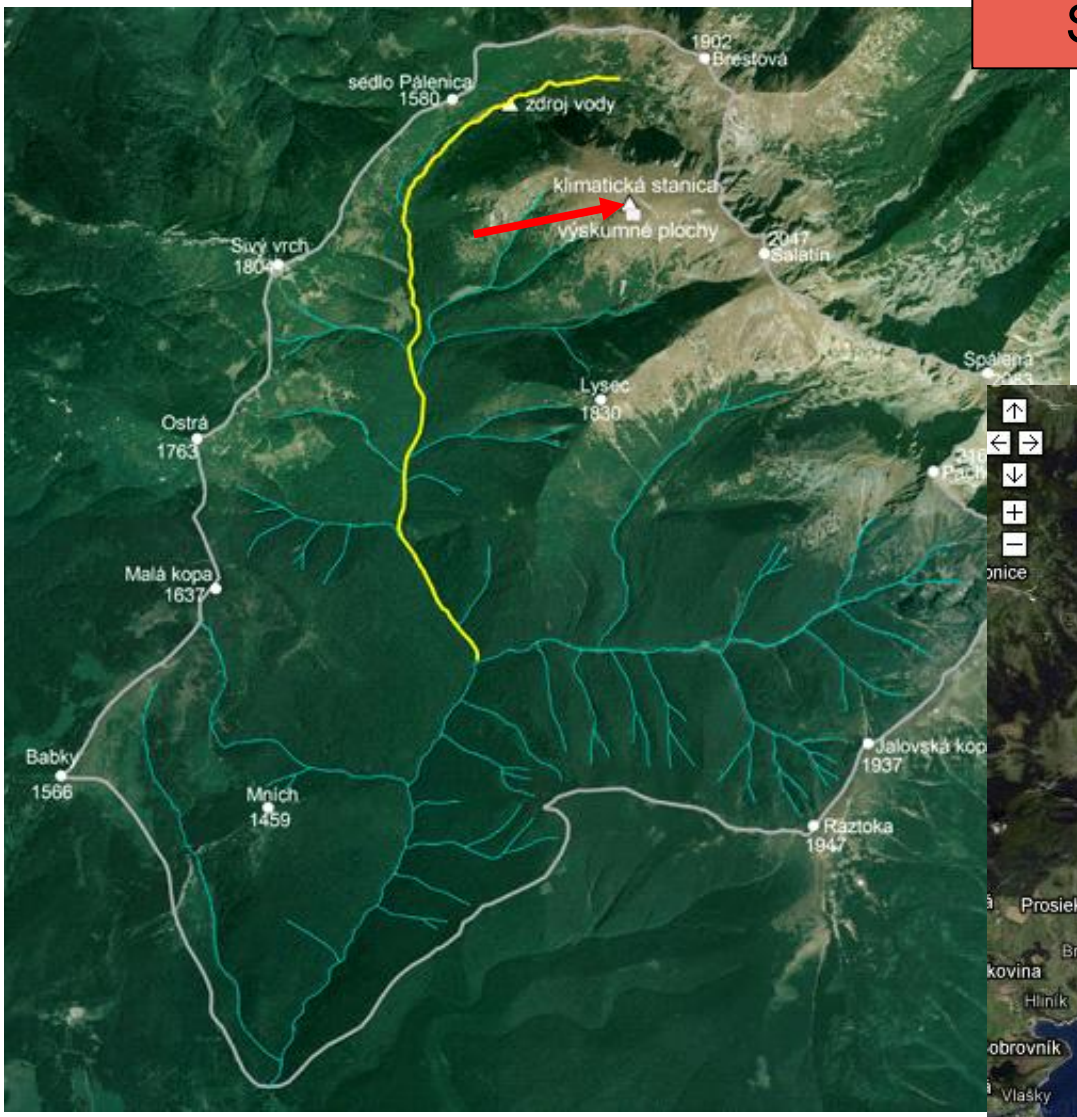
The ecosystem
is becoming
a source of nitrogen



(Van Breemen et al. 2001 Ecosystems)

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

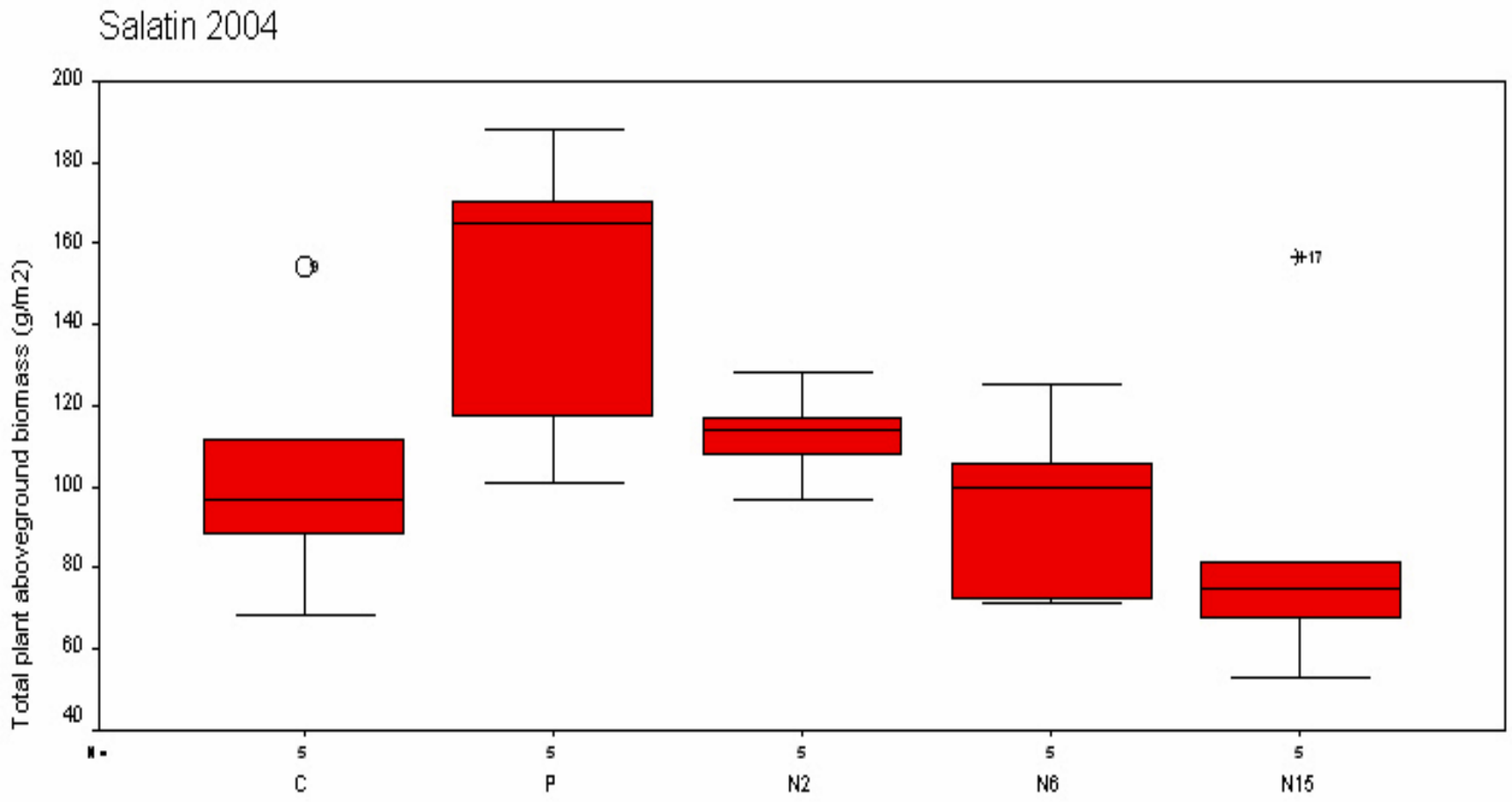
Treatments:
N2 (2 g N m^{-2} $year^{-1}$)
N6, N15,
P (5 g P m^{-2} $year^{-1}$),
K (control)

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

3. Examples of various types of experiments from Europe

Salatín, Slovakia

Experiment on the effects of nitrogen deposition on alpine grass vegetation



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OP Vzdělávání pro konkurenceschopnost
INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

3. Examples of various types of experiments from Europe

Luboš Halada – Coordinator of the project

4. Examples of manipulative experiments from CR

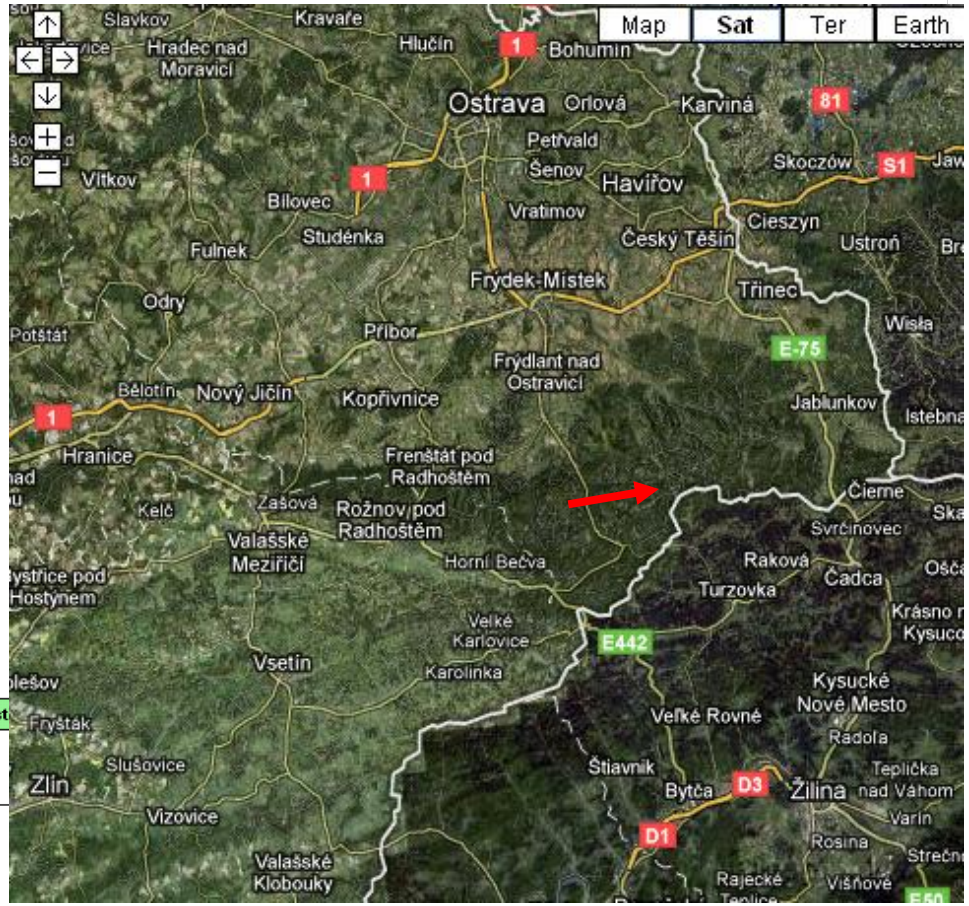
Search experiment	Update experiment	Add experiment	Information	Frontpage	ClimMani

Site name	Project name	Country	Location	Altitude
ILE	ECOCRAFT	CZECH REPUBLIC	49.30N, 18.32E	908
Site Description	**Project Description**	**Landuse**		
Bílý Kříž (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 MV, Kalina J, Matouskova 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:		



www.czechglobe.cz

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 lanscape carbon sinks in the context of global change (2007-2011)

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

EUROFACE - An integrated European scientific infrastructure for GC studieson 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)

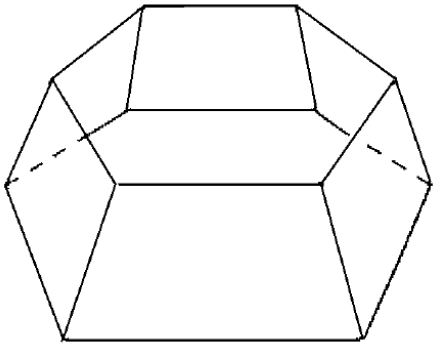
ECOCRAFT II - (1996-1999)

Another national projects

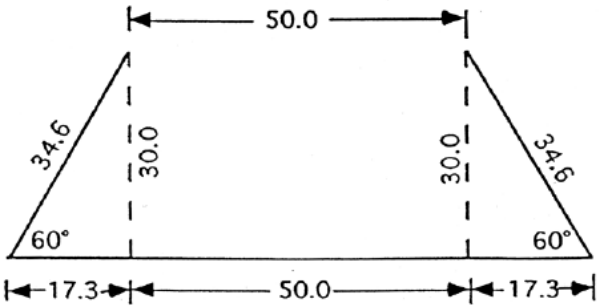
4. Examples of manipulative experiments from CR

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*)



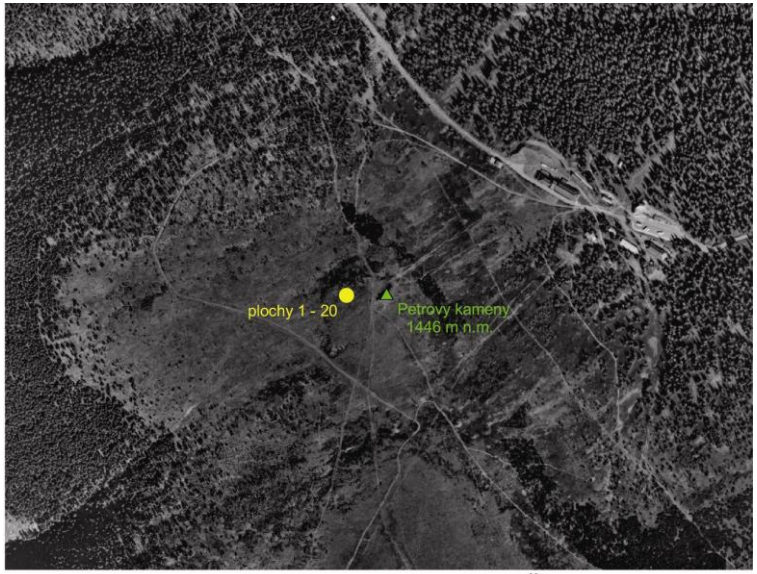
hexagonal OTC´s
according ITEX (Molau *et* Mølgaard 1996).



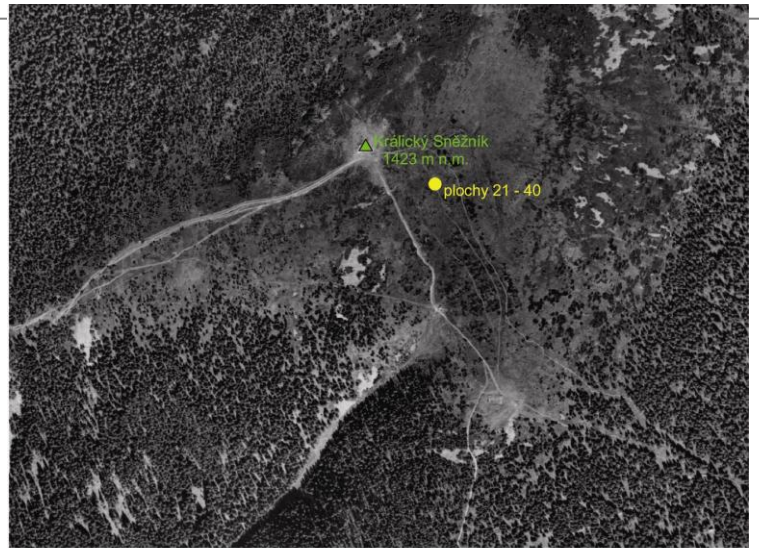
increase of the temperature by 1-3 °C
(Henry and Molau 1997).

4. Examples of manipulative experiments from CR

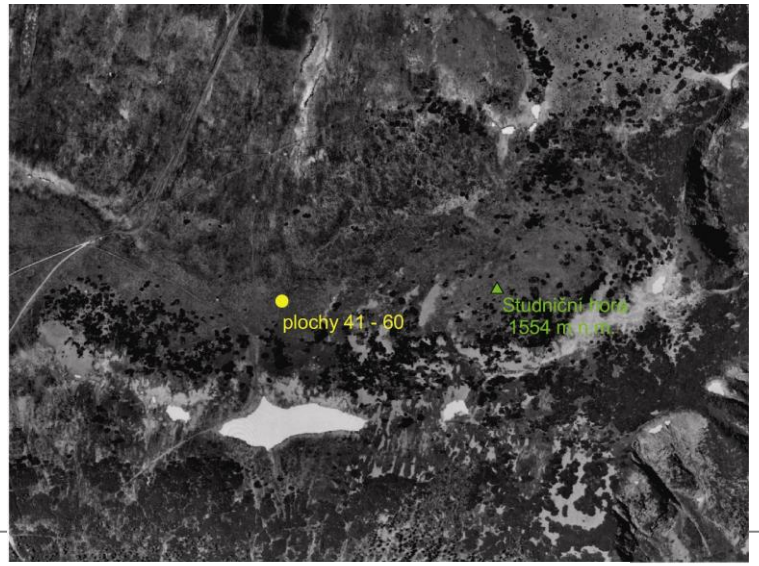
Localities:



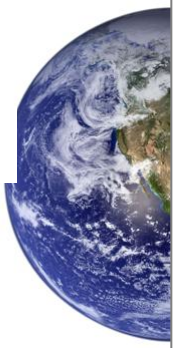
(1) Petrovy Kameny (Jeseníky)



(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 g N m^{-2} $year^{-1}$ - 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*)

wet meadow

mountain meadow

dry grassland

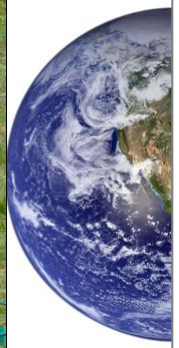
4. Examples of manipulative experiments from CR

elevation gradient

Lowland site:

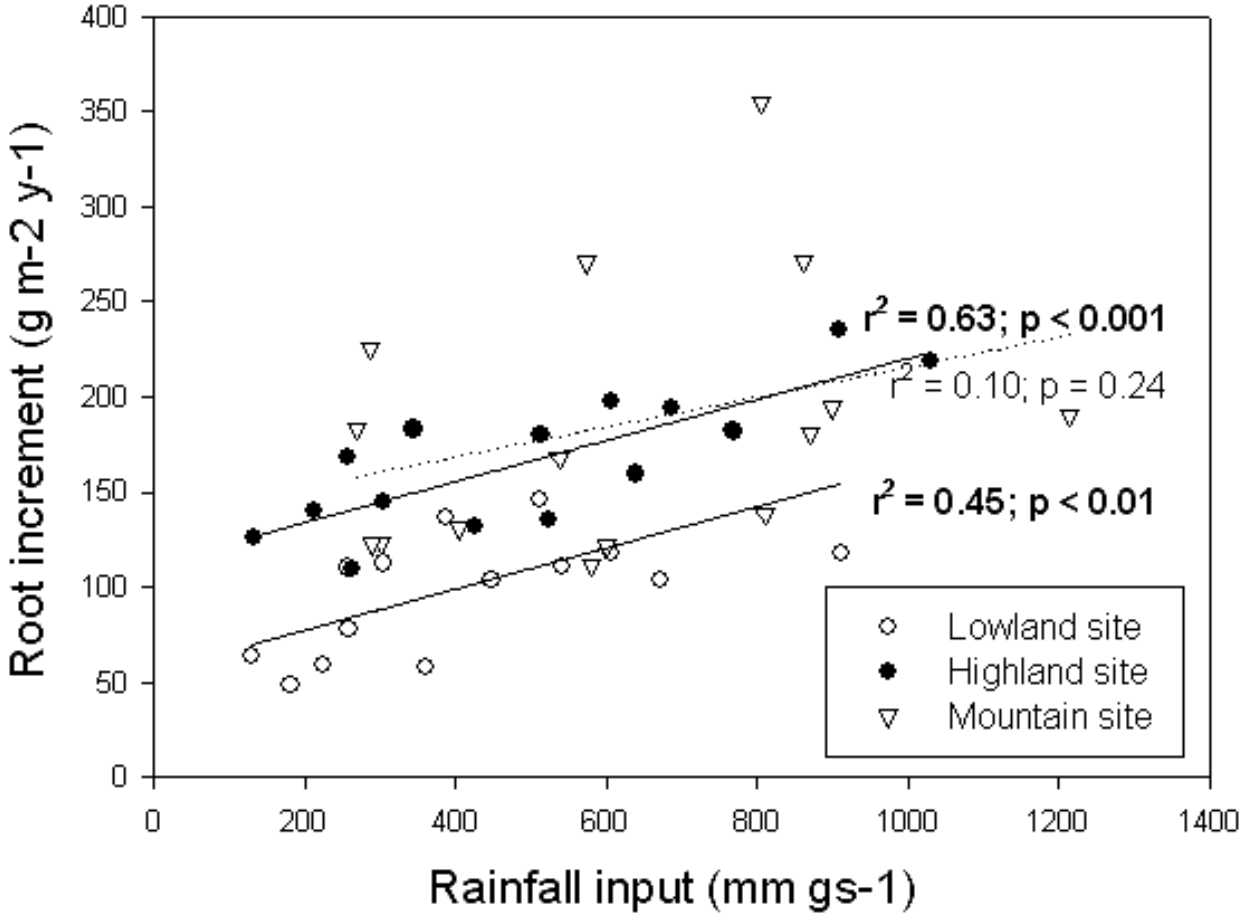
Highland site:

Mountain site:



precipitation gradient

4. Examples of manipulative experiments from CR



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.

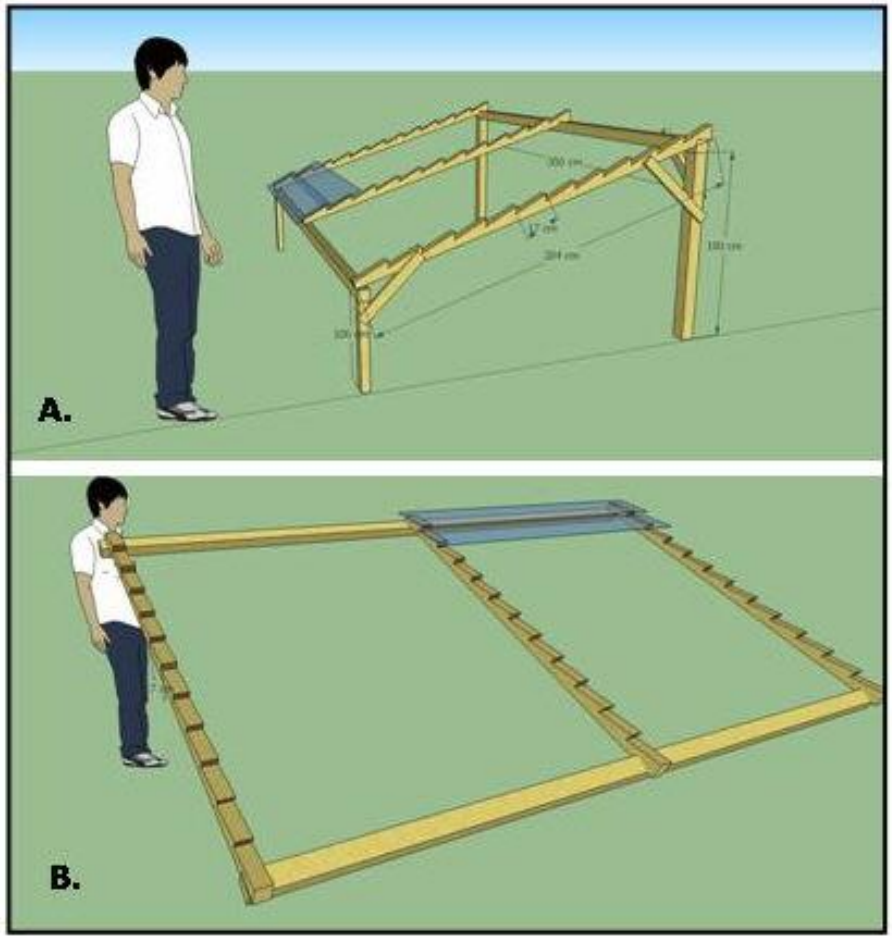
Design of the experiment:

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

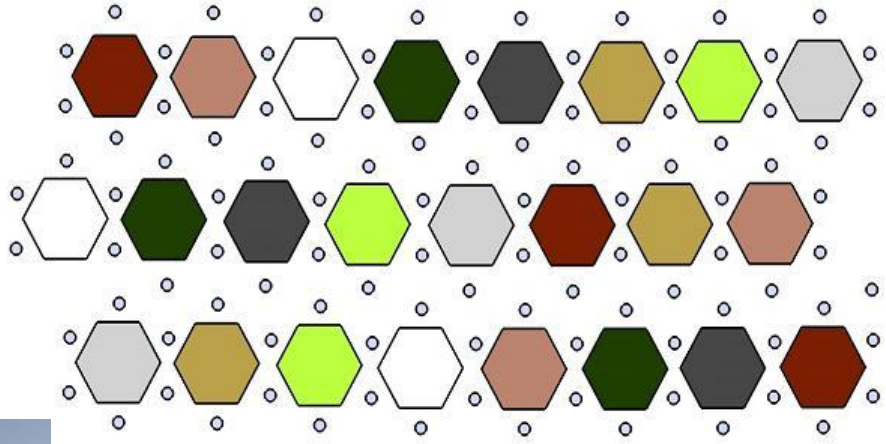
drought treatment for 4-6 weeks

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



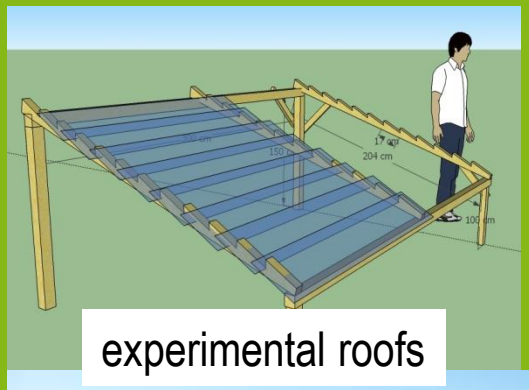
	elevated CO2		nitrogen		drought	
treatment	-	+	-	+	-	+
1 (---)	✓		✓		✓	
2 (+++)		✓		✓		✓
3 (--+)	✓		✓			✓
4 (-+-)	✓			✓	✓	
5 (+--)		✓	✓		✓	
6 (-++)	✓			✓		✓
7 (++-)		✓		✓	✓	
8 (+-+)		✓	✓			✓

5. Options for the future

Environmental factors in the global climatic changes and their interaction

drought stress **X** elevated CO_2,ozone, temperature **X** N, P - depozitions **X** UV radiation, light intenzity and quality

Manipulative experiments



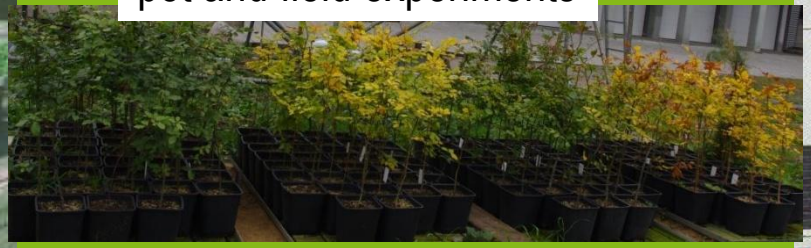
experimental roofs

„glass domes“

units with modulated UV

open-top chambers

pot and field experiments



growth chambers

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5.2.2014
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Thank you for your attention…

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2007–13

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