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Natural and Working Lands in North Carolina – Data and Methods Guide

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Overview and Organization

This guide describes the spatial datasets created to assess the scale of opportunities for on-the-ground management actions for natural and working lands that store carbon and contribute to resilient communities and ecosystems in North Carolina. Many of these data layers are shown in the Natural and Working Lands StoryMap and were used to estimate geographic scope, carbon potential, and co-benefits for many of the recommendations in the Natural and Working Lands action plan. Datasets are available to download from the Duke Library data repository.

These datasets were developed as part of an opportunities assessment focusing on all lands where a recommended action is possible given biophysical and ecological constraints. There is NO consideration of social or economic constraints. Therefore, all quantitative estimates (of geographic area, carbon storage and sequestration, etc.) are expected to be significantly higher than what will be observed. **This assessment provides potential scale, not realistic estimates.**

Datasets Created for NWL Project

The methods used to create each of the data layers used in the Natural and Working Lands StoryMap and action plan are described in table format. Tables with blue headings are for datasets included in the online data repository. Tables with green headings are for datasets that can be easily created from two other datasets in the repository.

#. Dataset name		
Description: Brief description of what dataset represents		
Methods: Summary of methods used to create dataset		
Data download	**Input data sources**	**Use in NWL report and StoryMap**
Link to data download in online repository, if applicable	List of data sources used to create dataset. Some of these are included elsewhere in this document; these referred to by their ID numbers for easy reference. Datasets published elsewhere are included in the reference list.	List of NWL report sections and maps in the National and Working Lands project StoryMap that use this dataset.

All of these data layers were created from existing spatial datasets; no new data collection was conducted for this project. Many of the data layers used are derived from other data layers created for this project. For example, the general terrestrial carbon storage dataset was clipped to various extents to estimate carbon stored in all unprotected forests, unprotected forests in water supply areas, and forests in floodplain and wetland areas. Methods for data layers used to derive several other data layers, such as the terrestrial carbon storage dataset, are presented first, followed by methods for data layers linked to specific NWL recommendations.

To reduce the number of published datasets, data layers that can be easily derived from two other datasets are not included in the online data repository; the underlying datasets are included, so interested users can recreate these data layers using the methods described in this document, usually by clipping one data layer to the extent of another. All data layers shown as maps in the StoryMap are included in the online data repository even if they are derived from two other datasets. Datasets available in the online repository are identified with a blue table heading; data layers that are easily derived and not shown in the StoryMap, and therefore not included in the online repository, are identified with a green table heading.

Other Relevant Datasets

At the end of the document, an "other relevant datasets" section includes short descriptions of and links to datasets published by others that may be useful for overlaying with the datasets developed for the Natural and Working Lands project. Some of these datasets were also used as inputs for the Natural and Working Lands project datasets.

DATASETS CREATED FOR NWL PROJECT

Datasets Used for Multiple NWL Recommendations

Carbon Storage and Sequestration

1. Terrestrial carbon storage

Description: Amount of carbon (metric tons C/acre, multiplied by 100 and rounded to the nearest integer to reduce file size) stored in terrestrial areas of North Carolina, based on data from Sleeter et al. 2018, which used a semi-spatial state-and-transition simulation model to estimate terrestrial carbon storage, combined with wetland soil carbon storage estimates from Nahlik and Fennessy 2016

Methods:

- Combine Level III ecoregions, NLCD 2016, and protected area database data for North Carolina to create a raster dataset identifying each unique combination of ecoregion, land cover class, and protection status in the state
- Join table of carbon storage by ecosystem type and state (Sleeter et al. 2018) to the combined raster. This provides carbon storage estimates for all land cover types except wetlands.
- Join table of wetland soil carbon storage estimates (Nahlik and Fennessy 2016) to the combined raster. The final raster includes carbon storage estimates for all terrestrial land in North Carolina.

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, carbon-related general datasets folder: TerrestrialCStorage.tif	Level III ecoregions NLCD 2016 PADUS Carbon storage by ecosystem type and state (Sleeter et al. 2018) Wetland soil carbon storage estimates (Nahlik and Fennessy 2016)	None

2. Carbon sequestration by existing forests

Description: Annual carbon sequestration (metric tons C/acre/year, multiplied by 100 and rounded to the nearest integer to reduce file size) in existing forests in North Carolina, based on forest extent, type, and age. This assumes that forests are left to grow and does not take into account their current management regime.

Methods:

- Update forest age dataset (from 2006) to 2019 forest age by adding 13.5 to forest age raster. Reclassify forest age dataset into 10-year age classes.
- Fill gaps in reclassified forest age dataset by using the Euclidean Allocation tool to assign pixels missing forest age information to the geographically closest age class.
- Extract USFS forest type data for North Carolina from the national reforestation opportunities dataset (Fargione et al. 2018)
- Combine classified and filled forest age layer with USFS forest type layer to create a raster identifying each unique combination of forest type and age class in North Carolina.
- Use USFS yield tables to calculate average annual carbon sequestration rate for each forest type and age class in North Carolina. When the yield table does not include all of the age classes for a certain forest type that are present in North Carolina, assign the average annual carbon sequestration rate for the closest possible age class of that forest type.
- Join average annual carbon sequestration rate by forest type and age class to the combined forest type/age class raster.
- Clip resulting raster to match the current extent of forests in North Carolina using NLCD 2016.
- Use lookup tool to create new raster with values equal to average annual carbon sequestration rate for North Carolina forests. Multiply this raster by 100 and convert to an integer raster to minimize size of final dataset.

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, carbon-related general datasets folder: CSeq_CurrentForest.tif	NLCD 2016 USFS type (Fargione et al. 2018) Forest age (Pan et al. 2012) USFS yield tables (Smith et al. 2006)	None

3. Potential carbon sequestration from reforestation

Description: Potential annual carbon sequestration (metric tons C/acre/year, multiplied by 100 and rounded to the nearest integer to reduce file size) on reforestable land in North Carolina, for the first 20 years of growth following reforestation (following the method used in the national-scale analysis in Fargione et al. 2018)

Methods:

- Extract USFS forest type data for North Carolina from the national reforestation opportunities dataset (Fargione et al. 2018)
- Clip USFS forest type data to extent of land in North Carolina that can support forests (field BPS = 1) using Fargione et al. 2018. The resulting raster represents the likely USFS forest type on that land (either existing, if the land is currently forested, or potential if the land were reforested). Note that the resulting layer includes all land that could support forest, including already forested land, developed land, and wetlands.
- Use USFS yield tables to calculate average annual carbon sequestration rate for the first 20 years of growth for each forest type in North Carolina. For forest types with a 20-year age class included in the yield table, this is equal to the carbon storage in a 20-year-old forest divided by 20. For forest types without a 20-year age class included in the yield table, this is equal to the average carbon storage for the two age classes bracketing 20 years (usually 15 and 25 years) divided by 20.
- Join average annual carbon sequestration rate by forest type to the clipped forest type raster.

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, carbon-related general datasets folder: CSeq_Reforestation.tif	USFS type (Fargione et al. 2018) Reforestation potential (Fargione et al. 2018) USFS yield tables (Smith et al. 2006)	None

Resilience-Related Datasets

4. High flood risk watersheds

Description: Watersheds in North Carolina with at least 3,000 people living in flood-prone areas

Methods:

- Clip 30-meter dasymetric population raster to the extent of the active river area
- Calculate the number of people living in the active river area in each hydrologic unit code level 10 (HUC 10) watershed using zonal statistics
- Extract HUC 10 watersheds with at least 3,000 people in the active river area

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, resilience-related general datasets folder: HighFloodRiskWS.shp	Dasymetric population (US EPA 2016) Active river area (Smith et al. 2008) HUC 10 watersheds (USGS 2019)	None

5. Water quality hazard watersheds

Description: Watersheds in North Carolina with at least 10-point source water quality hazards (swine lagoons, sewage treatment plants, and hazardous waste sites)

Methods:

- Clip swine lagoon, sewage treatment plant, and hazardous waste site point layers to the active river area
- Calculate the number of point source water quality hazards in the active river area in each hydrologic unit code level 10 (HUC 10) watershed using zonal statistics
- Extract HUC 10 watersheds with at least 10-point source water quality hazards in the active river area

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, resilience-related general datasets folder: WQHazWS.shp	Swine lagoons (NC DEQ 2018) Sewage treatment plants (NC REDC 1997) Hazardous waste sites (NC OneMap 2020) Active river area (Smith et al. 2008) HUC 10 watersheds (USGS 2019)	StoryMap: Reforestation opportunities spotlight, Map 2 uses the point datasets for swine lagoons, hazardous waste sites, and sewage treatment plants

6. Ecosystem resilience areas

Description: Areas scoring above 5 on the Natural Heritage Program's Biodiversity and Wildlife Habitat Assessment

Methods:

- Reclassify the Biodiversity and Wildlife Habitat Assessment so that all areas scoring above 5 are 1 and all other areas are no data

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, resilience-related general datasets folder: EcosystemResilAreas.tif	Biodiversity and Wildlife Habitat Assessment (NC NHP 2018)	None

Datasets Related to Specific NWL Recommendations

Protecting Forests and Woody Wetlands

7. Unprotected forests and woody wetlands

Description: Existing forests and woody wetlands in North Carolina that are not in protected areas.

Methods:

- Extract forests and woody wetlands from 2016 NLCD (classes 41, 42, 43, and 90)
- Exclude any forests and woody wetlands that overlap with protected areas as represented in PADUS

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, protecting forests and woody wetlands folder: MS_P_ForestsWetlands.tif	2016 National Land Cover Dataset (USGS 2019) Protected Areas Database of the United States (USGS GAP 2019)	NWL Action Plan: section 5.1.1 StoryMap: Forests, Wetlands, and Floodplains, Protection opportunities, Map 2

8. Unprotected forests in floodplain and wetland areas

Description: Existing forests in North Carolina that are not in protected areas and are either woody wetlands or in the active river area

Methods:

- Extract woody wetlands from the NLCD 2016 dataset and merge with the active river area
- Clip dataset #7 (unprotected forests and woody wetlands) to the extent of the combined woody wetland-active river area layer

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, protecting forests and woody wetlands folder: P_ForestsARA_WW.tif	NLCD 2016 Active river area #7 Unprotected forests and woody wetlands	NWL Action Plan: section 5.3

9. Unprotected forests in water supply watersheds

Description: Existing forests in North Carolina that are not protected and are in watersheds that provide drinking water.

Methods:

- Clip dataset #7 (unprotected forests and woody wetlands) to the extent of North Carolina Water Supply Watersheds dataset

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, protecting forests and woody wetlands folder: P_ForestWaterSupply.tif	#7 Unprotected forests and woody wetlands North Carolina Water Supply Watersheds (NC DENR 2017)	NWL action plan: section 5.7.1 StoryMap: Forests, Wetlands, and Floodplains, Protection opportunities, Map 3

10. Unprotected forests in urban areas

Description: Existing forests in North Carolina that are not protected and are within the boundaries of a municipality with at least 5,000 people.

Methods:

- Subset North Carolina municipal boundaries dataset to include only municipalities with at least 5,000 people
- Clip dataset #7 (unprotected forests and woody wetlands) to the extent of the municipal-boundaries subset

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, protecting forests and woody wetlands folder: P_UrbanForests.tif	North Carolina municipal boundaries (NC DOT 2017) #7 Unprotected forests and woody wetlands	NWL action plan: section 5.7.1 StoryMap: Forests, Wetlands, and Floodplains, Protection opportunities, Map 3

11. Unprotected forests and woody wetlands in floodplain or wetlands areas, in high flood risk watersheds

Description: Existing forests in North Carolina that are not protected, are in floodplain or wetland areas, and are within the boundaries of watersheds with many people living in flood-prone areas.

Methods:

- Clip dataset #8 (unprotected forests in floodplain or wetland areas) to dataset #4 (high flood risk watersheds)

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, protecting forests and woody wetlands folder: P_Forests_HiFloodRisk.tif	#8 Unprotected forests in floodplain or wetland areas #4 High flood risk watersheds	NWL action plan: section 5.1.1 StoryMap: Forests, Wetlands, and Floodplains, Protection opportunities, Map 3

12. Unprotected forests and woody wetlands in floodplain or wetlands areas, in water quality hazard watersheds

Description: Existing forests in North Carolina that are not protected, are in floodplain or wetland areas, and are within the boundaries of watersheds with many potential water quality hazards

Methods:

- Clip dataset #8 (unprotected forests in floodplain or wetland areas) to dataset #5 (water quality hazard watersheds)

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, protecting forests and woody wetlands folder: P_Forests_WQHaz.tif	#8 Unprotected forests in floodplain or wetland areas #5 Water quality hazard watersheds	NWL action plan: section 5.1.1 StoryMap: Forests, Wetlands, and Floodplains, Protection opportunities, Map 3

13. Carbon storage in unprotected forests and woody wetlands

Description: Existing carbon storage (metric tons C/acre, multiplied by 100 and rounded to the nearest integer to reduce file size) in unprotected forests and woody wetlands.

Methods:

- Clip dataset #1 (terrestrial carbon storage) to match the extent of dataset #7 (unprotected forests and woody wetlands)

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, protecting forests and woody wetlands folder: CStorage_UnprotectedForests.tif	#1 Terrestrial carbon storage #7 Unprotected forests and woody wetlands	NWL action plan: section 5.1.1 StoryMap: Forests, Wetlands, and Floodplains, Protection opportunities, Map 4

14. Carbon sequestration by unprotected forests and woody wetlands

Description: Current rates of carbon sequestration (metric tons C/acre/year, multiplied by 100 and rounded to the nearest integer to reduce file size) by unprotected forests and woody wetlands in North Carolina.

Methods:

- Clip dataset #2 (existing forest carbon sequestration) to match the extent of dataset #7 (unprotected forests and woody wetlands)

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, protecting forests and woody wetlands folder: CSeq_UnprotectedForests.tif	#2 Existing forest carbon sequestration #7 Unprotected forests and woody wetlands	NWL action plan: section 5.1.1 StoryMap: Forests, Wetlands, and Floodplains, Protection opportunities, Map 4

15. Carbon storage in unprotected forests and woody wetlands in water supply watersheds

Description: Existing carbon storage (metric tons C/acre, multiplied by 100 and rounded to the nearest integer to reduce file size) in unprotected forests and woody wetlands in water supply watersheds.

Methods:

- Clip dataset #13 (carbon storage in unprotected forests and woody wetlands) to the extent of water supply watersheds

Data download	Input data sources	Use in NWL action plan and StoryMap
This layer can be created from dataset #13 and NC Water Supply Watersheds as described above.	#13 Carbon storage in unprotected forests and woody wetlands NC Water Supply Watersheds	NWL action plan: section 5.7.1

16. Carbon sequestration by unprotected forests and woody wetlands in water supply watersheds

Description: Current rates of carbon sequestration (metric tons C/acre/year, multiplied by 100 and rounded to the nearest integer to reduce file size) by unprotected forests and woody wetlands in water supply watersheds.

Methods:

- Clip dataset #14 (carbon sequestration by unprotected forests and woody wetlands) to the extent of water supply watersheds

Data download	Input data sources	Use in NWL action plan and StoryMap
This layer can be created from dataset #14 and NC Water Supply Watersheds as described above.	#14 Carbon sequestration by unprotected forests and woody wetlands NC Water Supply Watersheds	NWL action plan: section 5.7.1

Reforestation Opportunities

17. Reforestation opportunities in North Carolina

Description: Land that has reforestation potential (is identified as fully reforestable by Fargione et al. 2018) and is not currently forested, wetland, or developed.

Methods:

- Extract fully reforestable areas (field BPS = 1) from Fargione et al. reforestation opportunities dataset
- Extract land that is not identified as forested, wetland, or developed in NLCD 2016
- Intersect the results of the first two steps to identify areas that are fully reforestable and not already forested, wetland, or developed

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, reforestation opportunities folder: MS_R_ ForestsWetlands.tif	Reforestation opportunities (Fargione et al. 2018) NLCD 2016	NWL action plan: sections 5.1.1 and 5.3.2 StoryMap: Forests, Wetlands, and Floodplains, Reforestation opportunities, Map 1

18. Reforestation opportunities in water supply watersheds

Description: Land that could be reforested and is within water supply watersheds.

Methods:

- Clip dataset #17 (reforestation opportunities in North Carolina) to the extent of the North Carolina Water Supply Watersheds dataset

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, reforestation opportunities folder: R_ ReforestWaterSupply.tif	#17 Reforestation opportunities in North Carolina NC Water Supply Watersheds	NWL Action Plan: section 5.7.1 StoryMap: Forests, Wetlands, and Floodplains, Reforestation opportunities, Map 2

19. Reforestation opportunities in floodplains or areas with wetland potential

Description: Land that could be reforested and is within the floodplain or on land with wetland restoration potential (areas of poorly drained soils that accumulate water due to topography but have been converted to agricultural land).

Methods:

- Merge the Active River Area dataset with the wetland restoration potential on agricultural land dataset
- Clip the result to the extent of dataset #17 (reforestation opportunities in North Carolina)

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, reforestation opportunities folder: R_Reforest_ARAWtland.tif	Active River Area (Smith et al. 2008) Wetland restoration potential on agricultural land (US EPA 2018) #17 Reforestation opportunities in North Carolina	NWL Action Plan: section 5.3.2

20. Reforestation opportunities in high flood risk watersheds

Description: Reforestation opportunities in North Carolina that are in floodplains or areas with wetland potential and are within the boundaries of watersheds with many people living in flood-prone areas.

Methods:

- Clip dataset #19 (reforestation opportunities in floodplains or areas with wetland potential) to the extent of dataset #4 (high flood risk watersheds)

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, reforestation opportunities folder: R_Reforest_HiFloodRisk.tif	#19 Reforestation opportunities in floodplains or areas with wetland potential #4 High flood risk watersheds	NWL Action Plan: sections 5.1.1 and 5.3.2 StoryMap: Forests, Wetlands, and Floodplains, Reforestation opportunities, Map 2

21. Reforestation opportunities in water quality hazard watersheds

Description: Reforestation opportunities in North Carolina that are in floodplains or areas with wetland potential and are within the boundaries of watersheds with many potential water quality hazards.

Methods:

- Clip dataset #19 (reforestation opportunities in floodplains or areas with wetland potential) to the extent of dataset #5 (water quality hazard watersheds)

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, reforestation opportunities folder: R_Reforest_WQHaz.tif	#19 Reforestation opportunities in floodplains or areas with wetland potential #5 Water quality hazard watersheds	NWL Action Plan: sections 5.1.1 and 5.3.2 StoryMap: Forests, Wetlands, and Floodplains, Reforestation opportunities, Map 2

22. Reforestation opportunities in ecosystem resilience areas

Description: Reforestation opportunities in North Carolina that are in areas with high ecosystem resilience

Methods:

- Clip dataset #17 (reforestation opportunities in North Carolina) to the extent of dataset #6 (ecosystem resilience areas)

Data download	Input data sources	Use in NWL action plan and StoryMap
This layer can be created from dataset #17 and dataset #6 as described above.	#17 Reforestation opportunities in NC #6 Ecosystem resilience areas	NWL Action Plan: sections 5.1.1 and 5.3.2

23. Carbon sequestration potential from reforestation

Description: Potential carbon sequestration (metric tons C/acre/year, multiplied by 100 and rounded to the nearest integer to reduce file size) if reforestation took place on the reforestable land identified in dataset #17.

Methods:

- Clip dataset #3 (reforestation carbon sequestration) to match the extent of dataset #17 (reforestation opportunities in North Carolina)

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, reforestation opportunities folder: CSeq_ReforOpp.tif	#3 Reforestation carbon sequestration #17 Reforestation opportunities in North Carolina	NWL action plan: sections 5.1.1 and 5.3.2 StoryMap: Forests, Wetlands, and Floodplains, Reforestation opportunities, Map 3

24. Carbon sequestration potential from reforestation in floodplain and wetland areas

Description: Potential carbon sequestration (metric tons C/acre/year, multiplied by 100 and rounded to the nearest integer to reduce file size) if reforestation took place on the reforestable land in floodplain and wetland areas

Methods:

- Clip dataset #3 (carbon sequestration potential from reforestation) to match the extent of dataset #19 (reforestation opportunities in floodplains and potential wetland areas)

Data download	Input data sources	Use in NWL action plan and StoryMap
This layer can be created from dataset #3 and dataset #19 as described above.	#3 Reforestation carbon sequestration #19 Reforestation opportunities in floodplains and wetland areas	NWL action plan: section 5.3

25. Carbon sequestration potential from reforestation in water supply watersheds

Description: Potential carbon sequestration (metric tons C/acre/year, multiplied by 100 and rounded to the nearest integer to reduce file size) if reforestation took place on the reforestable land in water supply watersheds

Methods:

- Clip dataset #3 (carbon sequestration potential from reforestation) to match the extent of North Carolina water supply watersheds

Data download	Input data sources	Use in NWL action plan and StoryMap
This layer can be created from dataset #3 and the water supply watersheds dataset as described above.	#3 Reforestation carbon sequestration Water supply watersheds	NWL action plan: section 5.7.1

Coordinated Buyouts

26. National Flood Insurance Program Claims by Census tract

Description: Number of National Flood Insurance Program (NFIP) claims that were made in each Census tract in North Carolina between 1975 and 2019.

Methods:

- Calculate the total number of NFIP claims made in each Census tract using the NFIP Redacted Claims dataset
- Attach result to spatial dataset of North Carolina Census tract boundaries

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, coordinated buyouts folder: NFIPClaims.shp	NFIP Redacted Claims dataset Census tract boundaries (TIGER)	StoryMap: Forests, Wetlands, and Floodplains, Coordinated buyouts and restoration, Map 1

27. Potential coordinated buyout areas

Description: Land in North Carolina that is developed and located within the active river area, classified by whether it is also in a Census tract with at least 100 National Flood Insurance Program Claims between 1975 and 2019.

Methods:

- Extract developed land from NLCD 2016
- Intersect the result of the step with the Active River Area
- Subset dataset #26 (NFIP claims by Census tract) to only include Census tracts with at least 100 claims
- Overlay the subset NFIP claims dataset with the result of step two (developed land in the active river area); classify all developed land in the active river area within Census tracts with at least 100 NFIP claims as 2 and all other developed land in the active river area as 1

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, coordinated buyouts folder: R_CoordinatedBuyouts_Full.tif	#26 NFIP claims by Census tract National Land Cover Dataset 2016 (USGS 2019) Active River Area (Smith et al. 2006)	NWL action plan: section 5.4.1 StoryMap: Forests, Wetlands, and Floodplains, Coordinated buyouts and restoration, Maps 2 and 3

Forests in Floodplains and Wetlands

28. Existing forests in floodplains and wetlands

Description: Existing forests in North Carolina that are in the active river area or in wetland areas.

Methods:

- Extract woody wetlands from NLCD 2016
- Merge the woody wetlands layer with the active river area for North Carolina
- Extract existing forests from NLCD 2016 (classes 41, 42, 43, and 95) and clip to the extent of the merged woody wetlands and active river area layer

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, forests in floodplains and wetlands folder: All_Forest_FPWetland.tif	NLCD 2016 Active River Area	NWL action plan: section 5.3

29. Carbon storage by forests in floodplains and wetlands

Description: Existing carbon storage (metric tons C/acre, multiplied by 100 and rounded to the nearest integer to reduce file size) in forests in floodplain and wetland areas.

Methods:

- Clip dataset #1 (terrestrial carbon storage) to the extent of dataset #28 (existing forests in floodplain and wetland areas)

Data download	Input data sources	Use in NWL action plan and StoryMap
This layer can be created from dataset #1 and dataset #28 as described above.	#1 Terrestrial carbon storage #28 Existing forests in floodplain and wetland areas	NWL action plan: section 5.3

30. Carbon sequestration by forests in floodplains and wetlands

Description: Existing carbon sequestration (metric tons C/acre/year, multiplied by 100 and rounded to the nearest integer to reduce file size) in forests in floodplain and wetland areas

Methods:

- Clip dataset #2 (carbon sequestration by existing forests) to the extent of dataset #28 (existing forests in floodplain and wetland areas)

Data download	Input data sources	Use in NWL action plan and StoryMap
This layer can be created from dataset #2 and dataset #28 as described above.	#2 Carbon sequestration by existing forests #28 Existing forests in floodplain and wetland areas	NWL action plan: section 5.3

Protecting Existing Coastal Habitats

31. Existing marshes by coastal asset protection

Description: Marshes identified as particularly important for coastal protection based on the InVEST coastal vulnerability model, classified by the types of coastal assets that they protect. For more detail on the InVEST coastal vulnerability model, see Appendix I.

Methods:

- Using the InVEST coastal vulnerability model output, identify shoreline segments for which marsh plays a key protective role by subtracting the coastal exposure index of each shoreline segment calculated with marsh present from its coastal exposure index with marsh removed. Shoreline segments with at least a 10% reduction in coastal exposure index with marsh present compared to removed are considered protected by marsh.
- For all shoreline segments protected by marsh, sum total population, historic sites, and acres of key natural areas within 1,000 meters (after Arkema et al. 2013)
- Classify all shoreline segments protected by marsh based on the total population, number of historic sites, and acres of key natural areas using the following thresholds:
- Population: at least 500 = 1, less than 500 = 0
- Number of historic sites: at least 5 = 1, less than 5 = 0
- Acres of key natural areas: at least 100 = 1, less than 100 = 0
- Extract all marshes within 1,000 meters of a shoreline segment protected by marsh. Classify each marsh based on the assets of protected shoreline segments within 1,000 meters of the marsh. For example, if at least one protected shoreline segment within 1,000 meters of the marsh has a 1 for population, the marsh also gets a 1 for population.

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, protecting coastal habitats folder: Marshes_CoastalAssetProtection.shp	InVEST model output (see appendix I) Dasymetric population (US EPA 2016) Historic sites (NC DCR) Key natural areas (NC NHP) Marshes (NWI)	StoryMap: Protecting existing coastal habitats, Map 1

32. Coastal habitats by water quality rating of nearest water body

Description: Coastal habitats (salt marsh and seagrass) classified by the water quality rating of the nearest body of water

Methods:

- Extract all salt marsh areas from the National Wetland Inventory (ATTRIBUTE field begins with E2EM)
- Merge salt marsh and seagrass layers into a raster
- Use Euclidean allocation tool to assign each 30-meter pixel in the North Carolina coastal zone to the water quality rating of the nearest body of water
- Use the combine tool with the salt marsh, seagrass, and new water quality rating rasters to identify each unique combination of habitat type and water quality rating

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, protecting coastal habitats folder: CoastalHab_WQRating.tif	NWI (US FWS 2019) Seagrass (NC DEQ 2019) Water quality ratings (NC DENR 2012)	StoryMap: Protecting existing coastal habitats, Map 2

33. Carbon storage and sequestration by North Carolina salt marsh and seagrass

Description: Table showing carbon storage, sequestration, and emissions by North Carolina salt marsh and seagrass for present-day and future sea level rise scenarios, from InVEST coastal blue carbon model (see appendix I for details)

Methods:

- Run InVEST coastal blue carbon model using existing salt marsh and seagrass extent and future scenarios for salt marsh (dataset #36)
- Use zonal statistics on InVEST output rasters to calculate carbon storage, sequestration, and emissions at each relevant time point for each scenario.

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, protecting coastal habitats folder: BlueCarbon_NC.csv	NWI (US FWS 2019) Seagrass (NC DEQ 2019) #36 Future salt marsh scenarios	Action Plan: sections 4.2 and 5.6 StoryMap: Facilitating marsh migration, Map 6

Facilitating Marsh Migration

34. Existing marshes by elevation

Description: Existing salt marshes classified by their elevation above sea level

Methods:

- Clip bathymetric-topographic elevation data to existing marsh extent from NWI
- Reclassify result into five elevation classes corresponding to sea level rise scenarios:
  - 1: < 1.5 feet
  - 2: 1.5–3 feet
  - 3: 3–4 feet
  - 4: 4–6.5 feet
  - 5: > 6.5 feet

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, facilitating marsh migration folder: marshelev.tif	NWI (US FWS 2019) Bathymetric-topographic elevation (NOAA CIRES 2014)	StoryMap: Facilitating marsh migration, Maps 1, 4, 5, and 6

35. Marsh migration space by protection status

Description: Marsh migration space classified by its current protection status

Methods:

- Create raster versions of the migration space polygons, for each sea level rise scenario (1.5, 3, 4, and 6.5 feet)
- Combine all migration space rasters into one total migration space raster
- Overlay protected areas database to identify migration space area that is within and outside of protected areas

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, facilitating marsh migration folder: MigSpace_ ProtectionStatus.tif	Migration space (TNC 2019) PADUS (USGS GAP 2019)	Action Plan: section 5.6.1 StoryMap: Facilitating marsh migration, Map 3

36. Future marsh scenarios

Description: Potential extent of marsh for several sea level rise scenarios, including marsh that has drowned due to sea level rise, existing marsh that has not been affected by sea level rise, and potential new marsh in the migration space

Methods:

- Reclassify dataset #34 (existing marshes by elevation) into two classes: one for marshes that have drowned due to sea level rise (are below 1.5 feet in elevation) (=3) and one for marshes that have not been affected by sea level rise (are above 1.5 feet in elevation) (=2)
- Merge the reclassified dataset with the migration space raster for the 1.5-foot sea level rise scenario (=1)
- Repeat the first two steps for each of the other sea level rise scenarios

Data download	Input data sources	Use in NWL action plan and StoryMap
Download from Duke library repository, facilitating marsh migration folder: FutureMarshScenario_1pt5ft.tif FutureMarshScenario_3ft.tif FutureMarshScenario_4ft.tif FutureMarshScenario_6pt5ft.tif	#34 Existing marshes by elevation Migration space (TNC 2019)	StoryMap: Facilitating marsh migration, Maps 5 and 6

OTHER RELEVANT DATASETS

These datasets can be overlaid with the NWL opportunity areas described above to provide additional context that may be useful for planning (e.g., proximity to existing protected areas) or considering additional benefits of NWL projects (e.g., open space priority access areas). Unless stated otherwise, these datasets were not developed by the Nicholas Institute for Environmental Policy Solutions. A brief description of each dataset and a link to the dataset source are included below.

National Land Cover Dataset

The USGS National Land Cover Dataset includes land use/land cover data for the United States for a series of years between 2001 and 2016, and change products highlighting areas of land cover change between years.

Protected Areas Database of the United States

The USGS Protected Areas Database of the United States (PAD-US) identifies land that is protected from development or managed for conservation purposes, including land owned by the federal or state governments (national and state parks and forests, national wildlife refuges, etc.), land owned by local governments (municipal parks), and privately protected land (private nature reserves and land with conservation easements that restrict development).

Open Space Access Priority Areas

The Nicholas Institute for Environmental Policy Solutions open space access priority areas dataset identifies the counties and Census Block Groups in the southeastern United States that are most in need of additional open space for recreation, in terms of the number of people who would benefit from increased access to open space. It was developed by the Nicholas Institute for Environmental Policy Solutions.

Dasymetric Population (EnviroAtlas)

The EnviroAtlas dasymetric allocation of population dataset represents the United States population on a 30-meter grid. It was created by spatially distributing the Census population estimates based on land cover.

CDC Social Vulnerability Index

The CDC social vulnerability index combines 15 demographic and socioeconomic variables to compare Census tracts and counties within a state in terms of the community's ability to withstand external stressors such as natural disasters or disease outbreaks.

Water Quality Ratings

North Carolina's water quality ratings classify water bodies by whether they support their designated uses or if one or more uses are impaired by water quality issues.

Resilient Coastal Sites

The Nature Conservancy's Resilient Coastal Sites project for the south Atlantic (which includes North Carolina) classifies coastal areas by how resilient they are to future changes due sea level rise. The resilience classifications integrate information on the size and quality of existing coastal habitats and the size and intactness of migration space into which coastal habitats may be able to move with sea level rise.

REFERENCES

Anderson, M.G., and A. Barnett. 2019. "Resilient Coastal Sites for Conservation in the South Atlantic US." The Nature Conservancy, Eastern Conservation Science. https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/Documents/SouthAtlantic_Resilient_Coastal_Sites_31Oct2019.pdf.

Arkema, K.K., G. Guannel, G. Verutes, S.A. Woody, A. Guerry, M. Ruckelshaus, P. Kareiva, M. Lacayo, and J.M. Silver. 2013. "Coastal Habitats Shield People and Property from Sea-level Rise and Storms." *Nature Climate Change* 3: 913–918. http://www.nature.com/doifinder/10.1038/nclimate1944.

Cooperative Institute for Research in Environmental Sciences. 2014. Continuously Updated Digital Elevation Model (CUDEM) - 1/9 Arc-Second Resolution Bathymetric-Topographic Tiles. NOAA National Centers for Environmental Information. https://doi.org/10.25921/ds9v-ky35.

Fargione, J.E., S. Bassett, T. Boucher, S.D. Bridgham, R.T. Conant, S.C. Cook-Patton, et al. 2018. "Natural Climate Solutions for the United States." *Science Advances* 4(11). https://advances.sciencemag.org/content/4/11/eaat1869.

Federal Insurance & Mitigation Administration. 2019. National Flood Insurance Program Redacted Claims Dataset. https://www.fema.gov/media-library/assets/documents/180374.

NOAA (National Oceanic and Atmospheric Administration) National Centers for Environmental Information. 2017. Global Self-consistent, Hierarchical, High-resolution Geography Database. https://www.ngdc.noaa.gov/mgg/shorelines/.

NOAA (National Oceanic and Atmospheric Administration) Office of Response and Restoration. 2016. North Carolina 2016 ESI Lines. https://inport.nmfs.noaa.gov/inport/item/47521.

North Carolina Department of Environment and Natural Resources. 2012. 2012 Overall Integrated Reporting Water Quality Ratings. https://www.arcgis.com/sharing/rest/content/items/95d0f80a808e4259a4a01cbfe966d6ea/info/metadata/metadata.xml?format=default&output=html.

North Carolina Department of Environmental Quality. 2019. SAV 2006-2008 Mapping Revised. https://www.nconemap.gov/datasets/ncdenr::sav-2006-2008-mapping-revised.

North Carolina Department of Environmental Quality Division of Water Quality. 2018. "North Carolina's Swine Lagoons." https://www.arcgis.com/home/item.html?id=4e17499ce2734282a6689d14fbd22edb.

North Carolina Department of Marine Fisheries. 2019. SAV 2006-2008 Mapping Revised. https://www.nconemap.gov/datasets/f6cf4ca894f34026aeeec060570a62c5_0?geometry=-87.105%2C33.811%2C-66.198%2C36.945.

North Carolina Natural Heritage Program. 2018. "Biodiversity and Wildlife Habitat Assessment." https://www.ncnhp.org/documents/biodiversity-and-wildlife-habitat-assessment.

North Carolina OneMap. 2020. "Hazardous Waste Sites." https://www.nconemap.gov/datasets/hazardous-waste-sites.

North Carolina Rural Economic Development Center. 1997. "Sewer Treatment Plants." https://www.nconemap.gov/datasets/sewer-treatment-plants-1997.

Pan, Y., J.M. Chen, R. Birdsey, K. McCullough, L. He, and F. Deng. 2012. NACP Forest Age Maps at 1-km Resolution for Canada (2004) and the U.S.A. (2006). Dataset. Available online [https://daac.ornl.gov/NACP/guides/NA_Tree_Age.html] from ORNL DAAC, Oak Ridge, Tennessee, U.S.A.

Pendleton, L., D.C. Donato, B.C. Murray, S. Crooks, W.A. Jenkins, S. Sifleet, et al. 2012. "Estimating Global 'Blue Carbon' Emissions from Conversion and Degradation of Vegetated Coastal Ecosystems." *PLOS ONE* 7(9): e43542.

Richmond, E., C. Morse, and K. Bryan. 2015. "Using InVEST to Model Coastal Blue Carbon in Port Susan Bay, Washington." https://depts.washington.edu/mgis/capstone/files/2015_5_Bryan_Morse_Richmond.pdf.

Sharp, R., H.T. Tallis, T. Ricketts, A.D. Guerry, S.A. Wood, R. Chaplin-Kramer, et al. 2018. *InVEST 3.6 User's Guide*. The Natural Capital Project, Stanford University, University of Minnesota, The Nature Conservancy, and World Wildlife Fund.

Siikamaki, J., J.N. Sanchirico, S. Jardine, D. McLaughlin, and D. Morris. 2013. "Blue Carbon: Coastal Ecosystems, Their Carbon Storage, and Potential for Reducing Emissions." *Environment: Science and Policy for Sustainable Development* 55(6): 14–29. https://www.tandfonline.com/doi/full/10.1080/00139157.2013.843981.

Sleeter, B.M., J. Liu, C. Daniel, B. Rayfield, J. Sherba, T.J. Hawbaker, et al. 2018. "Effects of Contemporary Land-Use and Land-Cover Change on the Carbon Balance of Terrestrial Ecosystems in the United States." *Environmental Research Letters* 13: 045006. https://doi.org/10.1088/1748-9326/aab540.

Smith, J.E., L.S. Heath, K.E. Skog, R.A. and Birdsey, R.A. 2006. Methods for Calculating Forest Ecosystem and Harvested Carbon with Standard Estimates for Forest Types of the United States. United States Department of Agriculture Forest Service, Northeastern Research Station. General Technical Report NE-343. http://www.actrees.org/files/Research/ne_gtr343.pdf.

Smith, M.P., R. Schiff, A. Olivero, and J. MacBroom. 2008. "The Active River Area: A Conservation Framework for Protecting Rivers and Streams." The Nature Conservancy. https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/Documents/ED_freshwater_ARA_NE2008.pdf.

U.S. Environmental Protection Agency, Office of Research and Development. 2016. EnviroAtlas – Dasymetric Population for the Conterminous United States. https://catalog.data.gov/harvest/object/5dbd7b6e-a89c-4a3c-82b5-16e202df2cda/html.

U.S. Environmental Protection Agency, Office of Research and Development. 2018. EnviroAtlas – Potentially Restorable Wetlands on Agricultural Land – Contiguous United States. https://edg.epa.gov/metadata/catalog/search/resource/details.page?uuid=%7B669E59E0-F583-4D98-A0D6-6C68E2E97C76%7D.

U.S. Fish and Wildlife Service. 2019. National Wetlands Inventory." ftp://128.104.224.198/State-Downloads/NC_shapefile_wetlands.zip.

U.S. Geological Survey Gap Analysis Project. 2019. Protected Areas Database of the United States 2.0. https://www.usgs.gov/core-science-systems/science-analytics-and-synthesis/gap/science/pad-us-data-download?qt-science_center_objects=0#qt-science_center_objects.

U.S. Geological Survey. 2019. NLCD 2016 Land Cover Conterminous United States. https://www.mrlc.gov/data/nlcd-2016-land-cover-conus.

U.S. Geological Survey. 2019. Watershed Boundary Dataset. https://www.usgs.gov/core-science-systems/ngp/national-hydrography/access-national-hydrography-products.

Zachry, B.C., W.J. Booth, J.R. Rhome, and T.M. Sharon. 2015. "A National View of Storm Surge Risk and Inundation." *Weather, Climate, and Society* 7(2): 109–117. http://dx.doi.org/10.1175/WCAS–D–14–00049.1.

APPENDIX I: INVEST MODELING DETAILS

InVEST Coastal Vulnerability Model

The InVEST coastal vulnerability model (Sharp et al. 2018) calculates the coastal exposure index, a relative index of coastal areas' exposure to flooding and erosion caused by storms, based on a variety of input factors that influence coastal processes leading to flooding and erosion. It has previously been used for analyses from watershed to national scales (Arkema et al. 2013). Coastal habitats are included in the model as a mitigating influence on coastal hazards (the presence of coastal habitats lowers the coastal exposure index), so the model is often used to analyze the protective effects of coastal habitats. The InVEST model was modified for North Carolina with input from members of the Natural and Working Lands coastal subgroup.

The shoreline in the study area is divided into segments (for this analysis, each segment was 250 meters long); each shoreline segment is ranked from 1 to 5 for each input factor: relief, geomorphology, coastal habitats, wave exposure, and storm surge depth. In each of these factor rankings, a higher number indicates greater exposure to coastal hazards. The final coastal exposure index is calculated as the geometric mean of the factor rankings.

Model Inputs and Parameters

The following input data was used for the model:

Input name	Description	Data source
Land polygon	Geographic shape of the coastline	NOAA Global self-consistent, hierarchical, high-resolution shoreline
Relief and bathymetry	Elevation (for land area) and depth (for submerged area)	NCEI Continuously Updated Digital Elevation Model (CUDEM) – 1/3 arc-second resolution bathymetric tiles and 1/9 arc-second resolution bathymetric-topographic tiles
Shoreline geomorphology	Shoreline structure, including natural protective features (e.g., rocky cliffs) and manmade protective features (e.g., seawalls)	NOAA Environmental Sensitivity Index
High dunes	Location of dunes >5 m in height	NOAA Environmental Sensitivity Index
Low dunes	Location of dunes <5 m in height	NOAA Environmental Sensitivity Index
Seagrass beds	Location of seagrass beds	National Wetland Inventory, NC Department of Marine Fisheries
Oysters	Location of oyster beds and reefs	NC Department of Marine Fisheries Shellfish Mapping Program (personal communication)
Coastal forests	Location of coastal forests	National Wetland Inventory
Emergent marsh	Location of emergent marsh	National Wetland Inventory
Climatic Forcing Grid	Location of points with wind values representing storm conditions	WindWatch III (provided with InVEST model)
Storm surge depth	Storm surge depth for category 2 hurricane	SLOSH MOM storm surge hazard (Zachry et al. 2015)

The protective function of coastal habitats is represented by assigning each habitat a rank (from 1 to 5, where 1 indicates the best protection) and protection range (the maximum distance from the habitat that protection is provided).

Habitat type	Rank	Protection range (meters)
Coastal forest	1	2,000
High dune	2	300
Marsh	2	1,000
Low dune	3	300
Seagrass	4	500
Oyster	2	100

The model was initially run using default parameters, and parameters were adjusted based on feedback from members of the Natural and Working Lands coastal subgroup. The final parameters used were:

Parameter	Value
Model resolution	250 meters
Depth threshold	7 meters
Exposure proportion	0.6
Depth contour level	150
Elevation averaging radius	5,000 meters
Mean sea level datum	0
Rays per sector	1
Maximum fetch distance	1,000 meters
Coastal overlap	250 meters
Coastal neighborhood	150 meters

Model Adjustments

The InVEST model estimates shorelines' exposure to storm surge based on the distance between the coastline and the edge of the continental shelf. For the North Carolina analysis, this relatively simple approximation was replaced with inundation estimates from the SLOSH storm surge model. SLOSH maximum-of-maximum storm surge inundation for a category 2 hurricane was used to calculate mean inundation in a 500-meter circle around each shoreline segment. Then, shoreline segments were ranked from 1 to 5 based on mean inundation, using quantiles.

The InVEST model ranks shoreline segments' wave exposure from 1 to 5 using quantiles (same number of shoreline segments in each category). North Carolina has a long estuarine coastline with relatively low wave exposure, so this method resulted in some sheltered coastlines receiving a rank of 5 despite having much lower estimated wave power than the ocean-facing shoreline. To address this, the intermediate wave power outputs were used to calculate new wave exposure rankings. All shoreline segments with wave power greater than 5 kilowatts/meter (these are the

ocean-facing shorelines) were assigned a rank of 5, and all shoreline segments with wave power less than 5 kilowatts/meter were assigned ranks 1 through 4 using quartiles.

Model Outputs

Model outputs include the factor rankings as well as the coastal exposure index for each shoreline segment. The coastal exposure index was recalculated using the modified storm surge and wave power rankings in place of the storm surge and wave power rankings generated by the model.

To identify areas where particular coastal habitat types are playing a large role in coastal protection, the coastal exposure index was also recalculated with each habitat type removed, so that its protective influence was not included. The difference between the original coastal exposure index and the coastal exposure index calculated without a certain habitat type gives an indication of where that habitat type is providing protection. This technique was used to identify marshes that are particularly important in protecting coastal assets (see dataset #31).

InVEST Coastal Blue Carbon Model

The InVEST coastal blue carbon model (Sharp et al. 2018) estimates the amount of carbon stored in coastal habitats at set time points and the amount of carbon sequestered by those habitats over time. It also calculates carbon emitted due to disturbance or conversion of those habitats. It has been used previously for watershed-scale analyses (Richmond et al. 2015); no state- or national-level analyses using this model were found.

This analysis focused on carbon stored in salt marsh and seagrass habitats in North Carolina, how much additional carbon would be expected to accumulate if those habitats persisted undisturbed for a period of time, and how carbon fluxes from marshes might change due to sea level rise. Seagrass habitats were assumed to be unaffected by sea level rise.

Model Inputs and Parameters

Key model inputs are rasters representing the spatial distribution of blue carbon habitats at different time points and tables with information about the amount of carbon stored in each habitat type, the rate at which the habitat type sequesters additional carbon, and the impact of disturbance on carbon stored in the habitat.

Current extent of salt marsh and seagrass habitats were obtained from the National Wetland Inventory and NC Department of Environmental Quality's submerged aquatic vegetation mapping. Future scenarios were derived from dataset #36 (future marsh scenarios), which identifies the fate of current marsh and the available migration space for four sea level rise scenarios (1.5, 3, 4, and 6.5 feet). To create a raster representing the future extent of marsh under each sea level rise scenario, the migration space and existing marsh above sea level rise elevation were reclassified to marsh, and the drowned marsh was reclassified to open water. These scenarios assumed that all migration space would become marsh. We also constructed a set of rasters for the same sea level rise scenarios, but assuming that only a proportion of the migration space would become marsh; the proportion was set to the current proportion of marsh in the tidal area. Due to a lack of information about what parts of the migration space are most likely to become

marsh, the rasters for these scenarios had marsh pixels randomly distributed in the migration space. Seagrass extent was held constant in all of the future scenarios.

The parameters for carbon storage, sequestration, and emissions due to disturbance were:

Habitat type	Carbon storage, million metric tons CO2-e/ha	Carbon sequestration, million metric tons CO_2-e/ha/year	Carbon emissions due to disturbance (conversion to open water due to SLR), % of stored carbon
Salt marsh	0.000674	2.75E-06	25–50%
Seagrass	0.000238	1.81E-06	NA

Carbon storage and sequestration rates for salt marsh were estimated by compiling field measurements of soil carbon in North Carolina marshes from a variety of sources, informed by the Natural and Working Lands coastal subgroup. Carbon storage and sequestration rates for seagrass were obtained from a global composite analysis of seagrasses as blue carbon habitats (Siikamaki et al. 2013). There is high uncertainty about the amount of stored carbon that is emitted when marshes drown due to sea level rise; the range of 25–50% in the table above represents the group's best estimate based on literature and experience (Pendleton et al. 2012).

The model was run multiple times for different sea level rise scenarios and assumptions about carbon emissions from marsh drowning. For each model run, the current habitat extent raster and one of the future habitat extent rasters (corresponding to a sea level rise scenario) were used as inputs along with the parameters in the table above. Each sea level rise scenario was modeled twice, once using the 25% of stored carbon released assumption, and once using the 50% of stored carbon released assumption. All models were run for 100 years following the transition from current to future habitat extent. For comparison, the model was also run with current coastal habitat extents remaining constant (no sea level rise).

Model Outputs

The model outputs a series of rasters representing carbon storage at different time points, carbon sequestration over the time period represented in the model, and carbon emissions over the time period represented in the model. For example, at a given time point, all cells representing blue carbon habitats have carbon storage based on the input parameter for that habitat type, and all other cells have zero carbon storage. The carbon sequestration raster has carbon accumulation in all cells that were blue carbon habitat during the time period, and the carbon emissions raster has carbon emissions from all cells that changed from a blue carbon habitat type to a non-blue carbon habitat type.

As described in dataset #36, these output rasters were summarized at the state level to calculate carbon storage, sequestration, emissions, and net carbon flux.

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Citation

Warnell, Katie. 2020. Natural and Working Lands in North Carolina – Data and Methods Guide. NI Guide 20-01. Durham, NC: Duke University.

Acknowledgements

This work was supported by the USGS Southeast Climate Adaptation Science Center. Lydia Olander (Nicholas Institute for Environmental Policy Solutions, Duke University) oversaw and provided guidance for the project. Gia Mancini (Nicholas School of the Environment, Duke University) contributed to geospatial analysis. Thanks to the many members of the Natural and Working Lands stakeholder group for their input and feedback.

Publication Number: NI Guide 20-01

Nicholas Institute for Environmental Policy Solutions

The Nicholas Institute for Environmental Policy Solutions at Duke University is a nonpartisan institute founded in 2005 to help decision makers in government, the private sector, and the nonprofit community address critical environmental challenges. The Nicholas Institute responds to the demand for high-quality and timely data and acts as an "honest broker" in policy debates by convening and fostering open, ongoing dialogue between stakeholders on all sides of the issues and providing policy-relevant analysis based on academic research. The Nicholas Institute's leadership and staff leverage the broad expertise of Duke University as well as public and private partners worldwide. Since its inception, the Nicholas Institute has earned a distinguished reputation for its innovative approach to developing multilateral, nonpartisan, and economically viable solutions to pressing environmental challenges.

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