
Questionnaires from Danube Countries



International Commission
for the Protection
of the Danube River

Internationale Kommission
zum Schutz der Donau

ANNEX to “The 2015 Droughts Report in the Danube River Basin”

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Questionnaires from Danube Countries

The Annex includes the “Questionnaire on the 2015 Droughts in the Danube River Basin” completed by thirteen Danube countries (AT, BA, BG, CZ, DE, HR, HU, MD, RO, RS, SI, SK and UA) including references to more specific information and data available on national level.

In addition, drought related information for Danube countries can also be obtained from the Drought Management Centre for Southeastern Europe (DMCSEE, <http://www.dmcsee.org/>) and the European Drought Observatory (EDO, <http://edo.jrc.ec.europa.eu/edov2/php/index.php?id=1000>) providing regular drought news via the DMCSEE Drought Bulletins and the EDO Drought News.

QUESTIONNAIRE ON 2015 DROUGHTS IN THE DRB - AT

Country:	Austria
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1. Did you experience significant drought phenomena in your country during 2015?

(if “No” then only questions 4, 5 and 8 might be relevant to be answered)

- Yes
 No

Please briefly describe:

The year 2015 was an extraordinary warm and dry year in Austria. The mean temperatures were during 10 months in parts considerably above the long term averages. Austria received a mean annual precipitation in 2015 of about 900 mm, which corresponds to about 80% of the long term average annual precipitation (1.100 mm) for the period 1981-2010. Starting with precipitation above-average in January, from February until August in almost all regions of Austria deficits in precipitation have been observed with regional variations in deficits (compared to the long term average) of up to -30%. The northern and eastern regions of Austria were mostly affected with serious consequences particularly in agricultural production. After September and October with close to normal precipitation, November and December we again very dry. Compared to the other months, December was the driest month with precipitation deficits around -80%. In total, all regions of Austria received annual accumulated precipitation in 2015 lower than the long term average for the period 1981-2010 (see also Figures 1 and 2).

Effects of the drought in 2015 have been experienced in almost all water-dependent sectors with different intensity. For rivers and lakes, elevated temperatures and low discharges/water tables have been observed but with little and regional effects on ecology only.

For more details please consult section 2, where also the meteorological and hydrological circumstances are explained more in detail below the table.

The webpage of the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management provides summaries on the monthly basis (and for December also a summary of the respective year) about the hydrographic characteristics (Air Temperature, Precipitation, River discharge, Groundwater levels) for different parts of Austria. For additional information please consult: https://www.bmlfuw.gv.at/wasser/wasser-oesterreich/wasserkreislauf/hydrograph_charakt_extrema/monatscharakteristiken.html.

2. If drought was a significant phenomenon, which water-dependent sectors were mainly impacted*?

	Please indicate o...no impacts x...low impacts xx...high impacts	Description**
Agriculture	xx	<ul style="list-style-type: none"> in Austria areas with irrigation are quite limited (in total about 30.000 ha¹), water demand increased significantly in areas with periodical irrigation due to significant deficits in precipitation starting with March/April and continuing in June/July 2015, E.g. in the Marchfeld² region the water demand for agricultural irrigation was significantly above (between +30% and +100%) the long-term average in September 2015, the Austrian hail insurance company (“Österreichische Hagelversicherung”) estimated total income losses due to losses in crop yields based on data of precipitation distribution (until the end of August) of about 175 Mio. €³; these losses were mainly attributed to maize (45%), potatoes (20%) soybeans (10%), sugar beets (7%), pumpkins (4%) and other crops types; but also to grassland (10%); regions with highest estimated income losses were Lower Austria (57%), Upper Austria (25%), Burgenland (7,5%) and Styria (5%) reduced income losses can partly be supported by crop yield statistics⁴, which indicate reduced crop yields e.g. for maize, potatoes, sugar beets but also considerably reduced crop yields for other crop types (see following table); however, crop yield statistics reflect an average situation, as irrigated areas may provide normal yields, losses in crop yields at non-irrigated areas will be significantly higher than reflected by this statistics

¹ Statistik Austria: Agrarstrukturerhebung 2010

(http://www.statistik.at/web_de/statistiken/wirtschaft/land_und_forstwirtschaft/index.html)

² Meteorologische, hydrologische und wasserwirtschaftliche Verhältnisse 2015. Betriebsgesellschaft Marchfeldkanal

³ Die Österreichische Hagelversicherung, Stand Sept. 2015 (Spezialkulturen, die üblicherweise bewässert werden, sind in dieser Aufstellung nicht berücksichtigt. Diese Schadenshochrechnung wurde erstellt auf Basis der Niederschlagsdaten je Gemeinde bis zum 31.8.2015. Die Höhe des Schadens errechnet sich für die Herbstkulturen auf Basis des Niederschlagsdefizites.)

⁴ Grüner Bericht 2015 (www.gruenerbericht.at), Grüner Bericht 2016 (unveröffentlicht)

		crop	reduced crop yield per hectare for 2015 [%] compared to the average (period 2010-2014)	regional variations in reduced crop yield per hectare 2015 [%] compared to the average (period 2010-2014)
		corn maize/ silo maize	-14 / -9	-18 (B), -25 (NÖ), -19 (OÖ)/ -5 (B), -12 (NÖ), -11 (OÖ)
		Potatoes (early/ late maturing)	-14 -22	-16 (NÖ), -8 (OÖ)/ -15 (B), -19 (NÖ), -18 (OÖ)
		Sugar beets	-13	-17 (B), -9 (NÖ), -12 (OÖ)
		Fodder beets	-15	-17 (B), -9 (NÖ), -12 (OÖ)
		sunflowers	-22	-11 (B), -22 (NÖ)
		Rape (winter/ summer)	-9/ -11	-21 (B), / -27 (B), -16 (OÖ)
		Abbr.: B... Burgenland, NÖ...Lower Austria, OÖ...Upper Austria		
Navigation**	xx	<ul style="list-style-type: none"> Between July and December 2015 critical fairway depths less than 2.5m were registered on 119 days in the free-flowing section east of Vienna and on 42 days in the free-flowing section Wachau due to low discharge values⁵ (see figure 4) Because of low discharge conditions transport of goods was significantly affected with reduced transport volumes (-15%) in 2015 compared to 2014; the biggest reductions in transport volumes were registered for the third quarter 2015 (-33%), this not only due to low discharge conditions but in addition due to branch specific trends⁶ Due to the low discharge conditions starting with July and lasting until the end of the year (see figure 4), the mean level of capacity of the ships was at 57% per month; between August and November only less than 50% of the capacity of ships could be used (in November 2015, for the transport of 659.000 tons of goods 828 drives were needed (level of capacity 43%); in April 2015 for the transport of 681.000 tons 567 drives were needed (level of capacity 72% - highest in 2015) However, due to efficient fairway maintenance shipping on Austrian parts of the Danube could be ensured throughout the year without interruptions 		

⁵ Fairway Rehabilitation and Maintenance Master Plan for the Danube and its navigable tributaries: National action plans, Update May 2016

⁶Information based on personal communication from via Donau

Water supply (drinking water)	x	<p>Based on a study⁷ issued by ÖVGW⁸, the University for Life Sciences examined the interrelation between climate change, heatwaves and the security of water supply based on experiences of water supply operators during 2015.</p> <p>main findings:</p> <ul style="list-style-type: none"> • Increasing water demand in summer due to increasing number of private swimming pools and irrigation systems; this trend has not yet been adequately addressed in planning criteria by many service provider • However, resources availability were not affected at the beginning of the dry conditions in summer 2015 • Introduced mitigation measures as a result of the drought in 2003 (interconnections between service networks between regional service providers; multiple resource use as basis for supply security) in regions vulnerable to resource limitations have proved their effectiveness in 2015 • Only little limitations in water supply were detected for 2015 (capacity of network is sufficient also during peaks of water consumption for about 90% of observed service provider); during peaks of water consumption particularly small service provider or individual water supplies are close to service limits; calls for savings of water at 10% and limitations in supply at 5% of observed providers (n=47) • Without mitigation measures already taken as a consequence of the drought in 2003 considerably larger restrictions in supply would have been expected
Energy (Hydropower)	x	<ul style="list-style-type: none"> • Average river discharges 2015 at about 86% of long-term average (in July/August at 65% of long-term average) • Reduced Hydro coefficients for 2015 (0,93) (2014: 1.02) as well as for 3rd quarter (Q3 2015: 0,8 (Q3 2014: 1.1))⁹ • Lower hydropower output for electricity generation (run-of-river) (-9,9%) compared to 2014 • no restrictions to supply security with electricity from hydropower
Industry (cooling water)	n.a.	

⁷ Source: Wasserversorgung im Jahre 2015 – Erfahrungen und Ausblick. Institut für Siedlungswasserbau, Industriewasserwirtschaft und Gewässerschutz. Department Wasser-Atmosphäre-Umwelt. Universität für Bodenkultur Wien. (https://www.ovgw.at/media/medialibrary/2016/04/Studie_Wasserversorgung_2015.pdf)

⁸ Austrian Association for Gas and Water (Österreichische Vereinigung für das Gas- und Wasserfach)

⁹ Source: Investoren-Präsentation Quartale 1-4/2015 (<https://www.verbund.com/cc/de/investor-relations/finanzpublikationen#tabbed-1>)

Water quality	xx	<ul style="list-style-type: none"> • elevated water temperatures were observed in almost all rivers in July and August 2015 • from 232 stations with continuous recording of e.g. data on water temperature, at 69 stations in 2015 the observed water temperatures exceeded the fish-region specific maximum water temperatures in July and August (see Figure 5) (the Austrian Quality Objective Ordinance - Ecological Status of Surface Waters¹⁰ lays down values, inter alia for general physico-chemical conditions, one of these the thermal conditions expressed as maximum water temperatures¹¹ for each fish region in Austria which is associated with the good ecological status), whereas 125 stations showed no exceedance (38 stations were excluded from evaluations due to different reasons); stations with observed water temperatures above the fish region-specific maximum water temperature were located in central and northern parts of Upper Austria (Innviertel, Mühlviertel), downstream (outflows) of great lakes (Salzburg, Upper Austria, Carinthia, Tyrol) and in lowland regions in eastern parts of Austria with considerably lower river discharges (see Figure 6), whereas stations within the alpine regions or at large alpine-fed rivers like Inn, Salzach or Danube did not show observed water temperatures above the maximum water temperatures • where measurements from regular surface water quality monitoring program (n=62) were available, observed water temperatures in July exceeded the long-term monthly average (1991-2014) at 94% of stations and the observed long-term monthly maximum at 45% of the stations; observed water temperatures in August exceeded the long-term monthly average (1991-2014) at 72% of stations and the observed long-term monthly maximum at 20% of the stations; exceedance of maximum values in July and August 2015 ranged between 1 and 47% of observed maximum monthly values for the period 1991-2014 • for the Danube river the highest monthly average water temperature at station Wolfsthal was observed in July/August with 21.8 °C (Maximum 24,3 °C); mean annual water temperature for 2015 at station Wolfsthal was the highest since the beginning of the continuous observations (2003)
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¹⁰ QZV Ökologie OG (BGBl . 99/2010, changed with BGBl . 461/2010)

¹¹ Exceedance of physico-chemical quality elements, e.g. of the maximum temperatures does not imply to fail the good ecological status, if good status as regards the biological quality elements is ensured in the long run

Ecology (Biodiversity)	x	<ul style="list-style-type: none"> • several extraordinary fish kills have been reported from Lower Austria^{12,13}, hydropower plant operators were asked to rise residual flows for rivers Traisen, Gölsen and Pielach • for some lakes extraordinary water temperatures of around 30°C and water levels minus 50cm below the average¹⁴ have been reported; for some fish ponds in Lower Austria additional aerations measures were needed to sustain the oxygen supply of aquacultures • Angler association of Lower Austria started to elaborate an emergency plan in cooperation with Lower Austria to avoid serious consequences for fish population due to future droughts¹⁵ • In the most affected regions of Austria some side arms of larger rivers or headwater of some small streams suffered from extremely low water tables or even fell dry (see also Table 1 and impacts on navigation sector), e.g. the side arms of the free flowing section of the Danube river east of Vienna (Lobau) as well as the headwaters of the some small streams in the Vienna Forest¹⁶; assessments of water quality of the respective waters were not carried out in 2015; • However, the reports from the public concerning increased fish kills could not be confirmed in general from regional river authorities
Recreation	o	<p>In 2015¹⁷ 99,6% (264) of Austrian bathing waters were compliant with the quality criteria of the EU bathing water directive. At 90,2% (239) of the sites, excellent water quality was observed, at 9,1% (24) a good water quality and at 0,4% (1) a moderate water quality. One bathing water had poor water quality. In total, 265 bathing waters were observed, 259 sites at lakes and six at rivers.</p>
Others		

* If available please make reference to quantitative information, however, expert judgement might also be necessary for answering this question

** Information on impacts on inland navigation is included in the National Action Plans in the frame of the FAIRway Danube project. This document is available [here](#).

¹² Source: NÖ Landesfischereiverband (http://www.noeflv.at/download/news/20150818_Die_groesze_Hitze.pdf)

¹³ Die Presse: http://diepresse.com/home/panorama/oesterreich/4797510/Hitzewelle_Fische-ersticken

¹⁴ Source: NÖ Teichwirteverband (<http://www.teichwirteverband-noe.at/?+Sauerstoffmangel+in+Karpfenteichen+durch+Hitze+&id=2500%2C2331499%2C%2C%2C>)

¹⁵ <http://noe.orf.at/news/stories/2730645/>

¹⁶ Personal communication of City of Vienna (Magistrat der Stadt Wien MA 45 - Wiener Gewässer)

¹⁷ Source: Federal Ministry of Health and Women's Affairs (<http://www.bmgf.gv.at/home/Gesundheit/VerbraucherInnengesundheit/Badegewaesser/#f6>)

Possible further descriptions:

Meteorological and hydrological conditions in 2015¹⁸:

Precipitation:

- mean annual precipitation in 2015 was 80% (900mm) of the long term average annual precipitation (1981-2010: 1100mm) and comparable to the situation in 2003, when the last significant drought was experienced (see figure 1);
- regional variation of annual precipitation shows that, except some regions in the south and in the west, all regions received annual precipitation below, in some parts (Upper Austria, Lower Austria, Burgenland) significantly below the long term average (see figure 2)
- long term average monthly precipitation (1981-2010) was received or exceeded in January, September and October, in all other months the accumulated precipitation was lower than the long term average; for August and December the accumulated monthly precipitation was lower than the lowest recorded value in the period 1981-2010 (see figure 3)
- except some regions in the south of Austria in July, all other regions of Austria suffered from monthly precipitation deficits with regional variations in June, July and August (up to -70%) as well as in November and December (-50% to -90% - highest relative deficits compared to long term average)

River discharges:

- Accumulated discharge for 2015 shows **for whole Austria** a deficit of -14% compared to the long term average (1981-2010) with regional differences up to -60% (Waldviertel – lower Austria)
- Discharge volume for 2015 **for the river Danube** was at 84% (50km³) of the long term average discharge (60 km³)
- From June, the monthly-averaged river discharges fell below the long term averages: in June up to -10% in regions east of Salzburg, in July in all regions up to -35%, and at the end of August at all discharge stations low flow conditions were observed (see also Figure 4 and Table 1)
- Monthly volume of the river discharge at the **river Danube** was in June at 95%, in July at 65% and in August at 61% of the long term average (Figure 4 and Table 1)

¹⁸ Source: Federal Ministry of Agriculture, Forestry, Environment and Water Management (https://www.bmlfuw.gv.at/wasser/wasser-oesterreich/wasserkreislauf/hydrograph_charakt_extrema/monatscharakteristiken.html)

Groundwater levels:

- In second half of 2015 groundwater levels were mostly near or below the average (see Table 2)
- In some parts of Austria groundwater levels fell below the lowest (monthly) observed groundwater levels (see Table 2 – indicated as red fields with values below -100%), this particularly within the period September – December

3. As a consequence of the 2015 droughts, have measures been put in place in your country to mitigate the impacts? Please briefly describe:

Measures have been put in place already as the consequence of the drought in 2003 and have proven their effectiveness (see sector water supply in Section 1). Additional measures as the consequence of the drought in 2015 are planned. E.g. the elaboration of an emergency plan to avoid fish kills due to future droughts has started in Lower Austria.

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If available, please provide pictures illustrating the impacts of the 2015 droughts in country and/or mitigation measures taken, including a source citation (a selection of pictures will be used for the report).

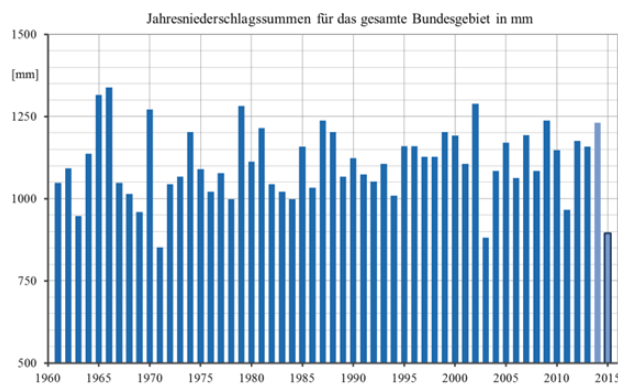


Figure 1: Accumulated annual precipitation in Austria 2015

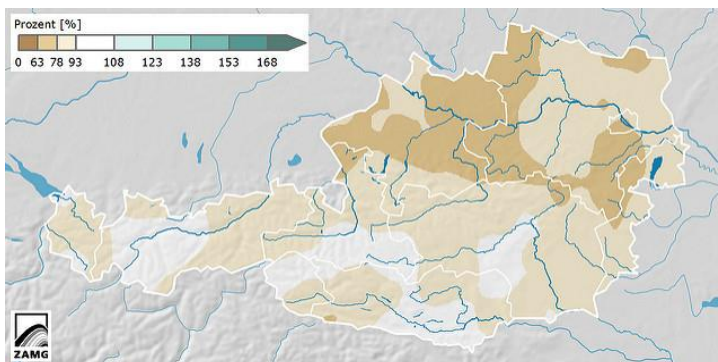


Figure 2: Spatial distribution of annual precipitation 2015 – deviation from average annual precipitation (1981-2010)

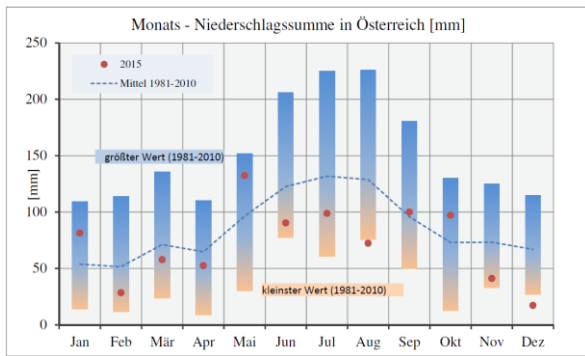


Figure 3: Monthly accumulated precipitation in Austria (compared to longterm average and its variance (lowest and highest value) for the period 1981-2010)

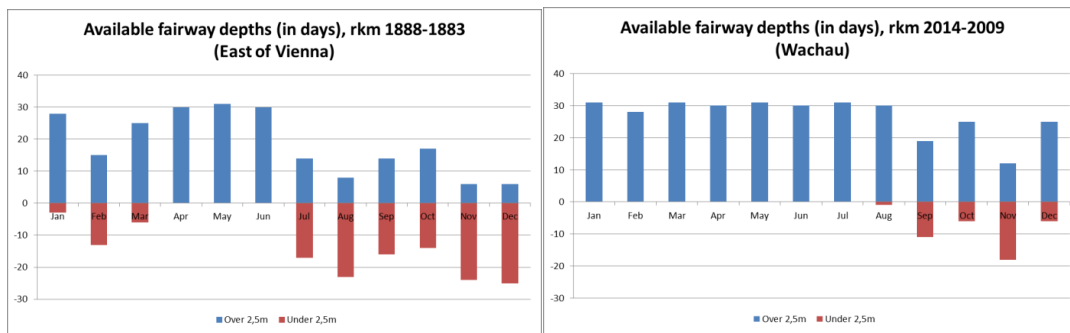


Figure 4: Impact on navigation sector

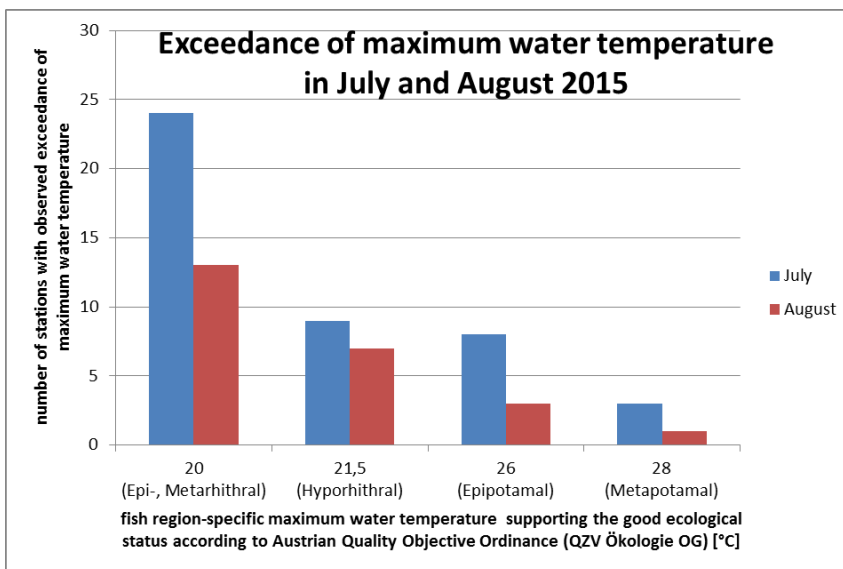


Figure 5: Number of continuously recording water quality stations where observed water temperatures in July and August 2015 exceeded the fish region-specific maximum water temperatures associated with good ecological status according to Austrian Quality Objective Ordinance (QZV Ökologie OG)

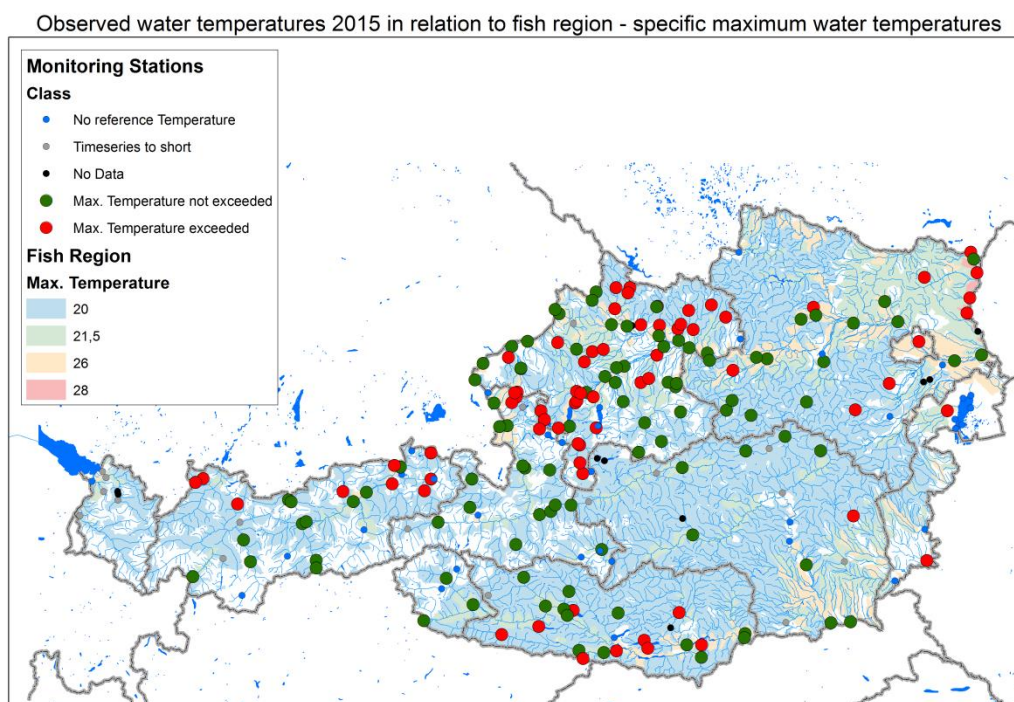


Figure 6: Regional distribution of water quality stations where observed water temperatures in July and August 2015 exceeded the fish region-specific maximum water temperatures associated with good ecological status according to Austrian Quality Objective Ordinance (QZV Ökologie OG)

Table1: Monthly discharge volumes of major rivers in Austrian Danube river basin 2015 compared to long-term average discharge volumes (1981-2010) (Red >175%, Blue: >75%-175%, brown: <75%)

Monitoring station	River	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dez
Innsbruck	Inn	127	127	92	103	114	114	89	85	100	116	105	88
Salzburg	Salzach	159	100	85	104	115	108	77	82	89	109	76	94
Federaun	Gail	133	121	88	56	64	62	60	89	113	102	52	63
Krottendorf	Lavant	175	152	110	79	82	80	79	84	89	162	101	94
Gumisch	Gurk	136	123	93	62	60	74	69	80	82	125	78	67
Mureck	Mur	146	114	75	89	86	74	69	78	70	136	75	65
Wels-Lichtenegg	Traun	151	59	59	94	96	77	48	39	49	85	47	80
Admont	Enns	187	125	86	120	108	93	69	77	78	114	78	93
Opponitz-Mirenau	Ybbs	164	75	74	91	99	61	47	39	45	98	56	116
Lilienfeld	Traisen	136	74	69	73	112	95	73	60	59	100	73	78
Raabs an der Thaya	Thaya	185	62	34	40	49	30	18	14	16	46	61	93
Angern	March	139	98	61	79	56	39	28	42	41	48	55	60
Deutsch Haslau	Leitha	175	124	86	76	98	66	46	30	31	77	51	46
Neumarkt	Raab	106	112	43	37	158	50	87	33	33	172	34	25
Kienstock	Danube	133	79	71	93	120	99	66	62	65	78	63	73
Korneuburg	Danube	133	82	72	92	117	95	65	61	64	80	64	73

Table 2: Groundwater levels in Austrian Danube river basin 2015 at the end of the month compared to the average groundwater level; highest groundwater levels observed are indicated with +100% (blue) and lowest groundwater levels observed with -100% (red), respectively

Station	Groundwater area	State	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dez
330431	Unteres Inntal	T	83	34	-33	22	8	-11	-54	-72	2	29	-26	-61
330670	Lienzer Becken	T	17	9	-14	-38	-47	-68	-85	-89	-99	-96	-118	-118
347781	Saalachbecken	Szb	47	25	-52	-26	28	3	-69	-76	-101	-156	-114	-119
320549	Unteres Salzbachtal	Szb	29	-4	-10	-3	44	10	-25	-23	-22	10	-23	-17
338632	Zollfeld	K	31	14	-2	-16	5	-4	-23	-40	-6	43	-4	-22
318089	Klagenfurter Becken	K	71	29	12	2	23	11	27	0	31	59	10	6
307777	Welser Heide	OÖ	17	0	-11	-10	5	3	-15	-40	-55	-40	-51	-61
323568	Südl. Linzer Feld	OÖ	-56	-103	-87	-63	-67	-77	-107	-97	-124	-118	-117	-136
327437	Erlaufthal	NÖ	31	30	8	7	33	1	-11	-6	-8	13	6	-4
303370	Nördl. Tullner Feld	NÖ	38	37	38	25	15	5	1	-8	-14	-5	0	1
301929	Südl. Wiener Becken	NÖ	69	78	81	76	67	44	28	10	-4	-11	-19	-23

312850	Marchfeld	W	61	63	65	64	61	43	39	31	30	34	37	38
343715	Oberes Murtal	Stmk	25	-67	-95	-53	-58	-79	8	-106	-39	18	-104	-114
311522	Leibnitzer Feld	Stmk	31	18	-4	-22	-4	-10	-29	-32	-42	27	-1	-33
306043	Seewinkel	B	78	82	65	67	89	62	25	26	19	50	46	30
345728	Raabtal	B	88	28	8	7	43	-17	-21	-41	-56	4	-29	-53
Abbr.: B...Burgenland; Ktn...Kärnten; NÖ...Niederösterreich; OÖ...Oberösterreich; Szb...Salzburg; Stmk...Steiermark; T...Tirol; W...Wien														

4. Has the issue of droughts been addressed in your country's updated River Basin Management Plan(s), or other management plans e.g. on water or specifically on droughts?

- Yes
 No

Possible further descriptions:

The issue of water scarcity and droughts is addressed via a separate chapter in the draft river basin management plan 2015¹⁹.

5. If the issue of droughts is included in your River Basin Management Plan(s) or other plans, are measures put in place to address the issue? and if yes, what measures are being put/in place or are planned?

- Measures to increase efficiency of irrigation
 Measures for reducing leakage in water distribution networks
 Natural water retention measures
 Wastewater recycling
 Rain water harvesting
 Drought mapping/forecasting
 Education of public on water-saving measures (e.g. water efficient appliances)
 Market-based or incentive instruments (e.g., user pays principle, block tariffs, penalties for excessive consumption)
 Other, please specify:

¹⁹ The Draft River Basin Management Plan 2015 is available for download at WISA:
http://wisa.bmlfuw.gv.at/fachinformation/ngp/ngp-2015/text/textdokument_ngp2015.html

Water scarcity and droughts are addressed in the draft of the river basin management plan 2015. Although Austria is rich in water resources, its spatial distribution is unevenly distributed. In average, only 3% of the available water resources are used for domestic, industrial or agricultural purposes. Water scarcity is not relevant for Austria. Droughts is a natural phenomenon which can occur regionally and seasonally also in a water-abundant country like Austria. Due to its regional and time-limited relevance, the establishment of country-wide drought risk management plans is not considered as necessary in general.

However, as a result of the drought in 2003 measures to improve the resilience of public water supply were introduced in vulnerable regions (mainly interconnections of supply network between different regions/operators and the exploitation of additional drinking water resources as back-up). They have proven their effectiveness since no major restrictions/limitations in public water supply have been observed during the drought in 2015. Additionally, much effort is put on the awareness raising of general public in terms of the efficient use of water.

The river basin management plan 2015 specifies some further options for actions considered in the light of climate change mitigation to enhance the natural water retention in catchments and to strengthen the sustainability of different water uses (efficiency in agricultural irrigation, artificial groundwater recharge, preparation of separate management plans,...) which support also the resilience against future droughts.

6. General lessons learned from the drought in 2015 (e.g. need for better preparedness in the future, need for better monitoring data and data sharing, need for structural or non-structural measure, raising awareness, etc.)?

Please briefly describe:

Overall precipitation in 2015 was quite similar to 2003 as can be seen from Figure 1, when the last significant drought was experienced.

Lessons learnt are:

- droughts appear regionally and periodically in future
 - the situations in 2003 and 2015 seem to be a good blue print to shape action for the adaptation to climate change, as conditions of these 2003 and 2015 droughts seem to be quite close to situations, which are forecasted for the future
 - actions taken as a consequence of the drought in 2003 to make water supply more resilient against effects of droughts have proven their effectiveness in 2015
-

7. If available, please provide reference to more specific information and data available for your country on the 2015 drought.

.....

8. Do you have additional comments to offer on this topic?

.....

QUESTIONNAIRE ON 2015 DROUGHTS IN THE DRB - BA

Country:	BOSNIA AND HERZEGOVINA
Name(s) of compiler(s):	Sabina Hodzic, Federal Hydrometeorological Institute, Sarajevo Naida Andelic, Sava Watershed Agency, Sarajevo Violeta Jankovic, PI Vode Srpske
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1. Did you experience significant drought phenomena in your country during 2015?

(if “No” then only questions 4, 5 and 8 might be relevant to be answered)

Yes

No

Please briefly describe:

In monitoring drought condition, Federal hydrometeorological institute used Standardized precipitation index (1,3,6,12) for vegetation mostly - SPI6 of September, which contains information for the whole vegetation season (from April to September). SPI 6 in 2015 showed some moderate and severe dry conditions were detected in northern and eastern Bosnia and Herzegovina.

In the north of the country, predominant crops are wheat, maize and vegetables. Unfavourable conditions in summer 2015, were reflected in large anomalies, especially from beginning of June (I, II decade), until September. Some areas in the north and eastern Bosnia suffered drought conditions during the summer, which were the consequences of rain shortages and very high air temperatures. A large number of consecutive hot days, when maximum air temperature exceeds 30 °C, were recorded.

Several heatwaves during the summer caused high evapotranspiration which influenced the crop water requirements, together with the lack of precipitation. Crops like maize and soya were during the summer exposed to heat and water stress. Extremely high daily and night air temperatures accelerated phenological development. Dry and hot weather in the peak of the summer caused inadequate soil moisture to satisfy the crop water demand for growth and development of maize.

Also, in many municipalities water supply companies introduced water restrictions as a result of water scarcity.

2. If drought was a significant phenomenon, which water-dependent sectors were mainly impacted*?

	Please indicate o...no impacts x...low impacts xx...high impacts	Description**
Agriculture	xx	Drought Impacts are commonly referred to as direct and indirect. Direct impacts include reduced crop, rangeland, and forest productivity, increased fire hazard, reduced water levels, increased livestock and wildlife mortality rates, and damage to wildlife and fish habitat. The consequences of these direct impacts illustrate indirect impacts. For example, a reduction in crop, rangeland, and forest productivity may result in reduced income for farmers, increased prices for food and timber, unemployment etc.
Navigation**	o	
Water supply (drinking water)	xx	Mainly impacted by drought and water scarcity were water supply activity in many municipalities. Water supply companies introduced water restriction during summer months.
Energy (Hydropower)	x	
Industry (cooling water)	x	
Water quality	x	
Ecology (Biodiversity)	x	
Recreation	x	
Others		

* If available please make reference to quantitative information, however, expert judgement might also be necessary for answering this question

** Information on impacts on inland navigation is included in the National Action Plans in the frame of the FAIRway Danube project. This document is available [here](#).

Possible further descriptions:

.....

3. As a consequence of the 2015 droughts, have measures been put in place in your country to mitigate the impacts? Please briefly describe:

Measures to increase efficiency of irrigation in some part of the country.

If available, please provide pictures illustrating the impacts of the 2015 droughts in country and/or mitigation measures taken, including a source citation (a selection of pictures will be used for the report).



Source:<http://www.avaz.ba/clanak/189060/susa-kisa-koja-je-jucer-pala-u-sjevernoj-bosni-slabo-ce-pomoci-sprzenom-povrcu?url=clanak/189060/susa-kisa-koja-je-jucer-pala-u-sjevernoj-bosni-slabo-ce-pomoci-sprzenom-povrcu>

4. Has the issue of droughts been addressed in your country's updated River Basin Management Plan(s), or other management plans e.g. on water or specifically on droughts?

Yes

No

Possible further descriptions:

.....

5. If the issue of droughts is included in your River Basin Management Plan(s) or other plans, are measures put in place to address the issue? and if yes, what measures are being put/in place or are planned?

- Measures to increase efficiency of irrigation
- Measures for reducing leakage in water distribution networks
- Natural water retention measures
- Wastewater recycling
- Rain water harvesting
- Drought mapping/forecasting
- Education of public on water-saving measures (e.g. water efficient appliances)
- Market-based or incentive instruments (e.g., user pays principle, block tariffs, penalties for excessive consumption)
- Other, please specify:

6. General lessons learned from the drought in 2015 (e.g. need for better preparedness in the future, need for better monitoring data and data sharing, need for structural or non-structural measure, raising awareness, etc.)?

Please briefly describe:

- ✓ need for better monitoring data and data sharing
 - ✓ need for storage and water supply projects, installation of a new irrigation system,
 - ✓ need for technical support in drought planning
 - ✓ public awareness and education
-

7. If available, please provide reference to more specific information and data available for your country on the 2015 drought.

http://www.dmcsee.org/en/drought_bulletin/; <http://www.fhmzbih.gov.ba/latinica/AGRO/AGS-pracenje.php>

8. Do you have additional comments to offer on this topic?

Measures to increase efficiency of irrigation are not related only on drought in 2015. This is activity which is implementing trough several project on more or less whole territory of BiH. Project which is in active phase of implementation is the World Bank`s Irrigation Development Project.

QUESTIONNAIRE ON 2015 DROUGHTS IN THE DRB - BG

Country:	Bulgaria
Name(s) of compiler(s):	Veselka Pavlova
Email address(es):	vesi.pavlova@bddr.org

1. Did you experience significant drought phenomena in your country during 2015?
(if “No” then only questions 4, 5 and 8 might be relevant to be answered)

- Yes
 No

Please briefly describe:

.....

2. If drought was a significant phenomenon, which water-dependent sectors were mainly impacted*?

	Please indicate o...no impacts x...low impacts xx...high impacts	Description**
Agriculture		
Navigation**		
Water supply (drinking water)		
Energy (Hydropower)		
Industry (cooling water)		
Water quality		
Ecology (Biodiversity)		
Recreation		
Others		

* If available please make reference to quantitative information, however, expert judgement might also be necessary for answering this question

** Information on impacts on inland navigation is included in the National Action Plans in the frame of the FAIRway Danube project. This document is available [here](#).

Possible further descriptions:

.....

3. As a consequence of the 2015 droughts, have measures been put in place in your country to mitigate the impacts? Please briefly describe:

.....

If available, please provide pictures illustrating the impacts of the 2015 droughts in country and/or mitigation measures taken, including a source citation (a selection of pictures will be used for the report).

4. Has the issue of droughts been addressed in your country's updated River Basin Management Plan(s), or other management plans e.g. on water or specifically on droughts?

- Yes
 No

Possible further descriptions:

The issues on climate change adaptation, including droughts are addressed in the River Basin Management Plan. The Programme of Measures of the RBMP includes actions for elaboration of Drought Management Plan.

5. If the issue of droughts is included in your River Basin Management Plan(s) or other plans, are measures put in place to address the issue? and if yes, what measures are being put/in place or are planned?

- Measures to increase efficiency of irrigation
 Measures for reducing leakage in water distribution networks
 Natural water retention measures
 Wastewater recycling
 Rain water harvesting
 Drought mapping/forecasting
 Education of public on water-saving measures (e.g. water efficient appliances)

Market-based or incentive instruments (e.g., user pays principle, block tariffs, penalties for excessive consumption)

Other, please specify: Measures related to improving the management of forest areas.

6. General lessons learned from the drought in 2015 (e.g. need for better preparedness in the future, need for better monitoring data and data sharing, need for structural or non-structural measure, raising awareness, etc.)?

Please briefly describe:

.....

7. If available, please provide reference to more specific information and data available for your country on the 2015 drought.

The National Institute of Meteorology and Hydrology (NIMH) is the main competent organisation in Bulgaria to calculate and analyse the drought indices, including:

- Standardized Precipitation Index (SPI)
- Soil Moisture Index (SMI)
- Standardized Runoff Index (SRI).

The listed drought indices are calculated for the whole territory of Bulgaria in a monthly basis and are publicly available at NIMH web-site at: <http://hydro.bg/>.

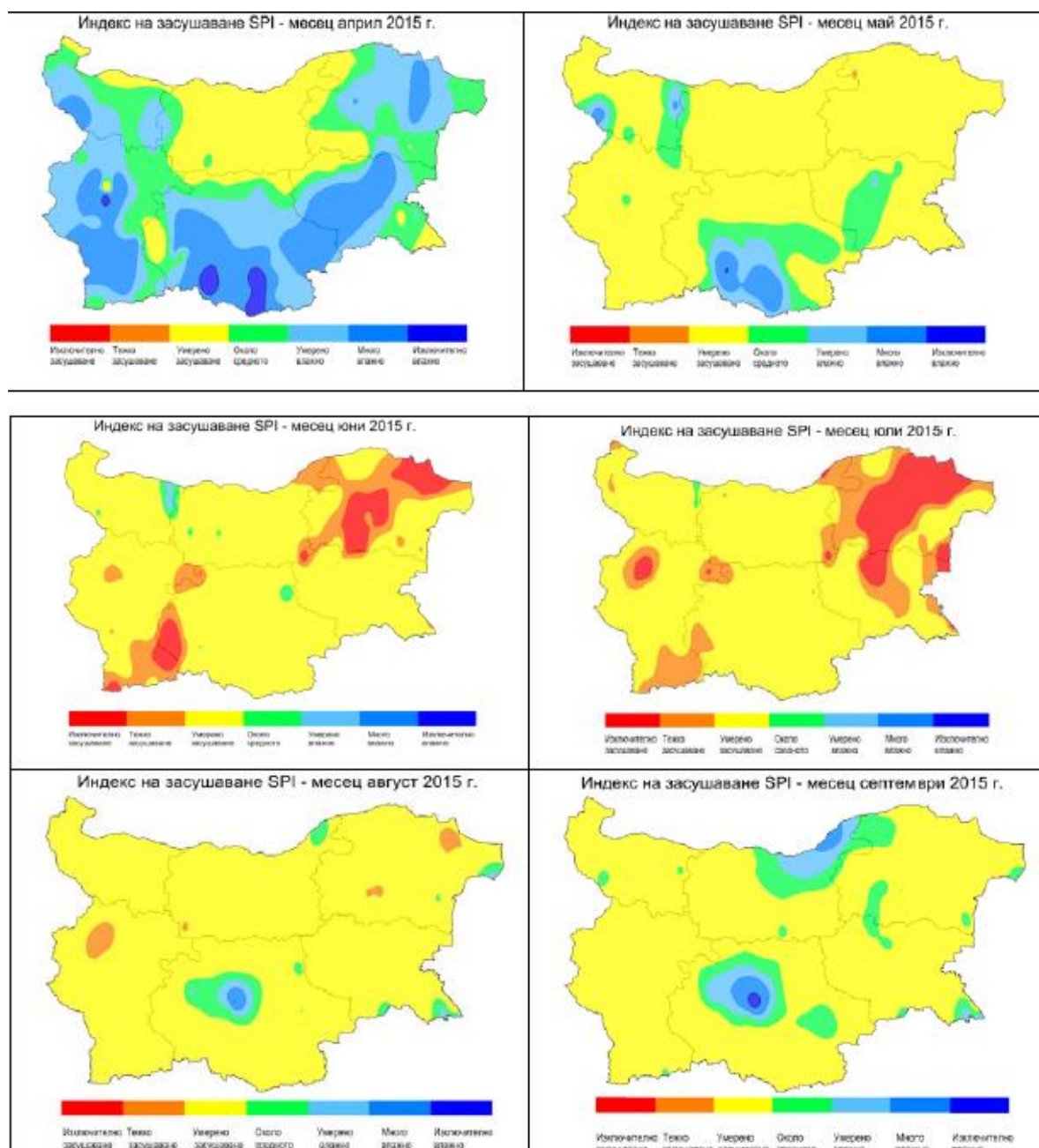
From hydrologic point of view the differences in the behaviour of the SPI and SRI are the basis for detection of drought.

Usually a drought is observed if the SPI value for long period is below -1.0. The SPI classification is as follows:

SPI values	Classification	Colours used in figures below to indicate the values
2.00 or more	Extremely wet	Dark blue
from 1.50 to 1.99	Very wet	Blue
from 1.00 to 1.49	Moderately wet	Light blue
from -0.99 to 0.99	Near normal	Green
from -1 to -1.49	Moderately drought	Yellow
from -1.50 to -1.99	Severely drought	Orange
-2.00 or less	Extremely drought	Red

The results from SPI monthly calculation in 2015 show that for the period April – September 2015 the values of the index are classified near normal or moderately dry. The only exception is the severely/extremely dry index values for the months June 2015 and July 2015 for some north-eastern parts of Bulgaria (figures in the middle; the areas are shown in orange and red colour).

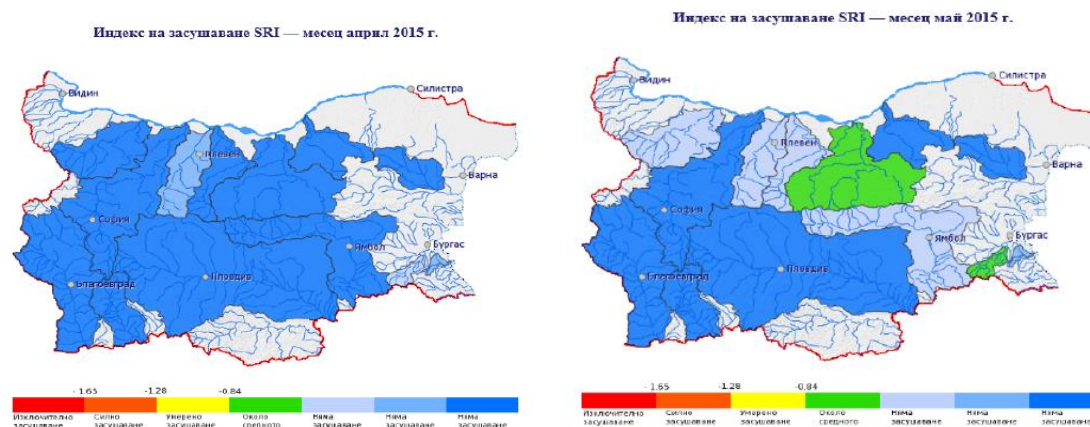
Below are some figures showing the spatial distribution of SPI for the period April – September 2015 in Bulgaria. The figures are presented in Final report of NIMH on the implementation of the activities under the agreement between NIMH and the Ministry of Environment and Water for 2015.



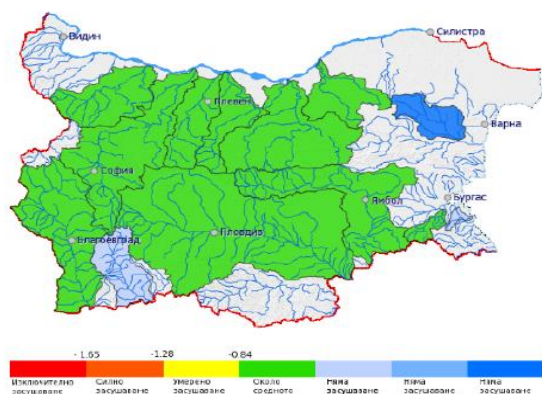
Diagnosing drought in hydrological plan is carried out in Bulgaria since 2012 by application of Standardized Runoff Index (SRI) through the implementation of an automatic monitoring system for drought and the SRI is presented at major watersheds level. The SRI values are classified as follows:

SRI values	Classification	Colours used in figures below to indicate the values
1.65 or more	Extremely wet	Blue
from 1.28 to 1.65	Very wet	Light blue
from 0.84 to 1.28	Moderately wet	Very light blue
from -0.84 to 0.84	Near normal	Green
from -1.28 to -0.84	Moderately drought	Yellow
from -1.65 to -1.28	Severely drought	Orange
-1.65 or less	Extremely drought	Red

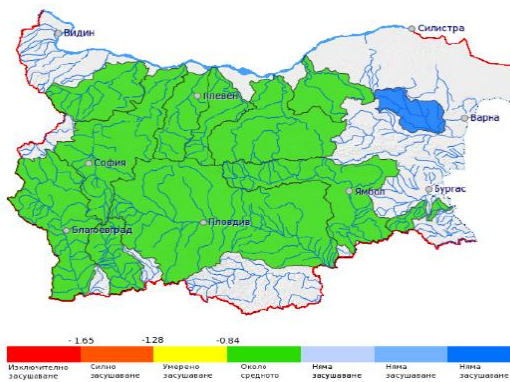
The results from SRI monthly calculation for the period April – September 2015 show that most of the months the SRI values were classified from extremely wet to near normal scale. The only exceptions are the values for Iskar and Vit watersheds in August 2015 when the SRI is classified moderately drought (*figure in the bottom left side; Iskar and Vit watersheds are in yellow colour*).



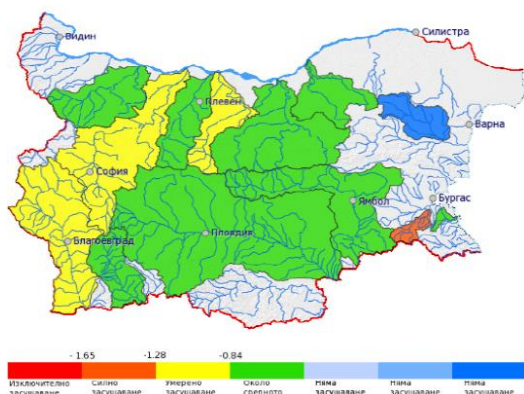
Индекс на засушаване SRI — месец юни 2015 г.



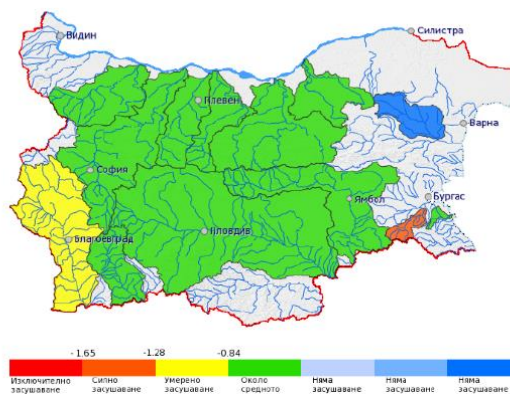
Индекс на засушаване SRI — месец юли 2015 г.



Индекс на засушаване SRI — месец август 2015 г.



Индекс на засушаване SRI — месец септември 2015 г.



8. Do you have additional comments to offer on this topic?

No additional comments.

QUESTIONNAIRE ON 2015 DROUGHTS IN THE DRB - CZ

Country:	The Czech Republic
Name(s) of compiler(s):	Veronika Matuszná, Tereza Davidová
Email address(es):	veronika.matuszna@mzp.cz , tereza.davidova@mzp.cz

1. Did you experience significant drought phenomena in your country during 2015?
(if “No” then only questions 4, 5 and 8 might be relevant to be answered)

- Yes
 No

Please briefly describe:

The 2015 summer drought in the Czech Republic ranked among its most serious historical drought episodes.

The precipitation deficit began to manifest itself as early as 2014, and from February 2015 it slowly continued during the spring months up to 150 mm by the end of July compared to the reference period 1981 to 2010.

At the beginning of summer, the country was already relatively dry, and the situation was also gradually worsened by recurring heat waves, some of which were extreme and lasted several days in a row. The distribution of high pressure formations and, in particular, the extensive and renewing anticyclones contributed to the fact that Central Europe was not reached by enough moist air from the surrounding seas and ocean. The frontal systems that reached the Czech Republic were not humid enough for the development of thunderstorms. The low relative air humidity and few clouds at the peak of summer also contributed to increased overall evaporation, thus further deepening the shortage of water in the country.

In August, abundant precipitation occurred, which temporarily helped the landscape to recover. However, its influence was limited to short period. The situation was worsening further during September and October. In October, the deficit of precipitation reached 180 mm. This continued until the end of 2015.

2. If drought was a significant phenomenon, which water-dependent sectors were mainly impacted*?

	Please indicate o...no impacts x...low impacts xx...high impacts	Description**
Agriculture	XX	
Navigation**	X	
Water supply (drinking water)	X	
Energy (Hydropower)	X	
Industry (cooling water)	X	
Water quality	O	The influence of drought on water quality could not be unambiguously proven. The reason can be consists in the raising number of waste water treatment plants which comes with increasing quality of water.
Ecology (Biodiversity)	XX	Many small water courses were run completely dry. This happened mainly in the Morava River basin.
Recreation	O	Recreation – lower inflows to water reservoirs and high temperatures resulted in growth of cyanobacteria which limited the recreational use of water reservoirs.
Others	X	Fish farming – many fish ponds needed to be fished out due to the lack of oxygen in water and fall of water level in summer 2015. Autumn fishing outs were on the other hand delayed due to smaller size of fish. Additionally, fishing outs had to be prohibited in some cases due to the lack of water for replenishing the fish ponds.

* If available please make reference to quantitative information, however, expert judgement might also be necessary for answering this question

** Information on impacts on inland navigation is included in the National Action Plans in the frame of the FAIRway Danube project. This document is available [here](#).

Possible further descriptions:

.....

3. As a consequence of the 2015 droughts, have measures been put in place in your country to mitigate the impacts? Please briefly describe:

Yes, the interdepartmental Commission WATER-DROUGHT commission prepared a document in July last year, 'Preparation of Measures to Mitigate the Negative Effects of Drought and Water Scarcity'. The aim of the document is to define the sectors involved and the most effective measures to be used to protect against droughts in the coming years. It includes monitoring, legislative, operational, economic, technical and environmental activities for which there are responsible institutions listed, as well as cooperating professional institutions and bodies to process the documents needed and provide broad viewpoints.

This document is the first step towards a comprehensive, long-term strategy to protect the country from the harmful effects of potential future droughts. Such a strategy must be presented to the Czech government by June 2017.

If available, please provide pictures illustrating the impacts of the 2015 droughts in country and/or mitigation measures taken, including a source citation (a selection of pictures will be used for the report).

The collection of comparative pictures presenting the drought can be found on the website of Morava River Basin Authority:

<http://www.pmo.cz/cz/galerie/sucho-srovnacni-fotografie/>

4. Has the issue of droughts been addressed in your country's updated River Basin Management Plan(s), or other management plans e.g. on water or specifically on droughts?

Yes

No

Possible further descriptions:

The program of measures in the national river basin management plan defines 15 steps necessary to take to tackle the issues of drought.

5. If the issue of droughts is included in your River Basin Management Plan(s) or other plans, are measures put in place to address the issue? and if yes, what measures are being put/in place or are planned?

Measures to increase efficiency of irrigation

Measures for reducing leakage in water distribution networks

Natural water retention measures

- Wastewater recycling
- Rain water harvesting
- Drought mapping/forecasting
- Education of public on water-saving measures (e.g. water efficient appliances)
- Market-based or incentive instruments (e.g., user pays principle, block tariffs, penalties for excessive consumption)
- Other, please specify:

6. General lessons learned from the drought in 2015 (e.g. need for better preparedness in the future, need for better monitoring data and data sharing, need for structural or non-structural measure, raising awareness, etc.)?

Please briefly describe:

As one of the most significant problems, the insufficient sensitivity of existing monitoring network has emerged. Many discharge gauging stations were not able to measure the discharge at low water levels. The monitoring network was analysed based on this finding and those which need to be modified were identified. Another finding consists in the lack of legislation related to droughts. The main problem is that there are no drought indexes, measurement procedures and methods for the assessment of drought included in our national legislation. Additionally, the plans for drought managements are missing which would define the actions for drought impacts mitigation related to different drought stages. These plans are being prepared now in cooperation with the Czech hydrometeorological institute.

In general, no critical situations were recorded by the River Authorities according to the reports on drought 2015. The most interventions needed to be applied in the basins of Morava River and Thaya River. However, these basins were prepared thanks to systematic preparation of these basins for drought after the experience with the dry year 2014. All the actions are described in the report (available only on Czech) issued by the Morava River Basin Authority. The actions among others consisted of the measurement of snow water storage in winter period in order to avoid unnecessary draining of water reservoirs. Another action was the transfer of water to water reservoir Hubenov from neighbouring basin. The manipulation on water reservoirs was operationally adapted to the needs of important water users and thus it could be possible to secure all the uptakes for drinking water supply. This was done with software called Management of limited water resources.

Authorities of other river basins have not even reported about the drought 2015 because the impacts of drought were not that high.

7. If available, please provide reference to more specific information and data available for your country on the 2015 drought.

There is a report on drought where more data on drought 2015 can be found following the link: http://portal.chmi.cz/files/portal/docs/meteo/ok/SUCHO/zpravy/en_drought2015.pdf

8. Do you have additional comments to offer on this topic?

No

QUESTIONNAIRE ON 2015 DROUGHTS IN THE DRB - DE

Country:	<i>Germany, Bavaria</i>
Name(s) of compiler(s):	<i>Hr. Michael Belau, Dr. Klaus Arzet, Fr. Natalie Stahl, Dr. Andreas Kolbinger</i>
Email address(es):	<i>michael.belau@stmuv.bayern.de</i>

1. Did you experience significant drought phenomena in your country during 2015?
(if “No” then only questions 4, 5 and 8 might be relevant to be answered)

- Yes
 No

Please briefly describe:

Due to very small precipitation in the winter 2014/2015 and little rain fall in 2015 almost until autumn, we had a significant lack of discharge in the rivers and lakes. The average deviation of the annual precipitation in Bavaria in 2015 relating to the average of the decade 1970 until 2000 was about 21%. Especially in the north-western and the eastern part of Bavaria this led in some areas to problems in water supply, navigation and water quality of surface waters. Many streams felt dry and a lot of rivers showed new low-levels of discharge as well.

Concerning the groundwater, the relative deviation of the groundwater recharge rate in 2015 relating to the average of the decade 1970 until 2000 was close to 50%, the average in Bavaria was about 30%.

Please find more information in the attached documents.

2. If drought was a significant phenomenon, which water-dependent sectors were mainly impacted*?

	Please indicate o...no impacts x...low impacts xx...high impacts	Description**
Agriculture	X	<i>In some areas, specifically in the north-western and eastern part of Bavaria (river catchment of the Rhine River), there was temporary high need for irrigation. Parts without irrigation had to showed a significant failure of crops.</i>
Navigation**	X	<i>Limited navigation at some days</i>
Water supply (drinking water)	X	Some small water supply companies had to accept some intensified restrictions. Singular small water supply companies were depending on additional water from other water supply companies. Several private wells were dry.
Energy (Hydropower)	X	Drop of production of energy.
Industry (cooling water)	0	No restrictions.
Water quality	0	
Ecology (Biodiversity)	X	<i>In general, the ecological operational capability was reduced in some areas, especially in the north-western part of Bavaria (river catchment of the Rhine River). In some few areas there was some eutrophication in small rivers with low flow velocity</i>
Recreation	0	
Others	0	

* If available please make reference to quantitative information, however, expert judgement might also be necessary for answering this question

** Information on impacts on inland navigation is included in the National Action Plans in the frame of the FAIRway Danube project. This document is available [here](#).

Possible further descriptions:

.....

3. As a consequence of the 2015 droughts, have measures been put in place in your country to mitigate the impacts? Please briefly describe:

A new temporary fund was established for the development of concepts of sustainable irrigation for agricultural purpose (due to WFD as well).

If available, please provide pictures illustrating the impacts of the 2015 droughts in country and/or mitigation measures taken, including a source citation (a selection of pictures will be used for the report).

Please find some pictures in the attached document.

4. Has the issue of droughts been addressed in your country's updated River Basin Management Plan(s), or other management plans e.g. on water or specifically on droughts?

Yes

No

Possible further descriptions:

5. If the issue of droughts is included in your River Basin Management Plan(s) or other plans, are measures put in place to address the issue? and if yes, what measures are being put/in place or are planned?

Measures to increase efficiency of irrigation

Measures for reducing leakage in water distribution networks

Natural water retention measures

Wastewater recycling

Rain water harvesting

Drought mapping/forecasting

Education of public on water-saving measures (e.g. water efficient appliances)

Market-based or incentive instruments (e.g., user pays principle, block tariffs, penalties for excessive consumption)

Other, please specify:

6. General lessons learned from the drought in 2015 (e.g. need for better preparedness in the future, need for better monitoring data and data sharing, need for structural or non-structural measure, raising awareness, etc.)?

Please briefly describe:

Even in Bavaria with normally sufficient rain fall, droughts might occur and cause the upper mentioned problems. Climate change scenarios show that droughts might occur more often in future. We identified a need for better preparedness in the future, especially concerning the effectiveness of water use in agricultural sector and a need for better monitoring data especially concerning the withdrawal of water in the agricultural sector.

7. If available, please provide reference to more specific information and data available for your country on the 2015 drought.

Figure below:

Average deviation of the annual precipitation in Bavaria in 2015 relating to the average of the decade 1970 until 2000.

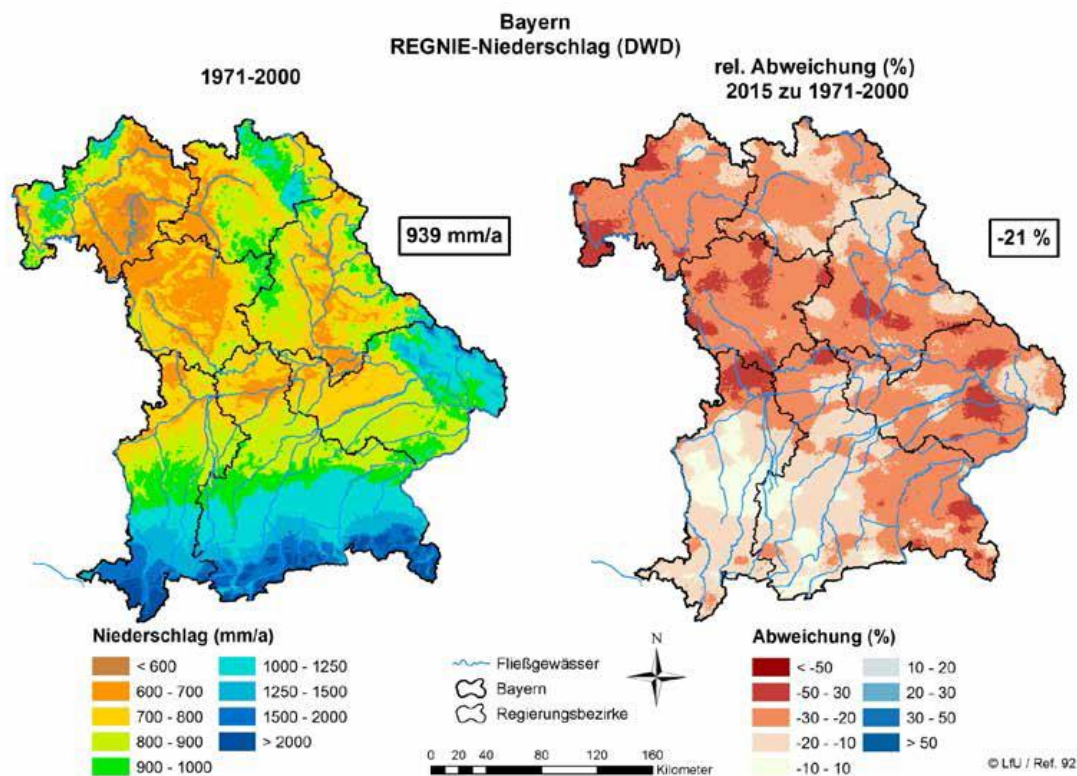
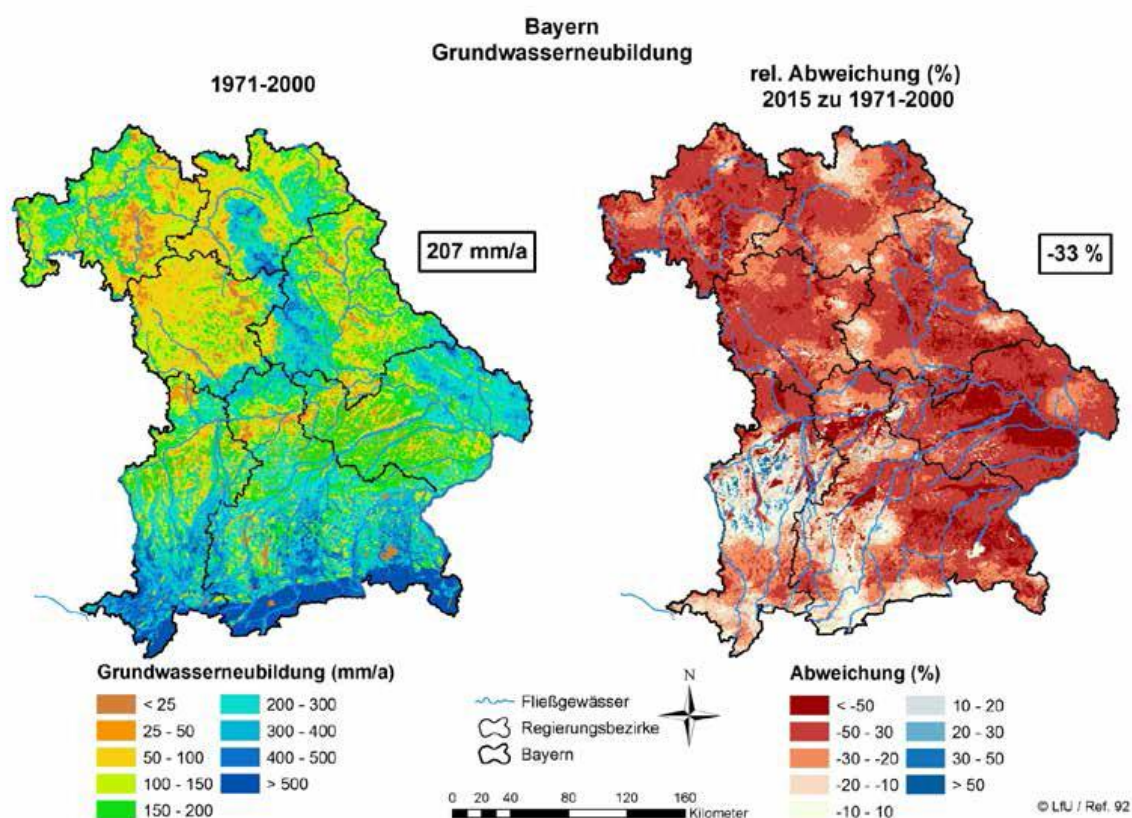


Figure below:

Relative deviation of the groundwater recharge rate in 2015 relating to the average of the decade 1970 until 2000



Please find more information in the attached document.

8. Do you have additional comments to offer on this topic?

Comparable to the “Alarmplan Main – Gewässerökologie” (emergency plan for the ecology of the Bavarian part of the Main) an emergency plan with focus on ecological aspects will be developed for the Danube River in the context of the River Basin Management Plan for the Danube River. This emergency plan will address the following topics:

- Aim / objective of this emergency plan
- Monitoring (parameters, monitoring network, implementation of monitoring, analysing the monitored data, ...)
- Responsibilities in the water management administration
- Warning and alarm criteria

- List of messages and receptors
- Measures in case of an alarm

As a result of the drought in 2013, the “Niedrigwasser-Informationsdienst Bayern” (low water information service Bavaria) was developed to early recognize droughts and periods of low water and to be better prepared in these cases. For more information please see: www.nid.bayern.de

For the north-western part of Bavaria (Unterfranken in the catchment of the Rhine River) a pilot project was started in 2012 to develop a guideline for the water administration how to better cope with demands on the part of water supply and irrigation in times of water scarcity.

QUESTIONNAIRE ON 2015 DROUGHTS IN THE DRB - HR

Country:	Republic of Croatia
Name(s) of compiler(s):	Alan Cibilić and Marija Pinter
Email address(es):	acibilic@voda.hr mpinter@voda.hr

1. Did you experience significant drought phenomena in your country during 2015?
(if “No” then only questions 4, 5 and 8 might be relevant to be answered)

- Yes
 No

Please briefly describe:

In the Republic of Croatia droughts occur on average every three to five years due to the evident climate change and global yearly temperature increase. In the year 2015 Republic of Croatia experienced severe droughts again. The occurrence of the droughts is causing high costs of economic damage. In some counties the drought damage equals the damage caused by flooding. On the country level the damage caused by droughts in 2015 exceeded the damage caused by flooding. At the same time, irrigation of agricultural land is insufficient and uses a negligible part of the water potential.

2. If drought was a significant phenomenon, which water-dependent sectors were mainly impacted*?

	Please indicate o...no impacts x...low impacts xx...high impacts	Description**
Agriculture	XX	Impact of droughts was the most significant on corn production due to its period of vegetation. (June-July)
Navigation**	X	There were interruption in navigation but it is considered as secondary damage which means that the costs of the damage have not been calculated

Water supply (drinking water)	X	Predominantly applies to the coastal area and islands
Energy (Hydropower)	0	
Industry (cooling water)	0	
Water quality	0	
Ecology (Biodiversity)	X	
Recreation	0	
Others	X	In Croatia forestry is not included in agriculture and is very much depending on water

* If available please make reference to quantitative information, however, expert judgement might also be necessary for answering this question

** Information on impacts on inland navigation is included in the National Action Plans in the frame of the FAIRway Danube project. This document is available [here](#).

Possible further descriptions:

.....

3. As a consequence of the 2015 droughts, have measures been put in place in your country to mitigate the impacts? Please briefly describe:

Due to the frequency of the droughts to mitigate the impacts Croatian Government has prepared and adopted a two comprehensive document addressing the issue of droughts: National Project of Irrigation and Management of Agricultural Land and Water in the Republic of Croatia (NAPNAV) and Multiannual Construction Program of water regulating constructions, constructions for protection from adverse water effects and melioration constructions where significant investments have been envisaged for irrigation.

If available, please provide pictures illustrating the impacts of the 2015 droughts in country and/or mitigation measures taken, including a source citation (a selection of pictures will be used for the report).

4. Has the issue of droughts been addressed in your country's updated River Basin Management Plan(s), or other management plans e.g. on water or specifically on droughts?

- Yes
 No

Possible further descriptions:

Previously mentioned documents are closely interlinked with national River Basin Management Plan.

5. If the issue of droughts is included in your River Basin Management Plan(s) or other plans, are measures put in place to address the issue? and if yes, what measures are being put/in place or are planned?

- Measures to increase efficiency of irrigation
- Measures for reducing leakage in water distribution networks
- Natural water retention measures
- Wastewater recycling
- Rain water harvesting
- Drought mapping/forecasting
- Education of public on water-saving measures (e.g. water efficient appliances)
- Market-based or incentive instruments (e.g., user pays principle, block tariffs, penalties for excessive consumption)
- Other, please specify:

6. General lessons learned from the drought in 2015 (e.g. need for better preparedness in the future, need for better monitoring data and data sharing, need for structural or non-structural measure, raising awareness, etc.)?

Please briefly describe:

Due to the amount of damage costs caused by droughts it is obvious that this issue must be the next water management priority.

7. If available, please provide reference to more specific information and data available for your country on the 2015 drought.

.....

8. Do you have additional comments to offer on this topic?

.....

QUESTIONNAIRE ON 2015 DROUGHTS IN THE DRB - HU

Country:	Hungary
Name(s) of compiler(s):	Karoly Fiala, Agnes Tahy, Peter Molnar
Email address(es):	tahy.agnes@ovf.hu , molnar.peter@ovf.hu

1. Did you experience significant drought phenomena in your country during 2015?
(if “No” then only questions 4, 5 and 8 might be relevant to be answered)

- Yes
 No

Please briefly describe:

In 2015 Hungary experienced a moderate drought according to the PAI drought index (see question nr. 7). Drought hit mostly the southern and eastern part of the country. Overall drought damage is estimated to HUF 100 billion (about EUR 333 million).

2. If drought was a significant phenomenon, which water-dependent sectors were mainly impacted*?

	Please indicate o...no impacts x...low impacts xx...high impacts	Description**
Agriculture	xx	The total area for which drought damage was reported in the agricultural damage mitigation system by farmers was 121647 hectares in 2015. HUF 4.1 million was disbursed for this purpose (Source: Ministry of Agriculture).
Navigation**	o	
Water supply (drinking water)	o	
Energy (Hydropower)	x	
Industry (cooling water)	o	

Water quality	x	
Ecology (Biodiversity)	x	
Recreation	o	
Others		

* If available please make reference to quantitative information, however, expert judgement might also be necessary for answering this question

** Information on impacts on inland navigation is included in the National Action Plans in the frame of the FAIRway Danube project. This document is available [here](#).

Possible further descriptions:

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3. As a consequence of the 2015 droughts, have measures been put in place in your country to mitigate the impacts? Please briefly describe:

Measures the water sector put in place in 2015:

Water retention in canals; filling reservoirs to pumping water level or above (from rainwater and flood); water transferred back from River Tisza; water transferred out from floods; pumping due to low water levels in Danube to meet ecological water demand and quality standards; limiting regional water transfer between water directorates.

If available, please provide pictures illustrating the impacts of the 2015 droughts in country and/or mitigation measures taken, including a source citation (a selection of pictures will be used for the report).

4. Has the issue of droughts been addressed in your country's updated River Basin Management Plan(s), or other management plans e.g. on water or specifically on droughts?

- Yes
 No

Possible further descriptions:

.....

5. If the issue of droughts is included in your River Basin Management Plan(s) or other plans, are measures put in place to address the issue? and if yes, what measures are being put/in place or are planned?

Measures to increase efficiency of irrigation

Measures for reducing leakage in water distribution networks

Natural water retention measures

Wastewater recycling

Rain water harvesting

Drought mapping/forecasting

Education of public on water-saving measures (e.g. water efficient appliances)

Market-based or incentive instruments (e.g., user pays principle, block tariffs, penalties for excessive consumption)

Other, please specify:

- Preparation of an Integrated Water Resources Management plan focusing on mitigation of drought and desertification until the end of 2018.
- Reservoir Development Programme
- Water retention / no drainage in excess water canals
- Measures to decrease illegal water abstractions (and well drilling activities)
- Artificial recharge to groundwater
- Development, modification or reconstruction of water supply for rehabilitation of water dependent ecosystems (oxbows, wetlands, meadows, lakes, floodplains, etc.)
- Measures against alien invasive species

6. General lessons learned from the drought in 2015 (e.g. need for better preparedness in the future, need for better monitoring data and data sharing, need for structural or non-structural measure, raising awareness, etc.)?

Please briefly describe:

Recent years' (including 2015) trends in drought occurrence implied that there is a need to change our reactive approach towards a proactive and operative way of thinking with regards to drought management.

Therefore it was decided that a drought monitoring system should be elaborated with its integration into the existing water damage control system (flood, excess water). Proper thresholds and respective drought stages will be the basis of operative actions.

To this end the development of the Hungarian Operative Drought and Water Scarcity Monitoring System has been started. The system will provide farmers and decision makers with timely information on the extent of water scarcity (supporting irrigation) and the current drought stage in order to avoid or reduce drought damage. It will support also irrigation development and further research programmes.

Achievements so far: The drought monitoring network was established with 16 stations to be extended in the upcoming years. As the heart of the monitoring system the Hungarian Drought Index (HDI) based on meteorological parameters and soil's water content and a data processing software was also developed. The preparation of a freely accessible online platform for the dissemination and visualization of drought information is in the process now.

7. If available, please provide reference to more specific information and data available for your country on the 2015 drought.

The average value of Pálfai Drought Index (PAI) for the whole country was 8.42 °C/100 mm in 2015. PAI is a commonly used index in Hungary to mark the drought severity for a whole year. Drought is considered minor between 4 and 6 PAI values, mild 6 to 8, moderate 8 to 10, severe 10 to 12, exceptional 12 to 14 and extreme above 14.

8. Do you have additional comments to offer on this topic?

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QUESTIONNAIRE ON 2015 DROUGHTS IN THE DRB - MD

Country:	Moldova
Name(s) of compiler(s):	Dumitru Drumea
Email address(es):	ddrumea559@gmail.com

1. Did you experience significant drought phenomena in your country during 2015?
(if “No” then only questions 4, 5 and 8 might be relevant to be answered)

- Yes
 No

Please briefly describe:

Drought event in Moldova is estimated according to the SPI. According to this index 2015 in Moldova could be estimated as moderate in northern and central parts of the country and severe in lower part of Central Moldova and southern part. Northern part of the country is used mainly for cultivation of such crops like wheat, maize, sugar bean, sunflower, orchards with predomination (90%) of apple ones.

Severe weather conditions begun in June 2015 and it continued practically the whole summer. Number of days with temperature more than 30 degrees was recorded as more than 45days. Extreme temperatures accelerated phenology of crops, but strong water and moisture deficit in soils did not allow to complete crop growing, which led to strong deterioration of the harvest, which in many cases even was not harvested. According to the estimations from 10 to 15% of national GDP was damaged by drought in 2015.

There were no water shortages in water supply in centralised system, in spite of advertisements on possible disconnections from the ape duct in local mass-media.

2. If drought was a significant phenomenon, which water-dependent sectors were mainly impacted*?

	Please indicate o...no impacts x...low impacts xx...high impacts	Description**
Agriculture	xx	Around 30% of agricultural harvest was lost. Mainly it reoffered to cereals (more than 50%), green biomass for animal breeding etc.
Navigation**	x	Navigation is developed in the lower part of the Prut river on its confluence with the Danube. Vessels used for transportation to the Djurdjulesti port facilities are of small tonnage and could park for processing. Anyway water level was rather low and it was necessary to use extra equipment to operate vessels during processing.
Water supply (drinking water)	x	Main impact was worsening of water quality
Energy (Hydropower)	x	Impact of Costesti-Stinca water reservoir in energy balance is rather small.
Industry (cooling water)	0	
Water quality	x	Monitoring data showed rising of the TDS and nutrients, as well as microbiology in water (especially small rivers) due to evaporation. According to estimations water flow reduced in 2 times (Prut river) and one could assume increasing of the TDS content for 20-30%.
Ecology (Biodiversity)	xx	Drying up of the water courses and vegetation. Large scale fires of dried vegetation, especially green carcasses on agricultural lands
Recreation	x	Worsening of water quality, algae blooming due to eutrophication
Others		

* If available please make reference to quantitative information, however, expert judgement might also be necessary for answering this question

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Possible further descriptions:

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3. As a consequence of the 2015 droughts, have measures been put in place in your country to mitigate the impacts? Please briefly describe:

Actually irrigated lands in the Prut river basin are recovered. Total 30-35 th ha. are irrigated.

If available, please provide pictures illustrating the impacts of the 2015 droughts in country and/or mitigation measures taken, including a source citation (a selection of pictures will be used for the report).

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4. Has the issue of droughts been addressed in your country's updated River Basin Management Plan(s), or other management plans e.g. on water or specifically on droughts?

- Yes
 No

Possible further descriptions:

GWP CEE funded Integrated Drought Management Program. Drought management issues are included in the national strategy on climate change and also in projects associated with adaptation to climate change – Climate Forum East, Creation of the Biosphere reserve in the Lower Prut region etc.

5. If the issue of droughts is included in your River Basin Management Plan(s) or other plans, are measures put in place to address the issue? and if yes, what measures are being put/in place or are planned?

- Measures to increase efficiency of irrigation
 Measures for reducing leakage in water distribution networks
 Natural water retention measures
 Wastewater recycling
 Rain water harvesting
 Drought mapping/forecasting – on initial phase. Issue is being developed in the Institute of Ecology and geography
 Education of public on water-saving measures (e.g. water efficient appliances)
 Market-based or incentive instruments (e.g., user pays principle, block tariffs, penalties for excessive consumption)

Other, please specify:

6. General lessons learned from the drought in 2015 (e.g. need for better preparedness in the future, need for better monitoring data and data sharing, need for structural or non-structural measure, raising awareness, etc.)?

Please briefly describe:

- Drought management activities have to be included in planning of local agendas. Relevant assistance should be provided based on the results of the projects developed on the Danube basin-wide scale with demo and attraction of best practices to the Eastern part of the Danube basin
 - Moisture conservation practices in agricultural lands could save harvest potential of main crops in case of droughts. Relevant educational materials should be published and presented to farmer community.
 - Ecosystem services could have a strong impact on local climate and relevant measures for nature restoration, precipitation harvesting etc should be promoted and included in local agendas. Public awareness on saving of water resources and its further use during drought event could contribute to overcoming of drought consequences.
-

7. If available, please provide reference to more specific information and data available for your country on the 2015 drought.

National statistic for 2015, Chsinau, 2016

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8. Do you have additional comments to offer on this topic?

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QUESTIONNAIRE ON 2015 DROUGHTS IN THE DRB - RO

Country:	<i>Romania</i>
Name(s) of compiler(s):	<i>National Administration "Romanian Waters" Cristian RUSU</i>
Email address(es):	<i>cristian.rusu@rowater.ro;</i>

1. Did you experience significant drought phenomena in your country during 2015?
(if "No" then only questions 4, 5 and 8 might be relevant to be answered)

- Yes
 No

Please briefly describe

According to the National Administration for Meteorology, during the year 2015 pedologic drought phenomena were registered in some regions from Romania (Moldova, Banat and in the most part of Crisana, Muntenia and Transilvania and also in the South – East of Oltenia) due to the reduced level of precipitations, especially in May. Beside this in the beginning of June it was registered higher temperatures values than normal ones and even the level of precipitations was more than 25/30 l/sqm in Moldova, these could not compensate the soil water deficit.

It should be underlined that hydrological drought phenomena were not registered.

2. If drought was a significant phenomenon, which water-dependent sectors were mainly impacted*?

Note: Regarding the impact of pedologic drought phenomena the agriculture sector has been impacted

	Please indicate o...no impacts x...low impacts xx...high impacts	Description**
Agriculture	x	Direct effects related to loss in the agriculture production, 173500 farmers were affected on an agriculture surface of around 1.6 million ha, the most affected crops being corn, sunflower, and potatoes. It has to be mentioned that the above farmers have benefited of financial compensation from the state budget
Navigation**		
Water supply (drinking water)		
Energy (Hydropower)		
Industry (cooling water)		
Water quality		
Ecology (Biodiversity)		
Recreation		
Others		

* If available please make reference to quantitative information, however, expert judgement might also be necessary for answering this question

Possible further descriptions:

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3. As a consequence of the 2015 droughts, have measures been put in place in your country to mitigate the impacts? Please briefly describe:

In 2015 the drought phenomena were at very local scale and for short periods of time. In general, (not referring to the year 2015), in case of drought phenomena, at different levels, there are established "Programs of measures for managing the drought". The main objectives

of these programs are the planning and adopting an efficient prevention and protection system against drought, intensification of the specific activities for prevention and limiting the consequences of the specific events of dry season.

It can be mentioned as specific measures the intensification of monitoring the quality of the water sources used for drinking purposes, intensification of monitoring the water level and groundwater quality from wells, ensuring alternative water supply sources in case of significant reducing the water flow in the drinking water distribution systems, applying the "Program for Restriction of water use in periods with water deficit".

As a general rule in Romania in case of drought, the "Regulation regarding the managing emergency situations in case of floods, dangerous meteorological phenomena, hydraulic infrastructure works accidents, accidental pollution on water stretches and marine pollution in coastal area" is applied.

If available, please provide pictures illustrating the impacts of the 2015 droughts in country and/or mitigation measures taken, including a source citation (a selection of pictures will be used for the report).



Corn crops impacted by 2015 drought

4. Has the issue of droughts been addressed in your country's updated River Basin Management Plan(s), or other management plans e.g. on water or specifically on droughts?

Yes

No

Possible further descriptions:

In Romania, the drought phenomena has been considered in the updated River Basin of Management Plan(s), taking also into account the EC Technical Report regarding development, implementation and integration of drought aspects (for 2009-2015 period). Also in the process of developing the Program of measures, the following national legislative regulations have been taken into consideration:

- National Strategy regarding reduction of the effects of drought, preventing and combating land degradation and desertification in the short, medium and long term
- Regulation regarding the managing the emergency situations in case of floods, dangerous meteorological phenomena, hydraulic infrastructure works accidents, accidental pollution on water stretches and marine pollution in coastal area
- Program for Restriction of water use in periods with water deficit
- Methodological Norms for the development of river basin operating rules and regulations” for the operation of dams, reservoirs and water intakes, which mentions the operative measures provided in the operating rules in case drought

5. If the issue of droughts is included in your River Basin Management Plan(s) or other plans, are measures put in place to address the issue? and if yes, what measures are being put/in place or are planned?

The 2015 updated National Management Plan and River Basin Management Plans (at sub-units level) include measures related to different sectors, such agriculture (e.g. measures foreseen in the Agriculture and Rural Development Program for increasing the efficiency of irrigation), human agglomerations (e.g. reducing leakage for drinking water supply networks), industrial installations (e.g. Wastewater recycling), hydromorphological alterations (e.g. Natural water retention measures) and other general measures/instruments and studies which address drought phenomena, too.

- Measures to increase efficiency of irrigation
- Measures for reducing leakage in water distribution networks
- Natural water retention measures
- Wastewater recycling
- Rain water harvesting
- Drought mapping/forecasting
- Education of public on water-saving measures (e.g. water efficient appliances)
- Market-based or incentive instruments (e.g., user pays principle, block tariffs, penalties for excessive consumption)
- Other, please specify:

6. General lessons learned from the drought in 2015 (e.g. need for better preparedness in the future, need for better monitoring data and data sharing, need for structural or non-structural measure, raising awareness, etc.)?

Please briefly describe:

It is not the case, since the drought phenomena were not significant in 2015

7. If available, please provide reference to more specific information and data available for your country on the 2015 drought.

Please briefly describe:

It is not the case, since the drought phenomena were not significant in 2015

8. Do you have additional comments to offer on this topic?

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QUESTIONNAIRE ON 2015 DROUGHTS IN THE DRB - RS

Country:	Serbia
Name(s) of compiler(s):	Miodrag Milovanović
Email address(es):	miodrag.milovanovic@jcerni.co.rs

1. Did you experience significant drought phenomena in your country during 2015?
(if “No” then only questions 4, 5 and 8 might be relevant to be answered)

Yes

No

Please briefly describe:

The summer of 2015 (June-August) was warmer than usual, with considerably less rainfall than the perennial average. Additionally, the distribution of rainfall during the summer was unfavorable (Fig. 1). Soil moisture conditions in Serbia (Fig. 2), estimated per the Standardized Precipitation Index (SPI-3), were the worst in a large part of the Province of Vojvodina, the valleys of the Kolubara and Zapadna Morava rivers, a part of the Timok region and the southernmost part of Serbia. The least favorable period for most crops lasted from the first decade of July to mid-August. Soil moisture conditions during the summer deteriorated due to scarce rainfall, high air and soil temperatures, and increased water demand. Rainfall in the latter part of August only partly mitigated the drought impact and came too late for some crops. The adverse combination of air temperature and humidity during the time period that coincided with sensitive stages of growth and insufficient application of agro-technical measures (irrigation, etc.) resulted in poorer quality and lower yields of certain fruits (strawberry, sour cherry, apricot, blackberry) and spring crops (maize, soy).

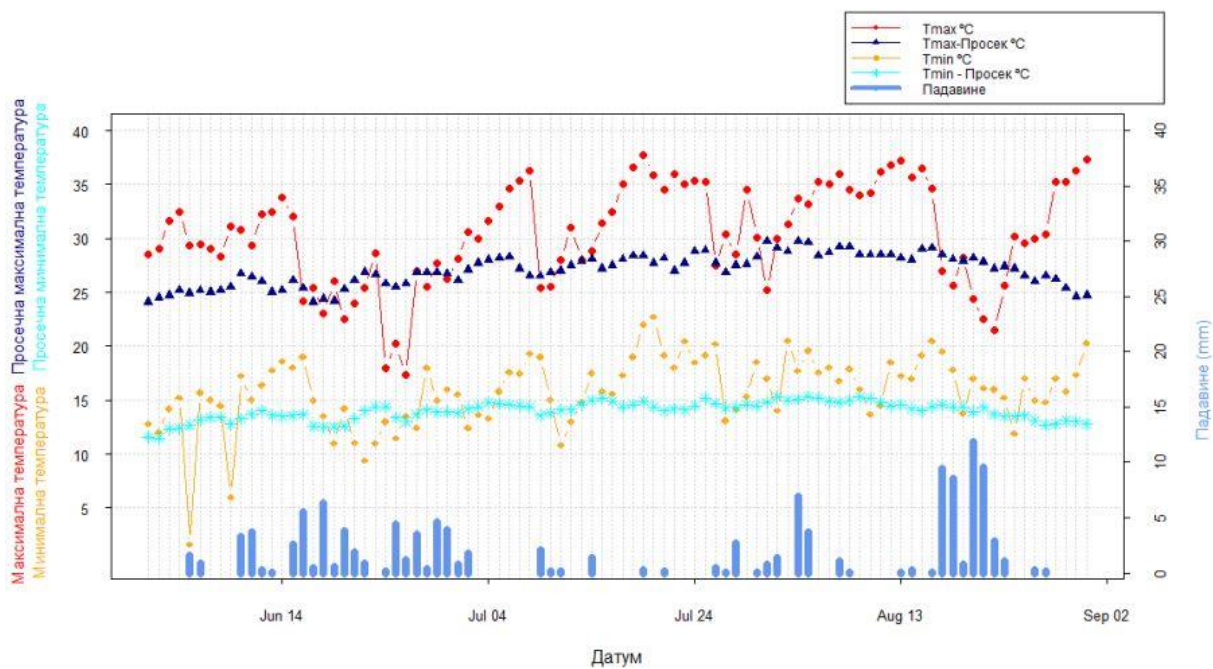


Figure 1. Mean maximum and minimum air temperatures, departures from the average (1981-2010) and average rainfall (mm) in the summer (1 June to 31 August) of 2015 in the agricultural region of Serbia. The summer of 2015 was warmer-than-average in Serbia, with sparser precipitation. In July, when the most important physiological processes of cash crops take place, there was almost no rainfall and this resulted in losses, particularly in maize production. The warmest part of the summer was the first half of August, with the highest temperatures on most days near or above 35°C.

(source: RHMSS)

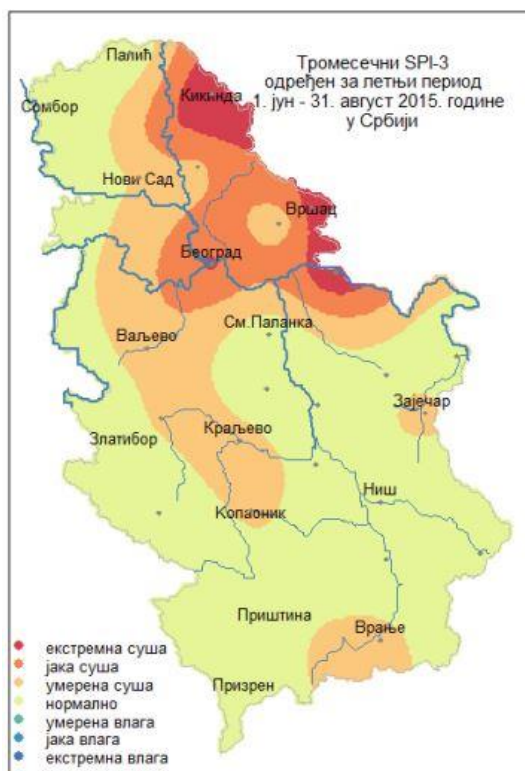


Figure 2. Soil moisture conditions in Serbia, estimated per the Standardized Precipitation Index (SPI-3), determined for the 90-day summer period (1 June to 31 August 2015). In the summer of 2015, moderate-to-severe drought prevailed in a large part of the Province of Vojvodina, the valleys of the Kolubara and Zapadna Morava rivers, the Timok region and the southernmost part of Serbia. Soil moisture in other parts of Serbia was normal.

(source: RHMSS)

2. If drought was a significant phenomenon, which water-dependent sectors were mainly impacted*?

	Please indicate o...no impacts x...low impacts xx...high impacts	Description**
Agriculture	xx	Due to unfavorable weather conditions and rare irrigation, the most affected crop was maize, which is the leading cereal crop in Serbia. The yield was about 30% lower than the perennial average. The yields of soy and certain fruits were also much lower than usual. .
Navigation**	o	Navigation was affected by low water levels, but it was not discontinued.
Water supply (drinking water)	x	During the summer, water-saving measures were introduced in a number of cities due to depleted water sources.
Energy (Hydropower)	o	
Industry (cooling water)	o	
Water quality	x	
Ecology (Biodiversity)	x	
Recreation	o	
Others		

* If available please make reference to quantitative information, however, expert judgement might also be necessary for answering this question

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Possible further descriptions:

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3. As a consequence of the 2015 droughts, have measures been put in place in your country to mitigate the impacts? Please briefly describe:

The onset of the period of moderate-to-extreme drought was predicted on time, at the end of July 2015, when a drought warning was issued under “Climate Watch” on a weekly basis, as an integral part of the WMO-RCC RA VI Climate Watch System. Monthly precipitation forecasts of ECMWF and RHMSS were used to develop the Standardized Precipitation Index – SPI, on the basis of which drought was predicted.

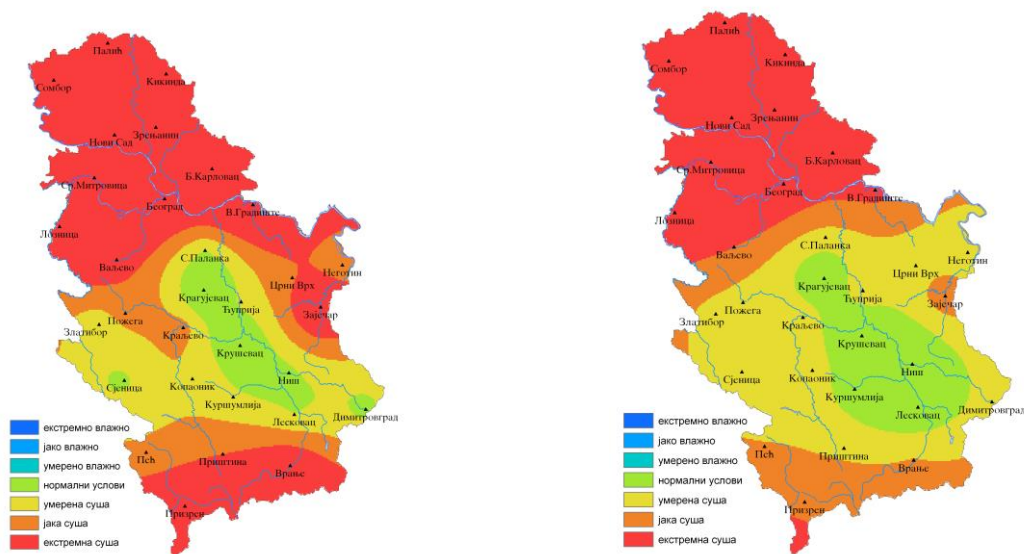


Figure 3. Soil moisture conditions in Serbia based on the Standardized Precipitation Index (SPI-2) for a 60-day period (29.05–26.07.2015) (source: RHMSS)

Figure 4. Standardized Precipitation Index (SPI-2) forecast for a 60-day period (28.05–26.07.2015), based on monthly precipitation observed and predicted by ECMWF and RHMSS. (source: RHMSS)

Unfortunately, irrigation systems are rare in Serbia. As a result, it was not possible to apply hydro-technical measures (irrigation) on most of the farmland and the yields, especially of maize and soy, were considerably reduced.

With regard to the public water supply, water utilities introduced water-saving measures to reduce water use for watering of plants in suburban areas.

If available, please provide pictures illustrating the impacts of the 2015 droughts in country and/or mitigation measures taken, including a source citation (a selection of pictures will be used for the report).



<http://www.telegraf.rs/vesti/1878870-susa-smanjila-prinose-za-trecinu-najvise-stradali-kukuruz-soja-suncokret-i-secerna-repa>



<http://www.pks.rs/Vesti.aspx?IDVestiDogadjaji=18880>

<https://seenews.com/news/drought-seen-cutting-serbias-maize-crop-exports-report-488745>

4. Has the issue of droughts been addressed in your country's updated River Basin Management Plan(s), or other management plans e.g. on water or specifically on droughts?

Yes

No

Possible further descriptions:

A public debate is under way in Serbia regarding the *Danube River Basin Management Plan for the Territory of Serbia*, which has been drafted by the parent Ministry of Agriculture and Environmental Protection. Apart from measures associated with various aspects of water use and water pollution control, which can mitigate the impact of droughts, the Plan sets the following objective for this specific segment: *Water management in drought and water scarcity conditions*, and identifies the following measures aimed at achieving this objective:

- Continuous study of the precipitation and evapotranspiration cycle and its effect on runoff and water resources;
- Definition of the ecological water demand of rivers and the water demand of other users (drinking water supply, electric power, irrigation), where the environment is an equal user;
- Development of drought management plans for water districts, including the definition of conditions for the declaration of drought or water scarcity and elaborated water management adaptation to such conditions, a summary of which is to be included in the water management plan of the water district;
- Characterization of water resources in drought conditions for each water district and, using historic data and climate change predictions, elaboration of a program of measures for preventing and mitigating drought impacts;
- Organizing and overseeing of consultations with stakeholders and coordinating the selection and implementation of suitable measures (preventative – for water retention in the river basin, operative – protection and controlled use of water resources during dry periods, or organizational – protocols for coordinated efforts of the water sector and other bodies involved in the use of water resources);
- Development of an observation and forecasting system based on monitoring data from the network of meteorological and hydrological stations, satellite imagery and on-the-ground inspection of vegetation. Along with comparison of the state of affairs in wet and dry conditions, assessment of the effect of water scarcity on the population, economy, and the environment.

Climate change strategy and action plan will be developed under the IPA 2014 project and will start in 2016.

The preparation of *National Adaptation Strategy* is requirement of the EU Regulation 525/2013 (MMR), while the transposition of Regulation 525/2013 starts with support of IPA 2013 twinning project: “Establishment of a mechanism for implementation of MMR”

Climate change division in cooperation with UNDP and external national experts developed a publication “The Heating up Of Crops – How to Respond” considering the impact of climate change on agriculture sector.

5. If the issue of droughts is included in your River Basin Management Plan(s) or other plans, are measures put in place to address the issue? and if yes, what measures are being put/in place or are planned?

- x Measures to increase efficiency of irrigation
- x Measures for reducing leakage in water distribution networks
- x Natural water retention measures
- Wastewater recycling
- Rain water harvesting
- x Drought mapping/forecasting
- x Education of public on water-saving measures (e.g. water efficient appliances)
- x Market-based or incentive instruments (e.g., user pays principle, block tariffs, penalties for excessive consumption)
- Other, please specify:

6. General lessons learned from the drought in 2015 (e.g. need for better preparedness in the future, need for better monitoring data and data sharing, need for structural or non-structural measure, raising awareness, etc.)?

Please briefly describe:

The following are needed to better respond to extreme droughts:

- More precise inclusion of drought issues in planning documents and creation of conditions for the implementation of measures called for by the plan.
- Better monitoring network in terms of soil moisture measurement.
- Denser meteorological network.
- Timely and official data indicative of losses in agriculture.
- Improvement of monthly and seasonal forecasting.

7. If available, please provide reference to more specific information and data available for your country on the 2015 drought.

Details of the meteorological conditions in the agricultural year 2014/2015 in Serbia are available on the website of the Hydrometeorological Service of Serbia:

<http://www.hidmet.gov.rs/podaci/agro/godina.pdf>

The following two links feature bulletins with early warnings of extreme events:

http://www.hidmet.gov.rs/podaci/meteorologija/bilten_rana_najava/Bilten%20rane%20najave%20klimatskih%20ekstremnih%20pojjava%20i%20anomalija%2026.6.2015.pdf

http://www.hidmet.gov.rs/podaci/meteorologija/bilten_rana_najava/Bilten%20rane%20najave%20klimatskih%20ekstremnih%20pojjava%20i%20anomalija%2024.7.2015.pdf

The Hydrometeorological Service of Serbia has produced an “Analysis of Hydrological Conditions in the Danube River Basin and other Major River Basins in the Republic of Serbia 2015” (attached hereto).

8. Do you have additional comments to offer on this topic?

QUESTIONNAIRE ON 2015 DROUGHTS IN THE DRB - SI

Country:	Slovenia
Name(s) of compiler(s):	Andreja Sušnik, Gregor Gregorič
Email address(es):	Andreja.susnik@gov.si , gregor.gregoric@gov.si

1. Did you experience significant drought phenomena in your country during 2015?
(if “No” then only questions 4, 5 and 8 might be relevant to be answered)

- Yes
 No

Please briefly describe:

Four intense, however relatively short heat waves hit Slovenia in summer 2015 (one in June, two in July and in August). The main impact on agriculture was caused by heat stress. Hot and dry periods were discontinued with precipitation episodes, therefore cumulative surface water balance values were close to long term normals (except in south west Slovenia near Adriatic coast, where surface water balance reached extremely low levels). Also spring (April-May) and late winter period were very dry.

2. If drought was a significant phenomenon, which water-dependent sectors were mainly impacted*?

	Please indicate o...no impacts x...low impacts xx...high impacts	Description**
Agriculture	x	Rainfed crops in SW Slovenia; other regions suffered due to heat stress.
Navigation**	o	Navigation is not important issue in Slovenia
Water supply (drinking water)	o	No impacts reported (apart from small village reservoirs)
Energy	o	Possible impacts were mitigated internally.

(Hydropower)		
Industry (cooling water)	o	No impacts reported
Water quality	o	
Ecology (Biodiversity)	o	
Recreation	o	
Others	/	

* If available please make reference to quantitative information, however, expert judgement might also be necessary for answering this question

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Possible further descriptions:

Descriptions of meteorological and hydrological situation (in Slovene language):

<http://meteo.arso.gov.si/met/sl/climate/natural-hazards/>

Description of agrometeorological situation and impacts on crops (in Slovene language):

http://meteo.arso.gov.si/met/sl/agromet/publications/wb_archive/

Slovenian Environmental Agency is also hosting DMCSEE and preparing monthly DMCSEE bulletins. DMCSEE products are also available through EDO platform (regional products for SEE).

3. As a consequence of the 2015 droughts, have measures been put in place in your country to mitigate the impacts? Please briefly describe:

Short answer: no.

Long answer: Chamber of agriculture has prepared a booklet with advices on technological measures during dry period – mainly as consequence of 2012/2013 droughts which were more intense than 2015. Discussions (in framework of IDMP in cooperation with GWP) on improvements of drought response (including update of RBMPs) are still taking place. In 2015, initiatives for regional and national irrigation plan (improvement of current situation regarding irrigation, including investments which are now put in place) were accepted.

If available, please provide pictures illustrating the impacts of the 2015 droughts in country and/or mitigation measures taken, including a source citation (a selection of pictures will be used for the report).

Experiments to test the efficiency of drip irrigation (Biotechnical Faculty, Fruit growing centre Bilje)



4. Has the issue of droughts been addressed in your country's updated River Basin Management Plan(s), or other management plans e.g. on water or specifically on droughts?

- Yes
(No

Possible further descriptions:

Updates of RBMPs regarding drought management are still discussed and were not included in recent update. Projects on improvement of irrigation efficiency are currently being executed (results are expected in 2-3 years).

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5. If the issue of droughts is included in your River Basin Management Plan(s) or other plans, are measures put in place to address the issue? and if yes, what measures are being put/in place or are planned?

(Measures to increase efficiency of irrigation

- Measures for reducing leakage in water distribution networks
- Natural water retention measures
- Wastewater recycling
- Rain water harvesting
- Drought mapping/forecasting
- Education of public on water-saving measures (e.g. water efficient appliances)
- Market-based or incentive instruments (e.g., user pays principle, block tariffs, penalties for excessive consumption)
- Other, please specify:

6. General lessons learned from the drought in 2015 (e.g. need for better preparedness in the future, need for better monitoring data and data sharing, need for structural or non-structural measure, raising awareness, etc.)?

Please briefly describe:

Mainly after intense droughts in 2012 and 2013, general awareness of vulnerability to drought was very high. More investments were dedicated to effective irrigation systems, projects on

improvement of irrigation efficiency were launched. Advices on how to reduced exposure to drought (diversification of crops, sowing of more drought-tolerant hybrids etc.) are being forwarded to farmers.

Apart from projects aiming at improved irrigation technology, also one major international project in Danube region (1st call of the Danube TCP) was accepted (DTP-182-2.4 DriDanube). Drought monitoring, forecasting and impact assessment will be improved using newly available data (mainly remote sensing data, made available in scope of the Copernicus programme).

7. If available, please provide reference to more specific information and data available for your country on the 2015 drought.

Some references are added to 2nd question. More comprehensive analysis (in Slovene language, with English summary and figure captions) will be available in 2016 issue of magazine UJMA, dedicated to disaster prevention. UJMA volumes are freely available on: <http://www.sos112.si/slo/page.php?src=sv61.htm>
2016 issue is expected in November. Analyses of droughts in 2012 and 2013 are already available in past issues.

8. Do you have additional comments to offer on this topic?

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QUESTIONNAIRE ON 2015 DROUGHTS IN THE DRB - SK

Country:	Slovak Republic
Name(s) of compiler(s):	Competent authority for the WFD implementation - Mr. Vladimír Novák (HoD), Ministry of Environment of the SR Compiler - Ms. Monika Supeková (RBMEG), Slovak Water Management Enterprise, state enterprise
Email address(es):	vladimir.novak@enviro.gov.sk monika.supekova@svp.sk

1. Did you experience significant drought phenomena in your country during 2015?
(if “No” then only questions 4, 5 and 8 might be relevant to be answered)

- Yes
 No

Please briefly describe:

Despite of extremely dry periods during 2015 at some localities (see Fig 1), the significant drought phenomena was not recognized at whole territory of SR. For example, June 2015 was extremely dry, worst in last 115 years, see <http://www.shmu.sk/sk/?page=2049&id=637>, or <http://dennik.hnonline.sk/slovensko/539131-slovensko-zasiahlo-najhorsie-sucho-za-poslednych-115-rokov>. Generally it is possible to conclude that the year 2015 was not extremely dry and an extreme long-term full-area dry was not observed.

In the River Basin Management Plans (implementation of the directive 2000/60/ES) the drought is not defined as significant water management issue in the SR.

In the year 2015 the internet portal *Intersucho* started to operate. There are available information such as maps and graphs showing different factors like drought intensity, soil profile saturation, water storage of soil, impacts of drought on vegetation. First map was published in January 2015, see <http://www.intersucho.cz/sk/mapy/?mapcountry=sk>.

2. If drought was a significant phenomenon, which water-dependent sectors were mainly impacted*?

	Please indicate o...no impacts x...low impacts xx...high impacts	Description**
Agriculture	XX	Although in the year 2015 the significant drought was not recognized during the whole year, the most attacked is agriculture. The cereals and further products harvested before or in the beginning of July 2015 brought good yields. Lower yields were recognized at later harvested plants like corn, soya, sugar beet or oil seed rape.
Navigation**	X	Second half of the year 2015 has affected the navigation too. For example on the Danube river the fairway depth measured in three sections was less than 2,5 m, the most critical section rkm 1735,50 – 1733,70 were 53 days below 2,0 m, 4 days with 1,6 m of depth only. Daily information is available online at www.teledan.eu , and information of gauging stations are available at www.danubeportal.com .
Water supply (drinking water)	X	Affected is also water supply in general, not only for drinking purposes. Drought in the SR is affecting the drinking water supply in the cases of insufficient capacity of shallow water resources at local level only.
Energy (Hydropower)	X	
Industry (cooling water)	0	
Water quality	X	Drought is partially influencing the quality of surface water too (rivers with low water discharge and water supply reservoirs).
Ecology (Biodiversity)	X	
Recreation	0	
Others	X	Water quantity – e. g. decreased water level to nonacceptable level, which causes low or no water level in side arms of rivers. This has impacted biota in ecosystems too.

* If available please make reference to quantitative information, however, expert judgement might also be necessary for answering this question

** Information on impacts on inland navigation is included in the National Action Plans in the frame of the FAIRway Danube project. This document is available [here](#).

Possible further descriptions:

.....

3. As a consequence of the 2015 droughts, have measures been put in place in your country to mitigate the impacts? Please briefly describe:

.....

If available, please provide pictures illustrating the impacts of the 2015 droughts in country and/or mitigation measures taken, including a source citation (a selection of pictures will be used for the report).

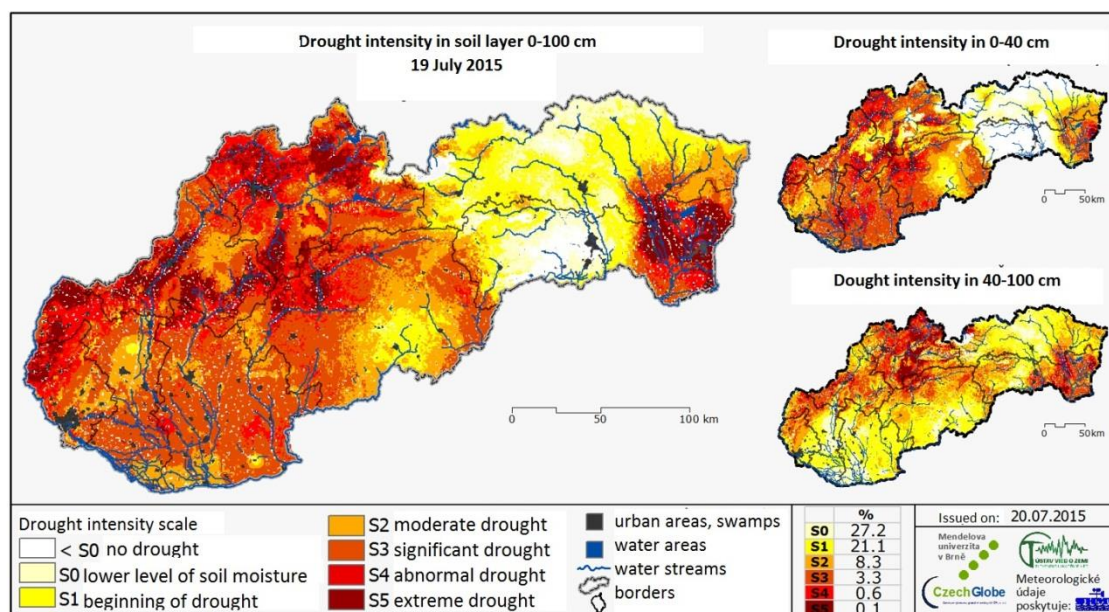


Fig 1 Drought intensity in middle of summer of 2015

Source: <http://www.intersucho.cz/sk/?mapcountry=sk> ;
<http://www.intersucho.cz/sk/?mapcountry=sk&popup=1&measurementid=178>

Comment: EN translation of information published on portal is under development.

4. Has the issue of droughts been addressed in your country's updated River Basin Management Plan(s), or other management plans e.g. on water or specifically on droughts?

- Yes
 No

Possible further descriptions:

Publication *Adaptation strategy of the SR to unfavorable impacts of climate change* (Stratégia adaptácie Slovenskej republiky na nepriaznivé dôsledky zmeny klímy), 2014. Drought is here mentioned in respect to biota, agriculture, forestry and energetics.

SR has addressed the drought in the *River Basin Management Plans 2016 - 2021* (RBMPs), particularly:

- Assessment of hydrological changes (p. 87), calculation of WEI+ index are incorporated. WEI+ expresses the ration of water demand to renewable water resources for particular locality. In the tables 4.1.28 and 4.1.29 there are presented assessment results of water uses index calculated for the back-end profiles of river basin district subunits and overview of assessment results of water uses index in critical points of selected water balance profiles of river basin districts.

- The assessment of surface water volume and regime due to data on average precipitations, data on yearly runoff from the territory of the SR and mainly data on total hydrological and water management balance.

The chapter 9.3 of RBMPs is focused on drought questions including the approach of the SR in E-flow. The drought is not defined as significant water management issue, but as new water management issue, which is necessary to focus on.

The Operational Programme Quality of the Environment for the period 2014 – 2020 (Operačný program Kvalita životného prostredia na obdobie 2014 – 2020, see http://www.opkzp.sk/wp-content/uploads/2015/05/OPKZP_verzia_2.0.pdf) and its priority axis are setting the frame for realization of measures focused on drought and its impacts:

- The demand of risks management affected by climate change
- The risks related to drought and its effect on water sources deficit
- The water retention measures in urbanized areas (residential areas)

5. If the issue of droughts is included in your River Basin Management Plan(s) or other plans, are measures put in place to address the issue? and if yes, what measures are being put/in place or are planned?

- Measures to increase efficiency of irrigation
- Measures for reducing leakage in water distribution networks
- Natural water retention measures
- Wastewater recycling
- Rain water harvesting

- Drought mapping/forecasting
- Education of public on water-saving measures (e.g. water efficient appliances)
- Market-based or incentive instruments (e.g., user pays principle, block tariffs, penalties for excessive consumption)
- Other, please specify:

Many of measures in country/river basins and on water courses defined in the Flood Risk Management Plans, which primarily are focused on flood protection are reflected in River Basin Management Plans too and serves simultaneously with positive impact on drought and water scarcity management too. In between other measures relevant for the SR it is worth to mention the revision of issued water abstraction permits.

6. General lessons learned from the drought in 2015 (e.g. need for better preparedness in the future, need for better monitoring data and data sharing, need for structural or non-structural measure, raising awareness, etc.)?

Please briefly describe:

SR agrees with the fact, that the drought and its impacts have to be reflected in the countries. Assumption for the determining of effective and targeted measures dealing with the drought phenomena is to assure better monitoring and sharing of the data and to focus on raising of public awareness too. The Drought Management Plans are necessary, but these are not available in SR yet.

7. If available, please provide reference to more specific information and data available for your country on the 2015 drought.

Internet portal *Drought monitoring* (Monitoring sucha) <http://www.shmu.sk/sk/?page=2166>, where information on drought monitoring, meteorological drought and soil drought are published. Webpage *Interdrought* (Intersucho), for SR, CZ and Central Europe, there are published data from 2015 and 2016, <http://www.intersucho.cz/sk/o-suchu/ako-sucho-monitorujeme/?mapcountry=sk>. River Basin Management Plans <https://www.minzp.sk/sekcie/temy-oblasti/voda/koncepcne-aplanovacie-dokumenty/vodny-plan-slovenska-aktualizacia-2015/>.

8. Do you have additional comments to offer on this topic?

.....

QUESTIONNAIRE ON 2015 DROUGHTS IN THE DRB - UA

Country:	Ukraine
Name(s) of compiler(s):	x
Email address(es):	x

1. Did you experience significant drought phenomena in your country during 2015?
(if “No” then only questions 4, 5 and 8 might be relevant to be answered)

- Yes
 No

Please briefly describe:

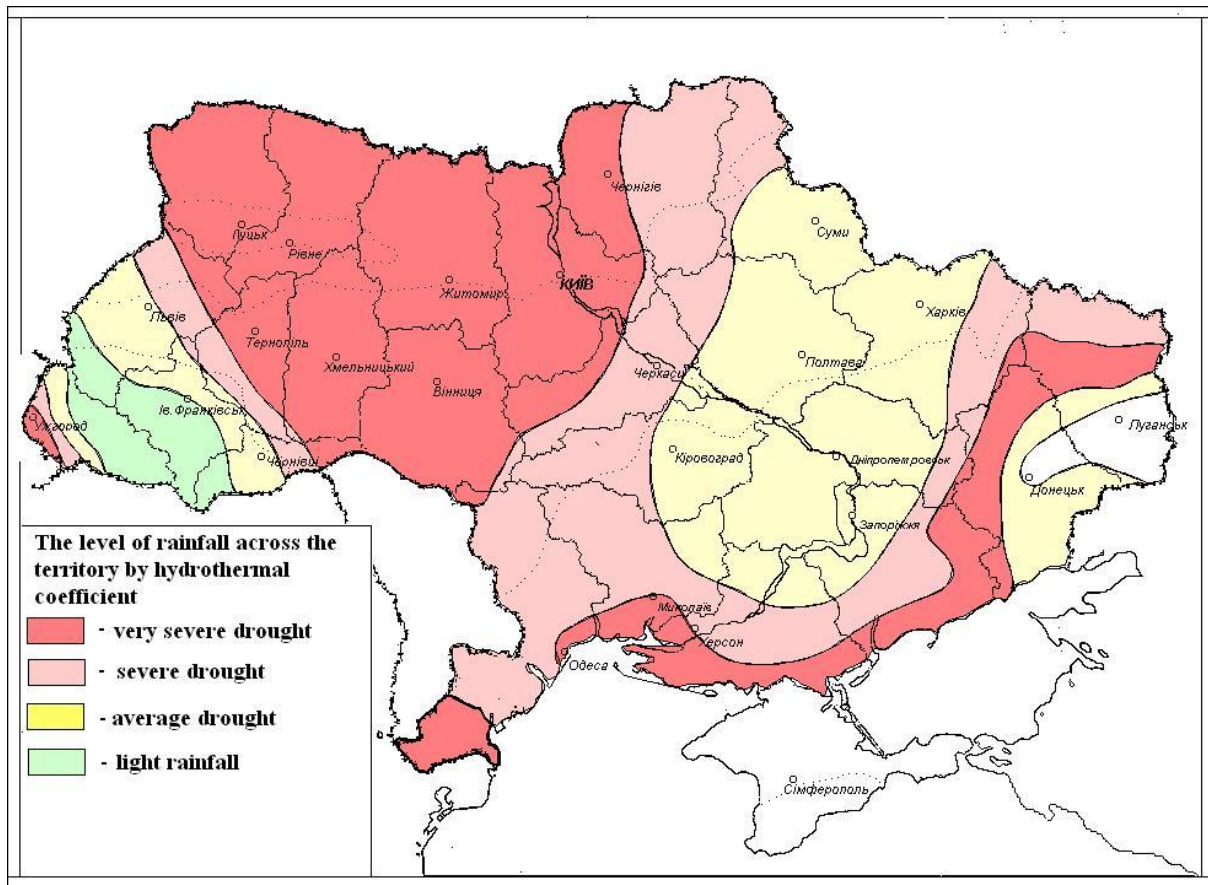
The average annual air temperature was on 1.8-2.8° above the norm across the country in 2015.

The most unfavorable phenomenon in 2015 was the summer-autumn drought, main feature of which was the combination of 3 types - meteorological (air), agricultural (soil) and hydrological (low water).

The largest precipitation deficit was noticed in areas with traditionally sufficient and unstable rainfall - north-west part of the country.

The situation deteriorated in July - August, when in almost dry weather conditions long heat waves with air temperature + 34-39° were noticed across the country within 10-20 days.

Firstly, these conditions led to the air drought and further - to a dangerous combination of it with the soil drought. The figure provides a drought assessment in June-August, 2015 by the criterion of hydrothermal coefficient (the ratio of precipitations amount to temperatures amount above +10°).



Water levels of many rivers of this Ukraine’s part dropped to the lowest indicators for the regular observation period.

2. If drought was a significant phenomenon, which water-dependent sectors were mainly impacted*?

	Please indicate o...no impacts x...low impacts xx...high impacts	Description**
Agriculture	x	
Navigation**		
Water supply (drinking water)	xx	
Energy (Hydropower)	x	
Industry (cooling)	xx	

water)		
Water quality		
Ecology (Biodiversity)		
Recreation		
Others		

* If available please make reference to quantitative information, however, expert judgement might also be necessary for answering this question

** Information on impacts on inland navigation is included in the National Action Plans in the frame of the FAIRway Danube project. This document is available [here](#).

Possible further descriptions:

.....

3. As a consequence of the 2015 droughts, have measures been put in place in your country to mitigate the impacts? Please briefly describe:

No measures have been put in place

.....

If available, please provide pictures illustrating the impacts of the 2015 droughts in country and/or mitigation measures taken, including a source citation (a selection of pictures will be used for the report).

4. Has the issue of droughts been addressed in your country's updated River Basin Management Plan(s), or other management plans e.g. on water or specifically on droughts?

Yes

No

Possible further descriptions:

.....

5. If the issue of droughts is included in your River Basin Management Plan(s) or other plans, are measures put in place to address the issue? and if yes, what measures are being put/in place or are planned?

- Measures to increase efficiency of irrigation
- Measures for reducing leakage in water distribution networks
- Natural water retention measures
- Wastewater recycling
- Rain water harvesting
- Drought mapping/forecasting
- Education of public on water-saving measures (e.g. water efficient appliances)
- Market-based or incentive instruments (e.g., user pays principle, block tariffs, penalties for excessive consumption)
- Other, please specify:

6. General lessons learned from the drought in 2015 (e.g. need for better preparedness in the future, need for better monitoring data and data sharing, need for structural or non-structural measure, raising awareness, etc.)?

Please briefly describe:

According to Annex XXX of Association Agreement EU-Ukraine river basin management plans for all 9 river basin districts will be developed till 2024. Taking into account that several droughts took place within last decade relevant measures will be developed in order mitigate negative impact.

7. If available, please provide reference to more specific information and data available for your country on the 2015 drought.

.....

8. Do you have additional comments to offer on this topic?

.....