LANCANG-MEKONG NEWSLETTER

June 2023, No. 10

Project Title:
Climate Change and Water Resources in Great Rivers Region in Southeast and South Asia

Principal Investigator:

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Junguo LIU, Southern University of Science and Technology, China

Participating Institutions:

Southern University of Science and Technology
Institute of Tibetan Plateau Research, CAS
Institute of Atmospheric Physics, CAS
Institute of Geographic Sciences and Natural Resources Research, CAS
Beijing Normal University
University of Gothenburg

Project Period:

March 2018 – February 2023

"Climate Change and Water Resources in Great Rivers Region in Southeast and South Asia"

Project Office

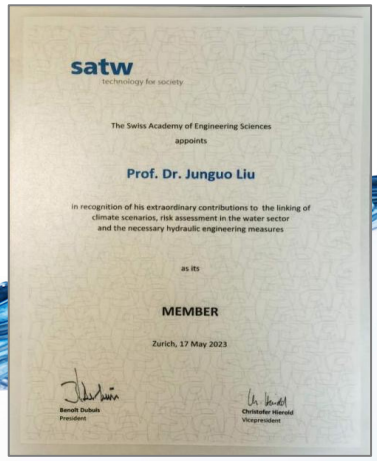
January 26

Junguo LIU elected as a member of the Swiss Academy of Engineering Sciences (SATW)

Chair Professor Junguo LIU of the School of Environmental Sciences and Engineering at the Southern University of Science and Technology (SUSTech), was elected as a member of the Swiss Academy of Engineering Sciences (SATW) in 2023 in recognition of his extradinary contributions to the linking of climate scenarios, risk assessment in the water sector and the necessary hydraulic engineering measures.

Prof. Junguo LIU is a member of the European Academy of Sciences, and a winner of the Outstanding Young Scientist from the National Science Foundation of China. He is also a Fellow of the American Association for the Advancement of Science, the Royal Geographical Society, UK, and the Royal Meteorological Society.

Prof. LIU has published more than 270 papers in scientific journals such as Nature, Science, PNAS, Nature Climate Change, Nature Communications, Nature Sustainability, and Science Advances. He has also been selected in the list of the world's Highly Cited Researchers.



June 8

Junguo LIU Receives International Hydrology Prize

The recipients of the 2023 International Hydrology Prize were recently announced by the International Association of Hydrological Sciences (IAHS).

Junguo LIU, Chair Professor of the School of Environmental Science and Engineering at the Southern University of Science and Technology (SUSTech) and vice president of the North China University of Water Resources and Electric Power, has been honored with this year's Volker medal of the International Hydrology Prize. This esteemed recognition acknowledges his significant contributions to water resources research, scientific and policy engagement, and his dedicated services to the hydrology community.

The International Hydrology Prize is jointly awarded by **IAHS, UNESCO, and WMO** (World Meteorological Organization). It stands as one of the most prestigious accolades within the global hydrological science community. The award ceremony took place at the 28th International Union of Geodesy and Geophysics General Assembly (IUGG2023) held in Berlin, Germany, on July 15.

April 13

Zhan Tian awarded the 2023 Royal Academy of Engineering International Distinguished Partner

Professor Zhan TIAN of the School of Environmental Sciences and Engineering at the Southern University of Science and Technology (SUSTech), was awarded the Royal Academy of Engineering International Distinguished Partner in 2023 for Climate Change Reliant Engineering Pathways for Mitigating Future Compound Flooding Risks.

The Distinguished International Associates Programme is a programme for excellent international engineers working across all sectors, who are at the cutting edge of engineering research or innovation and have existing collaborations or connections to the UK which they would like to intensify.

The programme aims to develop a broad international community or network of excellent diverse engineers across countries and disciplines, with research and innovation links to the UK, to work alongside the Academy to enhance progress towards achieving its goals for an inclusive economy and sustainable society.

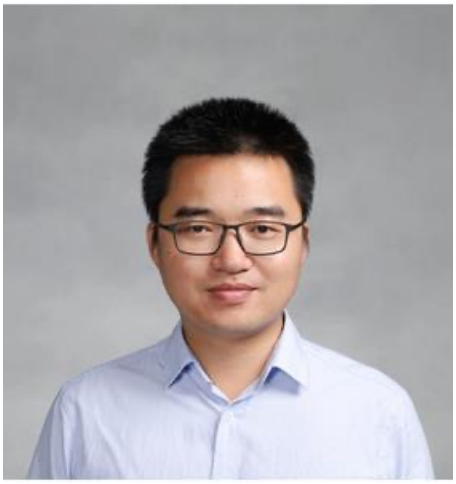
May 4

Lian FENG receives 2023 Shenzhen Youth May Fourth Medal

The Shenzhen Committee of the Communist Youth League and the Shenzhen Youth Federation recently announced the list of recipients of the 2023 Shenzhen Youth May Fourth Medal.

Lian FENG, Associate Professor of the School of Environmental Science and Engineering at the Southern University of Science and Technology (SUSTech), was awarded the Medal for 2023.

The activity was officially launched in January 2023 and has entered into the final stage, and organizers will present the prizes to 60 individual recipients and 30 units.



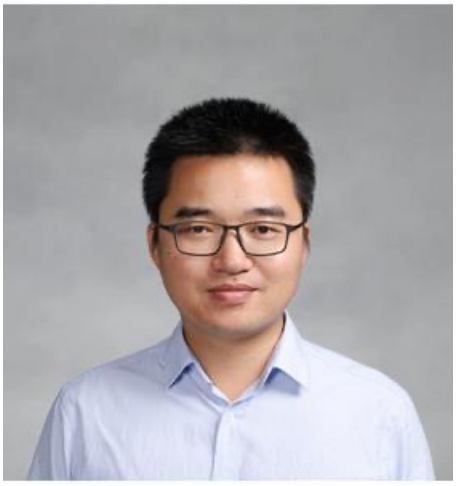
Professor Lian FENG joined SUSTech in 2017. He has been engaged in the theory, method, and application of remote sensing of inland and coastal water environments. Prof. FENG has published more than 50 SCI papers in top journals such as Nature, Nature Geoscience, Remote Sensing of Environment, Environmental Science & Technology.

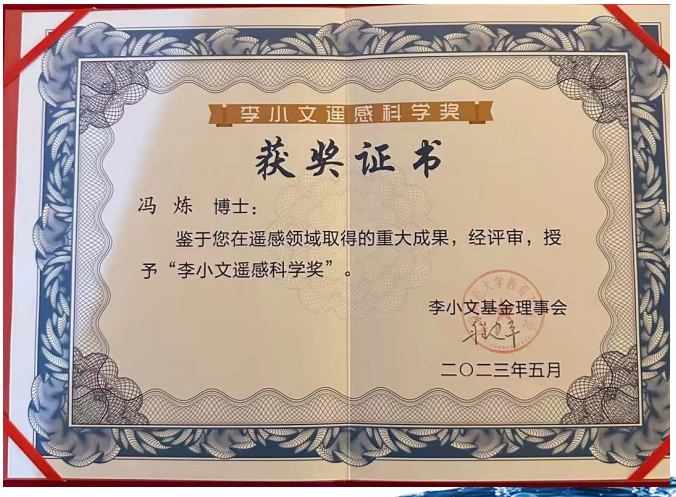
May 20

Professor Lian FENG wins 2023 Li Xiaowen Remote Sensing Science Award

On May 20, **Lian FENG**, Associate Professor of the School of Environmental Science and Engineering at the Southern University of Science and Technology (SUSTech), received the 2023 Li Xiaowen Remote Sensing Science Award.

The Li Xiaowen Remote Sensing Award, which is selected every two years, is used to award outstanding scientific researchers who have made significant innovations in the scientific theory, methods and applications of remote sensing and have made outstanding contributions to the scientific and technological progress of the entire remote sensing industry.





March 28

Project members were selected into the list of 2022 Elsevier's Highly cited Chinese researchers

On March 28, 2023, Elsevier released the 2022 list of "Highly Cited Chinese Researchers". Four members of the project: **Professor Junguo LIU, Professor Qiuhong TANG, Professor Qingyun DUAN**, and **Professor Xuejie GAO** were selected into the list of 2022 *Elsevier's "Highly Cited Chinese Researchers"*.

This list uses the global authoritative citation and index database Scopus as the statistical source of Chinese scholars' scientific research achievements, and uses the method developed by Shanghai soft Science Education Information Consulting Co., Ltd to analyze the performance of Chinese scholars' scientific research achievements. It has been released for the eighth time since its debut in 2015 to 2022, and has been highly concerned by many media and scholars at home and abroad.

May 30

Regional Workshop and Training

Water Diplomacy of the Mekong Basin: Towards a Shared Basin for Prosperity

On 30-31 May, the Regional Workshop and Training of the joint research project “Water Diplomacy of the Mekong Basin: Towards a Shared Basin for Prosperity” was held in Siem Reap, Cambodia, funded by the Mekong-Lancang Cooperation Special Fund. The project was conducted by a research consortium comprised of institutions from Cambodia, China, Laos (PDR), Thailand, Vietnam, which all of these countries are Lancang-Mekong country members.

With all partners, the regional workshop proposed a water diplomacy framework toward a shared basin for prosperity and provided policymakers with evidence-based information and systematic analysis of the water diplomacy framework enabling them to make appropriate decisions for future water management. **Prof. Junguo LIU** is a key of the partner of organization the workshop. Dr. Yuehan DOU and Dr. Aifang CHEN from Prof. Liu’s team attended the workshop and gave a presentation about “The Role of Scientific Research in Consensus Building.”

June 1

UNEP Report on “Ecosystem Assessment for Sustainable Livelihoods in the Lancang-Mekong Basin”

The “Ecosystem assessment in the Lancang-Mekong Basin for sustainable livelihoods” report was almost completed by **Professor Junguo LIU** and his team in partner with UNEP. The report is a product from a project entitled “Improving Ecosystem Management for Sustainable Livelihoods within the Framework of Lancang-Mekong Cooperation,” which aims to assess ecosystem service-dependent livelihoods with case studies demonstrated through pilot activities at selected areas in Cambodia and China, and to provide recommendations to promote improvement of ecosystem health, natural resources management, and sustainable livelihoods. The report is expected be published by UNEP in 2023.

The project is funded by the Ministry of Ecology and Environment of the People’s Republic of China, through the China Trust Fund to UNEP and partly supported by the Strategic Priority Research Program of Chinese Academy of Sciences (XDA20060402). Interventions are implemented jointly by the UNEP Regional Office for Asia and the Pacific, in partnership with UNEP- IEMP and the Lancang-Mekong Environmental Cooperation Centre, as well as the Biodiversity, People and Landscapes Unit of UNEP Ecosystems Division.

Research

A synthesis of hydroclimatic, ecological, and socioeconomic data for transdisciplinary research in the Mekong

The Mekong River basin (MRB) is a transboundary basin that supports livelihoods of over 70 million inhabitants and diverse terrestrial-aquatic ecosystems. There is an urgent need to better understand the changing hydrological and ecological systems in the MRB and develop improved adaptation strategies. This, however, is hampered partly by lack of sufficient, reliable, and accessible observational data across the basin. **Dr. Yadu POKHREL** from the Michigan State University led the research, and **Prof. Qiuhong TANG, Prof. Junguo LIU** co-authored the article published in *Scientific Data*, to fill the long-standing gap for MRB by synthesizing climate, hydrological, ecological, and socioeconomic data from various disparate sources.

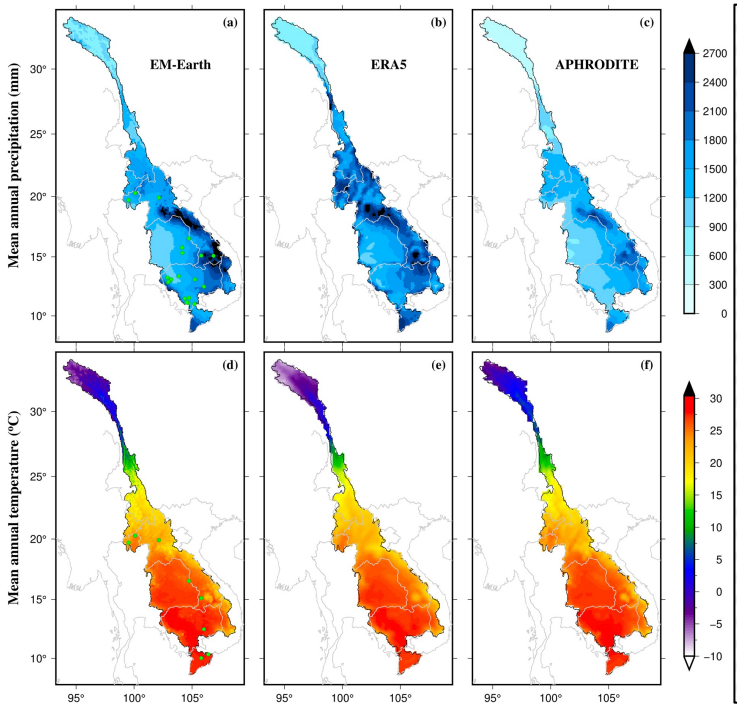


Fig.1 Projected Spatial coverage of mean annual precipitation (mm) (1971–2000) for (a) EM-Earth, (b) ERA5, and (c) APHRODITE data and mean annual temperature (°C) (1971–2000) for (a) EM-Earth, (b) ERA5, and (c) APHRODITE data. Green circles in precipitation and temperature data panels (a and d) show gauging stations for observed datasets obtained from the MRC

Research

The data— including groundwater records digitized from the literature— provide crucial insights into surface water systems, groundwater dynamics, land use patterns, and socioeconomic changes. The analyses presented also shed light on uncertainties associated with various datasets and the most appropriate choices. These datasets are expected to advance socio-hydrological research and inform science-based management decisions and policymaking for sustainable foodenergy-water, livelihood, and ecological systems in the MRB.

The results were published in ***Scientific Data***
Full article link: **https://doi.org/10.1038/s41597-023-02193-0**

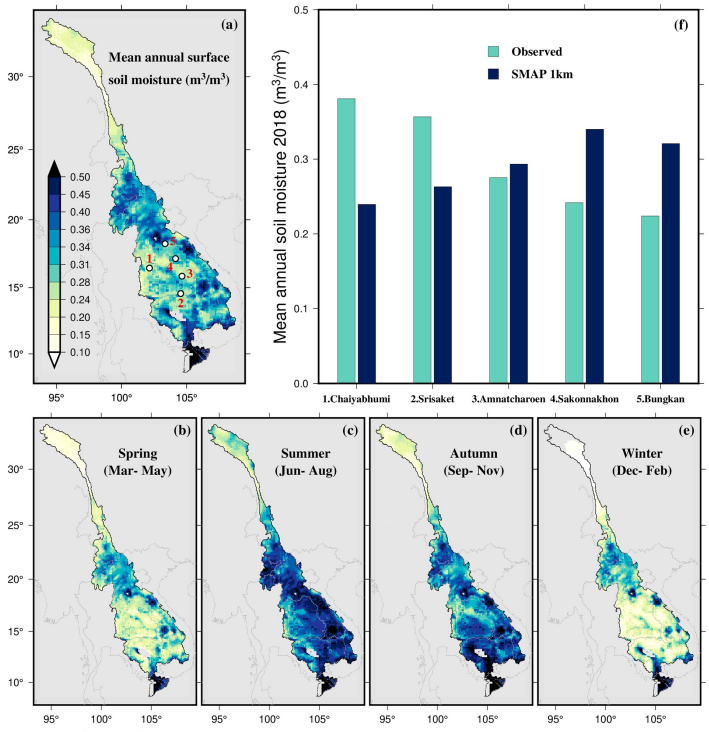


Fig.2 (a) Spatial distribution of downscaled SMAP soil moisture data at 1 km spatial resolution for 2016–2021 period. (b–e) Seasonal variation in the spatial distribution of SMAP data. The grey color indicates ‘no data’. (f) Comparison of SMAP data with in-situ observation at five locations in Thailand (white circle in panel a).

Research

Wet bias of summer precipitation in the northwestern Tibetan Plateau in ERA5 is linked to overestimated lower-level southerly wind over the plateau

The Tibetan Plateau (TP), also called the Third Pole, is considered to be “the world water tower”. The northwestern TP (NWTP), which has an average elevation higher than 4800 m, is an arid region where the summer precipitation is largely overestimated by the ERA5 global reanalysis product. Recently, **Prof. Deliang CHEN’s team** published an article on Climate Dynamics, hypothesized that this wet bias is mainly caused by unrealistic lower-level winds that trigger strong convection over the region; it can be reduced by using a high-resolution regional climate model with a large domain that allows realistically representing interactions between the Westerlies and Asian summer monsoons.

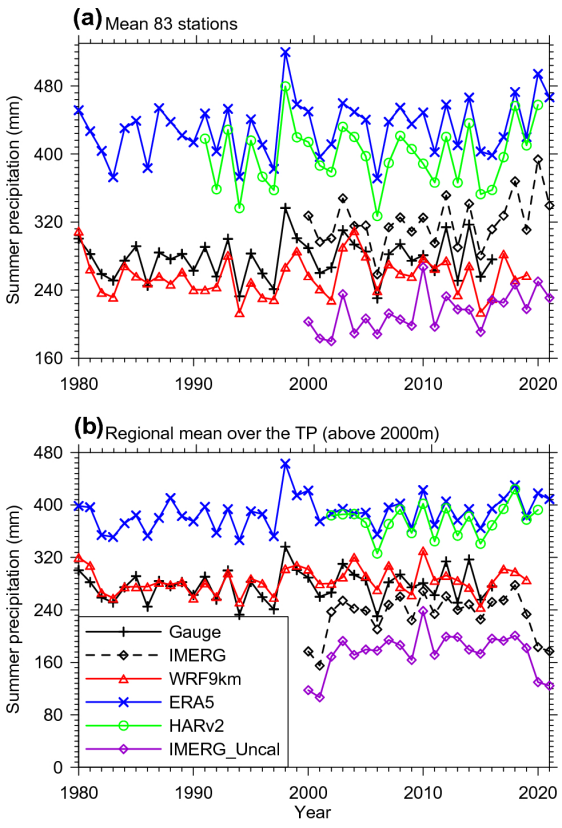


Fig. 1. (a) Time series of the interannual variation in summer (June– July–August) total precipitation (mm) over the TP obtained from 83 gauges, as well as the precipitation from gauge-adjacent grids of IMERG, IMERG_Uncal, ERA5, HARv2, and WRF9km during the period 1980–2021. (b) Same as (a) but the time series from IMERG, IMERG_Uncal, ERA5, HARv2, and WRF9km are the mean over the region [66.5–105.5°E, 24.5–41.0°N] with an elevation higher than 2000 m

Research

Here, downscaling using the Weather Research and Forecasting (WRF) model driven by ERA5 was conducted with a large domain (8°–50° N, 65°–125° E) at 9 km for the period 1979–2019 (WRF9km). Precipitation values from WRF9km and ERA5 were evaluated against satellite observations; compared with ERA5, WRF9km captured the climatological summer precipitation over the NWTP with a much-reduced wet bias. The ERA5 overestimation is mainly caused by excessive convective precipitation, likely linked to strong vertical motions over the NWTP induced by an overestimated lower-level southerly wind.

The results were published in ***Climate Dynamics***
Full article link**: https://doi.org/10.1007/s00382-023-06672-3**

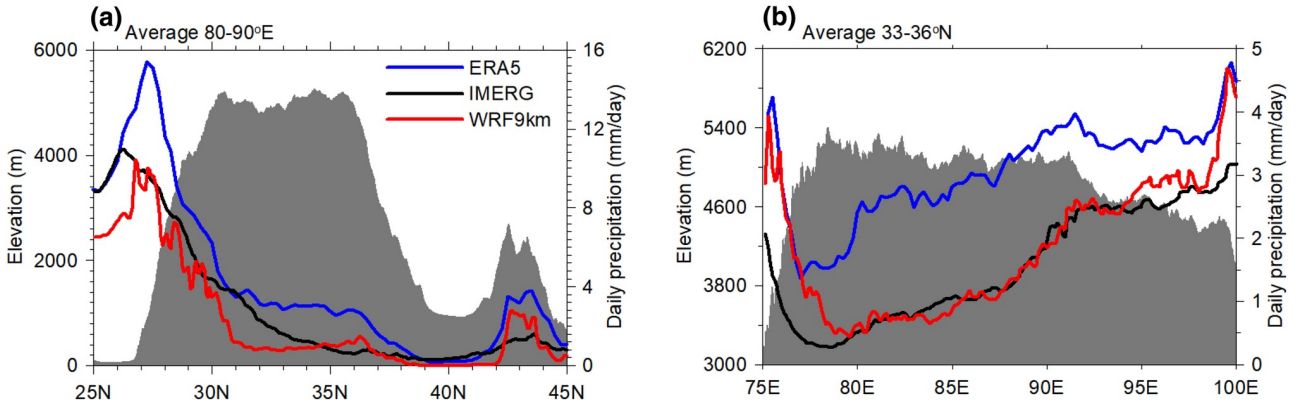


Fig. 2. (a) Latitude evolution (averaged between 80° and 90° E) and (b) longitude evolution (averaged between 33° and 36° N) of summer (June–July–August) mean precipitation (mm/day) during 2000–2019 from ERA5, downscaling driven by ERA5 (WRF9km), and IMERG. The gray shaded area shows the mean elevation

Research

Projected seasonal changes in future rainfall erosivity over the Lancang-Mekong River basin under the CMIP6 scenarios

Climate change is a driver of soil erosion, but the future projections of seasonal rainfall erosivity variability and spatial distribution over the Lancang-Mekong River Basin (LMRB) are still not well understood. Recently, **Prof. Qiuhong TANG, Prof. Deliang CHEN and an international team** published an article on Journal of Hydrology, assessed the impacts of future climate change on the seasonal rainfall erosivity over the LMRB, by using three widely applied empirical daily rainfall erosivity models based on the bias-corrected precipitation data from five GCMs in CMIP6 under SSP-RCP scenarios. The results show that in the near term, the ensemble mean of basin-wide rainfall erosivity would increase by 2.5%-8.7% compared to the baseline period (1980–2010), while in the far term, the ensemble mean would increase by 12.2%-31.0%.

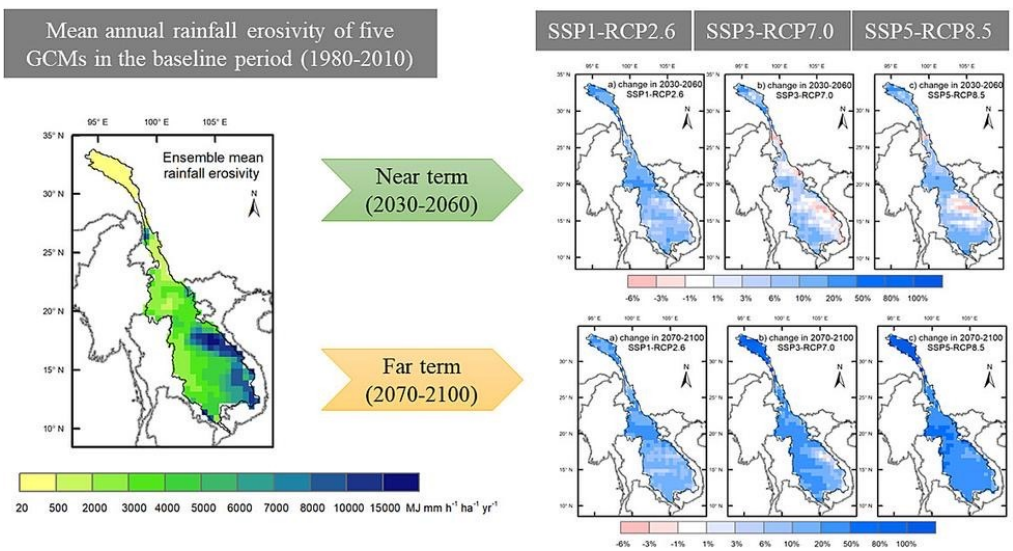


Fig.1 Projected relative change in ensemble mean rainfall erosivity under the three in the near and far term compared to the baseline period.

Research

Seasonal variations in rainfall erosivity show that summer rainfall erosivity from June to August accounts for more than two-thirds of the total annual rainfall erosivity. Although the projected basin-wide average summer rainfall erosivity would increase, the mid-southern basin in Thailand and southern Lao PDR would experience a decrease. For rainfall erosivity from March to May, large areas except for the mountainous part of China would also experience a decrease. The projected changes in rainfall erosivity can contribute to a better understanding of soil erosion risk under climate change across the LMRB.

The results were published in ***Journal of Hydrology***

Full article link: **https://doi.org/10.1016/j.jhydrol.2023.129444**

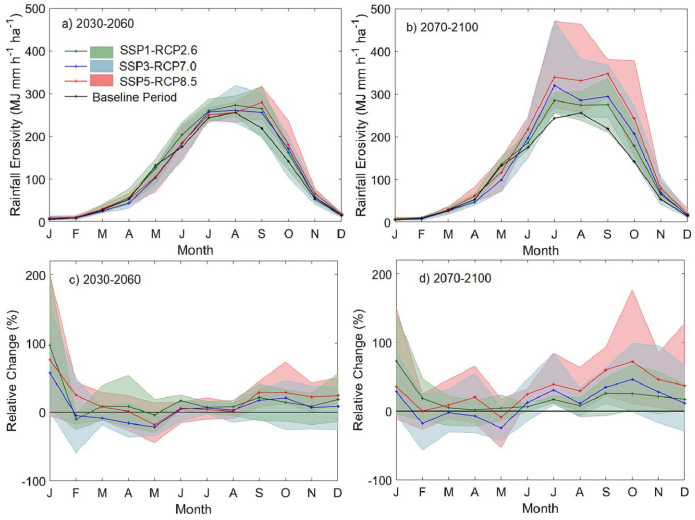


Fig.2 Seasonal rainfall erosivity in the near and far term (a, b), and the relative change compared to baseline period (c, d).

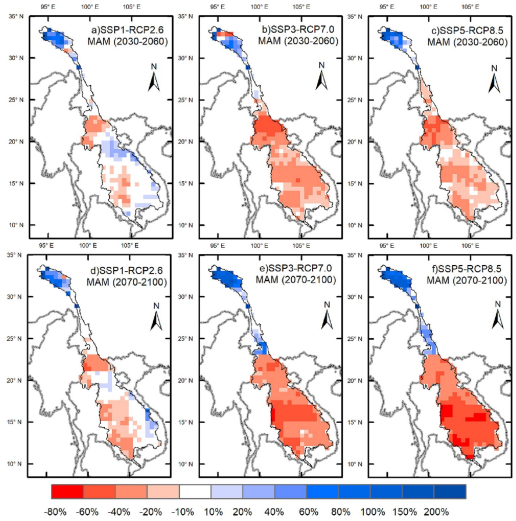


Fig.3 Projected relative change in ensemble mean rainfall erosivity of March to May.

Research

Effects of soil parameterization on permafrost modeling in the Qinghai-Tibet Plateau

Borehole-measured soil temperatures have been routinely used to calibrate soil parameters in permafrost modeling, although they are sparse in the Qinghai-Tibet Plateau (QTP). A feasible alternative is to calibrate models using land surface temperatures. However, the quantitative impacts of various soil parameterizations on permafrost modeling remain unexplored. Recently, **Prof. Qiuhong TANG's team** published an article on Cold Regions Science and Technology. Two sets of soil parameters (denoted as P_{soil} and P_{surf}) were obtained via calibration using borehole temperature measurement and ERA5-Land (the land component of the fifth generation of European *Re*-Analysis) skin temperature, respectively, and applied to the Geophysical Institute Permafrost Laboratory Version 2 (GIPL 2.0) model.

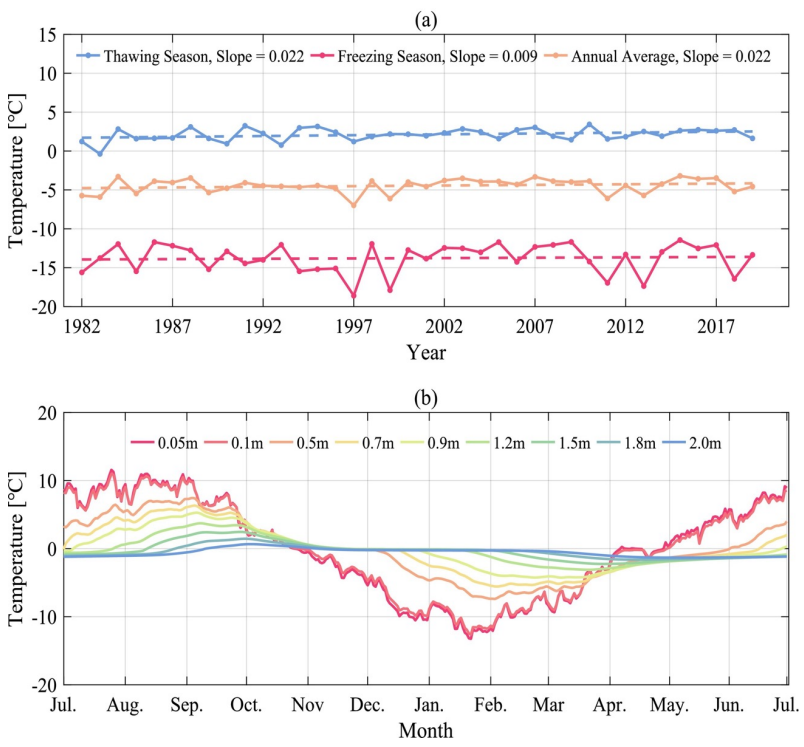


Fig. 1. a) The mean annual land surface temperature from July 1982 to July 2019 for site QT03 extracted from the ERA5-Land dataset. The freezing season: from November to March. The thawing season: from April to October. b) The in-situ soil temperature at different depths obtained from 1 July 2011 to 29 June 2012.

Research

Comparing against the borehole-measured soil temperatures of 4 soil layers, the *ERA5-P*$_{surf}$ simulation outperform *ERA5-P*$_{soil}$ during 2006–2014. The obtained P_{soil} and P_{surf} were then utilized as soil parameters in GIPL 2.0 to model permafrost dynamics for a long period from 1983 to 2019, respectively, using ERA5-Land as forcing data. Simulations revealed significant disparities. In comparison to the simulation using P_{surf} results using P_{soil} show that the mean annual soil temperature at 1 m depth was 2.72 °C lower with a 0.01 °C/a (50.0%) lower trend; the active layer thickness was 0.81 m (35.7%) less with a 2.16 cm/a (82.1%) lower trend. This study implies that choosing soil parameterizations is critical for model evaluation against observations.

The results were published in ***Cold Regions Science and Technology***
Full article link**https://doi.org/10.1016/j.coldregions.2023.103833**

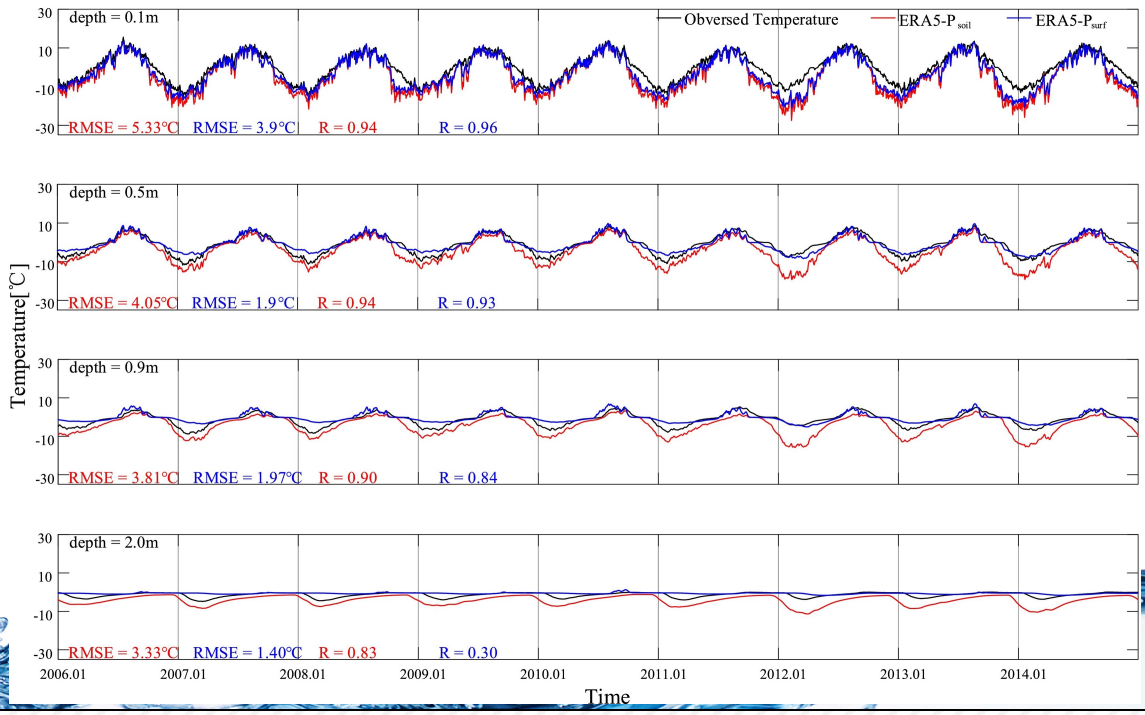


Fig. 2. Comparison of simulated and in-situ soil temperatures. The simulated soil temperatures were calculated by *ERA5-P*$_{surf}$ and *ERA5-P*$_{soil}$.

Research

Multi-model analysis of historical runoff changes in the Lancang-Mekong River Basin – Characteristics and uncertainties

Assessing the changes in runoff is crucial for ensuring the sustainable management of water resources in the Lancang-Mekong River Basin (LMRB). However, the understanding of historical runoff changes in the LMRB remains incomplete. To address this gap, the use of global hydrological models (GHMs) has provided valuable insights into runoff changes on a global scale. Recently, **Prof. Junguo LIU and his team** published an article in the *Journal of Hydrology*, where they conducted a comprehensive analysis using ten GHMs from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). Their study focused on temporospatial variations in runoff within the LMRB from 1971 to 2010, shedding light on the uncertainties associated with different model outputs.

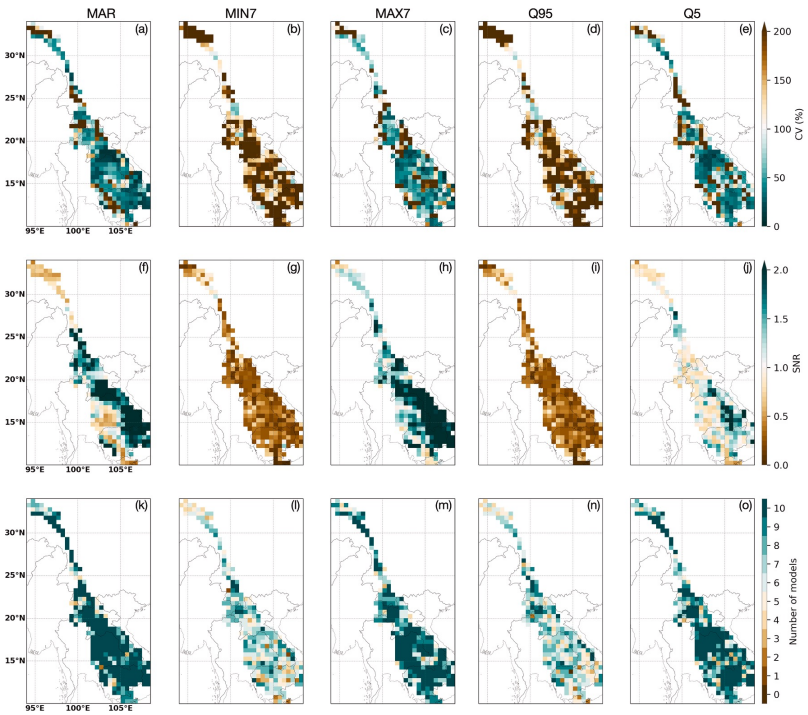


Fig. 1. Uncertainties in multi-model runoff trend detection quantified by (a-e) the coefficient of variation (CV) and (f-j) signal-to-noise ratio (SNR), and (k-o) the number of models that agree with the same trend as the model ensemble mean.

Research

Results show that the model ensemble mean has the best performance than the individuals when compared with the reference data. Based on the model ensemble mean, large spatial heterogeneity of runoff is found in the LMRB, with an overall slightly positive trend (8.03%). Besides, the models perform better in estimating the trends of high flow than low flow. As to the trend of runoff in the wet and dry seasons, about 32% (70%) of the basin became drier (wetter) in the dry (wet) season. Meanwhile, 17% of the basin has experienced a trend of drier dry seasons and wetter wet seasons. Overall, our results highlight the uncertainty of the runoff changes in the LMRB in the low flow simulation, particularly requiring more attention in future model improvement. The complex change patterns of the runoff suggest the importance of accurate runoff observations and projections for better water management.

The results were published in ***Journal of Hydrology***
Full article link**: https://doi.org/10.1016/j.jhydrol.2023.129297**

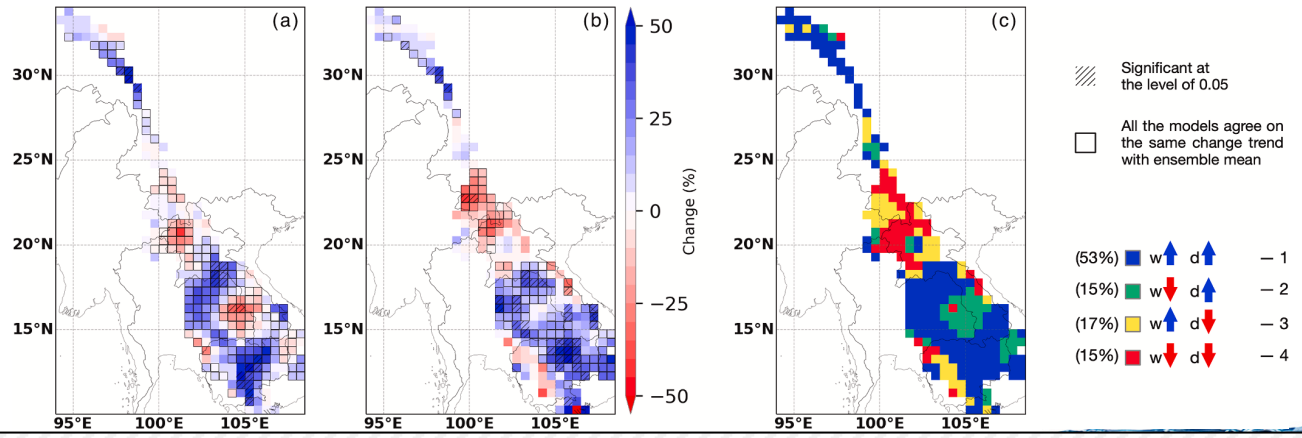


Fig. 2. Spatial distribution of runoff trends in (a) wet and (b) dry seasons based on the model ensemble mean during 1971–2010, and (c) runoff regime change in the LMRB from 1971 to 2010 based on four different change situations.

Research

Clarification of dominating drivers for streamflow changes in the upper reach of Mekong River Basin

Clarification of the influences of climate change and human activities on streamflow changes is necessary for the sustainable exploration of water resources. However, previous studies provided different results in terms of the roles played by climate change and human activities, leaving a knowledge gap in the complex streamflow variability and its physical causes in Lancang River Basin (LRB). To address this gap, the Budyko framework-aided analytical approach was applied to explore the streamflow decrease in LRB and its physical causes, by especially clarifying the different performances of eight Budyko equations and the influences of diverse baseline periods. Recently, **Prof. Yanfang SANG, Prof. Deliang CHEN and an international team** published an article in the *Journal of Hydrology: Regional Studies*, where they conducted a comprehensive analysis using ten GHMs from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP).

Their study focused on temporospatial variations in runoff within the LMRB from 1971 to 2010, shedding light on the uncertainties associated with different model outputs.

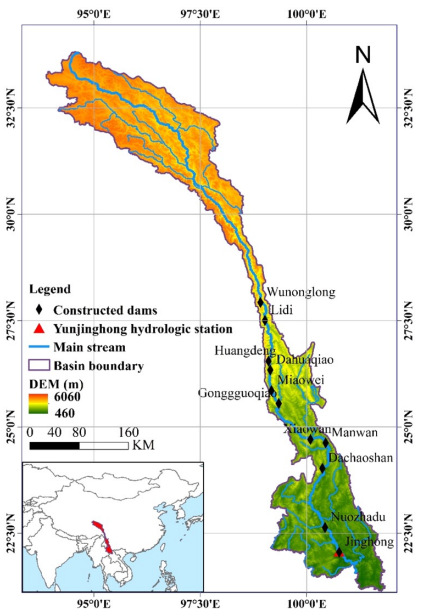


Fig. 1. Main hydrological station and the major cascade reservoirs on the main river channel in Lancang River Basin.

Research

Results revealed that the four parametric Budyko equations can provide proper parameters to reflect changes in catchment characteristics (including human activities) and their influences, and thus, they performed better than the four non-parametric Budyko equations. It was further found that more reasonable attribution results of streamflow change were obtained when a longer baseline period (at least 20 years) was used. Results also indicated that human activities (accounting for 158.9%) dominated the streamflow decrease during the transition period (1986–2004), by offsetting the positive effects of climate change (accounting for 58.9%). During the impact period (2005–2015), human activities (accounting for 65.6%) still dominated the streamflow decrease, and climate change (accounting for 34.4%) further aggravated the streamflow decrease in LRB.

The results were published in ***Journal of Hydrology: Regional Studies***
Full article link**: https://doi.org/10.1016/j.ejrh.2023.101456**

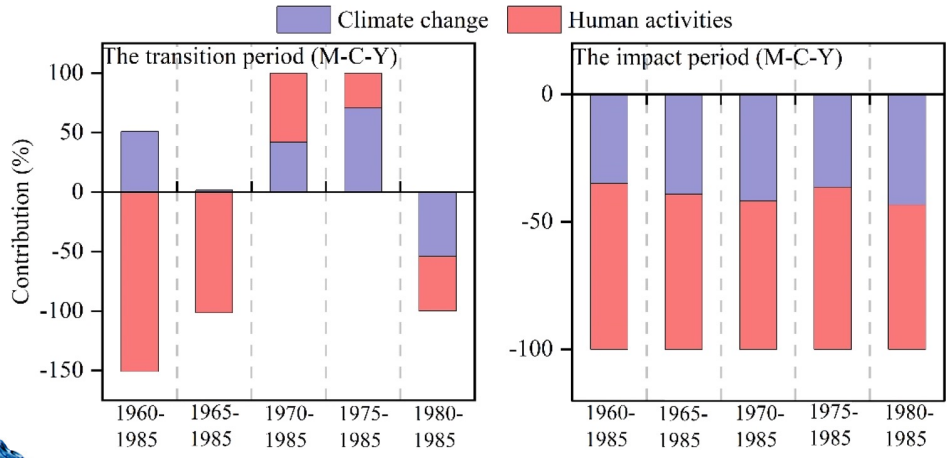


Fig. 2. Contributions of climate change and human activities to the mean annual streamflow decrease for different baseline periods.

Publications

Selected Publications Since December 2022

- Huang, Z., Y.-F. Sang, D. Chen, V. P. Singh, 2023: Clarification of dominating divers for streamflow changes in the upper reach of Mekong River Basin. Journal of Hydrology: Regional Studies 48, 101456. https://doi.org/10.1016/j.ejrh.2023.101456.
- Li, Y., Chen, A., Mao, G., et al. (2023). Multi-model analysis of historical runoff changes in the Lancang-Mekong River Basin – characteristics and uncertainties. *Journal of Hydrology*. https://doi.org/10.1016/j.jhydrol.2023.129297
- Li, T., Guo, L., He, B., Liu, L., Yuan, W., Chen, X., et al. (2023). The forest resistance to droughts differentiated by tree height in central Europe. *Journal of Geophysical Research: Biogeosciences*, 128, e2021JG006668. https://doi.org/10.1029/2021JG006668
- Ou, T., Chen, D., Tang, J., et al. (2023). Wet bias of summer precipitation in the northwestern Tibetan Plateau in ERA5 is linked to overestimated lower-level southerly wind over the plateau. *Climate Dynamics*. https://doi.org/10.1007/s00382-023-06672-3
- Prein, A.F., Ban, N., Ou, T. et al. (2023). Towards Ensemble-Based Kilometer-Scale Climate Simulations over the Third Pole Region. *Climate Dynamics.* https://doi.org/10.1007/s00382-022-06543-3

Publications

Selected Publications Since December 2022 (continued)

- Tiwari, A.D., Pokhrel, Y., Kramer, D. et al. (2023). A synthesis of hydroclimatic, ecological, and socioeconomic data for transdisciplinary research in the Mekong. *Scientific Data*. 10, 283 https://doi.org/10.1038/s41597-023-02193-0
- Xu, X., Yun, X., Tang, Q., et al. (2023). Projected seasonal changes in future rainfall erosivity over the Lancang-Mekong River basin under the CMIP6 scenarios. *Journal of Hydrology*, 620, 129444. https://doi.org/10.1016/j.jhydrol.2023.129444
- Zhao, Y., Tang, Q., Wu, T., et al. (2023). Effects of soil parameterization on permafrost modeling in the Qinghai-Tibet Plateau: A calibration-constrained analysis. *Cold Regions Science and Technology*, *210*, 103833. https://doi.org/10.1016/j.coldregions.2023.103833
- Zhu, Y., Y.-F. Sang, B. Wang, A. Lutz, S. Hu, D. Chen, V. P. Singh, 2023: Heterogeneity in spatiotemporal variability of High Mountain Asia's runoff and its underlying mechanisms. Water Resources Research. DOI: 10.1029/2022WR032721.

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