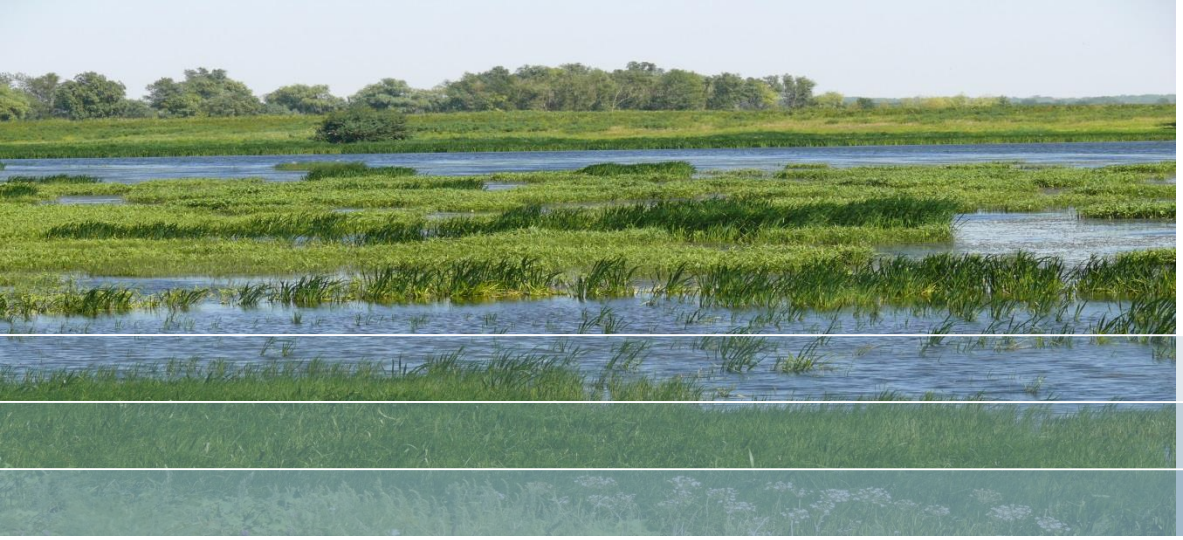

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Enabling Delta Life

Progress habitat suitability modeling

Mijke van Oorschot, Michelle Jeuken, Tom Buijse

5 februari 2015

Recap previous work

Completed work

- Habitat model for different life events of Ayu fish
- Habitat simulations for 3 separate hydrological years in varying sequences without bed level updates and with water quality for 3 reservoir flushing scenarios
- Results showed that discharge dynamics have larger effects than flushing scenarios

Recommendations

- Long-term hydro-morphodynamics including sediment transport, bed level updates and substrate distribution

Tasks 2018-2019

Main project

- Refining habitat model with long-term hydro-morphodynamics, water quality and changes in bed level

TKI project 2018 (extended until March 2019)

- Literature survey ecological implications of reservoir management
- Improve workflow HABITAT
- Habitat suitability analysis (meta-model) with new developments

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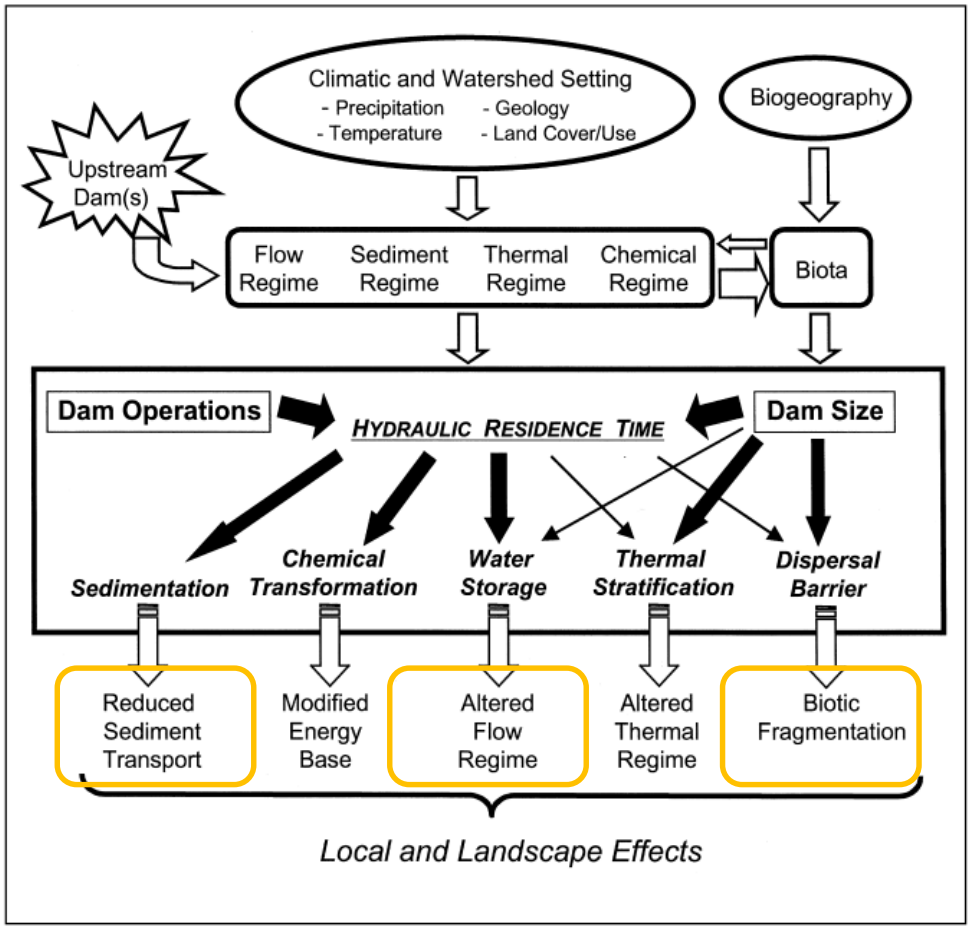
Literature survey ecological implications reservoir dams



Poff & Hart 2002

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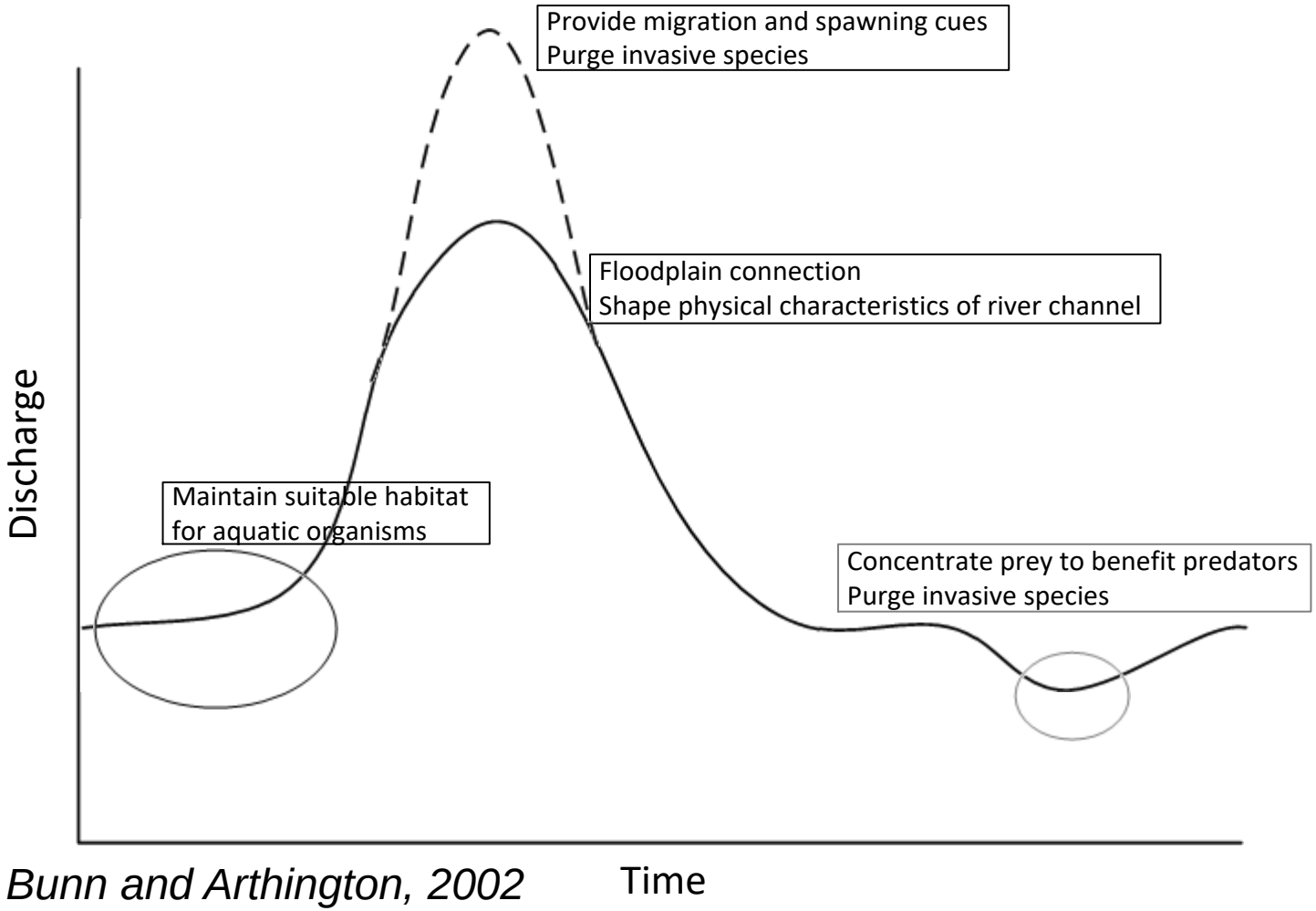
Natural flow regime



Bunn and Arthington, 2002

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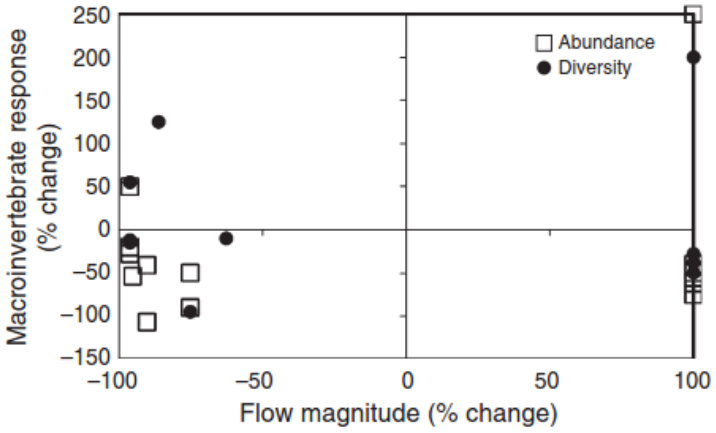
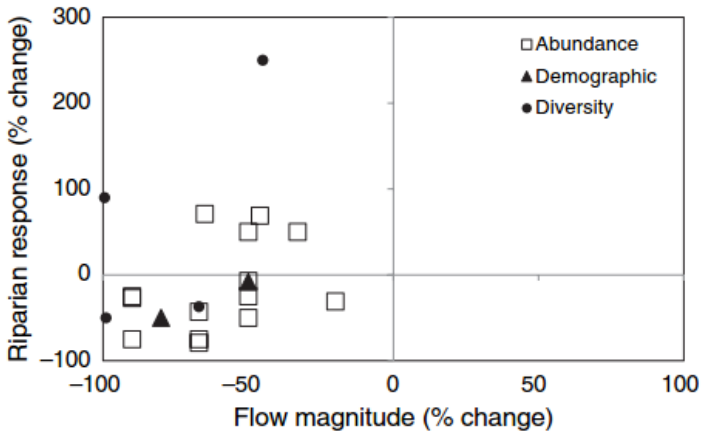
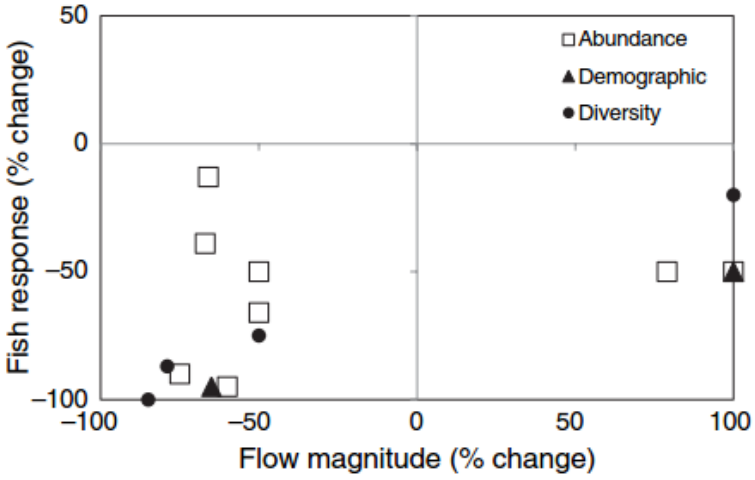
Effects of flow alteration

Any alteration in river flow leads to changes in the river ecosystem





Poff & Zimmerman, 2010



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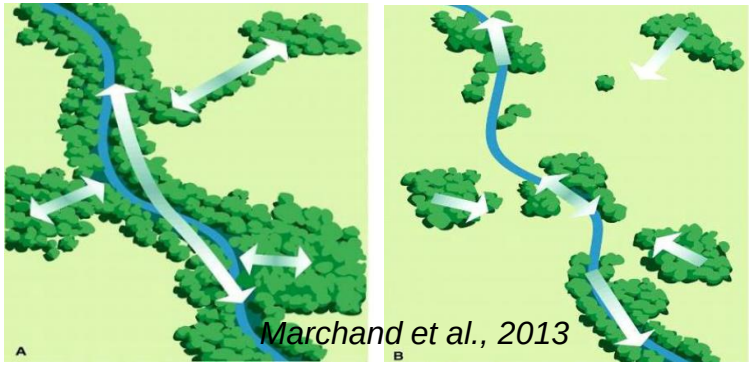
Effects of flow alteration

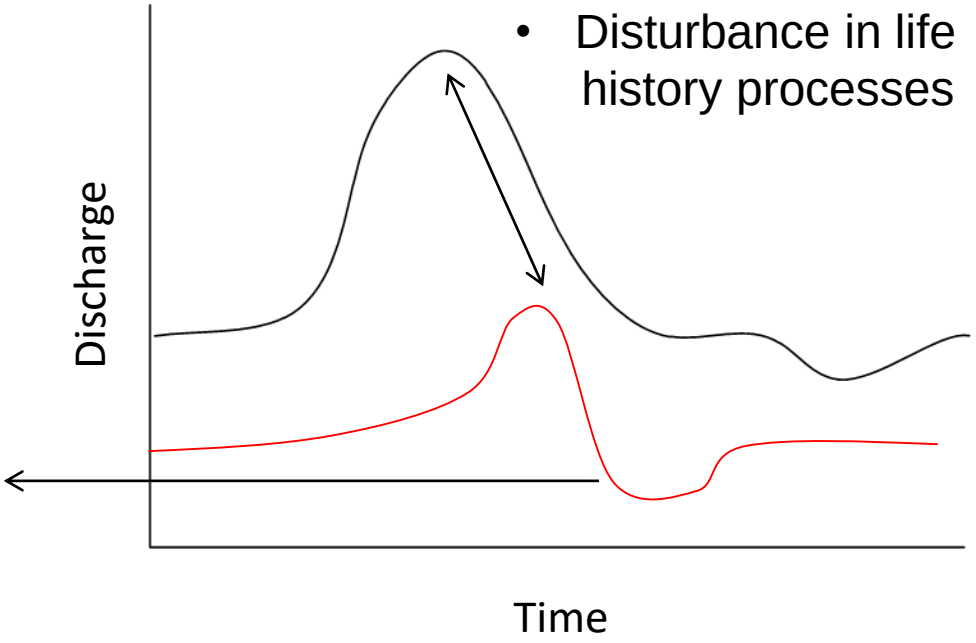
- Reduced flow
  - Disconnected floodplains



Marchand et al., 2013

Shift in flow timing

- Disturbance in life history processes



  - Dry river bed

Marchand et al., 2013

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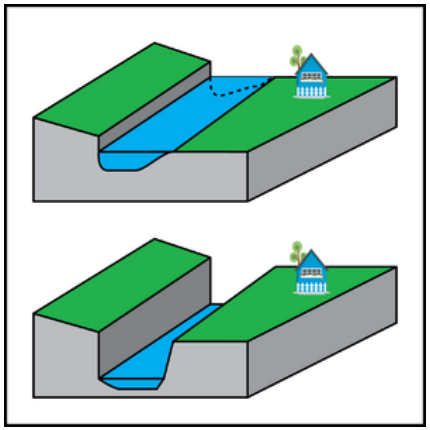
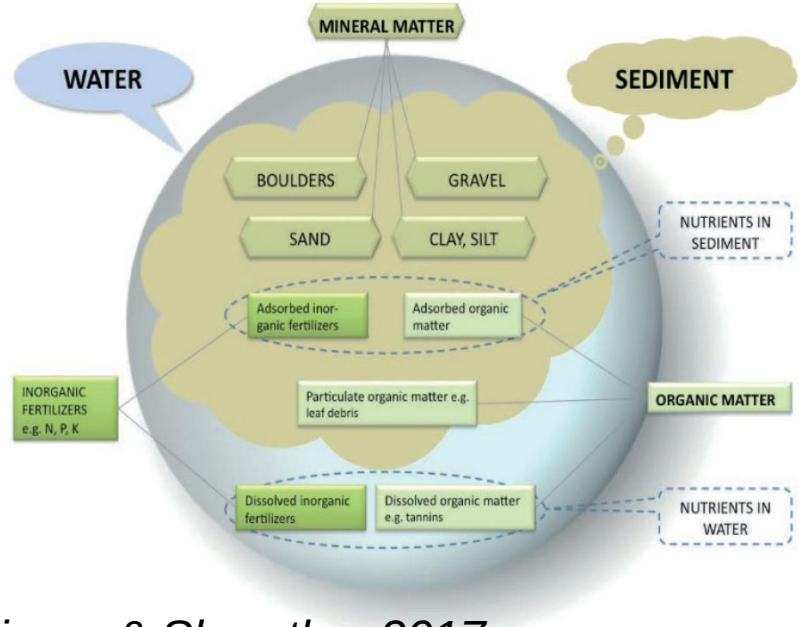
Sediment

- Dams trap sediment
  - River incision
  - Less sediment for habitat building
  - Less nutrients



Baran et al., 2015



Piman & Shrestha, 2017

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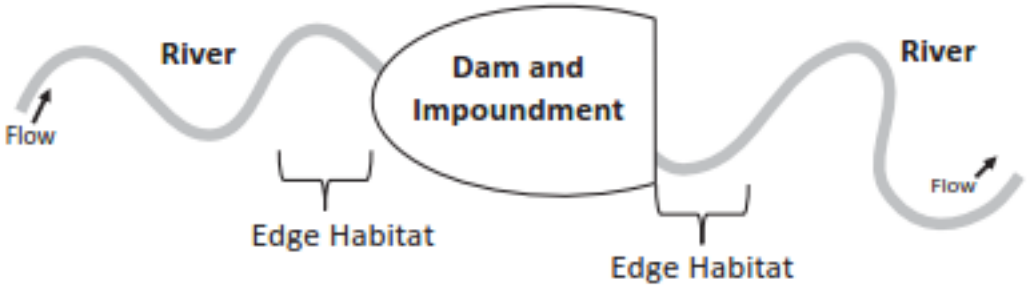
Habitat Fragmentation

- Dams block migration routes for fish
  - Physical obstructions
  - Changed habitat conditions



- Especially long distant migrant species (e.g. anadromous or catadromous species) are affected

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Reservoir management

- Important concept is: environmental flows (e-flows)

'Environmental flows describe the quantity, frequency, timing and quality of water and sediment flows necessary to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems (Worldbank 2018, amended from the Brisbane declaration 2007)'

- How much has the flow regime been altered?
- How does the altered flow- and sediment regime affect downstream ecosystems?
- How are all benefits and impacts distributed among stakeholders?

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Reservoir management

- Defining environmental flows can help to create a flow-regime that balances both ecological and socio-economic interests
  - Adapting flushing regimes to minimize ecological effects
  - Regulating discharges during spawning to create more spawning sites for Ayu
- Design of functional fish traps to promote fish migration
- New developments regarding sediment management (e.g. Kondolf et al., 2014)

Environmental flow example

- Advanced E-flow method in Murray-Darling basin, Australia
- Separate authority that determines water limits for diversion and environment
- Based on available water, choices are made to inundate parts of the wetland
- Advanced vegetation monitoring, linked to inundation schemes and climatic conditions continuously improves the water provision

Dyer et al., 2018

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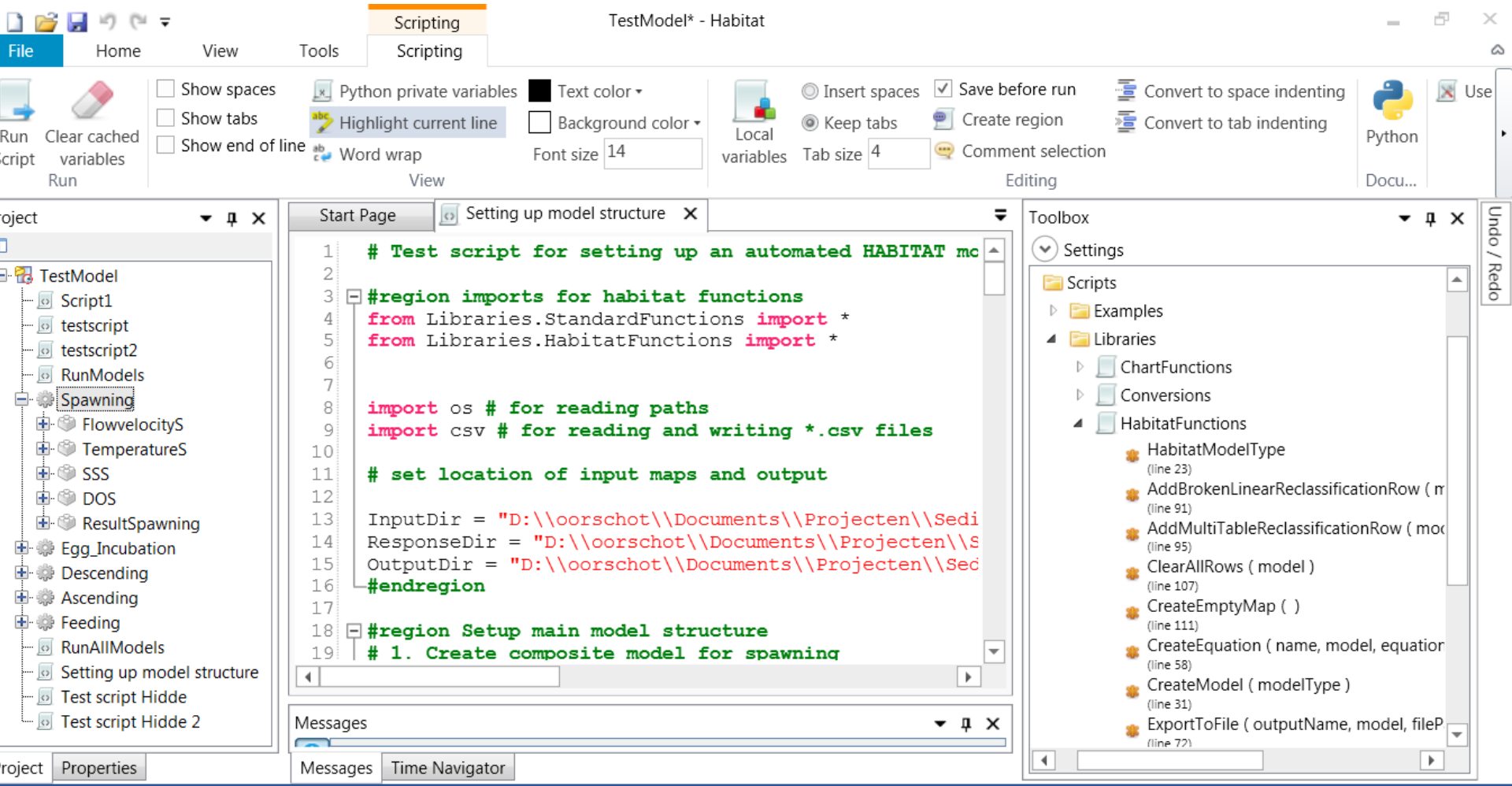
Improving workflow HABITAT

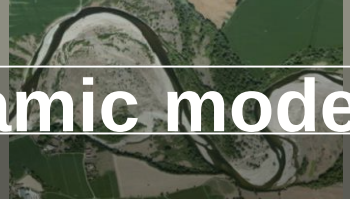
- A Python library is created with HABITAT functions



Improving workflow HABITAT

- This allows:
  - automated setup of the habitat model (i.e. model structure and input data)
  - automated running of several scenarios by updating input maps in a loop
- Advantages are:
  - increased speed in setting up and running the models
  - decreasing typos in defining response curves
  - fast addition of new response curves

Long-term hydro-morphodynamic modeling



- No stable long-term hymo & WQ model available yet
  - No new habitat modeling results
- Long-term morphological development was not stable at downstream boundary
- Now testing with new settings (Update Amgad)

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Water quality model

- Challenge in WQ model to deal with higher Morfac due to non-linear WQ processes at different time scales (e.g. re-aeration)

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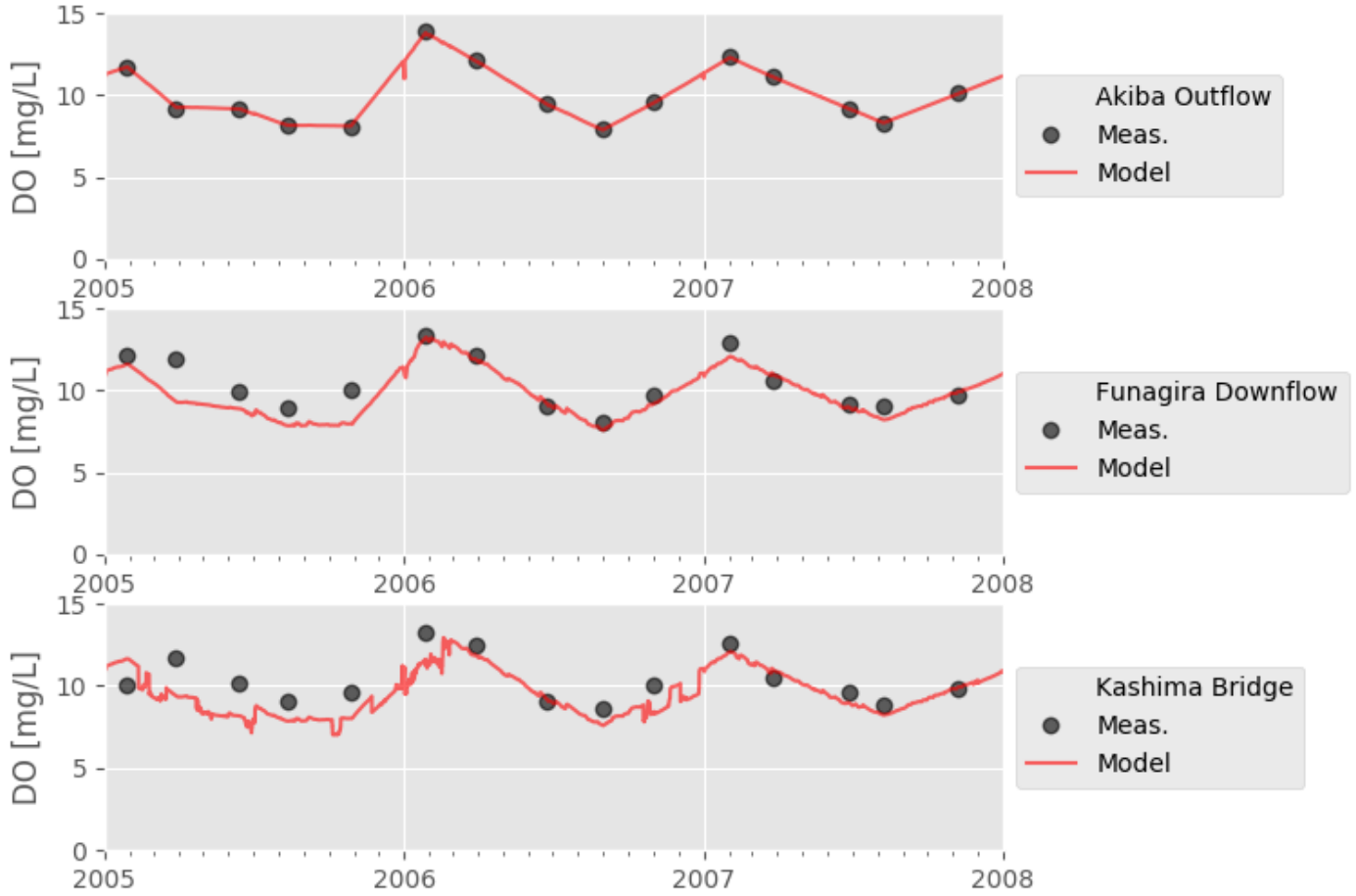
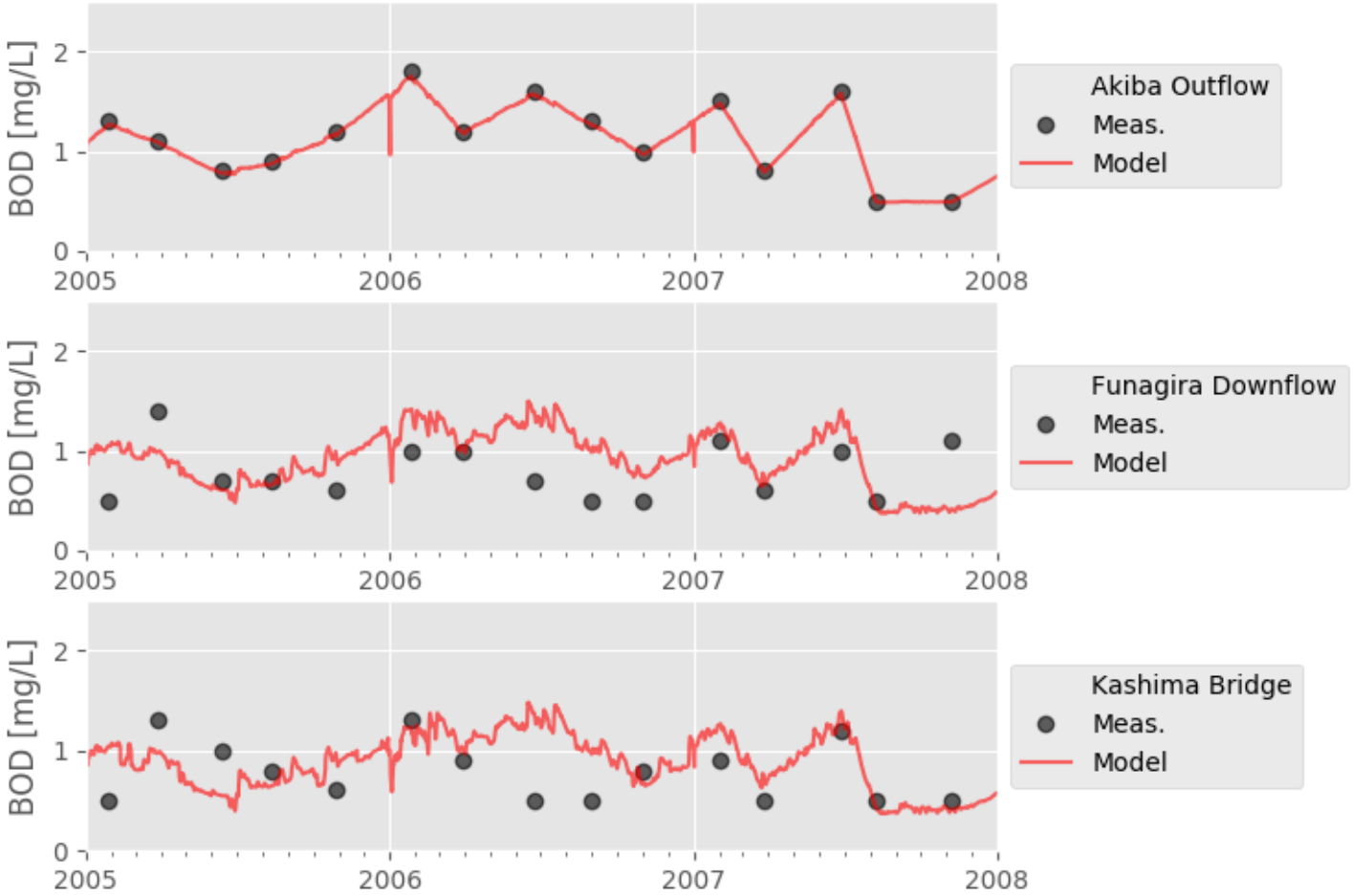
Previous results oxygen



Deltares

Previous results BOD



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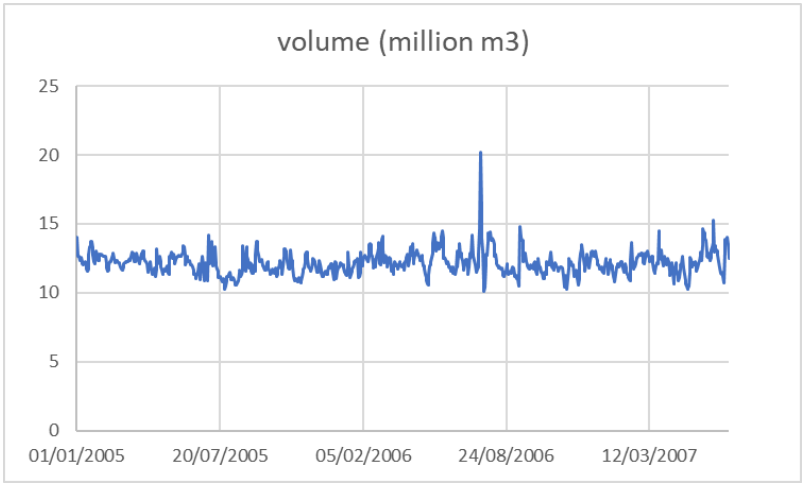
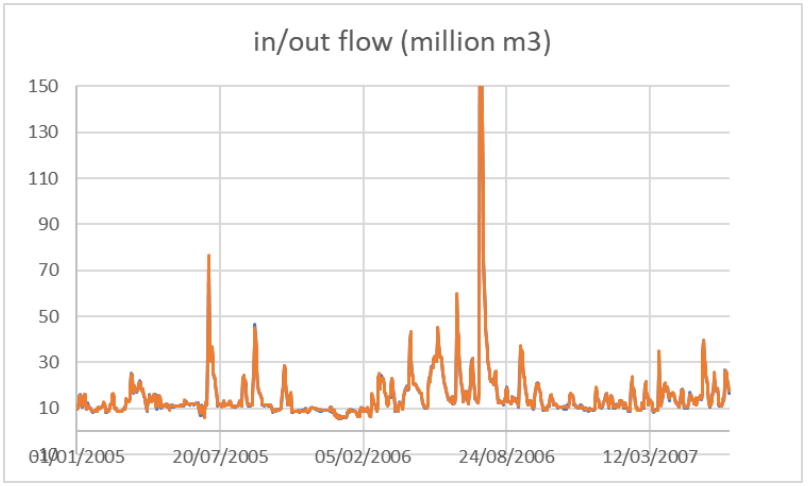
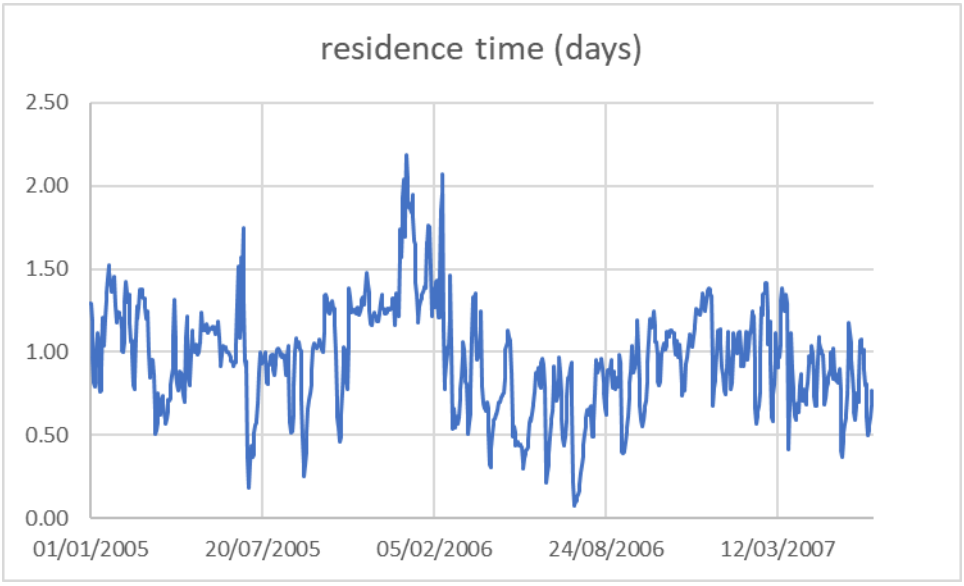
Previous results BOD







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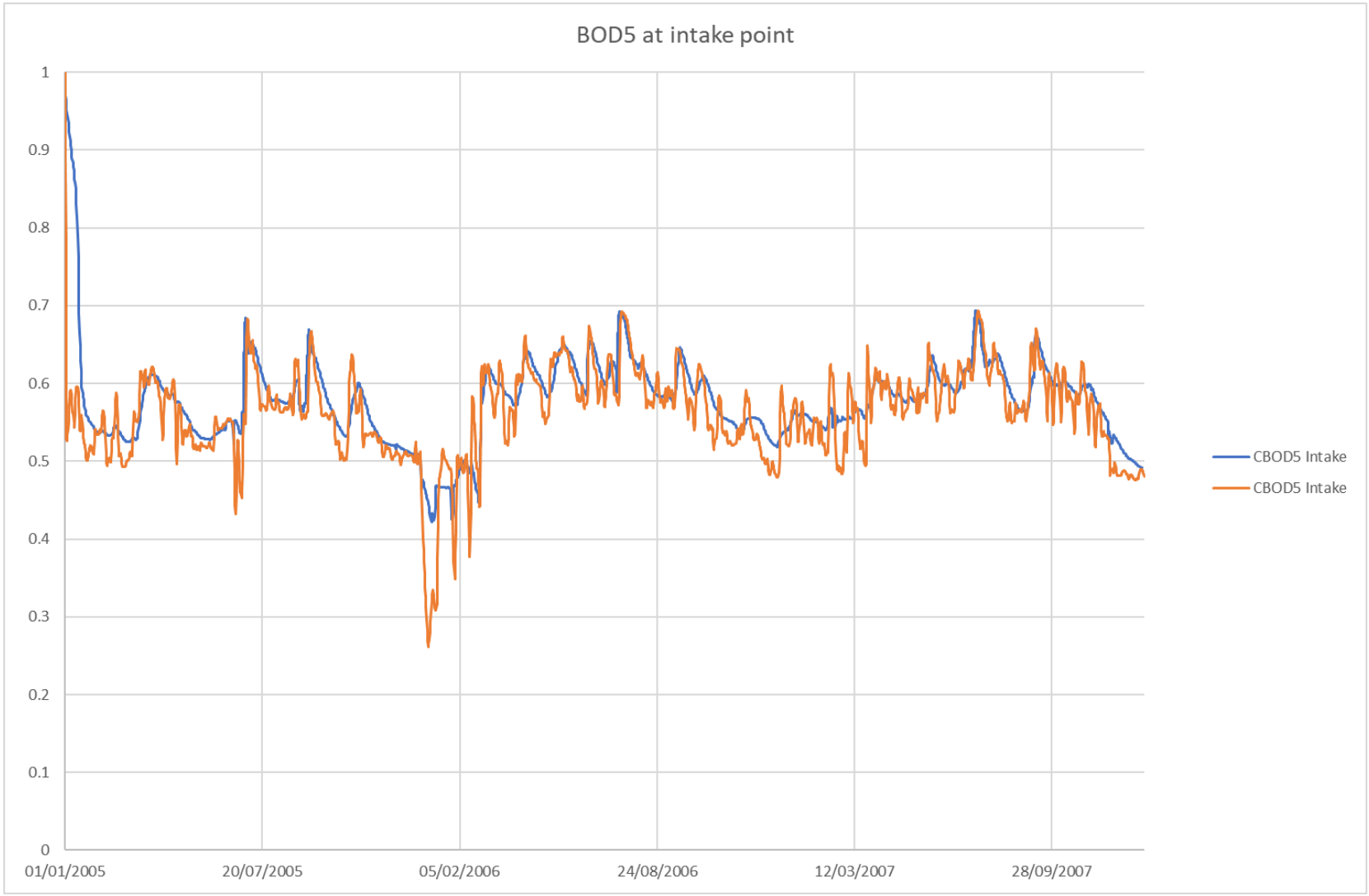
Normal run compared to run with MorFac (1/20)



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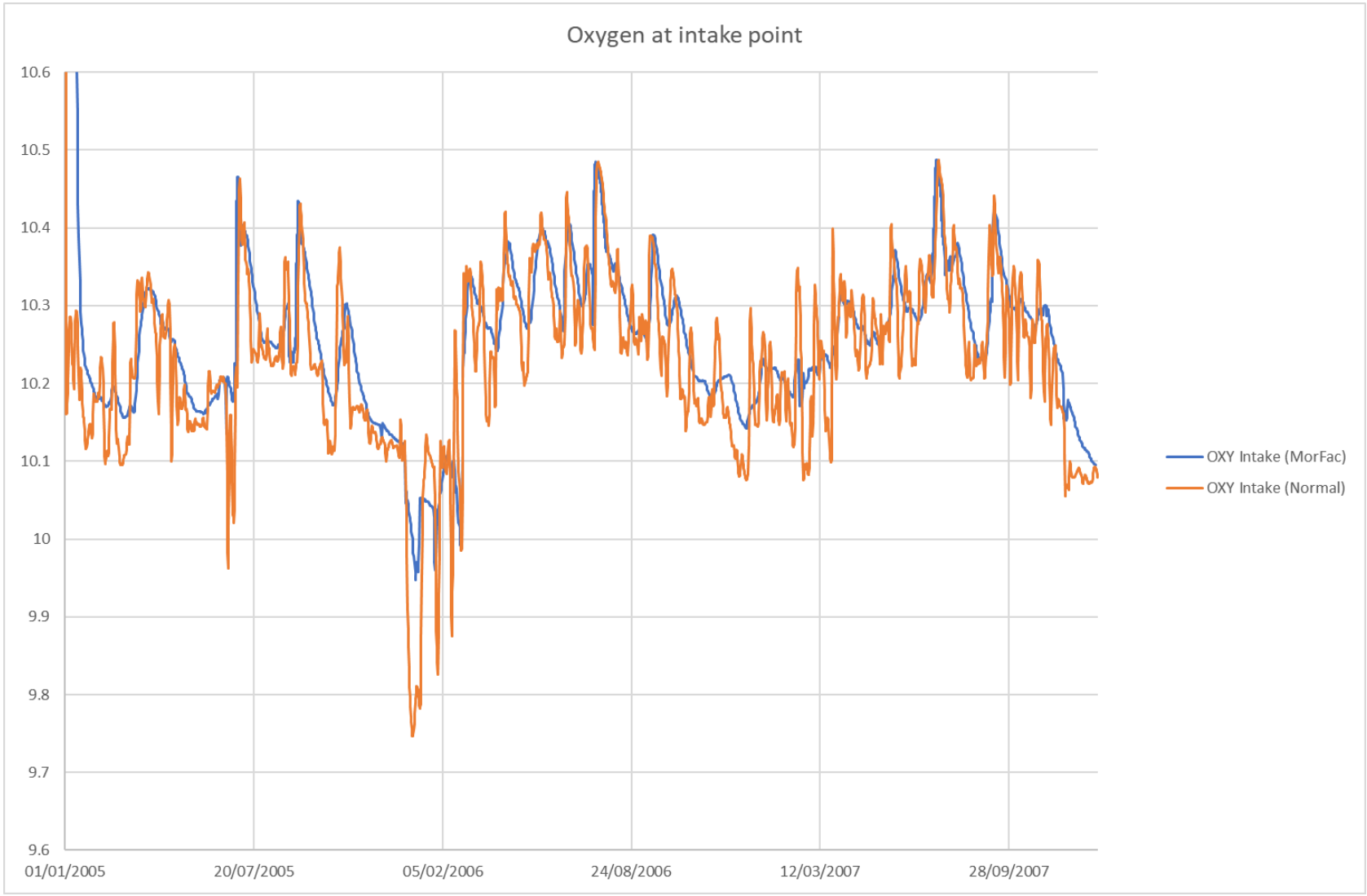

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Future steps

- Investigating method for WQ model to deal with Morfac > 1
- Testing and optimizing morphology calculations
- Combining hymo and WQ
- Habitat suitability analysis
- TKI 2019
  - Integrated D-FM model with morphology, WQ and habitat suitability
  - Routine for grid conversion and statistics calculation for habitat analysis with HABITAT tool