The 30th International Conference on Geoinformatics 2023

CPGIS 2023

Space-Time AI and Urban Analytics

July 19-21, 2023

1-19 Torrington Place, London, WC1E 7HB, UK

Conference Website: https://www.cpgis.org/

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Foreword from the Chairs

Dear attendees,

Welcome to University College London for CPGIS 2023. We are thrilled to have you here in this vibrant and culturally diverse city, and we hope to showcase some of London's rich heritage throughout the conference. Established in 1826, University College London is a leading multidisciplinary institution known for its commitment to challenging norms, questioning assumptions, and fostering innovative thinking. Our esteemed faculty, inquisitive students, and dedicated staff continuously strive for excellence, pushing boundaries, and making a real-world impact.

The GeoInformatics Conference series, initiated by the International Association of Chinese Professionals in Geographic Information Sciences (CPGIS) in 1992, has successfully organised twenty-nine annual international conferences on geographic informatics around the globe. This conference series provides a unique platform for GIScience professionals worldwide to exchange novel ideas and share cutting-edge knowledge in the field of geographic information sciences and technologies.

GeoInformatics 2023, the 30th CPGIS Annual Conference, will take place from July 19th to July 21st at University College London. The primary conference theme is "Space-Time AI and Urban Analytics," encompassing thematic presentations, group discussions, paper competitions, special forums, and more. All accepted full papers will be officially published as conference proceedings with EI retrieval. Furthermore, the conference will facilitate the submission of selected excellent papers to international relevant journals after a rigorous peer-review process.

Additionally, UCL SpaceTimeLab will be hosting a 10-year anniversary event in the afternoon of July 21st, immediately following the closure of GeoInformatics 2023, at the same venue. The event will commence with a workshop (13:00-18:00), bringing together current researchers, alumni, academic partners, and government and industry collaborators to reflect on the achievements of the past decade and set sights on the future. Subsequently, we will celebrate this milestone with a Thames river cruise and banquet (19:00-23:00). This event is free and open to all participants of GeoInformatics 2023.

We express our sincere gratitude to all the individuals and organisations whose efforts have made this event possible. Our heartfelt thanks go out to our sponsors: UCL Department of Civil Environmental and Geomatic Engineering, UCL Centre for Advanced Spatial Analysis, Alan Turning Institute, Dalian Maritime University, University of Electronic Science and Technology of China, and the School of Resource and Environmental Sciences (SERS) at Wuhan University. We would also like to acknowledge the invaluable contributions of our conference volunteers who have assisted with organization, coordination, communication, and logistics. Furthermore, we extend our appreciation to the peer reviewers for their time, effort, and constructive feedback on the submitted papers. Finally, we extend our gratitude

to all attendees, whose active participation continues to foster an environment of collaboration and support at CPGIS.

Once again, a warm welcome to University College London and GeoInformatics 2023. We wish you an enriching and memorable conference experience.

Best regards,

Chairs of CPGIS2023

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Professor in GeoInformatics
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Conference Volunteers (in order of surname alphabet)

We would like to thank for the generous assistance from the following volunteers to the conference.

Dr Meixu Chen, Mr Xiaowei Gao, Dr Yunzhe Liu, Ms Meihui Wang, Mr Xinglei Wang, Mr Yikang Wang, Mr Xianghui Zhang, Ms Fangzhou Zhou, Mr Zhengxiang Shi, Mr Mustafa Can Ozkan, Mr Natchapon Jongwiriyanurak, Ms Zhihui Song.

Conference Reviewers (in order of surname alphabet)

We would like to thank for the generous contribution of the following to the reviewers of the abstracts too.

Dr Huanfa Chen, Dr Song Gao, Dr Qili Gao, Dr Yi Gong, Dr Yuhao Kang, Prof Chaogui Kang, Dr Tian Lan, Dr Yijing Li, Dr Ziqi Li, Prof Bin Li, Prof Lan Mu, Dr Mingshu Wang, Dr Qingling Wu, Dr Zhonghua Zheng, Dr Fan Zhang, Dr Qunshan Zhao, Dr Di Zhu, Dr Rui Zhu (University of Bristol), Dr Rui Zhu (A*STAR, Singapore)

Additional Thanks and Acknowledgments

We would like to express our sincere gratitude to all the session chairs who generously volunteered their time and expertise to ensure the smooth operation of the conference. Your dedication and commitment to overseeing the sessions and facilitating fruitful discussions are greatly appreciated. Thank you for your invaluable contributions to the success of the conference.

Contact

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For emergency, please contact telephone number: +447737106369

Special notes on travelling in London and UK: there are tube strikes on 23-29 July 2023 and national rail strikes on 20, 22 and 29 July. More details can be found on https://tfl.gov.uk/campaign/strikes.

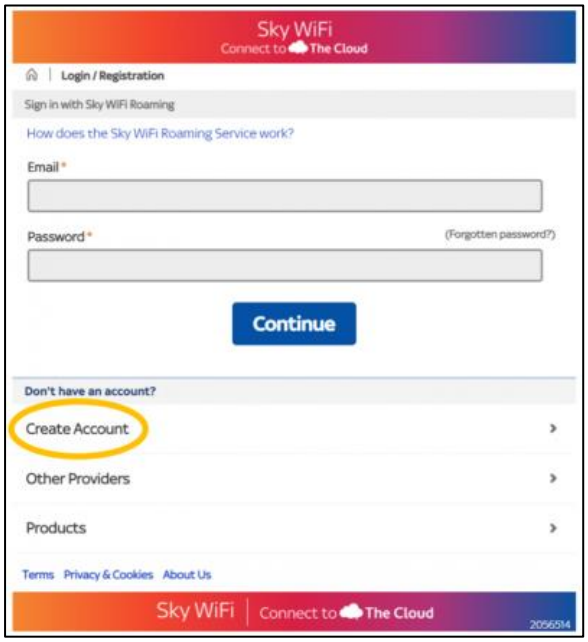
Wifi connection at UCL

If you have access to Eduroam wifi, you can directly connect to Eduroam wifi at UCL. Otherwise, you can connect to UCLGuest on UCL campus. This UCLGuest wifi is free for use. Before you start using UCLGuest, you must be aware of and abide by the UCL Computing Regulations and JANET Acceptable Use Policy. Instructions as below:

1. Select **UCLGuest** from your list of available Wi-Fi networks
2. Once connected, open a web browser and refresh your page

3. At the Welcome page (Fig.1), click **Go**

4. If you already have a The Cloud account, enter your email address and password and click **Continue**. If you do not have a The Cloud account, click **Create Account** to register (Fig.2)



5. After you have created a new account, you will be connected to UCLGuest. You will also receive an email confirmation with your details. Please write down your email address and password for The Cloud.

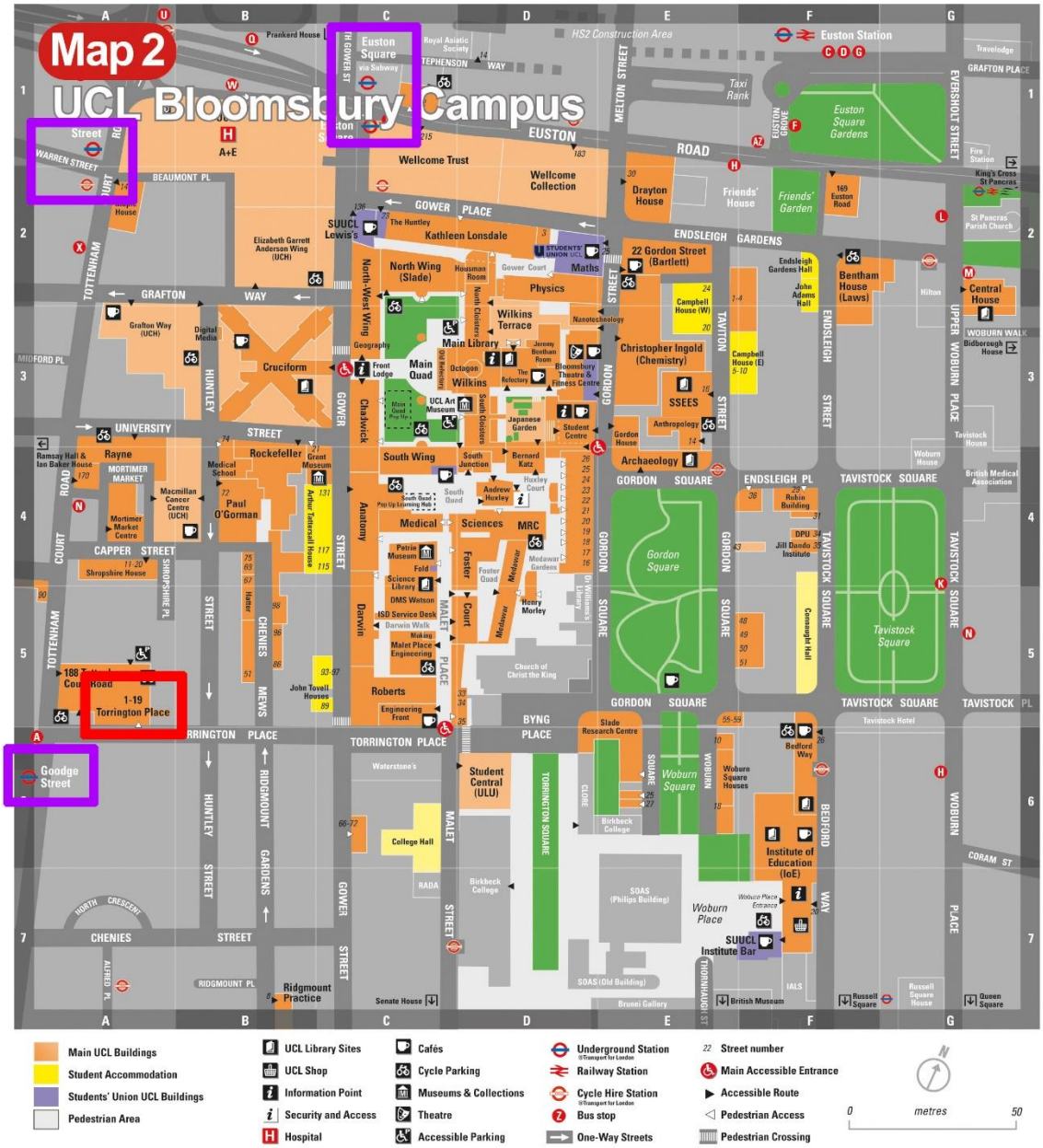
Conference Map

The conference site is the Bloomsbury campus of University College London (UCL), London, UK.

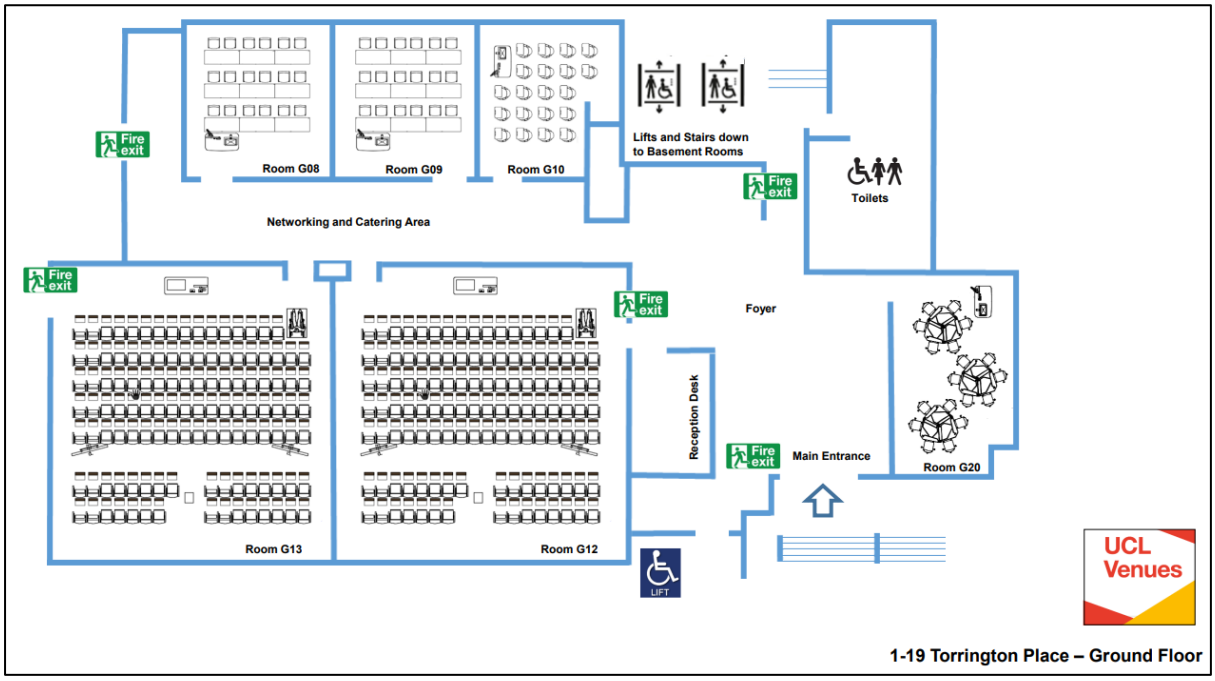
UCL was established in 1826 and is ranked 8th in the 2022 QS World University Rankings. UCL features several world-leading GIS research groups or centres, including SpaceTimeLab, CASA (Centre for Advanced Spatial Analysis), and CDRC (Consumer Data Research Centre).

The Bloomsbury campus of UCL is located in central London. It has good transport accessibility, as it is close to several major railway stations including Euston, King's Cross, and St Pancras within walking distance. Moreover, the campus is close to a number of important institutions, including the British Museum and British Library.

CPGIS 2023 will be held at the 1-19 Torrington Place, London, WC1E 7HB, which is marked in red on the map. Building entrance for the conference is from the South side of the building. See this link for a high-resolution version of the campus map. The nearest underground station is Goodge Street Station, which is on the Northern line's Charing Cross branch between Warren Street and Tottenham Court Road stations. The station has stepped and elevator access to platforms. Other nearby underground stations including Warren Street Station (Northern and Victoria Line) and Euston Square Station (Metropolitan, Hammersmith & City and Circle lines).

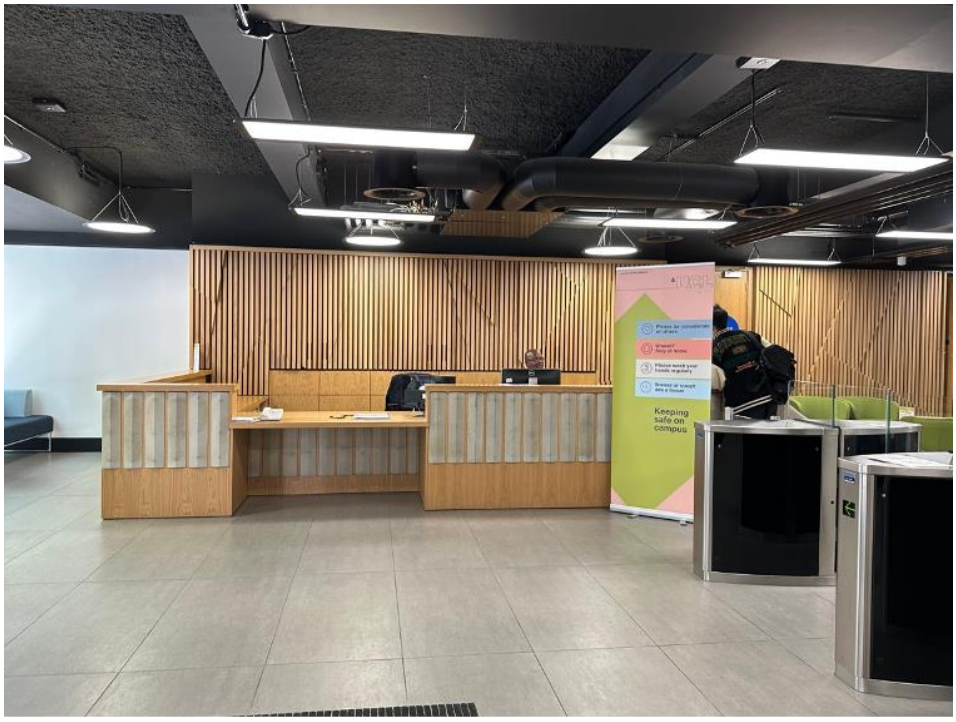

Map 2
UCL Bloomsbury Campus
Euston Square
Euston Station
Goodge Street
1-19 Torrington Place
Main UCL Buildings
Student Accommodation
Students' Union UCL Buildings
Pedestrian Area
UCL Library Sites
UCL Shop
Information Point
Security and Access
Hospital
Cafés
Cycle Parking
Museums & Collections
Theatre
Accessible Parking
Underground Station
Railway Station
Cycle Hire Station
Bus stop
One-Way Streets
Street number
Main Accessible Entrance
Accessible Route
Pedestrian Access
Pedestrian Crossing
0
metres
50

Floor plan of 1-19 Torrington Place



Outside Access (Main Entrance)

The conference registration is at the reception area, which is clearly visible from the entrance of the building.

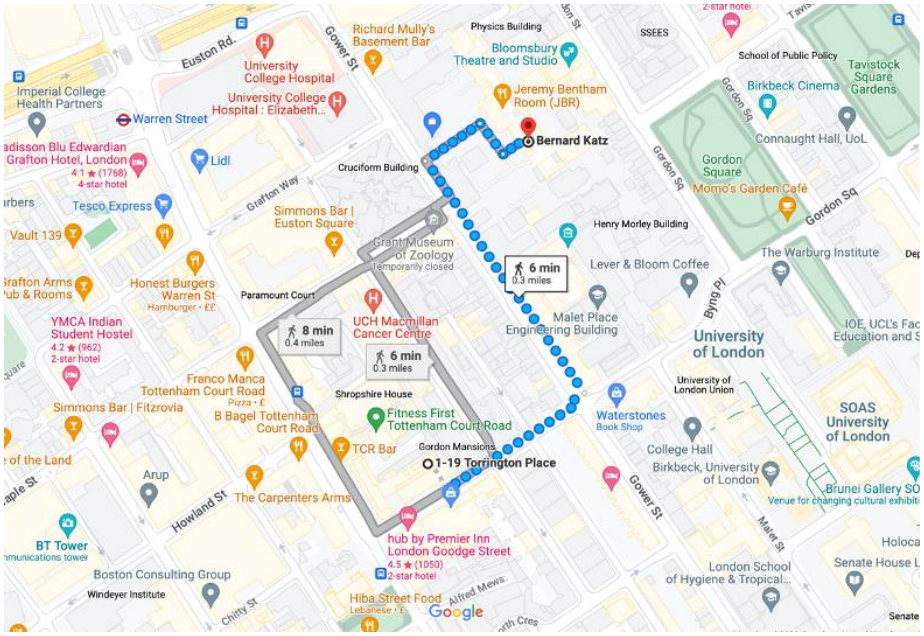


The ice-breaker (18:00-20:00, 18 July) will be at the Marlborough Arms (36 Torrington Place, London WC1E 7LY), which is a local pub. This pub is across the street of the conference building. In the ice-breaker, the conference will provide drinks for conference participants.

Map to UCL South Cloister (Poster and Reception Event, Wednesday 19 July)

Link to Google Maps directions: [1-19 Torrington Pl to UCL South Cloister]

Address: Gower Street, London WC1E 6AE

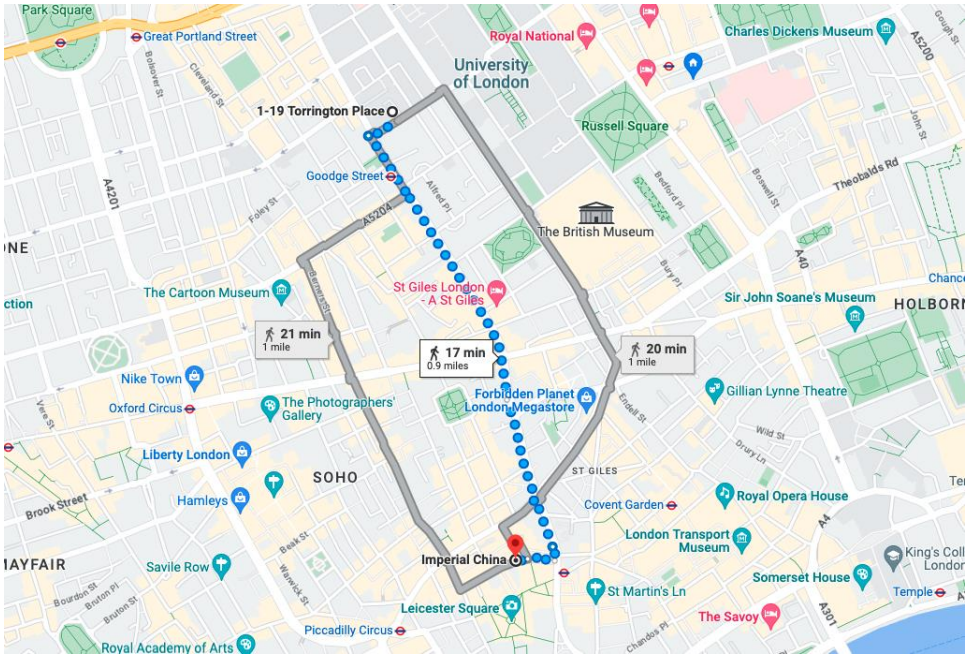


The UCL South Cloister is part of the main UCL building. The enclosed south cloisters connect the Octagon dome to the south wings of the quad. It is one of the main thoroughfares of the College, and accommodate a series of exhibitions and events throughout the year (for example shows from students of the Slade School of Art and from the UCL special collections).

Map to Imperial China (Gala Dinner, CPGIS night, Thursday 20 July)

Link to Google Maps directions: [1-19 Torrington Place to Imperial China]

Address: 25a White Bear Yard, Lisle St, London WC2H 7BA



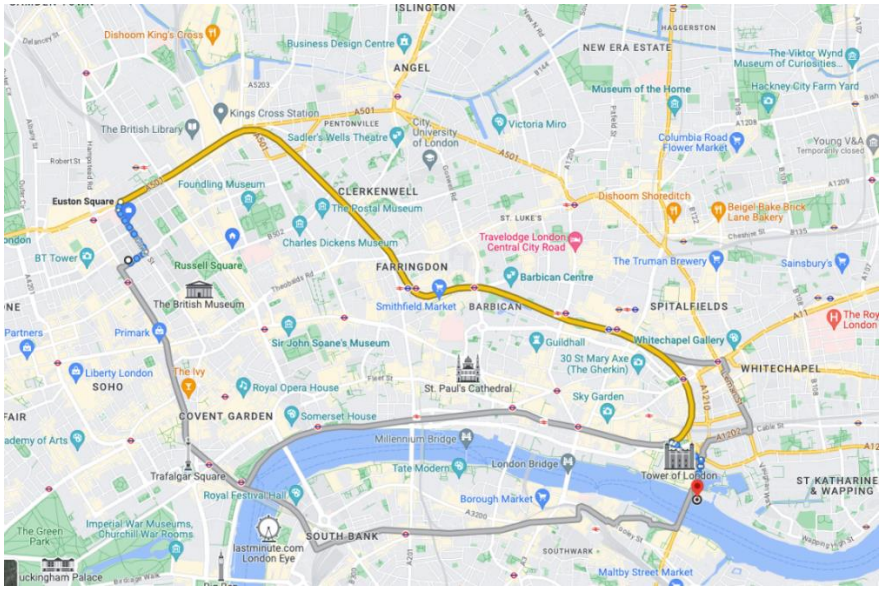
Founded in 1993, Imperial China London is a familiar sight in the area. It is quietly hidden within the bustling surroundings of Leicester Square and China Town. Imperial China is one of the largest Cantonese restaurants in China Town spanning over three floors with 8 private dining rooms.

Map to Tower Bridge Quay (Boat Trip, Friday 21 July)

Link to Google Maps directions: [1-19 Torrington Place to Tower Bridge Quay]

Address: Tower Bridge Quay, St Katharine's Way, London E1W 1LD

The nearest tube station to Tower Bridge Quay is Tower Hill station. There will be SpaceTimeLab volunteers outside this station and they will guide you to Tower Bridge Quay.



Accessibility and Inclusivity Information

You can use the University's interactive campus map. The map provides an introduction to each building, which is linked to Google Maps, allowing you to switch to Street View mode by clicking. At the same time, you can find routes from one building to another on the campus in the map, including wheelchair-friendly routes. You can also locate the water fountains in each building, indicating on which floor and at what location they are situated.

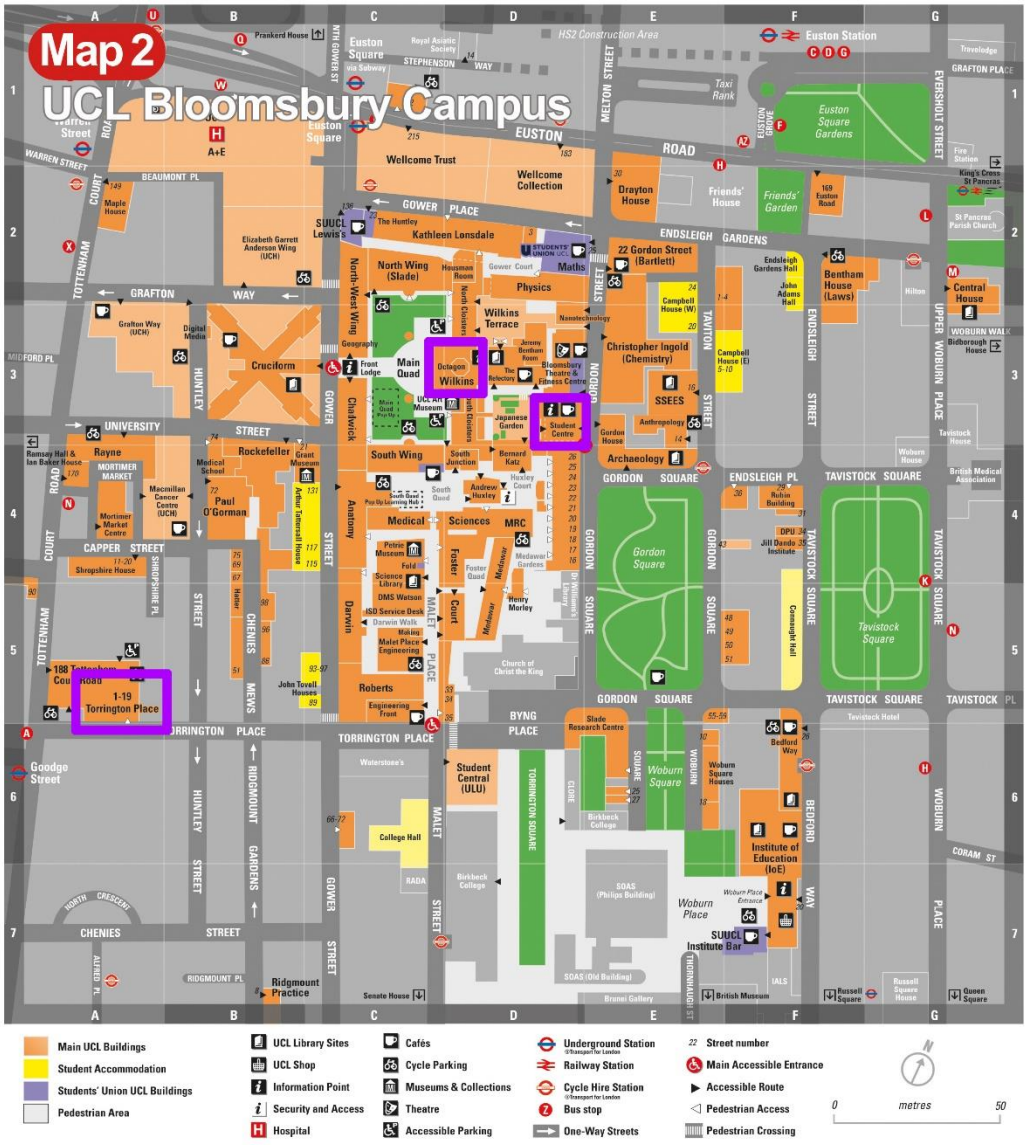
Additional information

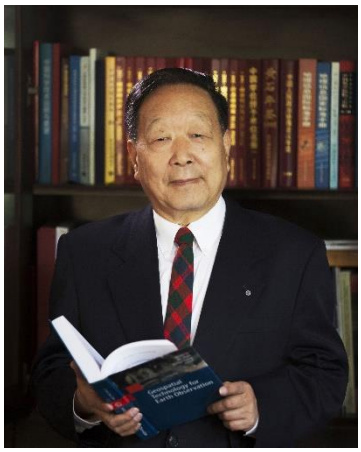
- If you are a wheelchair user or have other access requirements, you may need to adapt routes to meet your needs.
- Campus Maps are available from the official UCL student app, UCLGO! (for Apple, Android and Blackberry). Search for 'UCL' within the app store

Baby changing facilities

Baby feeding and changing facilities are available at the following 3 locations.

- **1-19 Torrington Place Room 359, Third Floor**
  - Accessible WC and baby-changing facilities: Baby-changing facilities available in the accessible women's WC located on the 3rd floor, opposite the west end lift lobby.
- **The Student Centre, Gordon Street Room G04, Level 00**
  - Baby-changing and first-aid room
- **Wilkins Building Rooms B03, B05 and B45, Lower Ground Floor**
  - Men's WC and baby-changing: Located in Room B03
  - Women's WC and baby-changing: Located in Room B05
  - Gender-neutral WC and baby-changing: Located in Room B45





LuoJia3-1 Satellite-Intelligent Remote Sensing Satellite Based on Internet

Bio: Professor Deren Li is a scientist in surveying, mapping and remote sensing from Wuhan University, China. He enjoys dual memberships of both Chinese Academy of Sciences and Chinese Academy of Engineering. He is also the member of International Eurasia Academy of Sciences and International Academy of Astronautics. He received doctor degree from University of Stuttgart in 1985 and honorary doctorate from ETH Zürich in 2008. In 2012, International Society for Photogrammetry and Remote Sensing awarded him the Honorary Member, the number of which ISPRS limits to a maximum of ten at any time as the highest honor. In 2020, ISPRS awarded him the Brock Gold Medal in recognition of outstanding contributions to photogrammetry.

Prof. Deren Li was the president of Wuhan Technical University of Surveying and Mapping, and director of State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing (LIESMARS). At present, he is the honorary director of academic committee of LIESMARS, director of Collaborative Innovation Center of Geospatial Technology, chairman of Wuhan Association for Science and Technology, and chief scientist of Optics Valley of China in Wuhan.

Abstract: This paper mainly describes the first intelligent remote sensing satellite based on internet, namely the LuoJia3-1. Focusing on the significant demand for Fast, Accurate and Flexible remote sensing information service to customers, this satellite creates a new mode of real-time service for intelligent remote sensing satellites on the internet, breaks through mission-driven high orientation and intelligent processing technology on orbit, and develops new generation remote sensing satellites with multimode open intelligent interconnection.

Designing Future Cities Using Artificial Intelligence

Bio: Professor Michael Batty is Bartlett Professor of Planning, University College London; Chair, Centre for Advanced Spatial Analysis (CASA); Co-Founder & Chair of the Digital Task Force for Planning. Mike has worked on computer models of cities and their visualisation since the 1970s and his recent publications *Cities and Complexity* (2005), *The New Science of Cities* (2013), and *Inventing Future Cities* (2018) all from The MIT Press. His forthcoming book *The Computable City* (MIT Press, 2023) is a history of how computers and digital technologies have and are changing the form and function of cities. He is a Fellow of the British Academy (FBA), the Royal Society (FRS), the Academy of Social Sciences and the RTPI. He was awarded the CBE in the Birthday Honours List in 2004. He received the Gold Medal of the Royal Geographical Society (2015) and the Gold Medal of the Royal Town Planning Institute. He has been the editor of *Environment and Planning B: Urban Analytics and City Science*, since 1982.

Abstract: Figuring out the best locations for urban development has been the quest of urban planning for a century or more. The notion that the determinants of optimal development are based on conflicting degrees of land suitability which can be overlaid and integrated to determine the most suitable locations has been at the basis of plan-design methods since the late 19th century. These methods now represent the essence of GIS and geo-design. In this talk, I will illustrate how we can integrate a series of factors or features using various kinds of weighting structures which can be represented as networks, first linking these ideas to social networks where the factors can be associated with different actors or stakeholders who then resolve their differences between using averaging or pooling processes that can be formalised as recurrent Markov chains. These weighting structures can be thought of as neural nets but with the nets being fixed in advance to optimise the way the factors merge to produce optimal locations. The corollary to these design methods is to determine the weights by training the process of averaging to meet spatial patterns known in advance and we can thus exploit various algorithms based on deep learning to determine the best weighting structures through feedforward neural nets. The association between designing an optimal urban system and understanding an existing one through machine learning has considerable potential for enriching our understanding of how best designs might be accomplished.

Reference: M. Batty (2021) Conflict Resolution and Opinion Pooling in City Planning, In Z. Neal and C. Rozenblat (Editors) *Handbook of Cities and Networks*, Edward Elgar Publishing Ltd, Cheltenham, UK, 389-408.

Spatiotemporal Analytics, Human Mobility and Health Research

Bio: Professor Meipo Kwan is a Choh-Ming Li professor of Geography and Resource Management and a director of Institute of Space and Earth Information Science at The Chinese University of Hong Kong. Kwan is a Guggenheim Fellow and a Fellow of the U.K. Academy of Social Sciences, the American Association for the Advancement of Science (AAAS), and the American Association of Geographers (AAG). She was named to the 2019 Highly Cited Researchers List compiled by the Web of Science Group as one of the world's most influential researchers. She has received many prestigious honors and awards, including the Distinguished Scholarship Honors, the Wilbanks Prize for Transformational Research in Geography, and the Stanley Brunn Award for Creativity in Geography from the AAG.

Kwan had served as an editor of Annals of the American Association of Geographers for 12 years. She has received over US$58.5 million grant support from sources including the U.S. National Institutes of Health, the U.S. National Science Foundation, the U.S. Department of Transportation, the National Natural Science Foundation of China, and the Hong Kong Research Grants Council. She has published over 330 books, journal articles and book chapters. She has delivered over 340 keynote addresses, invited lectures and other invited presentations in more than 20 countries.

Abstract: The rapid development and widespread use of advanced geospatial technologies such as GPS, remote sensing, mobile sensing, and location-aware devices in recent years have greatly facilitated the acquisition of enormous amounts of high-resolution space-time data. To build smart and healthy cities, we need to integrate these multi-source geospatial big data acquired by earth observation technologies and mobile sensing technologies to provide more accurate assessments of individual exposures to environmental or social risk factors, and to develop planning policies to improve health for all. In this presentation, I will discuss how these new developments can provide new insights into the relationships between people's mobility, health behaviors, and the complex spatiotemporal dynamics of environmental influence. Drawing upon my recent projects on individual exposures to green/blue spaces, light-at-night, and air and noise pollution, as well as on COVID-19, I explore how the collection, integration, and analysis of high-resolution space-time data enabled by advanced geospatial and mobile technologies (e.g., real-time mobile sensing and GPS tracking) can help identify the "truly relevant geographic context in space and time" and provide new insights into the relationships between human health, people's daily mobility, and the complex spatiotemporal dynamics of environmental influences.

Digital Twins for Cities and Regions–An Opportunity, or a Distraction?

Bio: Professor Mark Birkin is Professor of Spatial Analysis and Policy in the School of Geography, University of Leeds, and is Programme Director for Urban Analytics and Fellow at The Alan Turing Institute. He has longstanding interests in mathematical modelling of urban and regional systems including geodemographic, microsimulation, agent-based modelling, and spatial decision-support systems. Mark has a notable track record of collaboration, including ten years as an executive director of Geographical Modelling and Planning (GMAP) Limited. In this time, GMAP developed from occasional consulting projects into a market analytics business with 120 employees and global reach, working with household name partners such as Ford Motor Company, Asda-Walmart, HBoS, Exxon-Mobil and GSK. An ethos of collaboration with external partners in business and the public sector continues in his current role as Director of the Consumer Data Research Centre (CDRC), a national investment within the UKRI Digital Footprints programme. He is also PI for the ESRC Centre for Doctoral Training in Data Analytics, which coordinates more than eighty postgraduate research projects in tandem with external partners. Since 2014, Mark has been Director of the Leeds Institute for Data Analytics (LIDA). Having started as a partnership between CDRC and the MRC Medical Bioinformatics, LIDA now supports over 90 projects and programmes with more than £60M of funded research, bringing together over 200 researchers from across all eight faculties at the University. He is a Fellow of the Academy of Social Sciences and a Fellow of the Royal Geographical Society. In 2019, Mark was the recipient to the RGS-IBG Murchison Award for 'pioneering contributions to urban analytics'

Abstract: From origins in applied science, digital twins have begun to attract attention within the geoinformatics community. As with many scientific novelties, debates regarding their value can quickly become polarised and a nascent backlash is already in evidence. In this talk I will provide a brief review of the digital twin concept, and contextualise the idea within the frame of ongoing research priorities in regional science and geoinformatics. I'll provide some examples from ongoing work at the Alan Turing Institute and across its network of partners, and comment on the relative merits, actual and potential impact of the work. I will also suggest future pathways and attempt an evaluation of the long-term importance of digital twins for our discipline.

Conference Programme

Conference location: 1-19 Torrington Place, London, WC1E 7HB, UK

Paper session: each presentation consists of 14 min presentation and 4 min Q&A.

Rooms **(G13)** (G12) (115)

		7/18	7/19	7/20	7/21
		TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
08:00	09:00		Registration (Entrance)		
09:00	09:15		**Opening ceremony** (Chair: Tao Cheng) Welcome address by Prof Geraint Rees (UCL's Vice-Provost) Speech by Prof Lan Mu (CPGIS president) (G13)	**KEYNOTE by Prof Michael Batty** Chair: Min Chen (G13)	**F1: Innovative GIS topics** Chair: Xiao Li (G13)
09:15	09:30				**F2: Sustainable development** Chair: Yi Gong (G12)
09:30	09:45		**KEYNOTE by Prof Deren Li** Chair: Qiming Zhou (G13)		
09:45	10:00				
10:00	10:15			Speech by Sponsors Chair: Huanfa Chen (G13)	
10:15	10:30			TEA BREAK	TEA BREAK
10:30	10:45		TEA BREAK		
10:45	11:00			**D1: Environment and disaster**	**E1: Urban system** Chair: Yijing
11:00	11:15				**KEYNOTE by Prof Mark Birkin** Chair: Yang Yue (G13)

11:15	11:30		**A1: Health geography** Chair: Yongmei Lu (G13)	**B1: Geodemographics** Chair: Tian Lan (G12)	**C1: Urban mobility I** Chair: Chen Zhong (115)	Chair: Bo Huang (G13)	Li (G12)	
11:30	11:45							
11:45	12:00							**Closing Ceremony** (G13)
12:00	12:15							LUNCH
12:15	12:30					LUNCH		
12:30	12:45		LUNCH					
12:45	13:00							
13:00	13:15							**SpaceTimeLab's 10th Anniversary Celebration Workshop** "Unlocking Space and Time: Future AI and Smart Cities" (organised by SpaceTimeLab) (G13)
13:15	13:30					**D2: WebGIS and VGI** Chair: Rui Zhu (G13)	**E2: Street-level imagery** Chair: Mingshu Wang (G12)	
13:30	13:45		**A2: Spatial statistics** Chair: Chaogui Kang (G13)	**B2: Spatio-temporal AI** Chair: Song Gao (G12)	**C2: Accessibility and POI** Chair: Yanjia Cao (115)			
13:45	14:00							
14:00	14:15							
14:15	14:30							
14:30	14:45							
14:45	15:00		TEA BREAK			TEA BREAK		
15:00	15:15							

15:15	15:30		A3: Transport Chair: James Haworth (G13)	B3: Remote sensing Chair: Qunshan Zhao (G12)	C3: Urban mobility II Chair: Wei Tu (115)	**D3: CPGIS awards ceremony** Chair: Lan Mu (G13)		
15:30	15:45							
15:45	16:00					**KEYNOTE by Prof Mei-po Kwan** Chair: Yongmei Lu (G13)		
16:00	16:15							
16:15	16:30							
16:30	16:45							
16:45	17:00		TEA BREAK			TEA BREAK		
17:00	17:15							
17:15	17:30		**Poster session** (UCL South Cloister)					
17:30	18:00					**D4: GISalon Seminar** Organised by GISphere (G13)		
18:00	18:30	**Registration; Ice-breaker pub drink (Marlborough Arms, WC1E 7LY)**						
18:30	19:00		**Reception** (UCL South Cloister)			**D5: CPGIS Business Meeting** Chair: Lan Mu (G12)	**Thames Boat Trip till 11pm** (Tower Bridge Quay, E1W 1LA)	
19:00	19:30							
19:30	20:00					**Gala dinner & CPGIS night** (Imperial China, London WC2H 7BA)		
20:00	20:30							
20:30	21:00							

SpaceTimeLab's 10th Anniversary Celebration Workshop – 21st July 2023

Unlocking Space and Time: Future AI and Smart Cities

Agenda

12:00-13:00	Registration/coffee
13:00-13:30	***Welcome Address*** **Prof Jose Torero Cullen**, Head of Department, Civil, Environmental and Geomatic Engineering, UCL ***Unlocking Space and Time: SpaceTimeLab's 10th Anniversary Celebration*** **Prof Tao Cheng**, UCL SpaceTimeLab
13:30-14:15	***SpaceTimeLab Show and Tell*** PhD students of SpaceTimeLab Host: **Dr James Haworth**, UCL SpaceTimeLab
14:15-14:45	Coffee and demos
14:45-15:45	***Panel Discussion - Future AI and Smart Cities*** Panellists: **Mr Andy Emmonds** (Transport for London), **Dr Chris Gale** (Office for National Statistics), **Dr Olga Feldman** (Arcadis), **Prof Washington Ochieng** (Imperial College London) Host: **Dr Sarah Wise**, UCL Centre for Advanced Spatial Analysis
15:45-16:00	***Speeches by distinguished guests***
16:00-16:30	Coffee and demos
16:30-17:15	***ESRI Roger Tomlinson Prize & Student Award Session*** **Dr Huanfa Chen** (UCL Centre for Advanced Spatial Analysis), **Dr Mohamed Ibrahim** (University of Leeds), **Dr Nilufer Sari Aslam** (Birkbeck, University of London) Host: **Prof Paul Longley**, UCL Geography
17:15-18:00	***Keynote Address*** **Prof Ed Manley**, University of Leeds Host: **Prof Chris Brunsdon**, University of Maynooth, Ireland
18:00-19:00	Travel to Tower Bridge Quay, St Katherine's Dock
19:00-23:00	***Thames River Cruise and Banquet*** (dress code: Smart Casual) *Please note that children under 18s are not allowed on this boat trip*

The 30th International Conference on Geoinformatics in 2023

GISalon Seminar

17:30 - 18:30 Thurs 20 July 2023

G13, 1-19 Torrington Place, London WC1E 7HB

Zoom meeting: gisalon
https://zoom.us/my/gisalon

Topics

CPGIS Conference story

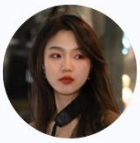
Networking Skills

Personal development path choices

.....

Hosts

Ce Hou
HKUST PhD student



Xinyi Liu
UCL Master student

Guest Speakers

Lan Mu President
Professor
University of Georgia

Song Gao Chair
Associate Professor
University of Wisconsin-Madison

Zhiyong Zhou
Postdoctoral Fellow
Universität Zürich

Nianhua Liu
PhD Student
Technical University of Munich

Seminar recording on:

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Sponsors Information

UCL Civil, Environmental and Geomatic Engineering
https://www.ucl.ac.uk/civil-environmental-geomatic-engineering/ucl-civil-environmental-and-geomatic-engineering

UCL CEGE – Civil, Environmental and Geomatic Engineering emphasise creativity, collaboration and communication by learning through multi-layered projects that bring in elements of social context - anything from human rights to the climate crisis. People are at the centre of what we do and our courses will help you to explore, build and design engineering solutions that make a tangible difference whether that's for a London commuter or a Chilean farmer.
Strong links to industry and research are embedded throughout our diverse range of programmes, with these links enhanced by our proximity to both major infrastructure projects and leading firms, thanks to our central London location.

https://www.ucl.ac.uk/engineering/

At UCL Engineering, our research is changing the world. Discover how our departments are focusing their research efforts in their disciplines and beyond. For over 190 years, UCL Engineering has been at the cutting edge of the discipline, home to some of the most successful engineering departments in the UK. Our work saves money, energy, and lives, as well as adding to the body of human knowledge.

https://www.ucl.ac.uk/bartlett/casa/bartlett-centre-advanced-spatial-analysis

The Centre for Advanced Spatial Analysis (CASA) is an interdisciplinary research institute focusing on the science of cities within The Bartlett Faculty of the Built Environment at UCL. CASA was established in 1995 to lead the development of a science of cities, drawing upon methods and ideas in modelling, sensing the urban environment, visualization, and computation. We seek to examine and offer solutions to the problems of resource efficiency and effective planning and governance shared by all cities. Our vision is to play a central role in the science of smart cities - applying it to city planning, policy, and architecture in the pursuit of making our cities better places to live.

Based in Bloomsbury, London, CASA is our living laboratory. As one of the world's truly global metropolises, there is nowhere more ideal than London for learning about the challenges confronting modern cities. Opening in 2022, UCL

East is now home to CASA's Connected Environments team. CASA has established a concentration of academics with a wide breadth of expertise from a range of disciplines, all with a common domain knowledge in cities. CASA's focus is to be at the forefront of what is one of the grand challenges of 21st-century science: to build a science of cities from a multidisciplinary base, drawing on cutting-edge methods and ideas in modelling, complexity, visualization, and computation.

The Alan Turing Institute

https://www.turing.ac.uk/

The Alan Turing Institute (ATI) is the national institute for data science and artificial intelligence, with headquarters at the British Library. The Institute is named in honour of Alan Turing (23 June 1912 – 7 June 1954), whose pioneering work in theoretical and applied mathematics, engineering, and computing are considered to be the key disciplines comprising the fields of data science and artificial intelligence.

The Turing consists of 10 research programmes, one of which is The Science of Cities and Regions which aims for the creation of a cross-cutting technology platform for data science innovation in the science of cities and regions. This programme is led by Professor Mark Birkin.

DALIAN MARITIME UNIVERSITY 大连海事大学 1909

http://rcb.dlmu.edu.cn

Dalian Maritime University (DMU), founded in 1909, is one of the largest and most esteemed maritime universities in China. It is the only key maritime institution under the Ministry of Transport. DMU holds the distinction of being listed under the "Double First-Class" university project and the "Project 211" university initiative. With its unique attributes and significant industry advantage, DMU is widely recognized as "the Cradle of Navigators."

Faculty positions include Xinghai Professors and Xinghai Associated Professors. Qualifications: 1. With a formal teaching or research position in overseas universities, research institutions or R&D departments in famous companies. 2. Below 35 years old (born after January 1, 1988). Or: below 40 years old (born after January 1,

1983) with more than 3 years' overseas research experience as well as remarkable academic performances. For applicants without qualifications above, if you have a PhD degree with outstanding research achievements, you can also apply for the two positions mentioned above.

The recruitment disciplines include engineering, science, management, humanities and social sciences. For Xinghai professor and associate professor, the annual salary is no less than 545,000 RMB and 375,000 RMB, respectively. More information can be found at:

https://en.uestc.edu.cn/

Renowned as China's cradle for the national electronic industry, University of Electronic Science and Technology of China (formerly Chengdu Institute of Radio Engineering) is situated in Chengdu, a city with over a thousand years of cultural history in "the land of abundance".

In the latest National Discipline Evaluation, both Electronic Science and Technology and Information and Communication Engineering rank No. 1. According to the 2022 US News Best Global Universities Subject Rankings, our featured discipline Electronic Science ranks No. 7 worldwide, Computer Science No. 19, and Engineering No. 46 worldwide as top 1‰ in the newest ESI.

With the motto of "to seek fact and truth, to be noble and ambitious," and talent cultivation as the foundation, as well as serving national and local economic construction as its mission, UESTC is unswervingly committed to strengthening the cross-study between basic disciplines and cutting-edge technologies. The university is determined to innovate with a pioneering and enterprising attitude, striving to build a world-class university with Chinese characteristics as soon as possible.

UESTC is now welcoming international faculty at all career stages, ranging from outstanding senior scholars to exceptional young scientists and from all backgrounds.

武汉大学 资源与环境科学学院
School of Resource and Environmental Sciences，Wuhan University

http://sres.whu.edu.cn/English/Home.htm

Situated at the shore of the beautiful Donghu Lake, the School of Resource and Environmental Sciences (SERS) at Wuhan University is a multidisciplinary school, spanning the fields of science, engineering, and management. SRES consists of 3 departments: Geographic Information & Map Science, Environmental Science and Engineering, and Geographic Science & Land Resources.

Its Geography and Environmental Science & Engineering disciplines are both ranked among the Top 100 by subject in the QS World University Ranking. In the ARWU Subject Rankings, Geographic Information Science and Land Resource Management have been rated as A+ level, while all other disciplines have been rated as A level.

At the School of Resource and Environmental Sciences, we are passionate about addressing the pressing challenges facing our generations, using theories and techniques drawn from GIScience, Geography, and Environmental Science. Join us at the SRES and embark on an exciting journey towards a more sustainable and prosperous future!

Presentation Sessions (14 min talk, 4 min Q&A)

Overview

A1: Health geography	**Spatiotemporal patterns of COVID-19 mortality and socioeconomic and environmental determinants in England** *Zhiqiang Feng* **Understanding the role of urban social and physical environment in opioid overdose events using found geospatial data** *Yuchen Li* **Incorporating fine-grained spatial heterogeneity to predict the local-scale infections and the superspreading areas of pandemic: A case study of COVID-19 in Hong Kong** *Ningyezi Peng and Xintao Liu* **Examining the Health Effects of Urban Gentrification** *Yongmei Lu* **Geospatial Research on Health and the Environment under the Social-Ecological Model** *Lan Mu, Inhye Kong, Jue Yang, Jielu Zhang and Nemin Wu*
B1: Geodemographics	**Fine-grained crowd distribution forecasting with multi-order spatial interactions** *Mingxiao Li, Song Gao, Wei Tu, Feng Lu, Huan Tong and Qingquan Li* **Diffusion Mapping The 2011 Census of England And Wales** *Gezhi Xiu and Huanfa Chen* **Population distribution modelling at fine spatio-temporal scale considering residents' behavior** *Yaxian Qing and Huayi Wu* **Creating enhanced population registers for measuring socio-economic inequalities in Great Britain** *Tian Lan, Paul Longley and Di Hu* **Multi-view spatiotemporal deep graph neural network model for travel demand prediction** *Tianhong Zhao, Zhengdong Huang, Wei Tu*
C1: Urban mobility I	**Short-term bike sharing demand prediction through feature fusion in spatial and topological domains** *Xinyu Li, Yang Xu and Ruojing Zhang* **Inferencing intercity freeway traffic volume based on potential destination city attractiveness** *Beibei Zhang, Shifen Cheng and Feng Lu* **Customer Profiling Based on Mobile Apps GPS Data - A Case Study on Westfield Shopping Malls** *Fangzhou Zhou, Xianghui Zhang, Xinglei Wang and Tao Cheng* **Deriving Multimodal Road Transport Greenhouse Gases Emissions from Mobile Phone GPS Dataset** *Xianghui Zhang and Tao Cheng* **Research on Dynamic Connection of Guangdong-Hong Kong-Macao Greater Bay Area Based on Big Data of Traffic Flow** *Minmin Li, Qi Yang, You Li, Ding Ma, Yuxia Kuang, Wenhua Guo and Wenchao Liu*
A2: Spatial statistics	**Explanatory spatial heterogeneity model for association analysis** *Peng Luo and Yang Li* **The Third Law of Geography: What is the big deal?** *A-Xing Zhu* **Clustering by measuring local direction centrality for data with heterogeneous density and weak connectivity** *Dehua Peng, Zhipeng Gui and Huayi Wu* **Delineating the "Bend Space" of Spatial Interaction Using Social Sensing and GeoAI** *Chaogui Kang and Cheng Huang*
B2: Spatio-temporal AI	**Graph convolutional neural networks for building simplification in vector maps: A multi-task learning perspective** *Zhiyong Zhou, Cheng Fu and Robert Weibel* **Generating Synthetic Trajectories by Combining Machine Learning and Mechanism Model** *Xin Jin and Kang Liu* **A robust spatio-temporal fusion method integrating super-resolution convolutional neural network and partial least squares regression model design for fusing Gaofen and Sentinel-2 data**

	Shuaijun Liu, Jin Chen, Zhuoning Gu, Hui Chen and Yang Chen **Ocean AI: A New Bridge from Data to Knowledge** *Ge Chen, Xiaoyan Chen, Linyao Ge and Baoxiang Huang*
C2: Accessibility and POI	**Measuring Access Inequality in A Hybrid Physical-Virtual World: A Case Study of Racial Disparity of Healthcare Access During CoVID-19** *Meiliu Wu, Qunying Huang and Song Gao* **Modeling and exploring the coordination relationship between green infrastructure and land use eco-efficiency: An urban agglomeration perspective** *Yin Ma, Minrui Zheng, Feng Xu, Yu Qian, Menglan Liu, Xinqi Zheng and Jiantao Liu* **Geographic distance or conscious distance: accessibility, socioeconomic status and parental cultural facility participation in Shanghai, China** *Jiarong Li* **Geospatial Data Triangulation - A Framework Design for matching food outlets in San Diego County** *Yanjia Cao*
A3: Transport	**Spatial optimization of solar photovoltaic installation for charging shared electric scooters** *Rui Zhu, Longxu Yan and Linlin You* **Regional Cycling Risk Prediction by Spatio-temporal Heterogeneous Graph Learning** *Xiaowei Gao, Xinke Jiang, Huanfa Chen and James Haworth* **A Data-Driven Approach to Deploying Wireless Charging Lanes on a Large-Scale Electrified Bus Network** *Shiqi Wang, Yuze Li, Anthony Chen and Chengxiang Zhuge* **Comparing Trip Chaining Behavior of Private Conventional and Electric Vehicle Users in Beijing** *Xiong Yang, Chengxiang Zhuge, Li Wan, Hao Zhang and Pinxi Wang* **Modelling the tradeoff between repositioning cost and quality of service in the urban sharing bike system** *Ge Wang, Chengchao Zuo and Xinli Ke*
B3: Remote sensing	**Multi-Scale Feature Fusion Network for remote sensing image captioning** *Haiyan Huang, Zhenfeng Shao, Qimin Cheng and Xiaoping Wu* **An Advanced spectral-spatial representation using stacked feature space for hyperspectral image classification** *Hui Chen, Jin Chen, Qiang Li, Shuaijun Liu, Zhuoning Gu and Yang Chen* **A deep learning-based approach to simulate large-scale dynamics of normalized difference vegetation index for the monitoring of vegetation activities and stresses using meteorological data** *Ying Sun, Jianfeng Huang, Xiaoyang Zhao and Qinchuan Xin* **Aerial Visual: Field Study for High-Throughput Monitoring of Fractional Vegetation Cover** *Guofeng Yang, Yong He, Zhenjiang Zhou, Lingzhen Ye, Hui Fang and Xuping Feng*
C3: Urban mobility II	**Quantifying responses to the expansion of the Ultra Low Emission Zone in London** *Yikang Wang and Chen Zhong* **Using XGBoost and SHAP for inter-urban mobility flows generation and feature analysis** *Qiuping Li, Hui Meng, Ruofei Ma and Yunfei Zhang* **Examining the Recovery of High Streets with Footfall as the Performance Measure** *Xinglei Wang, Xianghui Zhang and Tao Cheng* **Mapping fine-grained informal settlement mapping in the Guangdong-Hong Kong-Macao Greater Bay Area** *Wei Tu, Dongshen Chen, Yang Yue, Zhengdong Huang and Qingquan Li* **The effects of COVID-19 on park visitation in Los Angeles County, California** *Linna Li, Song Gao, Bo Xu, Prudhvi Goud Katta and Natalie Marcom*
D1: Environment and disaster	**Fracture Distribution and its Relationship with Health and Environment in a Japanese Prefecture** *Qiaohui Zhou, Riken Homma* **Using Human Mobility Data to Detect Evacuation Patterns in Hurricane Ian** *Yi Qiang, Xiang Li* **Influence of Social Vulnerability and Mobility on COVID-19 Transmission in the United States** *Bo Huang* **How does urbanization affect community resilience in ecological-fragile zones? Spatial-temporal evidence from Hengduan Mountain**

	Rui Wang and Jue Wang **Improved Satellite-Based Precipitation Downscaling In Data-Sparse Area: A Novel Deep Learning-Based Framework Using Transfer Learning** *Honglin Zhu and Qiming Zhou*
E1: Urban system	**The manifestation of unequal spatial potential under the premise of human-centeredness, taking Shenzhen as an example** *Yaxing Li, Xiaoming Li, Chuangchang Liao, Weixi Wang and Renzhong Guo* **Research on the spatiotemporal evolution characteristics, decoupling effect, and influencing factors of carbon emissions from land use in Hubei Province** *Mengjiao Fan* **Uncovering the balance between the physical and socio-economic environments of urban areas from house price in large American cities** *Ce Hou, Yuhao Kang, Fan Zhang* **Characterizing Agglomeration Network through Industrial Functions in China's Greater Bay Area** *Zidong Yu, Xintao Liu* **Uncovering long-term evolutions of intra-urban interactions** *Xiaoyue Xing*
D2: WebGIS and VGI	**An Exploratory Data Analysis of the Spatiotemporal Patterns of Heritage-Related Events on Twitter** *Nan Bai, Tao Cheng, Pirouz Nourian, Ana Pereira Roders* **Integrating Semantics of Circumstances and Events: The Information Organization Method of Flood Disaster** *Shunli Wang* **Highly Precise Routable Map Construction for Highway Interchanges Using Crowdsourced Trajectory Data** *Fengwei Jiao, Longgang Xiang* **Exploring Individual VGI Contributors' Participation Characteristics with Geovisual Analytics** *Guiming Zhang* **FAIR principal Influence Analysis and Geoscience Data Governance Strategies** *Juanle Wang*
E2: Street-level imagery	**eeFlowMinner: a library for functional semantics mining and geospatial workflow generation for scripts in Google Earth Engine** *Jianyuan Liang, Huayi Wu, Xianyuan Zhang* **A study on Multi-aspectual Urban Environment Perception and its Heterogeneity based on Three-dimensional Morphological Characteristics** *Chunhong Zhao* **Assessing Differences in Safety Perceptions using GeoAI and Survey across Neighbourhoods in Stockholm, Sweden** *Yuhao Kang, Song Gao* **A Quality Assessment Framework for Object-based Image Analysis (OBIA): An Experiment with Urban Building Objects** *Dongmei Chen*
F1: Innovative GIS topics	**Can GIS-enhanced animations facilitate the understanding of football tactics?** *Nianhua Liu, Joel Salazar, Chuan Chen, Yu Feng* **GISphere: A Crowd-Sourced Database of Global GIS Graduate Education** *Yuhao Kang, Yikang Wang, Jingyuan Zhang, Haokun Liu, Jinmeng Rao, Yuyan Liu, Bing Zhou, Pengyu Chen, Yanbing Chen, Xinyi Tong, Shan Ye* **Choosing GIS Graduate Programs from Afar: Chinese Students' Perspectives** *Yikang Wang, Yuhao Kang, Haokun Liu, Ce Hou, Bing Zhou, Shan Ye, Yuyan Liu, Jinmeng Rao, Zhenghao Pei, Xiang Ye, Song Gao, Huanfa Chen* **Multi-user indoor cooperative localization technology with opportunity encounters** *Sheng Guo, Minmin Li, You Li*
F2: Sustainable development	**Measuring and mapping travel time to healthcare facilities in China: Status and Barriers to achieving SDG3** *Liutong Chen, Yifei He, Bin Zhu* **Urban green and blue spaces and heat-related mortality in high-density cities** *Jinglu Song, Yi Lu, Kejia Hu and Yuming Guo*

	Developing a Cesium-based Lightweight CIM for Data Management in Neighborhoods Renewal: A Case Study of Yinhongyuan in Nanjing *Ziyu Tong, Xu Cheng* **Design and Research of Smart Sluice Station Based on GIS and BIM** *Zilin Li, Xinlong Liu, Xiaohong Yang*

A1: Health geography (Wednesday, 19th 11:00 – 12:30, Room G13)

Session Chair: Yongmei Lu

Spatiotemporal patterns of COVID-19 mortality and socioeconomic and environmental determinants in England

Zhiqiang Feng

Abstract: The COVID-19 pandemic has claimed over six million lives worldwide and also resulted in serious socio and economic consequences. England was one of the most affected country in Europe with over 200,000 deaths from COVID-19 and several waves of the pandemic over three years. Research has showed that there was a considerable variation over regions and time in COVID-19 deaths. Therefore, this paper examined the spatial and temporal pattern of COVID-19 mortality and its association with a number of socioeconomic and environmental factors in the first two waves of the pandemic in England. The monthly COVID-19 mortality rates for middle super output areas (average population=8000) from March 2020 to April 2021 were used in the analysis. Potential risk factors such as demographic composition, health condition, care home concentration, air pollution and COVID-19 infections were collected and used in the modelling exercises. SaTScan was used in the analysis of hotspots of COVID-19 mortality by each month and geographically weighted Poisson regression (GWPR) was used to investigate the association with socioeconomic and environmental factors. The results show that the COVID-19 mortality hotspots varied considerably by month with the hotspots moving from regions where the COVID-19 outbreak initiated to other parts of the country in the first wave. In contrast the hotspots appeared to concentrated in the north part of the country and then spread to the south. Overall, there was clear south-north divide and also urban-rural variation in concentrations of hotspots over the two waves of the pandemic. The GWPR analysis revealed that age composition, ethnic composition, income deprivation, care home, health condition and air pollution were all related to COVID-19 mortality. However the care home was the most important variable with the largest effect size which provides further evidence in terms of protecting vulnerable elderly in future pandemic. Although the relationship varied over space the association with these factors was fairly consistent over the first and second wave.

Understanding the role of urban social and physical environment in opioid overdose events using found geospatial data

Yuchen Li

Abstract: Opioid use disorder is a serious public health crisis in the United States. Manifestations such as opioid overdose events (OOEs) vary within and across communities and there is growing evidence that this variation is partially rooted in community-level social and economic conditions. The lack of high spatial resolution, timely data has hampered research into the associations between OOEs and social and physical environments. We explore the use of non-traditional, "found" geospatial data collected for other purposes as indicators of urban social-environmental conditions and their relationships with OOEs at the neighborhood level. We evaluate the use of Google Street View images and non emergency "311" service requests, along with US Census data as indicators of

social and physical conditions in community neighborhoods. We estimate negative binomial regression models with OOE data from first responders in Columbus, Ohio, USA between January 1, 2016, and December 31, 2017. Higher numbers of OOEs were positively associated with service request indicators of neighborhood physical and social disorder and street view imagery rated as boring or depressing based on a pre-trained random forest regression model. Perceived safety, wealth, and liveliness measures from the street view imagery were negatively associated with risk of an OOE. Age group 50-64 was positively associated with risk of an OOE but age 35-49 was negative. White population, percentage of individuals living in poverty, and percentage of vacant housing units were also found significantly positive however, median income and percentage of people with a bachelor's degree or higher were found negative. Our result shows neighborhood social and physical environment characteristics are associated with likelihood of OOEs. Our study adds to the scientific evidence that the opioid epidemic crisis is partially rooted in social inequality distress and underinvestment. It also shows the previously underutilized data sources hold promise for providing insights into this complex problem to help inform the development of population-level interventions and harm reduction policies.

Incorporating fine-grained spatial heterogeneity to predict the local-scale infections and the superspreading areas of pandemic: A case study of COVID-19 in Hong Kong

Ningyezi Peng and Xintao Liu

Abstract: The precise intervention targeting on high-risk groups or places has gradually replaced the non-targeted intervention for pandemic prevention and control (e.g., COVID-19), which requires a deep understanding of local-scale transmission in cities. Nevertheless, little has been done to explore and apply local-scale dynamics that drives the superspreading events or superspreaders to pandemic prevention and control. Though most existing models of pandemic in urban settings successfully predicted aggregate epidemic curve, it does not necessarily mean the successful prediction of local trends at a fine spatial scale. More local-scale validations are on the agenda. The major aim of this work is to reconstruct the local-scale transmission by incorporating fine-grained spatial heterogeneity. This study builds a spatially explicit agent-based model to predict the local epidemic curves across 214 tertiary planning units (TPUs) in Hong Kong during the Omicron wave from 1 February to 30 March 2022. The model incorporates the spatial heterogeneity in demographics and human mobility. To validate it, we compare the simulation outcomes with empirical data regarding three aspects: (1) the city-level number of daily confirmed cases; (2) the TPU-level number of daily cases confirmed by Rapid Antigen Tests (RAT); (3) the high-risk TPU subunits (TPUSBs) where most cases visited derived from contact tracing data.

Examining the Health Effects of Urban Gentrification

Yongmei Lu

Abstract: Gentrification refers to the process of urban neighborhood change due to influx of more affluent people and households. It is usually accompanied by increase in rent, shifts in neighborhood demographic characteristics, and reshaping of economic and cultural landscape. Although gentrification may be considered as a stage of urban development, it is often controversial for urban politics and planning when the well-being of the gentrified is concerned. For a gentrified neighborhood and the people who live through the process, gentrification is an issue of housing, culture, and health. Gentrification creates /exacerbates disparities and displaces people. Through a social justice lens, the author argues for a people-centered and place-based framework when examining the exposure to gentrification and its health impacts. Empirical findings on health impacts of gentrification in Austin, Texas will be discussed.

Geospatial Research on Health and the Environment under the Social-Ecological Model

Lan Mu, Inhye Kong, Jue Yang, Jielu Zhang and Nemin Wu

Abstract: GIScience for health and the environment is the overarching agenda of our research group. We select four latest publications first-authored by PhD students to demonstrate this topic at varied scales (SEM's individual, relationship, community and societal), and places (physical and virtual). Themes range from spatiotemporal optimization for Automated External Defibrillators (AED), physical activity environment and children's health, online grocery shopping discussion and behaviour during the COVID pandemic, and the analysis and interpretation of cultural ecosystem services (CES) from a crowdsourced online survey. We present our group's most recent geospatial research on health and the environment, from physical to virtual places, under the social-ecological model (SEM) framework.

B1: Geodemographics (Wednesday, 19th 11:00 – 12:30, Room G12)

Session Chair: Tian Lan

Fine-grained crowd distribution forecasting with multi-order spatial interactions

Mingxiao Li, Song Gao, Wei Tu, Feng Lu, Huan Tong and Qingquan Li

Abstract: This study proposed a novel crowd distribution forecasting method considering the multiorder spatial interactions along different places using mobile phone data. We applied a weighted random walk algorithm to generate simulated trajectories to improve the accuracy and robustness of the interaction characterizations in less crowded places. An embedding learning algorithm was adopted to model the multi-order spatial interactions among different places. A hybrid forecasting model was then constructed that combines a GCN and an RNN for modelling the spatiotemporal pattern of crowd distribution variations. Our proposed method was verified using a real-world mobile phone dataset in a country. The results indicate that proposed method outperformed other baseline methods.

Diffusion Mapping The 2011 Census of England And Wales

Gezhi Xiu and Huanfa Chen

Abstract: The census of England and Wales provides an extensive dataset with 1,450 key statistics and quick statistics over 181,408 Output Areas, each consisting of around 100 households. However, decomposing this dataset into a few interpretable spatial distributions of dominant factors of society has always been a challenging objective. Traditional methods often rely on globally consistent metrics that are difficult to match with actual social variables such as income, race, and education. To address this challenge, we introduce Diffusion mapping (Coifman and Lafon, 2006), a manifold learning method, to study the census data. We construct a sparse topological graph by linking the most similar Output Areas in terms of an Output Area's ranking vector. We then compare the hidden dominant factors of society with the spectral decomposition of the graph's Laplacian matrix to reveal the spatial structures of social components. By correlating the eigenvectors of the graph's Laplacian matrix (regarded as the dominant social components) with the original social variables, we can provide elaborate descriptions of the spatial structures. Further, more precise analysis can be performed on the eigenvectors to present both global and local insights.

Population distribution modelling at fine spatio-temporal scale considering residents' behavior

Yaxian Qing and Huayi Wu

Abstract: This paper presents a novel approach for dynamically simulating population distribution by utilizing multi-agent reinforcement learning and spatio-temporal big data. The proposed method leverages the autonomy and adaptability of individual behaviors, as well as the intricate interactions between individuals and their environment, to construct a unified model of spatial and temporal population distribution through deep reinforcement learning. This approach can simulate urban population distribution at a minute-level resolution.

Creating enhanced population registers for measuring socio-economic inequalities in Great Britain

Tian Lan, Paul Longley and Di Hu

Abstract: We introduce the creation of the enhanced population registers and demonstrate how they can be used for measuring socio-economic inequalities in Great Britain, which are proved to be a more granular and updateable alternative to census-based analysis. Disaggregating these blanket groups is very important to social inequality studies, as we observe in the analysis that countries of origin affect social mobility outcomes, which could be neglected when aggregating them into coarser categories.

Multi-view spatiotemporal deep graph neural network model for travel demand prediction

Tianhong Zhao, Zhengdong Huang, Wei Tu

Abstract: Public transit is a key component of transport system in large cities. Predicting transit travel demand helps improve transit network and service. Previous methods utilize spatial and temporal dependencies of one type of travel demand to improve prediction accuracy but pay little attention to the cross-modal dependency among multiple transit travel modes, i.e., bus, metro, and taxi. We propose a multi-view spatiotemporal graph neural networks (MSTGNN) model to predict short-term travel demand. It emphasizes the ability to capture cross-view dependencies derived from the spatially and temporally dynamic interactions among bus, metro, and taxi travel demands.

C1: Urban mobility I (Wednesday, 19th 11:00 – 12:30, Room 115)

Session Chair: Chen Zhong

Short-term bike sharing demand prediction through feature fusion in spatial and topological domains

Xinyu Li, Yang Xu and Ruojing Zhang

Abstract: This study proposes a deep learning model to predict short-term bike sharing usage through feature fusion in spatial and topological domains across two station-based bike-sharing systems in Chicago and New York. Based on the prediction results, the proposed model performs better than the baseline models. The results imply that the prediction model leveraging bike-sharing usage's spatial and topological features outperforms the model only using spatial features.

Inferencing intercity freeway traffic volume based on potential destination city attractiveness

Beibei Zhang, Shifen Cheng and Feng Lu

Abstract: Freeways play an irreplaceable role in social and economic development. It is a bottleneck problem for intelligent management of ground transportation to accurately infer and predict the temporal and spatial distribution of freeway traffic volume. Although the accuracy of the current popular freeway traffic volume inference and prediction methods based on machine learning models has been improving, the process is complex and the mechanism is difficult to explain. The models even contradict the particularity of freeway access with spatial constraints. From the perspective of the freeway traffic flow formation mechanism, namely potential destination city attractiveness, this study proposes a new method to infer freeway traffic volume. First, considering the spatial scope and direction constraints of road transportation, a restricted area search method for potential destination cities of freeway traffic trips is proposed. Second, combined with the distance and angle-weighted socio-economic statistics of each potential destination city, a method for traffic volume inference on freeway roads is constructed based on the potential destination city attractiveness factors. Finally, the interpretable inference model of freeway traffic flow is used to quantify the mechanism of each influencing factor. Validation is based on the measured data of freeway toll stations and comparison with popular machine learning inference methods based on road buffers. The results show that the proposed method has greater inference accuracy and computational efficiency. More importantly, fewer and more easily accessible indicators are required to infer freeway traffic volume, and the proposed model is more interpretable.

Customer Profiling Based on Mobile Apps GPS Data - A Case Study on Westfield Shopping Malls

Fangzhou Zhou, Xianghui Zhang, Xinglei Wang and Tao Cheng

Abstract: In order to provide a personalised experience to customers, it's essential for shopping centers to understand its customer base and their shopping behaviors. Building a well-developed customer profile is critical for improving marketing efficiency, expanding market share, and building long-term, stable business ties with trading partners. Currently, most shopping malls or retail businesses use footfall or customer surveys to grasp the customer behaviors, which are insufficient to obtain accurate and representative information about the customers. This study aims to provide a detailed customer profile for shopping centers using GPS datasets. We choose the two Westfield shopping malls in London as the case study area. In order to uncover additional customer information, this study focuses on four research questions: (1) Origin places of customers; (2) Their transportation mode to the mall; (3) The average dwell time of customers; (4) The pattern of return visitors. According to the results, malls can develop a range of marketing initiatives to provide a better shopping experience for customers and attract more of them.

Deriving Multimodal Road Transport Greenhouse Gases Emissions from Mobile Phone GPS Dataset

Xianghui Zhang and Tao Cheng

Abstract: In this paper, a real mobile phone GPS dataset is adopted to replace traditional transport modelling for accurately estimating road transport GHGs emissions. Multimodal transport GHGs emissions are estimated at the individual level by integrating a travel mode detection algorithm and distance-based GHGs estimation methods. It is also feasible to aggregate transport GHGs emissions to any spatial units. In order to examine its availability, the framework is adopted to examine the evolution of transport GHGs emissions in London before and after the COVID-19 pandemic. According to the analysis, the spatial distribution of road transport GHGs emissions has significantly changed. The development of this framework will facilitate the development of decarbonisation policies.

Research on Dynamic Connection of Guangdong-Hong Kong-Macao Greater Bay Area Based on Big Data of Traffic Flow

Minmin Li, Qi Yang, You Li, Ding Ma, Yuxia Kuang, Wenhua Guo and Wenchao Liu

Abstract: Traffic flow is the main carrier and manifestation of the flow of elements such as people and goods, and it is of great significance for understanding the urban system and network structure. Based on the AutoNavi travel big data of 2020, this study uses methods such as data modeling, GIS spatial analysis, and complex network analysis to carry out research on the dynamic connection of urban agglomerations in the Guangdong-Hong Kong-Macao Greater Bay Area (GBA). The results have shown that the interurban connection intensity on the east coast of the GBA is significantly greater than that on the west coast, and cross-city commuting is mainly concentrated in the Guangzhou, Shenzhen and Hong Kong metropolitan circles. The urban network centrality has the characteristics of polarization, and the centrality of Guangzhou, Shenzhen, Foshan and Dongguan is higher than other cities. The diversity of urban network is quite different, and the diversity of Shenzhen, Macau and Hong Kong is low due to the influence of traffic location and geographical location. Generally speaking, the GBA has not yet formed a wide-ranging communication chain. It is recommended to strengthen the construction of the transportation in the west coast, promote the linkage between the east and west coasts, and provide support for the integrated development of the GBA.

A2: Spatial statistics (Wednesday, 19th 13:30 – 14:45, Room G13)

Session Chair: Chaogui Kang

The Third Law of Geography: What is the big deal?

A-Xing Zhu

Abstract: Samples volunteered from citizens and other non-experts often do not maintain the global representative nature as those collected with well-designed approaches. However, the current doctrine in geographic analysis requires that samples to be globally representative so that the generalization thorough modeling using these samples is applicable globally. The disparity, between the requirement of globally representative and globally applicable by the existing geographic analyses and the lack of guarantee on the global representativeness of the volunteered samples, calls for a new principle in guiding the development of new geographical analytical techniques that do not require samples to be globally representative and do not have to be globally applicable. The common understanding of "the more similarity the geographic configurations of two locations, the more similar the target values (processes) at the two locations", referred as the "Third Law of Geography", can serve as such new principle. The significance of the Third Law in geographic analysis in this digital era is further illustrated through case studies ranging from non-globally applicable analysis, quality assessment of samples and effective sampling, and sample bias mitigation for globally applicable analysis. These case studies not only provide examples where the new law can succeed but the existing principles cannot, but also demonstrate a completely new direction in the development of geographic analytical techniques in this digital era.

Explanatory spatial heterogeneity model for association analysis

Peng Luo and Yang Li

Abstract: Identifying the spatial determinants of a geographical variable improve our understanding of the world. However, given the complex geographical surface and complex interaction, one response variable must be influenced by the interaction effect of multiple explanatory variables. Methods, such

as the spatial heterogeneity model, have been successful in quantitatively revealing the interaction effect. However, a question still exists: What is each explanatory variable's contribution to the interaction? SHAP (Shapley Additive Explanations) is a method initially from game theory and has been widely used to explain the output of machine learning models. It is promising to combine the SHAP with spatial analysis models to explain the complex spatial interaction between multiple variables. This research aims to develop an explanatory model for spatial association analysis. The spatial stratified heterogeneity (SSH) model and SHAP model are combined to explain the contribution of each explanatory variable to the response variable.

Clustering by measuring local direction centrality for data with heterogeneous density and weak connectivity

Dehua Peng, Zhipeng Gui and Huayi Wu

Abstract: This work aims to propose a boundary-seeking clustering algorithm (named CDC) by measuring centrality locally, which contributes to handling data with heterogeneous density and weak connectivity. Background: Heterogeneous density and weak connectivity in point distributions are challenging in cluster analysis. As a powerful machine learning method, clustering explores similar patterns lurking in data [1]. It aims to find an optimized partition to group independent points to clusters by maximizing the intracluster similarity and the inter-cluster difference. Identification of arbitrary shapes, adaptability to the high dimensionality and elimination of noisy instances are universal problems that have been studied extensively in cluster analysis. However, the heterogeneous density and weak connectivity also affect the clustering quality significantly and should receive more attention. Heterogeneous density means that a cluster with uneven density tends to be separated into parts and the sparse clusters are easy to be misidentified as noise, while weak connectivity causes nearby clusters difficult to separate. Although numerous clustering techniques based on diverse principles have been developed [2], it is still insufficient to tackle abovementioned challenges effectively using the proximity of physical distance or density alone.

Delineating the "Bend Space" of Spatial Interaction Using Social Sensing and GeoAI

Chaogui Kang and Cheng Huang

Abstract: Geographic distance is a key determinant of interactions in spatial-social systems. Yet, as transportation and communication technologies revolutionize in past decades, "the death of [geographic] distance" [1] has been widely debated in interaction systems that economic, cultural, political, scenic factors are also in play. Alan Wilson's entropy maximization framework [2] provides a robust technique to verify if geographic distance speaks or not. Evidence has indicated that, although geographic distance is not dying, it indeed has been distorted in different subsystems, for different sub-populations, and at different spatial scales [3]. Once the "effective distance" is derived from such bend spaces to be compared with the underlying geographic distance, it will enable us to understand the impact of aspatial factors (such as economic, cultural, political, scenic variables) on spatial-social interaction behaviors. This article introduces an analytical framework to delineate, analyze, and interpret "the bend space" that controls the embedding location of spatial-social interactions. It will provide a robust tool to measure the "effective distance" that synthesizes the effects of the geographic distance and many socioeconomic factors in spatial-social interaction systems.

B2: Spatio-temporal AI (Wednesday, 19th 13:30 – 14:45, Room G12)

Session Chair: Song Gao

Graph convolutional neural networks for building simplification in vector maps: A multi-task learning perspective

Zhiyong Zhou, Cheng Fu and Robert Weibel

Abstract: This extended abstract aims to introduce a multi-task learning paradigm to map generalization based on a graph convolutional neural network, which can automatically learn the cartographic generalization knowledge embedded in vector maps via deep learning models. We conclude that the multitask learning approach has great potential to allow for multiple operations involved in map generalization while causing only marginal harm to the performance of each individual task. In the future, we plan to formulate the tasks of more generalization operators besides the simplification operator that formed the focus of this study.

Generating Synthetic Trajectories by Combining Machine Learning and Mechanism Model

Xin Jin and Kang Liu

Abstract: Human movement behavior is closely related to applications such as infectious diseases, transportation, and public safety. Although the development of information and communication technologies (ICTs) have made it easy to collect large-scale individual mobile positioning data, raw trajectory data with issues of personal privacy as well as redundant, missing, and noisy are still limited in availability and usability in practice. It is a promising solution to establish human mobility models to generate synthetic trajectories that are statistically realistic and can replace the real data in applications. The objective of this study is to propose a simple but effective method to generate synthetic trajectories of urban residents that are statistically realistic and can replace the real data in applications.

A robust spatio-temporal fusion method integrating super-resolution convolutional neural network and partial least squares regression model design for fusing Gaofen and Sentinel-2 data

Shuaijun Liu, Jin Chen, Zhuoning Gu, Hui Chen and Yang Chen

Abstract: The increasing demand for high spatial resolution images underscores the importance of superresolution for various remote sensing applications. We developed DL-PLSR-STF to reconstruct a single image pair only, as there are currently few available images due to frequent cloud contamination and a large revisit. We conduct a thorough evaluation of our proposed spatio-temporal fusion method on two datasets, Gaofen-1 and Sentinel-2, with a focus on assessing its fusion performance. These datasets consist of optical images obtained from Gaofen-1 and data obtained from Sentinel-2, which depict the same geographical region. Although the training data for our model is derived from satellite imagery from Gaofen-1 and Sentinel-2, our proposed method is highly generalizable and can be adapted to other sources of satellite imagery.

Ocean AI: A New Bridge from Data to Knowledge

Ge Chen, Xiaoyan Chen, Linyao Ge and Baoxiang Huang

Abstract: Oceanography is a multidisciplinary science based on observation and experiment, and is therefore technology rich and data intensive. With the fast development of recent earth observation technologies, an era of big ocean data has arrived around the year 2015. Novel and rigorous artificial intelligence (AI) methodologies are employed to process and analyze big ocean data to improve our understanding of the marine system, serving as a new bridge between data and knowledge in

oceanography. The revolutionary deep learning technique, mainly composed of deep and complex neural networks, is having a far-reaching impact on marine science and ocean discovery. This presentation mainly focuses on the applications of associative statistical and physical traction neural networks on ocean data, which can provide promising solutions to the problems of data reconstruction, feature detection, and process prediction in the emerging field of AI oceanography.

C2: Accessibility and POI (Wednesday, 19th 13:30 – 14:45, Room 115)

Session Chair: Yanjia Cao

Measuring Access Inequality in A Hybrid Physical-Virtual World: A Case Study of Racial Disparity of Healthcare Access During CoVID-19

Meiliu Wu, Qunying Huang and Song Gao

Abstract: The disparity of resource access (e.g., food and healthcare) among different population groups essentially reflects social inequalities. Emerging information and communications technology (ICT) has facilitated the teleactivities that can replace or complement traditional physical visits, yet existing approaches for measuring access disparity still fail to consider virtual interactions. To this end, this study proposes a unified framework to measure access inequality in both physical and virtual spaces simultaneously, using the POIs' visit patterns from mobile phone data to capture spatial unevenness of accessibility among different groups (physical space), as well as the Household Pulse Survey data to reveal the group disparity of teleactivity access (virtual space). In particular, a novel Access Inequity Index is proposed based on the Information Theory Index and the Theil Index, to reveal the access inequality in physical and virtual spaces respectively. Next, to demonstrate the feasibility of the proposed framework, we examine racial groups and their disparity in physical-virtual healthcare access during the pandemic (April-July 2021) in U.S. 15 most populated metropolitans. Our results indicate: (1) race is a significant risk marker for underlying conditions that affect health, including telehealth access; (2) the usage of telehealth access aligns with the risk for COVID-19 infection, hospitalization, and death by race (e.g., the minority groups Black and Others are more vulnerable and in the higher demand of telehealth service); and (3) residential segregation impacts on the segregated pattern of physical healthcare access by race (e.g., the Black-dominant healthcare access zone highly matches the Black residential cluster in the south of Chicago), while such impacts may differ in different kinds of healthcare services (e.g., physicians, mental health practitioners, and dentists). Compared with traditional single-space approaches, the proposed hybrid-spaces approach not only provides more comprehensive and in-depth insights to understand the racial disparity in healthcare access, but also brings new opportunities to a broader understanding of access inequality in other domains.

Modeling and exploring the coordination relationship between green infrastructure and land use eco-efficiency: An urban agglomeration perspective

Yin Ma, Minrui Zheng, Feng Xu, Yu Qian, Menglan Liu, Xinqi Zheng and Jiantao Liu

Abstract: In limited land space, improving the construction of infrastructure with ecological services can help to achieve the goal of promoting land use eco-efficiency (LUEE). Based on the premise, this study explores the interactive coupling coordination relationship between LUEE and green infrastructure (GI) on the scale of urban agglomeration from the perspective of model thinking. The specific objectives of the paper are as follows: (1)To construct an interactive coordination relationship model of LUEE and GI, including entropy method model, super efficiency slack-based measure (SBM) model with undesirable outputs and coupling coordination degree model; (2) To explore the spatiotemporal characteristics of the interactive coupling coordination degree between LUEE and GI

in the Beijing-Tianjin-Hebei urban agglomerations from 2000 to 2020 based on the constructed model; (3) To reveal the coordination and development relationship between GI and LUEE and provide suggestions for land development and ecologically sustainable development of urban agglomerations in the future.

Geographic distance or conscious distance: accessibility, socioeconomic status and parental cultural facility participation in Shanghai, China

Jiarong Li

Abstract: Social economic status such as class and race determine the parenting style has a significant effect on children's development, resulting in social inequality [1]. The Chinese government has recently committed itself to developing the cultural industry and providing high-quality public cultural services to enrich people's spiritual lives. Meanwhile, a series of regulations were enacted in succession by the central government. Although many local governments have even regarded the improvement of 'soft power' as a long-term target of urban governance, remain relatively scarce resources, particularly for low socioeconomic groups. This study highlights the vital role of availability within walking distance for promoting cultural facility usage and diminishing the social inequality for children in low socioeconomic families. Therefore, small-scale neighborhood cultural facilities such as public book corners, community bookstores, and community libraries may help boost public cultural participation and promote social equality.

Geospatial Data Triangulation - A Framework Design for matching food outlets in San Diego County

Yanjia Cao

Abstract: Access and exposure to the built food environment may be an important component for human health, however diverging data sets and methods for measuring food environment result in lack of consistency of associations with health. In this research, we conducted a hierarchical point of interest (POI) matching strategy to compare and merge food outlets represented by government, commercial, and crowdsourced data for a case study in San Diego County. Two matching parameters were used: distance with latitude and longitude, and POI name match with Levenshtein distance (LD) and Double Metaphone (DM). Sensitivity analysis to determine thresholds of matching parameters was conducted. After the first data matching round, we applied a weighted multi-attribute model on the unmatched records using relaxed matching parameters and accounting for geographic distance, LD, and DM at the same time. We selected the top ranked match and combined results from first round matches. We assessed trends of matched and unmatched records to determine unique dataset characteristics. We selected 100-meter distance threshold, LD <=4 and DM <=2 match parameters for round one matching resulting in 21% matched records. The weighted ranking model returned 31% matched records. In total, 52% of food outlets were matched. Unmatched outlets consisted of beer gardens, personal chefs and food trucks. The hierarchical POI matching strategy found several reliable food POIs across datasets and identified unique food POIs to specific data sources. Triangulation of food environment data may increase reliability and precision of estimating relationships between food environment and health outcomes.

A3: Transport (Wednesday, 19th 15:15 – 16:45, Room G13)

Session Chair: James Haworth

Spatial optimization of solar photovoltaic installation for charging shared electric scooters

Rui Zhu, Longxu Yan and Linlin You

Abstract: Scooter sharing has emerged as a novel form of transportation, providing users with convenient and flexible mobility options. However, the limited battery capacity of e-scooters and the need for frequent charging pose challenges for operational costs, making the service less economically viable. The costs associated with charging and managing e-scooters can be substantial, including labour costs for collecting, charging, and redistributing e-scooters to maintain availability. Therefore, finding effective solutions to address these operational challenges, such as integrating solar charging systems, can greatly improve the sustainability and viability of scooter-sharing services. The objective of this study is to develop a distributed photovoltaic (PV) charging system that can support the energy demand for real-time scooter sharing. The proposed system integrates a real-time estimation of electricity generation from PV platforms at each parking station within a real-time scooter-sharing network. This system aims to provide an effective solar charging service for scooters, allowing them to be charged at the right times and places, thereby improving their availability and reducing the need for manual scooter transportation for charging purposes. This can result in significant labour cost savings and enhance the overall efficiency of the scooter-sharing service.

Regional Cycling Risk Prediction by Spatio-temporal Heterogeneous Graph Learning

Xiaowei Gao, Xinke Jiang, Huanfa Chen and James Haworth

Abstract: We have presented a novel Spatio-Temporal Heterogeneous Graph Learning model for predicting regional cycling risk levels at a fine-grained scale. By incorporating both spatial and temporal dependencies across different urban elements and scales, our model demonstrates its effectiveness in capturing the complex interplay between various factors influencing cycling safety. The proposed Spatio-Temporal Heterogeneous Graph Learning model offers a promising approach for fine-grained regional cycling risk prediction, with potential applications in urban planning and transportation safety.

A Data-Driven Approach to Deploying Wireless Charging Lanes on a Large-Scale Electrified Bus Network

Shiqi Wang, Yuze Li, Anthony Chen and Chengxiang Zhuge

Abstract: Electrifying public transportation systems is expected to benefit the environment at both the global and local levels. Charging infrastructure plays an important role in transportation electrification. Currently, charging posts/stations are the most common charging facilities. Yet, it takes a long time to get electric buses (E-buses) recharged through these traditional charging posts, which could influence the operational efficiency of the bus system. Therefore, attempts have been made to explore the technical and economic feasibility of those advanced charging facilities, such as WCLs, as they are expected to save charging time and further improve the operational efficiency of the electrified bus network. However, it remains unclear the extent to which these WCLs could improve operational efficiency, and whether the cost would be acceptable. This paper aims to propose a data-driven simulation-based optimization model to deploy both traditional charging stations/posts and wireless charging lanes (WCLs). With the model, we are able to explore the technical and economic suitability of deploying WCLs in an electrified bus network.

Comparing Trip Chaining Behavior of Private Conventional and Electric Vehicle Users in Beijing

Xiong Yang, Chengxiang Zhuge, Li Wan, Hao Zhang and Pinxi Wang

Abstract: Existing studies have been conducted to characterize and compare trip chaining behavior of travelers using different travel modes, such as CVs, public transit, and bicycles. In terms of comparative studies between CV and EV modes, many attempts have been made to examine traveling, parking, energy replenishing behavior, and patterns. However, few research explicitly investigated EV users' trip chaining behavior in relation to CV users in the same city on a consistent basis. The direction and magnitude of differences between CV and EV users in trip chaining behavior remains a significant knowledge gap. This research aims to compare trip chaining behavior between private conventional vehicle (CV) and electric vehicle (EV) users.

Modelling the tradeoff between repositioning cost and quality of service in the urban sharing bike system

Ge Wang, Chengchao Zuo and Xinli Ke

Abstract: This study investigates the relationship between repositioning cost and quality of service in the sharing bike system. The following research questions are addressed: (i) on-demand distribution: what is the spatial-temporal distribution of the sharing bike system and how do they vary during the course of a day? (ii) dynamic supply reposition: what is the relationship between repositioning cost and quality of service in the sharing bike system? To explore these questions, we draw on theoretical lens of on-demand rental networks and insights from the sharing economy and transportation literature. The research models are tested and verified based on a data set collecting from Mobike (the leading sharing bike operator in China).

B3: Remote sensing (Wednesday, 19th 15:15 – 16:45, Room G12)

Session Chair: Qunshan Zhao

Multi-Scale Feature Fusion Network for remote sensing image captioning

Haiyan Huang, Zhenfeng Shao, Qimin Cheng and Xiaoping Wu

Abstract: Remote sensing image captioning has inspired spread attention due to its application in generating sentence to input image flexibly. However, existing methods still have limitations in describing complex, multi-scale remote sensing image scenes. To solve this problem, we propose a Multi-Scale Feature Fusion Network (MS-Net) for remote sensing image captioning. Firstly, the features of different layers are fused to extract multi-scale feature. Further, we use the transformer encoder adaptively to fuse image features at different scales. To verify the performance of MS-Net, extensive experiments on four benchmark datasets, namely UCM-caption, Sydney-caption, RSICD, and NWPUcaption show that our MS-Net can surpass the current state-of-the-art methods, indicating the promising prospects in remote sensing image captioning.

An Advanced spectral-spatial representation using stacked feature space for hyperspectral image classification

Hui Chen, Jin Chen, Qiang Li, Shuaijun Liu, Zhuoning Gu and Yang Chen

Abstract: we develop a new spectral-spatial feature for CNN-based HSI classification. Experiments show that SSFSP not only achieves the best classification accuracy, but also reduces the dependence on model structure. The superiority of SSFSP can be attributed to the fact that SSFSP is an advanced spectral representation that translates implicit spectral relationships into spatial features that can be explicitly processed by CNNs. At the same time, BCS can automatically select an optimal set of band combinations for the data set to be classified. As SSFSP greatly reduces the reliance on expertise and

user interaction while improving classification accuracy, we believe it has great potential for practical applications and is worthy of promotion.

A deep learning-based approach to simulate large-scale dynamics of normalized difference vegetation index for the monitoring of vegetation activities and stresses using meteorological data

Ying Sun, Jianfeng Huang, Xiaoyang Zhao and Qinchuan Xin

Abstract: Vegetation activities and stresses are crucial for vegetation health assessment. While changes in an environment such as drought do not always result in vegetation drought stress as vegetation responses to the climate involve complex processes. Satellite-based vegetation indices such as Normalized Difference Vegetation Index (NDVI) have been widely used to monitor vegetation activities, whereas satellite only carries information for understanding past and current vegetation conditions. There is a need to model vegetation dynamics to make future predictions. We attempt to predict the vegetation activities and stresses via simulating NDVI based on only meteorological data using a deep learning method (bidirectional long short-term memory model, BiLSTM). Experimental results show that the predicted NDVI is consistent with the reference data (R2 = 0.69 ± 0.28). Both the monitored and simulated VCI indicated an upward but insignificant trend of vegetation activity in the past decade and increased vegetation stresses in the early growing season over northern China. Based on meteorological data, the deep learning-based solution shows the potential for not only retrospective analysis but also future prediction of vegetation activities and stresses under varied climate conditions as compared with remote sensing data.

Aerial Visual: Field Study for High-Throughput Monitoring of Fractional Vegetation Cover

Guofeng Yang, Yong He, Zhenjiang Zhou, Lingzhen Ye, Hui Fang and Xuping Feng

Abstract: Aerial visual perception is used to monitor field FVC during the whole growth stage, and an automatic monitoring framework for field FVC integrating UAV remote sensing, multispectral imaging and semantic segmentation is developed. Field experiments are conducted to generate aerial and ground datasets, which are used for various semantic segmentation methods to validate the developed framework. We test the advantage of using all five spectral bands using visible light images, a combination of the three bands, and selected VIs. Classical and latest learning semantic segmentation methods are extensively tested, and the results show that five-band images can achieve better segmentation performance than synchronously acquired RGB images. The synchronously acquired RGB image has better segmentation performance than the combined image of R, G, and B bands. The widely used VIs, the segmentation performance of the spectral VI image is also lower than that of the five-band image due to information loss in the band selection. It proves that the Transformer-based network architecture can effectively mine the correlation between image pixels, and has stronger feature extraction capabilities for multispectral images.

C3: Urban mobility II (Wednesday, 19th 15:15 – 16:45, Room 115)

Session Chair: Wei Tu

Quantifying responses to the expansion of the Ultra Low Emission Zone in London

Yikang Wang and Chen Zhong

Abstract: The study provides important insights into the impact of ULEZ expansion on human mobility, which can help inform future policymaking in this area. In future work, we plan to detect the travel modes (e.g. car, public transit and active travel) using mobile phone location data, and further

evaluate the impact of ULEZ on different travel modes. By further testing the transferability of the causal model to other regions, policymakers can gain a better understanding of the potential benefits and challenges of implementing similar policies in other areas.

Using XGBoost and SHAP for inter-urban mobility flows generation and feature analysis

Qiuping Li, Hui Meng, Ruofei Ma and Yunfei Zhang

Abstract: Road passenger transportation is an important component of urban and regional mobility. The study of the spatial interactions of passenger flows has been a popular topic in urban geography and transportation. Flow generation models in previous studies were mostly devoted to improving and extending the gravity model or radiation model. However, these models haven't considered the complex and non-linear relationship between mobility flows and various features. Therefore, we need more efficient models to generate more realistic mobility flows. In addition, how passenger flows are nonlinearly related to multidimensional features needs to be further explored. This study proposes an effective inter-urban flow generation model through the utilization of the extreme gradient boosting (XGBoost) model and the post hoc interpretable method Shapley additive explanation (SHAP) to generate road passenger mobility flows and exploit the nonlinear relationships between various features and inter-urban road passenger flows.

Examining the Recovery of High Streets with Footfall as the Performance Measure

Xinglei Wang, Xianghui Zhang and Tao Cheng

Abstract: This paper studies the recovery of high streets and addresses three major research gaps in the literature by clearly quantifying the degree of recovery, proposing a practical workflow to classify footfall, and exploring the temporal patterns of footfall with higher granularity. The preliminary results are promising in quantifying the landscape of high street recovery, characterising the dynamics of the high street vitality, and identifying the distinctive patterns of footfall change among three different people.

Mapping fine-grained informal settlement mapping in the Guangdong-Hong Kong-Macao Greater Bay Area

Wei Tu, Dongshen Chen, Yang Yue, Zhengdong Huang and Qingquan Li

Abstract: Timely and accurate information of informal settlements is essential to measure and help achieve United Nations' Sustainable Development Goals (SDGs). Traditional remote sensing-based methods lack semantic information on informal settlements. Here, we propose an effective approach for fine-grained informal settlement mapping by integrating openly available remote sensing imagery and points-of-interest (POI) data. We take the Guangdong-Hong Kong-Macao Greater Bay Area (GBA) in China as the study area, and experiments have demonstrated the effectiveness of the proposed method, with an overall accuracy of 91.82%. A fine-grained map of informal settlements in the GBA is produced and made publicly accessible. Based on the thematic map, we then analyze the spatial patterns of GBA's informal settlements from patch and city scales respectively. These findings provide insights for the assessment and monitoring of informal settlements in the large urban agglomeration, which are valuable for policy-making as well as SDG 11.1.1 measurement.

The effects of COVID-19 on park visitation in Los Angeles County, California

Linna Li, Song Gao, Bo Xu, Prudhvi Goud Katta and Natalie Marcom

Abstract: The trend of park usage was generally consistent with the development of the pandemic and the issuance of executive orders; however, there is a variance in the number of visitors and the service area of each park, dependent on park features, available facilities, different groups of population, people's perception of safety in parks, etc. Large iconic parks demonstrate a significant decrease in the number of visitors and the service area, while community parks maintained the same service area with a fluctuation in either positive or negative change in the number of visitors.

D1: Environment and disaster (Thursday, 20th 10:45 – 12:15, Room G13)

Session Chair: Bo Huang

Fracture Distribution and its Relationship with Health and Environment in a Japanese Prefecture

Qiaohui Zhou, Riken Homma

Abstract: Kumamoto Prefecture is facing the problem of aging. The rate of old seniors and older seniors reached 31.4% and 16.4% by October 2020, higher than the average. Medical expenses data of Kumamoto Prefecture shows that in 2013, medical expenses for fractures have exceeded those for chronic kidney disease, and have been on the top of the list since then. In 2021, the medical expenses for fractures covered 6.3% of all. Thus, to inhibit the growth of medical expenses, prevent frailty and care giving, and extend life expectancy, the 45 municipalities of Kumamoto prefecture are undertaking an integrated health promotion project, with setting a goal that the fracture number does not exceed 8,000 cases (the average number from 2017 to 2021) until the end of 2023. Using 39,577 older seniors (seventy-five years old and up) who received a health checkup in 2021 as the study object, the study aims to visualize the fracture rates of older seniors from 2017 to 2021 and estimate the relationship between fracture rates and other health indicators, self-perceived health, oral function, presence or absence of exercise and fall, cognitive function, social participation, and built environment.

Using Human Mobility Data to Detect Evacuation Patterns in Hurricane Ian

Yi Qiang, Xiang Li

Abstract: Research on hurricane evacuation is crucial for improving preparedness and response efforts in Florida, helping to reduce the number of lives lost and minimize the economic impact of disasters. Previous evacuation research primarily relies on qualitative methods such interviews and questionnaire surveys. However, the qualitative data are labor consuming and limited to small sizes. Recently, the emergence of various human dynamics data provides new opportunities to monitor and detect evacuation patterns in large geographic areas. We used human mobility data from SafeGraph to identify evacuation patterns during Hurricane Ian in 2022. Our research addresses three main questions: (1) Do evacuation ratios vary across different communities spatially? (2) Where did the evacuees relocate? (3) Which socio-economic variables are associated with evacuation decisions and destinations? Our study highlights the value of human mobility data in analyzing social and geographical disparities in hurricane evacuation. The analysis findings offer practical insights to support communities and decision-makers in enhancing evacuation plans and communication in future disasters.

Influence of Social Vulnerability and Mobility on COVID-19 Transmission in the United States

Bo Huang

Abstract: The significance of human mobility in the spread of COVID-19 locally and globally is well-known; however, the impact of social vulnerability on this relationship remains uncertain. In this study, we utilize a variety of epidemiological and socioeconomic data from US counties to create a COVID-19 Pandemic Vulnerability Index (CPVI) that measures social vulnerability levels. We then investigate how social vulnerability affects the relationship between mobility and disease transmissibility (indicated by the effective reproduction number, Rt) during the 2020 summer

epidemic wave in the United States. Our results show that counties in the highest CPVI quintile experienced nearly twice the COVID-19 transmission (45.02% of days with an Rt greater than 1) due to mobility, particularly intracounty mobility, compared to counties in the lowest quintile (21.90%). In contrast, counties with the lowest CPVI quintile demonstrated minimal impact from mobility levels. A25% change in intracounty mobility correlated to a 15.28% Rt change in the highest CPVI quintile counties, an eight-fold increase compared to the 1.81% Rt change in the lowest quintile counties. These findings emphasize the importance of considering community vulnerability when implementing social distancing measures to control mobility in future public health strategies.

How does urbanization affect community resilience in ecological-fragile zones? Spatial-temporal evidence from Hengduan Mountain

Rui Wang and Jue Wang

Abstract: Based on the data of 95 counties in Hengduan Mountain from 2010 to 2019, this study constructs a composite index system and evaluates community resilience using the game-theory combination weighting method, explores spatial-temporal evolution of community resilience by kernel density estimation and cold and hot spot analysis, and investigates the causal relationship between urbanization and community resilience using spatial two-stage least squares regression. The results show that: (1) the community resilience in Hengduan Mountain increased yearly with spatial differences: the high resilience counties are clustered in the south, while the low resilience ones are in the north; (2) urbanization has no significant impact on comprehensive community resilience; however, it promotes the environmental resilience and inhibits the social resilience; (3) local urbanization has negative externalities on the resilience of neighboring counties and tends to be more severe over time; (4) population effect is an important mechanism to explain the impact of urbanization on community resilience. This study helps to understand the differences in the ability of communities to resist external shocks in ecologically fragile areas and to formulate sustainable development policies.

Improved Satellite-Based Precipitation Downscaling In Data-Sparse Area: A Novel Deep Learning-Based Framework Using Transfer Learning

Honglin Zhu and Qiming Zhou

Abstract: Remote sensing satellite-based precipitation can be an effective alternative to rain gauge measurements for quantitative precipitation estimation. However, their spatial resolution is often too coarse for horological and meteorological applications at the regional scale. Deep learning-based downscaling techniques have been adopted to improve their resolution, but these models often struggle to generalize to other areas. To address this issue, this study proposed a deep learning-based downscaling framework with transfer learning (TL) to improve remote sensing precipitation downscaling. The proposed model was pre-trained in a data-rich domain, and then fine-tuned with the data from the target domain. Results showed that the fine-tuned model produced more accurate results than the original satellite data, with a correlation coefficient of 0.66 compared to 0.52. The study also found that the number of fine-tunable layers impacted the downscaling results, and the proposed transfer learning framework could be useful in regional hydrological modeling and water resources management. This study provides a novel approach to producing high-resolution and accurate satellite-based precipitation estimates for data-sparse areas using transfer learning.

E1: Urban system (Thursday, 20th 10:45 – 12:15, Room G12)

Session Chair: Yijing Li

The manifestation of unequal spatial potential under the premise of human-centeredness, taking Shenzhen as an example

Yaxing Li, Xiaoming Li, Chuangchang Liao, Weixi Wang and Renzhong Guo

Abstract: The United Nations has always had as one of its goals the elimination of inequalities and uneven. And fewer scholars have studied areas of inequality and uneven in 15-minute walk community. We constructed 15-minute walking life circle and poi-diversity. We proposed street spatial potential based on complex network. We made strategy development and formation of optimization results. The results shows that the spatial pattern of poi-diversity has “A-N line” fault. Through on-site investigation, it was found that even in the Nanshan District, the closer the area is to the natural landscape, the less convenient the transportation is and the less developed the environmental facilities are. Transportation technologies that work in symbiosis with nature need to be further explored and developed. The poi-diversity has a strong spatial autocorrelation when the spatial potential of the street network of this study is used as the spatial weight. Finally, taking the road potential as the leading factor, four main optimization strategies are obtained.

Research on the spatiotemporal evolution characteristics, decoupling effect, and influencing factors of carbon emissions from land use in Hubei Province

Mengjiao Fan

Abstract: Land use carbon emissions are an important factor affecting carbon emissions and carbon neutrality. Conducting research on land use carbon emissions within the framework of carbon emission reduction goals is of great significance for guiding regions to achieve the goal of carbon peak and carbon neutrality. The study aims to reveal the temporal and spatial evolution patterns of land use carbon emissions in Hubei Province, as well as their decoupling relationship with economic and social development, and the main influencing factors and their interactions. The goal is to provide references for the development and implementation of policies related to low-carbon utilization of land resources and high-quality economic and social development in Hubei Province.

Uncovering the balance between the physical and socio-economic environments of urban areas from house price in large American cities

Ce Hou, Yuhao Kang, Fan Zhang

Abstract: Sustainable urban development has evolved into a global issue, attracting the attention and participation of numerous nations and organizations in formulating sustainable development goals. However, the harmonious interplay between the physical environment and the socio-economic environment remains a challenging aspect to measure. Housing prices, which serve as indicators of urban development potential, are also impacted by the interrelationship between these two environments. Existing research has identified numerous determinants of property values in the physical environment, such as street layout, visual aesthetics, public spaces, and green spaces. However, social and economic disparities among cities, manifested through the accumulation in culture, public services, and development, also have an obvious influence housing price. While

previous studies have modeled the impact of the physical ands ocio-economic environments on housing prices, certain factors, such as visual appearance and spatial distribution, remain intangible and challenging to incorporate into their models. Furthermore, housing prices may differ between two seemingly similar properties in distinct cities due to variations in how socio-economic factors influence the perceived value of physical features. The advent of street view images (SVIs) provides urban researchers with a viable approach to quantifying the influence of the physical environment in various contexts. This study aims to explore the combined effects of physical and socio-economic environments on urban development, focusing on housing prices in major US cities.

Characterizing Agglomeration Network through Industrial Functions in China's Greater Bay Area

Zidong Yu, Xintao Liu

Abstract: One of the critical debates in regional studies in the context of contemporary globalization is the mechanism that initiates, shapes, and enhances the agglomerations of economic activities. The agglomeration externalities are denoted by early studies as those economic activities are geographically constrained within a certain area and have less relevance to the activities outside that area. The concept of the network has been considered a prevalent perspective to explore economic relationships, as research focal interest is gradually shifted from the internal mechanism of cities to external interaction among cities. Within this systematical framework, it can be seen that network science has introduced a series of quantitative strategies for characterizing and understanding the specific real-world phenomenon of regional issues. Despite such an in-depth understanding of how cities interact presented previously, there has been a relative scarcity of knowledge at both a fine and collective level with regard to local sectoral agglomeration economies. An improving perspective of the network organizations embedded in intraregional and even intracity agglomeration economies could be crucial to current literature and practical issues. This study introduces a data-driven intraregional perspective with the use of geospatial big data and network analytical approaches. By extracting functional traits of industrial activities from points of interest (POIs) in the Guangdong-Hong Kong-Macao Greater Bay Area (GBA), we construct an agglomeration network of functional linkages to understand its spatial-functional roles.

Uncovering long-term evolutions of intra-urban interactions

Xiaoyue Xing

Abstract: Long-term evolution of urban spatial structure enhances our understanding about the development of cities. Such structure is characterized by the arrangement and interactions of people, materials, and information in urban spaces. Existing studies uncovered the interaction derived from human mobility characteristics at two levels: the individual level and the aggregated level. At the individual level, year-to-year evolution of passengers' trip patterns, such as trip frequency and the number of stop stations, reveal changes of individuals' travel habits. Successive changes of the commuting patterns recorded by individuals' smart card data shed lights on the job-housing arrangements and profiles of underprivileged residents. On the contrary, at the aggregated level, studies pay more attention to the characteristics of the urban space. They use network theories to identify urban hubs and borders to see how local areas play changing roles and influence the overall spatial structure of urban movement. Taking advantages of detailed movement records, we can also find out how the local interaction structures vary at a fine spatiotemporal scale.

However, our ability to detect such urban dynamics has been largely limited by the coarse spatiotemporal resolution of statistical survey data, especially in developing countries. To fill the gap, we seek to develop theories and methods in spatial analytics and complex networks to uncover the long-term changes of urban spatial structures.

D2: WebGIS and VGI (Thursday, 20th 13:15 – 14:45, Room G13)

Session Chair: Rui Zhu (Bristol)

An Exploratory Data Analysis of the Spatiotemporal Patterns of Heritage-Related Events on Twitter

Nan Bai, Tao Cheng, Pirouz Nourian, Ana Pereira Roders

Abstract: Triggered by radical Heritage-Related Events (abbreviated hereinafter as HRE, such as the fire in Notre-Damede Paris in April 2019 or the more frequent floodsin Venice), communities around the world are being actively involved on social media to share the cultural significance they convey to heritage properties including their opinions and emotional attachments. Such opinions and emotions, as well as the dynamics of messages spreading on an intrinsic social network, could help heritage managers and urban planners make more informed and inclusive decisions. Furthermore, all the geo-tagged and time-stamped posts on social media, as well as the corresponding HREs themselves, are unavoidably embedded in their spatiotemporal contexts. Aggregating information on social media and mapping the spikes on both a discrete timeline and a spatial representation could yield visualizations easily understandable for decision-makers to make assessments of the impact caused by an HRE and draw conclusions on what to donext to better support urban conservation. This paper aims to present the results of an exploratory data analysis on a new graph-based spatiotemporal dataset collected from Twitter concerning events happening in UNESCO World Heritage properties that triggered global concerns. It could be used both in urban studies to mine the public opinions about heritage-related events, and by the GeoAI community to test spatiotemporal clustering algorithms.

Integrating Semantics of Circumstances and Events: The Information Organization Method of Flood Disaster

Shunli Wang

Abstract: The expression of flood disaster events is to process, simplify and abstract the semantic information of different spaces under the influence of flood disasters, and to scientifically and accurately reflect the multi-dimensional spatial semantic characteristics of flood disaster events. Under the background of spatial diversification, the traditional description framework focusing on a single space is insufficient to express the information of spatio-temporal objects in multi-dimensional space. This paper defines the concept of disaster circumstance, organizes the multi-dimensional spatial semantic information under the influence of flood disaster based on the integration of “circumstance-event”, proposes the expression framework of “circumstance-event” for flood disaster, and realizes the abstract description and quantitative expression of multi-dimensional spatial information such as natural space, human space, and information space.

Highly Precise Routable Map Construction for Highway Interchanges Using Crowdsourced Trajectory Data

Fengwei Jiao, Longgang Xiang

Abstract: The accurate and routable road maps provide vital information for many applications, including traffic planning, location services, and automated driving. Numerous studies have been conducted on road network extraction from vehicle tracking data. However, most of these studies focus on extracting intersections and road segments, such as road centerlines or road lanes. Research aimed at constructing the road network map of highway interchanges, which is a hierarchical three-dimensional (3D) structure with dense ramps and weaving sections, is rare. It has been proven that crowdsourced GPS trajectories enable the generation and updating of road-level maps with high efficiency and low cost. With the widespread use of GPS sensors in public transportation, private cars, and other mobile devices, these trajectories are available at a large scale. Constructing road network maps from GPS data has gained increasing research attention in recent years. However, existing algorithms tend to work well for common road structures but fail to generate high-accuracy maps in dense urban areas and complex junctions, particularly highway interchanges. In reality, highway interchanges use grade-separations to enable traffic movement between roadways crossing at different levels or directions without collisions. Accurate road geometry and topology of these areas are crucial for a city's road network, but they are difficult to extract. This paper aims to generate highly precise routable maps for highway interchanges from crowd sourced GPS trajectories.

Exploring Individual VGI Contributors' Participation Characteristics with Geovisual Analytics

Guiming Zhang

Abstract: The past two decades or so have witnessed booming adoptions of VGI for research and applications in geography, ecology, and sociology, among many other disciplines. Volunteer contributors, acting as citizen sensors on the ground, are at the center of VGI. A VGI record typically has four components: 'who' (observer) reports 'what' (thematic information) at 'where' (location) and 'when' (time). Existing studies on participation characteristics in VGI projects have largely focused on group-level participation patterns. There is a lack of investigation on the participation pattern of individual contributors, which can be complementary to a comprehensive understanding participation characteristics. This study develops a web-based geovisual analytics framework for exploring participation characteristics of individual VGI contributors along four dimensions: spatial, temporal, thematic, and social interaction.

FAIR principal Influence Analysis and Geoscience Data Governance Strategies

Juanle Wang

Abstract: With more and more geoscience data accumulated, there is an urgent requirement for geoscience data sharing. FAIR principle, i.e., Findable, Accessible, Interoperable, Reusable, when it was proposed in 2016, great influences has been achieved in the various fields. How about its influence and how to implement this principle in Geoscience data governance? This paper wants to find this answer based on bibliometric analysis and the real experience in geoscience data repository management.

E2: Street-level imagery (Thursday, 20th 13:15 – 14:45, Room G12)

Session Chair: Mingshu Wang

eeFlowMinner: a library for functional semantics mining and geospatial workflow generation for scripts in Google Earth Engine

Jianyuan Liang, Huayi Wu, Xianyuan Zhang

Abstract: The accumulation and isolation of the workflow scripts in GEE leads to a huge waste, and even worse, would cause “isolated island of information” in the cloud environment. Thus, capturing the provenance of the GEE workflow scripts and excavate potentially useful knowledge hidden in them gradually become an urgent issue. To address the above issues and promote the understanding of GEE-based workflow scripts, we present eeFlowMinner – a library for functional semantics mining and geospatial workflow generation for GEE-based scripts. EeFlowMinner strives to fill the gap between workflow scripts and general geospatial scientists by providing the representation of raw scripts from the semantic perspective. Specifically, we adopted and improved existing abstract syntax tree(AST) analysis and designed multiway tree traversal algorithm that are fit to GEE workflow scripts to achieve functional provenance in syntax level. Then geospatial semantics of diverse dimensions is explored based on OWL-S definition. Ultimately, the raw scripts can be converted into geospatial workflow with rich semantic information, which can further be integrated easily in GIS system for graph-based visualization or collected for data-driven geospatial knowledge discovery.

A study on Multi-aspectual Urban Environment Perception and its Heterogeneity based on Three-dimensional Morphological Characteristics

Chunhong Zhao

Abstract: With the increasing demand of urban residents for the quality of urban space, urban perception research is an essential topic of current urban study. Regarding the spatial characteristics of the multi-dimensional perception of the urban environment, most studies focus on specific issues but hardly involve exploring the spatial heterogeneity of urban perception and its driving factors from the perspective of the three-dimensional urban morphology, which is far from meeting the needs of refined urban management. Therefore, this study is committed to clarifying the characteristics of the three-dimensional morphological structure, efficiently evaluate the urban environment perception, and coupling the urban spatial structure and functional characteristics to understand the impact mechanism of urban environment perception, based on multi-source data and deep learning information mining. First, the study would develop a three-dimensional representation of the urban morphology that integrates gray buildings and green vegetation landscapes, with a case study of Changchun city. Then, the study would associate street scene images with visual elements, to evaluate the urban environment perception from six dimensions. Finally, the study would introduce various index factors of urban physical environment characteristics and functional characteristics, to explore the influence mechanism of urban environmental perception. Based on the three-dimensional morphological characteristics, this study will enrich the theoretical framework of urban environmental perception research and provide technical support for the comprehensive evaluation of urban spatial quality, by considering the influencing factors related to the physical environment and social functions of the urban environmental perception.

Assessing Differences in Safety Perceptions using GeoAI and Survey across Neighbourhoods in Stockholm, Sweden

Yuhao Kang, Song Gao

Abstract: Enhancing urban safety is essential for promoting social stability and building an inclusive and resilient environment. The consequences of crime, one of the primary threats to safety in cities, often go beyond immediate financial and personal losses: fear of crime and poor safety perceptions may also cause detrimental long-term effects on mental health and quality of life. Hence, to create safer cities and communities, it is crucial to examine and understand how people perceive the safety of the built environment. We aim to assess and compare two forms of people's safety perceptions: (1) GeoAI-based safety perception: a GeoAI model is trained by using street view imagery and running a local survey that collects citywide residents' safety perceptions of the city of Stockholm, Sweden. (2) Survey-based safety perception: a localized survey is employed that harvests neighborhood residents' safety perception. We investigate what these safety perception indicators show, what factors contribute to explaining their geography, and how to understand the perceptual difference (i.e., the discrepancy between the two safety perceptions).

A Quality Assessment Framework for Object-based Image Analysis (OBIA): An Experiment with Urban Building Objects

Dongmei Chen

Abstract: Object-Based Image Analysis (OBIA) has become a common approach for extracting and classifying meaningful information from high resolution remotely sensed images analysis. The increasing use of OBIA methods has raised several questions related to quality and accuracy of objects extracted from images. Image segmentation is often the first step in OBIA framework, and the efficiency and accuracy of the subsequent operations often depend on the segmentation quality. Although a large number of segmentation algorithms have been developed, there are no standard toolsets/models to objectively guide the assessment of segmentation quality. In this research we first reviewed different measures that have been developed to measure different aspects of segmentation quality including under segmentation, over-segmentation and combined metrics. Using building objects as an example, we have compared these metrics and illustrated their issues and limitations. We then proposed a targeted-based framework of measuring segmentation quality from different perspectives. This framework is based on the fact that different objects require different parameter settings to achieve optimal quality. The iterative segmentation is initiated, and results are compared against the reference feature automatically using the proposed framework until an optimal is achieved. Different geometrical properties of shapes are used to create index which describe the closeness of reference and target features. The output from these measures allows users to loop through a range of segmentation parameters and select the optimal ones.

F1: Innovative GIS topics (Friday, 21st 09:00 – 10:15, Room G13)

Session Chair: Xiao Li

Can GIS-enhanced animations facilitate the understanding of football tactics?

Nianhua Liu, Joel Salazar, Chuan Chen, Yu Feng

Abstract: GIS-enhanced animations offer a powerful way to capture the dynamic nature of football games through spatio-temporal analysis and visualization. Therefore, they have a great potential to enhance the understanding of football for unexperienced users and grassroots players. In this study, we created several animations using GIS tools, which were designed to capture specific scenarios. Two questionnaires were designed to analyze the users' experience with respect to their prior knowledge. In the next step, a u ser controlled experiment will be performed to test whether the animations can facilitate the understanding of football tactics of different users. This study is expected to provide recommendations for the future development and use of GIS-enhanced animations in football.

GISphere: A Crowd-Sourced Database of Global GIS Graduate Education

Yuhao Kang, Yikang Wang, Jingyuan Zhang, Haokun Liu, Jinmeng Rao, Yuyan Liu, Bing Zhou, Pengyu Chen, Yanbing Chen, Xinyi Tong, Shan Ye

Abstract: GISphere project creates a crowd-sourced database that summarizes education information in Geographic Information Science (GIS)-related fields for universities worldwide, with the goal of providing a comprehensive resource for students and scholars in the GIS community. The project aims to fill the gap in current resources by providing a comprehensive, standardized, and up-to-date database that includes information on GIS-related graduate programs and supervisors. By doing so, the project hopes to support the advancement of GIS education and research globally.

Choosing GIS Graduate Programs from Afar: Chinese Students' Perspectives

Yikang Wang, Yuhao Kang, Haokun Liu, Ce Hou, Bing Zhou, Shan Ye, Yuyan Liu, Jinmeng Rao, Zhenghao Pei, Xiang Ye, Song Gao, Huanfa Chen

Abstract: With the increasing demands for geospatial analytics in industry and academia, the need for Geographic Information Systems/Science (GIS) education is on the rise. A growing number of departments in geography have launched or expanded their GIS graduate programs. To date, there are over200 GIS certification and degree programs in the US and more than 400 programs globally. However, the factors influencing students choosing GIS programs have not been examined yet. This study provides a thorough examination of the factors that influence students' selection of GIS degree programs using a student-centred approach. In particular, we focus on Chinese students who apply for overseas (i.e., outside of mainland China) GIS programs, because China is one of the fastest-growing countries in GIS, which may produce the most students who major in GIS. We ask the following research questions: (1) What are the patterns of Chinese GIS students applyingfor overseas GIS programs? (2) What are the factors influencing Chinese GIS students'choices of overseas GIS programs? (3) What insights can be inferred forfuture GIS andgeography program development?

Multi-user indoor cooperative localization technology with opportunity encounters

Sheng Guo, Minmin Li, You Li

Abstract: Smartphone-based collaborative indoor localization technology is a rapidly evolving area of research that aims to provide convenient and accurate user indoor location information. This

technology encourages users to collaborate with each other using sensors commonly found in smartphones, such as WiFi, Bluetooth, and inertial sensors. By collecting and sharing data from multiple users, the collaborative system can overcome the limitations of individual devices and improve localization accuracy and efficiency. However, the need for fingerprint database establishment, frequent calibration, and the effects of signal strength fluctuations still plagues the development of the technology.To address these limitations, this paper proposes a collaborative indoor localization scheme that combines smartphone WiFi hotspots for information transmission with inertial sensor data to improve localization accuracy. The proposed method does not require additional equipment or tedious fingerprint database collection, and the use of information on the trend of WiFi signal strength changes also reduces the impact of signal fluctuations to some extent. The collaborative scheme can estimate the relative position and exchange information in an environment without external devices, which is of great significance for collaborative work and emergency response in special situations. Extensive experiments conducted in our office area demonstrate the proposed solution's ability to achieve satisfactory localization results.

F2: Sustainable development (Friday, 21st 09:00 – 10:15, G12)

Session Chair: Yi Gong

Measuring and mapping travel time to healthcare facilities in China: Status and Barriers to achieving SDG3

Liutong Chen, Yifei He, Bin Zhu

Abstract: Spatial accessibility directly reflects the residents' access to equitable healthcare services. This study aims to achieve the sustainable development goal set by United Nations (Goal 3: ensure healthy lives and promote well-being for all at all ages), update the travel time map of China, measure and visualize the spatial accessibility of healthcare, and quantify its driving factors. The findings might deserve consideration by the government in urban planning and evidence-based health policy making. Our results also provide references for the achievement of SDG3 in China.

Urban green and blue spaces and heat-related mortality in high-density cities

Jinglu Song, Yi Lu, Kejia Hu and Yuming Guo

Abstract: Background: Despite emerging recognition of the benefits of green and blue spaces on human health, evidence for their effect modifications on heat–mortality associations is limited. We aimed to investigate the effect modifications of green and blue spaces on heat–mortality associations among different age and sex groups and at different heat levels.
Methods: Daily mortality and meteorological data from 2008 to 2017 in Hong Kong, China were collected. The Normalized Difference Vegetation Index and distance to coast were used as proxies for green and blue space exposure, respectively. Time-series analyses was performed using fitting generalized linear mixed models with an interaction term between heat and levels of exposure to either green or blue space. Age-, sex-, and heat level-stratified analyses were also conducted.
Results: With a 1°C increase in temperature above the 90th percentile (29.61°C), mortality increased by 5.7% (95% confidence interval [CI]: 1.6, 10.1%), 5.4% (1.4, 9.5%), and 4.6% (0.8, 8.9%) for low, medium and high levels of green space exposure, respectively, and by 7.5% (3.9, 11.2%) and 3.5% (0.3, 6.8%) for low and high levels of blue space exposure, respectively. Significant effect modifications of green and blue spaces were not observed for the whole population or any specific

age and sex group, either at a moderate heat level or a heat level (Ps>0.05).
Conclusions: No significant effect modifications of green and blue spaces on heat-related mortality risk were observed in Hong Kong. These findings challenge the existing evidence on the prominent protective role of green and blue spaces in mitigating heat-related mortality risks.

Developing a Cesium-based Lightweight CIM for Data Management in Neighborhoods Renewal: A Case Study of Yinhongyuan in Nanjing

Ziyu Tong, Xu Cheng

Abstract: The creation of an appropriate City Information Model (CIM) is crucial for ensuring high-quality renewal of old neighborhoods. The study proposes the concept of lightweight CIM to manage the complex data in old neighborhoods and establishes a practical technical path, culminating in a lightweight CIM platform for the renewal of the Yinhongyuan neighborhood in Nanjing. The platform has been applied to the renewal of the project, allowing for unified data management and visual display and attribute query. Compared with traditional methods, the lightweight CIM can integrate more data types, present data more intuitively, and query data faster, which can better assist urban design and management.

Design and Research of Smart Sluice Station Based on GIS and BIM

Zilin Li, Xinlong Liu, Xiaohong Yang

Abstract: As an important water conservancy facility, sluice plays an important role in water conveyance, flood control, drainage and navigation. At present, the management of the sluice station is mainly based on manual control and general two-dimensional information management system. However, most sluice stations are long project lines and lots of engineering points, which easily leads to many management problems such as high monitoring and maintenance costs and difficult policy coordination. To address this problem, this study combined BIM with GIS to develop an intelligent early warning and dispatching system. Based on the BIM model, three-dimensional(3D) city building model and remote sensing data, the proposed smart sluice station system integrated GIS, BIM and IoT technology, built a smart sluice station cloud platform, and realized the remote unified management system for sluice station. As a study case, the proposed system was applied to Cijiang Sluice Station, and the results show that the proposed system can realize remote monitoring, early warning and real-time scheduling of the sluice station, which has greatly saved time and costs for the sluice management.

Comparing the capabilities of remote and human sensing data in uncovering urban socio-economics and built-environments

Jinzhou Cao, Xianyu Cao, Guanzhou Chen and Wei Tu

Abstract: This paper highlights the importance of measuring socio-economics and built environments using nighttime light imagery and mobile phone location footprints, but acknowledges that single data sources are insufficient for capturing a comprehensive picture of people's activities. To address these issues, we first produced two kinds of grid-level maps for the chosen study area, the Pearl River Delta (PRD) region from original data sources: NTL map from VIIRS satellites to capture the average night-time light intensity for each grid cell, and MOB map from mobile phone location footprint from communication operator company to gauge the spatial distribution of human activities. Using different urban geospatial data, we then identified related socio-economic factors (such as GDP and facility variety) and built-environmental factors (such as road networks and building density). The paper will lastly assess any potential advantages or disadvantages of each data type for modeling different urban indica-tors, as well as highlight key distinctions between the two data sources and the underlying mechanism used to estimate the metrics. The findings will also look at which types of data are better suited for estimating which indicators.

Recognising mobility-based urban scaling and socio-spatial inequalities: Evidence from UK cities

Qili Gao, Chen Zhong, Yang Yue and Qingquan Li

Abstract: The relationship between social inequality and urban size has been a research interest and debate in recent years. There is evidence that larger cities usually have higher degrees of inequality. However, few studies have examined it quantitatively, especially under the urban scaling law framework. Besides, existing arguments mainly rely on economic indicators, such as income, wage and housing price, and the inequality in human mobility patterns has been overlooked. Human mobility reflects the extent of access to urban opportunities and exposure to the urban environment and society, providing powerful perspectives to look into socio-spatial inequalities and the scaling relationship against city size. Benefiting from the advance of information and communication technology, this study aims to fill the above gaps by examining multiple mobility-related indicators of socio-spatial inequality from a large-scale mobile phone app dataset. The results improve our ability to understand the city in a quantitative and simple way. This paper aims to offer evidence supporting the urban scaling law and socio-spatial inequalities, as viewed through the lens of human mobility based on mobile phone app data.

Investigating the impacts of urban spatial structure on carbon emission by integrating local Digital Footprint Data

Ye Tian, Diego Pajarito Grajales, Philipp Ulbrich, Andrew Clarke, Massimo Cattino and Joao Porto de Albuquerque

Abstract: Reducing greenhouse gas emissions to improve climate mitigation has become a challenge for global sustainable development. Meanwhile, urban development and its spatial structure are the key factors affecting the distribution and magnitude of carbon emissions. However, limited research focused on the relationship between urban spatial structure and carbon emission on the local scale due to the data availability. Therefore, we apply the local Digital Footprint (DF) data from Urban Big

Data Center (UBDC) at the University of Glasgow, to bridge the research gaps between urban spatial structure and local carbon emissions at the neighborhood scale in the U.K. To illustrate, human mobility patterns are characterized by the CCTV (Closed-Circuit Television) Object Detection platform, which provides counts of street traffic and pedestrians through CCTV cameras. The degree of green travel is quantified by the Public Transport Accessibility Indicators, and the building energy performance is obtained through the EPC (Environmental Performance Certificate) data at the household level. Besides, the urban spatial structure is quantified by both 2D and 3D urban form metrics for each building as well. All DF data at UBDC will be combined to estimate the total carbon emissions at the neighborhood scale based upon multiple sectors (e.g., transport, manufacturing, housing, and land use) to improve the understanding of major drivers, spatiotemporal disparities, and potential mitigation strategies for carbon emissions, which promotes the study of local monitoring of SDGs (Sustainable Development Goals) and the application of social science research on climate action and provides insightful suggestions for the urban planners and local stakeholders to effectively control greenhouse gas emissions and improve climate adaptation.

Stability Analysis Method of Landslide Geological Disaster

Wenfeng Bai, Dian Wang, Yizhao Wang, Zhili Li, Zhi Wang, Honghui Lin and Fei Wang

Abstract: Landslide is one of the most common geologicaldisasters, which has a great impact on human life. Therefore, it isof great significance to carry out stability analysis and spatio-temporal prediction of landslide for economic development andpeople ’s safety. In this paper, Geo-Studio software is firstly used tocarry out two-dimensional modeling and simulation calculation ofa village landslide in Shaanxi Province, the stability coefficient ofthe landslide is then calculated,and the stability analysis isdone topredict the location of the landslide and the shape of the slip surface.Then, we used landslide displacement monitoring data to predictthe displacement of a landslide in Hubei Province based on the greymodel. Finally,the simplified model of stability coefficient isconstructed to predict the possible occurrence time of the landslide,taking the stability coefficient sequence as the input parameter. Theresults show that the absolute error of predicting the displacementof the landslide based ongrey prediction model is only 4.455%, andthe maximum absolute value of the error for predicting thelandslide occurrence time estimated by the simplified model of thestability coefficient is 0.046. The prediction accuracy is high,andthe prediction effect is good.

Simulation of land use change along the Silk Road under the constraint of sustainable development goals

Kai Wu, Tian Ya, Min Cao, Min Chen and Songshan Yue

Abstract: Sustainable development is the development that meets the needs of the present without compromising the own needs of future generations, which requires building an inclusive, sustainable and resilient future for people and the planet. To achieve sustainable development, three interconnected key factors must be coordinated: economic growth, social inclusion, and environmental protection. The United Nations has established 17 Sustainable Development Goals (SDGs) calling on the entire worldto work together to end poverty, safeguard the environment, and improve the lives and futures of all people. Land is an important aspect of natural resource since they provide the foundation for human exploitation and consumption of the land as well as the acquisition of living materials. The sustainable use of land resources is critical for the economy, society, and

environment to flourish in a way that is sustainable. This study selects 66 countries along the Silk Road as the research area, and divides the characteristics in research region according to the economic and climatic conditions of each country, thereby analyzing the historical development trend of land use change in the Silk Road. At the same time, four sustainable development scenarios (reference scenario, environmental protection scenario, economic development scenario and grain production scenario) are set according to the Sustainable Development Report 2020 released by the United Nations. A system dynamics model integrating socioeconomic and natural factors is used to predict land use change in 2030. The results show that different sustainable development scenarios have significant impacts on different types of land resources. The area of urban land expands the fastest under the economic development scenario, while the cultivated land declined slowly under the grain production scenario and the forest land decreases slowly the environmental protection scenario, respectively. This study can provide a basis for judging the land sustainability of countries along the Silk Road.

Future land-use change and its impact on terrestrial ecosystem carbon pool evolution, under SDG scenarios

Ya Tian, Min Chen and Hui Lin

Abstract: Sustainable development goals (SDGs) in the United Nations 2030 Agenda call for action by all nations to promote economic prosperity while protecting the planet. Projection of future land-use change under SDG scenarios is a new attempt to scientifically achieve the SDGs. Here in, we proposed scenario assumptions based on the SDGs. These included the sustainable economy (ECO), sustainable grain (GRA), sustainable environment (ENV), and reference (REF) scenarios. We projected land-use changes (resolution: 300m) and compared the impacts of urban expansion, cultivated land and forest conversion on terrestrial carbon pools. There were significant differences in future land use change and carbon stocks, under the four SDG scenarios, by 2030. In the ENV scenario, the trend of decreasing forest land was mitigated, and terrestrial carbon stocks in China increase by 0.60% compared to 2020. In the GRA scenario, the rate of reduction in cultivated land area slowed down and showed an increasing trend in East and Southeast Asia. In the ECO scenario, the rate of urban expansion showed increased, and it cause highest carbon losses, accounting for 0.28% of terrestrial carbon stock in 2020, by 2030. The study provides an understanding of how SDGs can help mitigate future environmental issues via accurate simulations that can be used on a global scale.

Addressing Property Abandonment Crisis in Shrinking Cities: An Agent-based Policy Simulation

Li Yin, Fuzhen Yin and Robert Silverman

Abstract: Shrinking cities must approach the problem of zombie properties more holistically. Policy making must be based on informed insight, decisions, and proactive interventions to break abandonment patterns. There has been, however, limited reference to theoretical insights and evidence-based analysis about demolition and abandonment. Recent studies have used Agent-based models (ABM) to help inform policymaking as an extension of exploratory analysis by generating potential alternative representations of future or counterfactual system conditions. This study builds on previous studies on abandonment and Buffalo's local housing market using the agent-based approach to explore housing abandonment in a declined city on the rust belt and explore alternative policy incentives to fight the problem of a large number of zombie properties.

Will the Industrial structure promote or reduce non-grain production expansion: evidence from the Yangtze River Economic Belt

Jiarui Song and Shougeng Hu

Abstract: This study selects the industrial structure as an important factor influencing the expansion of NGP and uses the Yangtze River Economic Belt as the study area to explore the relationship between changes in industrial structure and the NGP of cropland over the past 20 years. It aims to address the following important questions: (1) How does the NGP of cropland change in relation to the change in industrial structure? (2) How does the change in industrial structure affect NGP? Will it promote or reduce the expansion of NGP? (3) Does this impact vary across regions? Is it stage-specific? Based on the results of the analysis, the aim is to show how industrial structure optimization and adjustment can curb the expansion of NGP and provide policy recommendations.

Spatial-temporal evolution and spatial relationship analysis of land use carbon emissions and ESV in the Yellow River Basin

Chong Liu and Shougeng Hu

Abstract: It is essential to study the spatial-temporal evolution characteristics of land use carbon emissions and ecosystem services and analyze their spatial relationship, providing a scientific basis for the formulation of regional low-carbon and green development strategies. The study provides important insights into the spatial-temporal evolution of carbon emissions and ESV in the Yellow River Basin, highlighting the need for effective measures to prevent the negative impact of carbon emissions on the surrounding ecological environment. The research results of this paper are expected to propose emission reduction strategies for the Yellow River Basin, establish a low-carbon land use structure, improve the ecological environment, and provide support for the road of green and low-carbon development.

The Impact of Digital Economy on Urban Land Use Efficiency: Spatial Spillover and Threshold Effect

Haiyang Li

Abstract: As urbanization advances rapidly, low urban land use efficiency (ULUE) has become a key factor restricting high-quality development in the Yellow River Basin. The development and expansion of the digital economy (DE), which overcomes spatial and temporal limitations, has advantages in optimizing industrial structure, enhancing economic vitality, and reducing resource consumption, making it an effective way to improve urban land use efficiency. This study uses panel data from 54 cities in the Yellow River Basin to explore the relationship between the DE and ULUE. The results show that: (1) the benchmark regression model finds that the DE can effectively improve ULUE, and there is a significant inverted U-shaped relationship between them. (2) Spatial Durbin model analysis shows that DE has a significant direct impact on ULUE, but the indirect impact is not significant because the digital economy is still in the early stage of development and the spillover effect of knowledge and technology has not yet formed.(3) From the perspective of the threshold panel model regression estimates, when ULUE is high, the impact of DE on ULUE is more significant. Finally, policy suggestions for using the DE to improve ULUE are proposed.

Collective Flow Evolution Pattern: A mesoscopic exploration of spatial network dynamics

Zhongfu Ma and Di Zhu

Abstract: This paper introduces the Collective Flow Evolution Pattern (CFEP) to depict network evolutionary patterns from a flow perspective. An analytical framework is proposed for CFEP detection in a dynamic spatial network. Network snapshots are transformed into the evolutionary network and then separated into a positive graph and a negative graph by network standardization. A revised modularity-based optimization is applied to support the detection of four CFEP types: Co-increasing, Positive Co-stable, Co-decreasing, and Negative Co-stable. A simulation experiment on synthetic data is conducted and the evaluation result demonstrates that our method can accurately detect flow groups within each CFEP, and the significance of the results is provided for the evaluation purpose. A case study of large-scale human mobility data is carried out to investigate the CFEPs emerged during the evolution of the real-world spatial network from weekend to weekday. The uncovered four kinds of CFEP provide valuable sights of mesoscopic network dynamic patterns in the study area.

Study on Spatial Accessibility of Pension Institutions in Zhengzhou Based on Improved Two-Step Floating Catchment Area Method

Jiusheng Du, Wenbin Yuan and Yv Wang

Abstract: With the aging population increasing in China, it is of great significance to explore the spatial accessibility and equilibrium of pension institutions for alleviating the pressure and rational development of the pension industry. The differences in the service radius of pension institutions and the willingness of the elderly to choose pension institutions need to be considered. Under the two perspectives of the thirty-minute single threshold and the four-level segmented threshold, we studied the spatial accessibility and equilibrium of pension institutions in Zhengzhou by comprehensively utilizing the Gaussian two-step floating catchment area method, the Coupling coordination degree model and Moran's index. The results indicate that: First, there are differences in the spatial accessibility and equilibrium of pension institutions between the two thresholds. The spatial accessibility of thirty-minute single threshold and the equilibrium are better than that obtained by the weighted four-level segmented threshold. Second, under the thirty-minute single threshold, the spatial accessibility of pension institutions in Zhengzhou shows the characteristics of 'urban center is higher, urban edge is lower, decreasing from urban center to edge', and the equilibrium in the eastern part of the city is better than that in the western part of the city. Third, under the weighted four-level segmented threshold, the spatial accessibility of pension institutions in Zhengzhou also shows the characteristics of 'urban center is higher, urban edge is lower, decreasing from urban center to surrounding areas'. The overall equilibrium is poor, most townships are in a state of disequilibrium, and the township streets with better equilibrium are concentrated in the urban center. The results can provide decision-making basis for the allocation and optimization of pension institutions in Zhengzhou.

Urban Green Triangle (UGT): a new concept to evaluate the service of urban greenspace

Pengfei Chen and Yuetong Qin

Abstract: This study proposed an easy-implemented triangular index system UGT for the evaluation of UGS service. This system could promote the understanding about different types of greenspace in

a city and thus benefiting urban planning. However, as this is just a preliminary experiment of UGT, there are many works need to be done in the future. For example, a more comprehensive comparison within and across all cities at multiple scales in China could be further conducted. In addition, due to the triangular nature of our index system, the results can be converted into an RGB color system for better visualization.

IoT lidar sensing for real-time and accurate spatial perception

Peiguang Li, Miao Tang, Xiaoyi Chen and Wen Xiao

Abstract: In this study, we designed a cloud-edge-terminal collaborative sensing system using lidar as the IoT sensor. This paper aims to explore the fusion of lidar sensor and IoT technology to provide new solutions for future traffic management and urban planning. By using lidar as an IoT sensor, combined with the design and deployment of cloud-edge-terminal collaborative sensing system, high-precision detection and tracking of road targets can be achieved and accurate spatiotemporal information obtained. This technology can be widely used in traffic safety, intelligent transportation, vehicle-road cooperation and other fields.

Theoretical and Method Framework Construction for Representing Social Space with Geospatial Big Data: A Case Study of Gentrification Space

Jin Zeng, Yang Yue and Qili Gao

Abstract: Geographic Information Science (GIS), has been improved in representing and examining physical space, for more than 50 years. However, space is more of a product of society based on values and meanings than a container or stage for accommodating material production. Space possesses social attributes, allowing it to be intricately connected to daily life and impacting human practices and interactions. Given the growing proximity between space and daily life practices, it is imperative to understand space in terms of its social dimension rather than its physical dimension. GIS has strong capabilities for spatial data analysis; it has the potential to expand our understanding of social space both in depth and breadth. This study is conducted to propose a theoretical and method framework for representing social space with geospatial big data, using gentrification space, a typical social space, as a case study. This study would enhance the synergetic development of GIS and social space science.

A environment-augmented global localization solution using LiDAR and geo-referenced point cloud

Dong Xu, Yaofeng Hu, Xiangbing Cheng and Jingbin Liu

Abstract: Accurate global localization is still a huge challenge in complex condition, where satellite signals are obscured. Fusing LiDAR and geo-referenced point cloud is a feasible way to achieve accurate global locations in GNSS denied environments. However, the issues of limited generalizability and low accuracy remain with existing research using geo-referenced point cloud from various data collection systems. In order to solve the above problems, the proposed solution utilizes virtual LiDAR in the preprocessing procedure to generate a series of virtual scans conformed to the localization sensor parameters from the existing geo-referenced map, overcoming the generalizability limitation of the existing methods. At the same time, the proposed solution adopts an environment-augmented and LiDAR odometry checking and tracking strategy to improve global localization accuracy.

Comprehensive experiments were performed to evaluate this solution. The experiments confirm that the proposed method shows sufficiently improved performance.

Study on Forest Fire Diffusion Method Based on Cellular Automata

Tonghe Zhang, Qingxiang Meng, Jinchun Liu and Qifan Liang

Abstract: As one of the serious natural disasters, forest fire has the characteristics of strong suddenness, hard to detect, wide range of disaster, difficult to extinguish and heavy losses. Frequent forest fires put forward an urgent need for dynamic monitoring of forest fire diffusion and prediction of forest fire behavior. This paper constructs a forest fire diffusion model based on cellular automata, and outputs the visualization results of forest fire diffusion by inputting environmental factors such as terrain data, meteorological data and vegetation type data and the location of the fire point. Finally, the model is used to simulate the forest fire diffusion process in Xichang City, Sichuan Province, and the validity of the model is verified by remote sensing images. The results show that the over-fire area obtained by the simulation experiment is similar to the spatial distribution of the over-fire area extracted by Sentinel-2 satellite, which proves that the cellular automata model constructed in this paper has high accuracy.

A three-dimensional coverage path planning method for multi-UAV collaboration

Fan Wang, He Yang and Qingxiang Meng

Abstract: In this paper, a new multi-UAV coverage path planning method is proposed for the scenario that UAVs need to completely search and cover a large area, which can plan an optimal feasible path that can avoid obstacles for multi-UAVs to cover the 3D space cooperatively. The method firstly decomposes the target space into mutually independent free cells by the cell decomposition algorithm; then each cell is covered individually according to the field of view of the UAV-mounted camera; then the task allocation among UAVs and the order of connecting cells are determined by comparing two classical task allocation algorithms, simulated annealing algorithm and genetic algorithm, with the total length of the path and the equilibrium degree among UAVs as the objective function; finally the task allocation among UAVs and the order of connecting cells are obtained by interpolation. Finally, the three-dimensional coverage path is obtained by interpolation. The experimental results show that the simulated annealing algorithm converges faster and with higher convergence accuracy than the genetic algorithm, and the path obtained by this method has the advantages of not being affected by terrain, multi-UAV collaboration and being able to avoid obstacles.

Micro-scale urban operation model based on large-scale cell phone signaling data and its application in epidemic control policy evaluation

Kailu Xiong and Yao Yao

Abstract: The government has implemented measures such as community lockdowns to combat the COVID-19 pandemic, which have successfully controlled the spread of the disease but have also had significant impacts on social and economic structures. Simulating the changes in COVID-19 transmission under government measures and quantitatively analyzing their effects can help the government make better decisions. This study aims to construct a time-varying network for infectious

diseases at the community level by coupling population mobility, considering the simulation and prediction of disease transmission through interactions within cities. Firstly, this study uses mobile signaling data to construct a urban operation model and explore population interaction patterns between different areas to uncover potential patterns in urban population activity. Then, vector blocks are used as the modeling unit to construct a disease transmission network, which is combined with the urban operation model to simulate the development of the disease under the influence of population mobility. The constructed simulation is then validated against real data to verify the model's effectiveness. Different lockdown policy scenarios are constructed to analyze the social and economic impacts of different policies. The changes in population mobility and cumulative infection rates are quantified, and a loss function is constructed to evaluate different COVID-19 prevention policies based on these factors, thus exploring the most appropriate community lockdown policy. The study is simulated and predicted in Shenzhen, and the results show that (1) the urban operation model accurately simulates large-scale population flows between communities, with roughly equal inflow and outflow of people throughout the day, and areas with a high proportion of inflow during peak commuting times are highly correlated with commercial and industrial land with a correlation coefficient of greater than 0.7. (2) The model successfully simulates the initial spread of the disease in Shenzhen, displaying the spatial distribution of the epidemic, and the simulation scenario shows a correlation coefficient of greater than 0.85 with real infection data for the first fifty days, and the population flow change curve is obtained. (3) Optimal policy parameter combinations are obtained for different levels of priority, and the results indicate that there is a mutually restrictive relationship between population mobility patterns and cumulative infection rates. Over-emphasizing lockdown intensity reduces cumulative infection rates but leads to excessive losses in population mobility, which often results in suboptimal solutions. The results of this study will be helpful for public health departments and clinical doctors to understand the transmission mechanism of infectious diseases and plan prevention and control measures, and are of great significance for maintaining urban social stability.

Feasibility and Performance of Vector-Based Cellular Automata Models for Land Cover Simulation: A Case Study of Shenzhen

Ying Jiang and Yao Yao

Abstract: Cellular Automata (CA) models are one of the mainstream methods for simulating land use/land cover patterns and their evolution. This study aims to explore the feasibility of using vector-based CA models for land cover data and to help urban planners and related researchers better understand and use different CA models, providing feasible parameter tuning suggestions. This study simulated the land use changes in Shenzhen from 2008 to 2018. The FOM accuracies of FLUS, PLUS, and DLPS-VCA models were 0.265, 0.336, and 0.373 (>0.2), respectively, which confirmed the effectiveness of vector-based cellular automata (CA) models in simulating land cover data.

Three-dimensional Geographic Information System Based on BeiDou Vision

Yanning Ma and Xiaoliang Meng

Abstract: At present, with the progress of information technology, GIS has gradually developed from two-dimensional map to three-dimensional reality. How to build a realistic 3D model is the key to build a 3D geographic information system. At the same time, the three-dimensional geographic information

system also means that the amount of data processed by the system has tremendously increased. Therefore, this paper proposes the BeiDou positioning, lidar and camera data fusion technology and the technology of efficient spatial indexing and dynamic rendering for massive multi-source spatial data to build and manage 3D models more efficiently, high-quality and quickly, and realize multifunctional 3D geographic information system.

Simulation analysis of urban storm water in Zhongyuan District

Chuanli Wang, Qingxiang Meng and He Yang

Abstract: Based on the severe rainstorm and flood disaster in Zhengzhou city on July 20, 2020, we proposed a GIS-based urban rainstorm and flood disaster simulation analysis method, by using rainfall time series data and remote sensing image data. The results show that: (1) At 15 pm on the 20th, the rain gradually intensified with the center began to move from northwest to southeast. At 17pm, the intensity of extraordinary rainstorm reached the maximum (187.1 mm), and waterlogging depth in some areas exceeded 40 cm. (2) Considering the actual situation of Zhengzhou City, we optimized the drainage factor of the runoff-inundation model by distinguishing 8 runoff coefficients and 22 drainage weight coefficients of the road network. (3) We compared the calculation results of the stormwater inundation extrapolation model with the interpretation results of SAR images. The accuracy of the model is about 90%, which indicates that it has high accuracy and reliability in urban flood simulation, and can achieve the purpose of near real-time dynamic monitoring of flood spreading process in Zhongyuan District. This study contributes to urban emergency response and scientific decision-making, and has important significance for monitoring and evaluating the social and economic impact of flood disaster.

Spatiotemporal interaction characteristics and driving mechanism of intercity freight connections in China

Yibo Zhao, Shifen Cheng and Feng Lu

Abstract: Understanding the intercity freight connections is of paramount importance for the optimization of urban industrial structure. Previous studies based on statistical yearbooks hardly reflect the freight flow pattern, while studies based on online orders cannot ensure the representativeness of the sample. In this study, mass trajectory data are utilized to investigate intercity freight connectionsin China through spatiotemporal data mining and complex network methods. The results show the following: (1)The freight connections in China are characterized by temporal stability and spatial heterogeneity. For example, the Central Plains and the middle Yangtze River rely on the freight radiation effect of the developed areas such as Beijing-Tianjin-Hebei, neglecting internal cohesion. The Pearl River Delta, Southwest and Northeast are more inclined to resource agglomeration while neglecting interregional freight connections. (3) The spatial heterogeneity of intercity freight connections is driven by the interaction of multiple socioeconomic factors. The interaction of distance and economic development level presents nonlinear enhancement effects as the primary factor, explaining 41.5%–85.7% of freight connections. These findings provide insights into the urban network in China, eventually supporting the construction of regional integration and the optimization of the freight flow network system.

Predicting Urban Waterlogging Risks by Regression Models at Different Spatial-temporal Scales: Case of Nanchang City, China

Wu Xianyu, Lin Hui, Pan Jiayi and Zhong Yanting

Abstract: Nanchang, the capital of Jiangxi Province, in the north of East China, on the southwest shore of Poyang Lake, is crossed by the Ganjiang River. Its unique geography, unreasonable spatial layout, poor drainage and frequent rainstorms have led to urban waterlogging from time to time. Since urban waterlogging is a typical geographical phenomenon with high temporal and spatial variability, elucidating the typical factors that affect urban waterlogging at different spatial-temporal scales is critical for predicting the risk of urban waterlogging in Nanchang. Global climate change and rapid urbanization have broken the original balance of urban precipitation, catchment and drainage in cities, worsening the urban waterlogging problems in developing countries, causing a great loss to people's life and property. Revealing the influencing factors of urban waterlogging is beneficial to the rational planning of urban construction layout, and has great significance for the optimization of urban waterlogging prevention and management. This document aims to provide an important basis for urban development strategy planners to optimize urban spatial layout to mitigate urban waterlogging.

Progress of fragile area intelligent identification in ecological barrier

Meng Wang and Juanle Wang

Abstract: The geographical distribution of vulnerable ecological barrier areas is the spatial background of ecological barrier construction, and efficient and accurate identification of vulnerable ecological areas is the basis of accurate ecological security risk control. The rapid development of big data and artificial intelligence technologies has provided more intelligent methods to support the identification of vulnerable areas of traditional ecological barriers. How to successfully use artificial intelligence methods to improve the ability of ecological vulnerable area identification has become a new realistic demand and challenge. In order to meet this demand, this paper reviews and sorts out the progress of the identification methods of ecological vulnerable area identification, and puts forward future prospect of ecological vulnerable area identification in intellectualization aspect.

Contribution of land use and land cover change to terrestrial carbon cycle in Mongolia Plateau

Yating Shao and Juanle Wang

Abstract: This study has highlighted some important issues associated with the use of remote sensing and GIS combined method to derive information of LUCC and then estimate carbon emission, by providing spatially consistent coverage of large areas with both high spatial detail and temporal frequency. The challenge in this study was a lack of long-time ground observation data of carbon density, and this limitation may potentially lead to biases in estimation of carbon emission in the Mongolian Plateau. For future research, long-term observation and large-scale experiment are required to collect accurate data and establish a more reliable calculation of carbon emission during LUCC.

A MapReduce Framework for Large-Scale 3D Tiles Construction

Ye Zheng

Abstract: The three-dimension(3D) visualization technology for large-scale environment has been broadly applied in the construction of smart city. Three-dimension urban models are obtained

conveniently thanks to the development of surveying and mapping technology in recent year, which also brings challenge of these massive 3D models visualization. One possible idea is to divide the entire 3D scene into sub-regions, each of which loads only part of the 3D models. In this paper, we prototype a 3D visualization system using MapReduce for processing the large-scale urban 3D models into tiles. In the map stage, we obtain the viewpoint space partition, where the movement between any two points (while staying inside the set) have the same topological structure, by building a hierarchical cube index, which is based on the number and complexity of 3D models in the whole 3D space. In each of the cube, we create a viewpoint and export it to the reduce stage. The reduce executor builds the BSP tree inside the cube after obtaining the viewpoint and calculate potentially visible set using real-time occlusion algorithm. The 3D models in potentially visible set are export as vector tiles of geojson text with texture images. We experimented with a building compound, containing 200,000 geometric solids, in Shenzhen, China. The experimental results and the prototype system show that the proposed algorithms outperform competitors in terms of the processing efficiency and feasibility.

Unveiling the hidden impact of groundwater depletion on land subsidence in Lahore, Pakistan using PSInSAR techniques

Meer Muhammad Sajjad and Juanle Wang

Abstract: In the city of Lahore for the period 01/07/2019 to 06/06/2020 using PSInSAR techniques, observed a maximum subsidence rate of-105 mm/year. The evidence of significant annual variation in the groundwater level, continuing degradation and loss of the aquifer underlying Lahore city. This technique has great potential for detecting and predicting structural damage in civil structures due to differential subsidence. Overall in the urban regional area of Lahore city which is a significant downward trend of groundwater level and land surface deformation respectively. The outcomes of this study will contribute to a better understanding of the impact of groundwater depletion and land use change impact on the land surface and will provide insights for sustainable groundwater management and land-use planning in the area. To mitigate the negative impacts of groundwater extraction on land surface deformation, sustainable groundwater management practices such as recharge, recycling, and reuse must be implemented. This can help maintain groundwater levels and prevent the occurrence of land subsidence and sinkholes in urban areas and highways.

A parcel urban land use change model under community buyout policies

Yu Han

Abstract: This study developed a parcel land use change model to simulate the potential effects of property buyout strategies on future urban developments and flood risk reduction in Galveston County, TX. By randomly generating landowners' sociodemographic attributes and simulating their decisions on relocation under buyout policies, our developed parcel land use change model accurately reflect urban land use changes and identified vulnerable areas that need buyout planning. Our results indicate that property buyouts could significantly reduce community flood risk, generating cumulative benefits for vulnerable property owners. With sea-level rise potential effects, total community risk reduction from property buyouts would be even greater.

The spatiotemporal pattern of SARS-CoV-2 variants proportion and its impact on new waves of infections across 100 countries worldwide

Dan Zou, Suhong Zhou, Yitong Liao and Linsen Wang

Abstract: The COVID-19 pandemic has triggered several crises worldwide due to the mutations of SARS-CoV-2 over the past three years. To learn from these crises, it is crucial to understand the geographical distribution of SARS-CoV-2 mutations for custom-designed interventions based on the virus's specificities in different regions in the future. Although earlier studies have suggested the geographical specificity of SARS-CoV-2 variants, the dynamic changes in the spatiotemporal pattern have not been comprehensively captured to distinguish geographical specificity and provide timely implications for interventions. In this study, we introduce a consensus clusteringanalysis of DTW distance matrix based on time series of SARS-CoV-2 variant proportions to explore its spatiotemporal pattern. Based on the cluster result, we investigate the impact of temporal changes in SARS-CoV-2 variant proportions on new waves of COVID-19 infections through Granger Causality test and the estimation of time lag lengths. The results demonstrate that (1) the similarity of SARS-CoV-2 variant proportions forms a spatial pattern exhibiting geographical proximity; (2) temporal changes in SARS-CoV-2 variant proportions Granger cause new waves of COVID-19; (3) time lag lengths mainly range from 20 to 38 days and vary across different variants and geographical clusters. This proposed framework and finding are useful to provide reference for dealing with future pandemic.

Research on the pattern of commercial and residential space and their matching relationship in Shanghai

Lei Zhou, Xiangcheng Zhang and Rundu Shen

Abstract: Taking Shanghai as a case study, based on the POI data of commercial and residential spaces, we use GIS spatial analysis method to analyze the structural characteristics of urban commercial and residential spaces and explore the matching relationship between them. The study shows that the commercial and residential spaces show obvious aggregation characteristics. Commercial space as a whole has a polycentric spatial pattern of "one main and many times", while residential space has a "double core" spatial distribution. The spatial correlation between commercial and residential spaces shows the characteristics of "integration of high-frequency consumption and separation of non-high-frequency consumption". In the matching relationship between commercial and residential space, the high-frequency consumption mode matches well with residential space, while the development of daily extensive contact and diversified and experiential modes lags behind residential space, and the large volume comprehensive and purposeful consumption mode lags behind residential space more widely.

A novel spatiotemporal fusion method designed for agricultural scenarios with diverse phenological change (Agri-Fuse): incorporation of regression and change type unmixing

Zhuoning Gu, Jin Chen and Shuaijun Liu

Abstract: Predicting the images of key phenological periods is of great value for agricultural applications, which is also one of the challenges in STF. In this study, we propose a new STF method named as Agri-Fuse to address diverse phenological changes across heterogeneous farmland parcels during key phenological periods. The first highlight of Agri-Fuse is to focus on the change information. Agri-Fuse employs difference images for classification to better detect diverse crop changes, in

contrast to other methods that use the fine image on the base date. Another innovation is to conduct a category-based regression model considering the differences in regression relationships across change types. It can solve the scale effect problem in the conventional regression-based models with the aid of the unmixing model. Fusion experiments on two agricultural sites confirm that Agri-Fuse is superior in predicting diverse crop phenological changes with parcel heterogeneity, compared to four typical fusion methods.

Research on Homogeneous Point Pattern Decomposition Based on Adaptive Metropolis and Delayed Rejection Mechanism

Yuncheng Ma, Zhipeng Gui, Huayi Wu

Abstract: Point pattern decomposition can decompose complex point datasets into multiple point patterns based on their difference in distribution density, and analyze the composition structure of each pattern. However, there are few related studies and most methods are similar in thought. Although the Reversible Jump Markov Chain Monte Carlo (RJMCMC) method can complete the decomposition of point patterns without too much prior information and obtain parameters that fully match the true distribution, there are still deficiencies in the unstable number of iterations to convergences, the low time efficiency, and the insufficient decomposition accuracy when the number of iterations is limited. This work aims to propose a modified parameter estimation algorithm (named M-RJMCMC) by combining adaptive Metropolis algorithm and delayed rejection, which contributes to improve the time efficiency in point pattern decomposition.

A comparative analysis of urban street walkability in the city centers of London, Munich, and Prague

Meihui Wang, James Haworth and Huanfa Chen

Abstract: Urban walkability is a crucial index of urban liveability, which reflects levels of public health, environmental sustainability, and social equity. Walkability evaluation is essential in the city centers due to the diverse mix of land uses, distinctive urban design, and high population density. Understanding and improving walkability in city centers offers valuable insights to guide human-centered urban planning to promote the development of sustainable, liveable, and pedestrian-friendly cities. This research presents a comparative analysis of walkability in the city centers of London, Munich, and Prague. we assess and compare various metrics of walkability, including street connectivity, the density of POIs, and visual indicators, such as greenery, openness, pavement, and crowdedness. The data for calculating street connectivity and density of POIs are sourced from OpenStreetMap (OSM). Meanwhile, visual indicators are measured based on computer vision algorithms from Mapillary images. Preliminary findings show significant variations in walkability across city centers in these three cities. The dense and diverse fabric of central London, the organized layout of central Munich, and the historical, topographically varied structure of central Prague, each present distinctive characteristics affecting pedestrian's walking experience. This study enriches the understanding of walkability in different cultural and geographic contexts, highlighting the potential of using crowdsourced street-level imagery combined with traditional GIS data for urban analysis. It presents an attempt to data-driven urban planning, focusing on evaluating and improving pedestrian experiences, which is crucial for the future development of liveable cities.

Spatial and Temporal Evolution of Precipitation and Its Main Driving Factors in Jiangsu Province, China

Yiding Zhang, Xiangyuan Wang, Donglai Jiao and Jiaxin Liu

Abstract: Jiangsu Province in China is located along the coast and has both a temperate monsoon climate and a subtropical monsoon climate, with abundant precipitation and prone to extreme precipitation. Based on the temperature and precipitation data of 71 meteorological stations in Jiangsu Province and the European Center for Medium-Range Weather Forecasts (ECMWF) ERA5 data set, the temporal and spatial patterns of precipitation distribution in Jiangsu Province from 2001 to 2020 and the spatial changes of the impact of different factors on precipitation were analyzed by trend analysis, Moran index, and multi-scale geographically weighted regression. The results show that the precipitation in the northern part of Jiangsu Province is decreasing, while the precipitation in the southern part is increasing from 2001 to 2020. The high precipitation area is mainly concentrated in the southeast, while the low precipitation area is mainly concentrated in the west. Summer precipitation is negatively correlated with water surface pressure, and positively correlated with temperature, total evaporation, wind speed along the latitudinal line of 10 meters, wind speed along the meridional line of 10 meters, and altitude.

Emergency Evacuation Guidance Optimization in Urban Open Public Spaces

Jia Yu, Dawei Lu, Yanyan Niu, Renwu Mu, Yang Zhou and Yaqin Li

Abstract: This paper introduces a new emergency evacuation guidance optimization method for emergency evacuation in urban open public spaces. Based on the PSO algorithm, gradual covering model and ABM, the method optimizes the spatial allocation and the guiding paths of evacuation guiders. It also improves the evacuees' behavior simulation to make the evacuation simulation results more in line with the real evacuation procedures. A case study in Binjiang Green Space, Shanghai, China, was conducted to demonstrate the feasibility of the new method. The evacuation simulation results of different times proved that the optimized spatial allocation and the guiding paths of different guiders can significantly reduce the evacuation risk and improve the evacuation efficiency. The required number of staffs and recommended safety management suggestions were also proposed in the paper, which illustrated that the method of this study can provide useful decision support in emergency evacuation and help improving the emergency management capability in urban open public spaces.

A dual-encoder U-Net for landslide detection using Sentinel-2 and DEM data

Wei Lu, Yunfeng Hu, Zuopei Zhang, Wei Cao

Abstract: Accurate and timely landslide mapping plays a critical role in emergency response and long-term land use planning. Deep-learning-based methods represented by convolutional neural networks have been widely exploited in automatic landslide detection for their outstanding capability of feature representation and end-to-end learning mode. Most of recent deep-learning-based studies used toll-access high-resolution imagery for landslide detection. Considering demands for the future large-scale landslide mapping, this study aimed to develop a new deep-learning-based method to detect landslides using medium-resolution imagery and digital elevation model (DEM) data which are free-access and cover globally. Firstly, a workflow for constructing the landslide dataset is developed. Then,

we designed a semantic segmentation model to learn deep features and generate per-pixel landslide predictions. Specifically, the proposed network has a dual-encoder architecture with feature fusion to hierarchically represent deep features from the optical bands and DEM data. We also employed a self-attention module in the decoder of the proposed network to improve the performance. Experiments on two regions demonstrated that our method achieved the best F1 score of 79.24%, outperforming SegNet, U-Net and Attention U-Net, the models popularly used in the semantic-segmentation-based landslide detection. The proposed method may have an application potential in disaster risk assessment and post-disaster reconstruction, and provide a technical reference for the large-scale landslide mapping in the future.

Small Object Detection on Drone-view Images from Multiple UAVs Combination

Gui Cheng, Zhenfeng Shao, Qimin Cheng and Heng Luo

Abstract: With the continuous progress of remote sensing technology, unmanned aerial vehicle (UAV) remote sensing technology have been increasingly adopted in critical tasks, such smart cities, traffic surveillance and disaster assistance. However, identifying objects from drone-view images faces huge challenges: 1) small object; 2) scale variance; 3) non-uniform distribution; 4) occlusion. To handle this challenges, in this paper, we propose a remote sensing data collection strategy via multiple UAVs combination,which can obtain drone-view images from various scales, angles and multi-regions in real time. Then we perform small object detection on drone-view images via a novel network structure, called Query-YOLOX , which combines the Cascade Sparse Query mechanism and the YOLOX anchor-free detector. The results on VisDrone2019 dataset demonstrate that our proposed Query-YOLOX can significantly reduce the computation cost while keeping the detection accuracy for small objects, achieving the state-of-the-art performance in small objects detection ondrone-view images.

SwinUCDNet: A UNet-like Network With Union Attention for Cropland Change Detection of Aerial Images

Zehua Wu, Ying Chen, Xiaoliang Meng, Yiwen Huang, Tinghao Li and Jieyan Sun

Abstract: Cropland conversion disrupt local agricultural production systems and pose a serious threat to global food security. The application of remote sensing technology for change detection (CD) can provide an effective approach for in-time detection and prevention of such incidents. However, existing CD methods are difficult to generate change detection results efficiently and accurately. In addition, the local receptive field of the convolution operation limits CNN-based methods from capturing long-range dependencies. In contrast, Vision Transformer demonstrates its great potential in modeling long-range dependencies and obtains superior results in many vision-related tasks such as image classification, object detection, and semantic segmentation. Therefore, in this article, we propose a UNet-like network with union attention for cropland changedetection of aerial remote sensing imagery. Specifically, we adopt a Transformer-based encoder-decoder structure, which employs the Swin Transformer backbone as the encoder and designs an efficient union-attention Transformer block to construct the decoder. Finally, a multibranch prediction head with two CNN classifiers is applied to obtain change maps and enhance the supervision for deep layers. Comparative experiments with several CD methods prove the effectiveness and advantages of the SwinUCDNet.

A Knowledge Graph-driven Method for Geospatial Data Production

Shuai Ye, Naisheng Wang, Mu Bai, Xiaoliang Meng and Yuxuan Hu

Abstract: Under the background of new fundamental surveying and mapping construction, it is necessary to update and produce new geospatial data. Knowledge graph is an important branch technology of AI and the basis for data interconnection to knowledge interconnection services. Firstly, this paper carries out ontology modeling of geographic information. Secondly, Neo4j isused to semantically store the classification of fundamental geographic information and its geometric mapping relationship to construct the fundamental geographic information knowledge graph. Finally, experiments are conducted to verify the feasibility of graph-driven method by taking housing entity's production as an example. This method provides a new idea for the transformation and production of geospatial data in new fundamental surveying and mapping.

Drought prediction based on improved comprehensive drought index using mulitisource remote sensing data

Shuhe Zhao, Fanchen Peng, Xinyi Huang

Abstract: This paper fully considered the dimensional unification and information fusion of temperature, precipitation, and vegetation conditions in drought monitoring, and constructed an improved comprehensive drought monitoring index. At the same time, in view of the limitations of traditional drought prediction methods, this paper built a new drought prediction model, which can more accurately describe the nonlinear drought evolution situation, and at the same time more comprehensively predict the possibility range and probability space of drought changes Distribution, with high accuracy and stability, is of great significance in the study of long-term drought prediction in the future. It can provide a high-precision and high-stability nonlinear probability drought prediction model for long-term drought prediction in a large area in the future.

Mountain Vegetation Classification Method Based on Multi -channel Semantic Segmentation Model

Wang Baoguo, Xu Jun and Yao Yonghui

Abstract: This article aims to study the application of multi-channel semantic segmentation technology in vegetation remote sensing classification and explore methods to improve classification accuracy using diverse remote sensing data such as DEM and NDVI. Through experiments, it is found that the use of multi-source data is helpful in vegetation classification, and the accuracy is improved compared to using only remote sensing images for classification.

Spatial Relation Comprehension Based on Geographic Knowledge Graph

Lei Hu, Yunqiang Zhu, Yonghui Yao and Jun Xu

Abstract: The relation terms between geographic entities are influenced by many factors, such as geometric location, language habit, current context and described geographic entity type. The triplets automatically extracted from Wiki texts can analyze people's language habit of expressing the relation between different geographic entities, and the influence of geographical entity types on spatial relation items can be mined through the constraints of geographical entity types. The results of link

prediction show that spatial relation terms are related to geographical entity types and in the process of knowledge graph embedding, the addition of entity types can firstly filter inappropriate results of entity prediction candidate set and get geographic entity more in line with human's expected entity types; secondly, it can reduce the noise caused by automatic extraction of various relation expressions in knowledge graph embedding; finally, geographic entity type as additional information can effectively make up for the lack of long tail entity information.

Assessing How Road Traffic Emissions In London Have Changed Over The Covid-19 Pandemic

Hasnayn Yousat and Yijing Li

Abstract: The COVID-19 pandemic had radically changed mobility patterns across cities and continued to evolve as efforts to manage the post pandemic recovery. As cities went into lockdown, they reported historic decreases in air pollution levels. However, little research has explored in detail how road traffic emissions have changed over the pandemic in London.This study implements a series of GWR (geographicallyweighted regression) models to assess detailed spatial changes in NOX, CO2, PM2.5 and PM10 vehicle emissions. Additionally, it also explores the impact of sustainable mobility policies and schemes rolled out over the pandemic with respect to vehicle emissions. Results show that while the spatial profile of emissions has shifted, the overall distribution of emissions is not too dissimilar to pre-pandemic levels. Additionally, for the mostpart, roads with sustainable mobility schemes situated on them do not exhibit statically significant decreases in emission levels with respect to pre-pandemic levels.

Understanding the intra-city spatial patterns of taste preferences with a Glove-based restaurant embedding approach: a comparative analysis for 8 Chinese cities

Disheng Yi, Zixi Zhang, Zexin Zhao and Jing Zhang

Abstract: For deeply exploring and understanding taste preferences in the cities, this research analyzed the types of taste preferences with representation learning and clustering methods from the perspective of spatial contexts of food. The intra-city spatial patterns of taste preferences would be identified through clustering taste vectors. In the beginning, we developed a GloVe-based representation learning framework to train the single taste vectors and identify the clusters of them. In this framework, the spatial decay effect, as the weight of representation learning process, was calculated to represent the spatial relationship between taste neighbors. It considered the short-range effect and long-range effect of distance decay between two objects. Those taste vectors would be then clustered to further represent the intra-city spatial patterns of taste preferences within 8 cities in China. The main results illustrated that the taste preferences in Beijing, Chengdu, Shenyang, and Shenzhen have significant local characteristics, while the rest of the cities were discovered with common spatial patterns. Meanwhile, the numbers of patterns of taste preferences in those cities are different, even in the cities without unique characteristics. Most cities with local taste preferences have 8 patterns, and those common cities could almost discover only 5 patterns of taste preferences. At the same time, we discussed what urban structures unwrapped through the spatial distributions of taste preferences in different cities. The spatial distribution of casual taste preference was used to reflect the spatial patterns of daily human activities and urban structures. Also, some minority taste preferences such as foreign tastes could discover in the urban centers. Compared with previous research, there are two main contributions in this research. Initially, we understood the various fine-

grained mixed taste preferences and their intra-city spatial patterns with taste vectors, which could help to sense the details and differences in the dietary behaviors of residents. It is helpful for administrators to plan the spatial patterns of restaurants and emphasize the local characteristics as the city branding image.

Quantitative Evaluation of Passenger Flow at Metro Stations Based on Coarse-to-Fine Analysis

Yunjie Zhang, Siuming Lo, Shengjun Tang and Wei Tu

Abstract: The dense urban metro network plays an important role in urban transportation, and it is becoming increasingly important to improve the operation and management of metro facilities. The monitoring and management of passenger flow is a main concern in metro operation, and the re lable analysis of passenger flow can greatly improve the operational efficiency and safety of a metro station. Therefore, using the long-time in-and-out smart card data of Shenzhen metro stations, this paper proposes a Coarse-to-Fine passenger flow analysis method for the characterization of passenger flow on multiple time scales. This method, which is proposed from a new perspective based on the time series clustering of metro stations, precisely defines the peak travel hours and then extracts features for the evaluation of the crowdedness and disorder liness at each station. Finally, the metro stations are classified into nine levels according to those features. The stations that need urgent attention in terms of their passenger flow, including Shenzhen North Station, Buji, and Grand Theater, are identified for the reference of city managers.

Accessing primary care physicians among older immigrants in Toronto before and during COVID 19 pandemic: Integrating spatial and qualitative approaches

Lu Wang, Meira Greenbaum, Sepali Guruge and Janet Lum

Abstract: Older adults are the fastest growing age group in Canada and about 1 in 5 people are over the age of 65 (2021 Canadian census). Older adults are a highly culturally diverse age group, with approximately 30% are immigrants (2016 Canadian census). The increase of older adult population has led to increased demand for healthcare services. Older immigrants are particularly vulnerable facing spatial and aspatial barriers accessing healthcare. The study utilized a range of primary data collected from an on-line survey and five focus groups, as well as secondary data including the physician data and census. Spatial-quantitative analysis is conducted to analyze the potential spatial accessibility to same-language family physicians (or primary care physicians) for older Chinese immigrants living in the Toronto Census Metropolitan Area (CMA), one of the most culturally diverse cities in the world. Enhanced 2-step floating catchment area (E2SFCA) modeling reveals areas with poor to very high accessibility. To gain a deeper understanding of access to and use of care, both quantitative (survey) and qualitative (focus groups) data were analyzed and triangulated to explore individual experiences in managing health and accessing primary care prior and during the COVID pandemic. The study highlights the role of spatial access and other neighbourhood and individual characteristics in older immigrants' access to health care services, as well as the value of integrating spatial analysis with empirical data collected in health care research involving older immigrants.

Deep Learning based Wildlife Animal Monitoring using Drone Remote Sensing and Camera Trapping

Fang Qiu, Haitao Lyu and Hao Chen

Abstract: Wildlife animal monitoring has traditionally relied on visual survey in animal natural habitat, which is labor-intensive and time consuming, and with very limited spatial and temporal coverage. It is not only intrusive to the presence of animals, but also dangerous to the observers because disturbed animals can attack them. Camera trapping provide non-intrusive and continuous temporal coverage, but with limited viewing perspective and limited spatial coverage. It is also expensive to install, maintain and manage the cameras and to manually search the images collected to monitor animals. The latest advancement in drone and sensor technologies offers an exciting opportunity to revolutionize wildlife animal monitoring methods. Drone remote sensing are more cost-effective and flexible, providing much larger spatial coverage, while being less intrusive to animals and less dangerous for observers. To leverage these advancements, we conducted multiple remote sensing operations using drones equipped with both true color and thermal sensors in the Chitwan National Park of Nepal. The thermal sensors proved effective in monitoring animals, even when they are hidden beneath vegetation canopy due to their higher temperatures compared to the ambient environment. A convolutional neural network (CNN) deep learning classifier was developed to first detect the presence of wildlife animals and then identify their species types by labeling, training, validating, and classifying the high-resolution thermal images acquired by the drones. The overall accuracies for both animal detection and special identification exceeded 97%. The same deep learning classifier can also be used to detect and identify wildlife animals captured by cameral trapping with similar accuracies. By utilizing the GPS coordinates and additional information on pitch, yaw and roll captured by the drone gimbals, the results can be projected onto a map to visualize animal distribution and estimate their occupancy and density across landscape. The deep learning based wildlife animal monitoring using drone remote sensing and camera trapping has demonstrated great potentials in enhancing environment conservation and improving national park management.

WMO: a Useful Ontology for the Modeling and Integration of Wetland Monitoring Data

Xin Xiao, Hui Lin, Chaoyang Fang

Abstract: The semantic gaps is responsible for the most serious data heterogeneity problems, hindering the efficient interoperability between wetland monitoring sensors. Ontology, as a top-notch semantic technology, is widely used to resolve the challenges of heterogeneity, interoperability, and complexity of integrated domain. However, there have been relatively few attempts to develop dedicated ontologies for the wetland monitoring domain, despite the immense importance of wetland monitoring and the need to support interoperable data. As wetland is a special transitional ecosystem between terrestrial ecosystem and aquatic ecosystem, the monitoring of wetland ecosystem is different from the monitoring of general ecosystem, and it has its own particularity. Therefore, some general environmental ontology cannot be directly applied to the wetland context. Global wetlands are facing serious threats. Rich monitoring data generated by ubiquitous sensors play a significant role in wetland conservation from the prediction of natural disasters to emergency response. However, these data are still hidden in isolated silos, and their variety makes integration and interoperability a major challenge. Therefore, there is a need for a framework that can integrate static and dynamic monitoring data with spatio-temporal information in a uniform way to support the great variety of applications for wetland protection and assessment.

Fine Mapping and Multidimensional Analysis of Carbon Emission reduction in China

Feng Xu, Xinqi Zheng, Dongya Liu, Yin Ma, Tingting Wang and Xu Han

Abstract: With the continuous intensification of global climate change, carbon peaking and carbon neutrality have become hot topics of common concern among countries around the world. How to accurately measure the carbon emissions between regions and cities in order to formulate differentiated emission reduction and carbon neutral policies has become a challenging issue. To this end, we drew a grid map of carbon emission data with a resolution of 250 m, and constructed a national-level (2800 county-level units) database of China's carbon emissions. Analysis from multiple perspectives such as overall characteristics, urban clusters, county units, population density, per capita disposable income etc., provides new ideas for studying multiscale footprint spatial patterns dynamics. The results show that: (1) The 250m resolution Carbon Emission Database established in this study includes multiple levels such as country, province, county and urban-rural areas which can realize dynamic research on multi-scale Carbon Footprint Spatial Patterns; (2) The top 5% areas with highest Carbon Emissions account for about 1/5 of total Carbon Emissions in China while about 1/4 districts account for more than 50% of total Carbon Emissions in China;(3)The potential for Carbon Reduction in rural areas has been underestimated by more than 10%, while the potential for Carbon Reduction in western region is growing rapidly due to poverty alleviation;(4)Based on Gini coefficient and Thiel index ,the relationship between per capita carbon emissions and income inequality was constructed ,and regional differences between townships and villages were analyzed .This study provides new ideas for formulating emission reduction policies at all levels nationwide .