SOUTH EAST EUROPE
Transnational Cooperation Programme

DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

Use of WinISAREG model and Standardized Precipitation Index (SPI) in the detection of agricultural drought in the frame of DMCSEE

Andreja Sušnik,
Ajda Valher, Gregor Gregorič, Marko Trošt

Environmental Agency of the Republic of Slovenia
Meteorological Office (EARS)

Jointly for our common future

SOUTH EAST EUROPE
Transnational Cooperation Programme

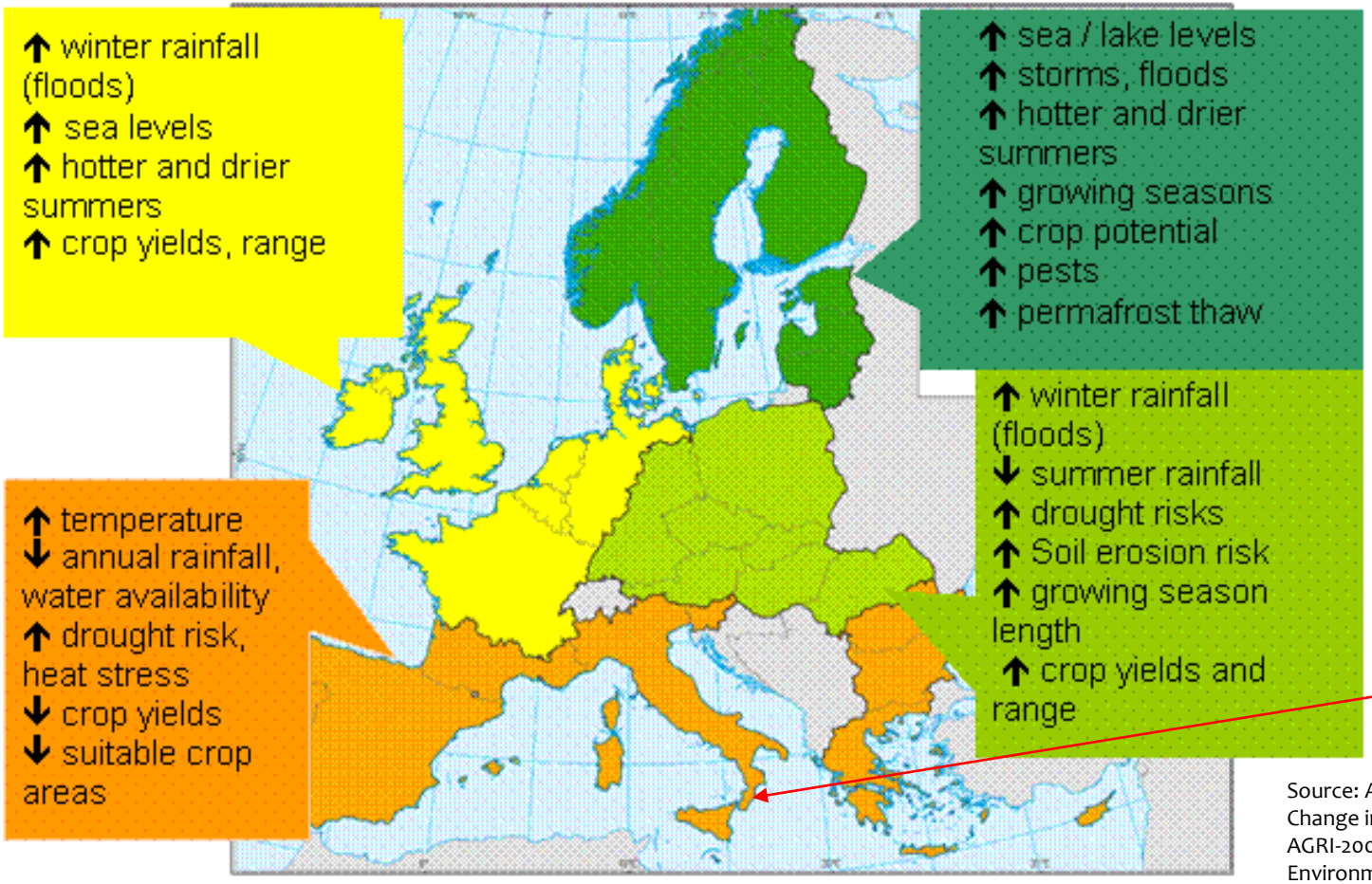
DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

Contents

- Outline of the problem
- DMCSEE – running project
- Recent developments: SPI, Water Balance, WinISAREG
- Case study for Slovenia
- A permanent platform for exchange of drought information – beyond 2012?

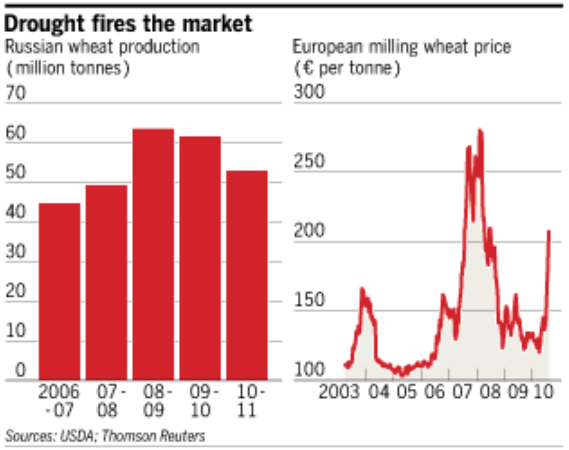
How will farming in the SE EU be affected by climate change?



Farming will be most affected by droughts in the **southern and south–eastern regions.**

Source: Adaptation to Climate Change in the Agricultural Sector AGRI-2006-G4-05, AEA Energy & Environment and ,Universidad de Politécnica de Madrid, 2007

Drought in SE Europe is not solely the matter of climate change



Period	Region / Countries affected	Economic costs (€ billion)
1976-77	**Western Europe** Cost of building damage due to land subsidence in London alone estimated at € 800 million	
1981- 82	**Iberian Peninsula** (Portugal, Spain, Southern France, Corsica, Italy)	> 5.0
1988- 91	**Mediterranean Region** (Portugal, Spain, Southern France, Italy, Albania, Greece)	> 2.1
1992- 94	**Eastern Europe** (Germany, Denmark, Poland, Lithuania, Hungary, Yugoslavia, Ukraine, Moldova)	> 1.1
1992- 95	**Spain**	> 3.7
2000	**Central Europe** (Romania, Hungary, Poland, Bulgaria, Greece, Yugoslavia, Czech Rep, Turkey, Germany)	> 0.5
2003	**Europe** (Romania, Hungary, Poland, Bulgaria, Greece, Yugoslavia, Czech Rep, Austria, Switzerland, Italy, Germany, Belgium, Denmark, Netherlands, Norway, UK, France, Spain, Portugal)	> 13.0

Europe 'will be hit by severe drought' without urgent action on emissions

Southern England would be badly affected – while Spain, Portugal, southern Italy, Greece would turn into semi-desert

David Adam in Copenhagen
guardian.co.uk, Thursday 12 March 2009 14.17 GMT
Article history

A burnt-out firefighters' truck after forest fi res devastated southern Greece during a heatwave last August. Photograph: Louisa Goulimaki/AFP/Getty Images

Europe will be struck by a series of severe droughts that will make life "hell" for hundreds of millions of people unless urgent action is taken to

Problem identification – recent updates

(Dnevnik.hr)

Hoće li Slavc
stvari stoje -
boca vode, a
žedna, a usj
kukuruz. **Rat**
Suša je iscrp
'Ovdje je nek
sada nema r
Nema police

Slavonia, Croatia: May 24, 2009 - agriculture hit by drought; 90 days lack of rain

Oborina je **palo čak 70 posto manje od prosjeka za ovo doba godine**. Usjeve napadaju i nametnici. **Sunce je spržilo većinu stočnog graška. Stoka će na prisilnu dijetu**. 'Stoka neće imati što jesti. Prinos mi je smanjen za 60 posto, a novčanik prazan', očajan je Mario Milušić. Ratare hvata panika. U proizvodnju hrane uložili su mnogo novca. Ne padne li kiša uskoro, očekuje ih teška godina. **Da kiša sutra padne, kažu, imat će opet 20 do 35 posto štete**. Seljaci **traže proglašenje elementarne nepogode**. Jedino tako se mogu izvući iz financijskih teškoća, jer **osiguranje usjeva od suše ne postoji**. 'Osiguravamo od požara i tuče, ali od suše ni u jednoj osiguravateljskoj kući ne postoji polica osiguranja', objašnjava **Matija Brlošić**, predsjednik Udruge poljoprivrednika

Bulgaria: June 10, 2009 – wheat output to fall by 20% due to dry conditions

Bulgaria Sees Drought Slashing '09 Wheat Crop by 20% - Media

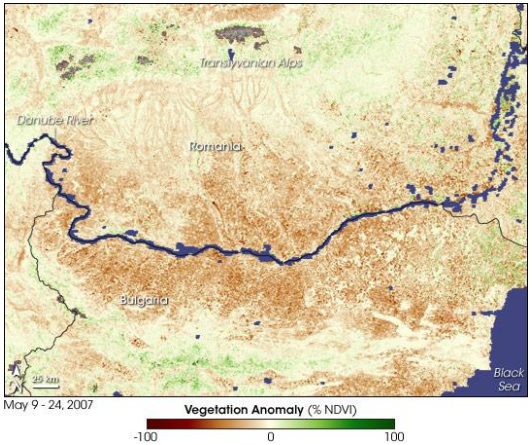
coding ▸ Jun 10, 2009 14:43 CET | Story | SeeNews - The Corporate Wire options ▸

© Anelia Nikolova

SOFIA (Bulgaria), June 10 (SeeNews) - Bulgaria expects wheat output to fall by 20% this year due to dry conditions, state-run news agency BTA reported on Wednesday.

The estimate is based on the assessment of crop condition by May 22, BTA (www.bta.bg) reported, quoting Deputy Agriculture Minister Svetla Bachvarova.

Bulgaria harvested 4.4 million tonnes of wheat from some 1.03 million hectares in 2008, the highest amount in four years and twice as much as the country needs to meet domestic demand.



Moldova: 2007 – one of the worst droughts ever Romania and Bulgaria: 2007.

Turkey: 2008 - the most affected country in SE Europe in 2008.

Turkey: Drought Cuts Food Production in Half

Posted On Jul 17

Environment

Add comments

"Production has been halved to 300 kilos (661 pounds) per 1,000 square meters (250 acres), even in well-irrigated parts of the region, as rainfall declined to one-fortieth of normal levels, Referans daily said on Wednesday, citing farmers and farming associations."

The government has selected 35 of its 81 provinces as eligible for financial assistance, Erdogan said. Farmers who have lost more than 30 percent of their harvest to drought can claim assistance and also postpone any agricultural loan payments by a year, he added.

Although, compensation will be given to farmers, the decision has not been praised by farming organizations. "We were expecting 10 new Turkish kurus (YKr) compensation per kilogram, the offer of 5 YKr is not adequate," member of the Union of Turkish Chambers of Agriculture's Board Mustafa Hepokur said on Tuesday.

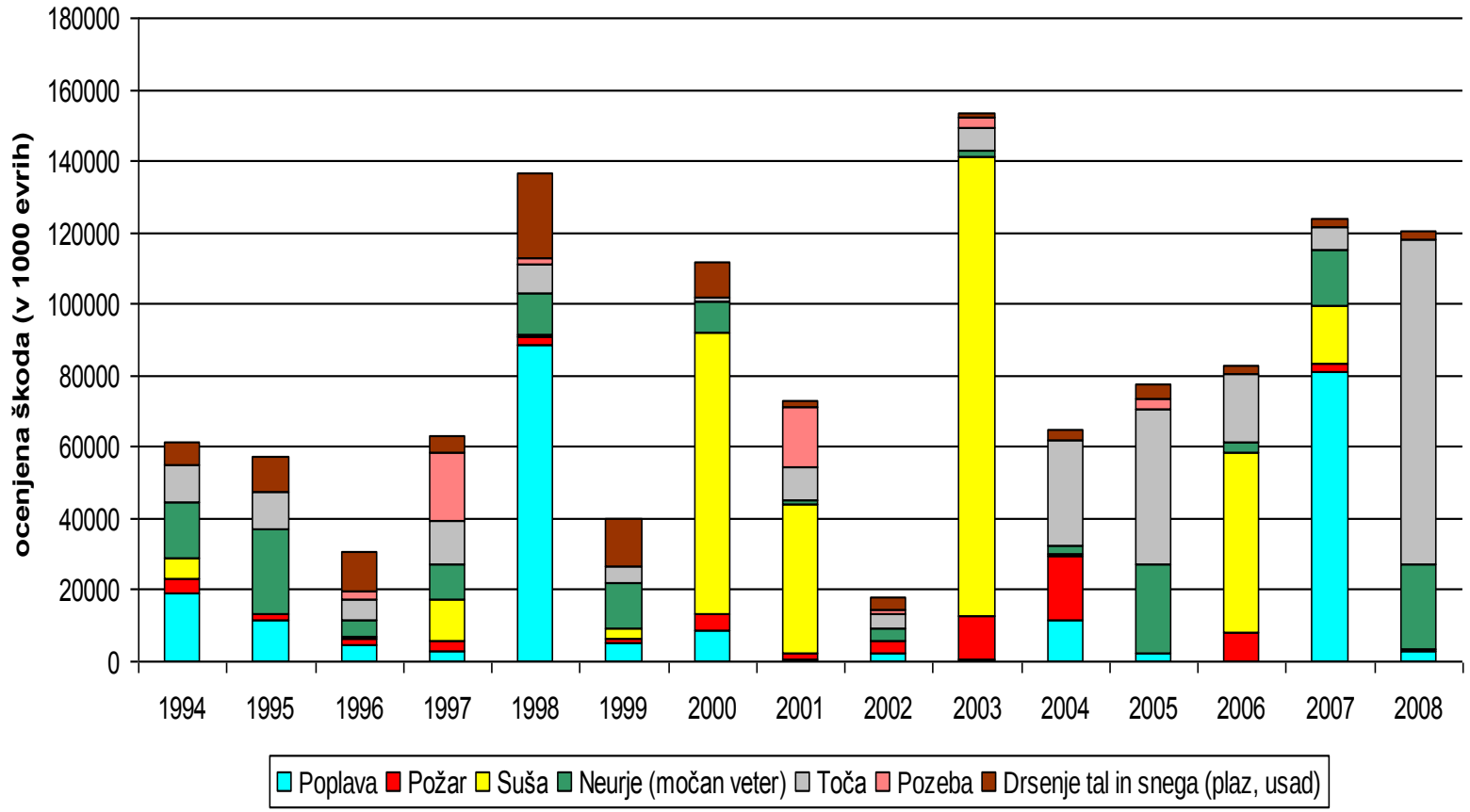
AFFECT OF DROUGHT

SOUTH EAST EUROPE
Transnational Cooperation Programme

DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

Slovenia – economical costs



droughts

floods

Jointly for our common future

SOUTH EAST EUROPE
Transnational Cooperation Programme

DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

Drought Management Centre for SE Europe
Background

DMCSEE initiative – "top-down" approach started in 2004 (A "Balkan Drought Workshop" in Poiana/Brasov (RO), co-sponsored by the UNCCD)

…developing in 2006 (Participants: UNCCD focal points, permanent representatives with the WMO + observers from UNCCD and WMO)

..and finally in September 2006: decision on DMCSEE host institution (procedure led by WMO).

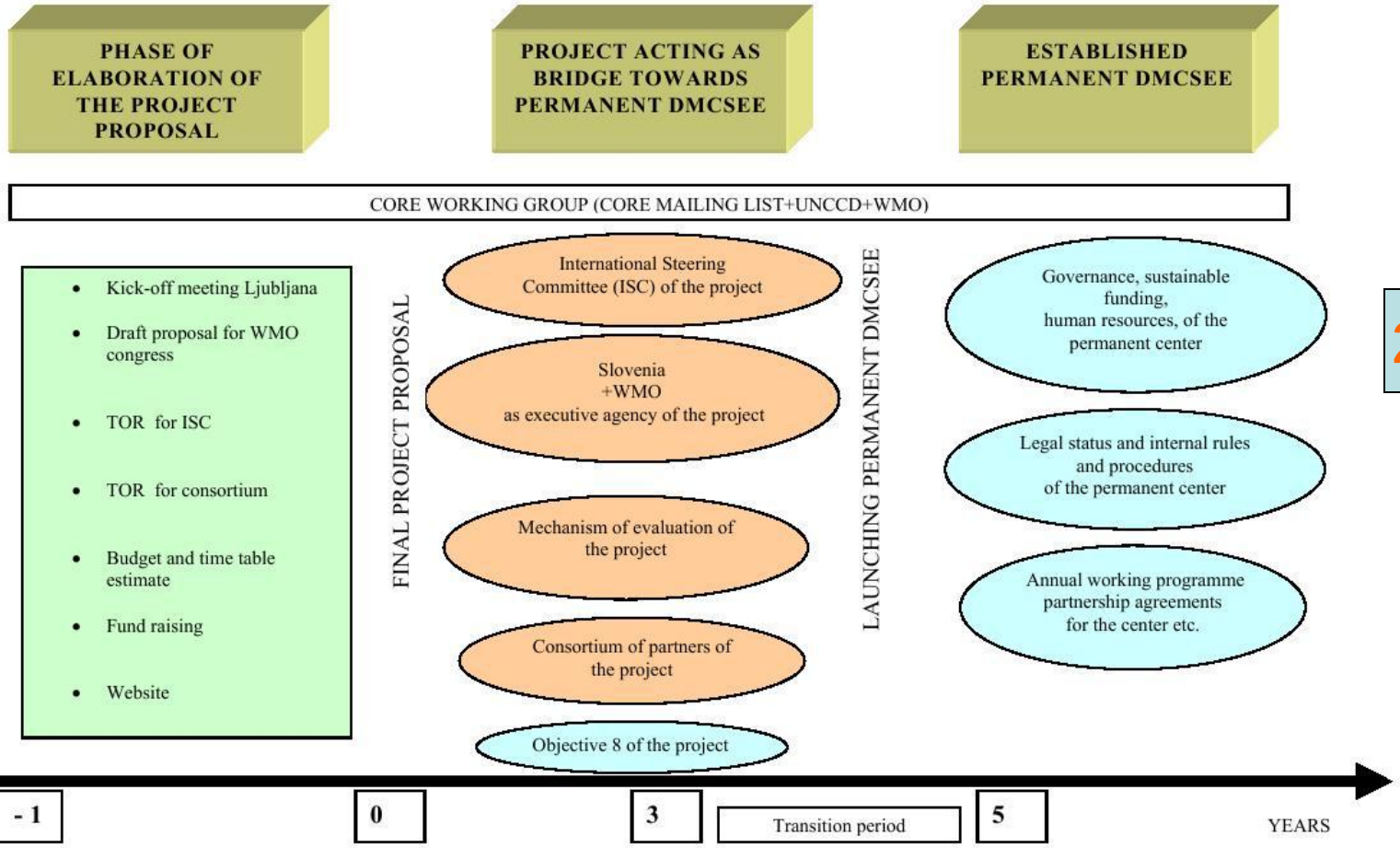
Jointly for our common future

SOUTH EAST EUROPE
Transnational Cooperation Programme

DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

DRAFT PROCESS FOR THE DMCSEE



2012!!

Jointly for our common future

SOUTH EAST EUROPE
Transnational Cooperation Programme

DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

What is DMCSEE?

The duration of DMCSEE Project from April 2009 until March 2012.

Currently, DMCSEE is in its **"bridge project"** phase aiming at permanent functioning centre.

Most suitable project framework (in the frame of EARS) was found to be

Transnational Cooperation Programme for SE Europe

www.southeast-europe.net

Main aim of transnational cooperation programme is to foster a balanced territorial development and territorial integration within the cooperation area

-> common infrastructure, not research!

Jointly for our common future

SOUTH EAST EUROPE
Transnational Cooperation Programme

DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

DMCSEE – TCP-SEE project

15 partners from 9 countries

Total project budget 2.2 M€

Not all countries participate!

(not all countries are eligible)

Secondment of staff to DMCSEE in the framework of WMO/DRR project: Turkey & Bosnia and Herzegovina

Environmental Agency of Slovenia	Slovenia	(lead partner)
Slovenian Institute of Hop Research and Brewing	Slovenia	
Hungarian Meteorological Service	Hungary	
VITUKI Environmental Protection and Water Management Research Institute	Hungary	
Directorate for Environmental Protection and Water Management of Lower Tisza District	Hungary	
Institute of Soil Science "Nikola Poushkarov"	Bulgaria	
National Institute of Meteorology and Hydrology	Bulgaria	
Agricultural university of Athens	Greece	
GEORAMA (non-governmental and non-profit organization)	Greece	
Meteorological and Hydrological Service	Croatia	
Republic Hydrometeorological Service of Serbia	Serbia	
Hydrometeorological Institute of Montenegro	Montenegro	
Hydrometeorological Service	FYROM	
Institute for Energy, Water and Environment	Albania	

Jointly for our common future

http:/www.dmcsee.eu

SOUTH EAST EUROPE
Transnational Cooperation Programme

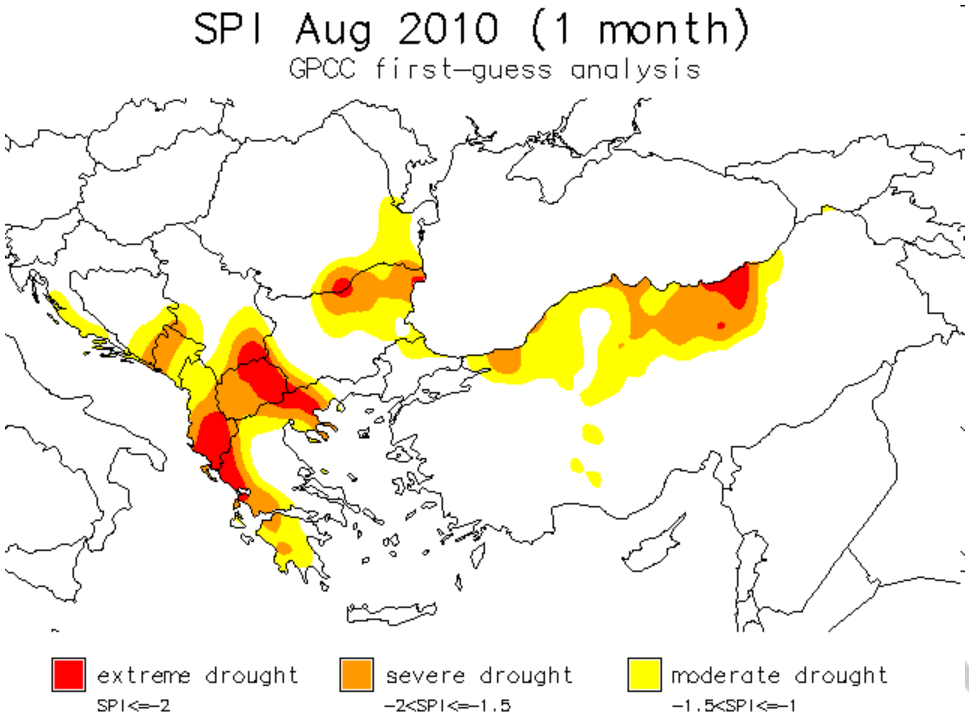
DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

DMCSEE – TCP-SEE project activities
Regional drought monitoring

-Overview of existing procedures for climatological mapping;
-Implementation of drought indices (SPI, PDSI, PAI,…)
-Maps available online.

Can we do better than just using global datasets (such as GPCC)?



Standardized precipitation index (SPI), computed from GPCC data (Global Precipitation Climatology Center)

SOUTH EAST EUROPE
Transnational Cooperation Programme

DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

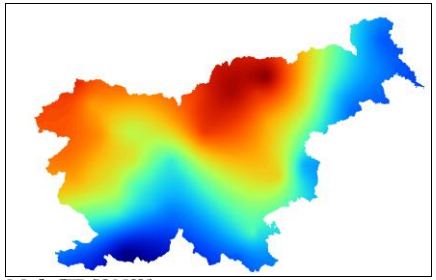
DMCSEE – TCP-SEE project activities
Climatological mapping

From regional to local implementation

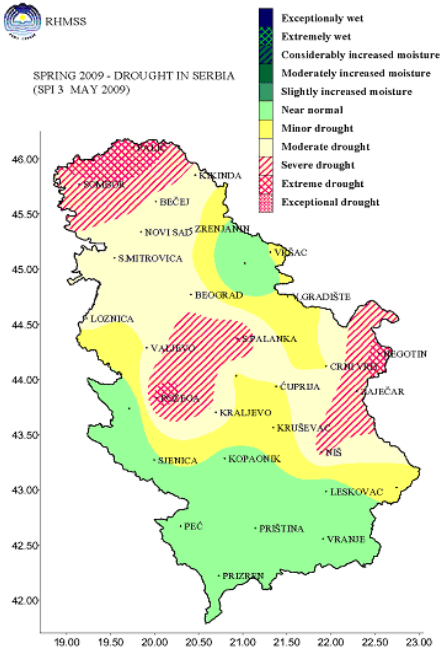
-Calculation of SPI

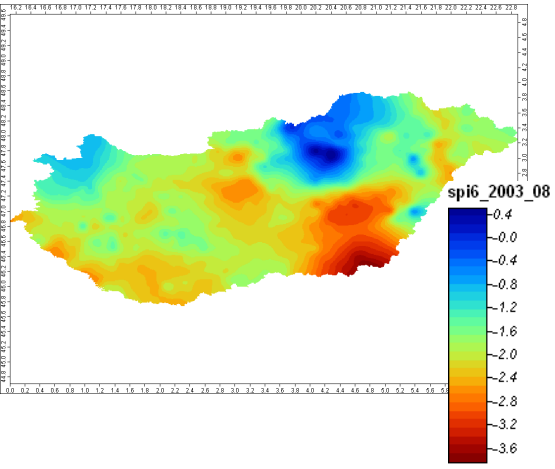
-Mapping of SPI

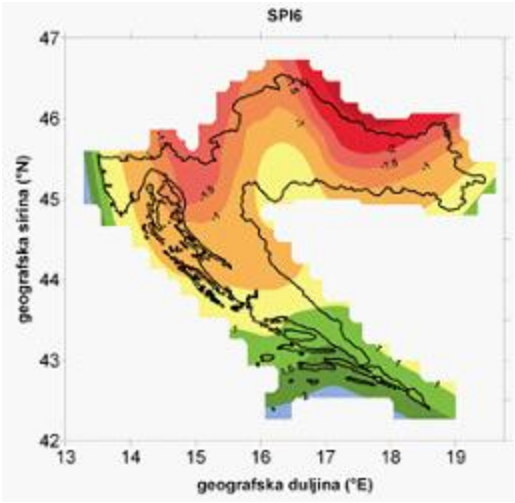
-Dissemination



Mp for SPI3 (2009)







Local capacity is the only way to guarantee sustainability
Neither a game of playing numbers nor producing nice-looking maps – usefulness

SOUTH EAST EUROPE
Transnational Cooperation Programme

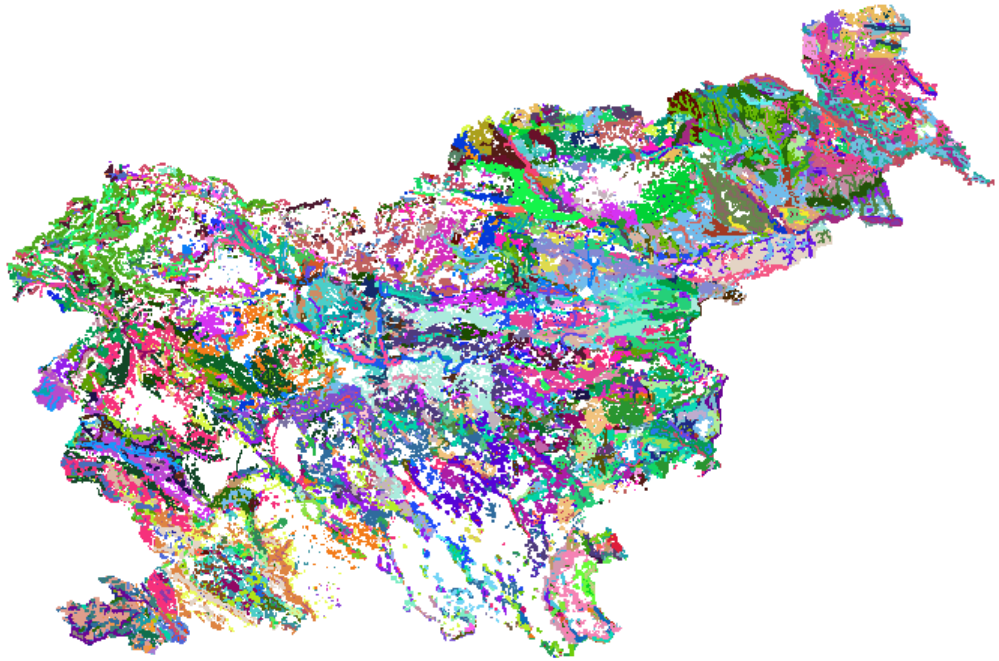
DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

DMCSEE – TCP-SEE project activities
Regional vulnerability assessment to drought impacts

Factors that increase vulnerability in agriculture:

- **soil water holding capacity**
- terrain slope and aspect
- land use / land cover
- access to irrigation infrastructure etc



SOUTH EAST EUROPE
Transnational Cooperation Programme

DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

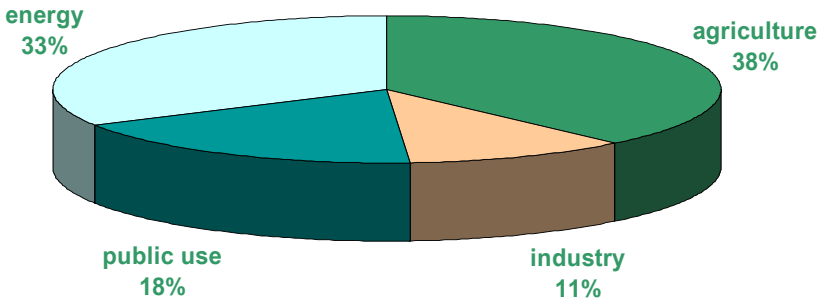
DMCSEE – TCP-SEE project activities

Water use efficiency in agriculture:

crop-water balance model WinIsareg (Pereira et al, 2010)
Irrigation scheduling

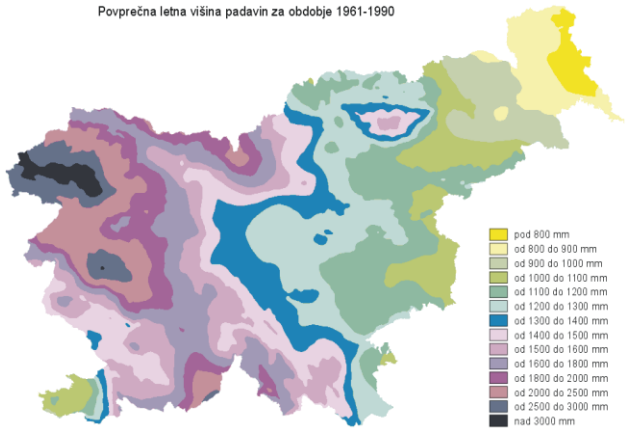
southern European countries have the highest water use for irrigation. It represents around **78 %** of the total abstraction in southern Accession Countries.

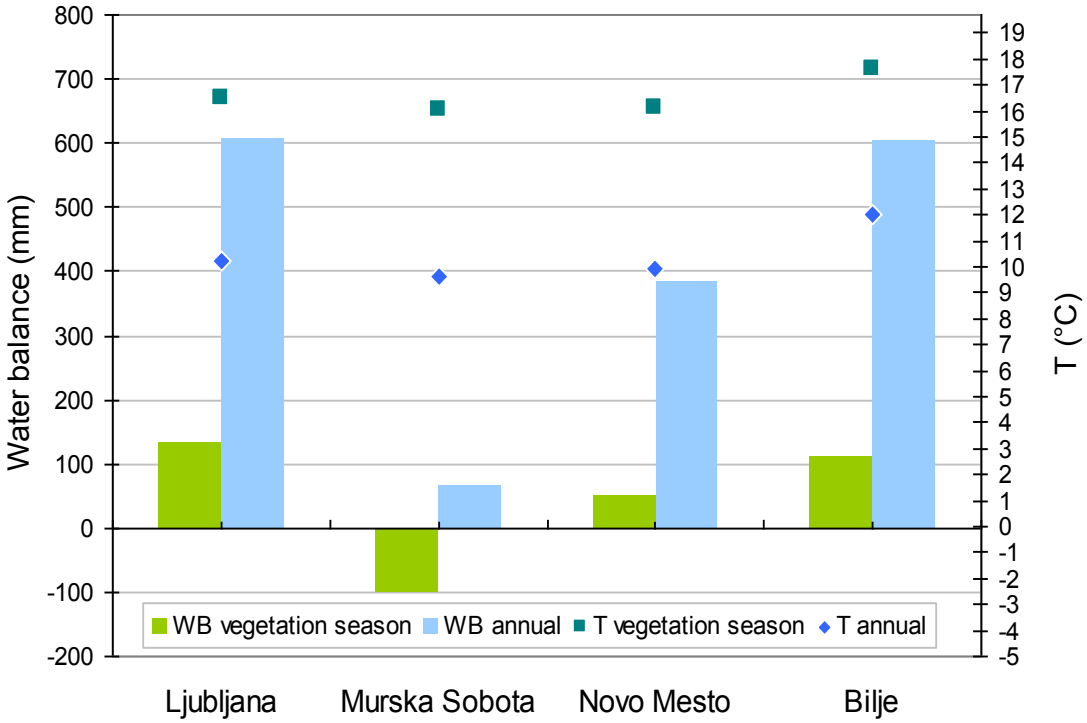
Europe



Case study for Slovenia

- Diversity of climate: (continental, alpine, sub-Mediterranean);
- Annual water balance in the period 1971-2000 sufficient, but vegetation period problems with rain distribution and high ETo
- NE part has average water deficit.





Meteorological data:
- Archive of EARS;
- Potential evapotranspiration (FAO Penman - Monteith).

Crop and Soil data

Crop

maize (*Zea mays*) hybrid Cisco

- Crop data referring to dates of crop development stages, crop coefficients (Kc); root zone depths Zr (m); soil water depletion fractions for no-stress (p); and the seasonal water-yield response factor (Ky)

stages	date	root depth (m)	p
A - sowing	20.4.	0.01	0.4
B – third leaf	7.5.	0.20	0.4
C - tasseling	9.7.	0.50	0.4
D – milky ripe	16.8.	0.50	0.4
E – fully ripe	8.10.	0.50	0.4
F - harvest	14.10.	0.50	0.4

date	K_c
30.4.	0.20
7.5.	0.50
11.5.	0.90
28.6.	1.10
9.7.	1.20
16.8.	0.60
20.9.	0.50

K_y = 1.25

Soil

Soil data for a multi-layer soil

The soil water content at field capacity θFC (m3 m-3) and the wilting point θWP (m3 m-3), or the total available water (*TAW*, mm)

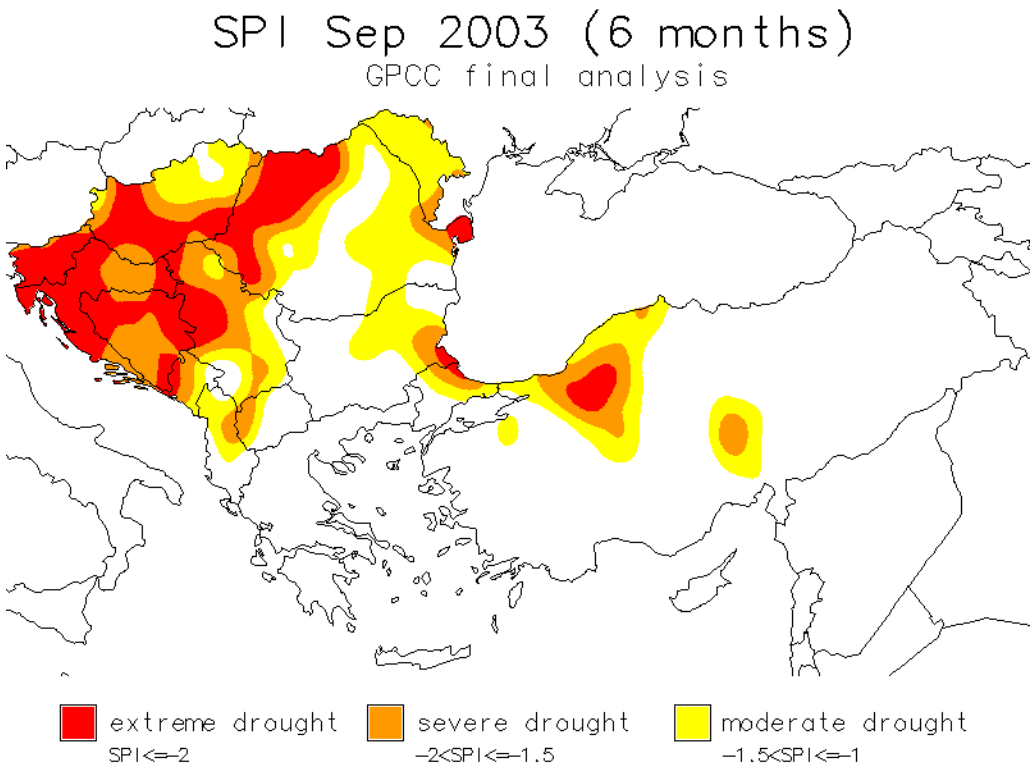
- Low Water Holding Capacity (78 mm)
- High Water Holding Capacity (156 mm)

Methods

Standardized Percipitation Index (SPI)

- probability distribution - average 1971-2000
- used time scale: 1- and 6-month

SPI value:	drought category
2.00 and above	extremely wet
1.50 to 1.99	very wet
1.00 to 1.49	moderately wet
-0.99 to 0.99	near normal
-1.00 to -1.49	moderately dry
-1.50 to -1.99	severely dry
-2.00 and less	extremely dry

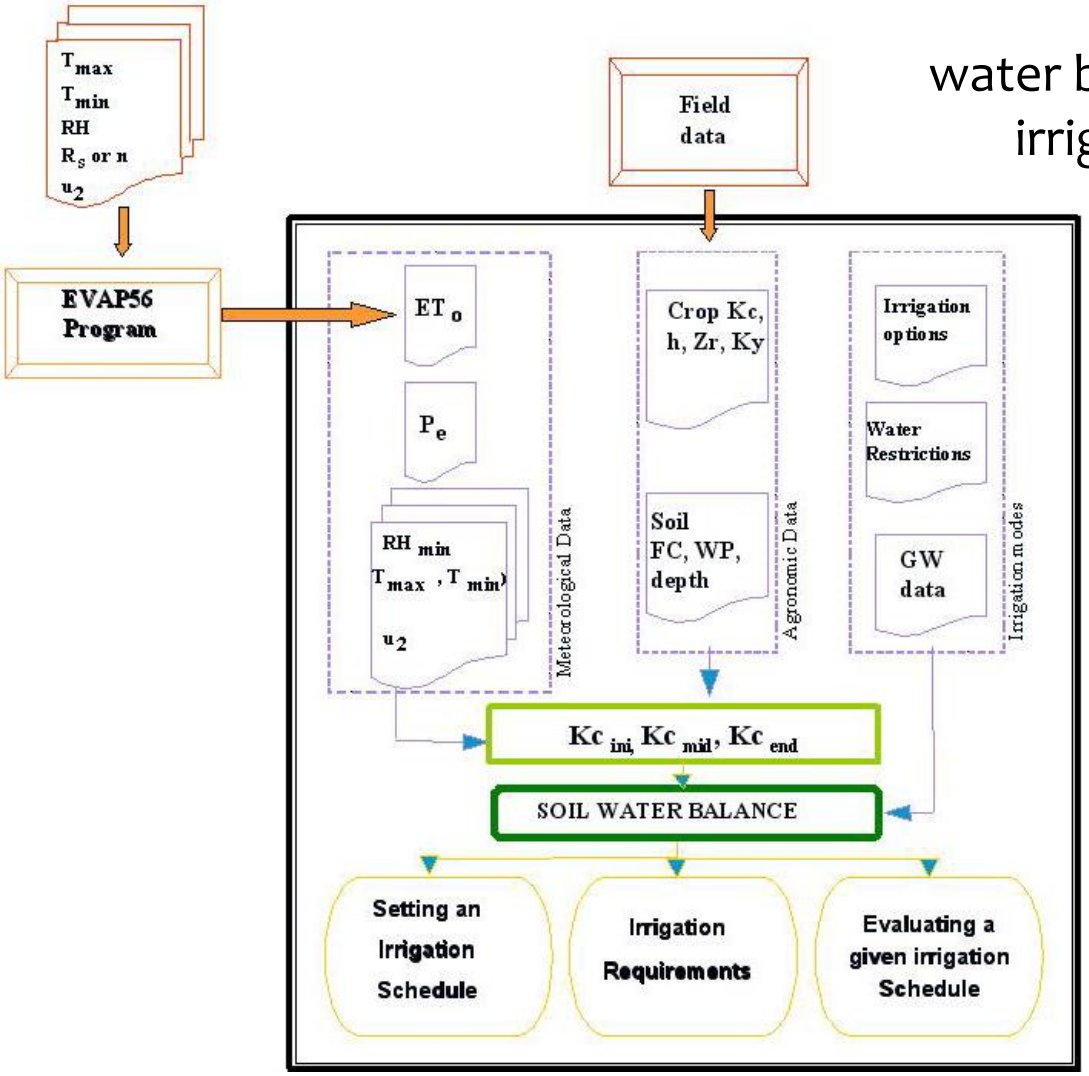


Water Balance

$WB=RR-ET_o$

FAO Penman - Monteith method

Methods



WinISAREG

water balance model for simulating crop irrigation schedules at field level.

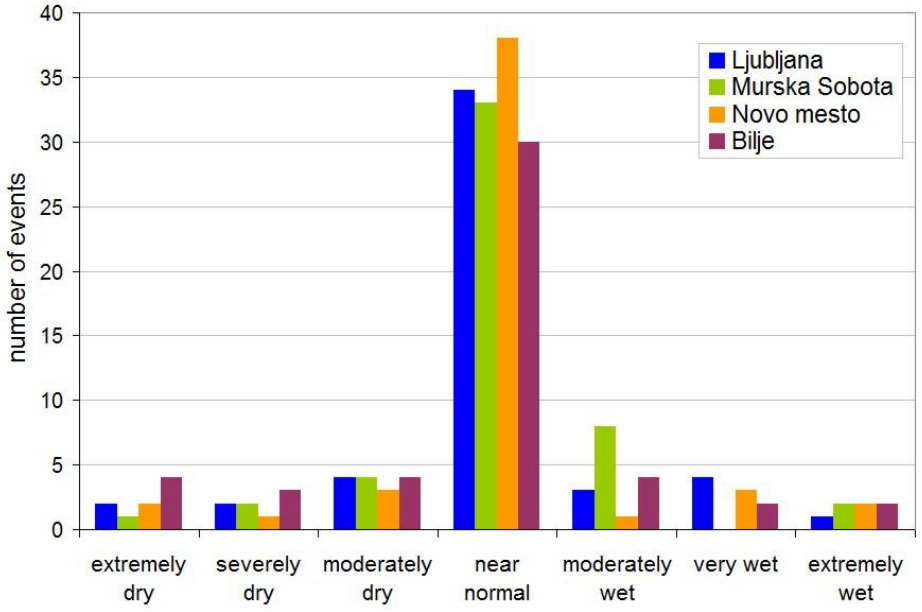
NIR

Net Irrigation Requirements

- agrometeorological reports of EARS (1960 – 2010)
- damage due to drought checked in reports of SURS (2010)
- trends

Analysis of vegetation seasons 1961 – 2010

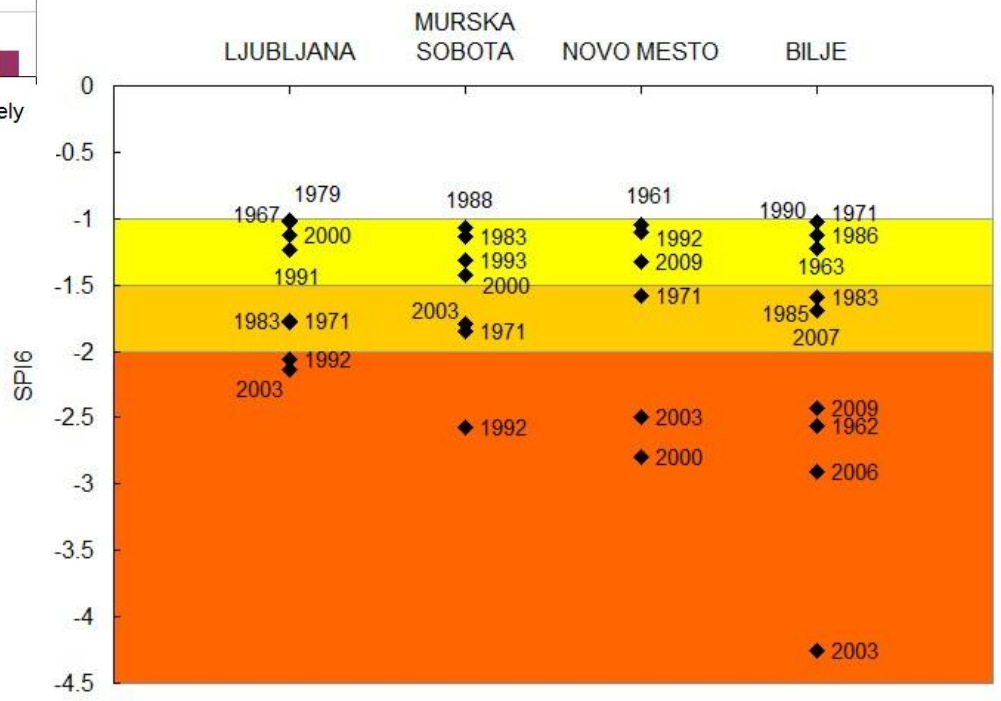
Number of vegetation seasons



Standardized Precipitation Index 6 – month (SPI6)

SPI value:	drought category
2.00 and above	extremely wet
1.50 to 1.99	very wet
1.00 to 1.49	moderately wet
-0.99 to 0.99	near normal
-1.00 to -1.49	moderately dry
-1.50 to -1.99	severely dry
-2.00 and less	extremely dry

Vegetation seasons classified in the range of **dry years**



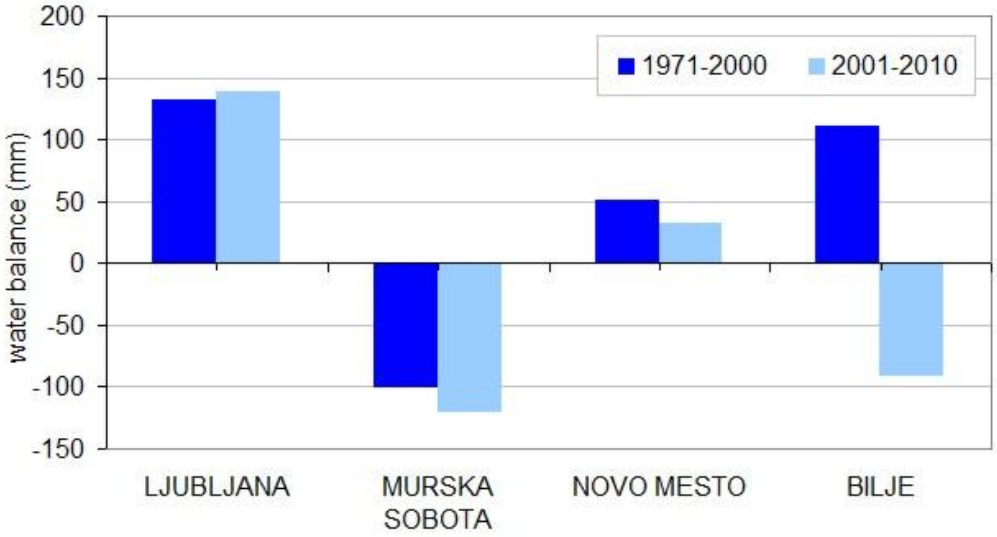
In 50 years SPI6 classified:

- 6-11 dry seasons;
- 6-10 wet seasons.

Minimum value of SPI6:
-4.26 (Bilje, 2003).

Analysis of vegetation seasons 1961 – 2010

Average vegetation water balance

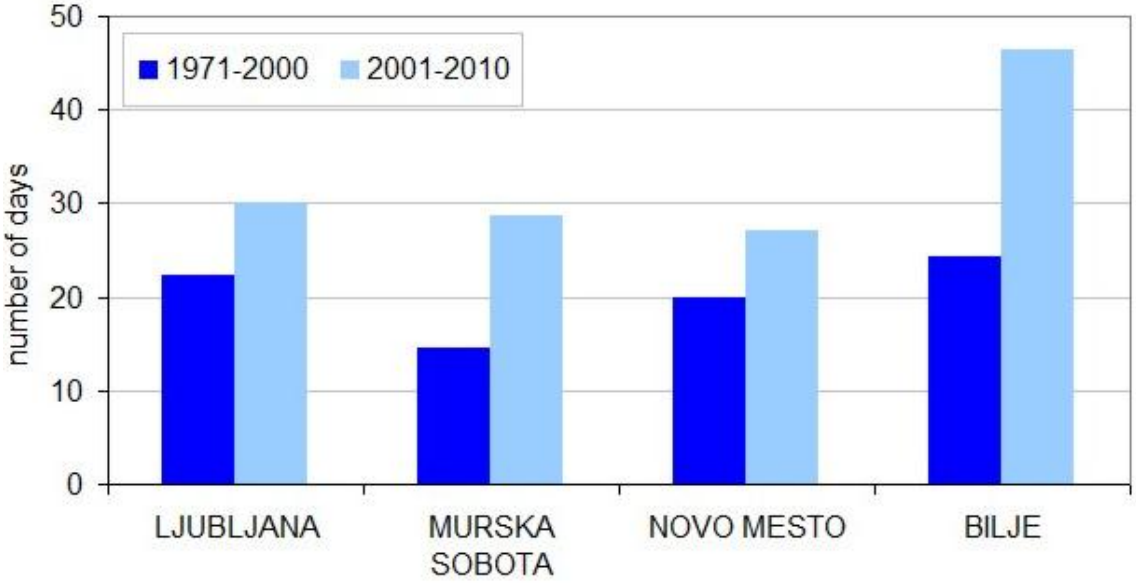


Water Balance

Higher evapotranspiration rate: in last 10 years from 7 to 22 days with ETo>5 mm more than in 1971-2000.

- the highest water deficit in Murska Sobota (NE Slovenia);
- decreasing water balance in the last 10 years (Ljubljana is and exception).

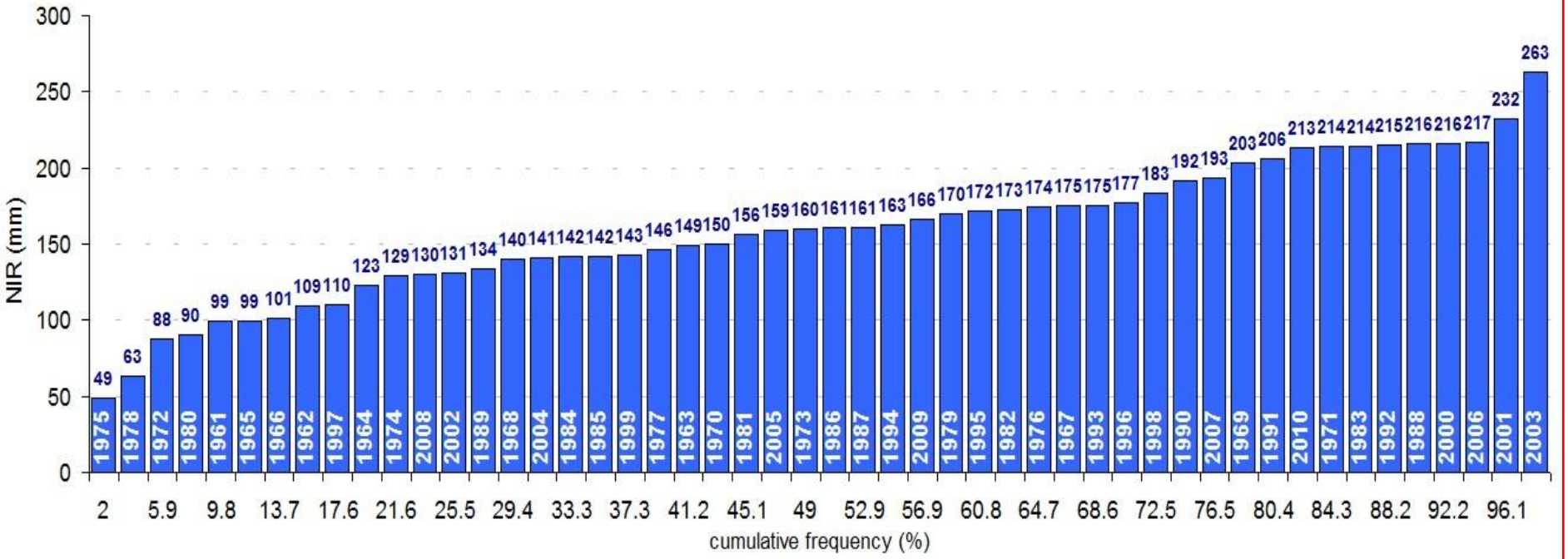
Number of days with ETo > 5 mm



Analysis for vegetation seasons 1961 – 2010

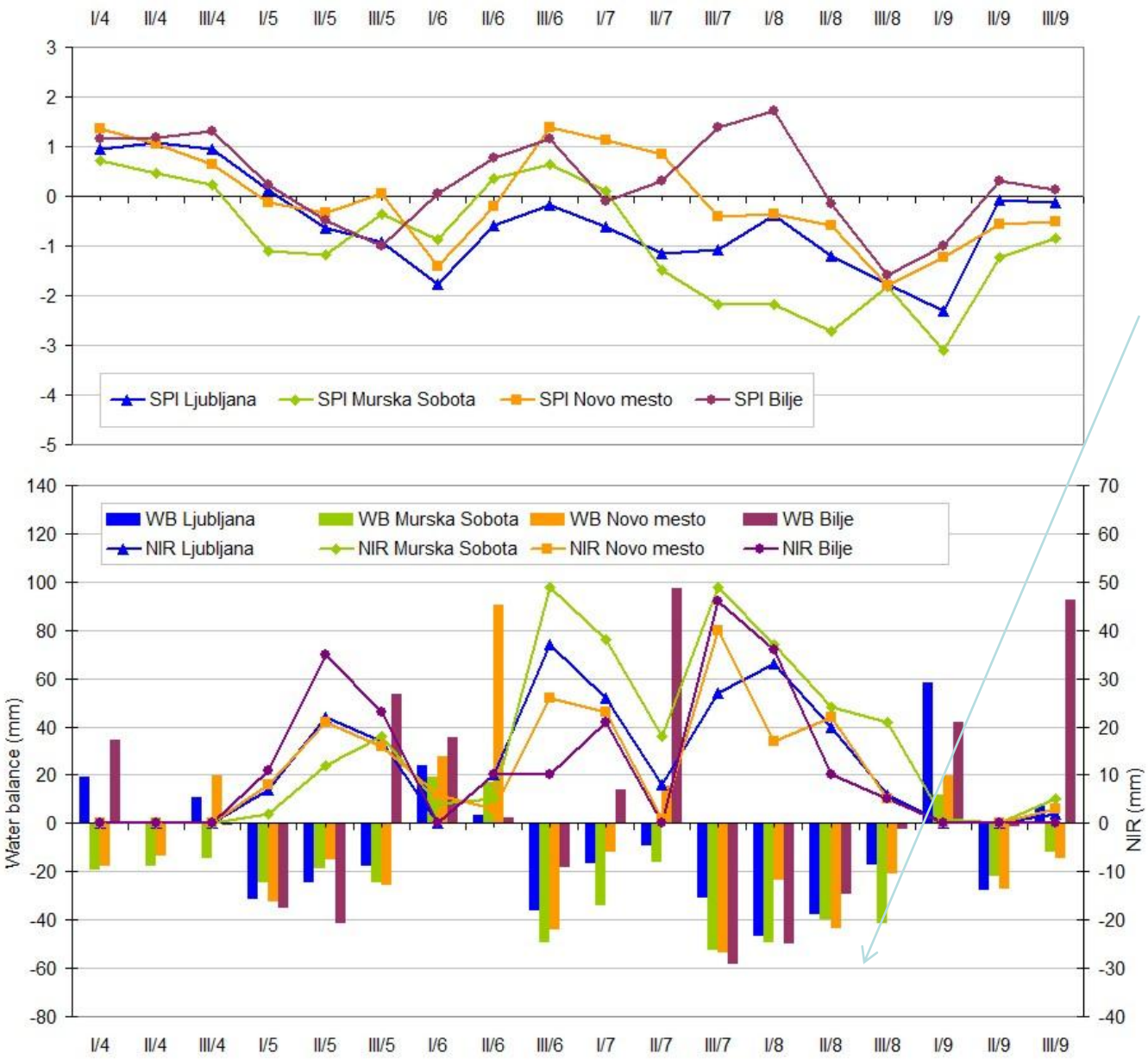
Net Irrigation Requirements

Classification of seasons according to NIR



- Years in the range between 80 % and 100 % determined as dry;
- Average difference of NIR between soils of LWHC and HWHC from 52 to 65 mm.

Year 1992 – drought development

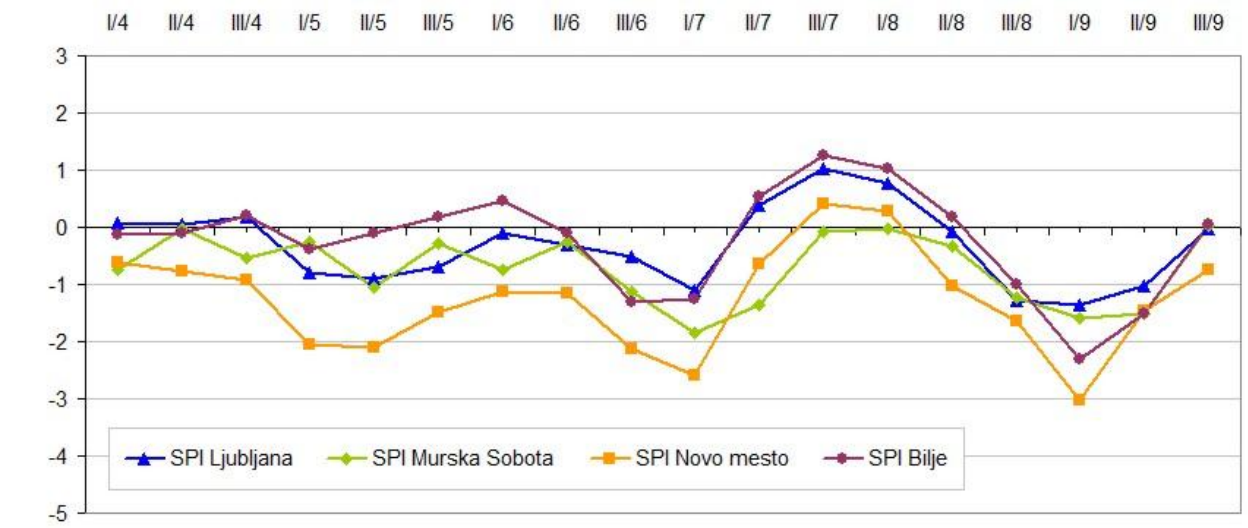


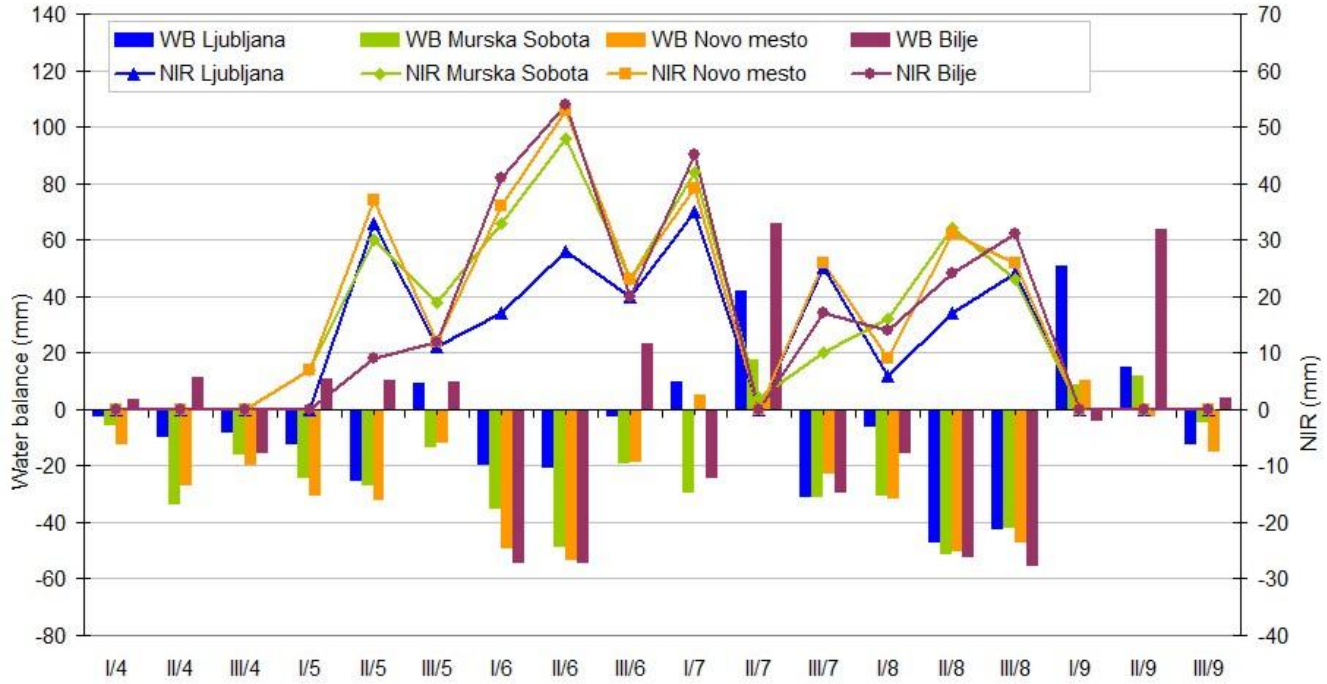
- SPI1 shows two major dry spells (end of May and in August);
- extreme drought(according to SPI6) in Murska Sobota from 3rd decade of July untill the end of the season;
- 3 major periods with negative water balance, which reflects on NIR;
- the largest irrigation water consumption in Murska Sobota from 3rd decade of June, which fits with SPI;
- the highest magnitude and the longest duration of drought in MS.

REPORTS:

- most extreme drought in Murska Sobota;
- drought at all parts of Slovenia;
- 70 to 90% of maize crops damaged due to drought.

Year 2000 – drought development



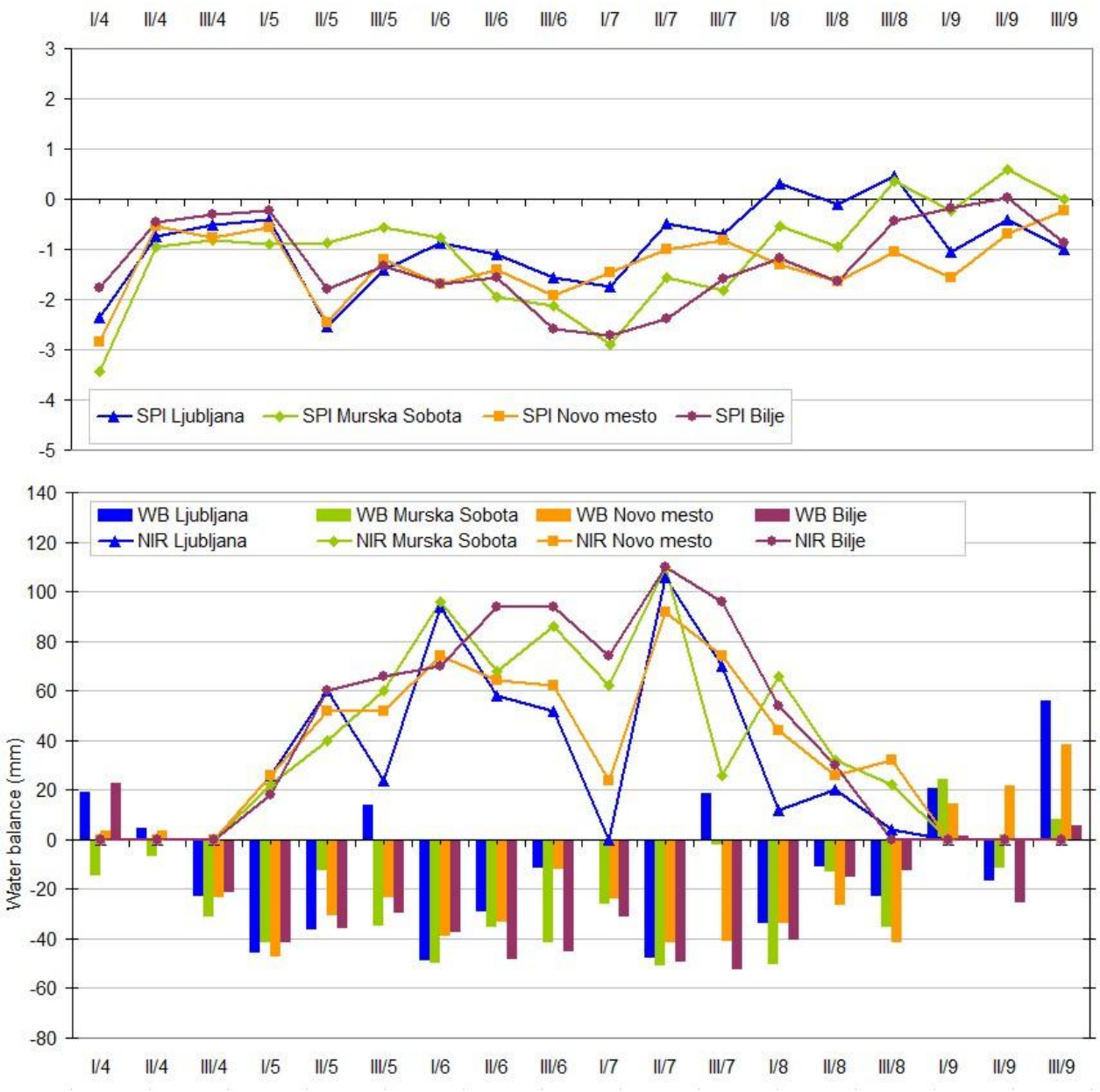


- According to SPI1 was drought in Novo mesto and Murska Sobota; only at the end of the season were at all four locations;
- three intervals of extreme drought (SPI6) in Novo mesto;
- irrigation needed through the all season with exception at 2nd decade in July, which reflect in positive WB and normal (even moderately wet) SPI1.

REPORTS:

- first interval of agricultural drought in the middle of April
- second dry interval in the summer;
- the most severe agricultural drought in the 10 – year period from 1990 to 2000;
- maximum damage recorded in maize crops;
- crop yield in Murska Sobota, Novo Mesto and Bilje reduced by 20 – 30 %.

Year 2003 – drought development

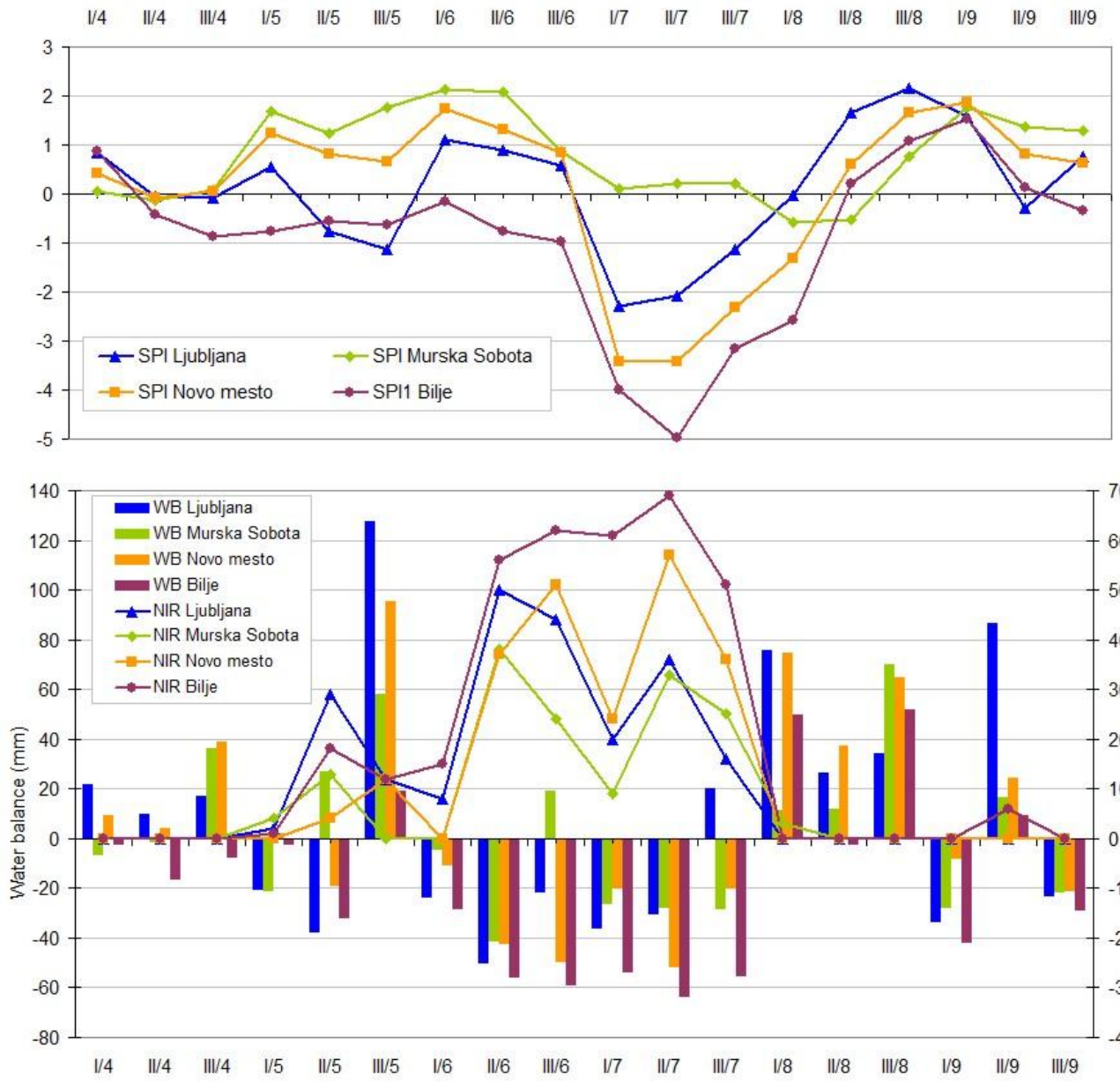


- SPI1 detects already extreme spring drought;
- according to SPI1 drought last through all the season, conditions getting better in August but still on the dry side;
- slightly better conditions only in Ljubljana;
- negative WB almost all the vegetation season;
- consumption of irrigation vater in season: Bilje 383 mm, Murska Sobota 345 mm, Novo mesto 311 mm and Ljubljana 263 mm.

REPORTS:

- drought lasted from the end of April up to second decade of July;
- natural disaster ranked amongst the worst in the previous 50 years;
- maize on shallow and sandy soils visibly lagged behind the normal growth;
- 70 % of Slovenian agricultural area distressed;
- damage assessed to 4.000 million €.

Year 2006 – drought development



- June and July were extremely dry according to SPI1 in Bilje, Novo mesto and Ljubljana;
- the largest WB deficit in Bilje;
- normal conditions only in Murska Sobota;
- one extreme peak in NIR in June and July;
- irrigation water consumption in June and July together : Bilje 314 mm, Novo mesto 205 mm and Ljubljana 174 mm;
- drought in 2006 was regional.

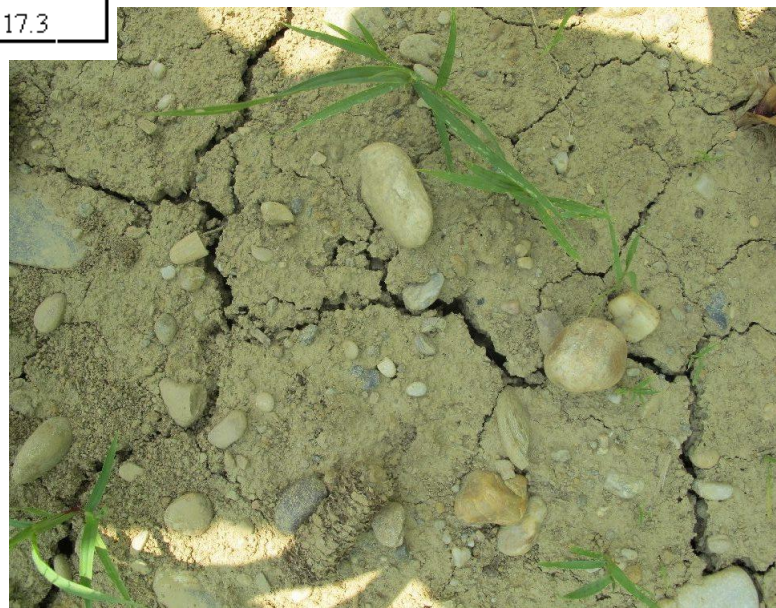
REPORTS:

- summer drought, intensified till the end of July at whole Slovenia;
- In Bilje maximum damage due to drought was recorded in maize crops;
- maize crop yield reduced by 40 to 90%.

Trend analysis

		Ljubljana	Murska Sobota	Novo mesto	Bilje *
ETP in vegetation season	absolute change (mm/10 years)	14.6	20.4	10.1	42.5
	relative change (%/10 years)	+ 2.4 **	+ 3.4 **	+ 1.7	+ 6.6 **
ETP > 5 mm in vegetation season	absolute change (NOD/10 years)	4.1	4.6	3.6	10.0
	relative change (%/10 years)	+ 18.6 **	+ 31.7 **	+ 18.1 **	+ 41.1 **
NIR for LWHC in vegetation season	absolute change (mm/10 years)	13.9	14.4	11.8	26.7
	relative change (%/10 years)	+ 8.8	+ 8.7	+ 7.2	+ 14
NIR for HWHC in vegetation season	absolute change (mm/10 years)	14.4	13.4	13.1	22.0
	relative change (%/10 years)	+ 15.5	+ 11.6	+ 12.8	+ 17.3

* Bilje from year 1962.



- statistically significant increase of ETo;
- statistically significant increase of days with ETo > 5 mm;
- increasing Net Irrigation Requirement;
- decreasing water balance (from -64.0 mm to -13.4 mm).

SOUTH EAST EUROPE
Transnational Cooperation Programme

DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

Future role of DMCSEE after 2012?

Understanding of the problem

Regional drought & regional vulnerability to drought impacts

Proper Planning

Informed decision making (promote and strengthen the capacity for drought preparedness)

exchange of knowledge, experience and best practice on drought issues (**SEE network**)

set-up permanent Drought Management Centre for SE Europe?

raise awareness of decision makers, relevant stakeholders and end users about importance of effective drought preparedness, monitoring and management.

Drought Risk Reduction

Jointly for our common future

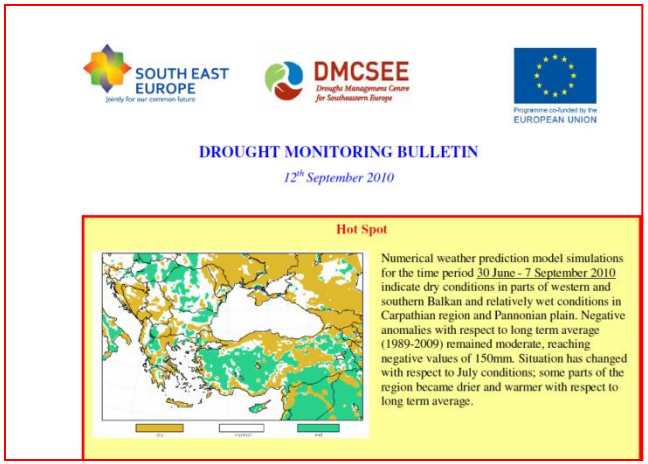
Visit DMCSEE web page for update

http://www.dmcsee.org/en/drought_bulletin/

In 2010 we have started to publish **Drought Bulletin for SE Europe. Bulletin** contains following sections:

Hot spot - short summary, possibly including a figure. It aims at very short insight of possible circumstances of drought at the time of issue.
Additional and auxiliary information (such as methology used, more detailed information on water balance or temperature situation)
Report on impacts; content of this section is based on information available in electronic media on the internet. To improve the information, you are most welcome to participate by informing us on drought impacts in the current season in your region. Send your contribution and comments through our contact. Also any other comments on the bulletin content would be highly appreciated.

Please find published issues of bulletin on the web.



SOUTH EAST EUROPE
Transnational Cooperation Programme

DMCSEE
Drought Management Centre for Southeastern Europe

Programme co-funded by the EUROPEAN UNION

Jointly for our common future