Emergent Marsh Classification within the Lower Mississippi Valley Joint Venture

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Background:

The Lower Mississippi Valley Joint Venture recognizes that emergent marsh, such as permanent and semi-permanent wetland composed of sedges, rushes, arrowhead, etc., is an important habitat component for a variety of birds and other wildlife. However, available large-scale shallow/emergent wetland mapping products (such as National Land Cover Database and National Wetland Inventory) lack the accuracy and precision necessary for wetland-dependent bird planning and design. Hence, the LMVJV partnership developed a region-wide Palustrine Emergent Wetland assessment, in coordination with the Ducks Unlimited Southern Regional Office. This product is intended as a necessary foundation for secretive marsh bird (e.g., King Rail) and wading bird conservation planning, but also will be useful for landscape-scale planning for other emergent wetland dependent wildlife (e.g., waterfowl, shorebirds, some songbirds). Without reasonably accurate GIS data layers, it is difficult to generate the desired species-habitat models for waterbirds in the LMVJV. The target habitat for this project was Palustrine Emergent Wetland, as defined by a modified Cowardin et al (1979) definition with minimal woody vegetation and open water: Erect, rooted, herbaceous hydrophytes, with <10% woody vegetation cover and <10% open water.

Methodology:

The majority of this analysis was made possible following methodology and code provided by Tassi et al. (2020). Minor changes to the methodology had to be implemented in order to run the classification over our entire study area of the Lower Mississippi Valley Joint Venture geography, which includes 26.5 million acres. Three Google Earth Engine scripts were written to perform the analysis:

Object raster and imagery mosaic - Four areas of interest were created to cover the entirety of our classification area. This was done to avoid memory limitation errors. Within this script Sentinel 2 was queried for a given period of interest (December 2018 - January 2022). Imagery was queried within our area of interest (AOI) and filtered to include only those images with < 10% cloud cover. To further reduce the area to classify, we masked out portions of the AOI using the National Land Cover Database (NLCD). We were only interested in classifying marsh so only included areas NLCD assigned as Open Water, Herbaceous, Pasture, Cultivated Crops, or Emergent Wetlands. Developed, Scrub Shrub, and Forested areas as defined by NLCD were removed from the analysis. Cloud masking was also performed on the imagery to reduce image corruption and misclassification. Normalized Difference Vegetation Index (NDVI) and Bare Soil Index (BSI) were calculated and added as bands to the Sentinel 2 band stack. Some additional band statistics were added as bands and the image was segmented using Simple Non-Iterative Clustering (SNIC). Gray level co-occurrence matrices (GLCM) was used to create textural characteristic indices and this was reduced to one band using a Principal Component Analysis (PCA).

Classify and export - Following Tassi et al. (2020), we used pixel-based and object-based Random Forest classifications. We created 168 reference polygons for 4 classes (62 vegetation, 48 woody, 31 water, and 27 wetland). We selected approximately 40% of polygons from each class to use for training and remaining for validation. Classifications were exported.

Display and clean - Each classification AOI was imported and merged to produce a single AOI raster for each classification method. A focal dilation and erosion was performed on the marsh class to reduce small pockets. The final raw output was delineated into "wetland" which represents marsh, water which represents open water, woody which represents forest, and vegetation which represents (Figure 1).

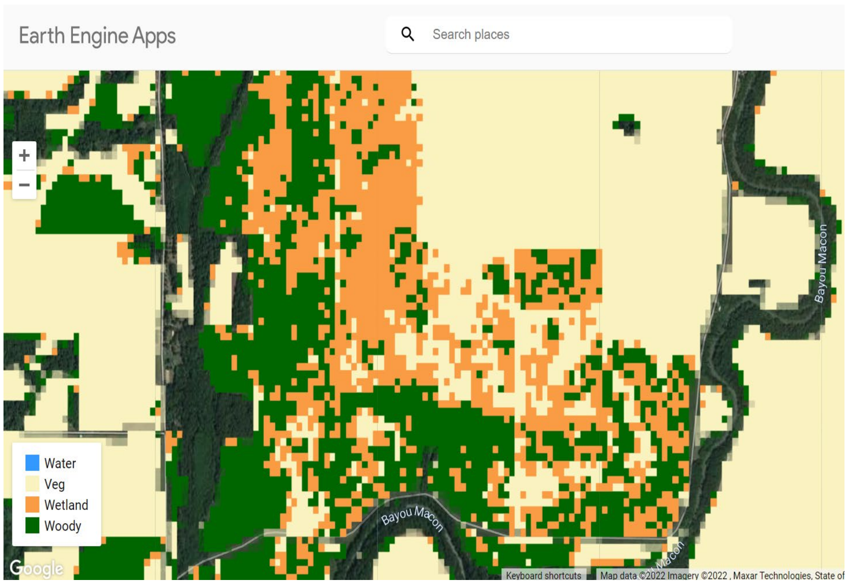

Figure 1. Example of raw classification output demonstrating four land cover classification categories.

Following initial examinations of the marsh classification, it was deemed beneficial to perform an additional level of "cleaning" in order to retain only larger patches of marsh that were associated with the water classification.

Marsh-only and Water-only raster layers were created and pixels reclassified to binary data (values as 1s or NoData cells). Using Arc GIS Pro 2.8.2, Marsh pixels were grouped based on attribute similarity and proximity (using Spatial Analyst, Region Group; 8 nearest neighbors method) to produce uniquely-identified Marsh patches, while Water pixels were extended the distance of one pixel (10m x 10m) using Spatial Analyst, Expand in order to intersect with Water pixels in close proximity to Marsh pixels. Spatial Analyst, Zonal Statistic – Maximum was used to identify those Marsh patches that overlap with Water pixels and those pixels were retained only if >1 acre in size (Figure 2). Finally, patches larger than 1 acre were combined with those larger-sized patches that intersect water to produce the final Marsh output classification layer.

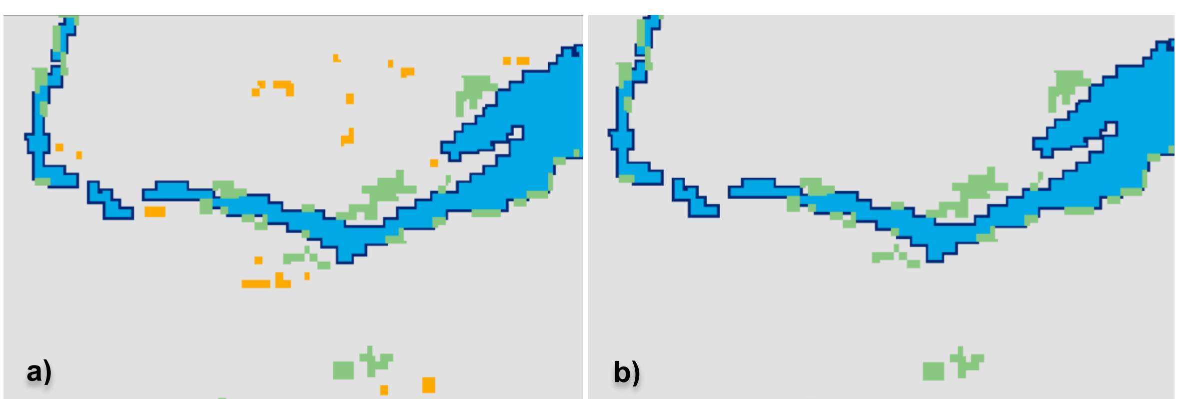

Figure 2. Example of (a) open water intersected with marsh, where blue represents open water, orange represents marsh, and green pixels represent the intersection; and (b) removing marsh pixels that were less than one acre in size

Results

The final classification resulted in 729,884 acres of emergent wetland across the geography of the MAV and WGCPO. Based on expert review, the LMVJV considers version 1.0 of the Palustrine Emergent Wetland data layer complete and ready to be used in classification. However, based on use in waterbird or other planning, this data layer may continue to be refined. The final product is available through Blaine Elliott [blaine_elliott@fws.gov].

Reference

Tassi, Andrea & Vizzari, Marco. 2020. Object-Oriented LULC Classification in Google Earth Engine Combining SNIC, GLCM, and Machine Learning Algorithms. Remote Sensing. 12. 3776. 10.3390/rs12223776.