Source-Pathway-Receptor Framework: A Structured Approach To System Understanding

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Sayers PB; Hall JW; Meadowcroft IC (2002). **Towards risk-based flood hazard management in the UK.** Civil Engineering 2002, 150(5), 36-42.

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What is a flood defence 'asset'

Type of asset		Example activities
Local scale infrastructure		
Private homes and businesses	Avoidance	E.g. the use of planning to relocate new properties away from flood a[...] or above flood levels.
	Resistance	E.g. the use of flood products to prevent water entering a property.
	Recovery	E.g. the use of building materials and practice that aid the rapid return post internal flooding.
Critical service nodes	Avoidance	E.g. the use of planning to relocate individual sites away from flood areas or above flood levels; consider spatial coherence in the design o[...] networks functions.
	Resistance	E.g. the deployment of property 'ring dykes'.
	Recovery	E.g. the use of function speci[...] redundancy to avoid loss [...] communication distribu[...]
System scale infrastructure		
Hard path infrastructure – Planning, design and management o[...]		
Linear and network assets	Active	E.g. barriers that can be [...] defences.
	Passive - Above ground	E.g. raised defences and [...] levee or dyke, breakwat[...]
	Passive - Below ground	E.g. individual pipes, C[...]
Point assets	Active	E.g. pumps, floodgates [...]
	Passive	E.g. dams, fixed trash s[...] link above and below gr[...] gullies.
Soft path infrastructure – Utilizing natural infrastructure system[...]		
Watercourse	Channel	E.g. the management of [...] shoal removal and dredgin[...]
	Floodplain	E.g. the management of floodplain roughness and debris recruitment.
Coast	Foreshore and backshore	E.g. the management of dunes and beaches through active (e.g. recycl[...] and profiling) and passive (e.g. sand fencing, marram grass planting) management as well as natural wetlands and soft cliffs.
Urban landscape	Urban land use	E.g. the engineering of urban green space, managing surface permeability (e.g. through SuDs) and debris recruitment.
Rural catchment	Rural land use	E.g. the management of rural run-off, sediment yields as and debris recruitment.

Sayers and Dawson, 2014

An flood defence asset is any feature that functions to reduce either the probability, depth, velocity or duration of a flood

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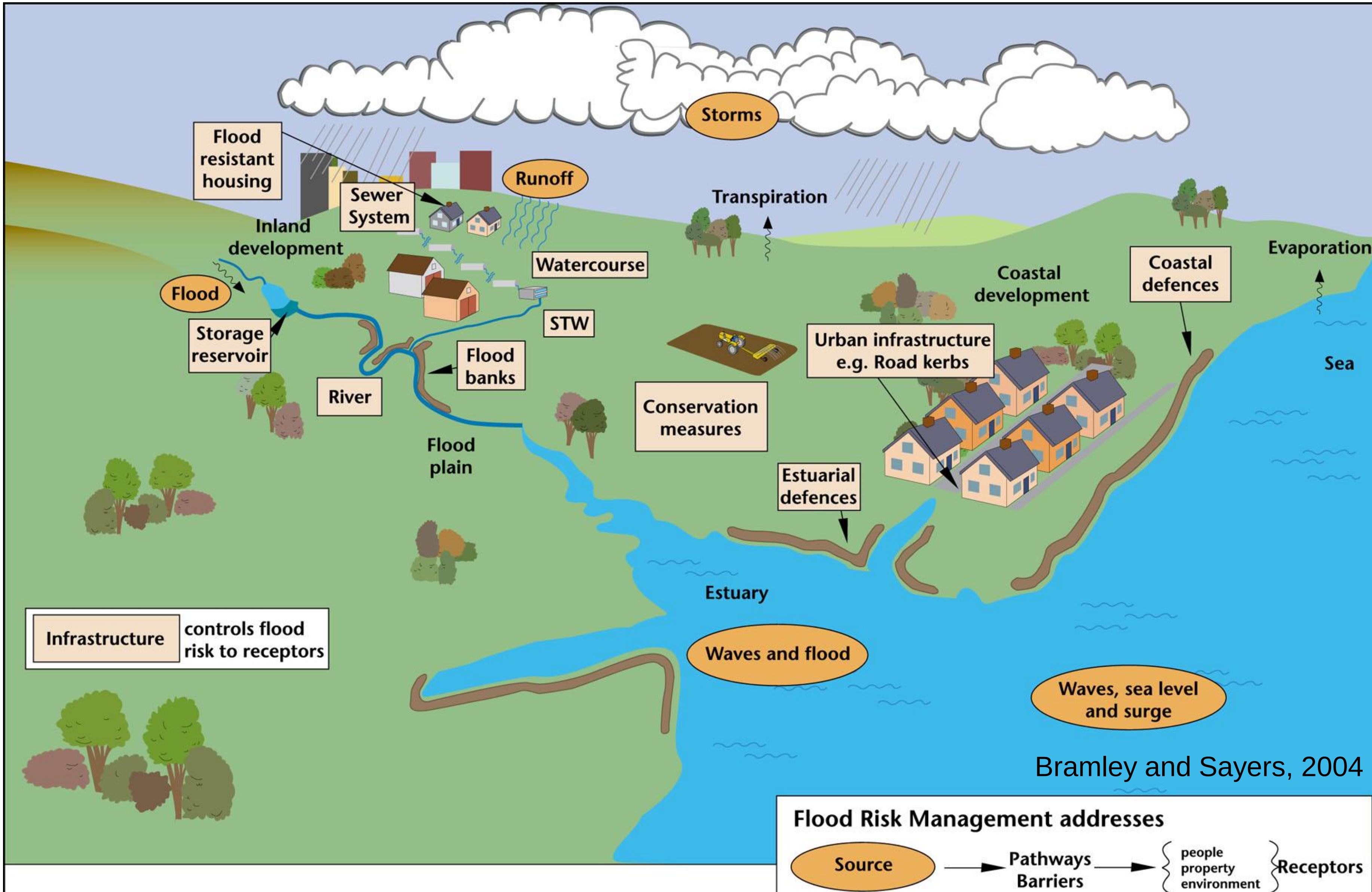
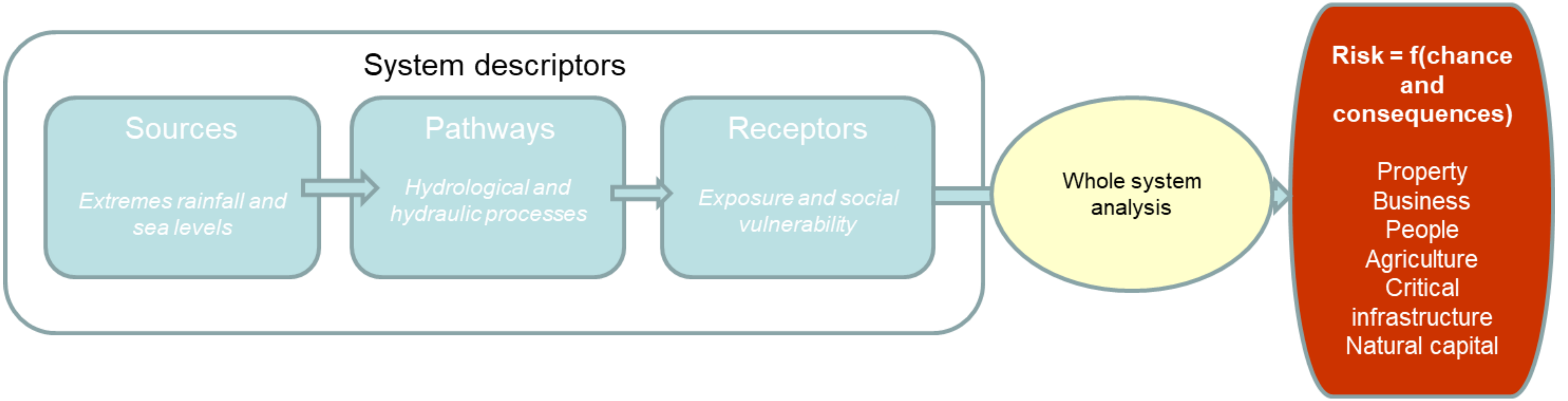
Flood defences systems exhibit spatial complexity



Bramley and Sayers, 2004

Approach: A whole systems based risk analysis



Source-Pathway-Receptor Flood System Framework; Sayers et al, 2002
Overall diagram adapted from Evans, Sayers et al, 2004 and presented in Sayers et al, 2015

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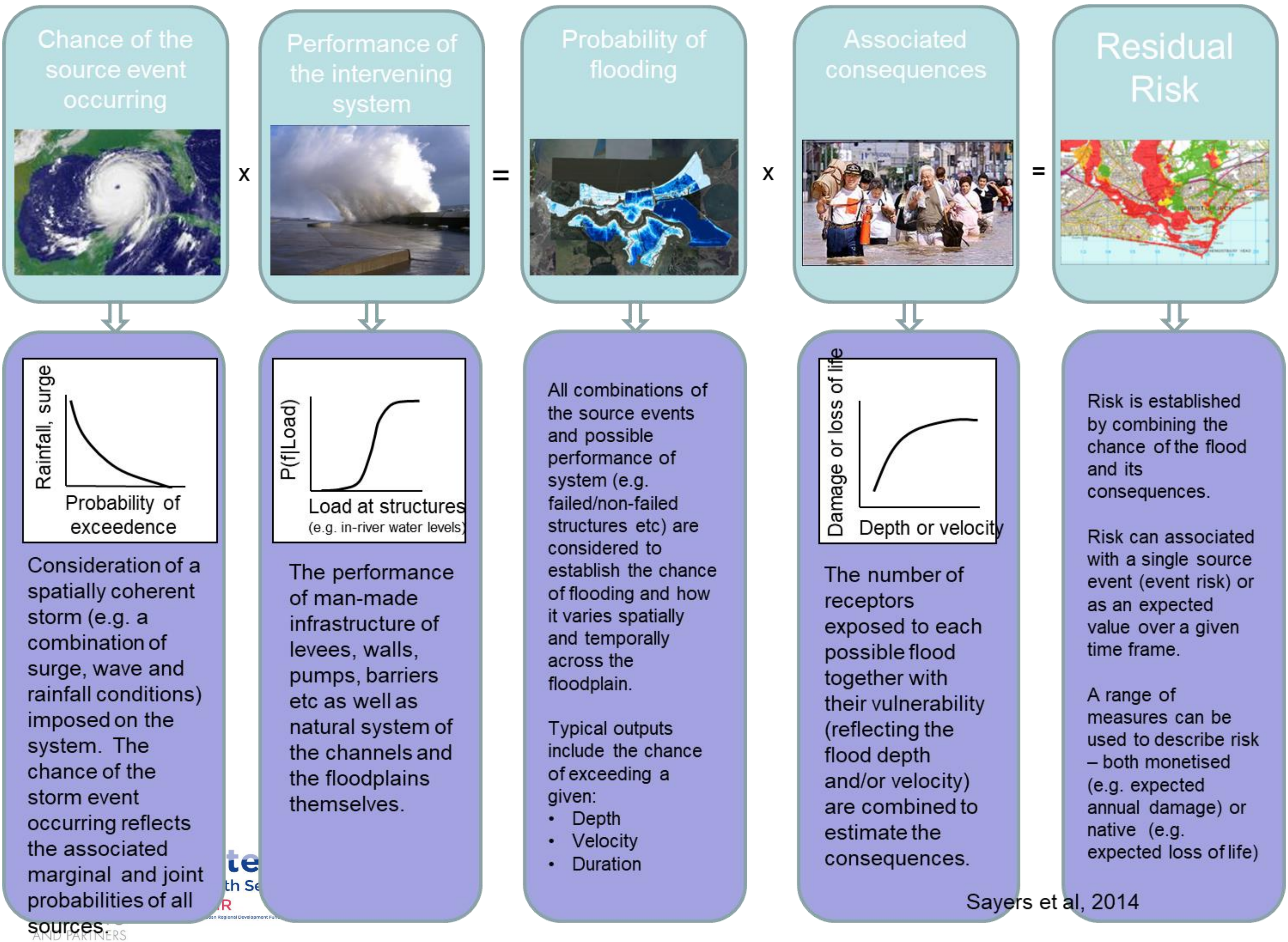

Chance of the source event occurring
x
Performance of the intervening system
=
Probability of flooding
x
Associated consequences
=
Residual Risk
Rainfall, surge
Probability of exceedence
Consideration of a spatially coherent storm (e.g. a combination of surge, wave and rainfall conditions) imposed on the system. The chance of the storm event occurring reflects the associated marginal and joint probabilities of all sources.
P(f|Load)
Load at structures
(e.g. in-river water levels)
The performance of man-made infrastructure of levees, walls, pumps, barriers etc as well as natural system of the channels and the floodplains themselves.
All combinations of the source events and possible performance of system (e.g. failed/non-failed structures etc) are considered to establish the chance of flooding and how it varies spatially and temporally across the floodplain.
Typical outputs include the chance of exceeding a given:
• Depth
• Velocity
• Duration
Damage or loss of life
Depth or velocity
The number of receptors exposed to each possible flood together with their vulnerability (reflecting the flood depth and/or velocity) are combined to estimate the consequences.
Risk is established by combining the chance of the flood and its consequences.
Risk can associated with a single source event (event risk) or as an expected value over a given time frame.
A range of measures can be used to describe risk – both monetised (e.g. expected annual damage) or native (e.g. expected loss of life)
Sayers et al, 2014

But its more complex of course …systems exhibit temporal complexity

Structural deterioration
- of levees – sheet pile corrosion, surface erosion

Vegetation growth
- in channel and in levee banks

Blockage
- anthropogenic and natural debris

Climate change
- desiccation of soils, increased loads

Demographic change
- in the “protected” floodplain

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…and the interventions options are numerous

Where?

Improvement of which asset would yield the greatest benefit (e.g. reduce risk most)?

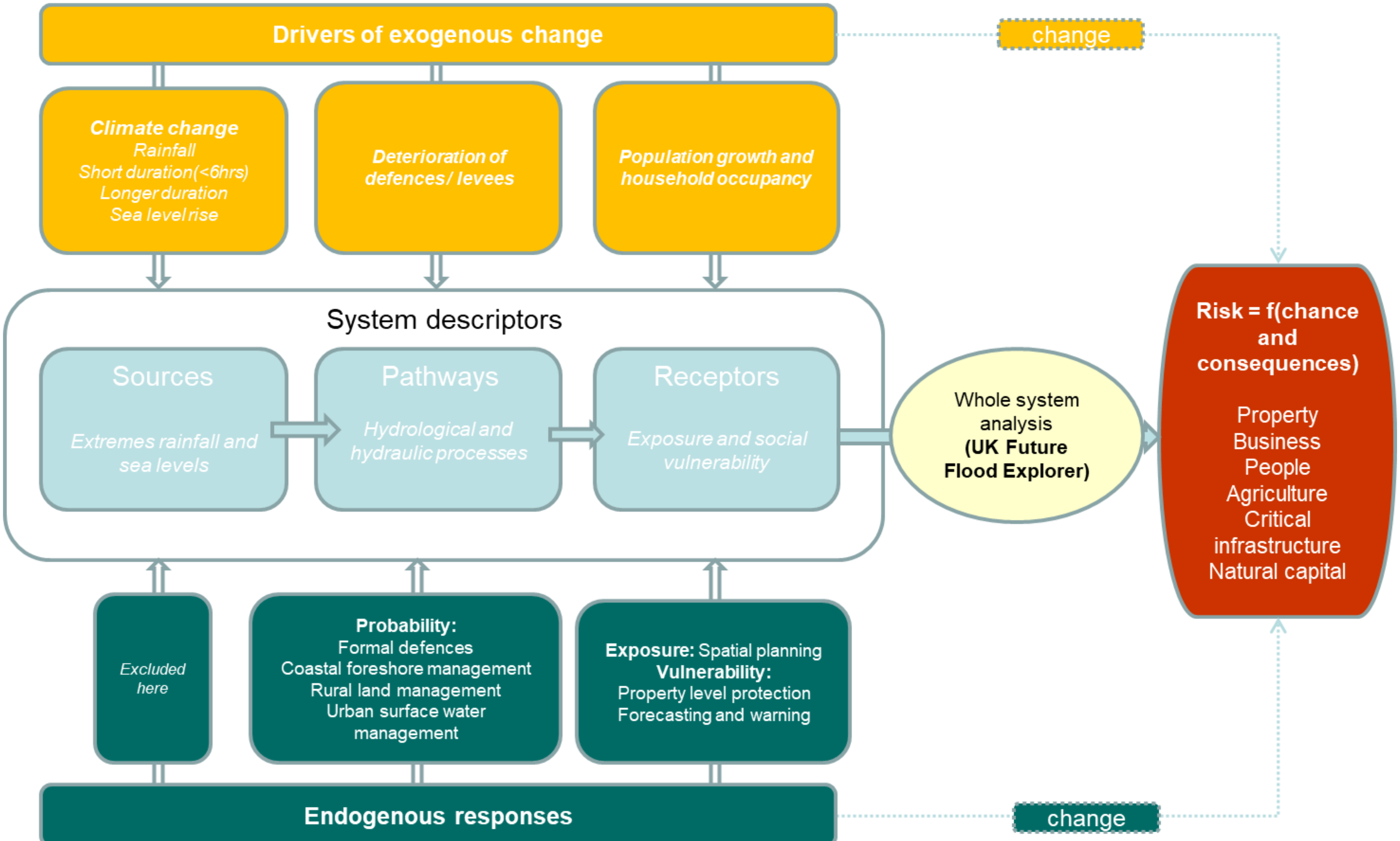
When?

Is action required now, or can investment be postponed?

How?

Should we collect more data or intervene?

A whole systems based risk analysis



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