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# Collaborative Interpretation in Land Change Science Meta-Studies

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**Abstract**

This article presents preliminary findings from an ongoing study of collaborative knowledge creation in the land change science (LCS) research community. Using observational data from two international workshops on LCS meta-study practice, we document the challenges to current approaches highlighting the need for direct interaction with case study authors. Results from the study are being used to enhance the meta-study process through GLOBE, new scientific cyberinfrastructure for users to share, compare, and synthesize local and regional data.

**Author Keywords**

CSCW; land change science; meta-study; eScience

**ACM Classification Keywords**

H.5.3.m. Group and Organizational Interfaces:  
Miscellaneous

**Introduction**

The use of meta-analysis as a systematic approach to synthesizing data is a well-established analytic approach. In particular, it has been used extensively within the medical sciences [2]. Recently, it has also become popular among the interdisciplinary land change science (LCS) research community [7]. LCS researchers use meta-study approaches to understand

the impact of human-driven changes to the terrestrial surface on Earth's ecosystems [5].

A meta-study consists of a systematic review and synthesis of a sample of published case studies identified in the literature. In LCS it is used to show variability in land change outcomes for a particular phenomenon or land system of interest. While LCS researchers have made great progress in synthesizing local and regional data to produce global knowledge [3], meta-studies in LCS remain limited. Not only must LCS researchers overcome logistical and technical challenges in locating and integrating large sets of cases, but variation in research questions, scales of analysis and theoretical models make synthesis difficult [3]. Indeed, one reason why meta-analysis in medical science has been so successful is that study procedures, data reporting, and metadata practices have been standardized across sub-disciplines [1]. To help streamline LCS meta-study practice, we are designing GLOBE, described in detail below.

### **Methods**

To understand LCS meta-study processes, direct observations and interviews were conducted at two international workshops. The first was held in May 2012 in Amsterdam (Netherlands), focusing on LCS synthesis methods. At this one-and-a-half day workshop, nine LCS experts described sample meta-studies, the ideal meta-study, and how the process could be improved. The second, in June 2013 in Annapolis (USA), focused on the content of LCS meta-studies. Over two days, twenty-five LCS researchers described similarities and differences in trends and drivers of land use change.

Two researchers took detailed field notes on the workshop activities, with a particular focus on meta-study practices. This was triangulated with a document review of the presentations and the meta-studies they discussed. These notes were then compared to identify common themes, trends, and issues.

### **Findings**

#### *Case Selection*

Participants described performing keyword searches in the Web of Knowledge and Science Direct databases to locate relevant cases. This was iteratively refined using journals and books identified in these articles. The apparent target for a convincing analysis was in the range of 100-120 cases. Those with more or less were viewed skeptically.

#### *Meta-Study Challenges*

LCS researchers encountered a number of logistical challenges for their meta-analyses that were less common in more established disciplines such as medicine. Indeed, participants identified three interrelated issues that required them to work directly with case study authors:

First, they discussed how inconsistencies in the way data were described or weighted across case studies impacted their ability for appropriate case comparison. Important factors in one study were often absent in another and variable weighting frequently differed across cases. They also noted that it was difficult to develop a full picture of trends, drivers, and impacts of land use change as important details were often absent. Participants resigned themselves to the fact that they were only able to study what the case study

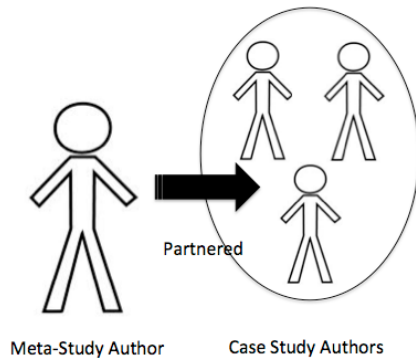


Figure 1: Meta-study author partners with case study authors to code cases.

literature permitted them to study. They were routinely faced with trying to compare the incomparable.

Second, participants commented on the performative nature of scientific communication. While the full details of a case may be available, they may not be completely fleshed out in a single case study publication because the author may have a particular story or audience in mind. Participants noted that in many situations a full description of variables would be too long for a single journal article and authors have to make decisions about where to draw the line to divide up the material across multiple publications. As a result, when these pieces are published, they rarely link together to form a whole. Without the help of these authors, meta-study researchers are forced to find each piece of the study and try to reassemble on their own.

Lastly, participants alluded to inconsistencies in data collection, analysis, and reporting practices that are indicative of the characteristically interdisciplinary nature of LCS research. This field draws from disciplines as diverse as biology and anthropology, geography and economics. Each have their own distinct worldviews and research traditions. These differences resulted in varying metadata standards, which frustrated meta-study authors' attempts at interpretation and integration.

#### *Participatory Meta-Analysis*

To overcome these challenges, participants stressed the importance of recruiting pertinent case study authors to participate directly in the meta-study process. They argued that author involvement was particularly important in interdisciplinary analysis as it is difficult to correctly interpret context across

disciplines. Through this *Participatory Meta-Analysis* approach, meta-study researchers are better able to ensure validity in their codes and resulting models.

Participants described two participatory meta-study approaches: The first involved asking case study authors' questions about their study site and having them code their cases based on a standardized classification scheme (see figure 1). The second involved asking case study authors to confirm whether their cases were interpreted correctly and coded accurately, allowing them to amend codes where necessary (see figure 2).

Despite the call for greater cross-disciplinary integration, engaging case study authors from different disciplines in the meta-study process is not an easy task. Participants described difficulties in networking across disciplinary boundaries because they did not know anyone from the disciplines that they wished to involve. To entice case study authors to work with them, participants reported offering co-authorship in exchange for assistance. Multi-author meta-studies are common practice in LCS [e.g., 6].

#### **The GLOBE System**

The GLOBE system specifically addresses the challenges laid out in this paper by making case study author identification and participation a central focus (see figure 3). Each case entered into GLOBE is attached to an originating author with clear provenance meta-data. System-generated quality metrics help identify cases with weak links that will likely be difficult to interpret and integrate (see figure 4). In these cases authors are invited to work collaboratively with case contributors to verify, correct or reenter case details

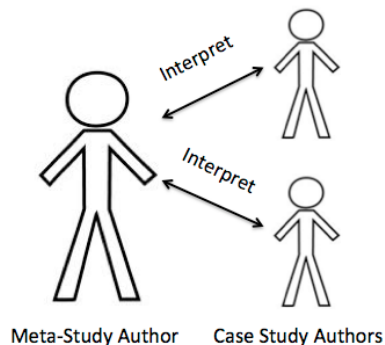


Figure 2: Meta-study author asks case study authors to vet coded cases.

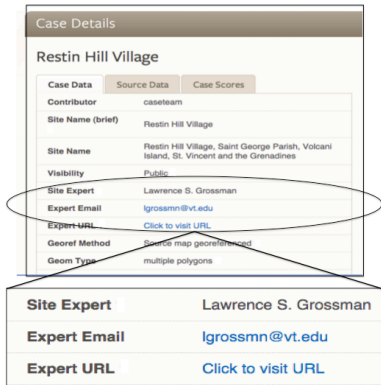


Figure 3: Author contact information in case details.

and geographic information. Cases vetted in collaboration with case study authors earn higher quality scores.

Linking cases to authors also allows meta-study researchers to more easily identify and build a network of individuals conducting research in a particular area of the world, on a specific topic, or variable. This information can be used to not only develop a network of potential future collaborators, but also to help identify underrepresented areas of the world to study.

Beyond simple database search capabilities, we are exploring design opportunities to enhance social networking among LCS researchers within the GLOBE system. We envision a system that would encourage data driven social connections where users would be brought together by the GLOBE cases, collections, and meta-studies. We are interested in observing how communities form around common topics, methodologies, geographies and spatial scales, and how they develop and evolve overtime.

### Conclusion

Conducting an LCS meta-study is a surprisingly collaborative activity. Recall that unlike meta-studies in more established scientific disciplines lack of standardization and increased interdisciplinarity means that LCS meta-study researchers must collaborate with case study authors to accurately code, interpret, analyze and synthesize case study data. To help streamline the LCS meta-study process, we introduce GLOBE: a collaborative system that links cases to authors and allows for collaborative case entry.

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Figure 4: Case quality scores.