

Wind effect on image-based river surface velocity measurements

Salvador Peña-Haro¹, Beat Lüthi¹, Robert Lukes², Maxence Carrel¹

¹photrack ag. Flow Measurements. Switzerland

²Federal Office for the Environment. Switzerland

pena@photrack.ch

<http://www.photrack.ch/>



Introduction

Image-based methods for measuring discharge in rivers have several advantages, like versatile camera mounting position, safe from floods, non-intrusive system, each measurement comes with an image which can help the operator to evaluate the system performance.

On the other hand, environmental factors, like wind, can affect the surface velocity and have a negative impact on the accuracy of the measurements.

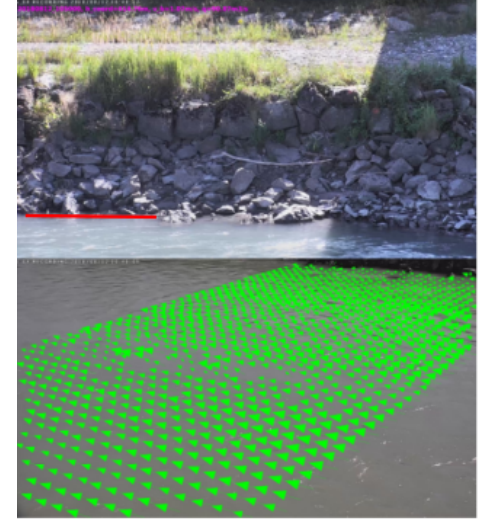
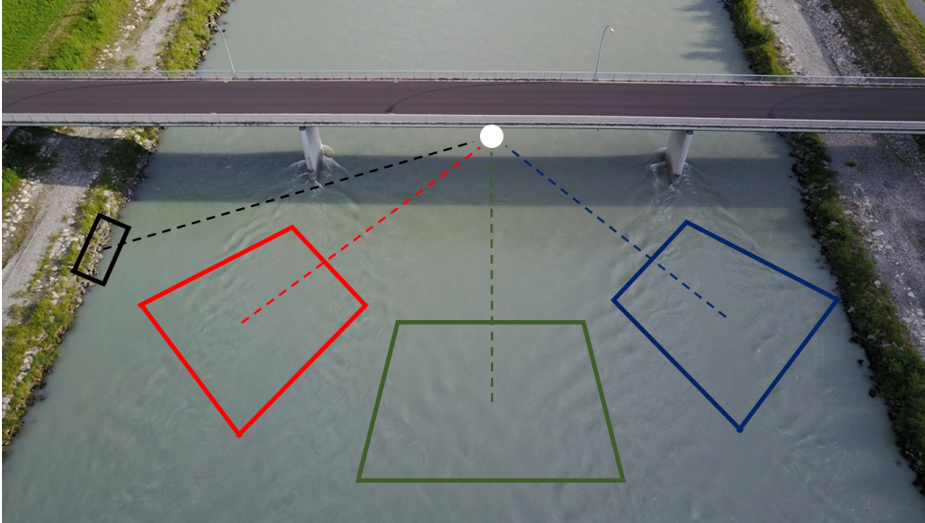
To study the wind influence on the measured discharge, a time series of flow velocities and wind from May to October 2019 was analyzed at river in Switzerland.

Study site



- Zollbrücke on the Rhine river
- River width 100 m. under low flow conditions. Flood plain is about 200m.
- Data analyzed is from May to October 2019
- The average flow velocity was 1.7 m/s
- The average discharge $320\text{m}^3/\text{s}$
- The average wind velocity was 2.3 m/s

DischargeKeeper



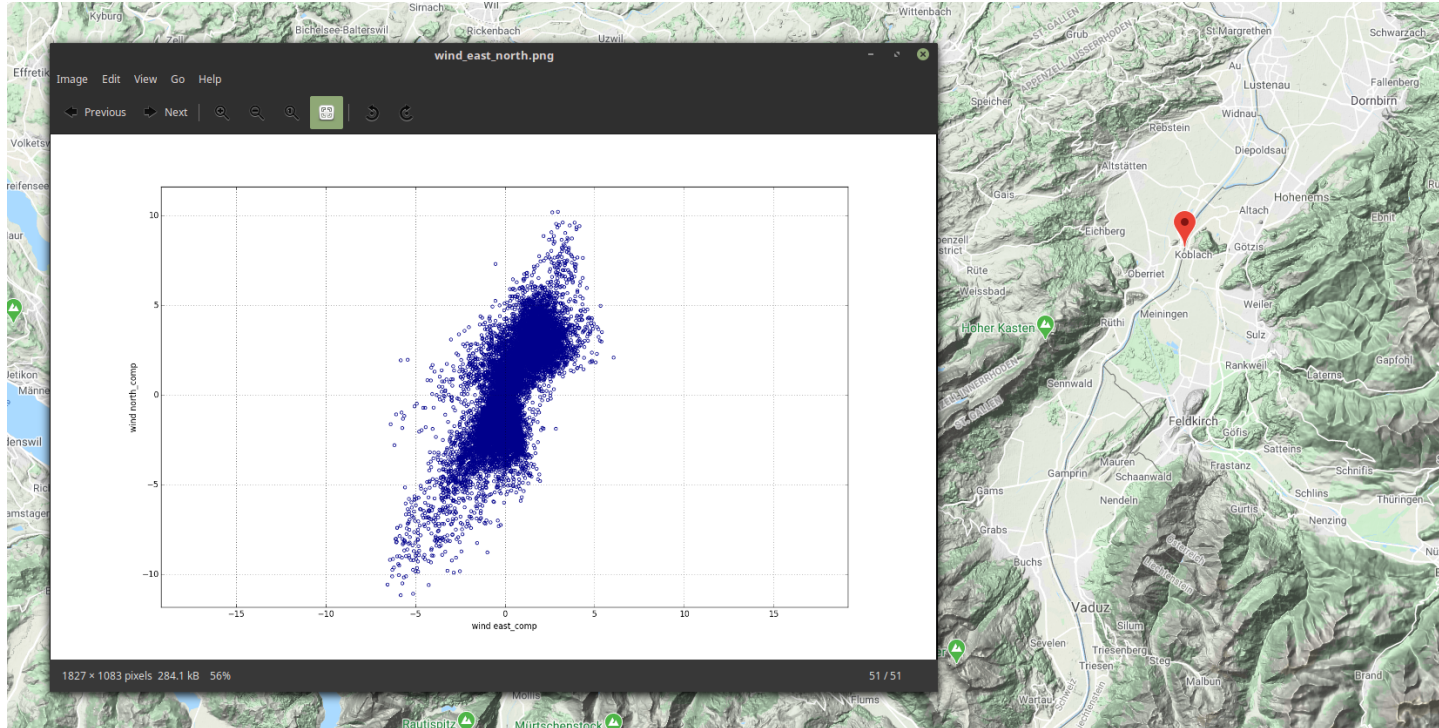
- A DischargeKeeper with a Pan Tilt Zoom camera was installed at the site
- The system measures the surface velocity in 3 different views
- It also measures the water level optically
- Combines these information to calculate the discharge

Wind sensor



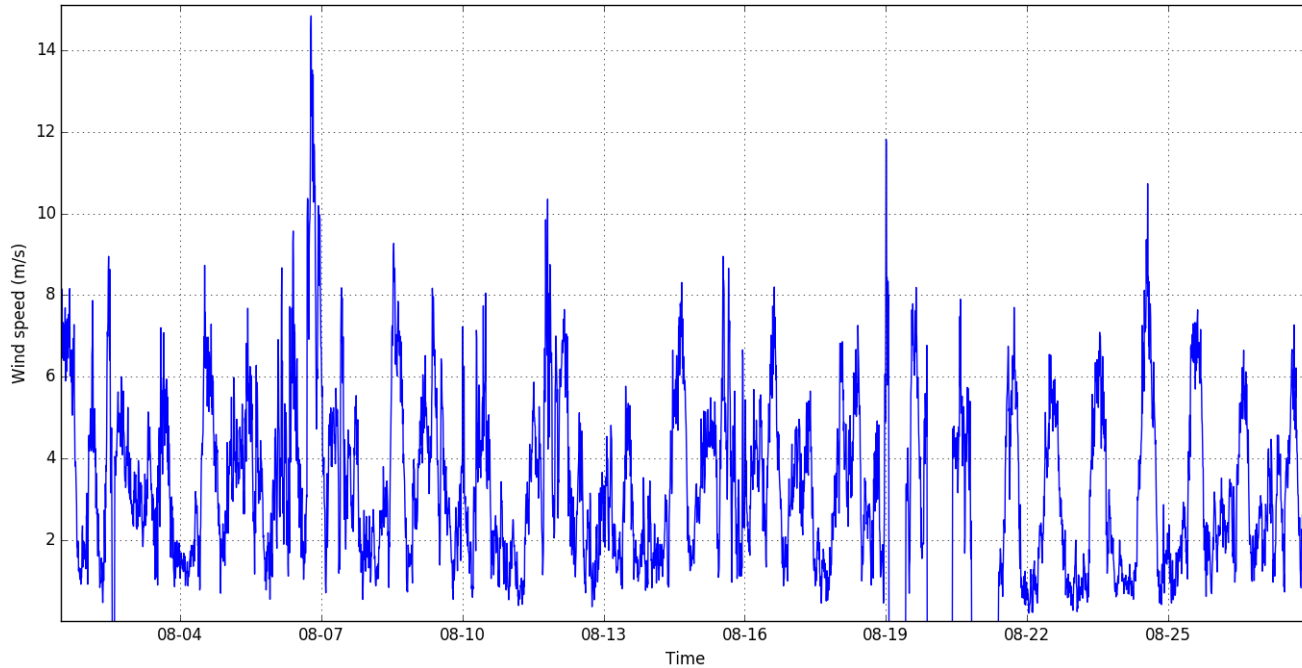
- At the bridge an ATMOS 22 ultrasonic anemometer was installed
- It can measure the wind intensity as well as the direction

Wind direction



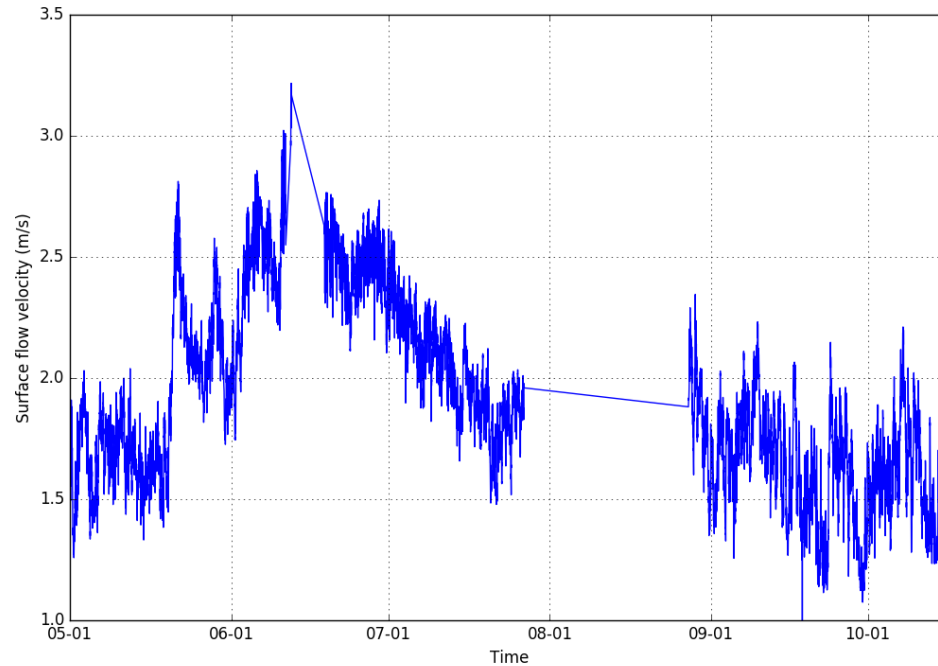
- The wind direction follows the direction of the valley which is SSW - NNE

Wind speed



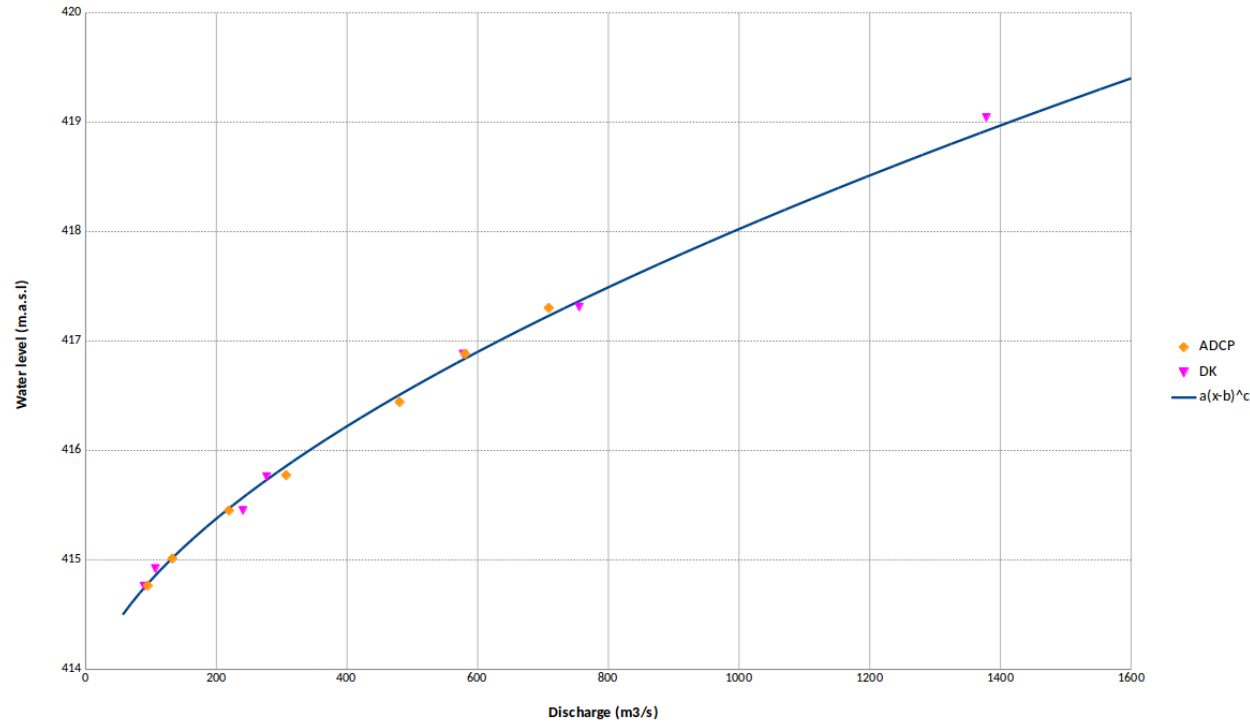
- Maximum wind velocities can reach 15m/s
- The average wind velocity between May and October 2019 was of 2.3m/s

Surface flow velocity



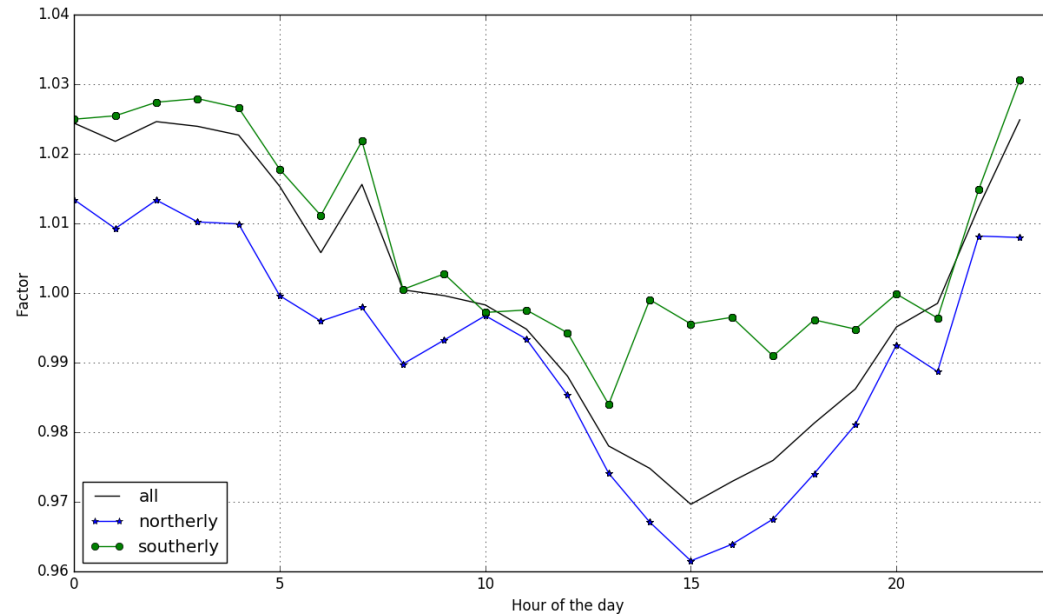
- The surface velocity ranges between 1.2 m/s to 3.2 m/s
- The surface velocity during the study period was of 1.7m/s
- The station was down during August, hence the data gap

Rating curve



- A rating curve following a power law function was fitted to ADCP measurements
- Videos taken at the same time to the ADCP measurements are also plotted

Wind effect



- The ratio between the measured discharge and the one from the rating curve was calculated
- This ratio is extracted when different conditions are met (different lines in the plot)
- The biggest ratio is from the wind coming from the north (against the flow) of 0.96

Conclusions

The wind influence was analyzed on a river 100 meter wide with an average discharge of $320\text{m}^3/\text{s}$. It was found that for maximum wind speeds of 10 m/s , blowing in the opposite direction of the river flow, there was a deviation of 8%. For the average wind speed of 2.3m/s , the deviation was found to be 3%.