Walk through: Deciding SSP assumptions

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Brian O’Neill

Workshop to Explore the New SMA/SSP Approach,
July 16-17, 2011
Touchstone: Berlin SSP scheme

Baseline Emissions
Decreasing Mitigation Capacity

Decreasing Adaptive Capacity
Increasing Sensitivity

SSP 5
SSP 2
SSP 1
SSP 4
SSP 3
Advancing the SSP conversation

<table>
<thead>
<tr>
<th>I. Operationalize concepts in axes for each SSP;</th>
<th>II. Transparent evaluation of internal consistency of SSP elements</th>
</tr>
</thead>
</table>
Advancing the SSP conversation

I. Operationalize concepts in axes for each SSP:

- SSP determinants
  - Baseline emissions
  - Mitigation capacity
  - Adaptive capacity
  - Sensitivity

II. Transparent evaluation of internal consistency of SSP elements
Advancing the SSP conversation

I. Operationalize concepts in axes for each SSP:

<table>
<thead>
<tr>
<th>SSP determinants</th>
<th>SSP descriptors</th>
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<tr>
<td>Baseline emissions</td>
<td>Population</td>
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<td>Mitigation capacity</td>
<td>Income</td>
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<td>Adaptive capacity</td>
<td>C intensity</td>
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<td>Sensitivity</td>
<td>Equity</td>
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II. Transparent evaluation of internal consistency of SSP elements
Advancing the SSP conversation

I. Operationalize concepts in axes for each SSP;

- SSP determinants
  - Baseline emissions
  - Mitigation capacity
  - Adaptive capacity
  - Sensitivity

- SSP descriptors
  - Population
  - Income
  - C intensity
  - Equity

- Descriptor states
  - Low/Med/High Quant ranges

II. Transparent evaluation of internal consistency of SSP elements

Mapping of states in SSP space

- Population(H), Income(M), C intensity(H), Equity(L)?
- Population(M), Income(M), C intensity(M), Equity(M)?
- Population(L), Income(H), C intensity(L), Equity(M)?
Advancing the SSP conversation

I. Operationalize concepts in axes for each SSP:

- SSP determinants
  - Baseline emissions
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- SSP descriptors
  - Population
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- Descriptor states
  - Low/Med/High Quant ranges

II. Transparent evaluation of internal consistency of SSP elements

- Cross-impact balance (CIB) analysis
- Inconsistency scores
- Consistent combinations of states in SSP space

- Mapping of states in SSP space

- SSP 5
- SSP 3
- SSP 2
- SSP 1
- SSP 4

- Population(H), Income(M), C intensity(H), Equity(L)?
- Population(M), Income(M), C intensity(M), Equity(M)?
- Population(L), Income(H), C intensity(L), Equity(M)?
I. Operationalizing concepts in axes for each SSP
Mitigation determinants ➔ descriptors

Baseline emissions
- (Kaya Identity)
  - Income
  - Population
  - E intensity
  - C intensity

Mitigation capacity
- (Economic capacity)
  - Tech: Energy intensity
  - Fuels research focus
- (Technological capacity)
  - Tech: Emission control
  - Tech: Fossil substitutes

(Impact capacity)
- (Institutional capacity)

(Effective policy)
- (Innovation policy)

(Know-how)
- Research collaboration
- Tech transfer

(Social capacity)
- Legal capacity
  - MRV
- Political will
  - Behavior change

Ag emissions non-CO2 gas
Deforestation

Livestock demand
Biofuel yields
Crop yields
Tech: Meat production

Deployment
II. Transparent evaluation of internal consistencies for combinations of SSP elements
8-descriptor example

Two-region world: OECD+, ROW
OECD+ includes countries such as Czech Republic, Argentina, Brazil, Chile, Mexico, Venezuela, Saudi Arabia (Romero-Lankao et al. 2008)
# Flavor of the cross-impact balance (CIB) method

<table>
<thead>
<tr>
<th>Fuels research focus</th>
<th>Fuels</th>
<th>Fossil subs</th>
<th>OECD+ Pop</th>
<th>OECD+ Inc</th>
<th>OECD+ Ed</th>
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Judgment section in CIB matrix

System decomposition: If the only information you have about the system is that factor $X_1$ has state $x$, would you evaluate the direct influence of $X_1$ on $X_2$ as a clue that

- Factor $X_2$ has state $y$ (promoting influence)? OR
- Factor $X_2$ does not have state $y$ (restricting influence)?

Evaluation according to 7-point Likert scale

<table>
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<tr>
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What does it mean for combinations of SSP elements to be internally consistent?

Internally consistent combinations are like attractors, i.e. the combination “evokes a self-consistent network of influences”; can be considered self-reinforcing (Weimer-Jehle 2006, p. 342)

Inconsistent combinations instead evoke new combinations
Perfectly consistent combinations

There is a small number of perfectly consistent combinations...
   But they’re pretty homogeneous for SSPs.
   Technology outcomes: Non-fossil worlds
   OECD+ outcome: Prosperity
   ROW outcomes: Convergence, Demographic Trap / Second Fiddle

So, is that all?
There are other interesting things that can be analyzed about the hundreds of combinations that perform well but not perfectly.
   • How often inconsistencies occur within a combination
   • Strength of influences within combination
Broader set of combinations and SSP mapping

Y-axis:
- Availability of fossil substitutes (mitigation capacity)
- Population pathways (reference emissions)
Broader set of combinations and SSP mapping

X-axis:
- ROW infrastructure (sensitivity)
- ROW income pathway (adaptive capacity)
Consistent members in SSP space

- SSP 5: Perfect consistency
- SSP 3: Nearly perfect consistency
- SSP 2: High consistency, strong influences (total impact score >50)
- SSP 1: Challenges to mitigation
- SSP 4: Challenges to adaptation
Consistent members in SSP space

- SSP 5
- SSP 2
- SSP 1
- SSP 3
- SSP 4

Challenges to mitigation

Challenges to adaptation

- Perfect consistency
- Nearly perfect consistency
- High consistency, strong influences (total impact score >50)
Summary

I. Operationalizing concepts in axes for each SSP
   • In our walk through, “short” list still contains 25+ descriptors
   • Difficult to holistically select combinations from so many descriptors with high confidence; discovery of consistent combinations may be preferred

II. Transparent evaluation of internal consistency of scenario logic
   • Simple case: 2-region world with 8 descriptors. Creates very large combination space (~10^6 possibilities)
   • However, can systematically explore space to find combinations of SSP elements with high internal consistency, comprised of strong influences; could be useful for iterating SSP assumptions
   • Preliminary results suggest SSP1, SSP3, SSP3*4, SSP4 may be comprised of strongest influences

Comments? Contact: Vanessa Schweizer, vanessa@ucar.edu
References


BACKUP
8-descriptor direct influence diagram
2 regions: OECD+, ROW

Romero-Lankao et al. (2008)

Group III (WB income classification - Upper-middle): Argentina, Australia, Belgium, Brazil, Chile, Mexico, Saudi Arabia, UK, Venezuela

Group VI (WB income classification - High): Canada, Czech Rep, France, Germany, Greece, Hungary, Italy, Japan, S. Korea, Netherlands, Portugal, US...
Why cross-impact balance (CIB) analysis?

Helps to define SSPs
• For even a modest number of descriptors, there will be MANY possible ways to combine them
• CIB analysis provides a way to scan through all combinations to identify subset that are internally consistent, possibly of interest

Helps evaluate SSPs once defined
• Often evaluation is somewhat ad hoc, difficult to document, and difficult to communicate
• CIB approach can bring string structure

Helps in iteration between defining, evaluating SSPs
• Actual process of SSP development likely to be iteration between thinking about possible SSPs and evaluating specific SSPs
# Choices to be made for SSP descriptors

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<tr>
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<th>Storyline – quantitative</th>
<th>Model – input</th>
<th>Model – marker output</th>
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<td>?</td>
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<td>?</td>
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<td>Energy intensity</td>
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<td>Ag emissions of non-CO2 gases</td>
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