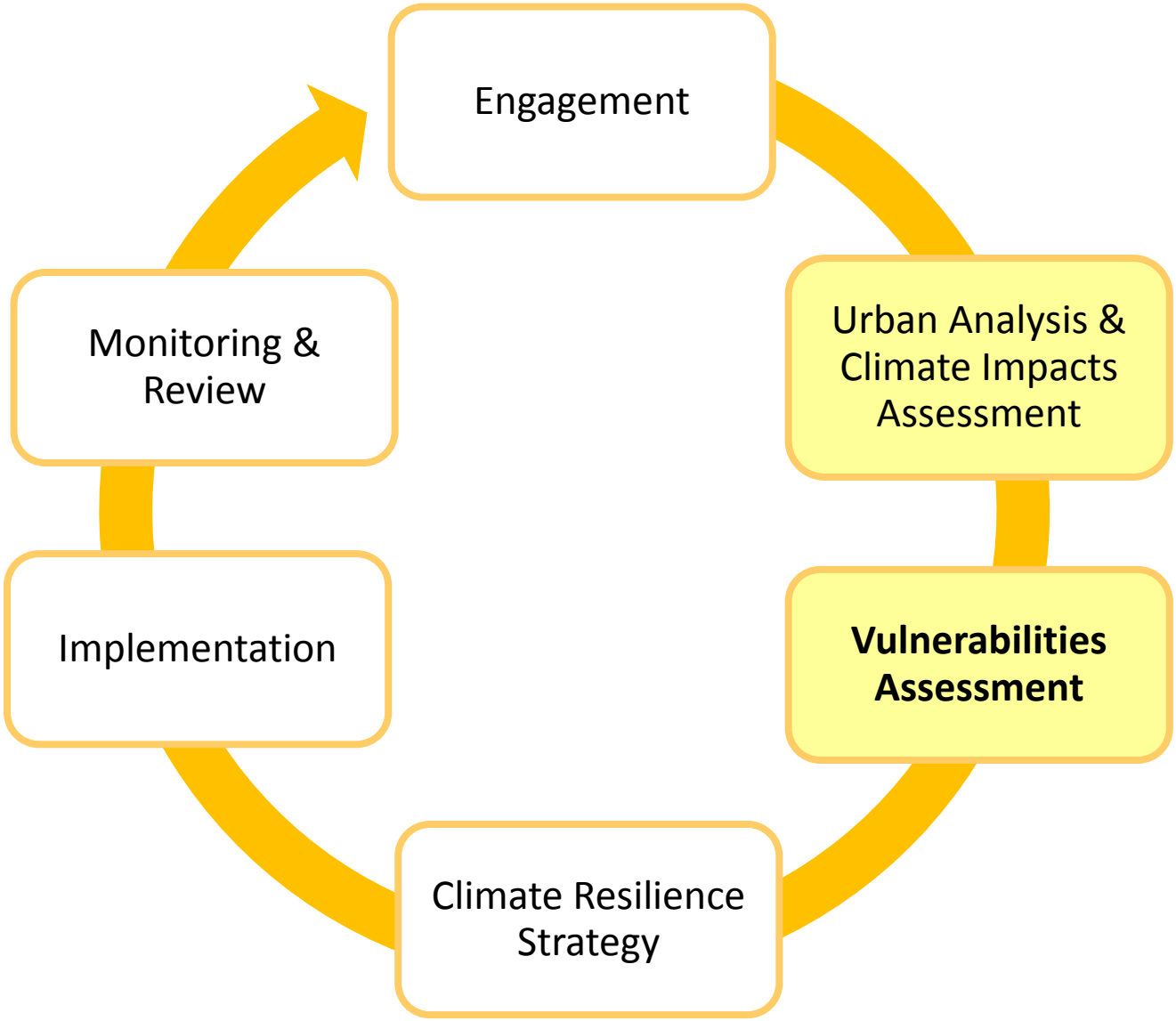
2.1 Vulnerability and Risk Assessment Tools

Steve Gawler, Director International Programs
ICLEI Oceania, 10 February 2012

ICLEI Generic Climate Resilience Planning Process



- What are the major components of vulnerability assessments?
- What are the various methods for carrying out vulnerability assessment?

Steps

1. Analyse climate change hazards (exposure)
2. Assess impacts of CC hazards on city systems (sensitivity)
3. Identify vulnerabilities (systems, people, areas)
4. Assess relative risks

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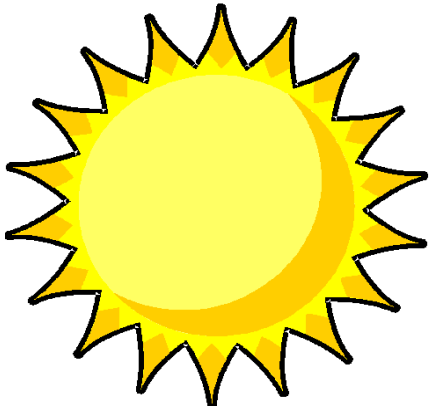
Climate impact – What to Assess



- Increase in Temperature

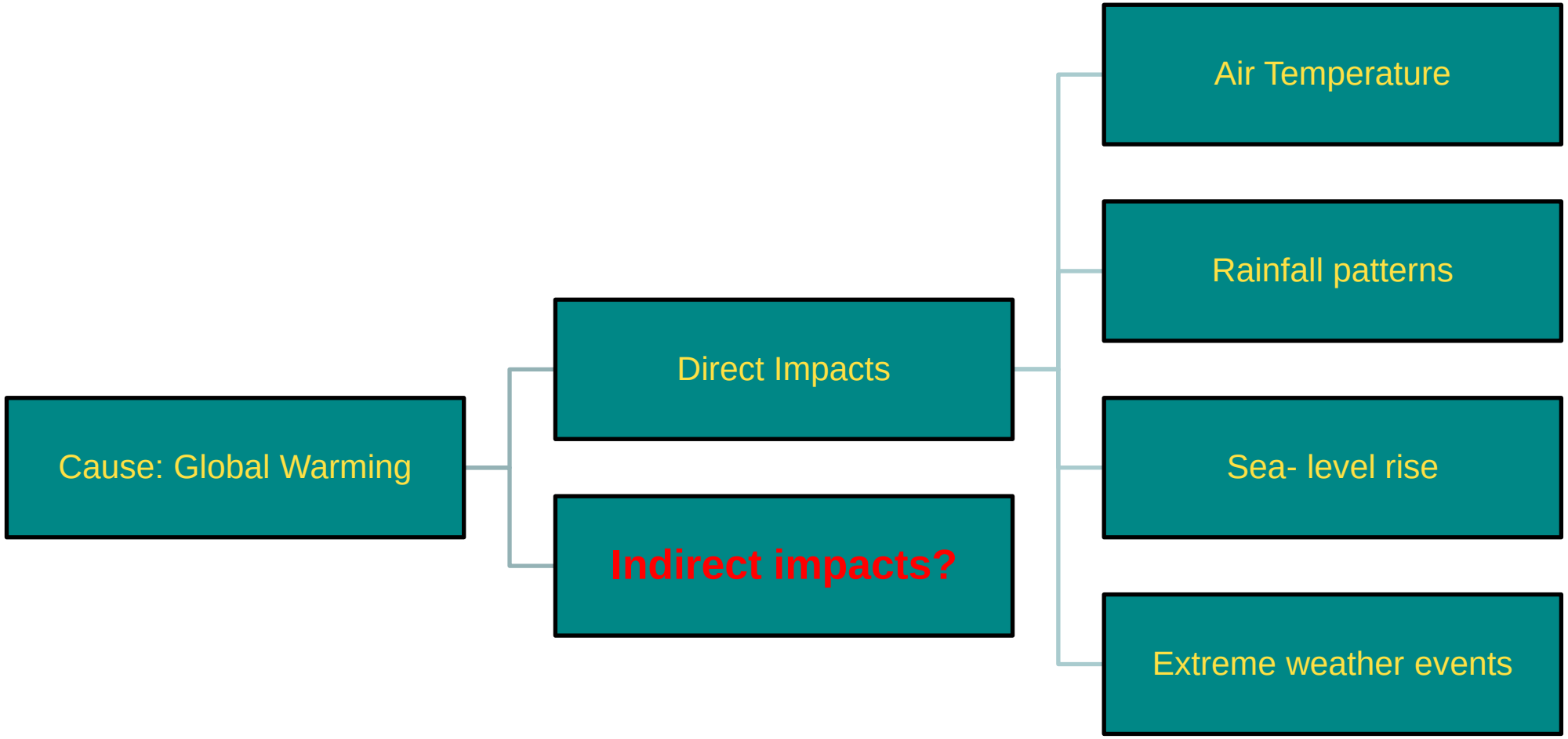
- Increase/decrease in Precipitation

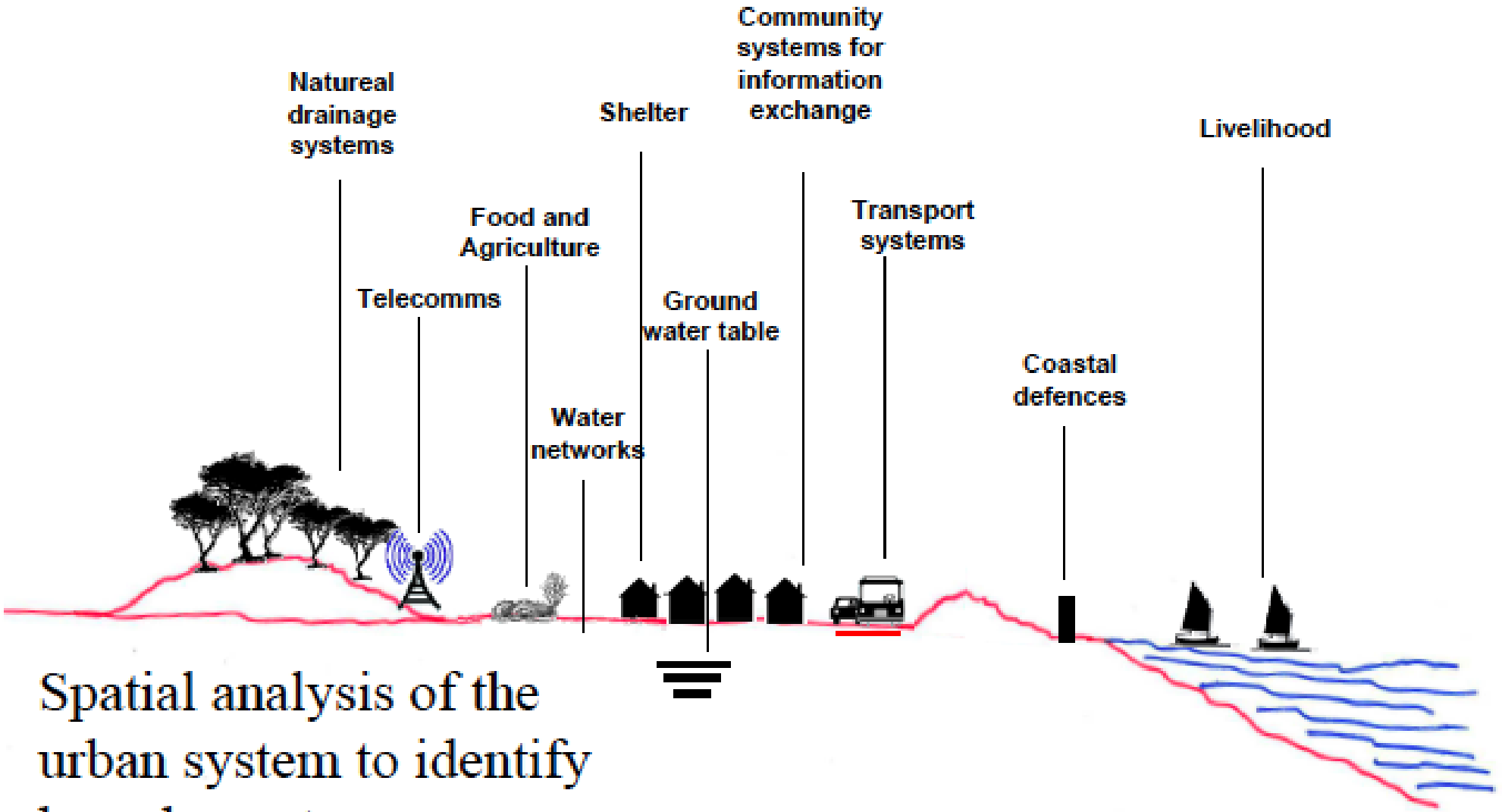
Main impacts of climate change

- Sea Level Rise

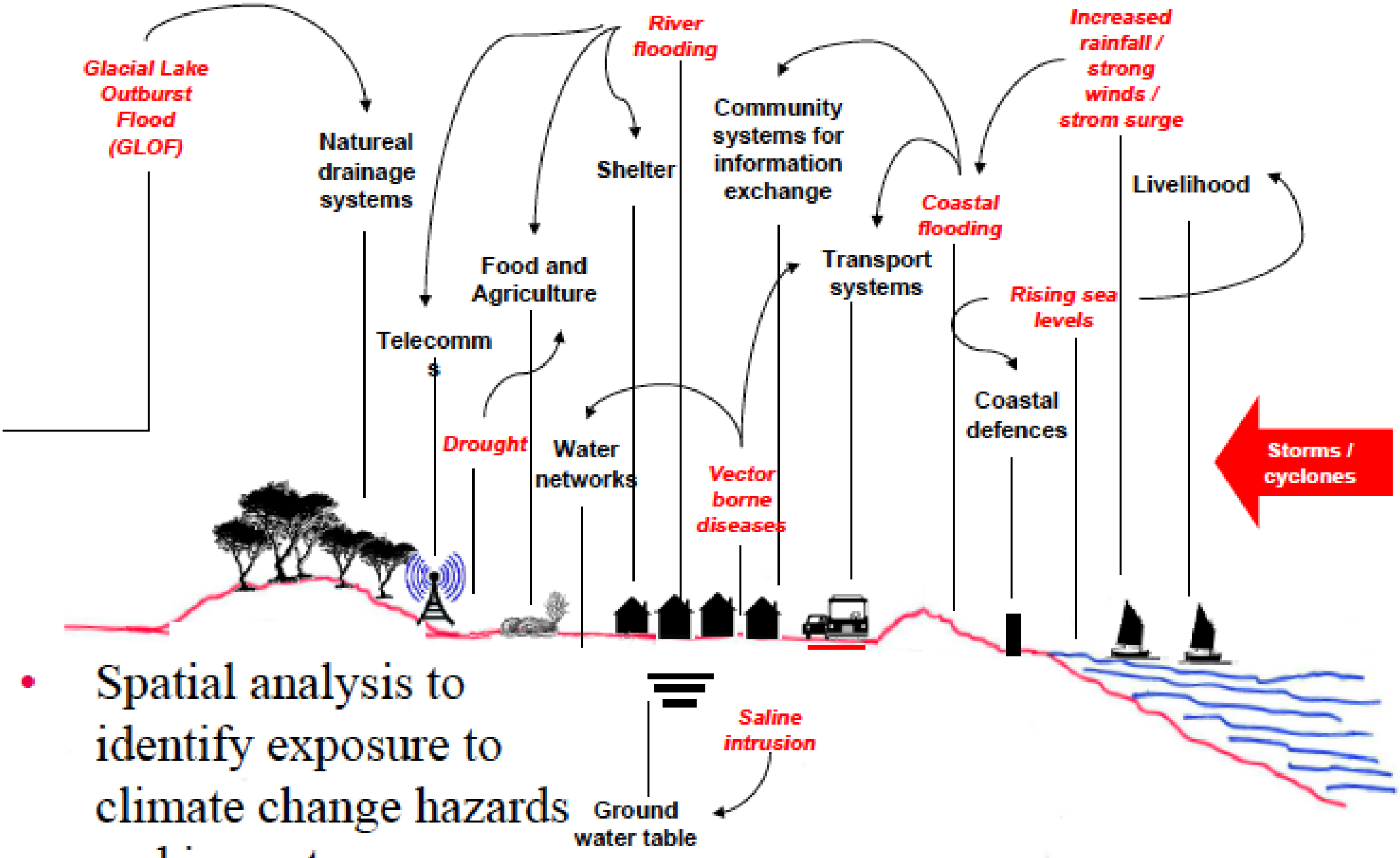
- Increase in frequency or intensity of Extreme Events e.g. Cyclone

Hierarchy of climate change impacts





- Spatial analysis of the urban system to identify key elements



- Spatial analysis to identify exposure to climate change hazards and impacts

ARUP

Discussion - Secondary impacts

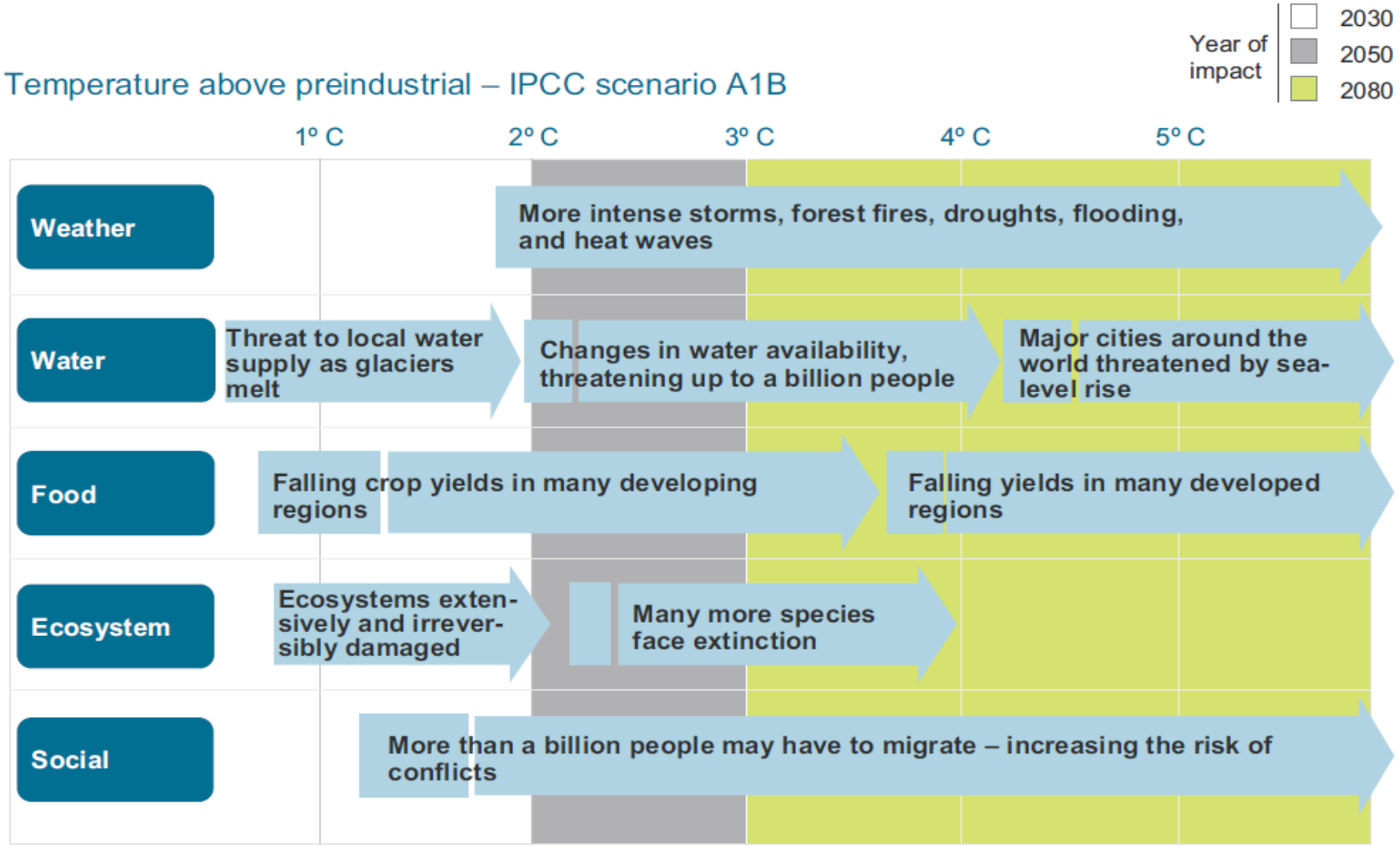
Discussions about climate change impacts usually focus on a predictable, small number of extreme phenomena, such as flooding, severe storms, heat waves, intense rainfall.

But there are many other less obvious impacts, often slow onset, more difficult to perceive…….

BRAINSTORM

What are some other, possibly unexpected, secondary impacts of climate change?

Climate Change Impacts Overview



Climate Scenarios

- Coherent, plausible description of a future state of the climate
- Means of understanding the potential impacts of climate change
- Not a prediction of the future climate, but based on certain assumptions

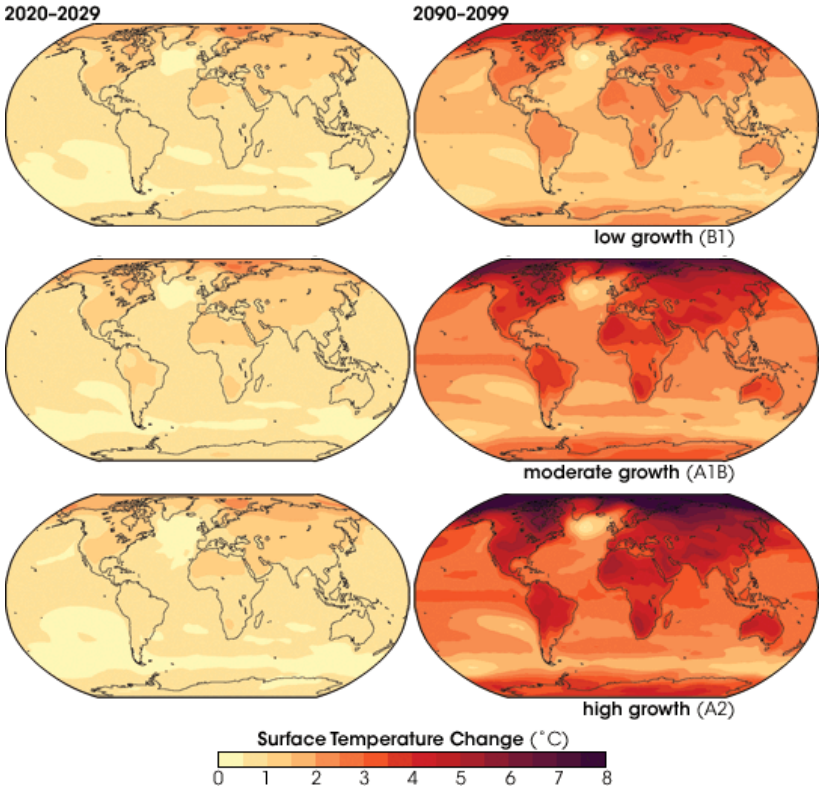


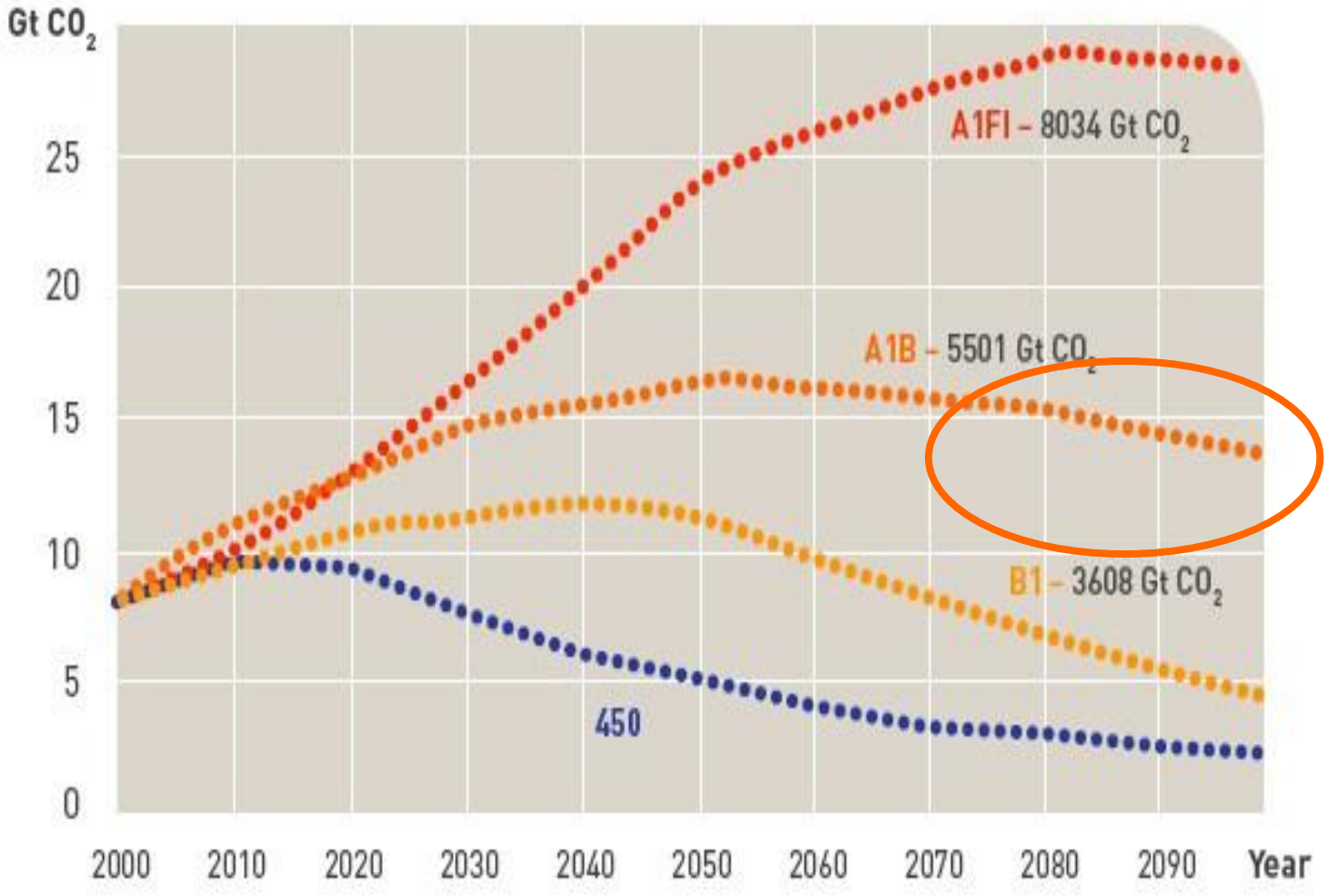
Photo source: http://www.epa.gov/climatechange/science/images/modeled_temperature_ipcc.gif

Cities need to select one or two scenarios to:

- Provide a consistent basis for assessing climate risks
- Narrow down adaptation options for planning and decision-making ('What are we adapting to?')

Climate Change Scenario A1B

Medium emissions growth scenario



Assumption:

- Balanced use of different energy sources – not just fossil fuels.

Expected change:

- CO2 emissions increase until 2030 and begin to decline around 2050
- By 2100 a global temperature increase of 2.8° C (1.7 to 4.4° C) is likely.

Source: Victorian Government DSE, 2008.

How to construct a climate scenario

Analyze all available climate data

- From scientific sources
- From the city's own records
- Validated by collecting "community knowledge"

Assess the overall climate picture

- Is the data consistent?
- Are the projections consistent? What year in the future will we choose for the scenario? (2030, 2050, ……)
- Are we confident to write a single scenario, or do we need an alternative scenario too?

Write a climate scenario, using the template in the workbook

Climate scenario template

Changing Climate Conditions	Assessments	Climate Scenario Summary Statements
Precipitation change	Local/regional Assessments if available	*e.g.There is a high level of confidence of an expected change of 1268±225.2 mm to 1604±175.2 mm in the precipitation change in the ….. Region by the year 2030. The projected change is net increase in rainfall from 60 to 206 mm and is expected to be maximum in monsoon months - June, July, August and September, and minimum in October, November and December.*
	Supplementary Local Assessments	
Temperature change	Local/regional Assessments if available	
	Supplementary Local Assessments	
Extreme events (please specify the event)	Local/regional Assessments if available	
	Supplementary Local Assessments	
Sea Level Rise	Local/regional Assessments if available	
	Supplementary	

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Urban Climate Resilience

Resilience is the capability of a system faced with shocks or stresses to maintain or quickly restore its function.

Includes the ability to:

- Learn from and adapt to experience – i.e. to change strategies or structure of the system
- Respond to unexpected events
- Change is an essential part of resilience

Urban Climate Resilience Framework – ISET / Arup

What?

- Urban ***systems*** comprise elements and linkages: ecosystems, infrastructure, knowledge
- Key characteristics: flexibility and diversity, modularity and redundancy, safe failure

Who?

- Focus on ***agents*** (individuals, organizations, groups): their behavior, socio-economic position, authority, marginalization, etc
- Key capacities: Responsiveness and (re-) organization, resourcefulness and planning, capacity to learn.

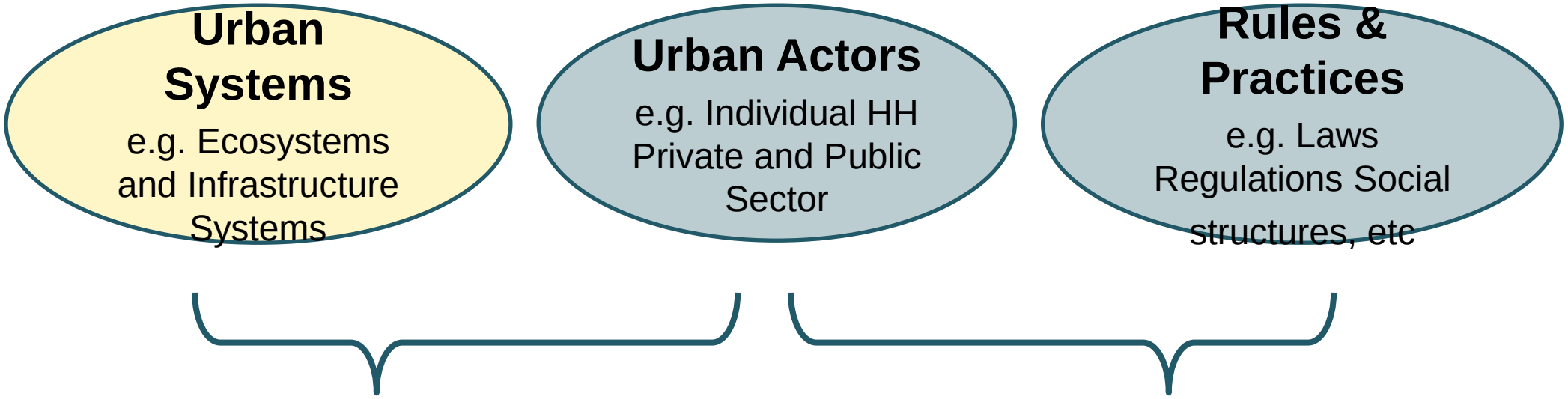
Urban Climate Resilience Framework – ISET / Arup

How?

- ***Institutions***: the rules or practices that guide how agents interact with each other and with systems
- Key factors: access (rights / entitlements); decision-making; information

Fragile systems / low capacity agents / weak institutions + **exposure** = VULNERABILITY

Urban Analysis: City Components



Can get affected by climate change

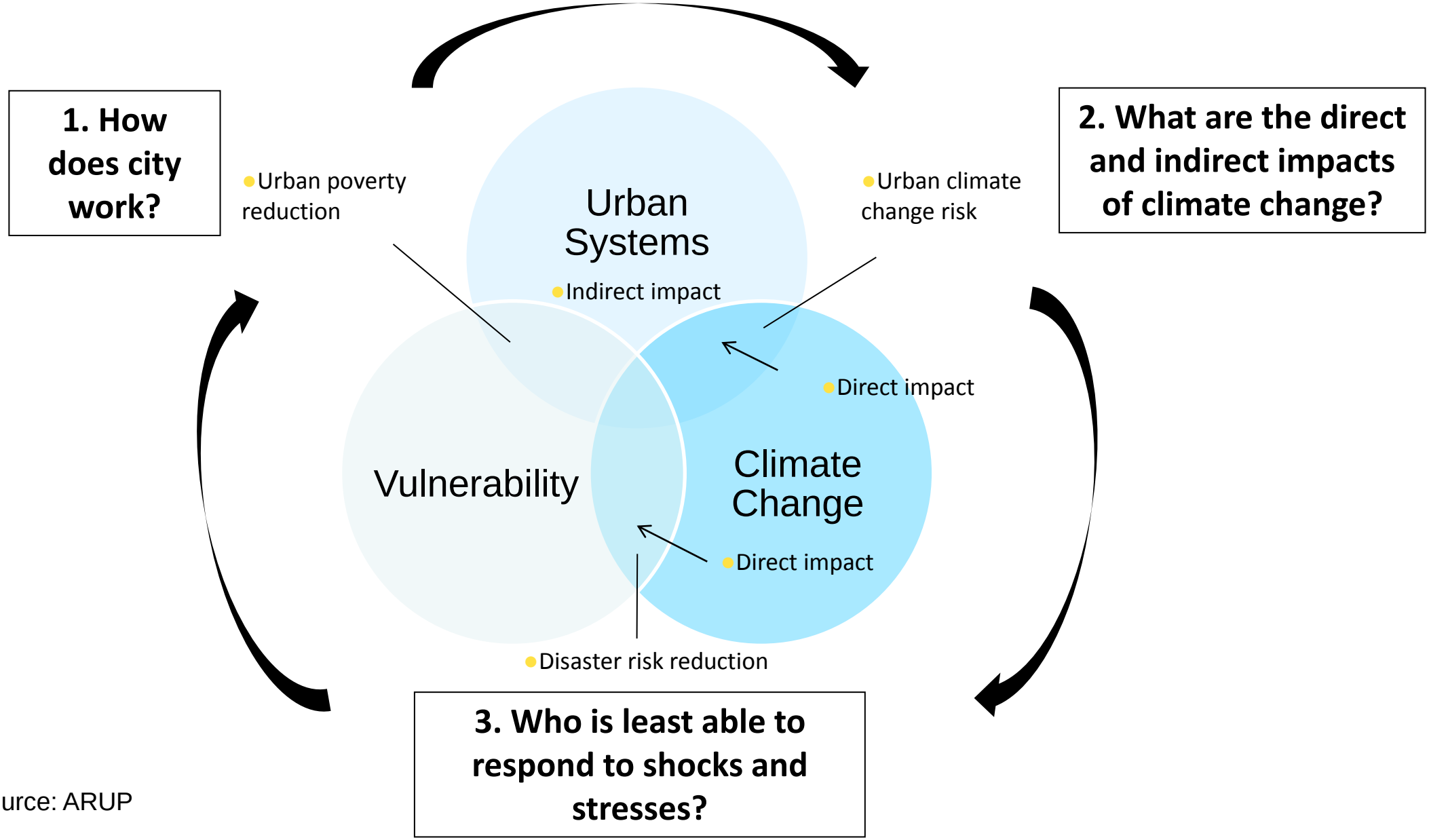
Play a role in adaptation (of urban systems and urban actors) to climate change

Urban Systems and Climate Change

Impact

Cause

Urban Systems and Climate Change



Source: ARUP

Flooding and tidal inundation hazards

Groups at Risk	Direct Impacts	Indirect Impacts	Sectors Affected
• Urban poor living near coast • Fishpond farmers • Female-headed households • The elderly • Children • Those without land titles	• Salinization of arable land • Infiltration of drinking wells • Infiltration of fish ponds • Damage to businesses • Damage to and loss of housing/ property	• Increase in price of commodities • Unemployment • Migration • Health epidemics • Farmers shift to wage paying labor • Decrease in investment to city	• City drainage system • Public health system • Emergency services • Housing authority • Public water supply system • City social services

Economic Loss (IDR)/year

ACTIVITY	IMPACT
Mangrove	US $ 81,000
Fishpond	US $ 81,000
Farming	US $ 81,000
Settlement	US $ 81,000
Infrastructure	US $ 81,000

Impact of flood and SLR

ACTIVITY	IMPACT
Fishpond	2,889 ha
Farming	902 ha
Settlement	10,425 houses
Infrastructure	2,27 km

Activities and infrastructure affected by flood and tidal inundation

TRANSPORTATION


Railway


Airport


Bus Station


Port

ECONOMIC


Rice Field


Fish Pond


Fisheries


Industry

INFRASTRUCTURE


Road


Settlement


Water

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CC Vulnerability

"The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity and its adaptive capacity."

(IPCC 2007, 883)

Urban Climate Resilience Framework – ISET / Arup

How?

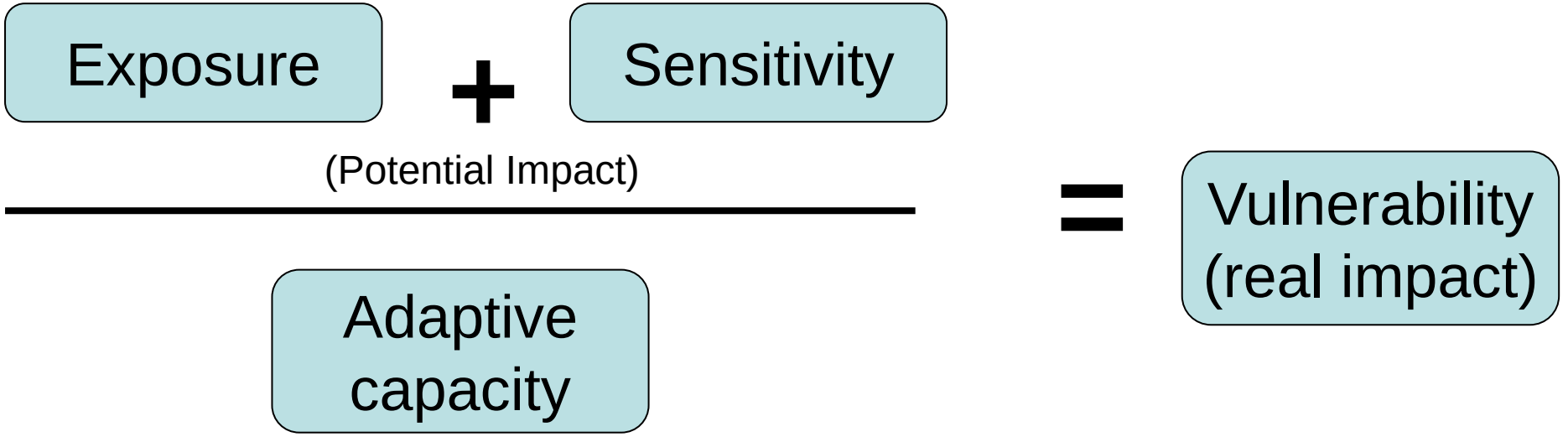
- ***Institutions***: the rules or practices that guide how agents interact with each other and with systems
- Key factors: access (rights / entitlements); decision-making; information

Fragile systems / low capacity agents / weak institutions + **exposure** = VULNERABILITY

Vulnerability formula

…to stimuli which may act on the system

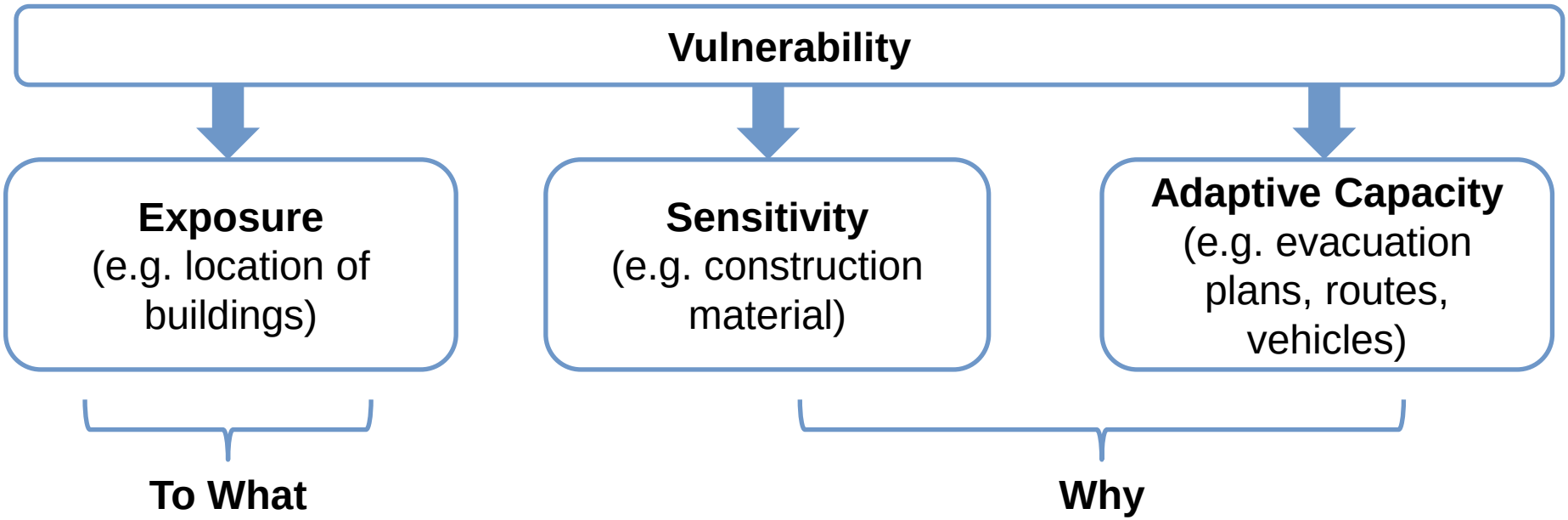
Responsiveness i.e. dose-response, or criticality



Ability of system to change to become better equipped to manage the exposure/sensitivity

Vulnerability

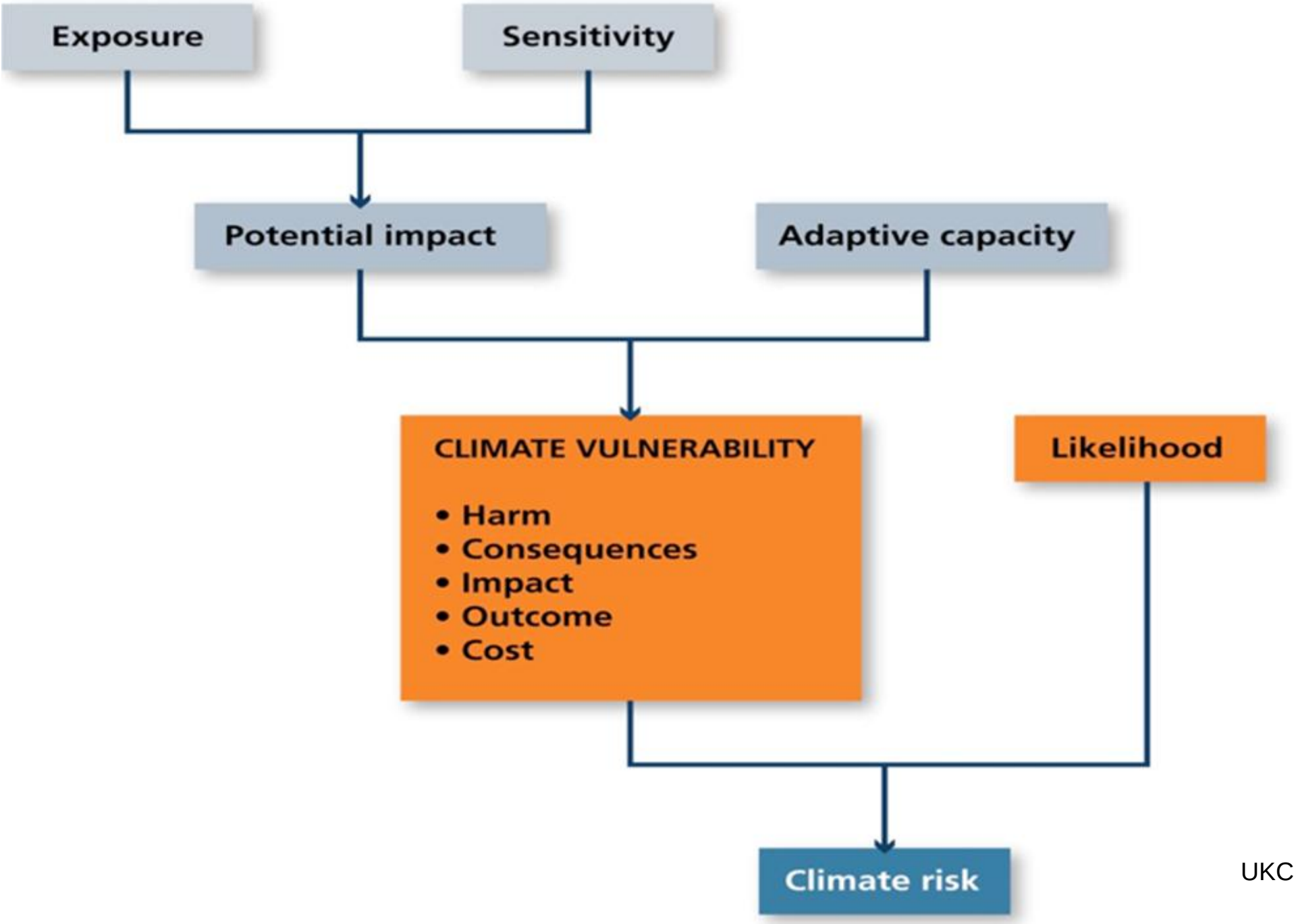
Who or What is vulnerable to What and Why?



Who or What: Population groups, zones/wards, and sectors (e.g. infrastructure for water supply, SWM etc.)

To What: Impacts of climatic threats (e.g. water scarcity, spread of vector borne diseases etc.)

Why: Capacities and resources to deal with the impacts of climatic hazards



UKCIP 2007

Key Components of Vulnerabilities Assessments

Data Collection: (e.g. Climate data, data on natural and physical environment, planning information, socio-economic data)

Sectoral Studies: Detailed sectoral and area wise study in terms of the climatic hazards

Areas & Populations: e.g. Zones / Wards and Slum dwellers / others

Due to climatic hazards (e.g. flooding)

Due to non-climatic conditions (e.g. poverty)

Nature and extent of likely impacts: Social, Economic, Environmental

Capacity assessment: assessing the capacity of the urban systems and different population groups to combat/withstand identified impacts

Methods of Vulnerabilities Assessment

Quantitative Assessment

- Climate and socio-economic scenarios and modeling
- Vulnerability mapping using GIS overlays of biophysical and social indicators
- Quantitative indices of vulnerability

Overlaps

- Household and community surveys
- Governance and institutional analysis
- Community resource mapping

Qualitative Assessment

- Focus group discussions and interviews
- Participatory vulnerability assessments with poor and vulnerable communities

Sequence for Vulnerabilities Assessment

Assess current vulnerabilities	Future stressors	Assess future vulnerabilities
Current risk and event history, responses to existing climate hazards Current dimensions of vulnerability • social group • sector • neighbourhood	Identify future direct and indirect impacts of climate change (from scenarios) Consider also development/growth trends for city	Identify most vulnerable groups, sectors, neighbourhoods and the inter-linkages between them Review governance, rules and practices which may increase or reduce the vulnerabilities

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Prioritizing Fragile Urban Systems

Prioritization of fragile urban systems can be done through a **Risk Assessment (RA)** based on the expected impacts of climate change on these systems and the degree of risk that each impact poses

Risk = Likelihood x Consequence

Likelihood rating	Consequence rating	Score
Almost certain	Catastrophic	5
Likely	Major	4
Possible	Moderate	3
Unlikely	Minor	2
Rare	Insignificant	1

Consequence Scales: Local Government Example

Consequence rating	Success criteria				
	Public safety	Local economy and growth	Community and lifestyle	Environment and sustainability	Public administration
Catastrophic	Large numbers of serious injuries or loss of lives	Regional decline leading to widespread business failure, loss of employment and hardship	The region would be seen as very unattractive, moribund and unable to support its community	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage	Public administration would fall into decay and cease to be effective
Major	Isolated instances of serious injuries or loss of lives	Regional stagnation such that businesses are unable to thrive and employment does not keep pace with population growth	Severe and widespread decline in services and quality of life within the community	Severe loss of environmental amenity and a danger of continuing environmental damage	Public administration would struggle to remain effective and would be seen to be in danger of failing completely
Moderate	Small numbers of injuries	Significant general reduction in economic performance relative to current forecasts	General appreciable decline in services	Isolated but significant instances of environmental damage that might be reversed with intensive efforts	Public administration would be under severe pressure on several fronts
Minor	Serious near misses or minor injuries	Individually significant but isolated areas of reduction in economic performance relative to current forecasts	Isolated but noticeable examples of decline in services	Minor instances of environmental damage that could be reversed	Isolated instances of public administration being under severe pressure
Insignificant	Appearance of a threat but no actual harm	Minor shortfall relative to current forecasts	There would be minor areas in which the region was unable to maintain its current services	No environmental damage	There would be minor instances of public administration being under more than usual stress but it could be managed

- Source: Commonwealth of Australia (2006): Climate Change Impacts & Risk Management - A Guide for Business and Government.

Likelihood Scales

- To describe the likelihood of a risk arising if a particular climate change scenario comes about.
- Most commonly used scales:

Likelihood rating	Recurrent risks	Single events
Almost certain	Could occur several times per year	More likely than not – probability greater than 50%.
Likely	May arise about once per year	As likely as not – 50/50 chance.
Possible	May arise once in 10 years	Less likely than not but still appreciable – probability less than 50% but still quite high.
Unlikely	May arise once in 10 years to 25 years	Unlikely but not negligible – probability low but noticeably greater than zero.
Rare	Unlikely during the next 25 years	Negligible – probability very small, close to zero.

Scope of the Risk Assessment Process

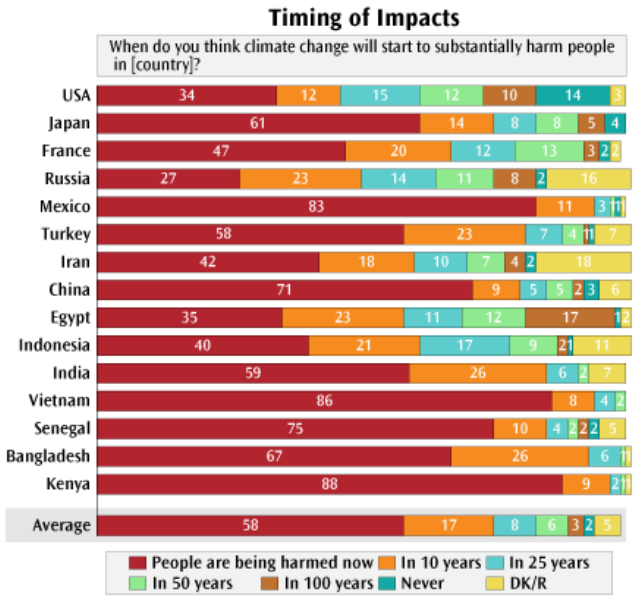
Geographic scope:

- All of your city?
- Only certain zones?

http://www.talkingproud.us/Military/Birddog/Birddog74RAC/files/page72-rungsatmap.jpg

Organisational scope:

- Risks to council?
- Community risk?



Time horizon considered:

- Until 2030?
- Until 2070?

http://blogs.worldbank.org/files/climatechange/ClimatePollFig2New.gif

Prioritizing Areas for Action

Risk rating = key factor for prioritising

Aim: treat all ‘extreme’ and ‘high’ risks

Observe medium and low risks for changes

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Medium	Medium	High	Extreme	Extreme
Likely	Low	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	High
Unlikely	Low	Low	Medium	Medium	Medium
Rare	Low	Low	Low	Low	Medium

Initial council risk assessments - Sydney councils

ICLEI Local Governments for Sustainability

Kogarah

Priority	Type of impact
1st priority	Increase in extreme weather events (storms)
2nd priority	Sea level rise
3rd priority	Expected lack of surface water
	Localised flooding problems
	Temperature increase

Canada Bay

Priority	Type of impact
1st priority	Temperature increase
2nd priority	Sea level rise
3rd priority	Drought / water availability

Holroyd

Priority	Type of impact
1st priority	Increase in extreme weather events (storms)
2nd priority	Increase in heatwaves
3rd priority	Water availability and food security

When to use risk assessment?

At any point in the process where you want to prioritize to show greatest risk to the city:

- Climate impacts
- Fragile systems
- Vulnerable groups or sectors

Workshop activity

Select at least three of your critical/fragile urban systems

Using the information in the summary sheets from last session, apply the risk assessment and prioritise the urban systems needing most urgent action