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ESTIMATING EVAPOTRANSPIRATION OF DIFFERENTLY MOISTURED PEATLANDS USING REMOTELY SENSED SURFACE TEMPERATURE

The upper Notec river catchment – 4098 km²

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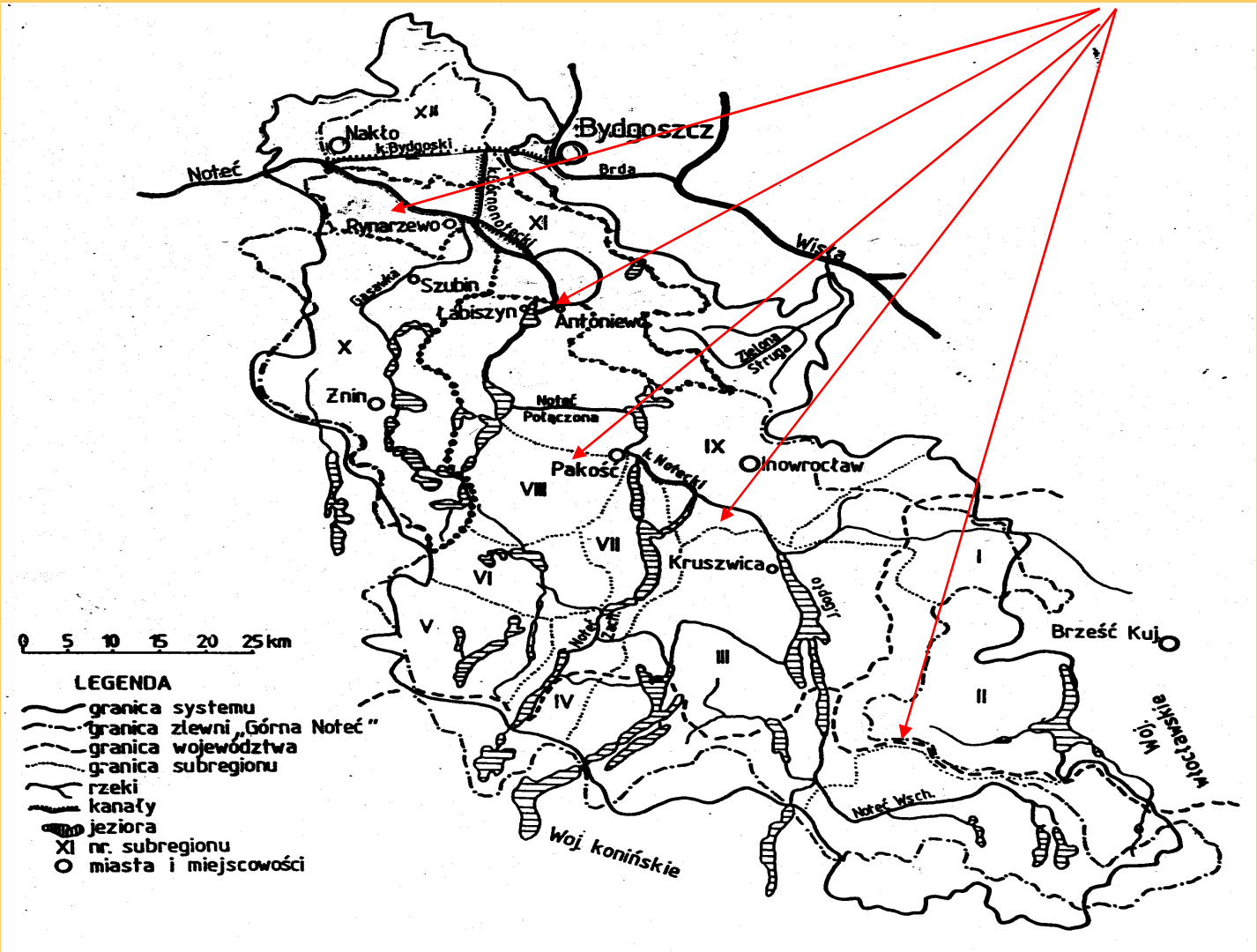
The area of the upper Notec river valley - 21000 ha



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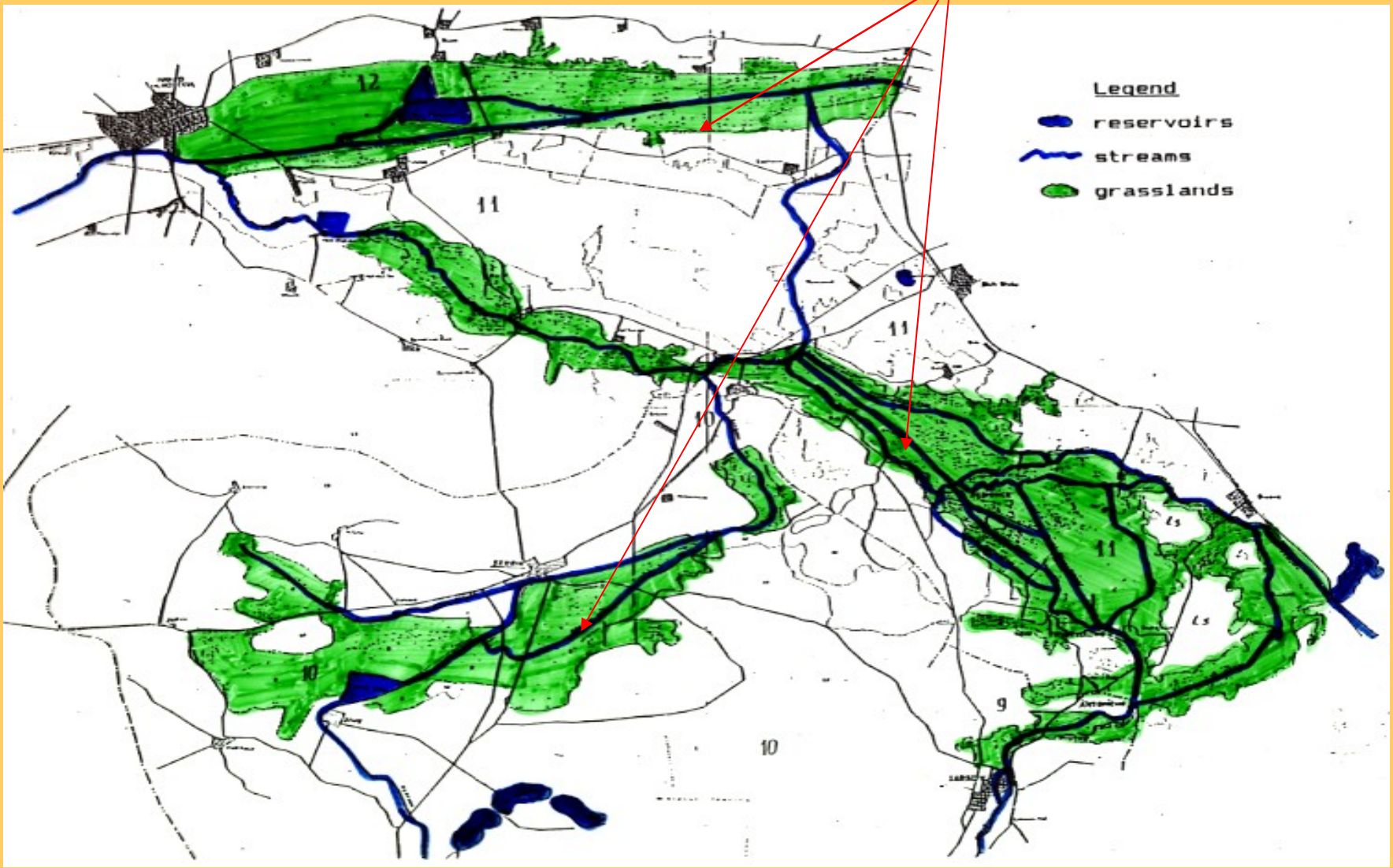
The area of peatlands in the river valley - 8950 ha



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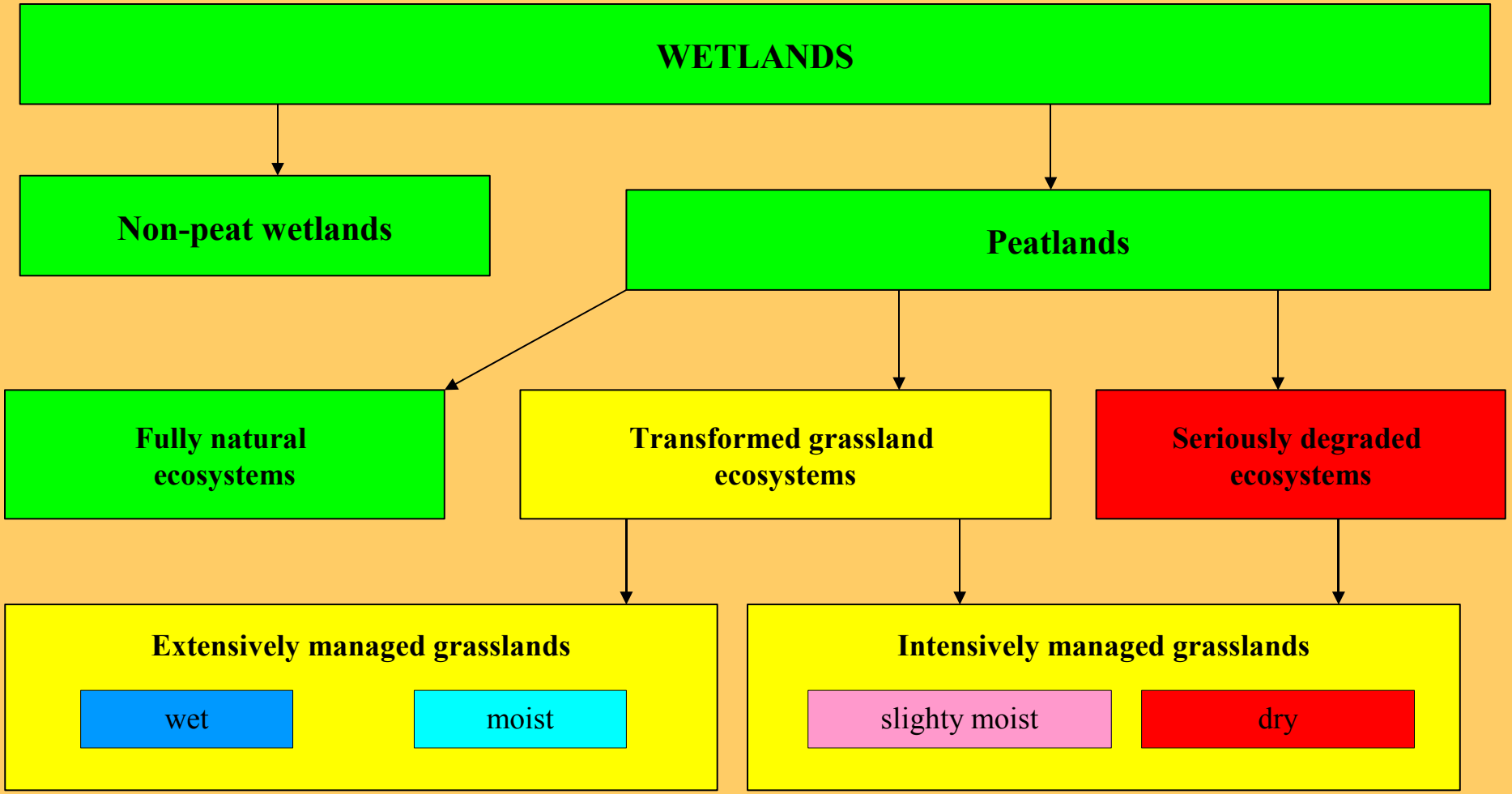
PEATLANDS IN THE NOTEC RIVER VALLEY



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The goal of the research

- **to estimate grassland evapotranspiration using surface temperature T_c**
- **to examine in three different peatland sites the differentiation of:**
  - **the surface temperature T_c**
  - **the difference between surface and air temperature T_c-T_a**
  - **the sensible heat flux H**
  - **the latent heat flux of evapotranspiration LE**

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Experimental procedures

- the 1999-2001 growing seasons
- three topogenous waterlogged grassland sites in the Notec river catchment:
  - periodically wet Pab, peat-moorsh soil MtIbb, 2-cut meadow, no fertilization
  - drying Pc, peat-moorsh soil MtIIcb, fertilized 3-cut meadow
  - dry Pd, moorsh soil Me11, pasture

Measured parameters:

- surface infrared temperature T_c
- air temperature T_a
- relative humidity RH
- solar shortwave radiation R_s
- wind speed
- plant canopy height

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Wet ecosystems

Moist and slighty moist transformed grassland ecosystems

Seriously degraded dry ecosystems

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Method of evapotranspiration calculation

$$R_n = G + H + LE$$

$G = 0.1R_n$ $(W \cdot m^{-2})$

$LE = 0.9R_n - H$ $(W \cdot m^{-2})$

$H = \rho c_p (T_c - T_a)/r_a$ $(W \cdot m^{-2})$

$r_a = (\ln(z - d)/z_o)^2/(k^2 u_z)$ $(s \cdot m^{-1})$

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Mean values and range of the examined parameters in the three sites

Parameter	Site		
	Pab	Pc	Pd
T_c (°C)	24.4 16.5 – 35.1	24.3 15.8 – 40.7	27.9 18.7 – 45.7
T_c-T_a (°C)	-1.1 -4.9 – 3.2	-1.3 -4.6 – 2.7	2.3 -4.3 – 8.7
H ($W \cdot m^{-2}$)	-197 -790 – 542	-226 -1052 – 879	245 -369 – 1349
LE ($W \cdot m^{-2}$)	405 -335 – 935	445 -528 – 1154	-65 -1226 – 483

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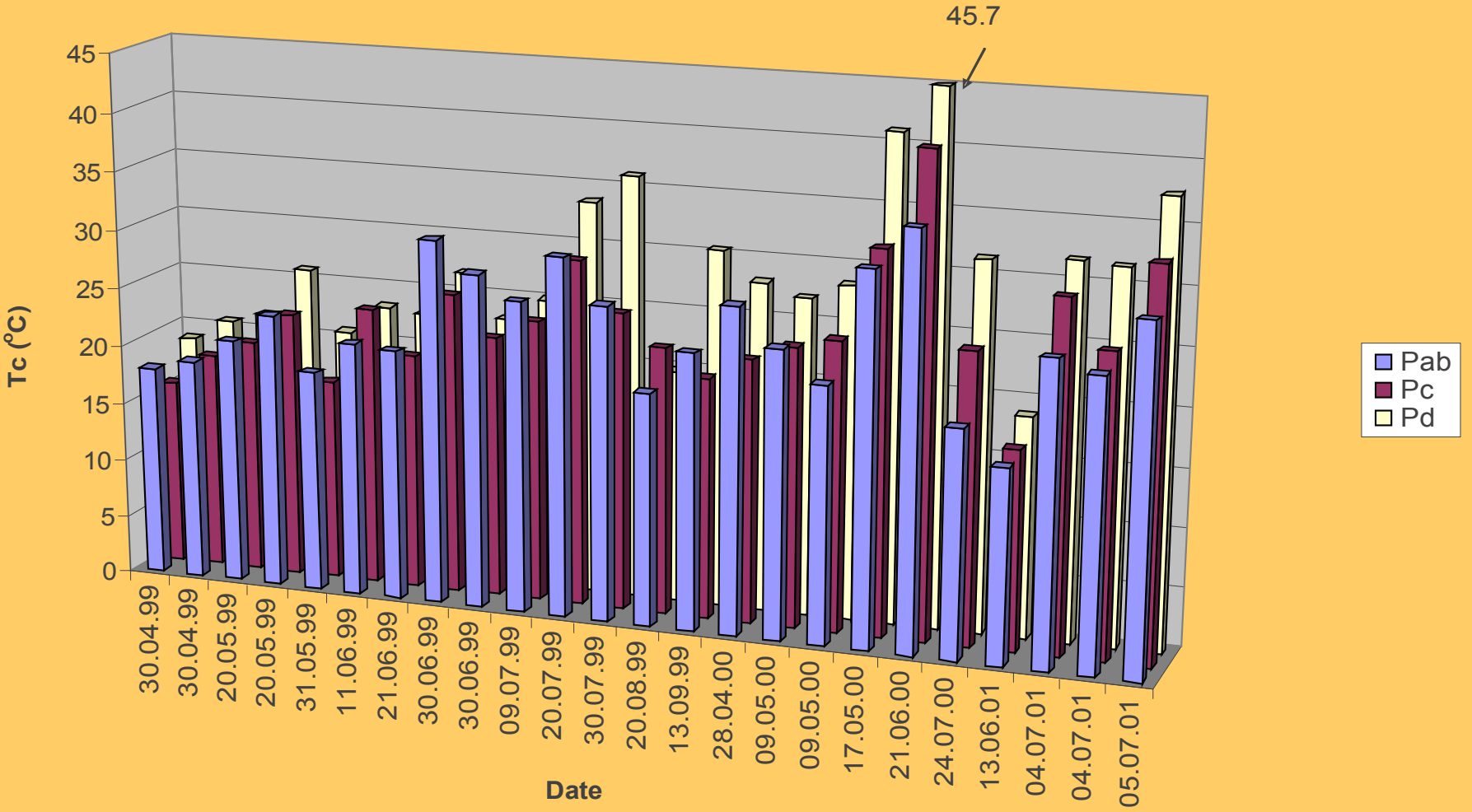

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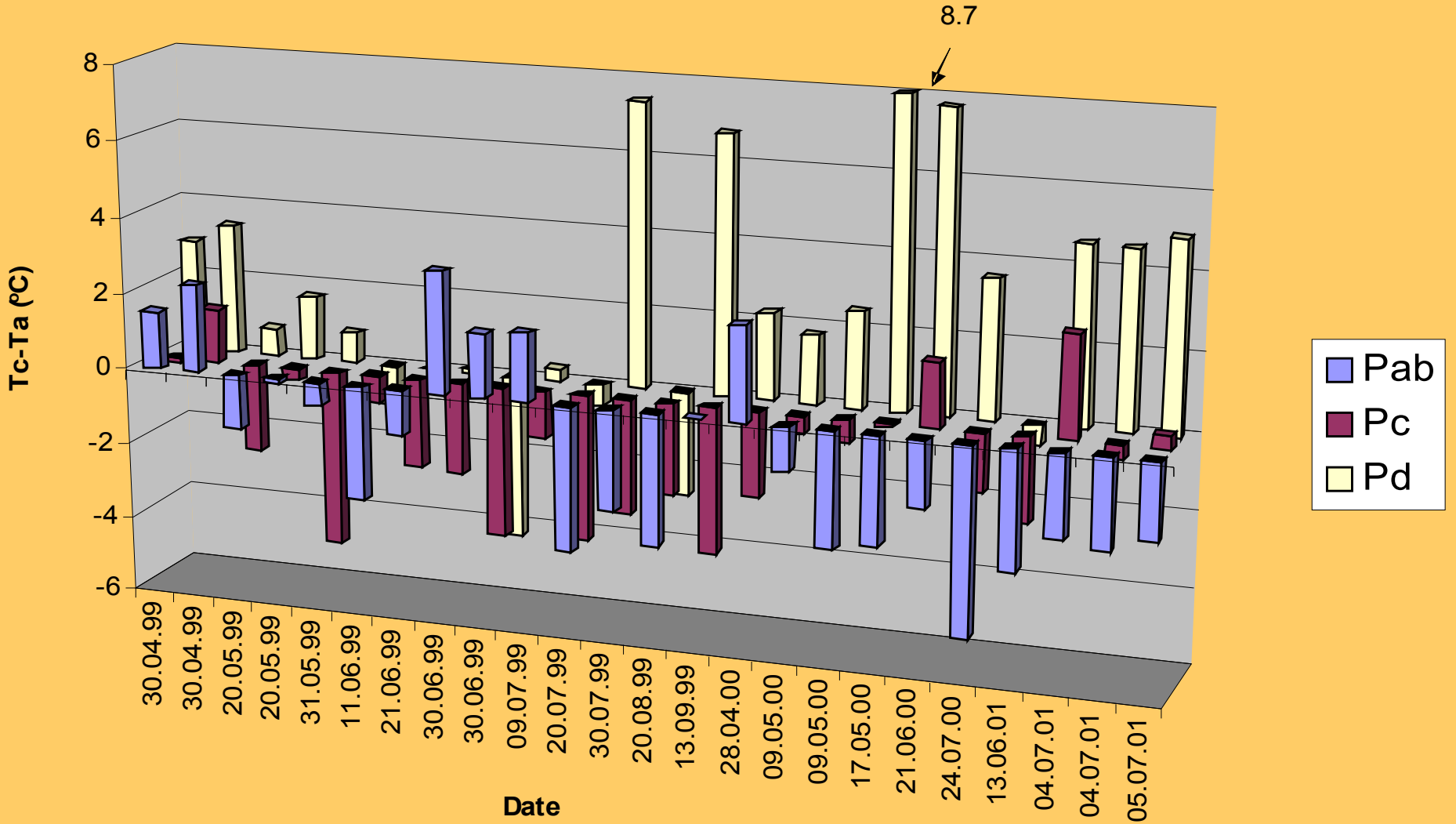

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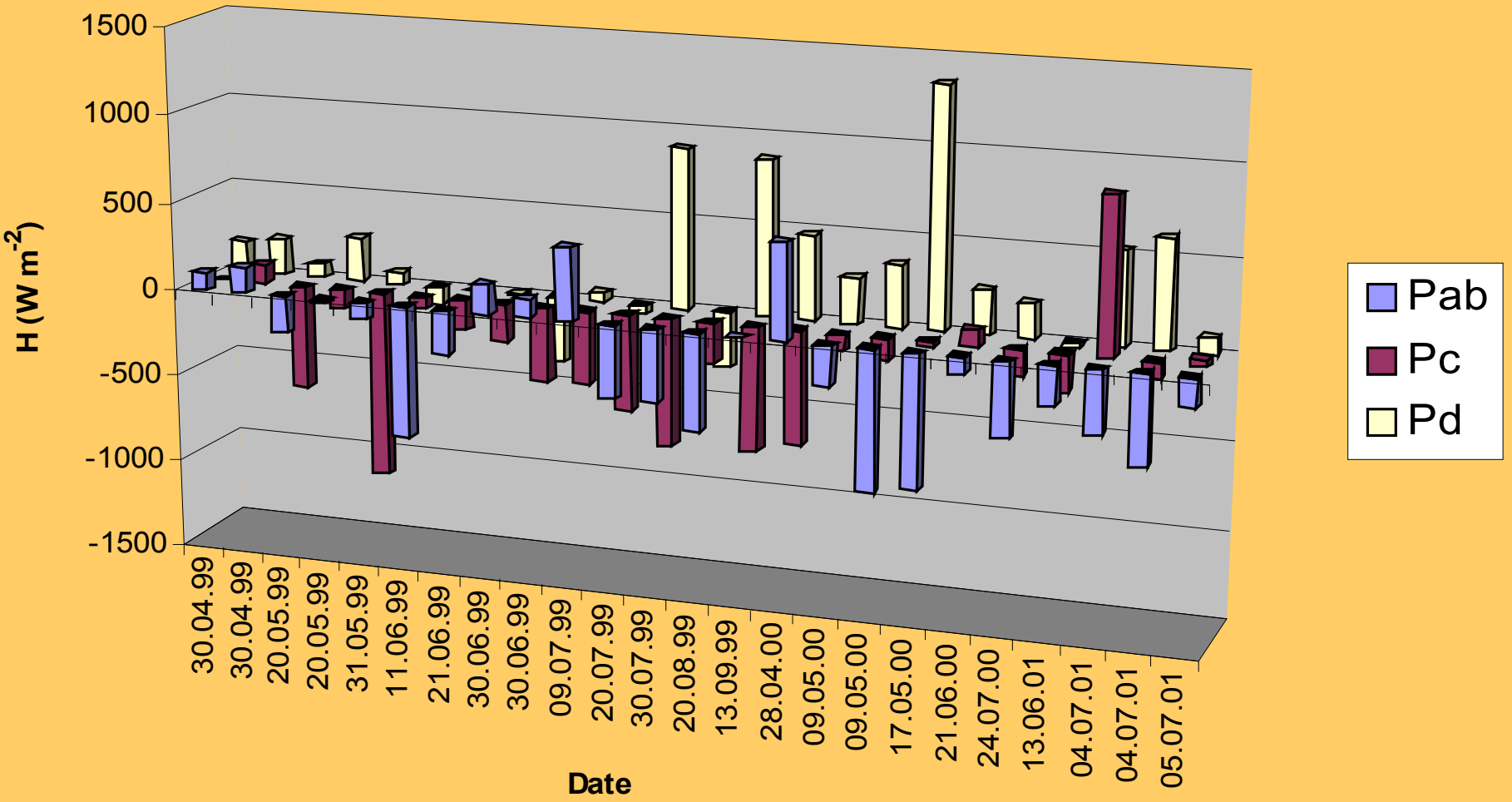

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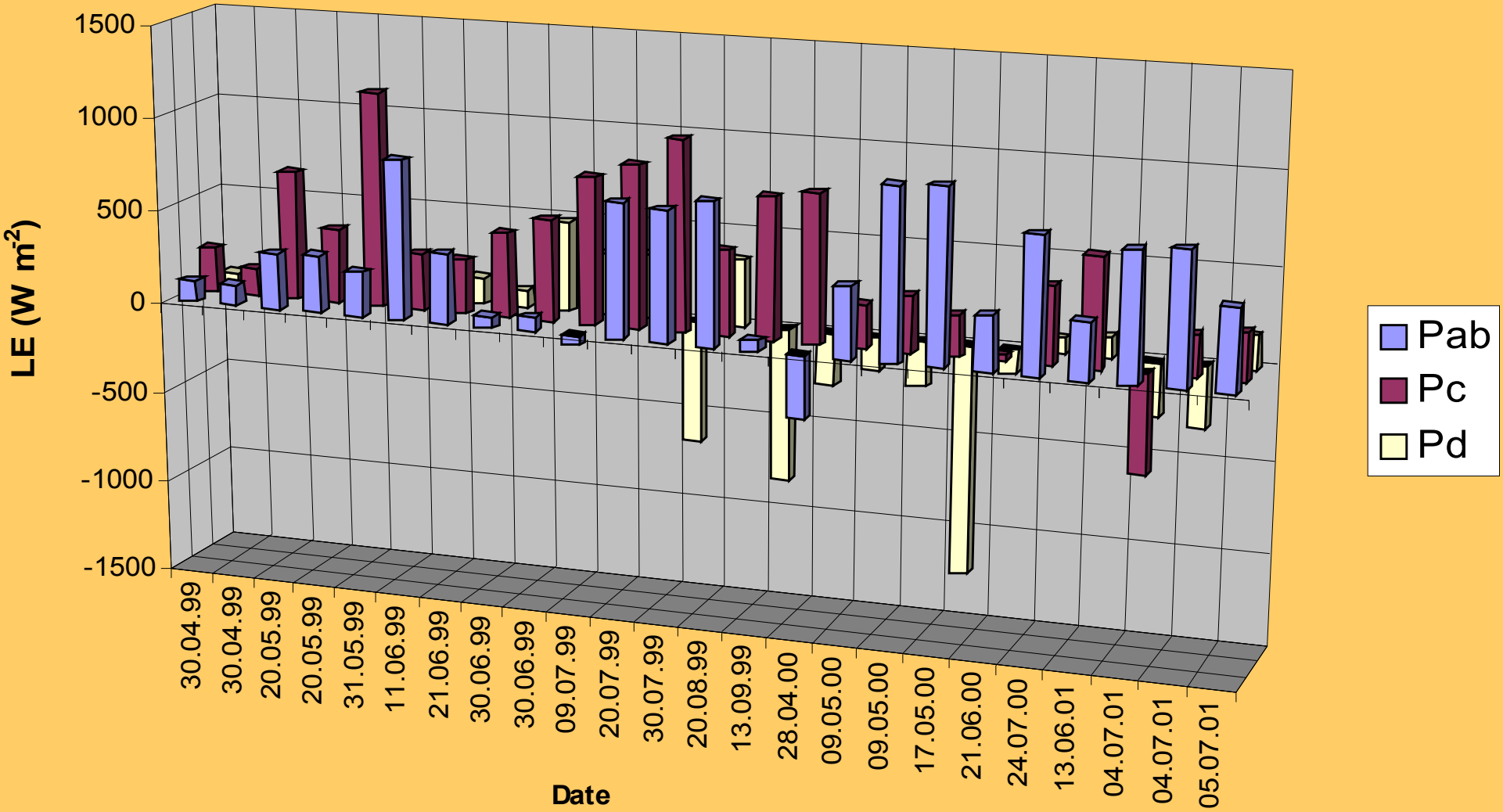

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Significance of the effect of the site conditions on the examined parameters (according to the F-Snedecor test)

Parameter	Significance level
T_c	0.069
T_c-T_a	0.000
H	0.000
LE	0.000

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Significance levels of the differences in the examined parameters (according to the Newman-Keuls test)

Parameter	Site	Pc	Pd
T_c			
	Pab	0.917	0.051
	Pc	-	0.098
T_c-T_a			
	Pab	0.745	0.000
	Pc	-	0.000
H			
	Pab	0.787	0.000
	Pc	-	0.000
LE			
	Pab	0.705	0.000
	Pc	-	0.000

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CONCLUSIONS

The difference of surface and air temperature as well as the sensible and latent heat fluxes calculated on the basis of surface temperature, seem to respond well to the site conditions (pedoclimatic and plant factors).

According to the actual values of these factors the courses of evapotranspiration rate in the examined sites were different. In most cases the highest rate was observed in the drying site with optimal soil moisture conditions and good status of plant cover.

Remotely sensed surface temperature, used in conjunction with net radiation, air temperature, wind speed and surface roughness, can be used for operational - in real time - estimation of evapotranspiration.

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Questions that need to be answered

how to extrapolate values from point measurements
to spatial scale

how to estimate the aerodynamic resistance so that the proper value is used and the proper stability correction can be made

how to convert one-time-of-day measurements
to daily totals of evapotranspiration

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Although more effort is still required, the goal of estimating regional evapotranspiration by remote means appears attainable.

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