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A hydrological model supporting water resources management in the Okavango Delta

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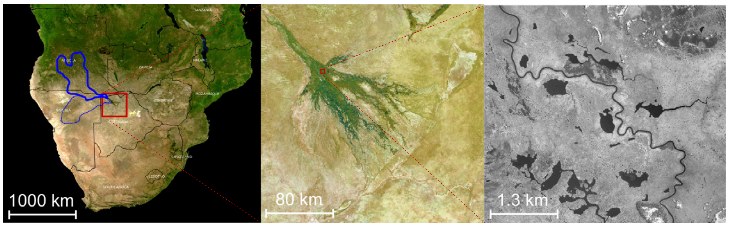
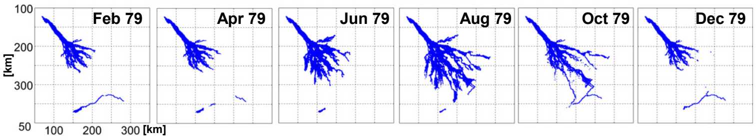
1. Introduction



Situated in northern Botswana the **Okavango Delta** is a large wetland classified as wetland of international importance by the Ramsar convention. The strongly seasonal flooding patterns (see time series below) add to make the area ecologically unique. Due to water shortage in its semi-arid surroundings projects of water abstraction have been promoted but never realized until now.

Changes in flow regime and sediment input as would result from upstream damming are likely to have significant impact on the shape of the delta.

Modelling will help to predict responses of the system to human impacts (water abstractions, dams, climate change).



2. Water Resources Management

Upstream:

Angola

Possible developments since end of civil war in 2002:
- Increased water abstractions for irrigation
- Construction of dams to generate hydroelectric energy

Namibia

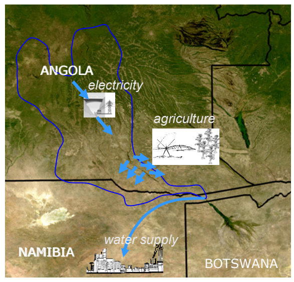
Possible abstraction of water for the capital Windhoek

Downstream:

Botswana

Economic value of the delta:
- Tourism
- Water supply to local towns
- Cattle feeding

Ecosystem services of the delta:
- Food supply for local communities
- Biodiversity (global importance)
- Water filtration & groundwater recharge
- cultural good ...



Requirements:

To remain in its current equilibrium the Delta needs sufficient inflow and seasonal variability of the inflow.

Possible compromise:

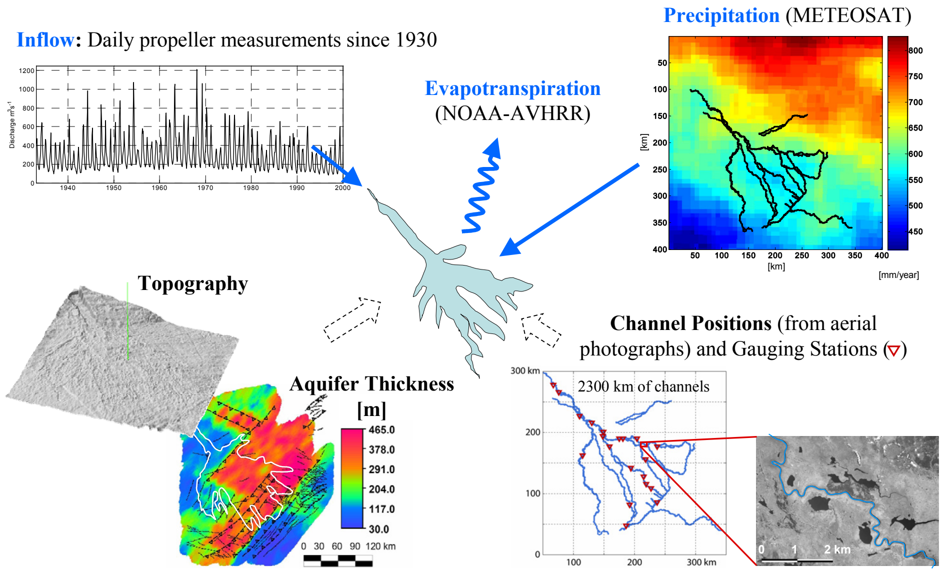
- Botswana pays compensations to Namibia and Angola to limit water abstractions.
- International participation in those costs is justified by the global importance of the delta in terms of biodiversity.

3. Hydrological Model

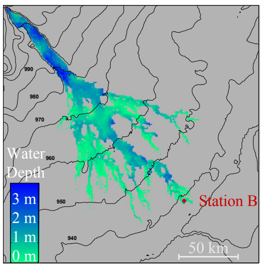
A Model Setup

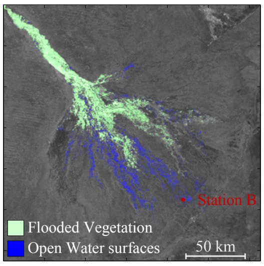
The hydrological model combines groundwater-, overland- and channel flow. It is implemented into **MODFLOW 2000**. The 1-D stream-flow routing package **SFR2** calculates flow velocities in the channels which are inputs for sediment transport calculations.

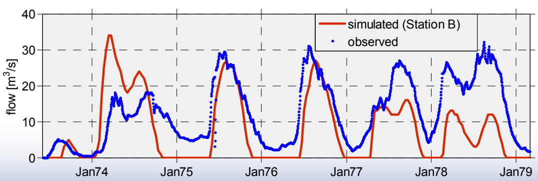
Model inputs are a combination of point data (inflow, temperature for ET calculation) and distributed data from remote sensing (topography, aquifer thickness, Precipitation, Evapotranspiration)



B Model Validation







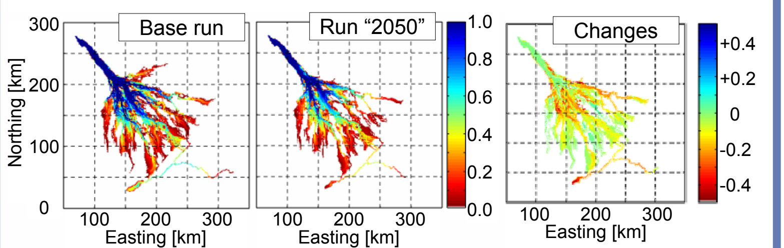
Observed and simulated discharge at station "B".

C Climate Change Impact

For the year 2050 the CCSR climate model with greenhouse gas scenario A2 predicts the following changes for the Okavango region:

· Precipitation: - 18 %
· Potential evapotranspiration: + 15 %

The inundation frequency: $f_{inound} = \frac{\textit{number of time steps flooded}}{\textit{number of time steps simulated}}$ for the base run under current conditions and the predicted conditions for the year 2050 are shown in the following figures.



The expected changes are predominantly towards a dryer Delta (yellow to red in the figure on the right). Although the total area is not affected much there is a strong impact on the fringes of channels. The length of permanent channels is reduced.