New in-situ measurements of hydraulics and morphology for the users of the Congo River

Nouvelles mesures in-situ de l'hydraulique et de la morphologie pour les usagers du fleuve Congo

Congo River users Hydraulics and Morphology, International Conference, July 2021

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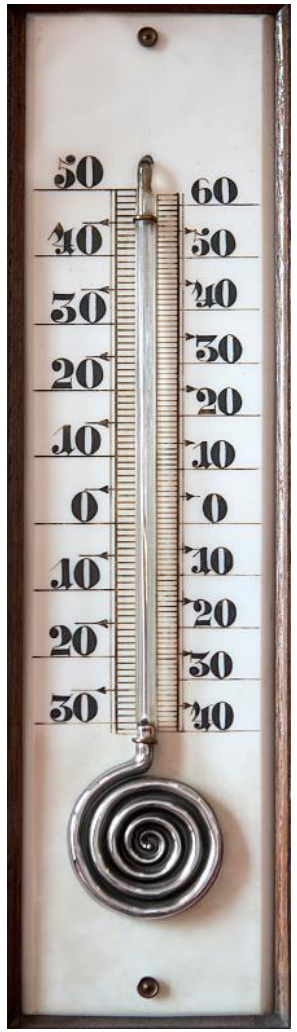
In-situ measurements

- Latin that literally means "on site" or "in position“ - Data measured in place
- Used to observe physical processes directly and provides new discoveries
- Important for complimenting other methods
- For example, in-situ data is used to calibrate/validate computer models and ground truth satellite data to reduce uncertainty
- The Congo has less in-situ data than many other river systems – holding back science research in the Basin
- In-situ measurements are a major component of the CRuHM project



CRuHM fieldwork campaigns

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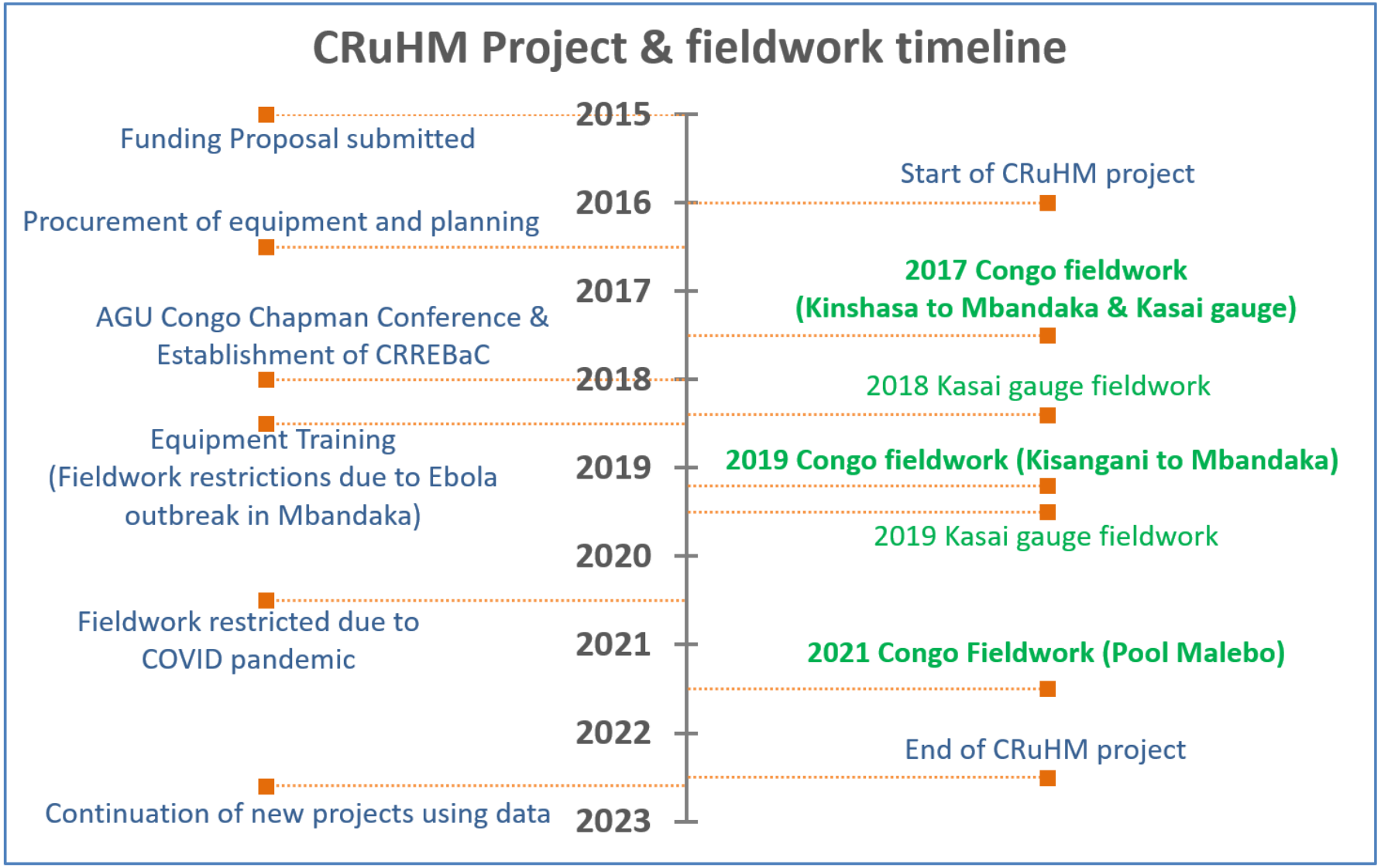

What does it involve?

- Lots of planning and coordination
- Procurement and shipping of equipment
- Training in use of equipment
- Logistics to hire boats, personnel, food etc.
- Multi-Government research permissions
- And have lots of flexibility and patience!

International Teamwork

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CRuHM fieldwork methods

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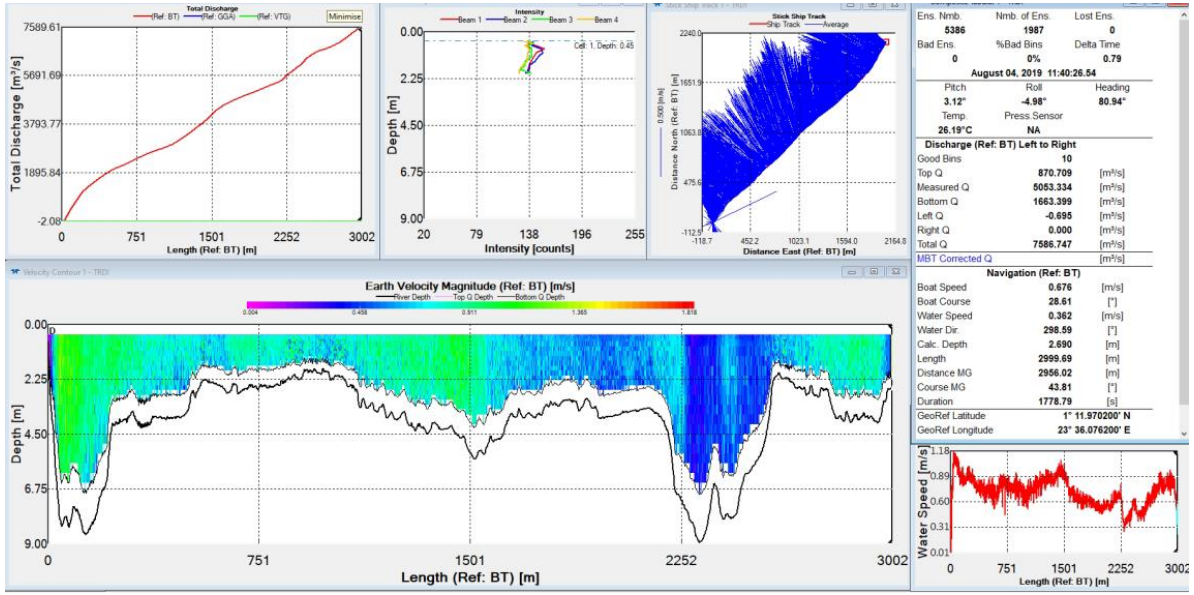
Methods	River Data
Acoustic Doppler Current Profiler	Point discharge (flow)
	2D georeferenced velocity profiles
Single Beam Echo sounder	River channel bathymetry
GNSS with PPP	Transient water surface elevations & slopes
Water Level Loggers	Suspended sediment samples
ISCO and grab samples	

CRuHM equipment - ADCP

- Acoustic Doppler Current Profiler
- Uses sounds to measure depth and velocity of water
- Installed on the side of a boat – connected to laptop
- Drive boat across a river section to integrate flow
- Produces very detailed velocity profile for river section

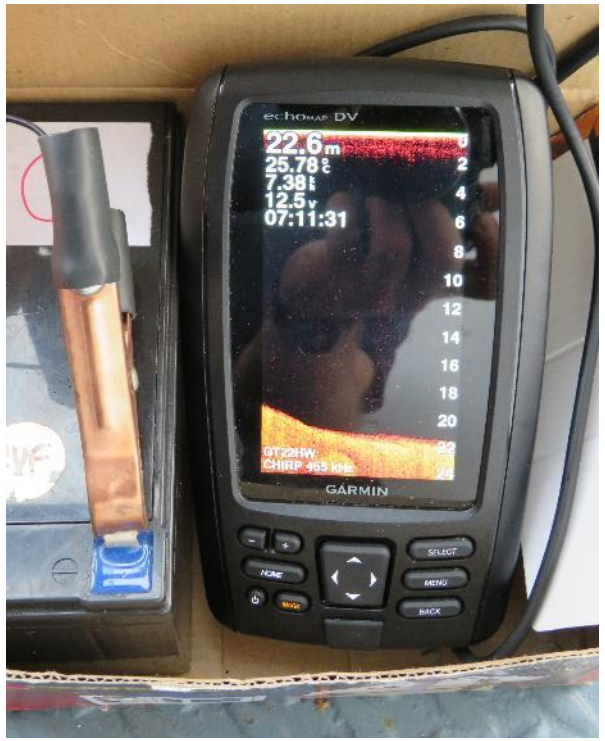


CRuHM equipment - Trimble

- Highly accurate GPS system (GNSS) for measuring elevations
- Uses special extra satellite to improve accuracy to ~5cm
- Setup on tripod with hand held display/control unit

CRuHM equipment - Sonar

- Sonar measures the depth of the water using sound
- An acoustic sensor (circled in red) is installed on the side of the boat in the water (photo shows pre-installation)
- A display unit shows and records the data



CRuHM equipment – WL Loggers

WL Loggers measure water pressure

Setup steps:

1. Build a logger housing
2. Measure key elevations
3. Setup logger measurement intervals
4. Install logger in tube
5. Leave and come back later to collect data

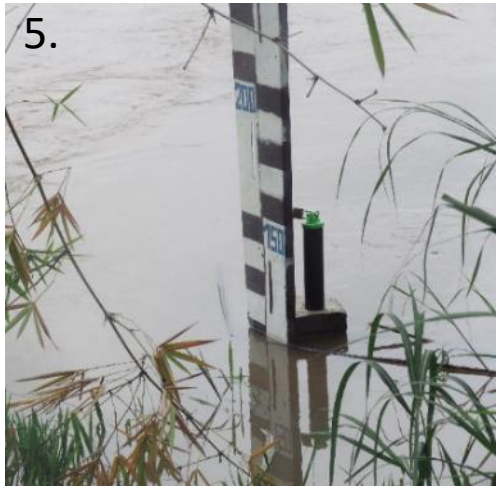
1.

2.

3.

4.

5.

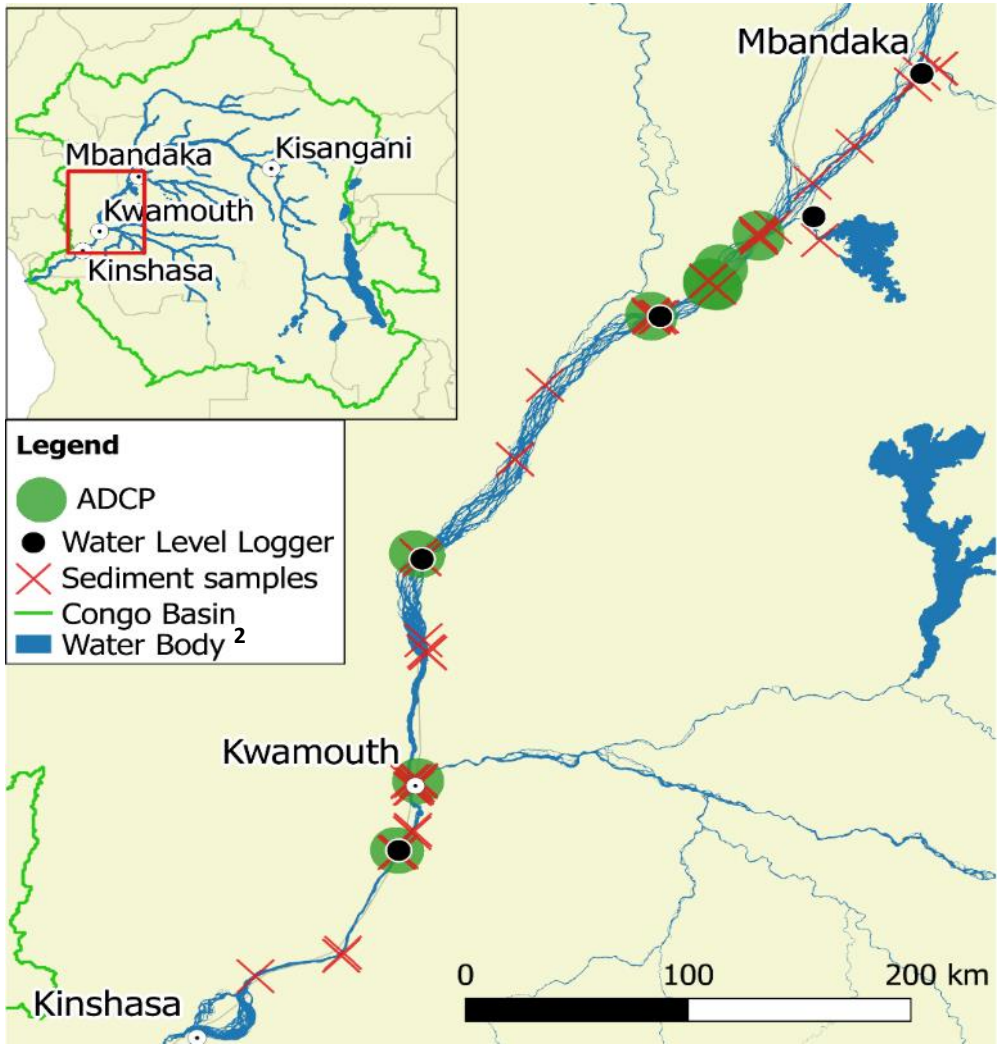


CRuHM equipment – Sediment samples

Different methods used:

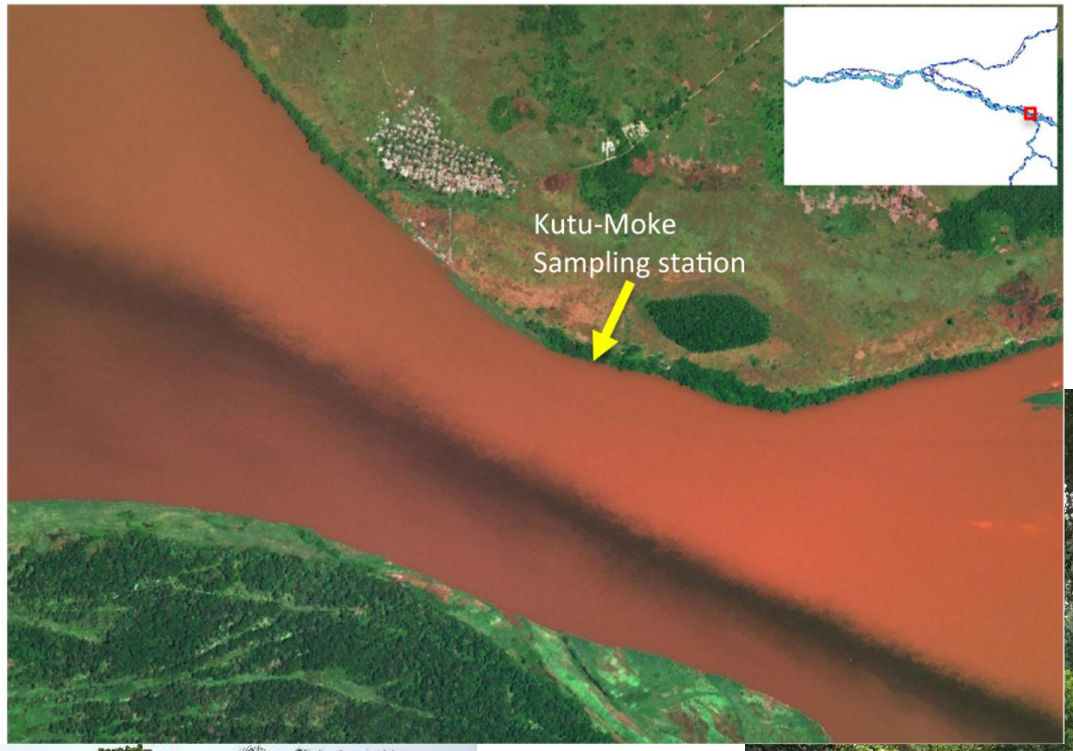
- ISCO daily automatic sampler
- Grab samples using pump
- Grab samples using Van Dorn sampler
- Turbidity sensor

2017 Congo fieldwork campaign



July-Aug 2017

2018 Training and Kasai campaign



May-June (Kasai) & July (training) 2018

2019 Congo fieldwork campaign

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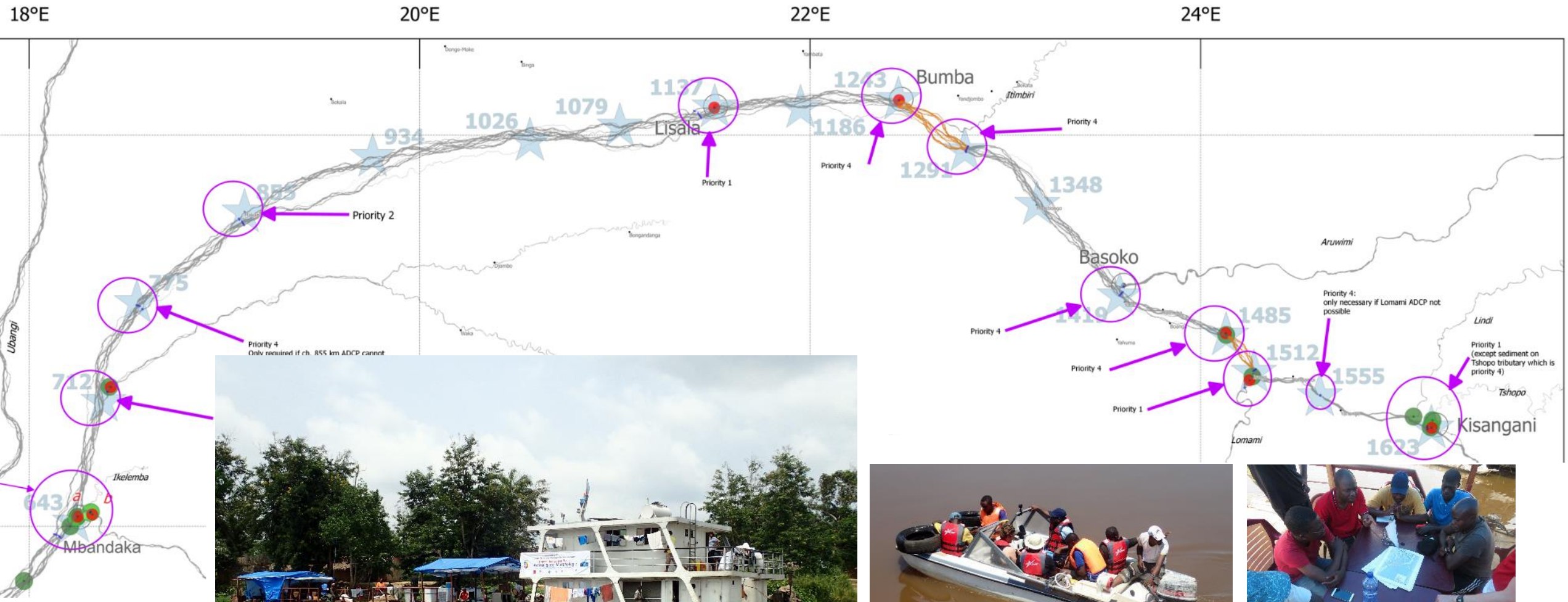

July-Aug 2019

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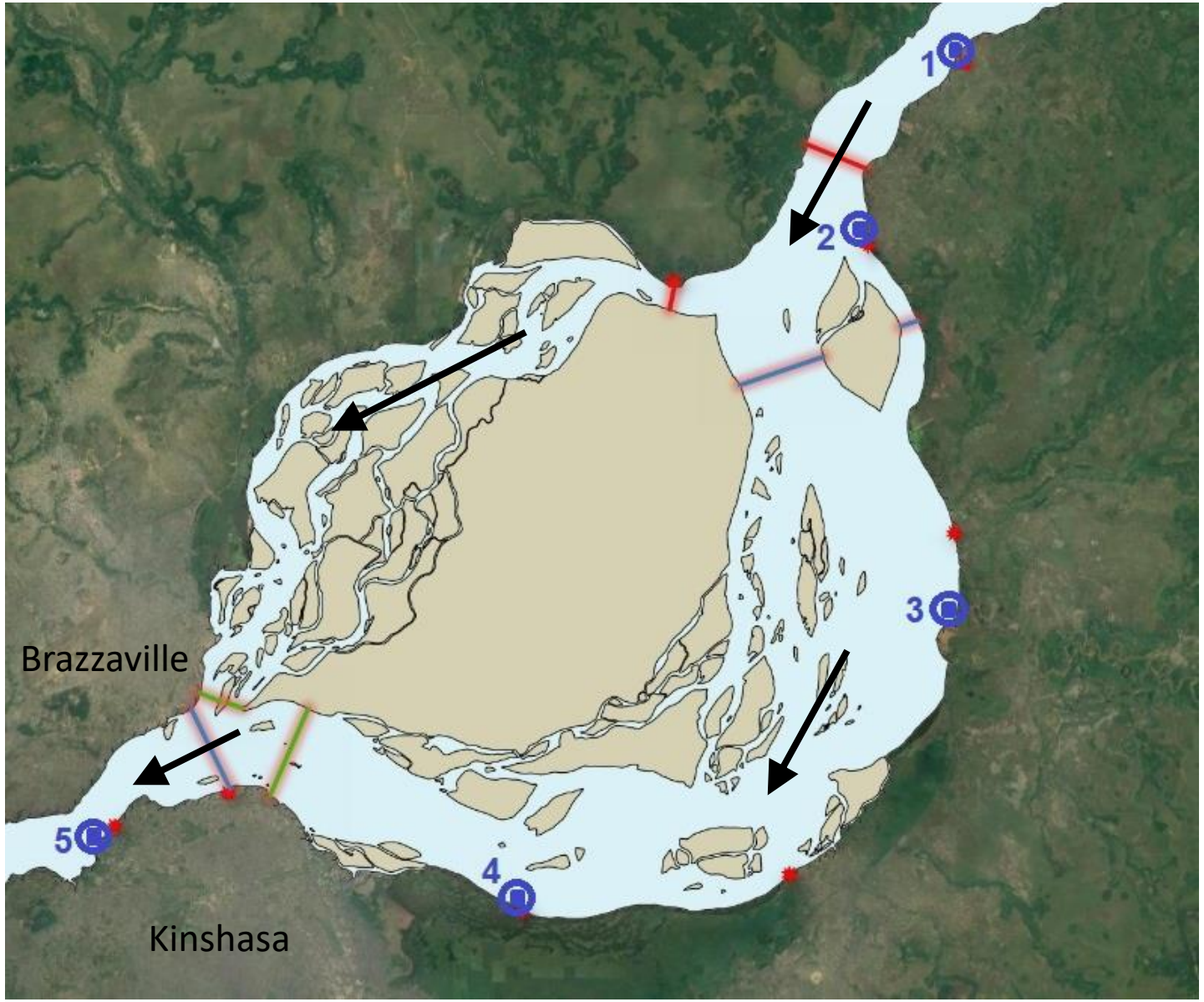
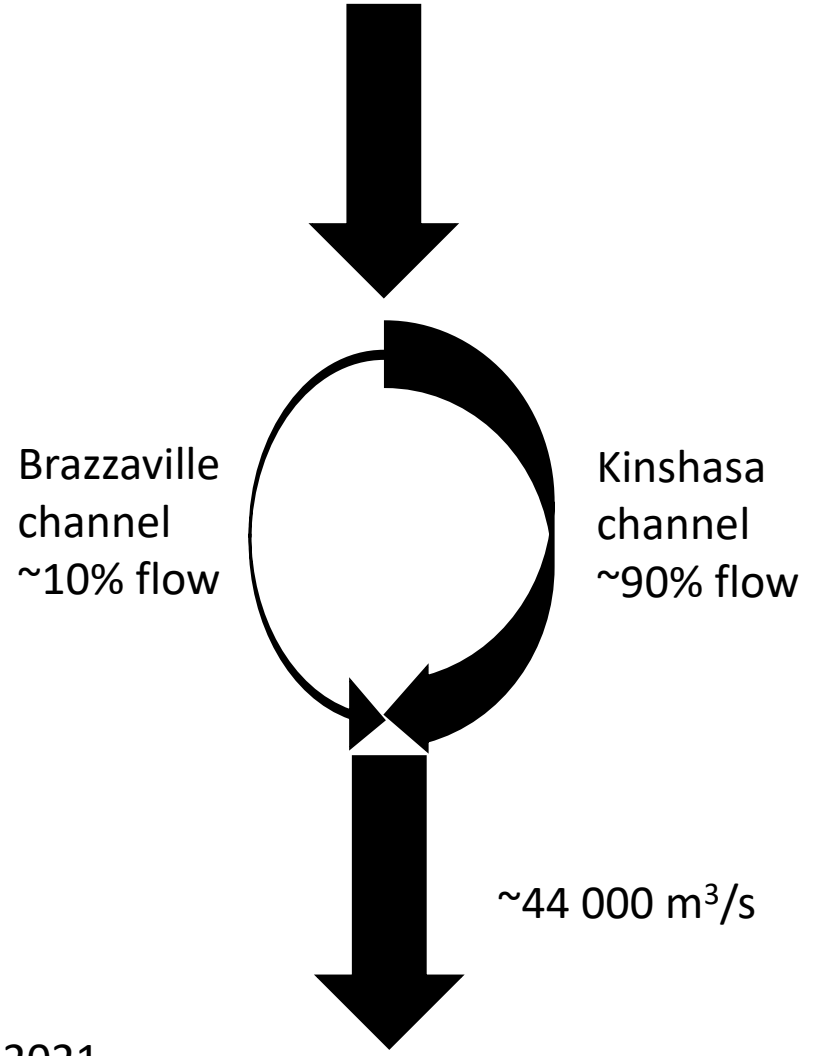
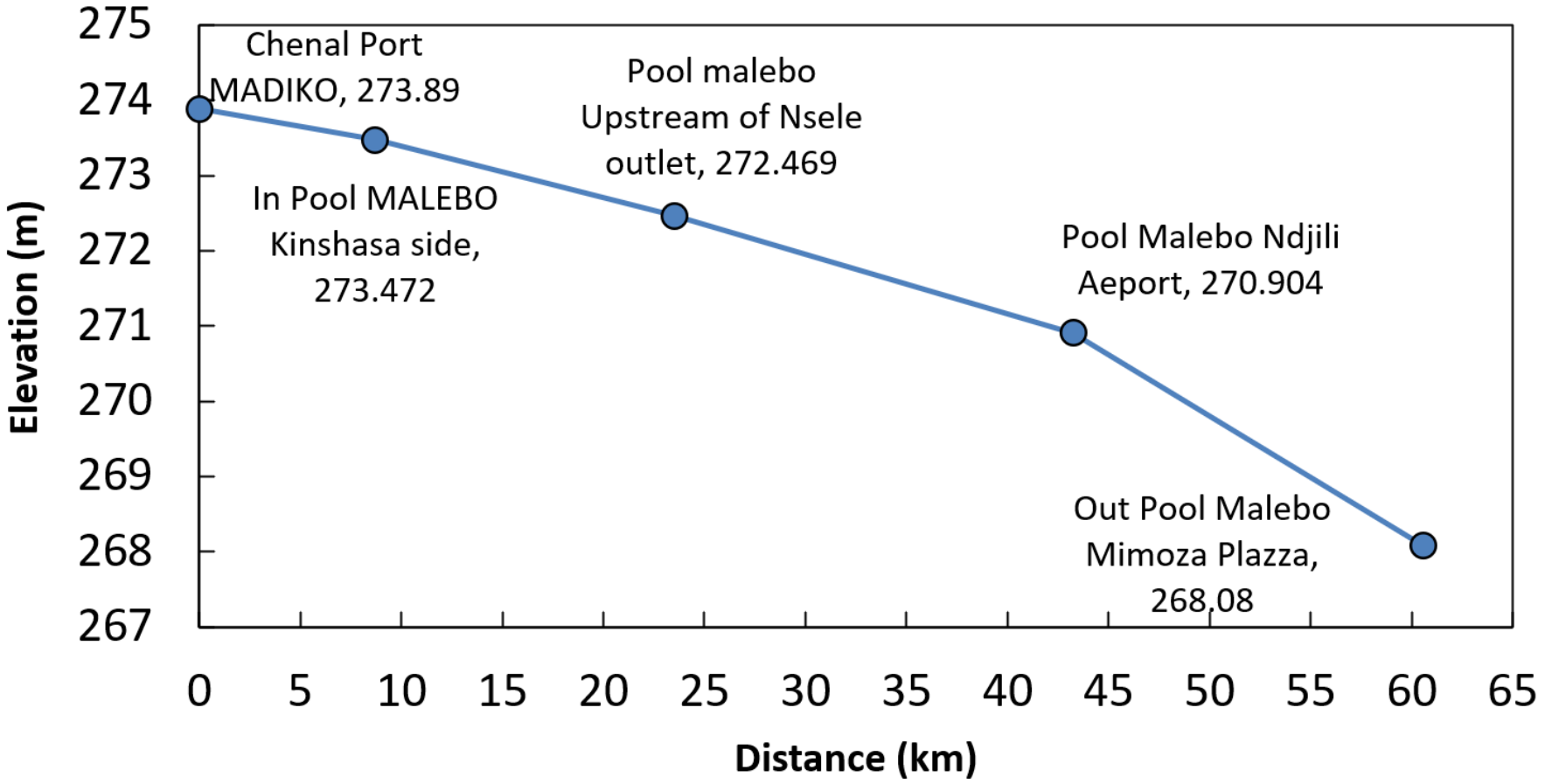
2021 Malebo Pool – River Flow





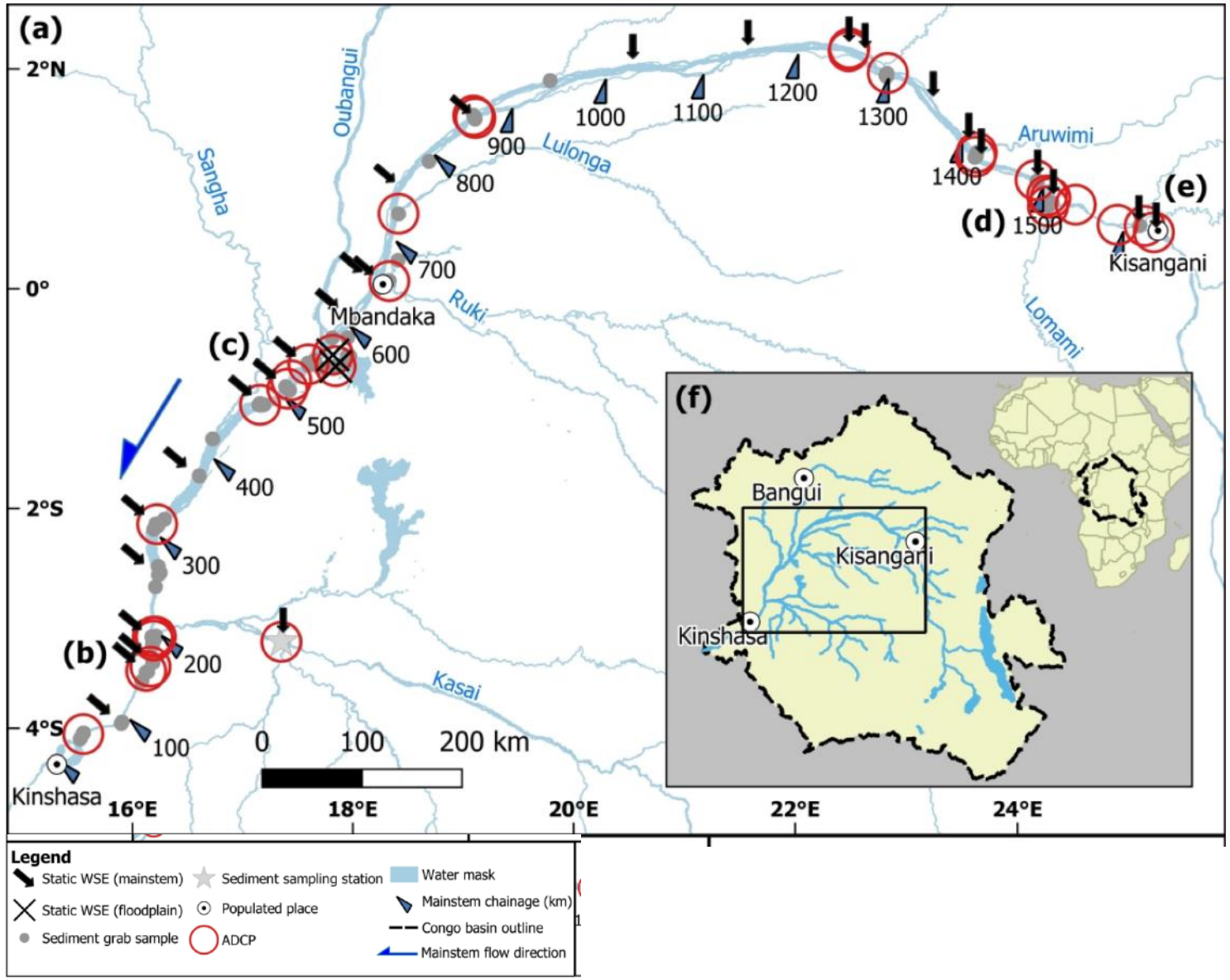
May 2021

2021 Malebo Pool – Water Elevation



- Steepening of water surface as river approaches exit from Malebo pool.
- Important for understanding flood risk to Kinshasa and Brazzaville

Summary of in-situ measurements



- 2000+ km of sonar (100 000+ river depth points)
- Water Elevations for at different periods
- 51 sediment sampling locations
- Sediment gauge at Kutu moke (Kasai) – timeseries of sediment
- 36 ADCP flow measurements – main stem plus tributaries
- Installed 12 water level loggers

= Huge quantity of completely new and unique data

New science!

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Later talks will provide more detail on the use of this data for CRuHM research

Geophysical Research Letters

RESEARCH LETTER
10.1029/2019GL083720

Greater Water Surface Variability Revealed by New Congo River Field Data: Implications for Satellite Altimetry Measurements of Large Rivers

Key Points:
- New field data show water surface slopes vary significantly at a major planform transition, but minimally elsewhere

Andrew B. Carr[1], Mark A. Trigg[1], Raphael M. Tshimanga[2,3], Duncan J. Borman[1], and Mark W. Smith[4]

Contents lists available at ScienceDirect

Catena

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Assessment of basin-scale soil erosion within the Congo River Basin: A review

C.A. Mushi[a,d,*], P.M. Ndomba[a], M.A. Trigg[b], R.M. Tshimanga[c], F. Mtalo[a]

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Journal of Hydrology: Regional Studies

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Establishing uncertainty ranges of hydrologic indices across climate and physiographic regions of the Congo River Basin

Pierre M. Kabuya[a,b,*], Denis A. Hughes[a], Raphael M. Tshimanga[b], Mark A. Trigg[c], Paul Bates[d]

New papers in upcoming AGU Book

AGU Books

New Measurements of Water Dynamics and Sediment Transport along the Middle Reach of the Congo River and the Kasai Tributary

Raphael M. Tshimanga[1], Mark A. Trigg[2], Jeff Neal[3], Preksides Ndomba[4], Denis A. Hughes[5], Andrew B. Carr[2], Pierre M. Kabuya[1,2], Gode B. Bola[1], Catherine A. Mushi[4], Jules T. Beya[1], Felly K. Ngandu[1], Gabriel M. Mokango[6], Felix. Mtalo[4], and Paul Bates[3]

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[5]Institute for Water Research, Rhodes University, South Africa,
[6]Regie des Voies Fluviales – RVF, Kinshasa, DR Congo

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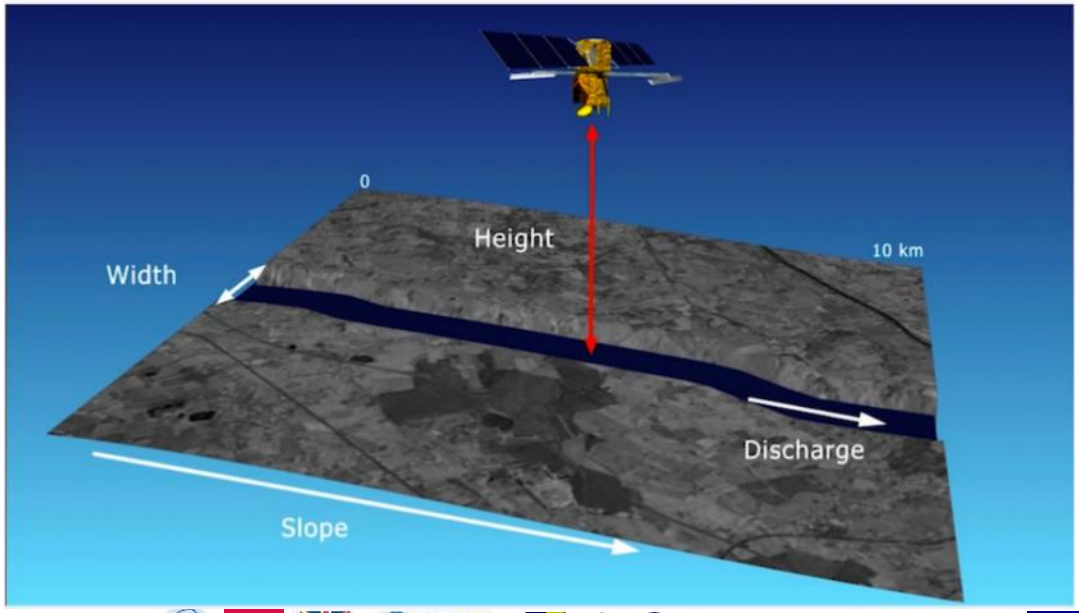
Future of fieldwork data

Lots of unique data – funder (and good science practice) requires that data is open to all for collaborations (through CRREBaC)

Two way sharing of data with RVF for improved river management for river users

Opening up new research opportunities:

- CRISP – Congo River Island Stability Prospects
- HYFLOOD – Understanding Congo Flood Risk
- Congo Canyon project
- Science partner for new NASA SWOT satellite - multichannel river science



Merci pour votre attention!

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