Summary of Theme 1 Progress
Jan 2025 – June 2025

Theme: 1. Global and local interactions
Lead: Justin Sheffield, University of Southampton, UK
Date: July 2025

Theme 1 is focused on hydrological science questions across scales, connecting the local to the global.

Theme Aims:

- To accelerate understanding of hydrological processes across scales
- To better understand how processes interact, and how they and their interactions affect water resources in the local context
- To recognize the interconnectedness of processes across scales and the need to understand local variability in the context of large-scale processes and changes.

Summary of WGs

Theme 1 has 15 working groups (WGs; table 1). The working groups cover a range of topics from urban water, water and biodiversity, drought in mountain regions and runoff generation processes. No new groups have been added in this reporting period.

Table 1: Working groups and lead(s)

Number	Working Group	Lead(s)
1	REHYDRATE - REtrieve historical HYDRologic dATa & Estimates	Miriam Bertola, Paola Mazzoglio
2	Decomposing Complexity	Ankit Agarwal
3	Irrigation quantification & management & its effect on water cycle	Chiara Corbari, Tim Foster
4	Urban Water - Urbanization phenomenon & adequate water management	Bertil Nlend
5	From local to large scale human-water dynamics Now merged with WG3.4 (HELPING with Human-Water Systems Science)	Mohammad Ghoreishi Cyndi Castro
6	Comparative understanding of runoff generation processes	Fuqiang Tian
7	Water for biodiversity in a changing world	Claudia Teutschbein
8	Understanding drivers & feedbacks of soil moisture variability	Justin Sheffield
9	Deep Explanation & Evaluation for Practices in Hydrological Changes (DEEPHY)	Suxia Liu
10	Effective Aquifer Governance for Agriculture	Maria Elena Orduna Alegria
11	Hydrologic Design - Solutions & Communication	Svenja Fischer
12	Water Quality Under Global Changes	Albert Nkwasa
13	Development & application of river basin simulators	Jun Xia
14	Ensuring evidence-based findings	Benjamin Dekongmen
15	Droughts in Mountain Regions	Francesco Avanzi, Marit van Tiel

Membership

WGs have wide membership, between about 30-150 members in each WG, with an average of about 65. Membership for each WG is generally quite diverse with representation from multiple countries and continents. There is a tendency for more representation from European countries or the region of the team lead.

WG Progress

- Most active WGs have finished start-up activities, such as kick-off meetings, and surveys.
- Many (about 2/3) are having somewhat regular online meetings, comms/newsletters.
- Several papers have now been published, focusing on state-of-the-art assessments, with many more in development or plan:
    - Fischer, S., Dallan, E., Fiori, A., Grimaldi, S., Kochanek, K., Prieto, C., ... Volpi, E. (2024). Hydrologic design in the HELPING decade – inspiring the community to innovate the hydrologic design concept. Hydrological Sciences Journal. DOI/full/10.1080/02626667.2024.2436634
    - Morbidelli, R., Flammini, A., Echeta, O., Albano, R., Anzolin, G., Zumr, D., ... Saltalippi, C. (2025). A reassessment of the history of the temporal resolution of rainfall data at the global scale. Journal of Hydrology, 654, 132841. DOI.org/10.1016/j.jhydrol.2025.132841
    - Dallan, E. T. Perez-Ciria, L. Giovannini, S. Davolio, D. Zardi, M. Borga, Rainfall elasticity functions explain divergent runoff sensitivity to rainfall errors in hydrological models (2025). Journal of Hydrology, 653, 132746, ISSN 0022-1694, https://doi.org/10.1016/j.jhydrol.2025.132746
- Some have hosted workshops, convened special sessions, or run short courses
- Some have made calls for research project ideas, and started to organize funding applications.
- Some WGs are still in early stages and have not gathered momentum. One of two might be dormant.

What is Working Well and Challenges

Progress has generally been facilitated by team leadership which has helped to share the work, provide support, and diversify ideas. Some WGs have not made as much progress as they had hoped, generally because of lack of time and sole leadership. Some WGs are reaching out to other global initiatives focused on similar topics to generate interest and collaboration.

Main challenges for the WGS are how to engage with the full membership and bridging between the diversity of interests represented by members. Active members in each WG are generally limited to 10-20 people including the leadership team. The Theme could develop ideas to increase engagement and improve communication within and across WGs. Anecdotally, some WG members have noted that they have not received much communication from WG leaders, but it is unclear if this is prevalent. Use of Google tools in China is a barrier to communication and collaboration.

Theme Activities

The Theme has continued to meet online and in person (pre-EGU meeting in April and ad-hoc individual meetings with WG leads) in the past 6 months to discuss progress and exchange ideas on how to progress. The EGU meeting was useful to discuss common themes and goals across the Theme and all WGs, and collaborative opportunities between subsets of WGs. Progress was made on identifying topics for a collaborative review/perspective type paper on global-to-local cross-scale process interactions, with a first outline proposed for this summer with follow-up discussion at IAHS-2025.

Analysis of the WG themes indicate common themes:

***Data and technology*:** Strong emphasis on the use of data and technology to advance hydrological research and applications. This includes the collection, digitization, and sharing of data, as well as the development and application of tools and techniques, such as remote sensing, machine learning, and modelling.

***Multi-scale analysis*:** The importance of studying hydrological processes across different scales, from local to global. This reflects a growing recognition that hydrological phenomena are interconnected across scales, and understanding these connections is crucial for effective water management.

***Understanding process complexity and variability*:** Many WGs acknowledge the complexity and variability of hydrological systems and seek to develop methods to better understand and represent this. This includes unravelling the interactions between different processes, quantifying uncertainty, and accounting for spatial and temporal variability. Explicit in some WGs, but also relevant to other groups dealing with complex phenomena like runoff generation, droughts, and hydrological changes.

***Impact of global changes*:** Impact of global changes, such as climate change, land use change, and socio-economic development, on water resources. Seek to understand how these changes affect various aspects of the water cycle, including water quality, water availability, and extreme events.

***Sustainable water management*:** Central theme across many WGS is promotion of sustainable water management. This involves developing a better understanding of hydrological processes, assessing the impacts of human activities, and developing tools and strategies to support informed decision-making.

***Science to Practice and Stakeholder Engagement*:** Several WGs highlight the importance of translating scientific findings into practical applications and engaging with stakeholders, including policymakers, local communities, and practitioners. A desire to ensure that research has real-world impact and addresses societal needs. This is a cross-cutting theme of the HELPING initiative.

The analysis also indicates potential synergies and collaborations:

Themes:

A. Data and technology
B. Multi-scale analysis
C. Understanding process complexity and variability
D. Global change impacts
E. Human-Water Interactions and Management

Potential synergies:

1. Water for biodiversity in a changing world: E, D, A
2. Urban Water: E, A, D
3. Comparative understanding of runoff generation processes: C, B, A
4. Irrigation quantification & management & its effect on the water cycle: E, B
5. From local to large scale human-water dynamics: E, B
6. REHYDRATE: A
7. Decomposing Complexity: C, B
8. Droughts in Mountain Regions: D, E
9. Ensuring evidence-based findings: A
10. Development and application of river basin simulators: A
11. Water Quality Under Global Changes: D, E, A
12. Hydrologic Design: Solutions and Communication: E, A
13. Effective Aquifer Governance for Agriculture: E
14. Deep Explanation and Evaluation for Practices in Hydrological Changes (DEEPHY): C

15. Understanding drivers and feedbacks of soil moisture variability across scales, from local to global: C, B, A

Next Steps

- Contact leads of WGs with stalled or slow progress to encourage activity and provide support.
- Follow-up on WG analysis, cross-cutting themes and potential inter-WG collaborations with individual WG leads.
- Develop an outline of the theme collaborative paper by end of August.
- Develop a plan for reporting on Theme progress at IAHS2025, and a session to progress the collaborative paper.
- Continue engagement and support of WGs via email and online meetings, including discussion on potential funding sources.