Ministry of Environment and
Natural Resources Protection of Georgia

The National Environmental Agency

საქართველოს გარემოს დაცვისა და
ბუნებრივი რესურსების სამინისტრო

Climate Services in Georgia NMHS

Regional Consultation Meeting WMO on Climate Services in the North-Eurasian Countries

19-20 October, Sochi, Russian Federation

The National Environmental Agency is the Legal Entity of Public Law under the Ministry of Environment and Natural Resources Protection of Georgia, established in accordance with the first paragraph of Decree of the President of Georgia, No1061 of 17 December, 2005

Structural Units of the Agency:

- ✓Department of Administration
- ✓Department of Strategic Planning and Management
- ✓Department of Hydrometeorology

  Meteorology & Climatology Division

  Data Processing Unit, Methodological Supervision Unit, General and Applied Climatology Unit, Agrometeorological Unit
- ✓Department of Geology
- ✓Department of Environment Pollution Monitoring
- ✓Department of License

Brief Historical Reference of Hydrometeorological Activities in Georgia

✓1832 – STARTING OF EPISODIC METEOROLOGICAL OBSERVATIONS;
✓1844 – ESTABLISHING OF TBILISI MAGNETIC-METEOROLOGICAL OBSERVATORY, WHICH BECAME THE BASIS OF REGULAR METEOROLOGICAL OBSERVATIONS;
✓1850 – STARTING OF GLACIOLOGICAL OBSERVATIONS;
✓1883 – STARTING OF AGROMETEOROLOGICAL OBSERVATIONS;
✓1904 – STARTING OF ACTINOMETRIC OBSERVATIONS;
✓1905 – STARTING OF HYDROLOGICAL OBSERVATIONS;
✓1914 – ESTABLISHING OF WEATHER BUREAU;
✓1930 – ESTABLISHING OF METEOROLOGICAL AND HYDROLOGICAL SERVICE;
✓1932 – STARTING OF FIELD WORKS ON SNOW COVER OBSERVATIONS;
✓1937 – STARTING OF UPPER AIR OBSERVATIONS;
✓1964 – STARTING OF MARINE HYDROMETEOROLOGICAL OBSERVATIONS;
✓1967 – STARTING OF HAIL SUPPRESSION WORKS;
✓1988 – STARTING OF ARTIFICIAL DESCENDING OF AVALANCHES

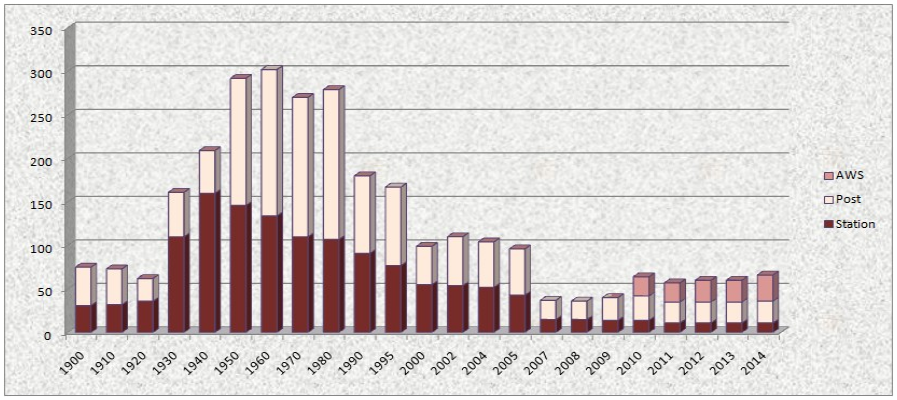
Dynamics of Changes in Hydrometeorological Observation Network

- ✓ Current network comprises:

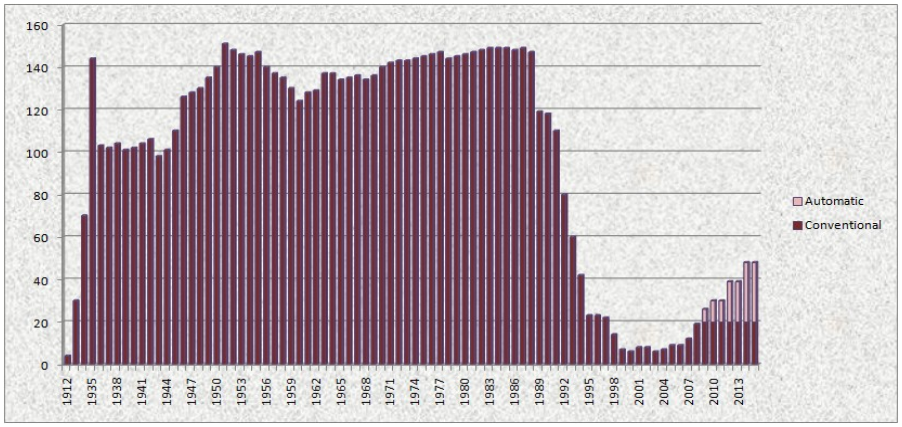
Meteorology: 11 conventional, 67 automatic and 26 precipitation stations. Among them: 4 agromet stations and 9 agromet posts.

Hydrology: 20 conventional, 28 automatic stations.

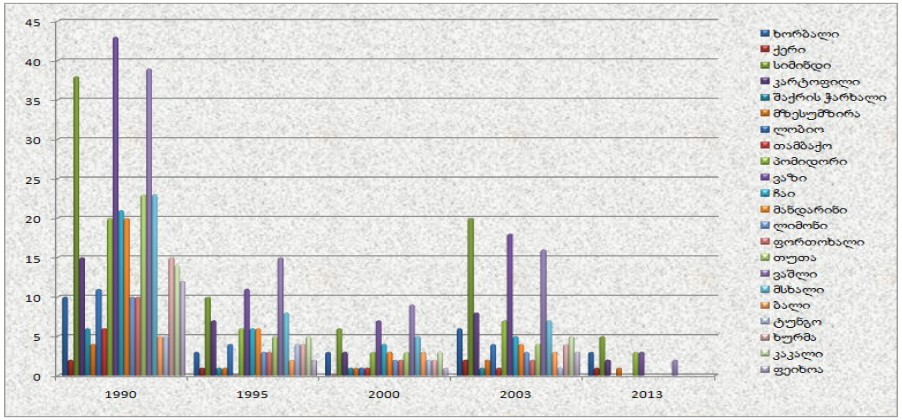
- ✓ *The stations of the observation network observe the standards established by GCOS*



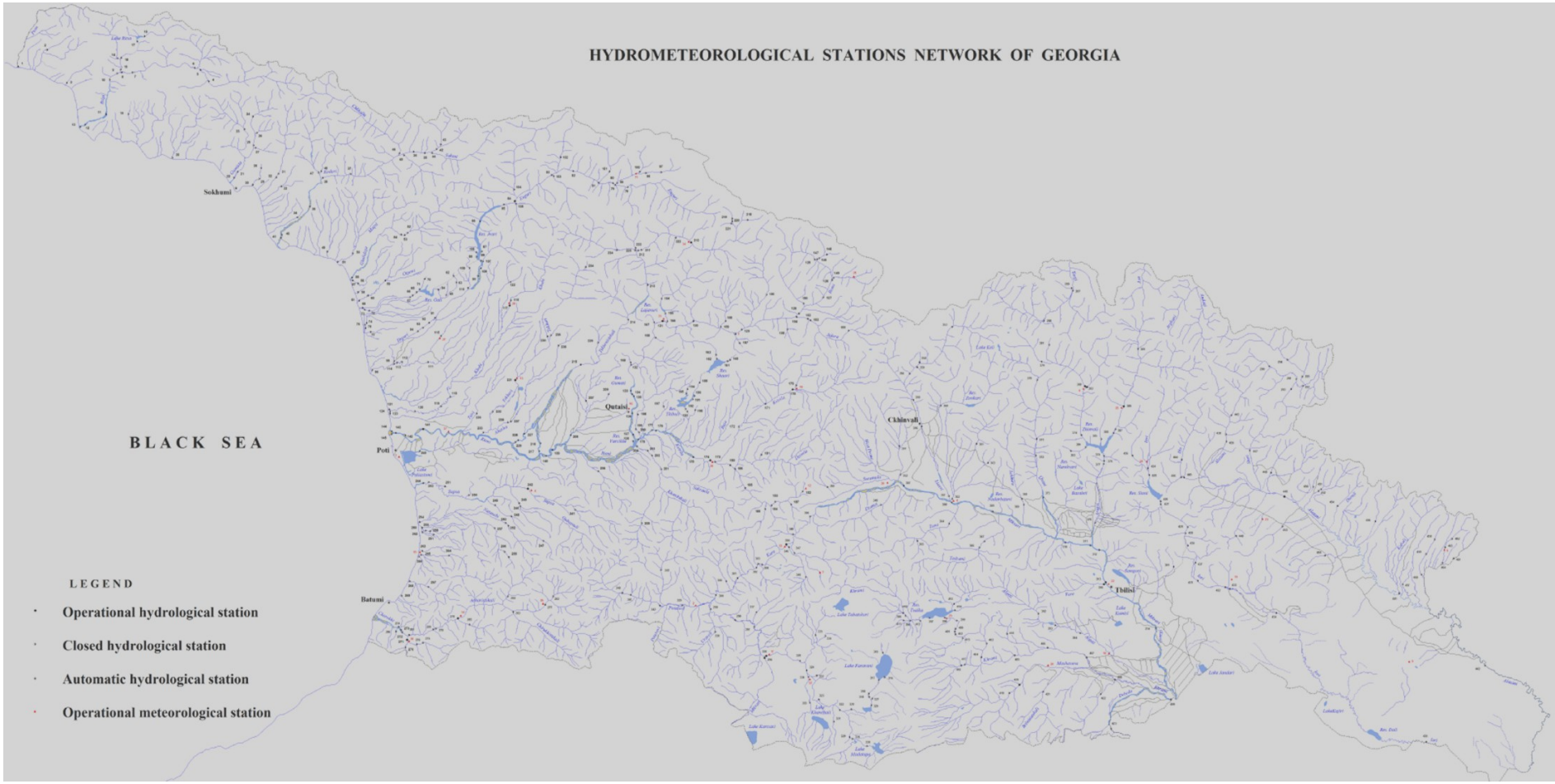
Number of stations in meteorological network of Georgia



Number of stations in hydrological network of Georgia



Number of agrometeorological stations


HYDROMETEOROLOGICAL STATIONS NETWORK OF GEORGIA
BLACK SEA
Sokhumi
Poti
Batumi
Qutaisi
Chiatura
Tbilisi
LEGEND
Operational hydrological station
Closed hydrological station
Automatic hydrological station
Operational meteorological station

Main Activities of NMHS

- ✓ Conducting the regular hydrometeorological observations over the territory of Georgia;
- ✓ Collecting and disseminating the meteorological observation data at the national and international levels in a daily, decade and monthly modes;
- ✓ Preparation and dissemination of short, medium and long-term weather, marine, river, agrometeorological and snow avalanches general and specialized forecasts and warnings on expected hydrometeorological hazardous events;
- ✓ Preparation and dissemination different types of climatological, hydrological and agrometeorological bulletins, reviews, tables and notes;
- ✓ Processing of initial observation data, formation of database and preparation of different types of statistical reference books in order to evaluate hydrometeorological regime of the country;

GEORGIA Climate Reports
REGION VI – EUROPE
Decadal (10-day) and monthly reports in codes of CLIMATE (SHIP).

8 Climate stations are in International Exchange,
1 station is included *GCOS* Surface Network (*GSN*)

WMO index number	NAME	LAT	LON	ELEVATION
37279	ZUGDIDI	42⁰ 31′	41⁰ 53′	118
37379	POTI	42°08'	41°42'	1
37395	KUTAISI	42⁰ 16′	42⁰ 38′	114
37432	PASANAURI	42⁰ 21′	44⁰ 42′	1070
37514	AKHALTSIKHE	41°39'	43°00'	989
37545	TBILISI	41⁰ 45′	44⁰ 46′	427
37553	TELAVI	41°56'	45°29'	568
37621	BOLNISI	41⁰ 27′	44⁰ 33′	534

Annual and monthly bulletins for regular publications of WMO about mean and extreme climate conditions like: heat waves or cold waves, extreme precipitation episodes, snow and wind storms, hail, droughts, etc.

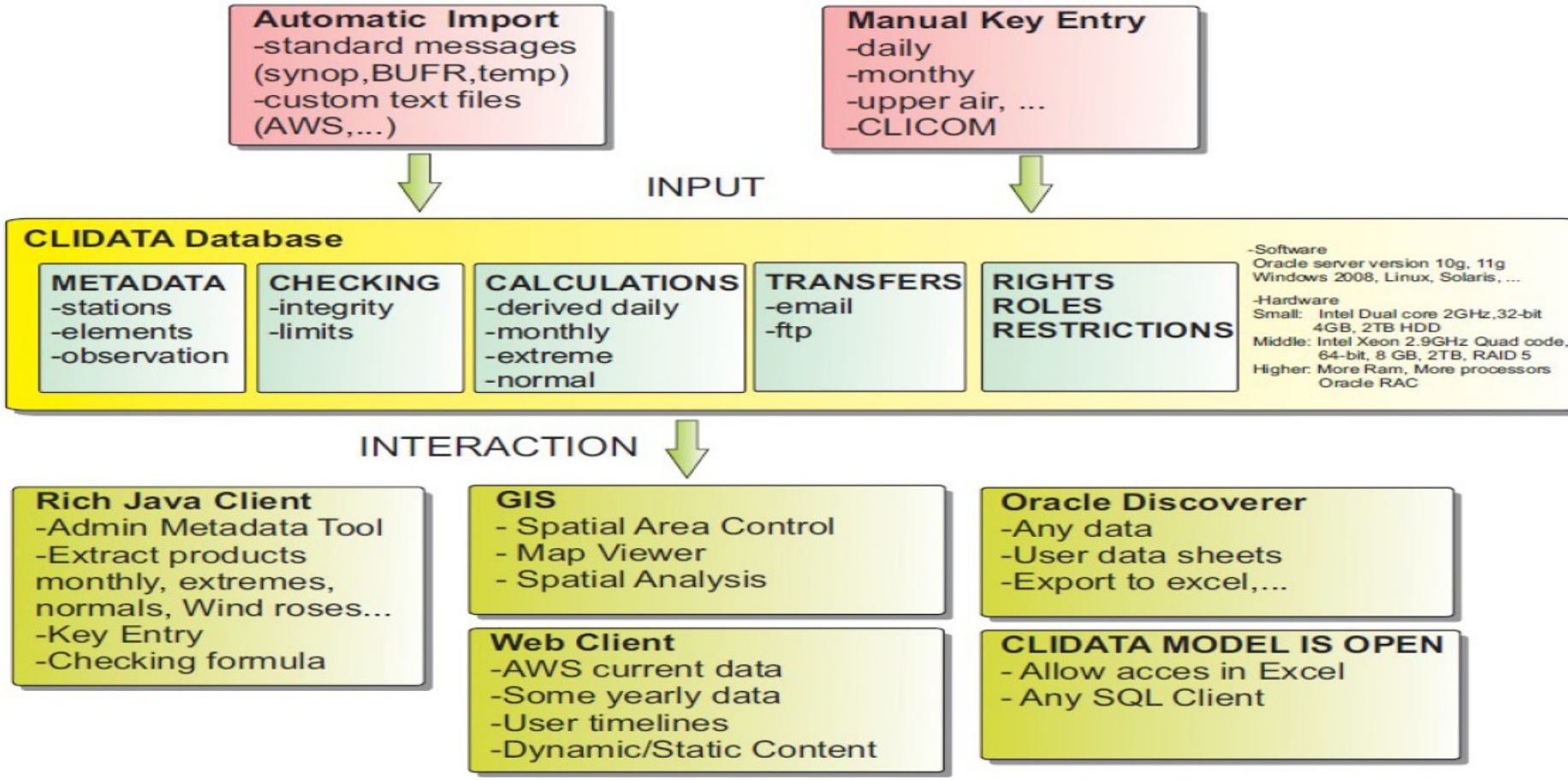
Climate Data Management

- ✓ Digitized are about 50% of dataset. Mostly data from1966, except the solar radiation and various graphs (pluviograph, thermograph...) data.
- ✓ Quality controlled are data from 1993. About 20% of full dataset;
- ✓ Quality controlled and homogenized are data of temperature, precipitation, snow cover for almost full observation period. About 30% of full dataset.
- ✓ Station history archives exist at Georgia NMHS but they are not complete for all stations during all periods and metadata are not digitized.

Climate Data Management System

- ✓ The CLIDATA system was implemented in 2013 in the frame of the project with Czech Development Agency.
- ✓ The system is primary intended for archiving of climatology data, for the data quality control and for administration of climatology stations and station observations.
- ✓ The system facilitates the population of data from automated (real-time) stations as well as the definition of personalized key entry forms.

Structure of Clidata Application



Clidata basic modules:

- Clidata Database – main storage, automatic processing
- Rich Java Client – main administrative tool
- Oracle Discoverer – data extraction tool

Clidata optional modules:

- Web Client – data reporting tool
- GIS – mapping tool
  - Map Viewer – simple mapping application
  - Spatial Analysis – advanced mapping application
  - Spatial Area Control – data checking on the map

Available Products Derived from the Climate Database

Types of stored measured data:

- Daily data (observed and automatic), Extremes, Monthly Data, Monthly Data Count, Meteorological Phenomena Monthly Data, Normals, Phenomena Monthly Data, Wind Rose, Long term rainfall gauge measurements, One minute precipitation, Provisory Edata, Upper air chart (not used)

Other products:

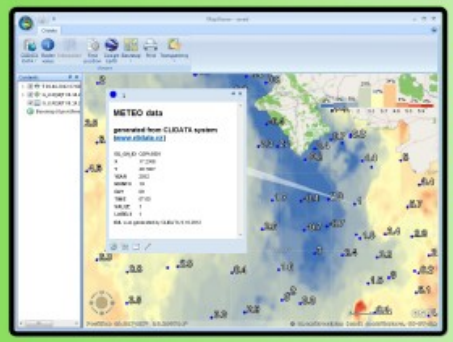
- Wind roses
- X-day function
- Chart of the rainfall intensity
- User defined extremes
- CLIMAT message
- Regular customers
- Automatic Email and FTP

Calculation possibilities:

- Daily data (according to formula
- Monthly data
- Long term normals
- Long term extreme values
- Interpolation of missing data
- Inventory of missing data

Area Control

- last quality control level in CLIDATA
- square color mean interval (probability of exceeding)
- every station compare measure value with their long term avarage
- can use WMS layer
- can use Radar images (rainfall data control)
- can estimate bad value by linear regression from closest stations
- use ArcGIS Explorer freeware from ESRI



Map Viewer

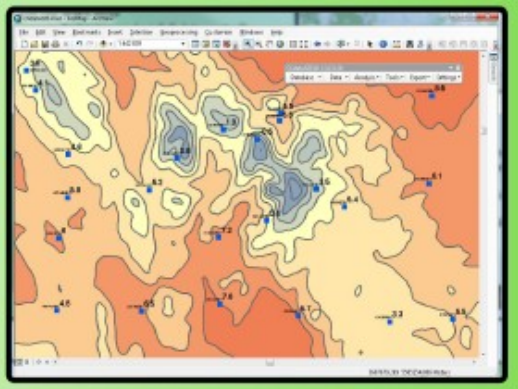
- simple stations mapping
- display data store in CLIDATA or local text file
- make surface from stations data (interpolation)
- can use WMS layer
- export stations data into KML (Google Earth)
- can use static climatological maps
- use ArcGIS Explorer freeware from ESRI

CLIDATA GIS

Spatial Analysis

Advanced
(Standard + Spatial Analysis)

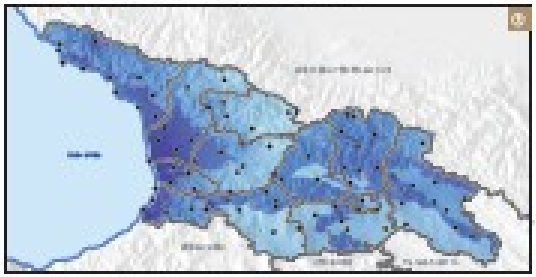
- extension into ESRI ArcGIS
- working without ESRI Spatial Analyst extension
- connect GIS program with CLIDATA
- working with data store in :
  - CLIDATA
    - daily data (RDATA)
    - monthly data (MDATA)
    - normals data (NDATA)
    - SQL query
  - Local text file
    - TXT, CSV files
- make surface from stations data (interpolation)
- interpolation methods (IDW,LLR,ClidataDEM, ClidataDEM R2)
- smoothing surfaces
- making isolines (isotherm, isohyet, ...)
- calculate zones statistics
- raster map calculator
- can use WMS layer
- export maps to PNG, PDF

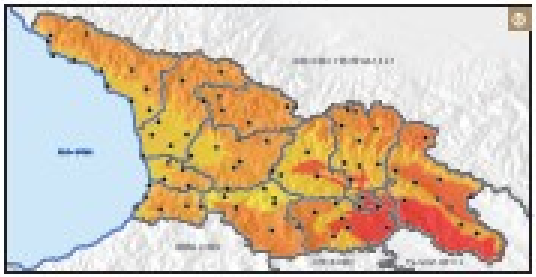


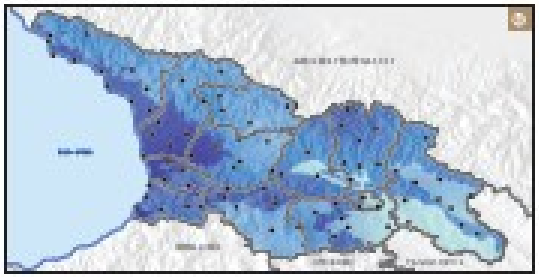
Climate Atlas

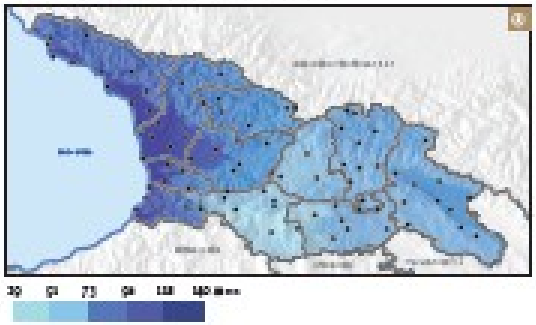
- Some maps of mean and extreme climate parameters and return values are included in:
  - ✓ Georgian National Atlas (published by the Institute of Geography)
  - ✓ Atlas of Natural Hazards and Risks if Georgia (**CENN-ITC,** http://drm.cenn.org/index.php/en/background-information/paper-atlas)

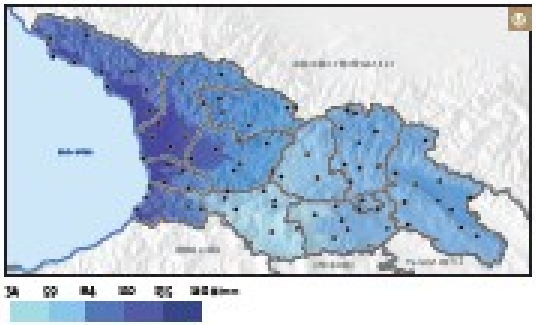
ნალექების ინდექსები/Precipitation Indices

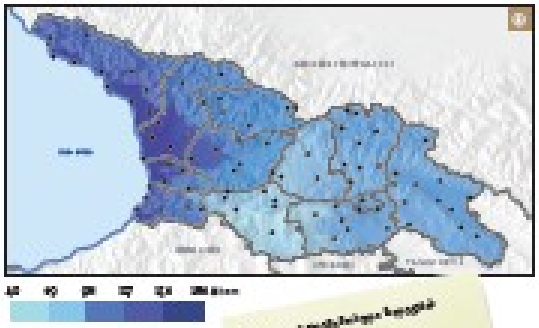


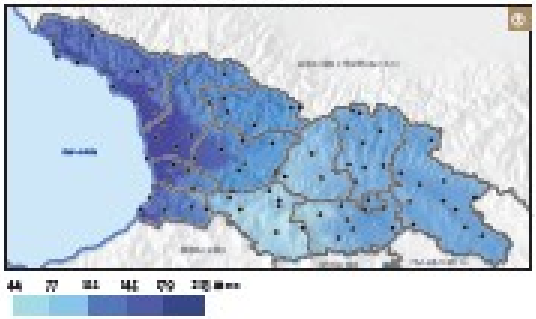


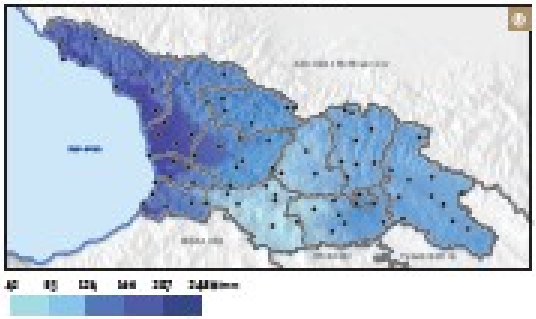


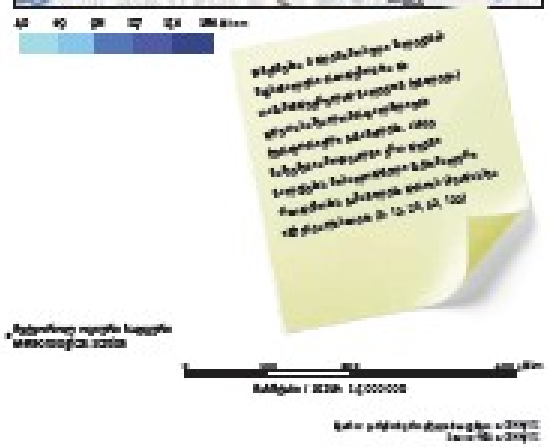




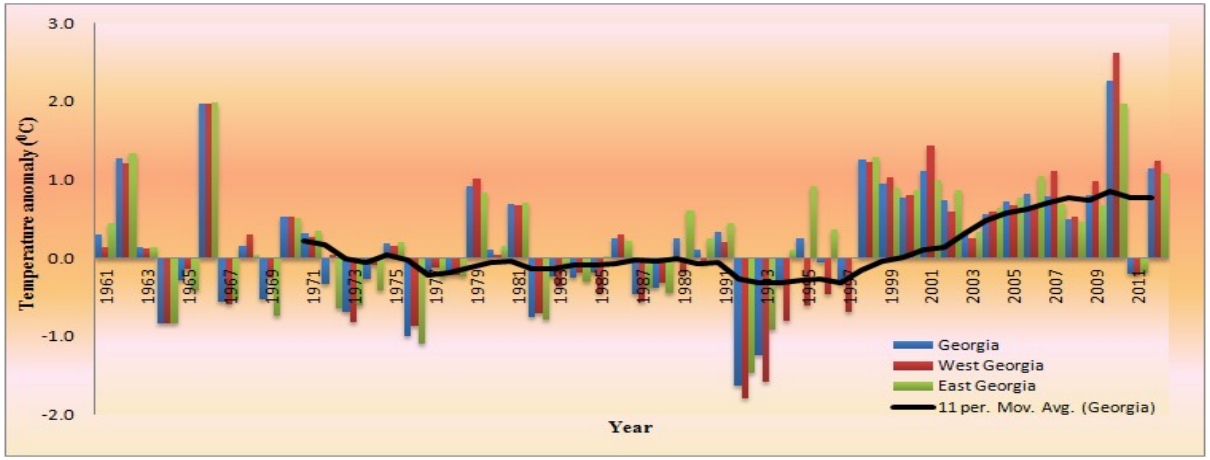




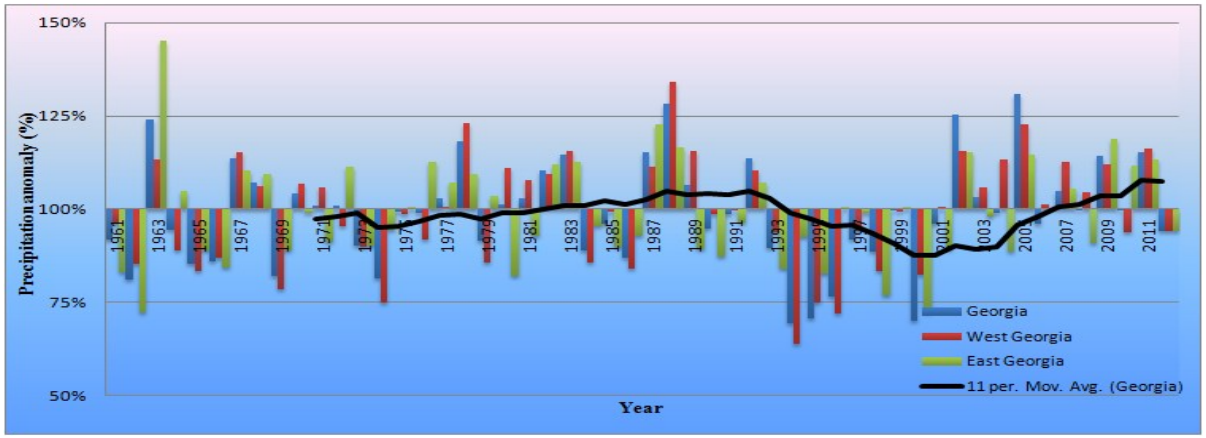




Climate Change Detection



Surface temperature anomalies (relative to 1961–1990) for the period 1961– 2012



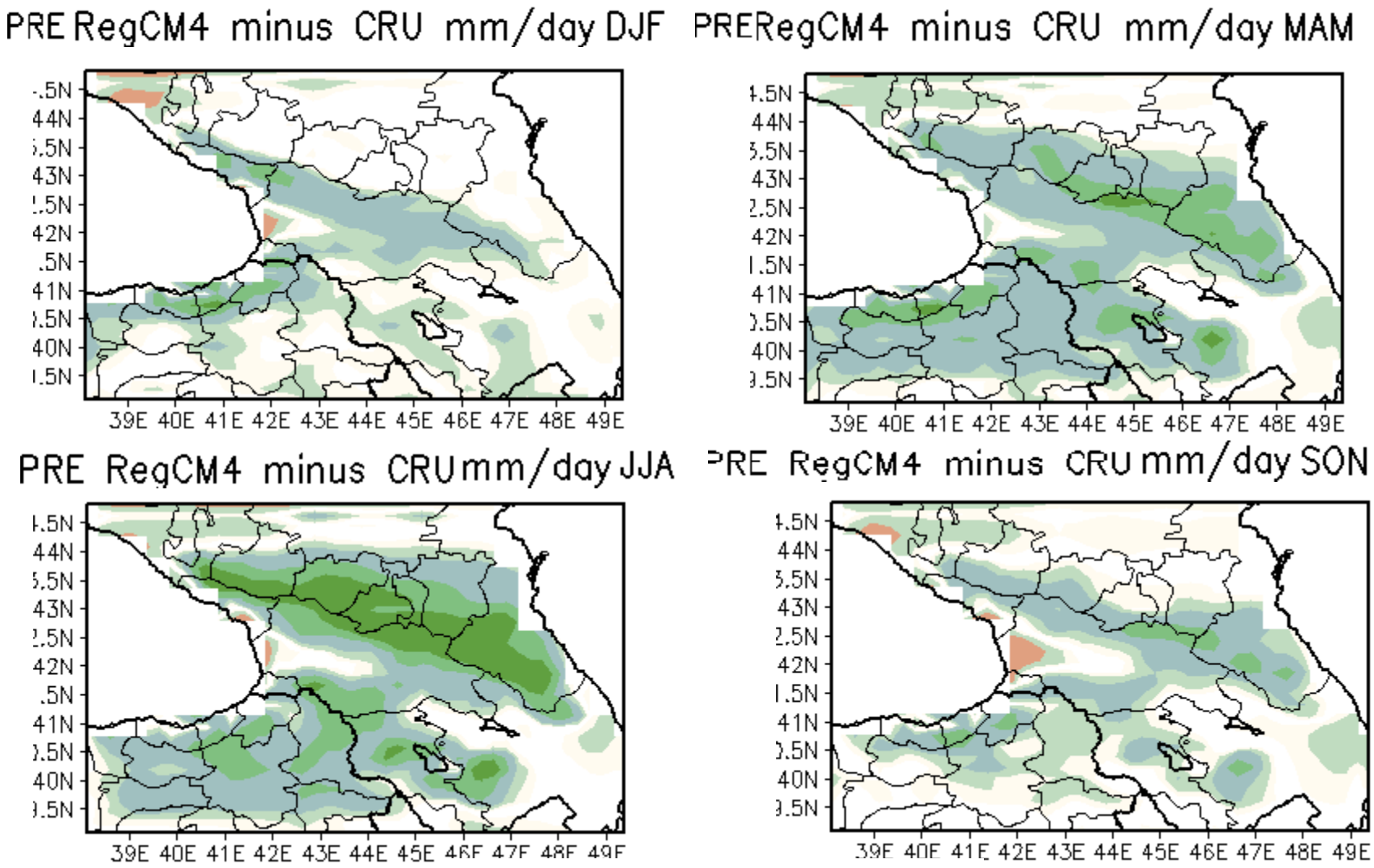
Annual precipitation anomalies (relative to 1961–1990) expressed as percentages above or below the long-term average for the period 1961– 2012

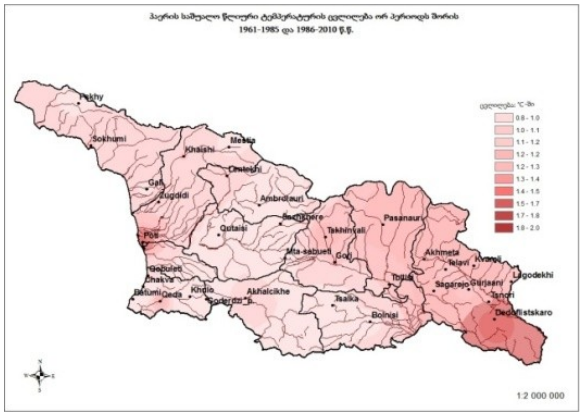
Climate Change Projection

The NMHS derives data from climate change scenarios for vulnerability analysis and application and conducts impact studies in agriculture, hydrology, tourism and health sectors

- *Changes in main climate parameters are constructed using Hadley Center regional climate model PRECIS and ICTP model RegCM4*
- *With boundaries from GCM EHCAM, ECHAM5/MPI-OM*
- *By SRES scenario B2, A1B*
- *For period 2021-2050, 2070-2100 for all seasons*

Validation RegCM4 by CRU (Climate Research Unit) (1961-1990 period precipitation seasonal sums)

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1961-1985 და 1986-2010 წ.წ.
ცვლილება °C-ში
0.8 - 1.0
1.0 - 1.1
1.1 - 1.2
1.2 - 1.2
1.2 - 1.3
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1.5 - 1.7
1.7 - 1.8
1.8 - 2.0
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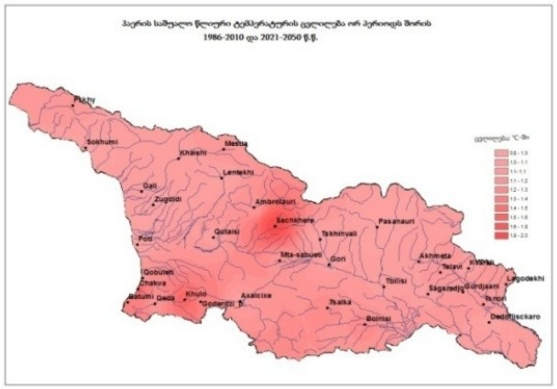
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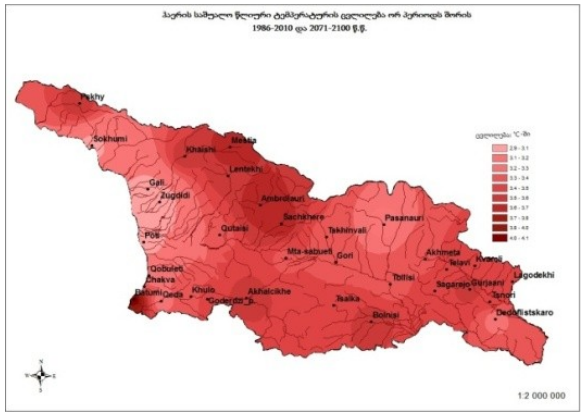
ცვლილება °C-ში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ცვლილება °C-ში
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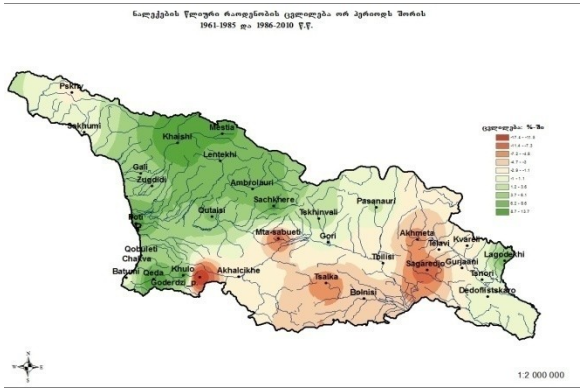
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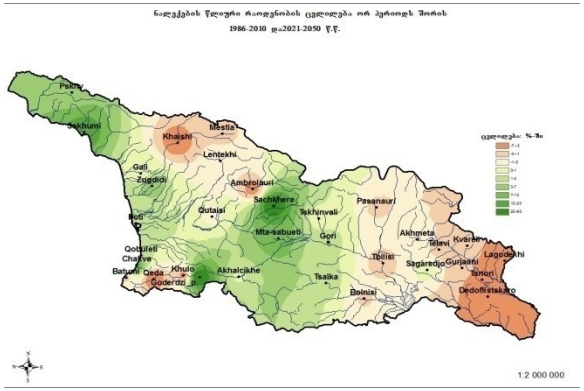
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ცვლილება: %-ში
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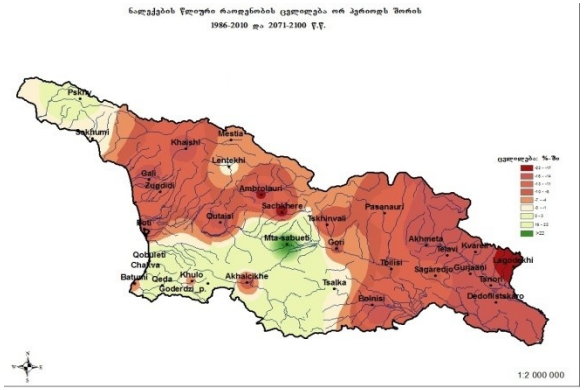
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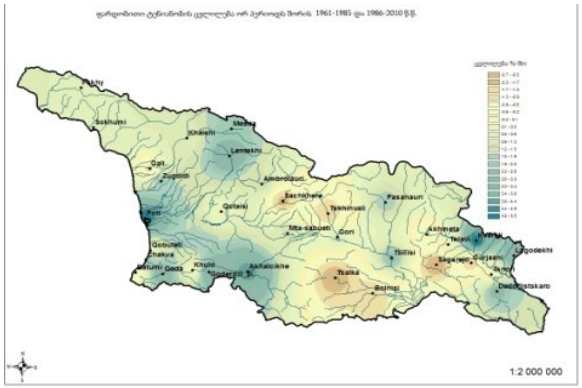
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ცვლილება %-ში
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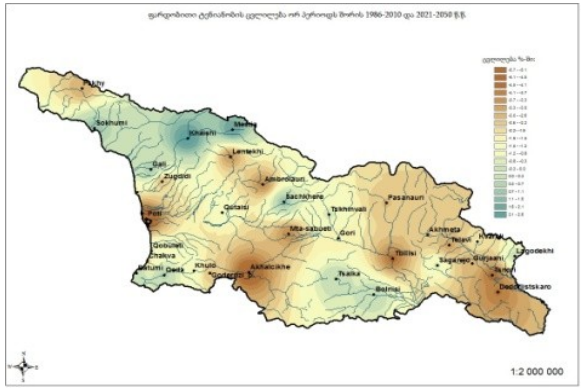
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ცვლილება %-ში
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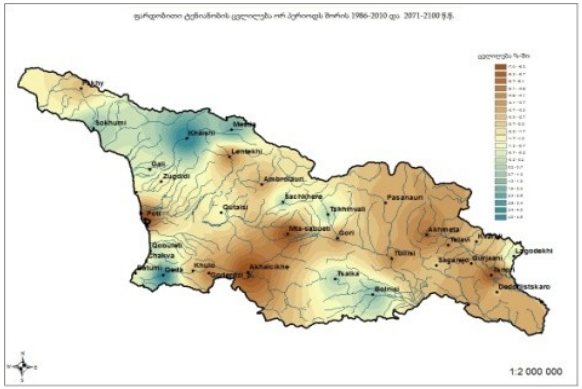
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ცვლილება %-ში
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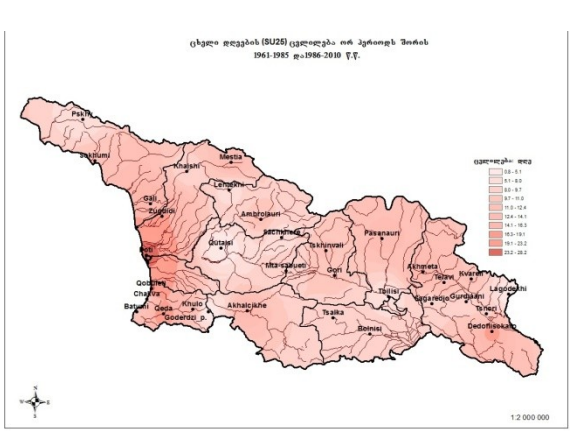
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ცვლილება: დღე
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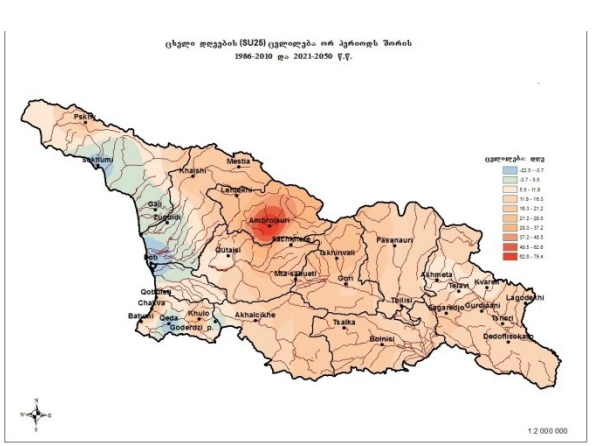
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1986-2010 და 2021-2050 წ.წ.
ცვლილება: დღე
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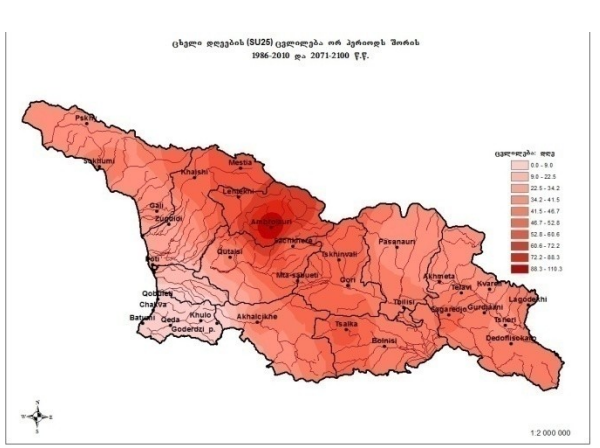
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1986-2010 და 2071-2100 წ.წ.
ცვლილება: დღე
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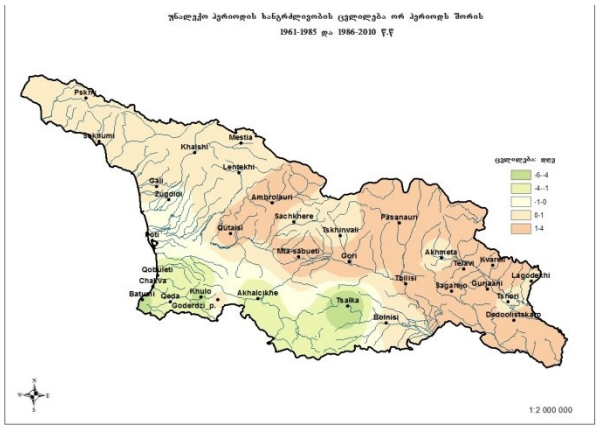
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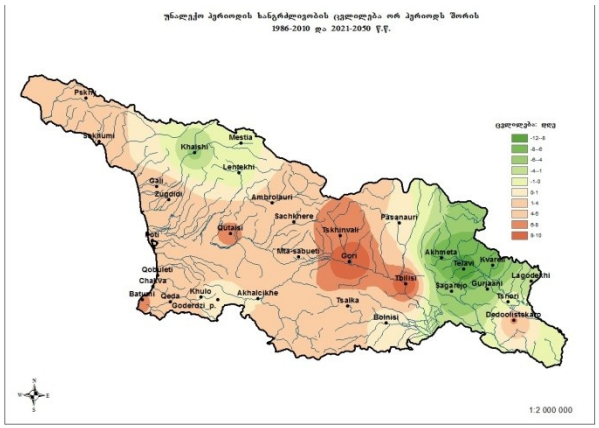
1961-1985 და 1986-2010 წ.წ
ცვლილება: დღე
-6--4
-4--1
-1-0
0-1
1-4
1:2 000 000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1986-2010 და 2021-2050 წ.წ.
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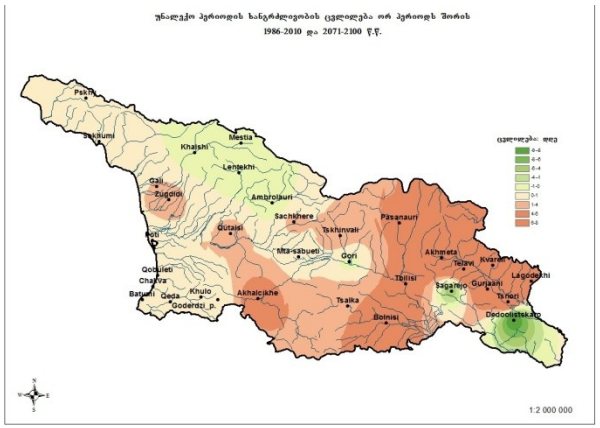
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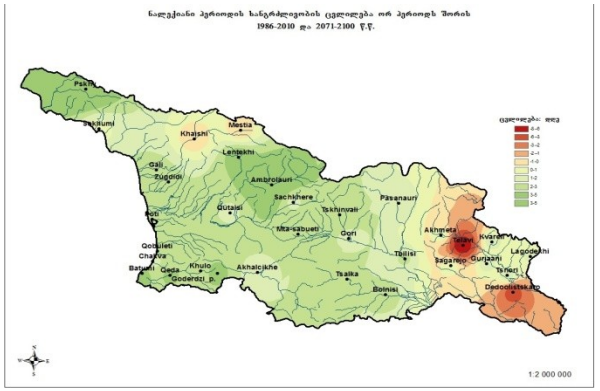
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1986-2010 და 2071-2100 წ.წ.
ცვლილება: დღე
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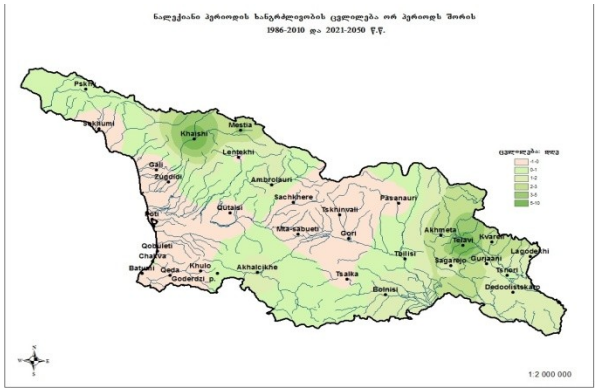
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1986-2010 და 2021-2050 წ.წ.
ცვლილება: დღე
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ნალექიანი პერიოდის ხანგრძლივობის ცვლილება ორ პერიოდს შორის
1961-1985 და 1986-2010 წ.წ
ცვლილება: დღე
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Impact Modelling

RegCM → AquaCrop

- For the assessment of productivity and water requirement of agricultural crops the Crop-Water Productivity model AquaCrop (developed by FAO-Food and Agriculture Organization) has been used.
- Productivity and net irrigation requirement was assessed for main crops (winter and spring wheat, maize, sunflower) in one of the most important agriculture region of Georgia - Kakheti:
- For climate change impact assessment crop yields in the past 1961-2010 years were compared to predicted values, which will lead by the future climate. Accordingly, the following values of net irrigation requirement and crop yields were considered:

- Baseline Period 1: 1961-1985
- Baseline Period 2: 1986-2010
- Projected Period 3: 2070-2099

- Main results are presented in Georgia's Third National Communication to the UN Framework Convention on Climate Change

Main Users of Climate Services

- Government
- Defense
- Agriculture
- Health
- Transport
- Energy
- Communication
- Incurrence
- Tourism, etc.

Climate Services to Climate-Sensitive Sectors

For **Agriculture** sector:

- ✓ Specific agro-climatic information on demand,
- ✓ Decadal (10-day) and monthly agro-meteorological bulletins to relevant governmental bodies.

For **Health** Sector:

- ✓ Heat/Cold Index (HI, CI),
- ✓ Heat/Cold wave thresholds,
- ✓ Extreme temperature, humidity, precipitation indices

for assessment of the correlation with health indices. e.g. mortality and morbidity rate, disease incidence and prevalence, social indices.

Climate Services to Climate-Sensitive Sectors

For **Water** sector:

- Observation and modelled data for current and future water supply modelling, for energy power assessment, etc.

For **Building** sector:

- building-climate codes and specialized building-climate parameters;

For **Insurance** sector:

- Extreme climate data, probability and recurrence of extremes, normals, etc.

Limitations

- ✓Reduction of meteorological observation network and measured meteo&agrometeorological parameters;
- ✓Lack of actinometric observations;
- ✓Lack of remote sensing (satellite-based) digital information and its usage methodology;
- ✓Lack of remote sensing (radar) observations;
- ✓Lack of field phenology observations;
- ✓Delay of delivery observation data from conventional stations is a barrier for the production of climate services operationally, also automatic stations are not connected to CDMS in real-time;
- ✓The interface mechanisms with users are not institutionalized.

Good Practices

- ✓ EU funded project “Building Safe and Resilient Communities” (South Caucasus), Phase I and II, for the component: Heat Wave Action Plan (HAP).

ClimPACT application for thresholds definition

Thank You for Attention!