Climate Change Assessment on Air Temperature over Han River and Imjin River Watersheds in Korea

S. Jang[1] and M. Hwang[2]

Abstract: the downscaled air temperature data over study region for the projected 2001 – 2099 period were then ensemble averaged, and the ensemble averages of 6 realizations were compared against the corresponding historical downscaled data for the 1961 – 2000 period in order to assess the impact of climate change on air temperature over study region by graphical, spatial and statistical methods. In order to evaluate the seasonal trends under future climate change conditions, the simulated annual, annual DJF (December-January-February), and annual JJA (June-July-August) mean air temperature for 5 watersheds during historical and future periods were evaluated. From the results, it is clear that there is a rising trend in the projected air temperature and future air temperature would be warmer by about 3 degrees Celsius toward the end of 21st century if the ensemble projections of air temperature become true. Spatial comparison of 30-year average annual mean air temperature between historical period (1970 – 1999) and ensemble average of 6-realization shows that air temperature is warmer toward end of 21st century compared to historical period.

Keywords: Climate Change, Air Temperature, Shared Rivers

I. Introduction

There is no doubt that climate change has started and greenhouse gases are the largest human influence on global climate according to the director of the National Oceanic and Atmospheric Administration's National Climatic Data Center, and the head of the Climate Analysis Section at the National Center for Atmospheric Research. They predict more frequent heat waves, droughts, extreme precipitation events, and related impacts. This will further melt already crumbling glaciers, flooding coastal areas. Many other studies have already shown that ice in Greenland, the Arctic and Antarctica is melting quickly. Carbon dioxide levels in the atmosphere have risen by 31 percent since pre-industrial times. Changing regional climate could alter forests, crop yields, and water supplies. It could also affect human health, animals, and many types of ecosystems. Deserts may expand into existing rangelands, and features of some of our National Parks may be permanently altered. Korea cannot escape from global climate change and could be affected by negative impacts such as floods and landslide. Hence, it is necessary to assess the future climate change on air temperature that affects various fields on natural system.

II. Spatial Downscaling of Air Temperature

A. *Study Area and Methodology*

The study area and methodology are same as the study by Jang et al(2015), the additional data for downscaling of spatial air temperature are developed using terrain information and ground air temperature data.

The method used in this study was applied to the Han River and Imjin River watersheds in Korea. Han River and Imjin River watersheds were first divided into 23 sub-watersheds. Air temperature values downscaled in this study were validated against ground observations and then future climate simulation results on air temperature were evaluated for the projections.

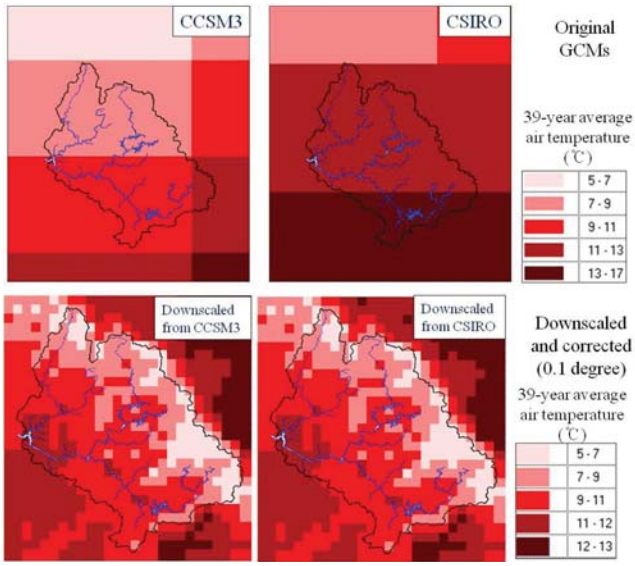

FIGURE I. Example of downscaled and corrected 39-year average annual mean air temperature from CCSM3 and CSIRO

B. *Validation*

The downscaled results were validated based on the ground observation stations.

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The plots in Figure II show the graphical comparisons of the downscaled GCM (CCSM3 and CSIRO) simulated monthly average air temperature against the ground observations during the historical January 1961 – December 1999 period. As shown in Figure II, both CCSM3- and CSIRO-based air temperature values are almost perfect compared to ground observations. Figure III shows the quantile-quantile plots of simulated and observed monthly average ground observed air temperature values. As shown in Figure III, both CCSM3- and CSIRO-based air temperature values are plotted perfectly along the 1:1 line.

From the results of graphical comparisons and statistical tests, it may be concluded that the performance of developed statistical downscaling method is within acceptable accuracy and it can be used for applying future climate change projections over study region.

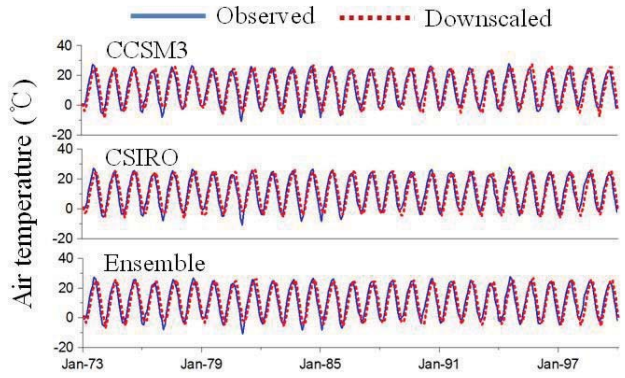

FIGURE II. Comparisons of downscaled and observed monthly average air temperature during 1973 – 1999 at Choongju station

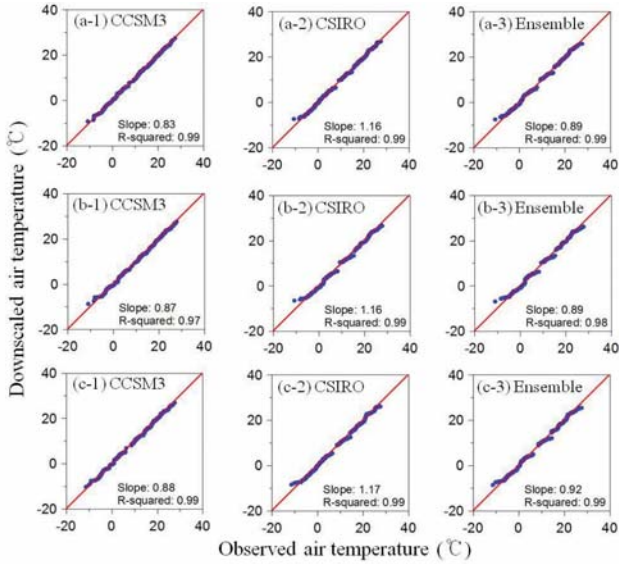

FIGURE III. Quantile-quantile plots of downscaled and observed monthly mean air temperature at (a) Chuncheon (1973-1999), (b) Chungju (1973-1999) and (c) Hongcheon (1973-1999) stations

III. Future Climate Change Assessment on Air Temperature

Comparisons of annual mean, annual DJF (December, January and February) mean and annual JJA (June, July and August) mean air temperature between CCSM3 and CSIRO during 21st century. All of results show a clear trend in warming with the passage of time for 5 watersheds. However the upward trends from CCSM3-based values slow down toward end of 21st century while CSRIO-based values increases almost linearly.

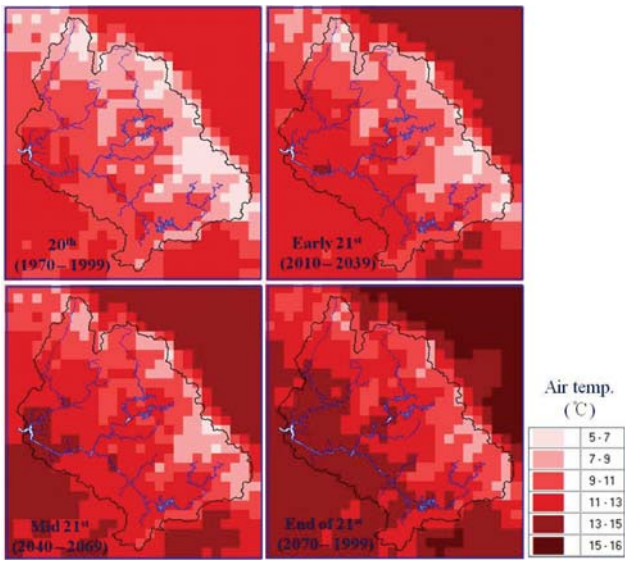

FIGURE IV. Spatial comparison of historical (21st: 1970 – 1999) and GCM-based (ensemble-average of 6-realization) 30-year average annual mean air temperature for early 21st: 2010-2039, mid 21st: 2040-2069, and end of 21st: 2070-2099 over study region

IV. Conclusions

Study results suggest that the downscaling of the GCMPs by the developed statistical method in this paper represent the actual local climatic conditions during the historical period over the study regions. From the results, temperature is increasing during the future period when compared to its counterpart in the historical period.

Acknowledgement

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References

[1] S. Jang, M. Hwang, Y.T. Hur, J. Lee, "Spatial downscaling of precipitation from GCMs for assessing climate change over Han River and Imjin River watersheds", *The 6th International Conference on Construction Engineering and Project management(ICCEPM2015)*, 2015