Arindan Mandal

National Postdoctoral Fellow (NPDF)
Interdisciplinary Centre for Water Research (ICWaR), Indian Institute of Science, Bangalore, India
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Education

Ph.D. (Glaciology / Environmental Sciences) **Jul 2016 – Feb 2022**
Jawaharlal Nehru University, New Delhi
Thesis: "Modeling of mass and energy balance and boundary processes of Chhota Shigri glacier in northern India"
Supervisor: Prof. AL. Ramanathan (Prof. Matthias Braun, DAAD Fellowship at FAU, Germany)

M.Phil. (Glaciology / Environmental Sciences) **Jul 2014 – Jun 2016**
Jawaharlal Nehru University, New Delhi
Thesis: "Integrating glacier mass loss and climate in the Lahaul-Spiti region, western Himalaya"

M.Sc. (Environmental Sciences) **Aug 2011 – Jun 2013**
Jawaharlal Nehru University, New Delhi

B.Sc. (Botany Honours) **Jul 2008 – Jun 2011**
Presidency College / Calcutta University

Experience

National Postdoctoral Fellow (NPDF) **Jun 2023 – ongoing**
Indian Institute of Science (IISc), Bangalore
Project: Regional glacier modelling and future water availability in Ladakh and Karakoram
Mentor: Dr. Bramha Dutt Vishwakarma

Beyond Fellow Postdoctoral Researcher **Dec 2022 – May 2023**
AI4EO Future Lab, Technical University of Munich, Germany
Project: Machine learning techniques in glacier mass balance modelling
Mentor: Prof. Jonathan Bamber

Institute of Eminence (IoE) Postdoctoral Fellow **Mar 2022 – Nov 2022**
Indian Institute of Science (IISc), Bangalore
Project: Glacier mass balance modelling in the Ladakh region
Mentor: Dr. Bramha Dutt Vishwakarma

Senior Research Fellow **Feb 2021 – Jul 2021**
Jawaharlal Nehru University, New Delhi
Work: GNSS, mass balance and meteorology measurements, DEMs-based geodetic analysis

Junior Research Fellow **Aug 2013 – Jul 2014**
Jawaharlal Nehru University, New Delhi
Work: Indo-Norwegian collaboration, glacier mass balance and meteorology measurements, data analysis

Field Trainer of glacier mass balance measurements **Oct 2014**
2nd Indo-Swiss Capacity Building Training Programme on Himalayan Glaciology

Scientific Programming and Remote Sensing Skills

Programming / Language	UNIX	●●●●○
	Python	●●●●○
	R	●●●◖○
Remote Sensing and Image Processing	QGIS	●●●●◖
	Python geospatial	●●●●○
	NASA ASP (Stereophotogrammetry)	●●●◖○

Climate Data Handling	CDO	●●●●○
	Python climate packages	●●●◖○
ML, Data Science Experience	scikit-learn	●●●◖○

Code / Data Repository

- Developed a surface energy balance (SEB) model in R which was used to model the 11-year snow sublimation of a Himalayan glacier (https://tc.copernicus.org/articles/16/3775/2022/). The reproducible model codes and datasets are available open-access through my GitHub page and Zenodo: https://doi.org/10.5281/zenodo.6609604

- Geodetic mass balance (2000-2021) datasets for all Ladakh glaciers including elevation change raster/vector files (SRTM-ASTER, SRTM-ICESat-2): https://doi.org/10.5281/zenodo.10663990

Award and Grant

EGU24 Early Career Scientist's Travel Support	2024
National Postdoctoral Fellowship, Government of India (2-year funding)	2023-2024
Beyond Fellows Scholarship, Technical University of Munich (6-month funding)	2022-2023
IOE Postdoctoral Fellowship, Indian Institute of Science (2-year funding)	2022-2024
EGU22 Early Career Scientist's Travel Support	2021
Best Student Presenter at the UKIERI-funded Conference	2020
DAAD Research Grants – Bi-nationally Supervised PhD in Germany (1-year funding)	2017-2018
CSIR Foreign Travel Grant, Government of India	2017
International Association of Cryospheric Sciences (IACS) Travel Grant	2017
Best Student Poster at GLACINDIA Workshop (India-Norway Initiative)	2016
Rajiv Gandhi National Fellowship (UGC), Government of India (5-year funding)	2014-2018
International Travel Support by SERB, Government India	2014

Professional Service

- **EGUsphere moderator** (since Nov 2020; preprint moderating and screening)
- **EGU Session Co-Convenor** (2018): Communicating geoscience to the media
- **Group Reviewer** of the Mountain Chapter in IPCC Second Order Draft WG II-2021
- **Articles Reviewed for Journals**: Climate Dynamics (x1), International Journal of Climatology (x1), Frontiers in Earth Science – Cryospheric Sciences (x1), The Cryosphere (x1), Scientific Reports (x1), Annals of Glaciology (x1), Journal of Geophysical Research – Atmospheres (x1), Journal of Glaciology (x1), Environmental Monitoring and Assessment (x1), Earth and Space Science (x1)

Course / Training

Glacier mass balance modelling using R (ICIMOD, Nepal)	Dec 2020
2nd SCAR Summer School on Polar Geodesy (St. Petersburg, Russia)	May 2020
Cryospheric modelling course (Oslo, Norway)	Jan 2015
KARTHAUS-2014 Glaciology Summer School (Karthaus, Italy)	Sep 2014

Science Blog and Podcast

Suno India Podcast Series on **When the Ice Melts** (based on my PhD work)	2020
EGU Image of the Week (CR Division)	2016

Fieldwork

Himalaya: Ladakh (x4), Himachal Pradesh (x~20; for my MPhil, PhD and other projects data collection and instrument maintenance) and Sikkim (x1).

Arctic: Field expeditions to Svalbard (x2; Vestre Broggerbreen and Feiringbreen glaciers) through Indian Arctic Expedition.

Fieldwork expertise includes: glacier surface mass balance measurements (stakes and pits/cores), AWS installation/maintainance, on-glacier logger/sensor/setup design, DGPS (ice velocity, geodetic elevation change profiling and mapping).

Publications

17. **Mandal, A.**, Vishwakarma, B.D., Angchuk, T., Azam, M.F., Garg, P.K., Soheb, M.: Glacier mass balance and its climatic and non-climatic drivers in the Ladakh region during 2000-2021 from remote sensing data, ***Journal of Glaciology****, 1-23, doi: 10.1017/jog.2024.19*

16. **Mandal, A.,** Angchuk, T., Azam, M. F., Ramanathan, A., Wagnon, P., Soheb, et al.: An 11-year record of wintertime snow-surface energy balance and sublimation at 4863 m a.s.l. on the Chhota Shigri Glacier moraine (western Himalaya, India), ***The Cryosphere***, 16, 3775–3799, 2022.

15. Vishwakarma, B.D., Ramasankaran, RAAJ., Azam, M.F., Bolch, T., **Mandal, A.,** Srivastava, S. et al.: Challenges in Understanding the Variability of the Cryosphere in the Himalaya and Its Impact on the Regional Water Resources, ***Frontiers in Water***, 4, 2022.

14. Kaushik, H., Ramanathan, A., Soheb, M., Sharma SM., Biswal, K., **Mandal, A.,** Singh, C.: Climate change-induced high-altitude lake: Hydrochemistry and area changes of a moraine-dammed lake in Leh-Ladakh. ***Acta Geophysica****,* 69, 2377–2391, 2021.

13. Angchuk, T., Ramanathan, A., Bahuguna, I.M., **Mandal, A.,** Soheb, M., Singh, V.B., Mishra, S., Vatsal, S.: Annual and seasonal glaciological mass balance of Patsio glacier, western Himalaya (India) from 2010 to 2017. ***Journal of Glaciology***, 67(266), 1137-1146, 2021.

12. **Mandal, A.,** Ramanathan, A., Azam, M.F., Angchuk, T., Soheb, M., Kumar, N., Pottakkal, J.G., Vatsal, S., Mishra, S. Singh, V.B.: Understanding the interrelationships among mass balance, meteorology, discharge and surface velocity on Chhota Shigri Glacier over 2002–2019 using in situ measurements. ***Journal of Glaciology***, 66(259), 727-741, 2020.

11. Soheb, M., Ramanathan, A., Angchuk, T., **Mandal, A.,** Kumar, N., Lotus, S.: Mass-balance observation, reconstruction and sensitivity of Stok glacier, Ladakh region, India, between 1978 and 2019***. Journal of Glaciology***, 66(258), 627-642, 2020.

10. Kumar, N., Ramanathan, A., Arora, A., Soheb, M., **Mandal, A.,** Sharma, P., Ranjan, S.: Study of isotopic seasonality to assess the water source of proglacial stream in Chhota Shigri Glaciated Basin, Western Himalaya. ***Hydrological Processes***, 34(5), pp.1285-1300, 2020.

9. Vincent, C., Soruco, A., Azam, M.F., Basantes-Serrano, R., Jackson, M., Kjøllmoen, B., Thibert, E., Wagnon, P., Six, D., Rabatel, A., Ramanathan, A., **Mandal, A**.: A nonlinear statistical model for extracting a climatic signal from glacier mass balance measurements. ***Journal of Geophysical Research: Earth Surface***, 123(9), 2228-2242, 2018.

8. Soheb, M., Ramanathan, A., **Mandal, A**., Angchuk, T., Pandey, N., Mishra, S.D.: Wintertime surface energy balance of a high-altitude seasonal snow surface in Chhota Shigri glacier basin, Western Himalaya. ***Geological Society, London, Special Publications***, 462(1), 155-168, 2018.

7. Engelhardt, M., Ramanathan, A., Eidhammer, T., Kumar, P., Landgren, O., **Mandal, A.,** Rasmussen, R.: Modelling 60 years of glacier mass balance and runoff for Chhota Shigri Glacier, Western Himalaya, Northern India. ***Journal of Glaciology*** 63, 240 (2017): 618-628, 2017

6. **Mandal, A.**, Ramanathan, A. L., Angchuk, T., Soheb, M., Singh, V. B.: Unsteady state of glaciers (Chhota Shigri & Hamtah) and climate in Lahaul and Spiti Region, western Himalaya: a review of recent mass loss. ***Environmental Earth Sciences***, 75:1233, 2016.

5. Bakke, J., Vasskog, K., Ramanathan, A. L., **Mandal, A.,** Kumar, O., Nesje, A.: The Water Tower of India in a Long-term Perspective – A Way to Reconstruct Glaciers and Climate in Himachal Pradesh during the last 13,000 Years. ***Journal of Climate Change***. Vol. 2, No. 1, 103–112, 2016.

4. Singh, V. B., Ramanathan, A. L., **Mandal, A.**: Hydrogeochemistry of high-altitude lake: a case study of the Chandra Tal, Western Himalaya, India. ***Arabian Journal of Geosciences***, 9:308, 2016.

3. Azam, M. F., Ramanathan, A. L., Wagnon, P., Vincent, C., Linda, A., Berthier, E., Sharma, P., **Mandal, A.**, Angchuk, T., Singh, V. B., Pottakkal, J. G.: Meteorological conditions, seasonal and annual mass balances of Chhota Shigri Glacier, western Himalaya, India. ***Annals of Glaciology***, 57(71), 328-338, 2016.

2. Soheb, M., Ramanathan, A. L., Pandey, P., **Mandal, A.**: Climate Change from Himalayan Glaciers' Perspective—Case Studies from India. ***Journal of Climate Change***. Vol. 1, 27-35, 2015.

1. Azam, M. F., Wagnon, P., Vincent, C., Ramanathan, A. L., Favier, V., **Mandal, A.,** Pottakkal, J. G.: Processes governing the mass balance of Chhota Shigri Glacier (Western Himalaya, India) assessed by point-scale surface energy balance measurements. ***The Cryosphere***, 8, 2195-2217, 2014.

Under pipeline / review

4. **Mandal, A.**, Bhardwaj, A., Azam, M.F., Vishwakarma, B.D., Angchuk, T.: Enhanced up-glacier thinning revealed by geodetic mass balance estimates for four major glaciers of High Mountain Asia (***Journal of Glaciology****; to be comm. shortly*).

3. **Mandal, A.**, Diaconu, C., Vishwakarma, B.D., Bamber, J.L.: Data-driven (machine learning) approach for glacier surface mass balance modelling in the western Himalaya: result, learning, challenges and way forward (*in prep. for* ***The Cryosphere***).

2. Azam, M.F., Vincent, C., Srivastava, S., Berthier, E., Wagnon, P., Kaushik, H., Hussain, A., Munda, M.K., **Mandal, A.**, Ramanathan, A.L.: Reanalysis of the longest mass balance series in Himalaya using nonlinear model: Chhota Shigri Glacier (India) *(in comm. in* ***EGUSphere/The Cryosphere****; egusphere-2024-644)*.

1. Harrison, S., Racoviteanu, A., Shannon, S., Jones, D., Anderson, K., Glasser, N., Ranger, A., **Mandal, A.**, et al.: Landscape response will reduce glacier sensitivity to climate change in High Mountain Asia (*under rev. in* ***Nature Geoscience***; *NGS-2023-10-02014-T*).

Volume / Chapter

1. Paul, F., Ramanathan, A.L., **Mandal, A**.: Ice caps in ***The International Encyclopedia of Geography: People, The Earth, Environment, and Technology, John Wiley***, https://doi.org/10.1002/9781118786352.wbieg0210

Presentation / Poster in Conference

8. **Mandal, A**., Bhardwaj, A., Azam, M. F., Vishwakarma, B. D., and Angchuk, T.: Increased up-glacier thinning in four major glaciers of High Mountain Asia revealed by geodetic mass balance estimates, ***EGU General Assembly 2024***, Vienna, 14-19 April, 2024 **(In-person Oral)**

7. **Mandal, A.**, Vishwakarma, B. D., Angchuk, T., Azam, M. F., Garg, P. K., Soheb, M.: Glacier mass balance and its climatic and non-climatic drivers in the Ladakh region during 2000-2021 from remote

sensing data, ***EGU General Assembly 2023***, Vienna, 23-28 April, 2023 **(In-person Poster)**

6. **Mandal, A**., Angchuk, T., Azam, M. F., Ramanathan, A. L., Wagnon, P., Soheb, M., Singh, C.: Surface energy balance and sublimation of the winter snow cover at 4863 m a.s.l. on Chhota Shigri Glacier moraine (western Himalaya, India) between 2009 and 2020, ***EGU General Assembly 2022***, Vienna, 23-27 May, 2022 **(Virtual Oral)**

5. **Mandal, A**., Ramanathan, A. L., Angchuk, T., Soheb, M.: Snow sublimation and surface energy balance of Chhota Shigri Glacier, importance and meteorological drivers, ***UKIERI-DST Workshop: Water sEcurity assessment of Indian rivers oriGinating from the Himalaya****,* 7-11 Sep, 2020, **(Virtual Oral: Best Student Presenter Award)**

4 **Mandal, A.**, Ramanathan, A. L., Angchuk, T., Soheb, M., Kumar, N., Vatsal, S., and Mishra, S.: Sub-seasonal melt measurement, its modelling and relation to local meteorology on Chhota Shigri Glacier during 2015 and 2016, ***National Conference on Polar Sciences, Goa***, 16-17 May, 2017, **(In-person Oral)**

3 **Mandal, A.**, Ramanathan, A. L., Angchuk, T.: Micro-meteorological variability in different elevation zones of Chhota Shigri Glacier, India: an analysis of three in situ stations during the summer season 2015, ***Third International Conference on Mountain Hydrology and Meteorology for the Sustainable Development, Kathmandu, Nepal***, 10-11 April, 2017, **(In-person Oral)**

2 **Mandal, A.**, Ramanathan, A. L., Angchuk, T., Soheb, M., Kumar, N., Azam, M. F., Mishra, S.: Mass balance record and meteorological conditions of Chhota Shigri Glacier, Indian Himalaya: 2002-2015, ***International Symposium on The Cryosphere In A Changing Climate, Wellington, New Zealand***, 12-17 Feb, 2017, **(In-person Oral)**

1 **Mandal, A.**, Ramanathan, A. L., Angchuk, T., Soheb, M.: Orographic control on the heterogeneous variations of long-term precipitation data of a densely glaciated region in Himachal Himalaya, India, ***International Symposium on Glaciology in High-Mountain Asia, Kathmandu, Nepal***, 2-6 Mar, 2015, **(In-person Poster)**

Google Scholar: https://scholar.google.com/citations?user=KFVC4LEAAAAJ&hl=en