IMPACT

*ITT et Modélisation Paysagère pour l'Appréciation Dynamique des ImpaCts sur le Territoire*

# LTI and landscape modelling as part of an ongoing appraisal of regional impacts

ITTECOP Seminar

April 15th 2013

Paris La Defense

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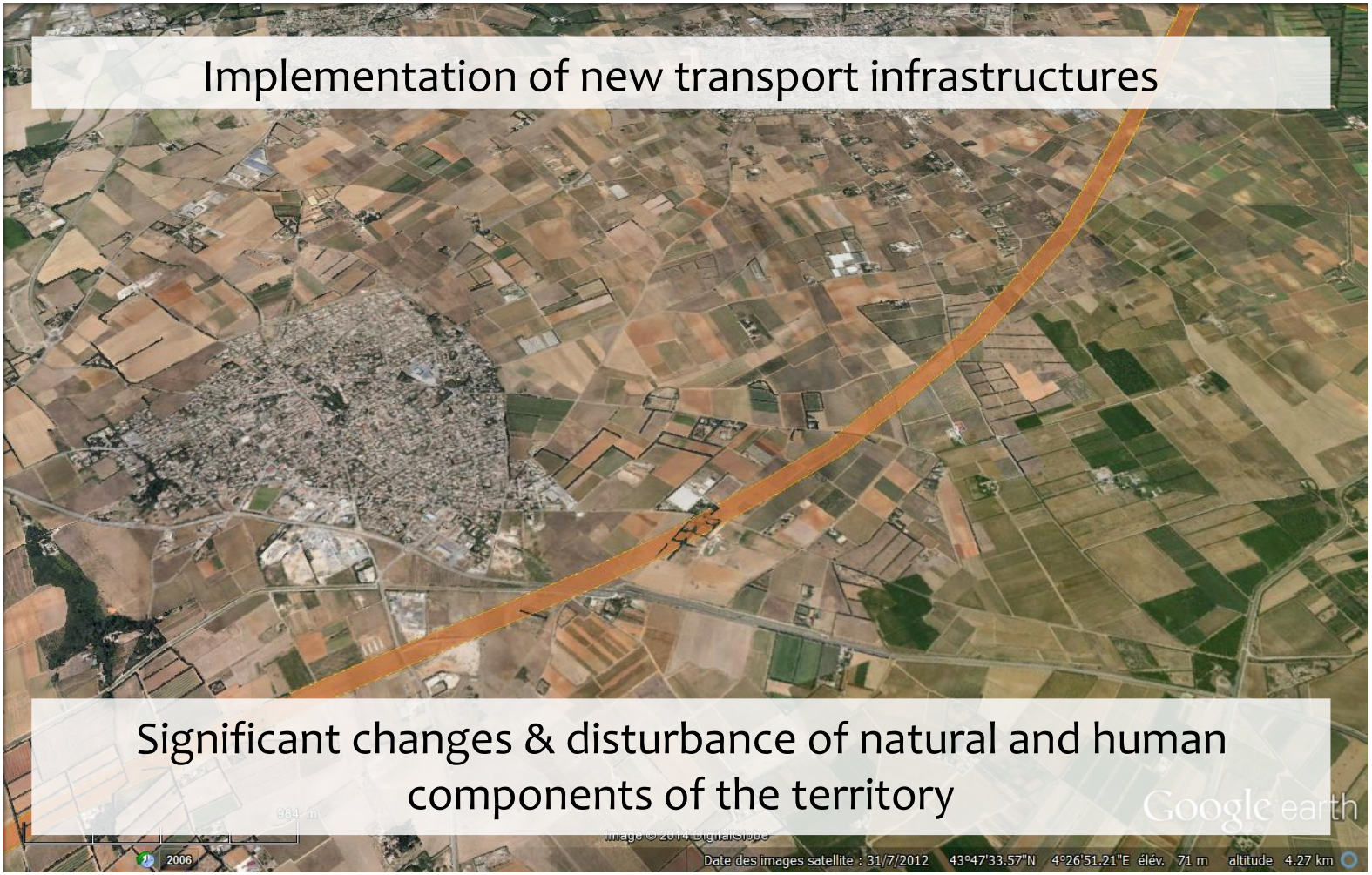
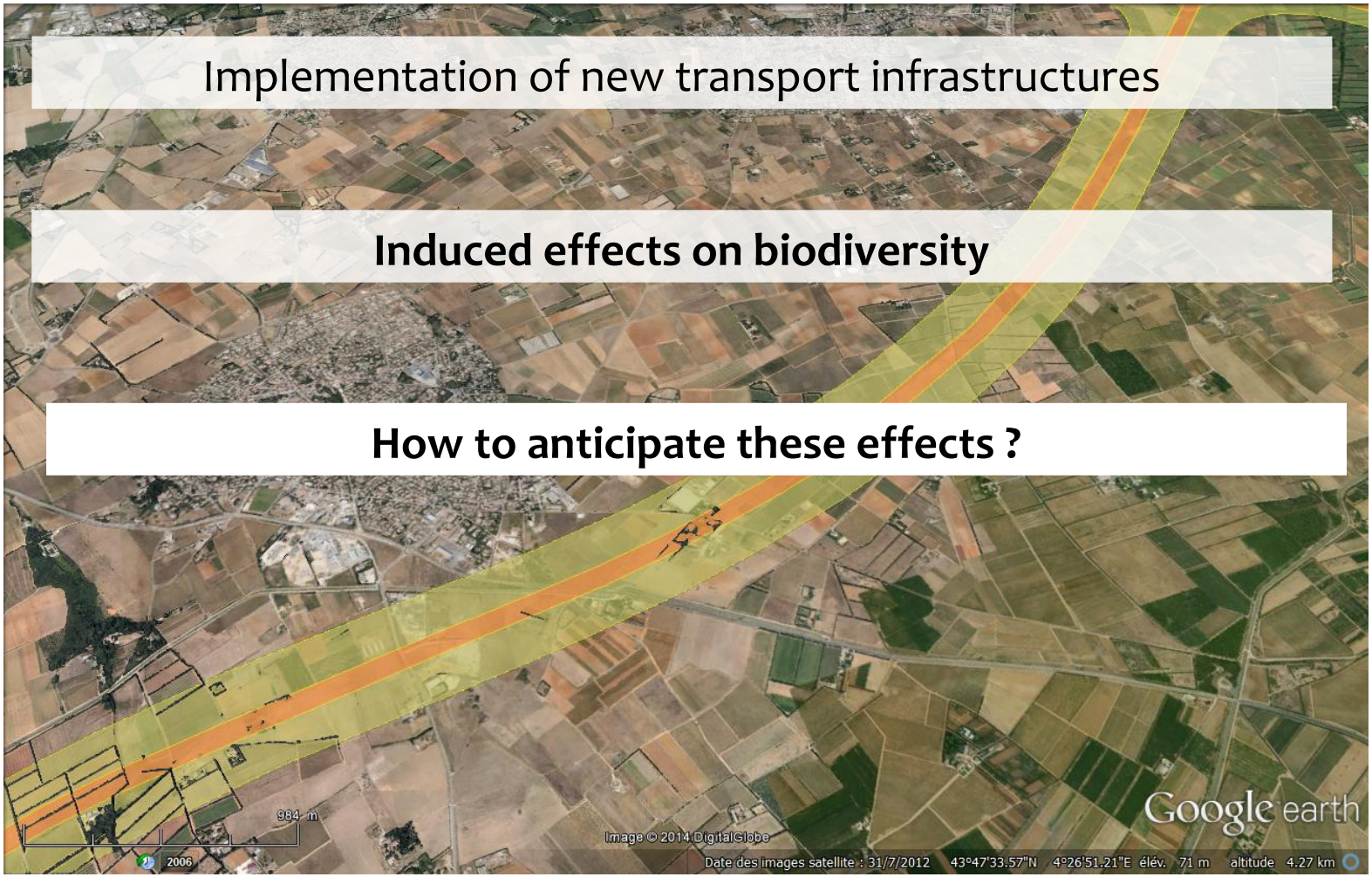
*GeoInformatics – Cirad Montpellier (TETIS Joint Research Unit)*

# Context


Implementation of new transport infrastructures
Significant changes & disturbance of natural and human components of the territory
Google earth
2006
Date des images satellite : 31/7/2012 43°47'33.57"N 4°26'51.21"E élév. 71 m altitude 4.27 km

# Context


Implementation of new transport infrastructures
Induced effects on biodiversity
How to anticipate these effects ?
984 m
2006
Image © 2014 DigitalGlobe
Google earth
Date des images satellite : 31/7/2012 43°47'33.57"N 4°26'51.21"E élév. 71 m altitude 4.27 km

## IMPACT Objectives :

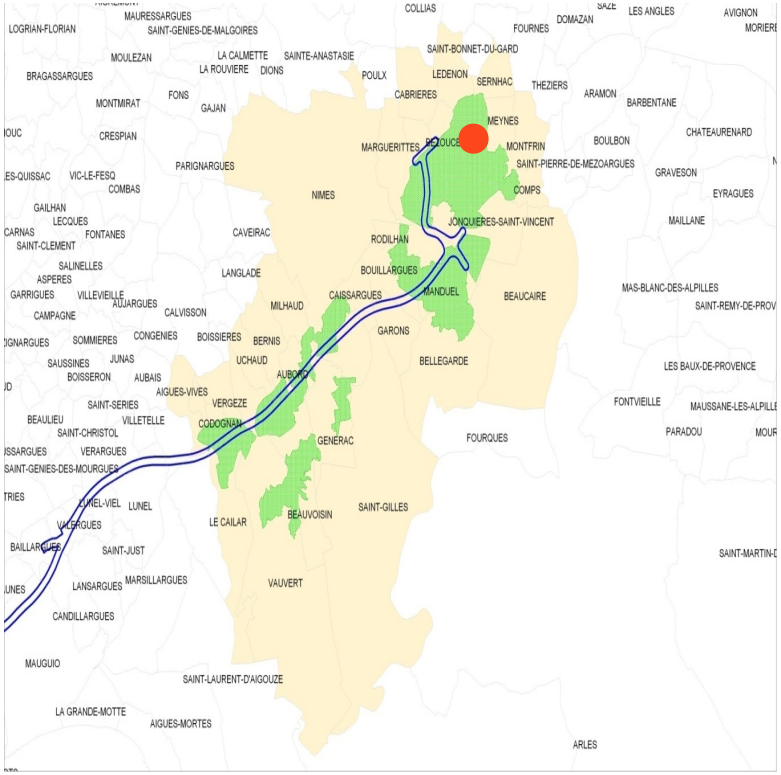
- Dynamic assessment of LTI impacts on the landscape
- Ecological valuation of landscape in a prospective analysis

## Expected Results

- Methodological development
- Open the way toward the development of a Decision Support tools

# Study area and issues

- 30 local councils close to Nîmes
- A new infrastructure project
  - High speed railway
  - New station
- Environmental issues
  - Protected areas
  - Specific issues (Tetrax tetrax)



*Little Bustard*

*Outarde canepetière*

# 6 steps approach

- Data collection

- Analysis of territory dynamics
  - Rules for changing
- Modelling
  - Model of landscape dynamics
- Simulations
  - Implementation of model
- Impacts and environmental services
  - Ecosystem services
- Analysis of decision making
  - Improvement of the process

# 6 steps approach

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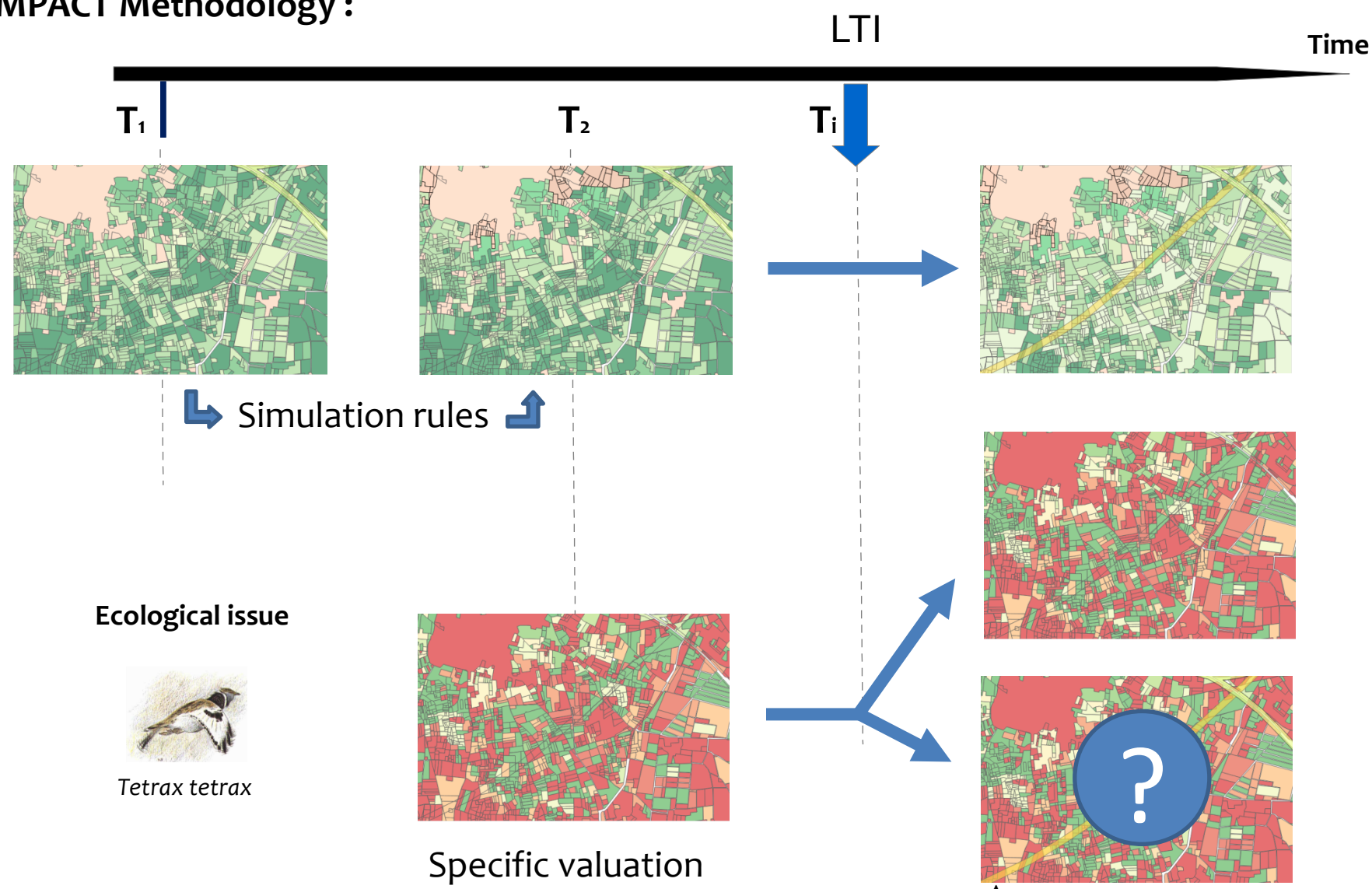
# IMPACT Methodology :



## Simulation rules

Several meetings with :

- state agencies
- local administrations
- economic actors

about urban planning, environment, agriculture

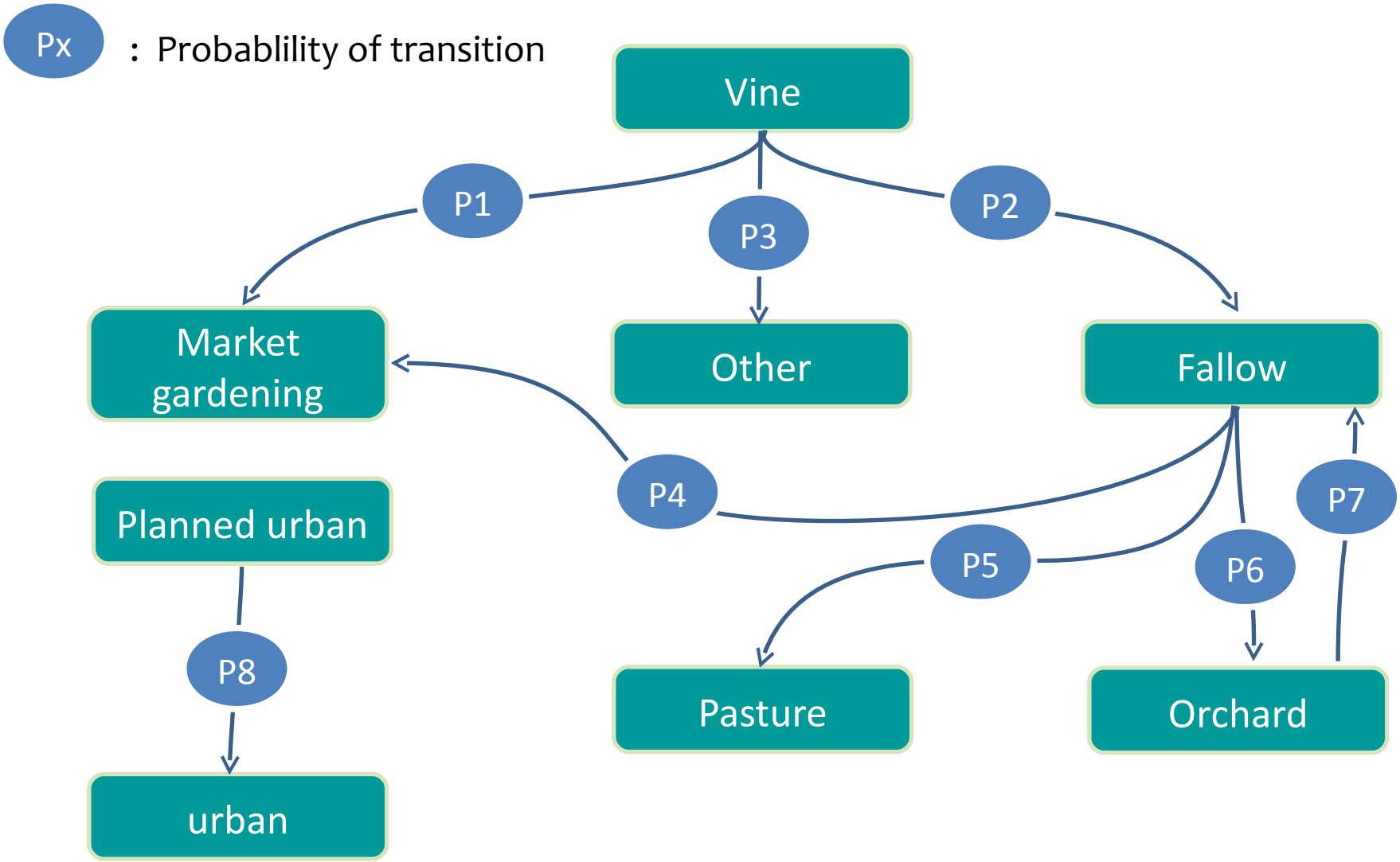
Bibliographic research and interviews (made by a student, L. Crowet)

A knowledge of the historical evolution of the territory

formalised into evolution rules related to :

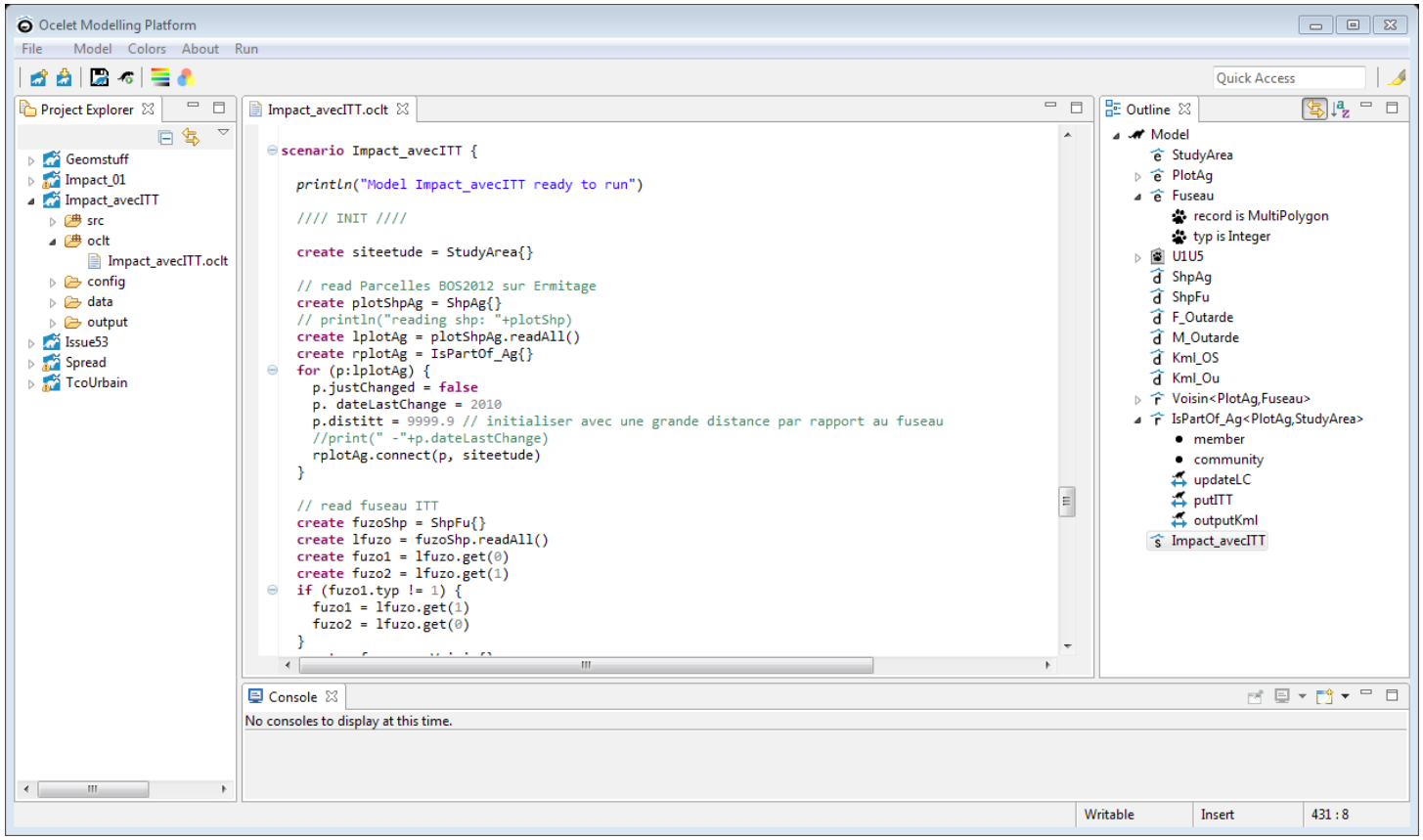
- Urban sprawl
- Cultivated land
- Fallow land

## Simulation rules



## Simulation platform

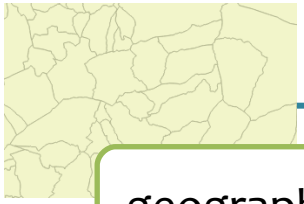
# ocelet Modelling Platform




Domain specific programming language for spatial dynamics simulation developped at TETIS research team.

# Simulation platform

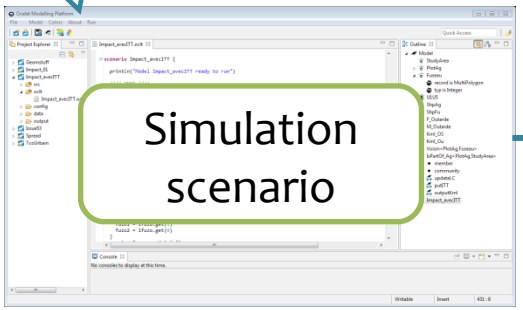
## Ocelet Modelling Platform



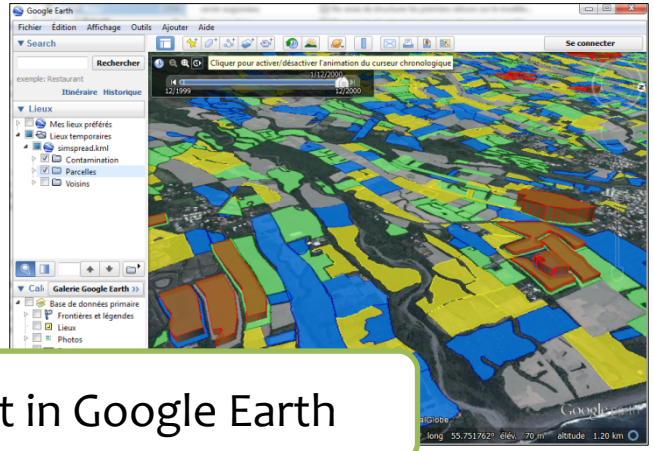
geographic data

| | | | | | |
|---|---|---|---|---|---|
| 1005 | Co... | 844808.0000000... | 1908899.000000... | 2890.0000000000 | 200.00 |
| 1006 | Co... | 850535.0000000... | 1874681.000000... | 750.0000000000 | 100.00 |
| 1007 | PrÃ... | 799506.0000000... | 1883198.000000... | 6478.0000000000 | 85900.00 |
| 1008 | Co... | 821882.0000000... | 1909033.000000... | 1604.0000000000 | 600.00 |
| 1009 | Co... | 866597.0000000... | 1872015.000000... | 2774.0000000000 | 1000.00 |
| 1010 | Co... | 861487.0000000... | 1860113.000000... | 590.0000000000 | 700.00 |
| 1011 | Co... | 823856.0000000... | 1890399.000000... | 904.0000000000 | 400.00 |
| 1012 | Chef... | 815645.0000000... | 1906298.000000... | 1889.0000000000 | 2100.00 |
| 1013 | Co... | 830637.0000000... | 1877845.000000... | 259.0000000000 | 200.00 |
| 1014 | Co... | 870925.0000000... | 1865940.000000... | 5607.0000000000 | 900.00 |
| 1015 | Co... | 830700.0000000... | 191 | | |
| 1016 | Chef... | 805897.0000000... | 18 | | |
| 1017 | Co... | 831620.0000000... | 19 | | |
| 1018 | Co... | 832618.0000000... | 18 | | |

Numeric data



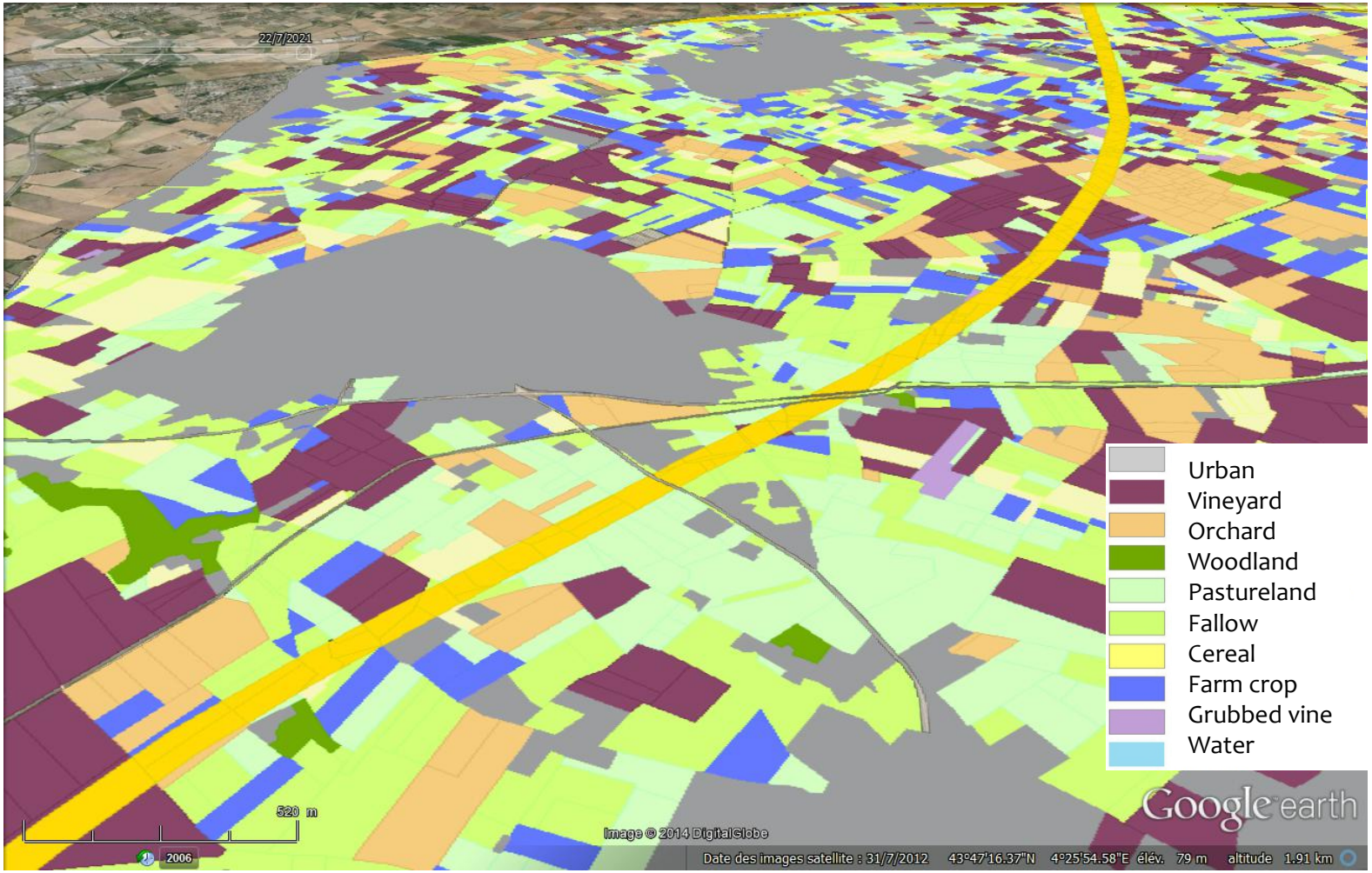
Simulation scenario



Dynamic map output in Google Earth

## Simulation output

### Landscape dynamic model from 2010 to 2021



# Tetrax tetrax values assigned to land use

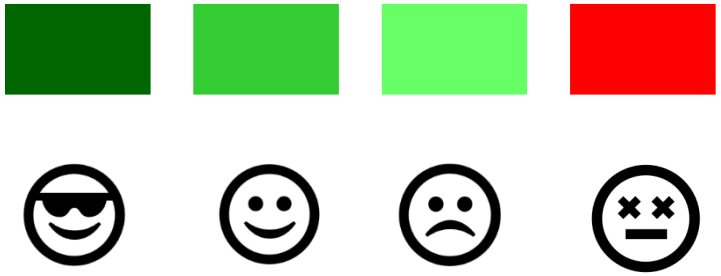
**Male**

| | U 1 Reproduction, Nidification | | | | | | | | | | | | U 2 Alimentation | | | | | | | | | | | | U 3 Abri, Repos, Dortoir | | | | | | | | | | | | U 4 Hivernage | | | | | | | | | | | | U 5 Halte migratoire | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Urbain | 0 | 0 | 0 | 0 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 |
| Vigne | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 |
| Arboriculture | 0 | 0 | 0 | 0 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 |

**Female**

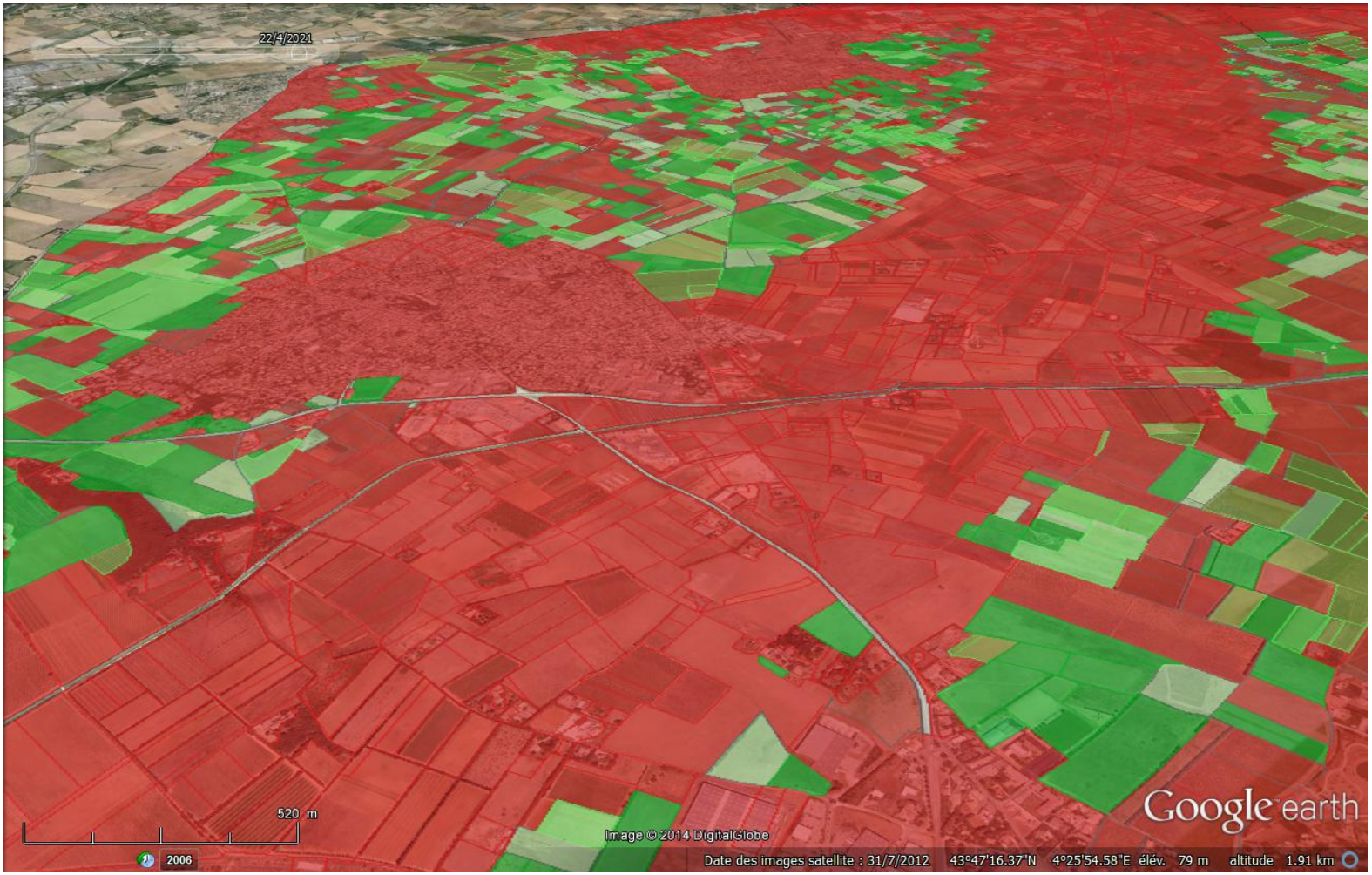
| | U 1 Reproduction, Nidification | | | | | | | | | | | | U 2 Alimentation | | | | | | | | | | | | U 3 Abri, Repos, Dortoir | | | | | | | | | | | | U 4 Hivernage | | | | | | | | | | | | U 5 Halte migratoire | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Urbain | 0 | 0 | 0 | 0 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 |
| Vigne | 0 | 0 | 0 | 0 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Arboriculture | 0 | 0 | 0 | 0 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| Bois | 0 | 0 | 0 | 0 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 | -1 |
| Prairie, Pâture | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 |
| Friche herbeuse | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 3 |
| Friche mixte | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| Friche arbustive | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | -1 | -1 | -1 | 0 | 0 | 0 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Culture | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 3 | 3 | 3 | -1 | -1 | 1 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| Maraîchage | 0 | 0 | 0 | 0 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | -1 | 1 | 1 | 1 | 1 | -1 | -1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vigne récemment arrachée | 0 | 0 | 0 | 0 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Eau | 0 | 0 | 0 | 0 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 | -1 |

**Land use** x **Male/Female** x **5 Uses** (reproduction, feeding, resting, wintering, staging)

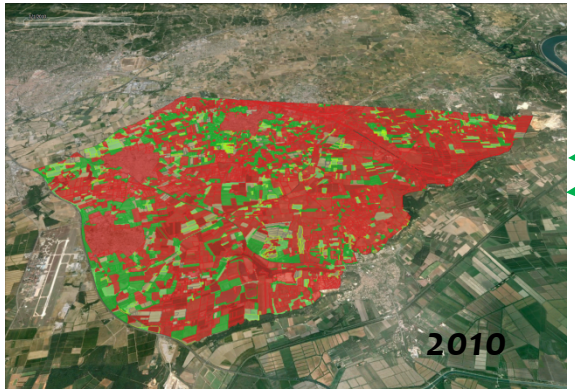


## Simulation output

### Tetrax tetrax value dynamic model from 2010 to 2021



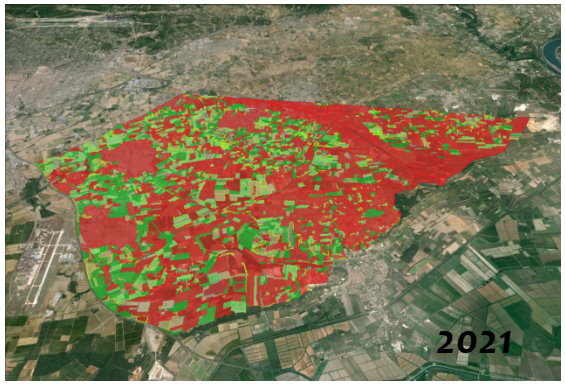
## Animated maps of usage index for *Tetrax tetrax*



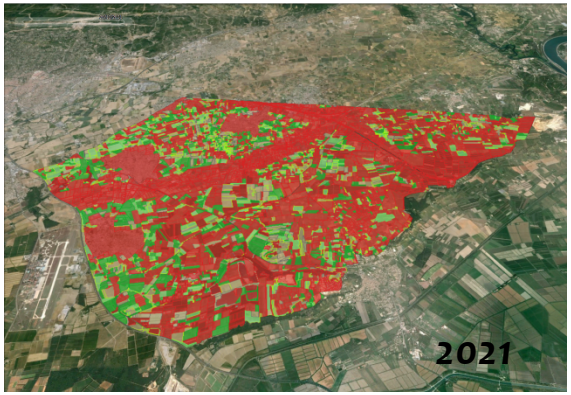

ocelet

Model

Without LTI




With LTI




The simulation results provide both qualitative and quantitative information

It helps study the synchronisation of some aspects of the system both in space and time

# Conclusion

- Still work in progress
  - Different action scenarios could be experimented
  - The level of detail of the model can be improved when a better knowledge of the tetrax behavior becomes available

- The people building the simulation model are the ones who learn most
  - Involving stakeholders in the modelling exercise is the way to go

- Genericity vs highly contextual specific model ?

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# as part of an ongoing appraisal of regional impacts

ITTECOP
Seminar

April 15th
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## Thank you for your attention.