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GEWEX is a Core Project of the World Climate Research Programme on Global Energy and Water Exchanges

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9th Global Energy and Water Exchanges
Open Science Conference
Sapporo, Japan | 7–12 July 2024

SCAN ME

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Abstract Submission Deadline Extended to Monday, February 19th, 2024

9th Global Energy and Water Exchanges Open Science Conference

7–12 July 2024

The 9th Global Energy and Water Exchanges Open Science Conference, Water • Climate, will celebrate more than 30 years of GEWEX research and the strong role of the Japanese research community, and will set the stage for the next phase of research. See the list of conference sessions and topics on pg. 14.

Inside This Edition

Commentary

Peter van Oevelen
Director, International GEWEX Project Office

This year will be an eventful and hopefully fun year for all of us in the GEWEX community, not in the least because of the 9th GEWEX Open Science Conference, which will be held in Sapporo, Japan, from 7–12 July 2024 (*https://www.gewex-events.org/meetings/gewex-osc2024/*). We look forward to building upon successful past conferences held in Canmore (2018) and the Hague (2014). Sapporo is an exciting city that offers something for everyone, from great food to wonderful shopping, to small jazz clubs. Hokkaido, the northern Japanese island on which Sapporo is situated, is known as a winter wonderland with great skiing, but it also offers a splendid natural environment with volcanoes and hot springs while also being a critical agricultural region for Japan.

The conference aims to bring together the international research community, offer those familiar with GEWEX a place to interact with new and old friends alike, as well as give researchers who are not yet familiar with GEWEX a chance to experience the broad research activities performed in the GEWEX and World Climate Research Programme context. In addition, we present a platform for local stakeholders to interact with the Japanese research community and link to international research and climate adaptation efforts.

Besides the main program, there will be several side events. On the Sunday (July 6, 2024) before the main conference starts, there will be a Space Agency Event aimed at bringing together young scientists and space agency representatives. Also before the main conference, the Early Career Researcher Workshop, Extremes in the water cycle and risks to society: Understanding "actionable" information in hydroclimate research, is being organized by the Young Earth System Scientists (YESS), the Young Hydrologic Society (YHS), the American Geophysical Union Hydrology Section Student Subcommittee (AGU-H3S), and local young Japanese researchers. They are putting together an enticing 3-day program of learning, experiences, and practice as well as fun social activities. Furthermore, several of the GEWEX Panels will also meet, and we look forward bringing these activities all together!

In April 2024, we will have our 36th GEWEX Scientific Steering Group (SSG) Meeting in Budapest, which is kindly hosted by the HungaroMet NonProfit Zrt. (formerly the Hungarian Meteorological Service). And this brings me to an important aspect of our organization: membership of the SSG. Everyone can nominate or self-nominate on our GEWEX nomination webpage at *https://www.gewex.org/nomination-for-a-gewex-panel/#gf_8*, and we are always looking for more potential members for both our SSG as well as our Panels (*https://www.gewex.org/panels/*). Our SSG members are chosen first and foremost on their scientific expertise (field) and contributions as well as their participation in international collaborative activities. We are continuously striving to achieve a diverse membership profile that is representative of our community in terms of regional and gender balance as well as career stage. Not always an easy feat, and but you can help us find those individuals you think would be great! For both SSG members and Panel members, it is an advantage to have already participated in one of our activities. Not sure how to get involved? Take a look at *https://www.gewex.org/about/get-involved/*! And if you still are not sure, feel free to contact us at *gewex@gewex.org* or contact one of the Panel Co-Chairs. It is a great way to promote your research, get exposed both in terms of scientific breadth as well as network, and learn from your colleagues. So please step up!

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New GEWEX Panel Members

Dr. Asaminew Teshome, a lead researcher and Deputy Director General of the Meteorological Forecast and Early Warning division at the Ethiopian Meteorological Institute, is a new member of GEWEX's Global Land-Atmosphere System Studies (GLASS) Panel. His expertise and research work focuses on weather, climate forecasting, climate change projection, quantifying uncertainties, land atmosphere interactions, land surface processes, Earth system models, remotely sensed observations, and climate change impacts on agro-climate-ecosystems. He has worked extensively with regional climate models. His more recent interest include seasonal climate forecasts, verification, weather and climate modeling using regional climate models, and reanalysis such as single and ensemble models. He is experienced in teaching weather and climate forecast courses and has published different articles as author and co-author. Dr. Teshome has experience in the coordination of research and grant projects, and is very active in training the next generation of scientists.

Qiaohong Sun, a professor in the School of Atmospheric Science at Nanjing University of Information Science & Technology (NUIST), has recently joined the GEWEX Hydroclimatology Panel (GHP). Her research focuses on climate change detection and attribution of hydroclimate extremes. Using various statistical methods and multi-source observation data, she examines changes in hydroclimate extremes, such as extreme precipitation, floods, heatwaves, and concurrent events, across different spatial scales. Dr. Sun has developed a novel framework to quantify the contributions of different external forcings to changes in extreme events.

Dr. Sun emphasizes the importance of the reliability of observations and model simulations for diagnosing and predicting changes in hydroclimate events. She looks forward to deepening her involvement in GHP to enhance the understanding and prediction of weather, climate, and hydrology on the regional scale.

Dr. Venkat Lakshmi joined the GHP Panel late last year. His areas of research interest are catchment hydrology, satellite data validation and assimilation, field experiments, land-atmosphere interactions, satellite data downscaling, the vadose zone, and water resources.

He is currently the John L. Newcomb Professor of Engineering in the Department of Civil and Environmental Engineering at the University of Virginia. Venkat is a fellow of the American Society of Civil Engineers (ASCE), Geological Society of America (GSA), and the American Society of Agronomy (ASA); he has published over 170 peer-reviewed articles, given around 600 presentations, and acted as thesis supervisor for 25 graduate students. He currently serves as editor for *Vadose Zone Journal* and is the founding editor-in-chief of *Remote Sensing in Earth System Science* (Springer Journals). He is the President-Elect of the Hydrology Section of the American Geophysical Union.

Reflecting Back and Looking Forward with H3S

Paige Becker[1] and Adam Price[2]

[1]Postdoctoral Fellow, Colorado School of Mines, CO, USA; [2]Research Hydrologist, U.S. Forest Service

H3S Chair-Elect Adam Price (left) and Outreach Chair Emily Ellis (right) at our AGU Fall Meeting booth, highlighting our events for 2023.

Happy New Year from H3S! As we get ready to welcome new members, we want to reflect on the successes of 2023. We hosted another cyber seminar series with the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) titled "Finding Your Niche", which focused on narrowing your professional path, developing your research brand, and cultivating effective mentorship relationships. The series can be viewed on YouTube at *https://www.youtube.com/playlist?list=PLPG5Ed5L1SY6fiQd8YbEOlRiCWklhWTnx*.

We also hosted a series of events at the American Geophysical Union (AGU) Fall Meeting, including an Innovative Session on communicating science to the general public, a Town Hall on the soft skills of being a scientist, an Innovative Session on knowledge sharing of Diversity, Equity, and Inclusion (DEI) strategies, and our annual Trivia Night hosted with multiple student and early career groups in AGU. We want to thank our sponsors who made hosting these events a reality: the Critical Zone Research Coordination Network, Integrated Ground Water Modeling Center, and The Meter Group supported our Trivia Night. Finally, we had a booth at the AGU exhibition hall to allow for increased networking and interaction among students and early career scientists in the Hydrology Section and beyond.

Looking forward, we have a lot of great events planned for 2024. We'll be hosting several formal and informal events at the 2024 Water Science Conference (WaterSciCon24) in St. Paul, MN, USA. There will be two workshops, one on supporting early career researchers in the water sciences, and one on preparing for non-academic careers. Our town hall will be taking a closer look at non-academic and academic-adjacent career options. Informal event planning is still in the works, so stay tuned for more information.

We are excited to welcome the new cohort of students and early career scientists to H3S! Stay up to date with all our happenings through our various platforms and subscribe (*https://www.agu-h3s.org/contact*) to our newsletter:

Website: *https://www.agu-h3s.org/*
Twitter (X): *https://twitter.com/AGU_H3S*
LinkedIn: *https://www.linkedin.com/company/agu-h3s*

YESS Outlook on Active Engagement at International Science Meetings

Faten Attig Bahar[1], Gerbrand Koren[2], Valentina Rabanal[3], Javed Ali[4], and the YESS Executive Committee

[1]University of Carthage, Tunisia Polytechnic School, Al Marsa, Tunis, Tunisia; [2]Copernicus Institute of Sustainable Development, Utrecht University, Utrecht, The Netherlands; [3]Argentinian National Meteorological Service (SMN Argentina), Argentina; [4]University of Central Florida, Orlando, FL, USA

We are delighted to announce that for the third consecutive year, YESS will actively participate in Future Earth's Sustainability Research and Innovation Congress (SRI). Our ExeCom member, Faten Attig Bahar, is serving as a conference co-chair and the lead for the Africa Satellite Event 2024. The event will consist of a mix of cross-cutting plenary sessions, parallel thematic sessions, and live discussion tables, and it will take place from May 28th to May 31st in Durban, South Africa. This year's event builds on the success of the 2023 conference, which brought together over 300 African experts from more than 34 countries. This year, the Early Career Researcher (ECR) corner held alongside the conference will be supported by various training and capacity development activities, including Earth observation and artificial intelligence. You can learn more about the event at *https://sricongress.org/sri2024-africa-satellite-event*.

Moreover, YESS is actively contributing to the planning of the 9th Global Energy and Water Exchanges Open Science Conference (GEWEX OSC) (*https://www.gewexevents.org/meetings/gewex-osc2024/ecr/workshop*). YESS members Lucia Cappelletti, Carla Gulizia, Valentina Rabanal, and Faten Attig Bahar are part of the organizing committee of the ECR workshop that will take place before the OSC. Other ECR networks, such as the Young Hydrologic Society (YHS), American Geophysical Union Hydrology Section Student Subcommittee (AGU-H3S), and the Japanese community of young researchers, are also part of the team in charge of the 3-day workshop on Extremes in the water cycle and risks to society: Understanding "actionable"information in hydroclimate research. This will be a working meeting designed to provide feedback for the GEWEX OSC 2024 and to produce a white paper describing the ECR perspective on research challenges and opportunities related to three overarching topics:

- Extremes in the water cycle and risks to society
- Understanding "actionable" information in hydroclimate research
- Emergent issues: Artificial Intelligence/Machine Learning applications in the water-energy nexus and climate intervention in the water and energy cycle

We at YESS are inviting early career researchers (including Master's students, Ph.D. candidates, postdoctoral scholars, or researchers within 7 years of obtaining their highest degree) in the Earth system sciences to join a vibrant community. Discover more about what we do, the benefits of membership, and how you can sign up by visiting our website at *www.yess-community.org*.

A New Initiating Regional Hydroclimate Project for the United States: H_2US

Tim Schneider[1], Sarah Tessendorf[1], and Peter van Oevelen[2]

[1]National Center for Atmospheric Research, Boulder, CO, USA; [2]International GEWEX Project Office, Fairfax, VA, USA

Introduction

At the July 2023 meeting of the GEWEX Hydroclimatology Panel (GHP) in Maynooth, Ireland, a Summary Level Science Plan, "A GEWEX US-RHP for Food, Energy, and Water Security in the Anthropocene", was presented. The GHP approved this plan in August, creating the newest addition to the GEWEX Regional Hydroclimate Project (RHP) family. Recently, this Initiating RHP was named the Humans and Hydroclimate in the United States, or "H_2US" for short.

Due to the scope and scale of human activity, people are now the dominant driver of change in our Earth's systems, such that many now consider us to be in a new geological epoch called the Anthropocene. For example, there are concerns that we will drive the system to a climatic tipping point (IPCC, 2022; McIntyre, 2023), and we are now witnessing the sixth great mass extinction (Ceballos et al., 2015; Cornford et al., 2023). Hence, the **H_2US** ***Mission***:

> *A ten-year effort to understand and characterize the water, energy, and carbon cycles (physical processes) in the Anthropocene, driven by a need for useful modeling tools and actionable products developed in collaboration with a multitude of stakeholders to address climate justice and support water, food, and energy security for natural and human systems in a changing future.*

It is worth noting that the last comprehensive land-atmosphere studies in the U.S. were the GEWEX Continental-Scale International Project (GCIP, from 1993 to 2000) and the GEWEX Americas Prediction Project (GAPP, running from 2001 to 2007), which merged into the Climate Prediction Program for the Americas (CPPA). Since these first RHPs, the rest of the world has conducted numerous RHPs, and the U.S. is lagging. Now is the time for a new large, coordinated effort focused on land-atmosphere processes. This calls for an RHP that reflects the physical realities presented by the Anthropocene that are unique to our geography, and that integrates and represents the human dimensions that exert a strong influence on the natural systems.

The Science Case

Given the rapidity and scale of change in the Earth system, we need models capable of representing the carbon, energy, and water cycles with greater fidelity and at the proper time and space scales to enable actionable and convergent science. Despite advances in GCIP and GAPP, our analyses (models + observations) cannot close the water and energy balances over the U.S. One important reason to close these balances is to understand the errors and uncertainties in all of the terms in the coupled water-energy-carbon cycles.

We now have the ability to model the continental United States (CONUS) at "high" resolutions (km grid spacing) over multiple decades. Land-surface models are becoming capable of reflecting processes on smaller scales (catchments to hillslopes, e.g., Fan et al., 2019). But are our models "right"? With advances in computing, the fidelity of our models is improving (increased resolution, representation of physical processes, etc.), and in many senses the models are "outstripping" our ability to observe nature (e.g., Lundquist et al., 2019).

And yet there are emerging observational capabilities, such as the GEWEX Land Atmosphere Feedback Observatory (GLAFO, *https://www.gewex.org/gewex-content/uploads/2021/06/2105_LAI_Workshop_wulfmeyer-et-al_GLAFO.pdf*) and the United States Geological Survey's (USGS) Next Generation Water Observing System (NGWOS, *https://www.usgs.gov/mission-areas/water-resources/science/next-generation-water-observing-system-ngwos*), which should be used to validate and improve these models, especially in places where we now have sufficiently extensive and long historical time series of observations to use for model development. H_2US is an opportunity to create an environment where we can link developments of improved observation capabilities and model representation in the spirit of co-creation.

The Programmatic Case

Since there has not been a major land-atmosphere project in the U.S. for a long time, H_2US is energizing and engaging the community and will serve as a focal point for this work. H_2US both provides a mechanism for engagement and serves as an agent for "open science"to make the outputs from our project available and accessible to as broad a range of people and institutions as possible. It is a means to leverage efforts, since one agency or entity cannot do it all. It also yields an economy of scale: as agencies are focused on their respective missions (as they should be), H_2US can help to coordinate and integrate these investments into a greater whole and provide a more efficient and effective use of taxpayer dollars.

An Overview of the Plan

The efforts proposed by H_2US are aligned with the GEWEX Science Plan (GEWEX, 2021), which identifies three science goals, all of which are addressed in multiple ways by this project:

> *Goal #1*: To determine the extent to which Earth's water cycle can be predicted. This Goal is framed around making quantitative progress on three related areas: the fast reservoirs of water, flux exchanges with the Earth's main reservoirs of water, and precipitation extremes.
>
> *Goal #2*: Quantify the inter-relationships between Earth's energy, water, and carbon cycles to advance our understanding of the system and our ability to predict it across scales.
>
> *Goal #3*: Quantify anthropogenic influences on the water cycle and our ability to understand and predict changes to Earth's water cycle.

The imperatives driven by these goals fall into three categories: understanding, modeling, and observing the physical and biogeochemical environment; predicting and understanding extremes and how they are changing; and the human dimensions that drive, and are driven by these goals.

Physical/Biogeochemical Science: We need to quantify and narrow the gap between models and nature (observations) using an uncertainty framework, and identify components in modeling and observations that are needed to take imperative actions. This will enable us to better determine the water, energy, and carbon budgets from headwater catchments to the continental-scale. We also need to improve our methodologies and tools to understand and address a changing hydroclimate. Our tools should represent the full complexity and coupled interactive nature of physical, biogeochemical, ecological, and socio-economic processes at the appropriate spatio-temporal scales, which lead to multiple cascading impacts and/or crises.

Extremes: Weather and climate-related extreme events are often composed of significant environmental forcings coupled with socioeconomic characteristics that produce serious impacts and hazards for both natural and human systems. An integrated approach to research and outreach to inform understanding of current hydrological extremes is necessary. We also need to improve our knowledge, monitoring, and modeling capabilities of compound hydroclimate extremes–such as drought-heatwave-wildfire or rainfall-flood-storm surge–and their societal impacts.

Human Dimensions: By building a diverse, inclusive community of scholars, professionals, and practitioners, we can broaden participation in multidisciplinary hydroclimate modeling and applications research to enable a convergent science approach. A large gap exists in integrating social, behavioral, economic, natural, physical, and indigenous science and knowledge and then learning from that integration to improve interdisciplinary, convergent research and the production of actionable knowledge. We can co-produce usable hydroclimate models and tools through collaboration with diverse users of hydroclimate models and tools, including Indigenous and other communities that have been historically underrepresented in research. A "digital twin" of the United States would broaden the accessibility of co-produced data, tools, and case studies for educators and community users.

Thematic Research Areas

To address these goals and imperatives, we organized our science plan into Thematic Research Areas. The H_2US Affinity Group identified these Thematic Research Areas as priorities and each one has an associated Working Group (illustrated in Fig. 1): Human Dimensions, Mountain Hydroclimate, Land-Atmosphere Processes and Coupling, Impactful Extremes, Organized Convection and Precipitating Systems, Advancing Observational Systems, and Digital Earth for the U.S. (DEUS).

Given the highly interconnected nature of these thematic research areas (WGs), several high-level cross-working group themes emerged.

Convergent Modeling: Models are one of our primary tools to predict or project what will happen in future. They are also important tools to test our understanding of a system; you cannot

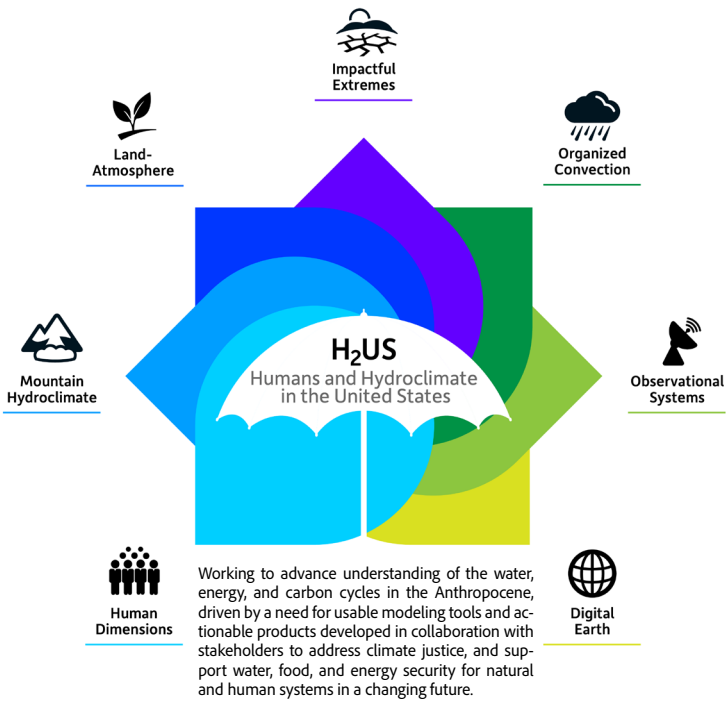

***Figure 1**. Thematic Research Areas of H_2US, each with an associated Working Group*

build an accurate model if you do not understand the system you are modeling. In this case, H_2US seeks to model the water, energy, and carbon cycles over the CONUS. Recognizing that all of the elements are interacting and evolving, our models need to to represent the human, the physical, the biogeochemical, and the ecological systems. We also need approaches to estimate and reduce the uncertainty of our model output.

The implications of the changes we are seeing in these systems, due to anthropogenic factors, lead to cascading and/or compounding events, and are potentially an existential threat to many forms of life. To develop models to represent these processes and understand how the natural and human systems are changing will require a deep integration across the disciplines represented by the WGs. This is convergent modeling.

Implicit in our modeling plans is the concept of Hierarchical System Development (HSD, *https://ufscommunity.org/articles/hierarchical-system-development-for-the-ufs/*), which is an efficient and scalable way to conduct systems development. It provides a structural framework to enable the complex undertaking inherent in the intersection of convergent modeling and observations.

Convergent Observations: Matching the complexity and challenges of convergent modeling, a comprehensive integrated strategy is required to measure and monitor a rapidly-changing system that is impacted immensely by human activity, and for which the physical, biogeochemical, and eco-systems are responding and evolving. It is particularly challenging to observe the Earth system at the requisite density and frequency, over a sufficiently long (hydroclimate) time period, and with a diversity of sensors to reduce errors and uncertainties and measure a more comprehensive suite of parameters.

Leveraging current infrastructure (including surface-based, remote, and spaceborne systems) and new developments in this arena, such as GLAFOs, will be critical for advancing our science. This needs to be conducted in a coherent and integrated manner, which is partially captured by our advocacy of a strategy of observational transects and a data hub to promote open science and widespread use of these data.

Intersections and Scales: A common theme amongst the WGs is the intersection of spatial and temporal scales and the feedback of processes up and down scales. How does a local event affect the regional? How does the regional affect the global? What are the implications for cascading or compounding extreme events? How do changes in the global state (say global warming) manifest at finer scales? There are also many similar questions across the WGs about predictions, predictability, and uncertainty across temporal scales, from analyses through decadal and centennial timeframes, though subseasonal to seasonal also comes up quite frequently.

Another dimension that emerged is the intersection of our approach to modeling and observations. An intersectional, convergent approach has already been discussed. Model development cannot be done without observations to inform that development and evaluate them against "truth". As such, the observational approach informs model development. The converse is also true: the development and application of models should inform the observational strategy. They intersect in an interdependent and interdisciplinary way.

An Integrating Framework: A construct is needed to share and synthesize data and information, and to enable the intersection of convergent modeling and observations and analyses. Such a framework creates the opportunity from which knowledge can be generated, and then shared openly in a way that (hopefully) the knowledge garnered is applied wisely to solve the great challenges of the day. It provides a hub for human interaction and sharing, both internally across the project as well as with partners and stakeholders. This is the function of DEUS.

Defining "Regional": Our Geographic Scope

The initial and rather expansive focus of H_2US is the CONUS. The CONUS encompasses a wide range of geomorphologies, land uses and land cover, weather phenomena, localized climates, and human uses. The CONUS also interacts with and is influenced by global phenomena such as dynamical processes (e.g., El Niño and La Niña, teleconnections), climate change, and large-scale events (dust storms, volcanic eruptions, etc.). Thus, there will be a range of modeling activities that span spatial and temporal scales: from the global to the regional (CONUS in this sense) to the hyperlocal (e.g., a watershed). These modeling efforts will be supported by sub-regional focal studies, driven by observational campaigns, which are optimally coordinated into transects that leverage existing as well as new assets. This is illustrated in Fig. 2.

The map in the center of the above figure prescribes our definition of CONUS for the purposes of H_2US, and notionally illustrates the idea of observational "transects" (the gray ellipses are not actual or even proposed transects, they are simply possi-

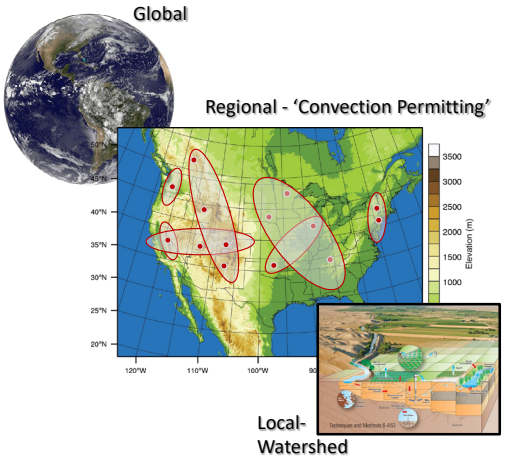

***Figure 2**. Transects within H_2US*

ble ones for illustrative purposes). The "Global" inset indicates how the CONUS scale activities are supported by global monitoring (e.g., satellites) and modeling of the weather, water, and climate systems. The "Watershed" inset represents the processes that are locally dominant and may require finer scale modeling and/or more intensive observations. The Regional domain is the link that ties it all together. There is also some dialogue about the notion of including Alaska and Hawaii in H_2US, but this will be driven by interest and resources.

In Summary

In his poem "Among School Children" (*https://www.poetryfoundation.org/poems/43293/among-school-children*), W.B. Yeats asks, "How can we know the dancer from the dance?" This seems to capture the spirit of what we hope to achieve in H_2US.

One of the primary drivers for this project is to reduce the uncertainty in our ability to measure, predict, and understand the coupled water, energy, and carbon cycles:

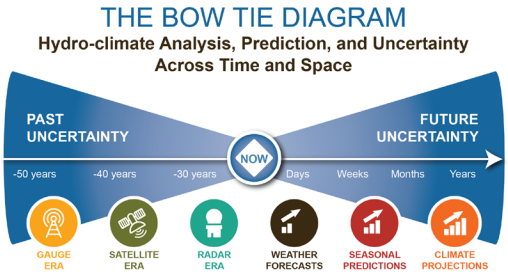

***Figure 3**. The bow tie diagram*

H_2US is an opportunity to develop a coordinated, holistic response to hydroclimate change. In the past several years, the U.S. has witnessed hydroclimate events that are without historical precedent (e.g., heat extremes, droughts, fires, relentless coastal storms, flooding, and record snowfalls), and the number of such events is growing. Yet the environmental science community often responds in a disjointed way, as there is no established mechanism to provide the needed coordination and synthesis. H_2US would create a flow of information that is sustained, coordinated, and actionable to the agencies and user communities, as these events and their aftermath unfold. This would help address and align the sizable gaps between the physical and human hydroclimate knowledgebase across the community. It is an opportunity to engage and co-produce science with Indigenous scientists and knowledge holders, in order to develop a more comprehensive and complete understanding of our changing hydroclimatic system. It is also an opportunity to center ideas about engagement, equity, and climate justice in knowledge co-production and application, to broaden participation in multidisciplinary hydroclimate modeling, observations, and applications research, and to make actionable outputs more accessible and usable to educators and community users.

Next Steps

In 2024 we will work to address the requirements required of an Initiating RHP. We will establish a formal governance, including a scientific advisory group; we will hold workshops to inform the first draft of an implementation plan; and we will continue to engage and coordinate with U.S. program and funding agencies and stakeholders to align with their mission priorities and create opportunities for support.

For more information, or if you have any questions, please reach out to Tim Schneider at *tls@ucar.edu*. The H_2US GEWEX webpage can be found here: *https://www.gewex.org/h2us/*. To join the H_2US Affinity Group and download a PDF of the Summary Level Science Plan, please visit: *https://ral.ucar.edu/projects/humans-and-hydroclimate-united-states-h2us*.

Acknowledgements

The plan was developed within the H_2US Affinity Group, which has (as of this writing) 168 diverse members. The Working Group Leads played an important role in organizing and drafting the content for their respective sections, as well as helping to integrate across the themes. ***Working Group Leads**: Jeff Basara, Mike Bosilovich, Dan Feldman, Craig Ferguson, Andrew Gettleman, Cenlin He, Mimi Hughes, Christine Kirchhoff, Rachel McCrary, Steve Nesbitt, Diamond Tachera, and Natalie Thomas.*

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Meeting/Workshop Reports

2023 GDAP Annual Meeting

New York, NY, USA
19–20 October 2023

Tristan L'Ecuyer[1] and Hirohiko Masunaga[1]

[1]GEWEX Data and Analysis Panel (GDAP) Co-Chairs

Accurately modeling Earth's energy imbalance and water cycle and their variability are fundamental to predicting the impacts of climate change. This motivated holding the 2023 GDAP Meeting in conjunction with the 2023 Clouds and the Earth's Radiant Energy System (CERES) fall science team meeting at the NASA Goddard Institute for Space Studies (GISS) in New York, USA from 19–20 October 2023. The venue provided an opportunity for GDAP to engage CERES and GISS researchers in scientific exchanges about the opportunities and challenges in using the growing satellite energy and water cycle data records for climate model development. The Panel meeting also included updates on all major GDAP projects and activities. Most Panel members and activity leads were able to join the Panel business meeting either virtually or in person on Friday morning.

CERES has played a key role in advancing energy budget science for more than two decades and has contributed to several GDAP activities. In addition to providing the latest updates on the CERES top of atmosphere and surface radiative flux products, the 2023 fall science team meeting addressed several current GDAP foci, including closure of the energy and water cycles, trends in Earth's radiation balance, and Earth's energy imbalance. Upcoming missions were introduced that promise to add a spectral dimension to radiation measurements and improve absolute calibration of top of atmosphere flux observations. Plans to extend the growing record of Earth radiation budget measurements with the Earth Ventures-Continuity Libera mission were also described, although some concerns remain regarding the ability to maintain a continuity with CERES.

The CERES meeting paved the way for GDAP to host a candid discussion between Panel members, CERES science leads, and GISS scientists on how GEWEX might foster increased use of global energy and water cycle observations to inform climate model development. Separate sessions covered the broad topics of water and energy cycles and convection. Introductory talks by Maria Hakuba, Ali Behrangi, Greg Elsaesser, and Kuniaki Inoue summarized current challenges and highlighted open questions to stimulate a broader discussion of potential avenues by which GDAP could contribute to advancing observation-model cooperation. Among the key messages were the acute needs for robust observational metrics and an understanding of structural uncertainties to avoid over-fitting models to spurious trends and variability. A careful distinction should also be made between observations for model evaluation and those that support model development. The latter generally consists of multi-dimensional metrics, or process-oriented diagnostics, that should be guided by model physics and able to be robustly simulated from model output. Spectrally-resolved radiation measurements spanning the top of atmosphere solar and thermal emission spectra that fit this model may be available soon. GDAP may sponsor a workshop focused on the value of spectrally-resolved radiation measurements for feedback analyses and model development.

The discussion revealed new methods for diagnosing systematic errors and improving model parameterizations such as multi-parameter tuning and energy and water closure, demonstrating progress in interfacing observations and models. However, the discussion concluded that, while there are many independent efforts to produce useful model diagnostics, progress is impeded by the lack of an internationally-coordinated effort to organize model and observational data and associated analytic tools on the cloud. While the shift toward open science is a valuable step toward expanding participation, higher-level coordination of assets and tools is needed to bring communities together and maximize progress, especially as data volumes grow.

The GDAP Panel convened on Friday to welcome two new members, Patrick Taylor and Brent Roberts, and offer our warmest thanks for departing member Seiji Kato. Hanii Takahashi accepted a nomination to join the Panel, representing new initiatives related to convective cloud tracking and observing energy and water cycle processes. Following new member talks by Brent Roberts and Patrick Taylor that highlighted challenges in compiling comprehensive reconstructions of Earth's energy and water cycles and understanding polar amplification, respectively, the Panel heard updates from each of the core projects and activities.

The GDAP Earth's Energy Imbalance (EEI) Assessment continues to advance under the leadership of Benoit Meyssignac and Tim Boyer. A second community workshop was held in Frascati, Italy, in May 2023, highlighting consensus between independent estimates from top-down (satellite-based) and bottom-up (in situ) approaches for deriving EEI. Several papers have emerged from this activity. Moving forward, the group will explore methods for increasing the spatial and temporal resolution of energy imbalance estimates with a target of demonstrating the potential for generating consistent regional, monthly estimates from multiple methodologies.

Following a productive meeting in 2022, the Baseline Surface Radiation Network (BSRN), under the leadership of Christian Lanconelli and Laura Riihimaki, has continued to expand the diversity of regimes monitored and implement enhanced quality control procedures. More efficient methods of data archival are being explored and a best practices white paper will be submitted soon. Plans to initiate a satellite working group in BSRN to strengthen the links between space-based and ground-based radiation measurements are ongoing.

The International Satellite Cloud Climatology Project Next Generation (ISCCP-NG) initiative continues to advance under project lead Andrew Heidinger. The Level 1 (L1G) data set

Participants of the 2023 GDAP Meeting

for the full Geostationary Earth Orbit (GEO)-ring of advanced geostationary imagers is being analyzed by several groups and feedback has been positive, prompting the application of Level-2 (L2) cloud algorithms to the L1G data. ISCCP-NG has been well received by agencies internationally and the National Oceanic and Atmospheric Administration (NOAA) and European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) have pledged to ensure continued progress.

In the past year, GDAP has been very active in sponsoring and participating in global energy and water cycle workshops. The Integrated Product (IP) workshop originally planned for spring 2020 was held in Toledo, Spain, in April 2023. Three days of fruitful discussions between land surface modelers, hydrologists, and the in situ and satellite observational communities laid the foundations for a future multi-scale, land-atmosphere closure initiative with the Global Land-Atmosphere System Studies (GLASS) Panel and GEWEX Hydroclimatology Panel (GHP). Both GDAP co-chairs also attended the 2nd EarthCARE modeling workshop in Shuzenji, Japan in March 2023. The meeting identified exciting new opportunities for engaging models with observations with the advent of km-scale Global Storm Resolving Models (GSRMs). Discussions are underway with the Global Atmospheric System Studies Panel (GASS) co-chairs regarding a potential cross-cutting activity centered on evaluating clouds and their radiative effects in GSRM simulations using modern satellite observations.

GDAP was also represented at the first convective tracking workshop in Oxford, UK, in April 2023 that highlighted the growing field of cloud tracking in global satellite observations and identified a need to coordinate efforts moving forward. Many tracking tools have been developed in the last few years that utilize different approaches to target different phenomena, but no coordinated effort has been undertaken to compare the results and articulate the performance of the various approaches. A key recommendation from the meeting was for GDAP to organize an assessment of cloud tracking algorithms in the near future.

The remainder of the meeting outlined future workshops and new initiatives in the coming year. In the next year, GDAP will continue to pursue cross-cutting activities with fellow GEWEX Panels GLASS, GASS, and GHP. GDAP will continue to support the Upper Tropospheric Clouds and Convection (UTCC) Process Evaluation Studies (PROES) activity with GASS by assisting with a second ISCCP-NG community workshop in Darmstadt, Germany (February 2024), focused on discussing time and space resolution needs and defining L2 ISCCP-NG products. GDAP will also sponsor a follow-up convection tracking workshop at NASA GISS in New York (April 2024) led by new panel member Hanii Takahashi. Approaches for implementing recent advances in cloud tracking in multi-channel geostationary observations (e.g., ISCCP-NG) and interfacing with km-scale models will be discussed. Another goal for this meeting will be to define the scope of a GDAP-led coordinated assessment of cloud tracking algorithms and to identify participants. The Panel pinpointed polar amplification, process-oriented model diagnostics, and a new radiation assessment addressing the vertical and spectral dimensions as avenues to target for new activities in the near future. Longer-range goals include a third precipitation assessment to update the previous assessment report published in 2021 with renewed foci including the global and regional precipitation trends over recent decades and challenges in solid precipitation estimates, which are expected to meet emerging GDAP interests such as EEI and polar energy and water cycles.

The meeting concluded with a brief discussion of remaining membership needs. The desire to establish liaisons with GASS and GHP was reiterated (Yunyan Zhang currently serves as a liaison to GLASS) and a gap in ground-based radar expertise was noted. GDAP continues to seek nominations for new members that complement existing expertise on the Panel and, especially, those who complement the gender, ethnic, and geographic diversity of the Panel. The next GDAP Panel Meeting will be held in conjunction with GEWEX Open Science Conference in Sapporo, Japan (July 2024).

The Flood Crosscut Workshop Summary

Online Meeting
September 22, 2023

Joshua Roundy[1] and Vidya Samadi[2]
[1]University of Kansas, Lawrence, Kansas, USA; [2]Clemson University, Clemson, South Carolina, USA

The Flood Crosscut (*https://www.gewex.org/floods-cc/*) is a new GEWEX initiative aimed at addressing the World Climate Research Programme (WCRP) Grand Challenge regarding global flood processes and impacts through evaluating the application of research and knowledge about the connection between flooding and the global water and energy cycles, and creating a mechanism for involvement from the global science community. To kick off this initiative, the first Flood Crosscut Workshop was held on September 22, 2023, as a virtual meeting. There were over 85 flood experts from across the globe that attended the workshop. The meeting started with an introduction to GEWEX and the Flood Crosscut initiative. There were then three breakout sessions focused on key areas of interest that included: hydrologic factors for flood generation, spatiotemporal variability of flooding, and the interplay of flooding with climate and land use change. Each breakout session consisted of three to four invited talks and then was followed by 45 minutes of discussion. During the discussion period, each group created a summary slide that contained key science questions, priorities, existing efforts, and designated advocates. After the breakout sessions, all participants reconvened for a wrap-up session where a representative from each of the three breakout sessions presented the group's report. This was then followed by a discussion with the entire group about the next steps and future meetings. A brief summary of the main priorities identified in each breakout session is given below; however, a full summary of the workshop, including slides, presentations, and the summary slides, can be found at *https://www.gewexevents.org/meetings/2023floods/program/*.

Hydrologic Factors: Three main priorities were identified, including hydrological process controls, observations, and human impact. Hydrological process controls include understanding the flashy behavior for small watersheds and streams, especially for drier regions with human activity. This includes identifying the mechanisms for very rare disastrous floods, which may have different mechanisms than more regular floods. This is particularly relevant for cold regions, which are poised to see the largest changes in climate. The opportunity to use remote sensing to understand and quantify these factors and different scales was also discussed. This includes precipitation extremes, hydrologic conditions, and human activity. Lastly, the need to understand the human impact from flood exposure and society's response to changing flood patterns was identified as a priority area.

Spatiotemporal Variability of Flooding: Four main priorities were identified, including understanding whether big floods are fundamentally different from small floods, the need for better collaboration between atmospheric science and the hydrologic and engineering communities, translation of flood science to better understand flood hazards, and activities to improve the collection of observational data sets. This includes identifying differences in storm types, runoff generation mechanisms, and translating information from large ensembles to local scale impacts. This is particularly relevant for engineering practices and developing new approaches and methods for flood evaluation of engineering design.

Interplay with Climate and Land Use: Three main priorities were identified, including creating projections of future physical changes in catchments driven by human activity, understanding the dynamic interaction between the policies and the potential for land use change, and the sensitivity of flooding at different scales and flood types under future scenarios of land use change. This includes understanding the impact of reservoir management, urbanization, and changes to agriculture on flooding. It also includes more natural processes, such as the feedback of evapotranspiration to the atmosphere due to land use change. It is necessary to include both natural and human-induced feedback when considering future scenarios and their impact on flood mechanisms.

As a direct result of this workshop, the Flood Crosscut will focus on structuring and incorporating the initiative to meet the priorities identified during the workshop. This includes completing the following three main goals over the next year.

- First, develop a white paper to summarize and synthesize the science questions and priorities identified during the workshop.
- Second, develop and submit a crosscut proposal to the GEWEX Global Hydroclimate Panel (GHP) to become an official GEWEX activity.
- Third, begin holding bi-monthly (every two months) meetings alternating between subgroup small meetings and the entire group.

Completing these goals over the next year will ensure continued development and progress of the Flood Crosscut initiative. If you would like to be involved with the Flood Crosscut initiative, please contact the Flood Crosscut team (*https://www.gewex.org/floods-cc/contact/*) and/or submit an abstract to the Flood Crosscut session as part of the GEWEX Open Science Meeting in Sapporo, Japan in July, 2024 (*https://www.gewexevents.org/meetings/gewex-osc2024/*).

Updates on the International Network for Alpine Research Catchment Hydrology (INARCH) and its 2023 Annual Workshop

Stanley, Idaho, USA
October 9–11, 2023

John W. Pomeroy[1], James McNamara[2], Andrew Hedrick[3], and Chris DeBeer[1]

[1]Centre for Hydrology and Global Institute for Water Security, University of Saskatchewan, Canada; [2]Department of Geoscience, Boise State University, USA; [3]Northwest Watershed Research Center, Agricultural Research Service, U.S. Department of Agriculture, USA

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 February 2023 issue of *GEWEX Quarterly* (*https://www.gewex.org/resources/gewex-news/*).

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

INARCH is conducting a Common Observing Period Experiment (COPE) over the period 2022–2024 as a focal network activity. The purpose of this is to collect high-quality measurements to the extent possible, along with supplementary observations and remote sensing campaigns, to produce a common, coherent, and well-documented and described data set of mountain meteorology and hydrology from INARCH basins over the two-year period at a minimum, and longer where possible. We plan to take different models, apply them across our basins, examine the impact of different forcing data and process representations and model structures, calculate snow and ice dynamics and hydrological responses, and look at these diagnostically using observations.

COPE is now well underway with intensive observation campaigns at most of our basins and frequent visits for fieldwork and site maintenance. We have developed detailed inventories of the sensors and instrumentation in place, the data being collected, and the models to be run and their input requirements and outputs. There is an ongoing effort to assemble the data and conduct basic quality assurance and control procedures and gap-filling for model input, as well as ensuring we have the proper variables for model testing and for further description of the hydrometeorology, where this is available. It is already clear that the period has covered a range of simultaneous and varying extremes—from extreme high snowpacks in the Sierra Nevada, USA, to devastatingly low snowpacks and snow-cover in the Alps in 2022–2023; from severe drought in many places such as the Canadian Rockies, the Andes, and Alps, interrupted by extreme rainstorms such as in central Chile in June 2023, to devastating floods such as in Sikkim, India, in October 2023; and with extreme heat causing extremely high melt of mountain glaciers.

The next steps will involve diagnostic model evaluations on INARCH basins—not the formal intercomparisons of snow water equivalent (SWE) simulation as has been done in the past, but evaluating the results of diagnostic modelling using field observations 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. Other planned analyses include comparison of the responses and sensitivity of COPE basins to temperature and precipitation changes, comparing trends and change points in basin cryosphere and hydrology, and comparing ecological changes occurring (e.g., treeline, shrubs, wildfire) and their impacts on basins. COPE will have tremendous scientific value in reducing the uncertainty of our understanding and ability to predict global change and water cycling and contributes directly to GEWEX; the World Meteorological Organization (WMO); the United Nations Educational, Scientific and Cultural Organization (UNESCO); Future Earth, the United Nations Framework Convention on Climate Change (UNFCC); and other global programs. It will produce a valuable and unique set of observations, model simulations and intercomparisons, new process understanding and insights, and better prediction of the changing mountain water cycle in the headwaters of many of the world's major river basins.

Summary of 2023 Workshop, Idaho, USA

INARCH's most recent annual workshop was held October 9–11, 2023 at the Mountain Village Resort in Stanley, Idaho, USA. Professor James McNamara and Dr. Ernesto Trujillo-Gomez of Boise State University (BSU), and Dr. Andrew Hedrick of the USDA Agricultural Research Service, were our 2023 workshop hosts, and there were 28 in-person attendees and 10 more online. Ahead of the workshop, participants visited the INARCH catchment at Dry Creek Experimental Watershed outside of Boise, with discussions of instrumentation, methodologies, goals, and scientific results, led by Jim McNamara, Ernesto Trujillo-Gomez, and Maggi Kraft. Following this, participants toured some of the cold laboratory facilities at BSU and then departed to Stanley in the Sawtooth Mountains.

The workshop included 1.5 days of presentations and discus-


***Left**: INARCH participants on October 11, 2023, outside of the Mountain Village Resort, Stanley, Idaho. **Middle**: field tour at the Dry Creek Experimental Watershed. **Right**: field tour at the Reynolds Creek Experimental Watershed as part of the 2023 annual INARCH workshop.*

sion on topics including: Observatories and Measurement Techniques, Observations and Modelling, and COPE Updates, as well as one hybrid session to allow for updates via Zoom. The presentations showed tremendous scientific advancements and covered the wide range of field and modelling activities underway as part of the COPE. Presentations, workshop photographs, and summaries of the different sessions are available at *https://inarch.usask.ca/news-events/inarch-workshop-2023.php*.

After the workshop, participants visited the INARCH catchment at Reynolds Creek Experimental Watershed in the Owyhee Mountains, with discussions of instrumentation, methodologies, history, and findings led by Andrew Hedrick, Gerald Flerchinger, and other USDA Northwest Watershed Research Center staff. Throughout the workshop and field tours, our hosts at BSU and USDA provided excellent hospitality, organization, and arrangements.

INARCH Statement 2023

- INARCH is helping to plan science for and contribute to the UN International Year of Glaciers' Preservation–2025, including snow, mountain water, and frozen ground.
- COPE is running successfully around the world, observations are being made and archived in a data management system, and models are being identified, with some prepared to analyze the data.
- Climate change and extremes continue to strongly affect basin cryosphere and hydrology during the COPE period, including rapid glacier retreat, groundwater destabilization, drought, fires, and floods.
- A greater appreciation of subsurface storage and flow pathways has emerged in INARCH, which is improving the ability to predict and diagnose future hydrology as snow and glacier contributions decline.

We need to:

- Develop detailed science investigations in COPE and ensure that COPE data is used by other groups (WMO, intercomparison projects).
- Apply atmospheric/hydrological/other models to INARCH basins for the COPE period.
- Co-develop plans to share experiences on increasing mountain community/regional science and decision-making capacity.

Upcoming Activities and Events

A resolution (*https://digitallibrary.un.org/record/3994297?ln=en*) was passed by the UN General Assembly in December, 2022, which noted "shrinking of the cryosphere, with mass loss from ice sheets and glaciers and reductions in snow cover, which have decreased the stability of high mountain areas and change the amount and seasonality of runoff and water resources in snow-dominated and glacier-fed river basins" and declared 2025 as the International Year of Glaciers' Preservation and each March 21st as the World Day for Glaciers. The UN invited "activities aimed at raising awareness of the importance of glaciers, snow, and ice in the climate system and the hydrological cycle…and to share best practices and knowledge in this regard". INARCH is well-positioned to support this initiative and contribute to its scientific milestones on snow and ice observations systems, assessment and prediction of their contributions to freshwater supplies, and development of modelling and information systems for mountain basins and development of adaptations in downstream river basins. It can also contribute to sharing knowledge and building scientific capacity. The results of COPE will be available for release in 2025 and will be a contribution to this Year.

INARCH will hold the next Annual Workshop from October 14–19, 2024 in Lanzhou and Zhangye in central China. The workshop will be hosted by Dr. Tao Che and Dr. Xin Li of the Chinese Academy of Sciences and will involve examination of research catchments in the Qilian Mountains. As with past workshops, the plan will be to hold scientific sessions and discussions, updates on COPE, and to visit local research basins and experimental field sites. Further details will be available on our website.

We are excited about the ongoing work and looking forward to seeing it through to completion. INARCH welcomes new participants who wish to contribute to its goals and objectives, and to participate in the COPE initiative. Feel free to contact us or check our website for updates.

HYDROSPACE 2023

Lisbon, Portugal
27 November–1 December 2023

Jérôme Benveniste[1], Jean-François Crétaux[2], and Peter van Oevelen[3]

[1]European Space Agency (ESA-ESRIN), Frascati (Rome), Italy; [2]Laboratoire d'Études en Géophysique et Océanographie Spatiales (LEGOS), Toulouse, France; [3]International GEWEX Project Office, Fairfax, VA, USA

The European Space Agency (ESA), in the context of the "Earth Observations Science for Society" Programme, GEWEX, and the Centre National d'Études Spatiales (CNES), organized a sequel joint event to Hydrospace2021 and the Earth Observation for Water Cycle Science 2020 Conference (EO-4Water2020). The 5th Space for Water Cycle and Hydrology Workshop, HYDROSPACE 2023, took place in Lisbon, Portugal from 27 November to 1 December 2023.

HYDROSPACE 2023 aimed at reviewing the latest advances in the use of Earth Observation (EO) technology for water cycle science and hydrology and its applications, exploring the potential offered by the existing and coming EO satellites together with advanced modeling and novel technologies as well as the main challenges and opportunities to enhance our current capacity to observe, understand, and predict the water cycle and its impacts and feedbacks with human activities and ecosystems. One of the goals of the event was to contribute to defining a community scientific agenda that may drive future scientific activities of ESA and other space agencies and partners to face one of the main societal challenges of our day.

The HYDROSPACE 2023 Workshop was open to EO scientists, water researchers and students, modelers, Earth system and climate scientists, industry, operational agencies, policy makers, representatives of local communities, and other stakeholders interested in sharing their knowledge and experience and in contributing to drive the scientific agenda for advancing EO water research and future applications. Overall, the event attracted 207 participants from 22 countries to Lisbon. The whole workshop was recorded and can be viewed on-line. Presentations and posters are also on-line at *https://www.hydrospace2023.org/photo-gallery-and-presentations*.

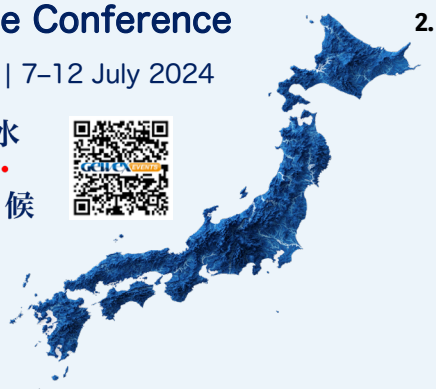
Since there were many fantastic presentations during this workshop, we can only highlight a few. Because of the recent launch of the Surface Water and Ocean Topography (SWOT) mission (https://swot.jpl.nasa.gov/), jointly developed by the National Aeronautics and Space Administration (NASA) and Centre national d'études spatiales (CNES) with contributions from the Canadian and UK Space Agencies, quite a few presentations centered around this wide-swath altimetry mission and showcased exciting new results and use possibilities of these new data, which should become widely-available in 2024. The expectations of SWOT seem clearly to be met, if not surpassed. Among all the noteworthy keynotes on flood management, surface water storage, hydrogeodesy, and more, results from the Italian Research Council, Research Institute for Hydrogeological Protection (CNR-IRPI) team showed the progress made in the development of a "hydrological digital twin". More traditional research areas such as soil moisture estimation from space using the Soil Moisture Ocean Salinity (SMOS) and Soil Moisture-Active Passive (SMAP) missions were also presented, including a new low-cost L-band radiometer that could be a follow-up to instruments on missions such as SMAP. Sentinel-3 and Sentinel-6MF water level data as well as total water storage using Gravity Recovery and Climate Experiment (GRACE) were also subjects of many presentations.

As stated, the workshop was meant to provide a scientific overview of the progress made and a forum for discussions among the community, and to establish needs perceived by the hydrological community concerning Earth observations. A detailed report will be drafted by the co-chairs of the sessions and the Organizing Committee, the "SUMMARY AND RECOMMENDATIONS FROM THE HYDROSPACE 2023 WORKSHOP" document; it will be published by ESA with a DOI on the HYDROSPACE-2023 website (*https://hydrospace2023.org/*) and may be the basis for a peer-reviewed publication.

9th Global Energy and Water Exchanges Open Science Conference

Sapporo, Japan | 7–12 July 2024

Water • Climate | 水 • 気候



Source: HydroSHEDS Database
Lehner, B., Grill G. (2013): Global river hydrography and network routing: baseline data and new approaches to study the world's large river systems. *Hydrological Processes*, 27(15): 2171-2186.
Natural Earth Data

Abstract Submission Deadline Extended to Monday, February 19th, 23:59:59 GMT

Program Topics and Sessions

Abstracts can be submitted to the areas of research and associated topic(s) and sessions listed below. Visit the conference website at https://www.gewexevents.org/meetings/gewex-osc2024/.

1. Determination of the extent to which Earth's water cycle can be observed and predicted

Topic: Observing the energy, water, and carbon cycles

Sessions:

- Observing the water cycle from space
- Global Precipitation Experiment (GPEX)
- Novel observation methods from ground-based, airborne, and space platforms for closing observational gaps in the water, energy, and carbon cycles
- Reconstruction of historical global and regional hydroclimate systems
- Sustainability of groundwater resources

Topic: Energy, water, and carbon cycle balance studies

Sessions:

- Earth's energy imbalance and the role of the water cycle
- Progress in closing the water, energy, and carbon budgets at basin to global scales

Topic: Regional and catchment scale perspective on the water and energy cycles

Sessions:

- The global and regional water and energy budget
- Observational and modeling initiatives for the Asian Monsoon Field Campaign (AsiaPEX and AMY-II)
- The mountain and cold region (cryosphere) water cycle
- Regional Hydroclimate Projects
- Understanding "actionable" information in hydroclimate research

Topic: Emergent issues

Sessions:

- AI/ML applications in the water-energy nexus
- Climate intervention in the water and energy cycle

2. Quantification of the inter-relationships between Earth's energy, water and carbon cycles to advance our understanding of the system and our understanding of the system and our ability to predict it across scales

Topic: Atmospheric processes (Centennial celebration of atmospheric science education and research in China)

Sessions:

- Understanding subdaily rainfall extremes and the diurnal cycle of precipitation
- Cold regions Earth systems change (including cold air outbreaks, precipitation occurring near 0°C and the role of snowfall in the water and energy cycle)
- Global energy and water cycles, clouds and radiation
- Changes in rainfall intensity and distribution in time and space and their effect on surface water partitioning
- Climate and weather processes in the Asian Maritime Continent
- Organized convection—Observation, tracking, modeling, and process understanding
- Upper troposphere-lower stratosphere interactions
- Mesoscale organization of deep convection
- Atmospheric boundary layer observations and modeling
- Aerosol-cloud-precipitation interactions
- Shallow mesoscale organized convection
- Cloud processes
- Storms and high-impact weather
- Challenges for lightning prediction and early warming
- Atmospheric dynamics-physics interactions

Topic: Land surface processes

Sessions:

- Evapotranspiration determination
- Moving beyond MOST (Monin Obukhov Similarity Theory): Towards the next generation of land-atmosphere coupling in Earth system models
- Monitoring and modeling of water and carbon cycle coupling including Solar Induced Fluorescence (SIF) over a range of ecosystems and climates
- Groundwater modeling and observations
- Comparisons of observations and land model output: Insights on process understanding and representation (Benchmarking and Metrics)
- Novel mechanistic modeling and monitoring of the soil-vegetation system for the improved prediction of land-atmosphere interactions
- Leveraging land surface temperature to advance understanding and modeling of land-atmosphere interactions

Topic: Land/atmosphere coupling

Sessions:

- Land-atmosphere interactions and climate predictability, including subseasonal to seasonal (S2S)
- Land-atmosphere interactions and water cycle over

the Third Pole Region

- Grand challenges in land-atmosphere interaction in Asia
- Land-atmosphere system—Synergetic observations, modeling for improved process understanding (including atmospheric boundary layer and GLAFO)

Topic: Modeling the Earth system

Sessions:

- Km-scale regional and global modeling—Advancements, opportunities, and challenges
- Monsoon—Atmospheric-land and atmospheric-ocean interactions (special celebratory session of 150 Years of the Indian Meteorology Department, together with SPARC/ACAM)
- Water, energy and carbon processes: Advances and challenges to bridge between models and current observational data records across scales

3. Quantification of the anthropogenic influences on the water cycle and our ability to understand and predict changes to Earth's water cycle

Topic: Interactions between the human and geophysical systems

Sessions:

- Advances in irrigation hydrology and its impact on the regional climate
- Human-climate water nexus, climate change, and water security, water management, and sustainability
- Water and climate in urban and/or coastal environments
- Land-atmosphere interactions for cities and urban climate
- High resolution hydrological modeling incorporating anthropogenic interventions
- The role of freshwater in sea level rise and near-coastal subsidence on water resources
- Coupled human-Earth system modeling

4. Extremes in the water cycle and risks to society

Topic: From extremes to risks to society

Sessions:

- Satellite observations for climate extremes
- Heatwaves and droughts in present and future climate
- Monsoon processes and society
- Documenting extremes
- Addressing the challenge of cascading and compound events
- Predictability and prediction of extreme events
- Early warning of climate and disaster risk management
- Generating climate information for smaller-scale decision-making
- Advance in flood research, its prediction, impact assessment and mitigation strategies

Additionally, there is a "Water and climate science open session" for those abstracts that do not fall under any of the above-mentioned sessions.

GEWEX/WCRP Calendar

For the complete Calendar, see http://www.gewex.org/events/

13–16 February 2024—AGU Chapman Conference on Remote Sensing of the Water Cycle: Sensors to Science to Society—Honolulu, HI, USA

12–13 March 2024—Workshop on Global Precipitation Monitoring in a Joint European Effort—Offenbach, Germany

13–15 March 2024—Confronting Earth System Model Trends with Observations: The Good, the Bad, and the Ugly—Boulder, CO, USA

18–22 March 2024—5th International Baltic Earth Winter School for Young Scientists on "Earth System Science for the Baltic Sea Region"—Sopot, Poland

7–10 May 2024—4th International Soil Modeling Consortium (ISMC) Conference—Tianjin, China

13–17 May 2024—5th Baltic Earth Conference—Jūrmala, Latvia

27–30 May 2024—8th WMO Workshop on the Impact of Various Observing Systems on Numerical Weather Prediction and Earth System Prediction—Norrköping, Sweden

2–7 June 2024—International Workshop on Stratosphere-Troposphere Interactions and Prediction of Monsoon weather EXtremes (STIPMEX)—Pune, India

3–6 June 2024—2024 Cloud Feedback Model Intercomparison Project (CFMIP) Meeting—Boston, MA, USA

23–28 June 2024—Asia Oceania Geosciences Society (AOGS) 2024—Pyeongchang-gun, South Korea

7–12 July 2024—9th Global Energy and Water Cycle Open Science Conference—Sapporo, Japan

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