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Effect of an isolated semi-arid pine forest on the boundary layer height

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Forests play an important role for earth's climate by influencing the surface energy balance and CO_2 concentrations in the atmosphere. Semi-arid forests and their effects on the local and regional climate are studied within the CliFF project (Climate Feedbacks and benefits of semi-arid Forests). This requires understanding of the atmospheric boundary layer over semi-arid forests, because it links the surface and the free atmosphere and determines the exchange of momentum, heat and trace gases. Our study site, Yatir, is a semi-arid isolated pine forest in the Negev desert in Israel. Higher roughness and lower albedo compared to the surrounding shrubland make it interesting to study the influences of the semi-arid Yatir forest on the boundary layer. Previous studies of the forest focused on the energy balance and secondary circulations. This study focuses on the boundary layer structure above the forest, in particular the boundary layer height. The boundary layer height is an essential parameter for many applications (e.g. construction of convective scaling parameters or air pollution modeling). We measured the boundary layer height upwind, over and downwind of the forest. In addition we measured at two sites wind profiles within the boundary layer and turbulent fluxes at the surface. This allows us to quantify the effects of the forest on boundary layer compared to the surrounding shrubland. Results show that the forest increases the boundary layer height in absence of a strong boundary layer top inversion. A model of the boundary layer height based on eddy-covariance data shows some agreement to the measurements, but fails during anticyclonic conditions and the transition to the nocturnal boundary layer. More complex models accounting for large scale influences are investigated. Further influences of the forest and surrounding shrubland on the turbulent transport of energy are discussed in a companion presentation (EGU2017-2219).