GOVERNING BOARD WORKSHOP

October 28, 2020

District Weather Support

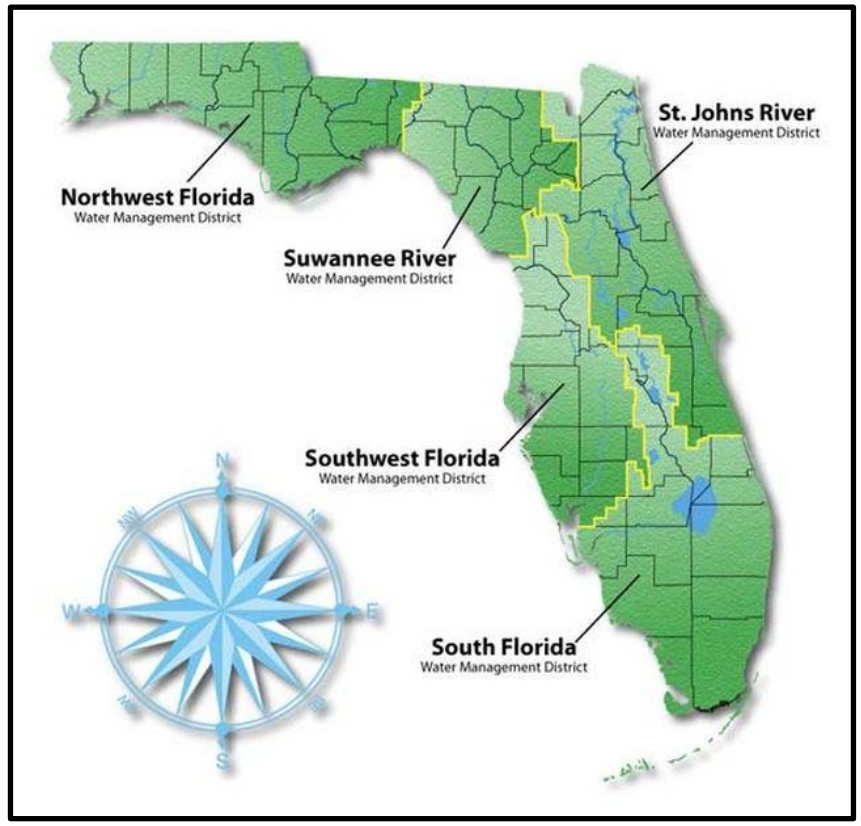
Meteorological Support to District Operations

Eric Swartz
Lead Meteorologist

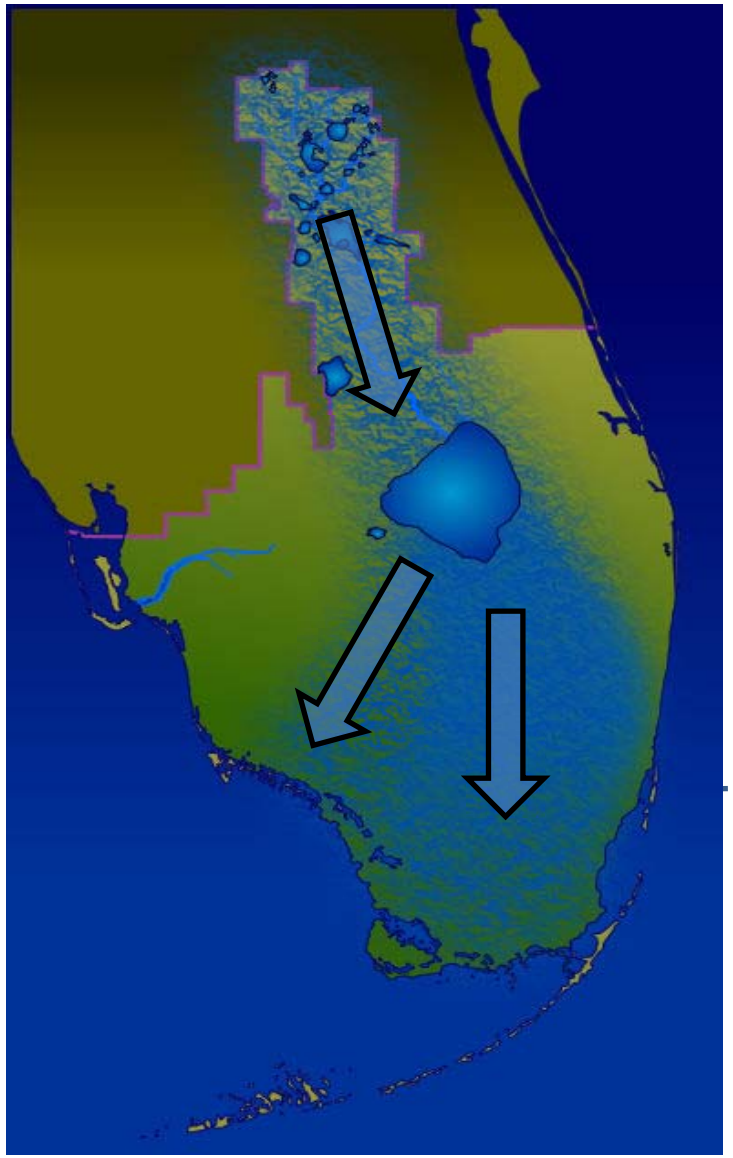
South Florida Water Management District
Lunch & Learn
Oct 28, 2020

District Weather Support

- Water management districts are separated by hydrologic boundaries
- All surface water that SFWMD manages arrives as rainfall over our District

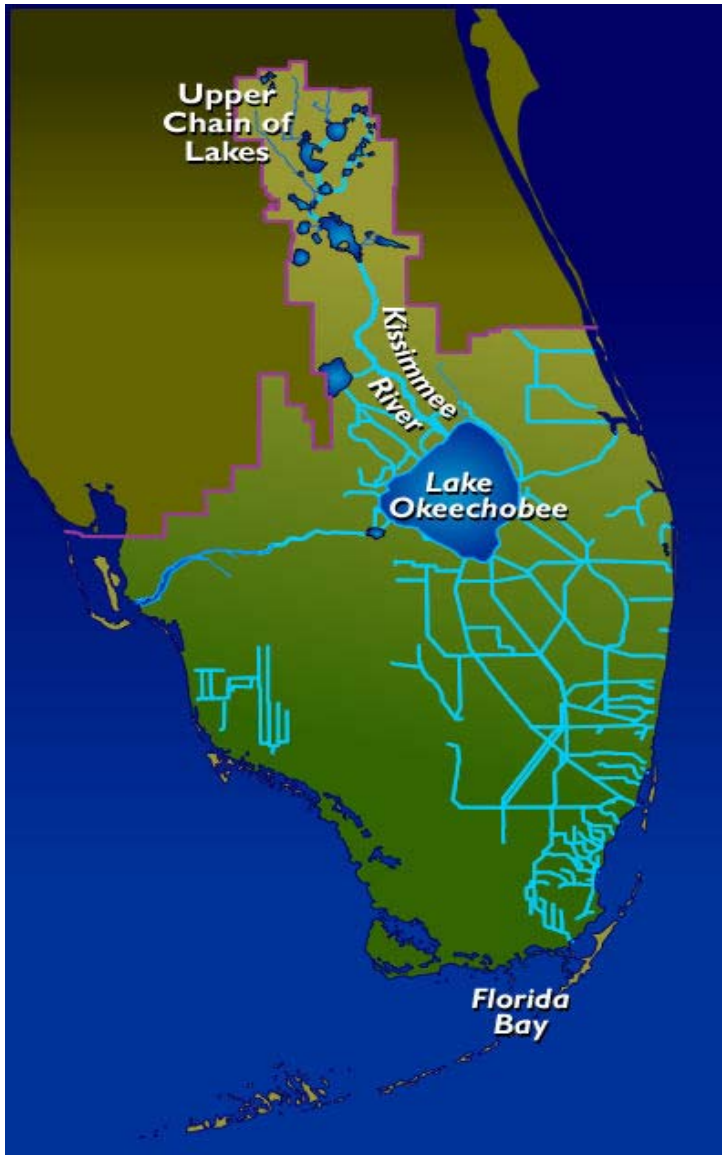


District Weather Support



- North of Lake Okeechobee
  - Downhill slope
  - Water managers work to control the rate of flow downhill
- South of Lake Okeechobee
  - Very flat
  - Slope is roughly 1” per mile
  - Water managers have more flexibility
  - Can move water “uphill”

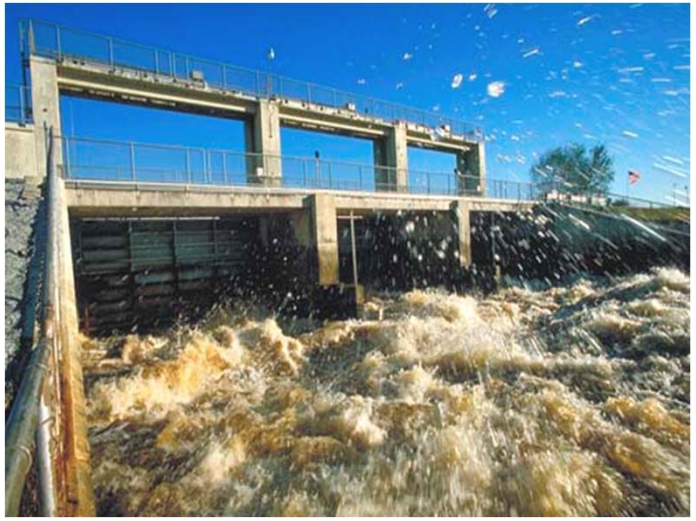
District Weather Support



- Population growth has exceeded the original design of the Central & South Florida Flood Control Project

- Operations needed to adapt in order to anticipate, monitor, and respond to areas of heavy rainfall
  - Operation Control Center with communications and control system staffed 24/7
  - Tailored meteorological forecasts

Quantitative Precipitation Forecast



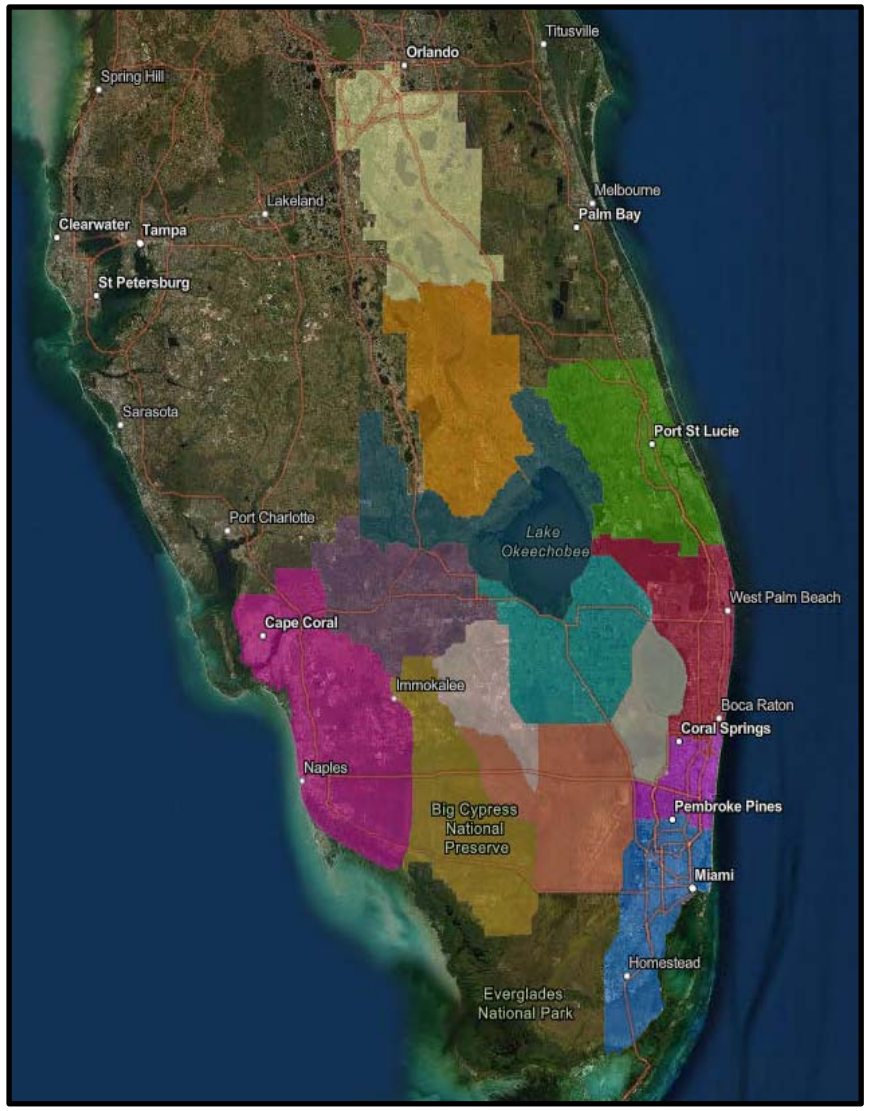
- How much rain ?

  "Heaviest rainfall occurs where it rains hardest for the longest period of time."

  - Noah et al. (c. 4000 BC)

- Meteorological support added in 1980s
  - 2 meteorologists
  - Quantitative Precipitation Forecast (QPF)

Quantitative Precipitation Forecast

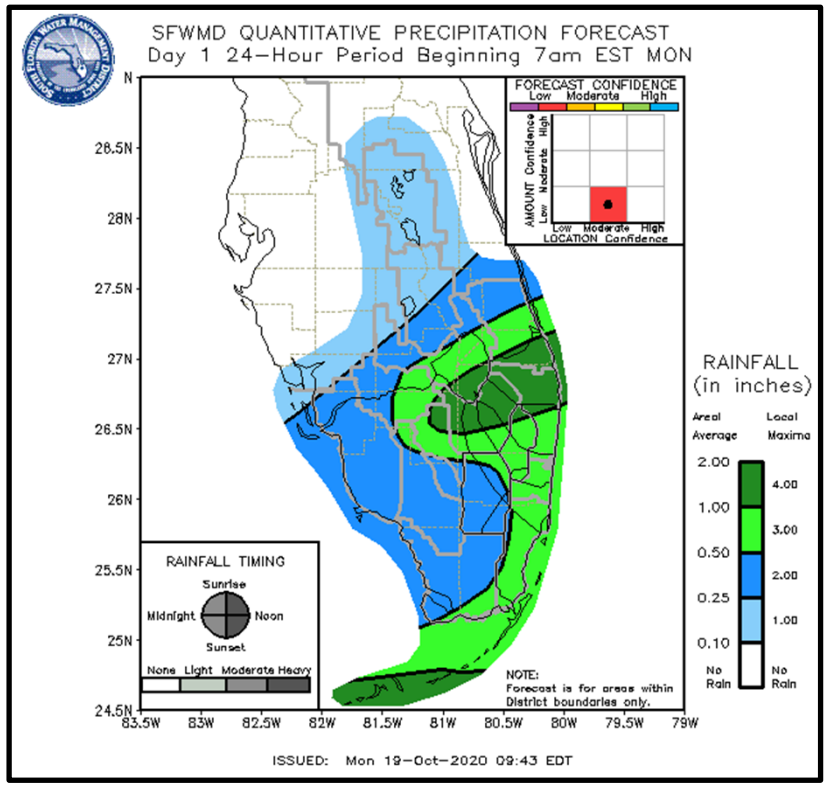


- Quantitative Precipitation Forecast
  - Divides the District in 14 areas
  - Quantifies average rainfall
  - Local maximum
- Represents a volume of water

Quantitative Precipitation Forecast

- Water managers evaluate the volume of water forecast by meteorologists
- Adjust their daily water strategy if needed
- Flood Control vs Water Supply

Quantitative Precipitation Forecast

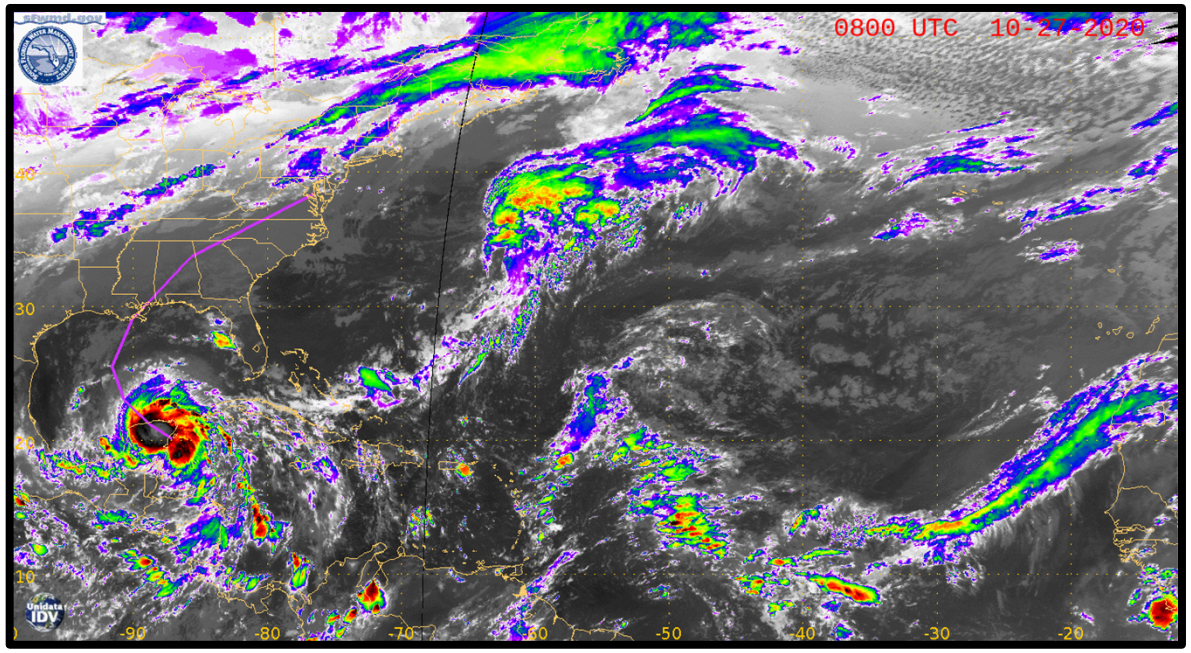


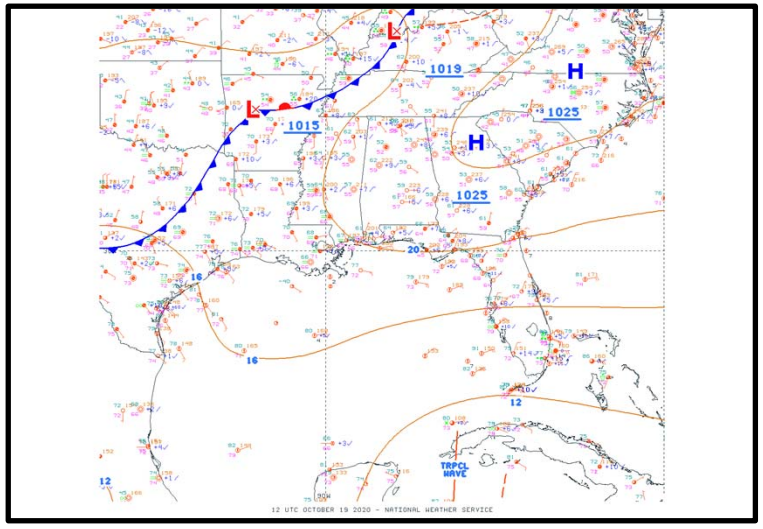
- Daily QPF for Day 1 through Day 7
  - Graphics
  - Text
- Includes descriptors of uncertainty
- Forecast posted on SFWMD website

South Florida Water Management District Weather
2:35PM Monday, October 19, 2020 (eps)

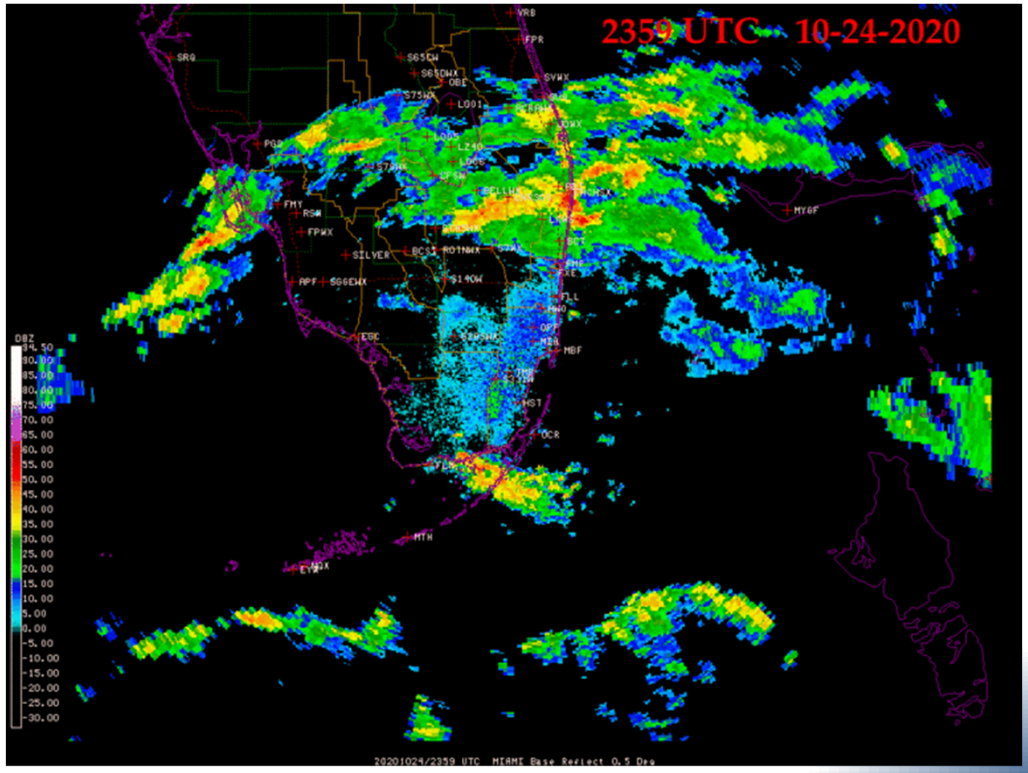
Quantitative Precipitation Forecast	24Hr Begin 7AM Mon	Local Max	24Hr Begin 7AM Tue	24Hr Begin 7AM Wed	24Hr Begin 7AM Thu	24Hr Begin 7AM Fri
Upper Kissimmee	.18	1"	.15	.20	.05	.10
Lower Kissimmee	.25	2"	.15	.25	.12	.05
Lake Okeechobee	.75	4"	.20	.40	.08	.05
East Agricultural Areas	1.20	4"	.35	.45	.08	.05
West Agricultural Areas	.85	4"	.30	.40	.08	.05
Conservation Areas 1&2	.80	4"	.45	.50	.15	.08
Conservation Area 3	.40	2.5"	.45	.45	.15	.08
Martin/StLucie Counties	.75	4"	.35	.60	.12	.05
East Palm Beach County	1.25	4"	.50	.65	.20	.10
East Broward County	.65	3"	.65	.45	.25	.10
East Miami-Dade County	.50	3"	.90	.45	.25	.10
East Caloosahatchee	.65	3"	.20	.40	.05	.10
Big Cypress Preserve	.35	2"	.40	.45	.12	.08
Southwest Coast	.50	2"	.35	.55	.20	.25
District Overall	0.60	-	0.35	0.43	0.13	0.10
Forecast Confidence	Mod-Low	-	Mod-Low	Mod-Low	Low	Low
Most Likely District-wide Range	0.40-0.80	-	0.20-0.60	0.15-0.55	0.04-0.28	0.02-0.33

Meteorological Tools

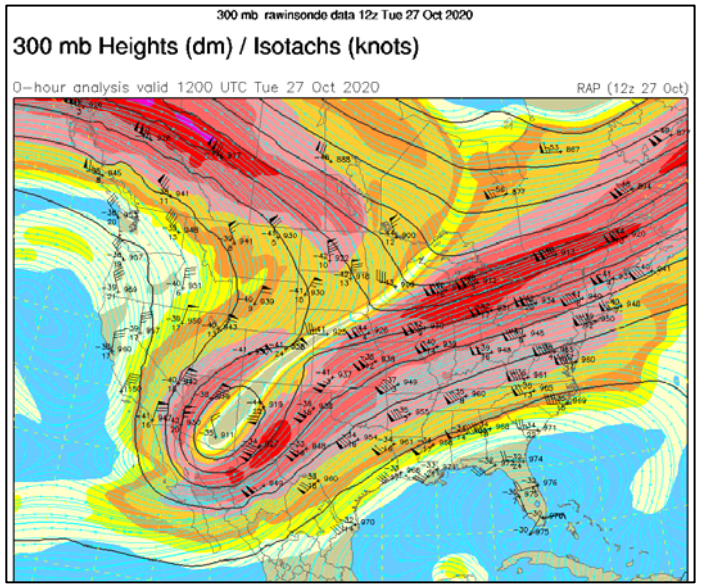


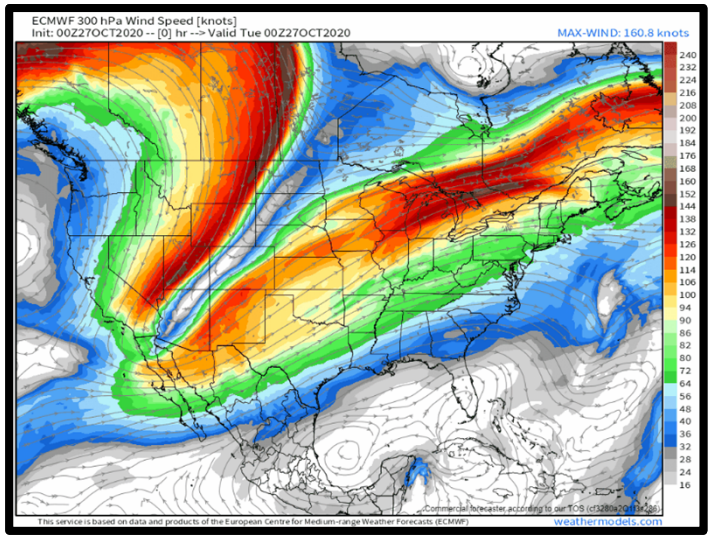


- Tools for near-term forecasting
  - Radar Data
  - Satellite Imagery
  - Observational Data



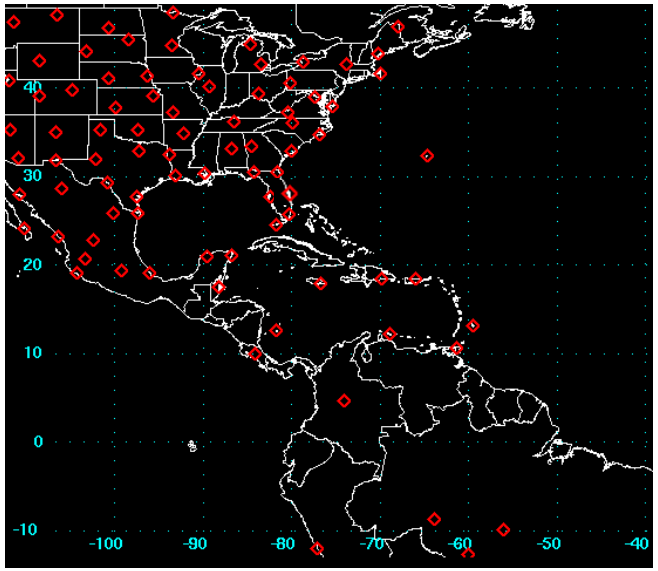
Meteorological Tools





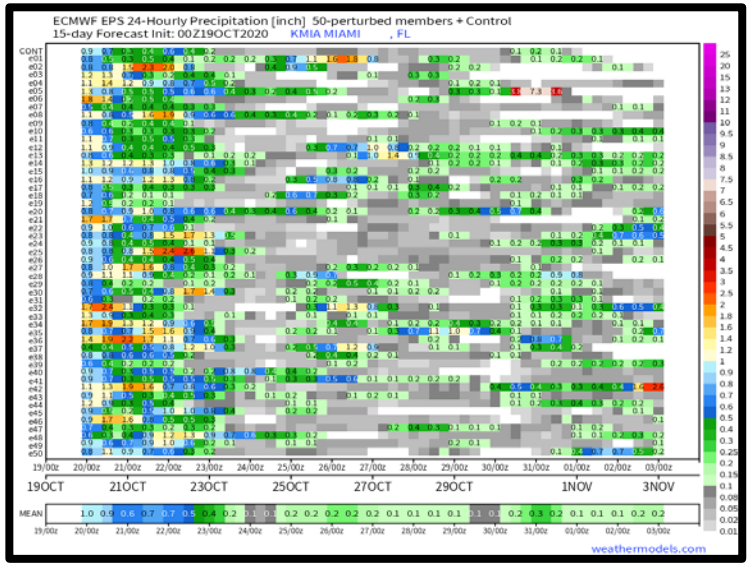
- Longer term forecasting relies heavily on computer models
- Require a good description of initial conditions
- Then use physics and math to calculate how these conditions change over time

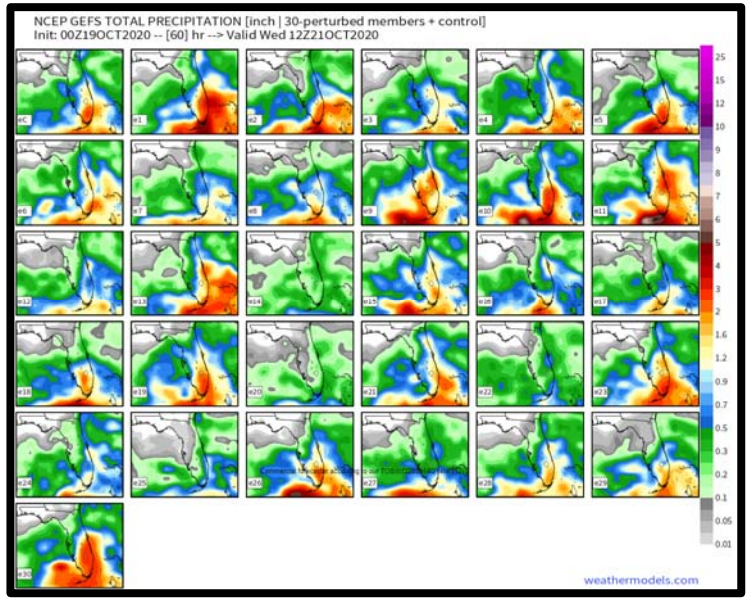
Meteorological Models



- For initial analysis, balloons are launched around the world twice daily
- Balloons sample data in grid-like pattern
- Data void areas can be supplemented with aircraft measurements and satellite estimates
- A good description of initial conditions is critical for reliable model results

Ensemble Models



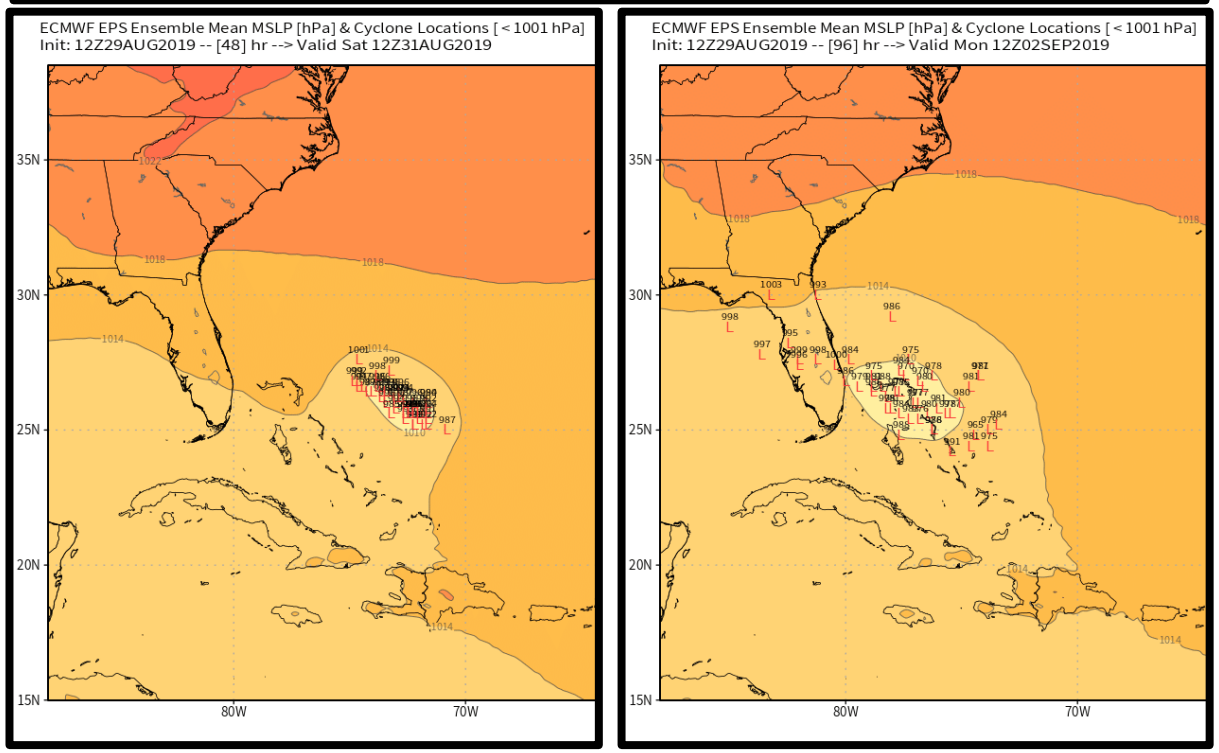


- Errors in models
  - Uncertainty of initial conditions
  - Assumptions
  - Simplifications
- Ensemble modelling reduces error by averaging the solutions of several model runs
- Different models: Diverse physics schemes
- Same model: Varying initial conditions
- Quantifies the sensitivity of forecast to these errors

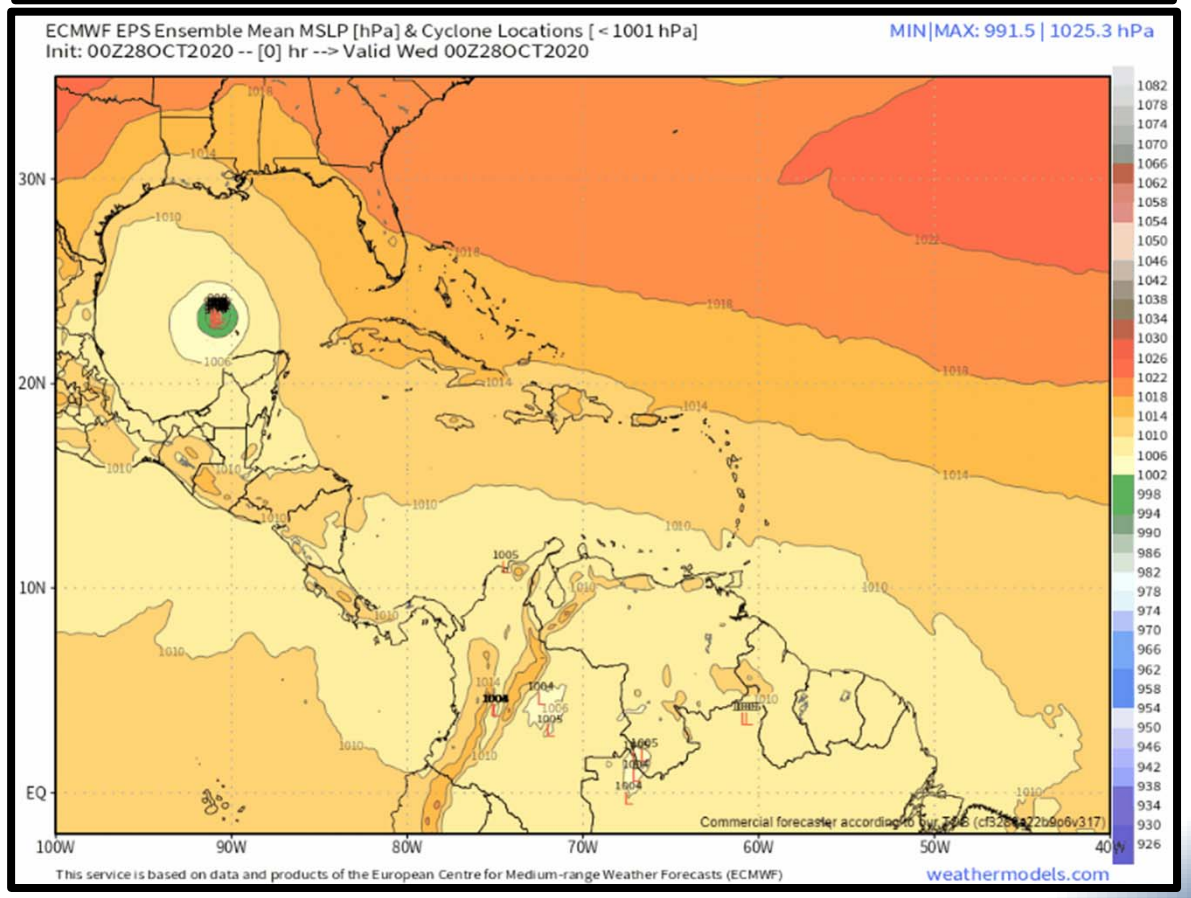
Ensemble Models

- Tropical cyclones: Spread of scatter helps quantify most likely range of possibilities

Hurricane Dorian 2019

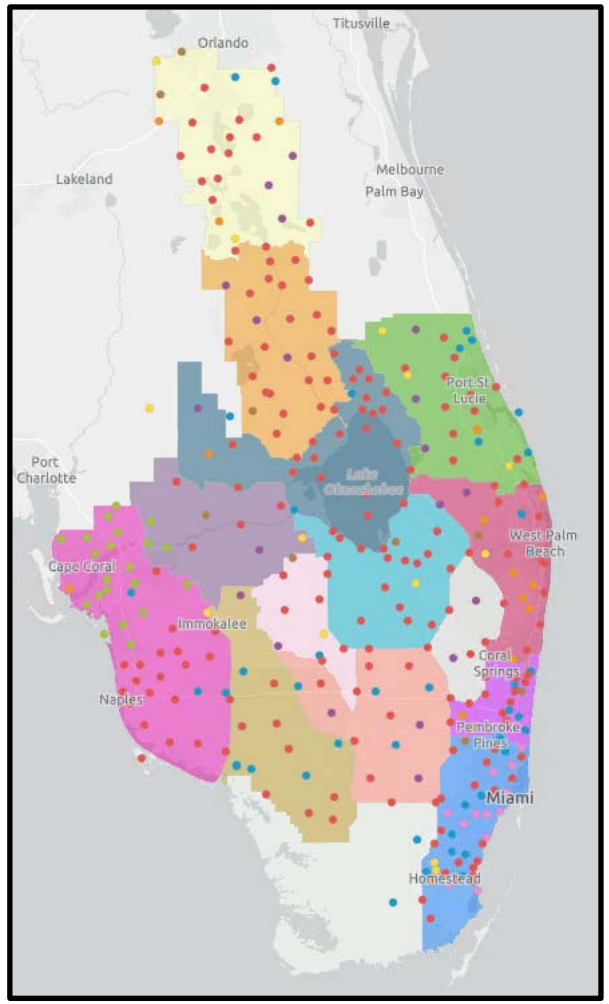


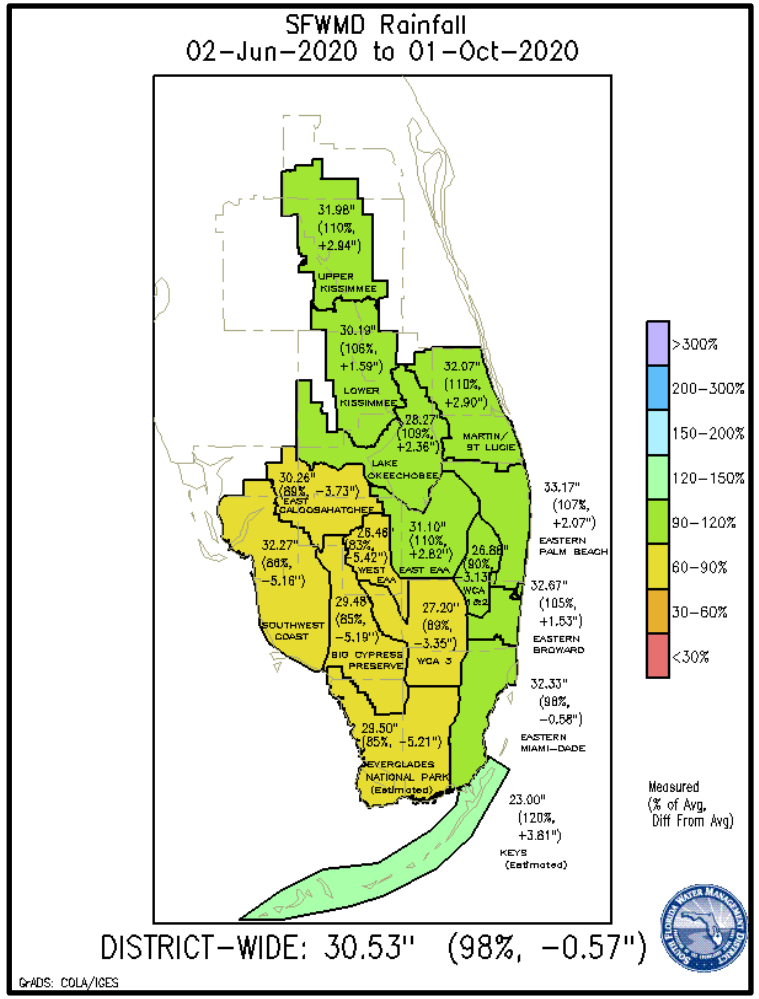
Hurricane Zeta 2020



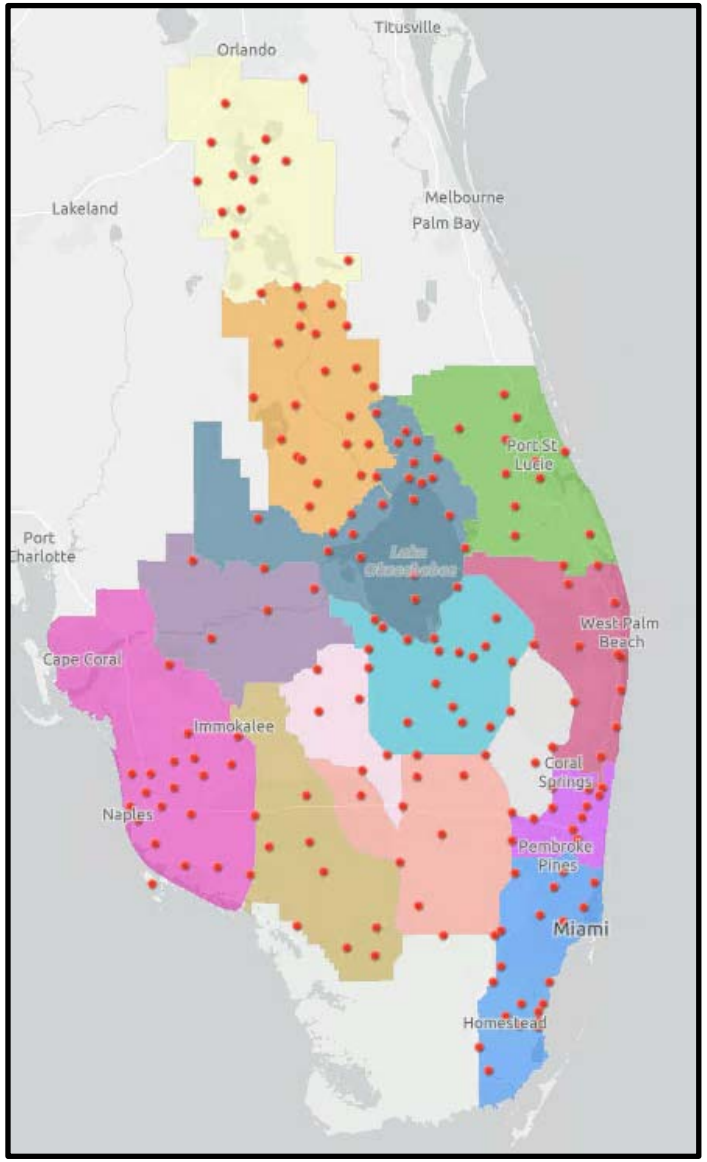
Rainfall Estimation

- How much rain has actually fallen?
- Network of 300 daily rain gauges from multiple agencies





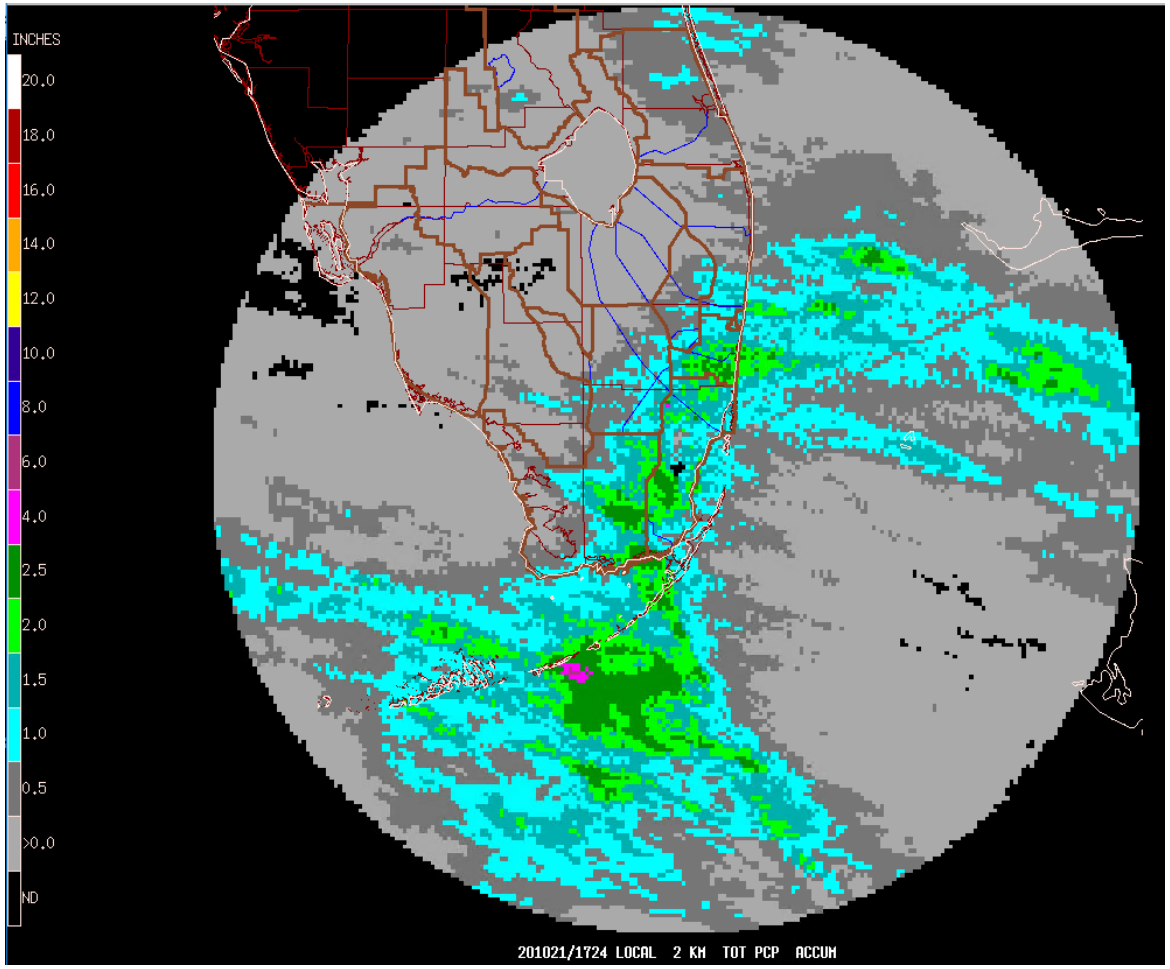
Rainfall Estimation



- 200 near-realtime SFWMD rain gauges
  - Excellent precision
  - Unavoidable gaps in network

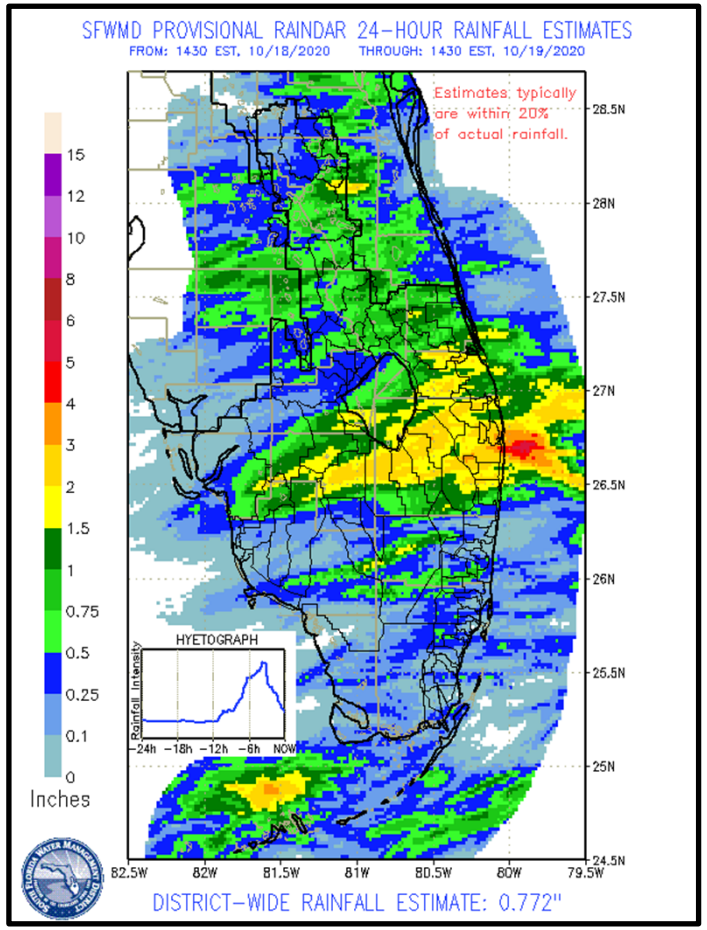
Rainfall Estimation

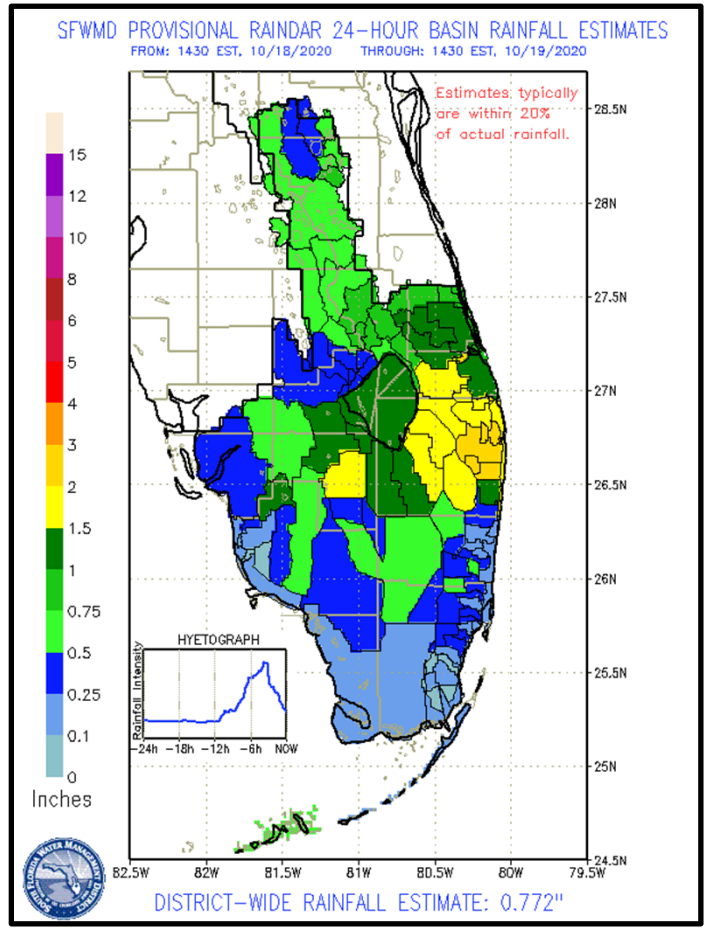
- Radar Data
  - Excellent spatial coverage
  - Limited precision of amounts



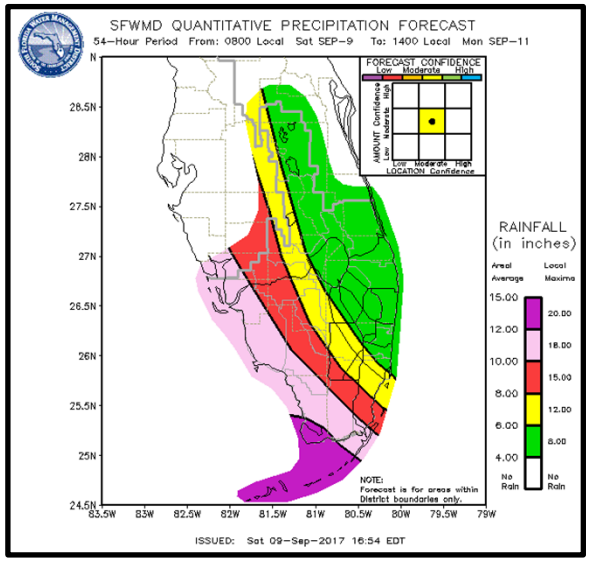
Rainfall Estimation

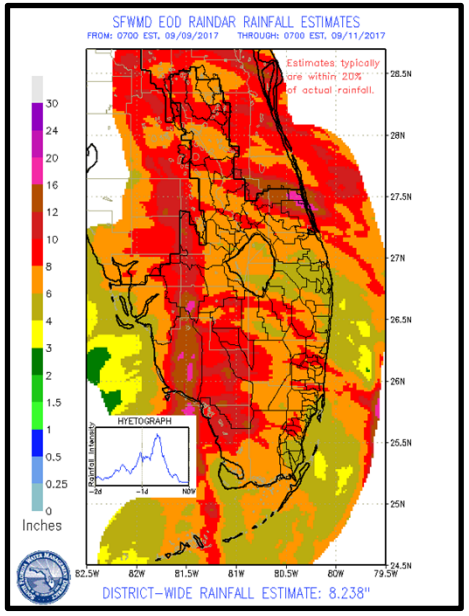
- "Raindar": Combining RAIN gauge and raDAR data
  - Optimizes the strengths of both networks
  - 2km-by-2km resolution every 15 minutes
- Posted on SFWMD website

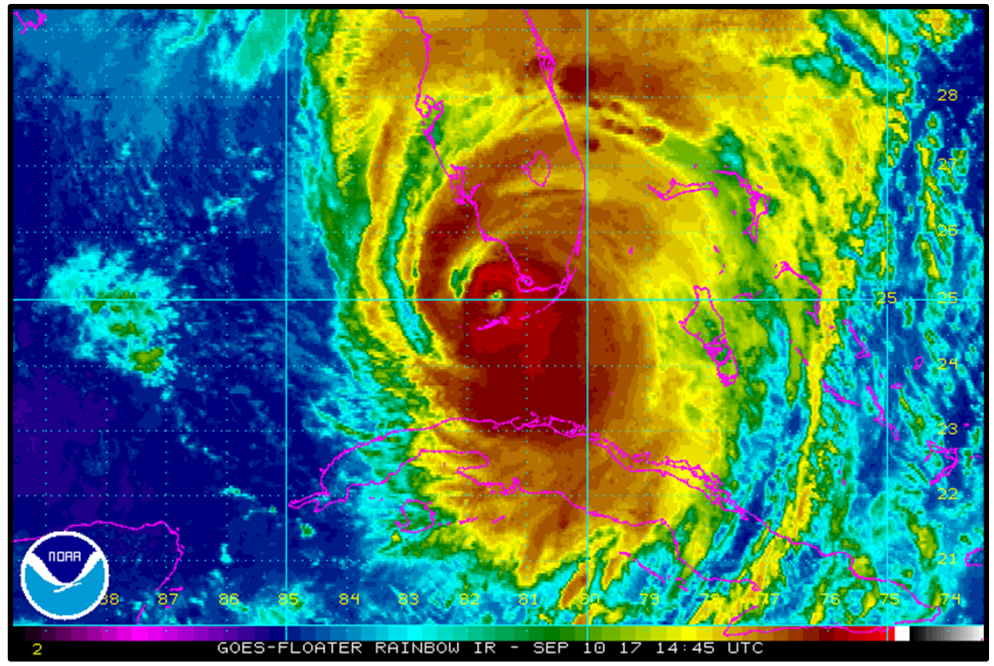




Hurricanes







- Products more colorful during hurricanes and other heavy rainfall events
- Provide guidance to SFWMD emergency response

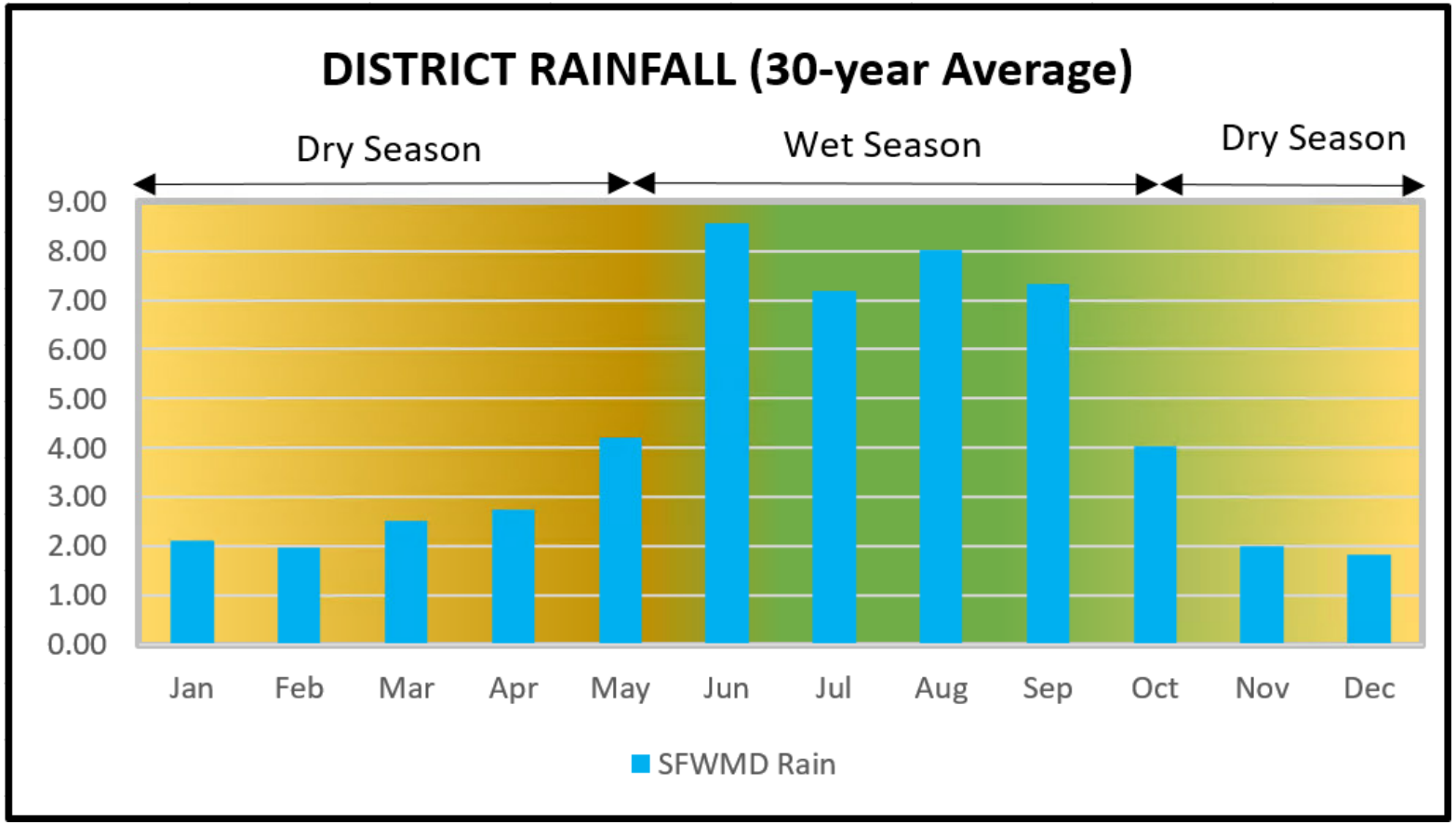
District Rainfall

Global Desert Regions

- Florida is at a latitude where sinking air is common, resulting in deserts in other parts of the globe
- Florida peninsula is optimized for seabreeze thunderstorm development
- 70% of annual rainfall occurs during 5-month wet season where these seabreeze thunderstorms dominate our weather

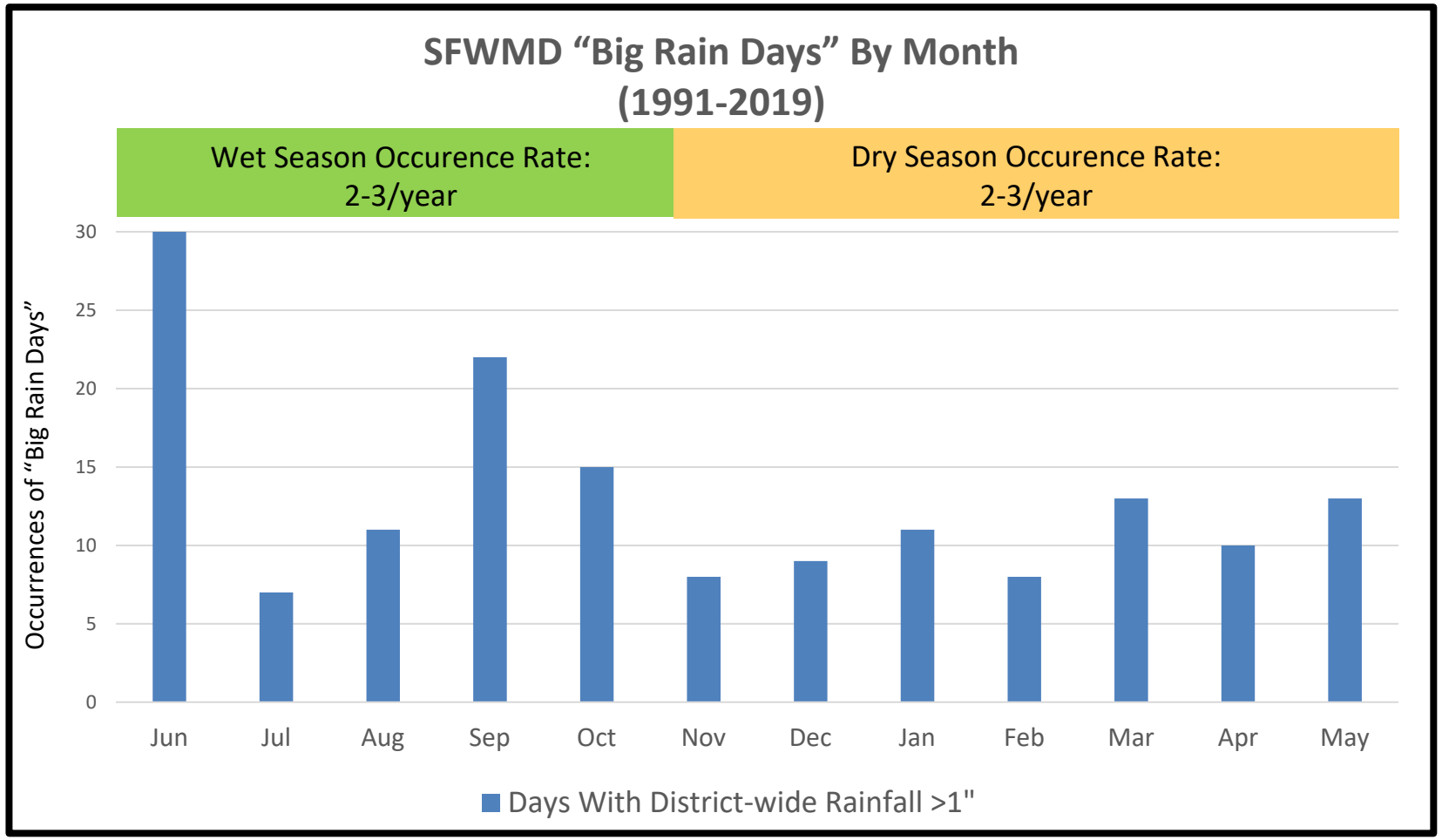
District Rainfall

- 5-month wet season (6-8” per month)
- 7-month dry season (2” per month)



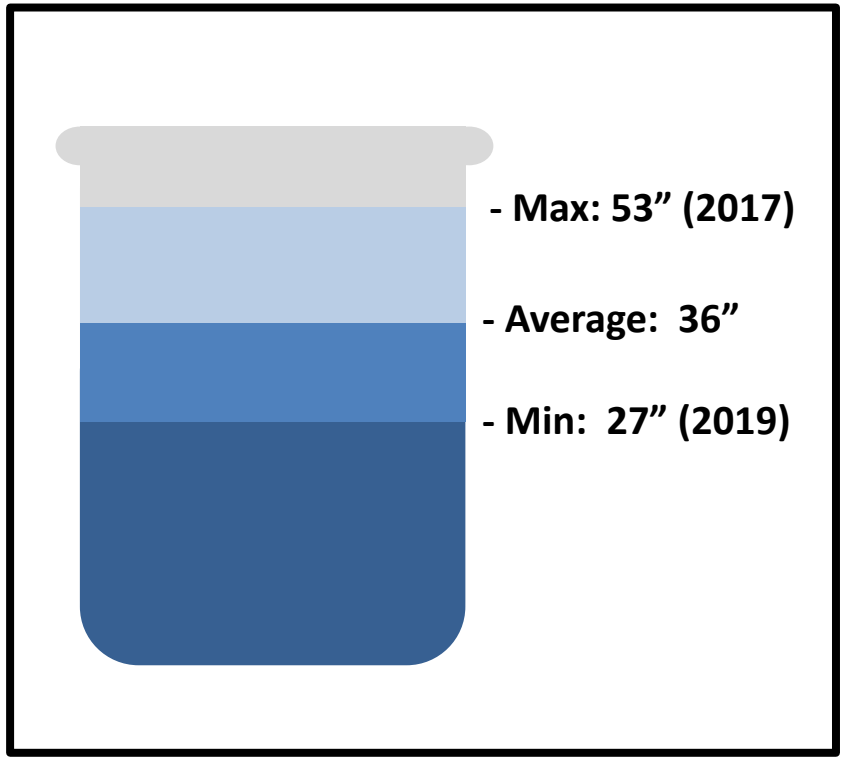
District Rainfall

- SFWMD averages 5-6 system-wide “Big Rain Days” per year
- “Big Rain Days” occur in both the wet season and the dry season



District Wet Season Rainfall

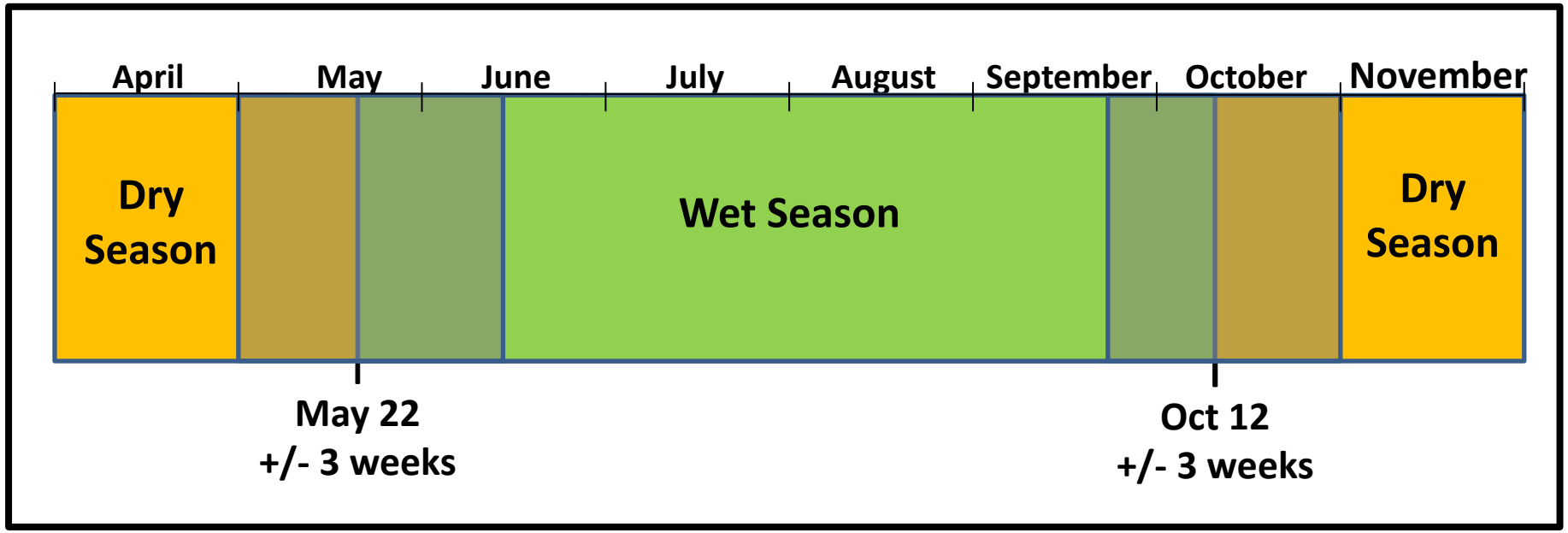
- No demonstrated skill at predicting total wet season rainfall
- What we do know:
  - There is a wet season every year
  - 4-5 months of 1.5-2.0” of rain per week
  - Rainfall totals roughly 3 feet +/- 1 foot



Wet Season Rainfall Over Last 30 Years (Source: SFWMD)

District Wet Season Rainfall

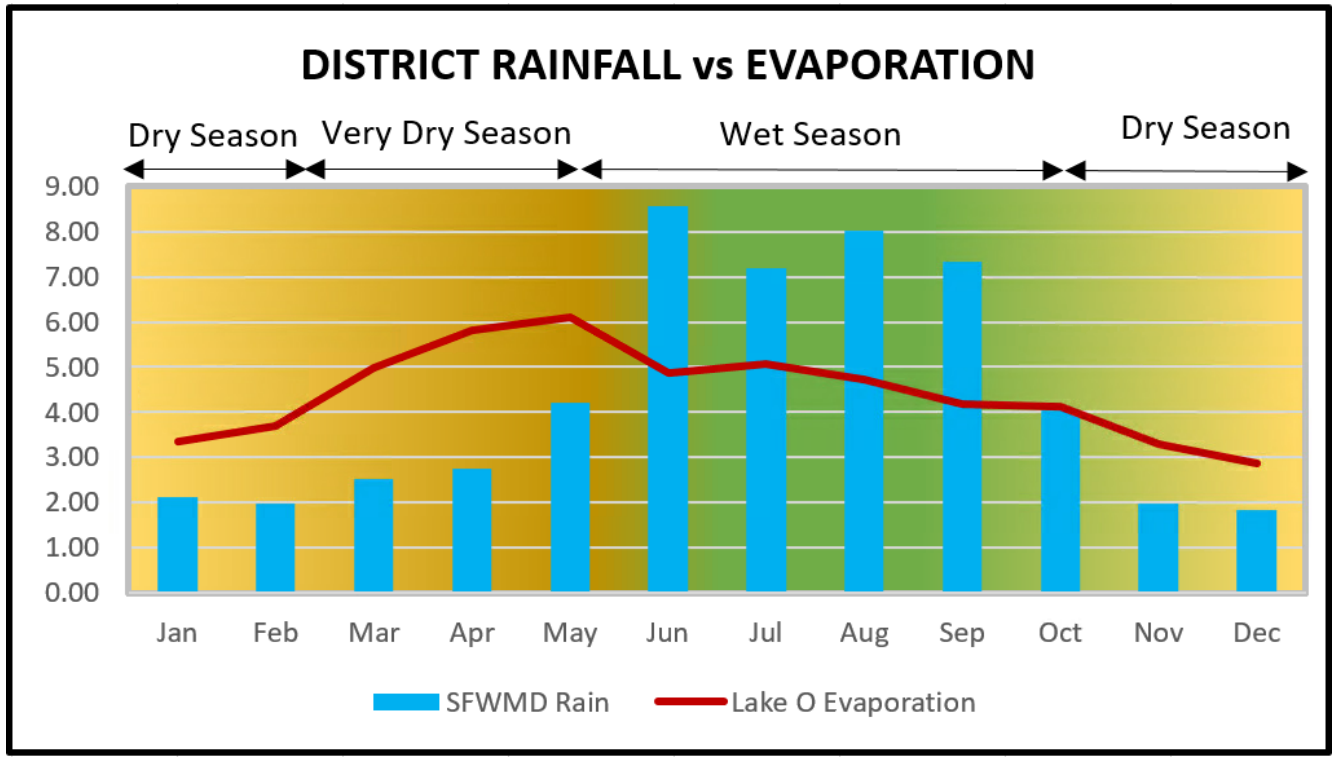
- Daily thunderstorm cycle begins between early May and mid June
- Cycle ends between late September or early November
- Early season rains are welcome relief after a dry Spring
- Late season rains prepare the region for the next Spring



Wet Season Start/End Dates Over Last 30 Years (Source: SFWMD)

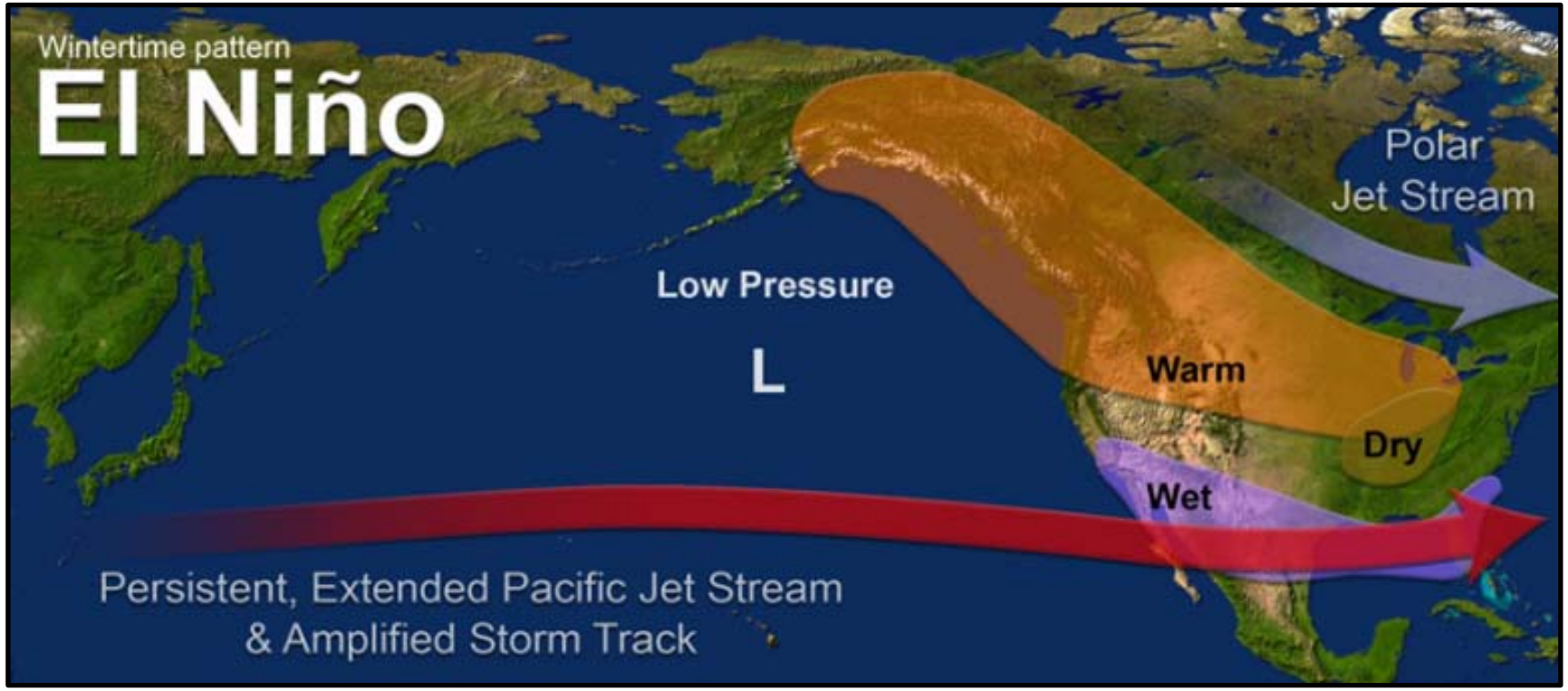
District Rainfall and Evaporation

- End of dry season can be the “Very Dry Season”
- Even with normal rainfall, evaporation rates outpace rainfall
- March, April, and early May will expose long-term rainfall deficits that can be masked by daily rainfall or lower evaporation rates the remainder of the year



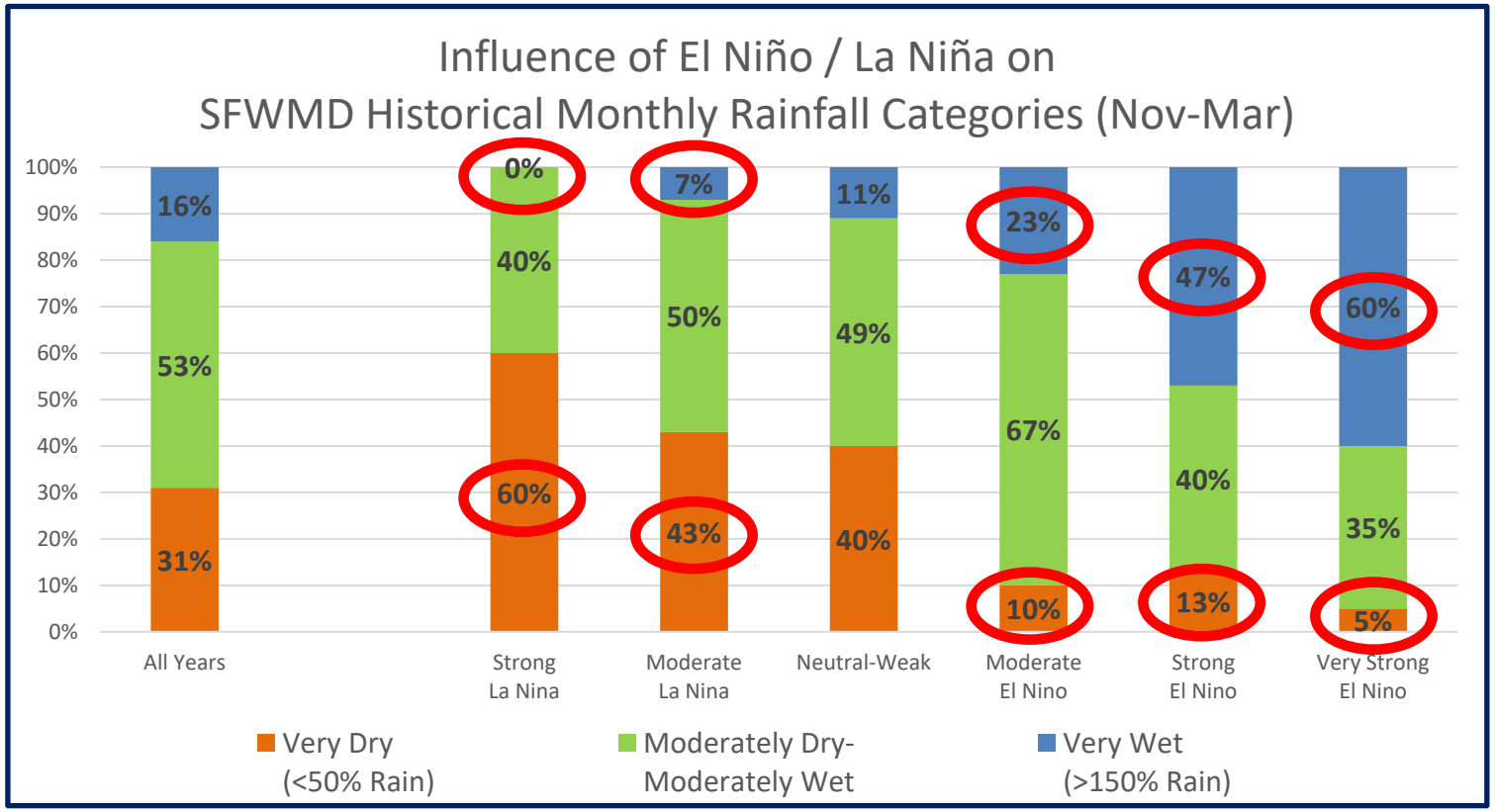
Dry Season Rainfall

- Skillful forecasts of dry season rainfall possible during some (not all) years
- Strong connection to moderate or strong El Niño / La Niña conditions
- Most pronounced over SFWMD November through March
- Important not to “oversell” weaker El Niño / La Niña events

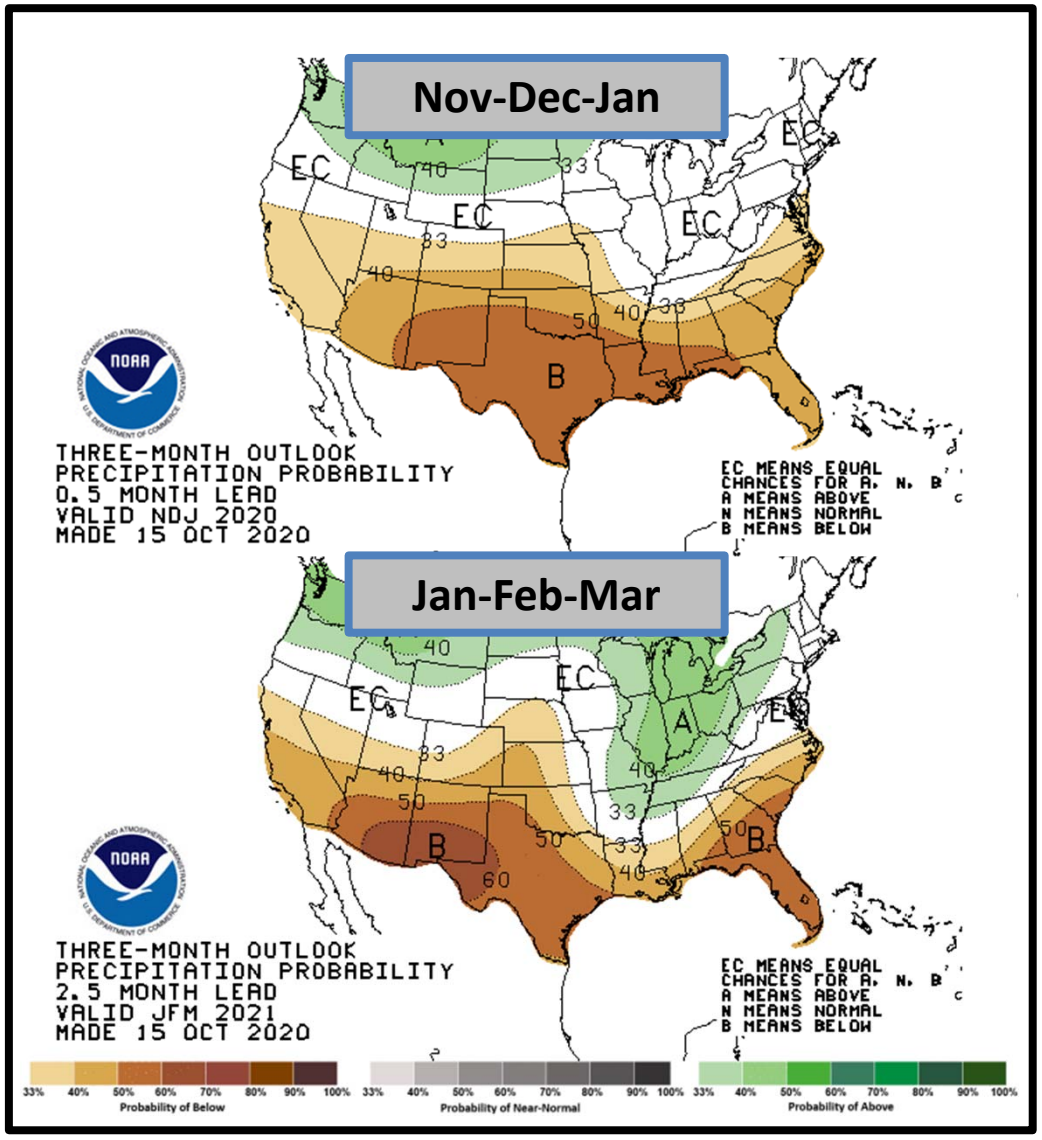


El Niño and La Niña Rainfall

- Strength of event matters
- Primarily during months of November through March
- Best forecast:
  - "Not Dry" during El Niño
  - "Not Wet" during La Niña



Current Rainfall Outlook



- Moderate La Niña conditions are present and forecast to continue
- Increased chances of below-average rainfall November-March over the District
- Overall below-average rainfall but typically still 1-2 months near the historical average
- “Not Wet” remains the best forecast for any individual month this November-March

3. Governing Board Discussion

Chauncey Goss
Chairman

Scott Wagner
Vice Chairman

Ron Bergeron

Cheryl Meads

Charlette Roman

Jay Steinle

Jacqui Thurlow-Lippisch