

## **ISPRS/IGU/ICA Joint Workshop on Borderlands Modelling and Understanding for Global Sustainability**

With the sponsorship of the International Society for Photogrammetry and Remote Sensing (ISPRS), International Geographical Union (IGU), International Cartographic Association (ICA), Geographical Society of China (GSC), and the Association of American Geographers (AAG), the ISPRS/IGU/ICA joint international workshop on Borderlands Modelling and Understanding for Global Sustainability was successfully organized on the 5th and 6th of December in 2013 in Beijing, China, by the School of Geography at Beijing Normal University (BNU) and National Geomatics Center of China (NGCC). This workshop aims to promote scientific research and academic exchange on digital modelling, advanced analysis and comprehensive understanding of borderlands. The Chinese Academician Dahe Qin (IGU Vice-President), Professor Jun Chen (ISPRS President) and Professor Yanhua Liu (GSC president) co-chaired the workshop, around 80 leading scientists and young researchers from 11 countries participated in the workshop.

This workshop organized two keynote sessions and five sub-topic sessions. The five sub-topics addressed are scientific challenges and perspectives in borderlands studies, analytical and quantitative methods for borderlands, understanding of borderlands features, understanding cross-border communication and security, and modelling and representation of digital borderlands.

In the keynote session one, Yujing Ouyang, the director in the Department of Boundary and Ocean Affairs, Chinese Ministry of Foreign Affairs, introduced the past, present, and future of China's boundary and ocean affairs. His speech emphasized the increasingly indispensable role of advanced technological supports was strengthened in the management of boundary and ocean affairs in China. From the perspective of boundary and ocean affairs, sustainability means cooperation management of mutual relations between China and its neighboring countries. Although some disputes about borders existed in specific areas in some specific periods of time, China has made great achievements in sustainable management of boundary and ocean affairs since 1949. Chinese successful experiences of boundary management have a good technological foundation, such as GIS related software, ocean information database, mapping the border, decision-making support system, and digitalization of boundary-related information.

Victor Konrad, the President of the Association for Borderlands Studies (ABS), gave a presentation on imagining and imaging borders. He claimed at the beginning that people have already know how borders grew in importance in the post-classical world, enshrined in law, treaty, surveillance, and security. However, borders are increasingly complex human responses and social constructions in a world where globalizing forces confront basic human concerns for security and certainty. Borders in globalization are the meeting points of globalizing forces of security,

trade and migration flows with emerging technologies, self determination and regionalization around the world. With a purpose to provide a framework for border studies, Professor Konrad continued to point out there are some important issues in six organizing principles that have not been known well yet, and further show how these organizing principles underlie the basic themes of border governance, flows, culture, history, security and sustainability. Finally, he gave two examples to illustrate potential imaging projects.

Paul Cheng, former Director, United Nations Statistics Division, is now a professor at National University of Singapore. In his view, the borderland was an interesting region for closer analysis in support of sustainable development and cross-border disaster mitigation. According to his introduction, we got to know that United Nations has established mechanisms for boundary determination and geographic names; however, UN Statistics Division has not systematically addressed any data issues related to Borderlands, excepted in disputed territories. Both the case of Jerusalem and the case of Singapore and Johor Bahru in his speech show the importance and necessity of establishment of Location Information Framework for Borderlands. However, there still exist these issues worth carefully thinking as follows, such as usage of information (how and for what purpose can the information be used?), institutional arrangement (who should be responsible?), source of information (direct or indirect?), spatial units (administrative or logical), and indicators (what types of indicators should be chosen for various domains?).

Stanley David Brunn, a professor at University of Kentucky, US, gave a broad vision of boundary in his speech. In his view, all the boundary crossing and blurredness that exists in the knowledge world on the one hand; on the other hand, there are still boundaries and barriers that exist, even in environmental and global thinking. The world can be still considered to be replete with boundaries at all scales, personal, community, disciplinary, national and global. Boundaries are not only rooted in cultural, ethnic, gender, political content, but also have many different meanings in the worlds of cyberspaces, which have changed and are changing the way we look at environmental and also other topics. Professor Brunn held such an idea that the fields, concepts and models concerning global sustainability call for an examination of both old boundaries and new boundaries, especially those that intersect different disciplines, scales and technologies. In this speech, he focused on new transdisciplinary boundaries that are essential to study sustainability at local and global levels and also cyberspace worlds where there is much fluidity, speed, networking that relate to issues of identity and territoriality.

In the keynote session two, Giuliano Bellezza, the IGU Vice President, Professor at University of Roma, Italy, discussed the historical evolution of borders and clarifies different types of borders in human history from natural borders to a possible borderless world in the virtual cyberspace. With the development of technology and globalization, border issue has been becoming more and more complicated than any time in history. At the end, he asked us to think about the border challenges in the

borderless cyberspace. With a retrospective review of thoughts about borders, professor Bellezza argues that borders are man-made, which could be the conflict sources among different human groups, but also could be a kind of protection for human beings, such as regulations in the virtual cyberspace. We need find solutions to the border challenges from history and in the human beings per se.

Rana Singh, a professor at Banaras Hindu University, India, presented from a cross-culture perspective to understand global sustainability. He assumed there are many different ways to approach the concept of sustainability, and Asian culture may be able to provide a new one. In Asian culture, the idea of wholeness was understood as holiness, which represented with sacred ecology and visualized through the cosmic frames of sacred landscapes. Understanding, feeling, living with, practicing and passing on these inherent meanings and aesthetics provide peace, solace and deeper feelings to human mind. On this theoretical base, Professor Singh argued human beings should think universally, see globally, behave regionally, and act locally but insightfully. He thought this is an appeal for sharing wisdom for global sustainability in making our cultural landscapes mosaic of happy, peaceful and sustainable places crossing all the borders and transitions.

Ayako Kagawa, Chief Geo Support Unit of UN Cartographic Section, presented the international boundary experiences by the United Nations. UN regards the adequate delimitation and demarcation of international boundaries as a very important element for the maintenance of peace and security in fragile post conflict situations, establishment of friendly relationships and cross-border cooperation between countries. The UN is involved in international boundary issues following the principle of impartiality and neutrality and its role as mediator. The paper, in detail, highlights some of the international boundary projects that the UN Cartographic Section conducted. They provide the technical support for different boundary requirements as each international boundary issue requires specific focus and attention.

Jun Chen, ISPRS President, discussed the importance of the application of geographical technologies to global sustainability. He argues that reliable information and effective analysis tools are requested to support borderlands studies through the integrated utilization of geospatial analysis, web service, and other specific expertise. The paper identifies three major challenges in the borderlands studies from geospatial information science, including integrated data modeling, comprehensive analysis and collaborative information service. In order to address these three challenges, suggestions are made for further studies: classification and representations of borderland information, derivation of neighborhood information, development of synergetic analysis, and design and development of a geo-portal for borderlands studies. Professor Chen also emphasizes the necessity of research collaboration among the social, natural and engineering sciences.

The 19 oral presentations in the five sub-topic sessions cover diverse topics by using quantitative and qualitative methods for analysis. One group of studies focuses on methodological and technical issues, and four major themes were summarized. The first theme is about the data sources and collection of borderlands information. Borderlands information is traditionally gained from various historical statistics data sources, such as borderlands' text documents, graphics, statistics and maps. With the rapid development of network and communication technologies, more and more borderlands information can be crawled from web data with geo-referenced text information, which plays an important role in Borderlands studies. Dongyang Hou's paper proposed a focused crawling method named KSRs-FC to collect situation information about borderlands. The other two papers provide examples that borderlands information can be extracted from open street maps (Xiaoguang Zhou's paper) and high-resolution remote sensing images based on multi-resolution segmentation (Peng Shao's paper) and so on. Ran Li's paper entitled "Quality assessment of CGLC30 georeferencing accuracy assisted by ZY-3 high resolution mapping satellite" developed a new set of methods to analyze data with higher accuracy to assess the data with lower accuracy.

The second theme is about the data analysis of Borderlands Information. Most of the existing borderlands information analysis use qualitative descriptive methods. With the big data revolution and statistical data model development, quantitative analysis methods have been applied more and more frequently for the Geopolitics research. For example, the research conducted by Dongyang Hou et al. proposed a key spatial relations-based relevance measurement method for quantitative borderlands situation analysis, which is one of the significant components for risk assessment and emergency response in borderlands regions. The study conducted by Hao Hu et al. entitled "using web crawler technology for text analysis of geo-events: a case study of the Huangyan island incident" applied a new method of big-data and new technology of web crawler to depict distribution of reactions to the event on the internet. The paper provides a vivid visual way of expressing information on the internet onto maps, and the paper shows that this method can also provide valuable information for real world decision making.

The third theme is related to visualization of borderlands information. Borderlands information includes graphic and text information, which can be represented by map symbol (point, line, polygon) and map annotation. Steve Pickering discussed the cartography change (e.g. symbol, line, color, etc.) of maps in Europe after the Order established by Treaty of Westphalia (1648), which addresses the issue of visualization of borderlands information from the historical perspective. Xiang Li et al. proposed a tag cloud-based visualization to process large amounts of geo-referenced text, using several visual metaphors including tag clouds, for the exploration of information on maps, instead of using just conventional cartographic approaches. Internal and external representations (Paper by Peter Jordan) and cartogram (Paper by Liao Hua & Weihua Dong) are used for borderlands information visualization.

The fourth theme is the application of newly developed method on borderlands management. The study by Changqiang Feng uses least-cost path analysis to conduct an automatic match between delimitation line and real terrain. Using this new method, the cost layer can be derived from the old delimitation line through straight-line distance analysis and terrain line network. The new delimitation line will generate from the least-cost path analysis with the consideration of resource allocation, including water, area, raw oil, coal and iron ore. Yibing Cao's report is about a surrounding transaction plotting and management system. It analyzes the common electronic map service platform by taking into account the surrounding affairs plotting aid management system. This research uses Google map service based on ASP.NET and C# web development technologies and Ajax technology. Ultimately it provides the efficient real-time online map plotting and sharing tools.

In the session 5, three reporters have emphasized in how to understand models application in the study of borderland. The first lecture presented by lili Wu, its theme is "The construction technology of the boundary environment model based on hexagon". In her research, she explained that the land boundary environment included natural geographical environment, human geographical environment and other aspects. The second presentation is given by Prof. M. Sun and his team; they explained three-dimensional geographic information system (3DGIS) images composited by laser scanner data are another kind of precise data source to replace traditional 3D modeling. In the end, Chen made a return about geographical environment unit division based on the algorithm of natural breaks. They took South Asia as case to analyze the geographical environment index system and the weighted stacking method. The result indicated that natural breaks method were perfectly and high accuracy on the geographical environment unit division. In short, all the lectures have put forward new perspective on model building. Each model could be apply in the different fields. We need to carefully analyze the new trial and approach on the broader study. Three methods are worthy of reference, but it also a new attempt and exploration. We wish more researchers devote themselves to develop new method in the future study.

The other group of the papers focuses on empirical studies on specific topics, such as polar region, Chinese border policy, cooperation between border cities, geo-energy security, and non-traditional security in the South China Sea.

Andrea Colombo's presentation concentrates on the polar region, one special sort of borderlands. This study mainly tells about the environmental and political challenges in the Arctic and Antarctica. In the region, the scientific research stations are the places where the environmental sustainability originates but in the meantime they are also the places where some critical situations have originated, such as oil spill, human daily activities, and tourism. The dispute on borderlands, the rights to explore resources, and the major and new players in the region will cause a huge geopolitical competition. The increasing impacts of human activities within the areas and global warming superimposed with a new

frontiers competition between powers implies that polar regions deserve more research attention. The presentation presented by Qianlong Bie makes a review on China's 50-years border policy evolution in Dehong Dai and Jingpo Autonomous Prefecture in Yunnan Province at the borderlands to Burma. China's borderlands policies are evaluated and the relative theories are tested. The authors find changes or instability of global economy and politics have more influences in this cross-border ethnic area. These findings are very important because it shows that the traditional theories may have some limitations to understand the uniqueness and diversity of the Chinese borderlands. Mikhailova studied the cooperation between Blagovershchensk-Heihe in Russian-Chinese border. Interesting facts are revealed that both sides soak to cooperation to build twin cities, but the cooperation was damped by the asynchronous paces in 2005 and 2010 respectively. Fieldwork by the author is helpful for the insight of the different understandings by both sides on the common goals. The paper by Hu and Ge built a geo-energy security evaluation model and evaluate China's geo-oil energy security in Russia's pacific oil pipeline construction from 1995 to 2010. The results show that the geo-oil safety index of China in the Russia's Pacific oil pipeline construction is rising. The proportion stability of China's oil consumption and China-Russian friendly relations eased China's geo-oil energy security. The economic development of China strengthens its power in the Northeast Asia's geo-oil competition. Dabova's paper pointed out the non-traditional actors challenge lines of communication, jeopardize access to strategic resources, complicate traditional defence tasks, and harm the environment. In this paper, a united problem-oriented approach is used for understanding the nature of non-traditional threats and making some recommendations for future improvements.

The research findings of these studies from past to present, from inside China to globe view, from competition to cooperation, makes them more valuable to understanding cross-border challenges. These papers perfectly emphasize two important issues of borderlands and sustainability studies: interdisciplinary and practice-oriented. A group of papers, from history, culture, and technology respectively, study the borderlands and sustainability. Borders and borderlands are man-made, then in order to understand borderland, we need to know relevant history and culture with appropriate and advanced technology. The other set of papers reflect that borderland study is highly policy and practice oriented. The challenges and solutions on borderlands derive from practice. The studies from history, culture and technology aim to solve the boundary issues in the real world. To advance borderland study in the future, we need multidisciplinary efforts by attracting people from varied majors including geography, international relation, law, environment science, economics and so on. Also ,we need to apply new technologies in GIS, Remote Sense and other necessary tools in the research. This workshop indicates the importance of multidisciplinary efforts. We hope it will shed light on future research on borderlands modelling and understanding.

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