AI driven Digital Twin for Water Management for Limpopo River Basin and Inclusive Integration with Citizen Science

IWMI

Gaborone, Botswana
9–11 June 2025

Online Agenda

bit.ly/4jVtXgR

REPUBLIC OF BOTSWANA

LIMCOM
LIMPOPO WATERCOURSE COMMISSION

DIWASA

Supported by

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Enabel

THE LEONA M. AND HARRY B. HELMSLEY CHARITABLE TRUST

In collaboration with

aws

Digital Earth AFRICA

Global Water Partnership Southern Africa

Microsoft


4 countries
1 River Basin
3 Days: Digital Twin, AI, Citizen Science
Botswana, June 9-11

Day 1

LIMPOPO
DIGITAL TWIN

Digital Twin Hands on

Listening Session for Data Challenges

Digital Twin Concept

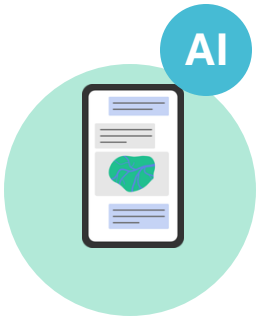
Hands on:

Water Availability

Irrigation Water Use

Droughts Index

Day 2



AI for Water Management

AI and Data Governance

101 generative AI

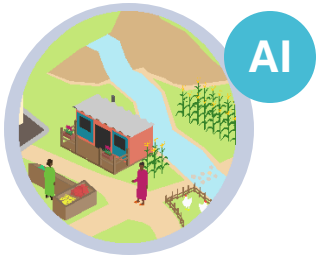
Prompt engineering

Hands On:

Limpopo

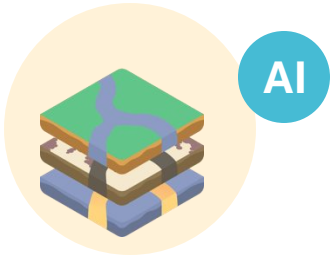
Water Copilot

Day 3



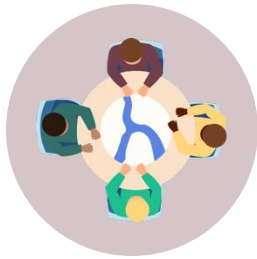
Citizen Science Co-designs

Creating trust on citizen science data



DIWASA Training

Use cases from DEA



Listening Session

Stakeholder consultation scaling opportunities

Tentative_schedule.docx

IWMI International Water Management Institute

Day 1

LIMPOPO
DIGITAL TWIN

Digital Twin Hands on

Listening Session for Data Challenges

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Hands on:

Water Availability

Irrigation Water Use

Droughts Index

Time	Description
8:30 – 9:15	**Online Registration**
9:15-10:00	**Welcome** IWMI, LIMCOM, HOST.
10:00- 11:00	**Overview of Digital Twin Project (P)** • Recap • Icebreaker • Listening Session: Fish Bowl Exercise • Task Team Top 5 data integration challenges (20 min)
11:00- 11:30	Group Photo and Tea
11:30 – 12:00	**Digital Twin Technology in Water Management (D)** • Live demonstration of digital twin software platforms • Walk-through of user interface and functionalities • Overview of system components and data integration
12:00 13:00	**Hands on into Digital Twin Applications (H)** • Case studies on environmental flow monitoring, dam monitoring, water availability and seasonal forecast.
13:00 - 14:30	**Lunch**
14:30 – 15:30	**Hands on into Digital Twin Applications (H)** • Case studies on Irrigated area mapping and drought monitoring
15:30 – 15:40	**Break**
15:40 – 17:00	**Feedback Session for Digital Twin Applications** • MDII Survey – Digital Twin • Q&A session to clarify technical aspects • Participants feedback Decision point: Dates for capacity building in each country.

AI driven Digital Twin for Water Management for Limpopo River Basin and Inclusive Integration with Citizen Science

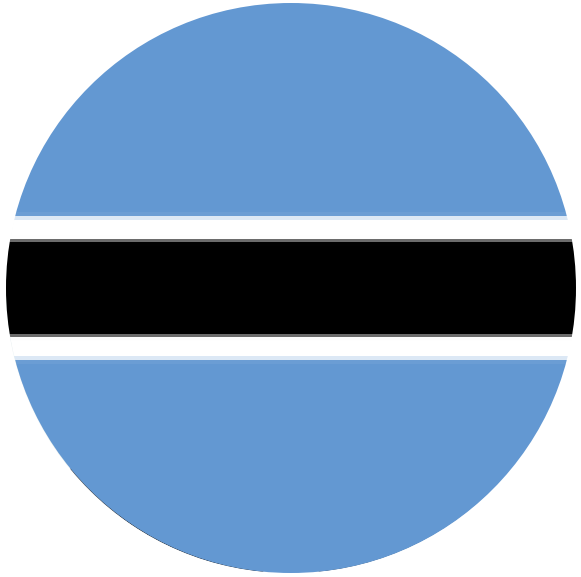
WELLCOME

Henry Roman

IWMI

Sergio Sitoe

LIMCOM



Host

Host Organization

REPUBLIC OF BOTSWANA

LIMCOM LIMPOPO WATERCOURSE COMMISSION

DIWASA

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Enabel

Official Partnership IWMI with LIMCOM

- To support advance citizen science in the region

LIMCOM Limpopo Watercourse Commission

IWMI International Water Management Institute

The integration of Enviro Champs data into the Digital Twin will significantly enhance modeling, forecasting, and scenario planning, ***creating new opportunities for data-informed decision-making*** *that is inclusive, equitable, and climate-resilient.*

Sergio Sitoe,
LIMCOM Executive Secretary

IWMI International Water Management Institute

Enabel

Partnership Agreement

LIMCOM LIMPOPO WATERCOURSE COMMISSION

IWMI International Water Management Institute

"The purpose of this Agreement is to formalize the partnership between IWMI and LIMCOM under the Enabel Project to enhance water resource management in the Limpopo River Basin. This collaboration focuses on implementing citizen science programs and ensuring effective integration of data into the Digital Twin for the basin. Through this partnership, ***IWMI and LIMCOM will work together to empower communities, improve decision-making, and advance sustainable water management practices across the Limpopo Region*** *"*

Activities	**Collaboration**	**Tentative Due Date**
Activity 1.4: Community Engagement Work with LIMCOM and communities to establish citizen scientist network - facilitate train the trainers and engagement	**1.The Digital Twin designated Country Focal Points Nominated** 2.Support the Schedule at least 3 Training engagements **3.Support the Schedule Co-design Citizen science workshop**	30 June 2025
Activity 3.3: Use case for citizen science data	Recommendations to develop citizen science use cases for decision making	15 August 2025
Activity 4.2: Citizen Scientist engagement	Support the execution of at least 2 capacity workshops	15 January 2026
Activity 4.4: Embed citizen science data	Support the adoption of the citizen science Data integrated into the Digital Twin	30 March 2026

IWMI International Water Management Institute

The Digital Twin designated Task Team

The objectives of the task tram are to:

1. ***Identify key data and use cases:*** Work collaboratively to outline specific data needed for digital twin applications relevant to the stakeholders for Limpopo.
2. ***Capacity building*:** Work collaboratively to increase capacity on the use of the digital twin for the region.
3. ***Enhance operational efficiency:*** Utilize the task team structure to promote cross-team collaboration and knowledge sharing, accelerating the adoption of digital twin technology.

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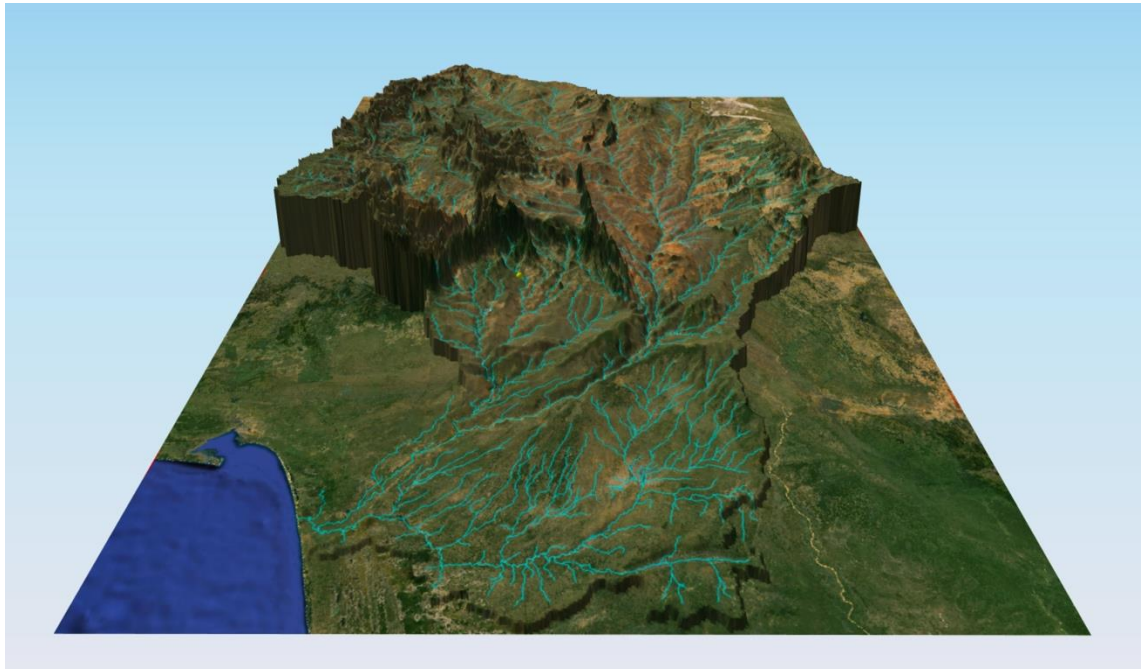
AI driven Digital Twin for Water Management for Limpopo River Basin and Inclusive Integration with Citizen Science



Digital Twin Limpopo Recap

International Water Management Institute

Angie Garcia

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Water managers

Government agencies

Water utilities

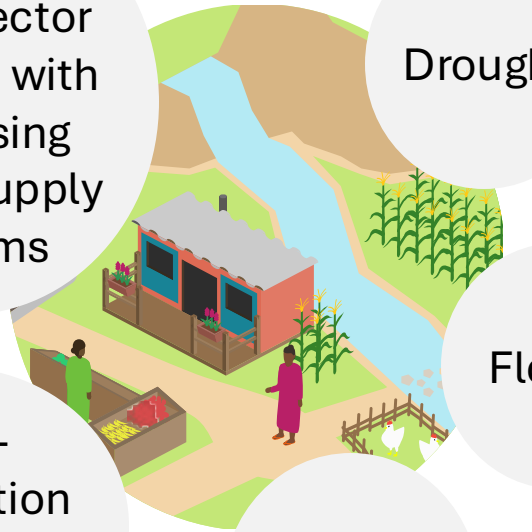
investors, water, energy and data technology companies

Farmers and food processing

Water challenges

Increasing multi-sector demand with increasing gap to supply systems

Drought



Floods

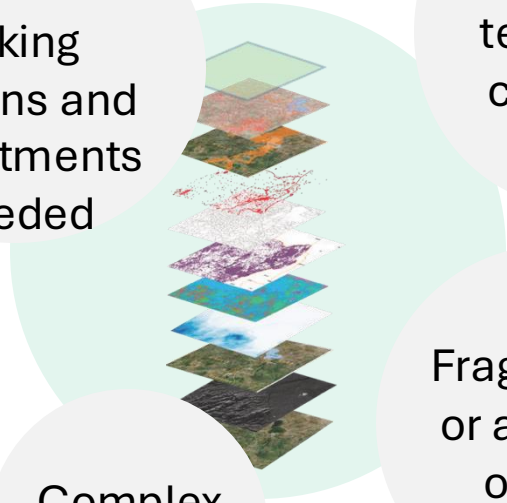
Over-abstraction, changing availability

Pollution

Water management problems

Delayed response to taking actions and investments needed

Limited technical capacity



Complex Science

Fragmented or absence of data

IWMI International Water Management Institute

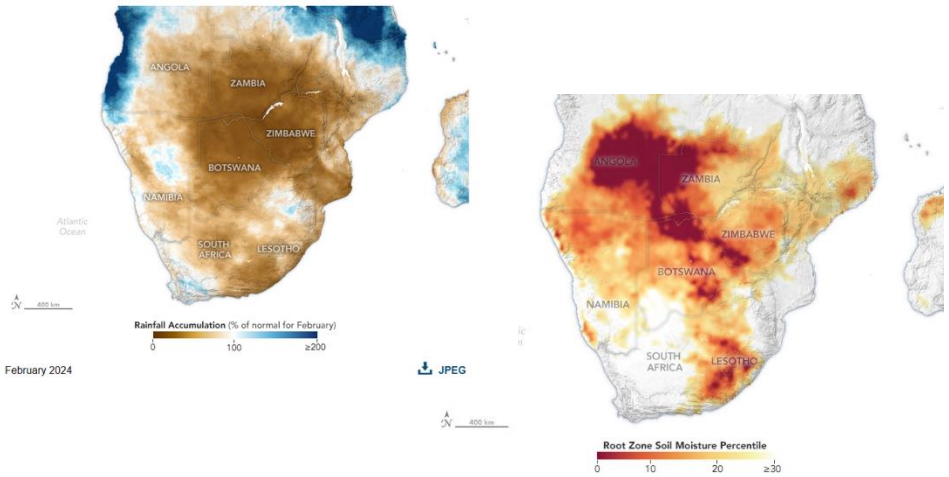
The problem: communities and economies are suffering from water insecurity

"We sometimes go for days without bathing as we try to preserve the little water we have for drinking and cooking. It is not healthy.

If it does not rain in the coming weeks, ***I do not think we are going to survive this time around.*** *This drought has gone for too long now."*

Mavis Chauke, resident, Limpopo Basin

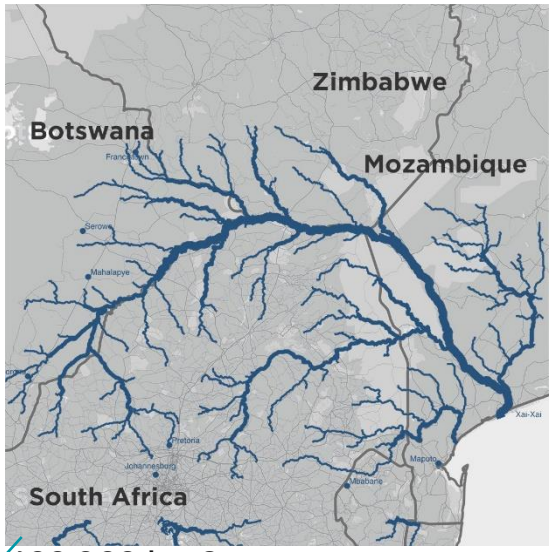
Severe Drought in Southern Africa



[NASA Report Severe Drought in Southern Africa (nasa.gov)]

Central Mozambique & Zimbabwe : faced "crisis level" food insecurity, meaning households require humanitarian assistance to meet minimum food needs.

- **What is needed to support timely informed decisions?**
- **Which communities, businesses and investments are at risk?**
- **Who and when can have water?**



400,000 km2

International Water Management Institute

Limpopo challenges

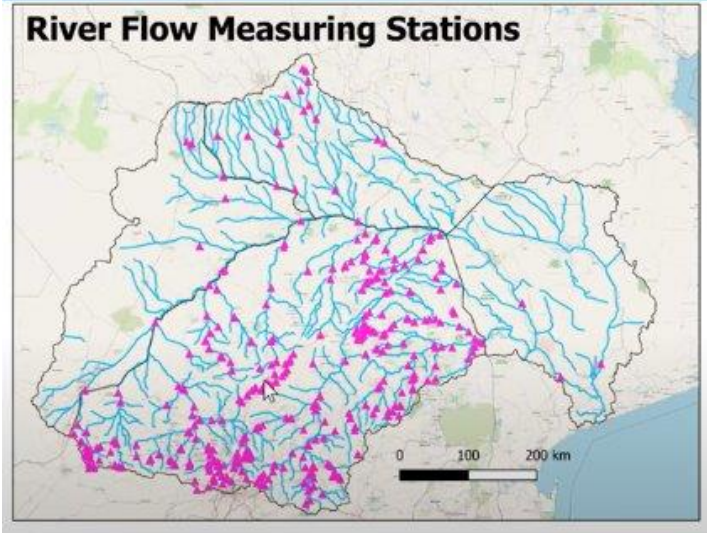
400,000 km2

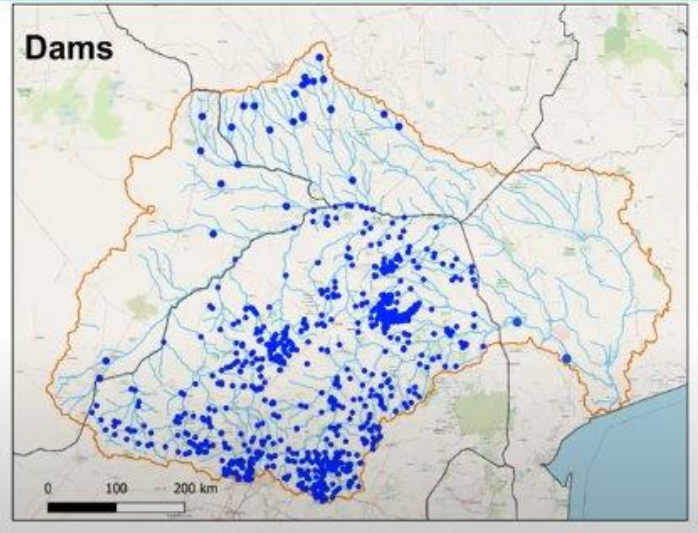
8M life depend on Limpopo River basin

We are all connected!

Deteriorating Water Quality

Weak Transboundary Water Resources Management





LIMCOM

"Integrated Transboundary River Basin Management for the Sustainable Development of the Limpopo River Basin."

In Partnership With Global Water Partnership Southern Africa

Supported by gef

Prioritised Transboundary Problems

i. Deteriorating Water Quality
ii. Declining Availability of Water Resources
iii. Weak Transboundary Water Resources Management
iv. Loss of Biodiversity
v. Land Degradation
vi. Sedimentation
vii. Low Resilience to Extreme Climatic Events

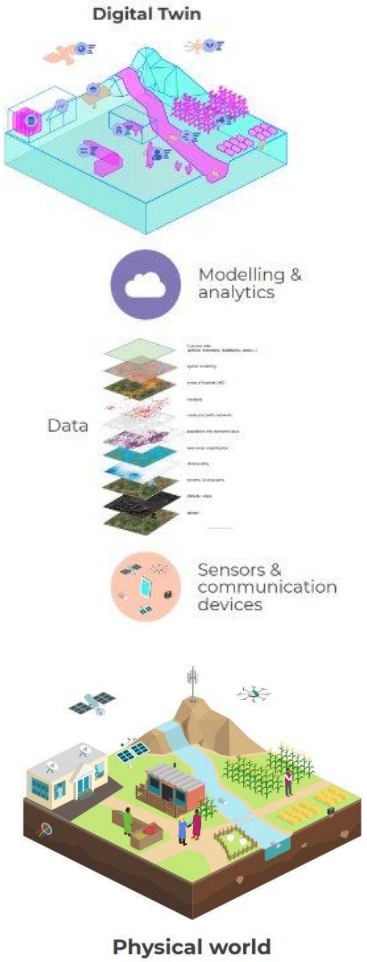
Managing our water resources is a highly complex – water is dynamic, moves and is used by many sectors

What if we could create a digital representation of our basin?

What if?

What now?

What next?



WORLD ECONOMIC FORUM

Join us Sign in

EMERGING TECHNOLOGIES

How digital twins are transforming the world of water management

Nov 1, 2024

The initiative follows a **USD100 million** deal secured by Naver in October 2023. Leveraging its advanced cloud technology and AI-driven solutions, Naver will create highly accurate **3D models of Riyadh, Medina, Jeddah, Dammam and Mecca,** with precision down to 10cm. These digital twins will serve as virtual replicas of the cities, enabling real-time data analysis and sophisticated simulations for enhanced urban management.

https://www.kwater.or.kr/

WIRED Middle East

Saudi Arabia wants to build digital twins for five major Saudi cities, including Mecca

The project will involve the creation of a cloud-based digital twin platform for the Kingdom's smart city project.

Oct 24, 2024

The National

Dubai employees could soon have AI digital twins, conference hears

Experts predict AI avatars could reshape workplace roles and intellectual property by 2027.

1 day ago

Khaleej Times

UAE's gym of the future: AI to guide on fitness, nutrition via a digital twin

The Department of Health, Abu Dhabi has introduced a new initiative called the 'Gym of the Future', reimagining how personalized health and...

1 week ago

وكالة أنباء الإمارات

MBRSC signs MoU with SpaceData to advance digital twin technology

DUBAI, 29th January, 2025 (WAM) -- Mohammed Bin Rashid Space Centre (MBRSC) has signed a Memorandum of Understanding (MoU) with SpaceData,...

Jan 29, 2025

GlobeNewswire

Infinite Reality Launches Immersive Digital Twin for DMCC's Crypto Centre in Dubai

INFINITE REALITY

Bespoke Virtual Experience Aligns with UAE's Dubai Digital Strategy, Offering Businesses an Interactive Digital Workspace...

Dec 17, 2024

Despite increase on data availability from remote sensing

NISAR

The NASA-ISRO (In
(NISAR) mission wil
Sentinel-1. Researc
monitor groundwa

SWOT

The Surface Water and Ocean Topography (SWOT) satellite provides freshwater data that can improve flood prediction.

Food and Agriculture Organization
http://www.fao.org › in-action › remote-sensing-for-wate...

WaPOR, remote sensing for water productivity

The FAO has developed a publicly accessible near real time **database** using satellite data that allows the monitoring of agricultural water productivity at ...

WaPOR data · Accessing WaPOR data · WaPOR project · WaPOR partners

NASA (.gov)
https://landsat.gsfc.nasa.gov › article › new-tool-provid...

New Tool Provides Rapid Evaluation of Water Quality

27 Jun 2024 — A new data processing tool that **rapidly ingests, processes, and displays water quality maps** generated from the Landsat 8 and 9 Operational Land Imager (OLI)

ESA Climate Change Initiative
https://climate.esa.int › projecten › river-discharge

River Discharge ESA CCI project

The ESA river **discharge** CCI project derives long-term (at least over 20-years) climate data records of river **discharge**

Space in Africa

Digital Earth Africa Launches Groundbreaking Waterbodies Monitoring Service for Continent-Wide Impact

Digital Earth Africa's Waterbodies Monitoring Service is unique among satellite-based global surface water datasets due to its accessibility,...

25 Jun 2024

We are still facing the same data challenges:

- •Data Gaps and Quality
- •Fragmented Data Sources
- •Data Sharing Hesitancy
- •IT Infrastructure Limitations
- •High Implementation Costs
- •Organizational Resistance
- •Skill Shortages
- •Training Gaps
- •Bias Concerns
- •Data Privacy and Security
- •Access Disparities
- •Policy and Research Gaps

Kinds **of scientific services** from an international science effort that would be **most useful** for their work

52% **water data and information** that can be used at a country scale

42% **forecasts, projections and scenarios** that can be used as a country scale

Water Policy Report 2023

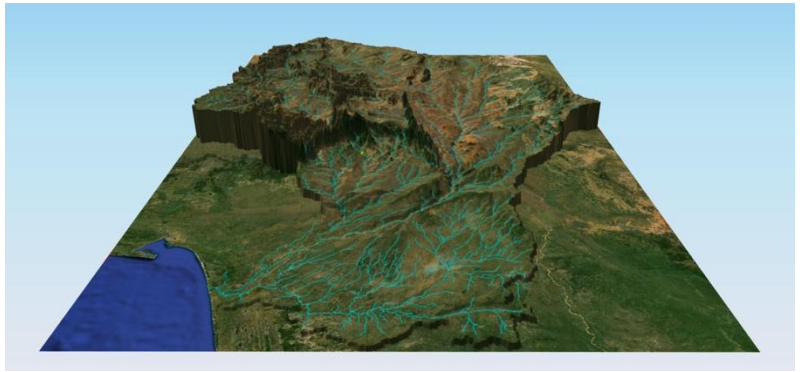
Can digital twins help river basin management in developing countries?

The adoption of digital twins can be challenging but opportunities are growing as technology becomes more affordable.

June 27, 2024 | By IWMI

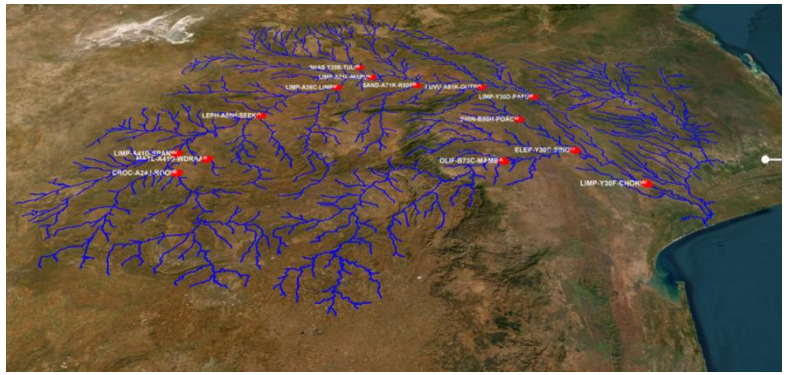
Botai, Joel O.; Ghosh, Surajit; Matheswaran, Karthikeyan; Dickens, Chris; Langa, Nkateko; Garcia Andarcia, Mariangel. 2023. ***Options for digital twin application in developing country river basin management: a review***. Colombo, Sri Lanka: International Water Management Institute (IWMI). CGIAR Initiative on Digital Innovation. 20p. https://hdl.handle.net/10568/134763

IWMI International Water Management Institute



Digital Model:
A digital model is a representation of a physical object or system in a digital environment. It is traditionally used in fields like engineering and design.

Purpose: Digital models serve various purposes, including concept evaluation, detailed design, and creating production and construction documentation.



Digital Shadow/replica:
A digital shadow is a reflection of a physical object captured in digital form.

The DS is a model which is fed by a **<u>one-way</u>** data flow with the state of an existing physical object

A change in state of the physical object leads to a change in the digital object, but not vice versa.

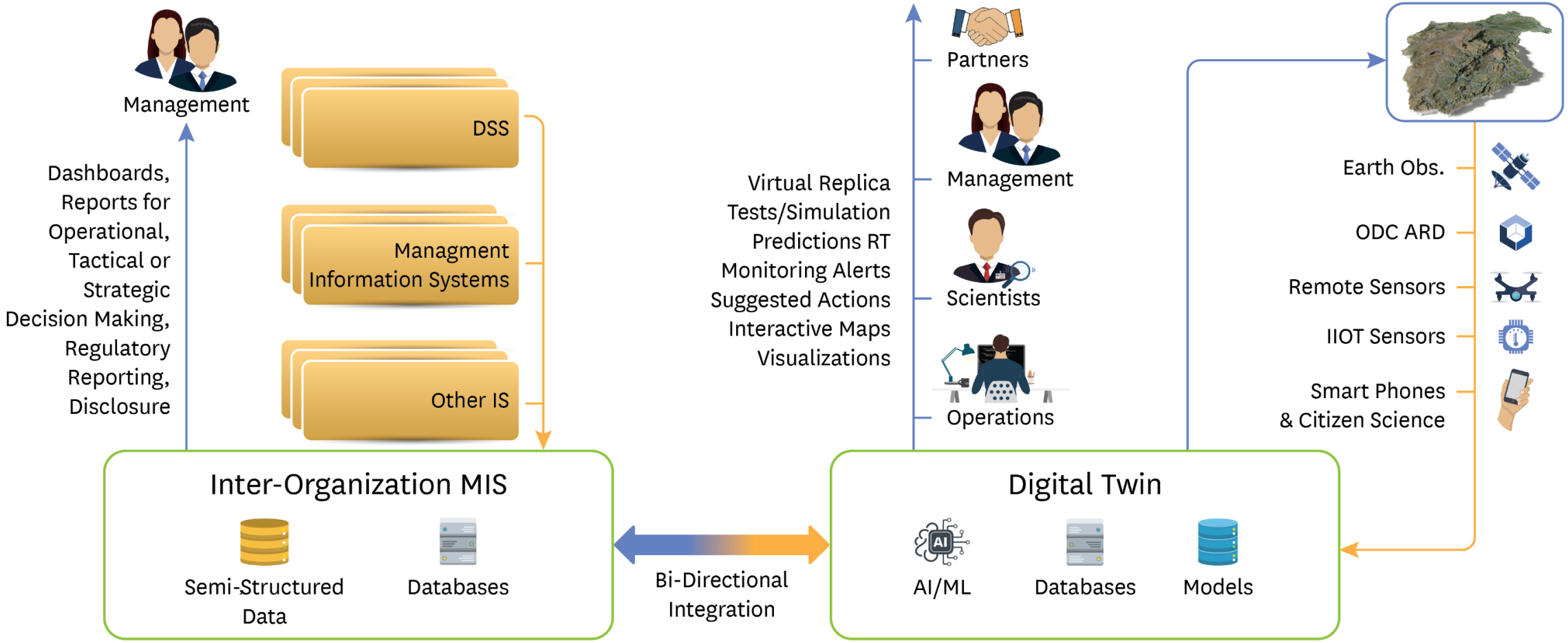
Digital Twin:
DT data flows between physical and digital object are fully integrated in **<u>both directions</u>**

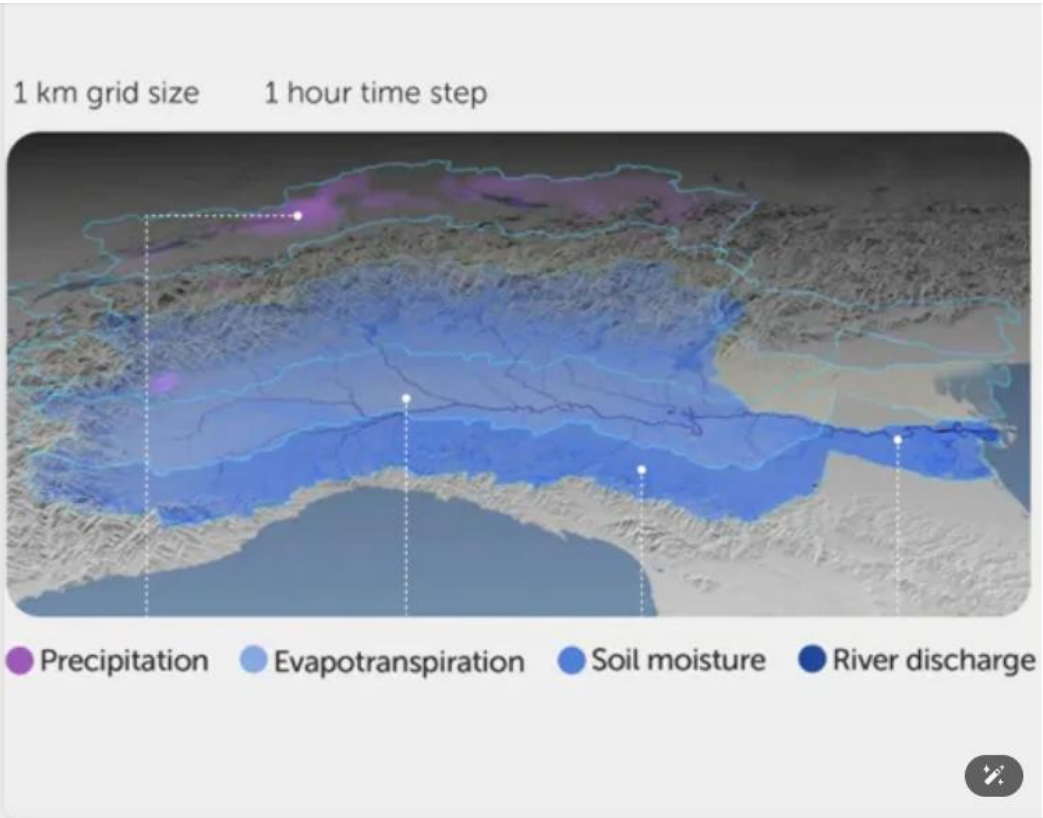
The digital twin was created to operate in parallel and **<u>interact with the real-world in near real-time</u>**

Source: https://www.wizata.com/.

https://www.iwmi.cgiar.org/news/digital-twins/

MIS vs Digital Twin for River Basin





Digital twins of the Earth are **digital representations of the Earth system, spanning scales and domains**. Their purpose is to monitor, forecast and assess the Earth system and the consequences of human interventions on the Earth system. 27 Aug 2024

Nature
https://www.nature.com › ... › perspectives

Digital twins of the Earth with and for humans - Nature

FRONTIERS IN SCIENCE LEAD ARTICLE

Published on 05 Mar 2024

A Digital Twin of the terrestrial water cycle: a glimpse into the future through high-resolution Earth observations

Luca Brocca · Silvia Barbetta · Stefania Camici · Luca Ciabatta · Jacopo Dari · Paolo Filippucci · Christian Massari · Sara Modanesi · Angelica Tarpanelli · Bianca Bonaccorsi · Hamidreza Mosaffa · Wolfgang Wagner · Mariette Vreugdenhil · Raphael Quast · Lorenzo Alfieri · Simone Gabellani · Francesco Avanzi ·

AI Overview

Learn more

A digital twin hydrology model is **a virtual replica of the Earth's water cycle that uses artificial intelligence and ICT technologies to simulate and monitor various water-related phenomena**. These models can be used to:

- **Forecast events**: Predict flash floods, landslides, and other extreme weather events
- **Support water management**: Optimize water usage, monitor drought, and support early warning systems
- **Support policy decisions**: Inform basin-wide adaptation policies and water management practices
- **Support equitable water sharing**: Facilitate decisions that promote equitable sharing of scarce water resources

Some examples of digital twin hydrology models include:

- **Digital Twin Earth (DTE) Hydrology Platform**: This platform simulates five water variables at a high resolution, including soil moisture, precipitation, evaporation, snow depth, and river discharge. It includes case studies that showcase how the platform can be used to visualize water anomalies, flooding events, and flood risk.
- **Hydrological digital twin model of a large anthropized Italian alpine**: This model was able to reproduce measured discharge, reservoir turbinated discharges, and snow cover and snow water equivalent.
- **Pipedream**: This interactive model is for natural and urban drainage systems.

Digital twin hydrology models are still evolving technologies, but they have the potential to provide innovative solutions to complex water management challenges.

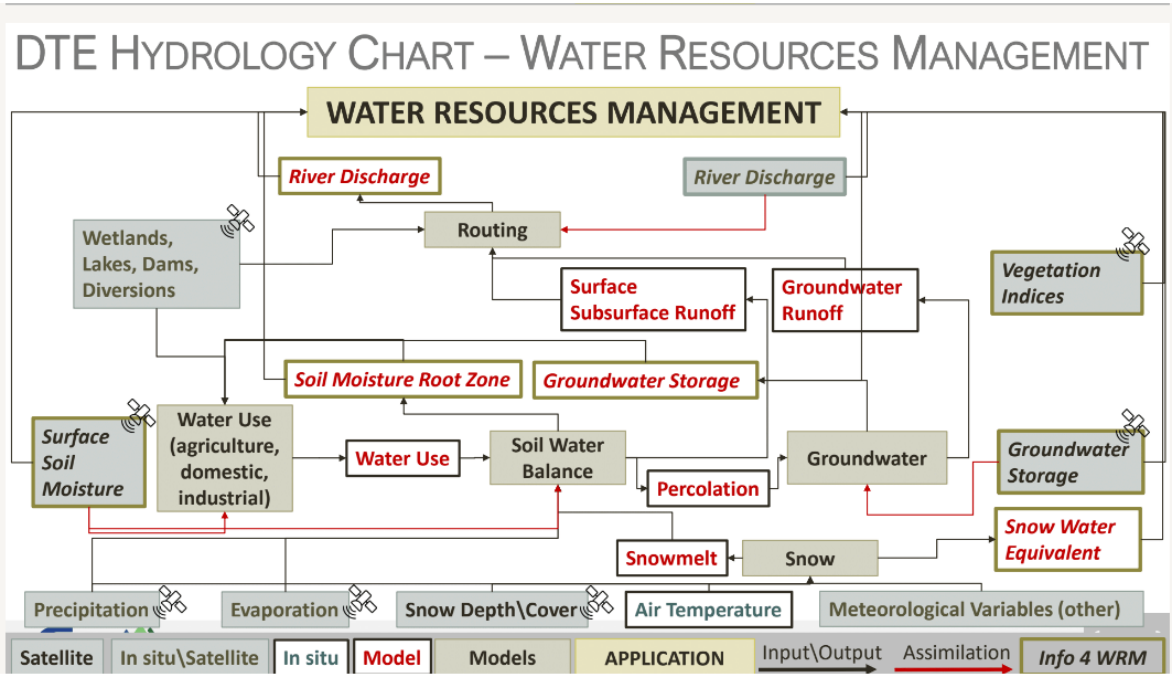
Hydrological digital twin model of a large anthropized italian ...
Overall, the HDT reproduces well the measured discharge in space and time with a Kling Gupta Efficiency (KGE) above 0....
ScienceDirect.com

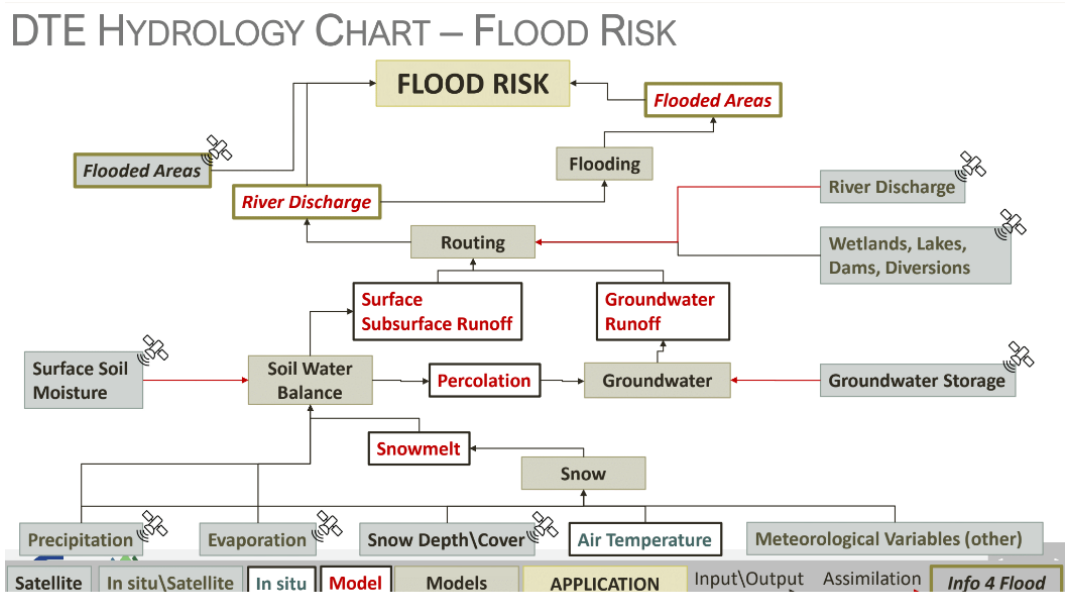
The Digital Twin Earth Hydrology Platform - Frontiers
A Digital Twin Earth (DTE) of the terrestrial water cycle offers a ground-breaking solution for monitoring and simulation, but it ...
Frontiers

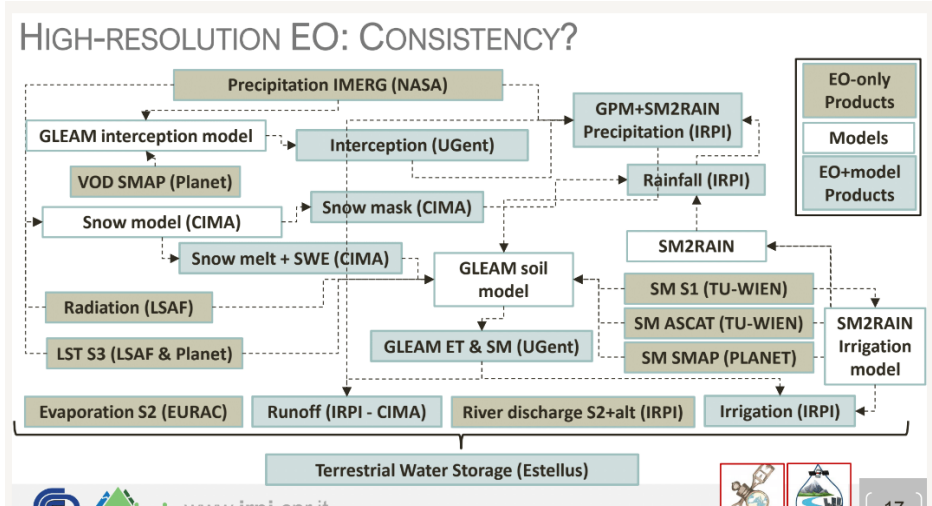
A digital twin for the water cycle - CIMA Research Foundation
5 Mar 2024 — Virtual (and digital) twins As we have already reported on our website, the idea of digital twins, namely virtu...
CIMA Research Foundation

Show all

DT for Water Management is very complex







[hydrology – Portal of the Hydrology Group @ IRPI CNR Perugia]

IWMI's Digital Twin Framework

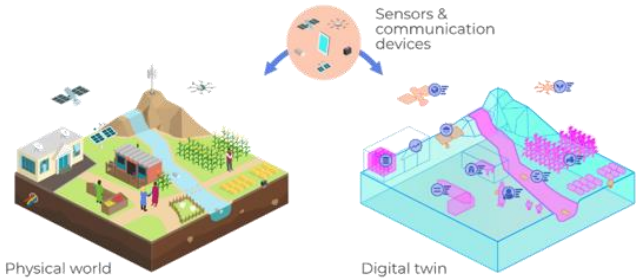
1 3D Virtual representation

2 Data

3 Monitoring

4 Forecasting

5 Scenarios



Scientific Products Builder

*Water Availability/Drought	*Irrigation Mapping	*Environmental Flows	*Water Quality
Seasonal rainfall Forecast*	Flood	Crop Type	Water Accounting (DIWASA)
Water Allocation & Energy (NexusGain)	Water Use	Policy …	Water re-Use

Co-Design/Decision Making Products

*WQ Alert System	*E-flows Alert Systems	*E-Flows Simulation and Implementation
Heat Waves	**Rainfall Alert System	Climate Risk

*This year
** Next year

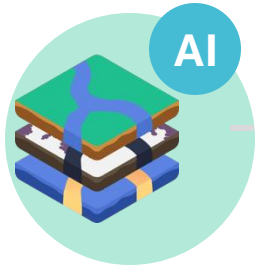
*Building a reliable and **scalable digital infrastructure for DT** that enables seamless integration of Water Managers applications to improve water management decisions*

IWMI International Water Management Institute

Digital Twin Framework

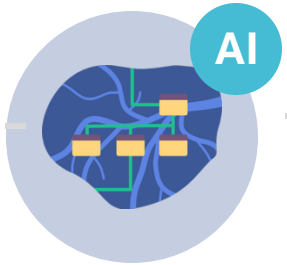
Co-design

Stakeholder-driven process with public sector NRM managers



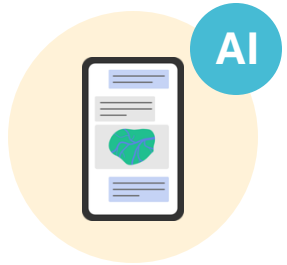
Open data cube

Integrates available data: monitoring stations, earth observation, remote sensors, UAVs, citizen science…



Foundational models

Hydrological models, forecasting, decision simulations

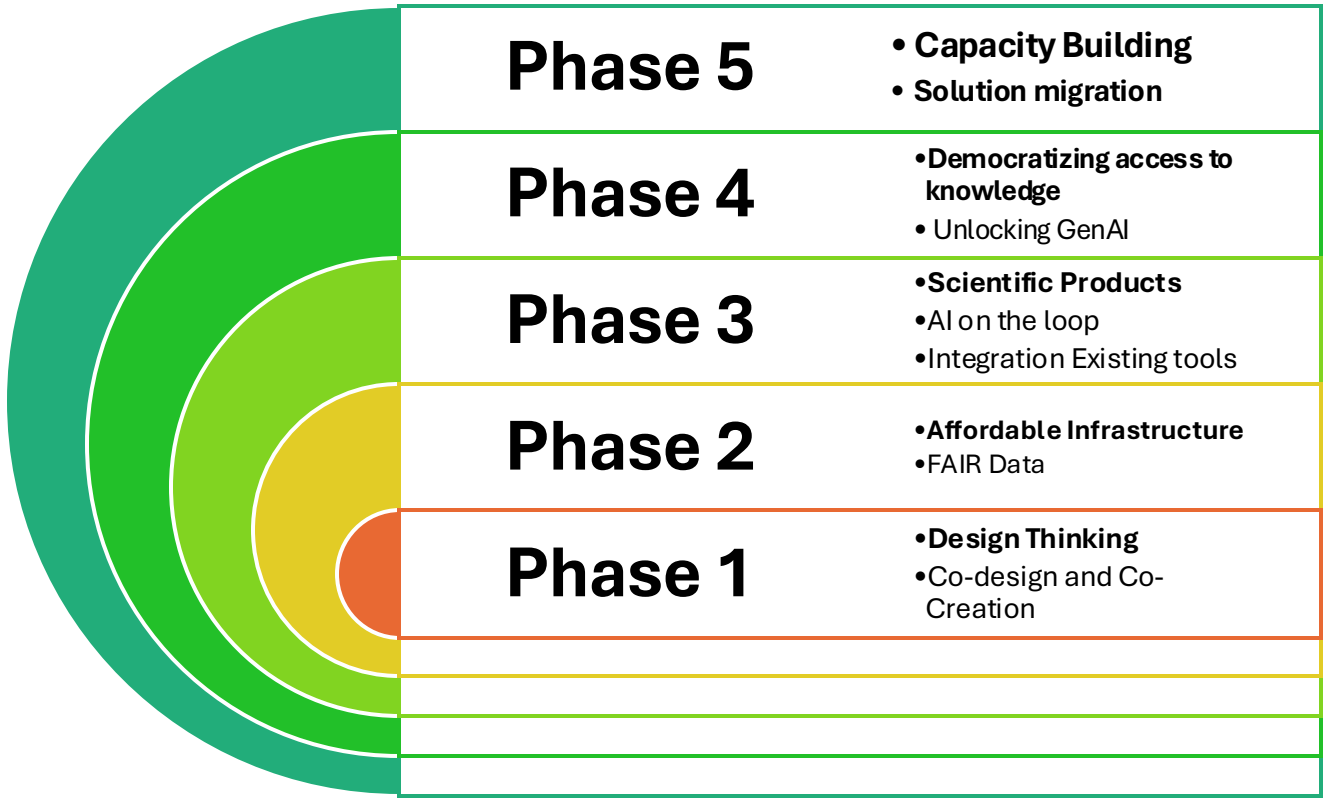


Inclusive interfaces

Digital Twins, Real-time dashboards, AI assistants, 3D modelling, VR/AR

5 Phases for development

*Building a reliable and **scalable digital infrastructure for DT** that enables seamless integration of Water Managers applications to improve water management decisions*

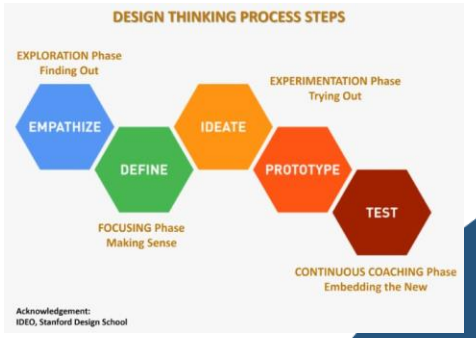


← We are here

← OPEN DATA CUBE

Open Data Cube (ODC) for the Limpopo River Basin Twin

The **Open Data Cube (ODC)** is a critical component of the Limpopo River Basin Twin, designed to facilitate efficient access, storage, and analysis of vast amounts of geospatial data. The ODC enables stakeholders to track and assess critical environmental variables, such as drought hazards, over both space and time.



Building a Digital Twin for water Management for all users

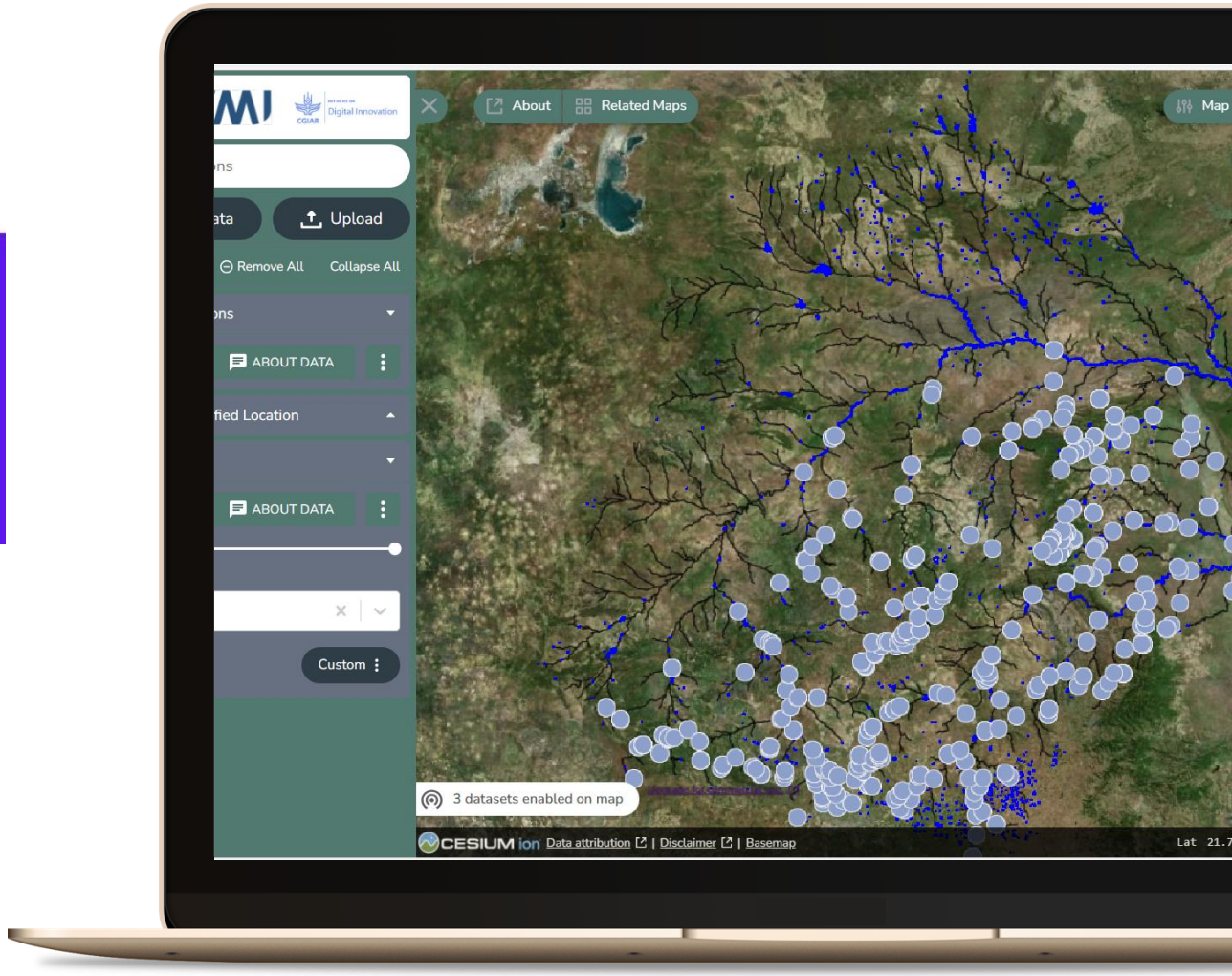
From Scientific evidence to decision making!

Researcher

Water Manager

Citizen

Policymakers



Prototype Digital Twin for the Limpopo River Basin

Accelerating water futures. one basin at a time.

LIMCOM
LIMPOPO WATERCOURSE COMMISSION

"Integrated Transboundary River Basin Management for the Sustainable Development of the Limpopo River Basin."

Digital Twin for Water Management
A 3D representation of the basin that integrates diverse datasets and existing resources/technologies (e.g., DEA, WAPOR, ECMWF, CHIRPS) to understand the current basin dynamics, offering monitoring, forecasting, and scenario analysis for informed decision-making..

For Limpopo: we are providing seasonal water availability forecast, operationalization of environmental flows using a modular approaches of scientific products.

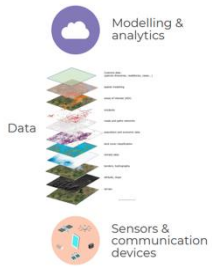
Citizen Science Data Integration
The DT will Empowers local communities to contribute data, closing information gaps and enriching water management insights across the region

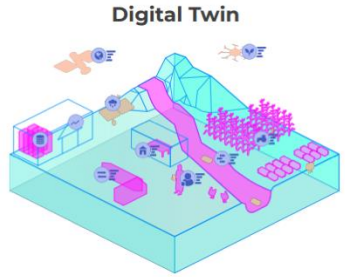
AI-Powered Virtual Assistant (research)
Translates complex science into timely, accessible insights, democratizing access to Trustworthy AI for decision-makers in the Global South.

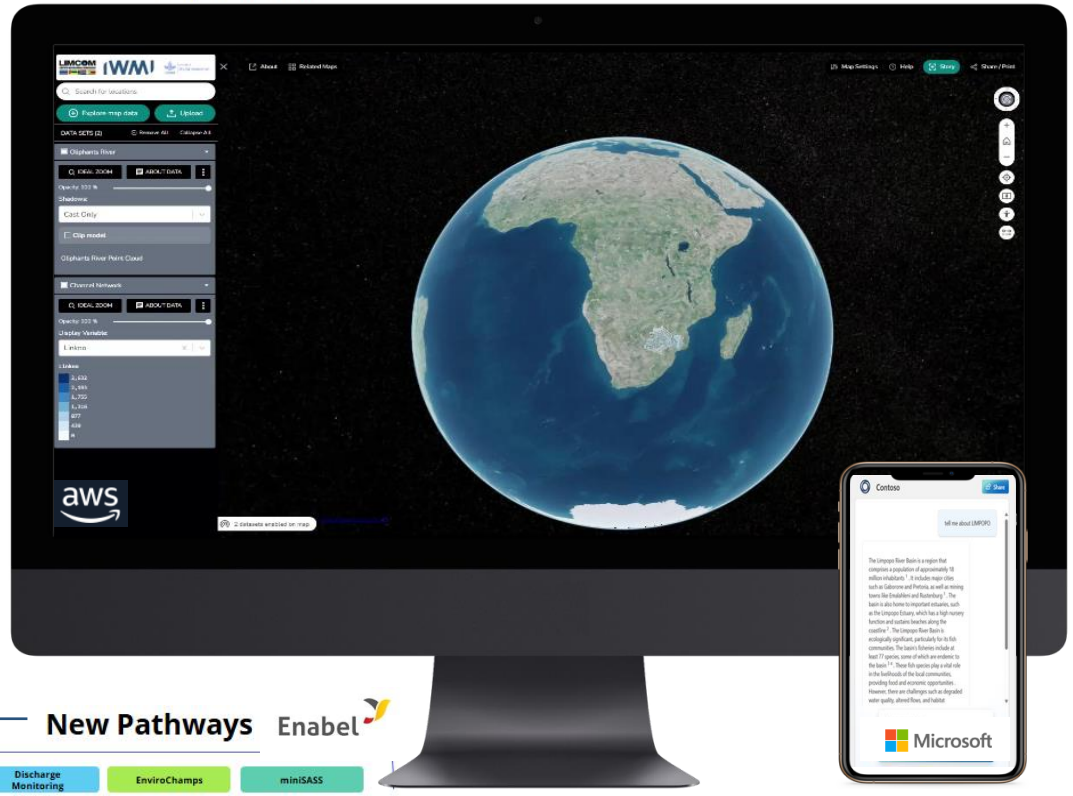
Only possible with:
Multi-Stakeholder Collaboration/Investments
Aligned with member states' **priorities** and leveraging local resources. Involves the tech/private sector in creating scalable, **interoperable** and accessible **open-source** data infrastructure.

iwmi-digitaltwins@cgiar.org

Digital Earth AFRICA







New Pathways Enabel

award HIDROMOD Rivers of Life GROUNDTRUTH environment & engineering

2024 – Incredible Year!

1. UNDP-GEF Project

United Nations Development Program-Global Environment Fund (UNDP-GEF)

What LIMCOM AIMS

To enable organizations to make informative decision on how we can optimize our resources minimizing the impact in other regions.

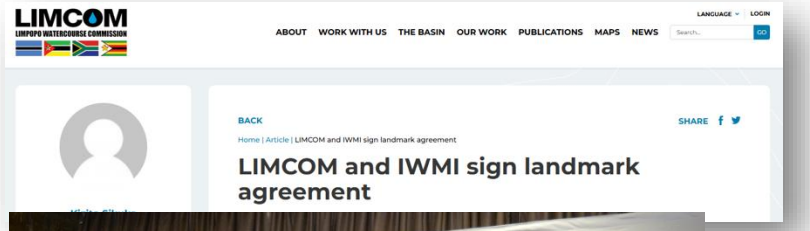
Visionary integration :: IWMI (cgiar.org)

2. World Water Week

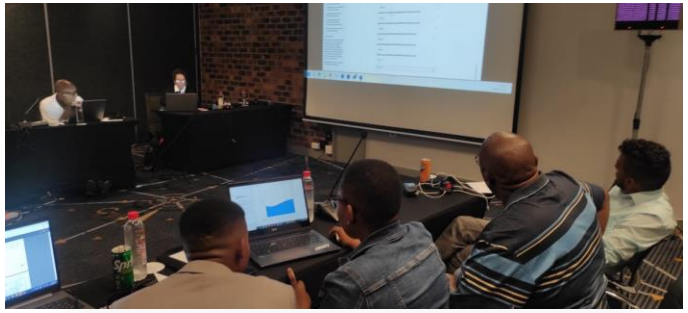
Sérgio Sitoe, LIMCOM Executive Secretary, at 10th World Water Forum in Bali discussing the importance of co-design at the 10th World Water Forum in Bali. Credit: LIMCOM

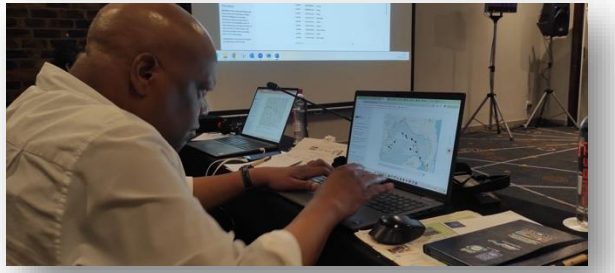
3. Design thinking workshop

4. WaterNet & MoU Signing



5. LIMCOM member state data sharing agreement workshop





THANK YOU TEAM

"Integrated Transboundary River Basin Management for the Sustainable Development of the Limpopo River Basin."

In Partnership With

Supported by

In collaboration with:

Project Lead

Digital Twin IWMI Lead
Angie Garcia Andarcia
IWMI - HQ

Visionary Researcher
Chris Dickens
IWMI – HQ

SA Country Representative
Henry Roman

Stakeholders

LIMCOM
LIMPOPO WATERCOURSE COMMISSION

Team up with

award

Digital Twin Core Team

DT Program Management
Upamali Surangika

Researcher
Surajith Ghosh

Post-doc
Zolo Kiala

Hydrologist
Thilina Gurusinghe

Data Scientist
Kayathri Vigneswaran

Virtual Reality Researcher
Nicole Langa

Interin Director Water Data Science
Ian Overton

Intern Data Scientist
Keerththanan Vickneswaran

Researcher
Karthikeyan Matheswaran

Intern Data Engineer
Abdul Afham

Digital Inclusion Researcher
Fellix Opala

AI Ethics and Digital Inclusion Expert
Daniella Darlington

Implementing Partners

Director
Mark Graham
(GroundTruth)

Research Scientist
Nicholas Pattinson
(GroundTruth)

Executive Director
Jai Clifford-Holmes
(AWARD)

Research & Development Manager
Hugo Retief (AWARD)

Senior Computational Hydrologist
Pedro Chambel (HIDROMOD)

Director
Gordon O'Brien
(Rivers of Life Aquatic Health Services)

External Leveraged Support Resources

Front End Developer
Akanbi Adeyinka

Senior IT Architect
Paulo Silva

Lead Impact YOMA - UNICEF
Michael Scheibenreif

YOMA-UNICEF Coordinator
Leah Khanya Bashe

Microsoft Research

Digital Earth AFRICA

IWMI

CGIAR Initiative on Digital Innovation

THE LEONA M. AND HARRY B. HELMSLEY CHARITABLE TRUST

Digital Earth AFRICA

Enabel

Consultants/External/Support

HIDROMOD Part of ABL

Rivers of Life Aquatic Health Services

GROUNDTRUTH environment & engineering

CUT Central University of Technology, Free State

unicef

aws

New to come

Thank you for joining the Tean!!
The Digital Twin Task Team

Digital Twin Task Team!

B. LIMCOM GEF

1. Maryna Storie
2. Laura Danga-Kuzora

C. Member Sates

1. Alhinos Rugara (Zw)
2. Shepherd Shereni (Zw)
3. Martha Gerls Alfonso Zunguza (Mz)
4. Moz Delegate (Mz)
5. Alfred Moloko (SA)
6. Vuledzani Thenga (SA)
7. Ogopotse Batlokwa Pule (Bw)
8. Samuel Manda (Bw)

The objectives of the task tram are to:

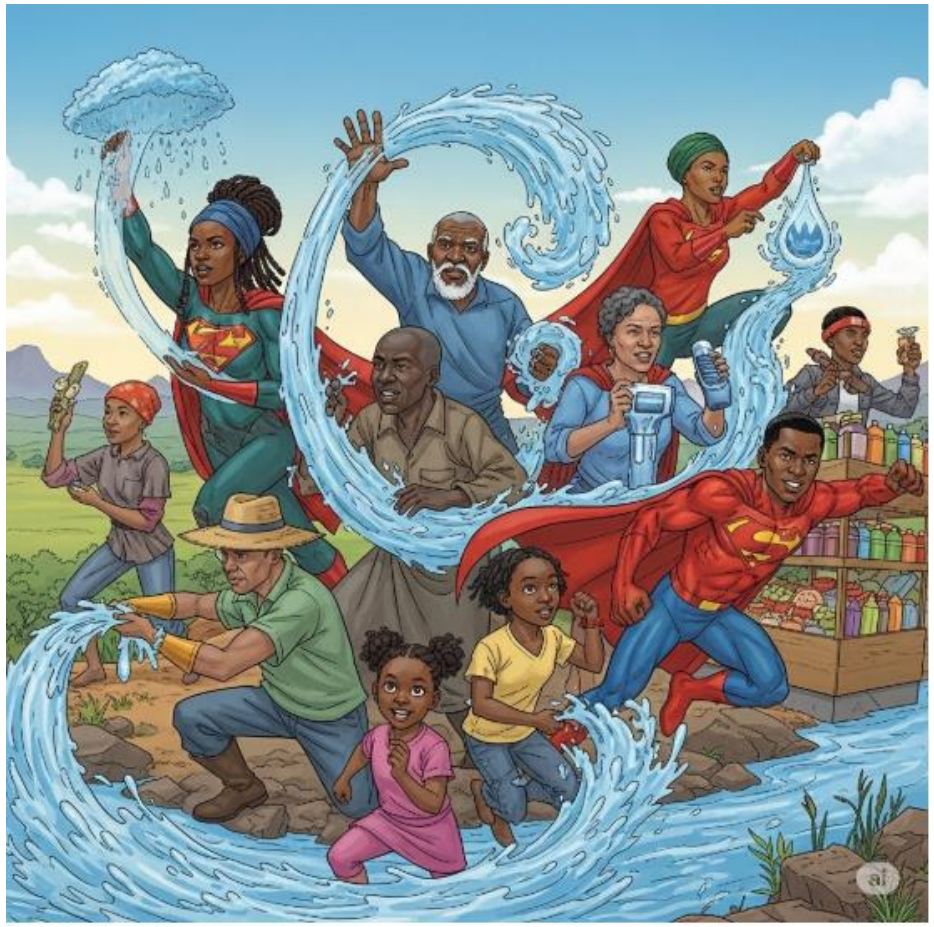
1. ***Identify key data and use cases:*** Work collaboratively to outline specific data needed for digital twin applications relevant to the stakeholders for Limpopo.
2. ***Capacity building*:** Work collaboratively to increase capacity on the use of the digital twin for the region.
3. ***Enhance operational efficiency:*** Utilize the task team structure to promote cross-team collaboration and knowledge sharing, accelerating the adoption of digital twin technology.

IWMI International Water Management Institute

Let's Meet each other: Your super power!

- Get to know your team! Imagine you have a superpower that can address any water management related issues.
  - What's your superpower?
  - Why did you choose it?
  - How would you use it?

- Activity 20 min
  - Draw your super power (5 min)
  - Shared with the person next to you (5 min)
  - Shared with your group 10 min



Menti Question

Moderator: Surajit

AI driven Digital Twin for Water Management for Limpopo River Basin and Inclusive Integration with Citizen Science

IWMI

Listening session 20 min

Moderators: Henry & Hugo

What Data Integration challenges do water managers encounter in the region?

What is the difficulty in accelerating decision-making for water management?

Henry

REPUBLIC OF BOTSWANA

LIMCOM LIMPOPO WATERCOURSE COMMISSION

DIWASA

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Digital Earth AFRICA

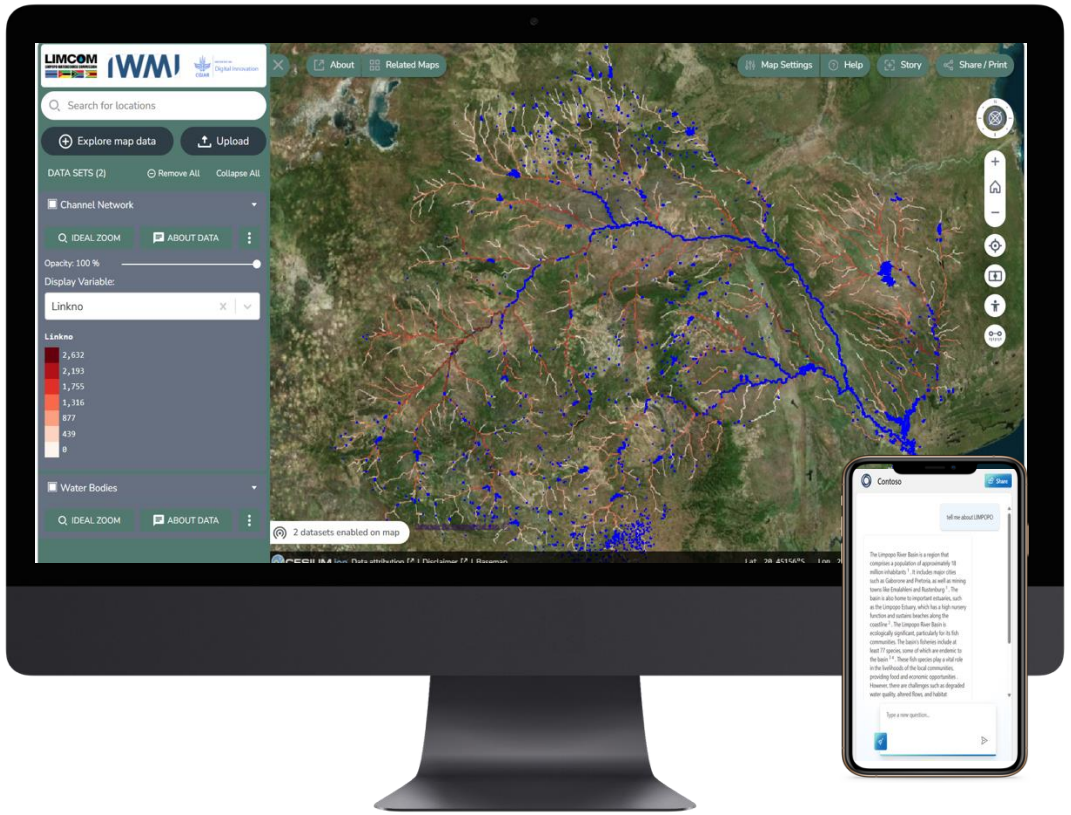
Global Water Partnership Southern Africa

Microsoft

Group Picture

Moderator: Laura

AI driven Digital Twin for Water Management for Limpopo River Basin and Inclusive Integration with Citizen Science



Digital Twin Limpopo Recap

AWARD

Hugo

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LIMPOPO WATERCOURSE COMMISSION

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Global Water Partnership Southern Africa
Microsoft

Hands on into Digital Twin Applications

Case studies on Irrigated area mapping and drought monitoring

What is the Limpopo Digital Twin?

A cloud-based water management platform built on TerriaJS that attempts to create a replica of the Limpopo River Basin

Core Platform Features

- 3D globe visualization with time-series animation
- Interactive chart pop-ups for any location
- Custom feature templates for data exploration
- Polygon drawing tools for spatial analysis
- Multi-layer overlay with transparency control

Built-in Analytics

- WPS (Web Processing Service) for on-demand calculations
- CSV data export for any point or polygon

TerriaJS Foundation

3D Cesium Engine
Globe-based visualization

Time Dimension
Historical playback

WMS/WFS Support
Standard OGC services

JSON Configuration
Easy customization

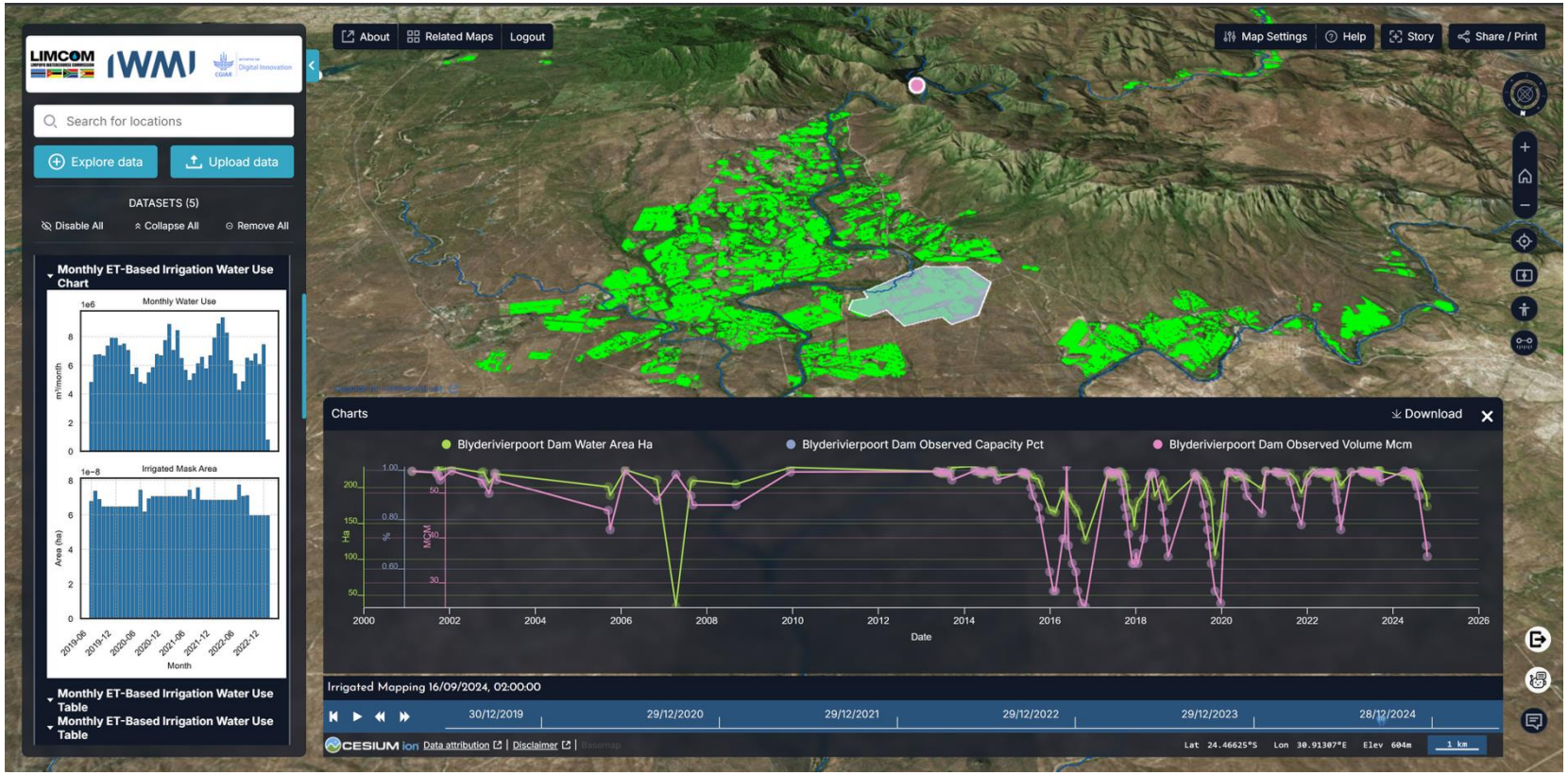
Data Integration Hub

Seamlessly combines multiple data streams:

- Satellite Imagery
- IoT Sensors
- Forecasts
- Model Outputs
- Field Data

"From raw data to actionable insights in a single, unified interface"

What does the Limpopo Digital Twin look like?



Key Interface Elements

Interactive 3D Globe
Pan, zoom, tilt to explore the entire basin from any angle

Layer Control Panel
Toggle 100+ data layers with transparency control

Time Slider
Navigate through historical data or view forecasts

Pop-up Charts
Click any feature for instant data visualization

Multiple Views for Different Needs

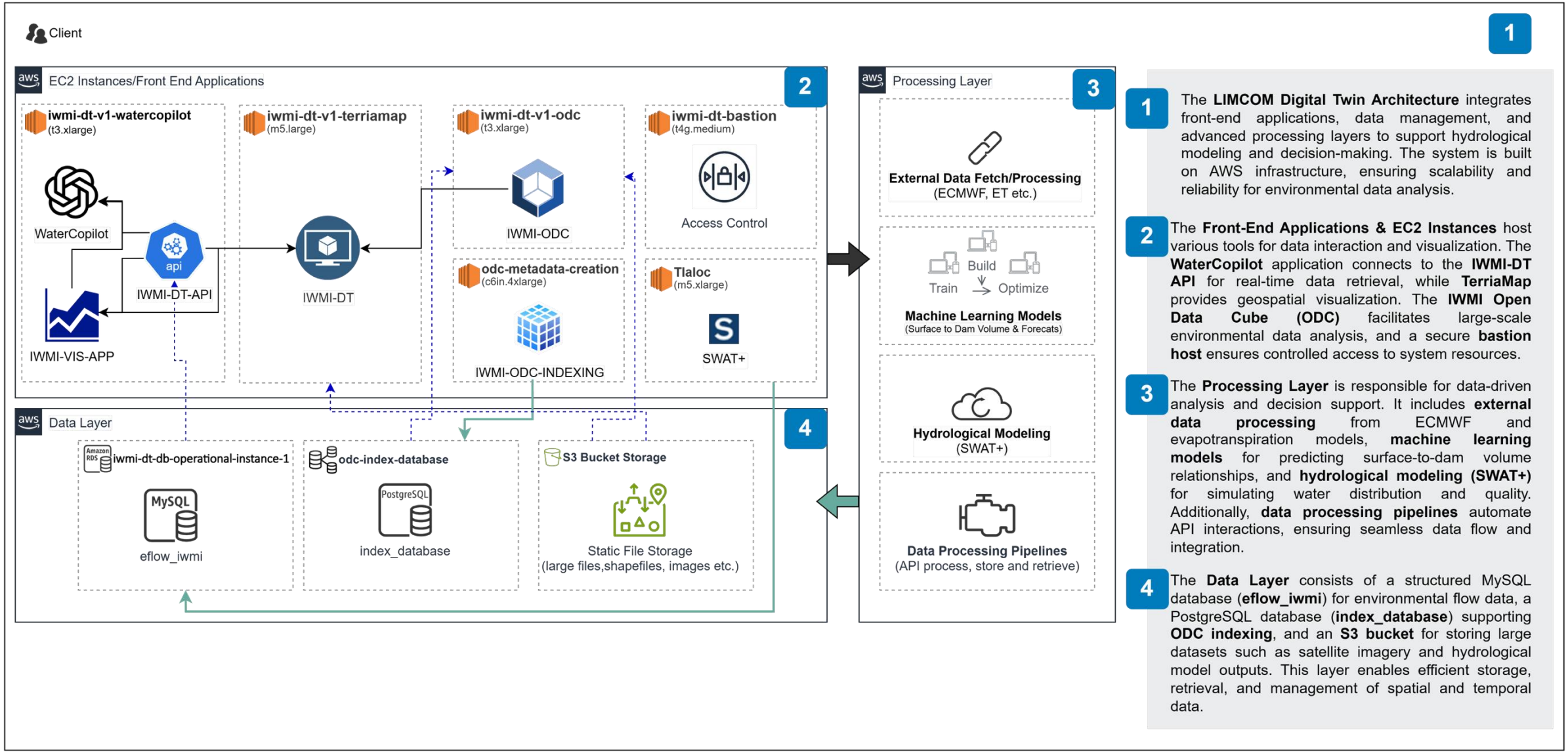
Basin Overview
Full catchment view

Data Analytics
Charts & time-series

Alerts
Real-time monitoring

Site Details
Location-specific data

How does it work?



1

1 The **LIMCOM Digital Twin Architecture** integrates front-end applications, data management, and advanced processing layers to support hydrological modeling and decision-making. The system is built on AWS infrastructure, ensuring scalability and reliability for environmental data analysis.

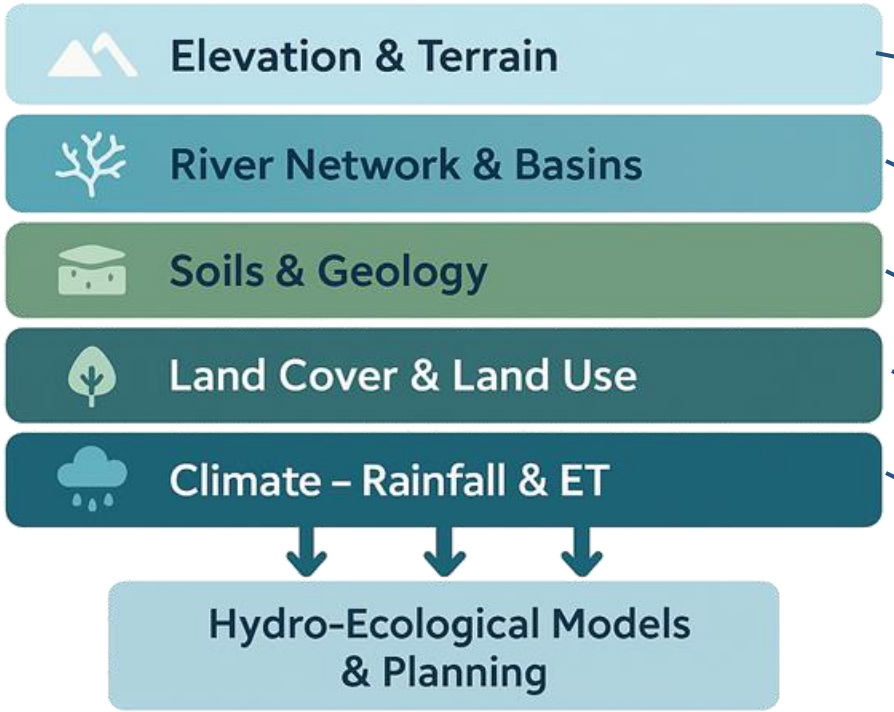
2 The **Front-End Applications & EC2 Instances** host various tools for data interaction and visualization. The **WaterCopilot** application connects to the **IWMI-DT API** for real-time data retrieval, while **TerriaMap** provides geospatial visualization. The **IWMI Open Data Cube (ODC)** facilitates large-scale environmental data analysis, and a secure **bastion host** ensures controlled access to system resources.

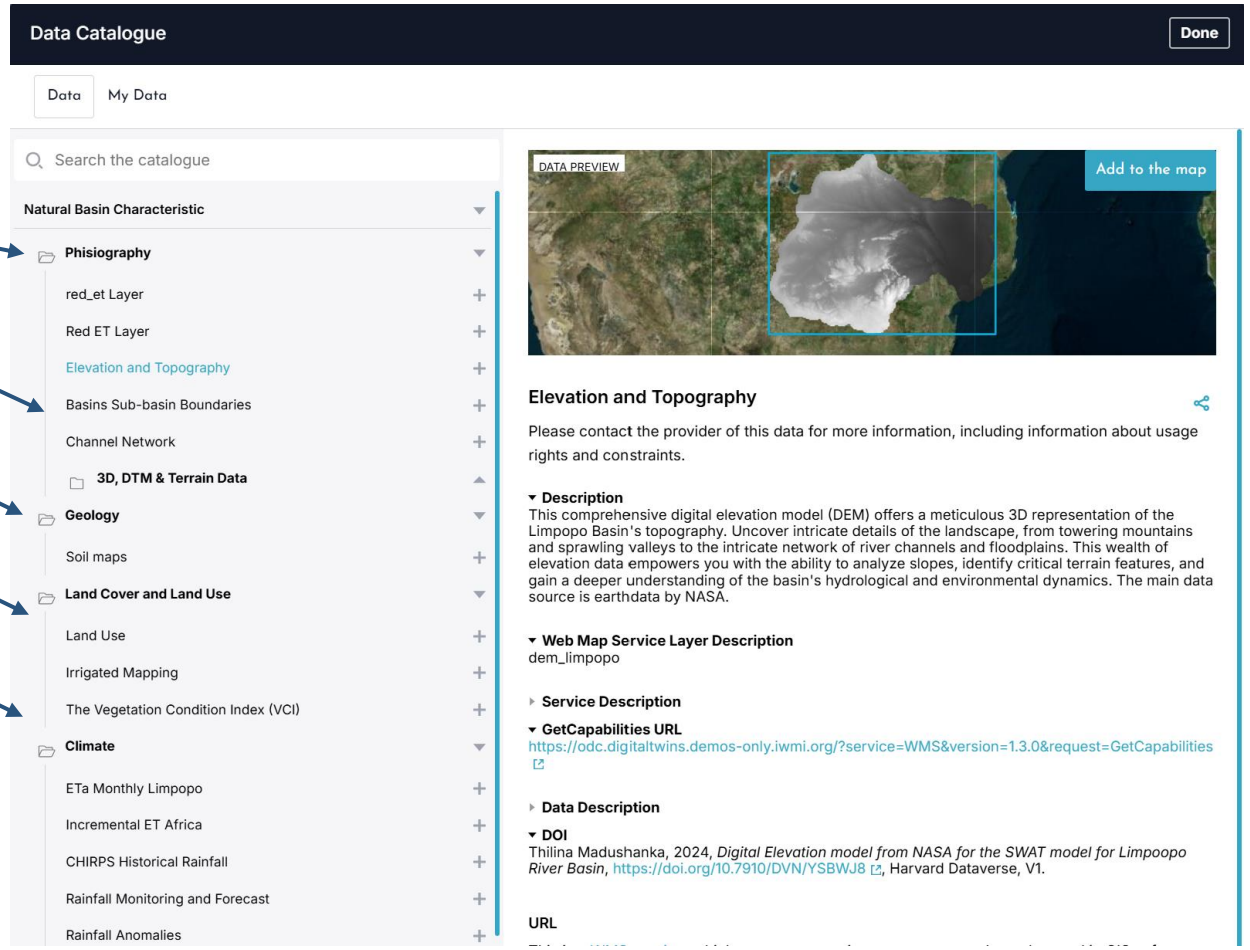
3 The **Processing Layer** is responsible for data-driven analysis and decision support. It includes **external data processing** from ECMWF and evapotranspiration models, **machine learning models** for predicting surface-to-dam volume relationships, and **hydrological modeling (SWAT+)** for simulating water distribution and quality. Additionally, **data processing pipelines** automate API interactions, ensuring seamless data flow and integration.

4 The **Data Layer** consists of a structured MySQL database (**eflow_iwmi**) for environmental flow data, a PostgreSQL database (**index_database**) supporting **ODC indexing**, and an **S3 bucket** for storing large datasets such as satellite imagery and hydrological model outputs. This layer enables efficient storage, retrieval, and management of spatial and temporal data.

Know the Landscape

Natural Basin Characteristics





Climate Signals in Real Time

Climate Hazards Center
UC SANTA BARBARA

IHE DELFT Institute for Water Education
under the auspices of UNESCO

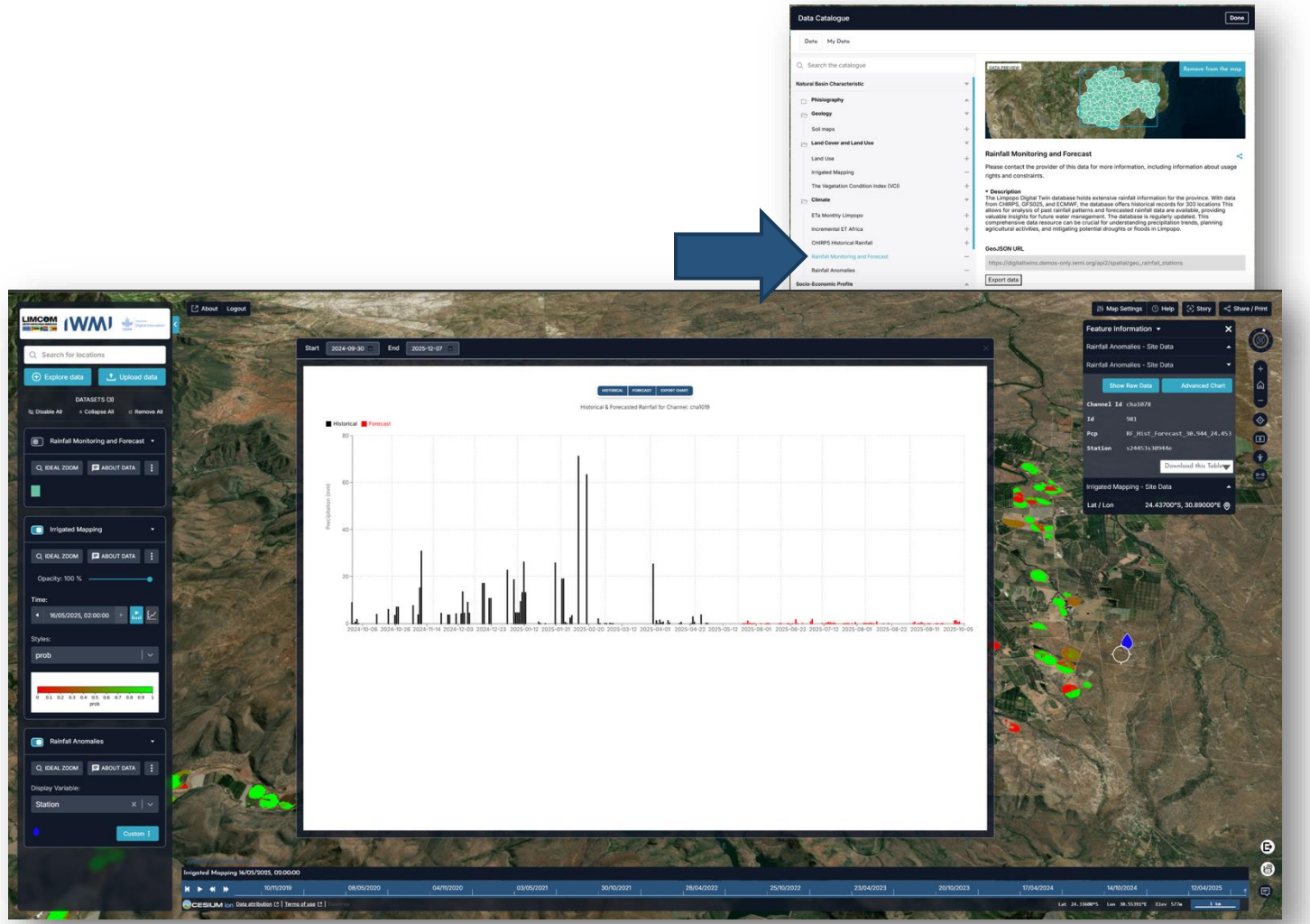
IWMI International Water Management Institute

Rainfall Observations

ETa Anomalies

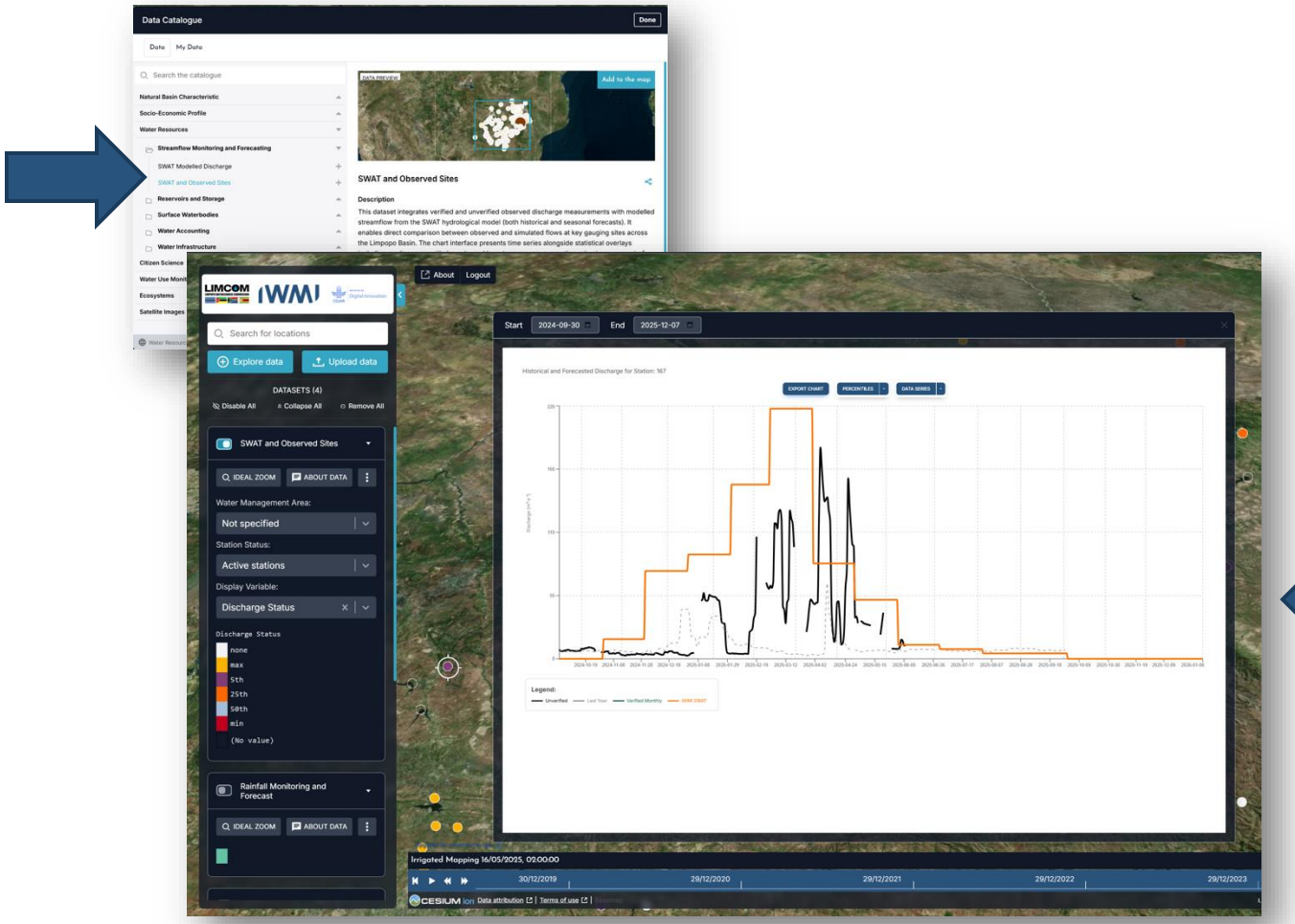
Forecasts

Early Warning

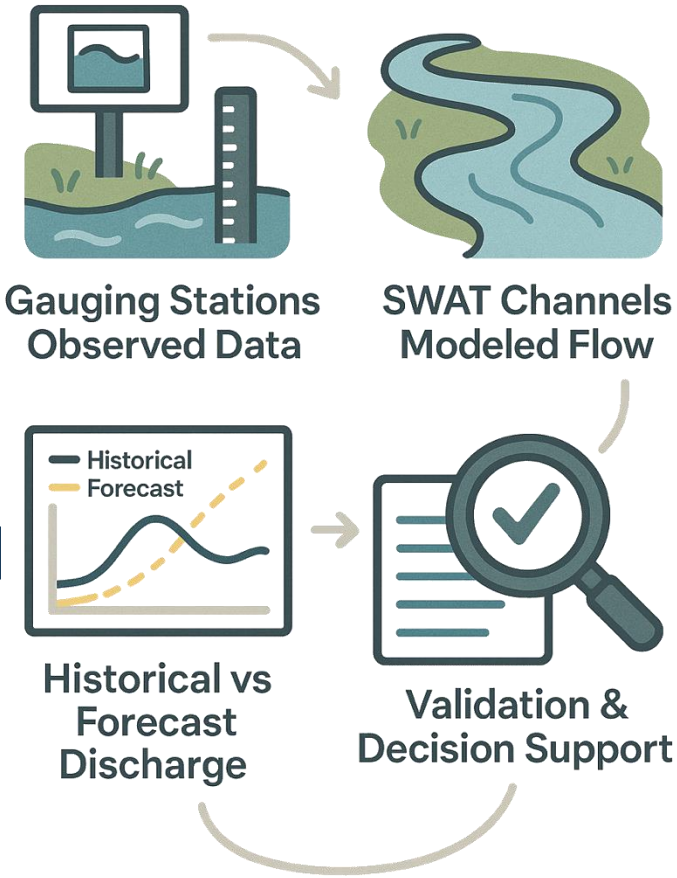


Observed vs Modelled Discharge

SWAT+
SOIL & WATER ASSESSMENT TOOL

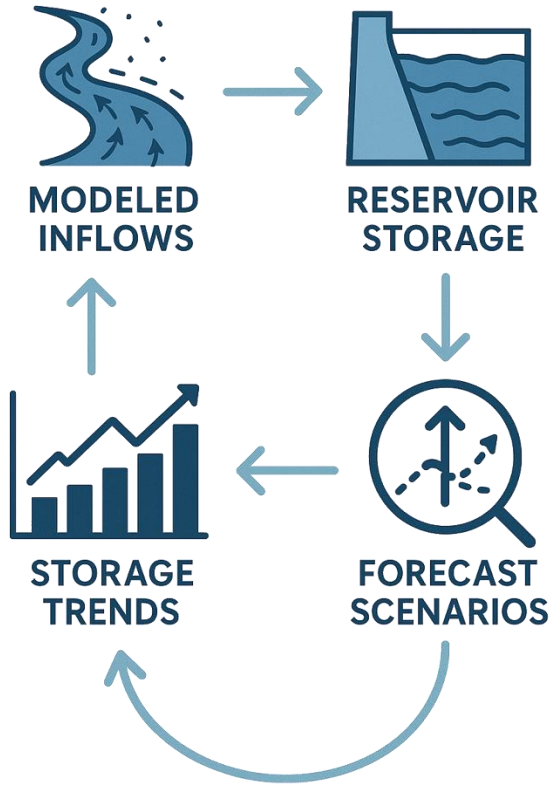


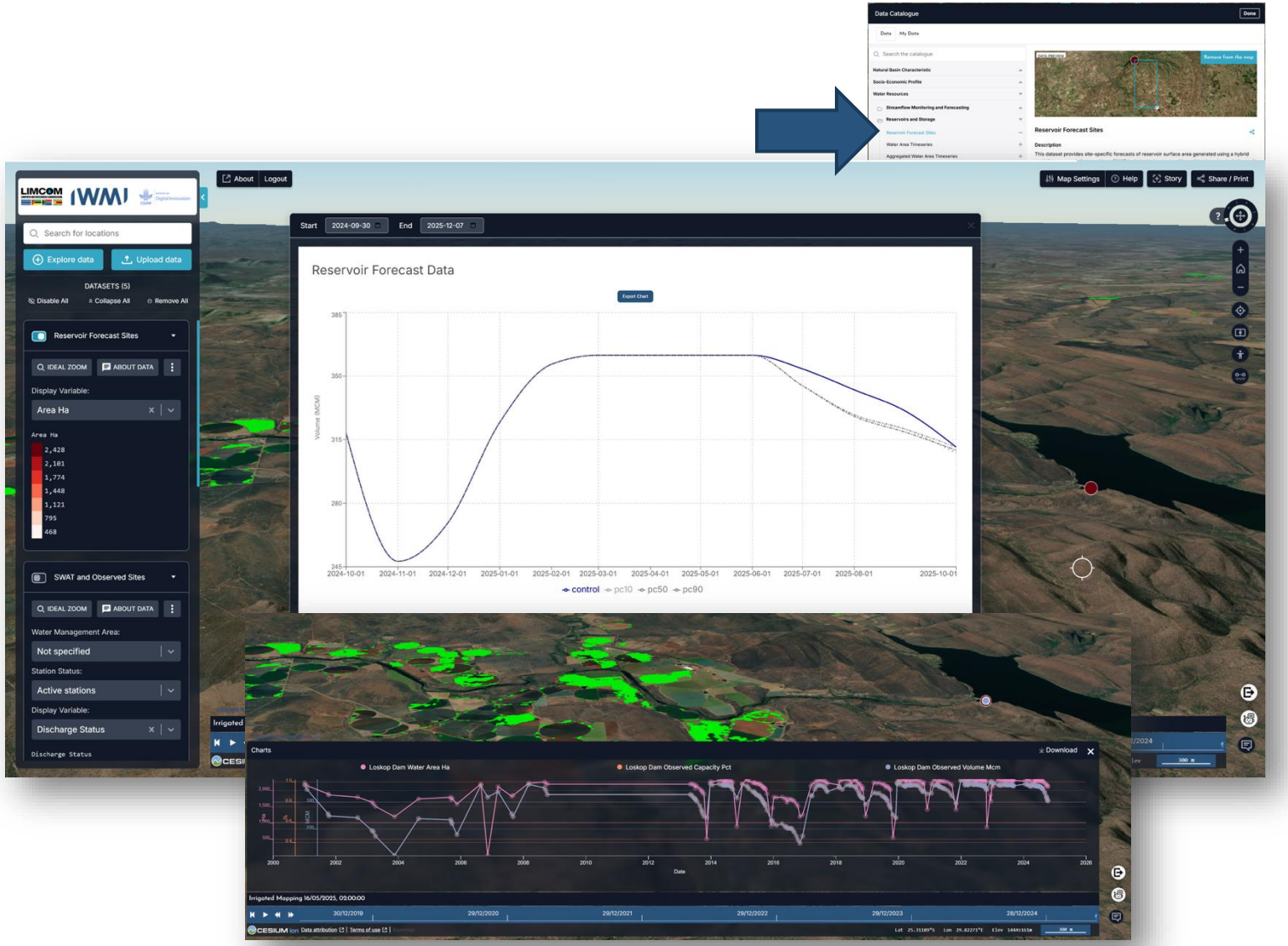
Streams under the Microscope



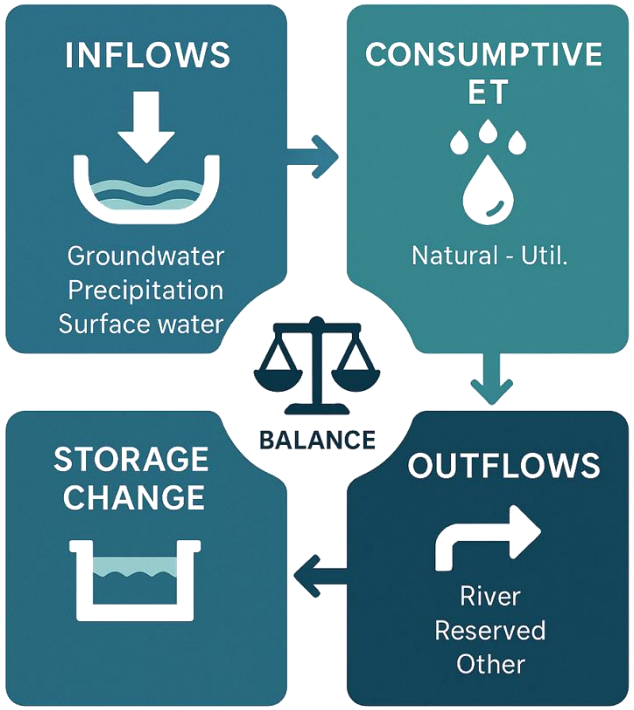
Reservoir Storage & Outlook

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

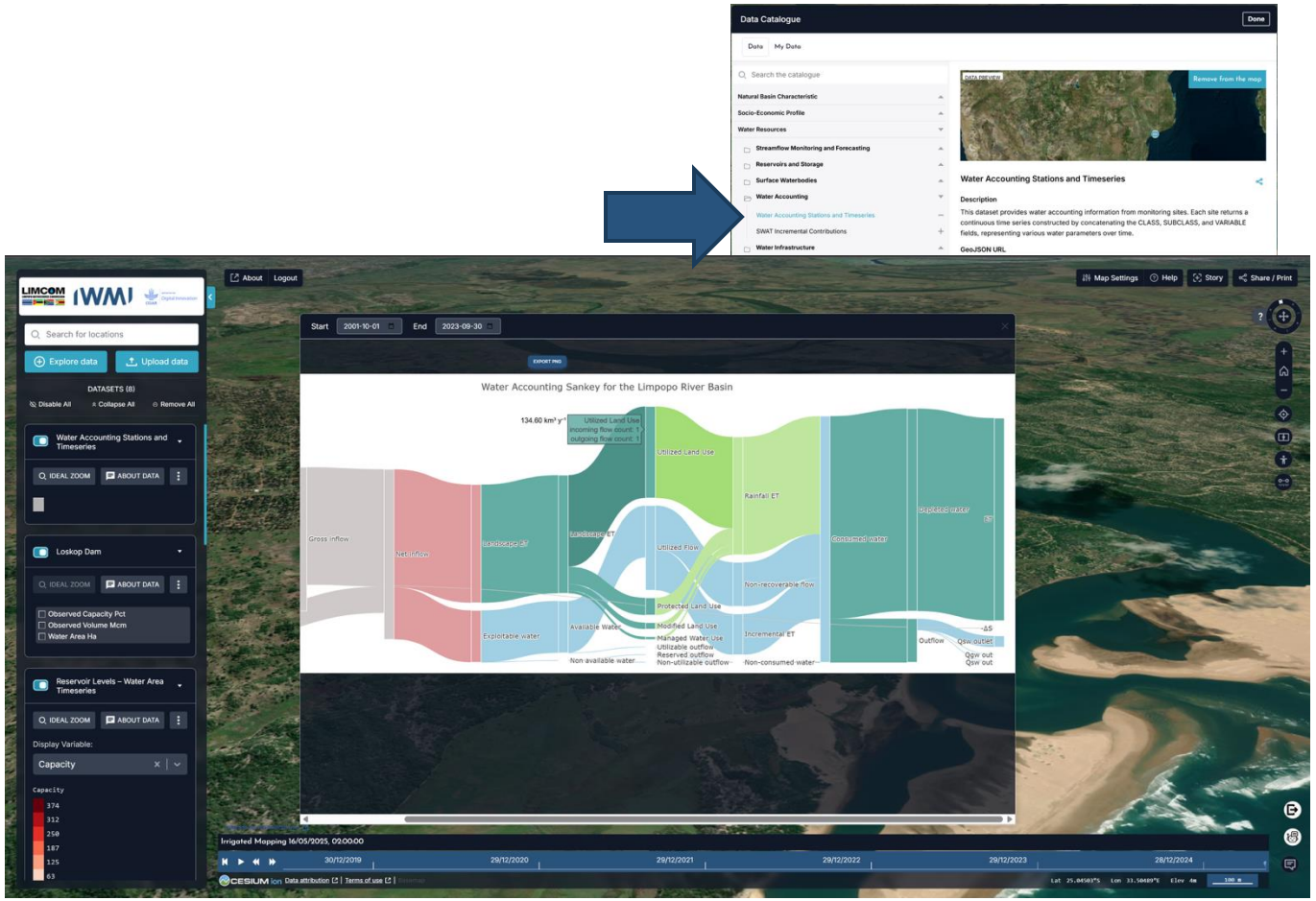




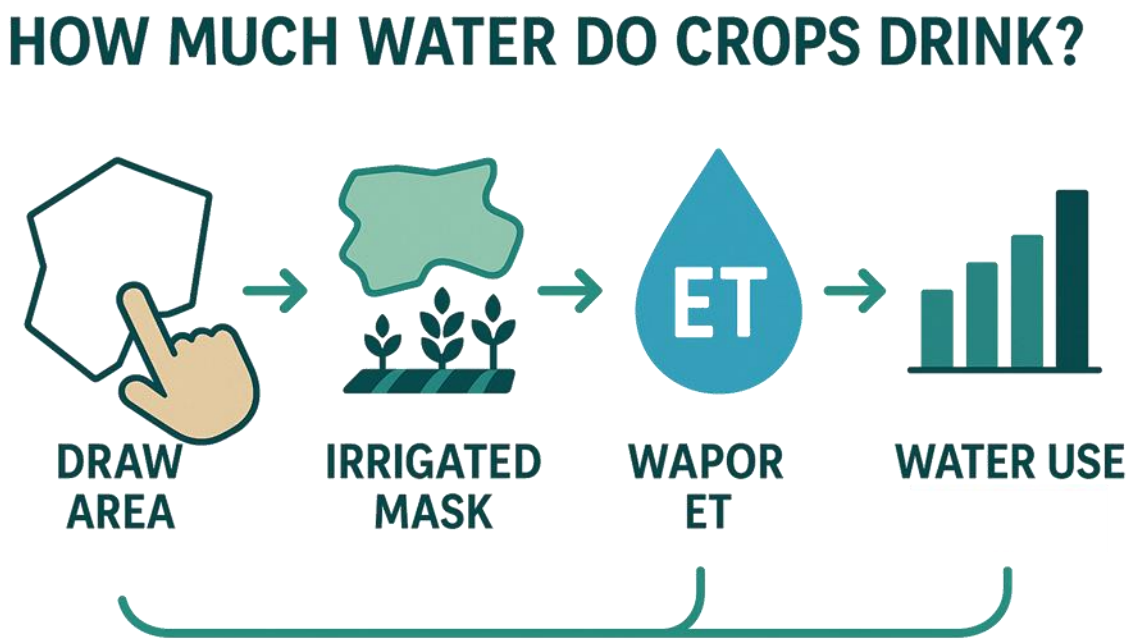
Basin Water Accounting

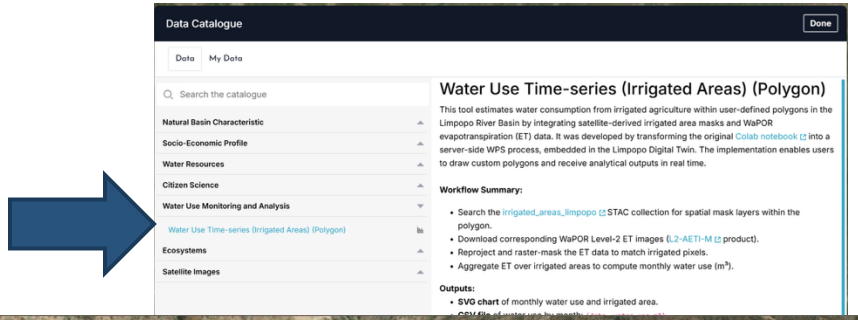


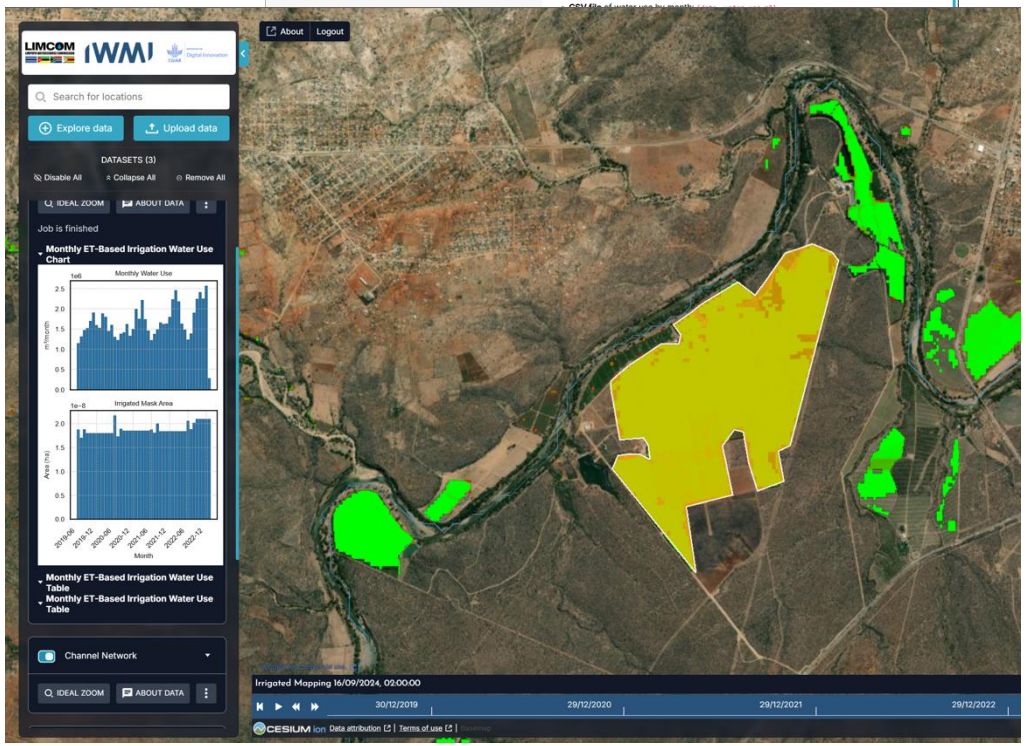
30+ standard categories



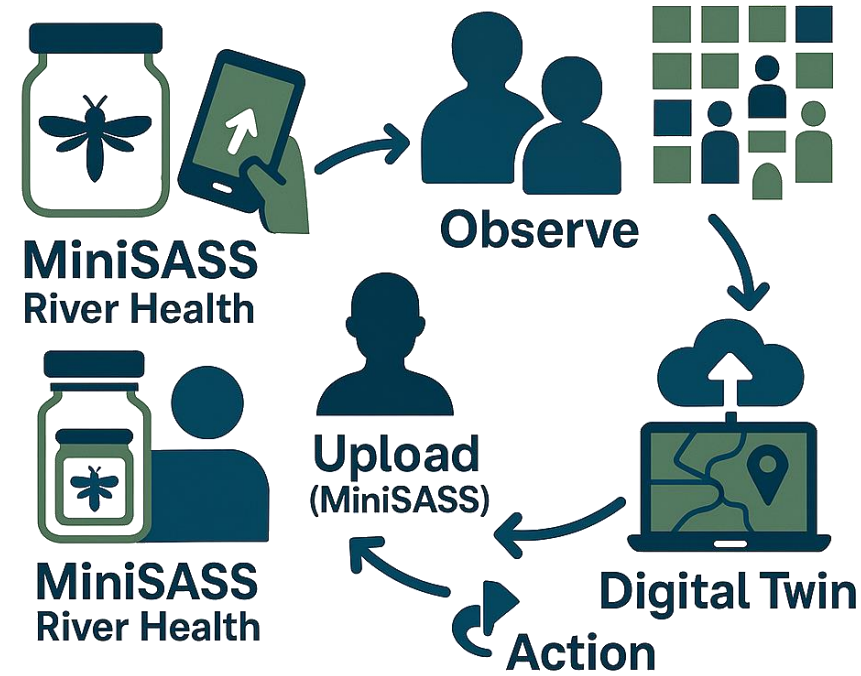
On-Demand Irrigation Water-Use Tool

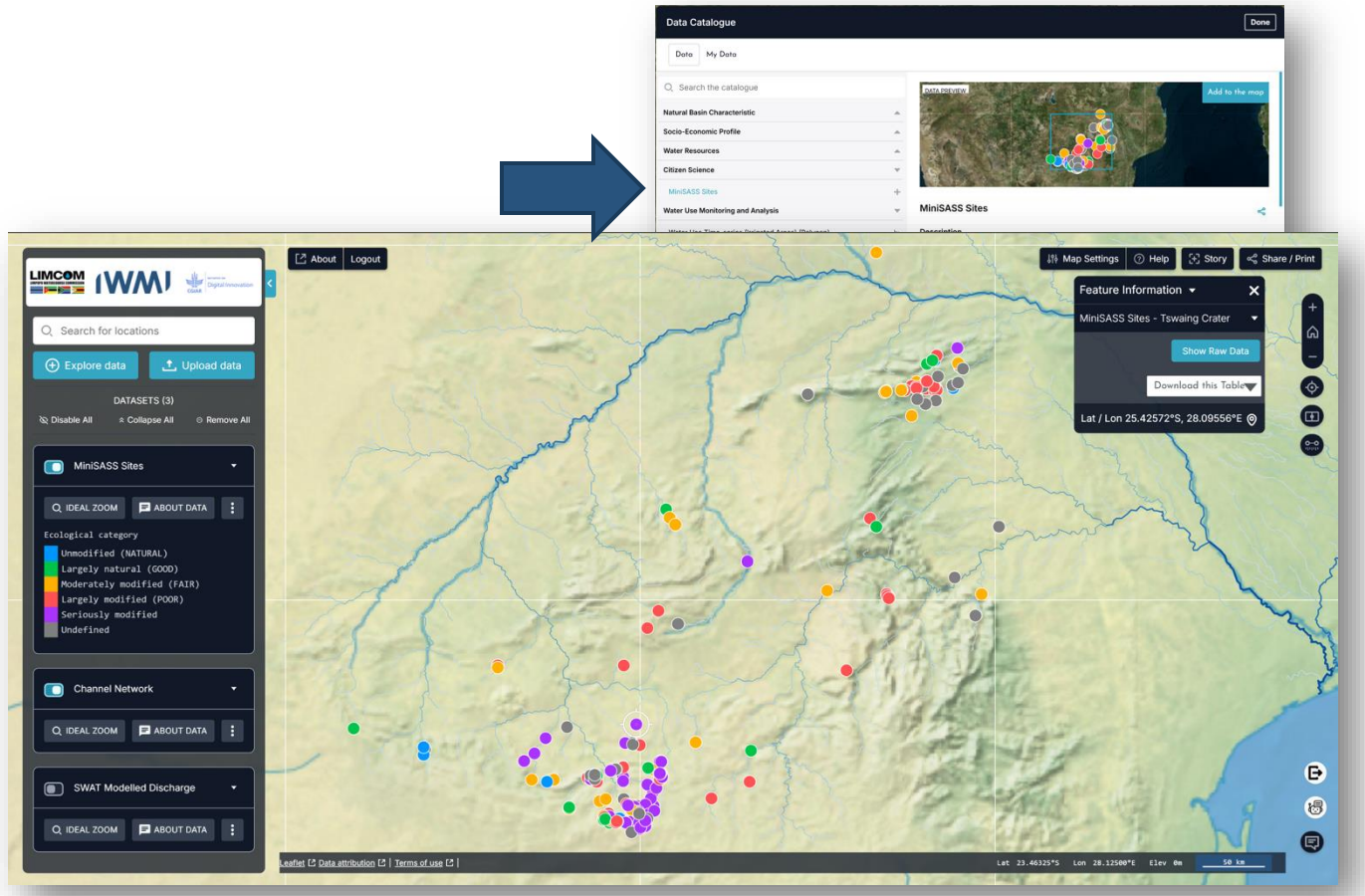




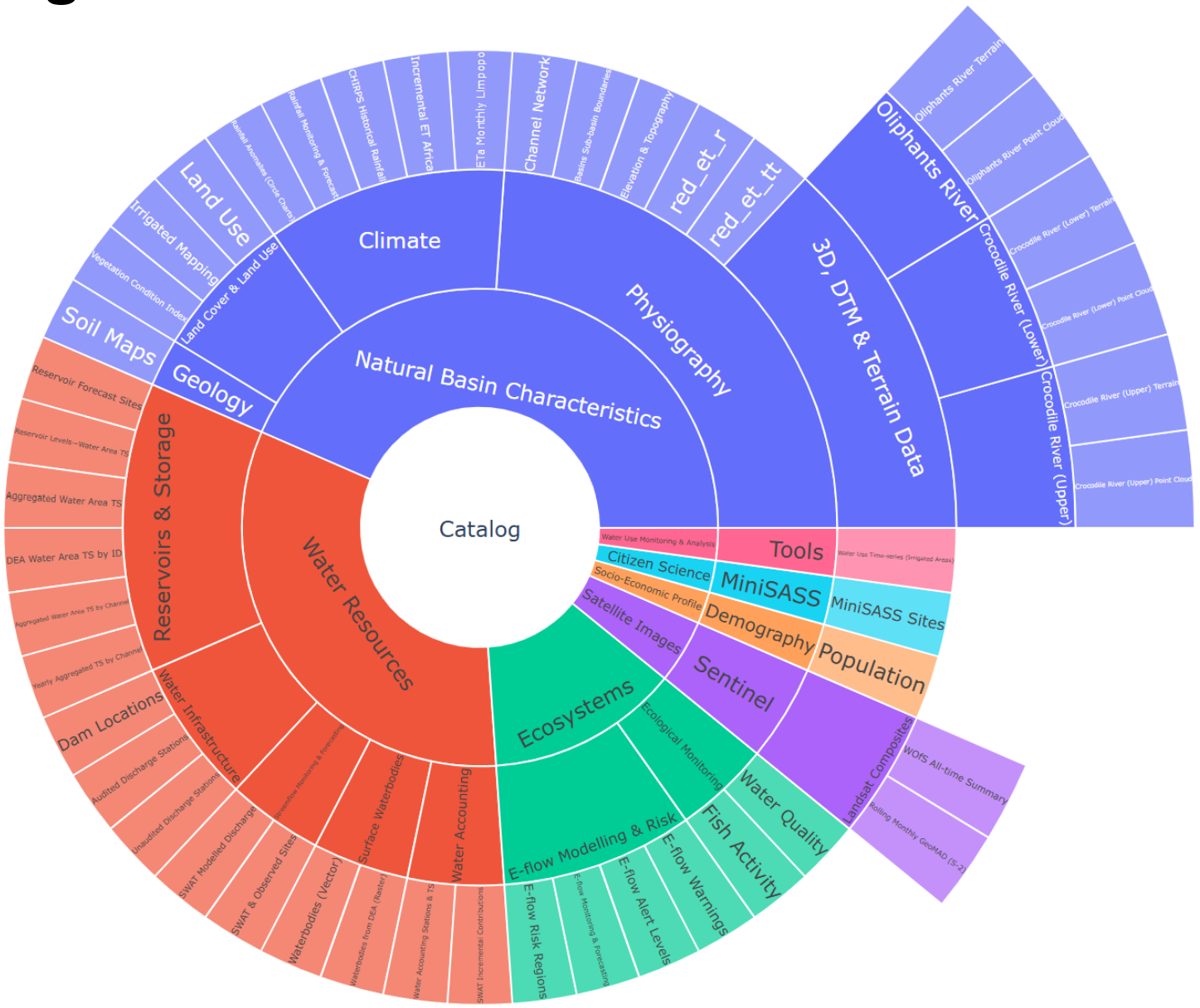


Citizen Science Matters





An ever growing catalog!

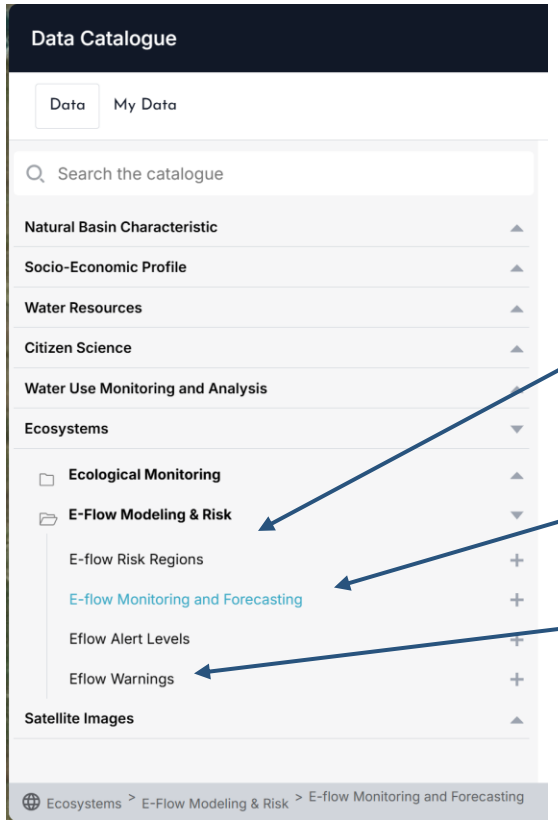


Quick demo of various features and functionalities

Let's get hands on with some case studies!

Use Case 1: Environmental-Flow Compliance and water availability

Use the Digital Twin to check whether present flows meet required e-flow targets at any one of the basins e-flow sites, in addition summarise the eflow alerts for the current hydrological year (2024-10-01 to today) across the basin.



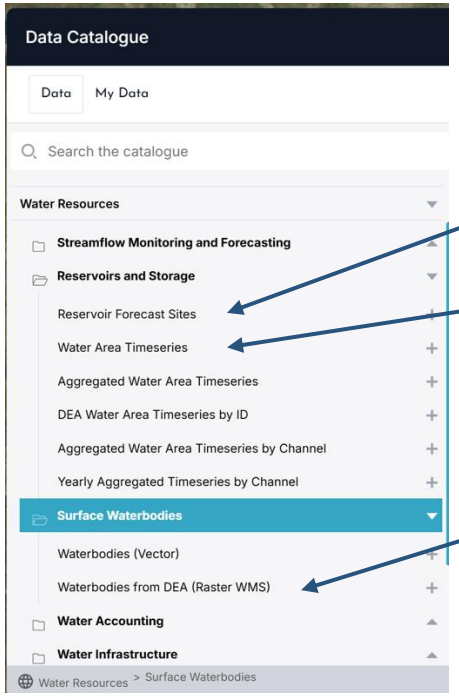
Maps areas of ecological and socio-economic risk related to insufficient environmental flows (e-flows)

Natural flow, present flow, and required e-flow

Alert levels for environmental flows (e-flows)

Use Case 2 – Dams, Lakes and Surface Water Body Monitoring

Using the Digital Twin platform, analyze the surface water extent changes for Massingir Dam over the past 6 months. What are the rainfall projections for coming months? What do the rainfall Anomalies tell us for the current year in relation to last year?



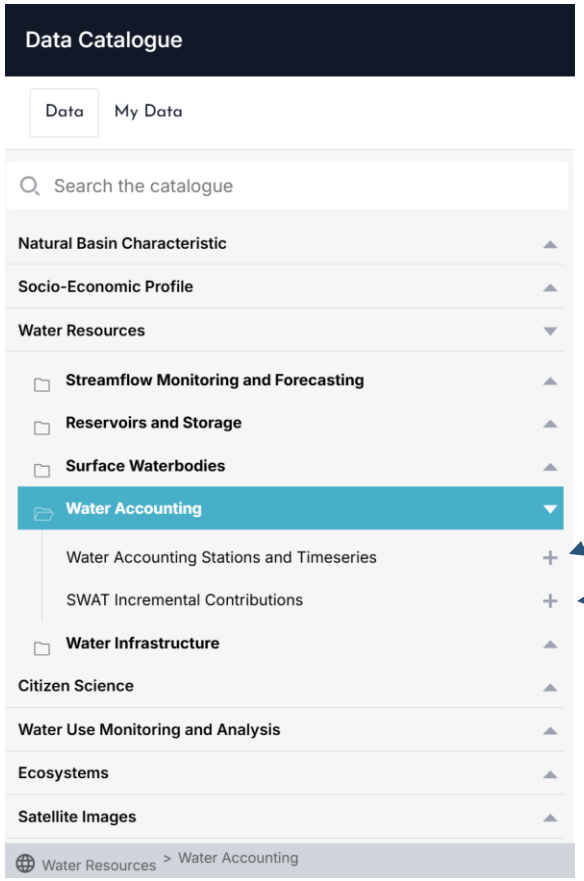
SWAT hydrological outputs with machine learning techniques

Detailed monthly time-series of surface water area

Maps persistent and seasonal water bodies and the change in their water surface area over time

Water Accounting

Using the Digital Twin platform, explore the water accounting framework implemented for the Limpopo Basin. Document the water accounting components and identify the areas of the basin that have the greatest negative balance (hint look at the incremental contributions).



Provides water accounting information for the basin

Simulated incremental contributions per channel