



Finding Robust Strategies in Complex Human-Environment Systems


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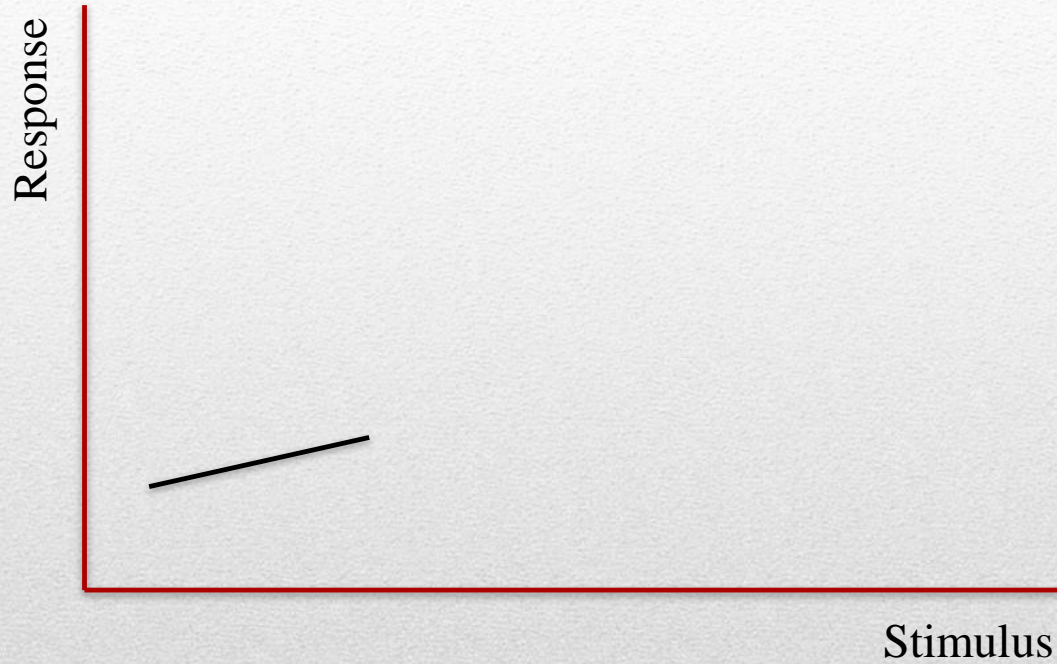
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1. On the Nature of Complex Systems
 2. Mediating Conflicts and Promoting Resilience:
A Case Example
 3. Science-Policy Interactions

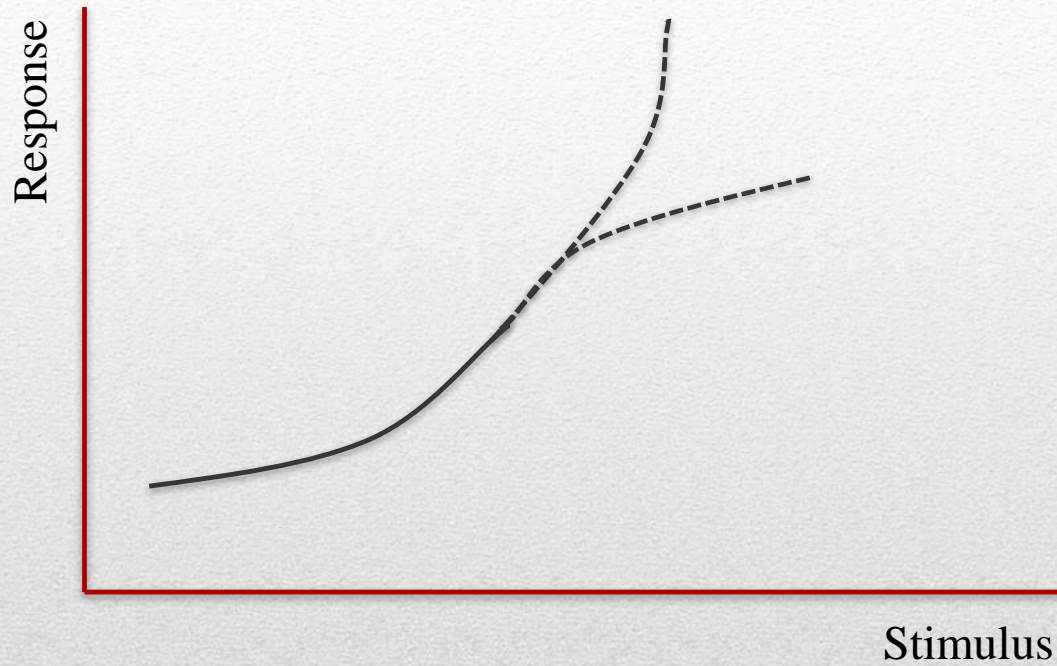
Finding Robust Strategies in Complex
Human-Environment Systems

Nonlinearities



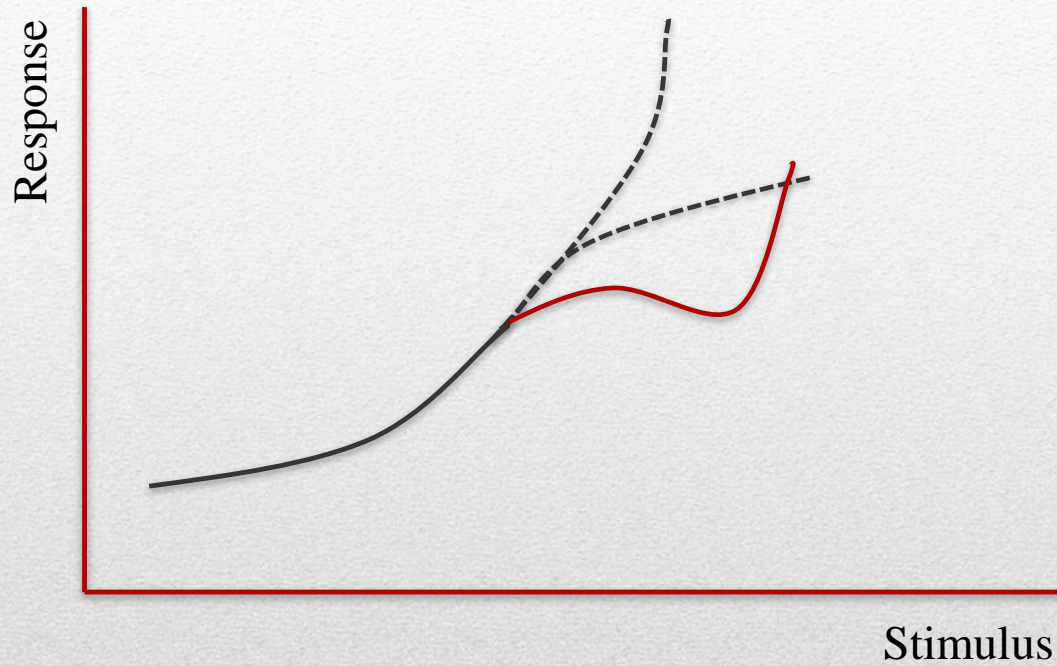
Complex Systems

Nonlinearities



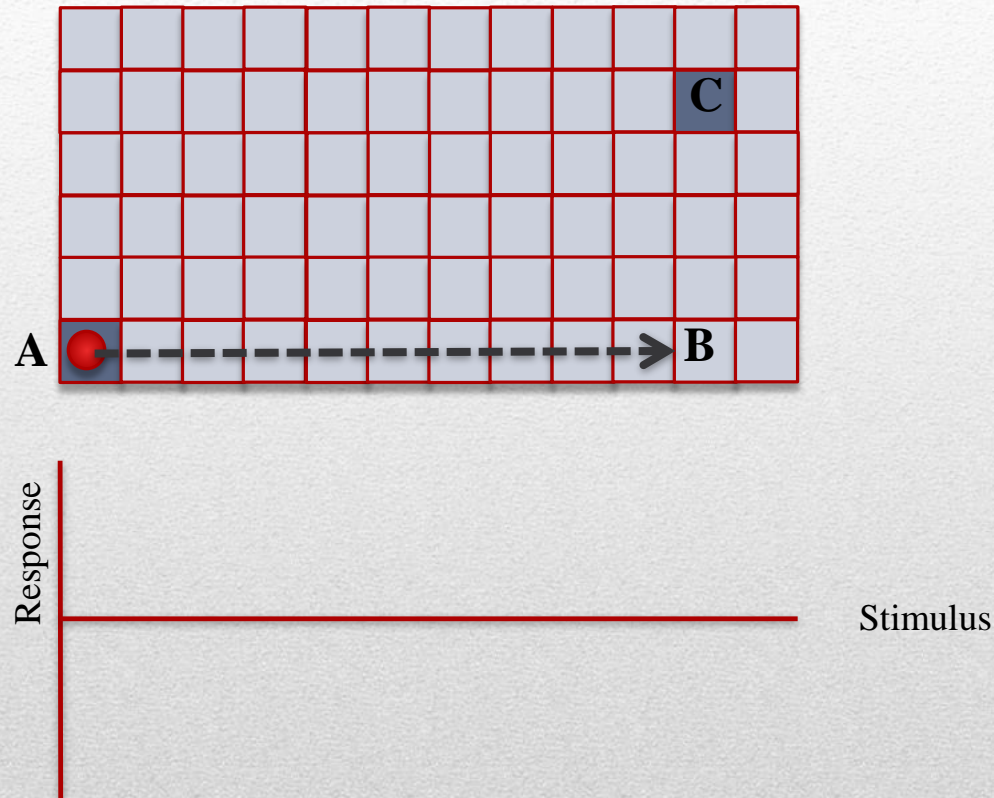
Complex Systems

Nonlinearities



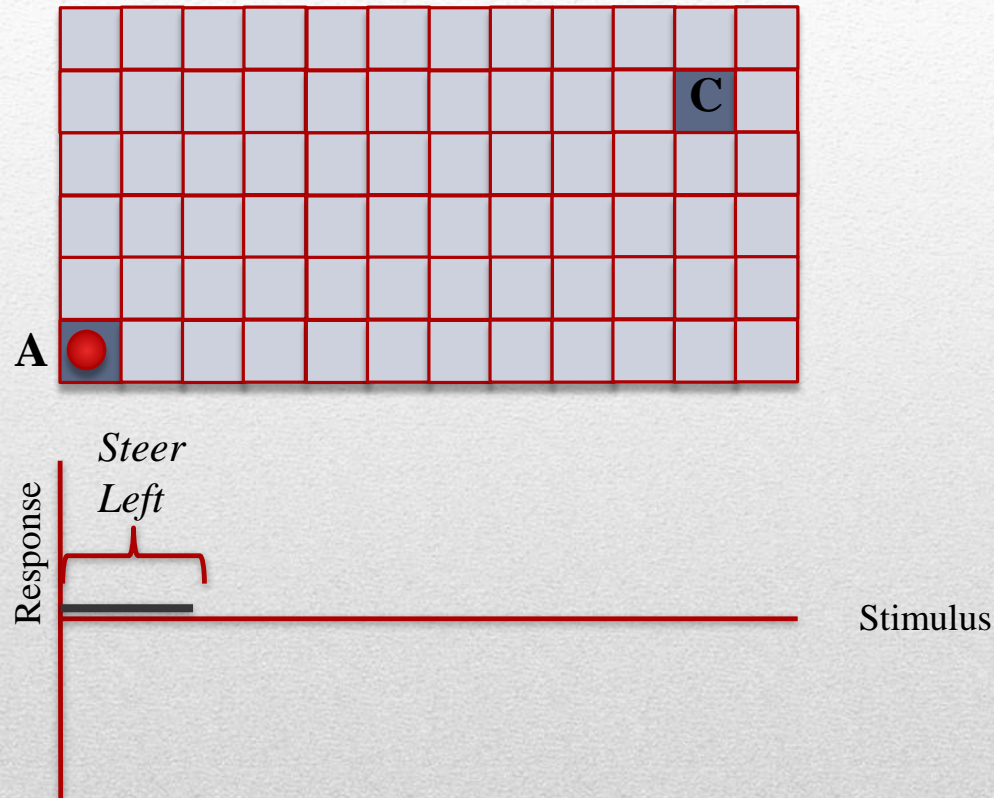
Complex Systems

Lags in Time and Space



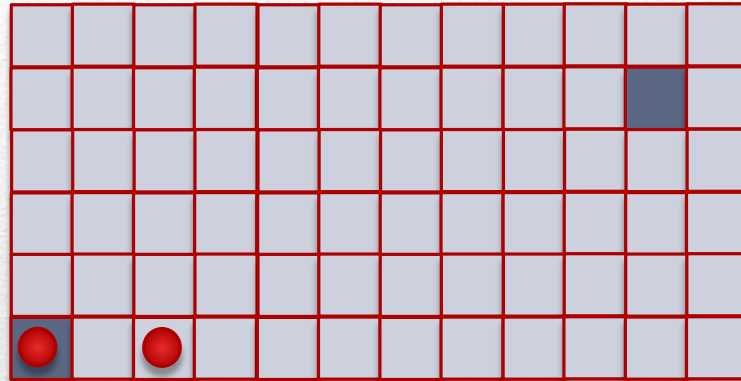
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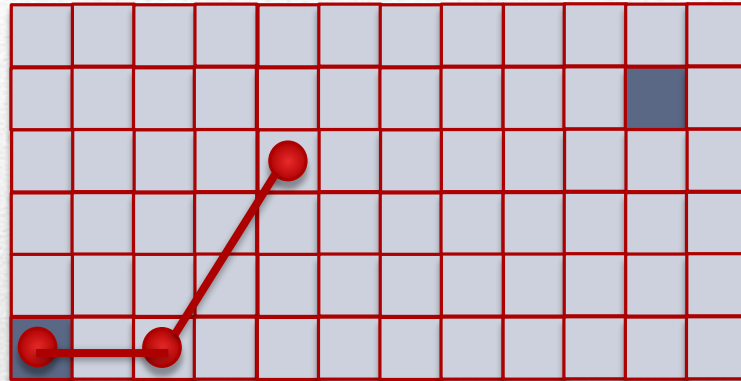
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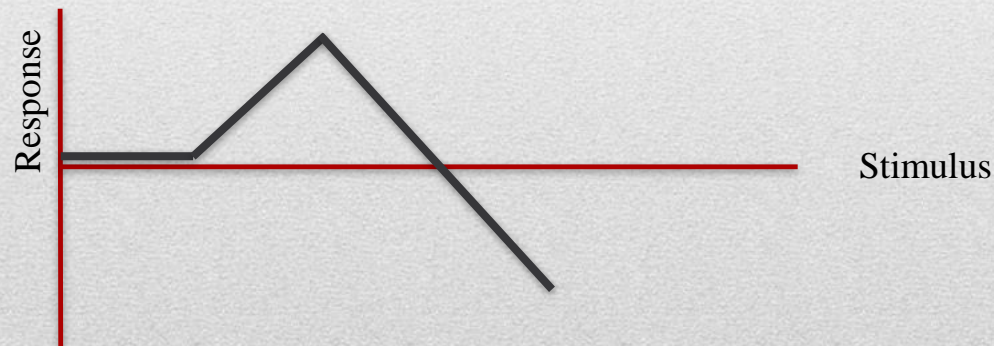
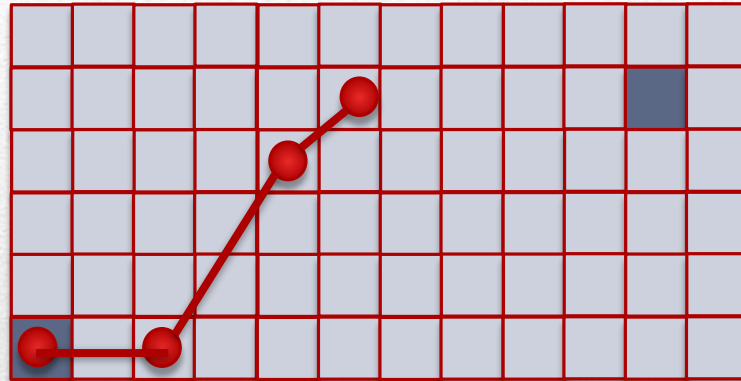
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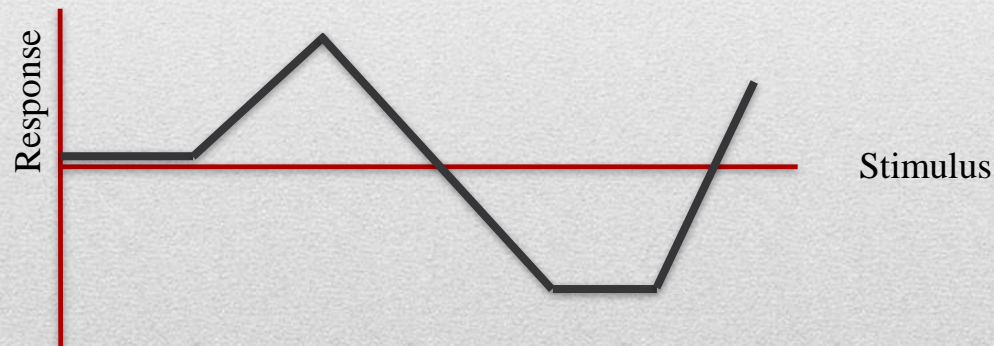
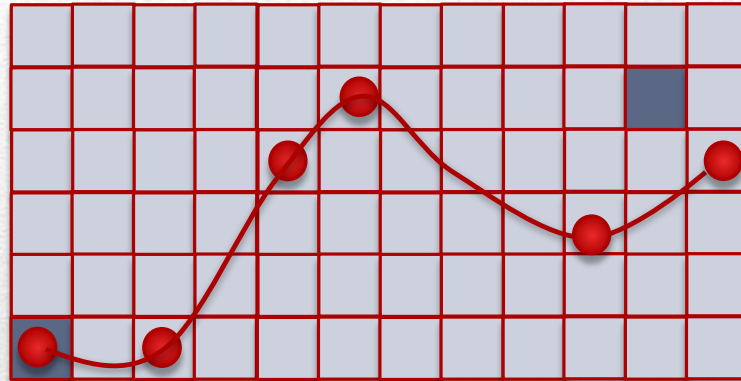
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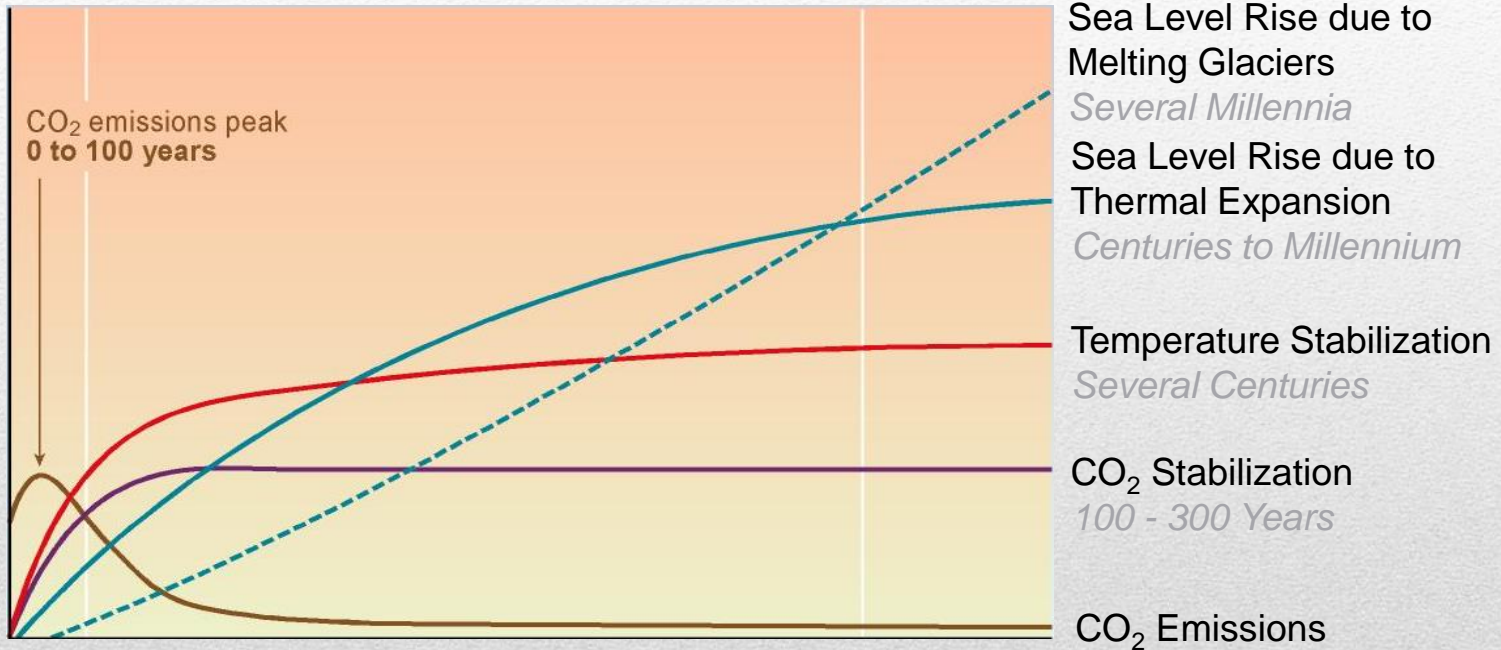
Complex Systems

Lags in Time and Space



Complex Systems

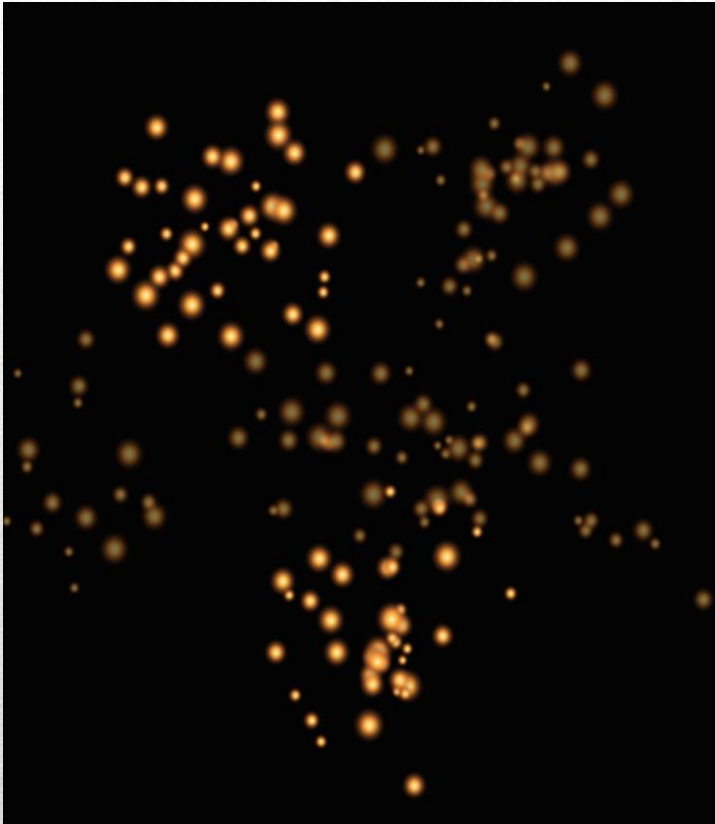
Lags in Time and Space



Intergovernmental Panel on Climate Change 2007

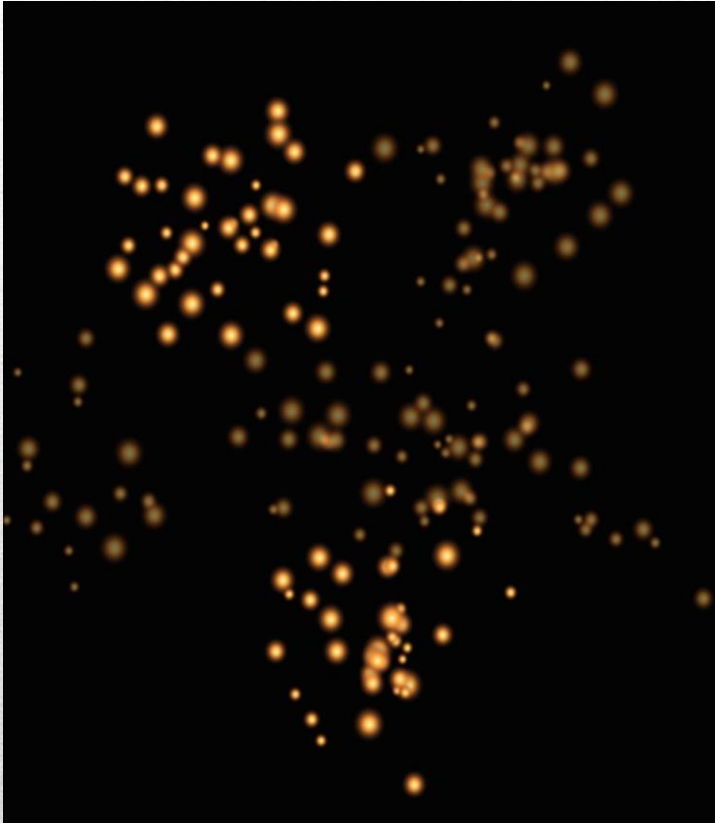
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Complex Systems

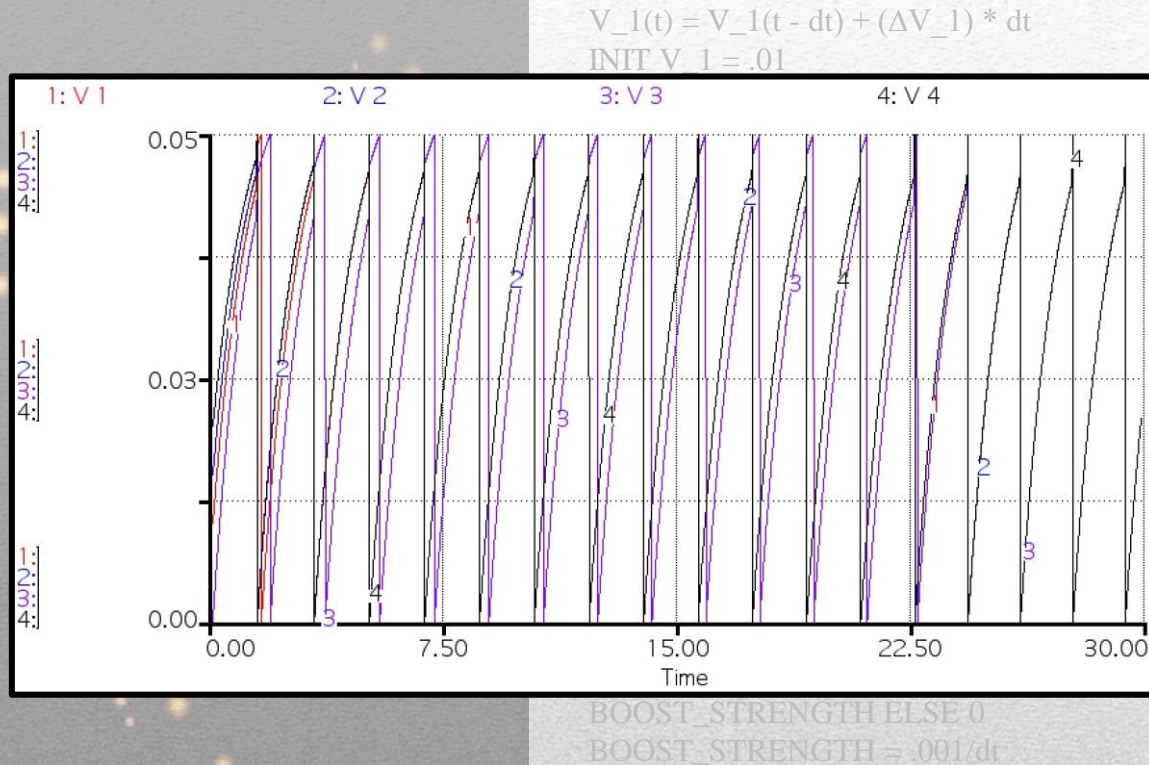
Lags in Time and Space



```
V_1(t) = V_1(t - dt) + (ΔV_1) * dt
INIT V_1 = .01
ΔV_1 = if V_1 ≤ .05 then (INPUT_CURRENT-
V_1/R1)/C1+BOOST else -V_1/dt
V_2(t) = V_2(t - dt) + (ΔV_2) * dt
INIT V_2 = .015
ΔV_2 = if (V_2 ≤ .05) then (INPUT_CURRENT-
V_2/R2)/C2+BOOST else -V_2/dt
V_3(t) = V_3(t - dt) + (ΔV_3) * dt
INIT V_3 = 0
ΔV_3 = if V_3 ≤ .05 then (INPUT_CURRENT-
V_3/R3)/C3+BOOST else -V_3/dt
V_4(t) = V_4(t - dt) + (ΔV_4) * dt
INIT V_4 = .02
INFLOWS:
ΔV_4 = if (V_4 ≤ .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
```

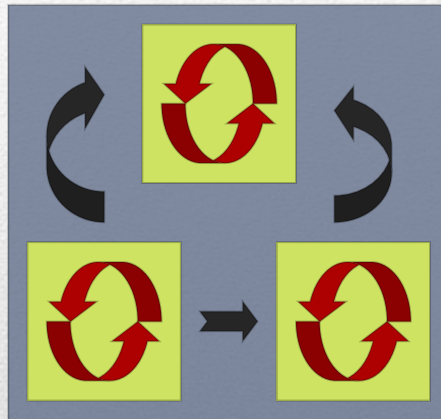
Complex Systems

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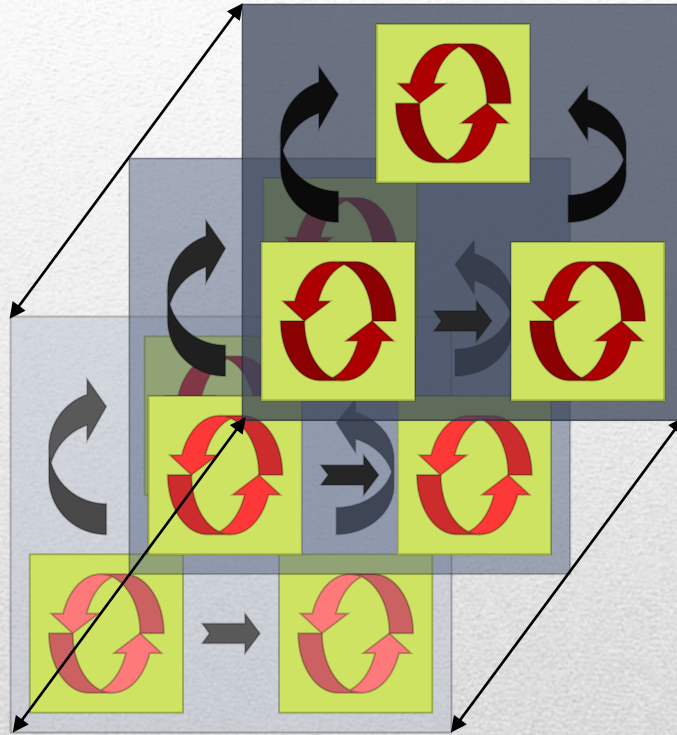
Complex Systems

Separability



Complex Systems

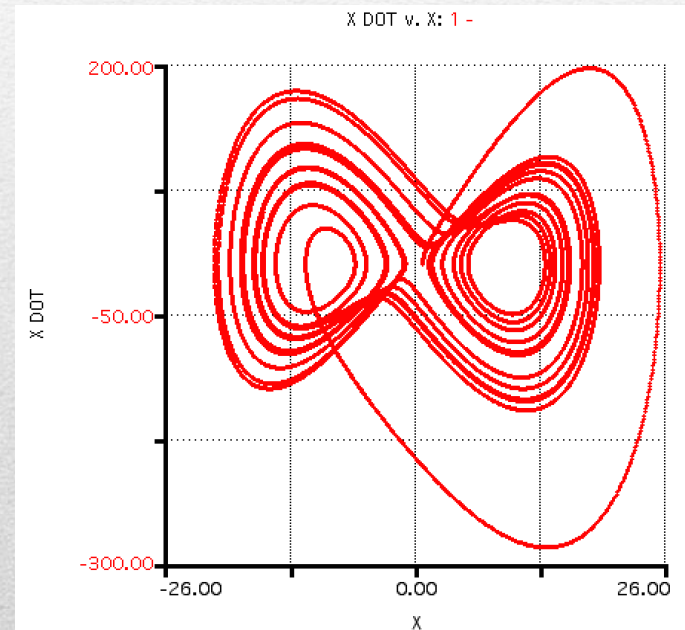
Separability



Complex Systems

Corollaries

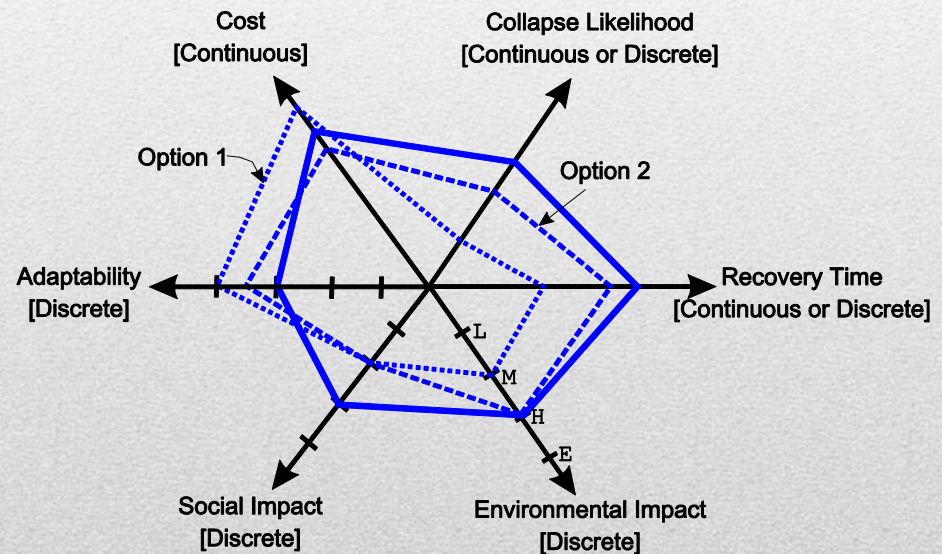
1. Dynamics matter, and historical trends may not



Complex Systems

Corollaries

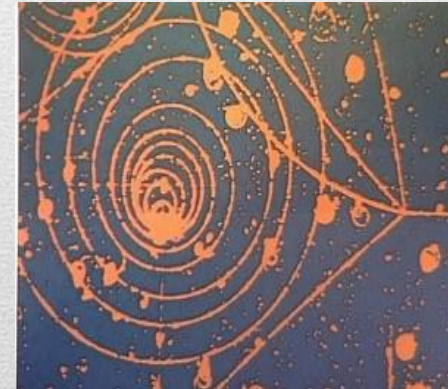
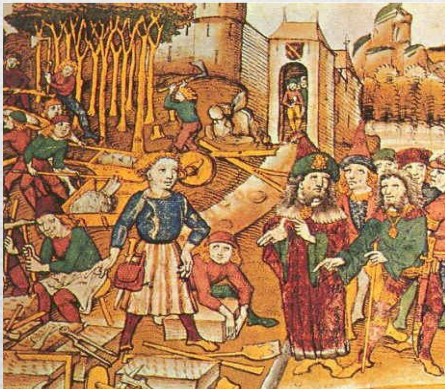
- Multiple perspectives are required to capture multiple objectives through multiple criteria



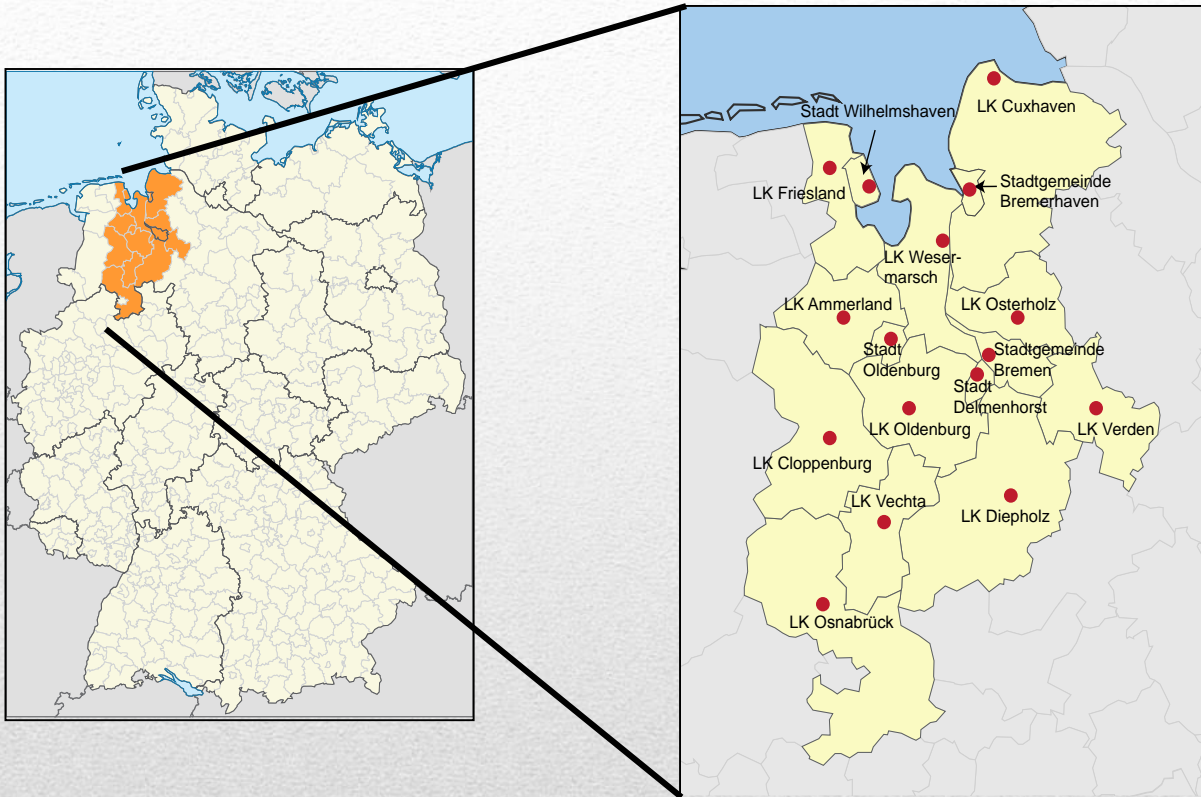
Complex Systems

Corollaries

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



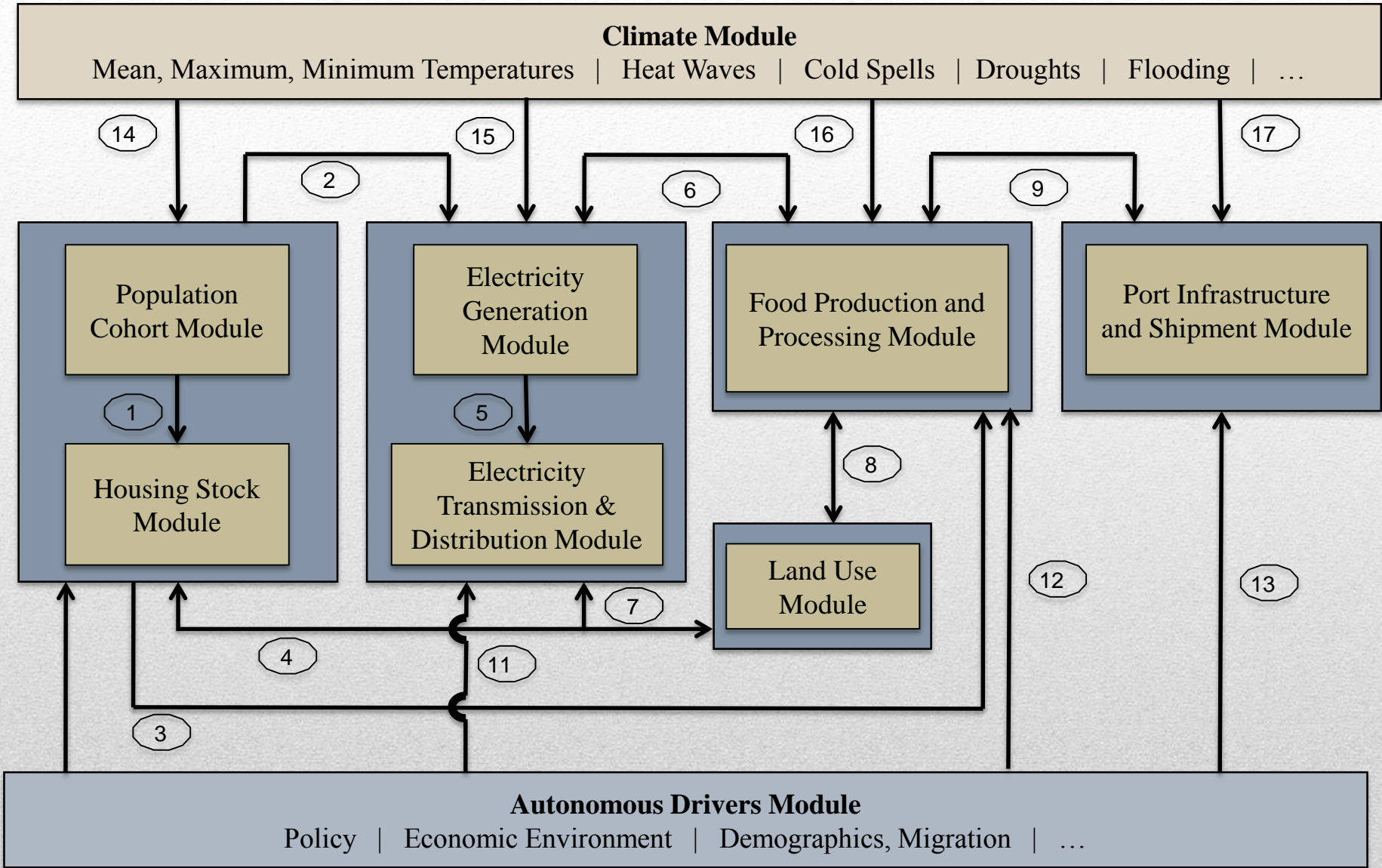
Complex Systems



Mediating Conflicts and Promoting Resilience



Mediating Conflicts and Promoting Resilience



nordwest2050 Framing Scenario Settings (Page 1/3) Jump To Run Control To Page 2

Scenario A: World of Regions
 Szenario A: Regionalisierte Welt

Scenario B: Sustainable Globalization
 Szenario B: Nachhaltige Globalisierung

Scenario C: Globalization without Limits
 Szenario C: Ungebremsete Globalisierung

Migration Scenario:
 Pessimistic (Off)
 Optimistic (On)

Living Space Change Scenario:
 0 1 2

Insulation Scenario:
 1 2 3

Building Temperature Reduction Scenario:
 -2 0 2

Optimistic Solar Efficiency Increase (On) or Pessimistic Solar Efficiency Increase (Off) Switch

Solar Contract (On) or Lifetime (Off) Switch

CO2 emission certificate price Scenario:
 1 2 3

Investment Cost Scenario:
 1 3 3

Climate Scenario:
 0: No Change (not a realistic scenario. Included to identify the climate impacts more clearly)
 1: Weaker Change (No extreme events)
 2: Stronger Change (Extreme events)

1 2

Climate Model:
 CLM REMO

Seed Switch
 The seed switch allows the user to select whether a 'seed' is used in random distributions. If the switch is green then the random number generated will remain consistent across each model run.

Organic Land Growth
 Use this slider to specify the monthly growth rate of organic land. The initial amount of organic land is 3% of total agricultural land.
 0.000 0.002 0.010

nordwest2050 Open New Power Plant Back to Parameters

Current Year.Month: 2050.12

1. Select Location:
 1 6 12
 Bring the slider to the corresponding number of the location in the following list:
 1. LK Friesland
 2. LK Ammerland
 3. Stadt Wilhelmshaven
 4. LK Cloppenburg
 5. Stadt Oldenburg
 6. LK Wesermarsch
 7. Stadt Bremerhaven
 8. LK Cuxhaven
 9. LK Vechta
 10. LK Oldenburg
 11. Stadt Delmenhorst
 12. Stadt Bremen
 13. LK Osterholz
 14. LK Diepholz
 15. LK Verden
 16. LK Osnabrück

or..
 Build solar/wind at all locations with capacity distributed equally to the counties

2. Select Electricity Capacity (MW):
 0 200 2000

To check existing capacities by location:

Wind Potential & Capacity by Location
 Biomass Potential & Capacity by Location
 Thermal Capacity by Location

3. Select Power plant type and type-specific options:
 0 3 12

1. Solar thermal plant
 2. Natural gas fired power plant
 3. Oil fired power plant
 4. Household waste fired plant
 5. Solar power plant
 6. Innovative biogas plant
 7. Nuclear power plant
 8. Hydropower plant
 9. Combined Cycle power plant
 10. Hard coal fired power plant
 11. Conventional biogas plant
 12. Wind

Type-specific options:

District Heating Option for thermal power plants (1,2,3,4,6,9,11) in the cities (3,5,7,11,12)

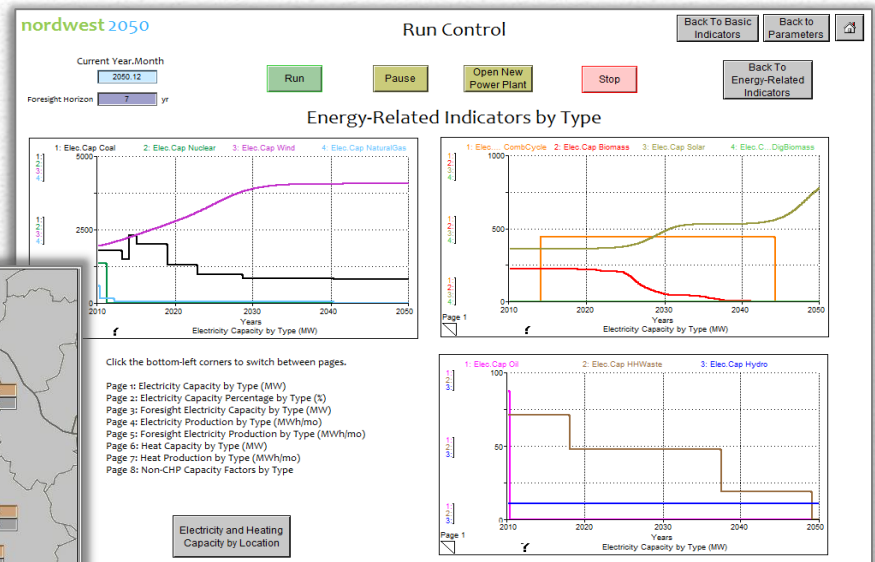
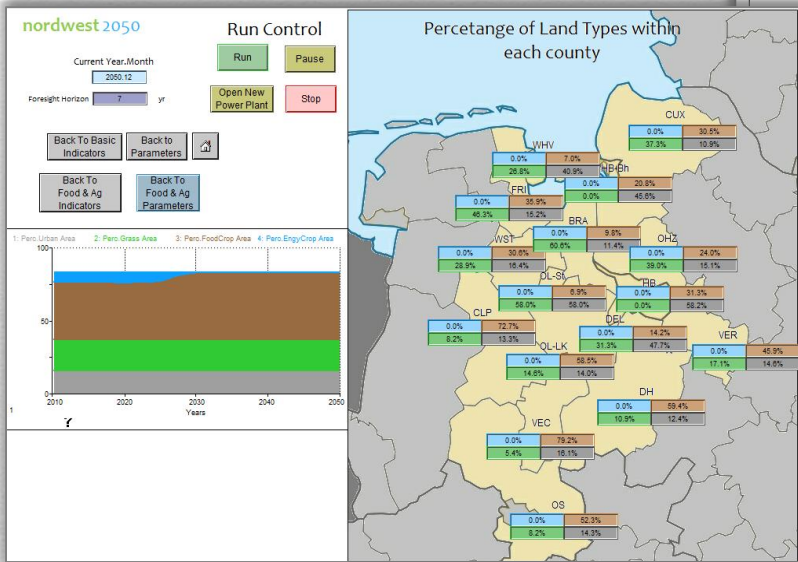
For Conventional Biogas (1):
 The percentage of energy output supplied from crops (the rest will come from manure):
 0 92 100
 The percentage of crops cannot exceed 5% according to current legislation

For Innovative Biogas (6):
 The percentage of energy output supplied from crops (the rest will come from digestate):
 0 82 100
 The percentage of crops should be between 25% and 82%

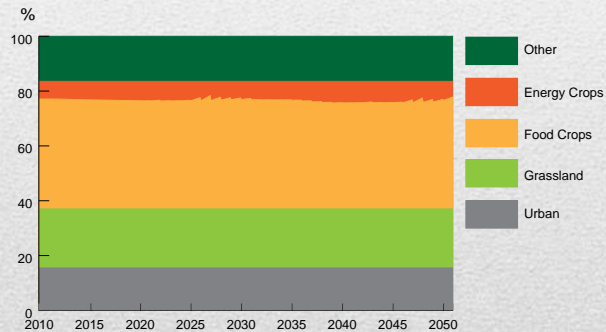
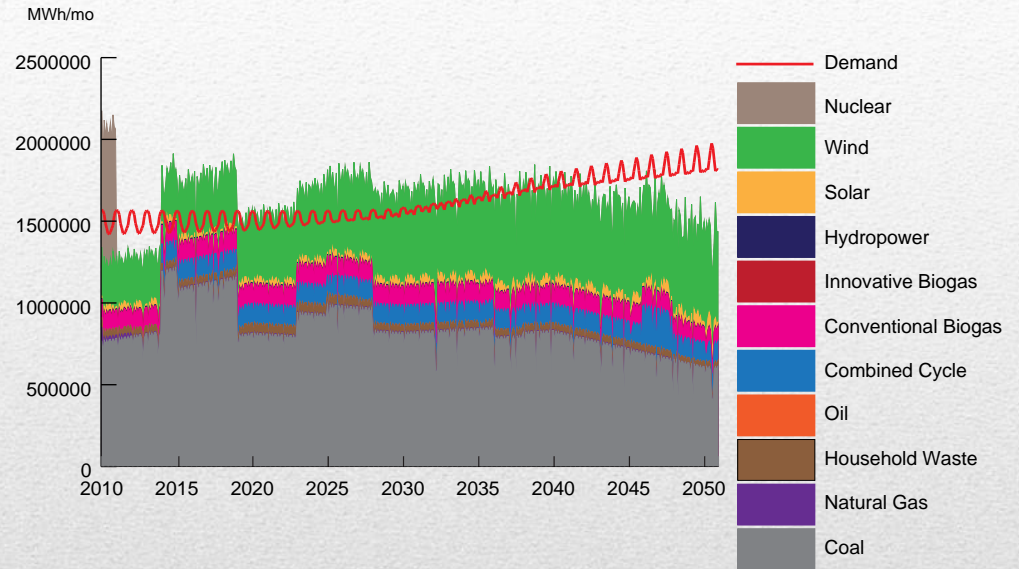
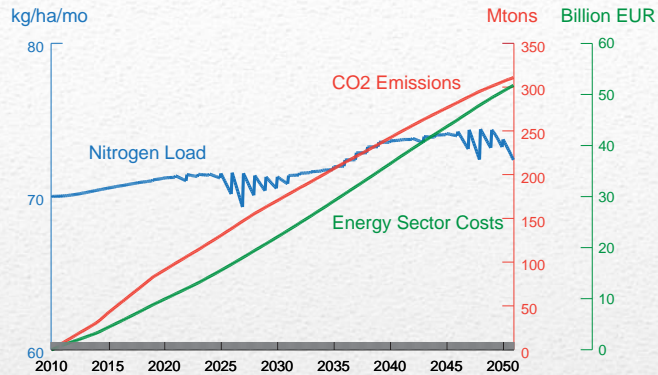
4: Go back to Run Control to Continue Run with New Plant Added

Basic Indicators
 Energy-Related Indicators
 Time Behaviors of Energy-Related Indicators by Type
 Electricity and Heating Capacity by Location
 Energy Demand Indicators
 Food & Ag Indicators
 Land Use by County
 Sustainability Indicators
 Climate Indicators

Mediating Conflicts and Promoting Resilience



Mediating Conflicts and Promoting Resilience



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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