

Topic Concept Note Template

Thematic Process, 11th World Water Forum

- **Theme Number:** 5
- **Theme Title:** Innovation for Water Management
- **Topic Number:** 5C
- **Topic Title:** Data and Overcoming the Lasting Challenge, Modernizing water information systems with real- time data, digital twins, and decision-support innovations.
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I. Topic Overview

Rationale and Context

Reliable, timely, accurate and accessible water data is essential for informed decision-making, adaptive management, and sustainable governance of water resources globally. Despite advances in monitoring technologies, significant data gaps remain at local, national, and transboundary levels, particularly in low-resource contexts. We need to strengthen national and local capabilities to collect, analyze, and use water data; facilitate regional and global learning networks. Additionally, the complex interlinkages between water and other sectors, such as food and energy, require extensive monitoring across time and space. Lack of continuous monitoring and reliable data is more pronounced in water-scarce regions. The current topic addresses these gaps by exploring innovations in data production, sharing, and transformation into actionable information. Examples from Africa, Asia, and Latin America illustrate how localized information systems, remote sensing, IoT, digital twinning technologies, and AI-enabled tools can improve water planning, climate resilience, and disaster risk management. The topic contributes directly to SDG 6, particularly targets 6.3, 6.4, 6.5 and 6.6, and strongly supports SDG 13 (climate resilience) and SDG 17 (partnerships and data cooperation). It also contributes indirectly to SDGs 2, 11, 14 and 15, where improved water information underpins effective planning for agriculture, cities and ecosystems.

Strong data governance and cybersecurity are also essential to ensure trusted data sharing, interoperability, and the long-term sustainability of water data systems across institutions and regions.

Objectives of the Topic

Technical objectives: Promote innovation in water data production, data sharing, processing, and visualization; demonstrate integration of in-situ and satellite data; enhance AI, real-time monitoring and modeling, and development of digital twins

Policy and institutional objectives: Investigate conditions that play a role in data scarcity and how to promote an enabling environment for benefiting from the recent advancement in technological solutions (e.g., remote sensing, drones, automated sensors, and AI-assisted tools and models), support development of governance frameworks enabling data sharing and interoperability; foster institutional collaboration across sectors and scales and promote clear data policies on access levels, roles/responsibilities, licensing and accountability.

Capacity-building and knowledge objectives: Strengthen local and national capacities for data collection, analysis, and utilization; facilitate knowledge exchange through regional and global networks implementing best practices in data management (e.g., the FAIR principles) at all stages

Culture and history objectives: Learn from history constitutes an important intellectual foundation for water-related disaster governance. Systematically reviewing and distilling historical water management experience, and integrating it with modern hydrology, hydrodynamics, information technologies, and risk management concepts, can provide long-term perspectives and cross-temporal wisdom for modern water-related disaster prevention and mitigation, while strengthening the cultural foundation and sustainability of disaster governance systems.

II. Key Issues, Opportunities, and Scope

Key Challenges

Persistent data gaps, inconsistent quality, and limited access.

Fragmented governance and lack of institutional coordination for data management.

Climate-related pressures affecting water availability and demand (extremes floods/drought).

Limited use of digital tools and innovative technologies for data production and analysis.

Financing constraints for water monitoring, data infrastructure, and capacity building.

Opportunities and Strategic Importance

Scaling up Earth Observation datasets, IoT, and AI-enabled data collection for cost-effective monitoring.

Strengthening cross-level and cross-sector data sharing and governance.

Enable transboundary water data cooperation through agreed exchange protocols, joint monitoring, and confidence-building measures

Expand groundwater monitoring

Promoting integrated water management through evidence-based policy and planning.
Facilitating public-private and multi-stakeholder partnerships for sustainable water data ecosystems.
Promoting citizen science for cost-effective and community-led water monitoring

Proposed Priorities of the Topic / Guiding Questions

How can low-cost, innovative data collection methods be deployed in data-scarce regions?
What institutional frameworks best support cross-sectoral and multi-level data sharing?
How can transboundary/Basin-level data exchange and Joint monitoring improve trust and risk management?
What data is needed to manage groundwater effectively?
How can data be transformed into actionable information for policymakers, local authorities, and communities?
How can gender, youth, and marginalized groups be included in data production and governance processes?
What financing models can sustain water data systems at local and basin scales?
How to speed up the process of converting the large accumulated raw dataset (e.g., from remote sensing) into information that is insightful for decision-making?

Proposed Sessions of the Topic

- 5.C.1 Interoperable water information systems and collaborative data governance
- 5.C.2. Digital twins and decision-support tools for water systems management
- 5.C.3. Automated multi-source data integration for real-time alarm, monitoring and forecasting systems
- CC 5A 5C TCG2 (Cross cutting session): Financing Digital Water Transformation

Description of the proposed Sessions of the Topic:

- **5.C.1 Interoperable water information systems and collaborative data governance**

Short description:

Effective water resource management—and the sustainable management of its various uses—depends on the ability to access, share, and combine data produced by multiple institutions. Yet, fragmented data landscapes continue to hinder this integration, highlighting the need for coherent institutional and policy frameworks supported by interoperable water information systems.

Addressing these challenges requires, as a priority at the national level, the development of enabling legislative frameworks that facilitate cooperation among institutions. Such frameworks should clearly define roles and responsibilities and support the establishment of shared data management strategies that respect the mandate of each data producer while fostering trust, coordination, and accountability.

These strategies should also strengthen the capacity of each institution to better manage its own data, while promoting the adoption of FAIR principles—ensuring that data is findable, accessible,

interoperable, and reusable. This includes the creation of data catalogues to improve the visibility and discoverability of data sources, the development of interoperability between information systems through web services that enable easier access to and reuse of existing datasets, and the deployment of platforms that support data access, integration, and valorization.

By aligning legislative frameworks, institutional roles, and technical solutions, this session will explore how to build sustainable, secure, and trusted water data ecosystems that enable effective cross-sectoral and transboundary collaboration, and support informed decision-making at all levels of authority.

- **5.C.2. Digital twins and decision-support tools for water systems management**

Short description:

This session examines the transformative potential of digital twinning technologies to create virtual, dynamic representations of water systems that simulate real-world conditions. It investigates how these advanced tools can be integrated into planning processes to test management scenarios, improve infrastructure resilience, and provide high-fidelity decision support for complex water challenges.

The session will highlight that effective water resources management—and the sustainable management of its multiple uses—requires a deep understanding of underlying processes and the ability to anticipate future scenarios. Achieving this depends on the capacity to access, as seamlessly and automatically as possible, the diverse data needed from multiple sources.

It will emphasize the importance of leveraging these data through advanced modeling approaches and AI-driven tools tailored to operational and strategic needs. Equally critical is the ability to deliver timely, actionable information to decision-makers, enabling informed choices and, where relevant, facilitating interaction with and adaptation of water infrastructures in response to evolving conditions.

By focusing on data integration, intelligent processing, and real-time decision support, the session will explore how digital twins can move beyond purely technical models to become practical, operational tools for water managers and policymakers.

- **5.C.3. Automated multi-source data integration for real-time alarm, monitoring and forecasting systems**

Short description:

This session addresses the technical and operational workflows required to convert massive, heterogeneous raw datasets—such as those from IoT sensors and remote sensing—into immediate, real-time alerts.

It focuses on the fundamental role of accessing and combining data produced by multiple institutions, including Earth observation sources, as a cornerstone for effective water resources management and the sustainable management of its various uses. Realizing this potential requires both robust technical architectures and enabling institutional conditions.

In this regard, the session will highlight the need for legislative frameworks that facilitate cooperation among institutions, alongside shared data management strategies that respect the roles and responsibilities of each data producer while fostering trust, coordination, and

accountability. It will also emphasize the importance of enabling, as far as possible, automated access to the necessary data from diverse sources through the application of FAIR principles—ensuring that data are findable, accessible, interoperable, and reusable.

Key challenges to be addressed include ensuring semantic interoperability by verifying data comparability and transforming datasets where necessary to enable meaningful integration. The session will explore approaches to integrate, combine, and add value to data in diverse formats, and to leverage these data through modeling tools and AI-based solutions tailored to operational and decision-making needs.

Finally, it will underline the importance of delivering timely, actionable information to support decision-making, including real-time alerts and forecasts, and—where relevant—enabling responsive interactions with water management infrastructures.

By linking governance, data interoperability, and advanced analytics, the session will demonstrate how automated multi-source data integration can transform continuous data streams into reliable, real-time monitoring, forecasting, and early warning systems capable of supporting rapid and effective responses to climate-related risks.

- **CC 5A 5C TCG2 (Cross cutting session) “Financing Digital Water Transformation”**

This cross-cutting session will explore financing models, partnership mechanisms, and long-term investment strategies to support the digital transformation of the water sector. As water systems increasingly rely on data infrastructure, Earth Observation, AI, and digital tools, ensuring sustainable financing becomes a key enabler for scaling innovation from pilot projects to operational, long-term services.

The session will examine how different funding sources, including public investment, development banks, donor programmes, and private sector participation, can be mobilized and combined through blended finance approaches. Particular attention will be given to how financial strategies can support not only the development of digital and data-driven water solutions, but also their maintenance, scalability, and institutional integration over time.

Discussions will focus on bridging the gap between innovation and long-term deployment, ensuring that investments cover the full lifecycle of digital water systems, including infrastructure, data platforms, model development, operational services, and capacity strengthening. The session will also highlight the importance of aligning financing mechanisms with user needs, governance frameworks, and policy priorities to ensure effective implementation at scale.

In addition, the session will explore opportunities to strengthen partnerships between governments, development banks, research institutions, and private sector actors to accelerate investment in digital water ecosystems. It will also address how to identify strategic investment priorities that can guide donors and financial institutions in supporting impactful and scalable solutions.

A key objective of the session is to ensure that financing strategies actively support existing initiatives and collaborative platforms, enabling them to grow, attract new partners, and move from experimental or pilot phases to sustained operational deployment.

III. Expected Outcomes and Deliverables

Policy and Strategic Outcomes

Recommendations for institutional frameworks to support interoperable water data governance, promoting clear data policies on access levels, institutional roles and responsibilities, data licensing, and accountability mechanisms.

Guidance on integrating innovation into national and basin-level water policies.

Pathways for moving from pilot solutions to operational stages, and strategies for scaling innovations.

Technical and Knowledge Deliverables

Case studies and synthesis notes on innovative data production and utilization.

Methodologies for combining in-situ, remote sensing, and citizen-generated data.

Tools and platforms for data integration, visualization, and exploitation into modelling and decision support system tools

Technical frameworks and tools supporting transboundary and basin-level data sharing, joint analysis, and cooperative decision-making.

Partnerships and Financing Outcomes

New partnerships between development banks, private sector, NGOs, and governments.

Innovative financing mechanisms for water data infrastructure and capacity building.

Actions and Initiatives for Implementation

Pilot projects deploying integrated data systems at national, basin or local scale to validate approaches, improve governance, and support climate-resilient planning.

Multi-stakeholder innovation challenges to scale up local solutions.

Connect governments, agencies, NGOs, private sector, and scientific institutions to co-develop and operationalize water data systems.

Memoranda of Understanding (MoUs) between data producers and water authorities.

Present pilot projects on satellite monitoring under the framework of the INBO/WMO Task Force and as a contribution to the One Water Vision and linked to the Basin Segment of the Political Process

Communication and Visibility

Key messages for public dissemination and Forum declaration.

Contributions to global water knowledge platforms and media coverage.

IV. Monitoring and Post-Forum Action

Establish monitoring mechanisms for pilot projects and partnerships.

Feed outcomes into preparation for the 12th World Water Forum.

Contribute to global agendas (UN processes, climate conferences, basin networks).

Promote continued knowledge-sharing through digital platforms and international networks.

V. Proposed Cross-Process Dialogue Areas

Within Themes: Collaborate with Theme 1: Water Security (especially 1A: Groundwater and Surface Water, 1C: Integrated Water Resource Management, and 1E: Securing Water for Food Security) on data-driven basin management and groundwater monitoring.

Engage with Theme 2: Water Finance (2A: Innovative Financing Mechanisms, 2C: Funding for Water Resilience and Climate Adaptation) to explore financing models for water data infrastructure and technology deployment.

Work with Theme 3: Water for Humans and Nature (3C: Protecting and Restoring Water Ecosystems and Aquatic Biodiversity, 3D: Improving Water Quality) on integrating monitoring data for ecosystem protection and water quality management.

Other processes: Collaboration with Ministerial and Basin Authorities to integrate local data initiatives into national planning.

Regional focus: Africa and Southeast Asia, given the high potential for localized data innovations and transboundary water management needs.