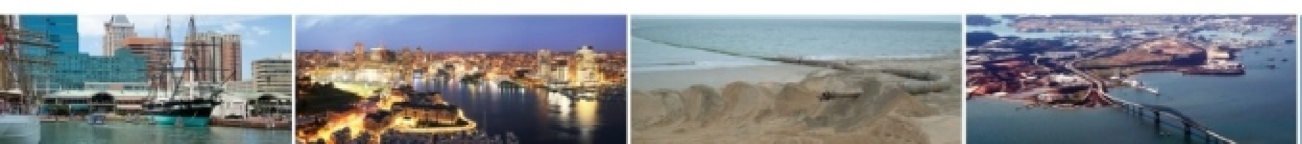
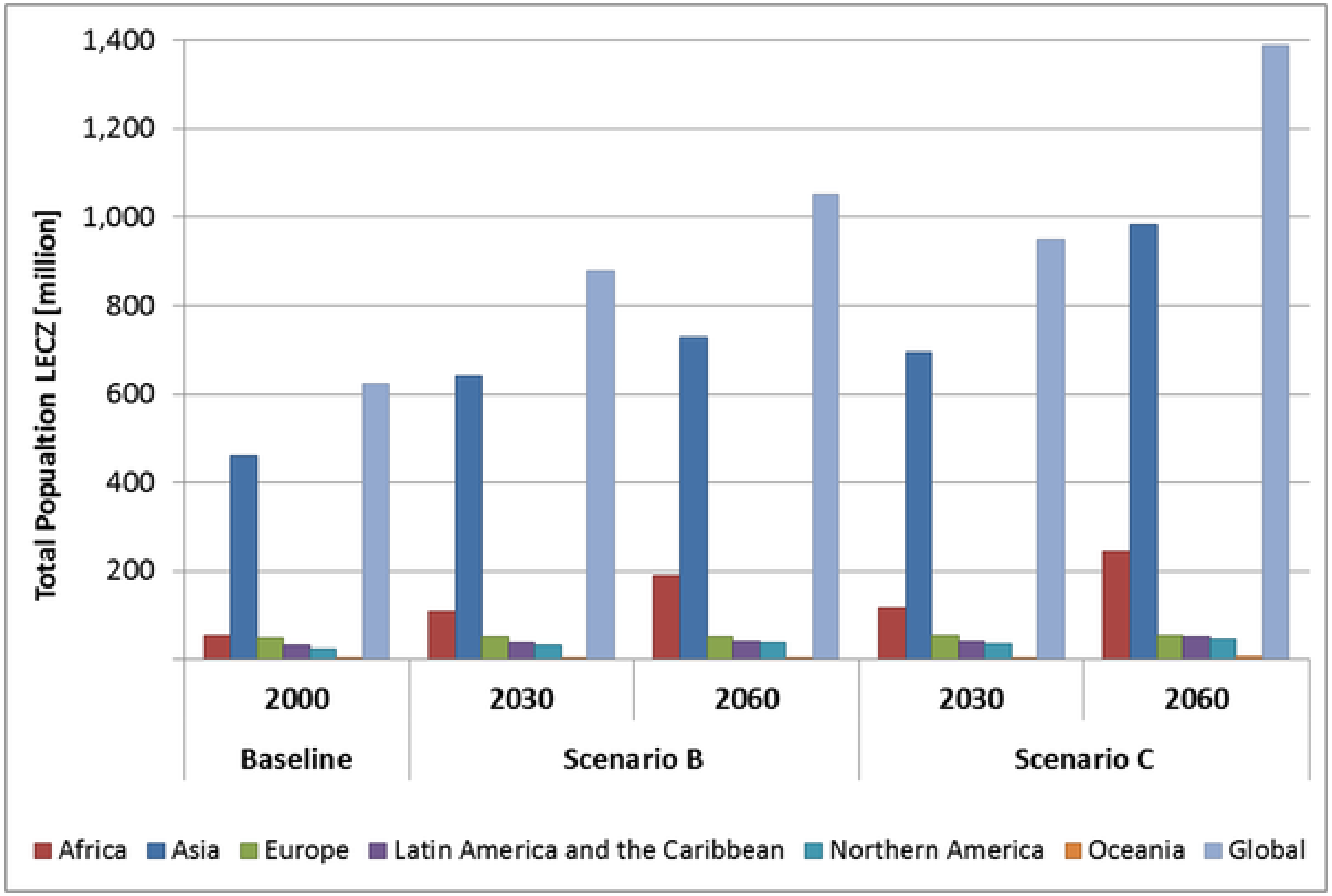
RISK ANALYSIS FOR COASTAL FLOODING UNDER CLIMATE CHANGE

Daiki Tsujio & Paul Bates

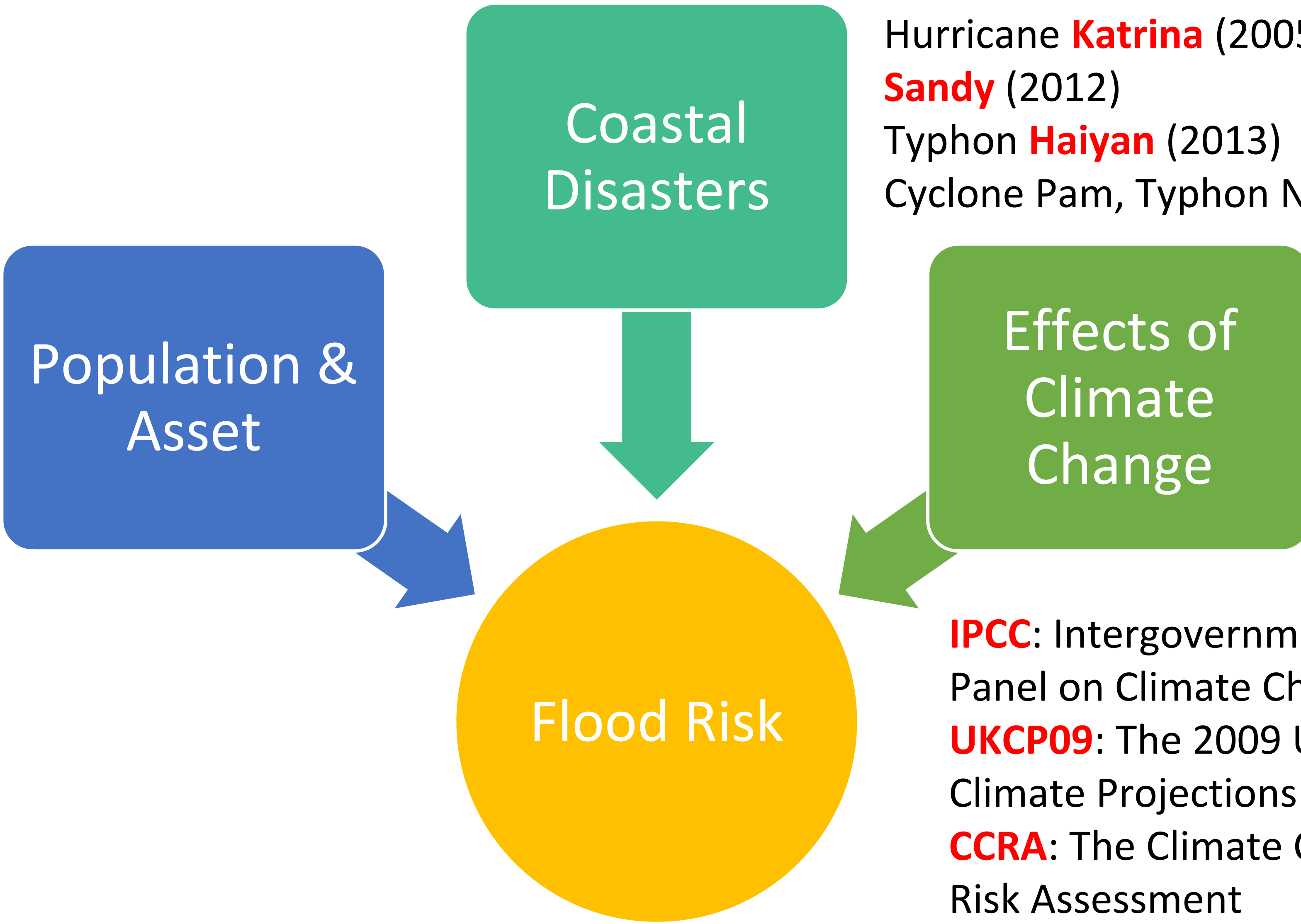


Population in Low Elevation Coastal Zone



Neumann B, Vafeidis AT, Zimmermann J, Nicholls RJ (2015) Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding - A Global Assessment. PLoS ONE 10(3): e0118571. doi:10.1371/journal.pone.0118571
http://127.0.0.1:8081/plosone/article?id=info:doi/10.1371/journal.pone.0118571

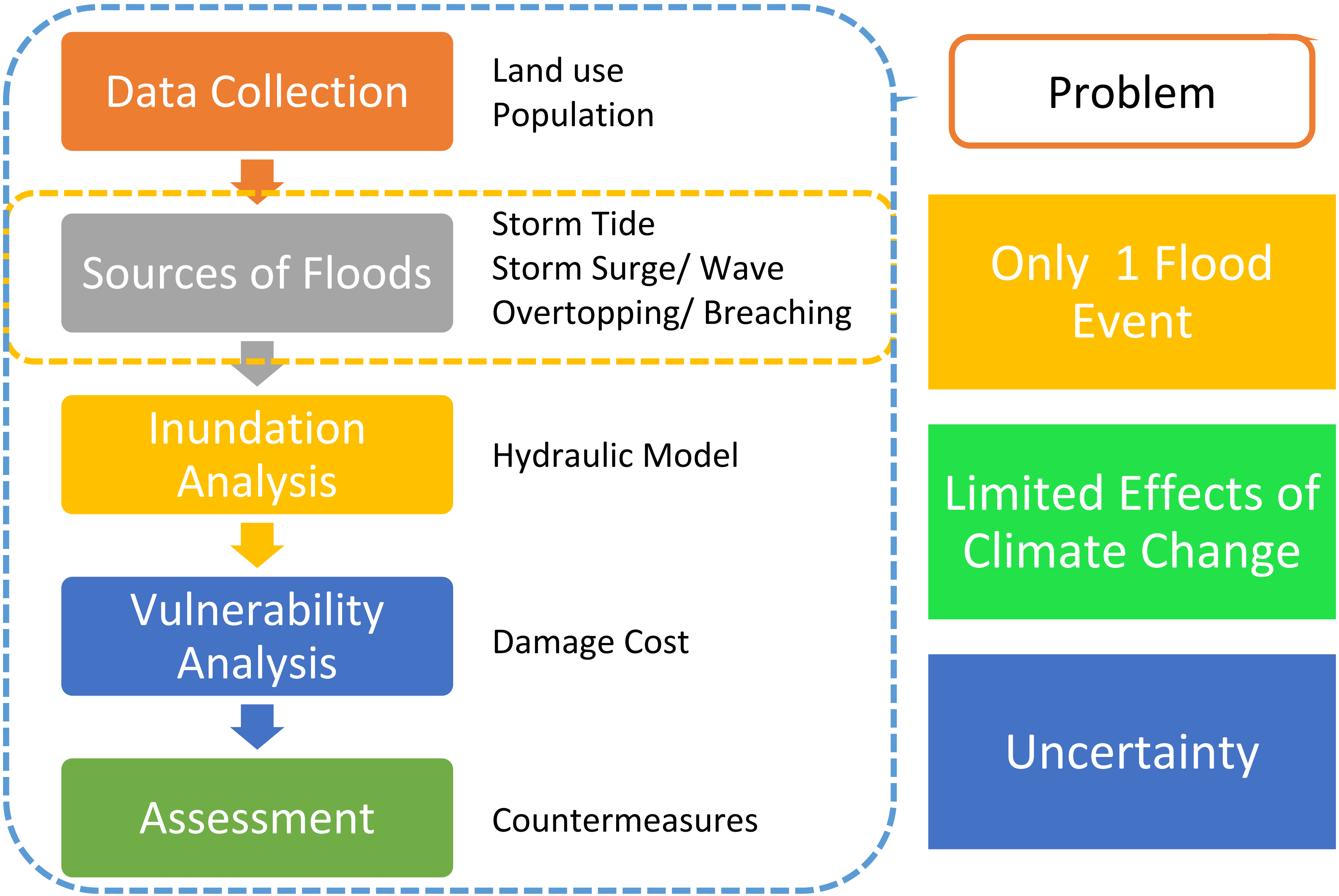
Coastal Flood Risk Management



Hurricane **Katrina** (2005),
Sandy (2012)
Typhon **Haiyan** (2013)
Cyclone Pam, Typhon Noul (2015)

IPCC: Intergovernmental Panel on Climate Change
UKCP09: The 2009 UK Climate Projections
CCRA: The Climate Change Risk Assessment

Risk Analysis Framework



Aim of This Research

An Integrated Risk Analysis Scheme

- Consider all effects of future climate change
- Cover all annual flood events

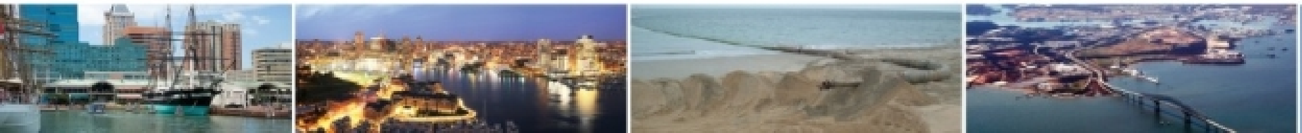
Actual Impact Analysis of Coastal Flood Risk

- Verify the presented method

Outline of Presentation

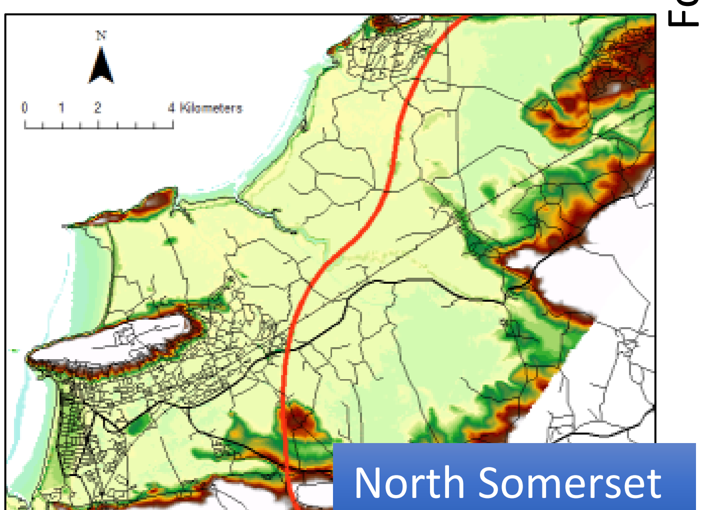
1. Motivation of This Study
2. Flood Risk Analysis Scheme & Calculation Conditions
3. Impacts on Future Flood Risk
4. Conclusions

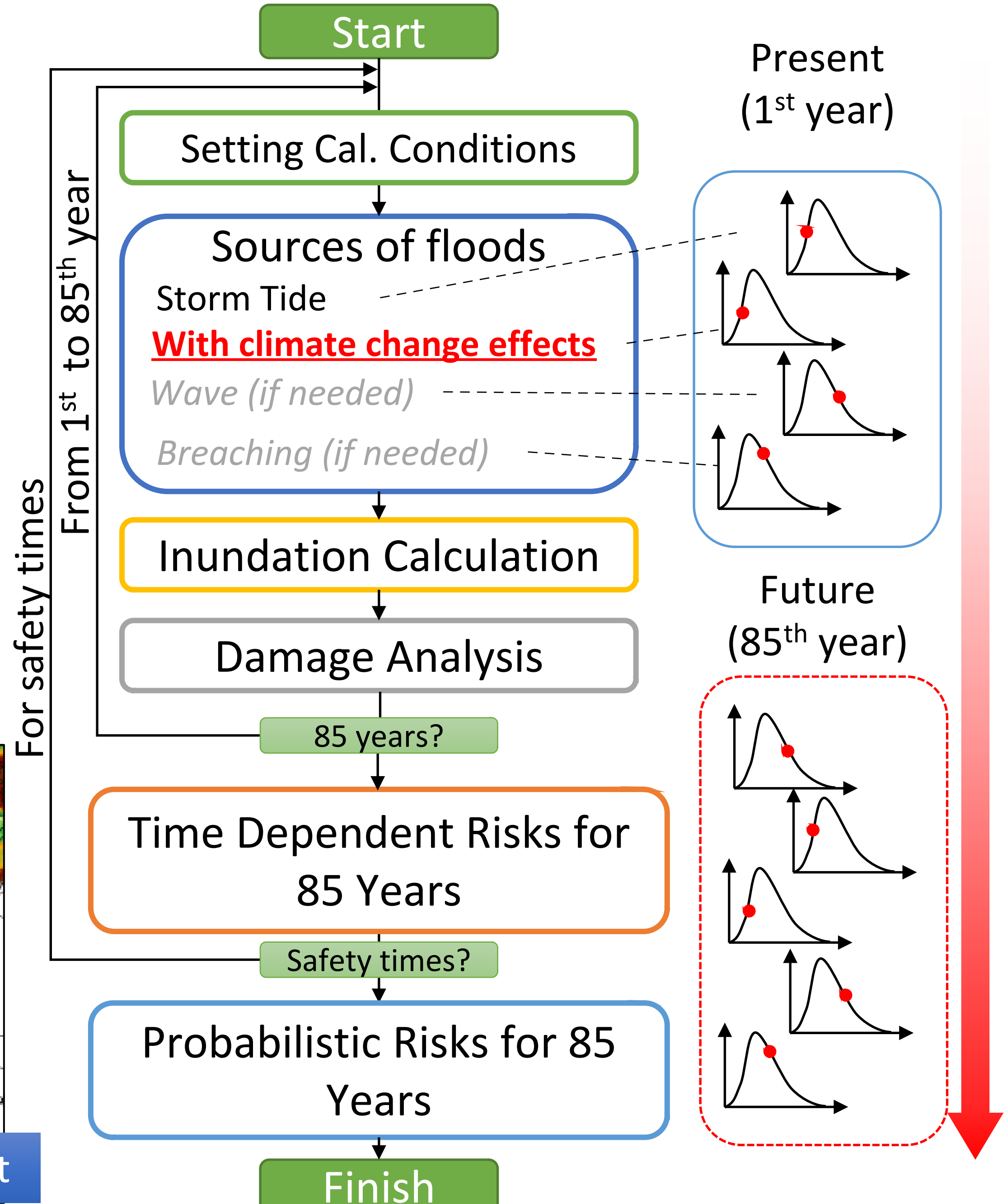
Flood Risk Analysis Scheme



Method

- **Probabilistic Risk Analysis**
- **Monte-Carlo simulation**
- Covering **all annual floods** in target terms
- **LISFLOOD-FP**

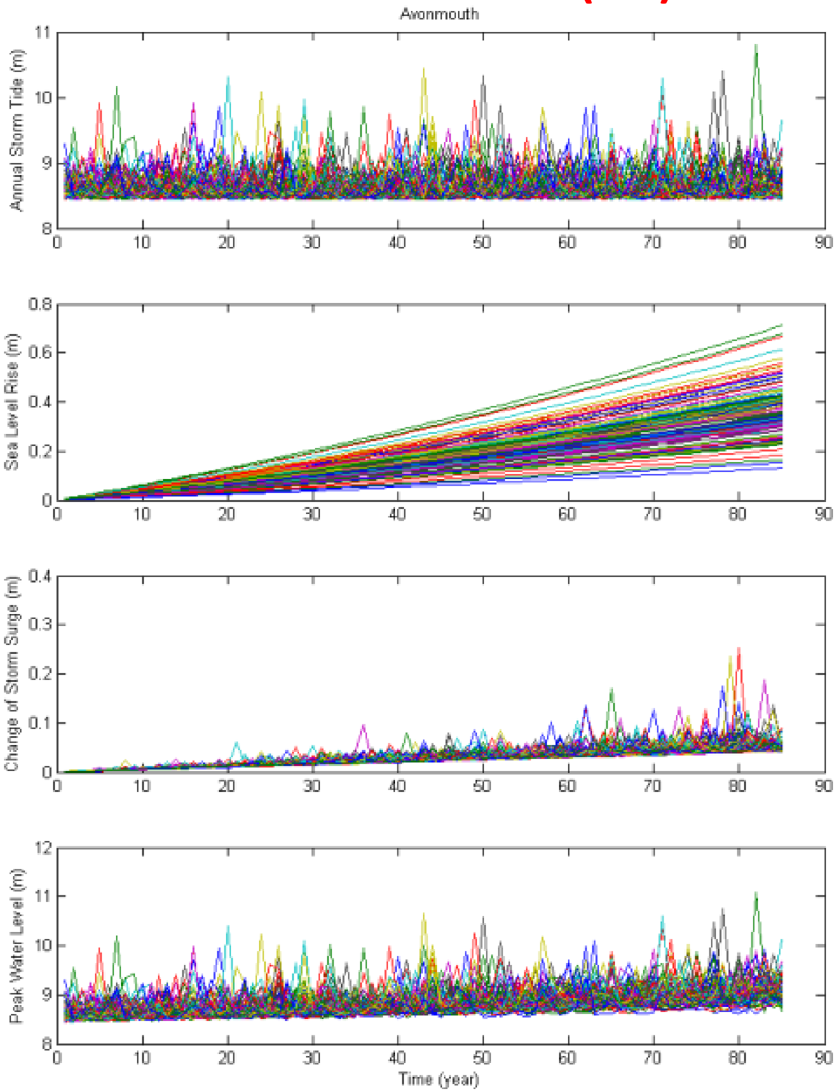




Hazard Modelling

Repetition: 100
Study Period: 2015-2100 (85 years)

1. Avonmouth (AV)



Storm Tide

+

Sea Level Rise

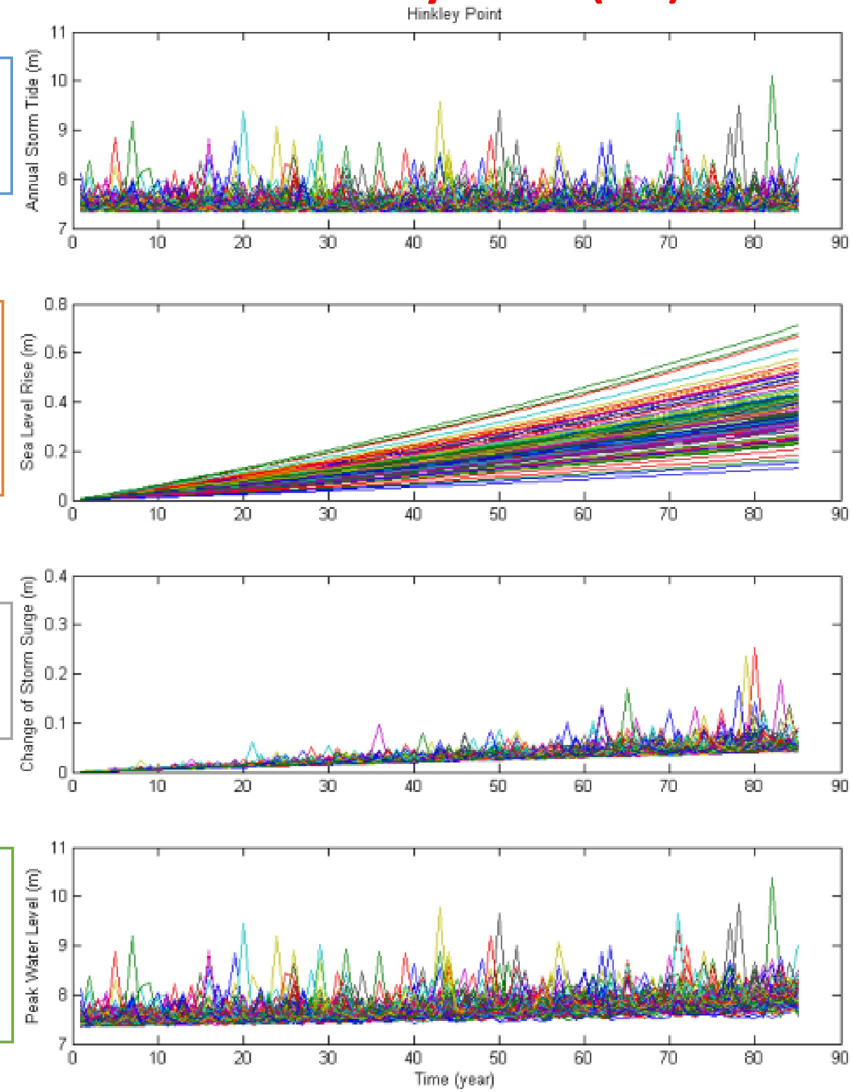
+

Storm Surge

=

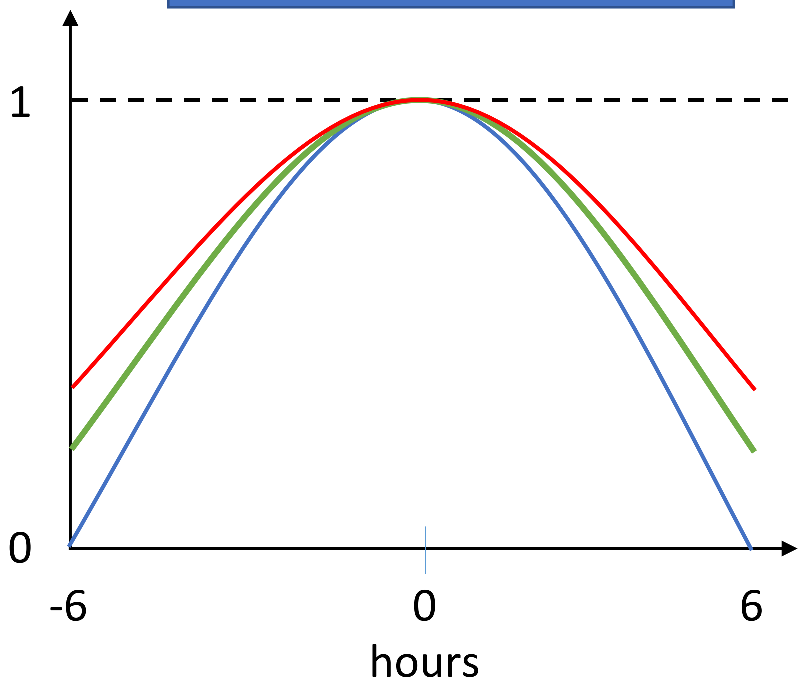
Peak Water Level

2. Hinkley Point (HP)



Variation – Duration & Boundary Condition

Temporal Variation:
Hydrograph

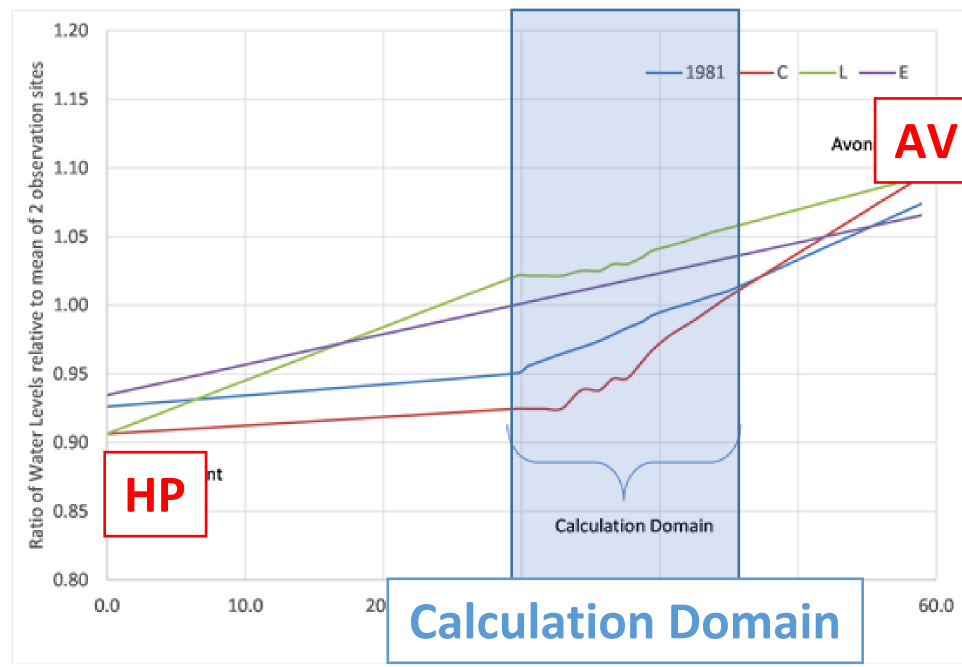


Source: Quinn et al. (2014)

1. Avonmouth (AV)

2. Hinkley Point (HP)

Spatial Distribution:
Boundary Condition



Source: Lewis et al. (2011)

Estimation of Total Damage Cost (C_t)

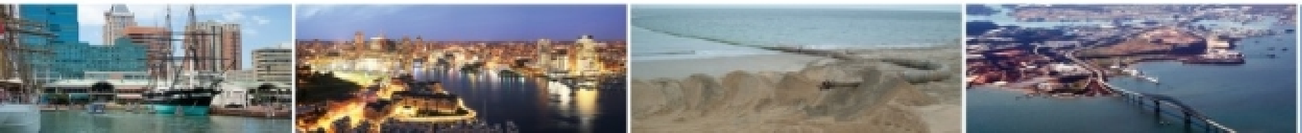
$$C_t = C_a + C_b + C_e + C_d + C_i$$

Damage Cost		Items	Values
C_a	Agriculture	Maximum Damage Value	- Fixed: £ 264 / 50 m^2
C_b	Building	Maximum Damage Value	- Normal Dist. - Mean: £ 1.15 M / 50 m^2
		Depth-Damage Function	- Normal Dist. - Multi Coloured Manual (MCM)
C_e	Emergency Service	Ratio to C_b	- Fixed: 5.6 % (MCM, 2010)
C_d	Death	Value of Statistical Life	- Normal Dist. (Mean: £ 2.4 M / person)
C_i	Injury	Method	- Defra (2006)

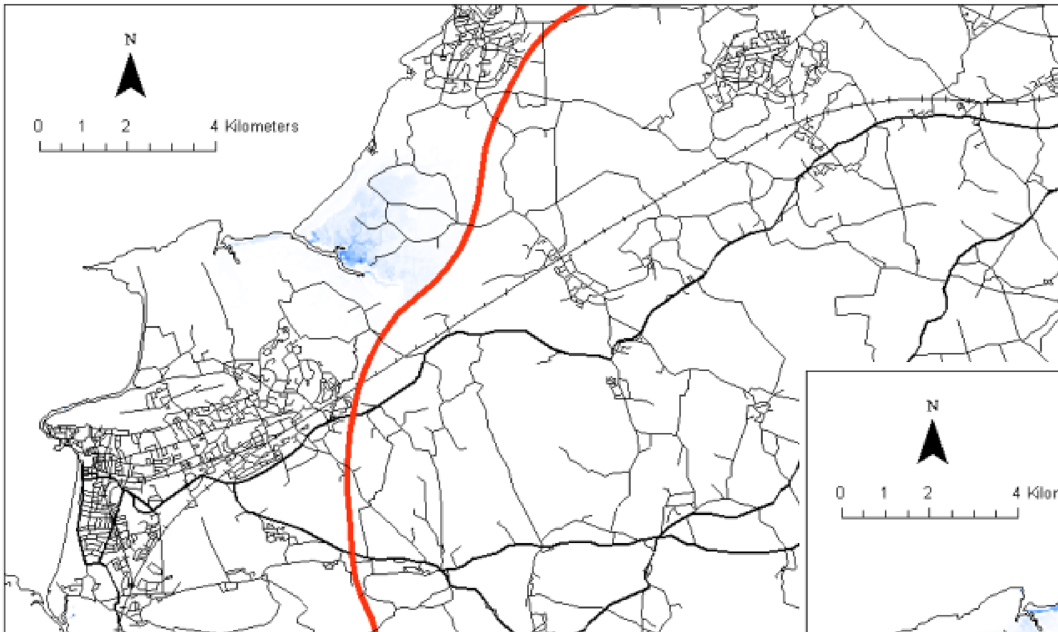
Calculation Cases

Case		Storm Tide	Sea Level Rise	Future Change of Storm Surge	Variation of Duration	Variation of Boundary Condition
1	Storm Tide	X	-	-	-	-
2	SLR (Low)	X	X: Low	-	-	-
3	SLR (Med)	X	X: Med	-	-	-
4	SLR (High)	X	X: High	-	-	-
5	Storm Surge	X	-	X: Med	-	-
6	Duration	X	-	-	X	-
7	Boundary C	X	-	-	-	X
8	All (SLR-L)	X	X: Low	X: Med	X	X
9	All (SLR-M)	X	X: Med	X: Med	X	X
10	All (SLR-H)	X	X: High	X: Med	X	X

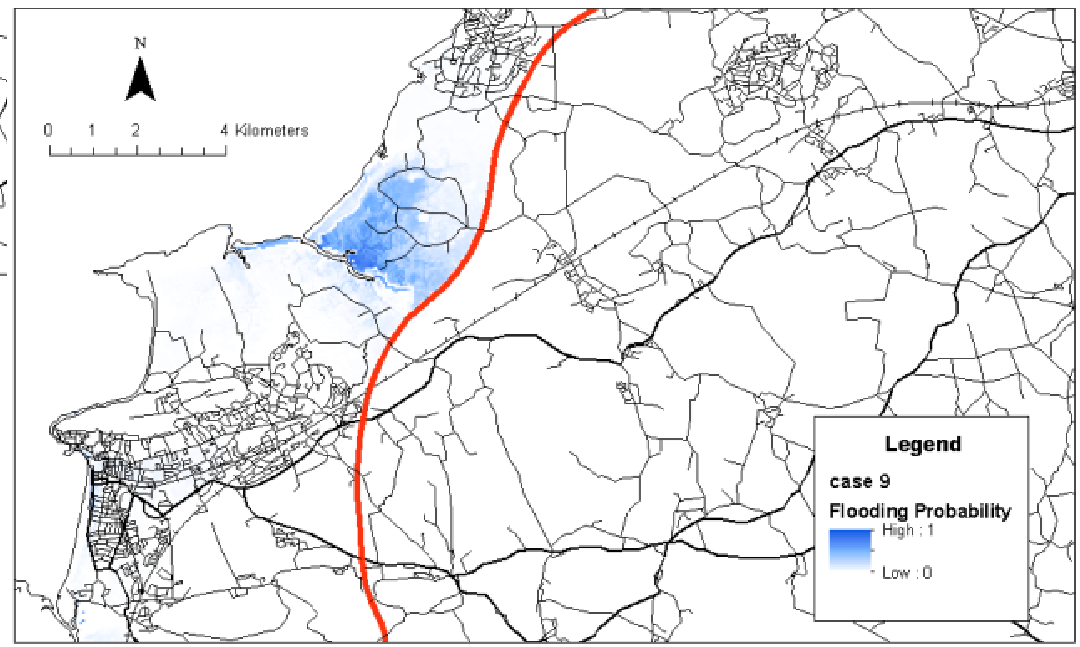
Impacts on Future Flood Risk



Results of Flood Area

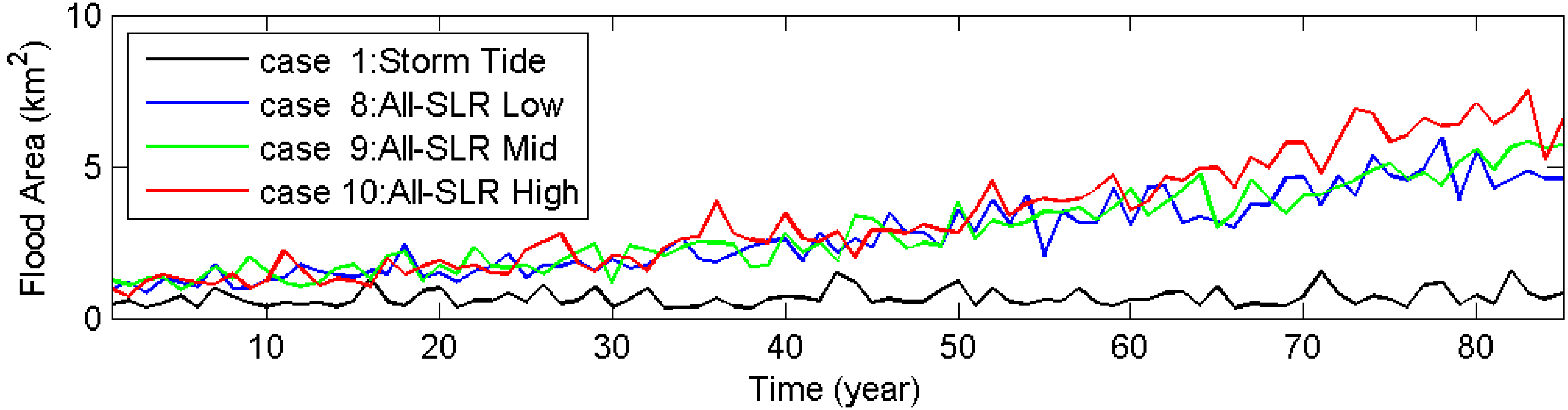


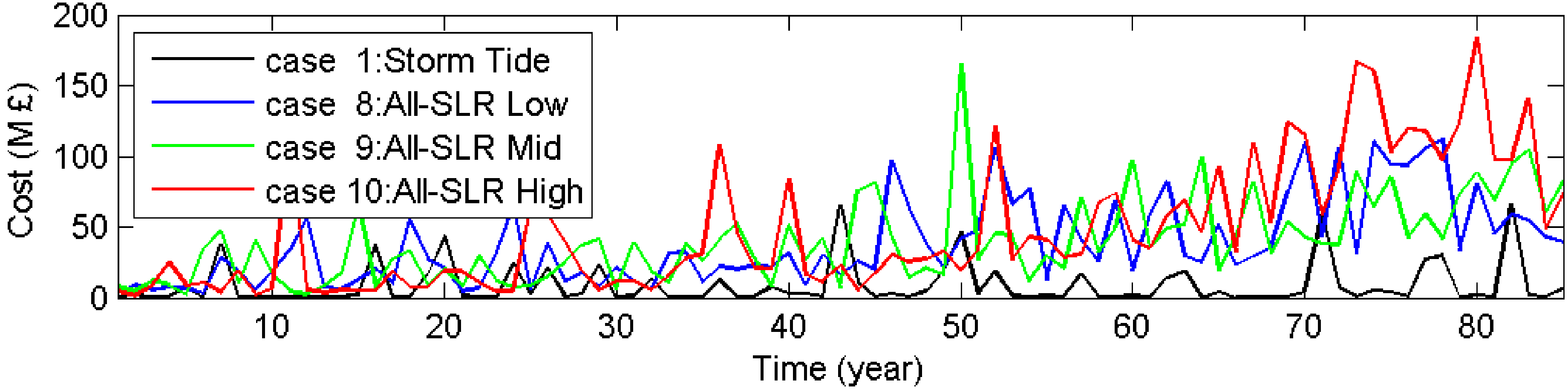
Case 1: Control Case



Case 9: 5 factors with medium SLR scenario

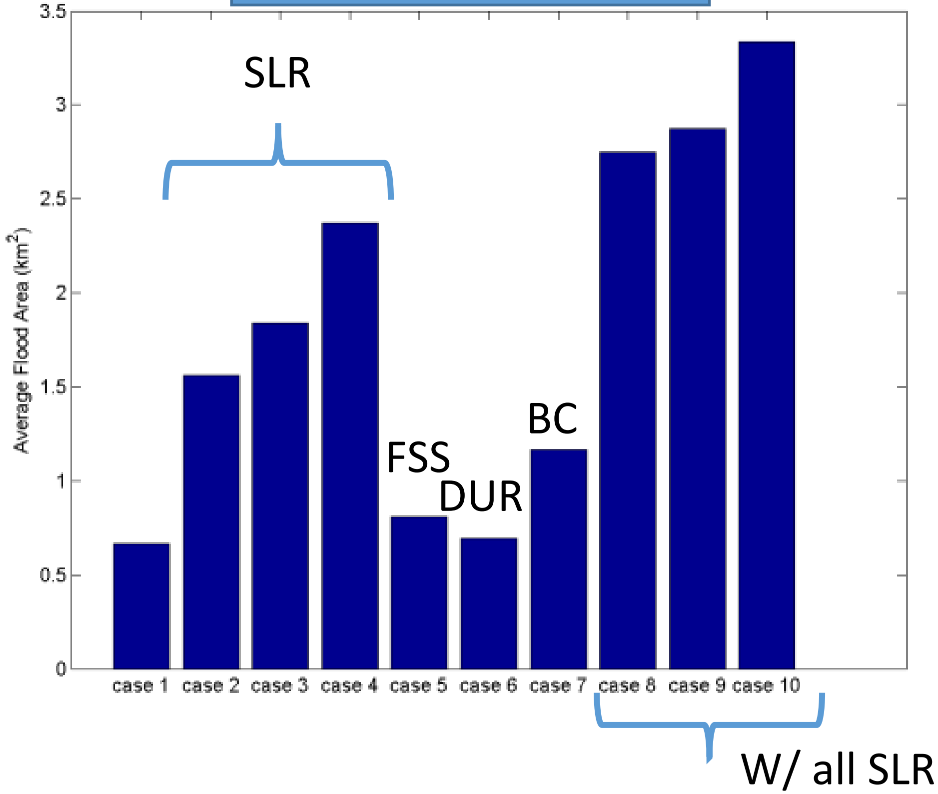
Time Series of Flood Area & Damage Cost



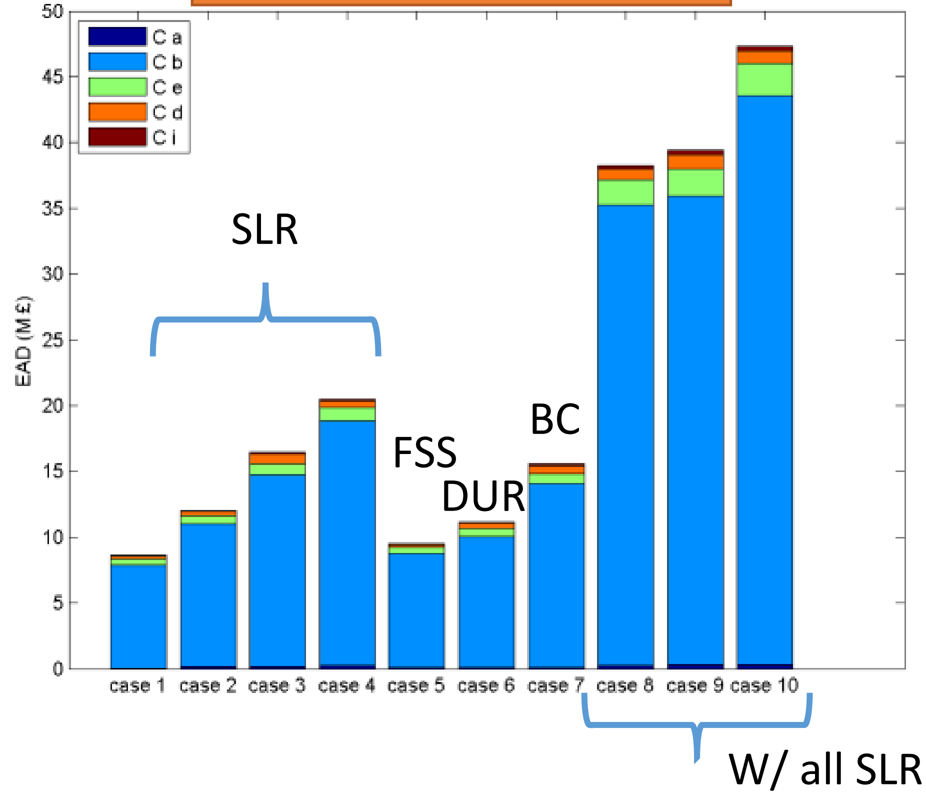


Impacts on Flood Area & Damage Cost

Flood Area (km^2)



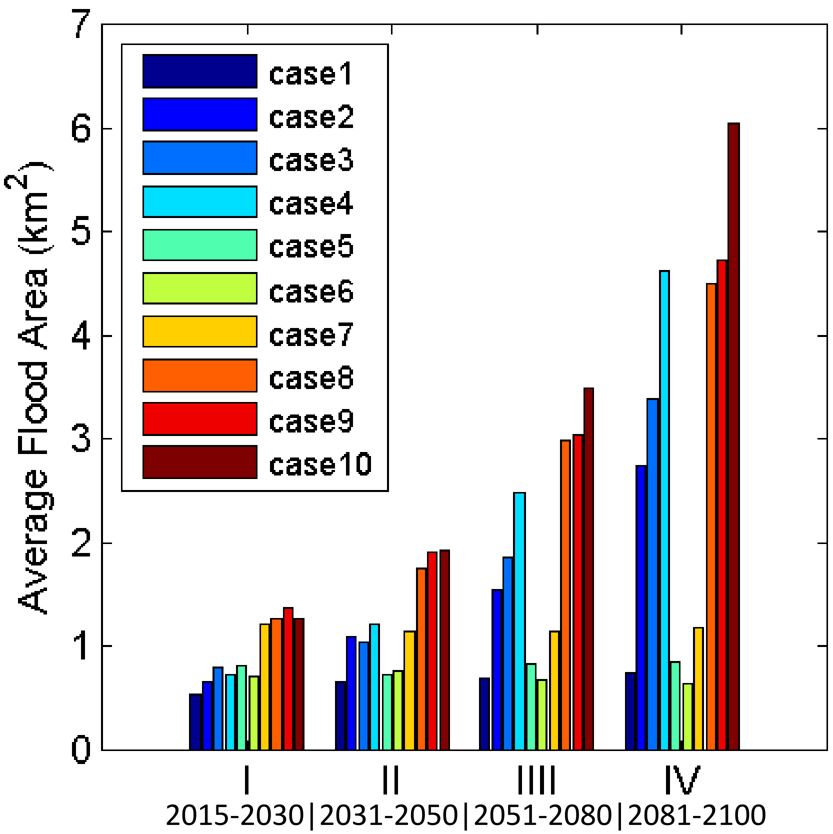
Damage Cost (M £)



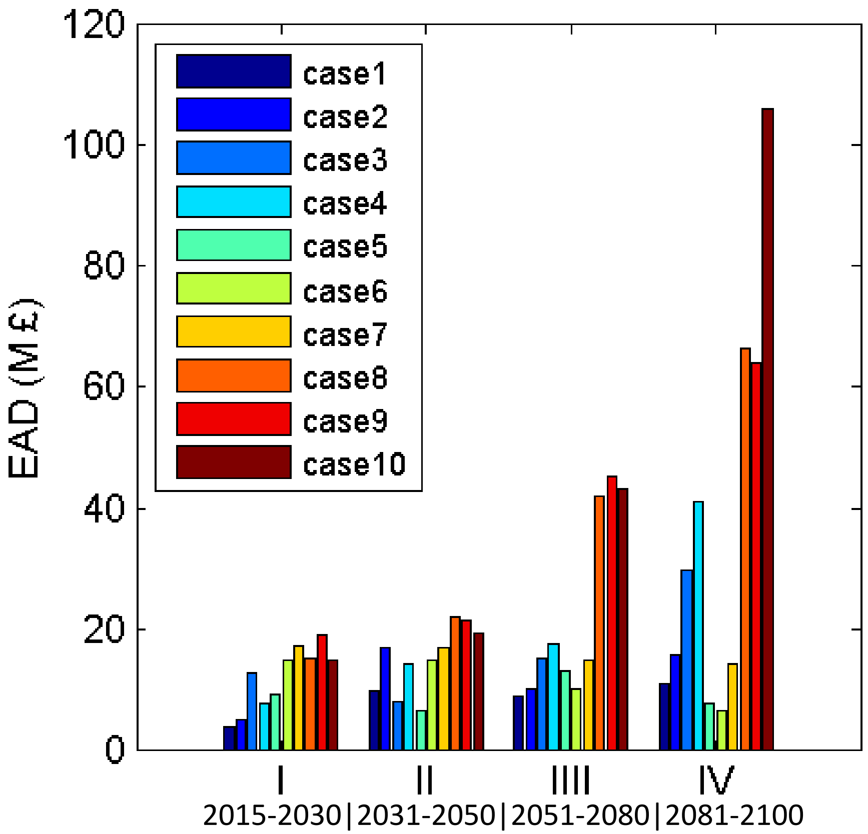
	1	2:SLR-L	3:SLR-M	4:SLR-H	5: FSS	6: DUR	7: BC	8: All-L	9: All-M	10: All-H
Flood Area	-	140%	180%	260%	20%	5%	80%	310%	330%	400%
Damage Cost	-	60%	90%	130%	20%	30%	80%	350%	360%	450%

Impacts with Projection Lead Time

Flood Area (km^2)

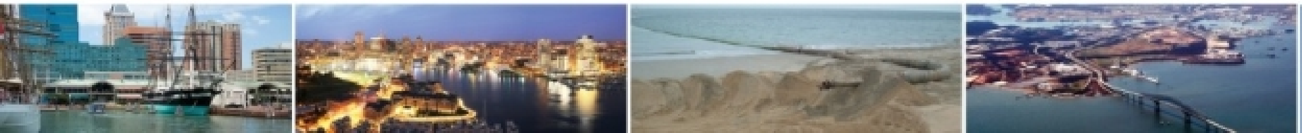


Damage Cost (M £)



I: 2015-2030, II: 2031-2050, III: 2051-2080, and IV: 2081-2100

Conclusion



Conclusion

Proposed Method

- to cover all annual flooding events
- to clarify the uncertainty

Future Risk

- SLR is the highest impact factor in North Somerset
- Combining other factors: from +200% to +400%
- Lead time influences the impacts on costs (> flood area)

Future

- Effects of wave overtopping and breaching
- Importing new projections supports decision-making

Thank you for your attention!