



Mapping Bank Erosion and River Morphology of the Petit Buëch River in France using timeseries of UAV imagery

Steven M. de Jong, Sven Hemmelder, Wouter Marra, Henk Markies & Maarten Zeylmans Van Emmichoven
Faculty of Geosciences, Utrecht University NL

Abstract

- An Unmanned Aerial Vehicle (UAV) was used to collect a timeseries of high-resolution images in 2014 and 2015 over parts of the Petit Buëch River in France (Alps).
- Structure from Motion (SfM) was applied to create Digital Surface Models (DSMs) and OrthoMosaics for both years.
- Two sites along the river were selected with known floodplain dynamics and bank erosion problems.
- DGPS points were collected in the field of markers, of bank erosion between the years and of changed location of channels. Data accuracy of the images is around 0.34 m in XY-direction and around 0.02 m in Z-direction.
- Areas up to 150 x 40 m were eroded between 2014 and 2015 with an estimated volume of 5855 m³.
- Bank erosion could be mapped along transects in great detail (centimeters).
- Channel displacement ranged up to 70 m within one year.
- UAVs are robust, cheap and easy to use tools to monitor bank erosion and river morphology dynamics.



The Petit Buëch River in the Hautes Alpes (F)

This river has a catchment area of approximately 389 km². The source is located in the Dévoluy massif and river length is around 44.5 km. Land cover in the catchment is forest for 80% and agricultural land for 20%. Discharge is highly variable: mean daily discharge is 14 m³/s, and 2, 10, and 50-year daily flood discharges are estimated at 140, 250, and 350 m³/s.

UAV used for image acquisition

A fixed-wing aircraft with manual control was used. The camera aboard was a Canon PowerShot D10 RGB compact camera with a resolution of 4000 by 3000 pixels and a focal length of 6.2 mm. The flight altitude was on average 130 m and was a trade-off between the size of the studied flood plain and the desired spatial detail of approximately 3 cm pixels.

One battery set allows approximately 10 minutes of flying. Per river section we required around 5 flights to cover the area.



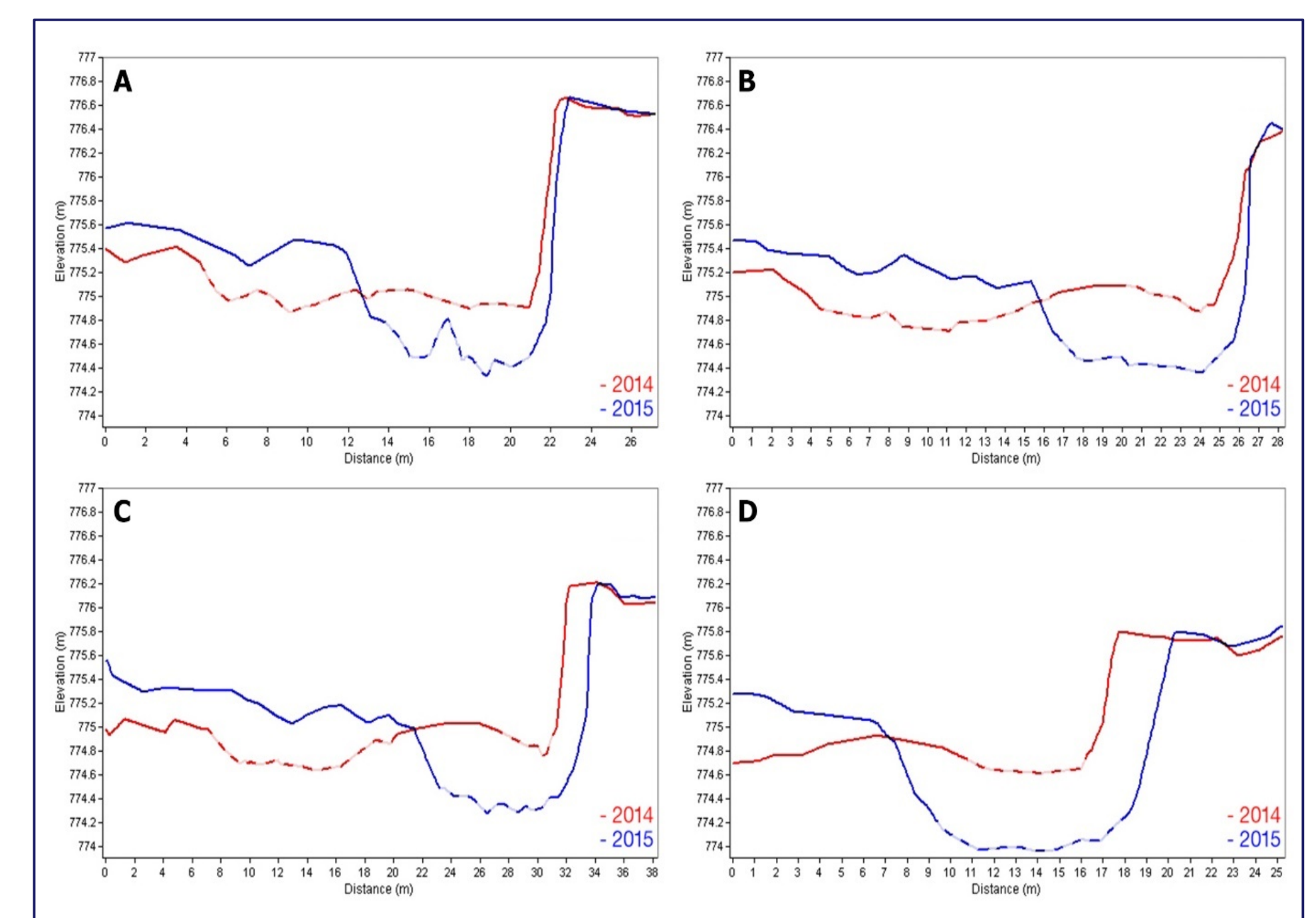
Profiles of UAV-derived river bank erosion

The figure on the right shows 4 elevation profiles of bank erosion and floodplain deposits by the Buëch river between 2014 and 2015 derived from the UAV-DEMs. The profiles are located perpendicular on the channel and cover the location of the field picture on the left. The dashed lines are locations of bank full channels.

Bank retreat and erosion could be mapped in great detail at decimeter level. Profile C and D shows bank retreat of 2 and 3 meter respectively in one year. Mapping is most accurate in open, vegetation free sites as overhanging trees, shadows and glitter sometimes hamper mapping efforts.

<- Bank erosion of the Buëch river at the Chabestan site

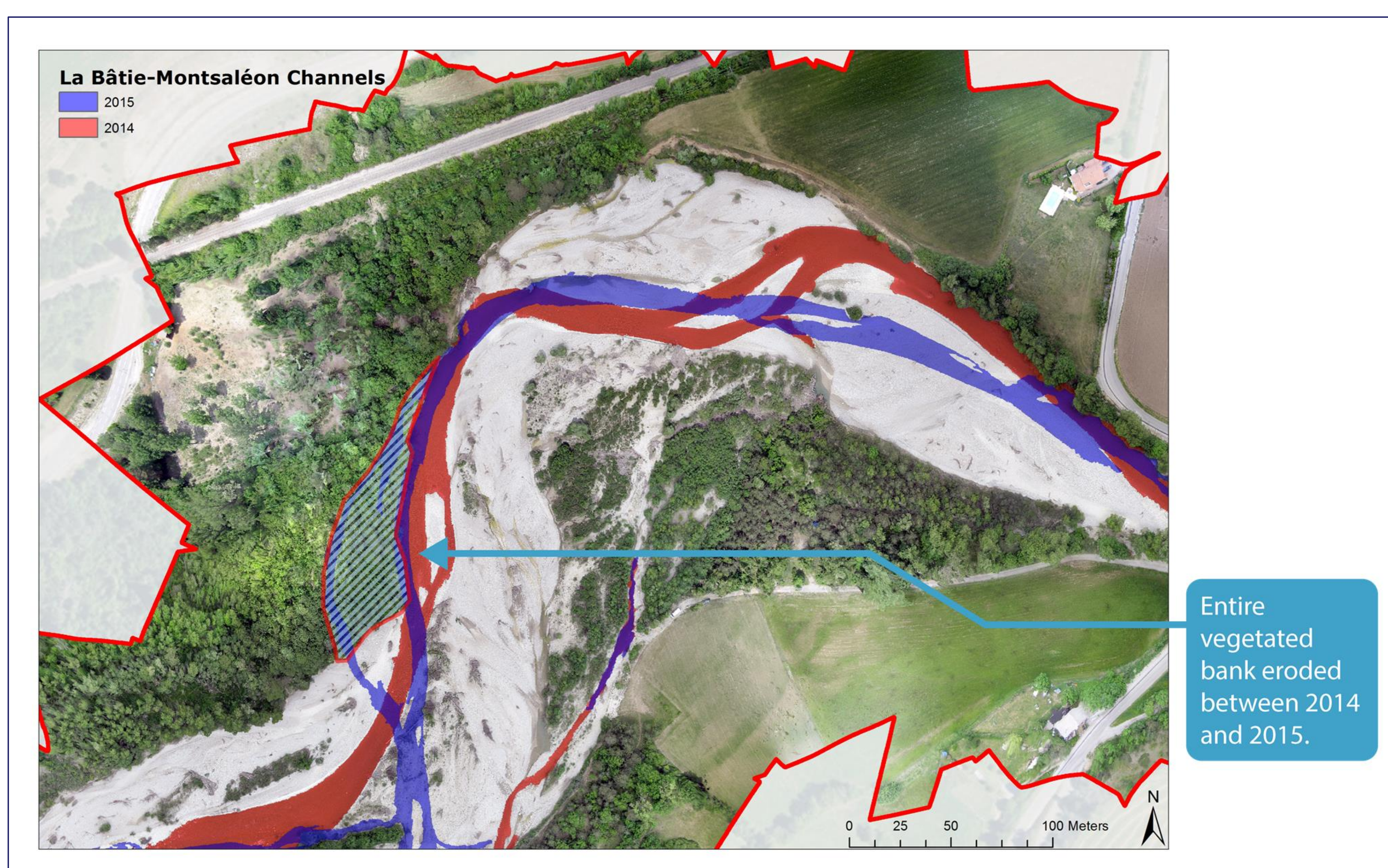
Four profiles of bank erosion and floodplain deposits ->



Example of Results

The figure on the left shows the Bâtie-Montsaléon section of the Petit Buëch river. The processed UAV images of June 2014 and June 2015 are overlaid.

- Note the large width of the floodplain, the mixed behavior of braiding and meandering and the position of the railroad just north of the Buëch river.
- Channel displacement within the floodplain between 2014 (red) and 2015 (blue) is clearly visible. Channel displacement ranged up to 20 m (and 70 m for the Chabestan side not shown here).
- The blue dashed polygon west of the floodplain is completely eroded between 2014 and 2015. This part of the river bank used to be covered with trees and shrubs. As a result many tree trunks were found downstream of this area posing a possible threat to infrastructure downstream.
- Volumes of the eroded area were assessed by comparing the DEMs of 2014 and 2015 and were approximate 5855 m³.
- Bank erosion may pose a possible threat to the railroad just north of the active floodplain.
- Drone imagery are easy, fast and flexible tools to keep an eye on river morphology, channel dynamics and bank erosion.



Entire vegetated bank eroded between 2014 and 2015.

Further reading:

S. Hemmelder, W. Marra, H. Markies, S.M. de Jong, 2018, Monitoring river morphology & bank erosion using UAV imagery – A case study of the river Buëch, Hautes-Alpes, France. Int. Journal of Applied Earth Observation and Geoinformation, Volume 73, December 2018, Pages 428-437.



Contact:

Steven M. de Jong, Utrecht University NL | S.M.deJong@uu.nl
Sven Hemmelder, Utrecht University NL | Sven@Hemmelder.net