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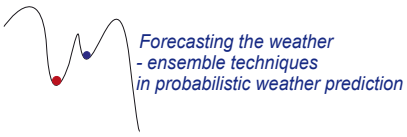


# Analytical urban surface similarity equations

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A new analytical bulk parameterization for the drag-coefficients for momentum and heat is presented. These stability functions are derived from the ones obtained from an iterative procedure according to the Monin-Obukhov similarity theory. In addition, the roughness sublayer has been taken into account. These analytical functions are compared with the iterative solution for the range $2 \leq \ln \frac{z}{z_0} \leq 15$ and $0 \leq kB^{-1} \leq 27$ which includes a wide range of natural and urban land covers, and for $-5 \leq Ri_b \leq 2.5$ which fits most realistic stability conditions of the boundary-layer. A good agreement between the analytical and iterative stability functions is found: for unstable atmospheric conditions and weakly stable conditions with $Ri_b < 0.05$, the relative error for the resulting drag-coeffients for heat and momentum is allways lower than $5\%$. For stable atmospheric conditions, the overall error is less than $10\%$.