Integrated GIS Model for Evaluating Surface Water Withdrawal Impacts on Wetlands

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The Hydroperiod Tool

Background

- Developed by the South Florida Water Management District to assess wetland hydrology for the Kissimmee River restoration project
- Modified by St Johns River Water Management to Include change analysis
- Ponded water depth is calculated across the floodplain using river stage data and wetland terrain elevation data
- Provides the ability to assess temporal and spatial patterns that vary with river stage and produce annual and seasonal statistics, as well as determine ponded depth and duration for specific wetland communities and species dependent upon those communities

Simplifying Assumptions

- Consideration of only the riverine portion of wetland hydrology (because other sources are expected not to be affected by withdrawals)
- Modeling of the water surface as a sloping flat pool (application 1) or true flat pool (applications 2 and 3) that extends laterally out across the floodplain with no effect of friction from wetland vegetation

Data Input (GIS)

- Land elevation (LiDAR-derived DEM) for wetland area
- Monitoring station layer
- Hydrology data (stage)
- Interpolation method of water surface
- Classified ponded depth (by criteria of interest)

Ponded depth in time series:

Automation provides the opportunity to assess temporal patters, produce annual and seasonal statistics for wetland ponded depth and duration (hydroperiod or duration of flooding

ANIMATION

Automation of GIS functions:

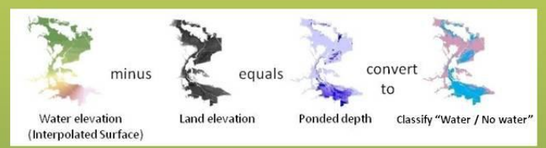
Hydrology Time Step Options:
- Daily time step
- Exceedence values ("pseudo time step")

Hydrology Scenarios
- Compare historic and modeled scenario
- Compare wet and dry years

HYDROPERIOD TOOL STEPS

1) Generate daily water surface (interpolation) → 2) Subtract land elevation (constant) → 3) RESULTS: Daily ponded depth → 4) Reclassify based on hydrologic requirements → 5) Accumulate results

Run for each time step for each scenario

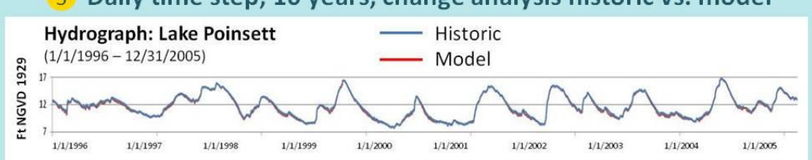


Application	Time step	Annual total	Years	Scenarios	Total iterations
1	Exceedence	20	10 yr exceedence	Historic, 4 modeled	100
2	Daily	365	2	Historic	7,304
3	Daily	365	10	Historic, 1 modeled	73,040

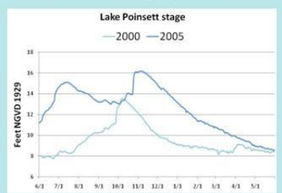
Hydrology Input Options (time step, scenarios)

Application 1 10 years historic and HSPF model data, statistically summarized as % exceedence ("pseudo time step") for 5 scenarios (change analysis).
Application 2 Daily time step, historic data only, 2 years (wet vs. dry comparison)
Application 3 Daily time step for 10 years, change analysis for historic data and HSPF model data (1 model scenario)

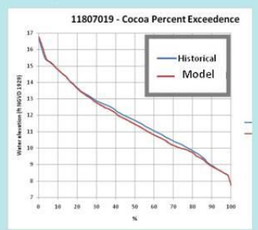
3 Daily time step, 10 years, change analysis historic vs. model



2 Daily time step, wet vs. dry year

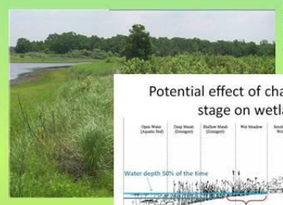


1 Per cent exceedence "pseudo time step", 10 years, historic vs. model

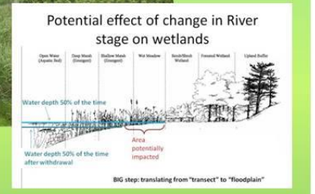


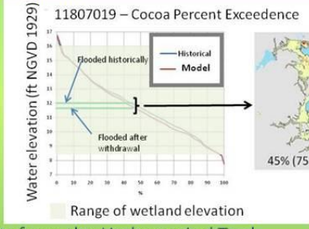
Three Applications of The Hydroperiod Tool

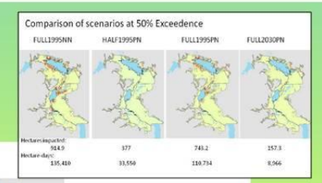
1 Modeling potential impacts of surface water withdrawals on riverine wetlands

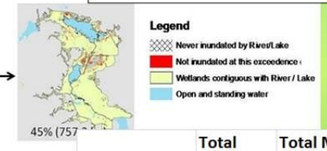


Four scenarios vary by withdrawal amount (Full = 155 mgd, Half = 77 mgd) landuse (1995, 2030) and inclusion of water control projects (P) or not (N)







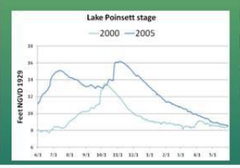


Scenario	Withdrawal amount	Land Use
Full1995N (worst case)	155 mgd	1995
Full1995P (test case)	155 mgd	1995
Half1995P (test case)	77 mgd	1995
Full2030P (most likely)	155 mgd	2030

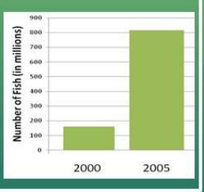
Results from the Hydroperiod Tool identified areas within the 18,256 hectares of wetlands that would experience fewer days of inundation for 4 withdrawal scenarios

Scenario	Total Area impacted (ha)	Total Max Hectare-days Impact (over 10 years)
Full1995N	5,014.5	666,788
Full1995P	3,763.9	405,396
Half1995P	1,831.7	115,482
Full2030P	697.2	30,204

2 Modeling fish productivity based on floodplain inundation for wet and dry years

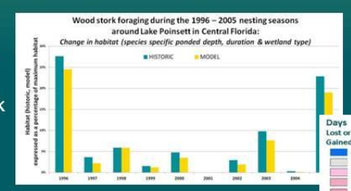


The data generated from the model is useful for comparing potential % changes in fish abundance that may occur under varying hydrological conditions, natural or man-made.

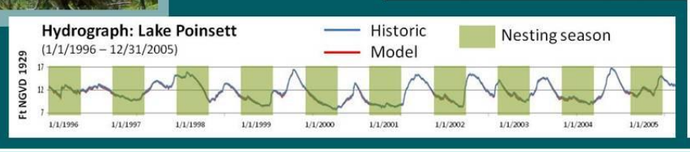


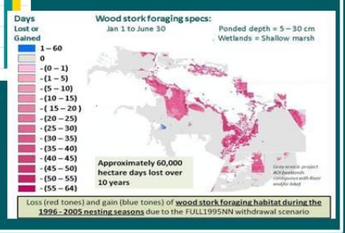
3 Modeling potential impacts of surface water withdrawals on wetland dependent wildlife

Withdrawal Scenario had measurable effects on wood stork foraging habitat



Small hydrologic changes can have a large effect on projected foraging area





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INTECOL

1 Related presentation Curacao 1& 2 Thursday 2 pm
2 Related presentation Curacao 1& 2 Thursday 2:20 pm
3 Poster #282, session 2

Reference: **Sorenson, J. K. and D.R. Maidment. (2004).** Temporal Geoprocessing for Hydroperiod Analysis of the Kissimmee River, CRWR Online Report 04-05, Center for Research in Water Resources, Bureau of Engineering Research, The University of Texas at Austin.