ASSESSMENT OF THE INFLUENCE OF CLIMATE CHANGE ON WATER RESOURCES AVAILABLE IN THE ARAL SEA BASIN

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Introduction

Observed climate change (global warming) is directly related to greenhouse gas (GHG) concentration increase in atmosphere. Global warming rates, scales as well as its effect in some regions depend on global GHG emissions volume in atmosphere of the Earth in future.

In 1992 Intergovernmental Expert Group on Climate Change (IEG) proposed 6 GHG emissions scenarios (IS92a, ..., IS92f). Scenario IS92a assumes that global population would increase up to 11.3 bln. by 2100, economical growth would be 2.3-2.9% annually, besides no attempts of restricting GHG emissions in atmosphere would be made. This is so called "business as usual" scenario. Scenarios IS92c и IS92d assume less quantity of emissions against scenarios IS92a и IS92b, and scenarios IS92e и IS92f – greater quantity due to difference in assessments of population increment, economical growth, use of various types of fuel and power sources [2, 14]. According to above mentioned scenarios there are the same number of global air temperature increase alternatives, moreover each variant has own uncertainty limits.

The most reliable tool for modeling physical processes, which define climatic changes, are three-dimensional numerical models of general circulation (MGC). Its advantage is that basing on conservation laws models, as much as possible, account physics of processes, which allow simulation and prediction of climate. However MGC has some constraints including horizontal resolution of models, which doesn't provide adequate regional climate simulation.

Great averaging on area, typical for global models, reduces amplitude of fluctuations of regional climatic characteristics.

Quality of air temperature changes simulation by climatic models in scale of hemispheres and continents is higher than for specific regions. Moreover, quality of regional climate change assessment depends on region location, its physical-geographical conditions, and used models.

While developing climate change scenarios on MGC basis it is necessary to take into account its different sensitivity. Regarding this climate sensitivity parameter is widely used, which is defined as global average air temperature variation by the surface in state of balance, which occurs in response for CO_2 concentration doubling in atmosphere. This parameter values are in range 1.5-4.5°C [17].

In spite of significant uncertainties, MGC is successfully applied for global climate description in general and specific regions' climate description as well. Results obtained on global models of general circulation of atmosphere and ocean are the most favorable basis for formation of climate change scenarios and regional vulnerability assessments [3, 7, 8, 13-17].

When using global models' results to assess regional climatic changes, it is necessary to take into account geographical features of certain regions, which are related to location relief, water objects, character of underlying surface etc. For this purpose «downscaling» methodic are used, by means of which climatic characteristics, given by models, are transformed to required for further use meteorological parameters with proper spatial and temporal resolution.

Given report presents results on forming regional climatic scenarios with using two approaches.

1. Use of dependencies between global temperature and regional climatic characteristics. This empirical-statistical approach is described in papers [6, 10, 12]. In this version assessments of global climatic characteristics are taken from IEG Technical guideline [11] for conditions of high climate sensitivity to GHG concentration increase in atmosphere for 6 IEG emission scenarios (scenarios IS92c and IS92d, IS92a and IS92b, IS92e and IS92f).

2. Statistical interpretation of MGC results in regular network grids with applying "ideal forecast" concept [9]. In given variant MGC outputs are used for conditions of average climate sensitivity to GHG concentration increase in atmosphere according to scenario IS92a ("business as usual" scenario) with account for mitigating impact of sulfate aerosols.