National Symposium on Hydrology and Meteorology-2016

December 29, 2016
Kathmandu

ABSTRACTS

Society of Hydrologists and Meteorologists - Nepal
SOHAM-Nepal

National Symposium on Hydrology and Meteorology-2016

(December 29, 2016)

Kathmandu, Nepal

ABSTRACTS

Organized by

Society of Hydrologists and Meteorologists-Nepal

(SOHAM-Nepal)

Supported by:

Department of Hydrology and Meteorology (DHM),

Government of Nepal and

World Wildlife Fund (WWF) Nepal

ABSTRACTS

National Symposium on Hydrology and Meteorology-2016
(December 29, 2016)
Kathmandu, Nepal

Society of Hydrologists and Meteorologists - Nepal
(SOHAM-Nepal)

Editors
Dr. Dibas Shrestha, Mr. Narayan Gautam, Mr. Suman Kumar Regmi and Dr. Rijan Bhakta Kayastha

Note: Authors are solely responsible for their abstracts and results. Any comments/remarks should be made directly to the authors. Society of Hydrologists and Meteorologists - Nepal is not responsible for any abstracts in this abstract compilation.

List of Presentations

Oral Presentations

Poster Presentations

ORAL PRESENTATIONS

Using seasonal climate forecasts in dynamic crop model to predict rice yield and optimize management

Prakash Jha[1*], Panos Athanasiadis[2], Silvio Gualdi[2], Vakhtang Shelia[3], and Gerrit Hoogenboom[3]
[1]*University of Venice, CA'Foscari, Venice, Italy*
[2]*Centro Euro-Mediterraneo Sui Cambiamenti Climatici (CMCC), Bologna, Italy*
[3]*University of Florida, Gainesville, Florida, USA*
[*]Corresponding Author: 956109@stud.unive.it

Abstract

Skilful seasonal climate prediction combined with the dynamic crop model can help farmers to optimize management and predict variability in yield associated with interannual climate variability. Until now, monthly or seasonal mean or anomaly forecasts are downscaled using weather generators to provide daily data required to run a crop model. However, considering the low skill of weather generators to accurately generate daily precipitation in the tropical regions, it is worth examining the potential of using daily outputs directly from the seasonal prediction systems (SPSs). This study's goal was to examine the skill of the daily outputs from SPSs for crop yield forecasting and management optimization. The predictive skill of the coupled forecast system model version 2 (CFSv2) hindcasts initialized at different lead times was examined against ERA-Interim reanalysis, weather station data and other observational data sets. Prior to running the hindcasts the CSM-CERES-Rice crop model was calibrated using the varietal trial data from the Hardinath station of the Nepal Agricultural Research Council and evaluated using the district yield data from the Ministry of Agriculture. Rice growth, development and yield, was simulated using weather station data, other observational datasets and daily hindcasts from CFSv2 at different lead times. The hindcasts simulation with the CSM-CERES-Rice model using station meteorological data shows that climatic variability, especially rainfall, can only explain a small part of the interannual variability of rice yield. This predictability is further reduced when using the forecasts. The results from our study indicate that the potential application of seasonal climate forecasts to the dynamical crop model, in the particular case here considered, is limited by the skill of the seasonal forecasts. Given that the model did not have satisfactory skill to predict yield using daily outputs from SPS, it cannot be used for management optimization. Therefore, in the next step we used ENSO categories of weather to optimize management. We found that rice yields simulated by the models were high in El Nino years, low in La Nina years and medium in the Neutral years. Also yields increased in proportion to the amount of N fertilizer applied. Rice yields were higher for the early planting date on June 14 than the existing practices in mid-July. Before generalizing, these conclusions must be verified by the research station trials.

Keywords: CFSv2, DSSAT, CSM-CERES-Rice, ENSO, climate variability

Maximum and minimum air temperature trends and its variability in Nepal

Tirtha Raj Adhikari[1], Shiva Prasad Nepal[2], Ram Hari Acharya[1*] and Nabaraj Dhakal[1]
[1]*Central Department of Hydrology and Meteorology, Tribhuvan University, Kirtipur Kathmandu, Nepal*
[2]*Department of Hydrology and Meteorology, Government of Nepal*
*Corresponding Author:omaramhari@gmail.com

Abstract

The observed monthly maximum and minimum temperature data from 1984 to 2013 (30 years) of 67 stations in Nepal were analysed to know the maximum and minimum temperature trends and its variability. The annual maximum temperature warming trends showed 0.198˚C/year, 0.183˚C/year and 0.047˚C/year, respectively in Middle Mountain, High Himalaya and Terai regions, whereas, Siwalik and Himalayan regions showed the maximum trends 0.071˚C/year. The annual minimum temperature trends 0.142˚C/year, 0.039˚C/year, 0.103˚C/year, 0.021˚C/year and 0.052˚C/year are respectively found in High Himalaya, Himalaya, Middle Mountain, Siwalik and Terai regions of Nepal. The physiographic zones were considered for the analysis of warming trends. The annual trends and spatial distribution of temperature were also analyzed. From the observed monthly temperature, the shortest records were found in Makalu station at altitude of 2,100 m a.m.s.l. where the monthly maximum temperature variation was found as 11.0˚C to 19.0˚C and the annual minimum temperature range of 18.0˚C to 4.0˚C. This temperature trends analysis was done by using the simple slope function method without interpolating missing data for the entire period of study.

Keywords: Temperature trend; Himalaya; maximum temperature; minimum temperature

Trend analysis and uncertainty estimation of the extreme climate indices: a case of Tamakoshi River basin

Anil Aryal[1, 2*] and Bhesh Raj Thapa[1,3]
[1] *Interdisciplinary Research Center for River Basin Environment (ICRE), University of Yamanashi,*
Takeda 4-3-11, Kofu, Yamanashi 400-8511, Japan
[2] *Hydro Energy and Environment Research Center (HEERC), KMC-16, Balaju, Kathmandu, Nepal*
[3]*Development Support Consult, Sinamangal, Kathmandu, Nepal*
*Corresponding author:anilsagar651@gmail.com

Abstract

Extreme climate indices and the events and change on them are often a point of discussion among the hydrologist and climatologist being much relevance to the society and the ecosystem. Thus, the importance of the study on the projection of the future climate extremes for robust decision has got a height. Together with this the projection of the future climate too has got the similar importance. This research was carried out at Tamakoshi River basin, a sub-basin of the Koshi River basin in the North East of Nepal. Climatic parameters temperature and precipitation of the study area are projected to change in near (2010-2039), mid (2040-2069) and far (2070-2099) future. Trend analysis of the climatic data was observed through both parametric and non-parametric approach. Mann Kendall method was applied for the non-parametric approach. Linear regression method was additionally applied to observe the trend in the climate pattern. Both minimum and maximum temperature are about to change by a significant amount. The maximum temperature is projected to rise up to 1.75ºC under RCP4.5 and up to 3.52ºC under RCP8.5 whereas the minimum temperature is expected to rise by 2.1ºC under RCP4.5 and 3.73ºC under RCP8.5 by the end of the 21st century. The precipitation in the study area is expected to change by -2.15% under RCP4.5 and by -2.44% under RCP8.5 scenarios. The trend analysis of different precipitation and temperature indices reveals that the TXx, TNn, FD, TR has significant change over the future time window. The climate indices are changing at -0.05ºC/year, -0.02ºC/year, +0.05 days/year and +0.43days/year, respectively. Similar significant change in case of precipitation indices has observed in the study area. It was thus concluded that the hydrological regime would be affected seriously and thus the discharge of the catchment area. Different sources such as emission scenario, climate models and downscaling methods were fed as the source of the uncertainty. From the analysis it was found that the climate models are the dominant source for the uncertainty of the climate indices. After that emission scenario also has the significant role in contributing as the source of uncertainty. The extreme climate indices are in a verge of changing drastically in the upcoming decades and its impact on the water resources and the crop yield is going to affect. The average temperature in the basin area is expected to rise both under RCP4.5 and RCP8.5 scenarios to a maximum of 4ºC and 4.5ºC, respectively by the end of the century. From the analysis of the uncertainty in sources, climate models are the driving source of the uncertainty in climate projection.

Keywords: Climate change, Regional Climate Models, Extreme Climate Indices, Uncertainty Estimation, ANOVA

Characterizing the intra-seasonal and interannual summer monsoon rainfall variability over Nepal

Sunil Kumar Pariyar[1,2*], Bhuwan Chandra Bhatt[2] and Sami Kunwar[1]
[1]*Center for Climate and Environment Research Nepal, Jwagal, Lalitpur, Nepal*
[2]*Geophysical Institute, University of Bergen, Bergen, Norway*
*Corresponding Author: sunilkumar.nature@gmail.com

Abstract

In this study, we investigate the observed temporal variability of rainfall in the summer monsoon season (June-September) over Nepal. This is a climatological study based on composites as well as using the EOF analysis. The daily APHRODITE rainfall data over Nepal for the period 1982-2007 has been analysed to understand the summer season intra-seasonal and interannual rainfall variability and their relationship. The spatial structure of daily and seasonal rainfall variance averaged over 26 years show noticeable differences with significantly larger values for daily rainfall compared to seasonal rainfall. From the EOF analysis of daily and seasonal rainfall anomalies two leading modes are extracted to understand the behaviour of interannual and intra-seasonal rainfall variability. The first mode (EOF-1) shows large spatial structure with one pattern over the entire country and the second mode (EOF-2) shows dipole structure, i.e. one sign over eastern Nepal and opposite sign over western Nepal for both daily and seasonal rainfall anomalies. The intra-seasonal rainfall variability is characterized by active and break rainfall phases with positive (negative) rainfall anomalies over the whole country during the active (break) phases. For the seasonal rainfall pattern, the strong monsoon years are characterized by large scale positive rainfall anomalies in most of the region and some weak negative anomalies over the north-western Nepal. However, during the weak monsoon years, negative rainfall anomalies dominate the entire country. The pattern correlation analysis between daily and seasonal rainfall anomalies indicates presence of the persistent seasonal component within the intra-seasonal variability. This implies that the summer monsoon rainfall over Nepal consists of both externally forced persistent component and a fluctuating intra-seasonal component within the active and break phases. This is on-going research and further model based studies with climate model experiments are needed to understand the role of persistent seasonal anomalies on intra-seasonal rainfall variability.

Keywords: Rainfall variability, summer monsoon, intra-seasonal, interannual

Spatial and temporal variations of rainfall during active monsoon period from 2011 to 2015 in Nepal

Sajeena Shakya* and Tirtha Raj Adhikari
Central Department of Hydrology and Meteorology, Tribhuvan University, Kirtipur, Kathmandu, Nepal
*Corresponding Author: sajeenashakya@gmail.com

Abstract

A study of spatial and temporal variations of rainfall during active monsoon period (July and August) from 2011 to 2015 is carried out using 176 daily and 8 hourly stations rainfall data across Nepal. The study was mainly focused on active monsoonal activities and rainfall intensity duration analysis was done using selected maximum and minimum rainfall events. The minimum average intensity of 2.8 mm/hr in duration of 18 hours at Lele, Bagmati, and the maximum average intensity of 12.27 mm/hr in the duration of 17 hours at Bagasoti, West Rapti is found. In average, 62.5% of the monsoon rainfall was received during active monsoon period. Similarly, the highest rainfall (64.3%) was received in the year 2012 and the lowest (57.6%) in 2013. In the La Nina phase of year 2013 the average maximum rainfall of 1484.9 mm and strongest El Nino of year 2015 lowest rainfall of 1185.2 mm which was below normal (81.4%) were recorded while rest of the years received normal monsoon rainfall (90 – 10%).

Keywords: Rainfall intensity duration, monsoon, El Nino, La Nina

Improving real time flood forecasting through a complementary error modeling framework

Dilip Kumar Gautam
Practical Action Consulting
Panipokhari, Lazimpat, Kathmandu, Nepal
*Corresponding Author: dilip.gautam@practicalaction.org.np

Abstract

A complementary error modelling framework presents an approach for improving real-time forecasting without needing to modify the pre-existing hydrological forecasting model, but instead formulating an independent additive or complementary model that captures the information the existing operational hydrological model may be missing. This paper presents the application of this principle for issuing improved daily flow forecasts for flood warning. The procedure presented comprises an error model added on top of an unalterable constant parameter conceptual rainfall-runoff model. The error model assimilates the latest observation and its corresponding prediction to inform the predictive distribution of the errors in future model predictions with respect to the observed data. It uses difference between the observations and model predictions to generate error time series. Auto-Regressive Integrated Moving Average (ARIMA) models are fitted to error series if the residuals are highly correlated. The structure of the error model is established based on attributes of the residual time series from the conceptual hydrological model. The model is then utilized to forecast errors. Error forecasts are added to model predictions to obtain corrected forecasts. This procedure is applied in the 42890 km^2Karnalicatchment in Western Nepal. HEC-HMS model has been developed to model the rainfall-runoff processes. The model accounts the snowmelt runoff, potential evapotranspiration, infiltration and base flow for total discharge estimation at the outlet of the basin at Chisapani. The model has been calibrated for the period 2008 – 2011 with Nash-Sutcliffe Efficiency (NSE) 0.80 and bias (PBIAS) 4.1% and validated for the period 2012 – 2014 with Nash-Sutcliffe Efficiency (NSE) 0.82 and bias (PBIAS) -5.7% using the observed temperature, precipitation and discharge data. A complementary ARIMA error model has been developed from the error series for calibration set and the predicted discharges were corrected using the error predictions from error model. After error correction, NSE and PBIAS was 0.92 and 0.6% respectively for calibration set and 0.87 and -0.9% respectively for validation set showing significant improvement in the skill of forecasts.

Keywords: Flood forecasting, error modelling, flood warning, hydrological model, ARIMA

Spatio-temporal distribution of extreme precipitation in Nepal

Rocky Talchabhadel[1,5*], Ramchandra Karki[2,5], Bhesh Raj Thapa[3], Manisha Maharjan[4] and Binod Parajuli[5]

[1]*Department of Civil and Earth Resources Engineering, Kyoto University, Japan*

[2]*Institute of Geography, University of Hamburg, Germany*

[3]*Interdisciplinary Research Center for River Basin Environment, University of Yamanashi, Japan,*

[4]*Department of Environmental Engineering, Kyoto University, Japan*

[5]*Department of Hydrology and Meteorology, Government of Nepal, Nepal*

*Corresponding Author: rocky.ioe@gmail.com

Abstract

Nepal is one of the climatologically most vulnerable Himalayan countries in the world. Although, Nepal lies near the northern limit of the tropics, wide range of climate in short latitudinal distance; from tropical in the Terai in the south to polar in the high Himalayas in the north, exist. The summer monsoon enters from south-eastern parts and advances to western parts, and covers the whole country generally within a week. Country as a whole receives approximately 80 % of its annual precipitation during the summer monsoon months (JJAS). Extreme weather events associated with heavy precipitations are the principal causes of natural disasters in Nepal. Landslides, debris flow and all types of floods are directly or indirectly triggered by extreme weather. This paper has attempted to analyse spatio-temporal distribution of extreme precipitation and its trend. Daily precipitation data is used to compute one value of extreme precipitation for a year. Kriging for point linear technique is used for spatial interpolation. The station wise trend of extreme precipitation has been analysed by applying non parametric Mann-Kendall test. Again, five decadal time steps from 1966-2015 are taken as analysis period for decadal analysis. Our finding shows extreme precipitation of all five decades is widely distributed across country having different degree of severity at different time in different regions. Daily precipitation exceeding 200 mm and monthly precipitation exceeding 1000 mm are very common in the country. It has been clearly understood that distribution of extreme precipitation is quite different than the annual or seasonal distribution. Southern belt of Nepal (Siwalik and Terai) that generally receive less total seasonal rainfall compared to middle hills are exposed to high precipitation extremes. Distribution of extreme precipitation has also been attempted to correlate with topographical elevation. Five N-S cross-sections are analysed throughout the country. Furthermore, the distributions of extreme precipitation along the profile of three major rivers (Koshi, Narayani and Karnali) have also been explored. From the analysis of available data, extreme precipitation is found to be more in low elevated area esp. Siwalik and Terai. Due to limitation of number of high-altitude stations the results may not be representative for high mountainous regions. Out of 291 stations, 60% shows falling trend of which one-third are significant and around 40% shows rising trend of which one fifth are significant. A significant positive trend in extreme precipitation has been found over hill and mountain of western region whereas significant negative trend in eastern region of country. In most of the places, mixed pattern of station wise increasing and decreasing trends are found in either with significance or not. The analysis of one day extreme precipitation has to be breakdown to understand hourly extreme weather condition for urban inundation and flash flood whereas it again has to be analysed in 48 hrs and 72 hrs extreme precipitation for riverine flooding.

Keywords: Spatio-temporal, trend, extreme precipitation

POSTER PRESENTATIONS

Geomorpholoigcal mapping of lower part of Ponkar Glacier, Bhimthang, Manang, Nepal

Ajit Sapkota, Aman Thapa, Rijan Bhakta Kayastha and Kumud Raj Kafle
Himalayan Cryosphere, Climate and Disaster Research Center, Department of Environmental Science and Engineering, School of Science, Kathmandu University, Dhulikhel, Nepal
*Corresponding Author: ajit.sapkota@student.ku.edu.np

Abstract

Geomorphological mapping of the lower part of Ponkar Glacier was done to map different surface morphological features and structures developed in the glacier. Ponkar Glacier (84˚28'14"E, 28˚37'49"N) is a debris covered glacier located in Marsyangdi Sub-basin of Gandaki River basin in Manang district, Nepal. It has an area of 28.509 km^2 with mean elevation of 5679 m a.s.l. Mapping was done in field using 1:50,000 scale topographic base map produced by the Department of Survey, Government of Nepal in June 2016. Glacier moraine ridge, glacier boundary, ice cliffs, crevasses, Ponkar Lake, water bodies, vegetation, and supra-glacial ponds were mapped. Along with these major things landslides, debris deposits, alluvial deposits, lake deposits, outwash deposits, light band and drainage pattern were also mapped. Depositional landforms such as lateral moraines, outwash deposit, glacial lake deposit were observed. Erosional landforms such as U-shaped valley, hanging valley, cirque were also marked in field. There are two major moraine dammed lakes which are Nyamlo Lake and Ponkar Lake. The length of Ponkar Lake was 1350 m and breadth 290 m measured using GPS track of lake outline. Comparison with topographic base map shows no significant change in water level of Ponkar Glacier. Geologically, Bhimthang Valley comprises two major succession namely Higher Himalayan rocks and Tibetan Tethys rocks. Higher Himalayan Granite covers most part of the study area as bedrocks of surrounding hills whereas the north east peaks shows bands of sedimentary succession of Tibetan Tethys rocks. A mixture of these rocks was found as the debris constituent. More than 90% of the debris consisting of granite with light minerals was mapped as light band whereas debris with dominant light to dark grey colored sedimentary rocks namely black shale, sandstone and gritty dolomite was mapped as dark band. The terminus of the glacier has shifted 50 – 80 meters as compared to topographic base map whereas glacier inventory of ICIMOD, 2010 estimated the shift more than 800 meters.

Keywords: Ponkar Glacier, geomorphological map, Ponkar Lake, debris constituent

Land cover dynamics and flood hazard assessment along the rivers of Nawalparasi district from 1991 to 2015

Anushilan Acharya*, Javed Hassan, Kumud Raj Kafle and Bikash Adhikari
Department of Environmental Science and Engineering, School of Science, Kathmandu University, Dhulikhel, Nepal
*Corresponding Author: anushilan.acharya@student.ku.edu.np

Abstract

Land cover change is the major problem in Churia-Terai region. Factors like developmental works, migration and urbanization have contributed a lot for the changes. Moreover, natural activities like floods, landslides which are mostly triggered by the human activities are also altering the land features of the Churia-Terai region. Nawalparasi district being a part of Churia-Terai region is facing the problem of altered land features and problems of floods almost every year. The present study deals with the land cover dynamics and flood hazard assessment along the rivers of Nawalparasi district, Nepal from 1991 to 2015. Geographical Information System and Remote Sensing techniques have been applied in order to meet the objectives. Decadal Landsat images and SRTM DEM have been considered for the land cover dynamics. Supervised Maximum Likelihood classification was applied on the images and each image was classified into four classes viz. bare land, settlement and crop land, forest and water bodies. Factors such as drainage density, land use/cover, rainfall distribution, slope and distance from the river are incorporated to develop flood hazard assessment map. Weightage map on the basis of each factor is created by providing ranks and weightage to the thematic maps. After analysis, it was found that bare land was decreased from 251 km^2 to 207 km^2 from 1991 to 2015. Settlement and crop land which was 835 km^2 in 1991 has increased to 851 km^2 in 2015. Forest which was 1007 km^2 in 1991 has increased to 1044 km^2 in 2015 but water bodies decreased by 8 km^2 from 1991 to 2015. Flood hazard map was developed by adopting Weighted Overlay Analysis method and five zones viz. very high, high, moderate, low and very low risk zones were evaluated considering all the factors considered in this study.

Keywords: Churia-Terai, GIS, RS, Multi Criteria Evaluation, Weighted Overlay Analysis

Hydro-chemical characterization of glacier melt water of Ponkar Glacier, Manang, Nepal

Reeju Shrestha*, Sandeep Shrestha and Rajendra Bhandari
Department of Environmental Science and Engineering, School of Science, Kathmandu University, Dhulikhel, Nepal
*Corresponding Author:shresthareeju@gmail.com

Abstract

This study comprises the hydro-chemical analysis of glacier melt water of Ponkar Glacier, Manang, Nepal. The water samples were collected from seven sampling sites, from the Ponkar Lake at 4100 m a.s.l. to the downstream at 3580 m a.s.l. Temperature was recorded by digital multi-thermometer on site. The samples were brought to the laboratory for the chemical properties analysis and the parameters were analyzed according to the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF) standards. The glacier melt water was found slightly basic in nature with pH 7.44 (±0.307). The hardness of melt water was 36.429±8.664 mg $CaCO_3$ L^{-1} which is in the range of 30 to 60 implying the water is moderately soft and the electrical conductivity was found to be 47.14 (±11.18) µS/cm. The concentration of anion was in the order of HCO_3^-> Cl^-> SO_4^{2-}> NO_3^-> TP-PO_4^{3-} with the concentrations of 194.286±40.677, 55.707±30.265, 11.533±1.132 mgL^{-1}, 1.00±0.7 mgL^{-1} and 0.514±0.32 mgL^{-1}, respectively. Calcium carbonate weathering was found out to be the major source of dissolved ions in the region. The heavy metals were found in the order of Al>Fe>Mn>Zn with concentrations of 1.34±0.648, 1.103±0.917, 0.08±0.028 and 0.023±0.004 mgL^{-1}, respectively. The concentration of iron, manganese and zinc in some sites were below the detection limit. These results represent baseline data of the physical-chemical properties of the melt water of Ponkar Glacier in Manang.

Keywords: Ponkar glacier, glacier melt water, hydro-chemical analysis, water chemistry