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Human Vulnerability Mapping Facing Critical Service Disruptions for Crisis Managers

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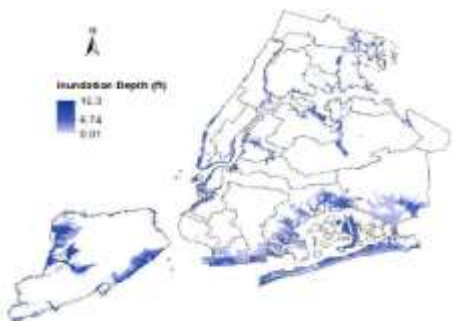
^c ENEA, Rome (IT)

^d JRC, Ispra (EU)



Context : Cascading effects causing critical service disruptions in crisis

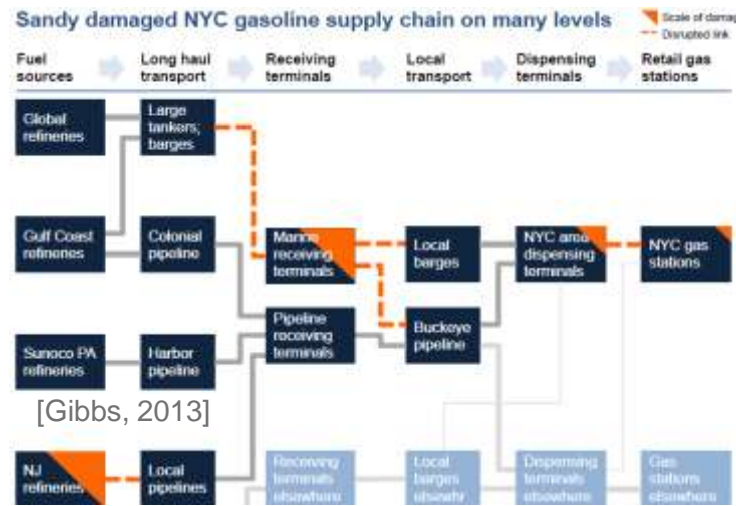
Katrina, 2012 USA



[Haraguchi, 2014]



New-York during Sandy. Picture : Hybirdd, Wikipedia, 30 October 2012, 10:38:53



Impacts on water utilities, transports, health facilities...



Strong interest for the crisis management

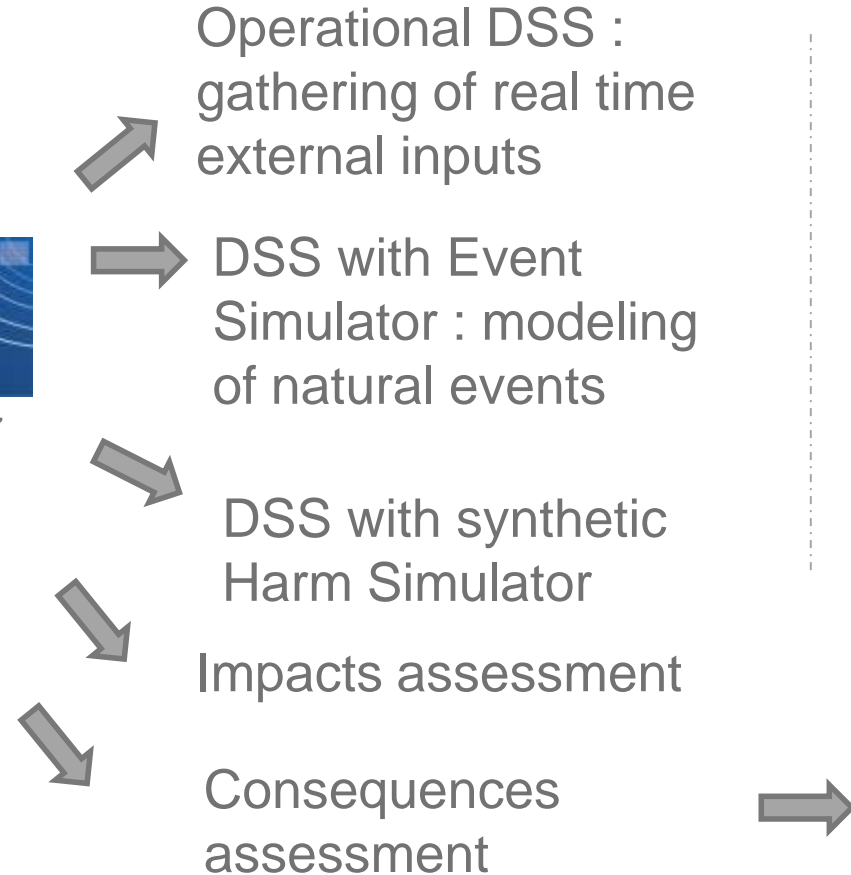
BUT

Weak point of the crisis planning

NEED OF :

- Critical infrastructure dependencies modelling
- Assessment of scenarios gravity

CIPRNet Decision Support System

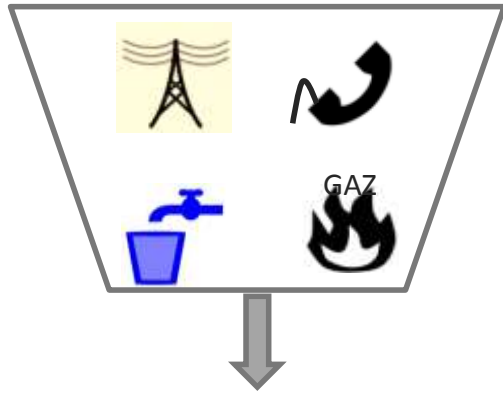


Consequences assessment in CIPRNet

[Di Pietro, 2015]

- based on Service Availability Wealth (SAW) indexes for 4 components :
 - Reduction of well-being to the population;
 - Reduction of primary services (hospitals, schools and so on) that affects the wealth and the well-being of the population;
 - Economic losses due to services outages;
 - Direct and indirect environmental damages.
- Crossing 5 service disruptions :
 - Electricity;
 - Telecommunications;
 - Water;
 - Gas
 - Mobility services (transports availability).

CIPRNet consequences assessment



- Service Availability (t)
Calculated in anticipation
- Wealth measure metrics
(number of casualties, of closed infrastructures and so on)

• Service relevance (t) →

[Di Pietro, 2015]

Relevance for component “Citizens”

- Based on statistical data : activities on a typical day

Service Availability Wealth degradation

More accurate assessment of scenario’s gravity

BUT

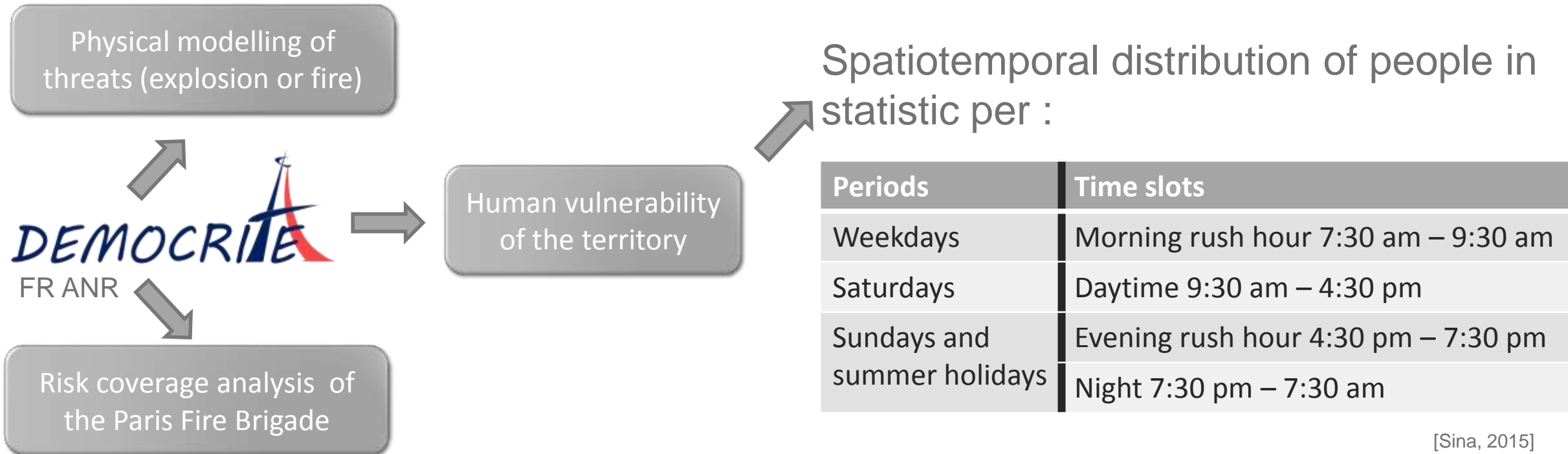
Empty accommodation

How are filled up the other places ?

Relevance	H
W : 1, E : 1, G : 0	7:30- 8:00
W : 1, E : 1, G : 1	8:00- 8:30
W : 0, E : 1, G : 1	8:30- 9:00
W : 0, E : 0, G : 0	9:00- 9:30
[0 : 1]	...

W : Water,
E : Electricity, G : Gaz

Improvement of the consequences assessment → Modelling People Mobility



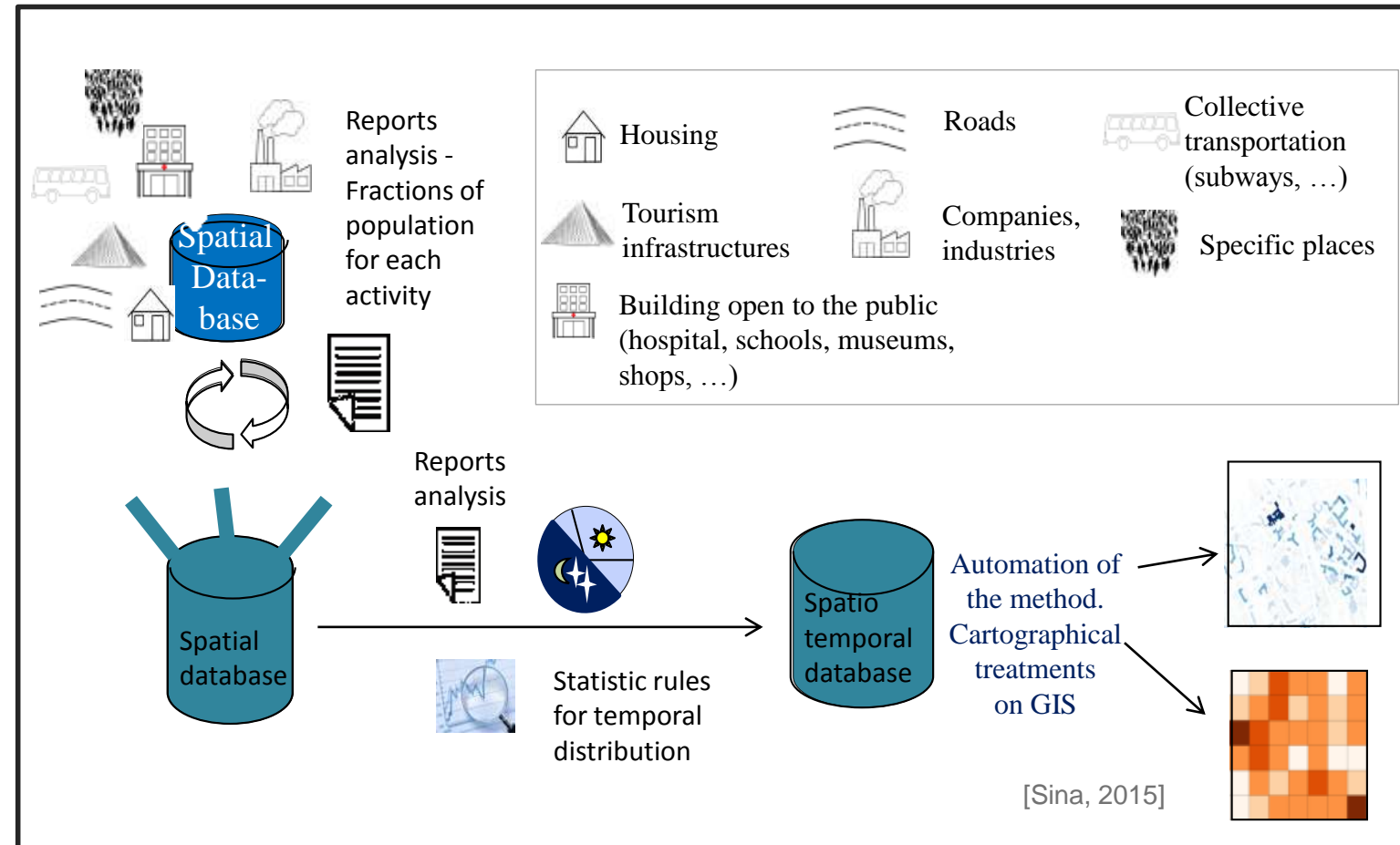
[Sina, 2015]

Improvement of the consequences assessment

→ Modelling People Mobility

70 databases used.
Method : →

- Data limits : ←
- Missing data (employees per industries f.i.)
 - Not detailed data (general statistics on large part of the territory)

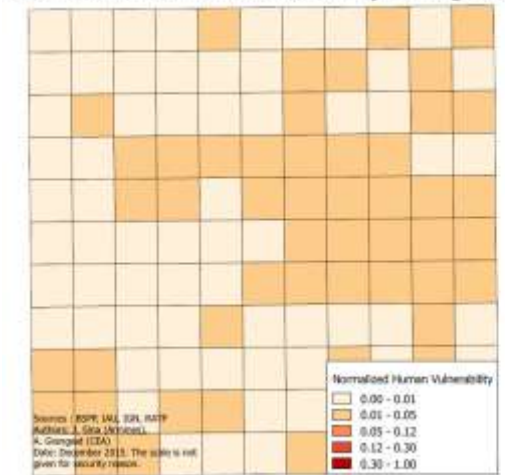
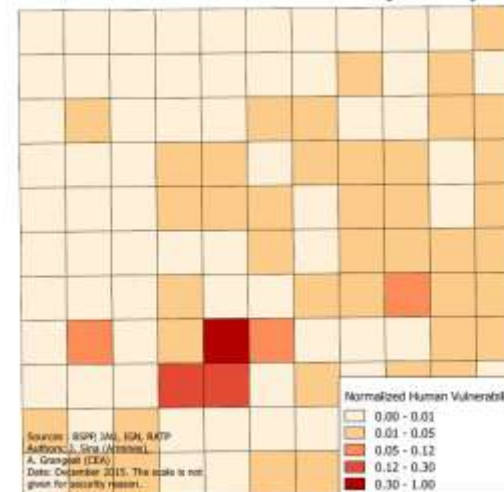
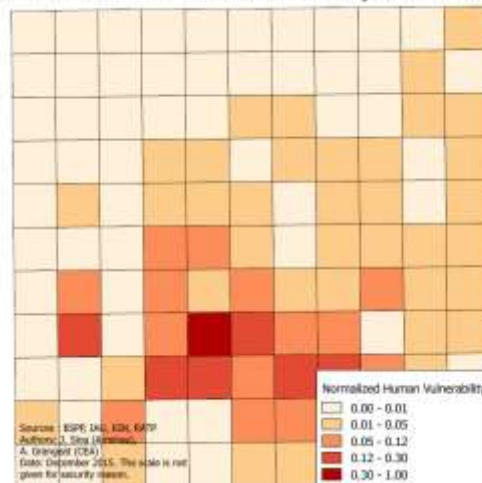
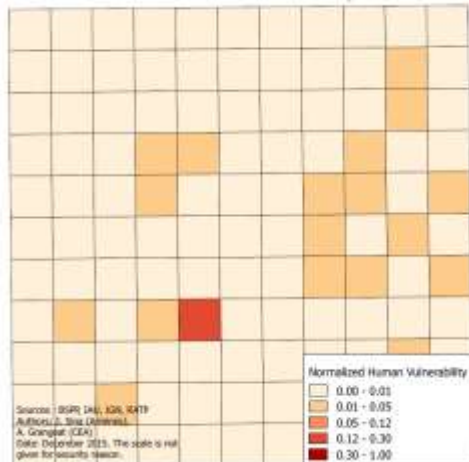


Improvement of the consequences assessment → Modelling People Mobility

! Sensitive results ! →

- Merged by meshes
- Normalized for the publication
- Localization and scale not published

Normalized Human Vulnerability 7:30 am - 9:30 am Normalized Human Vulnerability 9:30 am - 4:30 pm Normalized Human Vulnerability 4:30 pm - 7:30 pm Normalized Human Vulnerability during the Night



Improvement of the consequences assessment

→ Modelling People Mobility

- Limits :
 - Not exhaustive data
 - Time slots: - Working hours not the same for every worker
 - Evening time slot : hard to assess → activities, shopping or back home ?
- Discussion on the model validation :
 - Need of a survey like Osaragi (Ja., 2016, on the population density in transports)
 - Use of official statistics for the reliability
 - Simulating correctly the filling and emptying of business quarter in Paris
- Perspectives : - Distinguishing discomfort scenario of crisis to prioritize the studies
 - Proposing definitions of these terms, as a first point to debate.

Improvement of the consequences assessment

→ Modelling People Mobility

Vulnerability states	Definition [Grangeat, 2016]	Vulnerability states	Definition [Grangeat, 2016]
Discomfort state	<ul style="list-style-type: none">• A short period of resource disruption or a much localized disruption.• People can adapt themselves to the resource lack:<ul style="list-style-type: none">• using an alternative resource for a limited period,• or the resource is available closed by,• or they can deal with it for a limited period of time.	Crisis state	<ul style="list-style-type: none">• Degradation of the discomfort state, because of the too long duration of one resource lack on one important area.• It causes either :<ul style="list-style-type: none">• sanitarian problems (no more heating, toilettes out of order, and so on)• a strong obstacle for working (electricity or telecommunication interruptions) or travelling.• This state means that people will evacuate their living place or will not go to work because of this long interruption of resource.



Perspectives:

How long should be the disruption before this evacuation ?
How to assess the minimum service?

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Conclusion on the method of human vulnerability mapping :



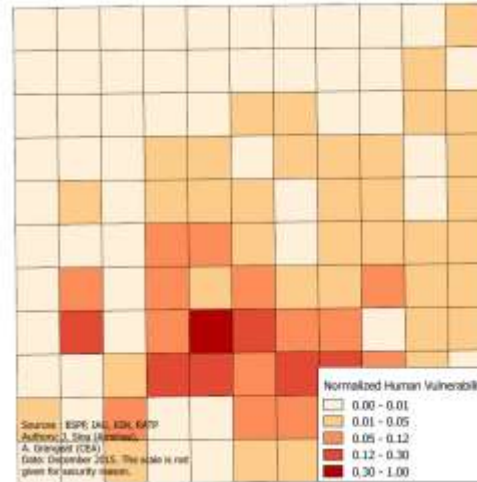
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[0 : 1]	...



Normalized Human Vulnerability during the Night



Normalized Human Vulnerability 9:30 am - 4:30 pm



A more accurate assessment of scenario's human gravity by automation
 =
A decision support towards crisis managers for sorting scenario's to reinforce by priority

Thank you for your attention

Bibliography

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Some questions ?

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