

# A Lattice-Boltzmann model for simulating bedform-induced hyporheic exchange Supplementary material

Davide Dapelo<sup>1</sup>, Stefan Krause<sup>2,3,4</sup>, Jesus D. Gomez-Velez<sup>5</sup>, John Bridgeman<sup>1</sup>

<sup>1</sup>Department of Civil Engineering and Industrial Design, School of Engineering University of Liverpool,  
Liverpool, United Kingdom.

<sup>2</sup>School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham,  
United Kingdom.

<sup>3</sup>11. Ecologie des Hydrosystèmes Naturels et Anthropisés (LEHNA), Université Claude Bernard Lyon 1,  
Lyon, CNRS, ENTPE, UMR5023, 69622, Villeurbanne, France.

<sup>4</sup>Institute of Global Innovation, University of Birmingham, Birmingham, United Kingdom.

<sup>5</sup>Climate Change Science Institute & Environmental Sciences Division, Oak Ridge National Laboratory,  
Oak Ridge, TN, USA.

Within this Supplementary Material, the code used within the main article is described, and instructions as how to run it are provided. The code is based on OpenLB version 1.2r0 (<https://www.openlb.net/download/>).

## Files provided

- **olb-1.2r0.tgz** Source code of OpenLB 1.2r0, as a tar archive.
- **debris.tar.gz** Source, as a tar archive (description below).

## Description of the code

- **debris.cpp** Source code of the LB application, written in C++.
- **makefile** Makefile for **debris.cpp**.
- **module.mk** Auxiliary file to **makefile**.
- **definitions.mk** Auxiliary file to **makefile**.
- **athena-acoustic5dunes.sh**, **athena-test10.sh** Launching scripts for SLURM job scheduler. Defines the parametrization of the run as a set of bash environmental variables in **main()**. Then it calls **Oresources/run.sh**.

- 28 • **cirrus-acoustic5dunes.sh** Same as above, with the OpenPBS job scheduler.
- 29 • **Oresources/run.sh** Running script. Creates an xml file as an input to the LB
- 30 application from the environment variables defined in the launching script and us-
- 31 ing **Oresources/input.xml**; runs the LB application; and performs post-processing
- 32 by launching **plots.py**.
- 33 • **Oresources/processOnTheSpot.sh** Launcher for **plots.py** alternative to **Oresources/run.sh**.
- 34 • **Oresources/input.xml** Template file read by **Oresources/run.sh** to create LB
- 35 application's input xml file.
- 36 • **plots.py** Post-processing script, written in Python 3.

## 37 Usage

- 38 1. Prerequisites: `gcc`, `openmpi`
- 39 2. Untar `olb-1.2r0.tgz`. The folder `olb-1.2r0` is created
- 40 3. Configure `/olb-1.2r0/config.mk` according to hardware settings
- 41 4. Execute the commands `cd /olb-1.2r0`; `make`
- 42 5. Create the folder `/olb-1.2r0/apps/name`
- 43 6. Untar `debris.tar.gz` on `/olb-1.2r0/apps/name`
- 44 7. Run the commands `cd /olb-1.2r0/apps/name/debris`; `make` which creates the
- 45 executable `/olb-1.2r0/apps/name/debris/debris`
- 46 8. Write a custom launching script based on the examples provided, desired settings,
- 47 job scheduler and hardware
- 48 9. Launch the script through the available job scheduler