

Mukund Palat Rao

Marie Skłodowska Curie Postdoctoral Fellow

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Education

2014-2020 *Ph.D. Earth and Environmental Science*, Columbia University, NY, U.S.A.
2012-2013 *M.A. Climate and Society*, Columbia University, NY, U.S.A.
2008-2012 *B.Tech. Chemical Engineering*, Amrita School of Engineering, Tamil Nadu, India

Fellowships and Scholarships

2022-present Marie Skłodowska Curie Postdoctoral Fellowship, European Research Commission
2021-2022 NOAA Climate & Global Change Postdoctoral Fellowship
2014-2019 Dean's Fellowship, Earth and Environmental Science, Columbia University, U.S.A.
2012-2013 Tuition waiver scholarship, M.A. Climate and Society, Columbia University, U.S.A.

Academic Profiles: [[Google Scholar](#)] [[ORCID](#)] [[ResearchGate](#)]

Professional Experience

2022-present *Marie Skłodowska Curie Postdoctoral Fellow*
Global Ecology Unit, Centre de Recerca Ecològica i Aplicacions Forestals | Centre for Research on Ecology and Forestry Applications (CREAF), Barcelona, Spain

2021-present *Postdoctoral Scholar*
Department of Plant Science, University of California Davis, U.S.A.

2021-present *Postdoctoral Research Scientist*
Lamont-Doherty Earth Observatory, Climate School, Columbia University, U.S.A.

2021-2022 *NOAA Climate & Global Change Postdoctoral Fellow*
Cooperative Programs for the Advancement of Earth System Science (CPAESS)
University Corporation for Atmospheric Research (UCAR), U.S.A.

2020-2021 *Research Assistant*
Ecology, Evolution, and Environmental Biology (E3B). Columbia University, U.S.A.

2018-2021 *Adjunct Professor of Environmental Studies*
Department of Environmental Studies, New York University (NYU), U.S.A.

2013-2017 *Graduate Teaching Assistant*, Columbia University, U.S.A.

2012-2014 *Research Assistant*, Tree-Ring Laboratory, Lamont-Doherty Earth Observatory of Columbia University (LDEO), U.S.A.

Current research areas

i. Forest carbon cycling; **ii.** Climate change; **iii.** Dendrochronology; **iv.** Plant ecophysiology; **v.** Ecology; **vi.** Land-atmosphere interactions; **vii.** Remote Sensing; **viii.** Earth system models; **ix.** Archaeology

Peer-reviewed publications and selected mentions in popular media

In Preparation

- [32] **Rao MP** et al. Oaks do not grow through the growing season (*in preparation*).
Nov 2021 - [[National Geographic](#)]; Oct 2022 – [[Scenic Hudson](#)]
- [31] Rollinson et al. Transforming phenology from descriptors of past change to leading indicators of future plant and ecosystem function (*in preparation for submission to Nature Climate Change*).
- [30] Bruner SG, Naeem S, Eitel JUH, Griffin KL, Menge DN, **Rao MP**, Terlizzi K, Schuster WSF
Aboveground biomass and species richness mediate rate of biomass recovery after loss of the dominant tree genus in a temperate forest (*in preparation*).
- [29] Pierrat Z, Magney T, Nelson S, Cheng R, Wong C, Bowling D, **Rao MP**, Nehemy M, Maguire A, Reblin J, Logan B, Bowling D, Richardson A, Stutz J. The biological basis for using optical signals to track evergreen photosynthesis (*prepared for submission to BioScience*).

Under Review & In Revision

- [28] Kattel G, Paszkowski A, Pokhrel Y, Wu W, Li D, **Rao MP**. How resilient are rivers of the Asian Himalayas? Finding adaptive measures for future sustainability. *Under review at The Wiley Interdisciplinary Reviews (WIRE) Water*.
- [27] Leland C, D'Arrigo R, Davi N, Anchukaitis KJ, Andreu-Hayles L, Porter T, Galloway T, Mant M, Wiles G, Wilson R, Beaulieu S, Oelkers R, Gaglioti B, **Rao MP**, Reid E, & Nixon T. Extreme cold in northwestern North America following the unidentified 1809 CE volcanic eruption. *Under review at Paleoceanography and Paleoclimatology*.
- [26] Eitel JUH, Basler D, Braun S, Buchmann N, D'Odorico P, Etzold S, Gessler, A, Griffin, KL, Krejza J, Luo Y, Maguire AJ, **Rao MP**, Vitasse Y, Walthert L, & Zweifel R. Reading between the lines – towards monitoring stem growth phenology from space with high resolution satellite data. *Under review at Agricultural and Forest Meteorology*.
- [25] Sharifazari S, Palmer JG, Higgins PA, **Rao MP**, Johnson F, Turney CSM, Martin-Benito D, & Andersen MS. Changing inflow into the Dez dam and implications for irrigation and hydropower generation in Southwestern Iran. *Under review Journal of Hydrology*.
- [24] **Rao MP**, Davi NK, Magney TS, Andreu-Hayles L, Baatarbileg N, Byambagerel S, Varuolo-Clarke, A, Cook BI, D'Arrigo RD, Pederson N, Odrentsen L, Rodríguez-Catón M, Leland C, Burentogtokh J, Gardner WRM & Griffin KL, Rapidly approaching a thermal tolerance tipping point in the Eurasian boreal forest at its southern margins. *Minor revisions at Nature Communications Earth & Environment*.

Published

2023

- [23] Pons D & **Rao MP**. Exploring the Potential for a Multi-Decadal Midsummer Streamflow Reconstruction of the Upper Samalá River Basin in Guatemala Using an *Abies guatemalensis* Tree-Ring Chronology. *Dendrochronologia*, in special issue, Advances in tropical and subtropical Dendrochronology in South America. [[link](#)]
- [22] Harley et al. The Longleaf Tree-Ring Network: Reviewing and expanding the utility of *Pinus palustris* Mill. dendrochronological data across the southeastern United States. *Progress in Physical Geography: Earth and Environment* [[link](#)] (24th co-author, 31 co-authors total).

2022

- [21] Cook BI et al. (2022) Megadroughts in the Common Era and the Anthropocene. *Nature Reviews Earth & Environment* [[link](#)] (27th co-author, 34 co-authors total)
Oct 2022 – [[The Conversation](#)]; Oct 2022 – [[New Scientist](#)]; Oct 2022 – [[Phys.Org](#)]
- [20] Haraguchi M, Davi N, **Rao MP**, Leland C, Watanabe M, & Lall U (2022). Estimating Return Intervals for Extreme Climate Conditions Related to Winter Disasters and Livestock Mortality in Mongolia. *Natural Hazards and Earth System Sciences*, 22, 2751–2770, 2022 [[link](#)]
- [19] Mundo IA, Murray C, Grosso M, **Rao MP**, Cook ER, & Villalba R (2022). Dendrochronological dating and provenance determination of a 19th century whaler in Patagonia (Puerto Madryn, Argentina). *Dendrochronologia*, 74. [[link](#)]
May 2012 - [[Sibylline – Marine Wildlife Center](#)]; Aug 2022 - [[State of the Planet](#)]; Aug 2022 - [[Boston Globe](#)]
Aug 2022 - [[Clarín](#)]; Aug 2022 - [[GIZMODO](#)]; Aug 2022 - [[CONICET](#)]; Aug 2022 - [[Jornada](#)]
Aug 2022 - [[Rhode Island Monthly](#)]; Aug 2022 - [[Daily Mail](#)]; Aug 2022 - [[Mirror](#)]
Aug 2022 - [[The Providence Journal](#)]; Aug 2022 - [[EcoMagazine](#)]; Aug 2022 - [[Newser](#)]
Aug 2022 - [[El Chubut](#)]; Sep 2022 - [[Ancient Archeology](#)]; Sep 2022 - [[Newsweek](#)]; Sep 2022 - [[DiCYT](#)]
Sep 2022 - [[El Ciudadano](#)]; Sep 2022 - [[Smithsonian Magazine](#)]; Sep 2022 - [[Damals](#)]
Sep 2022 - [[Yahoo News](#)]; Sep 2022 - [[New York Times](#)]; Jan 2023 – [[Columbia Magazine](#)]
- [18] Higgins PA, Palmer JG, **Rao MP**, Anderson MS, Turney CSM, & Johnson F (2022). Unprecedented high Northern Australian streamflow linked to intensification of the Indo-Australian Monsoon. *Water Resources Research*, 58, e2021WR030881. [[link](#)]
Mar 2022 - [[The Conversation](#)]; Mar 2022 - [[UNSW](#)]; Mar 2022 - [[EOS Magazine](#)];
Mar 2022 - [[VerveTimes](#)]; Mar 2022 - [[ABC News](#)]
- [17] Wang W, Dong Z, **Rao MP**, Lall U, & Jia B (2022). Last two millennia of streamflow variability in the headwater catchment of the Yellow River basin reconstructed from tree rings. *Journal of Hydrology*, 606, 127387. [[link](#)]
- [16] Rodríguez-Catón M, Andreu-Hayles L, Daux V, Vuille M, Varuolo-Clarke A, Oelkers R, Christie D, D’Arrigo R, Morales M, Christie D, **Rao MP**, Srur A, François V & Villalba R (2022). Hydroclimate and ENSO Variability Recorded by Oxygen Isotopes from Tree Rings in the South American Altiplano. *Geophysical Research Letters*, 49, e2021GL095883. [[link](#)]

2021

- [15] Bishop DA, Williams AP, Seager R, Cook ER, Peteet DM, Cook BI, **Rao MP** & Stahle DW (2021). Placing the east-west United States aridity gradient in a multi-century context. *Environmental Research Letters*, 16, 114043, [[link](#)]. Feb 2022 - [[News4Jax](#)]
- [14] †Leland C, †**Rao MP**, Cook ER, Cook BI, Lapidus B, Staniforth A, Solomon A, Holloway MY & Rodríguez-Catón M (2021). Dendroarchaeological analysis of the Terminal Warehouse in New York City reveals a history of long-distance timber transport during the Gilded Age. *Journal of Archaeological Science: Reports*, 39, 103114. [[link](#)]

†Leland & Rao contributed equally.

- Jan 2020 - [[6SQFT](#)]; Feb 2020 [[NYREJ](#)]; Aug 2021 - [[Inside Climate News](#)]
Aug 2021 - [[Earth Institute: State of the Planet](#)]; Aug 2021 - [[Real Estate Capital](#)]
Oct 2021 - [[ESA Frontiers in Ecology and the Environment News Dispatch](#)]
Oct 2021 - [[National Geographic](#)]; Jan 2022 - [[Columbia Magazine](#)]; May 2022 - [[New Yorker Magazine](#)]

Sep 2022 - [[Newsy](#)]

- [13] Davi NK, **Rao MP**, Wilson R, Andreu-Hayles L, Oelkers R, D'Arrigo RD, Nachin B, Buckley B, Pederson N, Leland C, & Suran B (2021). Accelerated recent warming and temperature variability over the past eight centuries in the Central Asian Altai from Blue Intensity in tree-rings, *Geophysical Research Letters*, 48, e2021GL092933. [[link](#)]

Aug 2021 - [[Earth Institute: State of the Planet](#)]

- [12] Rodríguez-Catón M, Andreu-Hayles L, Morales MS, Daux V, Christe D, Coopman RE, Alvarez C, **Rao MP**, Aliste D, Flores F, & Villalba R (2021). Different climate sensitivity for radial growth, but uniform for tree-ring stable isotopes along an aridity gradient in *Polylepis tarapacana*, the world's highest elevation tree-species, *Tree Physiology*, 41, 1353-1371. [[link](#)]

2020

- [11] **Rao MP**, Cook ER, Cook BI, D'Arrigo RD, Palmer JG, Lall U, Uriarte M, Woodhouse CA, Buckley BM, Bishop DA, Jian J, & Webster PJ (2020). Seven centuries of reconstructed Brahmaputra River discharge demonstrate underestimated high discharge and flood hazard frequency. *Nature Communications*, 11, 6017. [[link](#)]

Aug 2022 - [[The Probe](#)]; Nov 2020 - [[Earth Institute: State of the Planet](#)]; Dec 2020 - [[Outlook](#)]

Dec 2020 - [[The Indian Express](#)]; Dec 2020 - [[The Dhaka Tribune](#)]; Dec 2020 - [[Nation World News](#)]

Dec 2020 - [[SciDev.net](#)]; Dec 2020 - [[The Times of India](#)]; Dec 2020 - [[The Business Standard](#)]; Jan 2021 - [[Mongabay](#)]

Jan 2021 - [[Nature India](#)]; Nov 2022 - [[AP News](#)]

2019

- [10] Kakinuma K, Yanagawa A, Sasaki T, **Rao MP**, & Kanae S (2019). Socio-ecological interactions in a changing climate in Mongolia. *Sustainability*, 11(21), 5883. [[link](#)]
- [9] **Rao MP**, Cook ER, Cook BI, Anchukaitis KJ, D'Arrigo RD, Krusic PJ, & LeGrande AN (2019). A double bootstrap approach to Superposed Epoch Analysis to evaluate response uncertainty. *Dendrochronologia*, 55, 119-124. [[link](#)]
- [8] Bishop DA, Williams AP, Seager R, Fiore AM, Cook BI, Mankin JS, Singh D, Smerdon JE, & **Rao MP** (2019). Investigating the causes of increased 20th-century precipitation over the southeastern United States. *Journal of Climate*, 32(2), 575–590. [[link](#)]

2018

- [7] **Rao MP**, Cook ER, Cook BI, Palmer J, Uriarte M, Devineni N, Lall U, D'Arrigo RD, Woodhouse, CA, Ahmed M, Zafar MU, Khan N, Khan A, & Wahab M (2018). Six centuries of Upper Indus Basin streamflow variability and its climatic drivers. *Water Resources Research* 54(8), 5687-5701. [[link](#)]
- [6] Leland C, Cook ER, Andreu-Hayles L, Pederson N, Hessler A, Anchukaitis KJ, Byambasuren O, Nachin B, Davi N, D'Arrigo R, Griffin K, Bishop DA, & **Rao MP** (2018). Strip-bark morphology and radial growth trends in ancient *Pinus sibirica* trees from central Mongolia. *Journal of Geophysical Research: Biogeosciences*, 123 (3), 945–959. [[link](#)]

2017

- [5] Pages Hydro2k Consortium (2017). Comparing proxy and model estimates of hydroclimate variability and change over the Common Era. *Climate of the Past*, 13(12), 1851-1900. [[link](#)]
- [4] **Rao MP**, Cook BI, Cook ER, D'Arrigo RD, Krusic PJ, Anchukaitis KJ, LeGrande AN, Buckley BM, Davi NK, Leland C, & Griffin KL (2017). European and Mediterranean hydroclimate responses to

tropical volcanic forcing over the last millennium. *Geophysical Research Letters*, 44(10), 5104–5112. [\[link\]](#)

[Past Global Changes, Volcanic Impacts on Climate and Society working group contribution]

2016

- [3] Zafar MU, Ahmed M, **Rao MP**, Buckley BM, Khan N, Wahab M, & Palmer J (2016). Karakorum temperature out of phase with hemispheric trends for the past five centuries. *Climate Dynamics*, 46(5), 1943-1952. [\[link\]](#)

2015

- [2] Davi NK, D'Arrigo R, Jacoby GC, Cook ER, Anchukaitis KJ, Nachin B, **Rao MP**, & Leland C (2015). A long-term context (931–2005 C.E.) for rapid warming over Central Asia. *Quaternary Science Reviews*, 121, 89-97. [\[link\]](#)

June 2015 - [\[Earth Institute\]](#); June 2015 - [\[William Paterson University\]](#)

- [1] †**Rao MP**, †Davi NK, D'Arrigo RD, Skees J, Nachin B, Leland C, Lyon B, Wang S-Y, & Byambasuren O (2015). Dzuds, droughts, and livestock mortality in Mongolia. *Environmental Research Letters*, 10(7), 074012. †Rao & Davi contributed equally [\[link\]](#)

July 2018 - [\[Earth Island\]](#); Mar 2018 - [\[Caritas.org\]](#); Jul 2017 - [\[Marron Institute\]](#); Mar 2017 - [\[NewsWeek\]](#);

Jan 2017 - [\[The Guardian\]](#); Jun 2015 - [\[Earth Institute\]](#); Aug 2015 - [\[Environmental Research Web\]](#)

PhD dissertation: Hydroclimate variability and environmental change in Eurasia over the past millennium and its impacts. *Advisors:* Edward Cook, Rosanne D'Arrigo, Kevin Griffin [\[link\]](#).

Book Chapters (Peer Reviewed)

- [1] Ummenhofer C & **Rao MP**, *Past, present, and future of the South Asian monsoon* in The Indian Ocean and its role in the global climate system. Editors: Ummenhofer C, & Hood RR. Publisher: Elsevier. (*in preparation*)

Teaching

<i>Summer 2021</i>	Climate Change, NYU 26 students (Instructor)
<i>Spring 2021</i>	Climate Change, NYU 25 students (Instructor)
<i>Spring 2021</i>	Environmental Quantitative Methods, NYU 21 students (Course Assistant)
<i>Summer 2018</i>	Environmental System Science, NYU 26 students (Instructor)
<i>Fall 2017</i>	Quant. Models of Nat. & Human Syst., Columbia Univ. 35 students (Lab Instructor)
<i>Fall 2016</i>	Dynamics of Climate Variability and Climate Change Columbia Univ. 30 students (Teaching Assistant)
<i>Fall 2015</i>	Quant. Models of Nat. & Human Syst., Columbia Univ. 40 students (Lab Instructor)
<i>Fall 2013</i>	Quant. Models of Nat. & Human Syst., Columbia Univ. 39 students (Lab Instructor)
<i>Fall 2013</i>	Water Resources and Climate, Columbia. Univ. 17 students (Teaching Assistant)
	Total: 9 semesters (6 as instructor); 259 students total

Datasets and Code

- [7] Rodríguez-Catón M, Andreu-Hayles L, Daux V, Vuille M, Varuolo-Clarke A, Oelkers R, Christie D, D'Arrigo R, Morales M, Christie D, **Rao MP**, Srur A, François V, & Villalba R. (2022) Hydroclimate and ENSO Variability Recorded by Oxygen Isotopes from Tree Rings in the South American Altiplano. NOAA-National Center for Environmental Information. [\[link\]](#)
- [6] †**Rao MP**, †Leland C, Cook ER, Cook BI, Lapidus B, Staniforth A, Solomon A, Holloway MY & Rodríguez-Catón M (2021). Dendroarchaeological analysis of the Terminal Warehouse in New York City reveals a history of long-distance timber transport during the Gilded Age. NOAA-National Center for Environmental Information. †Rao & Leland contributed equally. [\[link\]](#)
- [5] Davi NK, **Rao MP**, Wilson R, Andreu-Hayles L, Oelkers R, D'Arrigo RD, Nachin B, Buckley B, Pederson N, Leland C, & Suran B (2021). Accelerated recent warming and temperature variability over the past eight centuries in the Central Asian Altai from Blue Intensity in tree-rings. NOAA-National Center for Environmental Information. [\[link\]](#) & [\[link\]](#)
- [4] **Rao MP**, Cook ER, Cook BI, D'Arrigo RD, Palmer JG, Lall U, Uriarte M, Woodhouse CA, Buckley BM, Bishop DA, Jian J, & Webster PJ (2020). Data for: Seven centuries of reconstructed Brahmaputra River discharge demonstrate underestimated high discharge and flood hazard frequency. NOAA-National Center for Environmental Information. [\[link\]](#)
- [3] **Rao MP**, Cook ER, Cook BI, Anchukaitis KJ, D'Arrigo RD, Krusic PJ, & LeGrande AN (2019). Data for: A double bootstrap approach to Superposed Epoch Analysis to evaluate response uncertainty, Mendeley Data, V1, doi: 10.17632/8p7y29hz5h.1. [\[link\]](#)
- [2] **Rao MP**, Cook ER, Cook BI, Palmer JG, Uriarte M, Devineni N, Lall U, D'Arrigo RD, Woodhouse, CA, Ahmed M, Zafar MU, Khan N, Khan A, Wahab M. (2018) Data for: Six Centuries of Upper Indus Basin Streamflow Variability and Its Climatic Drivers, NOAA-National Center for Environmental Information. [\[link\]](#)
- [1] Davi NK, D'Arrigo R, Jacoby GC, Cook ER, Anchukaitis KJ, Nachin B, **Rao MP**, & Leland C (2015). Data for: Northern Mongolia 1000 Year Summer Temperature Reconstruction. NOAA-National Center for Environmental Information. [\[link\]](#)

Articles (not peer-reviewed)

- [1] **Rao MP** & Cook BI (2021), Tree rings reveal a 700-year record of flooding in Bangladesh, Eos, 102. Published on 15 October 2021 [\[link\]](#).

Professional Activities

- [2] Co-convener and Co-chair, Climate of the Common Era Session at the American Geophysical Union Fall Meeting, 2022-present.
- [1] Site co-PI [LDEO PhenoCam](#) with Oryan B. This site joins a global ecosystem phenology camera network, [PhenoCam](#). It is located on Columbia University's Lamont-Doherty Earth Observatory campus, and continuously monitors the vegetation canopy status of the oak-maple dominated forest of the Palisades Interstate Park, NY, U.S.A. October, 2020 - present.
Nov 2020 - [\[State of the Planet\]](#), Nov 2021 - [\[National Geographic\]](#); Oct 2022 - [\[Scenic Hudson\]](#)

Scientific Grants

- Total awarded as PI: \$447,696
Including co-written proposals: \$1,122,125 († collaborative grants without PI status)
- [10] **2023-2028** **NSF Macrosystems Biology and NEON-Enabled Science (MSB-NES)**
\$1,942,575 total PIs: Jan E, Lee V, Magney T, Griffin K, **Rao MP**, & Wong C.
\$572,392 to Collaborative Research: MRA: Improved understanding and monitoring of the effects of
Columbia Univ. climate variability on tree growth across North America (*under review*).
- [9] **2022-2024** †**Knowledge Generation Projects 2021, Spanish Ministry for Science and Innovation**
€197,492.00 PI: Andreu-Hayles L. Research Team: Vallvé M-B, Gutiérrez-Merino E, Solanes JB,
González DP. Technical team: Domínguez-Delmás M, Wilson R, Ummenhofer C, **Rao MP**.
Long-term perspective to the current environmental crisis in the Iberian Mediterranean
region from dendrochronological and historical archives
- [8] **2022-2024** **European Research Commission, Marie Skłodowska Curie Postdoc Fellowship**
€172,932.48 The fate of TERRestriAl forest CARBon from photosynthesis to structural biomass under
climate change
- [7] **2021-2022** **NOAA Climate & Global Change Postdoctoral Fellowship**
\$157,440 The fate of forest carbon from photosynthesis to biomass under drought and climate change
- [6] **2021-2023** **Lamont-Doherty Earth Observatory Climate Center, Columbia Univ.**
\$11,000 PIs: **Rao MP**, Pacheco-Solana A, Jensen J, Oryan B, Rodríguez-Catón M, Griffin KL,
Andreu-Hayles L, Boelman N, Commane R, Gentine P, & Davi NK.
Temporal dynamics of tree-growth and photosynthesis and their environmental drivers in the
Lamont Sanctuary.
- [5] **2020-2021** **Chevron Student Initiative Fund, Dept. of Earth and Env. Sc, Columbia Univ.**
\$3,200 PIs: **Rao MP** & Oryan B
Developing the LDEO PhenoCam network to track the fate of forest carbon from
photosynthesis to growth.
- [4] **2017-2023** †**NSF Arctic Social Sciences**
\$1,184,346 total PIs: Honeychurch W, Gardner W, Fowell SJ, Davi NK & Andreu-Hayles L
\$459,475 to Student: **Rao MP** (co-wrote grant application)
Columbia Univ. Collaborative Research: Climate, human and ecosystem interactions in the face of a rapidly
changing North Asian biome [[link](#)]
- [3] **2015-2016** **Chuo University, Japan**
\$74,533 PIs: Davi NK, Lall U, D'Arrigo RD, Rao MP, Leland C, Haraguchi M
Research on Evaluation of Mean State and Climate Extremes in the Long Meteorological
Records in Mongolia.
- [2] **2013-2015** **Lamont-Doherty Earth Observatory Climate Center, Columbia Univ.**
\$11,000 PIs: Buckley BM, Davi NK, & **Rao MP**
Influence of atmospheric and oceanic forcings on the Southwest and Northeast Monsoons
over India: A paleoclimate perspective.
- [1] **04|2013-12|2013** **Chevron Student Initiative Fund, Dept. of Earth and Env. Sc, Columbia Univ.**
\$2,300 PI: Rao MP, A paleoclimate study of the Indian Monsoon using tree-ring based
reconstructions

Awards

- [3] *North American Carbon Program Leadership Award* | U.S. Carbon Program. \$1,000 (May 2022).
- [2] *Early Career Scientist Travel Support Award*, European Geophysical Union (EGU), Vienna, Austria (April 7-12, 2019).
- [1] *Student Travel Matching Grant*, Columbia University Graduate School of Arts and Sciences (GSAS), to attend the American Geophysical Union meeting, New Orleans, U.S.A. \$250 (October, 2017).

Other Grants

- [1] Lamont Campus Life, Columbia Univ, \$242 (04/2018), *Enhancing the operability and comfort of the Lamont nursing and lactation space*, Kim-Blanco P., McCarthy, C., Andreu-Hayles, L., & **Rao M. P.**

Community service to science agencies as proposal reviewer

Swiss National Science Foundation (2023)

Scientific community service as manuscript reviewer (total excluding revisions: 26)

American Geophysical Union AGU Books (1), Biogeosciences (1), Climate of the Past (1), Dendrochronologia (3), Ecological Monographs (1), Environmental Research Letters (3), Geophysical Research Letters (3), Global and Planetary Change (1), International Journal of Biometeorology (1), Natural Hazards (1), Nature Geoscience (1), Plos One (2), Scientific Reports (2), SoftwareX (1), Trees - Structure and Function (1), Quaternary Science Reviews (1), Quaternary Research (2)

Workshops conducted

- [1] **Rao MP** hosted by Rudi F (2014). *From dendrochronology to dendroclimatology: Understanding the big picture*. Conducted for undergraduate and master's students at Andalas University, Sumatra, Indonesia, June 9-10, 2014. *Partnerships for enhanced engagement in research (PEER) Science*, to "Strengthen the research and teaching capacity of Andalas University in climate change and natural resources management".

Invited lectures

- [10] *Oaks trees don't grow through the growing season*. UC Davis Plant & Environmental Science Seminar, November 9, 2022.
- [9] *Estimating the forest carbon cycle under climate change*. NOAA Seminar, October 31, 2022 (virtual)
- [8] *Hydroclimate variability and environmental change in South Asia over the past six centuries*. Centre for Climate Research and Development (CCRD), Islamabad, Pakistan, September 1, 2022 (virtual).
- [7] *Critical temperature of photosynthesis and tree-growth in the forest carbon cycle*. NOAA Climate & Global Change Workshop, Steamboat Springs, CO, USA, July 17-22, 2022.
- [6] *Extreme heat might threaten photosynthetic carbon assimilation by Siberian larch in the southern edge of the North Asian taiga*. University Corporation for Atmospheric Research, CPAESS Discovery Seminar, March 23, 2022.
- [5] *Seven centuries of reconstructed Brahmaputra River discharge demonstrate underestimated high discharge and flood hazard frequency*. Flood Risk and Climate Change Adaptation, February 11, 2022 (virtual).

- [4] *Stories trees tell us about the past and present*. Summer Research Experiences for Undergraduates (REU) lecture, Columbia University, New York, USA, June 15, 2021.
- [3] *Forests and Climate Change*, Science Honors Program, Columbia University, October 31, 2020.
- [2] *Stories trees tell us about the past and present*. Guest lecture, M.A. Science Journalism. An advanced science writing programme for experienced journalists, Columbia University, New York, USA, September 29, 2020.
- [1] *Understanding Coupled Natural and Human Systems: Climate related mass livestock mortality in Mongolia, Volcanoes and European hydroclimate, and Long-term Indus River streamflow*. Centre for Ecological Sciences Seminar, Indian Institute of Science, Bangalore, India, December 10, 2016.

Other news articles featured in

- [5] How does climate change impact fall foliage, State of the Planet, September 26, 2022. [[link](#)]
- [4] What Are Carbon Offsets, and Can They Combat Climate Change?, The Wall Street Journal, July 21, 2022. [[link](#)]
- [3] ‘Oldest Living Thing on Earth’ Discovered in Chile, Al Jazeera, July 19, 2022. [[link](#)]
- [2] Rooftop Camera Will Track How Local Forests Change With the Climate, State of the Planet, Earth Institute, Columbia University, November 3, 2020. [[link](#)]
- [1] Profile – ‘For the Love of Mother Nature’, Amrita Vishwa Vidyapeetham, July 30, 2012. [[link](#)]

Other selected news articles quoted in

- [2] Signs of Pinochet’s coup spotted in Chilean tree rings, Science, January 3, 2022. [[link](#)]
- [1] Raiders of the lost Bark, ScienceLine, July 29, 2018. [[link](#)]

Selected scientific conference presentations

2022

- [25] **Rao MP** et al. *Asynchronous carbon assimilation and tree growth explains ring-width climate sensitivity of Eastern US temperature oaks*. American Geophysical Union (AGU) Fall Meeting, Chicago, USA, December 12-16, 2022. (**poster**)
- [24] **Rao MP** et al. *Rapidly approaching a thermal tolerance tipping point in the Eurasian boreal forest at its southern margins*. American Geophysical Union (AGU) Fall Meeting, Chicago, USA, December 12-16, 2022. (**poster**)
- [23] **Rao MP** et al. *Rapidly approaching a thermal tolerance tipping point in the Eurasian boreal forest at its southern margins*. Ecological Society of America (ESA) conference, Montréal, Canada August 14-19, 2022. (**talk**)
- [22] **Rao MP** et al. *The potential of tree-ring drought atlases for dating and provenancing archaeological timbers*. AmeriDendro, Montréal, Canada, June 27-30 2022. (**talk**)
- [21] **Rao MP** et al. *Asynchronous phenologies of photosynthetic carbon uptake and tree-growth in Northeastern US temperate oaks*. AmeriDendro, Montréal, Canada, June 27-30 2022. (**poster**)
- [20] ***Rao MP** et al. *The potential of tree-ring drought atlases for dating and provenancing archaeological timbers*. From Forests to Heritage, Amsterdam, Netherlands, April 2022. (***Invited talk**)

- [19] **Rao MP** et al. *Asynchronous phenologies of photosynthetic carbon uptake and tree-growth in Northeastern US temperate oaks*. UC Davis Postdoc Symposium, March 2022. **(talk)**
- [18] **Rao MP** et al. *Asynchronous phenologies of photosynthetic carbon uptake and tree-growth in Northeastern US temperate oaks*. American Association for Geographers, February 2022. **(talk)**

2021

- [17] ***Rao MP** et al. *Seven centuries of reconstructed Brahmaputra River discharge demonstrate underestimated high discharge and flood hazard frequency*. American Geophysical Union, December 2021. **(*Invited talk)**
- [16] **Rao MP** et al. *Asynchronous phenologies of photosynthetic carbon uptake and tree-growth in Northeastern US temperate oaks*. American Geophysical Union, December 2021 **(e-lightning poster)**
- [15] **Rao MP** et al. *Rapidly approaching a thermal tolerance tipping point in the Eurasian boreal forest at its southern margins*. 2nd International Conference of Young Scientists on Climate Change and Environment in Central and Northeast Asia, Ulaanbaatar, Mongolia, November 20, 2021 **(virtual talk)**.
- [14] **Rao MP** et al. *Seasonal changes in canopy vegetation at Black Rock Forest after oak loss derived from drone based remote sensing*. Black Rock Forest Symposium, June 28, 2021 **(virtual talk)**.
- [13] Passow M, Buckley B, Oelkers R, & **Rao MP**. *The Lamont-Doherty Tree-Ring Lab and Earth2Class Programs: Sharing Dendrochronology with Students and Teachers*. American Meteorological Society Annual Meeting, U.S.A., January 10-14, 2021. **(talk)**

2019

- [12] **Rao MP** et al. *Photosynthetic heat tolerance, light response, and respiration rates across gradients in the northwestern Mongolian boreal-steppe*. American Geophysical Union, San Francisco, U.S.A., December 9-13, 2019. **(poster)**.
- [11] **Rao MP** et al. *Six hundred years of reconstructed Brahmaputra River flow demonstrate long-term flood risk is substantially underestimated*. American Geophysical Union, San Francisco, U.S.A., December 9-13, 2019. **(talk)**
- [10] **Rao MP** et al. *Seasonal reconstructions of Brahmaputra River discharge and applications for monsoon flooding risk*. European Geophysical Union, Vienna, Austria April 7-12, 2019. **(talk)**.

2018

- [9] **Rao MP** et al. *Sub-seasonal reconstructions of Brahmaputra River discharge Brahmaputra streamflow*. American Geophysical Union, Washington D.C., U.S.A., December 10-14, 2018. **(poster)**.
- [8] **Rao MP** et al. *Estimating variability in the volcanic forced climate response using key year resampling*. 10th World Dendro Conference, Thimpu, Bhutan, June 2-22, 2018. **(talk)**.
- [7] **Rao MP** et al. *Six centuries of Upper Indus Basin streamflow variability and its climatic drivers*. 10th World Dendro Conference, Thimpu, Bhutan, June 2-22, 2018. **(talk)**.
- [6] **Rao MP** et al. *Estimating the variability in volcanic forced climate response using key year resampling*. Volcanic Impacts on Climate and Society, Tucson, AZ, USA. January 12-14, 2018. **(lightning talk + poster)**.

2014-2017

- [5] **Rao MP** et al. (2017). *Five centuries of tree-ring reconstructed streamflow and projections for future water risk over the Upper Indus Watershed*. American Geophysical Union, New Orleans, December 10-16, 2017 (**talk**). [[link](#)]
- [4] Passow MJ, Takahashi T, Fiore AM, Clifton OE, Nitsche F, McManus JF, Winkler G, Jacobel A, Leland C, & **Rao MP** (2017). *Sharing Cutting-Edge Climate and Paleoclimate Research with Teachers and Students through Earth2Class*. American Meteorological Society (AMS), Seattle, WA, U.S.A., January 22-26, 2017 (**poster**). [[link](#)]
- [3] **Rao MP** et al (2016). *European hydroclimate response to tropical volcanic forcing over the past millennium*.
i. American Geophysical Union, San Francisco, CA, U.S.A., December 10-16, 2016 (**poster**).
ii. Volcanic Impact on Climate and Society (VICS), Palisades, NY, U.S.A., June 6-8, 2016 (**talk**)
- [2] **Rao MP** et al. (2015). *Tree-rings as an effective paleoclimate proxy for independent validation of historical climate anomalies*. European Association for South East Asian Studies (EUROSEAS), Vienna, Austria, 11-15th August, 2015 (**talk**).
- [1] **Rao MP** et al. (2014). *Tree-ring results from Southeast Asia: Myanmar and Vicinity*.
i. Andalas University, Padang, Indonesia, June 10, 2014 (**talk**).
ii. Southern Institute of Ecology, Vietnam Academy of Science and Technology, June 4, 2014 (**talk**).
iii. Atmospheric Circulation Reconstructions over the Earth (ACRE) Southeast Asia meeting, Kuala Lumpur, Malaysia, May 27-28, 2014 (**talk**).

Mentoring activities

- [6] 2022-present *Ms. Olivia Shehan*, Graduate Research Assistant (GRA)
M.A. Climate and Society, Columbia University. Research and academic mentor
- [5] 2021-present *Ms. Lily Klinek*, Ph.D. student
University of California Davis. Research and academic mentoring
- [4] 2021-present *Ms. Naveen Dilawar*, Ph.D. student
Lanzhou University, China. Ph.D. dissertation co-supervisor
- [3] 2021-present *Mr. Troy Nixon*, Technician
Tree Ring Laboratory, Lamont-Doherty Earth Observatory, Columbia University
Processing and maintaining instrumentation in the Lamont Sanctuary Forest
- [2] 2021-2022 *Mr. Erik George Valentine*, Graduate Research Assistant (GRA)
M.A. Climate and Society, Columbia University. Research and academic mentor
- [1] 2020 *Ms. Dhanya Karuppusamy*, B.Tech. Student
PSG College, Mentor for undergraduate final year thesis, Dendrochronology - drought and its analysis.

Leadership Positions

Representative, Campus Life Committee, for the Biology and Paleoenvironment Division and students of Department of Earth and Environmental Sciences, Lamont-Doherty Earth Observatory, Columbia University, (2015-2019, 5 years).

Co-editor and co-designer, magazine [hillScribe](#) Agenda for Survival, Centre for Science and Environment, New Delhi, June 2012.

Elected *Chair*, ChemAMRITA, student's representative body, Department of Chemical Engineering, Amrita School of Engineering, India, 2011-2012.

Co-editor, Amritadhwani, university magazine, Amrita School of Engineering, India, 2011-2012.

Elected *Student's Representative*, Class of 2012, Department of Chemical Engineering, Amrita School of Engineering, 2011-2012.

Workshops attended

- [6] The 13th Annual Flux Course, Niwot Ridge, July 25-August 9, 2022
- [5] Dendrochronology Field Week, 10th World Dendrochronology Conference, Bhumthang, Bhutan, June 2-9, 2018.
- [4] Modeling Past Climate Change and Human Adaptation, The Ohio State University, USA, May 4-5, 2018
- [3] Innovative Teaching Summer Institute, Columbia University NY, USA, June 2017
- [2] Community Earth System Model (CESM) Tutorial, NCAR, Boulder, CO, USA. August, 8-12, 2016
- [1] Dendroecological Field Week, organised by Columbia University, Da Lat Vietnam, January 2015

Fieldwork Experience

Bhutan, Costa Rica, India, Indonesia, Mongolia, Sweden, United States of America, and Vietnam.

Dendro-archaeology dating and provenance

- [1] Terminal Warehouse, Chelsea, New York, USA for L&L Holding Company, LLC, September 2019

Outreach presentations to science teachers and educators

- [3] **Rao MP**. Teaching in the Hudson Valley, a training workshop for school teachers, July 26, 2017.
- [2] **Rao MP**, Bishop D, & Oelkers R. *More than How Old? Understanding Climate Change from Tree Rings?* Earth2Class Science workshop, April 8th, 2017. To create interactions between high school teachers of science to help them bring science to their class rooms.
- [1] **Rao MP** & Leland C. *Trees, Climate, and Societal Relevance: A Case Study in Mongolia*, Earth2Class Science workshop, September 20th, 2014. [[link](#)]

Community Outreach

- [2] Organised multiple editions of Lamont-Doherty Earth Observatory's [Open House](#), (2012; 2014; 2016; 2017; 2018, 2019).
- [1] Conducted numerous outreach tours and workshops for high-school students, undergraduate college students, and the general public.
Selected workshops and tours conducted at the Tree-Ring Laboratory, Lamont-Doherty Earth Observatory, Columbia University:
 - [22] **Rao MP** Climate & Society class field trip (20 students), November 12, 2021.
 - [21] **Rao MP** International Federation of Red Cross Red Crescent (IFRC) Climate Youth Scholars Program, September 23, 2019.
 - [20] **Rao MP** St. Bernard School (10 students), May 22, 2019.
 - [19] **Rao MP** with Rodriguez MC. Central American children in foster care at the Cayuga Center, NY (30 children), Ages 8-10 (in Spanish), May 20, 2019.
 - [18] **Rao MP** with Leland C. High School group from Connecticut (15 students), March 20, 2019.

- [17] **Rao MP** Historical Geology Class field trip, Queens College (20 students), November 9, 2018.
- [16] **Rao MP** with Leland C. Workshop for staff at the Centre of Sustainable Development, Columbia University to help them develop science outreach modules on dendrochronology for students in rural India to work towards meeting UN Sustainable Development Goals, October 18, 2018.
- [15] **Rao MP** Undergraduate Environmental Science class field trip, Queens College (15 students), July 25, 2018.
- [14] **Rao MP** with Oelkers R. MS 302, Group 2 from Sophie Gerson Healthy Youth middle school, NY (50 students), May 15, 2018.
- [13] **Rao MP** with Oelkers R. MS 302, Group 1 from Sophie Gerson Healthy Youth middle school, NY (50 students), March 28, 2018.
- [12] **Rao MP** seniors' group from The Chappaqua Library, NY, March 16, 2018.
- [11] **Rao MP** with Leland C & Oelkers R. Shadow program for 2 female undergraduate students from Bates College, ME who were considering applying to graduate school, February 22, 2018.
- [10] **Rao MP** 'Meet-a-scientist' interaction and tree-ring workshop with a group of 9 home schooled girls from Highland, NJ (aged 6-14 years), February 21, 2018
- [9] **Rao MP** with Oelkers R & Leland C. Luisa Dessus Cruz, NY (50 students), January 29, 2018.
- [8]. **Rao MP** talk and workshop for a group of high school students (20 students), August 17, 2017.
- [7] **Rao MP** with Bishop D. St. Thomas Aquinas College, NY (33 students), July 27, 2017.
- [6] **Rao MP** with Bishop D. Hewitt School an independent K-12 girls' school in New York City (15 students), May 31, 2017.
- [5] **Rao MP** with Leland C and Bishop D. 5th grade students from St. Bernard School (30 students), May 3, 2017
- [4] **Rao MP** pre-college science and math STEM Scholars program (32 students), July 6, 2016
- [3] **Rao MP** meet-a-scientist workshop on dendrochronology for 6 middle school students, April 7, 2016
- [2] **Rao MP** middle school group from the Lawrenceville School (38 students), July 16, 2015
- [1] **Rao MP** with Leland C and Buckley B. Climate Stewards Club from the Pascack Hills High School in Montvale NJ, November 7, 2014

Languages

Proficient: English, Hindi, Malayalam, Spanish

Conversational: Urdu

Basic: Tamil, Kannada, Catalán

References

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