Journal of Environmental Science & Engineering (JESE)

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Started in 1958, Journal of Environmental Science & Engineering (JESE) is a peer reviewed quarterly journal published by the National Environmental Engineering Research Institute (NEERI, CSIR), Nagpur reporting various significant achievements in the field of environmental science and engineering, according to the R&D thrust areas of the Institute. The journal is providing communication links among the members of the scientific community engaged in research in India and abroad covering all the major aspects of environmental science and engineering.

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The scope of this journal covers Environmental Science and Engineering and the related areas. The journal intends to timely disseminate information related to monitoring of the environmental status across the country and abroad, innovative and effective S&T solutions to environmental and natural resource problems, significant R&D activities in the field of environmental science and technology, environmentally sound technologies and policy analysis. The journal aims at publishing both review and research articles in the field of environmental science and engineering. Case studies and short communications are also published to inform about the hazards and risks likely to occur to the people and environment due to certain materials, and the ways of controlling these hazards and associated risks. Various topics covered in the journal include: air quality monitoring, modeling and management; air pollution control; source management and apportionment studies; carrying capacity based developmental planning; soil and water chemistry, monitoring and management of land degradation; river and lake ecosystem studies; application of fly ash, sewage, sludge and mine tailing on land; ecological approaches to improve ecological and socio-economic values of land-use systems; integrated natural resource management; conservation and sustainable management of under ground biodiversity, remote sensing applications in environmental geo-science; ground water and rain water harvesting; water and waste water treatment; solid and hazardous waste management; eco-friendly technologies; waste land management; biodiversity assessment; biogeochemistry of rivers and estuaries; pollution chemistry, particularly metal speciation and bioavailability in water and soil systems; PAHs and volatile organics in atmosphere; environmental analytical methodologies; monitoring and modeling of urban noise; environmental impact and risk assessment studies; environmental audit studies; chemical process simulation and development; environmental policies; bioremediation and biodegradation studies; environmental biotechnology and genomics studies; research on environmental materials, etc.

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To provide environmental scientific information with description of timely, contemporary advances in environmental science and engineering, and management for use in improving our environment

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A preliminary Study on Trends of Extreme Precipitation and Droughts in Himachal Pradesh

SAKSHI THAKUR, ASHISH DOGRA AND ANKIT TANDON*

Abstract:

Manifestation of global climate change have been witnessed as changing rainfall pattern in different parts of the world impacts differently. Changes observed in hydrological extreme events have been reflected in increasing incidences of floods and drought causing human and economic loss. In the present study, daily rainfall dataset for three stations viz. Dharamshala, Shimla, Kullu of Himachal Pradesh were analysed. We performed a preliminary investigation to detect trend significance along with the rate of change in the magnitude and frequency of overall rainfall as well as, extreme precipitation indices viz. P99 and number of dry days i.e., total annual days without precipitation (N0) for the first two decades of twenty first century. The gridded daily rainfall dataset of TRMM (Tropical Rainfall Measuring Mission) product 3B42V7 with 0.25°×0.25° (latitude× longitude) spatial resolution for the past 21 years from 1999 to 2019 was accessed and analysed. We employed Modified Mann Kendall test to evaluate the significance of change and the Sen's slope method to assess the rate of change in the precipitation indices. Results indicated decreasing trend in the annual sum rainfall over Dharamshala, whereas, trends were increasing for Shimla and Kullu. Total summer monsoon rainfall over all the three stations showed decreasing trends. A statistically significant increasing trend with magnitude of +2.27 mm/yr was observed in extreme precipitation indicator i.e., P99 over Kullu. Whereas, a decreasing trend in the total annual rainfall and total summer monsoon rainfall with a trend rate of -7.70 mm/yr and -11.17 mm/yr, respectively, was observed over Dharamshala. Shimla witnessed no significant trend in rainfall characteristics. It was interesting to note the number of dry days (N0) during the study period was observed to be increasing significantly over all the three stations (1-2 days/yr) in Himachal Pradesh. Overall the present findings suggest that the rising extreme precipitation and droughts over Himachal Pradesh may have huge implications in the nearing future.

Keywords : *Extreme precipitation, Droughts, Mann-Kendall test, Theil Sen's slope, Himachal Pradesh*

1. Introduction

Precipitation has a significant role in the climate system. Substantial amount of precipitation fall as rains; thus the intensity, frequency and amount of rainfall is important for all the life forms and to determine the biodiversity over different regions on the Earth. Information on the rainfall characteristics is vital in fields related to meteorology, hydrology, agriculture, and for better water resource management. Precipitation is indispensable but the extreme precipitation is often perilous. Hydrological extreme events are commonly defined as floods and droughts.

As per the assessment of the Intergovernmental Panel on Climate Change (Houghton et al., 2001), there is a significant effect of global warming on precipitation pattern. Thus, expected outcomes of global warming would be a rise in the magnitude and frequency of extreme precipitation events caused by increased atmospheric moisture levels, low pressure events and large-scale storm activity.

Increased warming leads to greater evaporation and thus surface drying, resulting in increased intensity and duration of drought. Whereas, excessive precipitation often results in flooding which accounts for great loss of life and

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Changing Magnitude, Frequency and Intensity of Rainfall and Rainfall Extremes over the North-Western Himalayan Region of India

ASHISH DOGRA AND ANKIT TANDON

Abstract:

The Himalayan mountain ranges are a major source of fresh water for the Asian river system and also act as climatic division, causing abundant rainfall over many countries situated in Himalayan proximity. The changing climatic conditions, in particular the occurrence of extreme weather events adversely affect around half a billion people living across these regions. In our study, we present annual and seasonal changes observed in the characteristics of rainfall and rainfall extremes over the north-western Himalayan region of India (HRI). The daily rainfall records with high spatial resolution of 0.25° × 0.25° (latitude × longitude) were obtained from both the ground (IMD) and satellite-based (TRMM) observations, for the duration from 1999 to 2019. To examine annual and seasonal rainfall characteristics (magnitude, frequency, and intensity) we calculated total rainfall (Rtot), number of wet days (Rdays), and the ratio of Rtot to Rdays i.e., daily rainfall intensity (Ridx). The spatial pattern of Rtot variability over the study area reveals that the variability increases with increasing latitude and elevation. The performance of TRMM with respect to IMD suggests an overall good agreement, especially over the sub-Himalayan regions. Furthermore, Quantile regression (QR) method was employed to compute temporal changes in rainfall and rainfall extremes by estimating the slope coefficients at median (τ=0.5) and extreme quantiles (τ=0.1 and τ=0.9) of the rainfall distribution. The results suggest an overall positive trend in rainfall and rainfall extremes over northern part of the study area, while the Great Himalayan range of the study region showed both negative and positive trends in rainfall characteristics. The positive trends in rainfall magnitude and negative trend in frequency resulted in increased rainfall intensity over the north-western HRI. The findings also reveal that extreme rainfall over the study region are increasing at higher rate when compared with average rainfall. The season-wise trend analysis suggest a shift in rainfall and rainfall extreme from winter to pre-monsoon. In addition to this, inter annual rainfall variability analysis suggest huge variation in monthly rainfall estimates post 2011. Lastly, the Autoregressive integrated moving average (ARIMA) modeling was used to provide short-term forecasting of rainfall patterns over HRI.

Keywords : *Rainfall characteristics, North-western Himalayas, Quantile regression, Inter annual variation, ARIMA model*

1. Introduction

The Himalayas act as climatic division and pose a barrier to moisture laden monsoonal wind system causing abundant rainfall over south-east Asian countries, and thus act as a major source of fresh water for the Asian river system (Nandargi and Dhar 2011). The rainfall over the north-western Himalayan region of India (HRI) is mainly governed by two major weather systems, namely, the southwest Indian summer monsoon (ISM) and the mid-latitude westerlies or western disturbances (WD) (Bookhagen and Burbank 2010). The topographic features of the mountainous basins play an important role in the rainfall distribution. Interaction of moisture laden air currents against hilly terrain results in good amount of rainfall over the sub-HRI during ISM. However, due to this orographically controlled rainfall gradient, trans-HRI receives scares amount of ISM rainfall as compared to the

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Rotating Biological Contactor as Secondary Treatment for Dairy Wastewater

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Abstract:

Rotating Biological Contactor (RBC) is biological fixed film treatment technique and is part of secondary treatment. RBC is employed for treating the wastewater after primary and preliminary treatment. The waste water in an RBC reactor comes in contact with the discs which keep rotating in the vertical plane with the discs spaced evenly on the horizontal shaft. During rotation half the disc comes in contact with the wastewater, picking up the organic matter and getting exposed to air. Thus organic matter get oxidized reducing the biochemical oxygen demand (BOD). RBC includes a sequence of carefully spaced, side by side discs established on rotating shaft that is partially dipped in wastewater and partially exposed to air during rotation. Microorganisms grow at surface of discs wherein the active biological film helps in depleting the biochemical oxygen demand of wastewater. In the present study dairy wastewater was treated by applying RBC and achieved encouraging results. For a detention period of 48 hours BOD reduction was from 1015 ppm for raw wastewater to 180 ppm after the wastewater was passed through RBC. Similarly chemical oxygen demand (COD) also reduced from 1615 ppm to 198 ppm. Overall efficiency achieved through RBC application was 80.69% and 84.16% for BOD and COD reduction respectively.

Keywords : *RBC, Bio-film, Reactor, HRT*

Dairy wastewater primarily includes organic and biodegradable materials that can interact with aquatic and other terrestrial habitats. The milk-processing industries that discharge untreated orbit partially treated wastewater pose significant environmental problems due to more contamination load of dairy wastewater. Therefore, as an starting point, it's important to carry out wastewater treatment to optimize an easy and economical method to treat entire dairy effluent. In addition, very stringent rules for effluent discharge have been implemented by Indian government to secure the environment. Present days' research consists of phytoremediation, anaerobic digestion, membrane techniques, ultra filtration, nano-filtration etc. In recent times reverse osmosis was applied for effectively treating whey waste. Electro coagulation and other methods were employed for treating dairy waste, but not reported at larger scale [7]. This encouraged the need for alternate applications to treat the waste. Dairy wastewater treatment by Rotating Biological Contactor (RBC) is an alternative to induct the system as part of secondary treatment [4]. Application of RBC can be effective, both from treatment and cost wise, especially for small and medium industries.

A. Factors Influencing RBC Performance

Rotational speed of the discs is one of the significant criteria of RBC system. Transfer of nutrients and oxygen to bio-film and removal of bio-film substrate depends on rotational speed. DO concentration increases with increased rotational speed, resulting in greater rate of degradation of the organic substrate [8]. The microorganisms on disc may be Stripped-off the media causing quality of effluent to deteriorate and rate of degradation to decrease. Further, there is increased power demand for high speed rotation of the discs. This may prove uneconomical for wastewater treatment. Organic loading is another factor affecting the RBC performance. It is necessary for an accurate organic or BOD

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HYSPLIT Trajectory Model and its Application with Special Reference to the Third Pole

RIJU PARMAR[1], SHIKHA RAWAL[2], HARMINDER PAL SINGH[1] AND ANURAG LINDA[2]*

Abstract:

The present study gives a brief description regarding the sources of light absorbing pollutants in the Himalayan region (*The Third Pole)* using HYSPLIT back trajectory model. In the present work secondary data of various light absorbing pollutants over the Himalayan region were taken from the published literatures and further the HYSPLIT backward air trajectory model was run in order to identify the respective long range and short range atmospheric sources on monthly basis at a height of 4000, 5500 and 6500 m above ground level. Documented studies show increased concentrations of atmospheric deposition over the Himalayan region during the pre-monsoon season and winter dry season. In the present study it was found that the source of pollutants in the Himalayan region varies in different months and at different altitudes where the regional and long range atmospheric transport of light absorbing impurities (BC, OC EC & POPs) were found to be originating from the Middle East and Central Asia, and for the short rang transport the local trajectories were found to be effective. Seasonal and attitudinal variations of air masses may lead to the different types of pollutants on the glacier surface. HYSPLIT model is an open source that can be effectively used for source apportionment but the monthly monitoring of pollutants are required to substantiate the deposition of light absorbing pollutants in the areas mapped by the present study.

Keywords : *HYSPLIT, trajectories, topography, Himalayan, atmospheric.*

1. Introduction

Humans as well as different natural processes results in the formation of different types of byproducts, which directly or indirectly affects our environment. Byproducts like black carbon (BC), particulate matter organic and inorganic, atmospheric brown clouds after exceeding a thresh hold are known as pollutants. Based on the genesis, the source of pollutants can be categorized under two broad subheadings, if it originates from an identifiable single source then it is referred as a point source which is easy to control but if the source is dispersed or non traceable then it is referred as a non-point source of pollution.

Apart from Arctic and Antarctic region, Himalaya is the largest storehouse of fresh water in form of glaciers and thus it is also referent as a "Third Pole". As far as the serenity of environment is considered Himalaya is one of the least intermittent regions of the planet. But in recent past, intensive human intervention and climate change has adversely impacted its serenity. This has resulted in transforming snow characteristics, melting of Himalayan glaciers and proliferation of glacial lakes. Many cascaded events like GLOF (glacial lake outburst flow) has been associated with this. Due to its serenity, robust topography and a good source of fresh water, Himalayan region have received a great deal of attention in recent past. Many studies have shown loss of glacier mass in recent decades that is expected to continue in coming decades at a higher rate (Hugonnet et al.,2021).

In this paper an attempt has been made to review the pollutants of snow that results due to long range transport and to understand the seasonal variation in trajectories along the different glaciated region of Himalaya using HYSPLIT model. The approach induced in the present study will help to understand precisely the source dynamics of atmospheric deposition over the Himalayan region in different seasons.

1.1 Pollutants over the Himalayan Region:

Himalayan region exhibits both anthropogenic and natural sources of pollution but their relative importance is region specific which means it varies from region to region

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Climate Change, Surface Ozone and its Health impact on Human Health in Himachal Pradesh: A Study of North Western Himalayan Region

ISHA THAKUR[1] RENU LATA*[1] SAYANTA GHOSH[1] AND JAGDISH CHANDRA KUNIYAL*[2]

Abstract:

Climate change and air pollution have become a serious problem worldwide .Climate change include global warming and its effect on earths weather pattern. The effect of global climate change is evident from melting glaciers and shifting of seasons, shifting of apple belt to higher altitude region at Himachal Pradesh, also increase in temperatures and stagnant atmospheric condition has lead to increase of air pollutants such as surface ozone and $PM_{2.5.}$ The present study will help us determine the future climate change and its relationship with surface ozone and its health impact in Himachal Pradesh, based on the past analysis of temperature and precipitation data from 1901-2020 in Himachal Pradesh. Further Projected Climatology for Mean Temperature, Number of extremely hot days (>40ºC), cumulative 5 day rainfall was predicted using the climate model CMIP6 for scenario SSP1-1.9 for period 2020-2039 with reference 1995-2014.To understand the impact of climate change on surface ozone a correlation was established with surface ozone and meteorological parameters by using satellite data of OMI and available ground level data. The results revealed that surface ozone showed a positive correlation with temperature while a negative correlation with rainfall and with increase in temperature and increase in ozone there was also a increase in number of asthma and COPD cases from year 1991 to 2016.FurtherCMPI6 model predicted that the a rise of 1.09ºC in average temperature will be seen in 2020 to 2039 in Himachal Pradesh when compared to historical year 2014-2019 also the number of hot days are expected to show increase of 1.59days from 2020 to 2039 in Himachal Pradesh .This scenario indicated that with increase in temperature in future upcoming years there will be rise in levels of surface ozone, further due to increase in temperature and warmer days there is a risk of increase in number of COPD and asthma patients in the region.

Keywords : *Climate Change, surface ozone, correlation, CMPI6, COPD, Himachal Pradesh.*

1. Introduction

Climate change and air pollution has become a matter of concern worldwide. Increased Urbanization has lead to challenges in terms of climate action and sustainable development[1][2].Increased urbanization has also lead to increased anthropogenic activities and increased vehicular movement, industrialization which has led to increased pollution levels. Also increased urbanization has led to land cover changes and changing land use which effect climate leading to increased anthropogenic emissions, extreme precipitation which can lead to floods higher temperatures and heat waves which can negatively affect human health[3][4][5].The study related to combined effect of climate change, air pollution and its health impact is very limited in India[6][7].Climate change and air pollution both have severe health impacts on human health. Climate change will impair human health by increasing ground-level ozone and/or particulate matter air pollution in some areas, according to the National Climate Assessment[8] Furthermore, according to studies climatic projections for the next century, global warming would be accompanied by more frequent and powerful heat waves, which will raise the risk of wildfires and desertification. Due to a close link between the production and dispersion of outdoor air pollution and local patterns of temperature, wind, and precipitation, the impacts will be more severe in urban areas [9].Several studies showed that there is a connection between how an individual responds to climatic conditions, air pollution, and its sources and components [10, 11–15]. Climate-related conditions that favour the deposition of air pollutants (such O_3) at ground level are the root cause of some air pollution-related episodes of rhinitis and asthma aggravation. However, the effects of air pollutants on lung

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Micro Plastic Induced Toxicity in the Soil System: Perspectives for Potential Root of Climate Change-a Comprehensive Review

TANAY BARMAN[1, 2*] AND SHIVANGI THAKUR[2]

Abstract:

Plastic is an indispensable material essential for modern human life. With highly increasing demand for plastic use, however, environmental contamination by plastic litters has become an emerging issue. Concentrations of plastics are manifold higher in terrestrial system than the aquatic one. Micro/nano plastics have the ability to alter soil enzymatic system, soil properties and also affect soil borne microorganisms and earthworms. Micro/nano plastics inhibit plant growth, seed germination and gene expression; and they also induce cytogenotoxicity by aggravating ROS (Reactive Oxygen Species) generation. Here, we have compiled literature, studying the sources, migration of microplastics in soil, negative impacts on soil health and function, trophic transfer in food chains, and the corresponding adverse effects on soil organisms in order to address the potential ecological and human health risks caused by microplastics in soil. Furthermore, the focus of this review is on limiting microplastics in soil as well as establishing management and remediation measures to mitigate the risks posed by microplastic pollution.

Key words : *Micro plastics, Soil contamination, Toxicity, Migration, ecological impact*

1. Introduction

Plastics are synthetic polymers made from synthetic and semi-synthetic organic chemicals as well as fossil fuels like petroleum-ether and coal hardly biodegradable in nature which ultimately interact with living biota and causes ecotoxicological potential. It can be one of two types: (I) thermoplastics, which become malleable when heated and solidify when cooled, or (II) thermosets, which are highly heat resistant but breakdown when overheated (Rennie 1999). The principal thermoplastics which lead the market include polypropylene (PP), polyethylene (PE), polystyrene (PS), polyvinylchloride (PVC), and polyethylene terephthalate (PET) (Lithner et al. 2011). Some harmful monomers used in the manufacture of plastics, such as vinyl chloride, styrene, and bisphenol, stay in residual form following polymerization and are discharged into the environment during their lifetime (Revel et al. 2018). Millions of tons of plastic are produced each year and use of plastic polymers in various aspects of our life is inevitable and plastic is not an exception in our day-to-day life. Due to their vast range of uses in many industries such as agriculture, packaging, construction, automobile industry, biomedicine, and others, the global rate of plastic production has been expanding every year since the 1950s. Increasing annual plastic production and inefficient waste management result in increased environmental accumulation.

Plastic Pollution has become a global concern and Micro Plastic's (MPs) derived pollutants are an emerging contaminant and their presence in water and soil ecosystems has recently drawn considerable attention as they are a massive threat to an entire ecosystem and biodiversity. Plastic poses a serious danger to the health of biotic communities in both terrestrial and aquatic habitats (Bouwmeester et al. 2015; Huang et al. 2019; Li et al. 2019; Stapleton 2019; Mercogliano et al. 2020). Potential sorption ability of MPs for a wide spectrum of organic/inorganic contaminants may raise their ecotoxicological concerns (Brennecke et al. 2016; Munier et al. 2018; Caruso 2019; Dong et al. 2020). As a result, in this era of plastics, polymers represent as an emerging kind of environmental pollution (Maity et al. 2021). Plastics enter into the environment from sundry sources such as manufactured products used in our daily life; plastics containing waste water used for irrigation; unacceptable and uncontrollable throwing

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