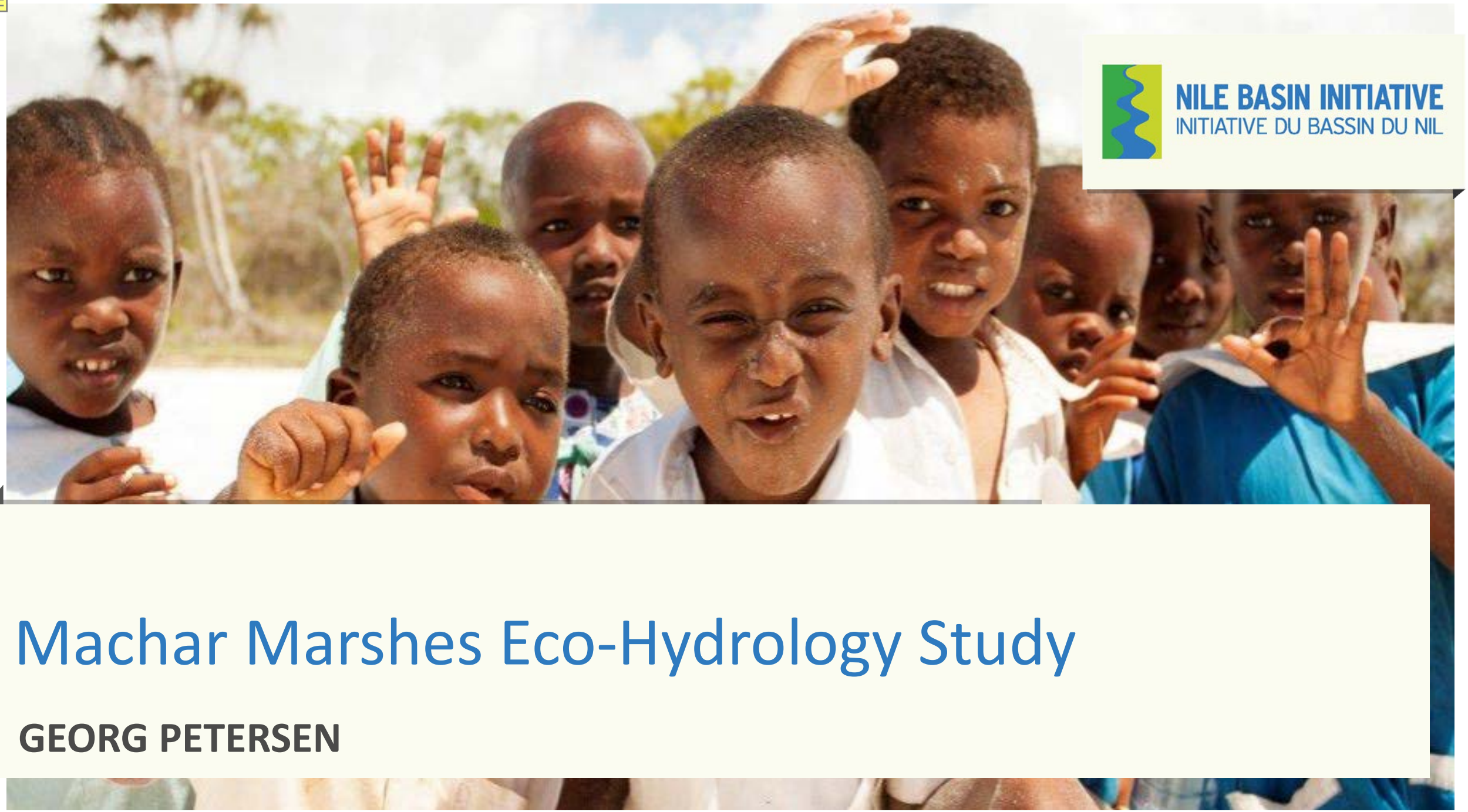


NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

Machar Marshes Eco-Hydrology Study

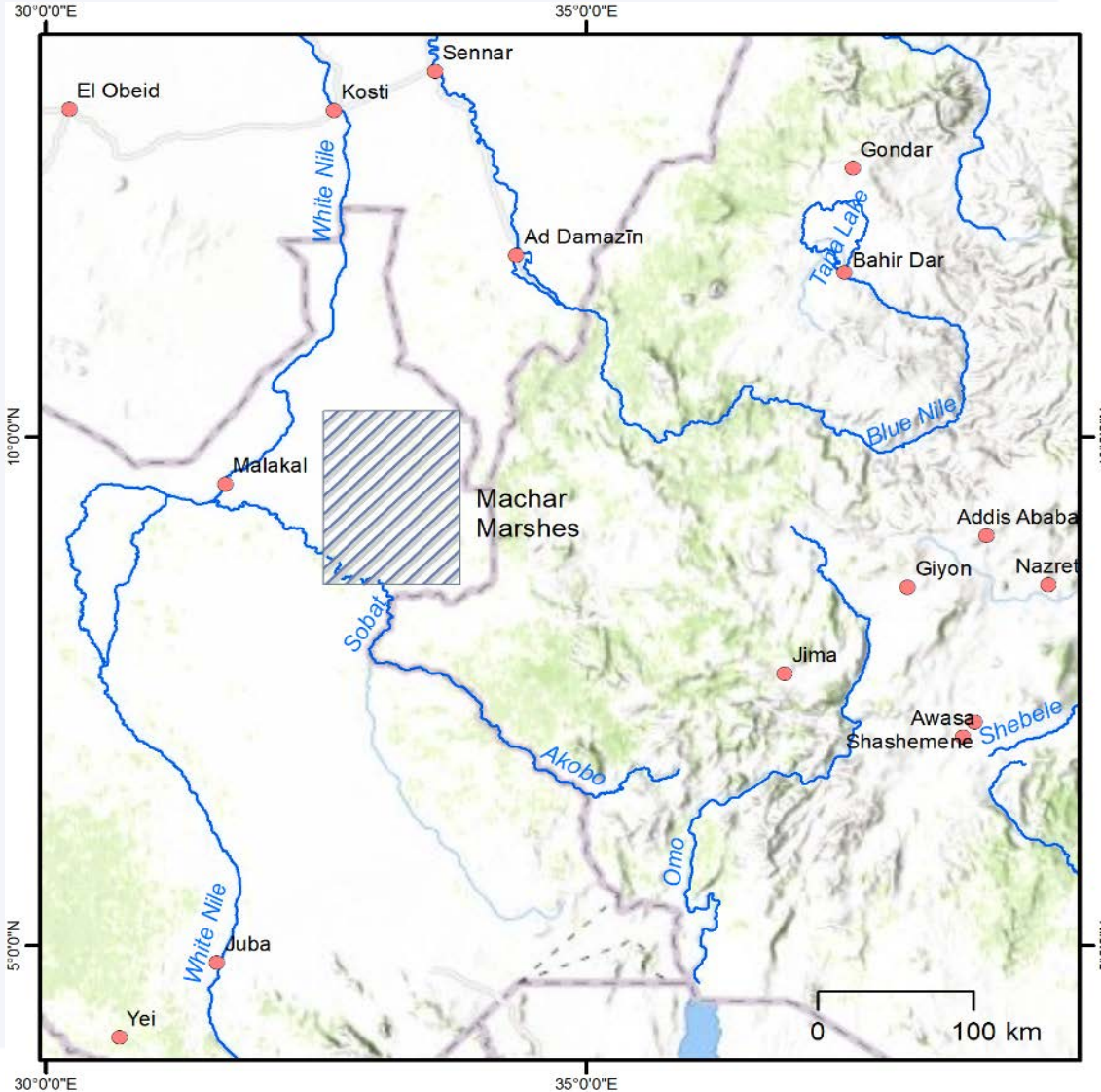
GEORG PETERSEN

Study objectives

- Machar Marshes Eco-Hydrology Study
  - Baseline assessment of water balance dynamics
  - Watershed schematization
  - Remote sensing to delineate wetland extent
  - Development of the water balance model and incorporate into the NileDSS
  - Development of the 2D Hydraulic model and incorporate into NileDSS
  - Assessment of ecosystem aspects
  - Establishment of the environmental flow requirements

The Machar Marshes

- Part of the Baro-Akobo-Sobat (BAS) system
  - vast and complex river- and wetland network
  - including a wide expanse of floodplains

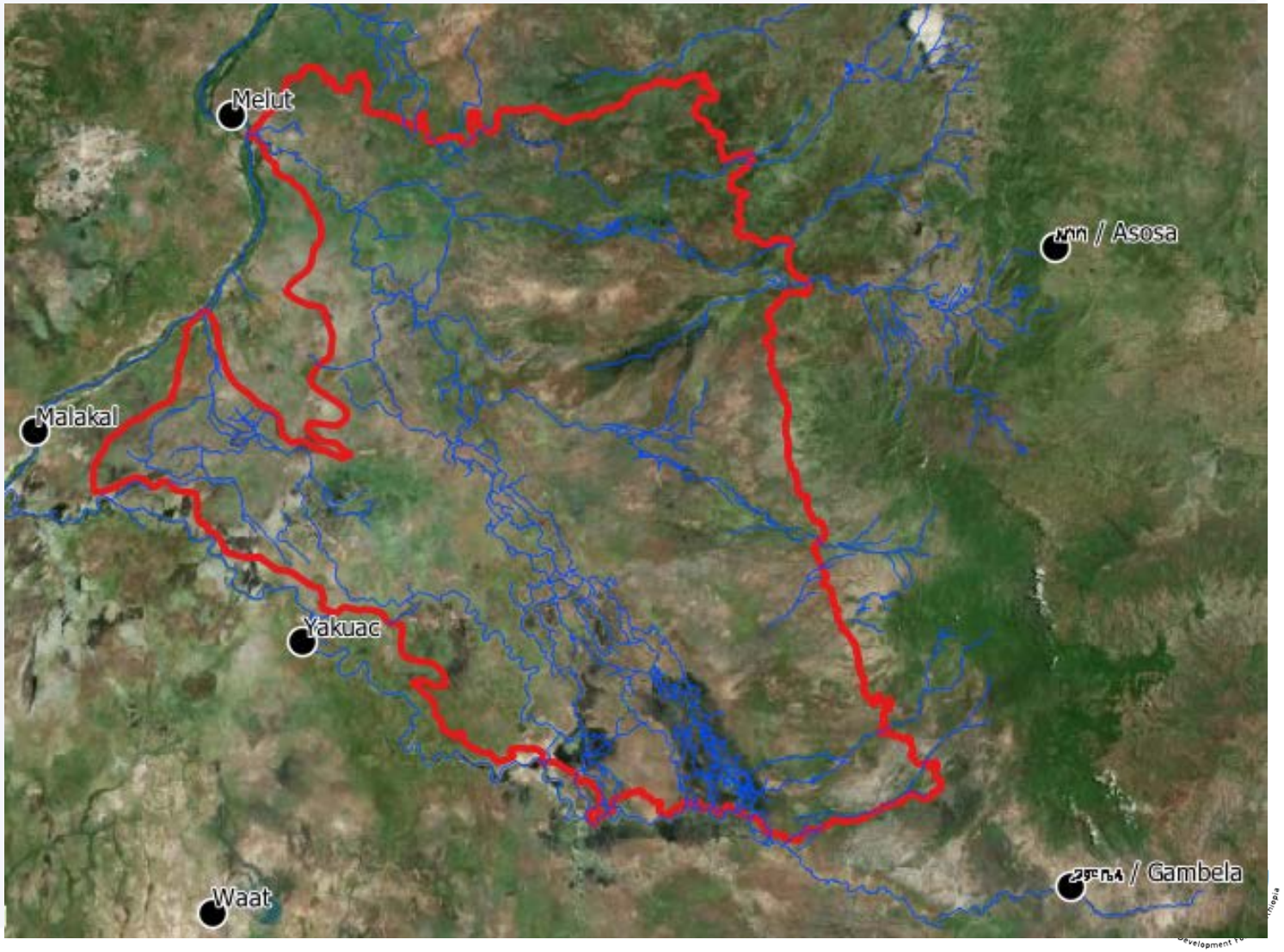


Data use

- Soils from SoilGrids , 250m resolution
- Vegetation cover from CCI Landcover 20m, and current Nile Wetlands study, 10m
- Detailed stream network, digitized
- Discharge data available from previous studies, 10daily temporal averages
- Actual evapotranspiration (AET): MODIS (2000-2013), 250m resolution, and FAO WaPOR (2009-2018), 250m
- Potential evapotranspiration (PET): Calculated from Princeton climate data based on the Hargreaves method
- Rainfall: CHIRPS (1981-near real-time), 5km resolution; Princeton5, 25km resolution
- Soil moisture: ESA CCI (1978-2018), 25km resolution and TerraClimate (1958-2019)
- Inundation: ENTRO flood monitoring website
- Digital Elevation Model (DEM) MERIT , 90m and Airbus WorldDEM Topographic data

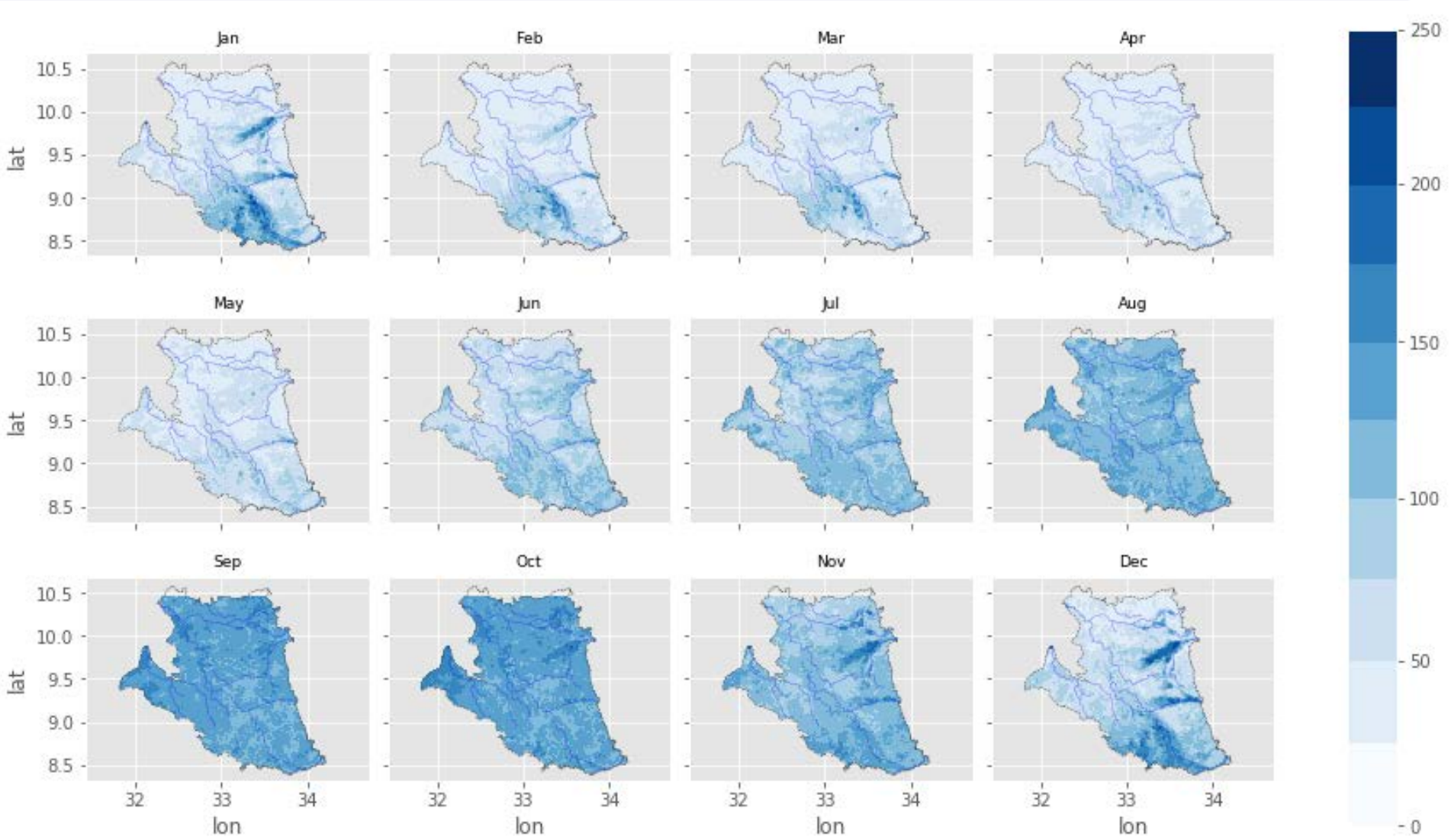
Watershed schematization

- DEM to identify catchment
- BAS-MWRD max Wetland extent
- Google Earth images



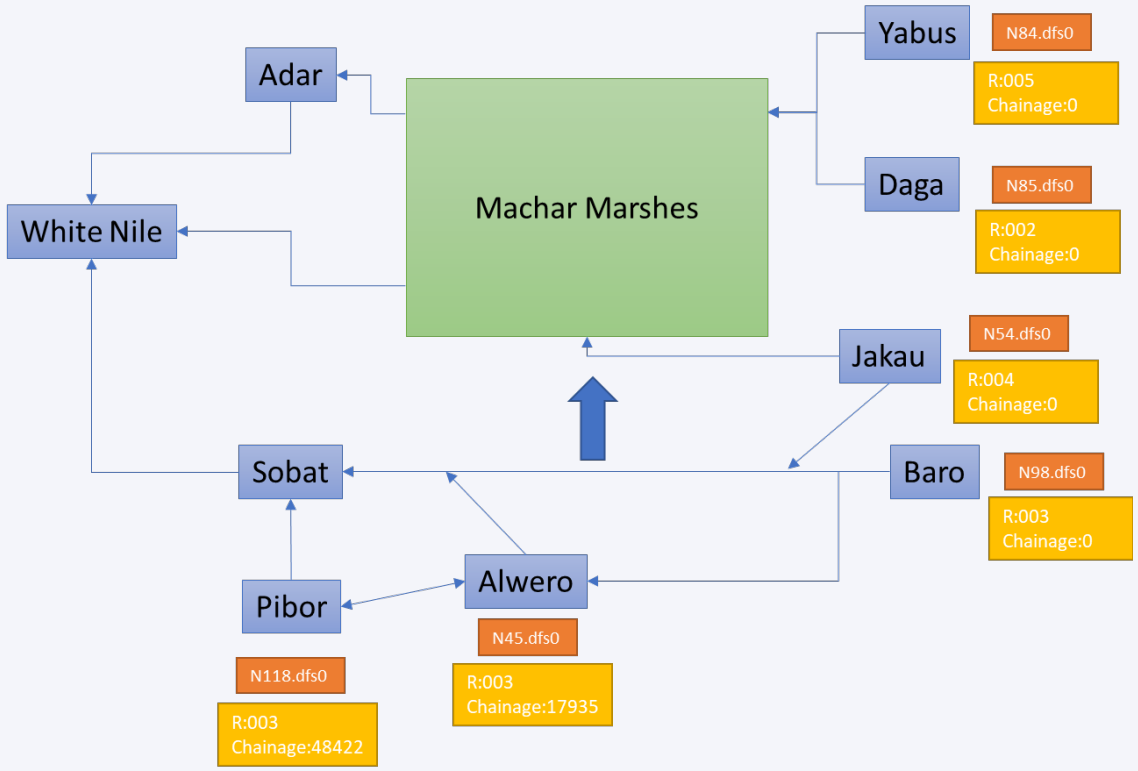
Wetland extent

- Remote sensing approach
- Extent from FAO WaPOR AET
- Average Machar Marshes extent
- = 6 947km²



Water balance model

- Conceptual model
- Mike SHE model setup
- Xxxx



Model runs / scenarios

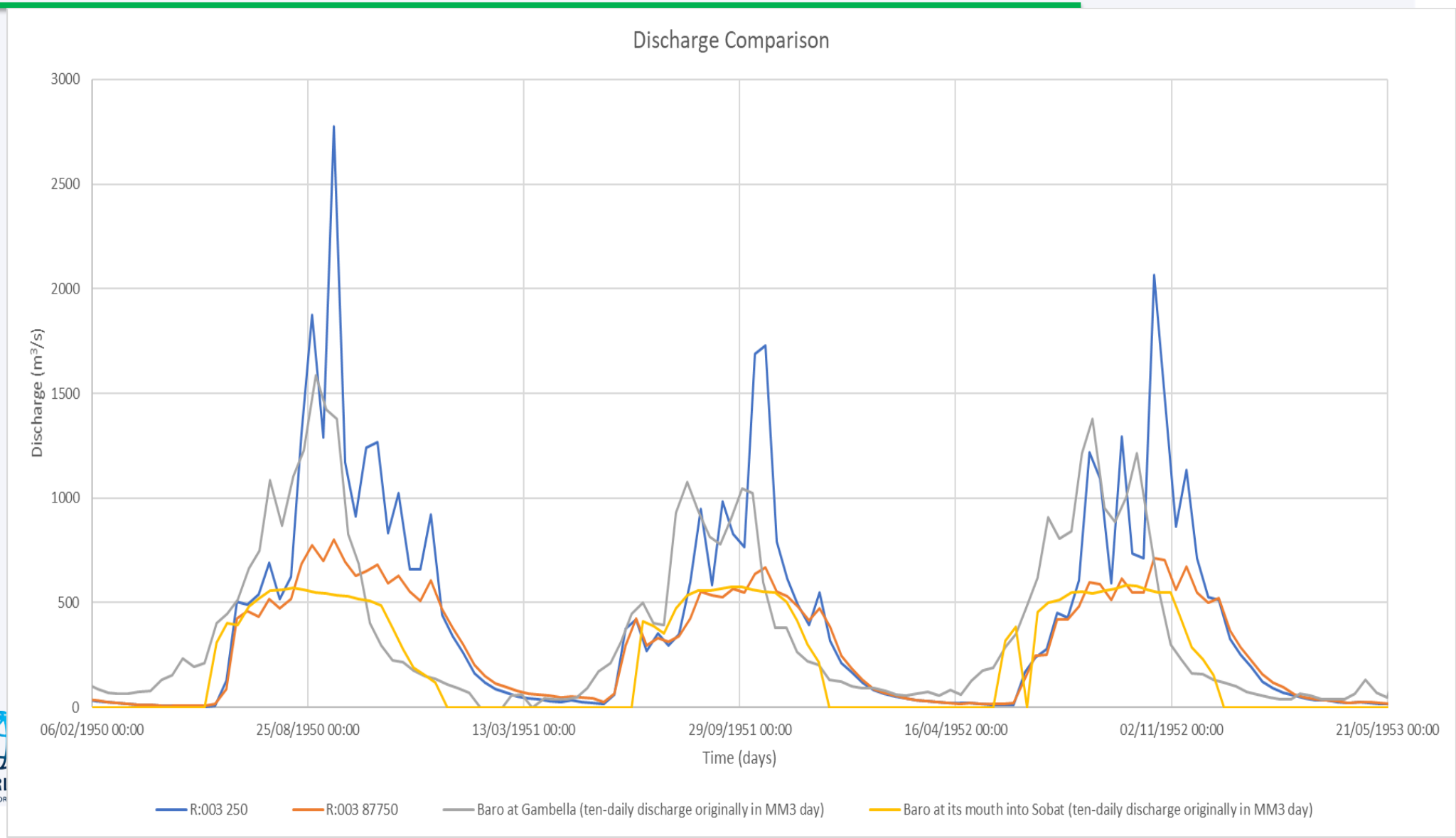
- OPTION 1: “Precautionary Principle” scenario, with reduced but significant irrigation areas (small-scale / large-scale) and with no encroachment into environmentally sensitive areas.
- OPTION 2: as per the Option 1 scenario above, but in this case, the Tams Dam and Birbir Dam are included.
- OPTION 3a: Intermediate case, similar to Scenario 2, but with environmental water releases imposed on all dams in order to conserve natural flow patterns.
- OPTION 3b: Intermediate case, similar to Scenario 4a, but with environmental water releases imposed on all dams in order to conserve natural flow patterns
- OPTION 4a: Full-development case, with Tams Dam operated to maximise hydropower production.
- OPTION 4b: Full-development case, with Tams Dam operated to optimise irrigation and flood control
- Xxxx

2D-Model

- MIKE SHE model implemented for the Machar Marshes
- MIKE 11 (1D) model implemented in order to represent the flow dynamics in the main watercourses
- MIKE 11 model provides water input into the MIKE SHE domain when the water in the channels spills out of the banks
- Gridded domain in MIKE SHE provides overland water input into the defined channels
- MIKE SHE - MIKE 11 coupled model calibrated against satellite data and against observed discharge values in several stations in the study area.

Modelling results - flow

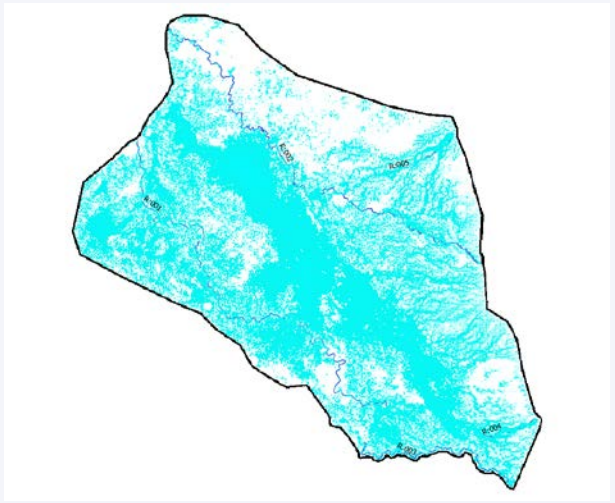
- Good fit of results



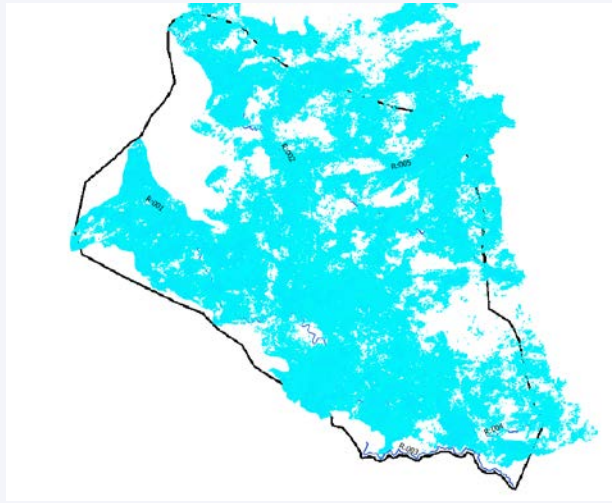
Modelling results - inundation

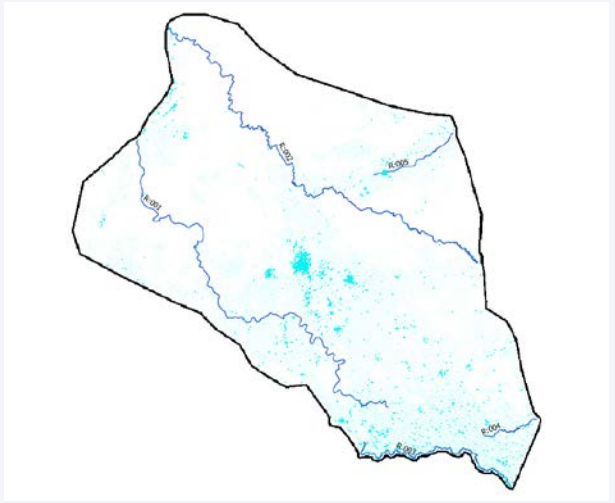
- Mike SHE results
- Good correlation with remote sensing analysis

MIKE SHE



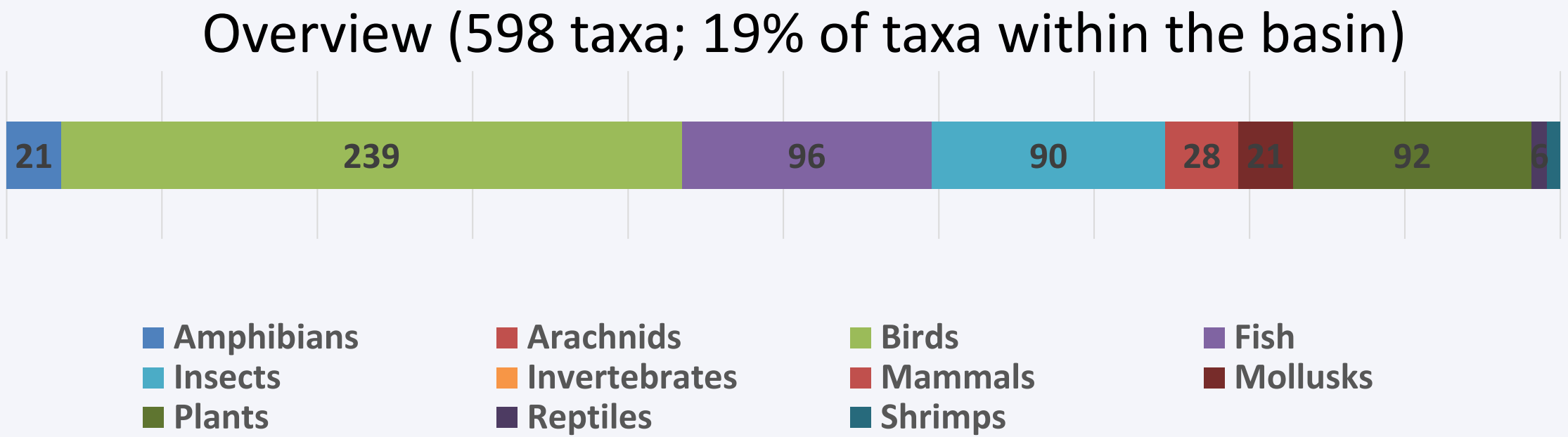
Remote Sensing





Biodiversity

- Overview of biodiversity generated



Wetland integrity

- Good wetland integrity score

Wetland	Integrity Scores 2018
Bahr_el_Ghazal	0.79
Dinder_Floodplain	0.50
Kagera_Swamps	0.96
Kyoga_Kwania_Swamp_Complex	0.93
Lake_Edward	0.98
Lake_George	0.93
Lake_Tana	0.97
Machar_Marshes	0.78
Mara_Wetland	0.76
Nyando	0.65
Nzoia_River	0.76
Semliki_Valley_Wetlands	0.67
Sio_Siteko	0.40
Sudd	0.87
The_Nile_Delta	0.35
Yala_Swamp	0.78

NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

A	>92 - 100
A/B	>88 - <= 92
B	>82 - <=88
B/C	>78 - <=82
C	>62 - <=78
C/D	>58 - <=62
D	>42 - <=58
D/E	>38 - <=42
E	20 - <=38
F	<20

german cooperation
DEUTSCHE ZUSAMMENARBEIT
giz
THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP
CIWA
2021
6th Nile Basin Development Forum, Ethiopia

Eco-rule matrix for eflows analysis

NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

- Established most favourable condition combinations for different plant species

Depth (max flood)	Inundation Duration (% Year)																		
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0	TR	TR	TR	TR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	RE	RE	PA
0.25	TR	TR	TR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	RE	RE	RE	RE	RE	RE	PA
0.5	TR	TR	GR	GR	GR	RE	RE	RE	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA
0.75	TR	GR	GR	GR	GR	RE	RE	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA
1	TR	GR	GR	GR	GR	RE	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	FR	FR	FR
1.25	GR	GR	GR	GR	GR	RE	PA	PA	PA	PA	PA	PA	PA	PA	FR	FR	FR	FR	FR	AQ
1.5	GR	GR	GR	RE	RE	PA	PA	PA	PA	PA	PA	PA	FR	FR	FR	AQ	AQ	AQ	AQ	OW
1.75	GR	GR	GR	PA	PA	PA	PA	PA	PA	PA	FR	FR	AQ	AQ	AQ	AQ	AQ	AQ	OW	OW
2	GR	RE	RE	PA	PA	PA	FR	FR	FR	FR	FR	AQ	AQ	AQ	AQ	AQ	AQ	OW	OW	OW
2.25	GR	RE	RE	PA	PA	FR	FR	FR	AQ	AQ	AQ	AQ	AQ	AQ	AQ	OW	OW	OW	OW	OW
2.5	RE	RE	PA	PA	FR	AQ	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW
2.75	RE	PA	PA	PA	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW
3	RE	PA	PA	PA	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW
Days	18.25	37	55	73	91	110	128	146	164	183	201	219	237	256	274	292	310	329	347	365

german cooperation
DEUTSCHE ZUSAMMENARBEIT

IBRD · IDA | WORLD BANK GROUP

NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

THANK YOU!