Patterns Of Variability In The EDEN DEM In The A.R.M. Loxahatchee National Wildlife Refuge (LNWR)

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Background

- The USGS Everglades Depth Estimation Network (EDEN) provides critical datasets for Everglades restoration research and also needs continual improvment

- The computed hydro-periods from EDEN data are more variable and patchy in LNWR than other sub-regions

Hydro-period (days)

Objective

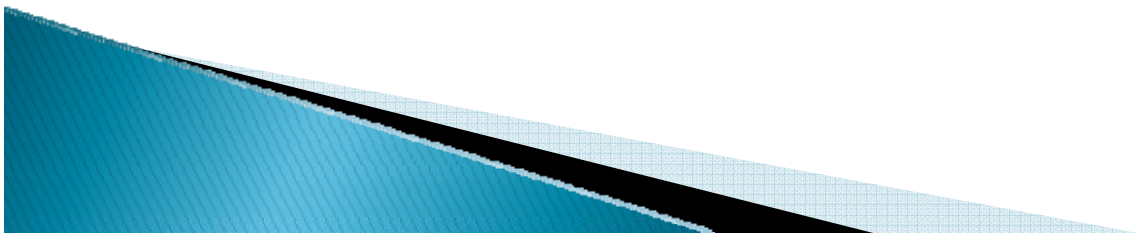
- Quantify the patterns of variability and error in the DEM within LNWR.
- Develop methodology to smooth the outlier hydro-period cells in LNWR.

Data

- EDEN DEM (400m)
- EDEN daily water level surfaces (400m)

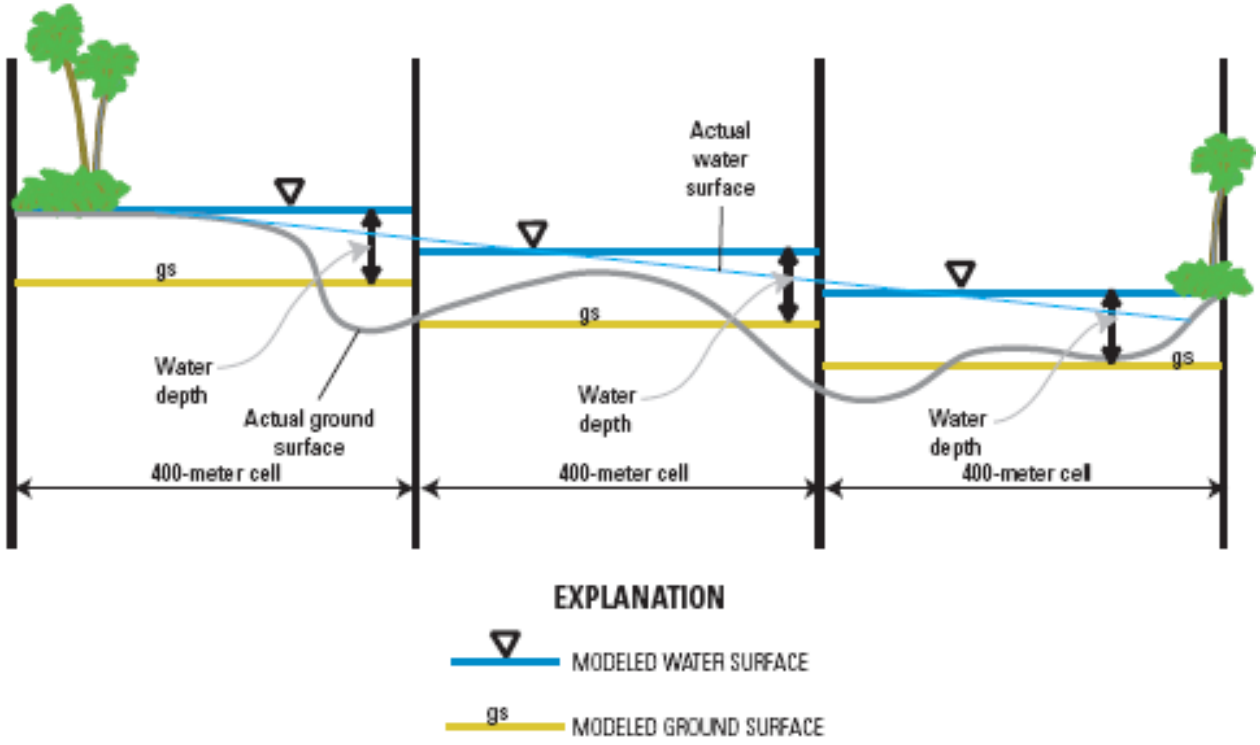
- USGS Airborne Height Finder (AHF) elevation (3496 points)
- Principal Investigator (PI) water depths (1491)

- FWC 2003 statewide vegetation map (30m)
- SFWMD vegetation map (50m)



Analysis

EDEN water surfaces — **PI water depths** = **PI elevation**



- http://sofia.usgs.gov/projects/eden/

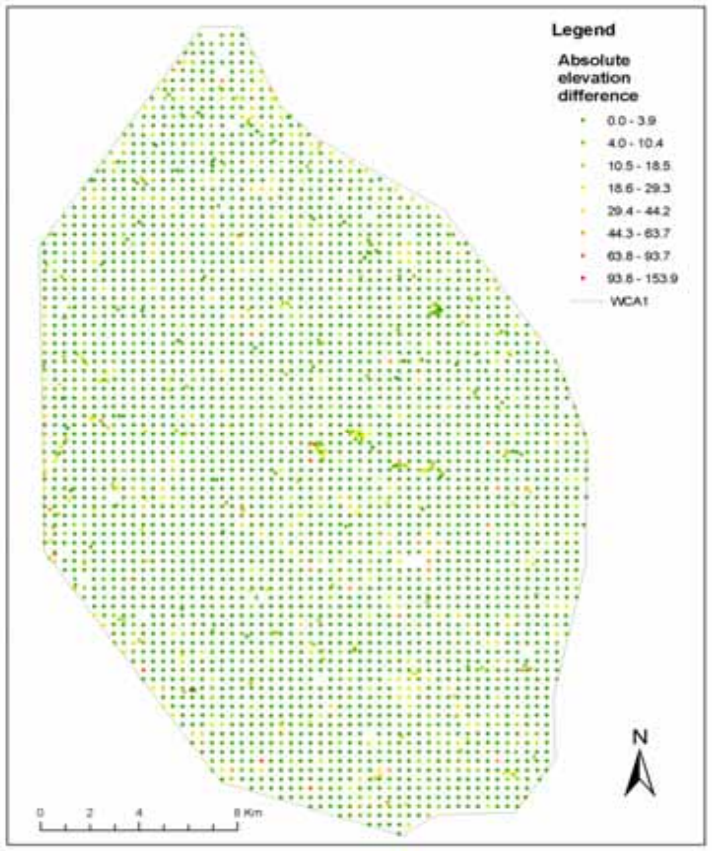
Reference elevation (AHF, PI)

−

EDEN ground DEM

=

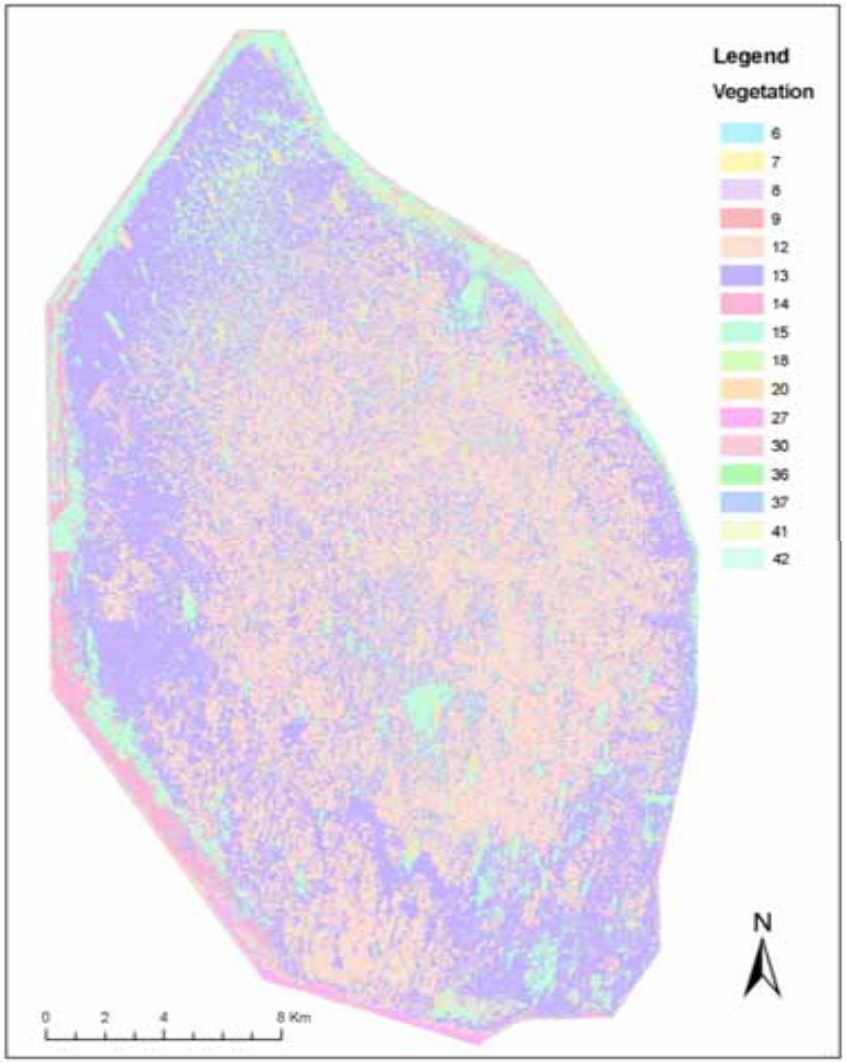
Elevation discrepancy (or Error)



	RMSE	MBE (mean biased error)	MAE (mean absolute error)
All	21.7	-5.8	10.6
AHF	9.3	1.3	4.2
PI	37.0	-22.4	25.5

Overall elevation differences

Elevation discrepancy vs vegetation
(surrogate for microtopography)



Reference points (AHF, PI)

- **Vegetation @ reference points**
- **Dominant vegetation @ EDEN cell**
- **Vegetation patch diversity @ EDEN cell**

$$SHDI = -\sum_{i=1}^{N} (P_i \times \ln P_i)$$

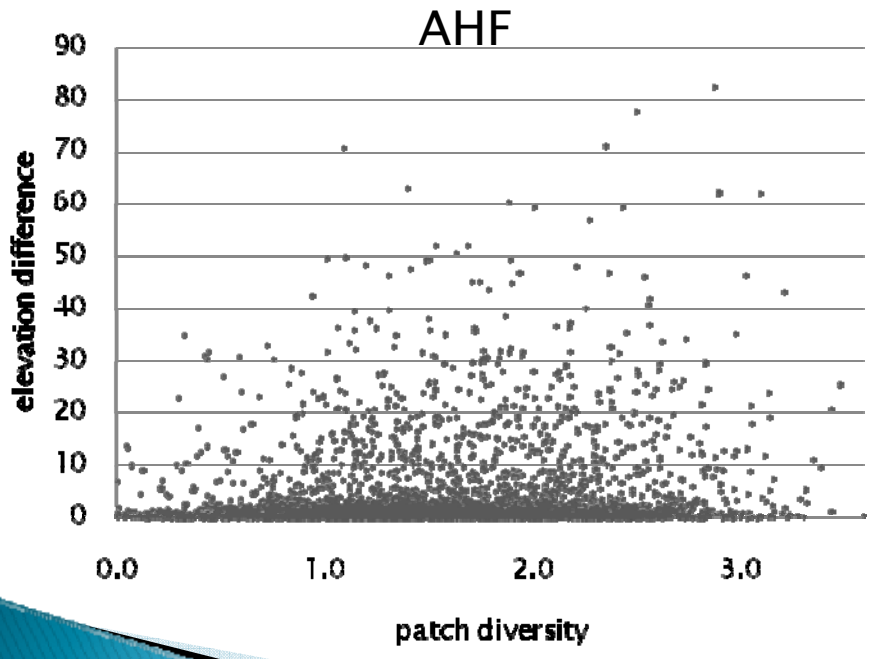
	Vegetation @ reference points	# Points	MIN	MAX	MEAN	STD
All	Freshwater marsh and wet prairie	1997	0.0	100.1	6.9	11.9
	Sawgrass marsh	1986	0.0	110.7	10.1	17.4
	Cattail marsh	242	0.1	153.9	**44.9**	41.5
	Shrub swamp	629	0.0	91.2	10.5	15.2
	Hardwood swamp	83	0.0	62.3	**14.0**	16.1
	Open water	50	0.0	42.7	5.1	8.2
AHF	Freshwater marsh and wet prairie	1333	0.0	77.9	3.1	7.0
	Sawgrass marsh	1433	0.0	82.5	3.5	7.3
	Cattail marsh	82	0.1	46.6	5.8	9.7
	Shrub swamp	519	0.0	49.3	7.3	10.0
	Hardwood swamp	80	0.0	62.3	**13.8**	15.8
	Open water	49	0.0	42.7	5.2	8.3
PI	Freshwater marsh and wet prairie	664	0.1	100.1	14.7	15.3
	Sawgrass marsh	553	0.1	110.7	**27.1**	23.3
	Cattail marsh	160	1.9	153.9	**64.9**	37.1
	Shrub swamp	110	0.6	91.2	**25.9**	24.0
	Hardwood swamp	3	0.6	49.7	**19.3**	26.5

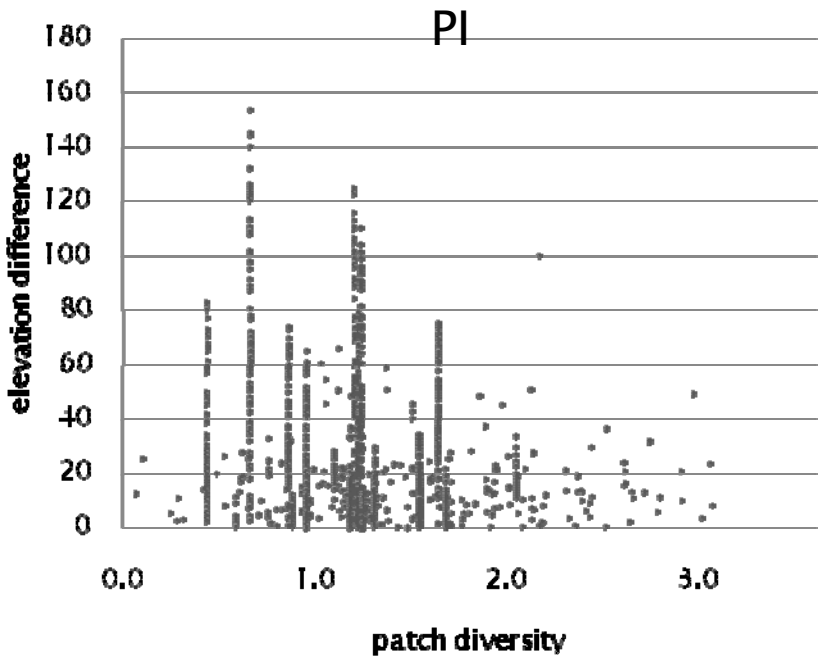
	Dominant Vegetation @ EDEN cell	#Points	MIN	MAX	MEAN	STD
All	Freshwater marsh and wet prairie	2355	0.00	82.50	6.65	11.16
	Sawgrass marsh	1887	0.00	110.72	10.61	17.90
	Cattail marsh	267	0.06	153.91	**42.11**	40.90
	Shrub swamp	431	0.00	91.19	**12.62**	16.88
	Hardwood swamp	19	0.17	52.17	**15.01**	16.81
	Open water	28	0.04	59.53	8.30	14.82
AHF	Freshwater marsh and wet prairie	1602	0.00	82.50	3.31	7.43
	Sawgrass marsh	1406	0.00	63.08	3.82	7.29
	Cattail marsh	104	0.06	71.13	7.54	13.14
	Shrub swamp	337	0.00	62.32	8.34	10.35
	Hardwood swamp	19	0.17	52.17	**15.01**	16.81
	Open water	28	0.04	59.53	8.30	14.82
PI	Freshwater marsh and wet prairie	753	0.07	75.59	13.75	14.09
	Sawgrass marsh	481	0.15	110.72	**30.46**	23.93
	Cattail marsh	163	1.94	153.91	**64.17**	37.15
	Shrub swamp	94	0.50	91.19	**27.95**	25.03

The correlation between patch diversity and the absolute elevation differences.

	overall	AHF	PI
Spearman's coefficient	-.093(**)	.126(**)	-.187(**)

**. Correlation is significant at the 0.01 level.





Field examination: Bumpy Micro-topography in LNWR

- Small “pop-up” tree islands
- Degradation on the larger strand islands (Rutchey, email communication)

Outlier cells

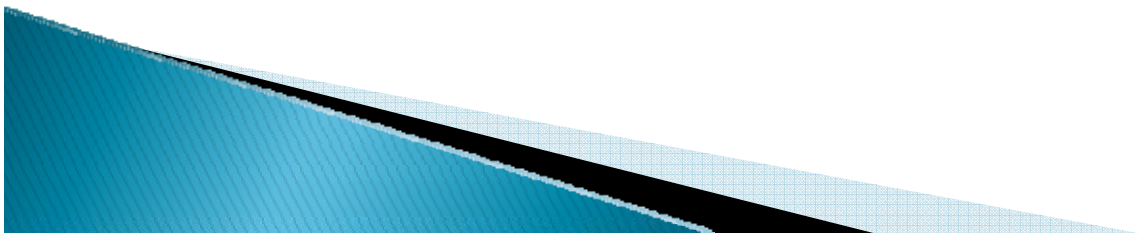
- have many small patches of ground surface (< 1m diameter);
- may NOT be discernable from the air

The DEM Values

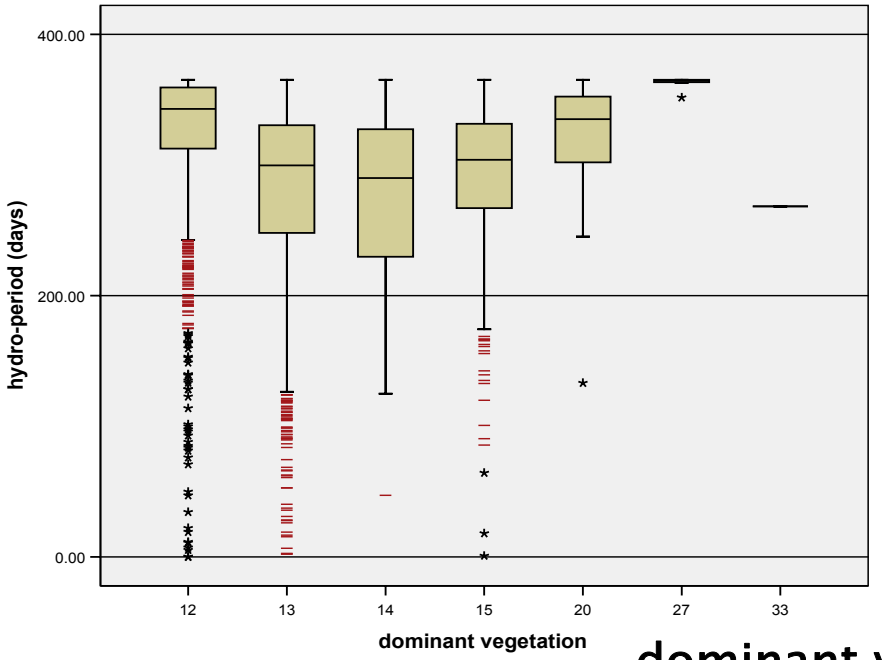
- may reflect the elevation of the small patches, instead of the cell average

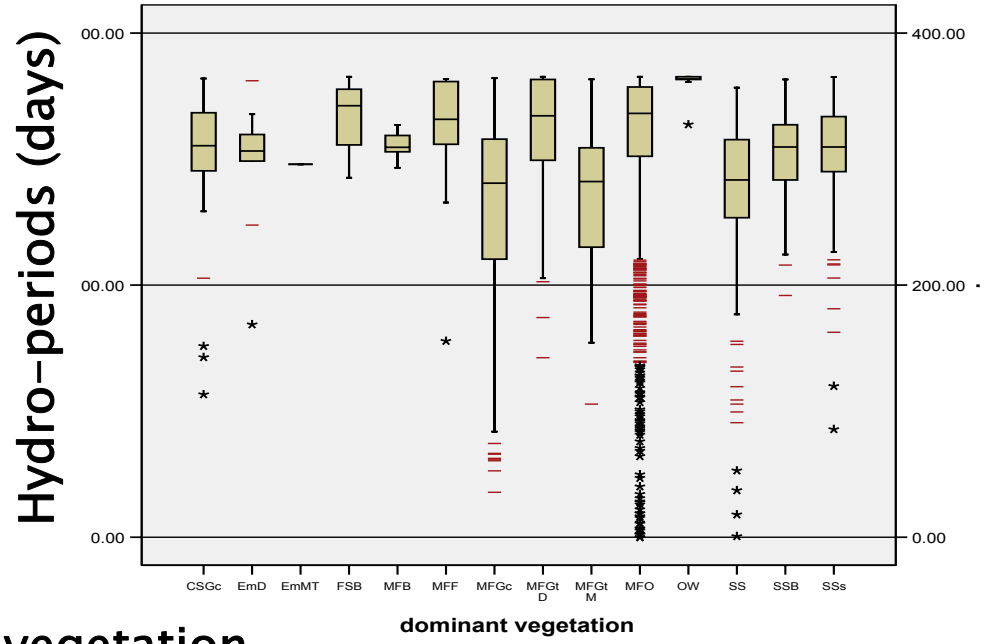
Hydro-period smoothing

- **Identify outlier cells**
  - Assumption: cells with the same dominant vegetation should have similar hydro-periods
  - Outlier cells are identified with boxplot of hydro-period vs dominant vegetation



Boxplot of hydro-period vs dominant vegetation





dominant vegetation

FWC vegetation map

SFWMD vegetation map

Outlier cells by dominant vegetation

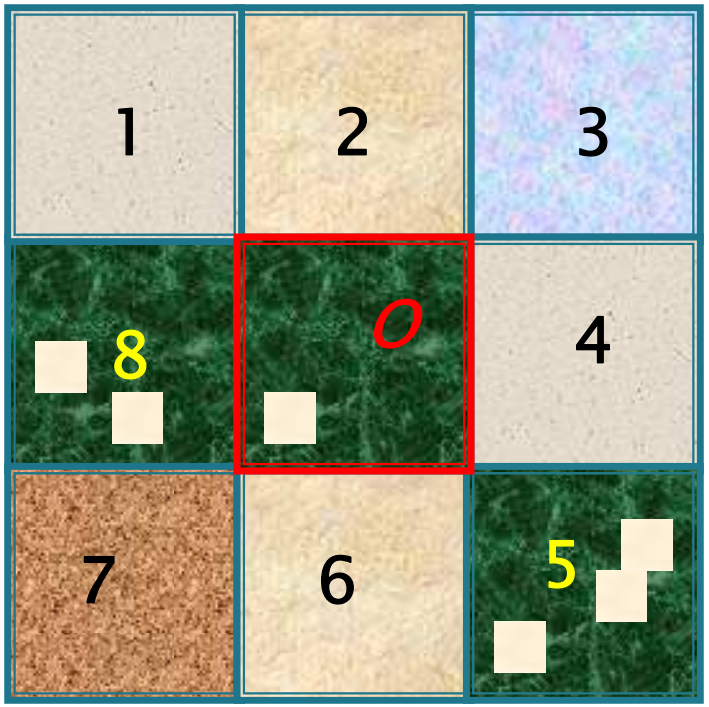
	dominant vegetation	# cells
12	**Freshwater marsh and wet prairie**	**104**
13	**Sawgrass marsh**	**63**
14	Cattail marsh	1
15	**Shrub swamp**	**19**
20	Hardwood swamp	1
27	Open water	1
		189

	dominant vegetation	# cells
CSGc	Swamp Scrub-Sawgrass	4
EmD	Melaleuca Dominant	3
MFF	Floating Emergent Marsh	1
MFGc	Sawgrass	8
MFGtD	Cattail Dominant	3
MFGtM	Cattail Monotypic	1
MFO	**Open Marsh**	**143**
OW	Open Water	**1**
SS	**Swamp Shrubland**	**13**
SSB	Bayhead Shrubland	2
SSs	Willow Shrubland	8
		187

FWC vegetation map

SFWMD vegetation map

Smooth hydro-period



Neighbor average

V_o = Average (V_1 + … + V_8)

Neighbor match

$V_o = V_8$

Cell 8 with the same dominant vegetation and similar areal coverage

The remaining outliers after smoothing

cell	Dominant vegetation	original hydro-period	hydro-periods after smoothing			
			neighbor average	outlier	**neighbor match**	**outlier**
c650	12	139	215	yes	283	NO
c935	12	88	221	yes	**221**	**yes**
c1364	12	234	235	yes	255	NO
c1755	12	128	196	yes	**196**	**yes**
c1817	12	222	200	yes	**200**	**yes**
c1871	12	171	214	yes	**214**	**yes**
c1873	12	221	182	yes	271	NO
c1928	12	198	186	yes	**186**	**yes**
c1929	12	216	208	yes	**208**	**yes**
c1931	12	152	163	yes	**163**	**yes**
c1986	12	201	207	yes	**207**	**yes**
c1987	12	239	218	yes	**218**	**yes**
c2044	12	100	211	yes	**211**	**yes**
c2045	12	153	228	yes	**228**	**yes**
c4368	27	352	355	yes	**355**	**yes**

(FWC 2003 vegetation map)

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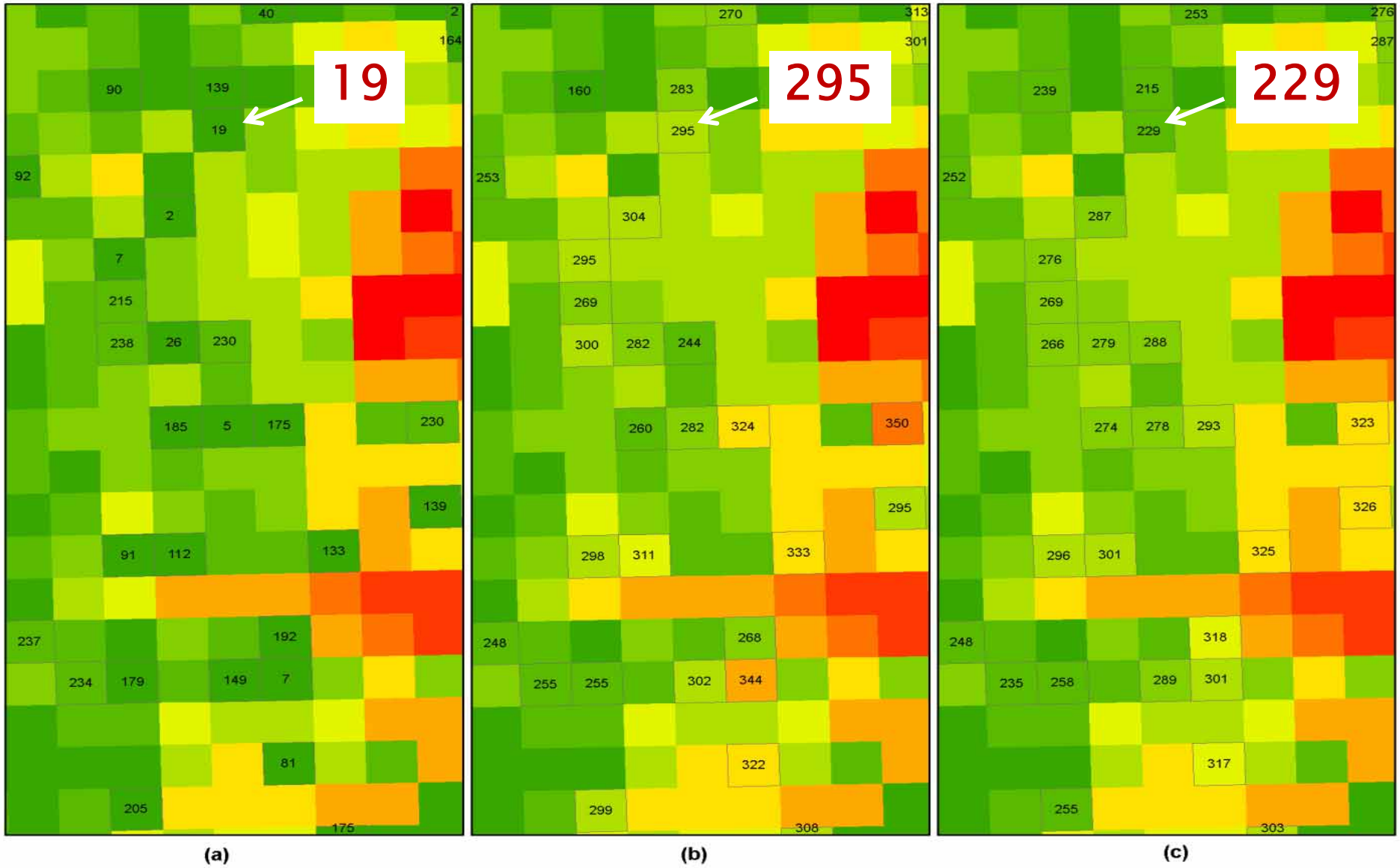
cell	Dominant vegetation	original hydro-period(days)	hydro-periods after smoothing			
			neighbor average	outlier	**neighbor match**	**outlier**
c1868	MFO	31	168	yes	**168**	**yes**
c1927	MFO	215	178	yes	**178**	**yes**
c1934	MFO	213	192	yes	**192**	**yes**
c2569	MFF	156	228	yes	**228**	**yes**
c351	CSGc	152	147	yes	**147**	**yes**
c687	SSB	192	197	yes	**197**	**yes**
c1038	MFO	191	211	yes	270	no
c1091	MFO	111	199	yes	270	no
c12	SSs	220	272	yes	271	no
c1476	MFO	131	220	yes	224	no
c1588	MFO	213	215	yes	224	no
c1638	MFO	143	150	yes	240	no
c1871	MFO	171	187	yes	223	no
c1928	MFO	198	183	yes	239	no
c1986	MFO	201	215	yes	239	no
c2044	MFO	100	216	yes	239	no
c352	MFO	210	211	yes	246	no
c389	MFO	189	200	yes	232	no
c690	MFO	162	193	yes	241	no

(SFWMD vegetation map)



A section of the study area with the hydro-period labeled for the outlier cells: (a) without smoothing, (b) smoothing with neighbor match, (c) smoothing with neighbor average. The colors represent hydro-periods (days)

Conclusion and Discussions

- The EDEN DEM is generally reliable in LNWR at the target scale of a 400-m grid cell.
- The vegetation and vegetation pattern in the cell seemingly affects the elevation discrepancy
- The smoothing methods may help characterize the hydrologic regimes in LNWR; the neighbor match method consistently produces better results.

Acknowledgements

Pamela A. Telis
Zhongwei Liu
Ken Rutchey
Nancy S Thoman
Wendy Stephens
Faith D. Graves

Funded by USGS (CESU agreement 5099HS012)

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