

# **Chapter 1 — GERNAC: Water Management and Natural Resources in Central Africa (CICOS)**

*Water Management and Natural Resources in Central Africa — Lead Institution: International Commission of the Congo–Oubangui–Sangha Basin (CICOS)*

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## **1.1 Background and Rationale**

Central Africa encompasses one of the planet’s most hydrologically rich landscapes—the Congo Basin—home to the world’s second-largest river by discharge and vast interconnected wetlands. These aquatic systems underpin regional transport, hydropower, fisheries, biodiversity, and livelihoods. Yet, until recently, their management was constrained by sparse observation networks, inconsistent data collection, and limited analytical capacity.

The **Water Management and Natural Resources in Central Africa (GERNAC)** consortium was created under the *GMES & Africa Programme* to bridge this gap by embedding **Earth Observation (EO)** technologies and modelling into operational water, forest, and ecosystem management. Led by the **International Commission of the Congo–Oubangui–Sangha Basin (CICOS)**, the consortium’s mandate is to provide reliable, timely information for safer navigation, improved hydrological forecasting, and sustainable natural-resource governance.

**Geographic coverage.** GERNAC’s operational reach spans nine Central African countries—Burundi, Cameroon, Central African Republic, Republic of the Congo, Democratic Republic of the Congo, Gabon, Equatorial Guinea, Chad, and São Tomé & Príncipe—covering the entire Congo Basin and its adjoining watersheds such as Lake Chad and the Ogooué system.

### **Phased implementation.**

- **Phase I (2017–2021)** established the foundational services and regional information systems.

- **Phase II (2022–2025)** expanded coverage to forests, fires, and biodiversity, deepened hydrological and navigation services, and prioritized sustainability and policy uptake.

## **1.2 Leadership, Governance, and Stakeholders**

**Lead institution.** The consortium is coordinated by **CICOS**, whose statutory mandate in transboundary river management and inland navigation provides a strong institutional anchor for regional EO applications.

**Partner network (Phase II).** The expanded partnership includes:

- *River and basin authorities:* Régie des Voies Fluviales (RVF, DRC), Lake Chad Basin Commission (CBLT);
- *Research and technical partners:* University of Kinshasa/CRREBaC (hydrodynamic modelling), OSFAC (forest EO), IGEBU (Burundi), CRECC (Cameroon), INCOMA (Equatorial Guinea), and BNED (Côte d'Ivoire);
- *Policy coordination bodies:* COMIFAC for regional forest governance.

**Continental coordination.** Phase II was formally launched during the **AU–EU Cotonou Kick-off (March 2022)**, which emphasised cross-consortia collaboration, user engagement, and long-term sustainability.

## **1.3 Service Portfolio and Methods (Phase I → Phase II)**

### ***Catalogue of Operational Services***

<b>Service Theme</b>	<b>Key Deliverables</b>	<b>Primary Users</b>	<b>Phase Progression</b>
<b>Inland Navigation</b>	Virtual water-level stations, navigable-depth layers,	CICOS, RVF, pilots,	I → II (expanded)

	“avis aux navigateurs,” prototype mobile app	navigation authorities	
<b>Hydrological Balance &amp; Floods</b>	Sub-basin water-balance models, flood maps, monthly/seasonal bulletins	Basin managers, ministries, civil protection	I → II (consolidated)
<b>Wetlands, Forests &amp; Fires</b>	Under-canopy flood dynamics, deforestation, degradation, biodiversity and fire maps	COMIFAC, forestry and wildlife agencies	II (new/expanded)
<b>Information Systems</b>	Monthly <i>Hydrological Bulletin</i> and geo-portal access	Ministries, agencies, public	I → II (institutionalised)

### ***Technical Approach***

- *Satellite altimetry and virtual stations:* Sentinel-3 and CryoSat tracks generate water-level time series for key river crossings, feeding navigation bulletins and route-depth estimates.
- *Hydrodynamic and rainfall-runoff modelling:* A 2D hydrodynamic model (CRREBaC/University of Kinshasa) assimilates altimetry and gauge data to estimate navigability; basin-scale water balance integrates CHIRPS rainfall and MODIS/Sentinel evapotranspiration products.
- *Under-canopy radar mapping:* Multi-temporal Sentinel-1 backscatter reveals flooding beneath forest canopies, while optical imagery (Sentinel-2, Landsat) supports monitoring of forest loss and fire dynamics.

## **1.4 Public Platforms and Data Access**

- **CICOS Hydrological Bulletins:** Monthly bulletins summarising water levels, flood risk, and navigation conditions, now published regularly (e.g., March and June 2025).<sup>1</sup>
- **CICOS Navigation Services:** Official online updates include *avis aux navigateurs*, navigation charts, and safety advisories.<sup>1</sup>
- **GERNAC Geo-Portal:** Hosted initially by AGEOS and later integrated into CICOS infrastructure, the portal disseminates EO-derived data and products to partners and the public.

The regular release of these bulletins marks GERNAC's transition from pilot demonstrations to full operational service, embedding EO-based hydrology into institutional workflows and public communications.

## **1.5 Achievements and Activities**

### ***Phase I (2018–2021): Foundational Achievements***

- **2018:** Project inception, consortium agreements, and installation of an EO receiving station (*e-Station*) for improved data access.
- **2019:** Development of pilot services—flood mapping, digitised navigation charts, and a prototype navigation app; publication of initial hydrology bulletins.
- **2020:** Launch of the regional geo-portal and operational water-balance forecasts despite pandemic disruptions.
- **2021:** 100% delivery of Phase I outputs; expanded EO use in navigation, hydropower, agro-pastoral planning, and biodiversity monitoring.

### ***Phase II (2022–2025): Scaling and Policy Uptake***

Date/Period	Activity	Users	Impact

Mar 2022	AU–EU Cotonou Kick-off for Phase II	All consortia	Strategic alignment on sustainability
Jun 2022	Douala workshop defining eight geo-applications (forests, fires, wetlands, biodiversity, floods, hydrology, navigation, pollution)	Regional partners	Expanded scope beyond Phase I
Jul 2024	Cross-consortium marine–coastal EO training (Brazzaville) with University of Ghana	6 coastal countries	Strengthens river–coast interface
Sep 2024	Brazzaville workshop on uptake & sustainability	CICOS, ministries, users	Institutional ownership & transition planning
Jul 2025	Hydrological Bulletins (e.g., March, June)	Basin authorities, public	Institutionalised routine communication
Jul 2025	Douala closing workshop	CICOS, ECCAS observers	Transition from project to owned services

**International recognition.** At the **16th EUMETSAT User Forum in Africa (Cotonou, 16–20 Sept 2024)**, CICOS presented its pioneering use of satellite altimetry and rainfall models to support inland navigation.<sup>2</sup>

## 1.6 Decision Pathways and Measurable Impacts

### *How Information Becomes Action*

- **Navigation safety:** Satellite-derived stage and depth maps inform *avis aux navigateurs*, reducing groundings, voyage time, and fuel costs.<sup>1</sup>
- **Flood preparedness:** Event-based flood maps and sub-basin bulletins guide emergency planning and community response.
- **Ecosystem stewardship:** Under-canopy flood and fire maps feed into COMIFAC coordination and national enforcement.

### ***Key Indicators***

<b>Indicator</b>	<b>Current Status</b>	<b>Planned Outputs</b>
Hydrological bulletins	Monthly bulletins (Mar, Jun 2025)	Annual synthesis with user reach metrics
Virtual-station coverage	Altimetry-based stations operational	Catalogue and metadata publication
Navigation safety	IENC layers, mobile app under test	Before/after analysis (incidents, hours saved)
Forest/wetland condition	Seasonal flood & fire mapping	Annual change statistics aligned with SDGs

The operational workflow now functions end-to-end — *measurement* → *modelling* → *bulletin/advisory* → *user action* — setting the stage for formal impact reporting under national and AU frameworks.

### **1.7 Capacity Development and Inclusion**

GERNAC has invested heavily in human and institutional capacity:

- **Training:** Over 650 professionals trained in satellite altimetry and hydrological monitoring; 20 Master's/PhD students supported through modelling research.

- **Workshops:** Regional radar-processing and geo-portal training for agencies across CEMAC and ECCAS regions.
- **Cross-fertilisation:** Collaboration with marine consortia (e.g., University of Ghana's Brazzaville training, July 2024) strengthens the river–coast data continuum.
- **Policy integration:** AU, EU, and ECCAS engagement reinforces alignment with regional frameworks.

## **1.8 Alignment with Agenda 2063 and the SDGs**

### ***Agenda 2063 Contributions***

- *Aspiration 1:* Sustainable prosperity through operational water and forest services.
- *Aspiration 2:* Regional integration via harmonised transboundary river management.
- *Aspiration 3:* Good governance through standardised hydrological reporting.
- *Aspiration 6:* People-driven development through inclusive flood and navigation services.

### ***Key SDG Linkages***

- **SDG 6 – Clean Water and Sanitation:** Real-time basin monitoring and hydrology services.
- **SDG 9 – Industry, Innovation and Infrastructure:** Safer, more efficient inland transport.
- **SDG 13 – Climate Action:** Flood forecasting and resilience building.
- **SDG 15 – Life on Land:** Forest and fire monitoring for ecosystem protection.

## **1.9 Sustainability and Outlook (2025–2027)**

**Operational consolidation.** CICOS will continue issuing Hydrological Bulletins and formalise **Standard Operating Procedures (SOPs)** linking each alert or layer to specific institutional actions (e.g., patrol deployment, navigation advisories).<sup>1</sup>

**Blended monitoring.** Rehabilitated hydrometric stations, combined with virtual-station backbones, will provide hybrid coverage for reliability and impact metrics.

**Continental linkages.** The upcoming **Space for Early Warning in Africa (SEWA)** initiative (AUC–ECMWF–EUMETSAT, launched 2025) will strengthen access to Meteosat Third Generation data and underpin hydrometeorological nowcasting across the Congo Basin.<sup>3</sup>

**Capacity continuity.** Complementary programmes—such as the **WMO Training-of-Trainers on Satellite-Based Hydrological Monitoring** (Lomé, March 2025)—will sustain expertise and expand practitioner networks.<sup>4</sup>

## **References**

1. CICOS. *Hydrological Bulletins and Navigation Updates*. <https://cicos.int>
2. EUMETSAT. *16th User Forum in Africa Report* (Cotonou, 2024). <https://www.eumetsat.int>
3. African Union Commission (AUC), ECMWF, & EUMETSAT. *Space for Early Warning in Africa (SEWA) Programme Brief*, 2025.
4. World Meteorological Organization (WMO). *Training-of-Trainers on Satellite-Based Hydrological Monitoring, Lomé 2025*.