

Introduction and Meeting Goals

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Motivation

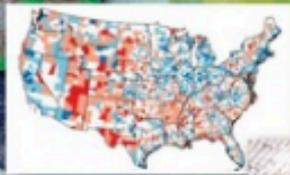
- Increasingly, the questions we are being asked involve overlapping disciplines.

Topics that may require multi-model frameworks

- Energy-water-land nexus
- Extreme events & infrastructure
- Air quality impacts
- Sea level rise and population dynamics
- Carbon cycle & Land-based mitigation

NATIONAL RESEARCH COUNCIL
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Advancing the Science of Climate Change



America's
CLIMATE
CHOICES



“The research needs and cross-cutting themes discussed in Chapter 4 (and listed in Box 4.1) argue for a new kind of climate change science enterprise, one that builds on the strengths of existing activities and

- Focuses not only on improving understanding, but helps to inform solutions for problems at local, regional, national, and global levels;
- **Integrates diverse kinds of knowledge** and explicitly engages the social, ecological, physical, health, and engineering sciences;
- Emphasizes **coupled human-environment systems** rather than individual human or environmental systems in isolation;
- Evaluates the implications of particular choices across sectors and scales so as to maximize co-benefits, avoid unintended consequences, and understand net effects across different areas of decision making;
- Develops and employs decision-support resources and tools that make scientific knowledge useful and accessible to decision makers;
- Focuses, where appropriate, on place-based analyses to support decision making in specific locations or regions, because the dynamics of both human and environmental systems play out in different ways in different places and decisions must be context-specific; and
- Supports adaptive decision making and risk management in the face of inevitable uncertainty by remaining flexible and adaptive and regularly assessing and updating research priorities.”



Residents in the flood-prone district of Kurigram, Bangladesh, move a community mosque to safer ground.

Model human adaptation to climate change

We can no longer ignore feedbacks between global warming and how people respond, say **Paul I. Palmer** and **Matthew J. Smith**.

Climate change impact modelling needs to include cross-sectoral interactions

Paula A. Harrison^{1,2*}, Robert W. Dunford^{1,2}, Ian P. Holman³ and Mark D. A. Rounsevell⁴

Climate change impact assessments often apply models of individual sectors such as agriculture, forestry and water use without considering interactions between these sectors. This is likely to lead to misrepresentation of impacts, and consequently to poor decisions about climate adaptation. However, no published research assesses the differences between impacts simulated by single-sector and integrated models. Here we compare 14 indicators derived from a set of impact models run within single-sector and integrated frameworks across a range of climate and socio-economic scenarios in Europe. We show that single-sector studies misrepresent the spatial pattern, direction and magnitude of most impacts because they omit the complex interdependencies within human and environmental systems. The discrepancies are particularly pronounced for indicators such as food production and water exploitation, which are highly influenced by other sectors through changes in demand, land suitability and resource competition. Furthermore, the discrepancies are greater under different socio-economic scenarios than different climate scenarios, and at the sub-regional rather than Europe-wide scale.

COMMENT

POLICY Progress report from international panel of 300 social scientists **p.616**

MILITARY Anthropologist asks whether drones rewrite the rules of warfare **p.618**

HISTORY Museum refit showcases Scotland, workshop of the world **p.620**



BIODIVERSITY Tally of cryptic species changes figures dramatically **p.621**



An islander adds to coastal protection at Anse Kerlan beach in the Seychelles.

Make climate-change assessments more relevant

Stéphane Hallegatte, Katharine J. Mach and colleagues urge researchers to gear their studies, and the way they present their results, to the needs of policymakers.

With the ink just dry on the Paris climate agreement, policymakers want to know how they can act most effectively. Ambition is high: the long-term goal is to keep the average warming of the planet to well below 2°C, and even to 1.5°C. Governments, corporations and communities have many options for minimizing

dangerous climate change, and must choose between conflicting priorities and objectives. For example, how should governments decarbonize energy while increasing access to it without resorting to fossil fuels?

No single approach will work for all. The risks and impacts of climate change differ by place and time. Local values and

contexts matter. Small islands are vulnerable to sea-level rise, for example, and fossil-fuel exporters will lose profits from the transition to low-carbon energy. We must consider value judgements, such as the relative importance of economic damage versus biodiversity loss, as well as inequality and fairness.

And the relevant climate and social

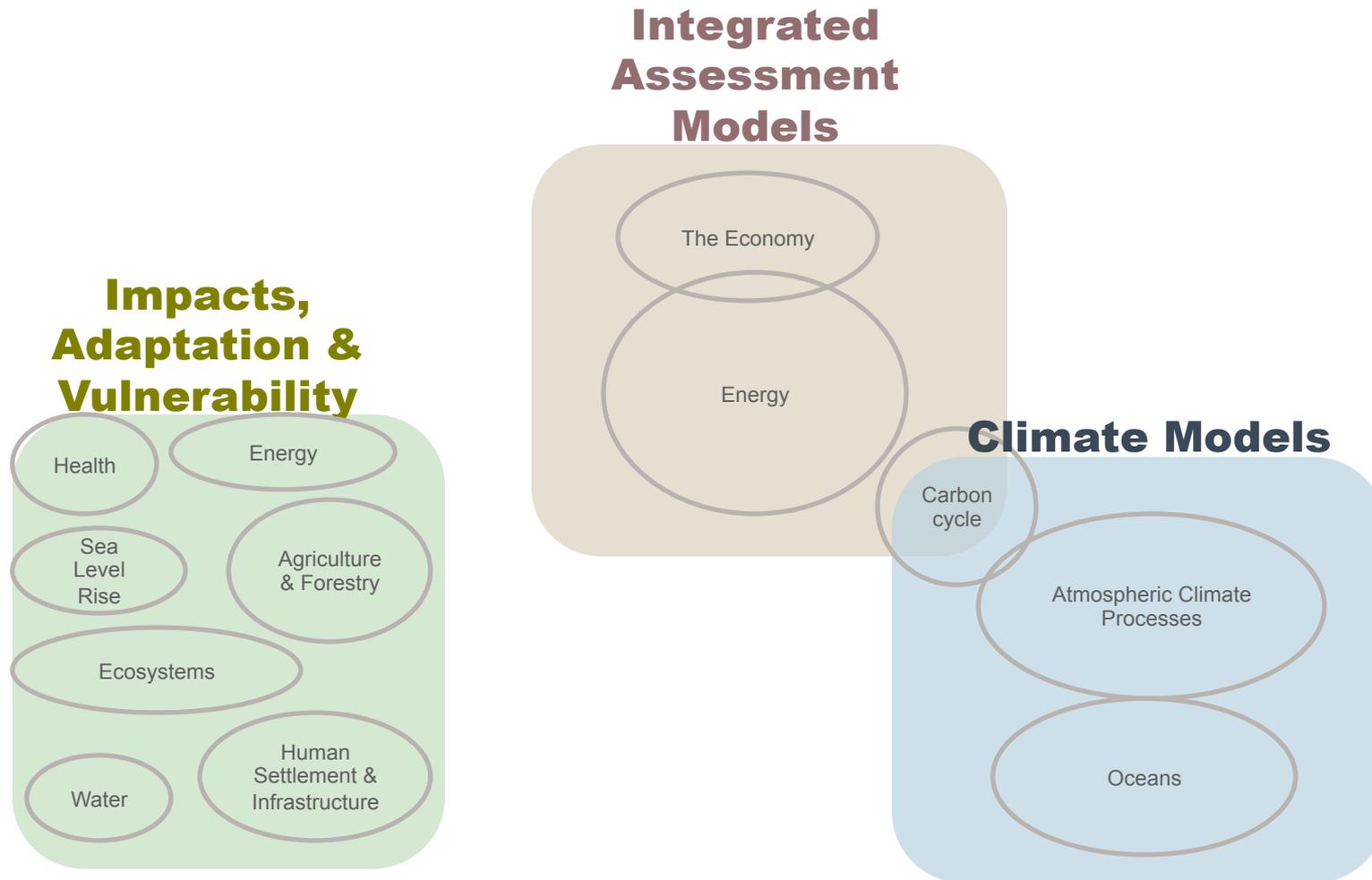
Their recommendations:

- Integrate disciplines from the start
- Explore multiple dimensions
- Consider uncertainty

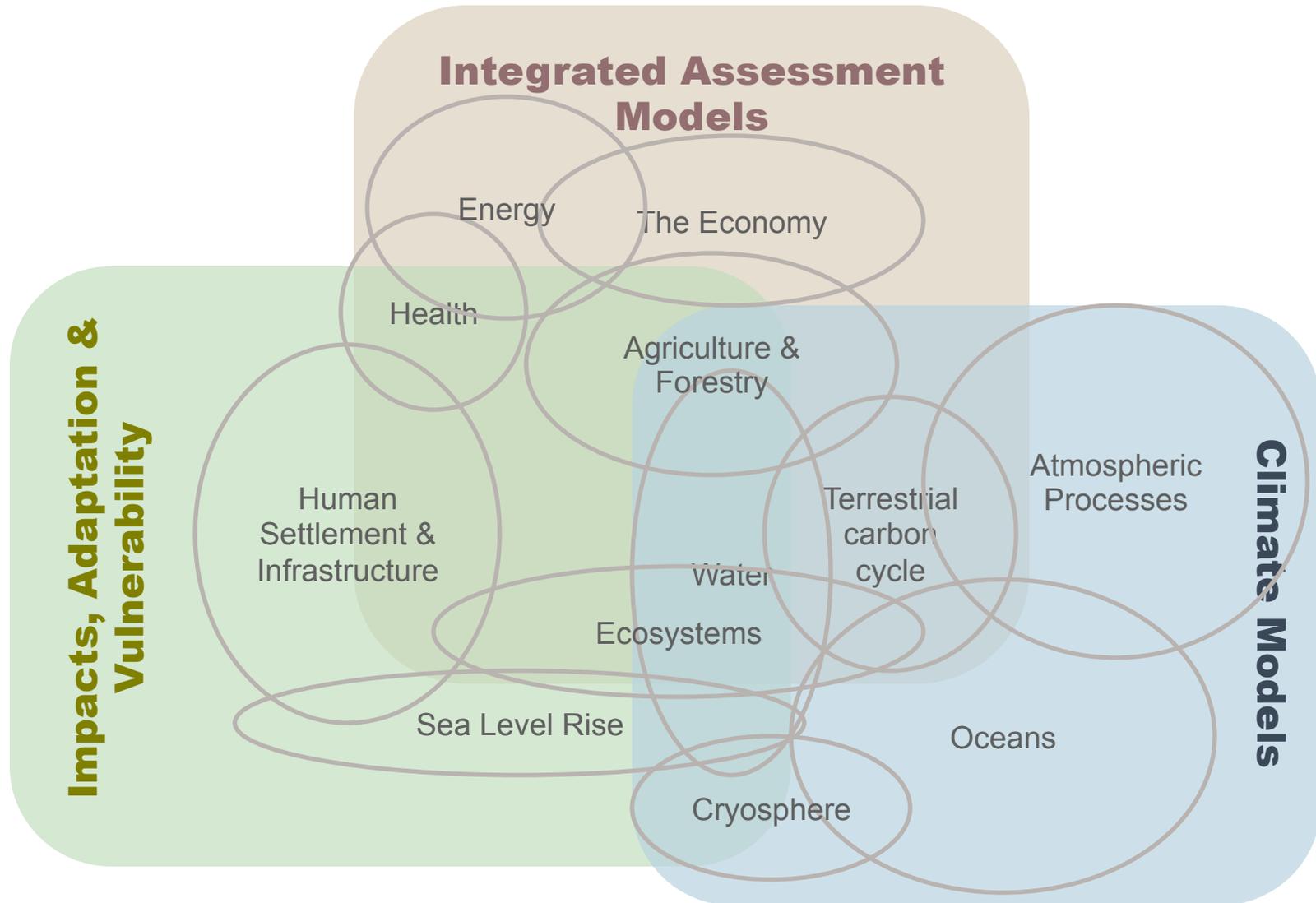
Motivation

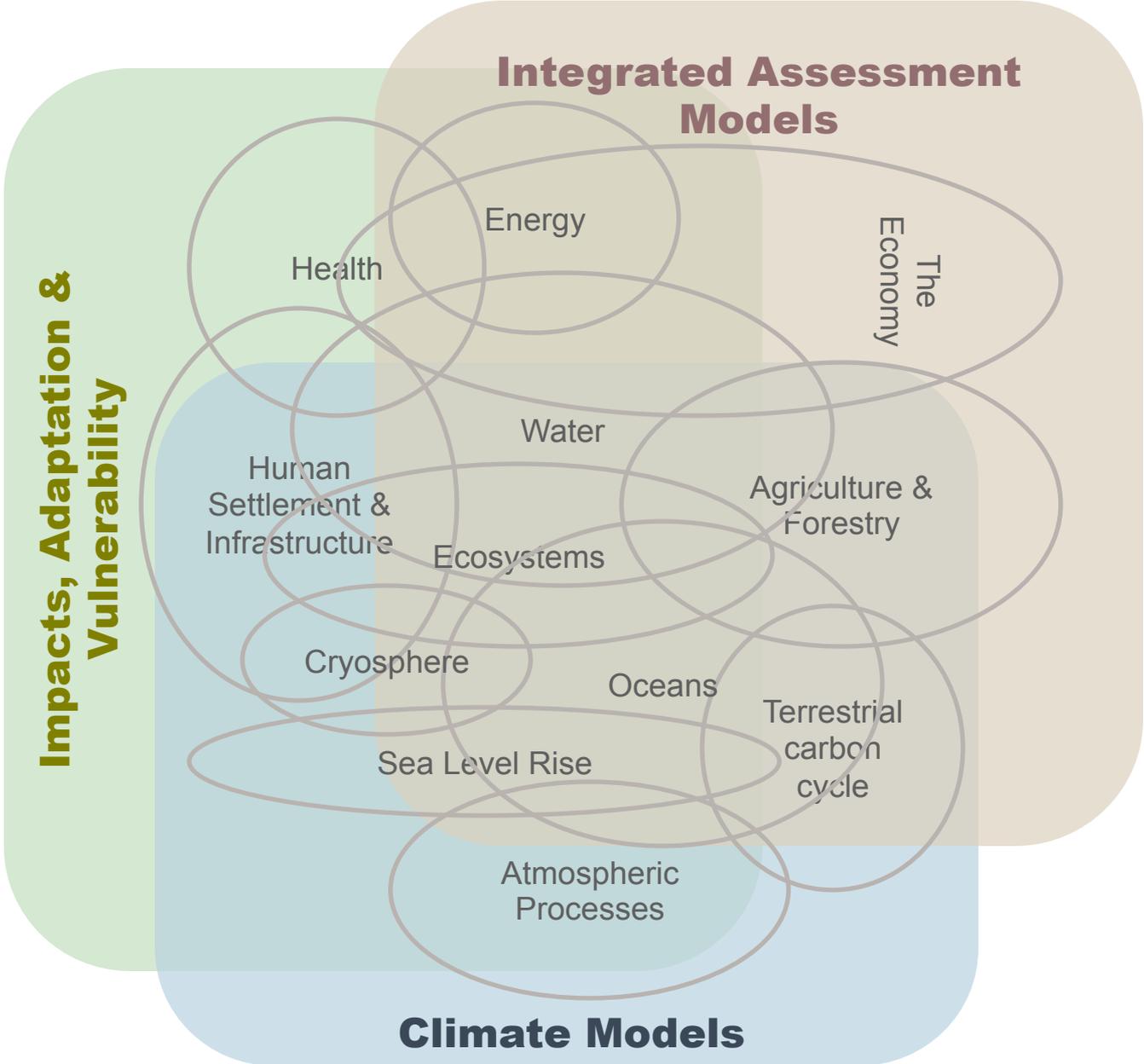
- Increasingly, the questions we are being asked involve overlapping disciplines.
- Addressing these questions requires new, enhanced, or coupled models.

Growing Overlap in Domains



Growing Overlap in Domains





Integrated Assessment Models

The Economy

Energy

Health

Water

Human Settlement & Infrastructure

Agriculture & Forestry

Ecosystems

Cryosphere

Oceans

Terrestrial carbon cycle

Sea Level Rise

Atmospheric Processes

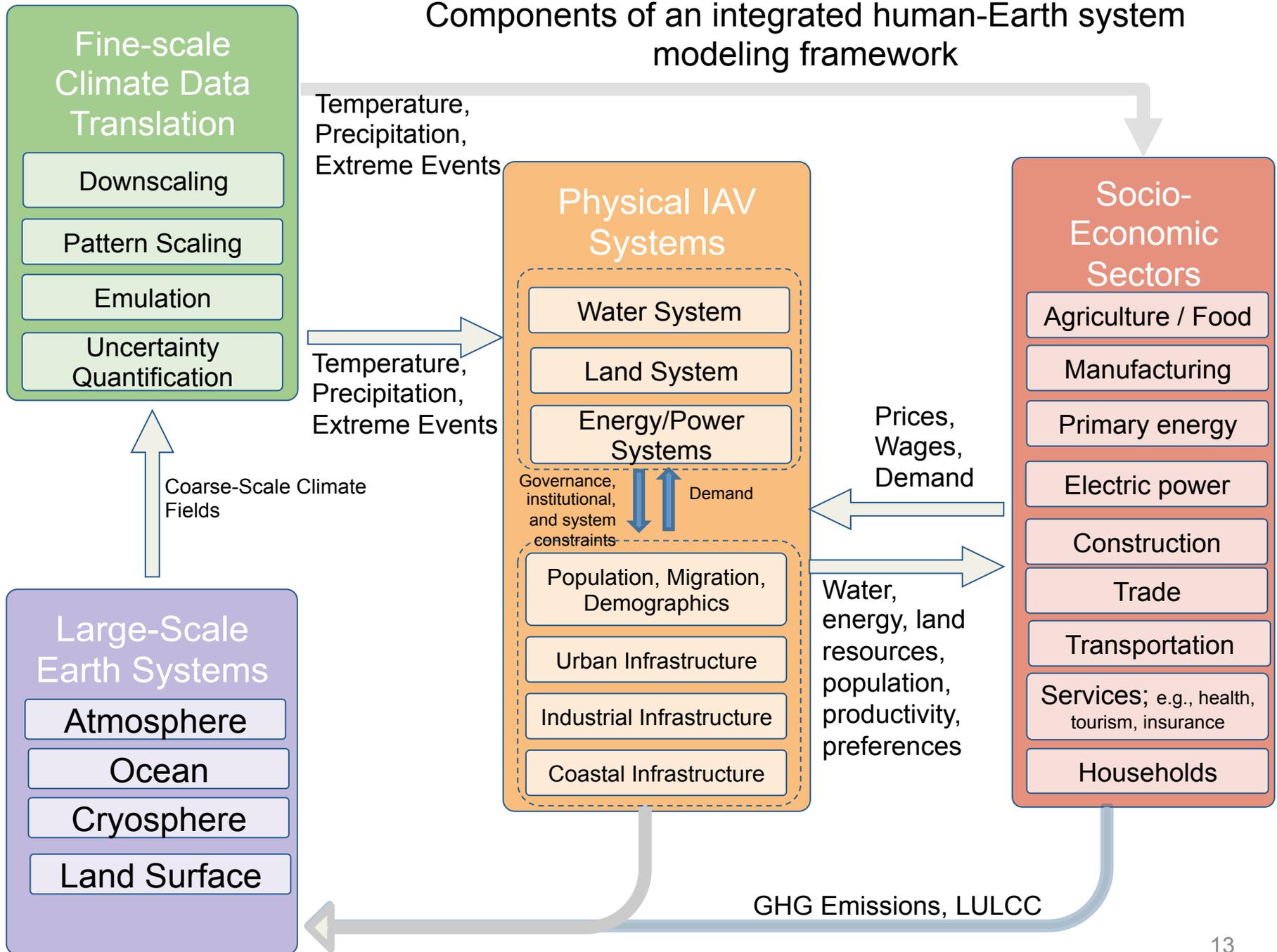
Impacts, Adaptation & Vulnerability

Climate Models

Motivation

- Increasingly, the questions we are being asked involve overlapping disciplines.
- Addressing these questions requires new, enhanced, or coupled models.
- There are many challenges to adapting/developing/coupling models for these purposes.

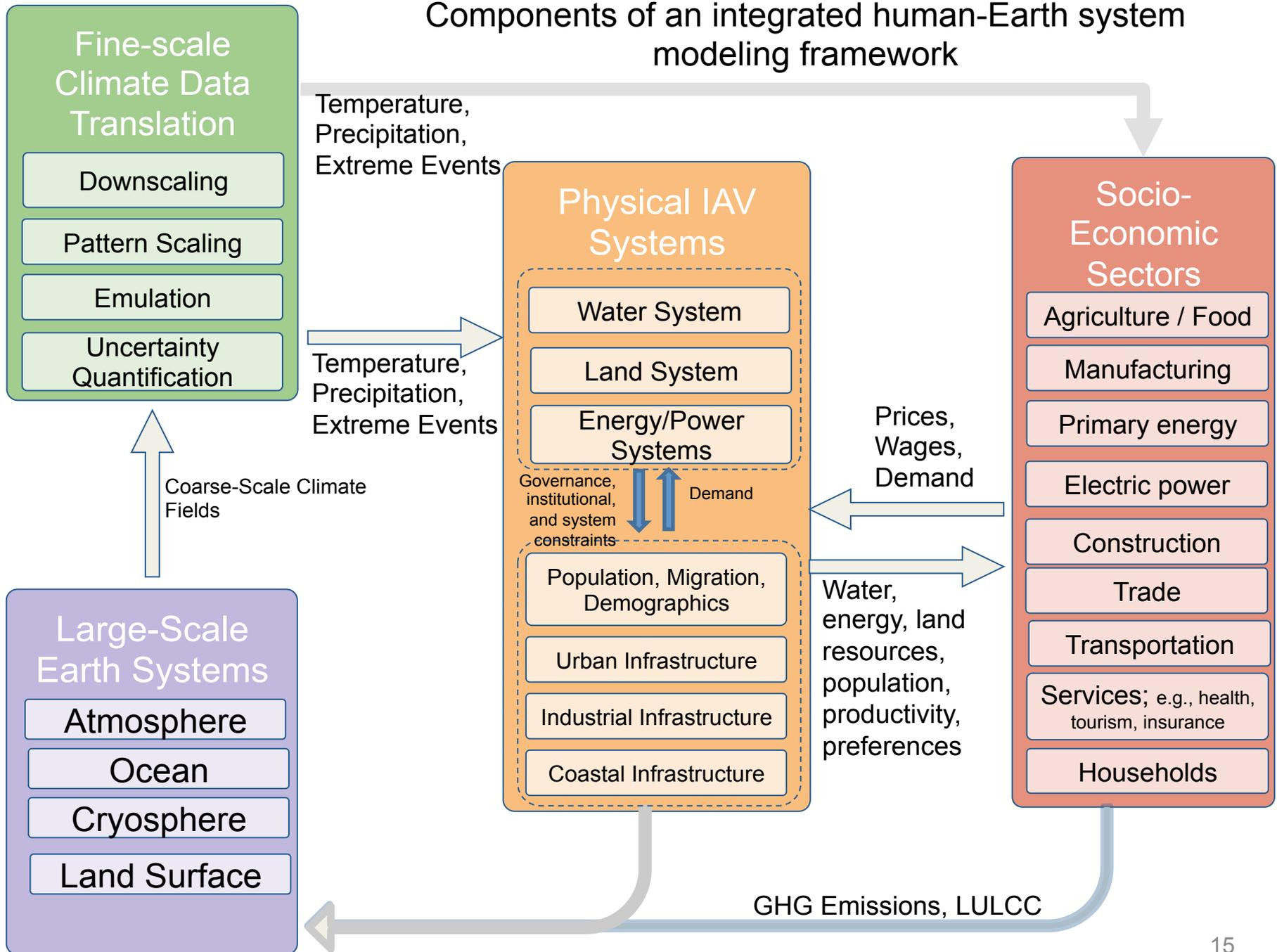
Components of an integrated human-Earth system modeling framework



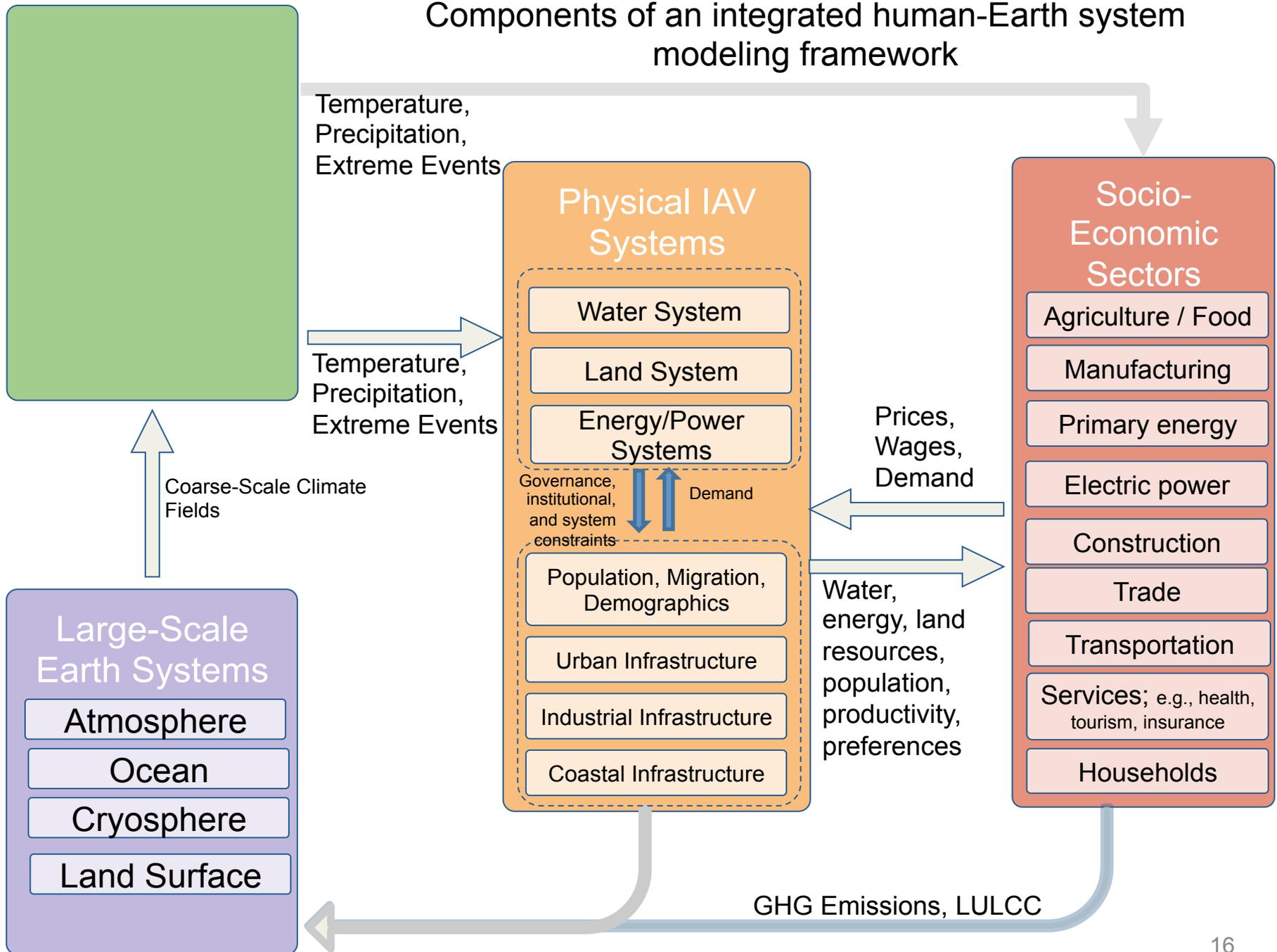
Modeling Decisions

- Which components?

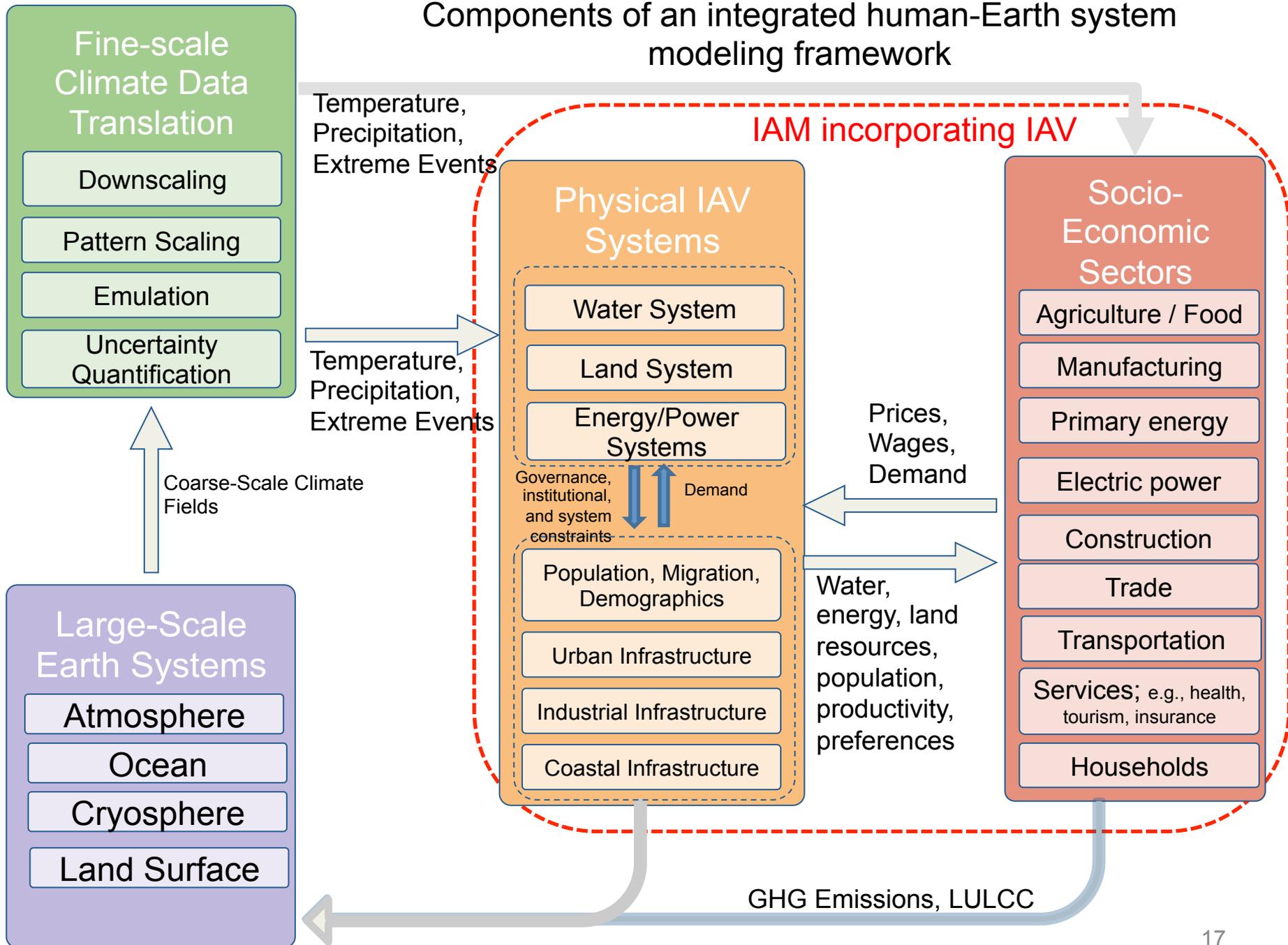
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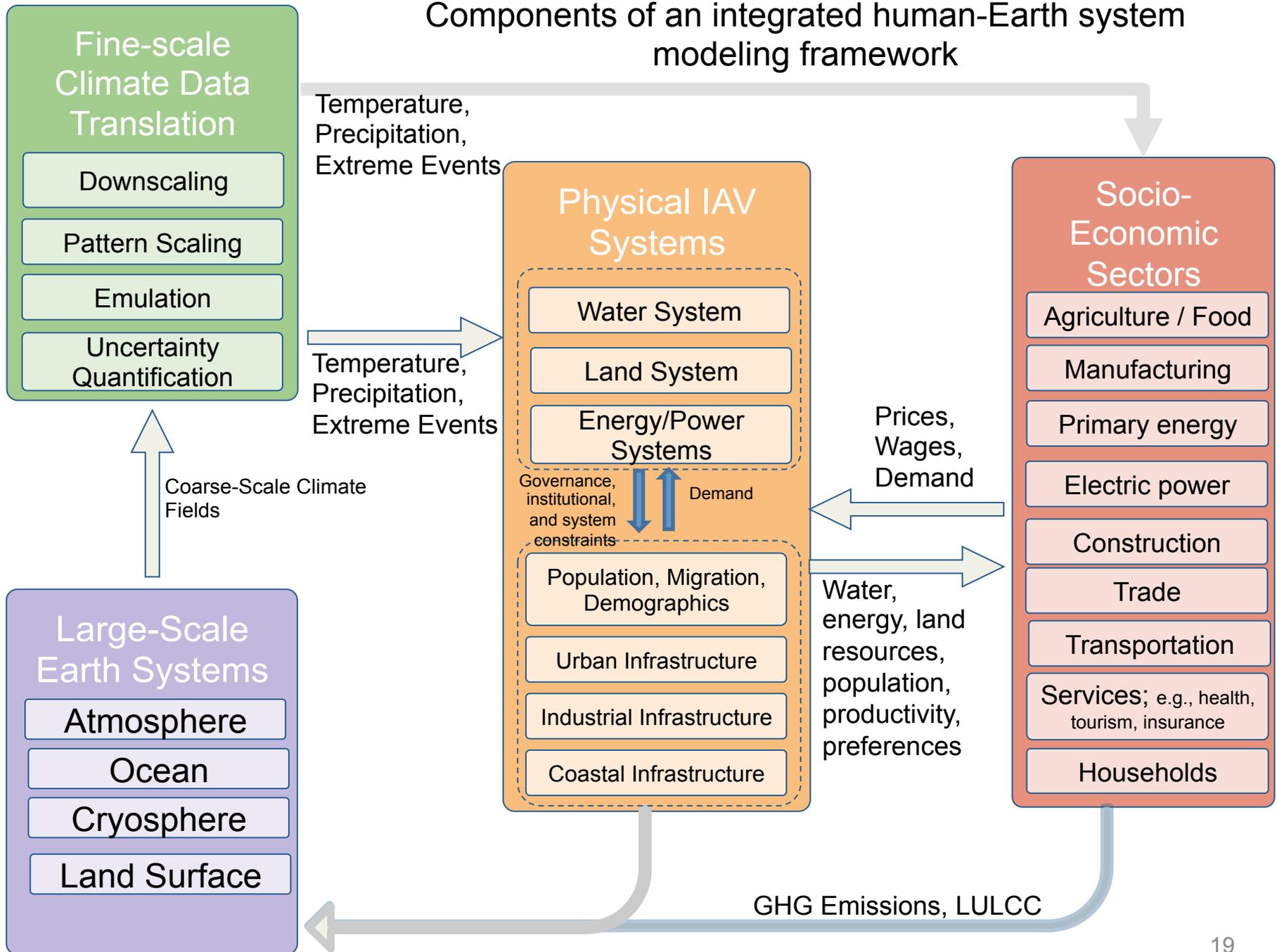
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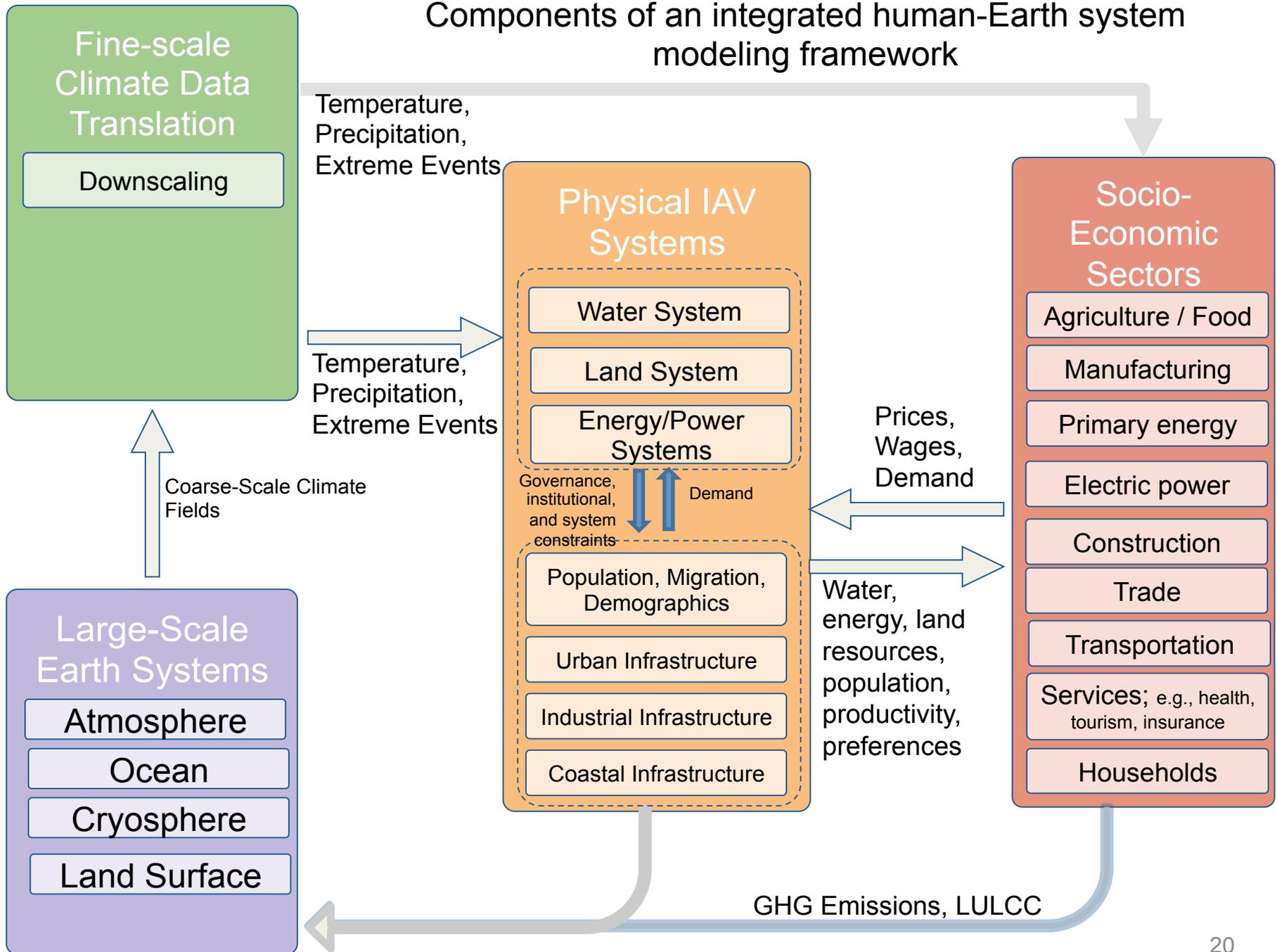
Modeling Decisions

- Which components?
- How complex are those components?

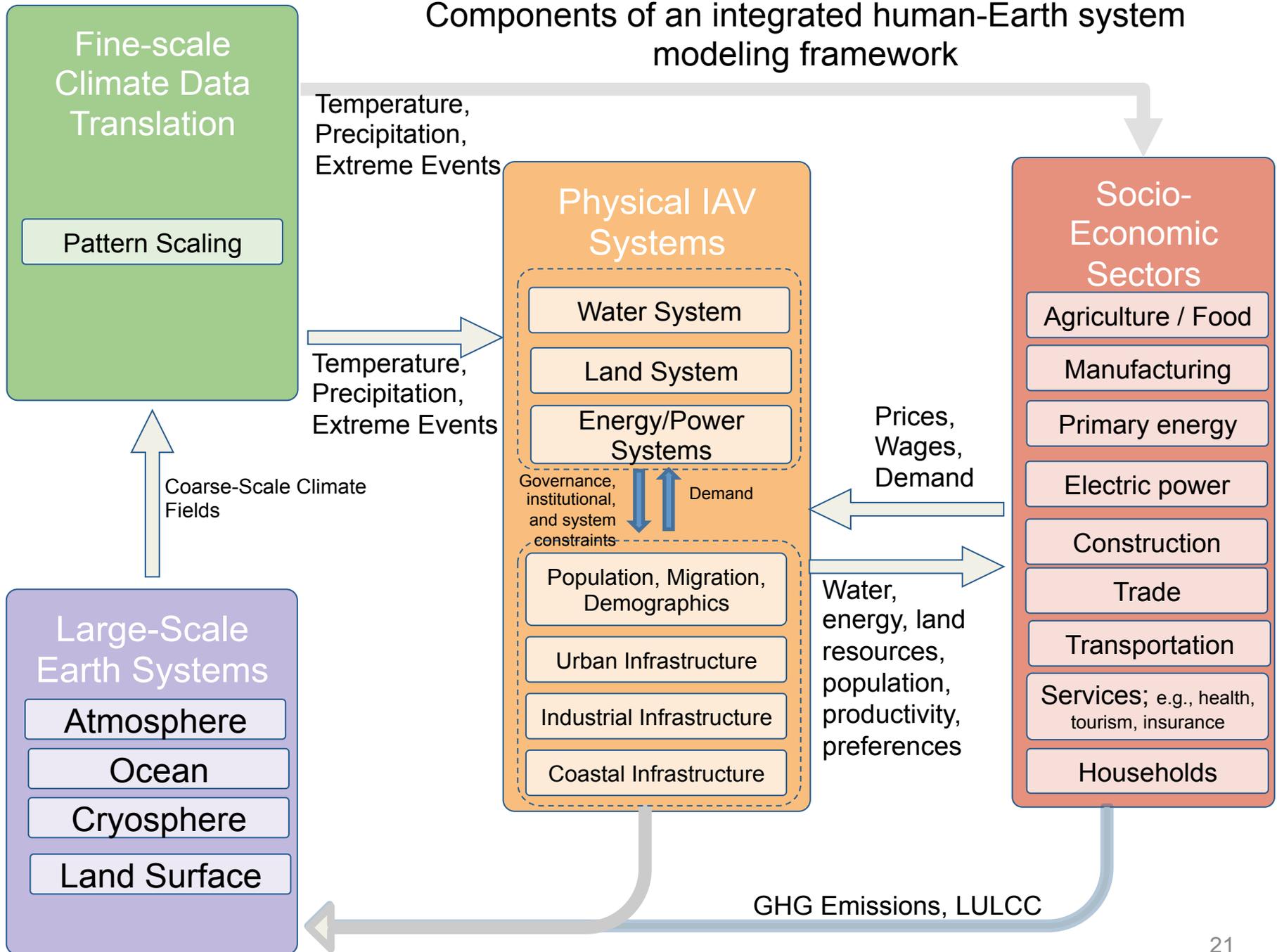
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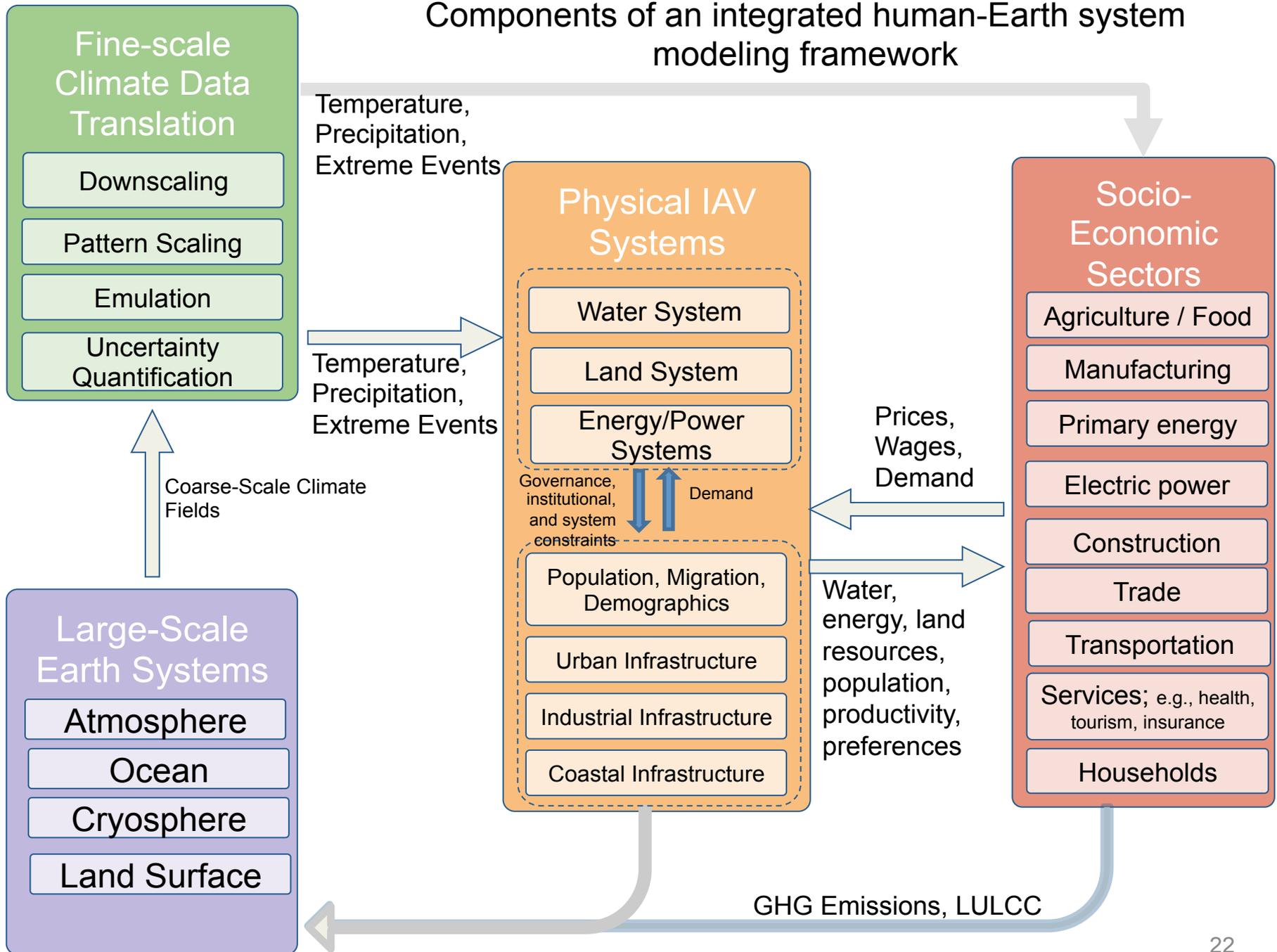
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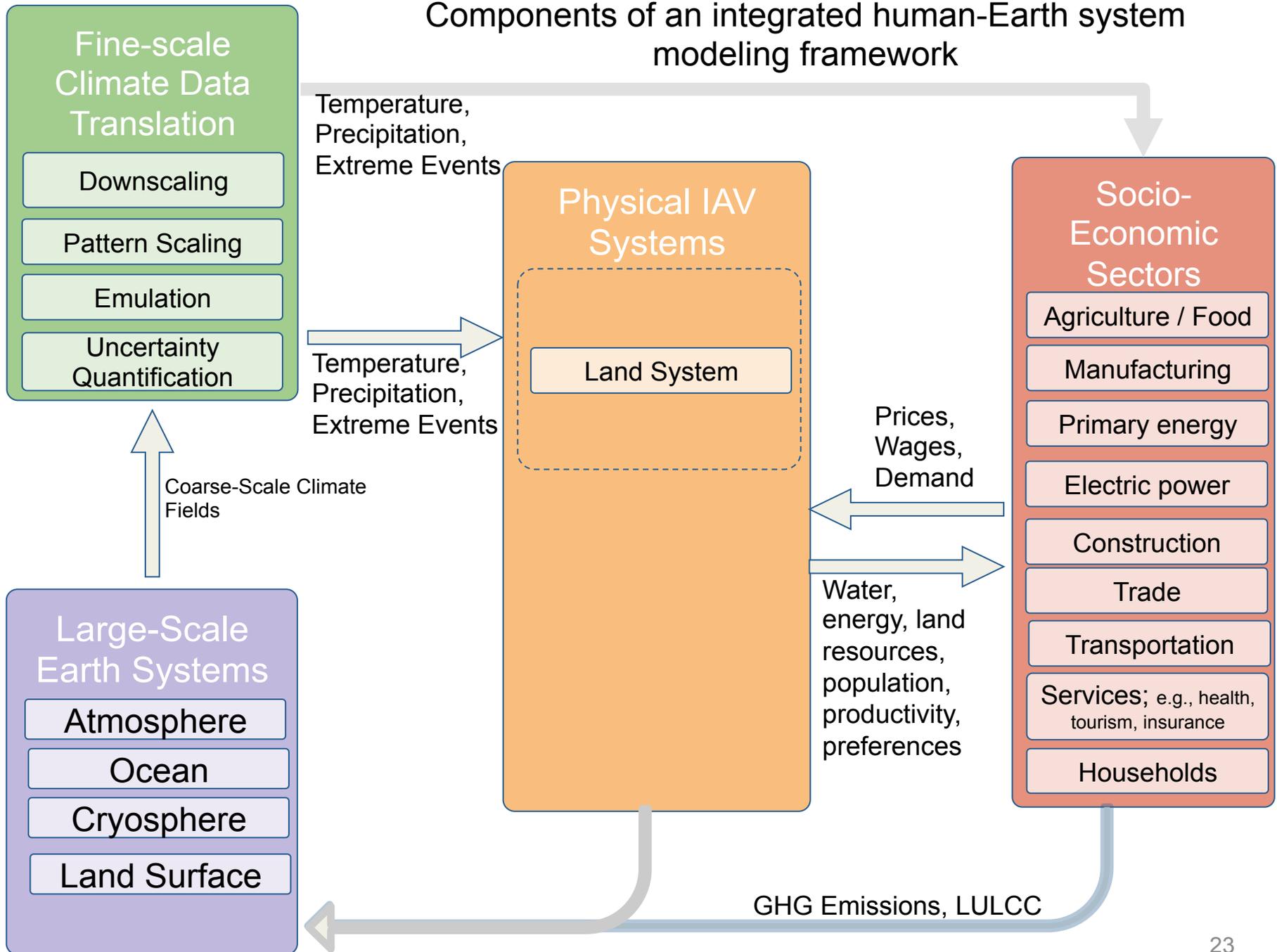
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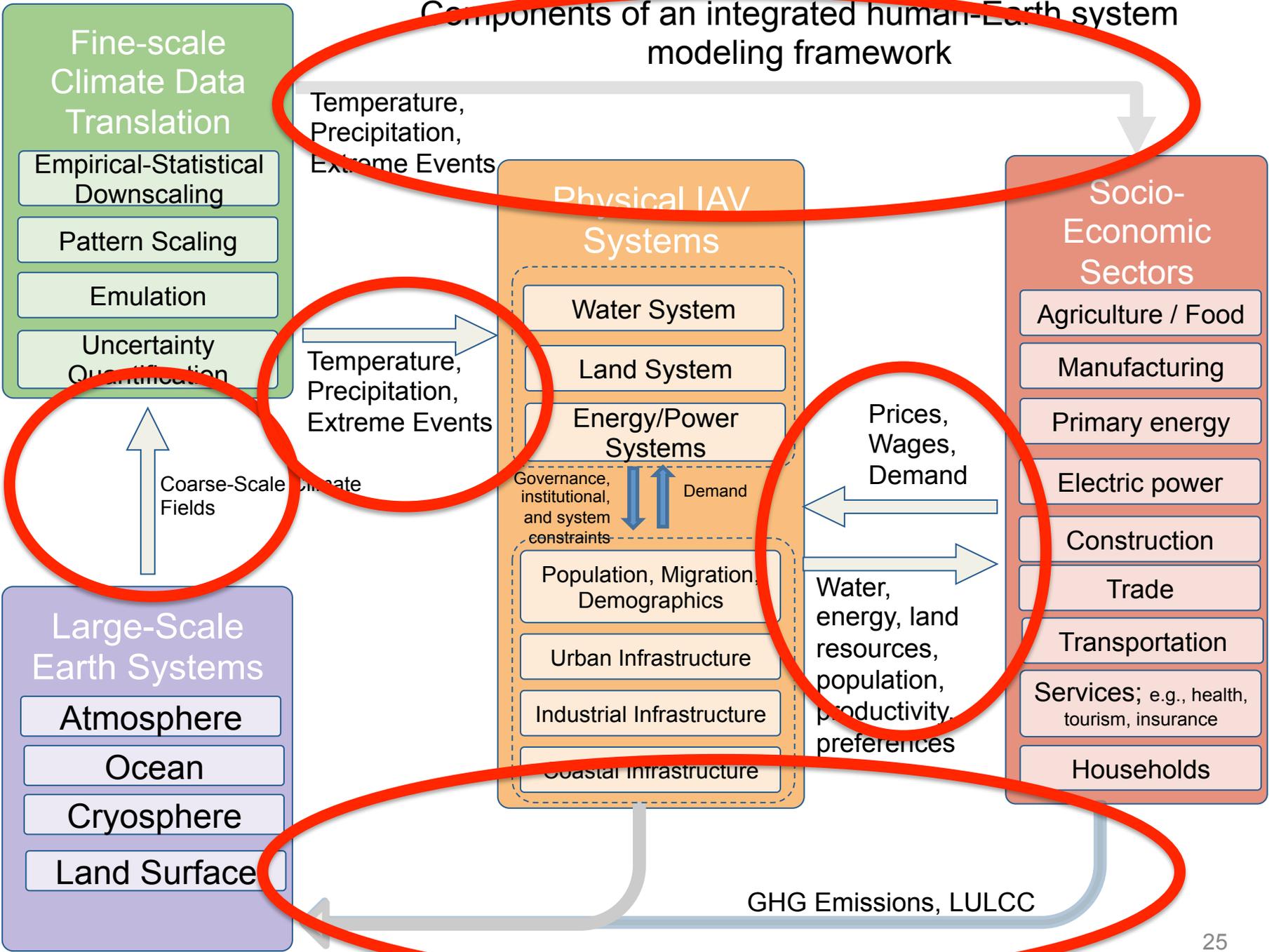
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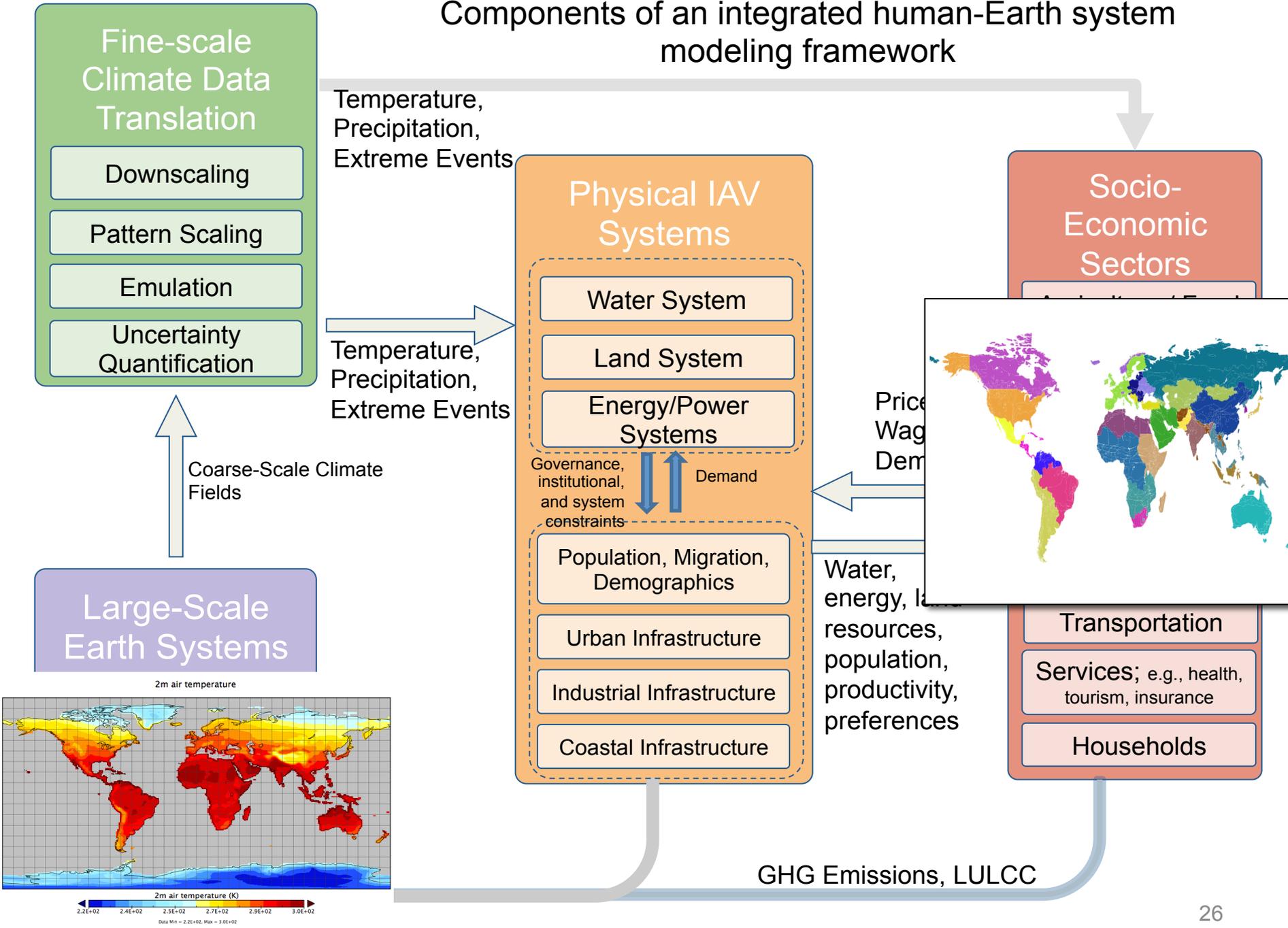
Modeling Decisions

- Which components?
- How complex are those components?
- How do we couple?

Components of an integrated human-Earth system modeling framework



Components of an integrated human-Earth system modeling framework



Modeling Decisions

Table 1. Advantages and disadvantages of the different types of IA–ES collaboration.

Method	Advantages	Disadvantages
A (off-line information exchange, one-way)	<ul style="list-style-type: none"> • Work with existing terminology and tools • Transparent information exchange • Flexibility • Separate research strategies 	<ul style="list-style-type: none"> • Feedbacks are only captured via (one-single) iterations • Potential inconsistencies
B (improved IAMs)	<ul style="list-style-type: none"> • Allows for good representation of uncertainty • Model complexity tailored to question • Detail in treatment of socio-economic processes 	<ul style="list-style-type: none"> • Lack of detail in treatment of biophysical processes (often meta-modeling)
C (improved ESMs)	<ul style="list-style-type: none"> • Higher resolution analyses than in IAMs • Detail in treatment of biophysical processes 	<ul style="list-style-type: none"> • Lack of detail in treatment of socio-economic processes • Limitation of model runs limits representation of uncertainty
D (full coupling)	<ul style="list-style-type: none"> • Assessment of feedbacks • Highest degree of consistency 	<ul style="list-style-type: none"> • Technical difficulties • Lack of representation of uncertainty • Inflexibility • Complexity/intransparency • Limitations in knowledge may hamper progress

Source: van Vuuren, D. P., L. Bayer, C. Chuwah, L. Ganzeveld, W. Hazeleger, B. van den Hurk, T. van Noije, B. O'Neill and B. Strengers (2012). "A comprehensive view on climate change coupling of earth system and integrated assessment models." Environmental Research Letters 7(024012).

Modeling Decisions

- The choices we make depend on:
 - What question we are asking,
 - Who is using the information,
 - How precise the answer needs to be,
 - When the information is needed,
 - ...

This Week

- Monday: IAV
 - Background, Drivers, Science Questions
 - Update from Existing Projects
 - Examples from sectors or modeling frameworks
 - Cross-cutting issues
- Tuesday: IAM
 - Background, Drivers, Science Questions
 - Update from Existing Projects
 - Examples from sectors or modeling frameworks
 - Cross-cutting issues
- Wednesday: ESM
 - Background, Drivers, Science Questions
 - Update from Existing Projects
 - Examples from sectors or modeling frameworks
 - Cross-cutting issues

This Week

- Thursday:
 - Breakout groups based on use cases
 - Panel discussion
- Friday:
 - Conclusions, wrap up, next steps
 - Workshop report writing

Thursday Morning Breakouts

- Goal: Explore coupling various models, data sets, and other capabilities to address a specific issue
- General topic: Implications of drought and increased variability on the energy-water-land nexus
- Breakout Groups:
 - Electric power generation perspective
 - Water resources management perspective
 - Agriculture and ecosystem productivity perspective

DISCUSSION