PANOPTIS

Development of a Decision Support System for increasing the Resilience of Road Infrastructure based on combined use of terrestrial and airborne sensors and advanced modelling tools-

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D3.2: High-resolution surface parameter maps

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Abbreviation List

Abbreviation	Definition
AdapteCCa	Adaptación al Cambio Climatico
CC	Climate Change
ENCA	European Network of Heads of Nature Conservation Agencies
EOAE	Egnatia Odos S.A.
EU	European Union
ITS	Intelligent Transport Systems
NRA	National Risk Assessments
RI	Road Infrastructure
SIOSE	Sistema de Información de Ocupación del Suelo en España
TI	Transport Infrastructure
UN	User Needs

Executive Summary

This document aims to impact the realization of the current project by recording all the necessary and available data for the thematic layers of land use and the surface parameters for the pilot areas that will be used as input data and surface boundary conditions for the numerical simulation that will be **performed in WP3**. **All datasets of surface parameters and climatic drivers have been successfully compiled and uploaded to the project repository**.

1. Introduction

The main aim of Task 3.2 was to compile, synthesize, homogenize, pre-process and finally deliver all data needed to be utilized as input boundary conditions for the numerical modeling work within the frame of Task 3.3. In this sense, Task 3.2 and hence D3.2 forms a necessary step for the successful implementation of WP3

D3.2 is closely associated with D2.4 as it receives direct input from it. More specifically, the main aim of D2.4 was to identify and list, in the form of an inventory the main tools, applications and data, necessary for the successful implementation of the PANOPTIS project. Following this information, in D3.2 all data needed for the numerical simulations and the development of the prediction module within the frame of Task 3.3 were collected, downloaded and obtained and all necessary numerical tools and services were acquired and obtained.

Essentially within the frame of D3.2 all necessary and ready available data for the thematic layers of land use and the surface parameters for the pilot areas that will be used as input data as well as surface boundary conditions for the numerical simulations and the dynamical downscaling process were acquired, validated and delivered. All datasets of surface parameters and climatic drivers were successfully compiled and uploaded to the PANOPTIS repository.

Data necessary for the generation of a CAD model and hence the computational domain and grid as well as the overall pre-processing and set-up of the numerical simulations for the target areas in Guadalajara – Spain and Metsovo – Greece within the frame of WP3 included:

- CORINE surface maps for land uses
- Digital Elevation Models (DEM) of the field trial areas in Guadalajara, Spain and Metsovo, Greece

- AUTOCAD drawings of bridges and main structures for both field trial areas in Guadalajara, Spain and Metsovo, Greece
- Exact locations of meteorological stations located close to the proximity of the target field trial areas as well as historical meteorological for the prevailing meteorological and climatic conditions in both field trial areas in Guadalajara, Spain and Metsovo, Greece

In addition, information for targeted numerical simulations towards future scenario assessment included the following:

- Very high-resolution time-dependent land use and land cover maps
- Historical data and future land use scenarios

All types of data as soon as they were collected were pre-processed and delivered to the official PANOPTIS repository.

1.1 Purpose of the Document

The main aim of this document, an accompanying document classified as a category "O" document, serves to accompany D3.2 which is actually the different types of data and data sets that were collected, analyzed, validated and compiled, towards the successful implementation of the dynamical downscaling and the numerical simulations currently taking place within the frame of Task 3.1.

To this end, the main, primary objectives of this document were the following:

- To clearly explain the different categories / types of data and data sets that were collected, analyzed, validated compiled and delivered
- To provide information on which data, numerical tools and services were acquired, compiled and obtained for each one of these different categories of data
- To list them in the form of small tables in an easily understandable and more accessible way to the potential users of all data and databases that were collected, analyzed, compiled and validated
- To document all data sources and data services that were utilized. This included both readily available data obtained from the PANOPTIS partners as well as sources outside the consortium such the different EU services, like THE EUROCordex initiative

The secondary objectives of the document were:

- The provision of information to WP3 partners not directly involved in the numerical simulations and the dynamical downscaling, in terms of data and databases that were pre-processed and were necessary for the successful implementation of other tasks within WP3
- The provision of information to any interested PANOPTIS partner in terms of data that would serve as input for the relevant regulatory framework currently under revision
- The provision of information to WP4 partners involved in the multi- hazard assessment work extended to cover CC related hazards as well as geo-hazards within the frame of Task 4.1
- The provision of information to any interested PANOPTIS partner in terms of potential input the on-site Integration, demonstration and validation of PANOPTIS platform

1.2 Intended Audience

D.3.2 is a public document. It will be available to all stakeholders involved in WP3 as well as anyone interested in the collected data outside of the PANOPTIS project, upon request.

2. Dataset Categories

Considering the general scope as well as the specific requirements of the project, specifications for nine dataset categories were defined in document D.2.4 “Geographic data and services inventory”.

For the needs of D3.2 the following three categories of interest for were identified

- Geometry
- Geotechnical
- Land

Information of the kind of high-resolution maps, data and databases that were collected, analyzed, pre-processed, validated and compiled for these three categories, are presented in tables 1 – 7.

More information regarding each category’s files, partner activities, responsibilities as well as data archiving and preservation methods can be provided upon the data user’s request.

2.1 Climate Data and Selection of Scenarios

The EURO-CORDEX material provided a selection of relevant episodes, as well as the quantification of the impacts to vulnerable infrastructures due to the increased frequency of such episodes.

Table 1: Climate Data and Selection of Scenarios Files

DATA Identification & Availability	**Climate** Data Specifications
Dataset description	Data sets of relevant atmospheric and surface variables.
Sources	https://euro-cordex.net/060374/index.php.en
Files & Types: NetCDF	
3D fields of climate variables	temperature, humidity, wind velocity etc.
2D fields of climate variables	surface precipitation, radiation, etc.
Resolution	0.11 degrees
Data exploitation and sharing	
Data exploitation (purpose/use of the data analysis)	The major aims of the CORDEX initiative are to provide a coordinated model evaluation framework, a climate projection framework, and an interface to the applicants of the climate simulations in climate change impact, adaptation, and mitigation studies.
Dissemination level: **Confidential or Public**	**Public**
Data sharing, re-use, distribution, publication	EURO-CORDEX data published via ESGF

2.2 Geometry

3D data for the geometrical characteristics of the main structures at the two field trial areas in Guadalajara, Spain and Metsovo, Greece including Digital Elevaltion Maps (DEM) were obtained, analysed and delivered the high-resolution numerical models with the necessary information.

This constitutes a necessary input to the high resolution numerical models that are employed, in order to resolve the impact of the extra terms of atmospheric turbulence, which are mechanically produced by the local scale topography and the artificial structures (e.g. buildings and bridges) at the selected field trial areas.

Table 2: Geometry Files

DATA Identification & Availability	**Geometry** Data Specifications
Dataset description	Inventory, location and design of road infrastructure, slopes, ditches, transverse drainage works, road sections, road signs, bridges and tunnels.
Sources	Project as built, Rehabilitation projects, data base of the Conservation Agency, EOAE, Open Data Epirus
Files & Types: XLSX, CSV, SHP, DWG, IGES, GEOTIFF	
3D Geometry	***3D data for the infrastructure*** of the test sections. Any format most CAD programs can read.
Digital Elevation Maps (DEM) SRTM 30m	***Digital Elevation Maps (DEM)*** topography of the test sections under consideration in raster format ".geotiff".
Digital Terrain Models (DTM)	***Digital Terrain Models (DTM)***
Digital Surface Models (DSM)	***Digital Surface Models (DSM)***
Drawing File containing road Points.	***Drawing*** of points topologically defined in two dimensions. The third dimension, corresponding to the points' altitude, is inferred in text format over each point.
Drawing File containing road Points.	***Drawing*** of points topologically defined in the UTM system, which uses a two-dimensional Cartesian coordinate system to specify each point's location.
Drawing File containing road Geometry.	***Drawing*** with geometrical and technical characteristics of the area. Design details of Spanish A2 Highway road corridor. Location of road infrastructure, slopes, ditches, transverse drainage works, road sections and road signs.
Drawing Files containing road Geometry and Grid Points	***Drawing*** that contains grid of points juxtaposed with the road's geometric outline and topographic terrain contours. Included are fence, side road as well as neighbouring vegetation, pipe line and other boundaries.
Road Surface Irregularities	***XLSX*** file with road surface irregularities.
Image and Video Files depicting features of the motorway.	***Image and Video Files*** of features related with the road, slope, bridges, fences, fauna.
DEM File	***Digital Elevation Models*** containing the area's elevation contours and the road's geometry.
Site Point List.	***Points*** that are topologically defined in two dimensions.
Data exploitation and sharing	
Data exploitation (purpose/use of the data analysis)	Models of the RI under study Information for vulnerability and risk analysis
Dissemination level: **Confidential or** P**ublic**	**Confidential**
Data sharing, re-use, distribution, publication	Authorised by ACCIONA/EOAE. Prior notice of any planned publication shall be given to ACCIONA/EOAE at least 45 calendar days before the publication.

2.3 Geotechnical Data

In the context of **work within WP3**, the hydrological and catchment area components of these datasets are exploited in Tasks 3.3 and 3.5 both for the high-resolution numerical simulations and as part of real time meteorological hazard assessment module.

Table 3: Geotechnical Data Files

DATA Identification & Availability	**Geotechnical** Data Specifications

Dataset description	Geological and geotechnical data (including hydrological and geological maps), seismic effects studies. Data are available for all four sections in which the road is divided.
Sources	ACCIONA/EOAE databases
Files & Types: PDF, PPTX, DWG, JPG	
Geological - Geotechnical Data	***Document*** with English geotechnical data summary.
Geotechnical Details	***Documents*** containing plotted drawings of the site's geotechnical details.
Slope Monitoring	***Presentation*** of the site's slope monitoring and early warning system.
Hydrological Map	***Document*** containing hydrological map.
Geological Analysis	***Document*** containing the geological analysis of the site and the origin of its materials.
Seismic Effects	***Document*** containing seismic effects on site.
Geotechnical Study	***Document*** containing geotechnical study of the road.
Road Geometry for geological maps	***Drawing Files containing road Geometry*** for the respective geological maps.
Geological Maps	***Documents*** containing geological site maps.
Rock Formation Analysis	***Images*** containing rock formation analysis.
Displacement Monitoring	***Documents*** containing information about the area's cumulative displacement and deformation.
Acceleration/Strain/Joint Meter Displacement Time Histories	***Documents*** containing information about the earth's cumulative displacement and deformation
Data exploitation and sharing	
Data exploitation (purpose/use of the data analysis)	RI Models. Info for vulnerability and risk analysis
Dissemination level: **Confidential or Public**	**Confidential**
Data sharing, re-use, distribution, publication	Authorised by ACCIONA/EOAE. Prior notice of any planned publication shall be given to ACCIONA/EOAE at least 45 calendar days before the publication.

2.4 Land Use

Land use / land cover data were downloaded in order to accommodate the numerical simulations with local scale high resolution CFD models such as the PALM LES. More specifically these data served as a basis in order to estimate the thermophysical soil properties, identify their potential impact on the results of the numerical simulations. Based on these findings their impact is included in the set-up of the main part of the numerical simulations as input boundary conditions (BCs) in the form of momentum sinks and sources for the prevailing climatic parameters such as temperature and humidity at the surface of the soil.

Table 4: Land Use Data Files

DATA Identification & Availability	**Land Use** Data Specifications
Dataset description	Land use and land cover maps.
Sources	Open Access inventories of the Spanish Administration: Ministry of Finance for land use https://www.sedecatastro.gob.es/Accesos/SECAccDescargaDatos.aspx SIOSE geoportal (Ministry of Public Works) and CORINE Land Cover, for land cover data
Files & Types: PDF, SHP, GPKG	
CORINE Land Cover 2012	***Freely available land use dataset.***
Data exploitation and sharing	

Data exploitation (purpose/use of the data analysis)	Feed for climatic and geo-hazards models
Dissemination level: **Confidential or** P**ublic**	**Public**
Data sharing, re-use, distribution, publication	Open source inventory. Can be published.

2.5 Vegetation

Data for the vegetation coverage was downloaded in order to be utilized as input boundary condition parameterizing the impact of vegetation coverage on the aerodynamic roughness of the ground / soil and drive a model cascade in a dynamical downscaling scheme to a scale of 1 to 3 km.

Table 5: Vegetation Files

DATA Identification & Availability	**Vegetation** Data Specifications
Dataset description	Vegetation maps of the area surrounding the site.
Sources	Open Access inventories of the Spanish Ministry of Environment
Files & Types: XLSX, SHP	
Vegetation Database	**XLSX and Shape files** that characterize the vegetation type in various geographical locations. file containing vegetation database**.**
Vegetation Database *data source:* Hellenic Cadastre	***Data*** are given on LSO25 Backgrounds (Large Scale Orthophotos) with 25cm GSD (Ground Sampling Distance).
Data exploitation and sharing	
Data exploitation (purpose/use of the data analysis)	Improve simulations of the climate related hazards on the road.
Dissemination level: **Confidential or** P**ublic**	**Public**
Data sharing, re-use, distribution, publication	Open source inventory. Can be published.

2.6 Hydrology (flood prone areas)

Georeferenced information for the location of the main flood prone areas at the selected field trial areas were collected in order to estimate the potential risk of floods in cases of extreme precipitation events at the selected field trial areas.

In addition to estimating the risk of flood in these areas during an extreme precipitation event, this information was deemed critical also for the estimation of the potential risk of triggering landslides. An example of the collected data files is shown in the following table.

Table 6: Hydrology Data Files

DATA Identification & Availability	**Hydrological** Data Specifications
Dataset description	Hydrological maps, rain precipitation historic, flood prone areas
Sources	Open Access inventories of the Spanish Ministry of Environment
Files & Types: SHP files	
Hydrology Data & Flood Hazards	
Information about flood hazard maps.	**Shape** files: vary for very high, high, medium, low
Data exploitation and sharing	
Data exploitation	Feed for climatic and geo-hazards models
Dissemination level: **Confidential or** P**ublic**	**Public**
Data sharing, re-use, distribution, publication	Open source inventory. Can be published.

2.7 Temperature Distribution (thermal map)

Surface temperature data from deployed monitoring stations were collected, analysed and validates as they are used in Task 3.3 in the process of dynamical downscaling, as well as in Tasks 3.5 and 3.6 in order to continuously update the results of numerical models.

Table 7: Temperature Distribution Data Files

DATA Identification & Availability	**Thermal Map** Data Specifications
Dataset description	Thermal profile of the road surface; thermal characteristics per georeferenced zone along the road corridor
Sources	ACCIONA data base
Files & Types: KMZ, PDF, XLSX	
Meteorological Data	***Temperatures, Difficult climatic actions*** (snow, ice heavy rain, wind, hail, fog)
KMZ files containing thermal data.	***KMZ files*** Characterizes the thermal characteristics of various zones along the Spanish A2 Highway (pk 62-pk 139.5).
Mapping, Measurements and Results	***Document*** containing information about thermal mapping, measurement methods and results.
Mapping, Measurements, Results and Sensors	***Document*** containing information about thermal mapping measurement methods and results. Cold area detection and proposed locations for sensors.
Preventive and Curative Road Treatments	***Reports*** of preventive and curative road treatments during winter operations necessitating snowplough, brine and salt use.
Necessary Road Treatment	***Report and Proposal*** for necessary road treatment, repairs and constructions.
Meteorological Measurement Stations	***KMZ file*** Road Weather Information System locations of Egnatia Odos S.A data which are published on the NAP.
Meteorological Measurement Stations	***XML Files*** containing information about weather conditions of various areas along the length of the road.
Wind Velocity/Direction Angle Time Histories	***Documents*** containing information about the area's wind velocity and direction.
Data exploitation and sharing	
Data exploitation (purpose/use of the data analysis)	Identify ice-prone areas on the road corridor (vulnerable RI). These areas should be equipped with sensors to control ice formation
Dissemination level: **Confidential or Public**	**Confidential**

3. Dataset Sources and Services & Data Management Applications

More information regarding dataset sources and services as well as data management applications can be found at deliverable D2.4.

Further information may also be provided upon request by the potential users of these data.

4. Conclusions

The present deliverable contains brief metadata documentation on the georeferenced data, in the form of thematic layers of land use, climate and surface parameters for the PANOPTIS pilot areas, delivered or available by online services in a GIS format. The main objectives of Task3.2 was to collect, analyze, compile, validate and finally deliver the necessary data and databases necessary for the successful implementation primary of Task 3.3 but also of Tasks 3.5 – 3.7. To this end, the data and datasets were consolidated and annotated.

In response to the collective data requirements of the WP3 partners, all datasets of surface parameters and climatic drivers have been successfully compiled and uploaded to the project repository. Climatic data and scenarios are provided by the EUROCordex initiative. Surface, structural and thermophysical data have been contributed by ACCIONA and EOAE (owners of the demonstration pilots in Spain and Greece respectively) and preprocessed by the AUTh. It is expected that in the course of the implementation of subsequent WP3 tasks, additional feedback will be used to streamline the delivery and QA/QC of these datasets.

5. References

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