



Adaptation For Climate Change

# Minutes of Advanced Workshop JRA2 COMPLEX

## Deliverable 5.10

Status: final

Version: 1.0

Date: 12 June 2017

EC contract no 654110, HYDRALAB+



## DOCUMENT INFORMATION

---

Title	Minutes of Advanced Workshop JRA2 COMPLEX
Lead Author	Agustín Sánchez-Arcilla
Contributors	
Distribution	Participants
Document Reference	

## DOCUMENT HISTORY

---

Date	Revision	Prepared by	Organisation	Approved by	Status
30/05/ 2017	Agustín Sánchez-Arcilla	Agustín Sánchez-Arcilla	LIM / UPC		draft
12/06/2017	Agustín Sánchez-Arcilla	Agustín Sánchez-Arcilla	LIM / UPC	Frans Hamer	final

## ACKNOWLEDGEMENT

---

The work described in this publication was supported by the European Community's Horizon 2020 Programme through the grant to the budget of the Integrated Infrastructure Initiative HYDRALAB+, Contract no. 654110.

## DISCLAIMER

---

This document reflects only the authors' views and not those of the European Community. This work may rely on data from sources external to the HYDRALAB project Consortium. Members of the Consortium do not accept liability for loss or damage suffered by any third party as a result of errors or inaccuracies in such data. The information in this document is provided "as is" and no guarantee or warranty is given that the information is fit for any particular purpose. The user thereof uses the information at its sole risk and neither the European Community nor any member of the HYDRALAB Consortium is liable for any use that may be made of the information.

## MINUTES OF ADVANCED WORKSHOP JRA2 COMPLEX

---

### VENUE AND ATTENDEES

Venue: IH Cantabria, Santander

Date: 18 May 2017

Attendees: See participants' list

Apologies: none

### TOPICS FOLLOWING AGENDA

Item	Time	Subject
1	13.30-13.40	Welcome and Introductions
2	13.40-14.00	Experimental investigations of biofilm behaviour and bio-stabilisation
3	14.00-14.20	Sediment-biota interactions under waves-currents
4	14.20-14.50	Laboratory observations of wave groups in the surf and swash zones
5	15.30-15.50	Acoustic inverse modelling for energetic mobile sediment bed experiments
6	15.50-16.10	Green interventions: Sediment and artificial sea-grass interactions
7	16.10-16.30	Revisiting the GM formulation for wave-current interactions

## 1 BACKGROUND

---

The increasing pressures on our coasts and riparian margins come from anthropogenic activities and climate change. The expected acceleration in climatic evolution will require further adaptation under conditions which will be different from the ones we encounter today. This means, among other issues, co-existing sediments of different sizes, and interactions with different types of biota and novel types of engineering interventions. Our present models, both numerical and experimental, are not prepared enough to deal with such complex interactions.

Within this framework the COMPLEX advanced workshop within HYDRALAB+ aims to incorporate recent developments in a) equipment, b) numerical modelling and c) process understanding so as to advance our experimental facilities and associated knowhow for tests dealing with future climate conditions. This will help to prepare the HYDRALAB+ facilities for future experiments and also contribute to advance present knowledge in topics such as sediment transport under mixed sediment conditions or co-existing waves and currents with different angles of incidence. This will lead to an improvement for better understanding the interactions between bed (geometry) – water fluxes – sediment fluxes, using the most advanced opto-acoustic tools nowadays available.

## 2 OUTPUTS

---

The COMPLEX workshop will coordinate the HYDRALAB+ community and invited external experts to:

1. Provide directions for preparing mobile bed tests to deal with a) different sediment diameters, b) co-existing sediment and biota and c) changing climatic conditions.
2. Define future needs for hydraulic experiments in coastal / river engineering.
3. Establish experimental datasets as a benchmark illustration for introducing climate change in hydraulic experiments.

From these settings the workshop is expected to generate:

- a) Synergies within the HYDRALAB+ community and the outside world for incorporating the novel adaptation interventions in hydraulic tests.
  - b) Good practice for hydraulic test experiments under future climate conditions that will affect the design, execution and subsequent analysis of the performed tests.
  - c) Incorporating the innovative equipment and the required advancement in protocols for higher resolution measurements that are able to capture the complex interactions near the domain boundaries such as the sea bed.
4. Integrate the advances from the different JRA's (RECIPE, COMPLEX & FREE) in terms of facility performance, observational equipment, data analysis and storage/interoperability.

5. Help to circumvent some of the present barriers to increase the complexity of mobile bed experiments which present already enough challenges.

The workshop program is therefore expected to lead to advances in experimental practice for topics such as co-existing sediments of different diameters which is of direct practical application to artificial nourishments, when the new sediment has a different size than the native one. The topics of bed stabilization with natural solutions such as vegetation or biofilms will also be present in the workshop, so as to facilitate the transfer to practicing engineers and coastal/river authorities.

### 3 CONTENTS

---

The workshop contents can be summarized by the following points:

- The workshop started with an overall presentation by Prof. Sánchez-Arcilla from UPC where after a general welcome and introductions he presented the various facilities and observational equipment that are available within Hydralab for dealing with complex interactions between sediment of different sizes and biota. He reviewed the way to schematize climate change into hydraulic experiments in terms of mean sea level and wave conditions. His talk also addressed conventional structures and innovative interventions, dedicating some time to solutions that work along natural processes and are therefore more sustainable. The question of how to develop protocols for introducing those novel tests into the existing guidelines was at the core of the seminar and the subsequent interventions.
- The talk “Experimental investigations of biofilm behaviour and bio-stabilisation” by W. van de Lageweg from the University of Hull addressed the role of natural and surrogate biofilms on stabilizing a sediment deposit. The starting point was the experiments carried out in Hull dealing with different sediment mixtures, bio-stabilization and the analysis of the corresponding results. It was shown how the combination of coarse and fine unimodal sediment resulted in different bed evolution with sediment combinations (for instance 50/50) presenting a more clear 2D pattern of bed forms, while for finer and coarser sediments the bed pattern is more clearly 3D. The biofilm colonization turns out to be affected by the bed forms, with different topography affecting the biofilm in different manners. The talk concluded with some considerations on the equipment to deal with hydrology plus ecology observations.
- The presentation “Sediment-biota interactions under waves-currents” by A. Carlier from IFREMER started by describing the wave-current equipment available in IFREMER-Brest. After some consideration of the performance capabilities and limits for both waves and currents and how that can be used for enlarging the possible tests under climate change the talk presented the interaction with biota analyses carried out at that institution. The emphasis was on how to prepare the tests, the plan for observations and the procedure for processing the measurements. Experiments with both active and passive biota were also described and linked to the field data available in the institution. This allowed some conclusions on how to combine field and laboratory experiments for sediment biota interactions.

- The talk “Laboratory observations of wave groups in the surf and swash zones” by J. M<sup>a</sup> Alsina from Imperial College London presented the role of low frequency oscillations in surf and swash zone morphodynamics. The basis for the analysis were the tests carried out at medium scale at Imperial College and the tests carried out at large scale in the CiEM flume in Barcelona. The emphasis was on the role of scaling and sediment sizes on the obtained hydro-morphodynamics, showing how the interactions between sediment transport and long period waves vary between the surf and swash zones. The talk ended with some considerations on how to incorporate those long period waves in conventional tests and how the low frequency energy will change under future climate conditions.
- The presentation “Acoustic inverse modelling for energetic mobile sediment bed experiments” by D. Hurther from CNRS-Grenoble dealt with the very high resolution acoustic profilers they have developed within Hydralab and on the application of inverse modelling for deriving directly applicable parameters such as fluid or sediment velocities, concentrations or bed topography. The detailed analysis of suspended and bed load for various combinations of drivers was also considered, showing how inverse modelling can lead to very promising and actually useful results for energetic sheet flow. The talk ended with a discussion on the role and importance of energetic sheet flow transport under present climate but particularly under future climate when the sea bed will be more out of equilibrium with acting hydrodynamics.
- The talk “Green interventions: Sediment and artificial sea-grass interactions” by M. Thom from Leibnitz Universität Hannover dealt with green interventions, focusing on the interaction between artificial sea grass and sediment transport. The talk presented a number of typologies and interactions between sea grass and sediment transport and bed morphology. This work was linked to on-going projects and past data sets, since because of the costly nature of such experiments it is critical to base our analysis on existing sets of experiments that have already reproduced the main phenomena under well controlled conditions. The talk also incorporated a discussion on the variations introduced by natural or artificial sea grass, considering scaling and the interaction of sediment, which in the case of natural sea grass results in a survival interval for the vegetation canopy, which will not be able to survive for strong erosion or accretion rates.
- The final presentation “Revisiting the GM formulation for wave-current interactions” by Prof. O. Madsen from MIT dealt with the importance of interacting waves and currents now and also under changing weather patterns associated to future climate scenarios in hydraulic tests. The starting point was revisiting the commonly employed Grant and Madsen formulation for co-linear waves and currents. In the talk it was clearly shown how that formulation may not provide the right answer for waves perpendicular to currents, which is the usual case in the field. This was followed by a more comprehensive analysis as a function of the wave-current angle leading to an improvement of the formulation and therefore an upgrading procedure for experimental tests in which waves and currents play an important role.
- The discussion session both before the coffee break and at the end of the workshop included the role that complementary opto-acoustic techniques could play in future hydro-morpho-ecologic tests. Particular attention was paid to bed imagers and ferro-fluids tracking techniques both under active development in Hydralab. The discussion also tackled the variation of the

morphodynamic and ecologic responses with the energy level of hydrodynamic drivers, emphasizing the importance of beach plan and profiles out of equilibrium with prevailing hydrodynamics, as it will happen under future climatic scenarios.

A summary of the final points discussed appears in what follows:

1. How to schematize the drivers, reaching the conclusion that there should be a combination of cases where not always the maximum for instance mean sea level, wave height and period would be that producing more damage.
2. We also discussed how to schematize the responses, reaching the conclusion that it would be important to combine a set of representative cases between morphodynamics structures and biota. In particular it was felt to be important to quantify natural recovery.
3. We considered how to combine small and large scale hydraulic test with numerical models for adaptation pathways. The conclusion was that the first assessment should be numerical models followed by small scale and large scale. It would be important to reach a commonly agreed upon set of indicators between numerical models and hydraulic modellers and also with the corresponding coastal authorities.
4. We also agreed on the importance of dealing with life cycle engineering rather than with the final performance of the structure. In the same manner the time scale should be corresponding to enlarge for instance to the catchment basin.
5. It was also converged on the importance of analysing the soil body as a foundation, looking at pore pressure sensor data suitably distributed.
6. Finally it was recommended to carry out a transition from present conditions step by step so that we can compare and advance with respect to the present level of knowledge in a robust manner.