Big Earth Data enhances the Implementation of PEEX along the Belt and Road regions

Yubao Qiu, Huadong Guo, Jie Liu, Fang Chen, Massimo Menenti

[1] Aerospace Information Research Institute, Chinese Academy of Science (AIR-CAS)
[2] Technische Universiteit Delft

8th May, 2020 @ EGU2020: Sharing Geoscience Online

Outline

DBAR
Digital Belt and Road

Big Earth Data & CASEarth

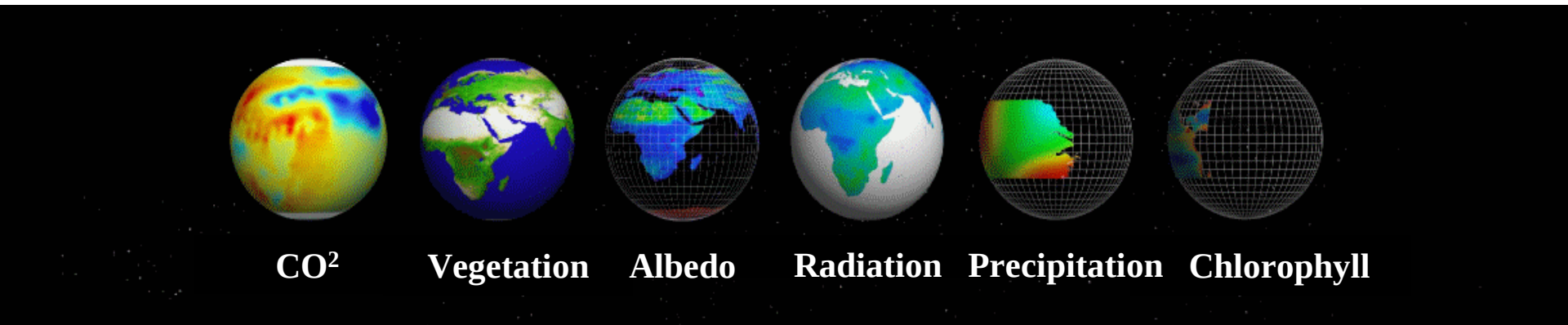
DBAR & CASEarth

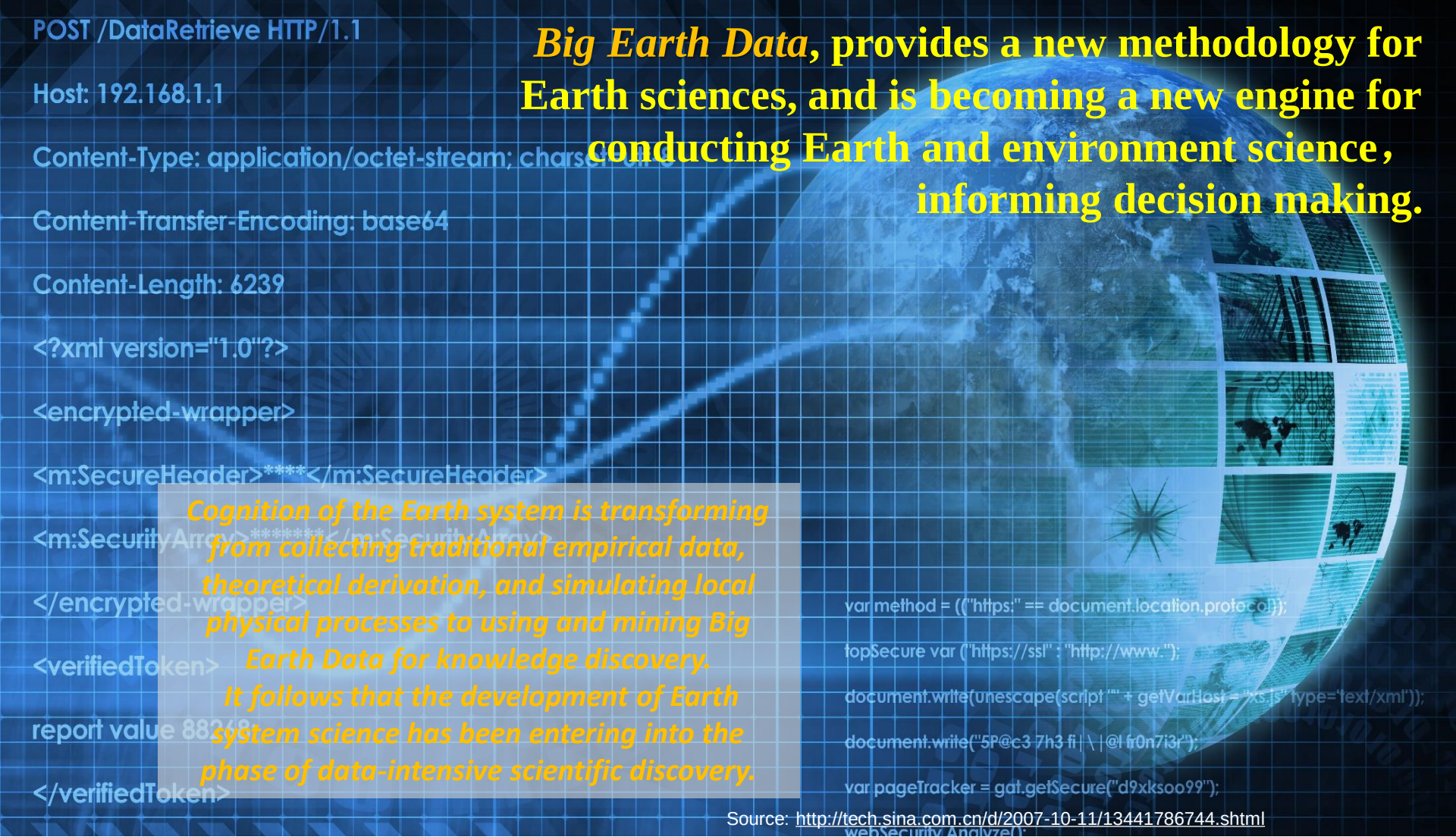
Big Earth Data for SDGs

Big Earth Data

Recognizes the natural and social domains of Earth as a holistic research object.

Manifested as a scientific and virtual representation of the physical model, mathematical model, information model and computer model of Earth.





***Big Earth Data*, provides a new methodology for Earth sciences, and is becoming a new engine for conducting Earth and environment science, informing decision making.**

Cognition of the Earth system is transforming from collecting traditional empirical data, theoretical derivation, and simulating local physical processes to using and mining Big Earth Data for knowledge discovery. It follows that the development of Earth system science has been entering into the phase of data-intensive scientific discovery.

Source: http://tech.sina.com.cn/d/2007-10-11/13441786744.shtml

Features of Big Earth Data

- Big data used in the Earth sciences.
- Supports data-intensive research in the Earth sciences.
- Characterized as being:

Massive: High-resolution, high-dynamic, multi-band, high spectral and spatial resolution, fast data rate, short cycle.

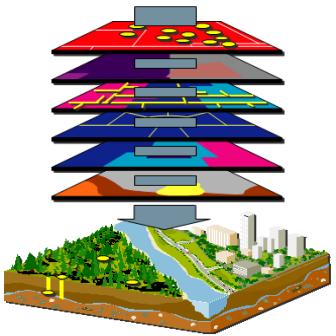
Multi-source: Data source and acquisition are diverse. Imaging mechanisms and models vary widely.

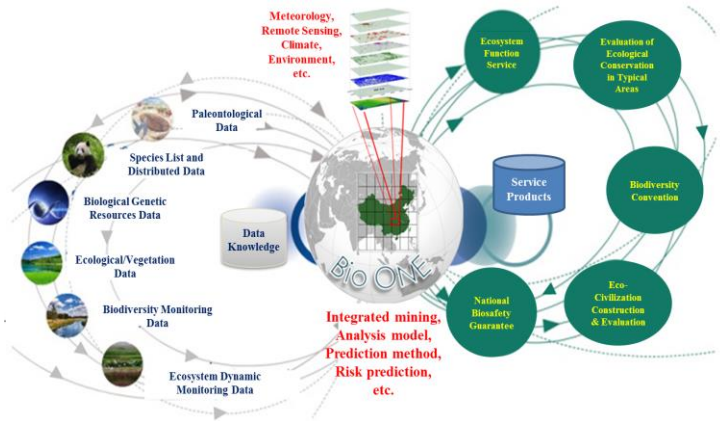
Multi-temporal: Sampling interval is shortening, data acquisition frequency is increasing.

High-value: In the ecological environment, land resources, natural disasters and other geosciences have an important role in economic and social value.

Data Resources in CAS

- The Big Earth Data resources are about **38PB**, and **8,000 million** records
  - **Earth observation data**: ~12PB
  - **Biology**: ~22PB
  - **Ecology**: ~3PB
  - **Resources and environment**: ~1PB
- **New data is expected to exceed 10PB over the next 5 years**
  - Earth observation satellite raw data: increasing **2.5TB daily**.





Big Earth Data Science Engineering Program (CASEarth)

BAR
Digital Belt and Road

CASEarth : CAS Strategic Priority Research Program.

* Oriented toward **technological problems** concerning overall and long-term development resolving **major scientific issues**.

* A strategic action plan that integrates technical problem-solving with **team- and platform-building**.

* Provide a new impetus for **interdisciplinary, cross-scale, macro-scientific discoveries using Big Earth Data**.

Outline

DBAR
Digital Belt and Road

1 ..... 2 3

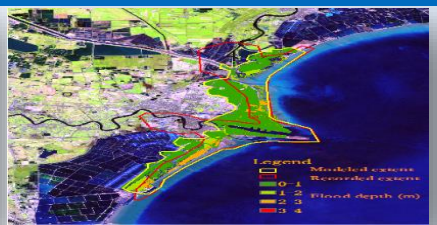
Big Earth Data & CASEarth

DBAR & Research Development

Implementation to PEEX in B&R

Digital Belt and Road Program

- International Science Program
- Promotes Big Earth Data cooperation among the Belt and Road
- Fill gaps in scientific knowledge to support the achievement of sustainable development goals



UN World Conference on Disaster Risk Reduction 2015 Sendai Japan

Sendai Framework for Disaster Risk Reduction 2015 - 2030

THIRD INTERNATIONAL CONFERENCE FINANCING FOR DEVELOPMENT 13-16 JULY 2015 · ADDIS ABABA · ETHIOPIA TIME FOR GLOBAL ACTION

UNITED NATIONS SUSTAINABLE DEVELOPMENT SUMMIT 2015 25 - 27 SEPTEMBER

SUSTAINABLE DEVELOPMENT GOALS

PARIS 2015

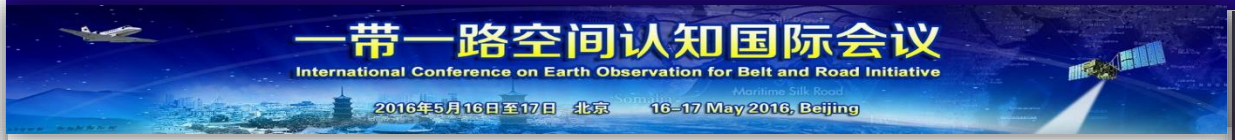
The Belt and Road region covers a ***vast area*** and involves a ***large population***, facing numerous challenges related to ***sustainable development***.

Digital Belt And Road Program

BAR
Digital Belt and Road

RADI · Pan-Eurasian Experiment · HUKMT · UNIVERSITÄT SALZBURG · ISDE · vito vision on technology · IRDR Integrated Research on Disaster Risk · GISTDA · University of Twente The Netherlands · UTM · ICIMOD · ACC · SCAI · SDIM · POLITECNICO MILANO 1863 · asean · IMHE · UAP · JAP · UNIVERSITY OF HELSINKI

Initiated at EOBAR, to be given full support by more than 20 countries



Beijing Declaration on Earth Observation for Belt and Road

May 17, 2016

We, scientists, researchers, academics, engineers, educators and administrators from more than 20 countries, and representatives of international organizations, met in Beijing, China, at the International Symposium on Earth Observation (EO) for Belt and Road (EOBAR), co-hosted by the Division of Earth Sciences of the Chinese Academy of Sciences (CAS) and related ministries, commissions, and international organizations, on 16 and 17 May 2016.

Background

Core Objectives

DBAR
Digital Belt and Road

Knowledge Gaps

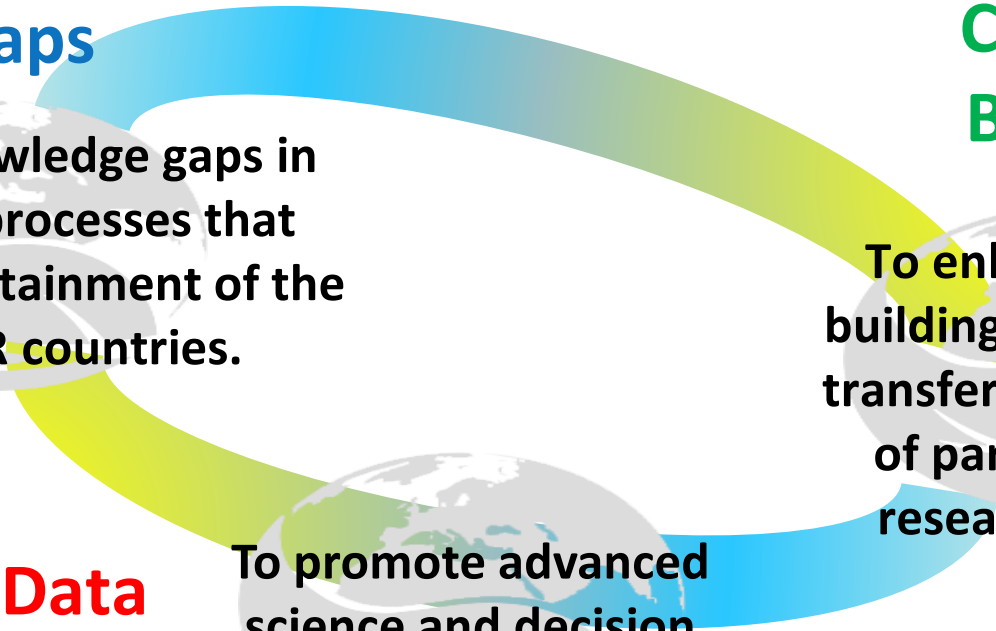
To address knowledge gaps in Earth system processes that constrains the attainment of the SDGs in B&R countries.

Capacity Building

To enhance capacity building and technology transfer within a system of partnerships and research networks.

Big Earth Data Services

To promote advanced science and decision support services using Big Earth Data.



DBAR Five Priority Areas

DBAR
Digital Belt and Road

1. **Enhance infrastructure.** ***An open platform with shared data, codes and algorithms is urgently needed for analyzing the vast amounts of data.***
2. **Promote data sharing and interoperability.** ***Data need to be openly exchanged if everyone in the region is to benefit.***
3. **Extend applications to more people.** ***Development across the Belt and Road region is uneven.***
4. **Identify research opportunities.** ***Knowledge could be discovered within the huge multidisciplinary data sets.***
5. **Strengthen international collaboration.** ***Belt and Road nations should set up bilateral or multilateral arrangements and stronger links with international scientific programs and organizations.***

DBAR Working Groups and Task Forces

DBAR Working Groups

Big Earth Data

Big Earth Data (DBAR-DATA)

Natural Impact

Water (DBAR-WATER)

Environment Change (DBAR-ENVI)

Disaster Risk Reduction (DBAR-DISASTER)

Agriculture and Food Security (DBAR-AGRI)

Natural and Cultural Heritage (DBAR-HERITAGE)

DBAR Urban Environment (DBAR-URBAN)

Social Development

Coastal Zone (DBAR-COAST)

DBAR High Mountain and Cold Regions (DBAR-HiMAC)

Special Domain (Regional Development)

DBAR Timeline

DBAR
Digital Belt and Road

Initial Design

Transition Team

Interim Secretariat

DBAR 10 year Program

Administration

May 2016 **2018** **2019** **2022** **2026**

Science Plan

- Science Committee
- Working Groups
- Secretariat
- Task Forces
- ICoEs
- Visualization System

Pilot Projects → Core Projects

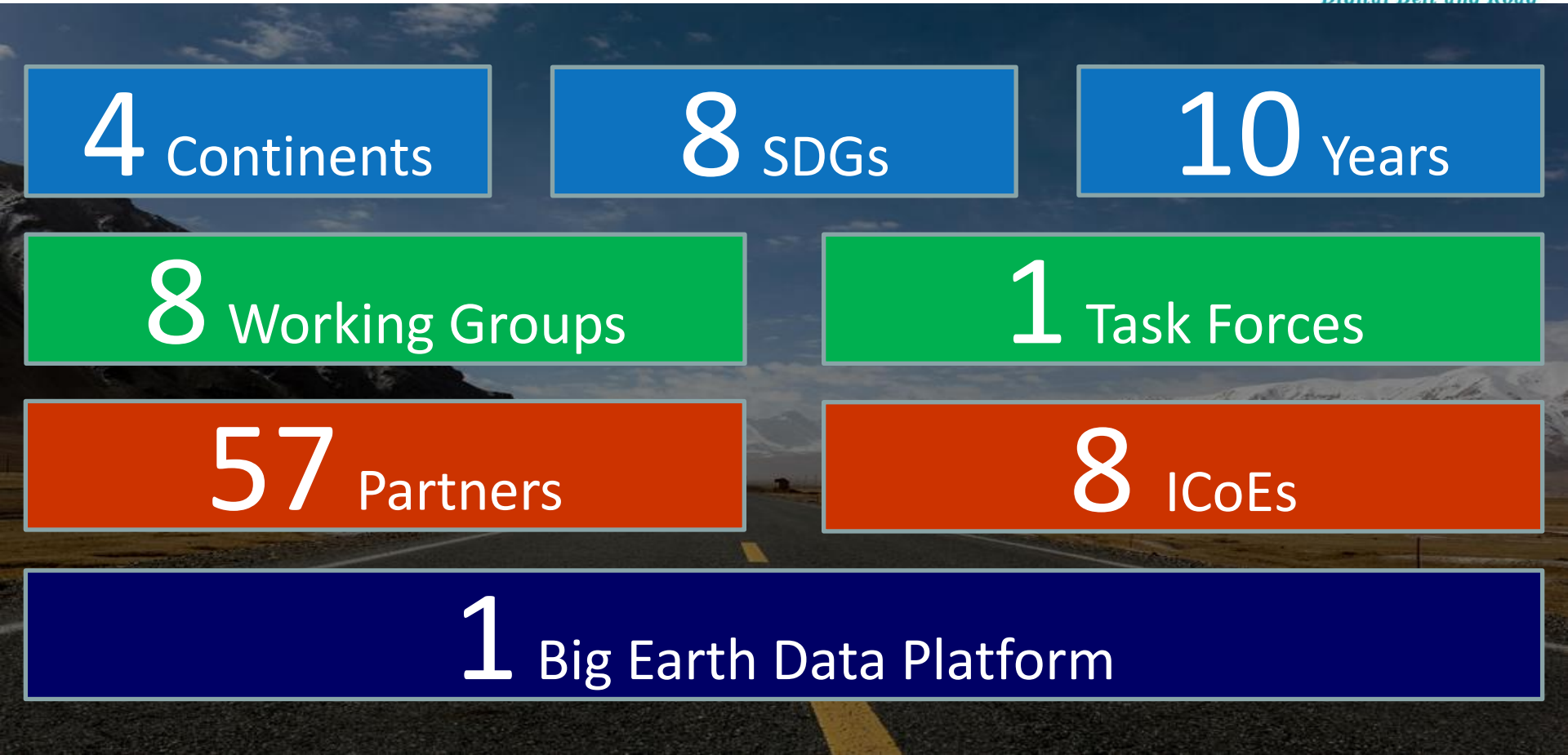
- Data Portal
- Model library for decision-making
- DBAR Big Earth Data Platform

Implementation

Over 50 Main Data & Knowledge Products

Preparatory Phase	Implementation Phase I	Implementation Phase II

DBAR in Numbers (2019)



DBAR ICoEs: A global network for Big Earth Data knowledge, expertise and researchers

Launching of DBAR ICoEs (Dec, 2017)

Launching of ICoE-Bangkok (Feb, 2018)

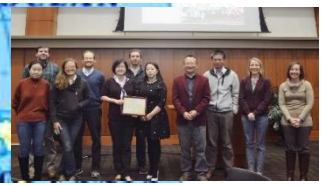
Launching of ICoE-El Jadida (Apr, 2018)

Launching of ICoE-Lusaka (Jun, 2018)

Launching of ICoE-Moscow (Sep, 2018)

Launching of ICoE-Helsinki (Oct, 2018)

Launching of Potenza (May, 2019)

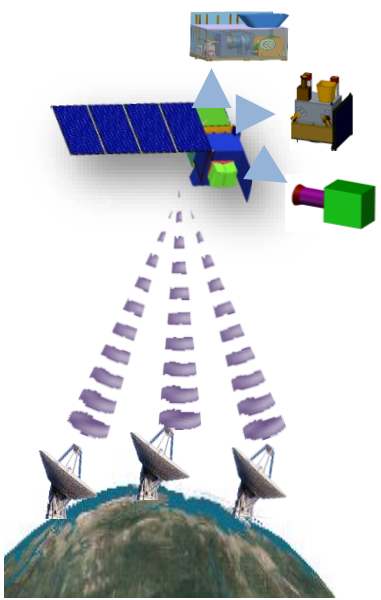


Launching of ICoE-Columbia (Nov, 2018)

oad.org

CASEarth Satellite for the Belt and Road

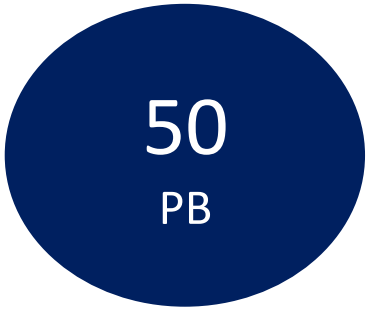
- Widescale (300 km), high-resolution (10 m), thermal infrared + nighttime-light + multi-spectral;
- Explore new methods to sense Earth's environment.



Payloads	Thermal infrared	Nighttime Light	MSS
Bands	8~10.5μm 10.3~11.3μm 11.5~12.5μm	PAN：450nm ~ 900nm B：430nm ~ 520nm G：520 nm ~ 615nm R：615nm ~ 900nm	B1：380nm ~ 420nm B2：420nm ~ 460nm B3：460nm ~ 520nm B4：520nm ~ 600nm B5：630nm ~ 690nm B6：765nm ~ 805nm B7：805nm ~ 900nm
Resolution (m)	30	10 (PAN) / 40(MSS)	10
Swath Width (km)	300	≥300	≥300
Revisit Frequency (day)	11	11	11

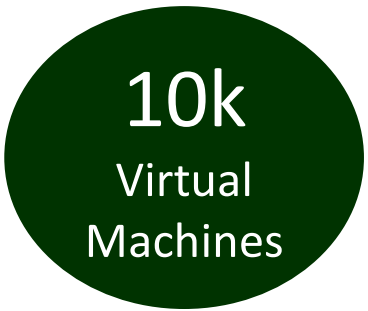
CASEarth Cloud Capabilities

Supercomputing

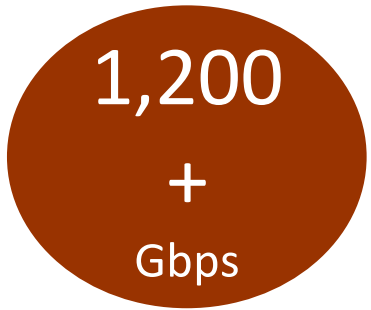


Storage capacity

Data analysis process



Cloud service capabilities



Data exchange capability

Outline

DBAR
Digital Belt and Road

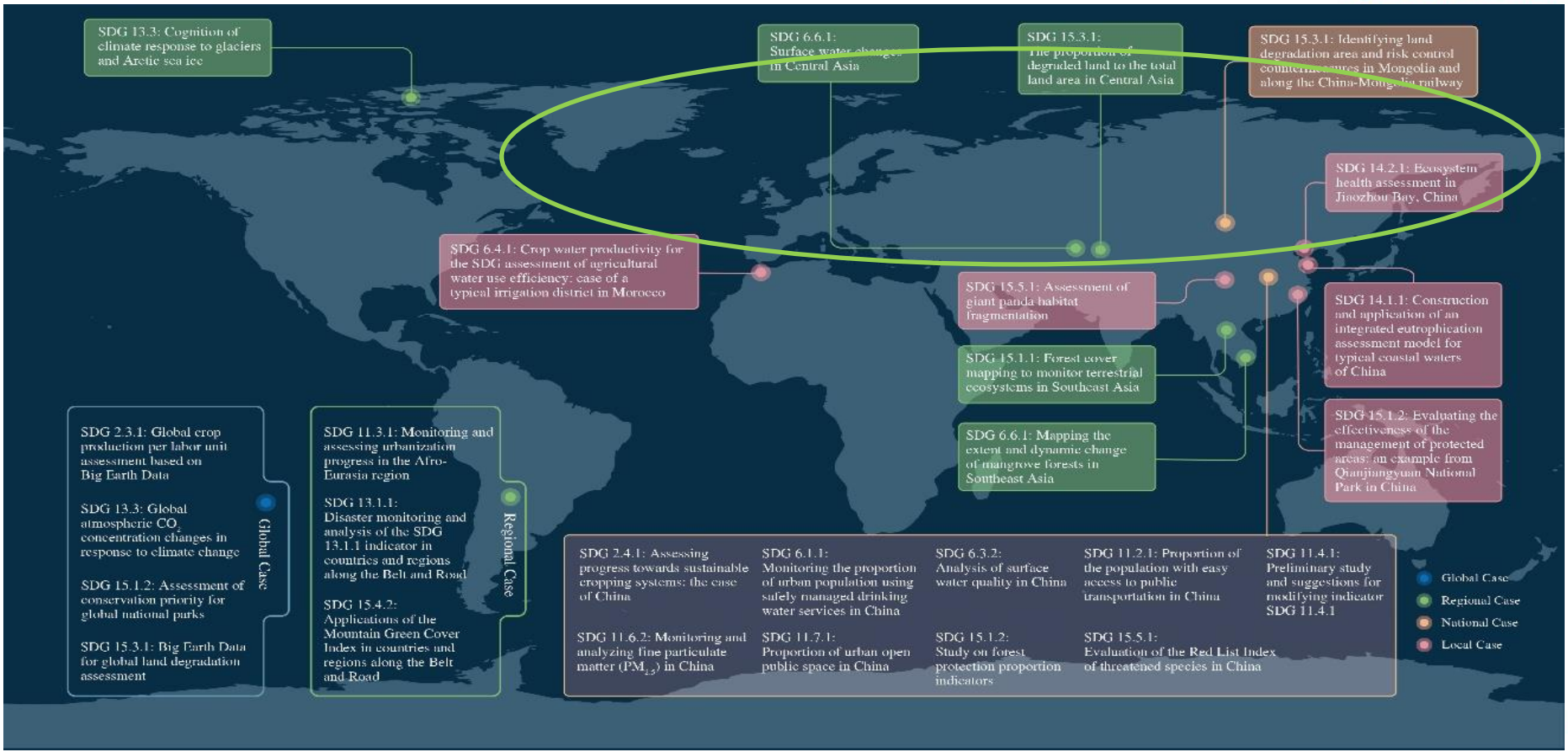
1 ..... 2 3

Big Earth Data & CASEarth

DBAR & Research Development

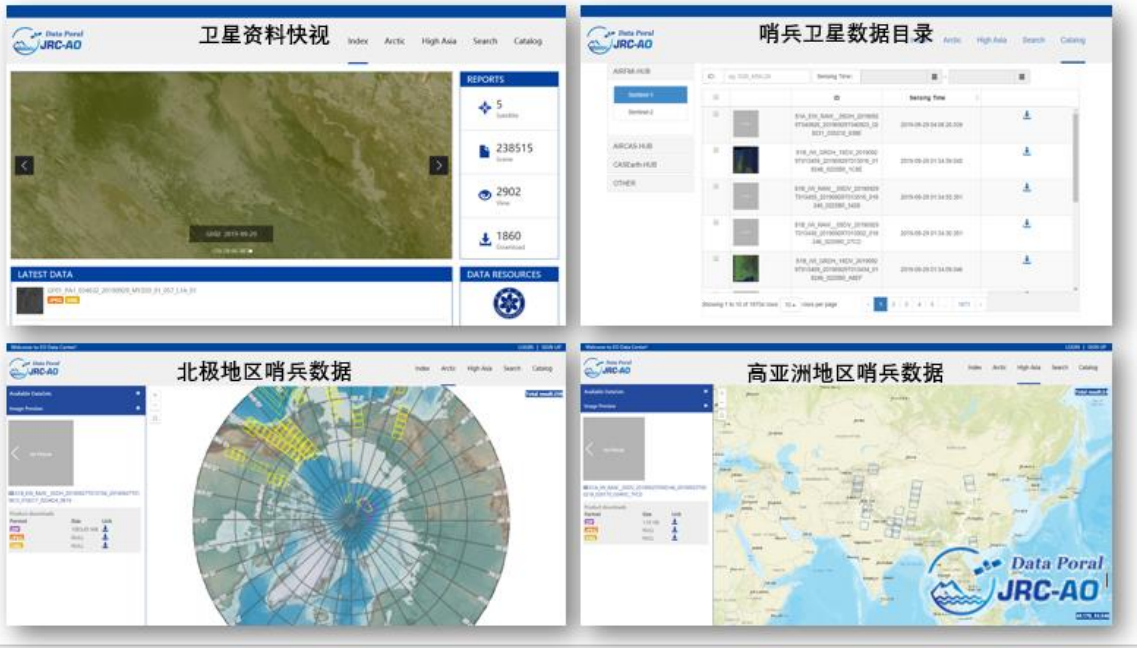
Support to PEEX in B&R

2019 - Cases aim to improve scientific methods and explore new and innovative technologies to support sustainable development.

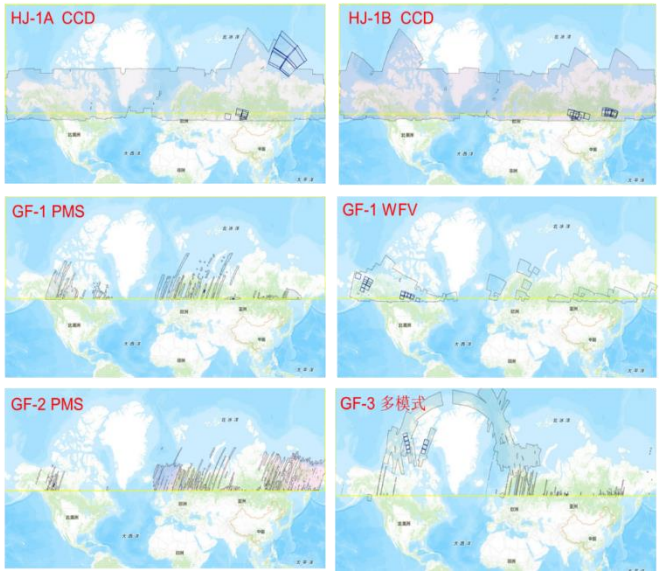


1

The satellite data expected to be used for Arctic Region monitoring



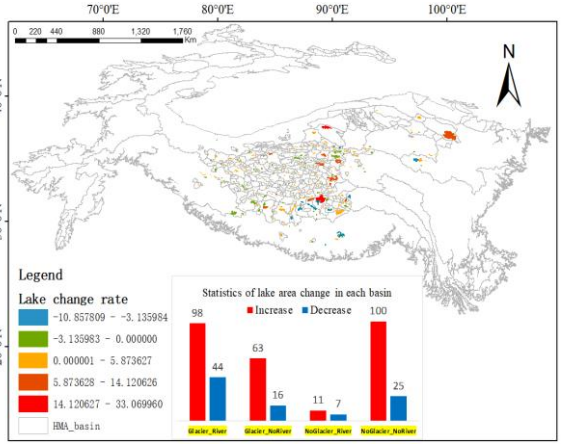
Data Portal of Chinese Satellite Dataset for HiMAC

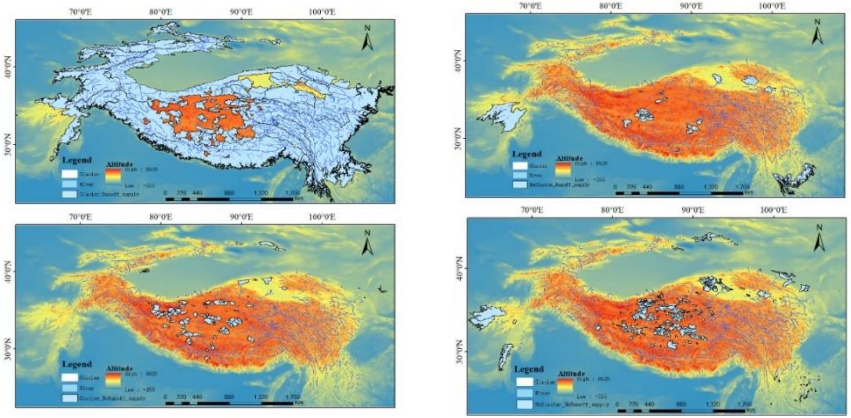


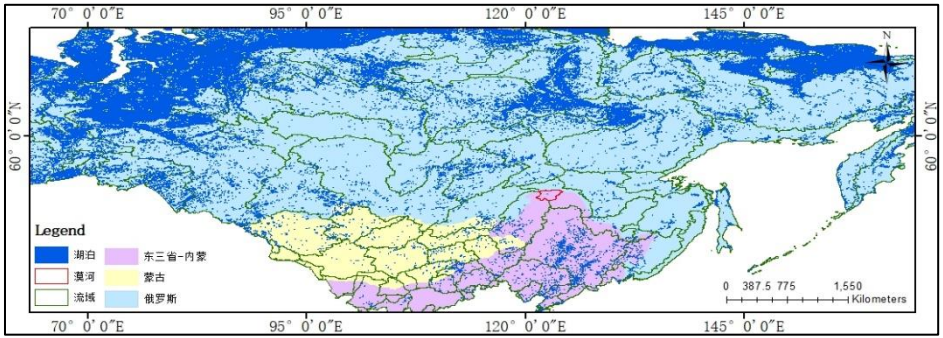
Coverage of high latitude regions of Arctic

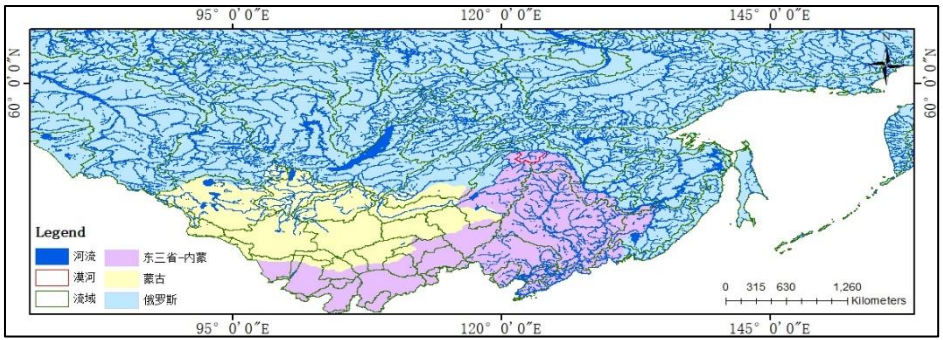
1 Lake and River - Datasets from Remote Sensing of Lakes and River - HiMAC

Basins with different water supply patterns over HighMountainAsia



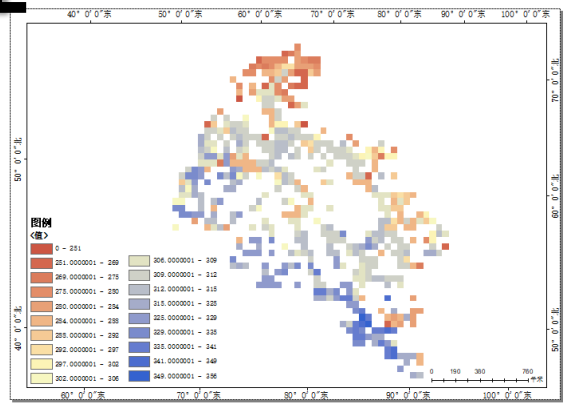




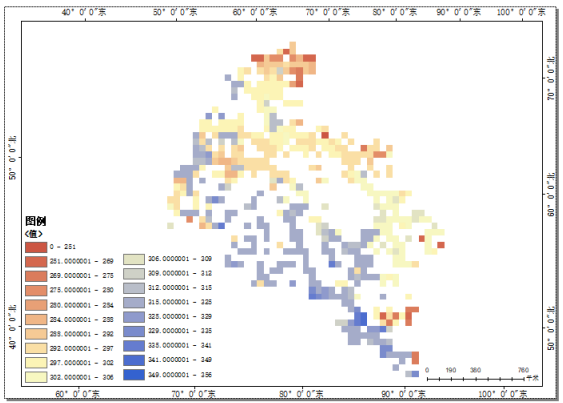


Separated river and lake vector dataset （2010）

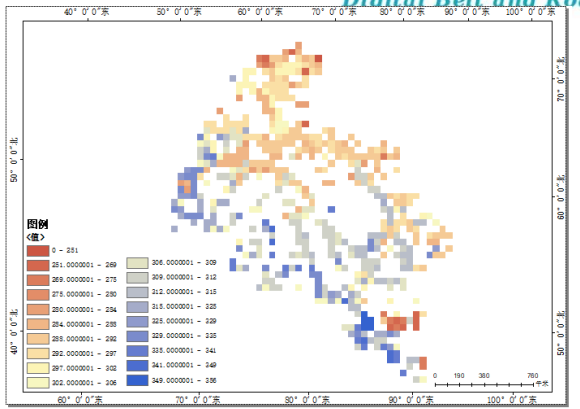
1 River ice fraction - Datasets from Remote Sensing of Lakes and River – HiMAC



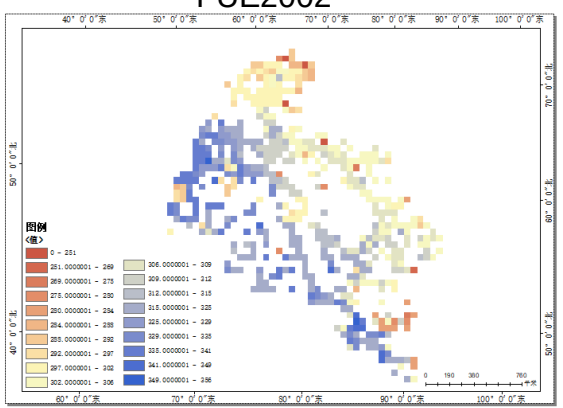
FUE2002



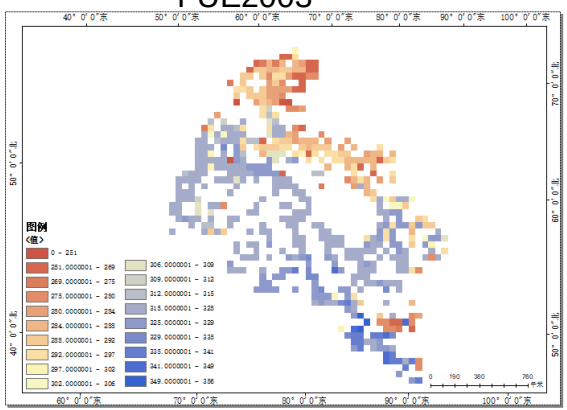
FUE2003



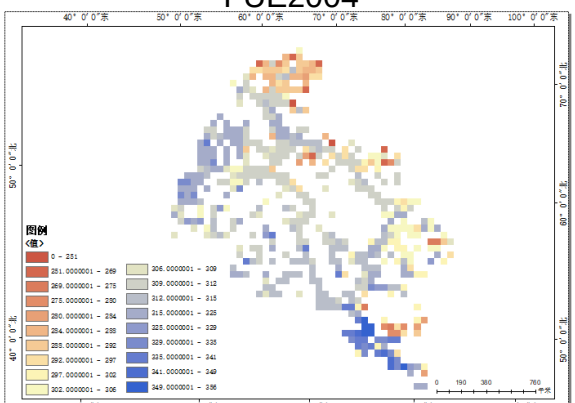
FUE2004



FUE2005

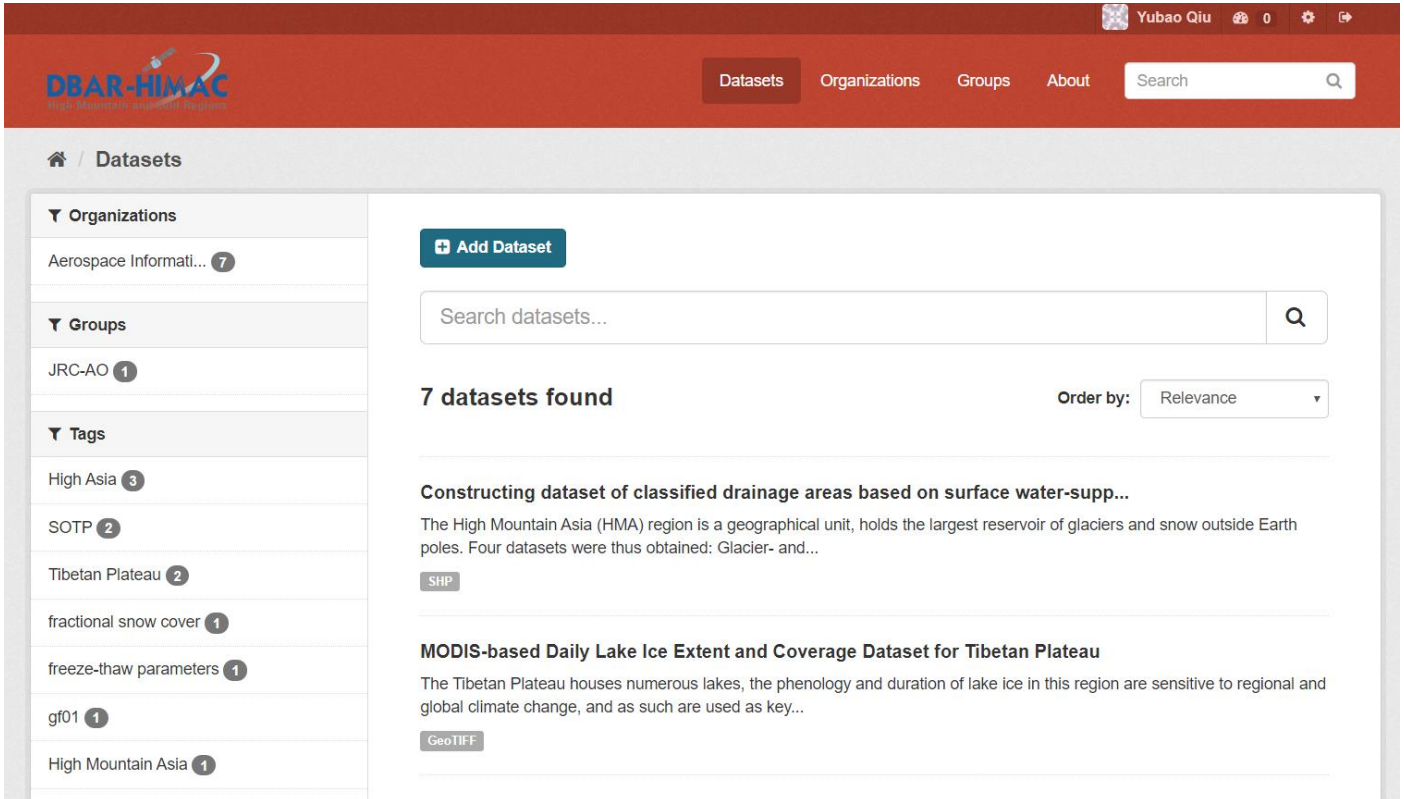


FUE2006



FUE2007

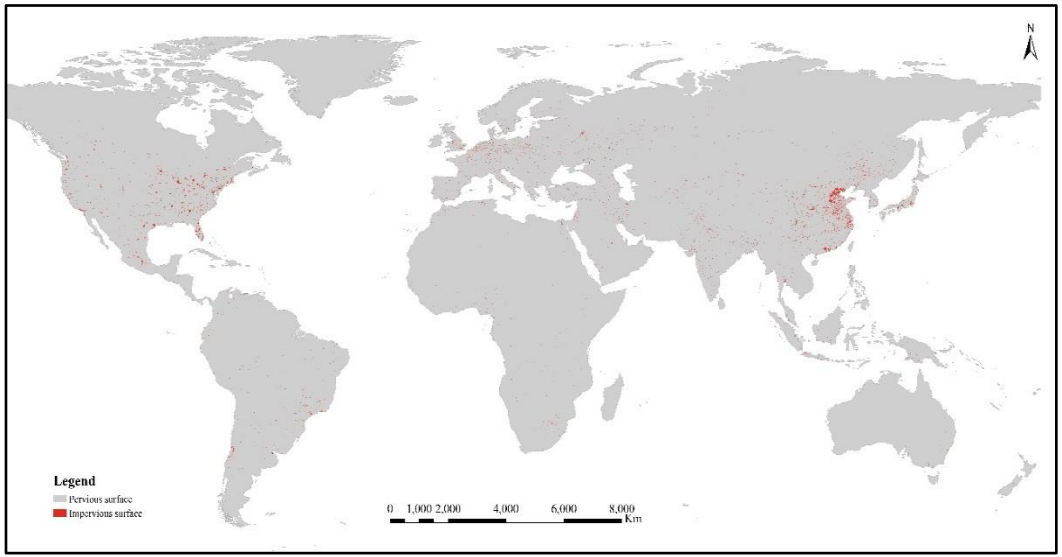
1 CKAN based system for data in HiMAC by projects in China

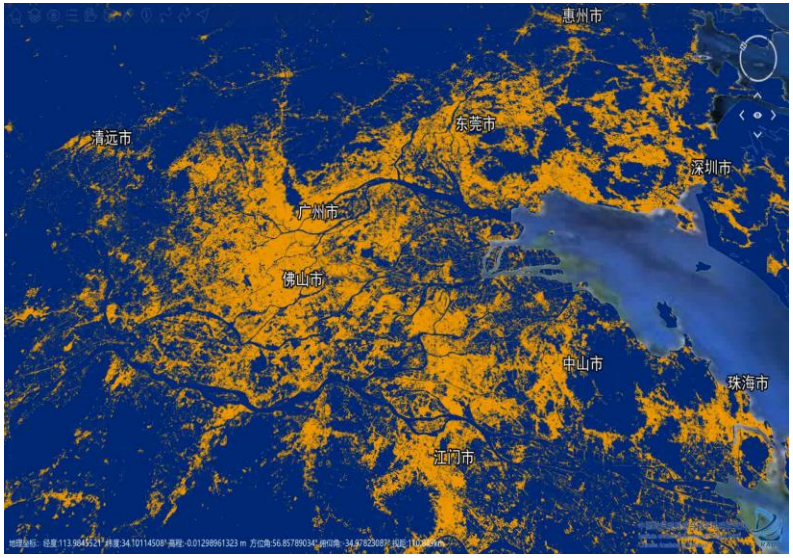


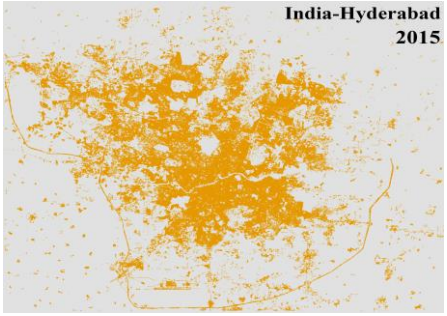
A CKAN based interoperability of dataset from Chinese investment to HiMAC.

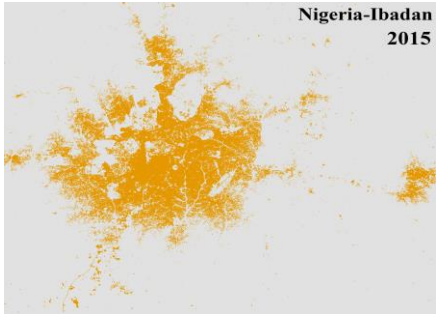
It is on going effort from last Feb.

2 Monitoring and assessing urbanization progress in the Belt and Road





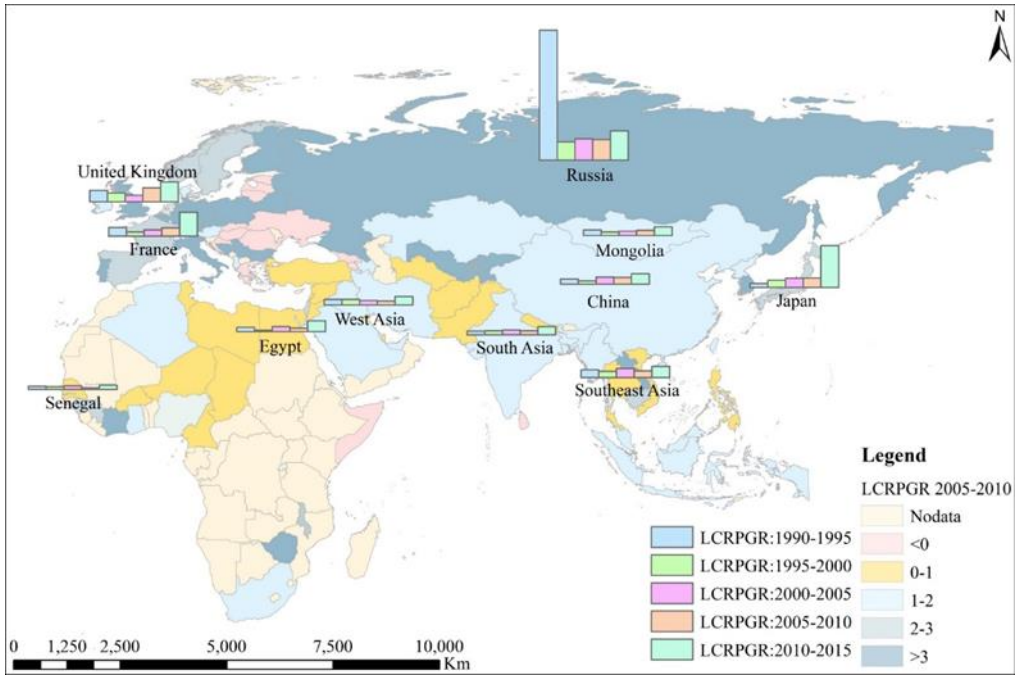




- Employing Big Earth Data processing technology with different sensors data (150,000 SAR and 340,000 optical images)
- The methodology is useful for identifying human settlements located in low latitude areas
- To help developing counties without technical and financial resources to monitor their urban development
- Be updated every three years.

2 Monitoring and assessing urbanization progress in the Belt and Road region

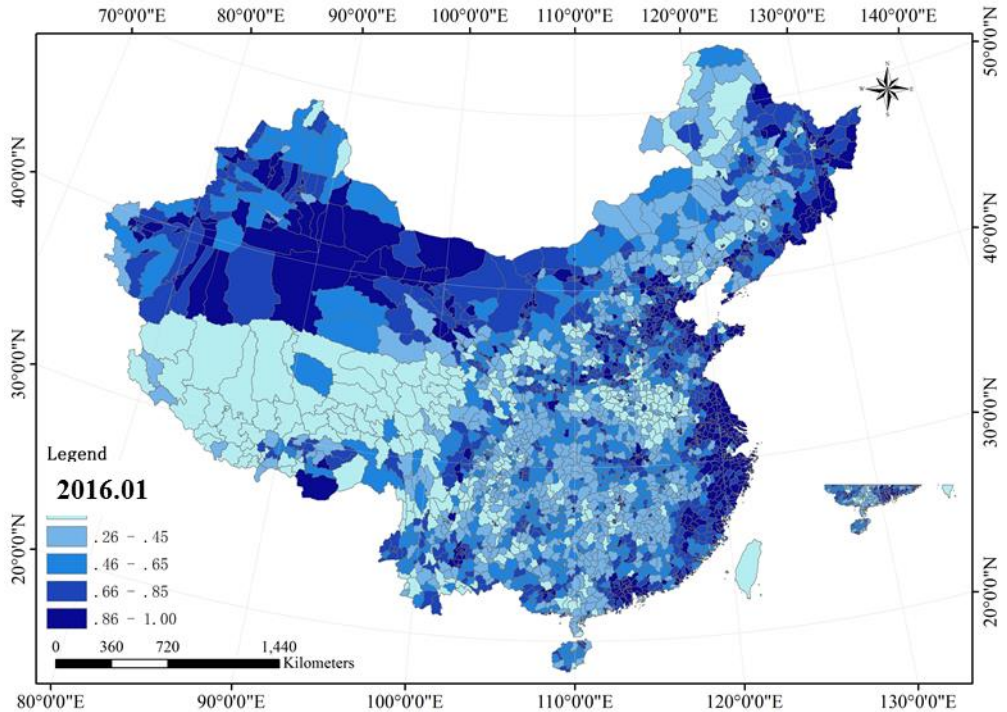
- 2000-2010 land consumption was faster than the 1990-2000 population growth.
- There were 19 cities in 1990-2000, and 47 cities in 2000-2010.
- Expansion of urban space: major challenge to sustainability; needs to be controlled.



Indicator 11.3.1: Ratio of land consumption rate to population growth rate

3 The proportion of urban population using safely managed drinking water services

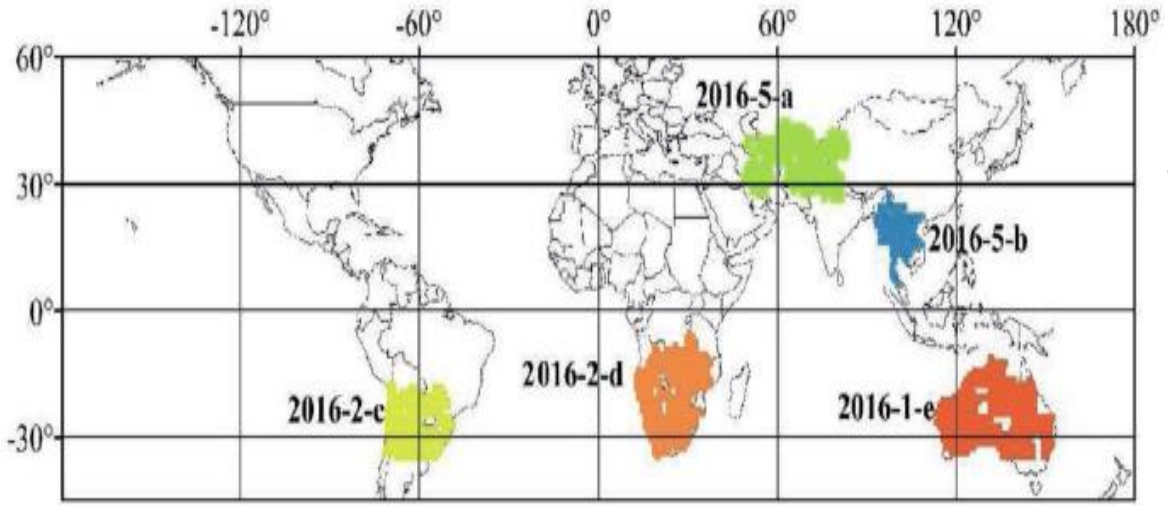
- 95.17% of urban pop. with safe water in China (2016). Higher in the east.
- Emergency plans and backup water sources address seasonal risks to water quality.



Indicator 6.1.1: Proportion of population using safely managed drinking water services

4 Improve capacity for climate change mitigation, adaptation, impact reduction, and early warning

Extremely high XCO_2 with the continuous grid in space and a time span

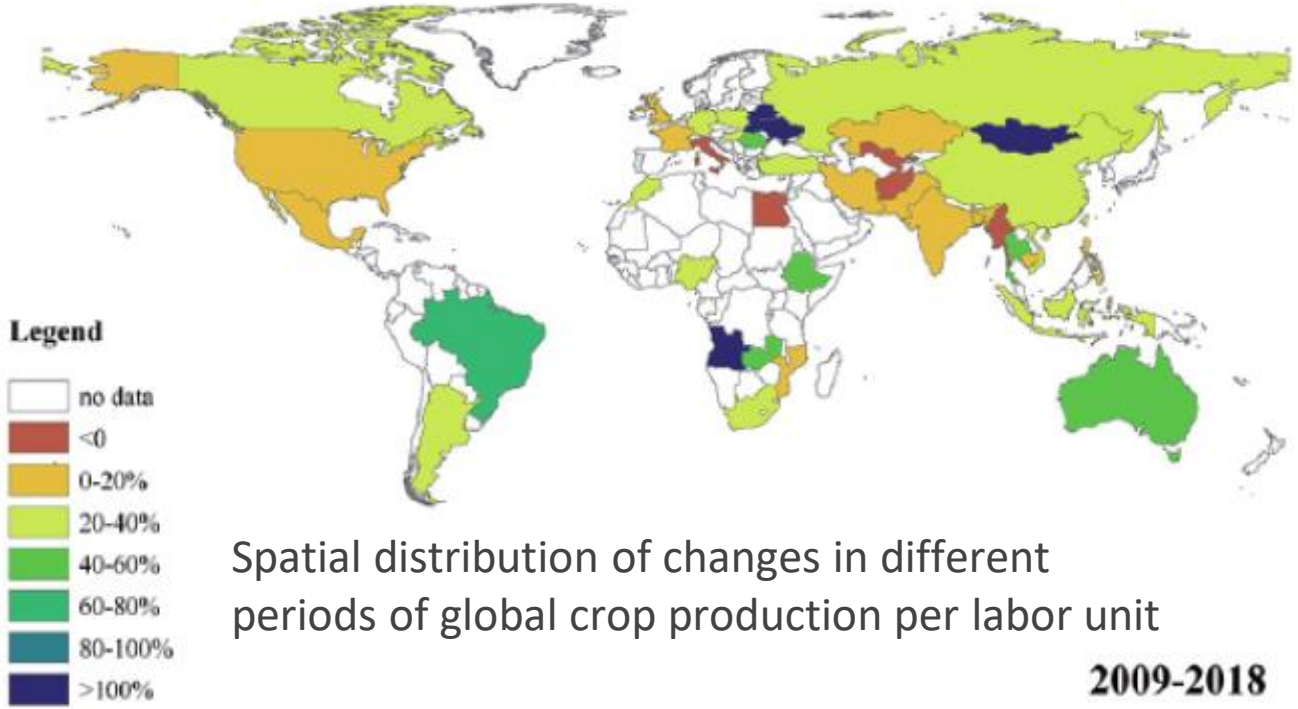


- The inter-annual increment of global atmospheric CO_2 concentration mainly comes from human-made CO_2 emissions.
- While controlling human-made CO_2 emissions, we also need to scientifically repair and manage sensitive terrestrial ecosystems in order to reduce the impact from extreme climate.

5 Volume of production per labor unit by classes of farming/pastoral/forestry enterprise size

Digital Belt and Road

Global crop production per labor unit increased by 10% from 2015 to 2018, and the global crop production system is becoming more efficient.



Spatial distribution of changes in different periods of global crop production per labor unit

- **Remote sensing data**

-GF-1, GF-2, ZY-3…

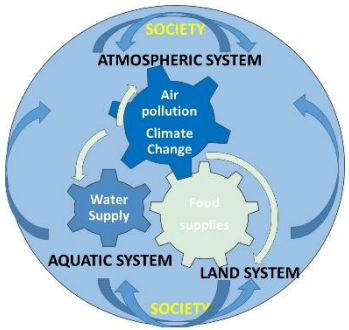
- **Statistical data**

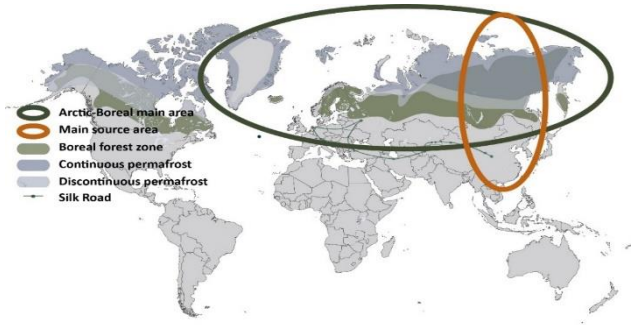
-National agricultural population data…

- **Ground survey data**

-Agro-meteorological stations….

Support to PEEX in B&R Region





Themes

DBAR High Mountain and Cold Regions (DBAR-HiMAC)

DBAR Urban Environment (DBAR-URBAN)

Environment Change (DBAR-ENVI)

Water (DBAR-WATER)

Agriculture and Food Security (DBAR-AGRI)

1. Develop a **concept framework** on the BED to support the PEEX, **follow up the PEEX designation** (detailed IJDE paper) under PEEX and DBAR agenda with Finland and Russia.
2. Development a **priority research domains**, like Arctic or its remote connections with changes in HMA (Finland, Russia, China)
3. **Enhance the ICoE-Helsinki** with **stations observations and Data Exchange and Interoperability** via the valued added dataset, and enhance the PEEX satellite components via Chinese dataset via the data portal.
4. Work lead under a GEO value concept idea of GEO CRI and HiMAC.

www.dbeltroad.org

Thanks

DBAR Secretariat
No.9 Dengzhuang South Road
Haidian District, Beijing 100094, China
Tel: +86 10 82178980
Fax: +86 10 82178959
www.dbeltroad.org