Wiscland-2 Quarterly Project Update 2

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Executive Summary

The objective of the Wiscland-2 project is to update the Wisconsin statewide land cover map to show the land cover of the state circa 2010. During this quarter (April – June 2015), the Project Team has been primarily involved in preparing for field collection, developing the training/validation sample database, and performing Level 1 cross-validation trials and initial map classifications. In the upcoming quarter, planned tasks are largely focused on continuing the Level 1 classification process and supporting the DNR field collection efforts.

Introduction

The purpose of this document is to update the Wiscland-2 Land Cover Guidance Team on the progress of the project in the previous quarter. Since issuing the first quarterly report in March 2015, all of the tasks outlined in the "Current Tasks" section have been completed:

- Photo-interpreted new urban, water, and barren areas.
- Completed Wiscland-1 sample data verification via aerial photo interpretation.
- Assisted DNR with preparation for field collection season.
- Finalized production version of LCFR field collection Web application, manual, and training materials.
- Developed field collection status Web application for project managers.
- Made final algorithm choices for image processing and classification.

We also engaged in outreach and training activities:

- Presented Wiscland-2 project overviews at the American Society for Photogrammetry and Remote Sensing event in Eau Claire and at the UW-Madison Geospatial Summit in Madison.
- Participated in DNR staff and LTE field collection training.

Results

Results related to samples database development:

1) Collected and labeled urban, water, and barren samples for statewide classifications.

Wiscland-2 classes that did not have a sufficient number of sample points from existing sources but did not require a field visit to identify the land cover were collected via aerial photo-

interpretation by the SCO. A stratified random sampling scheme was developed using buffers around known urban, water, and barren areas to define the strata. A 90-meter area (~3x3 Landsat pixel) around the random point was labeled with the aid of 2013 NAIP and Google Earth aerial imagery. In total, 67,500 points were crosswalked to one of the Wiscland-2 classes and incorporated into the database. Each of these classes is now fully collected statewide.

2) Completed verifying Wiscland-1 sample points.

Nearly 18,000 ground-truth areas from the original Wiscland 1 project were reviewed via photo-interpretation by the SCO. These sites were evaluated using 2005, 2010, and 2013 NAIP aerial imagery to determine if any change in land cover were visible since they were originally collected. If no change was observed, the polygons were processed and incorporated into the samples database according to the procedures outline for other polygon data sources. Any polygon that could not be confidently identified was included as a 'verification site' for potential field visits as described below.

3) Quality assurance and refinement of samples database.

Efforts are ongoing to ensure that the samples database provides high quality and accurate data for classification. This has included updating crosswalk rules in accordance with class definition changes and requests from DNR, filtering out duplicate samples and samples with conflicting attribute data, and implementing automated procedures to update outdated samples with new labels via LCFR submissions.

Results related to <u>field collection</u>:

4) Participated in training for Land Cover Field Technicians and FTE DNR staff.

The SCO contributed to field collection training activities by drafting training materials and providing training sessions on photo-interpretation, application usage, as well as a project overview.

5) Completed Land Cover Field Reporter (LCFR) and Field Collection Status Web applications.

The Land Cover Field Reporter (LCFR) online field collection application was completed prior to the field technician on-boarding. The Web application serves to ease information transfer from field visit to database by providing a means to submit field reports digitally. SCO staff have automated the workflow to process the field reports and ingest sample points into the samples database on a weekly basis.

A separate Field Collection Status application was also completed to aid DNR staff in monitoring field collection progress throughout the project. In the application, an interactive map can be used to visualize the data either by land cover by using a choropleth map for the entire state or by county by using a bar chart to express the land cover collections for a particular county. The map is update weekly as polygons are processed.

6) Compiled dataset of verification sites to direct field visits.

In addition to direction from field mentors, managers, and DNR staff, the Field Technicians will be provided with a data layer containing areas of interest where their collection classes may be found. The layer is primarily made up of land cover samples from other projects that were not able to be synthesized for Wiscland-2 because of concerns with the age of data, geolocation accuracy, or due to insufficient attribute data, including the Wiscland-1 sample polygons that could not be photo-interpreted. The layer is complete and separated into two tiers according to the level of detail available, and will be served through the LCFR app on the next scheduled update.

7) Created weekly report for field collection monitoring staff.

As the LCFR submitted field reports are synthesized into the database each week, a report outlining the per class, per county, per LTE number of polygons submitted that week, as well as the acres of each polygon, the number of points created from each of those polygons, and the total number of points collected to date for each class is forwarded to the LTE field coordinator.

Results related to <u>image classification:</u>

8) Algorithm selection.

Cross-validation was used to assess the performance of algorithms available for atmospheric correction, cloud-masking, and classification. Map classifications were produced for subsets of the state to compare the results visually and were used in addition to the statistical analysis from cross-validation trials to finalize algorithm selection:

i. Images will be corrected to surface reflectance using the open source Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS) for Landsat 5 and 7 data and the L8SR algorithm for Landsat 8 data,

ii. Images will be cloud-masked using the open source C code of the f-mask algorithm developed by Zhu and Woodcock (2014), and

iii. Feature classification will be performed using the C5 decision tree algorithm available through GNU General Public License.

9) Initial image classifications.

With algorithm selection complete, tools were developed to facilitate simple and efficient cross-validation and classification workflows. Initial runs have begun for two footprints with adequate level 1 data. The initial runs are intended to test predication accuracy by varying features and sample data to identify the best performing model.

Conclusions

During this quarter, the SCO has completed tasks in support of the field collection necessary for mapping statewide land cover. All available sample point data has been incorporated into the database and will continue to be augmented through field collection on a weekly basis as reports are submitted through the online application. With the algorithm selection finalized, the image preprocessing and cross-validation workflows have been automated so classification can begin immediately for footprints after their field collection is satisfied.

Current

The Project Team is currently focusing efforts on:

- Adding verification sites and parcel data to LCFR application. Monitoring, processing, and integrating field collected data.
- Performing cross-validation for Level 1 map categories. Developing tools and workflows for map classification and segmentation.

Upcoming

There are several priority tasks currently being worked on for the next quarter:

- Creating level 1 classification maps for each footprint as the minimum amount of training data becomes available.
- Creating level 2, 3, and 4 classification maps for each footprint as the field data collection proceeds.
- Identifying problematic classes and working with the Guidance Team to evaluate options for those classes if needed.
- Developing post-classification workflows for segmenting, mosaicking, and refining map classifications.
- Creating draft versions of the User's Guide and documentation that will be included in the final product delivery.
- Continuing outreach and coordination with other land cover mapping projects.

References:

Zhu, Z. & C.E. Woodcock, Automated cloud, cloud shadow, and snow detection based on multitemporal Landsat data: an algorithm designed specifically for monitoring land cover change, *Remote Sensing of Environment*, 152, 217-234, 2014.