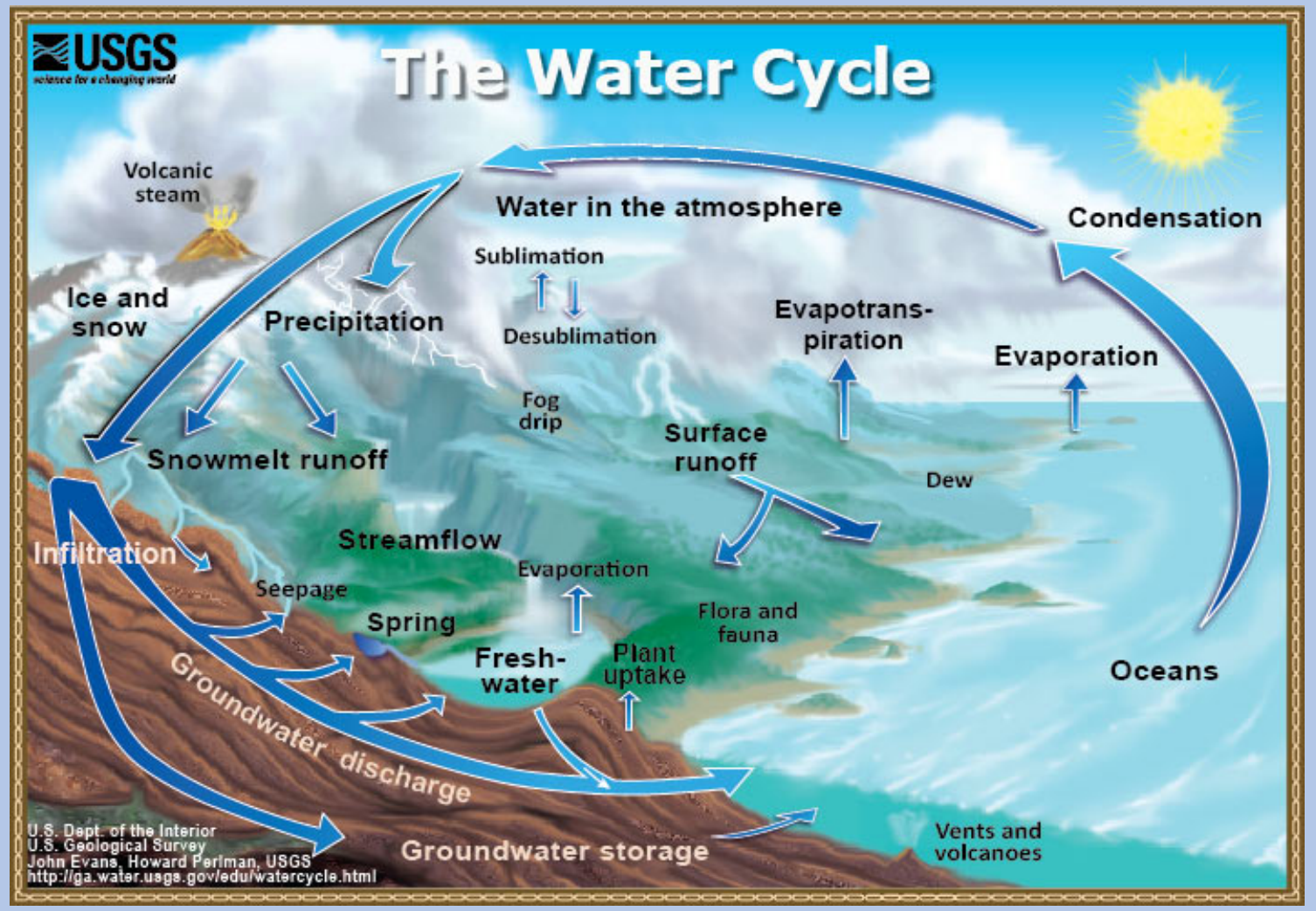
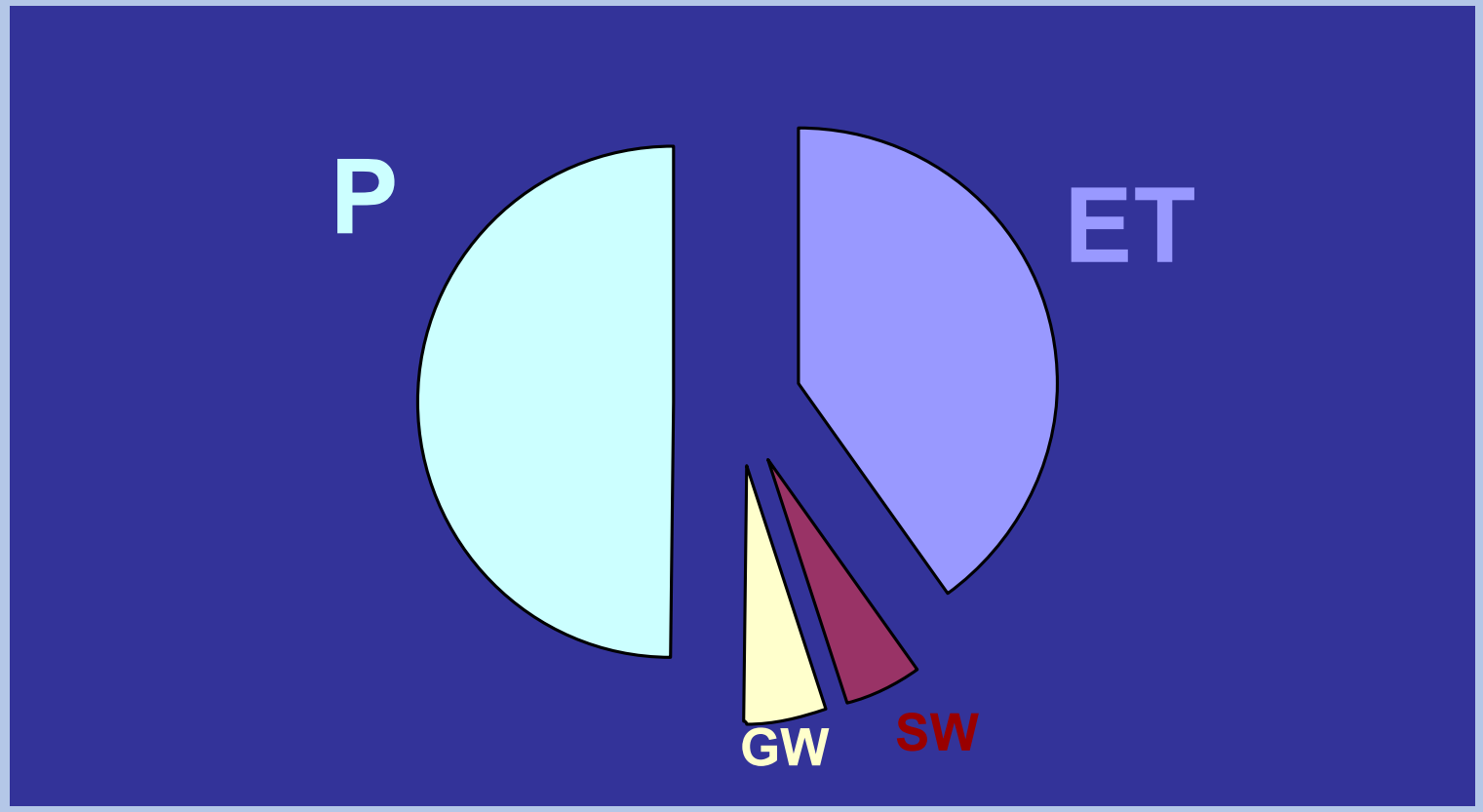
Precipitation is part of the story

By: W. Barclay Shoemaker, David M. Sumner, and Mike Holmes



Typical Florida water budget



ET = the “invisible” giant

Available Water- does work of hydrology

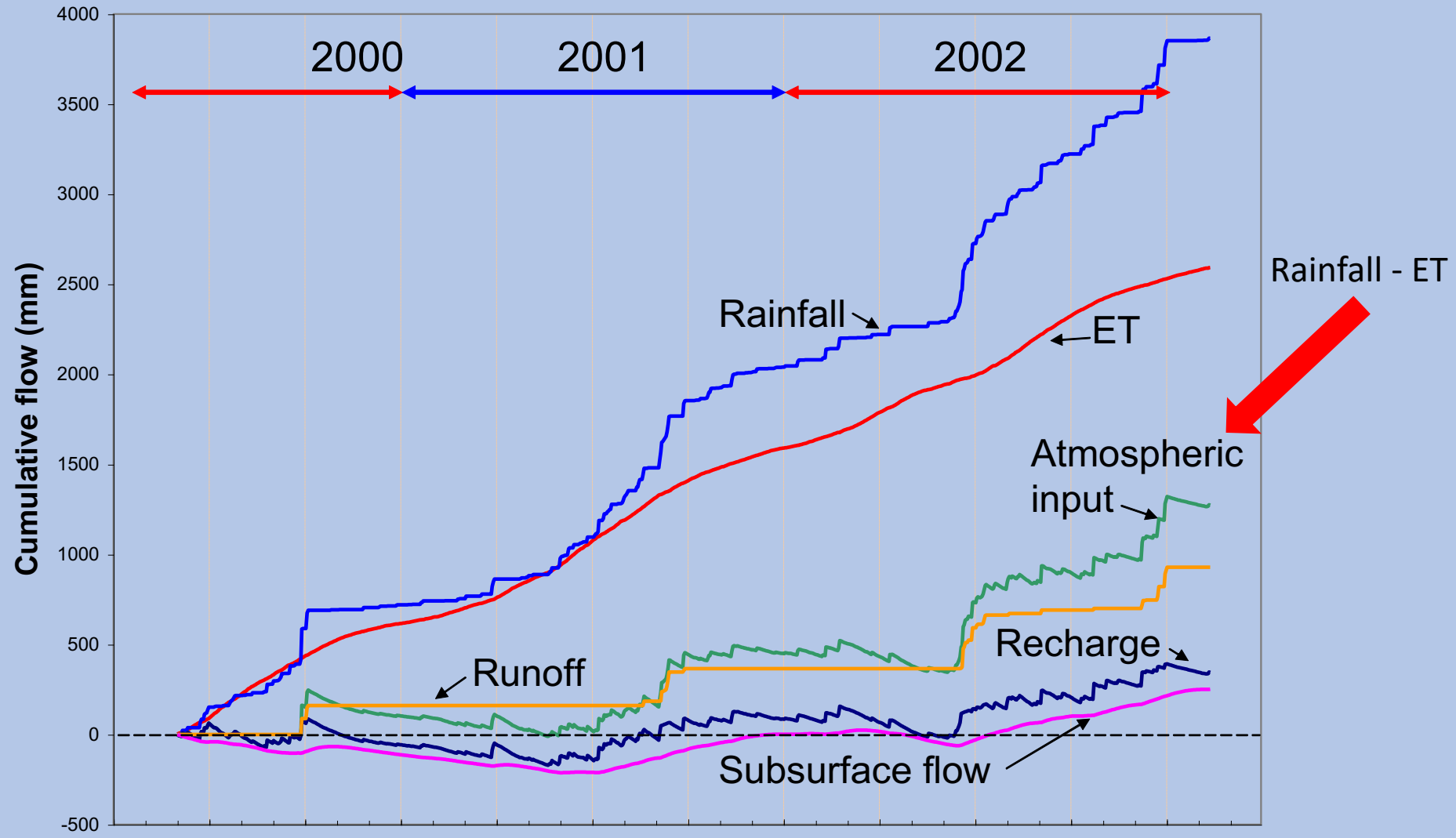
Better predictor of:

Water supply / deficits

Spring-flow

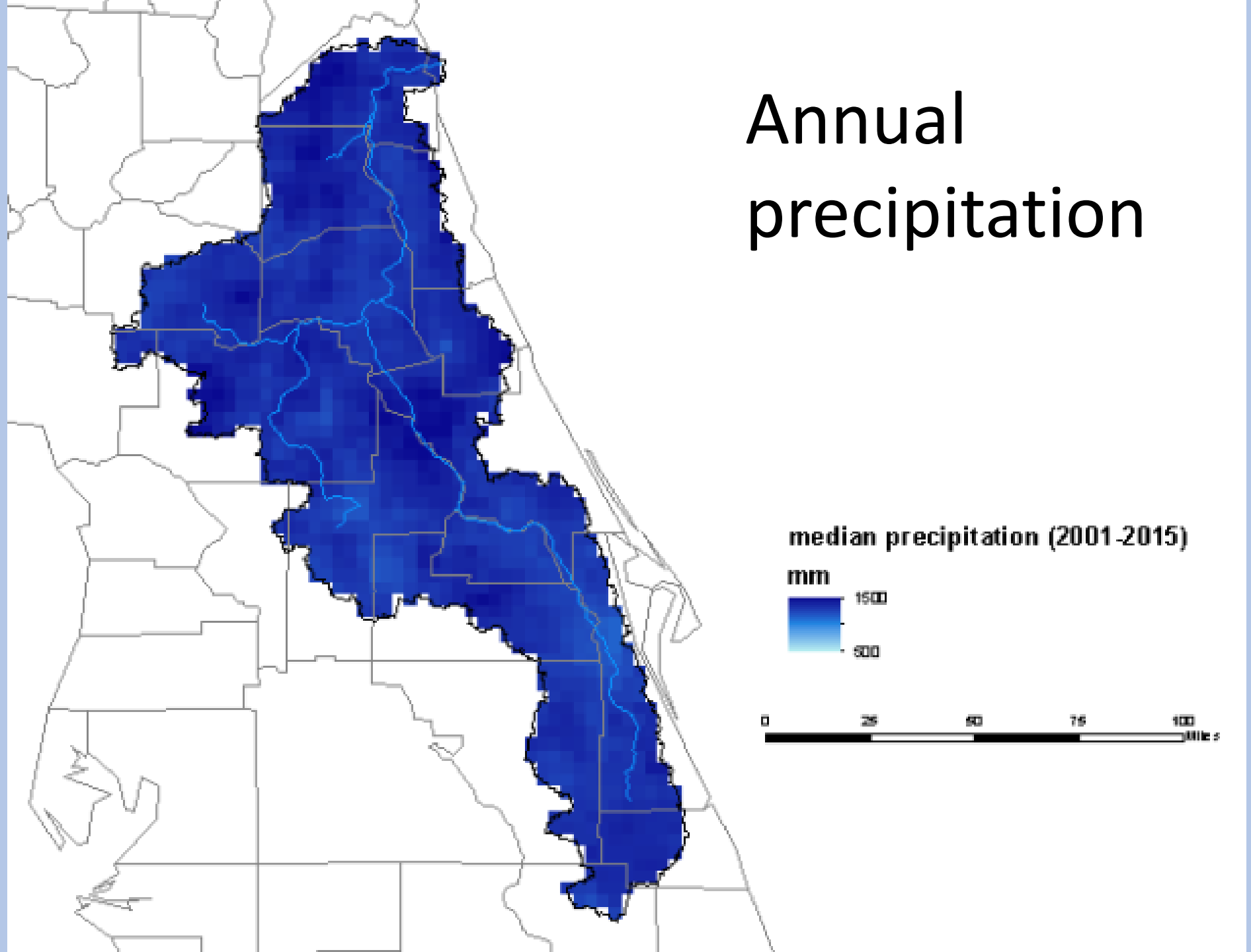
Saltwater intrusion

Results may be unexpected



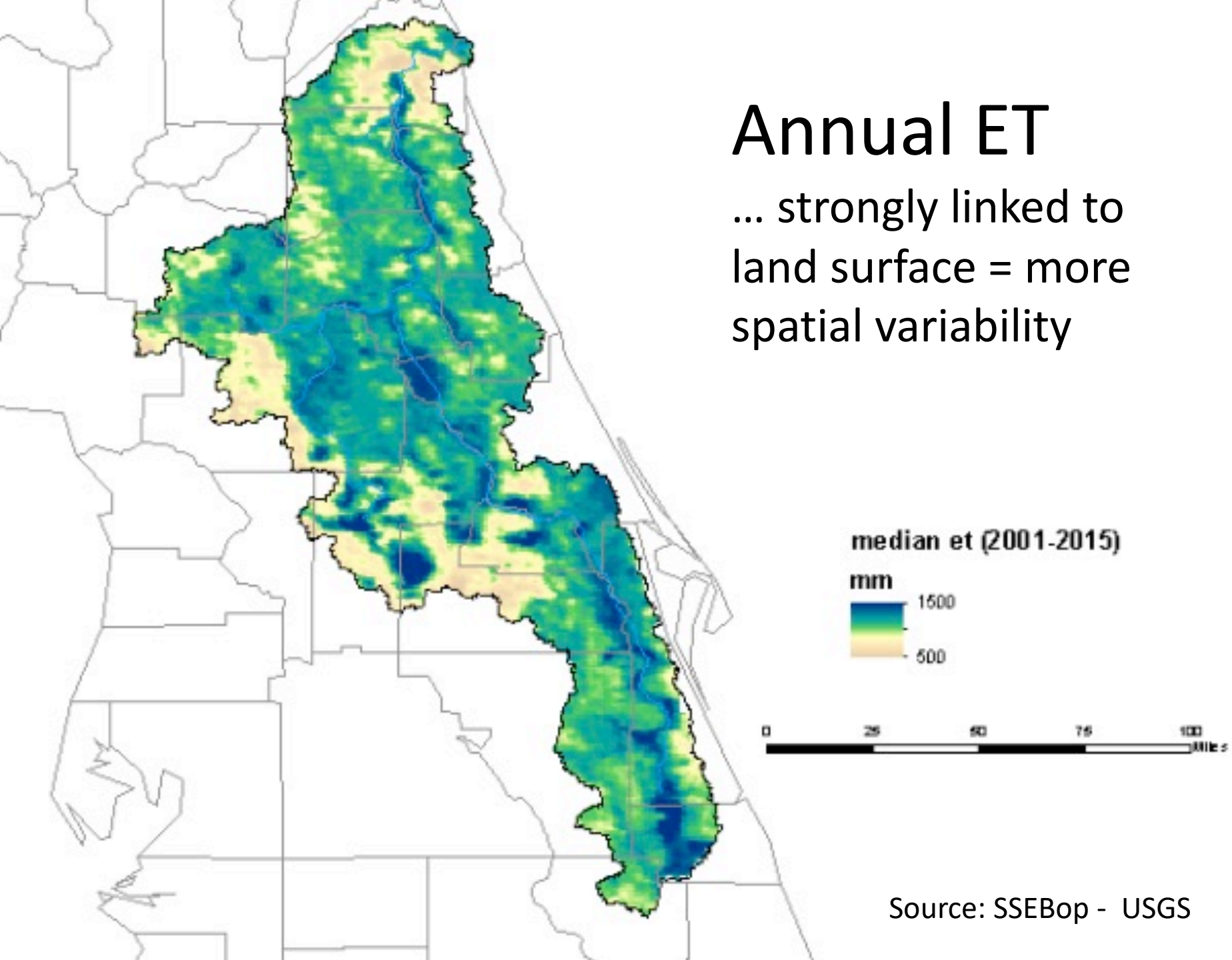
St. Johns River basin

Annual precipitation

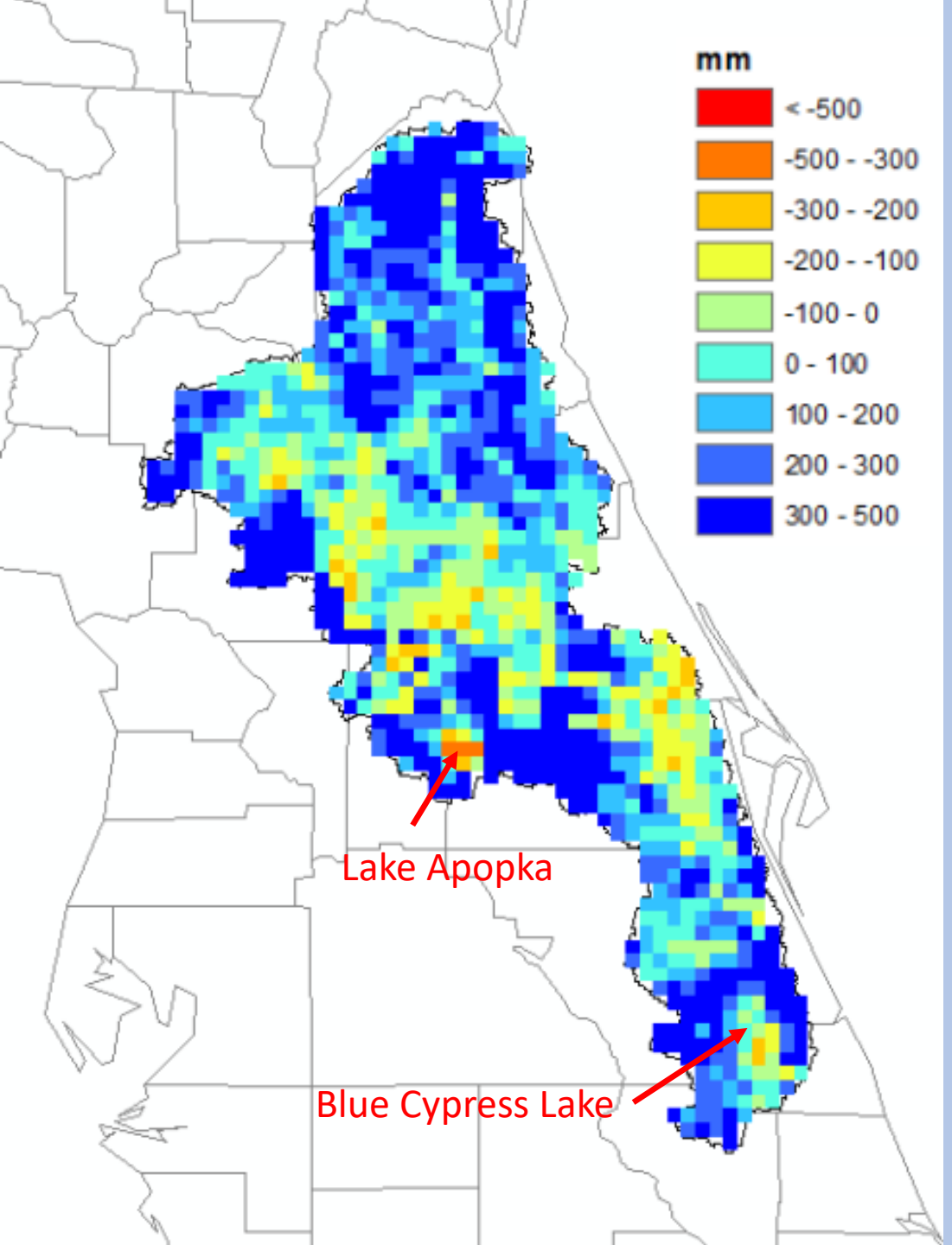


Annual ET

… strongly linked to land surface = more spatial variability



Source: SSEBop - USGS



Annual P - ET

… spatial variability in annual available Water largely governed by ET

Available water estimate is not easy - P and ET will change with climate, hydrology and landscapes

Climate changes to air temperature, clouds, CO2

Human and nature-induced changes to hydrology

Pielke et al. (1999) indicates P in 1993 was 11% less than P in 1900 -

Due to *landscape changes alone* *(independent of climate change)*

ET response to landscape change could be ***more profound –***

Albedo changes with urbanization

Plants to pavement, agricultural

USGS has products that can help quantify ET and available water

USGS has products that can help

1. ET stations

2. Gridded, PET and RET products

3. Gridded, global AET product

4. Gridded, solar insolation product

Can help calibrate historical climate simulations; and thus add credibility to projections

Contact: bshoemak@usgs.gov

Actual Evapotranspiration

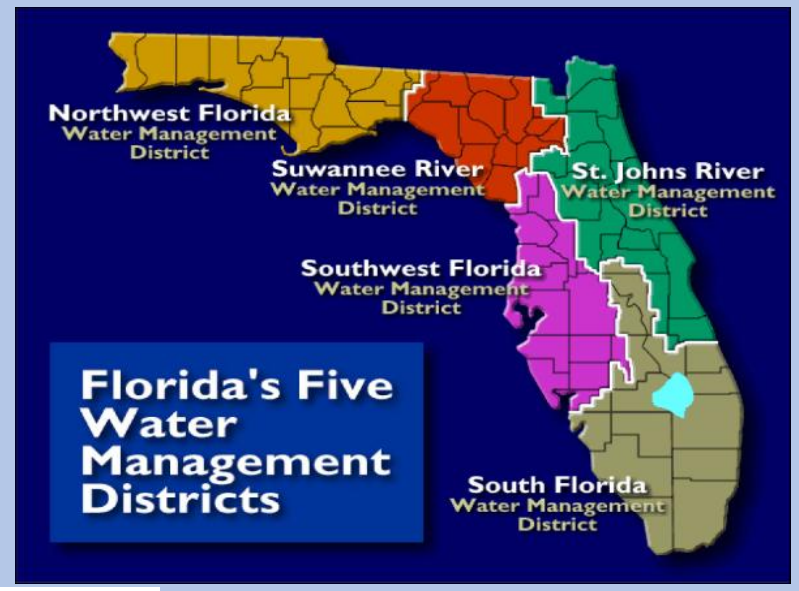
Actual evapotranspiration is that which occurs under field conditions, such as a crop-covered field.

Reference and Potential ET

Reference evapotranspiration is that from a grass surface that is well-watered. Potential evapotranspiration is that from a surface that has unlimited water (such as a lake).

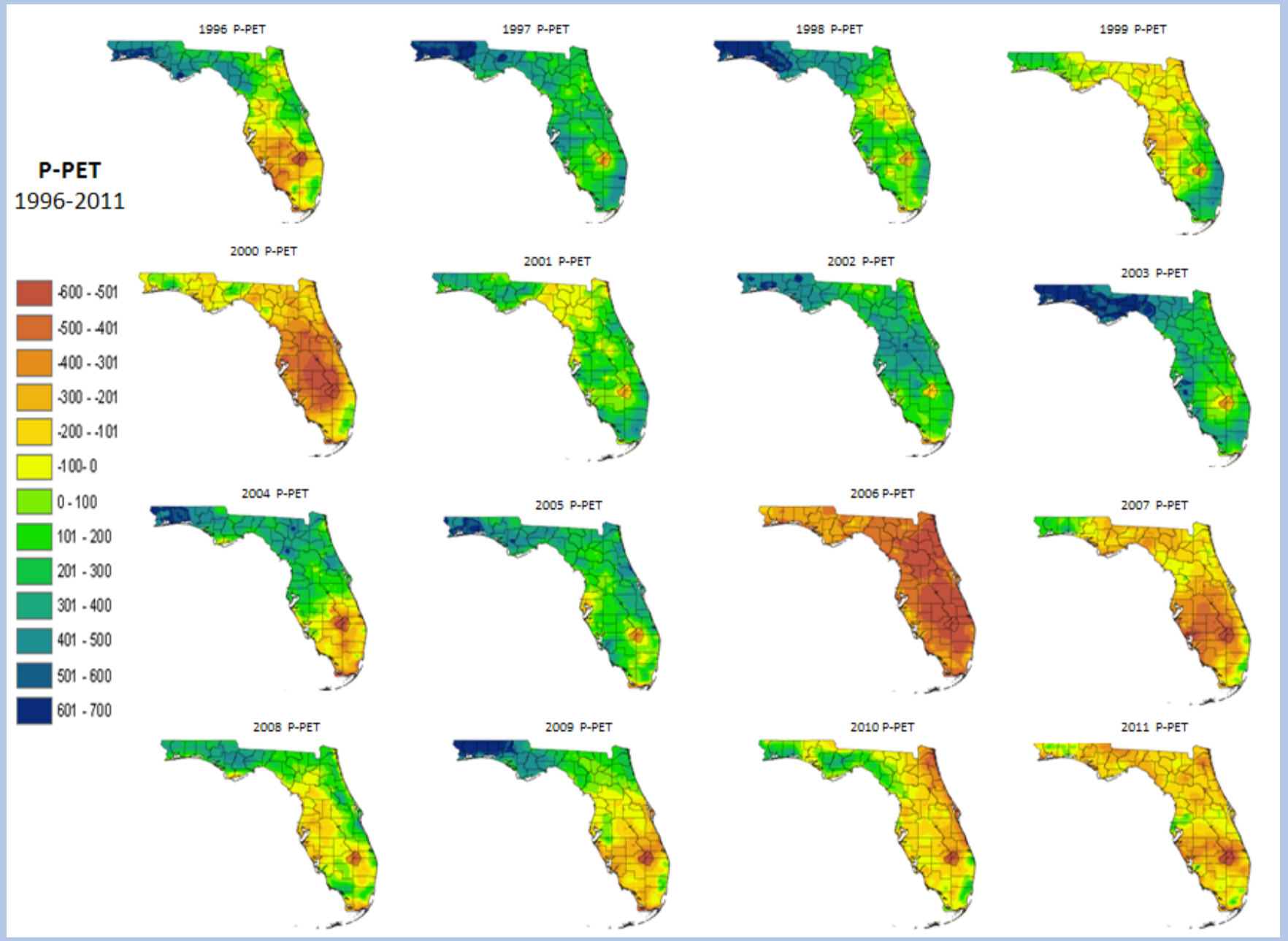
Evapotranspiration Network

USGS Florida Evapotranspiration Network is a network of 15 data collection sites representing various land cover types.



In cooperation with all **five Florida WMDs + Tampa Bay Water**

1996 to 2011 – available water (P-PET)



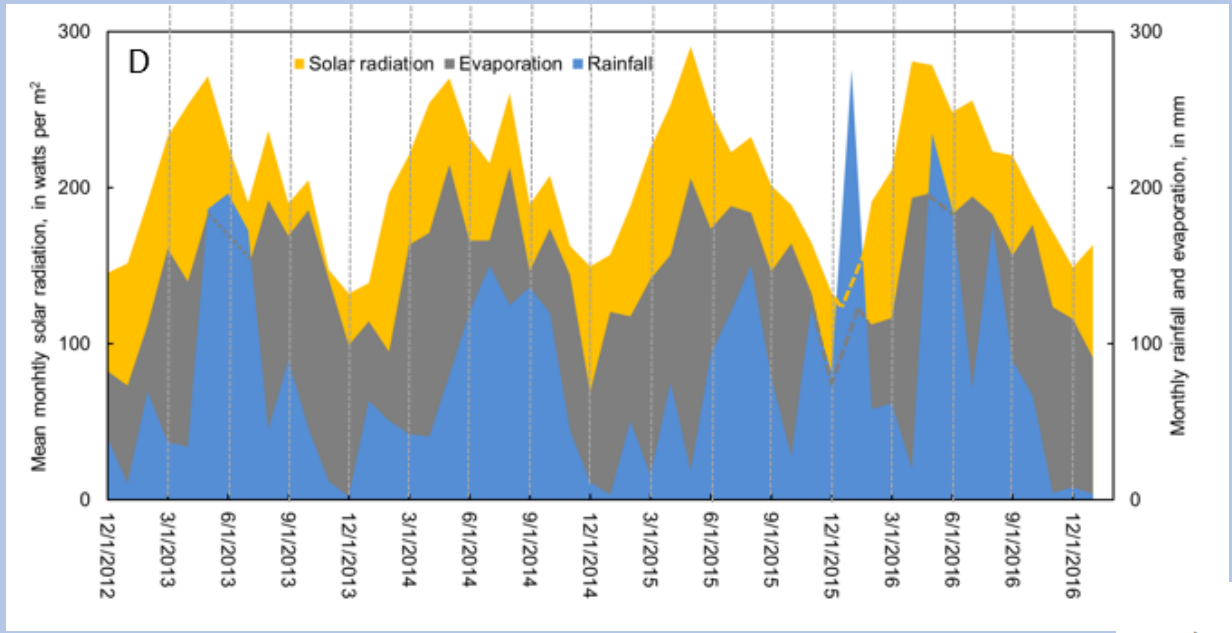
Lake Okeechobee Creates Its Own Weather

Less cloud cover = more incoming solar radiation = more evaporation
Lake Okeechobee has the largest evaporation rates in Florida

The “donut hole”

Evaporation of ~1800 mm per year From USGS Bowen ratio station at LZ40

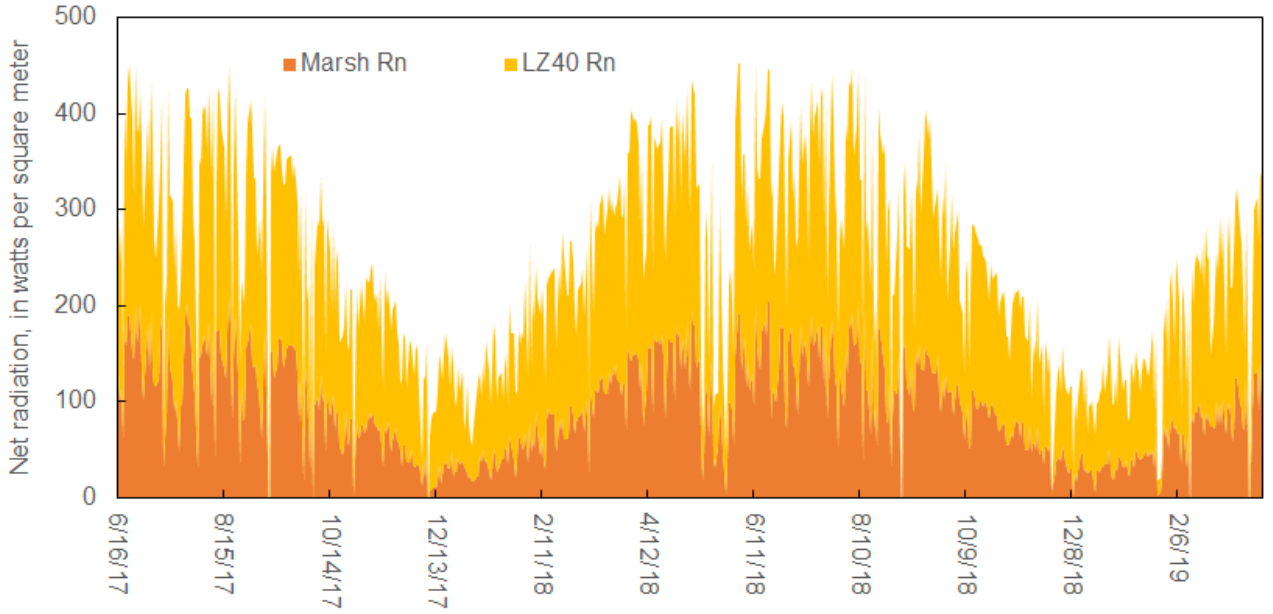
Lake Okeechobee Bowen ratio ET station at LZ40

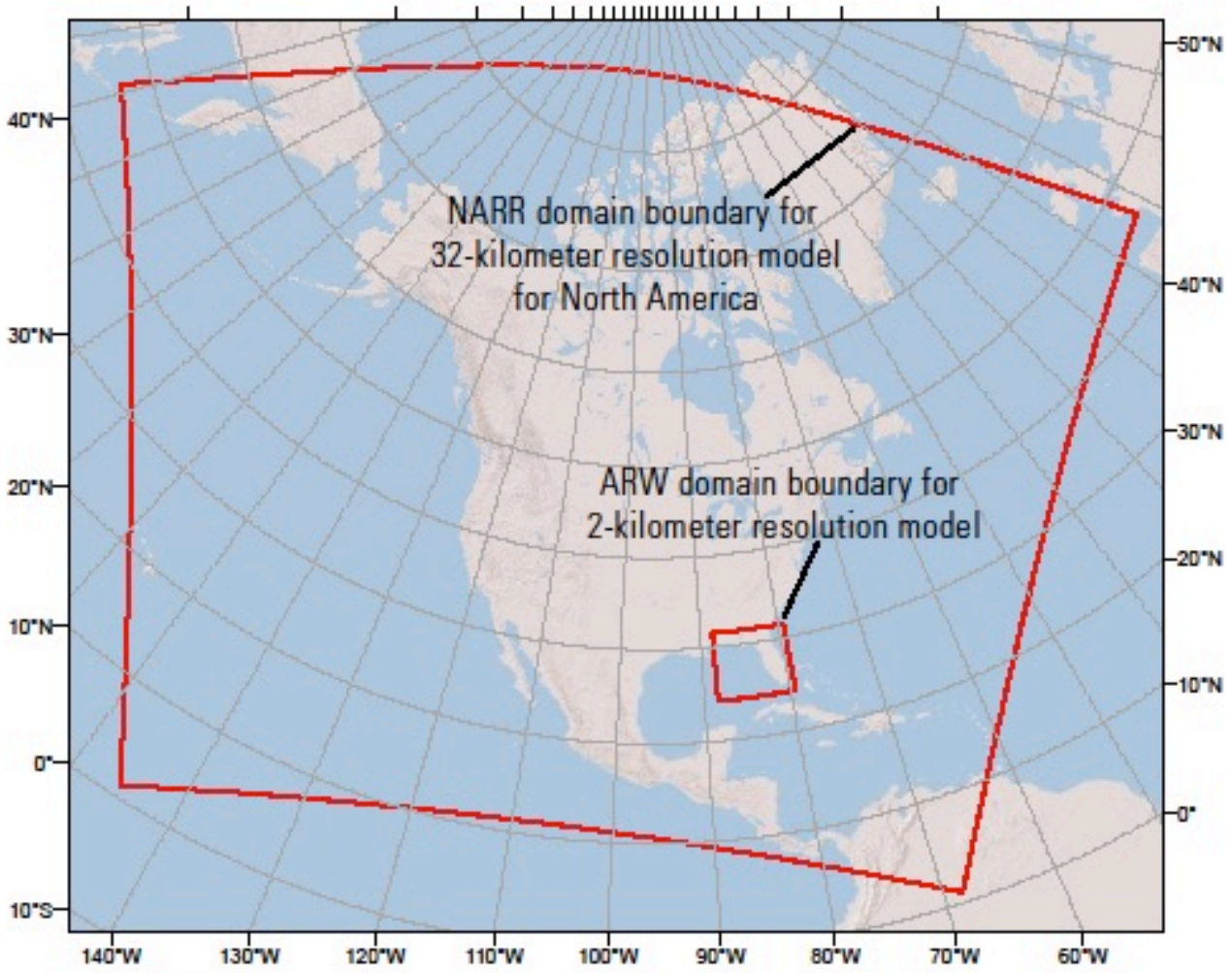


Evaporation of ~1800 mm per year

Rainfall of ~1500 mm per year

Rn(LZ40) ~ double Rn(Marsh)





NARR and AWR evaluations

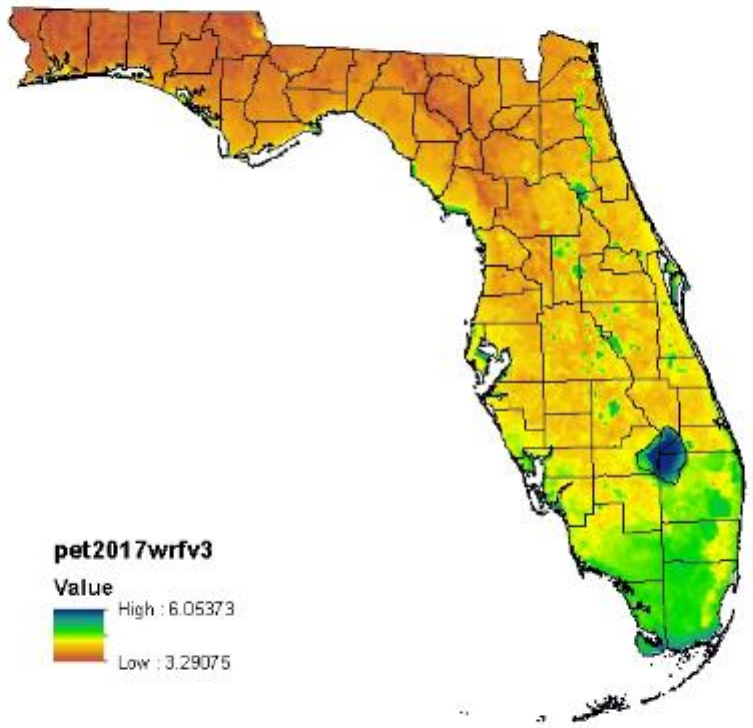
- Ta, Rh, Ws, PET and RET compared with data from 57 stations in 2017.
- Solar not examined
- Possible use of climate model variables in place of station data for PET/RET calculation

NARR/ARW bias analysis

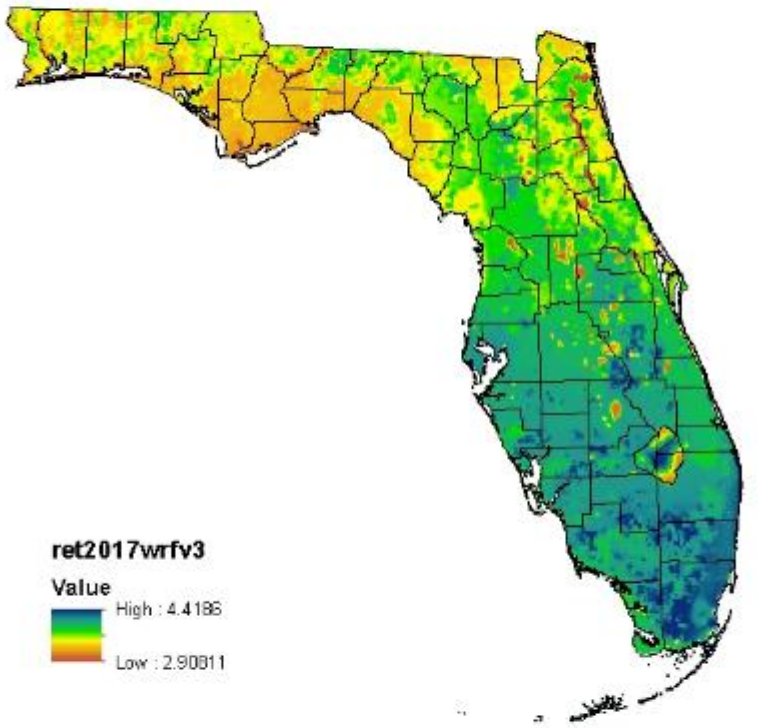
Mean correlations at 57 stations in 2017

Daily data time span	T_{min}	T_{max}	RH_{min}	RH_{max}	Ws	PET	ET_o		
North American Regional Ranalysis (NARR)									
Annual	**0.90**	**0.89**	**0.58**	0.29	**0.62**	**0.99**	**0.96**		
January	**0.68**	**0.75**	0.26	0.35	**0.57**	**0.85**	**0.64**		
February	0.43	**0.50**	0.28	0.37	0.39	**0.88**	**0.70**		
March	**0.71**	**0.84**	**0.51**	0.47	**0.59**	**0.93**	**0.72**		
April	**0.67**	**0.72**	0.49	**0.52**	0.44	**0.93**	**0.77**		
May	**0.74**	**0.76**	**0.53**	0.47	**0.54**	**0.95**	**0.78**		
June	0.34	**0.54**	0.35	-0.10	**0.53**	**1.00**	**0.94**		
July	0.16	**0.51**	0.17	-0.07	**0.52**	**1.00**	**0.95**		
August	0.05	**0.55**	0.10	0.04	0.41	**0.99**	**0.92**		
September	0.21	**0.63**	0.35	-0.14	**0.74**	**0.99**	**0.86**		
October	**0.90**	**0.80**	**0.58**	0.27	**0.56**	**0.96**	**0.78**		
November	**0.58**	**0.69**	0.31	0.23	**0.62**	**0.94**	**0.71**		
December	**0.76**	**0.74**	0.48	0.46	**0.50**	**0.87**	**0.59**		
								difference	
Advanced Research Weather Research and Forecasting Model (ARW)								PET	RET
Annual	**0.91**	**0.88**	0.45	0.43	**0.59**	**0.99**	**0.95**	0.00	-0.01
January	**0.76**	**0.73**	0.36	0.45	**0.53**	**0.86**	**0.56**	0.01	-0.08
February	**0.59**	**0.43**	0.37	0.35	0.41	**0.90**	**0.73**	0.02	0.03
March	**0.78**	**0.83**	0.46	0.48	**0.56**	**0.94**	**0.70**	0.01	-0.02
April	**0.74**	**0.68**	**0.51**	**0.50**	0.39	**0.93**	**0.74**	0.01	-0.03
May	**0.80**	**0.71**	**0.56**	0.37	**0.55**	**0.96**	**0.78**	0.00	0.00
June	**0.58**	**0.51**	0.42	0.11	**0.50**	**1.00**	**0.92**	0.00	-0.02
July	0.38	0.47	0.37	0.12	**0.53**	**1.00**	**0.93**	0.00	-0.02
August	0.40	**0.54**	0.42	0.17	0.47	**0.99**	**0.90**	0.00	-0.01
September	0.38	**0.55**	0.45	0.24	**0.77**	**0.99**	**0.88**	0.00	0.02
October	**0.92**	**0.80**	**0.54**	0.30	0.47	**0.96**	**0.78**	0.00	0.00
November	**0.67**	**0.66**	0.44	0.25	**0.63**	**0.95**	**0.69**	0.01	-0.01
December	**0.81**	**0.74**	0.47	0.34	**0.50**	**0.88**	**0.58**	0.01	-0.01

Average Daily PET WRF 2017



Average Daily RET WRF 2017



Conclusions

Don’t forget the invisible giant (ET) to have the full picture of available water.

Use historical USGS ET data for building climate model Integrity.

NARR/ARW bias analysis – mean monthly values at 57 stations in 2017.
-% indicates model underestimated the mean
+% indicates model overestimated the mean

Time Period (2017)	Evapotranspiration		NARR		NARR percent bias		ARW		ARW percent bias	
	PET	ET_o	PET	ET_o	PET	ET_o	PET	ET_o	PET	ETo
	(millimeters)		(millimeters)		(%)		(millimeters)		(%)	
Annual	1547	1568	1661	1535	7	-2	1552	1434	0	-9
January	56	87	64	84	15	-3	59	71	6	-18
February	77	98	86	92	11	-6	80	80	4	-18
March	118	139	130	130	10	-6	121	116	3	-17
April	155	165	166	155	7	-6	158	142	2	-14
May	192	190	206	180	7	-5	193	170	0	-10
June	171	144	180	145	5	0	170	146	-1	1
July	195	164	206	165	5	0	192	164	-2	0
August	191	161	201	164	5	2	188	160	-2	-1
September	156	139	162	138	4	-1	151	134	-3	-4
October	113	119	120	121	6	2	112	111	-1	-7
November	72	88	81	88	12	1	74	76	2	-13
December	51	74	60	71	16	-3	53	64	4	-13