Flood characteristics of the 2016-02-22 event on the Eshtemoa River, Israel

(https://doi.org/10.5880/GFZ.4.6.2020.006)

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1. Licence

2. Citation

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Lagarde, S.; Dietze, M.; Gimbert, F.; Laronne, J. B.; Turowski, J. M.; Halfi, E. (2020): Flood characteristics of the 2016-02-22 event on the Eshtemoa River, Israel. GFZ Data Services. https://doi.org/10.5880/GFZ.4.6.2020.006

The data are supplementary material to:

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3. Data Description

The Nahal (river) Eshtemoa is a gravel-bed river draining 119 km² of the Southern Hebron Mountains and the Northern Negev, northeast of Beer Sheva, Israel. The climate in the catchment is semi-arid, with a mean annual precipitation of 286 mm. Rainfall mainly occurs between October and May. The river is ephemeral with flash floods occurring on average five times per year (Alexandrov et al., 2009). The recurrence interval of the bankful discharge of 26 m3 s-1 has been estimated to be 1.25 years (Powell et al., 2012). Bedload fluxes are high by worldwide standards with sediment transport as much as 400 times more efficient than in a typical perennial humid river (Laronne and Reid, 1993; Reid and Laronne, 1995).

The river is equipped with a monitoring station in a straight channel section with a trapezoidal cross section. The banks are nearly vertical, 1.2 m high, and comprise aeolian fines and interbedded gravel. The mean channel slope is 0.0075, which is generally mirrored by the water surface slope, with exception during the arrival of a flashflood bore (Meirovich et al., 1998).

The monitoring station features five Reid-type bedload slot samplers, pipe and plate microphones (Laronne et al., 1992) to monitor bedload flux, as well as vented pressure transmitters to monitor water depth. Water depth is also monitored at five longitudinal locations to determine water surface slope and its variation during arrival of flash flood bores (Meirovich et al., 1998). Of the five slot samplers, only the three central ones are still operating because the channel has narrowed due to deposition of silt. The samplers are equipped with pressure-pillows, allowing for time-resolved bedload flux quantification. The slots are 11 cm wide.

Thus, bedload particles with diameter close to these sizes or larger are not sampled. They are sampled after every event to determine the temporal and cross-sectional evolution of bedload grain size. Due to the restricted capacities of the samplers (0.48 and 0.34 for the central and lateral devices, respectively), they usually fill before the cessation of bedload flux. Thus, to provide material flux information for an entire event, a calibrated pipe microphone and plate microphone are used.

The data presented here are for the flood of the 22nd February 2016. It shows a high bedload flux with peaks exceeding 1 kg/sm and water level between 0.5 and 0.8 m. The event has been previously described by Dietze et al. (2019).

The beginning of the event is defined as the onset of bedload flux recorded by the samplers at 05.40 UTC, considered to be minute 0 in this study. The following hour and a half of the event (05:40–07:32 UTC), during which bedload transport occurred continuously, was analyzed although water depth dropped logarithmically for the 13 following hours.

The data was used to assess the quality of a physical model (*Tsai et al. 2012*) predicting the seismic spectrum generated by the impact of bedload particles moving along the channel bed. The model requires knowledge on stream and sediment characteristics to constrain the source terms, e.g., the channel geometry and grain size distribution, and ground properties affecting the wave propagation, i.e., frequency-dependent wave velocity or attenuation characteristics. The complementary controlled source and passive seismological data are published in a separate data publication (Lagarde et al., 2020).

4. Methods

4.1. Bedload flux

Bedload flux was measured with the bedload samplers and the plate geophones, at a frequency of one value per minute. As the sampler boxes were progressively filled, sampler data was available only for parts of the event. Thus, three different methods were used to compute bedload flux.

During a first phase, an average of the fluxes of the three samplers is done, with the flux from the center sampler multiplied by 1.5 due to its representation of a larger area of the cross section. In a second phase, the right and centre samplers were full, but the left one was still operating: its bedload flux is multiplied by 1.3 to represent the entire section. Finally, in the third phase, all the samplers are full, the bedload flux is determined using the bedload calibration ($R^2 = 0.76$) of the plate hydrophone located immediately upstream of the left sampler. The calibration was done using a mass aggregation method, with constant mass intervals of 4 kg. This mass corresponds to the sensitivity of the sensor and allows to discriminate noise from the real bedload flux measurement.

4.2. Water depth

The depth of the river H was obtained using the vented pressure transmitters, with a temporal resolution of one minute.

4.3. Channel bed slope

The channel bed slope θ was measured with a total station.

4.4. Grain size measurements

The bed grain size distribution was obtained by randomly sampling and sieving pebbles on the bed in 2015, giving nine different class-intervals. The bedload grain size distribution was obtained by emptying and sieving the sampler boxes after the flood event, giving nine different class-intervals.

5. File description for Bedload and water depth measurements

This data publication includes the following data that are organized in the following files. The complementary controlled source and passive seismological data is published in a separate data publication (Lagarde et al., 2020).

5.1. station_measurements.txt

station_measurements.txt contains information on bedload and water depth measurements. The water depth (column water) is given in cm and the bedload flux in kg/(ms). The bedload flux used during the event is given in column qb_all. It corresponds to the succession of three different computation phases, detailed in the method section. Values in column qb_phase1 were computed using the first method, values in column qb_phase2 were computed using the second method and Values in column qb_phase3 were computed using the third one.

1.1. Folder “grain_size” measurements

This folder includes the measured data (subfolder grain_size_bedload) and the text file grain_size_from_bed.txt.

grain_size_from_bed.txt

The bed grain size distribution was obtained by sieving random pebbles. **grain_size_from_bed.txt** gives the number of grains per grain size interval. The grain size interval is presented in the form X_Y that one has to read as “class interval made of grain size from X to Y”.

Subfolder grain_size_bedload

This subfolder provides the “raw/measured” data and the additional summary files “all_samplers_total.txt”, “C_total.txt”, “LC_total.txt” and “RC_total.txt”

The bedload grain size was obtained by sieving the sampler’s content. The file names represent the location of sampling in the river (LC corresponds to the left sampler, RC to the right sampler and C to the center sampler) and the depth range in the sampler, e.g.:

The text file with name **RC_XX_YY.txt**, corresponds to data for the right sampler, for a depth in the sampler between XX and YY centimeters. The greater the depth, the earlier the grains fell in the box during the flood. In each text file, the first column corresponds to a grain size range (D in mm) and the second one to the mass of grain measured for this interval (weight in grams). The grain size interval is presented in the form X_Y that one has to read as “class interval made of grain size from X to Y”.

Additional summary files

- **C_total.txt”** corresponds to data for the whole center sampler (all depths summed up).
- **LC_total.txt”** corresponds to data for the whole left sampler (all depths summed up).
- **RC_total.txt”** corresponds to data for the whole right sampler (all depths summed up).
- **all_samplers_total.txt** corresponds to data for all the samplers (all depths summed up).

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