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D 3.4.4

Report on enhanced planning strategies and decision making for urban fringes including scenarios for future land use development

Montpellier Case study

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SIXTH FRAMEWORK PROGRAMME

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Colophon

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Abstract

The present delivrable is a report on enhanced pl anning strategies and decision making for urba n fringes including scenarios for fut ure land use development.

The methodology is in two parts: we built foresight scenarios to propose the combined effects of internal factors and external drivers on periurban land use in the city-region and, second we analysed the main effects in the scenario results of MOLAND model.

The results are only, in this report, based on the analysis of maps and data of MOLAND simulations. These simulations present interesting results about the effect of borders bet ween the Montpellier Agglomeration perimeter and its neighbors, with the differencial application of the SCoT spatial planning tool. The other main important result is the difference between the "Business As usual" scenario results for 2025 and the ones for the High Tech Scenario (Scot applied): in the first case, a important urban sprawl is possible, with particular fragmentation of new urban areas with little surfaces which affect the peri-urban landscape.

The next step is to present these fi nal and complete results to the local stakeholders who are relevant in the spatial planning.

Classification of results/outputs:
For the purpose of integrating the results of this deliverable into the PLUREL Explorer dissemination platform as fact sheets and associated documentation please classify the results in relation to spatial scale; DPSIR framework; land use issues; output indicators and knowledge type.

Spatial scale for results: Regional, national, European	Regional
DPSIR framework: Driver, Pressure, State, Impact, Response	All
Land use issues covered: Housing, Traffic, Agriculture, Natural area, Water, Tourism/recreation	All
Scenario sensitivity: Are the products/outputs sensitive to Module 1 scenarios?	Yes
Output indicators: Socio-economic & environmental external constraints; Land Use structure; RUR Metabolism; ECO-system integrity; Ecosystem Services; Socio-economic assessment Criteria; Decisions	Land Use structure, Decisions
Knowledge type: Narrative storylines; Response functions; GIS-based maps; Tables or charts; Handbooks	Narrative storylines, GIS-based maps, tables and charts

How many fact sheets will be derived from this deliverable:	**1**

1. Introduction

PLURELS WP 3.4
The objective of the work package is to develop locally adapted forecasting scenarios for the case study regions following a (Module 2 provided) typology of dynamics in European urban regions and the global scenarios by Module 1. The regionally specific scenarios will distinguish between general and locally specific land use relations and their impact in the urban fringe. To develop suggestions for enhancement of regional governance on the basis of the comparison report (3.3.8.), scenarios development (storylines), and spatially explicit results from M2/M5 MOLAND applications (D.2.4.3).

Contributions to PLURELs end-products
The results of this work package are presented in some chapters of the PLUREL book.

Objectives of the deliverable
The present deliverable is a report on enhanced planning strategies and decision making for urban fringes including scenarios for future land use development. As the total results of MOLAND application were available very late (between September and November 2010, with the report on them end of November 2010), the final regional workshop is not present in this deliverable. This workshop will be in the early months of 2011.

Structure of the deliverable
After analysing regional planning (D.3.3.2) and assessing the strategies of Montpellier Agglomeration (D.3.3.9) we are now reaching the final step of this study of Montpellier Agglomeration policy regarding the management of periurban fringes in PLUREL project. In this report we address the issue of improving the strategies of Montpellier Agglomeration in order to promote sustainable land use in periurban areas. Given the choices that have been made and the current socio-spatial dynamics observable in this field, how can emerging challenges be anticipated and best dealt with? How can the strategies of Montpellier Agglomeration be improved, both in the content and tools of spatial planning policy as in the way to make decision and build this policy?

Our approach to answer these questions consists in two main components presented in this report: first we work on foresight scenarios to study the combined effects of internal factors and external drivers on periurban land use in the city-region, second we analyse the main effects in the scenario results.

2. Four prospective scenarios to imagine the future of Montpellier Agglomeration

Four land use scenarios have been elaborated to explore the future of the Montpellier Agglomeration under different internal changes (in size and governance) and external pressures such as rising oil prices and climate change. How well do current development paths perform under these radically different conditions? What can be concluded for the future spatial planning in the peri-urban and instruments such as the SCOT from this exercise?

2.1 Method

The scenarios have been drawn to illustrate different possible futures for Montpellier Agglomeration, with a special concern to urban/rural relationships and sustainability of the urban system. All members of Montpellier Plurel team (Jennifer Buyck, Jean-Pierre Chery and Françoise Jarrige) worked on the writing of these scenarios, with a leading role played by Jean-Paul Gambier, as stakeholder of Montpellier Agglomeration, with precise expectations on the results of foresight modelling. The scenarios were completed in spring 2010, but due to delayed implementation of MOLAND modelling, their resulting impacts on land use will only be available late summer 2010. A workshop is planned in September 2010, to discuss on the scenarios and their socio-spatial impacts with an enlarged meeting of stakeholders of Montpellier city-region.

At this phase of the project, we can only specify how we wrote the scenarios and present their content.

This foresight approach aims at putting to the test the resilience of the strategy of Montpellier Agglomeration in the field of spatial planning and urban sprawl control thanks to the SCoT confronted to contrasted future environments. The scenarios are based upon local/ internal factors and global/external driving forces, more or less important according to scenarios. From a local point of view, strategic parameters for future alternative scenarios are:
- local political leadership and type of policies, and stakeholders association / involvement
- major activities of local economy, specially the future of farming in periurban areas
- the perimeter of Montpellier Agglomeration (will it stay at 31 municipalities or increase ? how large ?)

These local factors strongly beset the two first scenarios, 1) the "long March" or the advent of the hypertech metropolis, and 2) Back to "good old business" as usual. These scenarios showcase two radically different paths concerning local governance. The first one showcases the reinforcement of the power of the local government, renewing and enlarging the vision of local development coordinated at the scale of the entire city-region, socially and spatially integrated, and strengthened around Montpellier centre. This scenario follows

through the virtuous choices initiated with the SCoT . The second scenario showcases a weakening of local governance that will lead to a mitigation of urban sprawl control and an increase in socio-spatial segregation. "Back to old business" means free space for market forces and no or little public control on land use, as Montpellier city-region has experimented during three decades of demographic growth and urban sprawl before the creation of Montpellier Agglomeration and the drawing of the SCoT.

External driving forces are decisive in the two other scenarios, 3) Peak oil and the technopolitan model decline, and 4) Extrem water: Montpellier city-region victim of the Mediterranean see. These two last scenarios are less sensitive to local changes in governance. Whatever the future development strategies may be, external drivers have major impacts. So these two scenarios put to the test development decisions and choices made nowadays in the SCoT.

These four scenarios are presented following the same items list: policy, economy, urban planning, infrastructures, agriculture and climate. [We will then have a look at the comparative impacts of scenarios, and analyse the stakeholders reactions to this prospective exercise - to be done when we'll have the Moland results material].

2.2 The scenarios

2.2.1 The "long March" or the advent of hypertech metropolis

Figure 1: copy of the cover of the Montpellier Agglomeration newpaper *Harmonie*, November 2005 : Annoncing the publication of "*Montpellier, La longue marche (1970-2020)*, written by its President Georges Frêche (dead end of 2010).

2.2.1.1 Politics

The same party wins regional elections in 2010 and keeps the power in Montpellier Agglomération. Directly or indirectly, the same party controls regional public policies at all levels. This coordination is accelerated by the merger in a unique regional authority (nuts 2) of the 5 General Councils (Departements, nuts 3), after their bankruptcy following the reform of local governments and their taxation system (decrease of their tax resources). Montpellier Agglomération becomes an Urban Community, with enlarged competences, and covers an extended metropolitan area from Sète in the south west to Nîmes and Ales in the north east. Unified political management allows achieving a balance between economic, social and environmental issues at the scale of the city-region, which now fits with the functional urban area. At the end of 2025, the capacity of local actors to come into negotiation with their neighbours holding different, thus complementary, resources, becomes essential. An integrated regional governance system is achieved.

2.2.1.2 Demography

There is a record population growth : +1.7% to +2% per year. Through PLH (Local Housing Program), the population increase is absorbed without problems thanks to social and territorial solidarity in housing policy at the scale of the great metropolitan area. Long-distance commuters living part of the week in residential areas, dwellers in small towns and villages adjacent to the new centres, rural metropolitans: all newcomers have ways to take advantage of the new inter-territoriality.

2.2.1.3 Economy

The sector of personal services knows a record development in a "French California" type new economic metropolitan model ("Sud de France" University, coupled with Research and Development of local enterprises). New technologies are booming, from firms-nurseries like the public Montpellier International Business Incubator (MIBI).

Figure 2: View of the future *Montpellier International Business Incubator* (MIBI), which will open early 2011, on the cover page of " Eco Infos" n°24, economic newspaper of Montpellier Agglomeration (Source : Montpellier Agglomeration, march 2010)

2.2.1.4 Urban planning

The SCoT gets into version 2: the perimeter of the SCoT is extended to the whole corridor of Languedoc (from Sète to Nîmes). The establishment of the SPLA (Local Public Urban Planning Society), in charge of urban planning, "in house" operator of municipalities, enables the implementation of public policies without the hazards of setting competition between developers. Tested in Montpellier, it has now extended jurisdiction over the entire metropolitan area as quasi-monopoly public service.

2.2.1.5 Infrastructures

The PDU (Urban Transport Plan) is completed from Montpellier to the whole new area of the great SCoT. The tramway network reaches Mèze west in 2015. All major transport infrastructures planned are now built: highway A9bis, Nîmes-Montpellier High Speed Rail Line bypass (LGV), new TGV Rail station in 2020 in South-East of Montpellier, single airport for the metropolitain area, Sète competitive harbour in the new economic dynamics related to the Union for the Mediterranean. Like the Montpellier TGV rail

station district, mobility hubs have taken strategic values that help structuring new metropolitan urbanity.

Figure 3: G. Frêche, former Président of Montpellier Agglomeration, presenting the project of extension of tramway network until 2020, January 26, 2009 (Source: La Gazette de Montpellier, http://www.lagazettedemontpellier.fr/actualite/Freche-presente-le-futur-reseau-de-tramway-447.html).

2.2.1.6 Agriculture

Since the demise of General Councils in France, the legal competence on natural areas has been devoluted to Regional Councils, and rural land development has been devoluted to urban authorities (communautés d'agglomération or communautés urbaines). Public supports contribute to farming activities, more and more considered as common heritage of new urban territories. In the Languedocian Metropolis, agriculture is now based on high-tech and high quality farming systems: organic crops, greenhouses... with increasing local sourcing for food products, especially for "bourgeois bohemians" customers. Some high tech vineyard remains, successfully achieving competitiveness in a globalized wine economy. Besides vineyard, multifunctional agricultural areas are dedicated to both production and recreational uses.

2.2.1.7 Climate

The climate is not decisive in this scenario.

2.2.2 Back to "good old business as usual"

2.2.2.1 Politics

The regional elections of 2010 put an end to the current President era at Regional Council. At national level, the same President is re-elected in 2012, and locally, the political majority of the city changes. Economic liberalism, either chosen or imposed because of lack of public resources following financial crisis, drives public policies. State disengagement carries on and social inequality raises. The poorest have little access to quality of life and live mostly in cities. The spirit of gated communities now also applies to inter-municipalities. Montpellier Agglomeration becomes an Urban Community competing with neighbouring territories: Communities of Thau lagoon, Pic Saint Loup and Pays de Lunel. Contrary to the unified / centralized situation at the scale of the city-region in scenario 1, in this case there is a "balkanization of territories".

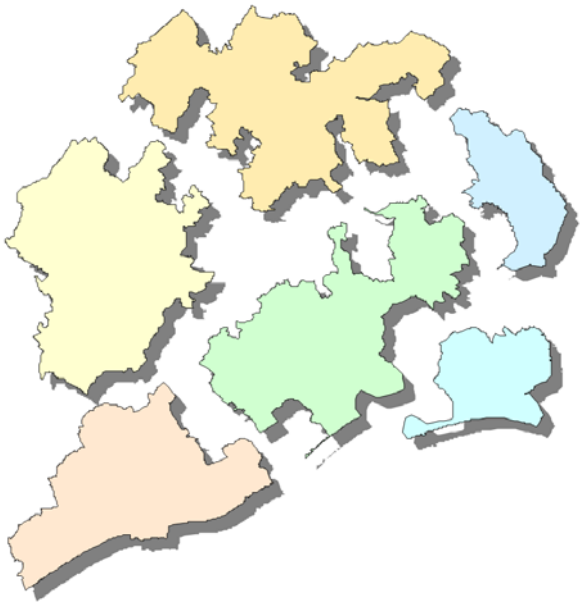


Figure 4: A mapping view of the puzzle of local communities, without coordination : an archipelago with important border effects

2.2.2.2 Demography

Demographic growth is still high (1.3% per year), but spatially segregated with "social sorting". Social barriers and local identity are at the heart of conflicts between local "ghettoized" populations.

2.2.2.3 Economy

The technopolitan model is questioned. Main economic activities are in the fields of personal services and residential economy. Most investments made in

local economy come from Qatar or other Middle-eastern offshore funds, in real estate and high-end services.

2.2.2.4 Urban planning

Urban planning is going out the window: the SCoT is putting on ice. "Land hunting" - delayed for too long - is reactivated. Public planning tools have been dissolved due to litigation inspired by the European law of competition in the free market of urban planning. Deletion of land pre-emption rights and of landowning public establishments is decided in the name of free competition in land market. This gives full place to the emergence of a private monopoly group of real estate. Urbanization is opened to provide access to sites with high landscape value, dedicated to high income executives and retirees, as the current model in Provence and Cote d'Azur. City centres are impoverished: there is no more OPAH (social housing improvement too). Social and spatial segregation is reinforced with the development of gated communities.

Figure 5: A view of north part of the peri-urban area outside of Montpellier Agglomeration: big villas with their individual smimming pools, cutting the mediteranean forest (Source: www.bing.com)

2.2.2.5 Infrastructures

Public transport infrastructures like tramways are given up because of lack of public funding. The A9 highway is doubled south of the Montpellier Agglomeration area. High Speed Railway (LGV) is built and the operating of the new TGV rail station is licensed in 2020 to a private company.

2.2.2.6 Agriculture

Horsification expands at the expense of farmland and vineyards. Owners of farmland massively turn to production equipment of solar energy. Accelerated disintegration of farming goes on because of globalized competition and the end of public support (from EU or local governments).

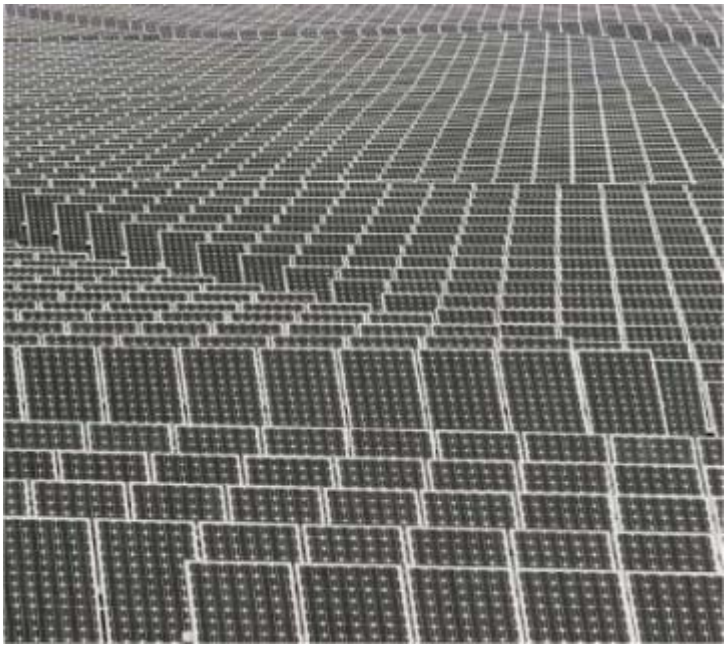


Figure 6: A possible new local landscape in rural area, with solar farms (Source: http://leblogduphotovoltaique.midiblogs.com, 24/08/2008)

2.2.2.7 Climate

The climate has no major impact in this scenario.

2.2.3 Peak oil and the technopolitan model decline

2.2.3.1 Politics

The time of finite urban world started with the disappearance of oil. A law now prohibits any new urban development without integrated solution of collective transports. It marks the end of the period known as peri-urban which was born, in France, in the 1960s with the explosion of car market. The Minister of Social Cohesion and Territorial Solidarity launches a program to support new neighbourhoods of large peripheral housing estates inherited of the old urban sprawl and penalized by their isolation.

2.2.3.2 Demography

The high cost of fossil fuels imposes a halt to population growth (0.1%). Peri-urban housing, which implies individual commuting, has become a major trap

for people who have no access to empl oyment. High social tension is transferred to the city centre. Municipalities are trying to support their citizens with difficulty.

2.2.3.3 Economy

The announcement that the forec asts of oil reserve stocks were completely overestimated has the effect of a gl obal tsunami. Transport bec omes the largest household budget item. Local economy has to be completely reviewed: it is n ecessary to resolve the decay of the technopolitan economic model. Logistics hubs of the langue docian corridor close one after the other. There is a widespread conversion wi th great difficulty. But new technologies make the most without damage of thi s delicate situation. Alternative energies are developing (solar cells, wind mills).

Figure 7: A cartoon about the surge in oil: "*No way to take the car to refuel!*"(Source: Petillon, in the national weekly "Canard enchainé", 2005)

2.2.3.4 Urban planning

Public transports, which pool the costs and are affordable, are at the heart of this scenario: the long phase of housing redistribution within expanded urban areas seems to have stabilized along transport infr astructure and near services. Urbanisation refocuses in a sense of strong polarization on Regiona l Express Train (TER) and tramway. Through this pr ism, spatial segregation is reinforced. A "gerontocratic" atmosphere prevails in peri-urban villages where high income European pensioners, released from commuti ng, are concentrated.

2.2.3.5 Infrastructures

Public transport is strengthened but not enlarged: the peri-urban is neglected. Regional train network is maintained for the benefi t of centra l cities. Municipalities have no means to pay for transport exte nsions such as new

airport. A9bis highway bypasses and High Speed Train Line (LGV) project is abandoned. There are no water projects for agriculture.

2.2.3.6 Agriculture

Although people from countryside feel they are the losers of development and spatial planning policies, "return to land" is a necessity. There is a boom in family food gardens, and for the movement "back to the land". The concept of agripark is developed. A problem remains for local food system if no solution is found to provide water for agricultural diversification.

Figure 8: View of a family food garden in Jacou, near Montpellier (Source: montpelliervillages.midiblogs.com, 2009)

2.2.3.7 Climate

This scenario is sensitive to climate: warming limits the production capacity in the farm-to-fork system; imports have become expensive because of transport costs.

2.2.4 Extrem water: Montpellier city-region victim of the Mediterranean sea

2.2.4.1 Politics

The politics is not in the heart of this scenario. Whatever the political options may be, they have little impact compared to global / natural / external factors which play a decisive role.

2.2.4.2 Demography

There is a very moderate demographic growth (0.3% per year) or even a population decline. This is due to two factors: the sea level rises of 1 or 2 meters (less room for new residents or for re-housing climate refugees) and Cevennes rain episodes are now very common (natural hazards also reduce land capacity for urban fabric).

2.2.4.3 Economy

Local economy follows the model of Agenda 21. All urban planning schemes are reviewed to put people out of risk. Tourism activities lose the seaside component since beaches have vanished, and most direct and indirect jobs linked to tourism disappeared. On the other hand, global warming allows taking advantage of hot winds that provide good generation power in addition to mass production of solar cells.

2.2.4.4 Urban planning

New urban developments have to respect enlarged corridors for possible flooding. The SCoT is reviewed in this perspective. Concentration of risk-free housing is the priority. It leads to the expansion of urban areas to accommodate climate refugees who fled away from Mauguio, Palavas and the Grande Motte (littoal municipalities). Land conflicts are exacerbated on the fringes of remaining spaces. The airport disappears under water. The topping out of High Speed Train Line is the frontline of the fight against the Mediterranean Sea.

2.2.4.5 Infrastructures

The dream of the President of Region Languedoc-Roussillon and former mayor of Montpellier materializes, but it is not "Montpellier which goes to the sea", it is the reverse… Montpellier harbour has to be built as Sète became an island, and its harbour has been overwhelmed. The High Speed Train Line is along the coast. The building of the TGV rail station in the south-east of the city is compromised.

2.2.4.6 Agriculture

Agriculture is de localized in the northern rural districts of the region. Municipalities have to care and provide open space freed up to maintain public access to nature, for people in situation of ecological stress. There is a revival of some Mediterranean productions like sheep. But warming raises a problem with no possibility of irrigation: the issue of water and water for agriculture is deteriorating.

2.2.4.7 Climate

Sea level rises of 1 or 2 meters and the Cevennes rain episodes are more frequent and devastating. Temperatures are rising and with them the risks of sun exposure for people. The attraction of the seaside disappears, it is swarming with jellyfish and the beaches no longer exist: the seaside tourism collapsed.

Figure 9: Wind gust at Palavas-les-Flots (Source photo : Bruno Monginoux / Photo-Paysage.com (cc-by-nc-nd))

3. Some results of MOLAND land use model for Montpellier Agglomeration prospective scenarios

The scenarios developed for Montpellier case study have been implemented in the MOLAND land use model by the JRC team. The model produces simulations of evolution under the constraints of the local context with the inclusion of different elements:

- the situation of land use in the years 1990 and 2000;
- the existing and in progress or programmed transport networks into the simulation period (until 2025);
- the zoning maps already established locally, including those related to Montpellier's SCoT since 2006;
- and the suitabilities of the landcover types, considered as potentially subject to artificialization: arable lands, vineyards, pastures, forests, heterogeneous agricultural areas, shrub, sparsely vegetated areas.

The model simulates the consumption and changes in land, considering possible extensions of built land uses:

- continuous urban fabric;
- discontinuous urban fabric;
- industrial and commercial areas,
- construction sites, ports and airport.

About the area used in the MOLAND Model, some adaptations were made to ensure a good reliability between geographic information, the global spatial system and the interests of our local stakeholders.

Two constraints were take into account :

- the functional urban area, considering this area as relevant for the urban rural system (commuters spatial system);
- the potential project of extension of the Communauté d'Agglomeration of Montpellier (the main local governance territory in terms of population and revenues): this extension is described in the book "Montpellier, la longue marche (1970-2020)" (see before the scenario of "the "long March" or the advent of hypertech metropolis"). It's a political perpective to reach a other level in the French typology of the local governance system: the "Communauté urbaine" (with a threshold of 500,000 inhabitants and new local powers, particularly in spatial planning).

These spatial considerations are proposed as a possible future in the region (fig. 10).

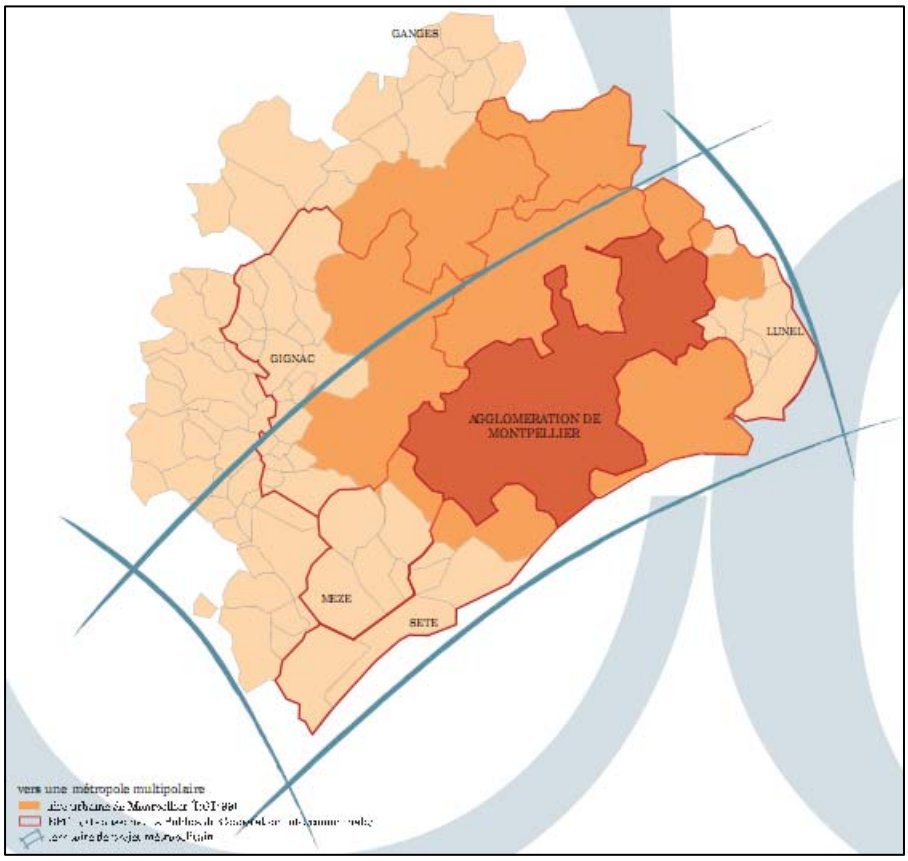


Figure 10: extract of the SCoT book of Montpellier Agglomération: "*towards a multipolar metropolis*" (page 126), with the different perimeters of Montpellier Agglomeration (in dark orange), the functional urban area (in medium orange) and the other local governance perimeters (with adopted or in construction SCoTs). (Source : Schéma de cohérence territoriale de l'agglomération de Montpellier, 2006)

We choose this global perimeter for spatial information in MOLAND model. The results are interesting to analyse, according to the effect of the local governance borders in this study area, especially between Montpellier Agglomeration and its neighbors (Etang de Thau, Vallée de l'Hérault, Pic-Saint-Loup-Haute Vallée de l'Hérault, Pays de Lunel and Pays de l'Or, see : Appendix B). How, with the different scenarios, the urban sprawl, more or less under spatial planning constraints, is in action? This point of view, for the analysis, was a development in MOLAND model application in the scenario "High Tech" : this scenario was finally made under two territorial structures : one considering the success of the Montpellier Agglomeration strategy to associate its neighbors and to promote the spatial tools in its SCoT for the whole area (scenario HT1); the second which considers a statu quo in the future between these local governance territories and the application of the Montpellier SCoT tools only in its own perimeter, with possible border effects in urban sprawl.

With this perimeter, useful land use data for MOLAND model is Corine Land Cover (EEA). Other data, more detailed are not available for the whole area.

The geographic extent chosen for this modelling is the functional urban area of Montpellier (93 municipalities), according to the criteria of the French

National Institute for Statistics and Economical Studies (INSEE) for 1999, supplemented by the portions of local governance territories that straddle the functional area and surrounding the Montpellier Agglomération territory (total: 134 municipalities).

According to the Rural Urban Region typology in PLUREL project, the Montpellier case study area presents these caractéristics (year 2000):

- Urban type : 10,767 ha
- Peri-urban type : 49,926.2 ha
- Rural type : 126,500.3 ha
- Natural type : 32,997.8 ha

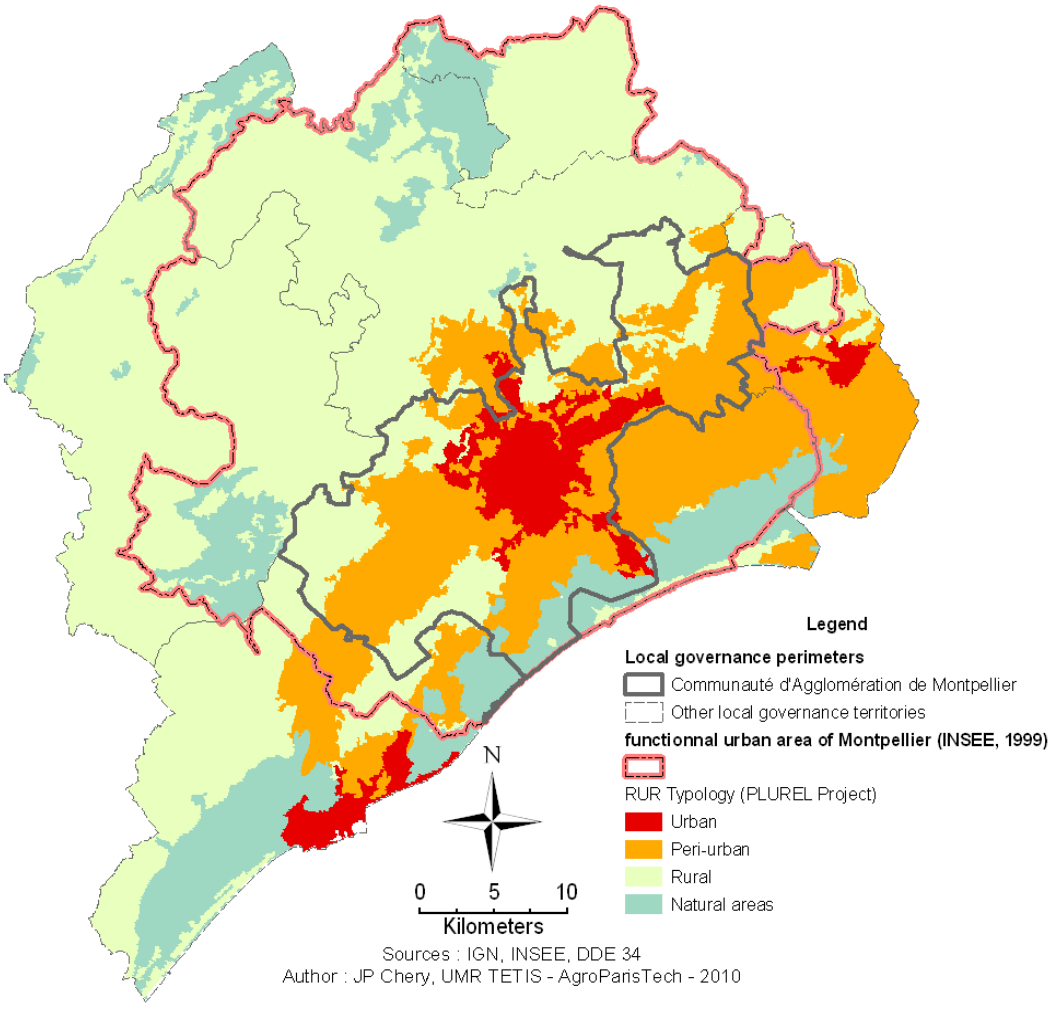


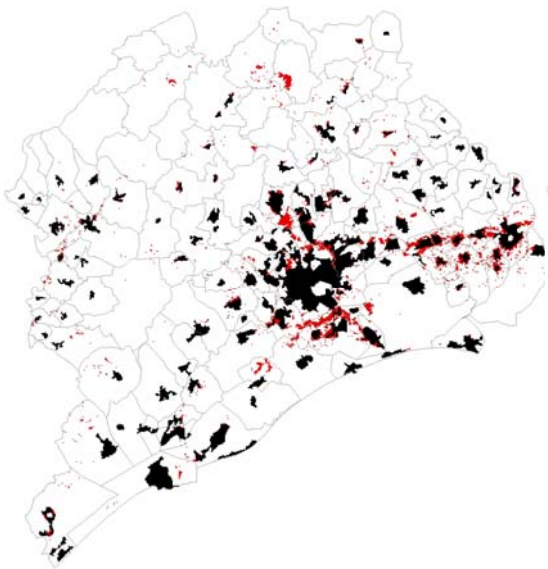
Figure 11: Area used for the MOLAND application of Montpellier scenarios

The model, calibrated on the analysis of changes completed between 1990 and 2000, includes various parameters that are held separately for expressing criterias related to the scenarios (see part 2). Comparison of changes of land use is presented for three scenarios: "*Back to the Old Business As Usual*" (BAU), "*The "long March" or the advent of the hypertech metropolis*" (HT) and "*Peak oil and the technopolitan model decline*" (PO). This comparison is based

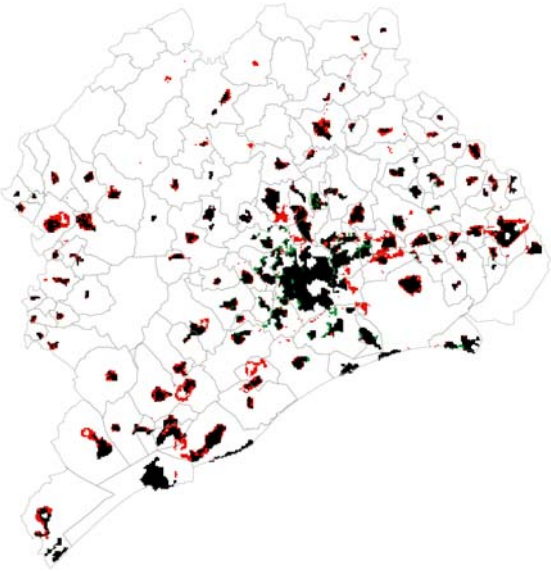
on the spatially explicit changes, particularly in the continuous urban fabric and discontinuous urban fabric.

MOLAND model shows maps of these changes, with a resolution cell of one hectare. The counting of cells with changed state between 2000 and 2025 allows to estimate the amount of surface affected by these changes, according to their types of land use. Maps locate these changes, in particular by analyzing the Rural-Urban Regions (RUR) types - urban, suburban and rural - based on the boundaries carried out under the project PLUREL for 2000 (fig. 11). These results therefore allow to compare the impact of the different scenarios on these different areas by 2025.

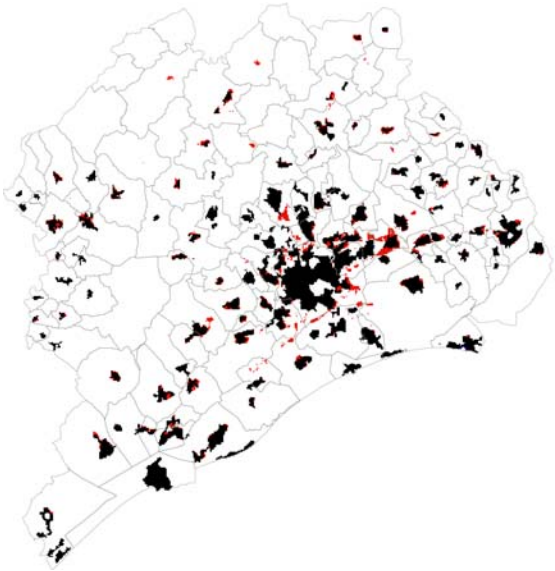
According to the three maps of the figure 12, the spatial impacts of the scenarios are quite contrasted. The main differences are visible with the changes of the discontinuous urban fabric, with is the main characteristic of the urban sprawl.



A - Back to the Old Business As Usual (BAU)



B - The "long March" or the advent of the hypertech metropolis" (HT)



C - Peak oil and the technopolitan model decline

Figure 12: Growth of discontinuous urban fabric areas in three scenarios with MOLAND simulations (black: areas in year 2000; red: new areas in year 2025)

A more detailed analysis of results from area changes between 2000 and 2025 helps a better understanding of spatial impacts of the different scenarios. The study region covers an area of 219,417 ha and the artificial types of land use represent 21,087 ha in 2000, i.e. 9.6% of this region. In 2025, the scenarios provide contrasting artificial growths (Fig. 13) both in terms of quantities and for their locations in the peri-urban and rural areas.

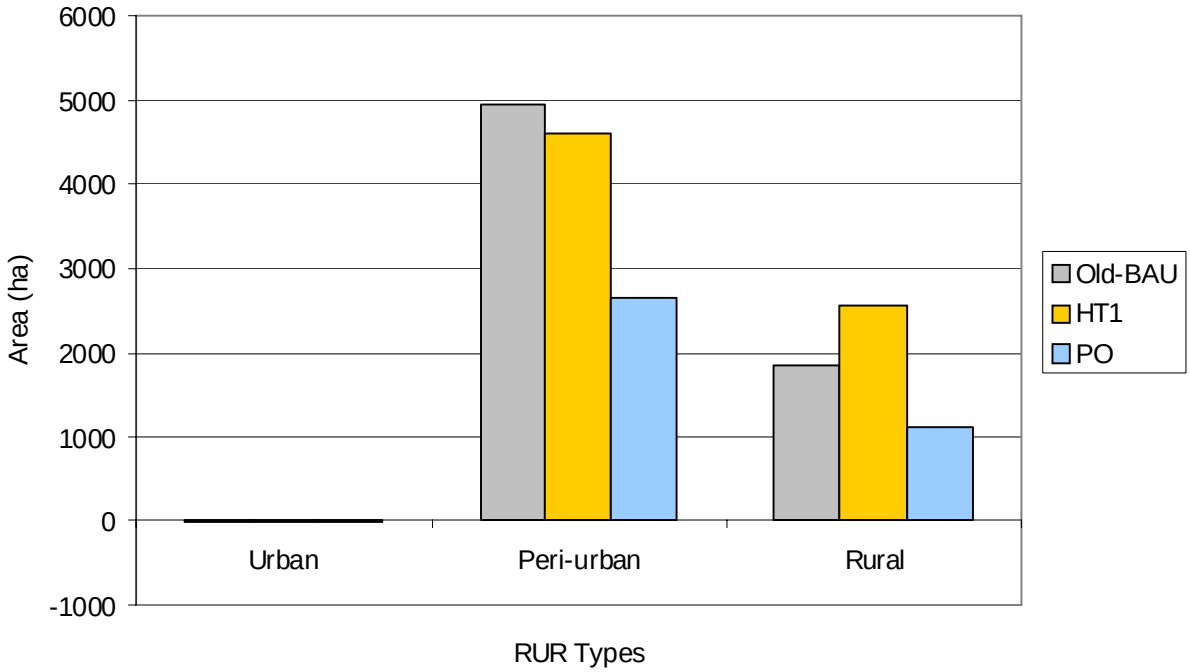


Figure 13: Comparison of area changes in urban land use (2000-2025) in PLUREL Rural-Urban types, according to the different scenarios

For scenario "*Old Business as Usual*" (Old-BAU), the growth is of 6,787 ha, with the largest increase of all scenarios in the area of peri-urban type of the Rural-Urban Region (RUR) PLUREL typology (4,960 ha). The map A of the figure 12 locates this growth in two spatial types: one is urban sprawl on the fringes of existing artificialized areas, with a process of neighbourhood, with an affinity for major transport equipments; the other is sparse urban development reaching important areas previously unaffected. This second type corresponds to urban development considered as having the greatest negative impact on the quality of landscape. This phenomenon is very strong in the eastern region of Montpellier, towards Lunel and beyond, Nimes, along the major axis of transport infrastructure in the plain.

The scenario of the hypertech metropolis (HT) shows an increase in artificial areas which is the most important of all scenarios: 7,168 ha over the entire study area. But this growth has spatial arrangements that appear consistent with the logic of the Montpellier SCoT. This scenario takes into account the different housing densities of the SCoT of Montpellier in the Moland model simulations for scenario HT. It is established by considering the A and B densities levels (greater than 50 and 30 houses by ha) integrated in the type of continuous urban fabric land use, while the C level (between 20 and 30 houses per hectare) belongs to the discontinuous urban fabric type of land use. Indeed, areas consumed in the peri-urban areas is less important than in the previous scenario (339 ha less), while the artificial in the rural area is higher, with 2,557 ha (against 1,844 for the "Old-BAU" scenario). In quantity, the difference is due to the higher demographic growth in the HT scenario, and therefore requires larger areas dedicated to housing. But the simulation result is interesting in its spatial expression: urban development is made in a single neighbourhood process on the fringe of existing urban areas. This

feature corresponds to the logic of SCoT for the preservation of landscape, and greatly limits urban sprawl. Thus, areas consumed affect all villages surrounding the centre of Montpellier urban pole, thereby limiting the dispersion of local housing. The eastern plain, between Montpellier and Lunel, is particularly preserved in comparison to the previous scenario.

Finally, the scenario "Peak oil and the technopolitan model decline" (PO) appears as the one whith the smaller increase in artificial surfaces: 3,763 ha (half of the HT scenario). The spatial extent in 2025 affects less sectors within the study area, and many villages away from Montpellier or isolated know virtually no growth.

The difference between the two "High Tech" scenarios (HT1: SCoT of Montpellier applied in all the study area; HT2: SCoT only applied in its perimeter) are very interesting to analyze (see map, in Appendix J). Some effects are structured on the border between Montpellier Agglomération and its neighbors: if the Montpellier SCoT is applied in the whole case study area, the main urban sprawl will be observed in the close areas of Montpellier urban pole (black and blue colors in the map). If there is a fragmentation of political local governance perimeters (HT2), the effects of the urban sprawl are visible close to Montpellier (black color) and, with more impacts, in the other areas, far away of the heart of the region: a part of the demographic growth is more located in the other parts of the area, in places where densities are not too restrictive in space consumption.

The last scenario, *Extreme water*, gives results with some difficulties to a good analyse: the sea level is proposed with a groth of 5 meters (2 meters in the GIEC original scenario). But this situation is a possible result of a combinaison of the sea elevation and the growth of flooding (see Appendix K).

4. Conclusion

The results of the MO LAND Model give to the Montpellier case study some very interesting perpective to analyse and to present to the local stakeholder, according to the original project to use them in the PLUREL work package 3.4.

As these results were received in late November 2010, the PLUREL local team of Montpellier will ensure the presentation, and the analyse of the reactions of the local stakeholders of the public and private sectors involved in the urban and spatial planning, in the early 2011.

We propose to carry out a benchmarking with other situations – either PLUREL case studies or other international situations – in order to make proposals to improve the strategies of Montpellier Agglomeration for more sustainable land use in periurban areas.

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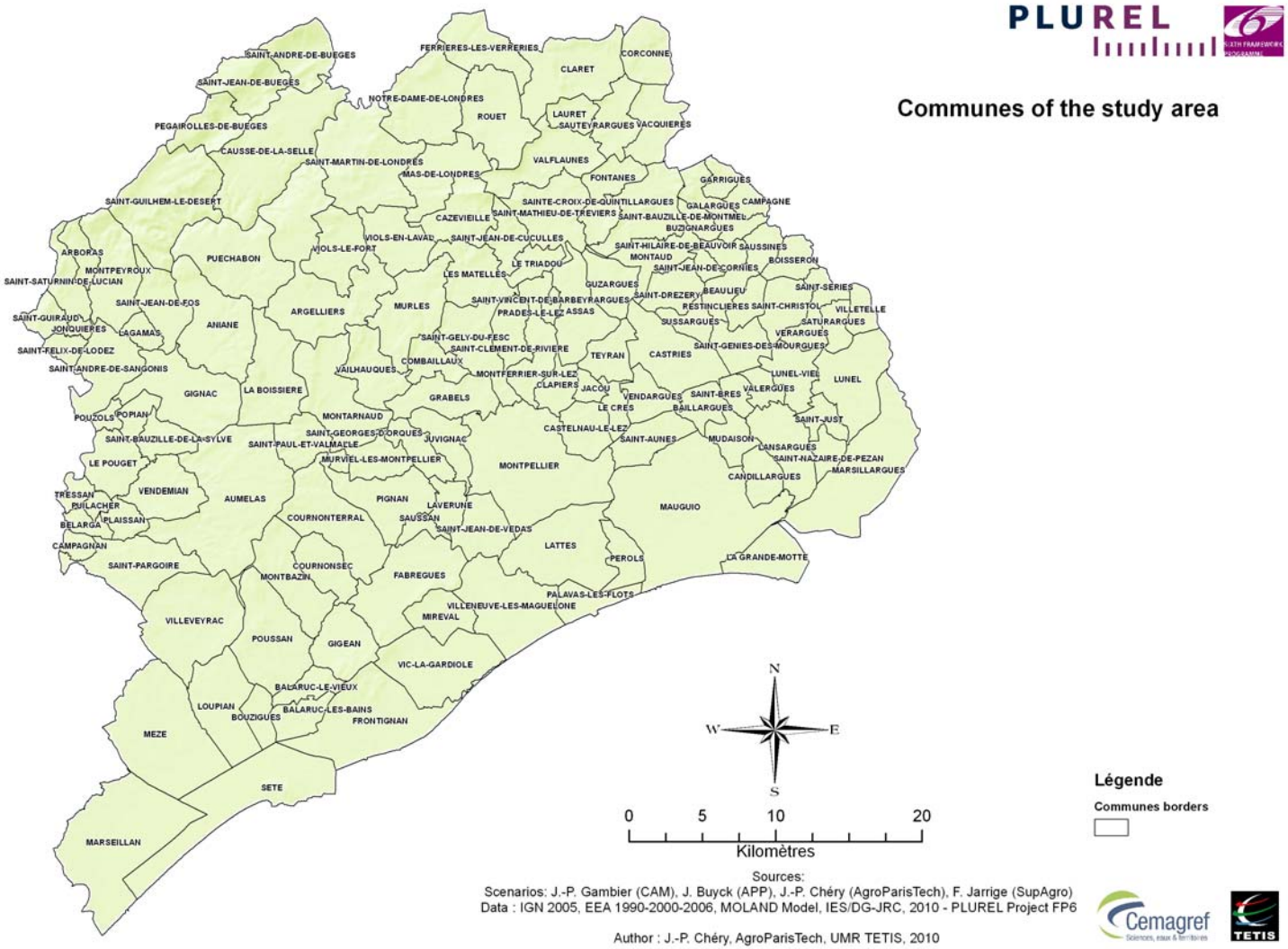
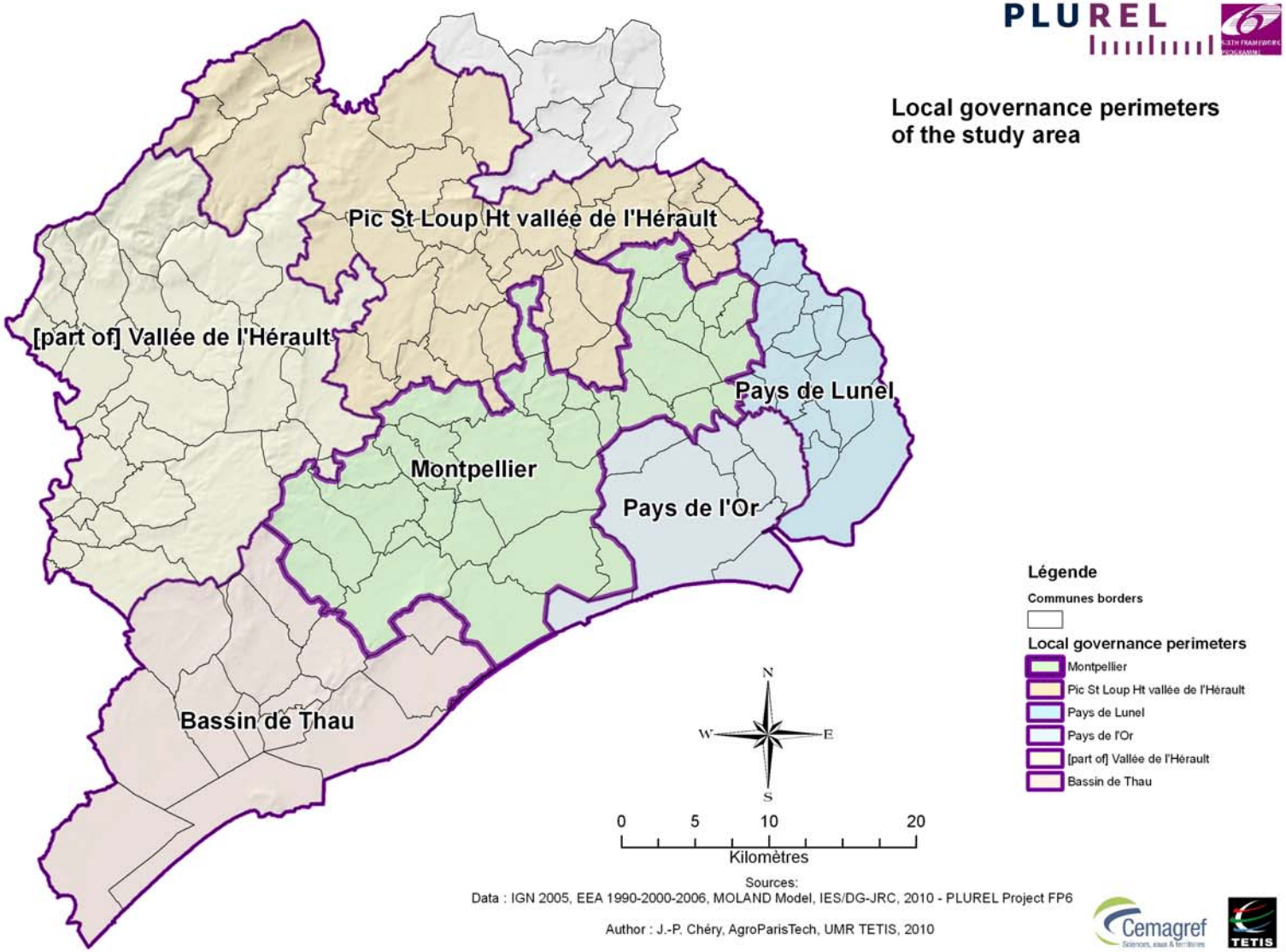
Appendix

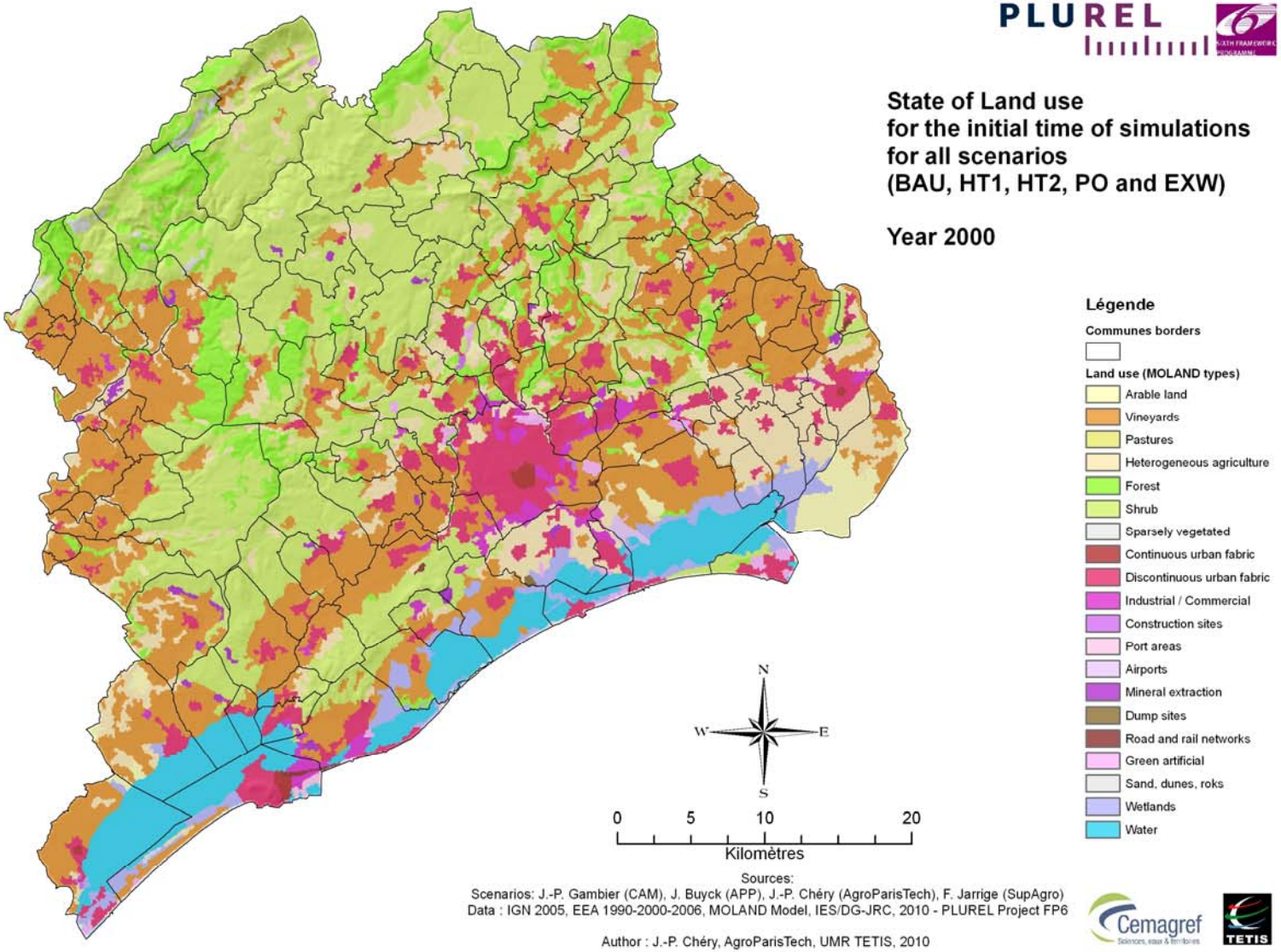
APPENDIX A: Map of the Communes in the Montpellier study area



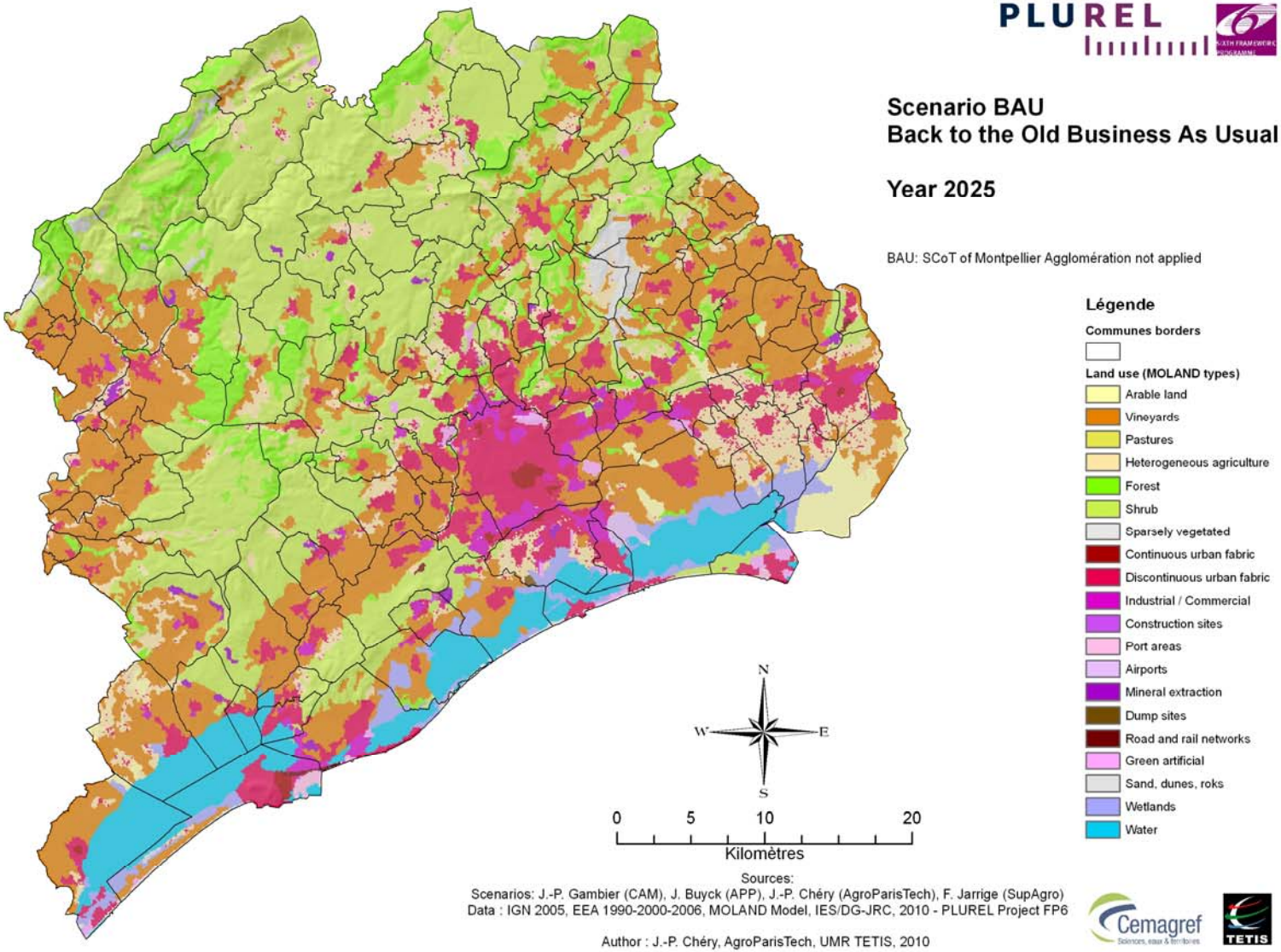
APPENDIX B: Map of the local governance units in the Montpellier study area



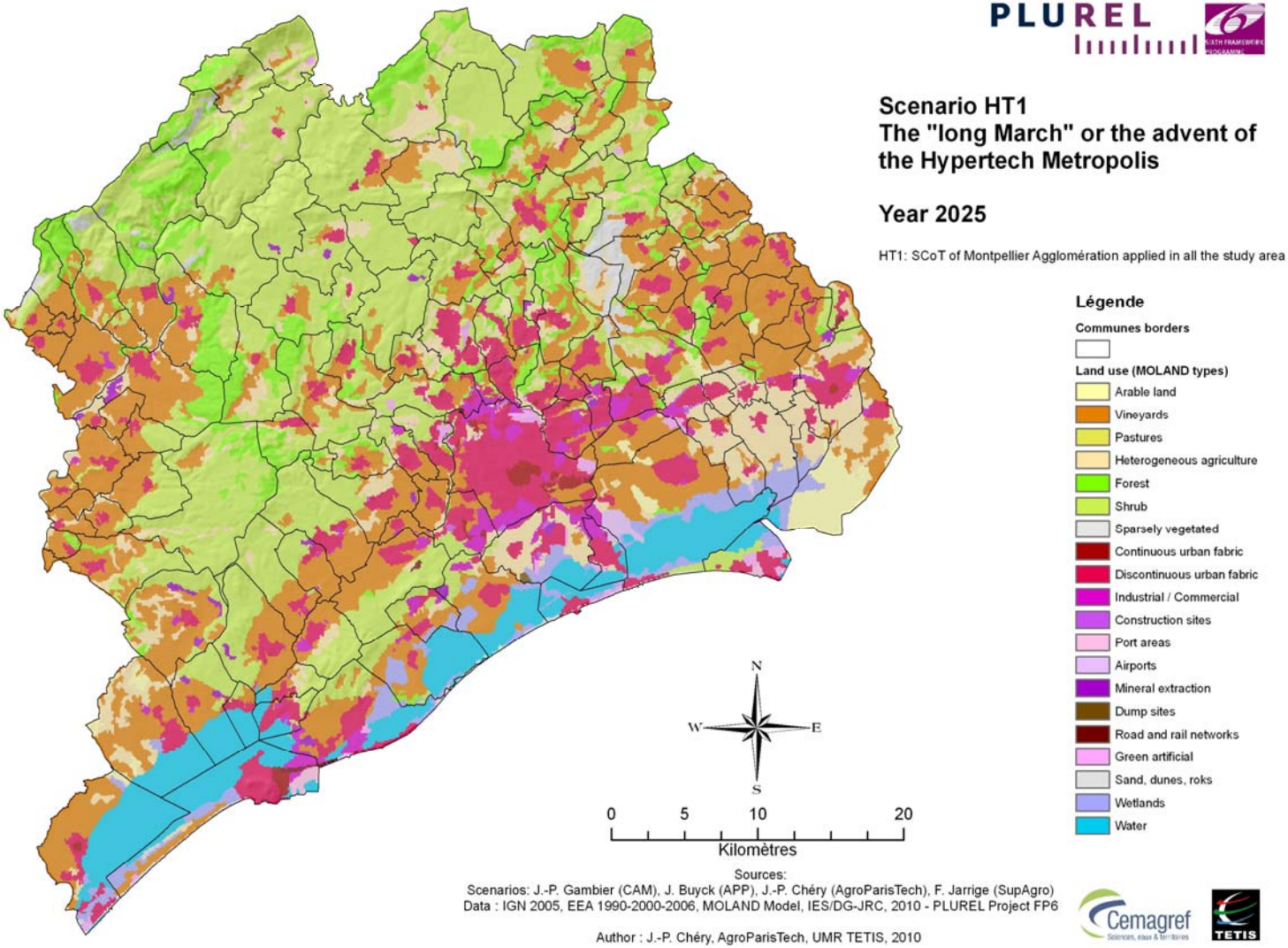
APPENDIX C: Map of land uses in 2000, in the Montpellier study area



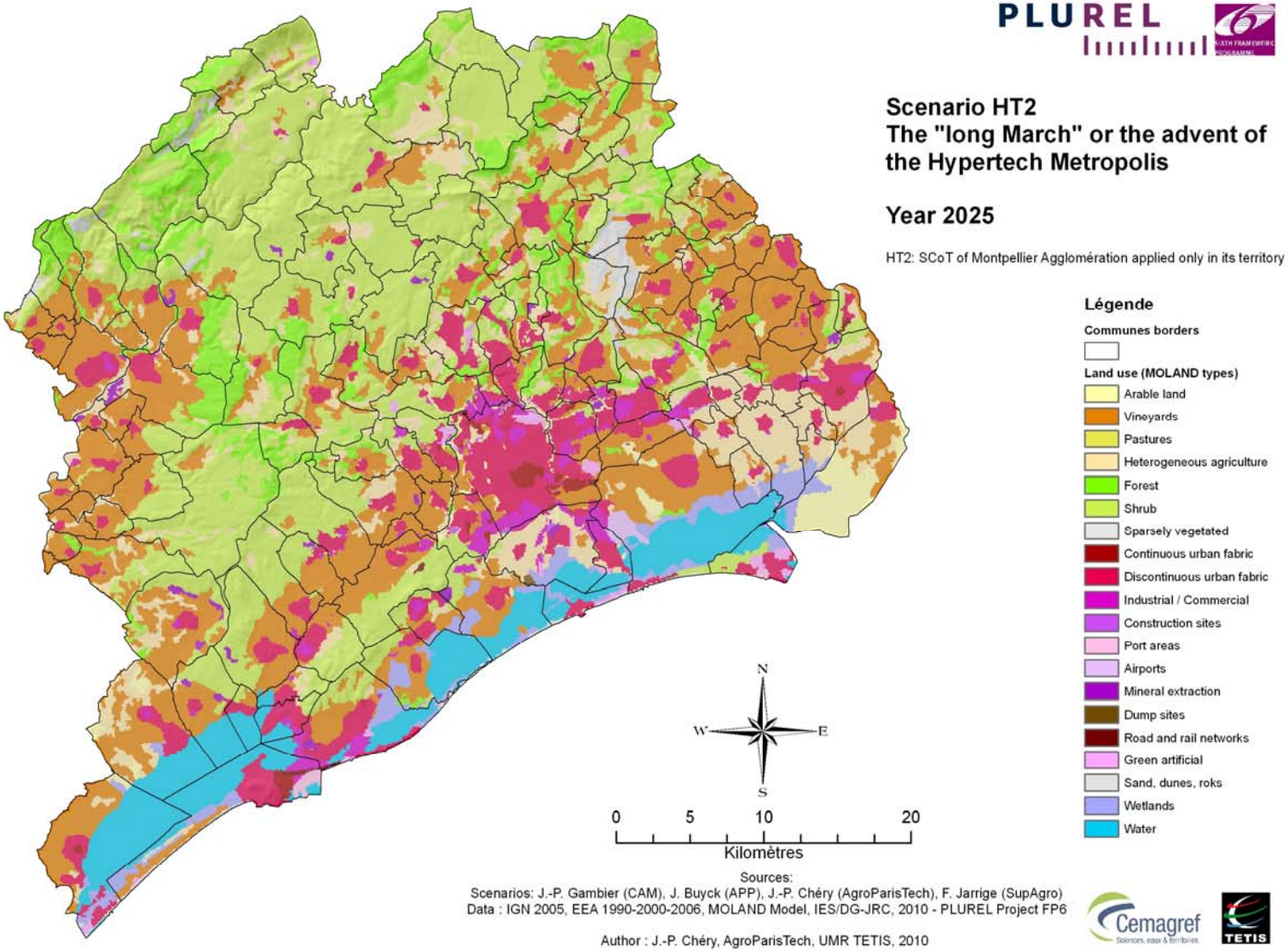
APPENDIX D: Map of land use in 2025, Scenario Business As Usual, in the Montpellier study area



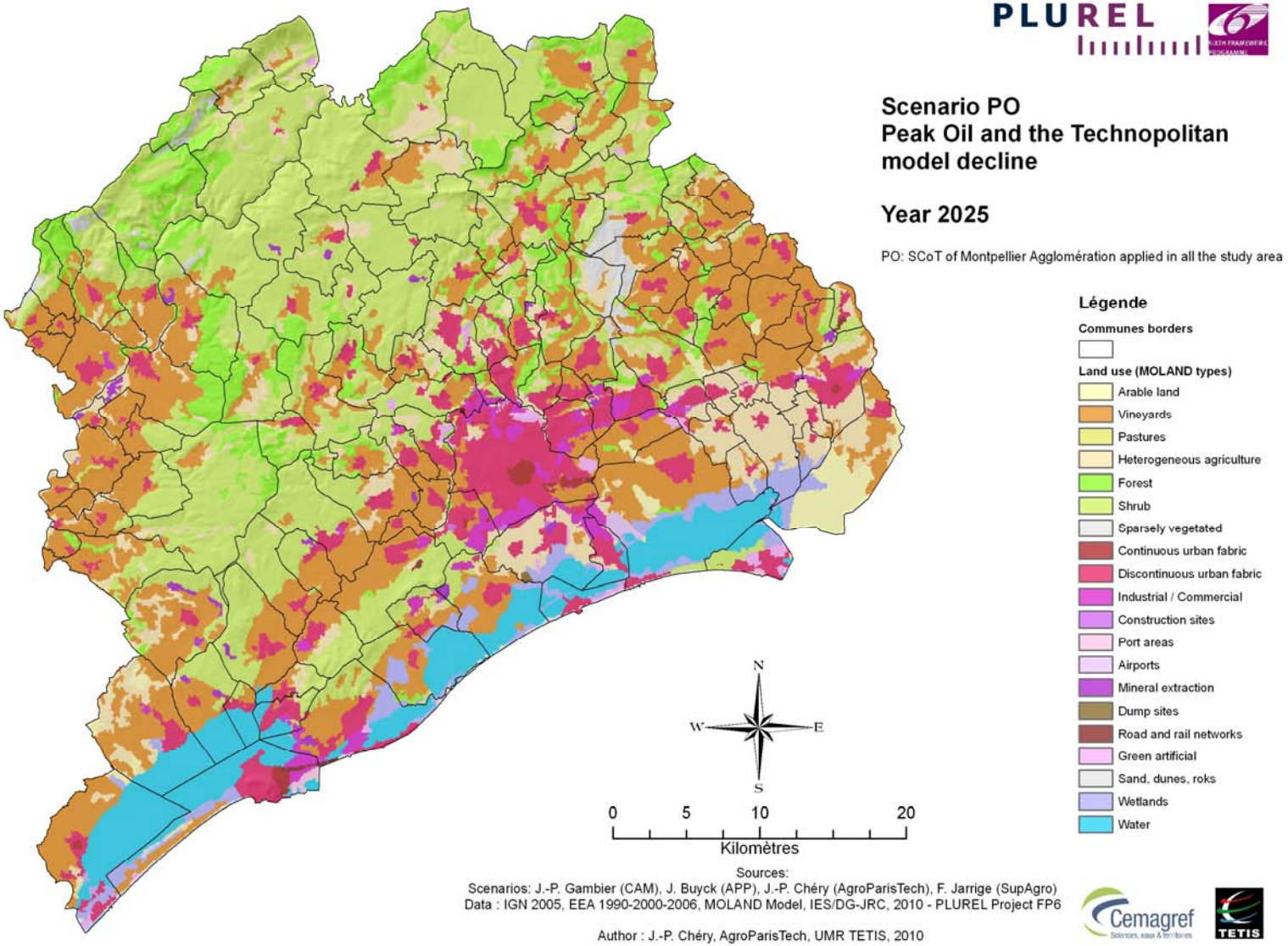
APPENDIX E: Map of land use in 2025, Scenario Hypertech Metropolis (version 1 – SCoT applied in all the study area)



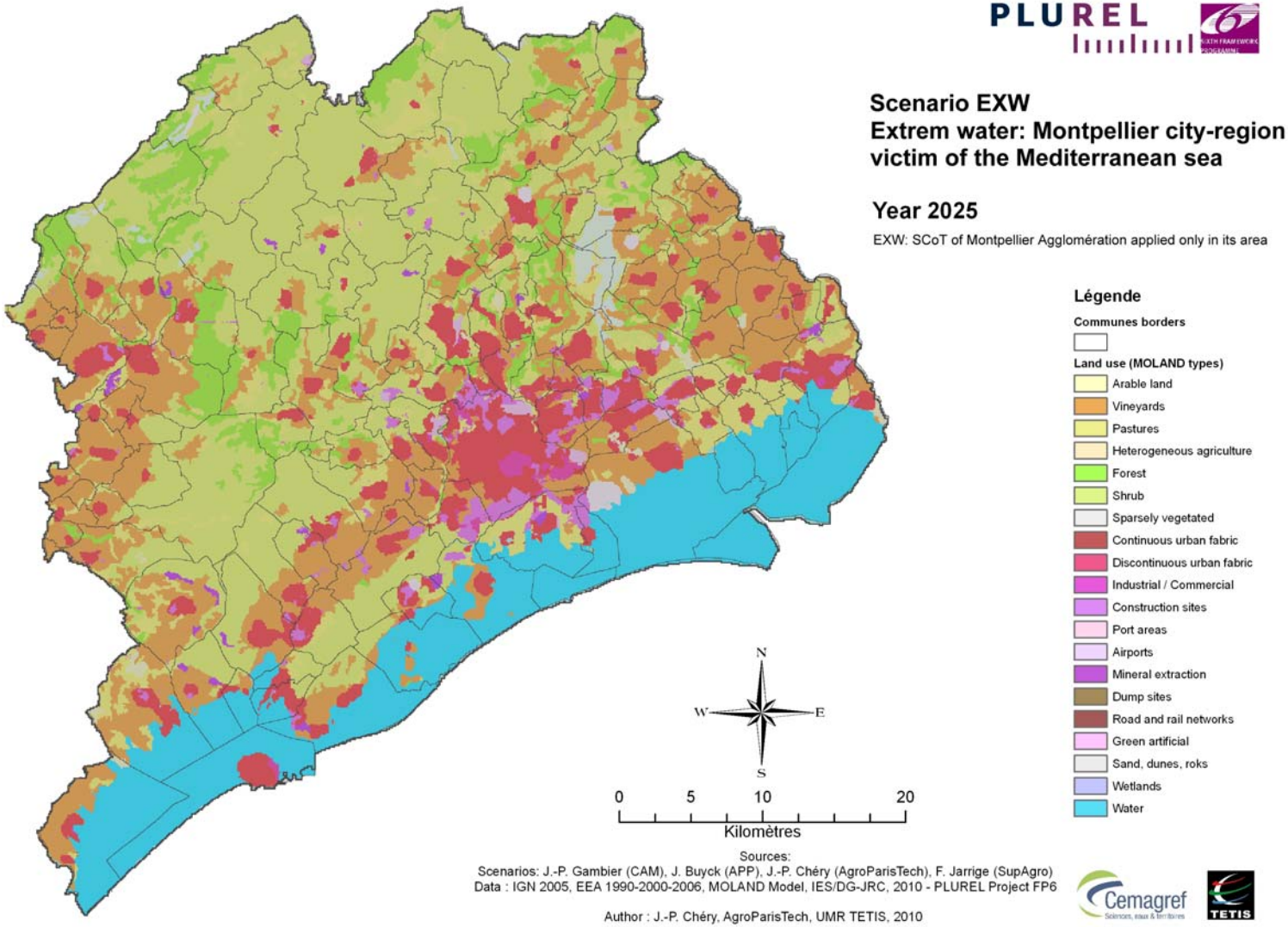
APPENDIX F: Map of land use in 2025, Scenario Hypertech Metropolis (version 2 – SCoT applied only in the CAM area)



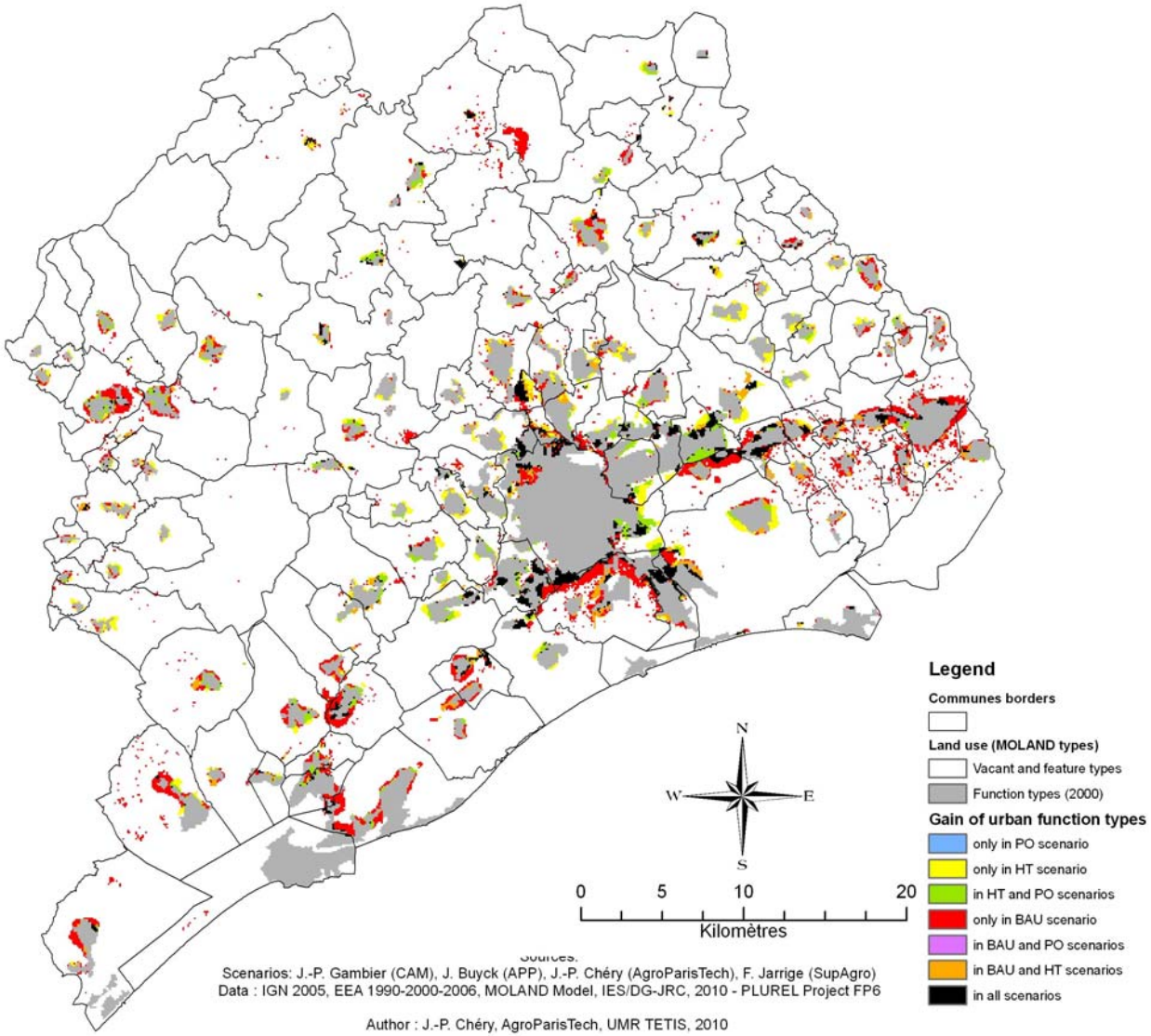
APPENDIX G: Map of land use in 2025, Scenario Peak Oil, in the Montpellier study area



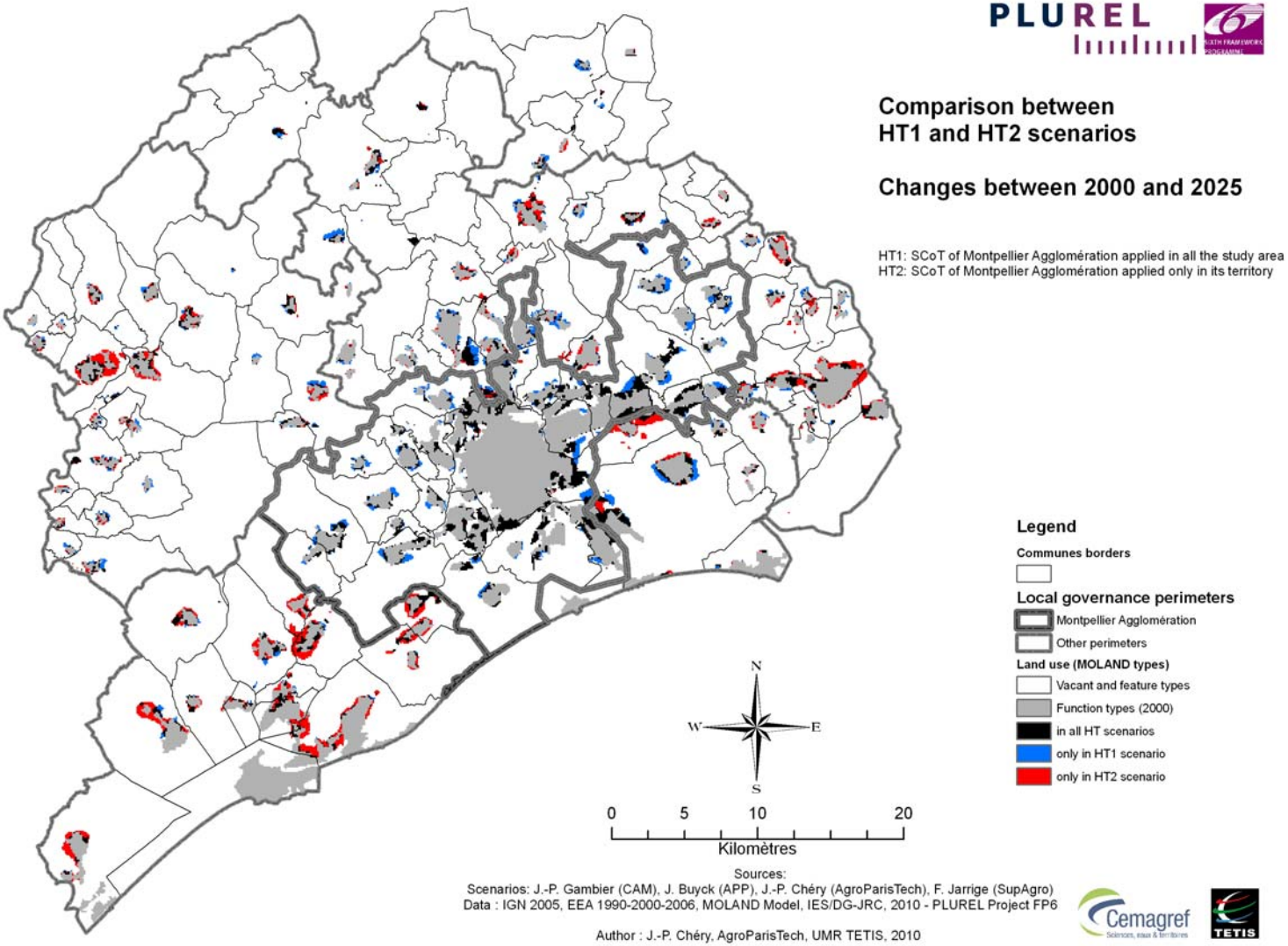
APPENDIX H: Map of land use in 2025, Scenario Extreme Water, in the Montpellier study area



APPENDIX I: Map of comparison of land use changes between the BAU, HT1 and PO scenarios (2000-2025)



APPENDIX J: Map of comparison of land use changes between the HT1 and HT2 scenarios (2000-2025)



APPENDIX K: Map of land use affected in 2025, Scenario Extreme Water, in the coastal part of the Montpellier study area