

How do long dry spells affect soil moisture in different forest stands?

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Soil moisture conditions under forests are subject to numerous influences that are directly linked to the tree species composition and age. On the one hand, there are characteristic traits of individual tree species such as the way they funnel intercepted water towards their stems or the way they use water from the soil at different depths and times. On the other hand, there is also the influence of inter- and intra-species competition which may considerably affect the water use behavior of the involved tree species.

In order to get insights into these complex relationships we studied spatial and temporal soil moisture patterns under pure and mixed forest stands of beech and pine of different ages in the TERENO observatory in northeastern Germany. We also specifically compared soil moisture conditions in the close vicinity of tree stems with conditions at greater distance from the trees (>1.5 m). The dataset used here derives from 450 sensors measuring soil moisture for 2.5 years at six different soil depths (from 10 cm down to 200 cm).

Inspecting the entire time series we found considerable differences between many of the locations (young vs. mature, pine vs. beech, mixed vs. pure). These differences became more or less pronounced during certain weather periods. In particular, we studied the effect of dry spells of different preconditions and length during the three summers 2014, 2015 and 2016. While 2014 was a relatively wet summer, 2015 was dry and warm. Generally speaking, the dry spell in the summer of 2015 led to a decrease in soil moisture differences between locations that was still observable in the following winter and even in the following summer. For example, in the summer of 2014 volumetric water content close to the soil surface under mature pine trees was almost 8% higher compared to beech trees, however, in the dry summer of 2015 this difference disappeared. Contrary to this observation, volumetric water content differences between young stands of pine and beech increased in the dry summer of 2015 (from 2% to 6%, this time with beech associated with higher moisture contents).