Comparison of Wetland Change Detection Data

Many different human activities cause changes in wetland habitats, from filling or draining for development, to sea level rise caused by climate change. In light of the effect of human activities on wetlands, it is imperative to study wetlands change on both a local and regional scales to understand the patterns of human activities driving wetland change.

For a regional level analysis such as ours (which focuses on the Chesapeake Bay Watershed), remote sensing technology is the most feasible way to collect data about wetlands and wetland change. Several existing datasets already exist that map wetlands using remote sensing: The National Wetland Inventory (NWI) and the Outlier Detection Analysis (ODA) used to identify change in the NWI, and three different land cover datasets in our study area: the National Land Cover Dataset (NLCD) the Coastal Change Analysis Program (CCAP) and the Chesapeake Bay Watershed Land Cover Data series (CBLCD).

Past remote sensing techniques of wetlands have been inadequate however, and have not been carried out at regular time periods to provide up to consistent, up-to-date information of wetlands location and wetland change. Because of this, new techniques are being developed to address the weaknesses of existing data on wetland change. These new techniques will take some time to develop however, and until then existing data must be used to analyze wetland change. There are a number of different existing datasets on wetland change, each with its own advantages and disadvantages. My work this summer attempted to assess the datasets and determine which was the most reliable in the mapping of wetlands and if it was possible to combine them, along with performing preliminary analyses of change.

The Datasets

NWI and ODA

The NWI was begun in the 1970’s and wasn’t completed until around 1998. The NWI used photo-interpretation of aerial photography, and different areas were mapped at different times. As a result the NWI is not consistent over time, and out of date. The ODA was created as an update for the NWI, using an automated, unsupervised technique to identify changes between the NWI and more recent imagery, and serves as a sort of update for the NWI to 2001. (Wilén and Bates 1995, Nielsen, Prince & Koeln 2009)

Land Cover

Techniques for creating thematic land cover classification have changed over time. All three of our land cover datasets use a Classification and Regression Tree (CART), an automated process using Landsat 7 satellite images. This process includes ancillary data, which is typically used to help the CART in cases where it is confused about the classification. The NWI is included as ancillary data in all these datasets, although they are not specific about how it is used and how much it is relied on. A change analysis technique is also used when updating the map, comparing past and present Landsat images and determining areas of change, and then reclassifying only those areas and overlaying these reclassified areas over the past land cover.

NLCD

The NLCD was begun in 1992, and has updates for 1992, 2001, and 2006. Unfortunately, the 1992 update is unusable by us due to inferior mapping techniques used at the time which identify forested wetlands simply as forest. The 2001 and 2006 updates used a CART analysis,
with a Multi-Indexed Integrated Change (MIIC) analysis being used to update from 2001 to 2006. The NLCD uses a great deal of ancillary data in the mapping of urban land cover classes, and as a result may have better urban land cover, along with mapping the road network as urban land cover. The NLCD also applies a Minimum Mapping Unit, aggregating clusters of same class pixels less than a certain number into the surrounding land cover classes. (Homer et. al. 2007, Fry et. al. 2011)

**CCAP**

The CCAP was also begun in 1992, and has updates for 1992, 2001, and 2006. The CCAP only has land cover for coastal regions and adjacent uplands, and as a result only covers a portion of our study area. Since most wetlands are in the coastal region surrounding the bay however, the CCAP covers approximately 98% of the wetlands in our study area. The 2001 and 2006 updates were done using a CART analysis, and the 2001-2006 changes were identified using Cross Correlation Analysis (CCA) technique. The CCAP includes six wetland class, rather than only two, like the other two land cover datasets (Burkhalter, Herold & Robinson 2005, Dobson et. al. 1995)

**CBLCD**

The CBLCD was created based on the CCAP and NLCD. For 2001, the CCAP and NLCD were combine to create a baseline map. This map was then updated for 2006, and retroactively for 1992 and 1984 using CCA and a CART. Because of this, the CBLCD is the most consistent for earlier time periods. The developers felt that the CCAP overcalled coastal emergent wetlands, and corrected for this. (MDA Federal 2009)

**Change Analysis**

A number of different change analyses were done on the datasets, and compared. Change analyses were done for all three land cover datasets for the 2001-2006 time period. Each showed about ~1 change over the 5 year time period. The CBLCD and CCAP had similar numbers for wetland change in most classes. The NLCD on the other hand, showed large losses offset by large gains in wetland area. This is most likely the result of the MIIC identifying change where it had not occurred, or pervious misclassification. This does indicate that the NLCD is the least reliable of the datasets. The CBLCD and CCAP were compared from 1992-2006 to a FWS report on Delaware Wetlands from 1992-2007, based on 2007 updates to the NWI. (Tiner et. al. 2011) Like the NLCD in the 2001-2006 time period, the CCAP from 1992-2006 showed large amounts of loss and gain, while the CBLCD was more stable. This is likely the result of changes in mapping technique for the CCAP from 1992 to 2001, indicating that the only land cover dataset reliable for dates earlier than 2001 is the CBLCD, which mapped them retroactively. A comparison between the 2007 NWI updates and the 2006 dates for the CCAP and CBLCD show that the NWI indicates somewhat less coastal emergent wetlands than the CCAP, but the CBLCD shows quite a bit less than the NWI. This indicates that although the CCAP might have overcalled coastal emergent wetlands, the CBLCD might have over compensated. Using a map of mapping areas for the NWI that included mapping dates I was able to normalize the ODA change, by expressing it as a rate of change/year. The rates were very high. This could indicate greater rates of change in earlier years, before policies for protecting wetlands were put into place. This could also be due to using to high a threshold for identifying change, or from incorrect mapping dates in some areas.

**Conclusion**

We were able to identify which land cover datasets were most reliable – the CCAP, and the CBLCD for earlier time periods. Knowing this, these datasets can be used to analyses change
while new wetland change detection techniques are being developed. Our work also indicates existing difficulties in the mapping of wetlands that needs to be addressed. Future analysis using these and new datasets will allow us to understand the spatial distribution of human driven change.

Citations


