

Annual Work Report of HIST

(2020)

This annual report is based on the Biennial Work Plan (BWP) for 2020 and 2021 of HIST which was approved by the Board on January 7, 2020. It reflects HIST's activities in 2020 and implementation priorities in 2021 in accordance with the 5 actions described in the BWP.

Due to Acad. Ding Zhongli's position change, Chinese Academy of Sciences (CAS) has appointed Acad. Zhang Yaping, Vice President of Chinese Academy of Sciences (CAS) as the new Chair of HIST Governing Board.

Action 1: Supporting UNESCO World Heritage Centre and its Regional Partners to implement the Periodic Monitoring of World Heritage sites in Asia and the Pacific.

The expected outcome of this action and the timeline foreseen, respectively, are:

At least one international event bringing together site managers, national-level World Heritage coordinators and other stakeholders concerned with Asia Pacific World Heritage sites organized in collaboration with WHITRAP (World Heritage Institute of Training and Research for the Asia and the Pacific Region) and other potential partners to collect and collate data, and share information, experience and knowledge that will feed into the preparation of the Action Plan for Periodic Monitoring of World Heritage sites in Asia and the Pacific (to be completed before the next session of the World Heritage Committee in Fuzhou, China, from 29 June to 9 July 2020)

Implementation of Action 1 for 2020:

As the scheduled in-person meetings to prepare the Third Cycle of Periodic Reporting in the region of Asia and the Pacific had to be cancelled due to the COVID-19 pandemic, UNESCO World Heritage Centre moved the training entirely online, in the form of short, (bi-)weekly training sessions for National Focal Points and site managers in Asia and the Pacific, running between September 2020 and April 2021. HIST, WHITRAP and Centre on World Natural Heritage Management and Training for Asia and the Pacific Region (in India) were invited to be part of the mentoring system for the Periodic Reporting exercises.

Action 2: Expanding and strengthening cooperation for the application of Space Technologies on identification, nomination, conservation, monitoring, management and sustainable development of World Heritage sites along the Belt

and Road region.

The expected outcomes of this action and timeline foreseen are:

- (1) A Memorandum of Understanding (MOU) for HIST-IICAS cooperation expected to be signed (before end of 2020);
- (2) At least 2 research and capacity building projects to be launched with the objective of generating successful nomination of new trans-border sites along the Silk Road Economic Belt for inclusion in the World Heritage List (before end of 2021).
- (3) The project on human-wildlife conflict in elephant habitats in Sri Lanka to be concluded in collaboration with appropriate partners in Sri Lanka and at least one research paper published in an internationally recognized journal (before end of 2021); and
- (4) At least two new projects that is directly relevant to attaining SDG 11.4, in combination with a selected number of other SDGs, considered important by local communities, will be initiated in partner countries that contribute to the implementation of the DBAR scientific plan (before end of 2021).

Implementation of Action 2 for 2020:

- (1) HIST signed a MOU with International Institute for Central Asian Studies (IICAS) on March 26, 2020 to establish and advance mutual cooperation.
- (2) HIST advanced cooperation with UNESCO and its Member States from Myanmar, Sri Lanka and forged new partnership with regional organization-IICAS, and research institutions from Greece and other countries.

Requested by UNESCO World Heritage Center (WHC), HIST conducted an emergency monitoring and assessment of potential impact of Super Tropical Cyclone Harold on East Rennell, a World Natural Heritage site in Rennell Bellona Province, one of four affected provinces of the Solomon Islands which were among four cyclone-stricken countries in early April, 2020. HIST research teams applied the ESA Sentinel-1 satellite radar imagery captured on 27 March 2020 (pre-disaster) and 8 April 2020 (post-disaster), and spotted four suspected regions of disaster impact based on Image Differencing Change Detection. The initial finding is that the impact of Tropical Cyclone Harold on East Rennell is limited based on the scope and the change of affected areas. The assessment report has been delivered to UNESCO WHC.

HIST and IICAS held active and close discussions and exchanges on the monitoring and protection of 33 World Heritage sites along the Routes Network of Chang'an-Tianshan Corridor. Remote sensing has significant advantages such as high temporal-spatial resolution, covering areas much larger than those covered by field research, low cost, high accessibility, repeatability and traceability, playing a pivotal role in the monitoring and protection of World Heritage sites. The satellite remote

sensing monitoring and evaluation were mainly carried out on the changes (528 km², 2014-2019) of the ten World Heritage sites and surrounding environmental factors in Kazakhstan and Kyrgyzstan. Due to the lack of high-resolution satellite image data of the Karamergen site (the area is 0.526 km²), it is not included in this evaluation. This work has not only provided scientific basis for the protection and management of ten world heritage sites, but also laid a foundation for cooperation in the field of heritage in Central Asia. Furthermore, a collaboration proposal among UNESCO World Heritage Centre, HIST and ICOMOS International Conservation Center-Xi'AN (IICC-X) on the nomination, monitoring, conservation and management of heritage sites along the Silk Road has been initiated.

In Greece, in partnership with the research team from Harokopio University of Athens, HIST launched a project to investigate and assess the performance and capability of InSAR monitoring tools for the preventive conservation of cultural heritage. In 2020, two pilot study sites, one from China (the Ming Great Wall) and the other in Greece (Acropolis), were comparatively investigated. High-resolution InSAR data from both sites were collected, shared and preprocessed. The deliverable of this bilateral project has been disseminated by the Newsletter of the project published in Greece; coauthored peer-reviewed journal papers on the potential of space-borne InSAR technology for preventive monitoring and conservation of large-scale architectural heritage across the globe have been published.

In Myanmar, in collaboration with Department of Archaeology and National Museum (Bagan Branch), the Ministry of Religious Affairs and Culture, Myanmar, HIST carried out the UAV-based optical remote sensing survey in Bagan World Heritage Site. On January 6, 2020, HIST completed the sorting of the UAV optical remote sensing data of Bagan site, and held a data handover ceremony in the Bagan Branch Office of the Department of Archaeology and National Museum, Myanmar.

In Sri Lanka, HIST researchers monitored and analyzed changes in the forest cover loss in Asian elephants' habitats based on data from multiple satellites, including forest loss and its ratio and others. The research provides a new, high-resolution and long-time series dataset for the protection of habitats of Asian elephants, describing recent forest loss in the habitats of natural protected areas, laying the foundation for habitat protection and restoration and benefiting sustainable development of Asian elephant habitats and surrounding landscapes.

HIST researchers also conducted the geologic and geomorphologic interpretations of geoparks along the Belt and Road and assessed their potentials using multiple remote sensing data based analyses and interpretation. They used space technologies to analyze and evaluate landscape features of geological heritage, discover scientific and aesthetic values of geological heritage, and assess educational value and its potential to promote economic development of adjacent

communities. These efforts provide important scientific data and technical support to assess the potentials of geological sites, in particular their international significance and possibilities to be nominated as UNESCO global geoparks. HIST compiled two reports, one focusing on the geologic and geomorphologic interpretations of Medina Volcano geopark in Saudi Arabia and the other on Salt Range geopark in Pakistan. Both sites have been included by Saudi Arabia and Pakistan in their respective tentative lists of sites to be nominated as UNESCO Global Geoparks.

In 2020, HIST established a partnership with ICOMOS International Scientific Committee on Interpretation and Presentation of Cultural Heritage Sites (ICIP), recommended one researcher to be an expert member of ICIP and will maximize the potential of space technologies in the interpretation and presentation of cultural heritage sites.

In addition, HIST responded to the open invitation announced by GEO, for using Earth Observations to monitor climate change impacts on Urban Heritage. A new community activity: GEO Urban Heritage Climate Observatory (UHCO) was launched on 26 April 2021.

In China, HIST conducted several important projects. First, for the project of space-air-ground integrated monitoring of the Jiuzhaigou World Heritage Site, HIST researchers have employed remote sensing and other technologies and conducted field investigations to evaluate bodies of water and vegetation, topography, and environmental factors in 2020. Research results show that Jiuzhaigou's ecological environment is gradually recovering after the impacts of the 2017 earthquake. HIST's research teams will go on to monitor disaster restoration levels in vegetation and water environment as well as risks from landslides. Second, another project focuses on monitoring and analyzing the pattern Change of Coastal Wetland System and its Dynamic Impact on Habitat of Red-Crowned Cranes in Yancheng, Jiangsu Province. In the field investigation, HIST researchers found that the coastal erosion and the expansion of exotic species (*Spartina alterniflora*) had damaged the habitats of millions of migrating birds. Third, HIST also conducted research on remote sensing monitoring and digital preservation of the Grand Canal (Beijing section) and developed key technologies for digital archiving, virtual reconstruction, dynamic monitoring, and evaluation of the entire chain of cultural heritage in the Grand Canal landscape corridor. Fourth, an interdisciplinary research on the discovery of the Jade Gate Pass of early Western Han Dynasty was carried out based on the non-destructive space archaeology approach, which combines the space-air-ground integrated remote sensing, geophysical prospecting and GIS-based spatial analysis with the related environmental methods in archaeology. Fifth, HIST researchers built a Big Data Platform on sustainable development of the Great Wall of China, which can manage and visually analyze all factors of 43,721 relics of the Great Wall including the walls, trenches, towers, and fortresses.

In addition, for the first time, HIST expanded the use of space technologies in assisting China's tentative heritage sites in the nominations to World Heritage List. HIST researchers are invited to participate in the monitoring and evaluations of Badain Jaran Desert—Towers of Sand and Lakes and provide suggestions on minor boundary modifications of Shennongjia World Natural Heritage Site to add an important area-Wulipo(Chongqing Municipality) to its core zone.

Action 3: Enhance capacity building on space technology research and applications for UNESCO designated sites in the developing member states of UNESCO.

The expected outcomes of this action and the timeline foreseen are:

- (1) 20-40 participants from Asian and African member states of UNESCO will participate in short-term training workshops to be organized by HIST (one in 2020 and another one in 2021);
- (2) At least 3 scholars from partner countries and organizations will be seconded to HIST to collaborate on developing and implementing studies and research projects on space technology applications addressing identification, nomination, conservation, management, monitoring and sustainable development of UNESCO designated sites (before end of 2021);
- (3) At least 3 students from less developed countries start their doctorate studies under the supervision of HIST/RADI scientists on specific research questions pertaining to conservation, monitoring, management and sustainable development of UNESCO designated sites with the aid of space technologies (before end of 2021).

Implementation of Action 3 for 2020:

- (1) In October 2020 HIST established its Jiuzhaigou Workstation, the first one within China's Natural World Heritage site, to give full play to space technologies in the restoration and sustainable development of Jiuzhaigou.
HIST organized a Training Workshop on Space Technologies for Post-Disaster Restoration of World Heritage Sites on 13 October 2020 to mark International Day on Disaster Risk Reduction and improve capabilities of managers, technicians and researchers from UNESCO-designated sites. Around 50 trainees from 10 Chinese World Natural Heritage sites have received a week-long training on remote sensing fundamentals, unmanned aerial vehicle operations, space disaster reduction and others.
- (2) Due to COVID-19, international scholars from partner countries and organizations cannot come to China to conduct studies and cooperate on research project. However, HIST formed a partnership with Issaak Parcharidis, Professor from Harokopio University of Athens, and Olga Markogiannaki, Researcher from University of Western Macedonia, Greece, to conduct investigations and assess the

performance and capability of InSAR monitoring tools for the preventive conservation of cultural heritage.

- (3) Najam us saqib Zaheer Butt from University of Gujrat, Pakistan, was newly recruited in 2020 to begin his doctoral studies in Cartography and GIS at HIST; he is expected to graduate in 2023.

Action 4: Heightening the visibility and reputation of HIST.

The expected outcomes of this action and the timeline foreseen are:

- (1) At least one side event organized during the 44th session of the World Heritage Committee to highlight the importance of space technologies for the identification, nomination, presentation, conservation, monitoring and management of listed and potential World Heritage sites (before end of July 2020);
- (2) HIST and RADI staff attend at least 4 side-events and/or panel discussions organized by UNESCO and its partners including IUCN, ICOMOS and ICCROM during the World Heritage Committee sessions, the 15th COP of CBD, the 9th International Conference on UNESCO Global Geoparks and other such events and make presentations to highlight HIST's mandate and services it can offer for implementing global programs and conventions in China and in other interested UN Member States (before end of 2021);
- (3) Capitalizing on the presence of a wide range of international organizations, UN Member States as well as international NGOs and civil society organizations, particularly during events such as the 15th COP of CBD, HIST will organize at least one event at HIST-RADI headquarters to discuss space technology applications' contributions to implement the UN 2030 Global Agenda to deliver SDG 11 in combination with selected number of other SDGs (before end of 2020).

Implementation of Action 4 for 2020:

In partnership with Aerospace Information Research Institute of CAS and Jiuzhaigou World Heritage Administration, HIST organized the **International Symposium on Big Earth Data and Sustainable Development of World Heritage** in Jiuzhaigou Valley, Sichuan Province, China, on 16 October 2020 to conduct in-depth discussions on the latest technological developments to monitor and conserve UNESCO-designated sites and gain insights from senior scholars, contribute their valuable views on how to use space technologies to implement 2030 Agenda for Sustainable Development. Dr. Jing Feng, Chief of the Asia and the Pacific Unit, World Heritage Center, UNESCO and Prof. Christopher Marrion, President of ICOMOS/ICORP and other international representatives delivered speeches at the Symposium. It attracted more than 100 representatives to be present at the symposium which was held in hybrid format with international speakers delivering pre-recorded video speech. HIST presented the latest

application of big Earth data and other space technologies in the achievement of sustainable development of World Heritage to all representatives. Several site managers expressed their need for technologies to improve their management and promote sustainable development of world heritage sites.

HIST held an **International Workshop on the Monitoring and Protection of World Heritage Sites** in Beijing on the morning of January 6, 2020. The workshop discussed new developments, ideas, and technologies in the field of heritage protection and facilitated academic exchanges in the natural and cultural heritage. HIST Governing Board members (Prof. Rosa Lasaponara, Senior Research Fellow of the National Research Council of Italy, Ana Roders, a professor with Delft University of Technology in the Netherlands) and other experts shared their cases in the monitoring and protection of various kinds of heritages by employing space and other technologies.

In the context of COVID-19, HIST staff attended several webinars to discuss and explore the new potential for utilizing space technologies to support the conservation, management and sustainable development of World Heritage sites.

Due to the long-term impact of COVID-19, the 44th session of UNESCO World Heritage Committee and other international events mentioned in expected outcomes have been rescheduled to July 16 to 31, 2021. HIST has made timely adjustments accordingly and is actively preparing for every side event and exhibition during aforementioned events.

Action 5: Dissemination of research results as well as other data, information and knowledge products for scientists and the general public.

The expected outcomes of this action and the timeline foreseen are:

- (1) At least 3 multi-authored publications in internationally recognized journals on the work of HIST/RADI and their contributions to promoting international cooperation on space technologies for natural and cultural heritage (end of 2021);
- (2) An Information Platform Prototype on Monitoring and Evaluation of Natural and Cultural Heritage Sites developed and published during the 44th session of the World Heritage Committee during June-July 2020 in Fuzhou, China (before end of July 2020);
- (3) An area specifically for displaying HIST-RADI publications and outputs within the exhibition during the 44th session of the World Heritage Committee (before end of July 2020); and
- (4) The English version of the book-*Introduction to Space Archaeology* designed, peer-reviewed and published (before end of 2021).

Implementation of Action 5 for 2020:

HIST launched an online “Digital Heritage Cloud Public Class” with the theme of “Space Information Technology as a Guardian of Cultural and Natural Heritage” on 13 June 2020-China’s Cultural & Natural Heritage Day. It widely promoted the significant role of space technologies in the identification, monitoring and protection of World Heritage and improved the awareness of site managers, decision-makers, heritage practitioners and the general public to the uniqueness of the latest space technologies. It attracted more than 70 thousand online viewers at home and abroad to watch the public class live. HIST posted the video footage on Tencent Video website to reach more viewers.

Meanwhile, HIST hosted an online photo exhibition featuring a combination of satellite images by HIST’s host institution AIR CAS with photos taken by photographers, piecing together the exceptional beauty of these sites from various viewpoints. The pictures demonstrated the universal value of these heritage sites for both people and the planet, the importance of heritage protection, as well as the advantage of space technology for better heritage monitoring and protection. All the sites demonstrated on the picture exhibition are part of HIST research projects in China. Some of site descriptions are derived from UNESCO website. It was published on CAS website in English and on UNESCO Wechat.

One of HIST researchers was interviewed by *China Daily* to publicize the ever-increasing role space technologies play in the promotion of sustainable development of UNESCO-designated sites. The news report “Space for new discoveries” was delivered globally by *China Daily* to draw international readers’ attention to the role of HIST and its space technologies in monitoring and preservation of heritage sites.

HIST’s brochures and newsletters (both in English and Chinese) were widely disseminated in a number of international, regional, and domestic events to promote its work and its interests in collaborating with a range of partners on the application of space technologies for UNESCO sites. Some of the important events are listed below:

- China Scenic Area Innovative Development Summit Forum, 24 July 2020
- Changbai Mountain International Ecological Conference, 20 September 2020
- Training Workshop on Space Technologies for Post-Disaster Restoration of World Heritage Sites, 13 October 2020
- International Symposium on Big Earth data and Sustainable Development of World Heritage, Sichuan, 16 October 2020
- Annual Conference of China Association of National Parks and Scenic Sites, 8-9 November 2020
- Annual Conference of UNESCO China National Commission’s Partners, 25 December 2020

It was decided that the 44th session of the World Heritage Committee, initially scheduled for 29 June-9 July 2020 was postponed to July 16 to 31, 2021. Relevant preparations for side event and exhibition are under way.

To develop and disseminate methodologies and demonstration cases on using space technologies to conservation and management of UNESCO-designated sites, the research team of HIST published one book-*Earth Observation Technology and Method for the Giant Panda Habitat* focusing on the application of space technologies in the monitoring, protection and prediction of giant panda habitat. HIST researchers and their collaborators also published several papers in internationally renowned journals. The most influential 5 papers are listed below:

- (1) Du J, Fu B, Guo Q, et al. Monitoring and Assessment of the Oasis Ecological Resilience Improved by Rational Water Dispatching Using Multiple Remote Sensing Data: A Case Study of the Heihe River Basin, Silk Road[J]. *Remote Sensing*, 2020, 12(16): 2577.
- (2) Cudahy T, Shi P, Novikova Y, et al. Satellite ASTER Mineral Mapping the Provenance of the Loess Used by the Ming to Build their Earthen Great Wall[J]. *Remote Sensing*, 2020, 12(2): 270.
- (3) Zhou W, Chen F, Guo H, et al. UAV Laser scanning technology: a potential cost-effective tool for micro-topography detection over wooded areas for archaeological prospection[J]. *International Journal of Digital Earth*, 2020: 1-23.
- (4) Wang X & Luo L. From remote sensing archaeology to space archaeology: A new task in the era of cultural heritage protection [J]. *Journal of Remote Sensing*, 2020, 24: 837-841.
- (5) Bachagha N, Wang X, Luo L, et al. Remote sensing and GIS techniques for reconstructing the military fort system on the Roman boundary (Tunisian section) and identifying archaeological sites. *Remote Sensing of Environment*, 2020, 236: 111418.

In addition, HIST fostered cooperation with Springer Nature and launched a special issue “Space Technologies for Sustainable Heritage” with *Heritage Science*, an international academic journal, to strengthen academic communications to commemorate its 10th anniversary in 2021.

Cost

Budget Implemented in 2020:

Chinese Academy of Sciences (CAS), representing the Government of China, takes the responsibility for providing annual operational budget to HIST while the host institution –Aerospace Information Research Institute of the Chinese Academy of Sciences provides other funding (salary, office premises, etc) to HIST. In 2020, CAS allocated 500,000 RMB for HIST’s daily operation. Costs for implementation of research

projects in the biennial action plan for 2020-2021 were mainly funded by the CAS Strategic Priority Research Program of Big Earth Data Science Engineering Project.