Report on Architecture & Environment Laboratory – AE LAB 1
11-13, September 2019, Florence, Italy

SUMMARY

Climate change and the increased need for food production due to growing populations and rapid urbanization makes it necessary to establish which way of agricultural production is most sustainable in a given context, while delivering high quality produce. This necessitates detailed research with focus on comparing different forms of industrial and traditional agriculture. Today not enough attention is given to the analysis of traditional agriculture and the terrain articulation and constructions associated with it, as well as their interaction with and modulation of the microclimate so as to yield high quality produce. For this reason, the research summarized in this report focuses on multi-scalar and multi-domain environmental analysis and modelling of terrain articulation and constructions for agricultural purposes and their interaction with the local topoclimate and modulation of the local microclimate. More specifically, this research focuses on the microclimatic performance of the terraced vineyards of Lamole in Tuscany. The first phase of the research commenced in 2015 and included field research in 2016 and 2017. The currently ongoing second phase of the research entails a series of annual field researches over a period of five years (2019-23), that are entitled AE LABs (Architecture and Environment Laboratories), as well as the initiation of LamoLab – Centre for Environmental Research.

PHASE 1

We focus our research on terraced vineyards that utilize dry-stone walls for improving microclimatic conditions for agricultural production, especially in higher altitude locations with unfavourable diurnal temperature ranges. Terraces in conjunction with different pruning strategies orient plants in a favourable way towards the sun for increased photosynthesis. As our research is beginning to show this is further enhanced by the thermal performance of the dry-stone walls that extent the temperature ranges for effective photosynthesis in the evening when temperatures fall rapidly at higher altitudes. During phase one the research focused on the lower Grospoli vineyard in Lamole.

The research included photogrammetry and the creation of a computational 3d model of the terrain, as well as thermographic imaging and analysis and the installation of industrial grade weather stations on site to obtain micro-climatic data of a full annual cycle. We correlated climate data obtained from the local meteorological station in Lamole, thermographic analysis of the terraced Grospoli vineyard provided by the Geomatics for Environment and Conservation of Cultural Heritage Laboratory of the Department of Civil and Environmental Engineering (DICEA) at the University of Florence, with industrial grade, as well as purpose made weather stations. The weather stations included sensors for ambient temperature and humidity, solar radiation, soil temperature and moisture, precipitation, and wind direction and speed. Additionally, we utilized computational simulation tools for analysing microclimatic performance.

During phase one of the research we experienced scattered data loss of the weather stations due to poor network coverage in the Lamole valley. For this reason, no full annual cycle of data was obtained. However, the data obtained over several months indicates the microclimatic performance of the dry-stone walls. As the lower Grospoli terrace changed ownership it was necessary to continue the research in phase 2 in different vineyards.

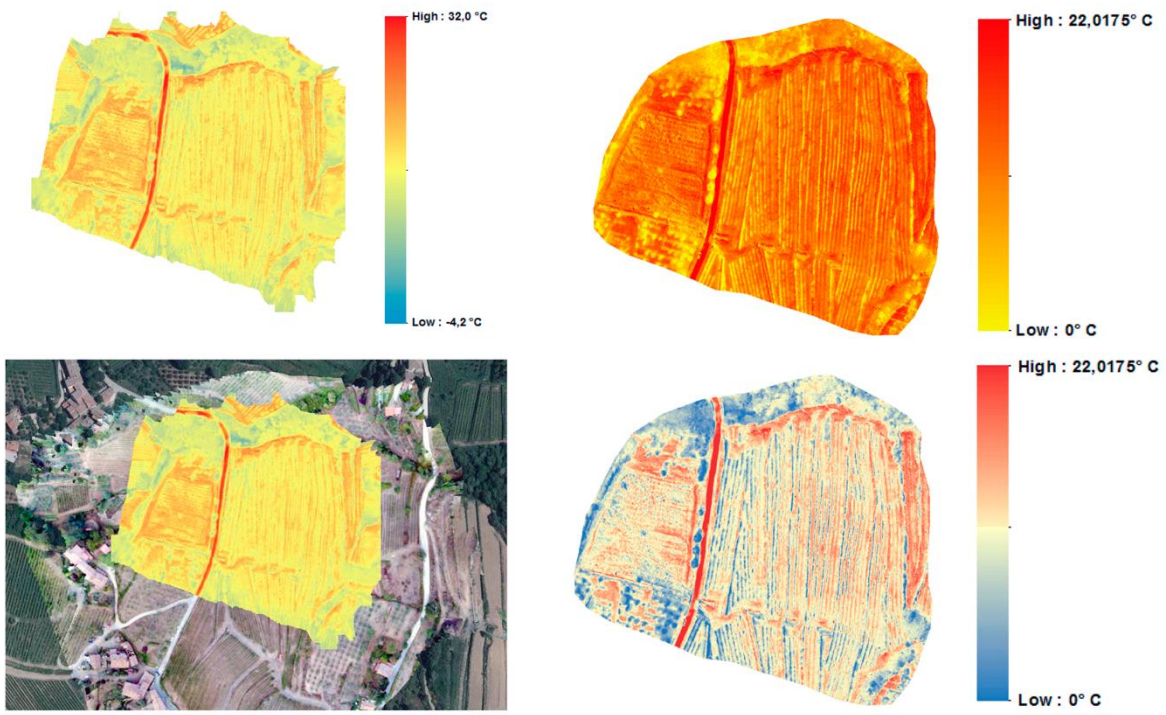

Fig. 1 Thermography of lower Grospoli vineyard

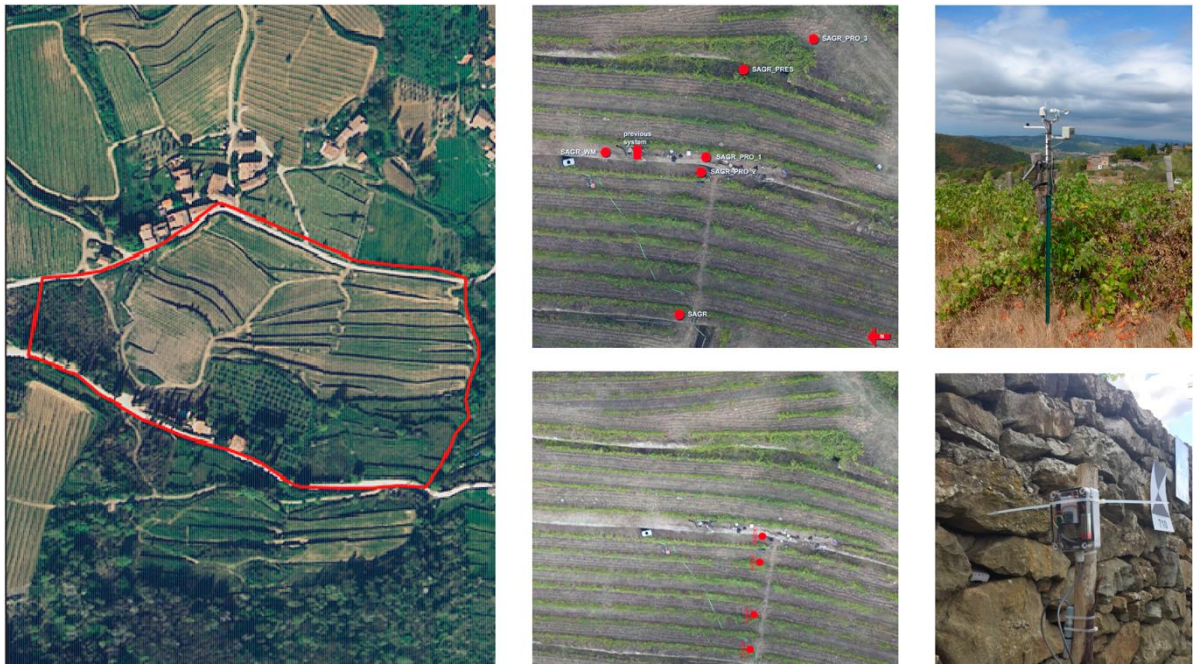

Fig. 2 Location and types of weather stations

	A	B	C	D	E	F	G	H	I	J	K
1	Date	Time	Serial Number	Station Name	?	?	Sensor Values				
2	03/08/16	06:42:39	408415758	SAGR	128	0	BAT:28	TCB:28.10	HUMB:48.1	PLV1:0.00	PLV2:0.00
3	03/08/16	06:42:40	408415758	SAGR	128	1	PLV3:0.00	ANE:0.00	WV:0	SOIL_C:47.10	
4	03/08/16	06:44:45	408415758	SAGR	128	1	PLV3:0.00	ANE:0.00	WV:0	SOIL_C:47.17	
5	03/08/16	06:54:10	408521292	SAGR	128	1	PLV3:0.00	ANE:0.00	WV:0	SOIL_C:52.40	
6	03/08/16	06:56:58	408521292	SAGR	128	0	BAT:26	TCB:28.70	HUMB:46.4	PLV1:0.00	PLV2:0.00
7	03/08/16	06:56:59	408521292	SAGR	128	1	PLV3:0.00	ANE:15.20	WV:12	SOIL_C:52.41	
8	03/08/16	06:57:54	408521292	SAGR	128	2	BAT:26	TCB:28.70	HUMB:47.3	PLV1:0.28	PLV2:0.00
9	03/08/16	06:57:55	408521292	SAGR	128	3	PLV3:0.00	ANE:0.00	WV:10	SOIL_C:52.49	
10	03/08/16	07:02:19	408521292	SAGR	128	0	BAT:26	TCB:28.65	HUMB:47.3	PLV1:0.00	PLV2:0.00
11	03/08/16	07:02:20	408521292	SAGR	128	1	PLV3:0.00	ANE:7.20	WV:4	SOIL_C:52.49	
12	03/08/16	07:03:07	408521292	SAGR	128	2	BAT:26	TCB:28.64	HUMB:48.3	PLV1:0.00	PLV2:0.00
13	03/08/16	07:03:08	408521292	SAGR	128	3	PLV3:0.00	ANE:0.00	WV:4	SOIL_C:52.58	
14	03/08/16	07:04:11	408521292	SAGR	128	0	BAT:26	TCB:28.63	HUMB:47.1	PLV1:0.00	PLV2:0.00
15	03/08/16	07:04:12	408521292	SAGR	128	1	PLV3:0.00	ANE:0.00	WV:4	SOIL_C:52.60	
16	03/08/16	07:22:46	408521292	SAGR	128	2	BAT:27	TCB:28.34	HUMB:48.0	PLV1:1.68	PLV2:0.00
17	03/08/16	07:22:47	408521292	SAGR	128	3	PLV3:0.00	ANE:0.00	WV:4	SOIL_C:52.49	
18	03/08/16	07:24:58	408521292	SAGR	128	0	BAT:27	TCB:28.29	HUMB:47.9	PLV1:0.00	PLV2:0.00
19	03/08/16	07:25:00	408521292	SAGR	128	1	PLV3:0.00	ANE:0.00	WV:4	SOIL_C:52.59	
20	03/08/16	07:28:34	408521292	SAGR	128	0	BAT:27	TCB:28.26	HUMB:48.1	PLV1:0.00	PLV2:0.00
21	03/08/16	07:28:35	408521292	SAGR	128	1	PLV3:0.00	ANE:0.00	WV:4	SOIL_C:52.56	
22	03/08/16	07:31:15	408521292	SAGR	128	0	BAT:27	TCB:28.19	HUMB:48.1	PLV1:0.00	PLV2:0.00
23	03/08/16	07:31:16	408521292	SAGR	128	1	PLV3:0.00	ANE:0.00	WV:4	SOIL_C:52.62	
24	03/08/16	07:33:57	408521292	SAGR	128	0	BAT:27	TCB:28.17	HUMB:48.2	PLV1:0.00	PLV2:0.00
25	03/08/16	07:33:58	408521292	SAGR	128	1	PLV3:0.00	ANE:0.00	WV:4	SOIL_C:52.61	
26	03/08/16	07:36:07	408521292	SAGR	128	0	BAT:27	TCB:28.16	HUMB:48.1	PLV1:0.00	PLV2:0.00
27	03/08/16	07:36:08	408521292	SAGR	128	1	PLV3:0.00	ANE:0.00	WV:4	SOIL_C:52.64	
28	03/08/16	07:38:07	408521292	SAGR	128	2	BAT:27	TCB:28.12	HUMB:48.3	PLV1:2.24	PLV2:0.00
29	03/08/16	07:38:07	408521292	SAGR	128	3	PLV3:0.00	ANE:0.00	WV:4	SOIL_C:52.64	
30	03/08/16	07:39:48	408521292	SAGR	128	4	BAT:27	TCB:28.10	HUMB:48.2	PLV1:2.24	PLV2:0.00
31	03/08/16	07:39:48	408521292	SAGR	128	5	PLV3:0.00	ANE:0.00	WV:4	SOIL_C:52.66	
32	03/08/16	07:40:49	408521292	SAGR	128	6	BAT:27	TCB:28.09	HUMB:48.1	PLV1:2.24	PLV2:0.00
33	03/08/16	07:40:51	408521292	SAGR	128	7	PLV3:0.00	ANE:0.00	WV:4	SOIL_C:52.71	
34	03/08/16	07:42:31	408521292	SAGR	128	8	BAT:27	TCB:28.06	HUMB:48.3	PLV1:2.24	PLV2:0.00
35	03/08/16	07:42:31	408521292	SAGR	128	9	PLV3:0.00	ANE:0.00	WV:4	SOIL_C:52.69	

Fig. 3 Example of different sensor data of one weather station

PHASE 2

The second phase will consist of five AE LABs (Architecture and Environment Laboratory) that will be held between 2019 and 2023 and focuses on multi-scalar and multi-domain modelling of Lamole in an accumulative manner.

The first “Architecture & Environment Laboratory – Land Knowledge, Practices & Data Acquisition” – AE LAB 1 was held in Florence (Italy) from September 11st to 13rd 2019. The AE LAB 1 focused on land knowledge, land use practices, and approaches, methods and technologies for land use related multi-scalar data acquisition on the case of the Castello and new Grospoli terraced vineyards in Lamole, Tuscany (Italy). This included photogrammetry and the creation of a computational 3d model of the terrain, thermographic analysis, a series of stationary and dynamic microclimatic measurements (*Climatewalks*), as well as correlation with climate data obtained from the meteorological station in Lamole.

AE LAB 1 was a collaboration between GECO - Geomatics for Environment and Conservation of Cultural Heritage Laboratory of the Department of Civil and Environmental Engineering (DICEA) at the University of Florence (UNIFI), the Department of Digital Architecture and Planning at Vienna University of Technology (TU Vienna), and the Chair of Building Technology and Climate Responsive Design at Technical University of Munich (TUM). The AE LAB 1 was co-sponsored by the International Society for Photogrammetry and Remote Sensing (ISPRS).

AE LAB 1 included a seminar and field research:

1. a collaborative seminar with focus on special cases for research, as well as different modes of data acquisition and data utilization as support and means of inquiry at the University of Florence – DICEA (11st September);

2. a targeted workshop in acquiring terrain and thermal data via drones (12nd-13rd September). The field research focused on two vineyards, owned by Mr. Paolo Socci (Fattoria di Lamole): Grospoli II (on 12nd September) and Castello (on 13rd September). Climate walks and thermal aerial analysis have been carried out in both the areas by TU Vienna and TUM, whereas a 3D aerial photogrammetric survey has been carried out only on the first vineyard (GECO Lab – UNIFI). The principal aim has been to study the influence of dry-stone walls on microclimate variations on the vegetation.

Fig. 4 : flyer and program of the AE LAB 1 seminar and some pictures of the AE LAB 1 seminar held on 11st September 2019 at the University of Florence, DICEA

Fig. 5 Aerial photo of upper Grospoli vineyard and Castello vineyard

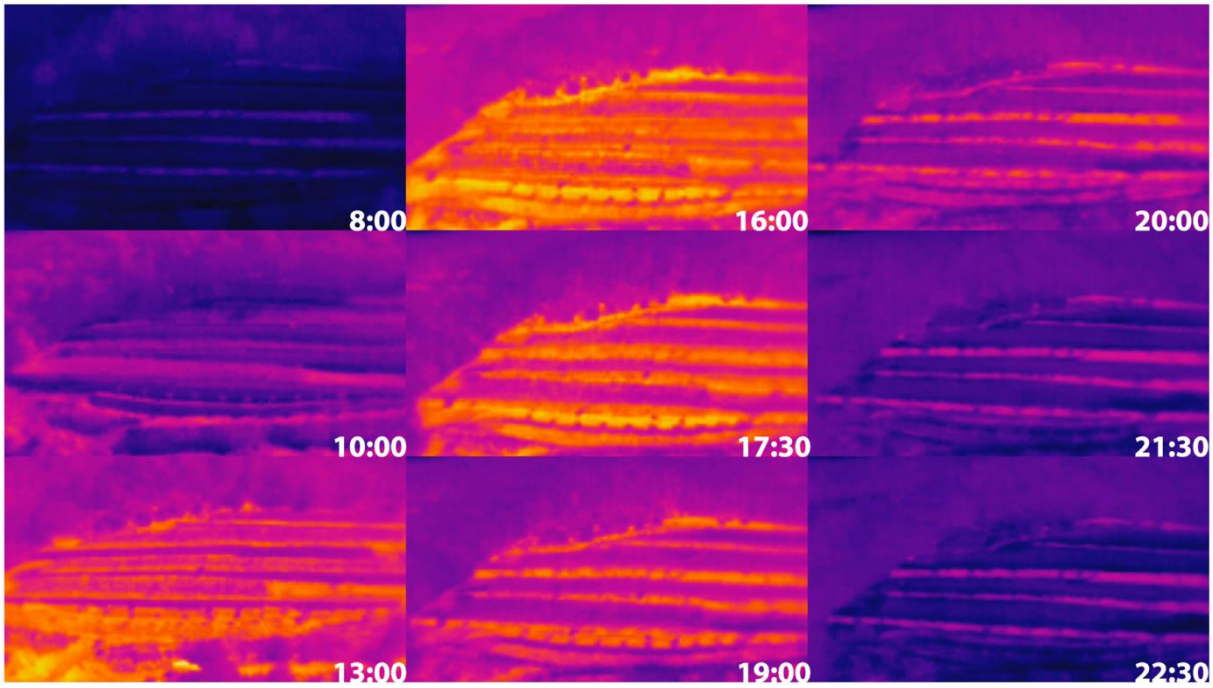

Fig. 6 Thermography of the upper Grospoli vineyard over a daily cycle

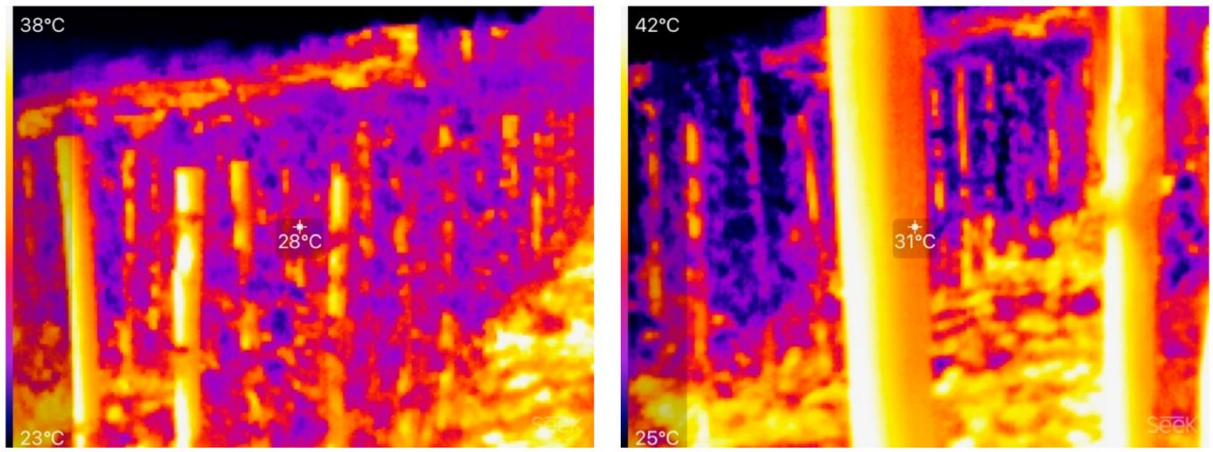

Fig. 7 Climatewalk thermographic survey of the upper Grospoli vineyard

The current research focuses on correlating and integrating the different data sets obtained during the AE LAB 1 and analysing the results. First results clearly indicate the thermal performance and contribution of microclimatic modulation by the terraces and the dry-stone walls and verify the results of phase 1 of the research.

A further and long-term aim of phase 2 is to initiate LamoLab – Centre for Environmental Research in Lamole. The centre will focus on the further development of multi-domain and multi-scalar modelling and analysis of Lamole as a primary case study. Additionally, LamoLab will focus on other case studies in the region and across Italy, transferring the knowledge and methodology gained in the Lamole case study.