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New Technologies, Techniques and Tools to Dynamically Manage Urban Resilience: the Fresnel Platform for Greater Paris

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As cities are put under greater pressure from the threat of the global impact of climate change, in particular the risk of heavier rainfall and flooding, there is a growing need to establish a hierarchical form of resilience in which critical infrastructure can become sustainable. The main difficulty is that geophysics and urban dynamics are strongly nonlinear with an associated, extreme variability over a wide range of space-time scales. To better link the fundamental and experimental research on these topics, an advanced urban hydro-meteorological observatory with the associated SaaS developments, the Fresnel platform (<https://hmco.enpc.fr/portfolio-archive/fresnel-platform/>), has been purposely set-up to provide the concerned communities with the necessary observation data thanks to an unprecedented deployment of higher resolution sensors, that easily yield Big Data.

To give an example, the installation of the polarimetric X-band radar at the ENPC's campus (East of Paris) introduced a paradigm change in the prospects of environmental monitoring in Ile-de France. The radar is operated since May 2015 and has several characteristics that makes it of central importance for the environmental monitoring of the region. In particular, it demonstrated the crucial importance to have high resolution 3D+1 data, whereas earlier remote sensing developments have been mostly focused on vertical measurements.

This presentation discusses the associated Fresnel SaaS (Software as a Service) platform as an example of nowadays IT tools to dynamically enhance urban resilience. It is rooted on an integrated suite of modular components based on an asynchronous event-driven JavaScript runtime environment. It features non-blocking interaction model and high scalability to ensure optimized availability. It includes a comprehensive and (real-time) accessible database to support multi-criteria choices and it has been built up through stakeholder consultation and participative co-creation. At the same time these components are designed in such a way that they are tunable for specific case studies with the help of an adjustable visual interface. Depending on that case study, these components can be integrated to satisfy the particular needs with the help of maps other visual tools and forecasting systems, eventually from third parties.

All these developments have greatly benefited from the support of the Chair "Hydrology for a Resilient City" (<https://hmco.enpc.fr/portfolio-archive/chair-hydrology-for-resilient-cities/>) endowed by the world leader industrial in water management and from previous EU framework programmes. To sustain the necessary public-private partnerships, Fresnel facilitates synergies

between research and innovation, fosters the theoretical research, national and international collaborative networking, and the development of various aspects of data science for a resilient city.