

Nguyen Quoc Long - Pham Thi Lan
Nguyen Viet Nghia - Khuong The Hung
Le Thi Thu Ha - La Phu Hien

Geo-spatial Technologies and Earth Resources (GTER 2017)



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GEO-SPATIAL TECHNOLOGIES AND EARTH RESOURCES (GTER 2017)

Nguyen Quoc Long, Pham Thi Lan, Nguyen Viet Nghia

Khuong The Hung, Le Thi Thu Ha, La Phu Hien

Editors

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Foreword

Hanoi University of Mining and Geology (HUMG) and the International Society for Mine Surveying (ISM) organize the International Conference on Geo-spatial Technologies and Earth Resources in Hanoi, Vietnam, from 5th to 6th October 2017 (GTER 2017). The conference is to mark the 50th anniversary of the Vietnam mine surveying education (1967-2017), the special event of Vietnamese mine surveyors.

The conference theme, “Geo-spatial Technologies and Earth Resources” is an invitation to researchers, academics and professionals to present their research results and exchange their new ideas and application experiences face-to-face. GTER 2017 is also an excellent opportunity for attendees to establish research or business relations and to find partners for future collaboration.

The conference’s call for papers was answered by 288 abstracts, of which 216 papers were under a double-blind review process. After the thorough reviews and selection process, 120 qualified papers from 18 countries were selected for the proceedings. We believe that this proceedings book provides a broad overview of recent advances in the fields of geo-spatial technologies and earth resources for readers. The major topics announced for GTER 2017 are listed below:

- Geo-spatial technologies;
- Advance in mining and tunneling;
- Geological engineering;
- Environmental engineering.

The conference program represents the efforts of many people. We would like to express our gratitude to the members of the Organizing Committee, Scientific Committee, and the external reviewers for their hard work in reviewing submissions. Full recognition is accorded to the kind and generous sponsors: Vietnam National Coal - Mineral Industries Holding Corporation Limited, Dong Bac Corporation, SISC Vietnam JSC, GPS Lands (Malaysia), and Henan Polytechnic University (China).

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GEO-SPATIAL TECHNOLOGIES

Establishing and sharing environmental database with web - based GIS application: case study in Thai Nguyen province

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ABSTRACT: Thai Nguyen is the gateway for socio-economic exchange between mountainous midland and plain area in the Northeastern region of Vietnam. In recent years, the operation of industrial zones, mining, etc in the province has been developing rapidly; however, these activities also impact *adversely* on the environmental quality and the health of people there. Therefore, the management of the environment is highly necessary for sustainable development in Thai Nguyen. Nowadays, GIS and Web-GIS are considered as the effective tools that allow people to manage, analyze and share maps, geospatial data due to the support of cloud computing technology. The objective of this paper is consequently to establish a Geodatabase using ArcGIS Desktop and share the environmental data of Thai Nguyen on the Internet with ArcGIS Online – a Web-GIS application. This research made and shared web maps which include the adequate information about environmental monitoring points such as air, surface water, wastewater, locations of the landfill on ArcGIS Online website at the same time; the result aims to provide authorities and people with an overall view of Thai Nguyen's environment.

KEY WORDS: environment, ArcGIS Online, Web-GIS, environmental monitoring points

1. INTRODUCTION

Major factors contributing to environmental problems include increasing considerably of the population, rapid urbanization, accelerating industrialization, weak enforcement of the laws on environmental protection, and a lack of education and cultural awareness. Nowadays, Government of Vietnam has promulgated laws, created institutions, expanded investments and decentralized authority to manage the resources and environment. In addition, many projects of monitoring environment and pollution management were realized, such as Vietnam Industrial Pollution Management Project. The objectives of the project are to be achieved through strengthening of the institutional and regulatory environment. Besides, The objectives of the project improved monitoring and enforcement. Finally, the project improved Centralized Effluent Treatment Plants (CETP) construction and operation of proper waste water treatment, and information disclosure and public participation in Nam Dinh, Ha Nam, Dong Nai, and Ba Ria - Vung Tau province, which were located along Day - Nhue River and Dong Nai river (World Bank, 2012-2018). Another program is monitoring water quality

in Cau River Basin from 2010 to 2015 (MONRE, 2010-2015). However, the data collected in these programs are unavailable online or are only used by the cooperators for current operational decisions, ongoing research projects, and future basin management.

In the world, the management of resources and environment by using GIS has become more popular. Several researchers realized the potential of using GIS technique in the management, analysis, and assessment of environment, such as Joseph K. Berry (1999), and the studies of Gabriela Droj (2012), or Ashwani Kumar Tiwari (2017) and others. In Vietnam, a great number of researchers presented results of application of GIS technology in evaluating surface water quality for the planning of surface water monitoring network (Vinh, 2014), or in assessing surface water pollution caused by the mining process (Huong et al., 2014), or in the management dust and simulation air pollution (Hung et al., 2015). Hence, the applications of modern technology and share the information for control environmental problems are necessary.

Thai Nguyen is the gateway for socio-economic exchange between mountainous midland and the

plain area in the Northeastern region of Vietnam. In recent years, Thai Nguyen has great potential in industrial development with hundreds of mineral deposits and many different types of minerals discovered across the province. According to Thai Nguyen Department of Natural Resources and Environment, the operation of industrial zones, mining, etc. has been developing rapidly but also impacted adversely on the environmental quality and the health of people. Therefore, authority needs to have drastic and continuous efforts to solve environmental challenges, so a full database is an urgent requirement to meet demands of environmental information for people.

Nowadays, GIS and Web-based GIS are considered as the effective tools that allow people to manage, analyze and share maps, geospatial data due to the support of cloud computing technology. ArcGIS Online is one of the best examples of cloud computing and is a unified web portal designed by ESRI (Environment System Research Institute). It contains a rich collection of Web maps, layers, and services contributed by GIS users throughout the world. Thus, basing on the Geodatabase established in ArcGIS Desktop, presenting the result of ArcGIS Online application in the sharing of the environmental data of Thai Nguyen province via internet. This research made and shared web maps which include the adequate information about environmental monitoring points such as air, surface water, wastewater, locations of the landfill on ArcGIS Online website. At the same time, the result aims to provide authorities and people with an overall view of Thai Nguyen's environment.

2. MATERIAL AND METHODS

2.1. The study area

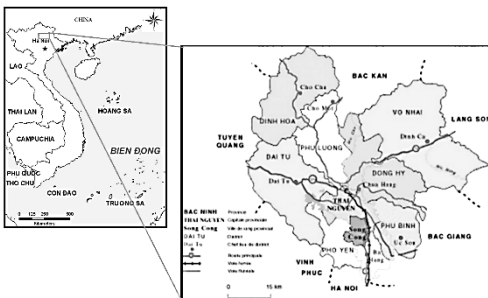


Fig 1. Location of Thai Nguyen Province

As mentioned earlier, for this research, Thai Nguyen province was selected as the pilot area for establishing and sharing environmental database

based on GIS and WebGIS technology. It located in the Northeastern region of Vietnam.

2.2. The input data

In this study, data are collected from many different sources and formats. Spatial data consist topographic map of the study area with layers: transportation, hydrological data/ drainage (river networks, water resource), administrative boundaries,...Moreover, special subjects include environmental monitoring points of air, surface water, wastewater, locations of the landfill. Attribute (non-spatial data) information such as name, the description of the location and parameters of environmental monitoring points are shown in excel tabular format.

The Environmental database will be built, standardized and integrated into a geodatabase by using ArcGIS 10.2. Then, from ArcMap, publishing it as a hosted service to ArcGIS Online. This hosted layer will expose all data included in the map document. Through ArcGIS Online, the Environmental database will be managed and shared by using PC, laptop, tablet or smart phone which connect the internet.

2.3. Research method

To manage and share Thai Nguyen's environment information, firstly, designing Geodatabase which includes Feature Datasets with WGS84/UTM zone 48N then creating Feature Classes with spatial data and attribute data from the input data. When building background data, authors convert data sourced from DGN format (Microstation) to Geodatabase and standardize data. Secondly, adding monitoring points that have coordinate (location x,y or latitude, longitude) in excel tables into a geodatabase, and attribute data are connected with spatial data by "Join" in ArcGIS Desktop. Besides geodatabase, shapefile format can be created in ArcGIS for storing the geometric location and attribute information of geographic features. Thirdly, to connect ArcGIS online, users need to have Internet, web browser and an ArcGIS online account. ArcGIS Online can be accessed with many different modes, such as access through web browsers, mobile devices. Finally, the information of environmental monitoring points will be shared via the internet by sharing maps and embedding them in a website or creating a new web app. The detailed process is given in Fig 2.

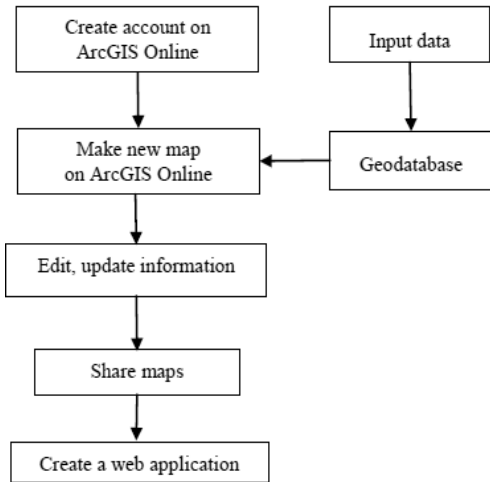


Fig 2. Flowchart of using ArcGIS Online for establishing and sharing database

2.4. Processing

2.4.1. Establishing Geodatabase on ArcGIS Desktop

The environmental geodatabase was established primarily on ArcGIS Desktop 10.2 and designed with two parts: geographical background and thematic database. Thai Nguyen topographic map was imported into a geodatabase, and then these layers were checked on spatial data by Topology. Topology is fundamentally used to ensure data quality of the spatial relationships and to aid data compilation. On the other hand, attribute data were linked to spatial data through key field.

In addition, as mentioned in research method, in the scope of this research, the subjects of management precisely are environment of Thai Nguyen province including monitoring points of water surface, waste water, air, disposal site; therefore, attribute data which are collected include relevant criteria below:

Table 1. Information of thematic feature classes

Feature Class	Attribute	Describe
Surface water monitoring points	name of monitoring points, Longitude, Latitude, temperature, turbidity, pH, COD, BOD5, DO, EC, TDS, total Nitrogen, Sulfur ...	These classes detail the parameters which affect the quality of the environment of Thai Nguyen. These properties

Feature Class	Attribute	Describe
Waste water monitoring points	name of monitoring points, Longitude, Latitude, temperature, turbidity, pH, COD, BOD5, SS...	are physical and chemical factors.
Air monitoring points	Temperature, humidity, NO2, CO2, CO, suspended dust, noise...	
Soil monitoring points	Location, pH, P, N...	
Disposal site / landfill	X, Y, name	the location of landfills in Thai Nguyen

2.4.2. Publishing data on ArcGIS Online

After Geodatabase on ArcGIS Desktop was perfected, sign onto ArcGIS Online account directly on ArcGIS Desktop Software. To publish data on ArcGIS Online, using “share as service” with following steps:

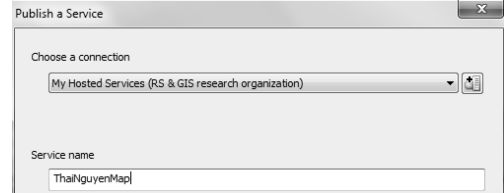


Fig 3a. Connecting My Hosted Services

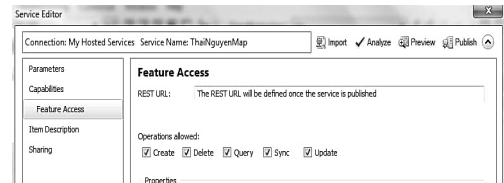


Fig 3b. Activating Feature Access and setting advanced properties

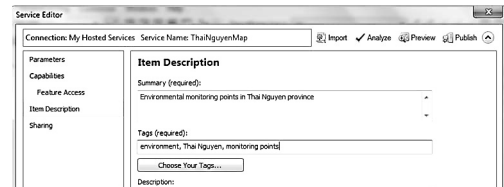


Fig 3c. Describing item of service

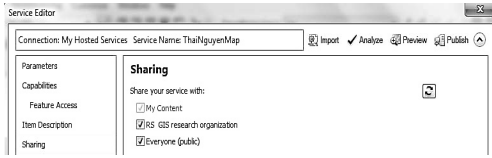


Fig 3d. Sharing options

Next, analytic process is executed and when there is no error, it is considered successful. Finally, geodatabase will be published in ArcGIS online. However, collected layers which have shapefile format should be archived in a Zip that is one of formats imported on ArcGIS online besides csv, gpx format.

2.4.3. Making and sharing map on ArcGIS Online

When access arcgis.com, login account, an ArcGIS Online interface appears including contents that were published in the previous step). The information of environmental data such as style, name, configure pop-up, labels can be edited and updated; moreover, users can perform analysis on attribute data of environmental monitoring points. Besides geodatabase established, basic mapping layer Open Street Map provided by ESRI was also used for the detailed expression regional transport system. Next, the map was made and shared on ArcGIS with creating a website application. ArcGIS Online offers apps that can help users to bring stories and present maps with narrative text, images, and multimedia content (Fig 4).

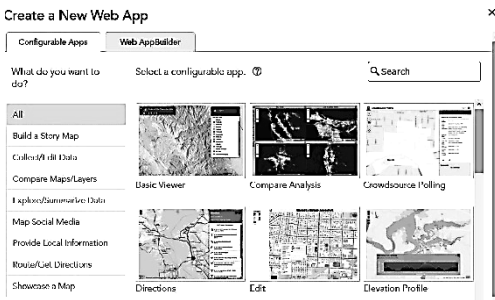


Fig 4. Web apps

3. RESULT AND DISCUSSION

In the study, Environmental Geodatabase was established base on GIS (Fig 5). It includes spatial database and attributes database with Feature Datasets, particularly Feature Dataset of environmental monitoring points.

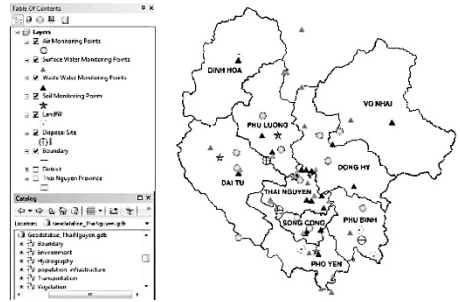


Fig 5. Environmental Geodatabase of Thai Nguyen

The map will be saved and published on ArcGIS online. After signing onto an account on arcgis.com, in the interface of ArcGIS Online, map and database will be presented in the interface of ArcGIS Online.

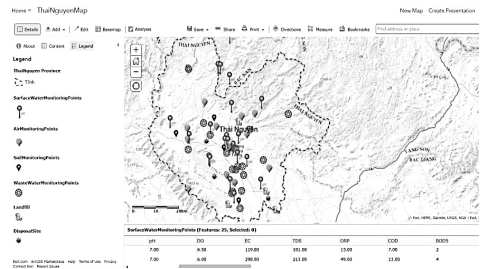


Fig 6. The web map on ArcGIS Online

Use the analysis tools integrated into the map viewer of ArcGIS Online to summarize data, find suitable locations, enrich data, analyze patterns, find out what's nearby (use proximity), and manage data. In this research, we perform "Interpolate Points" to predict values at unknown locations based available points by Kriging method. Several parameters were chosen as the basic data of the interpolation, example, sulfur dioxide (SO₂) and is shown in the Fig below.

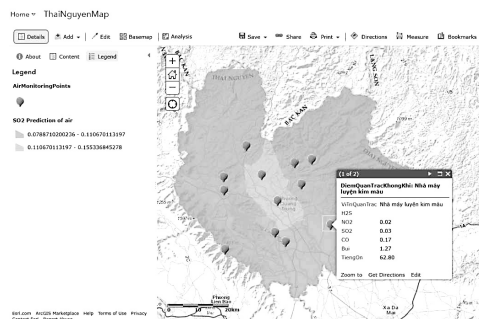


Fig 7. Interpolation result with SO₂ parameter of air

In addition, monitoring points can be filtered with information that satisfies given condition for example, according to national technical regulation

of surface water quality (QCVN 08 - MT: 2015/BTNMT), limit A2 of COD is 15 mg/l, so, we can query to find points which its COD is greater than 15 mg/l (Fig 8b) from all surface water monitoring points (Fig 8a). On the other hand, the information of monitoring points can be found by click on the location of these (Fig 7).

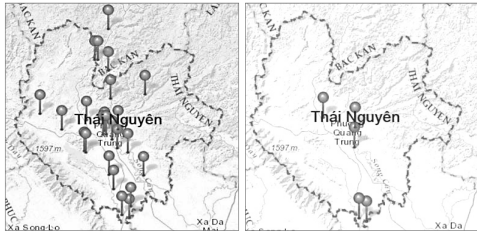


Fig 8. Screenshot of input data of filter process and Screenshot of the result of filter process (right)

Finally, sharing map on ArcGIS Online with creating a new web app which is named Story Map Journal. This app presents map-based narrative as a set of multimedia journal entries. With the Story Map Journal application, it is possible to set up information and images, links to environmental monitoring points. The Story Map Journal's new feature is the ability to drag directly and drop internal images from the computer into the story. This may be the easiest way for users to add images to their story map. Results of this process are shown in following pictures.

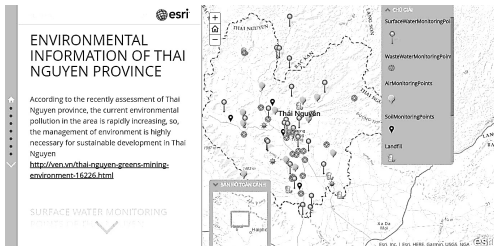


Fig 9. Home section of web interface on ArcGIS Online

The result of the study is “Environmental Information of Thai Nguyen province” Website on the Internet with beautiful and convenient interface, vivid images and rich contents. Main stage (includes maps and main tools) is on the right while side panel (include text, images, links...) is on the left. The Web contains entries, sections, that users simply scroll through. Each section, in turn, is a part of the compelling multimedia story which combines the content with maps, images (e.g. Fig 10a or Fig 10b) or illustrates with a chart (the chart of Fig 10d shows the information about COD of surface water

monitoring points in comparison with national technical regulation of surface water quality). Besides, the users can click a word automatically zooms the section’s map to a particular location (Fig 10c), or open popups for specific features on the map when they are clicked or tapped (Fig 10e).

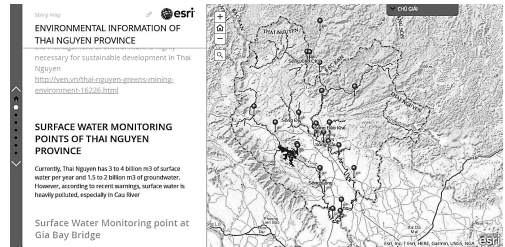


Fig 10a. Displaying the section of Thai Nguyen ‘s surface water

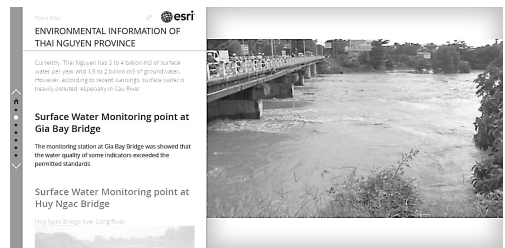


Fig 10b. Displaying a surface water monitoring point in a section of web

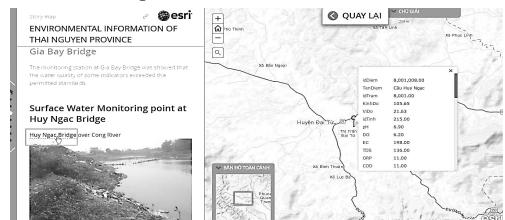


Fig 10c. Displaying a specific location by clicking a highlighted word

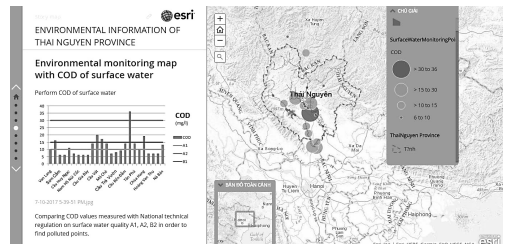


Fig 10d. Displaying the environmental monitoring map with COD of surface water



Fig 10e. Displaying popups for specific feature

Base on online mapping services that are managed and shared, users can exploit information about spatial position of monitoring points by using the tools of zooming out, in, movement; moreover, users can check information attribute by clicking the mouse button on the subject. Based on information from the website, people who want to know information can consult by a computer or other smart equipment that have an internet connection.

4. CONCLUSION

This research used ArcGIS Desktop, ArcGIS Online for establishing and sharing information about environment of Thai Nguyen. Due to database that built on ArcGIS Desktop, an Online map of environmental management was established and declared on ArcGIS application promptly and conveniently which is a relatively simple, close application to users, and assists managers to monitor, control, manage, edit, update the actuality of environment more visually and conveniently in comparison with traditional method.

Research built environmental database of Thai Nguyen including basic information such as position of monitoring points of water surface, wastewater, land, air, disposal site.

ArcGIS Online allows managers and users to get general information about environment, follow state of using, state of environment, consult quality of water, land, air via query tools, establish web map and share for various users. These tools bring many practical benefits, saves time and expense for managers in the sustainable progress of Thai Nguyen.

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Hanoi University of Mining and Geology (HUMG) and the International Society for Mine Surveying (ISM) organize the International Conference on Geo-Spatial Technologies and Earth Resources in Hanoi, Vietnam, from 5th to 6th October 2017 (GTER 2017). The conference is to mark the 50th anniversary of the Vietnam mine surveying education (1967-2017), the special event of Vietnamese mine surveyors.

The conference theme, “Geo-spatial Technologies and Earth Resources” is an invitation to researchers, academics and professionals to present their research results and exchange their new ideas and application experiences face-to-face. GTER 2017 is also an excellent opportunity for attendees to establish research or business relations and to find partners for future collaboration.

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