International Conference for Regional Climate, CORDEX, 14-18 October, Beijing, China

Session: D5 : Introduction and application of ESGF in CORDEX-EA domain

Date and time: 17 October 2019 14.00-16.00
Chair: Dong-Hyun Cha - Ulsan National Institute of Science and Technology, South Korea

Rapporteur: Victor Dike – Institute of Atmospheric Physics (IAP), CAS, China

The application of ESGF in the CORDEX-EA domain was the main focus of the D5 session during the CORDEX International Conference for Regional Climate 2019 (ICRC-CORDEX 2019). The current status of the CORDEX-EA data center, its future, and the ensuing results from the analysis formed discussions during the session. In all, six presentations were entertained during the session. The discussants highlighted the limitations of coarse resolution CORDEX simulations and underscored the benefits of finer resolution CORDEX simulations in reproducing precipitation and Typhon activities over East Asia. Participants agreed that the CORDEX EA phase II models with finer resolution than phase I shows less bias than the phase I models results. They also underscored the need for multi-model ensemble which performance is better than individual models.

Dong-Hyun Cha pointed the importance of CORDEX EA domain simulations and showed that a number of workshops have been held to facilitate the production of current and future regional climate over CORDEX-EA and the Korean Peninsula using 5 RCMs under the CORDEX framework and RCP scenarios driven by Multi GCMs for the benefit of users in the east Asian domain. Cha showed the results of their evaluation of the performance of the RCMs over CORDEX-EA and the Korean Peninsula. He indicated that in Korea that the RCM project is in the third phase since it started in 2010. With a major target of achieving finer resolution datasets, which is an added value from the 12km resolution already achieved in the phase II project. The new project (2018-2020) for the CORDEX EA is funded with ~3million USD, and they will pursue a tripartite task of conducting CORDEX core experiments, CORDEX FPS Experiments (CPM & LULC) and development of Coupled RCM. With the active participation of 5 institutions in East Asian, the data will continually be shared in the ESGF data node. Dr. Cha also evaluated the results of Phase I and II CORDEX East Asia Domain experiments and compared the performances in simulating high impact weather and climate. In general, RCMs with higher-resolution reasonably captured the spatial distribution of precipitation over the Korean Peninsula compared to those with lower-resolution. In particular, large precipitation regions related to complex mountain ranges are well simulated due to detailed topography in RCMs with higher-resolution. The RCMs in Phase II have the ability to reduce systematic cold bias of surface air temperature for heatwave cases due to more detailed topography and improved simulation of regional processes such as the Foehn effect, which underscores the importance of finer resolution simulations.

Jeongmin Han presented how to generate and distribute the CORDEX-EA metadata through ESGF Data-node in APEC Climate Center. He pointed out that as experiments are increasing rapidly to generate scenario data for global climate change response. Detailed scenarios and regional climate change data capacities are also steadily increasing as the resolution of regional models increases. To

manage, share, and distribute large volumes of data, the APEC center intends to show how to generate and distribute the CORDEX-EA metadata through ESGF Data-node. ESGF Data-node in the APEC Climate center has 48Tb storage capacity and will be increased to 100Tb in the near future to accomodate more dataset. However, he noted that the planned increase in capacity is still small due to funding constraints. There are 5 RCMs from CMIP5 GCMs for the CORDEX-EA domain in the data-node, and it is targeted that there will also be 5 RCMs downscaled from CMIP6 GCMs. To generate metadata, requires the following steps (Creating Metadata to APCC System, publication at Data Node local Thredds Server, Publication at Peer index Node, and Publish)

Jin-Uk Kim's talk was centered on the Regional Climate Model Performance in Simulating Present-Day Mean Climate Using CMIP5 & CMIP6 GCMs. He evaluated the performance of each model in CORDEX-EA and found that multi-model mean outperforms even the best individual model. The combination of CCLM & HadGEM2-AO, and HadGEM3-RA & UK-ESM have the best performance. Among the variables he considered, surface downwelling longwave radiation and surface downwelling shortwave radiation performance was excellent. On the other hand, minimum temperature and Surface Sensitive Heat Flux have low performance.

Gayoung Kim shared his views on the Projection of future changes in extreme precipitation indices over South Korea. He suggested that Multi-RCMs ensemble reasonably simulated mean and extreme precipitation intensities during the present period. During mid-21st century the in RCP4.5 and late 21st century, the in RCP8.5, mean and extreme precipitation intensities significantly increased, and extreme precipitation increased more than mean precipitation during the summer season. Furthermore, he demonstrated that convective precipitation increased while non-convective precipitation decreased, which means that the increasing extreme precipitation during summer is associated with the increasing atmospheric instability caused by global warming.

Minkyu Lee presented a talk on the " Future Change in Tropical Cyclone (TC) Activity over the Western North Pacific (WNP) in CORDEX-East Asia Multi-RCMs Forced by HadGEM2-AO".

He demonstrated that regional climate model (RCM), shows a more realistic TC genesis frequency or TC structure than the GCM. However, he suggested that the RCMs have suffered from the mismatch of physics between RCM and GCM, the lack of feedback of the simulated storm to the global climate system, and inherent uncertainties and systematic error induced by a single RCM. In his study, the future changes and TC activity over the WNP under the representative concentration pathway (RCP) 8.5 scenario were projected using four models (RegCM, SNURCM, WRF, and GRIMs) that participated in the CORDEX-East Asia project. His results show that the simulated climatological mean of TC activity for the present climate shows many characteristics similar to observations, such as the seasonal features of TC genesis and tracks. He further demonstrated that the enhanced TC activity over EA regions is mainly related to vertical wind shear weakened by reduced meridional temperature gradient and increased SST at mid-latitudes. The vertical wind shear (VWS) as a function of the meridional temperature gradient of HadGEM2-AO was compared with the 17 CMIP5 model ensemble. VWS and meridional temperature gradient show a positive correlation between them and a decreasing trend in future climate. Also, a consistent increasing signal is revealed for SST. Increased model resolution results show an improved simulation of typhoon activity over the western North Pacific. Higher-resolution RCMs in Phase II generally reproduce more realistic typhoon intensity compared with lower-resolution RCMS in Phase I. Therefore, large precipitation amounts over the Korean Peninsula for the late summer and early fall associated with typhoon activity can be properly captured by higher-resolution RCMs in Phase II.

Donghyun Lee focused on the Asian Summer Monsoon Changes at Different Levels of Global Warming using multi-RCM. He evaluated the intensity and frequency of extreme summer precipitation under global warming targets. In addition, they examined the potential uncertainty in multi-RCM future projections. His results indicate that extreme and heavy precipitation intensity increase (both GCM & RCM projections) and suggested that an additional half a degree warming will intensify extreme events in the region. Moreso, extreme precipitation frequency increase (both GCM & RCM projection). He also pointed out that an additional half a degree of warming will increase the frequency extreme precipitation events in the region. In most cases, South Asia future projection have more uncertainty than East Asia. For moderate and heavy precipitation, boundary GCM forcing (BGF) have larger contributions than RCMs.

Presentations by:

Dong-Hyun Cha - Ulsan National Institute of Science and Technology, South Korea
Title presentation: 'Added Values by Dynamical Downscaling for High Impact Weather Simulations over CORDEX East Asia Domain'

Jeongmin Han - APEC Climate Center Korea
Title presentation: 'Added Values by Dynamical Downscaling for High Impact Weather Simulations over CORDEX East Asia Domain'

Jin-Uk Kim- Climate Research Division, NIMS, KMA
Title presentation: 'Regional Climate Model Performance in Simulating Present-Day Mean Climate Using CMIP5 & CMIP6 GCMs'

Gayoung Kim- Ulsan National Institute of Science and Technology, South Korea
Title presentation: 'Projection of future changes in extreme precipitation indices over South Korea'

Minkyu Lee - Ulsan National Institute of Science and Technology, South Korea
Title presentation: 'Future Change in Tropical Cyclone Activity over the Western North Pacific in CORDEX-East Asia Multi-RCMs Forced by HadGEM2-AO'

Donghyun Lee - Ulsan National Institute of Science and Technology, South Korea
Title presentation: 'Asian Summer Monsoon Changes at Different Levels of Global Warming: A multi-RCM study