

Updates on the International Network for Alpine Research Catchment Hydrology (INARCH) and Its 2024 Annual Workshop

14–18 October 2024
Lanzhou and Zhangye, China

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Overview of INARCH

The International Network for Alpine Research Catchment Hydrology (INARCH, <https://inarch.usask.ca>) is a cross-cutting project of the GEWEX Hydroclimatology Panel (GHP) to better understand alpine cold regions hydrological processes, improve their prediction, diagnose their sensitivities to global change, and find consistent measurement strategies. At its core is a global network of highly-instrumented mountain observatories and experimental research sites, which are testbeds for detailed process studies on mountain hydrology and meteorology, developing and evaluating numerical simulation models, validating remotely sensed data, and observing, understanding, and predicting environmental change. There are now 38 research basins and sites in 18 countries and six continents, with more continuing to join the network. For a full description of INARCH and details on the research basins, participants, science questions, goals, and activities, visit our website and see the article in the Quarter 1 2023 issue of *GEWEX Quarterly* (<https://www.gewex.org/resources/gewex-news/>).

Update on the Common Observing Period Experiment (COPE), 2022–2024

INARCH has held the field observation phase of COPE as a focal activity to collect a high-quality and coherent observational data set of mountain meteorology and hydrology from around the world. In the diagnostic phase of COPE, these data will be used to address key INARCH science questions and for a series of hydrological process diagnostic modelling evaluations and analyses. The field observation phase progressed well, and there have been many successful fieldwork, experimental, and remote sensing activities. INARCH is now coordinating data management with the help of Global Water Futures Observatories and modelling activities at multiple institutions to make use of the observations. The aim is to better understand why models produce various behaviors and to see if models benchmark various known aspects and regimes of the coupled atmospheric-cryospheric-hydrological system. Model diagnostic evaluations will emphasize atmospheric, snow, glacier, and water processes in high mountain terrain and include sparse forest, non-needleleaf vegetation, glaciated, and alpine windblown sites. This has not been done globally in alpine regions and could be potentially

very powerful. Going forward, a collection of scientific papers will be submitted to a special issue of *Hydrological Processes* (<https://onlinelibrary.wiley.com/journal/10991085>) on “Improving measurement, understanding, and prediction of alpine cold regions hydrological processes and their sensitivities to global change,” and the data will be published and openly available for use in a special issue of *Earth System Science Data* on “Hydro-meteorological data from mountain and alpine research catchments” (https://essd.copernicus.org/articles/special_issue871.html). COPE will be completed by early 2026 and will be accompanied by press releases, outreach events, and plain language science summaries to explain the outcomes to the scientific community and policy makers.

Summary of 2024 Workshop, Lanzhou and Zhangye, China

INARCH held its 2024 Annual Workshop from 14–18 October 2024 in Lanzhou and Zhangye in central China, meeting as a network in Asia for the first time. The workshop was hosted by Dr. Tao Che, Dr. Shichang Kang, and Dr. Xin Li of the Chinese Academy of Sciences, along with tremendous local support from their staff and students. On 15th October, 46 scientists and students gathered in Lanzhou at the Northwest Institute of Eco-Environment and Resources, Chinese Academy of Sciences, for the workshop opening and keynote presentations, as well as a tour of the facility. That afternoon, a smaller group (36 participants) travelled by bus to Zhangye in Gansu Province, about 500km from Lanzhou and located in the Heihe River Basin near to field sites in the Qilian Mountains. Over the next two days, INARCH met at the Zhangye Hotel to convene scientific sessions on Observations, Remote Sensing, and Field Experiments and on Model Development, Applications, and Prediction, and held discussions on the Common Observing Period Experiment (COPE) and International Association of Hydrological Sciences-International Commission for Snow and Ice Hydrology (IAHS-ICSIH) initiatives, and took a tour of the Yakou snow observation supersite in the Qilian Mountains. Participants returned to Lanzhou on the afternoon of 18th October and departed from there.

The workshop was very fruitful in terms of assessing our progress, planning further activities, and scoping our contributions to global initiatives such as the International Year for Glaciers’ Preservation and the United Nations (UN) Decade of Action for the Cryospheric Sciences. The workshop statement below lists notable highlights and outcomes.

INARCH Statement 2024

- INARCH met in Asia for the first time and engaged with many scholars and institutes who are contributing substantially to increasing the capacity and advances of high mountain hydrometeorology and cryospheric science.
- Dramatic expansion of high-quality observations in High Mountain Asia and use of this data with sophisticated models to diagnose changing cryosphere and hydrology has occurred.
- Atmospheric forcing data including reanalysis continue to improve and refine resolution, but need bias correction in high mountains to be useable.



Top: INARCH workshop participants at the Northwest Institute of Eco-Environment and Resources, Chinese Academy of Sciences, Lanzhou, on October 15, 2024. Bottom: workshop participants at the snow observation site (Yakou) at 4,120m elevation in the Qilian Mountains, China, on 17th October 2024

- Risks and hazards in high mountains have been identified and there is a research need for observation, early warning, and prediction systems.
- Sub-surface flow and ecological interactions are important areas for development in INARCH with some advances and more needed.
- Black carbon and dust impacts on albedo and melt are a source of uncertainty that needs more attention.
- International teams are testing and applying a suite of models in multiple INARCH basins and show transferability of approaches and algorithms.
- INARCH should continue to develop collaborations with other groups and initiatives to enhance its capability and to build capacity.
- The International Year for Glaciers Preservation and UN Decade of Action for the Cryospheric Sciences start in 2025 and INARCH is poised to deliver advances in monitoring, science, and application to both initiatives. INARCH should continue.

Upcoming Activities and Events

EGU General Assembly 2025—INARCH session on “Improving Measurement, Understanding, and Prediction of the Mountain Cryosphere and Hydrological Cycle through Alpine Research Catchments”

The EGU General Assembly will be held in Vienna, Austria on 27 April to 2 May 2025. We have proposed a session for INARCH researchers and others in the mountain hydrology community and we encourage abstract submissions. See <https://meetingorganizer.copernicus.org/EGU25/session/51977> for further details. Abstract submission is now open and the deadline to submit is 15 January 2025 at 13:00 CET.

INARCH Workshop Obergurgl, Austria, 11–13 September 2025, and International Mountain Conference 2025, Innsbruck, Austria, 14–18 September 2025

We are pleased to announce the next annual INARCH workshop will be held at the Innsbruck University Center in Obergurgl, Austria on 11–13 September 2025. Our local hosts are Professors Lindsey Nicolson, Rainer Prinz, and Ulrich Strasser from the University of Innsbruck. The plan is to arrive by bus from Innsbruck in the early afternoon of 11th September and hold oral and poster scientific sessions that afternoon and on the 12th, then tour the Rofental Catchment on 13th September and return to Innsbruck on 14th September. The International Mountain Conference will begin that evening in Innsbruck, and INARCH has proposed a focus session there that will be open to all, called “High Mountain Hydrology and Cryosphere under Global Change – observations, modelling, prospects.” Watch the INARCH events page for further updates.