



## Advances in FACE and manipulation techniques

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## Keynote 2 Session 3:

### Advances in FACE and manipulation techniques

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Experimental techniques to expose plants and ecosystems to elevated CO<sub>2</sub> have been around for decades, starting out with branch cuvettes, chambers and green houses and in the 90ies leading to the development of the FACE (Free Air Carbon Enrichment) technique, which has been and still is widely used. The FACE technique is used under field conditions and has been developed over the years to be applied for many types of ecosystems from low stature shrub, grass and arable lands to high stature forest trees. These experiments have provided extensive knowledge and data on CO<sub>2</sub> effects on individual plants and processes as well as whole terrestrial ecosystems. The ultimate goal of any experiment is to mimic future conditions and stress factors in a realistic and/or relevant way and to measure important and relevant responses at various spatial scales. FACE experiments are still facing some clear challenges when it comes to the experimentation or scenarios typically tested as well as the response measurements performed, challenges that limits our knowledge and understanding and need to be addressed and overcome in the future. With respect to the experimentation and scenarios, a significant constraint for FACE experiments is the cost of the CO<sub>2</sub> in such experiments which increases substantially with ring sizes and vegetation height as well as of course the number of replicates. FACE experiments can relatively easily be combined with other stress factors, but for every factor a full factorial combination doubles the costs. Consequently, very few combination studies exist and knowledge on interactions among CO<sub>2</sub> and other factors is still very limited, and especially interactions with extreme weather events are largely unknown. However, recent data suggests that such interactions are important and may not be easily forecasted from single factor experiments. With respect to response measurements, a key scientific question is how elevated CO<sub>2</sub> will affect the atmosphere-biosphere feedback. However, there are significant challenges associated with directly measuring the ecosystem carbon balance in FACE experiments, and despite numerous such experiments, there is a general lack of carbon feedback measurements.