1. FINAL PUBLISHABLE SUMMARY REPORT

The ModAgSpace project focused on the study of times-space dynamics of agrarian areas in the long term (From Protohistory to the 19th century), mainly from the analysis of ceramic material collected "off-site" during fieldwalking operations, coupled with various other sources (written, planimetric, ethno-archaeological, environmental), especially lidar derived DTMs.

1- Contribution to the study of ancient development of the plain of Mauguio (France, Lunellois)

The main study area of this project is located in the South of France along the plain bordering the Mediterranean Sea (Languedoc). It is situated around the coastal lagoon between Mauguio and Lunel, a very flat area, a marshy zone heavily managed during the past and currently occupied by scrubland, vineyards and arable land. A lidar (Light Detection and Ranging) survey coupled with a hyperspectral data acquisition was carried out in 2006 in this area, covering a block of about 40 km². After filtering to retain only the ground points, a Digital Terrain Model (DTM) was produced by A. Marsetic & K. Oštir, with a resolution of 0.5 m. I tried to use these data as an archaeological detection source. **The aim is to detect, and then compare the location of the paleo-features identified with the knowledge acquired about the land use of this region from Protohistory to Modern times**, especially with the location of agrarian manurings and settlements discovered during fieldwalking campaigns.

The high resolution of the lidar DTM produced is adapted to the detection of micro-relief. But this precision is also problematic in the context of open fields which are still under cultivation, because a lot of noise is produced by the plough lines and other modern developments, which are not easily discriminated from the ground surface. If the main part of the processing of lidar data consists in the visual recognition of paleo-traces, this should be facilitated by the removal of this noise. **Thus, we tried to use existing tools from image processing software such as Erdas Imagine. But this methodology is very time-consuming, because it requires to extract each field and to filter it individually, the direction and rhythm of ploughing or vineyard being different from a field to another.**

A good recognition of paleofeatures on lidar images is also related to the way this image is displayed. Particularly, the hillshading model chosen is very important in our capability of identifying remains of human activity in this context of still cultivated landscape. In this particular case, we tested two different hillshading models: the Swiss Hillshade Model and the MDOW (Multi-Directional Oblique Weighting) Hillshade Model. **Our conclusion would be not to choose a single method, but to combine and test several ones, playing with superposition and transparency levels to maximize the number of features detected.**

The advantage of lidar DTM, comparing to other historical sources, is to allow the detection of very slight paleoreliefs which are invisible on the field. The manual digitizing of these anomalies allowed the detection of 85 paleofeatures within the extent of the lidar coverage. **The comparison of the location of these features with a recent orthophoto coverage showed that 80 % of them were not visible in the current landscape and 75% of them were not visible on the 19th century cadastral maps. This proved the real added-value of lidar data to detect former landscape structures, even in this particular context of plough-fields and open area.**

Most of these anomalies are linear features that we can interpret as former field boundaries, channeling or drainage ditches. The first step of analysis consisted in comparing the directions of these paleofeatures with several other known field systems first planned in the Roman times or drawn in the 19th century. **The main thing to notice is the global correlation between the Napoleonic cadastre direction spectrum and the model proposed**

for the two Roman cadastres. This implies that one of the first land division planned in the roman times organized the landscape in such a strong way that it was still readable in the 19th century.

The second step was to compare the location of lidar paleofeatures with the location of agrarian manurings and settlements identified during the fieldwalking campaigns, in order to build hypothesis on the chronology of these paleofeatures. The heart of the reasoning would be that a relevant spatial proximity – compared to a random distribution – would give a clue to prove the link between these two kinds of features. Thus, we automatically generated 30 samplings of the same number of random points as the number of lidar paleofeatures within the spatial extent of the lidar coverage. Then we computed the minimum distance between these two kinds of elements and the closest archaeological entity. **The results show a slight – but statistically relevant – difference between the minimum distances observed for lidar paleofeatures and that for random points. The average minimum distance for random points is much higher than lidar features, indicating a possible link between the location of paleofeatures detected by lidar and fieldwalking features.**

2- In Vaunage (France, East Languedoc): spreading material and written sources.

The Vaunage study area is located in the Northern part of the Languedoc area. It also benefited from fieldwalking operations during the 1980s and 1990s. It was the main area for a detailed study of the relationship between the pre-roman and roman settlement network, but the medieval and modern data collected during these fieldwalking campaigns were never systematically studied. It was then a good opportunity to compare the information provided by these data with other historical sources documenting the medieval and modern agrarian space.

The vector shapes of the agrarian manurings identified were already available at the beginning of this fellowship. But the semantic data regarding medieval and modern ceramics were not recorded. I had to go back to the field sheets and record all the types of ceramics identified for each agrarian manuring. 319 archaeological entities were recorded. But the recording of ceramic is still at the level of the typology, without indication of chronology of these different types. The work of translation from these types to absolute dates remains to be done. For that purpose, we need the skill of the ceramic specialist of this study area, who was contacted to be involved in this work

The particular question of medieval written sources was discussed during a meeting that was organized in Montpellier – Lattes (France). The aim was to create a particular workshop dedicated to the cross-study of medieval and modern written sources and archaeological manurings and then to group all the thematic specialists of the region about this topic.

A corpus of texts documenting the Languedoc, and especially Vaunage, comprises thirty groups of texts dated mid-twelfth century. They contain 56 contracts on donations of land. These documents will be studied in two main directions: the identification of changes in land uses, where plots can be located precisely enough, and assessment of land quality (by considering changes in tax bases, transaction amount, etc ...). These contracts often seem related to the enhancement of wetlands in the twelfth century, particularly evidenced by the excavations around the Lunel channel, near Marsillargues, which showed desiccation of land related to drainage and irrigation activities.

The work of integration of these different kinds of data is still largely to be done, as soon as the chronology of the agrarian manurings will be precise. Then the challenge will be to map as much information taken from the medieval texts as possible.