Geophysical Research Abstracts,
Vol. 11, EGU2009-9975, 2009
EGU General Assembly 2009

Multivariate estimation and conditional stochastic simulation of soil heterotrophic respiration at plot scale

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Soil heterotrophic respiration fluxes at plot scale are linked with a significant spatial and temporal variability. Chamber-based measurements of respiration fluxes were repeated for 15 measurement dates within the 13x14 m bare soil plot. Soil water contents and temperatures were measured simultaneously to be used as co-variates. Further, we used measurements of soil organic carbon content and apparent electrical conductivity as well as the prior measurement of the target variable as co-variates. After computing correlation coefficients, a stepwise multiple linear regression procedure was used to spatially predict bare soil respiration from the co-variates. In particular the prior measurement of the target variable and those co-variates linked to the water availability for the microbial decomposition of carbon, i.e. the soil water content and the apparent electrical conductivity, show a certain, even though limited, predictive potential. In a fist step we applied external drift kriging and regression kriging to determine the improvement of using co-variates in an estimation procedure in comparison to ordinary kriging. The improvement using co-variates ranged between 40 and 1 % for the single measurement dates. The difference in the improvement between using either external drift kriging or regression kriging was marginal. In a second step we applied sequential Gaussian simulations conditioned with external drift kriging to generate more realistic spatial patterns of heterotrophic respiration at plot scale. Compared to the estimation approaches, the conditional stochastic simulations revealed a significantly improved reproduction of the probability density function and the semivariogram of the original point data.