

Flow measurements and stage discharge relationships for model calibration developed

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1. Introduction

Flow data measurement is a relevant in situ data needed for many purposes and usually scarcely available. For this reason a dedicated campaign was set up in order to upgrade discharge time series in the regional territories.

2. Flow measurement

In date September 24th, 26th, 30th, October 2nd, 14th and 15th, November 17th and 30th 2020 dedicated surveys and flow measurements to updating rating curves, were carried on .

Thirteen measurements were realized in the year 2020 and included in Civil Protection discharge database.

From January to July 2021 twelve more measurements were realized in data 17th March, 8th of April, 28th of April, 29th of May, 29th of June and 6th of July.

In the following table measurement results are summarized. Stage discharge relationships were updated in 2022 with more flow measurements outside Stream project activities.

Table 1: flow measurement realized in year 2020

ID flow measurement	Station number and name	Date	Water level [m]	Discharge [m³s⁻¹]
1179	5 - Camponocecchio	2020-09-26	0.49	8.89
1180	505 - Colleponi	2020-09-26	-0.07	3.40
1181	7 - Musone	2020-09-30	0.24	0.57
1182	355 - Mercatale	2020-10-02	0.26	0.06
1183	106 - Acqualagna	2020-10-02	-0.22	1.62
1186	197 - Porta Cartara	2020-10-14	0.28	0.42
1187	25 - Tronto	2020-10-14	0.25	3.48
1188	196 - San Giorgio all'Isola	2020-10-14	0.08	0.34
1189	194 - Pontelatrave	2020-10-15	0.31	1.99
1190	192 - Madonna dell'Uccelletto	2020-10-15	0.19	1.25
1209	356 - S Angelo in Vado via Canale	2020-11-17	0.98	4.39
1210	355 - Mercatale	2020-11-17	0.56	1.96
1211	106 - Acqualagna	2020-11-17	0.31	21.79

Table 2: flow measurement realized in year 2021- period January-July

ID flow measurement	Station number and name	Date	Water level [m]	Discharge [m ³ s ⁻¹]
1291	355 - Mercatale	2021-03-17	0.55	1.93
1290	356 - S Angelo in Vado via Canale	2021-03-17	0.92	3.05
1289	350 - Pontedazzo	2021-03-17	0.33	0.986
1299	406 - Porto Recanati	2021-04-08	0.86	5.306
1298	126 - Fiastrone	2021-04-08	0.22	0.815
1308	356 - S Angelo in Vado via Canale	2021-04-28	0.93	3.41
1307	355 - Mercatale	2021-04-28	0.66	3.6
1321	126 - Fiastrone	2021-05-29	0.18	0.561
1320	194 - Pontelatrive	2021-05-29	0.3	2.11
1319	9 - Potenza 1	2021-05-29	0.48	3.99
1330	5 - Camponococchio	2021-06-29	0.00	1.03
1331	5 - Ributino	2021-07-06	0.08	1.064



Fig. 1 Flow measurement at Mercatale station (Foglia basin)



Fig. 2 Flow measurement at Camponocecchio station (Esino basin)



Fig. 3 Flow measurement at Pontelatrave station (Chienti basin)



Riepilogo misura di portata

Nome sito	Mercatale
Numero sito	355
Operatore	Sini Iazzeri
Nome file	Mercatale_20201002-100615.ft
Commento	A valle

Orario inizio	02/10/2020 09:39	Tipo di sensore	Impostazione dall'alto
Orario fine	02/10/2020 10:04	N # seriale	FT2H1648011
Start location latitude	43,767	Seriale sonda	FT2P1647004
Start location longitude	12,464	Versione firmware	1.23
Motore di calcolo	FlowTracker2	Versione software	1.3

# Verticali	Intervallo di calcolo della media (s)	Portata totale (m³/s)
18	40	0,056

Larghezza totale (M)	Superficie totale (m²)	Wetted Perimeter (M)
5,300	1,647	5,446

SNR medio (dB)	Profondità media (M)	Velocità media (m/s)
43,552	0,311	0,034

Temperatura media (° C)	Max depth (M)	Max velocity (m/s)
16,037	0,500	0,054

Incertezza Portata		
Categoria	ISO	IVE
Precisione	1,0%	1,0%
Profondità	0,2%	1,9%
Velocità	0,6%	3,6%
Larghezza	0,1%	0,1%
Metodo	2,0%	
# Verticali	2,8%	
Generale	3,6%	4,2%

Equazione della portata	Sezione centrale
Incertezza portata	IVE
Riferimento portata	Nominale

Impostazioni raccolta dati	
Salinità	0,000 PSS
Temperatura	-
Velocità del suono	-
Correzione del montaggio	0,000 %

Riepilogo generale

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Avvisi controllo di qualità

Fig. 4 Example of flow measurements summary report – section A



Riepilogo misura di portata

Nome sito	Mercatale
Numero sito	355
Operatore	Sini Iazzeri
Nome file	Mercatale_20201002-100615.ft
Commento	A valle

Impostazioni avvisi verticale	
Station discharge OK	Scarico di stazione < 5,000%
Cautela sulla portata del pannello	5,000% >= Scarico di stazione < 10,000%
Massima portata della verticale	Scarico di stazione >= 10,000%

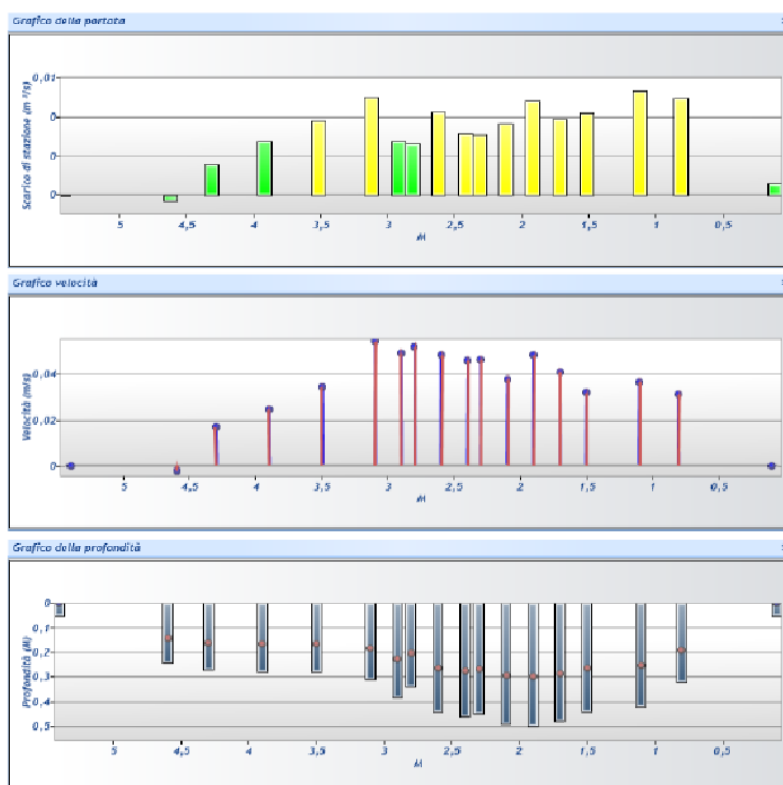


Fig. 5 Example of flow measurements summary report – section B

3. Rating Curve

Rating curve is the relationship that allows to correlate a water level high to the river discharge . It is needed to transform recorded water level meters in flow passing through a river section.

Public procurement for stage discharge relationships definition on 5 stations (Ributino, Ponte degli Schiavi, Tenna, Tesino, Tronto) was awarded the 13th of May 2021 From 20th to 23th of June awarded company started surveys and measurements and provided output.

Technical reports were updated in December 2021 when a relevant flood event took place and higher measurements could be realized.

Flow measurements, topographic surveys, hydraulic model were achieved and implemented in order to estimate rating curve in the river section close to five relevant water level sensors, already installed and part of the regional monitoring network.

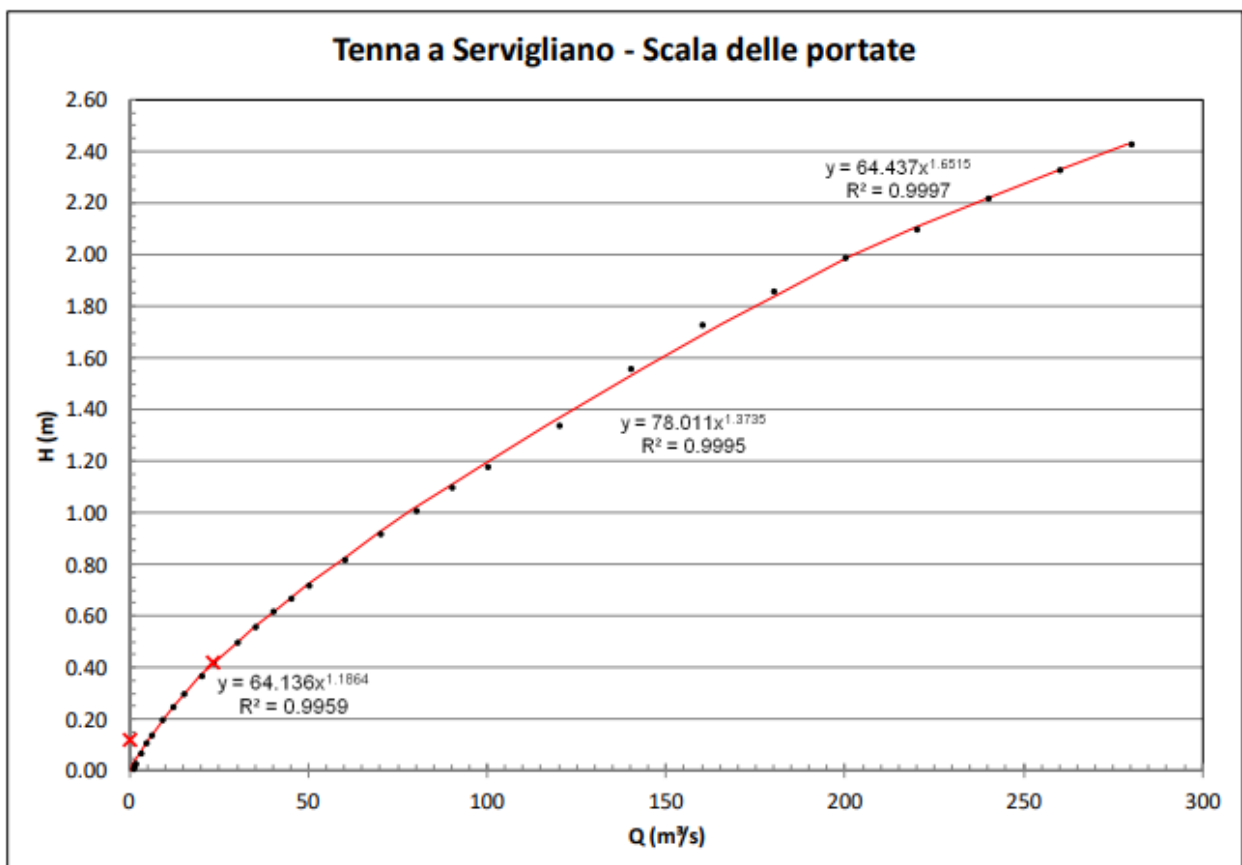


Fig. 6 Example of rating curve – Tenna station

Example of one of the five rating curve reports provided is available as ANNEX 1.

4. Conclusion

In order to better calibrate hydrological modelling, a campaign of flow measurement was set up and rating curve on five new relevant water level stations was calculated and implemented to estimate discharge from real time water level recorded data.

Ownership of the new data and formulas are by Marche Region. Flow data and rating curve formulas could be freely downloaded and available at <http://app.protezionecivile.marche.it/sol>.

5. Annex

- d.5.1.4_Annex1.pdf