→ EARTH OBSERVATION FOR SUSTAINABLE DEVELOPMENT

Urban Development

City Academy: Geospatial Data Applications for Urban Development, Sao Paulo 16.-17.09.2019

EO Data for climate resilience and disaster management city plans

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Outline of the Presentation

- what are the elements that can be measured from earth observation data to support climate resilience and disaster management city plans?

- Example of Terrain motion management

- Example of Flood risks management

11 SUSTAINABLE CITIES AND COMMUNITIES

- **UNDP SDG Goal 11 : Make cities inclusive, safe, resilient and sustainable**

Target 5:

"By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations"
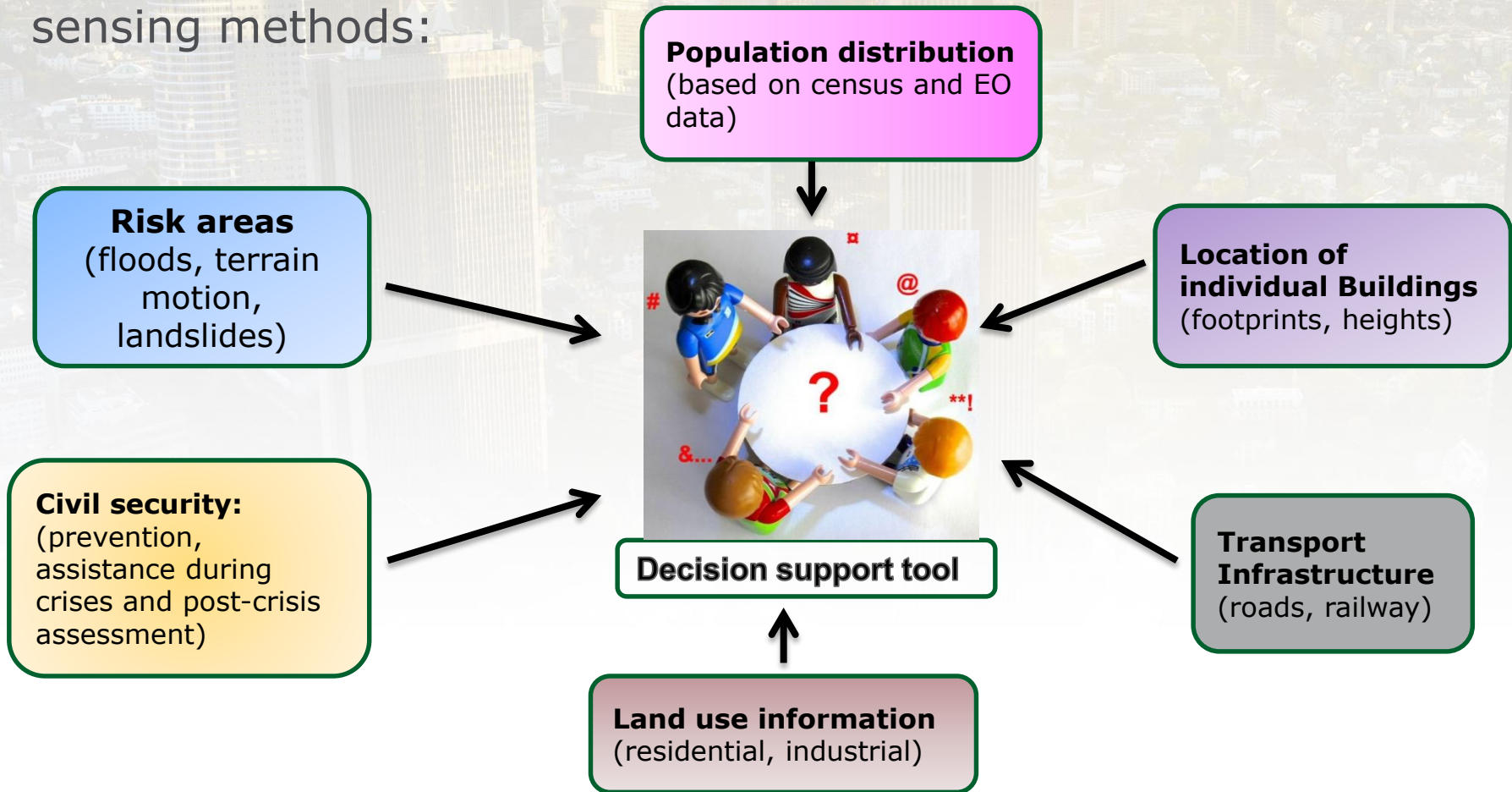
- **SDG Goal 11 Target 5**:

Indicators to monitor over time:

- Estimation of people living in high risk areas
- Estimation of people living in slums or inadequate housing within high risk areas

How can EO support?

The following parameters can be generated with EO data / remote sensing methods:

Population distribution
(based on census and EO data)

Risk areas
(floods, terrain motion, landslides)

Location of individual Buildings
(footprints, heights)

Civil security:
(prevention, assistance during crises and post-crisis assessment)

Decision support tool

Transport Infrastructure
(roads, railway)

Land use information
(residential, industrial)

Terrain and Infrastructure motion

What is terrain motion?

Upheaval or sinking of land

Terrain and Infrastructure motion

Various causes of t*errain motion*:

- Increased pressure on the surface due to concentrated building activities in combination with

- Geological disposition

- Groundwater extraction or mining

Subsidence can cause Cracks/ damages on buildings/infrastructure

Collapsing of buildings

- Natural factor (earthquake,

more frequent flooding, etc.)

Subsidence

Terrain and Infrastructure motion, How to map them?

Example of Radar Interferometry method:

Radar interferometry can be broadly defined by use of <u>phase measurements</u> to precisely measure the relative distance to an object when imaged by synthetic aperture radar from two or more observations separated either in time or space.

Terrain and Infrastructure motion, How to map them?

Interferometric coherence analysis for terrain motion mapping:

Comparaison of two coherence maps to assess damage caused by an earthquake or landslide (The coherence value)
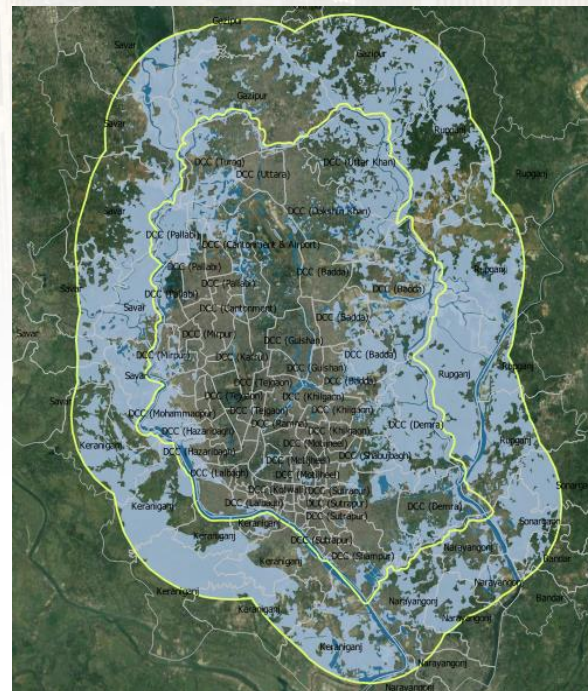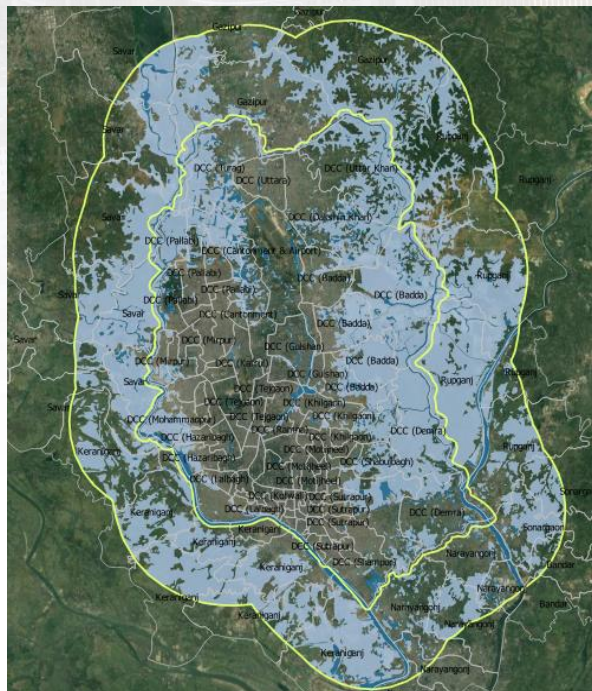
Example of Sentinel-1 data measurement

Mapping of Flood Risk area

- Major floods 2004, 2007, 2014, 2016
- 2004 flooding event as worst case reference
- August 2017 event

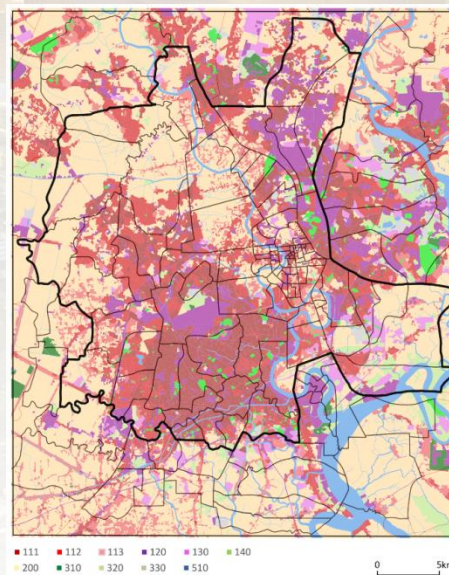|	2004	2007	2014	2016
Dhaka	Jun.20th - Oct.7th	Jul.21st – Oct.15th	Aug.13th – Sep.25th	Aug. 3rd – Sep.15th

August 2017

Flooded
Waterbody

LU/LC

Flood frequency

Potential Damage Assessment
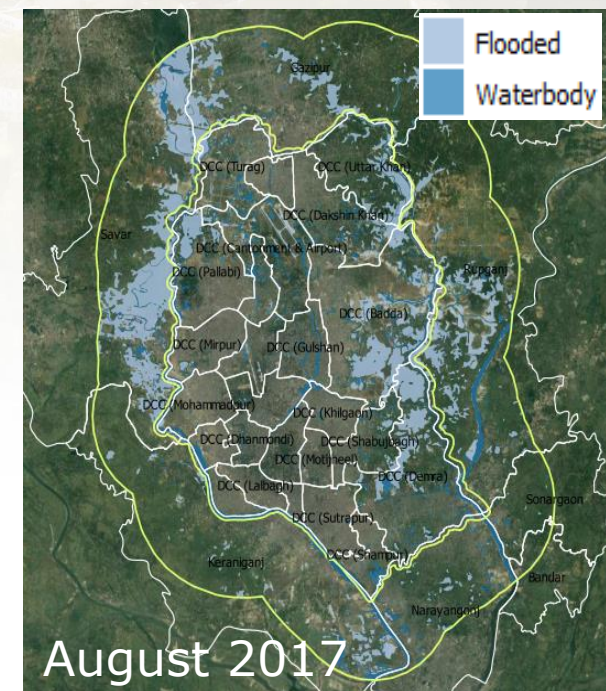
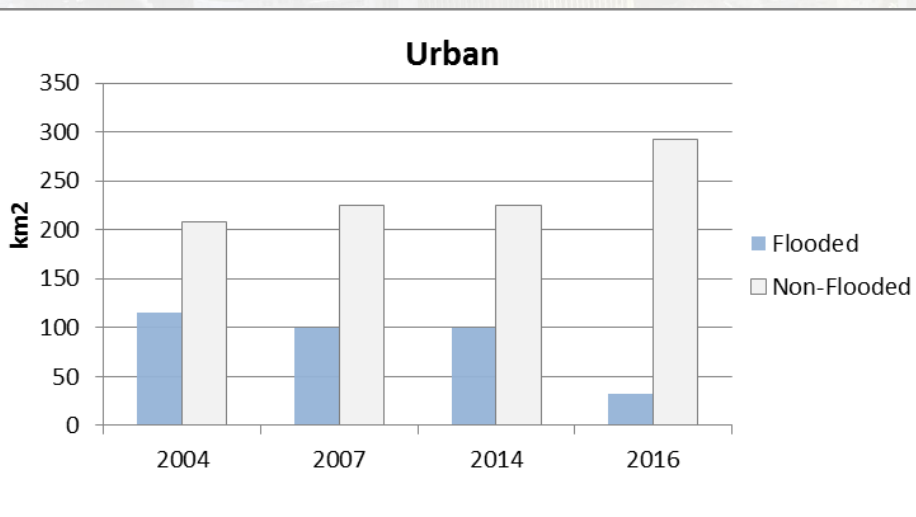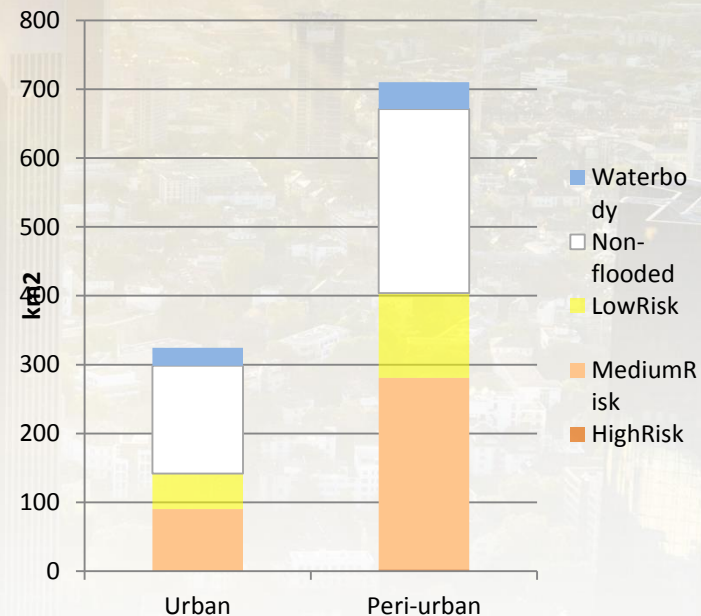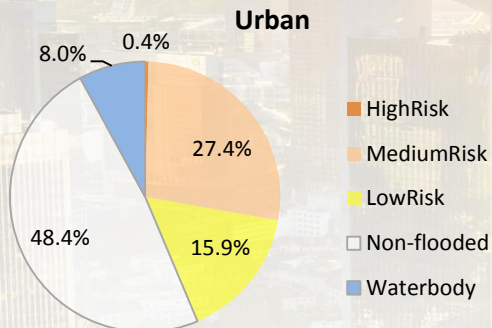|		Damage classes			
		A	B	C	D
Flood hazard level	1	1A	1B	1C	1D
	2	2A	2B	2C	2D
	3	3A	3B	3C	3D

Floods Hierarchisation

Table 9 Flood risk matrix

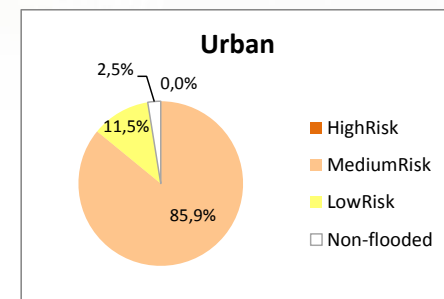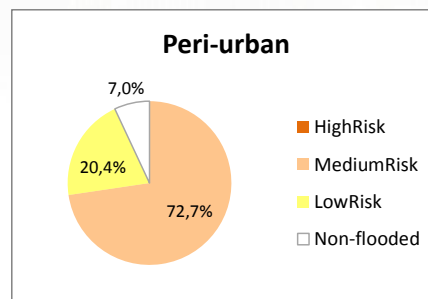|		Damage cost on land use			
		A	**B**	**C**	**D**
Flood hazard level	**1**	1A	1B	1C	1D
	2	2A	2B	2C	2D
	3	3A	3B	3C	3D
Flood Risk classification					
Low risk	1A 1B 2A				
Medium risk	1C 1D 2B 2C				
High risk	2D 3C				
Very high risk	3D				

- VeryHighRisk
- HighRisk
- MediumRisk
- LowRisk
- Waterbody

Peri-urban
- HighRisk
- MediumRisk — 39.1%
- LowRisk — 17.4%
- Non-flooded — 37.6%
- Waterbody — 5.5%, 0.4%

Urban
- HighRisk
- MediumRisk — 27.4%
- LowRisk — 15.9%
- Non-flooded — 48.4%
- Waterbody — 8.0%, 0.4%

Urban (bar chart)
- km2 axis 0–350
- Years: 2004, 2007, 2014, 2016
- Flooded
- Non-Flooded

(Stacked bar chart)
- km2 axis 0–800
- Urban, Peri-urban
- Waterbody
- Non-flooded
- LowRisk
- MediumRisk
- HighRisk

Agriculture only

Peri-urban
- HighRisk
- MediumRisk — 72,7%
- LowRisk — 20,4%
- Non-flooded — 7,0%

Urban
- HighRisk
- MediumRisk — 85,9%
- LowRisk — 11,5%
- Non-flooded — 2,5%, 0,0%

Risk areas: Floods risk

Exemple of Flood risk evaluation table

Important information for decision making

LU Classes	Damage				Total	Level
	Economic Costs 0-2	Social Damage 0-2	Physical Damage 0-2	Flood Duration 0-2		
Agricultural Land	1.5	0.5	0	1	3	B
Commercial and Industrial Units	2	0.5	1	0.5	4	B
Dump site	0	1.5	0.5	0	2	A
Construction Sites	1	0.5	0	0	1.5	A
Forests	0.5	0	0	0	0.5	A
Formal high density residential - Continuous urban fabric (Sealing level: 50%-100%)	1.5	1.5	2	1.5	6.5	D
Formal low density residential - Discontinuous urban fabric (Sealing level: 10%-50%)	1.5	1	2	1	5.5	C
Land Without Current Use	0	0	0	0	0	A
Mineral Extraction site	1	0	0.5	1	2.5	B
Non-Residential Urban Fabric	1	1	0.5	1	3.5	B
Other Natural and Semi-Natural Areas including Wetlands	0	0	0	0	0	A
Roads and associated land	1.5	1	2	1.5	6	C
Sports and leisure facilties	0.5	0.5	0	0.5	1.5	A
Other Urban / Artificial Area	1.5	1.5	1	0.5	4.5	C
Urban Greenery	0.5	0.5	0.5	1	2.5	B
Village Settlements (Sealing level 1-10%)	1.5	1.5	0.5	1.5	5	C
Water Bodies	0	0	0	0	0	A
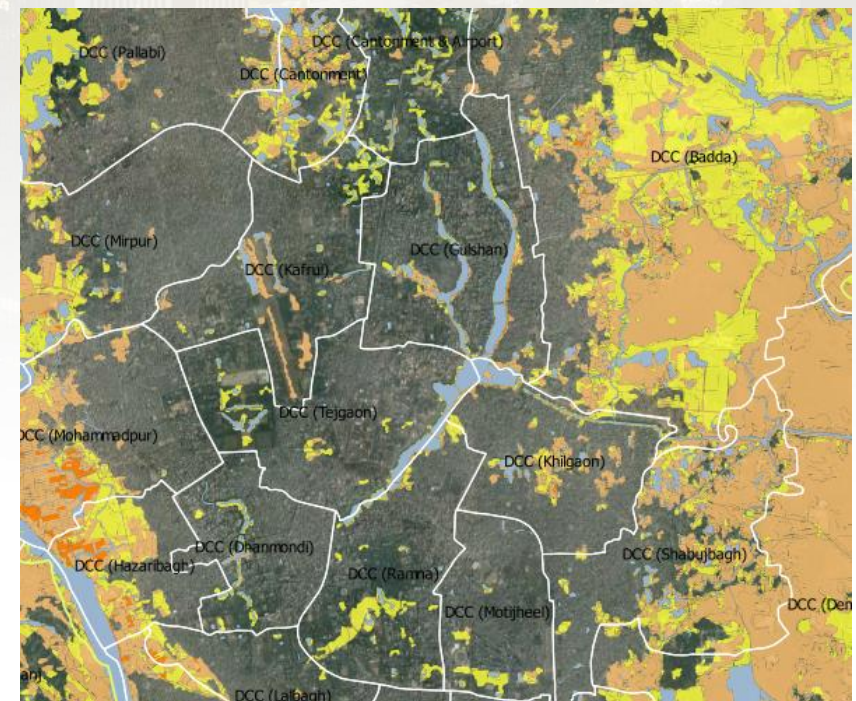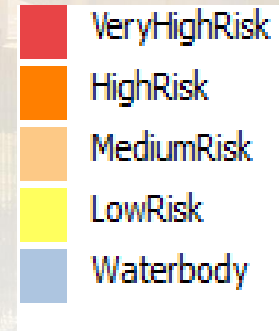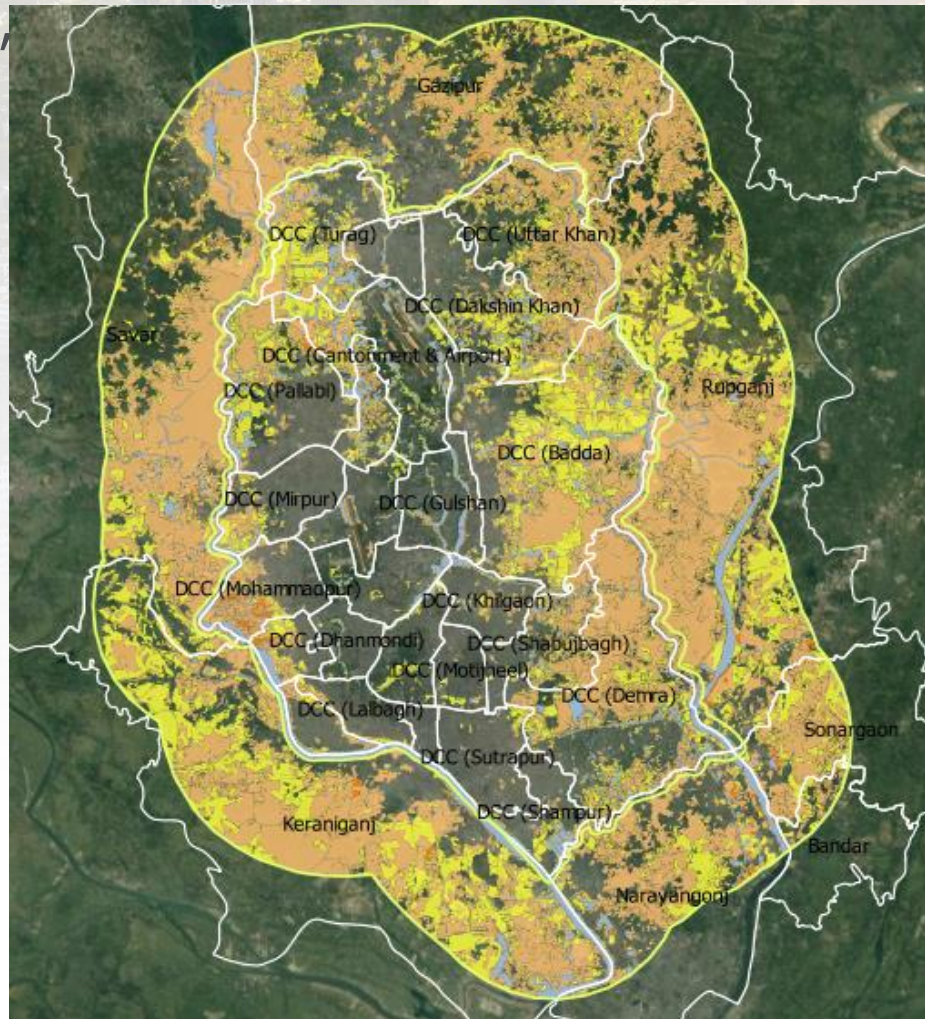
• **Floods**

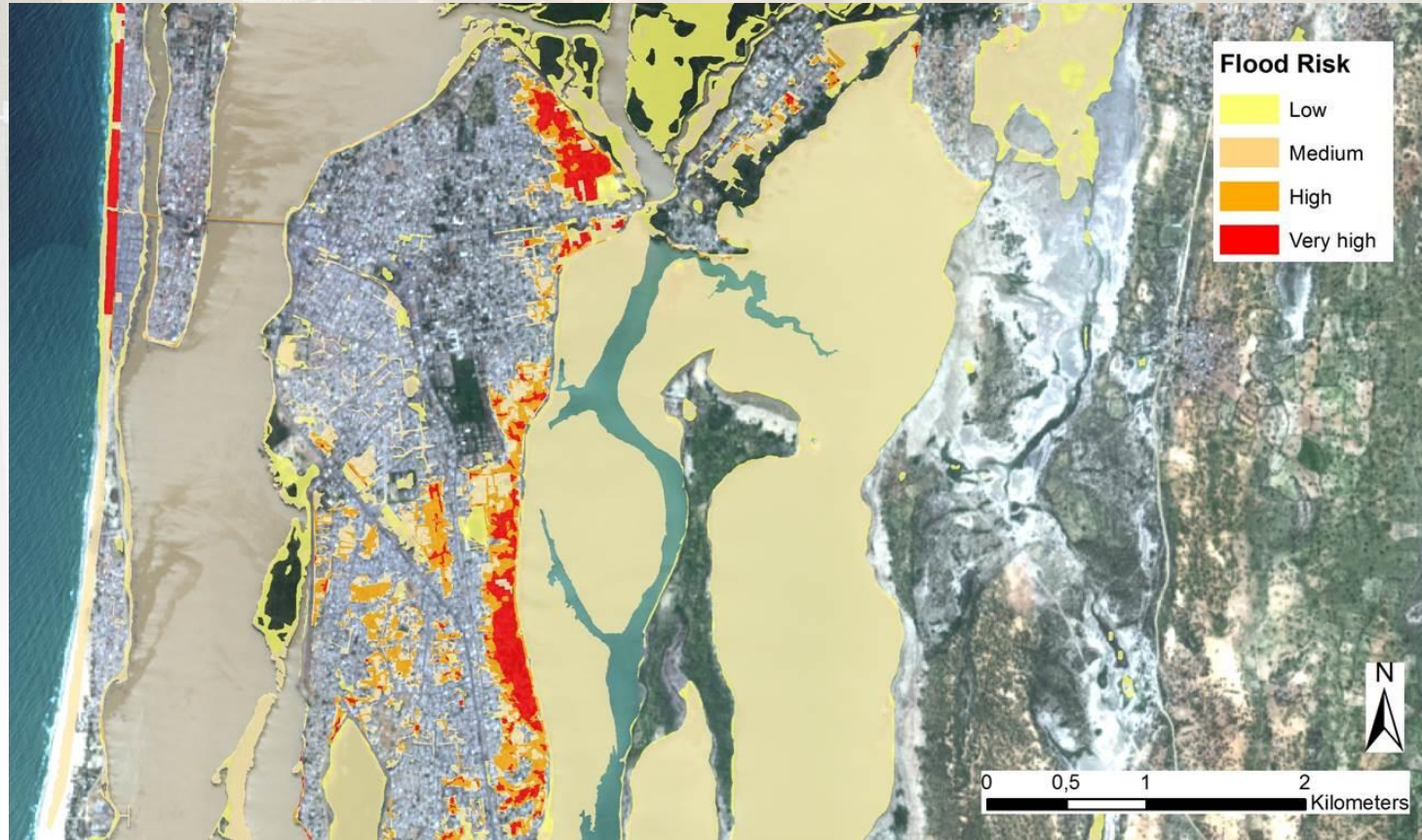• Flood risk hazard of Saint-Louis, status 2017

Subset of Flood Hazard Map of Saint Louis (Ile Saint Louis, northern part of Island of Sor, Khor) (Background Image: Sentinel 2, recorded on 10/09/2017)

• Floods

• Flood risk map
of Saint-Louis,
status 2017

Subset of Flood Risk Map of Saint Louis (Ile Saint Louis, northern part of Island of Sor, Khor)
(Background Image: Sentinel 2, recorded on 10/09/2017)

• **Floods**

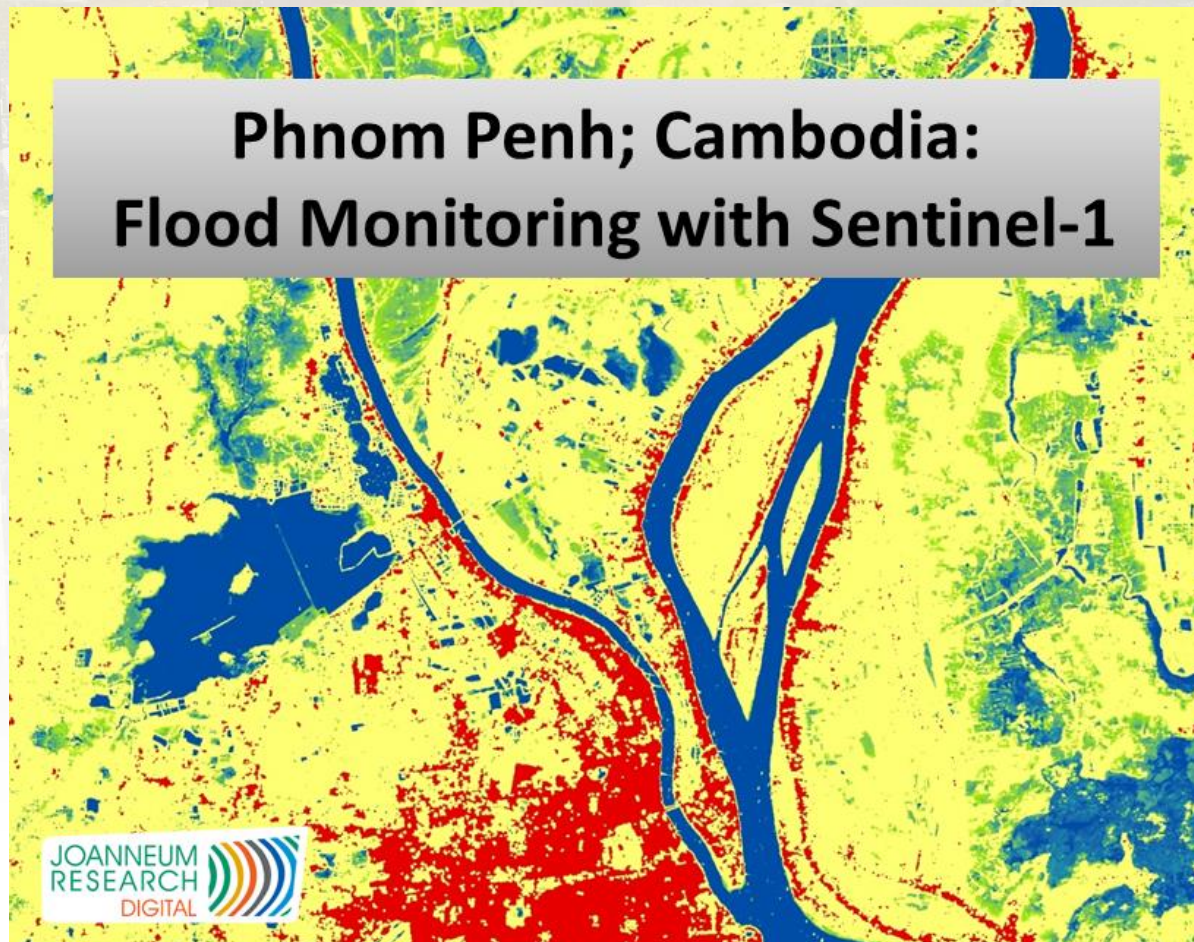• Flood risk map
of LIMA,
status 2017
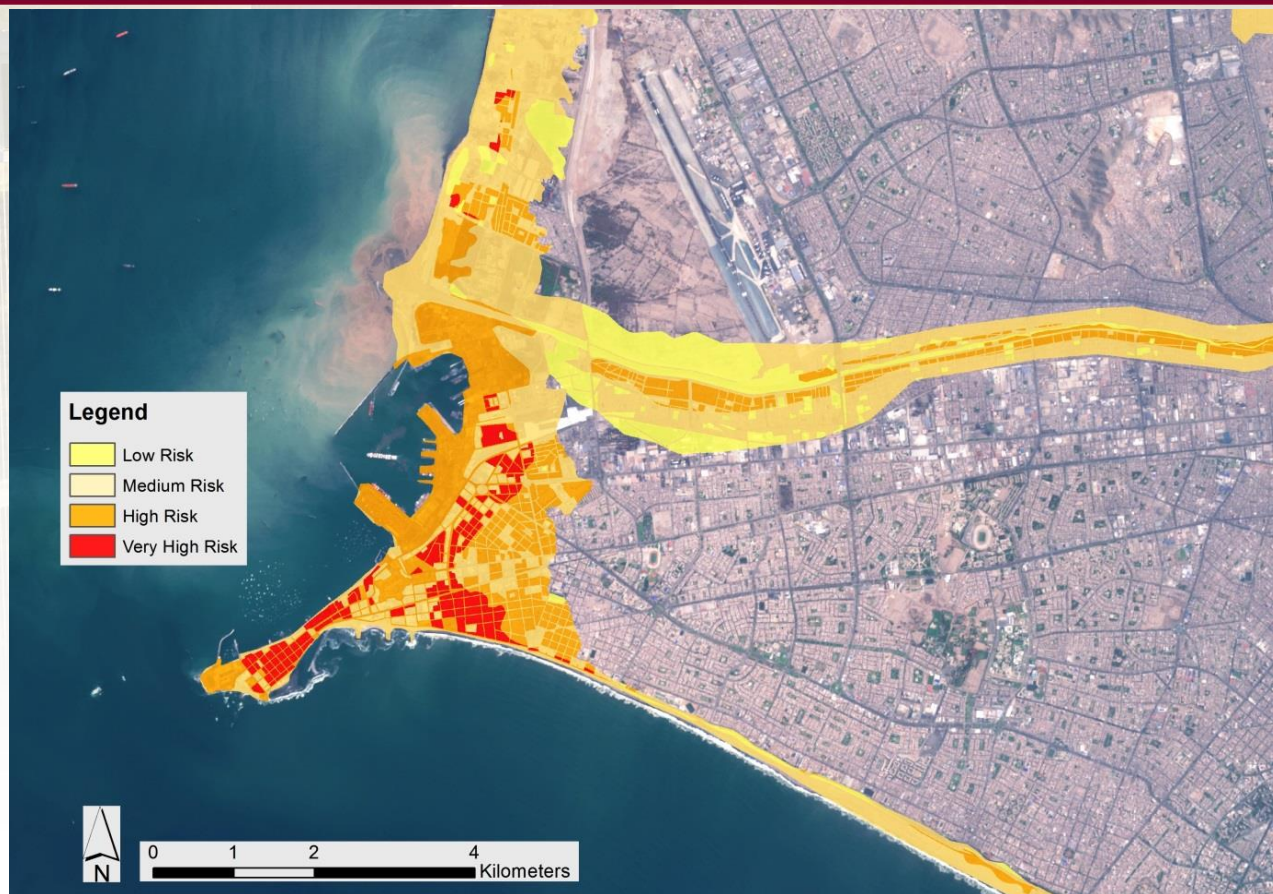
Flood Subset of Flood Risk Map for Callao – La Punta and Central Lima considering Tsunamis and flooding from River Rímac (Background Image: Sentinel2A 20170220)

Floods history:
Phnom Penh from
S1

Phnom Penh; Cambodia:
Flood Monitoring with Sentinel-1

Thank you for your attention!

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