Soil Water Balance Model Overview

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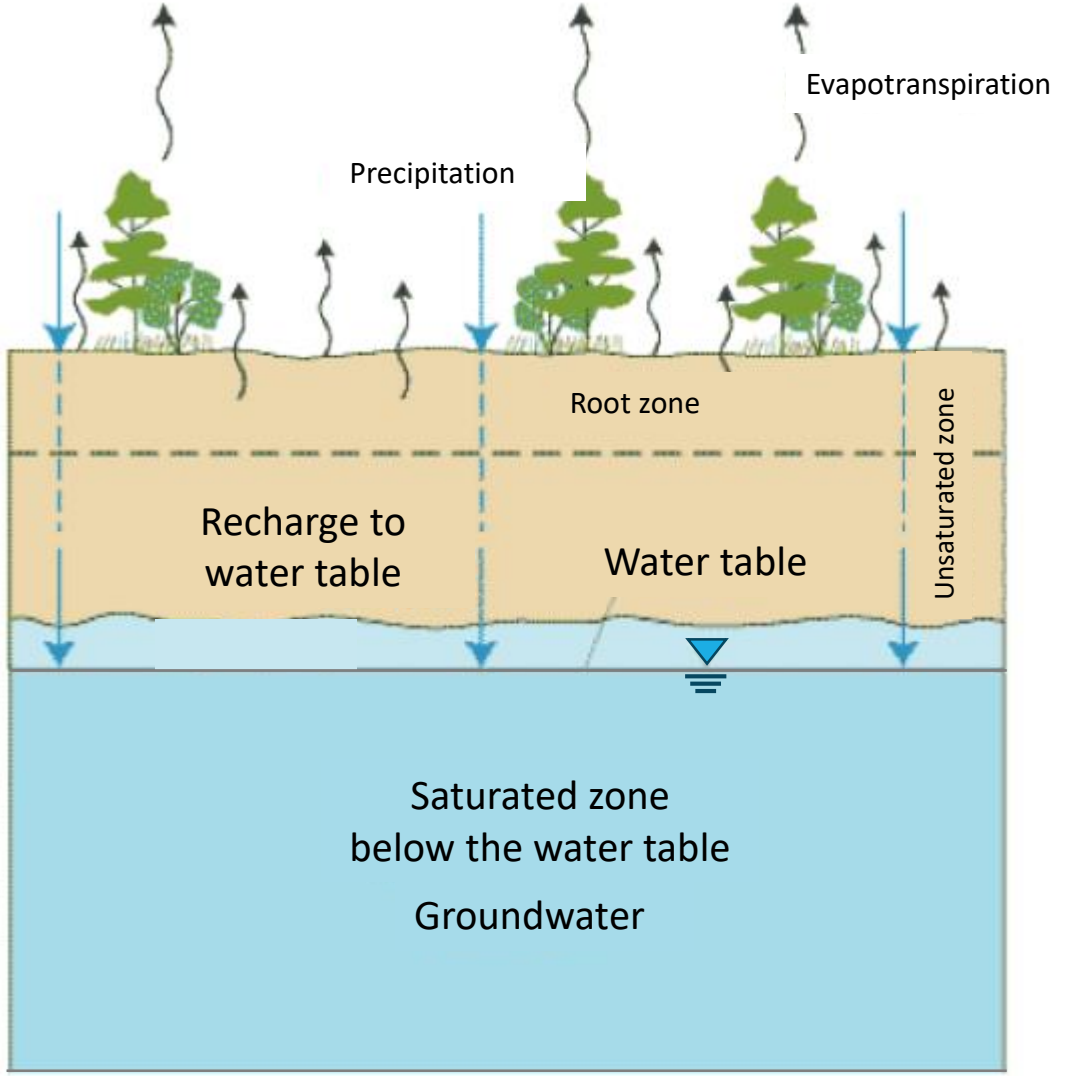
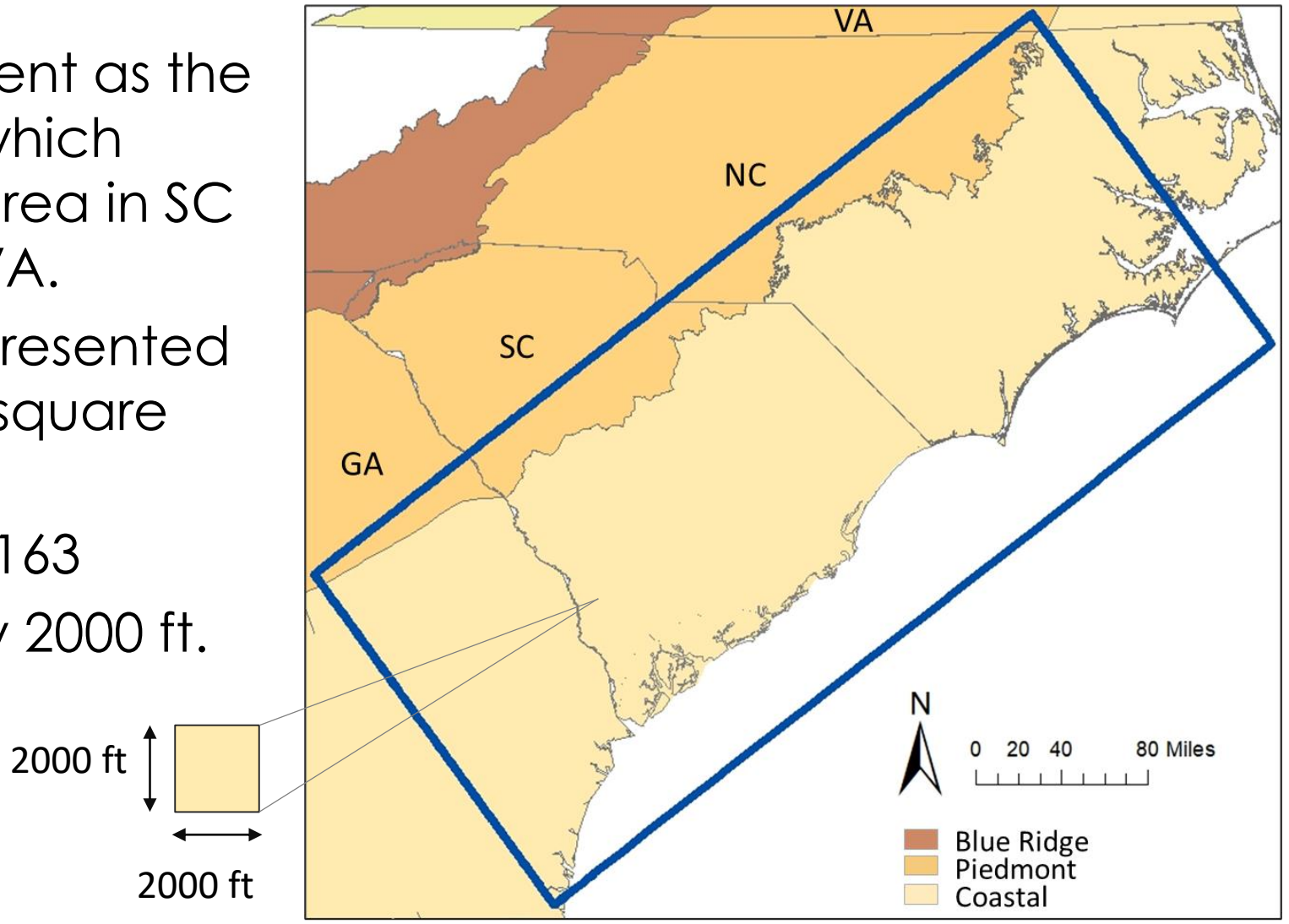
Soil Water Balance Model Overview

- USGS's Soil Water Balance (SWB) model was developed to estimate spatial and temporal distribution of groundwater recharge on a daily time step.
- Groundwater recharge is the volume of water that infiltrates past the root zone and reaches the water table, adding to the groundwater reservoir.
- Recharge output from SWB model is a primary input to the Groundwater Flow model.



Study Area

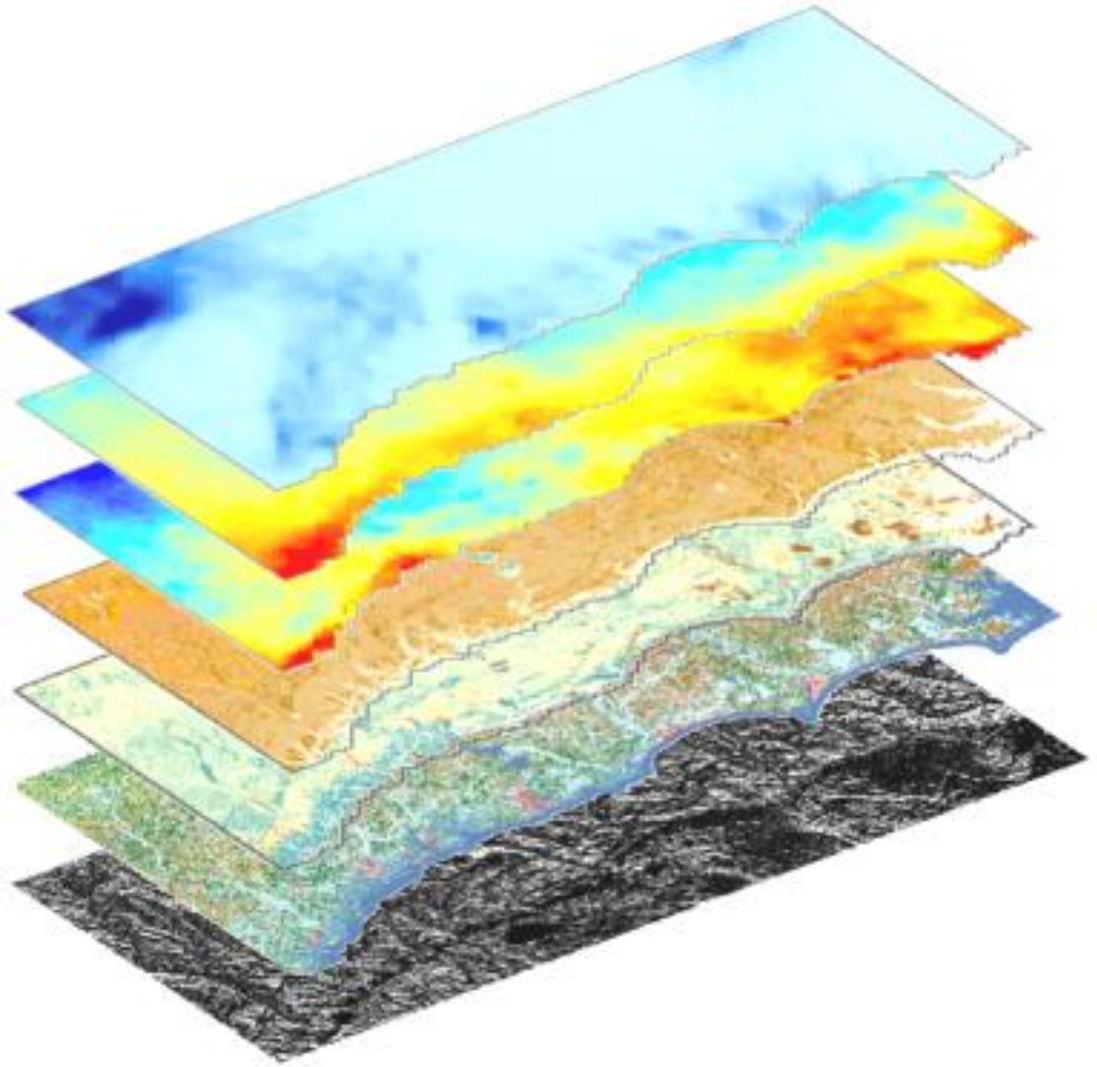
- Model covers the same extent as the Groundwater Flow model which includes the coastal plain area in SC and parts of GA, NC, and VA.
- The model study area is represented by a grid of uniformly sized square cells.
  - Total no. of cells = 1,255,163
  - Cell resolution of 2000 by 2000 ft.



Model Inputs

Input Data Grids

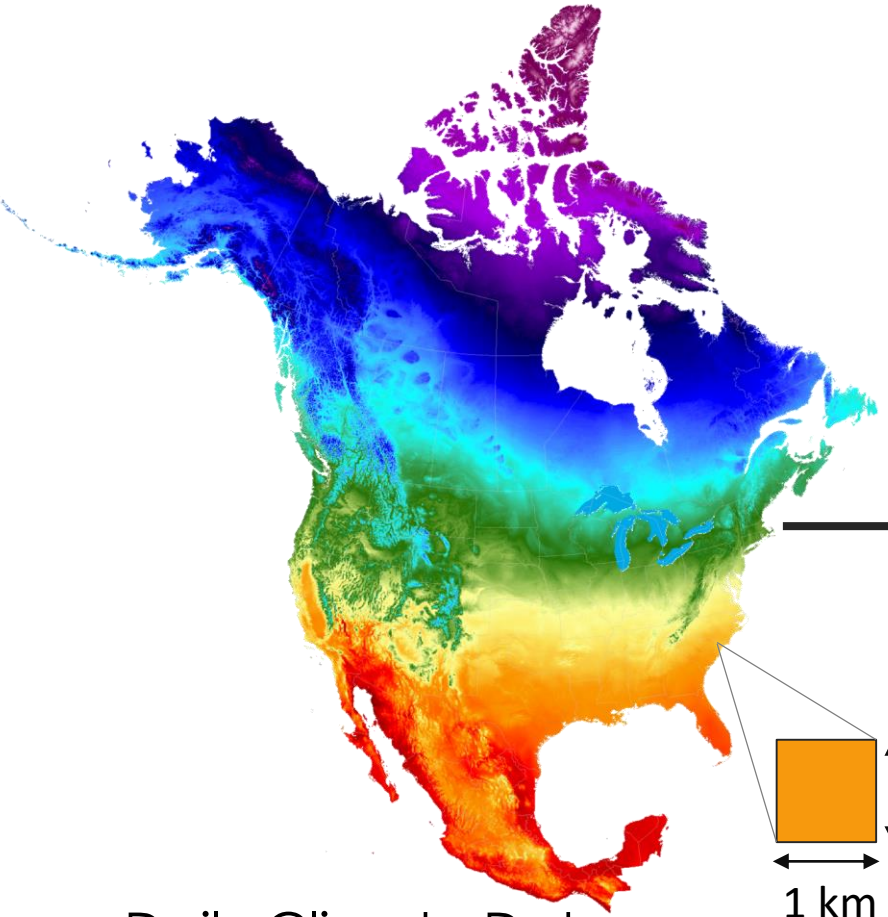
- Climate Data
  - Precipitation
  - Temperature
- Hydrologic Soil Groups
- Available Water Capacity
- Land Cover
- Surface Water Flow Direction based on Digital Elevation model (DEM)

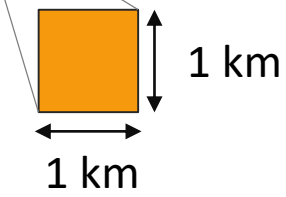


Model Inputs - Daily Climate Data

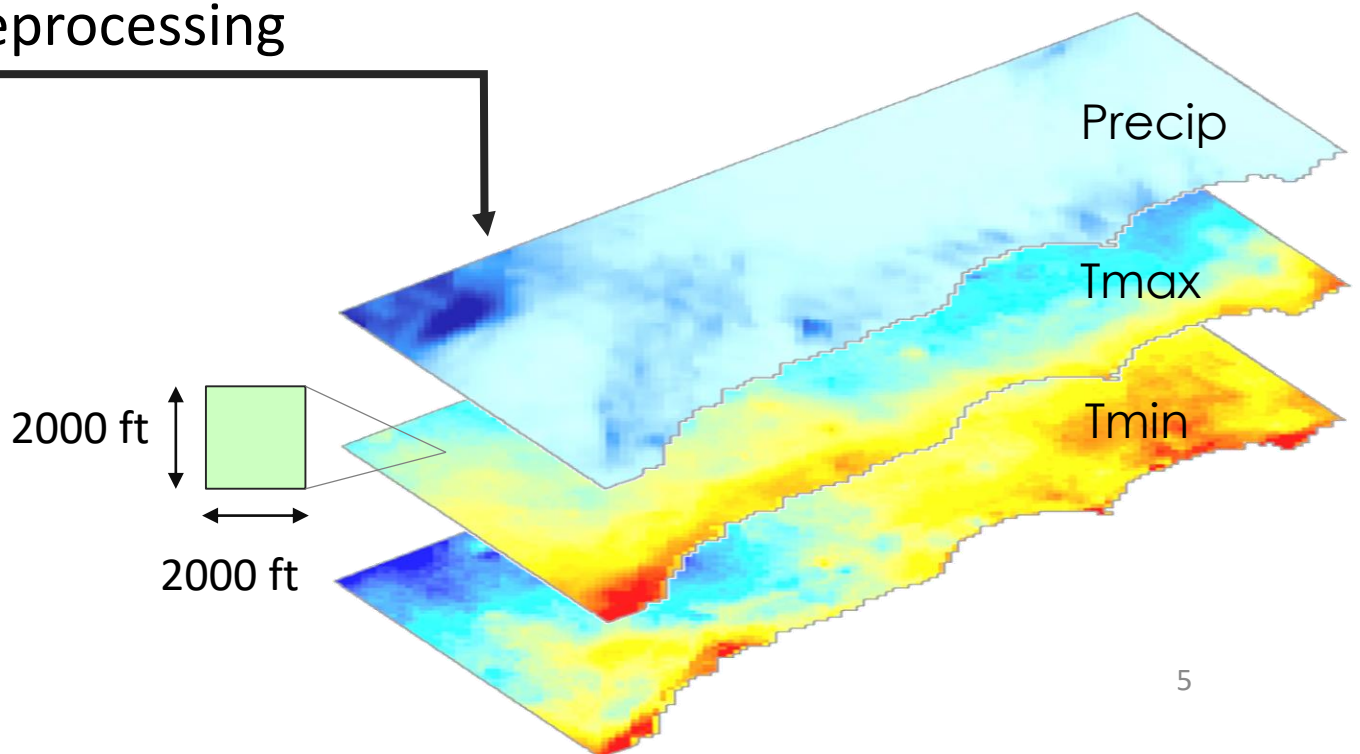
DAYMET Daily Gridded Dataset

- Gridded estimates of daily weather parameters (1 km x 1 km).
- Data available since 1980.





Data Preprocessing



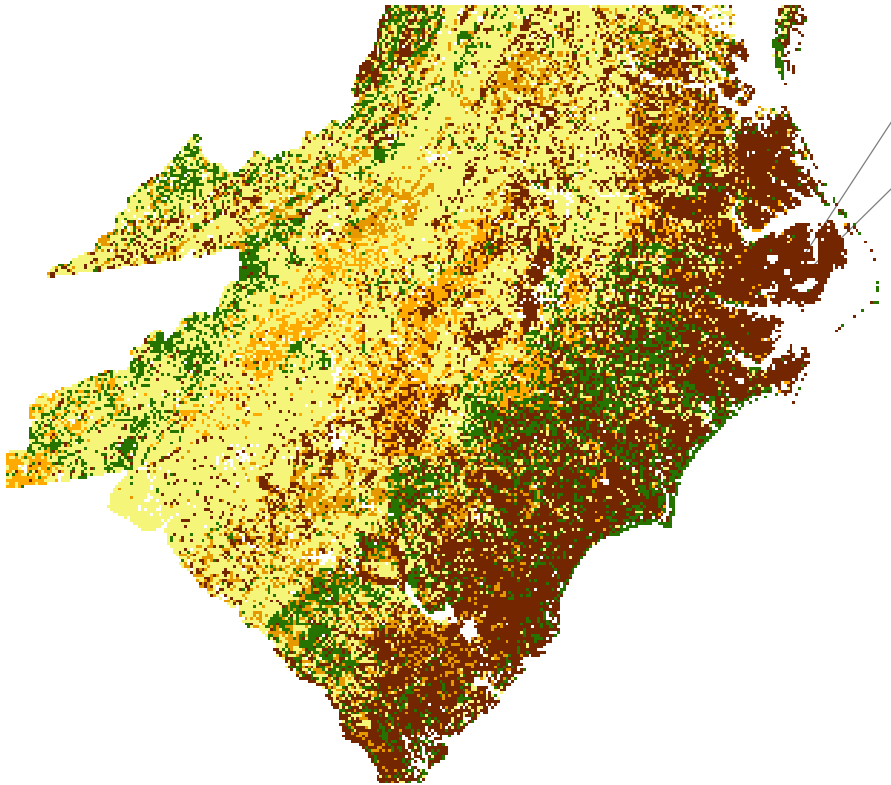
- Daily Climate Data
  - Precipitation
  - Minimum Temperature
  - Maximum Temperature

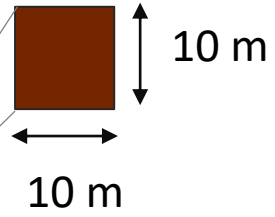
Model Inputs - Hydrologic Soil Groups

- Gridded Soil Survey Geographic Database (**GSSURGO**).
- Integer-valued grid containing soil group for each cell.
- Data provided by USGS.

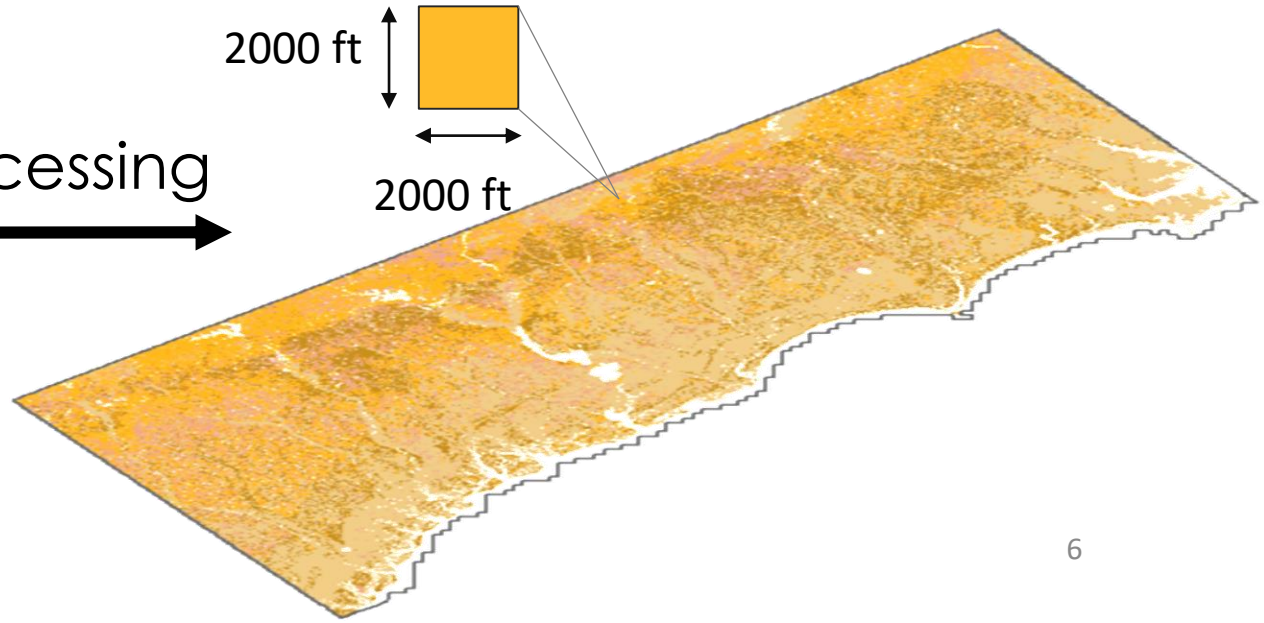
Table 2–2. Infiltration rates for hydrologic soil groups and associated Soil-Water-Balance (SWB) grid values.

Hydrologic soil group	Infiltration rate	Integer grid value
A	Greater than 0.3 inch per hour	1
B	0.15 to 0.3 inch per hour	2
C	0.05 to less than 0.15 inch per hour	3
D	Less than 0.05 inch per hour	4



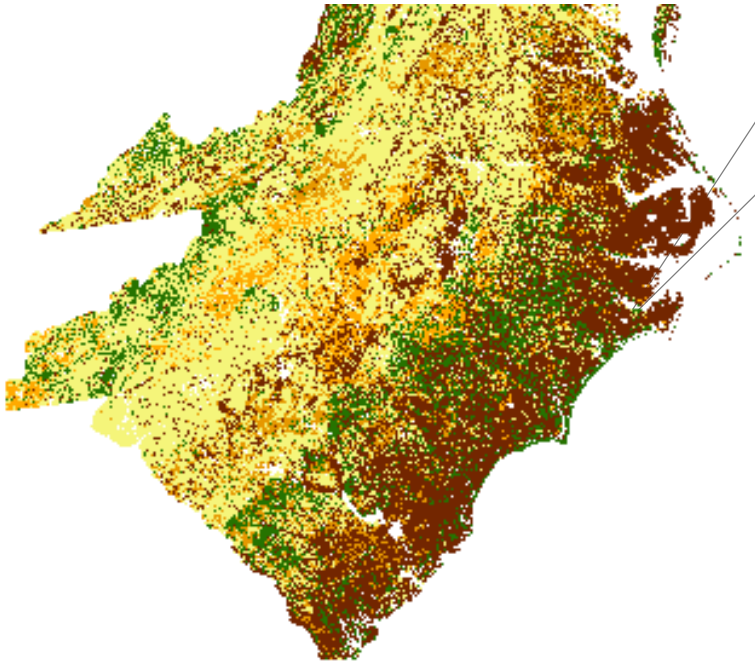


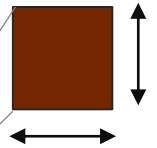
Data Preprocessing



Model Inputs - Available Water Capacity

- Amount of water that soil holds which can be lost to evapotranspiration.
- Used in conjunction with root zone depth to calculate total available water.
- Gridded Soil Survey Geographic Database (**GSSURGO**).
- Typically averaged over the top 0 -100 cm of soil profile.
- Data provided by USGS.

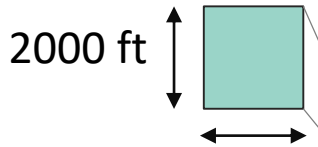


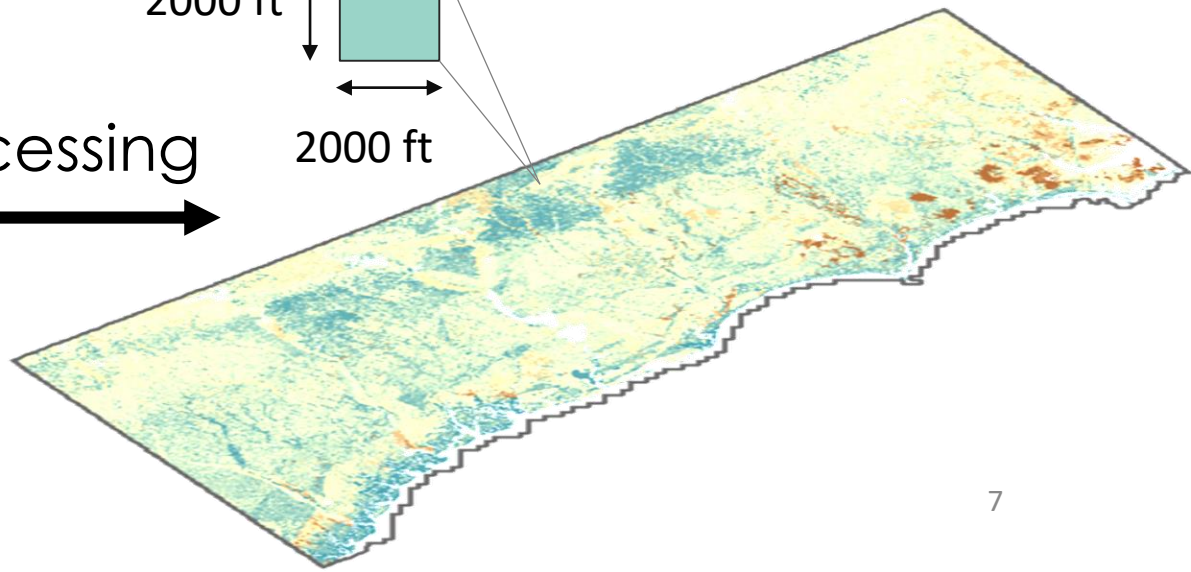


mm/100 cm

Data Preprocessing

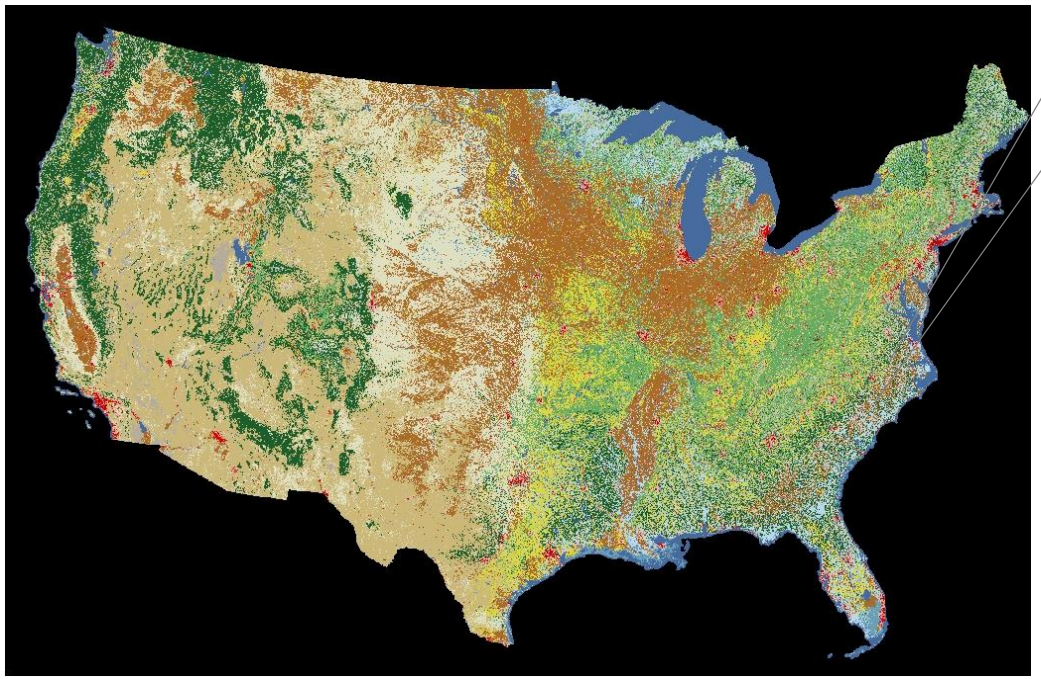
inch/ft

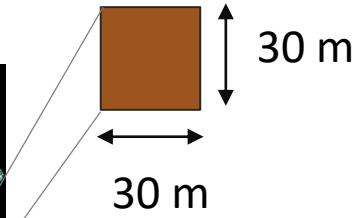




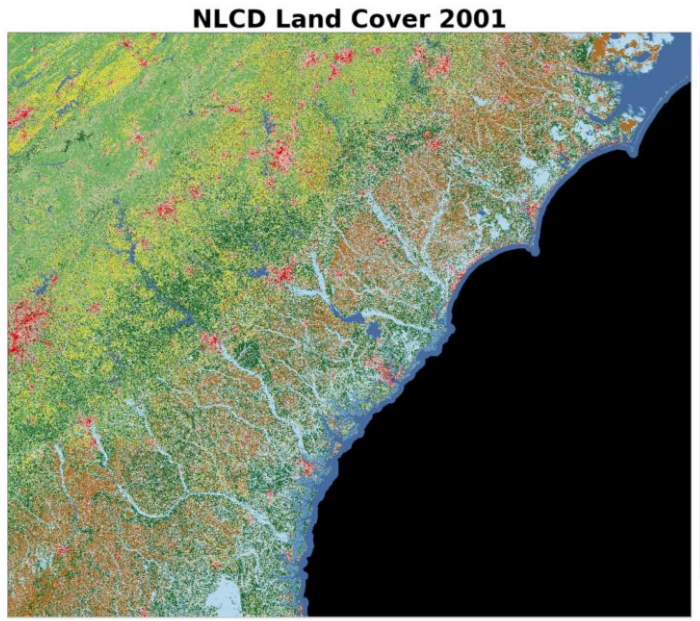
Model Inputs - Land Cover

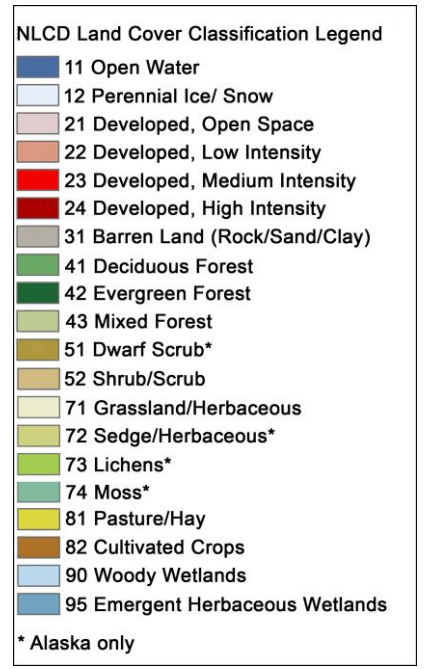
- National Land Cover Database (NLCD).
- Gridded data available for years 2001, 2004, 2006, 2008, 2011, 2013, 2016, 2019, and 2021.

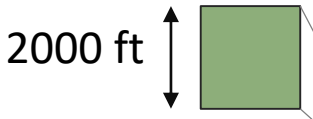


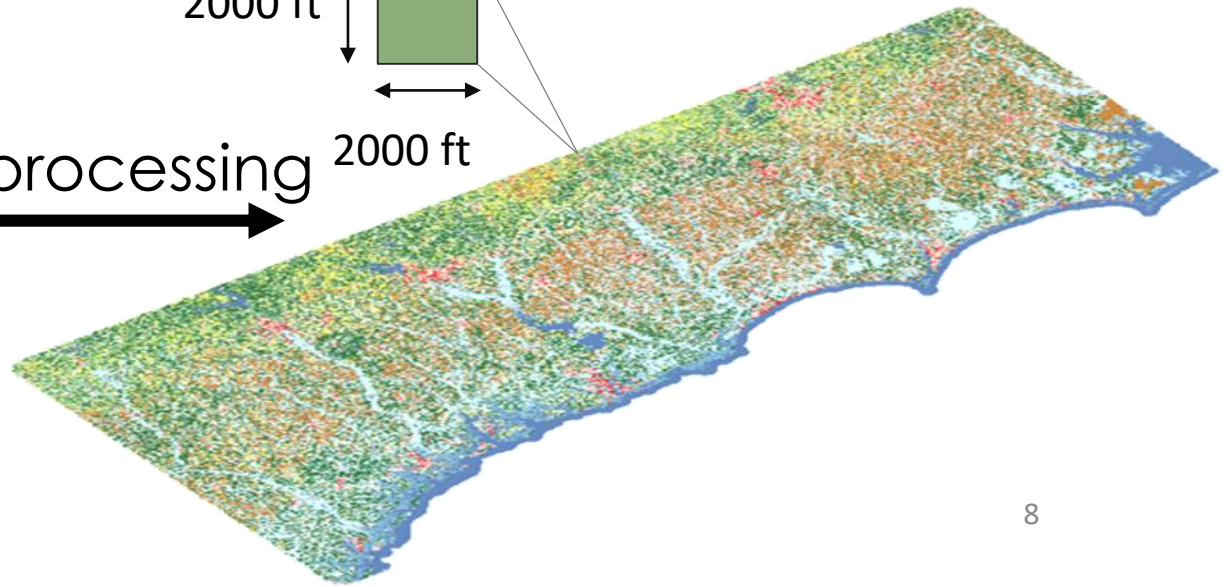


Data Preprocessing





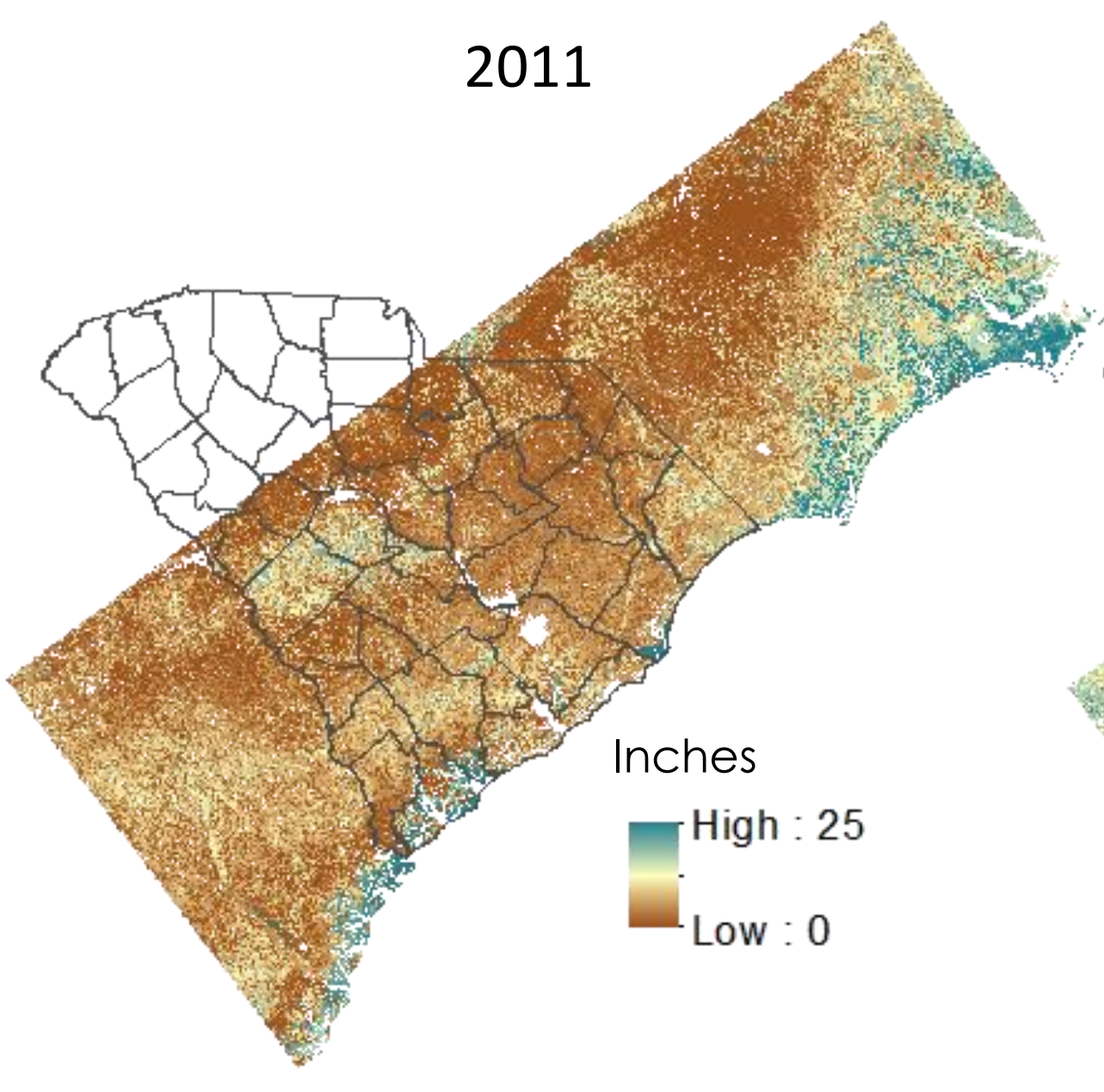


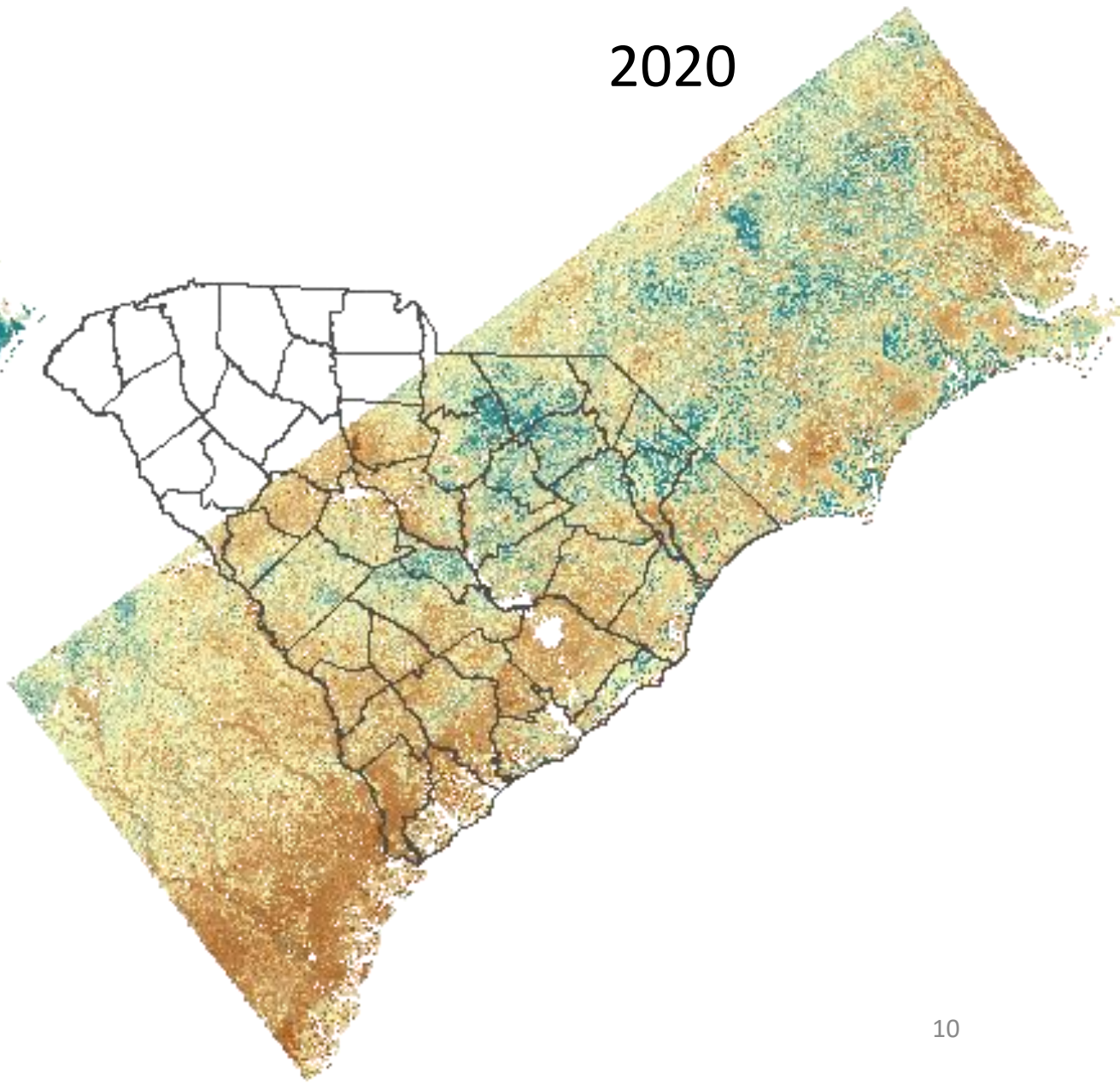


Model Simulation

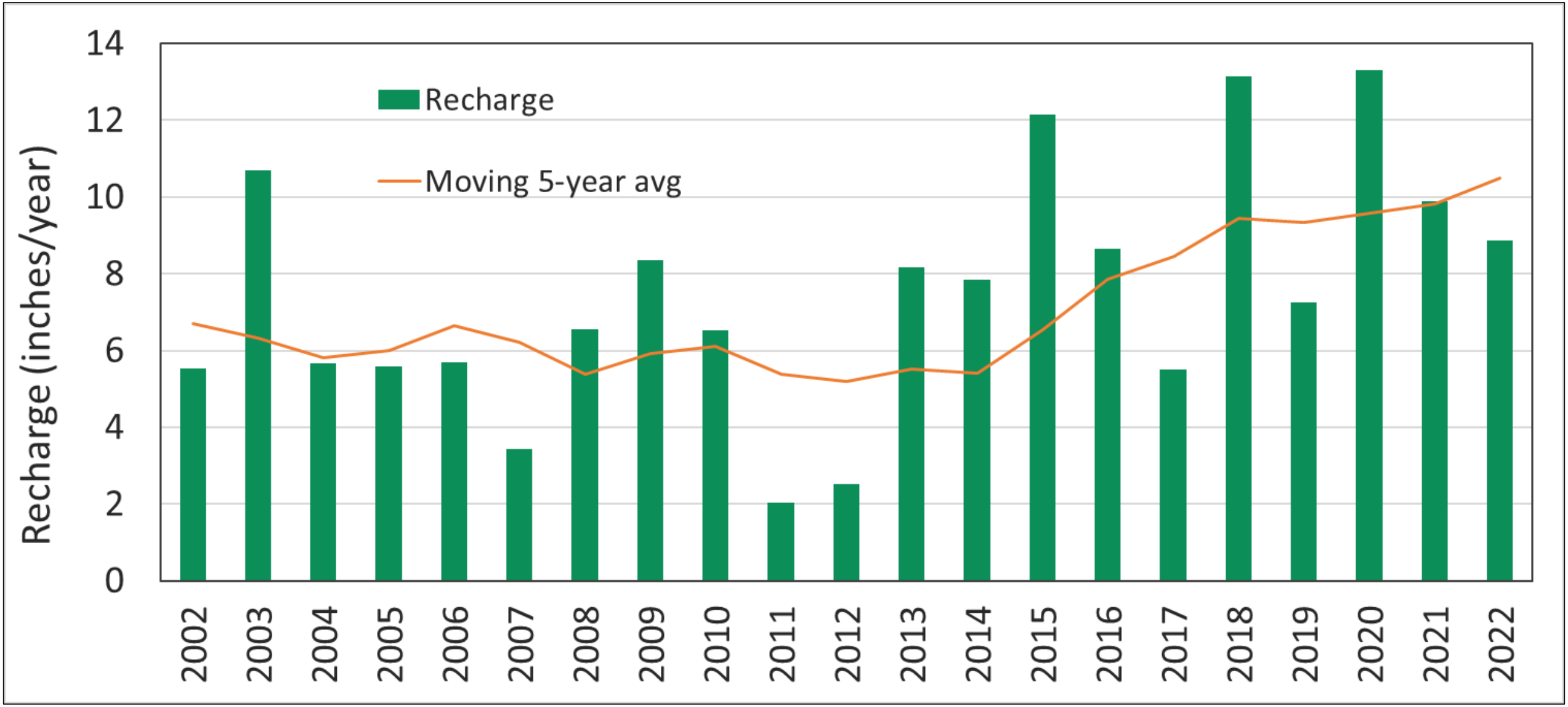
- Model runs several steps of decision making where the components of a water budget are evaluated.
- The model assumes that recharge takes place when soil moisture value exceeds total available water in a cell.

Annual Recharge for Dry vs Wet Year

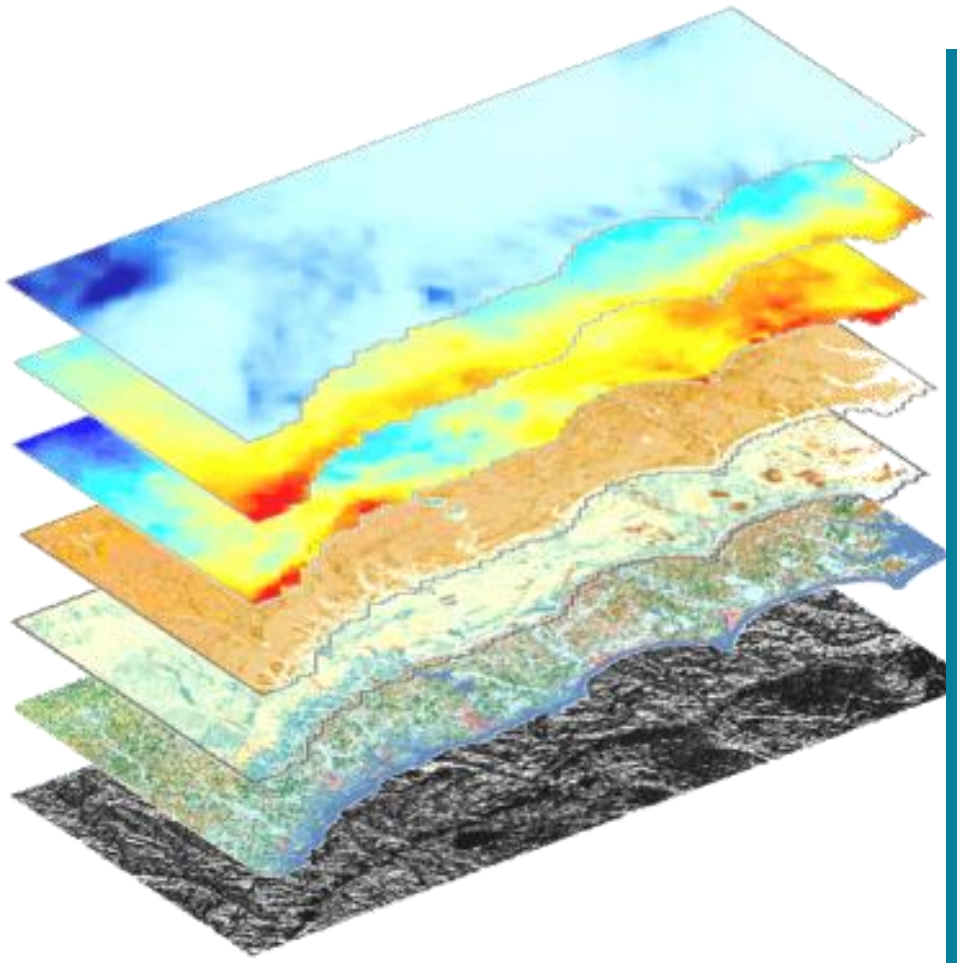




Mean Annual Recharge (2002-2022)



Summary



- Soil Water Balance (SWB) model was used to estimate recharge in the coastal plain extent at a 2000 by 2000 ft cell resolution.
- Model requires minimum data inputs of:
  - Climate data (Precipitation, Temperature)
  - Hydrologic Soil Group
  - Available Water Capacity
  - Land Cover
  - Flow Direction (Can be turned off)
- Model assumes that recharge takes place when soil moisture value exceeds total available water in a cell.
- Model outputs daily recharge values in inches.
- Daily recharge values are converted to monthly average recharge in ft/day for USGS.

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