

Título: Medición de caudales, precipitación y de nivel de ríos- HYDROMET

Title: Flow discharge, precipitation and water stage measurement - HYDROMET

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1.0 Data Set Overview:

- Introducción o Resumen / [Introduction or abstract](#)

El grupo de trabajo de la FCEFYN – UNC en conjunto con la APRHi realizan aforos periódicos en condiciones de aguas bajas y crecidas tanto en los ríos serranos, principales aportantes de los grandes embalses de la provincia, como en los principales ríos de la provincia como son el Ctalamochita, Carcarañá, Dulce, etc. En la cuenca de estudio del proyecto RELAMPAGO (Cuenca del Río Carcarañá) se monitorean periódicamente 30 sitios de medición. El grupo de la FCEFYN, además posee una amplia experiencia, reconocida a nivel internacional, en el desarrollo, optimización e implementación de técnicas experimentales para cuantificar caudales escurridos superficialmente con técnicas hidroacústicas (ADCP, ADV) y de velocimetría por imágenes de Partículas. Al trabajar en conjunto con la APRHi del gobierno de la Provincia de Córdoba toda la información de caudales es registrada con estas técnicas, se archiva en conjunto con datos de nivel de superficie libre y a las precipitaciones que generan dicho escurrimiento. Toda la información recolectada de caudales (utilizando las técnicas LSPIV y ADCP) como así también de precipitación y niveles relacionados a dichos caudales durante el proyecto RELAMPAGO es la que aquí se provee.

[The working group of the FCEFYN – UNC, in conjunction with the APRHi carry out periodic discharge measurements in high and low hydrologic conditions in the tributaries that feed the main reservoirs of the Córdoba Province, as well as in the main rivers of the province, such as the Ctalamochita, Carcarañá, Dulce, etc. In the study basin of the RELAMPAGO project \(Carcarañá River Basin\) 30 measurement sites are periodically monitored. The FCEFYN group also has extensive experience, internationally recognized, in the development, optimization, and implementation of experimental techniques to quantify flow discharge with hydroacoustic techniques \(ADCP, ADV\) and Particle Image Velocimetry \(PIV\). All the flow information registered with the mentioned techniques, is saved together with data of water stage and the rainfall data that produced the runoff event. All the information collected of flow discharge \(using the LSPIV and ADCP techniques\) as well as precipitation and water level during the RELAMPAGO project is the one provided here.](#)

- Periodo de cobertura de la información / **Time period covered by the data**

El periodo de datos corresponde al año hidrológico 2018-2019 (01/Mayo/2018 – 01/Mayo/2019), objeto de estudio del proyecto RELAMPAGO.

[The data period corresponds to the 2018-2019 hydrological year \(May/01/2018 – May/01/2019\), study period of the RELAMPAGO project.](#)

- Estructura de la información/**Structure of information:**

La información se organiza en 3 carpetas

- Discharge Data (Datos de caudales)
- Meteorological Data (Datos Meteorológicos)
- Water Stage Data (Datos de Nivel de Superficie Libre)

Dentro de la carpeta “Discharge Data” se encuentra las carpetas APRHi Data y FCEFYN Data que se corresponde con la institución que registro los datos. Dentro de dichas carpetas se encuentran los datos de caudales medidos con diferentes técnicas. En el caso de datos

medidos con ADCP dentro de cada una de las carpetas se encuentran archivos con extensión “.dis” que poseen toda la información medida para ser visualizados con Block de Notas. También se proveen los datos crudos a través de archivos “RIV” y “RIVR” para poder analizarlos con el Programa River Surveyor Live. En el caso de mediciones con PIV se provee una planilla Excel con los resultados y para las mediciones con FLOWTRACKER 2 se provee PDF resumen y los datos crudos a través de la extensión “Ft” para ser analizados con el programa correspondiente.

En la carpeta “Meteorological Data” se encuentra la información de las estaciones meteorológicas oficiales mantenidas por el gobierno de la provincia de Córdoba (Carpeta OMIXOM) y la información registrada por los ciudadanos a través del proyecto MATTEO. Dentro de la primera carpeta, se subdivide en dos carpetas: “Cuarto_basin” y “Tercero_basin”; referidas a las cuencas de río Cuarto y Tercero, respectivamente. Aquí se observa una tabla en formato “.CSV” que indica las coordenadas de cada una de las estaciones dentro de estas carpetas, cuya información se encuentra en formato “.XLSX”. Por otro lado, dentro de la carpeta MATTEO, los datos de las estaciones se encuentran en formato “.CSV”.

Finalmente, en la carpeta “Water Stage Data” se encuentra en formato “.XLSX” la información de nivel de agua. El nivel “0” (cero), se corresponde con el nivel donde se ubica el sensor, que resulta ser próximo al tablero de cada puente. En el archivo RELAMPAGO PIV DATA dentro de la carpeta “Discharge Data” se encuentra como referenciar estos niveles a la curva altura caudal para las estaciones analizadas en la cuenca alta del Río Carcarañá.

The information is organized in 3 folders

- Discharge Data
- Meteorological Data
- Water Stage Data

Inside the “Discharge Data” folder, there are the APRHi and FCEfyN Data folders that correspond to the institution that registered the data. Within these folders there are the flow discharge measured with different techniques. In the case of data measured with ADCP, in each folder there are “.dis” files that have all the measured information to be opened with plain text processor, like Windows Notepad. Raw data is also provided through “RIV” and “RIVR” files to analyze with the RiverSurveyor Live Software. In the case of PIV measurements, an Excel spreadsheet with the results is provided, and for measurements with FLOWTRACKER 2, a summary PDF and raw data are provided through the “Ft” file to be analyzed with the corresponding program.

In the folder “Meteorologic Data” the information of the official meteorological stations maintained by the government of the province of Córdoba (Folder OMIXOM) and the MATTEO project is reported. Inside the first folder, there are two sub-folders: “Cuarto_basin” and “Tercero_basin”; related to the upper basins of these rivers. At the same level as these folders it is a “.CSV” file that has the geographical coordinates of each station included in these sub-folders. This meteorological data is registered in “.XLSX” format for each station. In the other hand, inside the “MATTEO” folder, the data of every station is stored in “.CSV” format.

Finally, in the “Water Stage Data” folder there are water level of different stage stations in the Carcarañá river basin in “.XLSX” format. Stage “0” (zero) is where the sensor was located, that is nearside bridges board. In the RELAMPAGO PIV DATA file inside the “Discharge Data” folder, it is found how to reference these stages to the rating curve for the stations analyzed in the upper basin of the Carcarañá River.

2.0 Descripción del Instrumental / Instrument Description:

Para las mediciones con ADCP se utilizaron los instrumentos RiverSurveyor S5 y M9 cuyas características técnicas son las que se mencionan a continuación:

For ADCP measurements, RiverSurveyor S5 and M9 instruments were used. The technical characteristics of these instruments are mentioned below:

RiverSurveyor ACCESSORIES AND SPECIFICATIONS



Handheld Tablet:
Running on a tablet available from SonTek, RiverSurveyor Live software makes one-man system operation simple.
(Model subject to change.)



Power/Communications:
The Power/Communications Module (PCM) for the S5/M9 operates on standard AA batteries⁵. It can be factory-configured with 2.4 GHz telemetry, SBAS-GPS, or RTK GPS.



RTK GPS:
The optional SonTek RTK GPS³ solution is easy to use and offers an incredibly precise, fully integrated boat speed solution to augment, or be an alternative to, bottom tracking.



SonTek HydroBoard II:
All-in-one, rugged and easy to transport, this dive-resistant design allows the RiverSurveyor to be used in challenging flow conditions.



HydroBoard II Bags:
Ready to go where you are, these rugged bags are outfitted with shoulder straps and offer the perfect storage protection for the HydroBoard II.



Boat Mount:
Delrin/aluminum fixture that is custom designed for the M9 or S5 to facilitate mounting over the side of a boat. (Attachment to boat not included.)



Trimaran:
Contact SonTek for trimaran solutions to fit special applications.

	RiverSurveyor S5	RiverSurveyor M9
Velocity Measurement		
Profiling Range (Distance)	0.06m to 5m	0.06m to 40m
Profiling Range ¹ (Velocity)	+/- 20 m/s	+/- 20 m/s
Accuracy ¹	Up to +/- 0.25% of measured velocity; +/- 0.2cm/s	Up to +/- 0.25% of measured velocity; +/- 0.2cm/s
Resolution	0.001 m/s	0.001 m/s
Number of Cells	Up to 128	Up to 128
Cell Size	0.02m to 0.5m	0.02m to 4m
Transducer Configuration		
	Five (5) Transducers;	Nine (9) Transducers;
	4-beam 3.0 MHz Janus at 25° Slant Angle;	Dual 4-Beam 3.0 MHz/1.0 MHz Janus at 25° Slant Angle;
	1.0 MHz Vertical Beam Echosounder	0.5 MHz Vertical Beam Echosounder
Depth Measurement		
Range	0.20m to 15m	0.20m to 80m
Accuracy	1%	1%
Resolution	0.001m	0.001m
Discharge Measurement		
Range with Bottom-Track	0.3m to 5m	0.3m to 40m
Range with RTK GPS or DGPS	0.3m to 15m	0.3m to 80m
Computations	Internal	Internal

S5/M9 Additional Specifications

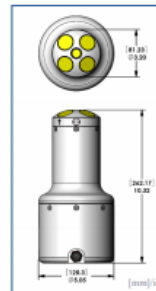
- Temperature Sensor
 - Resolution: $\pm 0.01^\circ\text{C}$
 - Accuracy: $\pm 0.1^\circ\text{C}$
- Compass/Tilt (Solid State Type)
 - Range: 360°
 - Heading Accuracy: $\pm 2^\circ$
 - Pitch/Roll: $\pm 1^\circ$
- Internal Recorder Size: 8GB
- Power/Communications
 - 12 - 18v DC
 - RS232 Communications
 - RS232 Serial GPS Input
 - Max Data Output Rate: 2 Hz
 - Internal Sampling Rate: Up to 70 Hz
- Physical/Environmental
 - Depth Rating: 50m
 - Operating Temperature: -5° to 45°C
 - Storage Temperature: -20° to 70°C

Power Communications Module

- Batteries
 - Type: Standard AA batteries⁵
 - Average duration: 8 hours of continuous operation (6 hours with RTK GPS enabled)
- GPS Options
 - SBAS GPS Horizontal Accuracy²: $<1.0\text{m}$
 - RTK GPS Horizontal Accuracy²: $<0.02\text{m}$;
 - Vertical Accuracy $<0.04\text{m}^{2,3}$

Range (Std.: 10 dBm)⁴ Range (High: 22dBm)⁴

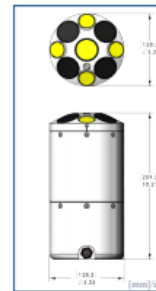
- Base to Rover: 1000 m 3000 m
- PC to Rover: 450 m 1500 m
- Bridge to Rover: 200 m 400 m



RiverSurveyor-S5

- Weight in Air: 1.1 kg (2.5 lb)

- Weight in Water: 0.3 kg (-0.7 lb)



RiverSurveyor-M9

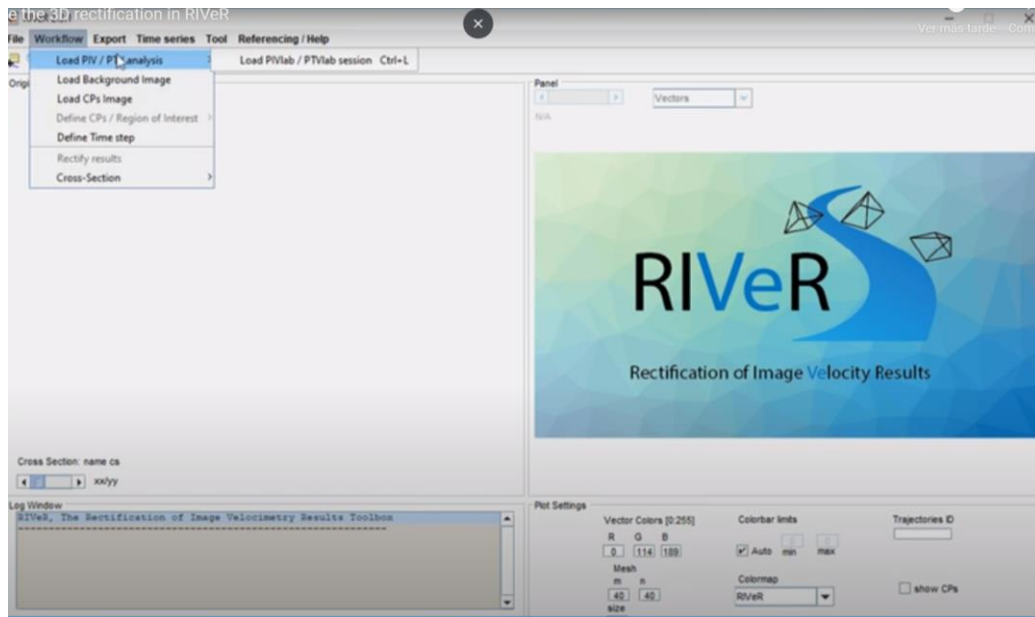
- Weight in Air: 2.3 kg (5.0 lb)

- Weight in Water: 0.6 kg (-1.3 lb)

¹Please contact SonTek for accuracies better than 1%, or velocities $>10\text{ m/s}$, satellite geometry, and ionospheric activity.
²Requires absolute RTK solution. Only available with HydroSurveyor.
³High power may not be available in all countries; all ranges with default 2 dBi antenna and line-of-sight.
⁴Standard AA batteries are defined as alkaline or NiMH rechargeables, with a diameter up to 14.5mm.

Para la realización de la Técnica LS-PIV se utilizó una cámara de un teléfono celular y el procesamiento se realizó con el programa PIVLab (<https://pivlab.blogspot.com/>) y RIVER (<http://riverdischarge.blogspot.com/>)

To carry out the LS-PIV Technique, a cell phone camera was used to record a video of the river and the processing was carried out with the PIVLab program (<https://pivlab.blogspot.com/>) and RIVER (<http://riverdischarge.blogspot.com/>)



Las mediciones de nivel (realizadas con equipos acústicos y de radar) y precipitación se realizó con estaciones oficiales de la empresa OMIXOM.

Measurements of water stage (made with acoustic and radar equipment) and precipitation were made with official stations of the company OMIXOM, main provider of these kind of instruments in the province.