Light Pollution
A Shared Challenge

Scientific Analysis Tools

UICN 2021

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September 8, 2021

What is DarkSkyLab?

Location

Toulouse, France

Founded

in 2014

Goal

Deliver expertise as well as services in the field of light pollution and its impacts on ecosystems

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Members

Sébastien Vauclair
Philippe Deverchère
Michel Bonavitacola
Gonzague Bosch

Agenda

- What is light pollution?
- Metrology
- Modeling

twonight.org

Casper
(Wyoming, USA)
55,000 inhabitants

August 20, 2017

42.853467 N
106.13447 E

15 km east of Casper. Photo towards west in direction of Casper

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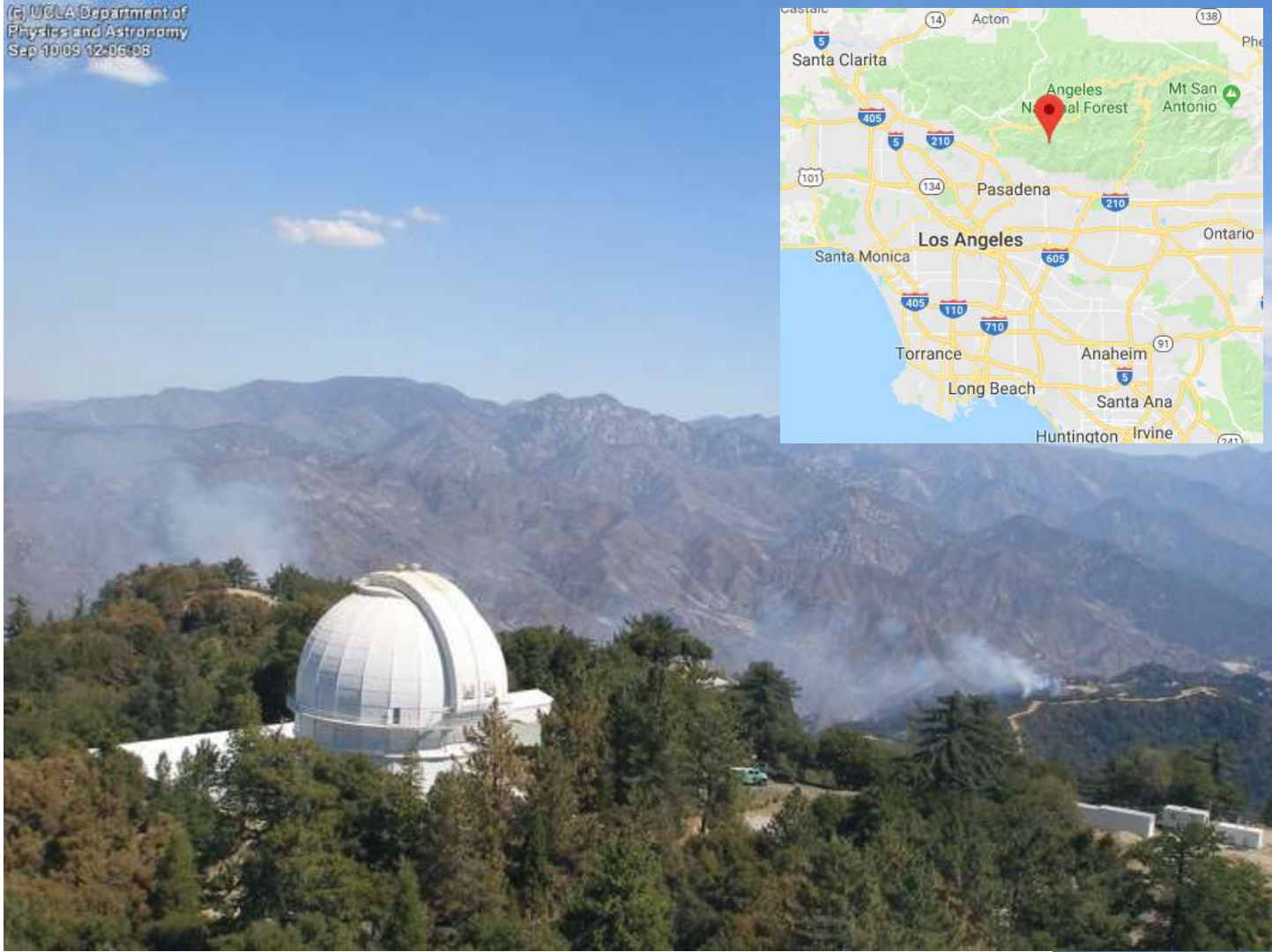
Mount Wilson
(California, USA)

25 km north-east of Los Angeles downtown



DARK SKY LAB

Mount Wilson
(California, USA)

Los Angeles at night in **1908**

DARK SKY LAB

Mount Wilson
(California, USA)

Los Angeles at night in **1958**

DARK SKY LAB

Mount Wilson
(California, USA)

Los Angeles at night in **2008**

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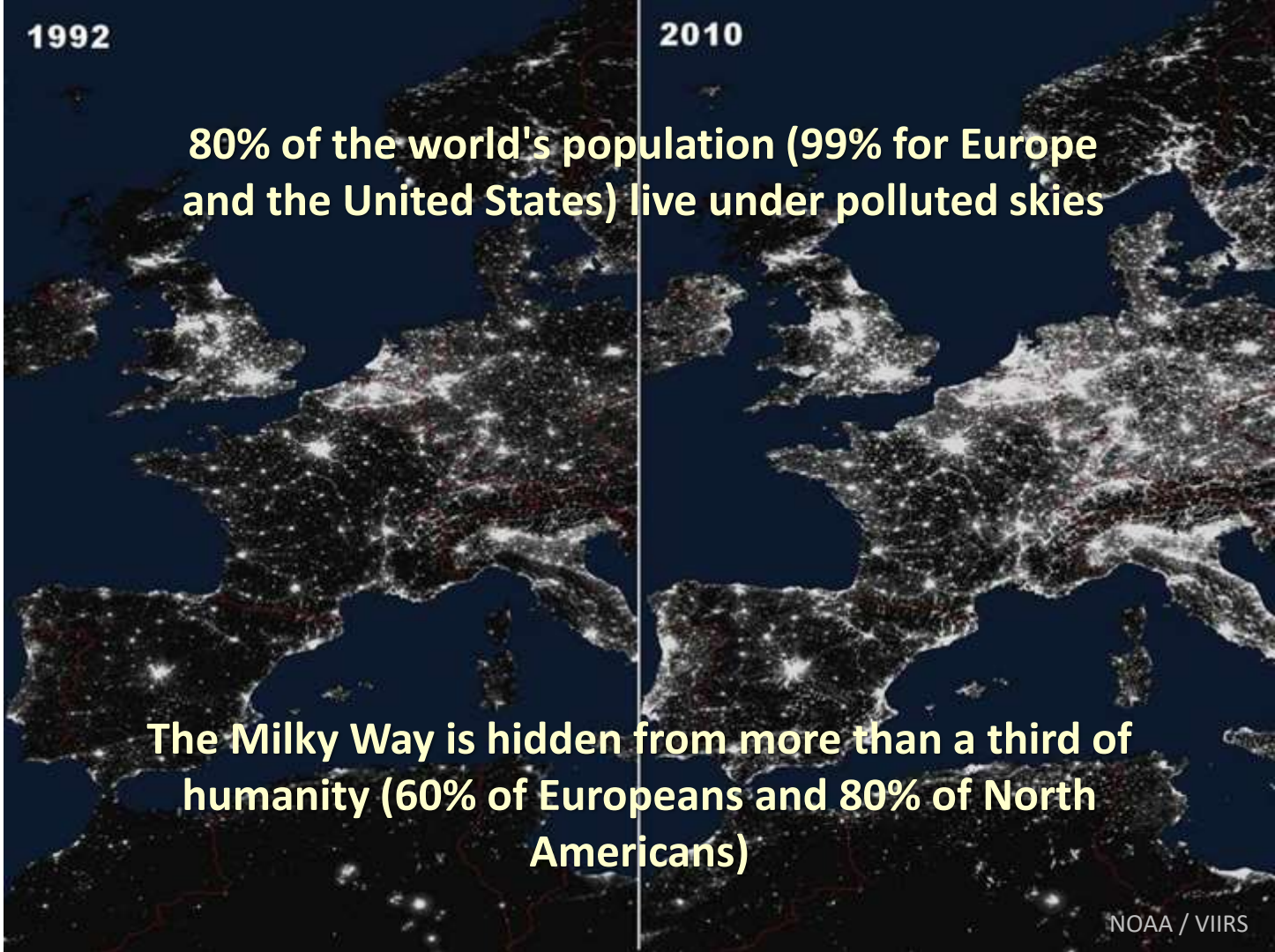
Western Europe

Evolution of anthropogenic light emission between 1992 and 2010

Between 2012 and 2016, an average growth of 2.2% per year was observed worldwide[1] (6% per year between 1990 and 2000 in Europe)



[1] Artificially lit surface of Earth at night increasing in radiance and extent, *Science Advances*, 2017

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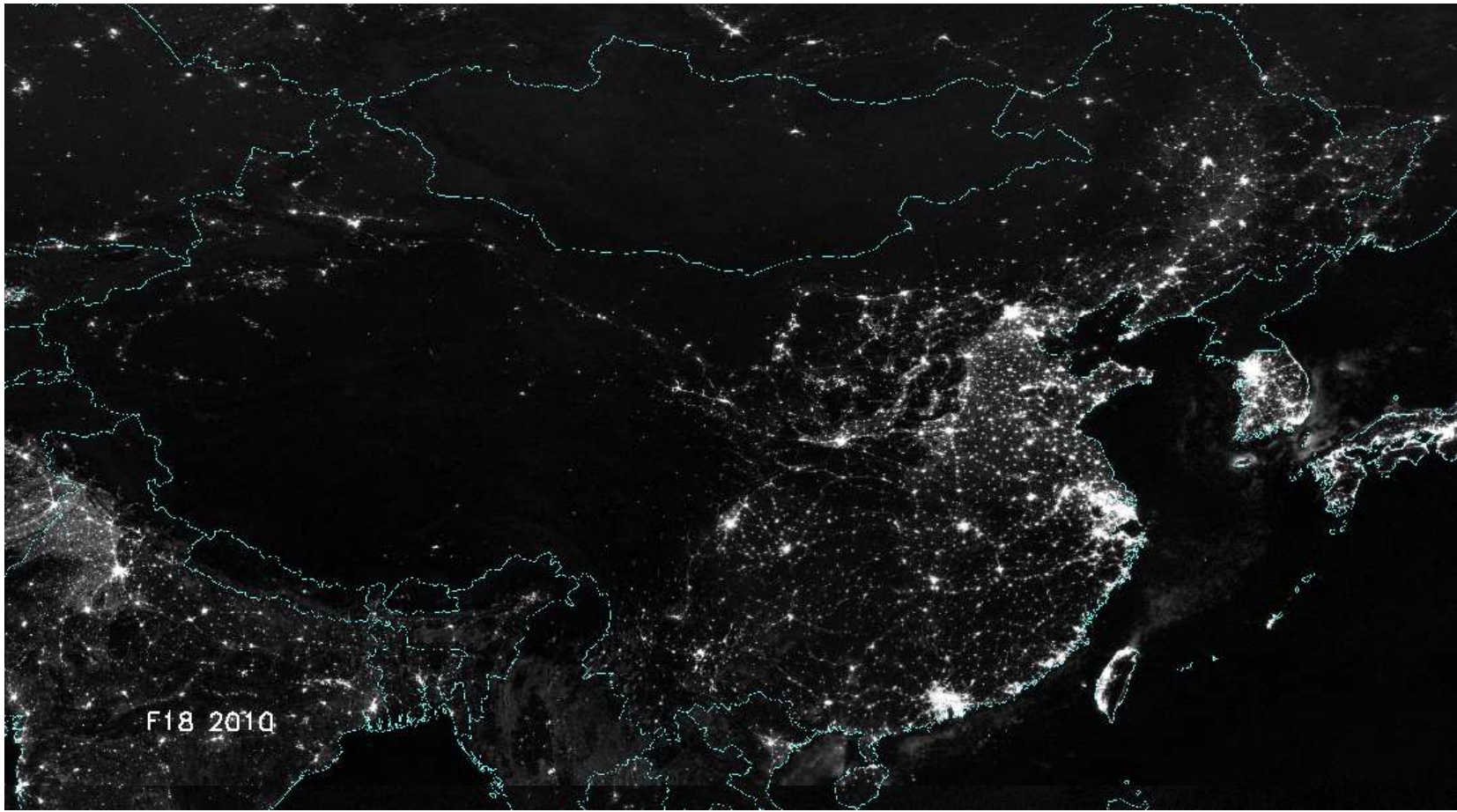
Asia
1992 - 2010



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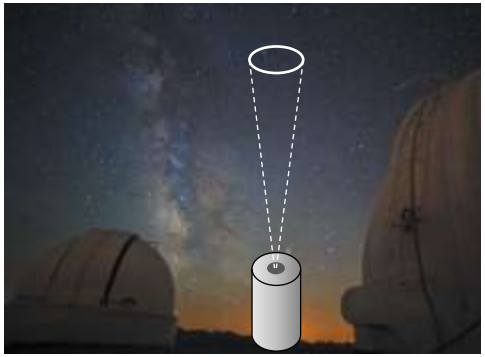
Metrology

Measuring Light Pollution with Ninox

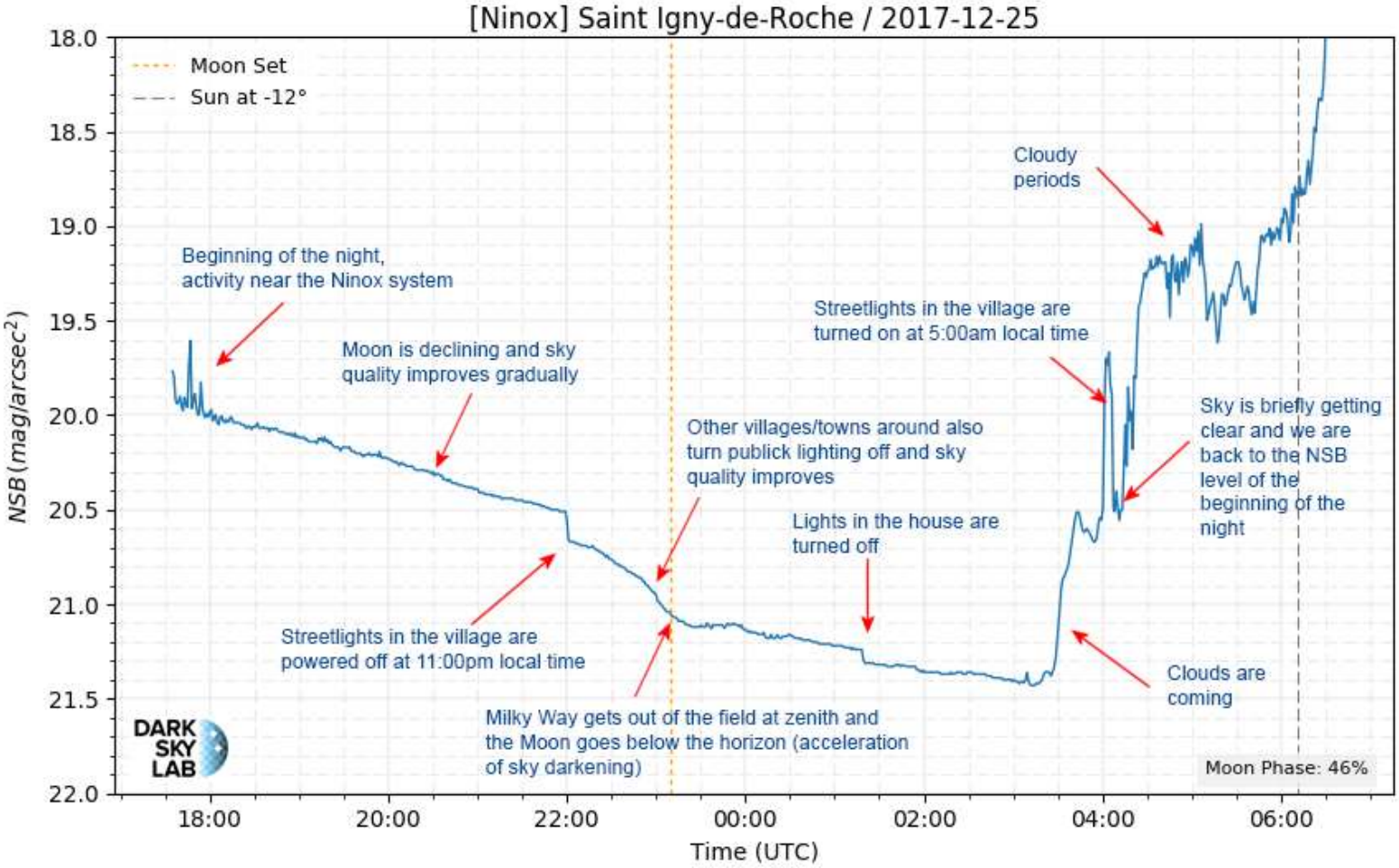


Measure of sky background brightness (luminance) in mag/arcsec^2

- Continuous and fully automated recording of sky brightness over long periods of time (months or years)
- Wi-Fi access point and Web interface to control the device and access data on site
- Statistical processing of the measures to fully characterize a location

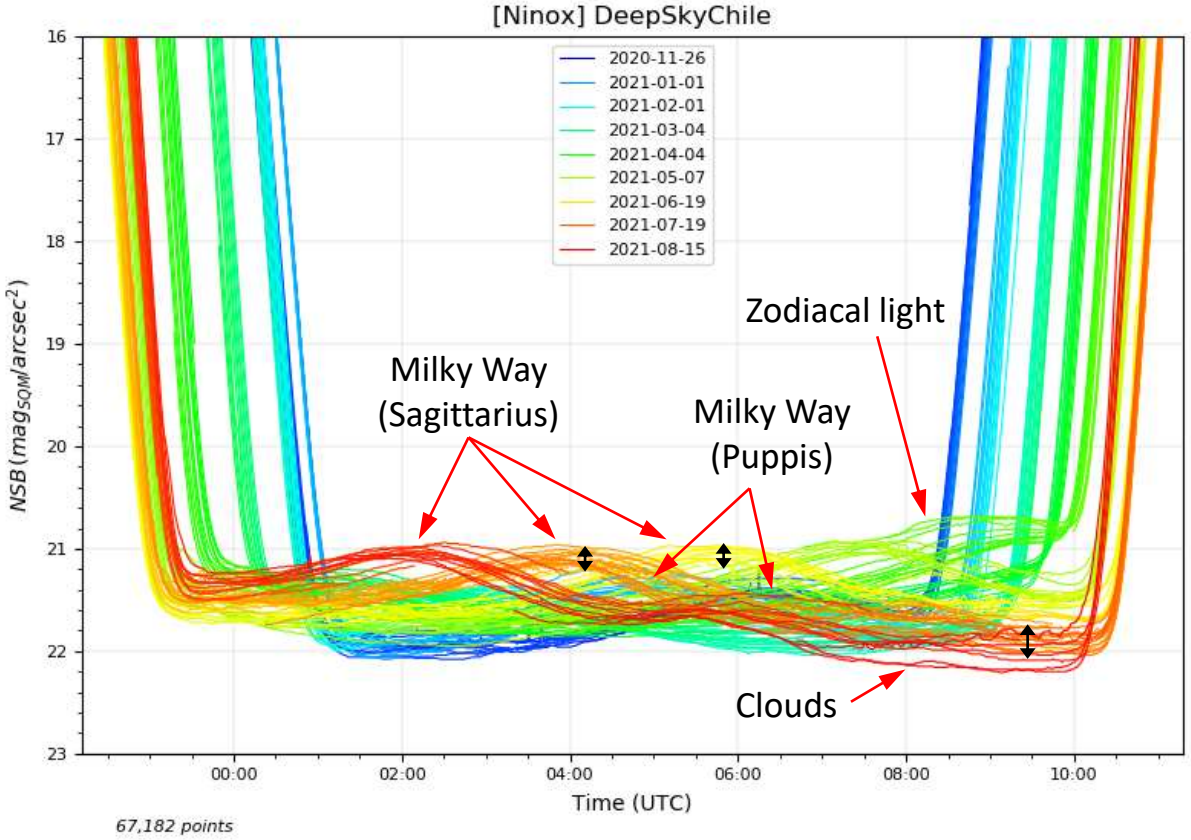
Ninox single night recording

Complex profile with multiple events

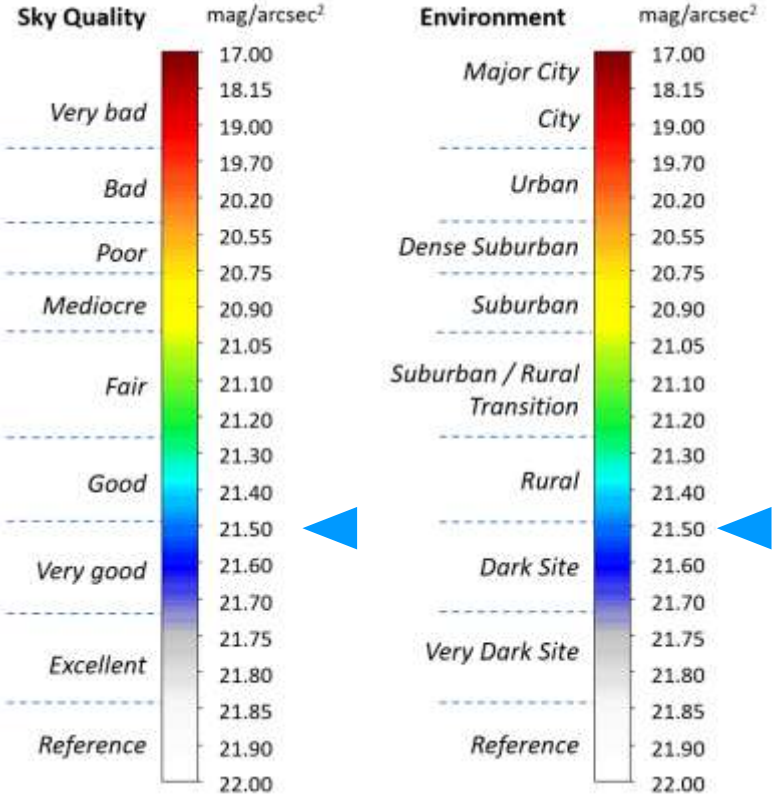


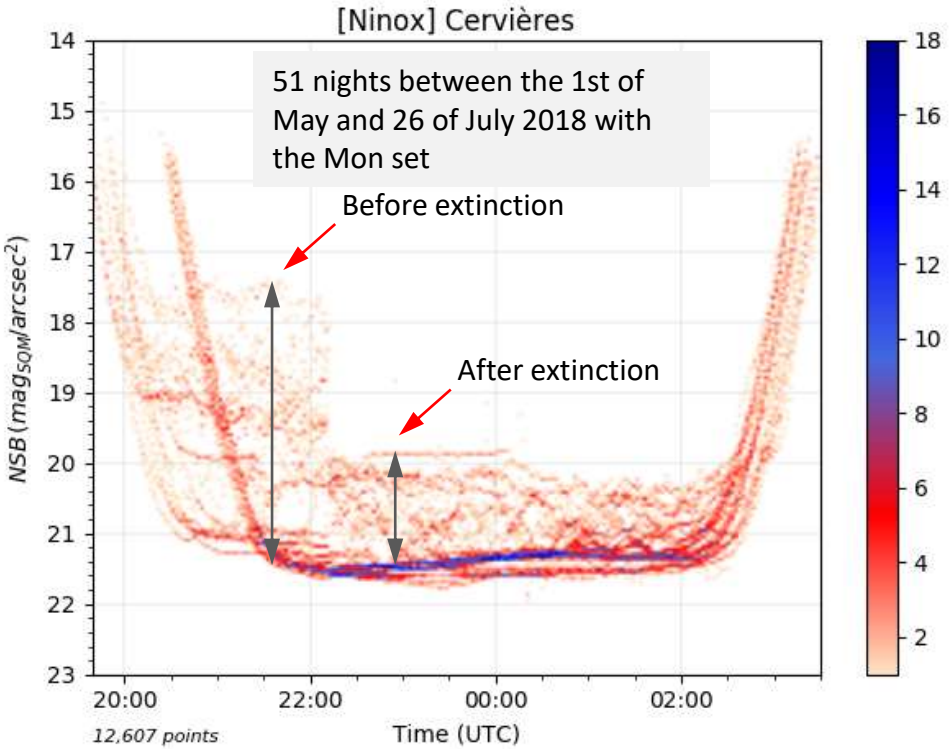
Natural Light Sources

Ninox measures in Atacama, Chile



Density Diagrams





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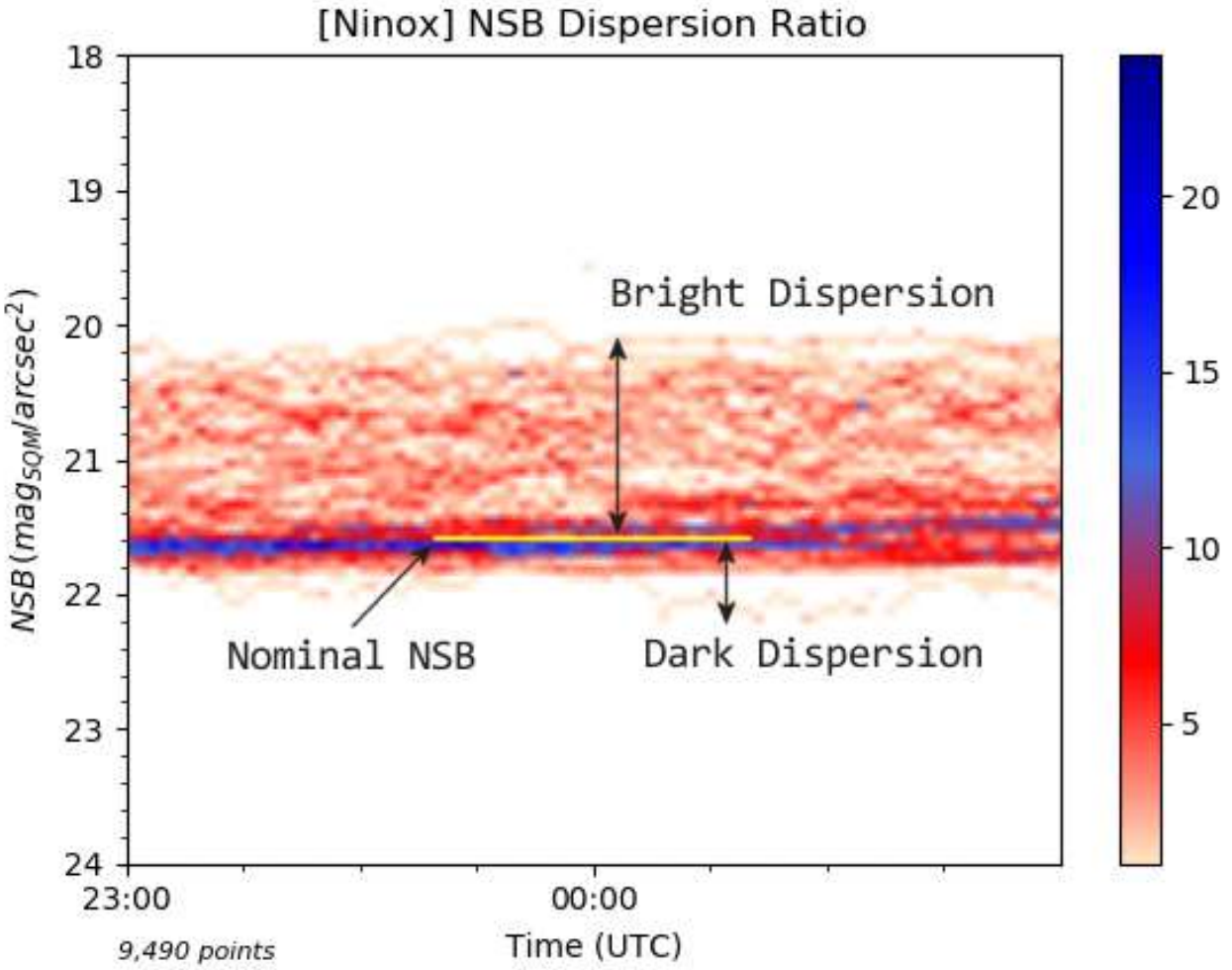
NSB Dispersion Ratio (NDR), an absolute night sky brightness indicator

NDR = MAD_{bright} / MAD_{dark}

(Median Absolute Deviation)



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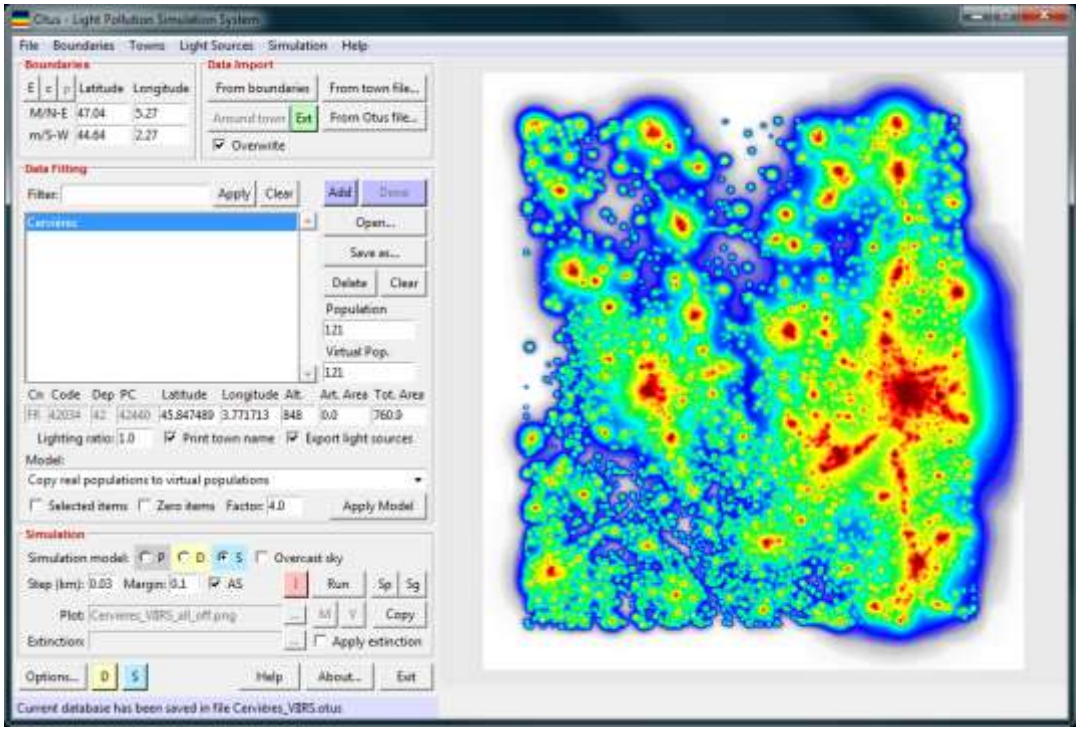
Modeling

Light Pollution Simulation with Otus

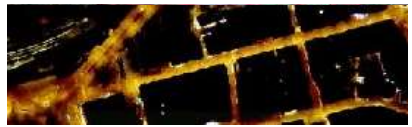


Production of light pollution prediction maps from various data sources

Population data

Geolocated light sources

NOAA VIIRS-DNB satellite radiance data



Orthophotography high resolution radiance data (plane or satellite)

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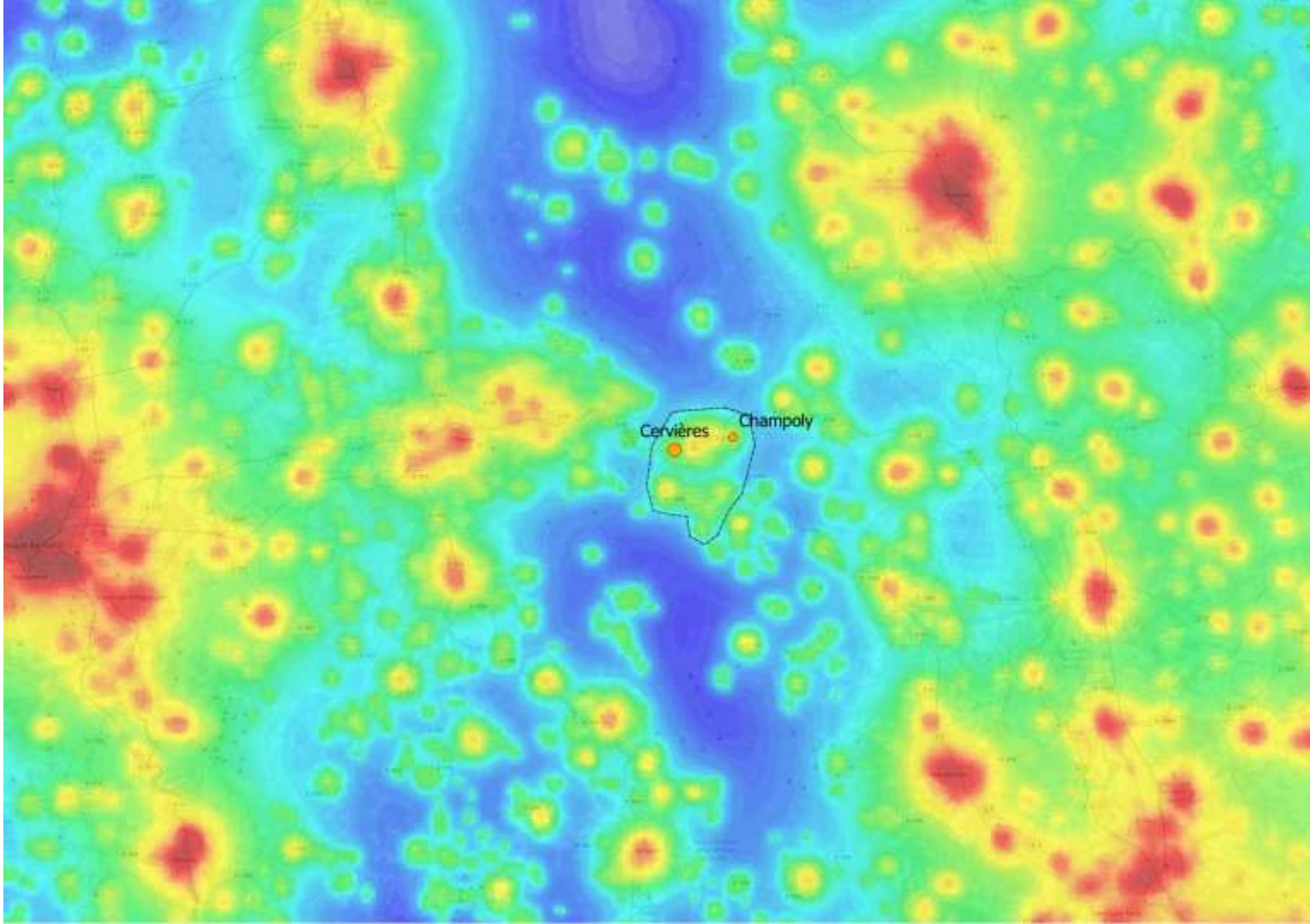
Simulation of a dark corridor rehabilitation

Extinction of a specific zone



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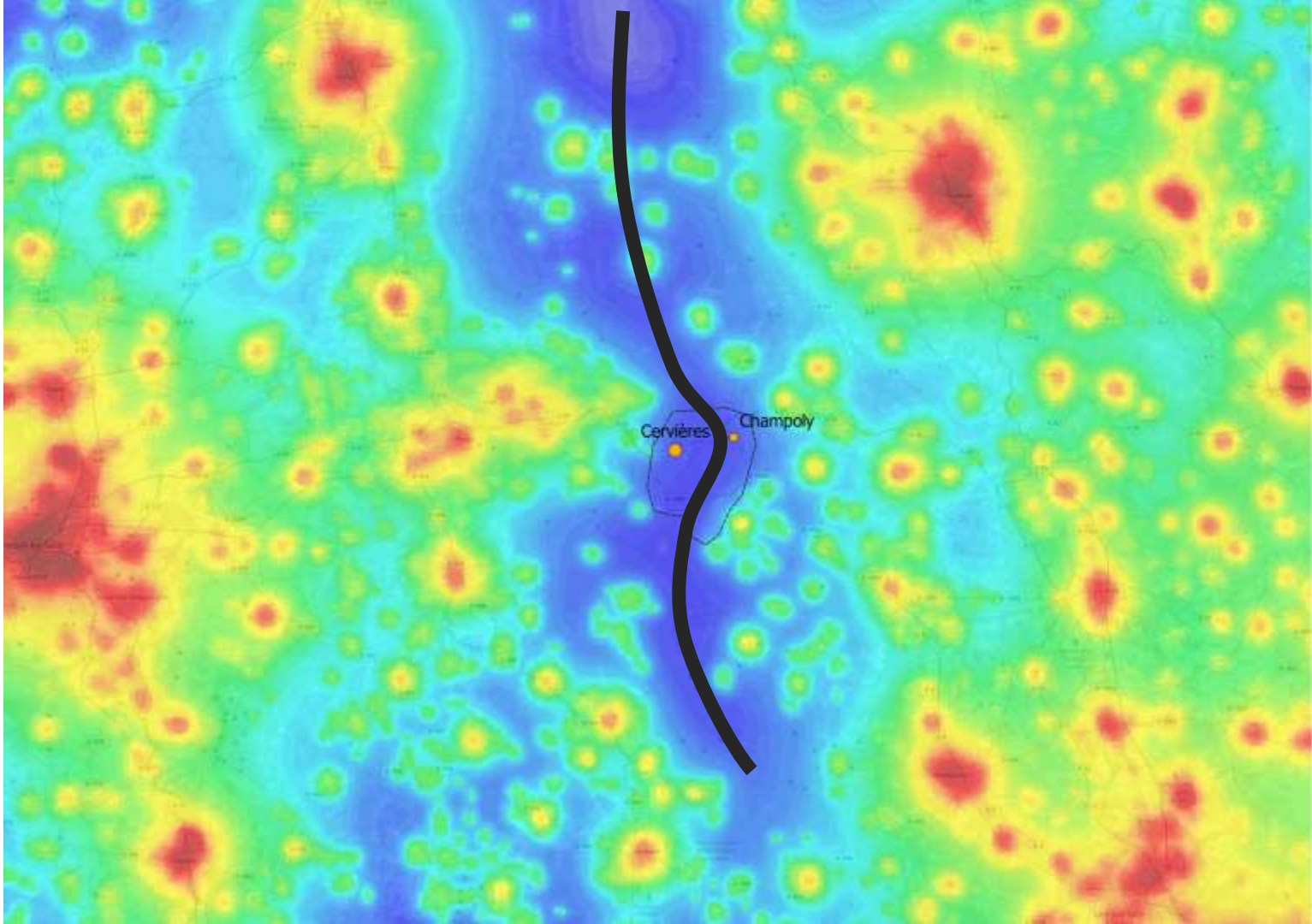
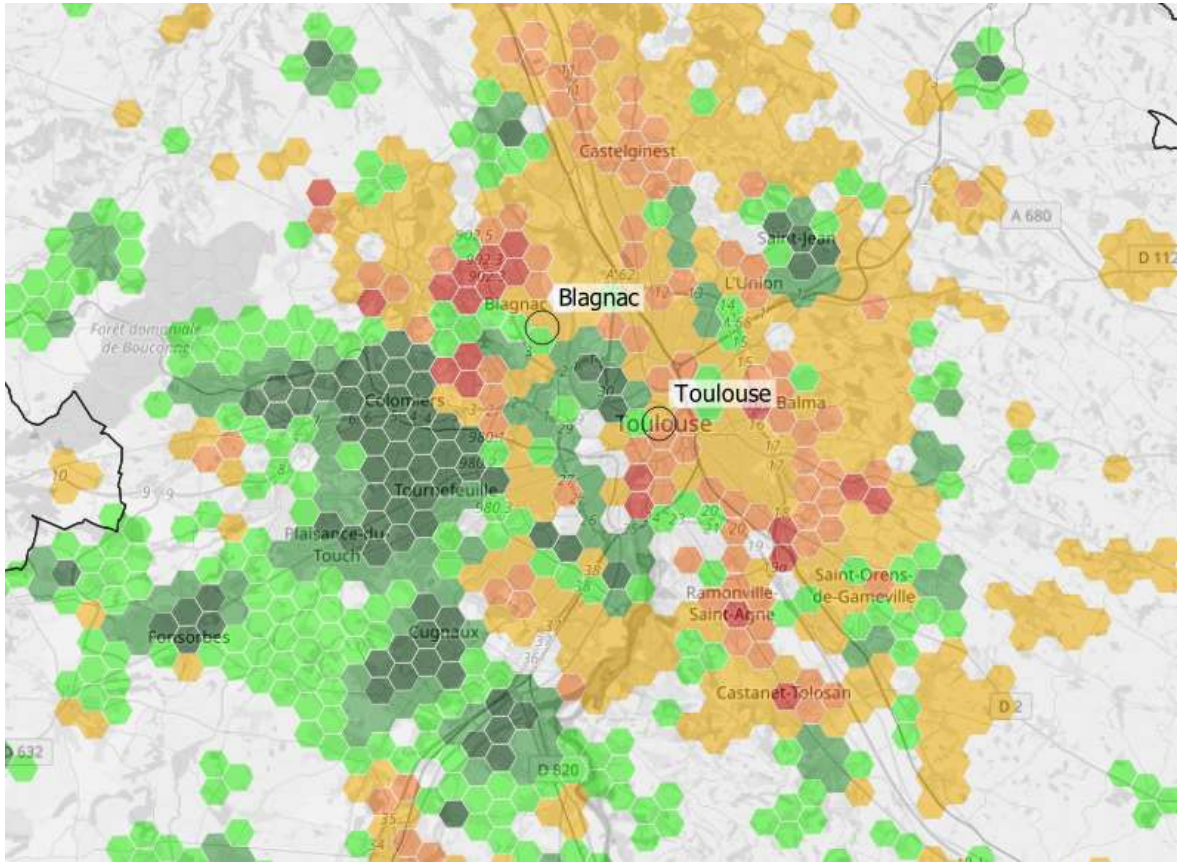
Simulation of a dark corridor rehabilitation

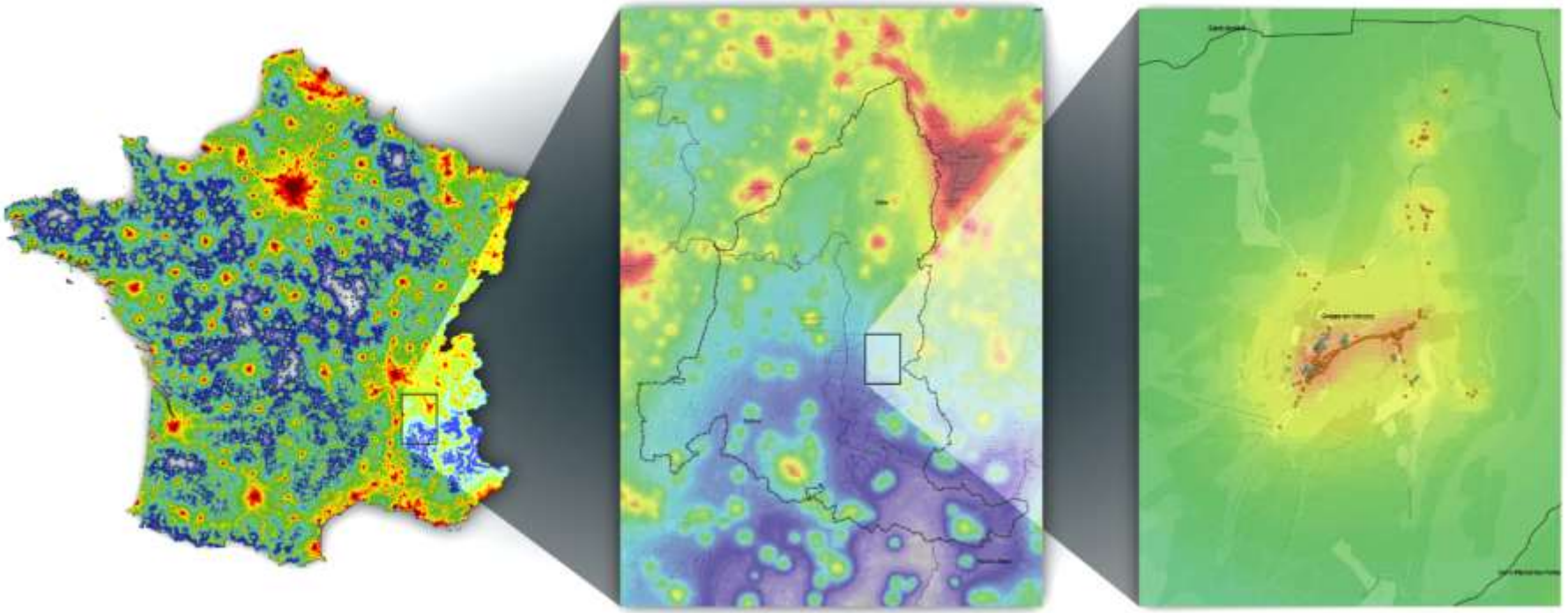
Example of the rehabilitation of a North / South corridor



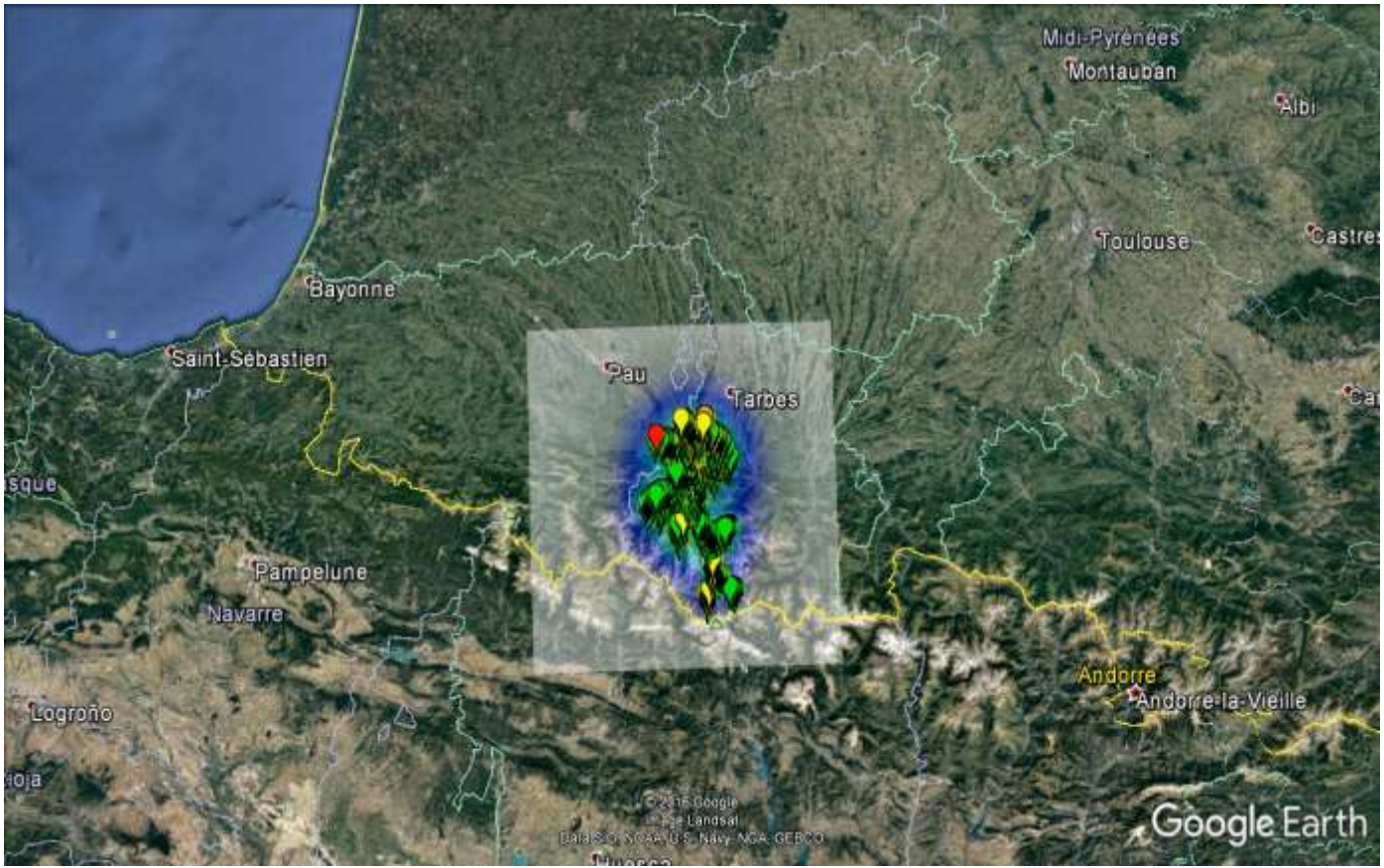
Temporal Evolution Indicator



Different Scales for Different Needs

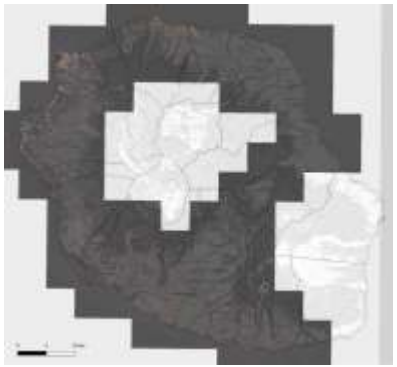


Public Light Source Set Analysis



Ortho-Photography analysis

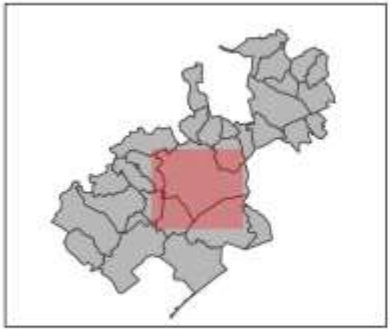
La Réunion Island Sport fields and private lightning analysis

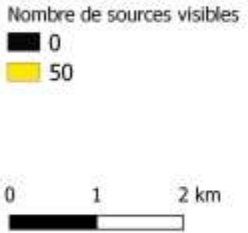


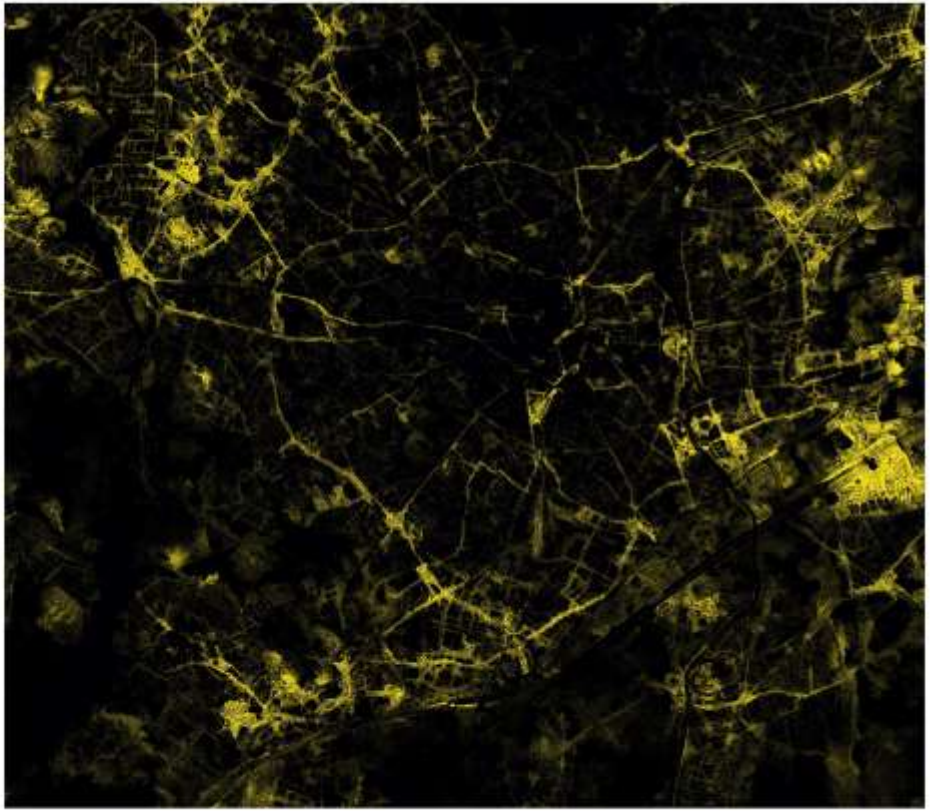
High résolution satellite imaging (Jilin – CG Sat)

Light source visibility by a ground based observer

Including masking from bulding and trees
Based on Jilin image and light source extraction







Sarah Potin

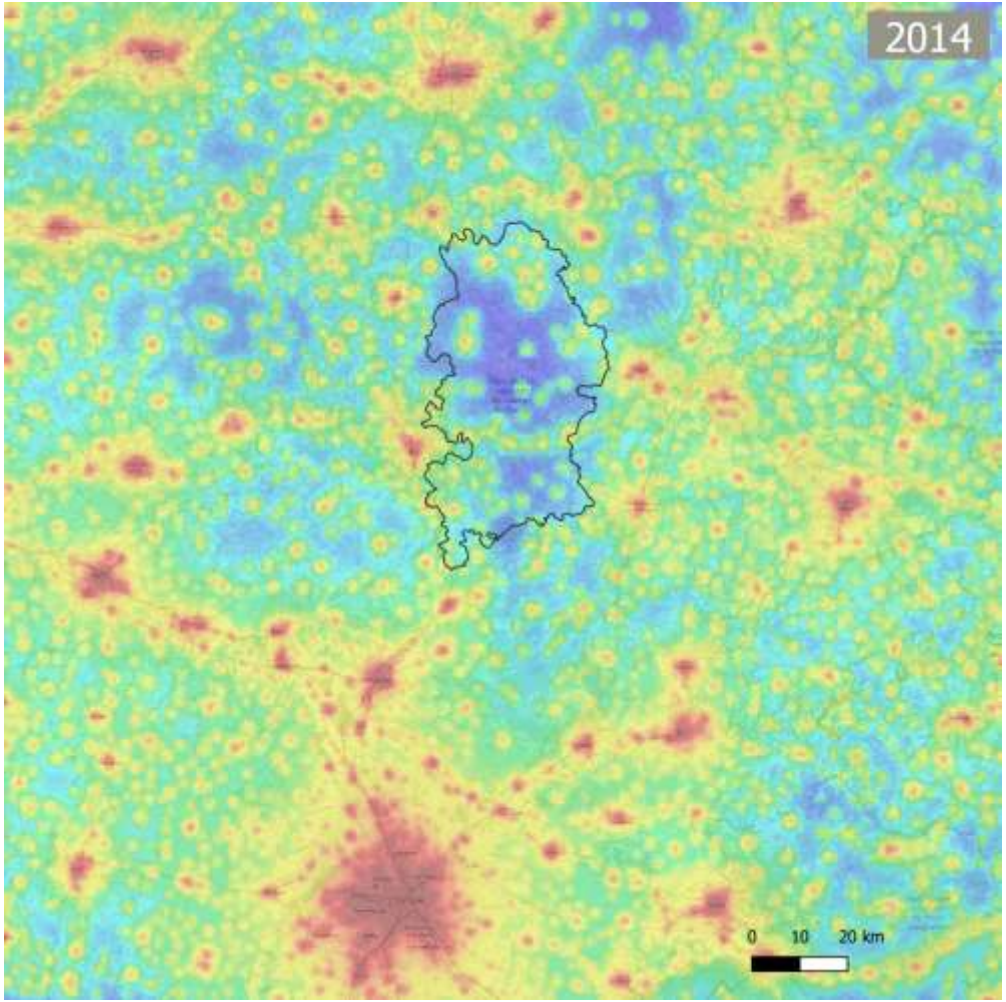
Public Lighting Extinction

Epinal - JF Hamard

Epinal - JF Hamard

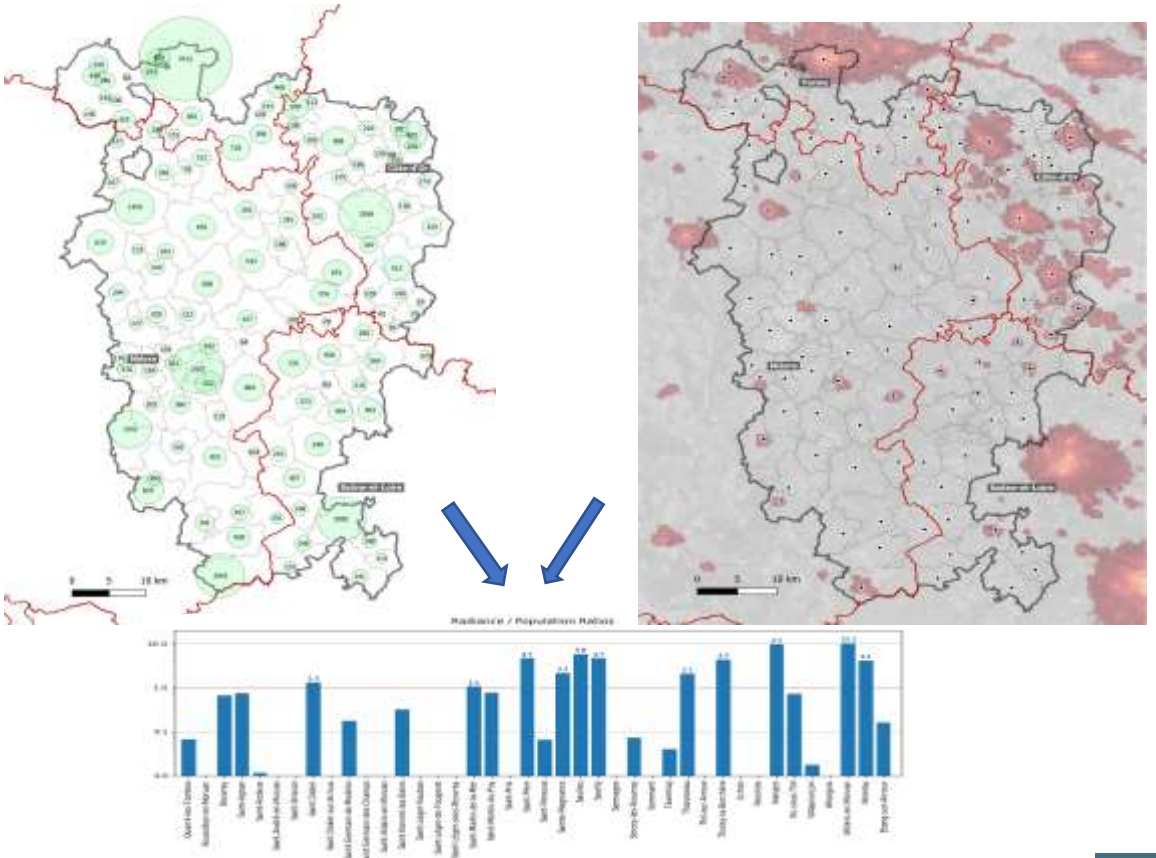
Public lighting extinction is becoming a more commonly adopted practice

Example of the *Parc Naturel Régional du Quercy* over 2014 to 2020



Public lighting Extinction Analysis

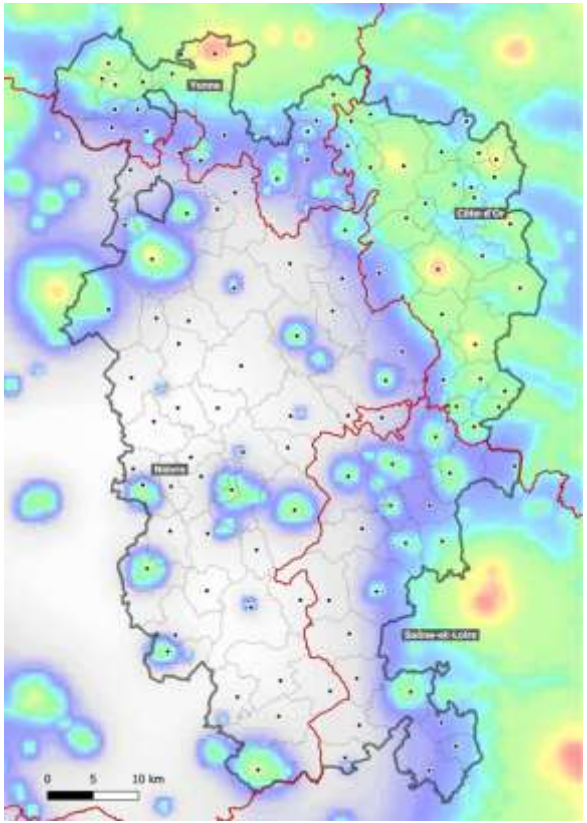
- Radiance / population comparison
- Automatic extinction detection

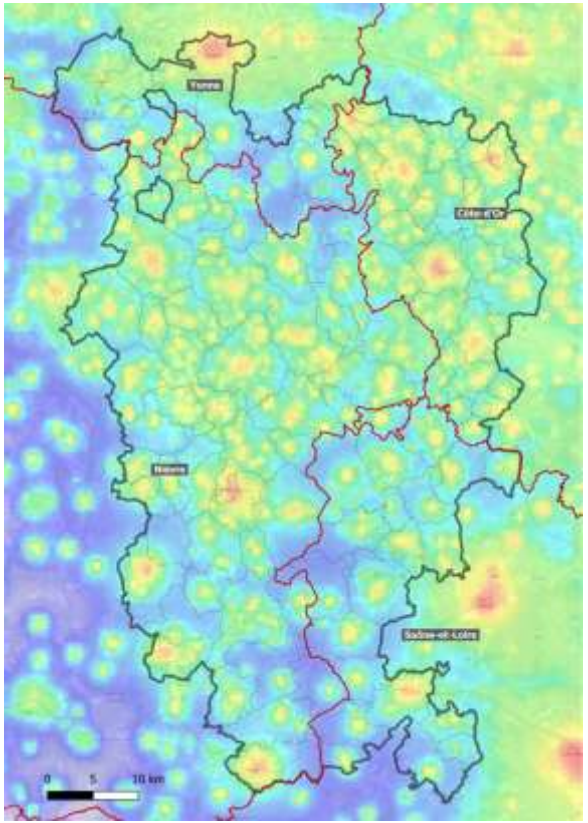


Public Lighting Extinction Analysis

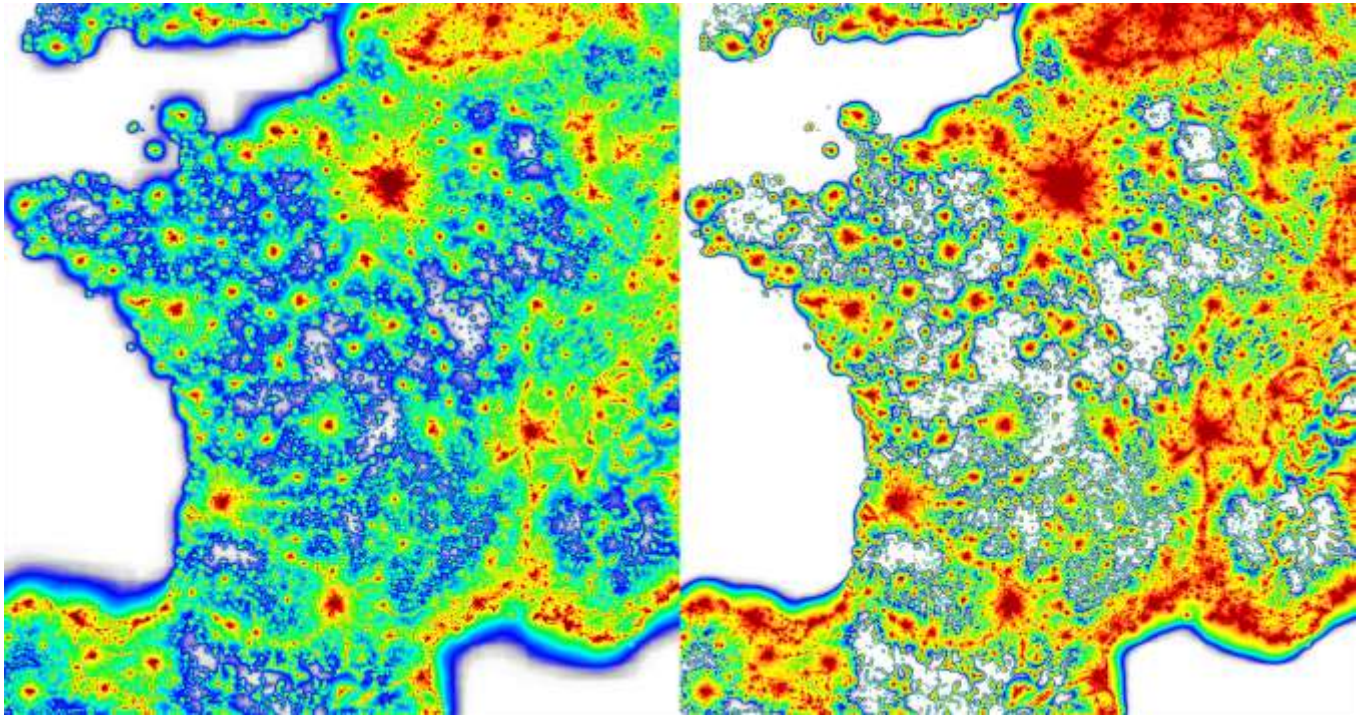
Light pollution maps:

- Nigth heart
- Night ends





Cloud Coverage Influence



Clear sky

Cloudy conditions

Towards a light pollution national indicator (11/2021 ONB)

Conclusion and Perspectives

What we have :

- Quite good knowledge of light pollution measurement (thanks to a high number of measures under many different meteorological conditions and to statistical analysis);
- Good ability to model light pollution at any time of the night (taking into account public lighting extinctions) and during cloudy nights.

What we need :

- Better understanding of light pollution impacts on biodiversity;
- Better access to outdoor lighting databases;
- Better spatial imaging of the Earth at night (calibration, sensitivity, resolution).