UNIVERSITY OF ŽILINA

https://doi.org/10.26552/aer.C.2022.2.3

DEPLOYMENT OF ENVIRO SYSTEM FOR OBTAINING GEOSPATIAL DATA FOR FOREST MONITORING AND IMPROVING FOREST MANAGEMENT AND PROTECTION

INFORMATIVE PAPER

Matúš Materna
Air Transport Department
University of Žilina
Univerzitná 8215/1
010 26 Žilina
materna1@uniza.sk

Andrej Novák
Air Transport Department
University of Žilina
Univerzitná 8215/1
010 26 Žilina
andrej.novak@fpedas.uniza.sk

Benedikt Badánik
Air Transport Department
University of Žilina
Univerzitná 8215/1
010 26 Žilina
benedikt.badanik@fpedas.uniza.sk

Branislav Kandera
Air Transport Department
University of Žilina
Univerzitná 8215/1
010 26 Žilina
branislav.kandera@fpedas.uniza.sk

Abstract

Paper describes deployment of ENVIRO System used for obtaining geospatial data for forest monitoring and improving forest management. Two main parts of ENVIRO system – Aerial segment and ground segment are described based of their construction and installation. Paper also describes functionality of the system in terms of data collection, processing and evaluation using ENVIRO System solution in real life deployment.

Keywords

ENVIRO System, forest monitoring, forest management, air quality

1. Introduction

Research and development of contactless methods for obtaining geospatial data for forest monitoring to improve forest management and enhance forest protection is nowadays important topic due to ever growing pollution and deforestation. This paper describes ENIRO System as method of obtaining geospatial data from real-life operations.

2. ENVIRO System specifications

ENVIRO System consists of two main segments – Aerial segment and Ground segments. Aerial segment installed in Viper SD4 aircraft is used for obtaining geospatial data. Ground segment is used for data handling, processing, and evaluation.

Figure 1: Viper SD-4 equipped with ENVIRO System. Source: Authors.

2.1. Aerial segment – ENVIRO System

Aerial segment is based on combined sensors installed in SENSORS chasis and datalogger installed in ENVIRO System BOX. All datalogger components are packed in one plastic case (IP68 protection class) and sensors are installed on robust SENSORS chassis.

Figure 2: ENVIRO System BOX datalooger. Source: TECHNISERV (2022[b]).

2.1.1. *System installation*

Both ENVIRO System Box and SENSORS chassis are installed within storage department of Viper SD-4 aircraft.

System is designed for fast implementation in harsh environmental conditions, as customized version designed for aircraft air quality monitoring application.

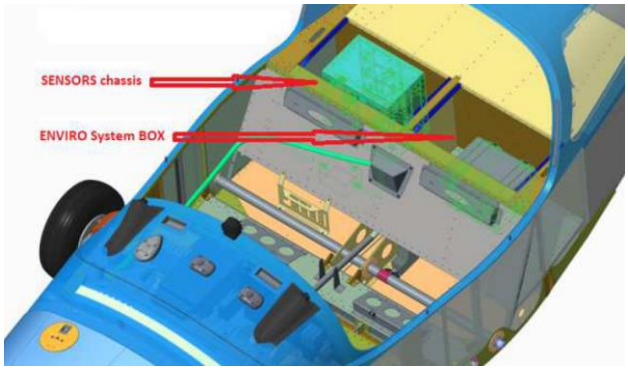

Figure 3: Placement diagram of ENVIRO System BOX and SENSOR chassis. Source: TECHNISERV (2022[b]).

Figure 4: Placement ENVIRO System Box datalogger inside Viper SD-4 aircraft. Source: Authors.

2.1.2. *Sensor equipment*

ENVIRO System is capable of monitoring and logging wide-range parameters using environmental sensors.

Table 1: Overview of ENVIRO System sensors and measured parameters. Source: Authors.

Sensor order	Parameter	UNIT
#(O1)	TA	deg Celsius
#(O2)	RH	%
#(O3)	PA	hPa
#(O4)	NO_2	ppb
#(O5)	NO	ppb
#(O6)	CO	ppb
#(O7)	CO_2	ppm
#(O8)	SO_2	ppm
#(O9)	H_2S	ppm
#(O10)	O_3	ppb
#(O11)	PM2.5	ug/m^3
#(O12)	PM10	ug/m^3
#(O13)	VOC	none (index)
#(O14)	UVA	W/m^2
#(O15)	UVB	W/m^2
#(O16)	UVC	W/m^2
#(O17)	FLOW	slm
#(O18)	LAT	deg
#(O19)	LON	deg
#(O20)	N_2O	ppm
#(O21)	V_{BATT}	V

Figure 5: Sensor's installation in air intake. Source: Authors

2.2. Ground segment - ENVIRO System GIS SW

ENVIRO System GIS SW is designed for fast processing as customized SW version designed for evaluation of aerial environmental quality monitoring application and data collected from the aerial segment of the system.

2.2.1. *Hardware*

ENVIRO System GIS SW works on customized workstation class computer WS HP-Z4-G4 combined with two LCD monitors U2720 and GIS SW for ENVIRO data (customized version, with

optimization for working with CS files). All hardware components are installed in 19'' RACK at the SHELTER module an GIS SW is preinstalled and configured for operational and easy import data from SD card. Additional hardware and software components for processing and SMART CAM are applied into this solution.

Ground segment is also equipped with local industrial-grade weather station Davis Instruments Vantage Pro2 equipped with wide range of sensors Weatherlink software. Weather station is capable of monitoring and logging following data:

- Outside temperature
- Outside humidity
- Dew point
- Wind speed and direction
- Wind chill and heat index
- Barometric pressure
- Rainfall and rain rate

Figure 6: Weather station Davis Instruments Vantage Pro2 instalment. Source: Authors.

2.2.2. System functions

System includes fully implemented software equipment for data evaluation (GIS SW for ENVIRO data – customized version, with optimization for working with CSV files), which serves as SW equipment for evaluation and interactive display of measured parameters on the map. At the same time, SW enables visualizations and various types of analysis and offers the following functionalities:

- Creating an interactive map and scene from files, databases and online resources *customizable version for working with CSV files.
- Visually model and analyse the process.
- Basic spatial analysis tools for overlap, proximity, and aggregation.
- Statistical tools for analysing spatial patterns, clusters, and relationships.
- Extensive tools for automated data management.
- Scripting, geoprocessing, and other operations using Python.
- Create maps at the GPS location level.
- View CAD data or satellite/aerial imagery.
- Charts to visualize categories, relationships, and changes in data.

2.2.3. SW Evaluation options

PC with two LCD displays and SW equipment for evaluating measured data from the ENVIRO system, ensures computerized data processing, whereby all measured parameters can be systematically sorted and graphically displayed on the map, with a link to the camera recording from the Smart camera on the second LCD monitors.

Spatial analysis tools such as the Raster Calculator and Minus tools can provide powerful insights on raster value differences between raster images that are geographically overlapping. In ArcGIS Desktop, these tools are located in the Spatial Analyst toolbox.

Alternatively, environments without the ArcGIS Spatial Analyst extension can use the difference function from the Image Analysis window.

3. Conclusion

Current deployment ENVIRO System offers powerful tool for obtaining geospatial data used for improving forest management and protection. System offers wide range of options for data collection, processing, and evaluation.

Acknowledgement

This work was supported under the project of Operational Programme Integrated Infrastructure: "*Research and development of contactless methods for obtaining geospatial data for forest monitoring to improve forest management and enhance forest protection*", ITMS code **313011V465**. The project is co-funding by European Regional Development Fund.

References

TECHNISERV, 2022[a]. ENVIRO System GIS SW User Manual Ver 2.0. Internal document.

TECHNISERV, 2022[b]. ENVIRO System BOX Installation Manual Ver 3.0. Internal document.