



Growing
ideas
through
networks

HARMONIOUS
uas for environmental monitoring

Exploring the optimal experimental setup for surface flow velocity measurements using PTV

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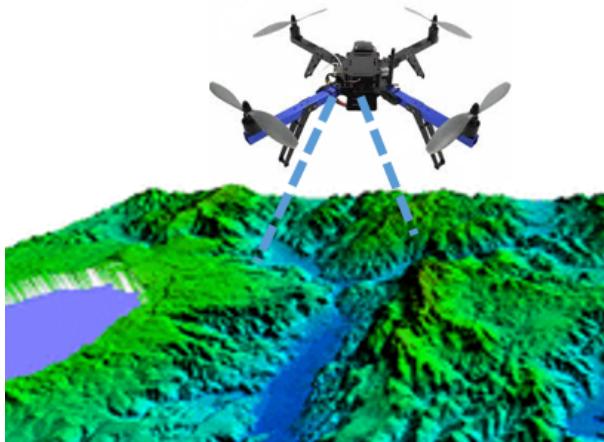
Funded by the Horizon 2020 Framework Programme
of the European Union



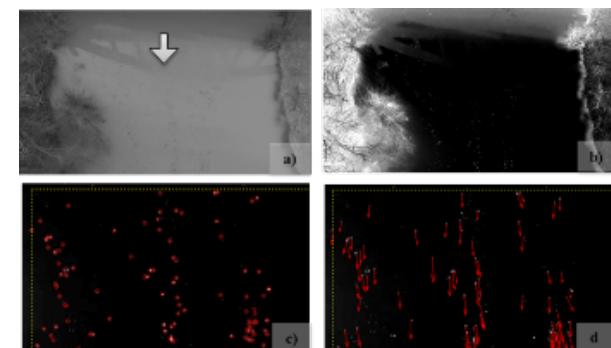
HydroLAB

Motivations & Objectives

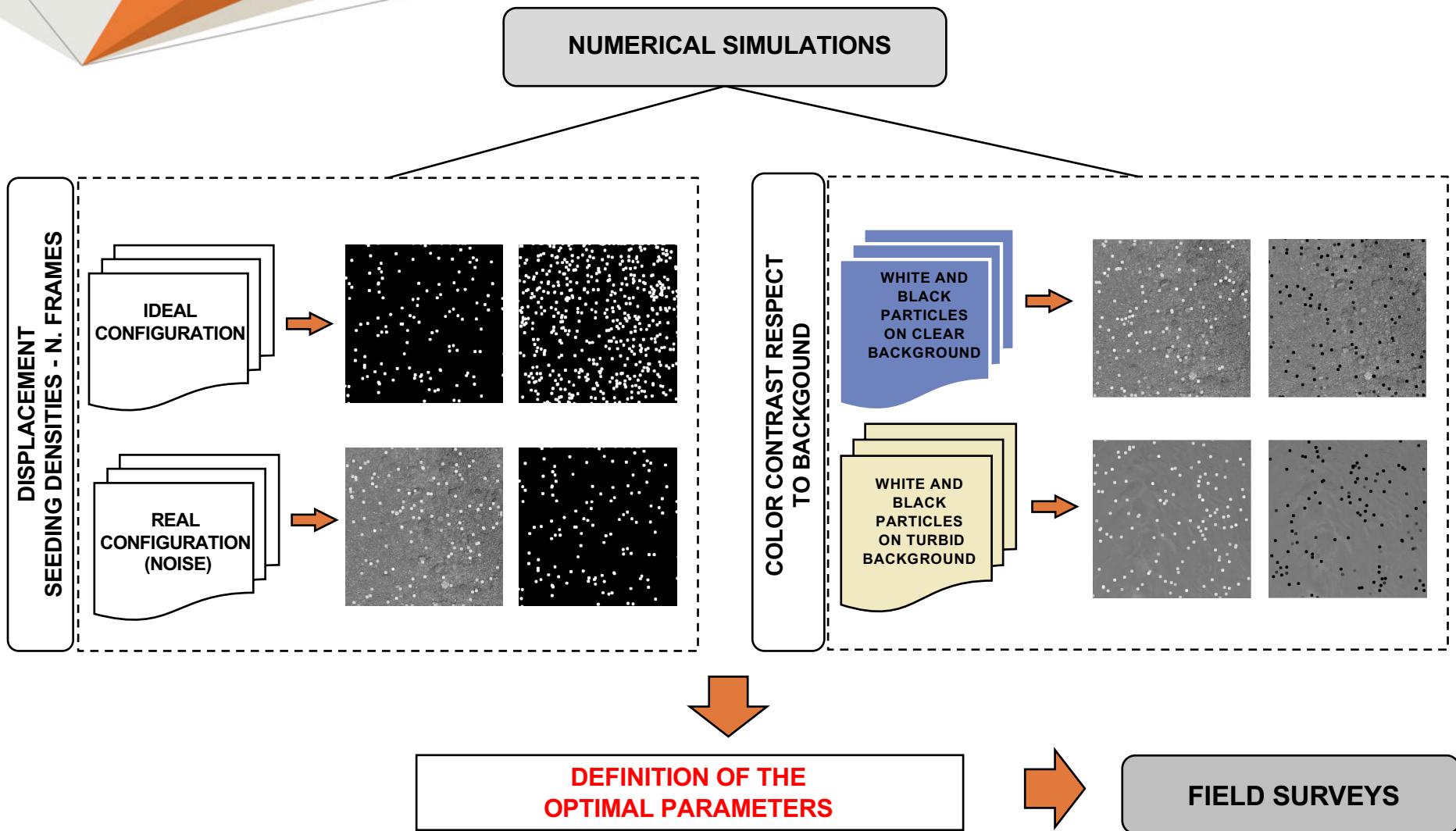
The influence of environmental conditions and technical settings
on image processing techniques



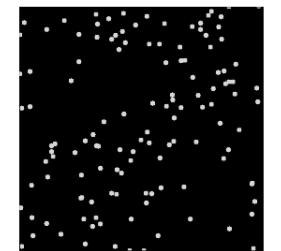
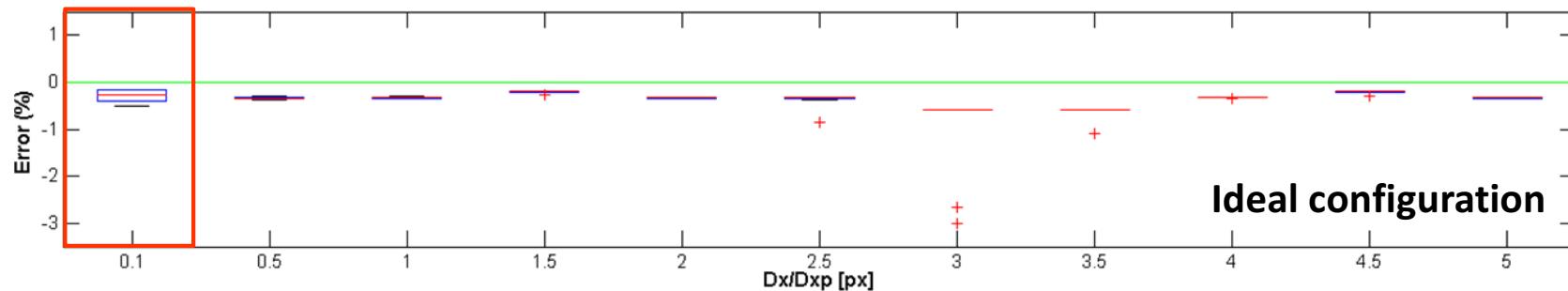
- ✓ Investigate the optimal parameters for **Particle Tracking Velocimetry (PTV)** in terms of particle seeding density, frame rate, and tracer characteristics (size and color) respect to background
- ✓ Define clear guidelines in order to describe accurately the dynamics of surface flow velocity both in space and time using **UASs**



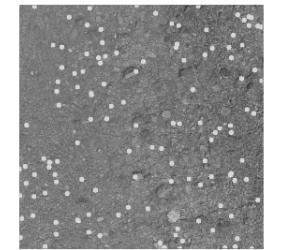
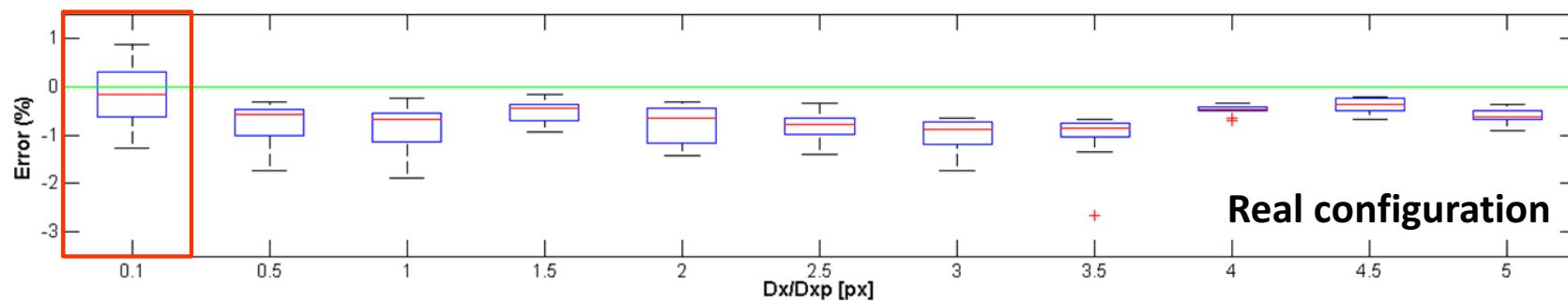
Methodology



Particle displacement



Ideal configuration

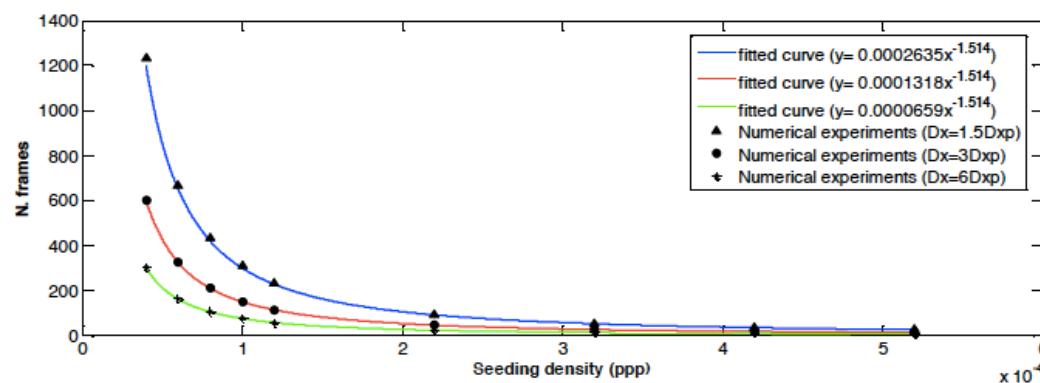
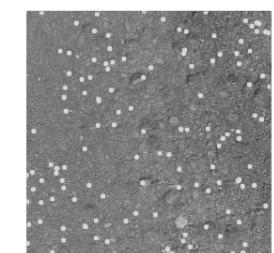
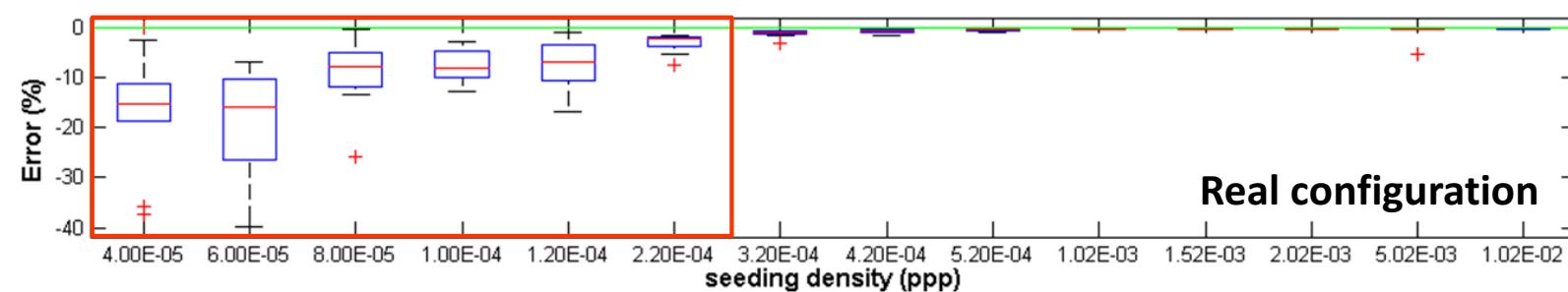
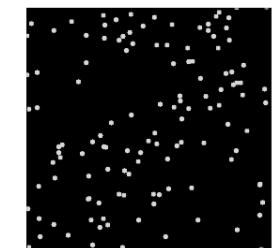
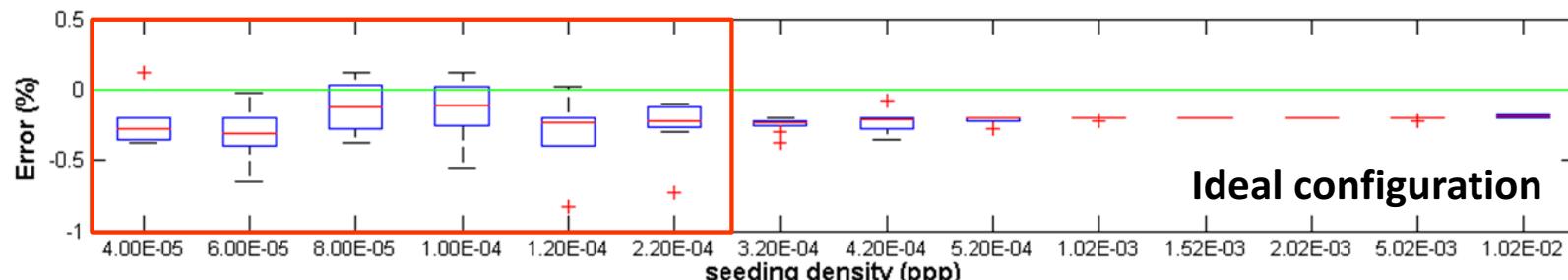


Real configuration

Particle diameter: $D_{xp}=10\text{px}$; Seeding density: $5.2E-04 \text{ ppp}$ – Number of frames: 20

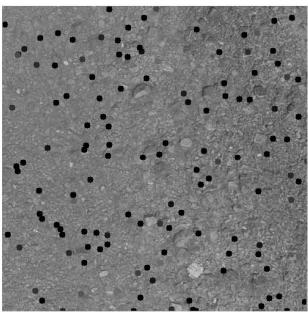
Seeding density

Particle displacement: $D_x=1.5D_{xp}$ – Number of frames: 20



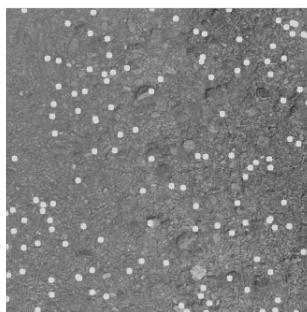
Tracer color contrast

Clear water



MRE (%): -0.53

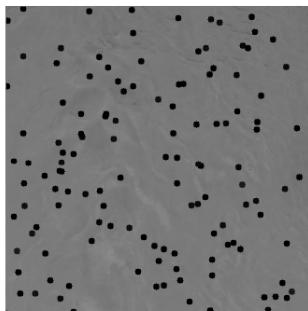
STD.DEV (%): 0.25



MRE (%): -0.52

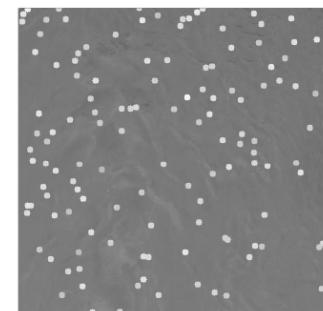
STD.DEV (%): 0.25

Turbid water



MRE (%): -0.21

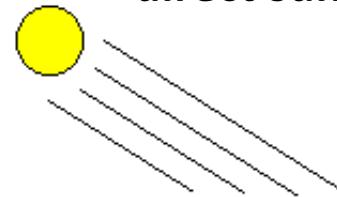
STD.DEV (%): 0.02



MRE (%): -0.21

STD.DEV (%): 0.01

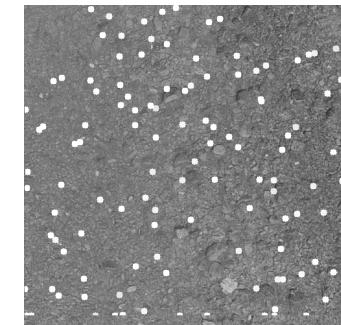
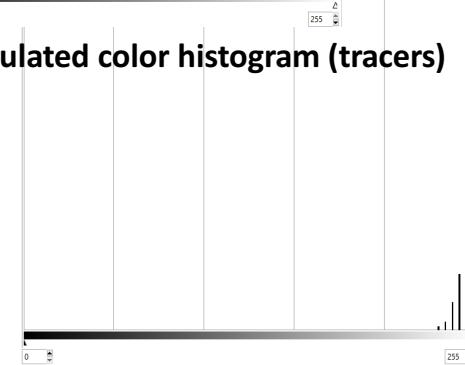
direct sunlight illumination



Real color histogram (tracers)

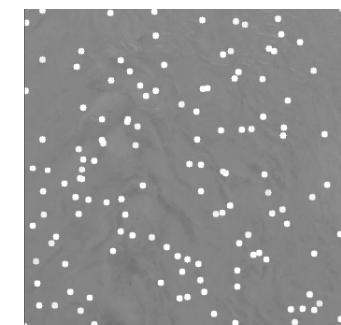


Simulated color histogram (tracers)



MRE (%): -0.20

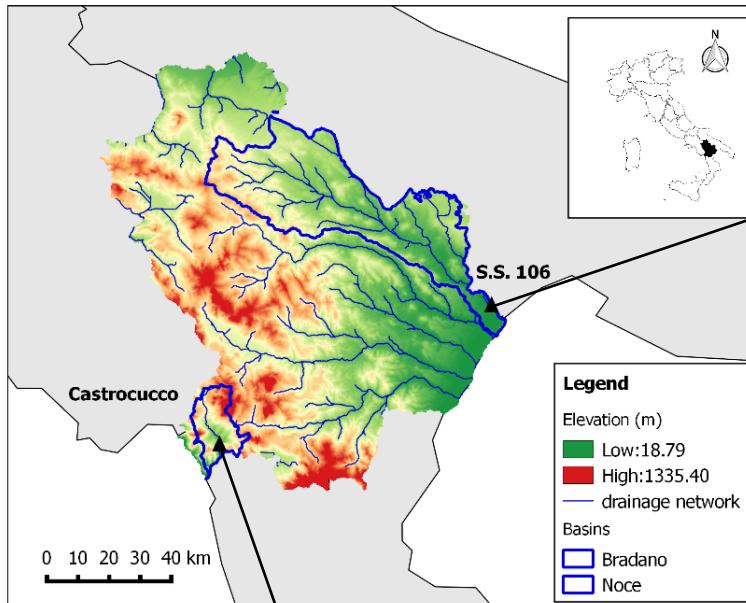
STD.DEV (%): 0.02



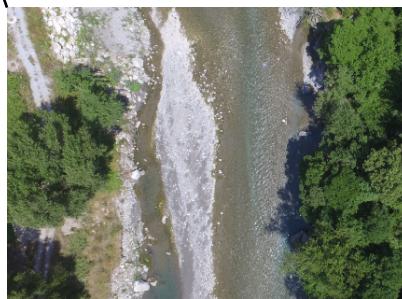
MRE (%): -0.20

STD.DEV (%): 0.02

Field surveys



Noce river
clear water



*Bradano river
turbid water*

Equipment



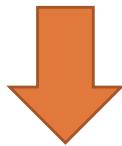
- FHD videos captured at 24 frames DJI Phantom 3 Pro Quadcopter
- Benchmarking velocities estimated using current meters Seba F1



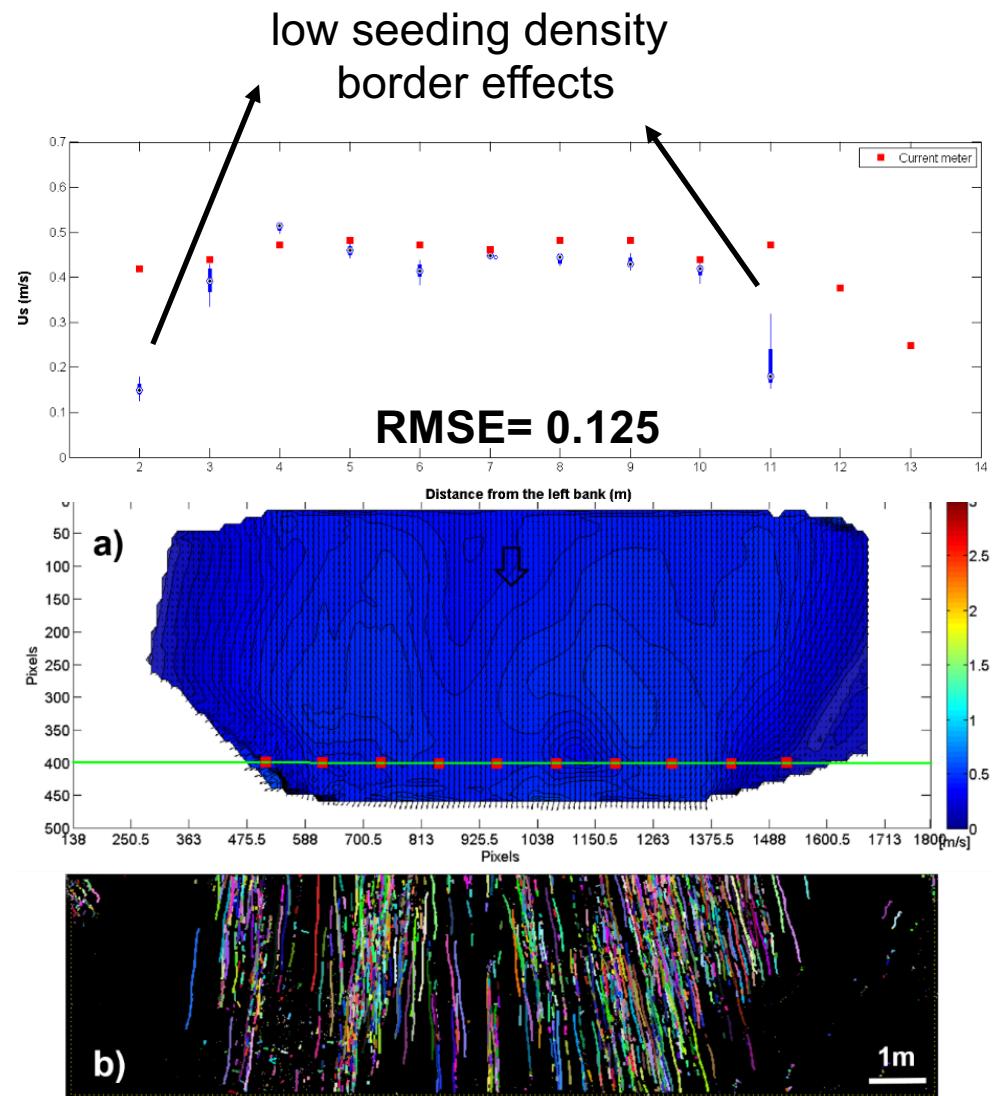
Field Results (1)

Noce river

FHD videos (1920x1080 pixels)
Clear water conditions
Direct sunlight illumination
Mean flow velocity = 0.4m/s
Seeding density: 1.6E-04 ppp



Wood chip tracers; 12 fps; up to 100 frames



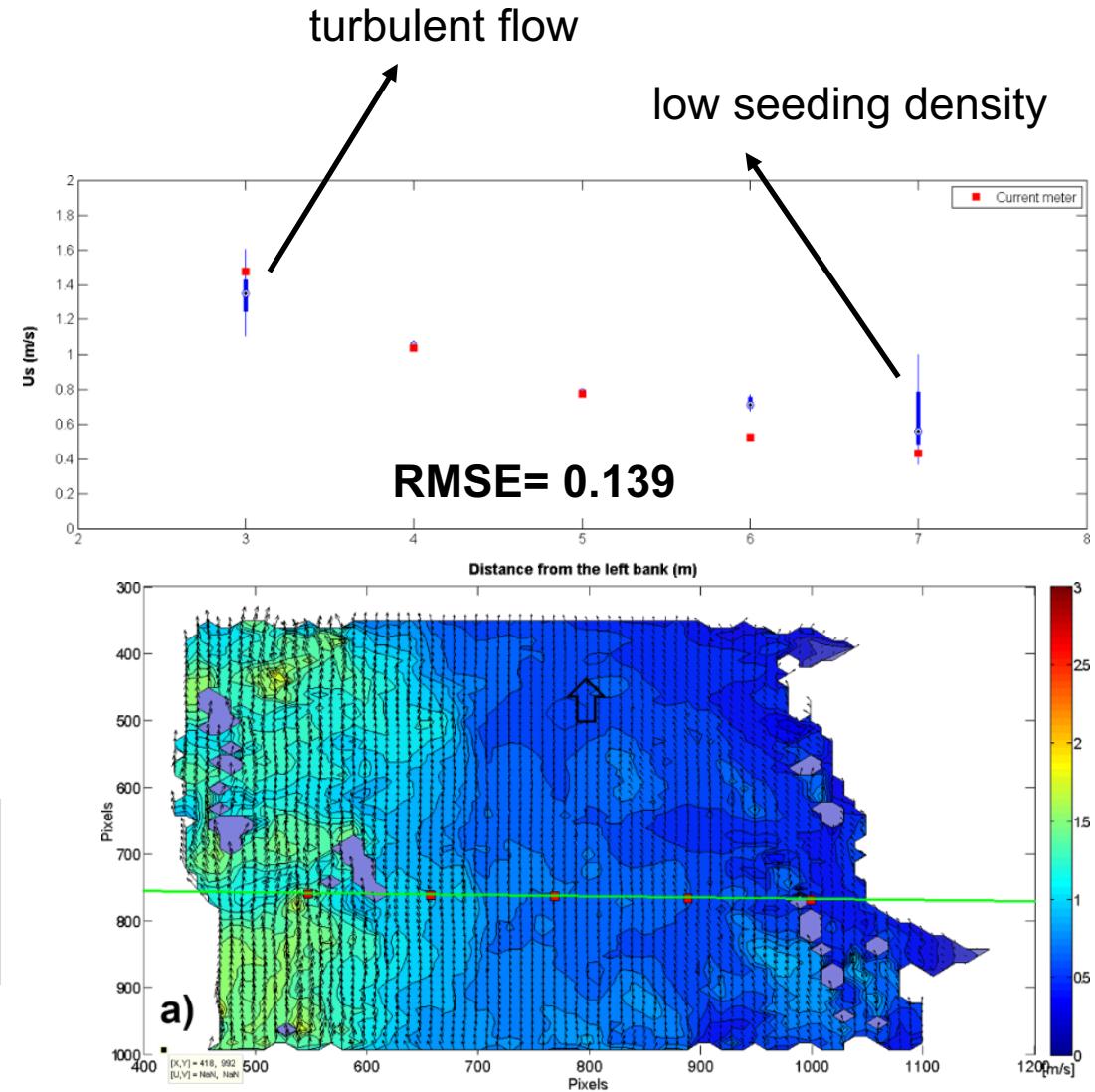
Field Results (2)

Bradano river

FHD videos (1920x1080 pixels)
Turbid water conditions
Mean flow velocity = **0.7 m/s**
Max flow velocity: **1.47 m/s**
Seeding density: **6.5E-04 ppp**



Charcoal tracers; 24 fps; ~ 600 frames



Conclusions

The accuracy of PTV results can be improved through the choice of correct equipment and setting parameters:

- ✓ Temporal image resolution (frame rate)
- ✓ Seeding particle densities and number of frames analyzed
- ✓ Tracer dimensions and color contrast respect to river background

Thanks for your attention...