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Set customers up for success: Baseline irrigation influences conservation

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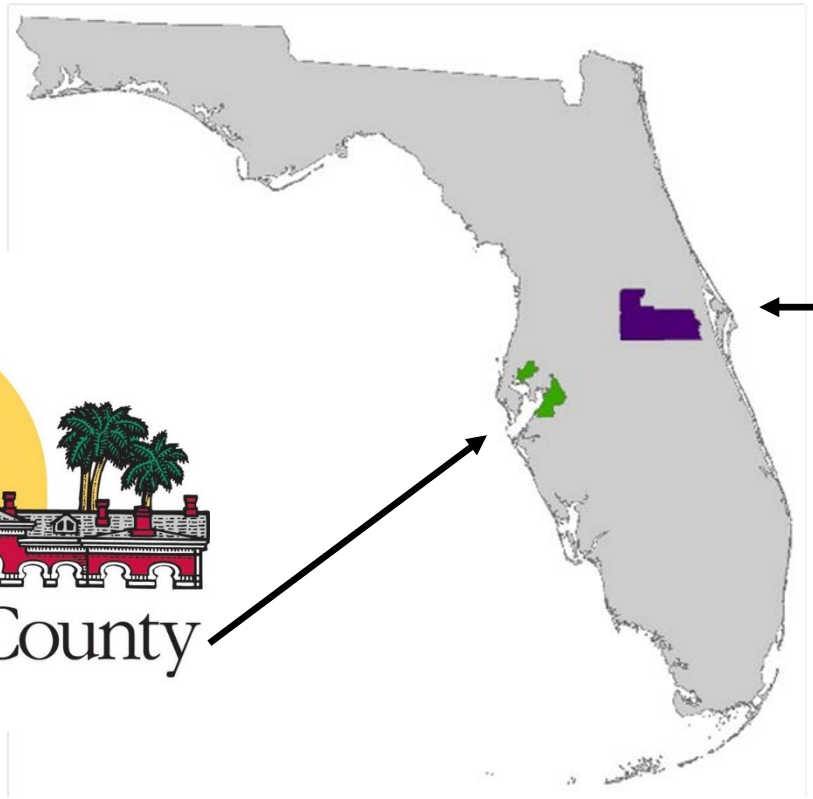
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

TAMPA BAY WATER
Supplying Water To The Region

Study area



Hillsborough County Florida

ORANGE COUNTY UTILITIES DEPARTMENT

- Single-family residential water customers without access to reuse water (assumed to irrigate with potable water)
- Reported per capita total water use: HCU= 74 gallons per capita per day (gpcd) and OCU = 177 gpcd

Objectives

- Review conservation technology (Florida-Friendly Landscaping, soil moisture sensors, and evapotranspiration controllers) in Florida
- Compare irrigation behavior of single-family residential customers in Hillsborough County Utilities (HCU) and Orange County Utilities (OCU)
- Classify HCU and OCU users as high, medium, low, or non-irrigators
- Evaluate the effectiveness of water conservation tools for each customer

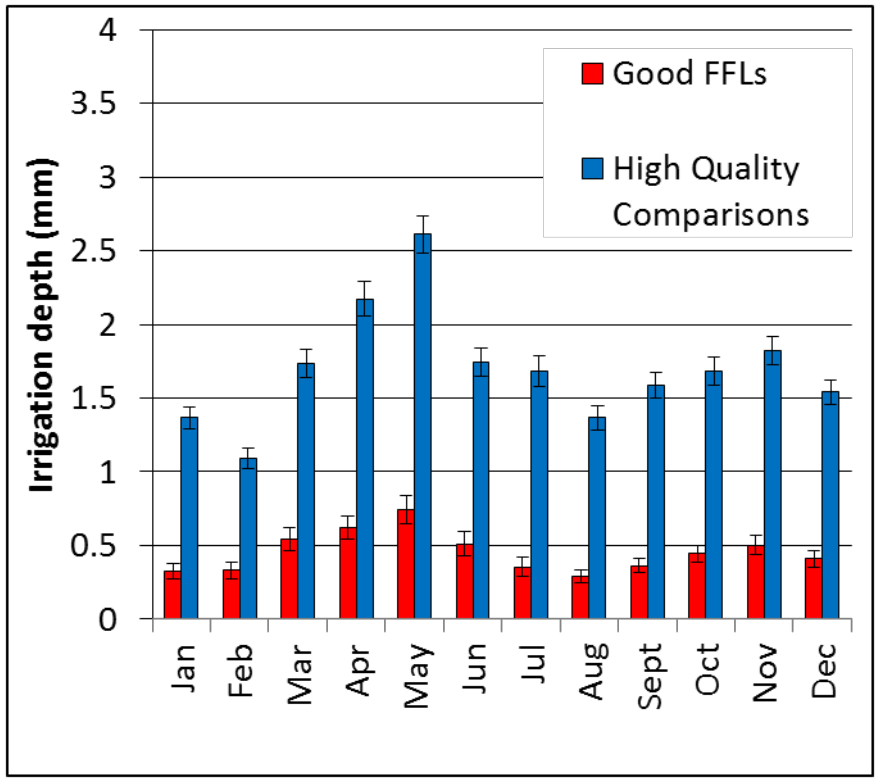
Florida-Friendly Landscapes (FFL)

- 9 FFL principles for attractive, low-maintenance landscapes
- Water efficiently principle
  - Rain gauge to track rainfall
  - Water only at signs of wilt
  - Group plants with similar water needs
  - Rain barrels
  - Reduce irrigation in summer and winter
  - Automatic rain shutoff device for sprinkler system
  - Low-volume irrigation in plant beds
  - Soil moisture sensor

FFL

FFL

Florida-Friendly Landscapes (FFL)



- FFLs use 50% to 70% less irrigation than traditional landscapes

FFL

Traditional

Soil Moisture Sensor Controller (SMS)

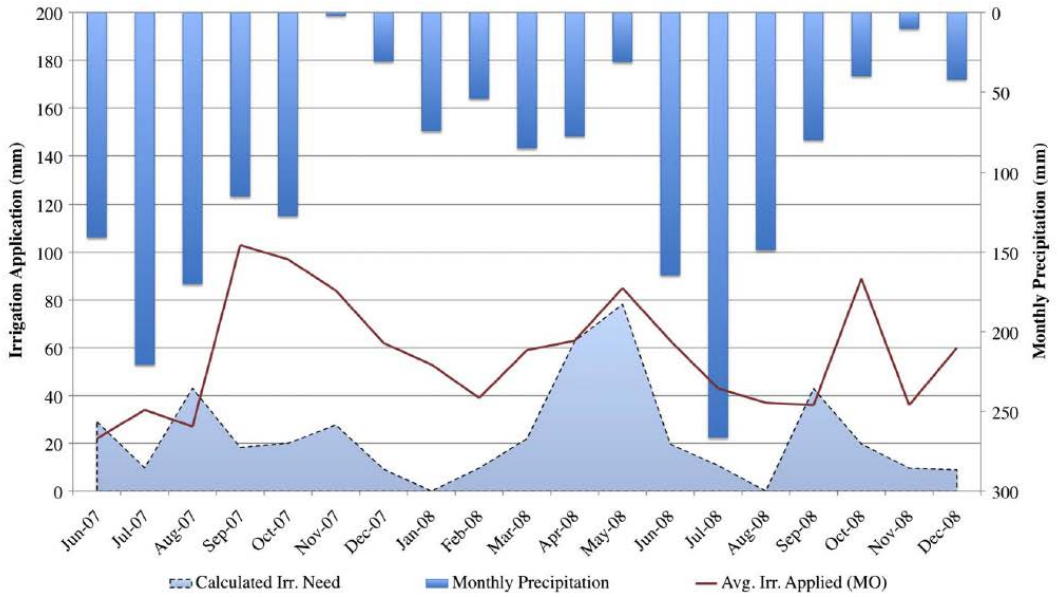
- When soil moisture is above threshold, signal sent from underground sensor to irrigation controller to stop irrigation
- Technology works with an irrigation controller
- **Can't increase irrigation unless irrigation controller is changed**
- Irrigation savings: 11-72% annually

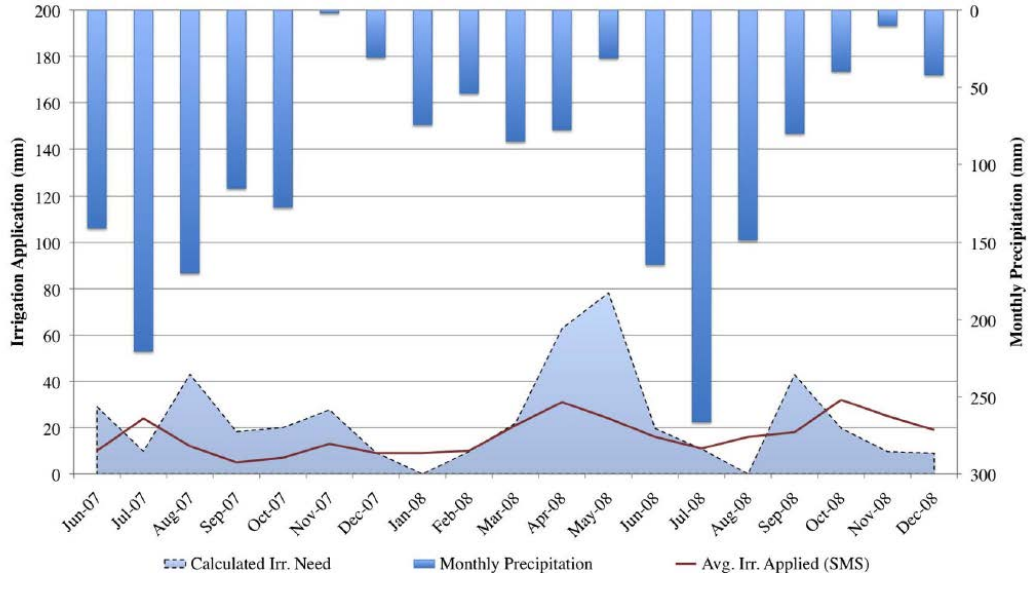
Soil Moisture Sensor Controller (SMS): Plot studies

Publication	Turfgrass type	Location	Water savings (%)	Technology tested	Comments
Cardenas-Lailhacar et al. 2008	Bermuda	North central FL	72	Acclima Digital TDT RS-500; Watermark 200SS-5; Rain Bird MS-100; Water Watcher DPS-100	Normal rainfall conditions
McCready et al. 2009	St. Augustine	North central FL	11-53	LawnLogic LL1004; Acclima Digital TDT RS500	Drought conditions with extended dry periods
Cardenas-Lailhacar et al. 2010	Bermuda	North central FL	34	Acclima Digital TDT RS-500; Watermark 200SS-5; Rain Bird MS-100; Water Watcher DPS-100	Drought conditions with extended dry periods
Cardenas-Lailhacar et al. 2010	Bermuda	North central FL	54	Acclima Digital TDT RS-500; Watermark 200SS-5; Rain Bird MS-100; Water Watcher DPS-101	Normal rainfall conditions
Cardenas-Lailhacar et al. 2016	St. Augustine	North central FL	63	Acclima Digital TDT RS-500; AquaSpy SMS-100; Baseline BiSensor; Dynamax SM200	Potable water
Cardenas-Lailhacar et al. 2016	St. Augustine	North central FL	55	Acclima Digital TDT RS-500; AquaSpy SMS-100; Baseline BiSensor; Dynamax SM200	Reclaimed water, dryer than potable water study

Soil Moisture Sensor Controller (SMS): Field studies

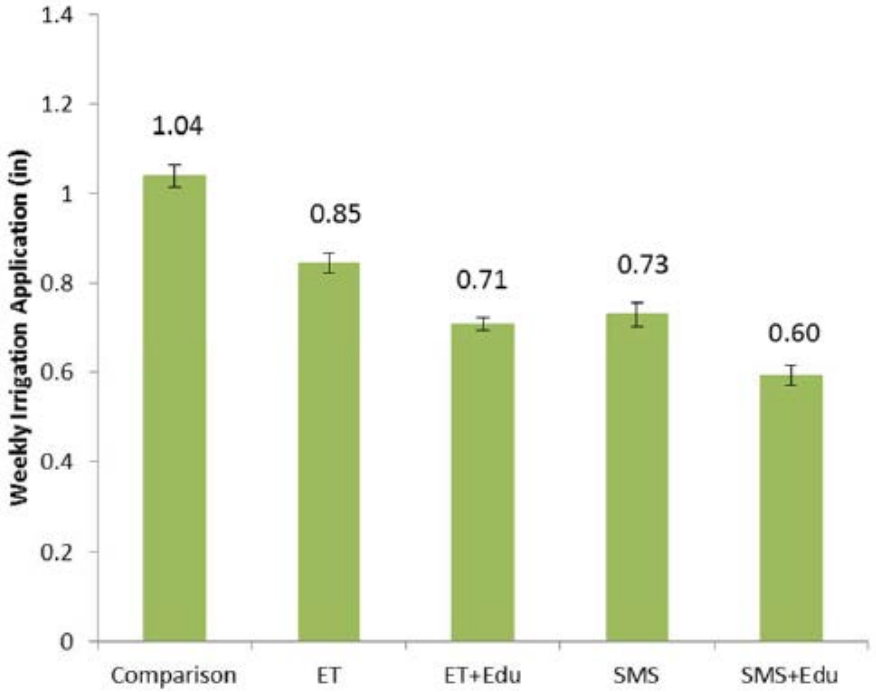
- Publication:
  - Haley and Dukes 2012
- Study setting
  - Palm Harbor, Pinellas County
- Turfgrass type
  - St. Augustinegrass
- Data collection
  - AMR monitoring of 58 homes (four treatments)
- Water savings
  - 65% as compared to monitored only homes
- Comments
  - All homes had automatic in-ground irrigation





Soil Moisture Sensor Controller (SMS): Field studies

- Publication
  - Breder and Dukes 2014
- Study setting
  - Orange County Utilities
- Turfgrass type
  - St. Augustinegrass
- Data collection
  - Comparison: 35 homes
  - **SMS: 28 homes**



- Water savings
  - **38% reduction** in irrigation as compared to monitored only homes
- Comments
  - All homes had automatic in-ground irrigation
  - High irrigating customers recruited for study

Evapotranspiration (ET) Controllers

- Determines when and how much irrigation to apply based on estimated plant water needs.
  - Reference evapotranspiration (ETO) determined from weather factors of temperature, relative humidity, solar radiation, and wind speed.
  - Uses on-site or satellite-retrieved data to calculate irrigation required
- Technology replaces an irrigation time clock.
- Irrigation savings highly variable
- **Can increase or decrease irrigation**

Weathermatic

ETwater

Toro

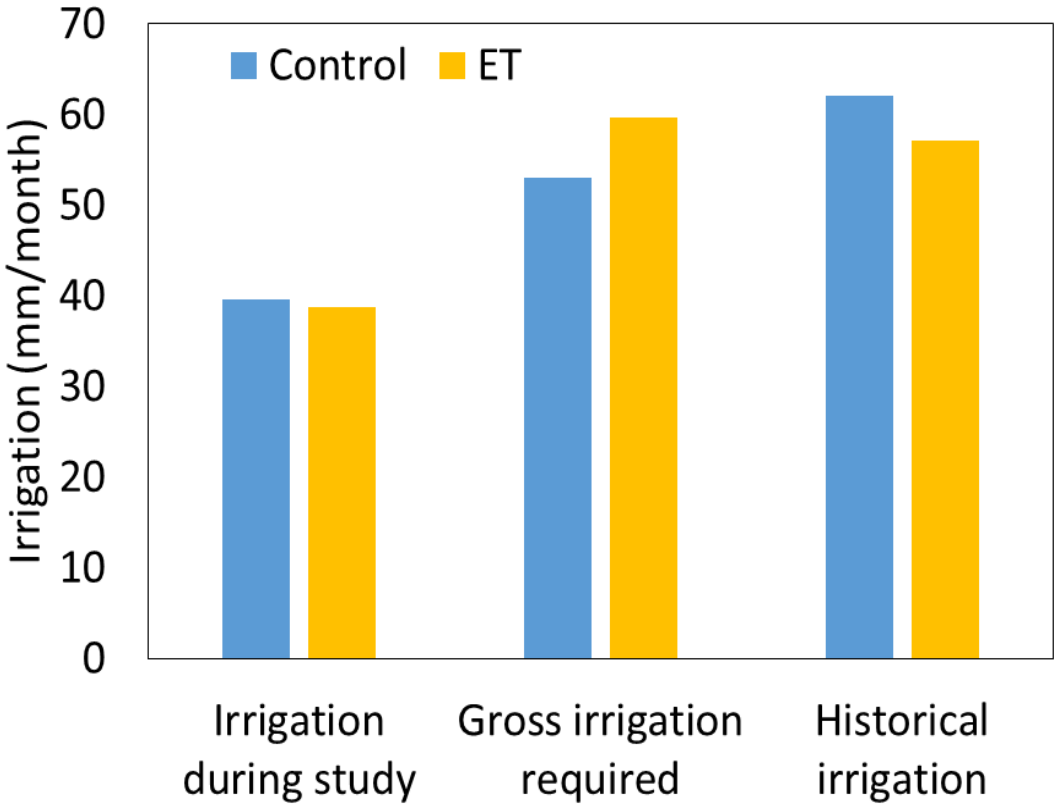
Rainbird

Evapotranspiration (ET) Controllers: Plot studies

Publication	Turfgrass type	Location	Water savings (%)	Technology tested	Comments
Davis et al. 2009	St. Augustine	Southwest FL	43	Toro Intelli-Sense; Etwater Smart Controller 100; Weathermatic SL 1600	Dry weather conditions
Rutland and Dukes 2012	St. Augustine	Southwest FL	25-41	Toro Intelli-Sense	Larger savings using rain sensor and rain pause
McCready et al. 2009	St. Augustine	North central FL	(20)-59	Toro Intelli-Sense; Rain Bird ET Manager	Drought conditions with extended dry periods

Evapotranspiration (ET) Controllers: Field studies

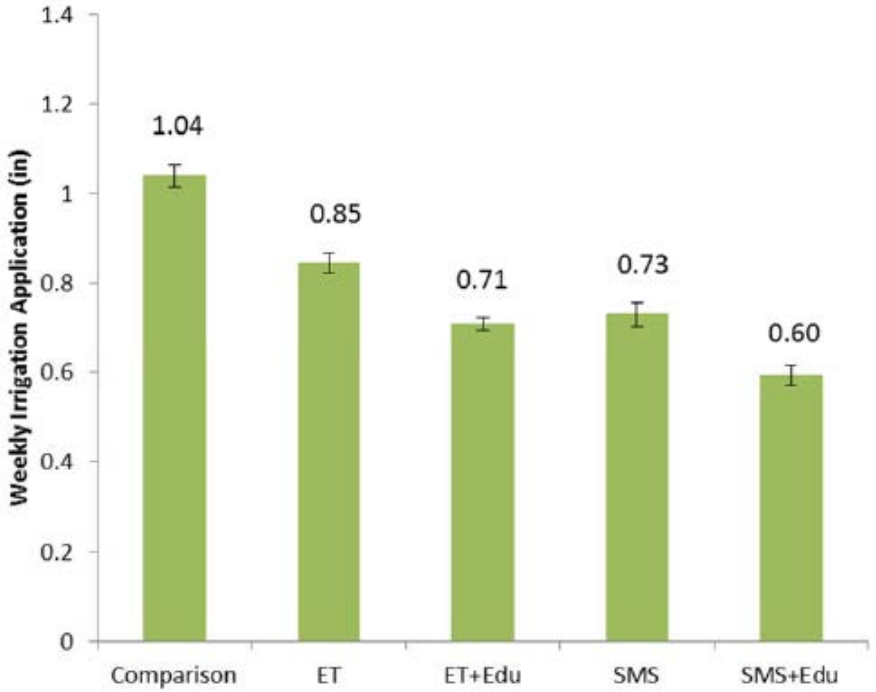
- Publication
  - Davis and Dukes 2013
- Study setting
  - Apollo Beach, Riverview, and Valrico, Hillsborough County
- Turfgrass type
  - St. Augustinegrass
- Data collection
  - Comparison: 15 homes
  - ET: 21 homes



- Water savings
  - None based on Comparisons, 32% based on GIR, 29% based on historical
- Comments
  - All homes had automatic in-ground irrigation
  - 25th to 75th percentile water users

Evapotranspiration (ET) Controllers: Field studies

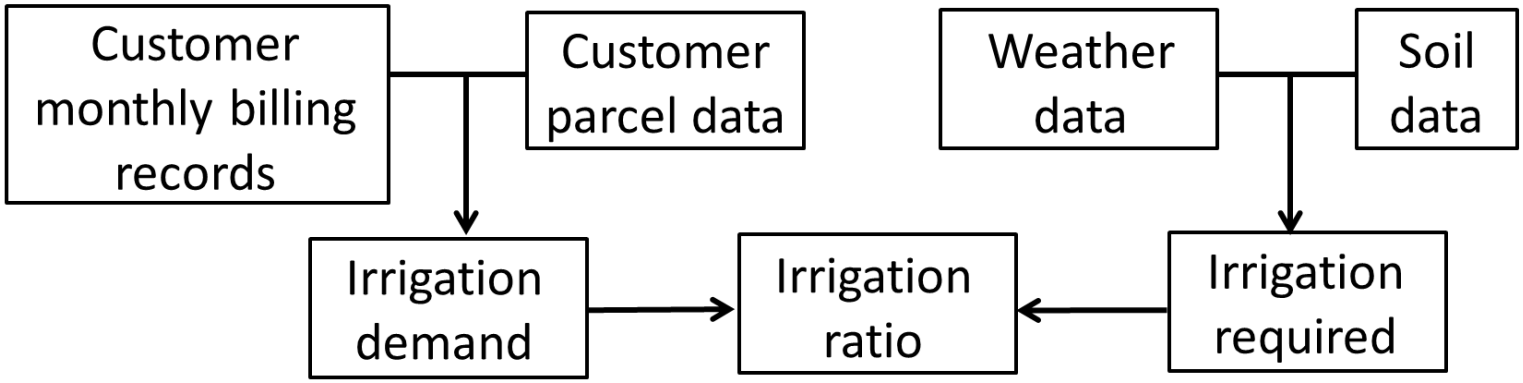
- Publication
  - Breder and Dukes 2014
- Study setting
  - Orange County Utilities
- Turfgrass type
  - St. Augustinegrass
- Data collection
  - Comparison: 35 homes
  - **ET: 28 homes**



- Water savings
  - **26% reduction** in irrigation as compared to monitored only homes
- Comments
  - All homes had automatic in-ground irrigation
  - High irrigating customers recruited for study

Data and calculations

- Over 14 million monthly potable residential water billing records (indoor and outdoor combined) for 1999-2009
- Daily evapotranspiration and rainfall data on 2-km grid
- Soil GIS maps for available water holding capacity
- Census GIS maps for block-level household size
- Previous research studies on conservation effectiveness
- Calculations performed in SAS, R, GIS, and Excel. All results statistically significant ($p<0.001$)

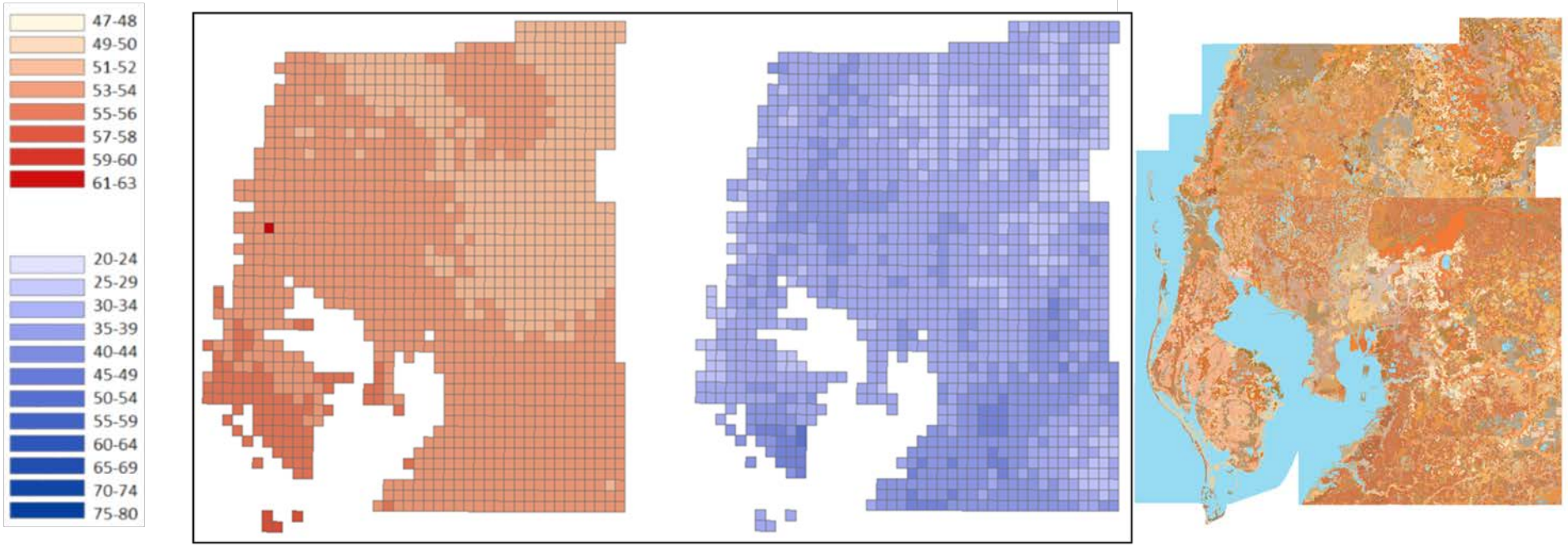


Irrigation demand

- Irrigation demand = Total water – Indoor water
  - Indoor water = (69.3 gallons per capita per day)(census block household size)(days/month)
  - Irrigation depth = Irrigation demand/green area
  - Green area = total parcel area – building footprint

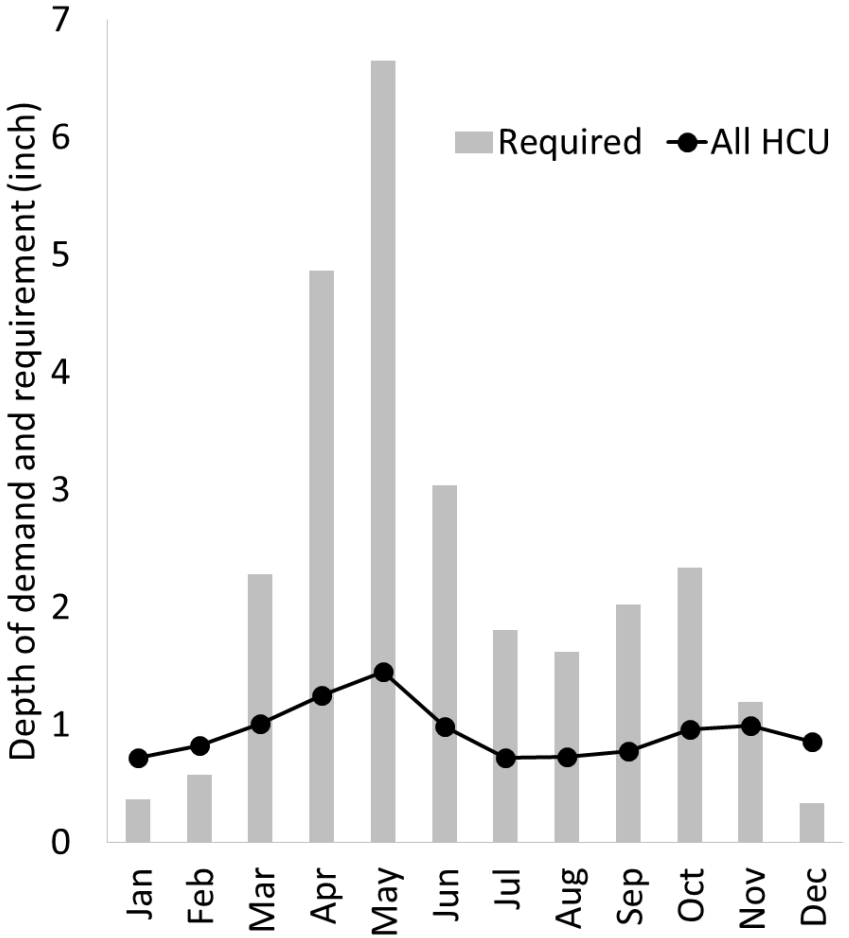
Gross irrigation required (GIR) and irrigation ratio

- Irrigation required
  - Daily soil-water balance to calculate monthly requirement
  - Customized for the site conditions of each customer

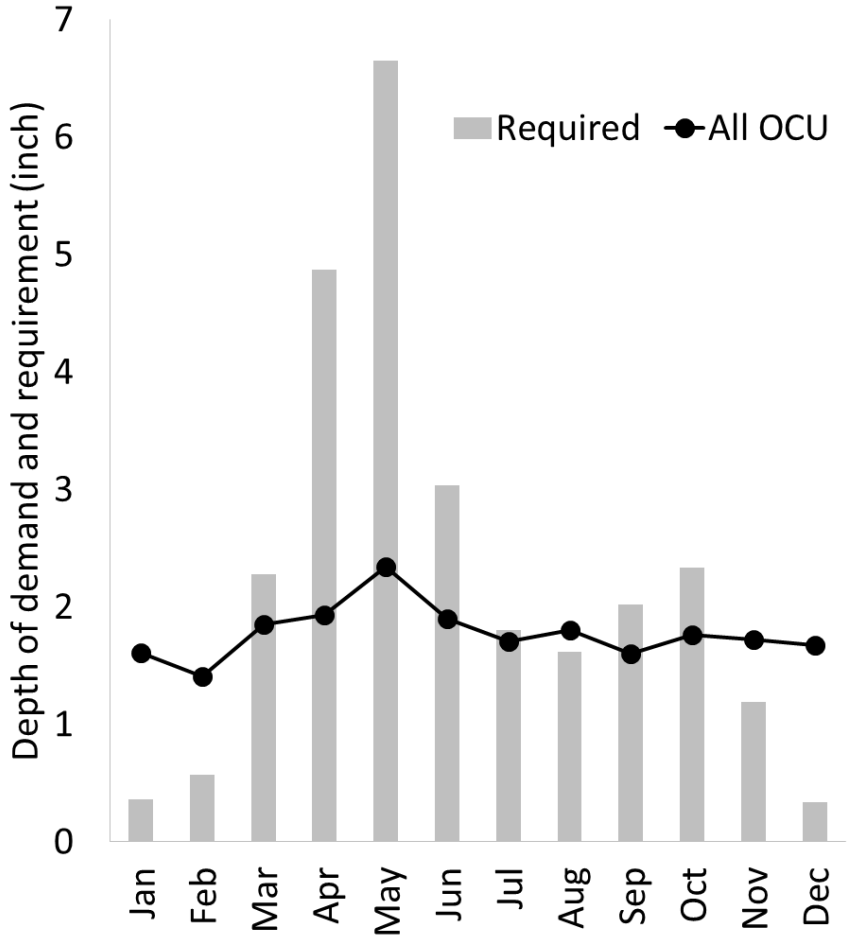


- Irrigation ratio = Irrigation demand/irrigation required
  - Accounts for the influence of weather and site conditions

Irrigation demand and required

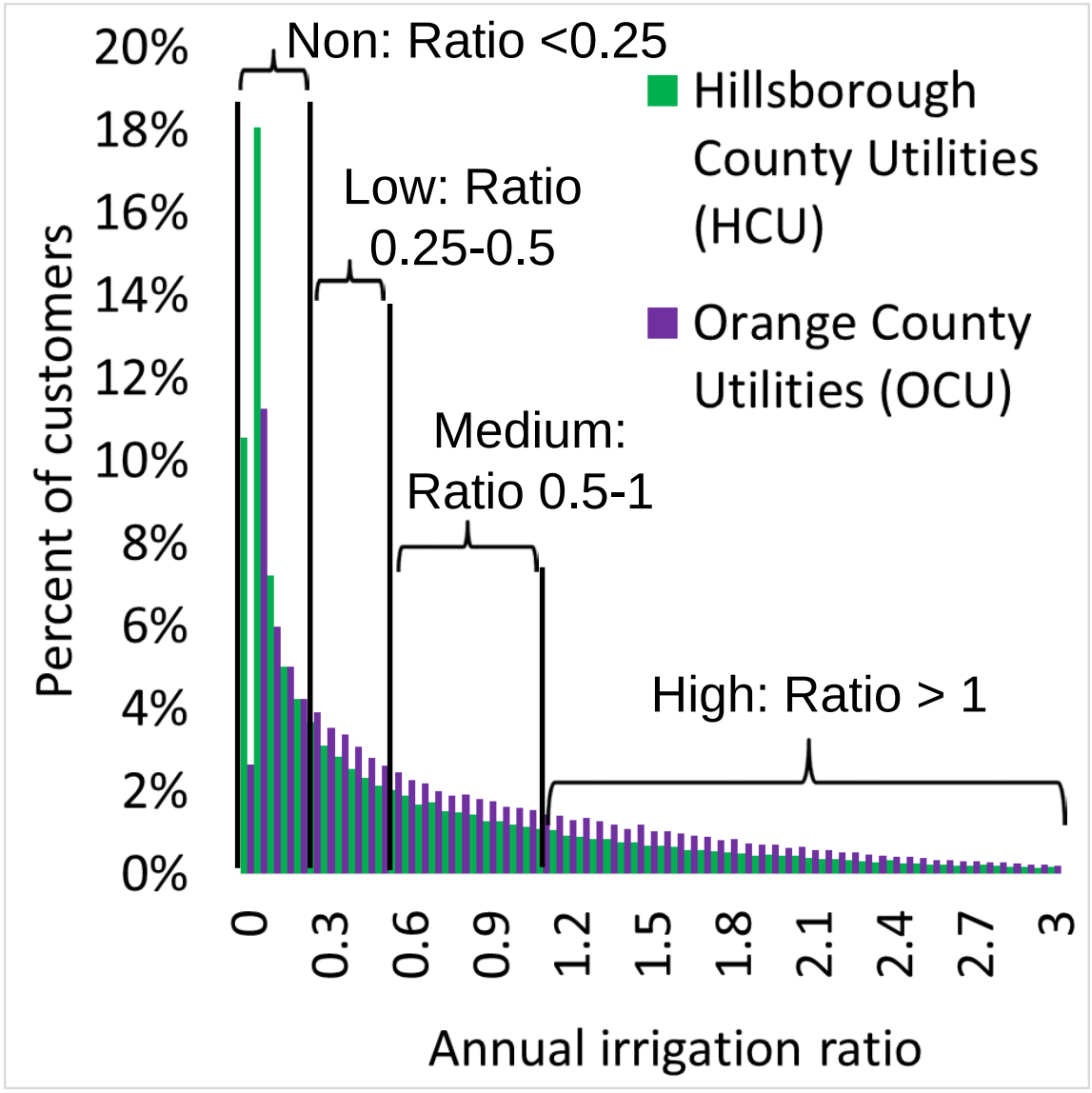


HCU: n= 94,438

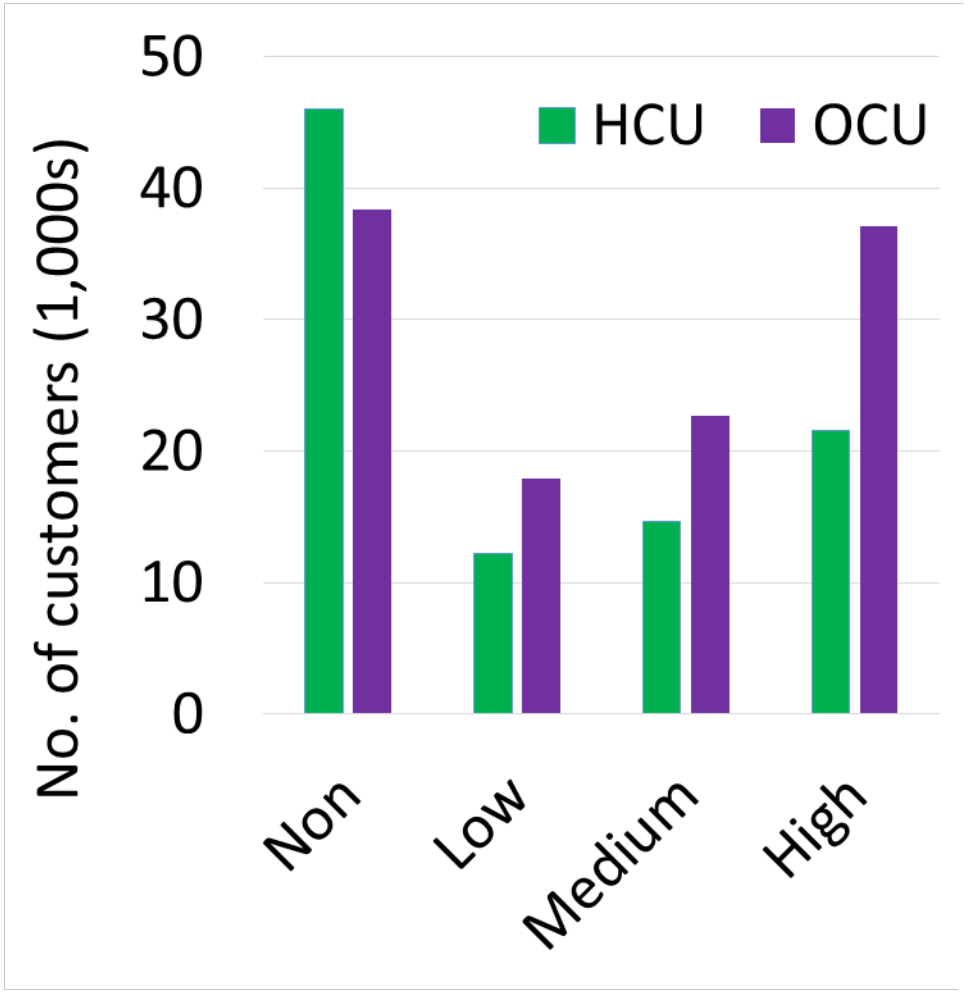


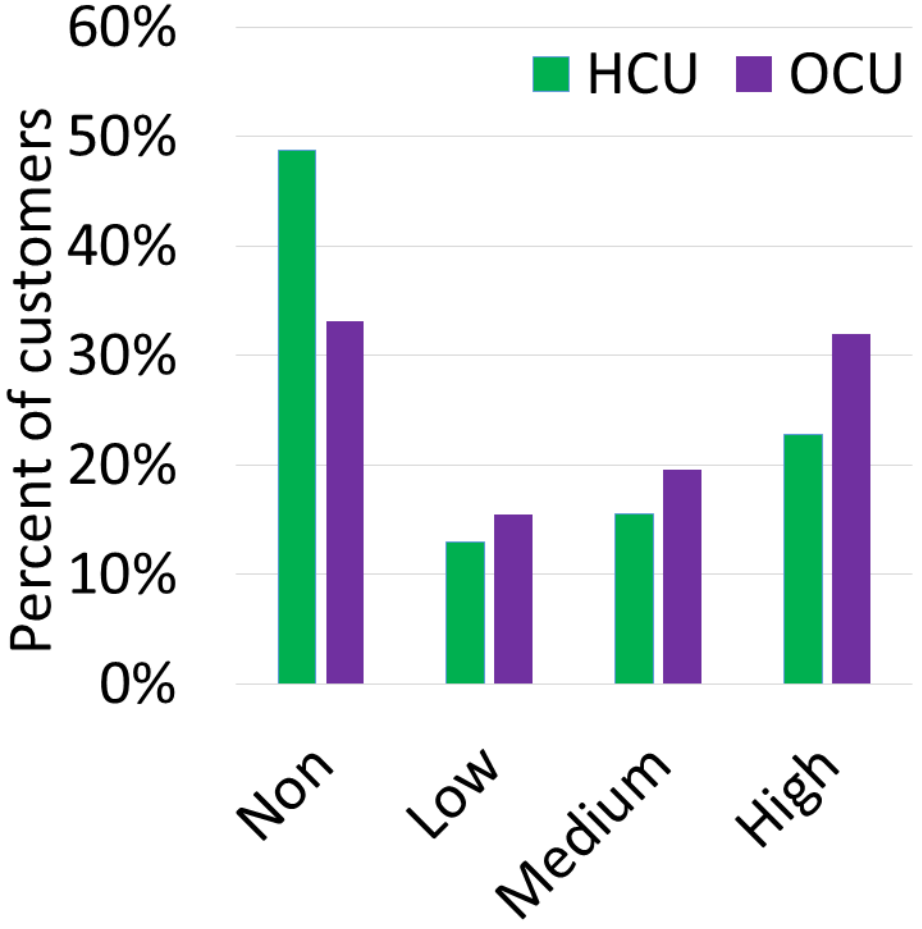
OCU: n=116,097

Results: Distribution of mean annual irrigation ratio

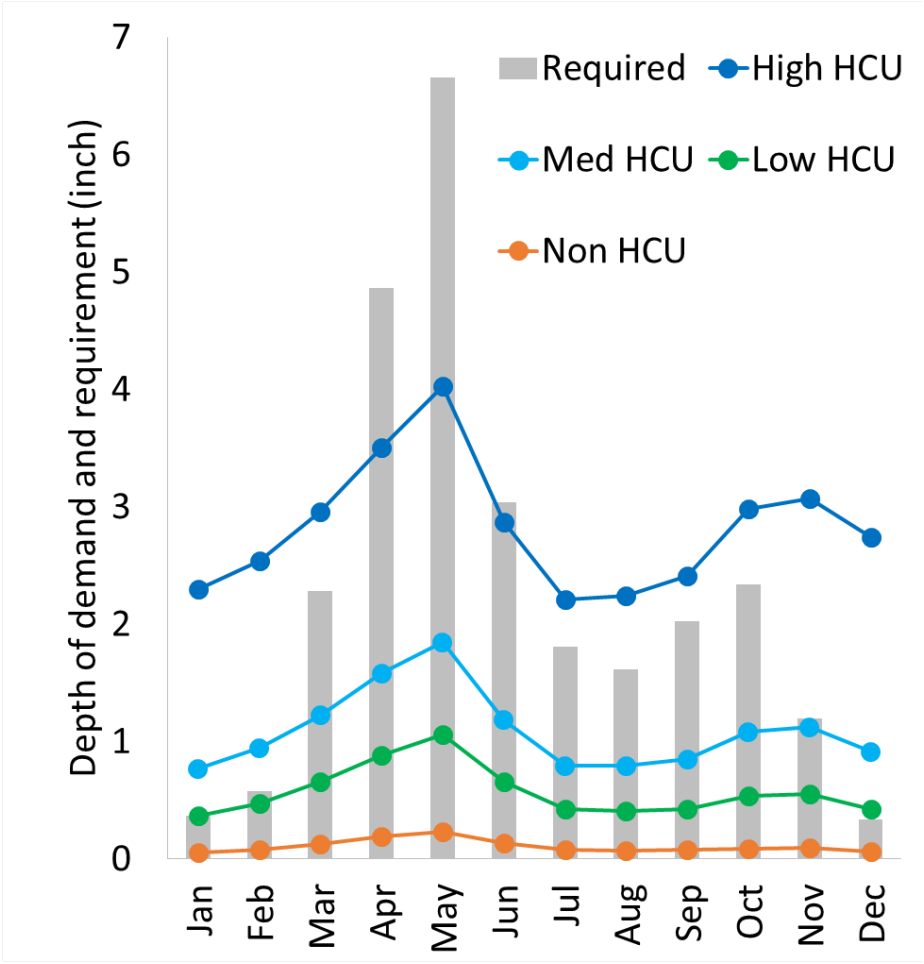


Customers in irrigating groups





Irrigation demand and required: non, low, medium, and high groups



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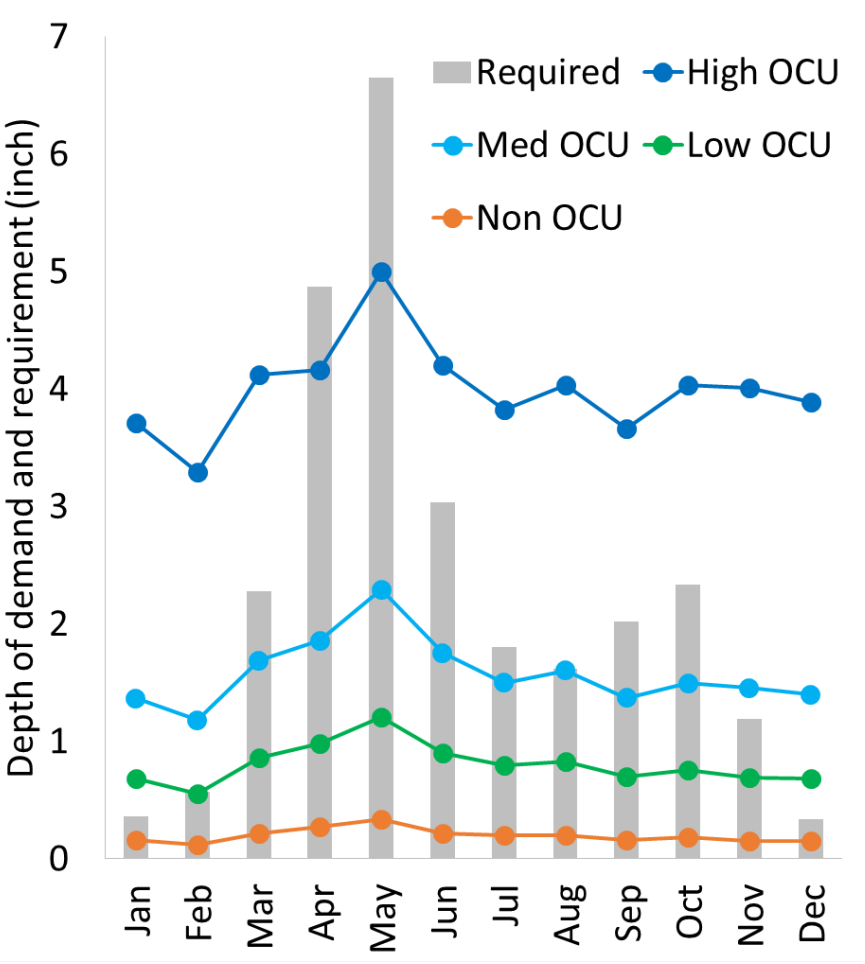

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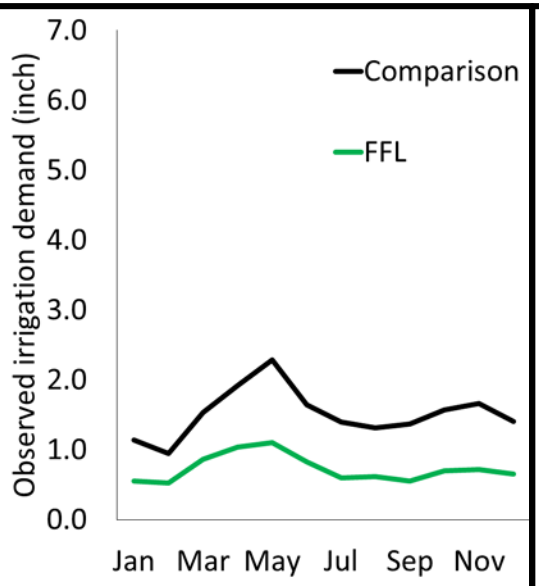
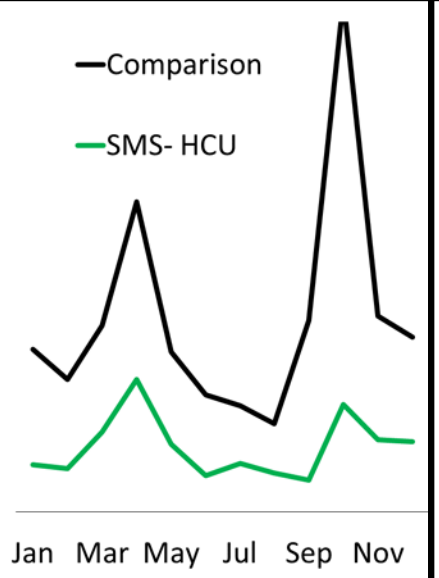
Benchmarks of conservation

FFL



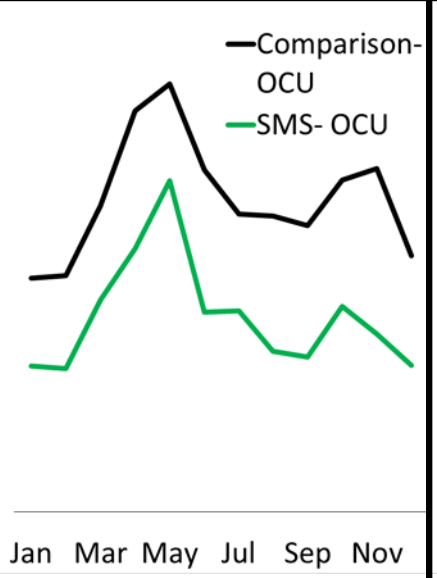
- Boyer et al. 2014
- Monthly billing records of 125 FFLs and 736 comparisons
- Hillsborough, Pasco, and Pinellas counties

SMS



- Haley and Dukes 2012
- AMR monitoring of 58 (four treatments)
- Pinellas County

SMS



- Breder and Dukes 2014
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  - Comparison: 35
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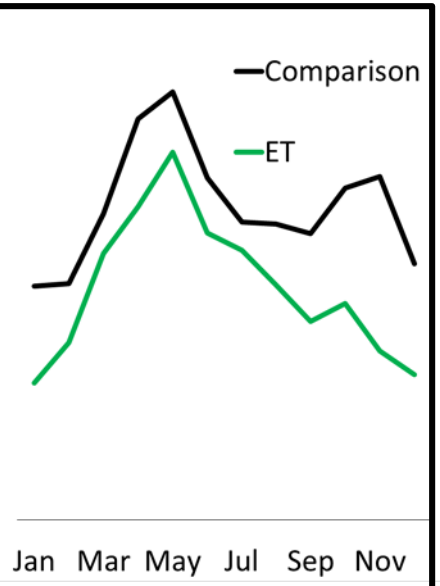
ET



- Breder and Dukes 2014
- AMR monitoring
  - Comparison: 35
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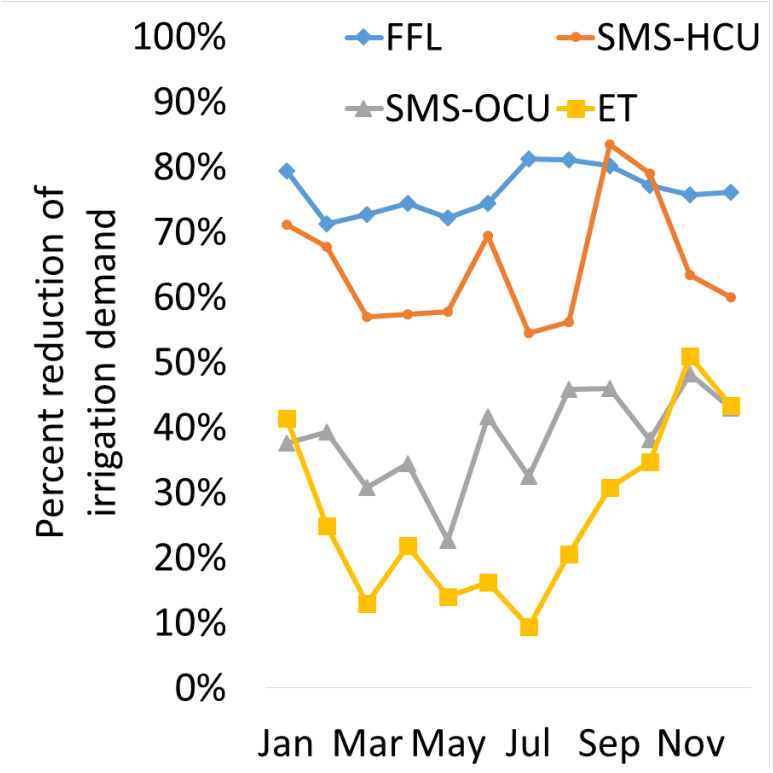
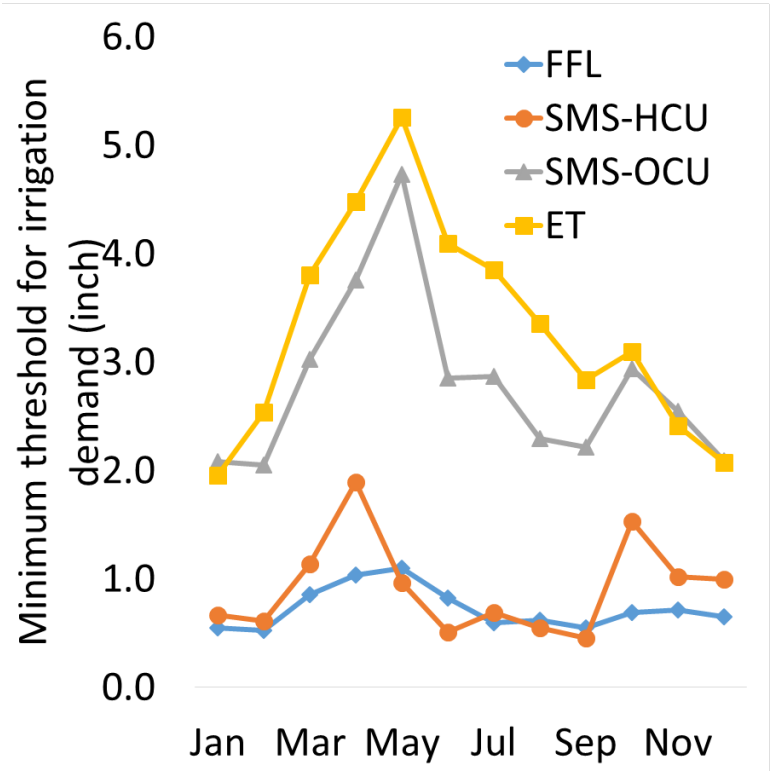
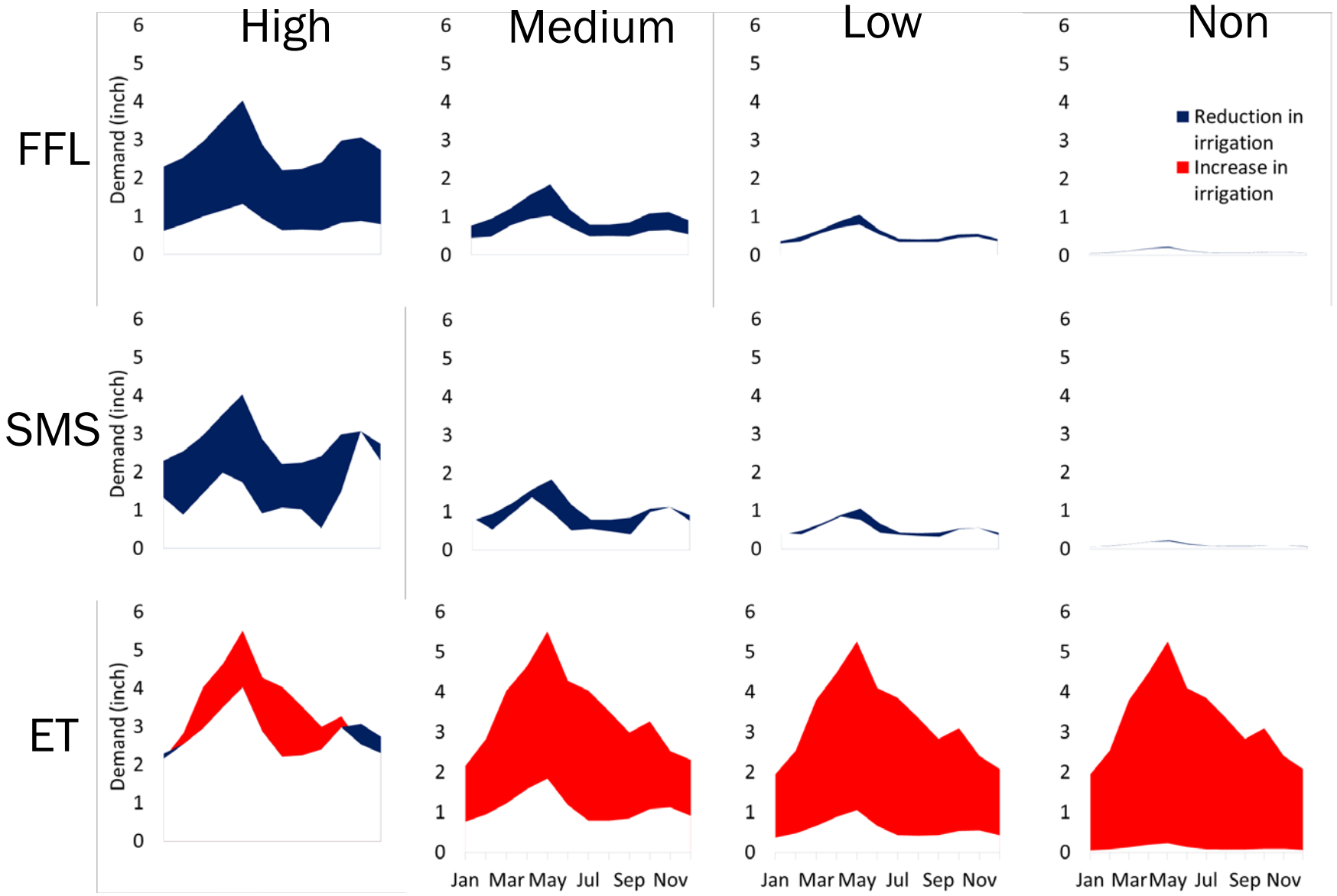
Effectiveness of conservation tools

- Reduction in each customer's irrigation calculated based on percentage reductions and minimum depths observed in previous studies

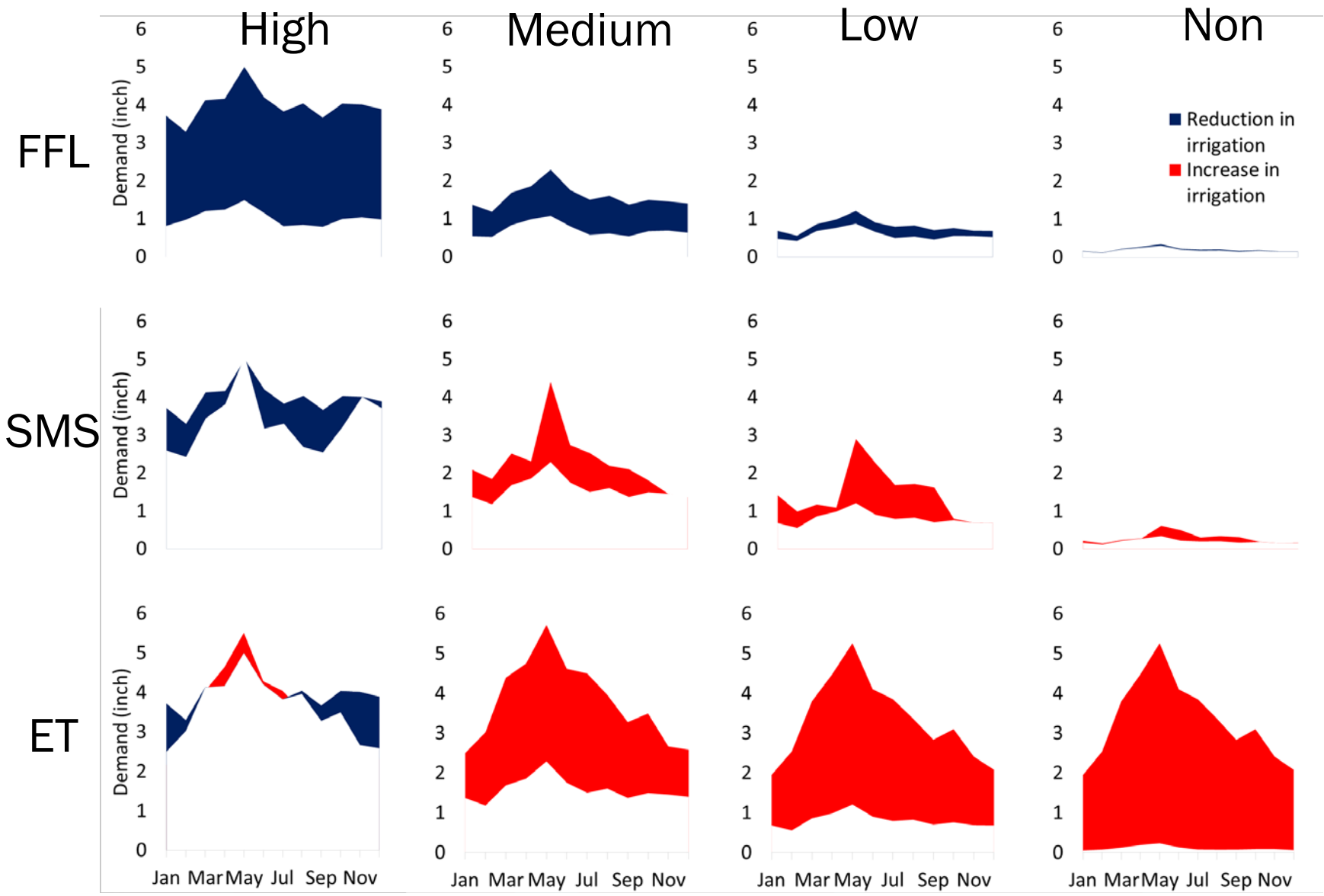




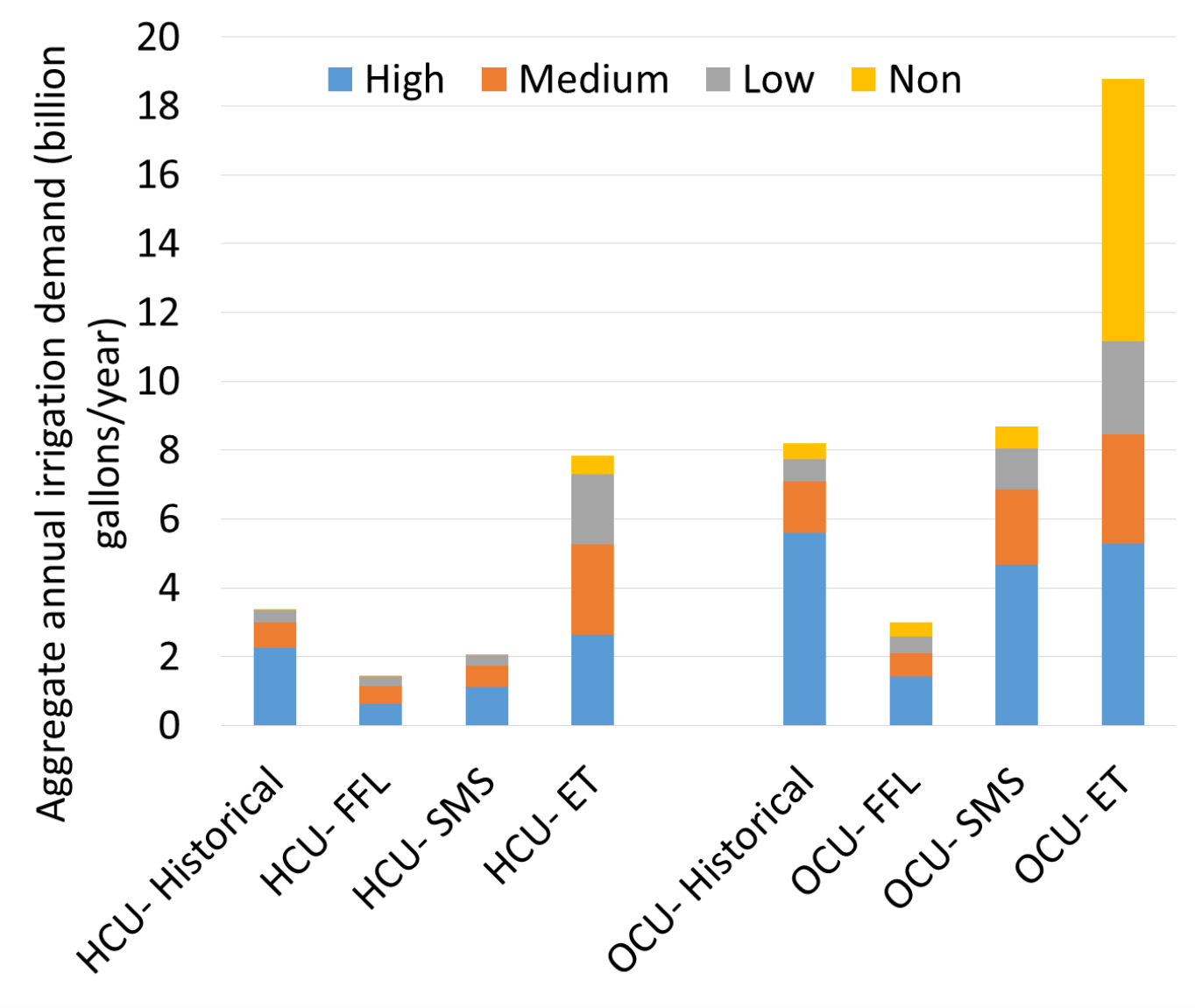
Mean change in irrigation demand for each group: HCU



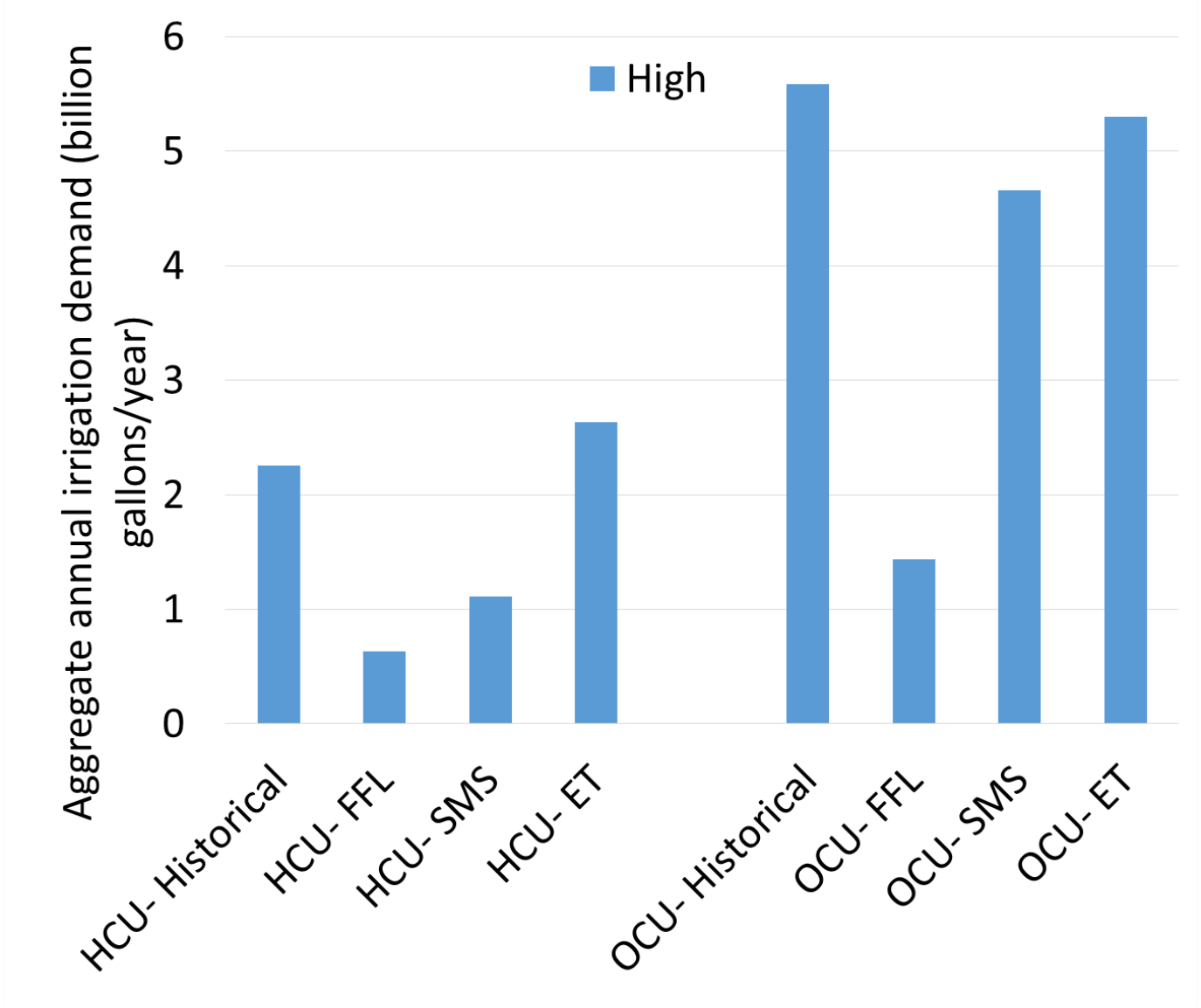
Mean change in irrigation demand for each group: OCU



Historical and projected irrigation demand



Historical and projected irrigation demand: High users



Conclusions

- OCU customers tend to irrigate more than HCU customers
- A substantial portion of customers (48% in HCU and 33% in OCU) do not irrigate and therefore should not be targeted for conservation
- Although the highest users could conserve using ET controllers, utility-wide irrigation would increase if adopted by all customers
- Florida-Friendly Landscaping shows the most potential for utility-wide water conservation (57% in HCU and 64% in OCU)

Referenerces

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