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NR.73-2023

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Buletini Mujor Klimatik Nr. 73 - 2023 ndodhet i publikuar në faqen "on line" të OBM, UPT, IGEO dhe një sërë institucioneve të tjera. Për buletinet e tjera mund të klikoni në logot përkatëse, që ndodhen në vijim.

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Shënim Editorial

Buletini Mujor Klimatik i përgatitur çdo muaj nga Departamenti i Meteorologjisë së Institutit të Gjeoshkencave të Universitetit Politeknik të Tiranës, paraqet një përmbledhje shkencore të vlerësimit të karakteristikave kryesore meteorologjike të muajit përkatës; si dhe në kontekstin klimatik një krahasim me vlerat përkatëse të periudhave të normës klimatike 1961-1990 dhe 1991-2020.

Të dhënat autentike të përftuara nga vendmatjet meteorologjike të Sistemit Kombëtar të Monitorimit Meteorologjik të Shqipërisë pasi janë digjitalizuar, kontrolluar e verifikuar përpunohen në bazë të metodologjive në përputhje me standartet e OBM. Më pas rezultatet e përftuara nga përdorimi i programeve të ndryshme komjuterike paraqiten në tabela, grafikë dhe harta duke mundësuar një vlerësim jo vetëm në kohë por dhe hapësinor të ecurisë së elementëve kryesore meteorologjikë dhe klimatikë. Paraqitja e anomalive përkatëse mundëson dhe një vlerësim të veçantë në konteksin e ndryshimeve klimatike dhe pasojave që ato përcjellin.

Në buletin një hapësirë të veçantë zenë dhe tematika mbi vlerësimin agrometeorolgjik të muajit apo ato mbi burimet e energjive të rinovueshme, siç janë energjia nga rrezatimi diellor apo era, të para më gjërësisht dhe në kontekstik klimatik të vendit tonë.

Buletini është i pajisur me kodin përkatës të ISSN të përftuar nga institucioni përkatës në Paris në vitin 2017. Në të publikohen herë pas here dhe artikuj shkencorë me tematikë në lidhje me klimën dhe mjedisin dhe që i nënshtrohen paraprakisht proçedurave të miratimit ashtu si në periodikët e tjerë shkencorë.

Dukuritë ekstreme të motit apo tematika të caktuara alternohen herë pas here sipas rëndësisë që paraqesin dhe periudhës së vitit. Çdo vit ky buletin ka patur përparësi një tematike të caktuar që për vitin 2023 do të jetë trajtimi i problemeve të thatësirës dhe energjisë nga era.

Editor's Note

The Monthly Climate Bulletin, produced monthly by the Department of Meteorology at the Institute of Geosciences, Polytechnic University of Tirana, provides a scientific summary of the main meteorological features for the given month, along with a comparison to climate norms from 1961-1990 and 1991-2020.

The authentic data obtained from the meteorological measurement sites of the National Meteorological Monitoring System of Albania, after being digitized, checked and verified, are processed based on methodologies in accordance with OBM standards. Then, the results obtained from the use of different computer programs are presented in tables, graphs, and maps, enabling an evaluation not only in time but also in space of the progress of the main meteorological and climatic elements. The presentation of relevant anomalies also enables a special assessment in the context of climate change and the consequences they convey.

In the bulletin, a special space focuses on the agrometeorological assessment of the month or those on renewable energy sources, such as energy from solar radiation or wind, viewed more widely and in the climate context of our country.

The bulletin is equipped with the corresponding ISSN code obtained from the relevant institution in Paris in 2017. Occasionally, scientific articles related to climate and the environment are published in it, subject to prior approval procedures, similar to other scientific journals in the country.

Extreme weather phenomena or certain topics alternate from time to time according to the importance they present and the time of year. Every year, this bulletin has prioritized a certain theme, which for 2023 will be the treatment of drought and wind energy problems.

Prof. Petrit ZORBA
EDITOR-IN-CHIEF

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HYRJE

Muaji janar 2023 u karakterizua kryesisht nga një mot i paqëndrueshëm dhe me reshje mbi vlerat e normës në territorin e Shqipërisë.

Gjithësesi temperaturat e ajrit ruajtën në vijimësi ashtu si dhe të muajit të mëparshëm dhjetor 2022 anomali pozitive, të cilat shënuan për muajin janar 2023 vlerën +2.9°C për Shqipërinë.

Nuk munguan orët me diell, të cilat shënuan vlera nga 80 deri në 150 orë në vartësi dhe të kushteve fiziko gjeografike të vendit.

Ajo çka ishte karakteristikë kryesore ishin reshjet e shumta mbi normë që e dallojnë vendin tonë dhe në shkallë kontinentale, të karakterizuar me vlera deri në mbi 300 mm ose mbi 200% kundrejt vlerave të mesatares shumëvjeçare.

Natyrisht në zonat e larta të vendit nuk munguan reshjet e dëborës, por gjithësesi duhet thënë se ato ishin të moderuara kundrejt asaj që është karakteristike për këto zona në këtë periudhë të vitit.

Gjatë muajit janar 2023 në territorin e vendit tonë nuk u vrojtuan dukuri eksetreme të motit me impakte në jetën dhe veprimtarinë e shoqërisë.

Viti i ri 2023 nisi me një situatë temperaturë të pazakontë, ku anomalitë e temperaturës së ajrit për datën 1 janar 2023 në pjesën qendrore të kontinentit Europian shënuan vlera deri në +14°C, siç paraqitet dhe në figurën në vijim.

INTRODUCTION

The month of January 2023 was mainly characterized by unstable weather and rainfall above normal values in the territory of Albania.

However, air temperatures continued to maintain positive anomalies, as in the previous month of December 2022, which marked for January 2023 the value of +2.9°C for Albania.

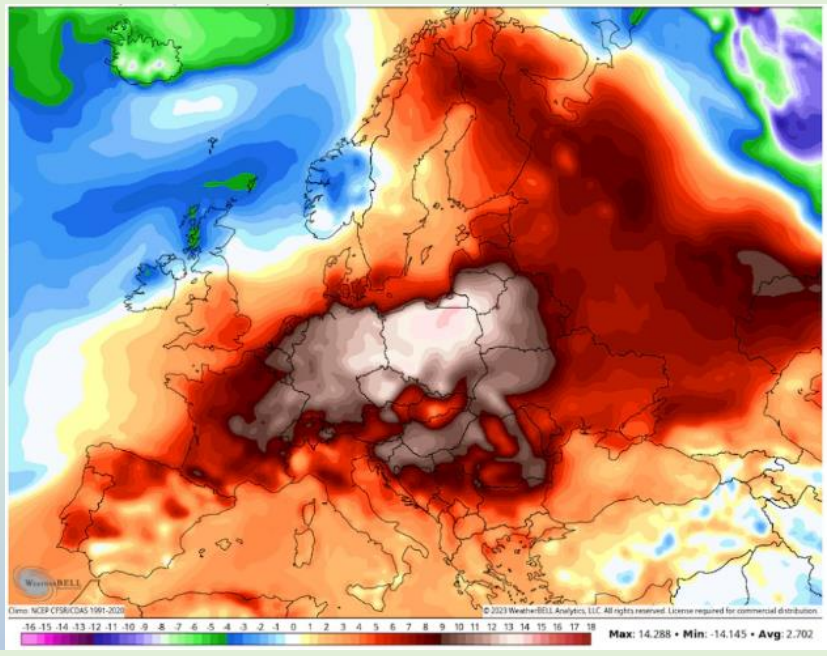
There was no shortage of sunny hours, which ranged from 80 to 150 hours depending on the physical and geographical conditions of the country.

What was the main characteristic was the numerous precipitations above the norm that distinguish our country on a continental scale, characterized by values up to over 300 mm or over 200% compared to the multi-year average values.

Of course, there was no lack of snowfall in the high areas of the country, but it must be said that they were moderate compared to what is typical for these areas at this time of the year.

During the month of January 2023, in the territory of our country, no extreme weather events with impacts on the life and activity of the society were observed.

The new year 2023 started with an unusual temperature situation, where air temperature anomalies for January 1, 2023 in the central part of the European continent recorded values up to +14°C, as shown in the following figure.



RREZATIMI DIELLOR

Viti i ri 2023 nisi me një ditë me diell siç tregohet dhe në figurë Nr.1, ku më pas gradualisht paqëndrueshmëritë atmosferike mbizotëruan duke mundësuar një rritje të vranësirave dhe një numër ditësh me reshje, të cilat analizohen në mënyrë më të detajuar në vijim. Si rrjedhojë dhe rrezatimi diellor në këtë muaj u shoqërua me luhatje në varësi të mbulesës së vranësirave.

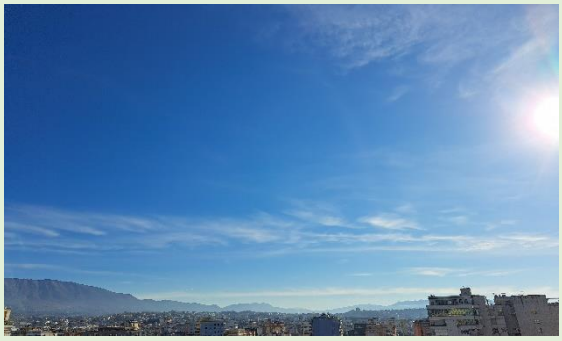


Figure Nr.1. – Pamje e qiellit mbi Tiranë datë 1 janar 2023.
Sky view in Tirana on January 1, 2023.

SOLAR RADIATION

The new year 2023 started with a sunny day as shown in Figure No.1, where then gradually atmospheric instabilities prevailed enabling an increase in cloudiness and a number of rainy days, which are analyzed in more detail in the following. As a result, the solar radiation in this month was accompanied by fluctuations depending on the cloud cover.

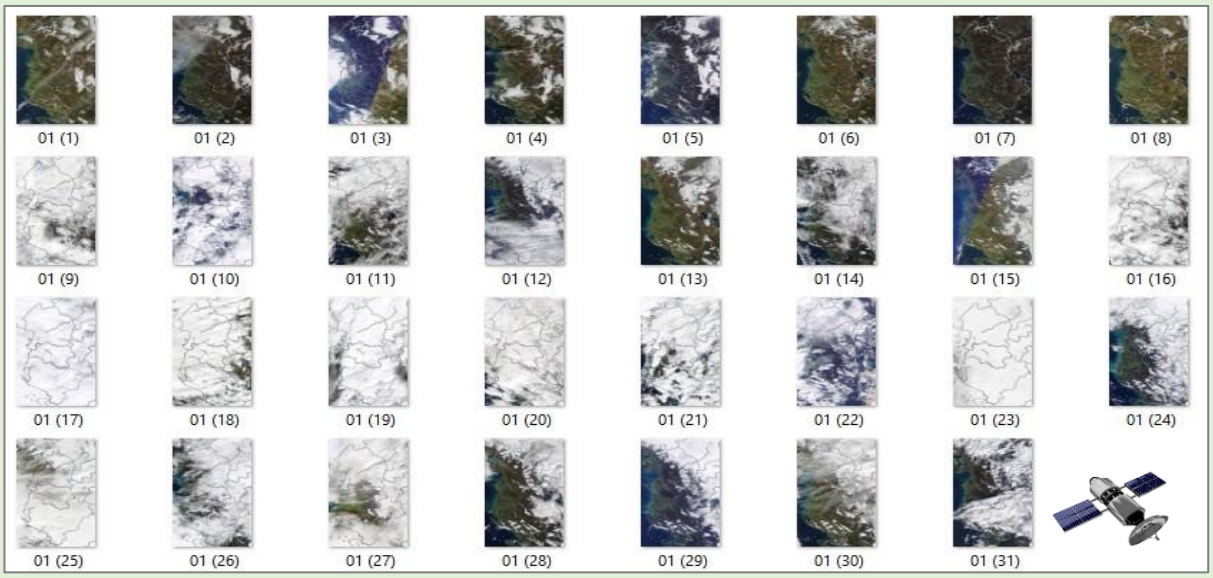


Figura Nr. 2 - Pamje satelitore ditore të muajit Janar 2023 mbi territorin e Shqipërisë sipas Eodis Worldview.
Daily satellite view of January 2023 over the territory of Albania according to Eodis Worldview.

Ndërkohë, sa i takon rrezatimit diellor dhe në veçanti treguesit të orëve me diell duhet thënë se gjatë këtij muaji në territorin e vendit tonë u shënuan gjithsejt rreth 80-150 orë me diell, natyrisht me ndryshime në vartësi të zonave dhe nënzonave të ndryshme klimatike.

Një pamje e shpërndarjes së vlerave të këtij treguesi për Shqipërinë paraqitet në hartën e dhënë në figurën Nr.3.

Meanwhile, as regards solar radiation and in particular the indicator of sunny hours, it should be said that during this month in the territory of our country, a total of 80-150 sunny hours were recorded, of course with changes depending on different climatic zones and subzones.

An image of the distribution of the values of this indicator for Albania is presented in the map given in figure No.3.

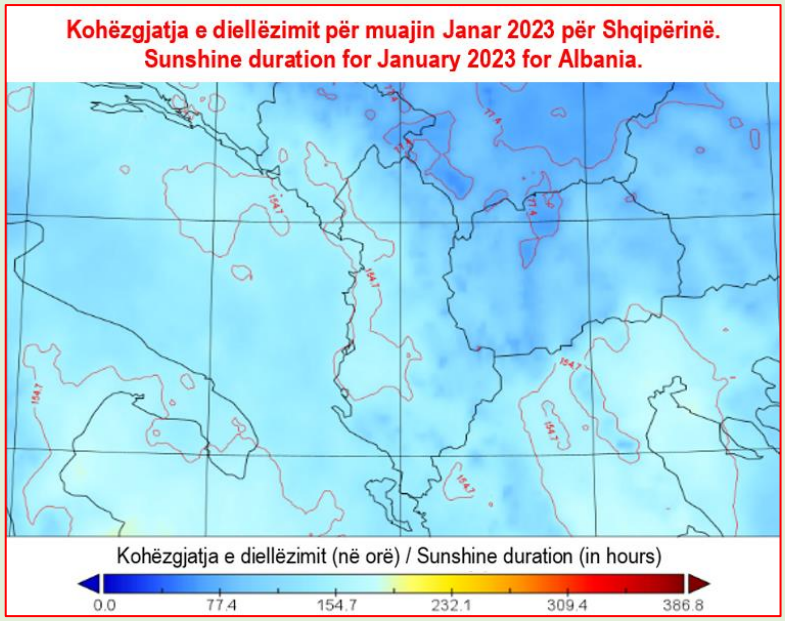


Figura Nr. 3 – Kohëzgjatja e diellëzimit në (orë) në muajin janar 2023 sipas Eumetsat.

Suneshine duration in (hours) on January 2023 according to Eumetsat.

Një vlerësim për diellzimin për muajin janar 2023 për disa nga vendmatjet meteorologjike të SKMM, paraqiten grafikisht në figurën Nr.5. Sasia e orëve me diell të matura nga stacionet meteorologjike janë në përputhje me matjet satelitore të Eumetsat.

Të dhënat tregojnë për 125 orë me diell në Koplik, 100 orë me diell në Fier, 82 orë në Pogradec dhe 104 orë me diell në Konispol.

Gjithashtu në vijim në figurën Nr.4 paraqitet harta me të dhënat e ndriçimit measatar natyror për muajin janar 2023 për vendin tonë të shprehuar në kLux.

An estimate for the sunshine for the month of January 2023 for some of the meteorological measurement sites of SKMM, is presented graphically in figure No.5.

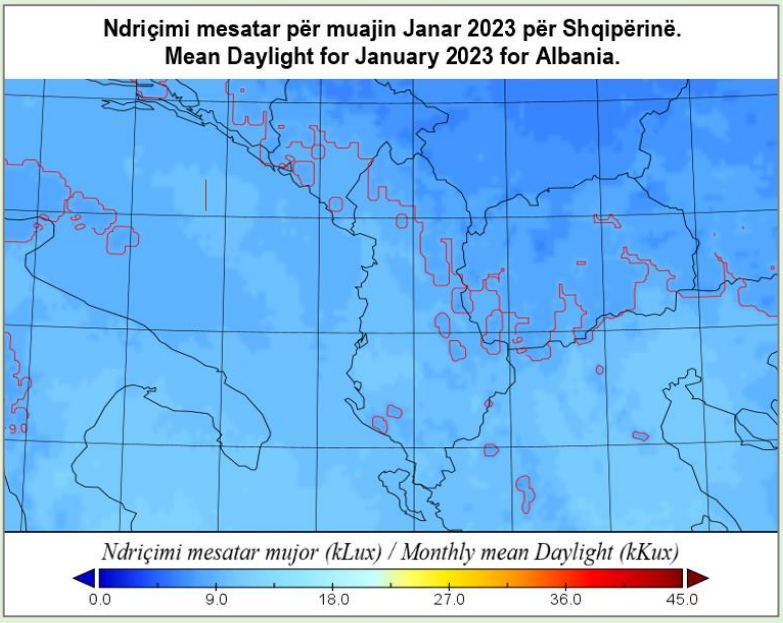
The amount of sunshine hours measured by the meteorological stations are consistent with the Eumetsat satellite

The data indicates 125 hours of sunshine. in Koplik, 100 hours of sunshine in Fier, 82 hours in Pogradec and 104 hours of sunshine in Konispol.

Also below in figure No.4 is the map with the average natural lighting data for the month of January 2023 for our country expressed in kLux.

Figura Nr.4 – Ndriçimi mesatar ne kLux per muajin janar 2023 sipas Eumetsat.

Monthly mean Daylight in kLux for January 2023 according to Eumetsat.



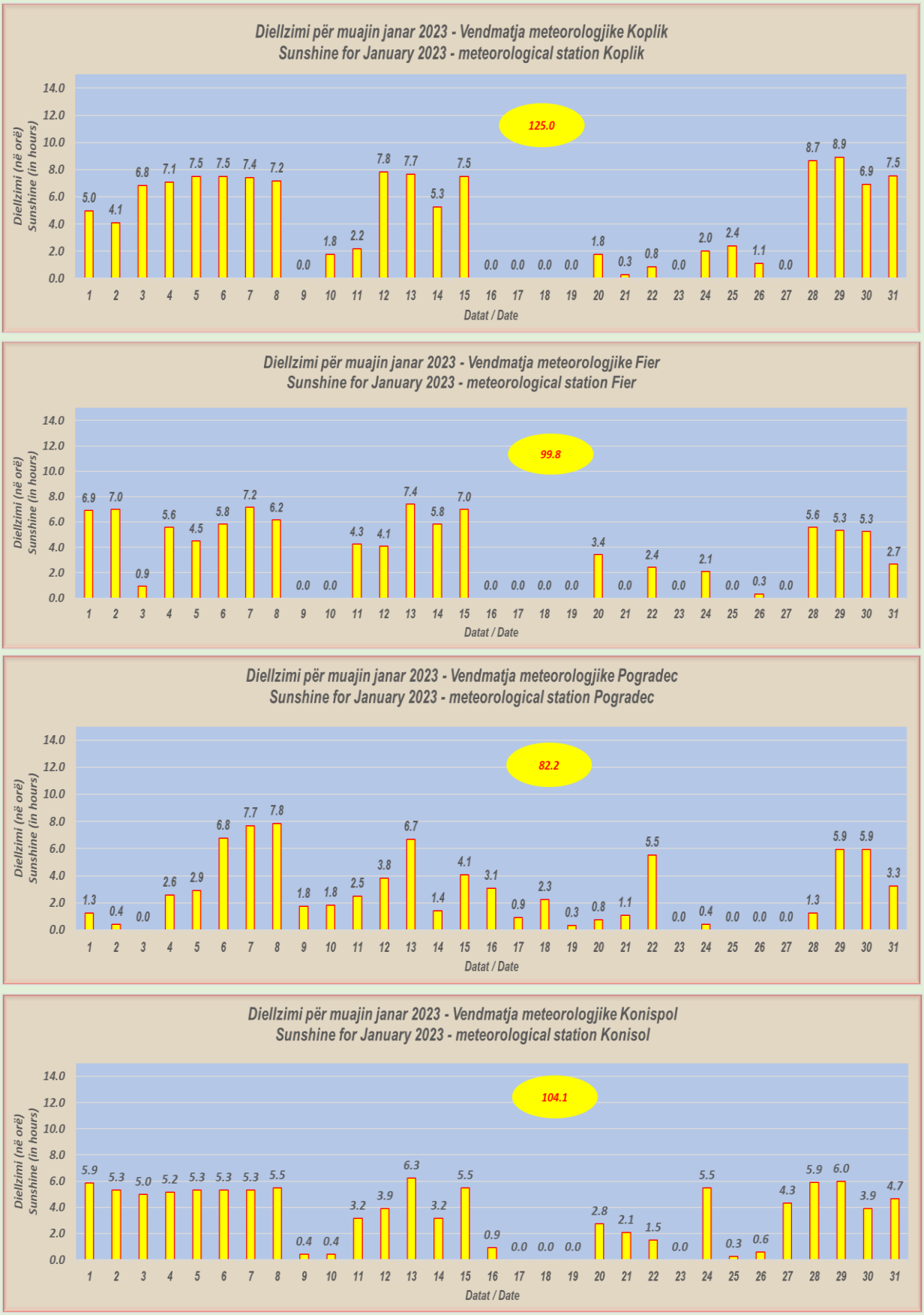


Figura Nr 5/ a,b,c dhe d – Kohëzgjatja e diellëzimit (në orë) për muajin janar 2023 për disa vendmatje meteorologjike të Shqipërisë.
Sunshine duration (in hour) for January 2023 some meteorological stations of Albania.

TEMPERATURAT E AJRIT

Në shkallë globale muaji janar 2023 u karakterizua me vlera të larta të temperaturave të ajrit krahasuar me vlerat e normës. Sipas raportit global të klimës për muajin janar 2023, temperatura mesatare globale e këtij muaji ishte 12.0°C ose 0.87°C mbi mesataren e shek. të 20-të. Sipas të dhënave shumëvjeçare muaji janar 2023 ishte muaji i shtatë më i ngrohtë në rregjistrin global 174-vjeçar.

Në figurën Nr. 6 dhe Nr. 7 paraqiten harta me situatat e temperaturave dhe anomalive të tyre në shkallë globale si dhe për kontinentin Europian për muajin janar 2023.

AIR TEMPERATURES

On a global scale, the month of January 2023 was characterized by high air temperature values compared to normal values. According to the January 2023 global climate report, thin month average temperature was 12.0°C or 0.87°C above the century average. the 20th. According to multi-year data, January 2023 was the seventh warmest month in the 174-year global record.

In figure No. 6 and No. 7, maps are presented with temperature situations and their anomalies on a global scale as well as for the European continent for the month of January 2023.

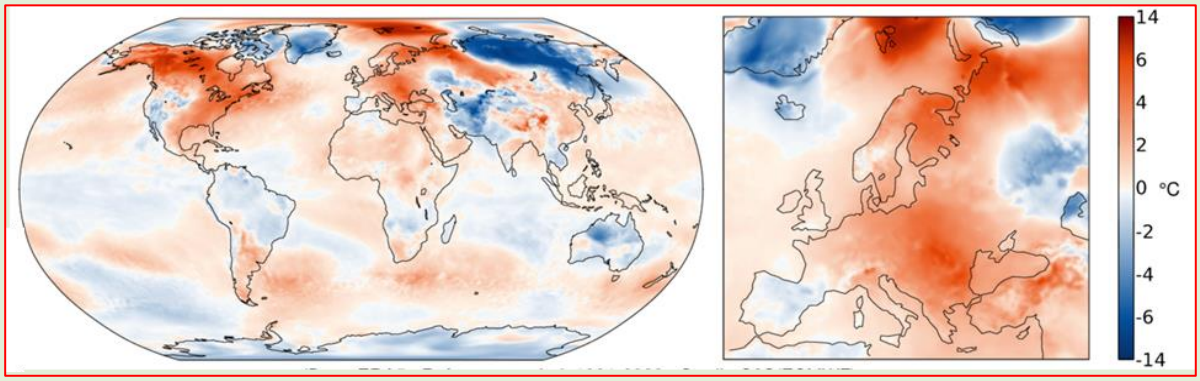


Figure Nr.6 - Anomalitë e temperaturës së ajrit pranë sipërfaqes për muajin Janar 2023 kundrejt periudhës 1991÷2020 në shkallë globale dhe për kontinentin Europian.
Surface air temperature anomaly in global scale and for the European continent for January 2023 compared to the period 1991÷2020 (Copernicus, ECMWF, etc.).

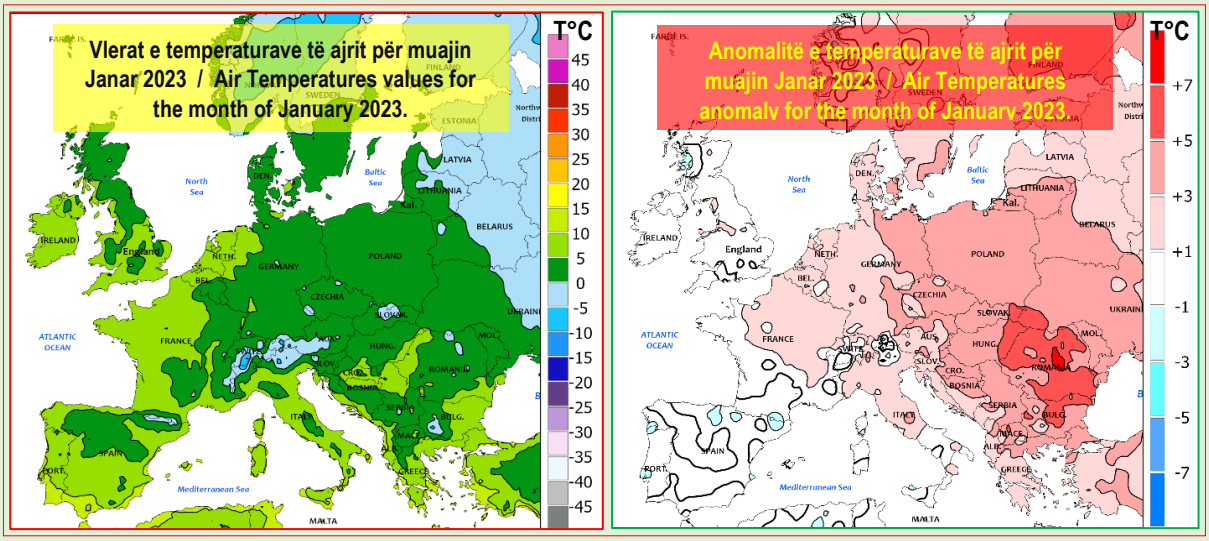


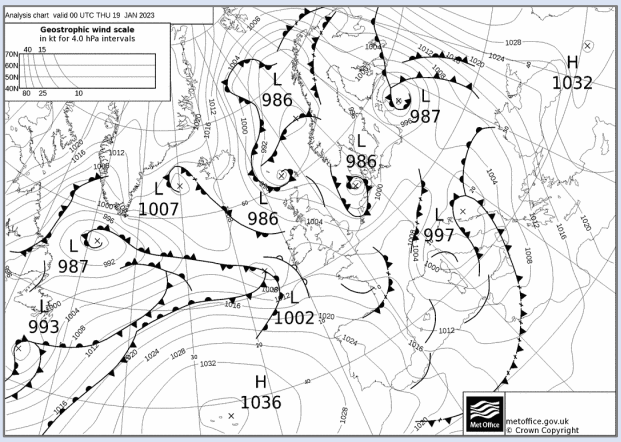
Figure Nr.7. - Vlerat e temperaturave mesatare të ajrit dhe anomalive të tyre për kontinentin Europian për muajin Janar 2023, sipas NOAA-s.
Values of mean air temperatures and their anomalies for the European continent for the month of January 2023, according to NOAA.

Situatat e ndryshme sinoptike ilustruar dhe në hartën e dhënë në figurën Nr.8 me një tipike prej tyre, që u alternuan herë pas here gjatë muajit janar 2023 mbi kontinentin Europian përcollën dhe mjaft paqendrueshmëri atmosferike që u reflektuan dhe në ecurinë e temperaturave.

The different synoptic situations illustrated in the map given in Figure No. 8 with a typical one of them, which alternated from time to time during the month of January 2023 over Europe, conveyed a lot of atmospheric instability that was also reflected in the trend of temperatures.

Figure Nr.8. – Situata sinoptike në Europë në orën 00:00 UTC, datë 19 janar 2023 sipas "Wetter3.de".

Synoptic situation in Europe at 00:00 UTC, January 19, 2023 according to "Wetter3.de".



Ecuria e anomalive të temperaturave të ajrit në shkallë kontinenti sipas javëve të ndryshme për muajin janar 2023, paraqiten ne hartat e figurës Nr.9.

The progress of air temperature anomalies on a continental scale according to different weeks for the month of January 2023, are presented in the maps of figure No.9.

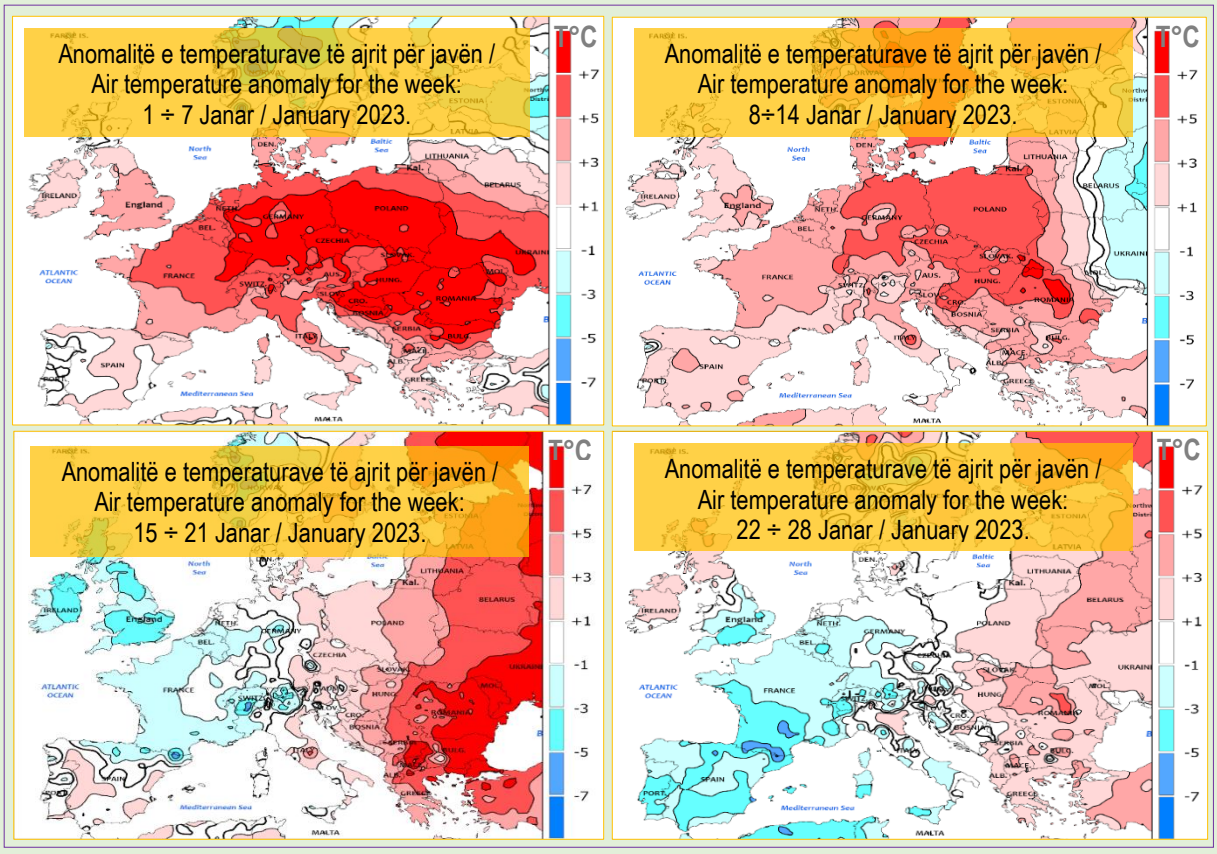


Figura Nr.9. -Vlerat e anomalive të temperaturave mesataret e ajrit për kontinentin Europian për 4 javët e muajit janar 2023, sipas NOAA-s.

Anomaly values of average air temperatures for the European Continent for the 4 weeks of January 2023, according to NOAA.

Vendi ynë karakterizohet me anomali pozitive, të cilat veçanërisht në javë e tretë janë më të theksuara dhe shkojnë deri në +3°C deri +5°C në zonat të catuara.

Vlerat e temperaturave mesatare të ajrit dhe ndryshimet me vlerat e normës referuar periudhës 1961-1990 për një sërë vendmatjesh meteorologjike të Sistemit Kombëtar të Monitorimit Meteorologjik, janë të paraqitura në figurën Nr.10 tregojnë për një anomali prej +2.9°C në shkallë vendi.

Our country is characterized by positive anomalies, which especially in the third week are more pronounced and go up to +3°C to +5°C in certain areas.

The values of average air temperatures and the changes with the values of the norm referred to the period 1961-1990 for a series of meteorological stations of the National Meteorological Monitoring System, are shown in figure No.10, indicating an anomaly of +2.9°C on a national scale.

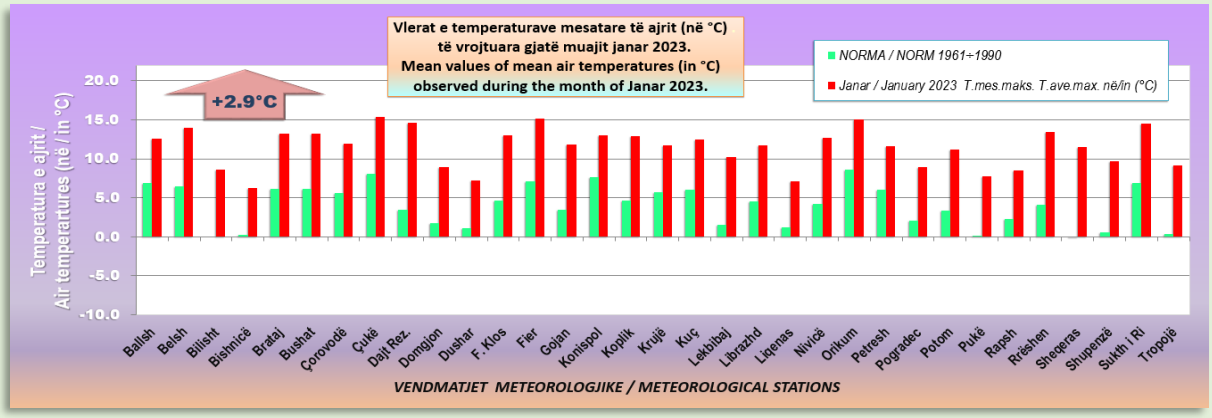


Figure Nr.10. - Vlerat e temperaturave mesatare të ajrit për disa vendmatje meteorologjike të muajit Janar 2023 për Shqipërinë.
Values of mean air temperatures for some meteorological stations of January 2023 for Albania.

Ecuria ditore e temperaturave maksimale dhe minimale të ajrit për 12 vendmatje meteorologjike të përzgjedhura për disa zona e nënzona klimatike të vendit së bashku me ecurinë ditore të reshjeve janë paraqitur në grafikët e dhënë në figurën Nr.11.

Sa i takon temperaturave maksimale të ajrit në shkallë Europiane hartat e dhëna në figurën Nr.12 paraqesin situatën e këtij treguesi sipas 4 javëve.

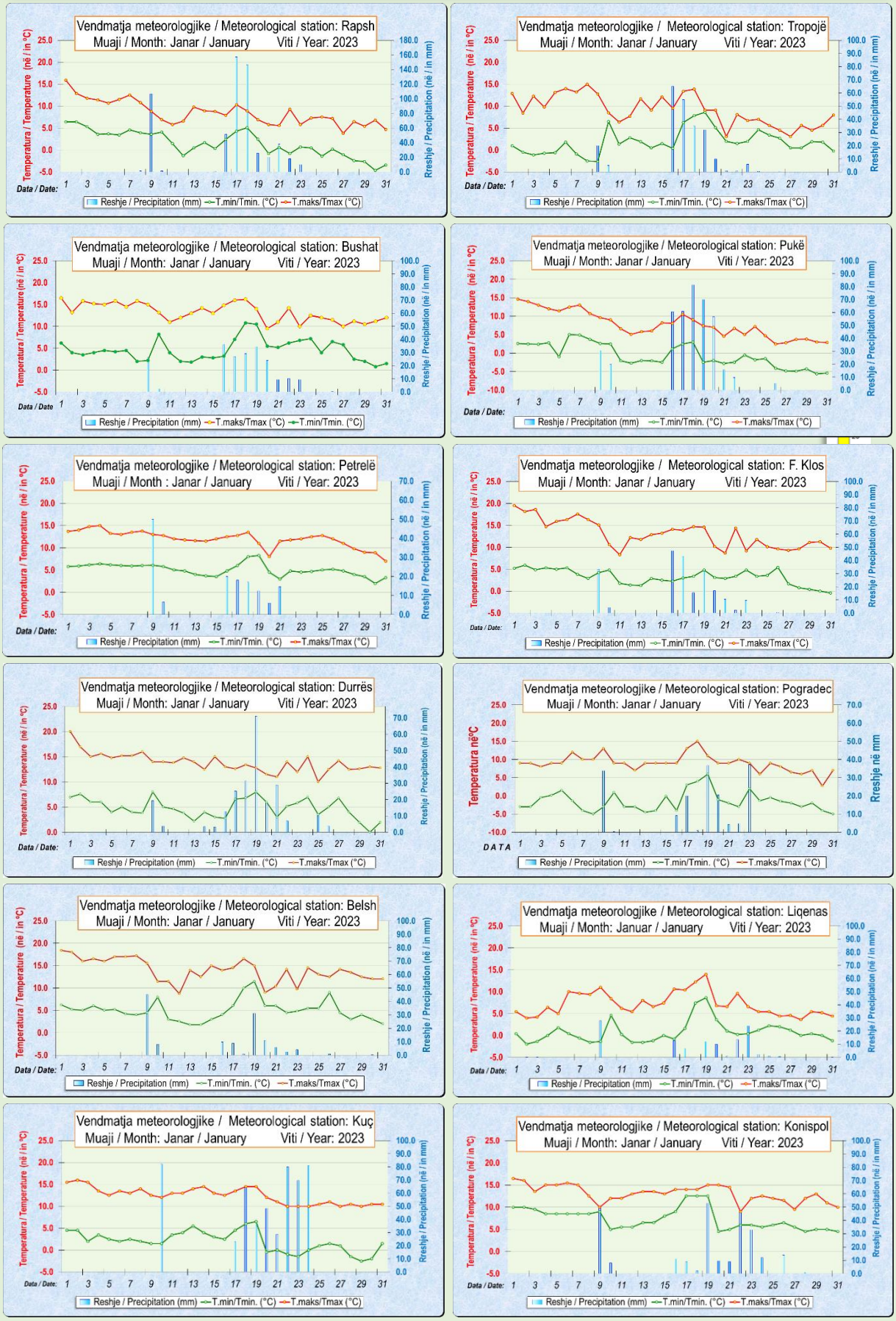
Të dhënat e vlerave maksimale të temperaturave të ajrit, të cilat shënojnë vlera relativisht të larta gjatë këtij muaji ku vlen për tu theksuar java e dytë në pjesën veriore e Ultësirës Perëndimore në territorin e Shqipërisë që karakterizohet me vlerat mjaft të larta. Për territorin e Shqipërisë në lidhje me këtë tregues për një sërë vendmatjesh meteorologjike për muajin janar 2023 të dhënat paraqiten grafikisht në figurën Nr.13 ku evidentohet një anomali prej +3.6°C në shkallë vendi.

The daily progress of the maximum and minimum air temperatures for 12 meteorological stations selected for several climatic zones and sub-zones of the country together with the daily progress of precipitation are presented in the graphs given in Figure No.11.

As for maximum air temperatures on a European scale, the maps given in figure No.12 present the situation of this indicator according to 4 weeks.

The data of the maximum values of air temperatures, which mark relatively high values during this month, where it is worth noting the second week in the northern part of the Western Lowlands in the territory of Albania, which is characterized by very high values. For the country territory, related to this index for a series of meteorological stations for the month of January 2023, the data is presented graphically in figure No.13, where an anomaly of +3.6°C is evident on a national scale.

Figure Nr. 11/1÷11/12 - Temperaturat ditore për disa vendmatje meteorologjike për muajin janar 2023 në Shqipëri.
The daily temperatures for some meteorological stations for January 2023 in Albania.



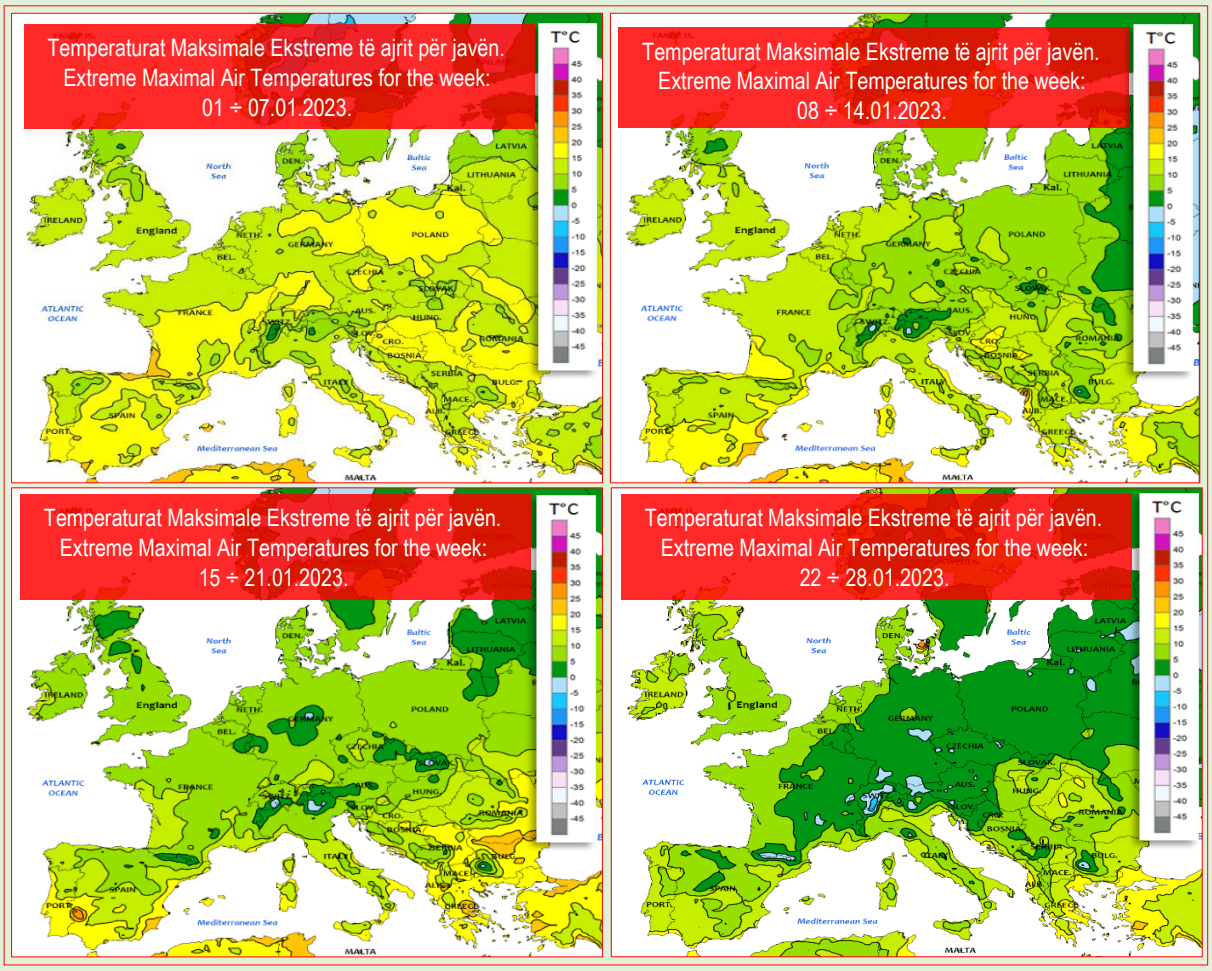


Figura Nr.12. - Vlerat e temperaturave maksimale ekstreme të ajrit për kontinentin Europian për 4 javët e muajit Janar 2023, sipas NOAA-s.
Extreme maximal values of air temperatures for European Continent for the 4 weeks of January 2023, according to NOAA.

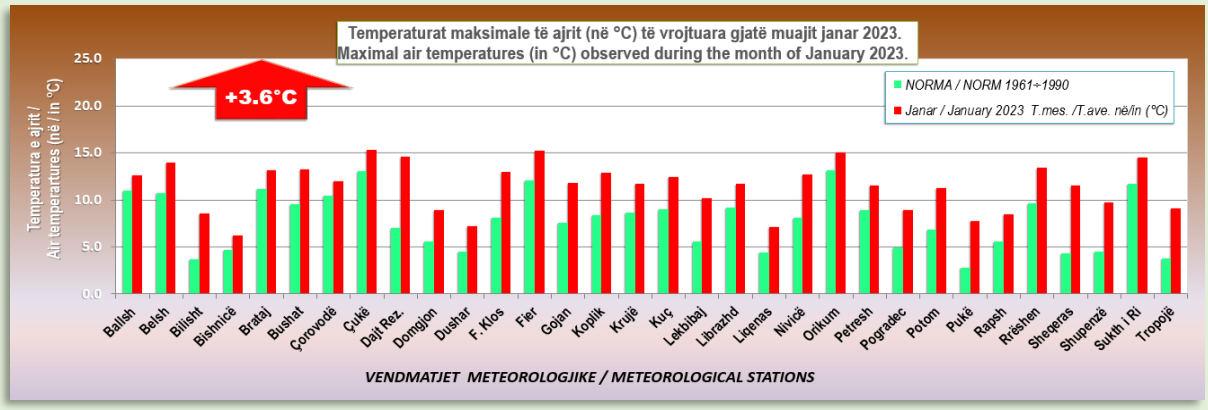


Figure Nr. 13. - Vlerat e temperaturave maksimale të ajrit për disa vendmatje meteorologjike të muajit Janar 2023 për Shqipërinë.
Values of maximal air tempertaures for some meteorological stations of January month 2023 for Albania.

Ndërkohë vlerat maksimale absolute të temperaturave të ajrit për disa vendmatje meteorologjike janë paraqitur grafikisht në figurën Nr.14 për muajin janar 2023 për Shqipërinë.

Meanwhile, the absolute maximum values of air temperatures for some meteorological stations are presented graphically in Figure No.14 for the month of January 2023 for Albania.

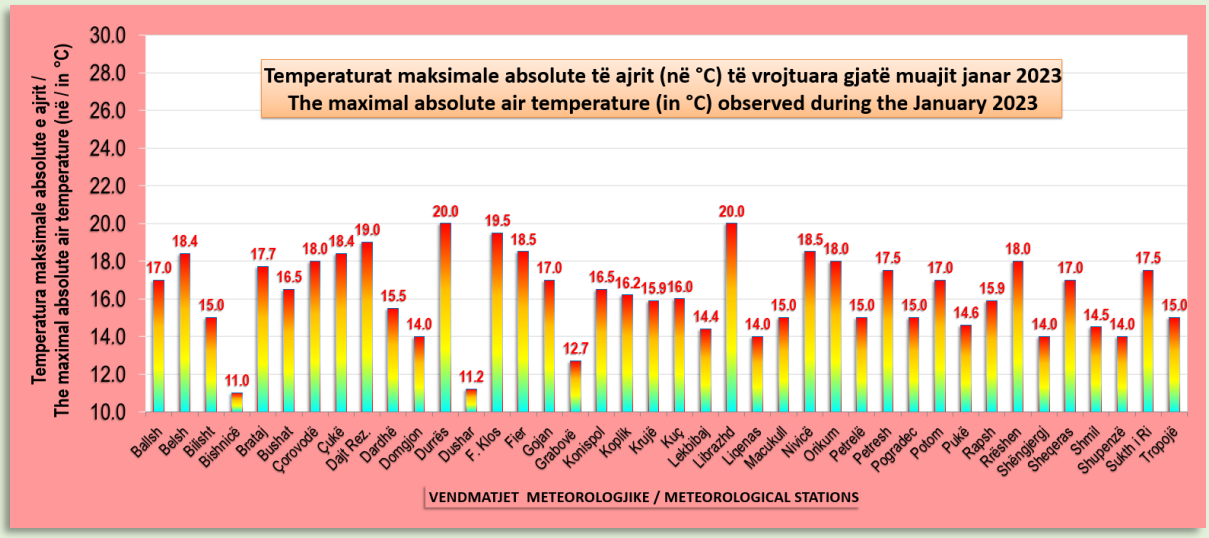


Figure Nr.14 - Vlerat e temperaturave maksimale të ajrit për disa vendmatje meteorologjike të muajit Janar 2023 për Shqipërinë.
Values of maximal air tempertaures for some meteorological stations of January 2023 for Albania.

Ashtu si vlerat e temperaturave maksimale të ajrit dhe ato minimale si në shkallë kontinentale dhe për vendin tonë paraqiten në terësi anomali pozitive. Në figurën në vijim Nr.15 paraqiten grafikisht të dhënat e temperaturave minimale për muajin janar për disa vendmatje meteorologjike të Shqipërisë. Si për temperaturat maksimale ashtu dhe ato minimale duhet theksuar se territori i vendit tonë përkundrejt situatës së këtyre treguesve në shkallë kontinentale ndodhet në periferinë e anomalive më të larta.

Like the values of the maximum air temperatures and the minimum ones, both on a continental scale and for our country, there are generally positive anomalies. In the following figure No. 15, the minimum temperature data for the month of January for several meteorological stations in Albania are presented graphically. Both for maximum and minimum temperatures, it should be noted that the territory of our country, compared to the situation of these indicators on a continental scale, is located in the periphery of the highest anomalies.

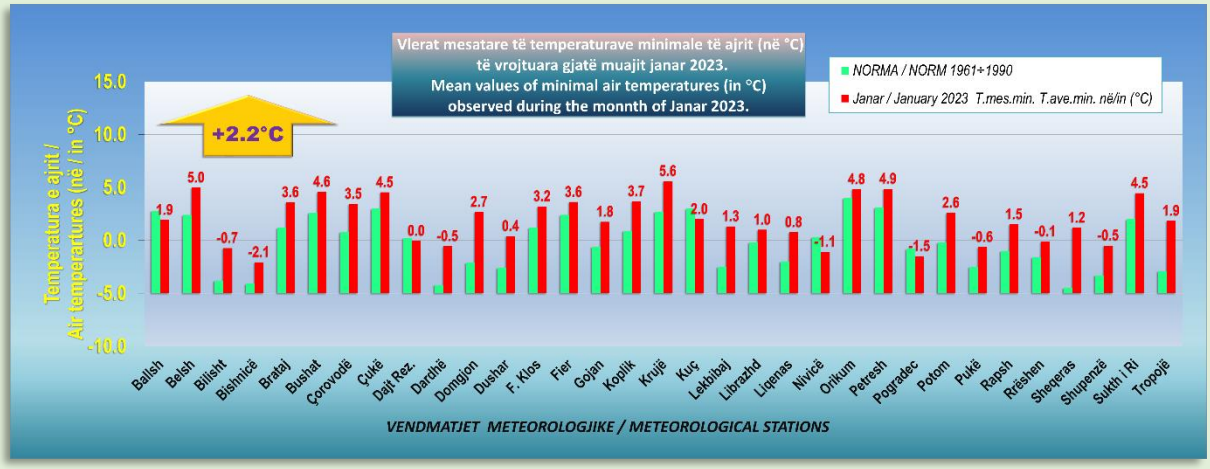


Figure Nr.15. - Vlerat e temperaturave minimale të ajrit për disa vendmatje meteorologjike të muajit Janar 2023 për Shqipërinë.
Values of minimum air tempertaures for some meteorological stations of January month 2023 for Albania.

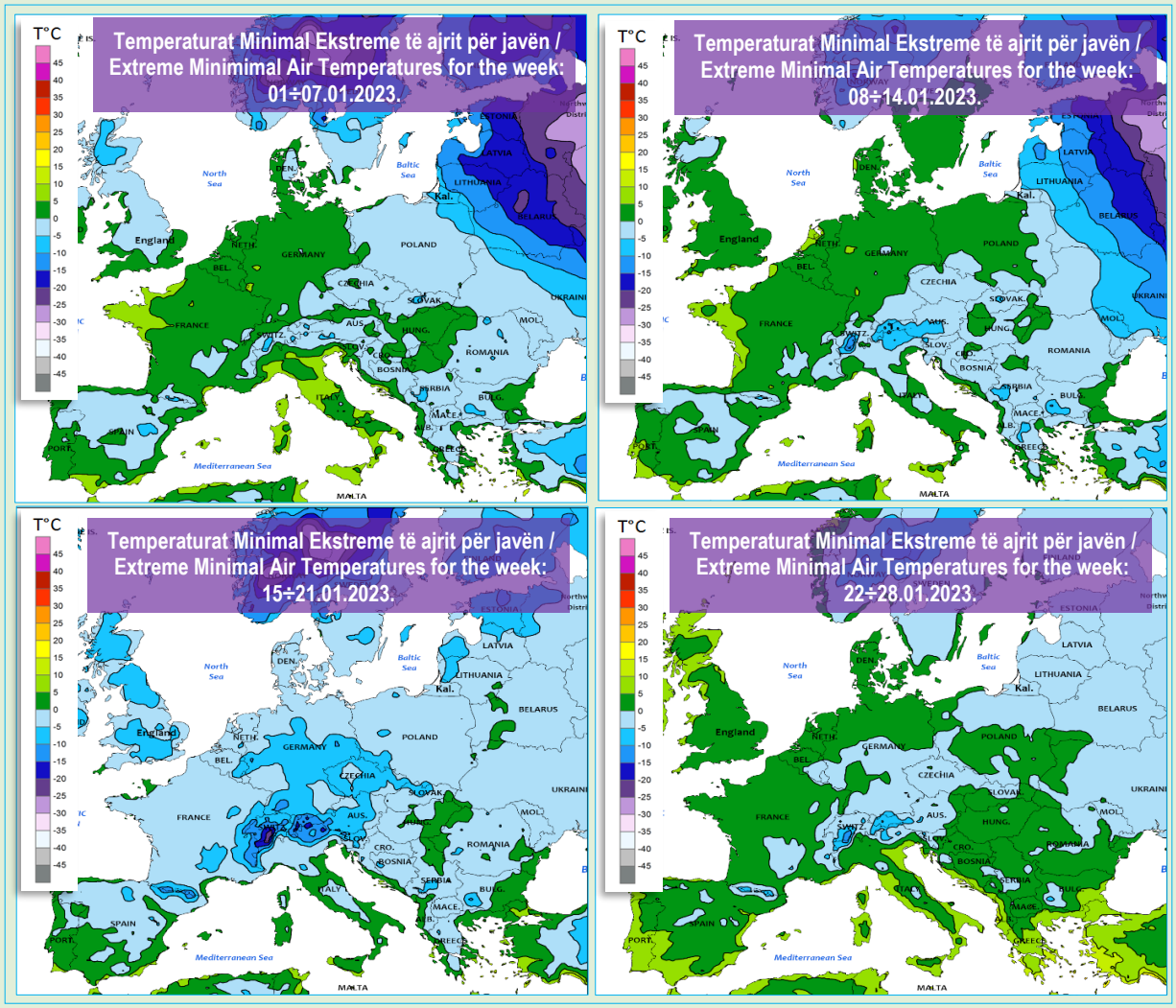


Figura Nr.16. - Vlerat e temperaturave minimale ekstreme të ajrit për kontinentin Europian për 4 javët e muajit Janar 2023, sipas NOAA-s.
Extreme minimal values of air temperatures for European Continent for the 4 weeks of January 2023, according to NOAA.

Në përfundim të kësaj analize për temperaturat e ajrit në vendin tonë në grafikun e dhëne në vijim në figurën Nr.17 paraqiten të dhënat e temperaturave minimale absolute të ajrit për muajin janar 2023 për disa vendmatje metorologjike.

At the end of this analysis of the air temperatures in our country, the following data graph in Figure No.17 shows the data of the absolute minimum air temperatures for the month of January 2023 for some meteorological stations.

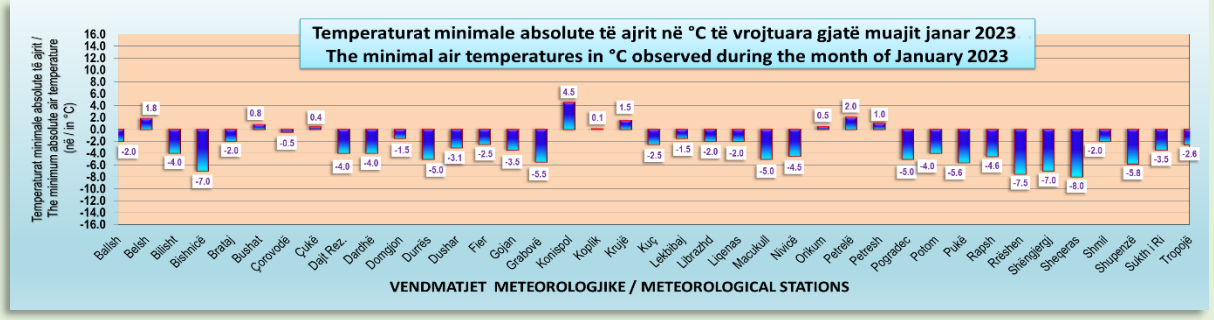


Figure Nr.17 - Vlerat e temperaturave minimale ekstreme të ajrit për Shqipërinë për muajin Janar 2023.
Extreme minimal values of air temperatures for Albania for January 2023.

RESHJET ATMOSFERIKE

Reshjet atmosferike gjatë muajit janar 2023 kanë patur shpërndarje jo uniforme në shkallë kontinentale. Duke iu referuar figurës Nr.18 ku paraqiten reshjet dhe

ATMOSPHERIC PRECIPITTAION

Atmospheric precipitation during the month of January 2023 had uneven distri-bution on a continental scale. Referring to figure No.18 where rainfall and the

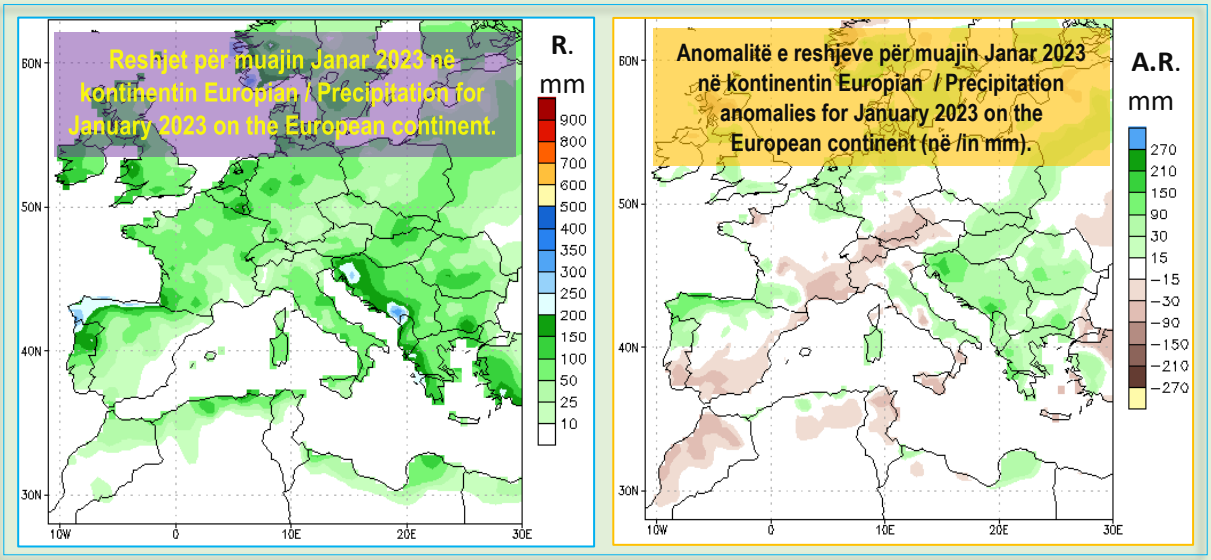


Figura Nr.18. - Reshjet për muajin Janar 2023 në kontinentin Europian dhe anomalitë kundrejt periudhës1981÷2010, sipas NOAA-s. / Rainfall for January 2023 at the European continent and their anomalies referring to the period 1981÷2010 according to NOAA.

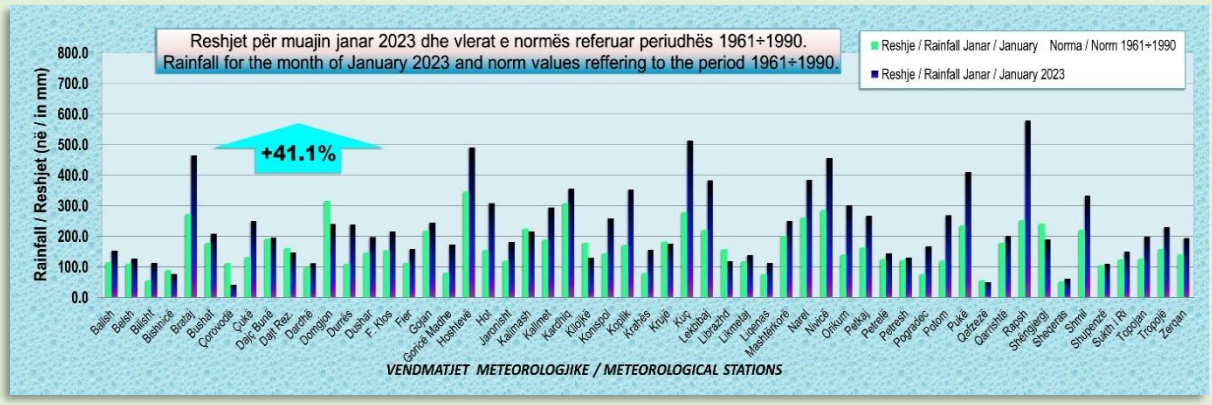


Figura Nr.19. - Lartësia e reshjeve për disa vendmatje meteorologjike të muajit Janar 2023 për Shqipërinë. / The amount of precipitations for some meteorological stations of January month 2023 for Albania..

anomalitë përkatëse në shkallë Europiane, vërehet se në pjesën veriore të gadishullit Iberik, Britania perëndimore, Vendet e Ulta, territori i Ballkanit si dhe gadishulli i Apenineve me përjashtim të Siçilisë paraqiten me anomali pozitive të reshjeve.

Shqipëria preket nga këto anomali pozitive, të cilat duke iu referuar të dhënave nga Sistemi Kombëtar i Monitorimit Meteorologjik arrijnë në +41.1% kundrejt lartësisë mesatare të normës klimatike

correspo-nding nomalies are presented on a Euro-pean scale, it can be noted that in the northern part of the Iberian Peninsula, in western Britain, in the Netherlands, the territory of the Balkans, in the Apennine Peninsula with the exception of Sicily are positive rainfall anomalies.

Albania has been affected by these positive anomalies which, referring to the data from the National Meteorological Monitoring System, reach +41.1% compa-red to the mean height of the climatic norm

1961-1990 së reshjeve atmosferike, siç paraqiten grafikisht dhe në figurën Nr.19.

Në figurën Nr.20 paraqitet harta e shpërndarjes së reshjeve për territorin e Shqipërisë për muajin janar 2023. Zona e Alpeve Perëndimore dhe malësia jug-perëndimore janë zonat me lartësinë më të madhe reshjeve në gjithë territorin me më shumë se 300 mm, ndërsa pjesa juglindore ka më pak reshje në nivelin e 150 mm.

Në pjesën tjetër të territorit reshjet kanë patur mesatarisht një vlere prej 200 mm kryesisht në zonën qendrore me tendencë të theksuar rritje në pjesët malore.

Në figurën Nr.21 analizohet treguesi i numrit të ditëve me reshje nga ku për muajin janar 2023 kundrejt periudhës së normës klimatike 1961-1990 reshjet janë nën normë me -1.7 %. Si rrjedhojë vërehet intensitet i shtuar në raport të shpërndarjes kohore. Kjo situatë është e dukshme dhe në figurën Nr.21 ku numri i ditëve me reshje me intensitet mbi 20.0 mm është mbi 5 ditë sidomos në zonën fiziko-gjeografike të alpeve të Shqipërisë dhe në zonën Jug-Perëndimore.

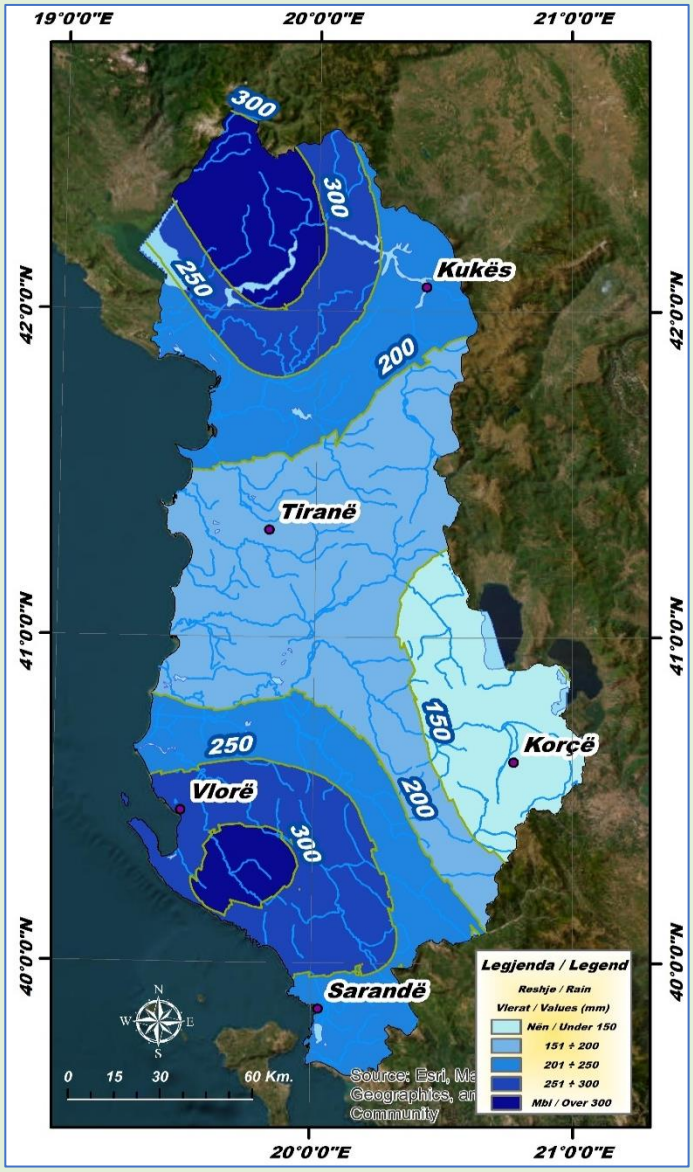


Figure Nr.20. - Vlerat e reshjeve (në mm) për Shqipërinë për muajin Janar 2023.
The precipitation values (in mm) for Albania for the month of January 2023.

1961-1990 of atmospheric precipitation, as grafically are resented on the figure Nr.19.

Figure no. 20 shows the map of the distribution of rainfall for the territory of Albania during the month of January 2023. The area of the Western Alps and the southwestern highlands are the areas with the highest rainfall in the entire territory with more than 300.0 mm, while in the southeastern part there is less rainfall at the limit of 150.0 mm. In the rest of the territory, the rainfall continued to average 200.0 mm, mainly in the central area, with a pronounced tendency to increase in the mountainous parts.

Figure No.21 analyzes the indicator of the number of days with rain, where for the month of January 2023 compared to the climate norm period 1961-1990, the rainfall is below the norm by -1.7%. As a result, an increased intensity is observed in relation to the time distribution. This situation is also visible in figure No.21 where the number of days with rainfall with an intensity of over 20.0 mm is over 5 days, especially in the physical-geographic area of the Alps of Albania and in the area south-west.

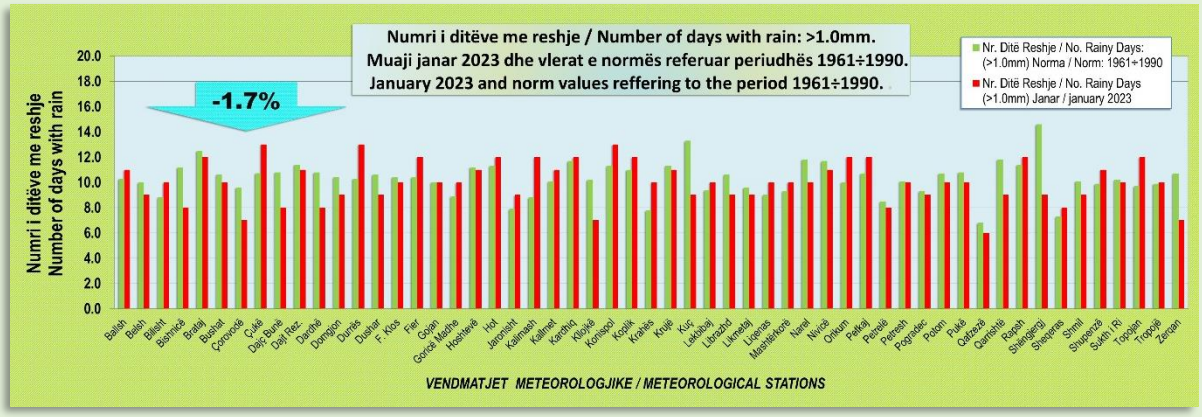


Figura Nr.21. – Numri i ditëve me reshje për disa vendmatje meteorologjike të muajit Janar 2023 për Shqipërinë.
The rainy days for some meteorological stations of January month 2023 for Albania.

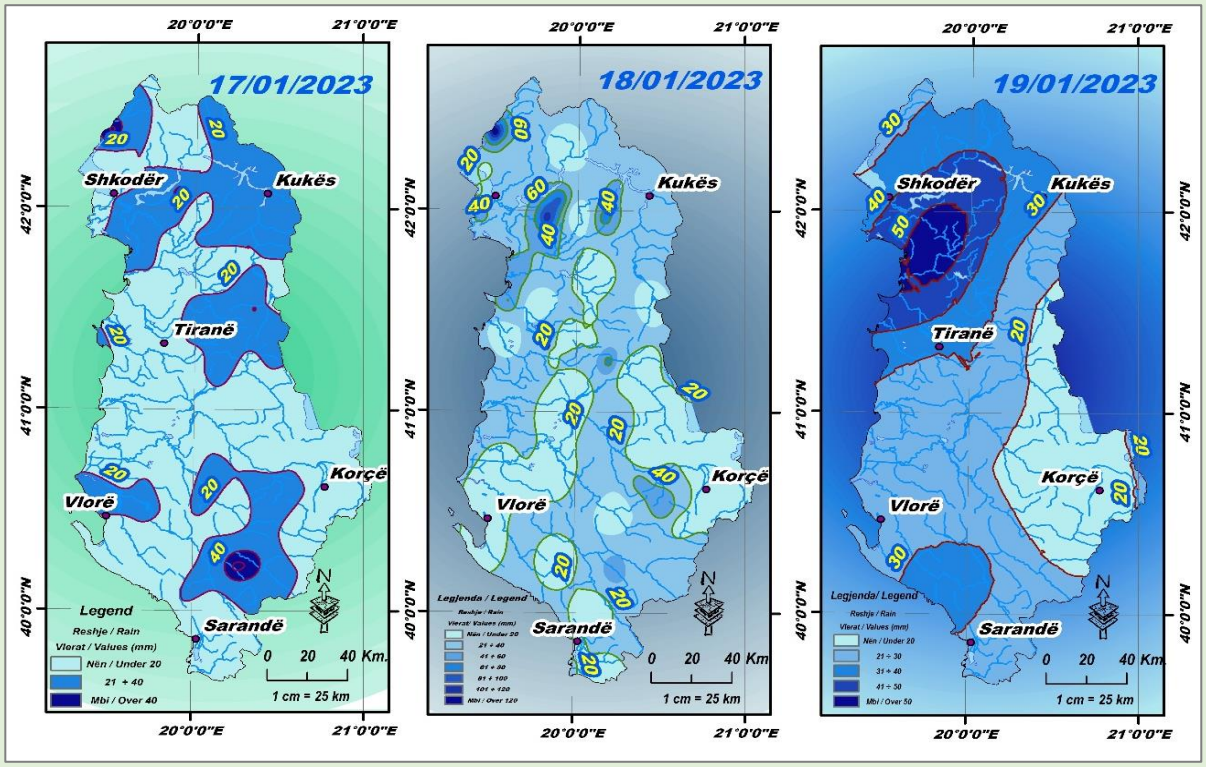


Figure Nr.22. - Vlerat e reshjeve (në mm) për Shqipërinë për datat 17, 18 dhe 19 Janar 2023
The precipitation values (in mm) for Albania for date 17,18 and 19 January 2023.

Ditët me më shumë reshje gjatë muajit janar 2023 ka qenë në intervalin kohor nga 17 deri në 19 janar të paraqitura në figurën Nr.22. Gjatë këtyre ditëve ka ushtruar ndikim fusha barike e presionit të ulët me qendër në veri të Adriatikut. Sistemi frontal, i cili ka kaluar gjatë këtyre ditëve ka sjellë reshje me intensitet 24 orësh mbi 50 mm në zonën e Nën-Shkodrës – Lezhë, siç tregohet dhe në figurën Nr.22.
Në figurën Nr.23paraqitet grafiku i reshjeve maksimale 24 orëshe e shoqëruar në figurën

The days with the most precipitation during the month of January 2023 was the time interval from January 17 to 19, presented in figure No.22. During these days, the baric field of low pressure, centered in the north of the Adriatic Sea, exerted its influence. The frontal system that has passed these days has brought rainfall with a 24-hour intensity of over 50 mm in the Nen-Shkodra Lezhe area as shown in figure No.22.
Figure No.23 shows the graph of maximum 24-hour rainfall accompanied in Figure

Nr.24 me hartën përkatëse ku zona veri-

No.24 with the corresponding map where

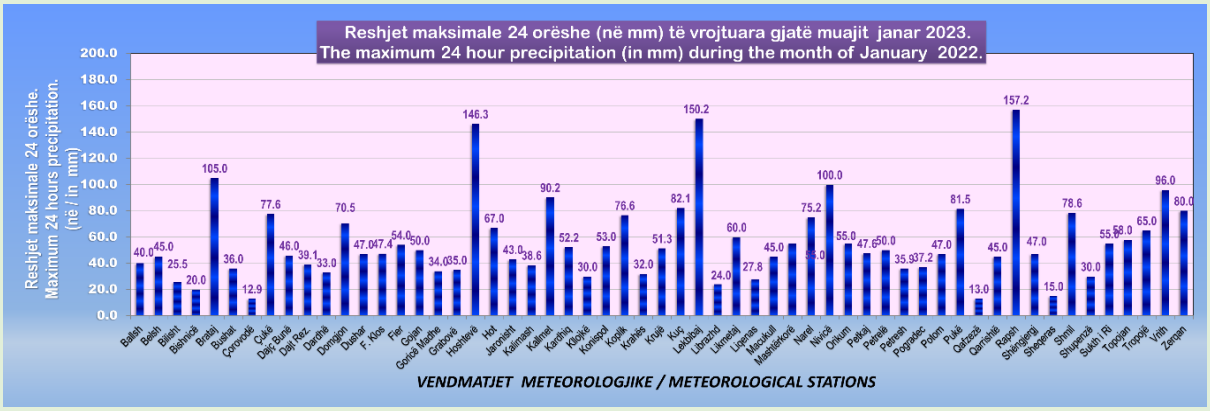


Figure Nr.23. – Reshjet maksimale 24 orëshe për disa vendmatje meteorologjike të muajit Janar 2023 për Shqipërinë.

The 24 hour maximal precipitation for some meteorological stations of January month 2023 for Albania.

përëndimore e Shqipërisë ka intesitetin më të lartë 24 orësh me mbi 80.0 mm reshje shiu.

Në vlerësimin e reshjeve atmosferike të vrojtuara për muajin janar 2023 një rëndësi të veçantë paraqet dhe treguesi i anomalive të tyre i shprehur në % kundrejt vlerave të normës. Në figurën në vijim Nr.xx paraqitet situata me vlerat e këtij treguesi në shkallë kontinentale ndërsa në mënyrë me të detajuar për vendin tonë këto anomali paraqiten në hartën e dhënë në figurën Nr.25.

Gjatë muajit janar 2023 u vrojtuan dhe reshje dëbore, të cilat kryesisht u vrojtuan në zonat malore në lartësi mbi 800 apo 1000 metër mbi nivelin e detit.

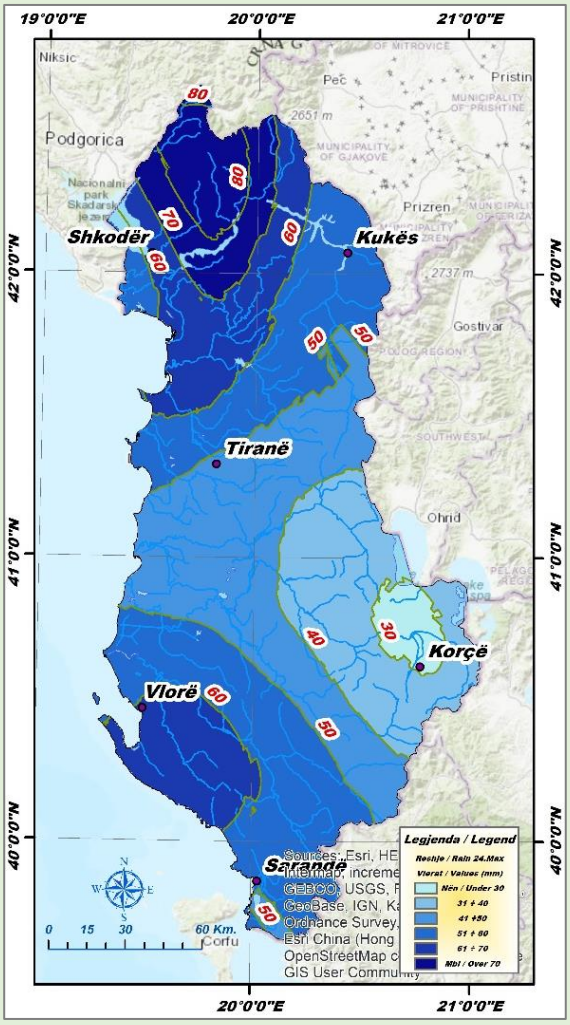


Figure Nr.24. – Lartësia maksimale 24 orëshe e reshjeve për muajin Janar 2023 për Shqipërinë.

The 24-hour maximal precipitation values of January month 2023 for

the northwest area of Albania has the highest 24-hour intensity with over 80.0 mm of rain.

In the assessment of the observed atmospheric precipitation for the month of January 2023, the indicator of their anomalies expressed in % compare to the norm values is of particular importance. The following figure No.xx shows the situation with the values of this indicator on a continental scale, while in more detail for our country, these anomalies are presented in the map given in figure No.25.

During the month of January 2023, snowfalls were also observed, which were mainly observed in mountainous areas at heights above 800 or 1000 meters above sea level.

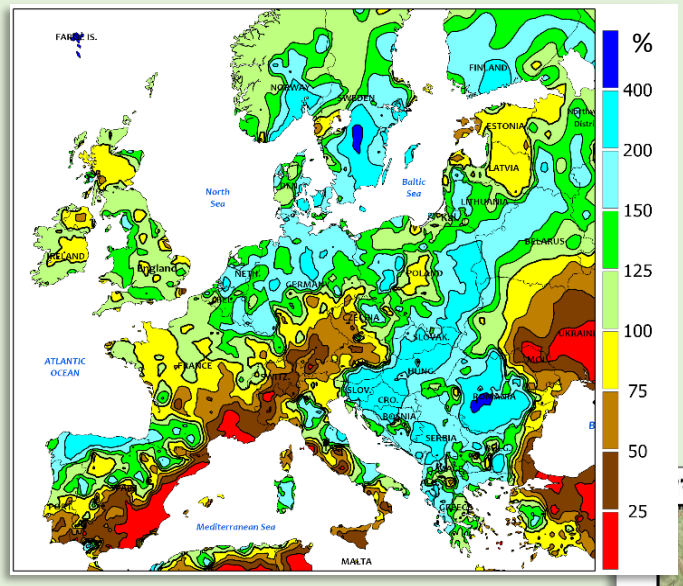


Figure Nr.25 - Anomalitë e reshjeve për muajin Janar 2023 në kontinentin Europian (in %) sipas NOAA.

Precipitation anomalies for January 2023 on the European continent (në /in %) according to NOAA.

Figure Nr.26. – Anomalitë e reshjeve në % kundrejt vlerave të normës për muajin Janar 2023 për Shqipërinë.
The precipitations anomalies in % for January month 2023 compare to norm values for Albania.

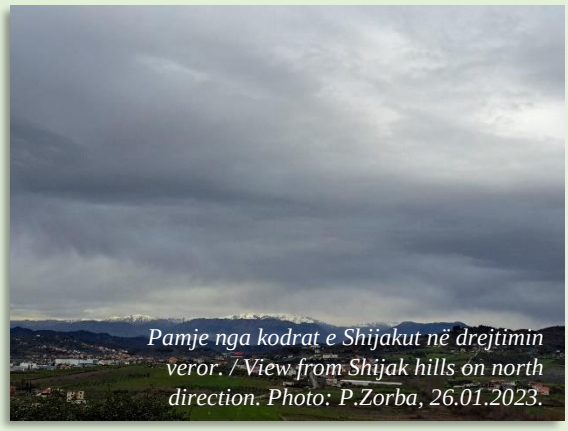
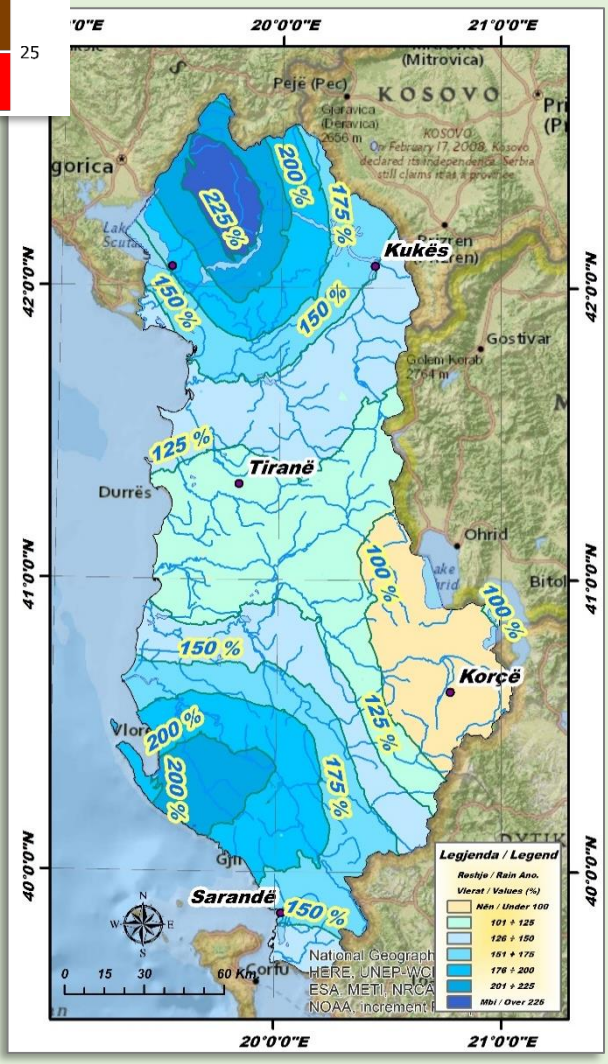

Pamje nga kodrat e Shijakut në drejtimin veror. / View from Shijak hills on north direction. Photo: P.Zorba, 26.01.2023.

Figure Nr.27. – Situata e motit me datë 26 Janar 2023 për pjesën qendrore të Shqipërisë .
Weather situattion on date January 26, 2023 for central part of Albania.



Disa të dhëna për lartësinë e dëborës gjatë këtij muaji paraqiten në tabelën Nr.1 në vijim, ndërsa për ilustrim pamja në figurën Nr.27 tregon për mbulesën e deborës e kreshat e vargmaleve të Skënderbeut për zonën Krujë – Tiranë.
Në tërësinë e vlerësimit të reshjeve për muajin janar 2023 një informacion plotësues në shkallë kontinetale për dy peri

Some data on the height of the snow during this month are presented in the following table No.1, while for illustration the view in the picture No.27 shows the snow cover and the crests of the Skanderbeg mountain ranges for the area Krujë - Tirana.
In the entirety of the rainfall assessment for the month of January 2023, additional information on a continental scale for the

Table Nr.1 – Lartësitë e reshjeve të dëborës gjatë muajit janar 2023 në disa vendmatje meteorologjike për Shqipërinë.
Snow levels for some meteorological stations for Albania during the January 2023.

Nr.	Vendmatja meteorologjike Meteorological station	Bora / Snow (në/in cm)	No.	Vendmatja meteorologjike Meteorological station	Bora / Snow (në/in cm)
1	**Bilisht**	**18.5**	8	**Kalimash**	**12.0**
2	**Bishnicë**	**2.0**	9	**Narel**	**7.0**
3	**Dardhë**	**10.0**	10	**Petkaj**	**2.0**
4	**Dushar**	**10.0**	11	**Qarrishtë**	**5.0**
5	**Goricë Madhe**	**3.0**	12	**Rapsh**	**10.0**
6	**Grabovë**	**10.0**	13	**Rrëshen**	**31.0**
7	**Jaronisht**	**5.0**	14	**Topojan**	**3.0**

-udhat më të veçanta, ku dalin në pah reshjet e shumta të vrojtuara në vendin tonë.

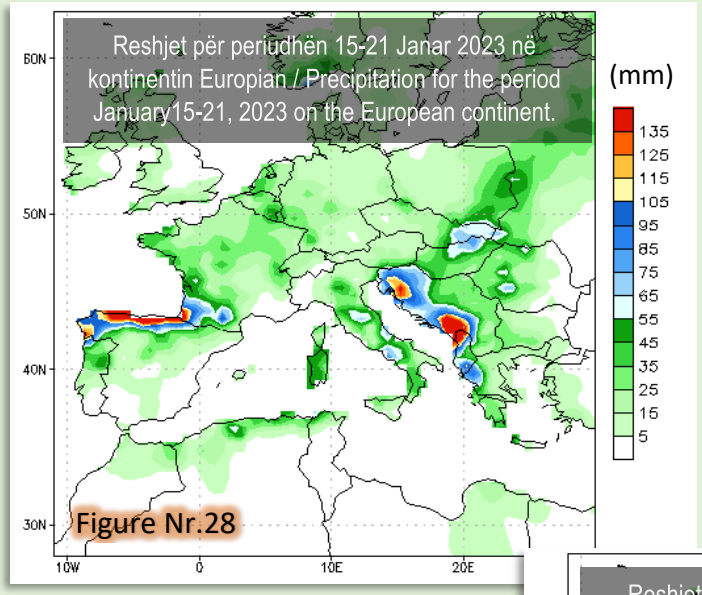


Figure Nr.28

Parë në një këndvështrim kontinental në hartat e dhëna në vijim në figurat Nr.28 dhe Nr.29 paraqiten reshjet e periudhës 15-21 janar dhe ato të periudhës 21-27 janar 2023.

Mjaft qartë shihet se territori i vendit tonë si në pjesën veriore ashtu dhe atë jugore është karakterizuar në nivele mjaft të larta të reshjeve atmosferike përkundrejt gjithë hapësirës tjetër të kontinetit Europian.

for the two most special periods, where the huge amount of rainfall observed in our country stands out.

Seen from a continental perspective, the following maps in figures No.28 and No.29 show the rainfall for the period 15-21 January and those for the period 21-27 January 2023.

It is quite clear that the territory of our country, both in the northern and southern parts, is characterized by high levels of atmospheric precipitation compared to the rest of the European continent.

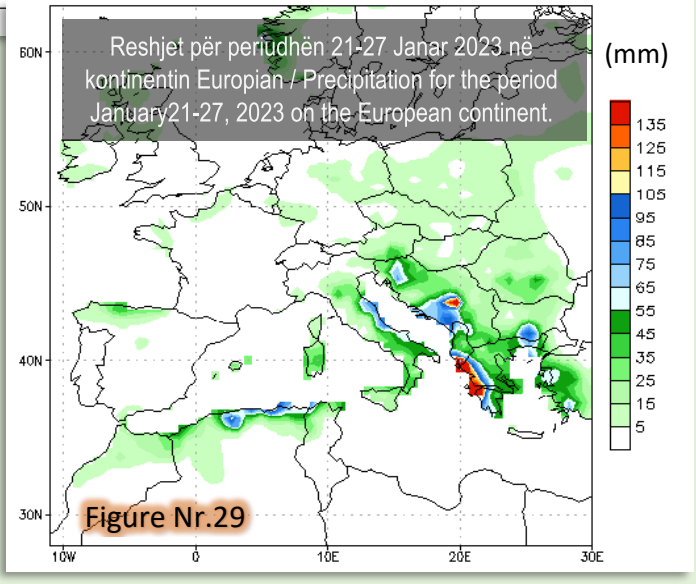


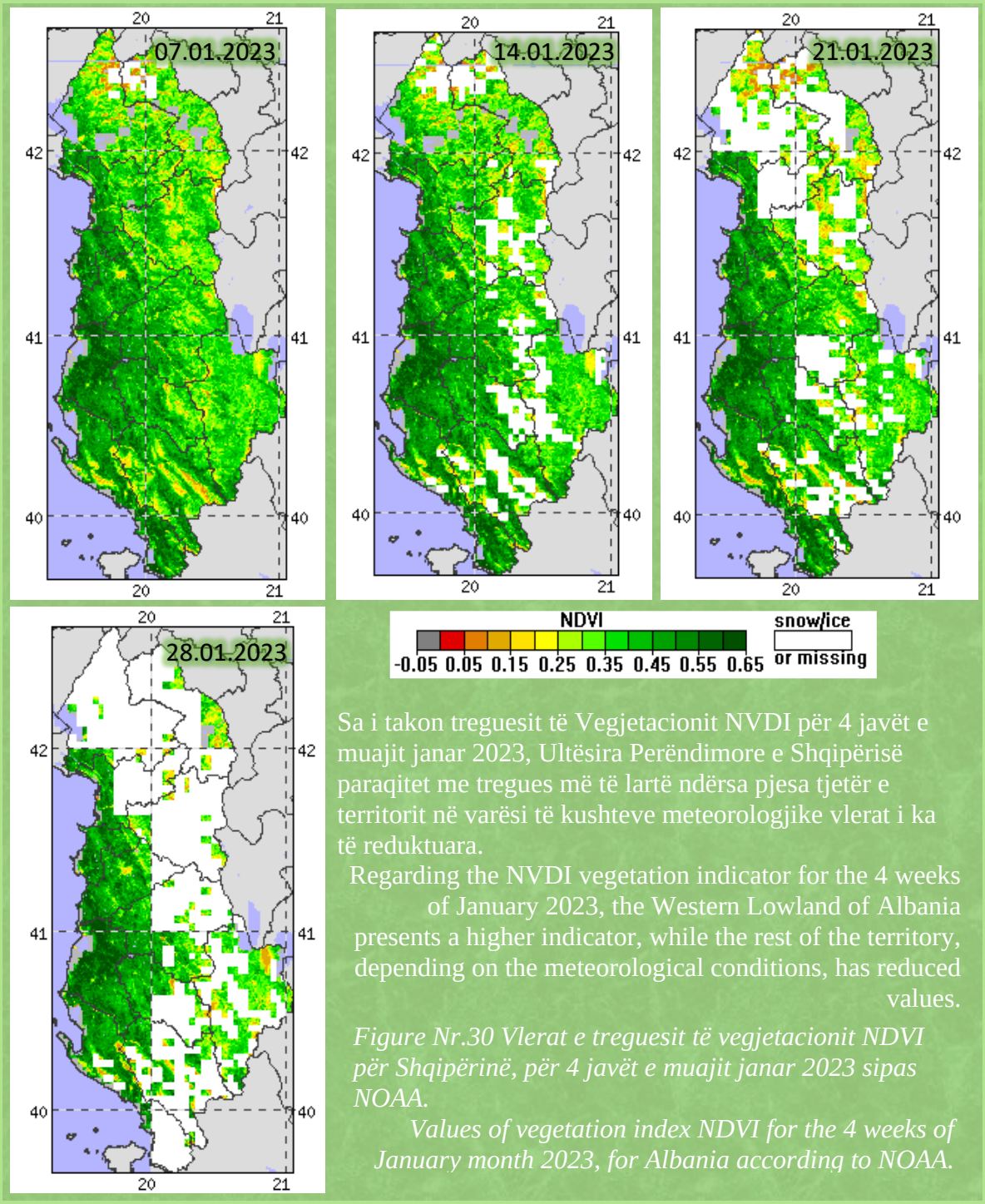
Figure Nr.29

AGROMETEOROLOGJI

Muaji janar 2023 vazhdon të jetë muaj qetësie sa i takon vegjetacionit. Në gjithë territorin e vendit bimësia është në “fjetje relative”, por kushtet meteorologjike të këtij muaji ndikojnë në ecurinë jetësore të kulturave bujqësore në fazat e mëpasëshme.

AGROMETEOROLOGY

The month of January 2023 continues to be a month of calm as far as vegetation is concerned. Throughout the territory of the country, the vegetation is in "relative sleep", but the meteorological conditions of this month affect the vital progress of agricultural crops in the subsequent stages.



Sa i takon treguesit të Vegjetacionit NVDI për 4 javët e muajit janar 2023, Ultësira Perëndimore e Shqipërisë paraqitet me tregues më të lartë ndërsa pjesa tjetër e territorit në varësi të kushteve meteorologjike vlerat i ka të reduktuara.

Regarding the NVDI vegetation indicator for the 4 weeks of January 2023, the Western Lowland of Albania presents a higher indicator, while the rest of the territory, depending on the meteorological conditions, has reduced values.

Figure Nr.30 Vlerat e treguesit të vegjetacionit NDVI për Shqipërinë, për 4 javët e muajit janar 2023 sipas NOAA.

Values of vegetation index NDVI for the 4 weeks of January month 2023, for Albania according to NOAA.

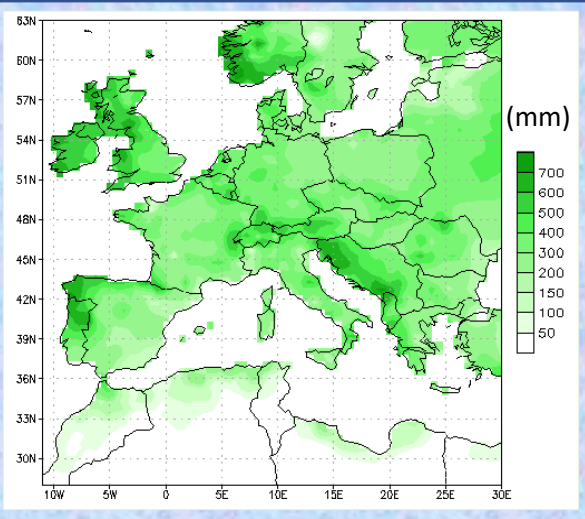


Figure Nr.31- Vlerat e përllogaritura të lagështisë së tokës për muajin janar 2023 (mm/muaj) sipas NOAA.
Calculated soil moisture for January month 2023 (mm/month) according to NOAA.

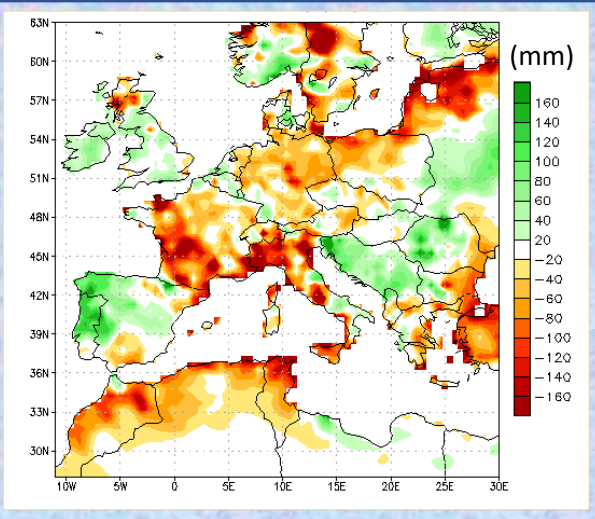


Figure Nr.32 - Vlerat e përllogaritura të anomalive të lagështisë së tokës për muajin dhjetor 2023 (mm/muaj) sipas NOAA.
Calculated soil moisture anomalies for January month 2023 (mm) according to NOAA.

Situata me gjendjen e lagështisë së tokës për kontinentin europian për muajin janar 2023 dhe anomalitë e saj të përllogaritura paraqitet në hartat e dhëna në figurën Nr.31&32. Vendi ynë siç shihet dhe në figurë praqitet në pjesën veriore me vlera më të larta anomalie të këtij treguesi, pjesa qendrore e me një situatë defiçitare, ndërsa pjesa jugore e vendit më pranë vlerave normale.

Një tregues i rëndësishëm është dhe vlerësimi i ditëve me ngrica. Ditët me temperatura të ajrit nën pragun 0°C për muajin janar 2023 u përllogaritën për disa vendmatje meteorologjike të përzgjedhura për zonat e nënzonat e ndryshme klimatike të Shqipërisë dhe janë paraqitur në grafikun e dhënë në figurën Nr.33.

The situation with the state of soil moisture for the European continent for the month of January 2023 and its calculated anomalies is presented in the maps given in figure No.31&32. Our country, as seen in the figure, is presented in the northern part with higher abnormal values of this indicator, the central part with a deficit situation, while the southern part of the country is closer to normal values.

An important indicator is the assessment of frosty days. The days with air temperatures below the 0°C threshold for the month of January 2023 were calculated for several meteorological stations selected for different climatic zones and subzones of Albania and are presented in the graph given in figure No.33.

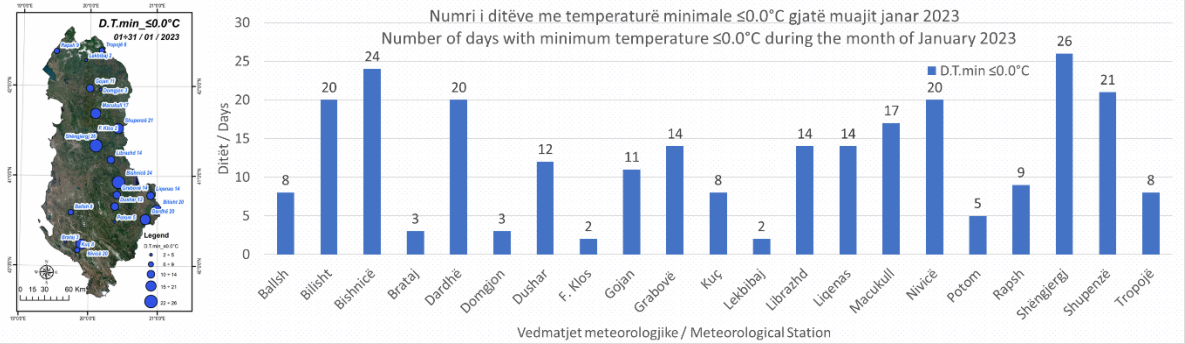


Figure Nr.33- Numri i ditëve me temperaturë minimale ≤0.0°C gjatë muajit janar 2023.
Number of days with minimum temperature ≤0.0°C during the month of January 2023.

"Comparative Analysis of SPI Errors Generated by Software Tools Using Data Series of Different Lengths for Meteorological Stations in Mediterranean and Humid Continental Climates"

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Abstract

Drought analysis often involves the use of various software and models. Nowadays, one commonly used methodology for drought estimation is the Standard Precipitation Index (SPI), which is widely applied in many countries. This study compares the SPI index values obtained from different software tools, namely "RDIT," "SPI Generator," and "DrinC," using monthly precipitation data as input. The comparison focuses on different lengths of data series while maintaining the same time frame, with a minimum duration of 30 years.

The analysis utilizes monthly precipitation data from two meteorological stations representing Mediterranean and Humid Continental climates. Despite employing the same methodology across the software tools, variations in the resulting SPI values are observed. These discrepancies or anomalies cannot be disregarded, as they can significantly impact drought assessments, sometimes even leading to a shift of two categories within the drought classification.

To evaluate these SPI discrepancies resulting solely from variations in the length of precipitation data series used, Spearman's rank correlation coefficient and other relevant indexes are employed. By examining the SPI changes, this study aims to shed light on the influence of data series length on drought evaluations, independent of the methodology or climate factors.

Keywords: Standard Precipitation Index - SPI; drought; meteorology; data processing; climate; "RDIT" software; "SPI Generator"; "DrinC".

Introduction

The analysis of drought using the Standard Precipitation Index (SPI) methodology relies on software tools such as the "RDIT" software available for purchase at AgriMetSoft.com, the "DrinC" software developed by the National Technical University of Athens, and the "SPI Generator" application provided by the National Drought Mitigation Center at the University of Nebraska-Lincoln, which is accessible for free on their respective websites. These tools require monthly precipitation data from meteorological stations.

In this study, the precipitation data from the Korça meteorological station in Albania, representing the Mediterranean Climate, and the Center Park meteorological station in New York (CpNy), USA, are utilized. The data spans a considerable observation period from 1931 to 2020, enabling comparisons between different time frames such as 30 or 60 years, as well as longer periods such as 90 years or other combinations.

It is widely recognized in meteorology that longer data series yield more accurate and reliable results. Therefore, for SPI estimation, a minimum data series length of 30 years is generally accepted. However, when longer data series are used, how do the results fare?

This paper, which is part of a broader study with the main objective of identifying errors that may arise from various factors when applying the same or different software tools, clearly demonstrates the need for caution.

It reveals that even a slight alteration in the length of the data series can lead to significant changes in the final SPI output for specific months.

Materials and methods

The analysis focuses on evaluating the discrepancies and variations between values obtained from the SPI indicator, calculated on monthly data series of different time lengths (but always not less than 30 years). The calculations are performed using the same models, stations, and time frame.

The analysis includes assessing differences, standard deviation, maximum (Max.A) and minimum (Min.A) values, the percentage of cases above or below a certain threshold, as well as calculating the Spearman coefficient for pairs of 30-year series compared to corresponding 60 or 90-year series, and 60-year series compared to the same time frame or corresponding 90-year series. This analysis is conducted for both CpNy and Korça locations.

To meet the specific requirements of each software used, differences arise in terms of data input. Therefore, the data firstly are prepared in the appropriate format (table or columns) and saved in "csv" and "excel" formats, which are required for processing and calculating the SPI index. To facilitate comparison of the final SPI values obtained from different software, the same procedure is applied to the outputs, following a specific module designed for this purpose.

Results and discussions

- The differences between the SPI values obtained from different time series were calculated. The analysis compared SPI values from the following periods: 1931-1960, 1961-1990, and 1991-2020 (ensuring a minimum of 30 years) with the SPI values derived from the 90-year period of 1931-2020 as the reference period, using the CpNy station in the USA.
- Specifically, only the SPI values corresponding to the same common 30-year period were compared, even if one series belonged to the 90-year period and the other to the 30-year period.

The objective was to identify the differences in SPI output values resulting from the use of different time series.

Precipitation time series of different lengths, which are used as input for the models, naturally exhibit variations in average values, median, standard deviation, and other statistical measures. Consequently, the outputs of the models, i.e., the obtained SPI series, also show differences. When comparing the SPI values, it was observed that they fluctuate within an average deviation range of -0.143 to +0.124 for the "SPI Generator" model, -0.145 to +0.117 for the "DrinC" model, and -0.146 to +0.118 for the "RDIT" model. Table No.1 presents these results for the CpNy station.

Index	SPI RDIT	SPI DrinC	SPI Generator
Average	-0.146	-0.145	-0.143
Max. A.	0.465	0.461	0.400
Min. A.	-0.908	-0.910	-0.800
SD	0.187	0.187	0.183
≥+0.1	38	38	34
≤-0.1	235	236	220
≥+0.1 (%)	10.6%	10.6%	9.4%
≤-0.1 (%)	65.3%	65.6%	61.1%
ρ	0.989	0.989	0.990

Table No.1 – Differences produced by each one of the 3 models of SPI calculation "SPI RDIT", "SPI DrinC" and "SPI Generator" for the pair of 30 years data series between different length series 90 and 30 years used like input, for CpNy station.

90 years of CpNy: 1931-1990 compared with 30 years 1931-1960 (left), 1961-1990 (left down) and 1991-2020 (down right).

Index	SPI RDIT	SPI DrinC	SPI Generator
Average	0.028	0.028	0.018
Max. A.	0.640	0.640	0.610
Min. A.	-0.640	-0.640	-0.660
SD	0.179	0.179	0.211
≥+0.1	126	125	143
≤-0.1	75	75	113
≥+0.1 (%)	35.0%	34.7%	39.7%
≤-0.1 (%)	20.8%	20.8%	31.4%
ρ	0.992	0.992	0.982

Index	SPI RDIT	SPI DrinC	SPI Generator
Average	0.118	0.117	0.124
Max. A.	1.043	1.044	0.830
Min. A.	-0.476	-0.476	-0.840
SD	0.196	0.196	0.194
≥+0.1	193	193	215
≤-0.1	40	40	29
≥+0.1 (%)	53.6%	53.6%	59.7%
≤-0.1 (%)	11.1%	11.1%	8.1%
ρ	0.987	0.987	0.987

- The results not only indicated an average error or mismatch of approximately 0.1, as mentioned earlier, but they were also accompanied by a standard deviation (SD) of around 0.2 (ranging from 0.179 to 0.211).
- Additionally, the maximum and minimum absolute anomalies observed in these series varied from -0.908 to +1.043 for the "RDIT" model, -0.910 to +1.044 for the "DrinC" model, and -0.840 to +0.830 for the "SPI Generator" model, as detailed in the table.

The analysis conducted on the three 30-year series from the CpNy station, matched with the corresponding parts of the SPI indicator values in the 90-year base series, revealed that approximately 10.3% to 53.6% of the SPI values obtained from the "RDIT" model exceeded the threshold of +0.1, while 11.1% to 65.3% of the cases recorded values lower than the threshold of -0.1. For the "DrinC" evaluation model, around 10.3% to

53.6% of SPI values were higher than the threshold of +0.1, while 11.1% to 65.6% fell below the threshold of -0.1. In the case of the "SPI Generator" model, the results showed that approximately 9.4% to 59.7% of SPI values exceeded the threshold of +0.1, while 8.1% to 61.1% had values below the threshold of -0.1.

However, it is important to note that overall results did not demonstrate any clear and consistent trend indicating higher or lower values for the longer 90-year period compared to the shorter 30-year period, or vice versa.

- The differences in SPI indicator data for the Korça station in Albania, calculated for the 60-year period of 1931-1990, which served as the reference baseline period, compared to those calculated for the 30-year periods of 1931-1960 and 1961-1990 respectively, revealed the following discrepancies or differences.

The results indicated an average deviation value for all models in the range of -0.088 to +0.093. These deviations were accompanied by a standard deviation ranging from 0.200 to 0.206. Furthermore, the maximum and minimum absolute anomaly values varied from -0.972 to +1.362 for the "RDIT" model, -0.972 to +1.362 for the "DrinC" model, and -0.970 to +1.360 for the "SPI Generator" model. Detailed information regarding the different calculation methodologies can be found in table No.2.

Table No.2 – Differences produced by each one of the 3 models of SPI calculation "SPI RDIT", "SPI DrinC" and "SPI Generator" for the pair of 30 years data series between different length series 60 and 30 years used like input, for Korça station.

Index	SPI RDIT	SPI DrinC	SPI Generator
Average	-0.088	-0.088	-0.088
Max. A.	0.708	0.707	0.710
Min. A.	-0.972	-0.972	-0.970
SD	0.201	0.201	0.200
≥+0.1	49	49	49
≤-0.1	186	185	192
≥+0.1 (%)	13.6%	13.6%	13.6%
≤-0.1 (%)	51.7%	51.4%	53.3%
ρ	0.988	0.988	0.988

Index	SPI RDIT	SPI DrinC	SPI Generator
Average	0.089	0.093	0.093
Max. A.	1.362	1.362	1.360
Min. A.	-0.559	-0.559	-0.550
SD	0.204	0.206	0.206
≥+0.1	163	163	169
≤-0.1	60	54	55
≥+0.1 (%)	45.3%	45.3%	46.9%
≤-0.1 (%)	16.7%	15.0%	15.3%
ρ	0.989	0.989	0.989

60 years of Korça: 1931-1990 compared with 30 years 1931-1960 (left) and 1961-1990 (right).

Additionally, it was found that approximately 13.6% to 45.3% of the SPI values obtained from the "RDIT" model, when comparing the 60-year series to the results obtained from the 30-year series (taking into account temporal alignment for the corresponding years and months), exceeded the threshold of +0.1. Furthermore, about 16.7% to 51.7% of the SPI values indicated values lower than the threshold of -0.1.

Regarding the "DrinC" evaluation model, approximately 13.6% to 45.3% of the SPI values exceeded the threshold of +0.1, while about 15.0% to 51.4% of the values fell below the threshold of -0.1.

In the case of the "SPI Generator" evaluation model, it was observed that around 13.6% to 46.9% of the SPI values were higher than the threshold of +0.1, and approximately 15.3% to 53.3% of the values indicated values lower than the threshold of -0.1.

- The data comparing the SPI indicator of the CpNY station in the USA, calculated for a 60-year period from 1931-1990 (serving as the reference baseline period), with those calculated for the 30-year series, specifically for the periods 1931-1960 and 1961-1990, revealed inconsistencies or differences as outlined below.

Table No.3 – Differences produced by each one of the 3 models of SPI calculation "SPI RDIT", "SPI DrinC" and "SPI Generator" for the pair of 30 years data series between different length series 60 and 30 years used like input, for CpNy station.

Index	SPI RDIT	SPI DrinC	SPI Generator
Average	-0.087	-0.087	-0.087
Max. A.	0.490	0.488	0.490
Min. A.	-0.719	-0.722	-0.720
SD	0.169	0.169	0.170
≥+0.1	53	52	55
≤-0.1	180	179	183
≥+0.1 (%)	14.7%	14.4%	15.3%
≤-0.1 (%)	50.0%	49.7%	50.8%
ρ	0.992	0.992	0.992

Index	SPI RDIT	SPI DrinC	SPI Generator
Average	0.087	0.087	0.087
Max. A.	0.441	0.441	0.440
Min. A.	-0.485	-0.485	-0.490
SD	0.145	0.145	0.145
≥+0.1	190	190	201
≤-0.1	44	44	45
≥+0.1 (%)	52.8%	52.8%	55.8%
≤-0.1 (%)	12.2%	12.2%	12.5%
ρ	0.994	0.994	0.994

60 years of CpNy: 1931-1990 compared with 30 years 1931-1960 (left) and 1961-1990 (right).

The results revealed an average mismatch value for all models ranging from -0.087 to +0.087. These discrepancies were accompanied by a standard deviation ranging from 0.145 to 0.170. Additionally, the maximum and minimum absolute anomaly values varied from -0.719 to +0.490 for the "RDIT" model, -0.722 to +0.448 for the "DrinC" model, and -0.720 to +0.490 for the "SPI Generator" model. More detailed information can be found in table No.3, which highlights the variations based on different calculation methodologies.

Furthermore, it was observed that approximately 14.7% to 52.8% of the SPI values obtained from the "RDIT" model, when comparing the 60-year series to the results obtained from the 30-year series (considering time correspondence for the respective years and months), exceeded the threshold of +0.1. Similarly, around 12.2% to 50.0% of the values indicated lower values than the threshold of -0.1.

In terms of the "DrinC" evaluation model, approximately 14.4% to 52.8% of the SPI values were higher than the threshold of +0.1, while about 12.2% to 49.7% of the values fell below the threshold of -0.1.

For the "SPI Generator" evaluation model, it was found that approximately 15.3% to 55.8% of the SPI values exceeded the threshold of +0.1, and around 12.5% to 50.8% of the values indicated lower values than the threshold of -0.1.

- Additionally, the differences between the reference base series of 90 years (1931-2020) and the 60-year series (1931-1990) were calculated, and the results for CpNy are presented in the table below.

The results revealed an average discrepancy or anomaly value for all models ranging from -0.059 to -0.062. These discrepancies were accompanied by a standard deviation of 0.092 for the "RDIT" model, 0.093 for the "DrinC" model, and 0.193 for the "SPI Generator" model. The maximum and minimum absolute values of anomalies varied from +0.590 to -1.050 for the "SPI Generator" model, from 0.401 to -0.426 for the "RDIT" model, and from 0.402 to -0.426 for the "DrinC" model. More detailed information regarding the different calculation methodologies can be found in table No.4.

Index	SPI RDIT	SPI DrinC	SPI Generator
Average	-0.059	-0.059	-0.062
Max. A.	0.401	0.402	0.590
Min. A.	-0.426	-0.426	-1.050
SD	0.092	0.093	0.193
≥+0.1	29	30	112
≤-0.1	204	203	292
≥+0.1 (%)	4.0%	4.2%	15.6%
≤-0.1 (%)	28.3%	28.2%	40.6%
ρ	0.997	0.997	0.985

Table No.4 – Differences produced by each one of the 3 models of SPI calculation "SPI RDIT", "SPI DrinC" and "SPI Generator" for the pair of 60 years data series between different length series 90 and 60 years used like input, for CpNy station.

90 years of CpNy: 1931-2020 compared with 60: 1931-1990.

It was observed that approximately 4.0% of the SPI values obtained from the "RDIT" model for the 90-year series, when compared to the results obtained from the 60-year series (taking into account time correspondence for the respective years and months), exceeded the threshold of +0.1. Conversely, around 28.3% of the values indicated lower values than the threshold of -0.1.

According to the "DrinC" evaluation model, approximately 4.2% of the SPI values were higher than the threshold of +0.1, while about 28.2% of the values fell below the threshold of -0.1.

For the "SPI Generator" evaluation model, it was found that approximately 15.6% of the SPI values exceeded the threshold of +0.1, and around 40.6% of the values indicated lower values than the threshold of -0.1.

- Another indicator analyzed in this context was the Spearman's rank correlation coefficient. According to certain authors, "The rankings of SPI values during a specific time period are an important indicator of the intensity of drought/wetness events".

The Spearman's rank correlation coefficient [rs] or [ρ] is calculated between paired values of SPI, which uses rankings as a basis for measuring the strength of the relationship between two SPI values. This indicator assesses how well the relationship between two variables can be described using a monotonic function. The Spearman's correlation is also described as a Pearson's correlation coefficient between two ranking variables.

The Spearman's rank correlation coefficient [rs] or [ρ] was calculated using the formula:

$$\rho = 1 - (6 * \Sigma d_i^2) / [n * (n^2-1)]$$

where [d] is the difference between the ranked SPI values from smallest to largest, respectively, according to the pairs created from this ranking, for the analyzed series, and [n] is the number of values in the series.

The data obtained from the analysis showed values of this coefficient [ρ] ranging from 0.982 to 0.999 for the pairs of 30, 60, and 90-year series analyzed for both meteorological stations, and are presented in more detail together with other indicators of average anomaly values, those of Max.A, Min.A, SD, the number of cases in % ≥1.0 and ≤1.0 in the tables mentioned above, No.1 - 4.

Some specific estimations related to the final impact of SPI index values.

The preliminary conclusion from the analysis is that there are discrepancies in the SPI values obtained for different lengths of rainfall series (30 years or longer) compared to longer ones. These differences result in series with SPI values that vary from each other. On average, these differences range from -0.1 to +0.1, with a standard deviation of 0.2. In some cases, these differences can be as high as 10% to 50% above or below the average fluctuations.

Additionally, the anomalies or discrepancies in the absolute values derived from these processed series are significant, ranging from -1.050 to +1.362. These magnitudes indicate substantial variations in the SPI values, further highlighting the differences between the series obtained from different lengths of rainfall data.

These findings emphasize the importance of considering the length of the rainfall series when analyzing SPI values and their impact on drought/wetness events. The observed discrepancies and fluctuations suggest that the choice of the time period for SPI calculation can have a notable influence on the results and should be carefully considered in drought monitoring and assessment.

Referring to the table of data and divisions of the SPI index into different categories of dryness or wetness, it is evident that small anomalies or mismatched values, such as those within ±0.1, or values that exceed this threshold, can have a significant impact on the classification of drought severity.

For example, let's consider a specific situation where the SPI value indicates moderate dryness with a value of -1.4. If this value is modified by another value of -0.1 due to the length of the series, resulting in a value of -1.5, it immediately falls into the category of severe dryness according to the classification criteria.

This example illustrates how even a small change in the SPI value can lead to a shift in the drought severity category. It highlights the sensitivity of the SPI index and the importance of considering the accuracy and consistency of the data used for its calculation, particularly when assessing and comparing drought conditions over different time periods or lengths of rainfall series.

Table No.5 – SPI index classification

SPI values	Classification
+2.0 and more	Extreme wet
+1.5 to +1.99	Severe wet
+1.0 to +1.49	Moderately wet
-0.99 to +0.99	Near normal
-1.0 to -1.49	Moderately dry
-1.5 to -1.99	Severely dry
-2 and less	Extremely dry

It is essential to carefully evaluate and interpret SPI values in the context of the specific classification thresholds and take into account any discrepancies or anomalies that may arise due to variations in data length or calculation methodologies.

Based on the described scenarios, it becomes evident that when changes in SPI values exceed ±0.1, which occur in a significant percentage of cases (up to 50%), the classification of drought severity can be significantly influenced. These modifications are not due to any fault in the model output but rather arise from using precipitation data with different durations (longer or shorter) as input.

For instance, a severe dryness state evaluated with an SPI value of -1.7, when mathematically modified due to a longer or shorter duration of the precipitation series, by adding a value of +0.5, would result in an SPI value of -1.2, indicating moderate dryness. On the other hand, if the correction is a subtraction of -0.5, the SPI value would become -2.2, indicating extreme dryness.

Similarly, a modification of +1.2 would change the assessment from SPI=-1.7 (severe dryness) to SPI=-0.5, indicating a situation close to normal. These examples highlight the sensitivity of the SPI index to changes in input data and the potential impact on the evaluation of drought severity.

Therefore, it is crucial to consider these potential modifications when analyzing dryness conditions. The results obtained from the SPI calculations should not be neglected, as they can deviate from the original assessment due to variations in the length of the precipitation series used as input data.

In summary, it is important to be aware of the potential impact of data modifications on SPI values and their corresponding drought severity classifications. Careful consideration should be given to the reliability and consistency of the input data when interpreting and comparing SPI results over different time periods or lengths of precipitation series.

Conclusions

- Different lengths of monthly precipitation data series can introduce errors in the final SPI index values. Therefore, it is crucial to exercise caution and remain aware while analyzing drought patterns.

- When processing drought maps using GIS or other software, it is vital to ensure that the precipitation data series not only have the same length but also correspond to the same time frame as the period being analyzed. Failing to do so can lead to significant errors and incorrect estimations of drought severity and its spatial distribution.
- These types of errors are produced by each of the three software programs when applied independently to the same database. Therefore, no preference should be given at the end of the analysis process.

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