Water storage and variations in densely impounded catchments in NE Brazil using TanDEM-X and RapidEye satellite data

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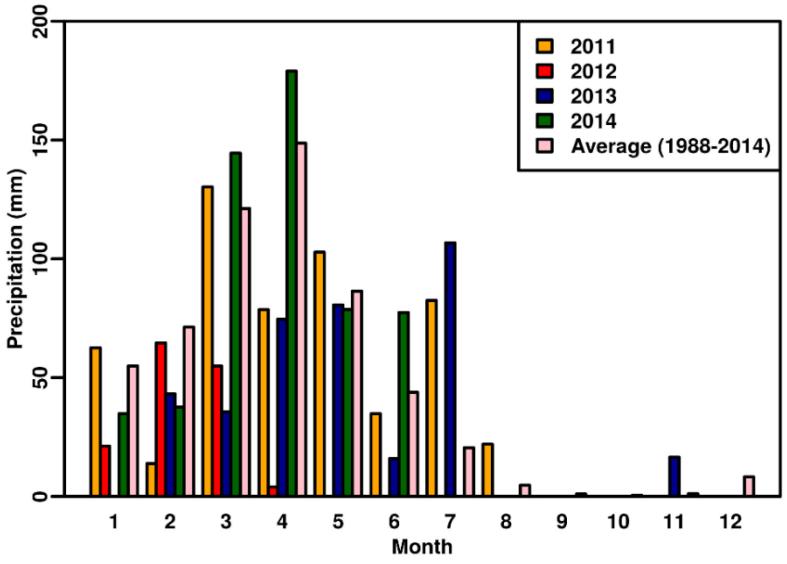
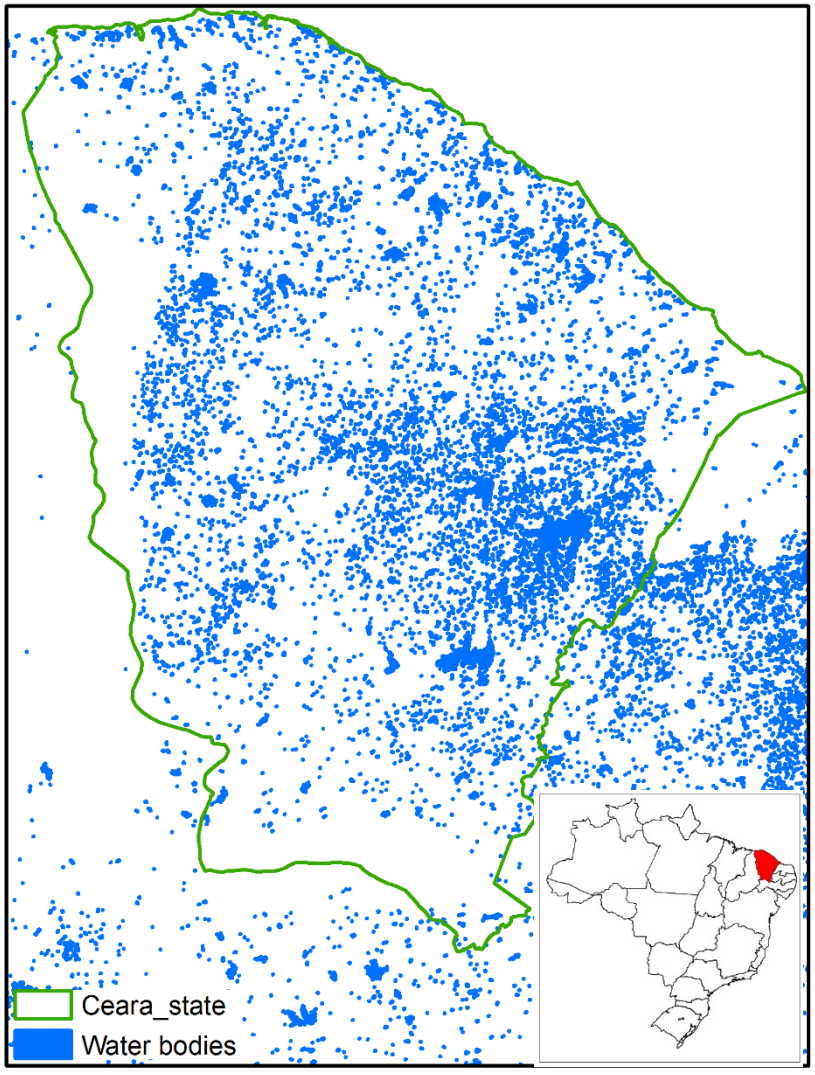
Outlines

- Study area (NE Brazil)
- Background (TanDEM-X mission)
- Objective (BistaticTanDEM-X data and reservoir bathymetry)
- Data and methods
- Results (reservoir bathymetry, temporal water storage)

Study area



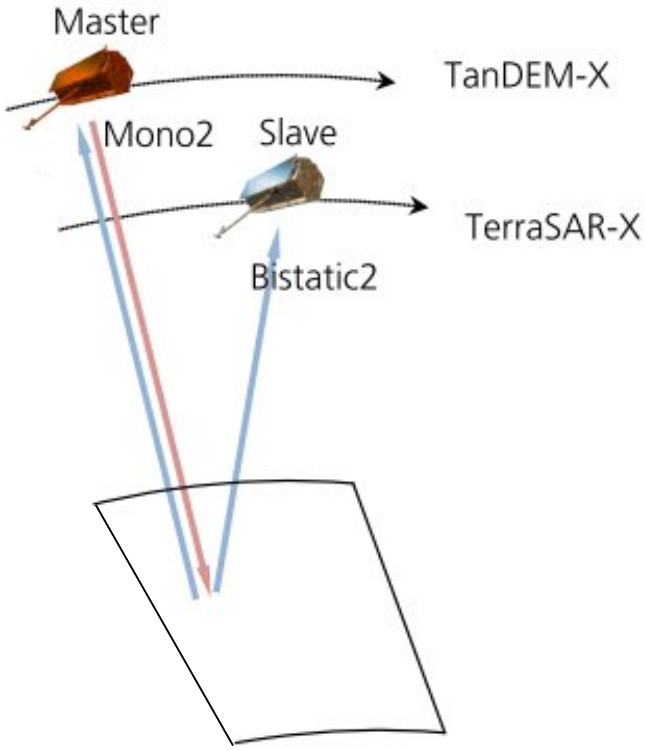


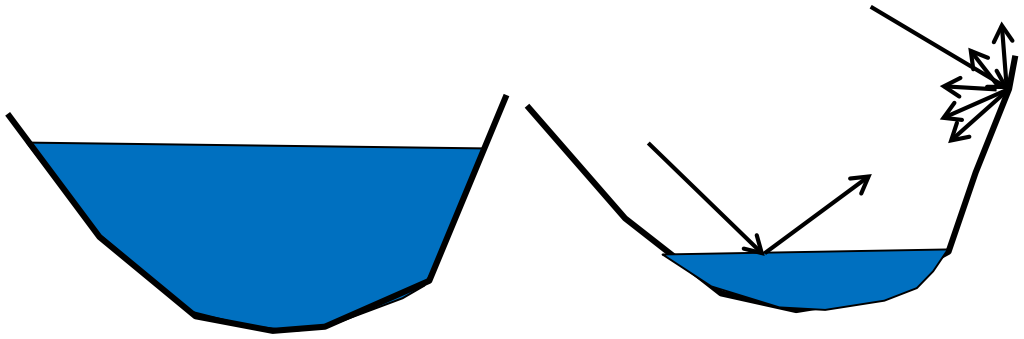
- Semi arid areas, wet + dry season
- No ground water, numerous reservoirs of various sizes
- Unknown inventory data (e.g. storage capacity and characteristics)
- Water supply vulnerable to droughts

Made by Shuping Zhang in November 2015

TanDEM-X mission

- Two satellites constellation, managed by DLR (from 2011 – 2016)
- Data : X- band SAR images, Bistatic mode, Aim: generate Global DEM (resolution:12 m, absolute accuracy 10m, relative accuracy 2 m) from two phases (~2011, ~2013)
- Characteristics: Water area indicated





Phase 1 (~2011) Phase 2 (~2013)

$$\phi = \phi_{topo} + \cancel{\phi_{dis}} + \cancel{\phi_{atm}} + \cancel{\phi_{orb}} + \phi_{noise}$$

Objectives

- Possible to derive the bathymetry for large number of reservoirs from TanDEM-X acquired in dry season?
- What is the storage capcacity & characteristics of the reservoirs in the region?
- How did the water resource change in the recent years?

Test sites and Datasets

Sites

4 catchments: Bengue, Madalena,

Sangue, Pentecoste

Date sets

13 tiles TanDEM-X (Oct - Dec 2015) ⇨ DEM (Bathymetry)

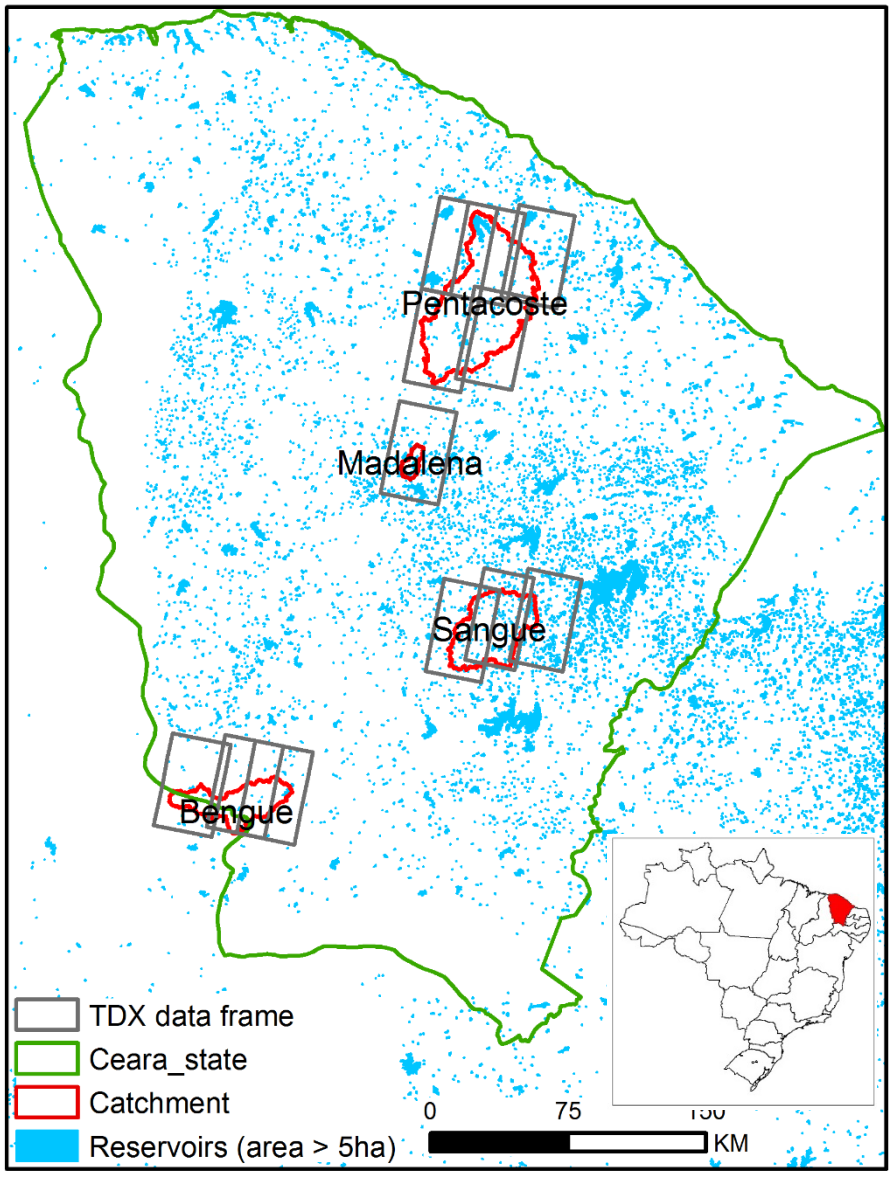
5 tiles global TanDEM-X DEM ⇨ DEM validation

RapidEye images (2009 – 2016) ⇨ Water surface

Methods

Single pass interferometry (GAMMA)

Segmentation NDVI & NDWI (R)

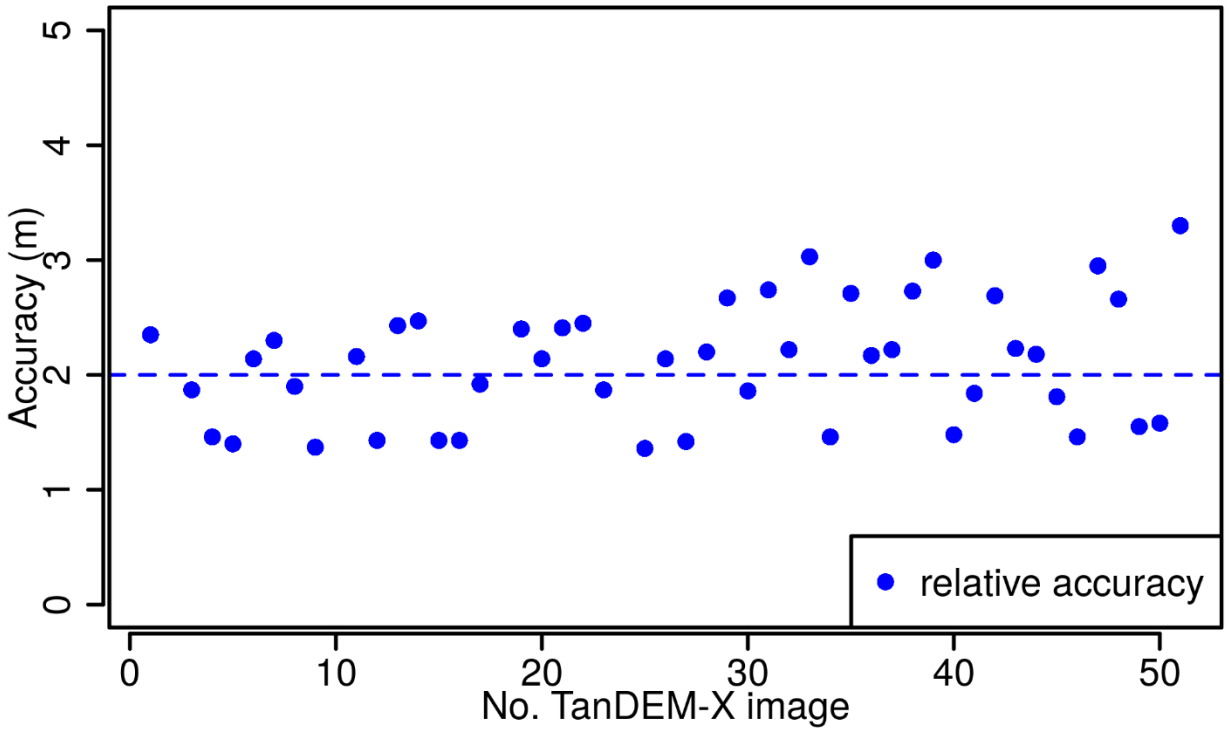


Results

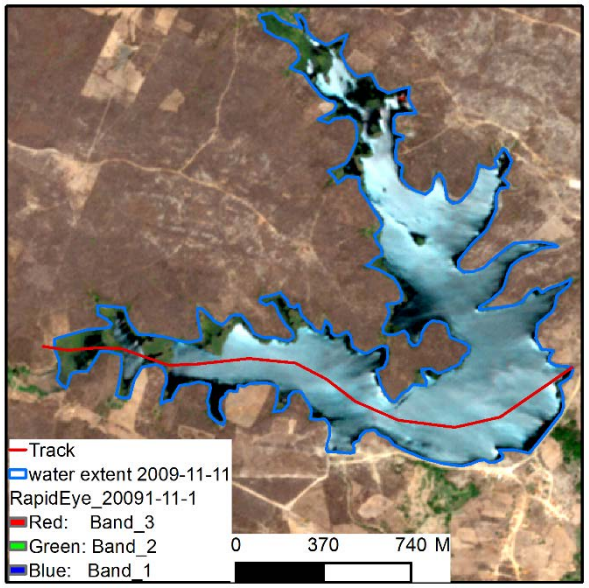
- DEMs from single pass TanDEM-X (Accuracy & Bathymetry replication)
- Contribution of different reservoirs (population, area & storage)
- Water storage variation along time series

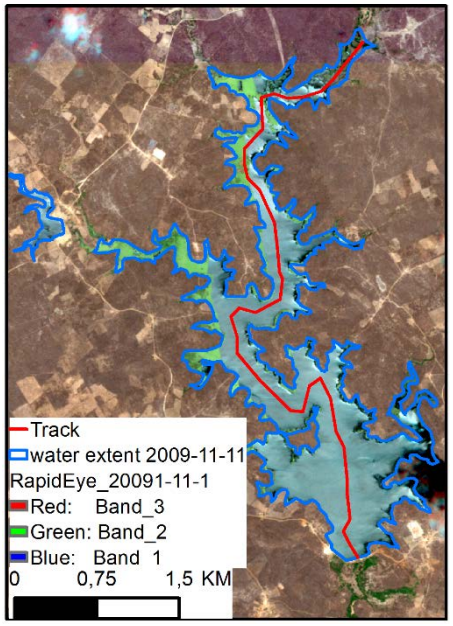
Result 1: Validation DEM_2015

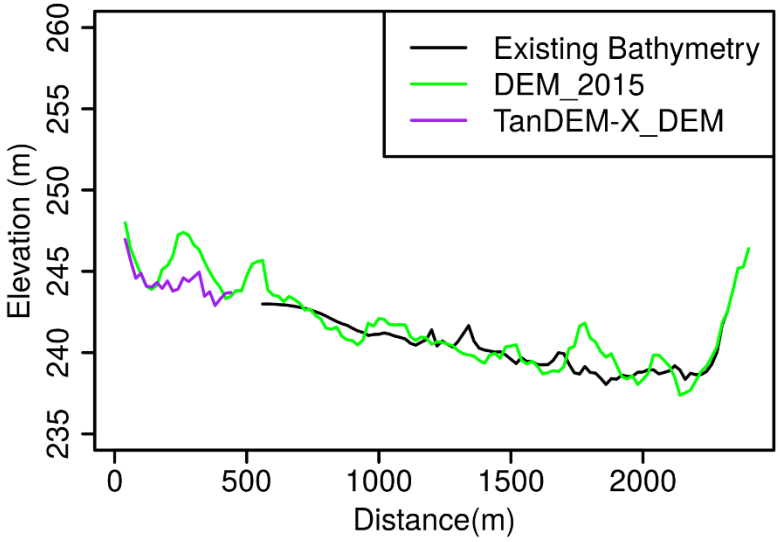
DEM_2015 VS globalTanDEM-X DEM (DLR)

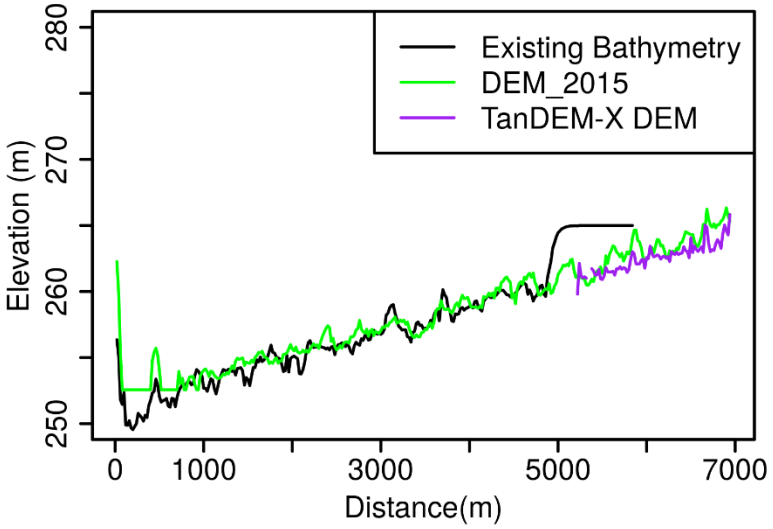


Result 1: Profiles of reservoirs on DEM_2015

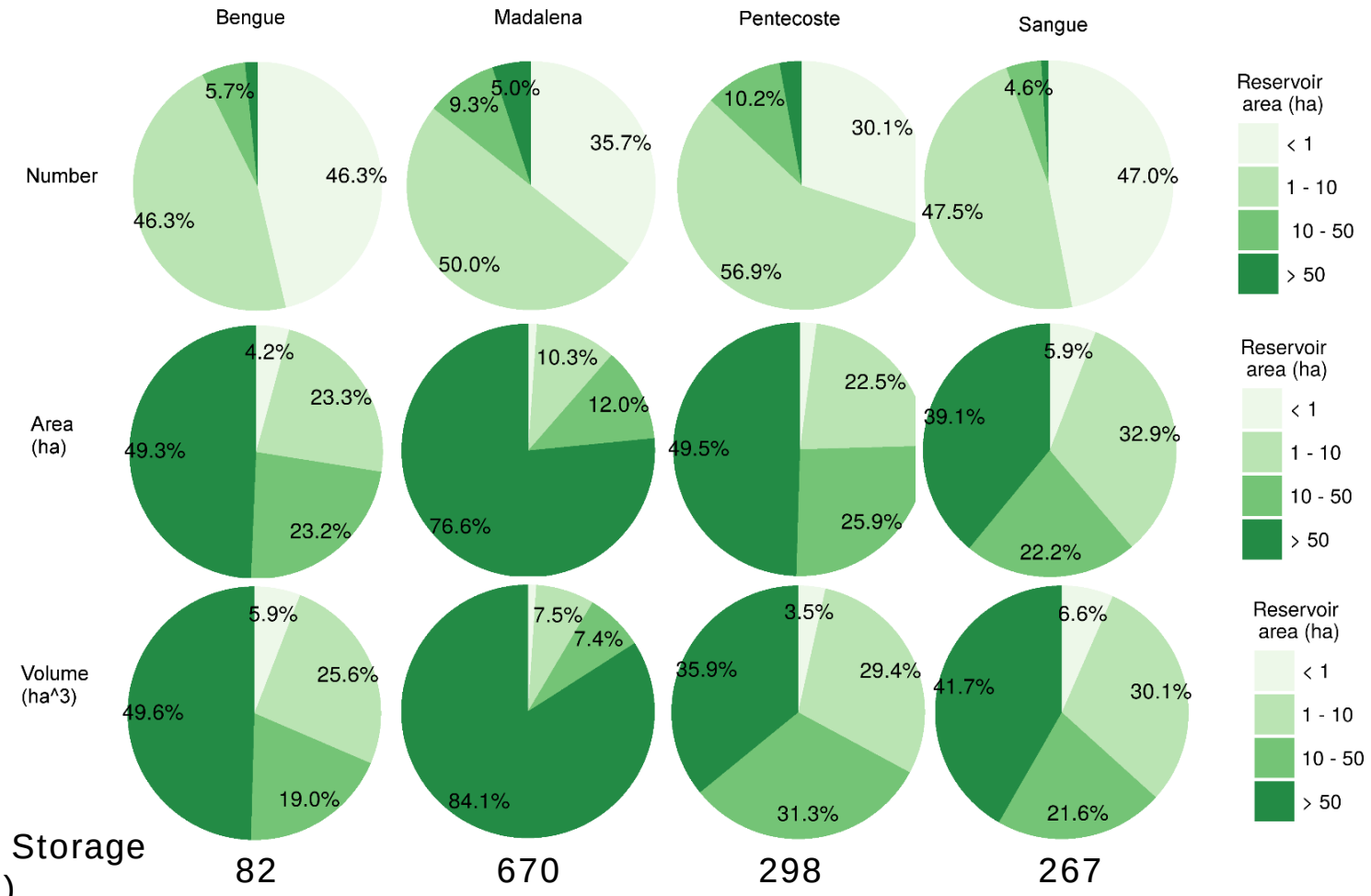






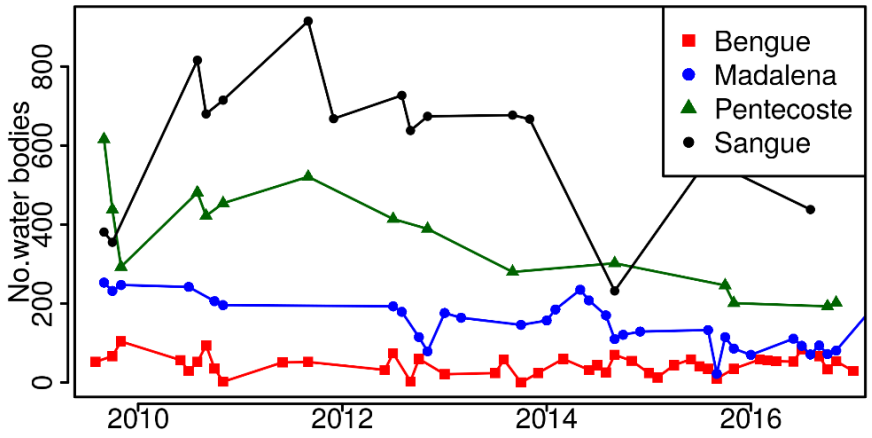


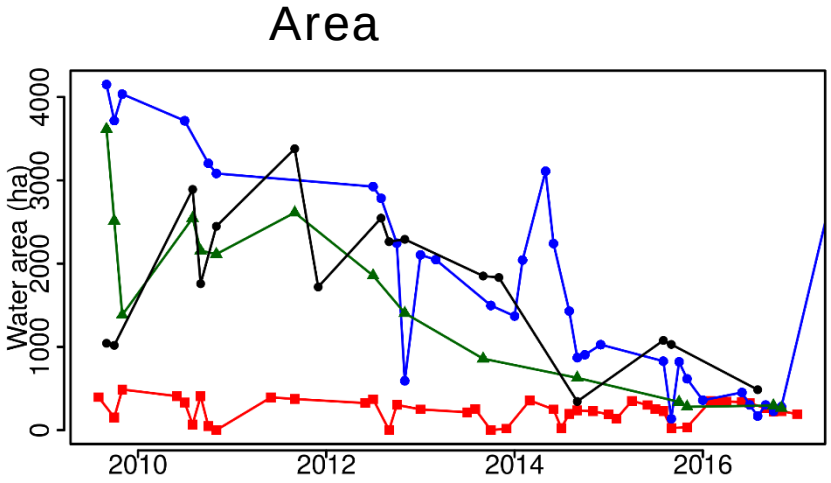
Result 2: Contribution of different reservoirs

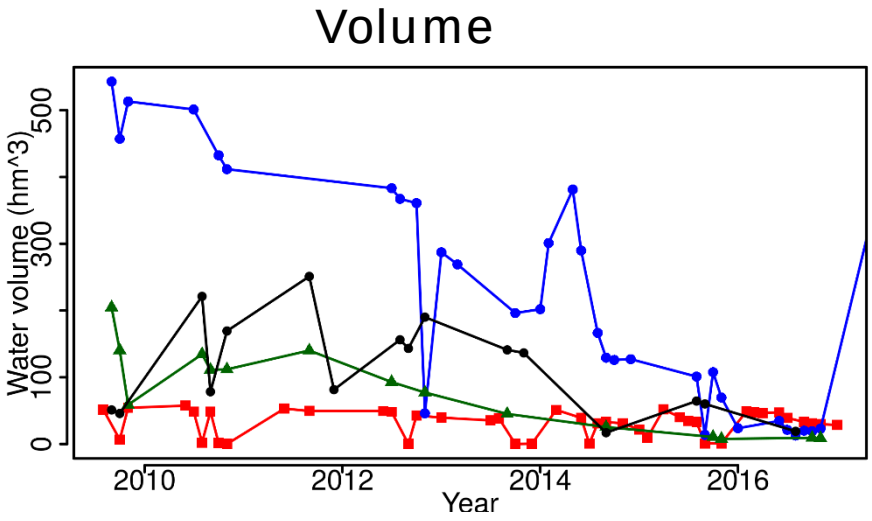


- Reservoirs of 1 - 50 ha contributed significantly to the regional water storage
- Reservoirs of 1-50 ha should also be considered in the local water management

Result 4: Variations along the time series of RapidEye images







- Water surface and volume have continuously decreased since 2010/2011.
- Water areas in the dry season 2015 are the smallest, the water storage based on DEM_2015 can act as effective benchmark of the period.

Conclusions

- DEM generated from TanDEM-X data acquired in the dry season can yield highly reliable bathymetry for reservoirs.
- Data gap in bathymetry, water storage capacity have been filled for ~ 2000 reservoirs in NE Brazil.
- Reservoirs 1-50 ha account for large in NE Brazil and should be considered in the local water monitoring and management.
- From 2009 to 2016, NE Brazil has constantly suffered from droughts.

Thank you!