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# New innovative directions of GIS application and research in land management

Throughout are planning, development and utilization of land resources in China, Geographic Information System (GIS) technology has unlimited potential in land resource management applications. Land resource management with GIS as the engine to build an intelligent system based on spatio-temporal information processing and 3D model display has become an indispensable presence in land resource management work. The future all-round and cross-platform GIS technology development provides guarantee for the realization of accurate and intelligent management of land resources management in China.

China has entered a critical period of development and construction of natural environmental civilization, which is a new era of vigorous development of ecological civilization construction, and scientific territorial resources planning and construction is indispensable in the process of ecological environmental protection construction, and the future establishment of territorial spatial planning with spatial governance and spatial structure optimization as the core has become a modernization of national governance system and governance capacity in the field of ecological civilization.

In order to achieve this goal, first of all, it is necessary to tap:

– the potential advantages possessed by the homeland spatial data;

– further scientific decision-making deployment by referring to big data analysis;

– making full use of big data to serve the work of homeland spatial planning;

– innovation from the direction of big data;

– management from the direction of big data;

– to achieve scientific planning and effective supervision.

According to the categories of data, planning data, management data, socio-economic data and so on, the basic mapping results covering urban and rural areas, above and below ground, land survey results, geographic census results, mineral resources survey results, various planning results and socio-economic big data and other data related to land space will be converged and integrated to form an interrelated, interconnected and mutually.

The map of natural resources covers the whole area and all elements, which are interrelated, connected and coordinated with each other. Through the use of various types of big data and APIs related to planning applications, it establishes such auxiliary planning tools as:

– the evaluation of resource and environment carrying capacity and the evaluation of suitability of territorial spatial development;

– the auxiliary use control tools for project site selection and compliance analysis;

– the dynamic monitoring and evaluation system;

– providing new digital methods and models for the preparation, approval, implementation and supervision of territorial spatial planning.

New methods and modes are of digitalization.

The program focuses on the core demand of smart city for data opening and sharing, adopts big data, cloud computing, artificial intelligence, Geographic Information System and other technologies, takes geographic entities as the basis, carries natural resources data, fuses government affairs data, integrates urban big data, and establishes a spatio-temporal cloud platform covering the whole process of spatio-temporal data convergence, fusion management, mining analysis and sharing services, forming a digital chassis of smart city for natural resources, government services, industry applications and other fields to provide spatial information services, drive urban planning and construction management, operation, decision-making and other areas of intelligent applications. The city and county unify construction management and promote multi-level collaboration and sharing.

Data managers use spatio-temporal data management system, based on the whole spatial information model, to provide spatio-temporal data management, map management, service management, data distribution, data visualization, metadata management and other tools to adapt to the needs of unified management and dynamic update of spatio-temporal basic data, public thematic data, real-time perception data, Internet crawl data and other multi-source data.

The «one map» platform for ecological and environmental information is a platform that integrates multi-element, multi-temporal and multi-regional basic geospatial data and ecological and environmental thematic data under a unified geospatial framework to form a «set of data» for ecological and environmental information. Based on a basic geographic data base map overlaid with various ecological and environmental management business

data, it can realize the visualization of any ecological and environmental information in any area; based on big data, artificial intelligence and other new generation information technology, it can dig deeper into data information, improve data based on the new generation of information technology such as big data and artificial intelligence, we can dig deeper into the data information, improve data value, focus on ecological environment problems and management difficulties, build a decision management system, and form an innovative management mode of technology-driven and decision making with maps. Finally, we can provide unified sharing services to various business departments, forming a new situation of interconnection, data sharing and business collaboration, and helping ecological environmental protection to step up to a new level, enhance a new level and open up a new situation.

GIS ushers in new opportunities in agricultural and rural development, from agricultural interconnection to cloud-leading counties, creating a top-level design for smart agriculture, transforming and upgrading traditional agriculture into smart agriculture, and using GIS core technology to create a smart agriculture system. The technology is based on Web GIS, Internet+, big data, Internet of Things and multi-source spatial information integration technology to build a set of agricultural meteorological disaster prediction and early warning, monitoring and diagnosis, risk analysis, disaster assessment, technical services as – integrated operational integrated service system. The platform realizes:

– fully automatic big data aggregation and processing;

– full life-cycle disaster progress monitoring;

– all-factor map comprehensive research and judgment and multi-channel refinement service from pre-disaster risk analysis and early warning assessment;

– disaster stumbling monitoring and diagnosis to post-disaster intensity analysis and damage assessment;

– realizes the whole process of agricultural meteorological disaster event stumbling management;

– can provide decision-making reference for agricultural meteorological disaster prevention and mitigation;

– improves the modernization of agricultural meteorological business management and service.

The modernization level of meteorological business management and service are providing timely and targeted meteorological service information for agricultural production departments and agricultural management departments, solving the last-kilometer problem of meteorological service for agriculture, and providing meteorological guarantee service support for agricultural modernization.

The future development of 3D GIS is based on the framework of 2–3D integrated GIS technology, further expanding the 2–3D integrated data model, integrating tilt photography, BIM, laser point cloud and other multi-source heterogeneous data, promoting 3D GIS to achieve outdoor and indoor integration, macro and micro integration and air/sky/surface/underground integration, empowering the full space of 3D Geographic Information System applications.

Cloud GIS technology is based on the development of cloud computing technology and GIS technology integration, from commercial services of VMware technology to open source systems of Open Stack technology, cloud computing technology has long been very good. Nowadays, the popular GIS practitioners are also exploring and accumulating the experience of building, using and managing cloud GIS, releasing quite excellent cloud GIS goods and manufacturing industry solutions according to cloud GIS, and more crucially, the characteristics and framework advantages of cloud computing technology can significantly promote the improvement of traditional GIS utilization.

Cloud computing and big data technologies have brought about radical changes to the GIS software industry, and now AI technology has emerged and brought us numerous surprises. By improving data security, visibility, accuracy, vividness, authority, and extensiveness, the Big Data GIS is designed to enhance the level and quality of information technology, and ultimately achieve the four central goals of:

– sharing and exchange;

– fusion processing;

– security supervision;

– application mining.

So that land resource management can easily experience the unprecedented convenience brought by the Big Data GIS. The spatial data technology used in Big Data GIS is far better than traditional GIS technology in terms of volume and type, and its data update is faster and has more potential for future development, so it is more in line with the current requirements of the world's land resource management work on Geographic Information System technology.

In recent years, GIS technology continues to develop and innovate, the rise of big data GIS and the rapid development of distributed parallel computing clusters and cloud computing technology has shown the way to the future of GIS technology, fast-running computers break through the limitations of traditional technology, leading the future of GIS technology to a better future.

As China's development continues to accelerate and the scale of national land resources development and utilization continues to expand, high-quality land resources development and utilization will assume the historical mission of creating high-quality living space for the people.