Università per Stranieri di Perugia

United Nations Educational, Scientific and Cultural Organization · World Water Assessment Programme

CiNiD
CONSORZIO INTERUNIVERSITARIO PER L'IDROLOGIA

DRONES FOR ENVIRONMENTAL MONITORING

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cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

UNIVERSITA' DEGLI STUDI DELLA BASILICATA

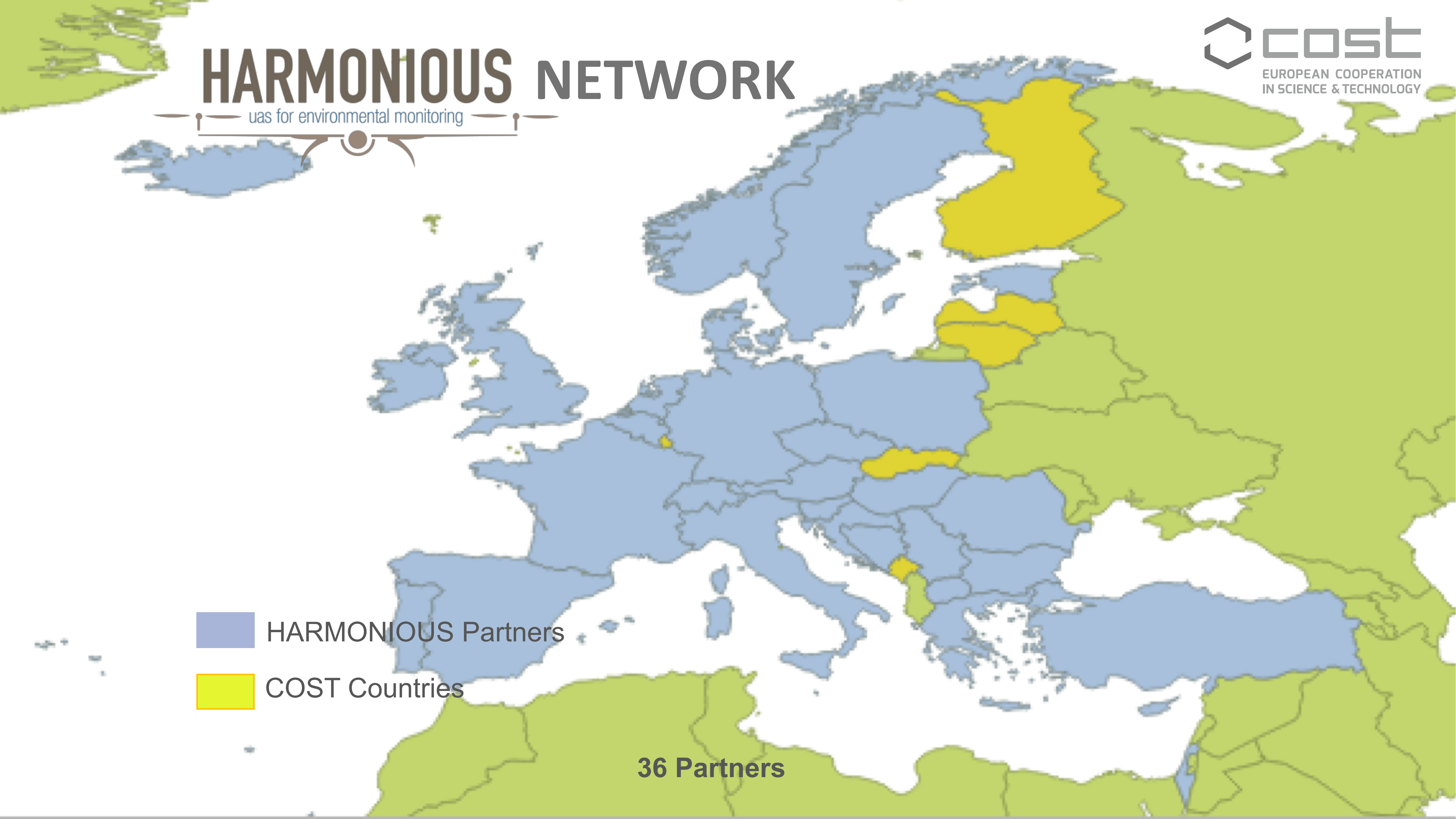
COST Action HARMONIOUS

A network of scientists is currently cooperating within the framework of a COST (European Cooperation in Science and Technology) Action named “HARMONIOUS”.

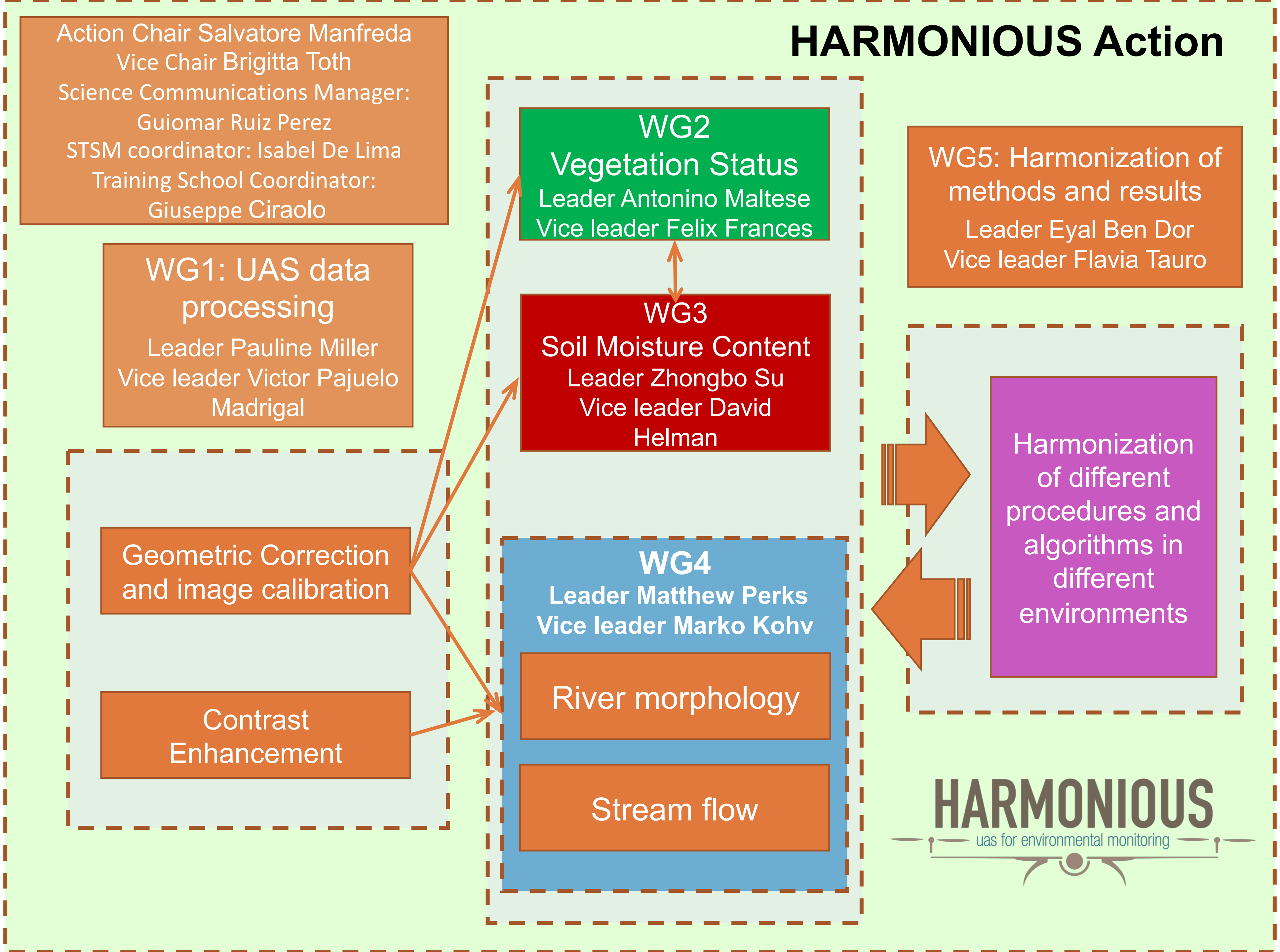
The intention of “Harmonious” is to promote monitoring strategies, establish harmonized monitoring practices, and transfer most recent advances on UAS methodologies to others within a global network.

HARMONIOUS NETWORK

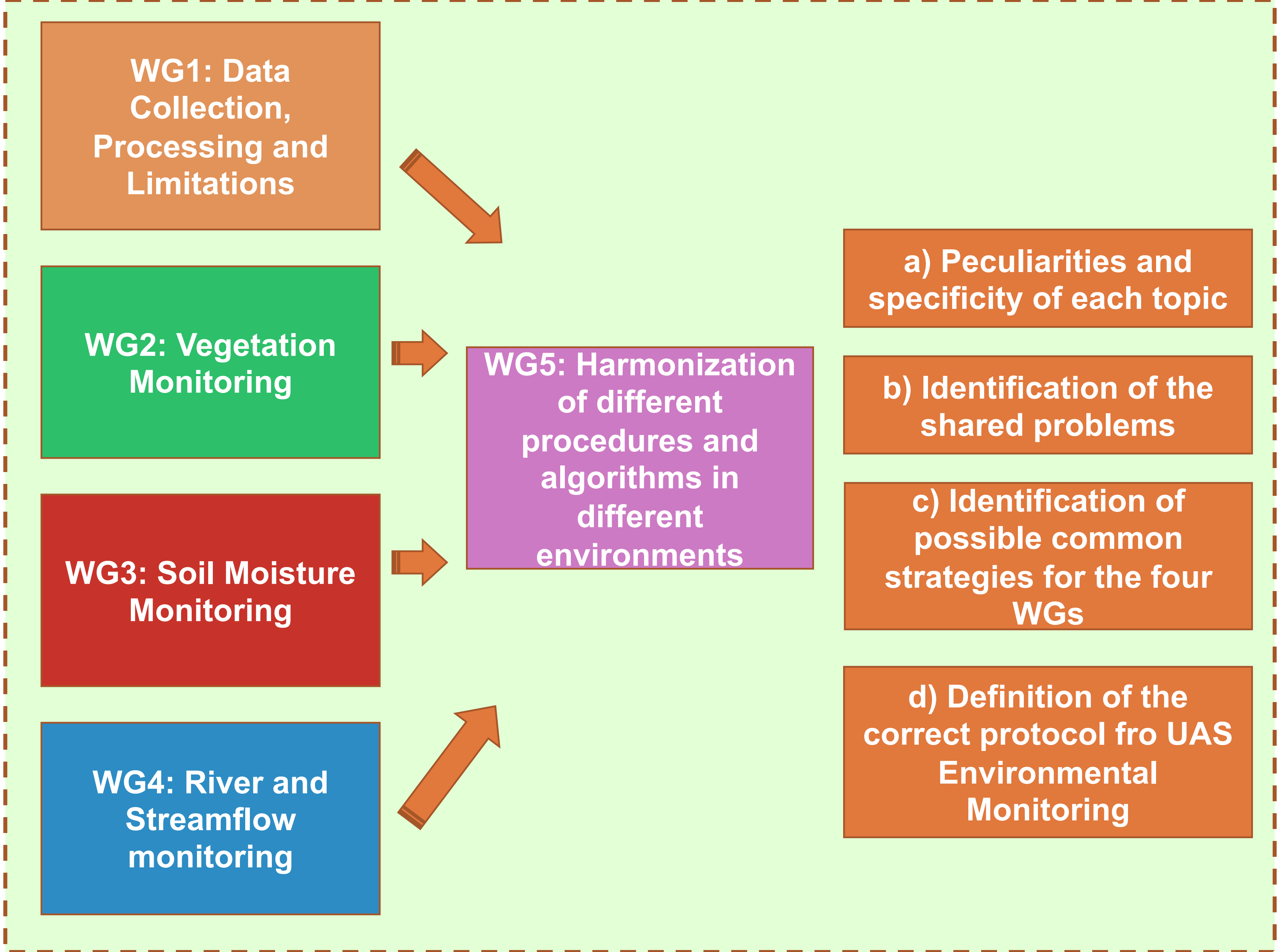
uas for environmental monitoring



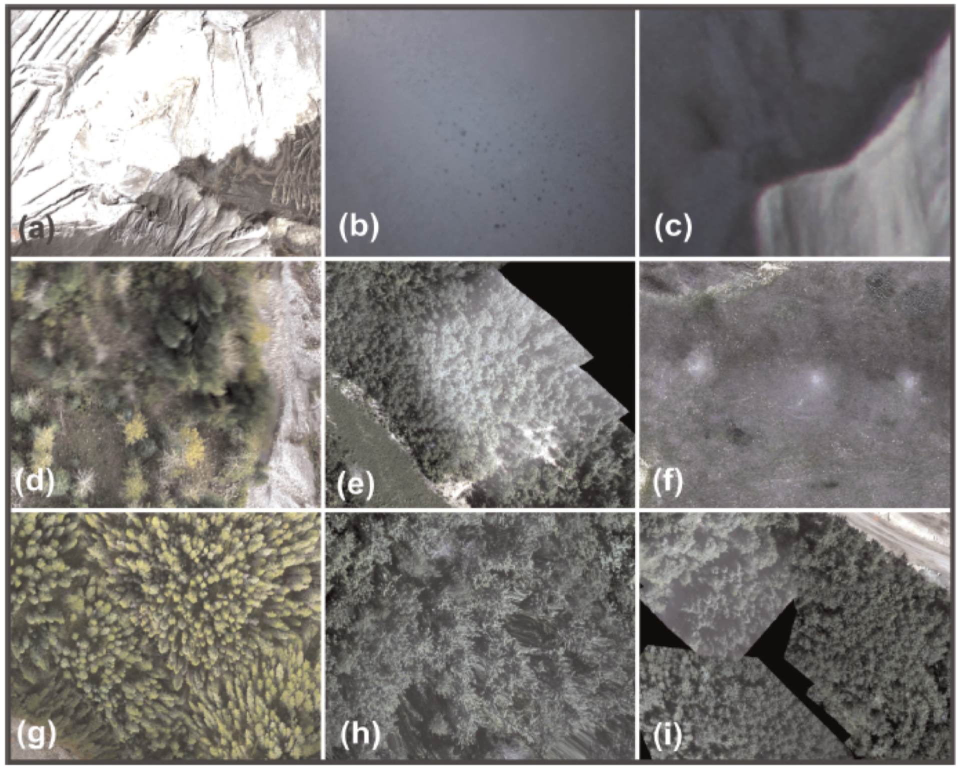
36 Partners



cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY


WG1: Data Collection, Processing and Limitations
WG2: Vegetation Monitoring
WG3: Soil Moisture Monitoring
WG4: River and Streamflow monitoring
WG5: Harmonization of different procedures and algorithms in different environments
a) Peculiarities and specificity of each topic
b) Identification of the shared problems
c) Identification of possible common strategies for the four WGs
d) Definition of the correct protocol fro UAS Environmental Monitoring

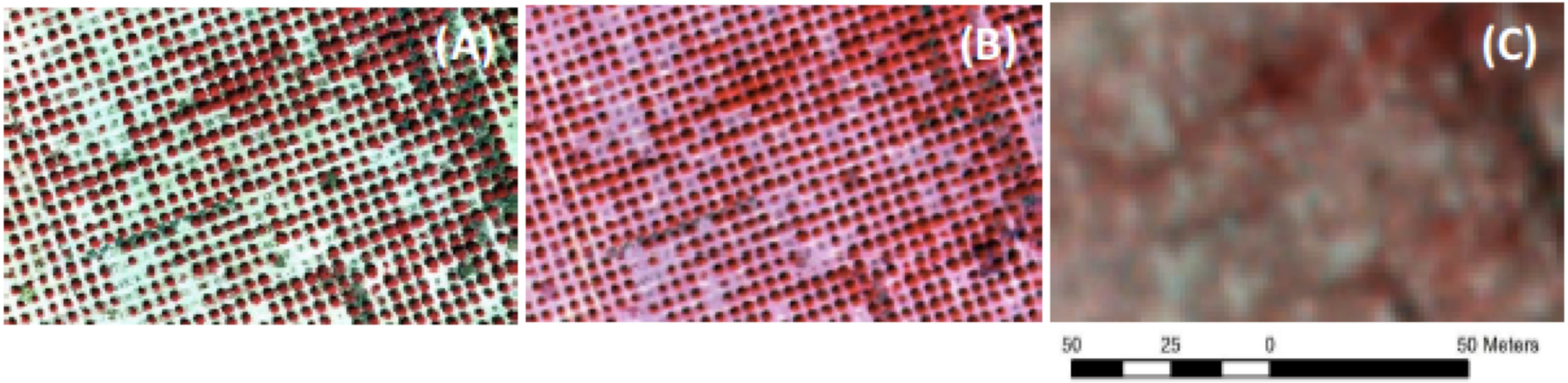
Examples of Common image artifacts



a) saturated image;
b) vignetting;
c) chromatic aberration;
d) mosaic blurring in overlap area;
e) incorrect colour balancing;
f) hotspots on mosaic due to bidirectional reflectance effects;
g) relief displacement (tree lean) effects in final image mosaic;
h) Image distortion due to DSM errors;
i) mosaic gaps caused by incorrect orthorectification or missing images.

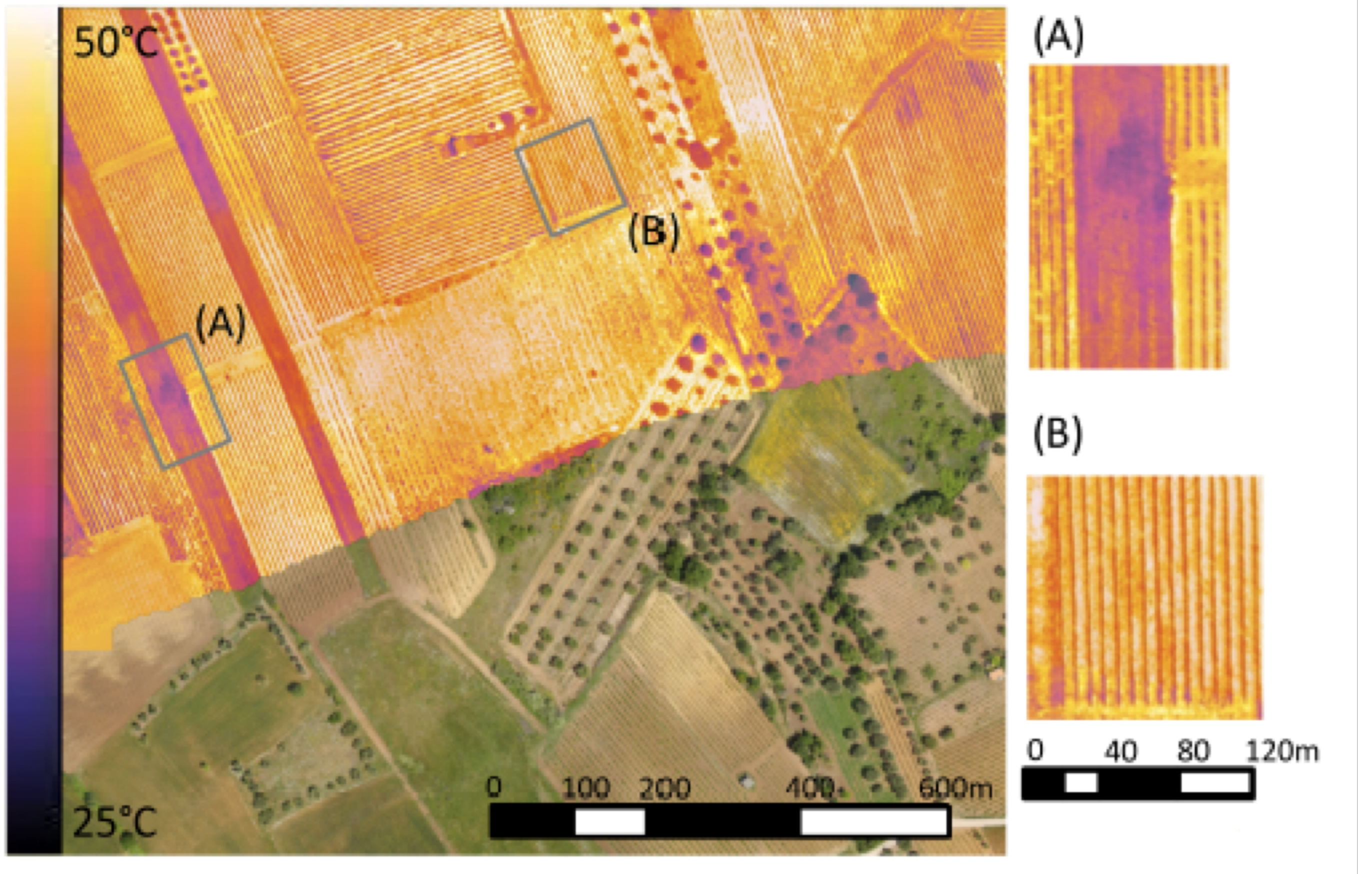
(Whitehead and Hugenholtz, 2014)

Comparison between a CubeSat and UAS NDVI map



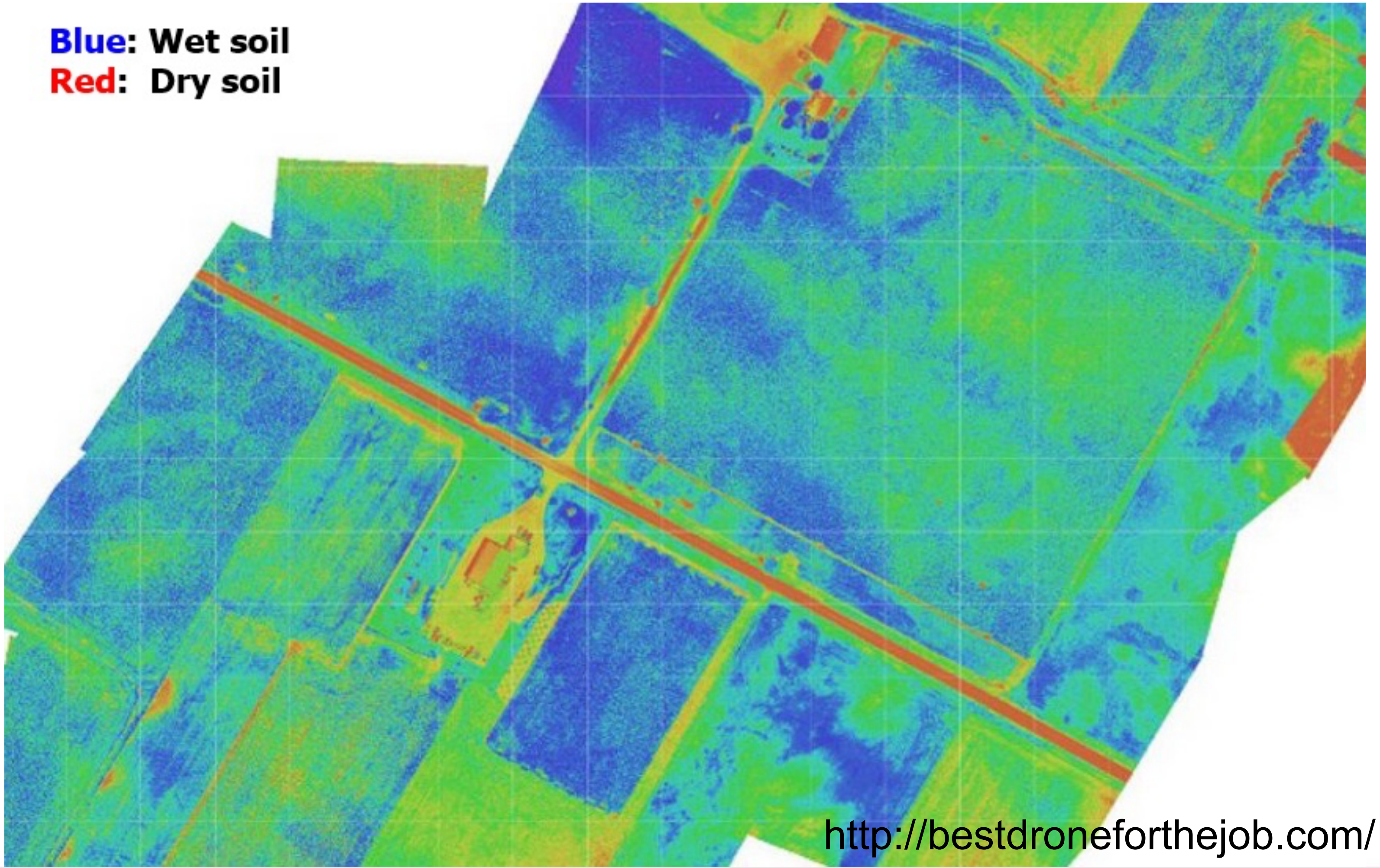
Multi-spectral false colour (near infrared, red, green) imagery collected over the RoBo Alsahba date palm farm near Al Kharj, Saudi Arabia. Imagery (from L-R) shows the resolution differences between: (A) UAV mounted Parrot Sequoia sensor at 50 m height (0.05 m); (B) a WorldView-3 image (1.24 m); and (C) Planet CubeSat data (approx. 3 m), collected on the 13th, 29° and 27th March 2018, respectively.

UAS thermal survey over an Aglianico vineyard in the Basilicata region (southern Italy)



(Manfreda et al., R.S. 2018)

Soil Moisture Monitoring

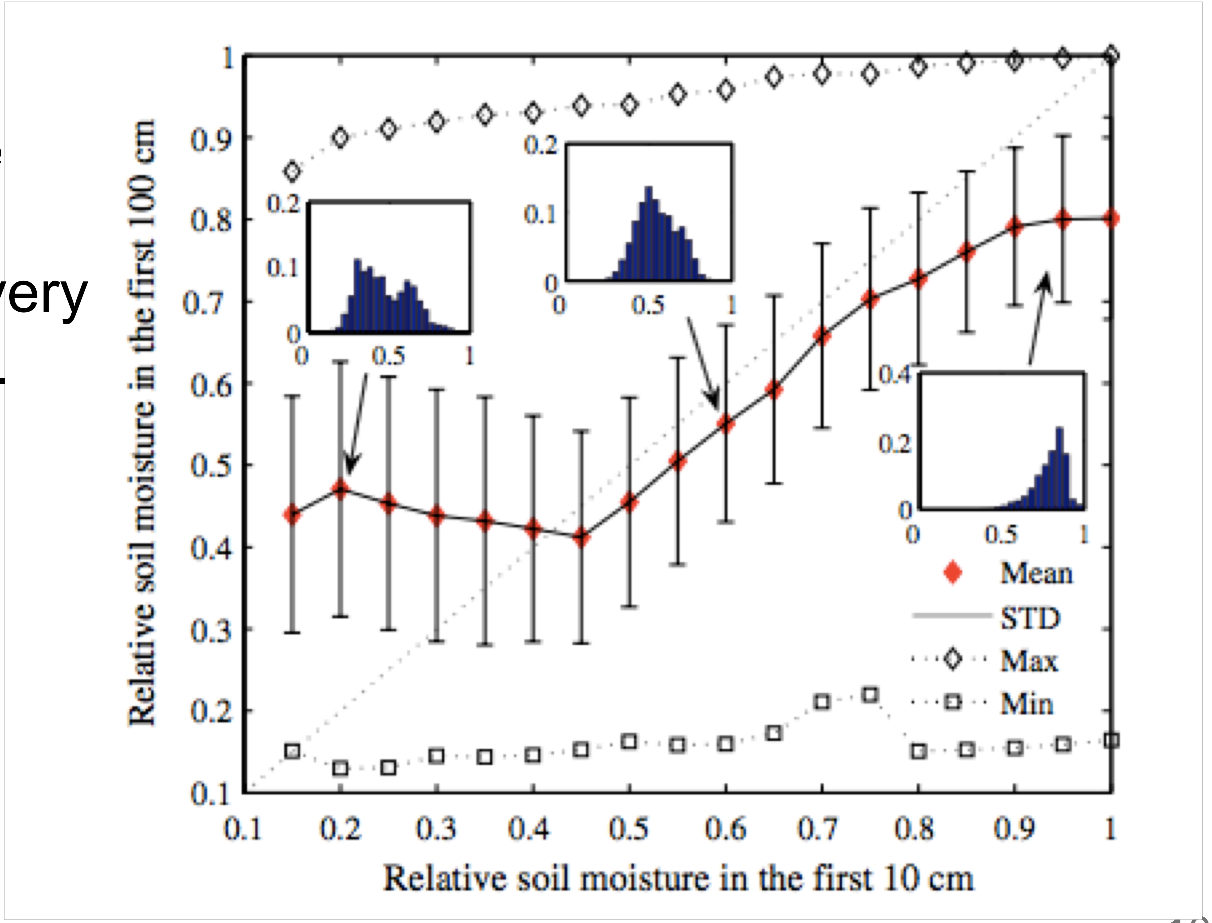


http://bestdroneforthejob.com/

Relationship existing between surface and root-zone soil moisture

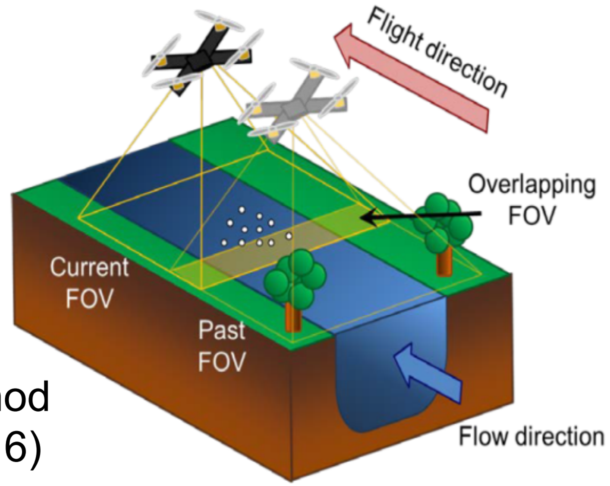
Developing a relationship between the relative soil moisture at the surface to that in deeper layers of soil would be very useful for remote sensing applications.

<u>This implies that prediction of soil moisture in the deep layer given the superficial soil moisture, has an uncertainty that increases with a reduced near surface estimate.</u>

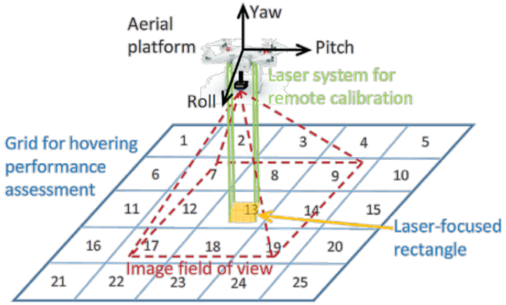


Manfreda et al. (AWR - 2007)

Stream flow monitoring with UAS Particle Tracking Velocimetry (PTV)



Lagrangian method
(Tauro et al., 2016)



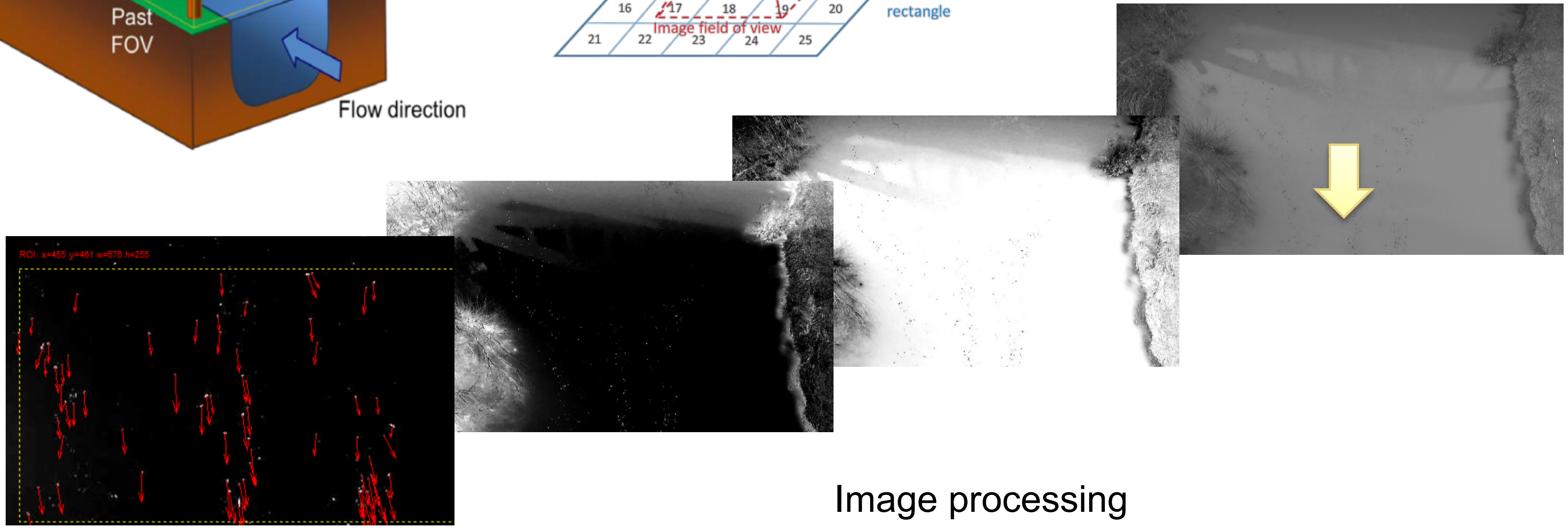
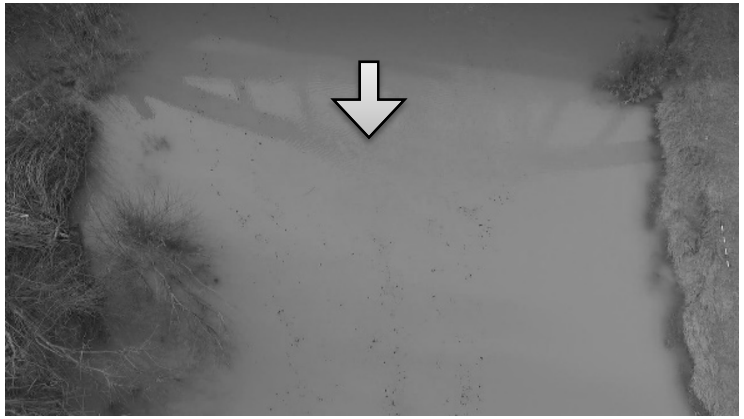
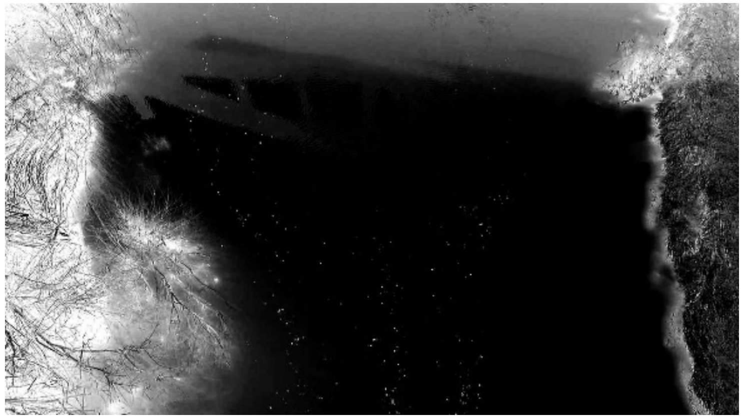
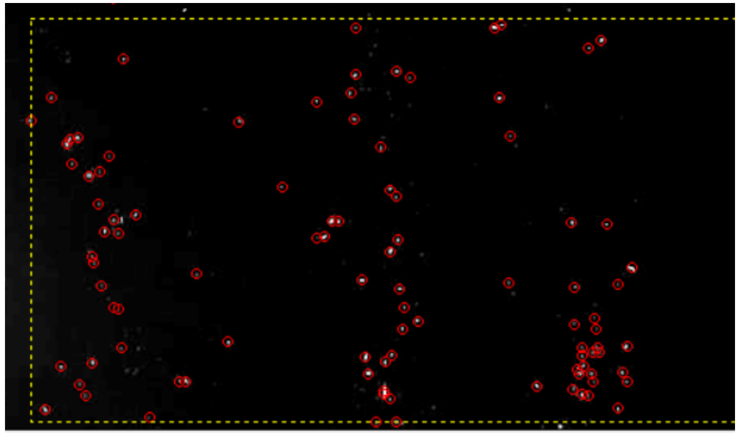


Image processing

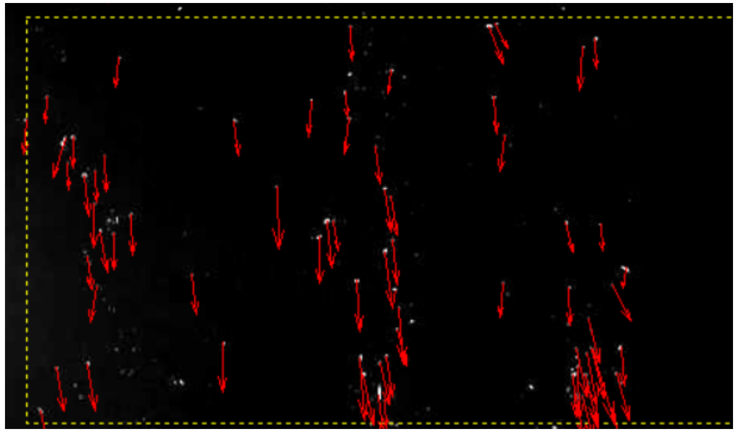
Particle Tracking







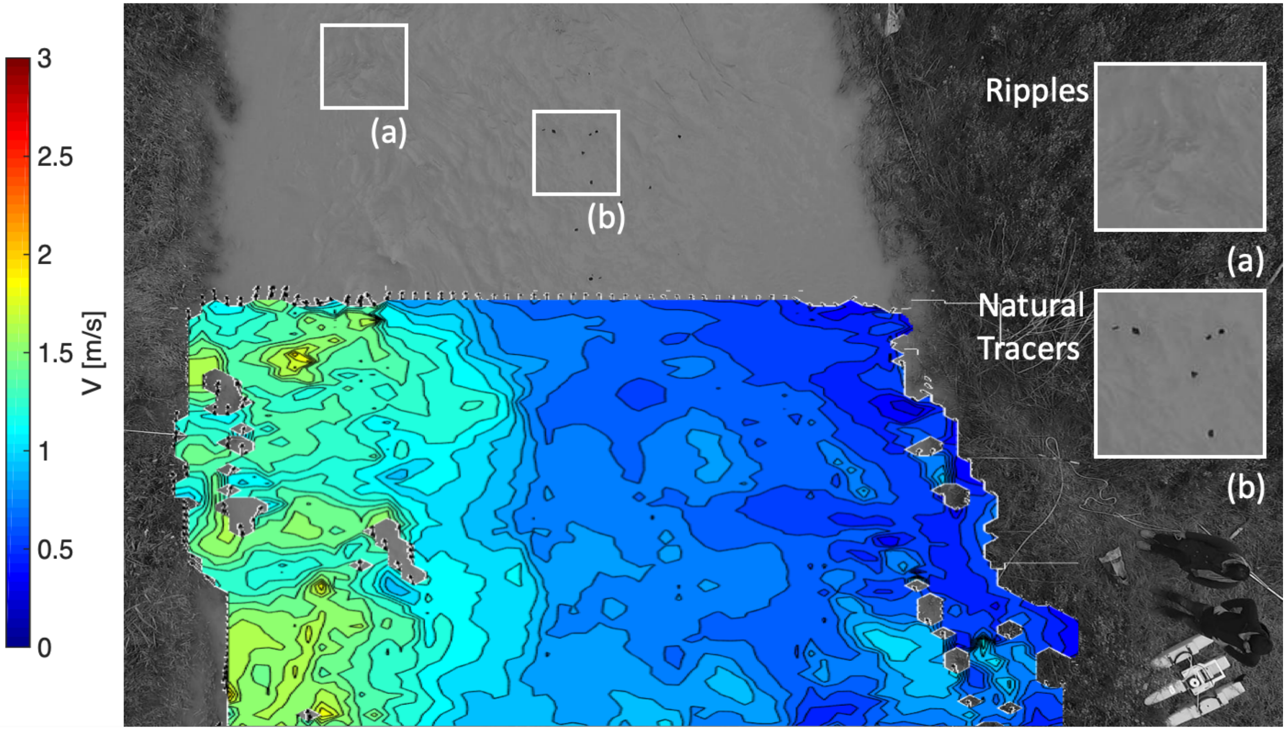
Particle detection



Velocity vectors

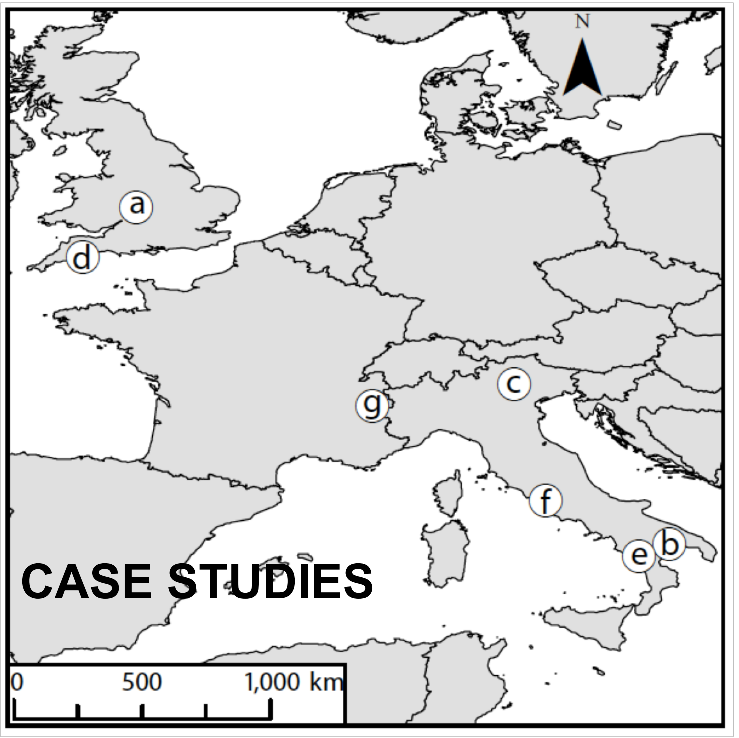
Image Velocimetry

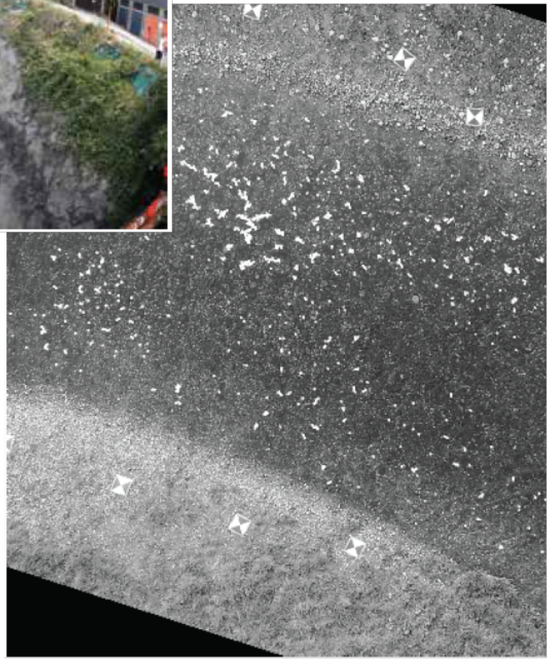
2-D flow velocity field derived using an optical camera mounted on a quadcopter hovering over a portion of the Bradano river system in southern Italy. One of the images used for the analysis is shown as a background, where surface features used by flow tracking algorithms are highlighted in the insets (a, b).



(Manfreda and McCabe, Hydrolink 2019)

Stream Flow Monitoring – Data Collection for Benchmarking Optical Techniques





Stream Flow Monitoring – Data Collection

Original Video File Name: [River]_[Country][ddmmyearhhmmUTC].mov
Camera Model:
Platform used (gaugecam, drone, mobile, etc.):
Camera setting (autofocus, field of view, ISO, stabilization, …):
Video resolution (4000x2000, …)
Video frequency (Hz):
Presence of tracers and type:
Optional Info
Lumen:
Wind speed and orientation:
Case Study
River Name:
River Basin Drainage Area (km^2):
Cross-Section Coordinates (Lat, Long WGS84):
Flow regime (low, medium, high):
Ground-true availability (yes or not):
File Format (mov, avi, mp4, etc.):
Reference paper:
Processed Data
File Name of Processed Frames: [River]_[Country][ddmmyearhhmmUTC].zip
Number of frames:
Frame rate (Hz):
Pixel dimension:
Pre-processing actions (contrast correction, channel used, orthorectification, stabilization, etc.):

Conclusion

- UAS-based remote sensing provides new advanced procedures to monitor key variables, including vegetation status, soil moisture content, and stream flow.
- The detailed description of such variables will increase our capacity to describe water resource availability and assist agricultural and ecosystem management.
- The wide range of applications testifies to the great potential of these techniques, but, at the same time, the variety of methodologies adopted is evidence that there is still need for harmonization efforts.

water
an Open Access Journal

IMPACT FACTOR 2.069

Hydrological and Environmental Modeling: From Observations to Predictions

Guest Editors
Prof. Dr. Félix Francés, Prof. Dr. Salvatore Manfreda, Prof. Dr. Zhongbo Su

Deadline
31 July 2019

Special Issue
Invitation to submit

remote sensing

an Open Access Journal

IMPACT FACTOR 3.406

Progress on the Use of UAS Techniques for Environmental Monitoring

Guest Editors

Dr. Salvatore Manfreda, Dr. Brigitta Toth, Dr. Giorgios Mallinis, Dr. Antonino Maltese, Dr. Matthew Perks, Dr. Zhongbo Su, Dr. Eyal Ben-Dor, Dr. Jana Müllerová

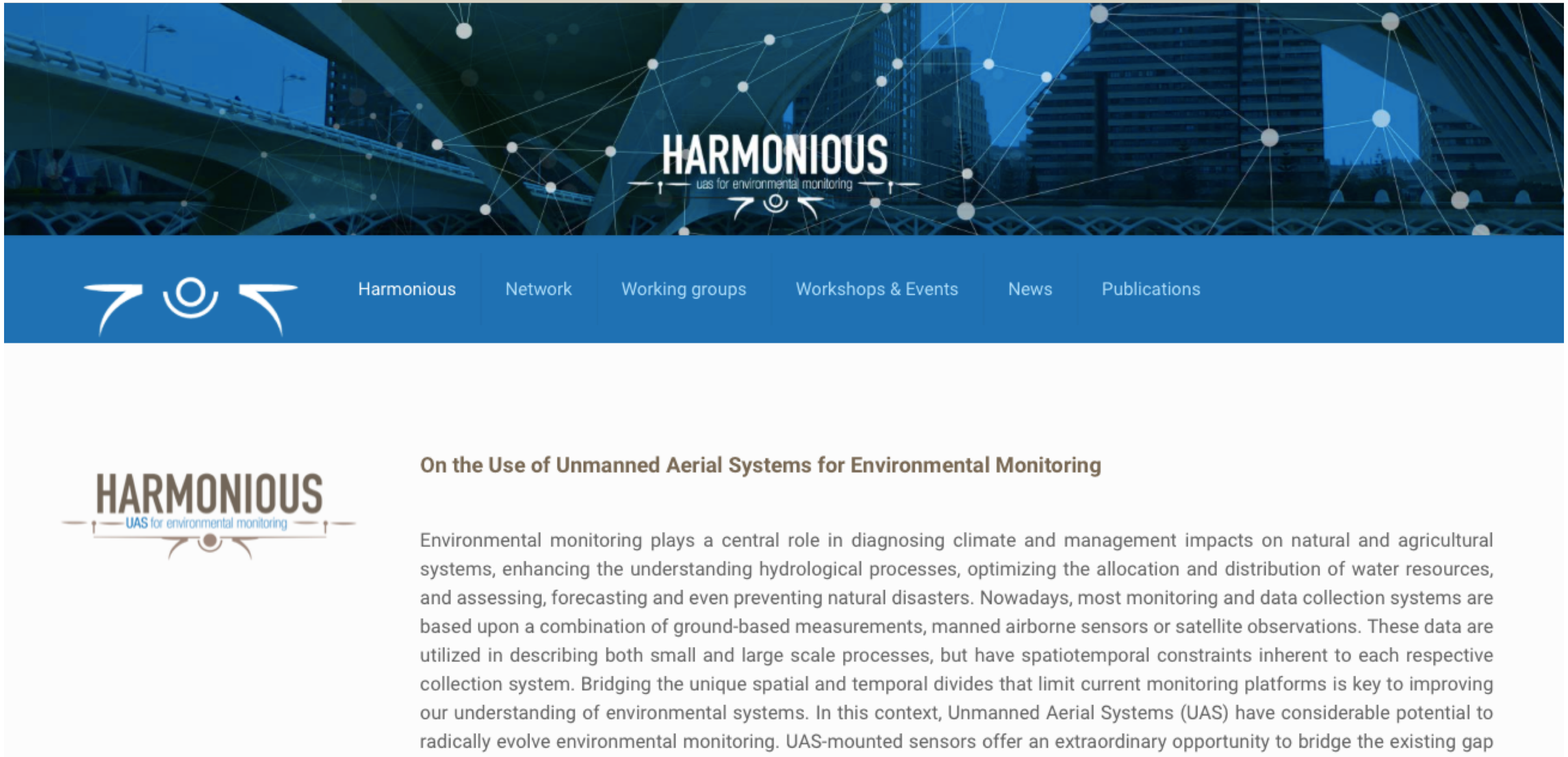
Deadline

20 December 2019

Special Issue

Invitation to submit

The Home Page - https://www.costharmonious.eu



HARMONIOUS
uas for environmental monitoring

Harmonious | Network | Working groups | Workshops & Events | News | Publications

HARMONIOUS
UAS for environmental monitoring

On the Use of Unmanned Aerial Systems for Environmental Monitoring

Environmental monitoring plays a central role in diagnosing climate and management impacts on natural and agricultural systems, enhancing the understanding hydrological processes, optimizing the allocation and distribution of water resources, and assessing, forecasting and even preventing natural disasters. Nowadays, most monitoring and data collection systems are based upon a combination of ground-based measurements, manned airborne sensors or satellite observations. These data are utilized in describing both small and large scale processes, but have spatiotemporal constraints inherent to each respective collection system. Bridging the unique spatial and temporal divides that limit current monitoring platforms is key to improving our understanding of environmental systems. In this context, Unmanned Aerial Systems (UAS) have considerable potential to radically evolve environmental monitoring. UAS-mounted sensors offer an extraordinary opportunity to bridge the existing gap

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Related Publications

- Manfreda and McCabe (2019). ***Emerging earth observing platforms offer new insights into hydrological processes***, Hydrolink.
- Perks, Hortobágyi, Le Coz, Maddock, Pearce, Tauro, Dal Sasso, Grimaldi, Manfreda (2019) **Towards harmonization of image velocimetry techniques for determining open-channel flow**, Earth system science data (in preparation).
- Manfreda, Dvorak, Mullerova, Herban, Vuono, Arranz Justel, Perks (2019) ***Assessing the Accuracy of Digital Surface Models Derived from Optical Imagery Acquired with Unmanned Aerial Systems***, Drones.
- Manfreda, ***On the derivation of flow rating-curves in data-scarce environments***, Journal of Hydrology, 2018.
- Dal Sasso, Pizarro, Samela, Mita, and Manfreda (2018) ***Exploring the optimal experimental setup for surface flow velocity measurements using PTV***, Environmental Monitoring and Assessment.
- Manfreda, McCabe, Miller, Lucas, Pajuelo Madrigal, Mallinis, Ben-Dor, Helman, Estes, Ciraolo, Müllerová, Tauro, De Lima, De Lima, Frances, Caylor, Kohv, Maltese (2018), ***On the Use of Unmanned Aerial Systems for Environmental Monitoring***, Remote Sensing.
- Baldwin, Manfreda, Keller, and Smithwick, Predicting root zone soil moisture with soil properties and satellite near-surface moisture data at locations across the United States, Journal of Hydrology, 2017.
- Manfreda, Brocca, T. Moramarco, F. Melone, and J. Sheffield, ***A physically based approach for the estimation of root-zone soil moisture from surface measurements***, Hydrology and Earth System Sciences, 18, 1199-1212, 2014.