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Technical guideline for urban ecosystem monitoring

城市生态系统监测技术指南

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1 Scope

The document provides guidance on the basic principles, the basic procedure, the monitoring objectives, the monitoring contents, the monitoring indicators and methods, and the quality control of urban ecosystem monitoring.

It applies to urban ecosystem monitoring work.

2 Normative references

The clause carries the standard wording on dated and undated references and then lists the documents cited. Among them are GB/T 14848 on groundwater quality, GB/T 18204.3 on airborne micro-organisms, GB/T 33027 on long-term positioning observation of forest ecosystems, GB/T 33703, GB/T 35224 and GB/T 35237 on automatic and surface meteorological observation, GB 50179 on river discharge measurement, HJ 164 on groundwater environmental monitoring, HJ/T 165 on acid deposition monitoring, HJ/T 166 on soil environmental monitoring, HJ/T 193 and HJ 664 on ambient air quality monitoring, HJ 655 on continuous automatic monitoring of PM₁₀ and PM_{2.5}, the HJ 710 series of biodiversity observation guidelines for terrestrial vascular plants, terrestrial mammals, birds, reptiles, amphibians, inland fish, freshwater macrozoobenthos, butterflies, medium and large soil animals and aquatic vascular plants, HJ 915 on automatic surface water monitoring, HJ 1295 and HJ 1296 on aquatic ecological monitoring of rivers, lakes and reservoirs, SL 24 on weir and flume discharge measurement and SL 219 on water environment monitoring.

3 Terms and definitions

3.1 urban ecosystem: the functional whole formed by the interaction between the biological environment, made up of the residents of the city and the animals and plants living in it, and the non-biological urban environment.

3.2 urban ecosystem pattern: the spatial arrangement and combination of the different sub-ecosystems within an urban ecosystem.

3.3 urban ecosystem element: a basic component that makes up the urban ecosystem and can reflect its characteristics. The note explains that this covers the biological elements such as plants, animals and micro-organisms that make up the urban ecosystem, the non-biological elements such as air, water bodies and soil, and the socio-economic elements.

3.4 urban ecosystem process: the process by which the various natural resources of an urban ecosystem, such as matter and energy, take part in the evolution of the system and serve human production and life.

4 Basic principles

4.1 Principle of applicability: the characteristics of the urban ecosystem are taken fully into account and, according to the main objectives, contents and tasks of the monitoring, reasonable indicators of urban ecosystem pattern, elements and processes are selected.

4.2 Principle of operability: the characteristics of the city are considered together and, according to the properties of the monitoring indicators, the operability of manual monitoring methods and of automatic monitoring methods is analysed objectively, so that a technically and economically feasible monitoring method is chosen and the monitoring task can be carried through.

4.3 Principle of scientific soundness: the preliminary preparation, the collection of data and samples and the analysis and organisation of the results are carried out in a scientific and standardised way, so that the accuracy of the urban ecosystem monitoring data is ensured.

5 Basic procedure

Urban ecosystem monitoring includes defining the monitoring objectives and the monitoring tasks, determining the monitoring content, selecting the urban ecosystem monitoring indicators and determining the monitoring techniques and methods. The techniques and methods should be determined according to Annex A and Annex B. The basic procedure is shown in Figure 1.

Figure 1 runs from the definition of the monitoring objectives and tasks, through three parallel blocks of monitoring content - ecosystem pattern with urban land cover and urban

land use, ecosystem elements with biological, non-biological and socio-economic elements, and ecosystem processes with the carbon cycle, the water cycle and the land surface heat balance - to the selection of the monitoring indicators and finally to the determination of the monitoring techniques and methods.

6 Monitoring objectives, contents, indicators, techniques and methods

6.1 Monitoring objective: remote sensing techniques, ground survey, fixed-point monitoring and data integration are applied together to obtain data on the elements, the pattern and the processes of the urban ecosystem, providing information and a scientific basis for urban ecological assessment, planning and management and for the social activities of the residents.

6.2.1 Urban ecosystem pattern monitoring: the content covers two kinds of monitoring, land cover and land use. Urban land cover monitoring is mainly concerned with the area and distribution of urban green space, water bodies and impervious surfaces; green space includes woodland, shrub and lawn, water bodies include rivers and lakes, and impervious surfaces include roofs, roads and squares. Urban land use monitoring is mainly concerned with the area and distribution of functional zones such as parks, residential areas, roads, schools, commercial districts and industrial districts.

6.2.1 continued: the types of cover and of land use are determined mainly through the analysis of high-resolution remote sensing data and ground GPS positioning. The remote sensing data are analysed by visual judgement or by supervised and unsupervised classification of the interpreted imagery, with a spatial resolution finer than 10 m, and are combined with ground verification to draw up distribution maps of urban land cover and land use. Table 1 has four columns - monitoring content, monitoring object, monitoring indicator and technical method - and pairs each object, that is urban green space, water bodies and impervious surfaces under land cover and parks, residential areas, roads, schools, commercial districts and industrial districts under land use, with the same indicators, area and distribution, and with one technical method: use of high-resolution remote sensing data with a spatial resolution finer than 10 m, visual interpretation and object-oriented classification, extracting land cover and land use information step by step through image segmentation.

6.2.2 Urban ecosystem element monitoring: the content covers the biological elements, that is plants, animals and micro-organisms, the non-biological elements, that is air, water bodies and soil, and the socio-economic elements. Among the biological elements, urban plants are monitored mainly for the community composition, growth, phenology and pollen of terrestrial plants and for the species and quantity of aquatic plants such as aquatic vascular plants and phytoplankton; urban animals are monitored mainly for the species and quantity of terrestrial animals such as birds, small mammals, amphibians, reptiles, insects

and soil animals, and for the species and quantity of aquatic animals such as fish, zooplankton and macrozoobenthos; micro-organisms are monitored mainly for the species and the relative abundance or colony count of soil and airborne micro-organisms.

6.2.2 continued: among the non-biological elements, air monitoring is mainly concerned with meteorological elements, weather phenomena, air quality, dry deposition and wet deposition; water body monitoring is mainly concerned with the hydrology and the water quality of surface water and groundwater; soil monitoring is mainly concerned with the concentration of soil nutrients, heavy metals and organic pollutants. The socio-economic elements are mainly the social factors, chiefly population, and the economic factors of living standards and economic development. Population is surveyed mainly for its size and structure, living standards refer mainly to household income and living expenditure, and economic development concerns mainly gross domestic product and industrial structure. Table 2 has five columns - monitoring content, monitoring object, first-level indicator, second-level indicator and technical method - and refers the technical method of every line to a subclause of Annex A.

6.2.3 Urban ecosystem process monitoring: the monitoring concentrates on the main urban processes, the carbon cycle, the water cycle and the land surface heat balance. For the carbon cycle the focus is on biological production, productivity and carbon flux; for the water cycle it is on evapotranspiration, tree transpiration and the surface runoff process; for the land surface heat balance it is on the heat balance process of the underlying surfaces of urban roofs, roads and green space. Table 3 has four columns - monitoring content, first-level indicator, second-level indicator and technical method - and refers the technical method of every line to a subclause of Annex B.

7 Quality control

7.1 Monitoring equipment: in order to safeguard the quality of the monitoring data, the monitoring equipment should be maintained and serviced on schedule. Item a) requires that instruments and equipment be maintained on schedule and that a corresponding inspection, maintenance and servicing plan be drawn up according to how often the equipment is used or to the specific requirements of the manufacturer's manual. Item b) requires that the servicing process and the relevant technical parameters of the instruments and equipment be placed on record as the basis for routine repair, and that, where an instrument has been left unused for a long time, a power-on check and cleaning be carried out at regular intervals.

7.2 Monitoring personnel: in order to raise the standardisation of the monitoring and the quality of the data, the monitoring technicians should be given periodic training and guidance. Item a) requires them to take part conscientiously in the operating training and study for the key equipment. Item b) requires them to master the operating procedures of the key equipment, to comply strictly with the rules for the use and maintenance of the