SOIL SURFACE REFLECTANCE AS A TOOL TO ESTIMATE WATER INFILTRATION RATE TO THE SOIL PROFILE

Nicolas Francos, Eyal Ben Dor*
THE REMOTE SENSING LABORATORIES
Nunzio Romano, Brigitta Szabó, Paolo Nasta, Antonino Maltese, Janos Mészáros and Monica Garcia

***Porter School of Environment and Earth Science Aviv University**

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Funded by the Horizon 2020 Framework Programme of the European Union

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uas for environmental monitoring

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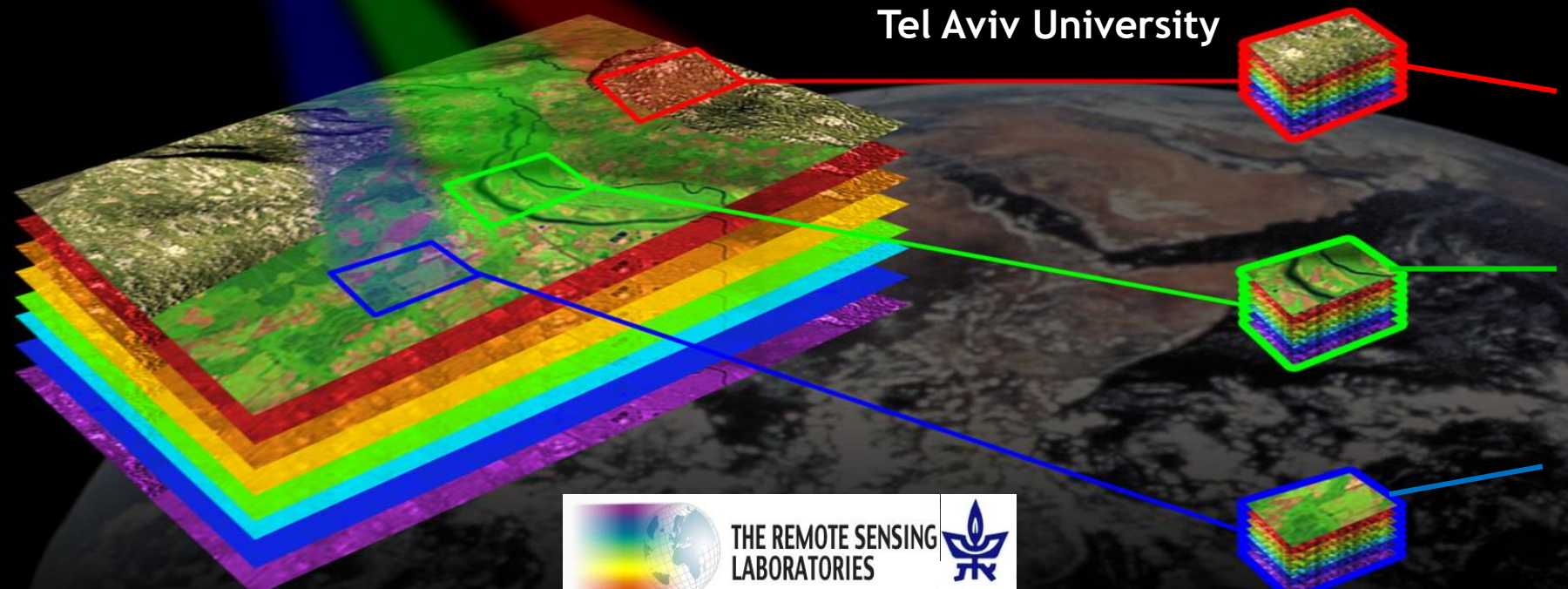

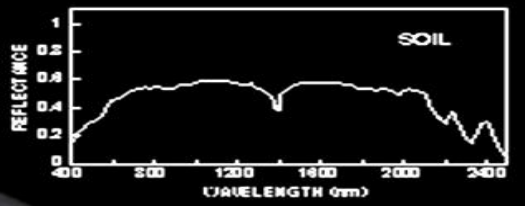

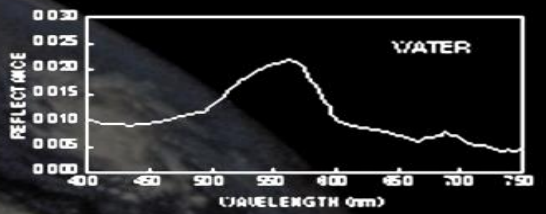

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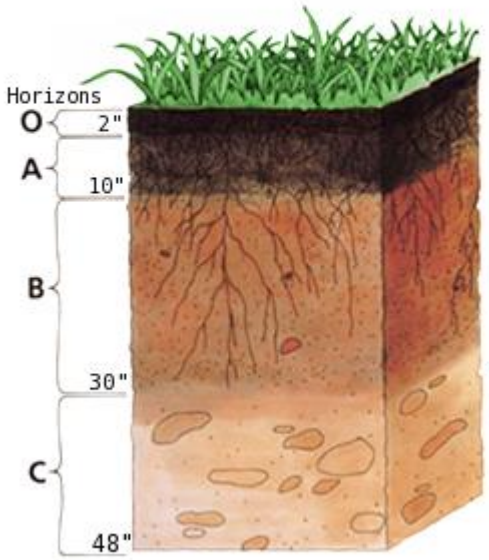
OUTLINE

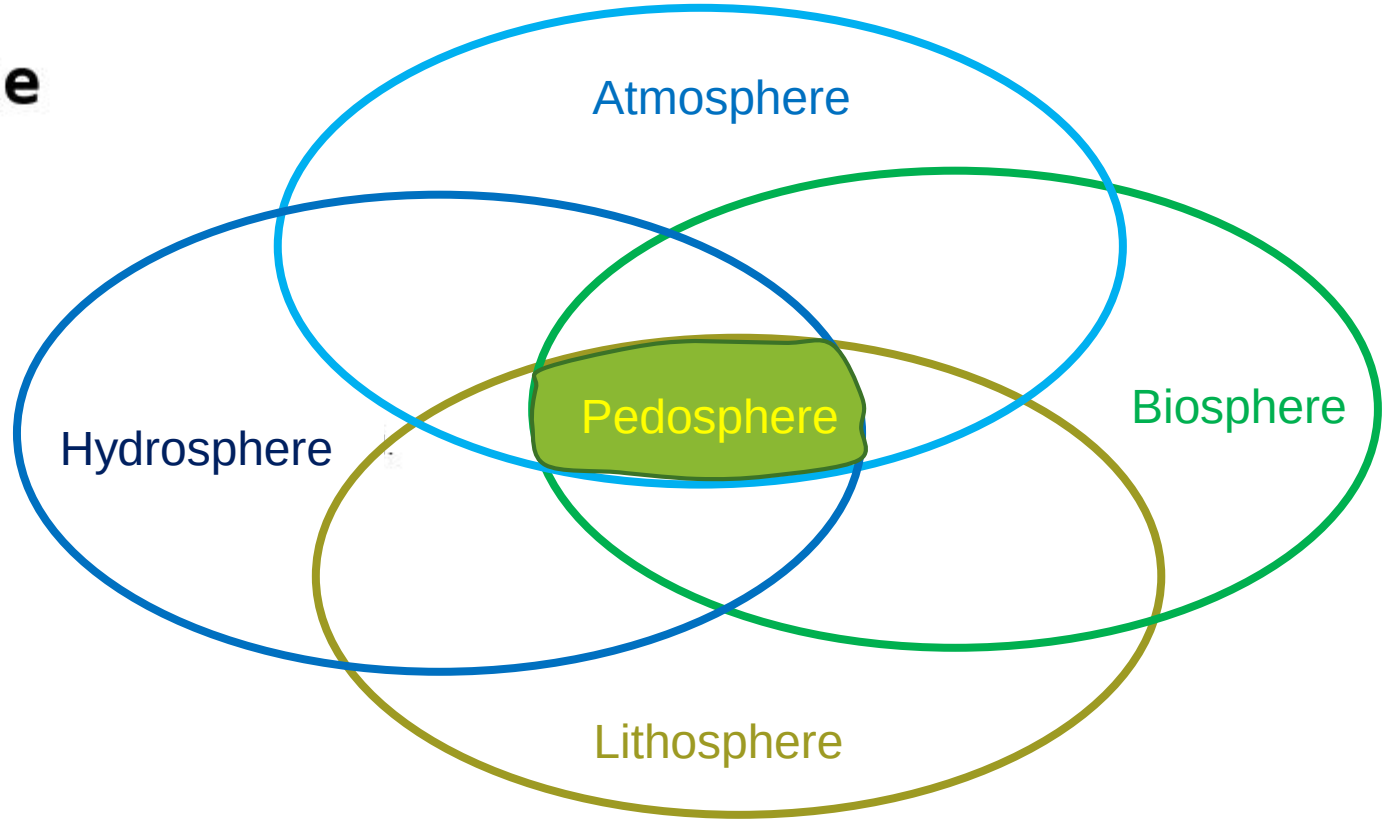
- The importance of Soil-Water interaction and the project status
- Soil Surface properties and spectroscopy: problem and solution
- Water infiltration rate to the soil: Importance, problems, solutions
- Experiment: Field location and data acquisition
- Spectral based Modeling
- Downscaling the proxy model for HSR sensor **on DRONE**
- Alento project
- Mapping infiltration rate using proxy model and partial HSR image
- Conclusion

Soil

The upper layer of the earth (≈0-2m) represent its loose surface material which is dug, plowed and being a medium for plants to grow. **(Thompson 1957)**

Soil Profile





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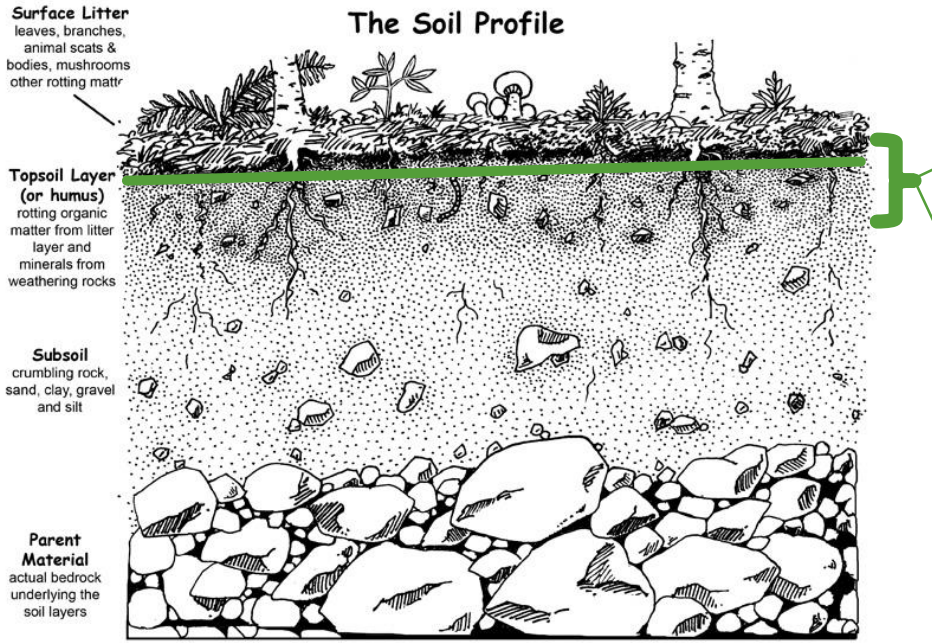
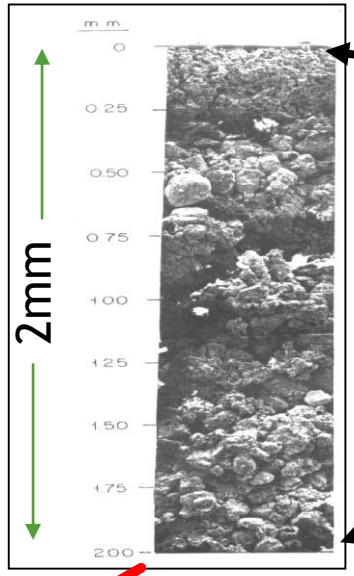
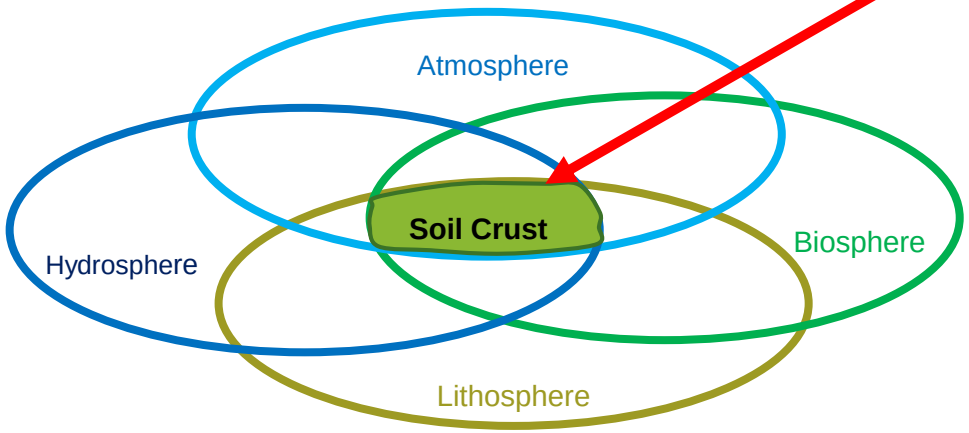
The important of Soil surface and water regime





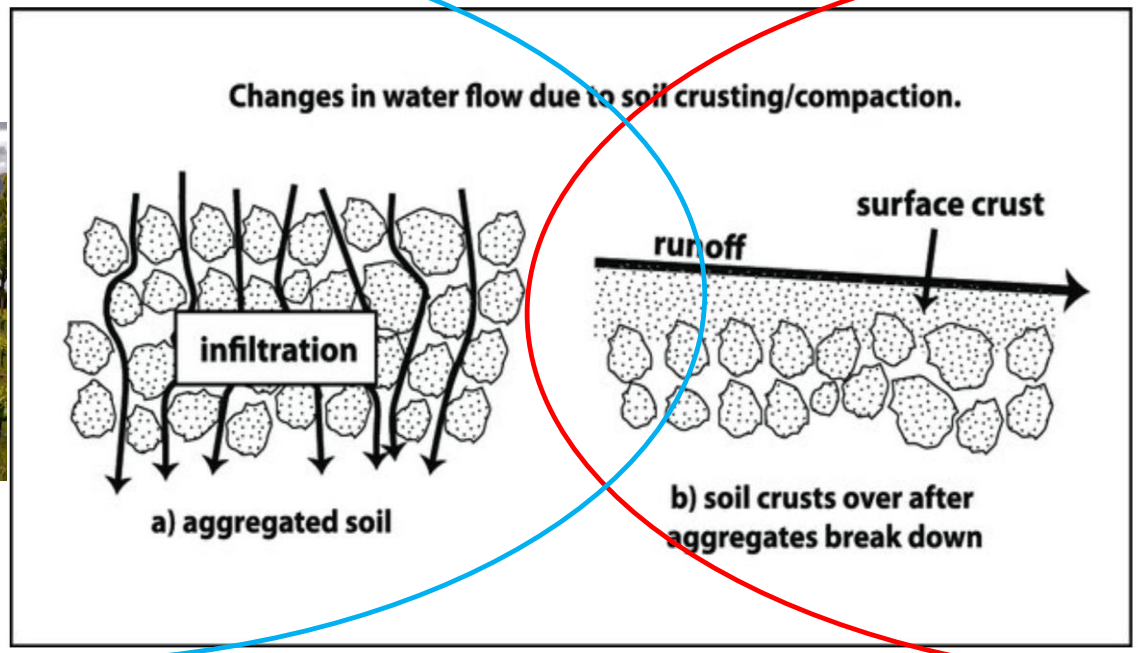
Crust

Sole



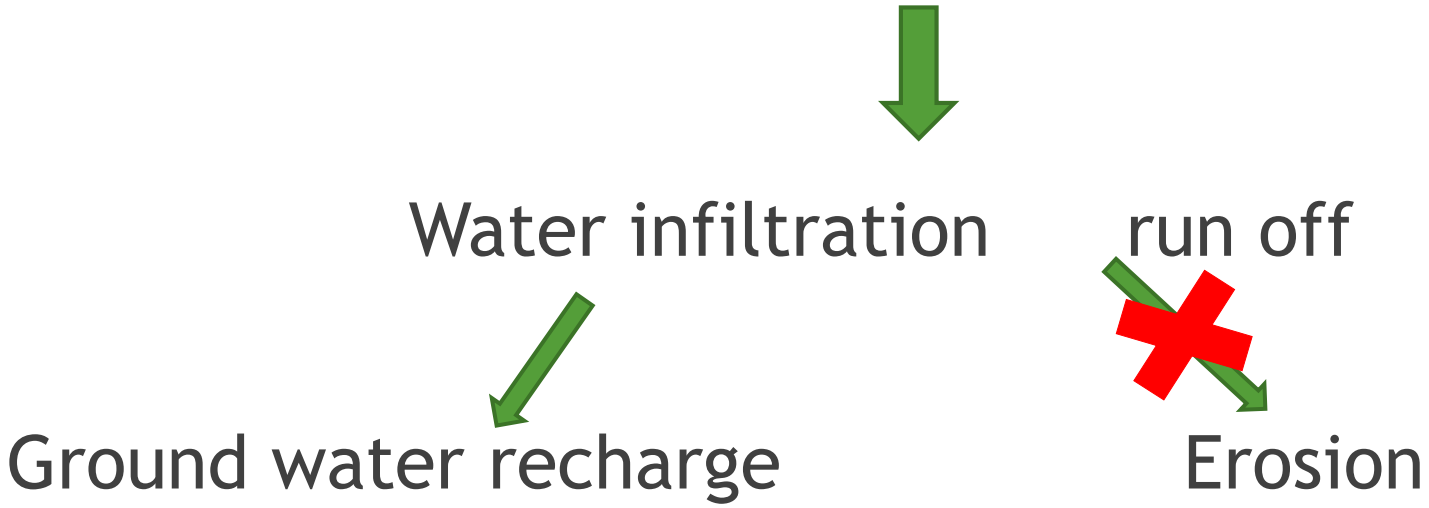
Water resource management needs to consider a wide range of spatial scales and address a variety of problems

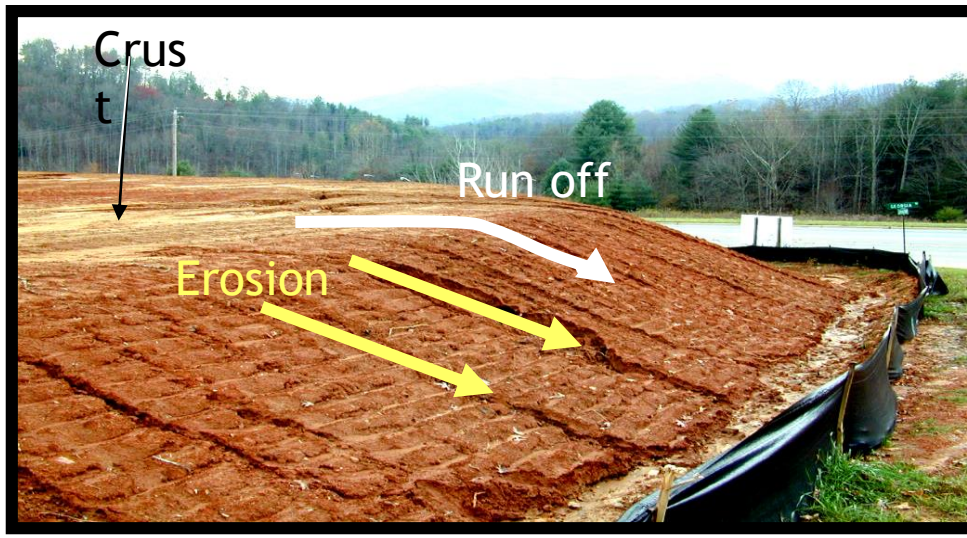
The water soil interaction on the surface is controlling the runoff, infiltration and water discharge in the soil profile



Soil surface properties

- The soil properties that refer to the interaction between atmosphere , hydrosphere and pedosphere are: Hydrophobicity, biogenic crust, physical crust. Dust, salinity, roughness





2018 JOINT CALL

Closing the Water Cycle Gap – Sustainable Management of Water Resources

iAqueduct

An integrative information aqueduct to close the gaps between global satellite observation of water cycle and local sustainable management of water resources

Water Joint Programming Initiative (Water JPI)

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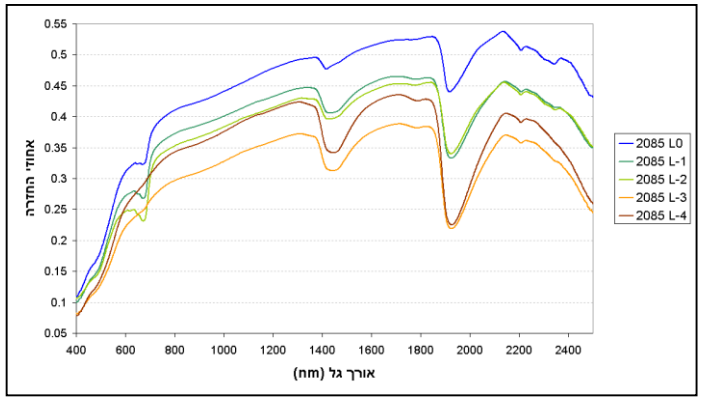
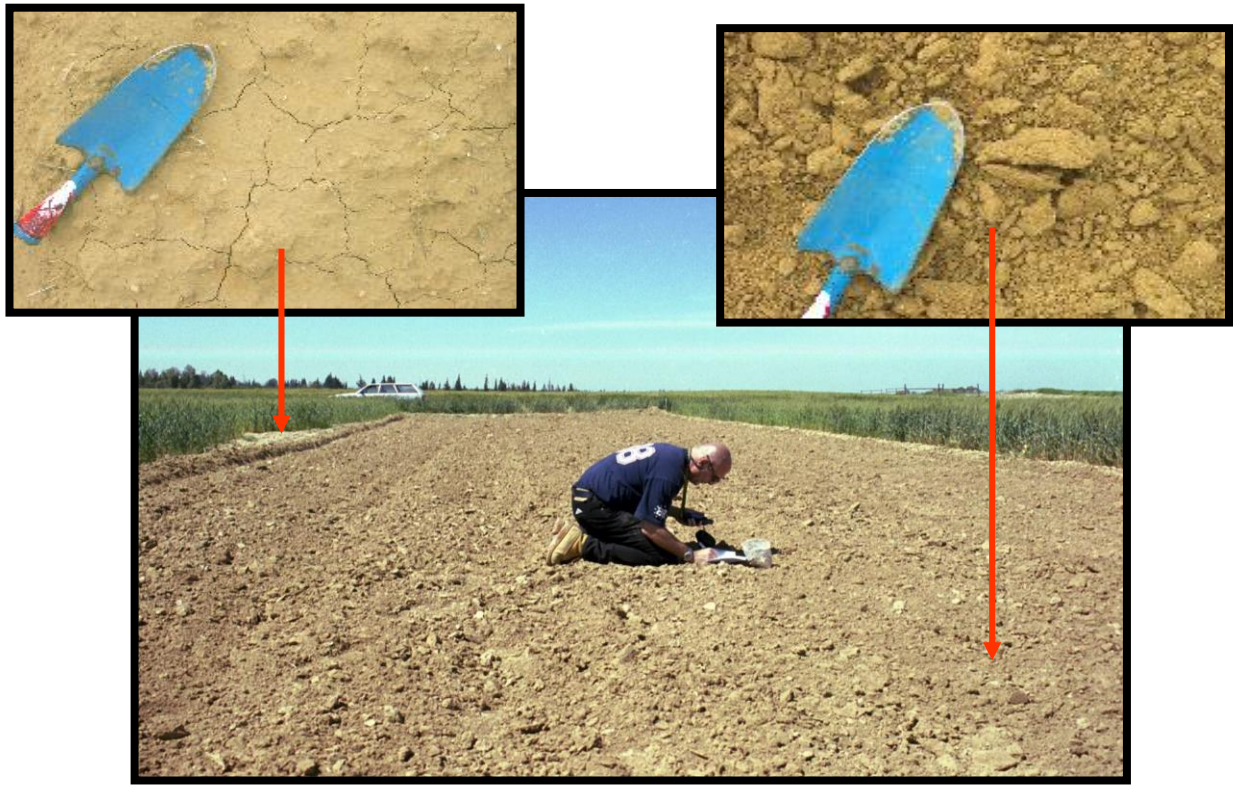
- Soil Spectroscopy refers to the reflectance part of the electromagnetic radiation that interacts with the soil (surface) matter across the VIS-NIR-SWIR spectral region (the sun illumination) range.



Undisturbed versus Disturbed Soil Surface

Crust

Braking Crust

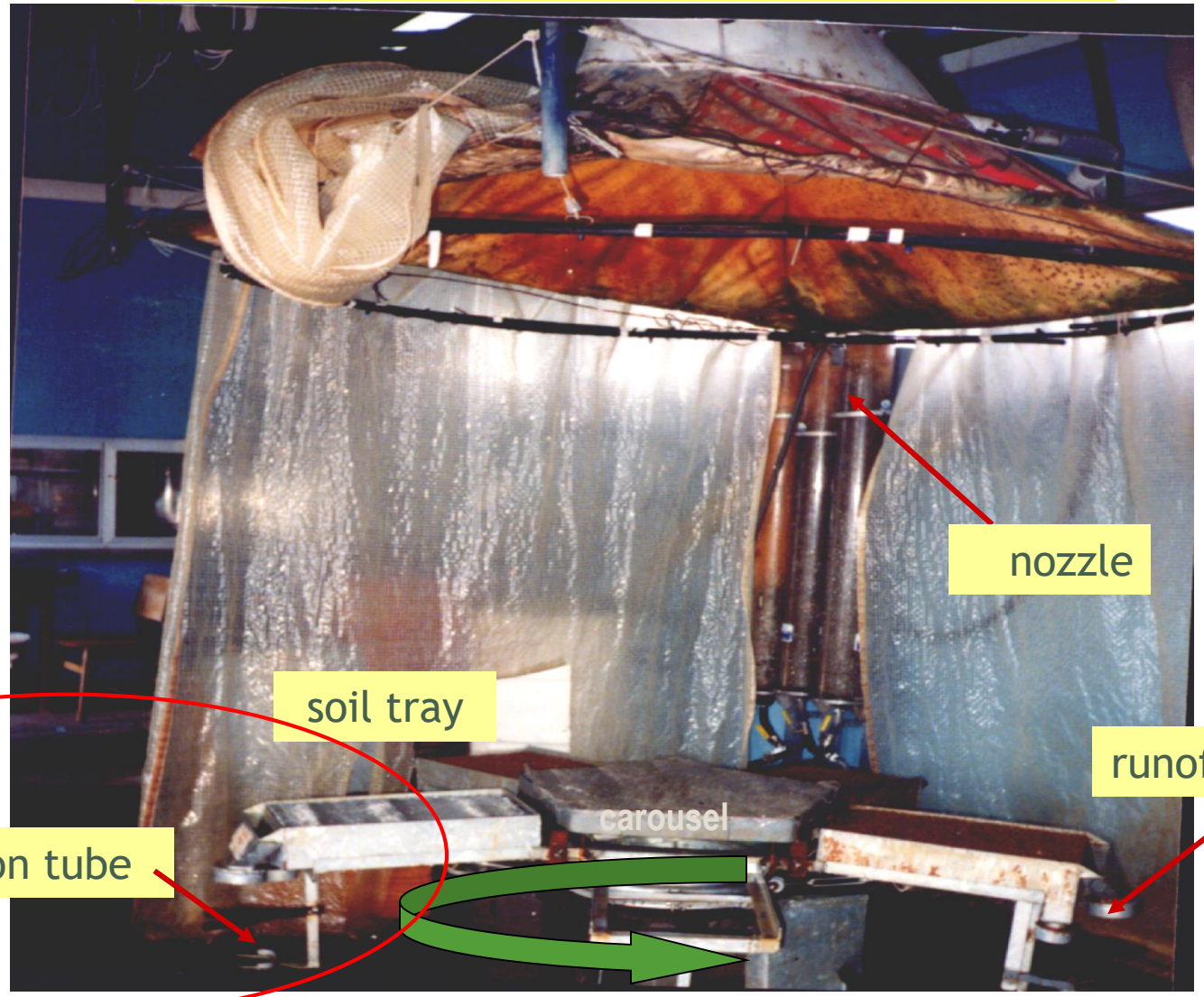


Loess

Haploxeralf

Rain Simulator

A facility to study the soil physical crust



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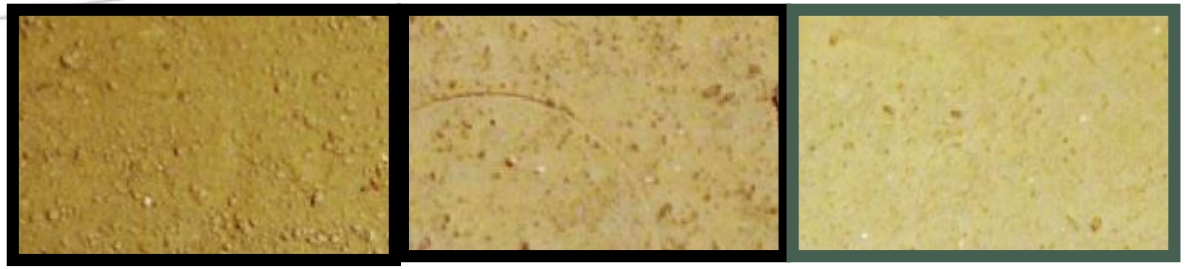
Laboratory Experiment

Loess Soil



0 joule

650 joule

1842 joule

The Problem

- The infiltration rate and spectral reflectance as measured in the laboratory is NOT mirroring the field conditions

The Solution

- Measuring both spectral and infiltration rate in the field while the surface is preserved
- Then - adopt the relationship between both attributes on a spatial domain using hyperspectral sensor on board DORNES.

Data Acquisition

The Minidisk Infiltrometer

The SoilPRO® Spectral Assembly

Data Sets

- This repertory contain samples of 6 different fields:

i) Kibbutz Sde Yoav, Israel (30 Samples)
ii) Apheta, Tel Aviv, Israel (18 Samples)
iii) Alento, Italy (21 Samples)
iv) Aminteo, Greece (45 Samples of 3 different fields)

- The dataset contains samples that can be divided into two groups:

i) **Clayey Soils (46 Samples)**
ii) **Sandy Soils (59 Samples)**

Aminteo, Greece (45 Samples) 3 different fields

Alento, Italy (21 Samples)

Afeka , Tel Aviv, Israel (18 Samples)

Clayey Soils (46 Samples)
Sandy Soils (59 Samples)

Kibbutz Sde Yoav, Israel (30 Samples)

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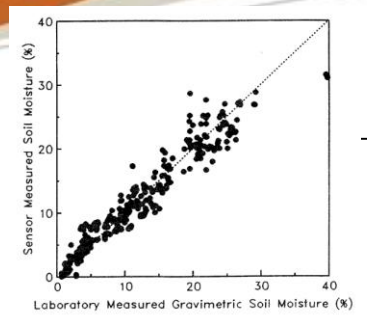
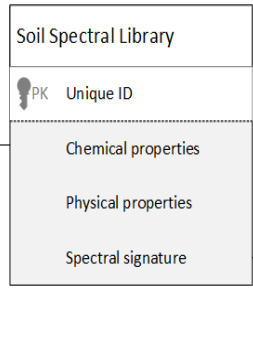
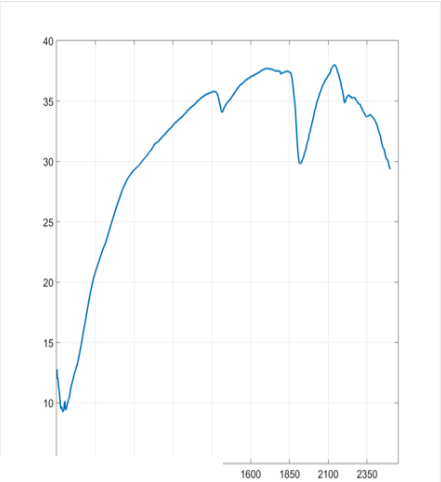
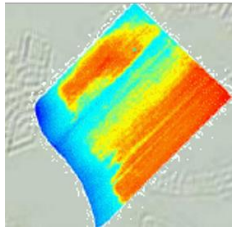
PARACUDA II ® A Machine Learning Algo

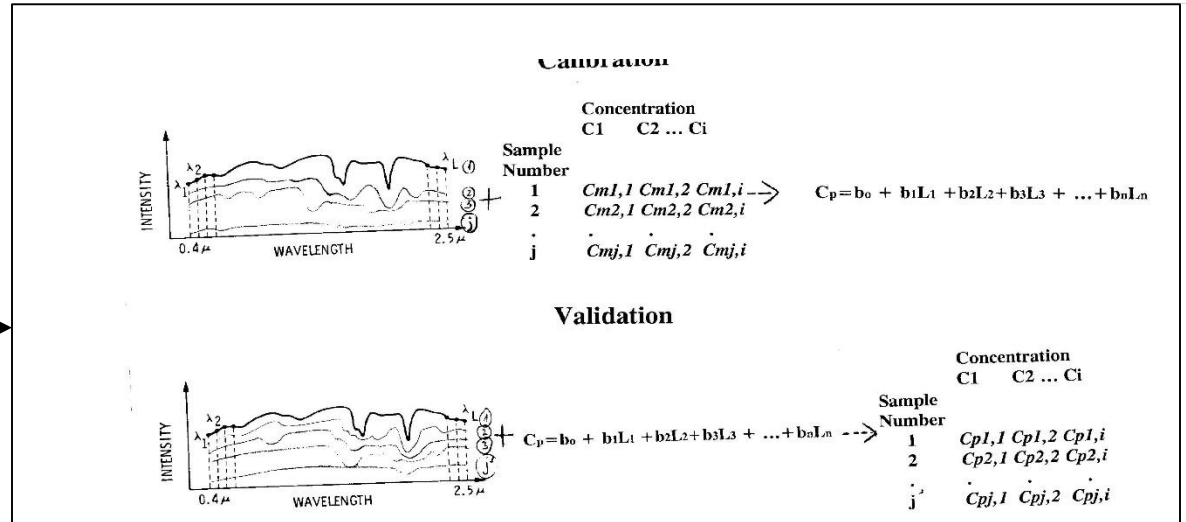








The following figures demonstrate the NIRA approach:



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An Advanced Analytical Approach for Spectral-Based Modelling of Soil Properties

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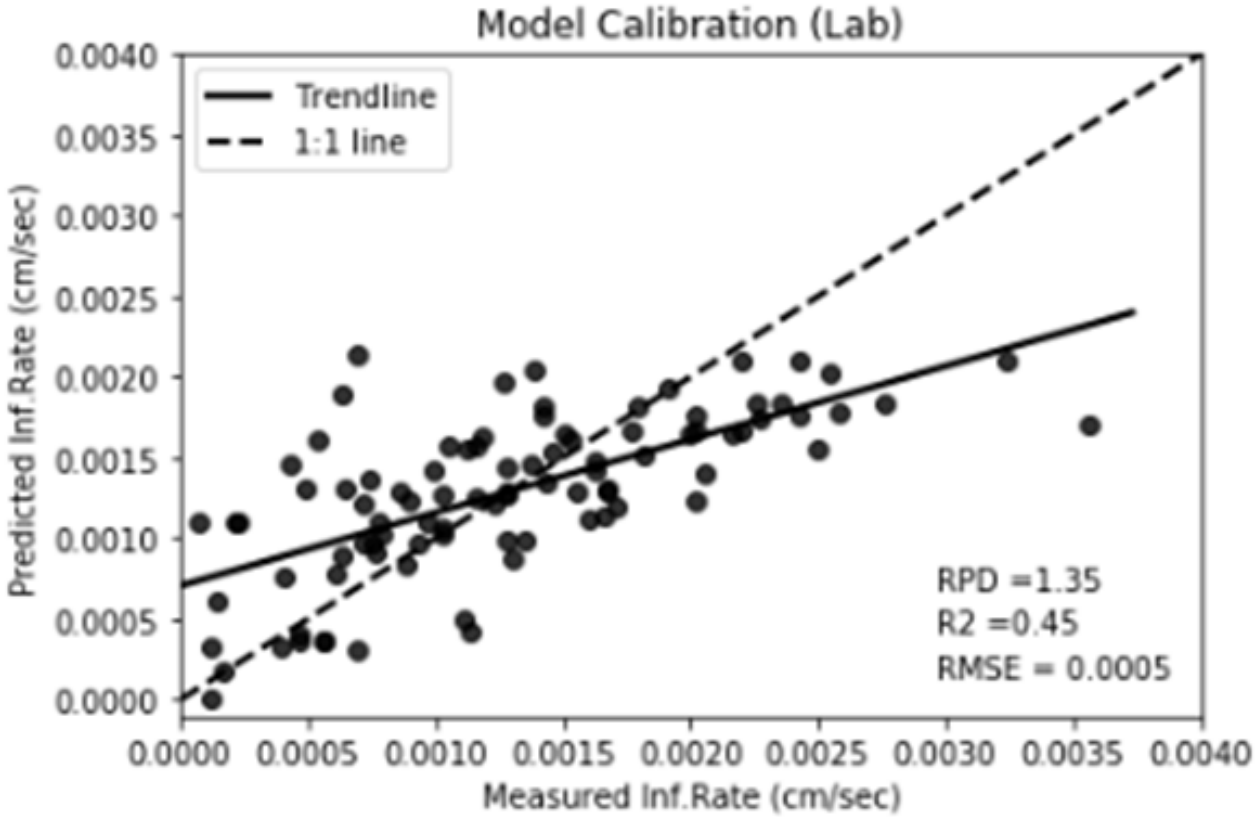
[2]School of Geosciences, Faculty of Exact Sciences, Tel-Aviv University

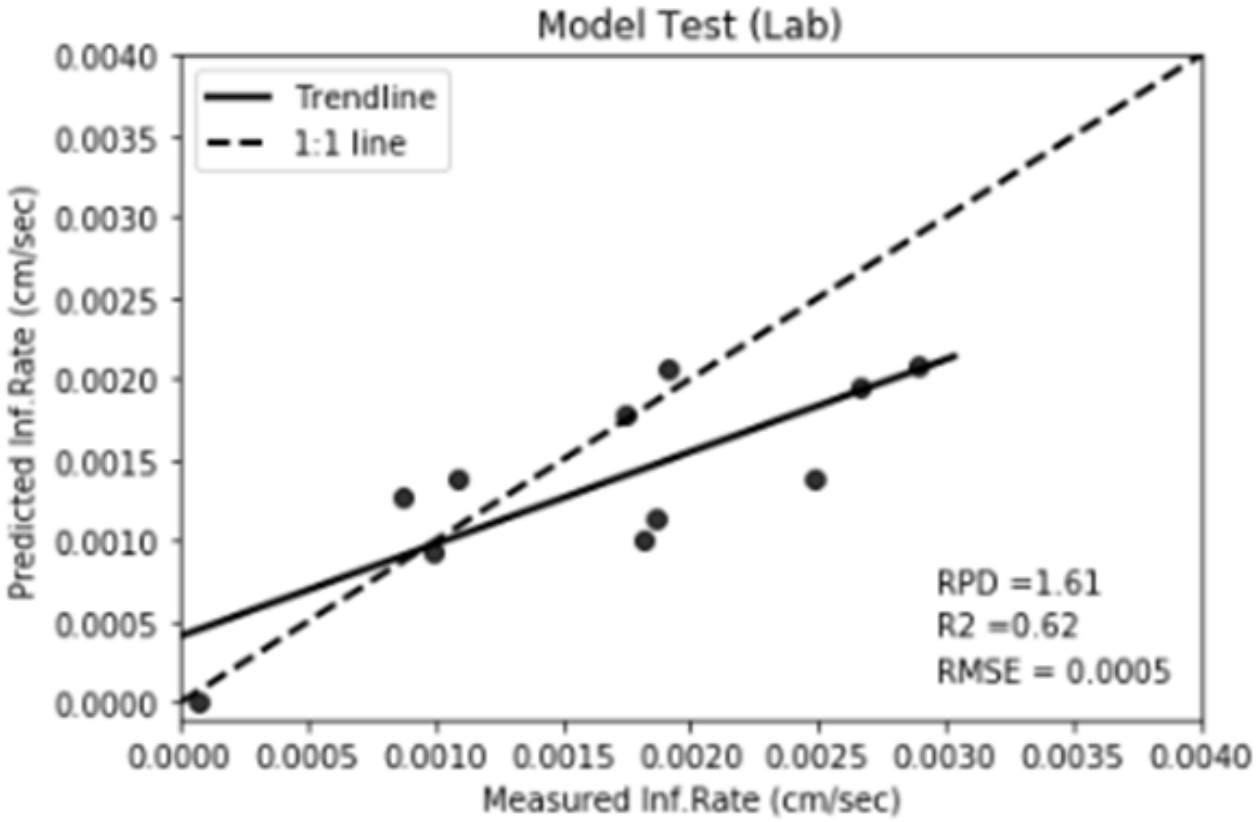
remote sensing
MDPI
Article

Examining the Performance of PARACUDA-II Data-Mining Engine versus Selected Techniques to Model Soil Carbon from Reflectance Spectra

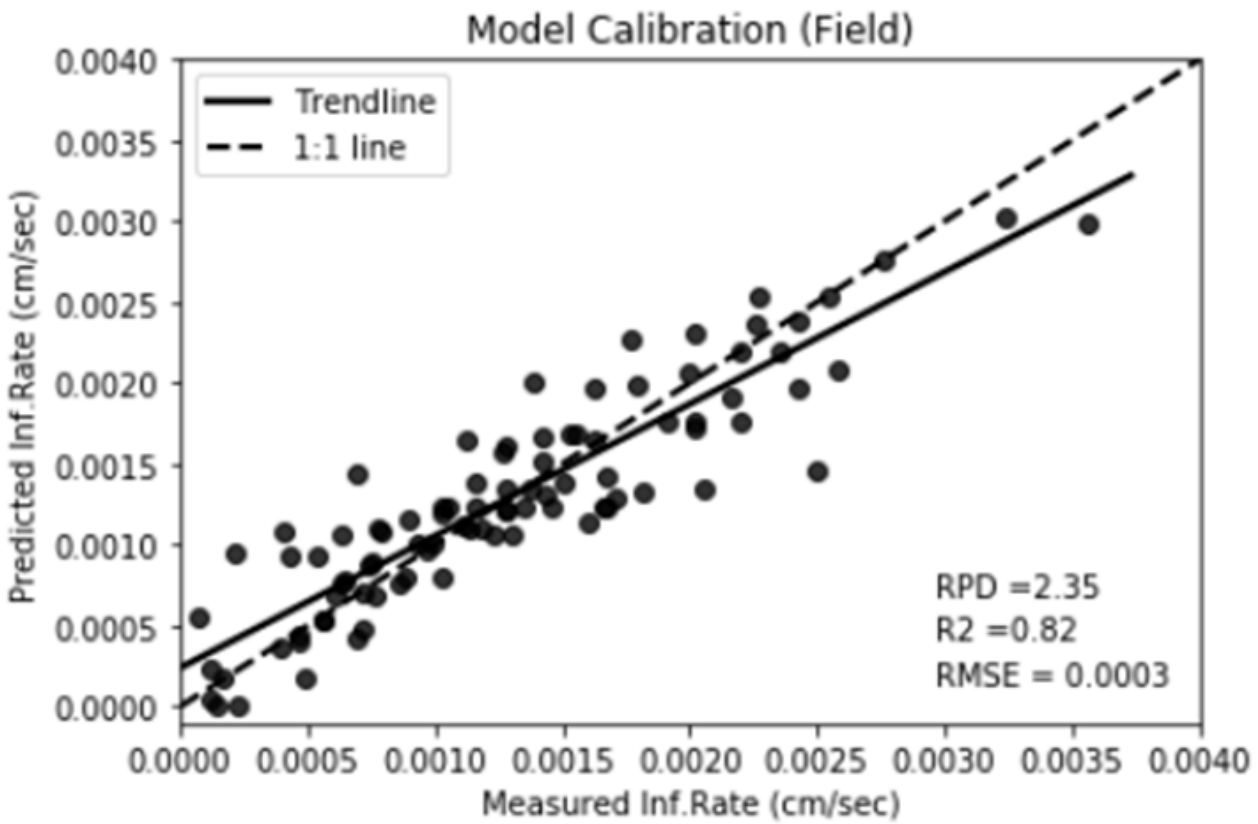
Asa Gholizadeh [1,2,*], Mohammadmehdi Saberioon [3], Nimrod Carmon [4,5], Lubos Boruvka [1] and Eyal Ben-Dor [4,*]

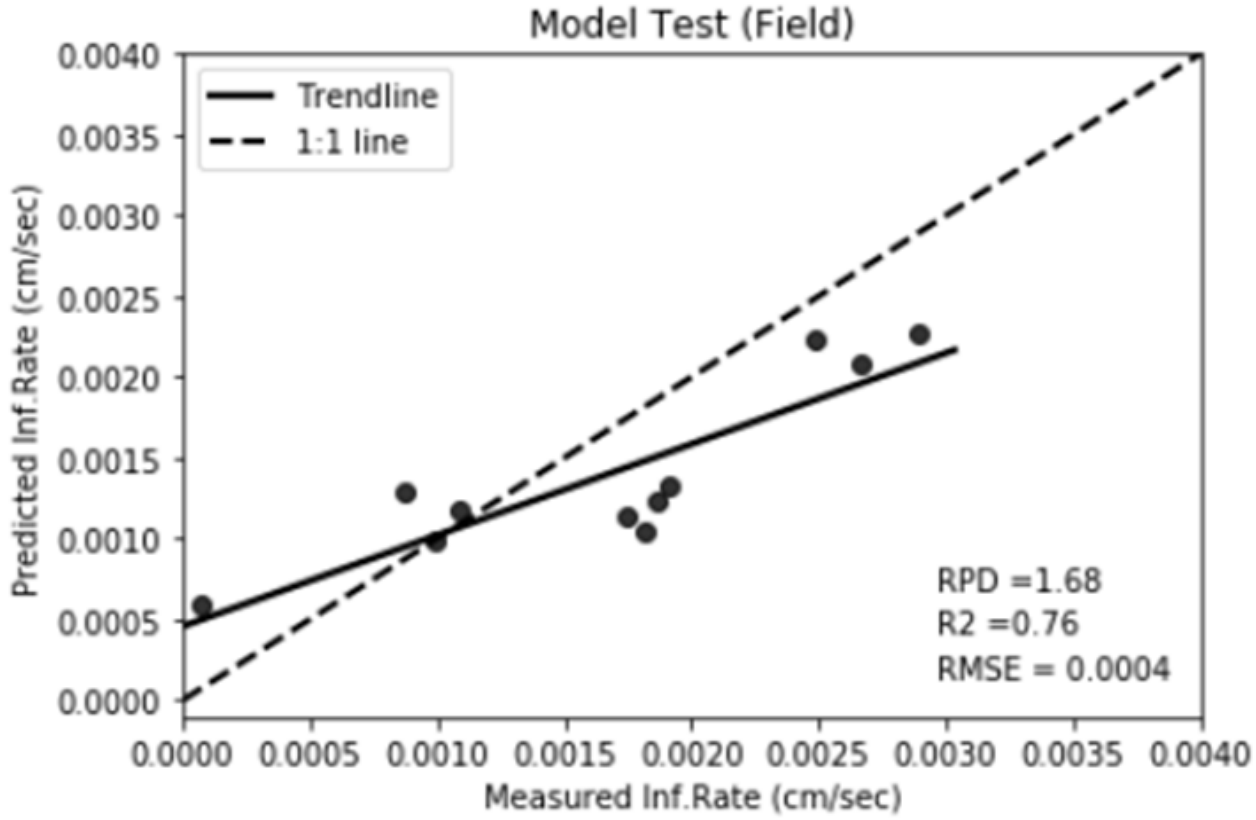
Results (3): PLSR, The whole dataset (Lab)



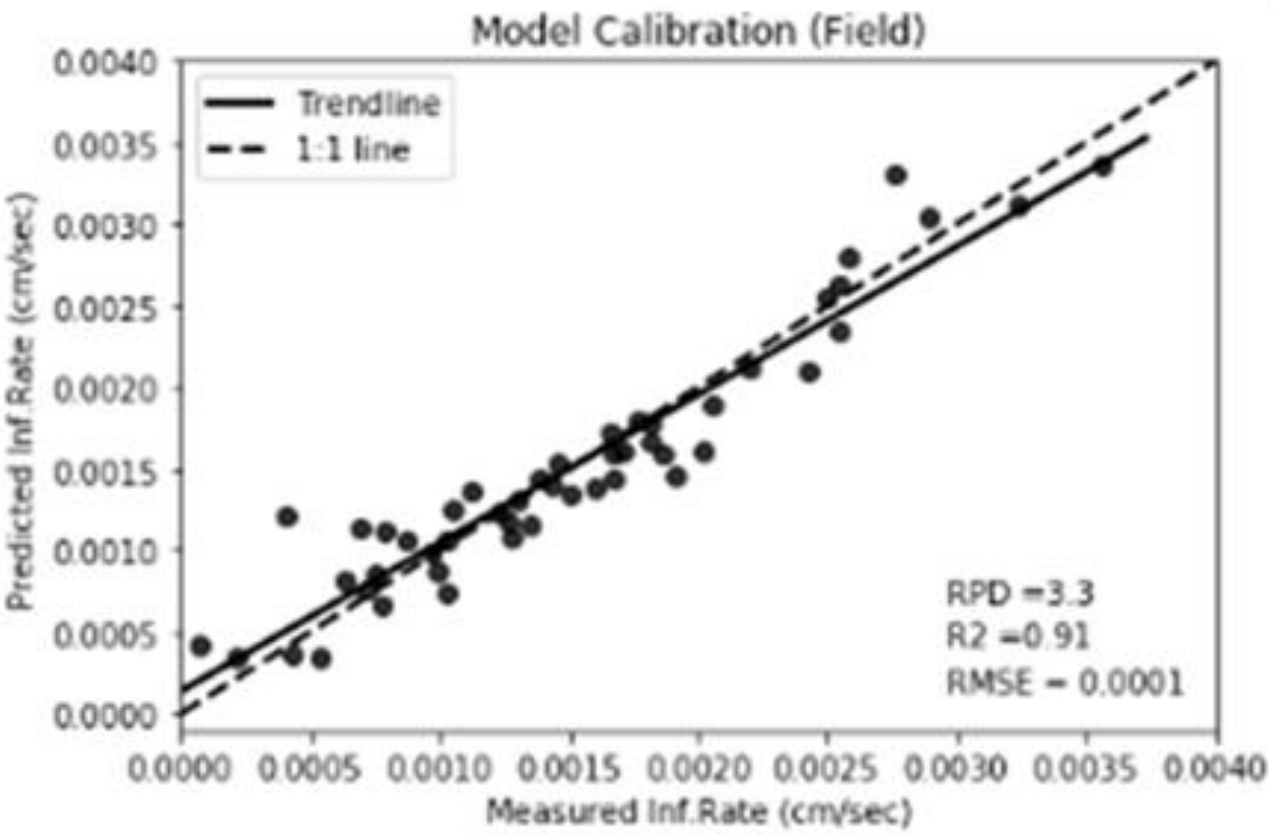


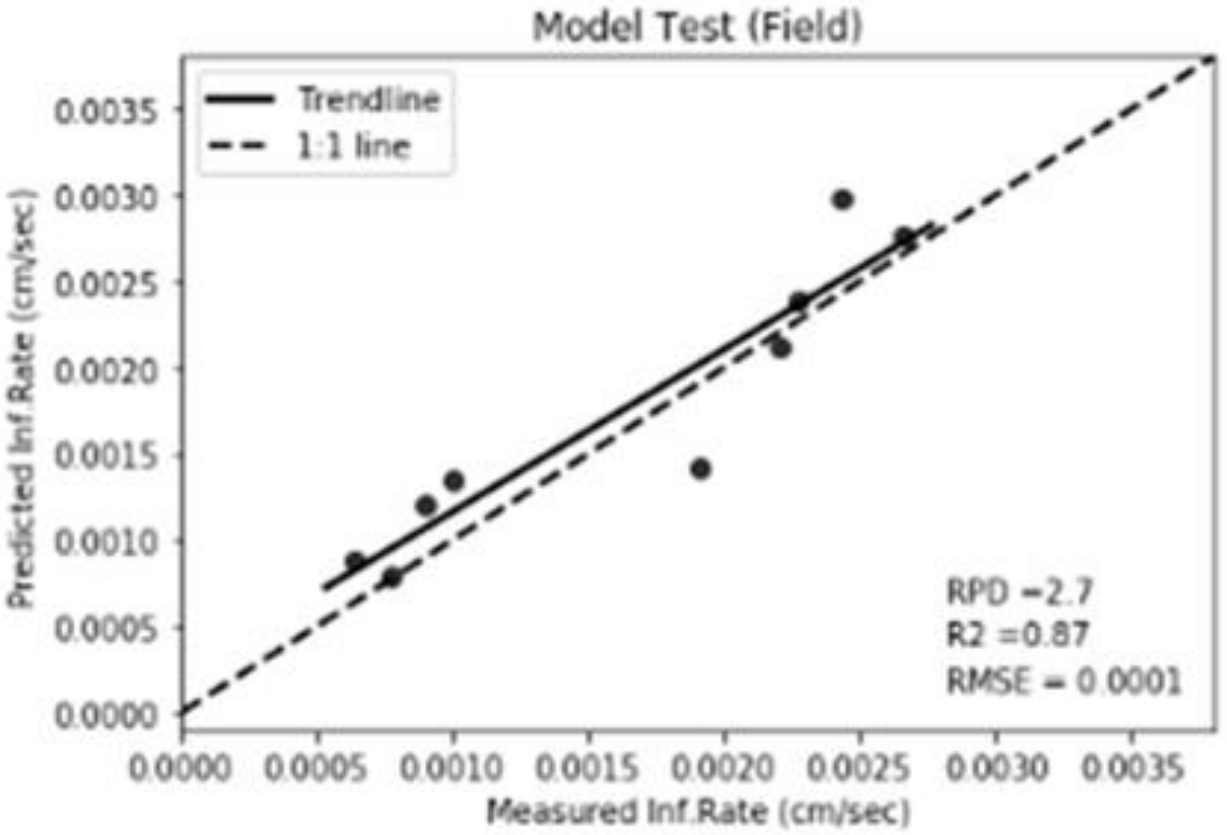
Results (2): PLSR, The whole dataset (Field)





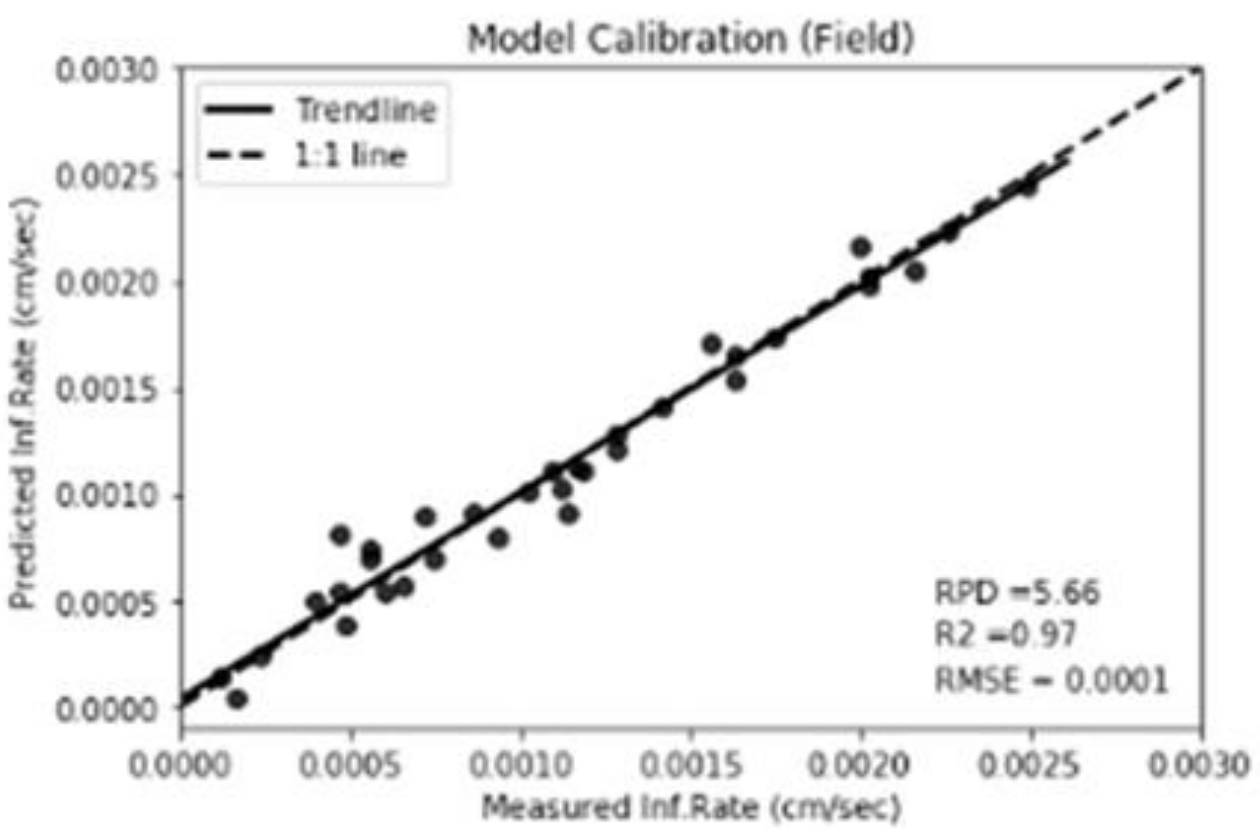
Results (3): PLSR, The sandy group

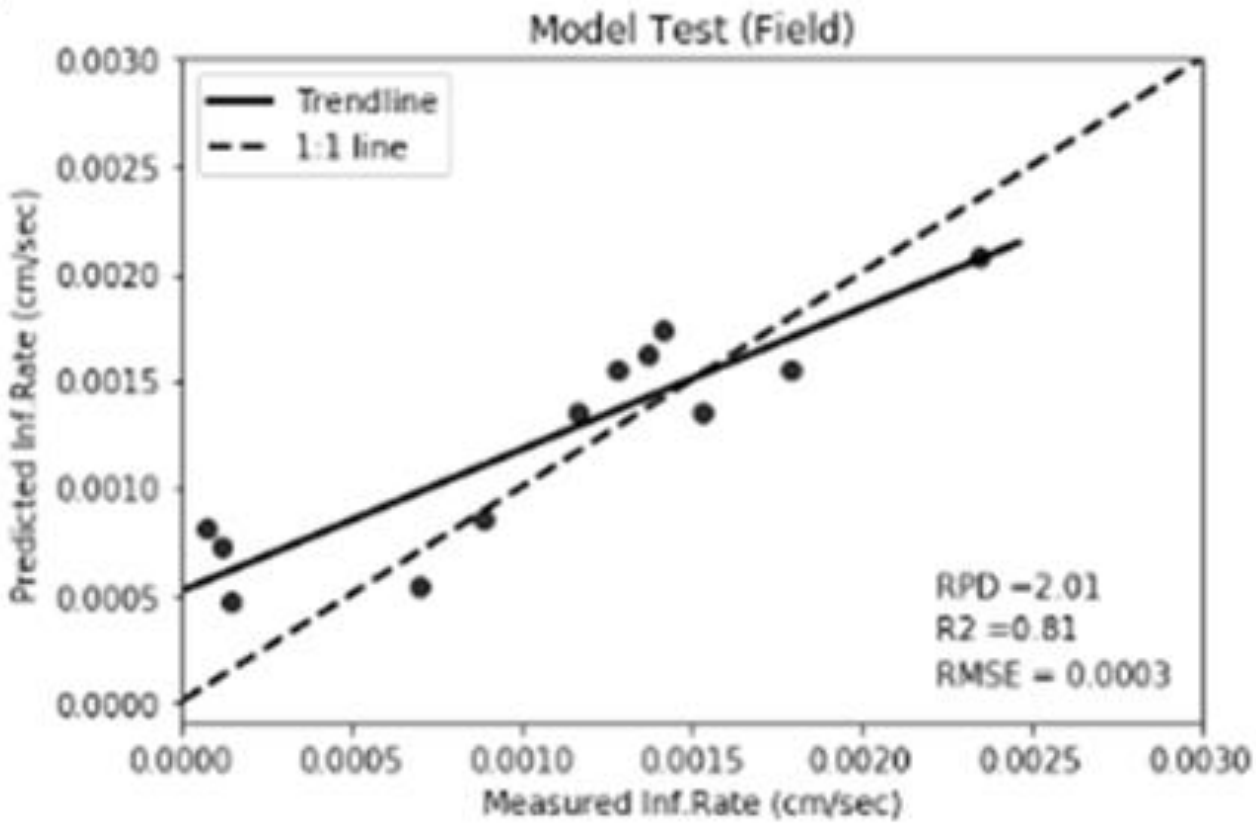




The Field Based Spectral Model of the sandy group: on the left the results of the calibration dataset, and on the right the results of the validation dataset after been randomly split

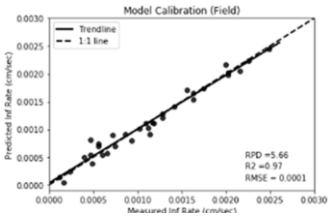
Results (4): PLSR, The clayey group



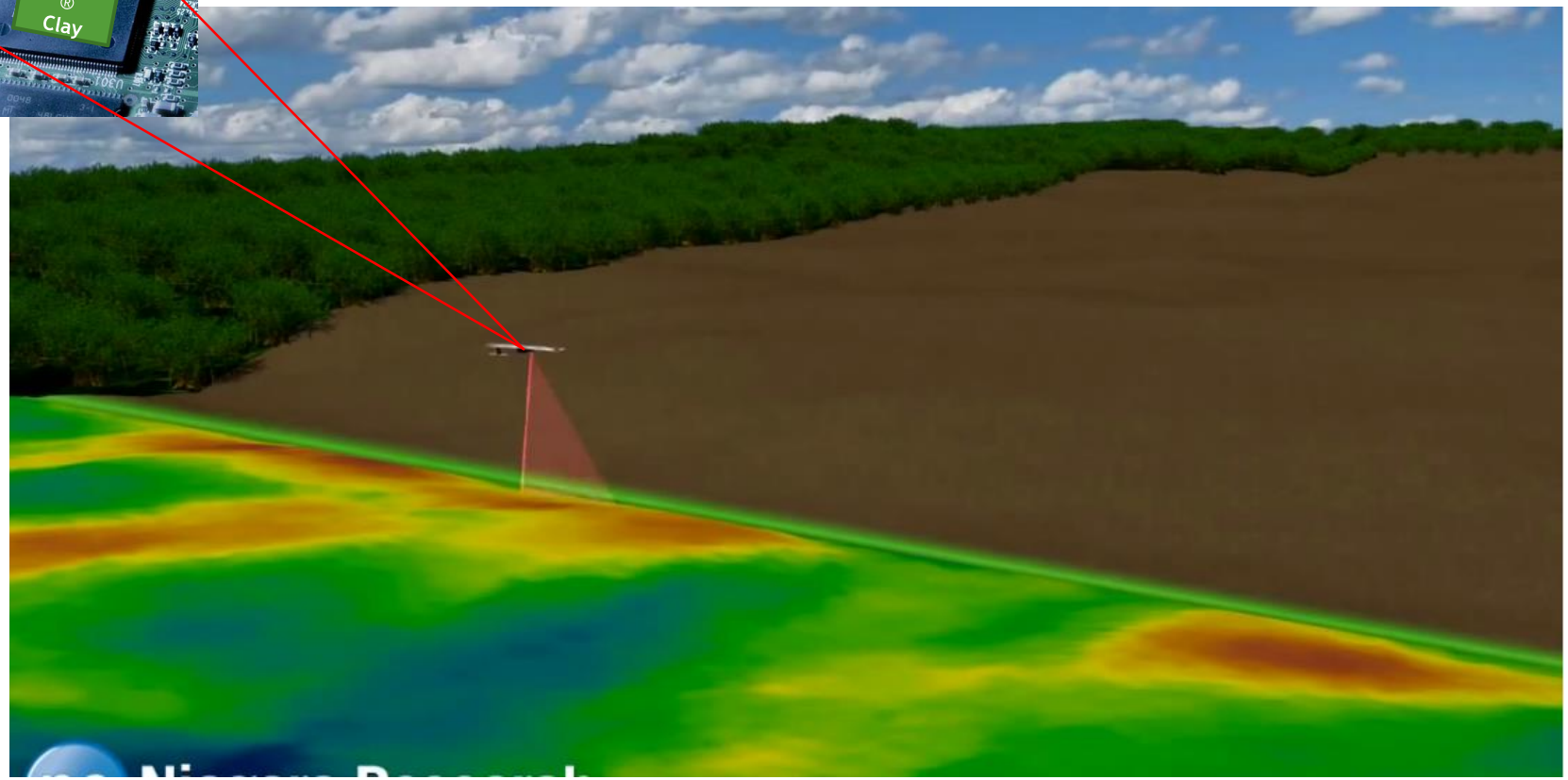


The Field Based Spectral Model of the clayey group before being spectrally resampled according Cubert: On the left: results of the calibration dataset, and on the right: results of the validation dataset after been randomly split.

Using Hyperspectral DRONE sensor and platform



A MODEL



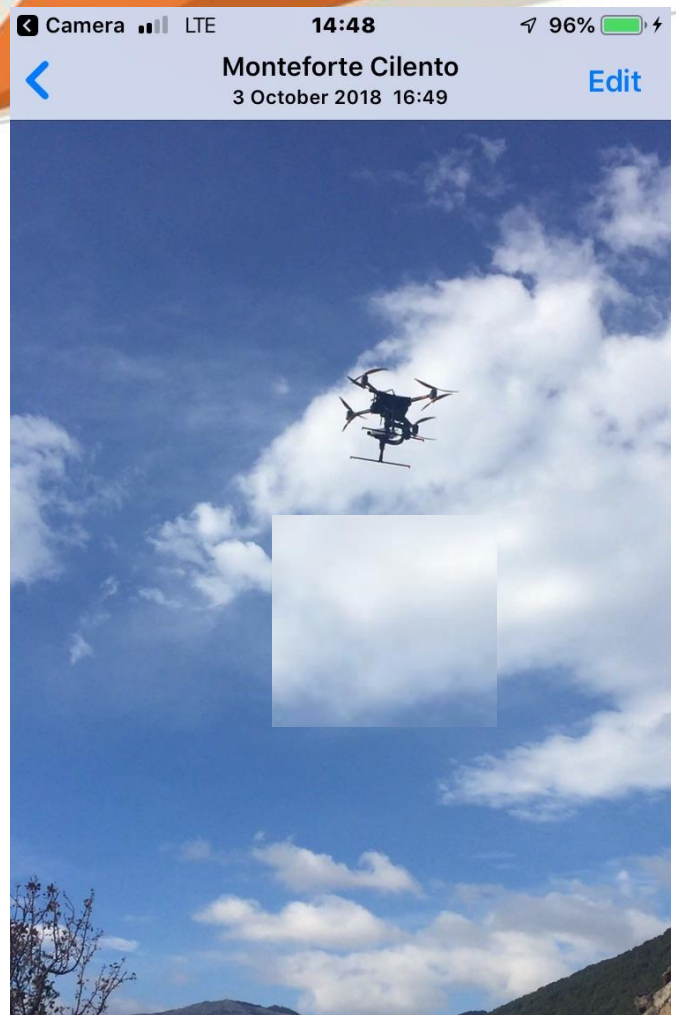
DRON set up : CUBERT sensor

Tóth Brigitta
János Mészáros,
Hungarian Academy of Sciences, Budapest

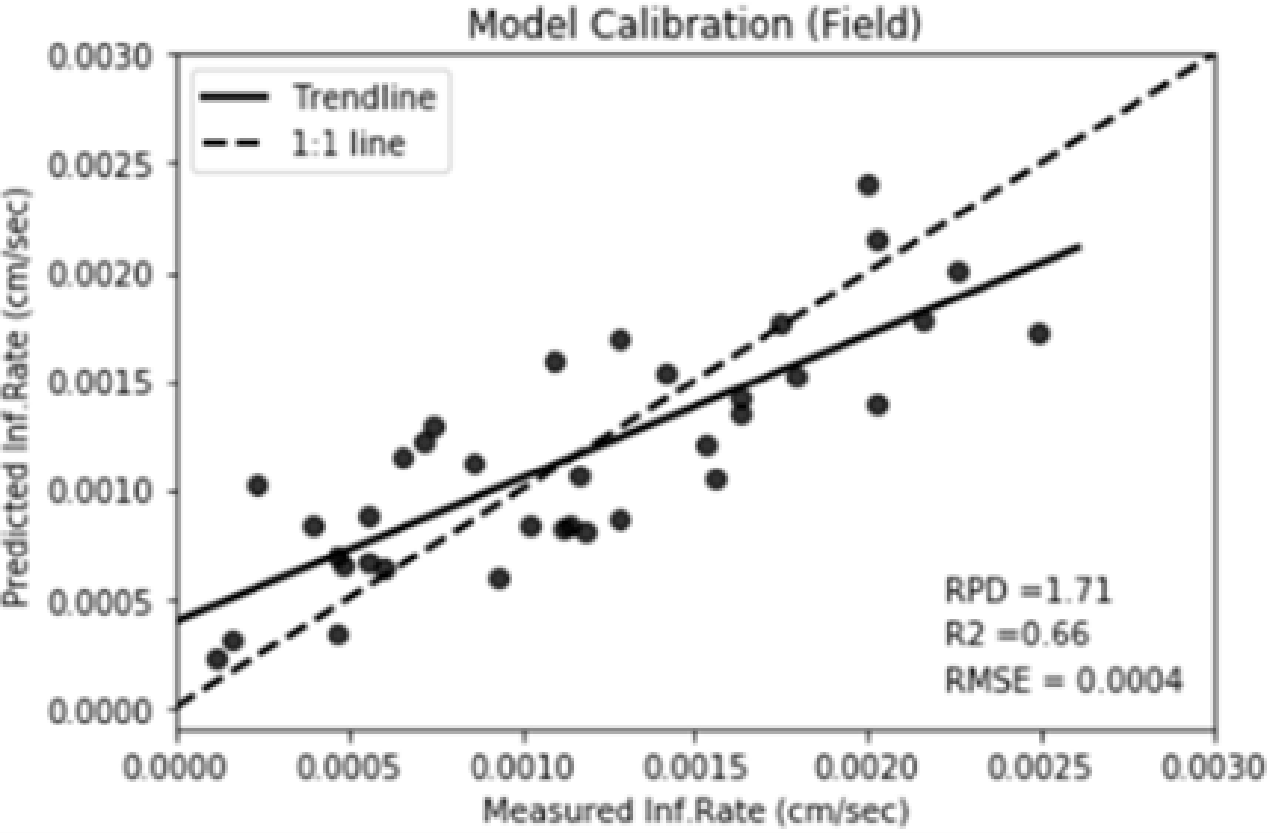
cubert Spectral Cameras Software Applications Support

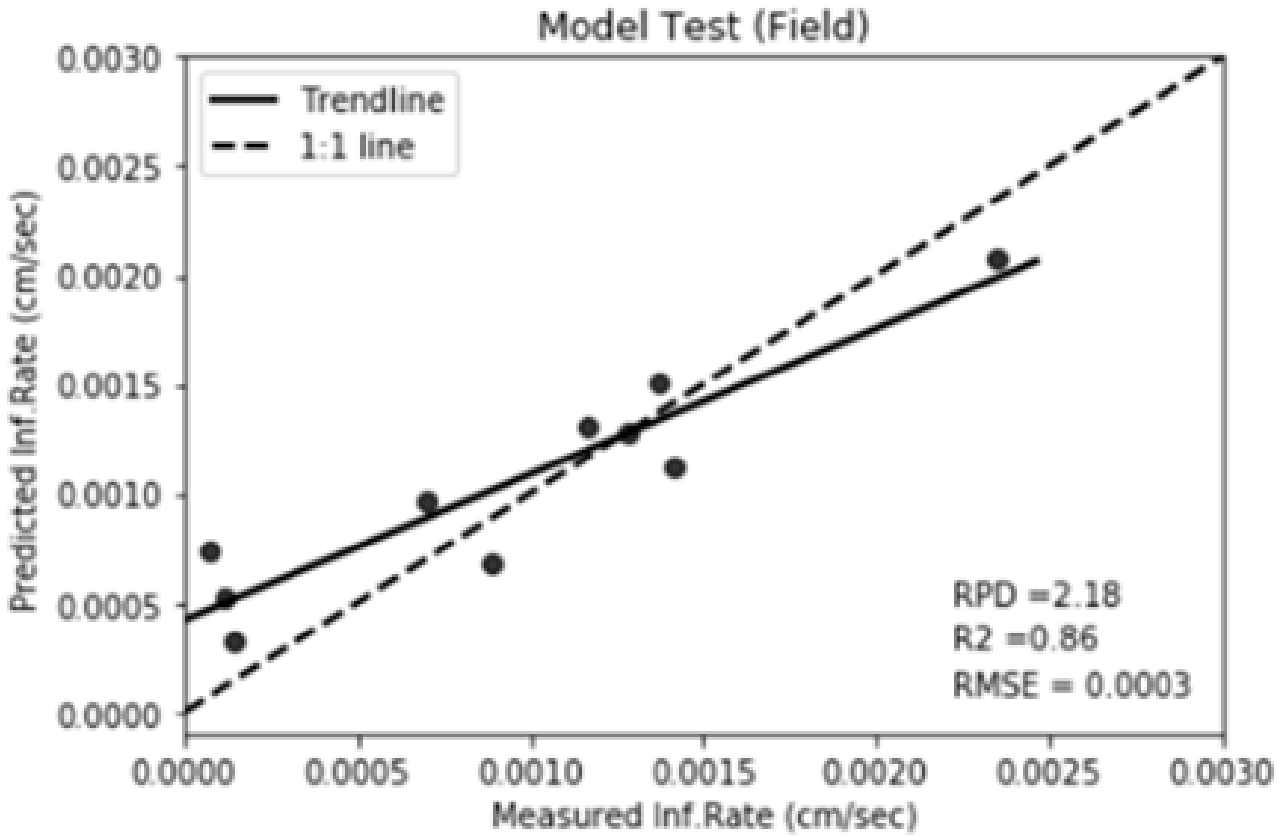
01 Technology	Multi-Point-Spectrometer
02 Number of spectral channels	125
03 Spectral throughput [spectra/capture]	2500
04 Wavelength range [nm]	450-950
05 Spectral resolution [nm]	8 @ 532
06 Sampling interval [nm]	4
07 Snapshot	yes
08 Sensor resolution [Mpixel]	2×1
09 Cube resolution [pixel]	50x50x125
10 Cube rate [fps]	max. 15
11 Measurement time [ms]	0,1-1000
12 Detector type	Si CCD
13 Digitization [Bit]	12
14 SNR max [dB]	typ. 58

Data Acquisition (UAV)



Results (5): PLSR, The clayey group after spectral resampling to DRONE





Results (6): RGB images of the study area of Alento.

RGB images of the study area of Alento.

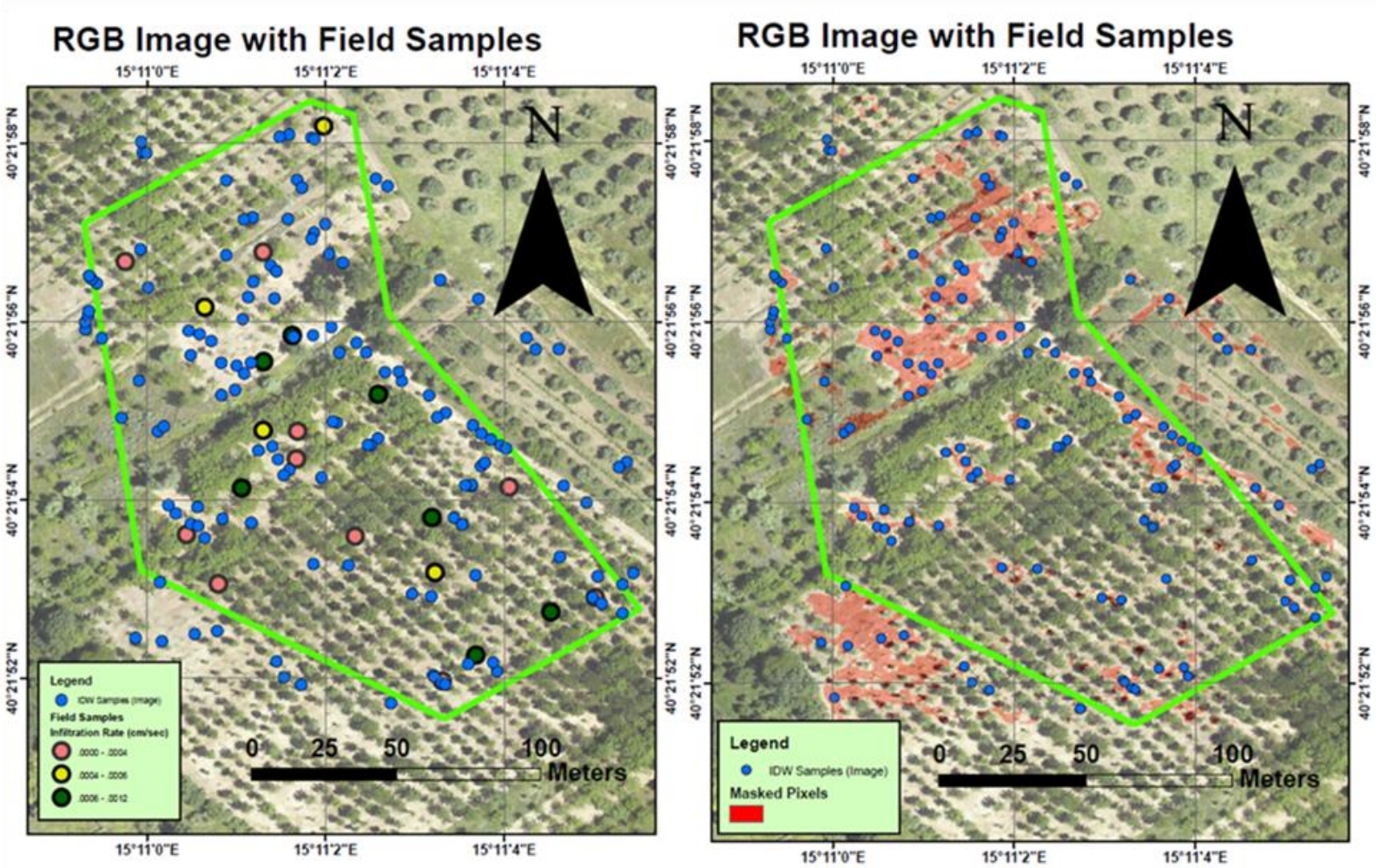
A) location of the field samples colored by their measured infiltration rate.

B) The blue points in both maps represent the clear soils pixels that were randomly selected in order to interpolate the masked pixels.

C) In red pixels with vegetation yellow are soils.

a Real

b Proxy



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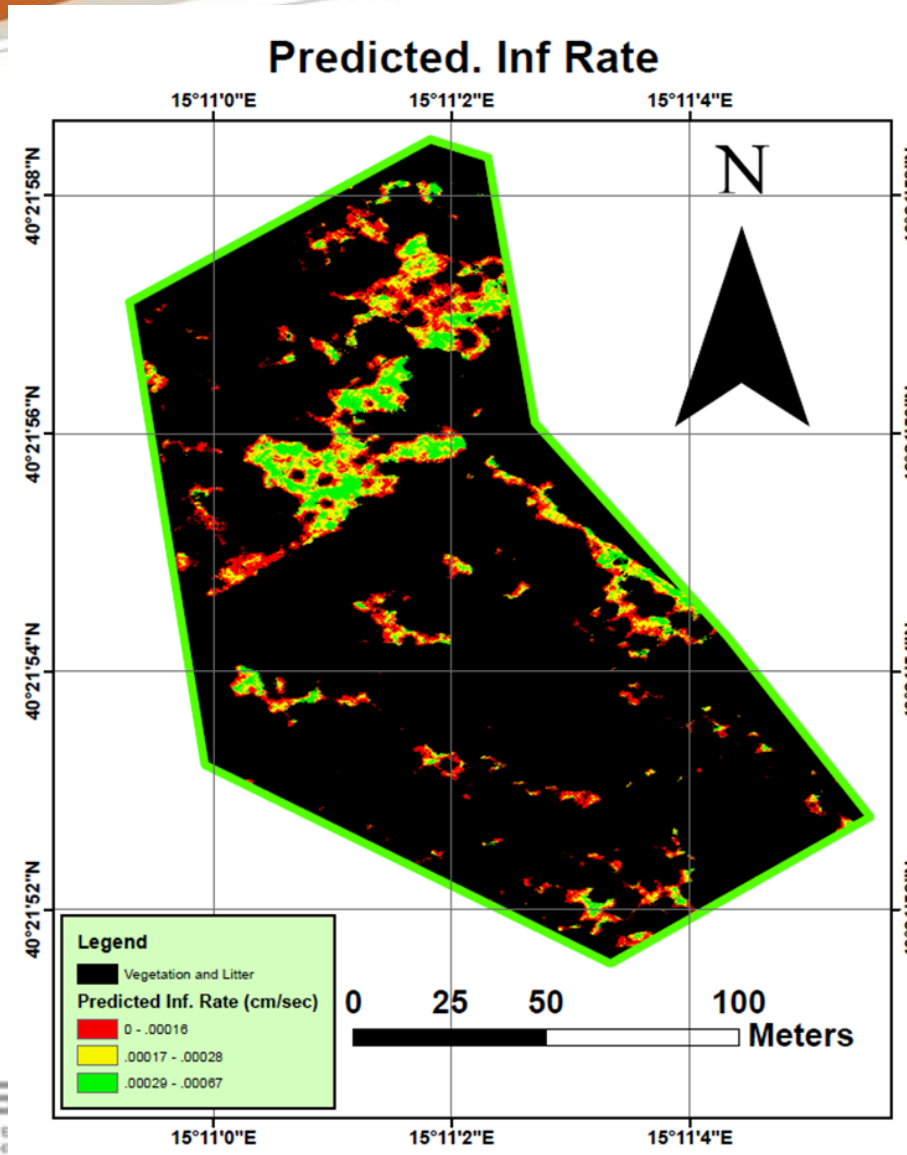
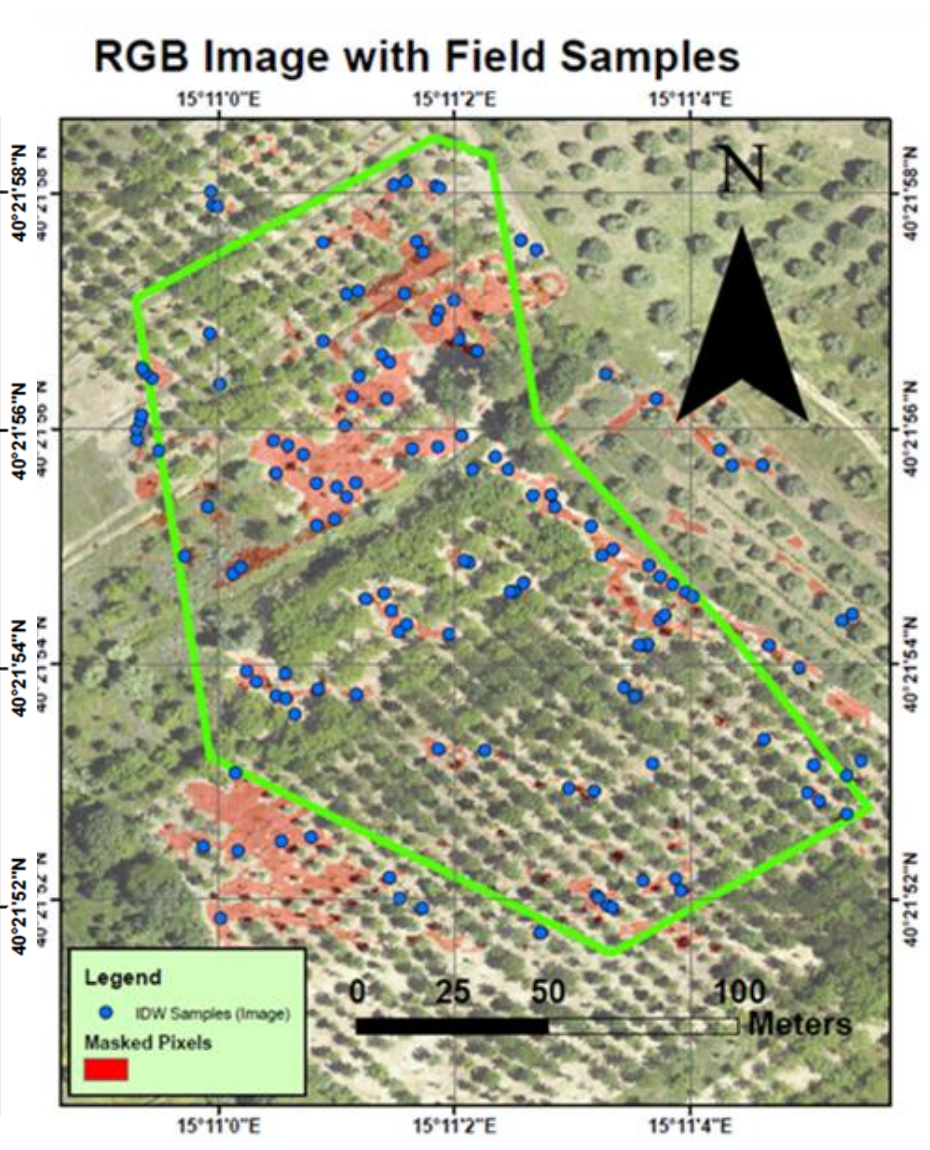
a


Predicted. Inf Rate
15°11'0"E
15°11'2"E
15°11'4"E
40°21'58"N
40°21'56"N
40°21'54"N
40°21'52"N
N
Legend
Vegetation and Litter
Predicted Inf. Rate (cm/sec)
0 - .00016
.00017 - .00028
.00029 - .00067
0 25 50 100
Meters

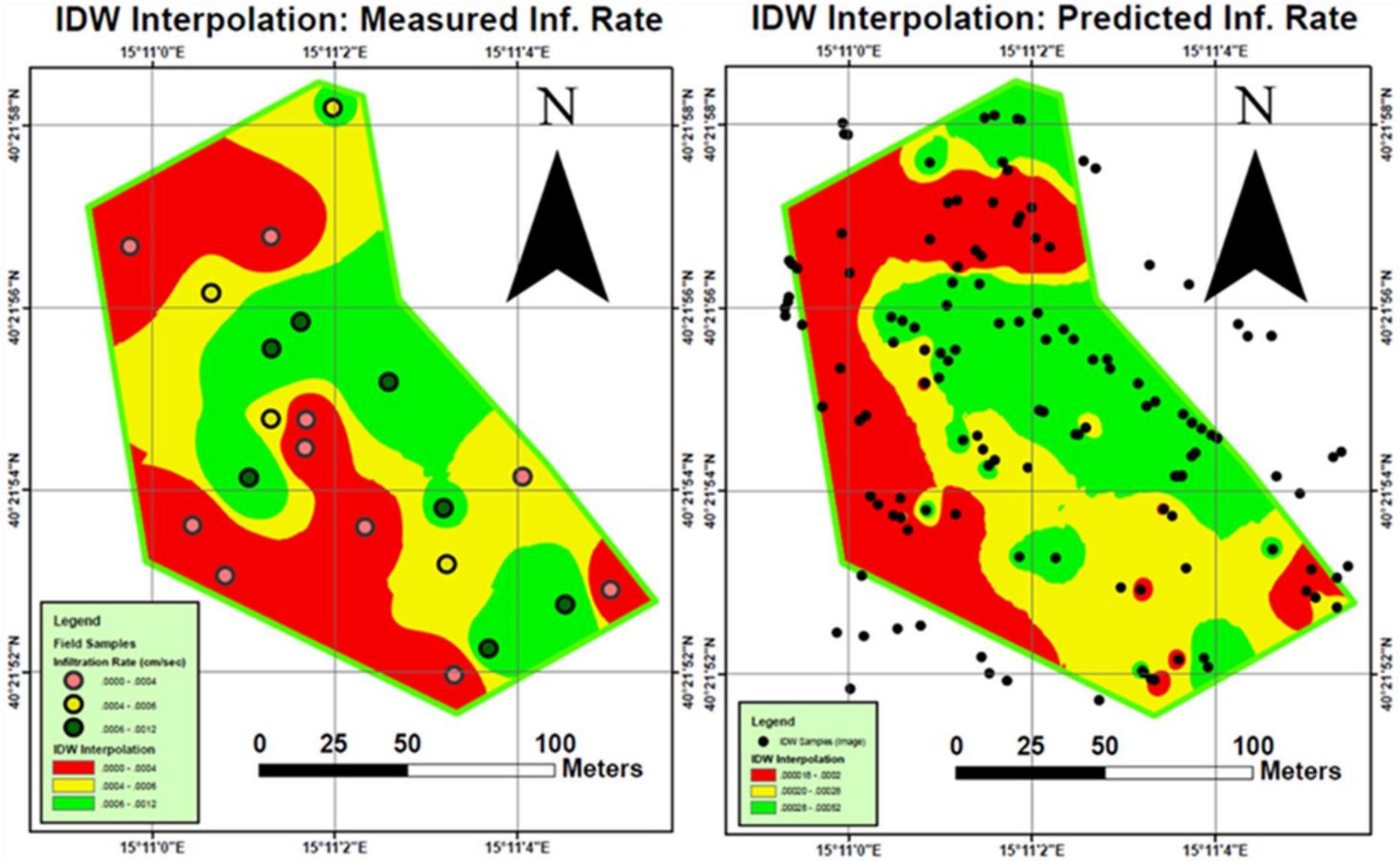
b


RGB Image with Field Samples
15°11'0"E
15°11'2"E
15°11'4"E
40°21'58"N
40°21'56"N
40°21'54"N
40°21'52"N
N
Legend
IDW Samples (Image)
Masked Pixels
0 25 50 100
Meters

Inf. Rate, Measured vs Predicted (Kriging)

a

b



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Conclusions

- Simultaneous field measurement of both Soil infiltration rate and spectral reflectance of undesired soils provides spectral based models that well represent the field condition

- Clay and Sandy soils hold different spectral based model to proxy Water Inf. Rate (WIR)

- Hyperspectral sensor from DRONES open a new Era for spectral based mapping of soil

- More samples in order to extend the spectral library of WIR is required and full spectral region should be cheeked using new generation of HSR sensors.

Thank You !

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http://www.tau.ac.il/humanities/geography/rsl/

Questions?