An Environmental Research Abstract

Headlines Himalaya

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For the 717th -718th issues of Headlines Himalaya, we reviewed researches from five sources and selected 12 researches from five countries. We selected three researches from Nepal and nine from other Himalayan countries (India, China, Bhutan and Pakistan).

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RARE FLOOD SCENARIOS FOR A RAPIDLY GROWING HIGH-MOUNTAIN CITY: POKHARA, NEPAL

Melanie Fischer, Jana Brettin, Sigrid Roessner, Ariane Walz, Monique Fort, and Oliver Korup

Natural Hazards and Earth System Sciences 22: 3105-3123

Pokhara (ca. 850 m a.s.l.), Nepal's second-largest city, lies at the foot of the Higher Himalayas and has more than tripled its population in the past 3 decades. Construction materials are in high demand in rapidly expanding built-up areas, and several informal settlements cater to unregulated sand and gravel mining in the Pokhara Valley's main river, the Seti Khola. This river is fed by the Sabche glacier below Annapurna III (7555 m a.s.l.), some 35 km upstream of the city, and traverses one of the steepest topographic gradients in the Himalayas. In May 2012 a sudden flood caused >70 fatalities and intense damage along this river and rekindled concerns about flood risk management. We estimate the flow dynamics and inundation depths of flood scenarios using the hydrodynamic model HEC-RAS (Hydrologic Engineering Center's River Analysis System). We simulate the potential impacts of peak discharges from 1000 to 10 000 $m^3 s^{-1}$ on land cover based on high-resolution Maxar satellite imagery and OpenStreetMap data (buildings and road network). We also trace the dynamics of two informal settlements near Kaseri and Yamdi with high potential flood impact from RapidEye, PlanetScope, and Google Earth imagery of the past 2 decades. Our hydrodynamic simulations highlight several sites of potential hydraulic ponding that would largely affect these informal settlements and sites of sand and gravel mining. These built-up areas grew between 3- and 20-fold, thus likely raising local flood exposure well beyond changes in flood hazard. Besides these drastic local changes, about 1 % of Pokhara's built-up urban area and essential rural road network is in the highest-hazard zones highlighted by our flood simulations. Our results stress the need to adapt early-warning strategies for locally differing hydrological and geomorphic conditions in this rapidly growing urban watershed.

For further reading: https://doi.org/10.5194/nhess-22-3105-2022

ESTIMATING BIODIVERSITY ACROSS THE TREE OF LIFE ON MOUNT EVEREST'S SOUTHERN FLANK WITH ENVIRONMENT DNA

Marisa C.W. Lim, Anton Seimon, Batya Nightingale, Charles C.Y. Xu, Stephan R.P. Halloy, Adam J. Solon, Nicholas B. Dragone, Steven K. Schmidt, Alex Tait, Sandra Elvin, Aurora C. Elmore, and Tracie A. Seimon

Iscience 25: 104848

Species composition in high-alpine ecosystems is a useful indicator for monitoring climatic and environmental changes at the upper limits of habitable environments. We used environmental DNA (eDNA) analysis to document the breadth of high-alpine biodiversity present on Earth's highest mountain, Mt. Everest (8,849 m a.s.l.) in Nepal's Khumbu region. In April-May 2019, we collected eDNA from ten ponds and streams between 4,500 m and 5,500 m. Using multiple sequencing and bioinformatic approaches, we identified taxa from 36 phyla and 187 potential orders across the Tree of Life in Mt. Everest's high-alpine and aeolian ecosystem. These organisms, all recorded above 4,500 m—an elevational belt comprising <3% of Earth's land surface—represents ~16% of global taxonomic order estimates. Our eDNA inventory will aid future high-Himalayan biomonitoring and retrospective molecular studies to assess changes over time as climate-driven warming, glacial melt, and anthropogenic influences reshape this rapidly transforming world-renowned ecosystem.

For further reading: https://doi.org/10.1016/j.isci.2022.104848

NATURE'S CONTRIBUTIONS TO PEOPLE AND THE SUSTAINABLE DEVELOPMENT GOALS IN NEPAL

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Environmental Research Letters 17: 093007

Nature's contributions to people (NCPs) underpin the attainment of the Sustainable Development Goals (SDGs) but are declining globally. It is therefore critical to identify the drivers of changes in NCPs, and to understand how and where NCPs can contribute towards the achievement of the SDGs. By integrating the conceptual framework of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBESs) and the SDGs, we can obtain a better understanding of how changes in the state of NCPs support or hinder attainment of the SDGs, and how changes in NCPs are driven by development interventions. We conducted a systematic synthesis of the literature to determine the state of research on NCPs, trends in NCPs and their drivers, and the contribution of NCPs towards achieving the SDGs in Nepal, a low-income and highly biodiverse country. We found that NCPs contributed positively towards the achievement of 12 SDGs. However, NCPs were reported to be declining across Nepal, ultimately undermining Nepal's ability to achieve SDG targets. The major direct drivers of decline were land-use change, over-exploitation, and climate change. These direct drivers were linked to conventional development interventions, including agricultural expansion and the construction of road and energy infrastructure. However, some interventions, such as community forestry and protected areas, increased the supply of NCPs. Better integration of Indigenous knowledge and local practices was also reported to be effective in improving the provision of NCPs and contributing to improving livelihoods at local scales. We identified opportunities for further research in NCPs, particularly in increasing geographical representativeness and improving our understanding of non-material NCPs. Our approach of combining the IPBES conceptual framework and the SDGs enabled us to more comprehensively identify how progress towards the SDGs are mediated by NCPs and provides actionable guidelines for how to take more integrative measures to achieve the SDGs in Nepal and countries facing similar development challenges.

For further reading: https://doi.org/10.1088/1748-9326/ac8e1e

India-Himalaya

DIVERSITY AND SPATIAL DISTRIBUTION OF BUTTERFLIES IN DIFFERENT MACROHABITAT OF NORTHEAST INDIA

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International Journal of Tropical Insect Science 42: 1-16

Butterflies play an ecological role in nature by serving as bio-indicators for maintaining habitat quality and ecosystem stability. The diversity and spatial distribution of butterflies in four habitats, i.e., roadside, garden, plantation and forest, were assessed from March to June 2021 to document the checklist of butterfly species on the campus during the spring and the summer seasons in Rain Forest Research Institute, Jorhat, India. In the present study, 613 individuals from 44 species belonging to five families, i.e., Nymphalidae, Pieridae, Lycaenidae, Papilionidae and Hesperiidae, were recorded by transect walk method. The maximum richness and abundance of butterfly species was found during the summer season (May–June). The family Nymphalidae recorded the highest percentage of species and individuals among the sampled butterfly families during both the seasons. This family also showed the highest Simpson dominance index, Shannon diversity index and Margalef index during both the

seasons. The analysis of alpha diversity indices showed the highest values of Simpson dominance index, Shannon diversity index and Margalef index in the roadside and garden habitat and the lowest in the plantation habitat. The models on abundance distribution (ADM) showed a significant difference in butterfly species composition in the forest habitat during the spring season and both the forest and plantation habitats during the summer season. Among the sampled butterfly species, six were categorized as threatened under Schedules II and IV of India's Wild Life (Protection) Act, 1972. The outcomes of this study highlight the relevance of this institutional campus as a butterfly's preferred habitat, offering a rich environment for butterfly conservation and future research studies. The study will further aid in the long-term conservation efforts of the butterfly species and their habitats.

For further reading: https://doi.org/10.1007/s42690-022-00885-5

PLANT DIVERSITY AND VARIATION IN SOIL PROPERTIES OF SELECTED LAND USE TYPES OF ARUNACHAL PRADESH: A LOCAL CLIMATE CHANGE PERSPECTIVE

Reetashree Bordoloi, Aribam Rocky Sharma, Biswajit Das, Genius Teron, Lobsang Tashi Thungon, Ashish Paul, Lal Bihari Singha, and Om Prakash Tripathi

Vegetos 35: 1-11

Changes in the pattern of land use and climate have increasingly threatened the terrestrial ecosystem. The study aims to quantify the responses of modified land use on species diversity and soil properties and also to document the local perceptions of climate change in the region. A total of 10 tree species, 10 shrub species and 12 herb species were recorded from the Seru area of Tawang district, whereas, 9 tree species, 8 shrub species and 11 herb species were recorded from the Ziro Valley of Lower Subansiri district. The density of tree species (674 stems/ha), shrubs/saplings (14,025 individuals/ha) and herbs/seedlings (57,083 individuals/ha) were found to be higher in the Seru area than in the Ziro Valley. However, the basal area of tree species was comparatively more (21.10 m^2/ha) in the Ziro Valley than in the Seru area (19.80 m^2/ha) in spite of more density. The soil of all the selected areas was recorded loamy to sandy loam. The soil moisture content and soil pH showed a significant correlation ($p < 0.05$; $p < 0.01$) with soil depth. Total phosphorus and soil organic carbon depicted a significant correlation with land use change and soil pH ($p < 0.01$), respectively. Available nitrogen showed a significant correlation with pH ($p < 0.05$) and soil organic carbon ($p < 0.01$) and total potassium with pH ($p < 0.05$) and total phosphorous ($p < 0.01$). Based on the local responses, it is clear that the region has been experiencing long term changes in climatic conditions and have influenced the species composition of the region. It is therefore, very important to address the process of adaptation and take necessary locally relevant management solutions.

For further reading: https://doi.org/10.1007/s42535-022-00484-2

China Himalaya

VEGETATION DYNAMICS IN RESPONSE TO CLIMATE CHANGE AND HUMAN ACTIVITIES IN A TYPICAL ALPINE REGION IN THE TIBETAN PLATEAU

Guosong Zhao, Lijie Ren, and Zilong Ye

International Journal of Environmental Research and Public Health 19: 12359

Understanding past and future vegetation dynamics is important for assessing the effectiveness of ecological engineering, designing policies for adaptive ecological management, and improving the ecological environment.

Here, inter-annual changes in vegetation dynamics during 2000–2020, contributions of climate change (CC) and human activities (HA) to vegetation dynamics, and sustainability of vegetation dynamics in the future were determined in Gannan Prefecture (a typical alpine region in the Tibetan Plateau), China. MODIS-based normalized difference vegetation index (NDVI), air temperature, precipitation, and land cover data were used, and trend analysis, multiple regression residuals analysis, and Hurst exponent analysis were employed. NDVI increased at a rate of $2.4 \times 10^{-3} \cdot a^{-1}$ during the growing season, and vegetation improved in most parts of the study area and some sporadically degraded areas also existed. The increasing rate was the highest in the Grain to Green Project (GTGP) areas. The vegetation in the southern and northern regions was mainly affected by CC and HA, respectively, with CC and HA contributions to vegetation change being 52.32% and 47.68%, respectively. The GTGP area (59.89%) was most evidently affected by HA. Moreover, a Hurst exponent analysis indicated that, in the future, the vegetation in Gannan Prefecture would continuously improve. The study can assist in formulating ecological protection and restoration projects and ensuring sustainable development.

For further reading: https://doi.org/10.3390/ijerph191912359

VEGETATION GROWTH STATUS AND TOPOGRAPHIC EFFECTS IN FROZEN SOIL REGIONS ON THE QINGHAI-TIBET PLATEAU

Ruijie Wang, Yanjiao Wang, and Feng Yan

Remote Sensing 14: 4830

The Qinghai–Tibet Plateau (QTP), which is known as Earth's "Third Pole", is a driver of global climate change, and long-term monitoring of QTP vegetation can reveal changes attributable to climatic and human influences. Previous research monitoring vegetation on the QTP focused primarily on spatiotemporal variations of vegetation indices, while few studies have considered fractional vegetation cover (FVC) in relation to topographic and frozen soil factors. We used MODIS-EVI, digital elevation models, and frozen soil data to investigate topographic effects on vegetation growth status in different soil types on the QTP during 2000–2020. (1) FVC showed a trend of increase during 2000–2020, and the FVC on the QTP decreased from the southeast to the northwest in spatial distribution. FVC in permafrost regions was the lowest, followed by seasonal frozen soil areas; FVC in unfrozen areas was the highest. (2) With increasing elevation, FVC of permafrost, seasonal frozen, and unfrozen soil areas showed downward trends for each aspect. In seasonal frozen soil areas, at elevation ≤4000 m (>4000 m), FVC of sunny (shady) slopes was greater than that of shady (sunny) slopes. In permafrost regions, except at elevations of 3000–4000 m, FVC of shady slopes was greater than that of sunny slopes. In unfrozen soil areas, at elevation >4000 m, FVC of sunny slopes was obviously greater than that of shady slopes. (3) With increasing slope, FVC in seasonal frozen and permafrost soil (unfrozen soil) regions showed a trend of increase (decrease). In seasonal frozen soil areas, FVC of sunny (shady) slopes was greater than that of shady (sunny) slopes on slopes ≤6° (>6°). In permafrost regions, FVC of sunny slopes was less than that of shady slopes. With increasing slope, the influence of aspect became more obvious. In unfrozen soil areas, FVC of sunny slopes was slightly greater than that of shady slopes. Topographic effects especially the elevation and slope effects might significantly affect the spatiotemporal variations of vegetation growth status in frozen soil regions on the QTP.

For further reading: https://doi.org/10.3390/rs14194830

INCREASING NEGATIVE IMPACTS OF CLIMATE CHANGE AND ANTHROPOGENIC ACTIVITIES ON THE QINGHAI–TIBET PLATEAU DURING 1982–2019

Bin Zhu, Zengxin Zhang, Jiaxi Tian, Rui Kong, and Xi Chen

Remote Sensing 14: 4735

Climate change, combined with ever-increasing anthropogenic activities, has had significant impacts on the vegetation of the Qinghai–Tibet Plateau (QTP). This study quantitatively analyzed the impacts of climate change and human activities on vegetation variation on the QTP from 1982 to 2019 based on AVHRR NDVI data and the residual trend method. The main results were as follows: (1) From 1982 to 2000, the vegetation of the QTP had an obvious restoration process, whereby 67.8% of vegetation coverage areas experienced an increasing trend, while it had a large range of degradation during 2001–2019, especially in the central QTP. (2) The positive effect of climate change on the vegetation of the QTP decreased, and the negative impact increased. The area of positive impact decreased from 68.54% in 1982–2000 to 47.13% in 2001–2019, while the negative-impact area increased from 31.46% to 52.87%. (3) The area negatively affected by human activities increased from 57.68% in 1982–2000 to 79.46% in 2001–2019 and was mainly concentrated in the grassland of the central QTP. The findings of this study provide a scientific basis for vegetation restoration and management in the QTP region.

For further reading: https://doi.org/10.3390/rs14194735

RELATIVE CONTRIBUTIONS OF CLIMATE CHANGE AND HUMAN ACTIVITIES ON VEGETATION PRODUCTIVITY VARIATION IN NATIONAL NATURE RESERVES ON THE QINGHAI–TIBETAN PLATEAU

Jia Zhou and Tao Lu

Remote Sensing 14: 4626

National nature reserves (NNRs) are at the forefront of conservation efforts on the Qinghai–Tibetan Plateau (QTP). However, few studies have examined the vegetation dynamics and their driving forces at the whole QTP scale. In this study, we used potential Net Primary Productivity (PNPP), actual NPP (ANPP), and human-activity-induced NPP (HNPP) to analyze the vegetation dynamics of 42 NNRs on the QTP. Further, we determined the driving factors of vegetation dynamics from 2000 to 2020. The results indicate that, during the 21 years studied, ANPP increased at 83.4% of the NNRs area on the QTP. Additionally, the contributions of climate change and anthropogenic factors to ANPP variation were 59.53% and 40.47%, respectively. The contribution of temperature to ANPP variation was considered high and stable, whereas the contribution of precipitation was relatively lower and variable. Residual analysis showed that human activities had both positive (51.30%) and negative effects (48.70%) on ANPP. Using Hurst exponent analysis, we found that 31.60% of the vegetation for the NNRs on the QTP will likely remain a persistent trend, and 65.4% will be stochastic in the future. By contrast, 3.00% of the vegetation mainly located in southern QTP would show a reverse trend, with most of them distributing in southern QTP, which deserves more attention. This study may help policymakers understand the relative impacts of climate change and human activities on vegetation in the different nature reserves on the QTP.

For further reading: https://doi.org/10.3390/rs14184626

Bhutan-Himalaya

TIMING AND CLIMATIC-DRIVEN MECHANISMS OF GLACIER ADVANCES IN BHUTANESE HIMALAYA DURING THE LITTLE ICE AGE

Weilin Yang, Yingkui Li, Gengnian Liu, and Wenchao Chu

The Cryosphere 16: 3739-3752

Mountain glaciers provide us a window into past climate changes and landscape evolution, but the pattern of glacier evolution at centennial or suborbital timescale remains elusive, especially in monsoonal Himalayas. We simulated the glacier evolution in Bhutanese Himalaya (BH), a typical monsoon-influenced region, during the Little Ice Age (LIA) using the Open Global Glacier Model driven by six paleoclimate datasets and their average. Compared with geomorphologically mapped glacial landforms, the model can well capture the patterns of glacier length change. Simulation results revealed four glacial substages (the 1270s, 1470s, 1710s, and 1850s) during LIA in the study area. Statistically, a positive correlation between the number of glacial substages and glacier slope was found, indicating that the occurrence of glacial substages might be a result from heterogeneous responses of glaciers to climate change. Monthly climate change analysis and sensitivity experiments indicated that the summer temperature largely dominates the regional glacier evolution during the LIA in BH.

For further reading: https://doi.org/10.5194/tc-16-3739-2022

Pakistan- Himalaya

ENVIRONMENTAL IMPACTS OF URBANIZATION ENCROACHMENT IN THE LOWLANDS OF KHYBER PAKHTUNKHWA, PAKISTAN

Fazeelat Rehman and Abdullah Khan

Sustainability 14: 11959

Urban encroachment due to urban sprawl and unchecked expansion in built-up areas is one of the top challenges developing countries such as Pakistan face. The fertile agricultural land is continuously converting into built-up areas reducing the capacity of food production and bringing down the livelihood opportunities associated with agricultural land. Pakistan is an agricultural country with extensive fertile areas. The GDP share of agriculture is more than 20%, and it engages more than half of the country's total labor force, producing a handsome foreign exchange. However, this fertile and productive land is now altering due to urbanization encroachment. The primary purpose of this study was to assess the level of urbanization encroachment and its temporal dynamics in the lowlands of Khyber Pakhtunkhwa. The sample area of District Peshawar was selected for this purpose. First, the study's objective was to detect the district's temporal dynamics in the land-use pattern. Secondly, the quantification of agricultural land converted to built-up in District Peshawar was also considered. The study of urbanization encroachment in temporal dynamics focused on the conversion of agricultural land-use change using high-resolution satellite images (Arc GIS 10.5), a detailed questionnaire survey, and interviews, and focus group discussions were conducted to obtain more profound insight into the study area. SPSS (Statistical Package for Social Sciences), ANOVA, and regression models were applied where needed. For the agricultural land investigation, data from the landowners were also incorporated to learn the size of the lands they currently hold. To claw out the fragmentation of the land, the previous status of the land, its selling, purchasing, and the causes thereof, have also been probed. The results show that 46.35 sq. km of the land area has been built-up since the first census in 1981. In 2019, it increased by 173.3049 sq. km in District Peshawar against the total area of 1257 sq. km. In the sample area, the fertile agricultural land shows a change five times greater than the population increase. The land is continuously reduced and utilized for different purposes. The land values also appeal to the land owners for handsome returns, which is another crucial factor of urban encroachment over the fertile agricultural area. A proper and active regularity authority is recommended, and policies for land transformation from agriculture to built-up coverings should be formed. Decentralization of facilities, subsidies, and incentives to the farmers are recommended to slow down the speed of land conversion.

For further reading: https://doi.org/10.3390/su141911959

PLANNING FOR SUSTAINABLE GREEN URBANISM: AN EMPIRICAL BOTTOM-UP (COMMUNITY-LED) PERSPECTIVE ON GREEN INFRASTRUCTURE (GI) INDICATORS IN KHYBER PAKHTUNKHWA (KP), PAKISTAN

Muhammad Rayan, Dietwald Gruehn, and Umer Khayyam

International Journal of Environmental Research and Public Health 19: 11844

Rising vulnerability of the urban green infrastructure (UGI) is grabbing global attention, for which inclusive urban landscape and greening policies (ULGP) and frameworks are crucial to support green growth. As such, this research intends to explore the local community's perspective to assemble sustainable UGI indicators for vital taxonomy of the urban green space (UGS) elements, aiming to develop a multi-functional and sustainable UGI-indicator-based framework that is eco-friendly and supports green-resilient cities in Khyber Pakhtunkhwa (KP) province, Pakistan. An in-depth household survey was executed in three KP districts: Charsadda, Peshawar, and Mardan, placing self-administered 192 questionnaires while covering themes around climate change adaptation, urban resilience, and UGI. Relative importance index (RII) and the interquartile range (IQR) methods were set up for data analysis that revealed excellent reliability ($\alpha > 0.88$) and internal consistency. The results confirmed community-based UGI indicators with a focus on promoting green-energy-saving strategies as e-imp (level 9, RII = 0.915), while other (ten) UGI indicators as important (RII = 0.811–0.894) and (eleven) as moderately important (RII = 0.738–0.792). These UGI indicators were found to be enhanced by UGS elements (RII ≥ 0.70). These findings provide a foundation for urban policy change and the development of a sustainable UGI framework to build an eco-regional paradigm for greener growth.

For further reading: https://doi.org/10.3390/ijerph191911844