Weighting atmospheric general circulation models in order to achieve the best fit models with area (Case Study: Isfahan)

Aghil Soltani Mohammadi [1], Mahmoud Reza Molaienia [2], Ali Ajamzadeh [3]

[1.] M.Sc. Student, Department of Civil Engineering, University of Zabol, Iran
[2.] Assistant Professor, Civil Engineering Department, University of Zabol, Iran
[3.] Graduate of Master of Engineering, Department of Civil Engineering, University of Zabol, Iran
aghilsoltani1992@gmail.com

Abstract: Increasing the density of greenhouse gases and expansion of industries, full color footprints of climate change. Including methods of estimating the size of climate change, the use of atmospheric general circulation models (GCM) is. In order to study climate change, the atmospheric general circulation models suitable for different models in the study area due to large-scale data generation is important. In this study, the results of general circulation climate models to simulate meteorological parameters were used for the statistical base period and data produced by 18 models of Fourth Report and 39 models of Fifth Report of the intergovernmental climate change an important loss, for the base period of four stations located in the province were compared with data monitoring and comparing the weight of each model according to data produced by each model and monitor data on monthly basis, on the other. Then, according to the weight of each model and root mean square error, models CGCM3T47, INMCM3 and MIROC3.2-MEDRES of the Fourth Report and models CCSM4, CSIRO-MK36 and HADGEM2ES of the fifth report were appropriate for the province.

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1. Introduction

The most reliable tool to study the effects of climate change on different systems using climate variables simulated by atmospheric-oceanic coupled models (GCM) is. GCM different projects based on the assumptions in the reaction between the atmosphere, vegetation, oceans, ice, clouds, greenhouse gas emissions and provides the suspended solids (Ghosh and Mujumdar, 2011).

The difference between the two climates for whatever reason that occur due to changes in the natural phenomena such as droughts, floods, storms, temperature changes, melting glaciers and events there are limits to the necessity of recognition makes it more than ever. Climate impact and effectiveness of processes in the complex system as a general matter and one of the most important issues in academic and political and economic even in developed countries is (Bandari et al., 2012).

Babaian and Kwon in 2004, South Korea's climate change using LARS-WG model for the period 2010 to 2039 were evaluated. The results indicate that changes in precipitation as well as the standard deviation of rainfall are not anticipated during the 2010 to 2049 period relative standard deviations difference scout and GCM model output rose in the same period.

Semenov and Stratonovitch in 2010, a method to reduce uncertainty stated GCM models. In this way, several models of global climate models to assess the impact that requires the effects of climate change scenarios require a local scale, was used.

Su and colleagues in 2015, precipitation and river flows under different scenarios SRES Air China's Song and RCP examined. The results showed that under scenarios of precipitation RCP, SRES emission scenarios is an increasing trend toward clearer.

2. Material and Methods

Isfahan province with an area of more than 107 thousand square kilometers, is the sixth Considering the vast province of Iran. The wide extent of this province in the country has led to a variety of natural and human features of shape, so that can be called small Iran. On the other hand, due to specific geographical conditions and placement of Isfahan in central Iran, check the proper management of water resources due to climate change and further development of the province and this effect is also felt in the neighboring provinces.

In general, the ability to scale in the production of different data models and choose the right model for downscaling is needed to compare data generated by models with observational data. In this study, the data produced by 18 models of Fourth Report and 39 models of Fifth Report approved by the Board of intergovernmental climate change an important loss, for the base period compared with observation data and the weight of each model according to the latest monthly data generated by these models and surveillance data, respectively. In weighting, mirroring the absolute value of the difference between the variable and modeled observation, the sum of the absolute value of the difference between the observation of the inverse modeling in all models is divided, so that the sum of weights should be one. Another way to select the top models, root mean square error. Each model has RMSE[1] was less and more weight, is selected as our model are calculated according to the following equation:

$$W_i = \frac{\frac{1}{\Delta T_i}}{\sum_{i=1}^{N} \frac{1}{\Delta T_i}}$$

$$RMSE = \left[\frac{\sum_{i=1}^{N}(P_i - Q_i)^2}{n}\right]^{\frac{1}{2}}$$

That in this equations:
Pi: The simulated values
Oi: The observed data
N: The number of years under study

[1] Root Mean Square Error

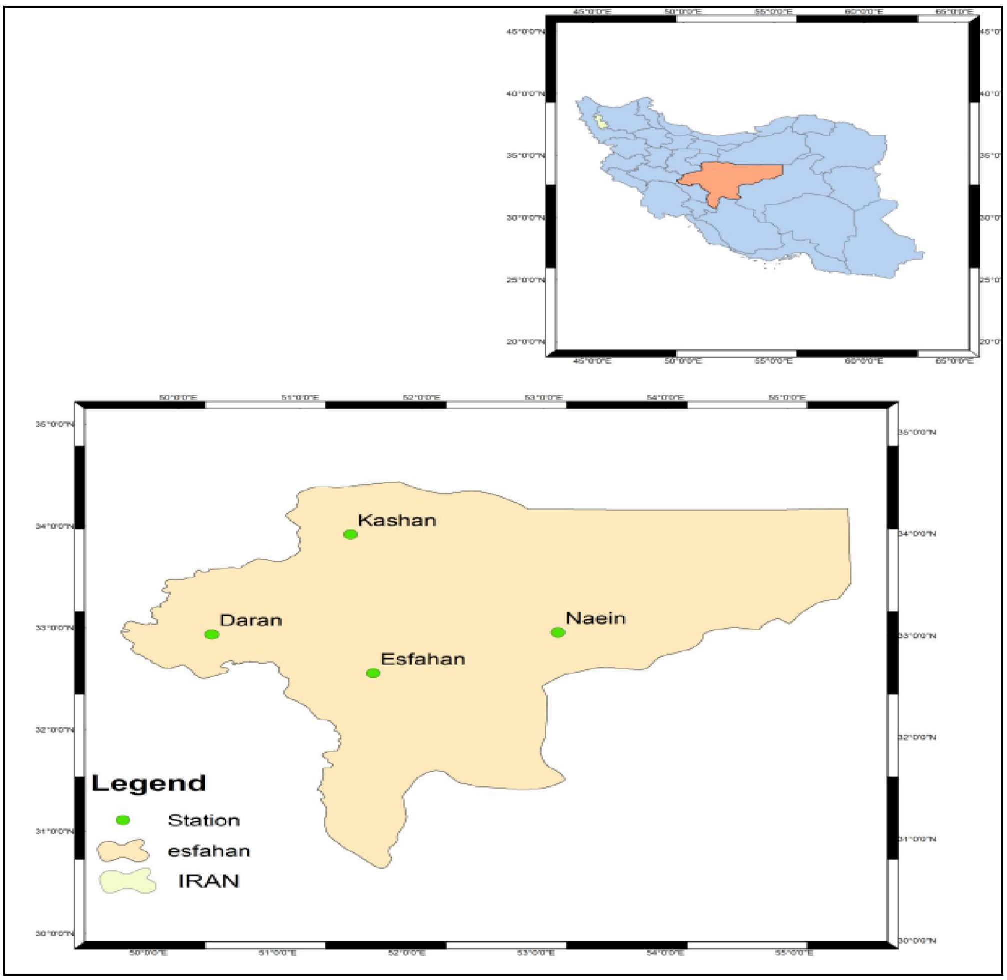

Figure 1: Geographic Area of Isfahan province

3. Results

Results weighting models of general circulation models of the atmosphere to separate the fourth and fifth reports of the intergovernmental climate change is given in the following tables. Choose a suitable model for the study area, after calculation criteria, in accordance with the following tables, models CGCM3T47, INMCM3 and MIROC3.2-MEDRES of the fourth IPCC report and models CCSM4, CSIRO-MK36 and HADGEM2ES of the fifth IPCC report which has the lowest Root Mean MSE and maximum weight, as the models used by most compatible with study area, we choose.

Table 1: Weighting and standard deviation for the top models of the fourth report

Stations	**Isfahan**		**Daran**		**Naein**		**Kashan**	
Models	**RMSE**	**Weight**	**RMSE**	**Weight**	**RMSE**	**Weight**	**RMSE**	**Weight**
Cgcm3t47	0.444	44.233	1.004	11.592	0.422	35.509	0.560	33.295
Inmcm3.0	0.478	41.587	1.029	10.335	0.473	31.468	0.576	27.031
Miroc3.2 medres	0.498	35.888	1.084	10.116	0.474	29.716	0.646	22.223
Cgcm3t63	0.531	22.179	1.142	9.559	0.520	19.016	0.672	21.975
Cnrmcm3	0.598	20.391	1.162	9.231	0.655	17.637	0.695	20.412
Csiromk3	0.652	19.619	1.163	9.227	0.679	15.956	0.700	18.878
Csiromk3.5	0.668	18.655	1.242	9.063	0.712	15.553	0.719	18.565
Echam5om	0.763	17.877	1.243	8.292	0.805	13.400	0.861	17.755
Echo-g	0.900	16.431	1.257	8.088	0.819	13.364	0.935	17.638
Gfdlcm2.0	1.011	15.877	1.268	7.923	0.849	12.816	1.019	13.608
Gfdlcm2.1	1.046	15.871	1.276	7.343	0.881	12.114	1.061	12.763
Giss-er	1.070	15.213	1.292	7.291	0.895	11.534	1.076	12.358
Hadcm3	1.075	14.178	1.302	7.052	1.025	11.487	1.139	11.873
Ipslcm4	1.103	14.150	1.389	6.902	1.034	11.002	1.372	11.251
Bcm2.0	1.108	13.212	1.409	5.840	1.078	10.521	1.434	11.126
Mri cgcm2.3.2a	1.115	12.232	1.410	5.311	1.133	10.272	1.580	8.456
Ncarccsm3	1.126	11.872	1.451	5.164	1.404	8.871	1.907	8.439
Ncarpcm	1.211	10.525	1.7377	4.662	1.630	8.756	2.605	7.346

Table 2: Weighting and standard deviation for the top models of the fifth report

Stations	**Isfahan**		**Daran**		**Naein**		**Kashan**	
Models	**RMSE**	**Weight**	**RMSE**	**Weight**	**RMSE**	**Weight**	**RMSE**	**Weight**
Ccsm4-R3	0.658	20.571	1.130	6.589	0.472	13.030	0.608	14.943
Csiro-mk3-6-0-R3	0.661	20.168	1.159	6.540	0.475	11.722	0.613	14.755
Hadgem2-es-R2	0.675	20.013	1.160	6.485	0.476	10.604	0.625	14.324
Bcc-csm1-1	0.676	19.521	1.174	6.319	0.478	10.433	0.627	14.162
Ccsm4-R1	0.679	19.070	1.177	6.222	0.482	10.421	0.628	14.110
Ccsm4-R2	0.681	18.305	1.199	6.180	0.483	10.164	0.629	14.045
Ccsm4-R4	0.682	18.031	1.200	6.125	0.487	10.159	0.630	13.387
Ccsm4-R5	0.683	17.908	1.209	6.105	0.488	9.945	0.631	13.356
Cesm1-cam5-R1	0.684	17.700	1.213	6.091	0.490	9.757	0.632	13.292
Cesm1-cam5-R2	0.685	17.631	1.223	6.087	0.491	9.743	0.633	13.148
Cesm1-cam5-R3	0.686	17.469	1.229	6.029	0.493	9.528	0.634	12.776
Csiro-mk3-6-0-R1	0.688	17.390	1.231	6.004	0.495	9.393	0.635	12.544
Csiro-mk3-6-0-R2	0.691	17.383	1.234	5.979	0.497	9.304	0.636	12.482
Csiro-mk3-6-0-R4	0.692	17.357	1.237	5.709	0.498	9.290	0.636	12.398
Csiro-mk3-6-0-R5	0.693	17.353	1.252	5.601	0.503	9.258	0.636	12.369
Csiro-mk3-6-0-R6	0.694	17.320	1.252	5.560	0.512	9.173	0.637	12.346
Csiro-mk3-6-0-R7	0.695	17.156	1.255	5.391	0.515	9.163	0.638	12.263
Csiro-mk3-6-0-R8	0.696	16.878	1.260	5.355	0.516	9.105	0.639	12.203
Csiro-mk3-6-0-R9	0.697	16.696	1.264	5.337	0.520	8.900	0.640	12.057
Fio-esm-R1	0.698	16.626	1.265	5.153	0.521	8.880	0.642	12.039
Fio-esm-R2	0.699	16.572	1.271	5.132	0.522	8.878	0.643	11.966
Fio-esm-R3	0.700	16.449	1.280	5.006	0.523	8.836	0.645	11.861
Gfdl-cm3	0.702	16.360	1.285	4.896	0.524	8.580	0.647	11.813
Gfdl-esm2g	0.703	16.355	1.291	4.883	0.525	8.554	0.648	11.784
Gfdl-esm2m	0.704	16.302	1.295	4.851	0.526	8.413	0.649	11.768
Giss-e2-r	0.705	16.290	1.311	4.733	0.529	8.372	0.650	11.748
Hadgem2-ao	0.707	16.122	1.312	4.733	0.530	8.267	0.653	11.744
Hadgem2-es-R1	0.709	16.101	1.313	4.666	0.531	7.950	0.657	11.319
Hadgem2-es-R3	0.710	16.013	1.324	4.472	0.532	7.949	0.659	11.272
Hadgem2-es-R4	0.711	15.682	1.326	4.453	0.533	7.932	0.660	11.234
Ipsl-cm5a-lr-R1	0.712	15.595	1.328	4.276	0.534	7.877	0.666	11.145
Ipsl-cm5a-lr-R2	0.715	15.503	1.331	4.260	0.536	7.842	0.667	11.042
Ipsl-cm5a-lr-R3	0.717	15.309	1.349	4.219	0.537	7.751	0.671	11.040
Ipsl-cm5a-mr	0.718	15.279	1.356	4.066	0.538	7.724	0.672	10.924
Miroc-esm	0.720	15.036	1.375	4.044	0.540	7.697	0.673	10.911
Miroc-esm-chem	0.721	14.960	1.377	4.043	0.547	7.340	0.675	10.624
Miroc5	0.725	14.947	1.388	3.824	0.549	7.078	0.678	10.391
Noresm1-m	0.727	14.330	1.408	3.791	0.563	6.996	0.679	9.795
Noresm1-me	0.729	14.231	1.420	3.769	0.575	6.973	0.689	9.599

4. Discussions

In this study, the results should be accompanied by discussions of uncertainty and uncertainty of the results of the general circulation of the atmosphere. The lack of accurate weather information and statistics for the previous period in many areas, especially mountainous regions, can be calibrated in the general circulation climate models, creates uncertainty and confidence in the results of the models. Differences in the structure and parameters of the atmospheric phenomena in these models, another reason is the uncertainty in the results. Uncertainty in the simulation of cloud formation and reaction to climate change one parameter out is the result of the difference in the process. Of particular interest to the simulated processes after physical equation is the time to solve. The time scale for solving these equations models is the 30 minutes, while physical processes, including processes related to clouds, seas and Oceans occur on time scales less that can not to correctly model and therefore will not accurately simulate climatic phenomena. Topographic differences between the actual area and non-compliance with what is considered the model of simulation models usually have low precision-made and according to the smoother shown itself very effective in models of moderation output another reason for this is the lack of confidence in climate data and finally uncertainty towards the fulfillment of each of the non-climatic scenarios and conditions of the future, as well as other issues of uncertainty in the results of these models.

Corresponding Author:
Aghil Soltani Mohammadi
M.Sc. Student, Department of Civil Engineering
University of Zabol, Iran
Telephone: 09132236368
E-mail: aghilsoltani1992@gmail.com

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