Republic of Serbia
Republic Hydrometeorological Service of Serbia

Agrometeorological activities in RHMSS

Department for applied climatology and agrometeorology
www.hidmet.gov.rs

Meteorological Observing System
- Meteorological Stations Network -

Programs of meteorological surface measurements and observations:

- Synoptical program - 32
- Climatological program - 97
- Precipitation program - 558
- Soil moisture program - 4
- Phenological program - 52

Observatories - 3 (Belgrade, Novi Sad i Niš)

Upper air observations - 2

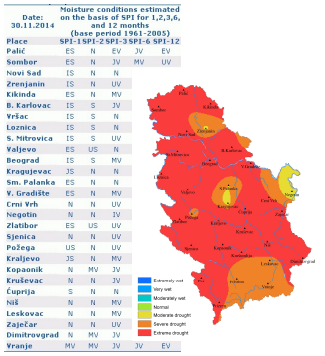
Automatic meteorological stations - 30

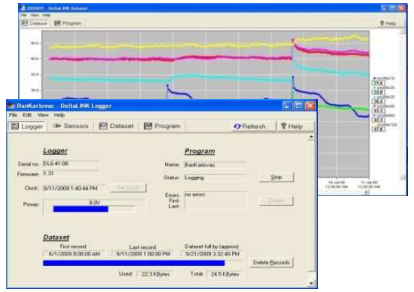
Scope in the field of Agrometeorology in RHMSS

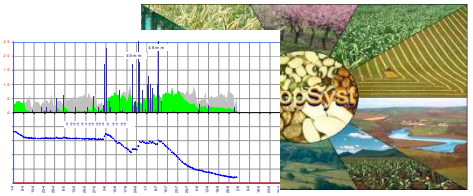
- Monitoring of the **observation program** implementation and participation in **special agrometeorological observations** (lysimeter measurements, measurement of the soil moisture);
- **Processing and analysis of agrometeorological data** and publishing of agrometeorological yearbooks: phenological, soil temperature, transpiration and evapotranspiration;
- **Analysis, monitoring and assessment of conditions for agricultural development** based on current and historical meteorological and other data, as well as the assessment of potential impacts of expected climate change on agriculture in Serbia
- Monitoring, analysis and assessment of weather and climate conditions impact are based on values of **agrometeorological indices**, application of **agrometeorological models** and results of **climate models**
- In area of **applied researches** special attention was paid to studying of climate extremes and meteorological phenomena causing major damages in agriculture and their consequences (drought, extremely high and low air temperatures)
- Application of **remote sensing observations** in agrometeorology – the fractional vegetation cover index is used for monitoring the plant growth and development conditions during the vegetation season. It is currently employed to monitor the vegetation condition at six locations covered with vineyards

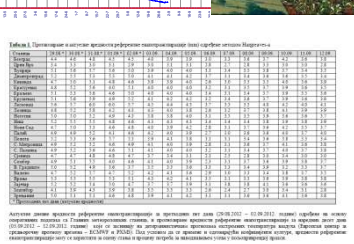
The program of operative tasks

- Operational production and analysis of a number of indices of humidity/drought and parameters in the framework of **drought monitoring**:
  - **Standardized Precipitation Index** (SPI) for the period of 1 to 12 months and above, calculated at the expiry of the month, while the calculation for the periods of 30, 60 and 90 days is done with one-day time step;
  - **Standardized Precipitation Evapotranspiration Index** (SPEI) calculated for the periods of 30, 60 and 90 days
  - **Palmer Drought Stress Index** (PDSI) and **Palmer Z Index**;
  - Value of the **soil moisture** obtained by measurement;
- Use of products of operational application of agrometeorological models:
  - **CROPSYST** (Cropping Systems Simulation Model) used for the simulation of growth, development and forecast of maize yield;
- Determination of current and forecast daily values of **evapotranspiration** (ETo), where the ETo forecast is based on deterministic forecasts of extreme air temperatures (ECMWF and RHMSS).









RHMSS Internet pages “Agricultural meteorology”

(Moisture conditions, Agrometeorological bulletins)

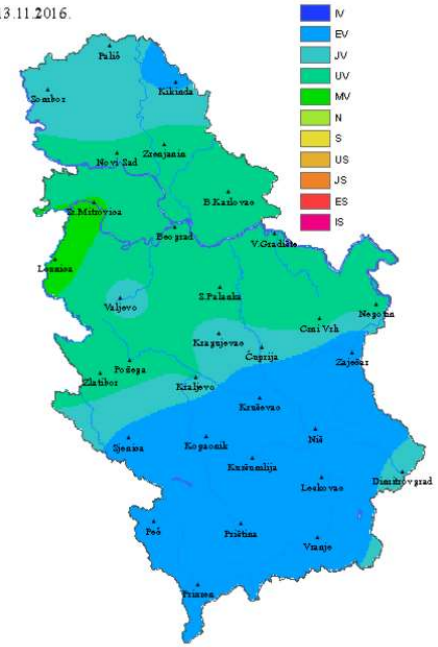
Agricultural meteorology

Agricultural meteorology
+381 11 3050 856
agromet@hidmet.gov.rs

Republic of Serbia

MOISTURE CONDITIONS-DROUGHT MONITORING
on the basis of Standard Precipitation Index (SPI)

13.11.2016.



Date: 31.10.2016	Moisture conditions estimated on the basis of SPI for 1,2,3,6, and 12 months (base period 1961-2005)				
Place	SPI-1	SPI-2	SPI-3	SPI-6	SPI-12
Palić	JV	JV	EV	UV	UV
Sombor	UV	UV	JV	JV	EV
Novi Sad	UV	MV	N	UV	UV
Zrenjanin	UV	MV	UV	EV	JV
Kikinda	JV	JV	UV	EV	JV
B. Karlovac	MV	N	JV	UV	MV
Vršac	UV	MV	N	N	N
Loznica	N	N	N	MV	UV
S. Mitrovica	MV	MV	N	N	N
Valjevo	MV	MV	UV	UV	JV
Beograd	MV	MV	MV	MV	N
Kragujevac	UV	MV	MV	MV	JV
Sm. Palanka	MV	N	N	N	MV
V. Gradište	UV	N	N	JV	JV
Crni Vrh	UV	N	N	MV	N
Negotin	UV	N	N	MV	MV
Zlatibor	UV	N	UV	JV	EV
Sjenica	MV	UV	JV	JV	EV
Požega	MV	N	JV	EV	EV
Kraljevo	UV	MV	N	N	MV
Kopaonik	UV	UV	JV	EV	EV
Kruševac	UV	UV	UV	EV	EV
Ćuprija	MV	MV	UV	UV	JV
Niš	JV	MV	MV	UV	UV
Leskovac	UV	MV	MV	UV	UV
Zaječar	JV	UV	MV	MV	UV
Dimitrovgrad	UV	MV	N	N	UV
Vranje	UV	MV	MV	UV	JV

MOISTURE CONDITIONS ON THE BASIS OF STANDARD PRETICIPATION INDEX FOR THE PREVIOUS 60 DAYS.
Index value calculated for the mentioned period can be used for the estimation of soil moisture conditions in the surface ground layer, as well as agricultural drought indicator. **More about SPI calculation and use...**
The analyses of moisture conditions on the territory of Republic of Serbia for the vegetation period, season...

EXPLANTION OF THE MOISTURE CONDITIONS CATEGORIES

Symbol	Moisture conditions	Value	
IS	Exceptional drought	SPI ≤ -2.326	
ES	Extreme drought	-2.326 < SPI ≤ -1.645	
JS	Severe drought	-1.645 < SPI ≤ -1.282	
US	Moderate drought	-1.282 < SPI ≤ -0.935	
S	Minor drought	-0.935 < SPI ≤ -0.524	
N	Near normal	-0.524 < SPI < +0.524	Usual moisture conditions
MV	Slightly increased moisture	+0.524 ≤ SPI < +0.935	
UV	Moderately increased moisture	+0.935 ≤ SPI < +1.282	
JV	Considerably increased moisture	+1.282 ≤ SPI < +1.645	
EV	Extremely wet	+1.645 ≤SPI < +2.326	
IV	Exceptionally wet	SPI ≥ +2.326	

Agricultural meteorology

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Republic of Serbia

THE FOLLOWING AGROMETEOROLOGICAL BULLETINS, REVIEWS AND ANALYSES (In Serbian) CAN BE DOWNLOADED:

Seven-day agrometeorological bulletin
The survey of the most significant characteristics of conditions for growth and development or winter resting of the important agricultural crops in the previous seven-day period (Monday to Sunday). Graphical presentation of the soil moisture storage changes and daily values of other important agrometeorological parameters for selected places in Serbia. The assessment of the influence of expected weather (according to short/medium-range weather forecast) in the forthcoming period on the crop performance and fieldwork operations.

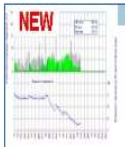
Ten-day agrometeorological review
The review of numerical values of agrometeorological parameters or their qualitative assessments given for the previous ten-day period. Chosen parameters relate to heat conditions in near ground air layer and surface soil layer, precipitation and moisture conditions as well as sunshine duration. During the winter resting period, special review of the dynamics of soil moisture storage accumulation is given. Places in Serbia for which data are given were selected taking care that all significant agricultural areas be represented.

Monthly agrometeorological bulletin for the previous month
Analysis and assessment of growth and development conditions and agricultural crop performance during the month on the basis of the value of agrometeorological parameters and crop needs in given development phases. The review of dangerous meteorological events and storms and their detrimental effects in agriculture. The assessment of the suitability of weather and ground conditions for performing current field work, as well as the occurrence and spreading of plant diseases and pests on the most important agricultural crops. Agrometeorological forecast on the basis of contemporary crop performance and their future requirements, medium/long-term weather forecast and possibility of undisturbed forthcoming field work performing.

Monthly Agrometeorological bulletin archives for the previous month: September

Annual agrometeorological analysis for the previous production year:
Brief review of the most important facts related to the influence of meteorological factors on various aspects of agricultural production in Serbia, as well as their consequences during the period of one year. The analysis relates to the production year: the period from the beginning of October of the previous year until the end of September of the current year, that is, from the beginning of sowing of the most important winter crops until the time of harvesting/picking of the most of spring agricultural crops. Annual agro meteorological analysis contains a number of relevant cartographic and graphic presentations prepared on the basis of the values of agrometeorological parameters from the territory of Serbia.

Annual agrometeorological analysis archives: 2009/2010



Products of the model CROP-SYST
On the basis of agrometeorological data from six chosen stations on the territory of Serbia, application of agrometeorological model CROP-SYST in the period April-October simulated the growth and development as well as yield of corn hybrids. The bulletin contains the assessment of the influence of weather conditions on the duration of vegetation period, water balance component and corn yield.

Location: Sombor

Products from agrometeorological bulletins

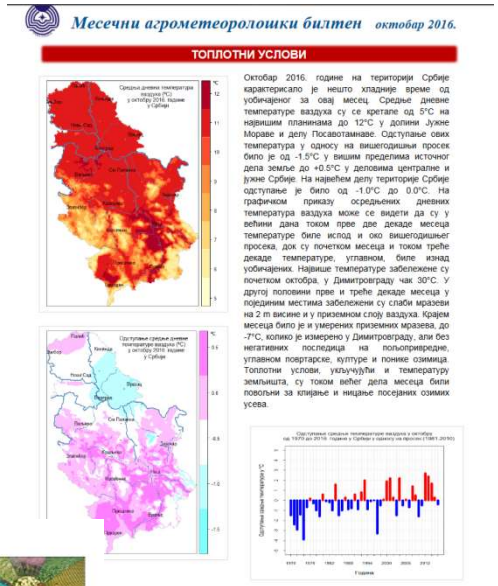
(Seven-day, ten-day, monthly, CropSyst bulletin and annual agrometeorological analysis)

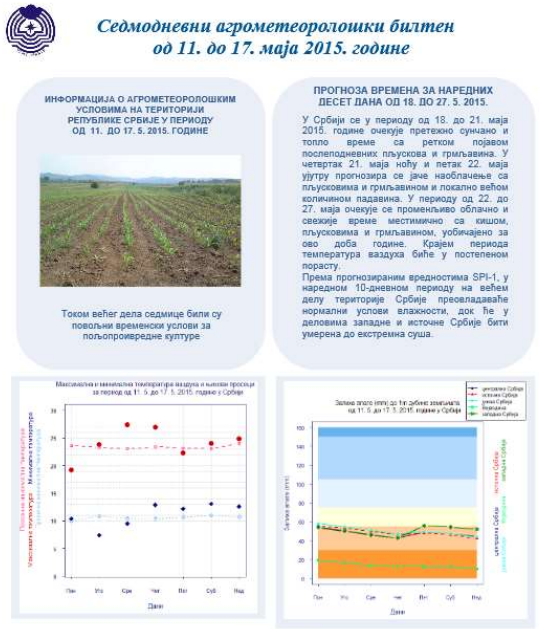
Republika Srbija
Republički hidrometeorološki zavod
Kneza Višeslava 66, 11000 Beograd
office@hidmet.gov.rs

POTENCIJALNA EVAPOTRANSPIRACIJA, mm

Stanica	13.11. *	14.11. *	15.11. *	16.11. *	17.11. *	18.11.	19.11.	20.11.	21.11.	22.11.	23.11.	24.11.	25.11.	26.11.	27.11.
Beograd	0.2	0.4	0.4	0.6	0.8	1.1	1.0	0.8	0.8	0.7	0.8	0.7	0.8	0.6	0.6
Crni Vrh	0.3	0.2	0.4	0.3	0.6	0.8	0.6	0.3	0.3	0.3	0.3	0.3	0.6	0.6	0.4
Ćuprija	0.6	0.4	0.5	0.8	1.1	1.0	1.0	0.7	0.6	0.5	0.6	0.7	0.8	0.7	0.7
Dimitrovgrad	0.7	0.4	0.3	0.7	1.2	1.0	1.0	0.9	0.8	0.6	0.7	0.7	0.7	0.8	0.8
Kikinda	0.5	0.5	0.6	0.5	0.8	0.9	0.8	0.7	0.7	0.6	0.7	0.7	0.7	0.7	0.7
Kragujevac	0.6	0.5	0.6	0.8	1.1	1.0	0.9	0.7	0.7	0.6	0.7	0.7	0.8	0.7	0.6
Kraljevo	0.6	0.5	0.4	0.7	1.0	1.1	1.0	1.0	0.9	0.8	0.8	0.8	0.9	0.7	0.4
Kruševac	0.7	0.5	0.4	0.8	1.2	1.2	1.1	0.9	0.9	0.8	0.9	0.9	0.9	0.7	0.6
Leskovac	0.8	0.6	0.2	0.7	1.2	1.1	1.1	1.0	0.8	0.9	0.8	0.8	0.9	0.9	0.6
Loznica	0.6	0.5	0.4	0.8	0.8	1.1	1.2	1.1	0.9	0.9	0.9	0.8	0.7	0.5	0.5
Negotin	0.6	0.5	0.7	0.8	0.8	0.8	0.8	0.6	0.5	0.4	0.6	0.5	0.4	0.4	0.3
Niš	0.7	0.4	0.3	0.7	1.2	1.1	1.1	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.6
Novi Sad	0.4	0.6	0.6	0.6	0.8	1.0	0.9	0.7	0.7	0.6	0.7	0.7	0.7	0.6	0.7
Palić	0.4	0.5	0.4	0.4	0.7	0.9	0.9	0.7	0.7	0.6	0.7	0.6	0.6	0.6	0.6
Požega	0.5	0.4	0.4	0.8	1.1	1.1	1.1	1.0	0.8	0.8	0.7	0.8	1.0	0.6	0.4
S. Mitrovica	0.5	0.6	0.6	0.6	0.8	1.0	1.0	0.8	0.7	0.7	0.8	0.7	0.7	0.7	0.6
S. Palanka	0.5	0.5	0.5	0.7	0.9	1.0	0.9	0.8	0.8	0.7	0.8	0.7	0.8	0.7	0.5
Sjenica	0.4	0.3	0.4	0.7	1.2	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.8	0.6	0.7
Sombor	0.5	0.6	0.6	0.6	0.8	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.6	0.6	0.6
V. Gradište	0.4	0.5	0.4	0.7	1.0	0.8	0.6	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5
Valjevo	0.5	0.5	0.3	0.7	1.0	1.2	1.1	1.0	0.9	0.9	0.9	0.7	0.7	0.4	0.5
Vranje	0.8	0.4	0.3	0.8	1.0	0.8	0.9	0.9	0.9	0.8	0.7	0.7	0.7	0.7	0.8
Zaječar	0.5	0.8	0.8	0.8	1.0	0.9	0.8	0.5	0.5	0.4	0.5	0.5	0.5	0.4	0.4
Zlatibor	0.3	0.3	0.3	0.6	1.0	0.8	0.8	0.9	0.9	0.9	0.8	0.8	0.7	0.5	0.4
Zrenjanin	0.5	0.6	0.6	0.5	0.8	0.9	0.8	0.7	0.7	0.6	0.7	0.7	0.7	0.7	0.7

** Prethodnih pet dana (aktuelne vrednosti)*

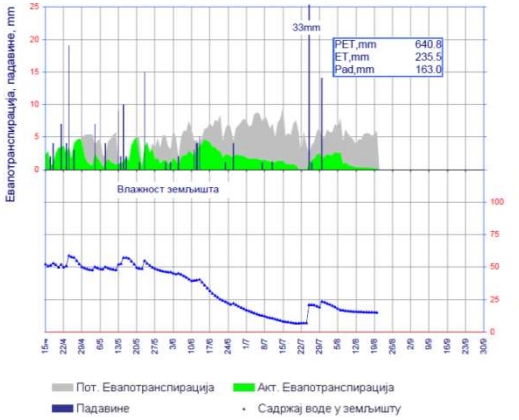




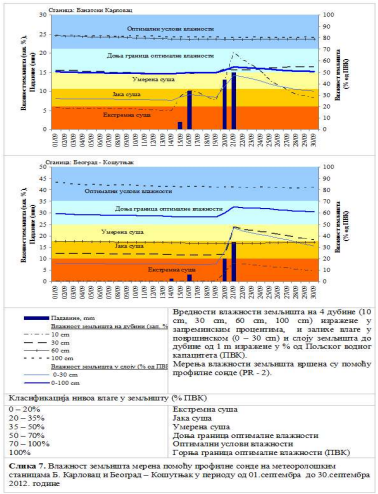
Република Србија
Републички хидрометеоролошки завод
Одељење за агрометеорологију
Кнеза Вишеслава 66, 11030 Београд Телефон / Факс 011/2542 687, 3050 941
http://www.hidmet.gov.rs/ciril/meteorologija/agrometeorologija.php

РЕПУБЛИЧКИ ХИДРОМЕТЕОРОЛОШКИ ЗАВОД
Република Србија
Одељење за Агрометеорологију
E mail: agromet@hidmet.gov.rs

АГРОМЕТЕОРОЛОШКИ БИЛТЕН СА АНАЛИТИЧКИМ И ПРОГНОСТИЧКИМ ПРОДУКТИМА CROPSYST МОДЕЛА ЗА КИКИНДУ



Датум симулације:	8/20/2012
Сушни и топли	
Датум:	
почетка наливања зрна	19.07
почетка зрења	10.08
жетве	26.08
Прогноза приноса,kg/ha:	901
Укупно у вегетационом периоду:	
PET,mm	667.5
ET,mm	236.8
Pad,mm	166.4
Просечни	
Датум:	
почетка наливања зрна	19.07
почетка зрења	10.08
жетве	26.08
Прогноза приноса,kg/ha:	901
Укупно у вегетационом периоду:	
PET,mm	664.9
ET,mm	240.7
Pad,mm	176.4
Влажни и свежи	
Датум:	
почетка наливања зрна	19.07
почетка зрења	10.08
жетве	26.08
Прогноза приноса,kg/ha:	901
Укупно у вегетационом периоду:	
PET,mm	663.8
ET,mm	240.5
Pad,mm	183.1



Класификација нивоа влаге у земљишту	(% ПВК)
0 – 20%	Екстремна суша
20 – 35%	Јака суша
35 – 50%	Умерена суша
50 – 70%	Доња граница оптималне влажности
70 – 100%	Оптимални услови влажности
100%	Горња граница оптималне влажности (ПВК)

Вредности влажности земљишта на 4 дубине (10 cm, 30 cm, 60 cm, 100 cm) изражене у запреминским процентима, и запис влаге у површинском (0 – 30 cm) и слоју земљишта до дубине од 1 m изражене у % од Пољског водног капацитета (ПВК).
Мерења влажности земљишта вршена су помоћу профилне сонде (PR - 2).

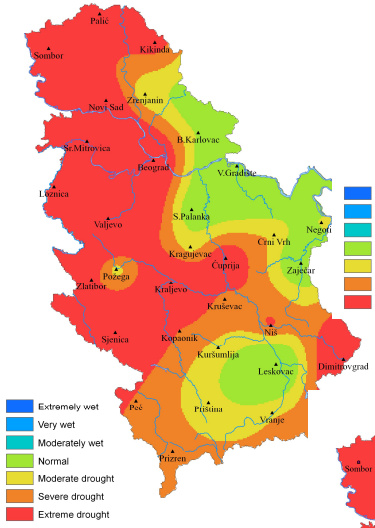
Слика 7. Влажност земљишта мерена помоћу профилне сонде на метеоролошким станицама Б. Карловци и Београд – Кошутњак у периоду од 01.септембра до 30.септембра 2012. године

Drought monitoring and early warning

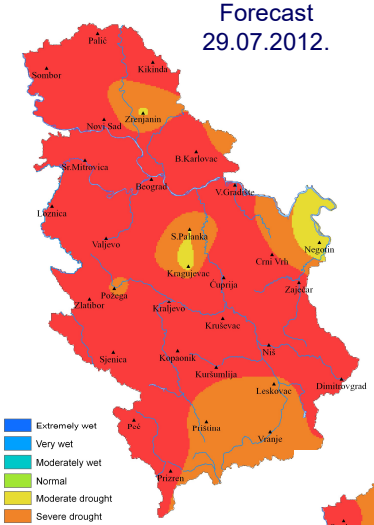
- The Republic Hydrometeorological Service of Serbia has established, within its Terms of Reference in the field of agrometeorology, an **operational drought monitoring and forecasting system** based on the actual and forecast values of meteorological parameters from short- and medium-range ECMWF/RHMSS forecast. The system provides constant monitoring of the state of deficit or surplus of soil moisture, and issues analyses, forecasts and alerts about the occurrence and intensity of drought in certain regions of Serbia.
- The drought monitoring system of the Republic of Serbia is included in the regional drought monitoring system coordinated by the Drought Management Centre for South East Europe seated in Slovenia.
- Within the National Program of Implementation of the UN Convention to Combat Desertification and Drought, RHMSS has actively participated in the preparation of the **National Action Plan to Combat Land Degradation and Drought**, which clearly defines the role of RHMSS in the implementation of that Action Plan.
- For the needs of the **assessment of drought vulnerability and risk** in agriculture and other economy sectors, RHMSS has performed, within its mandate, a drought vulnerability and risk assessment and produced drought frequency maps based on the three-month and six-month SPI index, in line with the “Instructions on the Methodology for the Production of Vulnerability Assessments and Plans for Protection and Rescue in Emergency Situations”.

Example of drought monitoring and early warning
Heavy drought in 2012

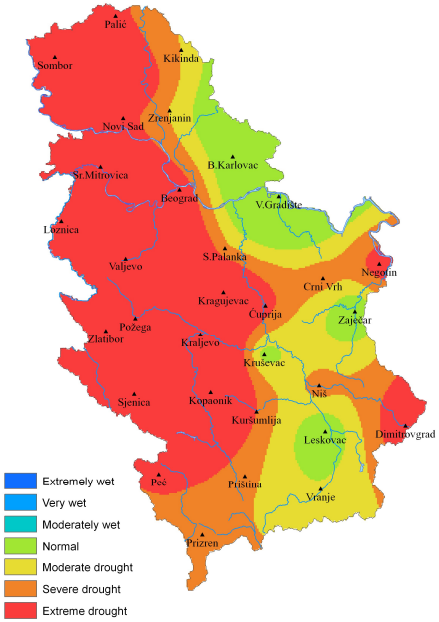
Monitoring
29.07.2012.



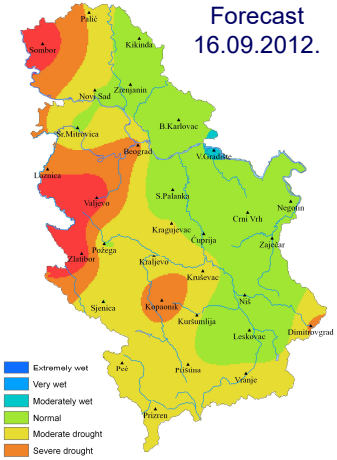
Forecast
29.07.2012.



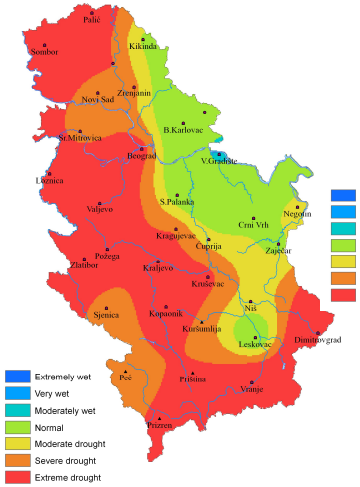
Moisture conditions in Serbia estimated on the basis of the Standardised Precipitation Index (SPI-2) forecast for next 30 days, based on precipitation forecast (ECMWF/RHMSS)



Forecast
16.09.2012.



Monitoring
16.09.2012.

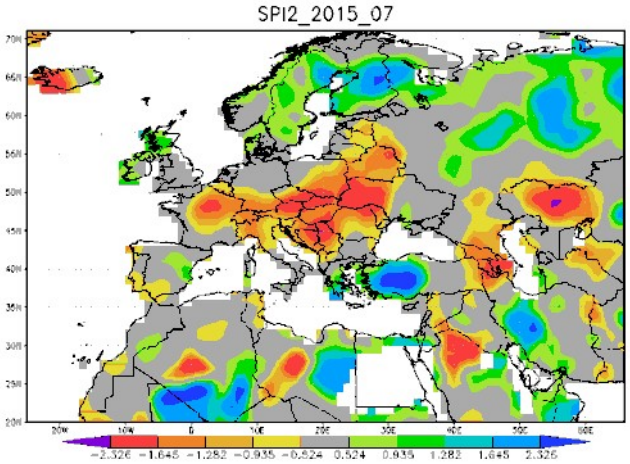


Moisture conditions in Serbia estimated on the basis of the Standardised Precipitation Index (SPI-2) determined for 60 days period

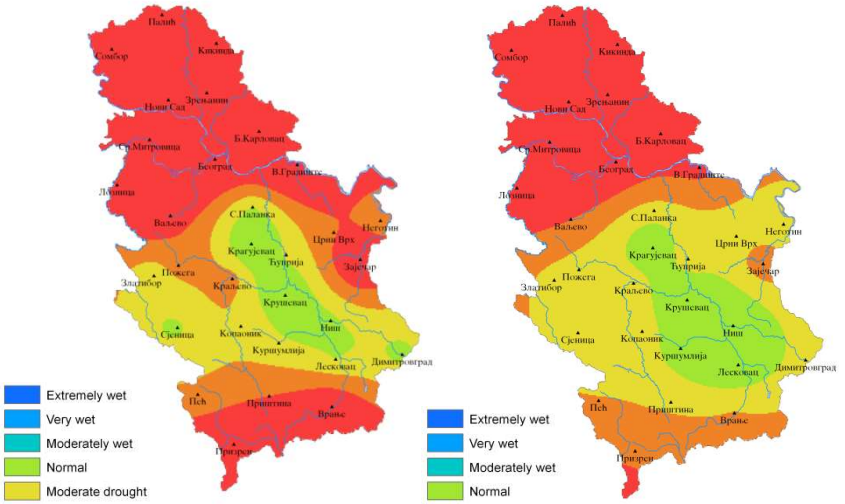
Moisture conditions in Serbia estimated on the basis of the Standardised Precipitation Index (SPI-3) determined for 90 days period
(July, August, September)

LRF ECMWF – SPI forecast

- **Drought monitoring and forecast for Europe**
- **Severe drought in Serbia – 2000, 2003, 2007, 2012, 2015**

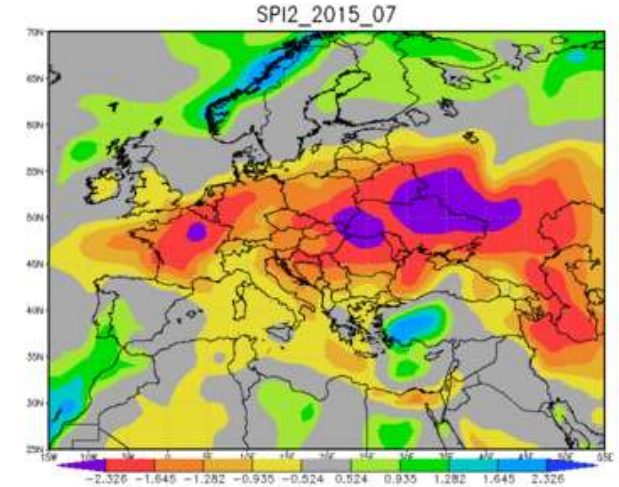


GPCC verification



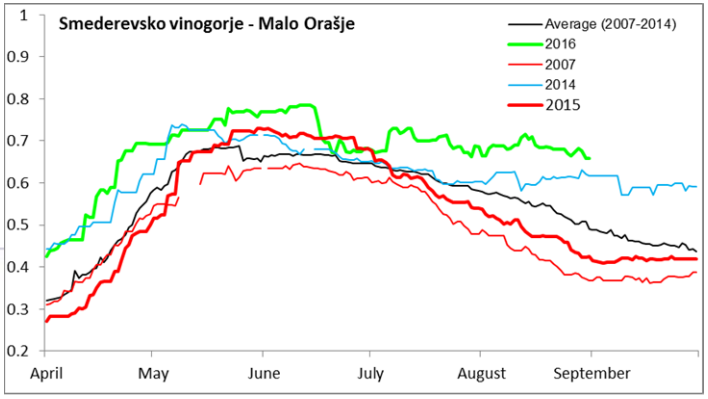
Observed

ECMWF monthly



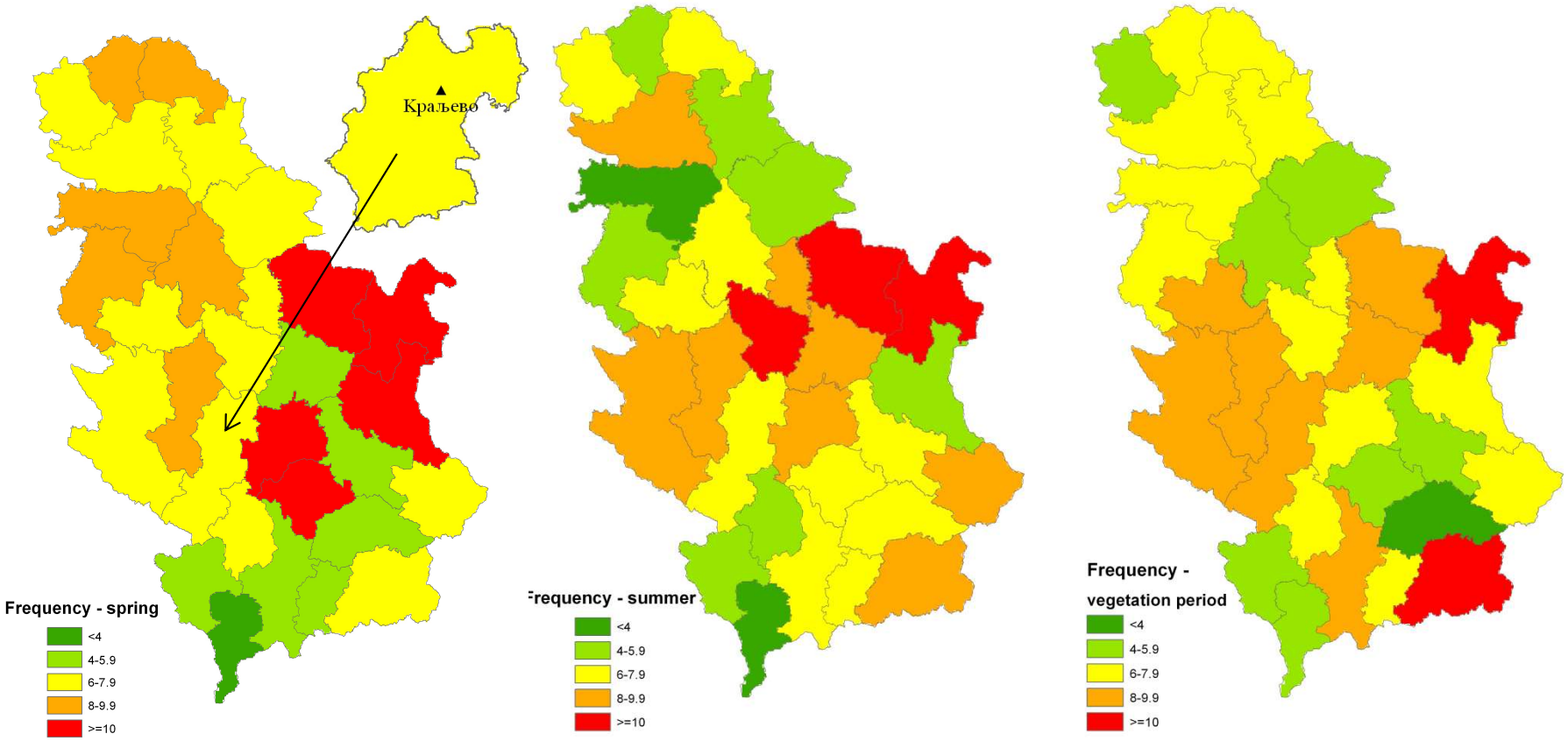
ECMWF seasonal

FVC



Drought frequency

"Climate characteristics and analysis of meteorological hazards for the Republic of Serbia"



For the needs of the assessment of drought vulnerability and risk in agriculture and other economy sectors, RHMSS has performed, within its mandate, **a drought vulnerability and risk assessment** and produced drought frequency maps based on the three-month and six-month SPI index, in line with the "Instructions on the Methodology for the Production of Vulnerability Assessments and Plans for Protection and Rescue in Emergency Situations".

Drought monitoring and early warning

- **Climate Watch System** (CWS) is an operative early warning system for climate warnings, based on the existing meteorological activities and infrastructure at the regional and national level. This system is established on the foundations of the existing Early Warning System, with the focus on the extreme climate events, such as heat waves, cold waves, large precipitation amounts that may cause floods, etc. The basic goal of this system is to support the Early Warning System by providing overviews of climate monitoring and long-range weather forecasts.
- Climate Review **aims to inform users** (one/two weeks, month ahead of time) about the probability and severity levels of climatic hazards (monthly/seasonal temperature, precipitation and SPI forecasts) in order to ensure execution of mitigation plans and avoidance of severe events.
- The main CWS product is the Early Warning Bulletin on extreme climate events and anomalies, issued once a week: **each Friday for the national level and each Monday for the region of South East Europe**

QF-E-016

Република Србија
РЕПУБЛИЧКИ ХИДРОМЕТЕОРОЛОШКИ ЗАВОД
Београд, Кнеза Вишеслава 66

БИЛТЕН РАНЕ НАЈАВЕ КЛИМАТСКИХ ЕКСТРЕМНИХ ПОЈАВА И АНОМАЛИЈА ЗА ПЕРИОД ОД 14.11.2016 ДО 28.2.2017. ГОДИНЕ

Иницијални Ажурирани Финални билтен, број: 45/16
Датум издавања: 14.11.2016.
Важи до: 27.11.2016.
Датум ажурирања билтена: 21.11.2016.

У периоду од 14. до 20. новембра очекује се средња недељна температура ваздуха испод граница просечних вредности на истоку и југоистоку земље са одступањем до -4°C. Вероватноћа до 90% да ће вредности бити у доњем терцилу.

0 Ниска опасност | 1 Потенцијална опасност | 2 Опасна појава | 3 Веома опасна појава

Слика 3. Услови влажности у Србији, процењени на основу Стандардизованог падавинског индекса (SPI-1) одређеног за временски период од 30 дана (12.10 – 10.11.2016. године)

Слика 4. Прогноза Стандардизованог падавинског индекса одређеног за временски период од 60 дана (SPI–2) рађена на основу осмотрених и прогнозираних месечних падавина (13.10 – 11.12.2016. године) ECMWF и РХМЗ

Topic: precipitation
Organization issuing the statement: SEEVCCC

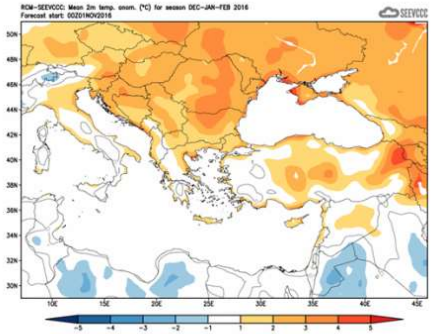
Issued/ Amended / Cancelled: 18-5-2015 12:00 P.M.

Contact: E-mail: cws-seevccc@hidmet.gov.rs
Phone: +381112066925
Fax: +381112066929

Valid from – to: 18-5-2015 – 31-5-2015 Next amendment: 25-5-2015

Region of concern: Greece, Turkey

„From May 18th to 24th 2015, above normal mean weekly air temperature is forecast for most part of the SEE region, with anomaly up to +4°C. Probability for exceeding upper tercile is in a range from 80% over the Balkans up to 90% in central and eastern Turkey. Precipitation surplus is forecasted over Ionian Sea, while deficit is expected in central Balkans, eastern parts of Turkey and south Caucasus. Probability for exceeding upper/lower tercile is up to 80%."



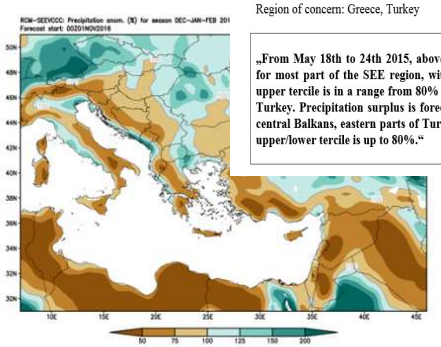


Figure5. Mean seasonal temperature and precipitation anomaly for the season DJF (seasonal outlook from RCM – SEEVCCC)

www.seevccc.rs/CWS

Future plans and needs

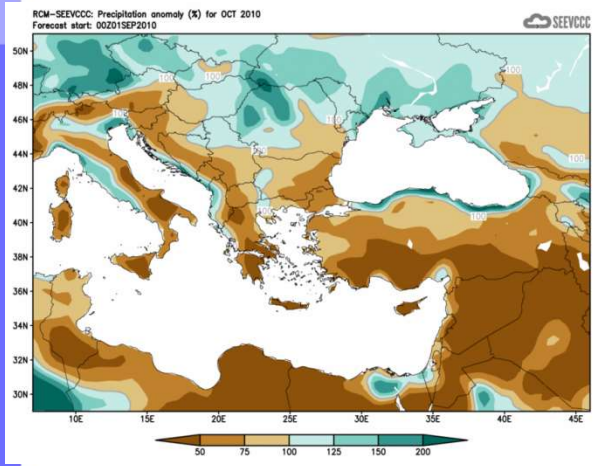
- Optimization and automatization existing stations (ordinary Climatological stations and precipitation stations)
- Expansion of the program and automation of agrometeorological **observation**;
- Expansion of **remote sensing observations** in agrometeorology to other products beside FVC;
- Defining the criteria for **identification of disasters** caused by drought and frost and re-ionization of Serbia according to the degree of risk of the occurrence of those disasters;
- **Agroclimatic classification and agroclimatic zoning** of the territory of Serbia for certain agricultural crops; researching a study on thermal regime of the soil in Serbia;
- Development and improvement of the **agrometeorological early warning system** based on integration of meteorological forecasts (short-range, medium-range, **long-range – seasonal**) and **agrometeorological models** as well as **land surface models**;
- Participation in the implementation of **international development projects**;
- **Training of personnel** in the application of remote sensing data from satellite and radar observations in the field of agrometeorology, with the view of obtaining a comprehensive review of crop growth phases and spatial characteristics of elements of heat and water balance in the plant cover in entire Serbia, especially in terms of extreme hydrometeorological phenomena (floods, frosts, droughts...);
- Training of personnel for the operational use of agrometeorological simulation models (crop-weather, crop-plant diseases), and for the use of products of regional climate models in assessing the influence of expected climate change on agriculture.

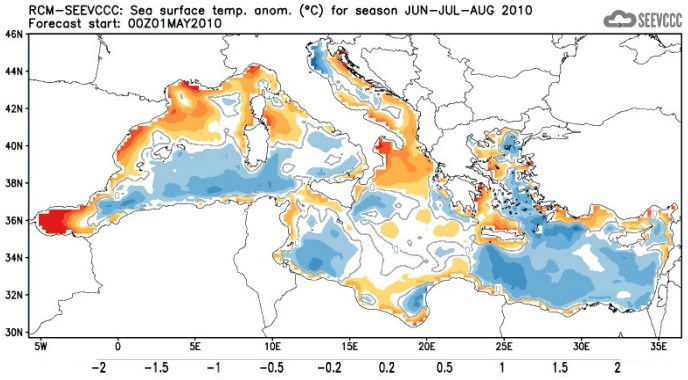
Future plans
implementation of SEEVCCC seasonal forecast

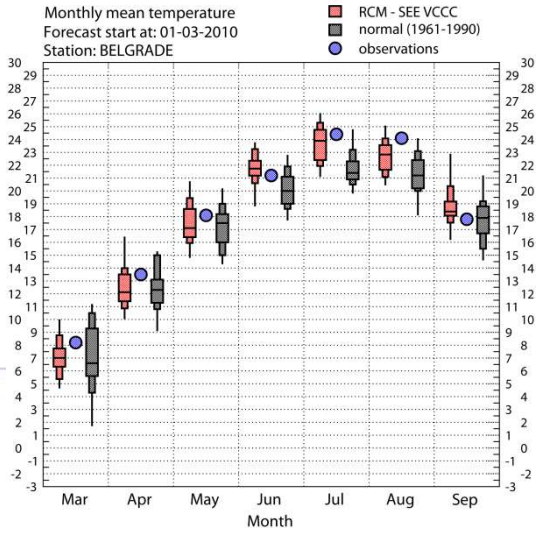
- **Probabilistic forecast** provides statistical summary of the atmosphere and ocean state in forthcoming season.
- **RCM-SEEVCCC LRF** regional dynamical downscaling using fully coupled atmosphere-ocean Regional Climate Model

  - model start: 08th of each month; operational since June 2009.
  - forecast duration: 7 months
  - model resolution: ~35km atmosphere ; ~20km ocean
  - model domain: Euro - Mediterranean region extended towards Caspian Sea
  - 51 ensemble members
  - initial & boundary conditions: ECMWF, ~75km
  - winter hindcast (1981-2010) – December run, 7 months
  - operational forecast available in GRIB via WIS-DCPC-Belgrade
  - Member of Med-CORDEX Initiative

www.seevccc.rs

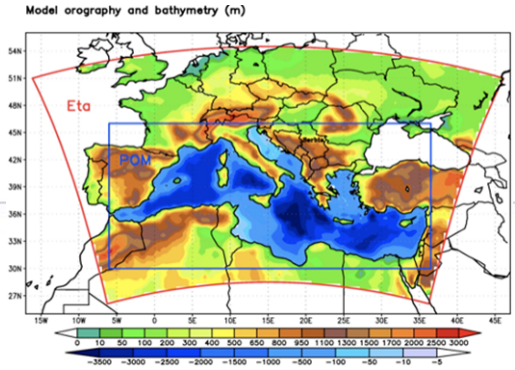




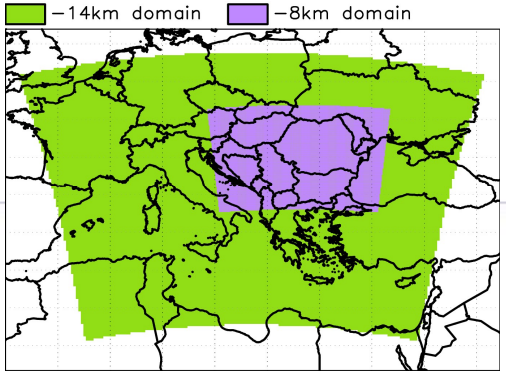


Future plans – agrometeorology and climate change

- **RCM-SEEVCCC regional climate model**
  - SINTEX-G (INGV) initial and boundary conditions on 120 km resolution
  - RCM-SEEVCCC - fully coupled atmosphere-ocean model (EBU-POM)
  - resolution: ~ 35 km atmosphere, ~ 20 km ocean
    - 1961-1990 - present climate simulation
    - 2001-2030 - SRES A1B scenario
    - 2071-2100 - SRES A1B and A2 scenarios
- **NMMB regional climate model**
  - 1971-2000 with ERA40 initial and boundary conditions
    - 14 km resolution, lager part of the Europe
    - 8 km resolution, part of the Balkan peninsula
  - 1971-2100 RCP8.5 with CMCC-CM initial and boundary conditions
    - 8 km resolution, part of the Balkan peninsula



RCM-SEEVCCC



NMMB

THANK YOU FOR YOUR ATTENTION

Slavica Radovanović
slavica.radovanovic@hidmet.gov.rs
Aleksandra Kržič
aleksandra.krzic@hidmet.gov.rs

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