



INSTITUTO NACIONAL DE ESTATÍSTICA  
STATISTICS PORTUGAL

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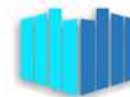
# DERIVING TERRITORIAL INDICATORS BASED ON THE INTEGRATION OF GEOSPATIAL AND STATISTICAL DATA

## CHALLENGES AND OPPORTUNITIES



INÊS FONTES AND CÁTIA NUNES

**SCORUS**  
Standing Committee on Regional and Urban Statistics



**Conference 2016**

29 June – 1 July

# OVERVIEW

1

Relevance of territorial information

2

Production of new territorial indicators based on the integration of geospatial and statistical data

3

Challenges and opportunities

# RELEVANCE OF TERRITORIAL INFORMATION

**Territorial  
information**

Key aspect to disentangle the conceptual and spatial complexity of cross-cutting issues that have been put forward in the European and global agenda

Smart , sustainable  
and inclusive growth

Sustainable  
Development Goals

Well-being and  
Quality of life



**Growing  
demand**

does not derive only from the need to provide greater spatial breakdown  
**but also**

from the need to have indicators that are able to grasp territory-based dimensions associated to well-being and quality of life monitoring, namely accessibility to services to environmental sustainability, and to climate change and spatial planning

# RELEVANCE OF TERRITORIAL INFORMATION

## Challenges for NSO

Specific and increasing needs for statistical territorial based information

*relevant for...*

To assess, monitor, evaluate results of strategies, targets and public policies

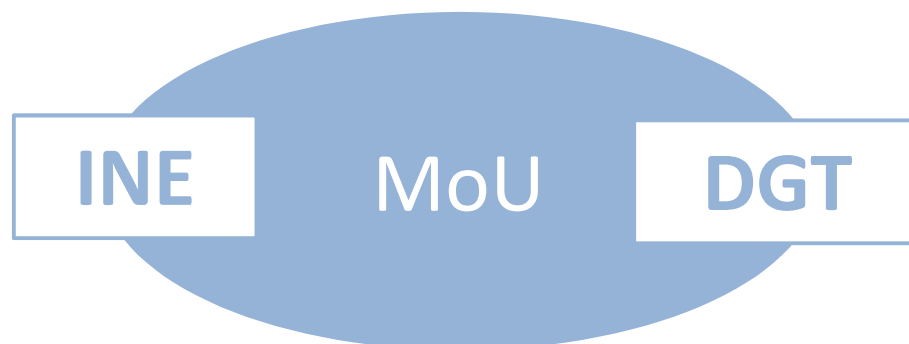


# RELEVANCE OF TERRITORIAL INFORMATION

Statistics Portugal's  
(INE) medium-term  
strategy

the need to promote a greater interoperability between spatial and statistical data to support statistical production and to promote spatial and statistical integration to produce new indicators

An important step within the scope of this strategy was recently achieved through the signing of a Memorandum of Understanding (MoU) between Statistics Portugal and the Directorate-General for Territory (DGT)



# RELEVANCE OF TERRITORIAL INFORMATION

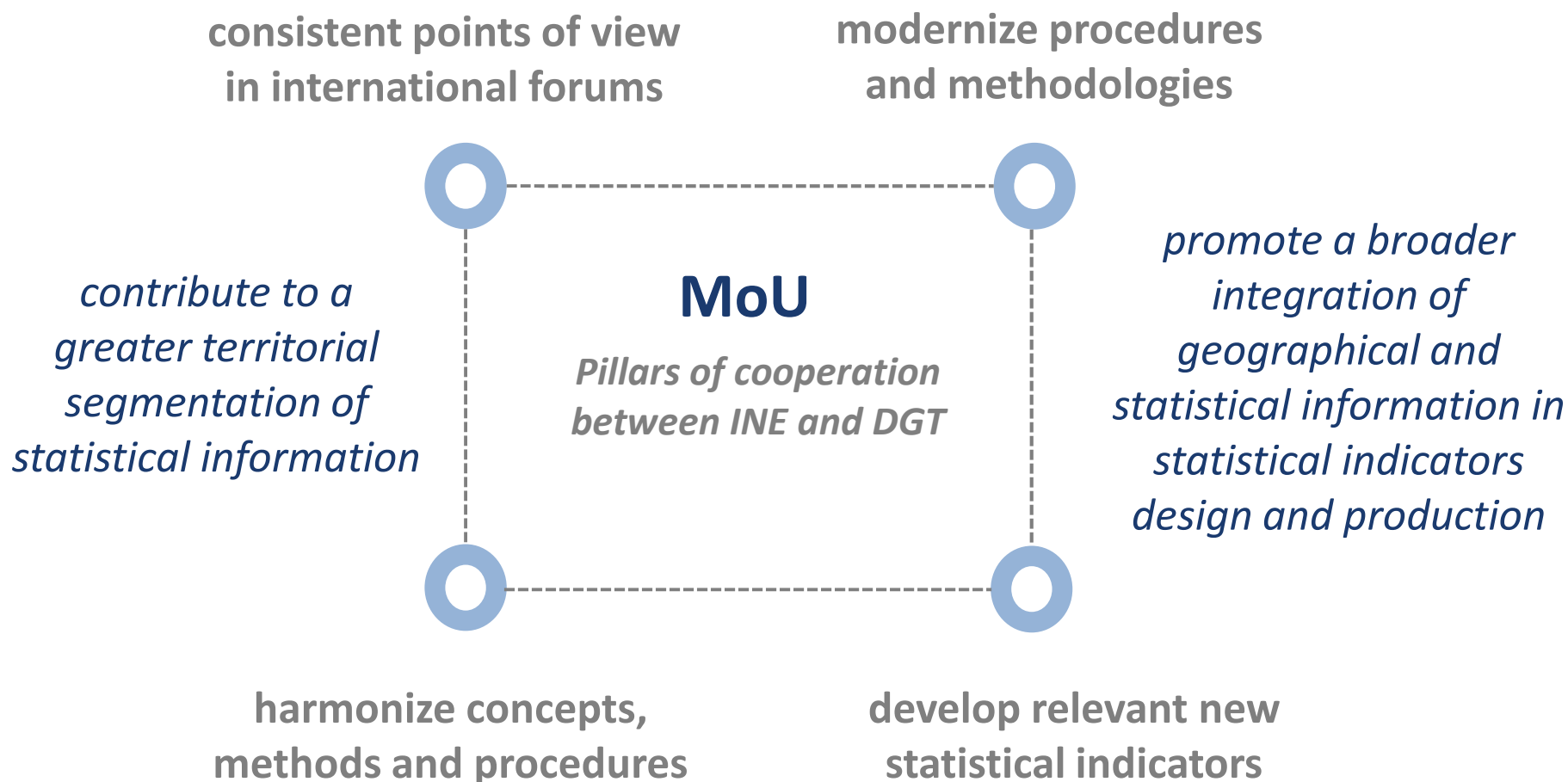
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# RELEVANCE OF TERRITORIAL INFORMATION



# TERRITORIAL INDICATORS BASED ON THE INTEGRATION OF GEOSPATIAL AND STATISTICAL DATA

## MAIN METHODOLOGICAL APPROACHES

1

### Extract Areas

*Proportion of protected areas*

2

### Spatial Analysis

*Territorial coverage of broadband internet access*

3

### Spatial Modelling

*Climate statistics*

4

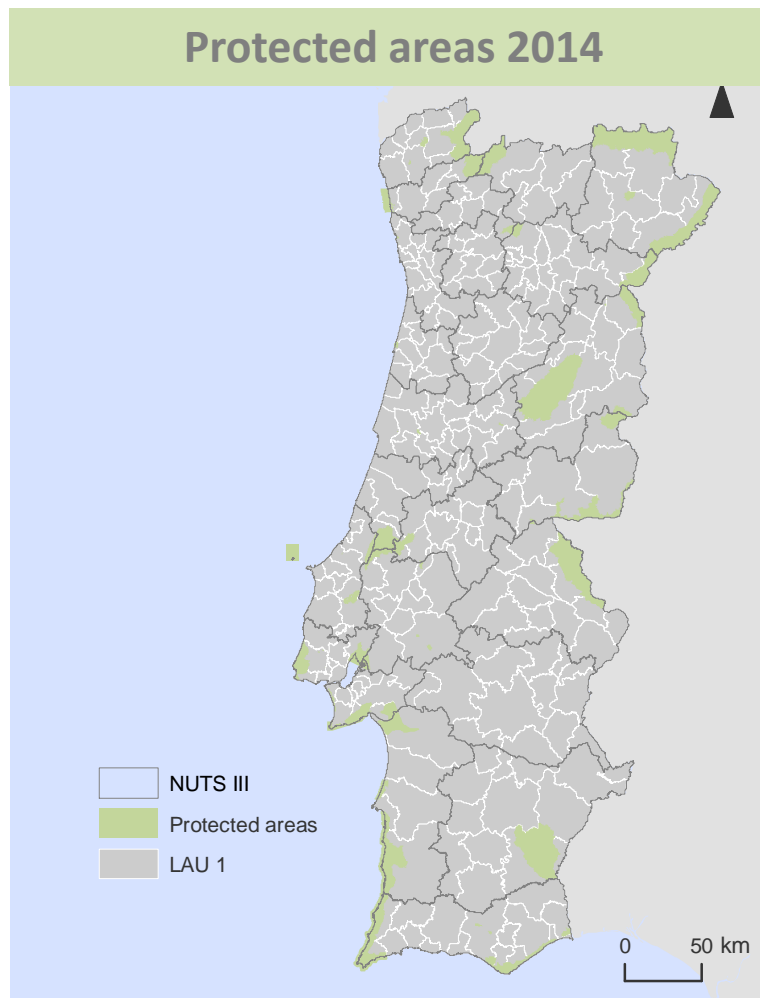
### Network Analysis

*Potential accessibility indicators to schools*



# EXTRACT AREAS

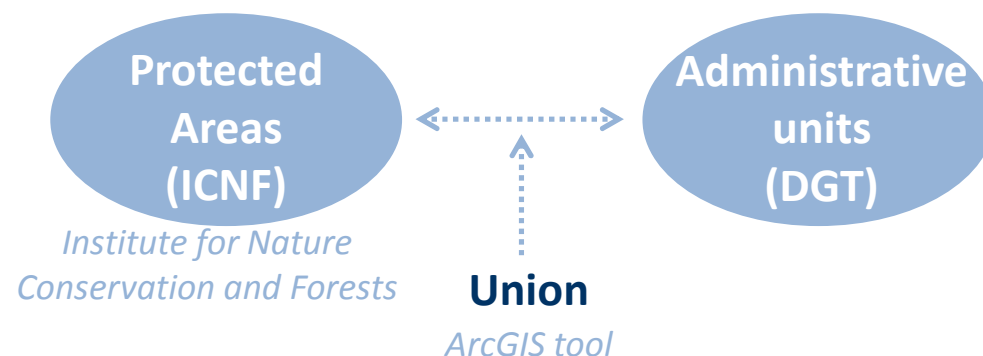
## Proportion of protected areas at LAU 1 and NUTS III



Resulted from the need to disseminate annual protected areas:

LAU 1 → Regional Statistical Yearbooks

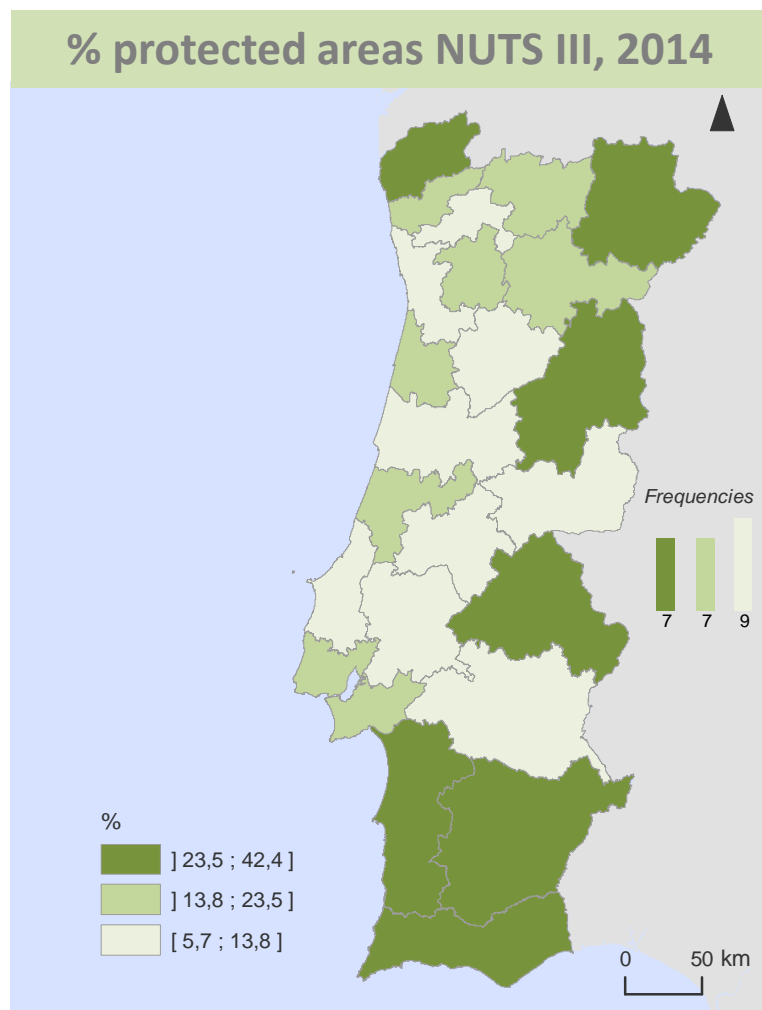
NUTS III → Input indicator for the environmental quality index - Regional Development Composite Index



**Union tool allows the extraction of areas at different territorial units**

# EXTRACT AREAS

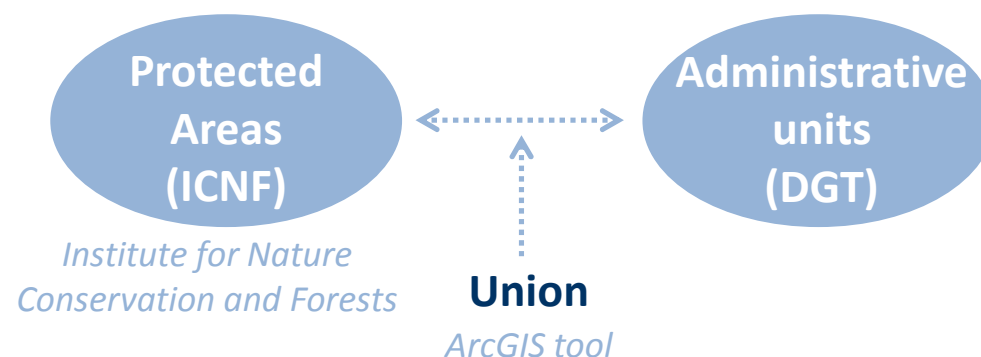
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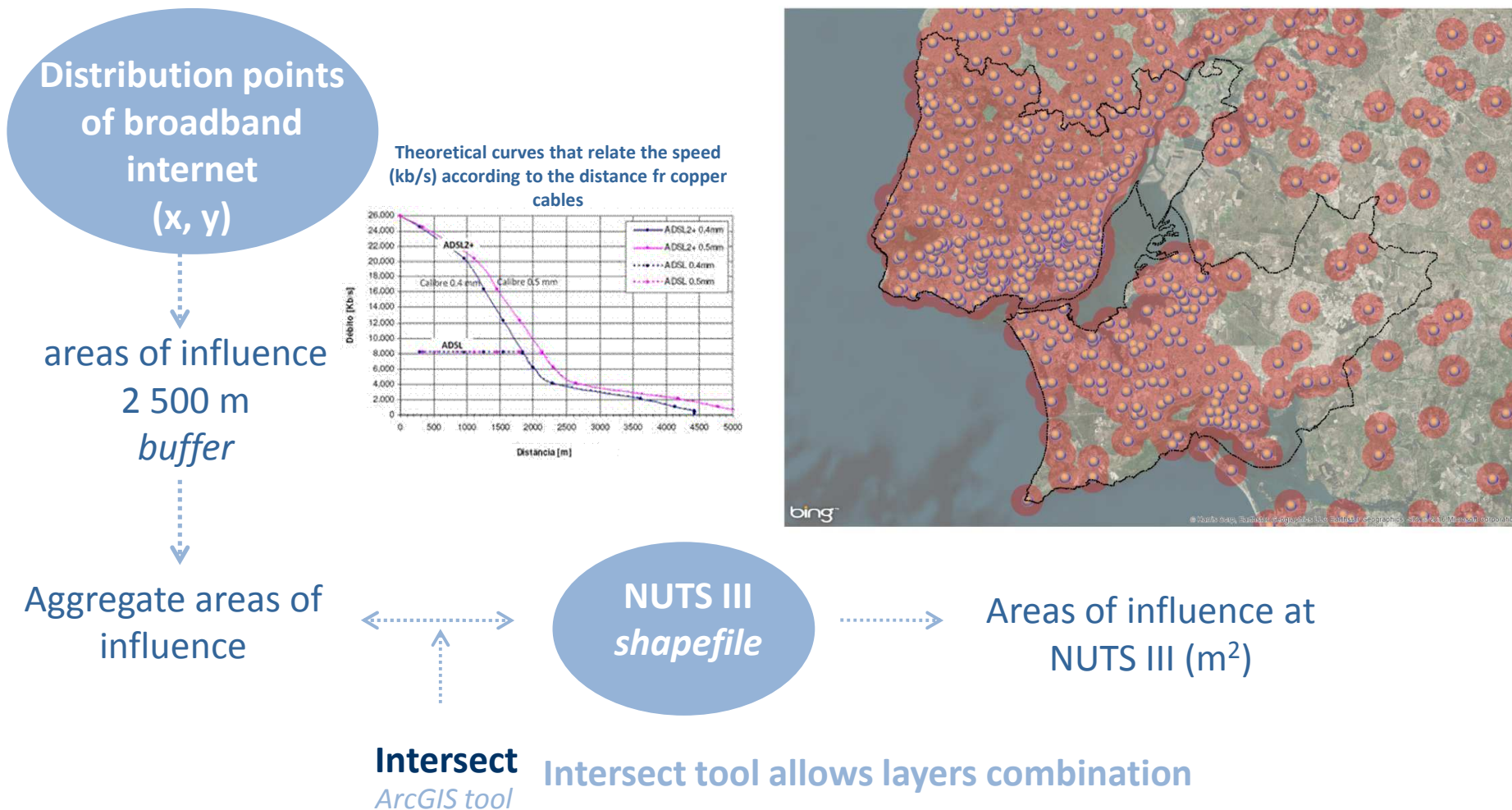
**Derived territorial indicator**

$$\frac{\text{Protected areas}}{\text{Total area of administrative unit}} \times 100$$

# SPATIAL ANALYSIS

## Territorial coverage of broadband internet access

Relevant input indicator for the Regional Development Composite Index  
Account for a technological service that is essential to assess regional competitiveness index



## Territorial coverage of broadband internet access

The combination of buffer zones with the Administrative Map of Portugal and the use of spatial analysis techniques



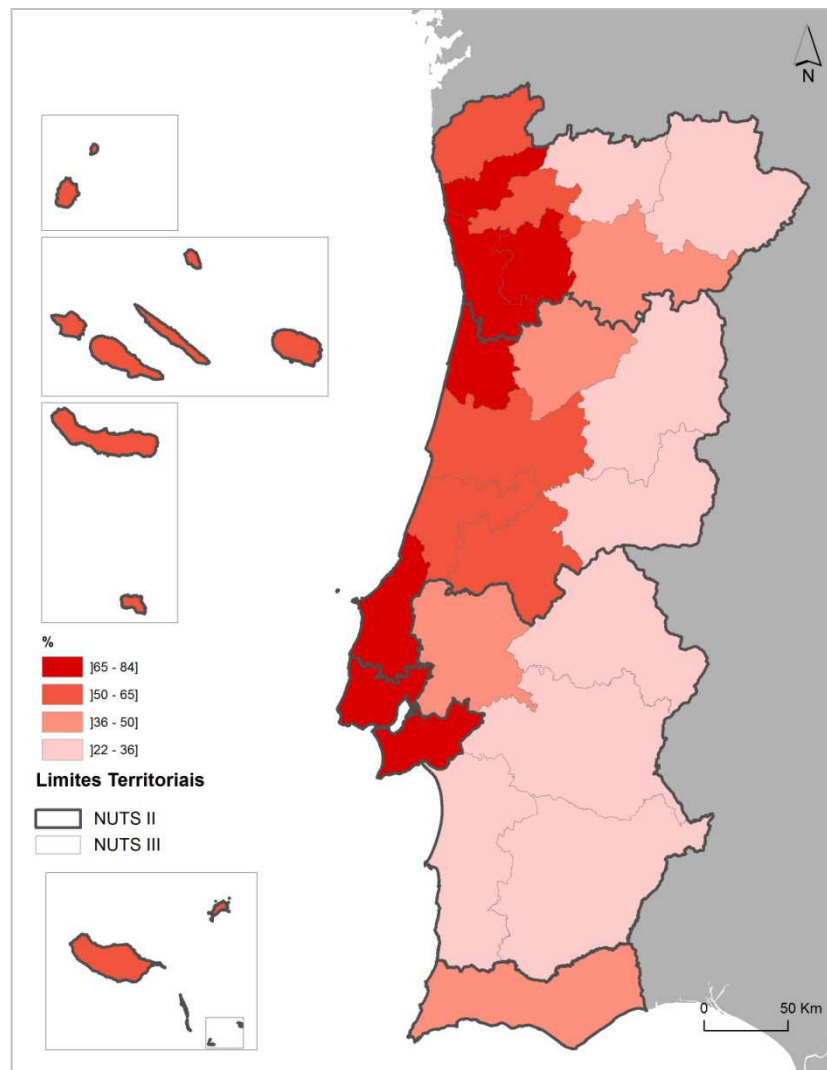
made it possible to obtain the potential broadband internet access associated to each NUTS III region



then derive a % of area covered with broadband internet access in the total area of each NUTS III region

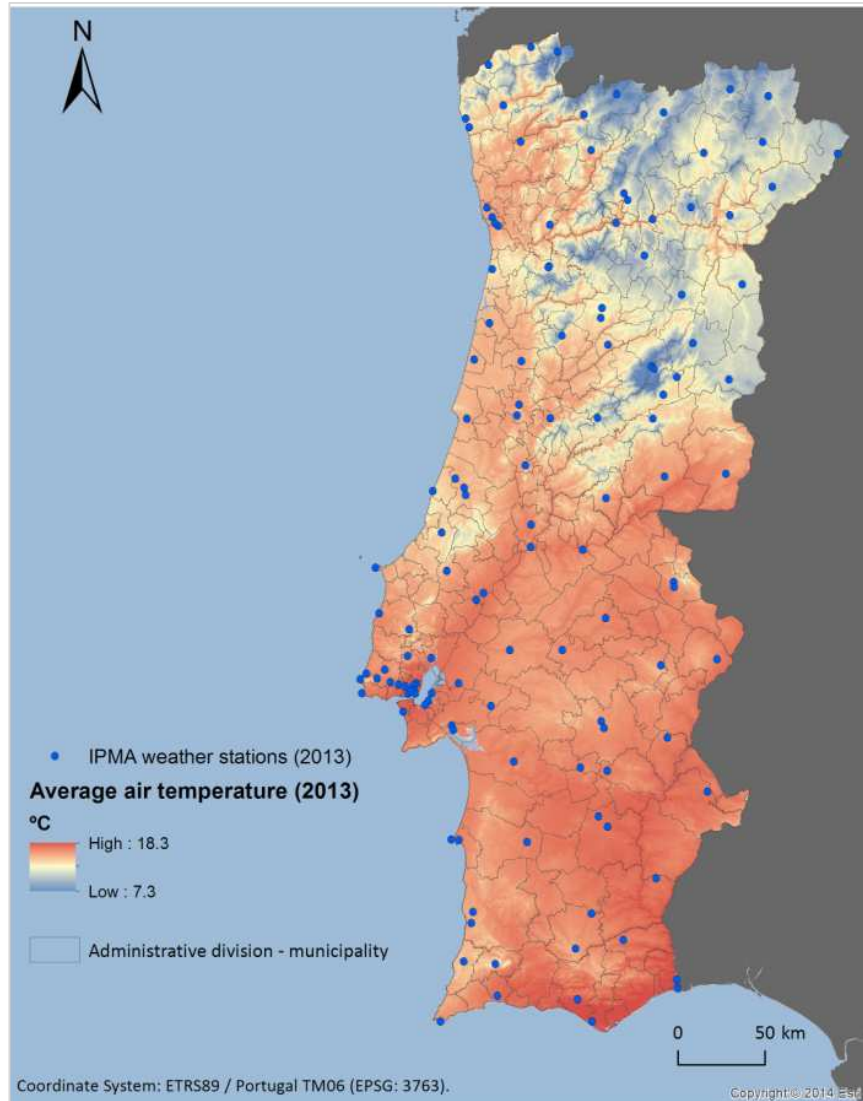
### Derived territorial indicator

$$\frac{\text{Territorial coverage of broadband at NUTS III}}{\text{Total area of NUTS III}} \times 100$$



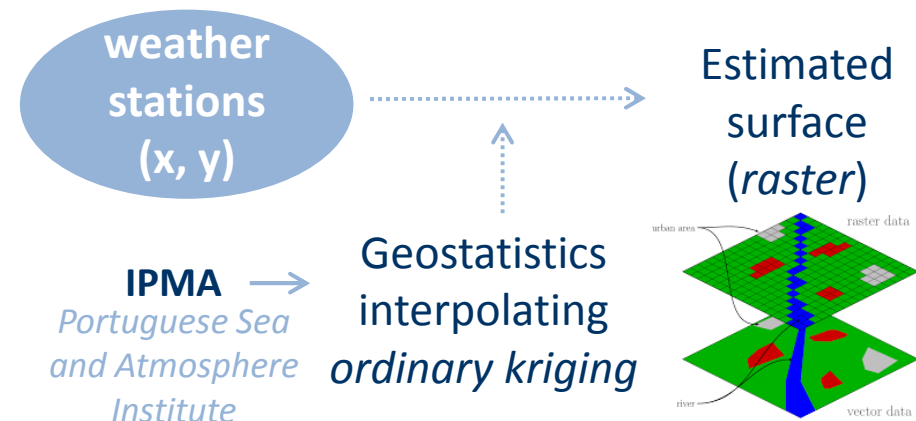
# SPATIAL MODELLING

## Climate statistics – annual air temperature



Resulted from the need to disseminate annually climate statistics at LAU 1 and NUTS III levels in the Regional Statistical Yearbooks

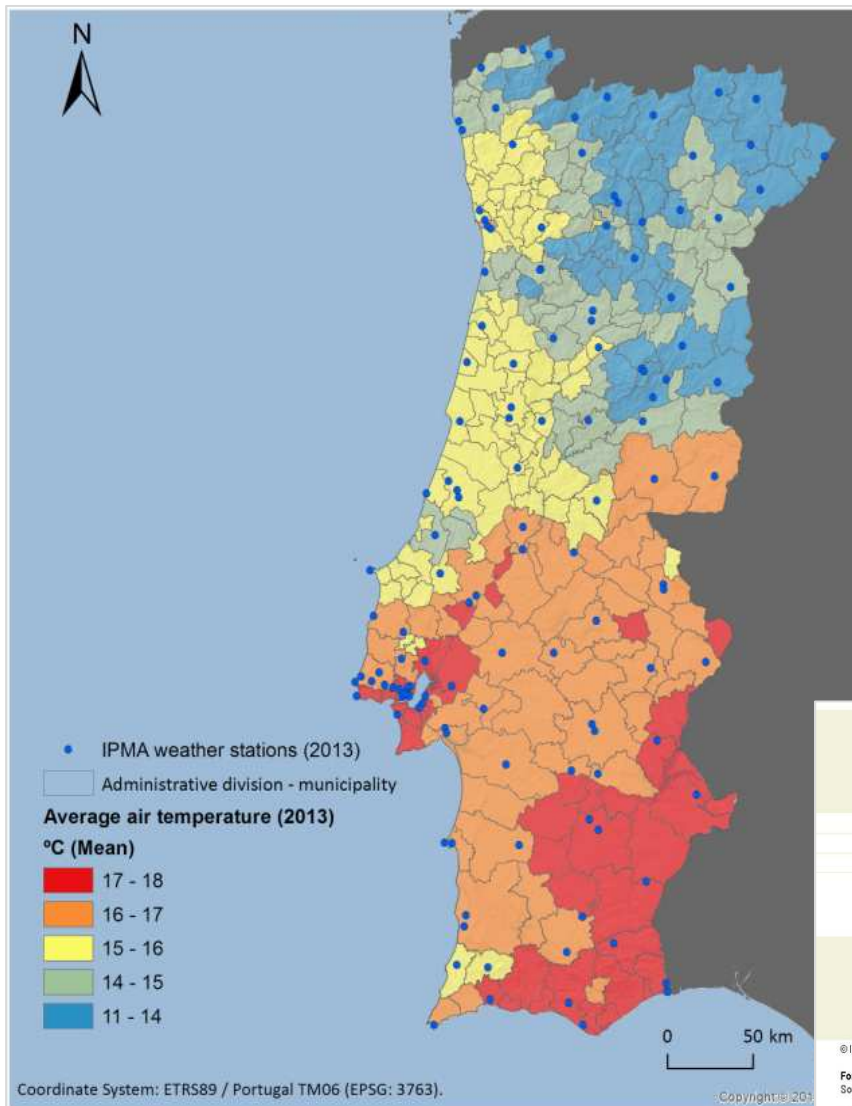
Climate variables are an important tool to monitor climate change at regional and local level.



*Kriging* assumes that the distance or direction between points reflects a spatial correlation that can be used to explain variation in the surface

# SPATIAL MODELLING

## Climate statistics – annual air temperature

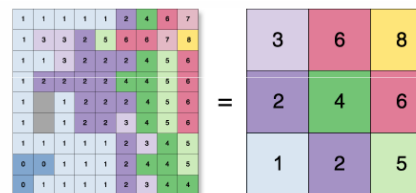


Estimated temperature (raster)



LAU 1 level (raster)

**Aggregate**  
*Mean*



## Regional Statistical Yearbooks

I.1.7	Média da temperatura anual			Precipitação anual
	Média	Mínima	Máxima	
	°C			mm
Continente	15,4	9,9	20,9	939,0
Norte	13,7	7,9	19,4	1.374,2
Minho-Lima	13,7	8,4	19,0	1.996,1
Arcos de Valdevez	13,3	8,0	18,5	x
Caminha	13,8	9,1	18,6	x
(-)				

°C			mm
Mean	Minimum	Maximum	Annual precipitation
Annual average temperature			

© INE, I.P., Portugal, 2014. Informação disponível até 30 de setembro de 2014. Information available till 30th September, 2014.  
 Fonte: Instituto Português do Mar e da Atmosfera, I.P.  
 Source: Portuguese Sea and Atmosphere Institute.

**Nota:** Os valores da temperatura foram obtidos por interpolação dos valores médios observados na rede de estações operacionais do Instituto Português do Mar e da Atmosfera, por regressão multivariada com altitude e distância ao litoral, e englobam residual. Os valores da precipitação foram obtidos por interpolação normal dos valores totais de precipitação observados na rede de estações operacionais do Instituto Português do Mar e da Atmosfera.  
**Note:** The data on the temperature were obtained by interpolating the average values recorded by the operating meteorological stations of the Portuguese Sea and Atmosphere Institute network, through multivariate regression with altitude and distance to sea and residual kriging. The precipitation data were obtained by ordinary kriging of the total precipitation values observed at the operating meteorological stations of the Portuguese Sea and Atmosphere Institute network.

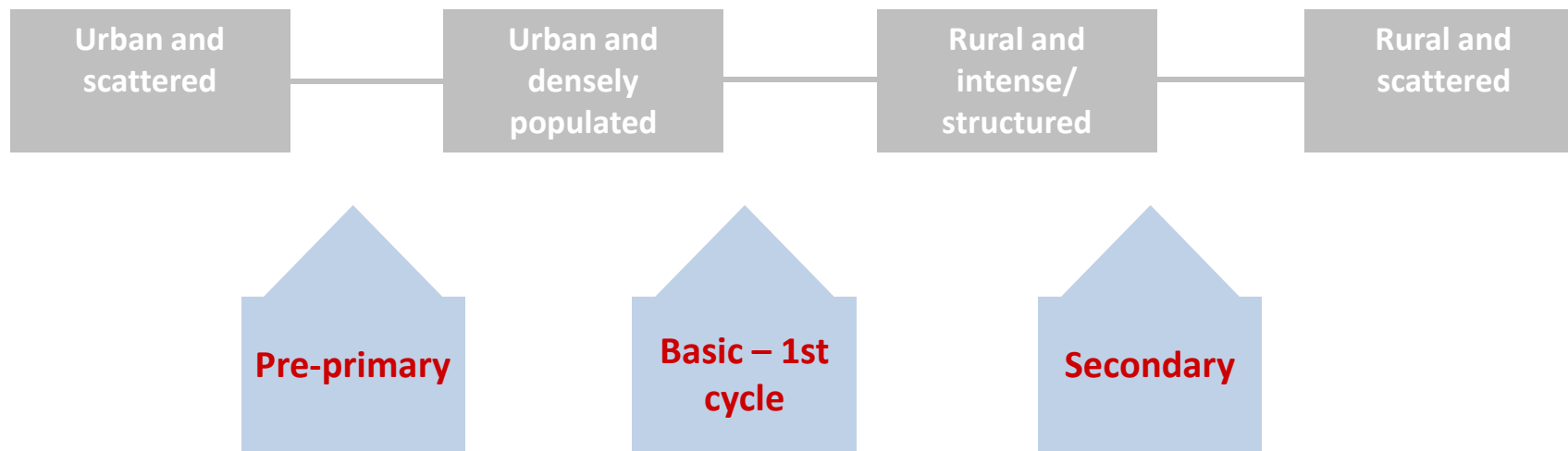
# NETWORK ANALYSIS

## Potential accessibility indicators to schools

AIM: to develop accessibility indicators to schools in order to assess the possibility of regular production within the National Statistical System

Experimental study based on a case-study approach

Four case study areas were selected based on the following principles: urban vs. rural areas, population density and distribution (intense vs. scattered)



# NETWORK ANALYSIS

## Potential accessibility indicators to schools

Two types of potential time-distance accessibility indicators based on the weighted average of the minimum distances between each territorial unit and schools:

**Territory – weighted by the area (m<sup>2</sup>)**

**Population – weighted by the population from the specific age group**

### ArcGIS Network Analyst shortest path

Modes of transport	Type	Speed
On foot		3,5 km/h
By car	Highway	120 km/h
	Outside localities	90 km/h
	Inside localities	50 km/h
	Localities < 2 000 inhabitants	50 km/h
5 seconds off at intersections in urban areas		

#### Potential territorial accessibility

$$IATerrit_j^k = \sum_{i=1}^n \left[ \text{Min}(\text{Distance}_{i \rightarrow j}) \times \left( \frac{\text{Area}_i}{\text{Area}_k} \right) \right]$$

#### Potential population accessibility

$$IAPop_j^k = \sum_{i=1}^n \left[ \text{Min}(\text{Distance}_{i \rightarrow j}) \times \left( \frac{\text{population}_i}{\text{population}_k} \right) \right]$$

Where:

$k$  – LAU 2

$i$  – statistical subsection

$j$  – level of education

$j$  – school of level of education



# NETWORK ANALYSIS

## Potential accessibility indicators to schools

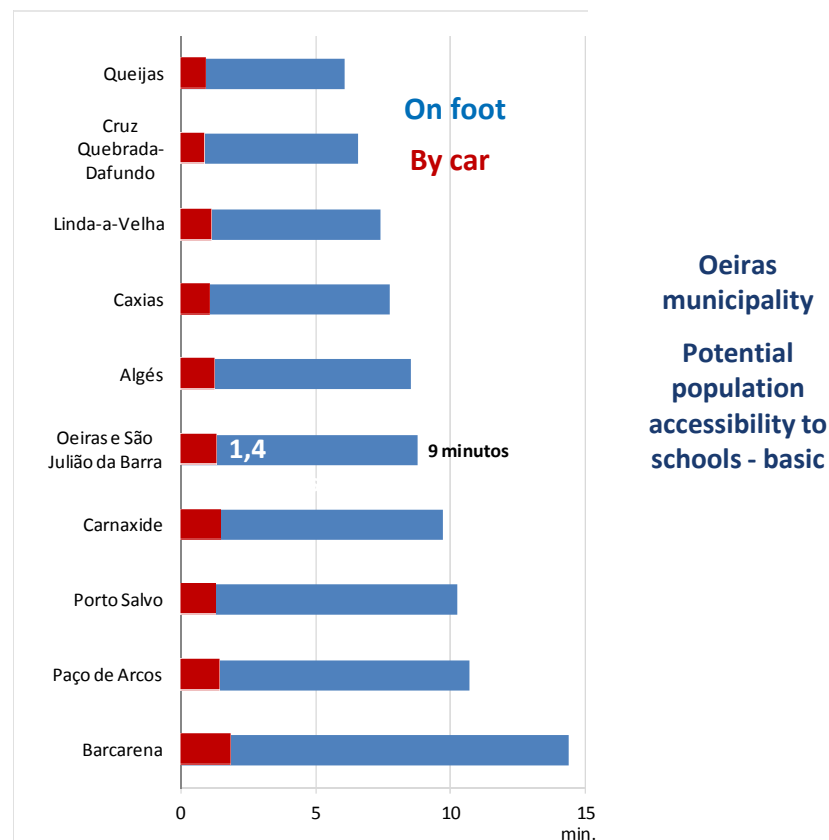
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# CHALLENGES AND OPPORTUNITIES

need to have coherent and integrated geospatial and statistical information,  
but also to comply with quality standards for statistical production

1

## metadata on input information

Earth observation data  
Geographic data  
Administrative data  
Statistical data

2

## metadata on operations and procedures

Accurate, consistent and  
validated methods on  
data analysis techniques –  
statistical and spatial

## *Four key aspects*

Euro SDMX  
Metadata Structure

GSBPM

ESS QAF

3

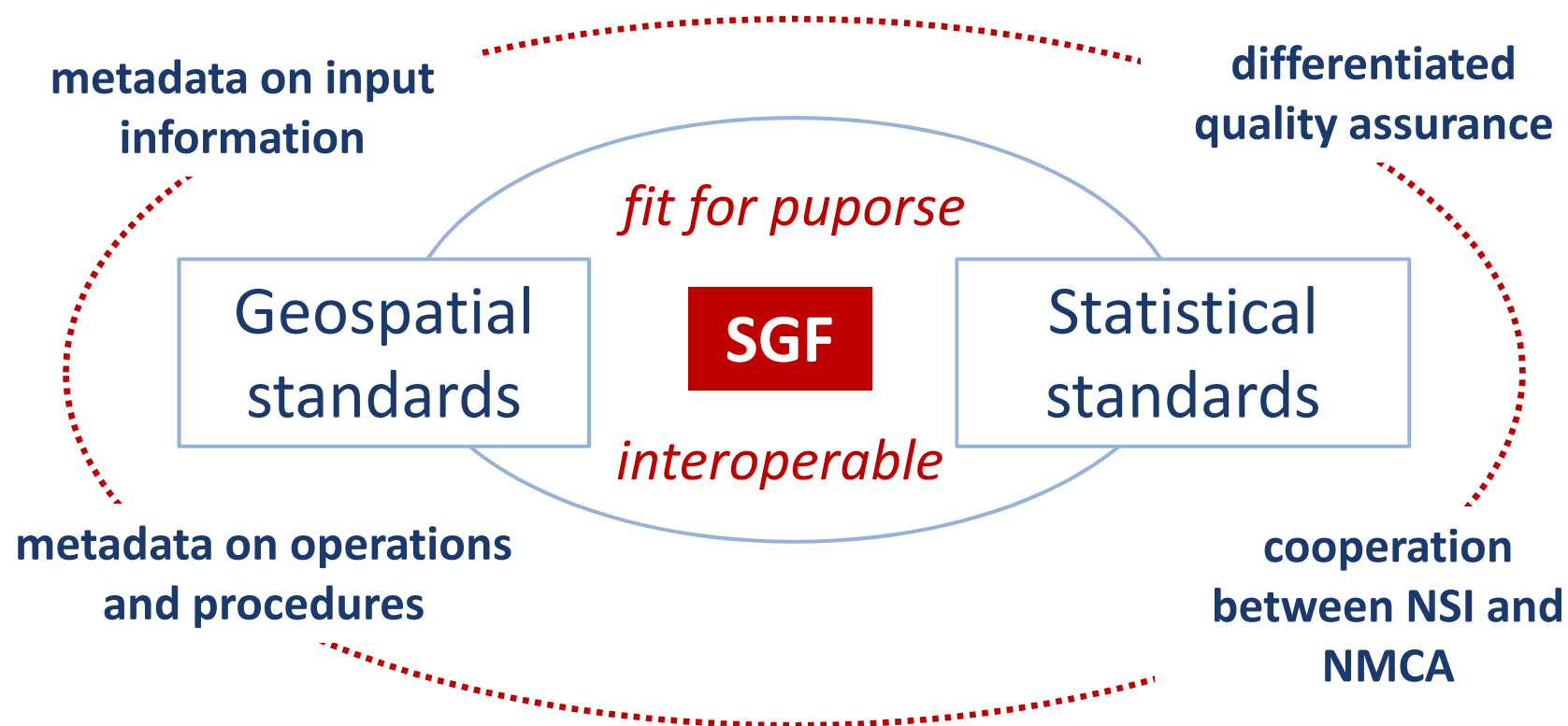
**differentiated  
quality assurance**  
Comply with quality  
standards for statistical  
production  
*Multi-source statistics*  
*Side-effects*

4

**cooperation  
between NSI and  
NMCA**

# CHALLENGES AND OPPORTUNITIES

need to have coherent and integrated geospatial and statistical information,  
but also to comply with quality standards for statistical production



# THANK YOU FOR YOUR ATTENTION

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