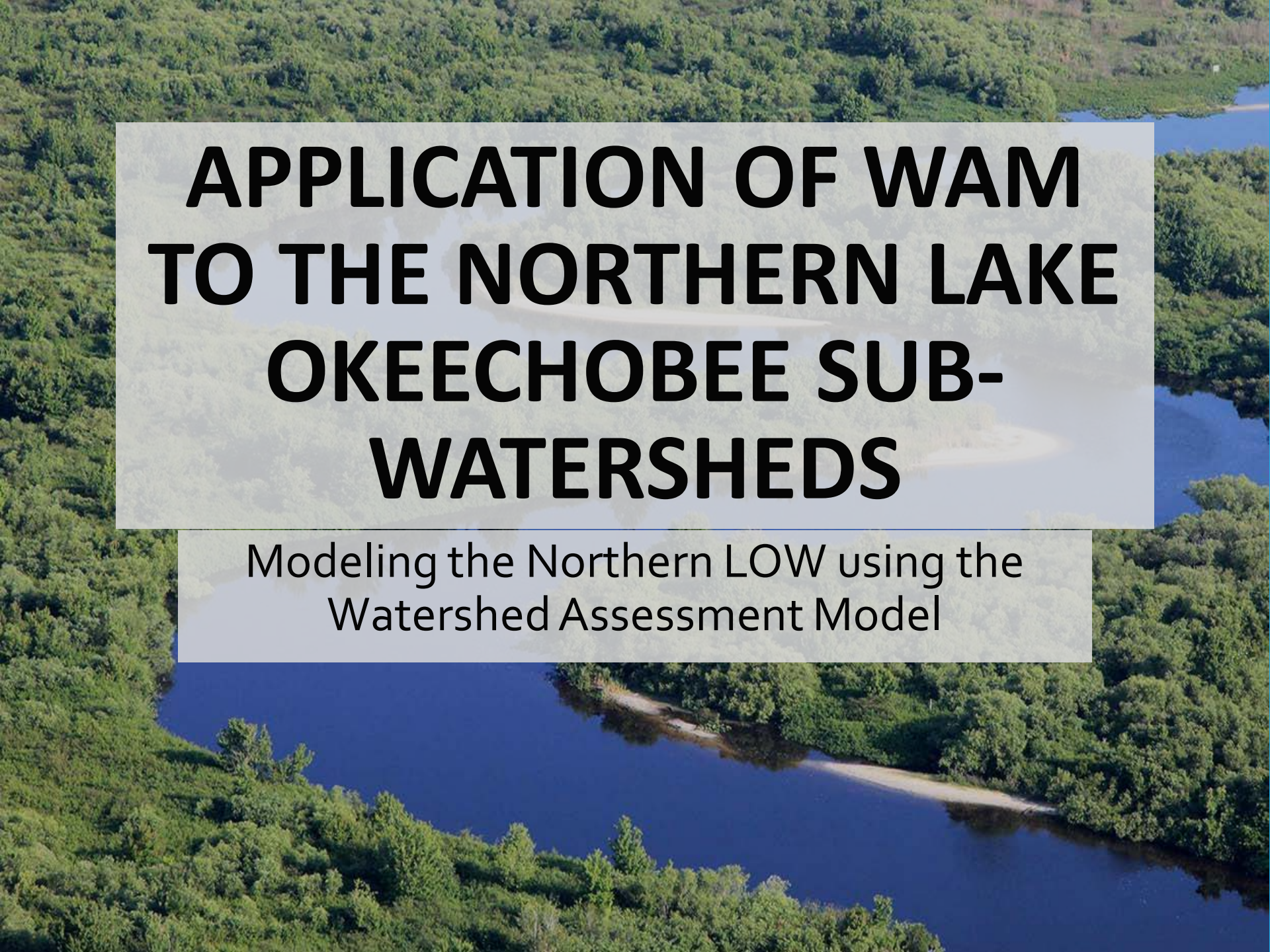


An aerial photograph of a river winding through a lush, green forest. The river is dark blue and reflects the surrounding trees. The forest is dense with various shades of green, indicating different types of vegetation. The river flows from the top right towards the bottom left, with a small sandy bank visible on the right side.

APPLICATION OF WAM TO THE NORTHERN LAKE OKEECHOBEE SUB- WATERSHEDS

Modeling the Northern LOW using the
Watershed Assessment Model

Goals

- Develop and refine a computer model that estimates water volumes and nutrient loads (N and P) flowing into Lake Okeechobee from the northern part of the LOW.
- Used for further development and implementation of the Lake Okeechobee BMAP.
- Also be used to evaluate N and P load reductions under agricultural BMPs.
- Provides comparisons of alternative BMP applications.
- Used to create spatial maps of estimated nutrient loading to Lake Okeechobee.

Background

- This summarizes the report submitted to the Coordinating Agencies (FDACS, SFWMD, and FDEP) on March 15, 2017.
- *Watershed Assessment Model (WAM) : Recalibration of the Northern Lake Okeechobee Basins. Deliverable 1: WAM Recalibration Report*
- The document has been reviewed and revisions are underway.
- Original work was completed in 2009: *WAM Enhancement and Application in the Lake Okeechobee Watershed Project*.
- The period of record for this earlier work was from 1998-2007.
- In 2012, Okeechobee WAM POR was extended to 1978 to 2010.
- Current recalibration project has its POR extended to 1975 to 2013.

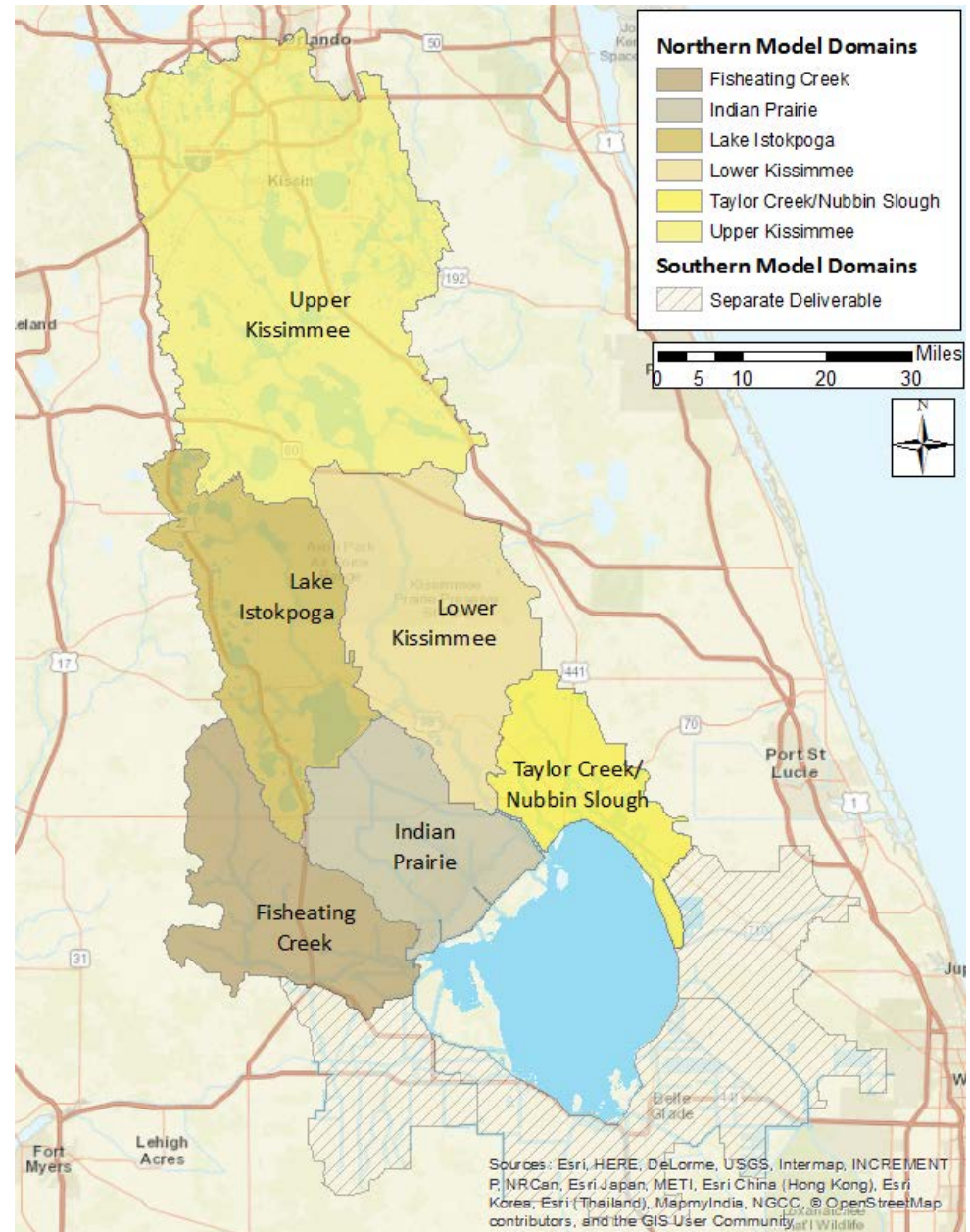
Northern LOW

Six sub-watersheds were simulated.

Each sub-watershed was modeled independently.

Flows and nutrient loads leaving each sub-watershed were simulated.

Three sub-watersheds to the east, south, and west of the lake were modeled separately.



Required Datasets

- Land Use (SFWMD)
- Soils (NRCS)
- Rainfall data (SFWMD)
- Hydrology (SFWMD AHED)
- Topography (SFWMD)
- Utility Zones (Local city and county, DOH)
- Hydraulic Structures (SFWMD)
- Boundary data, weather, etc. (SFWMD, FAWN, NOAA, etc.)
- Measured data (SFWMD)

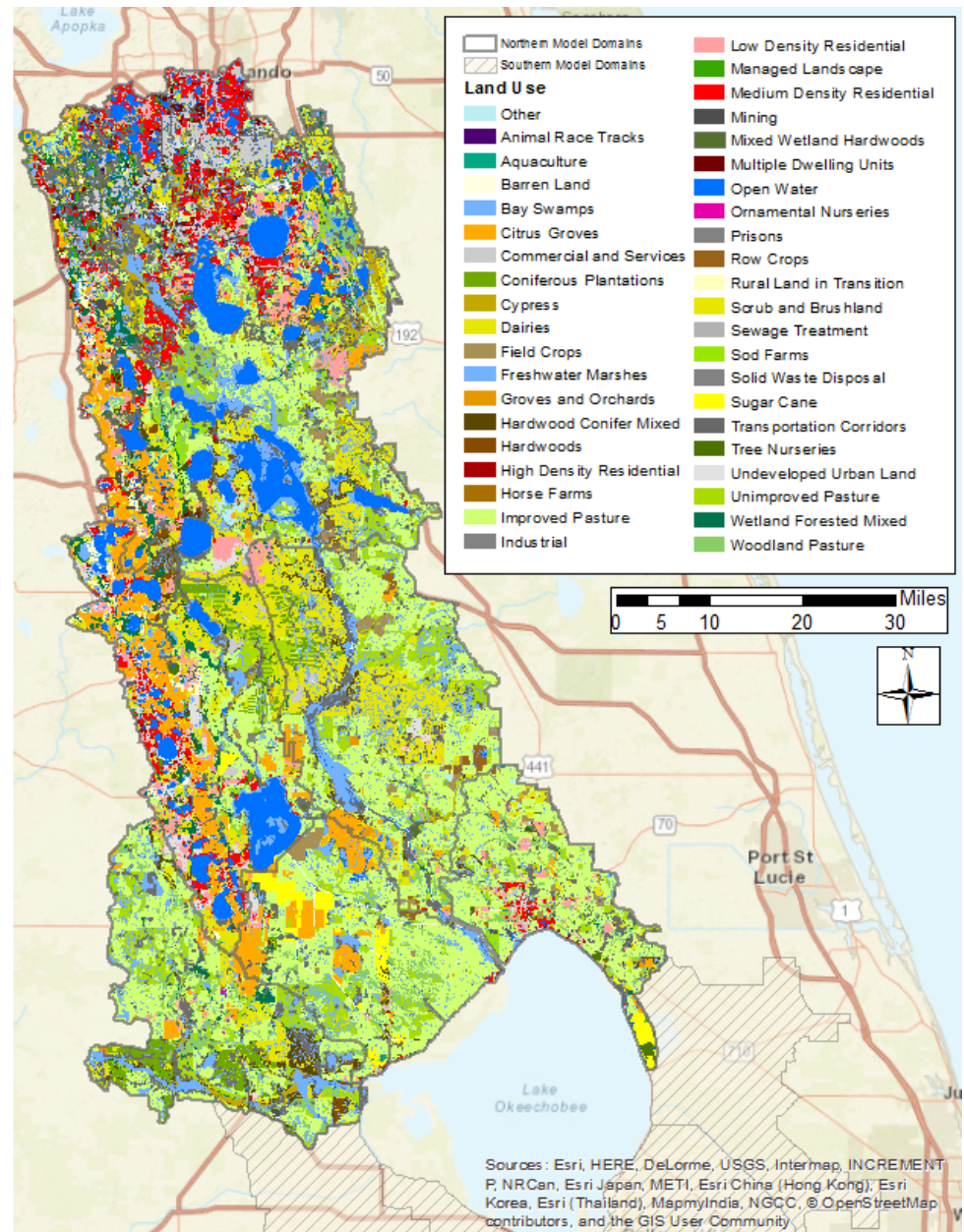
Model Setup

- The model was run using data from 1975-2013.
- Land-source models were run from 1972-2013; first three years were discarded as a spin-up period.
- BLASRoute was run from 1975-2013.
- Calibration/verification was the 11-year period from 2003-2013
- Calibration was split into two three-year time frames: 2003-2005 and 2011-2013
- Verification was the five-year period from 2006-2010.

Land Use

Land use was obtained from the SFWMD, the latest update used was from November 2016.

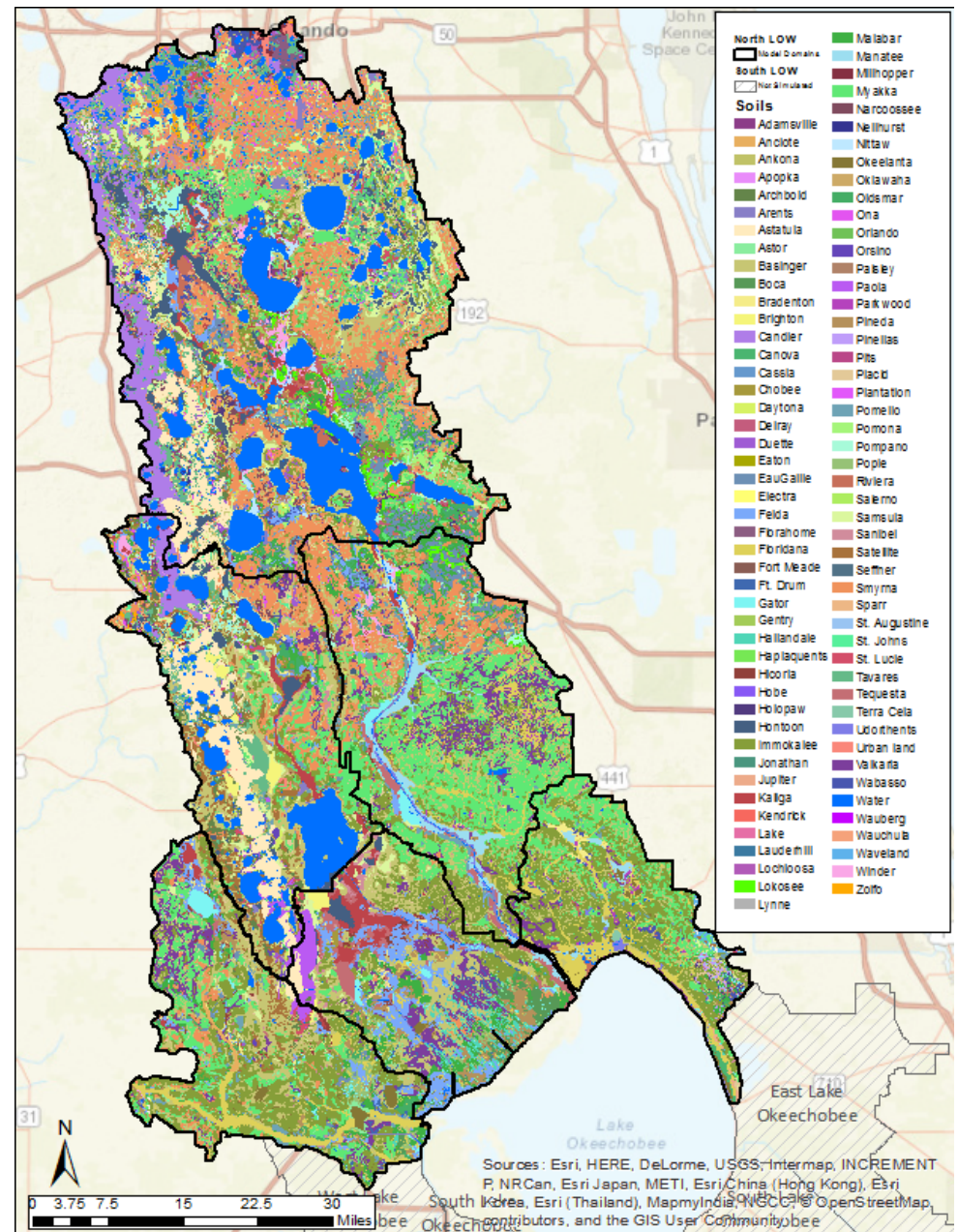
Dairy-specific land use updates were used in the TCNS sub-watershed.



Soils

Soils data was obtained from NRCS for all of the counties in the northern LOW.

Approximately 2,082,500 acres (79%) were considered high water table (run under EAAMod), 337,530 (13%) acres were well-drained (run under GLEAMS), and 224,160 (8%) acres were treated as special case (e.g., open water).

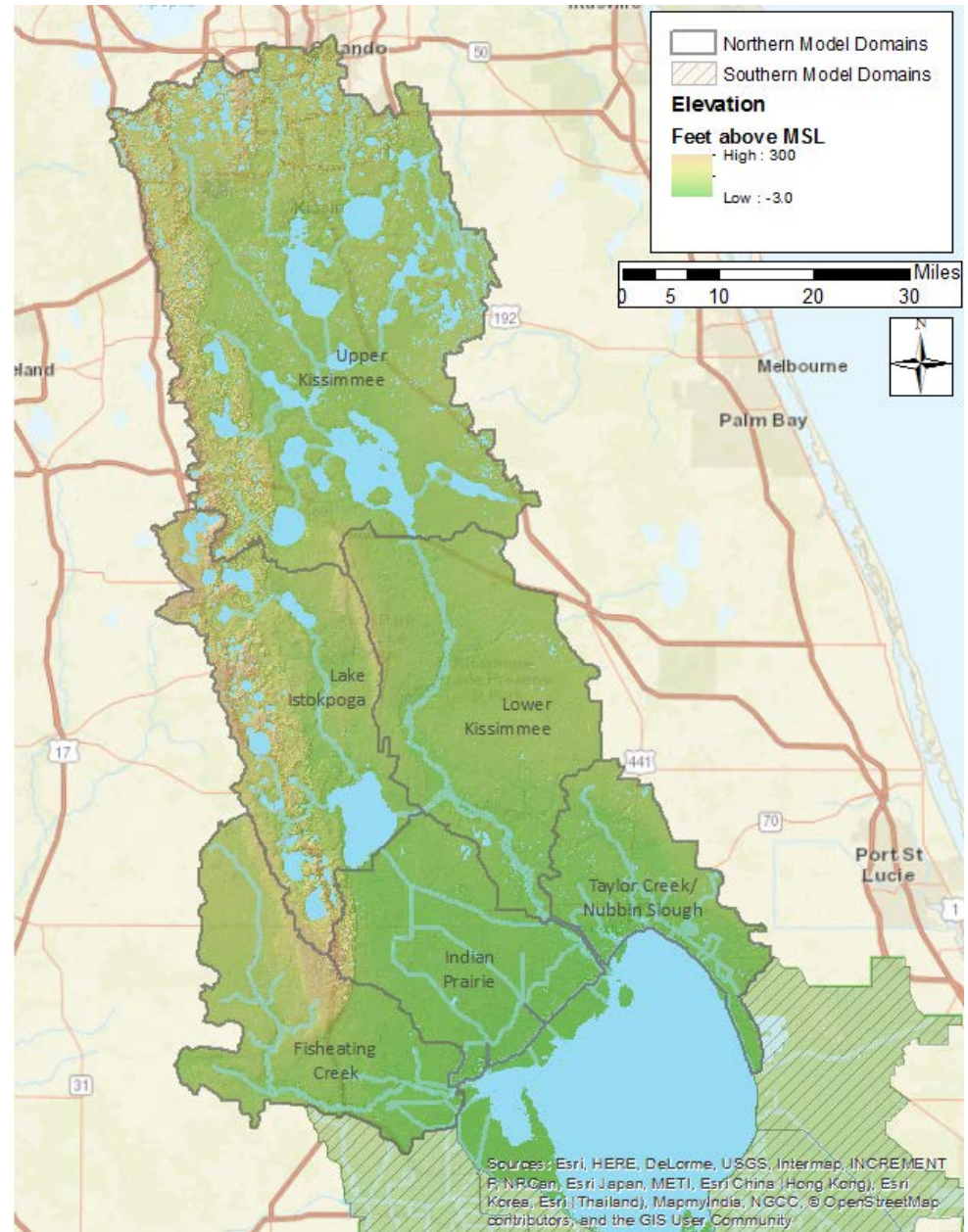


Topography

A DEM with that covers all of the LOW was obtained from the SFWMD.

The DEM has 50 ft x 50 ft grid cells.

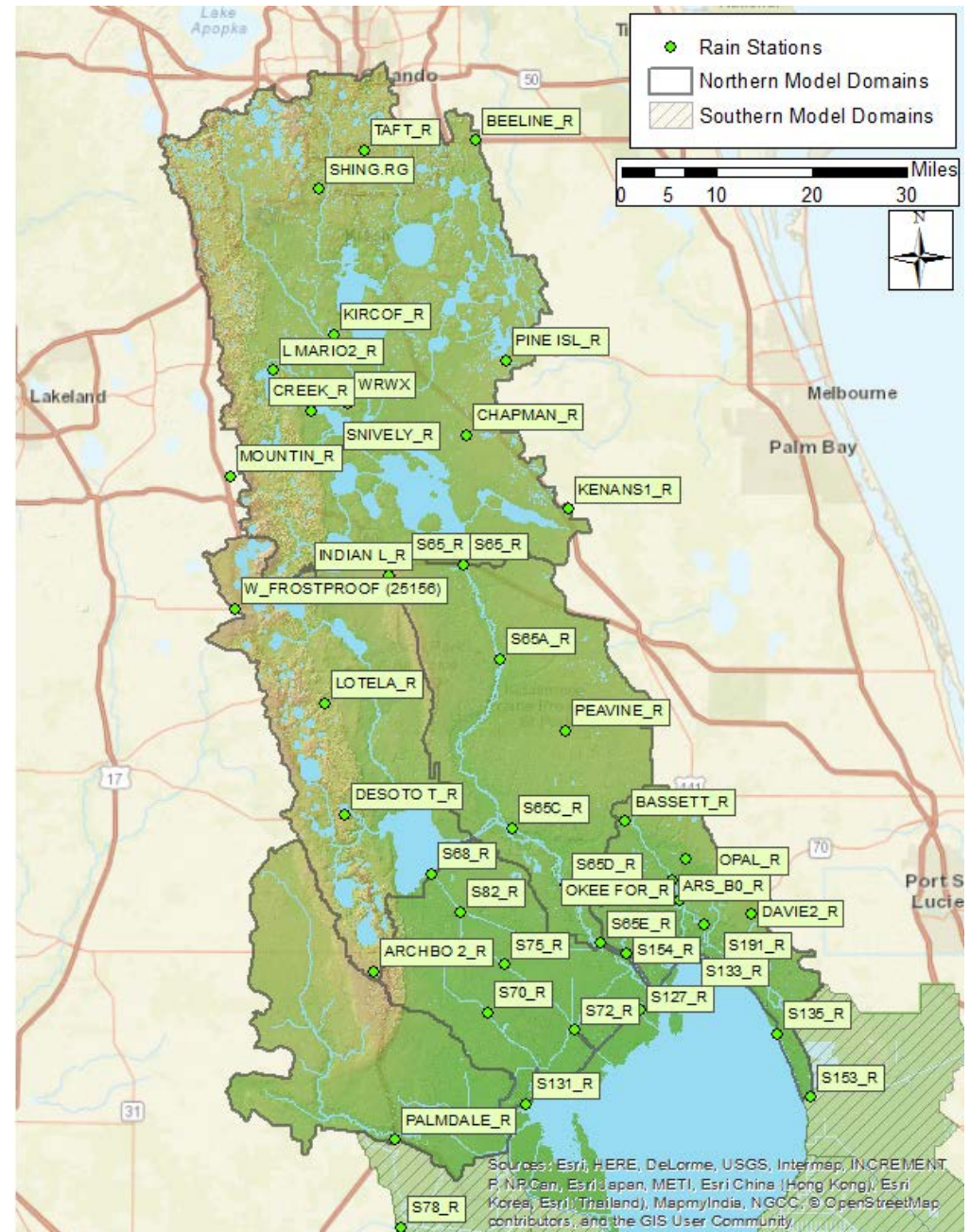
Used by WAM to determine flow directions from source cells to the reach network.



Rain Stations

45 stations were used.

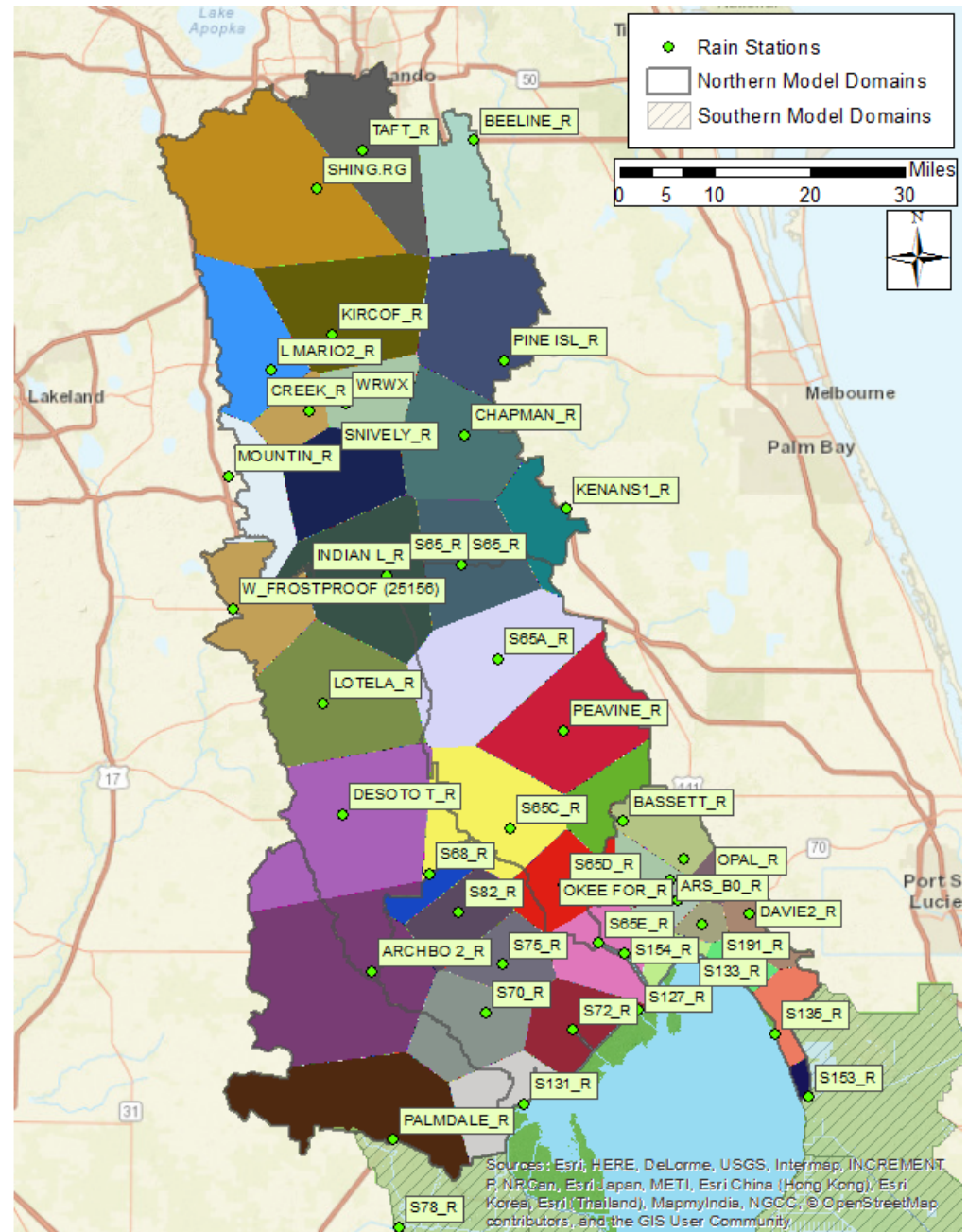
Most of these were used in the original 2009 model, but additional stations were added, particularly in the Upper Kissimmee sub-watershed.



Rain Stations

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Rainfall (a few Upper K stations)

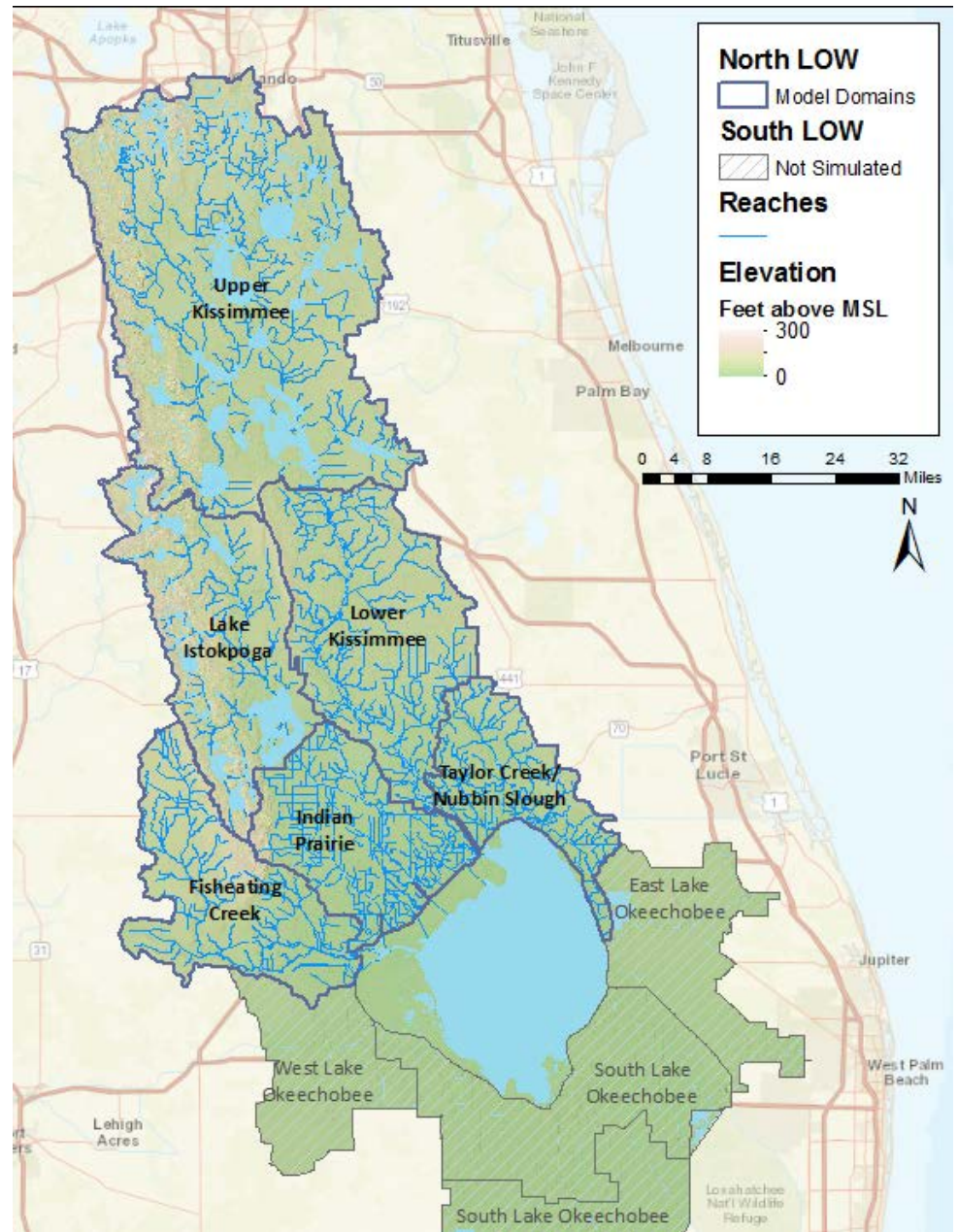
Year	Chapman	Beeline	Pine Island	Mountain	Indian L	Kenans1	L Mario 2	Snively	S65_R
2003	64	58	47	45	44	51	45	59	57
2004	61	76	61	67	53	65	67	53	59
2005	66	53	66	69	63	58	68	57	75
2006	35	36	35	32	32	35	32	25	43
2007	29	38	27	43	39	48	43	29	53
2008	41	51	41	28	49	54	28	38	52
2009	63	49	63	53	50	53	54	51	49
2010	46	50	46	54	59	39	54	49	39
2011	61	56	61	53	60	66	53	52	61
2012	57	47	57	40	54	49	38	47	54
2013	46	47	46	47	52	36	47	50	46
Total	570	562	551	531	555	555	528	510	587
Average	51.8	51.1	50.1	48.3	50.5	50.5	48.0	46.4	53.4

Annual rainfall in inches

Stream/Canal Network

The stream and canal network was obtained from the SFWMDs ArcHydro Enhanced Database (AHED).

Modifications were made to ensure connectivity of the network.



In-Stream Attenuation

- Nutrients within a stream undergo attenuation to a background concentration:

$$\frac{dL}{dt} = a_s A (C_0 - C_b)$$

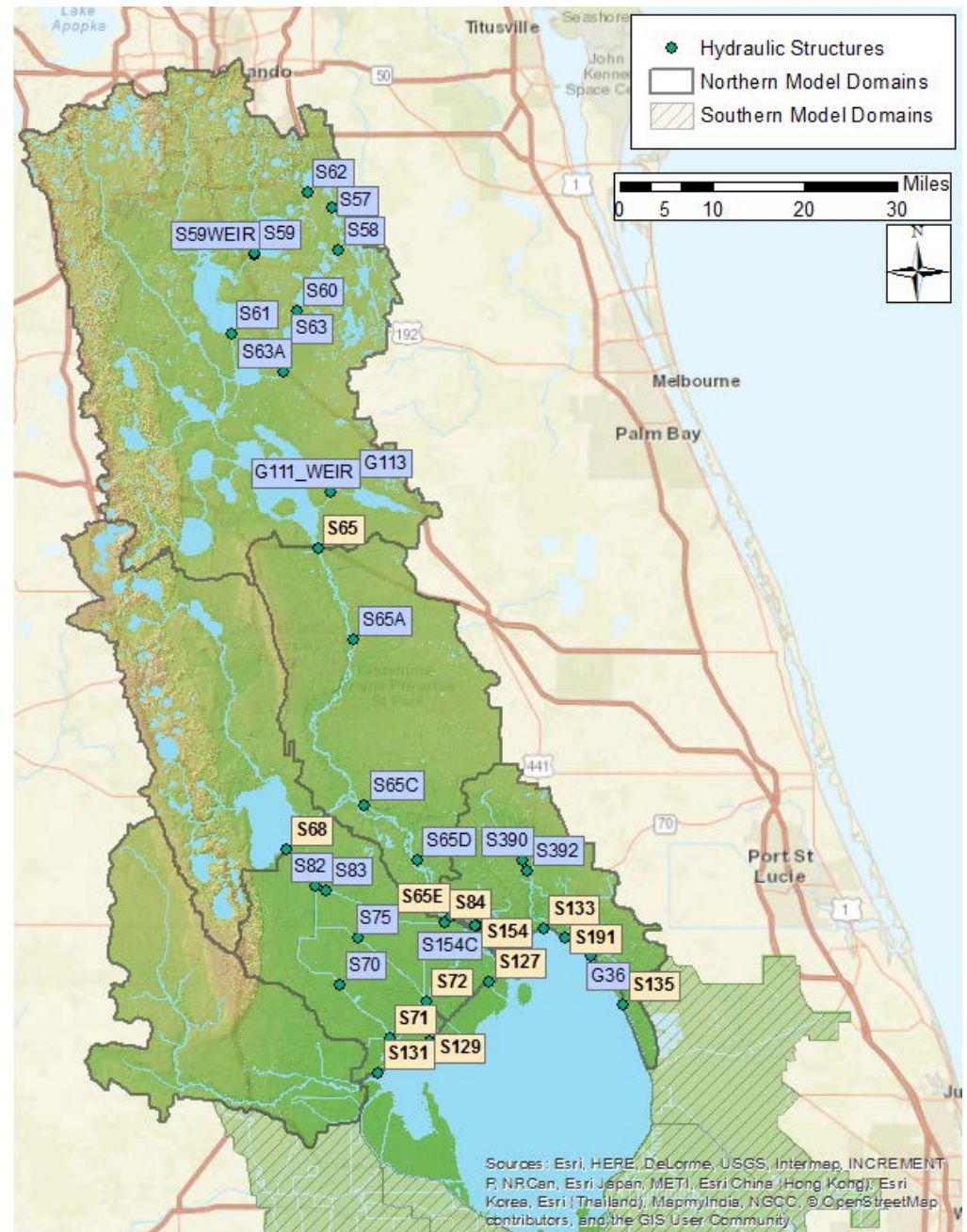
- Where L (g) is the nutrient load, a_s is the rate of load transfer (m/s), A is the stream wetted surface area (m²), C_0 is the concentration at the start of the time step, and C_b is the background concentration (both g/m³) .
- Have different reach types (e.g., lakes) with individual a_s and C_b coefficients.

Boundary Conditions

- Boundary conditions are needed at all outfalls.
- Stage conditions used for all northern LOW outfalls.
- Use Lake O stage or tailwater elevations (e.g., S-65).
- Lower Kissimmee and Indian Prairie have inflow boundary conditions as well (S-65 and S-68, respectively). These use flow and concentration data.

Structures

Control structures were added using data from the 2009 simulations and checked against AHED.



Water Quality and Flow Monitoring Points

- Monitoring points were also obtained from AHED data, and the associated data were downloaded from DBHydro.
- Points internal to the sub-watersheds were used to assist in calibration.
- Simulated flows and loads are reported at basin outfalls.

Preliminary Results: Summary of Water Volume

	Structure	Calibration Ac Ft			Verification Ac Ft		
		Measured	WAM	%	Measured	WAM	%
Upper Kissimmee	S65	6,418,704	6,062,315	-6%	2,764,116	2,799,490	1%
Lake Istokpoga	S68	2,370,655	2,296,841	-3%	769,705	737,212	-4%
Fisheating Creek	FECRL	1,852,205	1,738,800	-6%	728,839	870,372	19%
Indian Prairie	S71	1,419,507	1,338,393	-6%	608,434	615,673	1%
	S72	401,333	381,029	-5%	131,835	167,203	27%
	S84	1,541,974	1,498,653	-3%	542,139	551,797	2%
	S131	68,026	66,692	-2%	28,576	25,877	-9%
	S129	87,810	84,759	-3%	40,343	37,519	-7%
	S127	86,327	69,513	-19%	36,109	49,654	38%
Lower Kissimmee	S65E	9,054,083	8,360,900	-8%	3,376,513	3,771,502	12%
Taylor Creek/	S133	152,648	133,660	-12%	31,981	43,230	35%
Nubbin Slough	S135	146,622	148,980	2%	27,534	22,374	-19%
	S154	205,364	157,284	-23%	64,593	86,563	34%
	S191	717,997	606,167	-16%	235,135	315,283	34%

Questions/Comments