

The Impact of Biodiversity and Urban Ecosystem  
Services in Real Estate  
The Case of the Region Ile-de-France  
ERES 2021 – Theme G Sustainable Real Estate

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4th June, 2021



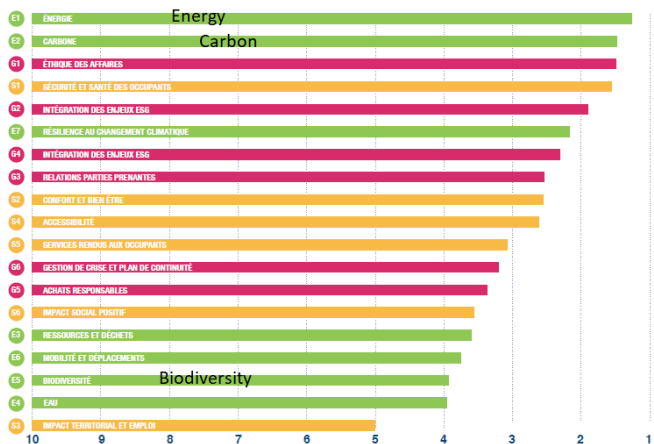
# The controversy of the Buren Columns in Paris



Photo credits: (left) Un jour de plus à Paris; (middle) Jacques Bousquier; (right) Georges Fontaine.

Endangered species : le flambé (*Iphiclides podalirius*); oeillet couché (*Dianthus deltoides*); fougère des montagnes (*Oreopteris limbosperma*); bruyère ciliée (*Erica ciliaris*); bergeronnette printanière (*Motacilla flava*)

# What is the perception of biodiversity in the French real estate market?



HIERARCHISATION DES ENJEUX ESG PAR LE SECTEUR DE L'IMMOBILIER D'INVESTISSEMENT (SOURCE : OJD 2020)

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## Nature in cities: urban ecosystem services

Urban ecosystem services (UES) of trees, green spaces and urban forests:

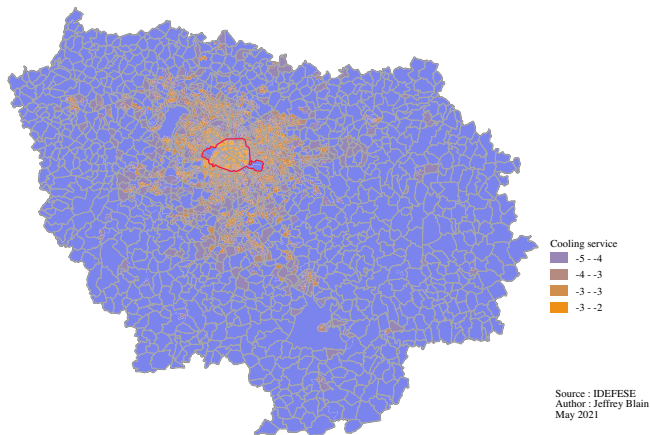
- air filtration,
- regulation of microclimate (city scale),
- noise reduction,
- rainwater drainage,
- wastewater treatment,
- recreational and cultural services.

### Exploratory research projet

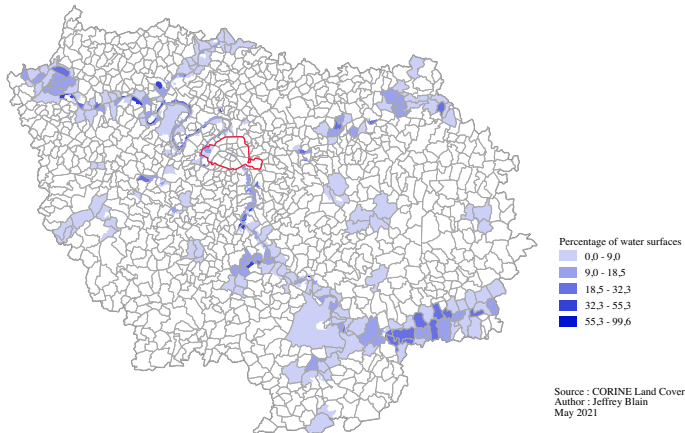
Raising awareness about the value of biodiversity and UES for the French real estate market in the private residential housing



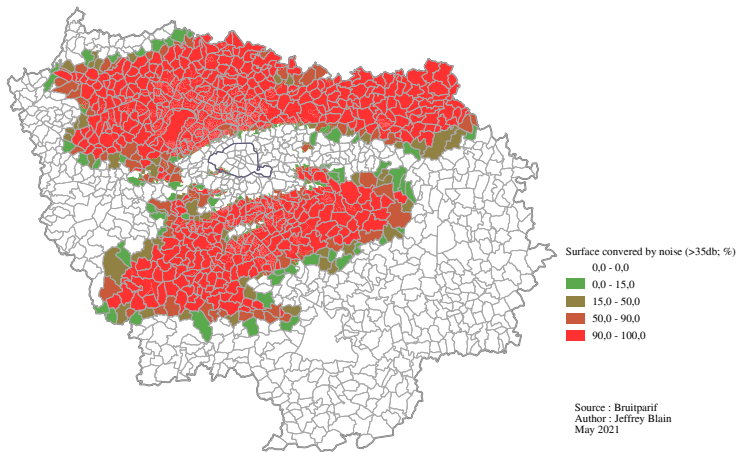
# Data: Cooling service in the region Île-de-France (2017)



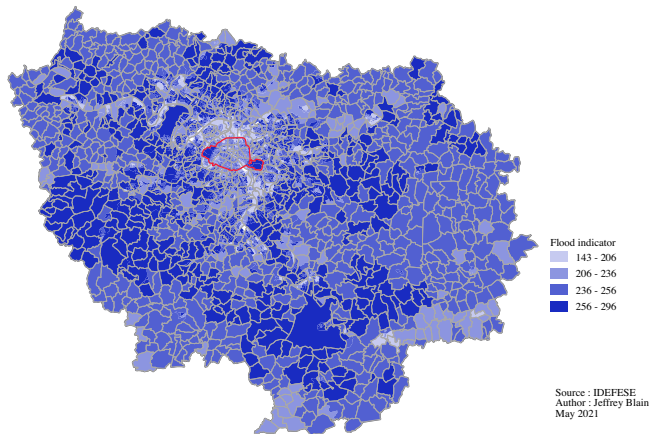
# Data: Water surfaces in the region Île-de-France



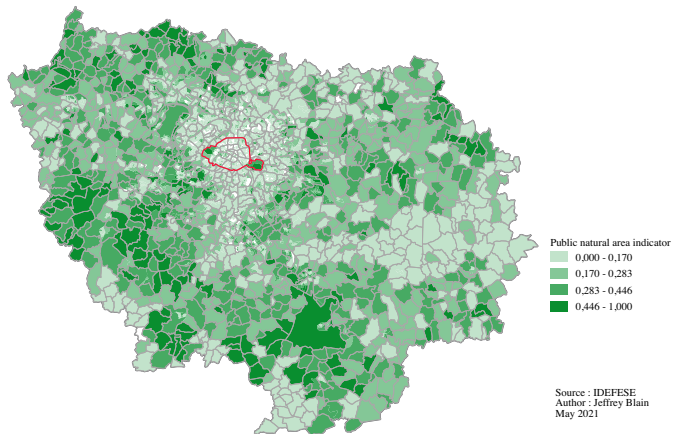
# Data: Noise level in the region Île-de-France (2018)



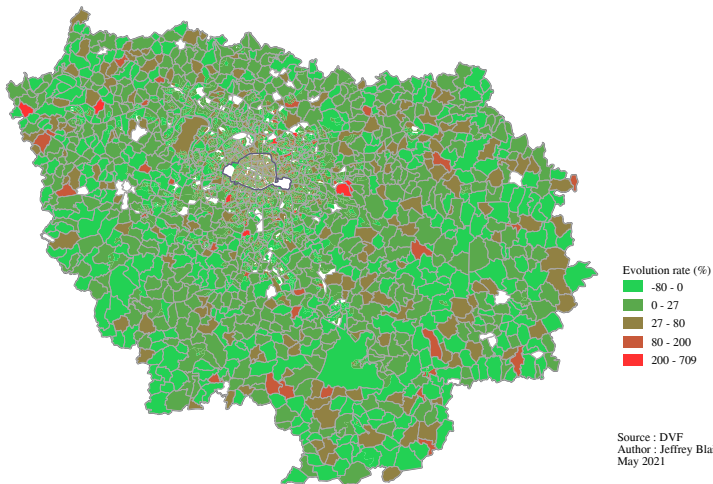
# Data: Flood indicator in the region Île-de-France (2017)



# Data: Public natural area in the region Île-de-France



# Data: Average price of transactions for residential housing in the region Île-de-France (2014–2020)



## Hedonic price and green areas

Some studies in France:

- Bono, Gravel, and Trannoy 2008 demonstrated that the price of housing in Marseille (1995–2000) is sensitive to the presence of more than 5% of a natural area in the neighborhood.
- Baudry et al. 2009 showed that the distance from the river to the nearest garden has not effect on apartment's prices over the period 1994–2001, but the distance to the nearest wooded area increase the price in the city of Rennes.
- Travers, Appere, and Larue 2013 found in the city of Angers that the price of housing is sensitive to the presence of green spaces, but only when these green spaces are relatively large.

## Hedonic price: estimating the social value of local public goods and amenities

Gravel, Michelangeli, and Trannoy 2006 use a (non-linear) hedonic model to estimate the implicit prices of 24 local public goods and amenities in the Paris suburban area on an data set of some 8500 units of housing.

They observed:

- pupils/teachers ratio does not explain significantly housing prices;
- grade repetition (measured by the fraction of junior high school students who have failed at least twice at school) affects significantly housing prices;
- housing owners' marginal willingness to pay for reducing commuting time is higher for public transportation than it is for car transportation.



## Data: 5259 IRIS and 101 variables

Description	Source	Period
Average price of transactions per $m^2$ per IRIS in private residential housing	DVF	2014–2020
Internal characteristics of housing <i>Housing</i> : number of houses, number of apartments, secondary housing and vacancy <i>Size of housing</i> by $m^2$ and by rooms <i>Property</i> : owners, renters, social housing, free <i>Age</i> of housing and households <i>Moving in</i> (years)	INSEE	2017

## Data: External characteristics of housing

Description	Source	Period
<i>Infrastructure:</i> train station, tramway station, metro, road station	Société du Grand Paris, IGN BD TOPO	2016 2021
<i>Centrality:</i> distance (in m) between the center of Paris and the center of the IRIS	estimated	2018
<i>Environment and transport</i>		
Air pollution: IRIS in a sensitive area	DRIEE IDF	2015
Noise: area and average dB/IRIS	Bruitparif	2018
Individual transport: number of cars by household, road in km	INSEE IGN BD TOPO	2017 2021

## Data: Socio-economic indicators

<b>Description</b>	<b>Source</b>	<b>Period</b>
<i>Education:</i> % of baccalauréat holders in the population aged over 15	INSERM	2019
<i>Income:</i> average income per household		
<i>Unemployment:</i> rate		
<i>Handworkers:</i> % of handworkers in the labor force		

## Data: Biodiversity and UES

Description	Source	Period
<i>Biodiversity indicators</i> Regional natural parks Project of regional natural parks Natural area of ecological, faunistic and floristic interest Classified site, quarry	DRIEE IDF	2019
<i>Urban ecosystem services</i> Public natural space indicator of at least 1.5 ha within a radius of 300m around each inhabitant Vegetation water retention indicator Cooling indicator	IDEFESE	2012–2017

## Data: Green areas

Description	Source	Period
<i>Green areas</i>	CORINE Land Cover	2018
Urban green areas ( $km^2$ )		
Arable lands ( $km^2$ )		
Vineyards ( $km^2$ )		
Orchards ( $km^2$ )		
Meadows ( $km^2$ )		
Agriculture ( $km^2$ )		
Forest ( $km^2$ )		
Swamp $km^2$ )		
Rivers ( $km^2$ of rivers and waterways)		
Water places ( $km^2$ of water bodies)		

# Log-linear model: MCO preliminary results

Dependant: <i>ln_price2017</i>	Model 1	Model 2	Model 3	Model 4
Intercept	7.631e+00***	8.402e+00***	8.748e+00***	8.822e+00***
<i>price2016</i>	1.212e-04***	1.278e-04*	1.879e-04***	1.377e-04
<i>price2015</i>		6.539e-05		
<i>price2014</i>		4.892e-05		
<i>bachelor</i>	7.037e-03**	1.318e-02	1.357e-02 .	1.474e-02
<i>family_income</i>	1.005e-05 .	-1.867e-05	-1.172e-05	-2.329e-06
<i>unemployment</i>	-2.260e-03	-1.579e-02	-1.876e-02	-4.101e-03
<i>housing</i>	3.479e-05	-3.038e-04	-3.042e-04	-5.646e-04
<i>second_homes_pct</i>	-6.614e-01*	-2.289e+00*	-2.343e+00*	1.287e-01
<i>vacancy_pct</i>	-1.604e+00**	-3.954e-01	3.754e-02	1.767e-01
<i>houses_pct</i>	-4.165e-02	8.188e-01**	8.548e-01**	1.011e+00 .
<i>owners_pct</i>	-1.972e-01	-1.353e+00	-1.586e+00 .	-1.432e+00
<i>hlm_pct</i>	4.354e-02	-6.426e-01	-7.151e-01	-5.075e-01
<i>moving_in</i>	9.992e-06 .	-7.942e-06	-2.139e-06	-9.564e-06
<i>car</i>	-2.184e-04 .	3.335e-04	2.403e-04	6.149e-04
<i>station_gpe_binOUI</i>	2.910e-01	6.028e-01 .	5.921e-01	7.645e-01
<i>tram_binOUI</i>	-8.763e-03	7.853e-02	7.865e-02	1.105e-01
<i>airOUI</i>	1.332e-01**	7.593e-02	4.542e-02	-2.417e-01
<i>flood2012</i>	2.419e-03	1.574e-02	1.777e-02 .	1.863e-02
<i>flood2017</i>	-4.097e-03	-1.700e-02	-1.936e-02 .	-1.930e-02
<i>city_refreshment2017</i>	-9.008e-03	5.063e-02	6.690e-02	1.007e-01
<i>rivers</i>			7.832e-04	2.747e-01
<i>public_natural_area</i>		-1.711e-01	-3.140e-01	-5.527e-01
<i>gree_area</i>		-1.443e-02	-1.386e-03	-1.386e-01
<i>centrality</i>				-5.297e-06
<i>noise_area</i>				-2.984e-02
Signif. codes: 0 '***'	0.001 '**'	0.01 '*'	0.05 '.'	0.1 ' ' 1

## Log-linear model: MCO preliminary results

Dependant: <i>ln_price</i> 2017	Model 1	Model 2	Model 3	Model 4
Multiple R-squared:	0.7921	0.906	0.8941	0.9036
Adjusted R-squared:	0.7785	0.812	0.8051	0.6264

## Discussion from MCO estimates

- Variables of biodiversity and urban green areas are not significant.
- Variables of UES: low level but significant for flood variables.
- Access to new infrastructure like GPE station is significant for two model.
- Traditional variables as education, income, number of houses, secondary houses, and vacancy impact the residential price.



## Next Model: SEM and RE-SEM

The two models will be estimated separately, and finally jointly in the RE-SEM model (Chakir and Le Gallo 2013; Chakir, De Cara, and Vermont 2011)

The hedonic model, in reduced form RE-SEM is:

$$P_{it} = \alpha + \sum_{k=1}^K \alpha_k X_{kit} + \sum_{l=1}^L \gamma_l X_{li} + u_{it}$$

$$u_{it} = \mu_i + \epsilon_{it}$$

$$\epsilon_{it} = \lambda \sum_{j=1}^N w_{ij} \epsilon_{jt} + v_{it}$$

where  $P_{it}$  is the average price of transactions of residential housing in the IRIS  $i$  to the date  $t$ , with  $i = [1 : 5259]$  and  $t = [2014 : 2020]$ .

## Discussion

Three mechanisms to analyze:

- Proximity: to distinguish the mechanism that explain the variation in the price of residential real estate by the presence of natural spaces (urban biodiversity and UES), as well as that of the price of the IRIS neighboring the area.
- Anticipation: to identify the variation in prices due to a benefit or a direct damage by the environmental amenity, of the variation due to mental processes of anticipation on the part of the owners, or the possible purchasers.
- Peri-urban area – rural area: to characterize the effects in peri-urban areas from those in rural areas. The dynamics and issues of artificialization suggest that the impact in price will act in a different way (Vermont 2016).

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Thank you

