



**40TH IAHR
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VIENNA – AUSTRIA**



21–25 AUGUST 2023

**RIVERS – CONNECTING
MOUNTAINS AND COASTS**

Hosted by
Spain Water
and IAHR, China

**IAHR Working Group on
Reservoir Sedimentation**

A CRASH COURSE ON ASSESSING AND MANAGING RESERVOIR SEDIMENTATION

Sunday 20 August 2022
10:00 -16:00 CET

Check Dam for sediment control in the catchment area
Photo: Nikolaos Efthymiou


MESSAGE

Reservoir storage is a valuable resource providing reliable, and dependable services crucial for water, food and energy safety as well as the clean energy transition.

Reservoirs have, however, a natural enemy, sedimentation that gradually diminishes their storage capacity and reduces reliability of the provided services, being associated at the same time with adverse environmental impacts downstream of dams. The reduced rate of dam constructions throughout the world combined with storage loss due to sedimentation currently result in more storage being lost annually than added.

This problem is further exacerbated by dynamic land-use changes in upstream catchment, causing increased surface erosion, as well as population growth, which result in a sharply decline in storage volume per capita. The climate change induced increase in hydrologic variability further impairs the performance of surface water supply, hydropower and flood control infrastructure, including dam safety.

It is therefore necessary to focus on storage preservation both for green-field and existing projects through implementation of effective reservoir sedimentation management strategies.



Sediment Sluicing with partial water level drawdown
Photo: Sebastian Pessenlehner, BOKU

OVERVIEW

This crash course is aimed at familiarizing the participants with a couple of technical analysis tools that facilitate sediment management analyses. The course is divided into two sessions, 2 hours each. Following a brief introduction in the topics of reservoir sedimentation and the state-of-the-art combating strategies, the participants will be trained in the application of the rapid assessment tool RESCON 2 and the process-based tool Delft3D-FM.

The intended audience includes:

- professionals working in the areas of hydropower and water resources planning; and
- researchers, masters and PhD students with areas of interest in sediment transport, sedimentation, reservoir sustainability, adaptation to climate change

It is expected that the participants have basic knowledge of river and reservoir hydraulics, sediment transport and morphology.

The course is organized by the IAHR Working Group on Reservoir Sedimentation
<https://www.iahr.org/index/committe/105>



Downstream propagation of sediment delta
Photo: Nikolaos Efthymiou



Empty flushing of sediment deposits
Photo: Nikolaos Efthymiou

AGENDA

20 AUG 23

10:00 – 11:00

Introduction

Convenors' team

- Reservoir sedimentation
- Combating sediment management strategies
- Combined effect of sedimentation and climate change on reservoir performance

11:00 – 13:00

Session 1 – RESCON 2

Nikolaos Efthymiou

- Rapid assessment of reservoir sedimentation
- Techno-economic screening of sediment management strategies
- Sedimentation management as adaptation to climate change

14:00 – 16:00

Session 2 – Delft3D-FM & D-RTC

Sanjay Giri & Amgad Omer

- A basic two-dimensional (2D) depth-averaged modelling of reservoir operation and sediment transport using Delft3D-FM coupled with D-RTC

SESSION 1 – RESCON 2 ANALYSIS

Rapid assessment of reservoir sedimentation and a techno-economic screening of management options using RESCON 2

REServoir CONservation (RESCON 2) model is a technical analysis tool facilitating a rapid sedimentation assessment as well as a techno-economic screening of the state-of-the-art sediment management alternatives for storage reservoirs and peaking run-of-the-River (RoR) hydropower schemes. It is intended to be used in early project development phases for pre-feasibility level analyses with limited data, in support of more detailed analyses with numerical and physical models.

A new version of RESCON 2 was recently released by the World Bank as a knowledge product of a global initiative aiming to support the planning and operation of effective and sustainable sediment management. The first block of the workshop will provide a hands-on training on the model application, demonstrating the RESCON 2 analysis on a reservoir case study.

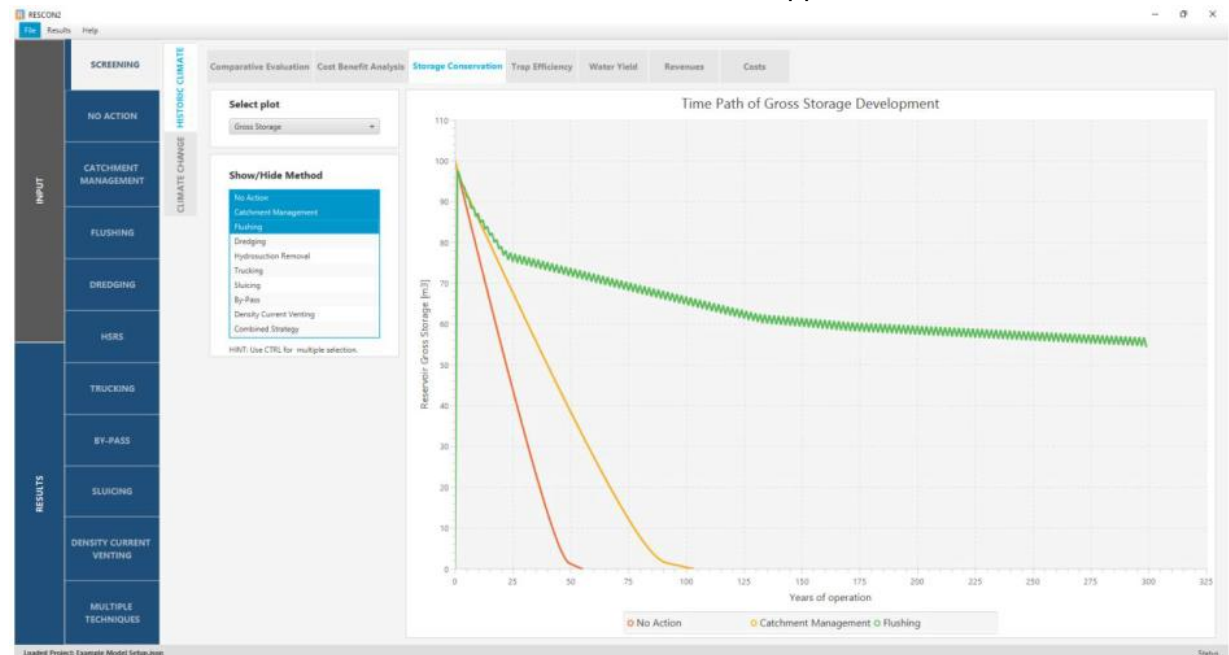
Following a step-by-step guided procedure, the participants will setup and run the model as well as interpret the results of the analysis.

The training will focus on the following topics:

- Data needs, and possible data sources, setup and calibration of the RESCON 2 model;
- Assessment of lifetime and long-term economic performance of the reservoir for the No Action Scenario, as well as for the sediment routing, deposit removal and catchment management techniques;
- Evaluation of the intergenerational equity that is created by the reservoir lifetime extension;

- The combined effect of sedimentation and climate change on reservoir performance, climate stress test of the reservoir performance and assessment of sediment management alternatives as possible adaptation strategies;
- Multi-criteria comparative evaluation of sediment management alternatives.

The participants will be asked to install the RESCON 2 model on their computers before the training in order to be able to follow the hands-on exercises and get acquainted with the model application.



SESSION 2 – Delft3D-FM and D-RTC

A basic two-dimensional (2D) depth-averaged modelling of reservoir operation and sediment transport using Delft3D-FM coupled with D-RTC

The Delft3D Flexible Mesh Suite (Delft3D FM 1D, 2D, 1D2D and 3D) can simulate detailed flows, waves, sediment transport, morphology and water quality, and is capable of handling the interactions between these processes. The flow module of this system provides the hydrodynamic basis for other modules such as morphology, water quality, ecology etc. The model is able to be run in two-dimensional (2D) mode, which corresponds to solving the depth-averaged equations. The 2D version of the morphological model can be used to compute details of hydrodynamic and morphological behaviour of the river reaches, particularly with interventions like weirs, dams and barrage. As the model incorporates also complex time-dependent multi-dimensional phenomena, assessment is also possible at the small and intermediate spatial scales.

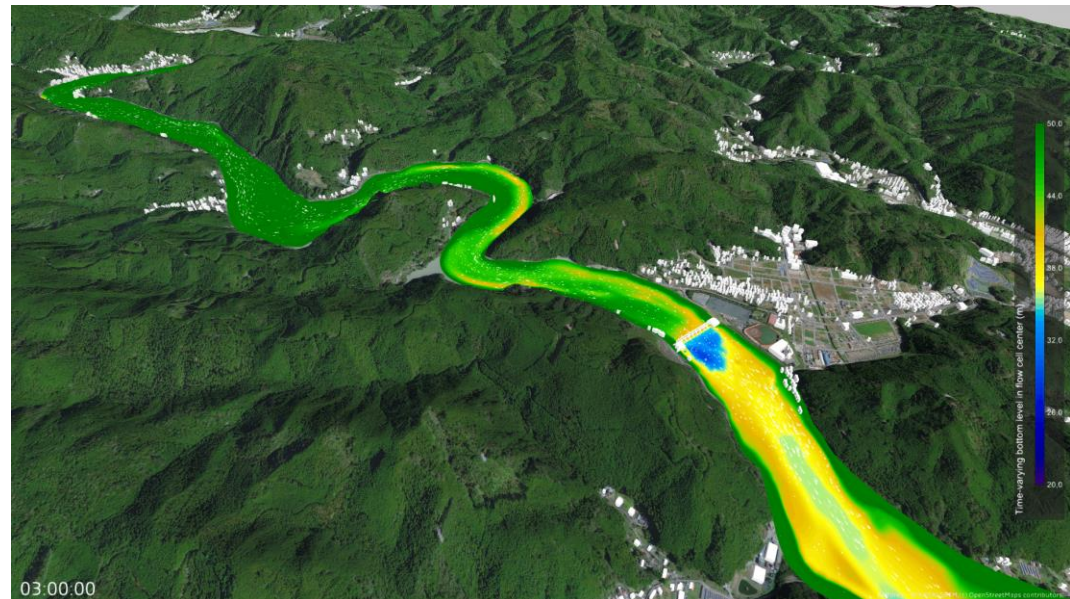
The important hydraulic structures are barrages, weirs and dams including their operation. Both one- and two-dimensional models are coupled with Real-Time Control

(D-RTC) tool. D-RTC is capable to link the gate operation with the required water levels at the reservoir. This means that providing input of one of them (gate opening, or reservoir water level based on operation rules) enables the model to compute and/or control the other component. The Delft3D-FM model coupled with D-RTC can also be used for a system of multiple dams with synchronized operation.

Within the scope of this short session, participants will be able to familiarize themselves with the setting up and running a reservoir model with dam operation.

We will also try to incorporate sediment transport and morphological processes in the modelling exercise (if time allows). This session will provide the participants an idea about how a process-based model can be applied to carry out simulations and analysis of reservoir operation and sediment transport processes. Such a process-based model can also be applied to determine the inputs for RESCON 2 in more precise manner.

The Delft3D-FM software will be provided to the participants to be installed on their computers before the session. Also, a handout with the modelling steps for a hands-on exercise will be provided.



CONVENORS



Kamal El Kadi Abderrezzak

Expert Research Engineer at LNHE, EDF R&D, France

An experienced hydraulic engineer with over 20 years of expertise in fluvial hydraulics:

- Flow and sediment transport in rivers
- Laboratory experiment and numerical
- Chair of IAHR WG on Reservoir Sedimentation
- Member of the Leadership Teams of the IAHR Committee on Flood Risk Management
- Associate Editor of the IAHR Journal of Applied Water Engineering and Research (JAWER)



Nikolaos Efthymiou

Consultant

Water resources and hydropower consultant with international experience in 25 countries.

Particularly specialized in:

- Sediment management and morphodynamic response of rivers to dam construction
- Reservoir climate stress tests and robust adaptation to climate change through sediment management

Main developer of RESCON 2 model for the World Bank.



Sanjay Giri

Senior Expert at Royal HaskoningDHV, The Netherlands

- Nearly 3 decades of experience in the activities related to river basins and water infrastructure
- A civil engineer, specialized in fluvial geomorphology, river and reservoir management, sediment management, water infrastructure, hydropower
- Extensive experience in the development and application of knowledge-based tools such as mathematical modelling of river/ reservoir dynamics and fluvial processes



Amgad Omer

Sr. Advisor at Deltares, The Netherlands

An experienced civil engineer with over 20 years of expertise in rivers-reservoirs dynamics and morphology.

Particularly specialized in:

- Sediment management in rivers with reservoirs.
- Numerical modelling
- Hydraulics and reservoir operation

Delft3D flexible mesh suite and RTC coupling expert