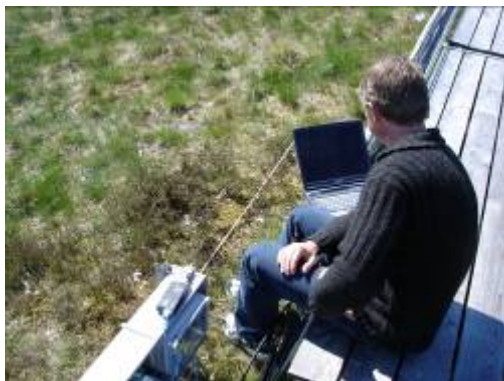


The VKR center of excellence



Midterm report  
November 2006

## Appendices



# Appendices

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2. Meetings, activities and science meeting participation
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## 1 - Publications, posters and presentations

### Scientific publications

Beier, C. (2004) Interactions of elevated CO<sub>2</sub> and temperature on terrestrial ecosystem structure and functioning – the role of whole-ecosystem manipulation experiments. *New Phytologist*, 162, 243-245.

Andresen, L. C. & Michelsen, A. (2005) Off-season uptake of nitrogen in temperate heath vegetation. *Oecologia* 144; 585 - 597.

Maraldo K, Christensen B, Strandberg B, Holmstrup M (2006) Effects of copper on enchytraeids in the field under differing soil moisture regimes. *Environmental Toxicology and Chemistry* 25: 604-612

Bahrndorff S, Holmstrup M, Petersen H, Loeschcke V (2006) Geographic variation for climatic stress resistance traits in the springtail *Orchesella cincta*. *Journal of Insect Physiology* 52:951-959

Jana L. Heisler and Jake F. Weltzin (2006) Variability matters: towards a perspective on the influence of precipitation on terrestrial ecosystems. *New Phytologist* (in press)

Holmstrup M, Maraldo K, Krogh PH (in press) Combined effect of copper and prolonged summer drought on soil Microarthropods in the field. *Environmental Pollution*

Christensen S., Bjørnlund L., Vestergård M. (In press) Decomposer biomass in the rhizosphere to assess rhizodeposition. *Oikos* (in press).

### Scientific papers submitted

Mikkelsen, T. et al. (Submitted) CLIMAITE - a three factor climate change ecosystem manipulation study: Set up and approaches for data analysis.

Gerten, D.; Parton, B.; Lou, Y.; Wengsheng, Y.; Cramer, W.; Beier, C. and Rustad, L. (Submitted) Results from the EPRERCOT model experiment. *Glob. Chan. Biol.*

Christian Damgaard, Torben Riis-Nielsen and Inger K. Schmidt. (submitted) Modelling plant competition and community dynamics using pin-point data: a case study of *C. vulgaris* and *D. flexuosa*. *Oikos*

Maraldo, K., Schmidt, I.K., Beier, C. & Holmstrup, M. (Submitted) Effects of warming and enforced summer drought on enchytraeids in a temperate heathland. Glob. Chan. Biol.

Knapp, A.; Beier, C.; Briske, D.; Classen, A.T.; Luo, Y.; Reichstein, M.; Smith, M.; Smith, S.D.; Bell, J.E.; Heisler, J.L.; Leavitt, S.W.; Sherry, R.; Smith, B.; Weltzin, J. and Yarie, J. (In prep) Consequences of altered precipitation regimes for terrestrial ecosystems. BioScience. (To be submitted March 2007)

### Scientific papers in preparation

T. Riis-Nielsen and IK Schmidt (in prep) Non-destructive plant biomass and cover estimates from point intercept analysis - a case study of *C. vulgaris* and *D. flexuosa*

Maraldo, K. & Holmstrup, M. (In prep) Sensitivity of enchytraeids to small changes in water potential

Jane Kongstad Pedersen et al. (In prep) Growth, phenology and nutrient allocation in *D. flexuosa* and *C. vulgaris* – responses to N and P

Christensen S., Priemé . Andersen K., Rhizosphere biota structure and function as dependent on plant species.

Albert K, Mikkelsen T.N, Ro-Poulsen H., Michelsen A. et al (in prep) Effects of elevated CO<sub>2</sub>, drought and temperature on the photosynthetic performance of *C. vulgaris* and *D. flexuosa*.

Albert K, Mikkelsen T.N, Ro-Poulsen H., Michelsen A. et al (in prep) Seasonal variation in photosynthesis, transpiration, maximum quantum yield and water potential in *C. vulgaris* and *D. flexuosa* exposed to elevated CO<sub>2</sub>, drought and temperature.

Andresen L. C., Ström, L., Jonasson, S., Michelsen, A. (in prep) Tracing *in situ* amino acid uptake in plants and microbes with <sup>15</sup>N <sup>13</sup>C labelled compounds.

Andresen, L. C., Rinnan, R., Ström, L. (in prep) Low molecular organic acids in heathland soil serve as substrate by microbial biomass.

### Other publications

Ryde, M (2004) Forskningen skal ud - og ses. Artikel om CLIMAITE og formidling. (in Danish). Riposten, 4, 14-15.

Andresen, L. C. & Michelsen, A. (2004) Optager hedeplanter kvælstof om vinteren, og vokser de? (In Danish) URT 28 4; 122 - 125.

Beier, C. and Jonasson, S. (2005) Et glimt af fremtiden (In Danish). Villum Kann Rasmussen årsskrift. P. 5-11.

Andersen, K. (2005) Tidsmaskine skal afsløre klimaeffekter (in Danish). MiljøDanmark, 6, p. 8-9.

Beier, C. (2006) Klimaforandringer vil ændre nedbøren (In Danish). Politiken, Sunday 12/10 - 2006 .

Beier, C. (ed.) (2006) Eprecot – Effects of precipitation changes on terrestrial ecosystems. Brochure for policy makers based on findings from the Eprecot workshop, May 2006, 12 pp.

Beier et al. (Submitted) Klimaforandringer påvirker de biologiske processer i naturen. CLIMAITE – centret skal hjælpe os med at forstå hvordan (In Danish). Jord & Vand

Kristian Albert: The Biological Time machine – Biological responses to multiple environmental and climatic changes. Presentation at Environment and Stress Symposium November 2006, KVL.

### **Oral presentations**

Beier, C. (2004) Research centre on biological effects of Climate Change. Scientific Friday seminar, Risø, 23<sup>rd</sup> April, 2004.

Martin Holmstrup: Methods to assess multiple environmental risks. Use of soil invertebrates. EU Workshop om interaktioner mellem klima og forurening, Mallorca, 8-12 november, 2004

Inger K Schmidt: CLIMAITE – et nyt dansk forskningsprojekt vedr. klimaforandringer. Foredrag, Skov & Landskab, KVL, 10. december 2004.

Teis N. Mikkelsen: Nationalt global change forsknings initiativ: CLIMAITE. Geografisk Institut, Københavns Universitet. (januar 05).

Søren Christensen: CLIMAITE – a Danish multifactor climate change experiments. Presentation at “Monitoring the effects of climate change, development of a future national initiative” arranged by Richard Bradshaw, (GEUS, København 13 og 20 januar 2005)

Beier, C. (2005) Effects of climate change on terrestrial ecosystems studied by field scale manipulation experiments. Foredrag ved 7th International Conference on Acid Deposition Acid Rain 2005, Prague, Tjekkiet, 12–17 June 2005

Beier, C. (2005) Field scale climate change experiments - what about biodiversity? Foredrag ved 2nd BIORHIZ symposium: ‘Rhizosphere Impact on Plant Communities - The Soil Biodiversity Conservation Perspective’ og 4th CONSIDER project workshop: ‘Global Climate Change and Soil Biodiversity’, Reading, 24. August 2005.

Andresen L. C., Michelsen A., Jonasson S., Ambus P., Beier C. CLIMAITE – Climate change effects on soil processes. 9th European Heathland Workshop. Oral presentation and abstract. Belgium, 13th – 17th September 2005.

Beier C. (2005) Vulnerability of European shrublands to climate change. Lecture at AVEC summerschool, Peyresque, France, 20 september 2005

Teis N. Mikkelsen: CLIMAITE – et nyt dansk forskningsprojekt. Åbent studiekreds arrangement – Orø beboerforening, Orø. (oktober 05).

Beier C. (2005) CLIMAITE – a project on climate change effects on biological processes in terrestrial ecosystems. NoNaKlim symposium “Conservation of Nordic Nature in a Changing Climate”, København, 14 oktober 2005

Merete Bang Petersen, CLIMAITE: Ecosystem-atmosphere exchange of carbon in a heath land under future climatic conditions. PhD Workshop: Hvordan formidler du din forskning? 27.– 29. januar 2006

Merete Bang Petersen, CLIMAITE: Ecosystem-atmosphere exchange of carbon in a heath land under future climatic conditions. Seminar at Risø National Laboratory, Biosystem Department, March 2006

Merete Bang Petersen, CLIMAITE: Ecosystem-atmosphere exchange of carbon in a heath land under future climatic conditions Isotope Ecology Course, Salt Lake City, Utah: 15. juni 2006

Beier C. (2006) Vulnerability assessment for European shrublands to climate change. Lecture at AVEC summerschool, Peyresque, France, 2<sup>nd</sup> September 2006

## Posters

Beier, C. (2005) CLIMAITE – a biological time machine. Poster presentation at the 7th International Conference on Acid Deposition Acid Rain 2005 (Prague, Czech Republic, 12–17 June 2005).

Schmidt IK, Beier C. 2005. CLIMAITE – Climate change effects on biological processes in terrestrial ecosystems. 9th European Heathland Workshop, p106. Poster og abstract. Belgium, 13th – 17th September.

Albert K., Ro-Poulsen H., Mikkelsen T.N. (2006) Den biologiske tidsmaskine og planternes fysiologiske respons. Poster & abstract, Copenhagen, BIO-dagen January 2006.

Andresen L. C., Michelsen A., Jonasson S., Ström L., Tracing amino acids through plants and soil with <sup>15</sup>N <sup>13</sup>C labeled compounds. 5th international conference on applications of stable isotopes in ecology; Belfast 13. – 18. august 2006. Poster and Abstract.

Petersen, MB, Ambus, P 2006. CLIMAITE: Presentation of PhD project: Ecosystem-atmosphere exchange of carbon in a heath land under future climatic conditions. Poster & abstract, EPRECOT, Helsingør, DK, May 2006

Maraldo, K., Schmidt, I.K., Beier, C. & Holmstrup, M.: Effects of warming and enforced summer drought on enchytraeids in a temperate heathland. Poster presented at 7 th International Symposium on Enchytraeidae, Masaryk University, Brno, Czech Republic, May 25-28 2006.

Albert K., Ro-Poulsen H., Mikkelsen T.N. (2006) How does prolonged drought affect plant physiological processes? - Focus on the interactions with increased temperature and elevated [CO<sub>2</sub>] within the CLIMAITE project. Poster & abstract, EPRECOT, Helsingør, DK, May 2006

Schmidt IK et al. CLIMAITE – Climate change effects on biological processes in terrestrial ecosystems. Poster & abstract, EPRECOT, Helsingør, DK, May 2006  
Beier, C. (2006) CLIMAITE – a biological time machine to investigate multifactor climate change effects in terrestrial ecosystems. Poster presentation at the 5th BIOGEMON Conference (Santa Cruz, US, 2–5 July 2006).

Albert K., Ro-Poulsen H., Mikkelsen T.N., Michelsen A., Beier C., Jonasson S., Pilegård K., Ambus P., Kappel Schmidt I., Holmstrup M., Primé A., Christensen S. (2006) The Biological Time Machine - Biological responses to multiple environmental and climatic changes. Poster & abstract, Environment and Stress, Ph.d. symposium at KVL October 2006.

Maraldo, K., Strandberg, B., Christensen, B., & Holmstrup, M.: Combined effects of copper and summer drought on enchytraeids: comparison of laboratory and field studies. Poster presented at SETAC Europe 15th Annual Meeting, The Raison d'Être of environmental toxicology and chemistry, Lille, France, May 22-26, 2005.

## 2 - CLIMAITE meetings and activities 2004-2006

<b>Scientific visits and public arrangements at Brandbjerg</b>			
<b>Visit/organisation</b>	<b>Time</b>	<b>Participants</b>	<b>Content</b>
Grand Opening	October 2005	CLIMAITE total group + Environmental minister, local NGOs, press and guests	Opening show involving all involved scientists. Show and discussion of the basic background for the project and all major activities.
Plant Physiology	April 2006	Helge Ro-Poulsen and Kristian Albert	Project presentation and discussion of plant eco-physiological thesis possibilities
Victorian Department of Primary Industries	August 2006	Teis Mikkelsen and Claus Beier	Visit to share experiences regarding design, development and running multifactor experiments including CO <sub>2</sub>
Environmental Council, Roskilde Council	August 2006	Claus Beier	Visit by administrators and politicians from the local Environmental Council. Discussion of climate change, impacts on the environment and relevance for the local community
Air Liquide	August 2006	Claus Beier & Teis Mikkelsen	Visit by Scandinavian Manager and Danish main group. Discussions of CO <sub>2</sub> system, results, societal relevance and potential extension of the project.
Local NGOs and Tourist organizations	2004-2006	Many	Show and demonstration of the project and the activities

<b>Participation in scientific meetings by CLIMAITE scientists</b>			
<b>Meeting</b>	<b>Participants</b>	<b>Role</b>	<b>Outcome</b>
Acid Rain 2005, Prague, May 2005	Claus Beier	Oral presentation, Poster presentation	Presentation
AVEC summer school, Peyresq, France, September 2005	Claus Beier	Oral presentation	Presentation
Research visit at AgResearch, Palmerston North, New Zealand	Claus Beier	Scientific consultancy and collaboration	Collaboration agreement
Effects of Drought, Christchurch, April 2006	Claus Beier	Participant	
EPRECOT, Helsingør, DK, May 2006	Claus Beier, Teis Mikkelsen, Inger K Schmidt, Karen Andersen, Jane K. Pedersen, Merete B Petersen, Kristian Albert	Organiser, discussion leader (Precipitation seasonality) and participants	2-3 papers
BioGeomon 5, Santa Cruz, CA, US, June 2006	Claus Beier, Preben Jørgensen	Poster Presentaion and session chair (Experimental manipulations)	Presentation
ESA, Memphis, US, August 2006	Teis Mikkelsen	Oral presentation	Paper
AVEC summer school, Peyresq, France, September 2006	Claus Beier	Oral presentation	Presentation
Establishment of a national network for characterisation of climate changes. GEUS (Richard Bradslaw), January 2005	Søren Christensen (Louise Andresen, Sven Jonasson)	Oral presentation	presentation
9th European Heathland Workshop. Belgium, September 2005	Inger K Schmidt, Louise Andresen, Klaus S. Larsen, Torben Riis-Nielsen	Oral and poster presentation	Presentation
NitroEurope summer school, Vienna, October 2006	Per Ambus	Lecture	Lecture

### 3 – Collaboration and networks

<b>Collaboration and networks</b>		
<b>Group/organisation</b>	<b>Contact person</b>	<b>Collaboration</b>
IBIMET/Italy	Franco Miglietta	Design and development of the FACE technique
DONG Energy	Charles Nielsen	Sponsoring Power system and power supply
Air Liquide Denmark	Jesper Hildebrandt	Sponsoring of CO <sub>2</sub> consumption and technical assistance on CO <sub>2</sub> dosing
TERACC	Lindsey Rustad	Terrestrial Ecosystem Research and Climate Change. A US based network aiming to coordinate terrestrial ecosystem research projects and synthesise results. CLIMAITE is connected to this network.
PrecipNet	Michael Loik	Precipitation change Network. An international scientific network of research projects and manipulation studies focusing on effects of precipitation change. CLIMAITE participates in this network.
Jyllands Markisefabrik	Erwin Bur Andersen	Development of warming and drought covers
AgResearch, New Zealand	Paul Newton	Advice and collaboration on experimental manipulations and agreement on student exchange
Jasper Ridge Global Change Experiment	Chris Field and Nona Chiariello	Visit to JRGCE (Chris Field & Nona Chiariello) to see the experiment and discuss experiences and potential collaboration
Victorian Department of Primary Industries		Visit to share experiences regarding design, development and running multifactor experiments including CO <sub>2</sub>

## 4 – Student projects and courses

<b>Student projects</b>				
<b>Title</b>	<b>Students</b>	<b>Content</b>	<b>Supervisor</b>	<b>Time</b>
Nutrient content in soil, roots and micro-organisms, and soil microbial biomass below <i>C. vulgaris</i> and <i>D. flexuosa</i> : seasonal variation and effects of nutrient addition	Pia Lund Nielsen	M.Sc thesis	Anders Michelsen ; Inger Kappel Schmidt	2005-6
The influence of nitrogen and phosphorus on phenology, growth and nutrient content in <i>D. flexuosa</i> and <i>C. vulgaris</i>	Jane Kongstad Pedersen	M.Sc thesis	Sven Jonasson; Anders Michelsen	2005-6
Global change effects on plant senescence.	Christine Aagaard	Biological project: Investigation of stress indices by means of chlorophyll fluorescence and leaf anatomical characters on <i>C. vulgaris</i>	Helge Ro-Poulsen and Kristian Albert	Okt.-nov. 2006
Global change affected eco-physiological winter processes in <i>C. vulgaris</i>	Kristine S. Boesgård and Kristina Louise Mathiesen	Bac. Project: Off season characterization of photosynthetic capacity and actual activity on <i>C. vulgaris</i> .	Helge Ro-Poulsen, Anders Michelsen, Kristian Albert	Okt.2006 – feb. 2007

<b>Lectures and education</b>			
<b>Title</b>	<b>Course</b>	<b>Lecturer</b>	<b>Time</b>
The use of stable isotopes in ecology	Terrestrial ecosystem processes, KU	Anders Michelsen	May 2005
CLIMAITE - Field scale climate change experiments	Terrestrial ecosystem processes, KU	Claus Beier	June 2005
Environmental and climate change effects on plants and terrestrial ecosystems	Experimental design and methodology in ecology, KU	Anders Michelsen	September 2005
The use of stable isotopes in ecology	Terrestrial ecosystem processes, KU	Anders Michelsen	May 2006
CLIMAITE - Field scale climate change experiments	Terrestrial ecosystem processes, KU	Claus Beier	June 2006
Environmental and climate change effects on plants and terrestrial ecosystems	Experimental design and methodology in ecology, KU	Anders Michelsen	September 2006
Climate change and ecosystems	Dansk Naturvidenskabsfestival 2006:Allerslev Skole, Lejre (DK), Deltagerantal: 150, 27. september 2006 Toftehøjskolen, Ølstykke (DK) Deltagerantal: 150, 26. september 2006 Rygaards Skole, Hellerup (DK) Deltagerantal: 120, 25. september 2006	Teis N. Mikkelsen	September 25 <sup>th</sup> , 26 <sup>th</sup> and 27 <sup>th</sup> 2006
CLIMAITE year two.	Globale geografiske regioner. Københavns Universitet (DK). Geografisk Institut	Teis N. Mikkelsen	January 12 <sup>th</sup> 2006

A Catalogue of student projects is enclosed with the report

## 5 - PhD projects – content and status/progress

**Plant ecophysiology – Kristian Albert** - Studies of short term acclimation of leaf physiology (photosynthesis, respiration, stomatal conductance, transpiration,  $J_{\max}$ ,  $V_{\max}$ , stress indices, etc.) and leaf characteristics (specific leaf area, chlorophyll, carbon, nitrogen,  $^{13}\text{C}/^{14}\text{C}$  isotopes) to climatic changes and seasonality on *C. vulgaris* and *Deschamsia flexuosa* (ongoing). Also, a specific task will be to scale up responses at the leaf level to the canopy and ecosystem level and link alterations in physiological processes to changes in plant species abundance and community structure (planned).

**Ecosystem carbon exchange – Merete Bang Petersen** – focus on carbon cycling in the ecosystem with main activity within work package 4, but also including elements of work packages 2 and 3. The main component of the project is the measurement of  $\text{CO}_2$  exchange by means of chamber technique at the plot scale and the partitioning of net ecosystem exchange into assimilation and respiration (ongoing). This will be combined with studies of belowground carbon dynamics and the effects of the treatments by means of the  $^{13}\text{C}$  labeling as a result of the  $\text{CO}_2$  fumigation of fossil fuel origin (planned/initiated). The project will also include measurements of biomass and its C content (planned).

**Cycling, uptake and sizes of N pools and interactions with carbon – Louise C. Andresen** - focus on the effects on internal nutrient transformations within the ecosystem, on mechanisms and pathways of microbial and plant mediated C and N assimilation, and on nutrient pool sizes within the ecosystem. Methods used include analysis of mineralization by the buried bag method (initiated), labeling with  $^{15}\text{N}^{13}\text{C}$  glycine and detection of uptake in plants and soil microorganisms (initiated), determination of microbial and nutrient pools (ongoing), and determination of changes in N pool sizes of the same pools (ongoing).

**Soil fauna physiology – Kristine Maraldo** - Focus on desiccation tolerance in enchytraeids, Collembola and mites. Studies of mechanisms the selected organisms cope with low soil water potentials, identify critical stress levels and examine life-history traits under sub-optimal soil water potential (ongoing). Also population recovery times after severe drought will be investigated in order to explain population dynamics observed in the field experiment (planned). Respiration and consumption rates will be measured under a range of soil moisture and temperature conditions, to be used for calculation of soil fauna contributions to decomposition, and interactions with microbial organisms (ongoing).

**Plant/fauna interactions - Karen Andersen** – Focus on the microfauna and its interaction with microbial activity in the rhizosphere. The effect of an altered climate (elevated  $\text{CO}_2$  and/or temperature, altered soil moisture) will be investigated in the field experiment at Brandbjerg. Test plants grown in the field plots will be the basis for growth chamber experimentation on the interaction of the plant with its rhizosphere organisms and foliar herbivores as dependent on environmental factors such as soil nutrient status and the climatic origin of the plants (ongoing). Two further laboratory experiments deal with the consumption of carbon from the plant and the soil by rhizosphere organisms, and survival/activity of the microfauna when soil dries out (planned).

**Plant community – Jane Kongstad** - Focus on plant responses, both on individual and community level, to the predicted climate change scenarios. Investigation of

predicted climate changes effects on the seasonal and the long term variations in the structure and dynamics of the vegetation and description of the plant responses with regard to acclimations, tolerance and recovering after extreme climatic events. The methods will include repeated pin-point analysis (ongoing) in order to describe variation in species composition, cover and compactness and the phenology of the two dominant species, *C. vulgaris* and *D. flexuosa*, over the season and from year to year. This method will furthermore allow conversion to biomass estimates. Individual plants will be marked and followed, and bud burst, shoot elongation, senescence and the number of active meristems will be registered (ongoing). The vegetation greenness indicator, NDVI will be measured in order to describe seasonal variations in plant cover (planned).