Finding Robust Strategies in Complex Human-Environment Systems

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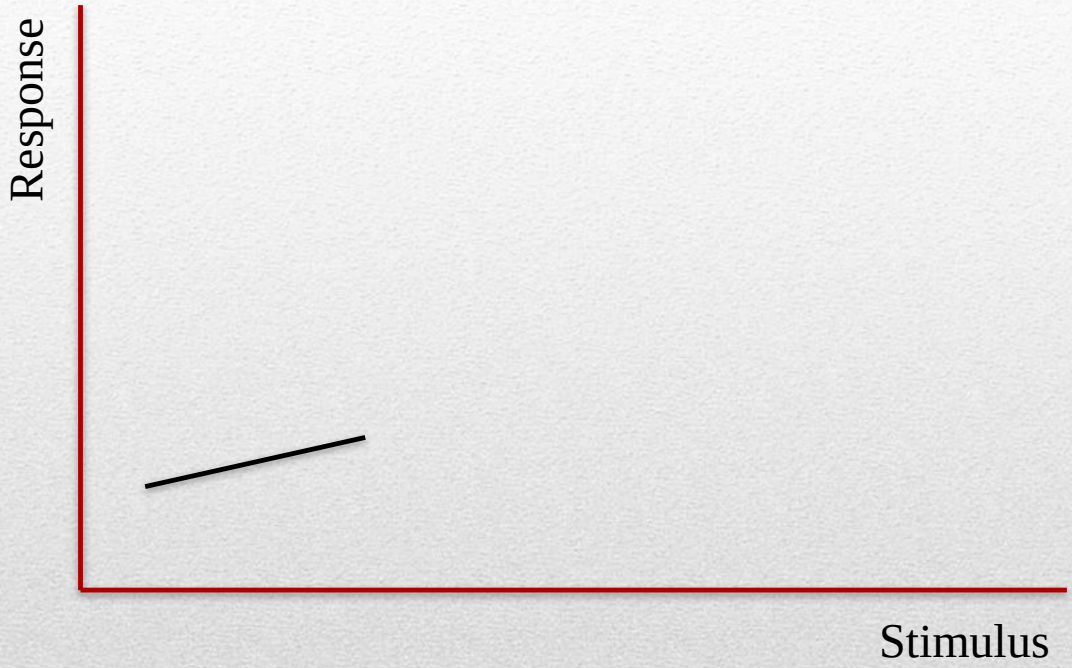
1. On the Nature of Complex Systems
2. Mediating Conflicts and Promoting Resilience: A Case Example
3. Science-Policy Interactions

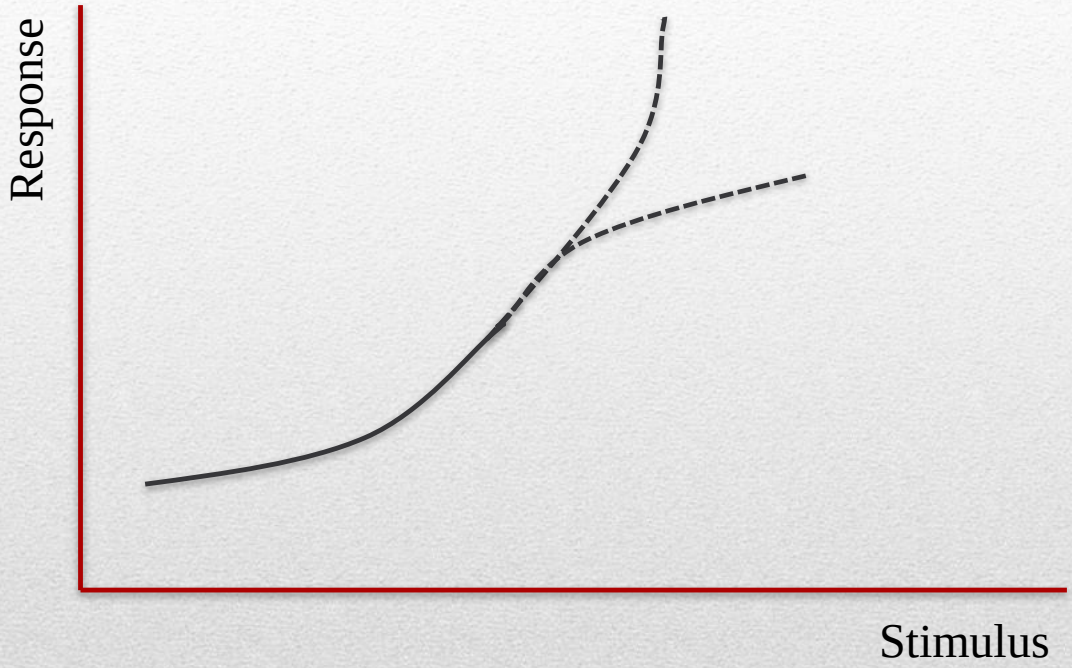
Finding Robust Strategies in Complex Human-Environment Systems

Nonlinearities



Complex Systems

Nonlinearities



Complex Systems

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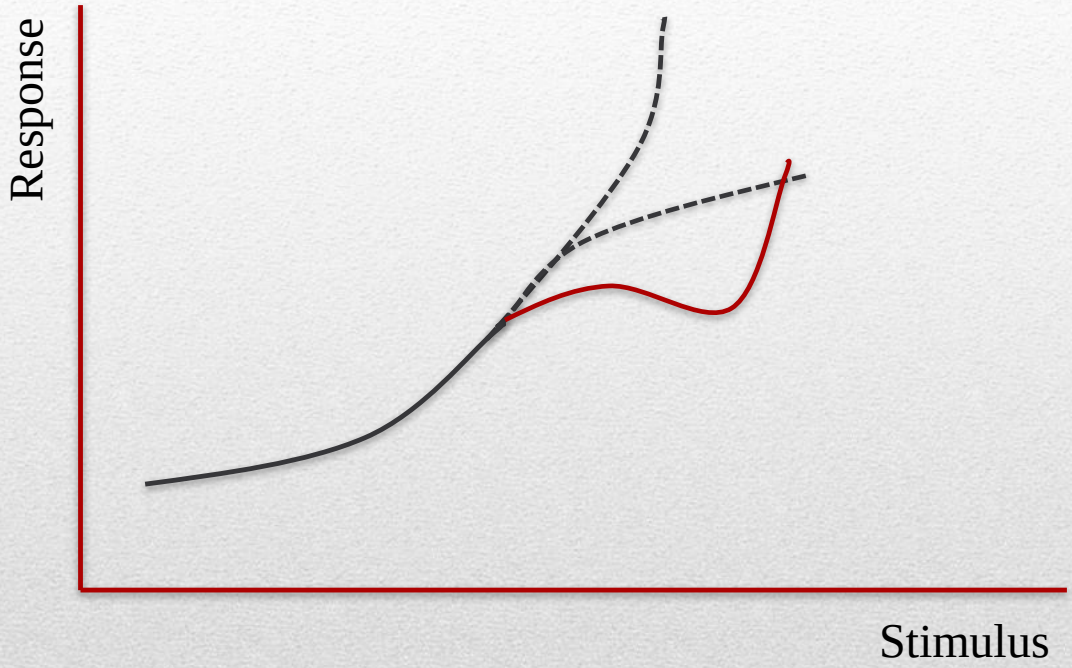
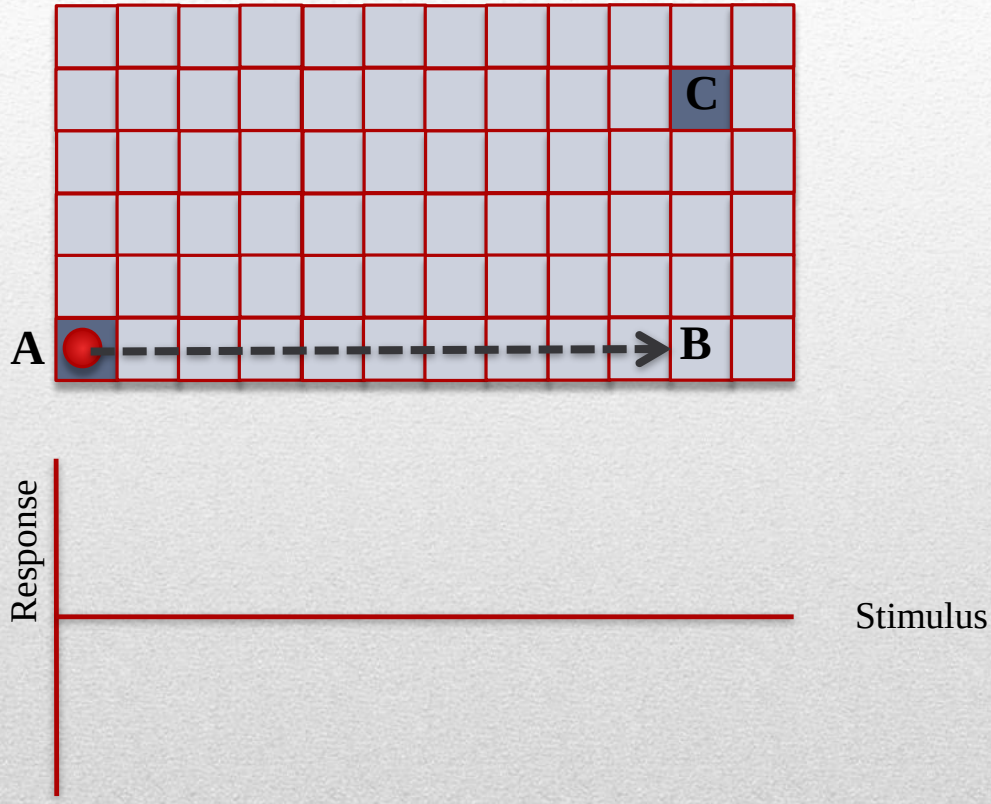


Complex Systems

Lags in Time and Space



Complex Systems

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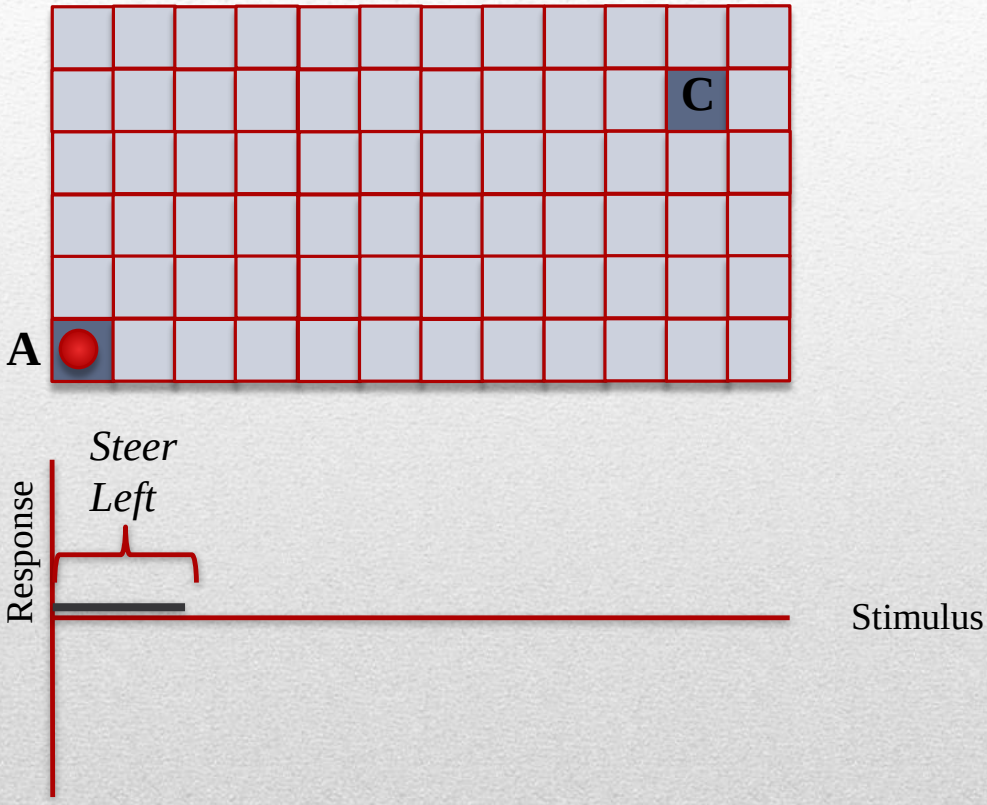

Complex Systems

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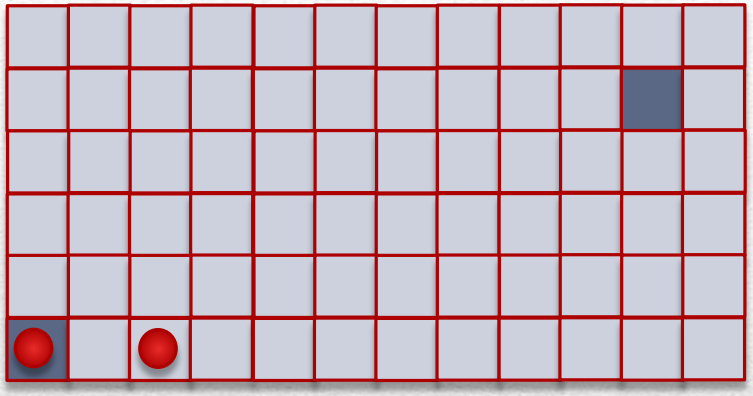

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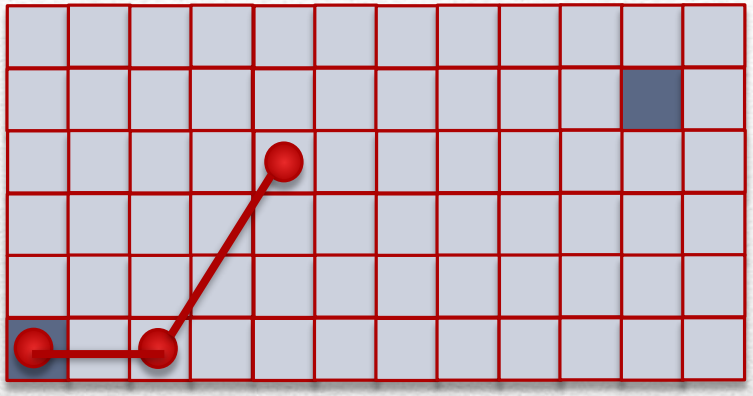

Complex Systems

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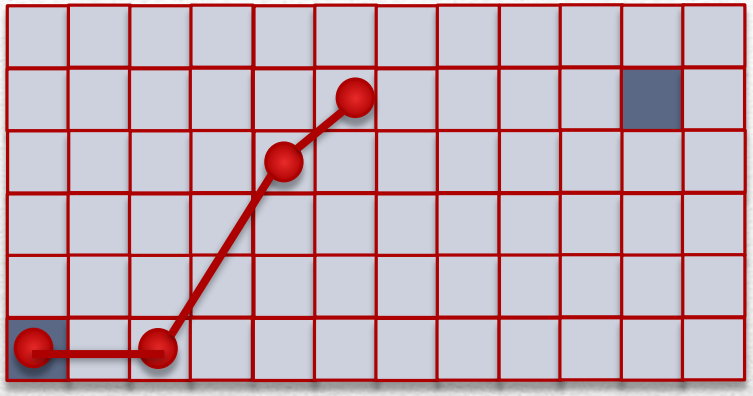

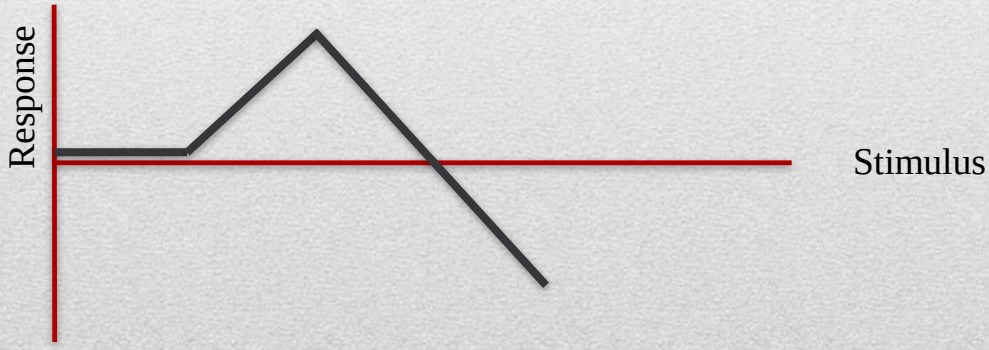

Complex Systems

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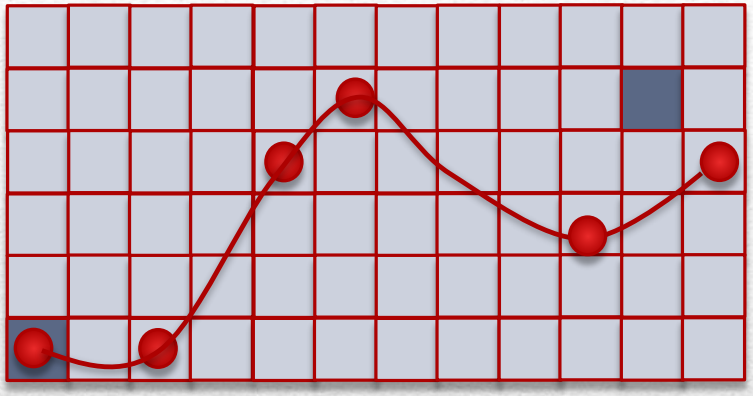

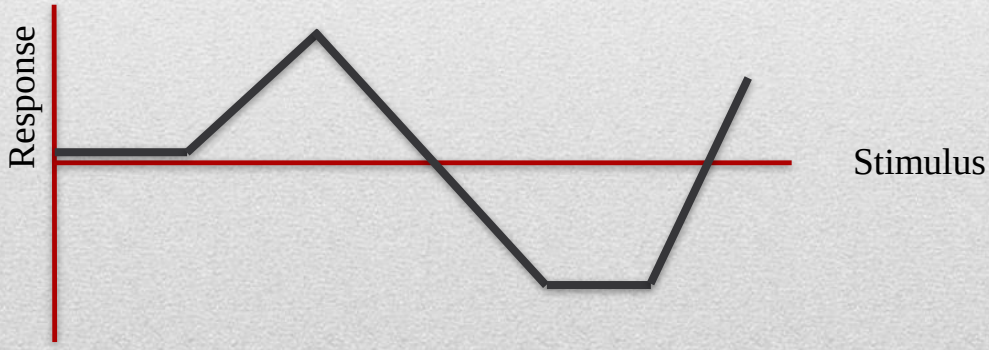

Complex Systems

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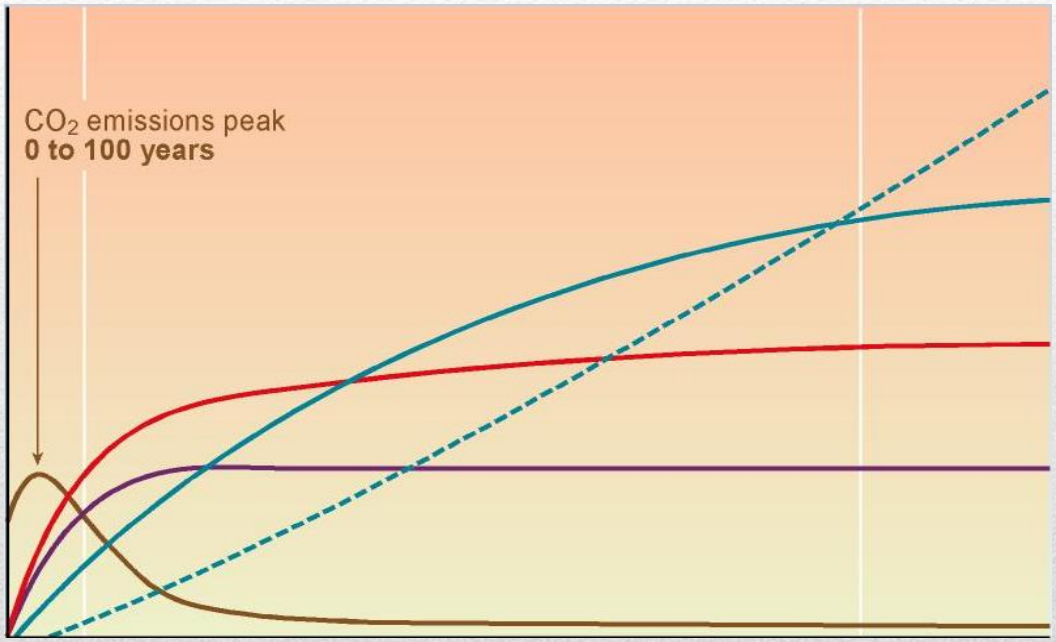


Sea Level Rise due to Melting Glaciers
Several Millennia

Sea Level Rise due to Thermal Expansion
Centuries to Millennium

Temperature Stabilization
Several Centuries

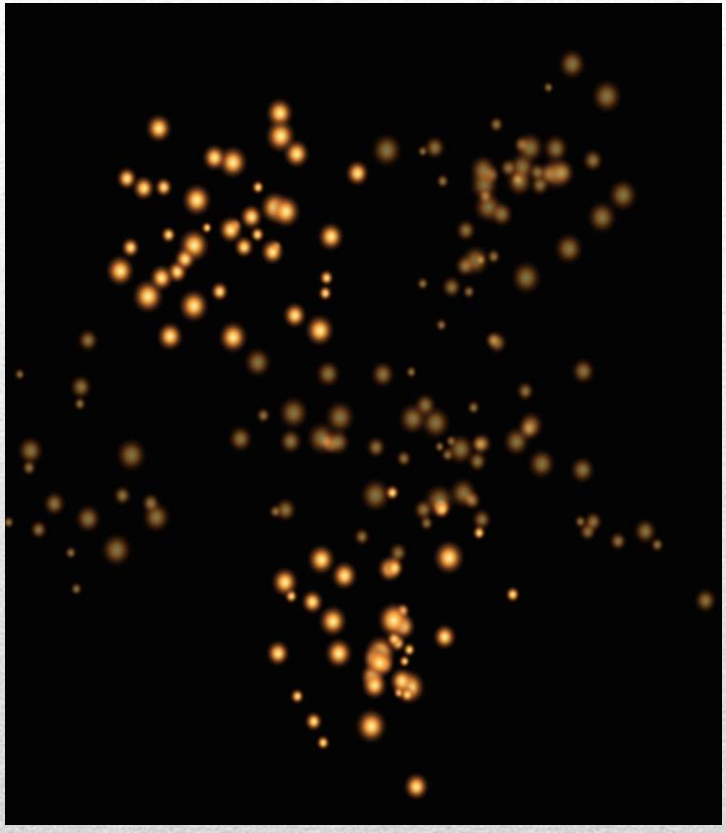
CO_2 Stabilization
100 - 300 Years

CO_2 Emissions

Intergovernmental Panel on Climate Change 2007

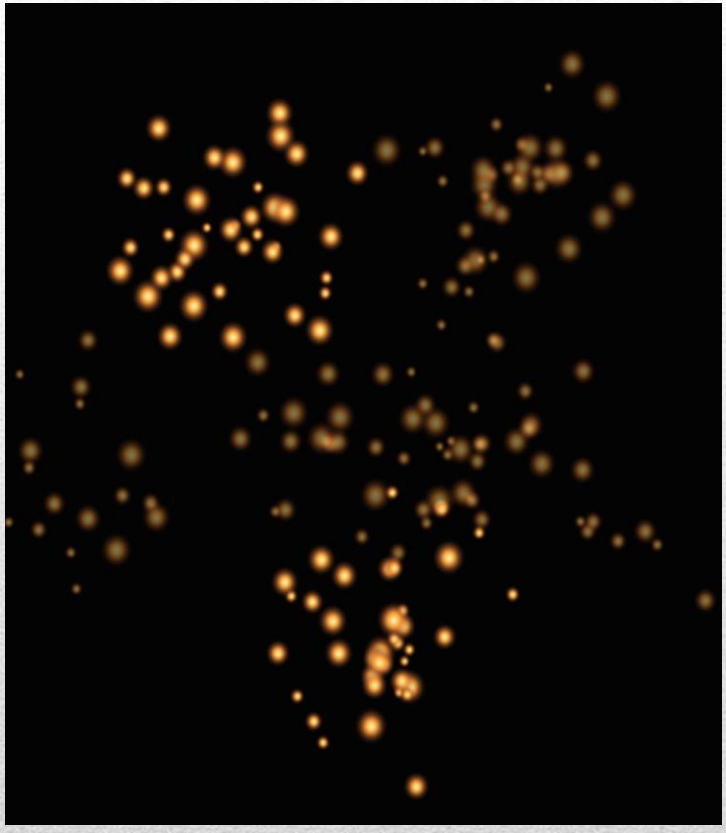
Complex Systems

Lags in Time and Space



Complex Systems

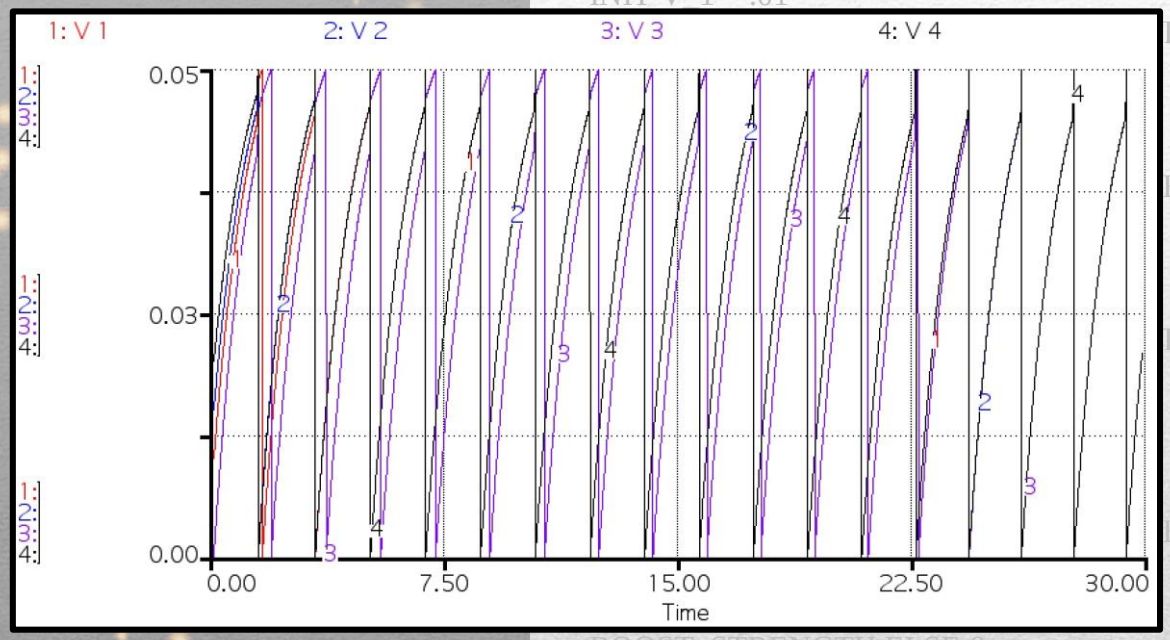
Lags in Time and Space



$V\_1(t) = V\_1(t - dt) + (\Delta V\_1) * dt$
INIT $V\_1 = .01$
ΔV_1 = if $V\_1 \leq .05$ then (INPUT_CURRENT-$V\_1/R1)/C1+BOOST$ else $-V\_1/dt$
$V\_2(t) = V\_2(t - dt) + (\Delta V\_2) * dt$
INIT $V\_2 = .015$
ΔV_2 = if $(V\_2 \leq .05)$ then (INPUT_CURRENT-$V\_2/R2)/C2+BOOST$ else $-V\_2/dt$
$V\_3(t) = V\_3(t - dt) + (\Delta V\_3) * dt$
INIT $V\_3 = 0$
ΔV_3 = if $V\_3 \leq .05$ then (INPUT_CURRENT-$V\_3/R3)/C3+BOOST$ else $-V\_3/dt$
$V\_4(t) = V\_4(t - dt) + (\Delta V\_4) * dt$
INIT $V\_4 = .02$
INFLOWS:
ΔV_4 = if $(V\_4 \leq .05)$ then (INPUT_CURRENT-$V\_4/R4)/C4+BOOST$ else $-V\_4/dt$
BOOST = IF (TOTAL_V > .18) THEN BOOST_STRENGTH ELSE 0
BOOST_STRENGTH = .001/dt

Complex Systems

Lags in Time and Space

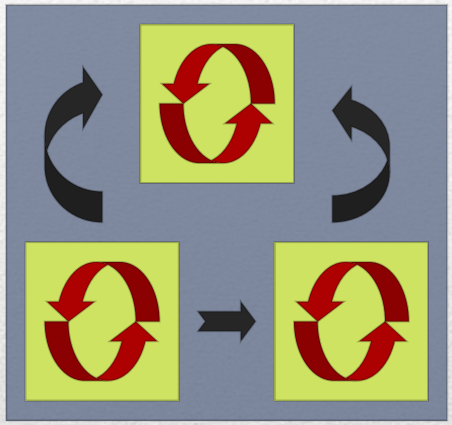


V_1(t) = V_1(t - dt) + (ΔV_1) * dt
INIT V_1 = .01

BOOST_STRENGTH ELSE 0
BOOST_STRENGTH = .001/dt

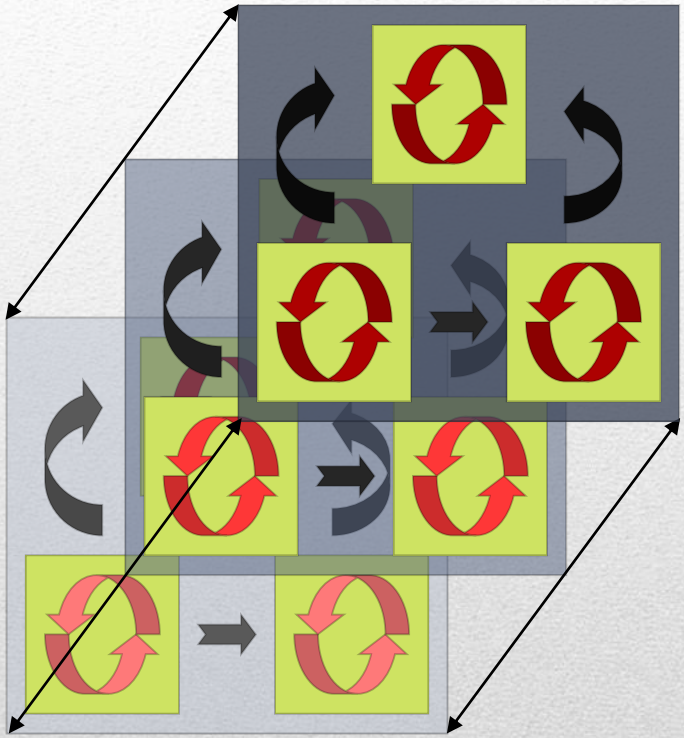
Complex Systems

Separability



Complex Systems

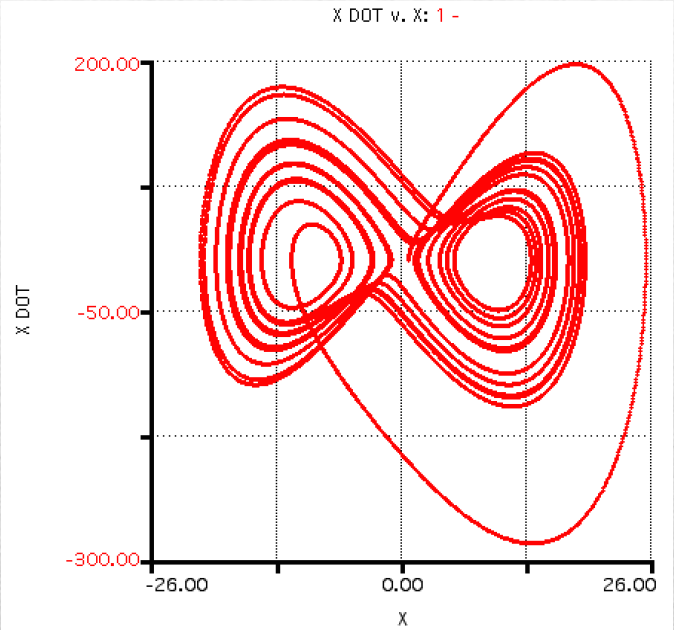
Separability



Complex Systems

Corollaries

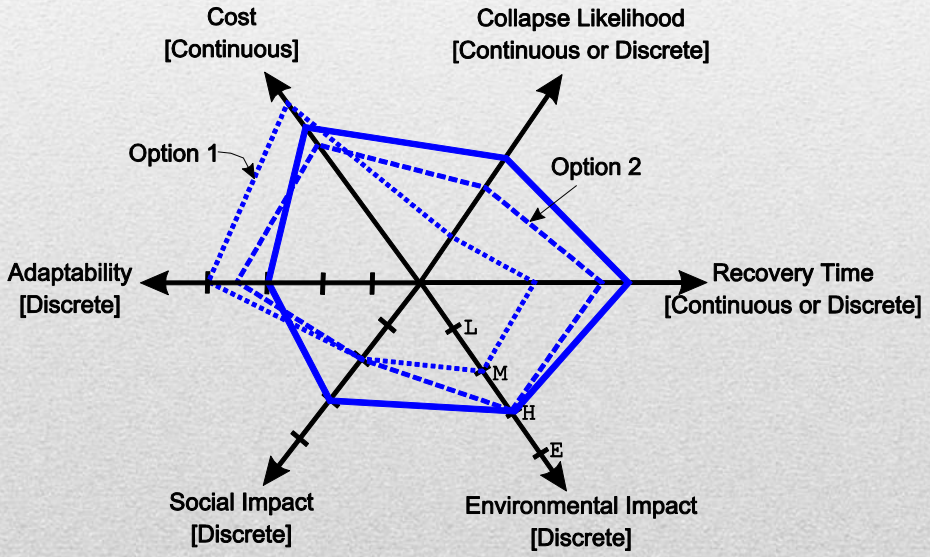
1. Dynamics matter, and historical trends may not



Complex Systems

Corollaries

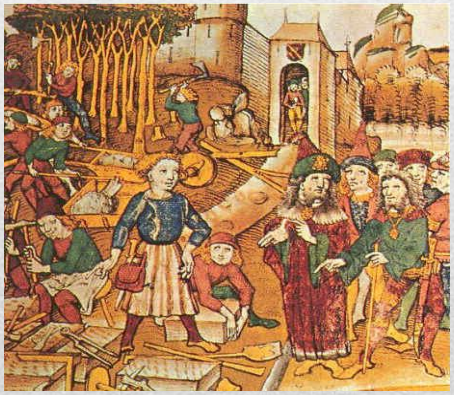
2. Multiple perspectives are required to capture multiple objectives through multiple criteria



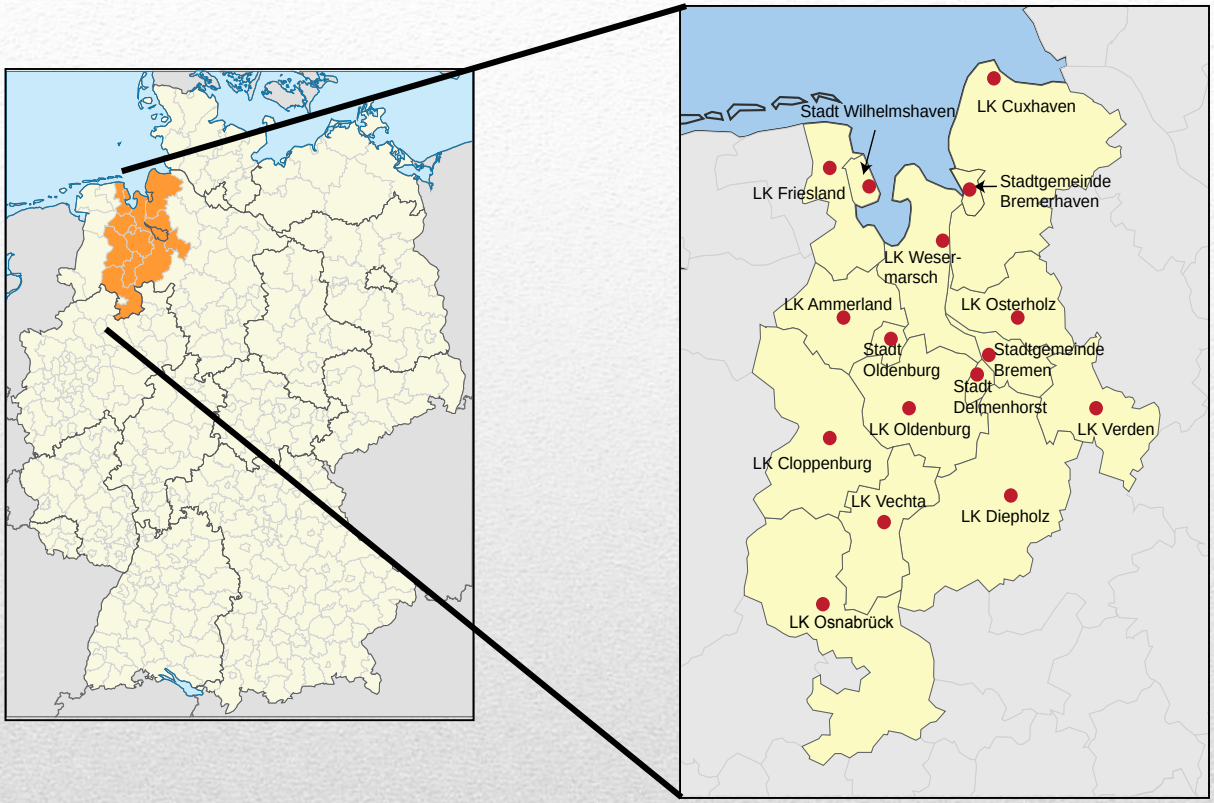
Complex Systems

Corollaries

3. The human brain is ill-equipped and easily overwhelmed, and so are the institutions that manage human-environment interactions



Complex Systems



Mediating Conflicts and Promoting Resilience

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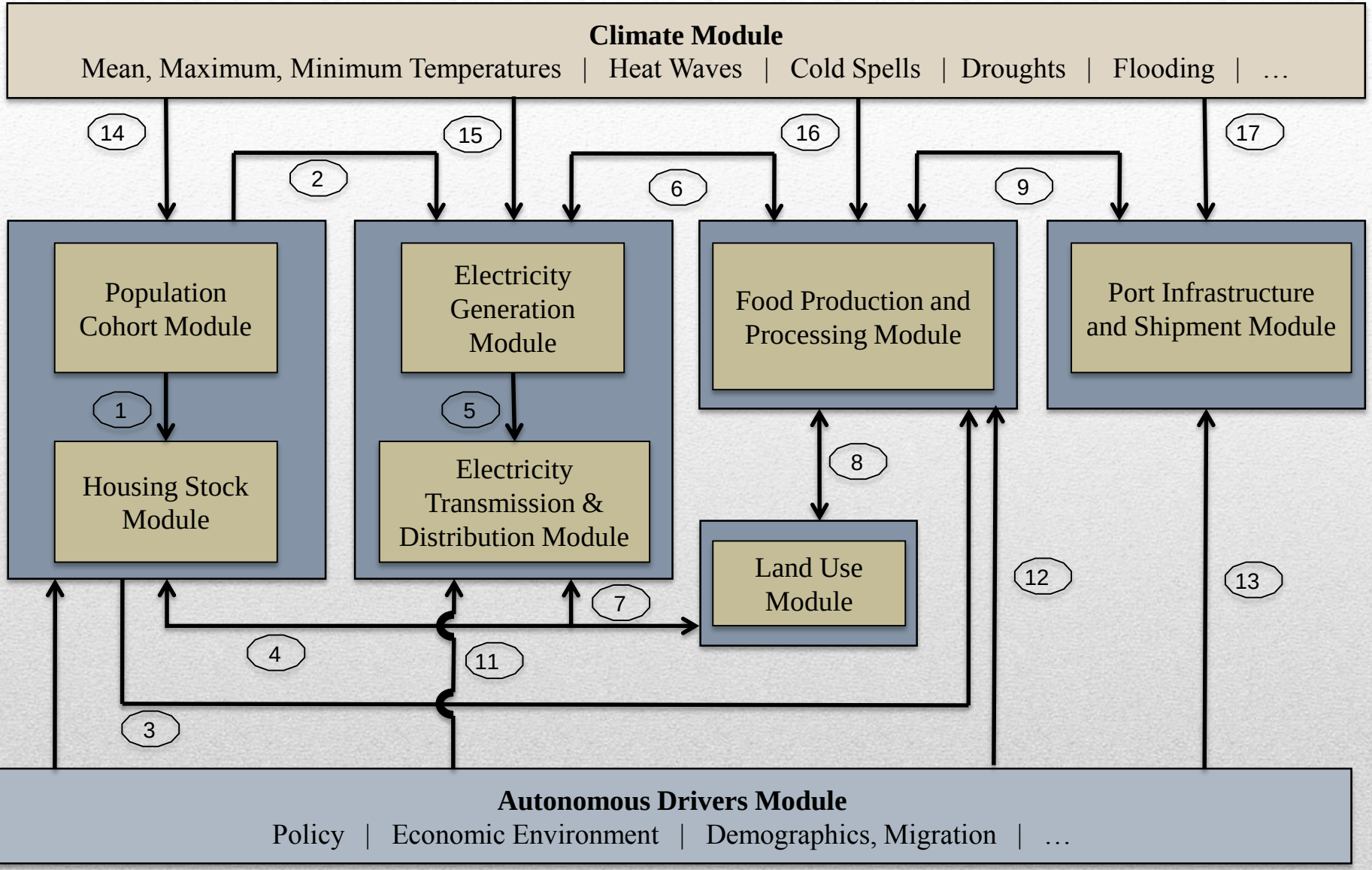
Climate Module
Mean, Maximum, Minimum Temperatures | Heat Waves | Cold Spells | Droughts | Flooding | …
Population Cohort Module
Housing Stock Module
Electricity Generation Module
Electricity Transmission & Distribution Module
Food Production and Processing Module
Land Use Module
Port Infrastructure and Shipment Module
Autonomous Drivers Module
Policy | Economic Environment | Demographics, Migration | …
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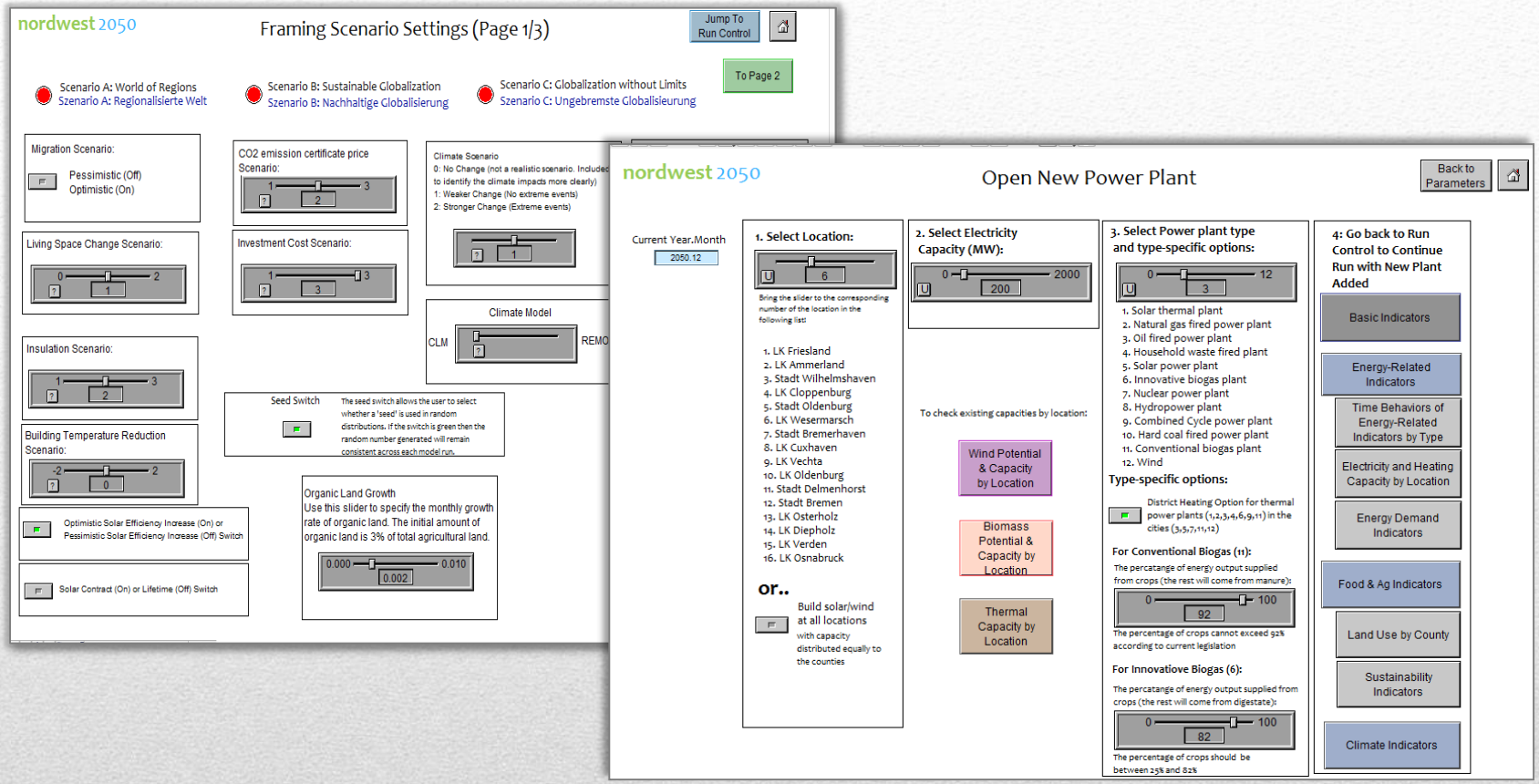

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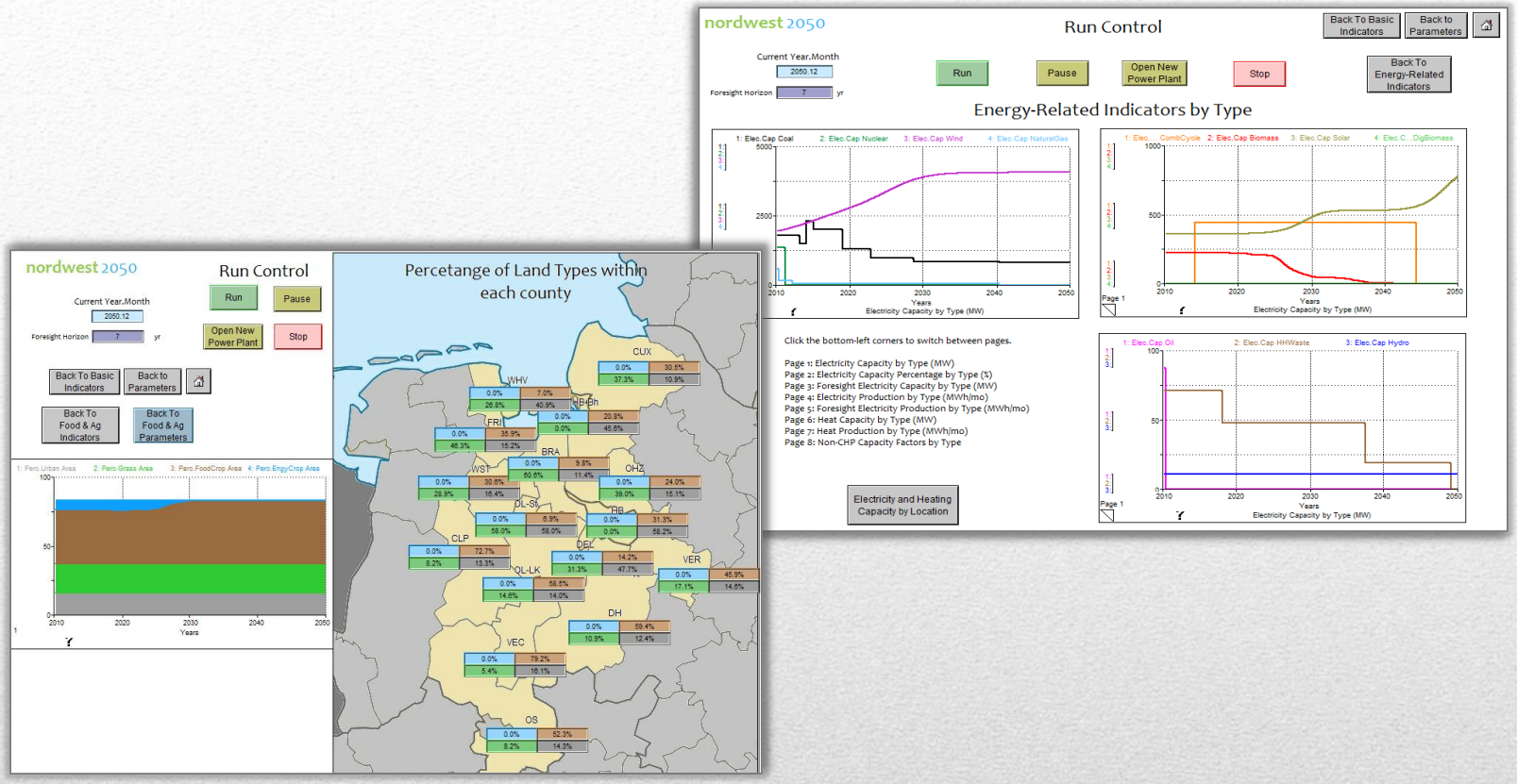

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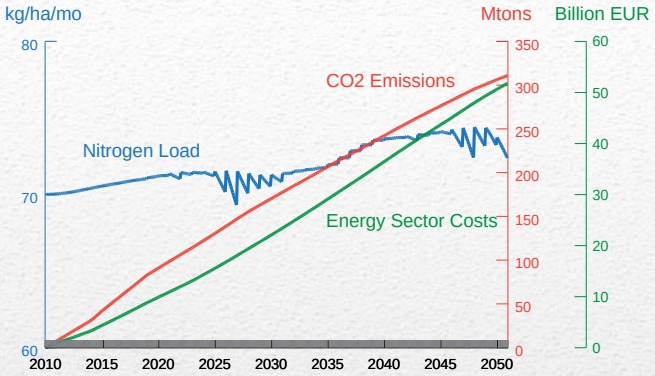

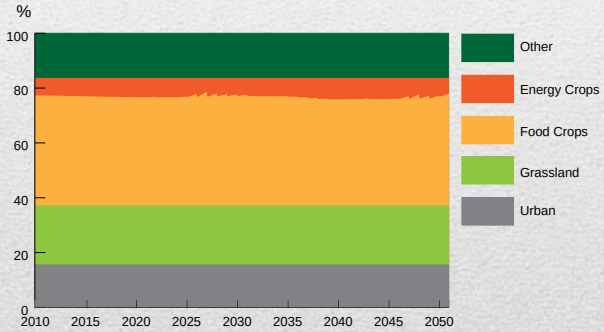

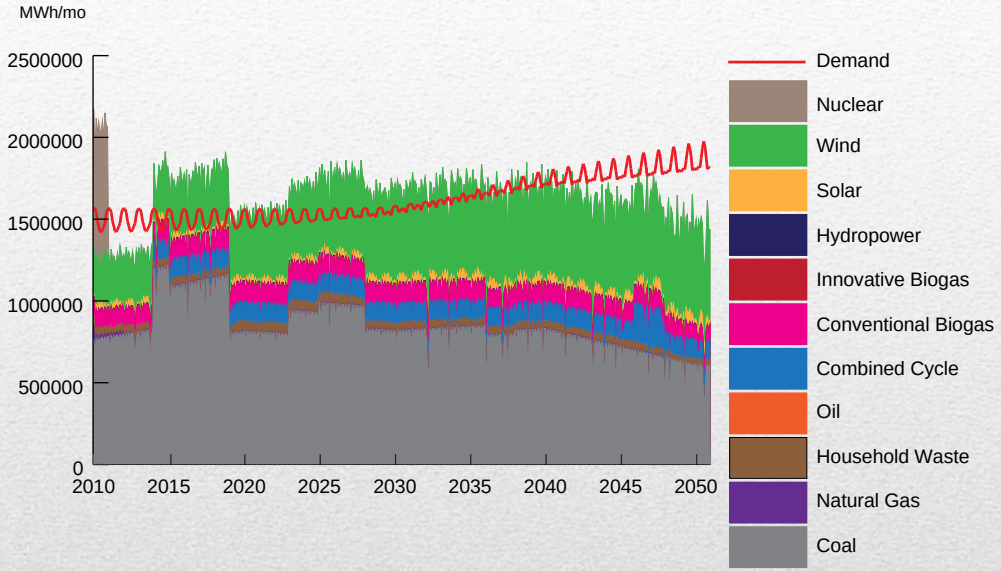

Mediating Conflicts and Promoting Resilience

1. Optimality is an artifact of mechanistic thinking and modeling

Science-Policy Interactions

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2. Robust strategies must be the goal, and adaptive management the default approach

Science-Policy Interactions

1. Optimality is an artifact of mechanistic thinking and modeling
2. Robust strategies must be the goal, and adaptive management the default approach
3. Need-inspired research requires stakeholder engagement

Science-Policy Interactions

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