PE&RS SPECIAL ISSUE

Global Land Cover Mapping and Validation

Foreword

Global land cover data are essential to most global change research activities, including assessing current global environmental conditions, and simulating future environmental scenarios that ultimately lead to public policy development. In addition, land cover data are applied in continental scale operational environmental applications (e.g., weather forecasting, fire danger assessments, resource development planning, and the establishment of air quality standards). Integrated science programs, such as the U.S. Global Change Research Program, have brought about substantial improvements in understanding the complexities of the Earth systems. However, real progress in predictive analyses requires that we improve all elements of the modeling triangle – theory, data, and models. The importance of the link between models and data was precisely stated by J.L. Lions of the French Centre National d'Études Spatiales when he opened an International Geosphere Biosphere Programme (IGBP) workshop in Toulouse, France on data requirements for global modeling. Lions remarked that "... a model without data has no predictive value. Data without models can only bring confusion." Clearly, an intertwined sequence of validated and calibrated theory, data, and models are essential to the improved prediction of both short- and long-term environmental phenomena.

Global scale land cover maps have existed for many years. They can be found in many atlases, textbooks, and even in the scientific literature. Some are generalizations based upon some knowledge of a combination of climate and landforms, others relate to categories of natural cover, and still others may mix anthropogenic categories (e.g. agriculture and populated places) along with natural vegetation. These maps were typically compiled from disparate sources. Some of these land cover representations have been compiled with considerable scientific understanding and care and serve as the "expert testimony" of their authors as to their conception of the spatial distribution of global land cover types. What we report on in this special issue is different.

Until the latter half of this century it was impractical to generate an internally consistent data set of the type needed to produce a science quality global scale land cover product. With the orbiting of civil Earth observing satellites in the 1960s the needed source data began to be acquired. Advances in computational capabilities in the late 1980s provided the ability to handle the volume of needed data. In the early 1990s, the international infrastructure to collect and process the required data became possible. Now, under the auspices of the IGBP, and through the sponsorship of the agency participants in the U.S. Global Change Research Program, along with the cooperation of many individuals and organizations, an internally consistent high-resolution global scale land cover product has been developed.

The production of the IGBP-Data and Information System 1km global land cover (DISCover) product led to the challenging task of carrying out the global scale validation project documented herein. This entire effort has been scientifically, technically, and logistically challenging. It could not have been accomplished without the help and cooperation of many institutions and organizations. We gratefully acknowledge the contributions of everyone who has participated. The research presented in this volume highlights our results, identifies the limitations and uncertainties, and provides insights into future global mapping and validation initiatives. We believe this work is an important step toward providing the quality of data and information that will improve both our fundamental understanding of the planet Earth and our ability to manage our planetary resources in a sustainable fashion.

The articles that make up this special issue provide a comprehensive review of the rationale and methods used to create and validate the IGBP DISCover global land cover data set. In the lead article, Belward *et al.* lays out the rationale for this undertaking, and highlights the extensive international participation that was involved in the DISCover initiative. Loveland *et al.* provides a review of the global mapping strategy and an analysis of the technical challenges faced when mapping the global land surface. Brown *et al.* explains the role and experiences of users in refining the DISCover database. Validation production issues, including validation data set development methods and issues (Husak *et al.*) and the role of image interpretation keys as aids in the validation process (Kelly *et al.*) are then presented. Scepan presents the accuracy assessment methods and results, and Scepan *et al.* review the challenges faced by interpreters developing the reference data used in the accuracy assessment. Muchoney *et al.* outlines how detailed land cover confidence site data collected during the validation project can be used to further understand DISCover characteristics. Defries and Los provide a frame of reference regarding the meaning of the accuracy statements by assessing their implications in climate modeling. Finally, Estes *et al.* offer a critical review of the successes, issues, and lessons that may benefit the next generation of global land cover mapping and validation projects.

There can be no more invigorating activity for any researcher than to participate in a "global first." Docu-

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mented here, to the best of our knowledge, is the first attempt to validate a global scale, land cover map. Will it be the last? We know that new mapping initiatives are on the horizon. There are plans to routinely use NASA's Terra Moderate Imaging Spectrometer (MODIS) data to map global land cover. However, we are not aware of any plans to continue a global validation program.

We welcome and encourage all constructive comments and criticisms of this work. We thank all of the authors and everyone associated with this effort for their contributions. We also thank the American Society of Photogrammetry and Remote Sensing for devoting this special issue to the global land cover mapping and validation story.

Project data sets are available at http://edcwww.cr.usgs.gov/landdaac/glcc/glcc.html

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