Climate Change Research: Evaluation and Policy Implications
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CLIMATE CHANGE RESEARCH IN BULGARIA

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INTRODUCTION

Climate is traditionally one of the main fields of research interest and objects for study in Bulgaria so many investigations on its genesis and specific features are carried out in the past and present. Recently climate change research appears to be the most actual topic and it is in the centre of climatic studies. A major part of these studies are realized at National Institute of Meteorology and Hydrology (NIMH) because of its essential role in collection and analysis of the basic climatic data for the country. In the paper brief description of the climate change research at NIMH is presented and the obtained results are summarized.

DESCRIPTION OF CLIMATE CHANGE RESEARCH

The two main types of study - general and concrete - are covered but in different extent. The general studies - greenhouse gas (GHG) emissions estimation, environmental pollution as climate forcing factor, etc. - are undertaken by researchers at NIMH in the last few years while concrete studies on the climate variability are carried out in the course of last decades. Most of the concrete research examine single climate elements - air temperature, precipitation, sun-shine duration; some of studies are on complexes of climate elements like air temperature - humidity, and on climatic phenomena - drought, extreme and unfavourable events, etc. The attention is focused mostly on air temperature and precipitation as well as to drought phenomenon considering their part in the climate system and their importance for present climate change processes both at local and regional (Balkan Peninsula) scale.

METHODS

In order to examine climate variability in Bulgaria time series of the basic climate elements are treated using the following methods: smoothing by weighted (9 or 10) moving averages, fitting by polynoms (of 7th to 9th order), integral difference curves, Spearman and Mann-Kendal rank tests. The first two methods are more subjective while the second two methods provide more objective results. Both types of methods could be used for short and long-term trend analysis. It could be mentioned also the introduced variability indexes D - for temperature [Koleva, Iotova: 1994], and P - for precipitation time series analysis [Koleva, Iotova: 1992] which make easier the task for trends identification in these series.

SUMMARY OF THE OBTAINED RESULTS

Before summarizing the obtained results it has to be pointed out the following specific features of the climate variation pattern in Bulgaria: the difference between the flat and mountain parts of the country as well as seasonal differences. These features are determined by the country's very complex orography conditions: two relatively large flats, few considerable for the small territory mountains (the Balkan Mountains, Vitosha, Rila, Pirin, the Rhodopes) and many closed or semi-closed plains. That is why the climate variability is usually studied separately for the flat and mountain parts as seasonal and annual characteristics of the climatic elements are processed.

The most summarized results on the air temperature variations in Bulgaria are presented in [Koleva, Iotova: 1994 (under press)] where it is concluded that the Spearman rank test results in negative trend in July and positive - in January for the most stations, with the 95% significance level. The annual temperature shows positive trend in North Bulgaria and negative - in South Bulgaria. Similar results for the annual temperature are obtained by the Mann-Kendal test [Koleva, Iotova: 1994]. The

last ones are compared with the corresponding figures for Bucharest, Prague and Northern Adriatic - showing positive trends, as well as for Warsaw and Thessaloniki - showing negative trend, as all these trends are statistically significant (95% level of confidence). So the global tendency for warming can reveal as temperature increase in someplace but, at the same time - temperature decrease in other one.

It is interesting to note the good agreement between the results for air temperature and these for the sun-shine duration [Koleva, Iotova: 1992]: there is positive trend in the winter and negative - in the summer, but the trends in the sun-shine duration time series are not statistically significant.

As it is mentioned above, the orography conditions in Bulgaria determine considerable differences between the climatic elements in the flat and mountain parts of the country. It is true especially for precipitation so separate examination of the precipitation variability for the two orography types is carried out [Koleva: 1994; Koleva, Iotova: 1992]. Both statistical methods - smoothed curves and Spearman/Mann-Kendal tests result in positive trend for January, and negative - for July and annual precipitation in the flat parts of Bulgaria. The spectral analysis is applied for the annual precipitation finding 4 and 6-7 year oscillations but not 11-year ones so that to be associated with the sunspot activity. In respect to the mountain parts the same methods result in similar pictures: the smoothed curves show a decreasing trend in recent two-three decades, and the Spearman/Mann-Kendall tests find negative trends with 95% significance for the half of mountain time series.

Drought phenomenon appears to be of great importance for Bulgaria, especially in the flat part of North Bulgaria (Danube Plain), where the continental type of climate occurs. In the last years considerable attention is paid in respect to drought and some results are already available [Koleva: 1994 (under press)]. It is found a tendency for dryness and frequent droughts in Danube Plain as a total lack of precipitation can occur in any month but the probabilities are very low in June and May. Using the Budyko's dryness ratio it is obtained that Danube Plain climate is insufficient moist - sub-humid. On the other part, the variability of average precipitation from year to year expressed by the variability index, which ranks the years of the 20th century from driest to wettest one, shows that the 1980-s is the driest decade in this century. In recent years drier than normal conditions persist in the examined region. Especially dry is May-September season.

NATIONAL CLIMATE PROGRAMME

In accordance with the WMO' World Climate Programme it is developed National Climate Programme (NCP) of the Republic of Bulgaria in order to unite all efforts in this regard. Beside of NIMH as initiator and co-ordinator, some other Institutes of Bulgarian Academy of Sciences - Institute of Forestry, Institute of Geography - and Higher Institute of Forestry, Nikola Pushkarov Institute for Soil Science and Agroecology, etc. are involved in NCP. The primary objectives of NCP are the following: creation of computerized climate data bank; research on possible climate change in Bulgaria as a reflection of global climate change; analysis and optimization of the weather and climate use as natural resources; improvement of the monitoring system for climate and related environmental elements observation and analysis. The NCP's particular objectives include: forwarding to Bulgarian Government information and analyses on climate, climate change and related topics; providing the public and governmental bodies with data and research results which they need and require. The above objectives are realized through 9 concrete projects without special financing for them.

Bulgarian NCP has to be actualized now - to do evaluation of what is done, what are the main results, and what new to be included in the light of the last international and national priorities. Bulgaria signed the Framework Convention on Climate Change (Rio de Janeiro, 1992), which is in force already, but it is still not ratified by Bulgarian Parliament. Everything necessary for the ratification is prepared by the Ministry of Environment and simultaneously corresponding activities are undertaken to develop Bulgarian National Programme for Actions in Response to Climate Change. In this way it will be met the Convention's and other international agreements' requirements.