### **Climate Vulnerability and Resilience of Water Resources in Mountainous Regions**

What does climate change mean for the Himalayas?

CRHM Modelling of the Nepal Himalayas



John Pomeroy, Xing Fang, Caroline Aubry-Wake, Kevin Shook Susa Manandhar, Bharat Dhungana, Manavi Chaulagain, Sujan Bhattarai, Kajol Basnet





# Three main discussions



- 1. How important is the change in precipitation compared to the change in glaciers?
- 2. Physically based glacial-hydrological models are essential for understanding and predicting (snow and) glacier changes.
- 3. The urgency of collaboration and networking between researchers, policymakers, and society to address the changes.



https://watchers.news/

https://kathmandupost.com/

https://news.abplive.com/

### Sikkim's Lachen Valley

Kagbeni in Mustang, Nepal

III III III

Ladakh, India

# Warming climate in mountains

- The Himalayas Cryospheric Changes: Glaciers are retreating, glacial lakes are expanding, and new glacial lakes are forming.
- Change in precipitation, and its phase?
- Climate change is threatening water resources in mountains, including the Himalayas.
- Changes in precipitation and its phase are key drivers of cryospheric changes in the Himalayas, leading to:
  - a. Reduced water availability
  - b. Increased risk of flooding
  - c. Changes in agricultural productivity
  - d. Impacts on hydropower generation



# The limited hydroclimatic study in Nepal Himalayas



- The northern part has a dense distribution of glaciers and glacial lakes.
- Increase rates in air temperature are generally higher than the global mean temperature increase.
- Precipitation change is heterogeneous.

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- Pronounced warming trends are experiencing greater warming than southern plains (rate of increase is elevation-dependent, higher in higher elevation).
  - The limited studies reveal that the glaciers are retreating at a faster rate, and are projected to retreat even faster.



# The Effect of Publicity and Warning of Disaster on Local People

- A Case Study of Tsho Rolpa Glacier Lake, October 1998 (Immersion Course on Contemporary Social Issues)
- Panic is at the downstream, not at the upstream

#### DHM lowered 2 of the potentially dangerous - Tsho Rolpa and Imja Lakes







www.germanwatch.org

As a result of the melting glacier nearby, the lake has grown six-fold, from an area of 0.23 square kilometres in the late 1950s to 1.5 square kilometres in 2000 (source: RGSL)



(Photo source: Gyawali, WECS)

# Voices of People \*2010

- Based on field observations, information, and interactions with the communities in Nepal
- More events of rainfall than snowfall in the mountains resulting in reduced snow deposition
- There used to be good snowfall in higher altitude but lately, only negligible snowfall.
- Areas that once used to be covered by snow throughout a year are now bare.
- In the mid-hills, drying up of spring waters
- Dry season much drier than it used to be
- Winter crops, snow, water sources, soil moisture, major change is in precipitation phase.





#### Impacts of Climate Change: VOICES OF THE PEOPLE



## Changes in snow and ice cover area







Go!

Goi



# Langtang River Basin





Modelling CRHM: The Cold Regions Hydrological Model

# Langtang River Basin

Area	354 km²
Elevation Range	3662 - 7180 m a.s.l.
Mean Elevation	5167.7 m
Hydrological Response Units (HRUs)	51
Latitude	28°08'N to 28°23'N
Longitude	85°35'E to 85°48'E
Mean Slope	26.7°
Mean Aspect	193.4682











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Qli.1

# **Bias-corrected reanalysis data**











# **Precipitation Phase**

- Rainfall Ratio
- Glacier dynamic is influenced by snow



1.0 -

0.9 -

0.8 -

0.7 -

monsoon post\_monsoon

winter

pre\_monsoon

•

•

### Sensitivity towards warming climate



Scenarios

Scenarios

% Change

% Change

Cumulative

Cumulative

### Sensitivity towards lapse rate



### If all the glaciers retreat?



### Increase in temp by 4°C and precip by 20%



### Increase in temp by 1.5°C and precip by 5%



### Increase in temp by 2°C and precip by 10%



## Ongoing – Research, Capacity Building, Awareness

- Consider new in-situ observed data from the Kyanging and the others in the basin and get parameters based on those datasets.
- Model based on the other available datasets and seasonal scenarios.
- Enlarge the study basin.



### Scientists-Teachers-Students-Community (STSC) Network

61 Years Together - Nepal & Australia

#### Dhiraj Pradhananga

#### Linking Science & Technology with People and Nature

I have always felt that human society needs to progress towards sustainable lifestyles; whether in the field of technology or adspting to climate change. Though I had already completed my Master's degree from Tribhuvan University in meteorology, lifet that this knowledge was not enough. I wanted to learn new skills; I wanted to explore and hence in the y through a fully funded scholarship pro Government to study in the Master in the prestigious University of Melbourn glacier hydrology from University of Sa foundation of which was earned from degree.

The University of Melbourne provided customizing my course. I could select from different faculties and Integrate the program. This tailor-made program wa realm of education. Additionally, the st from the beginning to work independe the Australians have conducted open I still haven't been implemented in Nepa concept of mentorship where a senior a certain orientation to the new studer seniors more responsible and the new comfortable.

My first priority when I was back in my introduce an education system that we



University of Study in Australia: University of Melbourne

Degree in Australia: Master in Environment

resourceful citizens for the future. Though the education system In Nepal Is guite rigid, I have always tried to introduce new

> Departments of Geography and Biological & Environmental Engineering

> > Date

Batch / Year of Education: 2002 - 2003

Current Organization Name: Tribhuvan University (TU),

**CREEW and SEN** 

two NGO's

Organization Position:

Assistant Professor at TU

and President In the other

UNT Course on Human-Nature Interactions in Nepal

**Certificate of Recognition** 

This certificate is awarded to

Dr. Dhiraj Pradhananga Tribhuvan University

In recognition of your contribution: Teaching Climates of Nepal-Man3oon 29 Dates Margaret Director Study Abroad Center and Acerda Date Director Study Abroad Center

Course Coordinator, Dr. Miguel Acevedo Date

Australia Awards	Scholarshij	os Short Courses	Alumni	Stories	About Se	arch Q
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#### < Back to previous page

Nepali alumni implement grant projects to help people with disability

Posted: 4 November 2020 Nepal, Alumni, COVID-19, Disability, Impact, Short Course

> students through "Slack", an online communication medium. All my power-points, lectures, group assignments etc. were stored









Tribhuvan University Alumni Association (TUAAN) On the occasion of International Women's Day presents its third webinar on

### Women and Indigenous Knowledge in the Water Sector 8 March 2022 (24 Falgun 2078) 8:00am - 9:30am

**Key note Speakers** 



Prof. Soni Mulmi Pradhanang **University of Rhode Island** 

Session Moderator



Dr. Dhiraj Pradhananga Associate Professor **Tribhuvan Univerity** 

Mr. Michael Croft Head of Office and Representative to Nepal UNESC

Prof. Sunity Shrestha Hada Chairnerson

**Commentators** 

#### Connect to Zoom through: http://tuaan.edu.np/webinar3 Zoom Meeting ID: 275 788 5380 Passcode: TUAAN





Prof. Sudarshan Raj Tiwari Tribhuvan University



#### International Mountain Day (IMD) **Photo Contest**

To visualize the importance of glaciers in Nepal, the United Nations in Nepal is organizing a Photo Contest as part of the International Mountain Day celebration. To enter the contest, send us a picture that projects the importance of glaciers in Nepal with a one sentence description of it. We are looking for photos that focus either on the importance of mountains. snow and glaciers, or the impact of receding glaciers in Nepal

Send us your entries digitally at kathmandu@unesco.org and cc it to p.gurung@unesco.org with the Subject "IMD Photo Contest YourName"

Important:

without prior notice.

Age: You must be between the ages of 18-30. Location of the Photo: Anywhere in Nepal (the location must be specified during submission) Deadline: 11:59pm (NPT), 11 December 2021 Minimal post processing of images is allowed, as long as it does not affect the integrity of the original Photo.

Winner will be announced on 18 December 2021.

Don't forget to use the hashtags #MyActionsMyFuture #Feeltheheat #ACallToActionForALivingHimalavas when posting your entries on social media.



#### **Tribute to Glaciers: Voices of the Nepalese Youth**

10:00am-12:00pm, 8 December 2021

Register in advance

https://bit.ly/3lFibfc

for this meeting:

The keynote speaker for the event will be Mr. Anil Mishra, the Chief of Hydrological Systems and Water Scarcity Section in the UNESCO Headquarters. A short presentation on the state of glaciers in Nepal will be given by Dr. Sudan Bikash Maharjan from the International Centre for Integrated Mountain Development (ICIMOD), This will be followed by a screening of the documentary 'Climate Change in the Himalayas' by the Crystal Mountain School in Dolpo.

Our panel includes Mohan B. Chand (Hokkaido University), Nishchal Baniya (Zhejiang University of Technology), Reeju Shrestha (Independent Glaciologist), Shreya K.C. (Mock COP), Sneha Pandey (Climate Analytics) and Umesh Balal Magar (Nepalese Youth for Climate Action). The session will be moderated by Dr. Dhirai Pradhananga, an Associate Professor in Tribhuvan University.

We invite you to virtually attend the event by registering with us. A link with a password will be sent to your registered email address.

To enter:

- UN Nepal reserves the right to modify the contest prizes and its rules and regulations as and when necessary,

- By participating in the contest, the photographer holds the copyright to the photos submitted, but UN Nepal retains the unlimited right to use the submitted photos for public information purposes in UN Nepal's fields of competence. UN Nepal will only use photos for non-commercial purposes which include education and advocacy materials,

- To participate in the contest, the photographers must own the rights of the content they are submitting

website, brochures, reports, flyers, at no cost. The photographers will be credited.







# **Climate Change and Water**

#### Article Hydro-Climatic Variability in the Karnali River Basin of Nepal Himalaya

Kabi Raj Khatiwada $^{1,2,*}\!\!$ , Jeeban Panthi $^2\!\!$ , Madan Lall Shrestha $^{2,3}$  and Santosh Nepal $^4$ 



Environmental Research Volume 185, June 2020, 109430



### Modeling the future impacts of climate change on water availability in the Karnali River Basin of Nepal Himalaya

Piyush Dahal <sup>a</sup>  $\stackrel{ imes}{\sim}$  🖾, Madan Lall Shrestha <sup>a, b</sup>, Jeeban Panthi <sup>a, c</sup>, Dhiraj Pradhananga <sup>a, d, e</sup>

INTERNATIONAL JOURNAL OF RIVER BASIN MANAGEMENT 2019, VOL. 17, NO. 2, 243-250 https://doi.org/10.1080/15715124.2018.1531421



### Water poverty in the context of climate change: a case study from Karnali river basin in Nepal Himalaya

J. Panthi (D) a,b, K. R. Khatiwada (D) a,c, M. L. Shrestha (D) a,d, and P. Dahala



### **SDG Confab:**

Synergizing Efforts towards Achieving SDG-6 and SDG-13 in Nepal

March 21, 2018



# Climate workshops with early career professionals

Intergenerational Dialogue on "Achieving Mountain Water Sustainability through Disaster Resilience Practices in Nepal" Dialogue on "Indigenous and local water management technologies for climate resilient communities".



## INTERNATIONAL SYMPOSIUM ON THE FORESTS-WATER-LIVELIHOOD NEXUS IN THE LESSER HIMALAYA

SEPTEMBER 29-30, 2023 POKHARA, NEPAL

#### In Associations with:





THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL



NATIONAL SCIENCE FOUNDATION



Hosted by:

.

TRIBHUVAN UNIVERSITY INSTITUTE OF FORESTRY NEPAL



Peak Perspectives : Navigating Challenges and Shaping Sustainable Futures in Nepal's Mountain Landscapes

Radisson Hotel, Lazimpat, Kathmandu

Of WHAT IN A RECOVER OF

# 17 Ashiqi 2080 (4th octabor 2023)

# Transdisciplinary Seminar





WINROCK ARECOFTC

Transdisciplinary Conference

Peak Perspectives: Navigating Challenges and Shaping Sustainable Futures in Nepal's SCAN FOR CONFERENCE MOUNTAIN LANDSCAPES



WISIONS of participations

Kathmandu Nenal

# **Collaboration and partnership**

- Education and Training Initiatives
- Developing projects, partnerships, and research initiatives.
- We are committed to continued collaboration and knowledge sharing for sustainable mountain water management.



# **International Year/Day of Glaciers**

- The year 2025 was declared the International Year of Glacier Conservation
- March 21 will be celebrated annually as World Glacier Day beginning in 2025
  - Nepal National Water and Weather Week (17-23 March)
  - March 22, World Water Day
  - March 23, World Meteorological Day



# Summary

1. Changes in precipitation patterns have significant impacts on people's livelihood and biodiversity changes.

Urgent action is needed to address the impacts on water resources in mountainous regions.

2. Glacier change is a sensitive indicator of climate change, and precipitation changes are key driver of glacier change.

Research is needed with physically based hydrological models.

3. Collaboration and networking are urgently needed for research, capacity building, and linking science-policy-society.

Enhancing the study in this region is not just a scientific necessity but also a vital step for sustainable development and DRR.

Developing projects, partnerships, and research initiatives, continued collaboration, and knowledge sharing are essential for sustainable mountain water management.



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