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A lysimeter-based approach to quantify the impact of climate change on soil hydrological processes

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The predicted climate change involving increasing CO_2 concentrations and increasing temperatures will have effects on both vegetation and soil properties and thus on the soil water balance. The aim of this work is to quantify the effects of changes in these climatic factors on soil hydrological processes and parameters. For this purpose data of six high precision weighable lysimeters will be used. The lysimeters are part of a Lysi-T-FACE concept, where free-air will be enriched with CO_2 (FACE-Technique) and infrared heaters heat the plots for investigation on effects of increasing temperatures (T-FACE-Technique). The Lysi-T-FACE concept was developed on the „Clim Grass Site“ at the HBLFA Raumberg-Gumpenstein (Styria, Austria) in 2011 and 2012 with a total of 54 experimental plots. These include six plots with lysimeters where the two climatic factors are varied in different combinations. On the basis of these grass land lysimeters the soil hydraulic parameters under different experimental conditions will be investigated. The lysimeters are equipped with TDR-Trime sensors and temperature sensors combined with tensiometers in different depths. In addition, a mechanical separation snow cover system is implemented to obtain a correct water balance in winter.
To be able to infer differences between the lysimeters reliably a verification of functionalities and a plausibility check of the data from the lysimeters as well as adequate data corrections are needed. Both an automatic and a user-defined control including the recently developed filter method AWAT (Adaptive Window and Adaptive Threshold Filter) are combined with a visualisation tool using the software NI DIAdem. For each lysimeter the raw data is classified in groups of matric potentials, soil water contents and lysimeter weights. Values exceeding technical thresholds are eliminated and marked automatically. The manual data control is employed every day to obtain high precision seepage water weights. The subsequent application of the AWAT Filter reduces up to 80% of the oscillations in the calculated precipitation and evapotranspiration. The filtered data of the reference plot in June 2014 yields a precipitation of about 100 mm, whereas the non-filtered raw data result in approximately 170 mm and thus an obvious overestimation of precipitation. The resulting evapotranspiration amounts to slightly more than 100 mm with filter and 200 mm without filter in the same time period. The total water balance (precipitation minus evapotranspiration) of the year 2014 obtained with the automatic and manual data filter is 470 mm on the reference plot but only 358 mm on a plot where CO_2 is enriched and temperature increased. In summary, these first results demonstrate that an adequate data correction is the precondition to identify changes of soil hydrological processes and properties.