On spurious correlation in the flux-profile relationships for the stable boundary layer.

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The stable boundary layer is poorly represented in current large-scale weather prediction and climate models. Turbulent flux calculations in these models are based on the traditional and widely used so-called flux-profile relationships. Flux-profile relationships relate observations of non-dimensional gradients of wind speed $\phi_m$, or temperature $\phi_h$ to the stability parameter $z/L$. In this study we firstly analyze the difference between obtained scatter for $\phi_m$ and $\phi_h$, and secondly we analyze the impact of spurious correlation on the scatter observed in flux-profile relationships. At first we obtain that implied uncertainties in the measured surface fluxes lead to enhanced scatter for $\phi_h$ while for $\phi_m$ the scatter remains hidden. This is due to the common variables in $\phi_m$ and $z/L$. At second, we find a strong impact of spurious correlation in the flux-profile relationship for $\phi_m$. Derivation of $\phi_m$ with randomized observations provided a similar flux-profile relationship as with real observations. This underlines that one should be aware of spurious correlation when applying similarity theory.