Standardized Precipitation Index

tool for drought monitoring

- Examples from Slovenia -

Sabina Bokal

Drought Management Centre for Southeastern Europe, DMCSEE

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- What is **S**tandardized **P**recipitation **I**ndex?
- SPI characteristics
- SPI methodology
- Practical experience with SPI
- Is SPI appropriate tool for monitoring agricultural drought?

What is **S**tandardized **P**recipitation **I**ndex?

- drought indices
- McKee – article in 1993
- most wide-spread use in practical drought monitoring
- "Lincoln Declaration on Drought Indices"

(Workshop on indices and Early Warning Systems for Drought, University of Nebraska-Lincoln, December, 2009)

"SPI will characterize the **meteorological** drought around the world."

SPI advantages / disadvantages

SPI

ADVANTAGES

- simple / input = precipitation
- describe drought on time scale
- standardization
- describe dry and wet periods in the same way
- independent from geographical position

DISADVANTAGES

- access to a long, reliable temporal time series
- meteorological drought
- short time periods (1,2 month) regions with low precipitations can give misleading SPI values

SPI - characteristics

amount of precipitation over a selected time period ⟺ normal or expected rainfall for this period

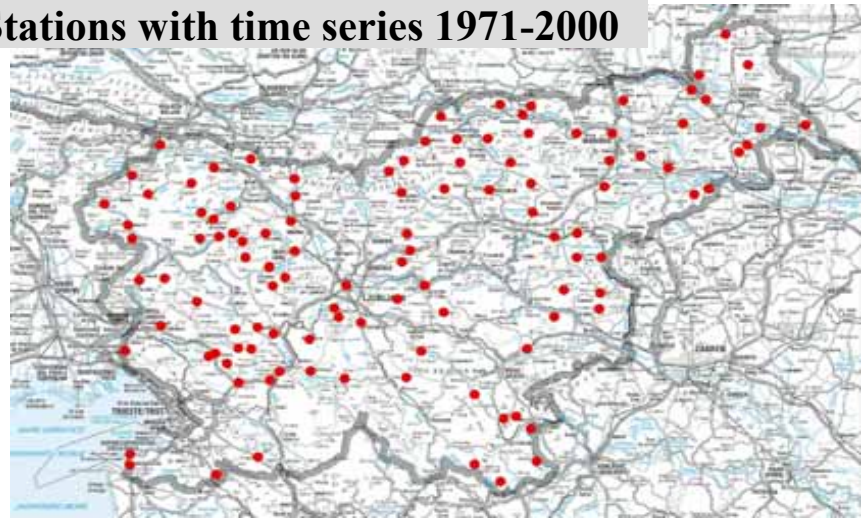
- characteristics of specific drought event:
  - lead-time
  - duration
  - **intensity** →

SPI value	Classification	Cumulative probability (%)
2.00 or more	Extremely wet	2.3
1.50 do 1.99	Very wet	0.4
1.00 do 1.49	Moderately wet	9.2
0 do 0.99	Mildly wet	34.1
0 do -0.99	Mild wet	34.1
-1 do -1.49	Moderate drought	9.2
-1.50 do -1.99	Severe drought	4.4
-2 or less	Extreme drought	2.3

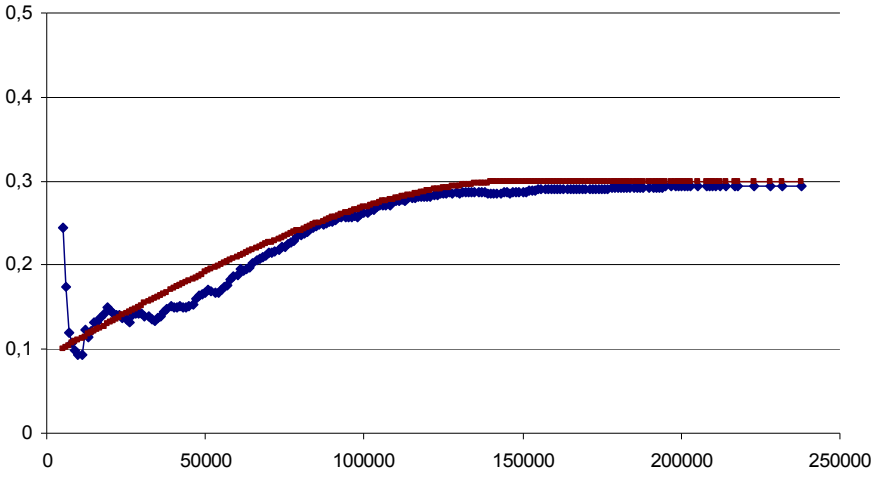
- different time scales
  - **1-month SPI:**
    - **short-term conditions**
    - **soil moisture**
    - **drought stress**
  - **3-month SPI:**
    - **seasonal estimation of precipitation**
    - **overall crop yield**
  - **6/12 –month SPI:**
    - **impact on groundwater**

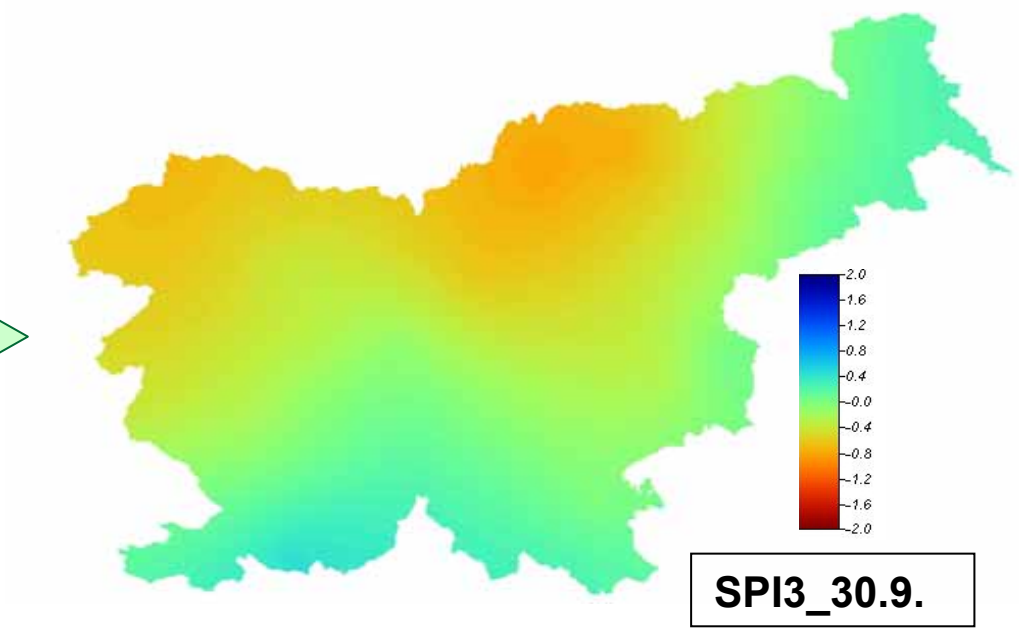
SPI – methodology of SPI mapping

Stations with time series 1971-2000



- ✓Long, continuous time-series (at least 30 years)
- ✓METEO office
- ✓Data availability delay - in the middle of the following month





SPI3_30.9.

SPI manual

SOUTH EAST EUROPE
jointly for our common future

DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

Use of SAGA GIS for spatial interpolation (kriging)

Technical instructions

Prepared for 1st DMCSEE-TCP training
Budapest, 2-5 February 2010

Environmental Agency of Slovenia

INTRODUCTION

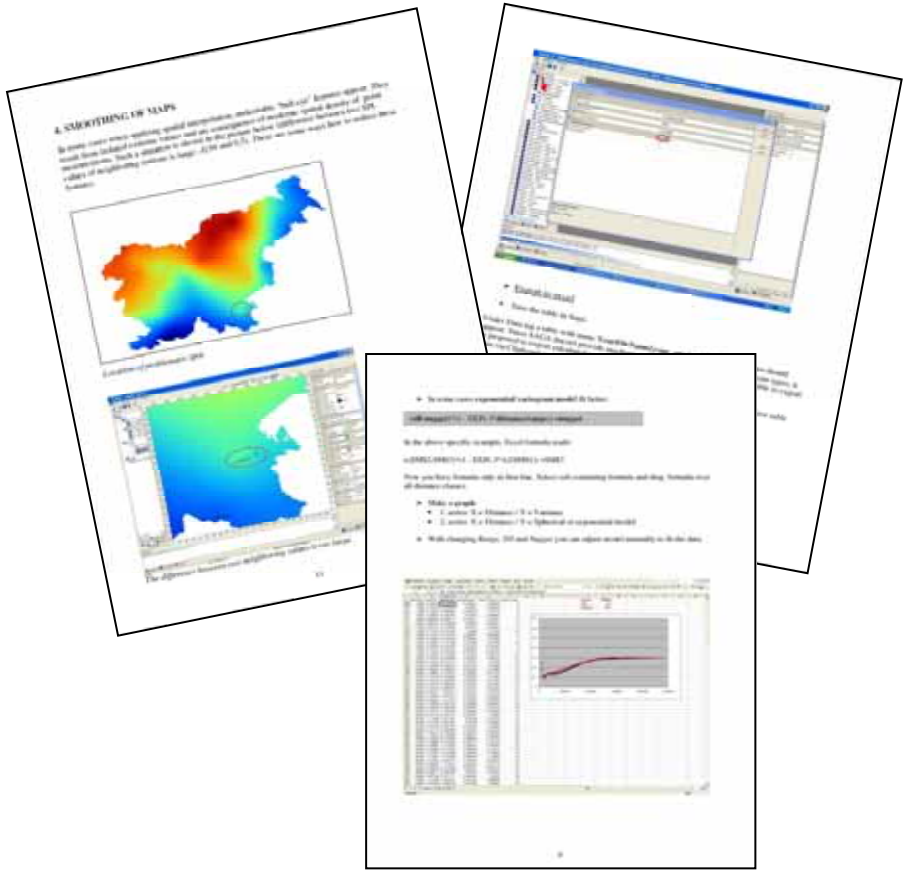
SAGA (System for Automated Geoscientific Analyses) is free open-source software, designed for implementation of spatial algorithms and geospatial visualization. It was designed by University of Goettingen and further developed by University of Hamburg (see http://www.saga-gis.org). Although kriging algorithms, implemented within SAGA, lack some of features (flexible variogram fitting, cross validation) it can be used as tool for spatial interpolation of meteorological data, at least as first approximation. This document describes in practical manner steps to be taken in order to obtain maps of meteorological variables from point values (i.e. station measurements). As example, interpolation of Standardized Precipitation Index (SPI) is presented for Slovenia, however, procedure is not limited to this variable and can be implemented for any spatial unit and any cartesian coordinate system.

1. PREPARATION OF DATA

SAGA uses Shapefile format for vector data (points, lines, polygons). Therefore, it would be easiest if measurement data is prepared as shapefile that includes measurement values as point attributes. Since many database applications don't support data output in shapefile format, easiest approach would be to prepare data in plain ASCII file. ASCII file should be organized in columns; among the columns, there have to be columns with X and Y coordinates; default is X as first column and Y as second column.

Another requirement is for columns to be separated with single TAB character. If that is not the case (for instance, if your file is comma delimited), you can use simple ASCII editor (such as Notepad) to replace commas with TAB character (easiest way to do so is to store TAB character on Clipboard and paste it using Ctrl+V into Replace form in Notepad). First line should contain attribute names (pleas use X and Y for both coordinates)

1



SAGA
System for Automated Geoscientific Analyses

Official SAGA Homepage
SAGA Project Homepage at SourceForge

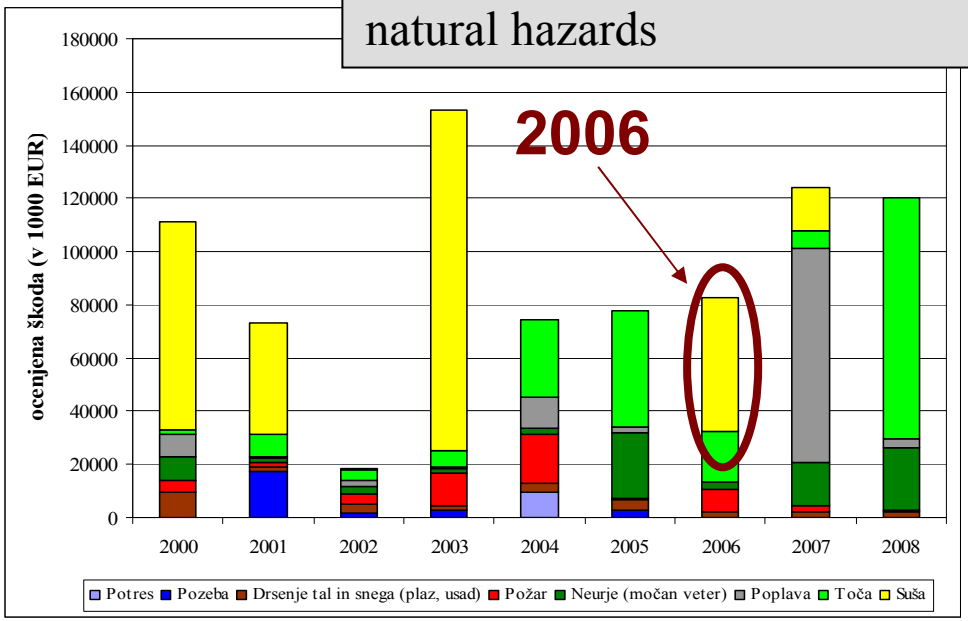
http://www.saga-gis.org

Practical experience with SPI

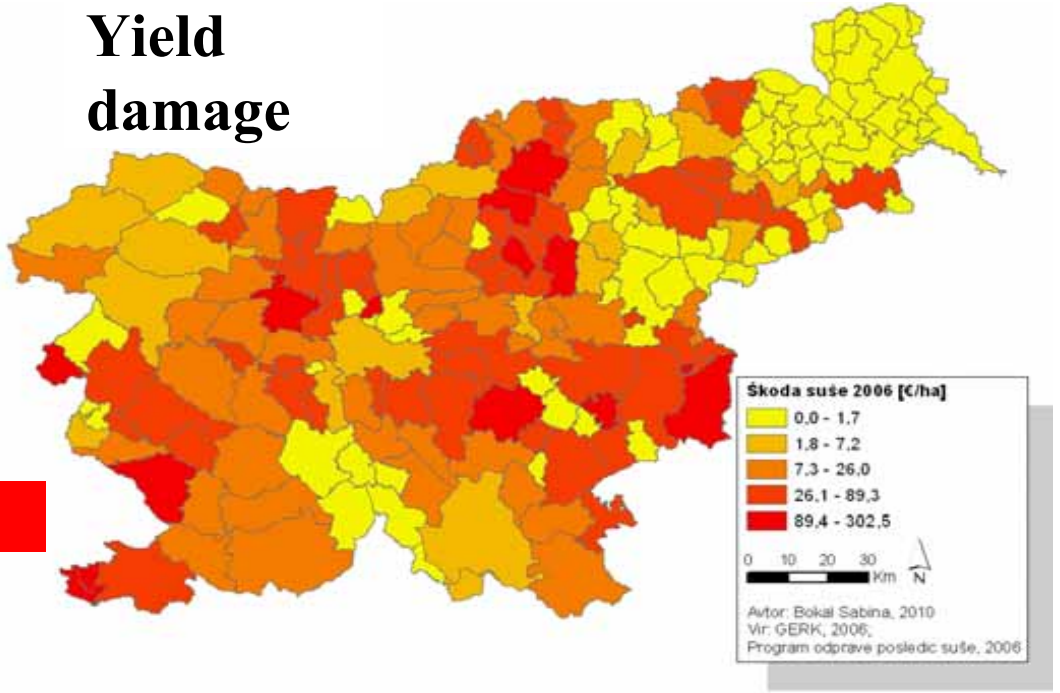
Drought development in 2006

- 20.998 people involved
- 139 municipality
- 178.296,78 ha
- 25% of the area + two month
- Very intensive
- 42.395.720 € damage

Yearly structural damage due to natural hazards

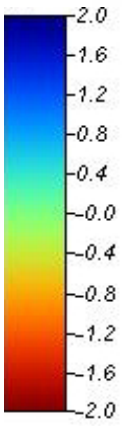


Yield damage

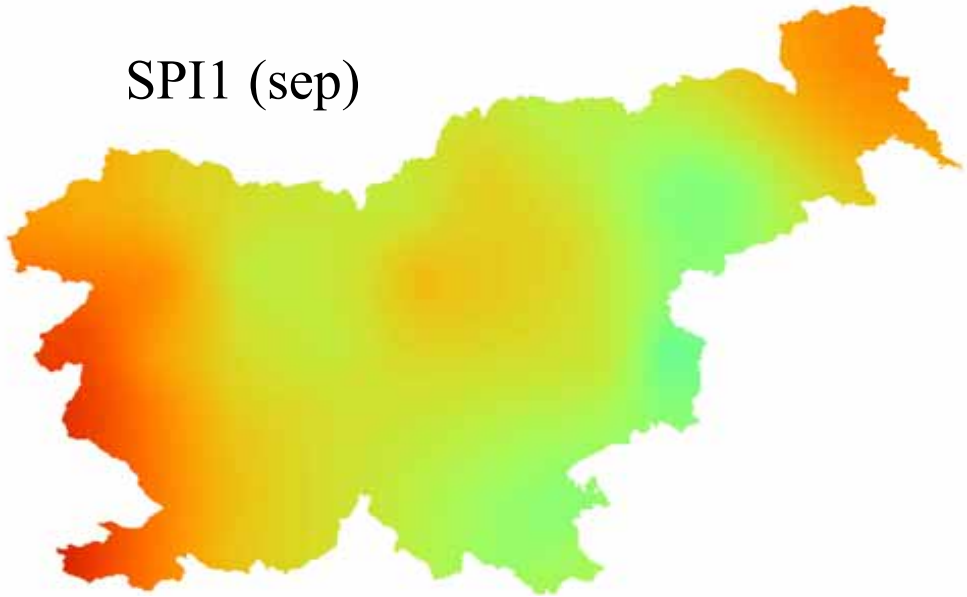


Red areas = >90 €/ha

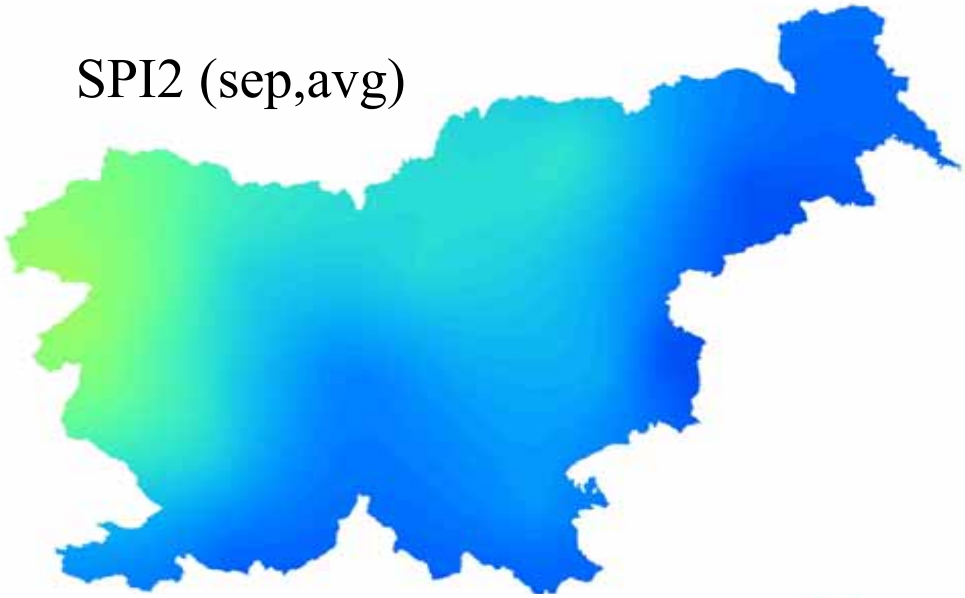
SPI development in 2006 (SPI calculated on 30.9.2006)



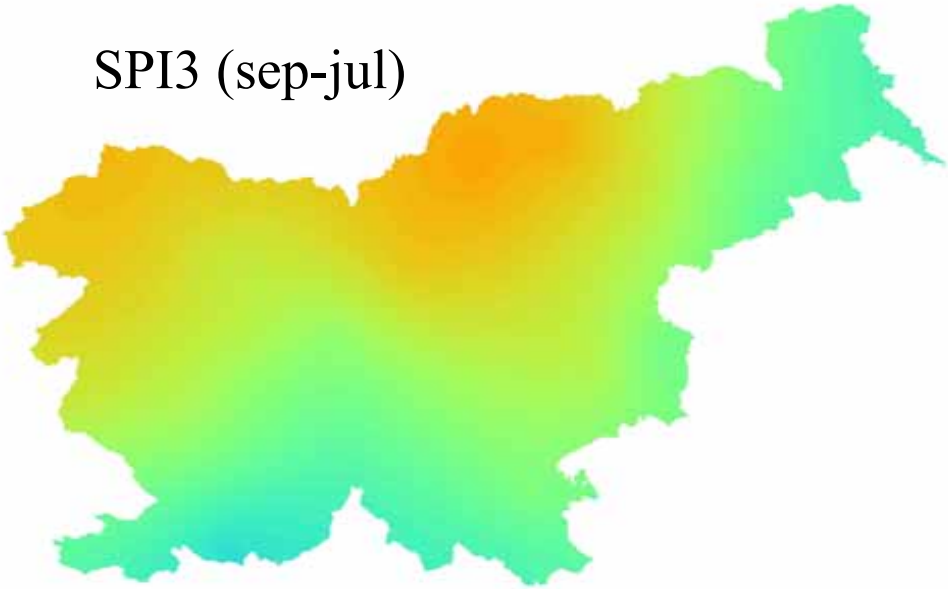
SPI1 (sep)



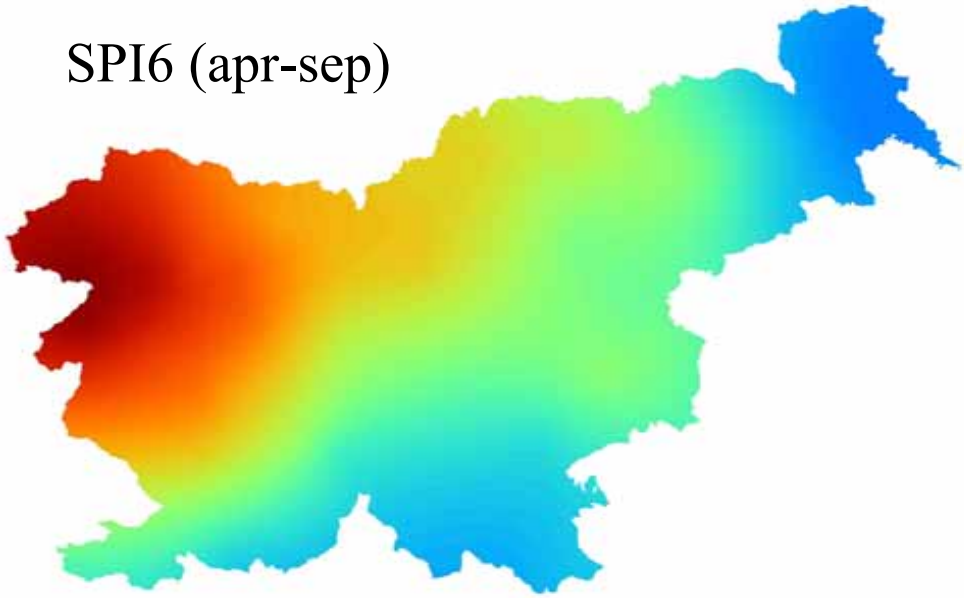
SPI2 (sep,avg)



SPI3 (sep-jul)



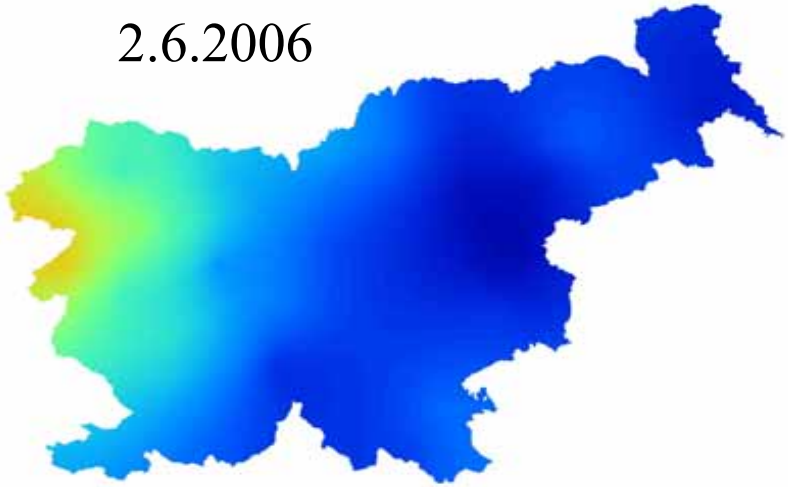
SPI6 (apr-sep)



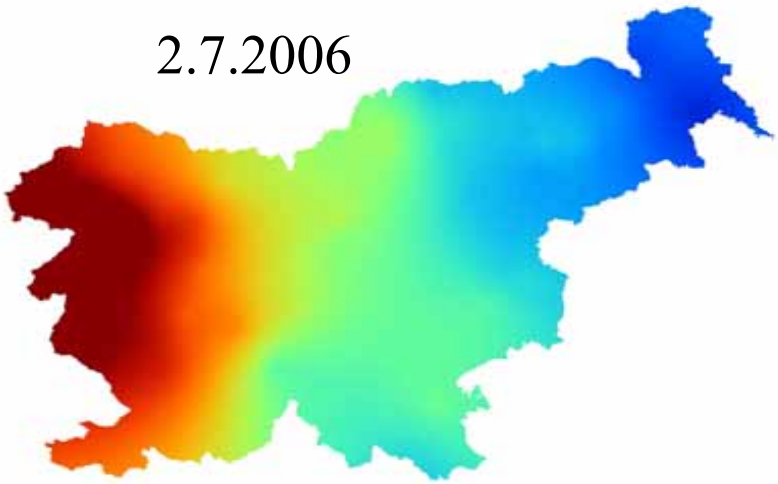
2.00 or more	Extremely wet	0 do 0.99	Mildly wet		
1.50 do 1.99	Very wet	0 do -0.99	Mild wet	-1.50 do -1.99	Severe drought
1.00 do 1.49	Moderately wet	-1 do -1.49	Moderate drought	-2 or less	Extreme drought

3-month SPI calculated on different dates

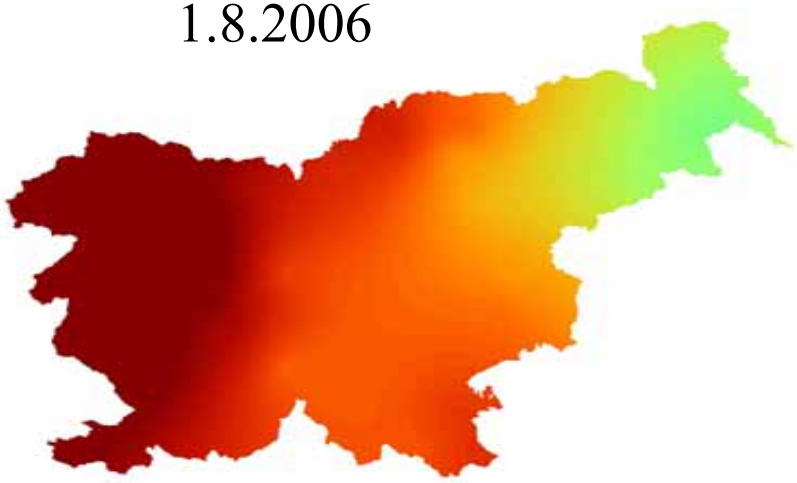
2.6.2006



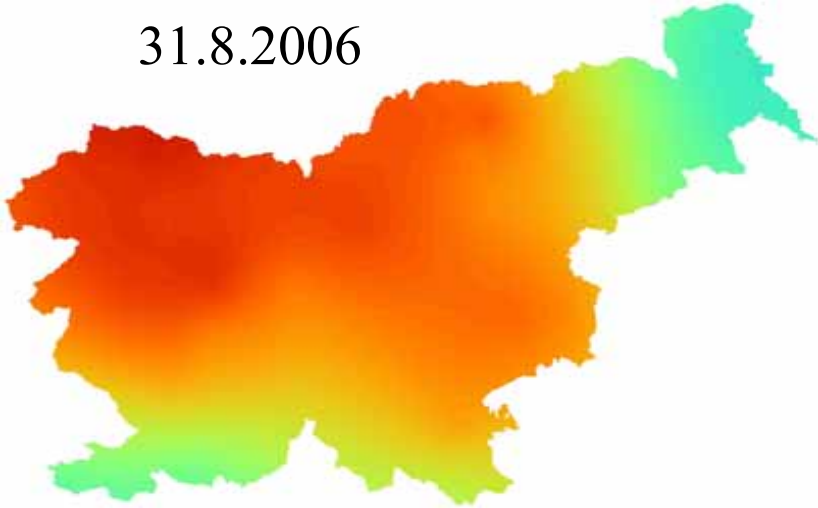
2.7.2006

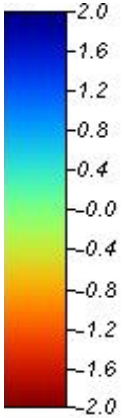


1.8.2006



31.8.2006





SPI value	Classification
2.00 or more	Extremely wet
1.50 do 1.99	Very wet
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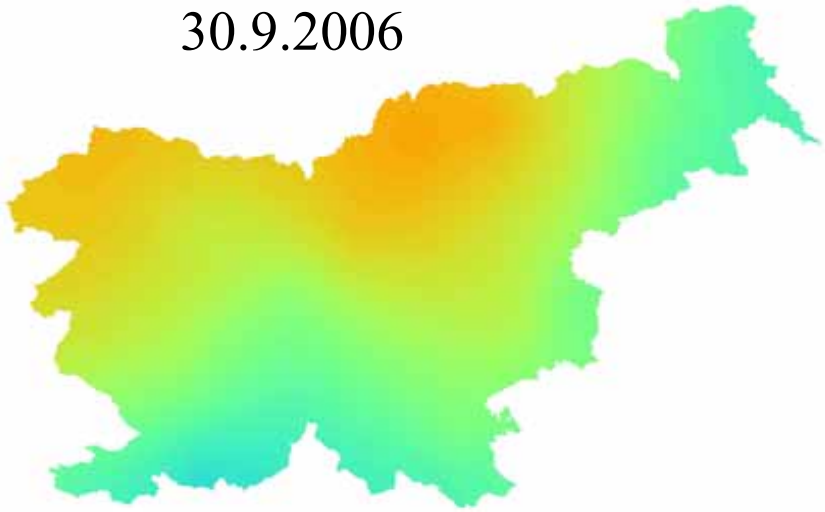
0 do 0.99	Mildly wet
0 do -0.99	Mild wet
-1 do -1.49	Moderate drought
-1.50 do -1.99	Severe drought
-2 or less	Extreme drought

30.9.2006



Is SPI appropriate tool for monitoring agricultural drought?

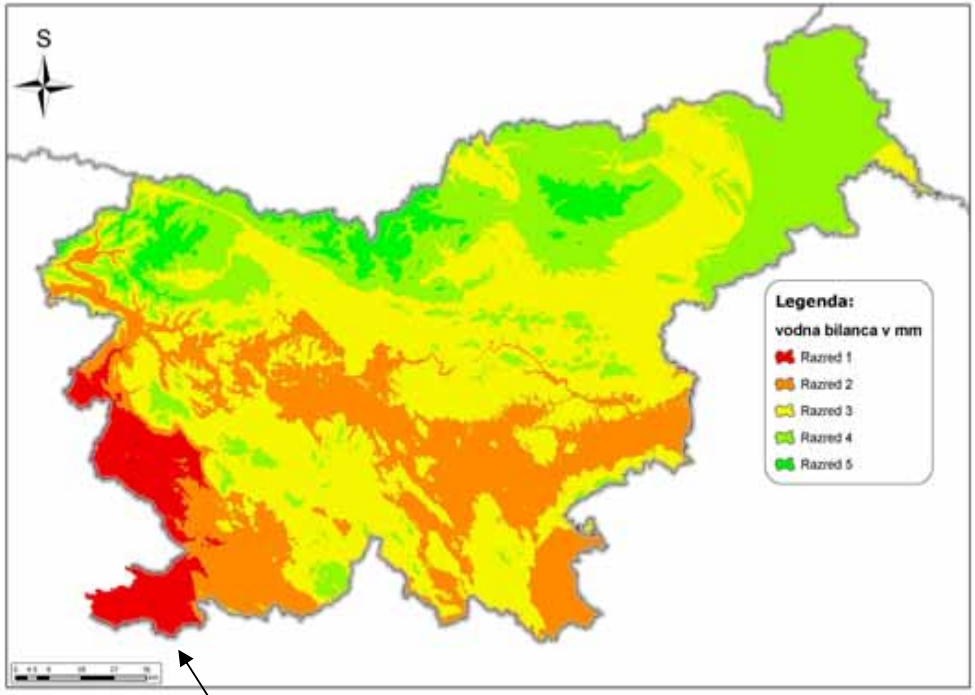
- water balance
- yield decrease

SPI & water balance

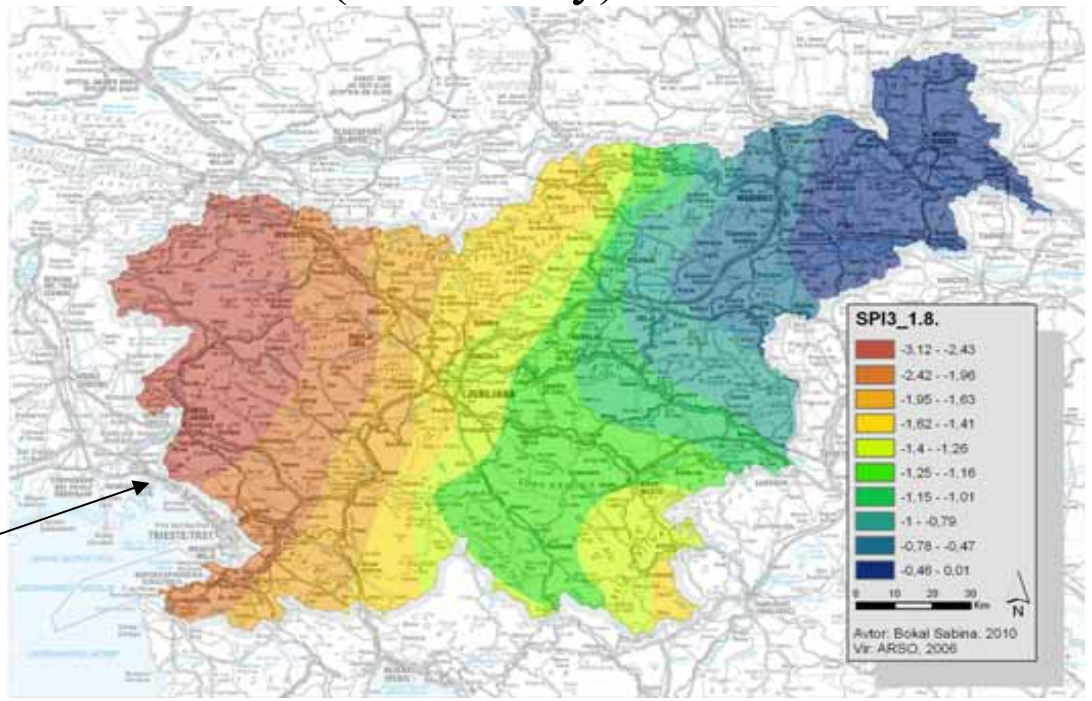
<u>Water balance</u> = absolute values

<u>SPI</u> = in comparison with long-term average

Water balance from 1.6. – 31.7.2006



2-month SPI (June – July)



Year with extreme dry areas

Drought analysis using SPI

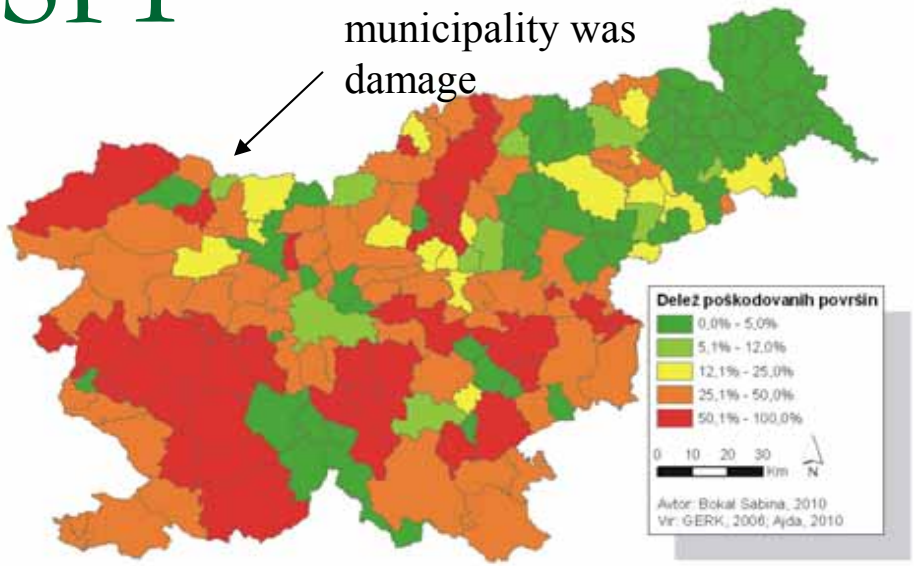
Data available for drought verification:

- bulletin
- archive
- **statistical reports**
- yield reports
- agrometeorological reports
- damage estimation

Identification of drought severity

comparison

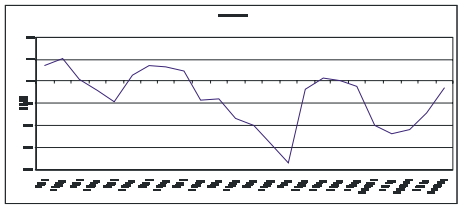
Red = more then 50% of all agricultural areas in municipality was damage

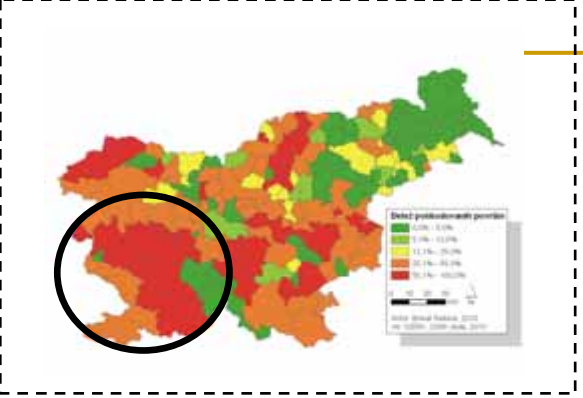


Share of damage agricultural areas

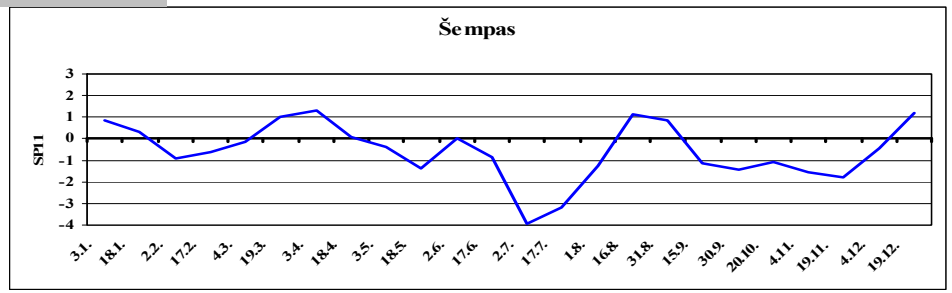
Spatial distribution of SPI

Temporal distribution of SPI

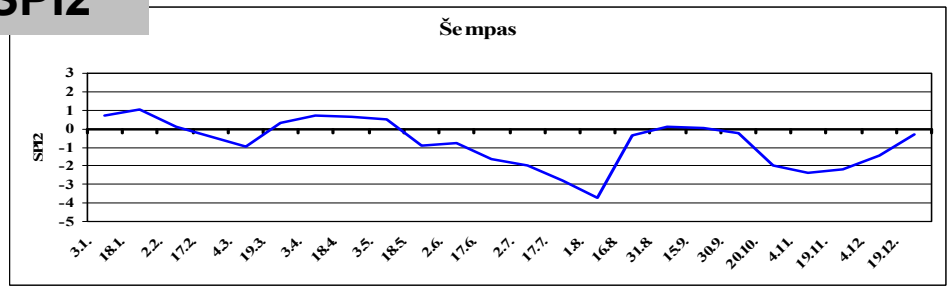




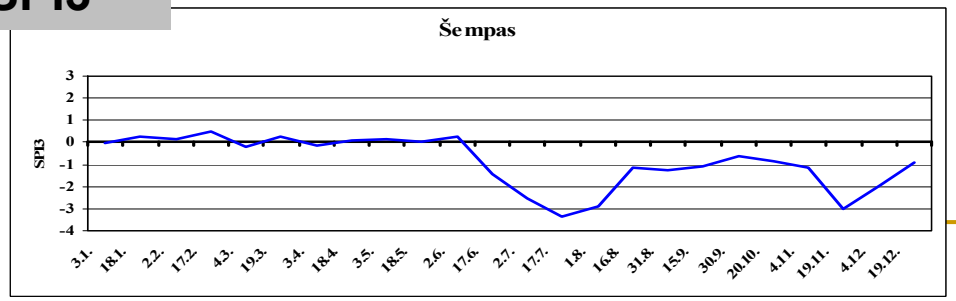
SPI1

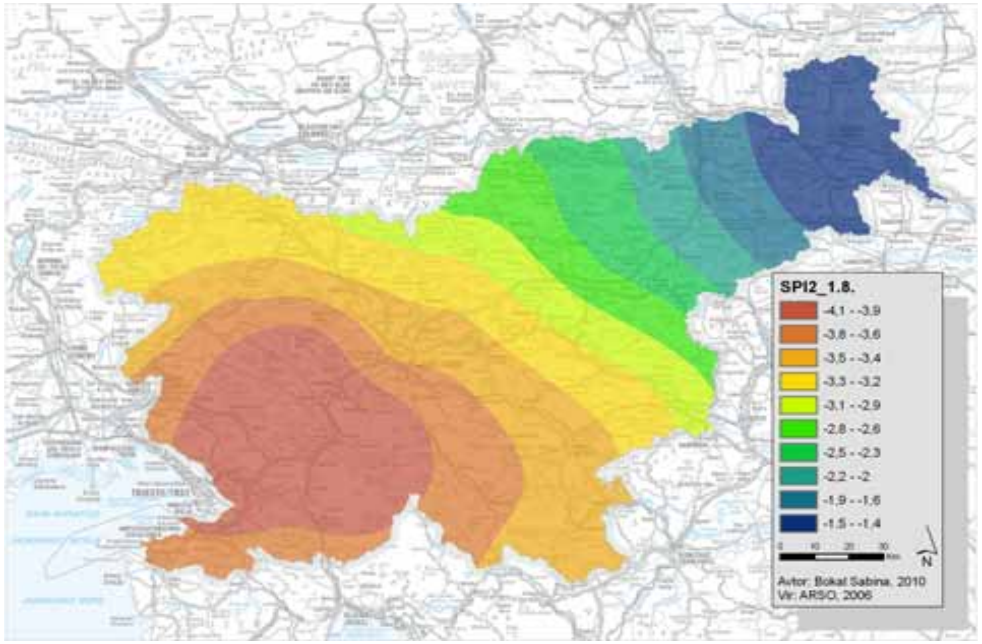


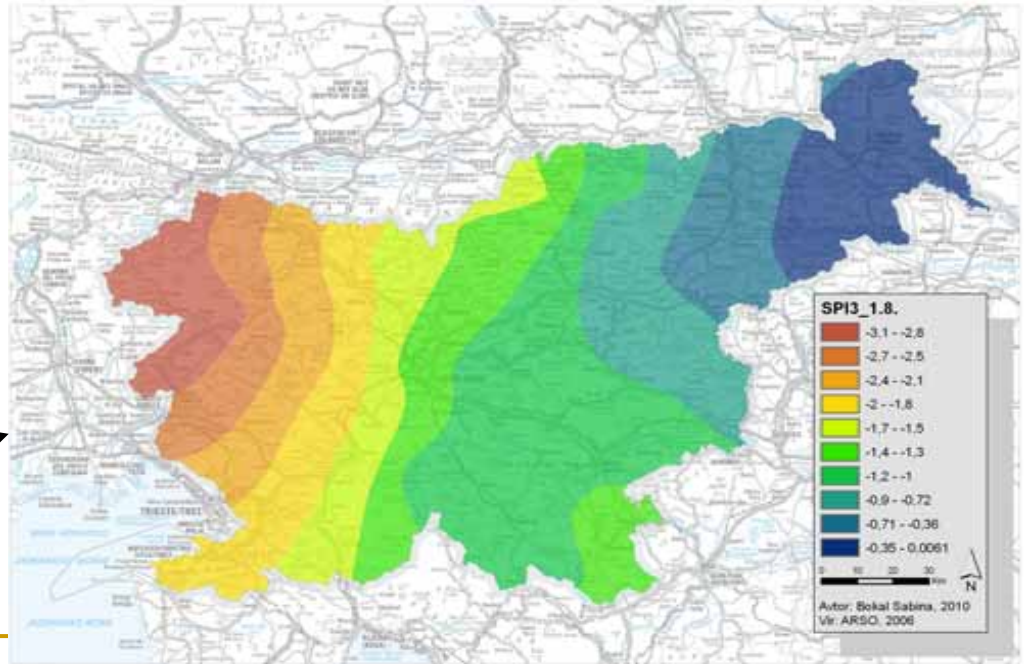
SPI2

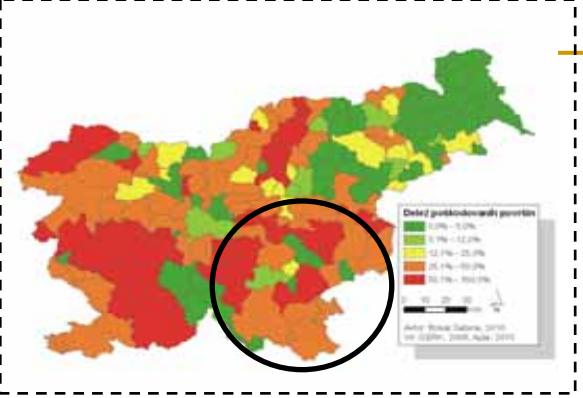


SPI3

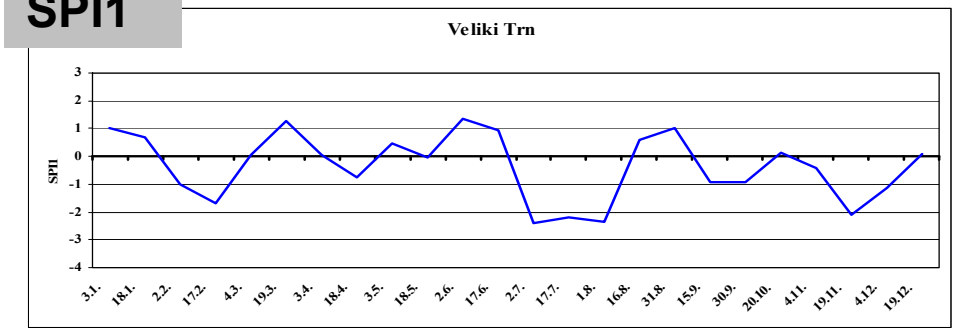




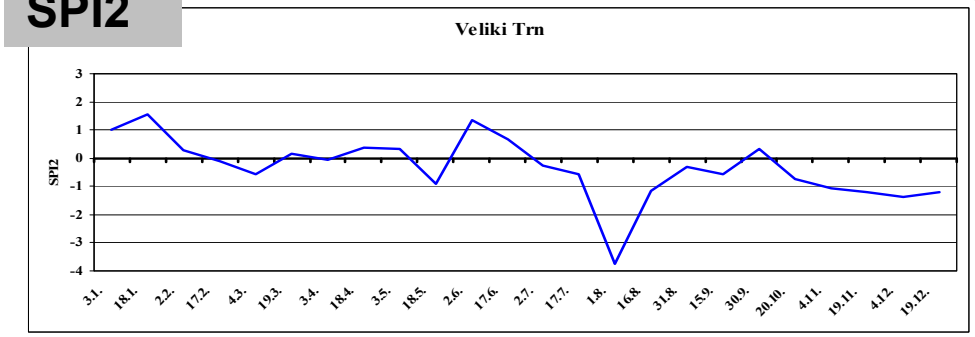




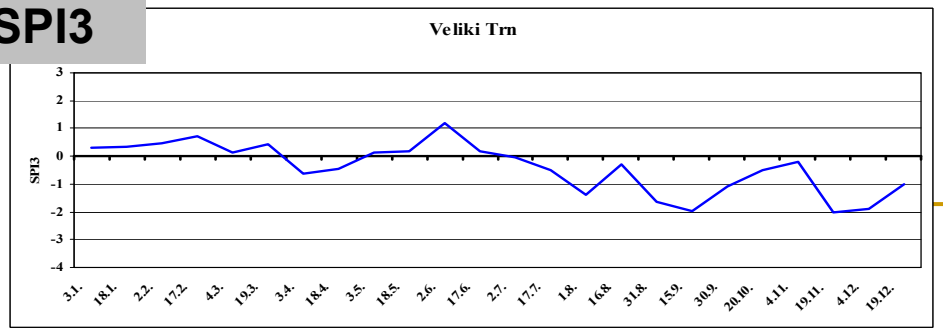
SPI1

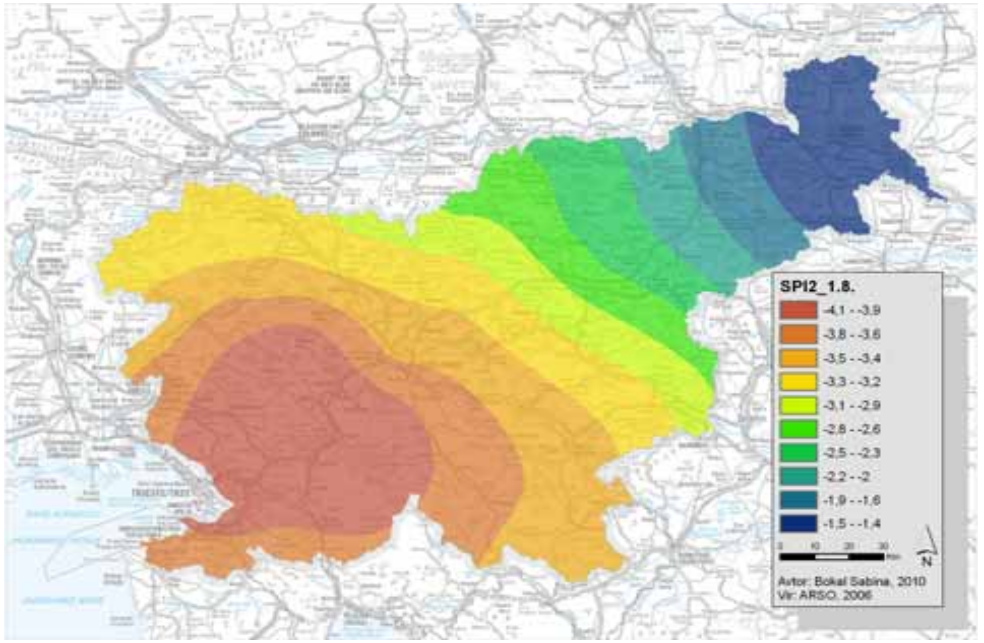


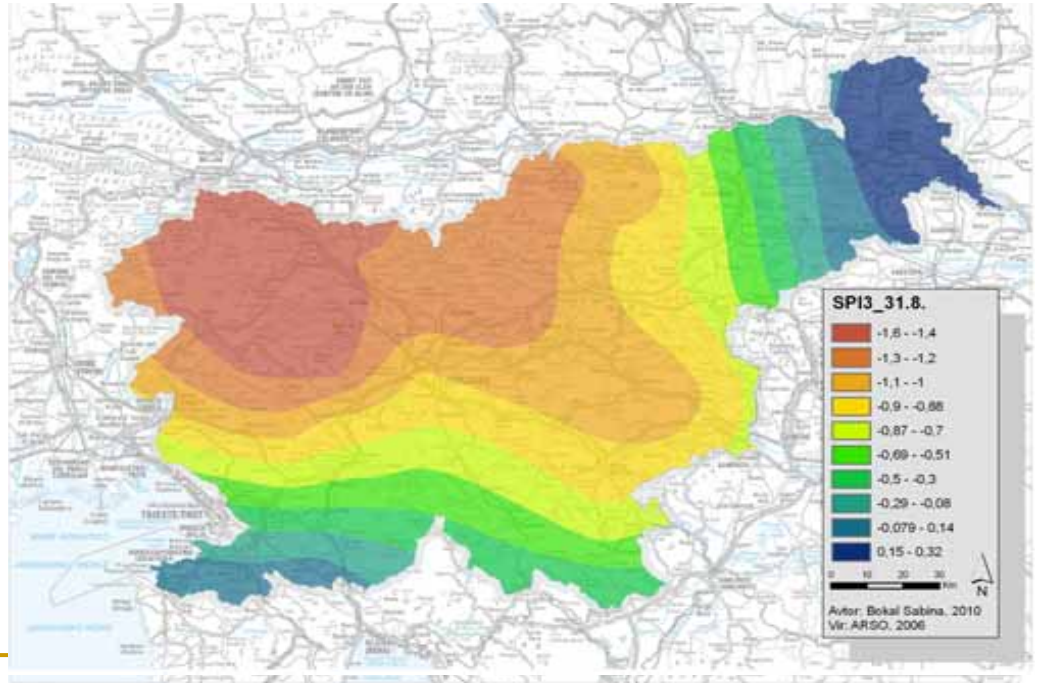
SPI2



SPI3







SO …let's now answer the question…

SPI is appropriate tool for monitoring agricultural drought …

BUT … in combination with other information: water balance, crop condition, …)