Toward a better knowledge of water flows in the Congo basin and hydropower potential with satellite altimetry. Perspectives with the future SWOT altimetry mission

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N° 341480

1. Context

1. New perspectives with the future **SWOT (Surface Water and Ocean Topography)** mission: first global survey of Earth's surface water elevations over rivers and lakes with a decimetre accuracy for rivers.

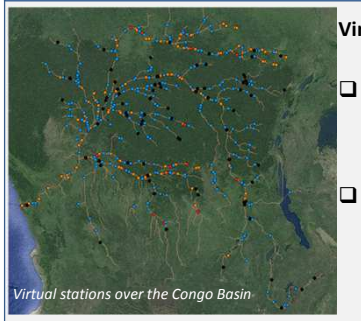
   ⇒ working group on space hydrology with 8 French institutions/companies to **leverage applications and services by using space data in hydrology**: CNES, AFD, BRLi, CNR, IRD, IRSTEA, IOWater, IRSTEA, CLS.

   ⇒ Fist pilot project= the Congo basin with the support of CICOS and AFD

2. The Congo basin: the world's second largest river basin:
   - Need of an integrated water resources management BUT the actual **operating gauge stations= ~30** over the whole basin
   - The **hydropower potential** of the basin is underexploited.

⇒ The current and future altimetry data can help to **increase the number of water elevation's observations** and thus **river discharge.**

2. Satellite altimetry and the future with the SWOT mission

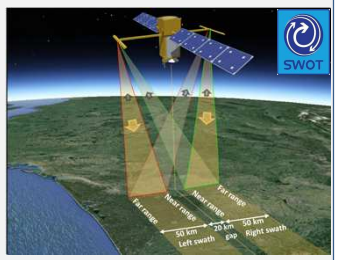


Virtual stations over the Congo Basin

Virtual station = Crossover between the altimeter ground track and the river = point of measurement of water elevation.

❑ **Today: 544 water elevation time series from virtual stations freely accessible on the HYDROWEB website:** http://hydroweb.theia-land.fr (+ 163 more time series from ENVISAT and 33 from Jason 2 available at CICOS and IRD).

❑ Ongoing work on **rating curves** from ENVISAT and JASON that are used as first guess for Sentinel 3 virtual stations (see posters from A.Paris n° 351525 & 341604 and from J.Santos Da Silva n°341436).



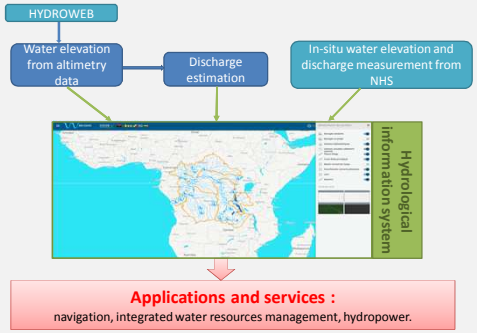
Total numbers of virtual stations in HYDROWEB (VS)	544
NB of operational VS with Sentinel-3A (in blue)	259
NB of operational VS with Jason (in black)	79
Nb of VS with Jason2 (in red)	52
Nb of VS with Envisat (in orange)	154

❑ **In 2021: The Future SWOT (surface water and ocean topography) mission:**
- Ka-band SAR Interferometer with a 21-day repeat cycle
- Free access to all SWOT data from
- Water elevation and surface of lakes >250*250m² with few cm accuracy
- Water elevation and discharge of rivers > 100m, with 10cm over 1km² accuracy

3. The hydrological information system - HIS

❑ Developed by BRLi and IRD for the CICOS with the support of AFD, the HIS integrates:
- in-situ measurements (water elevation, discharge and rating curves from the national hydrological services of the Congo basin)
- Water elevation from satellite altimeters

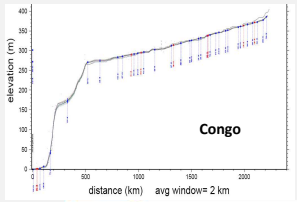
❑ The HIS will help to support future services and applications for navigation (water elevation forecast) and hydropower potential

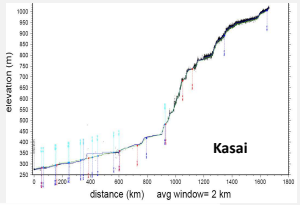


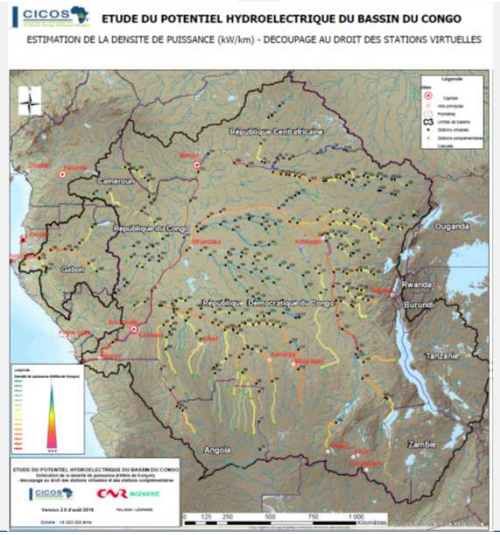
4. Hydropower potential

❑ **Hydropower potential in kW/km deduced from virtual stations**
- From virtual stations' water level → slope of the river
- Combined with additional discharge information and DEM (SRTM)

  → hydropower potential of a specific area.



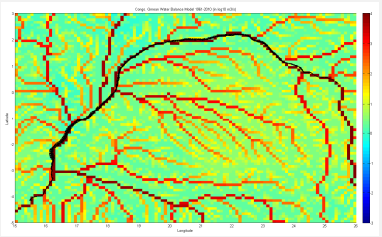




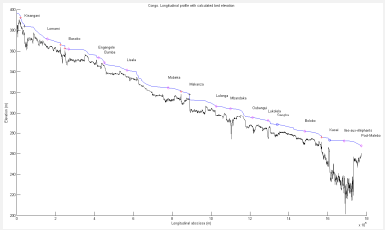
5- Discharge estimation

❑ Objective = Estimate **discharge from current altimetry data** with the **hydraulic model SIC2** ©IRSTEA.

Mean Discharge (1960-2010) from the Water Balance Model



❑ First step: defining a bathymetry with the use of MERIT DEM
(Yamazaki D. et al. A high accuracy map of global terrain elevations - Geophysical Research Letters, vol.44, pp.5844-5853, 2017)



Computed bed of the river (in black) with water elevation (in blue) from altimetry data

6. Future PLANS

❑ Finalize the **assimilation** of the altimetry data in the hydraulic model to compute discharge

❑ **Increase the number and quality** of observations and estimates of the hydrological variables

❑ Preparation to the **arrival of the future SWOT** data

❑ Further the **hydropower potential applications**

❑ Operational production of **navigation forecast** over the Sangha river and better knowledge of **Central basin and flooded forests**