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Scalewise anisotropy of the Reynolds stress tensor in the atmospheric surface layer and canopy sublayer

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The region of the atmosphere closest to the surface is important for many applications like transportation, agriculture or wind energy. Classical treatment of the surface layer and canopy layer with similarity theory has focused on mean profiles. The presence of surface roughness and thermal stratification modifies the components of the Reynolds stress tensor and introduces anisotropy in the kinetic energy distribution between the velocity components. This anisotropy has been used to study the range of validity of similarity scaling or the sensitivity of turbulent structures to roughness changes. The aim of this work is investigating the route of relaxation from anisotropy at large scales to isotropy at small scales. We assessed scalewise anisotropy of the Reynolds stress tensor from ultrasonic anemometer measurements in the atmospheric surface and canopy layer. Results showed that the canopy layer is more isotropic than the surface layer at large scales and has a faster return-to-isotropy across scales. The observed scale range covered by the return-to-isotropy was independent of stratification if normalized with integral length scale of the vertical velocity, suggesting surface properties are more important than stratification. Further, out results showed that the classical Rotta model is not sufficient to describe the return-to-isotropy for our measurements.