Groundwater salinization in the lower Florida Keys following Hurricane Irma storm surge

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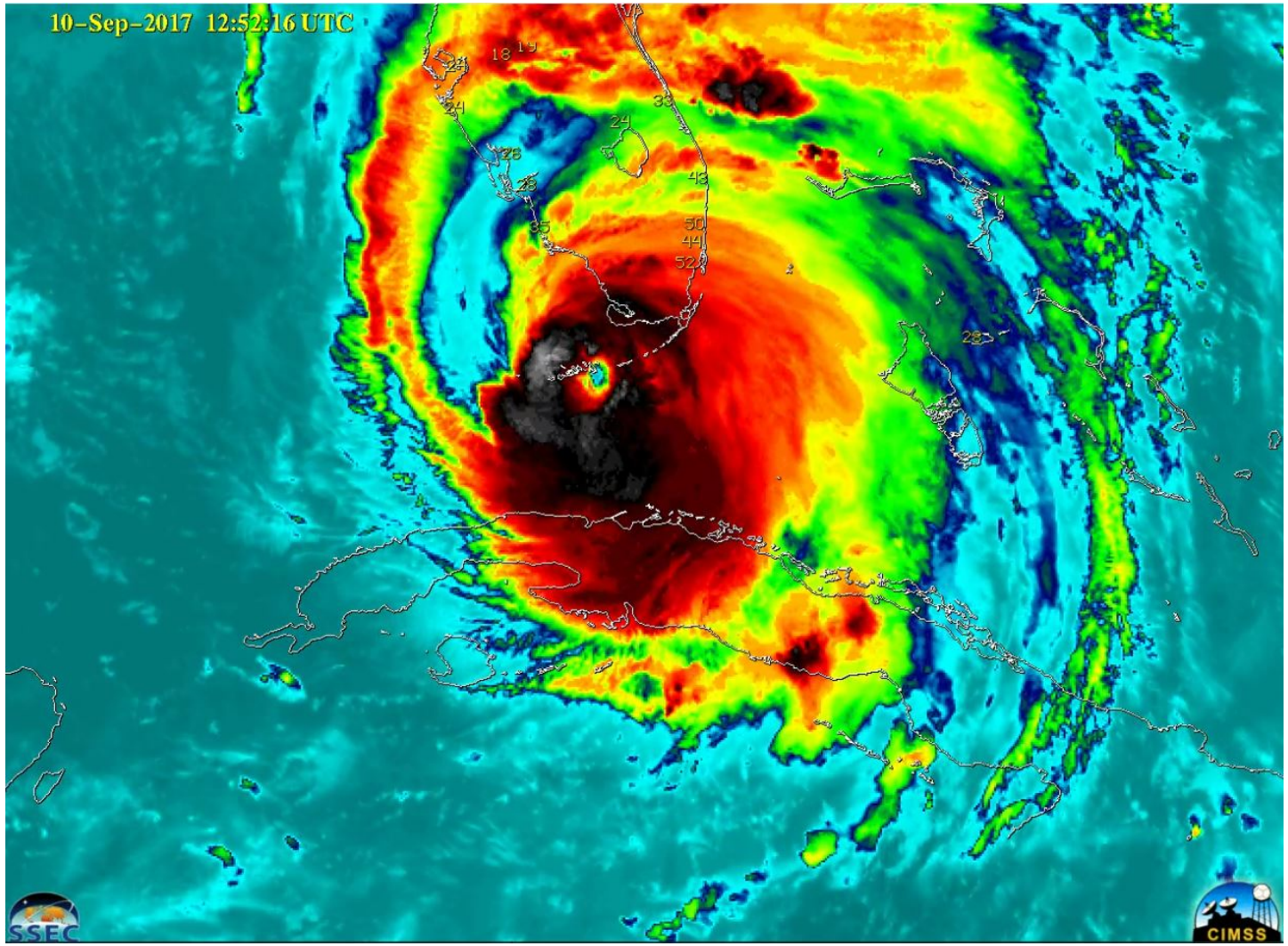
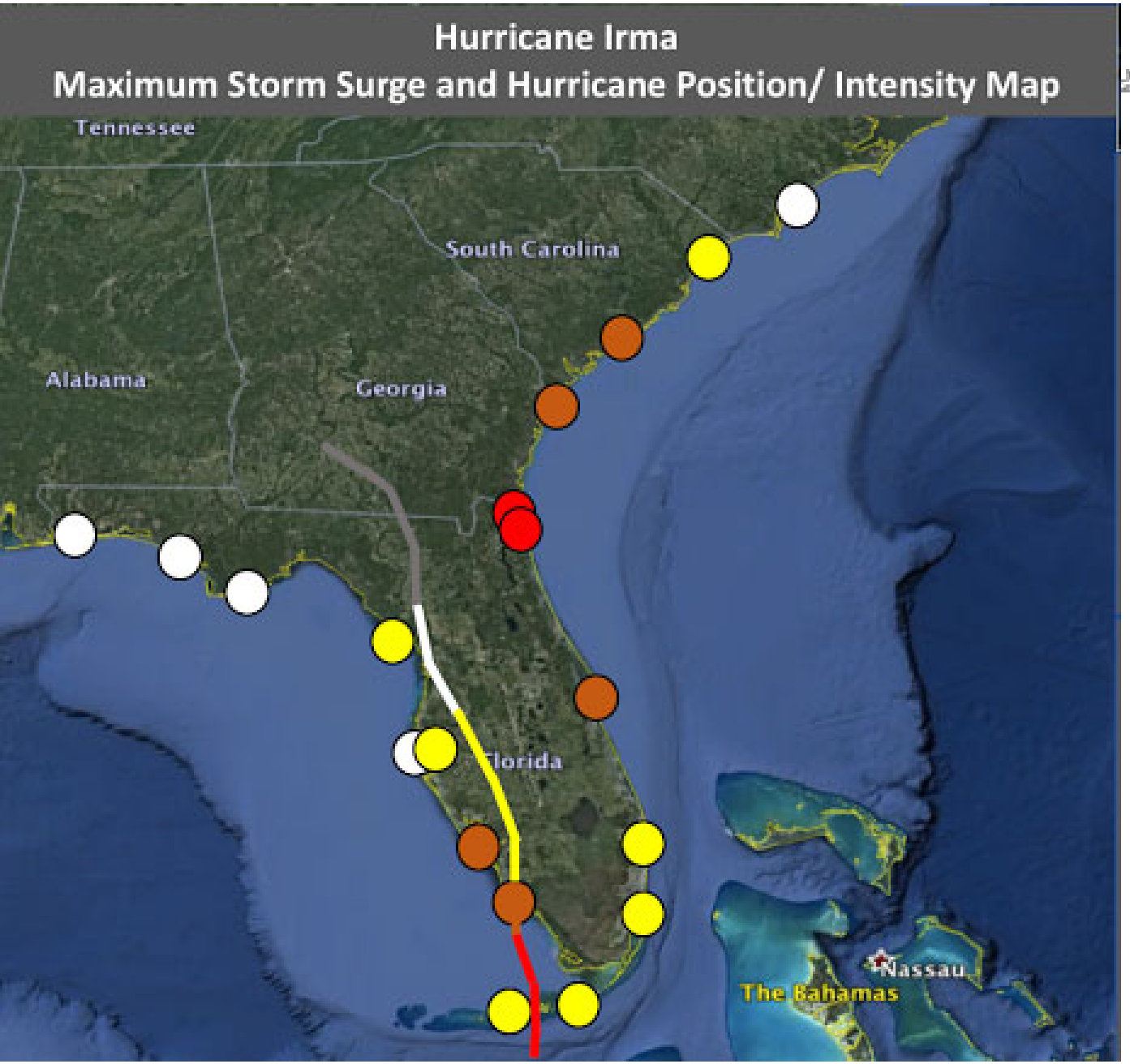
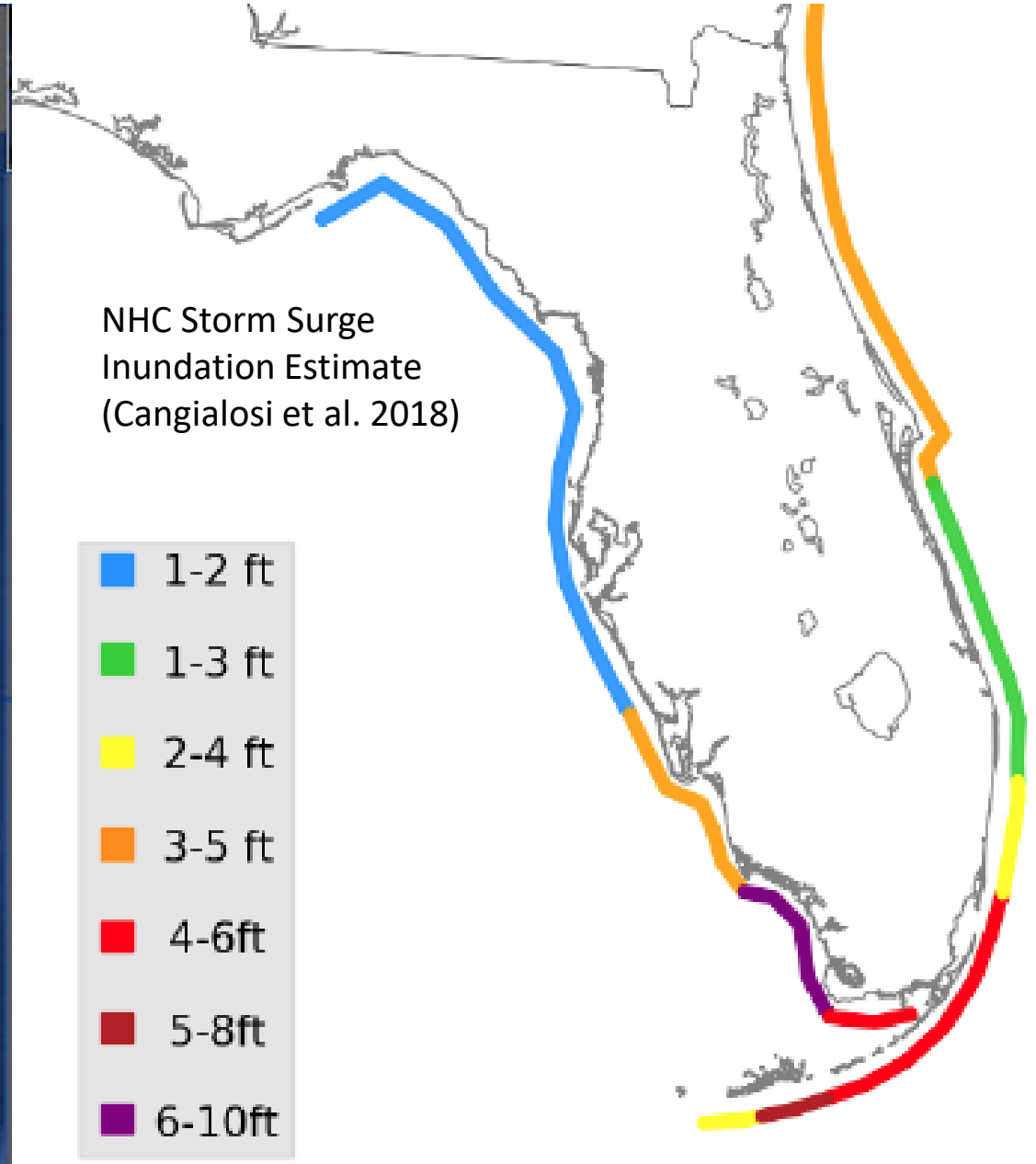
Hurricane Irma (September 10, 2017)



GOES-16 ABI Infrared imagery of Hurricane Irma landfall in the Florida Keys (cimss.ssec.wisc.edu)

Getty Images





Hal Needham/NOAA Tides and Currents

Evidence of storm surge on Big Pine Key

Captions:

a) Storm wrack in trees
b) Red mangrove seedling in pine
c) Storm wrack around wells
d) Brown pine needles
e) Marine marl in pineland

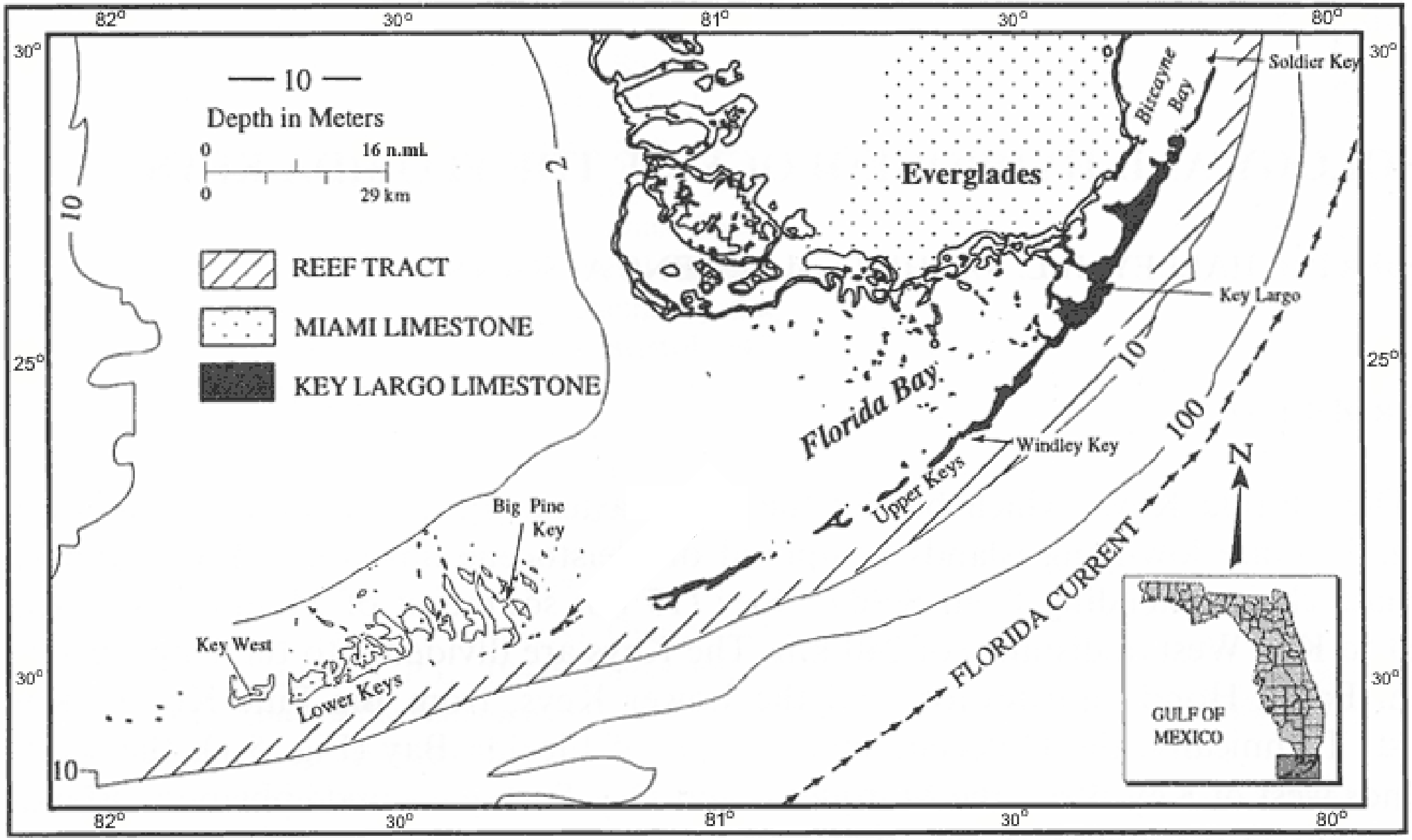
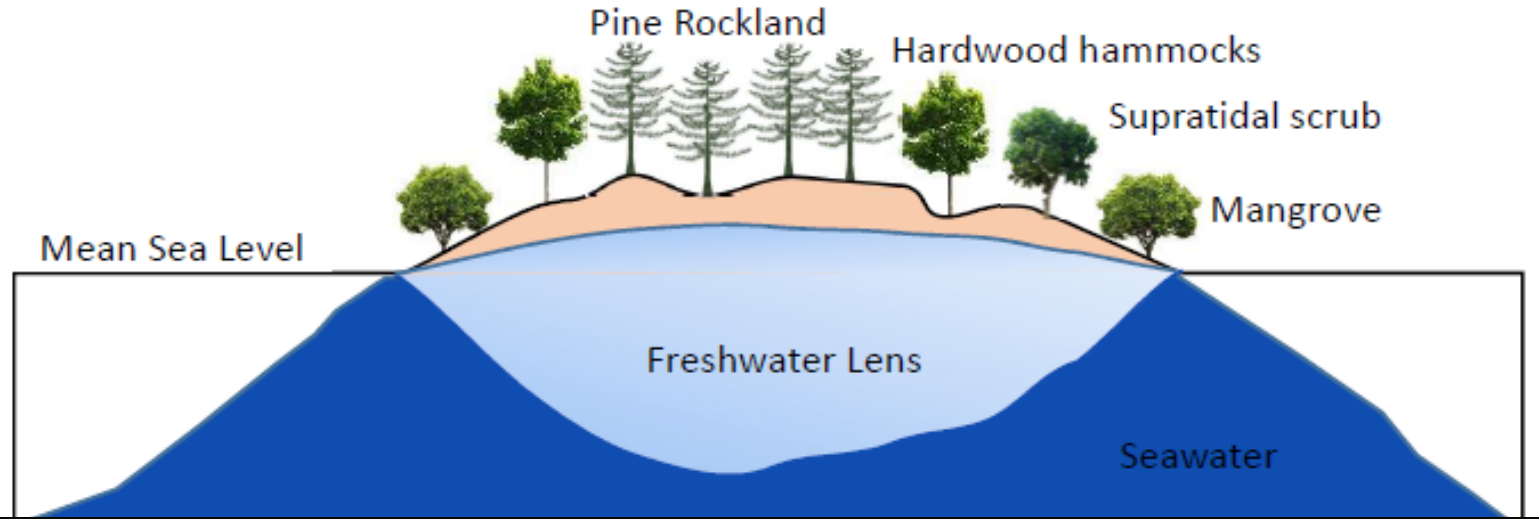
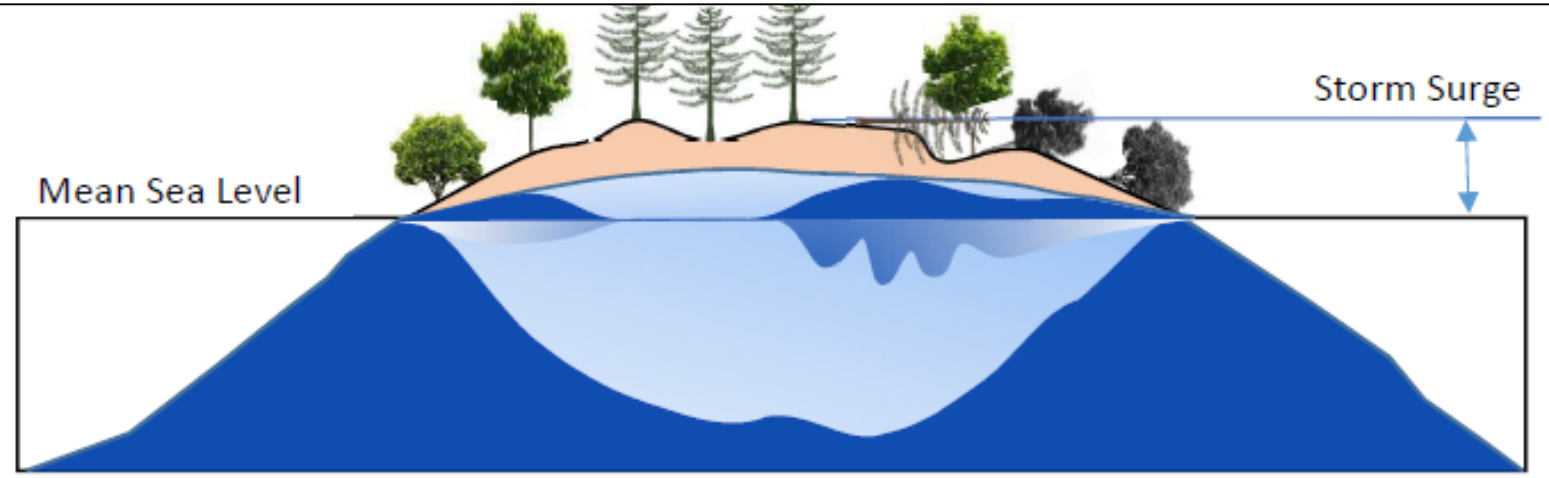


Fig. 5-1. Map showing the Florida Keys, their lithology, and location relative to mainland and reef tract. (Halley et al. 1993)

Storm surge impacts to island freshwater resources

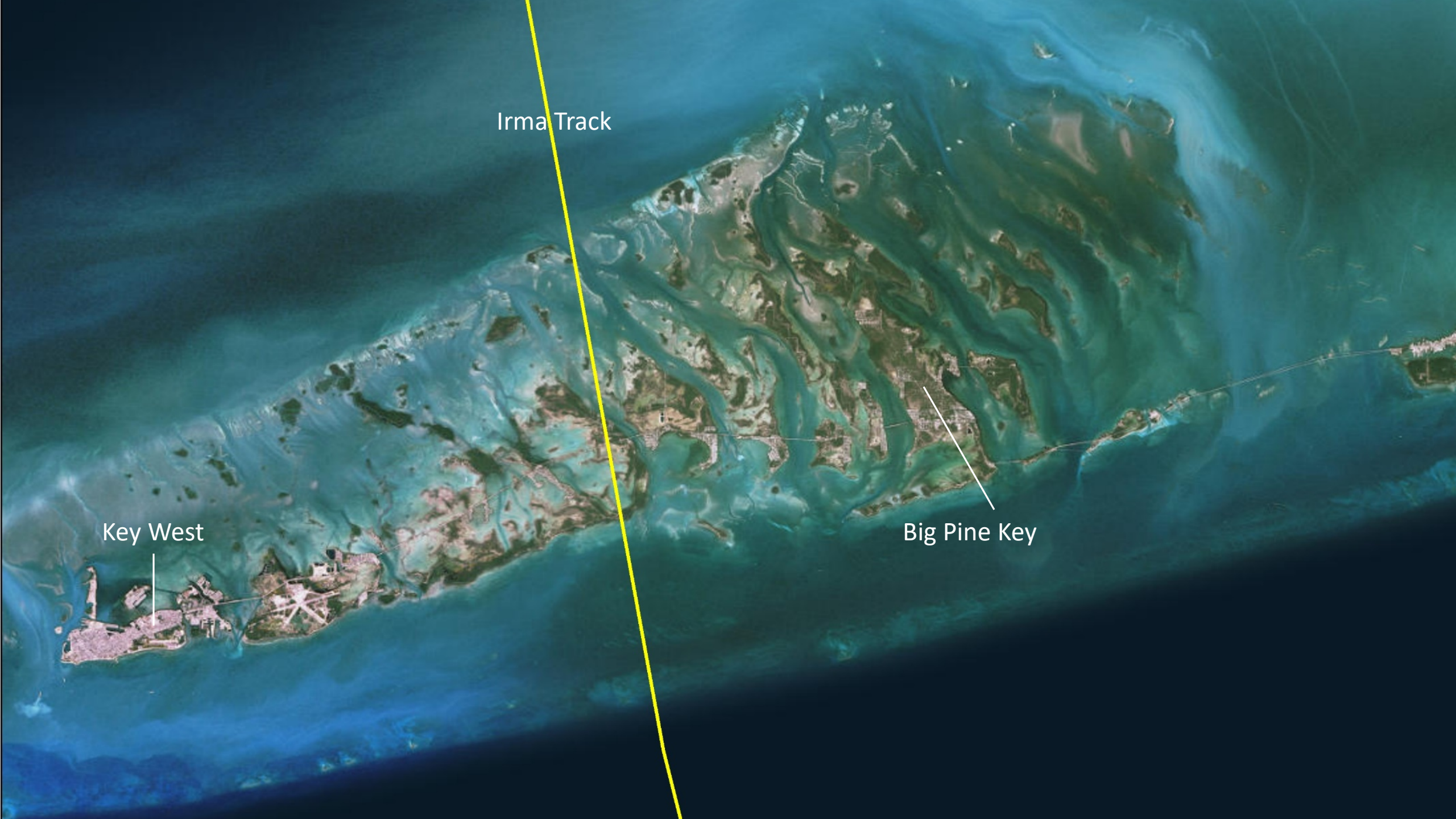


How much time and rainfall are required for groundwater to return pre-surge conditions?

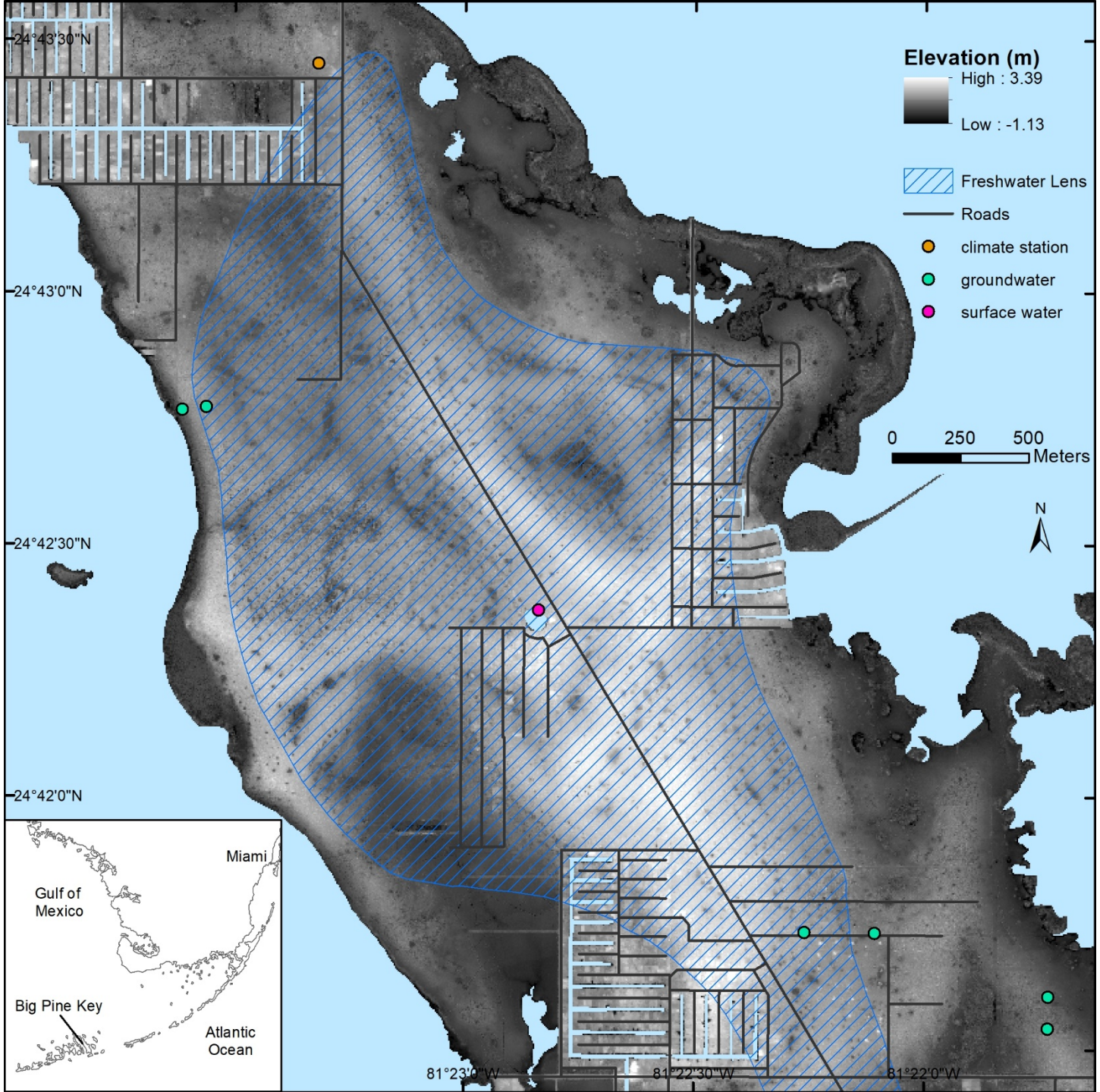


b) Post disturbance

Kiflai et al. *in review* in *Estuaries & Coasts*


Irma Track
Key West
Big Pine Key

Study Area: Big Pine Key



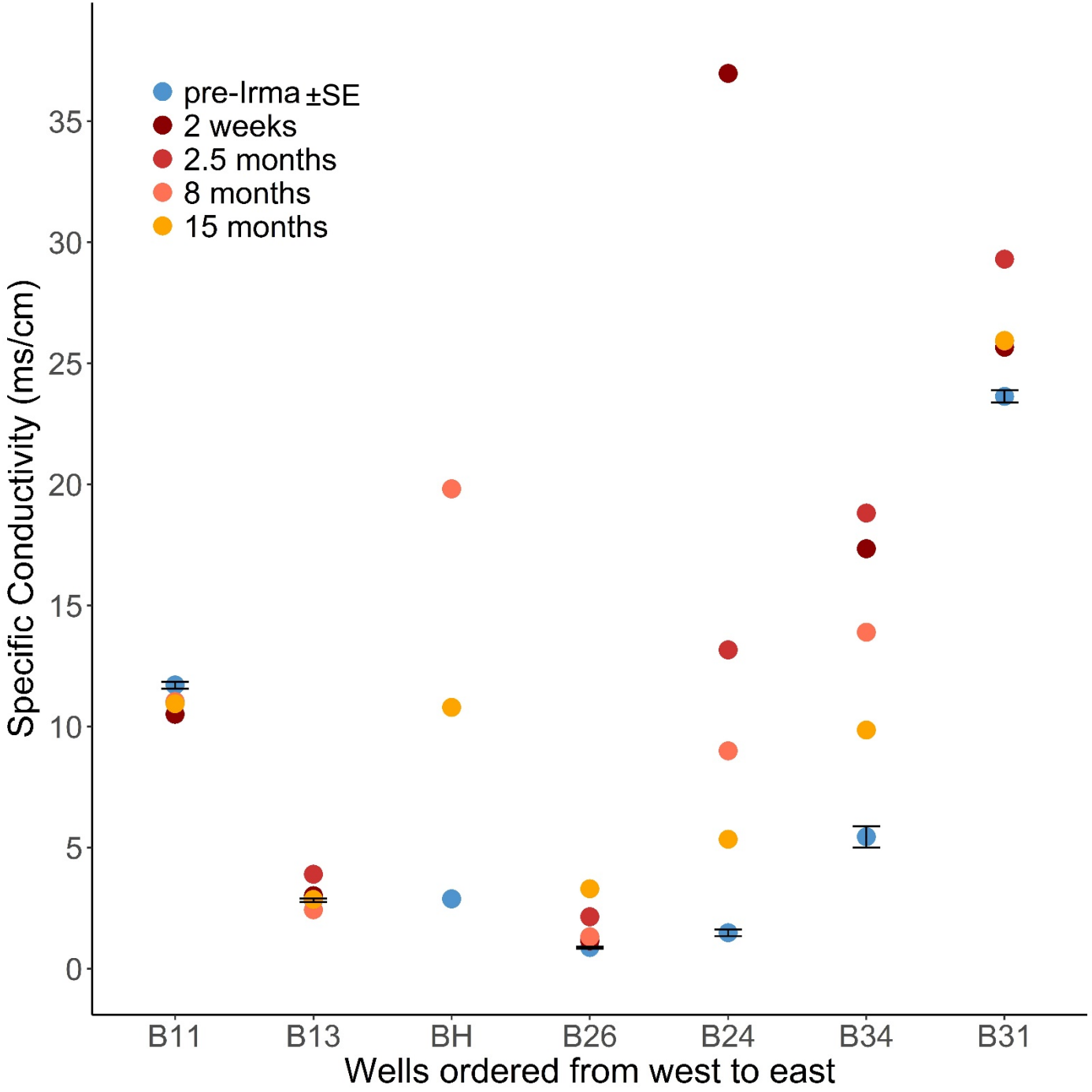
<u>Monthly samples (2011 – 2012):</u>
12 pre- and several post-Irma samples taken with YSI Model 30 handheld conductivity probe

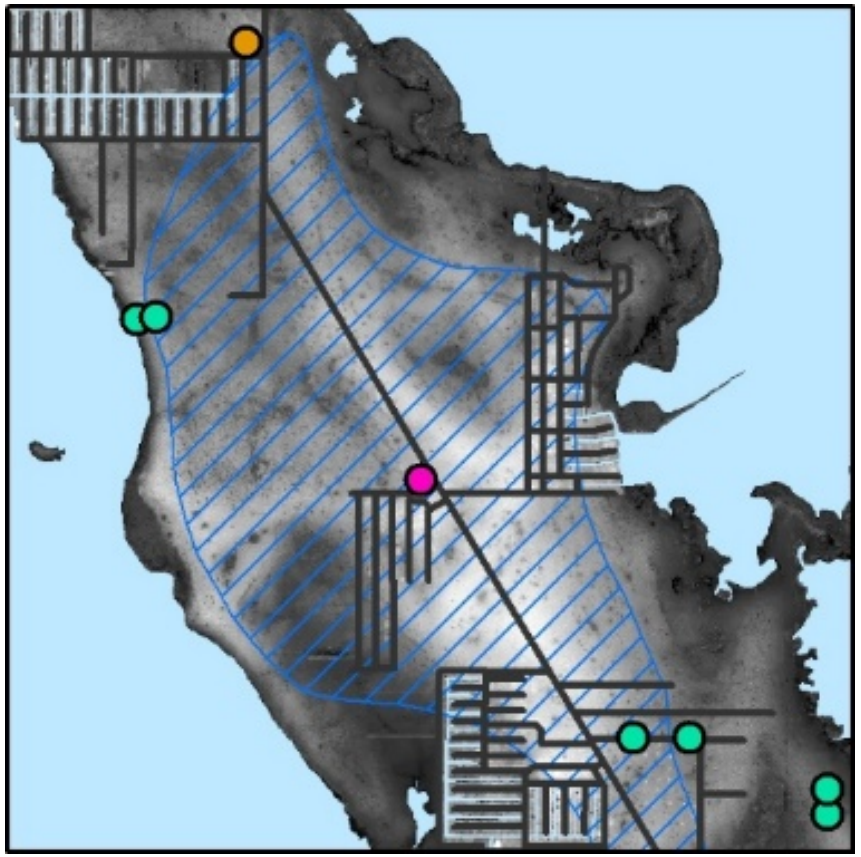
<u>June – December 2018:</u>
7 Solinst Levelogger Edge LTC units were deployed in 6 groundwater & 1 surface water location

<u>Loggers record at 30-minute intervals</u>:
- Water level (meters)
- Temperature (°C)
- Conductivity (us/cm)

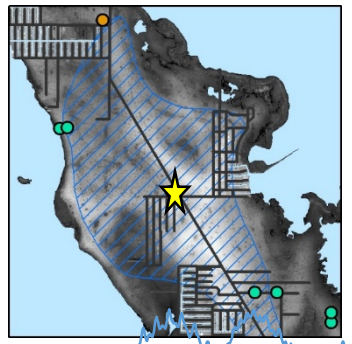
<u>Climate Station (2007 to current):</u>
- Hourly Precipitation (cm)
- Hourly Air Temperature & Solar Radiation
- Derived daily rainfall & potential evapotranspiration (PET)

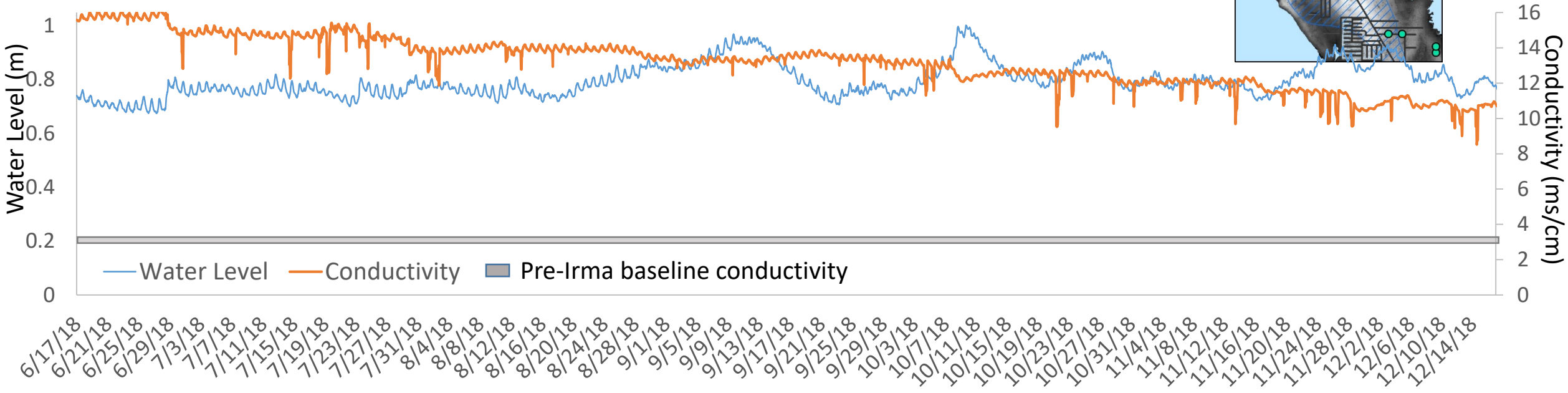
Comparison of pre-post Irma specific conductivity



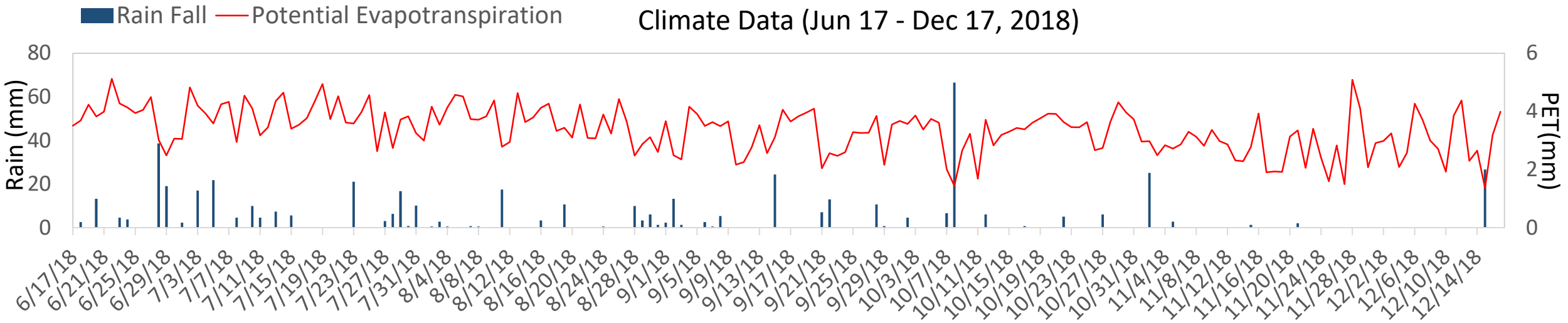


Blue Hole Surface Water Hourly Data (Jun 19 – Dec 17, 2018)

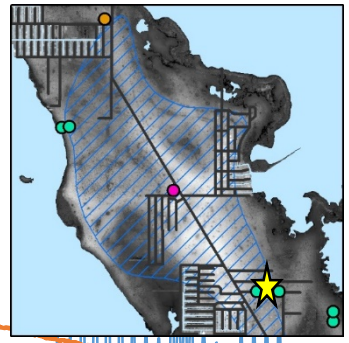




Climate Data (Jun 17 - Dec 17, 2018)



Groundwater Hourly Data (Jun 17 - Dec 17, 2018)



Water Level
Conductivity
Pre-Irma baseline conductivity

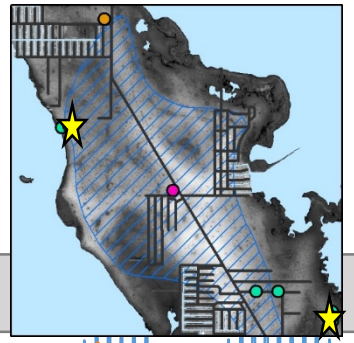
Water Level (m)
Conductivity (ms/cm)

B26

B24

6/17/18 6/21/18 6/25/18 6/29/18 7/3/18 7/7/18 7/11/18 7/15/18 7/19/18 7/23/18 7/27/18 7/31/18 8/4/18 8/8/18 8/12/18 8/16/18 8/20/18 8/24/18 8/28/18 9/1/18 9/5/18 9/9/18 9/13/18 9/17/18 9/21/18 9/25/18 9/29/18 10/3/18 10/7/18 10/11/18 10/15/18 10/19/18 10/23/18 10/27/18 10/31/18 11/4/18 11/8/18 11/12/18 11/16/18 11/20/18 11/24/18 11/28/18 12/2/18 12/6/18 12/10/18 12/14/18

Groundwater Hourly Data (Jun 17 - Dec 17, 2018)



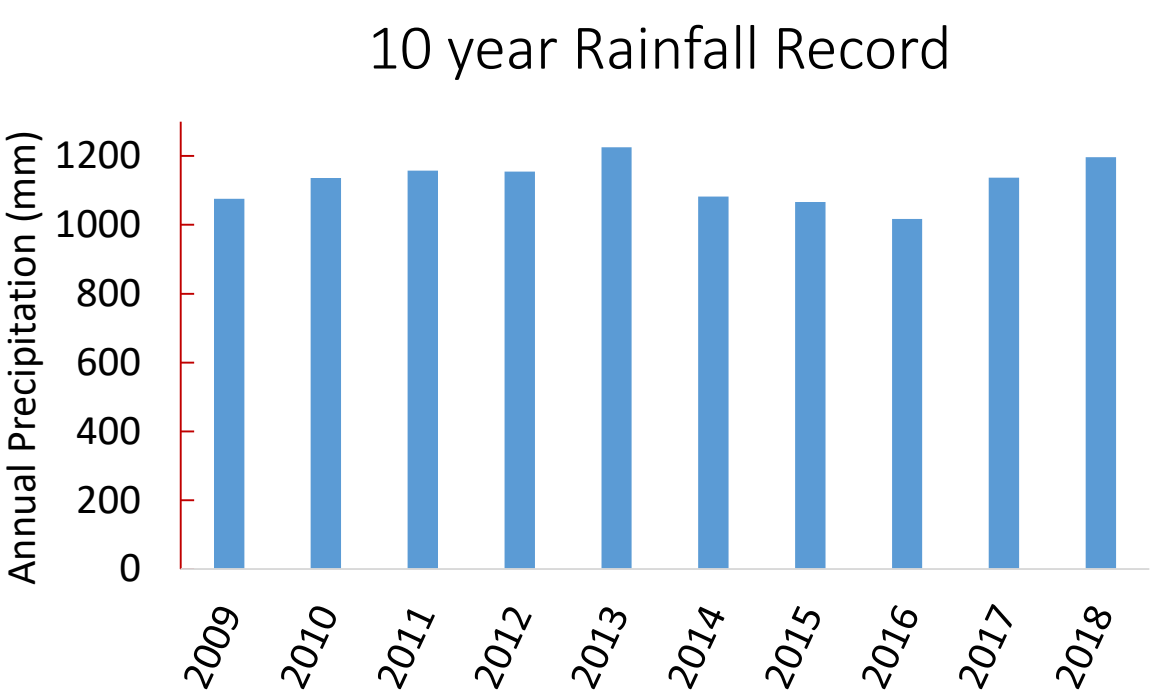
Water Level
Conductivity
Pre-Irma baseline conductivity

Water Level (m)
Conductivity (ms/cm)

B13

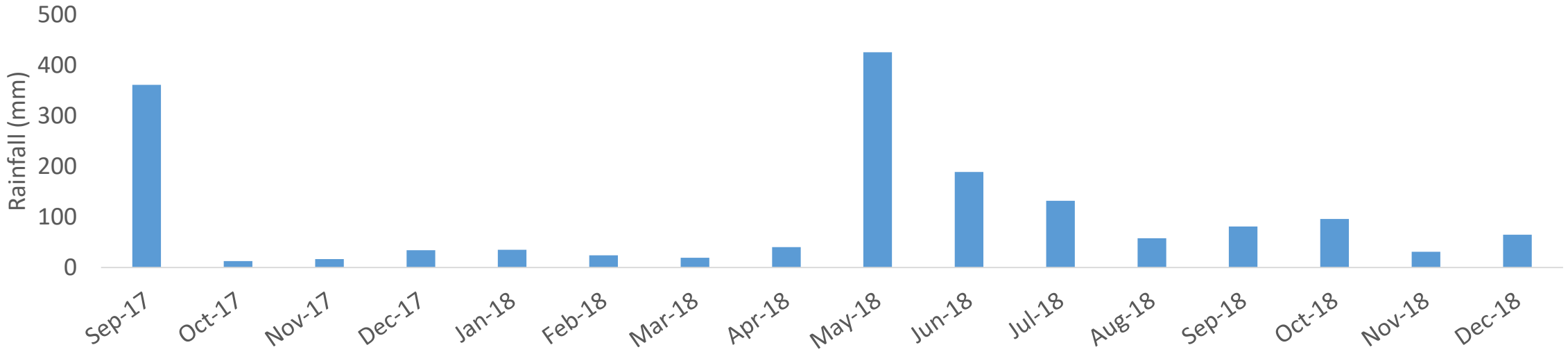
B34

6/17/18 6/21/18 6/25/18 6/29/18 7/3/18 7/7/18 7/11/18 7/15/18 7/19/18 7/23/18 7/27/18 7/31/18 8/4/18 8/8/18 8/12/18 8/16/18 8/20/18 8/24/18 8/28/18 9/1/18 9/5/18 9/9/18 9/13/18 9/17/18 9/21/18 9/25/18 9/29/18 10/3/18 10/7/18 10/11/18 10/15/18 10/19/18 10/23/18 10/27/18 10/31/18 11/4/18 11/8/18 11/12/18 11/16/18 11/20/18 11/24/18 11/28/18 12/2/18 12/6/18 12/10/18 12/14/18



Rainfall (mm)	During hurricane	Oct-Apr
Irma	320	220
Wilma	51	120

Marathon Airport 30 yr ave: 420 mm



Conclusions

- Salinization from storm surge impacts vary across the island of BPK
- Salts remain in soil for many months and are flushed into groundwater from heavy rain events, leading to temporary increases in conductivity
- Conductivity remains elevated above pre-Hurricane values for sites on the central and east side of the island
- Continued monitoring is required

Thank you!
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