Memo

To
Scour protection enthousiasts

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Subject
JIP HaSPro Public Data Delivery

1 Introduction

This document contains a concise overview of the public data delivery of the Joint Industry Project HaSPro. This data delivery contains:

- Reports of the physical model tests that have been performed during this JIP.
- Deltares' experiment viewer for visualizing 3D bathymetry data
- NetCDF files of 3D measurements performed during scour protection stability tests
- A more detailed <*>.mat file of a subset of the physical model tests

This memo discusses the deliverables, provides background information on the format of the data and how it can be used. It is strictly noted that no documentation can completely cover all the details associated with performing physical model tests, the routines that are used and the interpretation of the data. Deltares is eager to share this data with the hope that it can give a boost to all research that is performed on the topic, that it may spark new ideas, and above all that others are also motivated to share their data so we can compare our ways of working.

The use of the published data, or any derived information from the data, is at your own risk or expense. This dataset is publicly shared to advance the state of the art of scour and scour protection research without warranty of any kind. Deltares cannot take any responsibility for consequences following from the use of this data.

Figure 1 Physical model tests for scour protection performance in Deltares' Delta Flume.

2 Deliverable #1: Reports

This deliverable contains all documentation that is associated with the performed physical model tests within JIP HaSPro. Table 1 provides an overview of the reports and their respective subject matter.

Table 1 List of report references and their subject matter.

Report reference	Subject
1230924-002-HYE-0003	Analysis report of loose rock scour protection deformation tests
1230924-003-HYE-0001	Test report of loose rock scour protection external stability
1230924-003-HYE-0002	Test report of loose rock scour protection flexibility
1230924-003-HYE-0003	Test report of loose rock scour protection interface stability
1230924-004-HYE-0006	Test report of gabion mattress scour protection performance
1230924-004-HYE-0007	Test report of artificial vegetation scour protection performance
1230924-004-HYE-0008	Test report of ballast-filled mattress scour protection performance
1230924-004-HYE-0009	Test report of filling tests of ballast-filled mattress
1230924-004-HYE-0010	Test report of block mattress scour protection performance
1230924-004-HYE-0011	Test report of scour protection installation with self-installable frame
1230924-033-HYE-0001	Test report of loose rock berm performance in Delta Flume
1230924-033-HYE-0002	Test report of loose rock berm performance in Atlantic Basin
1230924-037-HYE-0002	Test report of stability of ecological elements in Delta Flume
1230924-037-HYE-0003	Test report of stability of ecological elements in Atlantic Basin
1230924-000-HYE-0026	Ecological framework for nature-inclusive scour protection design

3 Deliverable #2: Deltares experiment viewer

The Deltares experiment viewer is an executable (available in 32 and 64 bits) that can be used to visualize the measured 3D data that was generated in JIP HaSPro. The viewer is easy to use and provides an intuitive view on the 3D data. The 3D data is provided in NetCDF format and can be extracted from the NetCDF files using any type of programming platform (i.e., Matlab, Python). The structure of the NetCDF files is elaborated upon in Chapter. This chapter provides a brief description on the use of the Deltares experiment viewer.

Figure 2 shows the interface of the viewer and indicates some standard buttons. The “Help” button in the top menu bar provides a short description on how perform basic operations in the viewer.

Left mouse click will allow rotation of the model, right mouse click can be used to pan, the scroll wheel is used to zoom in and out. When changing between different models with different scales, it may be required to push the “Reset view” button (found in the top-right corner).

When pressing the “File” button, you are presented with the ‘open experiment folder’ option (alternatively: CTRL+O). The experiment folder is the folder that contains the NetCDF files to be loaded into the viewer. If the experiment folder is selected, the experiments that are within the NetCDF files are shown in the file viewer (Figure 3).

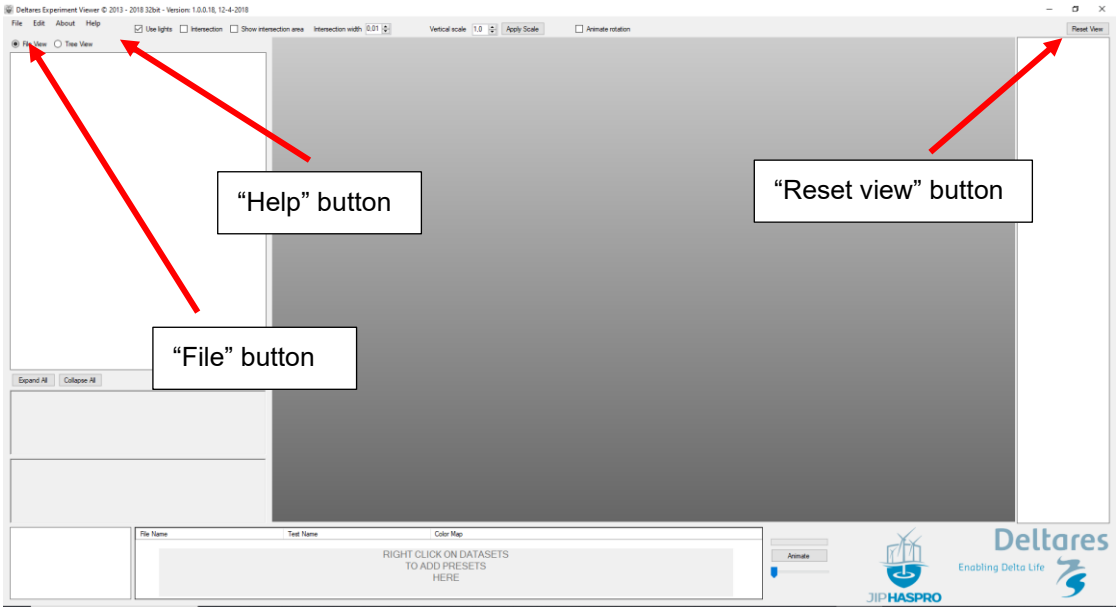

Figure 2 *Main interface of the Deltares experiment viewer.*

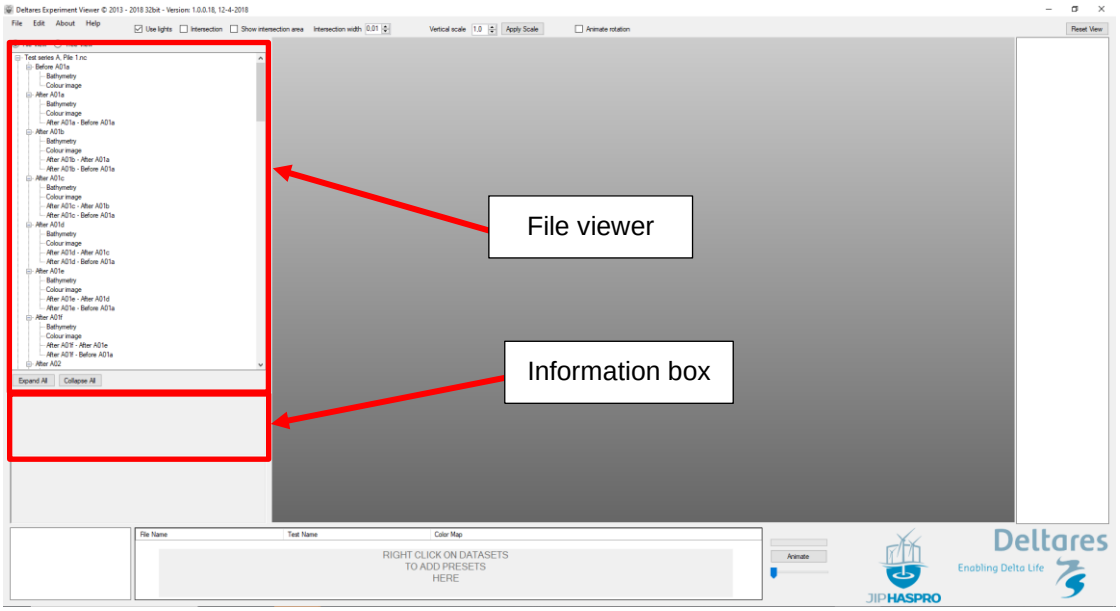

Figure 3 *Experiment viewer with selected experimental folder.*

The file-viewer shows which (sub)tests are available in the experiment folder. With the button above the file-viewer the user can switch between File-view and Tree-view. The latter explicitly shows the folder structure as well. Each datafile contains one or multiple fields to be selected, including ‘Bathymetry’, ‘Colour image’ and bathymetry differences (both cumulative difference and difference between subsequent tests). When one of the tests is clicked, the information box below the file viewer shows the associated test conditions.

Figure 4 shows the experiment viewer with a selected 3D dataset loaded. The viewer also supports making intersections by clicking the “Intersection” box. The intersection can be visually adjusted by clicking the “Show intersection area” box and rotating/panning the bathymetry measurement through the intersection box. The vertical scale of the measurement can be exaggerated as well. Finally, the viewer also supports making animations of the 3D measurement.

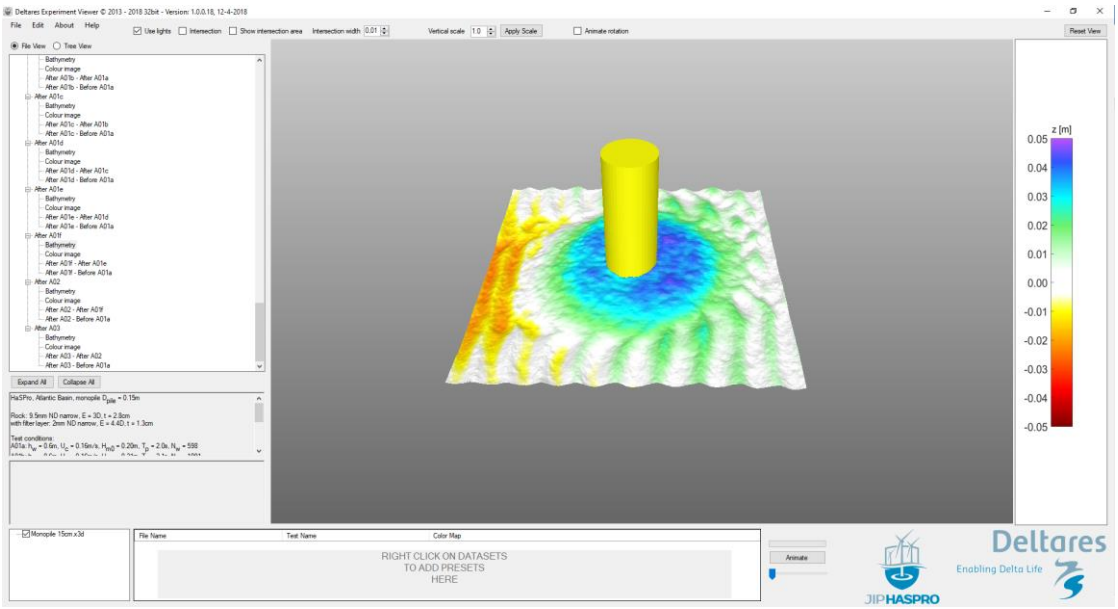

Figure 4 Experiment viewer with selected 3D measurement.

4 Deliverable #3: 3D scour protection performance data in NetCDF format

All 3D scour protection performance data of the external stability and flexibility scour protection performance tests is provided in NetCDF format. In this format it can easily be read and visualized with the Deltares' experiment viewer. The data stored in the NetCDF files can also be loaded and extracted with a standard programming language, like Matlab or Python. The variables that are present in the NetCDF file are as follows:

- 'in': run series information (i.e., structure, layout, test conditions).
- 'X' and 'Y': arrays with x- and y- coordinates of the bathymetry measurement on model scale.
- 'Zx' (with 'x' any number): 3D data on model scale of each subsequent stereophoto measurement. For example, 'Z1' is the pre-measurement, 'Z2' the measurement after the first test and depending on the amount of tests in a series 'Z6' would be the bathymetry after the 5th test. Each of these fields has a 'Label' which specifies the exact measurement. For test ID's and conditions, the reader is referred to the respective physical model test report.
- 'ZxC1' (with 'x' any number): colour field (RBG) of the bathymetry based on the added colour bars (see separate 'ZxC1_colorbar.png' file), also see the 'Label' attribute which specifies 'Bathymetry'. Mainly for use in the viewer.
- 'ZxC2' (with 'x' any number): colour field (RBG) of the colour image based on the added colour bars (see separate 'ZxC2_colorbar.png' file), also see the 'Label' attribute which specifies 'Colour image'. Mainly for use in the viewer.
- 'ZxC5' (with 'x' any number): colour field (RBG) of the bathymetry difference based on the added colour bars (see separate 'ZxC5_colorbar.png' file). Generally describes difference compared to previous measurement (but not always!). The 'Label' attribute specifies which bathymetry difference is considered. Mainly for use in the viewer.
- 'ZxC6' (with 'x' any number): colour field (RBG) of the bathymetry difference based on the added colour bars (see separate 'ZxC5_colorbar.png' file). Generally describes difference compared to first measurement (but not always!). The 'Label' attribute specifies which bathymetry difference is considered. Mainly for use in the viewer.

Thus, the 3D data can be found in the ‘Zx’ fields. With this data, bathymetry differences and plots can be made by the user. The additional fields can be used to derive these quantities as well, but this is more tricky as it concerns transforming RGB values to z-values based on colour bar limits. It is therefore strictly recommended to only use the ‘Zx’ fields for quantitative analysis.

The test conditions can be found in the ‘in’ field of the NetCDF files or can be derived from the factual test reports.

The following 3D deformation datasets are available:

- Loose rock scour protection
    - Monopiles
        - Atlantic Basin
          [reports: 1230924-003-HYE-0001 & 1230924-003-HYE-0002]
        - Delta Flume
          [report: 1230924-003-HYE-0001]
    - Rock berms
        - Atlantic Basin
          [report: 1230924-033-HYE-0002]
        - Delta Flume
          [report: 1230924-033-HYE-0002]
- Ballast Filled Mattress
    - Monopiles
        - Atlantic Basin
          [report: 1230924-004-HYE-0008]
        - Delta Flume
          [report: 1230924-004-HYE-0008 & 1230924-004-HYE-0009]
- Block mattresses
    - Monopiles
        - Atlantic Basin
          [report: 1230924-004-HYE-0010]
- Artificial vegetation
    - Monopiles
        - Atlantic Basin
          [report: 1230924-004-HYE-0007]
        - Delta Flume
          [reports: 1230924-004-HYE-0007 & 1230924-004-HYE-0011]
- Gabions
    - Monopiles
        - Atlantic Basin
          [report: 1230924-004-HYE-0006]
        - Delta Flume
          [report: 1230924-004-HYE-0006]
- Ecological aspects
    - Monopiles
        - Atlantic Basin
          [report: 1230924-037-HYE-0003]
        - Delta Flume
          [report: 1230924-037-HYE-0002]
    - Rock berms
        - Atlantic Basin
          [report: 1230924-037-HYE-0003]
        - Delta Flume
          [report: 1230924-037-HYE-0002]

5 Detailed data-file of Atlantic Basin Loose Rock stability tests

The ‘stormdef.mat’ file is a database file that stores test data associated with the loose rock external stability tests performed in the Atlantic Basin (reported in factual test report 1230924-003-HYE-0001). This <*>.mat file contains measured (and derived) quantities of the following parameters:

- Nondimensional parameters to evaluate scour protection deformation: MOB_{top}, KC_{um}, $KC_{uc.}$
- Measured quantities of H_{m0}, T_p, U_c, h_w.
- Model/layout information: D_{pile}, D_{50} of armour and filter, ρ_s of armour and filter, total protection thickness H_{prot}, sill height H_{sill} and protection extent E_{prot}.
- Gridded data:
    - X3D: x-coordinates on model scale
    - Y3D: y-coordinates on model scale)
    - Z3D: filtered scour protection bathymetry after test based on routine described in the analysis report 1230924-002-HYE-0003, scaled on the pile diameter.