Key Issues in rigorous accuracy assessment of land cover products

Background:

The earliest developers of land cover maps recognized the critical importance of reporting accuracy assessments, including: obtaining high quality reference data to which the map is compared; sampling to collect these reference data; and the role of an error matrix and accuracy measures derived from the error matrix to summarize the accuracy information.   Over the past half century these techniques have undergone substantial refinements.

Methods:

- Using the *Scopus* database to search for and review relevant articles published in *Remote Sensing of Environment,* this article describes the history and current status of accuracy assessment and identifies opportunities for future advances.
- The article is organized by the three major components of accuracy assessment: the sampling design, response design, and analysis.

Results:

- Quality reference data, sampling, and the error matrix have remained core elements of accuracy assessment through the years.
- The six basic good practice criteria are: map relevant; statistically rigorous; quality assured; reliable; transparent; and reproducible.
- Three examples of bad practice that are widespread are: the universal application of 85% target accuracy, normalization of the error matrix, and correction for chance agreement.
- Sampling design criteria must: satisfy the conditions defining a probability sampling design; be easy to implement for both selecting the sample and producing estimates of accuracy and area; be cost effective; readily allow for increasing or decreasing the sample size; be precise in the sense that estimates have small standard errors; have an unbiased estimator of variance; and be spatially well distributed across the study area.

- Simplicity and ease of interpretation remain guiding principles for choosing how to characterize accuracy of change products.
- The selection of reference data sources will vary with data availability and cost constraints, but it is essential that the reference dataset be more accurate than the map to be evaluated.
- Technological developments and new tools have revolutionized the generation of reference data.
- Object-based image analysis (OBIA) has become an increasingly popular approach and introduces new dimensions to all parts of accuracy assessment.

Significance:

- Accuracy assessment methods and documentation have advanced, but still must improve to enhance reproducibility and transparency, and to address new challenges.
- Greater attention to quality assurance of reference data will be needed to contribute to the overall reliability of accuracy assessments.
- Practitioners should continue to aspire to resolve the present day challenges, understanding the critical imperative to implement current methodology in a manner than ensures a statistically rigorous and map relevant accuracy assessment.