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Highlighting Thematic Priorities in Hydrological Research: Insights from the IAHS Digital Water Globe

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Abstract:

This study explores the thematic distribution of content within the International Association of Hydrological Sciences' (IAHS) Digital Water Globe (DWG), a platform designed to foster transparent and collaborative water research. By scraping and analyzing published entries across four content types - personal profiles, case studies, scientific publications, and data time series - we identify the frequently used terms within four key categories: general keywords, Sustainable Development Goals (SDGs), Unsolved Problems in Hydrology (UPH), and HELPING Working Groups. The analysis highlights that Personal Profiles and Case Studies dominate the DWG dataset, with topics such as climate-driven water challenges, integrated water management, and disaster resilience frequently cited. Clean water and Sanitation (SDG 6) and its sub-targets emerged as central, underscoring the water-centric focus of IAHS contributions. The results are visualized across four figures, showcasing the top cited elements by content type. As the DWG continues to grow, this framework offers a replicable approach for future monitoring of evolving research themes and community focus within hydrology.

keywords: Research communication, hydrology, Global Perspectives.

INTRODUCTION

In the academic context, research dissemination largely relies on established publication platforms and scientific databases. Repositories such as Web of Science, Scopus, Google Scholar, and open-access platforms like Zenodo and ResearchGate serve as essential tools for discovering peer-reviewed literature and datasets. These platforms are valuable for researchers to track scientific progress and locate published studies within specific fields.

However, despite the capabilities of these research tools, they often operate in silos, lacking full integration with one another. This fragmentation can create significant challenges especially for researchers seeking to collaborate on specific hydrological issues in localized regions. For instance,

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a hydrologist exploring flood resilience practices in West Africa or a practitioner studying community water management in the Andes may struggle to find relevant collaborators, localized case studies, or explore new published datasets.

In this context, the Digital Water Globe (DWG) (ARHEIMER, 2022) is an initiative by the International Association of Hydrological Sciences (IAHS), developed as a key component of the IAHS Scientific Decade HELPING (2023–2033) (ARHEIMER et al., 2024). The DWG offers a global, interactive, and user-contributed platform that bridges scientific knowledge with local expertise. By visualizing hydrological case studies, time series data, scientific publications, and personal profiles on a dynamic digital map (Castillo et al., 2024), researchers and practitioners can potentially discover collaborators, access regional data resources, and share context-specific hydrological knowledge (Palmate et al., 2024).

Rather than serving as just another database, the DWG functions as a collaborative tool designed to connect researchers, data, and experiences. In doing so, it supports more inclusive, locally relevant, and action-oriented hydrological science on a global scale.

The objective of this research is to provide an initial overview and analysis of how the DWG is currently populated. While the platform holds great potential, its content is still in an early phase of development. By examining the existing data categorized into people, case studies, databases, and scientific publications, this paper identifies which topics and regions are most represented, and explores the possible reasons behind these trends. Understanding where contributions are concentrated and what gaps remain can help inform strategies to enhance the DWG's reach, usability, and collaborative impact in the global hydrological research community.

Methodology

This study draws on publicly available data from the Digital Water Globe (DWG - https://dwg.smhi.se/dwg/list), a curated platform hosted by IAHS that aggregates hydrology-related content. The DWG database includes a range of published entries categorized into four main content types: Personal Profiles, Case Studies, Scientific Publications, and Data Time Series.

To extract and analyze this information, we developed a custom web scraper using Python. The scraper was designed to navigate the content list view and systematically collect structured data (Json format) across all available entries. This included not only metadata such as title, content type, and abstract, but also all associated keyword filters applied to each entry.

Filtering within DWG is supported through four thematic categories, each with its own vocabulary:

- Keywords (102 terms)
- Sustainable Development Goals (SDGs) (99 sub-targets)
- Unsolved Problems in Hydrology (UPH) (23 questions)
- HELPING Working Groups (29 groups)

Each entry may be tagged for each thematic category, offering a basis for deeper content analysis. After extracting the full dataset, we processed and cleaned the information using Python libraries including json, re, and pandas. Visualization and summary statistics were produced with the aid of seaborn and matplotlib.

Our analysis focused on quantifying and comparing keyword occurrences across the four content types, exploring patterns in thematic alignment with global sustainability goals, scientific challenges, and collaborative research initiatives in hydrology.

RESULTS AND DISCUSSIONS

The results of this study are presented in four main figures, each corresponding to a specific content type available in the Digital Water Globe (DWG). Within each content type, the analysis identified the most frequently cited terms across four thematic categories—general keywords, Sustainable Development Goals (SDGs), Unsolved Problems in Hydrology (UPHs), and HELPING Working Groups. For each category, the top 10 most frequently used elements were highlighted, offering insights into the prevailing research interests and thematic priorities within the DWG content.

Keywords

The top keywords found per content type in the DWG and per keyword class are shown in Figure 1. Personal Profiles and Case Studies dominate keyword occurrence across all content types, likely because they tend to emphasize individual researcher interests and project-specific contexts. In contrast, Scientific Publications and Data Time Series contribute fewer mentions, which is expected given their smaller representation in the dataset. Consequently, the discussion that follows will primarily focus on insights drawn from Personal Profiles and Case Studies. Moreover, it is important to note that we are analyzing the most cited keyword within each of the seven keyword classes.

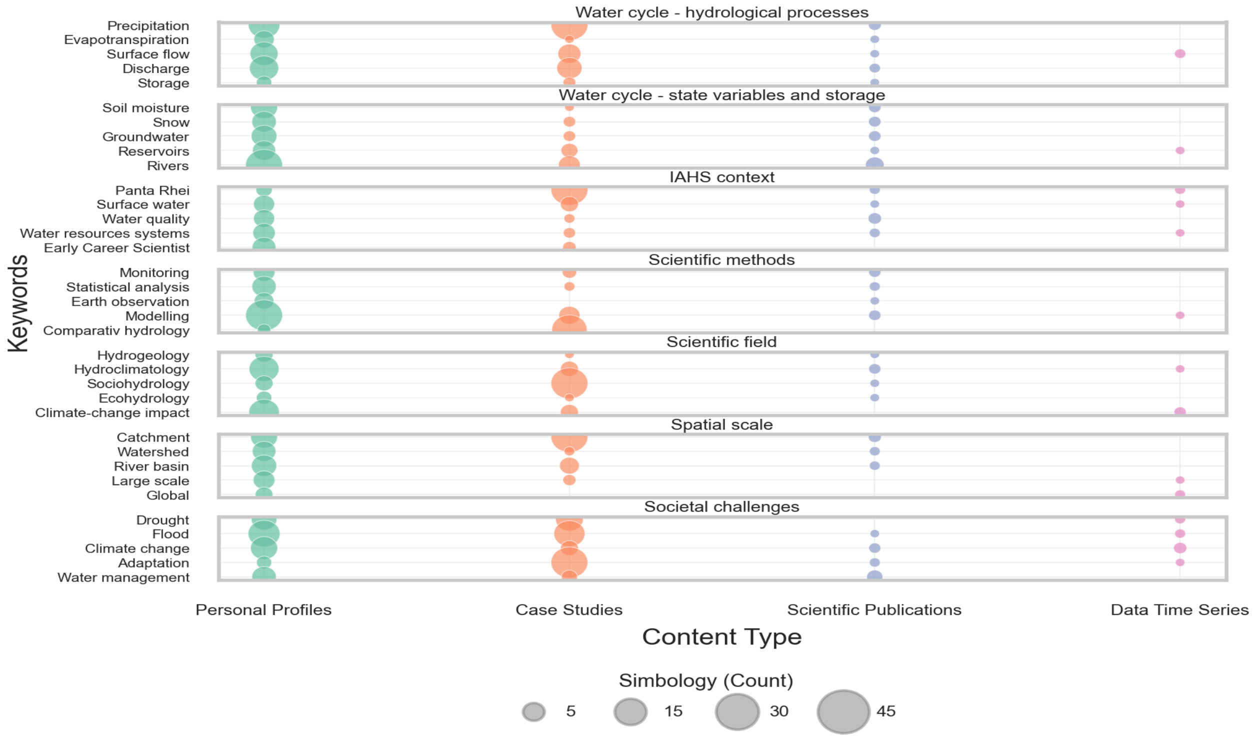


Figure 1 – Top keywords per content type for each keyword class targeted.

In the class Water Cycle Hydrological Processes, "*precipitation*" is the most frequently mentioned keyword. This is expected, as it is a fundamental driver of the water cycle and influences all downstream hydrological processes. In the same context, for State Variables and Storage, "*rivers*" are the most cited, which makes sense, as rivers are crucial water sources and are widely studied in terms of both quantity and quality.

Within the IAHS context class, the "*Panta Rhei*" scientific decade is the most prominent. This initiative is central to the IAHS research agenda, emphasizing the dynamic interactions between hydrology and society. Additionally, the keyword "*Early Career Scientist*" is most common in personal profiles, suggesting that the current sample includes a relatively high number of younger or early-career contributors.

In the Scientific Methods class, personal profiles emphasize "*modeling*", which is essential for prediction and scenario planning in some hydrological context. In contrast, case studies frequently mention "*comparative hydrology*", which may indicate a focus on evaluating and contrasting hydrological processes or models across different regions or conditions.

Regarding the Scientific Field class, "*hydroclimatology*" and "*climate change impact*" are most often used in personal profiles, reflecting current global concerns and research interest. In case studies, "*sociohydrology*" is notable, suggesting a growing importance of human-water interactions in real-world applications.

For the Spatial Scale class, both personal profiles and case studies commonly reference "*catchments*". This focus is logical, as catchments often serve as manageable spatial units for hydrological analysis, especially when data availability or project objectives are localized to specific regions or communities.

Finally, in the keyword class Societal Challenges, keywords like "*flood*", "*climate change*", and "*adaptation*" are frequently mentioned across both personal profiles and case studies, reflecting an emphasis on addressing pressing global water-related issues and the need for resilient water management strategies.

Sustainable Development Goals

The most frequently used sustainable development goals within the DWG are presented in Figure 2. As seen in the previous analyses, Personal Profiles and Case Studies dominate keyword mentions across all content types. This pattern holds true for the representation of Sustainable Development Goals (SDGs), where these two content types consistently account for the highest number of mentions. In contrast, Scientific Publications and Data Time Series contribute fewer mentions, which is expected due to their smaller presence in the dataset.

The most frequently-mentioned goals belong to SDG 6, which focuses on clean water and sanitation, a core theme of the dataset. Given the water-centric nature of the content, the prominence of SDG 6 and its specific targets is unsurprising. Water is a fundamental resource that intersects with numerous sustainability dimensions, making it a natural focal point in hydrological research and development agendas.

In addition, SDG 2.4, which promotes sustainable food production and resilient agricultural practices, appears frequently. Its relevance stems from agriculture's significant reliance on water resources, making effective water management essential for achieving both food security and environmental sustainability. Another notable goal is SDG 11.5, which aims to reduce the adverse effects of natural disasters. This target is particularly pertinent in water-related contexts, given the increasing frequency and severity of floods, droughts, and storms. Its presence highlights the research community's growing focus on disaster risk reduction and building resilience to climate-driven hydrological hazards.

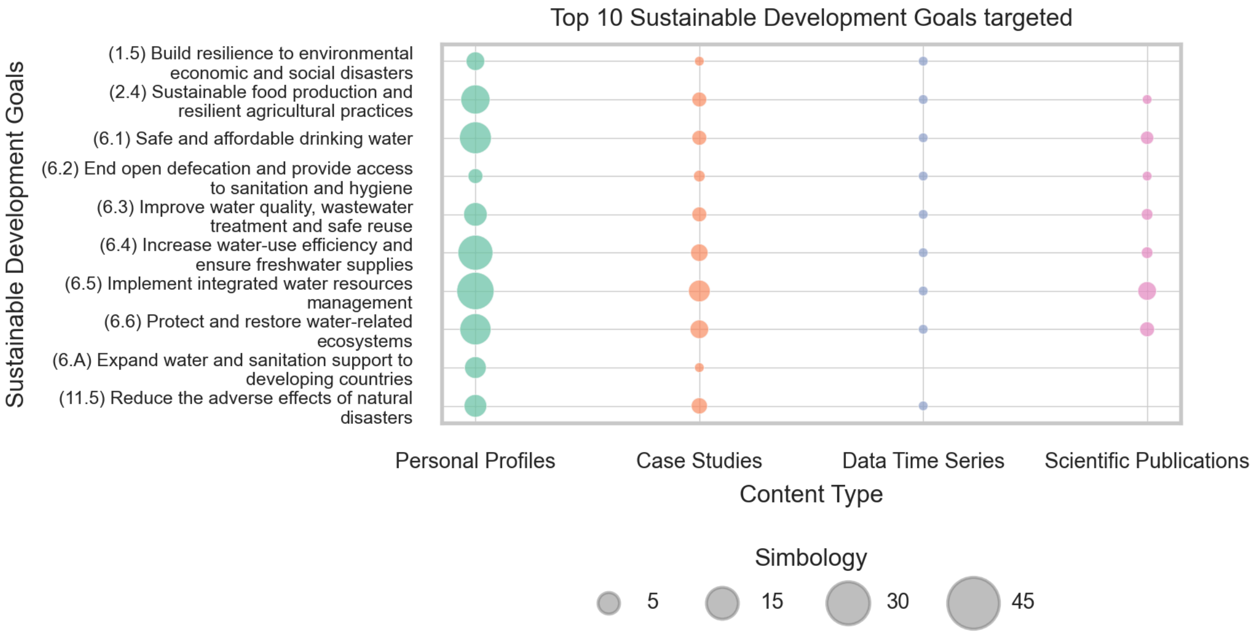


Figure 2 – Top sustainable development goals targeted per content type.

Unsolved Problems in Hydrology

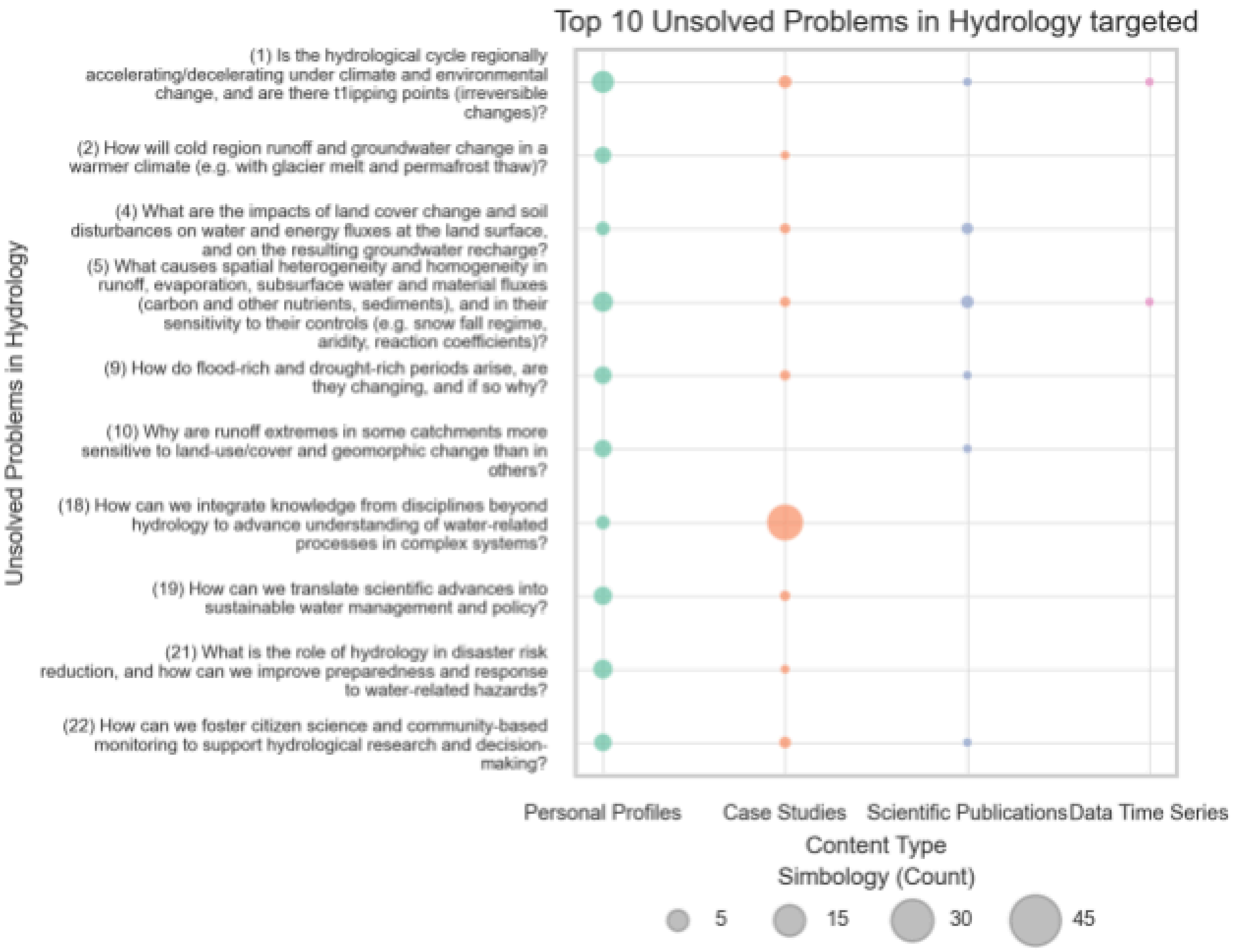
The most targeted Unsolved problems in hydrology - UPH (BLÖSCHL, 2019) within the DWG are summarized in Figure 3. In summary, the dominant Unsolved problems cited across this dataset are strongly climate-driven, with a clear focus on water availability, system variability, and the translation of scientific knowledge into actionable policies. This aligns with the water-centric and sustainability-oriented nature of the content. As observed with other indicators, Personal Profiles and Case Studies dominate the content distribution across the top Unsolved Problems in Hydrology (UPH), while Scientific Publications and Data Time Series contribute fewer mentions.

UPH 1 emerges as a crucial question in modern hydrology, as climate and environmental change are central themes throughout much of the dataset. The concern about tipping points underscores the urgency of understanding how irreversible transformations in the water cycle could affect global water security. Similarly, UPH 2 addresses the impacts of climate change in cold regions, particularly the shifting dynamics of water sources availability, topics already emphasized in earlier sections.

Another significant area of concern is UPH 5, which reflects a core methodological and conceptual challenge in hydrology: the difficulty of generalizing findings across spatially heterogeneous landscapes. Regional variability complicates the understanding of hydrological processes, the development of predictive models, and the planning of effective water resource management strategies.

In addition, questions related to governance, interdisciplinary collaboration, and disaster preparedness are strongly represented by UPH 19 and 21. These emphasize the need to bridge the gap between science and practice, resonating with the earlier identified relevance of SDG 11.5 (focused on disaster risk reduction) and SDG 6.5 (on integrated water resource management). Lastly, UPH 18 is particularly prominent in Case Studies, which are naturally suited for interdisciplinary exploration. These real-world applications often demand the integration of hydrology with fields such as ecology, sociology, and economics, reflecting the complex and multifaceted nature of water-related challenges.

Figure 3 – Top Unsolved problems in hydrology targeted per content type.



HELPING working groups

Related to the HELPING working groups, Figure 4 reveals a strong concentration of HELPING Working Group mentions in Personal Profiles, with virtually no presence in Scientific Publications or Data Time Series, and only a single mention in Case Studies. This is likely because HELPING Working Group affiliations are typically self-declared and tied to individual professional involvement, making them more relevant in profile-based content than in structured datasets or academic outputs. Additionally, the decade of HELPING is still relatively recent, and publications are only beginning to emerge at this time.

We identified two main clusters of HELPING Working Groups. The first cluster corresponds to the HELPING with Global and Local Interactions theme. These groups reflect a technical and modeling-oriented focus, dealing with the design, explanation, simulation, and communication of hydrological systems and interventions. Their appearance suggests that many individual contributors to the HELPING network specialize in applied and computational hydrology.

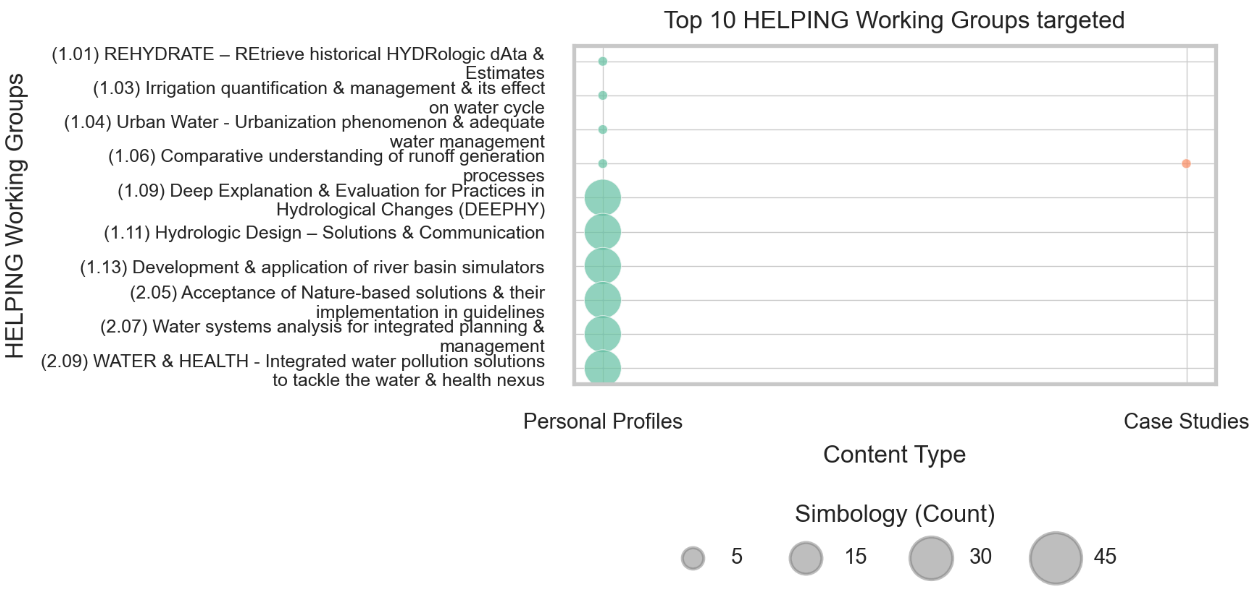


Figure 4 – Top helping working groups targeted per content type.

The second cluster falls under the HELPING with Holistic Solutions for Water Security theme. These groups emphasize a systems-thinking approach and demonstrate a clear focus on interdisciplinary, sustainable water management, integrating health, ecology, and governance. Their prevalence aligns with other indicators in the dataset that prioritize holistic and resilience-oriented solutions to water-related challenges.

Current and Future Steps for the DWG

To complement the quantitative analysis of the Digital Water Globe, we highlight several key activities connected to the IAHS community. Figures 5, 6, and 7 illustrate examples of collaborative efforts and support provided through IAHS working groups, including initiatives carried out in 2024 and planned engagements for 2025, and IAHS DWG perspectives for the future. These visuals serve to contextualize the evolving role of the platform within broader hydrological research networks and emphasize its potential for facilitating knowledge exchange and community-driven action.

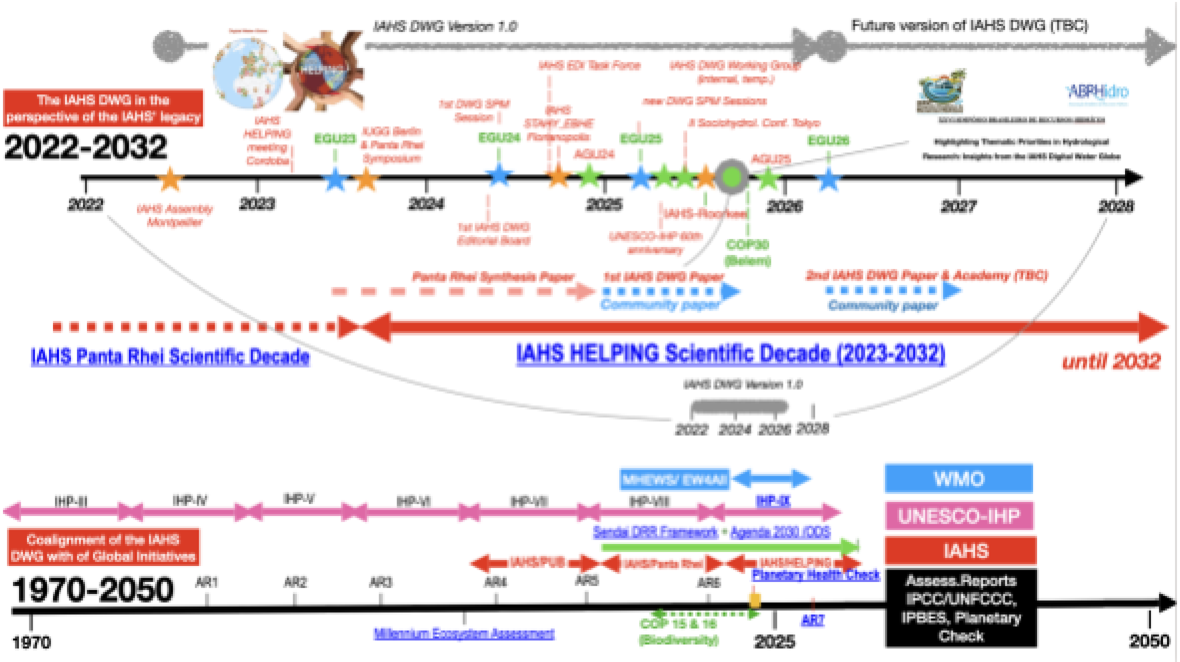


Figure 5- Timeframes of the IAHS DWG in the perspective of the IAHS' legacy (period 2022-2028, upper part) and under coalignment with other global initiatives (period 1970-2050, lower part).

IAHS DWG activities in 2024:

- EGU24 Splinter Meeting Presentation: https://presentations.copernicus.org/EGU24/EGU24-21088_presentation.pdf
- EGU HS Division Blog Post: https://blogs.egu.eu/divisions/hs/2024/06/19/iahs_digital_water_globe/
- Featured in the EGU newsletter: https://blogs.egu.eu/divisions/hs/tag/digital-water-globe/
- Signal-boosting via social media: https://iahs.info/uploads/HELPING/WG3.02%20Outreach%2C%20Communication%20%26%20Science%20Interfaces_Christina.pdf
- UNESCO Open Hydrology Publication (media release): https://www.unesco.org/en/articles/open-hydrology
- IAHS 9th IWRM & 14th STAHY: Presentation of DWG in Brazil: https://www.abrhidro.org.br/iebhe/index.php?ID=1864

IAHS DWG activities in 2025:

- Equality, Diversity and Inclusion (EDI) Action Plan: https://iahs.info/About-IAHS/about-iahs/#EDI
- HELPING Scientific Decade: https://iahs.info/Initiatives/Scientific-Decades/
- Working Groups: https://iahs.info/Initiatives/Working-Groups/
- Hydrological Sciences Journal Office: thanks for announcing the DWG with authors!
- USP ACADEMY Climares: https://internationaloffice.usp.br/uspacademy/#co9
- EGU 25: https://meetingorganizer.copernicus.org/EGU25/session/54485 (*)
- II Socio-Hydrology Conference, Tokyo, 2025: https://ishc2025.t.u-tokyo.ac.jp
- 2025 IAHS General Assembly, Roorkee: https://iahs2025.com
- ASCE 2025 EWRI Congress, https://www.ewricongress.org/
- XXVI Braz. Wat. Res. Symp., Brazil https://www.abrhidro.org.br/xxvisbrh/
- ASABE 2025 Annual International Meeting, https://www.asabemeetings.org/

The IAHS DWG is starting **dialogues** with IAHS' partners and the wide society i.e. :

- UNEP World Water Quality Alliance: https://iahs.info/About-IAHS/about-iahs/#EDI
- UNESCO Open Hydrology: https://www.unesco.org/en/articles/open-hydrology (*)
- WMO Expert Community: https://community.wmo.int/en
- IWA Digital Water Program 'Earth Observation for water management' Community of Practice: https://iwa-network.org/projects/earth-observation-for-water-management-community-of-practice/

Figure 6 - Some of the IAHS DWG's activities and dialogues with other global initiatives.

Figure 7 - Some pictures of social engagement and promotion of IAHS community through the synergy with DWG editors in 2024-2025, toward future actions with a human-friendly DWG, increasing ECS' profiles, cases, datasets and communities.

Conclusions

This analysis of the Digital Water Globe (DWG) content highlights clear thematic trends across four types of hydrological knowledge contributions—Personal Profiles, Case Studies, Scientific Publications, and Data Time Series. Personal Profiles and Case Studies dominate the landscape, reflecting strong individual and project-level engagement. Water-related issues—especially those linked to SDG 6, climate-driven changes in the hydrological cycle, and interdisciplinary water management—are the most frequently used. Unsolved Problems in Hydrology and HELPING Working Groups reveal a strong focus on sustainability, modeling, and integrated approaches. Overall, the DWG offers a transparent and structured reflection of current hydrological research priorities and challenges.

This analysis provides a foundational snapshot of the current thematic priorities within the Digital Water Globe (DWG), but it represents only an initial stage in what is likely an evolving landscape. As more contributions are added over time—particularly in underrepresented categories such as Scientific Publications and Data Time Series—the observed trends may shift. Repeating this analysis in the future will be essential to track changes in thematic focus, community participation, and global research priorities. Such longitudinal monitoring could reveal whether current patterns persist or if new challenges, regions, or research directions begin to take prominence within the IAHS community.

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