Recommendations (draft):

International Workshop on Asia Precipitation Experiment (AsiaPEX)/ South Asia, 1-2 March 2020, <u>Central University of Rajasthan</u>

List of Collaborating Countries: 5 (India, Japan, Nepal and Bangladesh, Myanmar)
Number of participants in the collaborative research: 30
Graduate students: 18

An international workshop on "Asian Precipitation Experiment (AsiaPEX)/ South Asia (SA)" was organized at the Central University of Rajasthan (CURAJ) during 1-2 March 2020. The workshop was organized in collaboration with the Disaster Prevention Research Institute (DPRI), Kyoto University, Sumitomo Foundation, and International Consortium for Earth and Development Sciences (ICEDS), Kagawa University, Japan. The workshop offered opportunities to discuss and identify key challenges in the hydroclimate science in the upcoming decade and to develop a science plan of the AsiaPEX/ SA. Many scientists and researchers of the South Asian countries including representatives of the Heads of the Meteorological Services participated in the workshop.

Asian Precipitation Experiment (AsiaPEX) is a new Regional Hydro-climatological Project under GEWEX framework, which was launched in Aug 2019 as a follow up of the MAHASRI (Monsoon Asian Hydro-Atmosphere Scientific Research and Prediction Initiative), which was conducted during 2006-2016. MAHASRI was a follow up of the GAME (GEWEX Asian Monsoon Experiment) that was completed in 2005. AsiaPEX aims to understand the Asian land precipitation over diverse hydro-climatological conditions for better prediction, disaster reduction and sustainable development. One of the objectives of the AsiaPEX is to conduct coordinated observation and modeling initiatives in the Asian monsoon region. This is also being carried out under AMY (Asian Monsoon Years)-II, which is planned from 2020 to 2023, with a POP (pilot observation period) from 2020 to 2021 and the IOP (Intensive Observation Period) from 2022 to 2023. Thus, AsiaPEX and AMY-II will be associated with each other. The first conference of AsiaPEX was successfully concluded in August 2019, with several contributors from South Asian countries. The seven targets areas for the science plan of AsiaPEX-SA were discussed during the conference, which are summarized below.

(1) Observation an Estimation of Asian Precipitation

(2) A process study of LULC atmosphere Coupling

(3) Predictability of S2S to decadal variability

(4) High Resolution Hydrology modeling/ human to the glacier

(5) Effect/ collaboration observation and modeling initiative

(6) Seeking practical and useful climate projection

(7) Precipitation events

Based on the deliberations of AsiaPEX-SA, following resolutions are made.

1. The domain area of the AsiaPEX-SA should cover from Afghanistan to Myanmar and from the Tibetan plateau to southern Mascerene high including the Bay of Bangal and Arbain sea. The spatial resolution of the domain should be 4 km, and temporal resolution should be 1 hour. For the extreme events, the spatial resolution should be 500 m, and the temporal resolution should be 10 minutes, which should be accumulated to 1 hour.

2. Observations/ analyses may be divided into four types: (a) Ground-Based, (b) Satellite, (c) RADAR, and (d) Benchmark analysis. They are elaborated as follows.

   The ground based observations should be made available by all national meteorological services including observations from the research stations as per the policies of the national governments. Regarding the satellite data, observations should be collected from different satellites launched by India, Japan, China and Europe (Meteosat) and the Oceansat covering the AsiaPEX region. Observations should include precipitation, cloud hydrometeors and SST retrieved from different channels of the satellite sensors.

   The RADAR observations, quality control, estimation of atmospheric paratemeters, validation, and data assimilation should be the focus area, which requires a common calibration of Radar from different countries. Some challenges that need to be addressed are the data gap regions of South Asia, i.e., Afghanistan, Pakistan, Nepal, Bhutan, and Myanmar.

Another big challenge is the integration of data and management, which requires human resources and funds. These challenges may be overcome in 5 years from now.

Other target areas are data quality assessments using model products and verifications. Intercomparing of data from different sources and bias removal, if any, is also necessary. Collection, intercomparing, and validation of data for selected station for different thresholds of precipitation is also required. Data policy of the AsiaPEX-SA needs to be made.

Finally, the benchmark data, such as the GPM-DPR (Global Precipitation Measurement-Dualband Precipitation Radar), reanalysis data from various modeling centers, climate projection data, and linkage with the CEOS (Committee on Earth Observation Satellites) were also discussed. It was suggested that an AsiaPEX-SA website related to this forum should be made for sharing and dissemination of information.

3. The target (2) of the science plan is related to studies of atmospheic coupling with different LULC (Land-Use-Land-Cover) including cryosphere, hydrosphere, biosphere, and land surface. The mechanism of precipitation during different seasons & regions, extremes and anomalies are not well understood. Members discussed about the available soil moisture data from COSMOS and soil temperature from SYNOP. There is a need to study the LULC/ Vegetation Fraction seasonality (NDVI/ EVI) obtained from MODIS data, flux tower observations, evapotranspiration from ground-based (Lysimeters) and those derived from satellites. The linkages of LULC coupling with land surface processes, PBL, surface energy balance, and convection have to be studied. Studies have to be made on the linkages of LULC coupling with diurnal variations during different epochs of the monsoon, extreme weather events including cloudbursts, MCS and the role of land surface processes.

4. The target (3) of the science plan is related to studies of Predictability of S2S to Inter-annual and decadal variability. The need for assimilation of various land surface parameters from different sources and the use of offline NCEP land data was emphasized. This study may be divided into 4 parts. In part-1, studies have to be made on observational analysis including the understanding of linkage with different temporal scales, global teleconnection, mechanisms of

various space and time scale processes, and their linkages to climate change scenarios both in the past as well as in the future. In part-2, studies have to be made based on model products focusing on the predictability of precipitation in different time scales using the mesoscale and global modeling systems with hindcast and projections at a spatial resolution of 2 km. In part-3, sensitivity experiments have to be carried out using COSMOS data in the model. In part-4, the predictability studies of various extreme events have to be made using the Ensemble prediction Systems.

5. The target (4) of the science plan is related to studies of high resolution Hydrology modeling/ Human to the Glacier. Under this target, various issues were discussed related to precipitation, runoff/ high flow/ streamflow, linkage of precipitation forecast to the surface hydrology & vice–versa, urban flooding, flash floods, Dam management, GLOF, Glacier mass balance, calibration and validation from various hydrological models, and High-resolution DEM.

6. The target (5) of the science plan is related to Synergy / Collaboration. Discussions were held on observations related to field experiments both for regional and individual countries. Discussion were also held on model intercomparison, calibration, and validation for precipitation. Capacity building is also very much important, which includes training programs, seminars and workshops, exchange programs, and public outreach.

7. The target (6) of the science plan is related to Effective and Usefulness of AsiaPEX (SA). Discussions were held on how the objectives of the AsiaPEX should be effective and useful to the common people. In this regard, discussions were held on application of precipitation prediction and projection (under Climate Change), agriculture, water resources, energy, urban health, and disaster management.

8. The target (7) of the science plan is related to extreme precipitation events. Under this target, discussions were held on the definition, classification, intensity, and duration of extreme precipitation events based on observations. Emphasis was made on monitoring and understanding the mechanism of occurrence of extreme precipitation events (season & region), and their predictabilities. The Role of LULC, convection, planetery boundary layer, surface processes (land and ocean), modeling of extreme precipitation events, their impact on various sectors, and on the Climate change were emphasized.