Coupled Data Needs for Water Science & Management

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Water is essential to people, a focus of expensive engineered systems, and fundamental in shaping Earth and ecosystems.

An effort to coordinate large-scale observations of water within human and natural systems spatially and temporally will enable advances in sustainability science and water management.
OUTLINE

✓ “Sustainability science”
✓ 2 case studies illustrating existing, uncoordinated data
✓ Survey of water community aspirations for data
✓ Conclusions & implications
Sustainability Science

✓ Advance **basic understanding** of the dynamics of human-environment systems;

✓ Facilitate the design, implementation, and evaluation of **practical interventions** that promote sustainability in particular places and contexts; and

✓ Improve **linkages** between relevant research and innovation communities on the one hand, and relevant policy and management communities on the other.

[http://www.hks.harvard.edu/centers/mrcbg/programs/sustsci, August 2012; emphases added]
CONCEPTUAL FRAMEWORK

Adapted from Brozović et al. (2007)
ADEQUACY OF CURRENT DATA TO ADDRESS COUPLED QUESTIONS: CASE STUDIES

We explored the potential and limitations of available data sets to address the following illustrative research questions:

Does local water quality affect

(a) water conservation?
(b) willingness to pay (WTP) for environmental protection?
(c) water recreation?
**Existing Data Sources**

**General Social Survey (2010)**
- **n = 2,044**

**Natl. Survey on Recreation and the Env. (2009)**
- **n = 8,073**

**Wadeable Streams Assessment (2005)**
- **n = 2,042**
## Survey Observations at Different Scales

<table>
<thead>
<tr>
<th>Data source</th>
<th>Number of points or respondents</th>
<th>Zip codes</th>
<th>Census tracts</th>
<th>Counties</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSA</td>
<td>2,042 Points</td>
<td>1,465</td>
<td>1,132</td>
<td>893</td>
</tr>
<tr>
<td>GSS</td>
<td>2,044 Respondents</td>
<td>986</td>
<td>512</td>
<td>324</td>
</tr>
<tr>
<td><strong>GSS/WSA</strong></td>
<td><strong>N/A</strong></td>
<td><strong>7</strong></td>
<td><strong>16</strong></td>
<td><strong>195</strong></td>
</tr>
<tr>
<td>NSRE</td>
<td>8,073 Respondents</td>
<td>5,607</td>
<td>2,345</td>
<td>1,122</td>
</tr>
<tr>
<td><strong>NSRE/WSA</strong></td>
<td><strong>N/A</strong></td>
<td><strong>214</strong></td>
<td><strong>327</strong></td>
<td><strong>487</strong></td>
</tr>
</tbody>
</table>

*Overlap numbers marked with an asterisk (*) are preliminary and subject to further refinement.
**RESULTS: W.Q. EFFECTS ON WATER CONSERVATION & WILLINGNESS TO PAY FOR ENVIRO. PROTECTION**

- For **water conservation**: Predic. attitude (+), Sex (-), Children (+), Income (+), Race (-) significant; Urban, regions, Green Group, WQ rarely significant

- For **WTP higher taxes** for Enviro. Protection: Pred. attitude (-), Age (+), Children (-), Race (-) significant; Income, Sex, Urban, regions, WQ rarely significant

- Adj R² ~ 0.15. County-level → imprecision & less variation

- Spatial autocorrelation unclear due to minimal spatial coverage
RESULTS: W.Q. EFFECTS ON RECREATION PARTICIPATION & FREQUENCY

- Fishing, swimming, boating, & viewing
- Regions globally significant & often individually significant
- Income(+/+), Age(+/?), Sex(+/?), Race(?/-), Hhold size(+/?), Impprotec (-/-) usually significant
- Rapid habitat measure of WQ (-/+)) more consistently (weakly) significant than chemical or biotic measures
- Pseudo-R² = 0.10 – 0.18
DATA ASPIRATIONS OF THE WATER COMMUNITY: A COMMUNITY SURVEY

National Survey on the Water Environment: Exploratory Questionnaire

This survey is divided into five parts:
I. Your Expertise and Work with Data
II. Science Questions
III. Policy Questions
IV. Participant Information
Thank you for your participation!
### Research Questions & Data Requirements

**Based on Textual Analysis:**

<table>
<thead>
<tr>
<th>Type of Research Question</th>
<th>Social System Data Only</th>
<th>Both Social &amp; Natural Systems Data</th>
<th>Natural Systems Data Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science&lt;sup&gt;a&lt;/sup&gt; (n=125)</td>
<td>77 (62%)</td>
<td>37 (30%)</td>
<td>11 (9%)</td>
</tr>
<tr>
<td>Policy (n=93)</td>
<td>69 (74%)</td>
<td>24 (25%)</td>
<td>1 (1%)</td>
</tr>
</tbody>
</table>

<sup>a</sup> Percentages by row do not sum to 100% due to rounding.
### Summary of Statistical Comparisons

<table>
<thead>
<tr>
<th>Data characteristic</th>
<th>Coupled data vs. social data questions</th>
<th>Natural scientists/engineers vs. social scientists</th>
<th>Academics vs. non-academics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data type (5)</strong></td>
<td>Social Q: Attitudes*</td>
<td>NS: Community conditions*</td>
<td></td>
</tr>
<tr>
<td><strong>Scale of data collection</strong></td>
<td>.</td>
<td>SS: Household* &amp; NS: community*</td>
<td></td>
</tr>
<tr>
<td><strong>Time scale of repeated observations</strong></td>
<td>.</td>
<td>.</td>
<td></td>
</tr>
<tr>
<td><strong>Units consistent over time</strong></td>
<td>.</td>
<td>.</td>
<td>Non-academics: panel data not important</td>
</tr>
<tr>
<td><strong>Natural system data type</strong></td>
<td>.</td>
<td>NS: Climate**</td>
<td></td>
</tr>
</tbody>
</table>

Results shown for science questions only; policy questions excluded.
SUMMARY OF RESULTS

✓ Types of data needed:
  – Strongest agreement was on the need for information about existence/behaviors/actions of individuals, entities, or groups
  – followed by information on attitudes and preferences.

✓ Spatial scales of data needed:
  – General agreement that data were most needed at the household and community scales
  – social and natural scientists differed over their relative priority, with social scientists focusing on household over community levels and vice versa
SUMMARY OF RESULTS (CONT.)

✓ Time scales
  – Annual time scales were considered most important
  – Differences between the science questions (more frequent) vs. policy questions (less frequent)

✓ Importance of repeated data over time (panel)
  – More generally important to academic users.
SCALES OF SOCIAL DATA COLLECTION

Braden et al., 2012
CONCLUSIONS

✓ Water is a critical subject and opportunity for sustainability science and management.
✓ Existing data sets do not align.
✓ Interest in cross-cutting questions is strong, and aspirations for data align to a surprising degree.
✓ An effort to coordinate national-scale observations of water within human and natural systems spatially and temporally will enable advances in sustainability science and water management.
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- Participants in October 2011 Workshop at Wingspread
- Data derived from Sensitive Data Files of the Generalized Social Survey are used under special contractual arrangements with the National Opinion Research Center designed to protect respondents’ anonymity. These data are available only from NORC.
- All opinions, interpretations, conclusions, and recommendations are entirely the responsibility of the presenters and not the aforementioned sponsors, organizations and individuals.