



**GMES**  
AND AFRICA



# **CICOS' Experience on EO support to navigation in Congo River basin**

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16th EUMETSAT



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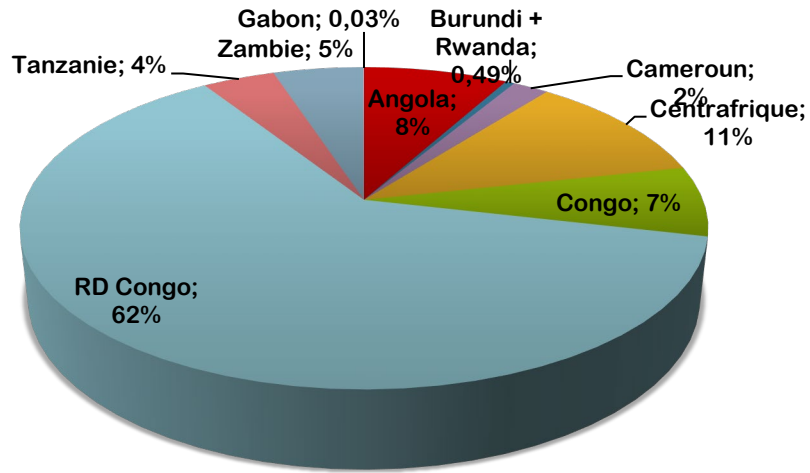


# Outline



- Context & Brief on the Congo Basin
- CICOS' mandate
- Role of CICOS in Hydrological monitoring
- CICOS' Experience on EO data and Spatial Hydrology
- Applications developed

# Brief on Congo basin



Area : 3 822 000 km<sup>2</sup>

Congo River length: 4,734 km  
(2d longest in Africa)



Average discharge : 41,000 m<sup>3</sup>/s (2d after l'Amazone)



## Key features of the Congo basin

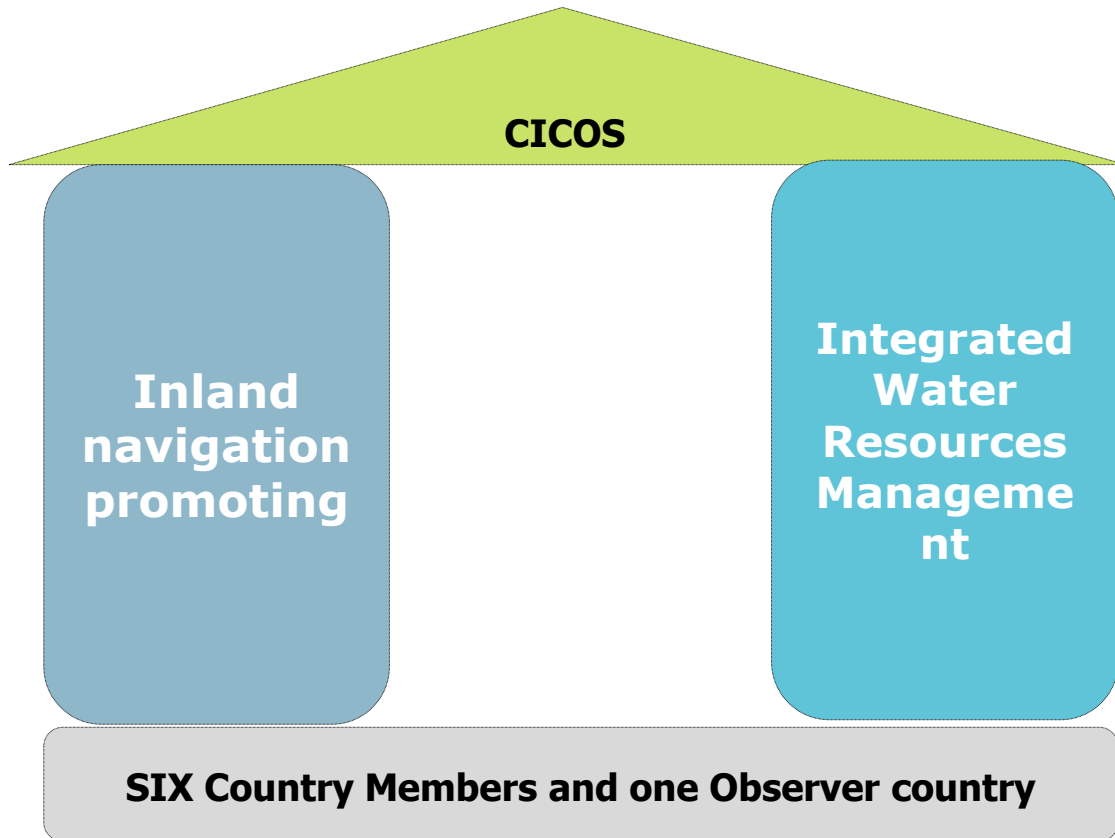


- **Congo Basin** is now the “**Earth’s first lung**”;
- **25,000 Km navigable channels** key driver for Blue economy of the region (transportation) ;
- Countries opened up only by inland waterways;
- Enormous hydropower potentials (**150 000 MW of which 44 000 MW**) located at Inga site;
- 204 millions ha of forests (5,3 millions Km<sup>2</sup>);
- 2nd World inundated forest after the Amazon;
- 26% of world’s inundated forests (46% of the Congo basin).



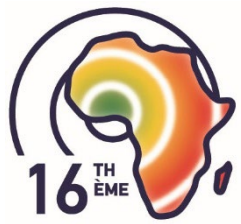


# CICOS' Mandate



CICOS is an intergovernmental Organisation charged with the promotion of inland waterway navigation and the Integrated Management of Water Resources (IMWR) in the Congo basin.

Legal Framework : Agreement (1999) and its Addendum (2007)



## Role of CICOS



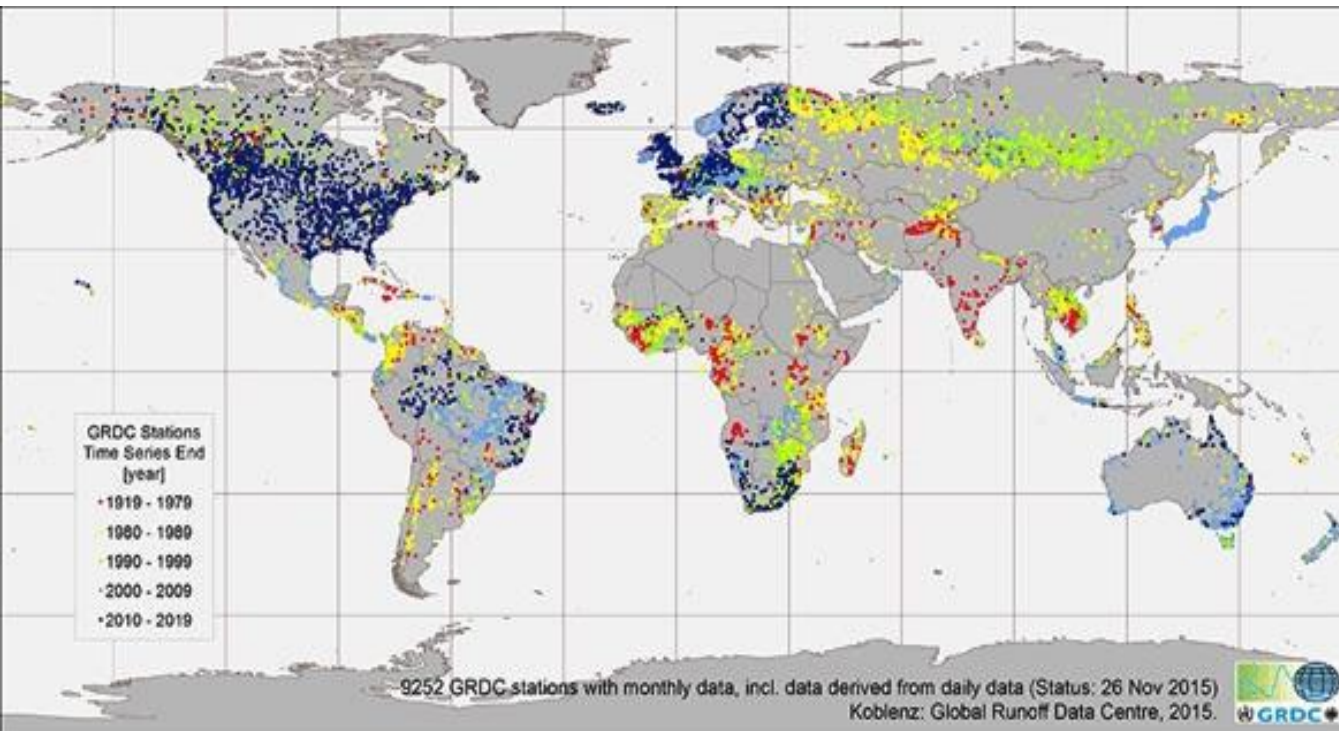
Mandate for coordinating hydrological monitoring in the Congo Basin.

CICOS:

- Facilitates access to EO data through satellite reception stations;
- support the NHS;
- Data centralization and dissemination (SIBCO – SIH);
- Raising awareness among country members on WRM ;
- Data sharing framework protocol monitoring ;
- Promoting innovative technologies for data acquisition (EO, spatial altimetry);

*In-situ* networks still lacking

- An innovative approach must be implemented to fill these gaps
- This approach must combine all possible data sources

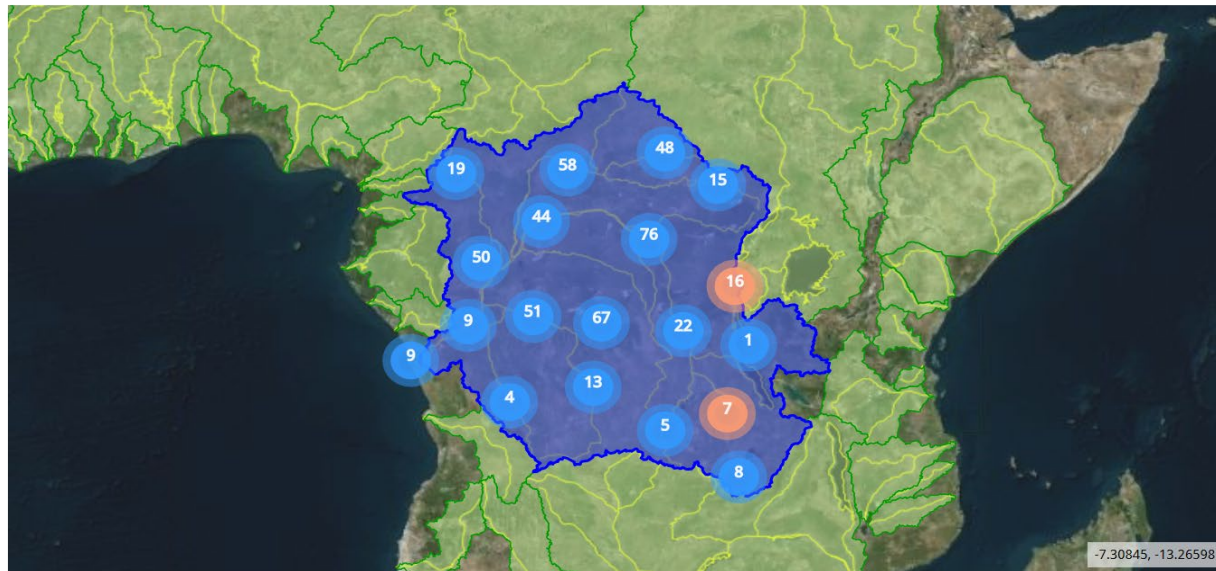




# Spatial altimetry Data accessibility



Hydroweb-NG platform <http://hydroweb.theia-land.fr/>  
eStation  
Eumetsat data access portfolio  
Copernicus portail



Accessible and free data.

Théia account to create, free and compulsory.

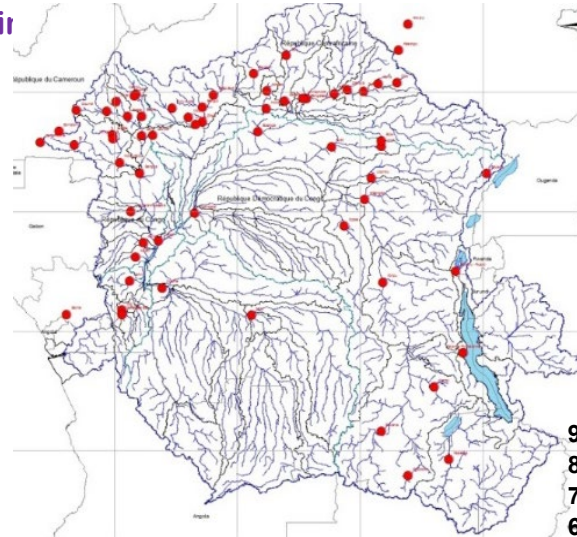
Data downloads in batches of 100 time series or automatically by scripts.



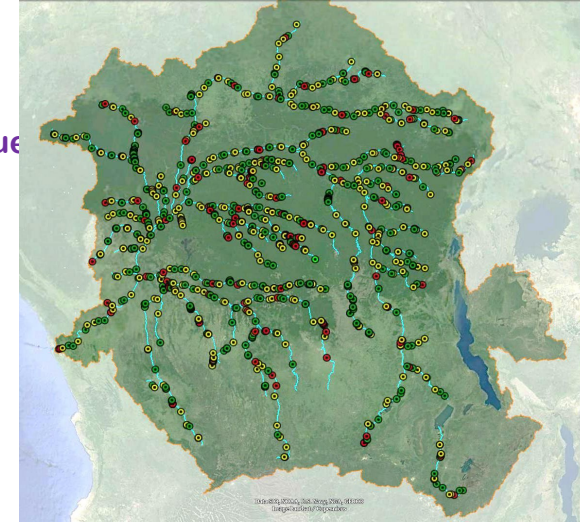
## EO Data contribution



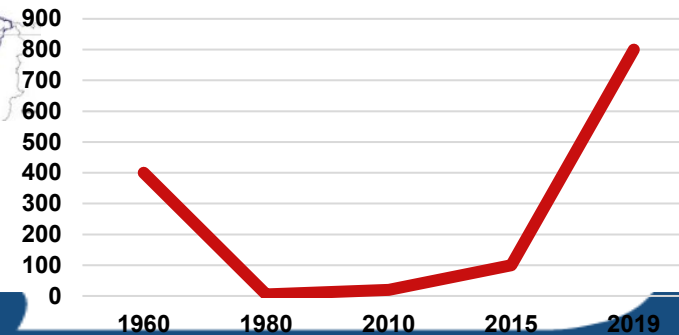
Plus de 100 stations  
in-situ

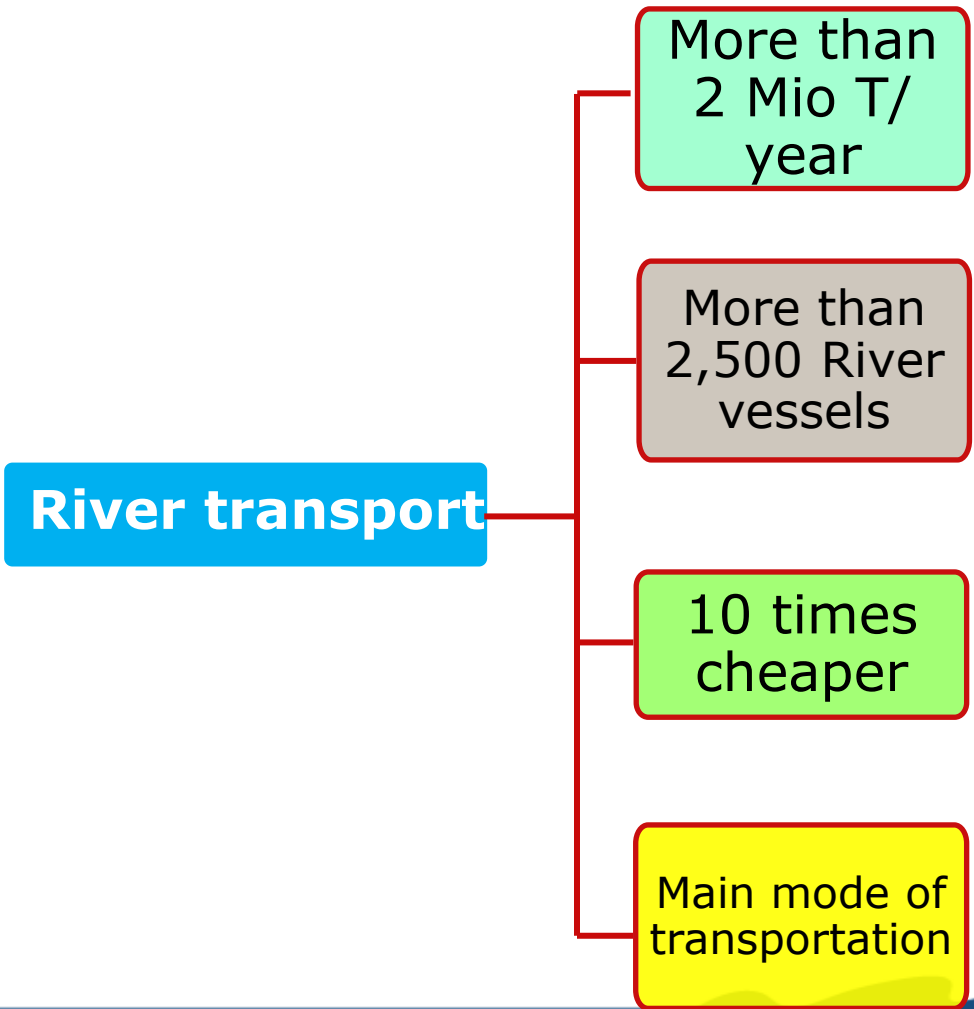


Plus de 800 stations (virtuelles  
+ In-situ) en fin 2019



Evolution du Nbr de stations





25,000 Km of waterways estimated



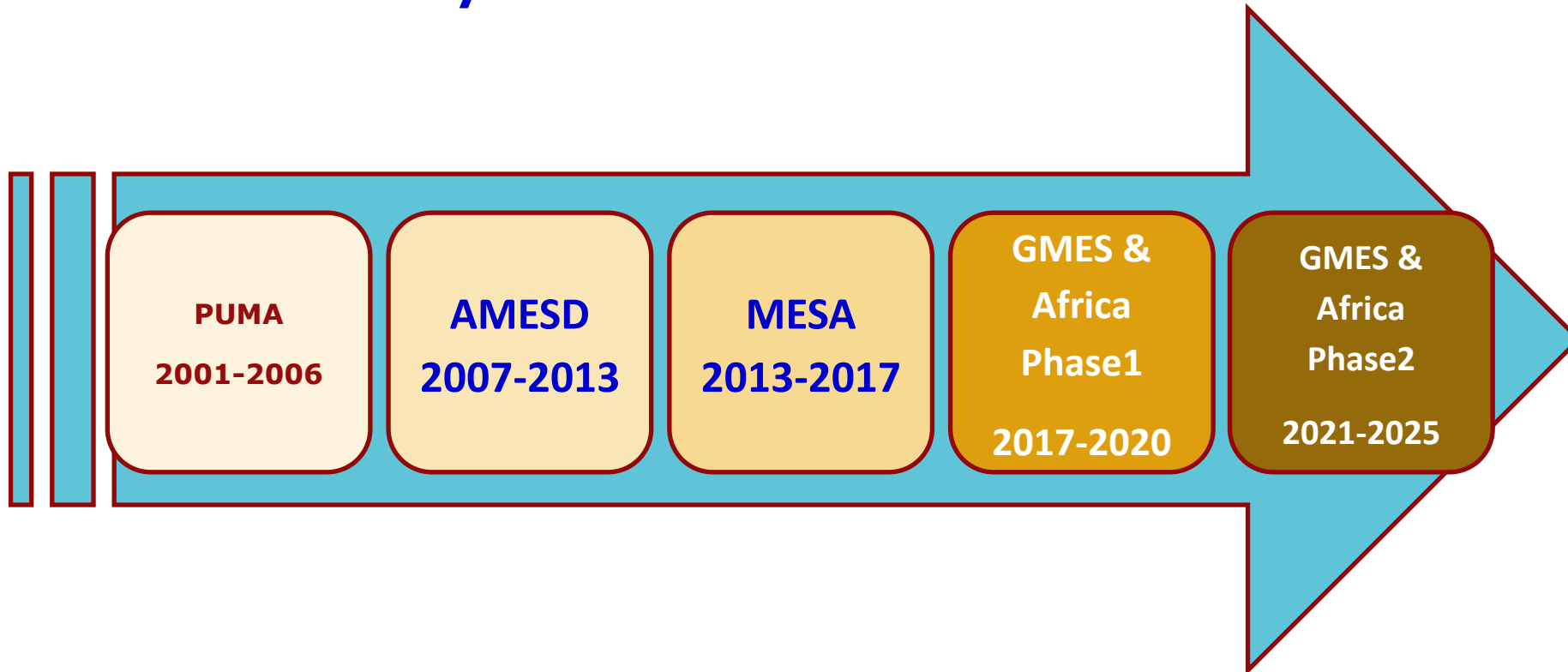
Carte des voies navigables dans le Bassin du Congo



# Experience on EO Data Using and spatial Hydrology



... a continuity of initiatives...

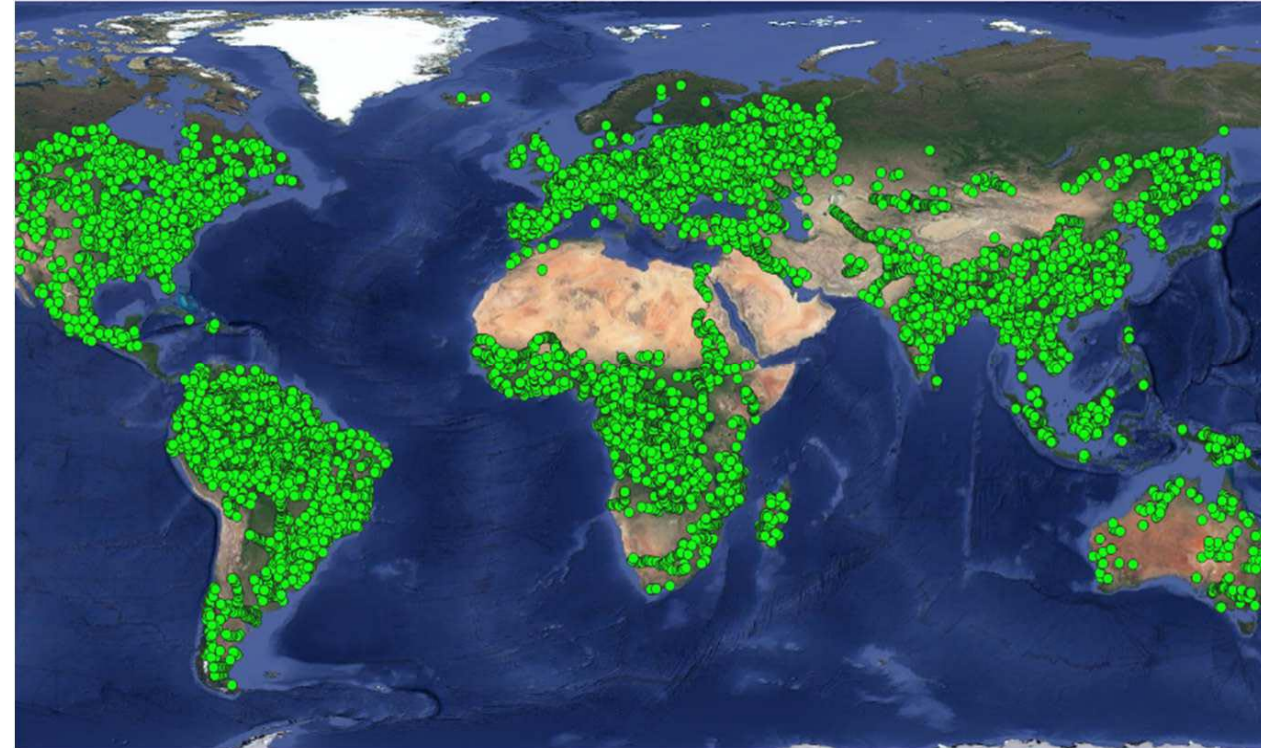


Funded under the AUC – EU Partnership



## EO data offers great application potential

- Aid to river navigation;
- Management of international water sharing;
- Better flood modeling;
- Stock management: urban, industrial and agricultural consumption
- Management of hydroelectricity production
- Prevention of the spread of epidemics, etc.



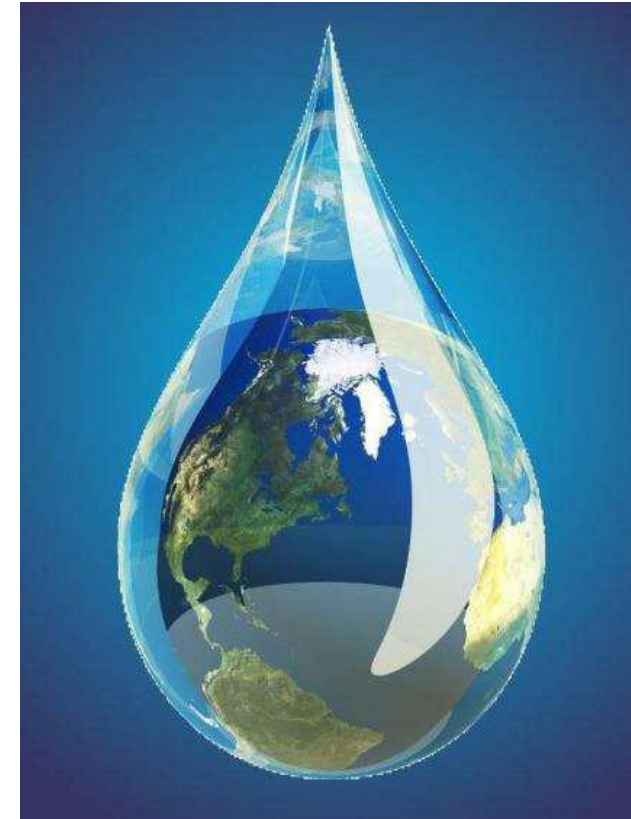


## Multi-sensor spatial data + in-situ/terrain, weather

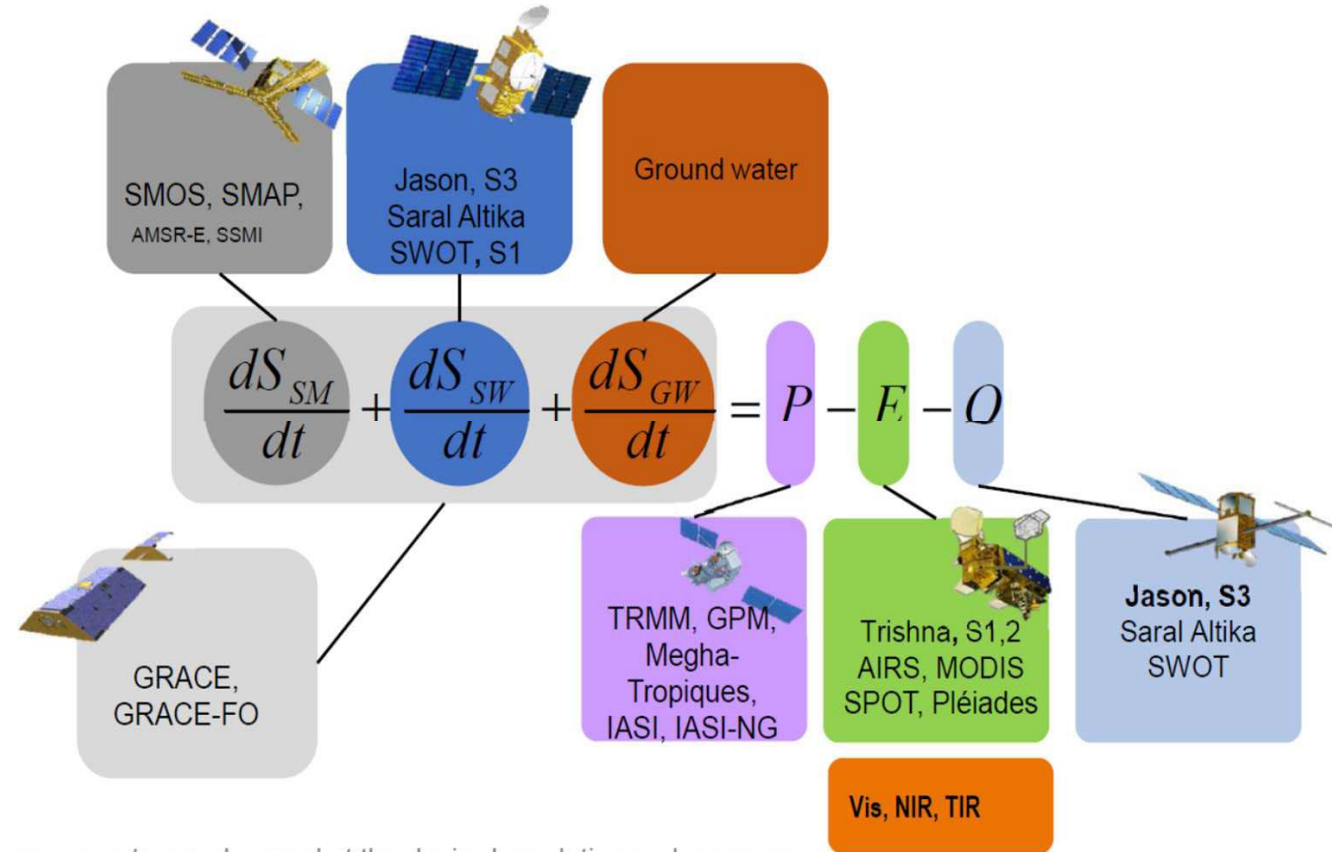
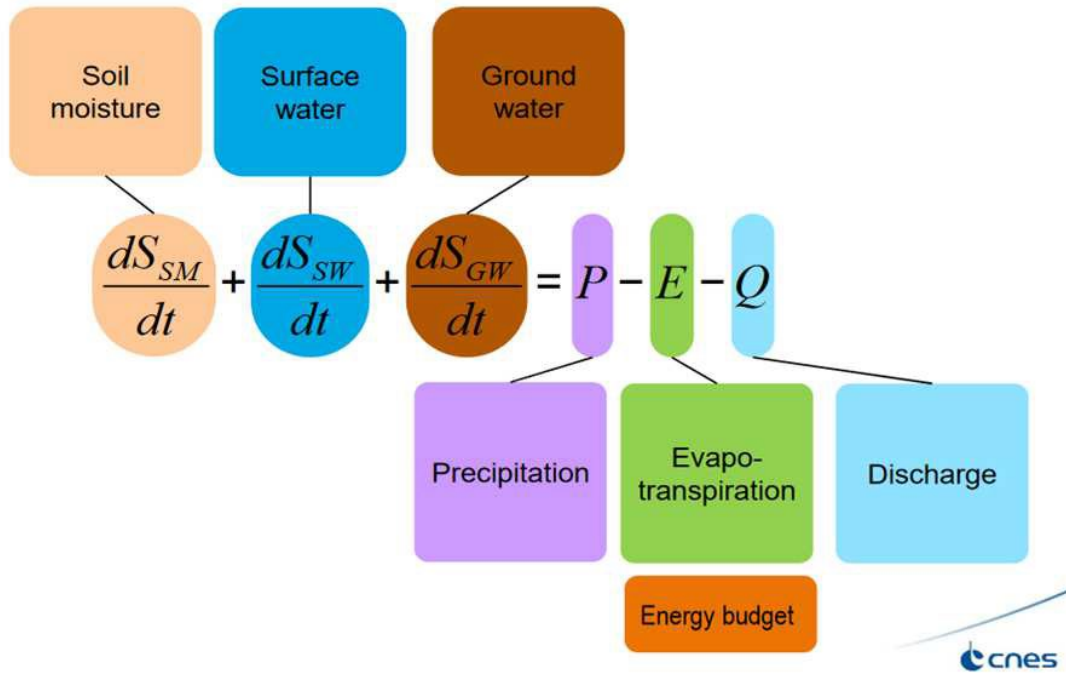
### Hydrological data used

- **Water levels** (spatial altimetry),
- **Discharges** (Spatial altimetry),
- **Precipitations** (TRMM, CMORPH, GPM, PERSIANN, Megha-Tropiques, etc.)
- **Evapotranspirations** (MODIS ET GLEAM, GLDAS Model, etc.)
- **Hydrological balance, etc.**

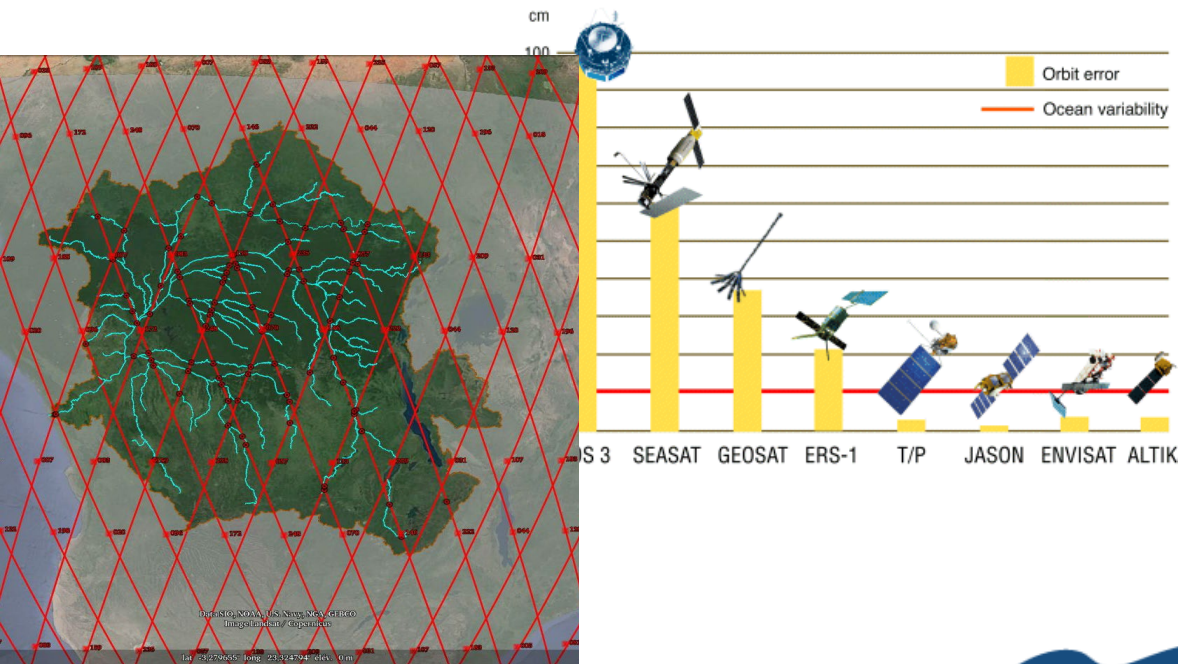
**Towards in-situ / spatial complementarity**



# Monitoring the water cycle by satellite



# Source of EO Data



Mission satellite	Lancement	Fin mission	Répétitivité (jours)	Distance inter-traces à l'Equateur (km)
Geosat	12/03/1985	30/01/1990	17	164
ERS-1	17/07/1991	31/03/2000	35	80
Topex / Poséidon	10/08/1992	18/01/2006	10	315
GFO	10/02/1998	26/11/2008	17	160
ERS-2	21/04/1995	06/07/2011	35	80
Envisat	01/03/2002	08/06/2012	30-35	80
Jason-1	07/12/2001	01/07/2013	10	315
Cryosat-2	08/04/2010	-	369	
Sentinel-3A	16/02/2016	-	27	104
Jason-3	17/01/2016	-	10	315
Saral (AltiKa)	25/02/2013	-	35	80
Jason-2	20/06/2008	-	10	315
Jason-CS / Sentinel-6	2020	-	10	315
<b>SWOT</b>	<b>2022</b>	-	<b>21</b>	<b>140 120 km de fauchée</b>

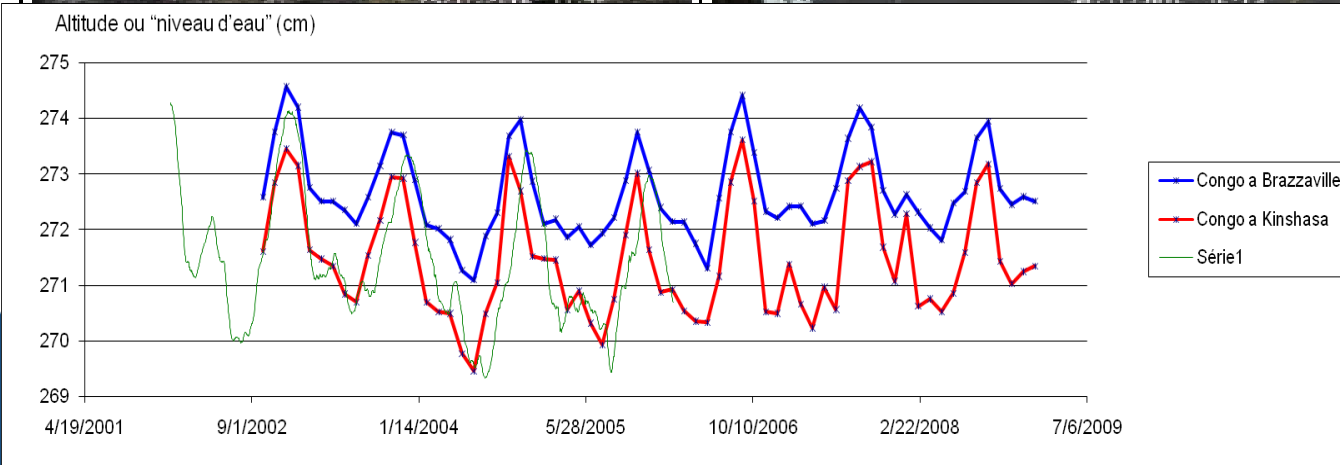
# EO Data validation using in-situ data



Installation of two hydrometric stations along a satellite track.

Development and testing of a methodology for calculating flow rates from altimetric satellite measurements over the Congo and Oubangui  
Through two station: **Maluku and Mbata**

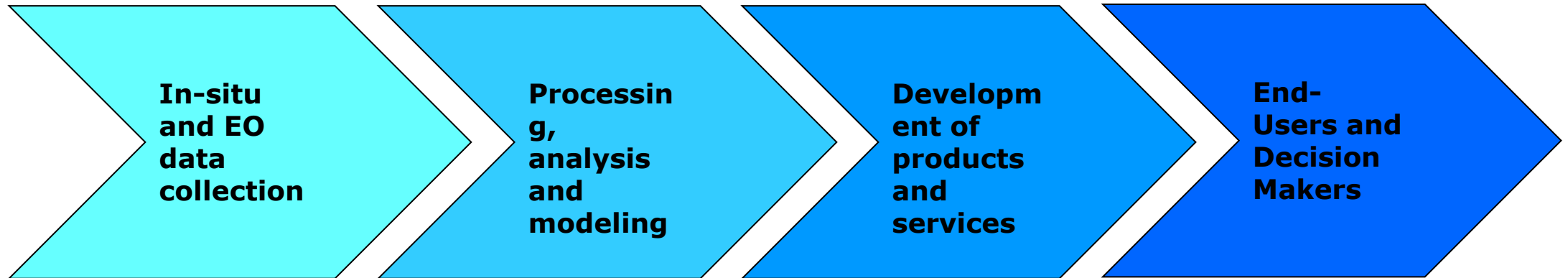
Surface Water and Ocean Topography





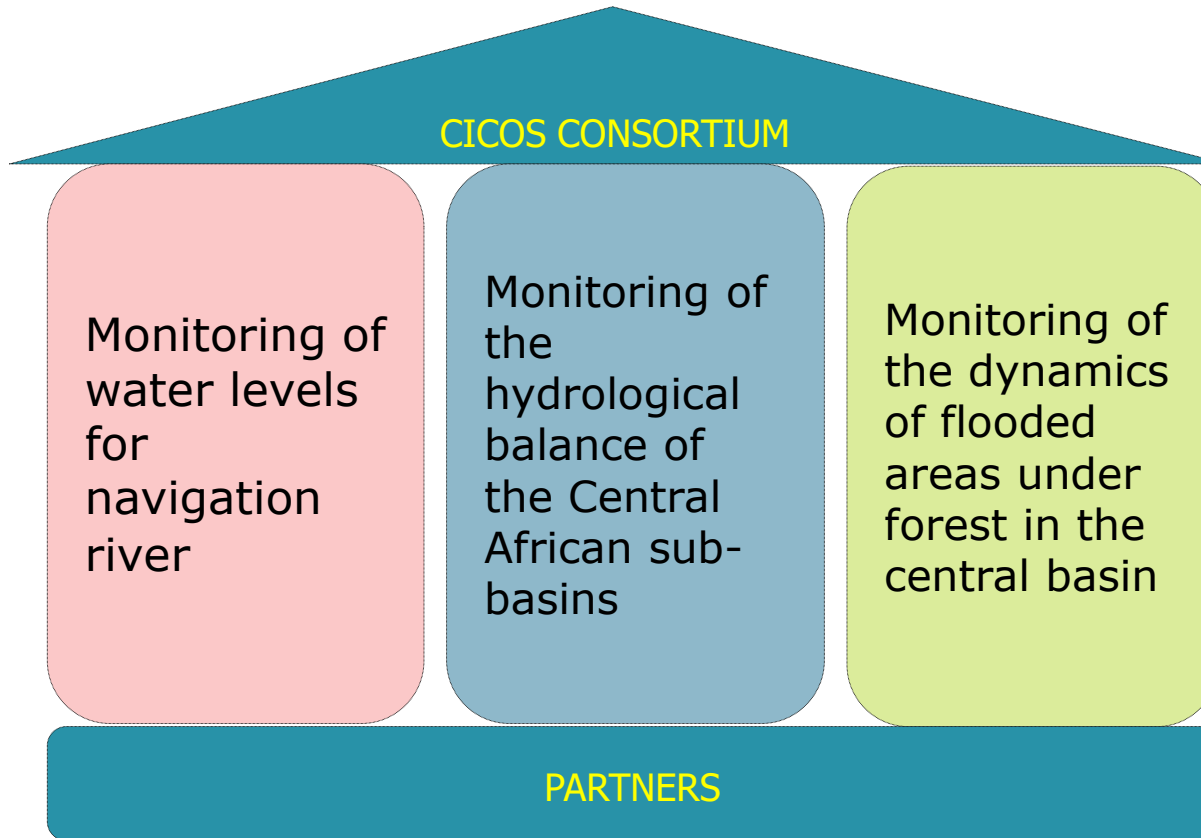


# Methodological approach of added value building



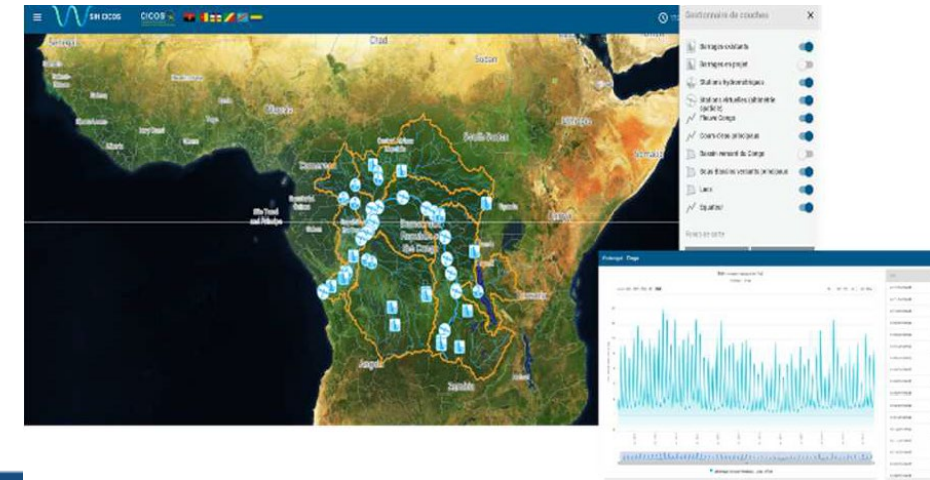
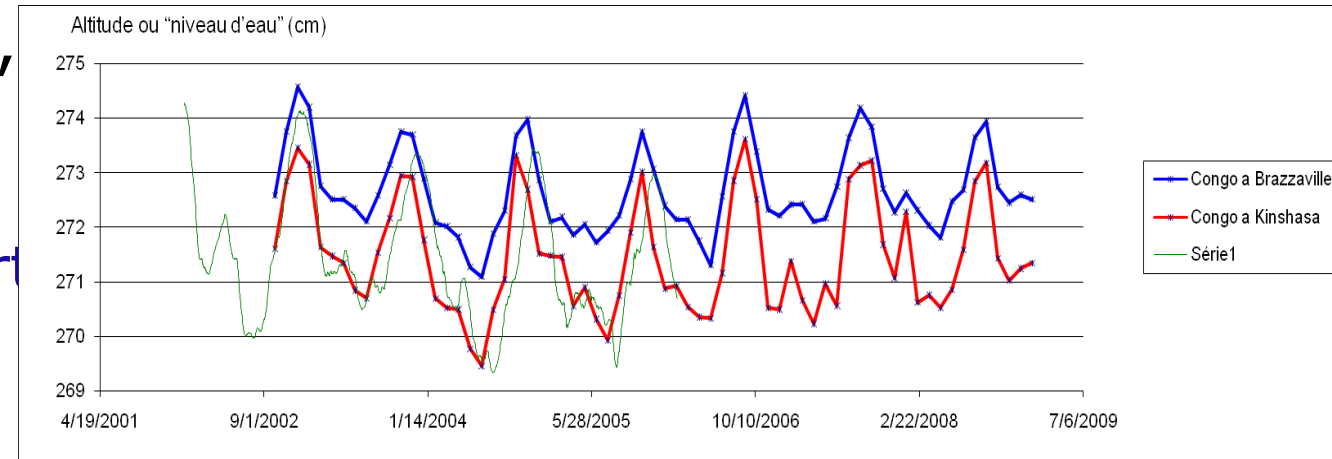


# Main themes tracking with EO data



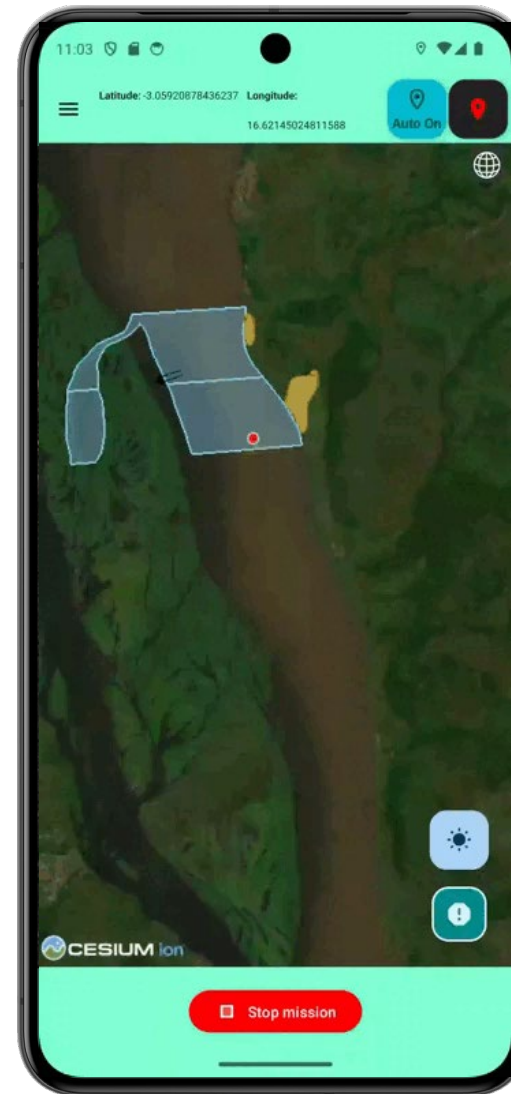
Downstream products and services,  
as:

- Development of water level alert navigation (smartphone App) ;
- Construction and updating of rating curves;
- Determining the longitudinal profiles of watercourses ;
- Identification of sections suitable for hydroelectricity (pico-micro);
- Flow (discharges) monitoring through spatial altimetry data.

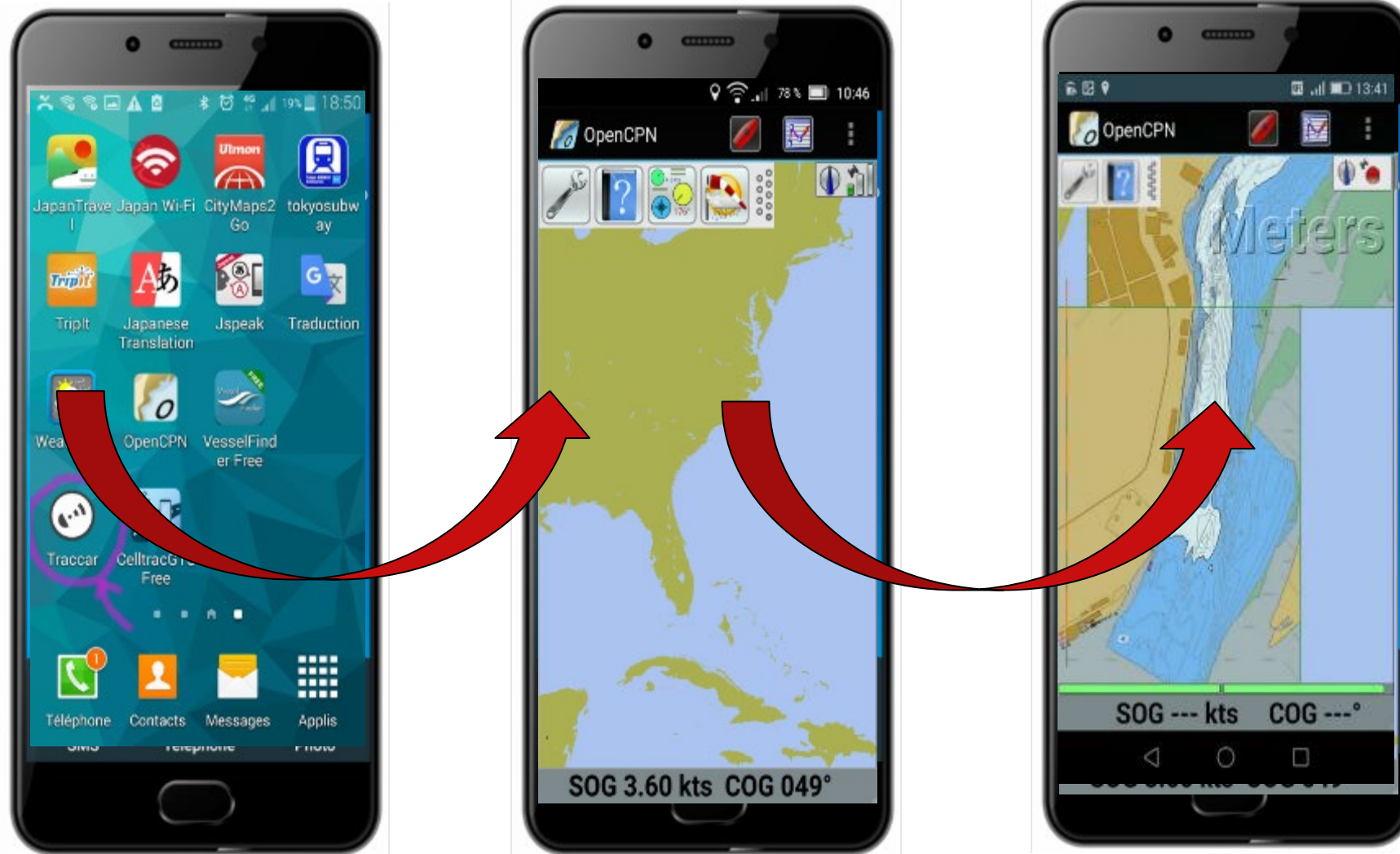


## Progress of a mission

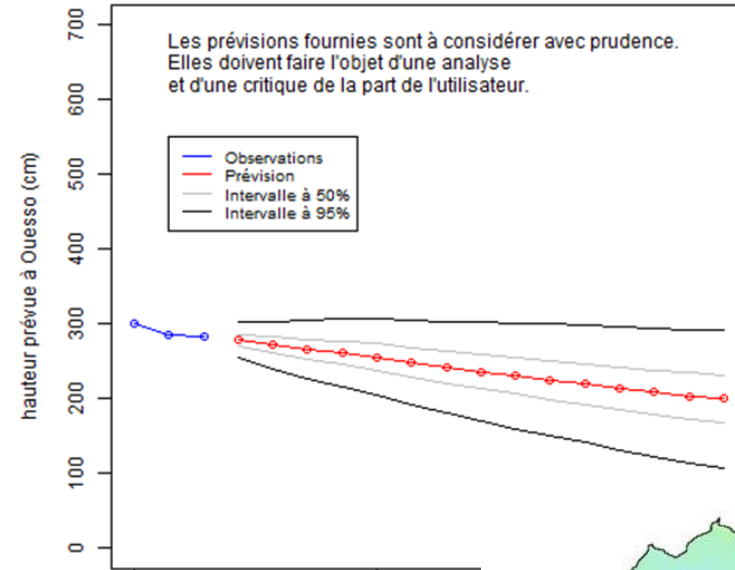
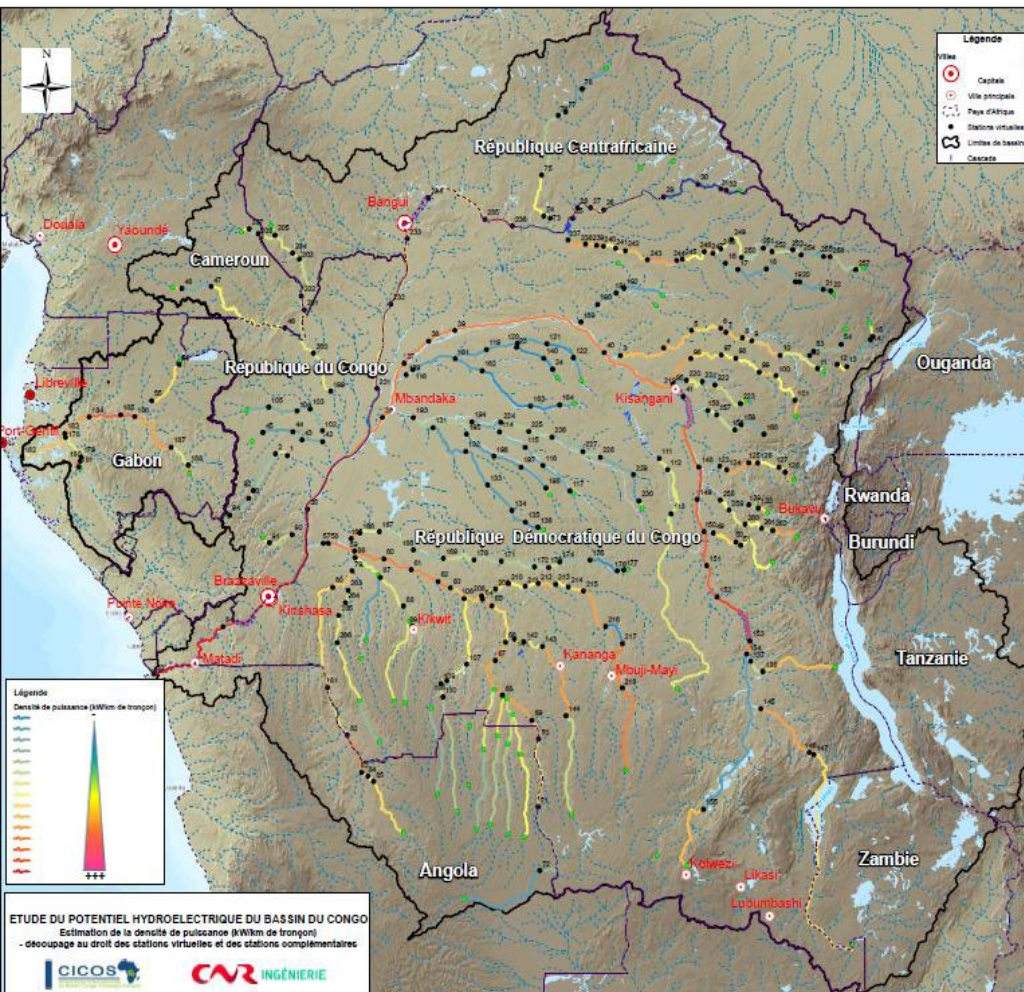
- The mission is in progress, takes place without connection to an Internet network;
- Navigation progress;
- Navigation data progress as progress is made;
- GPS data recording in the form of logs (.csv spreadsheet), and the GPS route (.kml file)
- Possibility of sharing information (Observations, remarks, incidents, or other).  
For example, a moved or damaged beacon.



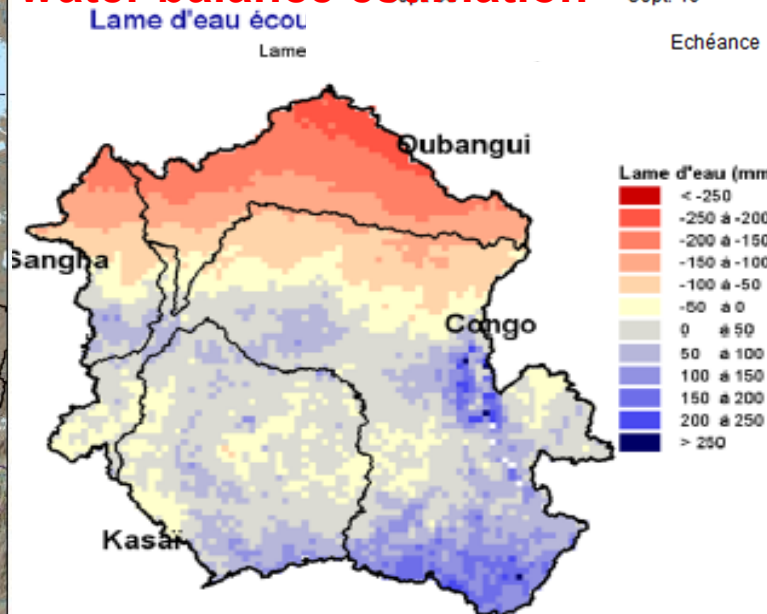
## A SmartPhone Application and Electronic Navigation Maps



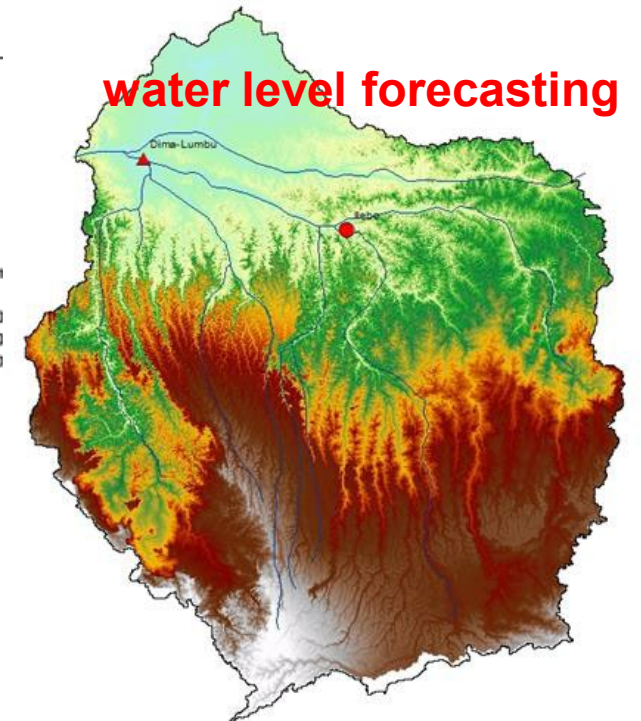
## hydropower potential sites



## water balance estimation



## water level forecasting





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**Geo-services development**



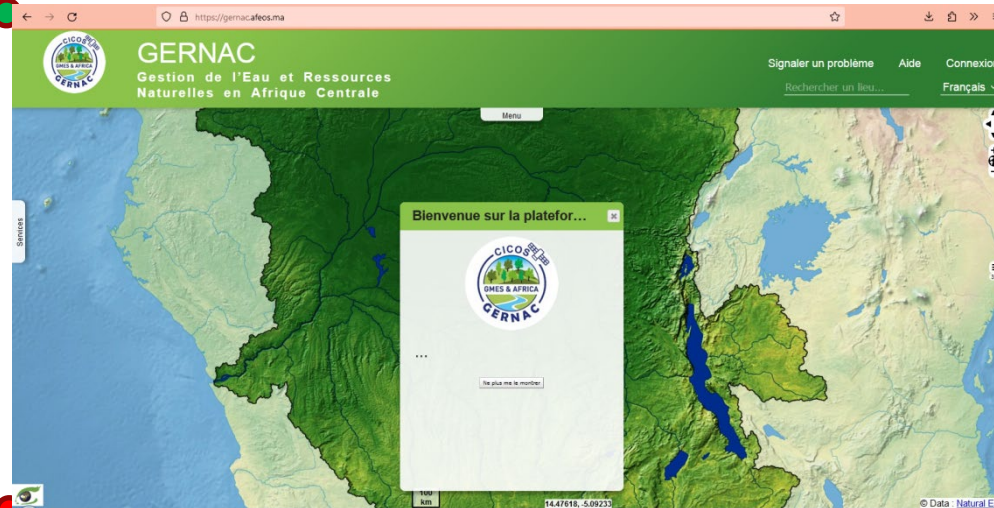
## Geo-Services Web Interface

A screenshot of the GERNAC web interface. The browser address bar shows 'https://gernacafeos.ma'. The page header is green and contains the GERNAC logo, the text 'GERNAC Gestion de l'Eau et Ressources Naturelles en Afrique Centrale', and navigation links: 'Signaler un problème', 'Aide', 'Connexion', 'Rechercher un lieu...', and 'Français'. The main content area is a map of Central Africa with a 3D view. A pop-up window titled 'Bienvenue sur la plateforme...' is centered on the map, displaying the GERNAC logo and a button that says 'Ne plus me le montrer'. The map includes a scale bar (100 km) and coordinates (14.47618, -5.09233). A 'Services' sidebar is visible on the left, and a 'Menu' button is at the top center of the map area.

## Clusters of Geo-Services

**ÉTAT DES FORÊTS**  
(déforestation,  
occupation de sol,  
biodiversité,  
sequestration CO2)

**ÉCOULEMENTS**  
(inondations,  
Hauteur d'eau,  
bilan hydrologique)



**FEUX DE BROUSSE**  
(perte végétation,  
émission CO2)

**POLLUTIONS**  
(exploitation  
minière, qualité  
des eaux, etc)





Thank you



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