



Quantification of non-rainfall water for a low mountain range and alpine grassland ecosystems

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Dew and hoar frost formation is a mechanism by which water can be added to the soil-plant system. In many arid regions non-rainfall events (e.g. dew, hoar frost, and fog) supply a substantial amount of water and are an important ecohydrological component of arid ecosystems. However, the role and importance of dew and hoar frost formation for northern humid ecosystems are largely unknown.

Thus, the aim of this work is to quantify the amount and the temporal distribution of dew and hoar frost formation as well as to estimate the ecological relevance for two distinct humid grassland ecosystems. In addition, we used standard meteorological variables and the Penman-Monteith equation, to predict the amount and seasonal patterns of dew and hoar frost formation.

Weighable lysimeter data of two consecutive hydrological years were used to determine non-rainfall water and to better understand the relevance of dew and hoar frost formation for a low mountain range and alpine grassland ecosystems.

The results showed that dew and hoar frost formation ranged on a yearly basis between 42.1 to 67.7 mm, which corresponds to 4.2 to 6.0 % of the total annual amount of precipitation. During dry periods, dew and hoar frost contribute up to 16.1 % of the total monthly precipitation amount. The investigation showed that dew and hoar frost formation was an ecologically important source of water during periods of droughts. During colder periods of the year, hoar frost formation was ecologically relevant at both grassland sites, because it thermally protected plants and thus potentially reduced the risk of low temperature injuries.

Estimates of potential dew and hoar frost formation based with the Penman-Monteith equation could predict the observed seasonal patterns and amount of non-rainfall water relatively well. However, during colder periods of the year and specific meteorological site conditions (i.e. high wind speeds at night) the model underestimated the amount of non-rainfall water. Our study results reveal that dew and hoar frost formation contribute substantially to the water budgets of a low mountain range and alpine grassland site.