The Biological Time Machine - Biological responses to multiple environmental and climatic changes

Environment and Stress, Ph.d. symposium at KVL October 2006

Albert, Kristian; Ro-Poulsen, Helge; N. Mikkelsen, Teis; Michelsen, Anders; Beier, Claus; Jonasson, Sven Evert; Ambus, Per Lennart; Schmidt, Inger Kappel; Holmstrup, Martin; Priemé, Anders; Christensen, Søren

Publication date:
2006

Document version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Albert, K., Ro-Poulsen, H., N. Mikkelsen, T., Michelsen, A., Beier, C., Jonasson, S. E., ... Christensen, S. (2006). *The Biological Time Machine - Biological responses to multiple environmental and climatic changes: Environment and Stress, Ph.d. symposium at KVL October 2006*. Abstract from The Biological Time Machine - Biological responses to multiple environmental and climatic changes, .

Kristian Albert
Biological Institute
Department of Terrestrial Ecology
Øster Farigmagsgade 2D
DK-1353 København K

kristiana@bi.ku.dk
www.climaite.dk

Abstract: The biological time machine

Ecosystem responses to multiple environmental and climatic changes are being studied within the framework of the Danish research centre CLIMAITE. Construction of ‘The biological time machine’ facilitates the large scale multifactor experiment. Here we expose a temperate semi-natural heath ecosystem to a realistic Danish climatic scenario anno 2075 - with regards to increased CO_2, increased temperature and summer drought. Since the direction of ecosystem responses can not be deduced from single factor experiments this necessitates the multifactor approach. By means of novel manipulations, extensive climatic documentation and proper statistical approaches the study are expected to be a benchmark, setting the new standard within this type of studies. Moreover responses are investigated across almost all levels of the ecosystem, why focus are not only to understand response patterns, but also to provide a synthesis across scales at ecosystem level. Several plant eco-physiological responses have been identified as potential ‘gaps of knowledge’, why elucidating these is a key part of this puzzle. The single factors may or may not act in an additive way f.x. an elevated CO2 level may increase photosynthetic carbon uptake and the water use efficiency, while drought may act opposite. Passive night warming, temperature, may increase the length of growth season, but also increase evaporation and lower the soil moisture. Moreover the manipulated single factors have different strength during the growth season. This motivates repeated measurement campaigns throughout the growth season. At the leaf level, the Carbon input and Water consumption through photosynthesis are measured by state of the art gas exchange techniques on Common Heather (*Calluna vulgaris*) and Hair Grass (*Deschampsia flexuosa*). In addition, parallel measurements of plant stress and water status are conducted monthly. Presently the data from June 2006, prior to the onset of the drought, clearly suggests that both plant species acclimated to elevated CO2 by down regulation of their photosynthetic capacity, but at very different levels. In parallel, the direction of response for passive night warming were the same, but a weaker response was observed. In the combined treatment an additive effect were only seen for *Calluna* as photosynthetic capacity were lowest here. Despite down regulation then the plants in elevated CO2 actually had the highest carbon uptake at ambient conditions. The responses at leaf scale provide in combination with other measures the basis for photosynthetic sub-modelling. The aim is to integrate sub-models from all scales and link causal responses into an ecosystem model driven by climatic factors. Then prognosticated response patterns to climatic changes can be deduced and immediately tested against measures from the manipulations. We expect that this probably will lead to new insights and provide identification of new ‘gaps of knowledge’. In this way a continuous hypothesis development and testing are believed to advance our understanding of ecosystem functioning and response patterns to future climate changes. This is in essence the conceptual framework within we travel the ‘biological time machine’.