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Wavelet Analysis of Soil Water State Variables for Identification of Lateral Subsurface Flow: Lysimeter versus Field Data

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Preferential and lateral subsurface flow may be responsible for the accelerated transport of water and solutes in sloping agricultural landscapes; however, the process is difficult to observe. One idea is to compare time series of soil moisture observations in the field with those in lysimeters, where flow is vertically oriented. This study aims at identifying periods of deviations in soil water contents and pressure heads measured in the field and in a weighing lysimeter with the same soil profile. Wavelet Coherency Analysis (WCA) was applied to time series of hourly soil water content and pressure head data (15, 32, 60, 80, and 140 cm depths) from Colluvic Regosol soil profiles in summer 2017. The phase shifts and periodicities indicated by the WCA plots reflected the response times to rain events in the same depth of lysimeter and field soil. For many rain events and depths, sensors installed in the field soil showed a faster response than those in the lysimeters soil. This could be explained by either vertical preferential flow or lateral subsurface flow from upper hillslope positions. Vice versa, a faster sensor response in the lysimeter soil could be indicative for vertical preferential effects. The WCA plots comprise all temporal patterns of time shifts and correlations between larger data time series' in a condensed form to identify potentially relevant periods for more detailed analyses of subsurface flow dynamics.