SOIL MOISTURE IN HODONÍN AND STRÁŽNICE IN YEARS 2009–2011

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Abstract. Soil moisture can be determined by measuring equipment or calculated using models. The results of measurements of soil moisture using VIRRIB equipment were compared with results from AVISO and FAO Crop Evapotranspiration models. The comparison was based on data from the area of light soils in Hodonín-Pánov and data from heavier soils in Strážnice from period 2009–2011. The measured and model data in wetter years 2009 and 2010 brought very similar results, while in drier year 2011, both models underestimated the measured values of soil moisture.

Introduction

Water accessible by plants is limited by soil hydrolimit of wilting point, which determines soil moisture, time when plants are constantly insufficiently supplied with soil water, when water absorption by their root system is substantially lower than the intensity of transpiration, as a result of which these plants wilt (Kutilek, 1966). The second important hydrolimit of soil proves to be water-holding capacity (field capacity), which indicates the maximum amount of suspended water that soil is able to hold (Kutilek, 1966). Soil moisture can be measured by measuring equipment or calculated using various models. Our contribution compares results of measurements and models of soil moisture in Hodonín and Strážnice in 2009–2011.

Material and methods

A variety of agro-meteorological measurements took place in Hodonín-Pánov area of grassland on light sandy soils in 2009–2011 within the grant "A model project of prevention of biological soil degradation in arid climate conditions". One of the agro-meteorological measurements took place in the form of measurement of soil moisture using VIRRIB equipment produced by Amet company from Velké Bílovice (Litschmann, 1991). Soil moisture was recorded at several levels, however, in this paper we work only with average values of soil moisture in the layer of 0–60 cm. Data on soil moisture in the layer of 60–100 cm were not measured as this contribution did not aim at this layer. Soil moisture was measured at a number of habitats with specific characteristics within the locality mentioned (Hora, 2011); however, this paper analyzes only the data from habitats presence of solely natural soils. Due to meteorological measurements, soil moisture was modeled in the layer of 0–100 cm using FAO methodology (Allen *et.al*., 1998) and using AVISO model (Vitoslavský and Kohut, 1999). In addition to special-purpose measurements in Hodonín, we also present the results of measurements of soil moisture from the regular network of CHMI in Strážnice. Soil moisture was recorded using VIRRIB device which made it possible to record data of soil moisture up to the depth of 90 cm.

In order to analyze soil moisture, it is important to determine selected soil hydrolimits. Repeated pedological measurements in Hodonín-Pánov brought inconsistent information, which, however, always indicated that the value of retention water capacity is significantly higher than the actually measured values of soil moisture (not only measured by VIRRIB device, but also occasional gravimetric measurement), respectively higher than the value that should theoretically correspond to the area of soils occurring in this locality. Values of soil hydrolimits were therefore obtained for the purposes of our own measurements of soil moisture during the whole period analyzed.

Soil water-holding capacity at Hodonín-Pánov locality was enumerated by this method at 12 %, wilting point to 6 %. For climatological station in Strážnice, these hydrolimits were estimated to 26 % (water-holding capacity of soil) and 15 % (wilting point).

Results and discussion

Comparison of measured and model data on soil moisture in Hodonín-Pánov is presented in Figure 1. The graph also includes amount of precipitation, in a scale compatible with the models of soil moisture. As stated above, measurements of soil moisture in Hodonin were applied only for the 0-60 cm layer, so the comparison with the models of soil moisture is not completely accurate. AVISO model can simulate soil moisture only in the range of hydrolimits of water-holding capacity and wilting point (the usable water capacity of soil), which relates to the identification of this model. In contrast, FAO model is intended to work with the states when the soil moisture rises above the hydrolimit of water-holding capacity. Under natural conditions, however, short-term fluctuations below the wilting point are possible.

Comparing the measured and model values of soil moisture, we can see very good accordance between 2009 and 2010. In the second half of 2011, greater difference was observed between the model and measured values of soil moisture, the model values were significantly lower in case of both models.

In addition to data quality issues, in case of both - soil moisture and the data used as input into the model, there are several theoretical explanations of mutual inhomogeneities between the individual models and measurements. In addition to the above mentioned, the problem in non-uniform depth of the layer used to calculate or measure soil moisture can be a major problem in modeling of vegetation development. In a period of sufficient water supply, modeling of the conditions of plants is very satisfactory, but in the event of prolonged dry period, wilting of plants occurs in natural conditions. During subsequent precipitation, it appears that both models underestimate the

evapotranspiration of drought-affected crop, and thereby underestimate the real conditions of soil moisture.

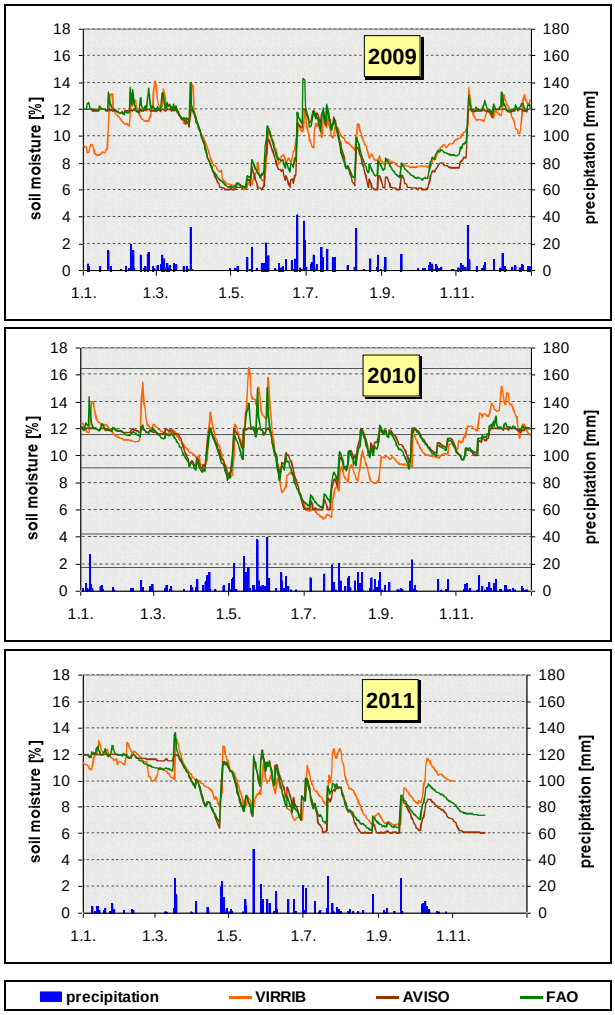

Figure 1. *Measured and model soil moisture and precipitation in Hodonín-Pánov in the period of 2009–2011.*

All three data series point out several facts in the dynamics of soil moisture. Light soils with low water-holding capacity dry up very quickly. In case of further rains, however, the soil moisture gets relatively close to the values of water-holding capacity in a relatively short time. Years 2009 and 2010 were above the regular values of precipitation in Hodonin, in 2011, however, precipitation was normal. In 2011 there were frequent alternations of periods of low and high soil moisture, while the most significant period of low soil moisture occurred in August and September.

Figure 2 compares the measured and model soil moisture in Strážnice. Since data from 2011 seem to be problematic in terms of quality, we present only the situation in 2009 and 2010 in our contribution. At first sight it is evident that the dynamics of changes in soil moisture for soils with higher available water capacity is slower than that of light soils.

Conclusions

The aim of the paper was evaluation and, in particular, comparison of measured and calculated (model) values of soil moisture in Hodonín-Pánov and in Strážnice in the period of 2009–2011. Basic assumptions were confirmed, that the lighter soils in the area of Hodonín are characterized by frequent alternation of high and low status of soil moisture, while the heavier soils in Strážnice area are characterized by slower fluctuation of hydrolimits of soil moisture of water retention capacity and wilting point. VIRRIB equipment and both models are used, namely AVISO and FAO brought comparable results, especially in wetter years of 2009 and 2010. In drier year of 2011, both models underestimated values of soil moisture compared to the values measured in Hodonín-Pánov.

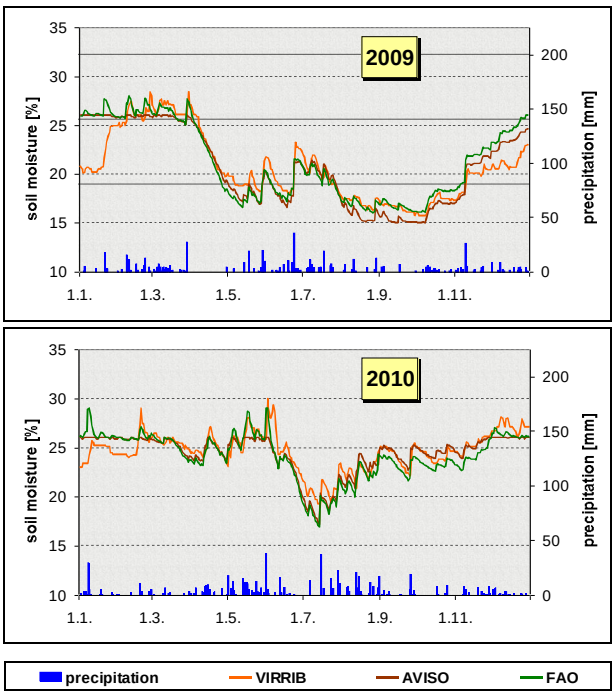

Figure 2. *Measured and model soil moisture and precipitation in Strážnice in the period of 2009–2011.*

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