Geophysical Research Abstracts
Vol. 16, EGU2014-5388-1, 2014
EGU General Assembly 2014

Coupling the 3D hydro-morphodynamic model Telemac-3D-sisyphe and seismic measurements to estimate bedload transport rates in a small gravel-bed river.

Renaud Hostache (1), Andreas Krein (1), Julien Barrière (2,3)

(1) CRP-Gabriel Lippmann, Environment and Agrobiotechnologies, Belvaux, Luxembourg (hostache@lippmann.lu, +352 470264), (2) National Museum of Natural History of Luxembourg, Luxembourg, (3) European Center for Geodynamics and Seismology, Luxembourg

Coupling the 3D hydro-morphodynamic model Telemac-3D-sisyphe and seismic measurements to estimate bedload transport rates in a small gravel-bed river.

Renaud Hostache, Andreas Krein, Julien Barrière

During flood events, amounts of river bed material are transported via bedload. This causes problems, like the silting of reservoirs or the disturbance of biological habitats. Some current bedload measuring techniques have limited possibilities for studies in high temporal resolutions. Optical systems are usually not applicable because of high turbidity due to concentrated suspended sediment transported. Sediment traps or bedload samplers yield only summative information on bedload transport with low temporal resolution. An alternative bedload measuring technique is the use of seismological systems installed next to the rivers. The potential advantages are observations in real time and under undisturbed conditions.

The study area is a 120 m long reach of River Colpach (21.5 km2), a small gravel bed river in Northern Luxembourg. A combined approach of hydro-climatological observations, hydraulic measurements, sediment sampling, and seismological measurements is used in order to investigate bedload transport phenomena. Information derived from seismic measurements and results from a 3-dimensional hydro-morphodynamic model are exemplarily discussed for a November 2013 flood event.

The 3-dimensional hydro-morphodynamic model is based on the Telemac hydroinformatic system. This allows for dynamically coupling a 3D hydrodynamic model (Telemac-3D) and a morphodynamic model (Sisyphe). The coupling is dynamic as these models exchange their information during simulations. This is a main advantage as it allows for taking into account the effects of the morphologic changes of the riverbed on the water hydrodynamic and the bedload processes. The coupled model has been calibrated using time series of gauged water depths and time series of bed material collected sequentially (after each flood event) in a sediment trap.

Seismic measurements are performed with one broadband sensor installed close by the Colpach-River next to the gauging station. Since the investigation area is located close to a small settlement with a near-by farm, one seismometer was set up in this settlement to capture the local seismic noise sources. Furthermore, in order to get insights into the background ambient noise of the area, one sensor was installed at several hundred meters distance away. This combination of recordings allows for an assessment of which signals observed at the seismometer close to the river are truly originating from the river.

The ambient seismic noise level is extracted from the time-frequency analysis of seismograms. Only the analysed data recorded on the riverbank exhibits a significant correlation with the water level during the flood event. However such a relationship is mainly due to water flow variations rather than bedload transport. Seismic measurements seem a promising non-invasive method for bedload transport monitoring despite its applicability is highly limited by the energy and the bedload size of the river investigated.

Acknowledgments
This study is supported by the National Research Fund, Luxembourg (BEDLOAD C11/SR/1158445).