

Disaster Adaptation to Mitigate Storm Surge (DAMSS)

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Motivation

Theory predicts 5% increase in hurricane winds per degree c of ocean warming (Emmanuel, 2005)

For lowest possibility,

- Expected ocean warming by 2100 SST: 1 - 2 degrees C (IPCC,2007)
- (i.e.) hurricane wind speed will increase by 5-10%;
- Damage from hurricanes & tropical storms increases 1.5-3 times

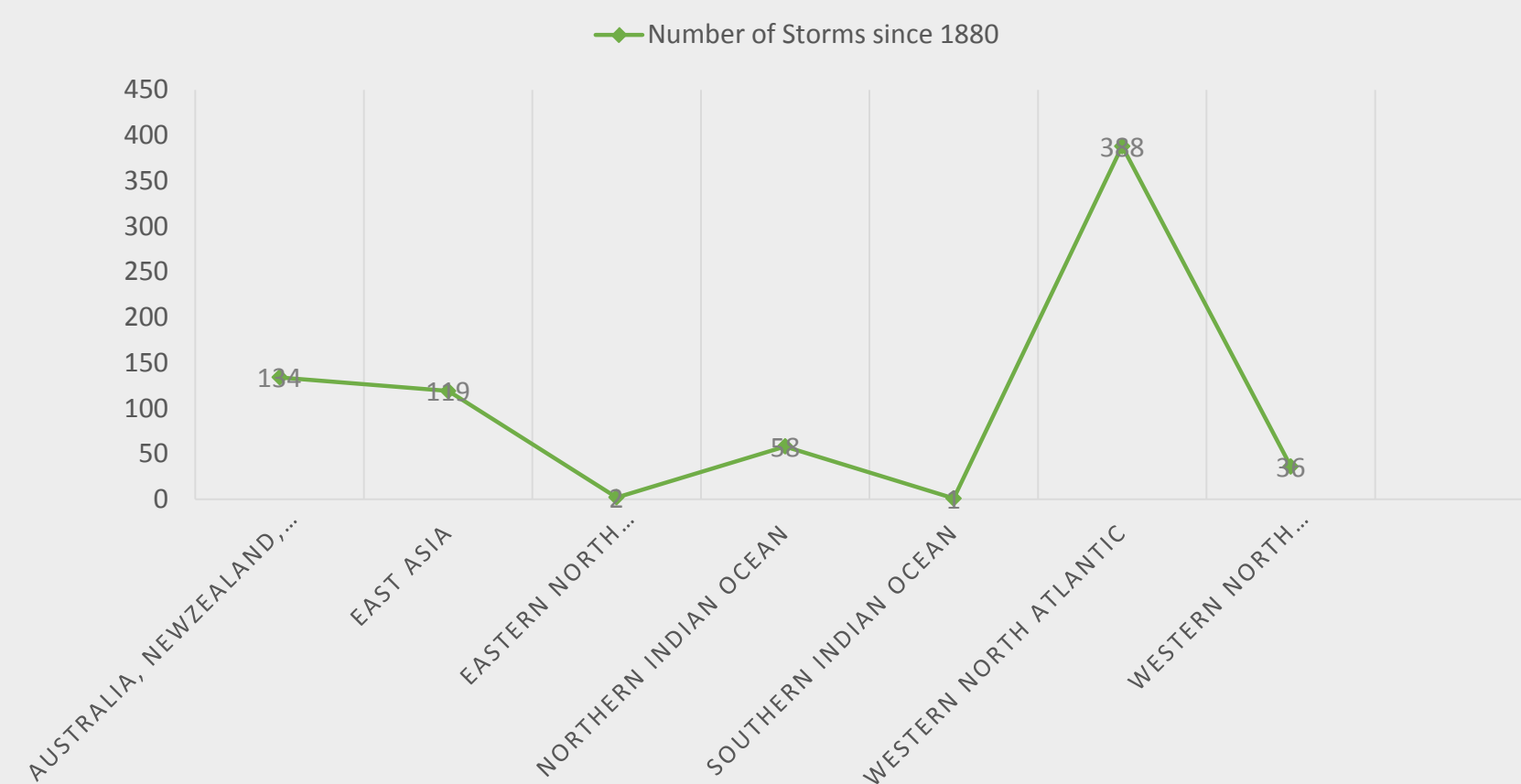
Aim

This research in principal aims to develop a framework to make a significant step for the preparedness and adaptation of coastal cities and infrastructures bridging disparity between the present and future requirements

- Investigate storm surge characteristics, monitoring, existing mitigation methods.
- Comparative study on disaster adaptation strategies regulated in developed and developing countries.
- Examination of possible deviation and implication identification in previous frameworks, to define successful DAMSS framework
- Practical recommendations to policy makers if applicable.

Storm Surge

NUMBER OF STORMS SINCE 1880



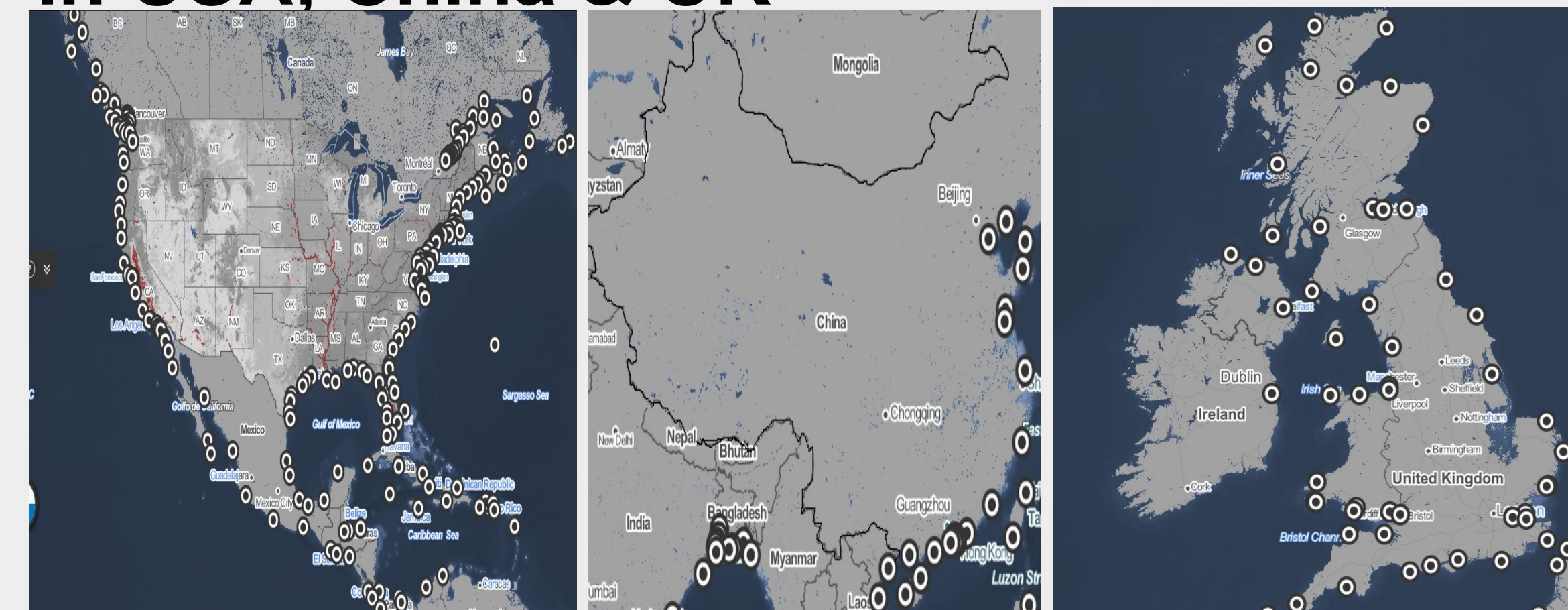
Ref: SURGEDAT: The World's Storm Surge Data Centre – Global Peak Surge Map

- Storm surge is complex phenomenon because of its high sensitivity to the slightest change in storm intensity, such as speed, size, angle of approach, atmospheric pressure and also depends on shape and characteristics of coastal features such as bays and estuaries.
- Hurricane Katrina's Storm surge is measured as 27.83 ft. Lesson learnt from hurricanes Katrina and Sandy shows that a storm surge, of 23 ft. has the ability to inundate 67% of interstates, 57% arterials, almost half of rail miles, 29 airports and virtually all the ports in Gulf Coast area.
- 1 Cubic yard can hold 1700 pounds of water (Climate Central)

Vulnerability Facts

- Most coastal population are located in low elevation coastal zones(LE CZ) i.e. 10 feet above the mean sea level or within 500 m. (NHC).
- In European Union, around one-third of population lives within 50 Km of coast with an estimated economic assets within 500m costing €500-1000 bn.
- 75% of world's countries with their largest cities whose population is at least one million are either located at close coastal proximity or at low elevation levels i.e., below 10 meters.
- From 1960 to 2008, the U.S Coastline population expanded by 41 million which is 84.3% increase
- According to U.N atlas of the oceans, 8 out of 10 world's largest cities are located near coasts (< 10m)
- China's territories with two-third of its population, are situated below flood level of major rivers
- Total Energy facilities in United States, which are less than 5 ft just above the normal high tide, are 328 in numbers.
- Bank of England, insurance report states that, weather related insurance pay-outs has tripled increased from US\$10 billion in 1980 to US\$50 billion

Potential sea level rise vulnerable areas in USA, China & UK



Ref: Picture courtesy Surging seas(sea level rise analysis by Climate Central)

Methods



- Real-life context approach in understanding the Storm surge characteristics
- Root cause, critical pathways, consequences and impact boundaries
- Peculiarity of surge occurrences and impacts based on the country's geo-positions could be studied in detail for each scenario

- Risk assessment & hazard identification
- Vulnerability assessment
- Speed and adaptability to response
- Inter-relationship for emergency response
- Risk distribution (Insurance)
- Land Use planning & Building regulations

Results

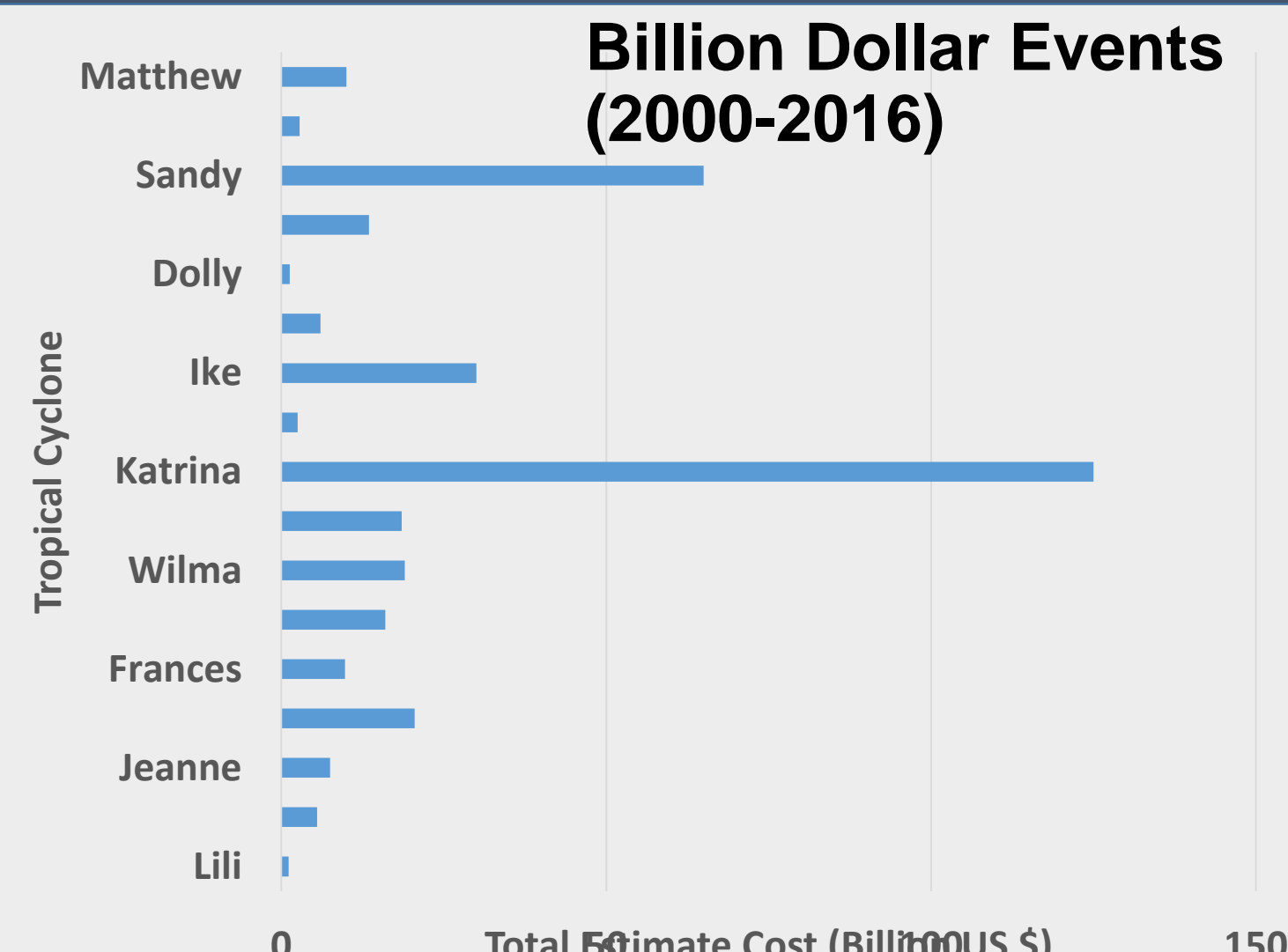
Gap Analysis

- Saffir-Simpson hurricane wind scale, categorises hurricanes based on their wind speed and does not account storm surge inundation levels.
- Calculating the accurate or approximate coastal inundation risk or level again cannot be modelled as the storm intensity factor.
- Most reliable European model, underestimated hurricane Sandy(2012).
- FEMA was widely criticized for its responses during hurricane Katrina
- Most CAT(catastrophic modelling) is observed to be greatly deviated by either underestimating or exaggerating the impact areas.

U.S Coastal Cities- Population and assets exposure to storm surge hazard

COUNTRY	CITIES (Urban Agglomeration)	ASSET EXPOSED (IN BILLION US\$)	EXPOSED POPULATION
USA	Miami	416.29	2,003,000
USA	New York	320.20	1,540,000
USA	New Orleans	233.69	389,614
USA	Virginia Beach	84.64	437,994
China	Guangzhou	84.17	2,718,000
China	Shanghai	72.86	2,353,000
China	Hong Kong	35.94	7,324,300
China	Tianjin	29.62	956,000

Ref: A global ranking of port cities with high exposure to climate extremes. Climatic Change,(2011) 104(1), 89–111.

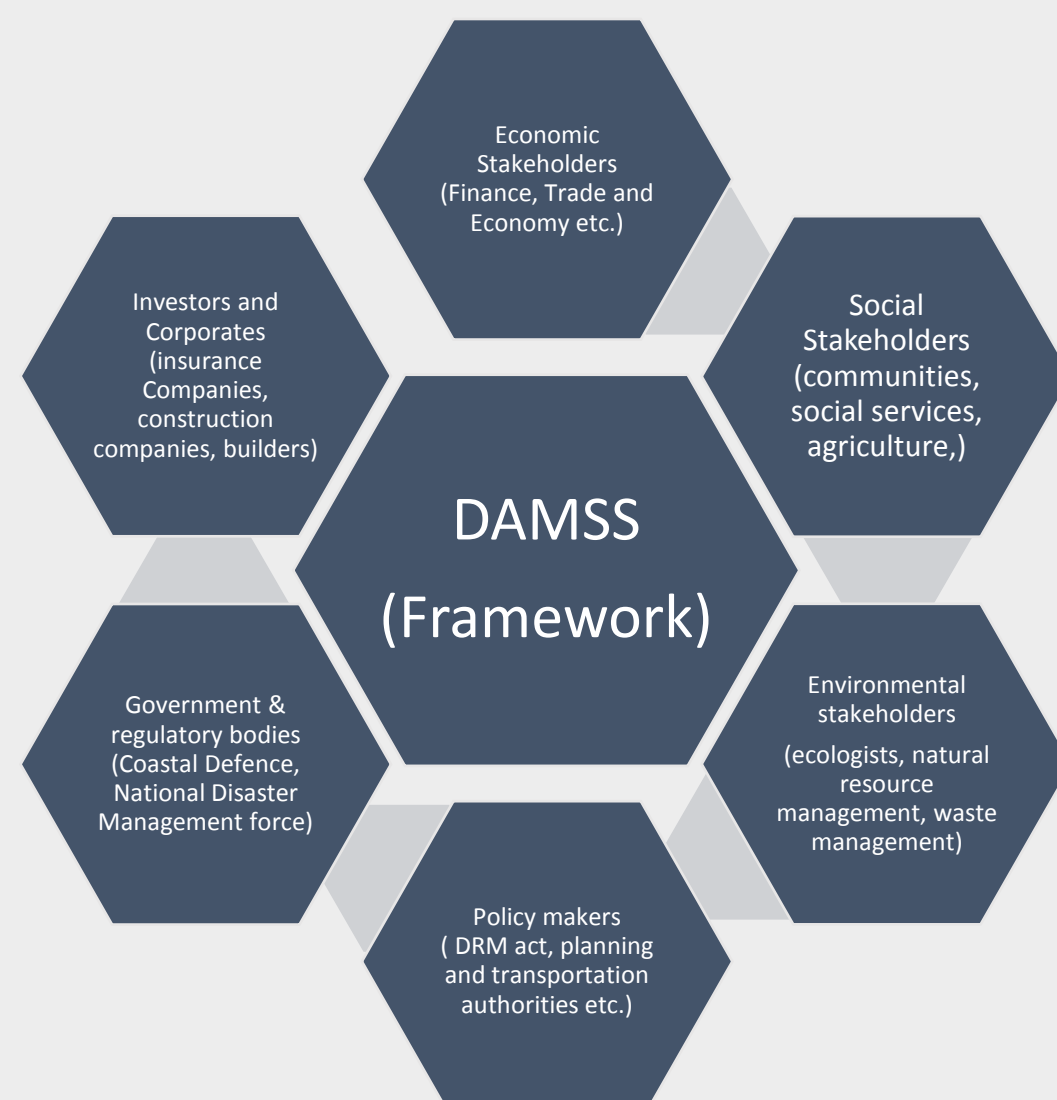


Ref: NOAA (NHC) (Billion-Dollar weather and climate disaster events)

DAMSS Stakeholders

DAMSS will provide a framework combining:

- best practice from previous mitigation methods used and how the end users would benefit if the gap between previous and current future techniques were merged
- providing both economic and social stakeholders resulting towards input for policy change and a better understanding of mitigation and preparedness methods.



Outcome: Framework Development

Priorities of framework

- Storm surge resilience characteristics
- Analysing integration into policies for storm surge
- Data linking approaches to align surge with hurricane scale
- Alternative option for storm surge barrier investment

Government & Private Sectors on surge protection

- Insurance industries and damage cover from storm surge
- Construction companies and need for flood proof infrastructures
- Government - storm surge governance, management
- Enhance surge preparedness for effective response

Limitation Overcomer:

- Identification of mapped data with surge prediction tools
- Insurance and reinsurance coverage
- Upgraded protection