Introduction
Rising global temperatures, fewer number of precipitation days and an increased intensity of drought events are projected to shape the future climate of central Europe. Changes in water availability and more intense drought events will have significant impacts of the central European vegetation and can impair the ecosystem goods and services provided to our society. Importantly, critical mechanisms that determine how changes in water availability and drought will impact the functioning of temperate ecosystems are poorly understood and not well represented in earth system models. Anticipating the consequences of a future climate for the functioning of temperate European ecosystems is therefore limited and hinders the design of mitigation options and future ecosystem management plans.

Most experiments that attempt to improve the mechanistic understanding of drought responses of terrestrial ecosystem have to date focused either on the experimental manipulation of grasslands or on investigations with tree seedlings or saplings. Although forests play an essential role for the delivery of ecosystem goods and services, very few experiments exist worldwide that mechanistically investigate the responses of mature trees and forest to changes in water availability or drought. The experimental research platform of the ‘Swiss Canopy Crane II’ closes this critical research gap and will provide the opportunity over the next two decades to address some of the key open questions with respect to how mature trees and forests respond to anticipated changes in water availability and drought.

The experimental research site at Hölstein (BL)
The research site is located at an elevation of 550 m a.s.l. and is positioned of the top of a gentle hill. The mean annual temperature is 9.0°C and the mean annual precipitation is 1009 mm. The soil type was classified as Rendzic Leptosol with a clay fraction of up to 40%. Within an area of 1.6 ha, the site contains 538 mature trees from 14 different species with a DBH >10 cm (Fig 1). The estimated age of the trees ranges from 20 up to 150 years.

The infrastructure includes state of the art instrumentation for the continuous assessment of critical environmental and physiological variables, a 50 m crane that provides access to the canopy and a specially designed mobile roof for the experimental drought treatment.

In the center of the plot, a 50 m tall canopy crane with a 50 m jib was installed in spring 2018. The crane provides canopy access to 256 trees from 10 species (Fig. 1). The drought manipulation will be achieved by a 3100 m² roof that we plan to install in the fall of 2019 under the canopy of the trees in the north-eastern side of the research site. The roof will be between 2 – 3 m high and consist of transparent (mostly) mobile panels that can be closed at the onset of a rain event.
Fig. 1: Description of the 120 x 160 m research site in Hölstein, BL close to the University of Basel.
Drought treatment in the main experiment

Climate projections for Switzerland forecast a reduction of summer precipitation between 30 and 40% (Fischer et al. 2015; Swiss Academy Reports 2016). This reduction is the result of fewer precipitation days rather than a declining intensity of individual precipitation events (Rajczak et al. 2013). Although associated with larger uncertainties, it is also projected that the number of extreme events will increase in the future, including a higher frequency of heat days and a higher risk of soil drying (Orlowsky et al. 2013; Trenberth et al. 2014).

The goal of the main experiment that we seek to establish at the research site is to simulate projected changes in the precipitation regime for at least the next 17 years.

To apply our treatment, we will manipulate the number of precipitation days in our experiment with a 3100 m² roof that will be installed 2 – 3 m above the ground. The roof will consist of mobile panels that can automatically be opened or closed. Over the entire duration of the experiment we will reduce the number of precipitation days by on average 50% relative to the control plot.

Fig. 2: Natural variability of precipitation in close proximity to our research site 1983 – 2017 (grey bars) and the simulated experimental precipitation regime 1983 – 2017 as a result of 20%, 50%, or 80% throughfall reduction. Red lines indicate the threshold for a negative (lower line, 476 mm) or positive (upper line 831 mm) water balance for the years 1983 – 2017. Climate data are from the Meteo Swiss station Rünenberg.

However, in order to account for the projected increased inter-annual variability in precipitation, we will not manipulate the number of precipitation days uniformly each year, but reduce the number of precipitation days for a given year by either 20, 50, or 80% in a three-year block (Fig. 2). These three-year blocks will then be repeated throughout the duration of the experiment.

Botanical Garden

In the afternoon, we will visit the botanical garden of the University of Basel.

The history of the botanical garden of the University of Basel goes as far back as the 16th century by Caspar Bauhin, making it one of the oldest botanical gardens in the world. The diverse plant collection of more than 7,000 species is used for research, education and species protection. The botanical garden is open to the public all year. A widely diverse range of plant life flourishes inside four different greenhouses and one outdoor site (Fig. 3). We will have a guided tour through the outdoor site and the greenhouses of the botanical garden (Fig. 4).

Fig. 4: Greenhouses, Alpinum and Spalentor (University Basel; https://botgarten.unibas.ch/)

Including a presentation of recent greenhouse experiments of the Physiological Plant Ecology Group that focus on plant-mycorrhiza-soil interactions.
Fig. 3: Map of the Botanical Garden (University Basel; https://botgarten.unibas.ch/)
**Literature**


