Parallel Session D: Domain/cross-domain meetings, Convection permitting models

D1: Third Pole Environment: high resolution simulation/reanalysis and its implication/application

POSTER PRESENTATIONS

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D1-P-01

Classification of precipitation features associated with meso-scale convective systems in the Third Pole region

Julia Kukulies, *University of Gothenburg, Sweden*

***Julia Kukulies, University of Gothenburg, Sweden; Deliang Chen**, University of Gothenburg, Sweden;*
***Jianping Tang**, Nanjing University, China*

The Third Pole (TP) refers to the Tibetan Plateau and all the mountain ranges that surround it, as it acts as the world's largest freshwater storage after the Arctic and Antarctica. The region is characterized by faster warming rates compared to global average, which has led to vigorous hydroclimatic changes during the past decades. These changes include changes in large-scale atmospheric moisture transport, a generally increasing precipitation trend and an accelerated hydrological cycle through increased local moisture recycling. Since the plateau is marked by intensive surface heating and sufficient moisture supply through mid-latitude westerlies and the monsoon circulation, convection is a key component for the water cycle. Furthermore, the TP has a clear seasonal cycle of convective clouds and precipitation, which is primarily due to the impact of the large-scale atmospheric circulation. During the summer monsoon season between May and September, meso-scale systems such as Tibetan Plateau vortices (TPV) and Tibetan convective systems (TCS) have been found to be the major precipitation-producing systems in the region. These systems are therefore directly linked to river runoff and water resources, as well as to severe storm and flooding events which affect downstream located societies. Furthermore, meso-scale weather systems in the TP region encompass systems at different spatial and temporal scales which originate from various thermodynamic processes. Yet, no clear relationship between precipitation characteristics and the different systems has been established. For example, it is unknown which system types have the largest environmental impact of persisting heavy precipitation. In addition, there is a lack of knowledge about how these organized forms of convection are linked to the synoptic background conditions and surface features.

In order to draw more robust conclusions about hydroclimatic changes in the TP region, it is thus crucial to understand what role precipitation induced by meso-scale systems has in comparison to small-scale convection and how possible changes in large-scale circulation would affect these systems. Using different high-resolution satellite and reanalysis precipitation products, we identified and tracked areas of meso-scale precipitation based on contiguity, rain rates and time persistence. We then segmented these tracked precipitation areas into different groups and analyzed the spatial and temporal patterns of precipitation features, in order to evaluate the possible linkage to meso-scale weather systems. In addition to the segmentation, we performed a cluster analysis and compared the results to clusters of large-scale and convective precipitation in the recently created regional reanalysis for China (CNRR), to see how much of the precipitation in general can be attributed to convection.

This work provides the first step for a more comprehensive analysis of the synoptic environment which favors meso-scale weather systems and associated precipitation. In order to establish a more clear relationship between different types of meso-scale convective systems and extreme precipitation In the TP region, additional parameters from the regional reanalysis will be included in the analysis by linking the precipitation segments and clusters to vorticity, updraft, pressure and wind fields.

Keywords: extreme precipitation, mesoscale convective systems

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D1-P-02

Downscaled summer convective activities and precipitation over the Tibetan Plateau through ensemble-based data assimilation

<u>Hui-Wen Lai</u>, *University of Gothenburg, Sweden*

***Hui-Wen Lai**, **Deliang Chen**, University of Gothenburg, Sweden; **Fuqing Zhang**, The Pennsylvania State University, United States; **Jie He**, Nanjing University of Information Science and Technology, China; **Tinghai Ou**, University of Gothenburg, Sweden*

Summer convective systems and associated precipitation over the Tibetan Plateau (TP) are crucial for the regional hydrological cycle and water management. They could also affect the large-scale circulation, such as mid-level troughs, jetstreaks and the Asian monsoon. The TP has experienced amplified warming in recent decades which could change the convective systems, but exactly how the convective system and precipitation have changed and what mechanisms behind the changes remain to be determined and understood. In situ observations are sparse in this region and current global reanalysis datasets have too coarse spatial and temporal resolutions to accurately represent the mesoscale convective systems over this high mountainous area. To better understand the convective activities over the complex terrain, we use a high-resolution numerical weather model to study synoptic- and mesoscale circulation including the convective systems and related precipitation and over the TP region. We used the convection-permitting Weather Research and Forecasting (WRF) model and a regional data assimilation system based on the ensemble Kalman filter (EnKF) that assimilates observations from the Global Telecommunication System to build a high-resolution regional reanalysis with a grid spacing from 30 km down to 10 km. Here we will present preliminary results from the WRF-EnKF reanalysis for the summer months (June through August) of 2015. The reanalysis results are evaluated against independent observations and compared with two global reanalyses, namely ERA-Interim and ERA-5. We focus our analyses on the characteristics of convective systems over the TP and their physical mechanisms.

Keywords: Mesoscale convective systems, Tibetan Plateau, WRF, Data assimilation

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D1-P-03

Sensitivity of soil moisture to rainfall simulations associated with western disturbances over north India

<u>Liby Thomas</u>, *Cochin University of Science and Technology, India*

Liby Thomas, *Cochin University of Science and Technology, India**; S K Dash**, Indian Institute of Technology Delhi, India;* ***U C Mohanty****, Indian Institute of Technology Bhubaneswar, India;* ***C A Babu****, Cochin University of Science and Technology, India*

Winter precipitation over north India is important for agriculture, horticulture, transport, domestic use and power generation. North India mainly gets winter precipitation mainly from the Western Disturbances (WDs). The sensitivity of soil moisture to the simulation of rainfall during eight WDs are investigated using Weather Research and Forecasting model. For this purpose one control experiment is done for each of eight cases of WDs with the suitable combination of parameterization schemes. Then the simulations are repeated with 10 % increase and 10 % decrease in the soil moisture respectively. The area averaged rainfall encompassing domain (72o E-83o E to 27.5o N-38.5o N) from model simulations are compared with the TRMM observations. Results indicate that there is 1.7% increase in precipitation from the control simulation by the enhancement of 10% soil moisture. The rainfall is decreased by 1.4% when soil moisture is reduced by 10%. Model simulated values of rainfall are also compared with corresponding India Meteorological Department observed values at different stations. It is observed that the simulated rainfall corresponding to station observations increase with the enhancement in soil moisture and rainfall decreases with the reduction in soil moisture. The winds at various levels, mean sea level pressure and relative humidity patterns are reasonably well simulated by model.

Keywords: western disturbances, rainfall, soil moisture

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D1-P-04

From GCM'S to river flow: Linking patterns to processes over the western Himalayas

P. R. Tiwari, *Centre for Atmospheric and Climate Physics Research, University of Hertfordshire, UK*

P. R. Tiwari, *Centre for Atmospheric and Climate Physics Research, University of Hertfordshire, United Kingdom;* ***S. C. Kar****, National Centre for Medium Range Weather Forecasting, India*

Studies have shown that the Himalayan climate system is sensitive to global warming and climate change. Most of the snowfall over this region comes from wintertime precipitation. This precipitation, in turn, helps in maintaining the glaciers, which serve as the vast storehouse of freshwater supply to millions of people downstream throughout the year through rivers of western Himalayan origin. Therefore, for a country like India that gets more than 50% of its fresh water supply from the rivers of Himalayan origin, the question arises what would happen to regional hydrology and the downstream water flow in a warming environment? So to answer this question an integrated approach based on linking patterns to processes is applied here. The aim of the present study is in three-folds. Firstly, to access the predictive skill of state-of-the-art CMIP5 models and identify forecast windows of opportunity. Secondly, to reproduce the patterns of the GCM at higher spatial resolution, both dynamical (ICTP-RegCM nested with HadGEM3-ES2 at 25 km resolution) and statistical downscaling (based on Canonical Correlation Analysis) approaches with bias correction have been applied. Thirdly, a hydrological model (SWAT) has been used to simulate the Satluj river streamflow for the present and future climate using the bias corrected downscaled data obtained from RegCM. Finally, why process based investigation and its implementation is important and how CORDEX framework has played a key role in addressing such issues is highlighted.

Keywords: Western Himalayas, Hydroclimate, Coupled dynamical system