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Five typologies based on the regional road network and land use data**

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### Data Article

# Airport location in European airport regions: Five typologies based on the regional road network and land use data



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#### ABSTRACT

Describing the location of an airport within a region, the vocabulary of urban studies is often dominated by ill-defined terms such as urban fringe, centre, suburb, corridors, etc. The dataset presented by this manuscript aims to provide a basis to describe and compare the location of 76 major European airports within their respective urban regions. The dataset consists of seven types of data: Betweenness centrality of major roads at 45 km radius of each airport region, population density, distribution of urbanized areas, location of agricultural lands, location of the natural area, and distribution of leisure and industrial sites. Ultimately, employing hierarchical clustering, five typologies of the European airport regions, given the regional location of airport, are identified: (1) Urban airports; (2) Urban periphery airports; (3) Agricultural-area airports; (4) Natural-area airports; (5) Remote airports.

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Specifications Table

Subject	Social Sciences: Geography, Planning and Development
Specific subject area	Airport regions
Type of data	GIS data (ESRI shapefile), excel files (descriptive statistics), JPG maps
How data were acquired	The raw data are extracted from different sources and analysed by ArcGIS Pro software, and UCL Depthmap software.
Data format	Raw and analysed
Parameters for data collection	The data on road centerlines, population and five types of land use are collected from European and global sources. The analyses are conducted at the so-called Larger Urban Zones (LUZ) in 50 km vicinity of 76 European which: (1) had more than 1 million passengers in 2012; (2) road network file at their vicinity was complete.
Description of data collection	The basic data is collected from open, georeferenced data sources, and being analysed subsequently.
Data source location	Europe (54.5260° N, 15.2551° E)
Data accessibility	With the article

### Value of the Data

- The data provides a comparable set of data and five typologies of 76 European airports and their respective regions.
- The dataset provides a comprehensive analysis of road network betweenness centrality of 76 European airport regions.
- The dataset is multiscale and could be employed for further studies at local, regional and continental levels of scale.

## 1. Data

### 1.1. Major airports and airport regions of Europe

The point of departure of the dataset presented by this manuscript is the location of 76 major airports of Europe. All selected airports had more than one million passengers in 2012 [1], and Open Street Map properly provided the data on the road network of their respective regions. The polygons of the airports are provided by the European Environment Agency [2] which subsequently converted to point (the two files are available in the folder titled as "Airports.gdb"). Subsequently, the larger urban zones (LUZ) in the 50 km adjacency of the 76 airports are selected (see the folder "LUZ.gdb"). Fig. 1 represents the airports and airport regions [3].

### 1.2. Raw data

#### 1.2.1. Road network

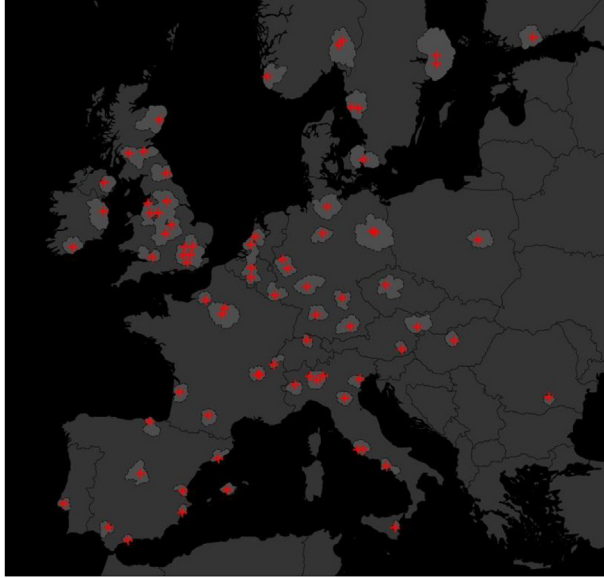
The road network data is provided by the Open Street Map database [4]. Four types of roads, with the highest levels of hierarchy, are selected for the analysis: motorways, trunks, primary, and secondary. (see the folder "Road\_Network.gdb".)

#### 1.2.2. Population

The Eurostat provides the data on population in 2011 in the format of  $1 \times 1$  km grid [5]. (see the folder titled "GEOSTAT-grid-POP-1K-2011-V2-0-1"). Table 1 shows the descriptive statistics of population in the European airport regions (LUZs).

#### 1.2.3. Land use

Five types of land uses are extracted from CORINE land-cover database of 2012 [6]: urbanized, agricultural, natural, leisure, and industrial areas. (see the folder titled "CORINE"). Table 2 show the detail land use categorised by each of the types, and their related CORINE code.



**Fig. 1.** The 76 airports and the regions in their 50km adjacency.

### 1.3. Analysed data

#### 1.3.1. Network betweenness centrality

The measurement of Betweenness centrality assesses the location of airports in the regional road network. Betweenness centrality of road segment  $i$  is defined as follow, adapted from Ref. [7]:

$$C_i^B = \sum_{j,k \in G, j \neq k \neq i} n_{jk}(i) \quad (1)$$

where  $C_i^B$  is betweenness centrality of road segment  $i$ ,  $G$  is the set of road segments in 45km adjacency of road segment  $i$ , and  $n_{jk}(i)$  is defined as follow:

$$n_{jk}(i) = \begin{cases} 1, & \text{if the shortest path between } j \text{ and } k \text{ contains segment } i \\ 0, & \text{otherwise} \end{cases} \quad (2)$$

**Fig. 2** represents five samples of the betweenness centrality, calculated for seven airport regions. The analysed data on betweenness centrality of radius 45 km could be found in the “Road\_Netwrok.gdb”, stored in the field titled as T1024-Chice\_R45000\_metric.

#### 1.3.2. Kernel density

Ultimately all analysed data on betweenness centrality, population and five types of land uses –i.e. urbanized, agricultural, natural green, leisure, and industry–are interpolated across all airport regions by use of Kernel density interpolation method. **Fig. 3** represents the kernel density values of the population as a sample. (The data stored in the folder titled “Mask\_Kernel.gdb”).

### 1.4. Typology of airport regions

Employing hierarchical cluster analysis, five typologies of airport regions are distinguished. The choice of five as the appropriate number of clusters is based on the change of coefficient in the agglomeration schedule of the hierarchical clustering, and the observed change of slope from five

**Table 1**

Descriptive statistics of population in the European airport regions, i.e. LUZs in 50 km adjacency of major airports.

	Minimum	Maximum	Mean	Std. Deviation
Population	5267	154,580,616	4,326,299,07	16,014,482,72
Population density per square km	2	17,291	1630,39	2568,04

number of clusters to six (See the file titled as “Agglomeration Schedule” in the folder named as “Hierarchical clustering”). Ultimately, the typologies are characterised through mean values of Kernel density (See the file titled as “Descriptive\_Cluster5” in the folder named as “Hierarchical clustering”). In the following, the five typologies are briefly described and illustrated.

#### 1.4.1. Type#1: Urban airports

The first typology, the so-called *Urban airports*, consists of the airports with high concentrations of urban land use and the population at their adjacency, e.g. Geneva, Zurich, Graz (Fig. 4).

#### 1.4.2. Type#2: Urban periphery airports

The second typology, the so-called *Urban periphery airports*, consists of the airports at adjacency of urban areas and high concentration of industrial and leisure, e.g. Berlin, Bordeaux, Malaga (Fig. 5).

#### 1.4.3. Type#3: agricultural-area airports

The third typology of airports, the so-called *Agricultural-area airports*, is solely characterised by adjacency to agricultural land use, e.g. Paris, Barcelona, Amsterdam (Fig. 6).

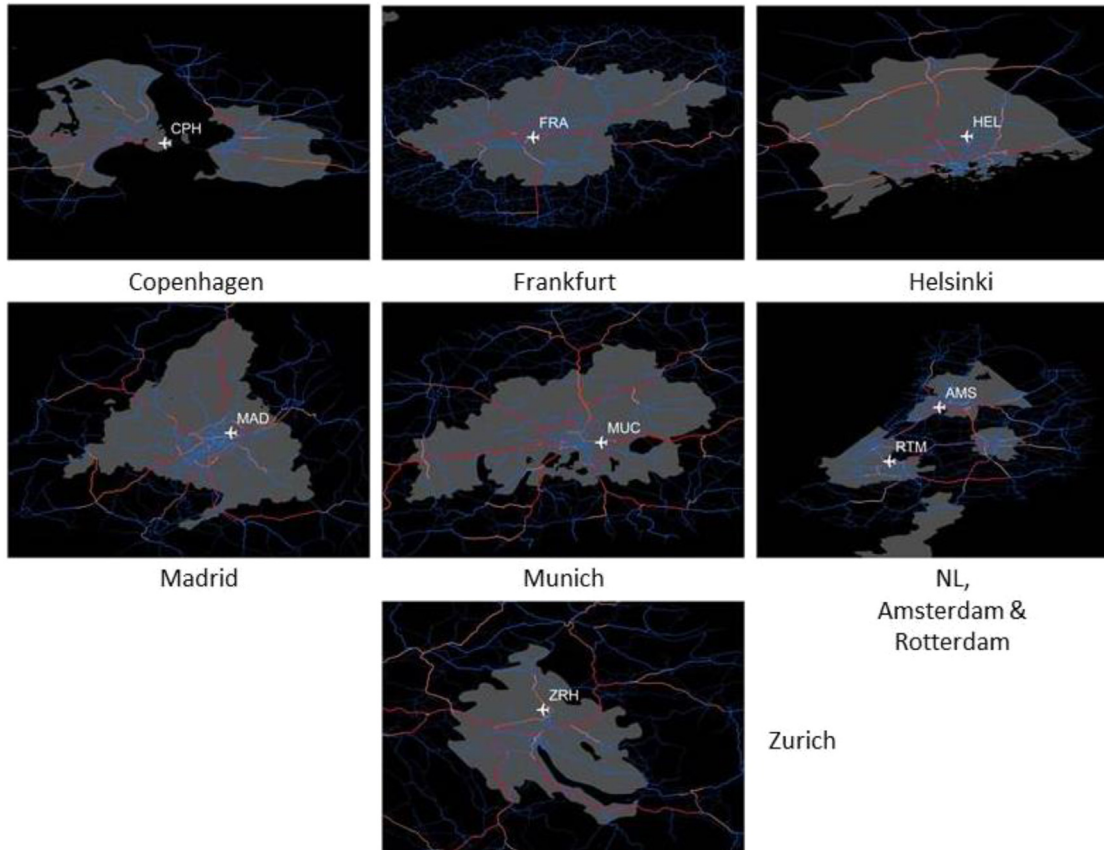
#### 1.4.4. Type#4: natural-area airports

The fourth typology of airports, the so-called *Natural-area airports*, is characterised by closeness to natural areas and distance from leisure, industry and major road network, e.g. Milano (Fig. 7).

**Table 2**

Description of the five land use types and associated CORINE codes.

TYPE	CORINE Code	Description
Urbanized	111	Continuous urban fabric
	112	Discontinuous urban fabric
Agricultural	211	Non-irrigated arable land
	212	Permanently irrigated land
	213	Rice fields
	221	Vineyards
	222	Fruit trees and berry plantations
	223	Olive groves
	231	Pastures
	241	Annual crops associated with permanent crops
	242	Complex cultivation patterns
	243	Land principally occupied by agriculture with significant areas of natural vegetation
	244	Agro-forestry areas
Natural	311	Broad-leaved forest
	312	Coniferous forest
	313	Mixed forest
	321	Natural grasslands
	322	Moors and heathland
	323	Sclerophyllous vegetation
	324	Transitional woodland-shrub
	331	Beaches - dunes - sands
	332	Bare rocks
	333	Sparsely vegetated areas
	334	Burnt areas
335	Glaciers and perpetual snow	
Industrial	121	Industrial or commercial units
Leisure	142	Sport and leisure facilities



**Fig. 2.** Sample representations of betweenness centrality radius 45km.

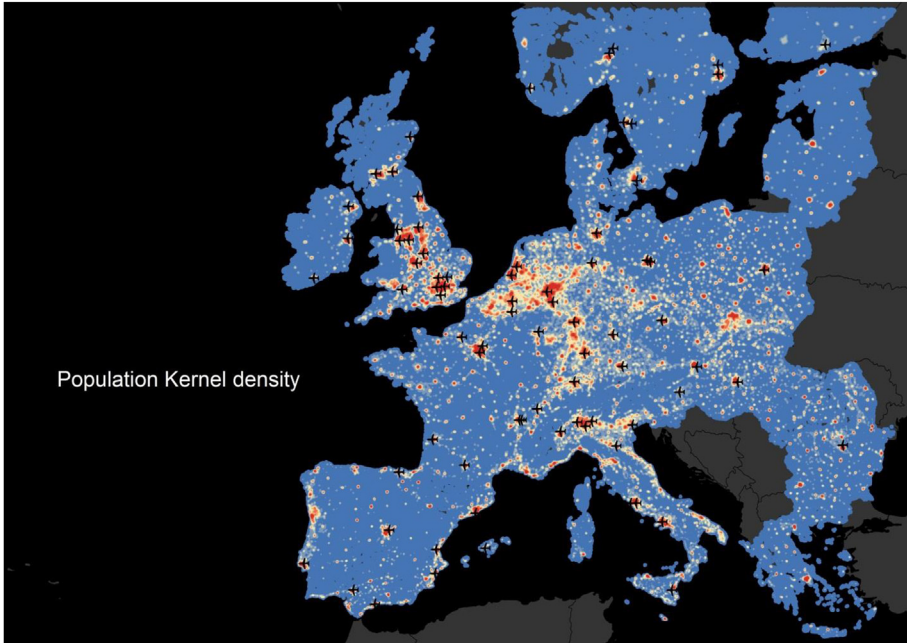


Fig. 3. The interpolated values of population, the results of kernel density, is represented as a sample.

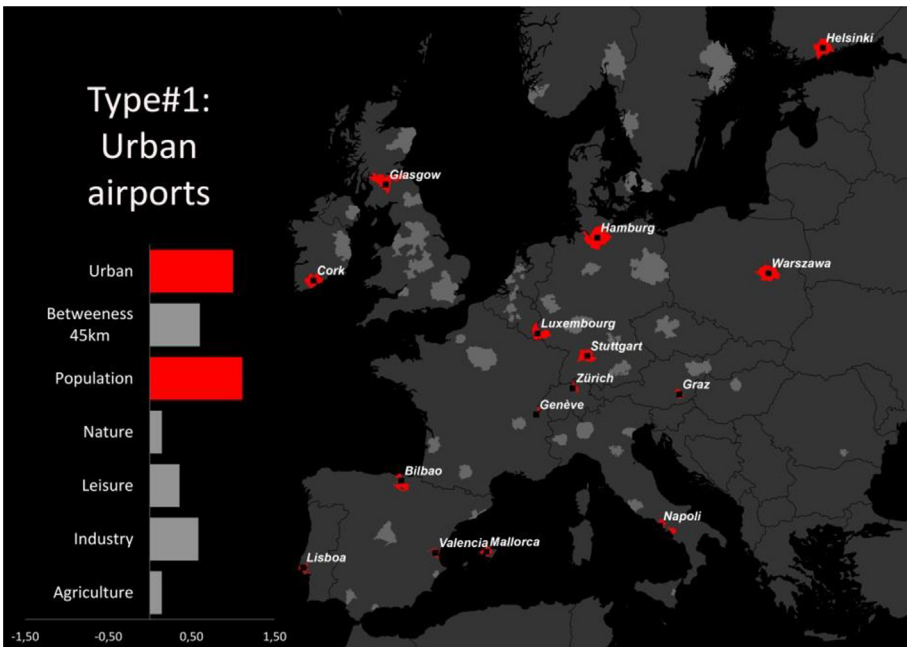


Fig. 4. The first typology. Bar chart shows distinguishing mean values of kernel density in colour.

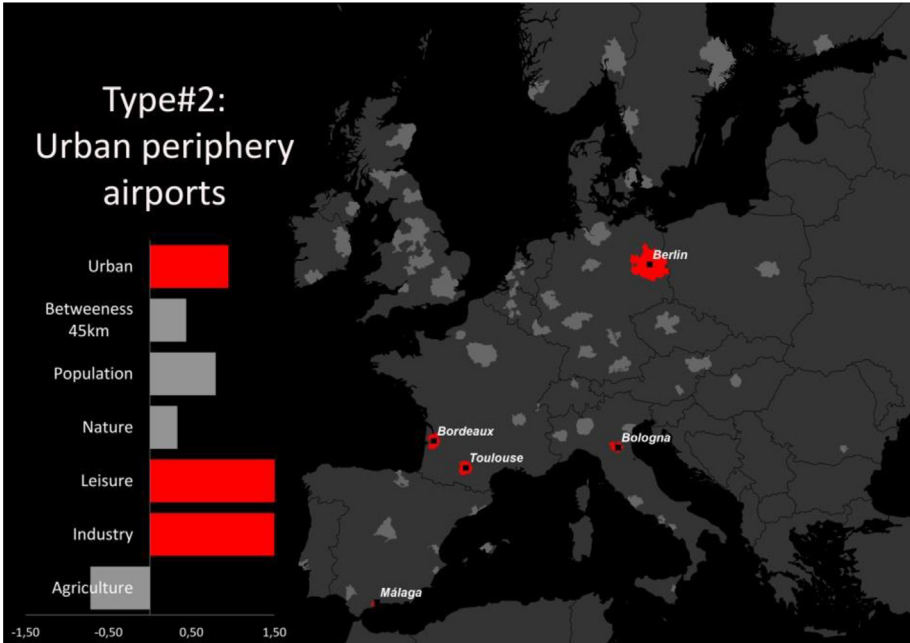


Fig. 5. The second typology. Bar chart shows distinguishing mean values of kernel density in colour.

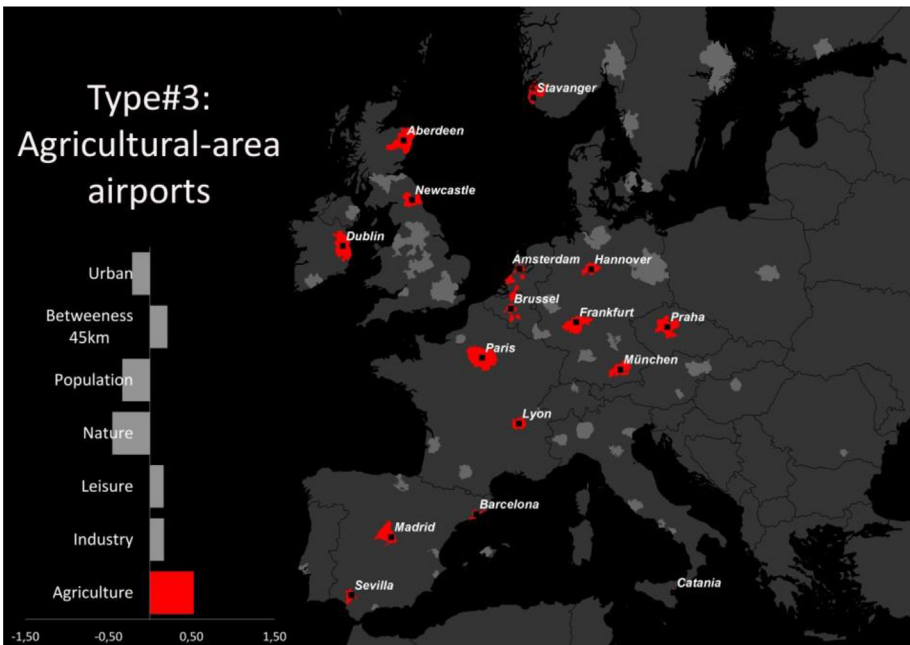


Fig. 6. The third typology. Bar chart shows distinguishing mean value of kernel density in colour.



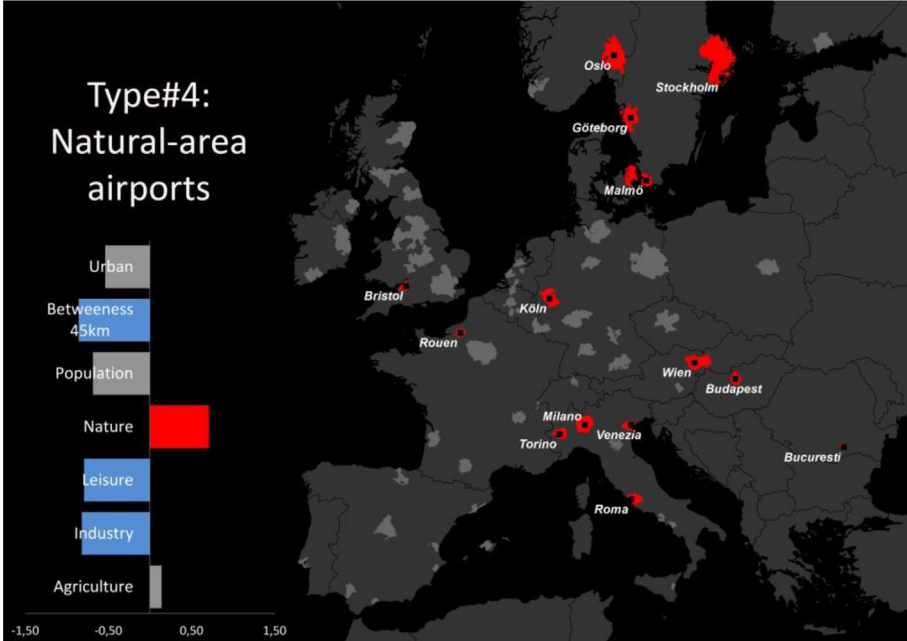


Fig. 7. The fourth typology. Bar chart shows distinguishing mean value of kernel density in colour.

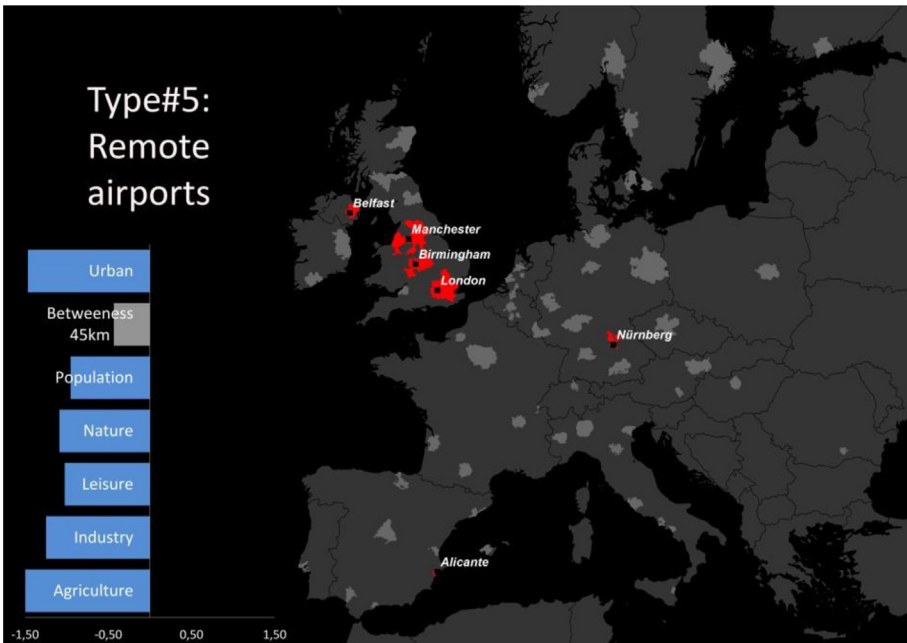


Fig. 8. The fifth typology. Bar chart shows distinguishing mean value of kernel density in colour.

#### 1.4.5. Type#5: Remote airports

The fifth typology, the so-called *Remote airports*, are characterised by being located at a long distance from all five land uses and population centres, e.g. London, Nuremberg, Belfast (Fig. 8).

## 2. Experimental design, materials, and methods

A particular property of the dataset is its multiscale characteristics. At the micro-scale, the dataset offer centrality measures at the scale of road centerlines, land use at the scale of  $100 \times 100$  m, and the population density at the scale of  $1 \times 1$  km. At the meso-scale, it characterises the airport regions of Europe. At the macro-scale, it provides the opportunity for a continent level of analysis and comparison. The dataset, in this respect, paves the way for further studies on the impact of airports on regional development at different levels of scale. First, by use of micro-scale centrality measures of the roads, combined with the data on building density and building regulations, the dataset could be further utilized for studying the potentials of urban development in airport regions (as a sample see Ref. [8]). Second, the dataset could be used for further studies aiming to distinguish between economic impacts of airports at the local and regional scale (as a sample see Ref. [9]), or to distinguish between regional- and continental-scale impacts (as a sample see Ref. [10]). The dataset could be further used for the impact of airports on land cover and indirectly urban microclimate, e.g. formation of urban heat islands, with regard to the location of airports within their respective urban region (as a sample see Ref. [11]).

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## Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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