

# Application of the Sea-Level Affecting Marshes Model (SLAMM 5.1) to Conscience Point NWR

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<b>Introduction.....</b>	<b>1</b>
<b>Model Summary .....</b>	<b>1</b>
Sea Level Rise Scenarios.....	2
<b>Methods and Data Sources .....</b>	<b>3</b>
<b>Results .....</b>	<b>6</b>
<b>Discussion .....</b>	<b>15</b>
<b>References .....</b>	<b>16</b>
<b>Appendix A: Contextual Results .....</b>	<b>18</b>

## Introduction

Tidal marshes are among the most susceptible ecosystems to climate change, especially accelerated sea level rise (SLR). The International Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES) suggested that global sea level will increase by approximately 30 cm to 100 cm by 2100 (IPCC 2001). Rahmstorf (2007) suggests that this range may be too conservative and that the feasible range by 2100 could be 50 to 140 cm. Pfeffer et al. (2008) suggests that 200 cm by 2100 is at the upper end of plausible scenarios due to physical limitations on glaciological conditions. Rising sea level may result in tidal marsh submergence (Moorhead and Brinson 1995) and habitat migration as salt marshes transgress landward and replace tidal freshwater and Irregularly Flooded marsh (Park et al. 1991).

In an effort to address the potential effects of sea level rise on United States national wildlife refuges, the U. S. Fish and Wildlife Service contracted the application of the SLAMM model for most Region 4 refuges. This analysis is designed to assist in the production of comprehensive conservation plans (CCPs) for each refuge along with other long-term management plans.

## Model Summary

Within SLAMM, there are five primary processes that affect wetland fate under different scenarios of sea level rise:

- **Inundation:** The rise of water levels and the salt boundary are tracked by reducing elevations of each cell as sea levels rise, thus keeping mean tide level (MTL) constant at zero. The effects on each cell are calculated based on the minimum elevation and slope of that cell.
- **Erosion:** Erosion is triggered based on a threshold of maximum fetch and the proximity of the marsh to estuarine water or open ocean. When these conditions are met, horizontal erosion occurs at a rate based on site-specific parameters.
- **Overwash:** Barrier islands of under 500 meters width are assumed to undergo overwash during each 25-year time-step due to storms. Beach migration and transport of sediments are calculated.
- **Saturation:** Coastal swamps and fresh marshes can migrate onto adjacent uplands as a response of the water table to rising sea level close to the coast.
- **Salinity:** In a defined estuary, the effects of salinity progression up an estuary and the resultant effects on marsh type may be tracked. This optional sub-model assumes an estuarine salt-wedge and calculates the influence of the freshwater head vs. the saltwater head in a particular cell. The “classic” estuary geometry is not present in Jefferson County, TX, so this model was not used in this analysis.

For a thorough accounting of each of these processes and the underlying assumptions and equations see the SLAMM 5.0 technical documentation (Clough and Park, 2008).

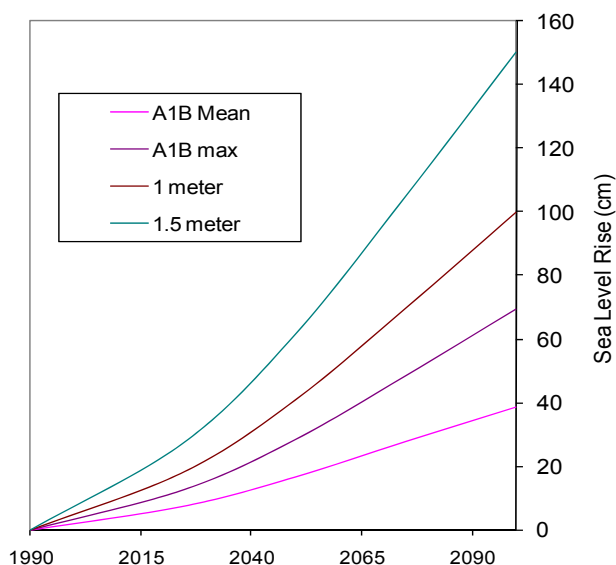
## Sea Level Rise Scenarios

SLAMM 5 was run using scenario A1B from the Special Report on Emissions Scenarios (SRES) – mean and maximum estimates. The A1 scenario assumes that the future world includes very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. In particular, the A1B scenario assumes that energy sources will be balanced across all sources. Under the A1B scenario, the IPCC WGI Fourth Assessment Report (IPCC, 2007) suggests a likely range of 0.21 to 0.48 meters of sea level rise by 2090-2099 “excluding future rapid dynamical changes in ice flow.” The A1B-mean scenario that was run as a part of this project falls near the middle of this estimated range, predicting 0.40 meters of global sea level rise by 2100.

The latest literature (Chen et al., 2006, Monaghan et al., 2006) indicates that the eustatic rise in sea levels is progressing more rapidly than was previously assumed, perhaps due to the dynamic changes in ice flow omitted within the IPCC report’s calculations. A recent paper in the journal *Science* (Rahmstorf, 2007) suggests that, taking into account possible model error, a feasible range by 2100 might be 50 to 140 cm. Pfeffer et al. (2008) suggests that 2 meters by 2100 is at the upper end of plausible scenarios due to physical limitations on glaciological conditions. A recent US intergovernmental report states “Although no ice-sheet model is currently capable of capturing the glacier speedups in Antarctica or Greenland that have been observed over the last decade, including these processes in models will very likely show that IPCC AR4 projected sea level rises for the end of the 21st century are too low.” (US Climate Change Science Program, 2008) A recent paper by Grinsted et. al. (2009) states that “sea level 2090-2099 is projected to be 0.9 to 1.3 m for the A1B scenario, with low probability of the rise being within Intergovernmental Panel on Climate Change (IPCC) confidence limits.”

To allow for flexibility when interpreting the results in this report, SLAMM was also run assuming 1 meter and 1½ meters of eustatic sea level rise by the year 2100. The A1B- maximum scenario was scaled up to produce these bounding scenarios (Figure 1).

**Figure 1: Summary of SLR Scenarios Utilized**

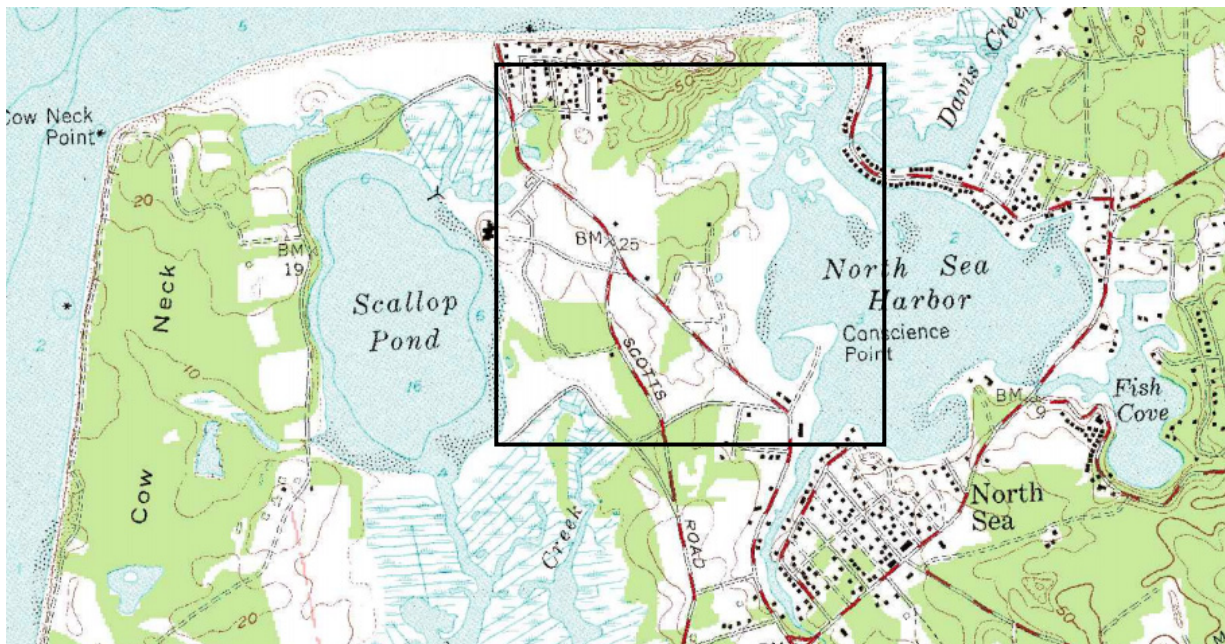


For simplicity sake, this application report will focus on the A1B-Mean, A1B-Max, and 1½-meter scenarios but a complete set of model results are available for all four scenarios discussed above.

Additional information on the development of the SLAMM model is available in the technical documentation, which may be downloaded from [the SLAMM website](#) (Clough and Park, 2008).

## Methods and Data Sources

LIDAR data were not found for Conscience Point NWR, so the elevation data used are based entirely on National Elevation Data (NED). NED metadata indicates that this digital elevation map (DEM) was derived from a 1956 survey with 10 foot contour intervals and 5 foot supplemental contours (Figure 2).



**Figure 2:** Conscience Point Refuge Topographical Map.

The National Wetlands Inventory for Conscience Point is based on a photo date of 2004.

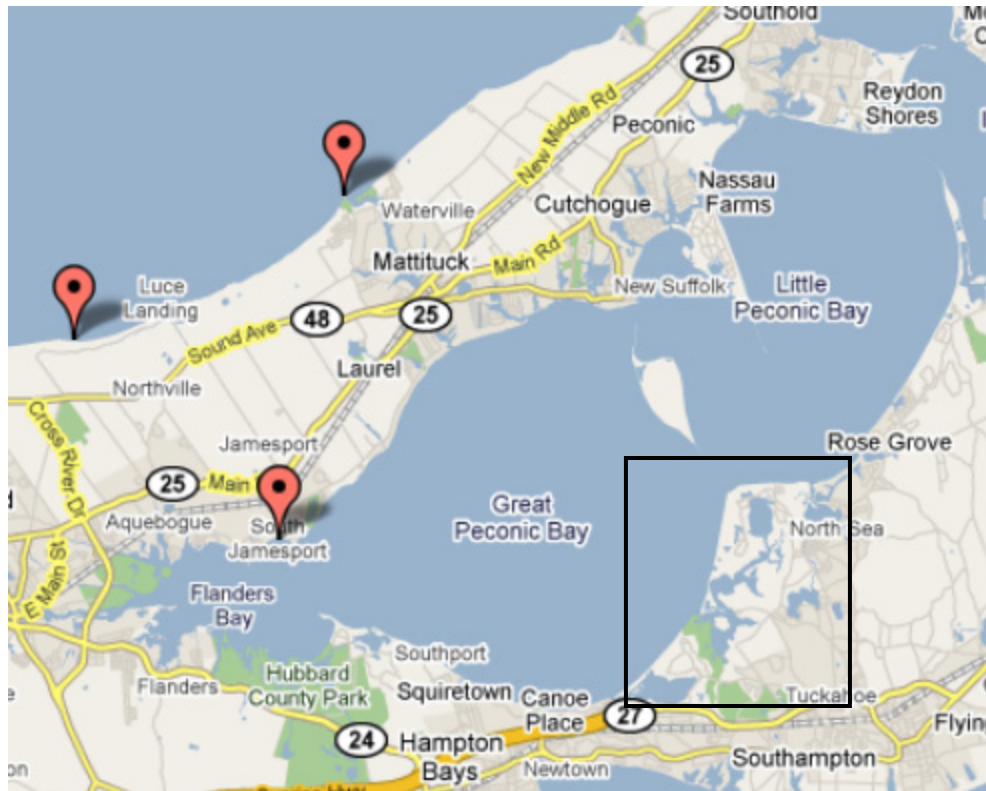
Converting the NWI survey into 30 meter cells indicates that the approximately sixty acre refuge (approved acquisition boundary including water) is composed of the categories as shown below:

Undeveloped Dry Land	81.8%
Irregularly Flooded Marsh	14.2%
Developed Dry Land	2.5%
Estuarine Open Water	1.1%

There are several diked or impounded wetlands in the region of the Conscience Point NWR according to the National Wetlands Inventory. However, no dikes lie within the refuge boundaries.

The historic sea level rise for Conscience Point NWR was estimated at 2.61 mm/year, based on the average of the two closest gages (8514560, Port Jefferson, NY; 8510560, Montauk, NY).

The tidal range for the Conscience Point NWR is estimated at 0.993 meters (Figure 3) using tidal data from the closest gage (8512735, South Jamesport, NY) which is approximately 13 kilometers away.



**Figure 3:** NOAA Gages Relevant to the Study Area (in rectangle).

Accretion rates in salt and irregularly flooded marshes were set to 2.5 mm/year, the mean of accretion values from Wertheim NWR and from Barn Island Wildlife Management Area, CT (McLetchie, 2006; R.A. Orson, 1998).

The MTL to NAVD correction was derived using VDATUM. Multiple geographic points were input into VDATUM to produce several corrections in the study area. These values ranged from -0.1250 to -0.1253 meters (less than one millimeter apart). The resulting correction value is an average of these values.

Modeled U.S. Fish and Wildlife Service refuge boundaries for New York are based on Approved Acquisition Boundaries as published on the FWS National Wildlife Refuge Data and Metadata website.

The cell-size used for this analysis was 30 meter by 30 meter cells. However, the SLAMM model does track partial conversion of cells based on elevation and slope.

Because of the poor vertical resolution of the input elevation dataset, the elevations of wetlands classes were estimated as a function of the local tidal range using the SLAMM elevation pre-processor.

Developed vs. undeveloped lands were estimated based on the National Land Cover Database (2001).

## **SUMMARY OF SLAMM INPUT PARAMETERS FOR CONSCIENCE POINT NWR**

	Conscience
<b>Description</b>	<b>Point</b>
DEM Source Date (yyyy)	1956
NWI_photo_date (yyyy)	2004
Direction_OffShore (N S E W)	N
Historic_trend (mm/yr)	2.61
NAVD88_correction (MTL-NAVD88 in meters)	-0.1251
<i>Water Depth (m below MLW- N/A)</i>	2
TideRangeOcean (meters: MHHW-MLLW)	0.993
TideRangeInland (meters)	0.993
Mean High Water Spring (m above MTL)	0.84405
MHSW Inland (m above MTL)	0.84405
Marsh Erosion (horz meters/year)	1.8
Swamp Erosion (horz meters/year)	1
TFlat Erosion (horz meters/year) [from 0.5]	0.5
Salt marsh vertical accretion (mm/yr) Final	2.5
Brackish March vert. accretion (mm/yr) Final	2.5
Tidal Fresh vertical accretion (mm/yr) Final	2.5
Beach/T.Flat Sedimentation Rate (mm/yr)	0.5
Frequency of Large Storms (yr/washover)	35
Use Elevation Preprocessor for Wetlands	TRUE



## Results

Conscience Point NWR is predicted show effects from sea level rise across all scenarios. In any scenario above 0.39 meter sea level rise the refuge is expected to lose from 80% to 100% of its irregularly flooded (brackish) marsh. Dry land loss is not predicted to be as severe, but still ranges from 15% to 36%.

SLR by 2100 (m)	0.39	0.69	1	1.5
Undeveloped Dry Land	15%	21%	27%	36%
Brackish Marsh	31%	80%	100%	100%
Developed Dry Land	17%	31%	41%	59%

**Predicted Loss Rates of Land Categories by 2100 Given Simulated Scenarios of Eustatic Sea Level Rise**

Maps of SLAMM input and output to follow will use the following legend:





Conscience Point NWR

IPCC Scenario A1B-Mean, 0.39 M SLR Eustatic by 2100

Results in Acres

	Initial	2025	2050	2075	2100
Undeveloped Dry Land	50.0	49.9	49.0	46.7	43.5
Brackish Marsh	8.7	8.7	8.7	8.2	7.2
Developed Dry Land	1.6	1.6	1.5	1.5	1.4
Estuarine Open Water	0.7	0.7	0.7	0.7	0.7
Inland Open Water	0.2	0.2	0.2	0.2	0.2
Trans. Salt Marsh	0.0	0.2	1.1	3.5	6.8
Saltmarsh	0.0	0.0	0.0	0.5	1.4
<b>Total (incl. water)</b>	<b>61.2</b>	<b>61.2</b>	<b>61.2</b>	<b>61.2</b>	<b>61.2</b>



Conscience Point NWR, Initial Condition



Conscience Point NWR, 2025, Scenario A1B Mean Protect Developed Dry Land



Conscience Point NWR, 2050, Scenario A1B Mean Protect Developed Dry Land



Conscience Point NWR, 2075, Scenario A1B Mean Protect Developed Dry Land



Conscience Point NWR, 2100, Scenario A1B Mean Protect Developed Dry Land

Conscience Point NWR

IPCC Scenario A1B-Max, 0.69 M SLR Eustatic by 2100

Results in Acres

	Initial	2025	2050	2075	2100
Undeveloped Dry Land	50.0	49.7	47.3	42.8	40.4
Brackish Marsh	8.7	8.7	7.7	4.7	2.3
Developed Dry Land	1.6	1.6	1.5	1.3	1.2
Estuarine Open Water	0.7	0.7	0.7	0.7	0.7
Inland Open Water	0.2	0.2	0.2	0.2	0.2
Trans. Salt Marsh	0.0	0.4	2.8	7.5	7.8
Saltmarsh	0.0	0.0	1.0	4.0	8.7
<b>Total (incl. water)</b>	<b>61.2</b>	<b>61.2</b>	<b>61.2</b>	<b>61.2</b>	<b>61.2</b>



Conscience Point NWR, Initial Condition



Conscience Point NWR, 2025, Scenario A1B Maximum Protect Developed Dry Land



Conscience Point NWR, 2050, Scenario A1B Maximum Protect Developed Dry Land



Conscience Point NWR, 2075, Scenario A1B Maximum Protect Developed Dry Land



Conscience Point NWR, 2100, Scenario A1B Maximum Protect Developed Dry Land

Conscience Point NWR  
1 Meter Eustatic SLR by 2100

Results in Acres

	Initial	2025	2050	2075	2100
Undeveloped Dry Land	50.0	49.4	44.7	40.7	37.2
Brackish Marsh	8.7	8.7	5.6	2.0	0.1
Developed Dry Land	1.6	1.6	1.4	1.2	1.0
Estuarine Open Water	0.7	0.7	0.7	0.7	1.4
Inland Open Water	0.2	0.2	0.2	0.2	0.2
Trans. Salt Marsh	0.0	0.6	5.5	7.3	5.3
Saltmarsh	0.0	0.0	3.1	9.2	15.4
Tidal Flat	0.0	0.0	0.0	0.0	0.7
<b>Total (incl. water)</b>	<b>61.2</b>	<b>61.2</b>	<b>61.2</b>	<b>61.2</b>	<b>61.2</b>



Conscience Point NWR, Initial Condition



Conscience Point NWR, 2025, 1 meter Protect Developed Dry Land



Conscience Point NWR, 2050, 1 meter Protect Developed Dry Land



Conscience Point NWR, 2075, 1 meter Protect Developed Dry Land



Conscience Point NWR, 2100, 1 meter Protect Developed Dry Land

Conscience Point NWR  
1.5 Meters Eustatic SLR by 2100

Results in Acres

	Initial	2025	2050	2075	2100
Undeveloped Dry Land	50.0	48.7	42.3	37.2	32.9
Brackish Marsh	8.7	7.9	2.7	0.0	0.0
Developed Dry Land	1.6	1.5	1.3	1.0	0.7
Estuarine Open Water	0.7	0.7	0.7	1.5	4.6
Inland Open Water	0.2	0.2	0.2	0.2	0.0
Trans. Salt Marsh	0.0	1.4	7.5	5.4	4.5
Saltmarsh	0.0	0.8	6.5	14.0	13.9
Tidal Flat	0.0	0.0	0.0	1.8	4.5
<b>Total (incl. water)</b>	<b>61.2</b>	<b>61.2</b>	<b>61.2</b>	<b>61.2</b>	<b>61.2</b>



Conscience Point NWR, Initial Condition



Conscience Point NWR, 2025, 1.5 meter Protect Developed Dry Land



Conscience Point NWR, 2050, 1.5 meter Protect Developed Dry Land





Conscience Point NWR, 2075, 1.5 meter Protect Developed Dry Land



Conscience Point NWR, 2100, 1.5 meter Protect Developed Dry Land

## Discussion

The most significant model prediction is the loss of irregularly flooded (brackish) marshes under the higher scenarios of eustatic sea level rise. Once sea level rise is predicted to exceed measured accretion rates these marshes are assumed to convert, first to regularly-flooded salt marsh, then to tidal flats, and finally to open water under the highest sea level rise scenarios utilized.

Predicted loss rates of brackish marsh within SLAMM are functions of initial marsh elevations, estimated marsh vertical accretion rates, and predicted local sea level rise rates. Initial marsh elevations are quite uncertain due to the age and precision of the National Elevation Dataset. Accretion rates are predicted to remain constant over the study period and are also a source of model uncertainty.

Up to one third of dry land at this site is also predicted to be lost. This is primarily a function of initial dry land elevation, tidal range, and the sea level rise scenarios utilized. The low vertical precision of the elevation data is the largest source of uncertainty for these model results.

## References

- Cahoon, D.R., J. W. Day, Jr., and D. J. Reed, 1999. "The influence of surface and shallow subsurface soil processes on wetland elevation: A synthesis." *Current Topics in Wetland Biogeochemistry*, 3, 72-88.
- Cashin Associates. 2006b. *Spotted Turtles: Use of Mosquito-control Ditches*. Suffolk County Vector Control and Wetlands Management Long-Term Plan and Environmental Impact. [accretion reference]
- Chen, J. L., Wilson, C. R., Tapley, B. D., 2006 "Satellite Gravity Measurements Confirm Accelerated Melting of Greenland Ice Sheet" *Science* 2006 0: 1129007
- Clough, J.S. and R.A. Park, 2007, *Technical Documentation for SLAMM 5.0.1* February 2008, Jonathan S. Clough, Warren Pinnacle Consulting, Inc, Richard A. Park, Eco Modeling.  
<http://warrenpinnacle.com/prof/SLAMM>
- Craft C, Clough J, Ehman J, Guo H, Joye S, Machmuller M, Park R, and Pennings S. Effects of Accelerated Sea Level Rise on Delivery of Ecosystem Services Provided by Tidal Marshes: A Simulation of the Georgia (USA) Coast. *Frontiers in Ecology and the Environment*. 2009; 7, doi:10.1890/070219
- Council for Regulatory Environmental Modeling, (CREM) 2008. *Draft guidance on the development, evaluation, and application of regulatory environmental models* P Pascual, N Stiber, E Sunderland - Washington DC: Draft, August 2008
- Glick, Clough, et al. *Sea-level Rise and Coastal Habitats in the Pacific Northwest An Analysis for Puget Sound, Southwestern Washington, and Northwestern Oregon* July 2007  
<http://www.nwf.org/sealevelrise/pdfs/PacificNWSeaLevelRise.pdf>
- IPCC, 2001: *Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change* [Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881pp.
- Lee, J.K., R.A. Park, and P.W. Mausell. 1992. Application of Geoprocessing and Simulation Modeling to Estimate Impacts of Sea Level Rise on the Northeast Coast of Florida. *Photogrammetric Engineering and Remote Sensing* 58:11:1579-1586.
- McLetchie, K.M. 2006. A Retrospective Study of Salt Marsh Response to Historical Anthropogenic Modifications at Seatuck and Conscience Point National Wildlife Refuges. Marine Sciences Research Center, Stony Brook.
- Meehl GA, Stocker TF, Collins WD, Friedlingstein P, Gaye AT, Gregory JM, Kitoh A, Knutti R, Murphy JM, Noda A, Raper SCB, Watterson IG, Weaver AJ and Zhao ZC. 2007. Global climate projections. Pp. 747-845. In: Solomon S, Qin, D, Manning M, Chen Z, Marquis M, Averyt KB, Tignor, M and Miller HL, (eds.) *Climate change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK: Cambridge University Press.

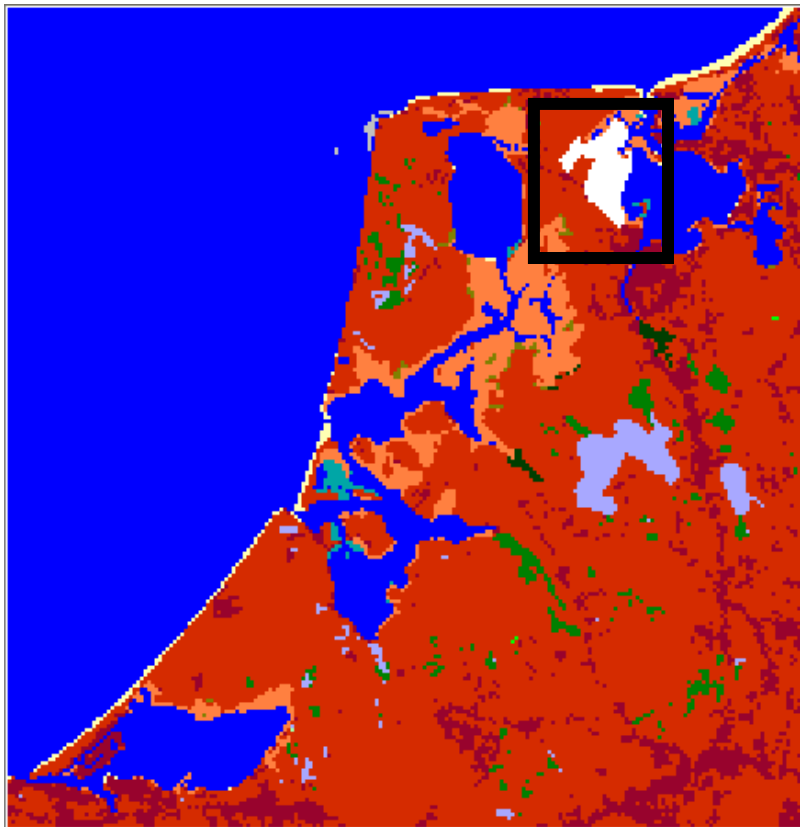
- Monaghan, A. J. *et al*, 2006 “Insignificant Change in Antarctic Snowfall Since the International Geophysical Year” *Science* 2006 313: 827-831.
- Moorhead, KK and Brinson MM. 1995. Response of wetlands to rising sea level in the lower coastal plain of North Carolina. *Ecological Applications* 5: 261-271.
- Orson, R.A., R.S. Warren, and W.A. Neiring, 1998: Interpreting sea level rise and rates of vertical marsh accretion in a southern New England tidal salt marsh. *Estuarine, Coastal and Shelf Science*, 47, 419-429.
- Park, R.A., J.K. Lee, and D. Canning. 1993. Potential Effects of Sea Level Rise on Puget Sound Wetlands. *Geocarto International* 8(4):99-110.
- Park, R.A., M.S. Trehan, P.W. Mausel, and R.C. Howe. 1989a. The Effects of Sea Level Rise on U.S. Coastal Wetlands. In *The Potential Effects of Global Climate Change on the United States: Appendix B - Sea Level Rise*, edited by J.B. Smith and D.A. Tirpak, 1-1 to 1-55. EPA-230-05-89-052. Washington, D.C.: U.S. Environmental Protection Agency.
- Park, RA, JK Lee, PW Mausel and RC Howe. 1991. Using remote sensing for modeling the impacts of sea level rise. *World Resources Review* 3:184-220.
- Clark, J. S. and W. A. Patterson III. 1984. Pollen, Pb-210 and sedimentation in the intertidal environment. *Journal of Sedimentary Petrology* 54(4):1249-1263.
- Pfeffer, Harper, O'Neel, 2008. Kinematic Constraints on Glacier Contributions to 21st-Century Sea-Level Rise. *Science*, Vol. 321, No. 5894. (5 September 2008), pp. 1340-134
- Rahmstorf, Stefan 2007, “A Semi-Empirical Approach to Projecting Future Sea-Level Rise,” *Science* 2007 315: 368-370.
- Reed, D.J., D.A. Bishara, D.R. Cahoon, J. Donnelly, M. Kearney, A.S. Kolker, L.L. Leonard, R.A. Orson, and J.C. Stevenson, 2008: “Site-Specific Scenarios for Wetlands Accretion in the Mid-Atlantic Region. Section 2.1” in *Background Documents Supporting Climate Change Science Program Synthesis and Assessment Product 4.1: Coastal Elevations and Sensitivity to Sea Level Rise*, J.G. Titus and E.M. Strange (eds.), EPA430R07004, Washington, DC: U.S. EPA.  
[http://www.epa.gov/climatechange/effects/downloads/section2\\_1.pdf](http://www.epa.gov/climatechange/effects/downloads/section2_1.pdf)
- Stevenson and Kearney, 2008, “Impacts of Global Climate Change and Sea-Level Rise on Tidal Wetlands” Pending chapter of manuscript by University of California Press.
- Titus, J.G., R.A. Park, S.P. Leatherman, J.R. Weggel, M.S. Greene, P.W. Mausel, M.S. Trehan, S. Brown, C. Grant, and G.W. Yohe. 1991. Greenhouse Effect and Sea Level Rise: Loss of Land and the Cost of Holding Back the Sea. *Coastal Management* 19:2:171-204.

## Appendix A: Contextual Results

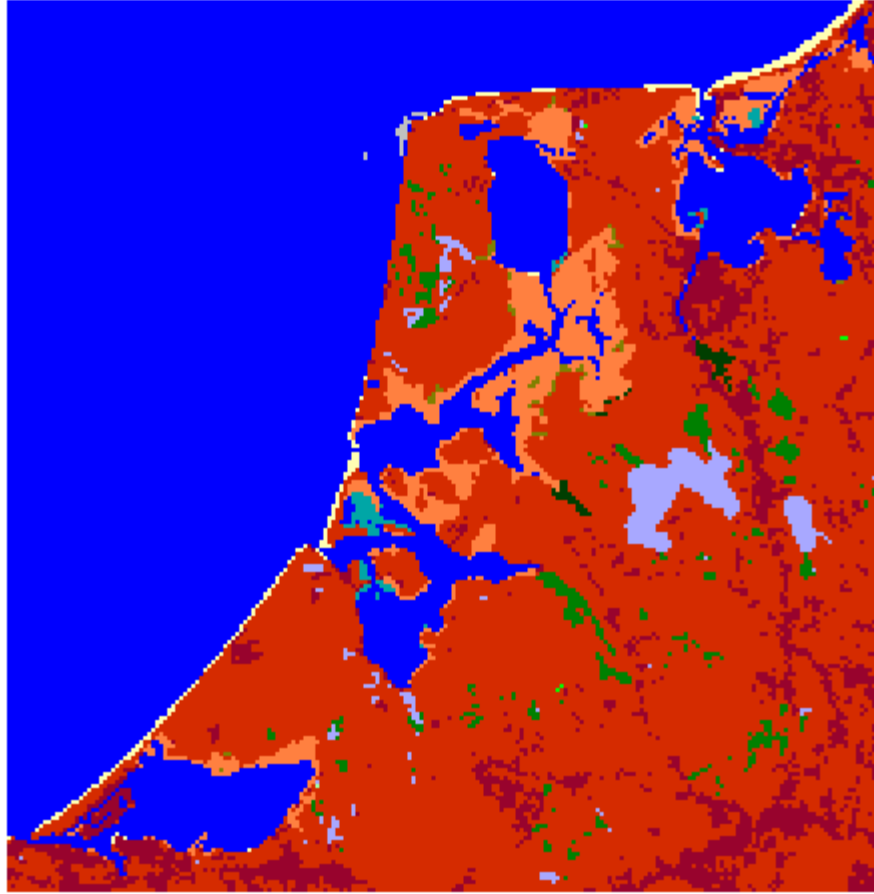
The SLAMM model does take into account the context of the surrounding lands or open water when calculating effects. For example, erosion rates are calculated based on the maximum fetch (wave action) which is estimated by assessing contiguous open water to a given marsh cell. Another example is that inundated dry lands will convert to marshes or ocean beach depending on their proximity to open ocean.

For this reason, an area larger than the boundaries of the USFWS refuge was modeled. These results maps are presented here with the following caveats:

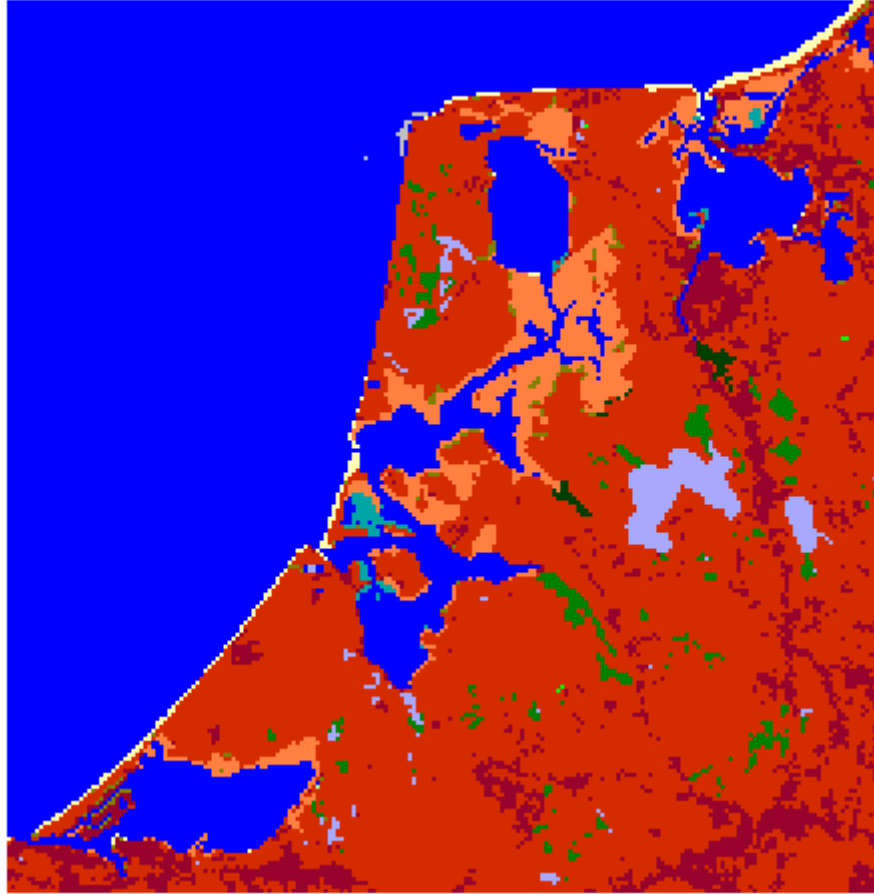
- Results were closely examined (quality assurance) within USFWS refuges but not closely examined for the larger region.
- Site-specific parameters for the model were derived for USFWS refuges whenever possible and may not be regionally applicable.
- Especially in areas where dikes are present, an effort was made to assess the probable location and effects of dikes for USFWS refuges, but this effort was not made for surrounding areas.



Location of Conscience Point National Wildlife Refuge (white area in rectangle) within simulation context

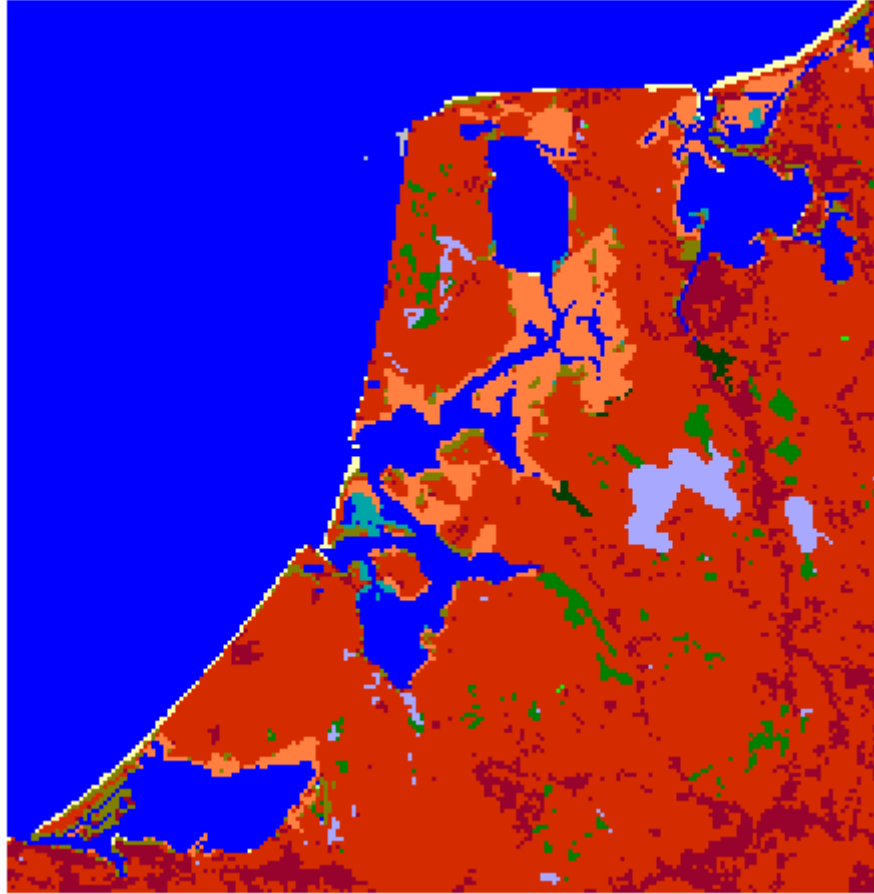


Conscience Point NWR, Initial Condition

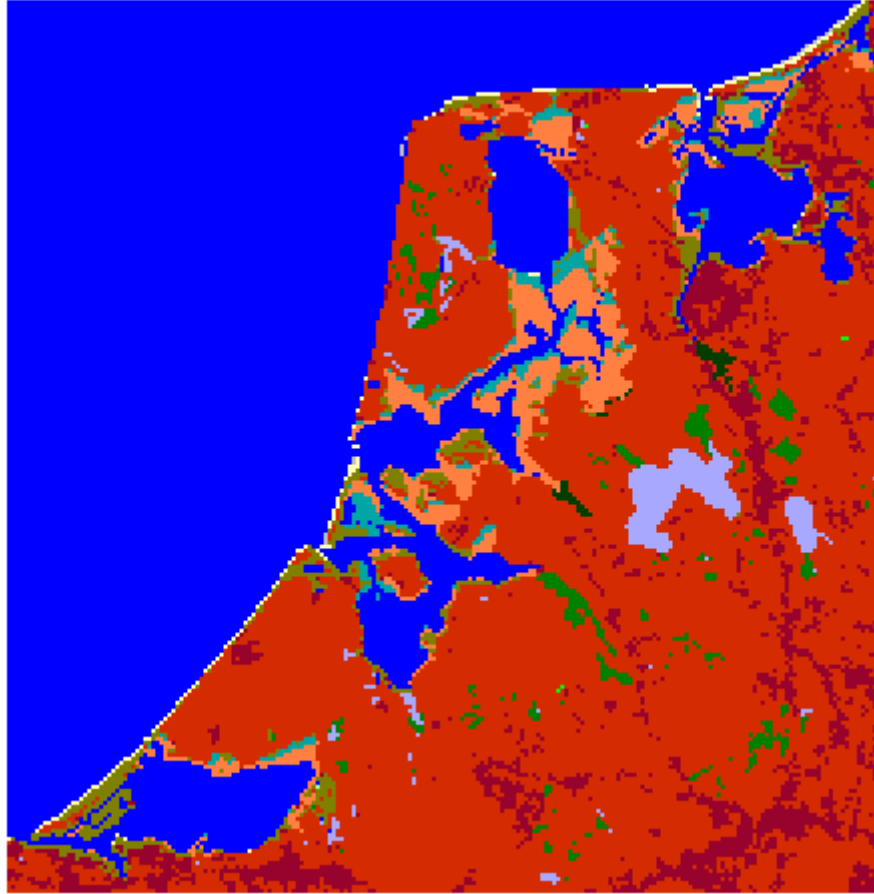


Conscience Point NWR, 2025, Scenario A1B Mean Protect Developed Dry Land

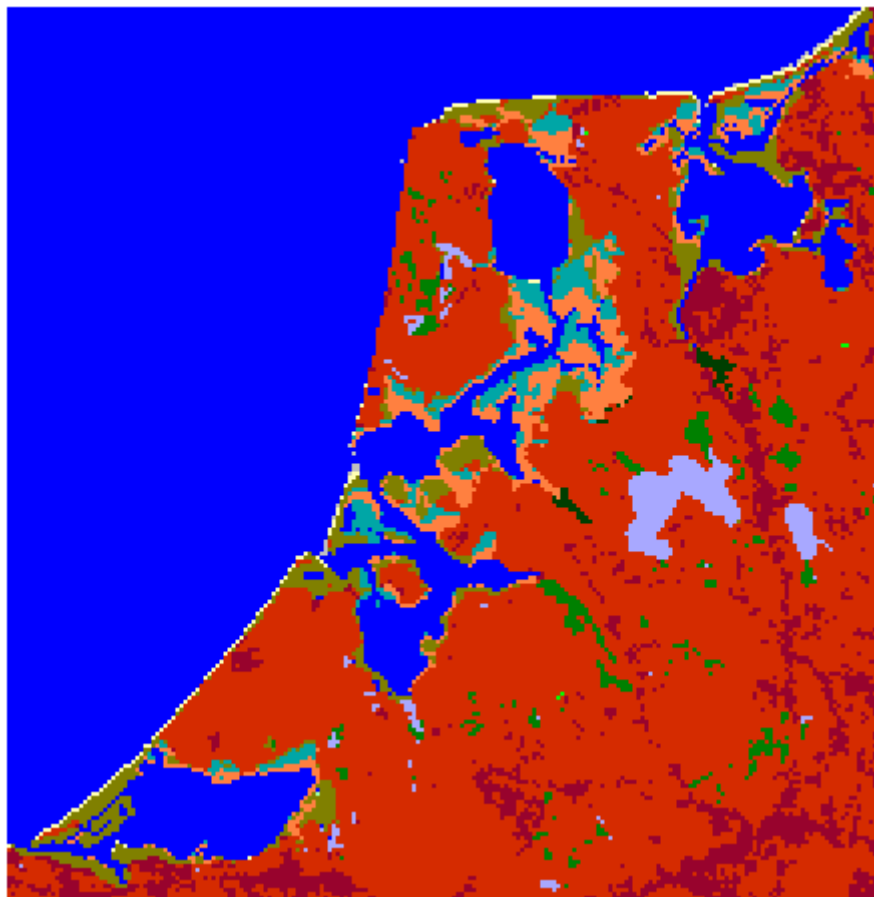




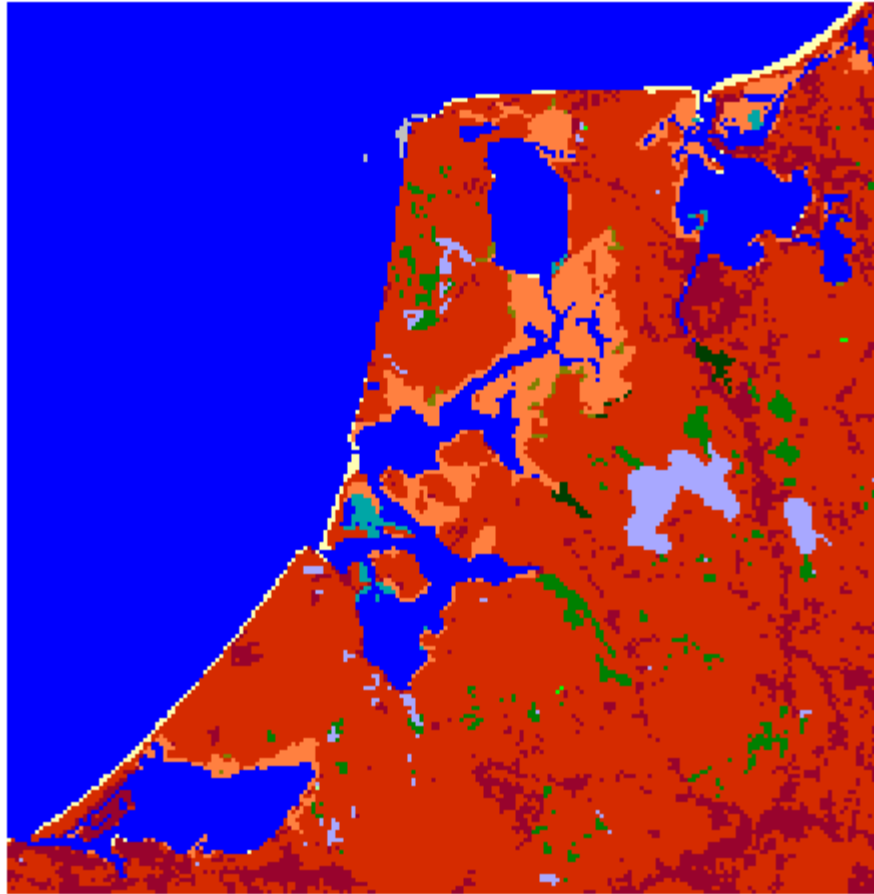
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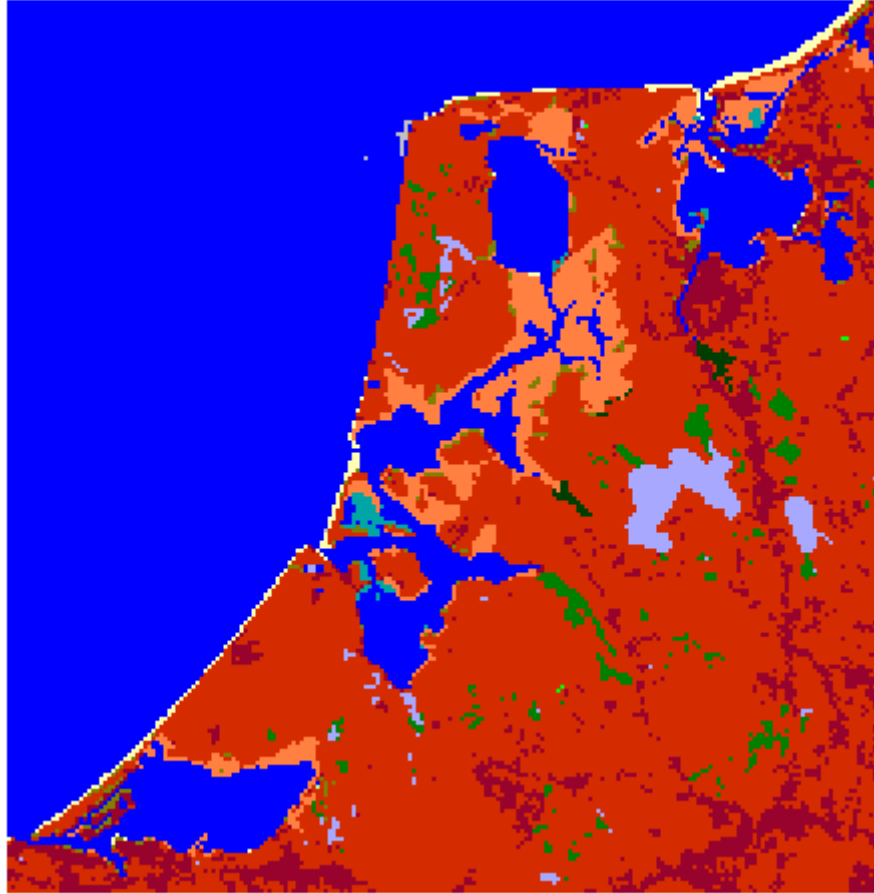
Conscience Point NWR, 2075, Scenario A1B Mean Protect Developed Dry Land



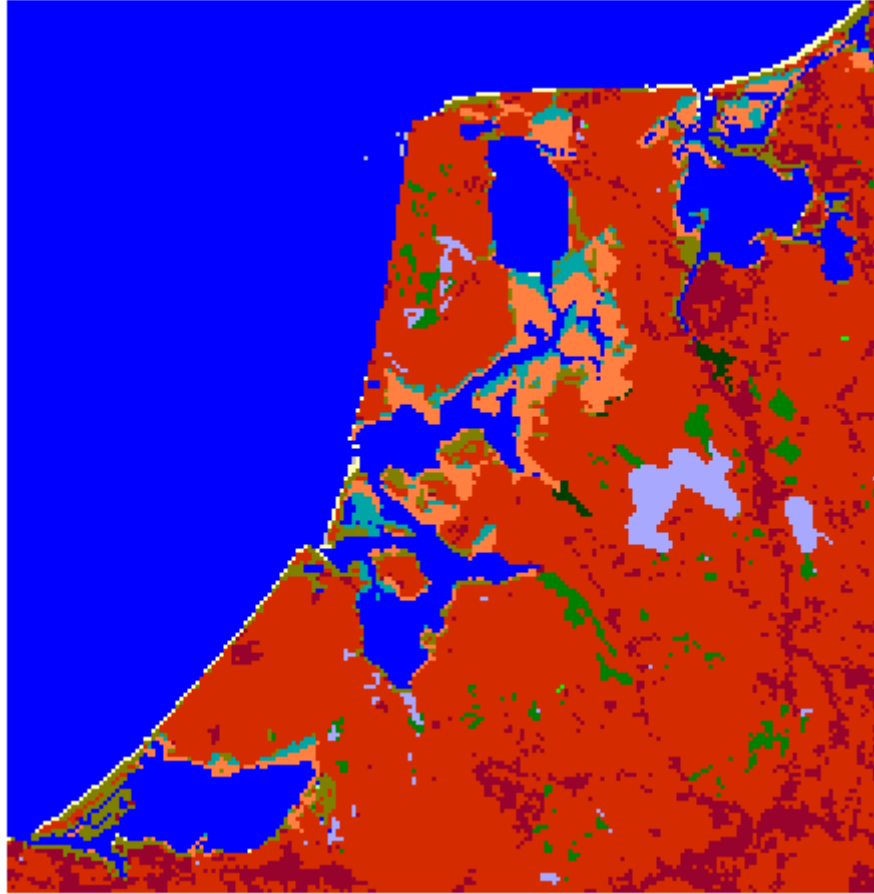
Conscience Point NWR, 2100, Scenario A1B Mean Protect Developed Dry Land



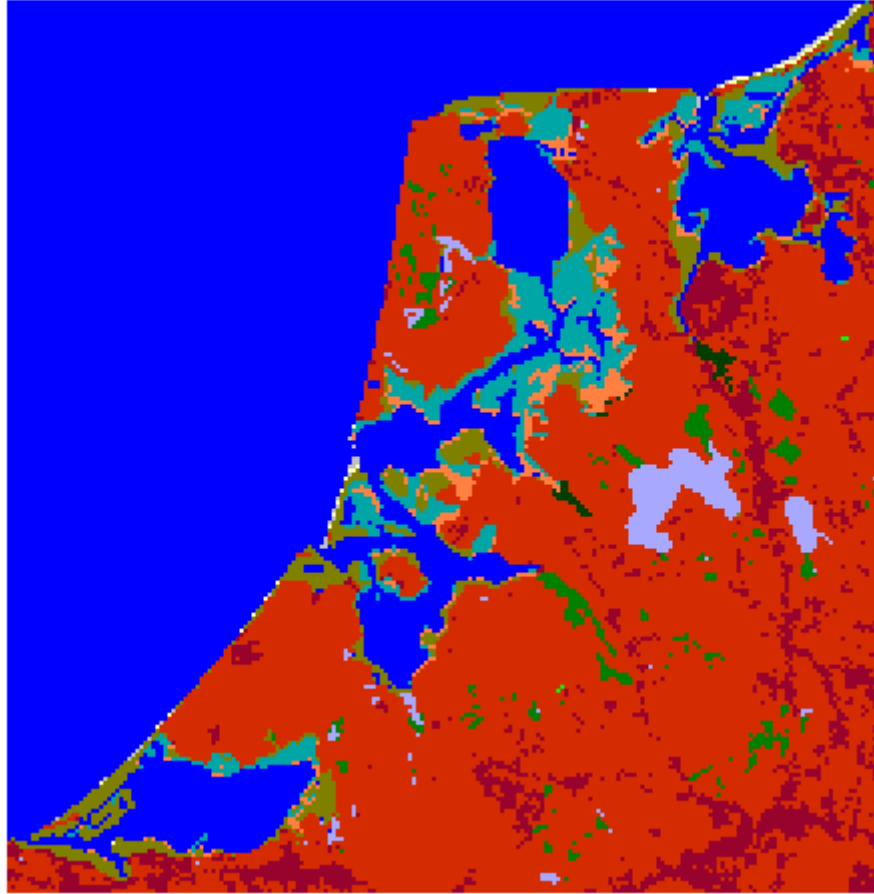
Conscience Point NWR, Initial Condition



Conscience Point NWR, 2025, Scenario A1B Maximum Protect Developed Dry Land

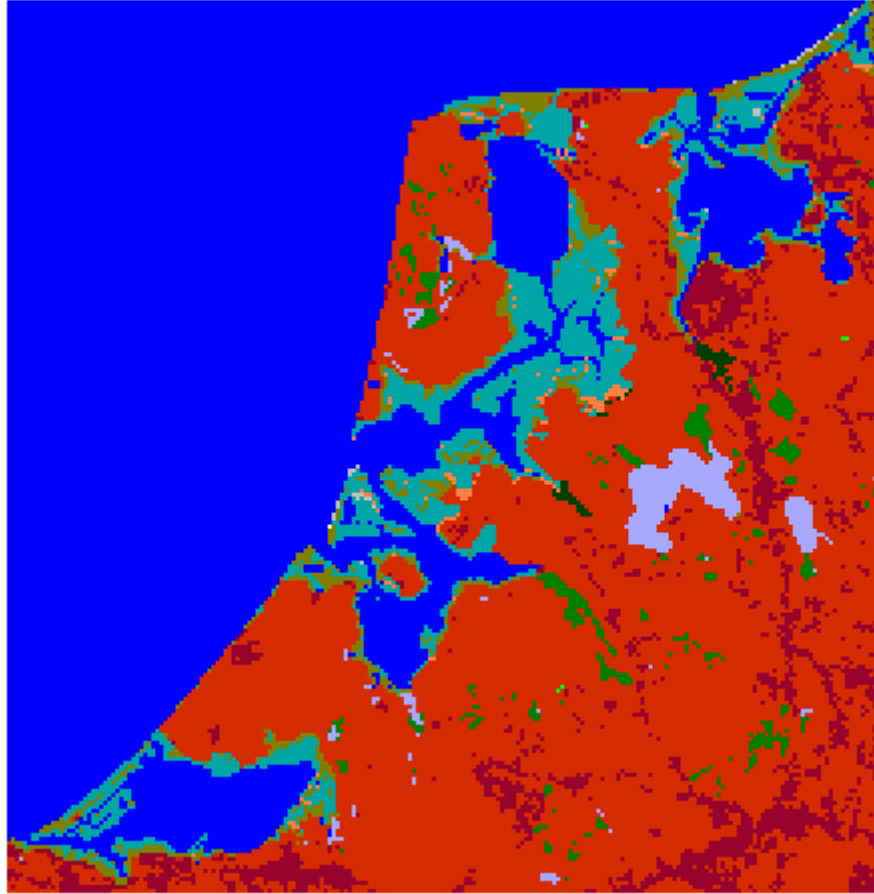


Conscience Point NWR, 2050, Scenario A1B Maximum Protect Developed Dry Land

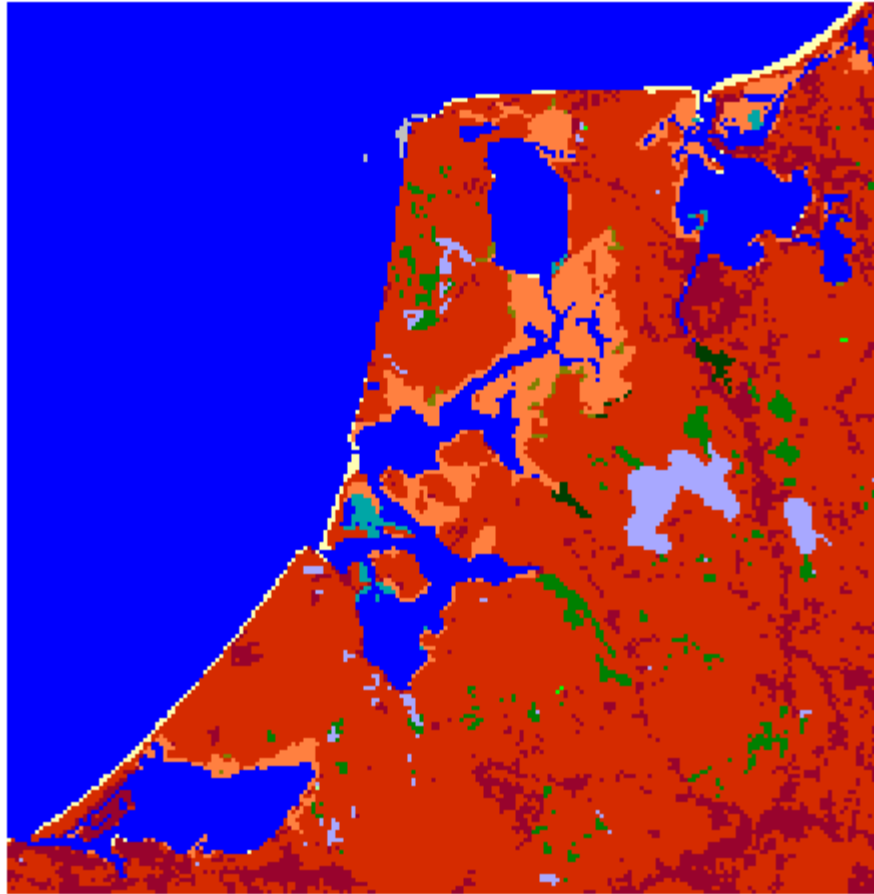


Conscience Point NWR, 2075, Scenario A1B Maximum Protect Developed Dry Land

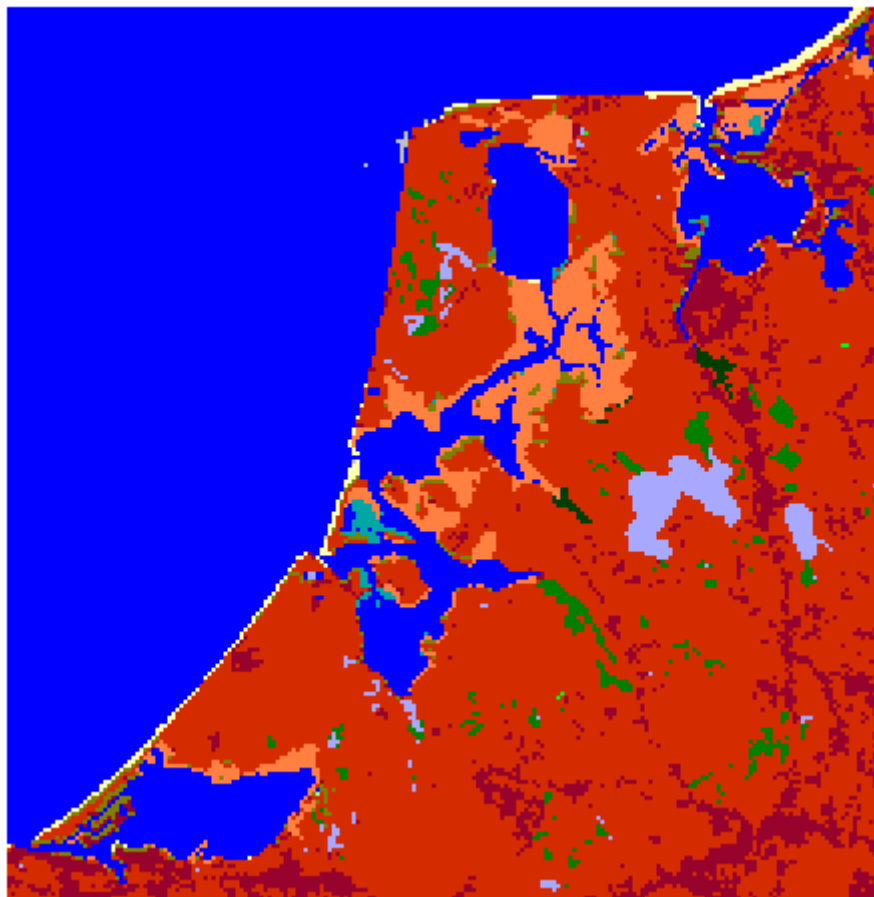




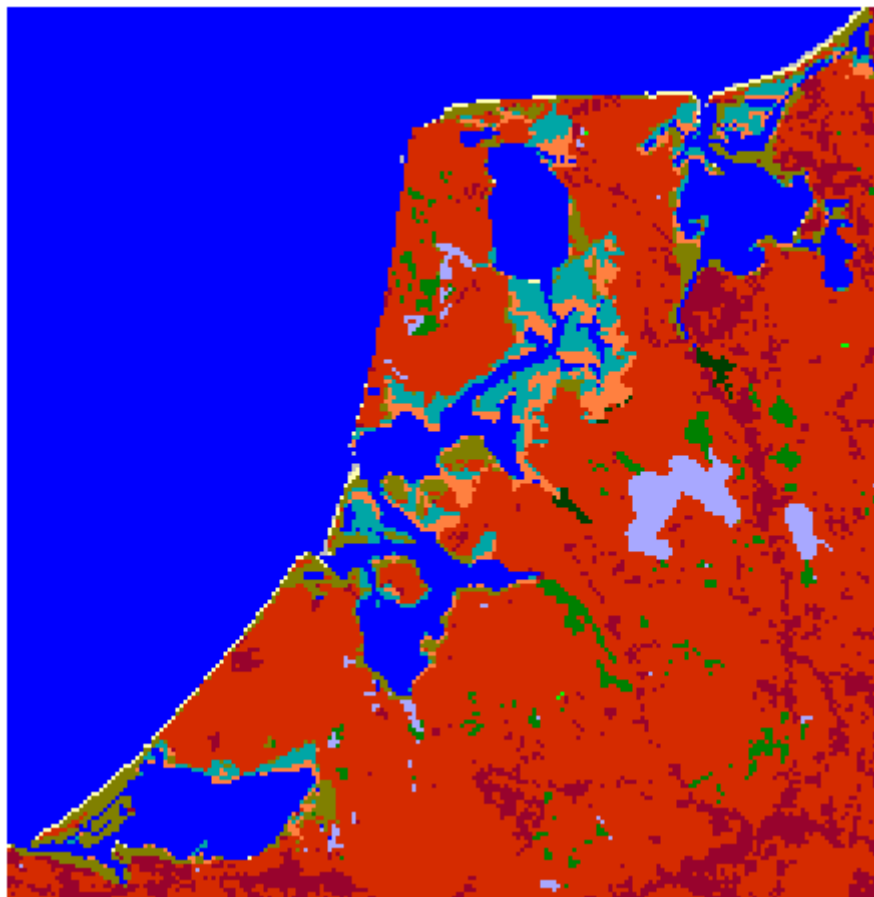
Conscience Point NWR, 2100, Scenario A1B Maximum Protect Developed Dry Land



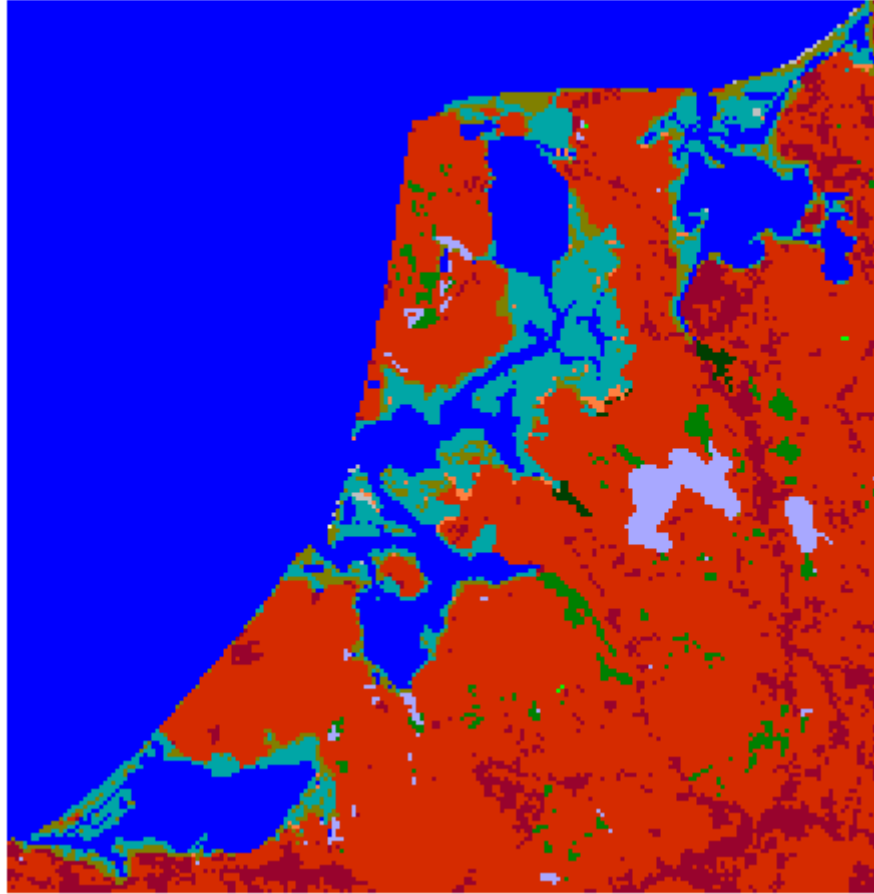
Conscience Point NWR, Initial Condition



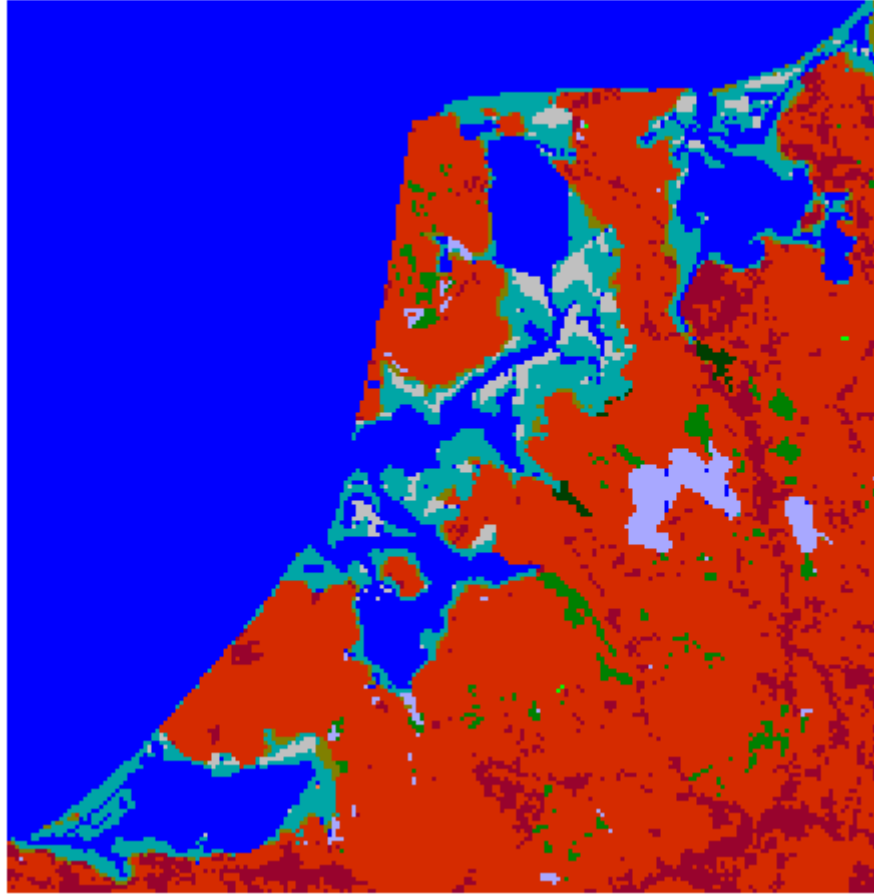
Conscience Point NWR, 2025, 1 meter Protect Developed Dry Land



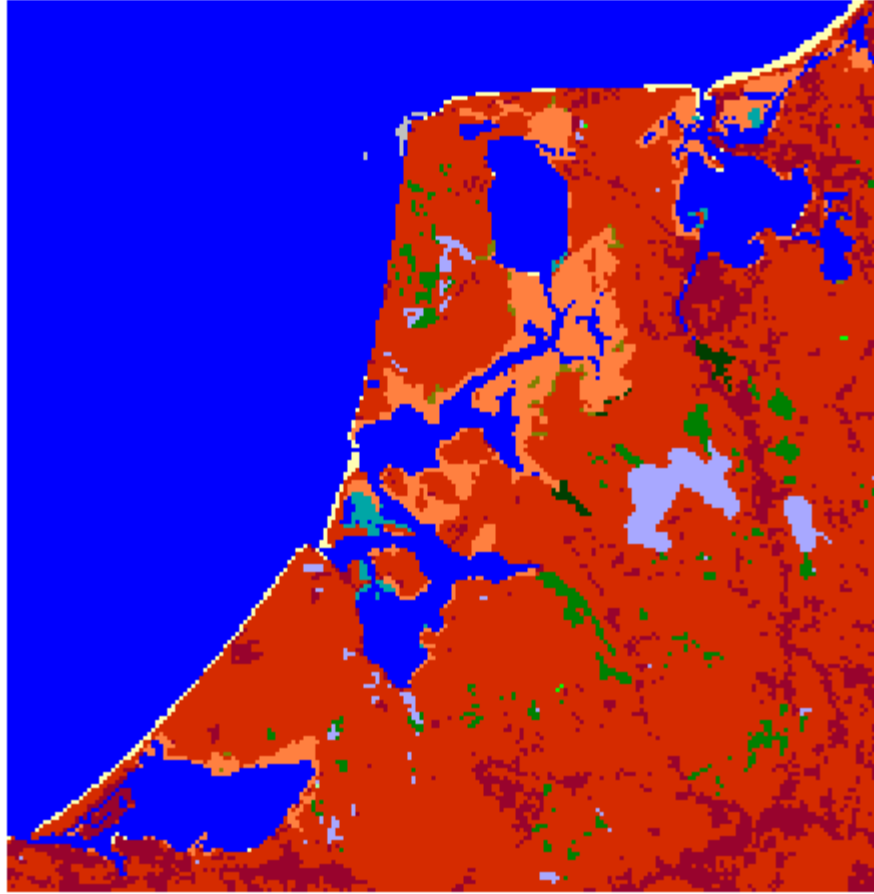
Conscience Point NWR, 2050, 1 meter Protect Developed Dry Land



Conscience Point NWR, 2075, 1 meter Protect Developed Dry Land

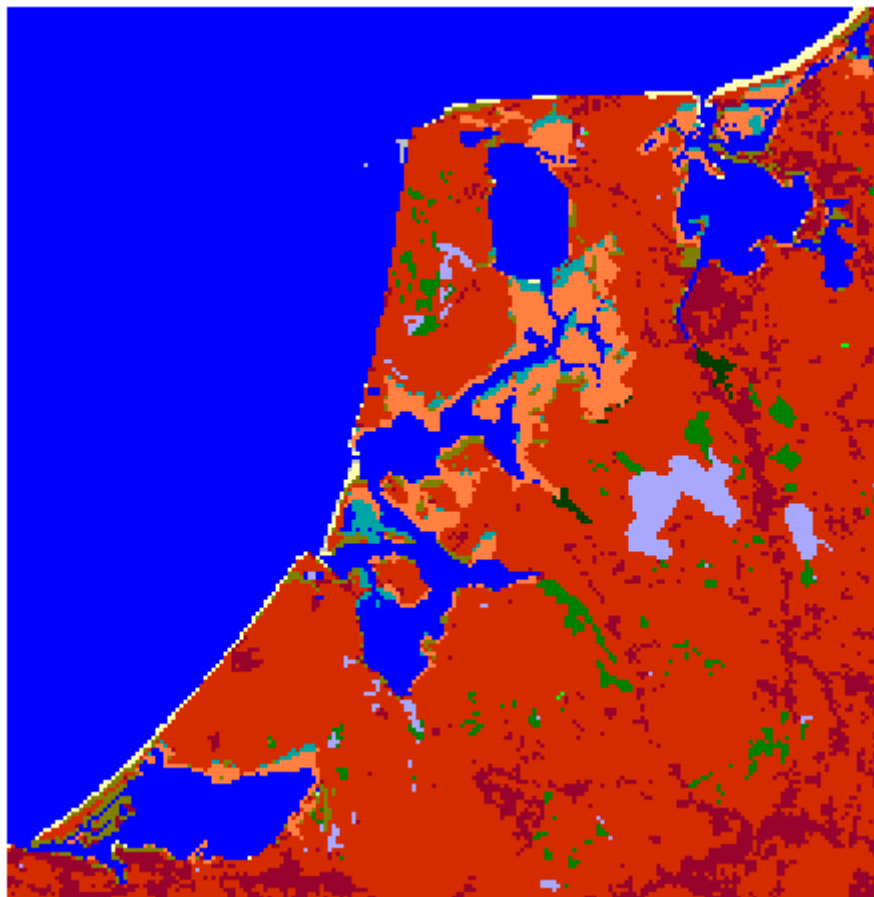


Conscience Point NWR, 2100, 1 meter Protect Developed Dry Land

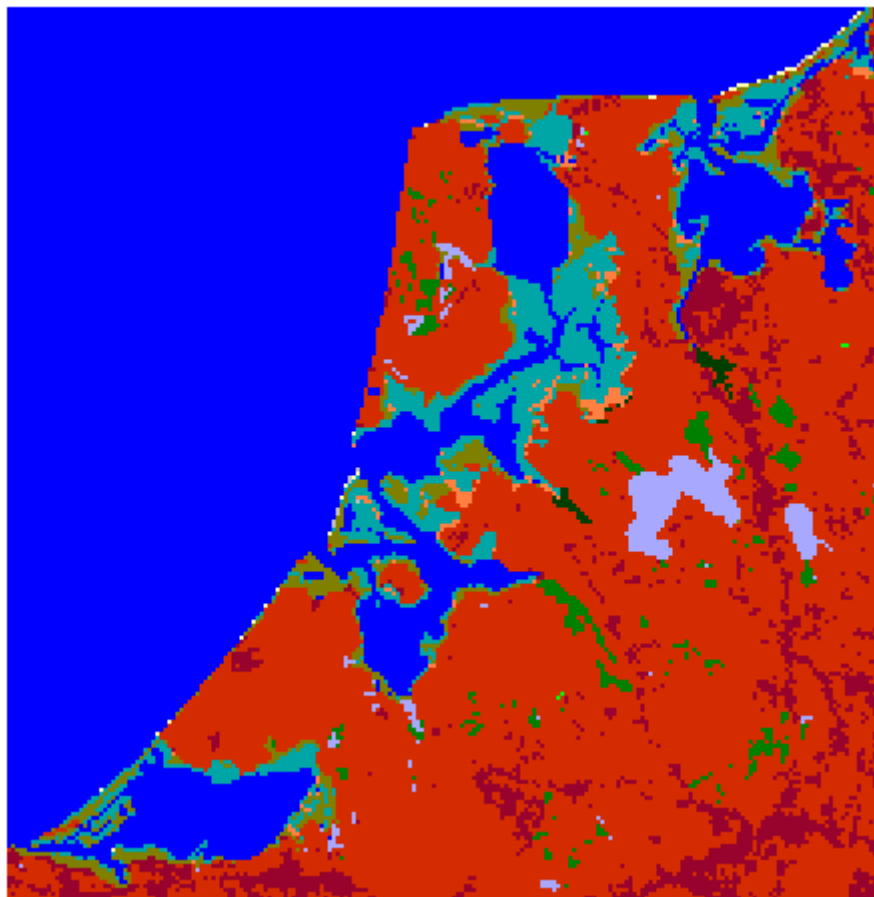


Conscience Point NWR, Initial Condition

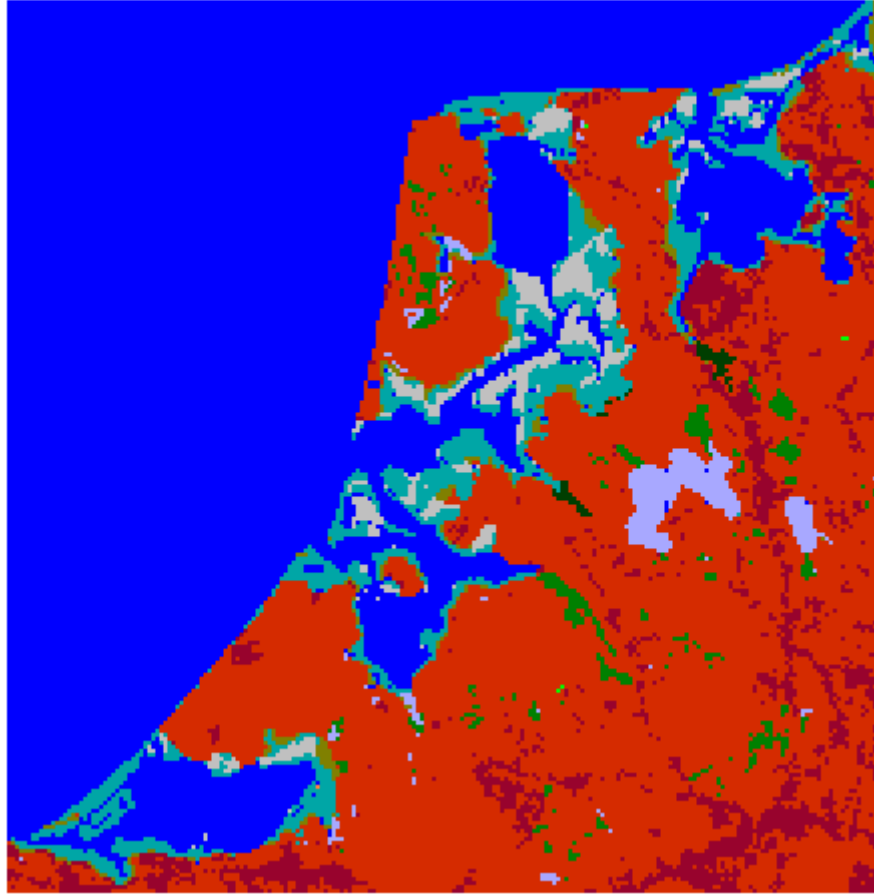




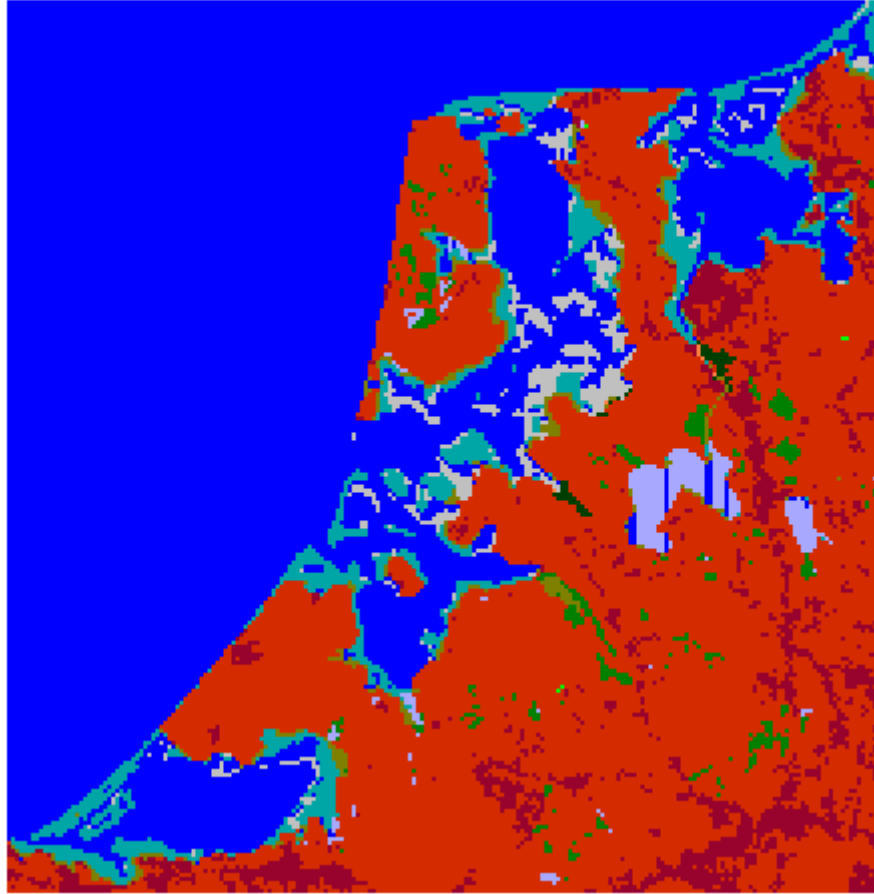
Conscience Point NWR, 2025, 1.5 meter Protect Developed Dry Land



Conscience Point NWR, 2050, 1.5 meter Protect Developed Dry Land



Conscience Point NWR, 2075, 1.5 meter Protect Developed Dry Land



Conscience Point NWR, 2100, 1.5 meter Protect Developed Dry Land