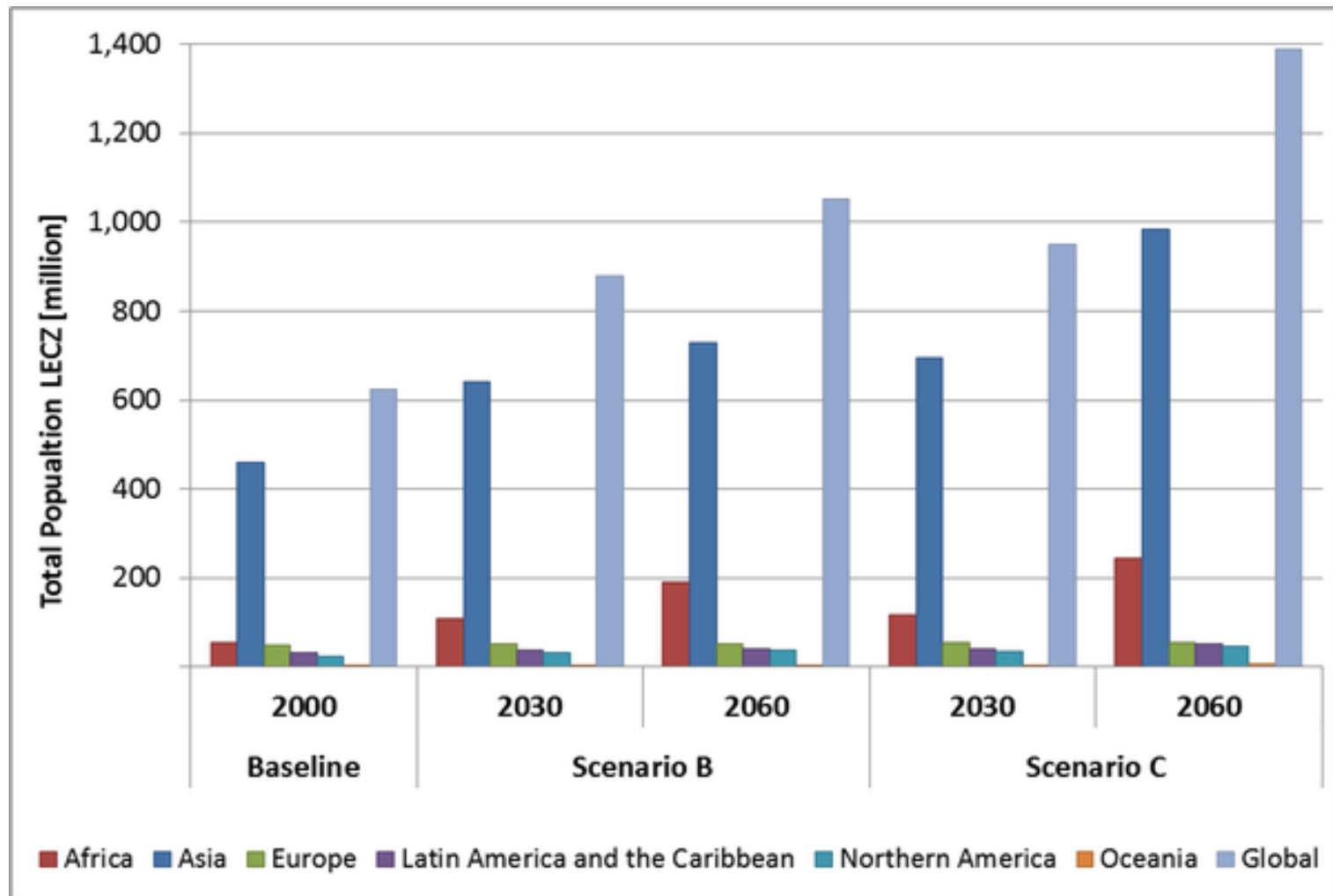


# RISK ANALYSIS FOR COASTAL FLOODING UNDER CLIMATE CHANGE

Daiki Tsujio & Paul Bates



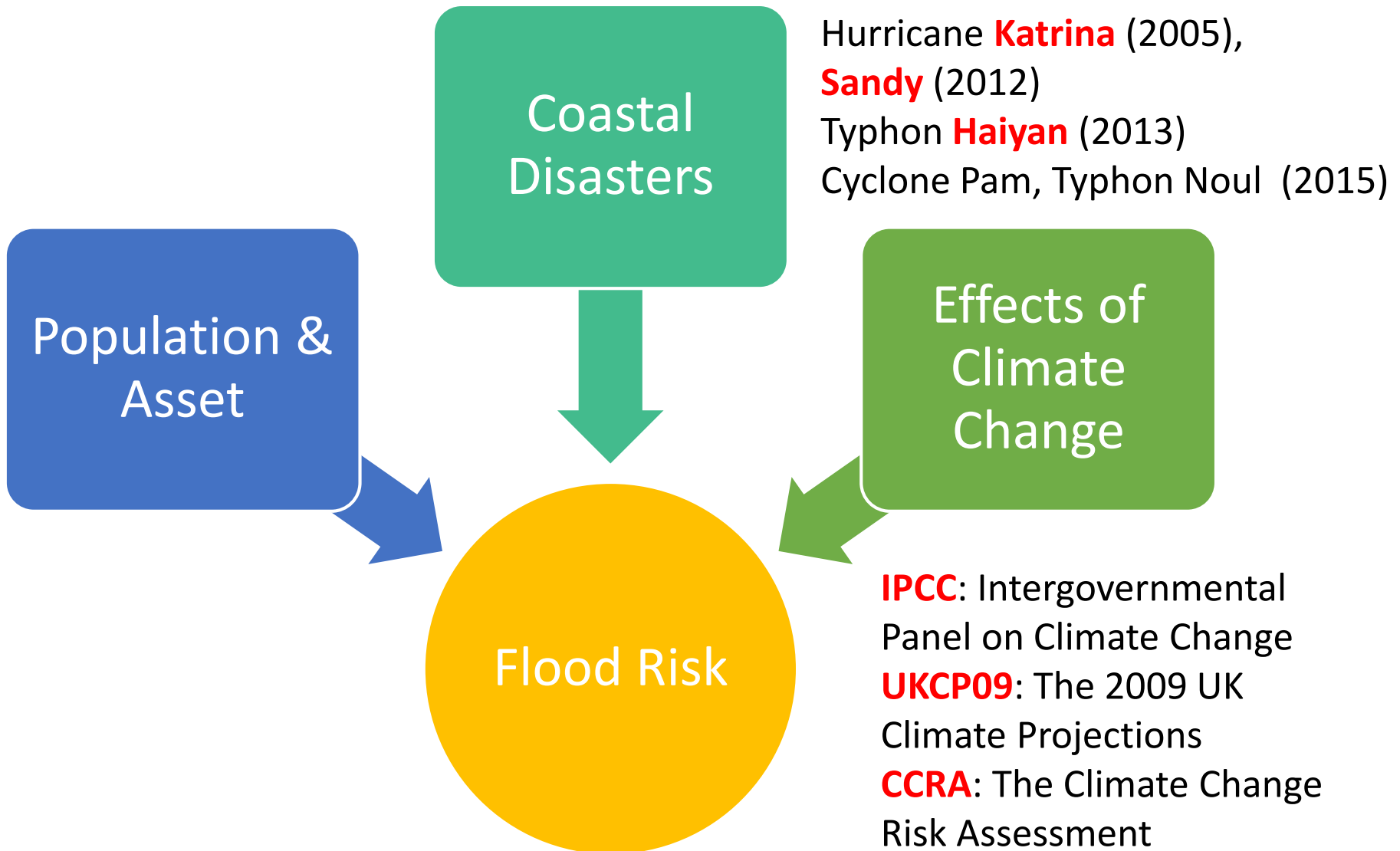
# Population in Low Elevation Coastal Zone



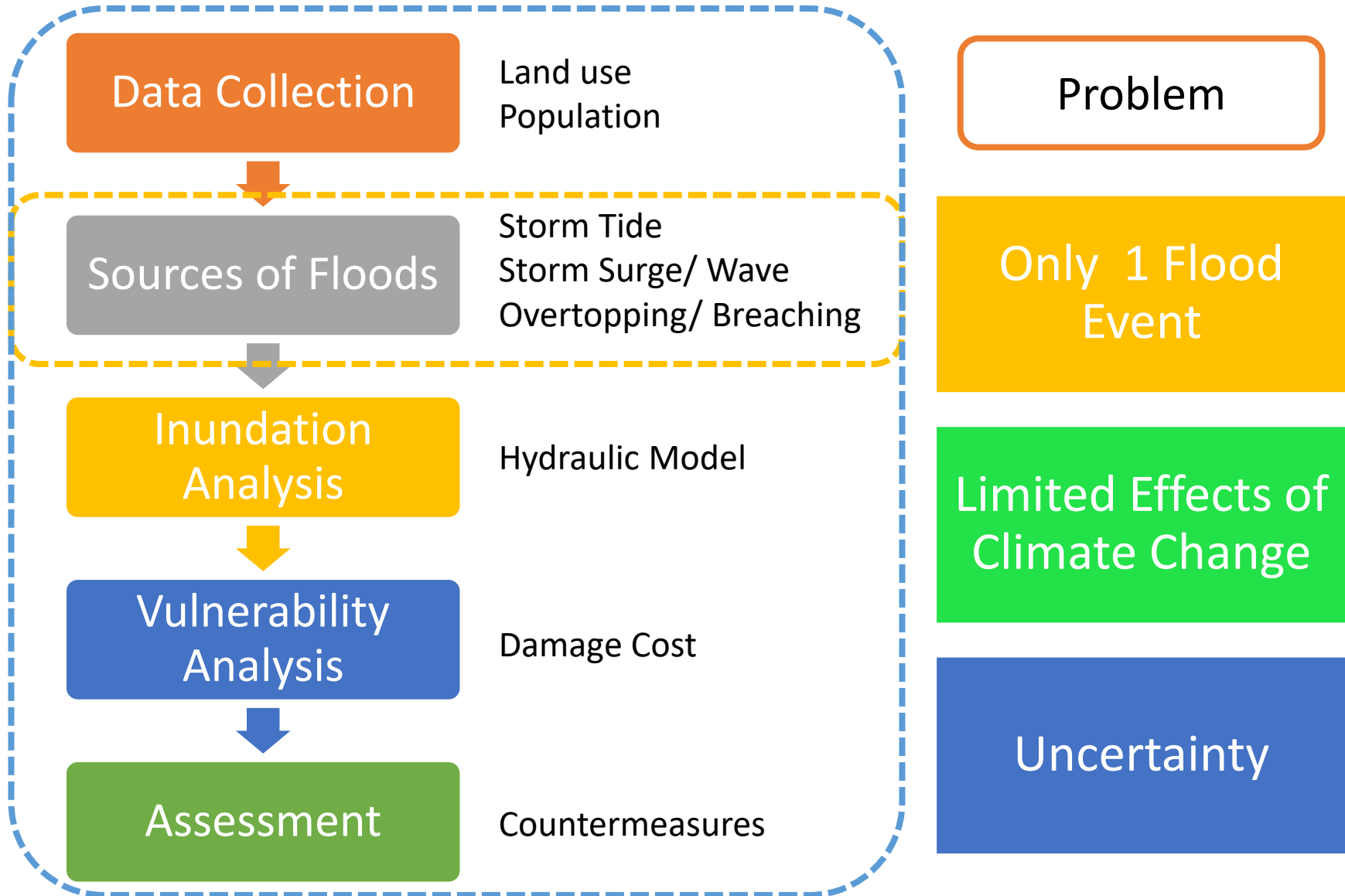
Neumann B, Vafeidis AT, Zimmermann J, Nicholls RJ (2015) Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding - A Global Assessment. PLoS ONE 10(3): e0118571. doi:10.1371/journal.pone.0118571

<http://127.0.0.1:8081/plosone/article?id=info:doi/10.1371/journal.pone.0118571>

# Coastal Flood Risk Management



# Risk Analysis Framework



# Aim of This Research

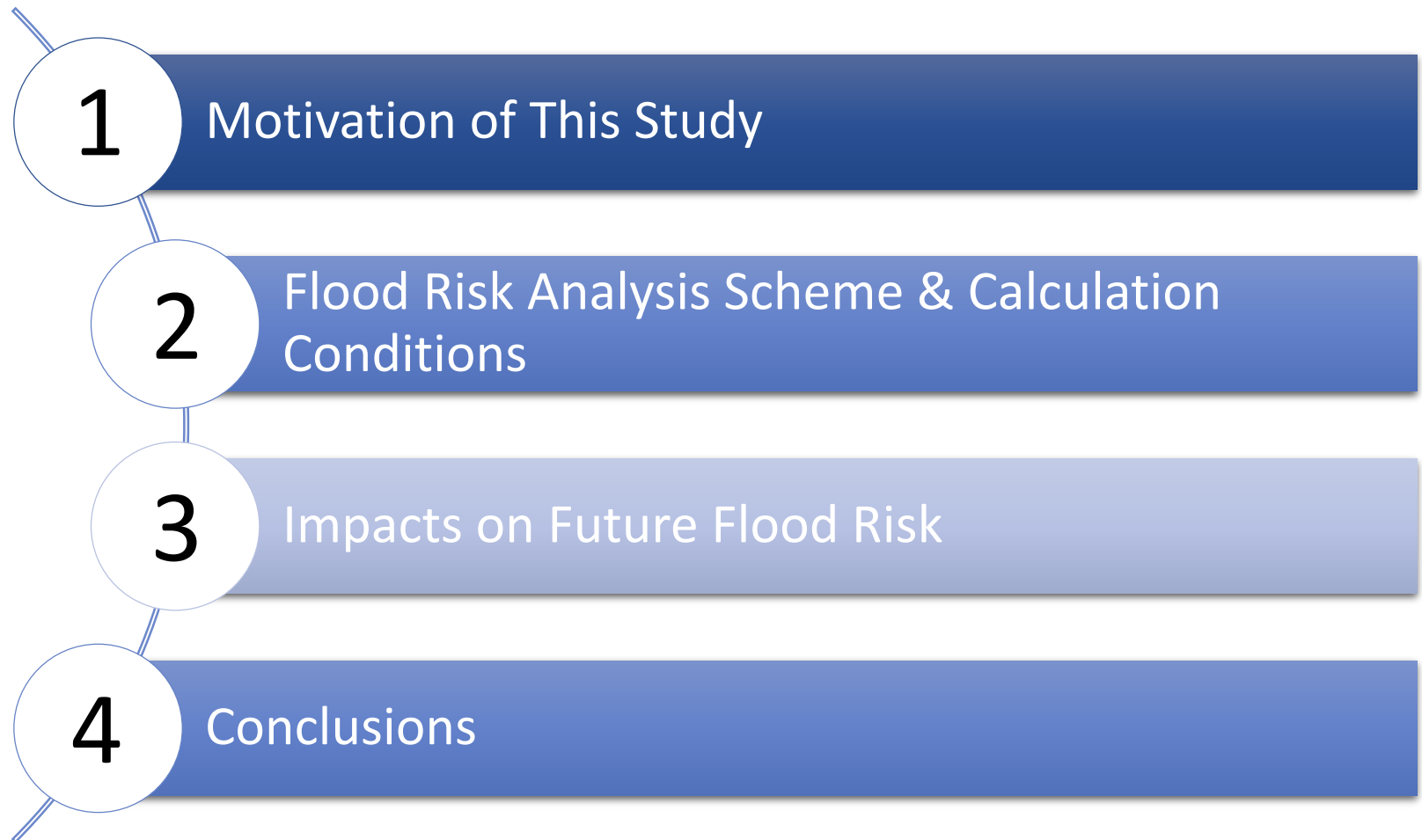
## An Integrated Risk Analysis Scheme

- 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

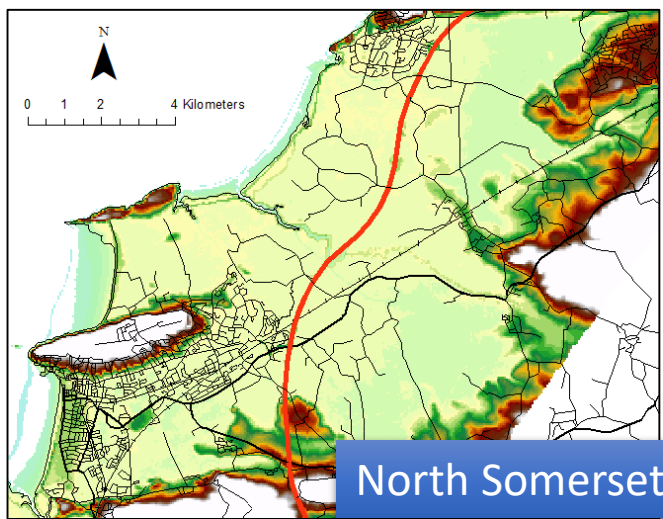
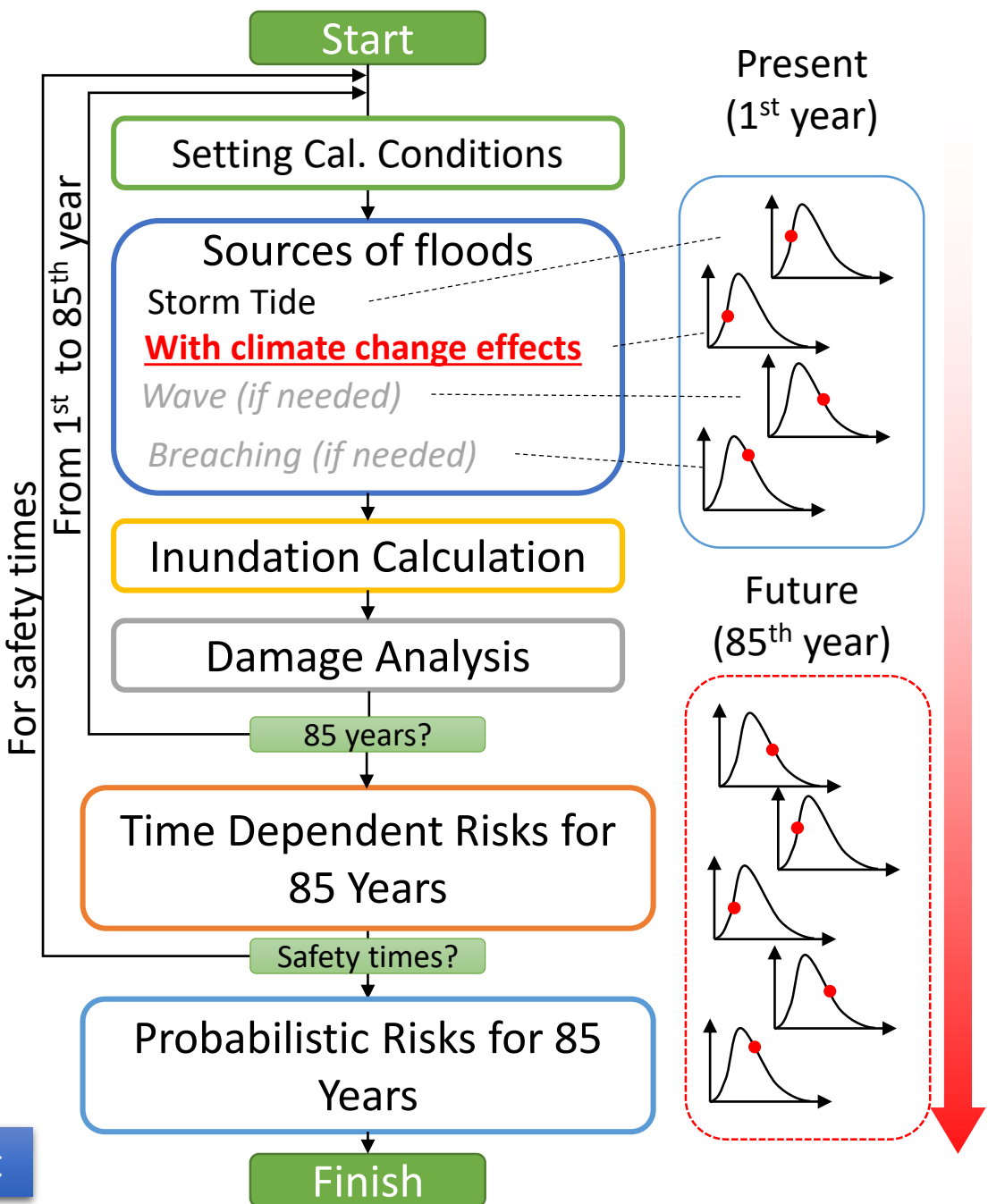


# Flood Risk Analysis Scheme



# Method

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

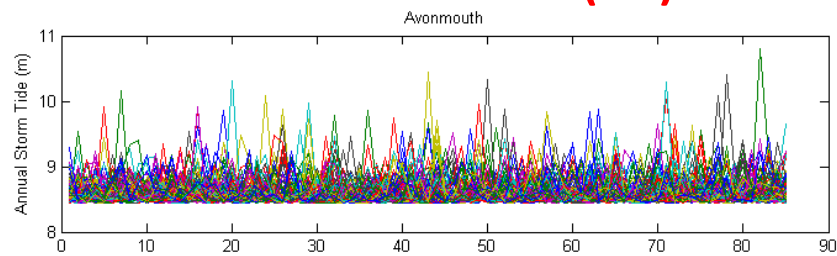




# Hazard Modelling

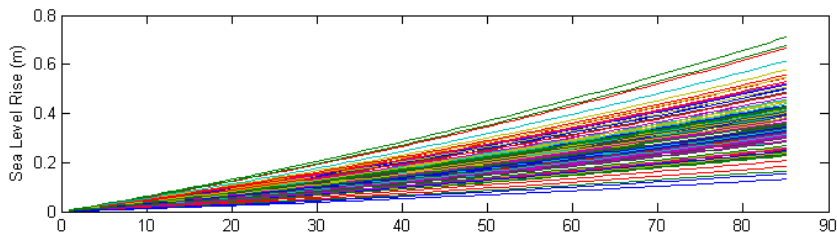
Repetition: 100  
Study Period: 2015-2100 (85 years)

## 1. Avonmouth (AV)



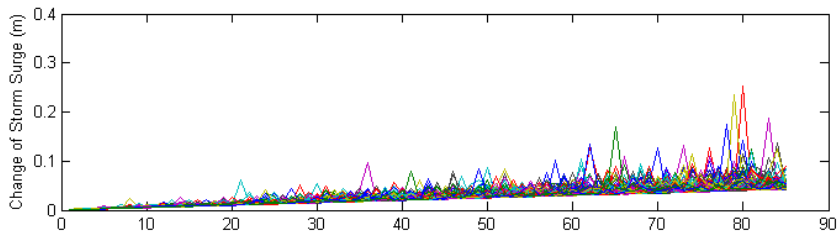
Storm  
Tide

+



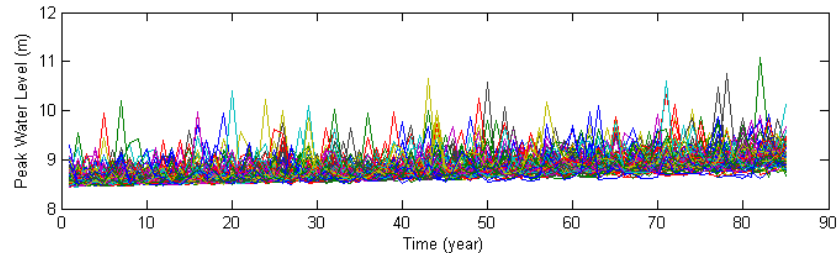
Sea  
Level  
Rise

+



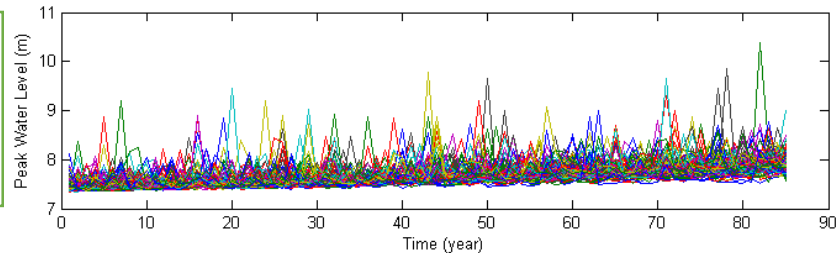
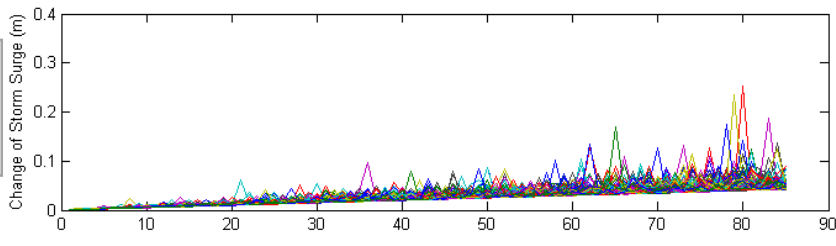
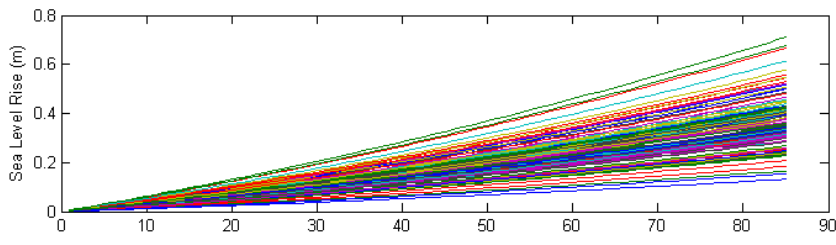
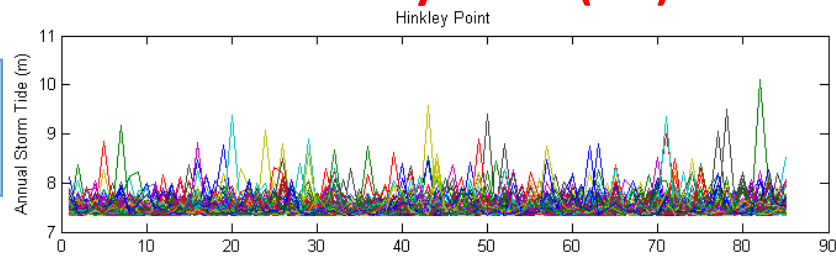
Storm  
Surge

||



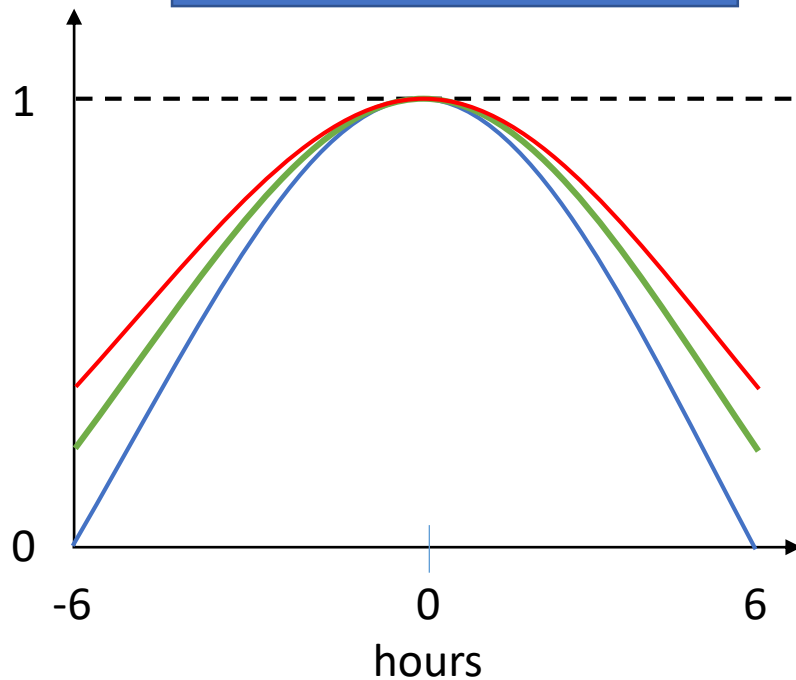
Peak  
Water  
Level

## 2. Hinkley Point (HP)



# Variation – Duration & Boundary Condition

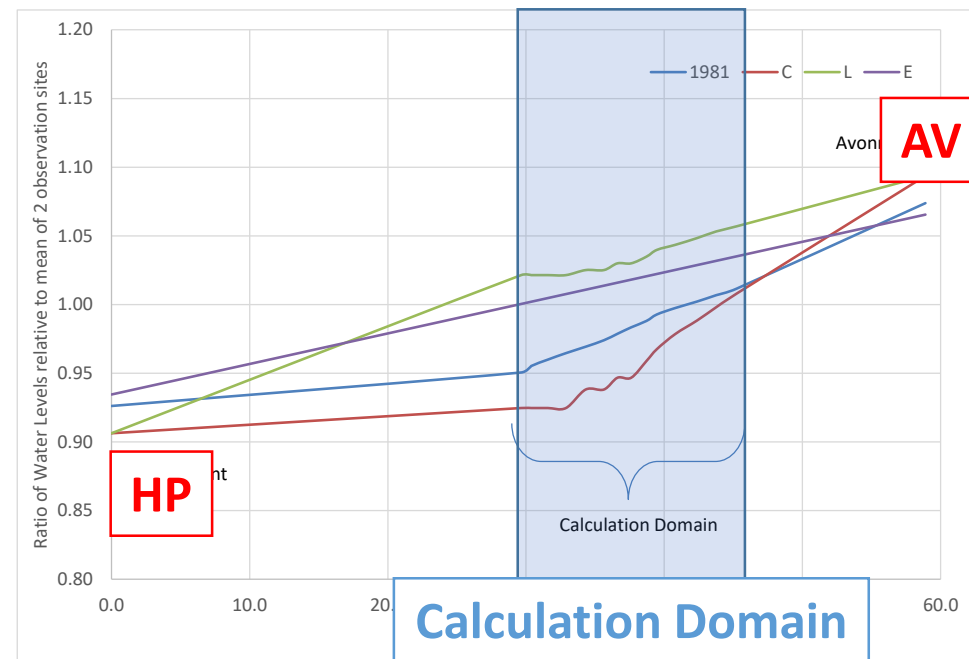
Temporal Variation:  
Hydrograph



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 <sup>2</sup>
$C_b$	Building	Maximum Damage Value	- Normal Dist. - Mean: £ 1.15 M / 50 m <sup>2</sup>
		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)

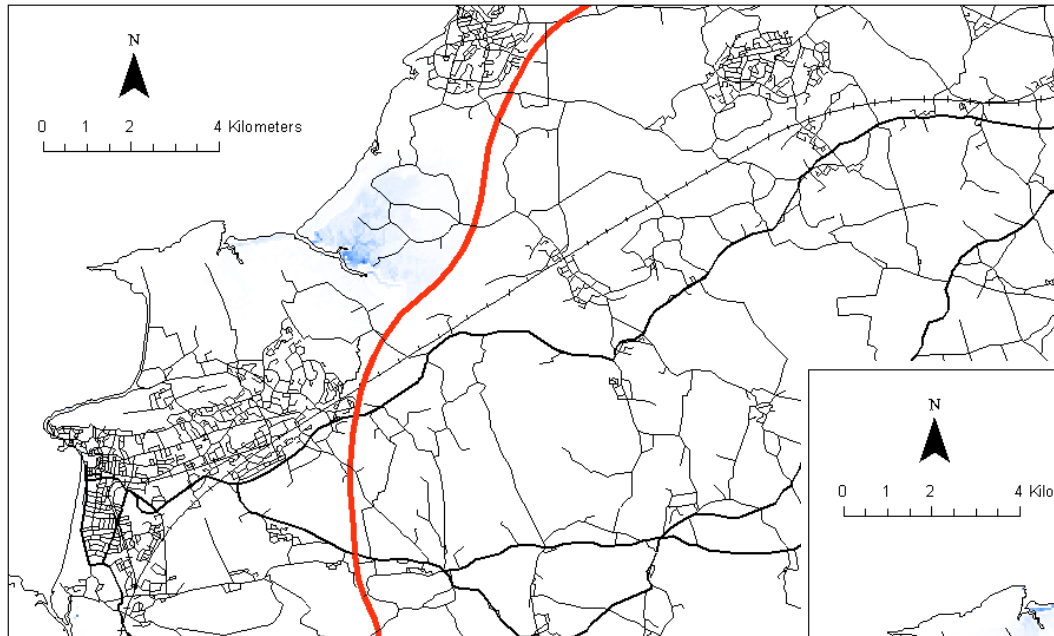
# Calculation Cases

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

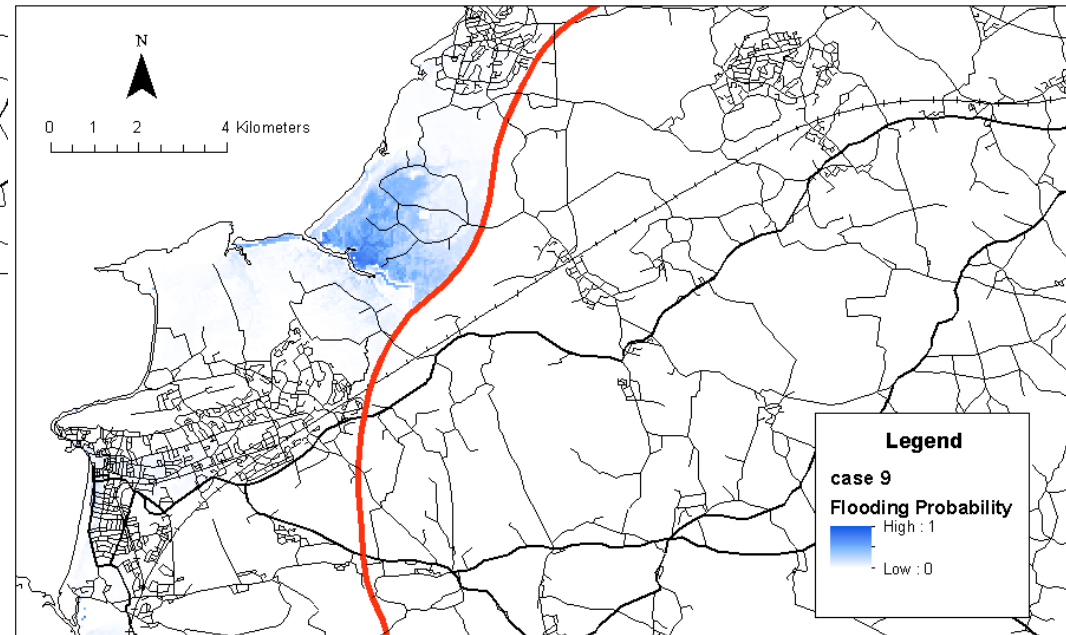
# Impacts on Future Flood Risk



# Results of Flood Area

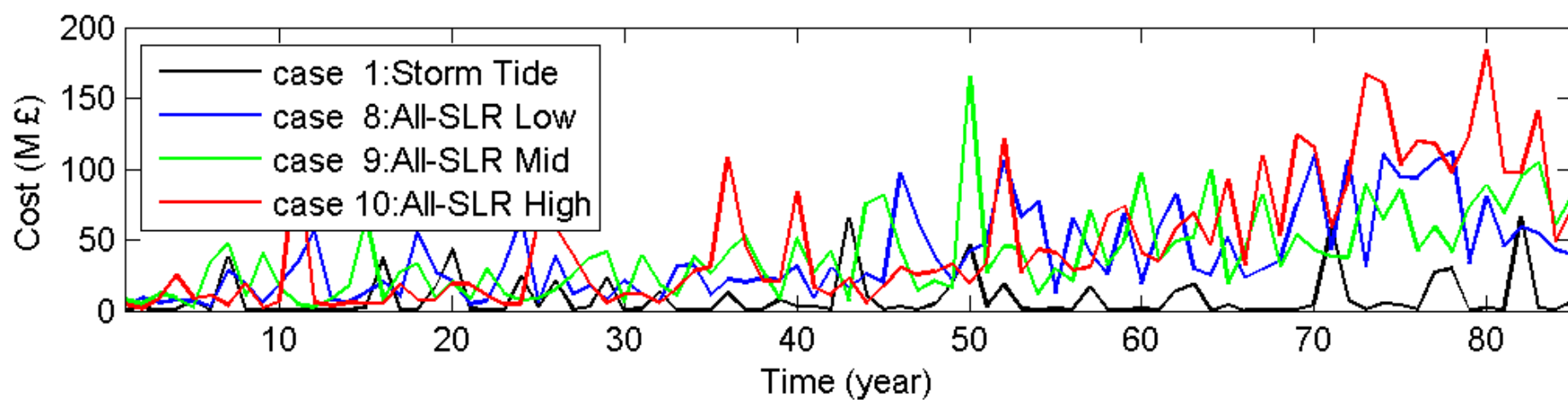
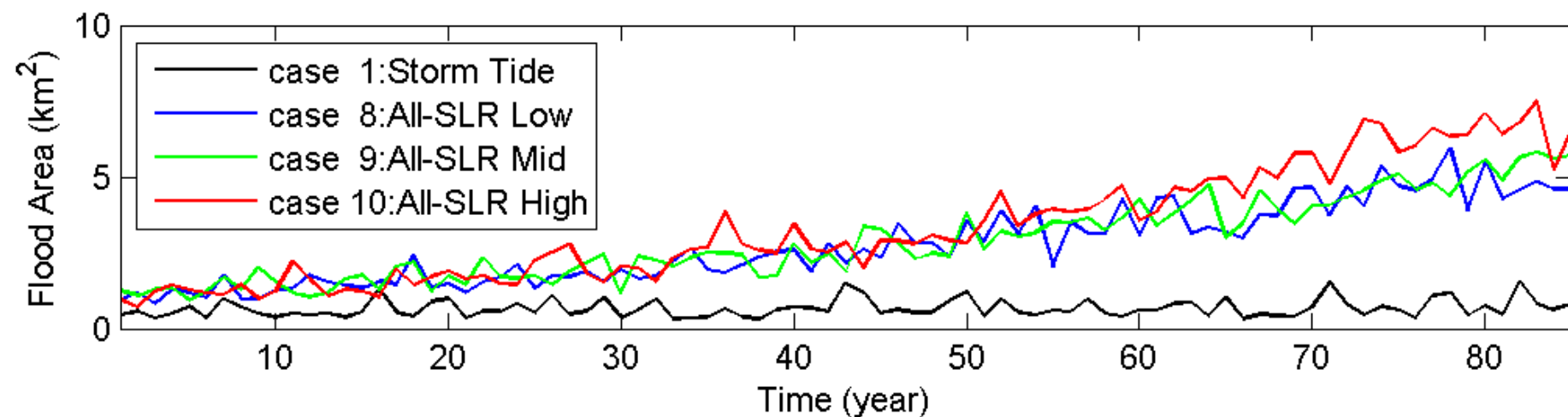


**Case 1:** Control Case

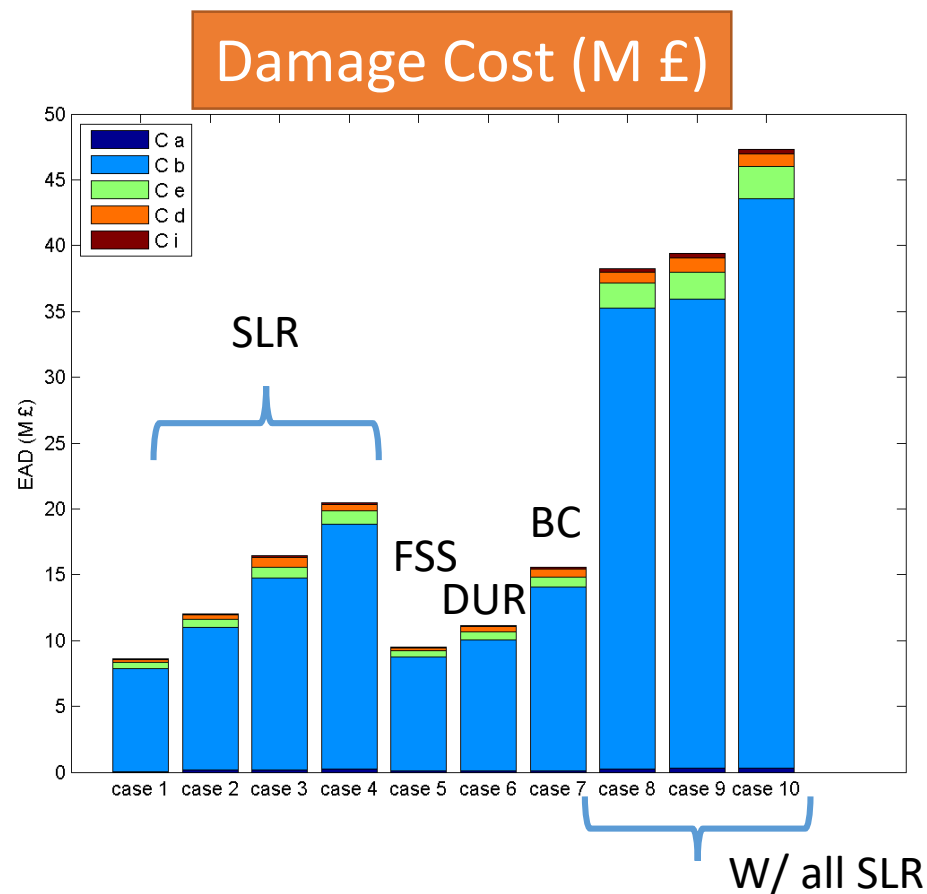
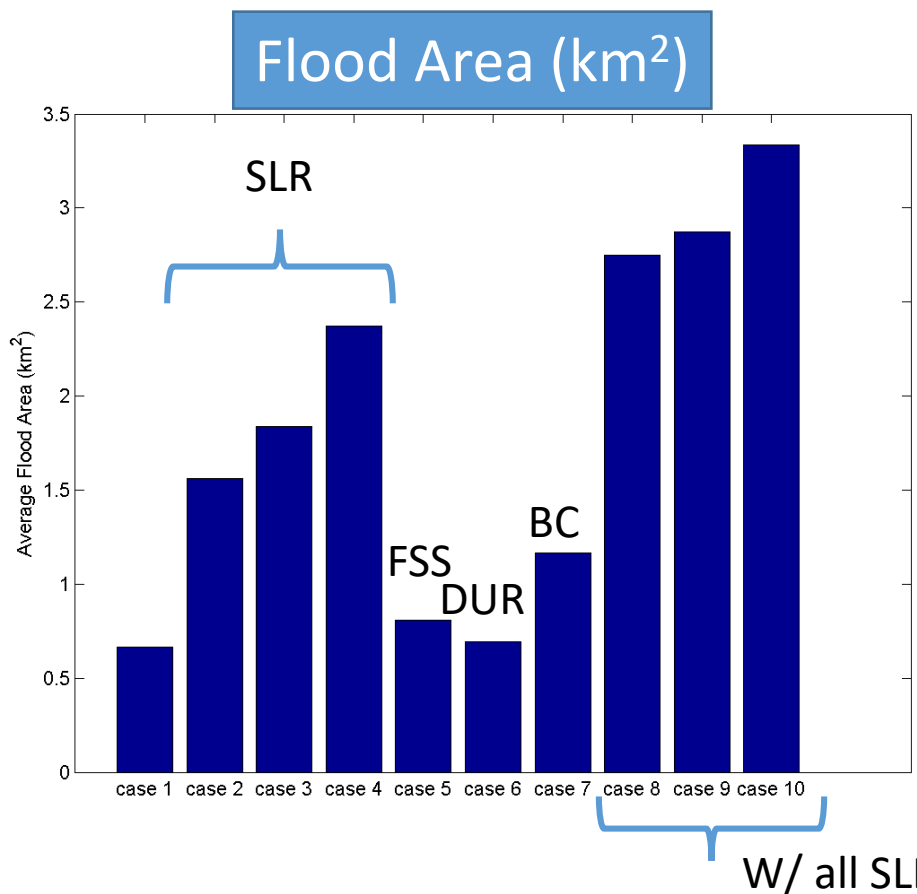


**Case 9:** 5 factors with medium SLR scenario

# Time Series of Flood Area & Damage Cost



# Impacts on Flood Area & Damage Cost

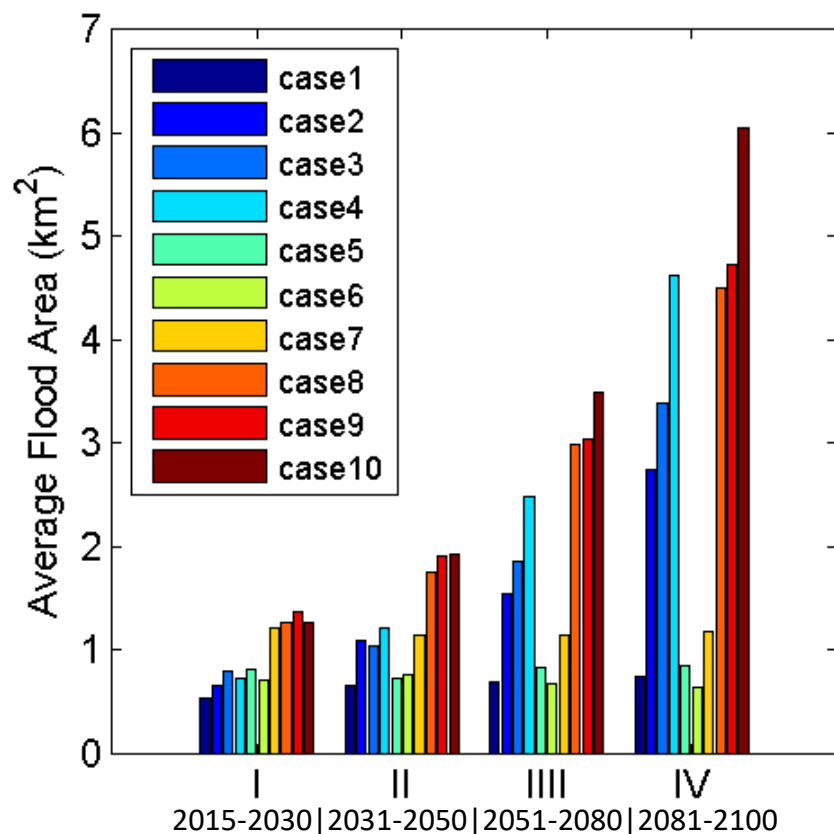


	1	2:SLR-L	3:SLR-M	4:SLR-H	5: FSS	6: DUR	7: BC	8: All-L	9: All-M	10: All-H
Flood Area	-	140%	180%	260%	20%	5%	80%	310%	330%	400%
Damage Cost	-	60%	90%	130%	20%	30%	80%	350%	360%	450%

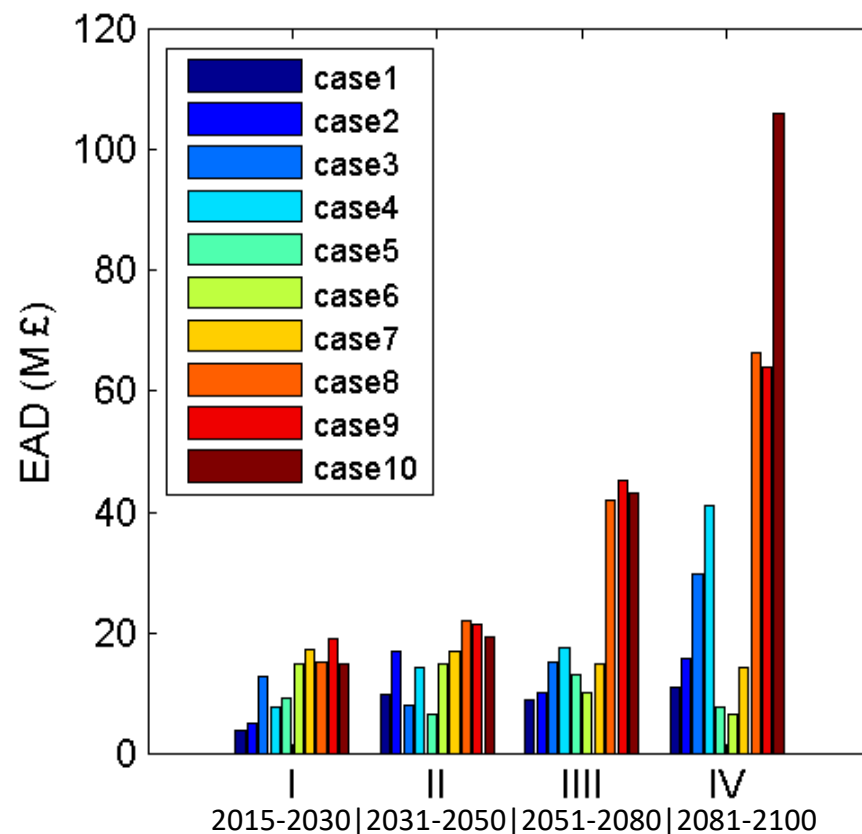


# Impacts with Projection Lead Time

Flood Area (km<sup>2</sup>)



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!

