Tecniche innovative di misura dei livelli delle portate

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Arpav – U.O. Supporto alla Protezione Civile

Padova, 30 maggio 2024

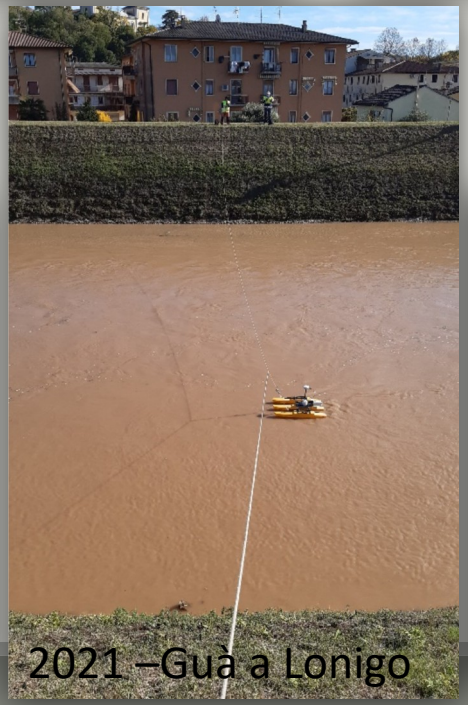
- Importanza delle misure idrologiche livello - portata;
- Misure puntuali di portata:
  - sistemi Doppler: profilatori e misure puntuali radar;
  - tecniche di analisi video;
- Applicazioni per misure di livello-portata in continuo: esempi di recenti installazioni;

Misure con profilatori Doppler

2021 – Adige a Verona

2023 – Sile a Santa Cristina (TV)

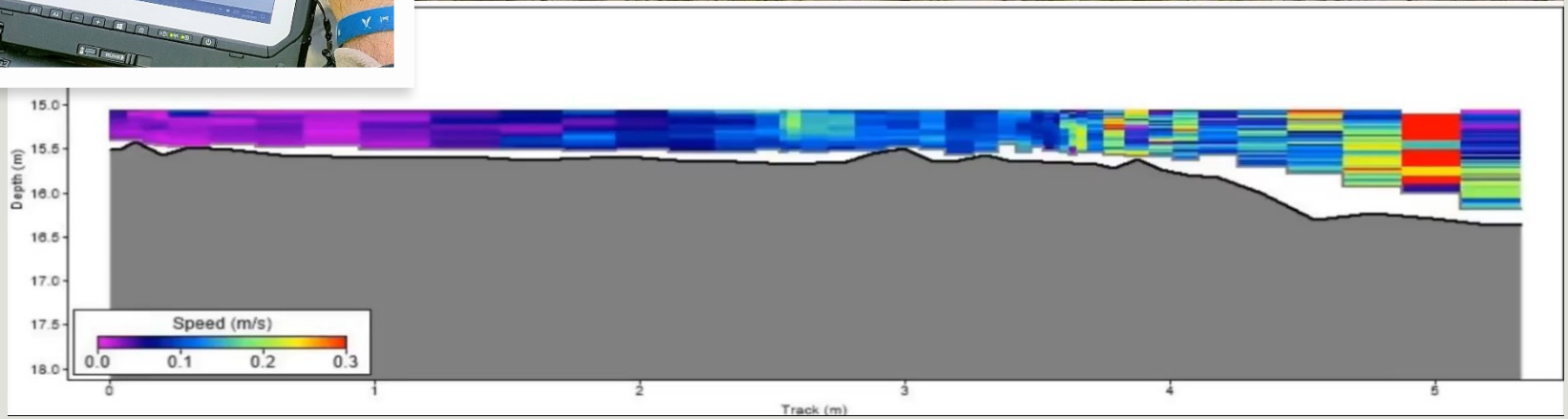
2023 – Delta Po



2021 –Guà a Lonigo

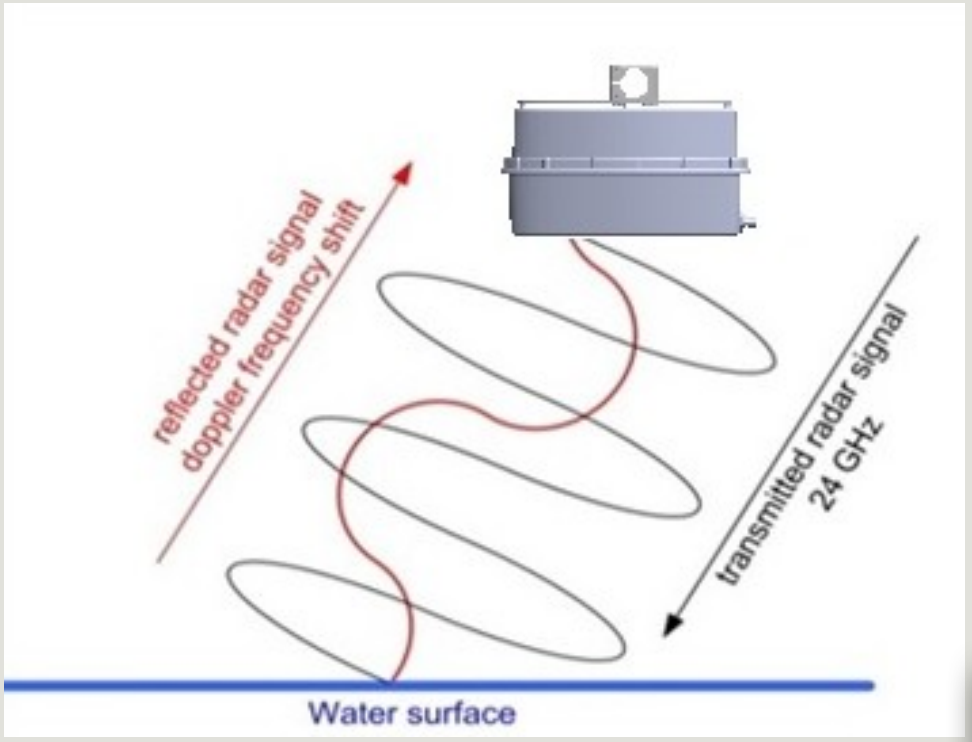
2024 –Brenta a Campolongo

Misure con profilatori Doppler



2017 - Piave a Ponte di Piave

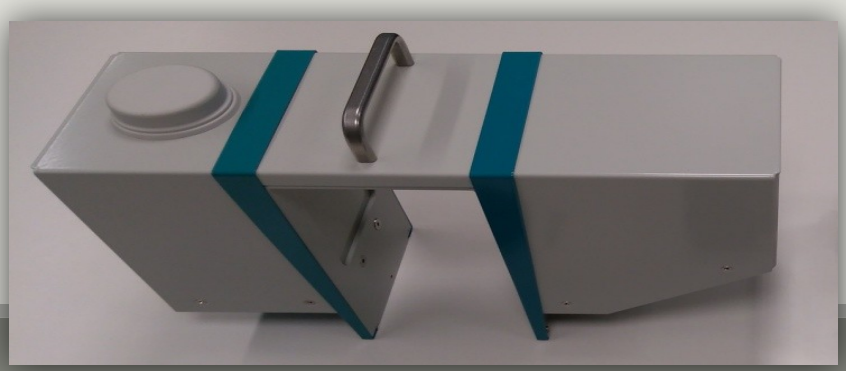
Misuratori radar Doppler non a contatto



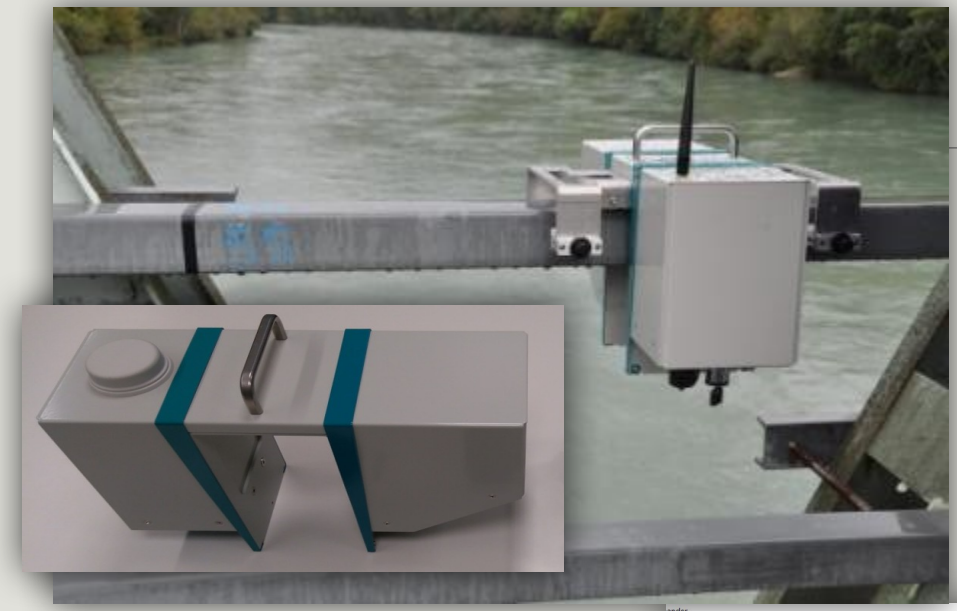
Sfruttano il principio Doppler per la misura della velocità superficiale.

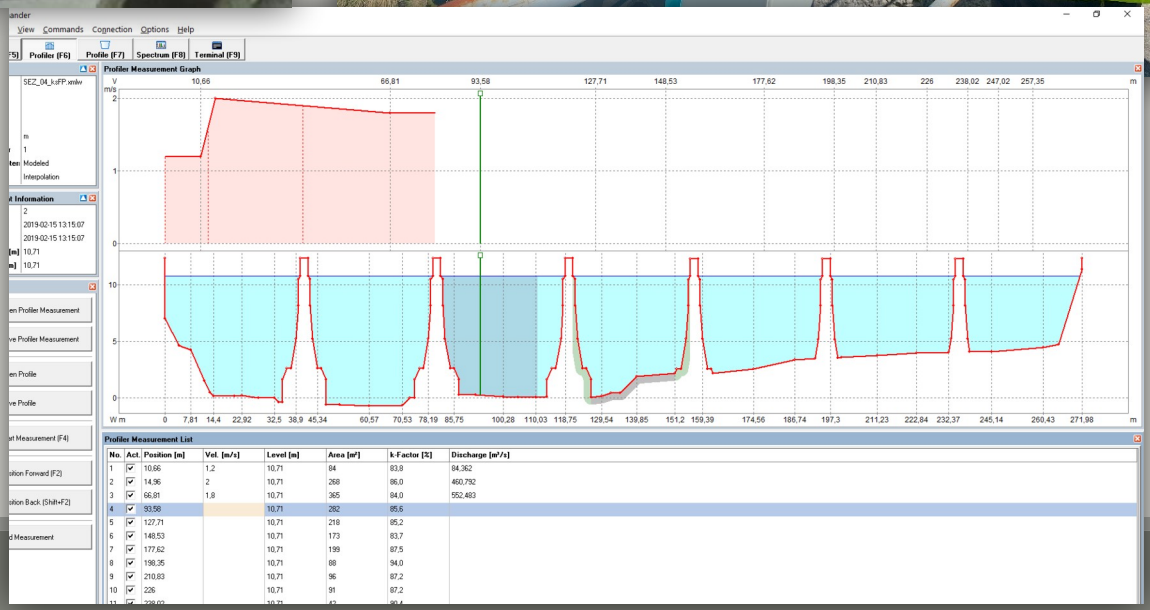
Altezza onda 0.3-0.5 cm

Inclinometro



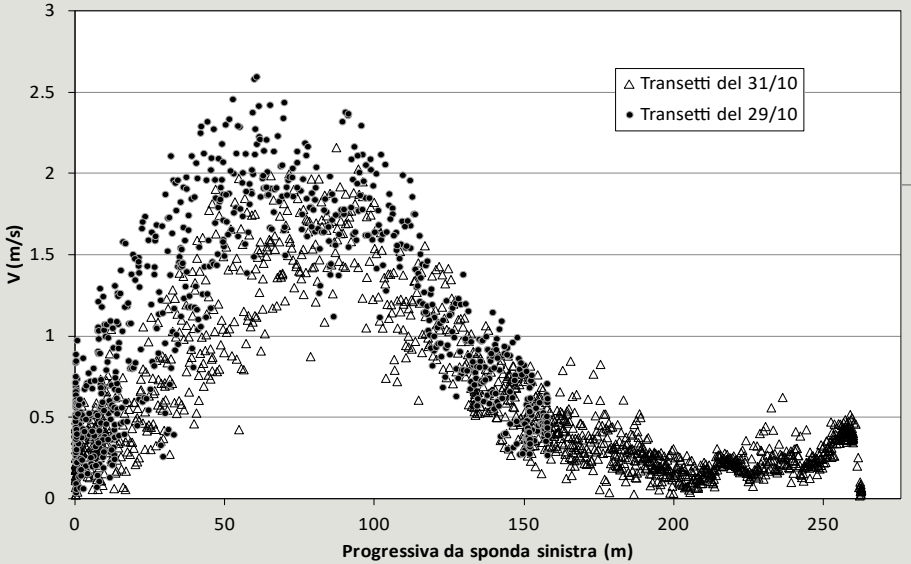
Misure con sensori radar Doppler

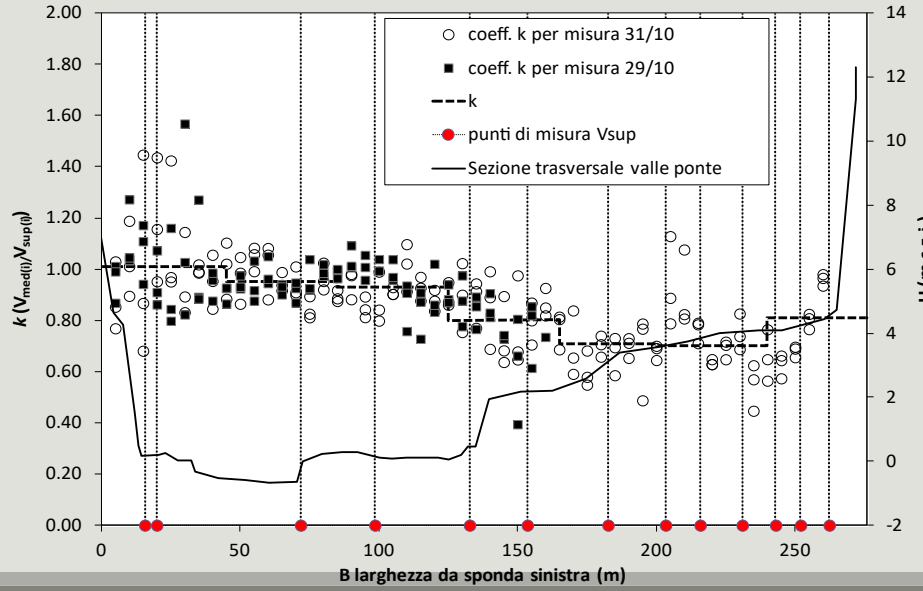




Vmed = k* Vsup

Integrazione di metodologie diverse





ADCP:

1. Estrazione da dati ADCP di valori velocità superficiali e medie sulle verticali;
2. Stima e valutazione variabilità trasversale del rapporto vsup/vmed.

RADAR:

3. Utilizzo di un coefficiente di proporzionalità tra vsup/vmed sito specifico.

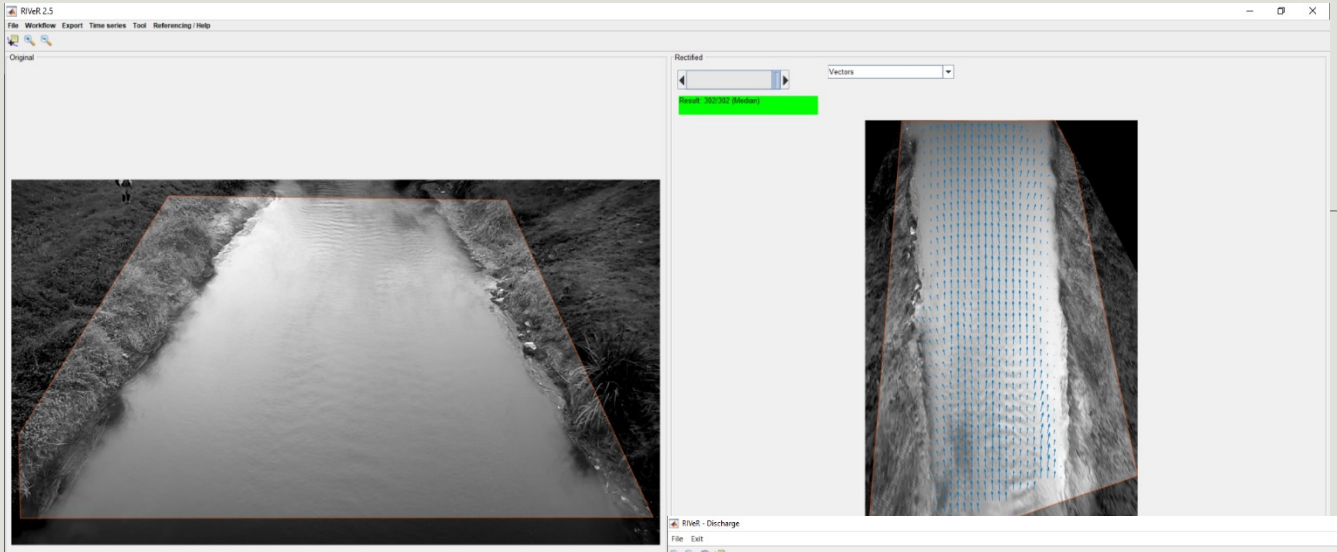
Tecniche di analisi video

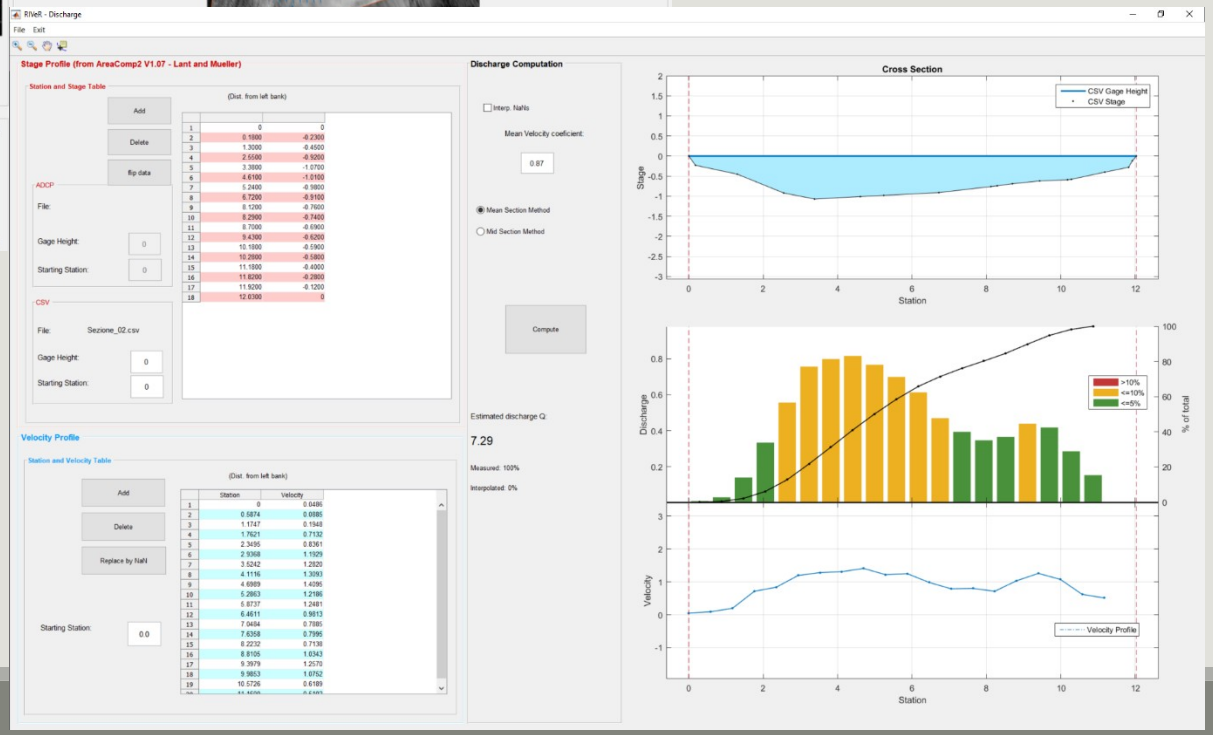
DOI: 10.1016/j.cageo.2017.07.009 Computers & Geosciences (2017)

LSPIV (Large Scale Particle Image Velocimetry)

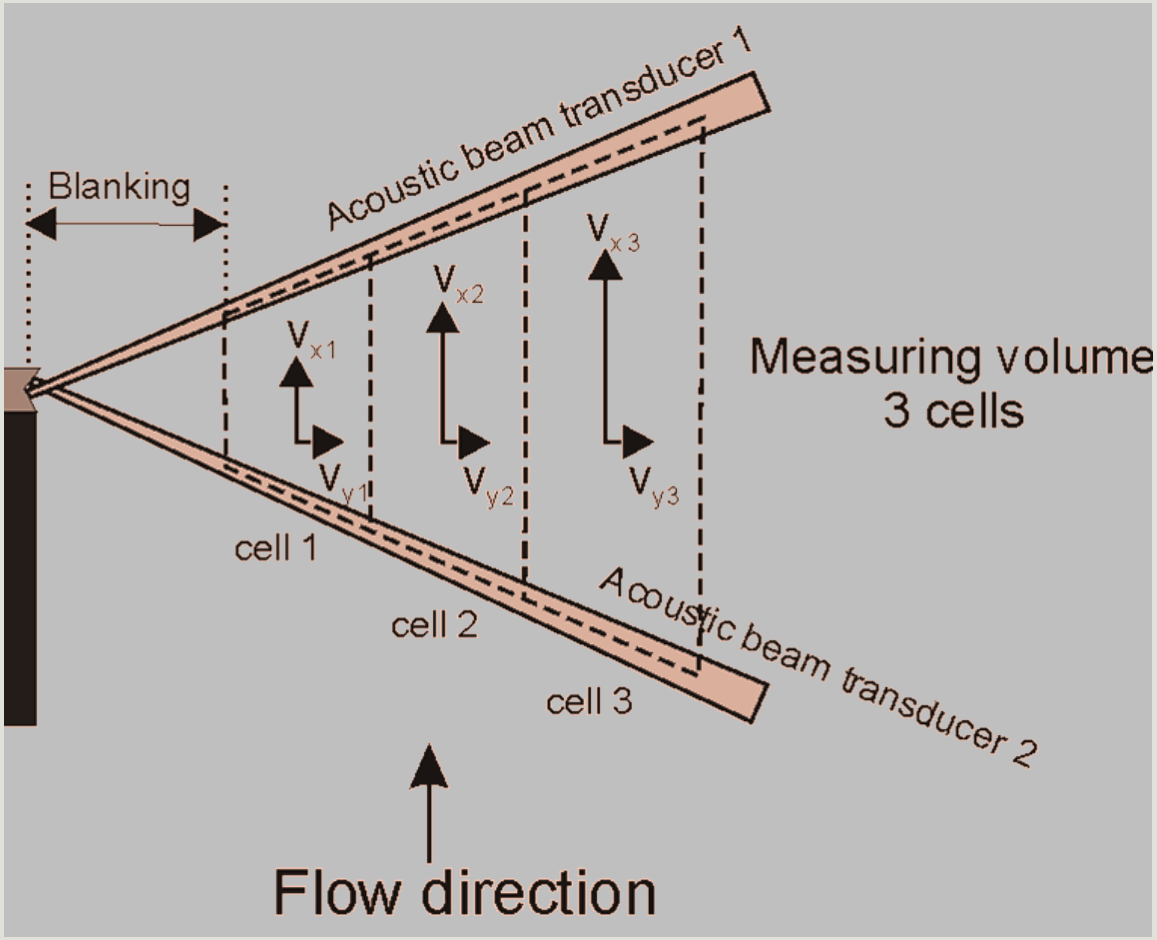
LSPTV (Large Scale Particle Tracking Velocimetry)

Tecniche di analisi video





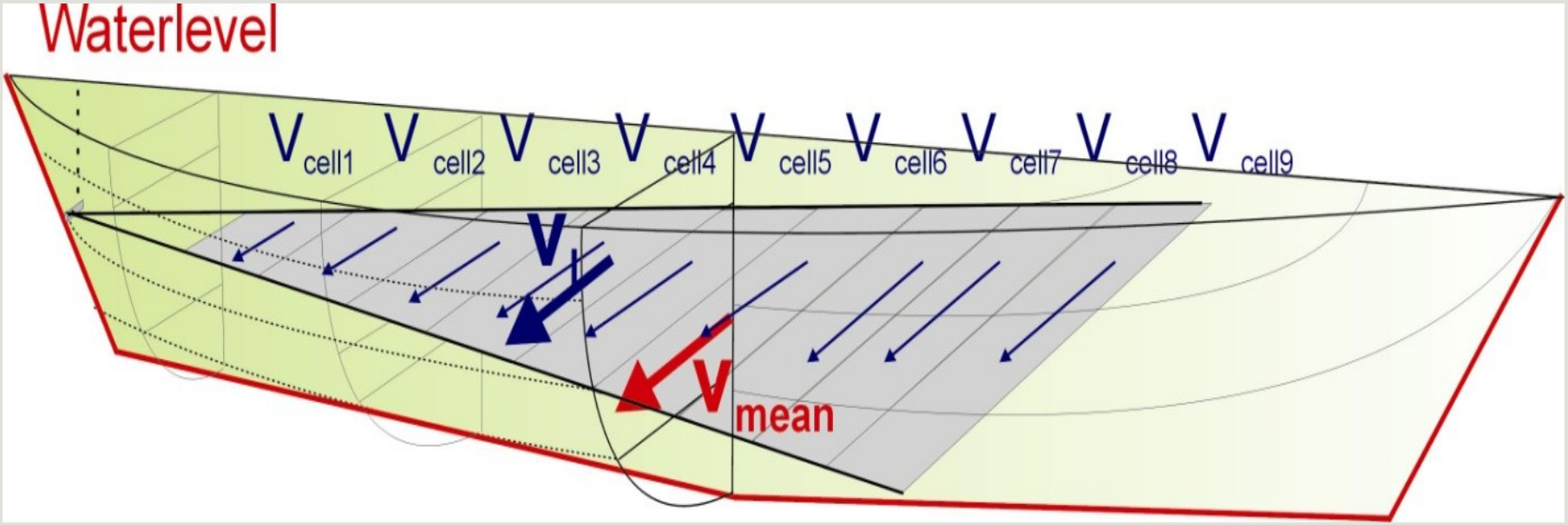
Misure di livello-portata in continuo profilatori Doppler



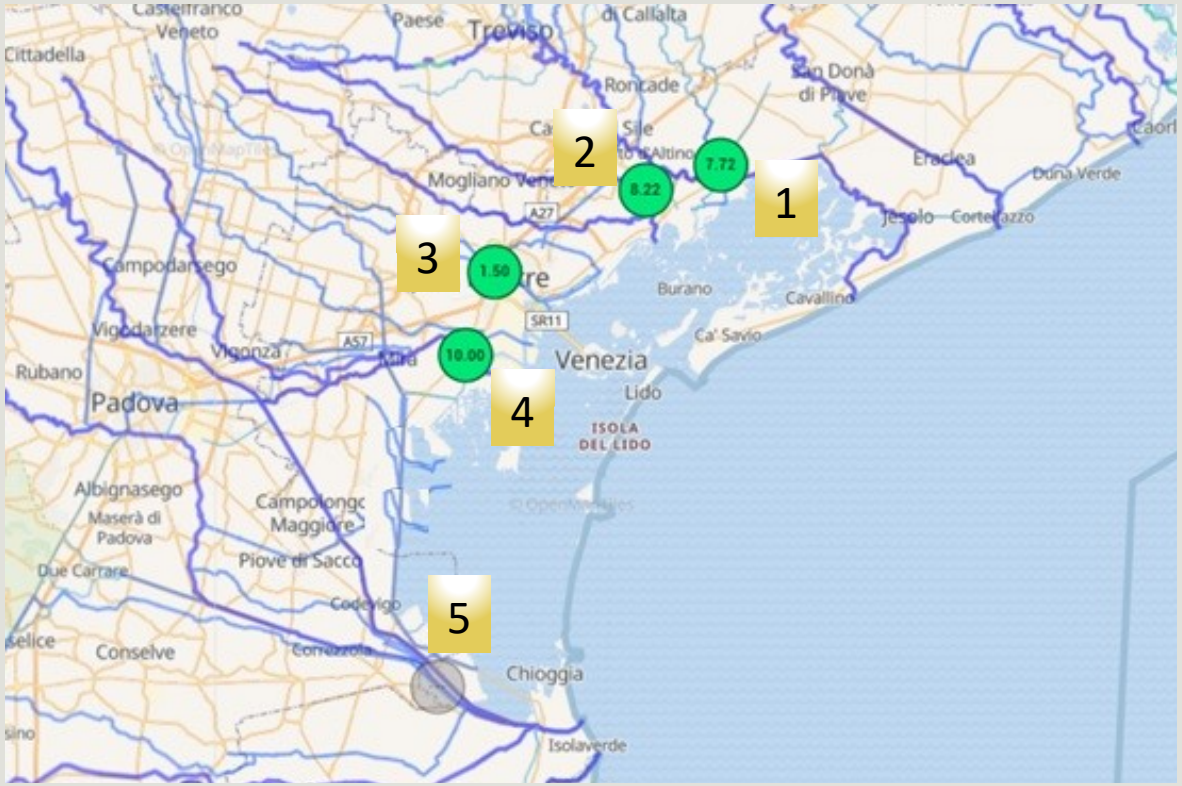
Misure di livello-portata in continuo profilatori Doppler

In una determinata sezione viene effettuata contemporaneamente:

- **Misura del Livello**
- **Misura della Velocità** di 9 celle orizzontali

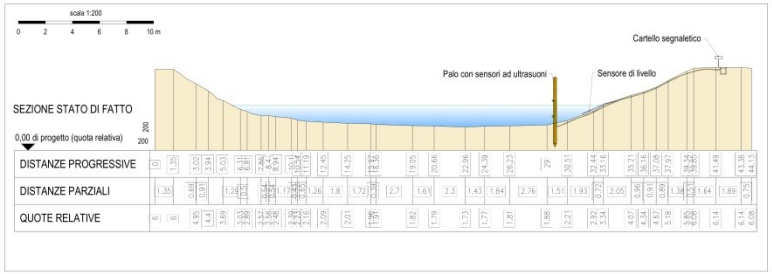


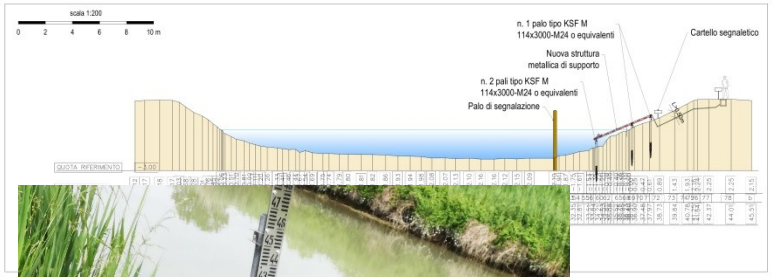
Misure di livello-portata in continuo profilatori Doppler

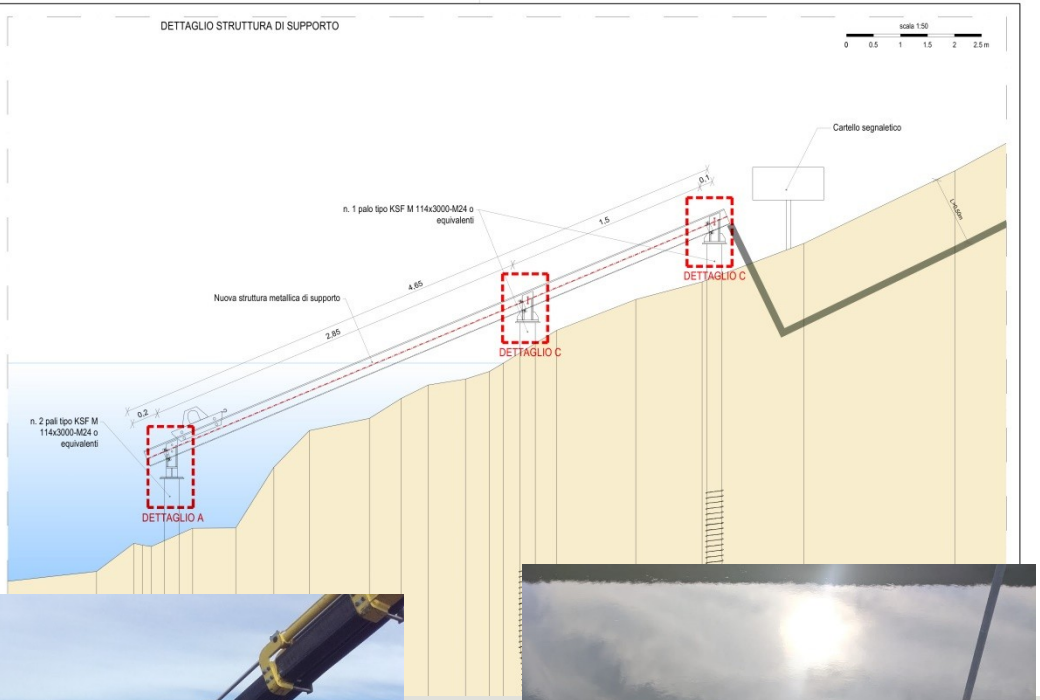


1. Canale Vela a Ponte Vela
2. Zero a Carmason
3. Marzenego a Mestre
4. Naviglio Brenta a Malcontenta
5. Canal Morto a Sostegno Priula

Misure in continuo - profilatori Doppler







Misure in continuo - profilatori Doppler

FASE DI CALIBRAZIONE:

Misure dirette di portata ⇒ Vmed

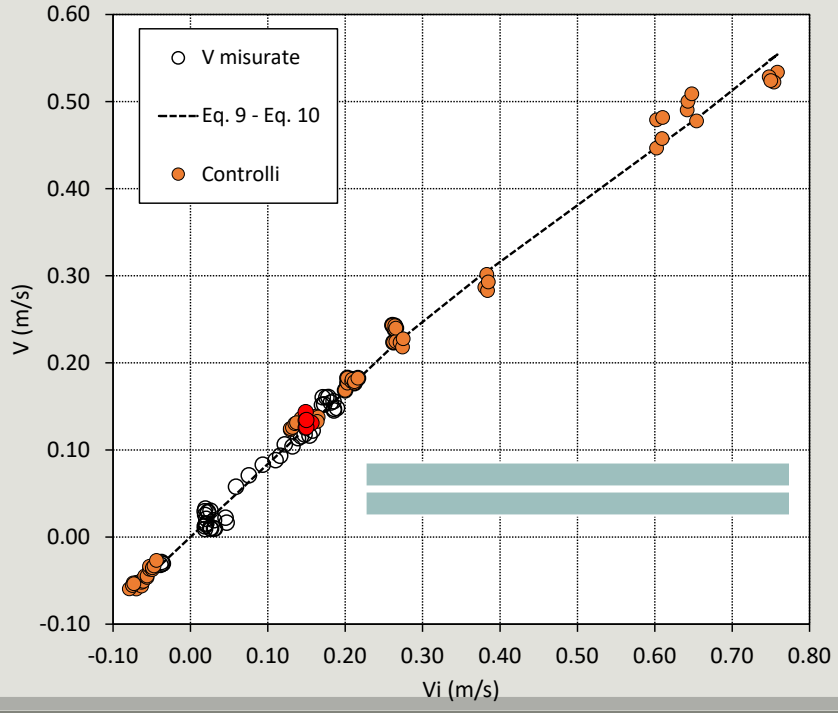
Dati stazioni ⇒ Vi, H

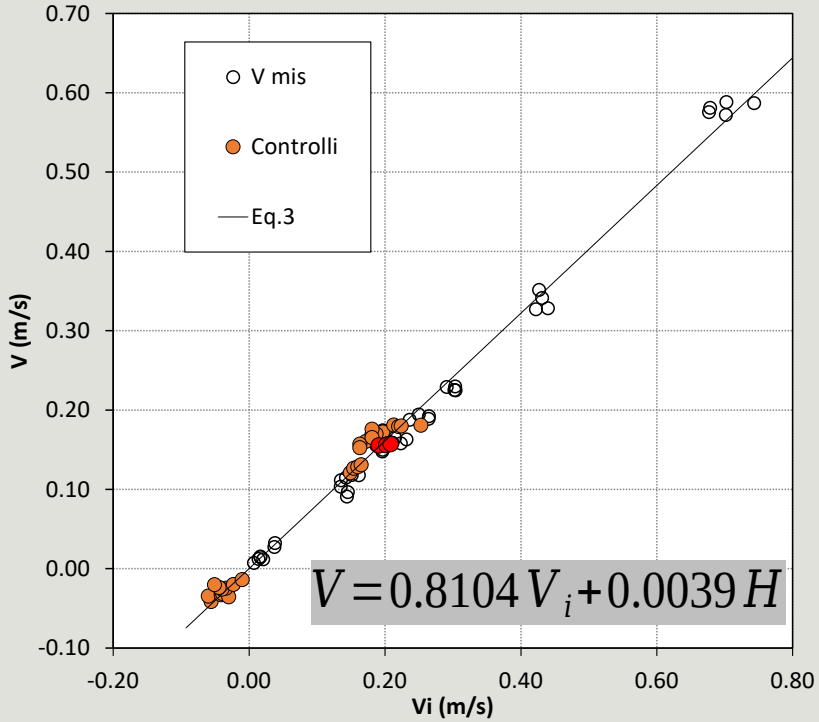
Regressione lineare multipla

Vmed f (H, Vind)

Y = Vmed

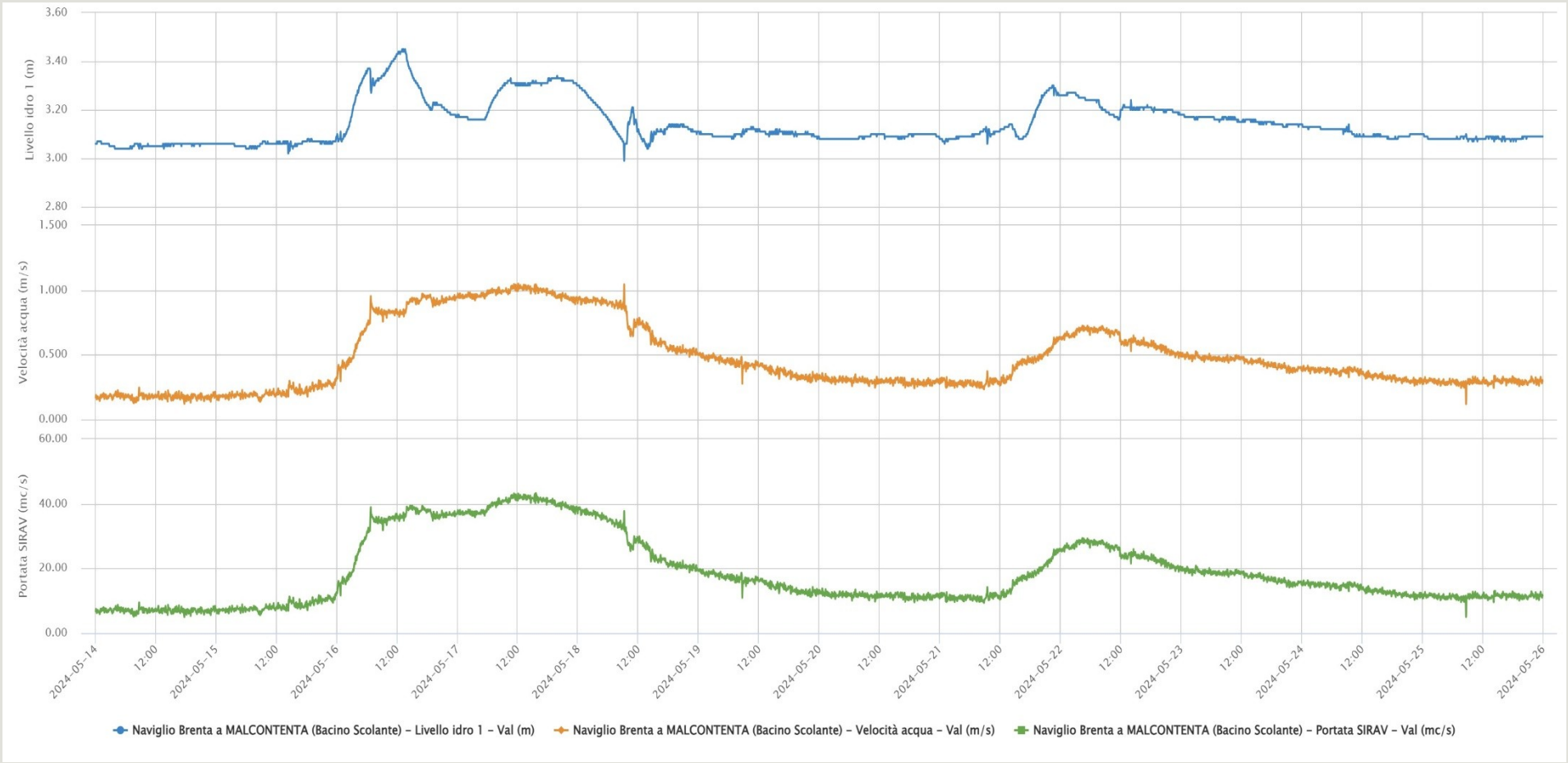
X= (H, Vind)





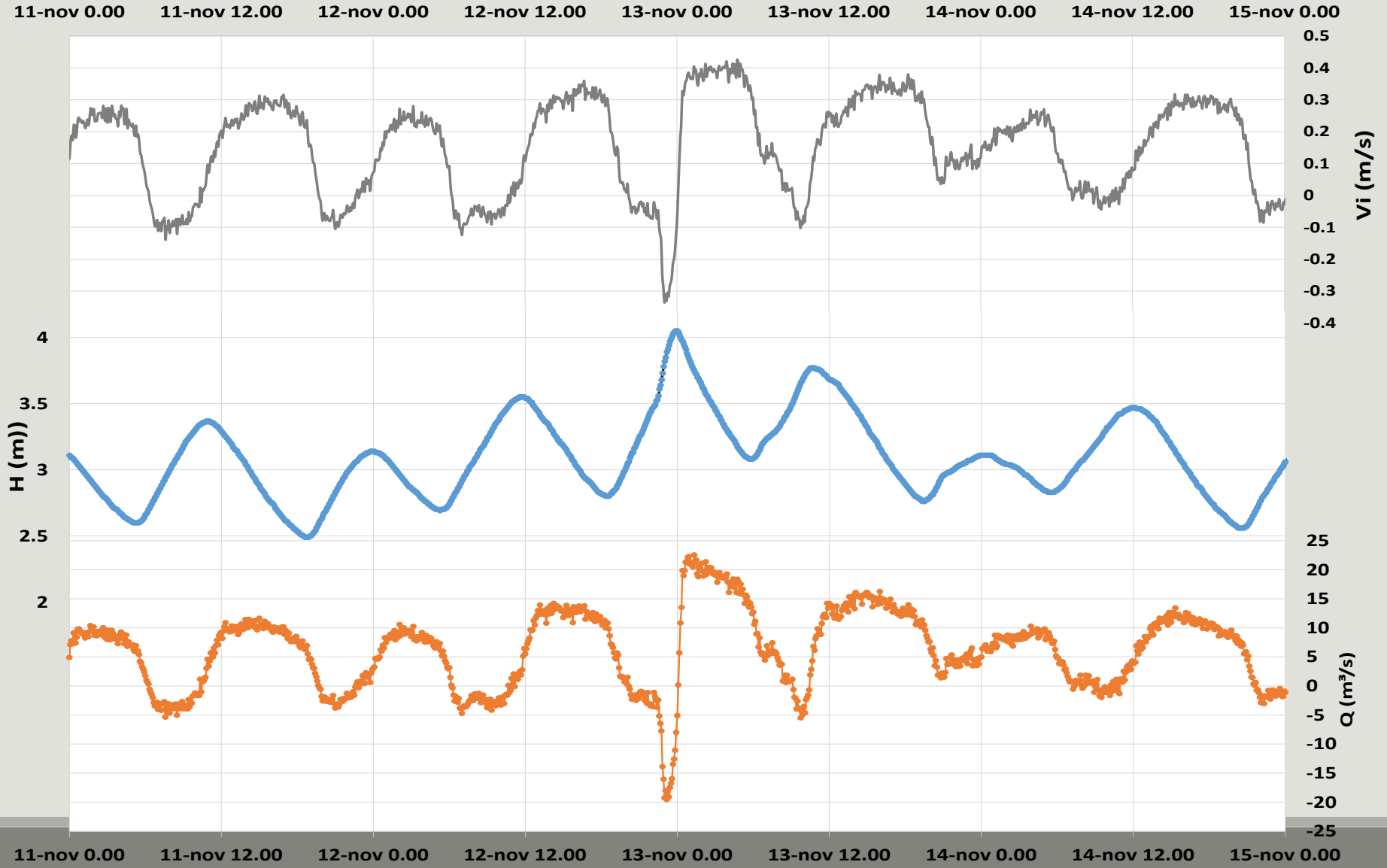
Misure in continuo - profilatori Doppler

Naviglio Brenta a Malcontenta – maggio 2024



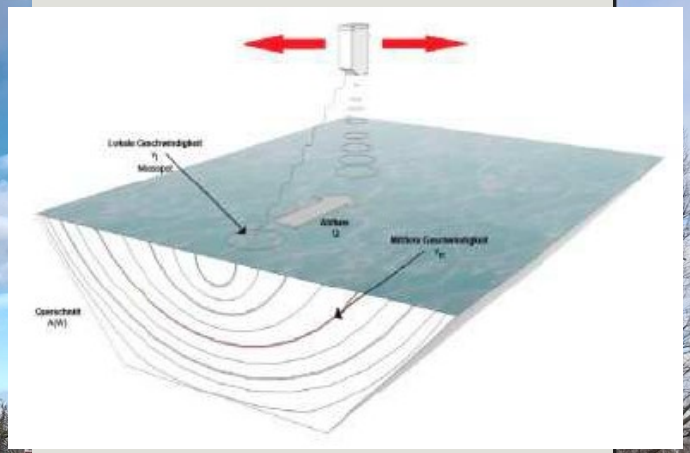
Misure in continuo - profilatori Doppler

Zero a Carmason– novembre 2019



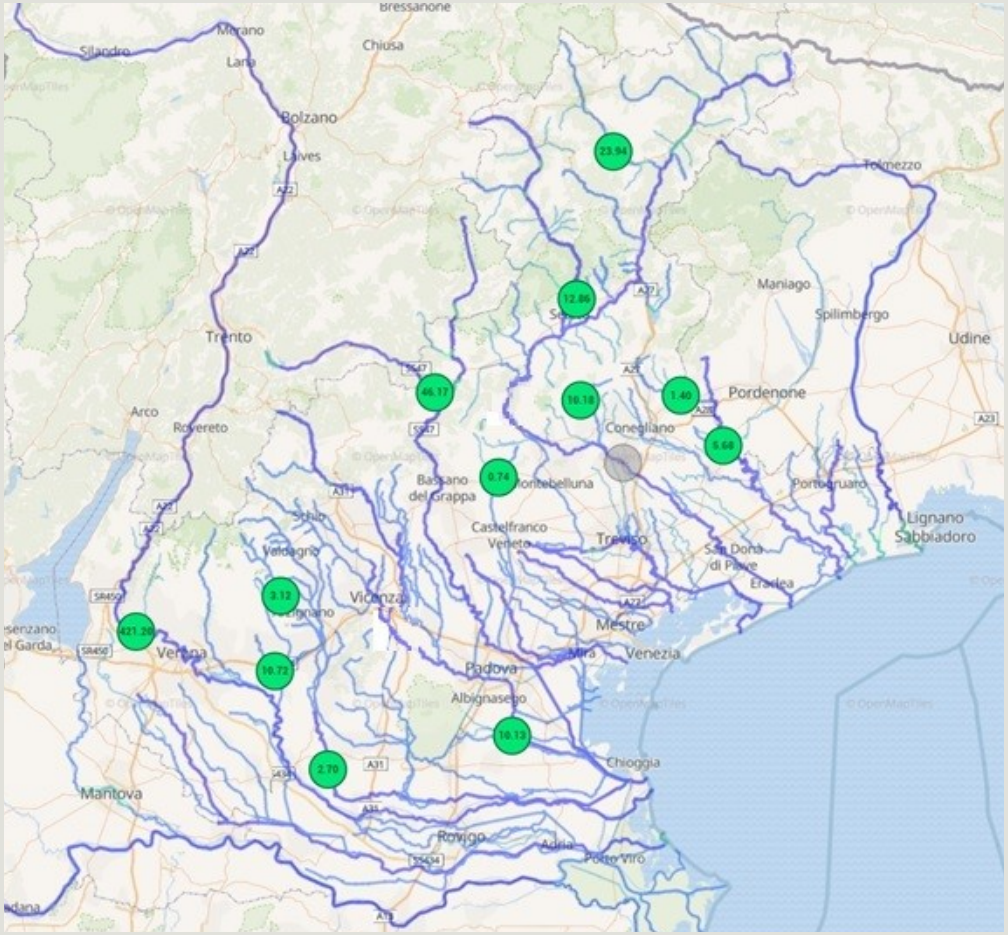
Misure in continuo - radar Doppler

V sup + H + topografia → Vmed + A → Q



Misure in continuo - radar Doppler

Misure in continuo - radar Doppler



1. Boite a Cancia
2. Cordevole a Sass Muss
3. Brenta a Primolano
4. Soligo a Pramaor
5. Muson a Asolo
6. Meschio a Cordignano
7. Livenza a Portobuffolè
8. Chiampo a Chiampo
9. Alpone a San Bonifacio
10. Adige a Pescantina
11. Fratta a San Salvaro
12. Cagnola a Bovolenta
13. Piave a Ponte della Priula??

Variabilità di condizioni!!

Misure in continuo - radar Doppler

FASE DI CALIBRAZIONE:
Misure dirette di portata → Vmed
Dati stazioni → Vi, H

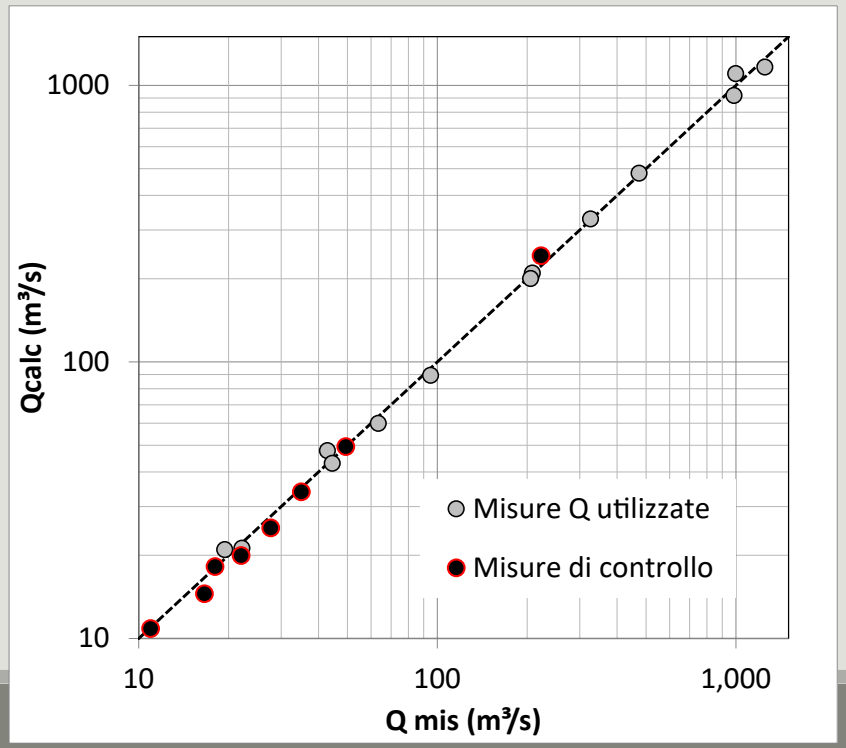
Regressione lineare multipla
Vmed f (H, Vind)
Y = Vmed
X= (H, Vind)

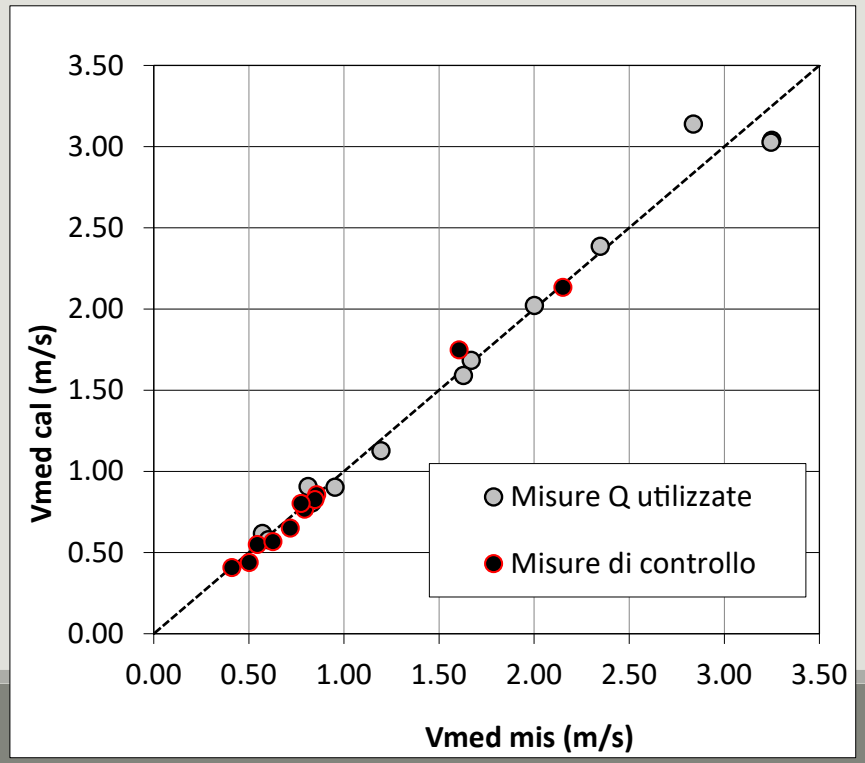
Adige a Pescantina (2019):

1 . Q= A*(0.826*Vi + 0.0912*H)

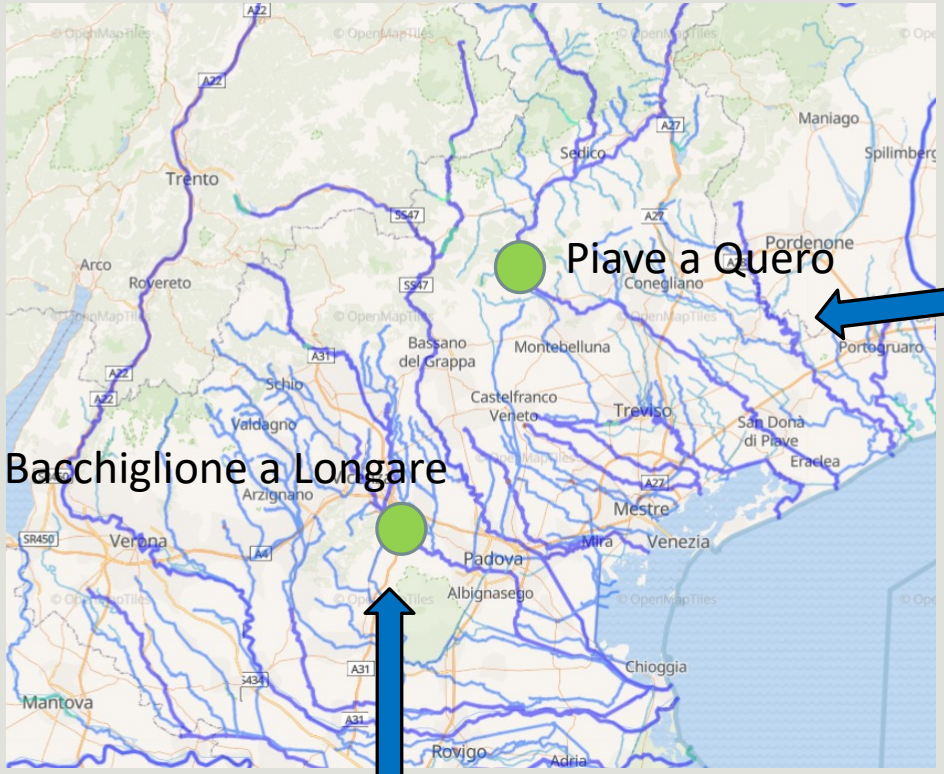
Se Vi <= ((0.945+0.190*H)/0.314)

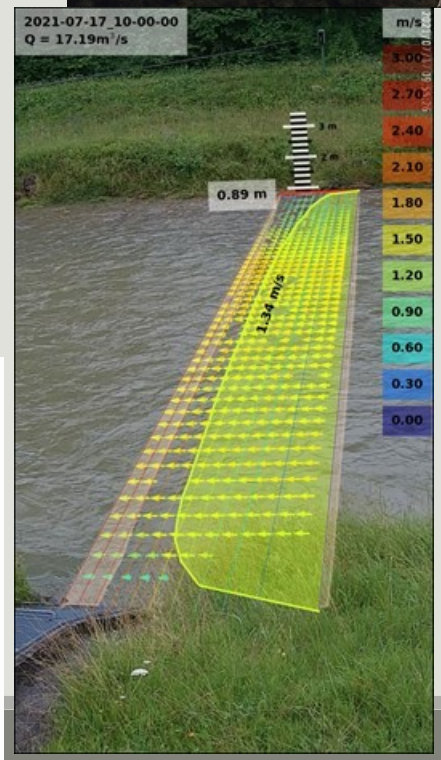
2. Q= A* (0.945 + 0.512*Vi + 0.281*H)





Misure in continuo - analisi video





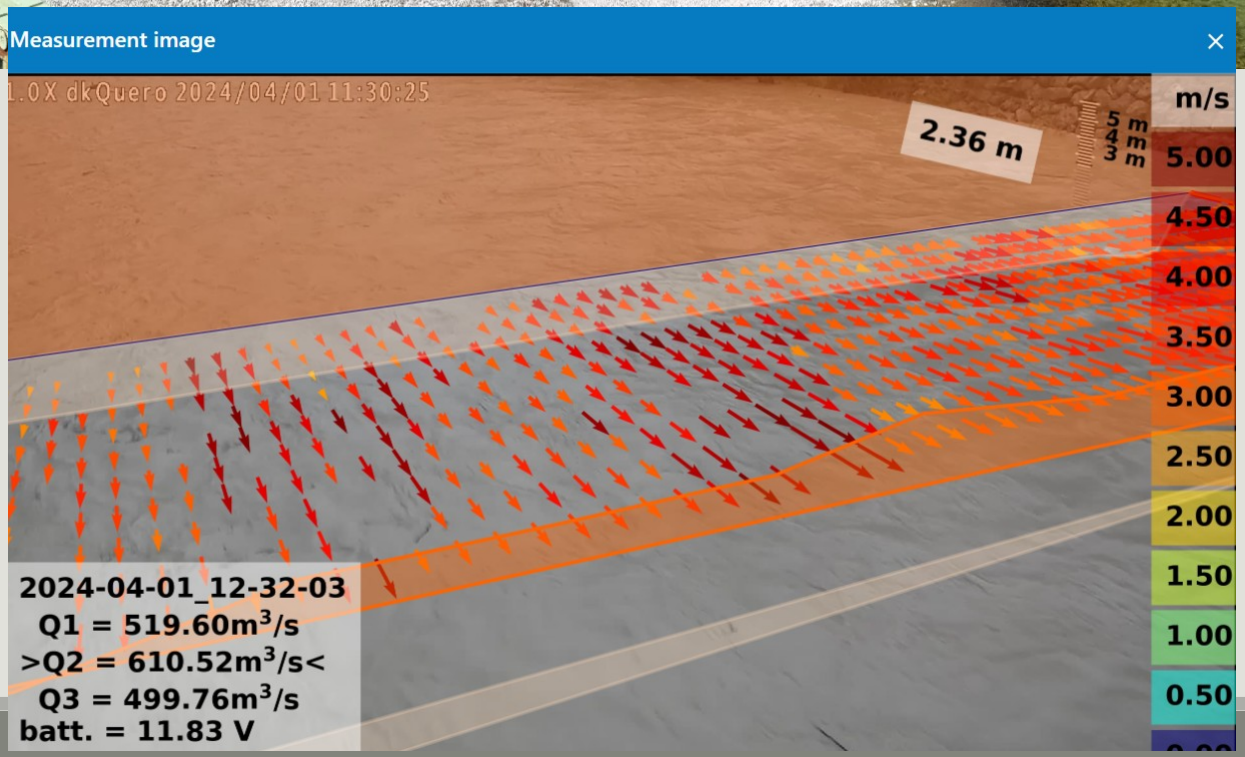
Vmedia su verticale

Vmedv= k*Vsup

Vmedv =*f*(ks,y)

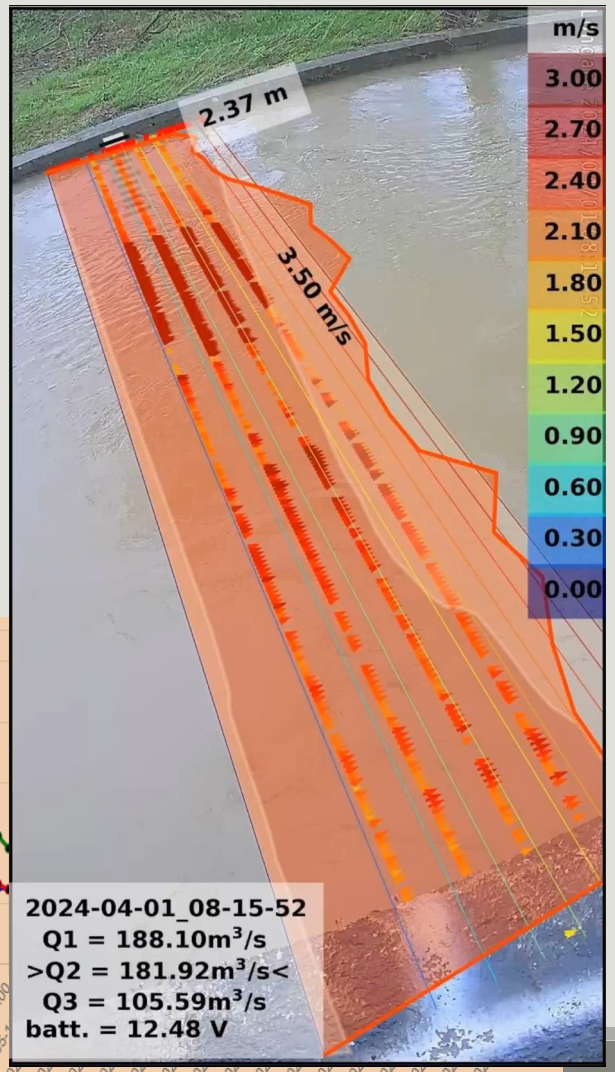
Misure in continuo - analisi video

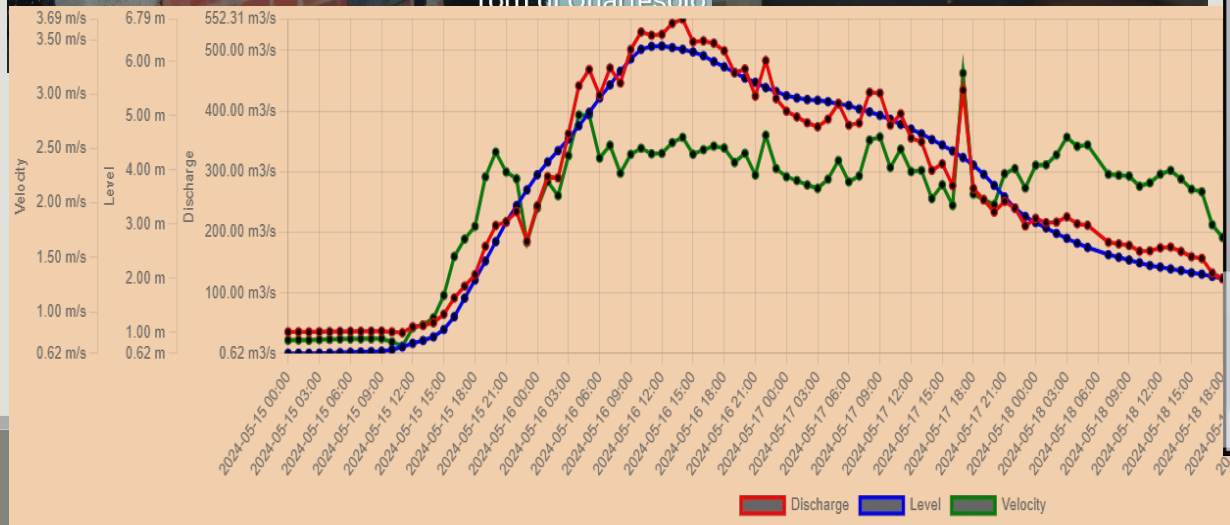
Piave a Quero



Misure in continuo - analisi video

Bacchiglione a Longare





GRAZIE