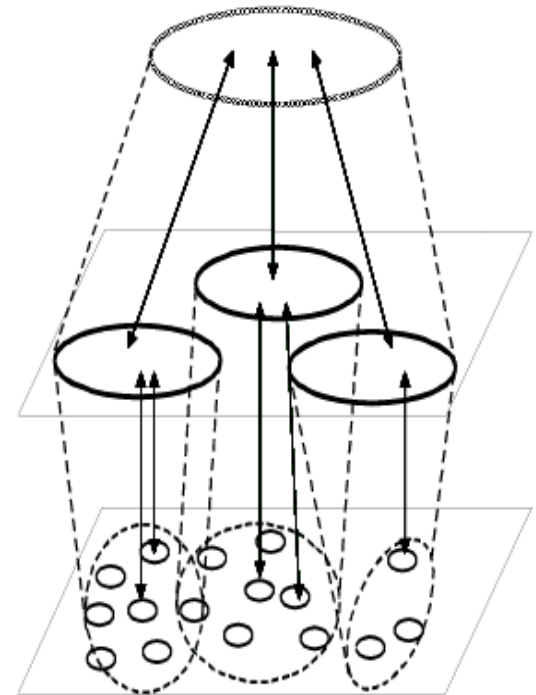
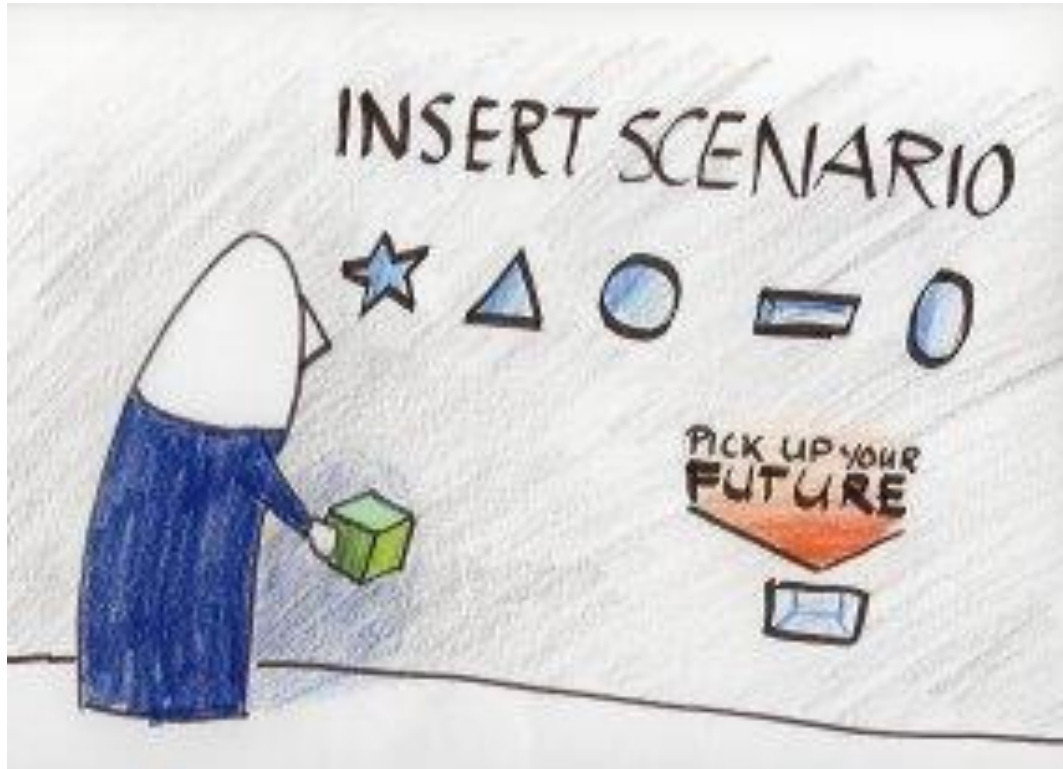


# Top-down or bottom-up participatory scenario development?



*Kasper Kok (Wageningen University)*

*PBL Lunch lecture*

*Bilthoven, 29 October 2015*

# Content

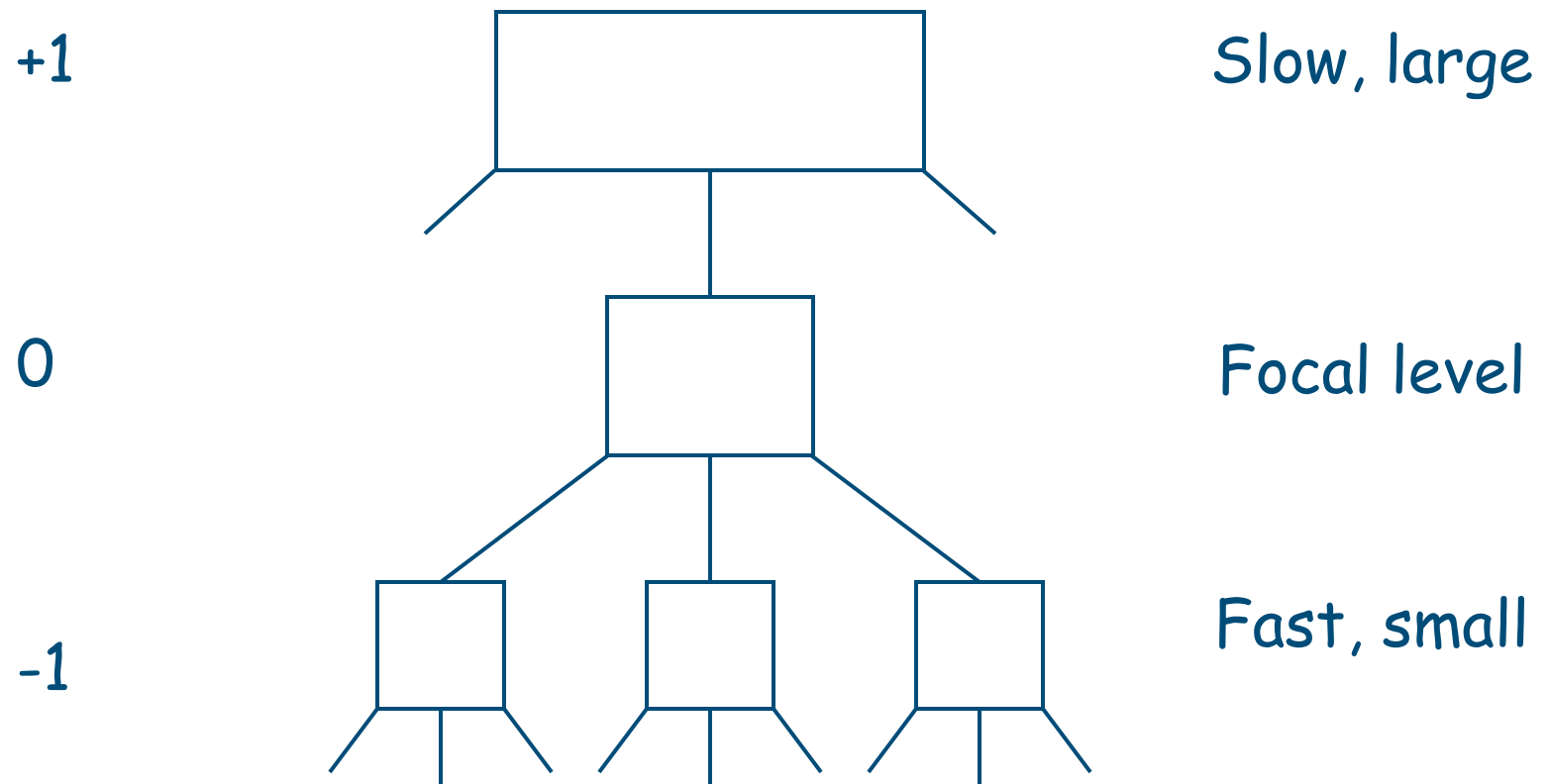
---

- Conceptual considerations
- State-of-the-art methodology
- Practical examples
  - Overview of important methods
  - (Extending the) Shared Socioeconomic Pathways
  - Implementation in the IMPRESSIONS project
- Conclusions

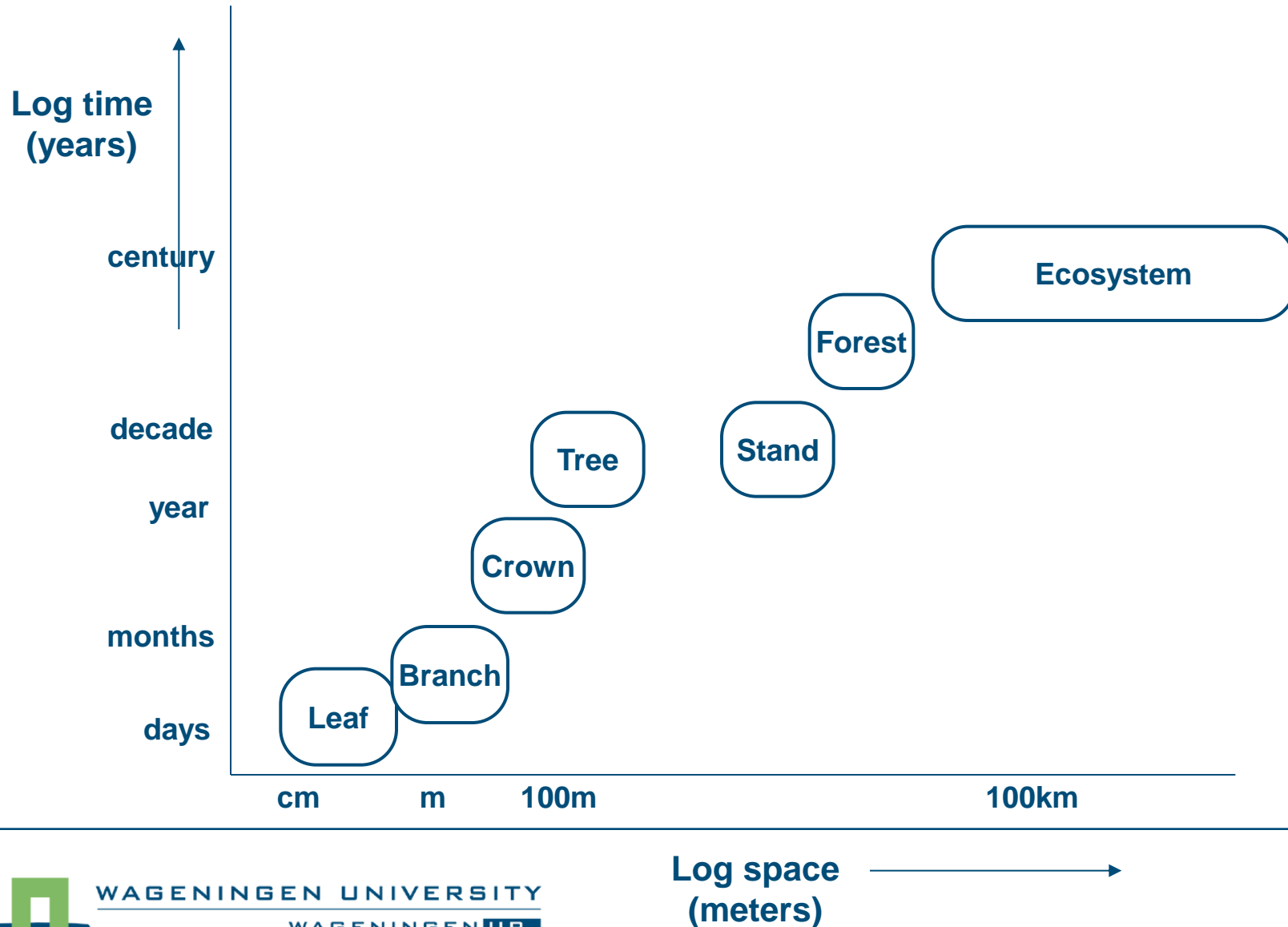
---

# Conceptual considerations

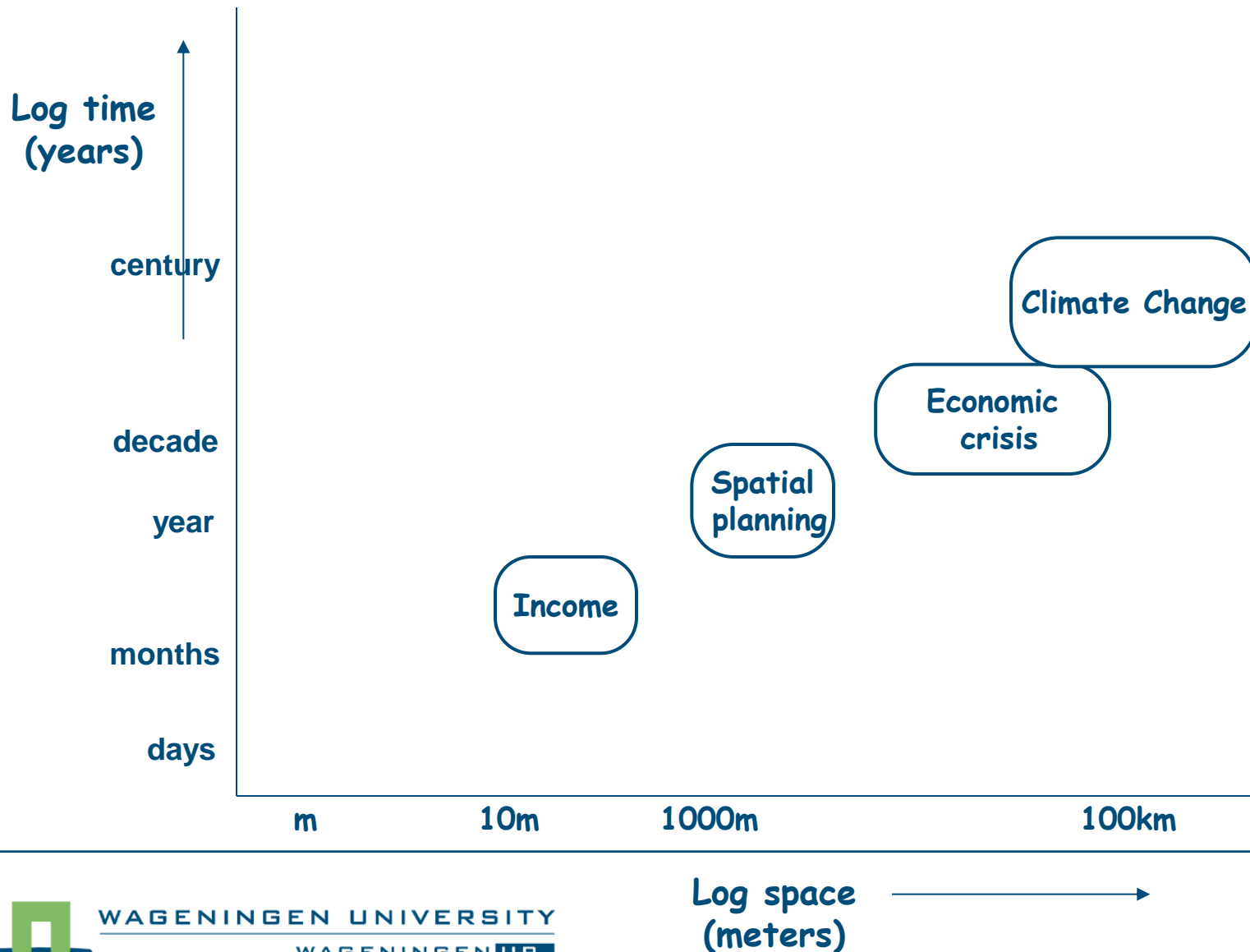
# Rooted in ecological theories: The Hierarchy Theory



# Rooted in ecological theories: space-time dependency



# Rooted in ecological theories: space-time dependency



---

# Methodology

# Two fundamental methodological choices

---

## 1. Top-down or bottom-up

Top-down: global scenarios (e.g. SSPs) as boundary conditions; regional scenarios maintain strong link with global.

Bottom-up: start with regional scenarios that are matched to global scenarios (e.g. SSPs) *a posteriori* or in the process

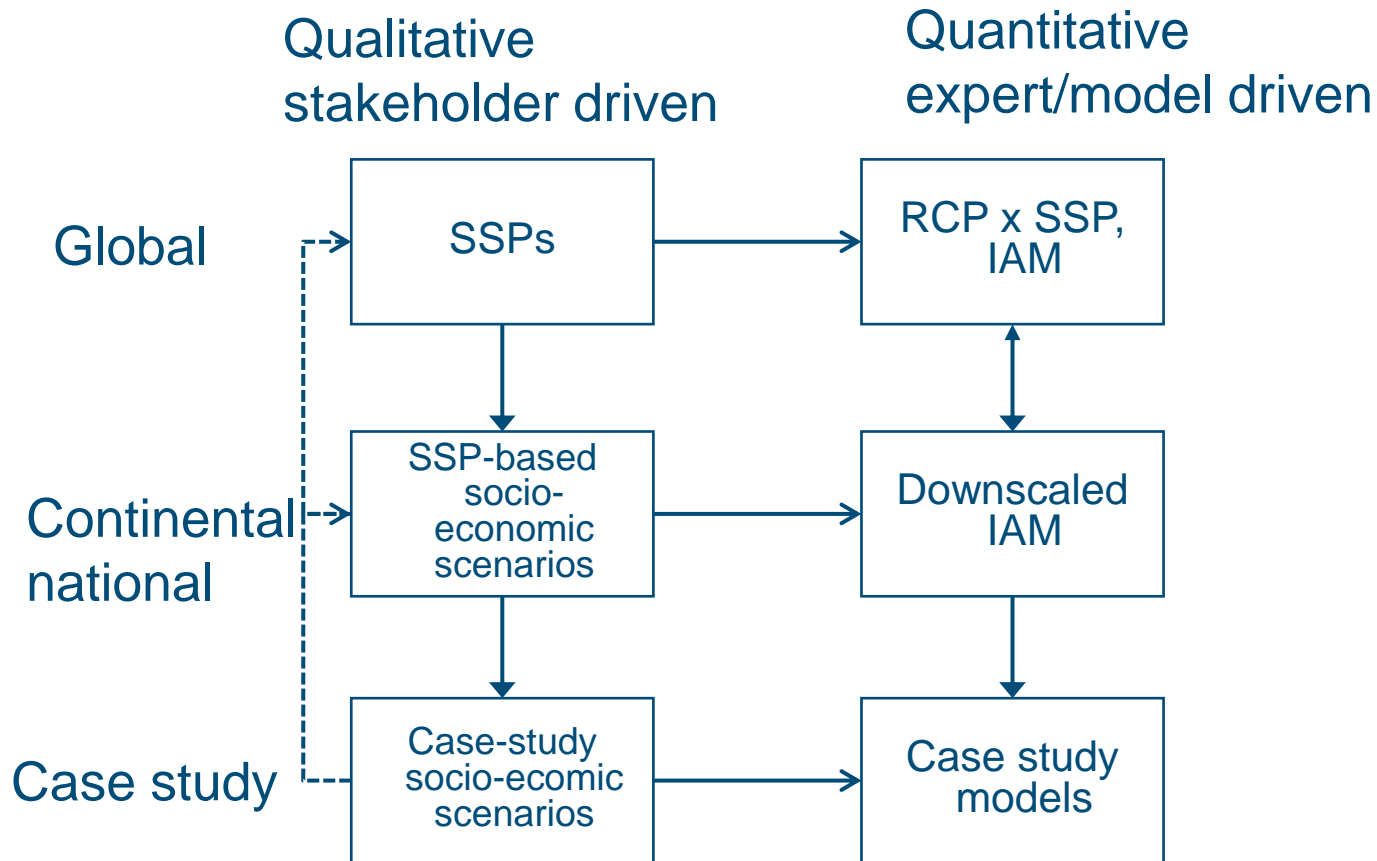
## 2. Participatory stakeholder involvement or expert-driven

Participatory: stakeholder-driven; content of resulting scenarios with strong tie to regional specifics.

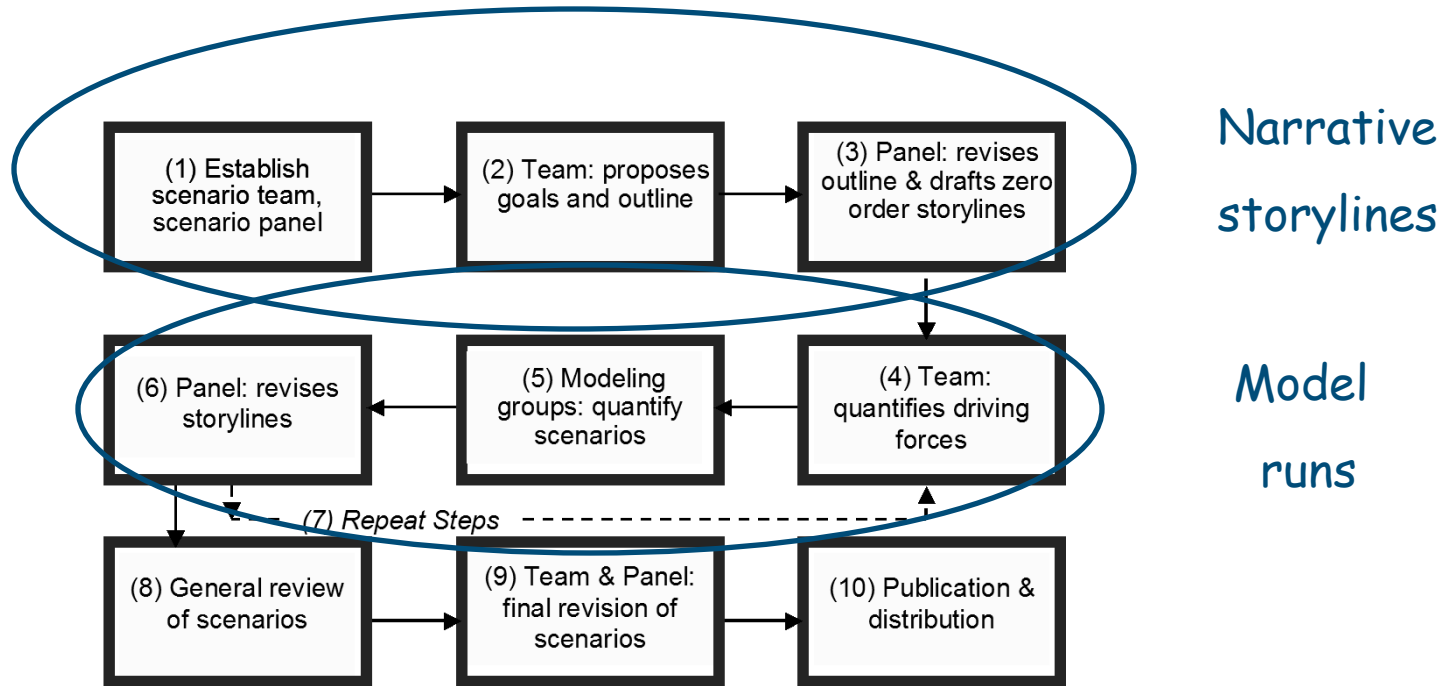
Expert-driven: Model-based; resulting scenarios can have stronger link with global scenarios.



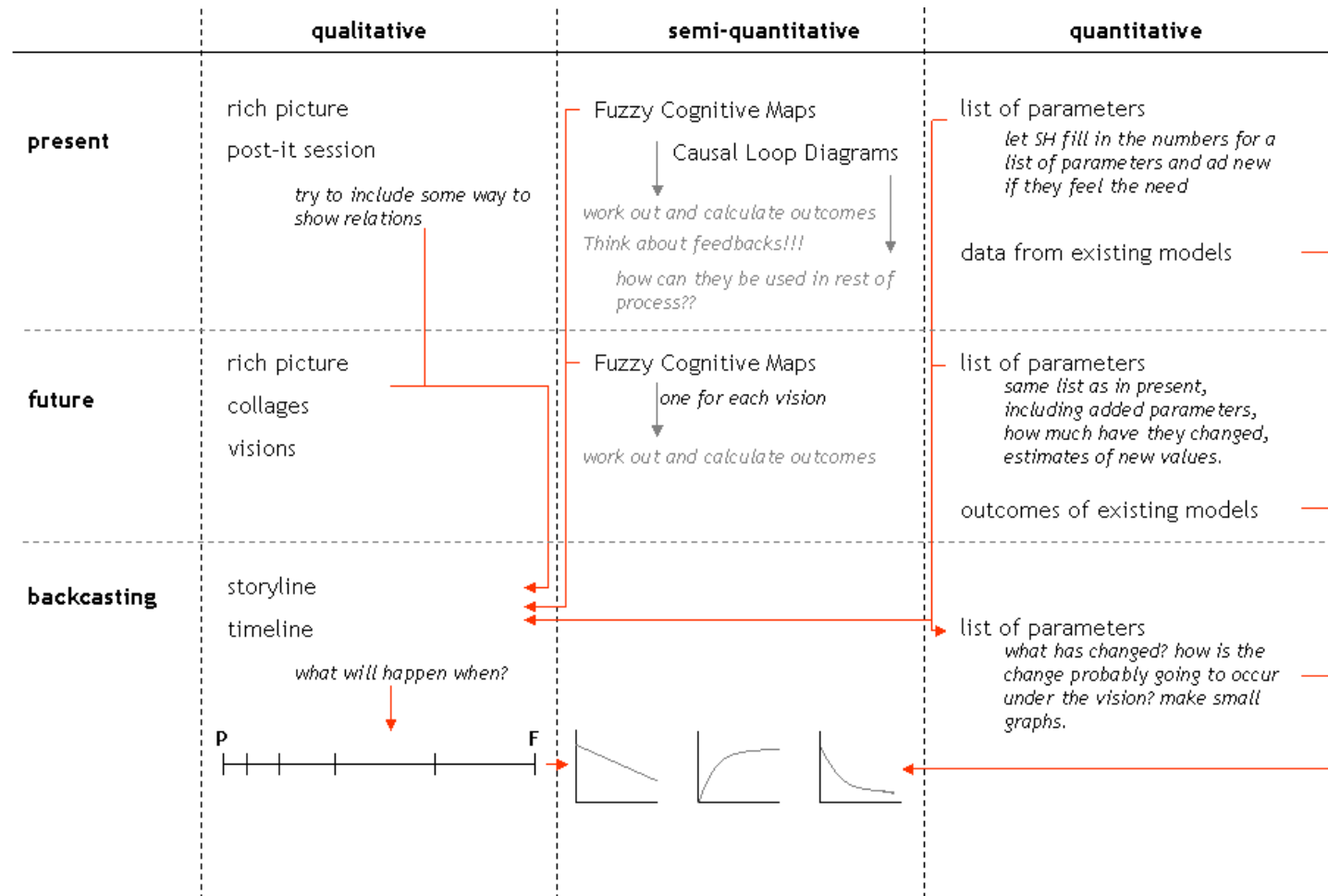
# Multi-scale scenario development



# Story-And-Simulation approach



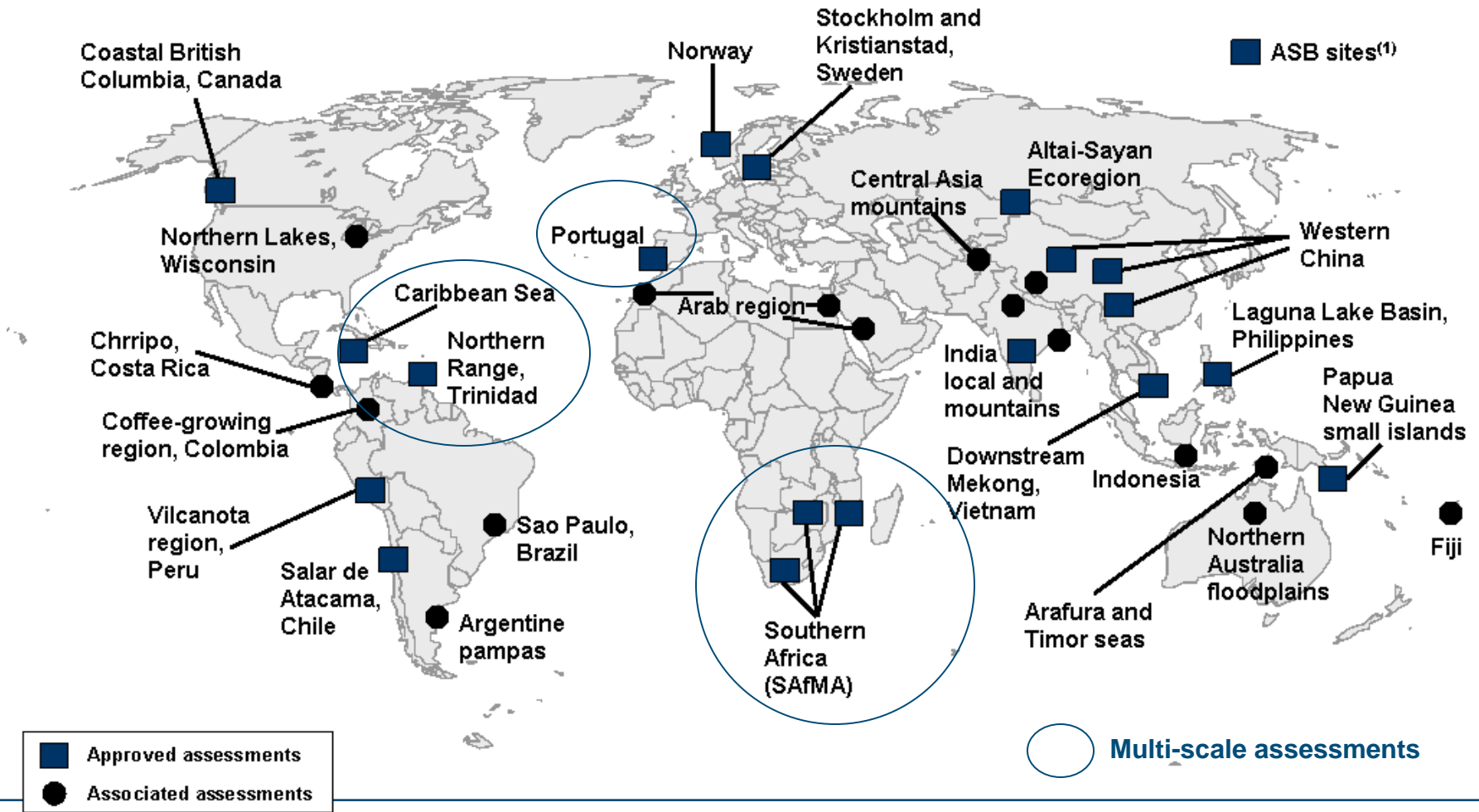
# Scenarios - a toolbox of methods



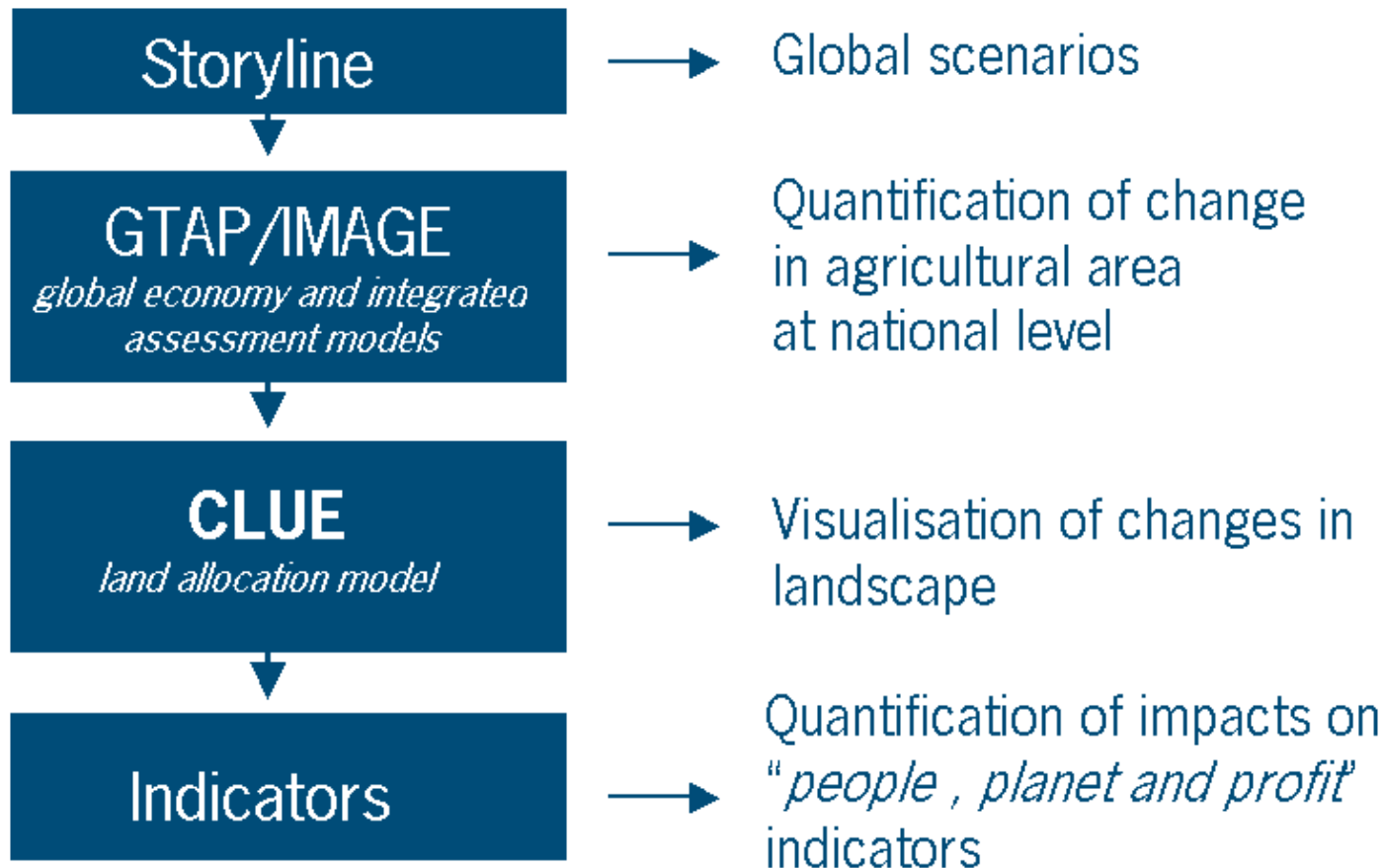
---

# Overview of important methods

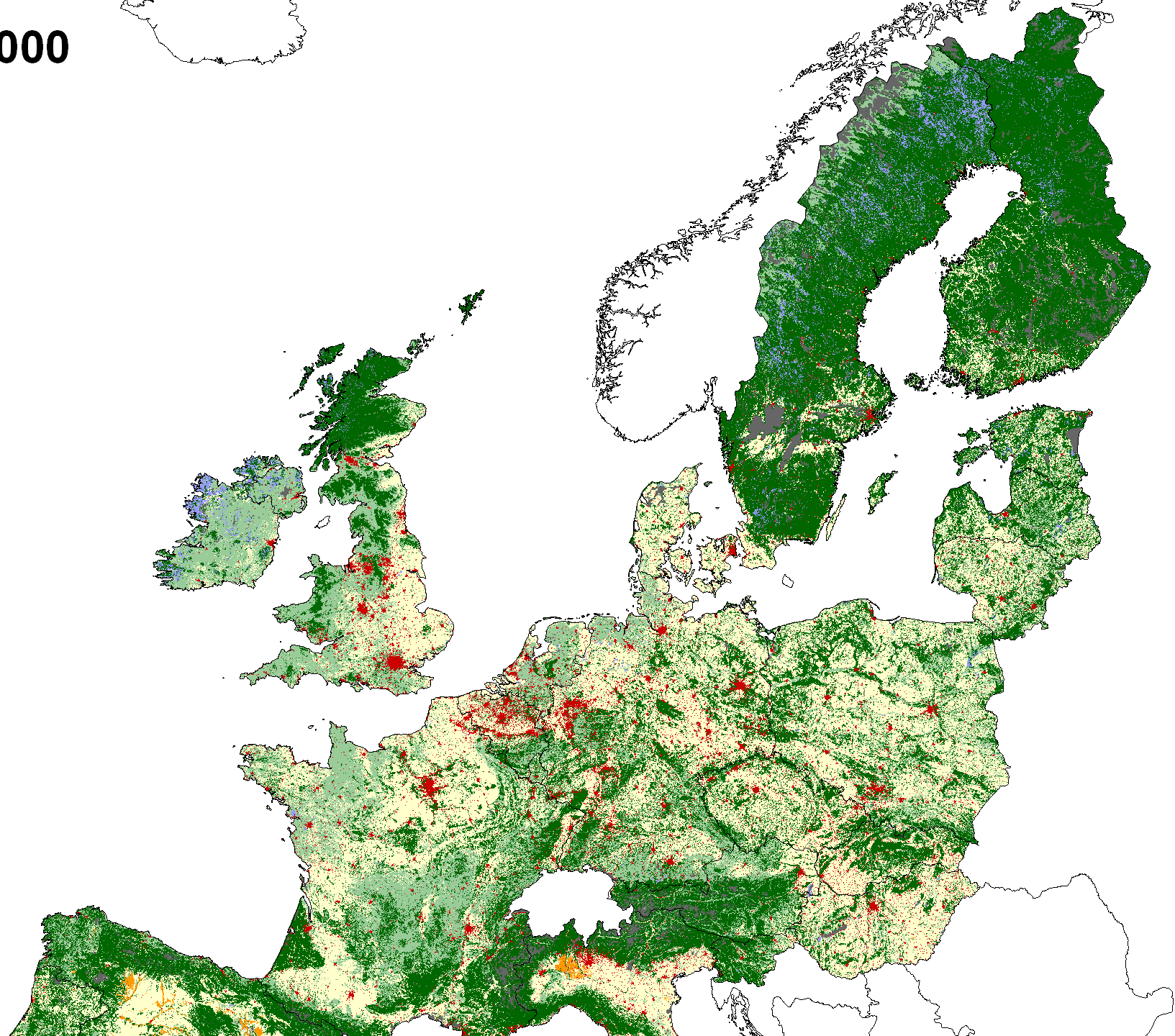
# Millennium Ecosystem Assessment: largest evidence base!



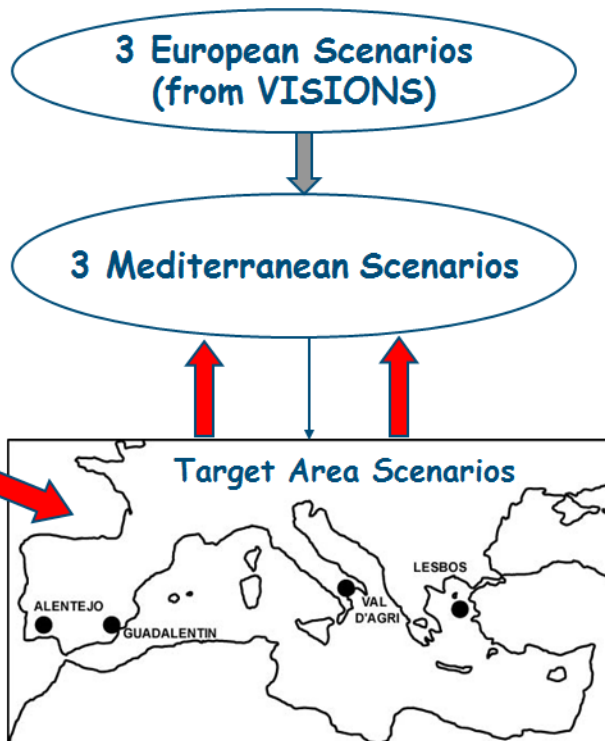
# EURURALIS: expert and model driven



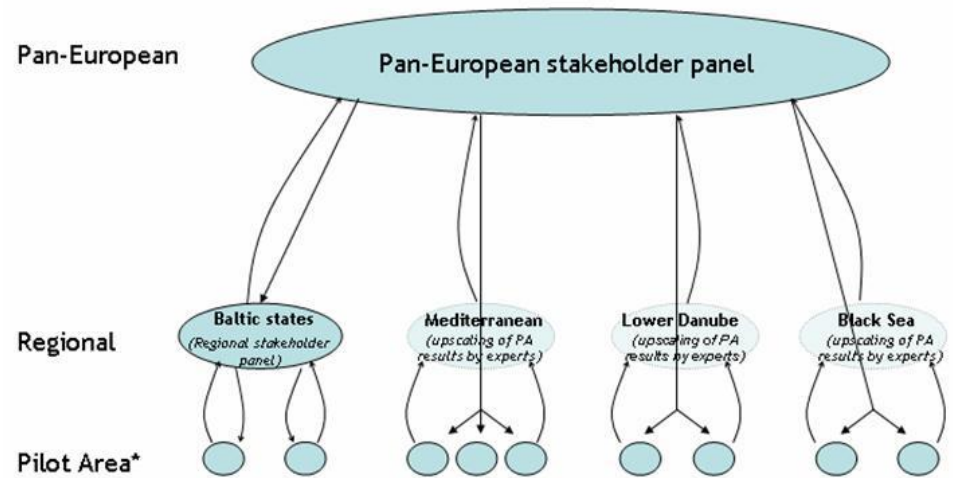
2000



# Bottom-up participatory



MedAction



\* Stakeholder panels and workshops in all Pilot Areas

Scenes



# Local perceptions of drivers: Writing post-its



# Local explorative scenarios: Narratives



END  
MARKET ASST 2023 → 2050

No subsidies for agriculture  
 Population movement to urban areas with abandonment of rural areas  
 Manufacturing - increasing scandals of water pollution - re-intervention of government.  
 Electricity - Continuing trend from middle period (+ some new innovations)  
 Widespread privatisation of water supply + treatment.  
 Agriculture - Entrenchment of industrial agriculture in Europe.  
 Pockets of high pressure on water resources  
 Locally agriculture out-competes other sectors  
 Increasing inter-basin water transfer (now economically viable)  
 Mass. low level treatment of ag wastes to make ecologically attractive products.  
 Domestic - Continuous increase in price of water.  
 Intensive local competition between domestic + agricultural sectors  
 Increasing economic incentives to improve water use efficiencies + new water saving technologies.



# Local visions: Collages





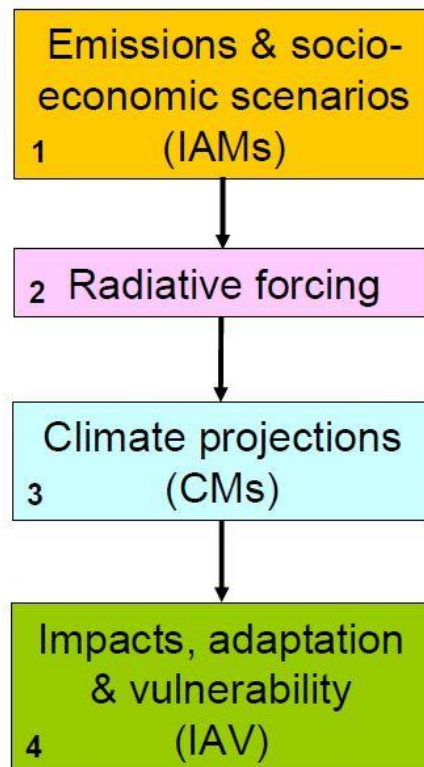
---

# The new global scenarios

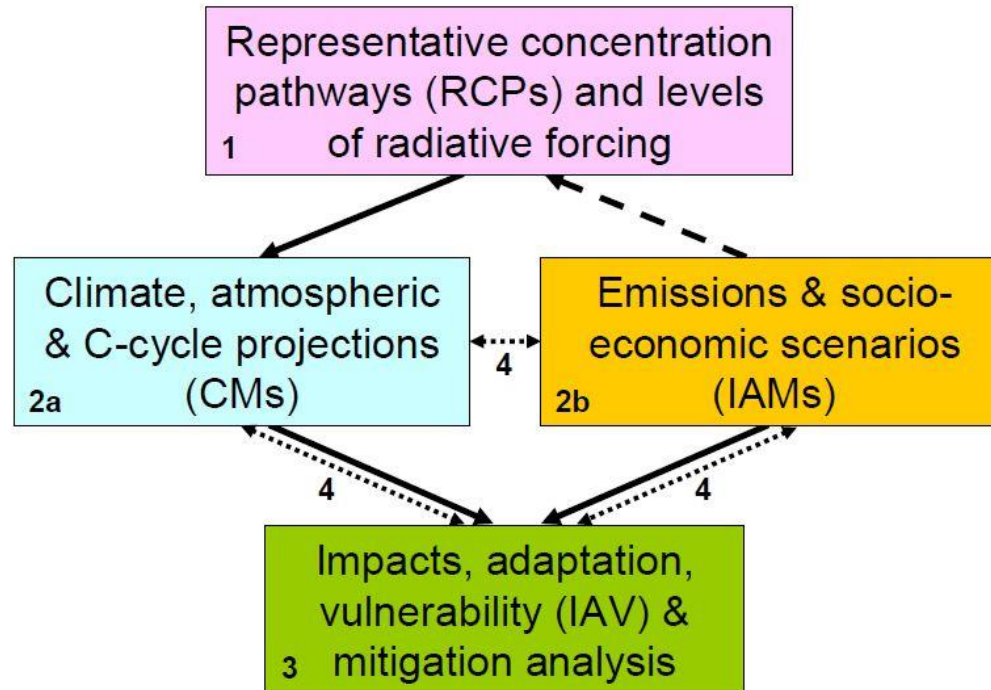


# The new global scenarios: The RCP x SSPs

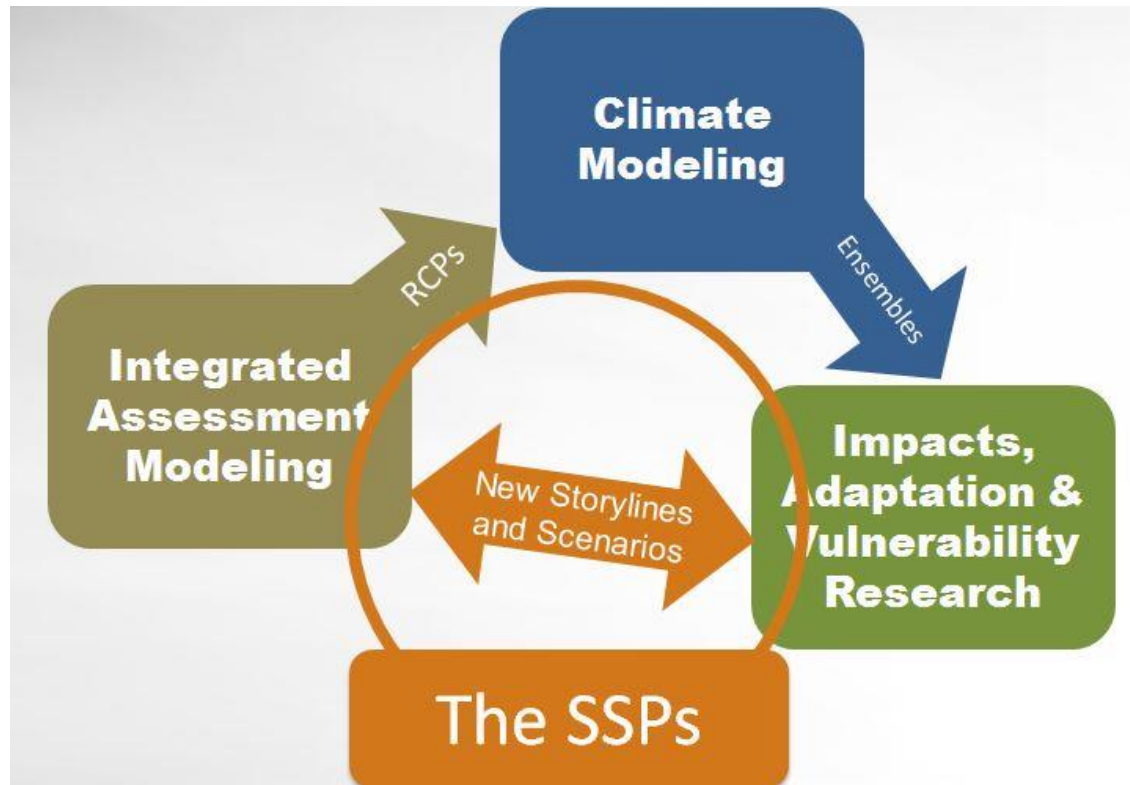
(a) Sequential approach



(b) Parallel approach



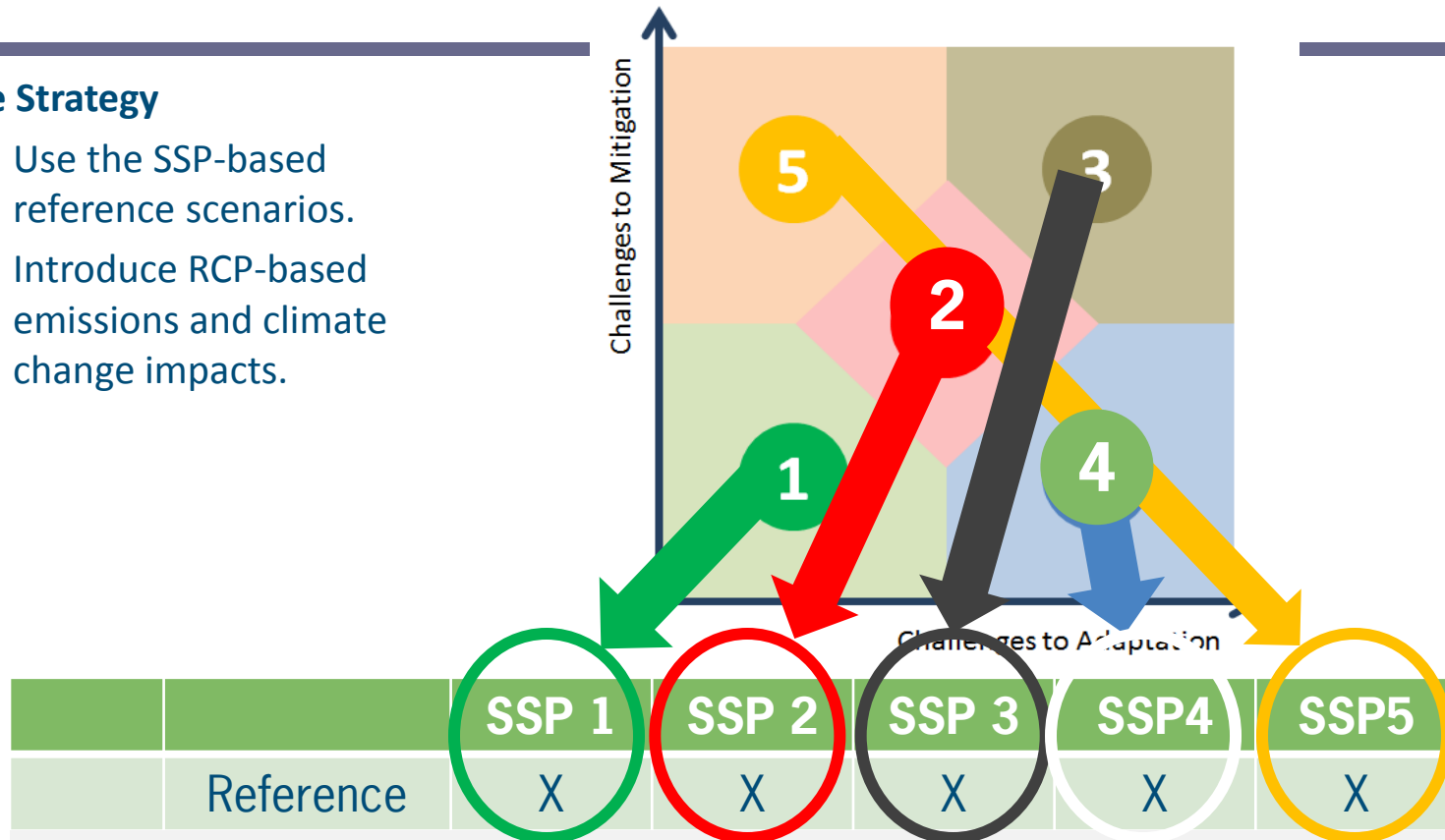
# The new global scenarios: The RCP x SSPs



# The scenario matrix - SSP

## The Strategy

- Use the SSP-based reference scenarios.
- Introduce RCP-based emissions and climate change impacts.

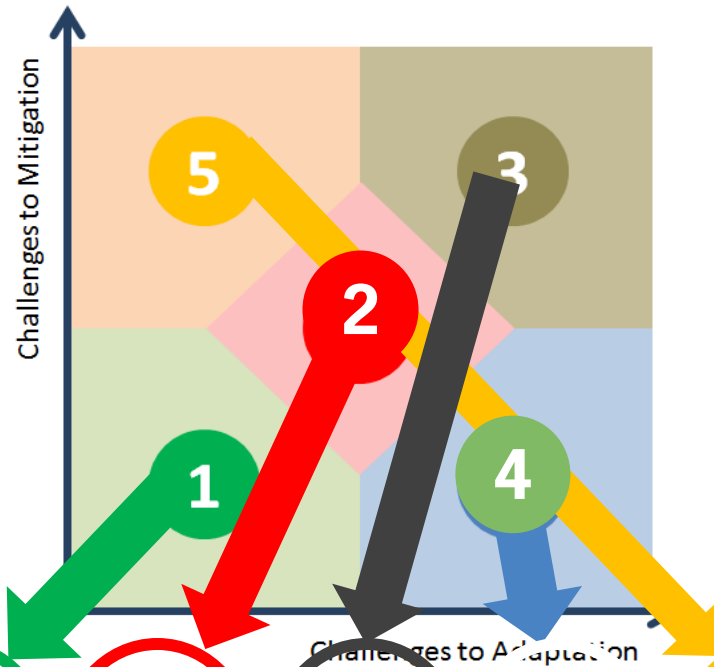




# The scenario matrix - SSP x RCP

## The Strategy

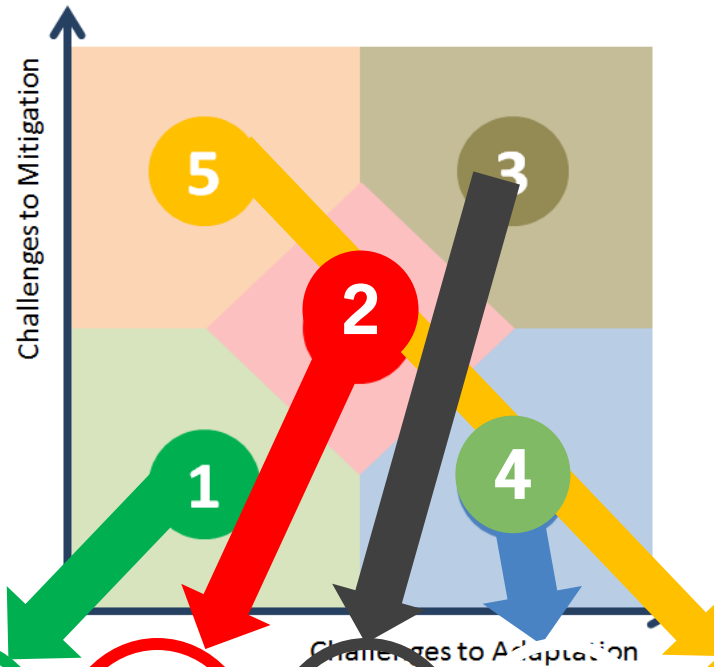
- Use the SSP-based reference scenarios.
- Introduce RCP-based emissions and climate change impacts.
- ▶ Of course, not every RCP can be replicated starting from every SSP reference scenario



|                    |                      | SSP 1 | SSP 2 | SSP 3 | SSP 4 | SSP 5 |
|--------------------|----------------------|-------|-------|-------|-------|-------|
|                    | Reference            | X     | X     | X     | X     | X     |
| Replication<br>RCP | 8.5 Wm <sup>-2</sup> |       |       |       |       | X     |
|                    | 6.0 Wm <sup>-2</sup> | X     | X     | X     | X     | X     |
|                    | 4.5 Wm <sup>-2</sup> | X     | X     | X     | X     | X     |
|                    | 2.6 Wm <sup>-2</sup> | X     | X     |       |       | X     |

# The scenario matrix - SSP x RCP x SPA

- The final element in the Scenario Matrix Architecture are the **Shared Climate Policy Assumptions (SPAs)**
- SPAs define**
  - What policies?
  - Who mitigates? and when?



|                    |                      | SSP 1 | SSP 2 | SSP 3 | SSP 4 | SSP 5 |
|--------------------|----------------------|-------|-------|-------|-------|-------|
|                    | Reference            | X     | X     | X     | X     | X     |
| RCP<br>Replication | 8.5 Wm <sup>-2</sup> |       |       | SPAs  |       | X     |
|                    | 6.0 Wm <sup>-2</sup> | X     | X     | X     | X     | X     |
|                    | 4.5 Wm <sup>-2</sup> | SPAs  | X     | X     | X     | X     |
|                    | 2.6 Wm <sup>-2</sup> | X     | X     |       |       | X     |

# On-going initiatives in Europe and Latin America

| RCP x SSP | SSP1  | SSP2                     | SSP3                                   | SSP4                    | SSP5   |
|-----------|---|--------------------------|--|-------------------------|--|
| RCP2.6    | ROBIN   |                          |  |                         | ROBIN  |
| RCP4.5    | IMPRESSIONS<br>GLOBAQUA<br>AMAZALERT<br>ECONADAPT<br>TRANSMANGO | GLOBAQUA<br>MARS<br>BASE | IMPRESSIONS<br>ECONADAPT<br>TRANSMANGO | IMPRESSIONS<br>GLOBAQUA |  |
| RCP6.0    |   |                          |  |                         |  |
| RCP8.5    |   |                          | IMPRESSIONS<br>AMAZALERT               | ROBIN                   | IMPRESSIONS<br>GLOBAQUA<br>MARS<br>ROBIN<br>BASE |

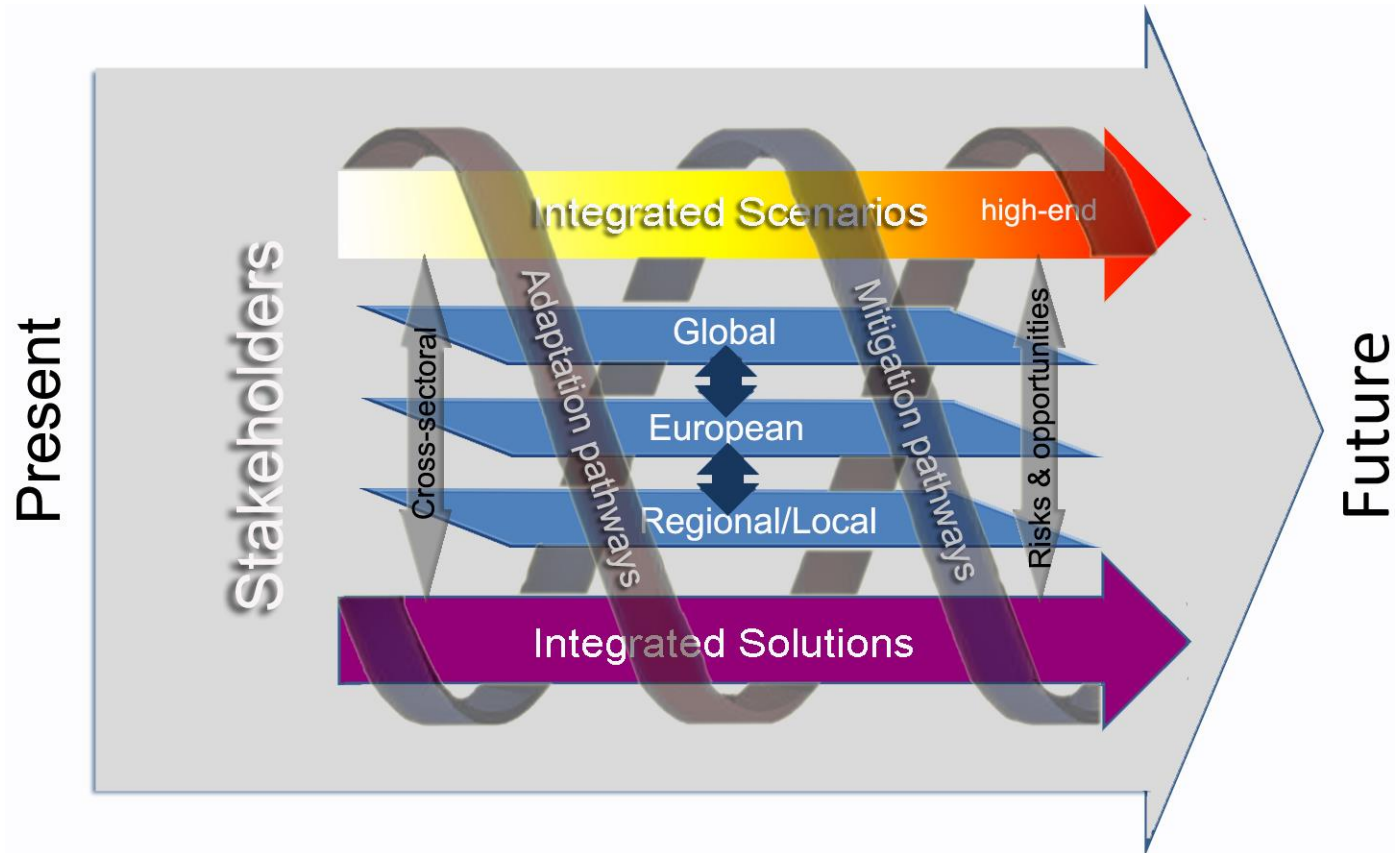
# The IMPRESSIONS scenarios

---

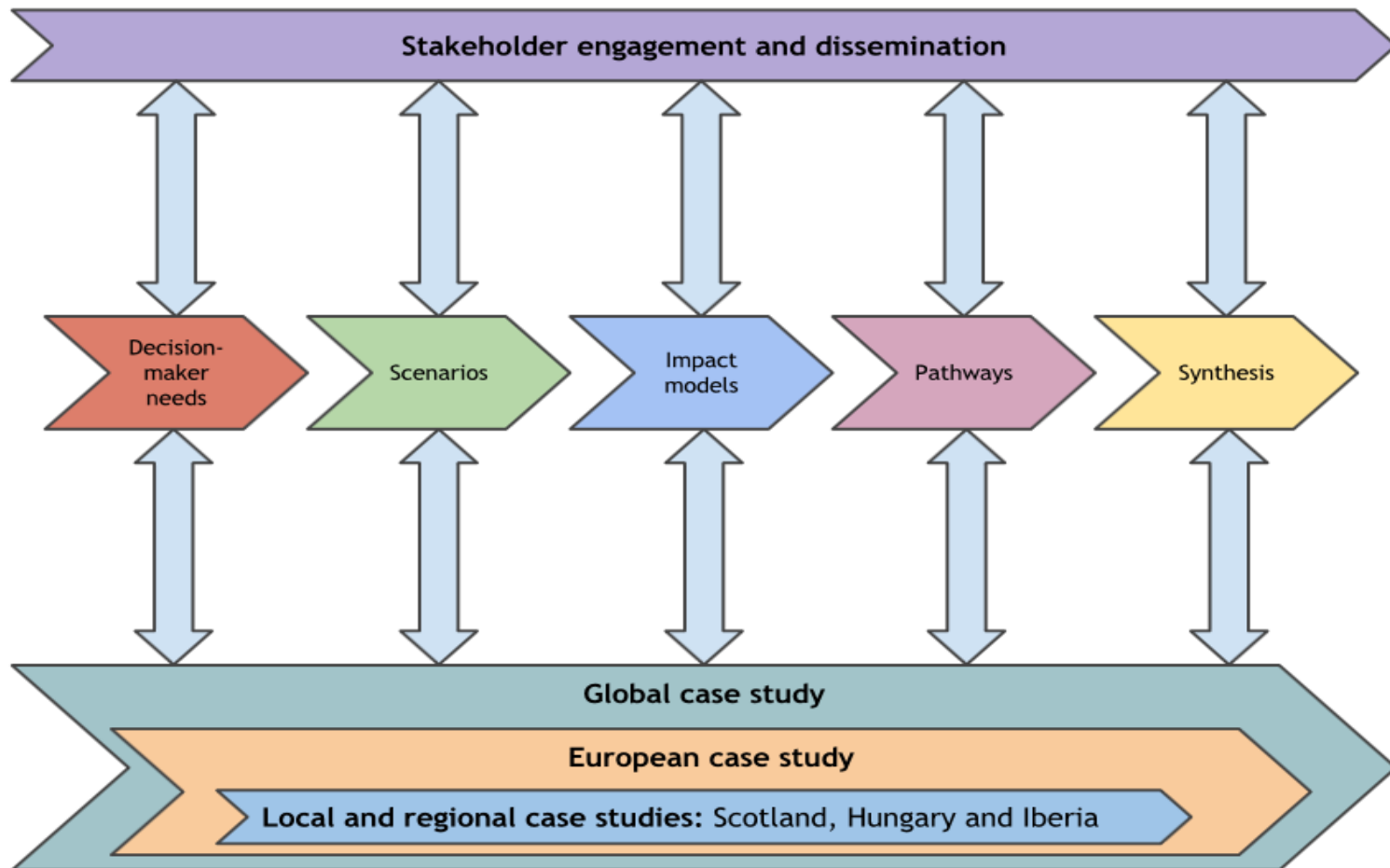


Impacts and Risks from High-End Scenarios:  
Strategies for Innovative Solutions

# IMPRESSIONS: Integrated scenarios for Europe

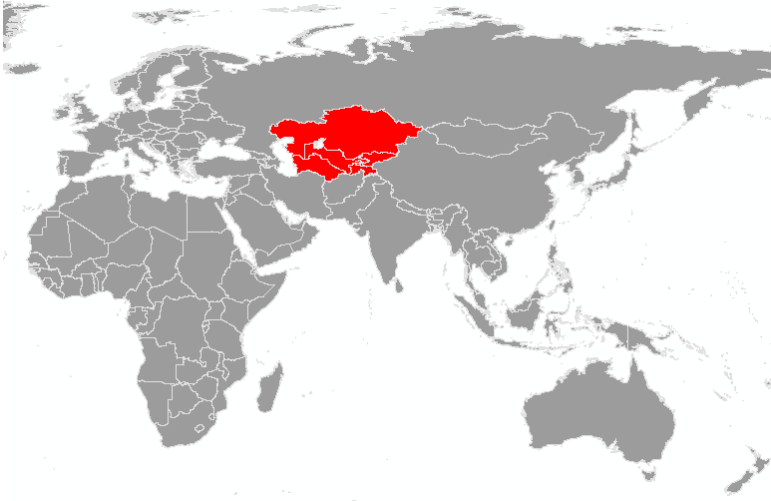


# Scenarios, pathways, and solutions



# Six case studies

## Global and central Asia case studies



- ▲ 3 regional/local case studies  
(Scotland, 2 Iberian catchments,  
2 Hungarian municipalities)

## European case study



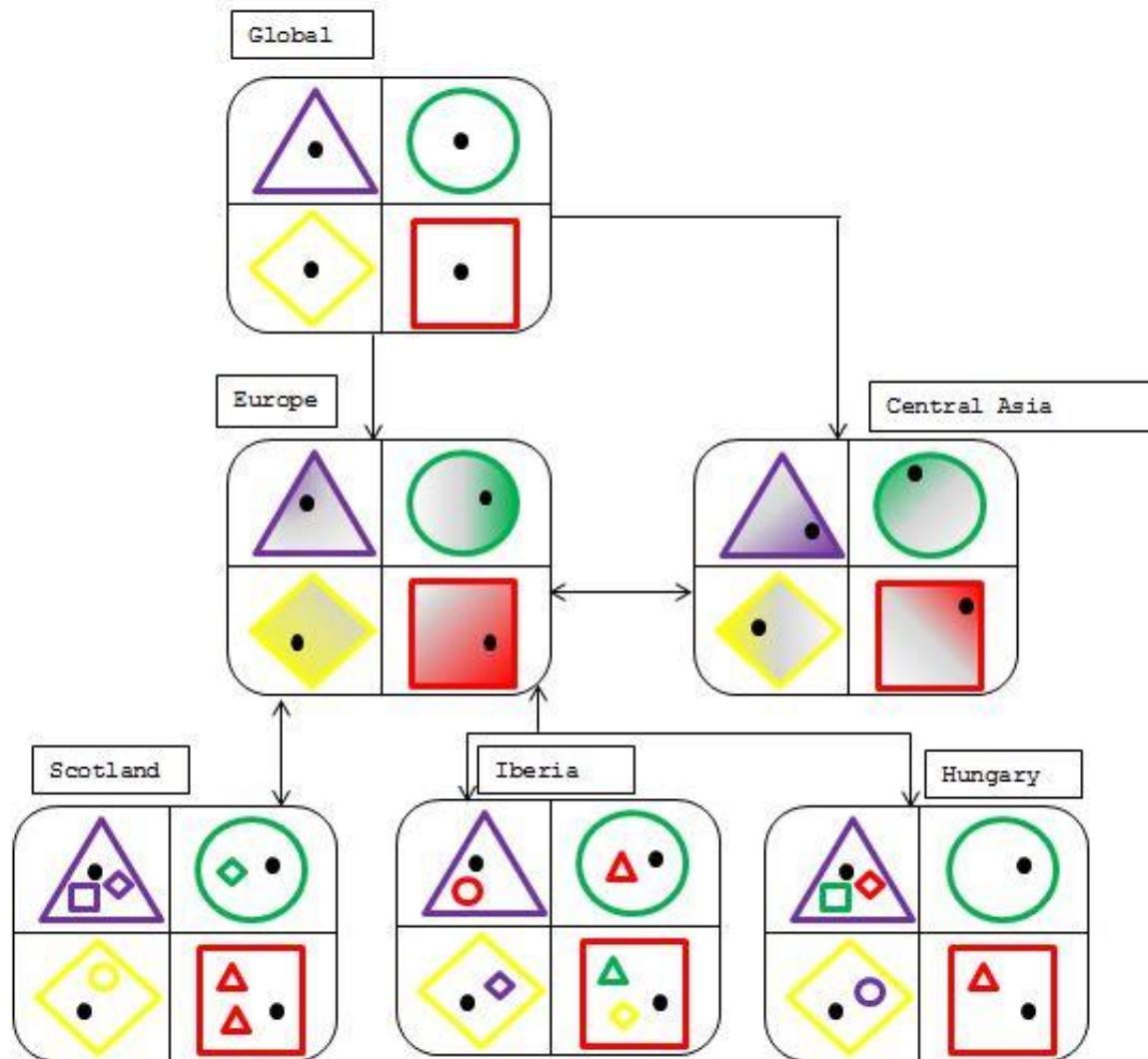
# Three key scenario questions

---

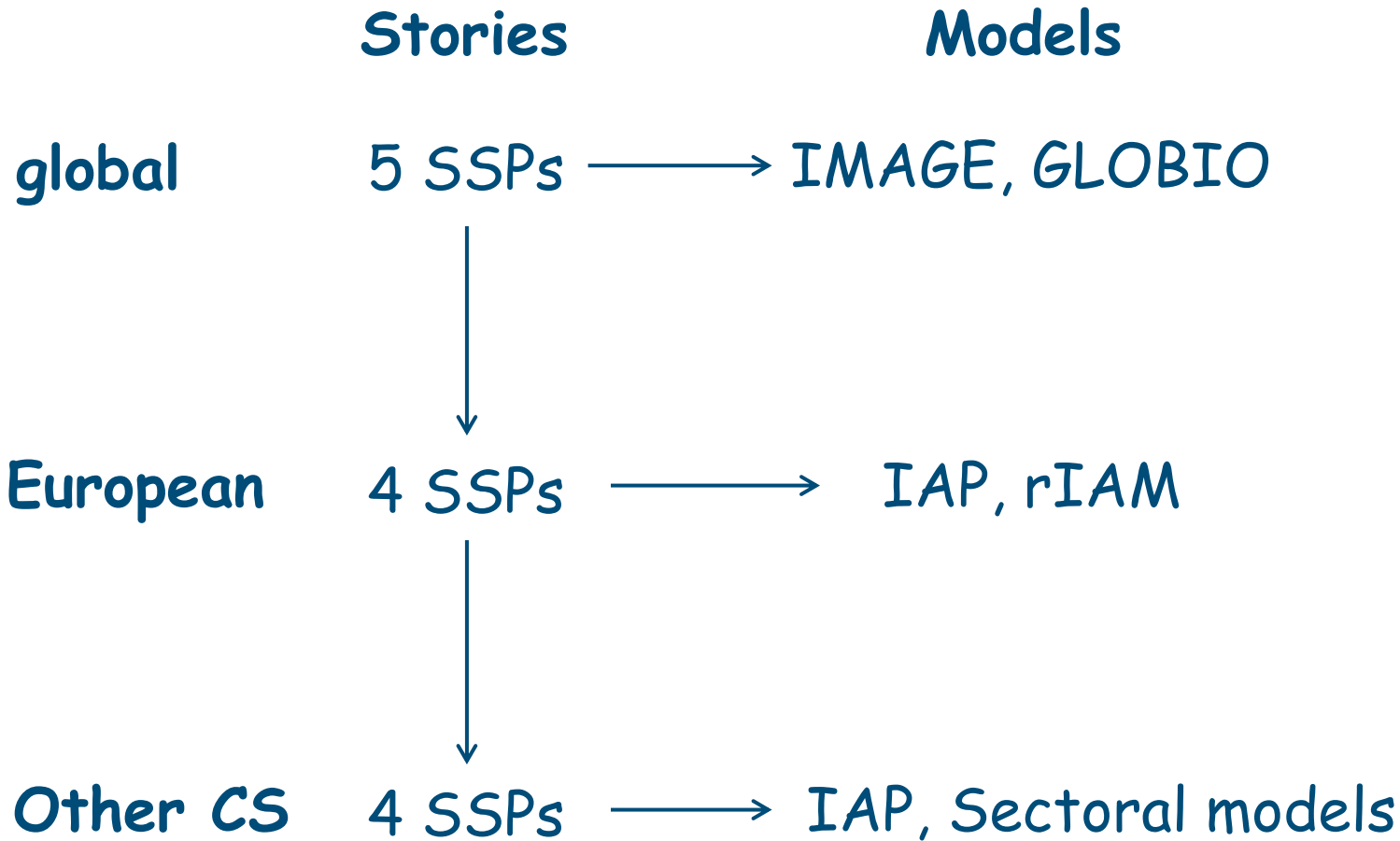
1. How to upscale and downscale?
2. How to integrate RCPs and SSPs?
3. How to link qualitative and quantitative scenarios?



# Multi-scale scenario development



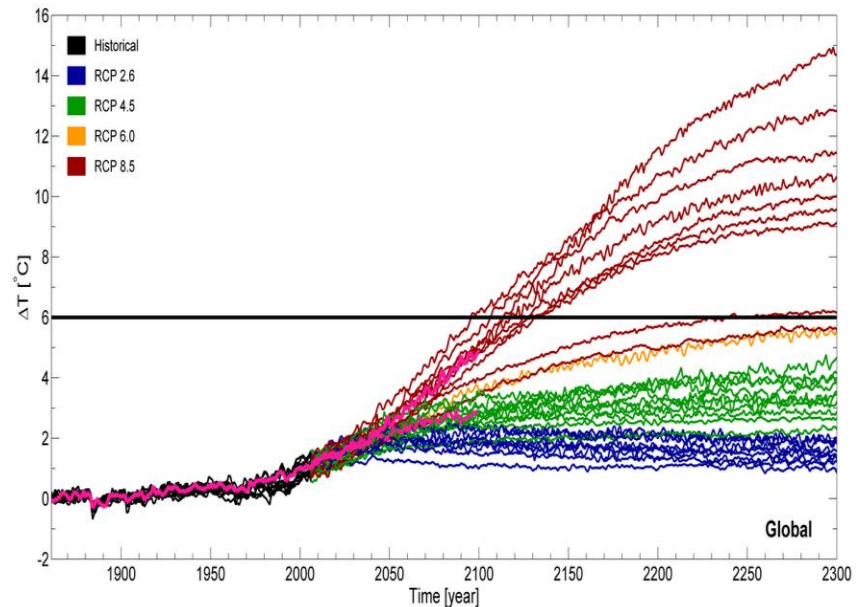
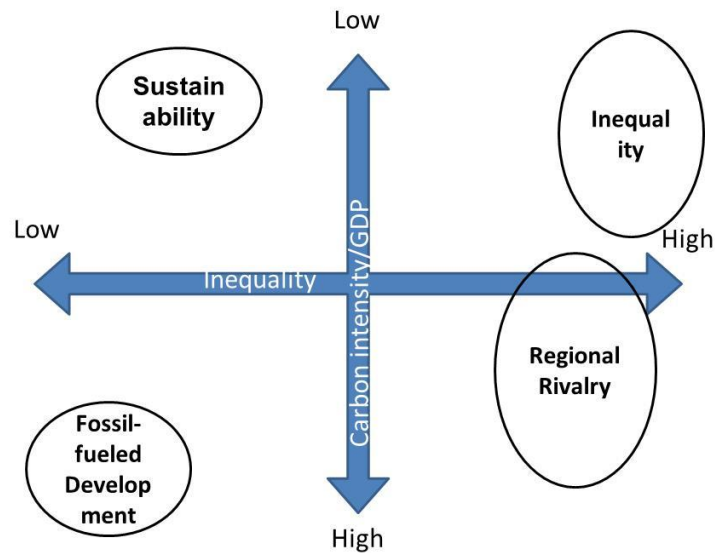
# Multi-scale scenario development



# Integration of RCPs and SSPs

## Which RCPs and SSPs?

- Four global SSPs (SSP2 excl.) selected as starting point
- Two RCPs selected (RCP4.5 and RCP8.5)



# Integration of RCPs and SSPs

## Which combinations?

### GLOBAL (plausibility of combination)

| RCP<br>(W/m <sup>2</sup> ) | T<br>(change) | SSP           |          |          |             |
|----------------------------|---------------|---------------|----------|----------|-------------|
|                            |               | SSP1          | SSP3     | SSP4     | SSP5        |
| 4.5                        | 2-4           | Possible      | Possible | Possible | Possible    |
| 8.5                        | 3-6           | Very unlikely | Possible | Unlikely | Most likely |

### REGIONAL (usefulness of combination)

| RCP<br>(W/m <sup>2</sup> ) | T<br>(change) | SSP                  |             |               |               |
|----------------------------|---------------|----------------------|-------------|---------------|---------------|
|                            |               | SSP1                 | SSP3        | SSP4          | SSP5          |
| 4.5                        | 2-4           | Not very challenging | Challenging | Useful        | Less credible |
| 8.5                        | 3-6           | Very interesting     | Interesting | Less credible | Interesting   |

# Integration of RCPs and SSPs

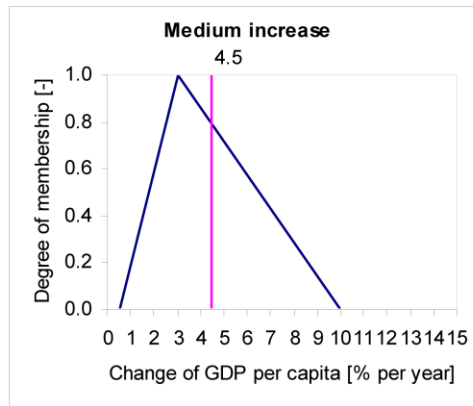
## Which climate models?

| Selected GCM | Global $\Delta T$ |             | Selected RCM   | Europe $\Delta T$ |             |
|--------------|-------------------|-------------|----------------|-------------------|-------------|
|              | RCP8.5            | RCP4.5      |                | RCP8.5            | RCP4.5      |
| HadGEM2-ES   | <b>4.19</b>       | <b>2.35</b> | <b>RCA4</b>    | <b>4.28</b>       | <b>2.15</b> |
| CanESM2      | <b>4.06</b>       | 2.11        | <b>CanRCM4</b> | <b>4.26</b>       | 2.44        |
| IPSL-CM5A-MR | <b>4.01</b>       | 2.05        | <b>WRF</b>     | <b>4.02</b>       | 2.34        |
| MPI-ESM-LR   | 3.22              | <b>1.46</b> | <b>CCLM4</b>   | 3.07              | <b>1.42</b> |
| GFDL-ESM2M   | <b>2.39</b>       | <b>1.07</b> | <b>RCA4</b>    | <b>2.86</b>       | <b>1.46</b> |

# Integrating qualitative and quantitative?

## Fuzzy Sets

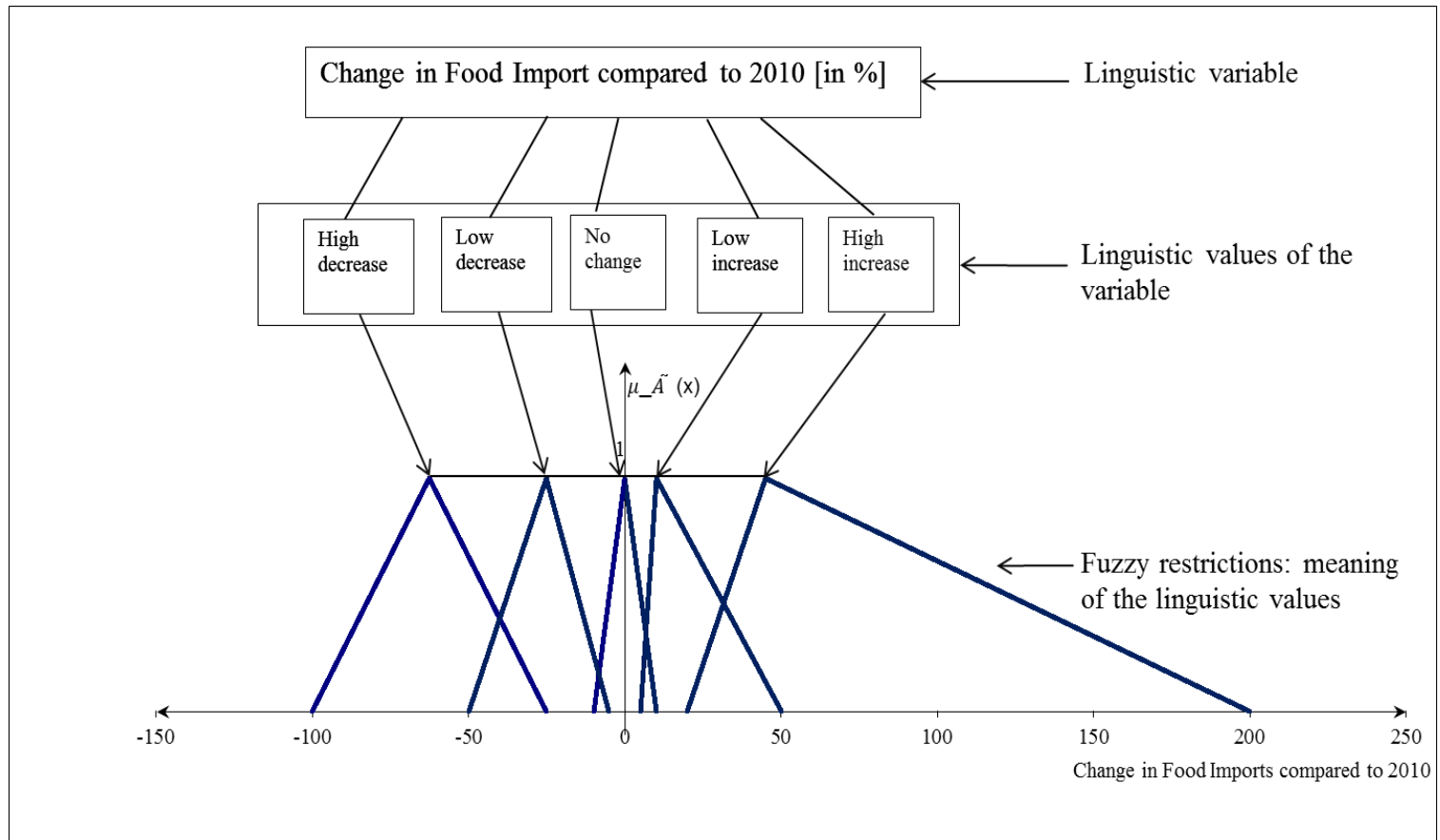
| Region | Markets First   |                         |
|--------|-----------------|-------------------------|
|        | 2005-2025       | 2025-2050               |
| WE     | Medium increase | Low increase            |
| CE     | Medium increase | Low increase            |
| EE     | Medium increase | Medium to high increase |



| Region | Markets First |             |
|--------|---------------|-------------|
|        | 2005 - 2025   | 2025 - 2050 |
| WE     | + 4.5         | + 2.3       |
| CE     | + 4.5         | + 2.3       |
| EE     | + 4.5         | + 2.3-4.5   |

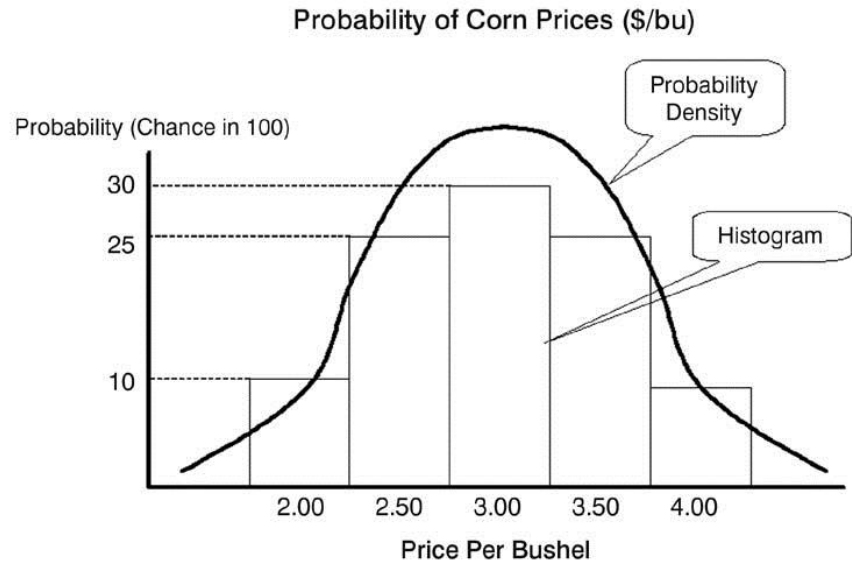
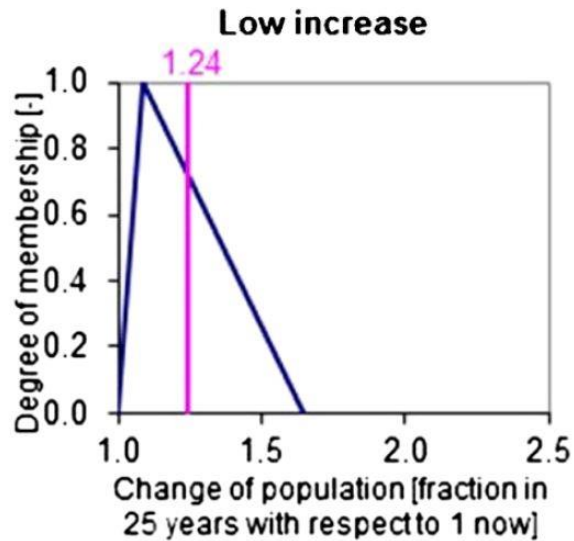
# Integrating qualitative and quantitative?

## Fuzzy Sets



# From fuzzy numbers to probabilities

SH ws output: fuzzy numbers      Model input: probabilities



??



# What has been produced?

---

- Socio-economic scenarios until 2100 linked to the global SSPs, either hard-wired or more softly linked.
- Different products:
  - Stories
  - Other elements (uncertainties, capitals, “5 questions”)
  - Fuzzy Sets with trends of key model parameters + quantification of subset

# SSPs: Results and key findings

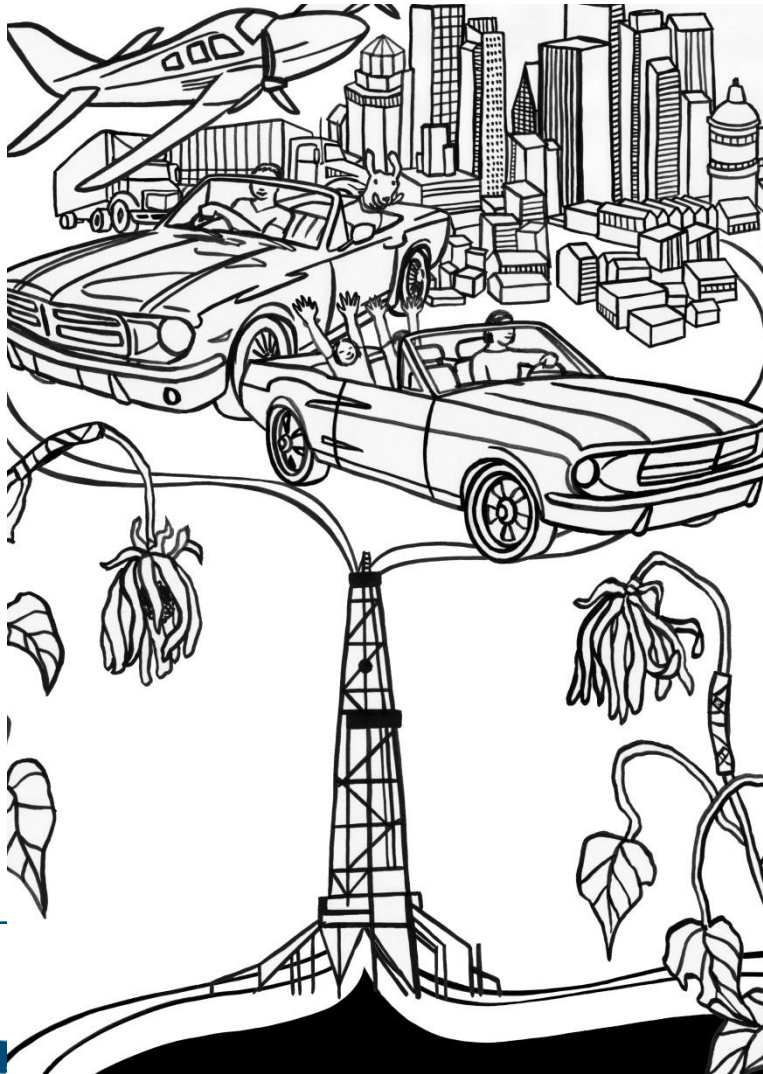
| Case study | SSP1                        | SSP3                          | SSP4                          | SSP5                                      |
|------------|-----------------------------|-------------------------------|-------------------------------|---|
| Europe     | EU-SSP1                     | EU-SSP3                       | EU-SSP4                       | EU-SSP5                                   |
| Scotland   | SC-SSP1: Mactopia           | SC-SSP3:<br>Mad Max           | SC-SSP3:<br>Tartan Spring     | SC-SSP5                                   |
| EUx        | EUx-SSP1:<br>Sustainability | EUx-SSP3: Regional<br>Rivalry | EUx-SSP4:<br>A Game of Elites | EUx-SSP5:<br>Fossil-Fueled<br>Development |
| Iberia     | IB-SSP1                     | IB-SSP3                       | IB-SSP4                       | IB-SSP5                                   |
| Hungary    | HU-SSP1                     | HU-SSP3                       | HU-SSP4                       | HU-SSP5                                   |

## Key findings

- Sets of (global) SSP-related socio-economic scenarios have been developed successfully for all case studies.
- Scenarios encompass highly divergent future outlooks, posing extremely different challenges related to, for example, inequality (across and within countries), carbon use intensity, geo-political stability, and social cohesion.
- Scenarios are the challenging context within which future decisions on mitigation, adaptation and transformation must be developed and implemented.

# Cartoons EU-SSPs (1)

## EU-SSP5



## EU-SSP3



# Stories for two (integrated) scenarios

## **SSP1 x RCP4.5 - We Are The World**

There is a high commitment to achieve development goals through effective governments and global cooperation, ultimately resulting in less inequality and less resource intensive lifestyles. Advances in technology are stimulated by international competition. Challenges to mitigation and adaptation are relatively low.

## **SSP3 x RCP8.5 - Icarus**

Sparked by economic woes in major economies and regional conflict, antagonism between and within regional blocs increases, resulting in the disintegration of social fabric and many countries struggling to maintain living standards. Ultimately, a high-carbon intensive Europe with high inequalities emerges. Challenges to mitigation and adaptation are relatively high.

# Conclusions – concepts and methodologies

---

- **Scale theories and concepts deserve re-examination.** Do not start from readily available methods!
  
- **There are two fundamental choices to be made**
  - Top-down or bottom-up?
  - Stakeholder-driven or Expert-determined?
  
- **No need to reinvent the wheel**
  - Concepts to develop multi-scale scenarios exist (Zurek and Henrichs, 2007!)
  - Tested and applied approaches exist (e.g. SAS)
  - A multitude of methodologies, methods and tools are readily available
  
- **The new global RCP x SSP framework is an excellent starting point**

# Conclusions - practicalities

---

- **Link between qualitative stories and quantitative models remains weak:**
  - Stakeholders prefer not to provide quantitative estimates
  - Modellers prefer not to use stakeholder generated numbers
  - Methods to link are not fully developed (e.g. FCMs and FS)
  
- **Integrating climate and socioeconomic scenarios is easier said than done:**
  - Operationalising the RCPxSSP framework has not been completed
  - Only a small part of the uncertainty space can be included and explored
  - Timing of integration is debated
  
- **Upscaling remains challenging, particularly non-environmental scenarios:**
  - Irreducible uncertainties at local level
  - Fundamental differences in perception at different scales
  - Context-specific factors exist that cannot be scaled

# Take-home messages

---

- Scenario development has become increasingly popular over the last decades. This has spurred an enormous evidence-base of concepts, methodologies, methods, and tools.
- This abundance has led to a multitude of applications and scenario practitioners, but to a dwindling interest in methodological rigor and conceptual considerations
- Scenarios are a powerful 'boundary object', but one that can only be used to its full potential with intensified collaborations between practitioners and scientists to ensure the necessary conceptual and methodological advances.

# Questions?

---