RECHARGE ZONES IDENTIFICATION BY MOISTURE STRESS ASSESMENT

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Recharge zones, where the considerable infiltration of precipitation takes place, contribute substantially to the quality and quantity formation of underground water resources (Doležal, Kvítek, 2004). Recharge zones are characterized by more permeable, shallower and drying soils compared to discharge zones, so the possibility of faster soil water stress development is created. Supposing it, during water stress the canopy surface temperature in recharge zones is increased due to limited transpiration process and as a result, pronounced soil moisture and surface canopy temperature differences between both zones are found. Consequently, the space identification of recharge zones by means of surface canopy temperature measuring with infrared camera can be done. The increased surface canopy temperature above the optimum level (22-25°C) is revealed not only on days with limited transpiration rate after depletion of readily available soil water (RAW) and after soil moisture below the point of decreased availability (PDA) drops, but also if the low proportion of the active transpiring biomass occurs (Duffková, 2006). The increased canopy temperature due to water stress is proved during the warm sunny spell without rain (Idso *et al.*, 1981), when canopy surface is not cooled by air or/and precipitation (Zavadil, Doležal, 2005) and simultaneously the canopy is composed of the transpiring biomass in a large extent. If these assumptions are fulfiled, remote sensing by means of infrared camera using can be applied.

For the purpose of recharge zones identification by the moisture stress assesment method mentioned above the experimental small agricultural catchment Dehtáře was chosen. It is located in the Bohemo–Moravian Highland and is covered mainly by arable land. In the lowest south-east part of the catchment there is a partly artificially drained and intensively used grassland (Figure 1). Artificial systematic subdrainage was built in the year 1977 in the western half of the catchment. The Dehtáře catchment is a typical example of a catchment on crystallic and methamorphic (paragneiss, partly migmatised paragneiss and migmatite) rocks, without permanent surface flow, which is tile drained. The highest point in the catchment is 549.8 m a.s.l., the lowest point is 497 m a.s.l.

Differentiation of territory into recharge and discharge zones allows us to show that localities with drainage systems and areas which are downstream from the drainage systems can always be considered as discharge zones. Localities higher than drainage systems are recharge zones. The soil type of the recharge zone is Cambisol first of all (main soil unit 29, Fig. 1), which is characterized by quite high sand content, is quite permeable and shalow, with a lower soil retention capacity. The discharge zone includes Stagnosol (main soil unit 50) and despite of the fact that it is tile drained, its permeability is less and maximal capillary water capacity and clay content is higher compared to Cambisol.

As to the soil moisture (θ) by volume, it is observed by Time Domain Reflectometry on three sites (Figure 1) at the depths of 0.3 m, 0.6 m and 0.9 m. Meteorological information is obtained by automatic weather stations (met A - D, Figure 1) and consequently reference evapotranspiration values are calculated.

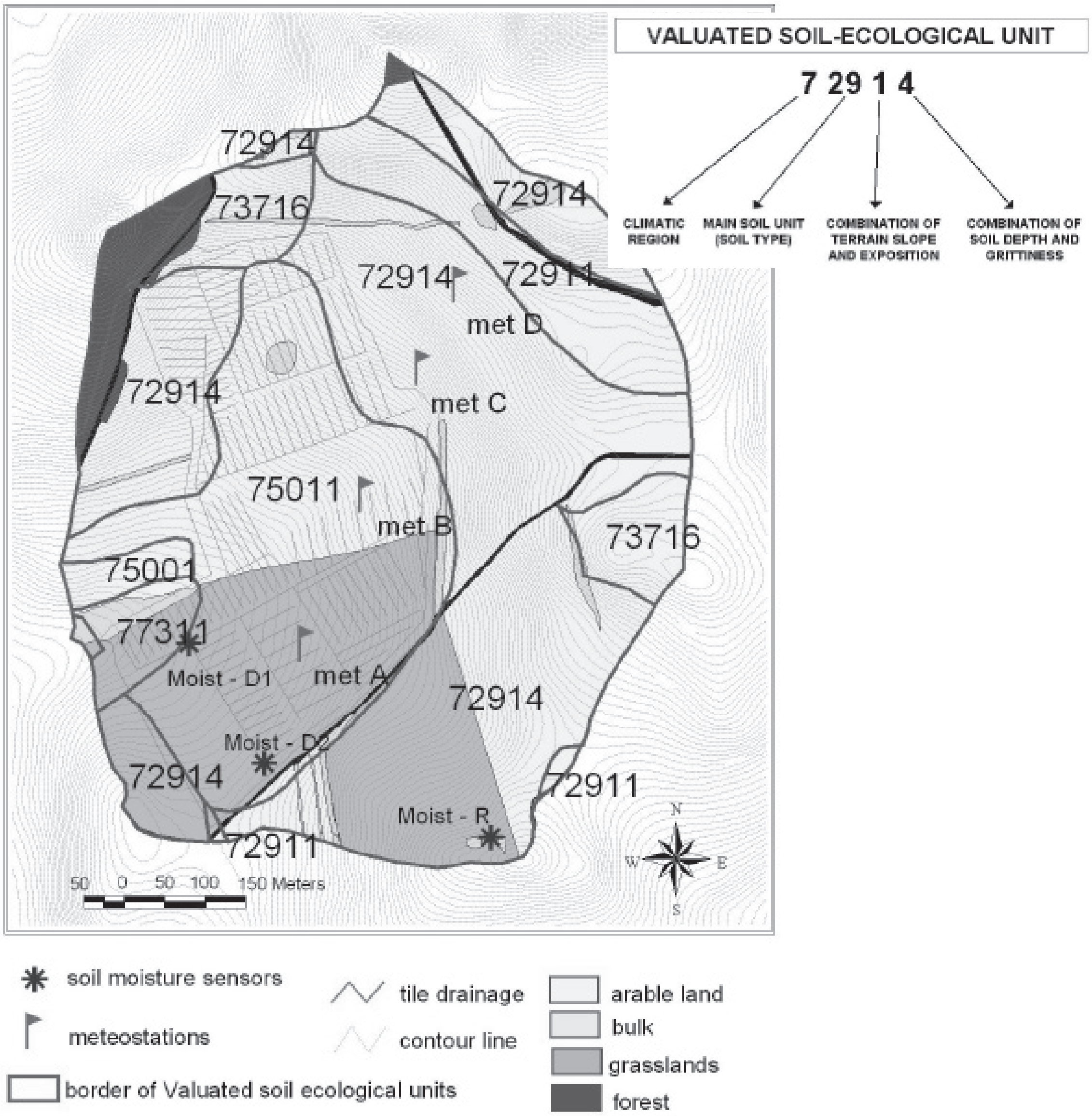

Figure 1. The map of the Dehtáře catchment

When the RAW (in mm) is extracted from the root zone, the crop is said to be water stressed (Allen *et al.*, 1998). This part of the soil water **p** (dimensionless quantity) can be expressed as a fraction of total available water (TAW, in %, being calculated as the difference between soil water content at field capacity FC and wilting point WP). When the reference surface[1] is considered, than subsequently **p** can be presented as: **p** = 0.4 + 0.04(5-ETo), where ETo is reference evapotranspiration in mm, i.e. evapotranspiration of the reference surface. It is evident when available water storage (in %, AWS = θ-WP) drops below threshold value (1-**p**)TAW or depleted fraction of TAW exceeds **p**, soil water stress is revealed (Figure 2):

$\theta - WP < (1-\mathbf{p})TAW$ or $1-(AWS/TAW) > \mathbf{p}$

[1] being defined as a hypothetical reference crop with an assumed crop height of 0.12 m, a fixed surface resistance of 70 s.m^{-1} and an albedo of 0.23 and resembling closely an extensive surface of green grass of uniform height, actively growing, completely shading the ground and with adequate water.

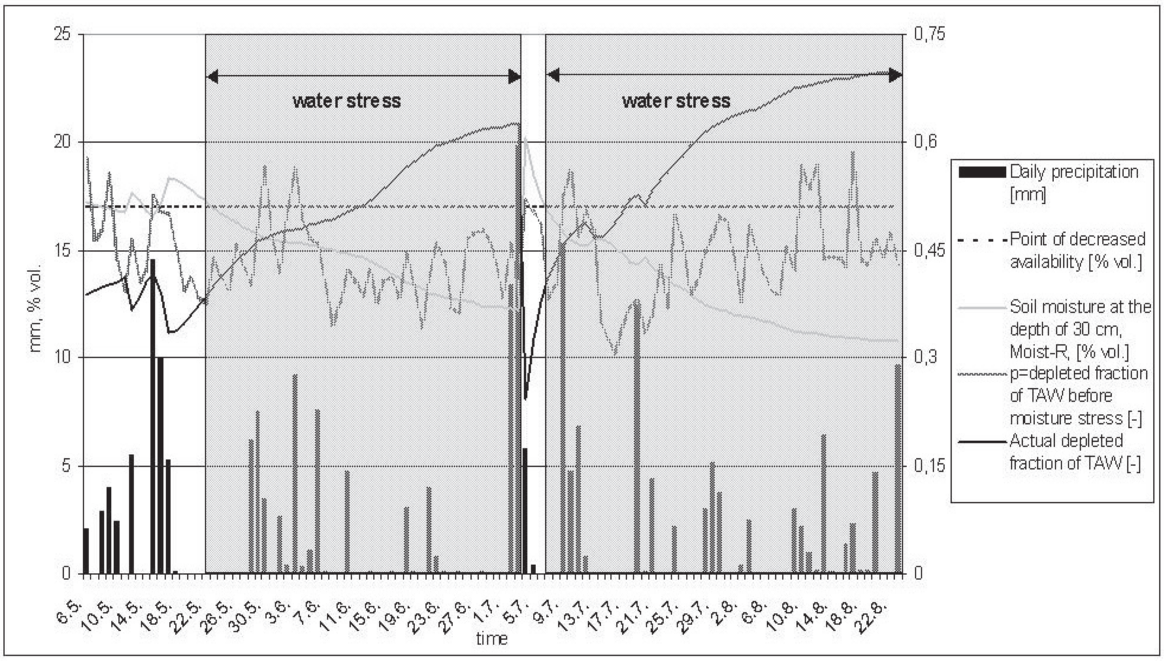

Figure 2. Stress moisture assesment by depleted fraction of total available water and by point of decrased availability reaching, recharge zone, Dehtáře 2007

The point of PDA (in %) means soil hydrologic coefficient, i.e. soil moisture content by volume when the soil water mobility and availability for plants are reduced substantially. PDA reflects approximately the suction pressure value 10^5-$2{\cdot}10^5$ Pa and it is considered practically (Kutílek, 1978) that PDA = WP+0.6(FC-WP).

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