The Palfai Drought Index (PaDI) –
Expansion of applicability of Hungarian PAI for South East Europe (SEE) region
Summary

In Hungary the Palfai drought index (PAI) worked out **for users in agriculture and in water management** has been used for numerical characterization of droughts since the beginning of the 1980s.

This index characterizes the **strength of the drought for an agricultural year with one numerical value**, which has a strong correspondence with crop failure.

In the course of the DMCSEE project we analyzed the possibility of using the PAI in the South-East European area, and we also examined what kind of changes its wider practice demands considering especially the basic data availability.

The calculation of what is called the base-value of PAI is essentially the same because it's simple, data demand is easily satiable, only monthly mean air temperature and sum of precipitation are needed for calculations

However, in the formula of PAI the determination of three correction factors, based on daily temperature and precipitation values, as well as groundwater levels is difficult. For easier practical use we have worked out a new, simpler method for the calculation of these factors, which is based on monthly mean air temperature and monthly sum of precipitation.

The formula of the base-value of the modified index, named Palfai's Drought Index (PaDI) is:

$$PaDI_o = \frac{\left[\sum_{i=apr}^{aug} T_i\right] \; / \; 5*100}{c + \sum_{i=oct}^{sept} \left(P_i * w_i\right)}$$

where

$PaDI_0$ – base-value of drought index, °C/100 mm
T_i – monthly mean temperature from April to August, °C,
P_i – monthly sum of precipitation from October to September, mm,
w_i – weighting factor,
c – constant value (10 mm).

The weight factors (w_i) of precipitation in Table 1. express the difference between the moisture accumulation in soil and the water demand of plants.

Table 1. Weight factors

Month	w_i **weight factors**
October	0,1
November, December	0,4
January-April	0,5
May	0,8
June	1,2
July	1,6
August	0,9
September	0,1

Calculation of PaDI

$$PaDI = PaDI_o * k_1 * k_2 * k_3$$

PaDI – Palfai Drought Index, °C/100 mm
k_1 – temperature correction factor,
k_2 – precipitation correction factor
k_3 – correction factor, which characterizes the precipitation circumstances of the previous 36 month

From the correction factors the temperature factor k_1 represent the relation between examined and annual summer mean temperature, the precipitation factor k_2 represent the relation between examined and annual summer precipitation sum and k_3 represent the effect of precipitation circumstances of previous 36 month.

For eight Hungarian stations we have determined the PAI and PaDI values for the period 1961-2009, and there is no significant difference between the results. Because the geographical and climate relations of Hungary and the South East European countries somewhat differ, the classification of drought strength is wider for PaDI (Table 2.): seven classes have been introduced instead of the five used before.

Table 2. Drought categories

PaDI, ºC/100 mm	Description
< 4	droughtless year
4 – 6	mild drought
6 – 8	moderate drought
8 – 10	heavy drought
10 – 15	serious drought
15 – 30	very serious drought
> 30	extreme drought

The PaDI results for some stations from the SEE region for the period 1961-2009 are represented in column graph format on Fig.1.

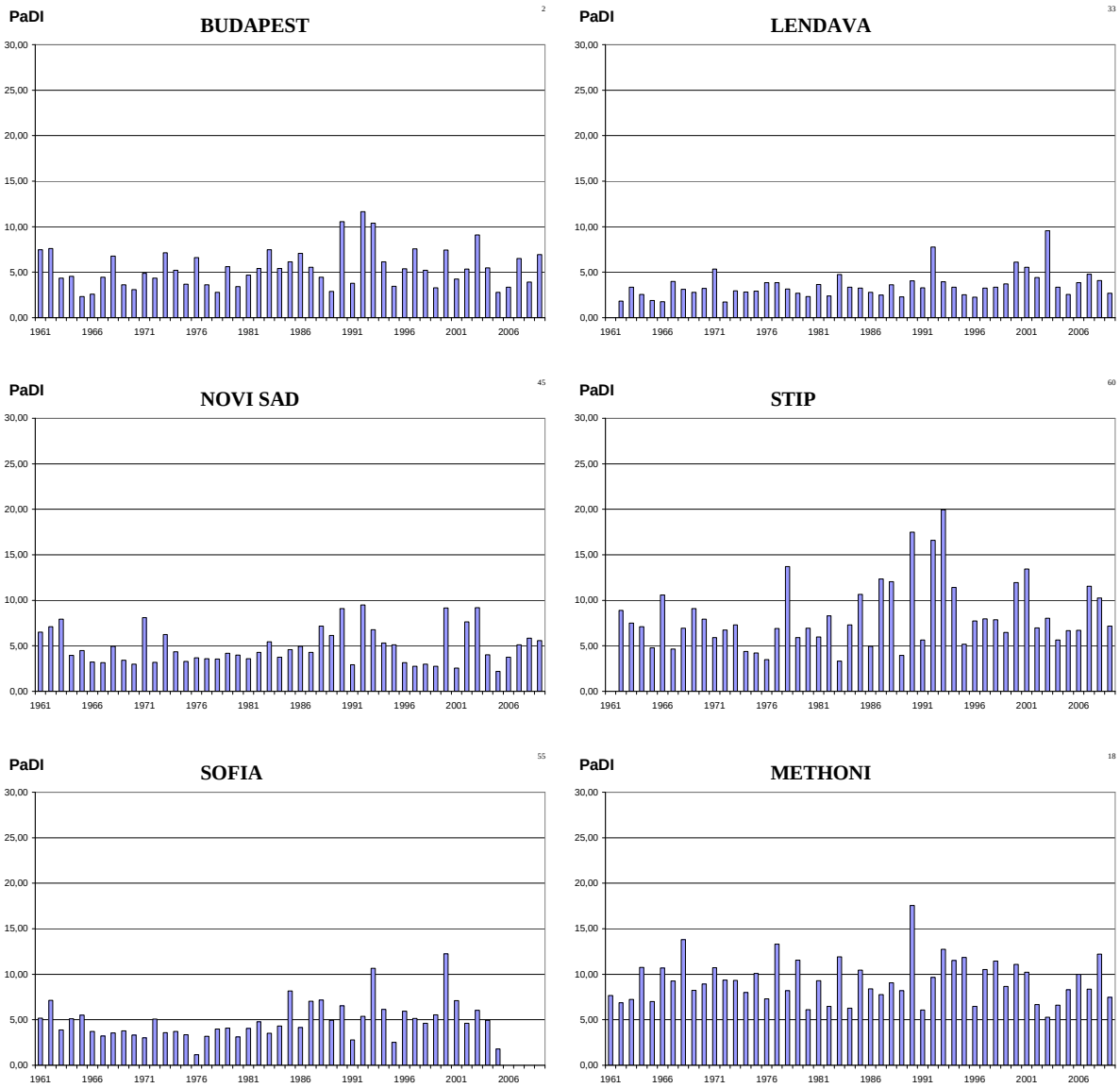

Fig 1. PaDI time series for 10 stations: Budapest (H), Lendava (SLO), Novi Sad (SRB), Stip (MK), Sofia (BG) and Methoni (GR)

According to the figures in the second part of the examined period the more droughty years are more common. The highest values of PaDI in the whole region are in the following years: 1990, 1992, 1993, 2000, 2003 and 2007.

For these droughty years using all 63 stations the spatial distribution of PaDI for SEE region was defined. These are on Fig.2. It can be established, that the strength of drought shows different spatial distribution year by year, but affects mainly the south part of the examined area. In the Carpathian Basin the drought intensity is smaller (except in 2003), but frequency is similar.

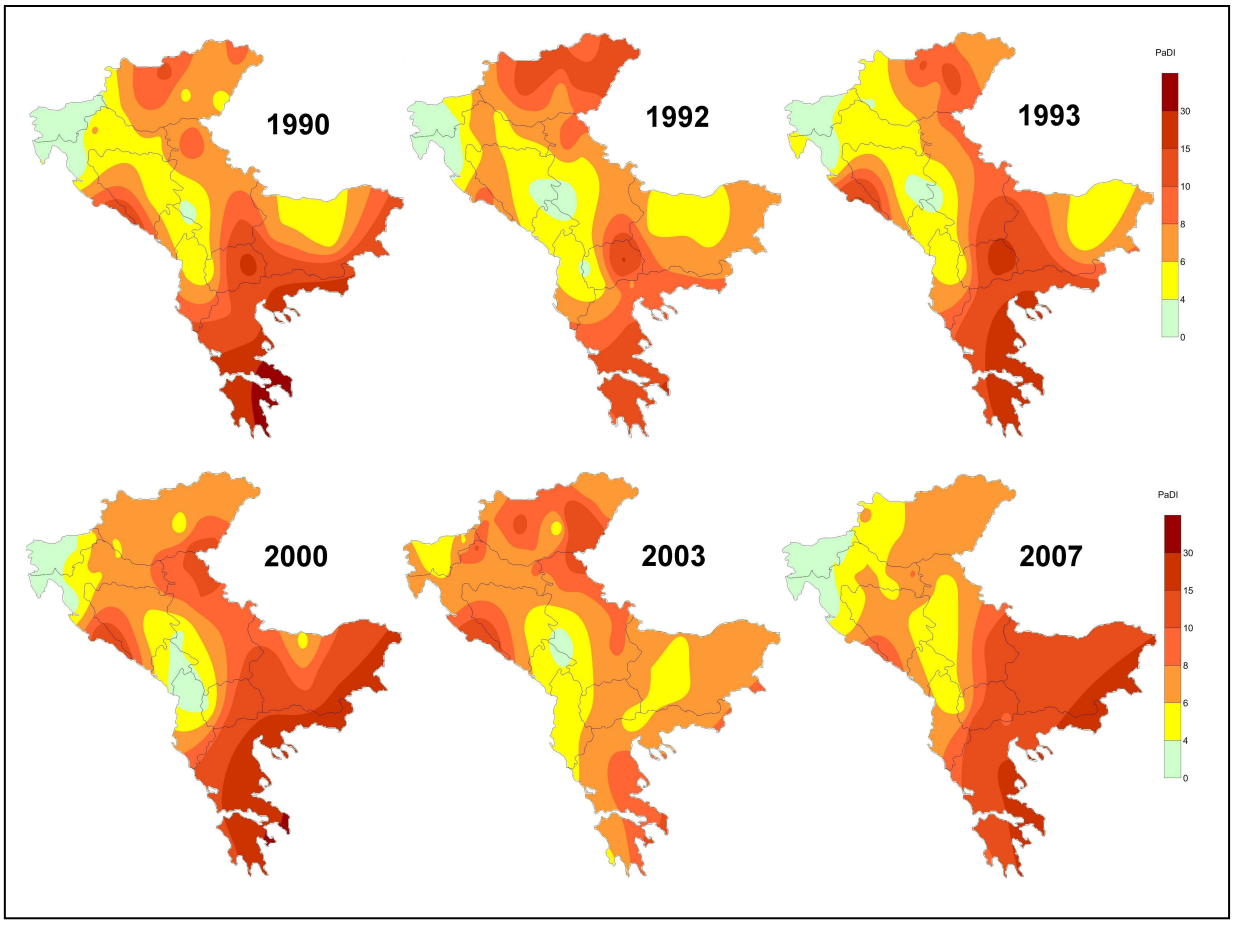

Fig. 2. Spatial distribution of PaDI in SEE region for years 1990, 1992, 1993, 2000, 2003 and 2007.

The map constructed from the 10% probability of occurrence of PaDI expresses the spatial difference of droughtness inside the region. It is shown on Fig. 3.

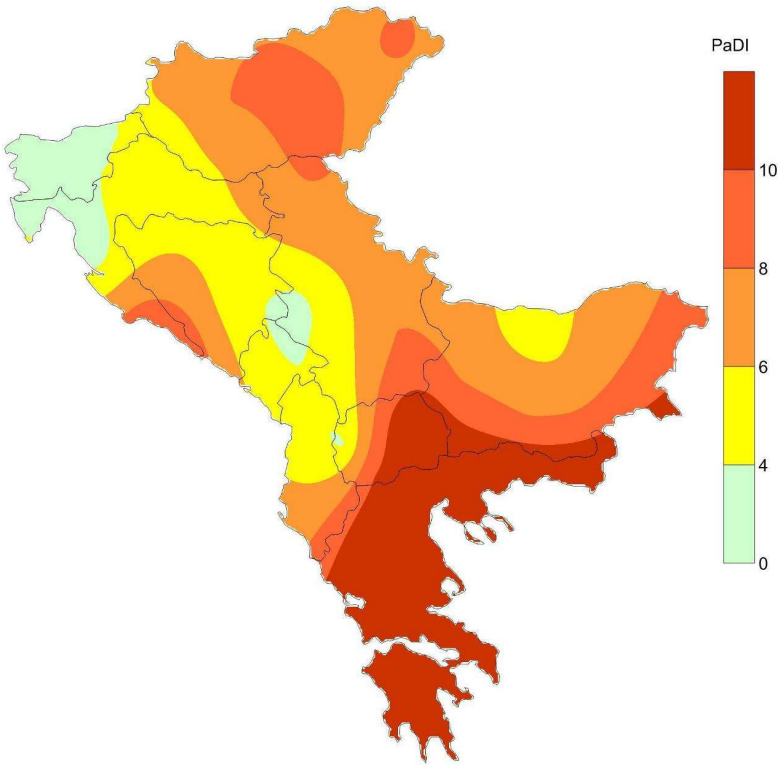

Fig.3. The 10% probability of occurrence of PaDI in SEE region

As PaDI expresses the strength of drought for a whole agricultural year, the application of SPI_3 or SPI_6 is also practical for the characterization of seasonal drought. Beside drought characterization of past years PaDI is also useful to forecast drought in a way that the raw data known is expanded month by month with the presumed data in more variations.