Use of ground cameras to monitor riverscape changes: example of wood rafts and ice cover dynamics

Introduction

- Ground imagery is easy to set up, is low cost and has a set of advantages compared to aerial and satellite imagery
- Automatic cameras mainly provide a high temporal resolution which can be critical to survey some riverine processes
- Large datasets are produced and their visual analysis is limited and very time consuming
- We propose a method to optimize image acquisition and to automate their processing

What to consider when setting up a ground camera

Many fluvial processes could be observed or measured through ground imagery: changes in water level or velocity, changes in bed material conditions, wood or sand flux, changes in morphology, vegetation dynamics, etc. All these issues must be thought of in terms of spatial and temporal scales and footprint, influencing camera characteristics and position:

- Choose the stand
- Avoid unified framing and blurring
- Consider battery life or power supply to limit field visits
- Protect the camera against bad weather
- Think about image size, resolution and lens distortion to optimize processing
- Consider camera Euler angles and orientation
- Use spatial or radiometric markers
- Organize large volume and safe place for data storage
- Use a polarizing filter to study the river bed
- Expect to see artefacts
- Orthorectification of pictures to measure correctly the raft area over time

Data processing: wood raft dynamics

Defining discharges which are critical in terms of wood production

Pieces of wood cannot pass through the hydroelectric dam: a wood raft grows up in the reservoir and mechanical extraction is needed 3-4 times a year.

Method

- Extraction of radiometric and textural parameters in squares of 20*20 pixels
- Validation sample = 80 images chosen randomly or for their visual properties
- Manual classification (Wood/Water) of each square of the Region Of Interest (ROI)
- Discrimination of classes with random forest (randomForest) function in R
- Prediction of the class of the squares in the whole dataset with this Random forest
- Orthorectification of pictures to measure correctly the raft area over time

Results

Time series of the wood raft predicted in the Genissiat dam reservoir (black line) and hydrological series of the Rhone River (blue area) 3.7km downstream from the dam (Surjoux gauging station)

Data processing: ice cover dynamics

Understanding river ice dynamics linked with hydrology

An ice cover develops on rivers during winter in cold regions. This affects discharges and floods which can have significant consequences on riparian environments.

Installation

- a PC300 Hypertech Reconyx camera
- one picture every hour
- winter 2010-2011
- 2048*1436 pixels
- bands available: RGB

Method

- Same method than the one applied on the Genissiat dam dataset, but:
  - Validation sample = 25 images
  - Squares = 32*32 pixels
  - Classification is more complex
  - Images can’t be orthorectified
- Prediction of the class of the squares in the whole dataset with this Random forest
- Orthorectification of pictures to measure correctly the raft area over time

Results

Time series of the of the ice classes predicted in the Saint Jean River and values observed over winter 2011

Conclusion

- Processing tested on these two datasets gave promising results. We demonstrated that ground imagery presents a high potential to monitor stream processes with high temporal resolution and to observe rapid and stochastic events.
- Main errors in classification come from image quality which is why a significant effort is needed to optimize data acquisition.

To go further