VII Annual International Conference of REC Caucasus
"Climate Change Adaptation – Challenge and Opportunity for the Caucasus"

VII Ежегодная международная конференция РЭЦ Кавказ
«Адаптация к изменению климата – вызовы и возможности для Кавказа»

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Tbilisi, Georgia / Тбилиси, Грузия

CENN	**Climate Change Adaptation and Disaster Mitigation (CCADM) project-Tamar Mtvarelidze**
SUSTAINABLE DEVELOPMENT	**Energy security of the Azerbaijan Republic and the problem of sustainable development of alternative energy sources Fikret Djafarov**
ENERGY, ECOLOGY, ECONOMY	**Influences of Regional Change of the Climate on the Environment- Shamil Movsumov**
ARMENYAN ECOTURISME ASSOSIATION	**Mainstreaming Climate Change Considerations into Tourism -Zhanna Galyan**

It is expected that the reports and lessens learned from climate change adaptation projects will be presented by all three South Caucasus Countries.

14:15-14:30 **Discussion**

Questions:

14:30-15:30 Lunch

Session Three:

15:30-16:40 Climate Change adaptation perspectives of the Academia
Thesis/Presentation

Chairman: **Khayyam Rahimov**

Tamaz Chelidze **"On the climate change in Georgia in the past, at present and in the future: what should be done for filling the gaps "**
M.Nodia Institute of Geophysics of Iv.Javakhishvili Tbilisi State University

Nicholas Meskhidze- **"Climate Change and Sustainable Development with the Emphasis on the Southern Caucasus"**
North Carolina State University, Raleigh, NC, USA

George Fayvush **On the impact of global climate change on the flora and vegetation of Armenia**
Institute of Botany, National Academy of Sciences of Armenia

Khayyam Rahimov **Assessment of the impact of expected cllimate change on population of Azerbaijan and possible adaptation**
Climate and Agroclimate Department of Geography Institute, NASA.

Tahira Gahramanova **Several aspects of Geosystem climate change influenced by wind erosion within the coastal region of Azerbaijan.**
Baku State University

Marat Tsitskishvili **The Problem of Adaptation to Climate Change**

On the climate change in Georgia in the past, at present and in the future: what should be done for filling the gaps

A. Amiranashvili, T. Matcharashvili, G. Melikadze, T. Chelidze

The greenhouse effect (global warming) is one of the main hazards facing the whole planet. The climate forcing is due to rising concentration of greenhouse gases (CO2, methane, water vapor): according to different assessments, the temperature will rise by 1.4-5.80C at the end of 21-th century. This can cause a lot of devastating effects and many of them will be impossible to prevent, which means that the humankind should find some way to adapt itself to global warming.

Georgia is prone to many negative effects, connected with climate change: the mountain glaciers will melt and partially disappear, the sea level can rise, the vast areas of land can became deserts, water resources can be seriously affected.

Despite some earlier efforts, devoted to assessment of climate change in Georgia, the results are still ambiguous. In particular, the research carried out shows that during last decades the mean temperature in the Eastern Georgia is rising and in Western Georgia it is decreasing. These conclusions are debated and there is a need to re-consider them using new data and new methods of mathematical analysis of meteorological time series. For reliable assessments new modern methods of obtaining and analysis of climate data in the past, present and future is necessary to use.

i. One of the frequent questions related to CC is: is the temperature rising in the last years something new or such effects were experienced earlier in the Earth history? It also can be formulated in other way: is the climate change in the last decades due to anthropogenic impact or it is a natural phenomenon, which takes place on the Earth without any human intervention? In order to get quantitative information on the climate change in the past one of the most reliable methods is analysis of geothermal imprint of the past climate in deep wells, as the other methods, such as tree rings, are prone to large bias. Detailed variations of the surface temperature are evaluated from long-term highly resolved temperature measurements in boreholes, because the temperature variations slowly penetrate into the subground and can be measured hundreds or thousands of years after its occurrence. As the most part of heat comes from the Earth interior to the surface, the temperature profile would be linear increase with depth in case of constant temperature at the Earth surface (Fig.1). If the Earth surface is warming than larger the warming larger the deflection of temperature profile from the linear behavior; using mathematical inversion methods the past climate can be reconstructed up to 1000 years back. In Georgia there is a good technical basis for application of this method, namely, the network of monitored wells and precise microtemperature measuring equipment.

ii. Under present period we imply the time interval, when the instrumental data on temperature and other meteorological parameters are available. For Georgia this is a period for the last (approximately) 160 years. These data have been analyzed earlier, but now application of new methods of statistical analysis can give more reliable results and evaluate uncertainities of assessments.

iii. As it is well known that the meteorological processes are as a rule, nonlinear, the correct forecasting of evolution of natural process, including climate change, is impossible without understanding its basic qualitative and quantitative dynamical features. Therefore we propose that main statistical peculiarities of atmospheric processes in Georgia for last decades should be recalculated by means of modern linear data analysis and trend significance assessment techniques. Then dynamical characteristics of atmospheric processes should be investigated using complete toolbox of modern nonlinear data analysis methods.

Exactly for quantitative assessment of changes in dynamics of air temperature, atmospheric pressure, humidity etc. data sets, long range correlation fractal correlation dimension, Lyapunov exponent calculations as well as recurrence quantitative analysis (RQA) should be carried out [Zbilut, 1992; Abarbanel, 1993; Kantz, 1997; Hegger, 1999; Marwan, 2002; Romano, 2005]. Nonlinear structure testing surrogate methods should be used too [Kantz, 1997]. To test distributional characteristics of processes of interests Shannon and Tsallis entropy measures as well as mutual information should be calculated [Kantz, 1997]. All these calculations will be carried out for complete data sets as well as for different time span sliding windows. Both individual and averaged characteristics for considered data sets will be analyzed.

Linear multiscalling methods such as: regression of power spectrum exponent, wavelet transformation, R/S and detrended fluctuation exponents calculation, memory testing based on Fokker Plank function calculation for real data should be performed to reveal time scale dependent variations in analysed processes [Bassingwighte, 1994; Peng, 1995; Peinke, 1997].

Nonlinear forecasting methods for available meteorological data sets should be used [Kantz, 1997; Sprott, 2005], such as neural networks etc.

References:

Archer, D. Global Warming Blackwell Publishing. 2008.

ISAM Integrated assessment model for future climate change. http://understanding the forecast.org/projects/isam.html