TRACK: Track Network Analysis and the systemic and critical assessment of infrastructures

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"AGILITY IS COMING"

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INTRODUCTION TO THE TRACK

Due to interconnected infrastructure, city must be studied like a system, especially like a complex one: such systems are not fully predictable, due to the inherent uncertainty in how these systems evolve. As illustrated in the literature a city appears as a set of components interconnected by networks with some critical infrastructures. Evaluating critical infrastructure interdependencies for potential vulnerabilities is an important component of a strategic planning, particularly in the context of managing and mitigating service disruptions. Yet, multiple networks that innervate cities are particularly sensitive to risks, through their structures and geographic constraints. There is a need to understand how networked systems are resilient because societal functions are highly dependent on networked systems and the operability of these systems are vulnerable to disasters.

Infrastructures include all networks and buildings that are essential for the functioning of society during the flood event and for the recovery from the flood event. The importance and the nature of the infrastructures to consider are case study, hazard and scale specific. They may be limited to physical infrastructure delivering essentials services such as electricity networks, water supply and drainage networks, communication related infrastructure, and roads, but can also include schools and hospitals, banks, financial institutes considered as a network rather than individual entities. Critical infrastructure is considered 'critical' because an outage of the infrastructure has a serious effect on many people and other infrastructure during the event and the recovery. As such the consideration of critical infrastructures in crisis management requires complementary approach to the traditional direct loss assessment approaches. Asset susceptibility assessment considers the initial shock to an infrastructure and the distribution of the losses within a network but cannot represent the secondary effects of outage in and outside the crisis area and interdependencies and cascading effects to other sectors. This is equally important when managing the crisis during an event to understand additional obstacles in providing emergency services than when prioritizing the recovery process. For getting a full picture of the spatial, time and cascade failure, it is thus necessary to capture second and third order consequences by conducting a systemic and critical assessment commonly requiring a network analysis. Alternative methods are empirical analysis, statistical analysis, network analysis, flow modelling or agent-based modelling. Network analyses are faster and less data-demanding than complex modelling approach, easy to integrate in GIS environment and can provide enough accuracy to decision makers. Based on Graph Theory the technique analyses the network's structural properties based on node and link characteristics such as the connectivity between two nodes (shortest pathways, level of connection, maximum flow) or the centrality of a node in a network (degree, closeness, betweenness).

Location of critical infrastructure, their relation to other infrastructure and to inhabitants are also aspects that must be taken into account to assess resilience to disasters of a territory. For example, information about housing, companies, infrastructures, hazards and networks are needed (location, condition, exposure…). This type of information is referred to as spatial information, and when visualized, we can see relationships, patterns, and trends that may not otherwise be apparent. It is well known that GIS Sciences can be used to recover the spatial component of risk and it is clear that risk assessments have an important spatial component. For instance, to better respond to post disaster activities, GIS Sciences provide a logical tool for integrating the necessary information and contributing to preparedness, rescue, relief, recovery and reconstruction efforts. GIS is seen as a necessary tool in the area of emergency response. But now resilience requires looking beyond lonely emergency response in order to optimize recovery after a flood event thanks to preparedness and resilience assessment. That is why this track focus on coupling critical infrastructure resilience modelling with GIS Sciences to decide for more resilient territories.

TRACK TOPICS

In this session we propose:

- To present current methodological approaches in using network analysis (data collection, hazard scenario, representation of the network, indicators)
- To provide various examples of network analysis application (from single network to cascading effects, from different hazard perspectives, for different uses)
- To provide Spatial Decision Support Systems applied to critical infrastructure modelling and resilience strategies
- To discuss limitations and future development (20 minutes of the session could be used for discussion at the end)

Main topics: GIS, System infrastructure, decision support systems, case studies and reflections from practices (data collection), modeling approaches, data representation, risk reduction

AUTHORS AND REVIEWERS RECRUITEMENT

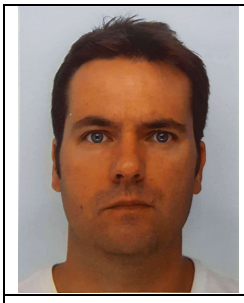
The ESPACE lab has a huge experience in research dealing with territory adaptations facing different phenomenon like urbanization and climate change. The question of urban systems facing risks is central as well as the question of spatial decision support systems design. This research is undertaken in a broad international network including for example the EU programs, EGU, ICLEI… Damien Serre is able to mobilize a large audience thanks to his own networks like the FloodRisk community members, the EU board of endusers, the GDR MAGIS and several groups interested in the resilience actions.

The Flood Hazard Research Centre has gained international recognition for its research and a methodology into the socio-economic assessment of flood risk and flood risk management in the UK and internationally. FHRC is leading the basis of economic appraisal of flood and coastal risk management in the UK and is involved in various EU projects (Risc-kit, System-risk, flood CBA, ecoshaz, conhaz).

TRACK CHAIR AND CO-CHAIR

Damien Serre is Professor at the University of Avignon (France) and member of the UMR ESPACE (lab of quantitative geography. He is leading research in the area of urban resilience with a special focus on critical infrastructure management and spatial decision support systems to optimize resilience to different types of risks at the urban environment scale. He chaired or co-chaired many international tracks or session in his area of expertise e.g. the EGU General Assembly in Vienna in 2009 and 2010 as well for the next one in 2017,the FLOODRISK 2016 International Conference in Lyon in 2016 (Disaster risk and recovery session). He is editor of the Journal of Water and Climate Change (IWA), editor of the journal Urban Risk Studies (ISTE) and member of the Editorial Board of the Journal of Flood Risk Management (Wiley).

Christophe is senior research fellow at the Flood Hazard Research Centre and has gained experience in working and leading interdisciplinary research in the field of flood risk management at National and European level. With a background in Geography, Christophe is working at the interface of economic and physical sciences in the development of methodologies for the socio-economic assessment of flood risk. His recent research works are focusing on the development of Geographic Information System and network analysing tools for assessing flood vulnerability and losses; in particular by considering traffic, utilities and business supply chain disruption and recovery time.

	*Damien Serre** *Damien.serre@univ-avignon.fr* *UMR ESPACE, Université d'Avignon et des Pays du Vaucluse, France*
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