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Systems Thinking for Stakeholder Engagement

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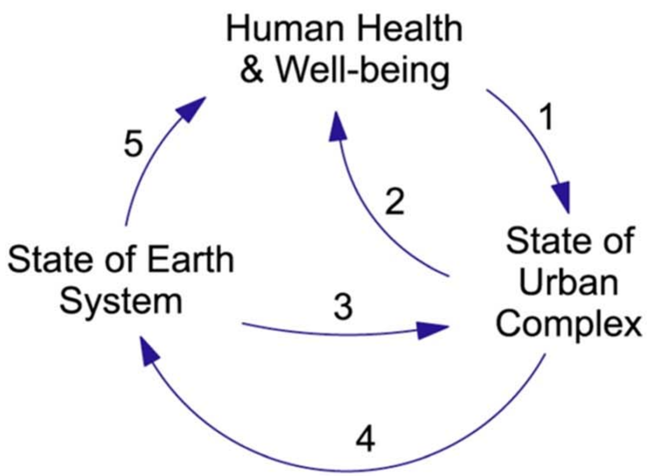
CCM for Stakeholder Engagement for Health Adaptation (SC Lung modified from Proust et al., 2012)

- **Step 1:** Identify studied systems, ex: public health, atmospheric environment
  - Identify several systems which are related to climate-related disasters and health adaptation
- **Step 2:** Select studied variables, ex: cardiovascular mortality
  - Select focused and measurable variables within the studied systems
- **Step 3:** Clarify interactions among systems
  - Clarify interactions of these studied variables among different systems
  - Brainstorming potential intervention points in the interfaces of these studied systems
- ~~Step 4: Complicate diagrams within your own system~~

- Reminders:
  - Systems diagrams of CCM are conceptual and are a collaborative outcome of brainstorming from multidisciplinary scientists
  - The focus is the interfaces and interactions among different systems (disciplines); the scientific context within each system should be kept to the experts in that system to avoid confusion and streamline communication between scientists and stakeholders
  - The interactions among systems could be quantitative or qualitative; it is helpful for the collaboration between social scientists and natural scientists

Co-Effects Template

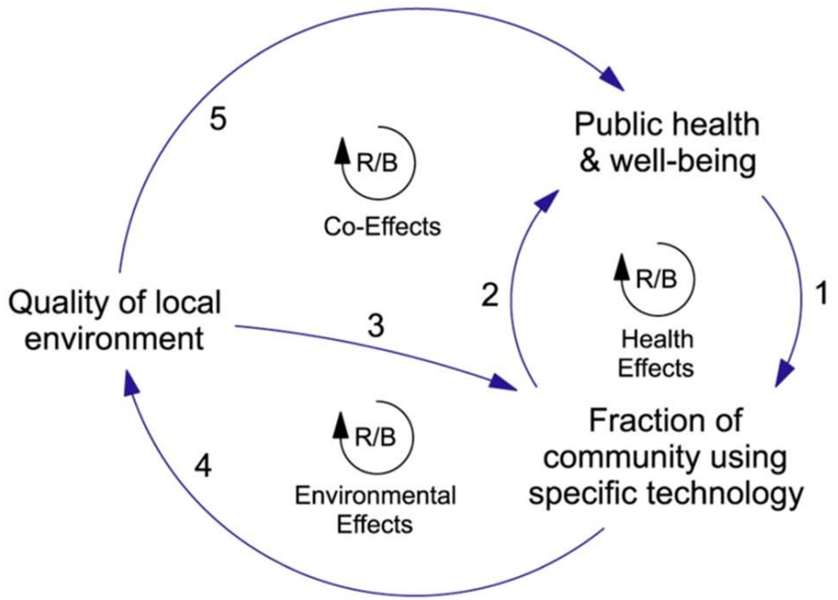
Figure 4. The Co-Effects Template. The blocks of text in this influence diagram represent system stocks (state variables) grouped into three high-level sub-systems. Examples of these stocks are given in Table 1. The arrows represent bundles of causal links. Examples of the flows (state-change processes) associated with each link are given in Table 2.



REF: *Int. J. Environ. Res. Public Health* ***2012, 9, 2134-2158; doi:10.3390/ijerph9062134***

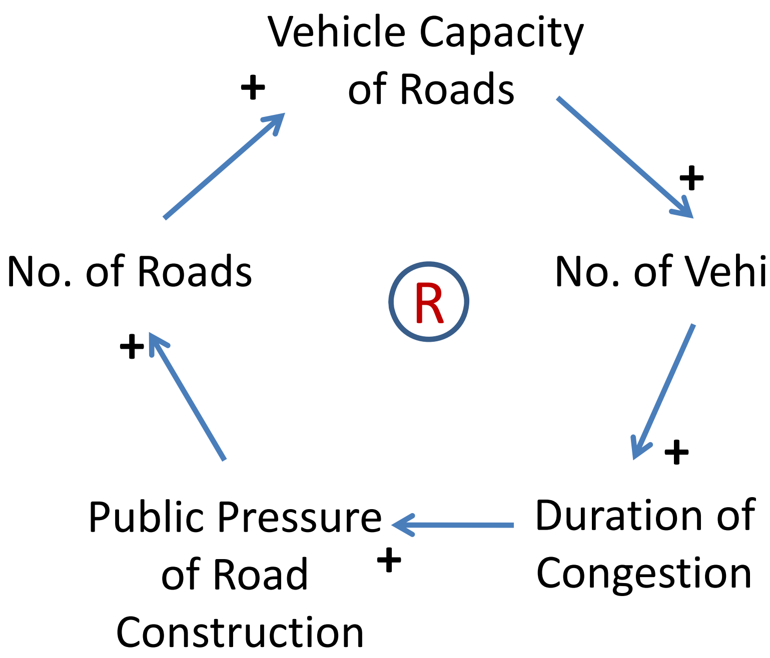
Reinforcing or Balancing Relationships among Urban-Environment-Health Systems

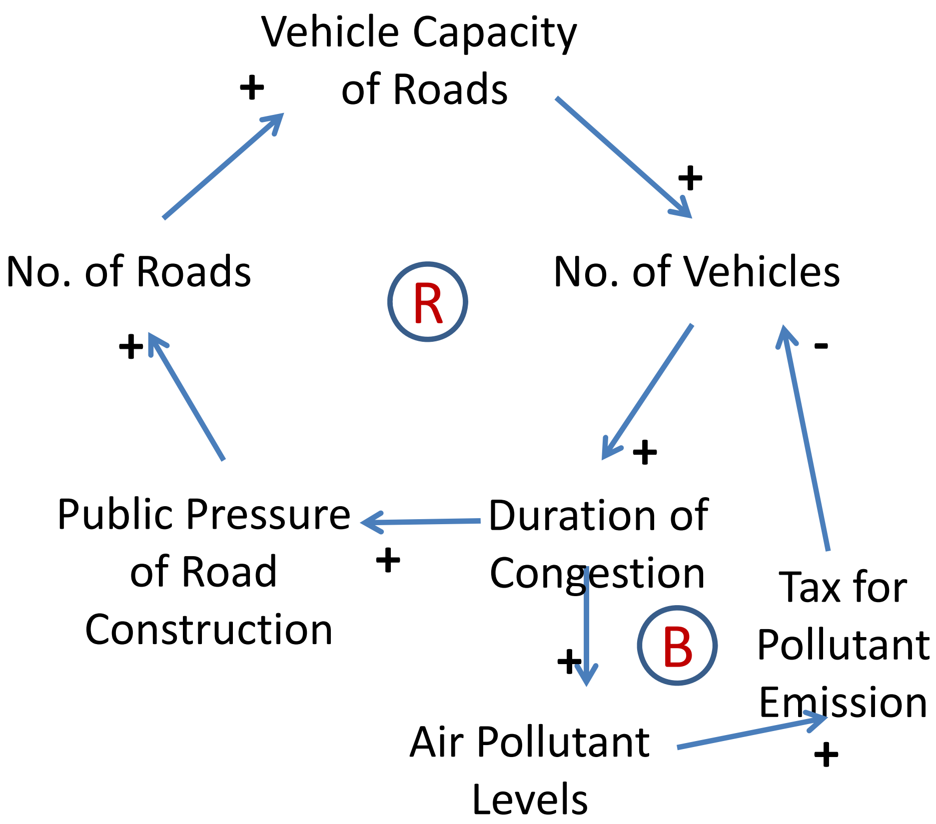
Figure 5. An intermediate-level hypothesis concerning technology dependence in urban settings. The structure is derived from the Co-Effects Template and the arrows (causal links) are labelled in accordance with the numbering scheme used in Figure 4. The state-change processes represented by each arrow are described briefly in Table 3. The encircled symbol (R/B) in the centre of each feedback loop indicates that the loop is either reinforcing or balancing, depending on the net effect of its causal links.



REF: *Int. J. Environ. Res. Public Health* ***2012, 9, 2134-2158; doi:10.3390/ijerph9062134***

Cases of Reinforcing (R) and Balancing (B) Relationships



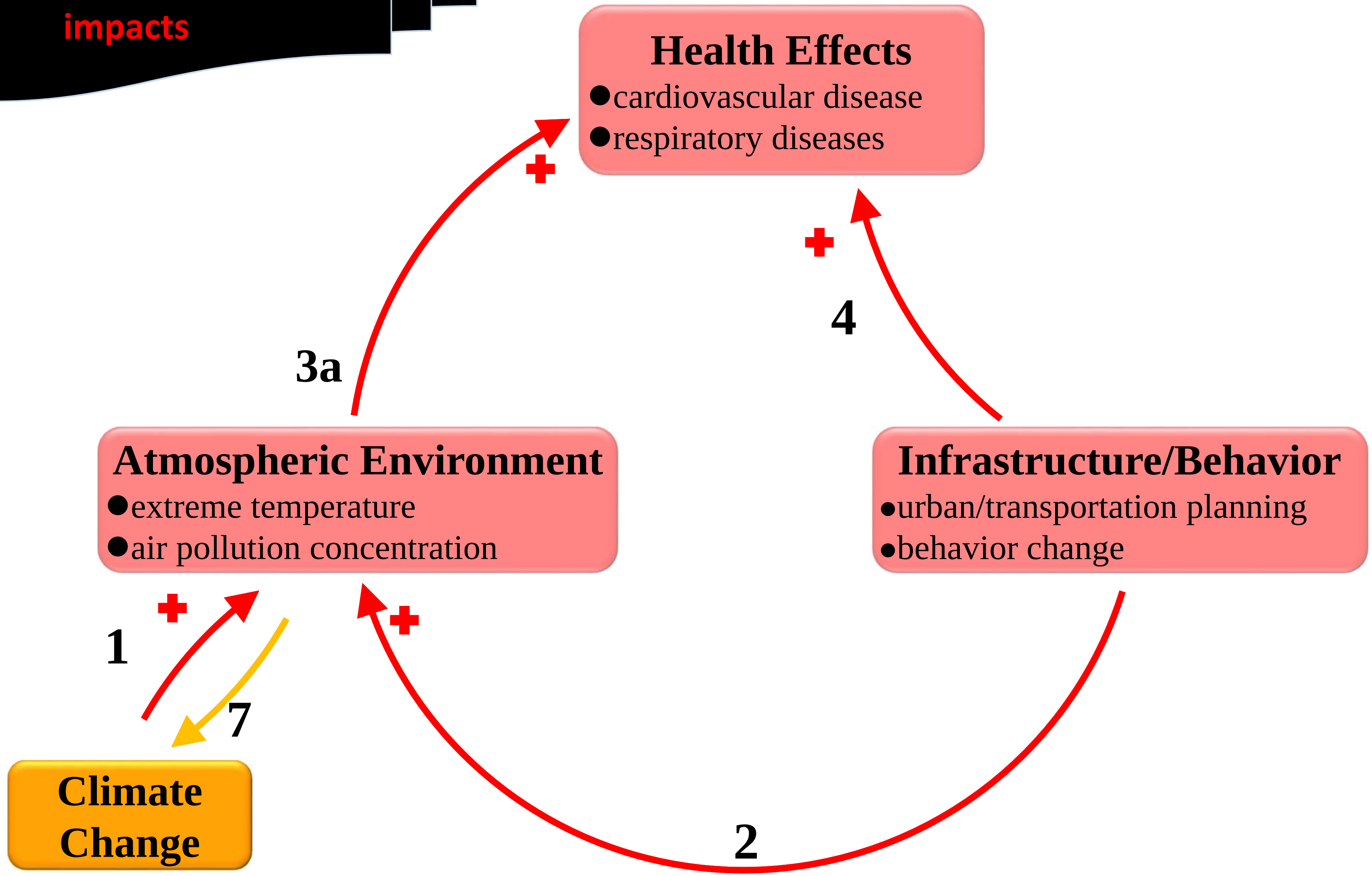


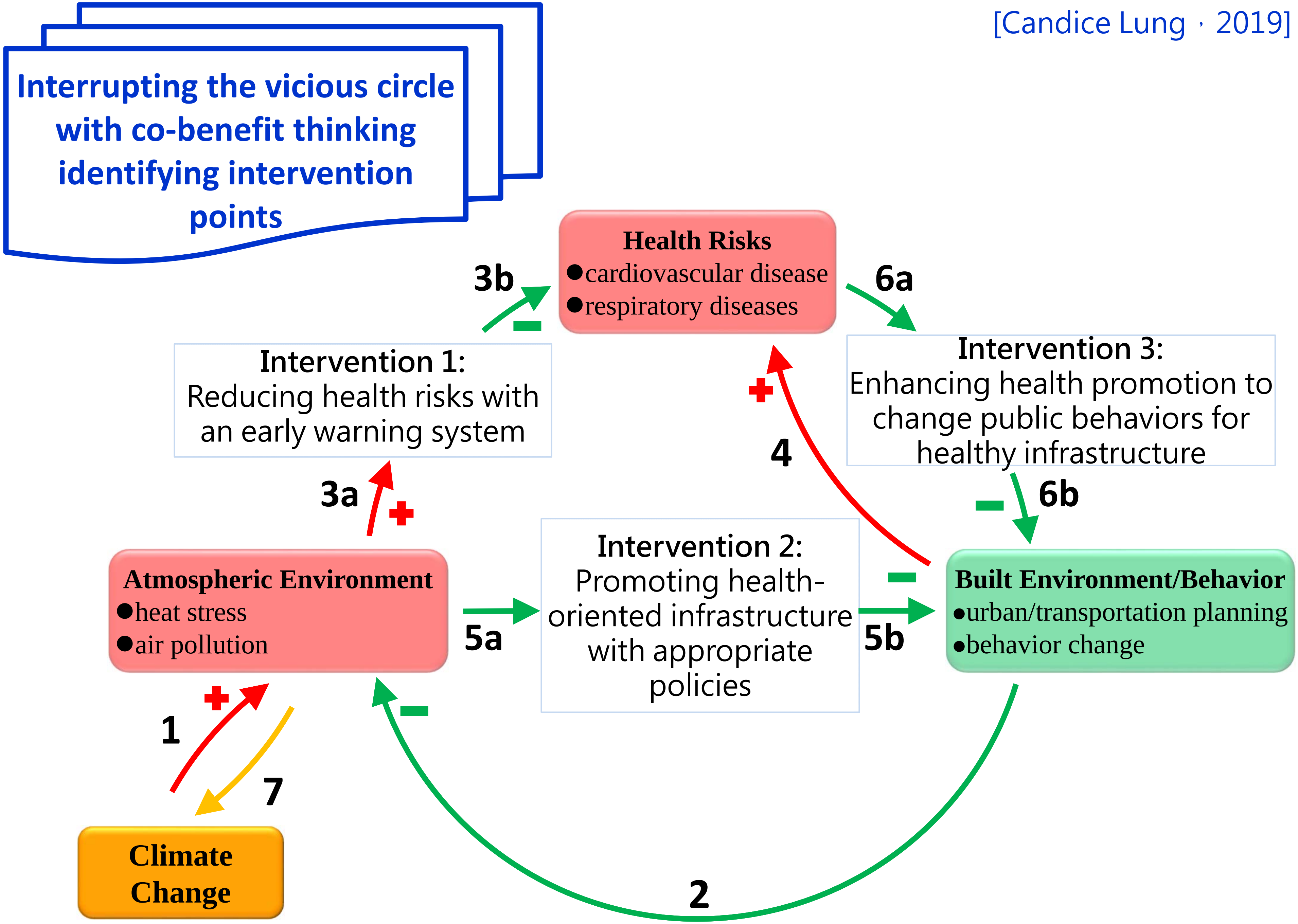
Example 1: Reinforcing loop, this is environmental unfriendly

Example 2: Reinforcing loop, plus one policy-intervention Balancing loop to reach the ultimate goal of environmental friendly

Problem: Current infrastructure planning leads to vicious circle of environment and health impacts

[Candice Lung，2019]





[Candice Lung，2019]
Interrupting the vicious circle with co-benefit thinking identifying intervention points
Health Risks
●cardiovascular disease
●respiratory diseases
3b
6a
Intervention 1:
Reducing health risks with an early warning system
Intervention 3:
Enhancing health promotion to change public behaviors for healthy infrastructure
4
3a
6b
Intervention 2:
Promoting health-oriented infrastructure with appropriate policies
Atmospheric Environment
●heat stress
●air pollution
5a
5b
Built Environment/Behavior
●urban/transportation planning
●behavior change
1
7
Climate Change
2

Step 1: Identify Studied Systems

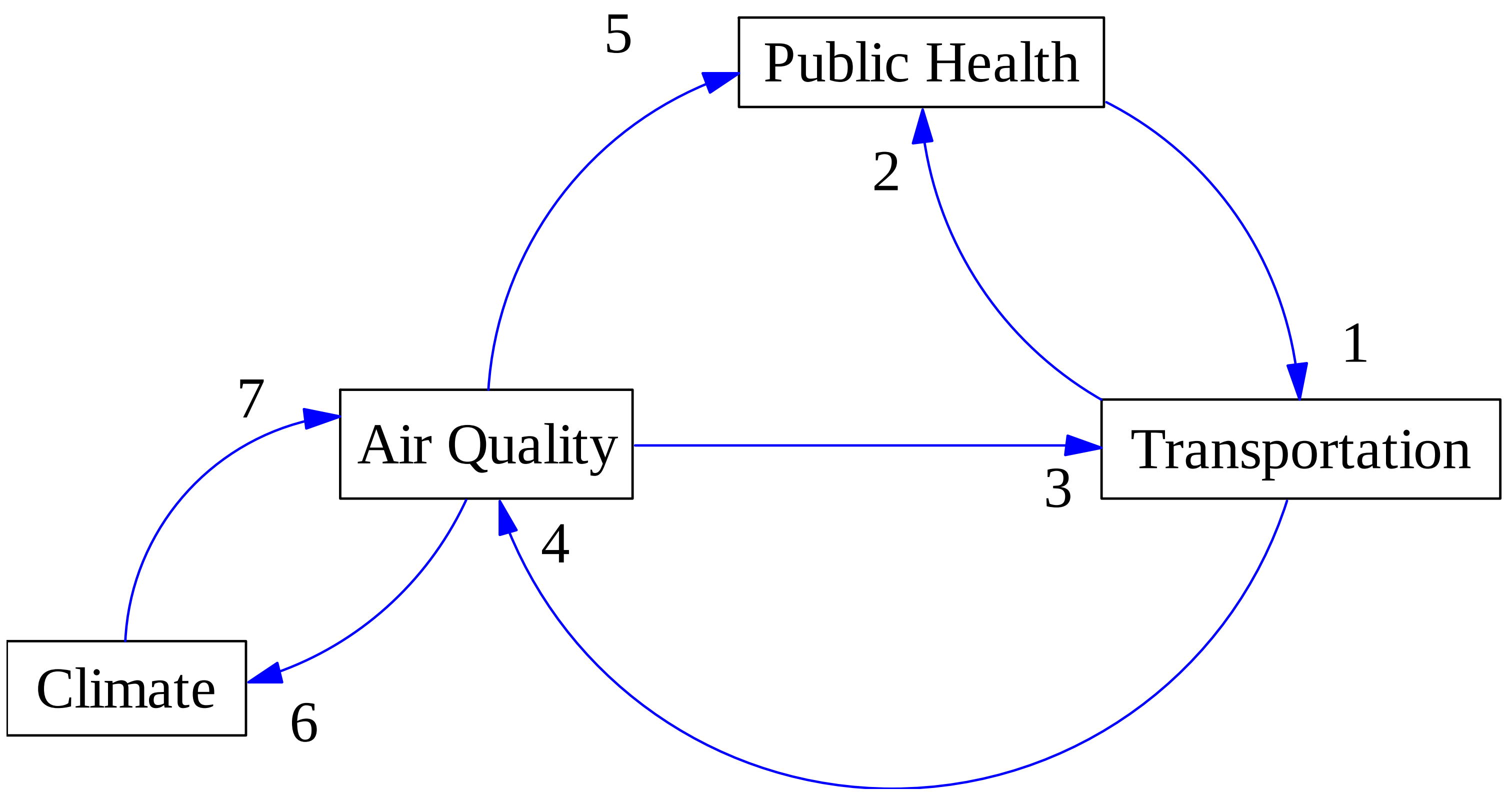


Figure 1. The conceptual interactions among transportation, air quality (and climate), and public health

[Lung et al., 2013]

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Step 2: Identify Studied Variables

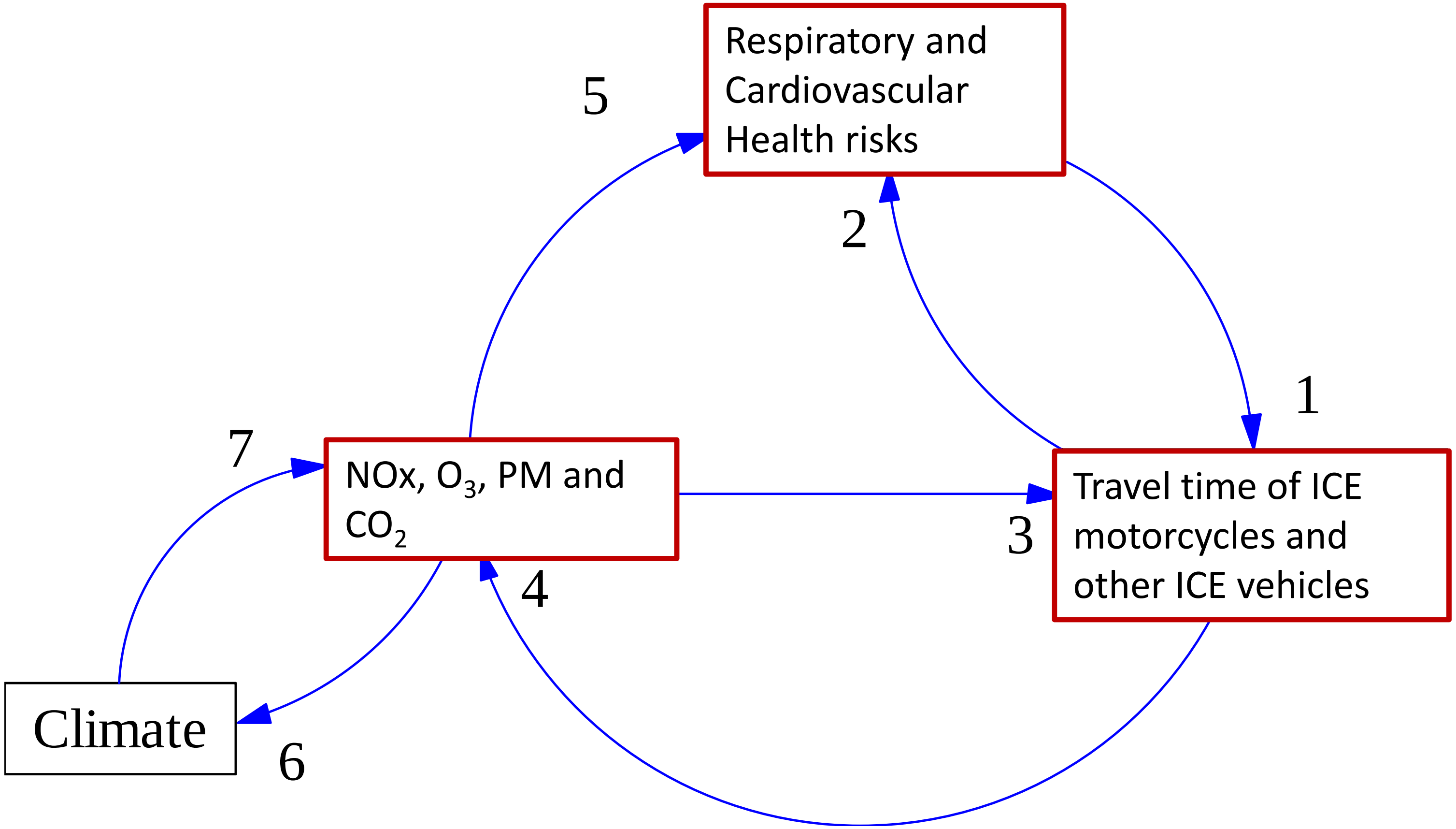


Figure 2. The specific targeted variables in the fields of transportation, air quality (and climate), and public health;
ICE: internal combustion engine; PM: particulate matter;

[Lung et al., 2013]

Step 3: Clarify Interactions among Systems

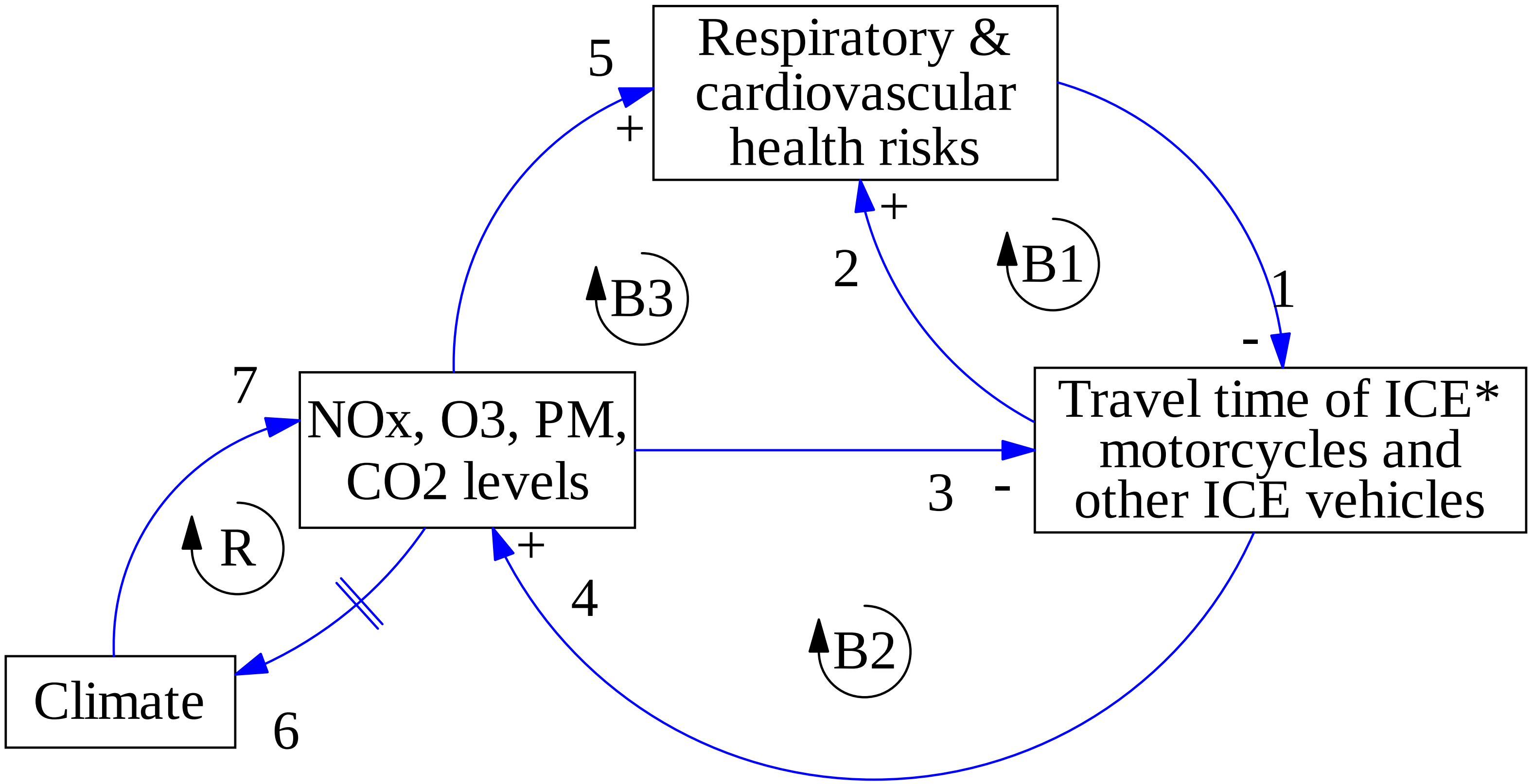
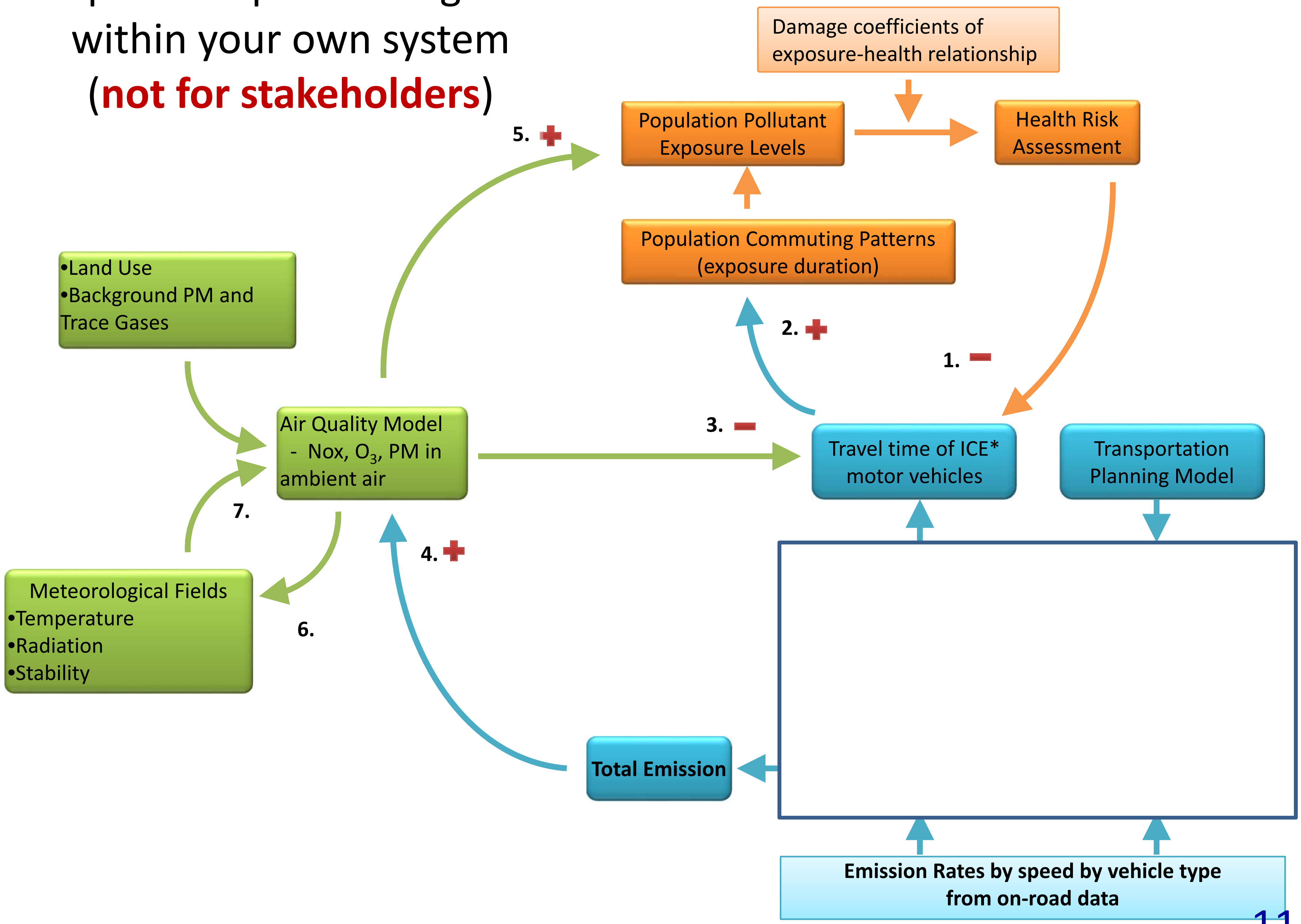


Figure 3. Clarify interactions among System of Interest
ICE: internal combustion engine; PM: particulate matter; B: balancing loop;
B1= links 1 and 2; B2= links 3 and 4; B3=links 1, 4, and 5; R: reinforcing loop

[Lung et al., 2013]

Step 4: Complicate diagrams within your own system (**not for stakeholders**)



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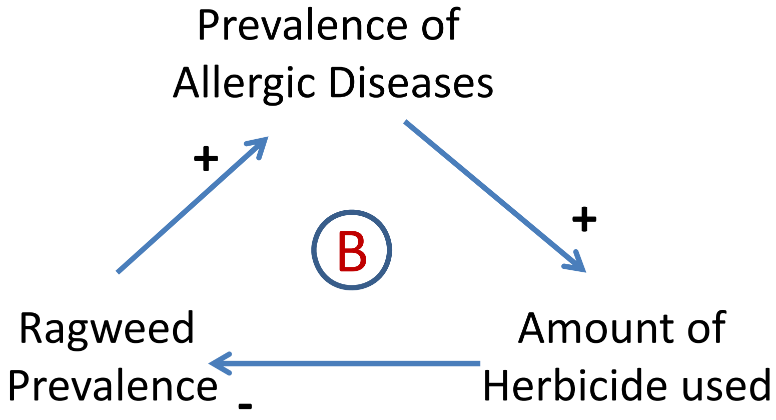
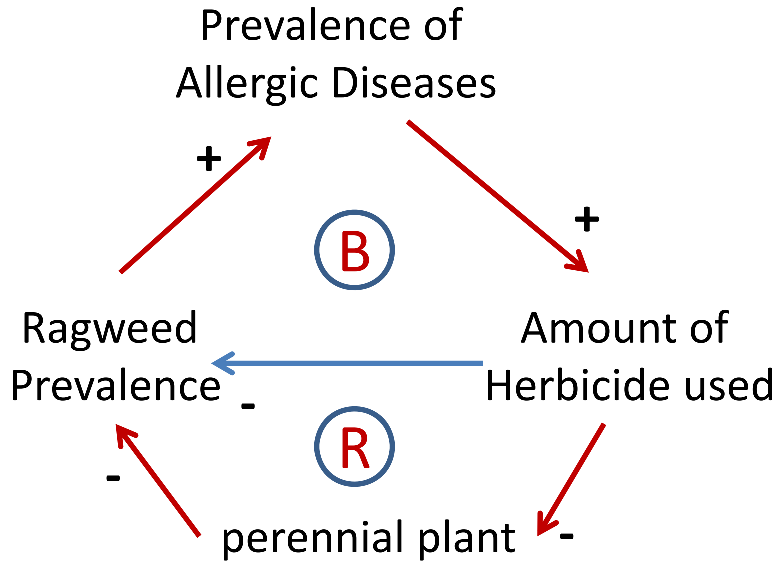
Advantages of applying CCM

- Present reinforcing or balancing relationships among systems based on integration of multidisciplinary knowledge, facilitating communication focusing on the interfaces of systems among experts from different disciplines
- Easier to identify potential intervention points and pathways as options for adaptation strategies
- Easier to examine the consistence in tempo-spatial scales of focused variables in each system which facilitate communication between scholars and stakeholders
- Facilitate the construction of transdisciplinary integration tools for research, policy and industry applications
- Identify interactions among different systems in advance to avoid policy surprises! (unwanted consequences due to unexpected interactions)

Policy surprise (Example) [Newell & Proust, 2014]
Problem of Allergy-inducing Ragweed

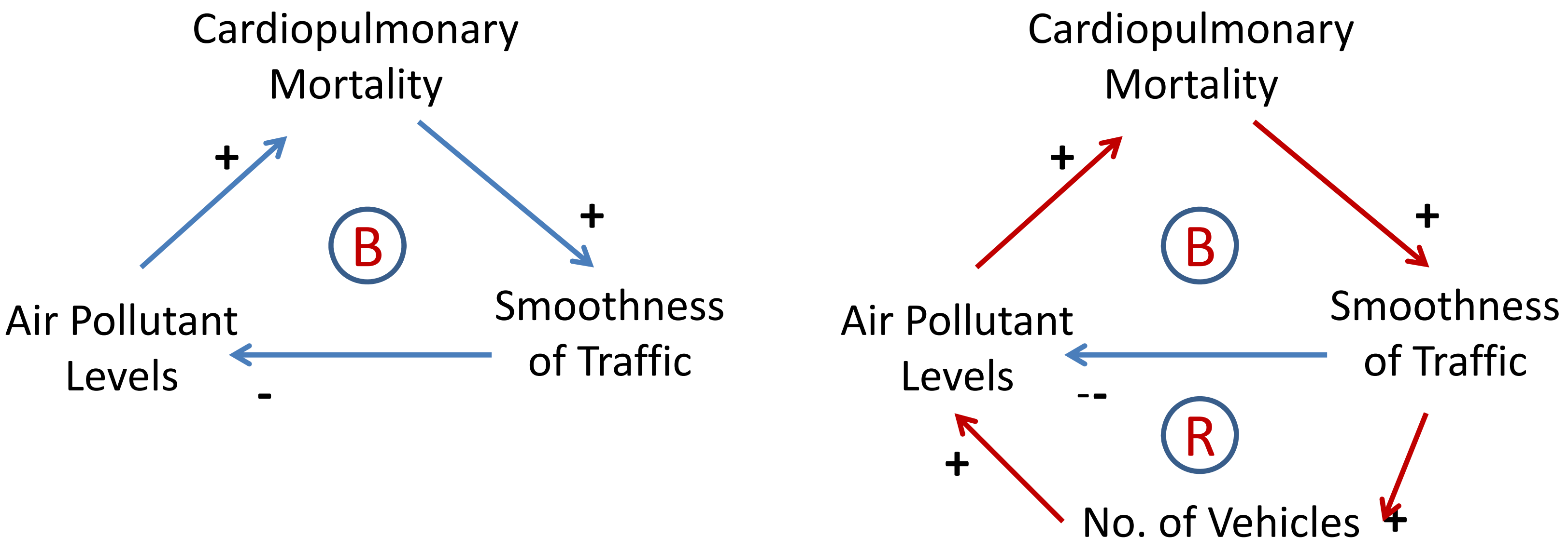




Questions: should be a balancing loop, but the prevalence of Ragweed increased in the second year.
Policy Surprise!? Why?

Answer： Using untargeted herbicide killed Ragweed and other perennial plants. Since Ragweed grows faster than those perennial plants, the prevalence of Ragweed increased in the second year. Red color shows the Reinforcing loop which was missed resulting in policy surprises

Policy surprise (Example)
Transportation-Air Quality-Health Systems



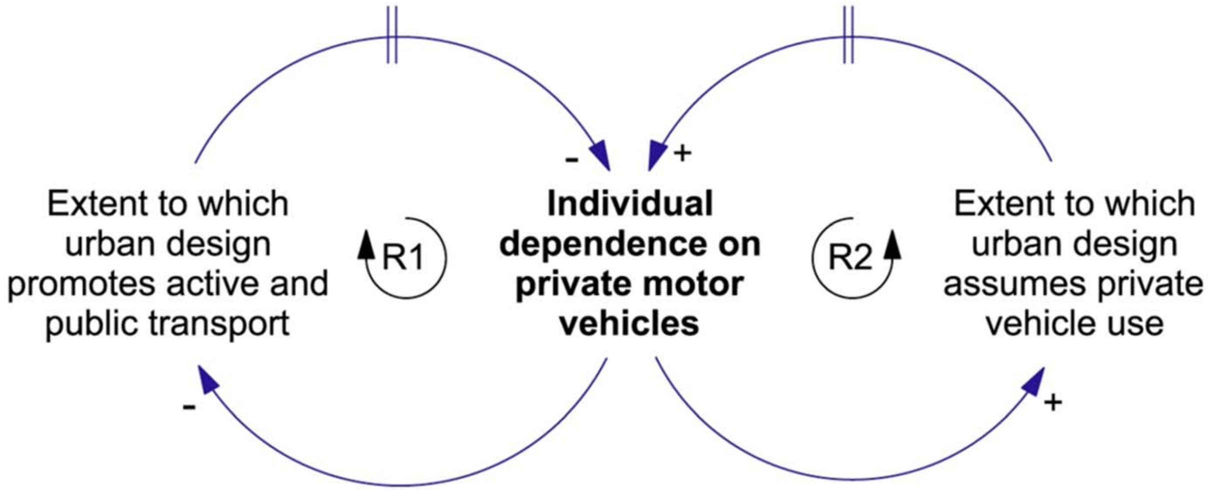
Questions: it should be a balancing loop.
But air pollutant levels not necessarily reduced.
policy surprise?!
Why?

Answer: Smooth traffic encourage more cars in the roads resulting in higher air pollutant levels. Red color shows reinforcing loop.
To ensure environmental friendly results, need to consider policy interventions

[Lung SCC, 2015]

Application in sustainability science (1): Avoid current unsustainable living styles

Figure 9. The Adaptive Challenge. This causal loop diagram instantiates the feedback structure of the Success to the Successful archetype. There are two reinforcing loops, R1 and R2, that work together to affect the extent to which individuals depend on cars. This feedback system has contributed to the growth of car dependence in modern cities. The challenge is to reverse this trend.



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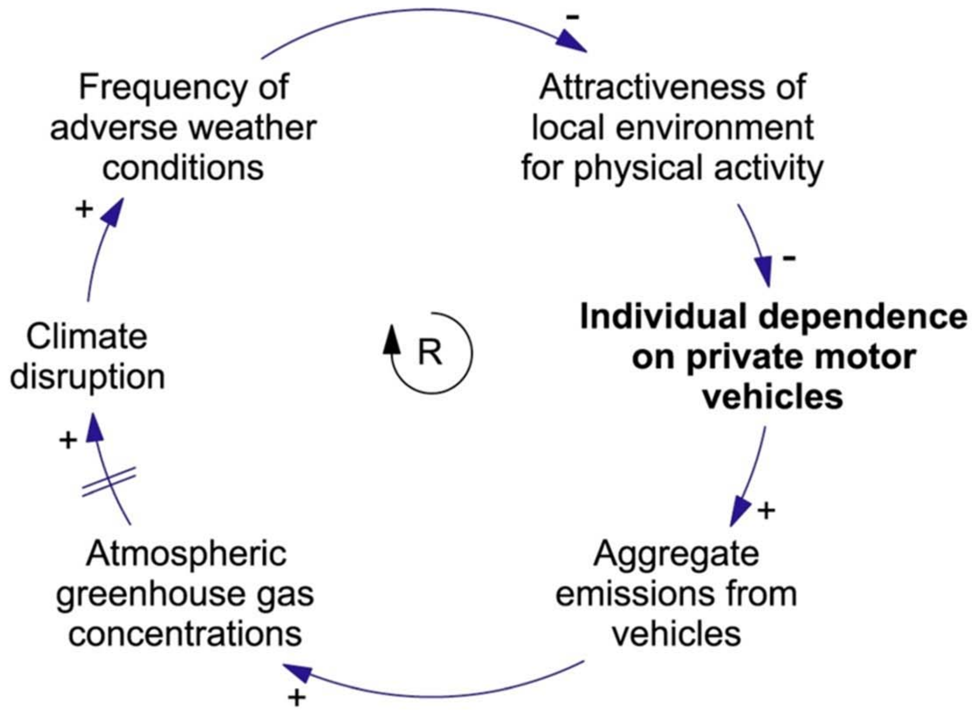
Application in sustainability science (2): innovatively identifying intervention points

Figure 8. A dynamic hypothesis concerning the interaction between car dependence and climate change. The short parallel lines crossing the link from **Atmospheric greenhouse gas concentrations** to **Climate disruption** indicate a delayed effect.



Note：1. focusing on intervention points in the interfaces of systems during the transdisciplinary discussion;

2. within your own studied system, try to identify all possible intervention points

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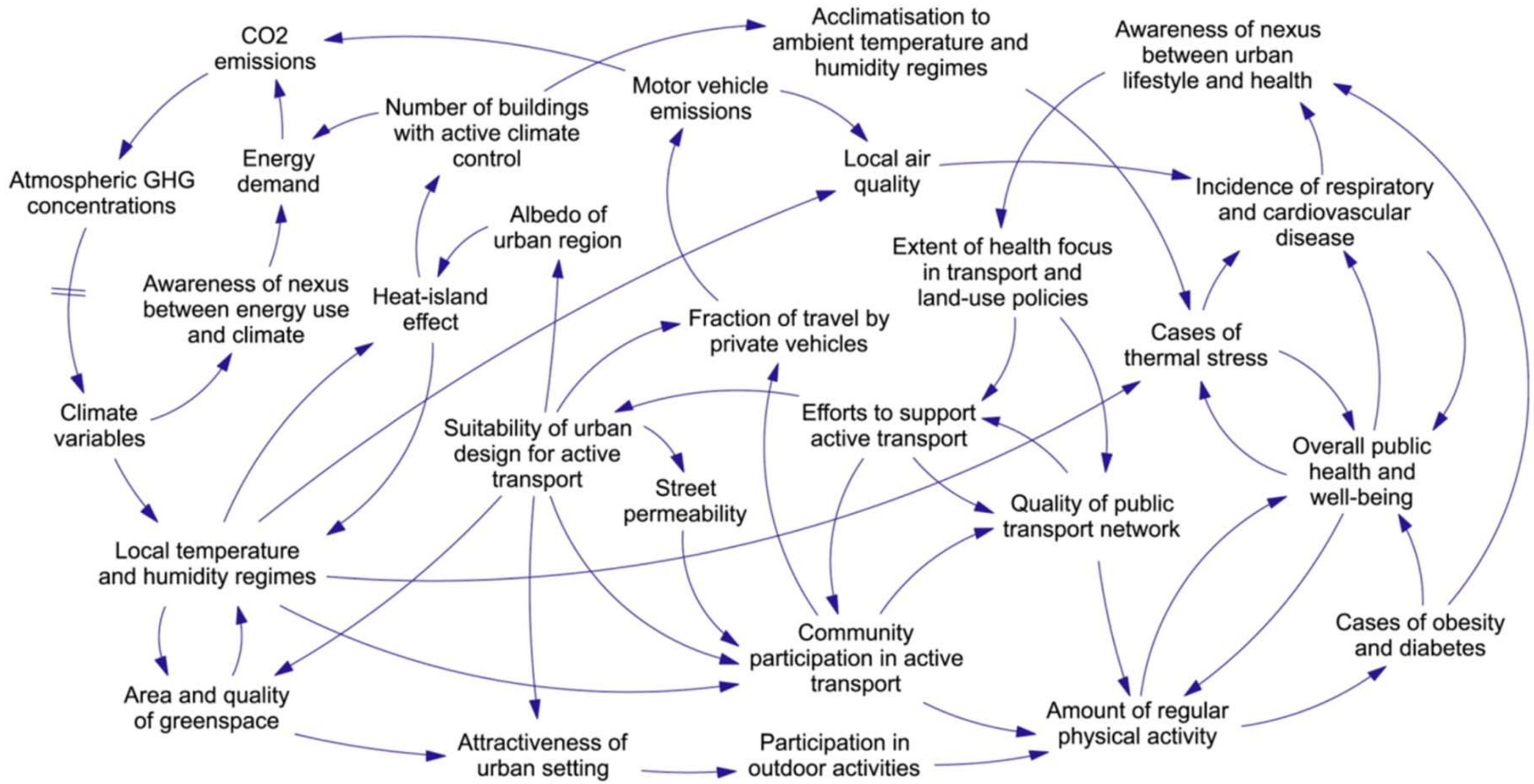
Urban planning-climate-health complicate relationships
(too complicated, it is better to keep it within your own systems, not for transdisciplinary discussion)

Figure 2. An hypothesis concerning selected aspects of the causal structure of urban climate-health systems. In this influence diagram the blocks of text represent system variables, and the arrows represent causal links.



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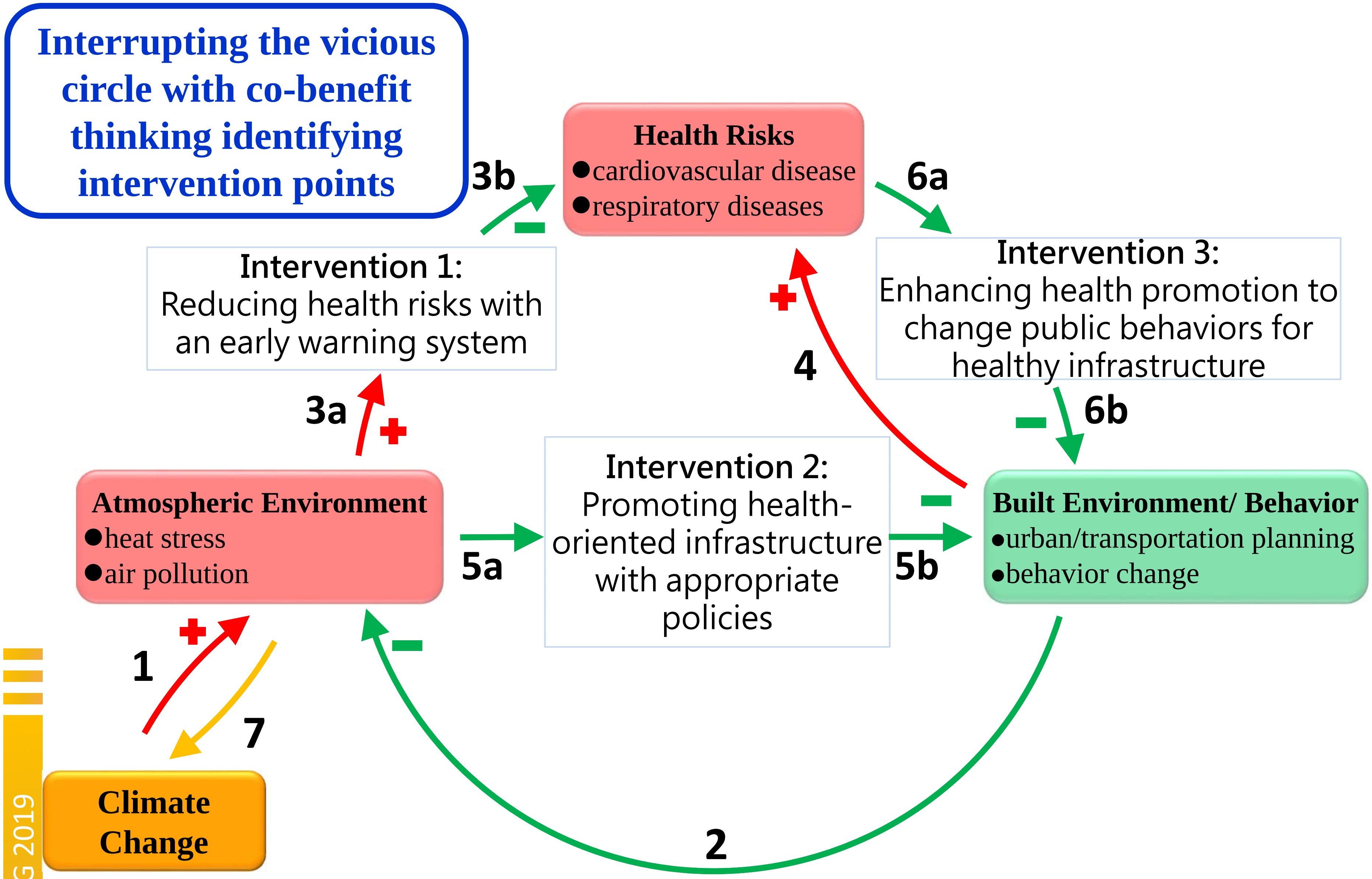

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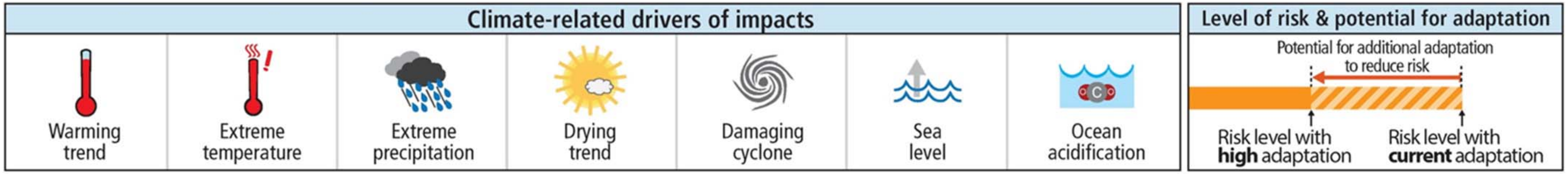
[Candice Lung · 2019]

Table 24-1. Key risks from climate change and the potential for risk reduction through mitigation and adaptation in Asia. (IPCC AR5 Chap 24)



Key risk	Adaptation issues & prospects	Climatic drivers	Timeframe	Risk & potential for adaptation
Increased risk of heat-related mortality (*high confidence*) [24.4]	• Heat health warning systems • Urban planning to reduce heat islands; Improvement of the built environment; Development of sustainable cities • New work practices to avoid heat stress among outdoor workers		Present Near term (2030–2040) Long term (2080–2100) 2°C / 4°C	Very low — Medium — Very high
Increased risk of drought-related water and food shortage causing malnutrition (*high confidence*) [24.4]	• Disaster preparedness including early-warning systems and local coping strategies • Adaptive/integrated water resource management • Water infrastructure and reservoir development • Diversification of water sources including water re-use • More efficient use of water (e.g., improved agricultural practices, irrigation management, and resilient agriculture)		Present Near term (2030–2040) Long term (2080–2100) 2°C / 4°C	Very low — Medium — Very high
Increased risk of water and vector-borne diseases (*medium confidence*) [24.4.6.2, 24.4.6.3, 24.4.6.5]	Early-warning systems, vector control programs, water management and sanitation programs.		Present Near term (2030–2040) Long term (2080–2100) 2°C / 4°C	Very low — Medium — Very high

Information Supporting Observed and Projected Impacts in Asia (IPCC AR5 Chap 24)

Table 24-2 | The amount of information supporting conclusions regarding observed and projected impacts in Asia.

Sector	Topics/issues	North Asia		East Asia		Southeast Asia		South Asia		Central Asia		West Asia	
	O = Observed impacts, P = Projected Impacts	O	P	O	P	O	P	O	P	O	P	O	P
Human health, security, livelihoods, and poverty	Health effects of floods	x	x	x	x	x	x	/	x	x	x	x	x
	Health effects of heat	x	x	/	x	x	x	x	x	x	x	x	x
	Health effects of drought	x	x	x	x	x	x	x	x	x	x	x	x
	Water-borne diseases	x	x	x	x	/	x	/	x	x	x	x	x
	Vector-borne diseases	x	x	x	x	/	x	/	x	x	x	x	x
	Livelihoods and poverty	x	x	/	x	x	x	/	x	x	x	x	x
	Economic valuation	x	x	x	x	/	/	/	/	x	x	x	x

Key:
/ = Relatively abundant/sufficient information; knowledge gaps need to be addressed but conclusions can be drawn based on existing information.
x = Limited information/no data; critical knowledge gaps, difficult to draw conclusions.
NR = Not relevant.

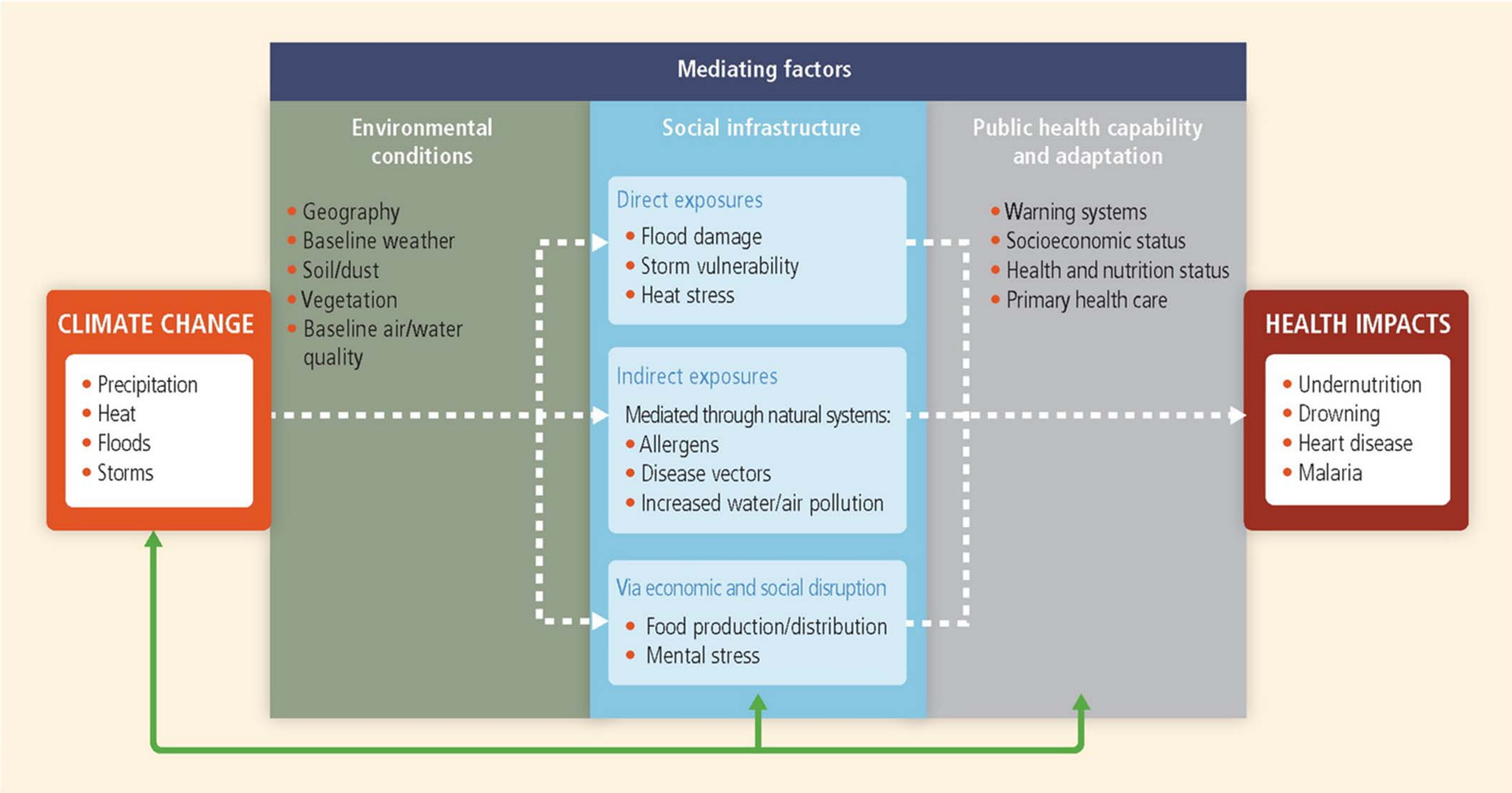


Figure 11-1 | Conceptual diagram showing three primary exposure pathways by which climate change affects health: directly through weather variables such as heat and storms; indirectly through natural systems such as disease vectors; and pathways heavily mediated through human systems such as undernutrition. The green box indicates the moderating influences of local environmental conditions on how climate change exposure pathways are manifest in a particular population. The gray box indicates that the extent to which the three categories of exposure translate to actual health burden is moderated by such factors as background public health and socioeconomic conditions, and adaptation measures. The green arrows at the bottom indicate that there may be feedback mechanisms, positive or negative, between societal infrastructure, public health, and adaptation measures and climate change itself. As discussed later in the chapter, for example, some measures to improve health also reduce emissions of climate-altering pollutants, thus reducing the extent and/or pace of climate change as well as improving local health (courtesy of E. Garcia, UC Berkeley). The examples are indicative.

[IPCC AR5 P716, Fig 11-1]

Climate-Resilient Pathways

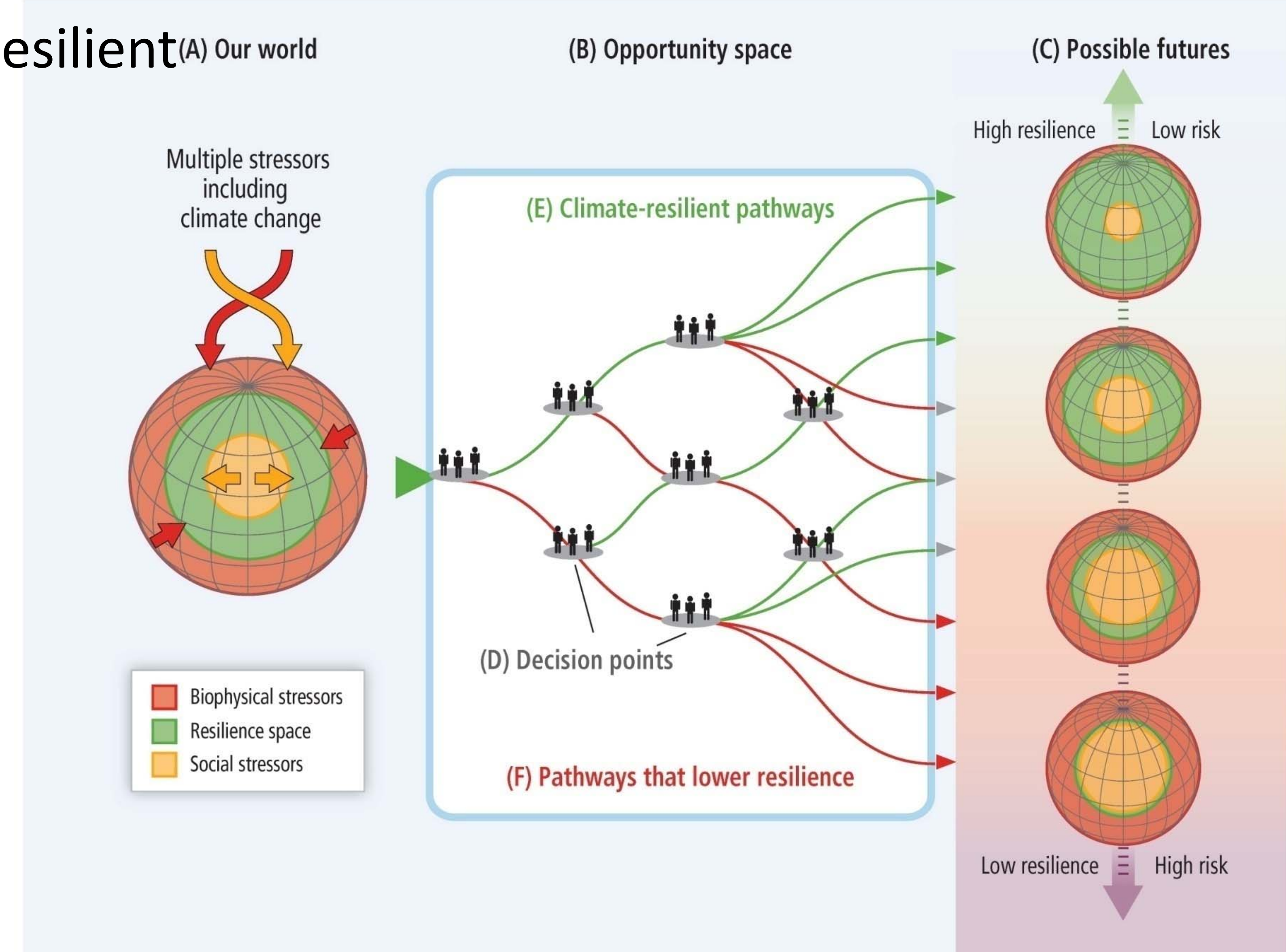


Figure SPM.9 | Opportunity space and climate-resilient pathways. (A) Our world [Sections A-1 and B-1] is threatened by multiple stressors that impinge on resilience from many directions, represented here simply as biophysical and social stressors. Stressors include climate change, climate variability, land-use change, degradation of ecosystems, poverty and inequality, and cultural factors. (B) Opportunity space [Sections A-2, A-3, B-2, C-1, and C-2] refers to decision points and pathways that lead to a range of (C) possible futures [Sections C and B-3] with differing levels of resilience and risk. (D) Decision points result in actions or failures-to-act throughout the opportunity space, and together they constitute the process of managing or failing to manage risks related to climate change. (E) Climate-resilient pathways (in green) within the opportunity space lead to a more resilient world through adaptive learning, increasing scientific knowledge, effective adaptation and mitigation measures, and other choices that reduce risks. (F) Pathways that lower resilience (in red) can involve insufficient mitigation, maladaptation, failure to learn and use knowledge, and other actions that lower resilience; and they can be irreversible in terms of possible futures.

Any Questions?

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