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Investigation of the spatial variability and possible origins of wind-induced air pressure fluctuations responsible for pressure pumping

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The exchange of greenhouse gases between the soil and the atmosphere is highly relevant for the climate of the Earth. Recent research suggests that wind-induced air pressure fluctuations can alter the soil gas transport and therefore soil gas efflux significantly.

Using a newly developed method, we measured soil gas transport *in situ* in a well aerated forest soil. Results from these measurements showed that the commonly used soil gas diffusion coefficient is enhanced up to 30% during periods of strong wind-induced air pressure fluctuations. The air pressure fluctuations above the forest floor are only induced at high above-canopy wind speeds (> 5 m s^{-1}) and lie in the frequency range 0.01-0.1 Hz. Moreover, the amplitudes of air pressure fluctuations in this frequency range show a clear quadratic dependence on mean above-canopy wind speed. However, the origin of these wind-induced pressure fluctuations is still unclear.

Airflow measurements and high-precision air pressure measurements were conducted at three different vegetation-covered sites (conifer forest, deciduous forest, grassland) to investigate the spatial variability of dominant air pressure fluctuations, their origin and vegetation-dependent characteristics. At the conifer forest site, a vertical profile of air pressure fluctuations was measured and an array consisting of five pressure sensors were installed at the forest floor. At the grassland site, the air pressure measurements were compared with wind observations made by ground-based LIDAR and spatial temperature observations from a fibre-optic sensing network (ScaleX Campaign 2016).

Preliminary results show that at all sites the amplitudes of relevant air pressure fluctuations increase with increasing wind speed. Data from the array measurements reveal that there are no time lags between the air pressure signals of different heights, but a time lag existed between the air pressure signals of the sensors distributed laterally on the forest floor, suggesting a horizontal propagation of the air pressure waves.