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The neutral surface layer above rough surfaces

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It is generally accepted that turbulent fluxes (momentum and scalar fluxes) are approx. constant with height above horizontal surfaces with low roughness. But what will happen when the roughness sub-layer is large as found over cities, forests and rough seas?
In a study of the kinematic structure of the near neutral atmospheric surface layer, Högström, Hunt and Smedman, 2002, it was demonstrated that a model with detached eddies from above the surface layer impinging on to the surface (Hunt and Morison, 2000) could explain some of the observed features in the neutral atmospheric boundary layer. Thus the detached eddy model proved successful in explaining the dynamic structure of the near neutral atmospheric surface layer, especially the shape of the spectra of the wind components and scalars and corresponding fluxes.
Here we make the hypothesis that the detached-eddy model can also be used to explain the experimental results related to the 3-dimensional turbulence structure above rough surfaces. Measurements are taken both over land (grass and forest) and over sea (Baltic Sea and hurricane Fabian in the Atlantic) above the roughness sub-layer. Analysis of the turbulence structure shows a striking similarity between the different sites.

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Högström, U., Hunt, J.C.R., and Smedman, A., 2002: Theory and measurements for turbulence spectra and variances in the atmospheric neutral surface layer, Bound.-Layer Meteorol., 103,101-124.