Digital Belt and Road Initiative

DBAR: International Science Program for Sustainable Development of the Belt and Road Region Using Big Earth Data

Guo Huadong[1,4*] Qiu Yubao[1] Massimo Menenti[1,2] Chen Fang[1] Zhang Li[1] John van Genderen[3]
Ishwaran Natarajan[4] Simon Hodson[5] Paul Uhlir[5] Liu Jie[1,4] Liang Dong[1]

1 Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing 100094
2 Delft University of Technology, Delft 2628 CN
3 University of Twente, Enschede 7500 AA
4 International Centre on Space Technologies for Natural and Cultural Heritage, Beijing 100094
5 CODATA (Committee on Data of the International Council for Science), Paris 75016

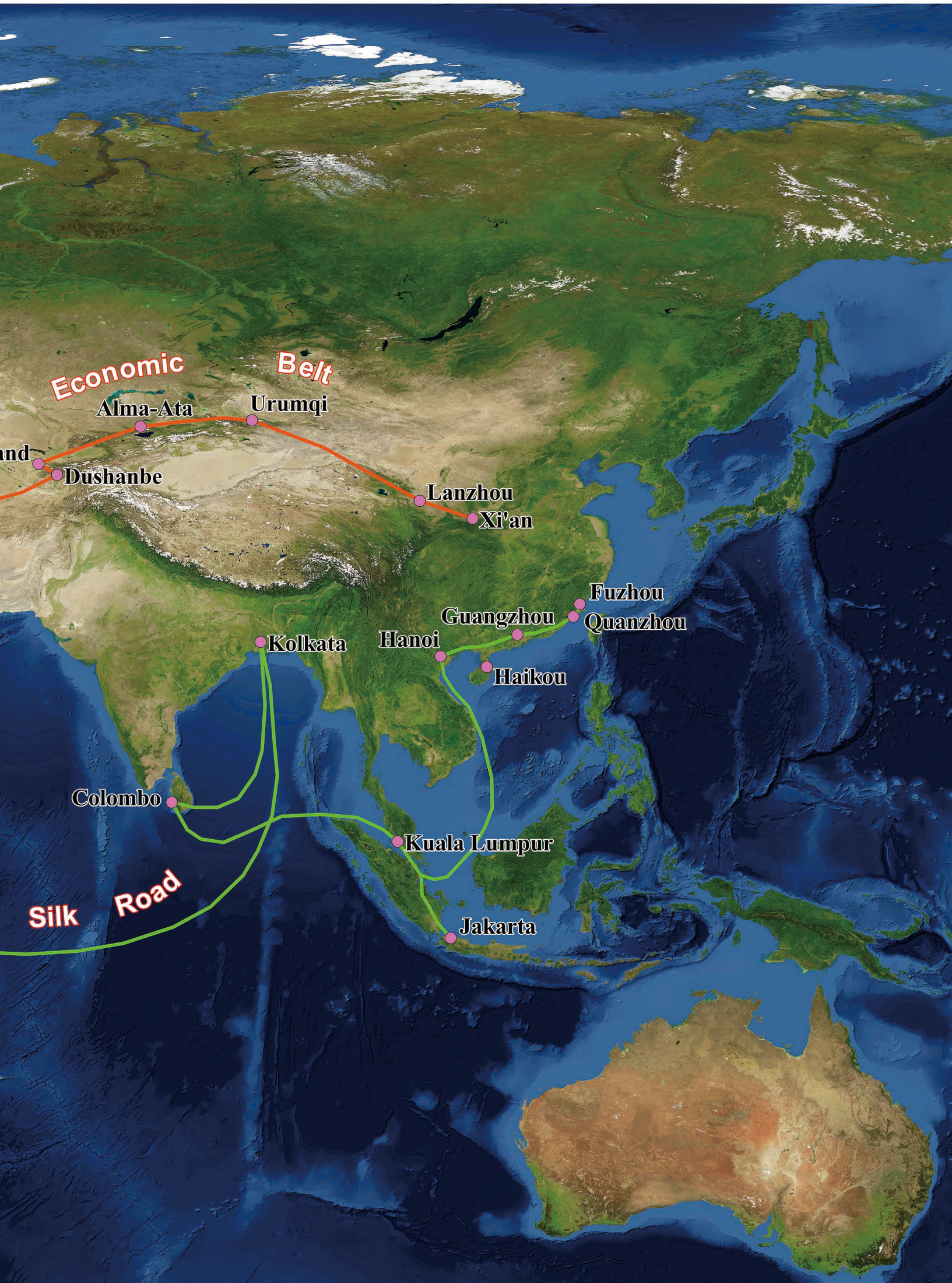
The New Silk Road, much like the historical route, is a network of trade routes through Asia connecting the East and West from ancient China to the Mediterranean Sea. Together with the Maritime Silk Road (officially the 21st Century Maritime Silk Route Economic Belt), the two were consolidated as the "Belt and Road" (B&R). This initiative is a forward-looking vision on international cooperation and shared development that spans three continents and their contiguous oceans and seas.

The combined pressure of climate variability, intensified use of land and marine resources, and the fragility of many ecosystems in the B&R countries make it very challenging to achieve the UN Sustainable Development Goals (SDGs). Moreover, many environmental threats in the B&R countries are inherently transnational, such as the management and use of water resources, the mitigation of air pollution, and the improvement of the quality of both inland and coastal waters.

Assessing and monitoring both terrestrial and marine ecosystems require observations which must be precise, accurate, and timely, while measuring both objects and processes across a range of spatial and temporal scales. By acquiring space-air-ground integrated data resources, it will establish a common "Big Earth Data" platform for multiple fields concerned with sustainable development. The initiative proposes the critical needs for initiating and operating an international scientific program.

To promote cooperation with countries along the Belt and Road route to demonstrate and foster the smart uses and applications of "Big Earth Data" in support of the sustainable development of people and economies at local, national, and regional levels, in 2016, the "Digital Belt and Road (DBAR)" initiative was initiated by the Institute of Remote Sensing and Digital Earth (RADI) of the Chinese Academy of Sciences (CAS), with the support of over 20 countries along the Belt and Road.

* E–mail: hdguo@radi.ac.cn


Economic Belt
Alma-Ata
Urumqi
Dushanbe
Lanzhou
Xi'an
Fuzhou
Guangzhou
Quanzhou
Kolkata
Hanoi
Haikou
Colombo
Kuala Lumpur
Jakarta
Silk Road

Scientific Progress of DBAR

Guo Huadong, Professor of the Institute of Remote Sensing and Digital Earth (RADI), Chinese Academy of Sciences (CAS), an Academician of CAS, a Foreign Member of Russian Academy of Sciences, a Fellow of the World Academy of Sciences (TWAS), and Chair of DBAR Science Committee

The DBAR vision is the promotion of international cooperation that integrates Earth observation science, data, technology, and applications to address environmental change and attain SDGs in the B&R region. The uniqueness of DBAR is its goal of building upon the diverse Earth observation capacities in the B&R countries in Asia, Africa, and Europe through comprehensive, well-funded action, and effective interdisciplinary applications.

The DBAR scientific goals will be addressed by a flexible system of DBAR Working Groups (WGs) and Task Forces (TFs). In the startup phase, the seven working groups (Big Earth Data, Agriculture and Food Security, Coastal Zone, Environmental Change, Natural and Cultural Heritage, Disaster Risk Reduction, and Water) and two task forces (Urban Environment, High Mountain and Cold Regions) have been established. The contributions of the working groups and task forces to address the DBAR scientific goals are briefly explained below (Figure 1 & Table 1).

(1) The DBAR Big Earth Data Working Group (DBAR-DATA) was established to improve regional Earth observation data cooperation. The main task of DBAR-DATA is to build and maintain a big data platform for DBAR, which will be the fundamental facility of DBAR.

(2) The DBAR Agriculture and Food Security Working Group (DBAR-AGRI) aims to enhance the capacity of partner countries in the field of monitoring food resources in the framework of DBAR. It will focus on capacity building by designing and transferring an advanced food remote sensing monitoring system (building upon the CropWatch system) to the B&R countries by joint research, field trips, calibration, and customization.

(3) The DBAR Coastal Zone Working Group (DBAR-COAST) will focus on promoting cooperation with countries along the Maritime Silk Road to advocate and demonstrate the applications of Big Earth Data. It will attempt to improve access to appropriate and up-to-date scientific data, technology, and knowledge on coastal and marine environmental monitoring, conservation, and management, as well as take full advantage of Earth observation from space for monitoring and assessing coastal resources and environment. The group will support the sustainable development of people and economies at local, national, and regional levels to deliver sustainable development policies and strategies for coastal and near-shore environments.

Figure 1 DBAR work flow

Table 1 National and international agencies/programs involved in DBAR

Country	Name
Australia	Mineral Mapping Technology Group CSIRO
Austria	University of Salzburg, Austria
Belgium	Vlaamse Instelling voor Technologisch Onderzoek (VITO)
China	Institute of Remote Sensing and Digital Earth (RADI), Chinese Academy of Sciences
Finland	University of Helsinki
Germany	Fraunhofer Society for Cardiac Angiography and Interventions
India	National Institute of Technology Patna India
Italy	Politecnico di Milano
Kazakhstan	Earth Remote Sensing Department of National Centre of Space Research and Technologies
Kyrgyzstan	Institute of Physical and Technical Problems and Material Science, National Academy of Sciences, Kyrgyz Republic
Laos	ASEAN SCOSA – National Focal Point Ministry of Science and Technology
Malaysia	Institute of Geospatial Science & Technology (INSTeG)
Mongolia	Information and Research Institute of Meteorology, Hydrology and Environment
Morocco	Chouaib Doukkali University
Nepal	International Centre for Integrated Mountain Development (ICIMOD)
The Netherlands	University of Twente
Spain	isardSAT
Sri Lanka	Arthur C. Clarke Institute for Modern Technologies (ACCIMT)
Tunisia	Institut des Régions Arides
Organization/Program	**Name**
AARSE	African Association of Remote Sensing of the Environment
CODATA	Committee on Data for Science and Technology
HIST	International Centre on Space Technologies for Natural and Cultural Heritage
PEEX	Pan-Eurasian Experiment
SDIM	CAS-TWAS Centre of Excellence on Space Technology for Disaster Mitigation
IRDR	Integrated Research on Disaster Risk
ISDE	International Society for Digital Earth

(4) The DBAR Environmental Change Working Group (DBAR-ENVI) aims to establish a dynamic analysis of the Belt and Road ecological environment, cooperatively conduct an ecological-environmental remote sensing evaluation in the region, reveal the processes and mechanisms of environmental changes in terrestrial ecosystems and water resources, analyse their impact and response to global environmental changes, and assess the ecological risk of the B&R implementation and the impact of global change.

(5) The DBAR Natural and Cultural Heritage Working Group (DBAR-HERITAGE) will serve as the forum to bring together all concerned international, regional, national, and local actors to clearly demonstrate the added value that Earth observation science, technology, and expertise can bring for the conservation and sustainable development of natural and cultural heritage along the Belt and Road region.

(6) The DBAR Disaster Risk Reduction Working Group (DBAR-DISASTER) aims to integrate Earth observation and social vulnerability data to promote the implementation of the Sendai Framework in the Belt and Road region.

(7) The DBAR Water Working Group (DBAR-WATER) mainly focuses on research topics related to water using Earth observation techniques, such as the water cycle, water resources management, crop water use efficiency, droughts, and floods in the B&R countries.

(8) The DBAR Urban Environment Task Force (DBAR-URBAN) aims to develop technologies to derive information and products on human settlement with Earth observation data, to generate a wide variety of data and information on human settlements and their dynamic, and to evaluate and analyze the cutting edge of urban development and their impacts to support sustainable development along the B&R region.

(9) The DBAR High Mountain and Cold Region Task Force (DBAR-HIMAC) will focus on science driven objectives, producing knowledge and services based on a scientific understanding of changes and their interactions in High Mountain and northern Cold Regions (HiMAC). Big Earth Data on HiMAC will be incubated to support sustainable development through improving risk awareness and enhancing assessments over the high altitude and high latitude B&R regions.

Key DBAR Related Events

The International Symposium on Earth Observation for Maritime Silk Road

The International Symposium on Earth Observation for Maritime Silk Road (EMSR) was convened in Sanya, a coastal city in southernmost China, on November 25–27, 2015（Figure 2). The three-day event wrapped up with the adoption of the Sanya Declaration and an intention to cooperate regarding the joint construction of an Earth observation network, which marks the start of substantial cooperation on using Earth observation technology, especially for the countries along the 21st Century Maritime Silk Road.

Organized by the Institute of Remote Sensing and Digital Earth (RADI) under the Chinese Academy of Sciences, a leading research institute in China's Remote Sensing and Digital Earth field, the symposium aimed to provide a platform for over 300 participants from 28 countries to discuss how space technology can better serve the 21st Century Maritime Silk Road initiative, a part of China's Belt and Road Initiative proposed by Chinese President XI Jinping in 2013. It was well received by the countries along the Silk Road.

The Sanya Declaration, a result of the symposium, calls for cooperation on Earth observation infrastructure, data sharing networks, and the building of an Earth observation system based on the advantage of next-generation technologies among the countries of the region (Figure 3). The Declaration also emphasizes that the cooperation and integration should be extended to government departments, international scientific organizations, and educational and scientific research communities, as well as business enterprises and private sectors engaged in the development and application of Earth observation technology.

The symposium contributed to the building of an Alliance of Big Earth Data for the Maritime Silk Road, which aims to develop collaboration on Earth observation and related application fields concerning the Maritime Silk Road.

Figure 2 EMSR for promoting cooperation on using Earth observation technology especially for the countries along the 21st Century Maritime Silk Road

Figure 3 Participants for the round table meeting of the Sanya Declaration

International Symposium on Earth Observation for One Belt and One Road

The International Symposium on Earth Observation for One Belt and One Road (EOBAR) was convened in Beijing, on May 16–17, 2016 (Figure 4). The event was attended by over 300 Earth observation scholars and experts from more than 40 countries and regions along the Belt and Road, as well as international organizations such as UNESCO.

Revolving around the theme of "Earlier, Deeper, Broader Understanding of the Belt & Road", the conference aimed to provide an international platform for discussing rising issues in fields where Earth observation has found important applications, such as infrastructure and capacity building, spaceborne observation for the economic belts along

Figure 4 EOBAR for Earlier, Deeper, Broader Understanding of the Belt & Road

the Belt and Road, urban layout and construction, world heritage site protection, and space technologies for disaster mitigation. The brainstorming at the symposium, as anticipated by the organizers, might help establish needed platforms and mechanisms for proper technology/data sharing and enhanced cooperation.

The "Beijing Declaration on Earth Observation for the Belt and Road" (Beijing, 2016), released on May 16, 2016, stated that the B&R initiative is a crucial endeavor to meet the development challenges of the future for nations in the B&R region, and called for the implementation of the "Digital Belt and Road (DBAR)" initiative, a science and technology partnership for optimal use of Earth observation for the sustainable development of the B&R region (Figure 5-9).

Figure 5 Symposium Chairman Prof. Guo Huadong addresses the EOBAR opening

Figure 6 Ms. Barbara Ryan (Secretariat Director of the Intergovernmental Group on Earth Observations, GEO) emphasizes her support for the DBAR Initiative

Figure 7 Dr. William Paton (then Executive Director of IRDR) says that the partnership network of DBAR and the foci of DBAR on social issues and risks are similar to IRDR

Figure 8 Dr. Ishwaran Natarajan from UNESCO HIST addresses the EOBAR

Figure 9 Round table meeting for the Beijing Declaration on Earth Observation for the Belt and Road

6th Digital Earth Summit

The 6th Digital Earth Summit, hosted by the International Society for Digital Earth (ISDE), was held in Beijing, China, from July 7 to 8, 2016, under the theme of "Digital Earth in the Era of Big Data". About 300 delegates of scientists, engineers, technologists, and scholars from 30 countries attended the summit.

During the summit, the participants discussed the collaboration between ISDE and DBAR and explored the development of DBAR under the support of Digital Earth. It was concluded that DBAR can provide the Belt and Road region with important Digital Earth technology to conduct "Big Data" applications for the ecological environment and enhance the productivity, wellbeing, and lifestyle of humankind (Figure 10-12).

Figure 10 Dr. Geoffrey Boulton (President of the Committee on Data for Science and Technology, CODATA) presents at the 6th Digital Earth Summit

Figure 11 Dr. Abbas Rajabifard (Former Chairman, Global Spatial Data Infrastructure Association, GSDI) presents at the 6th Digital Earth Summit

Figure 12 DBAR and the Pan-Eurasian Experiment (PEEX) become sister initiatives
(from left to right: Prof. Valery Bondur, Academician of the Russian Academy of Sciences; Prof. Guo Huadong, Academician of the Chinese Academy of Sciences; Prof. Markku Kulmala, Academician of the Academy of Finland)

The 11th International Conference of the African Association of Remote Sensing of the Environment

From October 24 to 28, 2016, a delegation of the Digital Belt and Road (DBAR) initiative was invited to attend the 11th International Conference of the African Association of Remote Sensing of the Environment (AARSE 2016), held in Kampala, Uganda. The major objective of the participation was to establish a formal partnership between DBAR and the African Association of Remote Sensing of the Environment (AARSE), and to promote international cooperation with the "Silk Road Economic Belt and the 21st Century Maritime Silk Road" (abbreviated "Belt and Road") Initiative between DBAR and Africa, particularly North and East African countries and regions. DBAR organized a special session titled "DBAR and AARSE: New horizons for cooperation between Africa and China" and Prof. Guo Huadong, as DBAR Chair, signed a Memorandum of Understanding (MoU) between DBAR and AARSE with Prof. Olajide Kufoniyi, President of AARSE. It reached a consensus on spatial Earth observation for sustainable development of the Belt and Road, and on the promotion of the development of Digital Earth. Each organization agreed to the development of plans for future-oriented cooperation (Figure 13, 14).

Figure 13 Special Session "DBAR and AARSE: New horizons for cooperation between Africa and China

Figure 14 Guo Huadong and Olajide Kufoniyi sign an MoU

1st Digital Belt and Road (DBAR) Meeting

The 1st Digital Belt and Road (DBAR) Meeting was held in Beijing on December 6–7, 2016 (Figure 15). Nearly 100 experts and scholars from China, the Netherlands, India, Pakistan, Laos, Tunisia, Morocco, and other countries and international organizations attended the meeting (Figure 16). Their goal was to discuss and formulate a DBAR Science Plan, establish a DBAR Science Committee and working groups, consider the strength of DBAR in 2017, and explore better scientific approaches to serve sustainable development along the Belt and Road.

It formally established the DBAR Science Committee; seven working groups, namely Big Earth Data Working Group (DBAR-DATA), Agriculture and Food Security Working Group (DBAR-AGRI), Coastal Zone Working Group (DBAR-COAST), Environmental Change Working Group (DBAR-ENVI), Natural and Cultural Heritage Working Group (DBAR-HERITAGE), Disaster Risk Reduction Working Group (DBAR-DISASTER), and Water Working Group (DBAR-WATER); two task forces, namely DBAR Urban Environment Task Force and DBAR Cold Region Task Force; and completed the DBAR Science Plan (V1.0). The DBAR is thus in formal implementation.

DBAR is a ten-year program of three phases. The first phase (2016–2019) will create a Big Earth Data platform, form an international research network, and bring benefits to the region along the Belt and Road.

Figure 15 1st DBAR Meeting: To explore better scientific approaches to serve sustainable development along the Belt and Road

Figure 16 The first Science Committee members appointed to DBAR

Conclusions

The DBAR initiative is a pioneering international venture to share expertise, knowledge, technologies, and data to demonstrate the significance of Earth observation science and technology and Big Earth Data applications for large-scale sustainable development. The extensive geographical scope of the B&R initiative calls for smart uses and applications of “Big Earth Data” in the design, development, and implementation of diverse projects related to infrastructure improvement, environmental protection, disaster risk reduction, water resource management, urban development, agriculture and food security, coastal zone management, and the conservation and management of natural and cultural heritage sites.

DBAR will focus on projects and actions relevant to the implementation of all 17 sustainable development goals (SDGs) adopted by the UN in September 2015. It will integrate “green”, low carbon, and sustainable approaches to social and economic growth that are vital for the implementation of the United Nations Framework Convention on Climate Change (UNFCCC) adopted in December 2015 and the Sendai Framework for Disaster Risk Reduction 2015–2030.

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