Bye Bye Bayou

Analyzing anthropogenic-driven wetland loss in Louisiana through Cropscape

Introduction

Louisiana swamps, marshes, and bayous host an abundance of wildlife, from whooping cranes to crawfish, and provide vital ecosystem services—among them, protecting coastal cities from flooding and sea-level rise. The loss of these wetlands due to natural processes is well-documented. Natural processes include the cyclical ebb and flow of wetland edging—transforming woody wetlands to mixed or deciduous forest and herbaceous wetlands to scrubland. Wetlands in Louisiana are also disappearing completely, permanently eroded to open water. This transformation stems from reduced sediment flows from the Mississippi River Basin that naturally recharge wetlands.

It is estimated that Louisiana loses a football-field of wetlands every hour, much of which the literature attributes to coastal erosion of wetlands. In early 2017, the Coastal Protection and Restoration Authority released a $50 billion master plan to mitigate coastal erosion over the next 50 years. The plan is designed to restore wetlands in an effort to protect coastal communities, and the livelihoods of many interest groups—among them commercial fisheries and farmers.

However, research on the extent of wetland conversion lost to human-driven activities and its effects on local ecosystems is far from complete. With the plan emphasizing erosion-mitigation tactics, the likelihood that anthropogenic-driven wetland loss will be overlooked is quite high. Without a full understanding of the multitude of factors driving wetland loss, it would be imprudent to put this plan into action. The plan proposes constructing coastal barrier islands and generally "improving wetland habitats," but does not consider expanding wetland conservation areas that are inland, like the White Lake Wetlands Conservation Area (WLWCA) in Vermilion parish.

Under current regulations, many acres of the WLWCA are "working wetlands," where agricultural production and commercial aquaculture (oysters, crawfish, catfish etc.) are permitted. Such activities lead to drainage, manipulation of natural vegetation, disturbance of sediment through tillage, and degradation from nutrient applications (cultivation and horticulture) and fecal matter (aquaculture and livestock). To assess the extent of wetland loss to anthropogenic activity, I will examine change between 2011-2016 through the Cropland Data Layer, published by the USDA National Agricultural Statistics Service.

Methodology

To assess wetland loss driven by anthropogenic activities, and in particular, agricultural production and aquaculture, I initially examined the National Wetlands Inventory and the National Land Cover Dataset. However, the NWI does not provide historic or completely current wetlands data—some areas have not been updated since the 1970s in coastal Louisiana. The NLCD is updated every five years (most recently in 2011), but offers relatively little categorical granularity through which to examine wetland change.

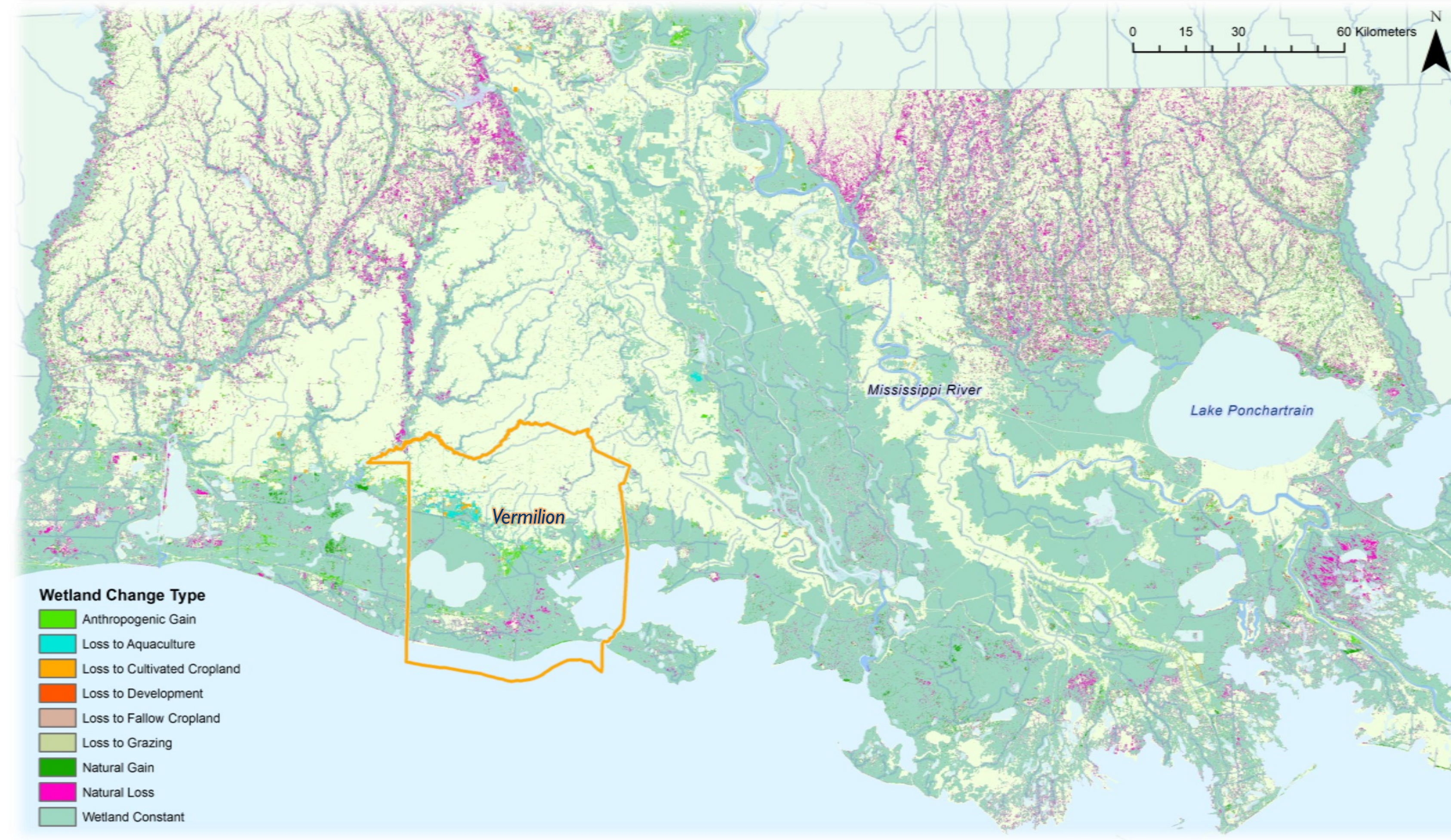
Cropscape has raster data available for Louisiana from 2004-2016, containing 254 classes of crops, industrial/residential development (varying by intensity), and a variety of natural ecosystems. To assess the capability of cataloging wetland change through the Cropland Data Layer (CDL), I used a Cropscape change model that combined raster data from 2011 and 2016 and increased spatial granularity from 30m to a 10m cell size. Next, the model added fields that derived categorical data from lookup tables to match classification codes in the CDL metadata.

After the Cropscape change output raster was created, I used SQL to identify areas of wetland loss, gain, and those with no change. I then reclassified anthropogenic gains and losses to distinguish them from the natural processes that change wetlands. Finally, I grouped and reclassified the mechanisms of anthropogenic-driven wetland loss (see chart to left).

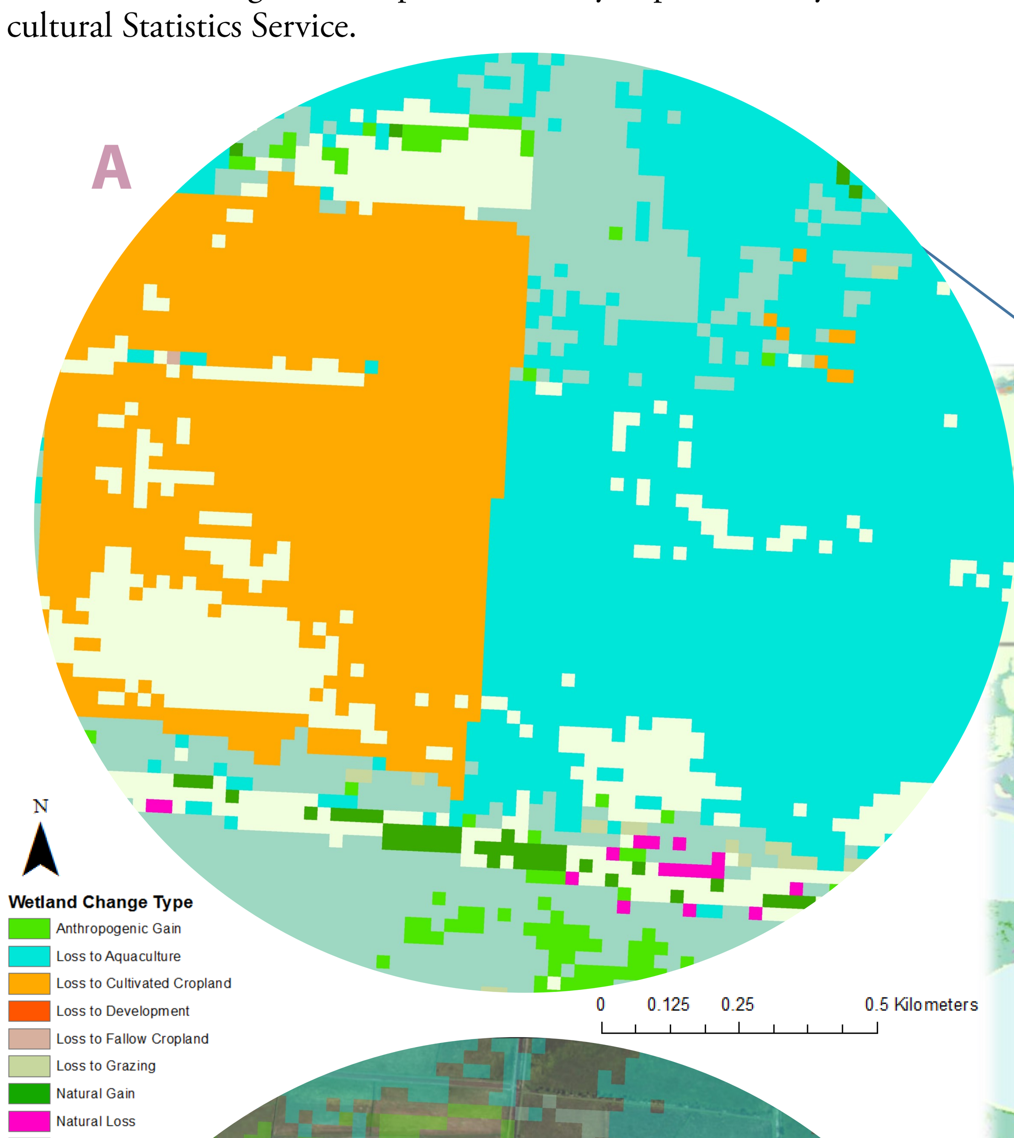
	CDL categories reclassified	Mechanism of wetland loss
Loss to aquaculture	Aquaculture	Possibly "working wetlands;" not always complete drainage of wetlands, but rather a conversion and degradation.
Loss to cultivated cropland	All crops (grains, oilseeds, forage crops, cotton, sugarcane, vegetables, tree fruits, intercropped, herbs etc.)	Often permanent infrastructure; requires drainage and manipulation of natural vegetation, tillage and soil disturbance (even for rice—requires inundation/drainage periods that do not mimic natural wetland cycles).
Loss to development	Developed—high, medium, low intensity Developed/Open Space	Drainage, added impervious surface and permanent structures; little hope of returning to wetlands in the future.
Loss to fallow cropland	Fallow/Idle Cropland	Possibly misclassified in areas (wetlands observed in dry season); or drained/manipulated for cropland, but not planted—fallow periods problematic, as the fertile soil remaining from drainage could be lost to erosion.
Loss to grazing	Grass/Pasture Sod/Grass seed	Drainage and manipulation of natural vegetation in favor of forage grasses, perennial sod crops to support livestock production.

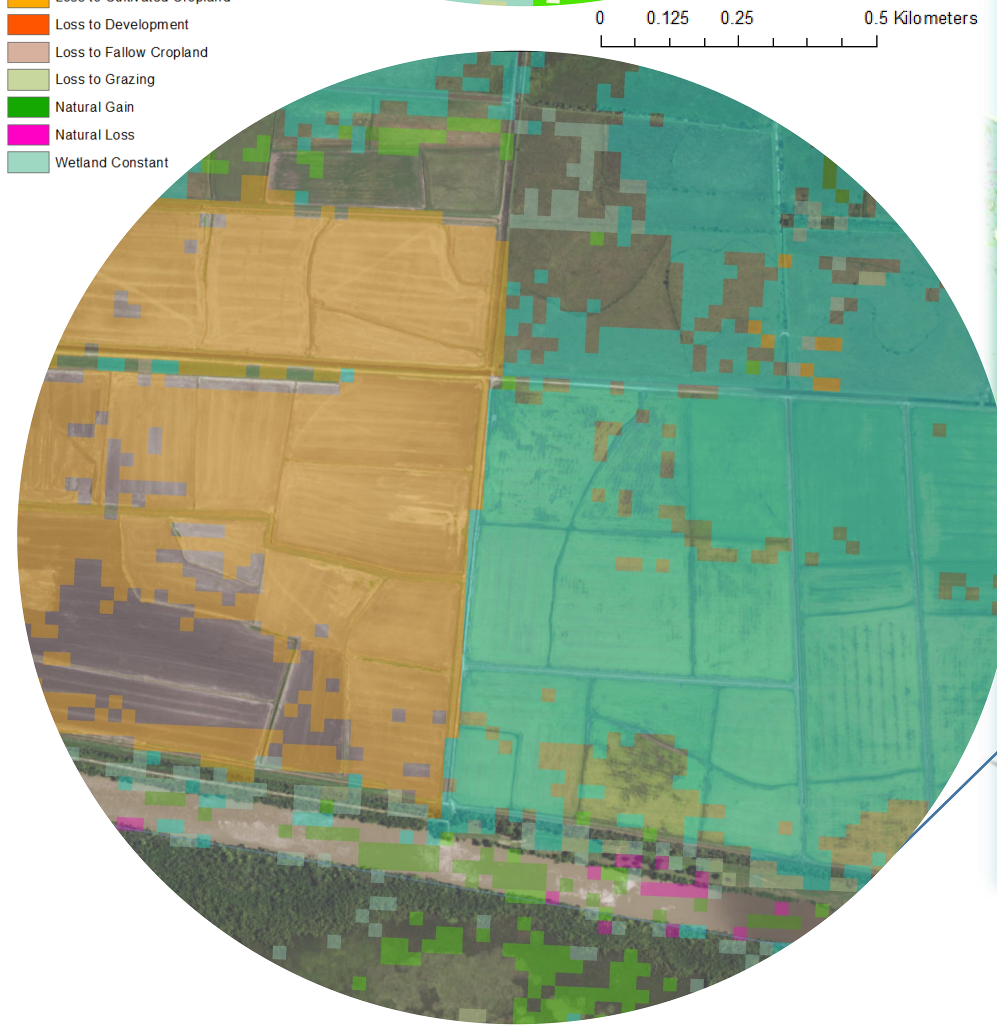
In the maps below (A-D), aerial photos from 2015 were over laid with the Cropscape change raster to assess its accuracy in estimating anthropogenic-driven wetland loss (see discussion).

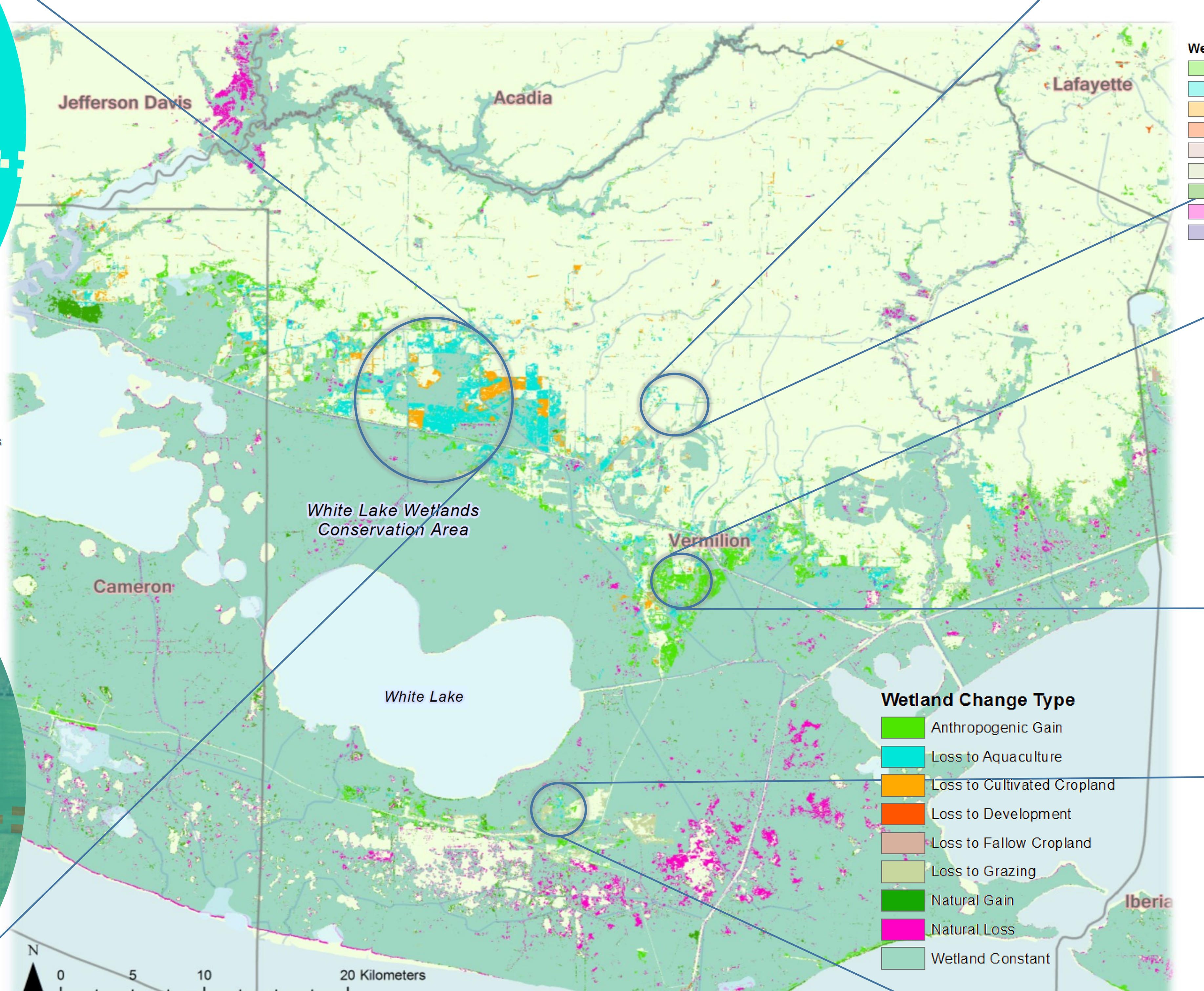
Cropscape wetland change 2011-2016



A







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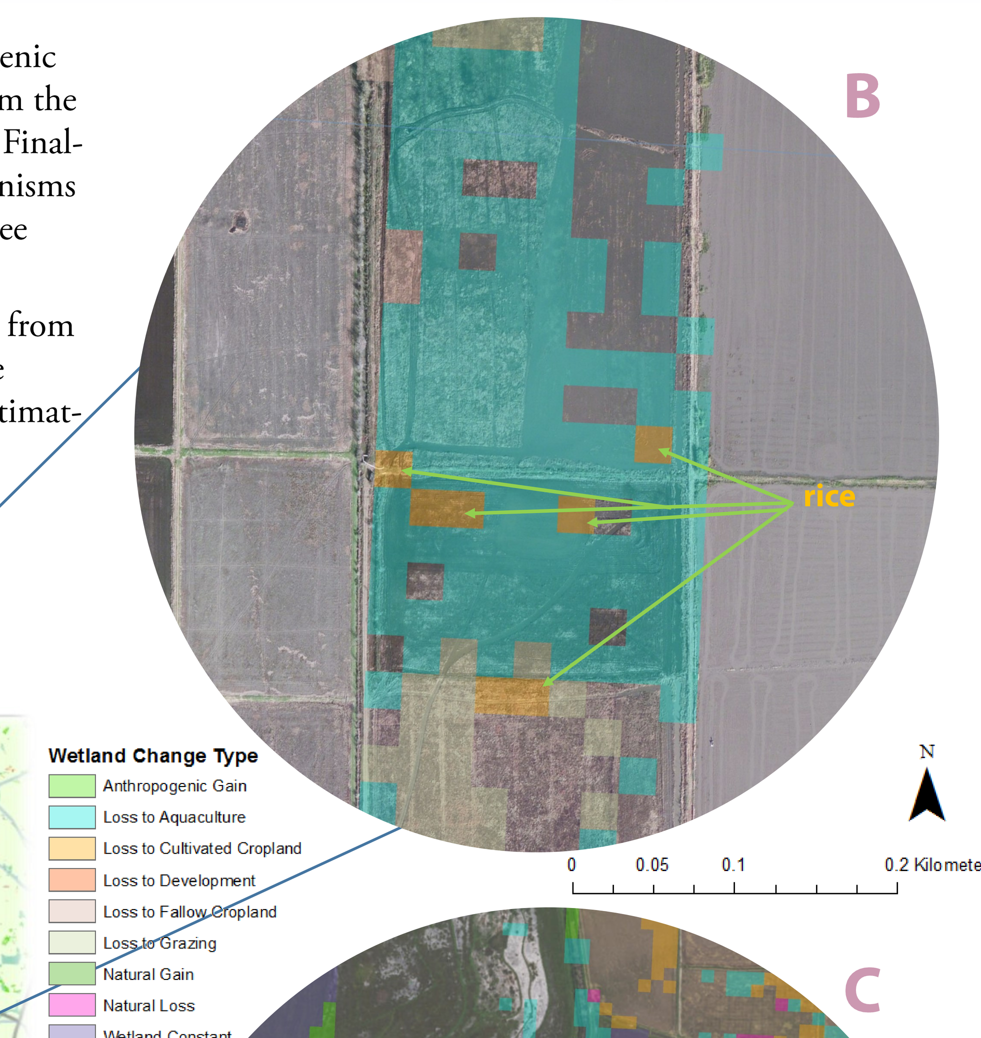

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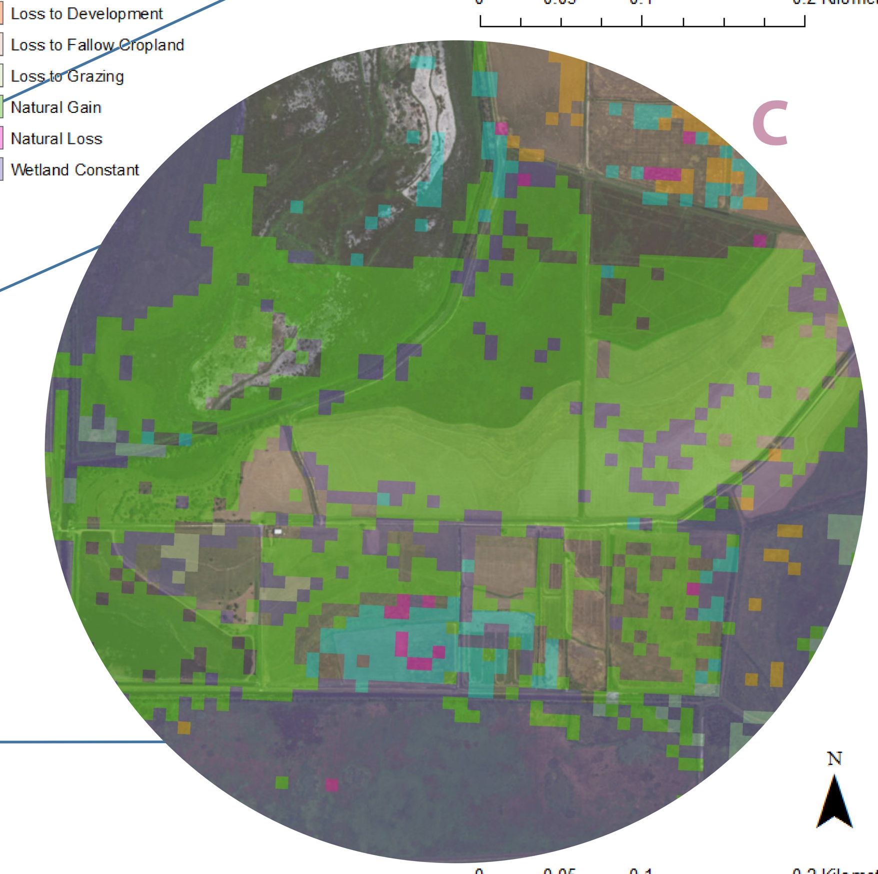

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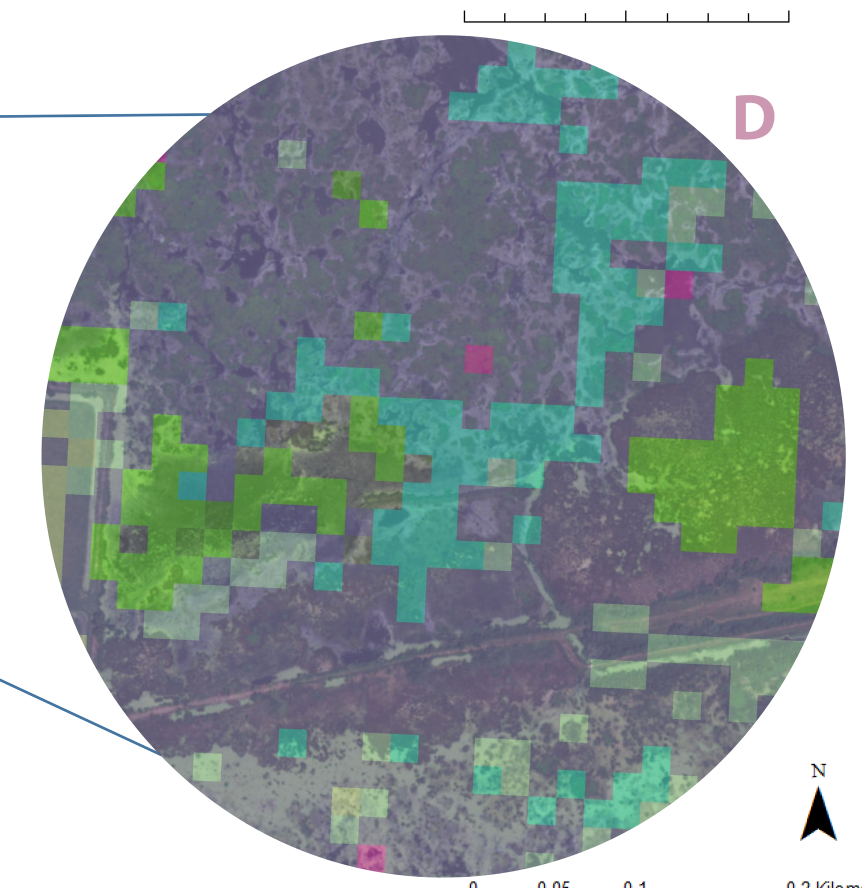

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Fundamentals of GIS for Food, Agriculture, and Environmental Applications, Spring 2017

Projection: NAD 1983 State Plane Louisiana South
T.E. Dahl and S.M. Stedman. 2013, published by USFWS & NOAA, www.fws.gov/wetlands/Documents/Status-and-Trends-of-Wetlands-In-the- Coastal-Watersheds-of-the-Conterminous-US-2004-to-2009.pdf
Cropland Data Layer: NASS, 2011 ed., published January 2012 by USDA
NASS, 2016 ed., published January 2017 by USDA
www.nass.usda.gov/Research_and_Science/Cropland/metadata/meta.php
Hydrography: Water Bodies and Streams, 2010, published by ESRI
Counties: USA County Boundaries, 2010, published by ESRI
Base Map: USDA FSA, August 2015, published by ESRI
Photos: Louisiana Dep. Of Wildlife and Fisheries

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Results

The Cropscape change model estimates that Louisiana lost more wetland acreage to natural processes than to anthropogenic activities (1.31 million vs. 109 thousand) between 2011 and 2016. Of the acres lost to anthropogenic activities, most were lost to food production; only 11,644 acres were lost to commercial and residential development. Statewide, most wetland loss to food production came from conversion to grazing land and to cultivated cropland, with smaller acreages ceded to aquaculture and fallow cropland. Vermilion parish had comparatively higher estimated losses to aquaculture (nearly 40% of statewide loss) than to any other human-driven activity. Acreage lost to grazing and cultivated cropland were nearly identical for the parish. From 2011-2016, Vermilion lost only 157 more acres to natural processes than to aquaculture. Losses in wetland acreage in Vermilion represent nearly 20% of statewide loss to all anthropogenic activities.

Wetland loss to:	Acreage (est.)	
	State	Vermilion
Aquaculture	19,976	12,758
Cultivated cropland	29,827	3,991
Development	11,644	102
Fallow cropland	16,737	455
Grazing	31,078	3,848
Anthropogenic loss (total)	109,262	21,154

Discussion

Case A: Top map: captures granularity (10m cell) of the change raster depicting wetlands lost to rice (orange) production next to those lost to aquaculture (blue). Lower map: seems likely that assessments by the CDL are fairly accurate. Rice production and aquaculture require similarly structured fields and are often produced adjacent to one another. The patches within each field not depicting wetland loss to these activities were classified in 2011 as aquaculture and rice, possibly indicating an expansion of production in this area (adjacent to WLWCA), or a wetland misclassification in 2011.

Case B: depicts an area where Cropscape was unsuccessful in identifying wetland change. The random distribution of 100 m² areas of loss to rice in a field lost to aquaculture defies logic. It is unlikely that a farmer planted so few acres of rice inside an aquaculture operation where interactions between fish and crops are undesired. The aerial photo however, could possibly confirm the CDL identification of loss to aquaculture.

Case C: CDL estimates a large wetland gain from aquaculture (green). The magnitude of the area gained makes it difficult to believe that Cropscape correctly identified these areas (given the value of aquaculture in LA). The aerial image from 2015 depicts man-made contours characteristic of aquaculture. It is very unlikely that in one year the area would have been returned entirely to wetlands. This indicates a misidentification of aquaculture as wetlands in 2016.

Case D: Relative balance of wetland loss to (blue) and gain from (green) aquaculture possibly indicates that operations were shifting within the wetland (purple = constant wetlands). Some operations might favor this shift, perhaps to avoid severe degradation of a single area. Alternatively, these areas could be misidentified by Cropscape, but the ratio of gains and losses merits consideration of possible accuracy.

Conclusion: As modeled in this project, Cropscape is not an ideal dataset to examine wetland change. Its merits stem from annual publication, which other data sets lack, and more specific categorical granularity, but is limited by its design to identify crops first and foremost. Also, depending on the time of year the photo was taken, seasonal discrepancies in CDL identification could be particularly problematic in interpreting cropland and natural ecosystem change. Making a final judgement call on using the CDL warrants a multi-year analysis, which is outside the scope of this study.