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Progress on Network of Field Observation and Research Stations for Natural Resource

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Natural Resources

Disciplines

Geography Geoscience Geology Tectonic geology Exploration for resources

Skills and expertise

Integrated natural resources surveys
Integrated evaluation of natural resources
Regional geological and mineral survey
Exploration and evaluation of mineral deposits

Technology for
the Future

A community of life
for human and nature

Technology for
the Future



1. Scientific Essence & National Strategic Needs
2. Concept of Natural Resource Field Observation Station Network
3. Framework of Natural Resource Field Observation Station Network
4. Application Example of Natural Resource Field Observation Station Network
5. Prospects

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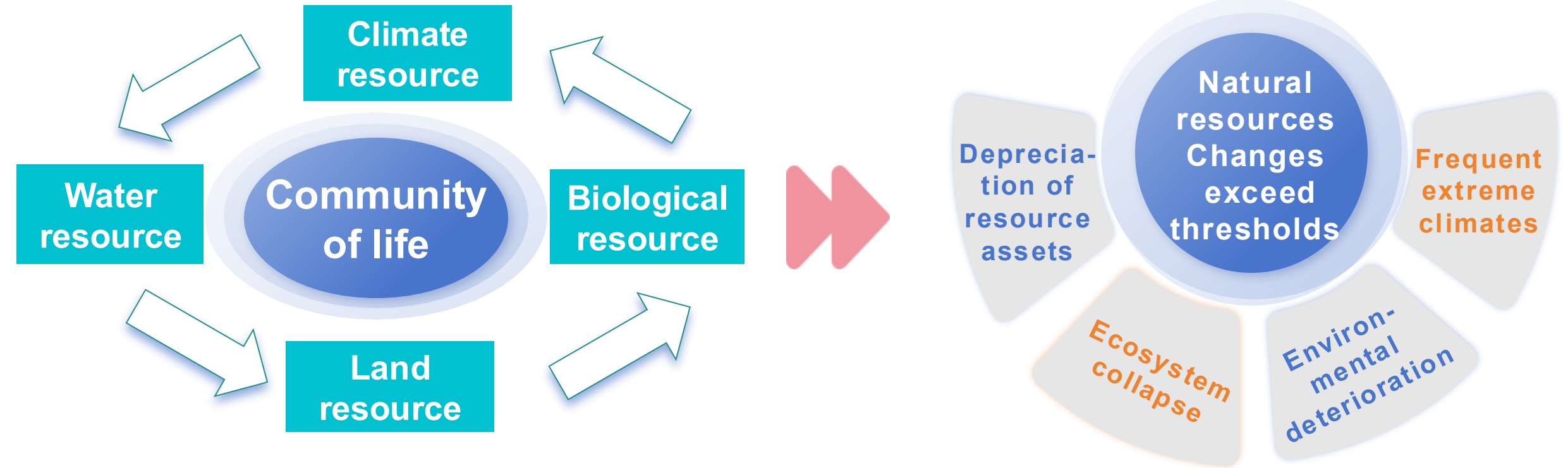
(1) Scientific Essence : Scientific connotation and strategic significance



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The Earth's Water resources(hydrosphere), Land resources(pedosphere), Climate resources(atmosphere), and Biological resources (biosphere) are interconnected.

A natural resource change exceeds a certain threshold could lead to complex problems of resources and ecosystems

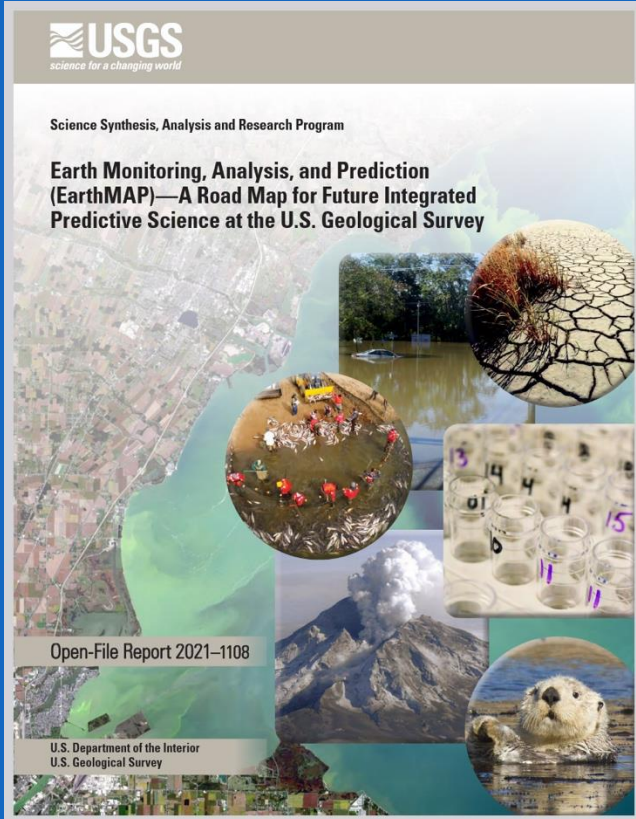
(1) Scientific Essence : Scientific connotation and strategic significance



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USA: EarthMAP Program (2020—2030)



China: Habitable Earth Program (2021—2030)

To address these issues, the international community has launched a number of initiatives and put forward a series of scientific research frameworks for resources and ecology based on the process of "observation – experiments – analysis – modelling– decision support":

- **USA:** *Earth Monitoring, Analysis, and Prediction (EarthMAP) (2020—2030)*
- **China:** *Strategy for the Development of Earth Sciences: The Past, Present, and Future of a Habitable Earth (2021—2030)*

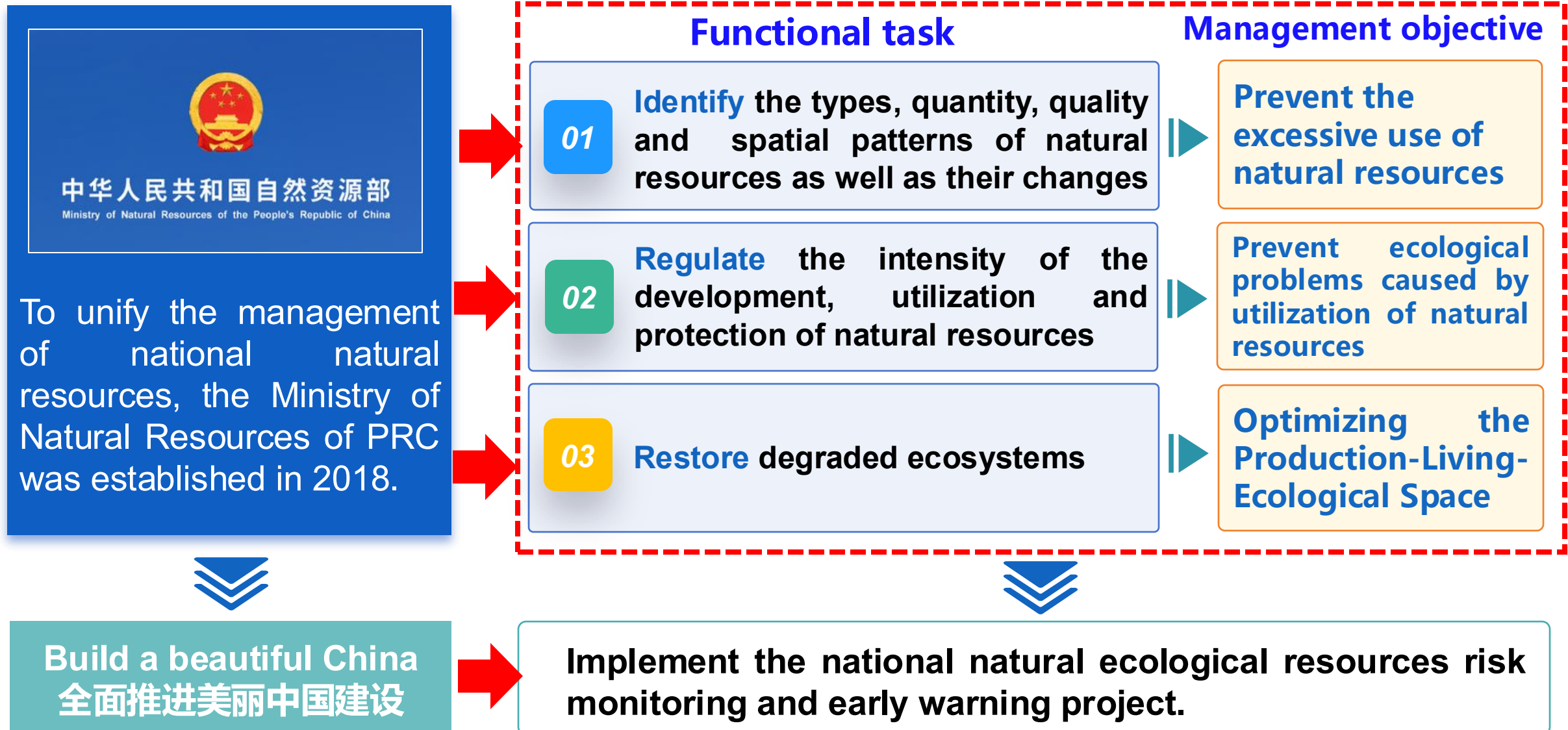
(2) National Strategic Needs



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VS



Physical examination of
human being

Physical examination of
Natural resources and ecosystem

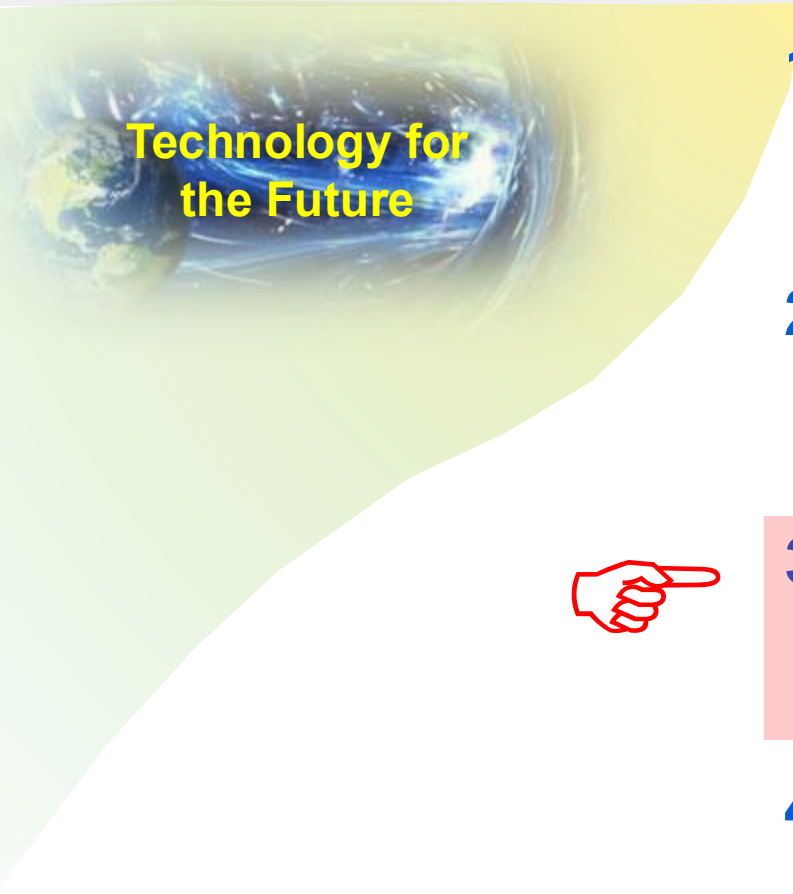
Physical examination of **Natural resources and ecosystem** :
Why? How? Who?

Idea of Field Observation Network— Physical examination of Humans VS Natural Resources & Ecosystem



Category	Sampling analysis	Continuous monitoring	Key indicators	Scenario Categories	Measures
Humans 	Routine blood/urine tests	Ultrasound (B-mode), X-ray fluoroscopy, electrocardiogram (ECG), etc.	Height, weight, hearing, vision, etc.	Healthy	No intervention
				Potential	Regulate lifestyle
				Mild	Medical intervention
				Severe	Treatment
Natural Resources & ecosystem 	Field sampling of water, soil, forests, and grass	① Water: flow rate, velocity, water level, etc.	Water: river channel, shoreline, etc.	Safety	Development
		② Soil: temperature, respiration, moisture, infiltration, etc.	Soil: profile structure, etc.	Potential	Protection
		③ Forests/grasslands: phenology, biomass growth, evapotranspiration, etc.	Forests/grasslands: stand structure, community trait, etc.	Severe	Restoration
		④ Atmosphere: precipitation, temperature, wind speed, etc.	Atmosphere: climate zone		

To **perceive** changes in natural resources and ecosystems, **quantify** the status of resource development and utilization, provide timely **early warning** of change-related risks, **establishing an observation stations network of natural resources** is needed.



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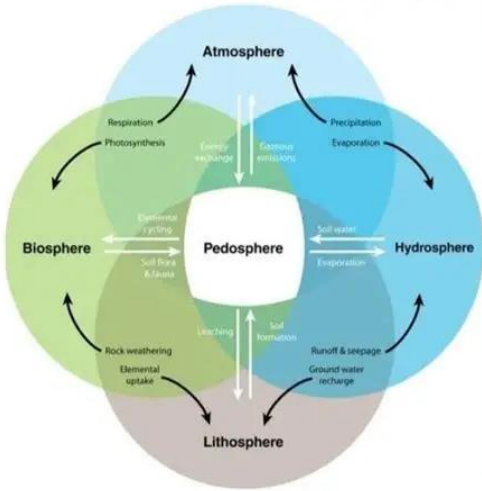
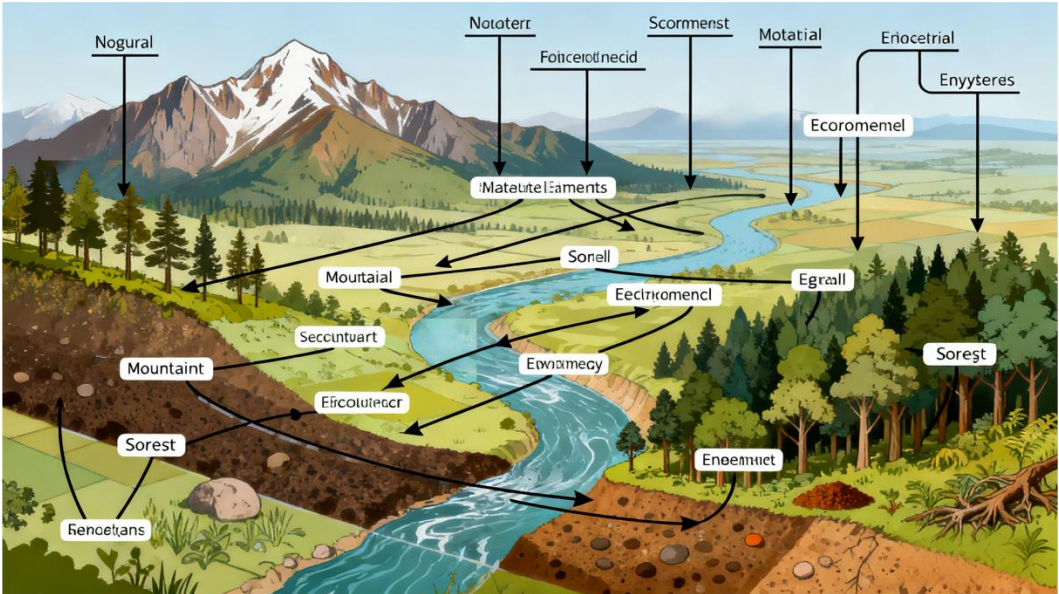
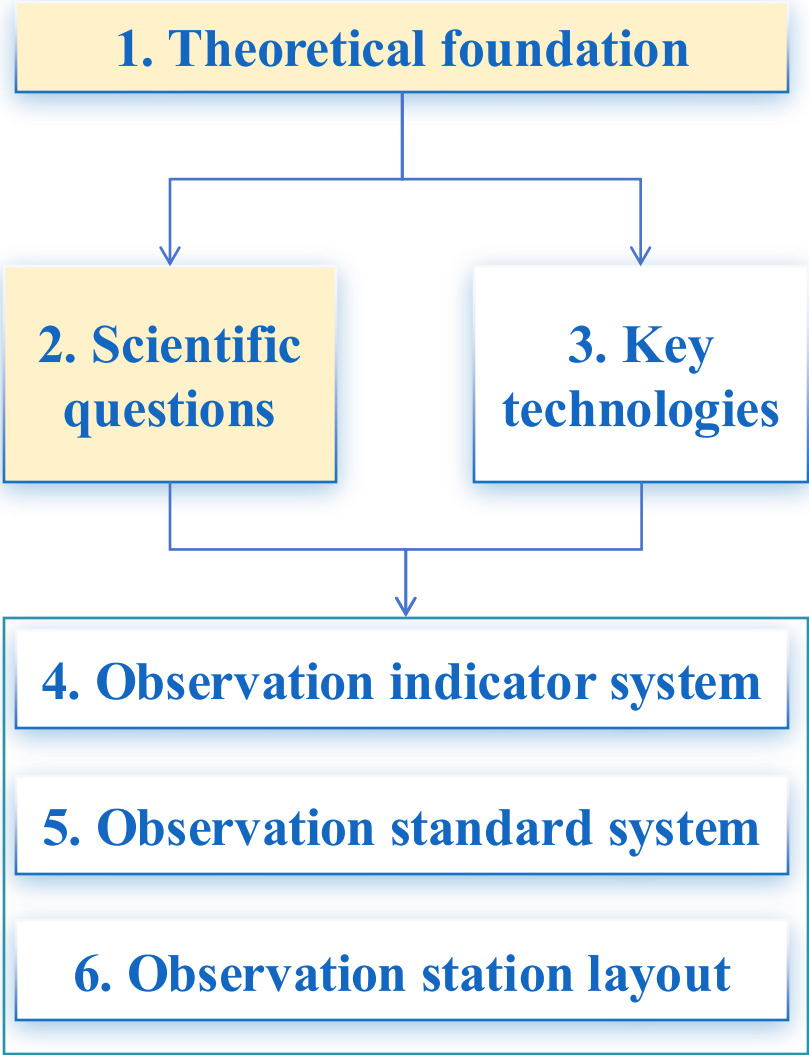
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3. Framework of Observation Networks

Theoretical foundation and Scientific questions



1. Key theoretical point

Natural resources, ecosystems, and environment form a complex and integrated whole (system), linked by geographic elements.

2. Key question:

What effects will changes in natural resources have on ecosystem structure/functions and natural resource assets? How to perceive and predict these effects?

3. Framework of Observation Networks

Key technologies



1. Theoretical foundation

2. Scientific questions

3. Key technologies

4. Observation indicator system

5. Observation standard system

6. Observation station layout

- **Collaborative Observation Technology:** Multi-scale integration of satellite remote sensing , aerial remote sensing, ground station networks, and mobile observations.
- **Full-process Technology:** a closed-loop process consisting of **observation and experiment** → **process modelling** → **prediction and evaluation** → **intelligent decision-making**.



3. Framework of Observation Networks

indicator system



Key Observation Indicators

- **Climate resource:** precipitation, sunshine duration, temperature and humidity.
- **Biological resource:** evapotranspiration, coverage (NDVI), leaf area (LAI), carbon fixation (NPP). Diameter at breast height, tree height, age, stemflow and sap flow, litter thickness, litter moisture, degree of decay, community.
- **Land resource:** Moisture, temperature, N, P, K content and pH, organic matter content, runoff, infiltration.
- **Water resource:** flow rate, flow velocity, water level and quality. glacier thickness, glacier ablation rate, thickness of the permafrost active layer

Mainly study the structural allocation of natural resources (types, quantity, quality, and so on), and their ecological functions.

1. Theoretical foundation

2. Scientific questions

3. Key technologies

4. Observation indicator system

5. Observation standard system

6. Observation station layout

3. Framework of Observation Networks

standard system



1. Theoretical foundation

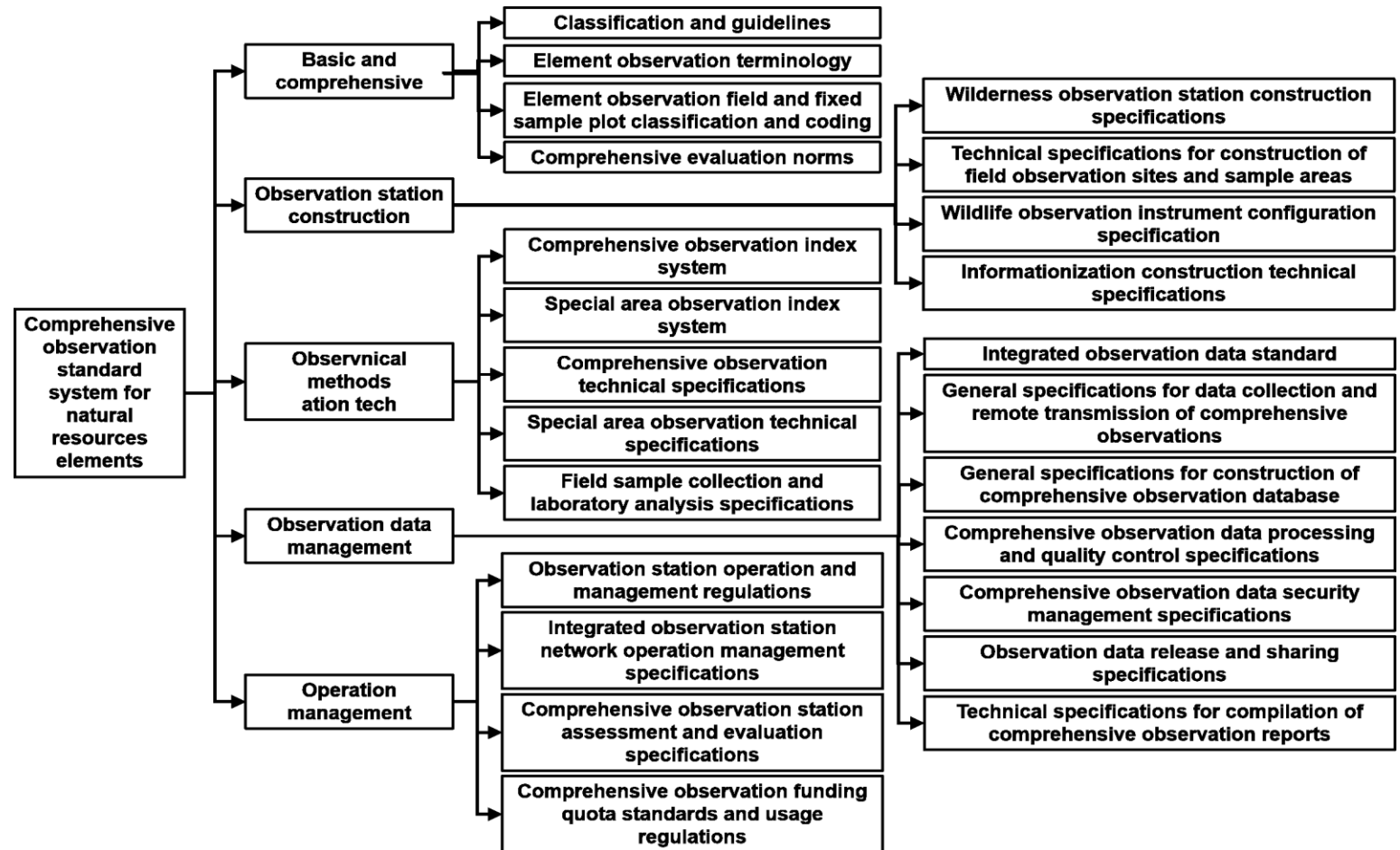
2. Scientific questions

3. Key technologies

4. Observation indicator system

5. Observation standard system

6. Observation station layout



Standard system of **Observation Networks** includes **five** major categories (station network construction, data collection, modelling, product services, and operational mode) and **25** documents.

3. Framework of Observation Networks

station layout



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1. Theoretical foundation

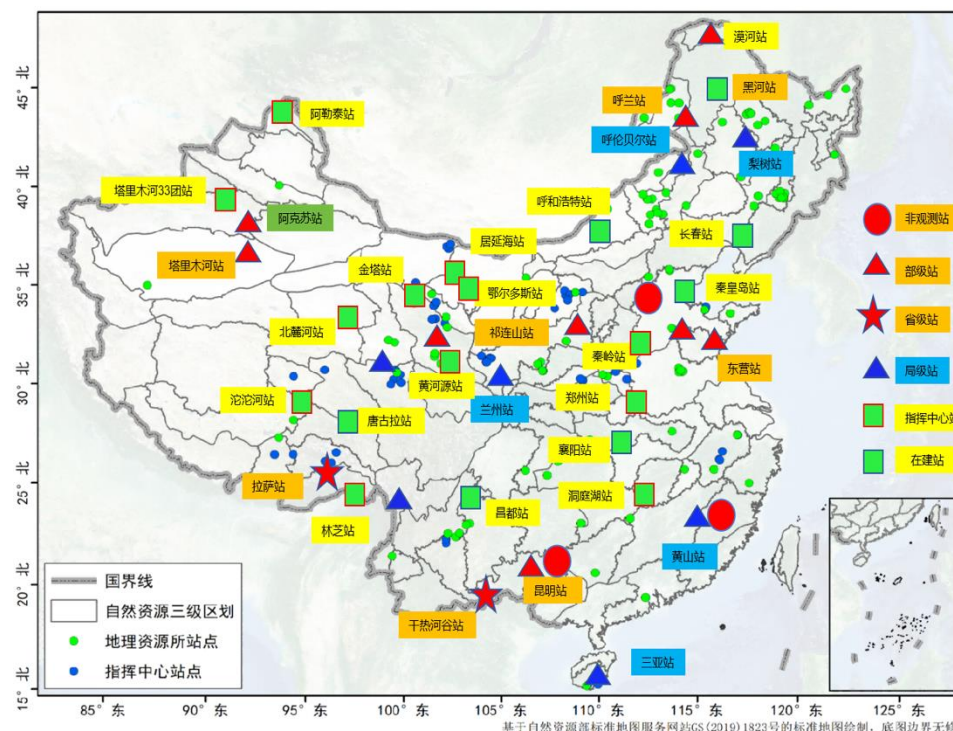
2. Scientific questions

3. Key technologies

4. Observation indicator system

5. Observation standard system

6. Observation station layout



Since the start of Natural Resource Field Observation Station Network in 2019, we have formed a three-level network:

- ✓ **11 Main stations** (100% coverage)
- ✓ **25 Sub-stations** (25% coverage)
- ✓ **200 Observation points** (25% coverage)

(1) Bottom-layer, serving for research

- ◇ **Main stations:** control Level-1 zoning (11 in total)
- ◇ **Sub-stations:** control Level-2 zoning (105 in total)
- ◇ **Observation points:** control Level-3 zoning (800 in total)

(2) Top-layer, serving for Management

Main stations, Sub-stations, Observation points, dynamic monitoring points

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National Demands
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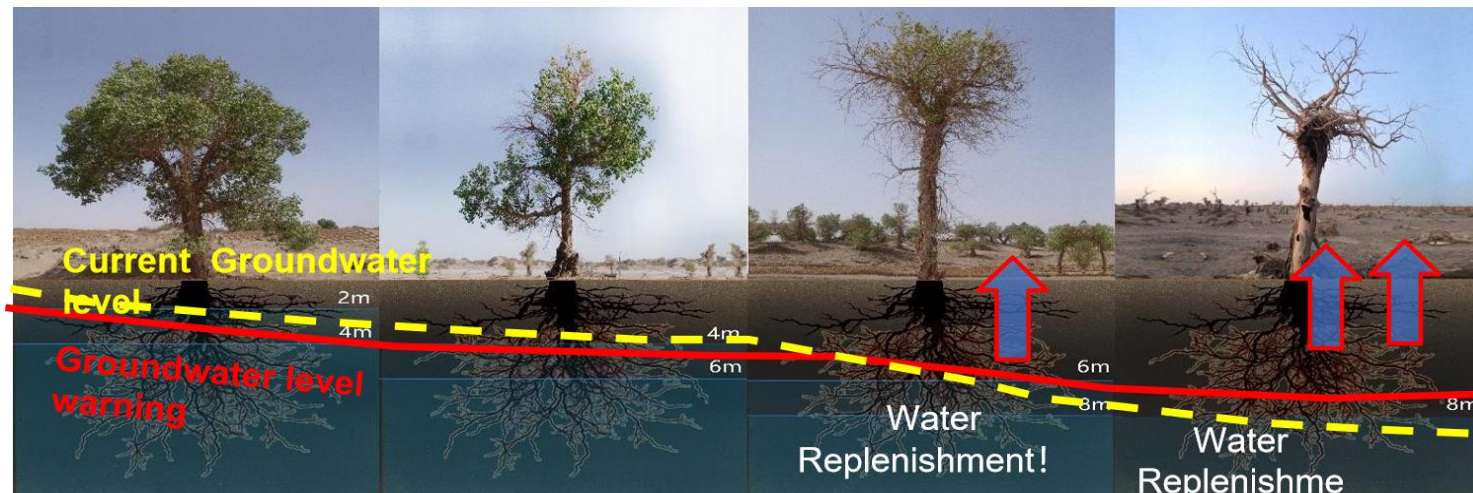
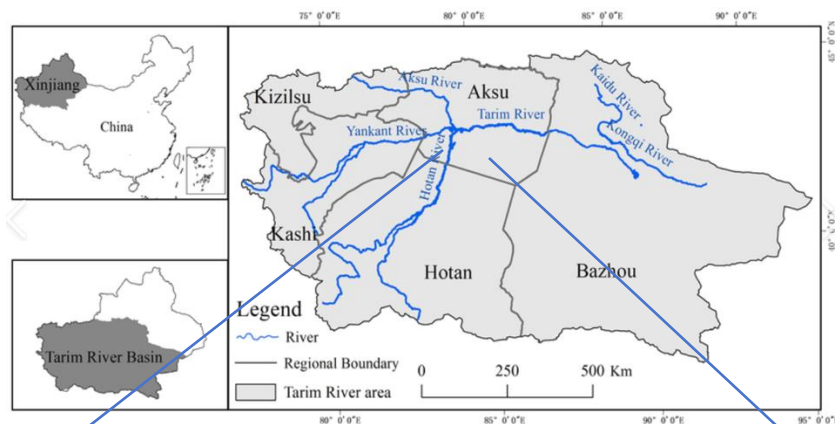
4. Application example



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Forest stage of <i>Populus euphratica</i>	Groundwater safety warning level (m)
Young	4.0
Near adult	5.0
Adult	6.9
Old	7.8

Based on this observation network, we investigated the relationship between the growth of *Populus* forest of different ages and the duration of groundwater level persistence in the Tarim Basin.

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5. Prospect—Form four unities



01

An observation network covering national-level tertiary zones

02

A set of long-term continuous observation datasets

03

A full-process standards and specifications system

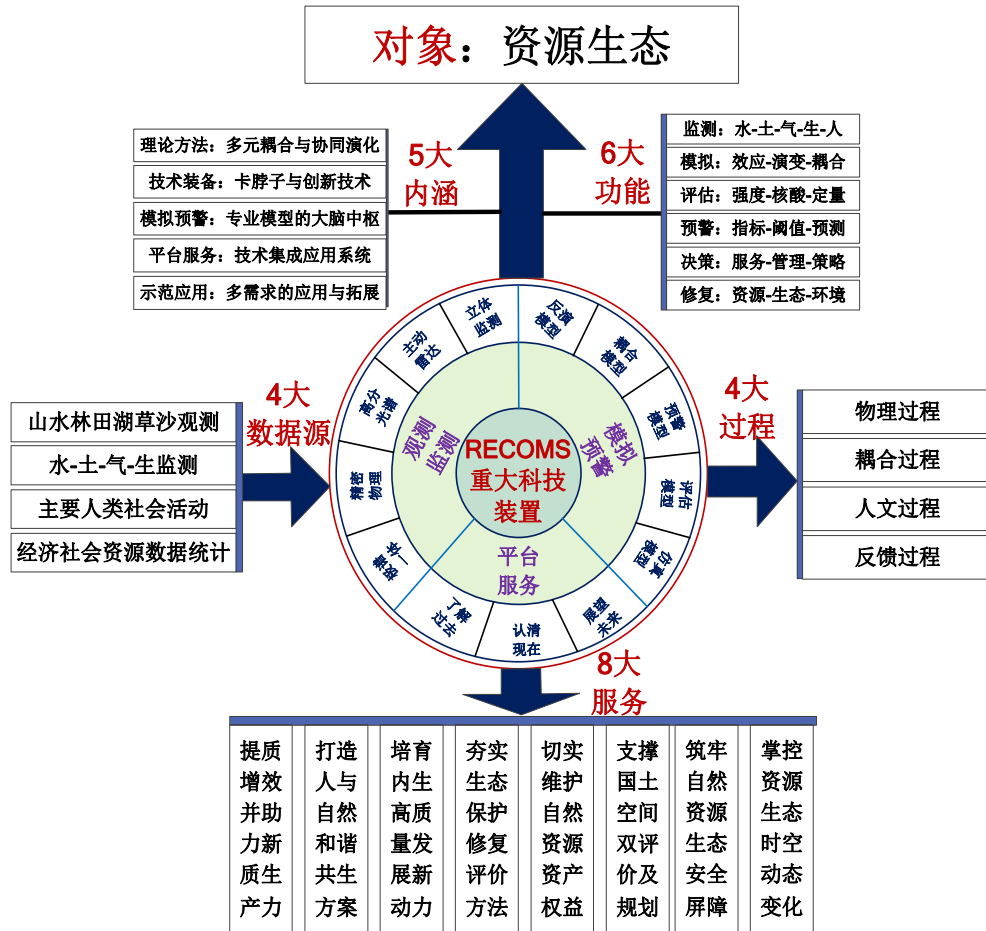
04

A theoretical model of natural resource change effects



Support scientific research and management in natural resources and related fields

5. Prospect——Build “RECOMS”



- ◇ **Research Objects:** Nature resources and Ecosystems
- ◇ **5 Core Connotations:** Theory&Methods, Equipments, Modelling&Early Warning, Data Platform&Services, Pilot
- ◇ **6 Major Functions:** Monitoring, Modelling, Assessment, Early Warning, Decision-making, Restoration.
- ◇ **4 Major Data Sources:** Ecological observation, Monitoring, Human activities, Socio-economic statistics
- ◇ **4 Key Processes:** Physical Process, Coupling Process, Human Process, Feedback Process
- ◇ **8 Major Services:** New-quality productive forces, solutions for harmonious coexistence, high-quality development, harmonious coexistence between man and nature, ecological restoration, natural resource assets, territorial spatial planning, ecological security, dynamics of natural resources

Build RECOMS

Resource Ecosystem Cooperation Observation and Monitoring System (RECOMS), a China-led Large-scale Scientific Observation Facilities



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Thanks for your attention!

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