Drought monitoring in Romania

Kick-Off of the Network of Drought Observatories in the EU

- *June 16th-17th, 2022* -
- ISPRA, JRC

Daniel ALEXANDRU
National Meteorological Administration

AGROMETEOROLOGY DEPARTMENT

WHO WE ARE?

National Meteorological Administration is the national authority in the meteorological field in Romania, with a **continuos service since 1884**. NMA is subordinated to the Ministry of Environment and Forests (MEF), functioning on the basis of Law 216/2004.

- The National Meteorological Observation Network within the NMA is made up of 7 **Regional Meteorological Centers** / RMC.

- Romania is a founding member of the **International Meteorological Organization** (IMO), and beginning with 1948 it has become a full member of the World Meteorological Organization (WMO).

http://www.meteoromania.ro/

AGROMETEOROLOGY DEPARTMENT

WHAT WE DO?

Daily agrometeorological prognosis / diagnosis, weekly, monthly and seasonal

Parameters maps of thermal vulnerability and risks at national level, regional / local (temperature, cold/frost units, **intensity and duration of the scorching heat**, etc.)

Indicators of water stress at national, regional and local level (**ETP**, relative air humidity, **rainfall**, etc.)

Aridity indices (standardized at the level of the entire agro network)

Weekly Agrometeorological bulletin includes specific information (air temperature, precipitation, ETP, soil moisture, crop water requirement) useful for assessing the occurrence of drought

Specialized agrometeorological studies

Soil moisture maps updated daily according to the operational activity are made available to the public on the ***NMA website*** (***www.meteoromania.ro***)

METEO ROMANIA

AGROMETEOROLOGY DEPARTMENT

THE NATIONAL AGROMETEOROLOGY NETWORK in ROMANIA
7 REGIONAL METEOROLOGICAL CENTERS

- 7 Regional Meteorological Centers;
- 68 agrometeorological stations
- phenological observations and soil moisture measurements (winter wheat, maize, sunflower, rape, fruit trees and vines).

OLTENIA

DOBROGEA

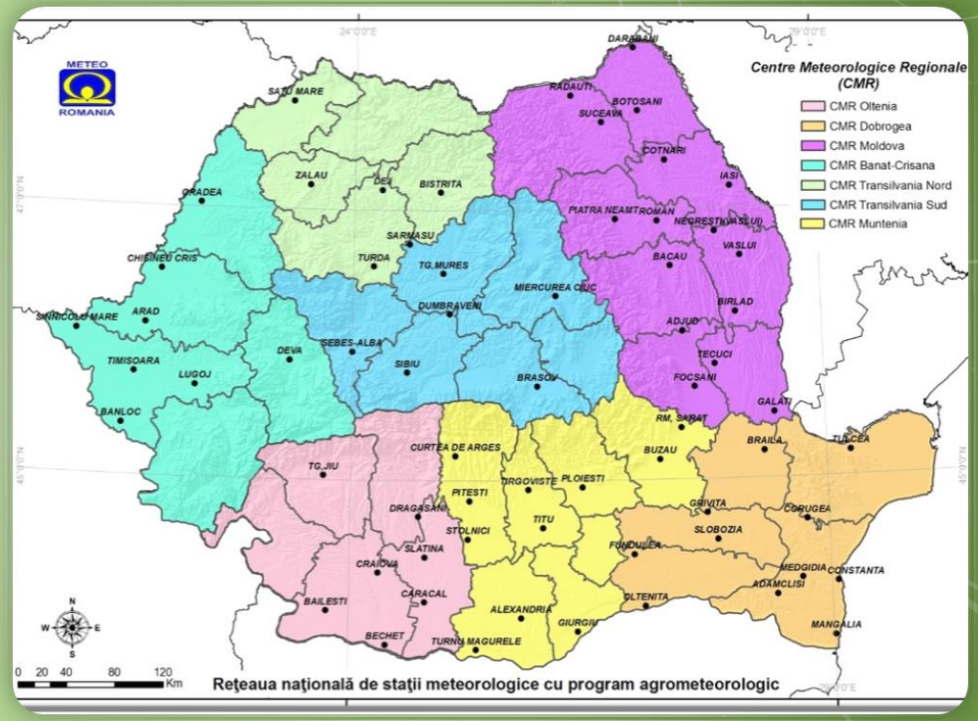
MOLDOVA

Transilvania Nord

Banat-Crisana

Transilvania Sud

MUNTENIA



In Romania, the network of meteorological stations with agrometeorological program operates according to the recommendations of W.M.O. and is administered by the National Meteorological Administration.

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HOW WE DO?

Romanian National Agrometeorological Monitoring Network

ROMANIAN AGROMETEOROLOGICAL PLATFORMS

IN – SITU SOIL MOISTURE MEASUREMENTS

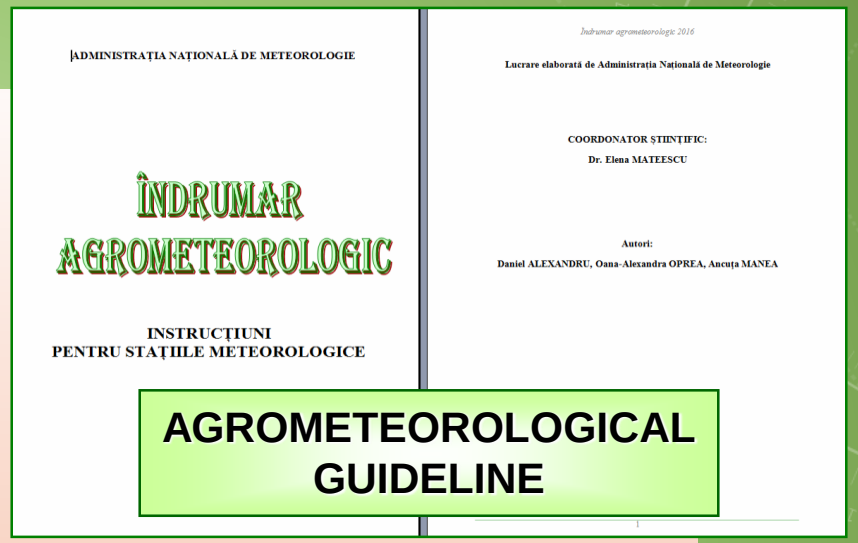
PHENOLOGICAL OBSERVATIONS OF CROPS VEGETATION PHASES ROMANIAN AGROMETEOROLOGICAL PLATFORMS

Agro-meteorological data and the specific phenological observations are used for the current agro-meteorological service, and for agro-meteorological data of The National Meteo Data Base for the purpose of their use in scientific research works and specific projects.

METEO ROMANIA

PHENOLOGICAL OBSERVATIONS OF CROPS VEGETATION PHASES

- Agro-meteorological platform;
- European coding system BBCH phase of growth and development of agricultural plants;
- Phenological observations;
- The density of the plant;
- Biometric measurements;
- Weeding of crops;
- Damage to crops produced by adverse weather phenomena, diseases and pests;
- Estimation of the state of the crop growing season field and fruit trees in the winter;
- Visual estimation of the state of vegetation in the warm season (summer);
- Quantitative estimation of the state of vegetation;
- Biological analysis of the yield.



AGROMETEOROLOGICAL GUIDELINE

- ***Description of observation platforms and their layout plan;***
- ***Observations on soil temperature;***
- ***Soil moisture;***
- ***Phenological observations, density, biometric measurements, vegetation and harvest analysis;***
- ***Agrometeorological Monitoring and AGROMETEO Software System.***

AGROMETEOROLOGY DEPARTMENT

PHENOLOGICAL OBSERVATIONS OF CROPS VEGETATION PHASES

- The surface thermal regime (instant, minimum and maximum temperature) and depth (5, 10, 20, 50 and 100 cm).
- The soil moisture regime, determined by gravimetric method in a decadent monthly, seasonal or on-demand decade.

Complex visual appreciation of soil condition related to:
- the humidity level;
- frost or thaw;
- the degree of snow cover and its thickness;
- degree of compaction;
- degree of liveliness;
- crust;
- cracks;
- muddy leaks on the slopes, the appearance of holes, etc.

Biological determinations include:
- plant biometry (increase in height, volume, weight, etc.) differentiated according to the stage of development and the specificity of each species observed;
- density;
- quantitative and visual estimation of the vegetation state;
- degree of enrichment;
- damages caused to plants by the attack of diseases and pests, as well as those caused by unfavorable meteorological phenomena.

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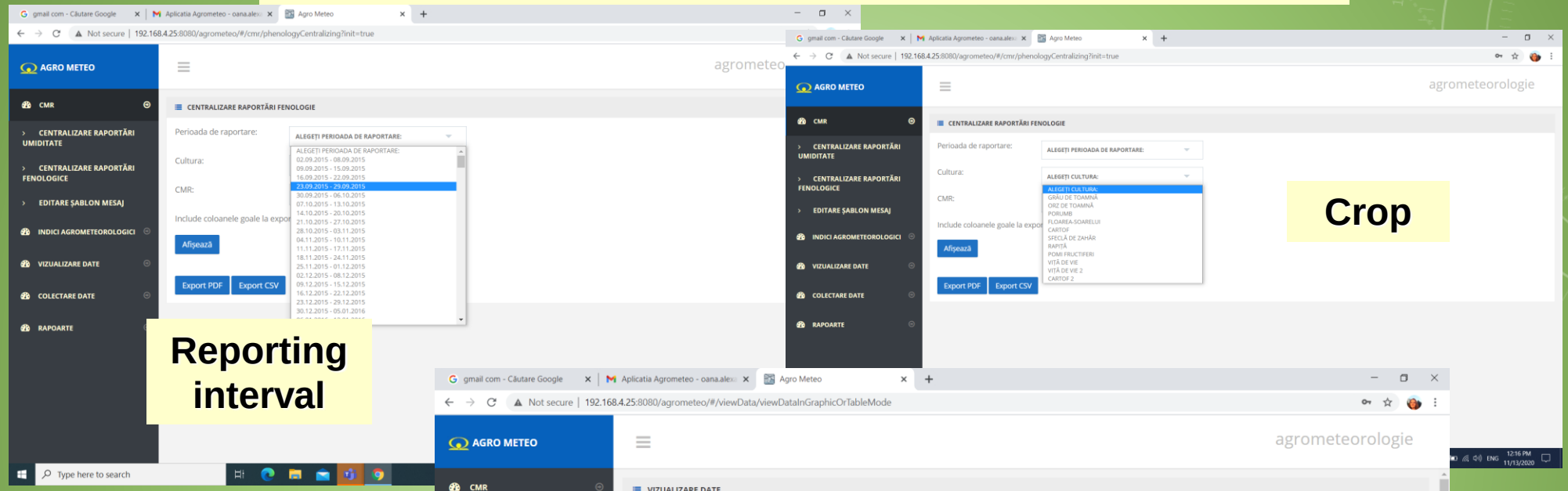
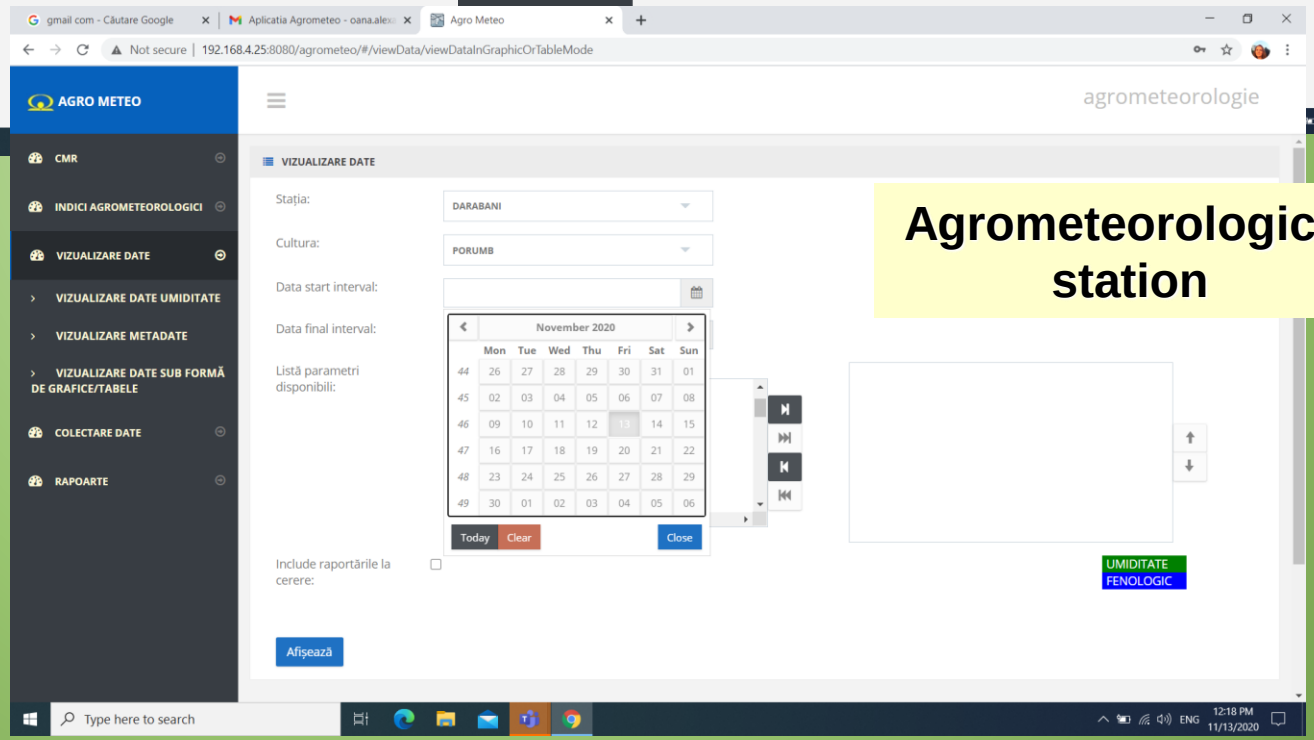
PHENOLOGICAL OBSERVATIONS OF CROPS VEGETATION PHASES

AgroMeteo Agrometeorological web-software application



Reporting interval

Crop

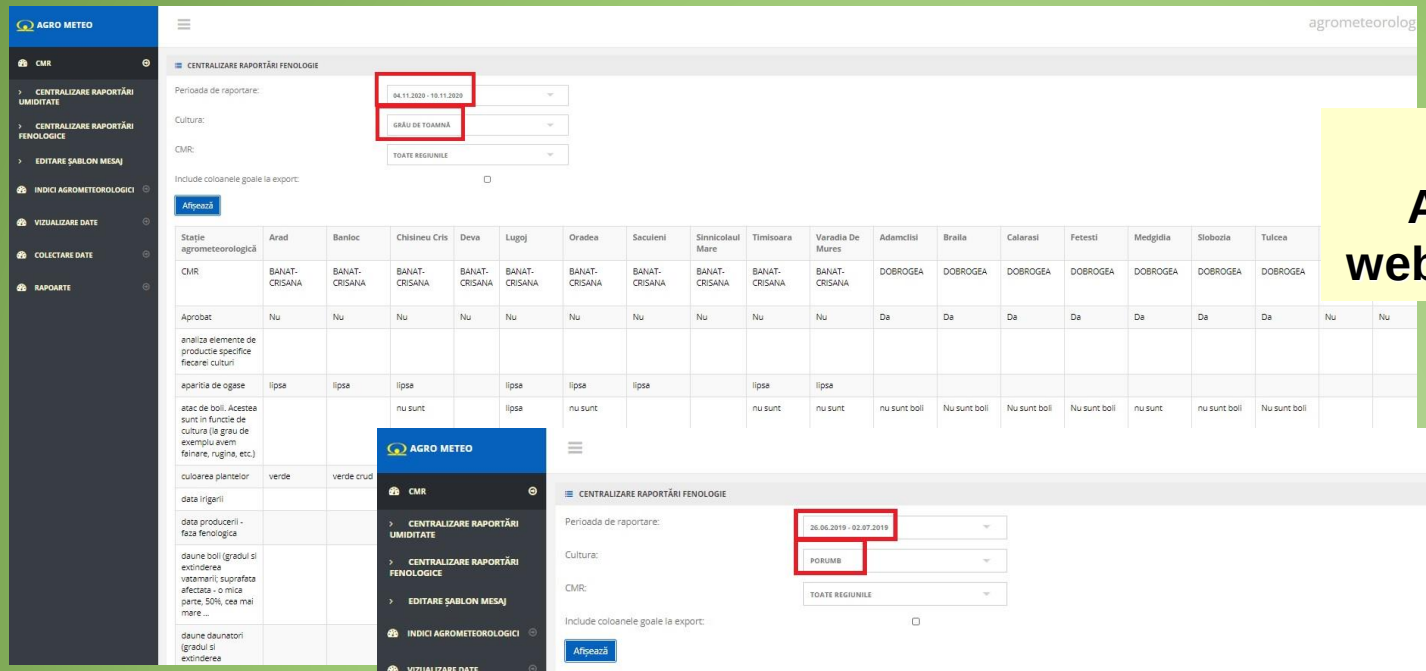


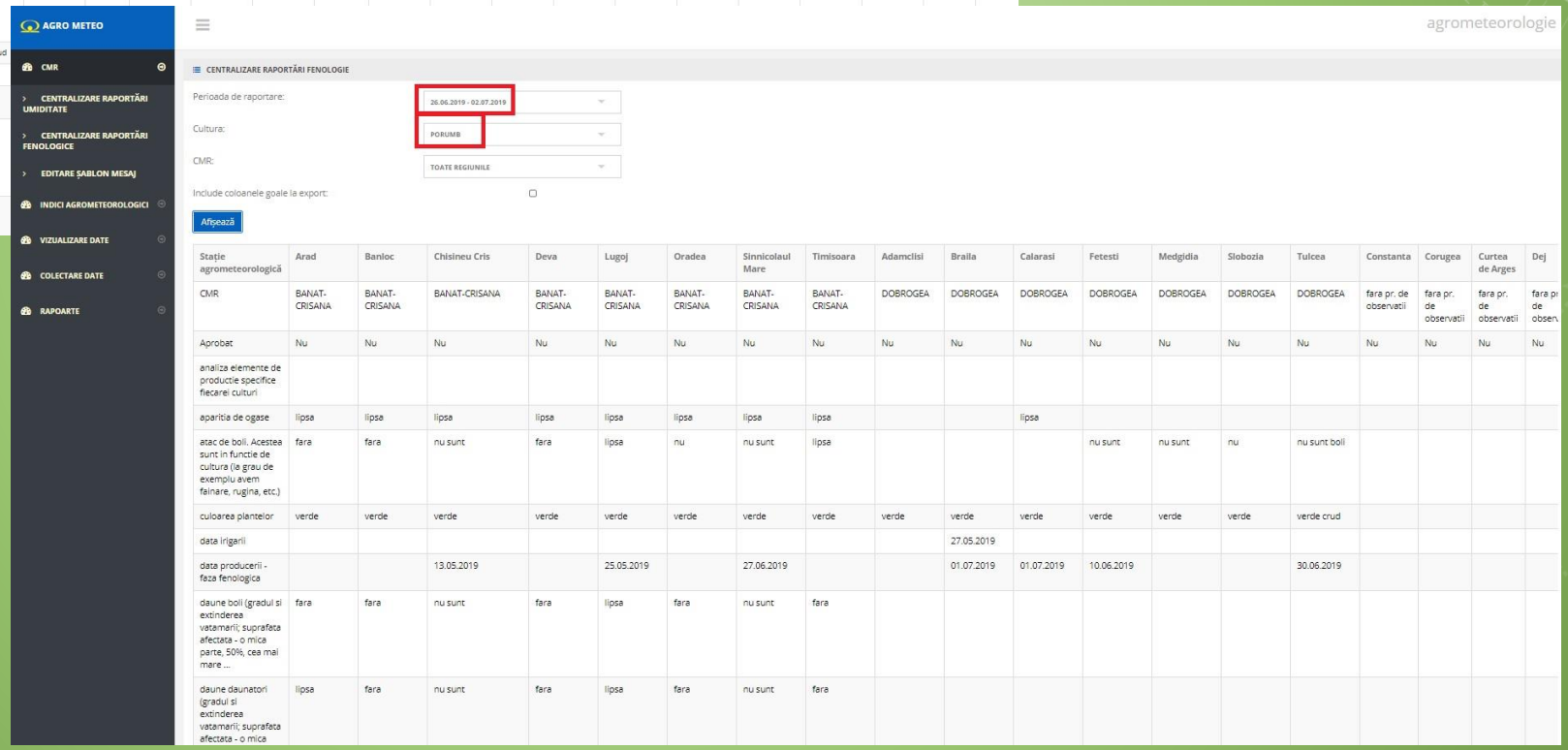
Agrometeorological station

METEO ROMANIA

AGROMETEOROLOGY DEPARTMENT

PHENOLOGICAL OBSERVATIONS OF CROPS VEGETATION PHASES





AgroMeteo app
Agrometeorological web-software application

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AGROMETEOROLOGY DEPARTMENT

PHENOLOGICAL OBSERVATIONS OF CROPS VEGETATION PHASES

European coding system for the growth and development of agricultural plants

- European Standard BBCH -

Biologische **B**undesanstalt, Bundessortenamt und **CH**emische Industrie"

http://www.fao.org/3/x8234e/x8234e05.htm#bm05

METEO ROMANIA

Agrometeorological Products
Thermal indicators

WINTER SEVERITY

SPRING INDEX

HEAT INTENSITY

THE FIRST FROST IN THE AUTUMN (PRODUCTION DATE)

THE LAST SPRING FROST DATE (PRODUCTION DATE)

The specific thermal parameters necessary to assess the influence on the vegetation conditions of winter wheat and maize crops, were studied in direct correlation with plant water requirements, specific phases and interfaces.

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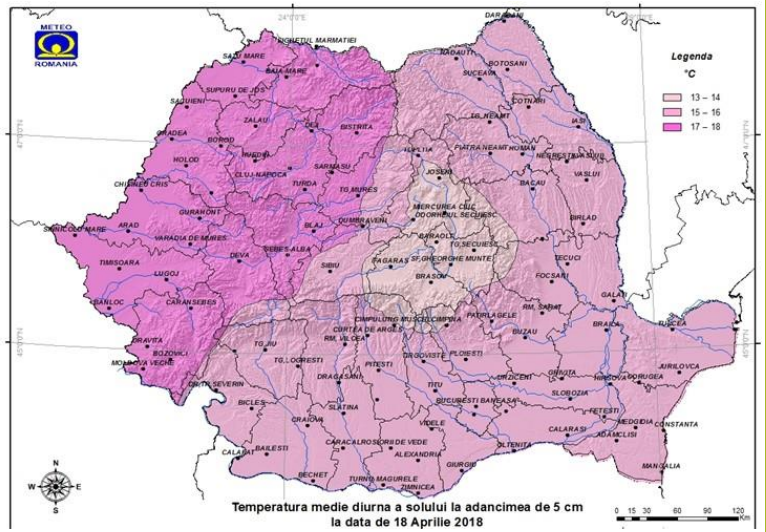
AGROMETEOROLOGY DEPARTMENT



AGROMETEOROLOGICAL MONITORING INDEXES

Average daily soil temperature at 5 and 10 cm depth

- Average daytime temperatures were generally favorable for further sowing of sowing crops (sunflower, corn, potato, sugar beet) and for sprouting germination in species sown until that date.

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Agrometeorological Products
Water indexes

SOIL MOISTURE RESERVE (m^3/ha)

RAINFALL AT INTERVALS OF AGRICULTURAL INTEREST

REFERENCE EVAPOTRANSPIRATION

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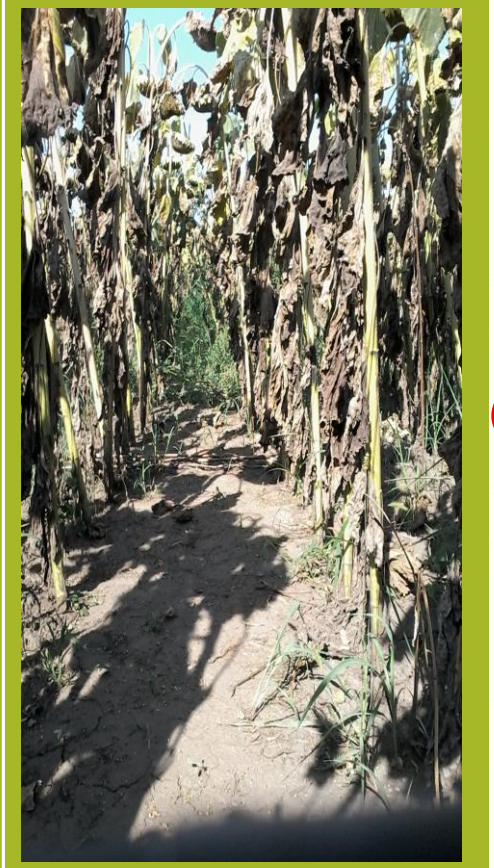
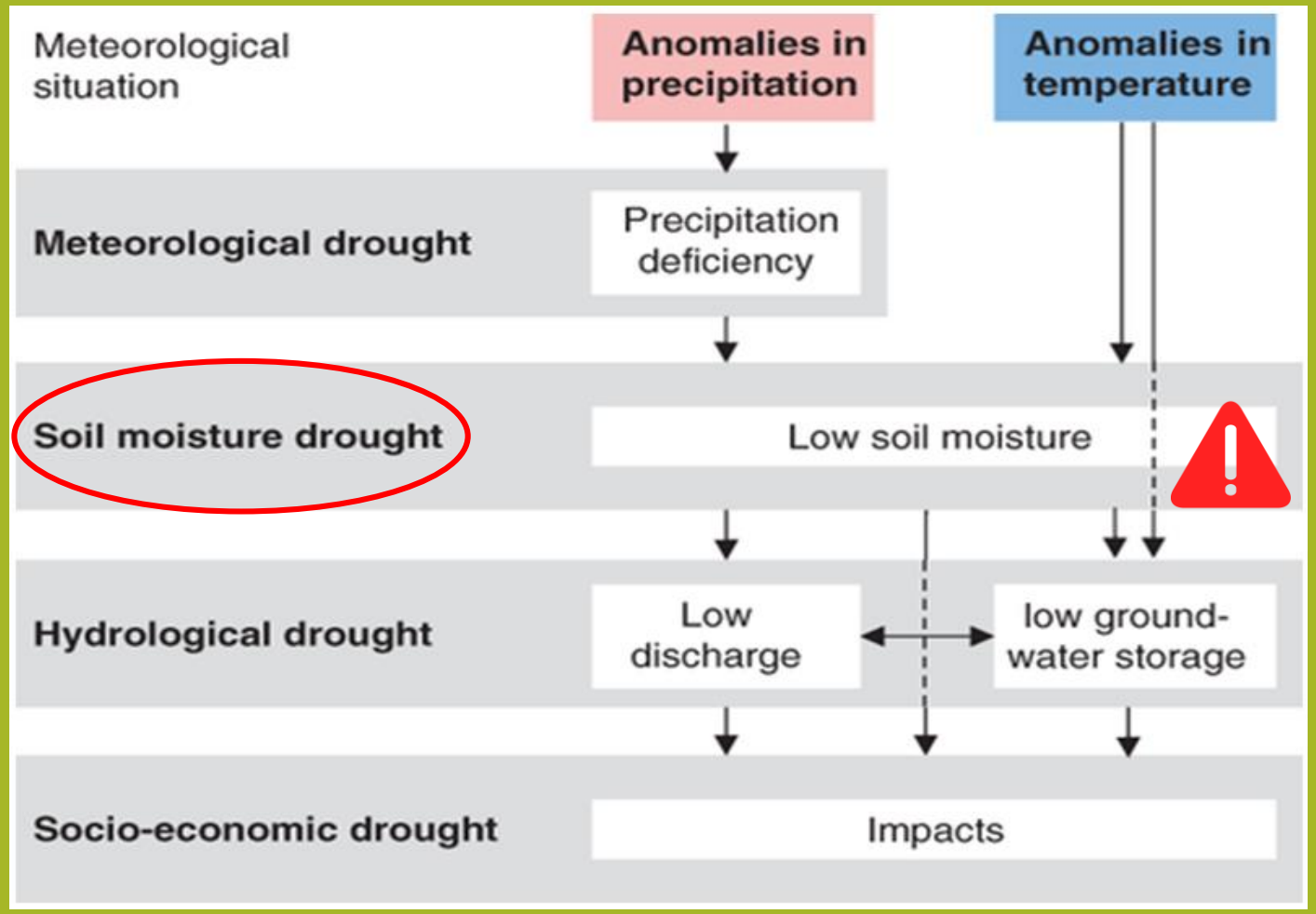
AGROMETEOROLOGY DEPARTMENT

DROUGHT TYPES AND CAUSES





Scheme representing different categories of drought and their development. (Derived from Peters, Van Loon, Stahl)

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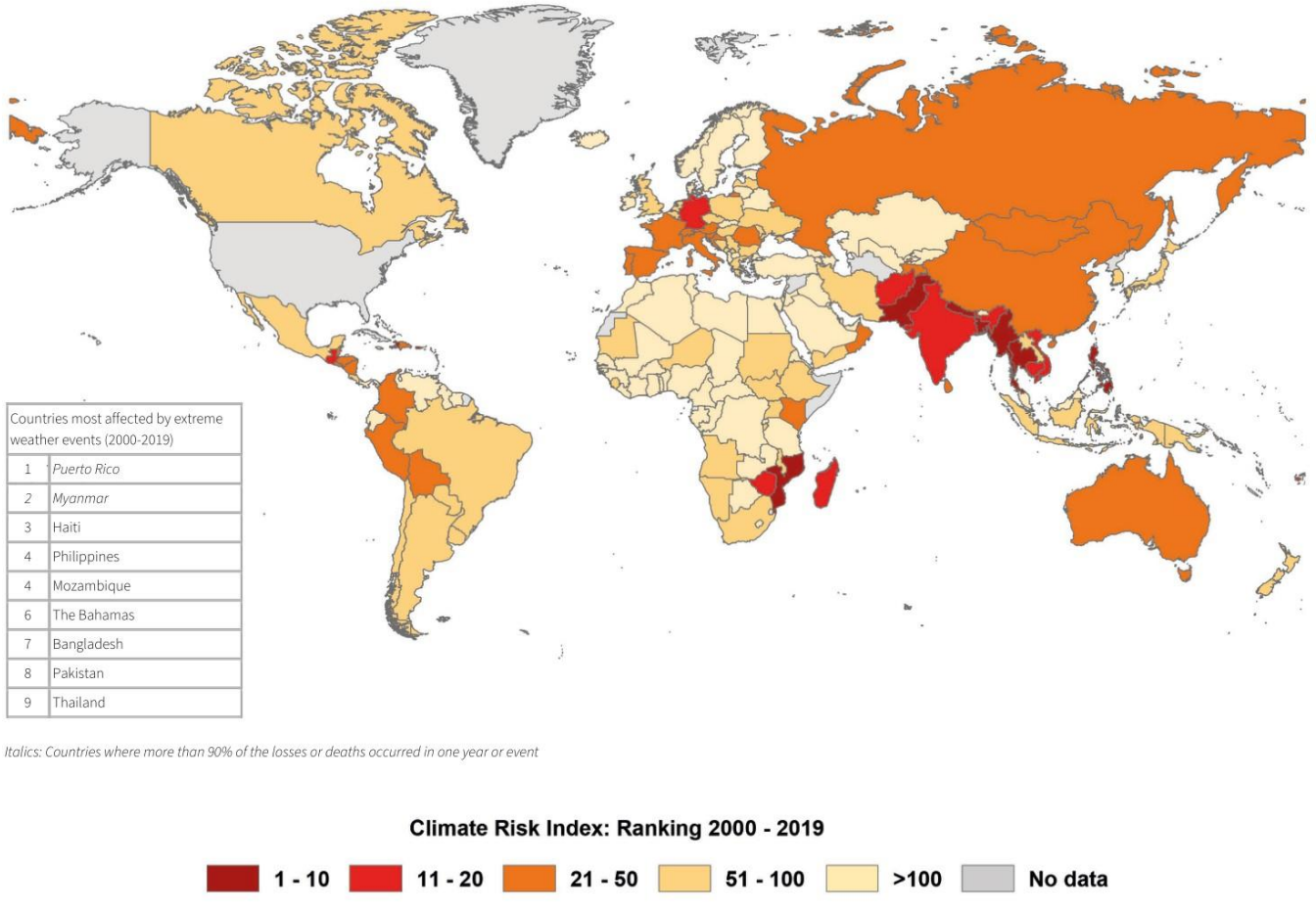
CLIMATIC RISK INDEX (CRI) / 2000 - 2019

The most affected countries 2000 - 2019

CRI Rank	Country	CRI score	Average Fatalities 2000-2019 (Rank)	Average Fatalities per 100 000 inhabitants 2000-2019 (Rank)	Average Losses in million US$ (PPP) 2000-2019 (Rank)	Average Losses per unit GDP in % 2000-2019 (Rank)
61	Paraguay	67.00	102	100	40	30
45	Peru	57.67	33	58	39	79
4	Philippines	18.17	7	16	8	31
76	Poland	75.17	44	87	27	103
21	Portugal	38.67	20	12	36	76
1	Puerto Rico	7.17	19	3	6	6
180	Qatar	173.67	172	172	170	178
160	Republic of Congo	148.67	127	121	175	174
79	Republic of Yemen	76.17	48	71	85	91
41	Romania	56.33	56	73	22	57
32	Russia	48.50	2	6	17	130
117	Rwanda	105.83	73	72	150	134
70	Samoa	72.67	155	54	143	15
111	Saudi Arabia	100.33	57	93	51	154
138	Senegal	123.00	109	146	117	110
67	Serbia & Montenegro	70.83	96	112	35	35
168	Seychelles	160.33	172	172	172	137
92	Sierra Leone	85.83	55	29	156	123
179	Singapore	172.00	172	172	162	177
128	Slovak Republic	114.83	119	127	84	116
39	Slovenia	55.00	80	25	76	62

Figure 1: World Map of the Global Climate Risk Index 2000 – 2019

Source: Germanwatch and Munich Re NatCatSERVICE



Italics: Countries where more than 90% of the losses or deaths occurred in one year or event

Source: The Global Climate Risk Index - 2021 / Germanwatch
https://www.germanwatch.org/en/cri
German Federal Ministry for Economic Cooperation and Development - BMZ

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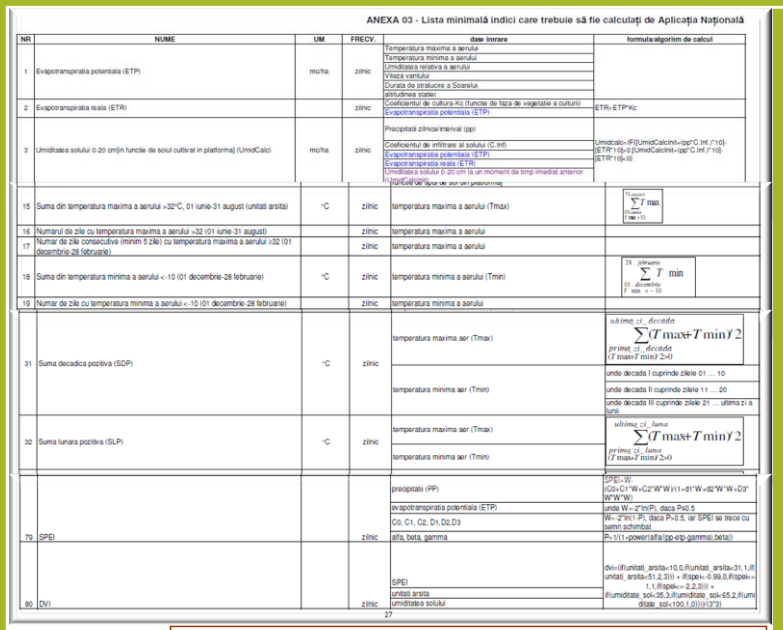
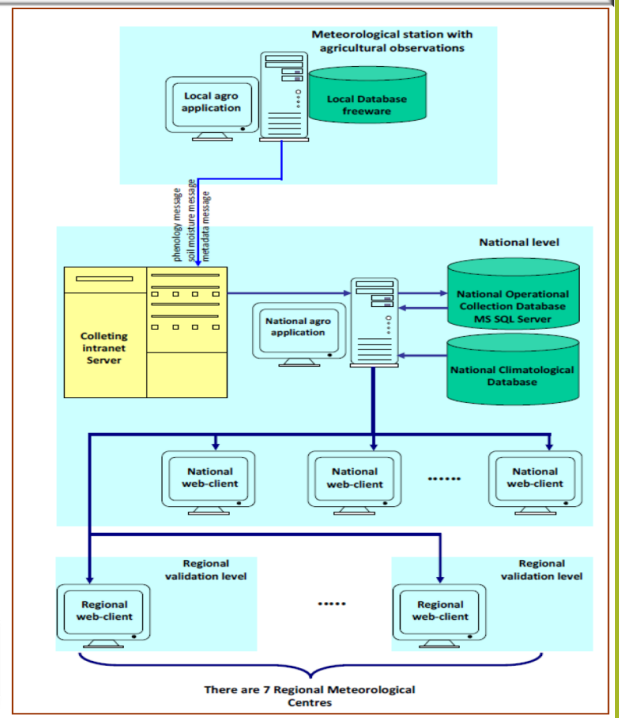


ANEXA 03 - Lista minimală indici care trebuie să fie calculați de Aplicația Națională

NR	NUME	UM	FRECV.	date intrare	formula/algoritm de calcul
1	Evapotranspiratia potentiala (ETP)	mc/ha	zilnic	Temperatura maxima a aerului Temperatura minima a aerului Umiditatea relativă a aerului Viteza vantului Durata de stralucire a Soarelui altitudinea statiei	
2	Evapotranspiratia reala (ETR)		zilnic	Coeficientul de cultura-Kc (functie de faza de vegetatie a culturii) Evapotranspiratia potentiala (ETP)	ETR=ETP*Kc
3	Umiditatea solului 0-20 cm(in functie de soiul cultivat in platforma) (UmidCalci	mc/ha	zilnic	Precipitatii zilnice/interval (pp) Coeficientul de infiltrare al solului (C.Inf) Evapotranspiratia potentiala (ETP) Evapotranspiratia reala (ETR) Umiditatea solului 0-20 cm la un moment de timp imediat anterior (functie de faza de vegetatie)	Umidcalc=-IF([UmidCalcInit=(pp*C.Inf.)*10]-[ETR*10]<0;0;[UmidCalcInit=(pp*C.Inf.)*10]-[ETR*10]>0;0)
15	Suma din temperatura maxima a aerului >32°C, 01 iunie-31 august (unitati arsita)	°C	zilnic	temperatura maxima a aerului (Tmax)	$\sum_{\substack{01\ iunie \\ 31\ aug.}} T_{max}$ unde $T_{max} > 32$
16	Numarul de zile cu temperatura maxima a aerului >32 (01 iunie-31 august)		zilnic	temperatura maxima a aerului	
17	Numar de zile consecutive (minim 5 zile) cu temperatura maxima a aerului >32 (01 decembrie-28 februarie)		zilnic	temperatura maxima a aerului	
18	Suma din temperatura minima a aerului <-10 (01 decembrie-28 februarie)	°C	zilnic	temperatura minima a aerului (Tmin)	$\sum_{\substack{01\ decembrie \\ T\ min\ <\ -10}}^{28\ februarie} T_{min}$
19	Numar de zile cu temperatura minima a aerului <-10 (01 decembrie-28 februarie)		zilnic	temperatura minima a aerului	
31	Suma decadica pozitiva (SDP)	°C	zilnic	temperatura maxima aer (Tmax) temperatura minima aer (Tmin)	$\sum_{prima\_zi\_decada}^{ultima\_zi\_decada}(T_{max}+T_{min})/2$ unde $(T_{max}+T_{min})/2>0$ unde decada I cuprinde zilele 01 ... 10 unde decada II cuprinde zilele 11 ... 20 unde decada III cuprinde zilele 21 ... ultima zi a lunii
32	Suma lunara pozitiva (SLP)	°C	zilnic	temperatura maxima aer (Tmax) temperatura minima aer (Tmin)	$\sum_{prima\_zi\_luna}^{ultima\_zi\_luna}(T_{max}+T_{min})/2$ unde $(T_{max}+T_{min})/2>0$
79	SPEI		zilnic	precipitatii (PP) evapotranspiratia potentiala (ETP) C0, C1, C2, D1, D2,D3 alfa, beta, gamma	SPEI=W-(C0+C1*W+C2*W*W)/(1+d1*W+d2*W*W+D3*W*W*W) unde W=-2*ln(P), daca P≤0.5 W=-2*ln(1-P), daca P>0.5, iar SPEI se trece cu semn schimbat P=1/(1+power(alfa/(pp-etp-gamma),beta))
80	DVI		zilnic	SPEI unitati arsita umiditatea solului	dvi=(if(unitati_arsita<10.0;if(unitati_arsita>31,1;if(unitati_arsita<51,2,3)))+if(spei<-0.99,0;if(spei<-1,1;if(spei<-2,2,3)))+if(umiditate_sol<35,3;if(umiditate_sol<65,2;if(umiditate_sol<100,1,0))))/3*3)

27



National AGROMETEO Data Platform

Local level / agrometeorological station - metadata

National level - web application

Agrometeorological monitoring & data validation at 7 regional centers - *friendly web interface*

80 Agrometeorological parameters and indices

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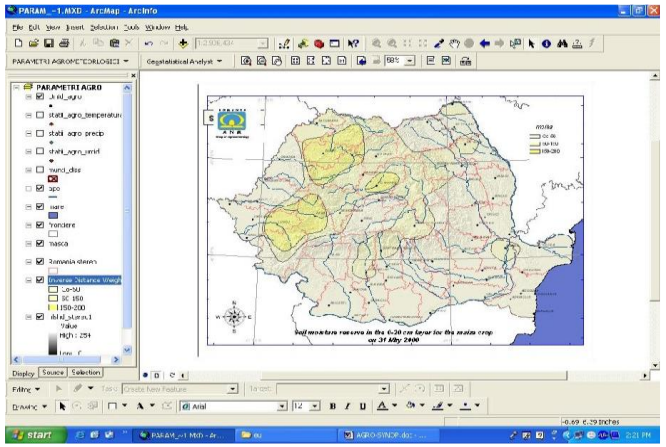
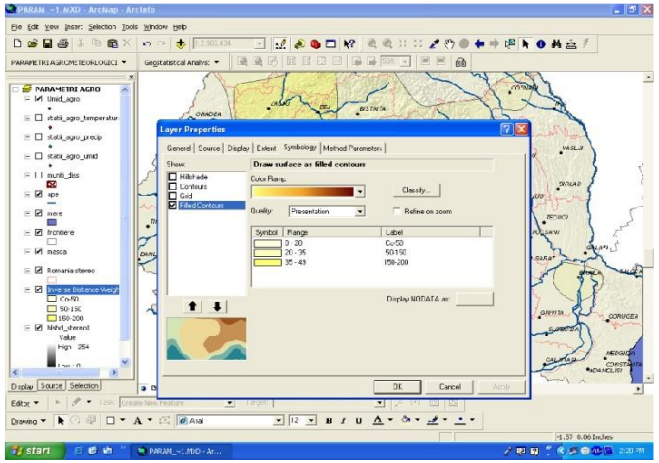


National AGROMETEO Data Platform

MODULE I
Soil moisture



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IN-SITU

MEASUREMENTS SOIL MOISTURE

For the purpose of continuous monitoring of the soil moisture status of the agricultural areas of Romania, 68 stations, distributed evenly in the agricultural territory, have a complete soil moisture determination program in the meteorological network.

At these stations, soil samples are taken at the main field crops, forage crops and vineyard plantations, up to a depth of 100 cm to determine soil moisture.

Humidity measurement at agro-meteorological stations uses the Theta Probe - ML2x/d soil moisture measurement systems and Stevens Water Field POGO System (plus "Hydra Probe" and "Stevens Water Hydramon App" for the tablet).

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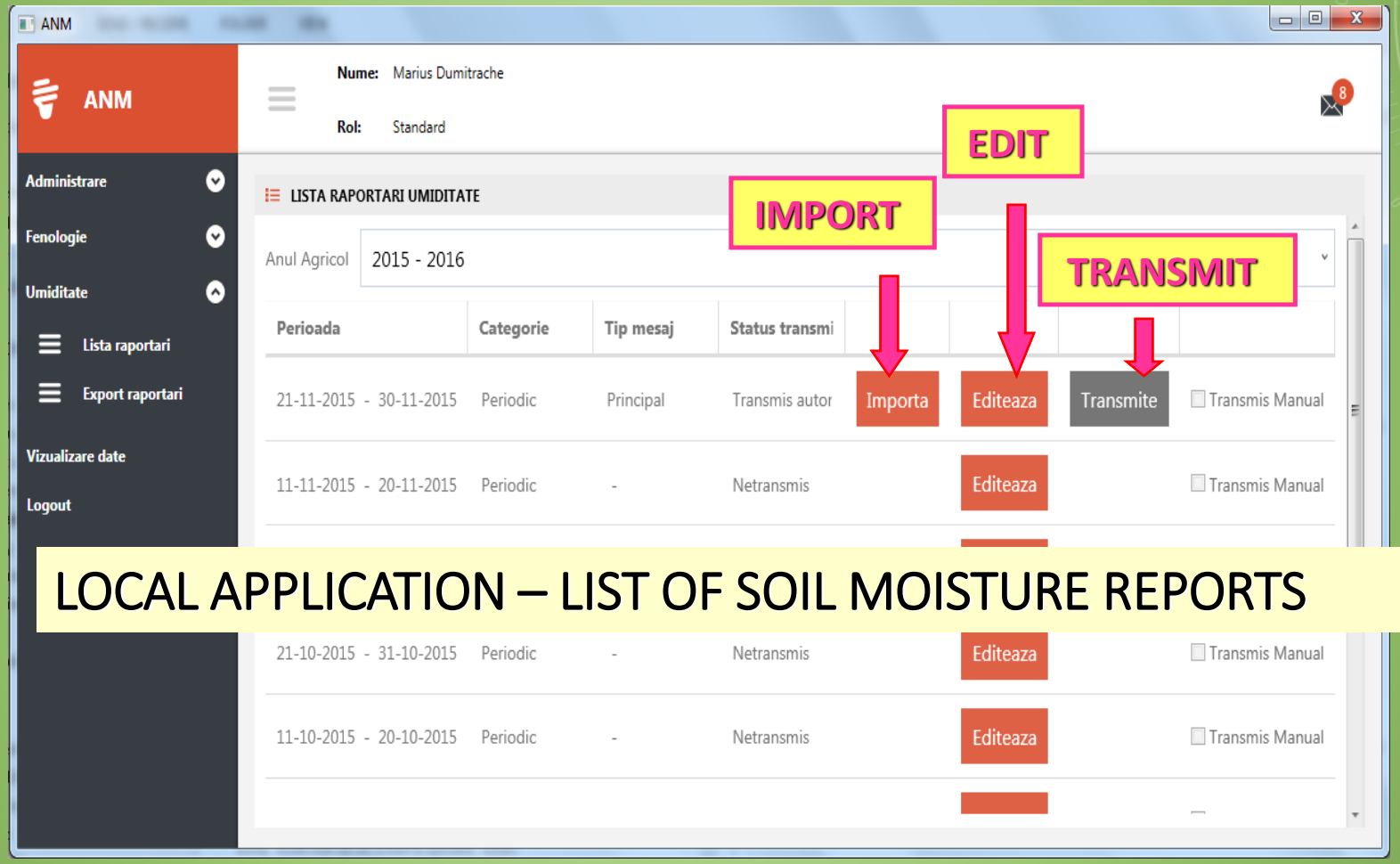
IN – SITU SOIL MOISTURE MEASUREMENTS PLATFORM

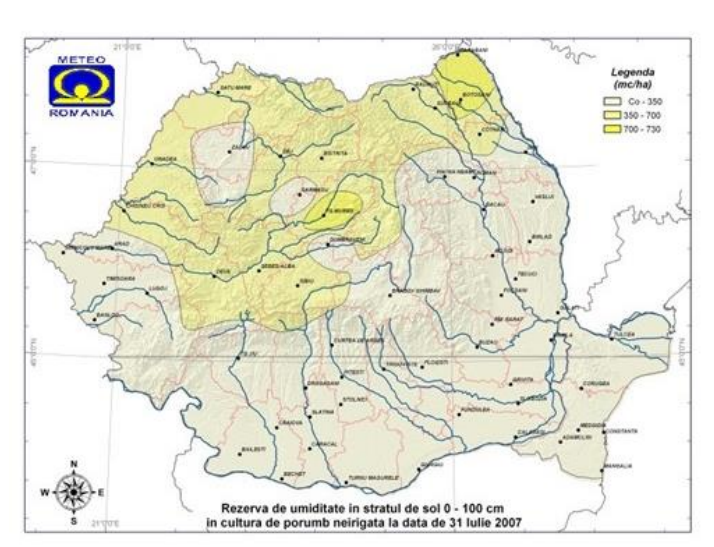


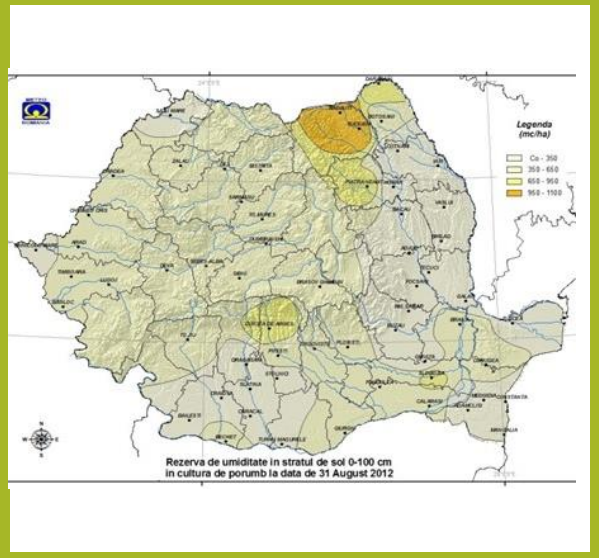
LOCAL APPLICATION – LIST OF SOIL MOISTURE REPORTS

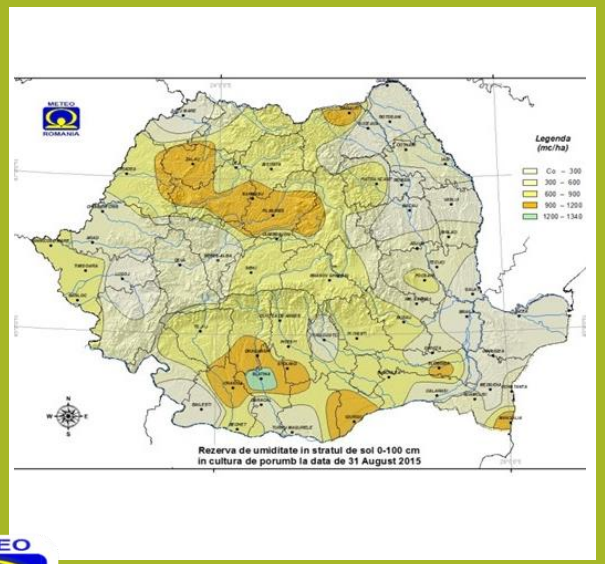
Maize soil moisture July-August

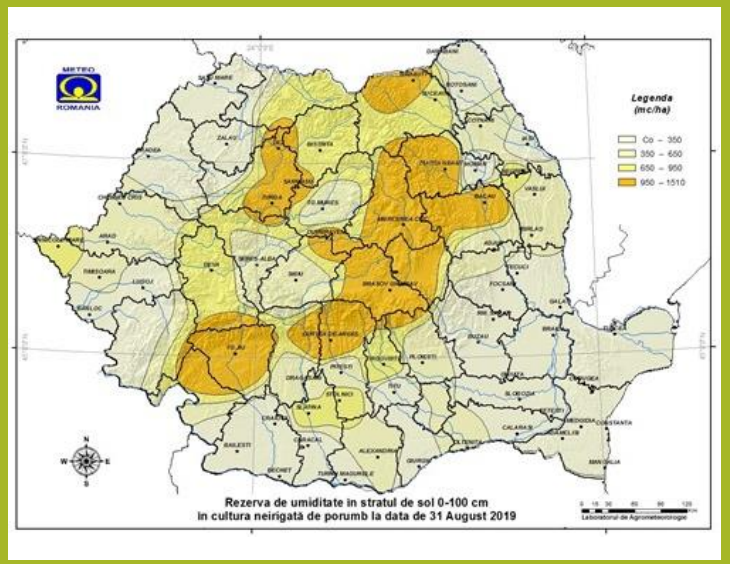
Most droughty years

2007 / 2012 / 2015 / 2019









MAIZE CROP

EXTREME PEDOLOGICAL DROUGHT

STRONG PEDOLOGICAL DROUGHT

MODERATE PEDOLOGICAL DROUGHT

SATISFACTORY SUPPLY

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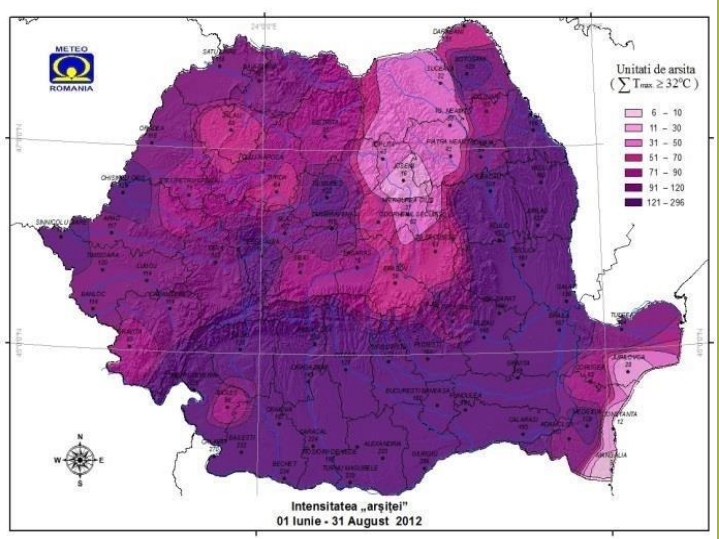
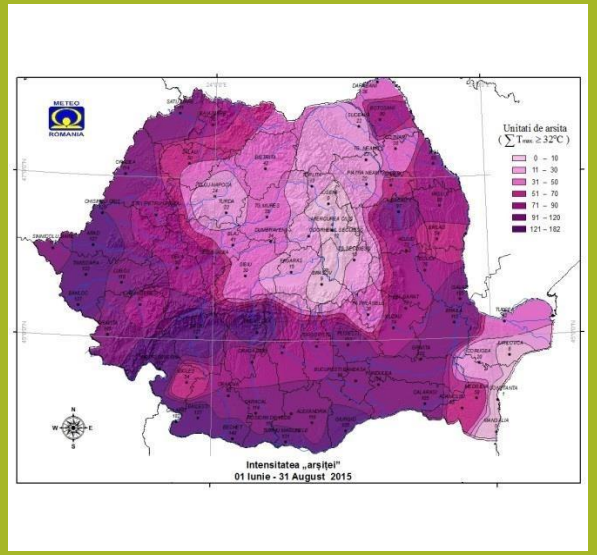
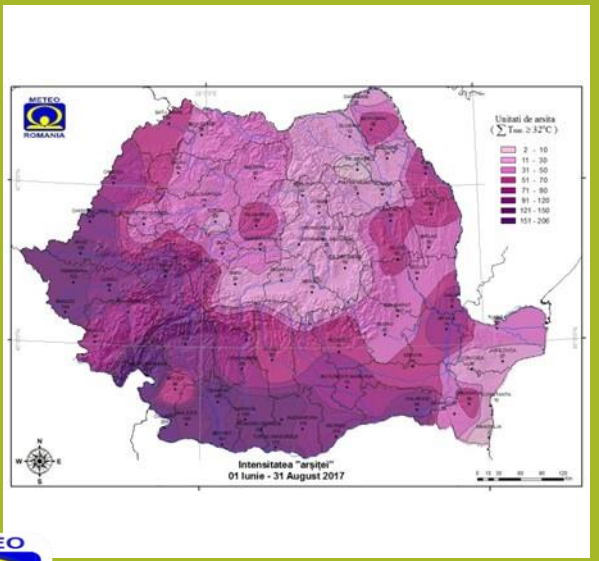
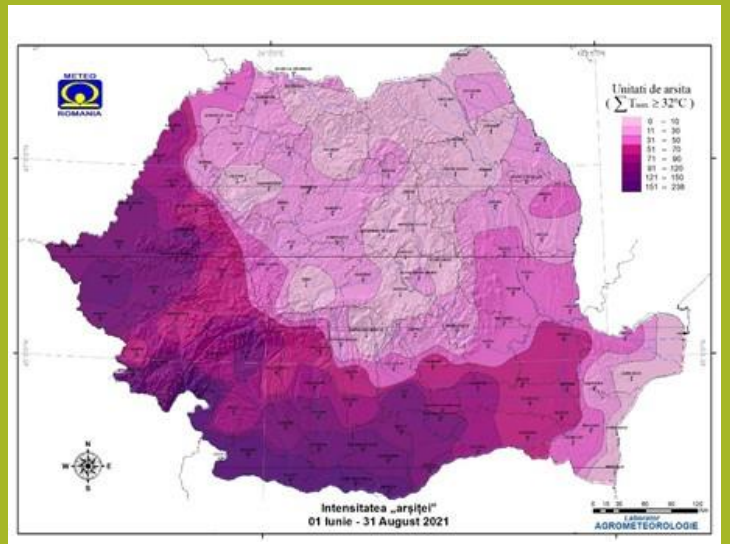
AGROMETEOROLOGICAL MONITORING INDEXES

Scorching heat (ΣTmax≥32°C)









Heat Intensity

2012	2015	2017	2021
123.1	73.3	65.5	56.1

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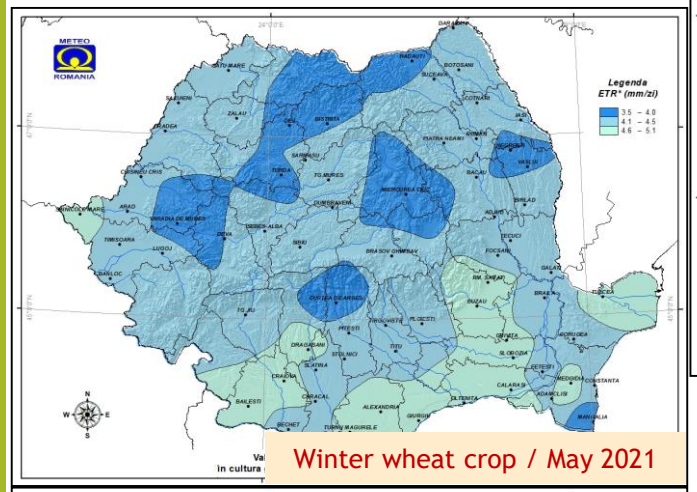
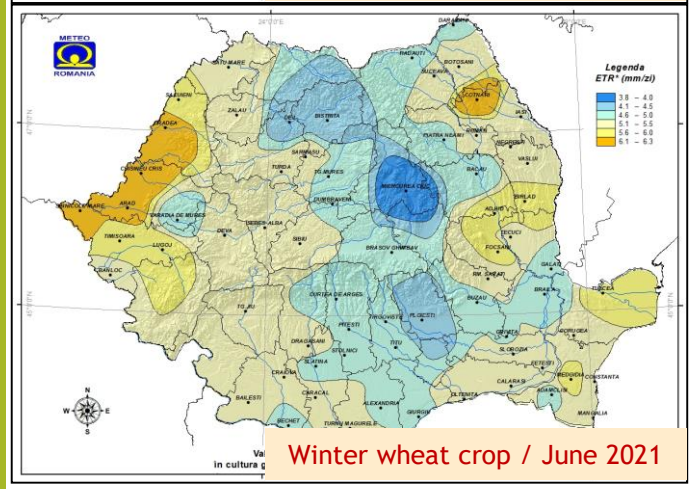
REFERENCE EVAPOTRANSPIRATION IN AGRICULTURAL CROPS

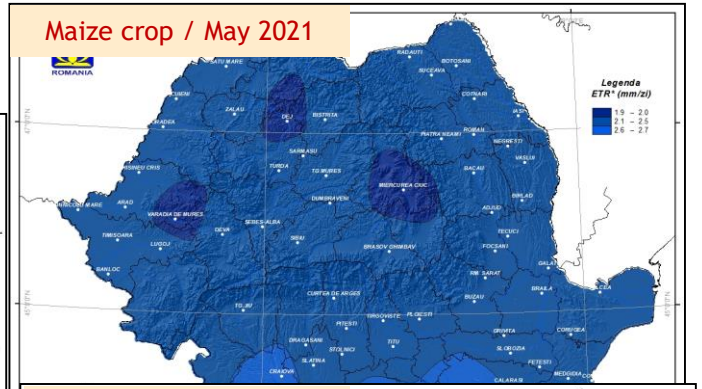


Winter wheat crop / May 2021

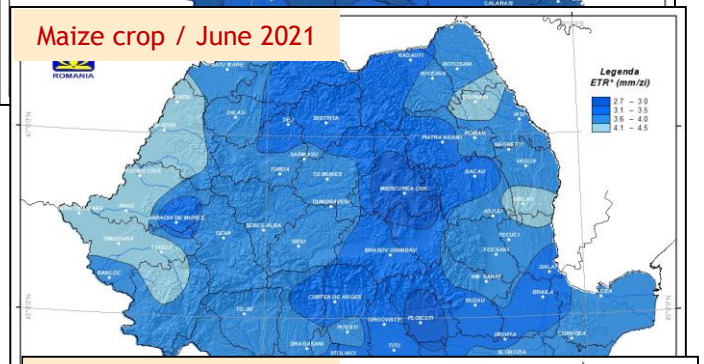


Winter wheat crop / June 2021

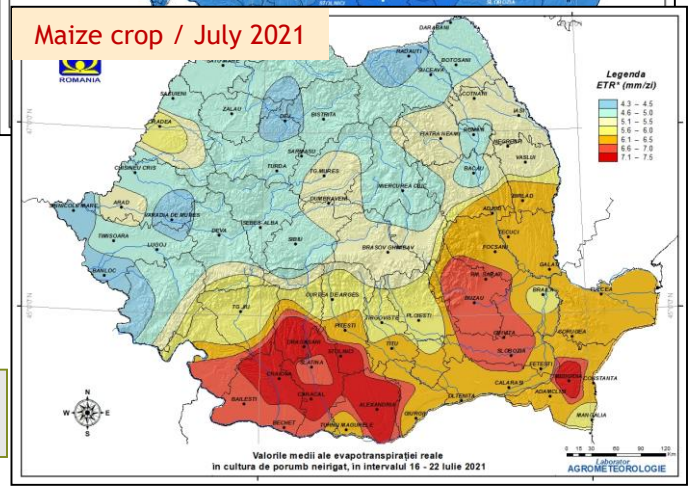
Maize crop / May 2021



Maize crop / June 2021

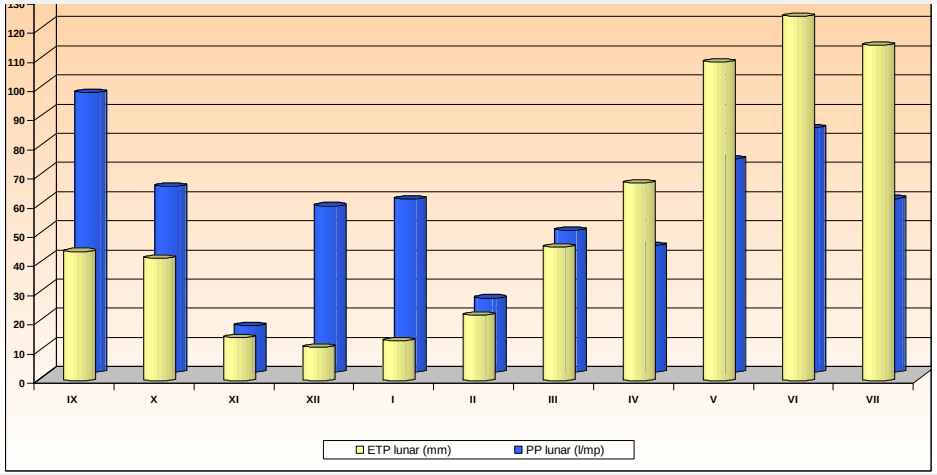


Maize crop / July 2021

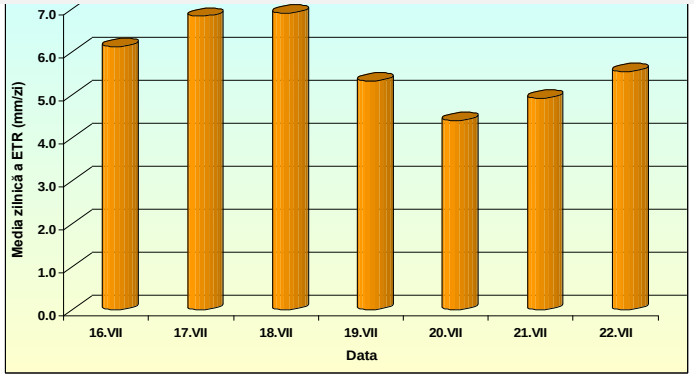


http://www.meteoromania.ro/Upload-Produse/agro/evapotranspiratie.pdf

Monthly mean values of the reference evapotranspiration for the maize crop in comparison to monthly rainfall / 2020-2021 Agricultural year



Daily mean values of the reference evapotranspiration / 16 – 22 July 2021



Reference evapotranspiration (ETR) is calculated by **Penman-Monteith method (FAO)**, in correlation with vegetation phases, for winter wheat and non-irrigated maize crops during an agricultural year.

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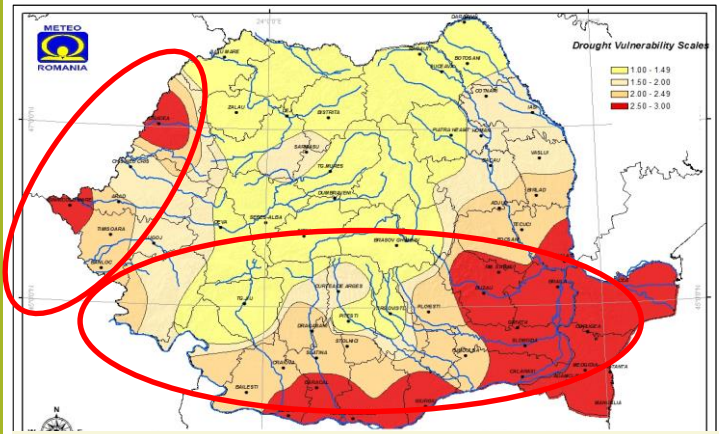
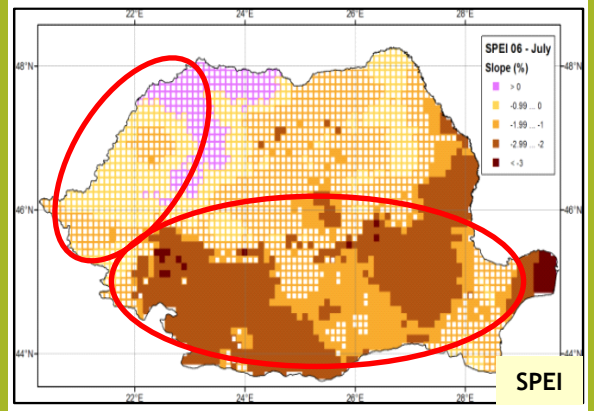
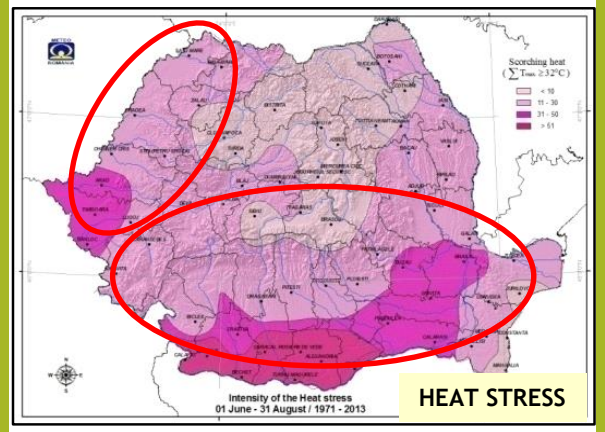
Drought Vulnerability Index for maize crop during the critical period for water plant needs (August) based on climatic variables



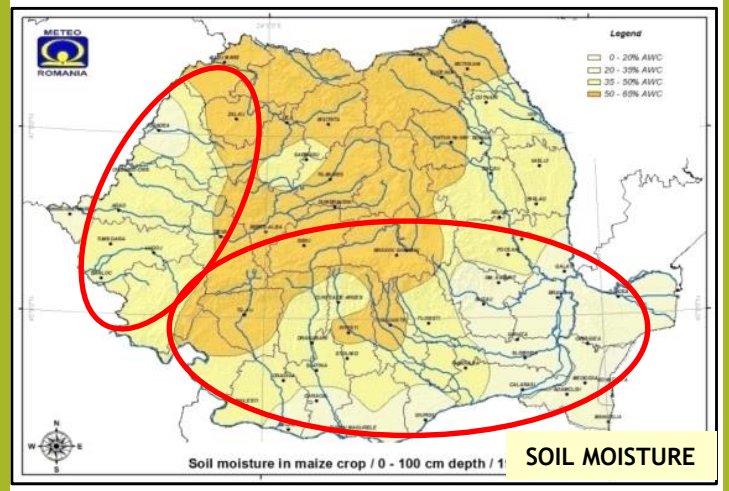
The most critical areas is recorded in the south, south-east and west regions



SPEI



HEAT STRESS



SOIL MOISTURE

DVI	Vulnerability Scales	Color scale
0.00 – 0.49	No or less vulnerability	
0.50 – 0.99	Low vulnerability	
1.00 – 1.49	Medium vulnerability	
1.50 – 1.99	High vulnerability	
2.00 – 2.49	Very high vulnerability	
2.50 – 3.00	Extreme vulnerability	

Vulnerability has been expressed as a function of exposure and intensity at different level in time and space.

The approach is useful in evaluating the vulnerability of crop systems to drought and may help the decision makers to formulate more specific and targeted climate adaptation policies to reduce production losses in agriculture.

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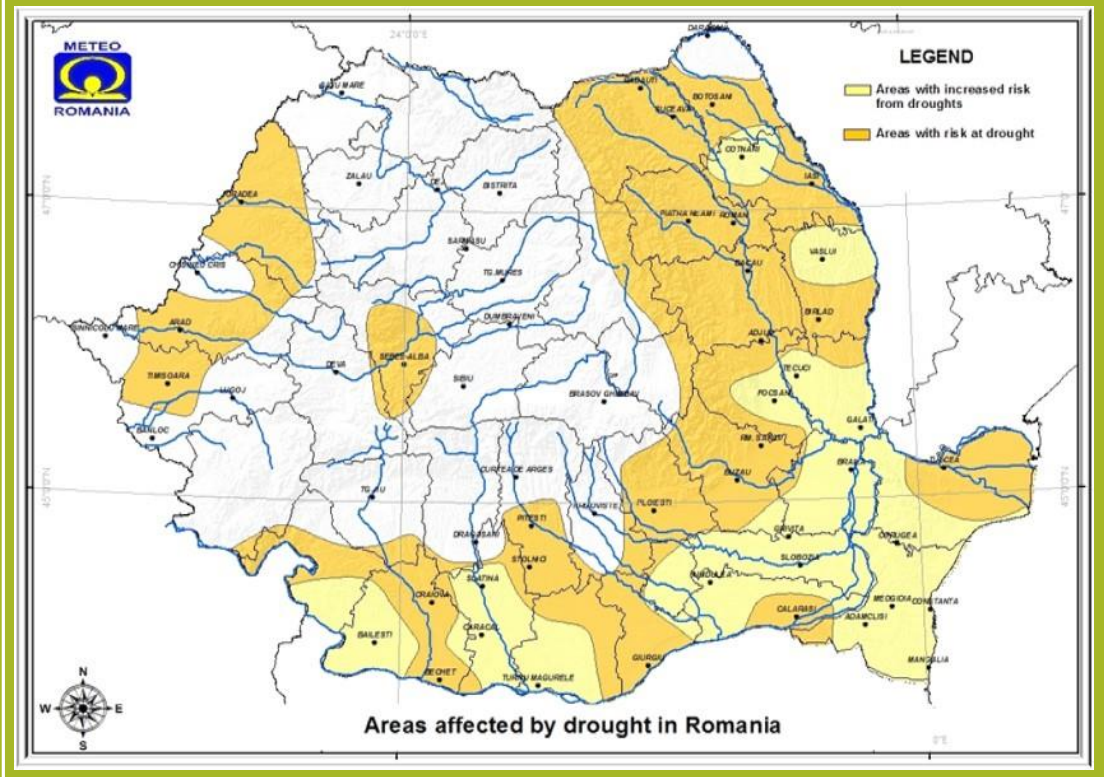
AGROMETEOROLOGICAL DROUGHT INDICATORS OPERATIONAL USE AND RESEARCH ACTIVITIES



Areas affected by drought in Romania

THE SOUTH, SOUTH-EAST AND EAST OF ROMANIA ARE THE REGIONS WITH RISK OF WATER SCARCITY AND DROUGHT

Climatic indicators: SPI, Aridity index, etc

Agrometerological indicators: Soil moisture, scorching heat indicator, Drought Vulnerability Index (DVI), etc

Satellite-derived products: Normalized Differences Vegetation Index (NDVI); Normalized Difference Water Index (NDWI), Normalized Difference Drought Index (NDDI); Leaf area Index (LAI); Fraction of Absorbed Photosynthetic Solar Radiation (fAPAR)

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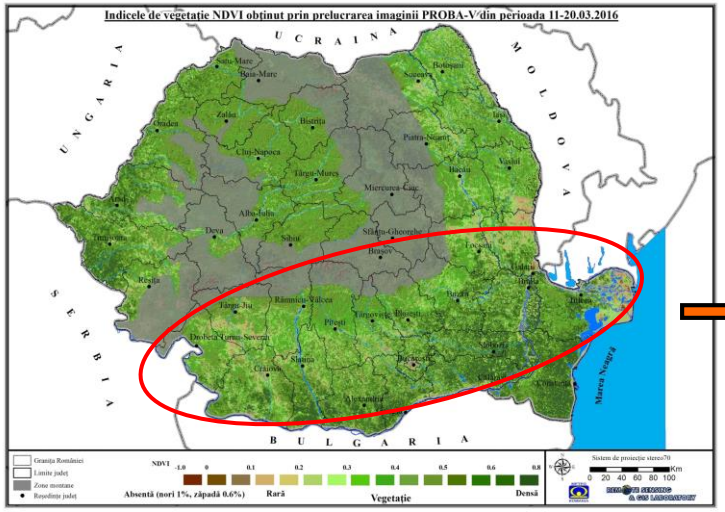
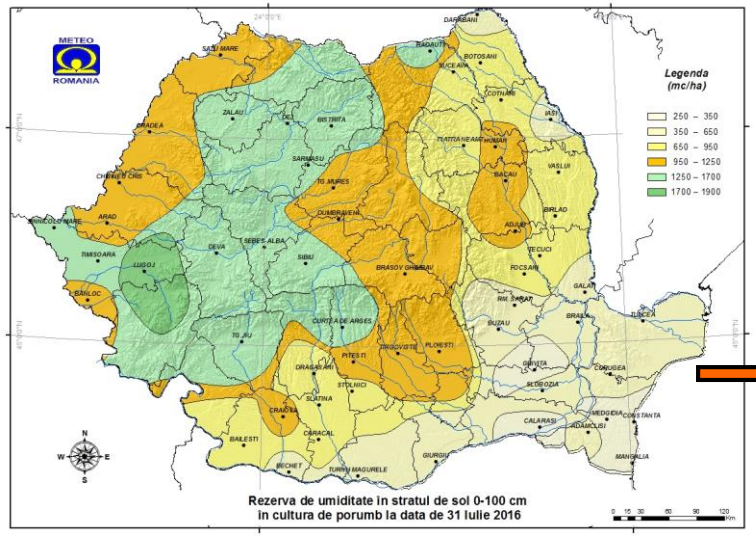
NDVI vegetation index image obtained by processing PROBA-V



- Less dense vegetation (NDVI 0.2-0.3)
- Rare vegetation (NDVI 0.1-0.2)
- Rich and dense vegetation (NDVI 0.3-0.8)

Maintaining heat and hydric stress from the air and soil

Soil moisture in maize crop July 2016



- Extreme pedological drought
- Strong pedological drought
- Moderate pedological drought
- Satisfactory supply
- Almost supply

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Phenology summer crops / maize and sunflower (MeteoRO AGROMETEO Monitoring)

Vaslui/Moldova

Călărași/Muntenia

Iași/Moldova

Adamclisi/Dobrogea

Călărași/ Muntenia

Iași/Moldova

METEO ROMANIA

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Extreme weather IMPACTS in Romanian agriculture - case study 2018

March 2018

SNOW

April 2018

FLOOD

DROUGHT

May 2018

Maize crop

Winter wheat

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Droughty / rainy years in Romania / 1901-2020

DECADE	XX-TH CENTURY	
	EXTREMELY DROUGHTY YEARS	EXTREMELY RAINY YEARS
1901-1910	1907-1908	1910
1911-1920	1917-1918	**1911, 1912, 1915, 1919**
1921-1930	1923-1924, 1927-1928	1929
1931-1940	1934-1935	1937, 1939, 1940
1941-1950	**1945-1946, 1947-1948, 1949-1950**	1941, 1944, 1947
1951-1960	1952-1953	**1954, 1955, 1957, 1960**
1961-1970	1962-1963, 1964-1965	1969, 1970
1971-1980	1973-1974, 1975-1976	**1972, 1974, 1975, 1976**
1981-1990	**1982-1983, 1985-1986, 1987-1988**	1981, 1990
1991-2000	**1992-1993, 1997-1998, 1999-2000**	1991, 1997
	XXI-ST CENTURY	
2001-2010	**2000-2001, 2001-2002, 2002-2003, 2006-2007, 2008-2009**	**2005, 2006, 2008, 2010**
2011-2020	**2011-2012, 2014-2015, 2015-2016, 2016-2017, 2017-2018, 2019-2020**	

Since 1901 until now, Romania has seen in every decade one to four extremely droughty/rainy years, an increasing number of droughts being more and more apparent after 1981

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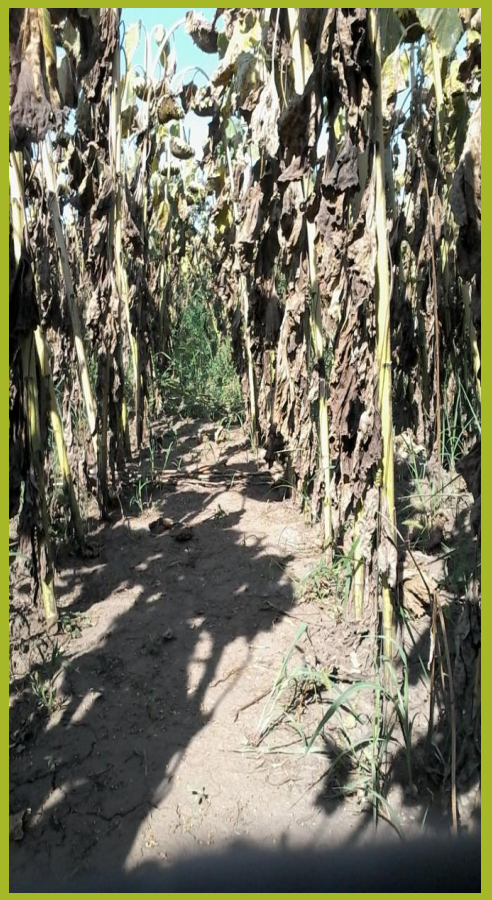
DROUGHT RISK ASSESSMENT IN ROMANIA



Sunflower crop
August 21st, 2017
Călărași region

Vulnerability assessments has a major role in the design of appropriate adaptation policies to CC impacts on agriculture field and not only. Risk is a function of the characteristics of a physical event or hazard (e.g. severity, duration, frequency, and trend) and the societal and environmental vulnerability.

risk identification (identify what may happen);

risk analysis (determine the level of probability and consequences of the hazard);

risk evaluation (decide what is acceptable).

Drought affects sustainable development through interrelations with social problems and enhances them:

heavy rains / floods, landslides, hail, lightning, ice, avalanches, storms, blizzards, droughts, heat waves, cold waves;

reduction in water reserves, potential for food production and thus food security for the population;

poverty, the most serious dysfunction in areas affected by these phenomena;

deterioration of human health due to inadequate food consumption, generating anemia, malnutrition and malnutrition.

Maize crop
August 21st, 2017
Călărași region

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OUR PRODUCTS

•**Agrometeorological indicators / products (maps, charts, graphics)**

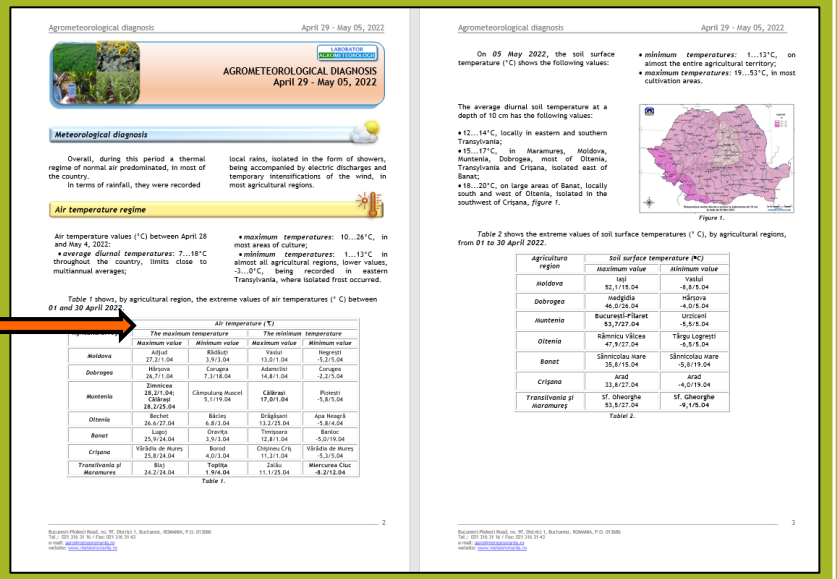
•**921** thematic maps: soil moisture, actual evapotranspiration, thermal indicators (heat intensity, cold and frost units,spring index), water indices (intervals with precipitation, days without precipitation)

- ***141 charts/graphics*** (with maximum and minimum values of air and soil temperature, highest and lowest amount of precipitation by agricultural regions and in reference intervals specific to the weekly agrometeorological newsletters)

•**Agrometeo products** which include processed products:

•**47** weekly **agrometeorological bulletins** at **national level** (which contain diagnoses and prognosis) http://www.meteoromania.ro/

•**365** weekly **regional agrometeorological forecasts** (*Oltenia*-52, *Muntenia*-53, *Moldova*-52, *Transilvania* and *Maramures*-52, *Dobrogea*-52, *Banat-Crisana*-52)



Years	Authorities (ministries, research institutions, etc.)	Mayors	Agricultural companies / associations / farmers	Other (insurance companies)	Total /Year
2016	4	1	6	1	12
2017	4	1	15	2	22
2018	20	2	19	1	42
2019	6	1	14	1	22
2020	22	1	52	3	78
2021	10	0	17	1	28
TOTAL	**204**				

Beneficiaries type of Agrometeorological indicators and products by request

Agrometeorological indicators and products contracts with media

Agrometeorological products for specialised media tv and magazines

- **250 daily diagnoses/prognosis** for AGRO TV;
- **51** weekly articles for magazine “Profitul Agricol”
- **24** monthly articles for magazine “GROUPAMA”

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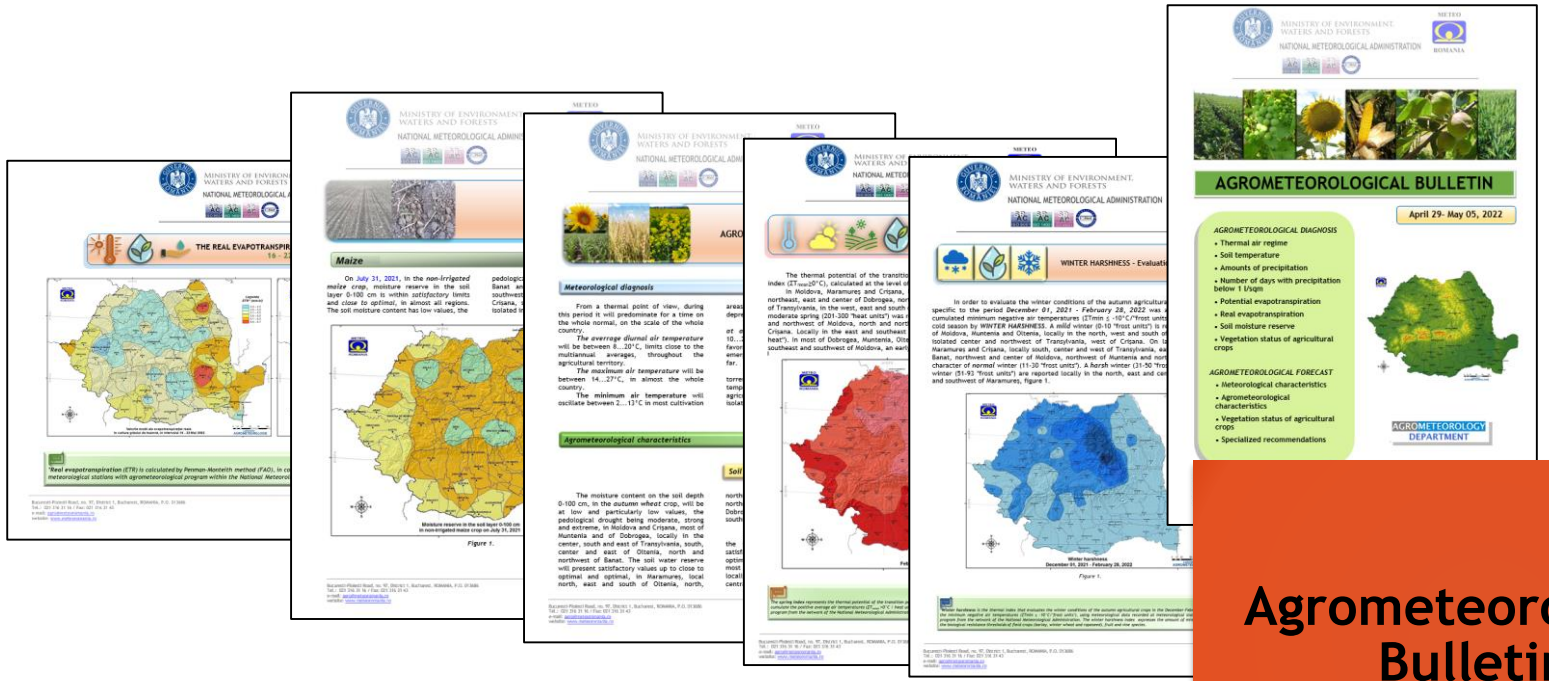
TYPE OF SERVICES



Meteo Romania Web-site:
http://www.meteoromania.ro/

Agrometeorological Bulletins

National and Regional agrometeorological forecasts

Agrometeorological diagnosis

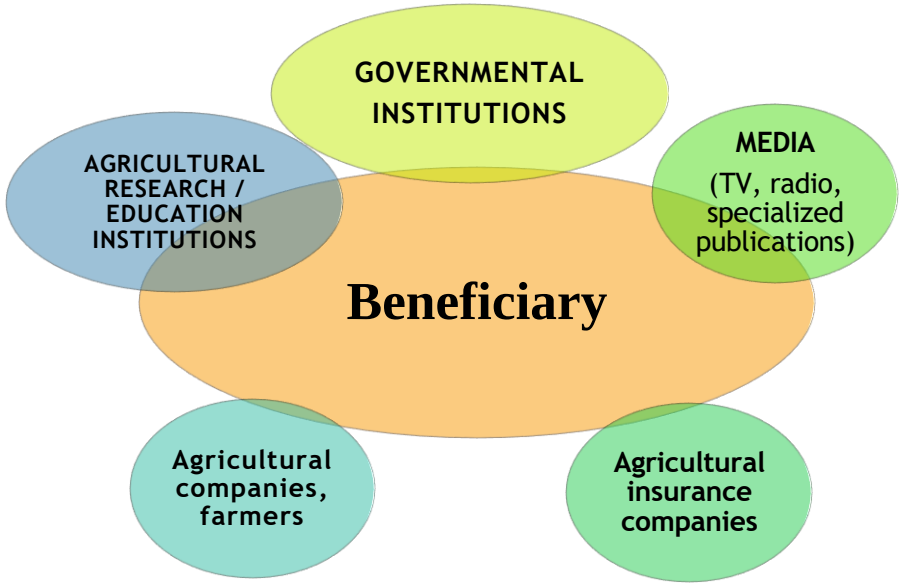
Specialized recommendations

Agrometeorological indicators:

- Soil moisture
- Heat Intensity
- Spring Index
- Winter severity
- Rainfall
- Soil temperature
- Potential and Real evapotranspiration
- No. of days with precipitation under 1 l/mp

Agrometeorological studies by request

Extreme meteorological phenomena with negative impact in agriculture



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European and World engagement

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Capitalizing the results

INTERNATIONAL PROJECTS RELATED TO DROUGHT AND IMPACT ON AGRICULTURE

National projects:

- ✓ ***ADER 12.3.1*** project: *The portal for soil information `in mirror` to that achieved by Joint Research Centre in Europe (JRC) (2015-2018)*
- ✓ *Operational Sectoral Programme for Environment (**POS-MEDIU**) - The development of the national system of monitoring and warning of extreme weather phenomena for the protection of life and property materials (2014-2020)*
- ✓ *National Risk Assessment - **RO RISK** - (SIPOCA code: 30, co-financed under EFS through Operational Programme Administrative Capacity) under coordination of General Inspectorate for Emergency Situations (2015-2016)*

European Projects:

- ➢ INTERREG IVC/ **WATERCoRe Project:** *Water scarcity and drought - Co-ordinated activities in European Regions"*, **2010-2013** (http://www.watercore.eu)
- ➢ SEE Project **ORIENTGATE -** *A structured network for integration of climate knowledge into policy and territorial planning"*, **2012-2014** (http://www.orientgateproject.org)
- ➢ **Green Path to Sustainable Development** project - *European Economic Area Financial Mechanism*, **2009-2014**, http://caleaverde.ro/
- ➢ **IRIDA** Project - *Innovative remote and ground sensors, data and tools into a decision support system for agriculture water management - Programul ERA-NET Cofund Water Works 2014, Research and Innovation for Developing Technological Solutions and Services for Water Systems (**2016-2019**)*
- ➢ **DRI-DANUBE** project: *"Drought Risk in the Danube region"*, **2017-2019**
- ➢ **CAMARO-D** project- *"Cooperating towards Advanced Management Routines for land use impacts on the water regime in the Danube river basin"*, **2017-2019**

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"Green Path towards Sustainable Development" Project

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NMA has been a partner in a consortium within RO07 Program - Adaptation to Climate Change 2009-2014 Program, financed by funds provided by Iceland, Liechtenstein and Norway through the EEA Financial Mechanism, EEA GRANTS 2009 -2014.

The overall objective of this project was to reduce human vulnerability and ecosystem to climate change and to develop a set of good practices on adaptation to climate change.
The main goal of the project - to support and promote the protection of the environment, population and economic activities against the effects of climate change, especially extreme weather events.

The main deliverables elaborated by NMA were carried out ***5 climate studies:***

- ✓ ***Meteo study regarding climate analysis of representative data for the basis of the development of regional strategies for Braşov, Sibiu and Târgu-Mureş municipalities***
- ✓ *Data collection and cartridge - study regarding the development of climatic resources (1961-2010) for the development of regional policies for managing meteo extreme phenomena*
- ✓ *Determination of potential energy resources (eleven and solar) as a basis for the development of alternative energy systems*
- ✓ *The study of the numerical design experiments that involves the climate regional model on the level of the 7 central region, is intended to obtain details of climate variability and changes to very fine resolutions (10 km)*
- ✓ ***Guidelines for adapting agricultural technologies to climate changes in the Region 7 Centre***

- ❖ ***Installation of 3 automatic meteorological stations for monitoring meteorological parameters in Brasov, Sibiu and Targu Mures;***
- ❖ ***Construction works to increase the energy efficiency*** *of the "Brothers Grimm" kindergarten building in Sibiu;*
- ❖ ***Execution works*** *at the Sibiu Environmental Protection Agency - Good practice model through constructive and energetic adaptation of the building in the context of climate change;*
- ❖ ***Intervention works on increasing the energy efficiency*** *of the Social Center Tg. Mures;*
- ❖ ***Planting 30 trees*** *in bus stations in Sibiu;*
- ❖ *„Caravan The Green Path" in Târgu Mureş, Braşov and Sibiu;*
- ❖ ***Creation of infrastructure for underground telecommunication*** **10 km** *cables and public lighting on Vasile Milea, Victoriei, Corneliu Coposu, Alba Iulia Road and Calea Dumbrăvii from Sibiu*

CAMARO-D

Cooperating towards Advanced MAnagement Routines for land use impacts on the water regime in the Danube river basin

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Partnership

- 14 Project partners from 9 countries
- 9 Associated partners from 6 countries

The project aimed at developing comprehensive recommendations towards a strategic policy for the implementation of an innovative transnational catchment-based "Land Use Development Plan" for the Danube River Basin. It will also provide important inputs for the further development of the EU Strategy for the Danube Region (EUSDR) and other relevant EU-policies. Its main goals were:

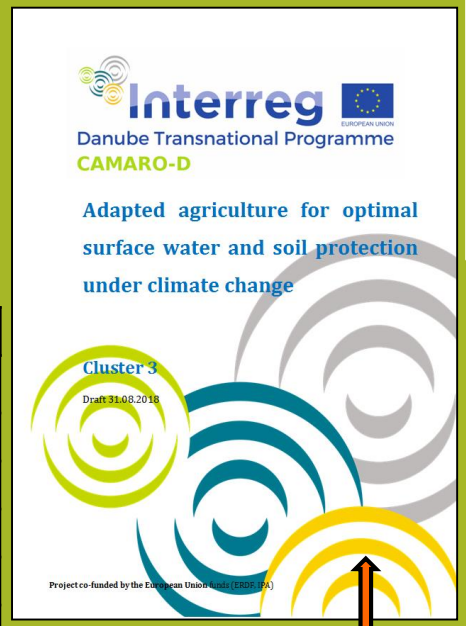
- Setting the frame for a harmonized transnational land use management system, taking into account the demands of water resources protection and flood prevention.
- Harmonizing and improving the protection of water resources against negative impacts of land use and climate change as well as reduction of flood risk.
- Bringing life to the project outcomes by developing a transnational "Land use Development Plan" as a driving force for a transnational land use management

Besides the existing cooperation in CAMARO-D project, the signing parties state their common wish to develop various kinds of cooperation aiming at:
Acknowledging the **importance of the coordination within the Danube river basin** towards integrated river basin management, both in terms of water resources and flood-risk and
Considering the **need of advanced concerted actions**, particularly considering the impacts of land use and vegetation cover on the water regime within the Danube river basin area and
Recognizing that the thematic field **"protection of water resources and prevention of floods"** is prominent and can be sustained in the focus of interest for the general public by promoting the topic
Expressing the desire to **foster the cooperation in the field of strategic policy** for the implementation of an innovative concept for a transnational catchment-based Land Use Development Plan (LUDP)

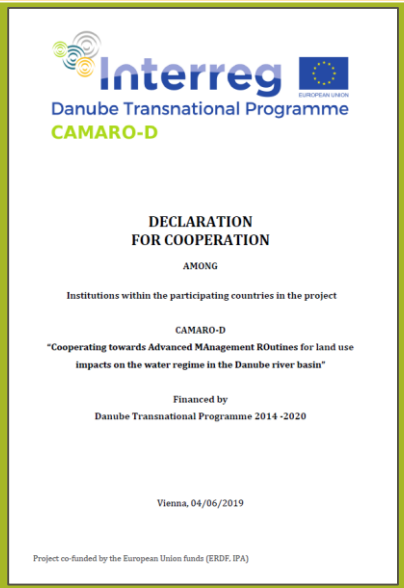
National Meteorological Administration contributed to the realization of two products:

- BMP Catalogue (best management practices in agriculture, forestry, water management, territory planning, etc.)
- GAP Catalogue (non-recommended practices in agriculture, forestry, water management, territory planning, etc.)

The Catalogs contain information on practices / measures applicable at national level.



Vegetation cover / Land use	Vulnerability/ undesirable developments	Partners				
		AT	CZ	RO	RS	HU
Agriculture	Soil degradation	✓	✓	✓	✓	✓
	Soil compaction	✓	✓	✓		✓
	Extreme weather events	✓	✓	✓		
	Soil and water quality	✓	✓	✓	✓	✓
	Biodiversity	✓	✓	✓	✓	✓



The Agrometeorology Laboratory was responsable, as an expert in the field, for completing the information on the best management practices applied in the partner countries for the Agriculture Catalogue.

All the project countries have specific measures / practices in the *agricultural management*, and this guide aims for a transnational cooperation in this domain, in order to *improve strategic and planning documents* in the agricultural field.

WE WORK ONLINE

Virtual training course: Vegetation indexes, in-situ phenology observations and remote sensing products for monitoring the cereal crops, forest and pastures Malawi and Tanzania
06-09 September 2021

Virtual Training Course on the Use of Satellite Products on Drought Monitoring and Applications in Agrometeorology
WMO/FAO/EUMETSAT/MeteoRomania
23 November - 10 December 2020

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Future Regional Perspectives

Regional Agrometeorology Center for the WMO Europe Region RA-VI

Launching the initiative

Date: 8 June 2019

Place: Geneva, World Meteorological Organization

Event: 18th World Meteorological Congress

Launch: *Regional Agrometeorology Center for the WMO Europe Region RA-VI*

INFRAMETEO PROJECT APPROVAL

Infrastructure upgrading for monitoring and warning of severe hydro-meteorological phenomena in order to ensure the protection of life and material goods. SMIS 2014+ 128047

SUPPORT

UNDER IMPLEMENTING

Starting Date: July 1st 2020

Duration: 31 months

Ending Date: December 31st 2023

Place: **National Meteorological Administration headquarters**

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Regional Agrometeorology Center for the WMO Europe Region RA-VI

Providing relevant agrometeorological data and information such as soil moisture and phenology, agrometeorological bulletins and products/services and training activities to Region VI European countries.

MAIN GOALS

- **Cooperation** and further bond with the Drought Management Centre for South-East Europe and Integrated Drought Management Program;
- **Strengthen** regional cooperation and national capacities for agrometeorology activities and drought monitoring in Europe;
- **Development** of training and education programs within WMO initiatives and Regional Training Centre objectives;
- Cooperation with WMO Global Campus for exchange of agrometeorological products and technologies developed by different **Global Centers of Research and Excellence in AgroMeteorology** (GCREAMs).

AGROMETEOROLOGY DEPARTMENT

Regional Agrometeorology Center for the WMO Europe Region RA-VI

SMART & GREEN

DATA CENTER

RESEARCH

COMMUNICATION

TRAINING

AGROMETEOROLOGY DEPARTMENT

OPERATIONAL ACTIVITIES

In-situ soil moisture monitoring
Main crops phenology observations
Agrometeorological diagnosis/forecasts
Monthly bulletins
Agrometeorological indicators

LOGISTICAL SUPPORT

IT Data Center
Web-Portal communication
Agrometeorological platform
Network and Security
Virtual IT infrastructure
Conference rooms

RESEARCH

EU pilot projects in common thematic areas / climate change impacts and water resources management, etc
The impact of extreme weather events on existing and future agricultural systems, food security
Enhanced capability in development of weather/climate-agricultural decision support systems
Good practice guides **for long-term sustainability in agriculture for** RA VI Europe

EDUCATION

Knowledge transfer
Trainings: workshops, webinars, field days
E-learning
Virtual courses

Regional Agrometeorology Center for the WMO Europe Region RA-VI

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meteoromania.ro

THANK YOU FOR ATTENTION!

Daniel ALEXANDRU
danyalex77@gmail.com