Web GIS CLIMATE as a step to virtual research environment for NEFI

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Outlines

•The state of the art (data, information, knowledge, services)

•Approaches (e-science, cyberinfrastructure, virtual research environment; mainstream from datacenters to huge processing platforms)

•Web GIS Climate as a step to VRE for the region (approach, current functionality, plans))

•Alternative way to VRE for NEFI (regionally distributed network of thematic web GIS)

The state of the art

- Data & information (measurements & modeling) ⇒ processing & analysis ⇒ knowledge ⇒ services
- Data volumes Pb (big data data intensive domain),
- Datacenters
 Data & Processing Centers (huge data
- storage + supercomputer supporting required analytics)
- Final result information computational infrastructure
- supporting Earth science and applications.
- Remote access to data, instruments for their analysis and
- results obtained.

Wanted

- detail information on ongoing and possible climatic changes
- in regions and their consequences for society and
- economics. WMO: from climatic projections towards climatic
- services for stakeholders
- Mainstream development of Data & Processing and
- Analytic Centers (required proper funding).

- We suggest less expensive way for the Northern Eurasia
- development of regionally distributed network of thematic
- web GIS (thematic clones of the web GIS Climate)

Some data: global, NE and Siberia

Weather stations (WMO, NOAA, WDC-Obninsk) Satellite data (NASA, Eurospace (Copernicus)

Modeling (historical and ongoing) Reanalysis (ECMWF ERA5 and other) <u>Copernicus Climate</u> <u>Change Service (C3S) Climate Date Store</u>

Climatic modeling (historical and projections): CMIP6 & CORDEX

Regional data (forecasts) – limited access Hydrometcenter of Russia SibNIGMI Meteomeasuring network supported by IMCES (under development)

ERA5

- A first segment of the ERA5 dataset is now available for public use (1979 to within 5 days of real time). ERA5 provides hourly estimates of a large number of atmospheric, land and oceanic climate variables. The data cover the Earth on a 30km grid and resolve the atmosphere using 137 levels from the surface up to a height of 80km.
- ERA5 includes information about uncertainties for all variables at reduced spatial and temporal resolutions.
- The entire ERA5 dataset from 1950 to present is expected to be available for use in 2020.
- ERA5 combines <u>vast amounts of historical</u> <u>observations</u> into global estimates using advanced modelling and data assimilation systems.





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CMIP6 - Coupled Model Intercomparison Project

Model output Access:

Summary table of currently available data

- The complete archive of CMIP6 output is accessible from any one of the following portals:
 - USA, PCMDI/LLNL (California) <u>https://esgf-node.llnl.gov/projects/cmip6/</u>
 - France, IPSL <u>https://esgf-</u> node.ipsl.upmc.fr/projects/cmip6-ipsl/
 - Germany, DKRZ <u>https://esgf-</u> <u>data.dkrz.de/projects/cmip6-dkrz/</u>
 - UK, CEDA <u>https://esgf-</u> index1.ceda.ac.uk/projects/cmip6-ceda/

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Forecasts > Uncategorised > Medium-rang	ge forecasts for cities of	Russia						
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description	Actual weather							
Short-range limited area forecasts by COSMO-RU model: Meteograms	1-week forecast	GRAPHS						
	₽	Sunday September,	Monday 6 September,	Tuesday 7 September	Wednesday 7, 8 September, 9	Thursday September, 10	Friday September, 11	Saturday September, 12
 COSMO-RU model with grid spacing 7km: Forecast maps 	Day	\rightarrow	<i>.</i> ?		\sim	\mathbf{Q}	\mathbf{P}	
> COSMO-RU model with grid spacing 13km:		13°	15°	16°	12°	13°	15°	17°
Forecast maps	Precipitation, mm (probability)	2.3 (95%)	2.4 (73%)	3.3 (85%)	2.5 (83%)	1.4 (77%)	0.6 (64%)	0
Nowcasting of precipitation intensity	Wind, m/s	个 3	Κ1	← 1	N 1	→ 2	71	Κ1
	Pressure	746	749	748	748	749	749	748
Global forecast of ocean wave parameters	Night							N
Global medium-range forecast fields in GRIB ormat		4°	5°	5°	6°	5°	6°	
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WRF Model Select forecast date: 00 v show	
COSMO Model Forecast for: 06.09.2020-00	
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Meteograms(SLAV)	
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MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT OF THE RUSSIAN FEDERATION THE RUSSIAN FEDERAL SERVICE FOR HYDROMETEOROLOGY AND ENVIRONMENTAL MONITORING (ROSHYDROMET) Federal State Budgeatary Institution "SIBERIAN REGIONAL HYDROMETEOROLOGICAL RESEARCH INSTITUTE" (FSBI "SibNIGMI")	

License of the ROSHYDROMET

Some Data&processing centers

- Copernicus climate change service
- ENES (European Network for Earth system modeling)
- Climate data Library
- Extreme Earth





Climate bulletins



Climate Data Store



Data in action



In focus

The European State of the Climate 2018, an essential snapshot of the region and a useful benchmark for future assessments of the environment.

https://portal.enes.org/data/data-metadata-service/analysis-platforms



data

First Call Deadline EXTENDED: 11 of November 2019

The climate modelling community faces the challenges of contributing to the next assessment report of the Intergovernmental Panel on Climate Change through the 6th phase of the Coupled Model Intercomparion Project **©**CMIP. The ENES

Step to climatic services



The Data Library offers free access to hundreds of high-value datasets (climate, geophysical, health and agriculture) and provides the tools and training to perform analysis. It can revolutionize the way individuals and organizations approach their work.

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IRI/LDEO **Climate Data Library**

Google Custom Search

IRI/LDEO Climate Data Library

The IRI Data Library is a powerful and freely accessible online data repository and analysis tool that allows a user to view, analyze, and download hundreds of terabytes of climaterelated data through a standard web browser.

It is a powerful tool that offers the following capabilities at no cost to the user:

- access any number of datasets:
- · create analyses of data ranging from simple averaging to more advanced EOF analyses using the Ingrid Data Analysis Language:
- monitor present climate conditions with maps and analyses in the Maproom;
- create visual representations of data. including animations;
- · download data in a variety of commonlyused formats, including GIS-compatible formats.



IRI Climate and Society Map Room

The climate and society maproom is a collection of maps and other figures that monitor climate and societal conditions at present and in

the recent past. The maps and figures can be manipulated and are linked to the original data. Even if you are primarily interested in data rather than figures, this is a good place to see which datasets are particularly useful for monitoring current conditions.

Data by Source

Datasets organized by source, i.e. creator and/or provider.

Data By Category

Selected Datasets for particular topics

Dataset and Map Room Browser

Find datasets and maps organized by many characteristics and keywords



Navigating Through the IRI Data Library: A Tutorial

The goal of this tutorial is to introduce you to the structure of the Data Library and the many ways to navigate through it.

Statistical Techniques in the Data Library: A Tutorial

Statistical techniques are essential tools for analyzing large datasets: this statistics tutorial thus covers essential skills for many data library users.

Function Index

Index for functions that can be used to analyze data within the Data Library.



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Help Resources

The Help Resources include basic and statistics tutorials, function documentation, and other resources to help you get the maximum utility out of the Data Library

IRI for Climate and Society https://iri.columbia.edu/re sources/data-library/



EU Flagship Project (ca 1 B Euro)



Information-computational infrastructure based on Web GIS Climate (http://climate.scert.ru/)

- Spatial-temporal data of observation and modeling
- OGS standard
- Open software
- Web technologies
- Statistical analysis of big spatial data archives
- Statistics of extreme values
- Results of analysis– fields of characteristics in desktop GIS formats

Web GIS Climate Architecture



Hardware requirements: 2 high performance servers (calculator&geoportal) + data storage

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Monitoring and forecast research web cer	er CLIMAT	E				
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Limited functionality is provided by the portal by default. Full functionality is available for authorized users only. Authorization is under the heading labeled with a special icon in the upper right corner of the screen. To register please contact portal administrator webmaster@scert.ru.

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Ĵ Up one level	EDUCATIONAL RESOURCES
Training on Future Climate Analysis	Currently on the Internet there is a huge amount of educational resources in English. In this regard, the scientific team had the
Training on Climate Extremes Analysis	task of developing an original educational resource for the Russian-speaking population. It is available in Russion section now
Climate Change Monitoring and Prediction	http://climate.scert.ru/resources/.
	Find below a short list of educational resources in English.
	https://unfccc.int/topics/education-and-outreach/focal-points-and-partnerships/un-alliance-on-climate-change-educationtraining- and-public-awareness United Nations Alliance of Climate Change: Education, training and public awareness.
	https://cleanet.org/index.html The CLEAN Collection of Climate and Energy Educational Resources.
	https://esseacourses.strategies.org/module.nasa.html NASA Global Climate Change Education Modules.
	http://nasawavelength.org/ This reviewed collection of NASA Earth and space science resources is for educators of all levels: K- 12, higher education and informal science education. Find climate resources in the collection at the following link, which can be

filtered by audience, topic, instructional strategy and more.



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Educational resources	task of de	eveloping an o	riginal educational resource for the Rus	sian-speaking popul	lation. It is	available in Russion section now	
General public	https://rea	adymag.com/u	56689182/894805/.				
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Links	Impacts an	d risks from higl	h-end scenarios: Strategies for innovative solu	itions http://impression	ns-project.e	u/	
Climate characteristics archive							
	five-degre warming i levels, ac	five-degrees-two-degrees/. Carbon Brief has extracted data from around 70 peer-reviewed climate studies to show how global warming is projected to affect the world and its regions. Scroll down to see how these impacts vary at different temperature levels, across a range of key metrics. Click on the icons below to skip to specific categories and regions.					
	Earth Sys	Earth System Research Laboratory Global Monitoring Division https://www.esrl.noaa.gov/gmd/. Providing the best possible information on atmospheric constituents that drive climate change, stratospheric ozone depletion, and surface radiation.					
	European	European Climate Assessment & Data (ECA&D) https://www.ecad.eu/icad.php. Daily data from weather stations.					
	Emission: Models.	Emissions and concentration projections https://tntcat.iiasa.ac.at/RcpDb. RCP database with data from Integrated Assessr Models.					
	KNMI Clir	KNMI Climate explorer https://climexp.knmi.nl/plot_atlas_form.py. A web application to analysis climate data statistically. Активация Windows					
	https://clir maps and download	https://climate4impact.eu Web interface to data hosted on ESGF servers (CMIP5, CORDEX and other) that allows: plotting ^{TE B} maps and time-series graphs; some limited analysis; combining with own data; statistical downscaling tool without needing to download data.					

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1 Up one level		DATA LIBRARY	OF CLIMATE CHARACTE	RISTICS INC	L. EXT	REMES
Anomalies of meteorologi	Anomalies of meteorological characteristics The library presents the calculated fields of anomalies of meteorological characteristics, climatic indices and various					
Climate Indices hydrothermal coefficients obtained using the web-GIS CLIMAT *. These characteristics will help to understand how the extr						elp to understand how the extremes
Hydrothermal coefficients	•	of temperature and pred	cipitation change from year to year in Sib	oeria (50-65 ° N, 60-	120 ° E).	

>> Anomalies of meteorological characteristics

>> Climate Indices

>> Hydrothermal coefficients

To calculate the characteristics of the modern period are used:

1. ERA5 (Copernicus Climate Change Service (C3S) (2017) reanalysis data: ERA5: Fifth generation of ECMWF atmospheric reanalyses of the global climate. Copernicus Climate Change Service Climate Data Store (CDS), date of access. Https://cds.climate.copernicus.eu/cdsapp#I/home).

To calculate the characteristics of the future period are used:

1. High spatial resolution data from the CORDEX * project for Central Asia (CAS-22) according to the global model of the Earth system MPI-M-MPI-ESM-LR (model of the Max Planck Institute for Meteorology), the calculation results of which were used as the basis for downscaling using the regional model REMO2015 of the GERICS center (Climate Service Center Germany).

Активация Windows

2. CMIP6 project data according to the global model of the Earth system MPI-ESM-HR2 (model of the Max Planck Institute for Meteorology). раздел "Параметры".

Maps&files ready for usage by regional stakeholders!





Climatic analysis 📼 Educational resources General public Data library of climate characteristics Climate glossary Links **Climate characteristics archive a b** RU EN ANOMALIES OF METEOROLOGICAL CHARACTERISTICS 1 Up one level Anomalies of air temperature (modern period) The anomaly is the deviation of the studied meteorological characteristics from their average perennial state. A 30-year time Precipitation anomalies (modern period) interval is usually considered as the base period (norm). According to the latest WMO recommendations, the definitions of climatological standard norms now apply to the last 30-year period, which ends with a year ending with the number 0 (at the Anomalies of air temperature (future period) time of writing - 1981-2010), and not to non-overlapping 30-year periods (1901-1930., 1931-1960, 1961-1990 and in the future Precipitation anomalies (future period) 1991-2020), as it was before. However, the period from 1961 to 1990 is still a standard reference period for the long-term assessment of climate change (WMO Guidelines for the Calculation of Climate Norms, 2017). The interval from 1981 to 2010 * was taken as the base period for the modern period according to ERA5 reanalysis, respectively, the characteristics were calculated for each season of each year from 2011 to 2018. * At the end of 2019, it is planned to expand reanalysis to 1950 (https://www.ecmwf.int/en/forecasts/datasets/reanalysisdatasets/era5). After that, the base period will be recalculated for the interval from 1961 to 1990, and the anomalies from 1991 to 2018.

>> Anomalies of air temperature (modern period)

>> Precipitation anomalies (modern period)

To calculate anomalies in the future:

1. The interval from 1971 to 2005 was taken as the base period according to CORDEX high-resolution data, respectively, the characteristics were calculated by scenario dataset (RCP 8.5) for each season of each year from 2006 to 2100.

2. The interval from 1961 to 1990 was taken as the base period according to CMIP6 data, respectively, the characteristics were calculated by scenario dataset (SSP 585) for each season of each year from 2015 to 2100.

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Ĵ Up one level		CLIMAT	E INDICES						
Heat and cold indices (modern pe	eriod)	These indice	es were develope	d and recommended by the CCI / CLIVA	R Expert Team for (Climate Cl	hange Detection Monitoring		
Extreme precipitation indices (mo	dern period)	and Indices (ETCCDMI). A more detailed description of the indices, as well as detailed information on the work of this group, can							
Heat and cold indices (future period	od)	be found at http://etccdi.pacificclimate.org/index.shtml.							
Extreme precipitation indices (fut	ure period)								
		These indice	es can be calculat	ted for a year or a single month.					
		For the modern period according to the reanalysis Era5:							
		>> Heat and	>> Heat and cold indices (modern period)						
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		For the futu	ure period accord	ding to the CORDEX data					

- >> Heat and cold indices (future period)
- >> Extreme precipitation indices (future period)

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Hydro-thermal Coefficient of Selyaninov (HTC)	The study of	f the hydrotherma	I conditions of a territory (drought or wate	erlogging) is carried	out using	various integrated indicators,
Ped's drought index	which in mos	which in most cases are various combinations of air temperature and rainfall values. There are a huge number of such indicators				
SPI/SPEI	worldwide.					
PDSI/sc-PDSI	The followin	g indicators are u	sually used in Russia: :			
	>> Hydro-th	ermal Coefficient	of Selyaninov (HTC)			

>> Standardized Precipitation Index (SPI) / Standardized Precipitation and Evaporation Index (SPEI)

>> Palmer Index (PDSI) / Palmer Self-Calibrating Index (sc-PDSI)

>> Ped's drought index

The most common worldwide indicators:

- >> Maximum of daily minimum temperature (TNx)
- >> Minimum of daily maximum temperature (TXn)
- >> Minimum of daily minimum temperature (TNn)

Let TN be the minimum daily temperature. Then TNn is the minimum value for the year of the daily minimum temperature, TNn = min (TN).

Trend of minimum of daily minimum temperature (TNn) 1979-2018 [Download NetCDF]



Climate characteristics archive

	Name	Last modified	Size	Description
۶	Parent Directory		-	
	Anomalies/	20-Nov-2019 12:53	-	
	Climate extremes ind>	20-Nov-2019 12:36	-	
	Drought indices/	20-Nov-2019 12:37	-	
	Readme.txt	20-Nov-2019 12:40	922	
	Readme_ru.txt	18-Dec-2018 13:45	841	

The archive contains two sets of calculated climatic characteristics:

1. Set of anomalies (the set was created as part of the task of the PRAS programm #51)

2. Set of indices of droughts (the set was created as part of the task of the grant of the RSF #16-19-10257)

3. Set of indices of climatic extremes (the set was created as part of the task of the PRAS programm #51)

Characteristics were calculated for Southern Siberia (50-65°N, 60-120°E) and for the time range is characterized by the greatest climatic changes. For different sets of source data, the start and end dates may not be the same, but the general time interval is close. Their linear trend is also calculated, which shows changes in the index over 10 years over a specified period of time.

The names of the original data sets are specified in the Readme.txt file (Readme_ru.txt), which is located in the folder of each characteristic.

Ongoing (ERA Interim, ERA5) Possible future (CMIP6, CORDEX, MPI ESM)

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End date:	1983	Y January	▼ 01 ▼				
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Suggested for NEFI approach with realistic funding Network of the thematic ICS (nodes of the web GIS climate)

forming digital platform/digital twin "NE environment"

- •Novosibirsk (FRC ICT and ICMMG) central node at the future Siberian National Center of high-performance computing, processing and data storage
- •Tomsk (IMCES, TSU, IAO) atmosphere, surface, region
- •Krasnoyarsk (IF and ICM) forestry, air quality and region
- •Irkutsk (ISSTC, IG, LIN and ISTP) Baikal, upper atmosphere and region

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Thank you for attention!