GHP Working Group (Project) Reports for the 35th GEWEX SSG Meeting 2023

Full Panel Name (Acronym)	**:** United States Regional Hydroclimate Project (US RHP)
Reporting Period	**:** 01 January - 31 December 2022
Starting Date	**:** 2020 (development of concept)
End Date (where appropriate)	**:** Nominally 10 years as planned
URL	: TBD (should have one by Maynooth meeting)

Membership

Lead(s) & Contact(s) : Tim Schneider
Sarah Tessendorf
Peter van Oevelen

Working Group (Project) Objectives, Goals and Accomplishments during Reporting Period

Overall Working Group (Project) Objective(s)

A cohesive multi-institutional effort to understand and address a changing hydroclimate in the United States, and to reduce uncertainty. We are proposing a ten-year effort to understand and characterize the water, energy, and carbon cycles in the Anthropocene: driven by a need for climate justice and for tools to address water, food, and energy security in a changing future.

As of 2023 the US-RHP remains aspirational.

List of Panel Goals

To continue to grow our scientific community, and share and learn about our communities science; to develop a summary-level science plan that is aligned with US-Agency missions and goals to secure support, and become an Initiating RHP.

List of 2 to 3 Key Results

Identified thematic research areas (8), formed working groups around seven of them. Drafted an annotated outline of a science plan for the US-RHP.

Other Science Highlights

Organized and hosted technical sessions at AMS (2022 Annual Meeting) and AGU (2022 Fall Meeting)

Panel Activities during Reporting Period

List of Panel Activities and Main Result

Biweekly meetings to share science and build community; in 2022 we grew our Affinity Group to over 100 members (161 as of this writing in 2023). Work towards a Summary Level Science Plan resulting in 8 thematic research areas identified and 7 working groups and an annotated outline.

List of New Projects and Activities in Place and Main Objective(s)

N/A

List of New Projects and Activities Being Planned, including Main Objective(s) and Timeline, Lead(s)

Science Issues and Collaboration during Reporting Period

Contributions to Developing GEWEX Science and the GEWEX Imperatives.

a. Data Sets

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b. Analysis

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c. Processes

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d. Modeling

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e. Application

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f. Technology Transfer

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g. Capacity Building

Annotated outline for US-RHP Summary Level Plan.

List contributions to the GEWEX Science Goals and plans to include these.

As the US-RHP remains aspirational in 2022, there are no specific and direct activities to report. However the 8 thematic research areas identified in our plan align with the GEWEX Goals. They are:

1. Human Dimesions

Goal # 1 (GS1): Determine the extent to which Earth's water cycle can be predicted. This Goal is framed around making quantitative progress on three related areas posed in terms of the following questions:

1. **Reservoirs:**

What is the rate of expansion of the fast reservoirs (atmosphere and land surfaces), what is its spatial character, what factors determine this and to what extent are these changes predictable?

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2. **Flux exchanges:**

To what extent are the fluxes of water between Earth's main reservoirs changing and can these changes be predicted and if so on what time/space scale?

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3. **Precipitation Extremes*:***

How will local rainfall and its extremes change under climate change across the regions of the world?

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Goal # 2 (GS2): 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:

1. **Forcing-feedback understanding:**

How can we improve the understanding of climate forcings and feedbacks formed by energy, water and carbon exchanges?

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2. **ABL process representation:**

To what extent are the properties of the atmospheric boundary layer (ABL) defined by sensible and latent energy and water exchanges at the Earth's surface versus within the atmosphere (i.e., horizontal advection and ABL-free atmosphere exchanges)?

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3. **Understanding Circulation controls:**

To what extent are exchanges between water, energy and carbon determined by the large-scale circulations of the atmosphere and oceans?

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4. **Land-atmosphere interactions:**

How can we improve the understanding of the role of land surface-atmospheric interactions in the water, energy and carbon budgets across spatiotemporal scales?

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Goal # 3 (GS3): Quantify anthropogenic influences on the water cycle and our ability to understand and predict changes to Earth's water cycle.

1. **Anthropogenic forcing of continental scale water availability:**

To what extent has the changing greenhouse effect modified the water cycle over different regions and continents?

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2. **Water management influences:**

To what extent do water management practices and land use change (e.g., deforestation) modify the water cycle on regional to global scales?

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3. **Variability and trends of water availability:**

How do water & land use and climate change affect the variability (including extremes) of the regional and continental water cycle?

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Other Key Science Questions

List 1 – 3 suggestion that you anticipate your community would want to tackle in the next 5-10 years within the context of a land-atmosphere project

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Contributions to WCRP including the WCRP Light House Activities

Briefly list any specific areas of your panel's activities in particular to the WCRP Light House Activities (Digital Earth, Explaining and Predicting Earth System Change, My Climate Risk, Safe Landing Cimates and WCRP Academy) https://www.wcrp-climate.org/lha-overview.

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Cooperation with other WCRP Projects, Outside Bodies and links to applications

e.g. CLIVAR, CliC, SPARC, Future Earth, etc.

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Workshops and Meetings

List of Workshops and Meetings Held in 2021

Meeting title, dates and location.

AMS 2022 Annual Meeting:
AGU Fall Meeting

List of Workshops and Meetings Planned in 2022 and 2023

Meeting title, dates and location and anticipated travel support needs.

Organized conference sessions related to US-RHP:

A joint session at the AMS 2023 Annual Meeting, with the 36th Conference on Hydrology and 26th Conference on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface (IOAS-AOLS), 25 January 2023, Houston, TX:

- Joint J5A - Improved Monitoring, Modeling, and Prediction of Water Availability across Scales. Part I
- Joint J6A - Improved Monitoring, Modeling, and Prediction of Water Availability across Scales. Part II

AGU 2023 Fall Meeting, Hydrology Conference, 15 December 2022, Chicago, IL, session:

- *H43A-08 - An Observational and Modeling Strategy in Support of a Regional Hydroclimate Project "Digital Twin" of the United States*

Other Meetings Attended On Behalf of GEWEX or Panel in 2022

Poster at 3RD PAN-GASS MEETING • UNDERSTANDING AND MODELING ATMOSPHERIC PROCESSES - 25-29 JULY 2022 | MONTEREY, CA, USA
DC USGCRP Fall

Publications during Reporting Period

List of Key Publications

AMS 2022 Annual Meeting (25 January 2022):

> J6A.4 A Science Plan for a Coordinated Regional Hydroclimate Project in the United States Focused on Land -Atmosphere Processes, Timothy L. Schneider, NCAR, Boulder, CO; and S. A. Tessendorf, P. Van Oevelen, F. Dominguez, A. Nazemi, and X. Zeng

AGU 2022 Fall Meeting (15 December 2022):

> H43A-08 - An Observational and Modeling Strategy in Support of a Regional Hydroclimate Project "Digital Twin" of the United States, Timothy Schneider, Sarah A Tessendorf, Peter J van Oevelen, Craig R Ferguson, Francina Dominguez, Ali Nazemi