Agrometeorological services provided by HMS

BRIEF INFORMATION OF SERVICE

► 1891 -1899: The first meteorological measurements and observations in Macedonia were carried out in Skopje

► 1947: The Hydrometeorological Service in Republic of Macedonia was officially established

► 1978: it becomes Republic Hydrometeorological Institute, a governmental organization of special importance for carrying out work in meteorology and hydrology

► 1992: The Law on Hydrometeorological Matters was delivered

► 1993: as independent country, Republic of Macedonia became a permanent member of the WMO

► 2001: part of Ministry of agriculture, forestry and water economy

STRUCTURE OF THE HYDROMETEOROLOGICAL SERVICE

Hydrometeorological Service of Macedonia
DIRECTOR

- Division of human resources
- Division of Internal revision

STATE COUNSELORS

Department of Meteorology
- Division of Meteorological monitoring
- Division of Meteo Data base
- Division of Climatology and Climate Changes
- Division of Agriculture Meteorology
- Division of Meteorological Laboratory

Department of Weather Forecast and Warnings
- Division of Weather Forecasting and Analyses
- Division of Radar Monitoring, Severe Weather Warnings and Weather Modification
- Division of IT and Technic

Department of Hydrology
- Division of Surface Waters Hydrology
- Division of Underground Waters Hydrology
- Division of Hydrology Forecasting, Data base Studies and Information

Department of Water Quality
- Division of Water quality laboratory
- Division of Water quality monitoring

Department of Legislation, international and public relation
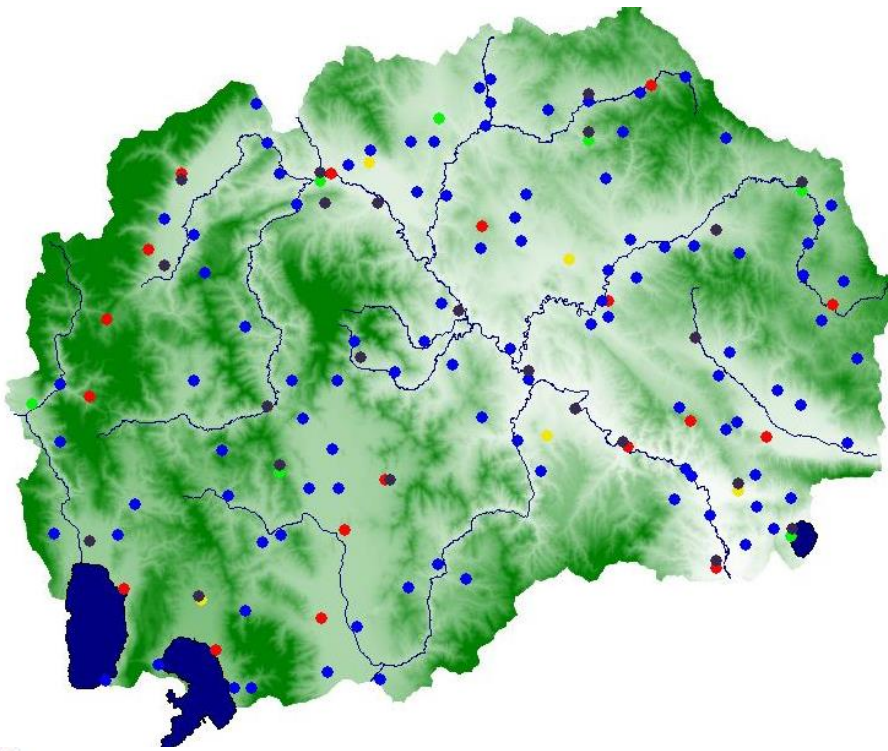- Division of legislation and common works
- Division of international cooperation and public relations

Department of Finance
- Division of budget coordination
- Division for Budget control
- Division of Accounting

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9 - 10 November 2016 Ljubljana, Slovenia

Meteorological network includes:

- o 19 Main meteorological stations
     (with professional observers)
- o 7 Climatological stations
- o 24 Phenological stations
- o 14 AWSs
- o 103 Precipitation stations
- o 2 Weather radars
- o 3 regional points for soil moisture
     measurement

met network
- ● phenological station
- ● automated meteorological station
- ● main meteorological station
- ● climatological station
- ● precipitation station

Meteorological department \ main activities

- Observations, control, processing of meteorological data

- all meteorological data are managed using CLIDATA software.The available period of digitalized data is from 1951 until now.

- meteorological information are applied in the field of water management, agriculture, forestry, transportation, urbanism, civil engineering, space planning tourism, protection of environment and human health;

- agrometeorological information and forecasts on weather and climate influence over agricultural production especially at adverse weather situations (frost, drought and other weather disasters) etc.

Division of Agricultural Meteorology

CURRENT PRODUCTS AND USERS OF AGRO-METEOROLOGICAL INFORMATION

- Once a week we prepare agrometeorological information about the influence of weather on crops according the general forecast issued by HMS to all media

- Once a week agrometeorological information is present on TV channel for farmers

  In case of extraordinary condition, special warnings are issued

- For insurance companies we provide information on their request

- Ministry of agriculture, forestry and water management is regular user of annual agrometeorological information

- Students from Faculties for agriculture and forestry , ecology are regular data users

- We prepare decadal agrometeorological bulletins/statistical analysis

- Vine companies, agricultural community, investors on their request

Division of Agricultural Meteorology

Agro-meteorological software currently used and their purpose:

• SAGA-GIS
• Drought calculation indices

    Current or future project(s) :

• FAO and MAFWE
  Project Title: Reducing Vulnerability of Agriculture to Climate Change

  Goals of the project: To increase institutional capacity of government and other entities to assess climate-change impacts and identify adaptation options and provide improved extension and education materials to farmers.

  HMS –Goals of our component: To enhance the technical capacities of the National Hydrometeorological Service (specifically the Agrometeorology Department) to develop climate services tailored to the needs of stakeholders in the agricultural sector and provide early warning.

As separate pilot project, in the first step three points for installation of AWS are chosen:

- Vine yards – central part
- Rice region – east part
- Organic production – southeastern part of country

During one year trial period, it is an intention to provide direct users/farmers with simple and clear current and forecasted meteorological information with tailored information for agro technical field activities.

Meteo alarms for frost, heat waves, drought, heavy rain, wind and hail will be issued when needed.

We are still defining the means for dissemination (web, TV, brochures) and entities for cooperation (Extension agency, Rural Development Network organization etc). Also, planned are several seminars in order to provide feedback from final users.
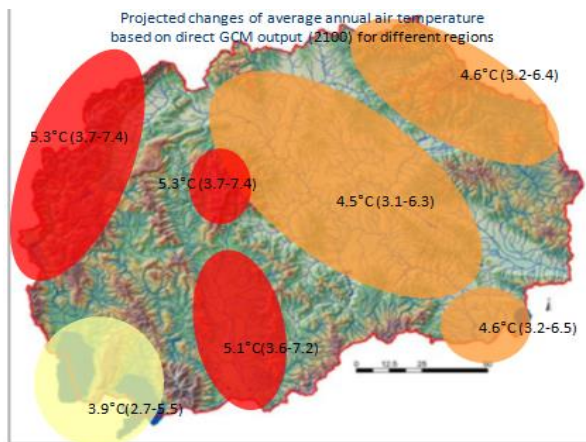
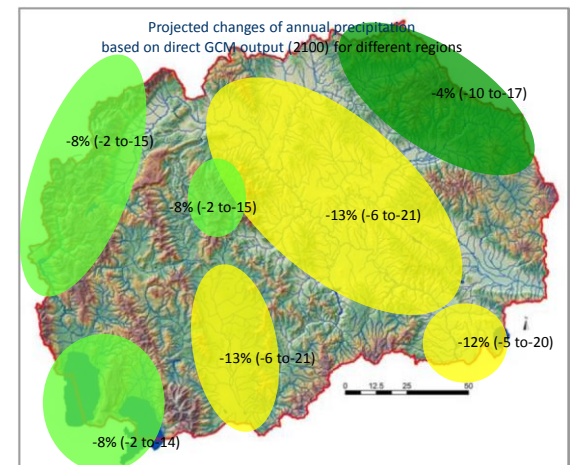Vine yards – central part

Rice region – east part

Organic production – southeastern part

HMS participated in preparation of three National Communications on Climate Change up to date (in 2003, 2008 and 2013). Climate and climate change products were used in various sectors (also agriculture) to elaborate vulnerability, adaptation and mitigation strategies.

- According to scenario for entire country based on the direct Global Circulation Model (GCM) output, the projected changes in average daily air temperature (°C)and precipitation (%) for the Republic of Macedonia, based on direct GCM output interpolated to geographic location 21.5°E and 41.4° N (base period 1990)

- In addition, local climate scenarios were developed for the first time according to national climate sub regions, by further scaling to other marker SRES emission scenarios (A2, B2, A1T, A1b, A1FI, B1) using the pattern scaling method. (University of Nova Gorica/Bergant 2008)

Projected changes of average annual air temperature based on direct GCM output (2100) for different regions

4.6°C (3.2-6.4)
5.3°C (3.7-7.4)
5.3°C (3.7-7.4)
4.5°C (3.1-6.3)
4.6°C (3.2-6.5)
5.1°C (3.6-7.2)
3.9°C (2.7-5.5)

	Average temperature change [°C]				Precipitation change [%]			
	annual				annual			
Year	2025	2050	2075	2100	2025	2050	2075	2100
Low	0.9	1.6	2.2	2.7	-1	-2	-4	-5
Mean	1.0	1.9	2.9	3.8	-3	-5	-8	-13
High	1.1	2.1	3.6	5.4	-6	-7	-12	-21

Projected changes of annual precipitation based on direct GCM output (2100) for different regions

-4% (-10 to-17)
-8% (-2 to-15)
-8% (-2 to-15)
-13% (-6 to-21)
-12% (-5 to-20)
-13% (-6 to-21)
-8% (-2 to-14)

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Based on the results of the climate change scenarios up to 2100, both at national level and the down-scaled ones, *the vulnerability assessment analyses in agriculture sector* was prepared

The most vulnerable agricultural zone is Povardarie region, especially area of conjunction of Crna and Bregalnica Rivers with Vardar River (Kavadarci as a corresponding meteo station), very vulnerable zones with the corresponding meteo stations are: Southeastern Part of the country (Strumica), Southern Vardar Valley (Gevgelija), Skopje-Kumanovo Valley (Skopje), Ovche Pole (Stip), and less vulnerable zones with the corresponding meteo stations are: Pelagonija Valley (Bitola), Polog (Tetovo and Gostivar - no climate scenario), Prespa/Ohrid region (Resen)

- Following crops were defined as vulnerable crops: *vine grape* as most important crop in Povardarie Region, *tomato* as most important vegetable crop in predominantly vegetable growing agriculture in South Eastern part of the country (Gevgelija - Strumica), *winter wheat* as most important cereal in Skopje - Kumanovo and Ovche Pole region, *apple* in Prespa/Ohrid region, especially Resen, *Alfalfa* as crop with very high water demand and huge importance in livestock sector that is vulnerable in all agricultural regions in the country, especially for Bitola region.

Defining most vulnerable zone to climate changes
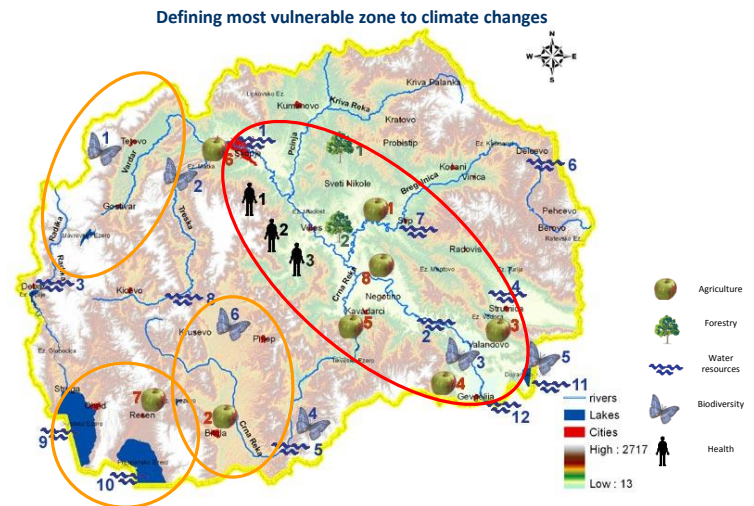
- In the frames of the Third Communication, further digitalization of data, long term data analysis, calculation of climate indices and their long term trend (heat and cold waves indexes) was carried out.

- Climate change prediction in Macedonia was carried out with MAGIC/SCENGEN v5.3 software package, in accordance with the IPCC's basic recommendations and the results contained in the last Fourth Assessment Report/AR4. Six scenarios were used (A1B-AIM, A1FI-MI, A1T-MES, A2-ASF, B1-IMA and B2-MES).
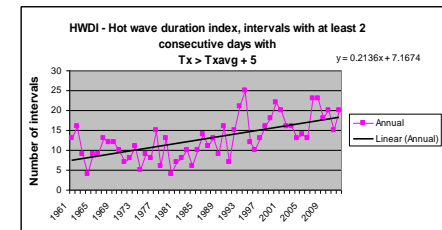
Some results on basis of departure of air temperature from normal 1961-90

► Is noted increase of departure from normal 1961-90 in last 20 years, more significant in sumer.
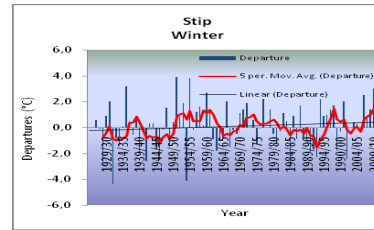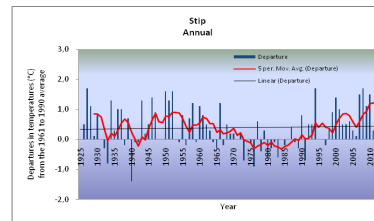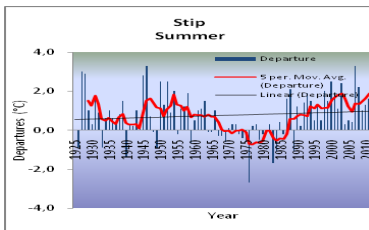
Some results - temperature climate indices

► Graph of HWDI change during period 1961 – 2012 – increase in the number of intervals

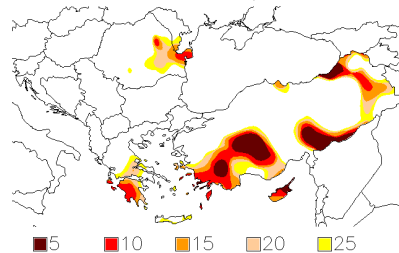► Graph of CWDI change during period 1961 – 2012 – slight decrease in the number of intervals
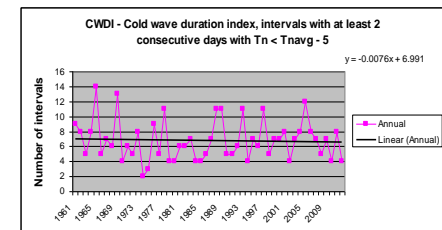
HMS participated in DMCSEE- Drought Management Centre for South Eastern Europe Project during 2009-2012 together with 15 partners from 9 counties, co-founded by EU and led by EARS.
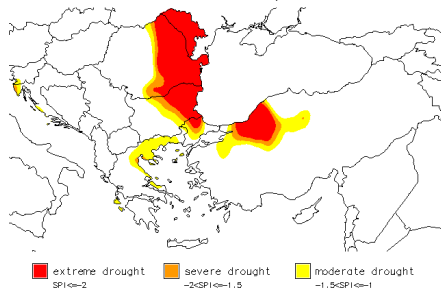
Current products of the DMCSEE are in use to provide on time information and warnings about drought conditions.

- Current use of DMCSEE
- Historical maps of various SPI, precipitation and percentiles (1951-2000)
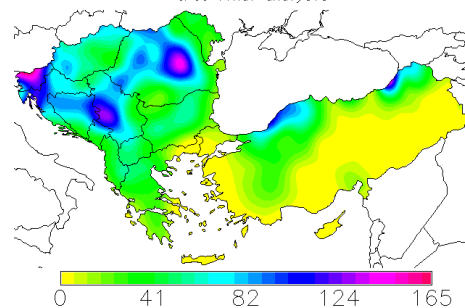- Monthly drought monitoring products
- Drought Bulletin for SE Europe

Precipitation percentiles Feb 2016
GPCC final analysis

5   10   15   20   25

SPI Jul 2016 (1 month)
GPCC final analysis

extreme drought   severe drought   moderate drought
SPI<=-2   -2<SPI<=-1.5   -1.5<SPI<=-1

Precipitation map Aug 2016
GPCC final analysis

0   41   82   124   165

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Conclusions

- There is a necessity of continuous meteorological monitoring followed by high quality data processing in order to provide quality service and products for the agricultural sector.
- International cooperation in sharing knowledge and further education is also a necessity (eg. WMO RTC Bet-Dagan, FAO etc) especially for implementation and use of models for crop monitoring, irrigation, disease and pests preparation, seasonal forecast for agriculture.
- Regarding climate services, an additional Regional Climate Modelling and statistical/ dynamical downscaling is needed to explore local changes within the country (as it can be expected that the complex orography of the country will lead to significant local modifications of the projected national average changes) in order to provide reliable input for further agricultural studies.

Thank you for your attention !

How ?

AWS – point/ separate pilot projects
- Vine yards – central part
- Rice region – east part
- Organic production – southeastern part of country

What?

Info – clear , simply , ready for next day
Web site – weather forecast, for 5 days
Meteo alarms – Frost, Hot wave, Drought, Heavy rain, Hail, wind
Agro technical field activities tailored information
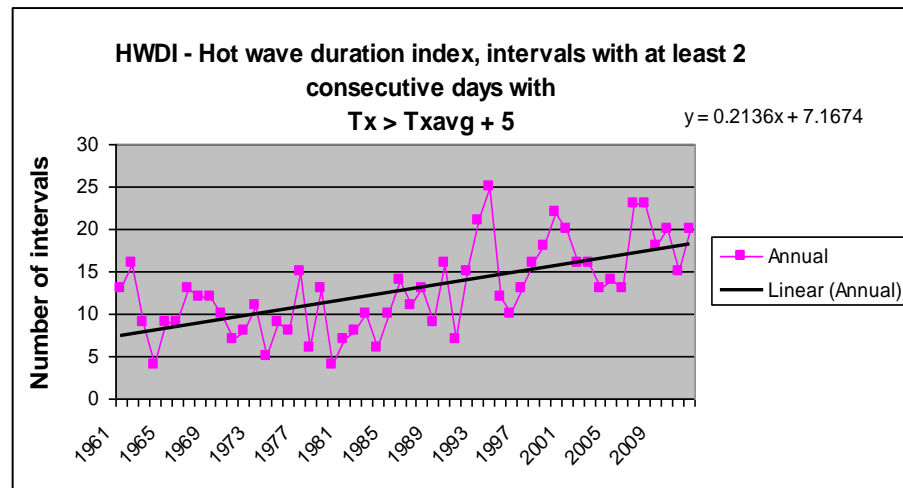one year to adjust all possibilities

Dissemination
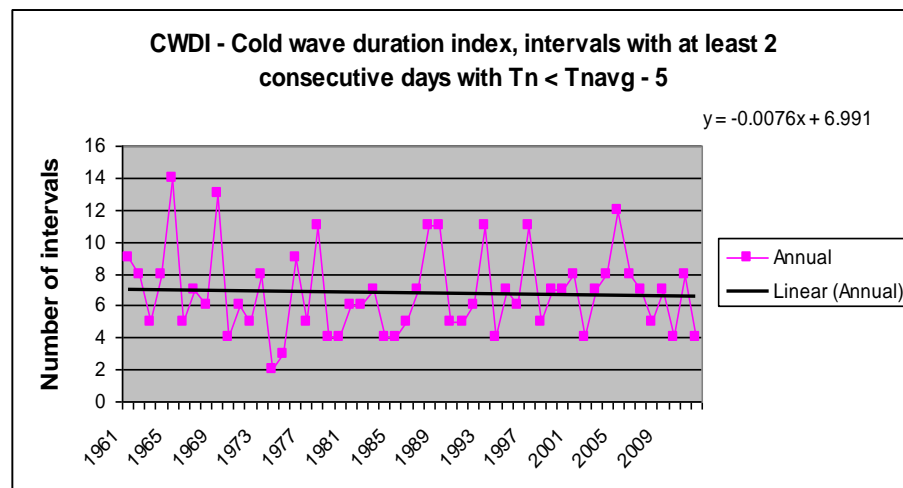
- Info- brochure
- Info – TV
- Seminars – for feedback

Some results - temperature climate indices

▶ Graph of HWDI change during period 1961 – 2012 – increase in the number of intervals


HWDI - Hot wave duration index, intervals with at least 2 consecutive days with
Tx > Txavg + 5

$y = 0.2136x + 7.1674$

▶ Graph of CWDI change during period 1961 – 2012 – slight decrease in the number of intervals

CWDI - Cold wave duration index, intervals with at least 2 consecutive days with Tn < Tnavg - 5

$y = -0.0076x + 6.991$

Some results on basis of departure of air temperature from normal 1961-90

► Is noted increase of departure from normal 1961-90 in last 20 years, more significant in sumer.
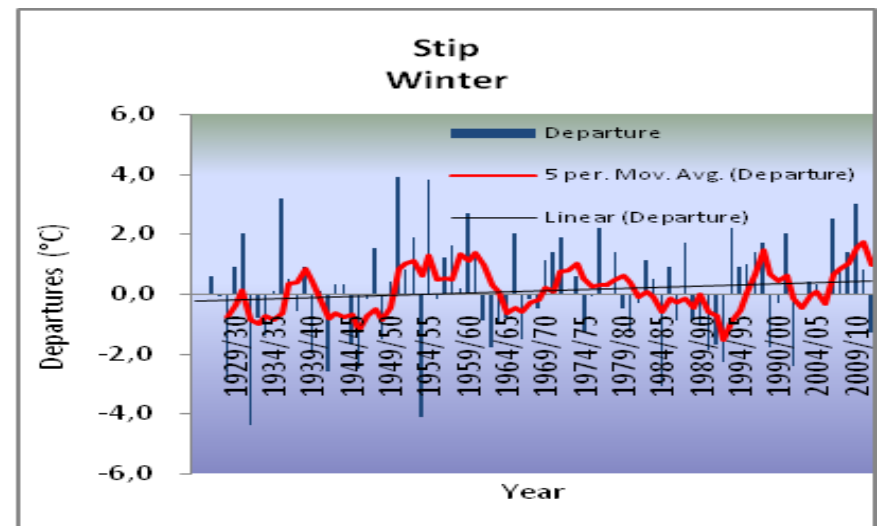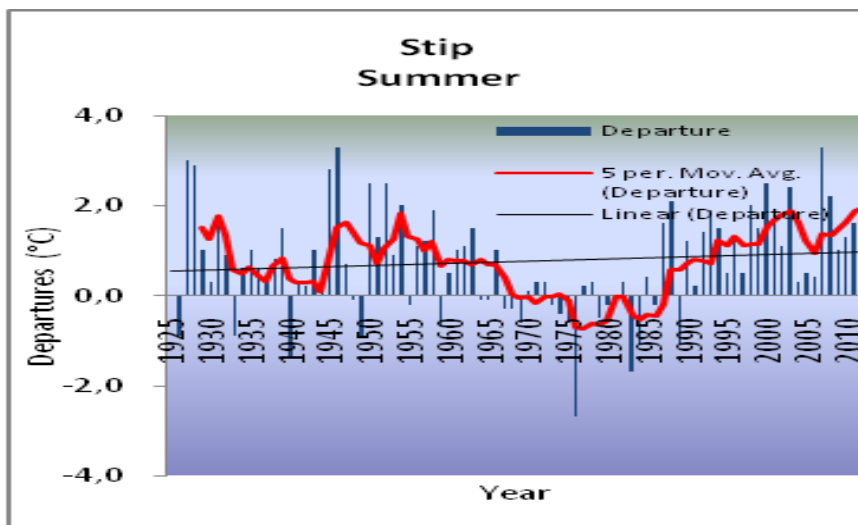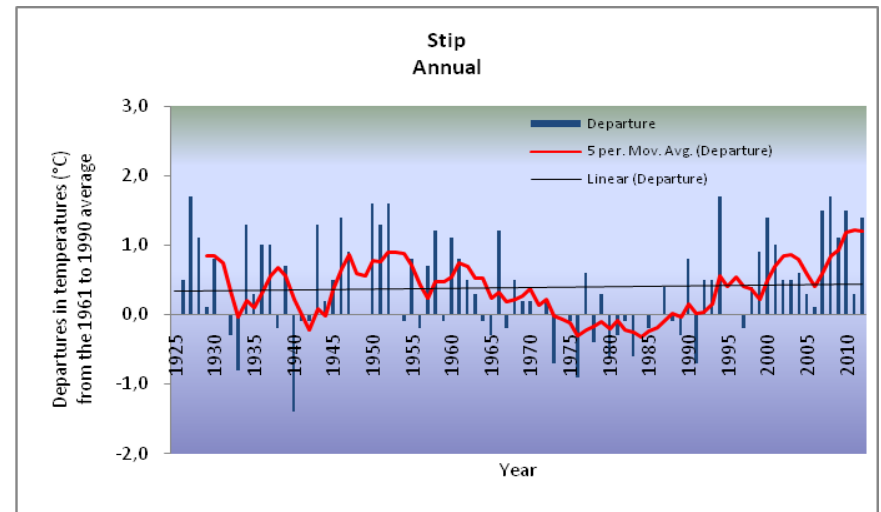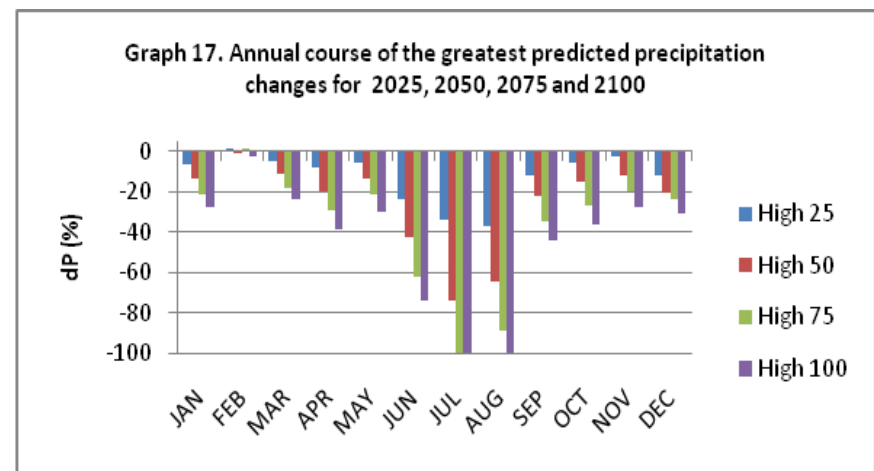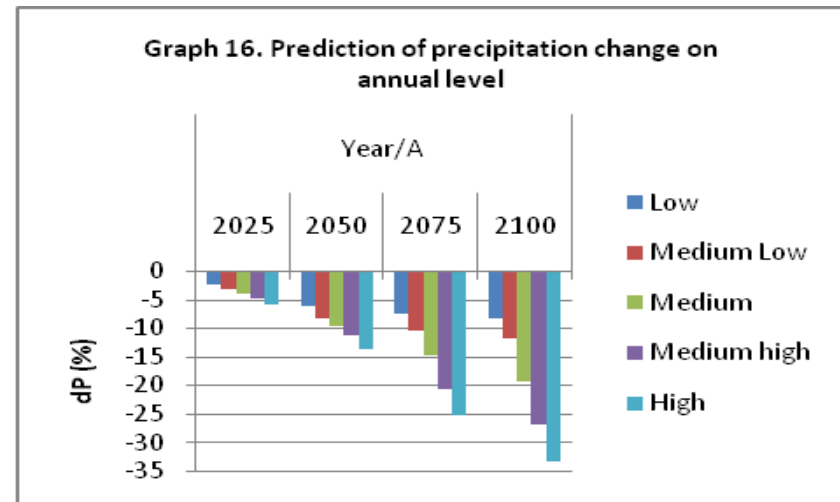
Some results- precipitation changes

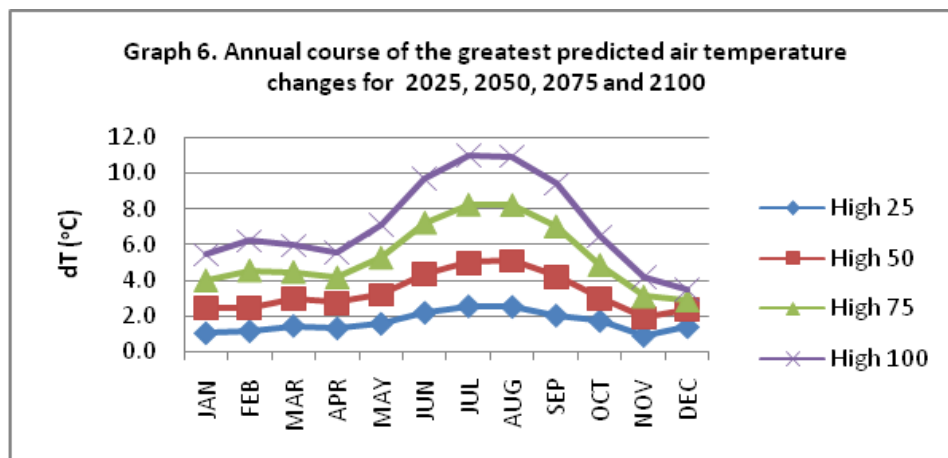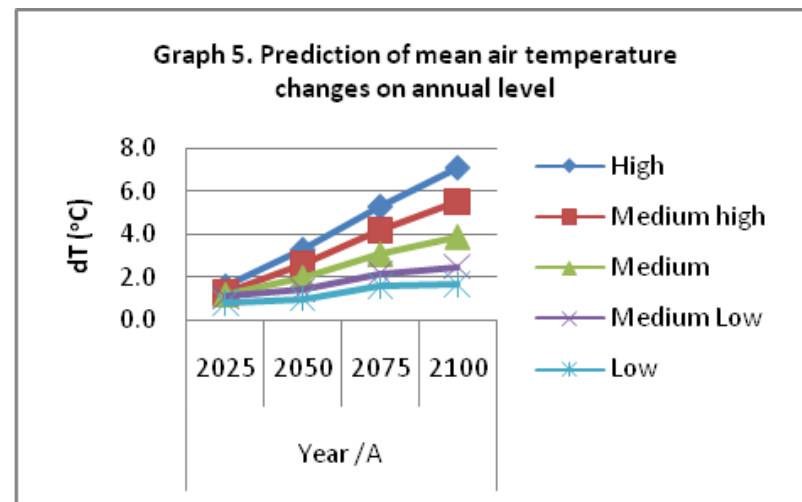Predictions on precipitation quantity changes at annual level:

► 2025 - change -4 [-2 / -6] %,
► 2050 - change -10 [-6 / -14] %,
► 2075 - change -15 [-8 /-25]%,
► 2100 - change -19 [-8 / -33] %.

Changing of predicted average monthly changes of precipitation quantities in the central point A by months

Graph 16. Prediction of precipitation change on annual level

Graph 17. Annual course of the greatest predicted precipitation changes for 2025, 2050, 2075 and 2100

Some results - air temperatures changes

► Temperature changes at annual level:
► 2025 - change 1.2 [0.8 – 1.6] oC,
► 2050 - change 2.0 [1.0 – 3.3] oC,
► 2075 - change 3.1 [1.6 – 5.3] oC,
► 2100 - change 3.9 [1.7 – 7.1] oC.

► The data indicate an air temperature increase in the whole period 2025–2100

Graph 5. Prediction of mean air temperature changes on annual level

Graph 6. Annual course of the greatest predicted air temperature changes for 2025, 2050, 2075 and 2100

Changing of predicted mean monthly air temperature changes for central point A, by months – annual course

Obtained data generally showed no significant difference with previous findings in SNC
(0.1° C-0.2° C; 1%-6%).