

# Research on sudden environmental pollution public service platform construction based on WebGIS

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**Abstract.** In order to actualize the social sharing and service of the emergency-response information for sudden pollution accidents, the public can share the risk source information service, dangerous goods control technology service and so on, The SQL Server and ArcSDE software are used to establish a spatial database to restore all kinds of information including risk sources, hazardous chemicals and handling methods in case of accidents. Combined with Chinese atmospheric environmental assessment standards, the SCREEN3 atmospheric dispersion model and one-dimensional liquid diffusion model are established to realize the query of related information and the display of the diffusion effect under B/S structure. Based on the WebGIS technology, C#.Net language is used to develop the sudden environmental pollution public service platform. As a result, the public service platform can make risk assessments and provide the best emergency processing services.

## 1. Introduction

In order to deal with accidental pollution, many countries have set up relevant public service websites, such as the chemical information net CSIN system developed by The United States National Environmental Protection Agency. For major accident consequence analysis, at present, simulation technologies are widely used, using mathematical models to analyse the results. Based on domestic and foreign advanced technologies, the author proposes research on sudden environmental pollution public service platform construction [1-2].

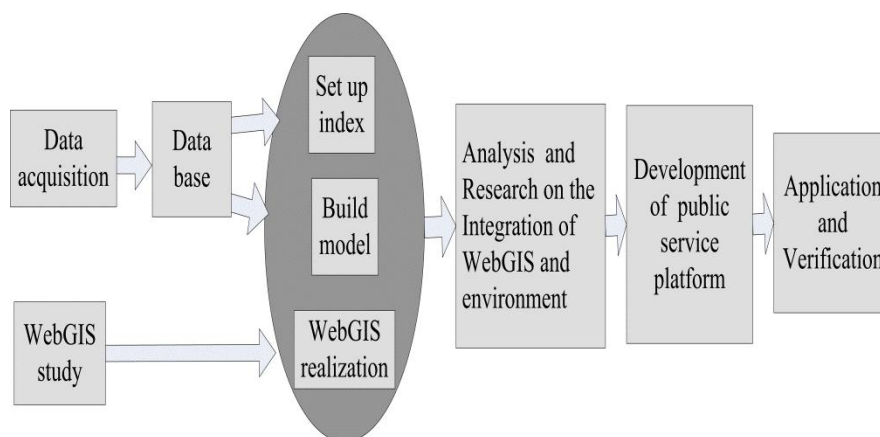
## 2. Technical route

Under the guidance of the idea and method of software engineering, we establish a public service platform based on WebGIS for accidental pollution. The research of WebGIS will combine with environmental risk source investigation, database, modeling and simulation technology. The technical route is shown in Figure 1. WebGIS is commonly used in domestic and overseas for performance of environmental information, and it is proven that the combination between them can complement each other.

Taking the accidental pollution actual location as standard, a mathematical model of simulation and indication is used to combine the GIS with the mathematical model solutions to perform analysis of pollution diffusion from two aspects of space and time and calculate the diffusion area of pollution in each period and analyze the pollution degree of different pollutants and the mass concentration of the pollutant itself to obtain some important information for accidental pollution, such as surrounding



units, population and so on. Thereby, it can obtain influence and range on the surrounding environment of the accidental pollution and provide the corresponding emergency measures.



**Figure 1.** Technology roadmap.

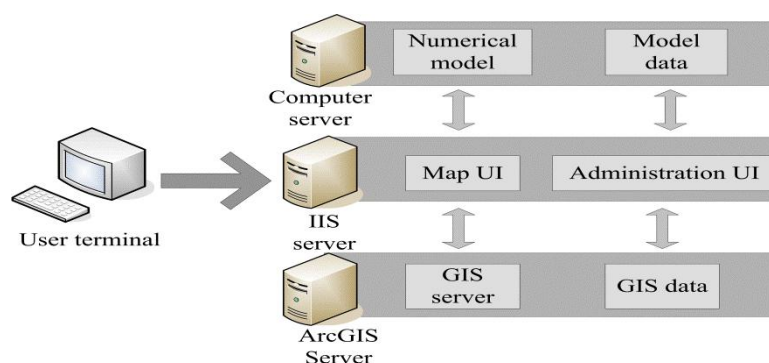
### 3. System design

In combination with the actual work needs, the overall design of the system must meet the needs of users: easy to use, manage and maintain, and must become a powerful tool for them. On the basis of practicality, it also needs to have some advances that are the guarantee of future utility, advanced technology, method, equipment, etc, and it should be used as much as possible to improve the technical level of the system. The development of a public service platform is to realize social sharing and service of the information of sudden pollution accident emergency measures, and abide by the principles of opening and sharing. As a large number of industries and departments are involved in the implementation of the application of large-scale, critical information system applications, so safety and reliability is also essential. The realization of the system should be based on the function and performance index, and then reduce the cost as much as possible. At the same time, we should pay attention to the integrity of the system structure and technical standard, making it easy to carry out a wide range of promotion [3].

#### 3.1. Architecture design

In order to minimize the load on the user terminals, the map processing and computing work should be done as a service, the system uses a B/S structure, the end-user access to the Web server in the browser is used to operate the Silverlight applications.

From the point of construction of the server, the system is distributed on three different logical servers, as shown in Figure 2. Completing a forecast requires three servers to participate: at first, the IIS providing the user interface, receiving the user's query and the forecast parameters of this stimulation, query control module and then tidy data to transfer the request to the computing service; secondly, computing service after the execution algorithm will return the result to the IIS service, but this result cannot be directly displayed on the interface; finally, the IIS service will find the result then deliver it to GIS service processing request, using the results of the calculation service layer, the IIS service will be used to display [4].



**Figure 2.** Information system service distribution.

### 3.2. Database design

The database includes four parts: atmospheric elements, surface water elements, ecological elements and others. Based on existing standards and requirements to organize and classify four types of elements of the relevant data and record it in table form. Atmospheric elements related to data include: pollution source information, air quality monitoring station, atmospheric environment function zone; surface water data elements include: surface water pollution source data, surface water monitoring sections data; data related to ecological factors include: schematic diagrams of the typical ecological protection measures layout, distribution of ecological monitoring, spatial distribution of the ecologically sensitive area, land used maps, project plan, project location map of the area, and the vegetation type map [5].

## 4. Mathematical model and effect

### 4.1. Liquid diffusion model

The model of the surface water uses the recommended model of the "technical guidelines for environmental impact assessment of water environment" (HJ/T2.3-1993) to simulate the distribution of pollutants. In the case of general rivers, the length, depth and width are smaller than real size, the pollutant is discharged into the river, and the water quality of the river is considered to be one of the one-dimensional water quality, which can be considered as one-dimensional water quality [6].

When the rivers flow slowly and the pollutant can move across the river fast, it only be used in the one-dimensional water quality model. According to the principle of the conservation of mass, the basic model of the one-dimensional water quality of rivers is derived from equation (1).

$$\frac{\partial c}{\partial t} + \mu_x \frac{\partial c}{\partial x} = D_x \frac{\partial^2 C}{\partial x^2} - K_1 C \quad (1)$$

In the practical application of the model, according to different pollution sources, it can be divided into a stable release source and an instantaneous release source [7]. The initial conditions and boundary conditions are different, so the calculation model will have some changes. The output on the map is shown in figure 3.

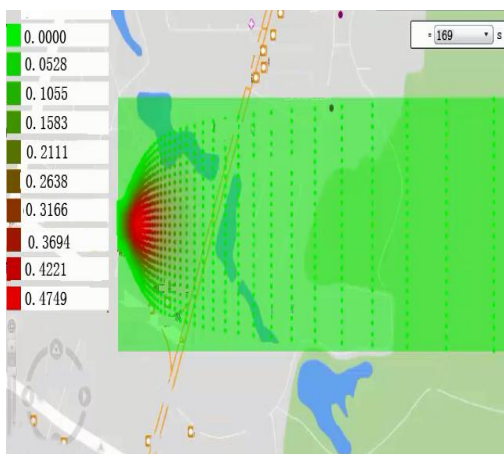
### 4.2. Atmospheric dispersion model

According to the relevant provisions of the "environmental impact assessment technology guide" (HJ2.2-2008), the EPA provides a partial dispersion model for the standard of atmospheric environmental assessment in China. It recommends model SCREEN 3 for the simulation. The SCREEN 3 model can calculate the maximum ground concentration of the surface source pollution source, and the maximum ground concentration under spatial conditions such as buildings, smoke, and so on, which are embedded in a variety of meteorological combination conditions, including some of the most unfavorable weather conditions, while such weather conditions in a certain area are not

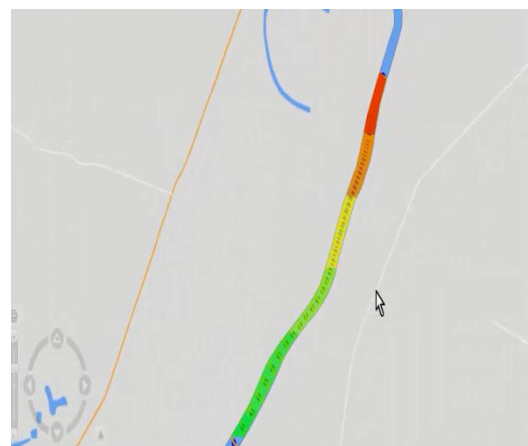
necessary. The calculation of the surface source emissions of pollutants near the ground level can be carried out by equation(2).

$$x = \frac{Q_A K}{2\pi u_s} \int_x \frac{V \cdot D}{\sigma_x \sigma_y} \left( \int_y e^{-0.5 \left( \frac{y}{\sigma_y} \right)^2} dy \right) dx \quad (2)$$

The result of the combination of model SCREEN3 and SLAB are packaged to provide a graphical user's interface that facilitates the operator to input the relevant parameters, invoking the encapsulated model to stimulus after acquiring the users' parameter input. Finally, the system makes a visual output on the map, which is about the pollution source, pollutant information, weather conditions, terrain conditions, and so on, as shown in figure 4.



**Figure 3.** Effect of SCREEN3 diffusion.

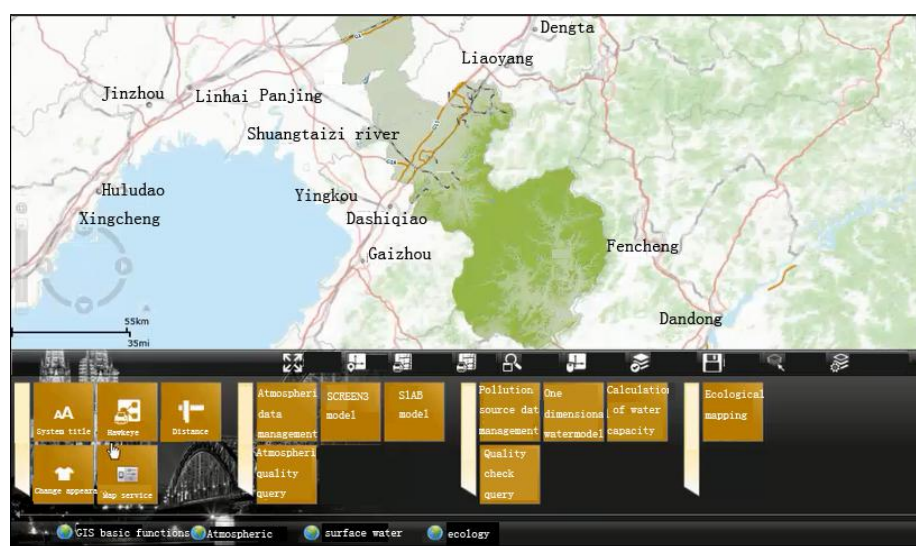


**Figure 4.** Effect of one-dimensional liquid diffusion.

## 5. Main functions and effect

To establish the space database of the risk source and dangerous goods, and the method database of the chemicals and emergency disposal, the risk source information of the space database and the more detailed items will be better. Particularly, the space distribution of the risk source should cover the entire study area. Regular storage and preservation of urban images, the risk sources and their related data storage and updating of dangerous goods is much better than ordinary file management, with its characteristics of timeliness, accuracy, and visibility, among others. Provide free information inquiry services to the public will improve the people's ability to deal with emergencies, and enhance the awareness of self-prevention.

The main function is to develop a public service platform for sudden environmental pollution on the Internet that can provide the public with environmental pollution sources, emergency disposal of dangerous goods, evacuation routes, relevant expert inquiry, air pollution diffusion simulations, water pollution diffusion simulations, pollution assessment and other environmental information integrated services, as shown in figure 5.



**Figure 5.** System main interface.

## 6. Conclusions

The public service platform is the "people's livelihood project", and the public can conveniently obtain the risk source's distribution and characteristics involving their own safety, and can carry out risk assessment simulation analysis. Therefore, it has strong social and environmental benefits. At the same time, the research results can be used in all sorts of cities, which has great economic value and application prospect.

## Acknowledgements

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## References

- [1] Yin F 2005 *Theoretical and experimental study on the diffusion of air pollutants* (Shandong: Ocean university of China)
- [2] Bi T P, Jin C Z, Zhong S J and Shang J H 2010 *Northeastern University (Natural Science)* **11** 56
- [3] Ma Y J 2007 *ArcObjects based spatial data management platform* (Lanzhou: Lanzhou University)
- [4] Erl T 2005 *Service-oriented architecture (SOA)* (London: University College London)
- [5] Zhang W, Guo Y G and Wang J Z 2014 *Northern Environment* **7** 156
- [6] Wang Z F, Zhang S Y, Zhang H C, Zhao H and Ji Y Q 2009 *Environmental Engineering* **6** 100
- [7] Zhang Q, Xu Y X, Li H R and Ying S L 2012 *Yellow River A* **3** 100