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Comparative assessment of evapotranspiration derived from water balance, energy balance, eddy covariance and the BROOK90 model (Tharandt Forest, Germany)

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As a component of the water balance subject to changes due to land use or climate changes, evapotranspiration (ET) has been widely studied and meteorological or hydrological models were applied to determine effects on the local and regional water budgets. However, ET is difficult to measure and therefore model validation often relies on discharge only. In forests, classical methods such as weighting lysimeters and soil water budget are difficult to carry out due to the necessary size or the heterogeneous soil. Hence, micrometeorological based methods are usually applied. ET can be derived either from direct measurements such as eddy covariance (EC) or indirectly by water balance and energy balance approaches. Each method has its pros and cons.
This study aims to cross-evaluate EC measurements by comparing them with the multitude of other measurements available at this long-term tower site (since 1996) and catchment (since 1968), respectively. BROOK90 (a lumped parameter model) is used for the simulation of ET which is via a two layer approach (applying the well-known Penman-Monteith equation twice). The model will be applied for the "Wernersbach" catchment located approximately 6 km away from the EC tower "Anchor station Tharandt".The period of 2006-2015 is used for a start, as the data situation is specifically favourable.
Results show a spread in annual ET with lower bound marked by EC measurements and upper bound derived from water balance but the interannual variation as well as the seasonal changes are similar among methods with the exception for water balance method in the year 2010 and 2011.Differences can be attributed to systematic methodological bias or to different precipitation at both locations. Moreover, ET is considered sensible to the starting point which accumulative period is defined. Here, we try to narrow the resulting uncertainty by the use of traditionally stable relationships of ET to precipitation or net radiation.