Soil water dynamics affected by micro rainwater harvesting structures in Jordanian Badia restoration context

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Background information

Badia

Land degradation

Water scarcity

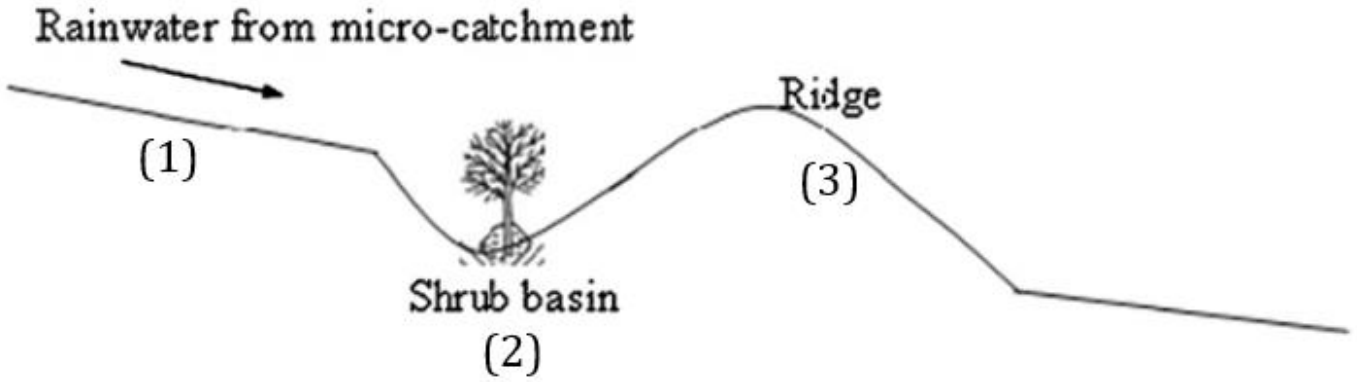
Agriculture

Water harvesting

Vallerani micro water harvesting

Relatively new

Automated ploughs




(Haddad, 2019)
2017
2018
2019

Study objectives

- To quantify the soil moisture dynamics in the field in and around the Vallerani structures
- Model the soil moisture dynamics using Hydrus-2D
- Evaluate the water retention capacity of the Vallerani structures throughout different climate change scenarios

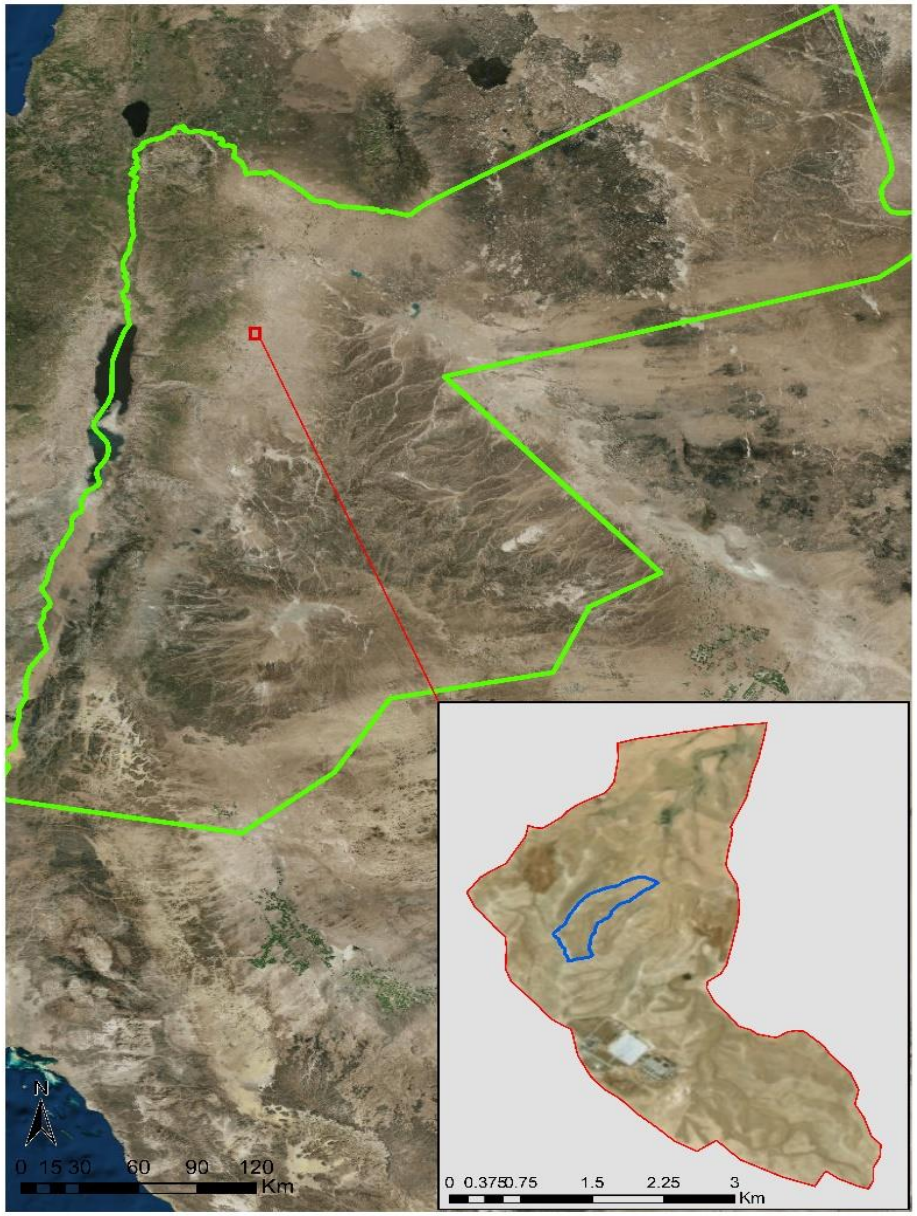
Study area

Jordanian Badia

Watershed

Sparsely inhabited

Barley & grazing animals



Study area

30 hectares

Atriplex Halimus

Rainy season: September - May

Crusted soil

Methods

HYDRUS 2D

Subsurface flow

Van Genuchten – Mualem model

Rosetta parameter estimation

Water level

Infiltration

Filled to maximum capacity

Monitored over time

Two Vallerani RWH structures

Photogrammetry

Close-range photogrammetry

Markers

373 photos

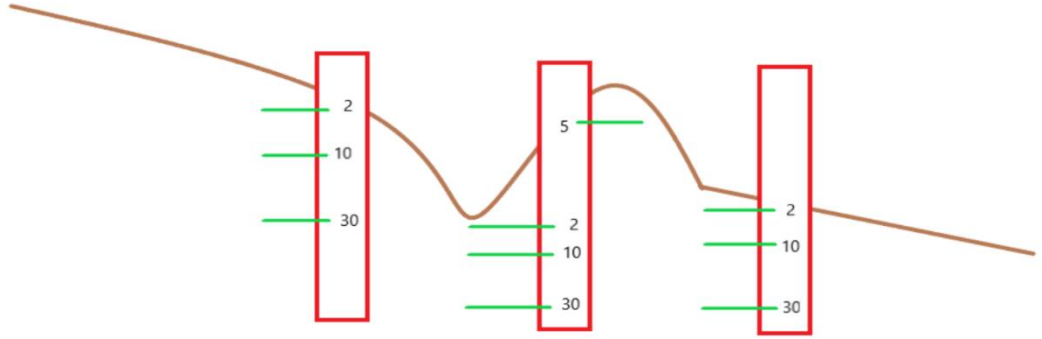
Soil moisture

Decagon 5TE

10 sensors

Rebuilding structure

TRIME-PICO



Climate scenarios

Three scenarios

Based on literature

Scenario	Rainfall amount %	Temperature change °C	Intensity changes
1	-10	+1.2	None
2	-20	+2.5	Smallest events combined into more intense events
3	-30	+3.5	Smallest events removed. small events made into heavy events.

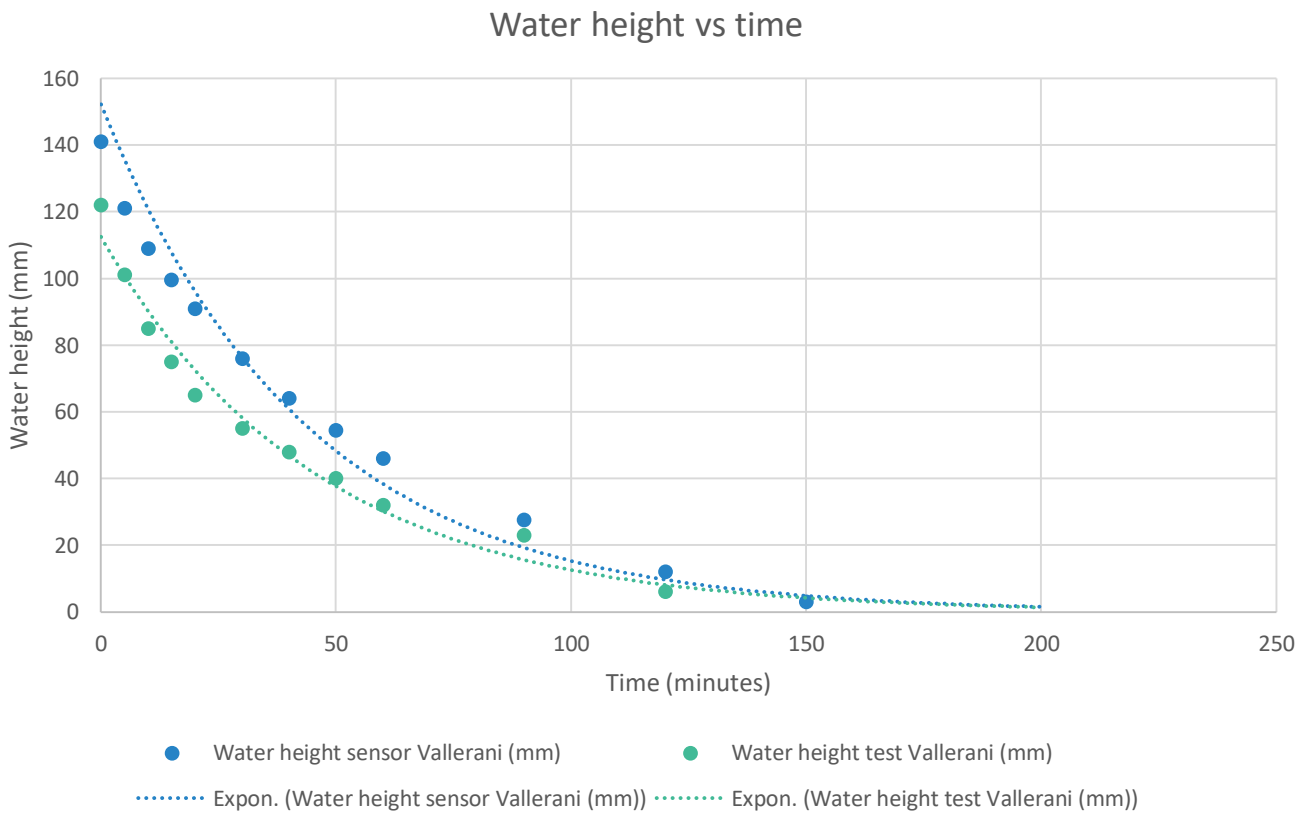
Results

Infiltration rates

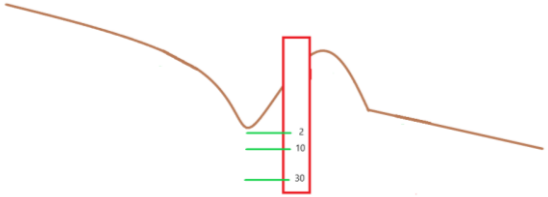
260 liters

~2.5 hours

No preferential flow



Soil moisture underneath

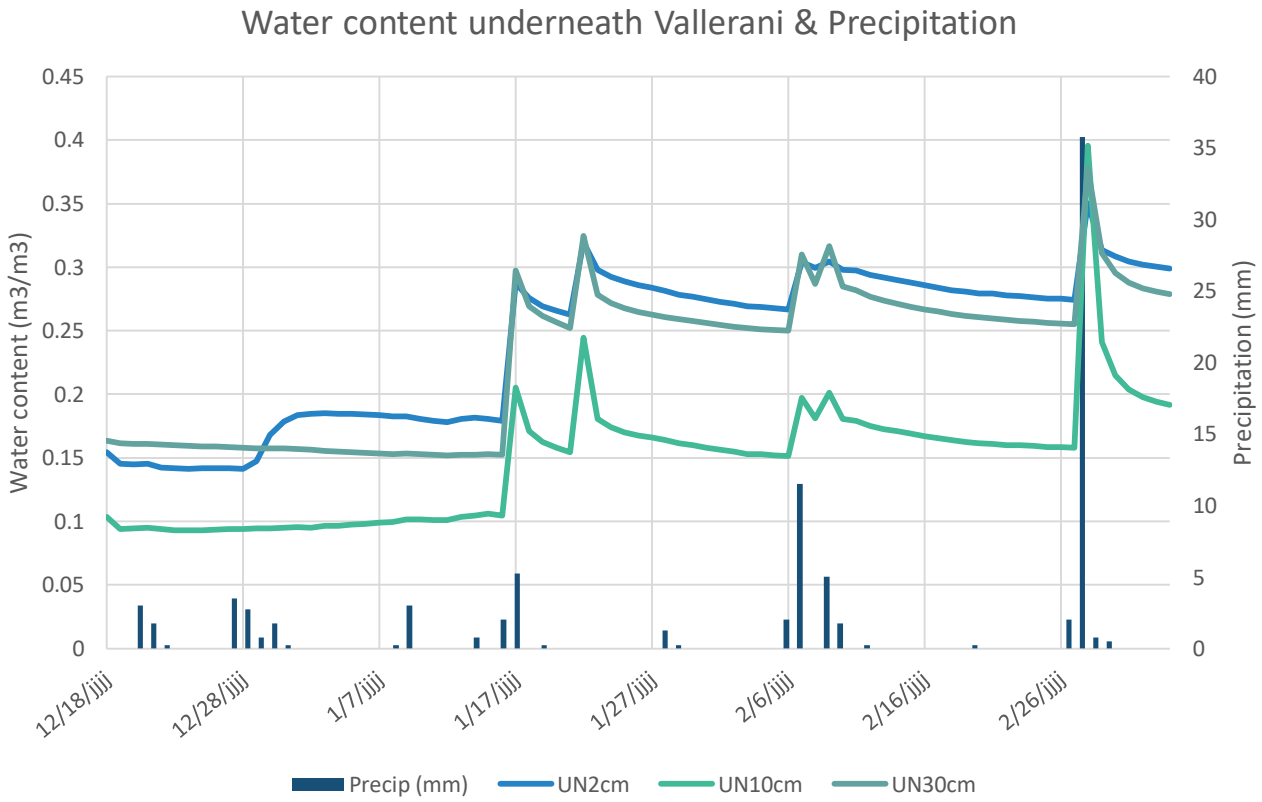


Poor results

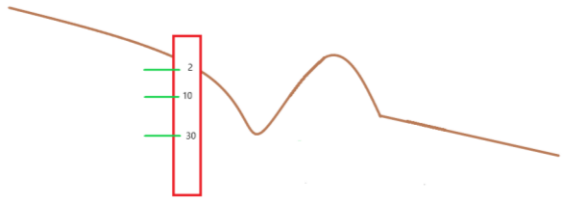
Unrealistic values

Realistic pattern

Lowest values

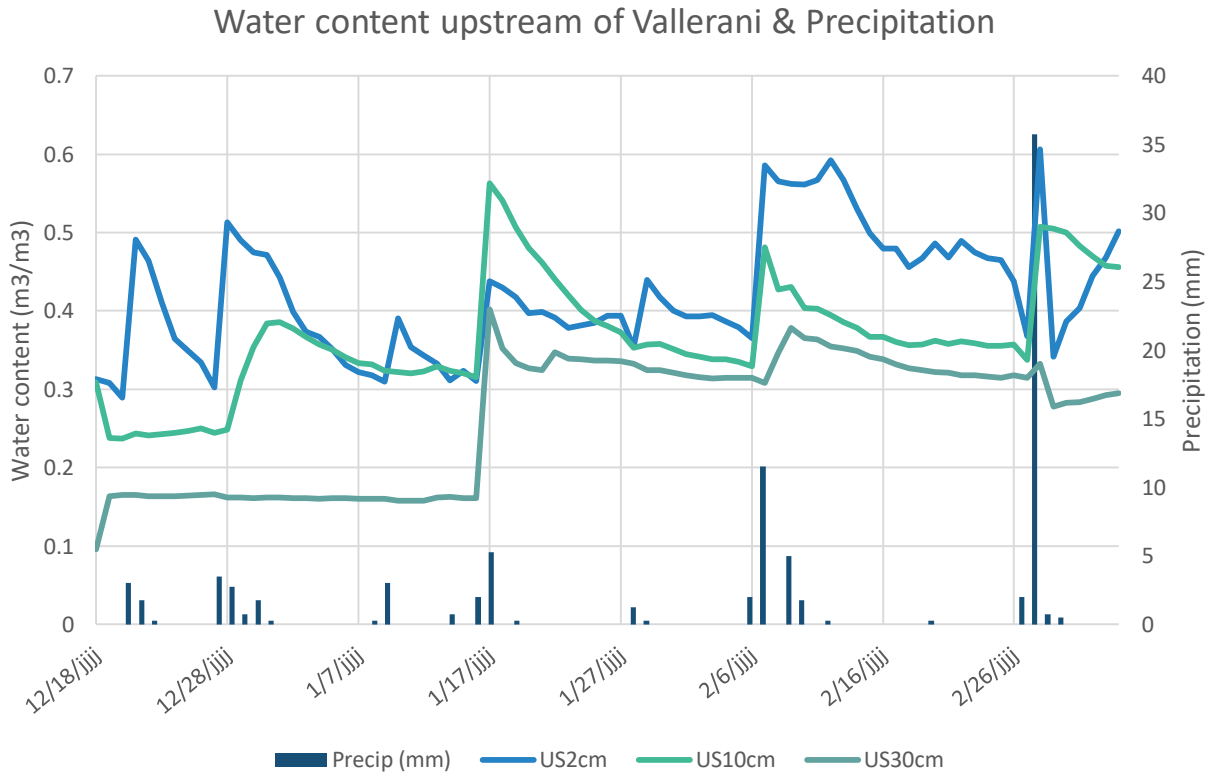


Soil moisture upstream



Chaotic pattern

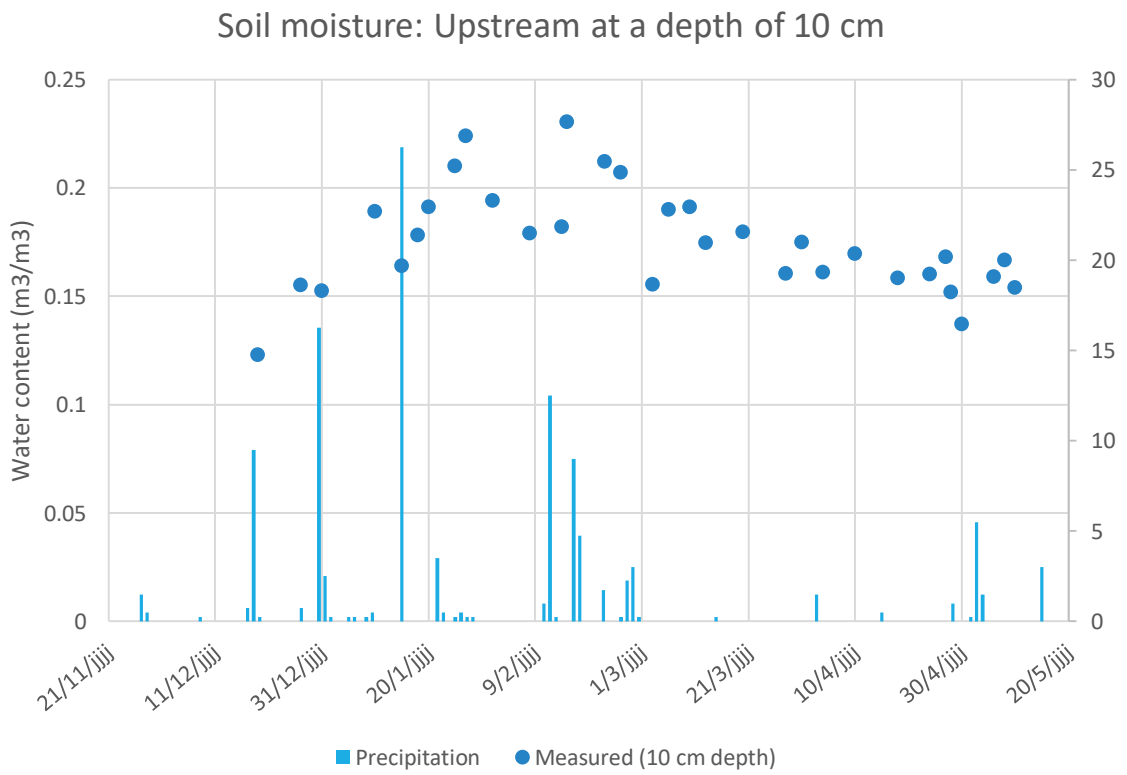
Impossible values



Soil moisture

Settling time

TRIME-PICO



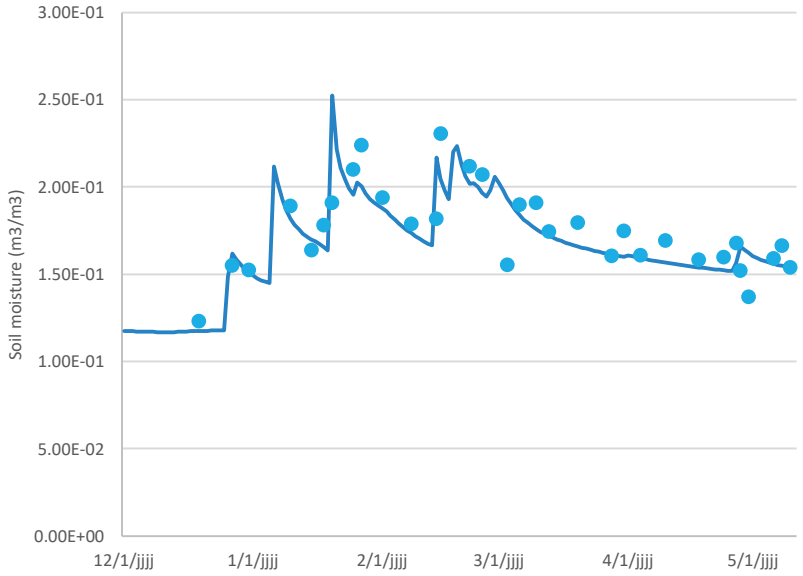
Model evaluation

5 model runs

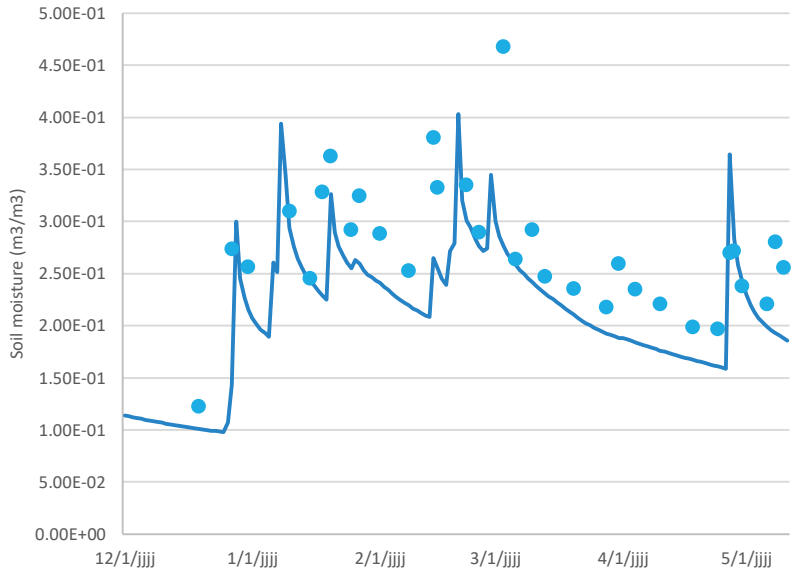
Clear winner

Parameter set	Correlation (-)	Bias (%)	Kling-Gupta Efficiency (-)
1	0.5	18.2	0.42
2	0.49	14	0.4
3	0.44	10.2	0.34
4	0.46	8.9	0.35
5	0.73	-2	0.55

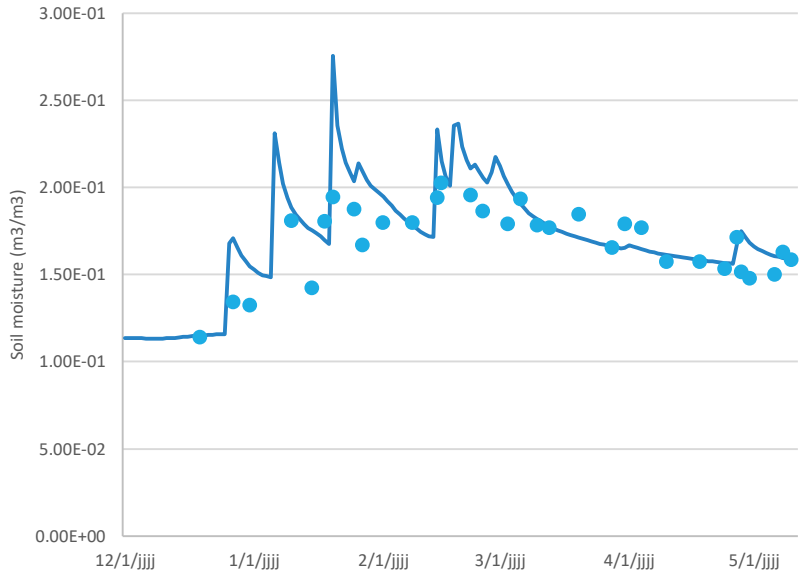
Upstream 10 cm depth



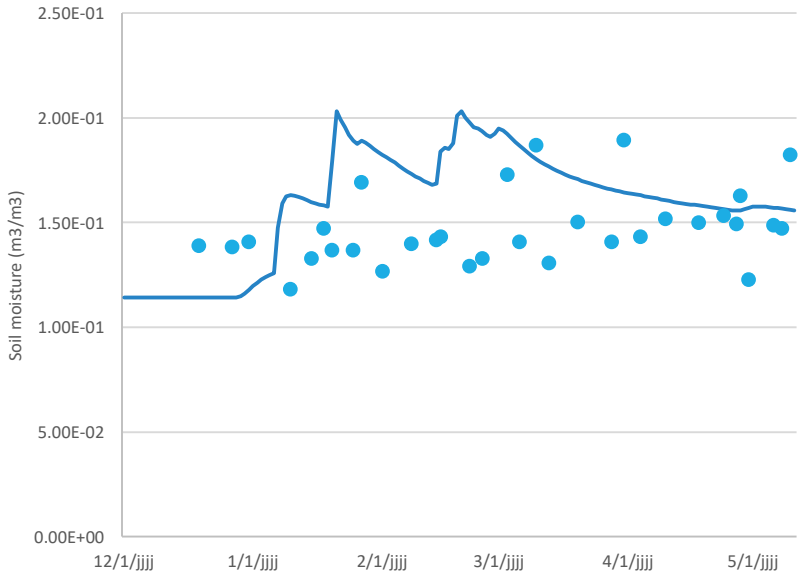
Underneath 10 cm depth



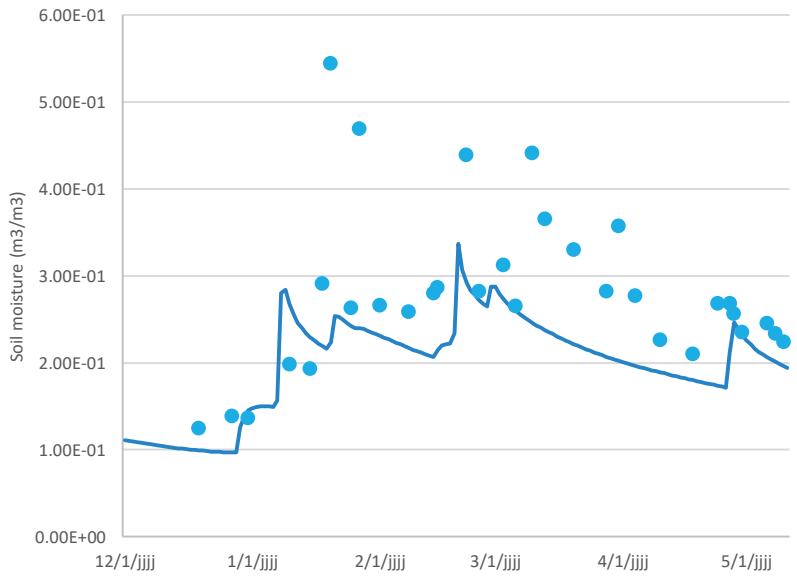
Downstream 10 cm depth



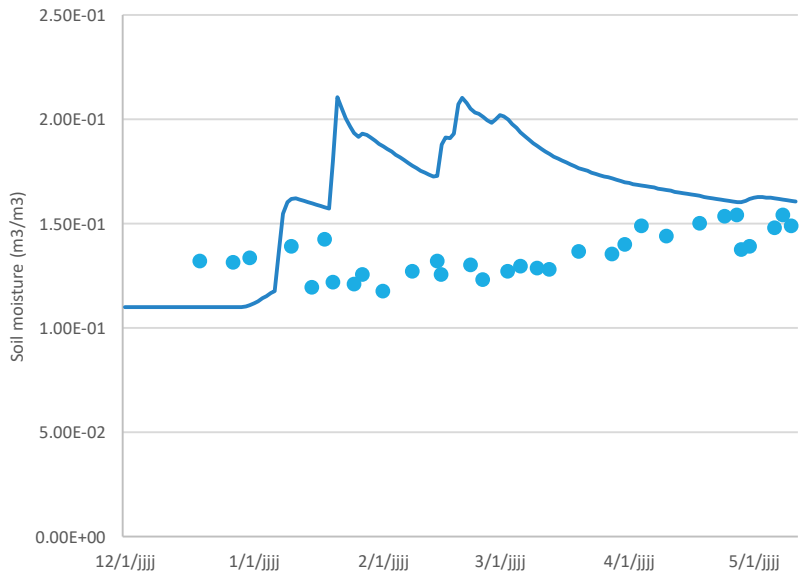
Upstream 30 cm depth



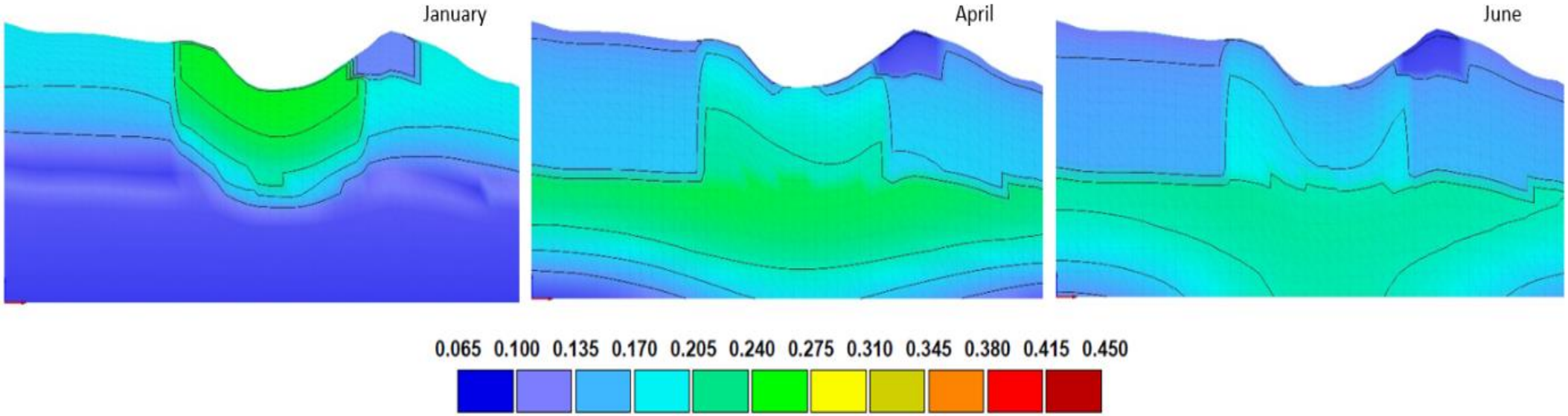
Underneath 30 cm depth



Downstream 30 cm depth



Modelled soil moisture



Water stress

Depth dependent

Significant increase

Intensity

Annual days of water stress

Depth	Present	Scenario 1	Scenario 2	Scenario 3
10 cm	83	97	125	101
20 cm	80	95	125	103
30 cm	62	89	121	106

Discussion & Recommendations

Software

Seedling vs Shrub

Rainfall intensity

Climate change mitigation

Conclusion

Rejuvenation

More research