CGA Virtual Forum: Responding to the COVID-19 Pandemic with Geospatial Research and Applications

10:00am – 1:00pm EDT, Friday, May 1, 2020

Click on **Topic** to download presentation slides (with permission from speakers).

Agenda

Time (EDT)	Topic	Speaker
10:00 AM	*Welcome & Introduction*	Jason Ur (Harvard)
10:05 AM	Measuring Changes in Mobility due to Social Distancing Interventions against COVID-19	Caroline Buckee (Harvard)
10:20 AM	Protecting Individual Geoprivacy in COVID-19 Research in the Big Data Era	Mei-Po Kwan (CUHK)
10:35 AM	Geo-social Media Analytics to Track the Spread of COVID-19	Bernd Resch (U. Salzburg)
10:50 AM	Surveillance and Modeling of COVID-19 Epidemics with Human Movement Trajectory Data	Xun Shi (Dartmouth)
11:05 AM	Digital Tracing for Identifying Geospatial Temporal Hotspots of COVID-19 Transmission	Yulin Hswen (Harvard)
11:20 AM	*Break*	
11:30 AM	Using GIS to Understand and Plan for Hospitals Surge and Alternate Care Locations	Este Geraghty (Esri)
11:45 AM	Geospatial Relationships in the COVID-19 Misinformation Infodemic	Rhys O'Neill (Novetta)
12:00 PM	Taking the pulse of COVID-19: A spatiotemporal rapid response	Phil Yang (GMU)
12:15 PM	Overcoming Obstacles to Accessing, Sharing, and Using Confidential COVID-19 Geospatial Data	Doug Richardson (Harvard)
12:30 PM	*Panel Discussion*	Matt Wilson (UKY) - Moderator

Center for Geographic Analysis
Harvard University

Abstracts and Biography

Measuring Changes in Mobility due to Social Distancing Interventions against COVID-19

Caroline Buckee (Harvard)

Abstract: The COVID-19 Mobility Data Network aims to "provide daily updates to decision-makers at the state and local levels on how well social distancing interventions are working." This program is led by Caroline Buckee, Satchit Balsari, and Andrew Schroeder. The team is made up of a network of infectious disease epidemiologists located at universities around the world, working in partnership with tech companies — including Facebook, Camber Analytics, and Cuebiq — to use aggregated mobility data in support of the COVID-19 response.

Dr. Caroline Buckee is an Associate Professor of Epidemiology and Associate Director of the Centre for Communicable Disease Dynamics at Harvard T.H. Chan School of Public Health. Her work is focused on understanding the mechanisms driving the spread of infectious diseases that impact the most vulnerable populations worldwide, particularly malaria. Before coming to Harvard, Dr. Buckee completed a D.Phil. at the University of Oxford, and Omidyar and Wellcome Trust fellowships at the Santa Fe Institute and the Kenya Medical Research Institute, respectively, where she analyzed malaria parasite evolution and epidemiology. Dr. Buckee's group uses a range of mathematical models, experimental and genomic data, and "Big Data" from mobile phones and satellites to understand how human pathogens spread and may be controlled. Her work has appeared in high profile scientific journals such as Science and PNAS, as well as being featured in the popular press, including CNN, The New Scientist, Voice of America, NPR, and ABC. Dr. Buckee was featured as one of MIT Tech Review's 35 Innovators Under 35, a CNN Top 10: Thinker, and Foreign Policy Magazine's 100 Global Thinkers.

Protecting Individual Geoprivacy in COVID-19 Research in the Big Data Era

Mei-Po Kwan (CUHK)

Abstract: Over 1200 research articles on COVID-19 have been published to date. Some of the key findings helpful for controlling its spread include: (a) drastic intervention measures (e.g., mobility restrictions) could mitigate the spread of COVID-19, and (b) including active strategies such as widespread testing, contact tracing, and quarantine is more effective than using only passive physical distancing strategies. Geospatial big data and methods have tremendous potential for supporting the development and implementation of some of these active strategies. For example, to effectively conduct contact tracing and quarantine, high-resolution individual space-time data (e.g., GPS) can be used to detect human mobility patterns, identify individuals who are in close contact (co-location in space and time), and prevent disease transmission through social networks (spatial social networks identification). However, the need to protect individual privacy (including geoprivacy) can be a major challenge in the process because certain conventional methods of privacy protection (e.g., aggregation) cannot be applied due to the need for highly accurate location data. In this presentation, I will first discuss how geospatial big data analytics can be used to assess COVID-19 mitigation strategies (e.g., evaluating the effectiveness of physical distancing) and the associated risk of geoprivacy breach (e.g., reidentification). I will then discuss how geospatial methods can be used to protect individual privacy when using high-resolution geospatial big data in COVID-19 research. I will also present some of the

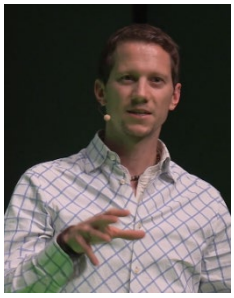
recent advances in this research area relevant to controlling the spread of COVID-19 (including newly developed disclosure risk assessment methods).

Mei-Po Kwan is Choh-Ming Li Professor of Geography and Resource Management and Director of the Institute of Space and Earth Information Science at the Chinese University of Hong Kong. Kwan is Fellow of the U.K. Academy of Social Sciences, the American Association for the Advancement of Science (AAAS), the American Association of Geographers (AAG) and the John Simon Guggenheim Memorial Foundation. She has received many prestigious honors and awards, including the Distinguished Scholarship Honors from the AAG and a Research Award from the US University Consortium for Geographic Information Science. Kwan has been included in the 2019 Highly Cited Researchers list by the Web of Science Group. She has delivered over 230 keynote addresses and invited lectures in more than 20 countries. Kwan's research interests include environmental health, sustainable cities, human mobility, urban/social issues in cities, and GIScience. Her recent collaborative projects include the development of a Geospatial Virtual Data Enclave (GVDE) for sharing and analyzing confidential geospatial data, and examination of the health risks of female sex workers, adolescent and adult participation in high-risk drug use, individual exposure to air pollution and noise, and environmental influences on physical activity. More information about Kwan is available at http://meipokwan.org.

Geo-social Media Analytics to Track the Spread of COVID-19

Bernd Resch (U. Salzburg)

Abstract: The epidemiology of airborne infectious diseases such as the coronavirus SARS-CoV-2 is an inherently spatio-temporal phenomenon. Moving through time and space, a disease can be tracked by interpreting geographical data such as medical incidence and news reports, but also from informal accounts such as geolocated social media posts. Statistical models for disease outbreak monitoring and prediction can make use of this fact by incorporating the data from a region of interest, as well as their respective neighbourhood. Aiming at the analysis of disease patterns, we employ and extend a wide range of from the fields of geostatistics, geo-machine learning and natural language processing. Further, we develop our methods with the aspects of data privacy and handling personalised data in mind, resulting in a strong privacy-by-design aspect of our work. Through our analysis, we are able to identify spatial COVID-19 hot spots and track them through space and time in near real time.



Bernd Resch is an Associate Professor at University of Salzburg's Department of Geoinformatics - Z_GIS and a Visiting Scholar at Harvard University (USA). Bernd Resch did his PhD in the area of “Live Geography” (real-time monitoring of environmental geo-processes) together with University of Salzburg and MIT. His research interest revolves around understanding cities as complex systems through analysing a variety of digital data sources, focusing on developing machine learning algorithms to analyse human-generated data like social media posts and physiological measurements from wearable sensors. The findings are relevant to a number of fields including urban research, disaster management, epidemiology, and others. Bernd received the Theodor Körner Award for his work on "Urban Emotions". Amongst a variety of other functions, he is an Editorial Board Member of IJHG, IJGI and PLOS ONE, a scientific committee member of various international conferences (having chaired several conferences), an Associated Faculty Member of the doctoral college "GIScience", and an Executive Board member of Spatial Services GmbH.

Surveillance and Modeling of COVID-19 Epidemics with Human Movement Trajectory Data

Xun Shi (Dartmouth)

Abstract: Data of people's daily movement trajectories can be used to precisely derive information about contact between individuals, and in turn estimate the likelihood of occurrence of transmission between individuals. We applied this idea to surveillance and modeling of the COVID-19 epidemic in Nanchang City, China. With the coordination of the city government, we gained access to the mobile phone service carrier's records of mobile phone locations. With these data, we mapped the high-risk areas based on the trajectories of those confirmed COVID-19 patients; tracked down people who had close contact with those patients, and assisted establishing transmission chains (epidemic forest) of the patients. By analyzing the quantified overlap between the trajectories and the established epidemic forest, we extracted the information about the epidemics (e.g., R0) and conducted scenario analysis under different control and intervention measures. Our work demonstrates that individual-level movement trajectory data, when properly used, can be tremendously useful in surveillance and modeling of outbreaks of communicable diseases.

Xun Shi, Ph.D., Professor of Geography, Dartmouth College. Trained as a geographer and a GIS scholar, Dr. Shi's specialty is in health-related spatial analysis and modeling. He has been working on disease mapping, disease-environment association detection, spatiotemporal modeling of communicable diseases, assessment of access to healthcare services, quantification and modeling of uncertainty in health data, modeling of environmental exposures, and handling of confidential health data. He developed ArcHealth, a software package specially for spatial epidemiological analysis and modeling. He has extensive collaborations with epidemiologists and biomedical researchers. He received funding from NIH and CDC. He has published more than 70 journal articles, as well as books and other publications.

Digital Tracing for Identifying Geospatial Temporal Hotspots of COVID-19 Transmission

Yulin Hswen (Harvard)

Abstract: Emerging computational methods and digital data sources are changing the landscape of population health research. As COVID19 continues to spread across the US and globally, it is essential to leverage digital footprints to identify novel cases and areas of high risk of transmission. In this presentation, Dr. Hswen will cover three key objectives spanning the fields of computational epidemiology and population informatics in relation to COVID19. First, Dr. Hswen will provide an overview of the application of novel computational methods for uncovering patterns of disease and exploring the links between individual behaviors and illness trajectories. Second, Dr. Hswen will demonstrate how digital data can advance our understanding of COVID19 and citizen science methods that engage and inform the public on COVID19. Last, Dr. Hswen will consider how big data and computational methods can advance our understanding of the impact of social and environmental influences related to COVID19 on human health and well-being. Across each aim in this presentation, Dr. Hswen will draw from her work to highlight digital studies on COVID19. With access to myriad sources of unconventional digital data, Dr. Hswen will conclude by highlighting the opportunities afforded by these digital sources and platforms for discovering new insights about human behaviors and the spread of disease, and why this is now one of the most exciting times in modern history of medical research as there is potential to understand human health in ways that were previously not possible.

Dr. Yulin Hswen is a Computational Epidemiologist and Faculty in the Innovation Program at Boston Children's Hospital, Harvard Medical School. Dr. Hswen completed her doctoral training as a social and computational epidemiologist at the Harvard T.H. Chan School of Public Health, where her research focused on leveraging big data to uncover hidden social determinants and patterns of disease. Her current work within the Innovation Program seeks to develop and test new methods to capture informal online data sources towards generating population health insights that can be used to predict the onset and course of various diseases and public health threats. Dr. Hswen's research involves the design and development of digital surveillance methods, as well as novel tools that can transform public practice and influence health policies. Dr. Hswen has received awards and competitive funding from the Canadian Institutes of Health Research, The Embassy of France, Harvard University, the Weatherhead Center, and the National Institutes of Health for her work in the field of social and computational epidemiology. Her work has been published in the New England Journal of Medicine, the American Journal of Public Health, Preventive Medicine, and the Journal of Medical Internet Research, and has been featured in Nature, Fast Company, Kaiser Health News, and Bloomberg.

Using GIS to Understand and Plan for Hospitals Surge and Alternate Care Locations

Este Geraghty (Esri)

Abstract: It has been said that all models are bad, but some models are useful. During the COVID-19 pandemic, a plethora of hospital surge models have been proposed and used to help governments and healthcare systems plan resources for when and where they will be needed. This presentation will review a few selected models and follow them through to their logical conclusions – what resourcing decisions do the models support? What are the next steps?

Este Geraghty, MD, MS, MPH, CPH, GISP is the Chief Medical Officer at Esri, developer of the world's most powerful mapping and analytics platform. She heads Esri's worldwide health and human services practice and is passionate about transforming health organizations through a geographic approach. Formerly a Deputy Director with the California Department of Public Health, she led the state's open data initiative. She also served as Associate Professor at the University of California Davis, conducting research on geographic approaches to health policy and community development. Geraghty is the author of numerous health and GIS peer reviewed papers and book chapters. She has lectured extensively around the world on a broad range of health GIS topics from social determinants of health to climate change and data privacy. She received her medical degree, master's degree in health informatics, and master's degree in public health from UC Davis. She is board certified in public health and a geographic information system professional. See https://www.esri.com/en-us/industries/health/overview for more information.

Geospatial Relationships in the COVID-19 Misinformation Infodemic

Rhys O'Neill (Novetta)

Abstract: In challenging environments with limited access to rapidly access information, accurate details concerning novel diseases and preventative measures to combat the growth of an outbreak often reach communities in incomplete, piecemeal fashion. The absence of information often leaves media

personnel or authoritative figures to fill those gaps and can lead to dissemination of inaccurate descriptors or misinformation. Through Novetta's approach to tracking print and broadcast media (radio, television) in parallel to social media, we attempt to identify where information gaps are prevalent and what communication systems are failing to reach vulnerable populations, particularly those outside of regions with accessible or adequate healthcare infrastructure. Discovering and defining damaging misinformation and disinformation in these environments allows Novetta to map geospatial relationships between prevalence of this inaccurate content with the availability of appropriate communication channels to qualify target locations as "high risk." This method is intended to notify on the ground communication teams and promote targeted corrective messaging that limits the risk of community resistance to preventative measures during the spread of COVID-19 throughout our current area of responsibility in Africa.

Rhys O'Neill is an Open Source Analyst in the Novetta Mission Analytics Division and has been supporting DoD and HHS missions for six years. Rhys joined the Novetta team in 2015 and has been supporting the NIH's clinical trials for Ebola in Africa by providing key insight in challenging environments to drive operational success. He has served in the USMC and US Army and recently attended the 2019 Harvard GIS Institute program.

Taking the pulse of COVID-19: A spatiotemporal rapid response

Phil Yang (GMU)

Abstract: Since the outbreak of the novel coronavirus, it has spread fastly around the world. The WHO declared pandemic and many countries declared national emergencies. However, the factual information of COVID-19 and its impact to socioeconomic, policy, and even the real number of cases is unknown or complex. We put together international task forces to provide a response to this pandemic in a rapid fashion and continue to address these challenges in real time with 1) a live global covid-19 map with minute level case update from over 20 international sources; 2) correlation analyses between the outbreak and the policies and socioeconomic changes, as well as 3) providing an international collaboration forum and platform to develop, test, and share different models to understand better the past, present, and future of this global emergency. The research activities are integrated and sustained at the covid-19.stcenter.net gateway.

Dr. Chaowei Phil Yang is a leader of GIS and computing on identifying, learning and utilizing spatiotemporal patterns to enable science discoveries and engineering development. He is PI on over $10M research grants and participated in over $40M projects. Several of his numerous publications have been among the top five cited and read papers of IJDE and CEUS. His PNAS spatial computing definition paper is captured by Nobel Intent Blog in 2011. He placed ~20 professors in the U.S. and China, edited 10+ journal special issues & 6 books, and served in 10+ leader positions for organizations and development teams with fundamental GIS impact.

Overcoming Obstacles to Accessing, Sharing, and Using Confidential COVID-19 Geospatial Data

Doug Richardson (Harvard)

Abstract: Research generating and analyzing geospatial data related to the COVID-19 crisis is now at the frontier of many scientific domains, including the health, social and environmental sciences. However, the potential opportunities and benefits of COVID-19 scientific collaboration are constrained by requirements to protect the locational privacy and confidentiality of subjects in research using geospatial data. The Center for Geographic Analysis at Harvard University (CGA), the Inter-university Consortium for Political and Social Research (ICPSR) at the University of Michigan, and the University of Illinois at Urbana- Champaign (UIUC) have achieved both proof of concept and the development of a Geospatial Virtual Data Enclave (GVDE) for addressing confidential geospatial data sharing, protection, analysis, and use needs by COVID-19 researchers. The NSF-funded research involves a) Developing a Geospatial Virtual Data Enclave and its Core Functions; b) Evaluating and Implementing Masking and Encryption Capabilities for the GVDE; c) Developing the GVDE Researcher Credentialing System; and d) Ensuring Sustainability of the GVDE.

Douglas Richardson is Distinguished Researcher at Harvard's Center for Geographic Analysis. From 2003-2019, he was the Executive Director of the American Association of Geographers (AAG), led a highly successful renewal of the organization. He greatly expanded its membership and international footprint, developed dynamic and wide-ranging new research initiatives, and built strong academic, publishing, and financial foundations for the AAG, and for geography's future. Prior to joining the AAG, Dr. Richardson founded and was the president of GeoResearch, Inc., a scientific research firm that developed and patented the world's first real-time space-time interactive GPS/GIS functionality, which has transformed the ways in which geospatial data and geographic information is now collected, experienced, mapped, and used within geography and other disciplines, and in society at large.

Jason Ur is Professor of Anthropology in the Department of Anthropology at Harvard University, and director of its Center for Geographic Analysis. He specializes in early urbanism, landscape archaeology, and remote sensing, particularly the use of declassified US intelligence imagery. He has directed field surveys in Syria, Iraq, Turkey, and Iran. He is the author of Urbanism and Cultural Landscapes in Northeastern Syria: The Tell Hamoukar Survey, 1999-2001 (2010). Since 2012, he has directed the Erbil Plain Archaeological Survey, an archaeological survey in the Kurdistan Region of northern Iraq. He is also preparing a history of Mesopotamian cities.

Matthew W. Wilson is Associate Professor of Geography in the Department of Geography at the University of Kentucky and an Associate at the Center for Geographic Analysis at Harvard University. He is co-editor of Understanding Spatial Media (SAGE) and his most recent book is New Lines: Critical GIS and the Trouble of the Map (University of Minnesota Press).