

Palfai Drought Index (PaDI)

Easy method to analyze drought,
tool for forecast, for early warning

DMCSEE

Final meeting

14th May – 16th May 2012, Ljubljana

Arpad Herceg

ATI-VIZIG, Szeged, Hungary

hercega@ativizig.hu

Jointly for our common future



PaDI (Palfai Drought Index)

Indicates strength of drought for
one agricultural year with one data

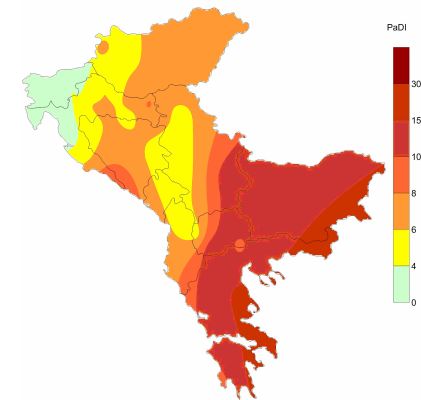
Proportional with crop decrease

Uses results of meteorological measures, but the **summer precipitation is more weighted** → characterization of water scarcity in agriculture

Contains the most determinant factors

Gives time series proper for trend analysis

Suitable for correlation analysis (yield, pests, etc.)



PaDI (Palfai Drought Index)

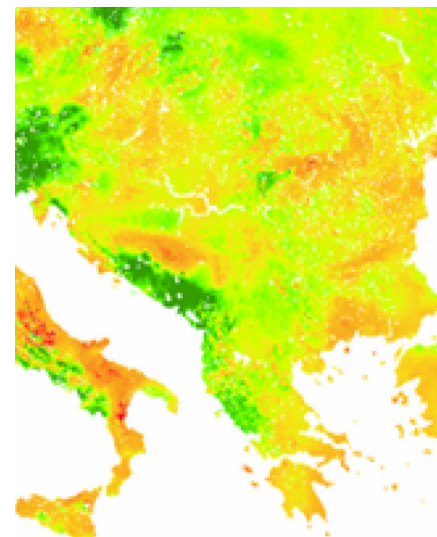
Based on Hungarian PAI

- Theoretically the same, but less data demand
- Calculating is more simple
- Relates to local average conditions

Calculation data demand:

- monthly mean temperature
- monthly precipitation sum

Possibility to preparing entire map of droughtness ($\text{PaDI}_{10\%}$) for larger regions (countries, Carpathian Basin, SEE, Europe)



PaDI (*Palfai Drought Index*)

$$PaDI_o = \frac{\left[\sum_{i=apr}^{aug} T_i \right] / 5 * 100}{10 + \sum_{i=oct}^{sept} (P_i * w_i)}$$

Month	w _i
X	0.1
XI, XII	0.4
I,II,III,IV	0.5
V	0.8
VI	1.2
VII	1.6
VIII	0.9
IX	0.1
Σ=	7.5

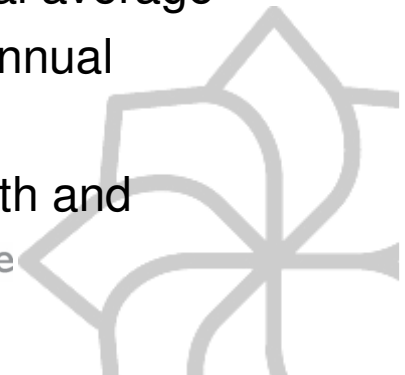
$$PaDI = PaDI_o * k_1 * k_2 * k_3$$

k_1 = relation between summer average temperature and annual average

k_2 = relation between summer min. monthly precipitation and annual average

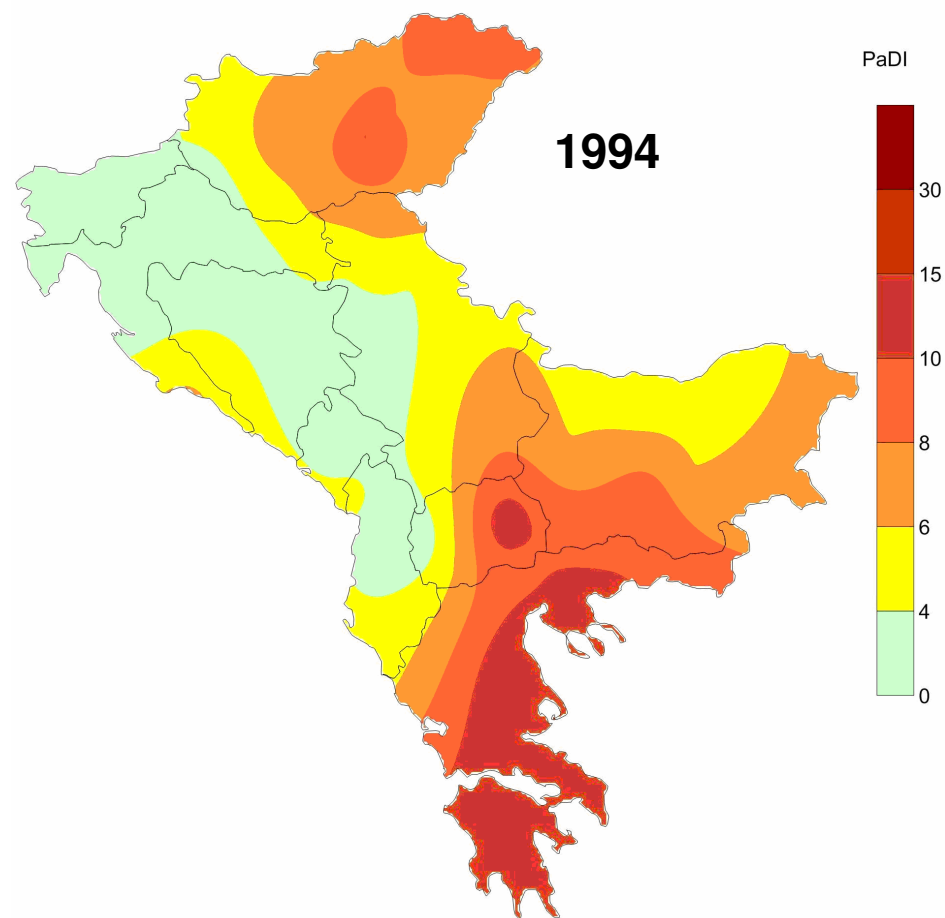
k_3 = relation between average precipitation of previous 36 month and annual average

Jointly for our common future



PaDI (*Palfai Drought Index*)

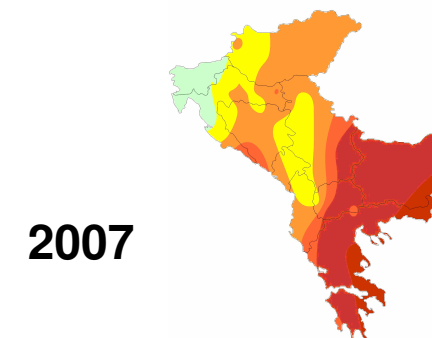
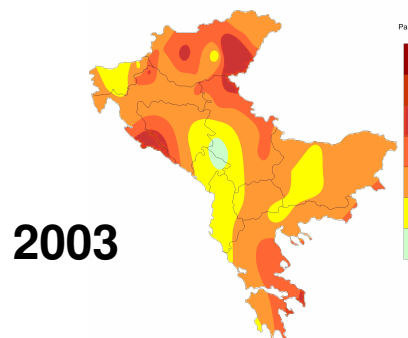
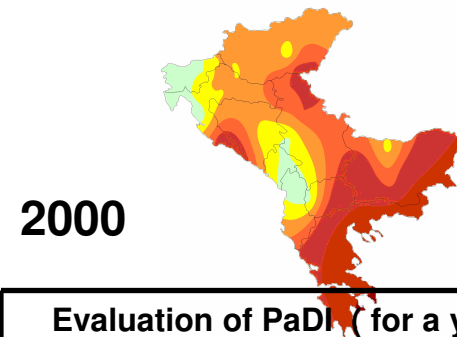
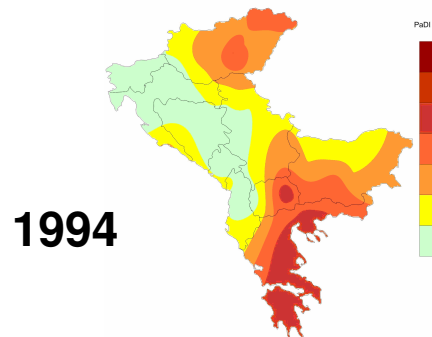
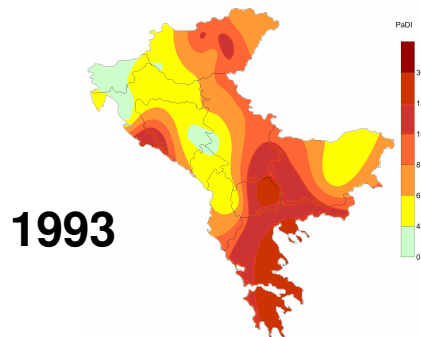
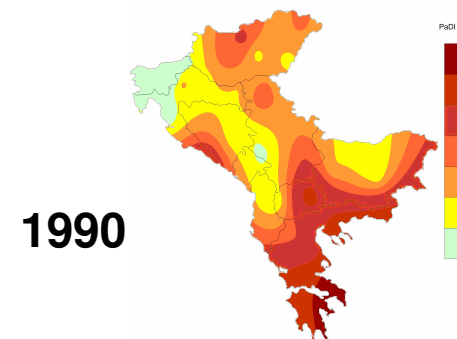
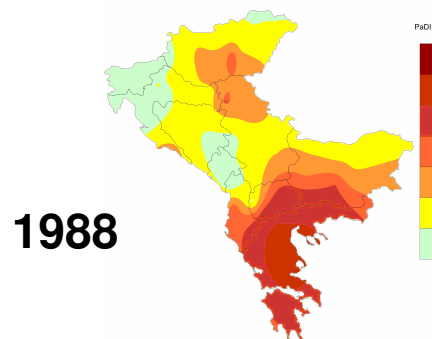
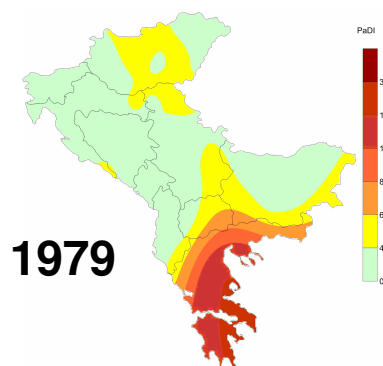
Evaluation of PaDI (for a year)	
4-6	mild drought
6-8	moderate drought
8-10	medium-weight drought
10-15	serious drought
15-30	very serious drought
>30	extreme drought



Jointly for our common future



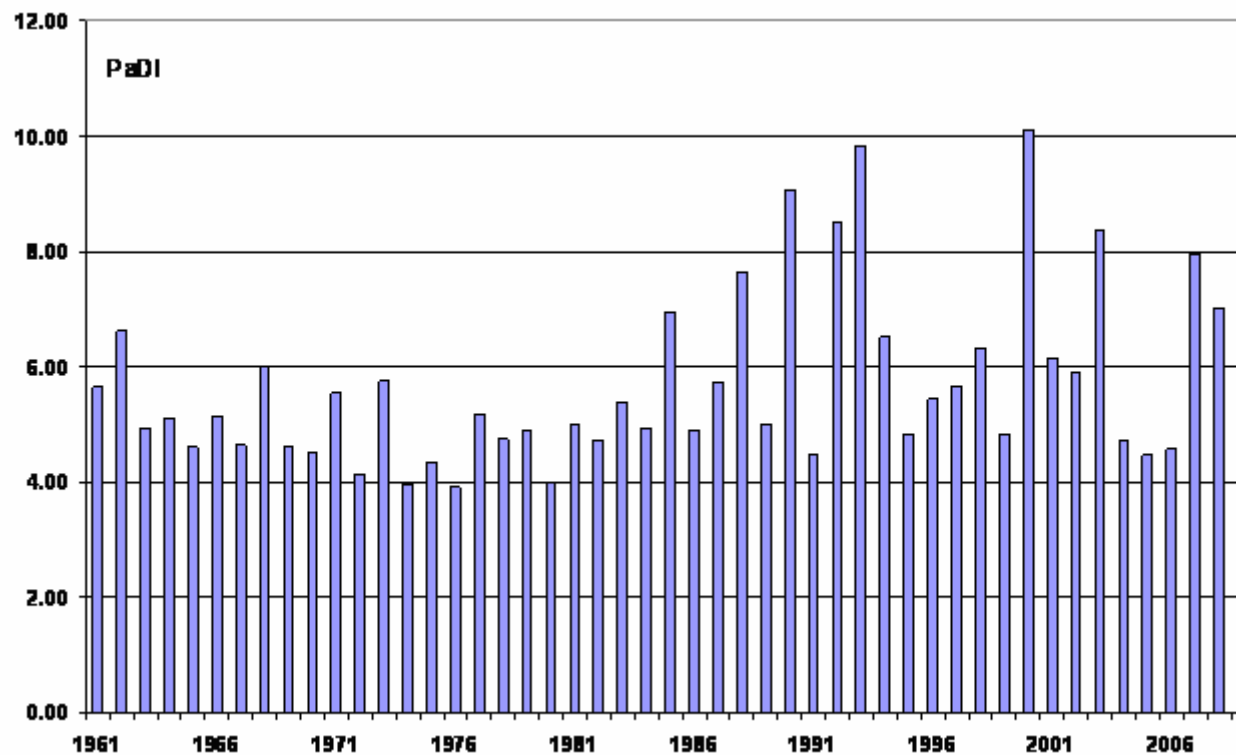
PaDI (*Palfai Drought Index*)



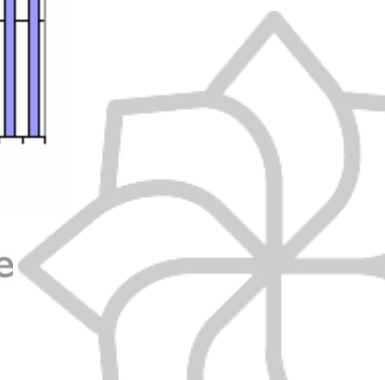
Evaluation of PaDI (for a year)	
4-6	mild drought
6-8	moderate drought
8-10	medium-weight drought
10-15	serious drought
15-30	very serious drought
>30	extreme drought

PaDI (*Palfai Drought Index*)

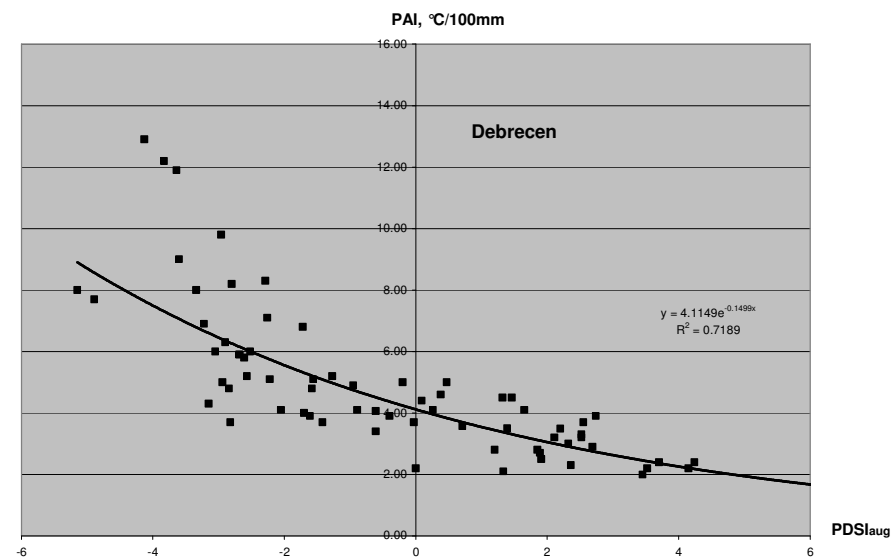
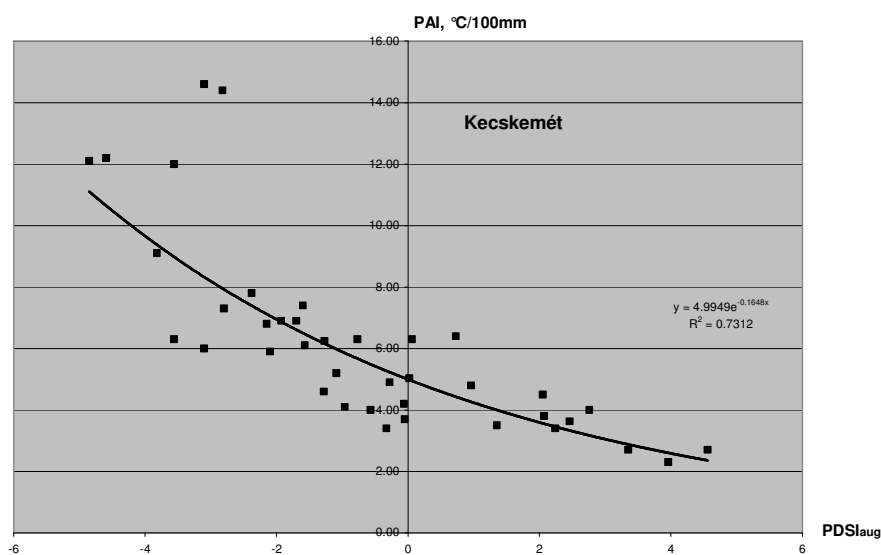
Regional averages of PaDI in period 1961-2009



Jointly for our common future



Regression between PaDI and PDSI



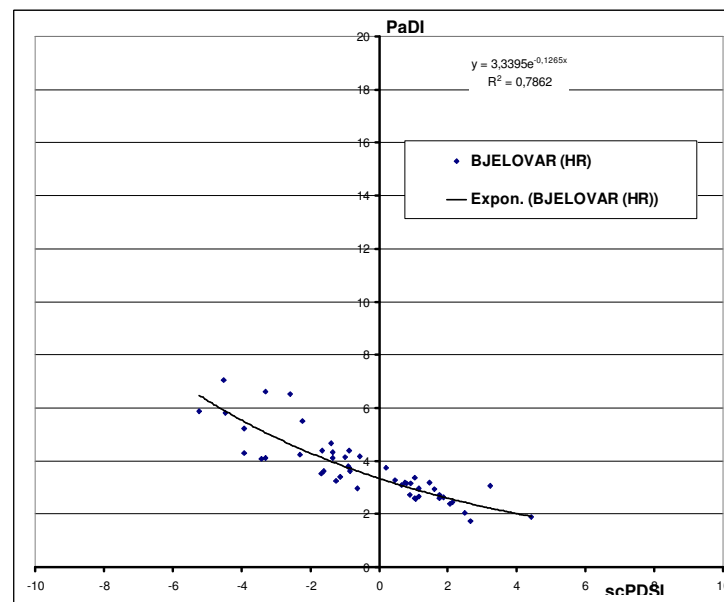
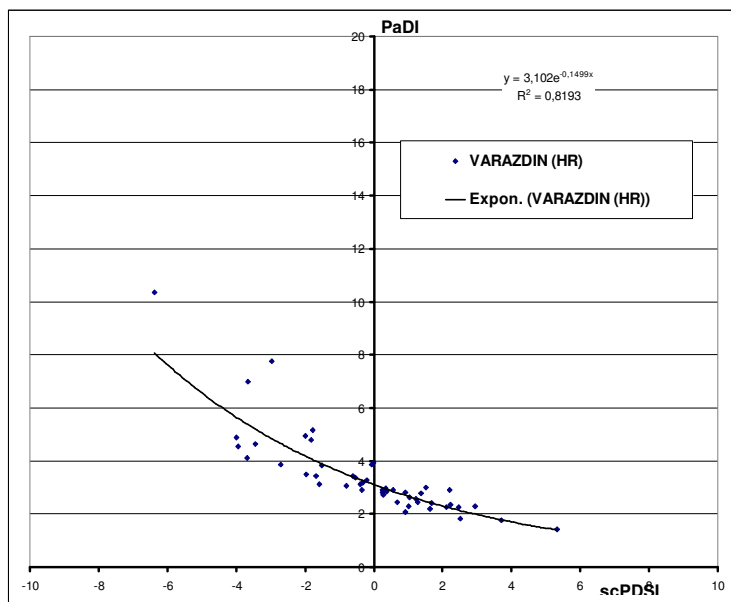
in Hungary

$$y = a * e^{bx} ; R^2_{avg} > 0,7$$

Jointly for our common future



Regression between PaDI and scPDSI



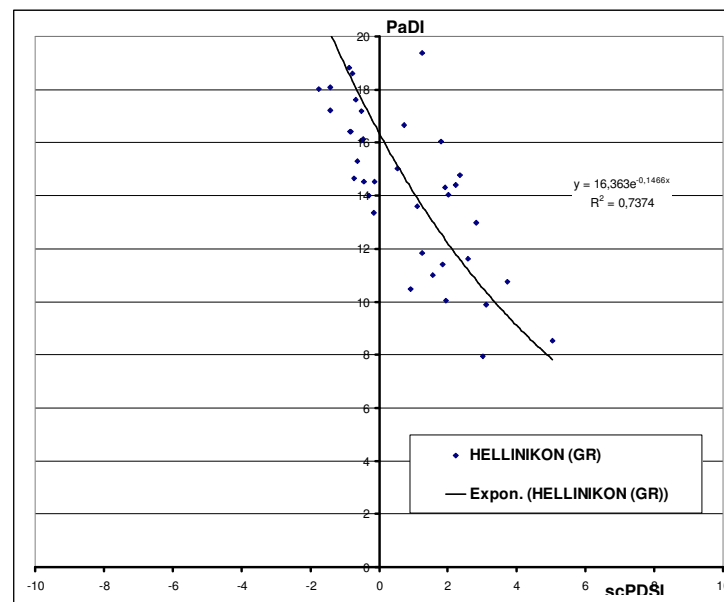
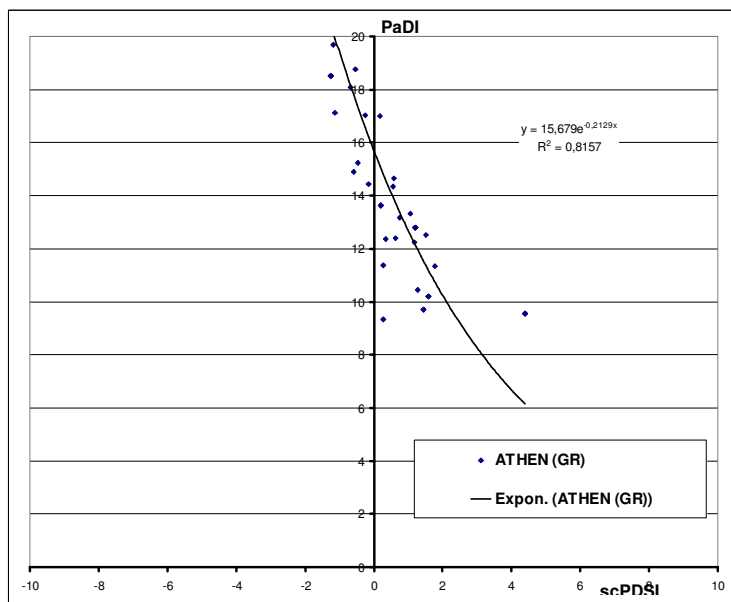
Croatia

$$y = a * e^{bx} ; a_{avg} = 4,05 \quad b_{avg} = -0,13 \quad R^2_{avg} = 0,69$$

Jointly for our common future



Regression between PaDI and scPDSI



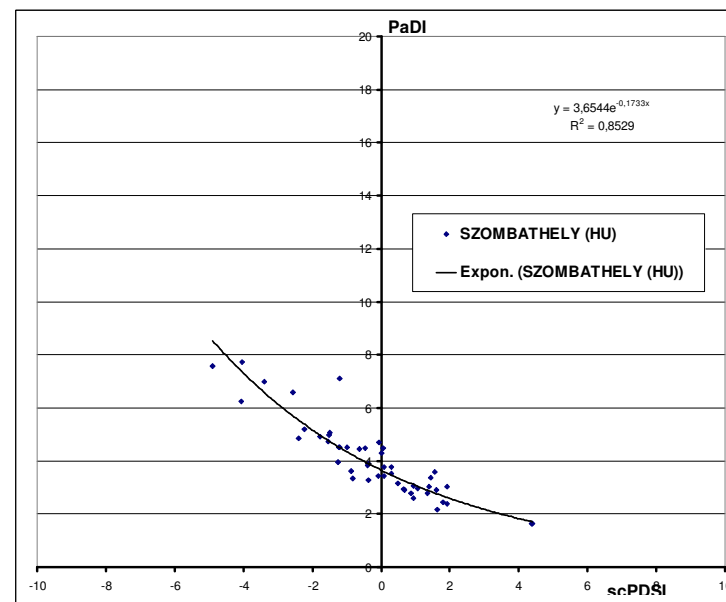
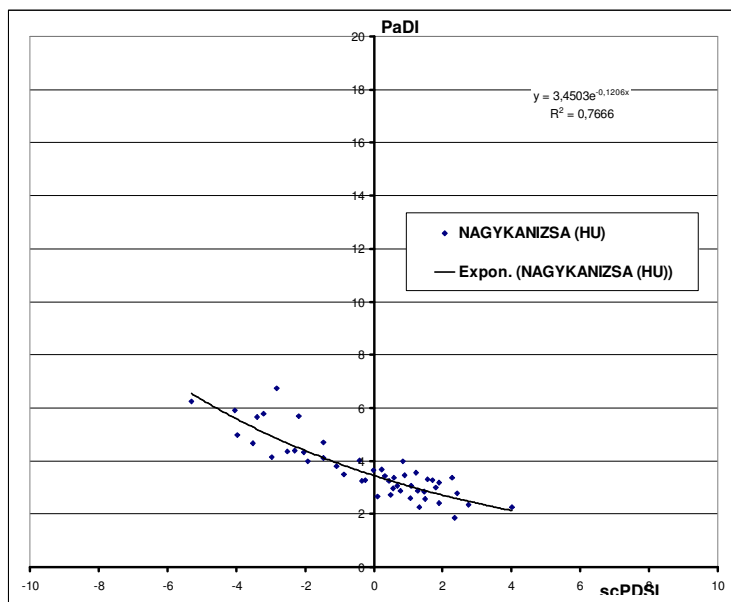
Greece

$$y = a * e^{bx} ; a_{avg} = 13,10 \quad b_{avg} = -0,13 \quad R^2_{avg} = 0,69$$

Jointly for our common future



Regression between PaDI and scPDSI



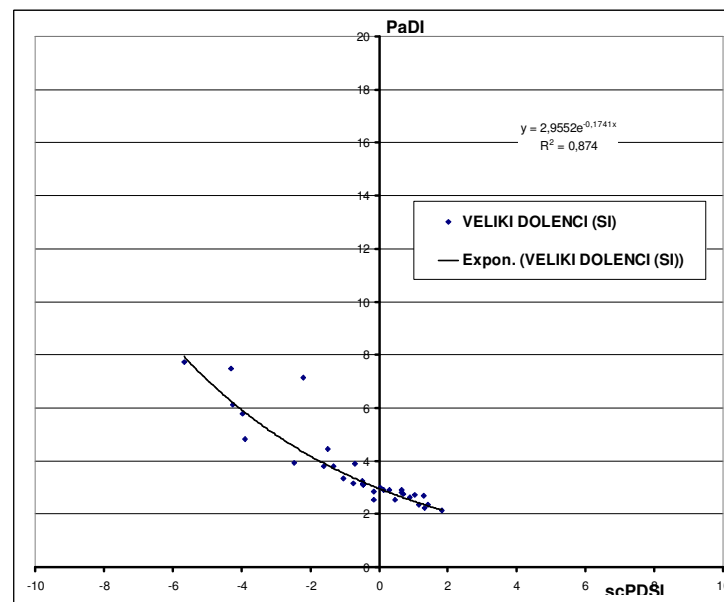
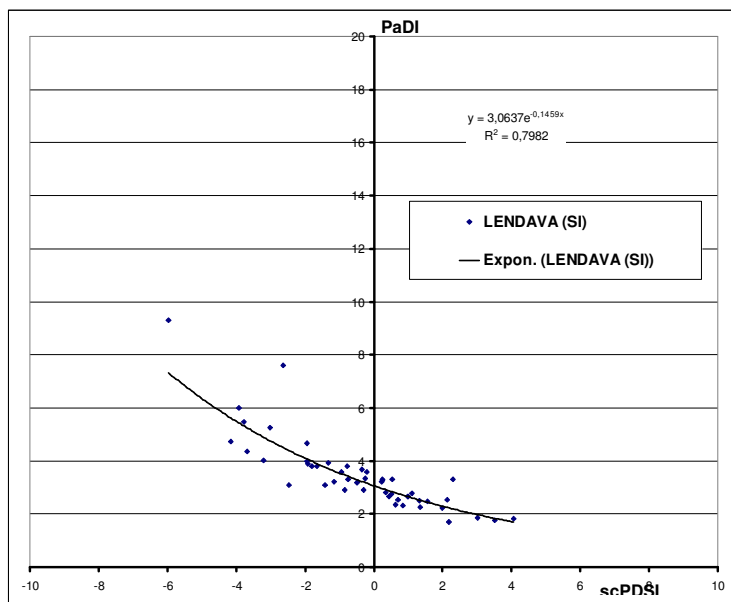
Hungary

$$y = a * e^{bx} ; a_{avg} = 4,40 \quad b_{avg} = -0,14 \quad R^2_{avg} = 0,71$$

Jointly for our common future



Regression between PaDI and scPDSI



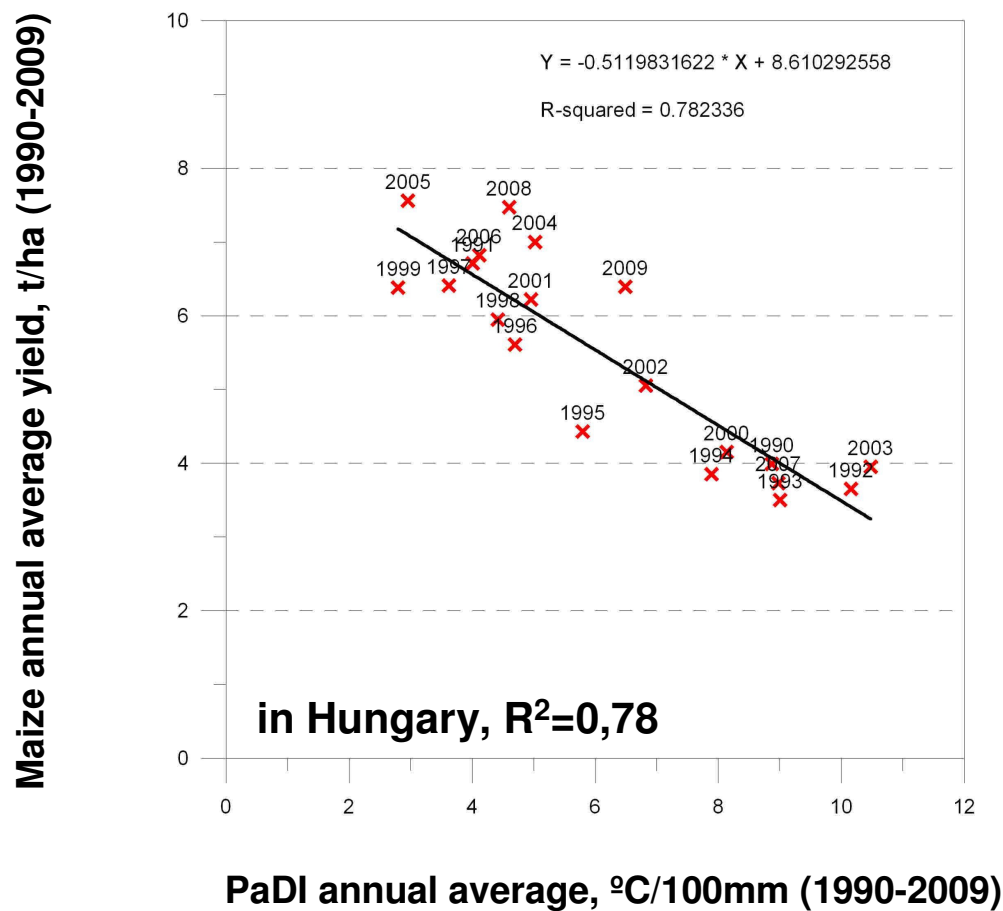
Slovenia

$$y = a * e^{bx} ; a_{avg} = 2,55 \quad b_{avg} = -0,14 \quad R^2_{avg} = 0,72$$

Jointly for our common future



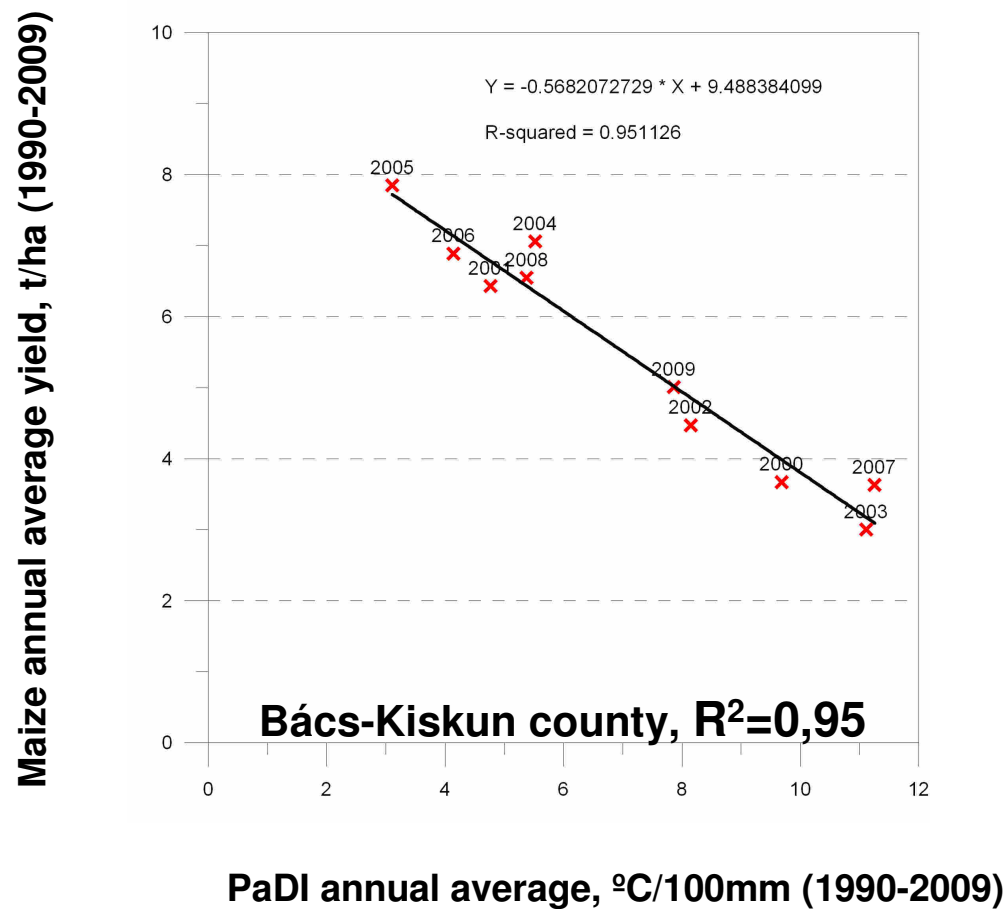
Regression between PaDI and maize yield



Jointly for our common future



Regression between PaDI and maize yield



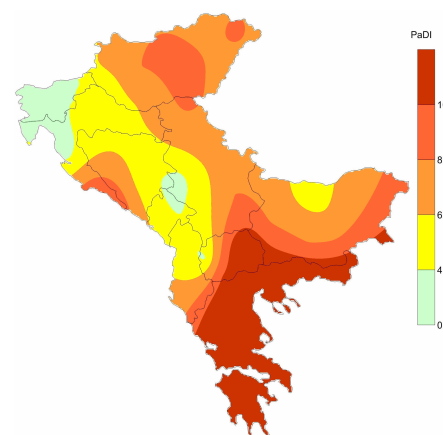
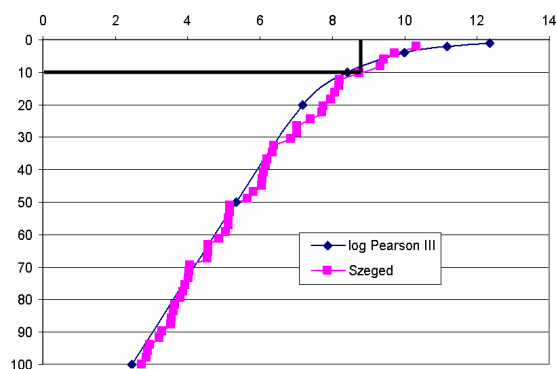
Jointly for our common future



PaDI_{10%} (*Palfai Drought Index - frequency*)

Drought frequency, map of droughtness:

- 10% probability of occurrence (log-Pearson Type III Distribution) of PaDI, given from long data queue
- expresses the climatic factor (geographical characteristic) of region – drought intensity and frequency,



Jointly for our common future



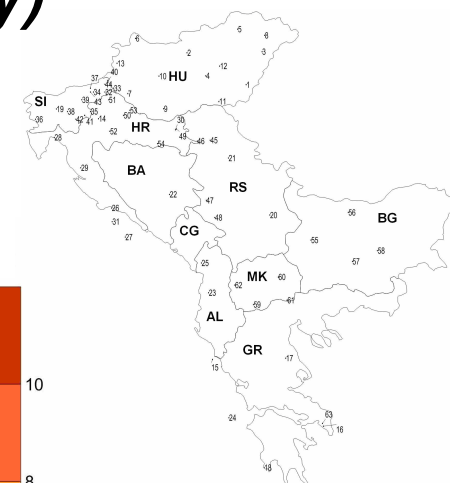
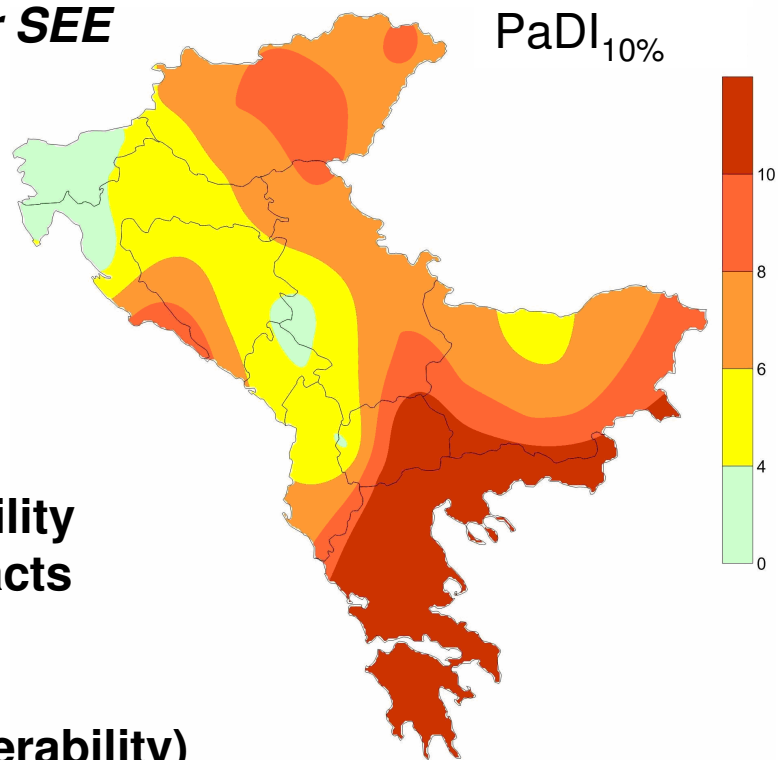
PaDI_{10%} (*Palfai Drought Index - frequency*)

The 10% probability of occurrence of PaDI for SEE region (PaDI_{10%})

→ Droughtness

Droughtness → Probability of impacts

(Risk * Impacts = Vulnerability)

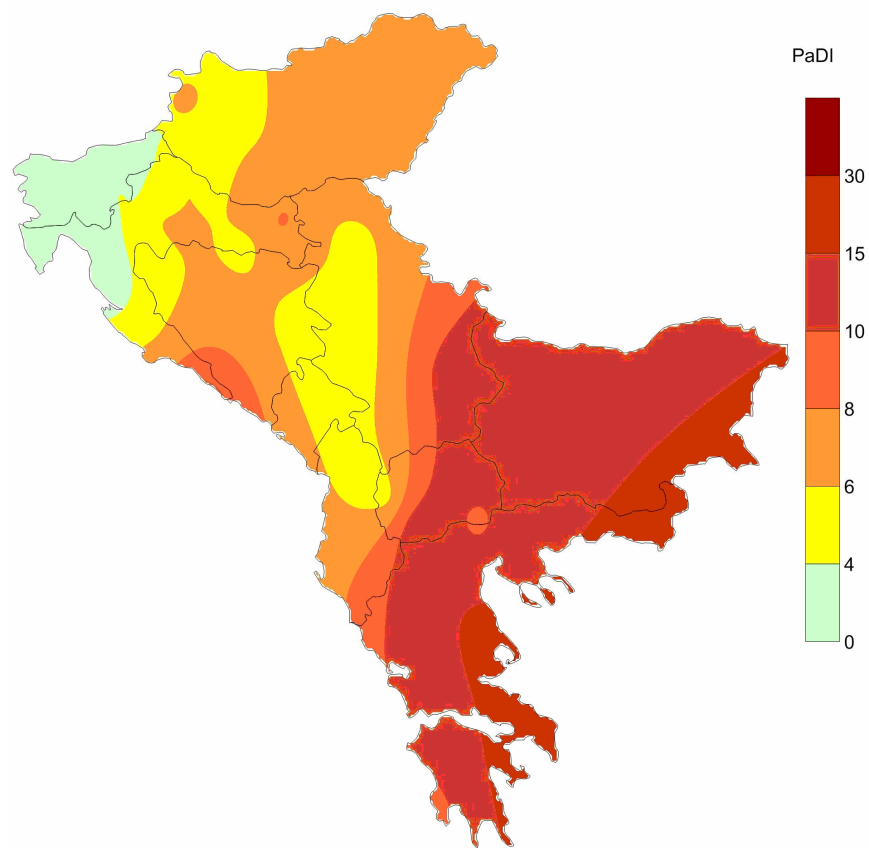


Jointly for our common future



PaDI forecast (early warning)

PaDI 2007



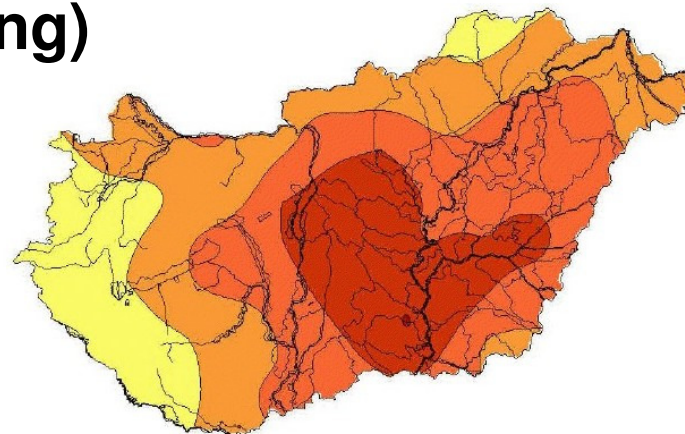
Jointly for our common future



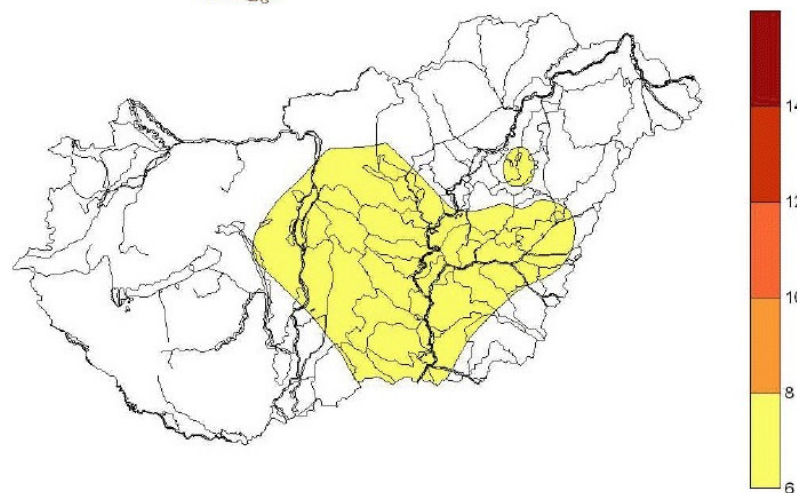
PaDI forecast (early warning)

Drought forecast in May 2007

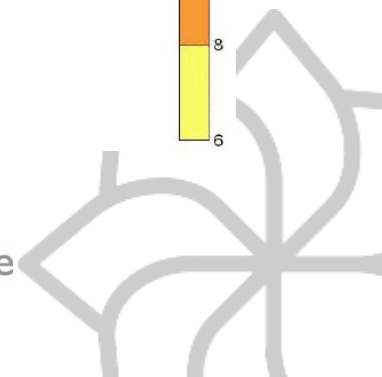
In case of dry weather



In case of average weather



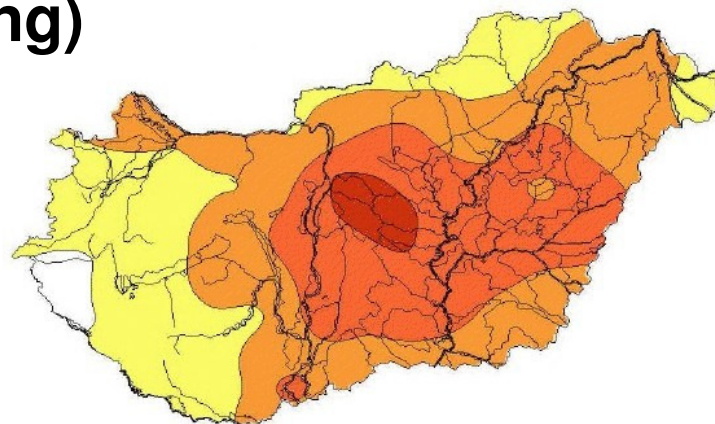
Jointly for our common future



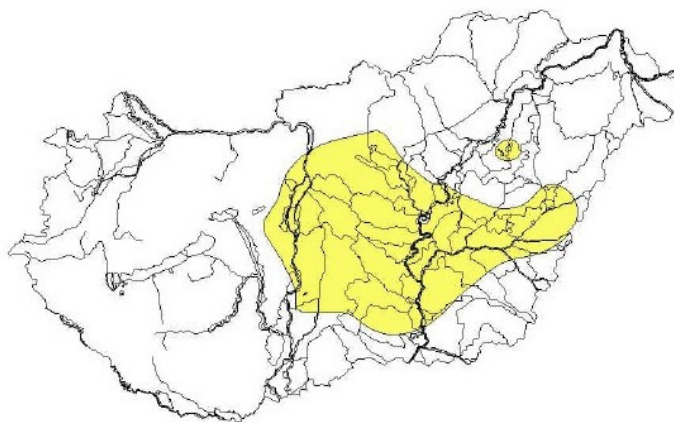
PaDI forecast (early warning)

Drought forecast in June 2007

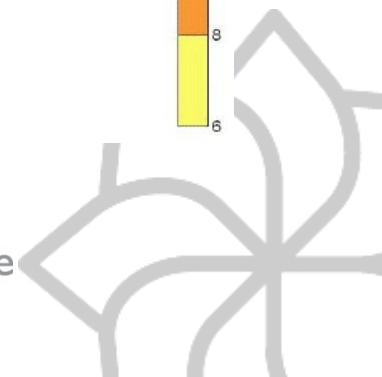
In case of dry weather



In case of average weather

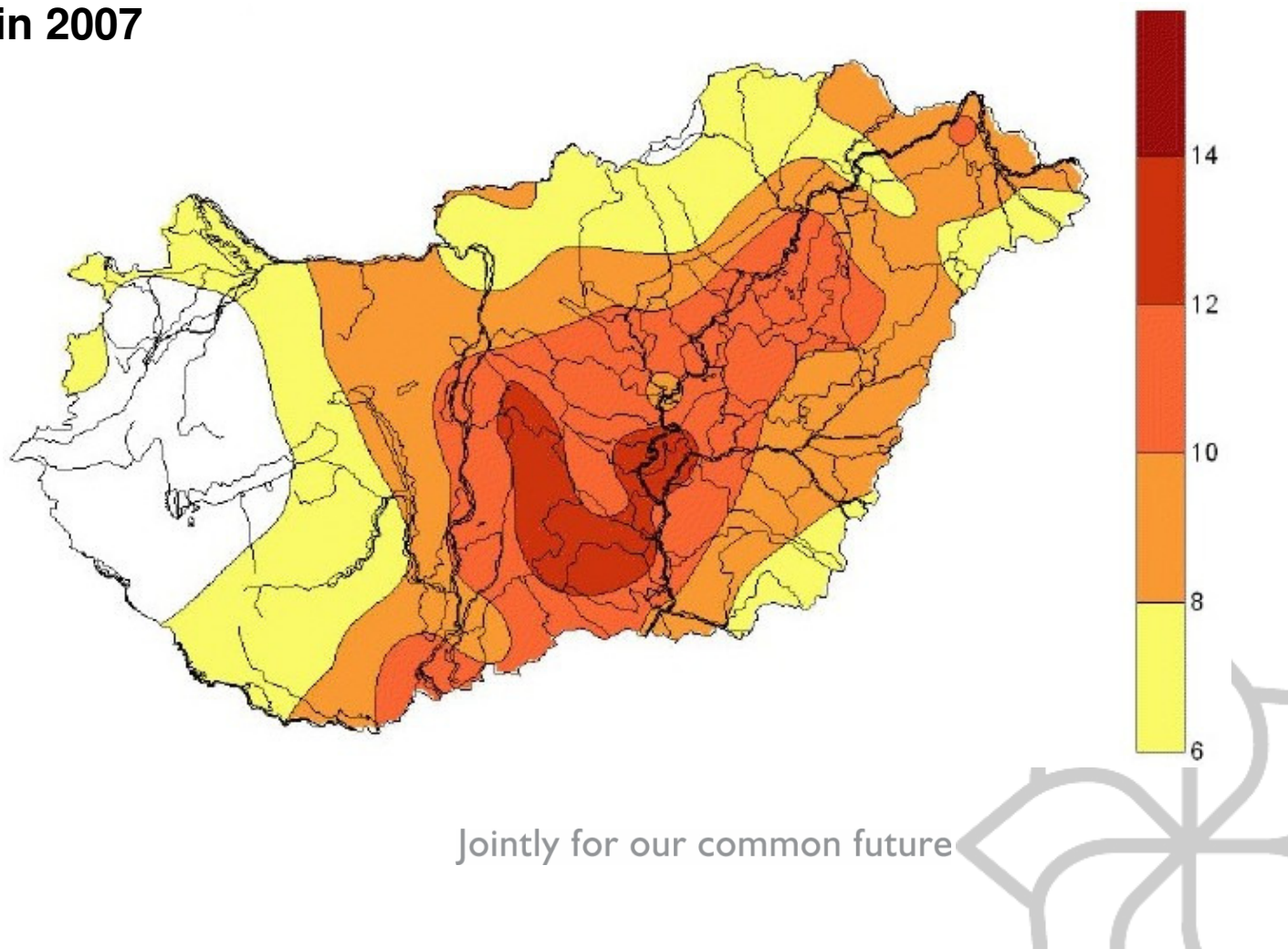


Jointly for our common future



PaDI forecast (early warning)

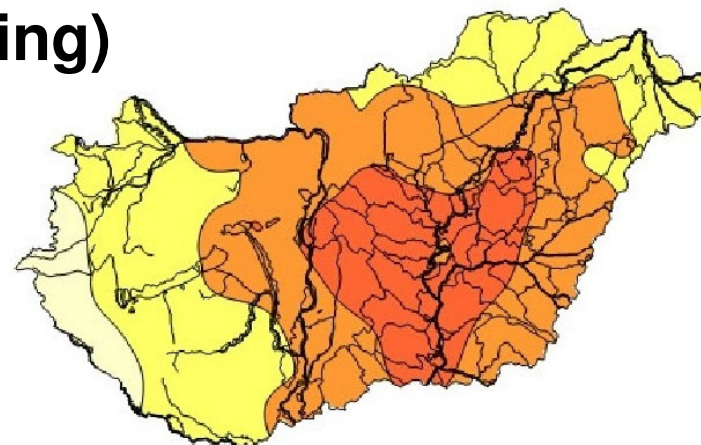
Drought index in 2007



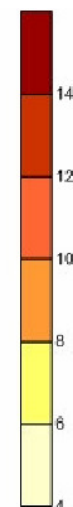
PaDI forecast (early warning)

Drought forecast in April 2012

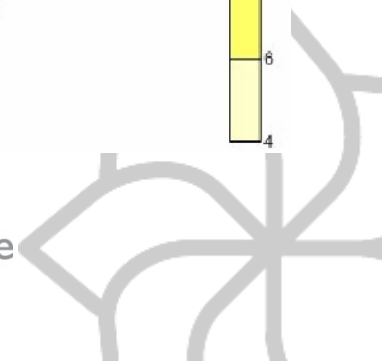
In case of dry weather



In case of average weather



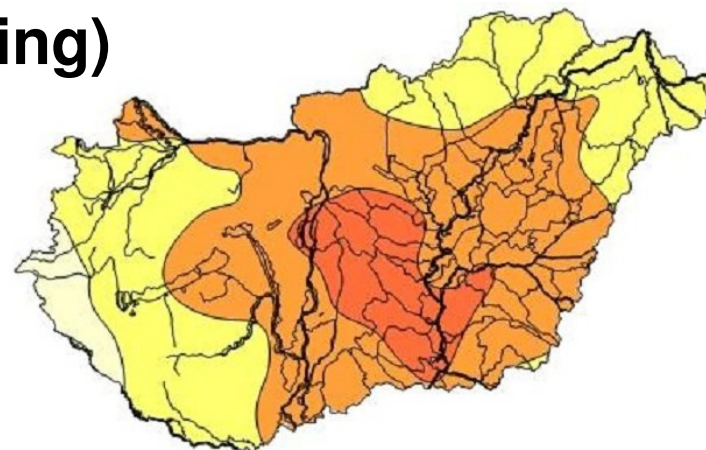
Jointly for our common future



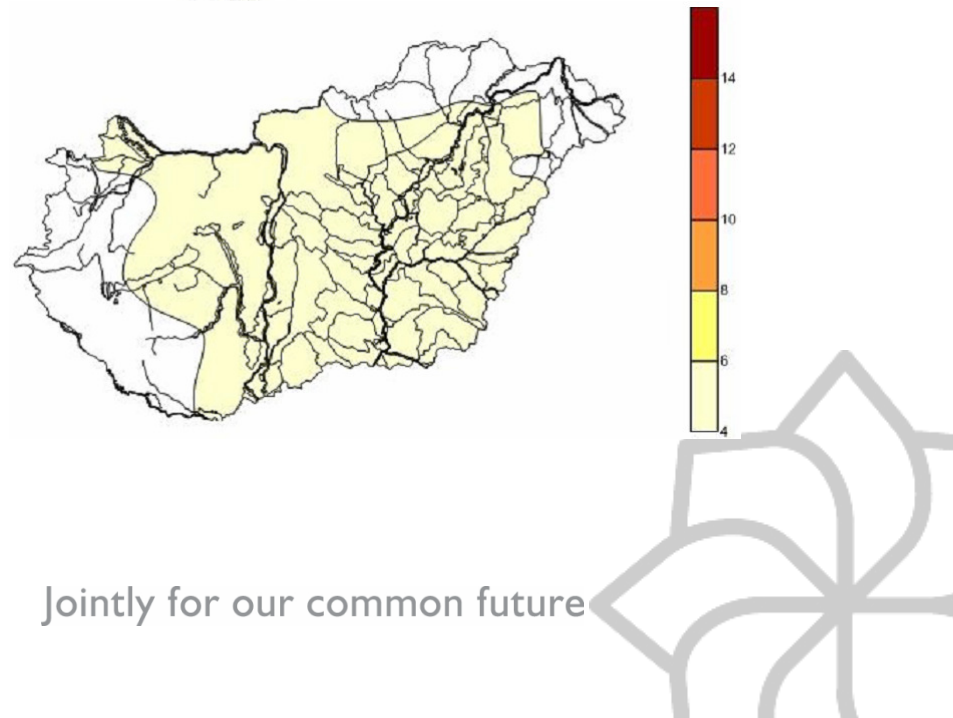
PaDI forecast (early warning)

Drought forecast in May 2012

In case of dry weather



In case of average weather



Jointly for our common future

PaDI (Palfai Drought Index)

Conclusions, suggestions:

- Calculation, data processing and understanding of PaDI is easy
- Expresses well crop decrease
- Correlation between scPDSI and PaDI is good ($R^2 > 0,7$)
- PaDI and SPI₃ (for spring or summer) together expresses strength and reason of drought
- Useful for medium-term forecast of drought
- Practical for multi-decade data series analysis and mapping, for the assessment of the possible climate change scenarios regarding drought.





PaDI (*Palfai Drought Index*)

Thank you for your attention!

Arpad Herceg
ATI-VIZIG, Szeged, Hungary

Jointly for our common future

