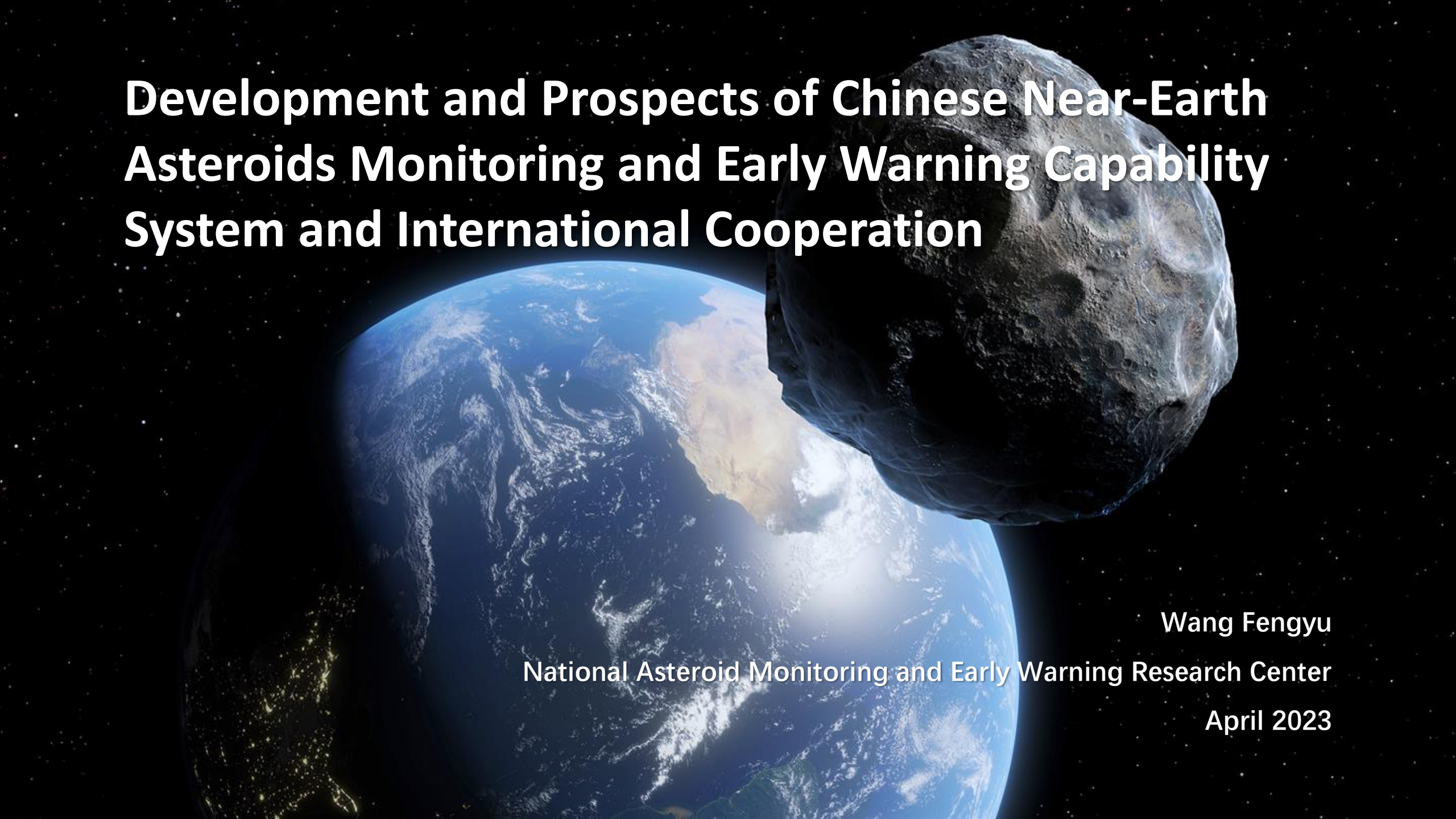
Development and Prospects of Chinese Near-Earth Asteroids Monitoring and Early Warning Capability System and International Cooperation



Wang Fengyu

National Asteroid Monitoring and Early Warning Research Center

April 2023

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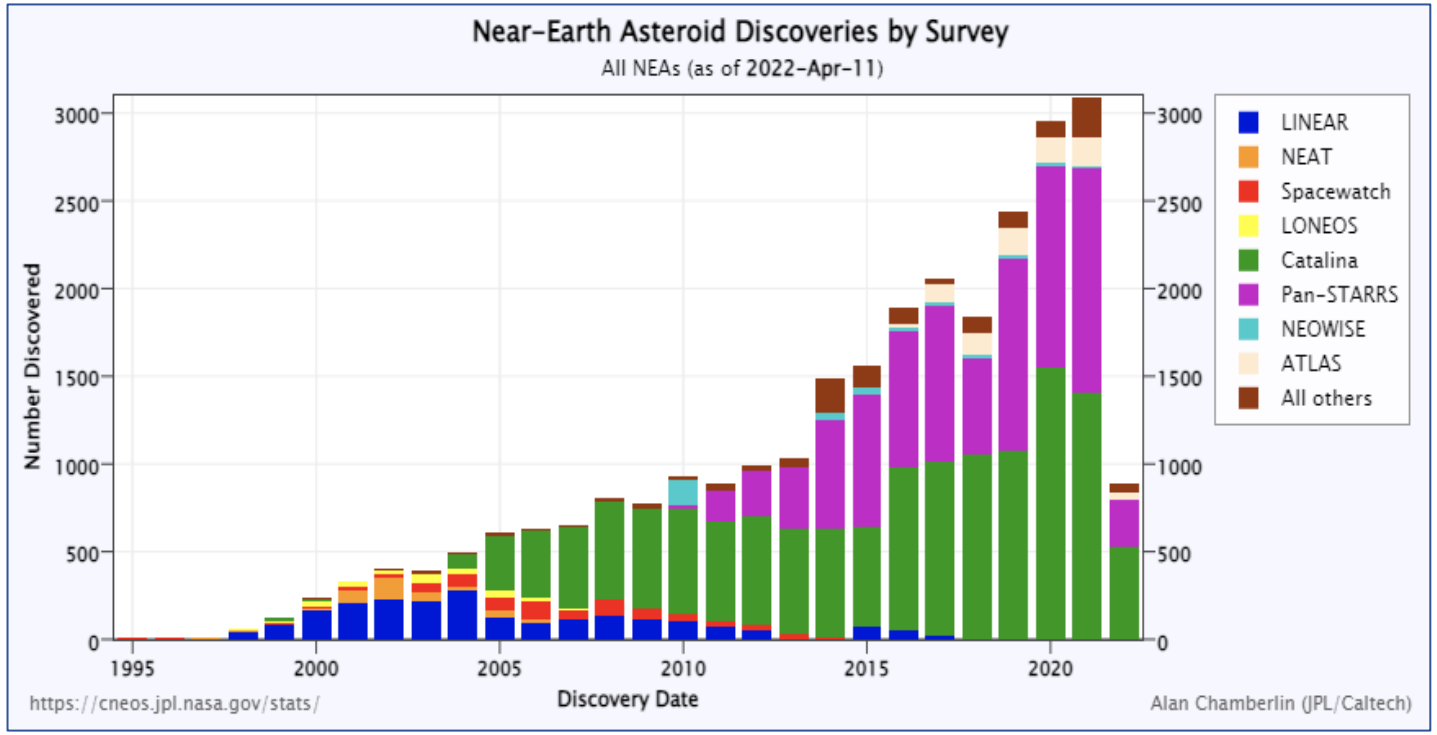
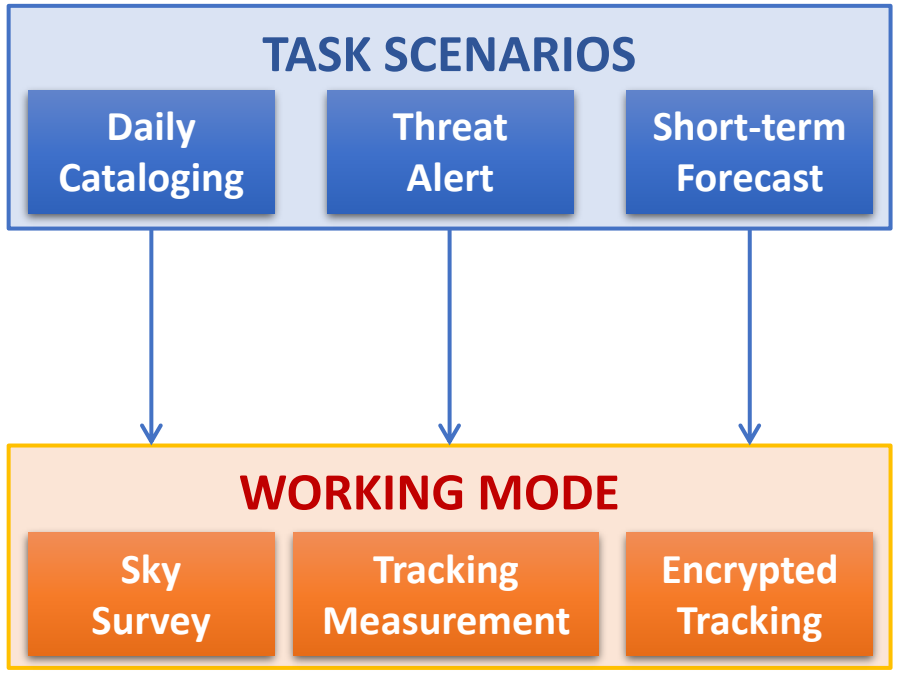
(1) Current Status of Near-Earth Asteroids Cataloging



Equivalent Diameter	Rank of Disaster	Theoretical Quantity	Discovered Rate
1000m	Global	940	94%
140m	Region	27k	34%
50m	Large City	**210k**	**3.7%**
20m	City	**500k**	**1.3‰**

(2) Requirement Analysis for Monitoring and Early Warning



NEA's Monitoring and Early Warning System Mission:

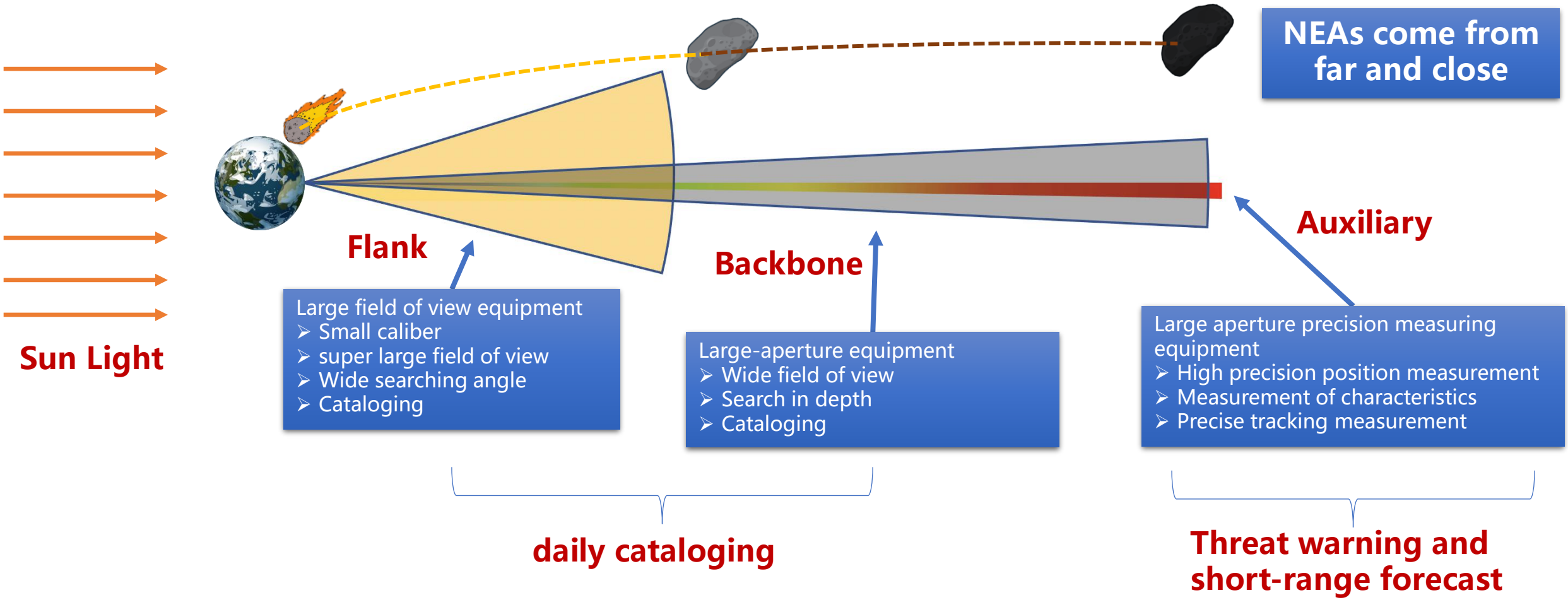
① For unknown NEAs:

- Wide-area sky survey
- Alert the proximity

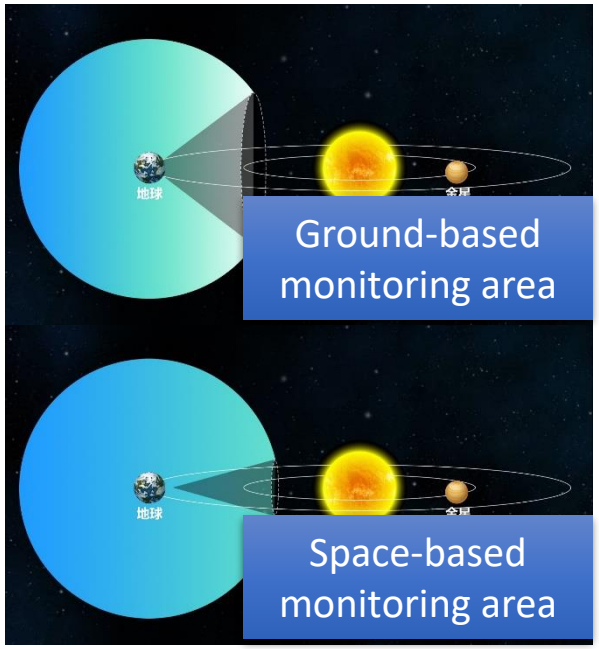
② For discovered NEAs:

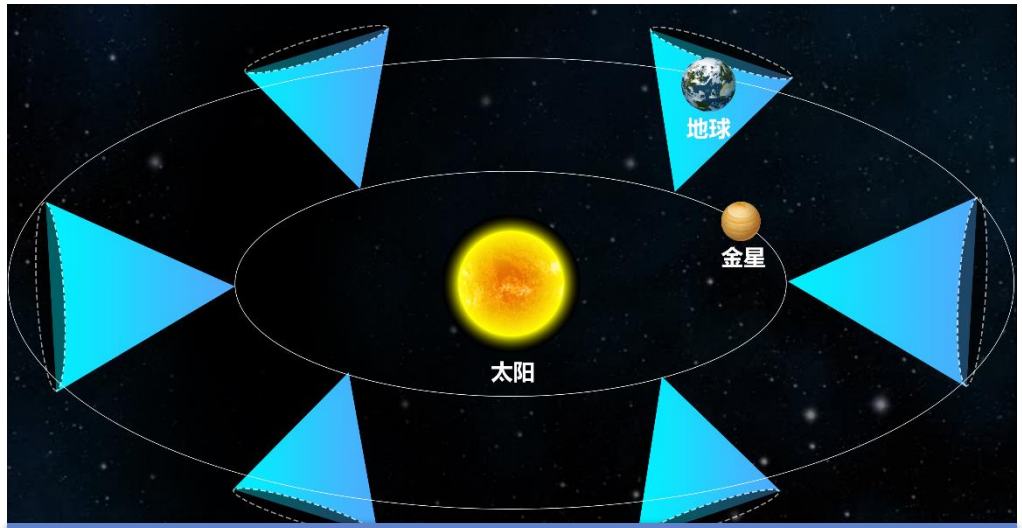
- Tracking and precise measurement
- Encrypted tracking to realize "**precise warning**"

(3) Ground-based monitoring requirements

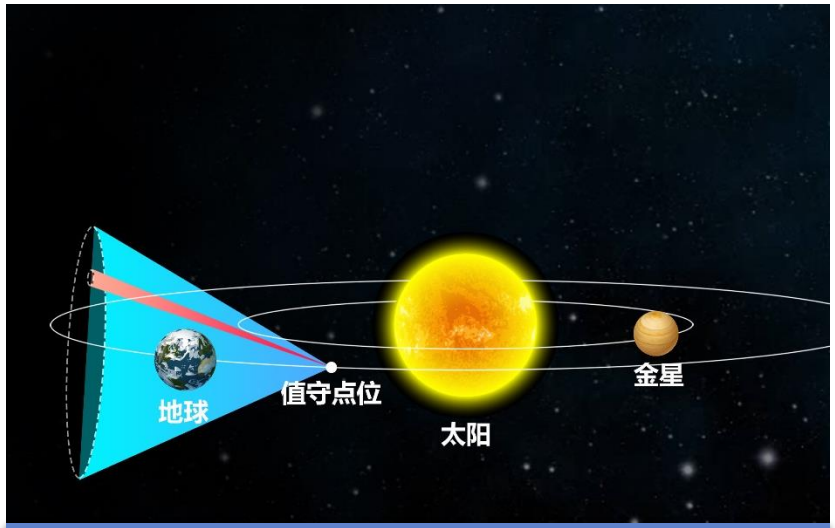


(4) Space-based monitoring requirements





the deployment around the Sun-Earth network patrol orbit



the deployment of stable watch points relative to the sun and earth

daily cataloging

Threat warning and short-range forecast

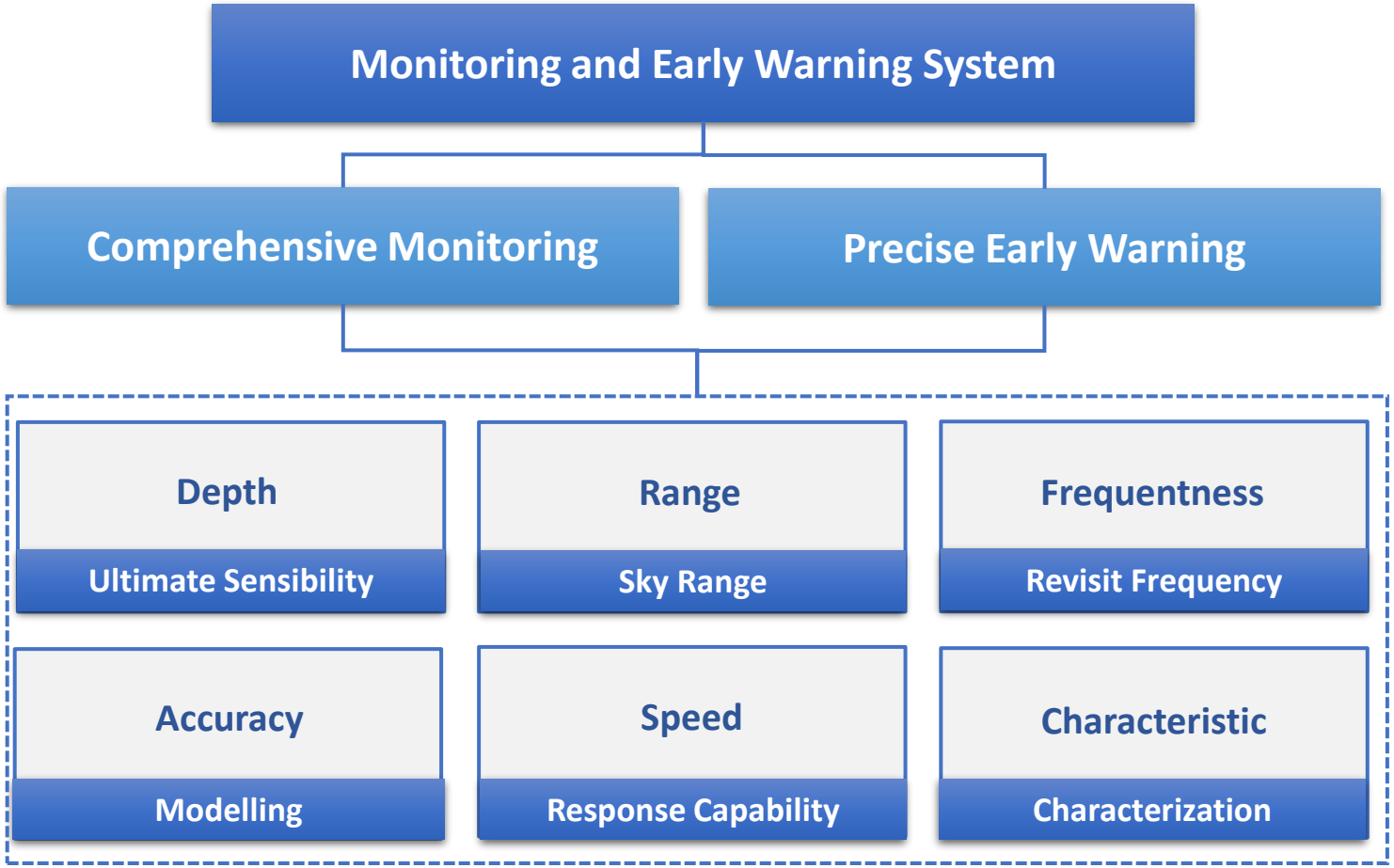
(5) Early warning service

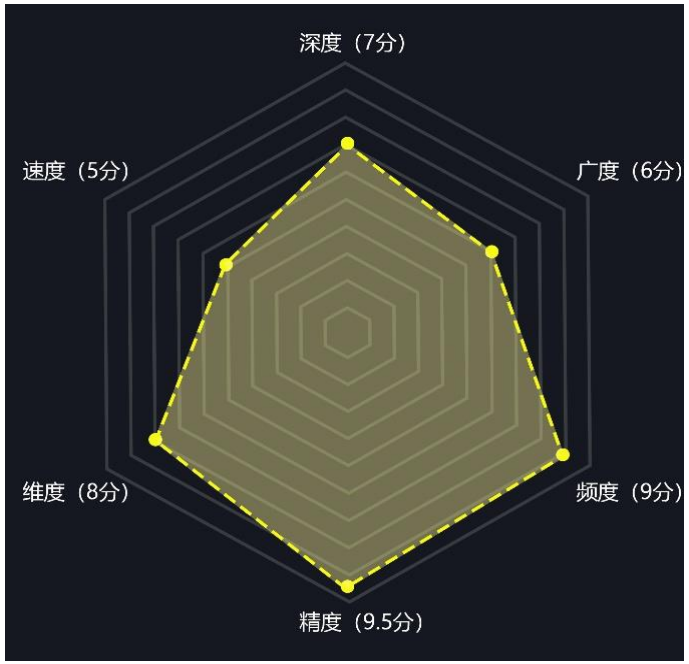
"**Five Precise**" early warning services to assess the risk of asteroid impact:

Asteroids Impact Risk Early Warning

Precise Orbit Determination	**Precise** portrayal characteristics	**Precise** Rendezvous Prediction	**Precise** Risk Warning	**Precise** Hazard Assessment
To determine the initial orbit of near-Earth asteroids and precise orbit determination.	To describe multi-dimensional characteristics such as rotation, shape and material.	To accurately forecast the Earth's rendezvous event within 200 years.	To accurately calculate the asteroid impact probability and impact area.	To accurately assess air burst and surface impact hazards.

(6) Chinese monitoring and early warning system





The Capability Value Diagram

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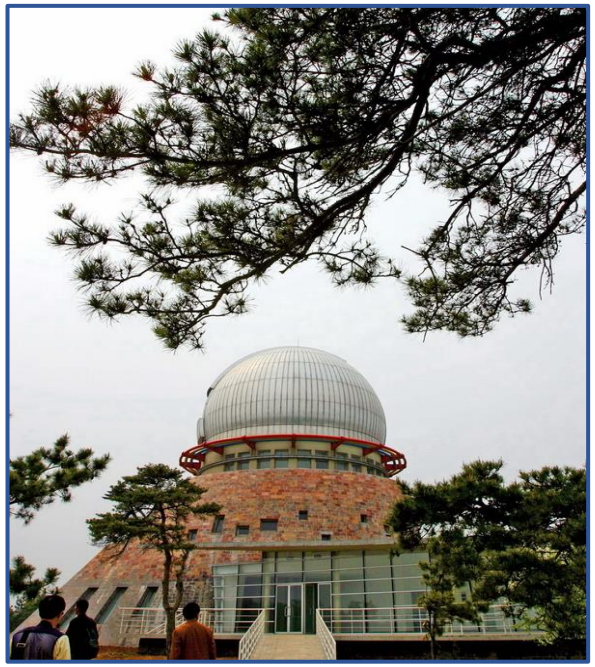
2.Latest Status

(1) China's monitoring and early warning capabilities — Specialized

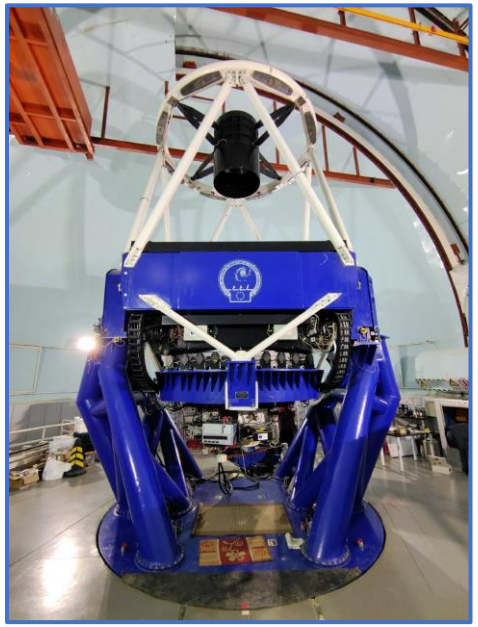


At present:

- China has one specialized **1-meter aperture** monitoring equipment
- More than **30 near-Earth asteroids** have been discovered, ranking 6th

2.Latest Status

(2) China's monitoring and early warning capabilities — Dual-use Telescopes



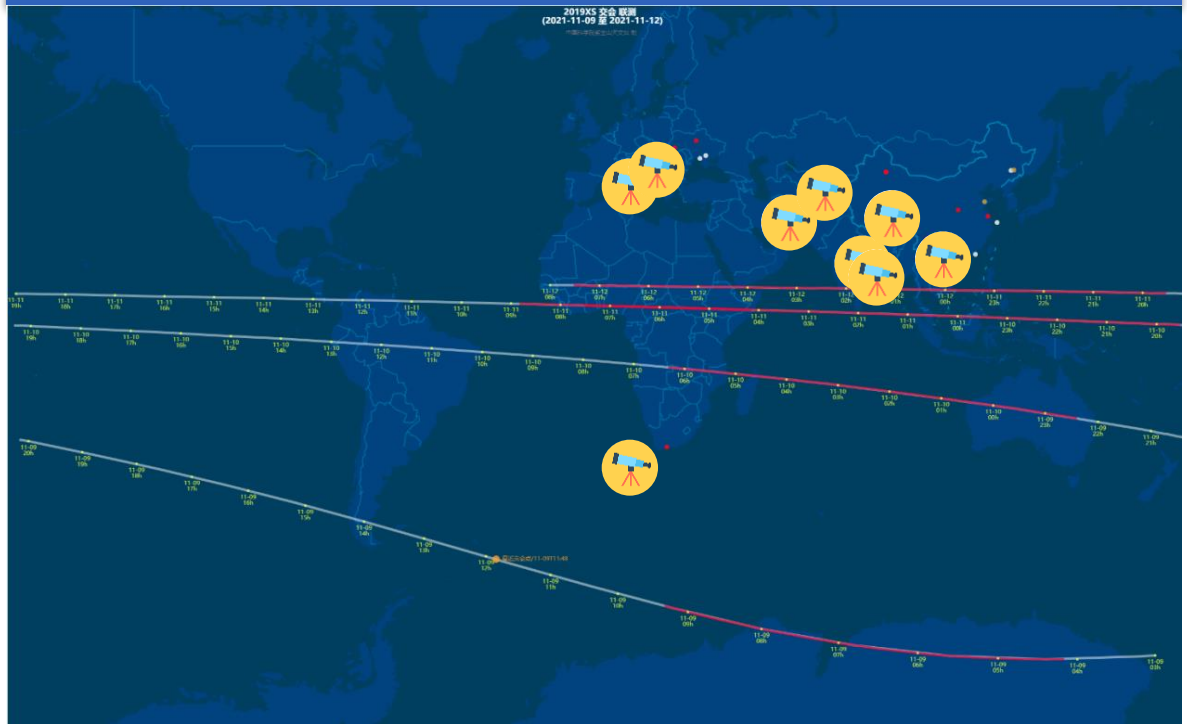
Lijiang 2.4m

Xinglong 2.16m

Yao’an 0.8m

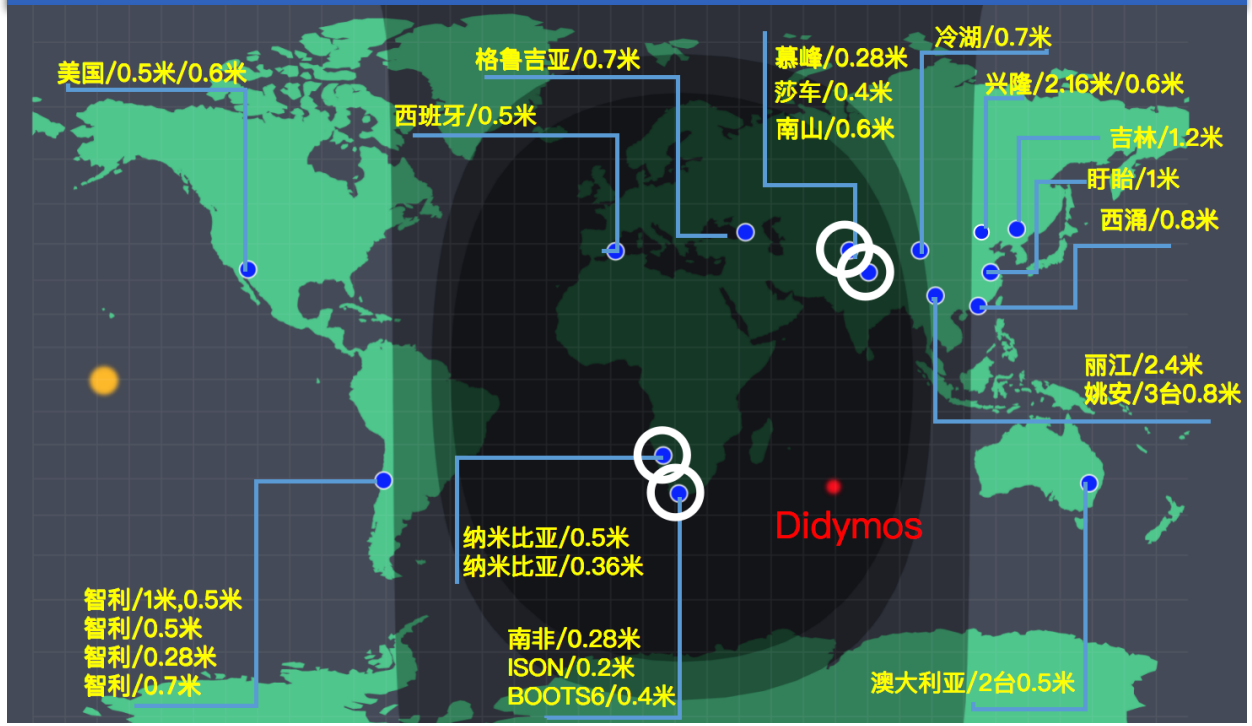
(3) Chinese major international cooperation - Joint Survey

IAWN-2019XS Joint Survey



- Participate in conducting IAWN 2019XS joint survey activities.

DART-Didymos Joint Survey



- A total of 43 domestic and foreign telescopes were organized to conduct joint measurements of the DART mission.

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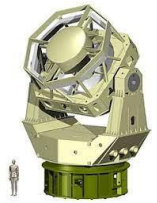
3.Prospect

(1) the development of ground-based monitoring capacity system vision

Daily Cataloging



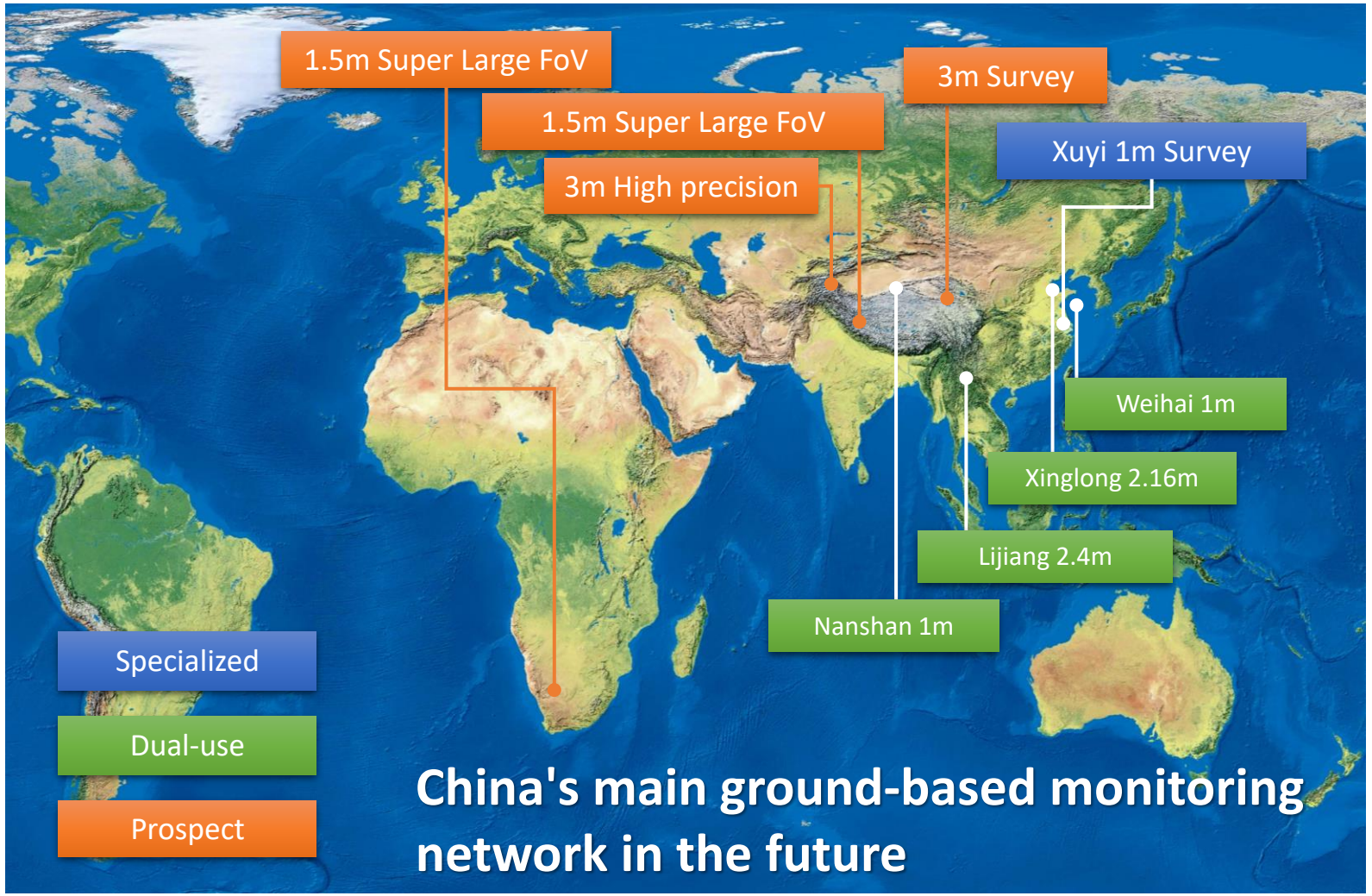
Large-Aperture
Survey
One 3-m 9 Deg2

Threat Alert

Super Large FoV
Two 1.5-m
36 Deg2

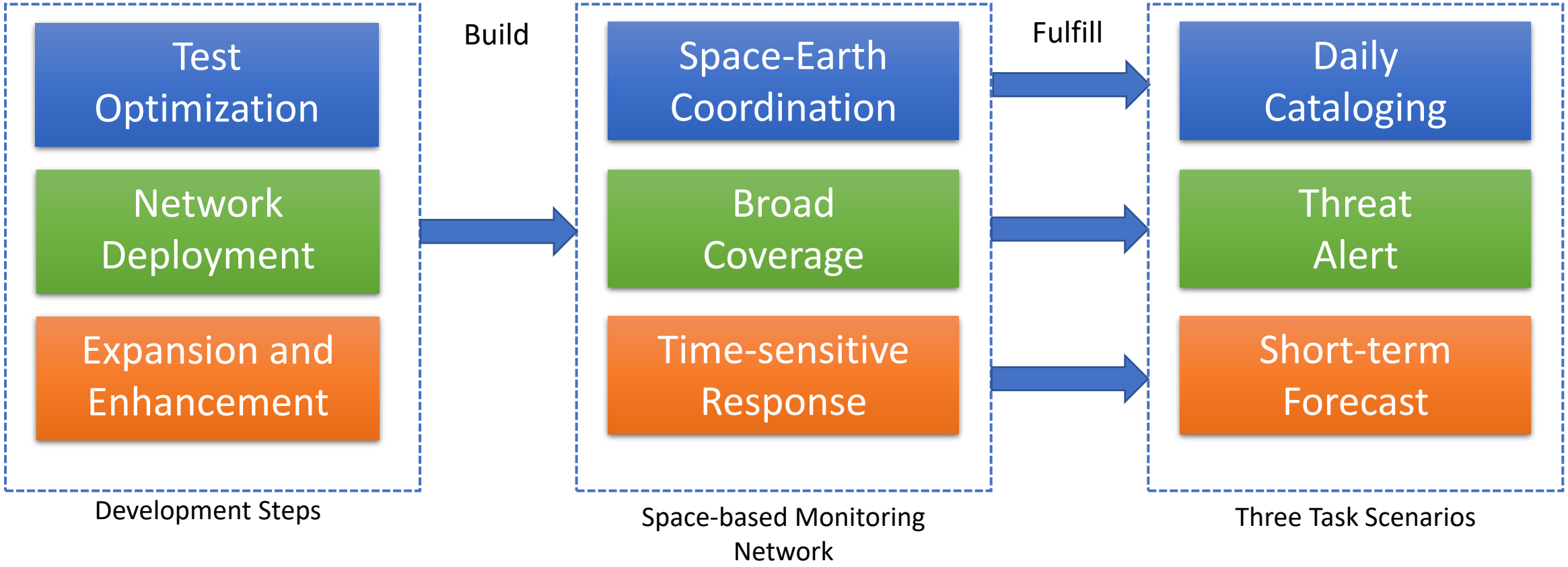
Short-term Forecast

Large-Aperture
High precision
One 3-m
spectrum



China's main ground-based monitoring network in the future

(2) spaced-based monitoring network



(3) Prospect of Early Warning System

Asteroid impact risk Early warning

Precise Orbit Determination	**Precise** portrayal characteristics	**Precise** Rendezvous Prediction	**Precise** Risk Warning	**Precise** Hazard Assessment
➢ Initial orbit determination ➢ Precise orbit determination	➢ Characteristic of light variation ➢ Characteristic of spectrum	➢ Short-term forecast ➢ Long-term forecast	➢ Probability of impact ➢ Risk Corridor	➢ Surface impact hazards ➢ Air burst

(4) International Cooperation and Opening-up Initiative

Accelerating diversification of cooperation	Data storage, processing, and sharing	Keep making progress on the research
1. Overseas ground-based monitoring stations 2. Cooperative space-based monitoring 3. Space-Earth joint observation missions	1. Setting up international data center 2. Establishing orbit cataloging database 3. International data exchange	1. Strengthen the study on international policies 2. Cutting-edge research on international regulations 3. Workflows and mechanisms

(5) Specialized Organizations/Entities

National Asteroid Monitoring and Early Warning Research Center

Focus

- Monitoring And Early Warning
  1. Strengthen the coordination between domestic organizations
  2. Collaboratively explore the potential of monitoring resources

Aim

- Rapidly and effectively promote the progress of monitoring and early warning
- International cooperation

Thank you!

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National Asteroid Monitoring and Early Warning Research Center (Arrangement Office)

April 2023