

NWS COASTAL FLOODING PREDICTIONS

ROB HART

WFO CRP COASTAL PROGRAM LEADER

Our Organization



NOAA

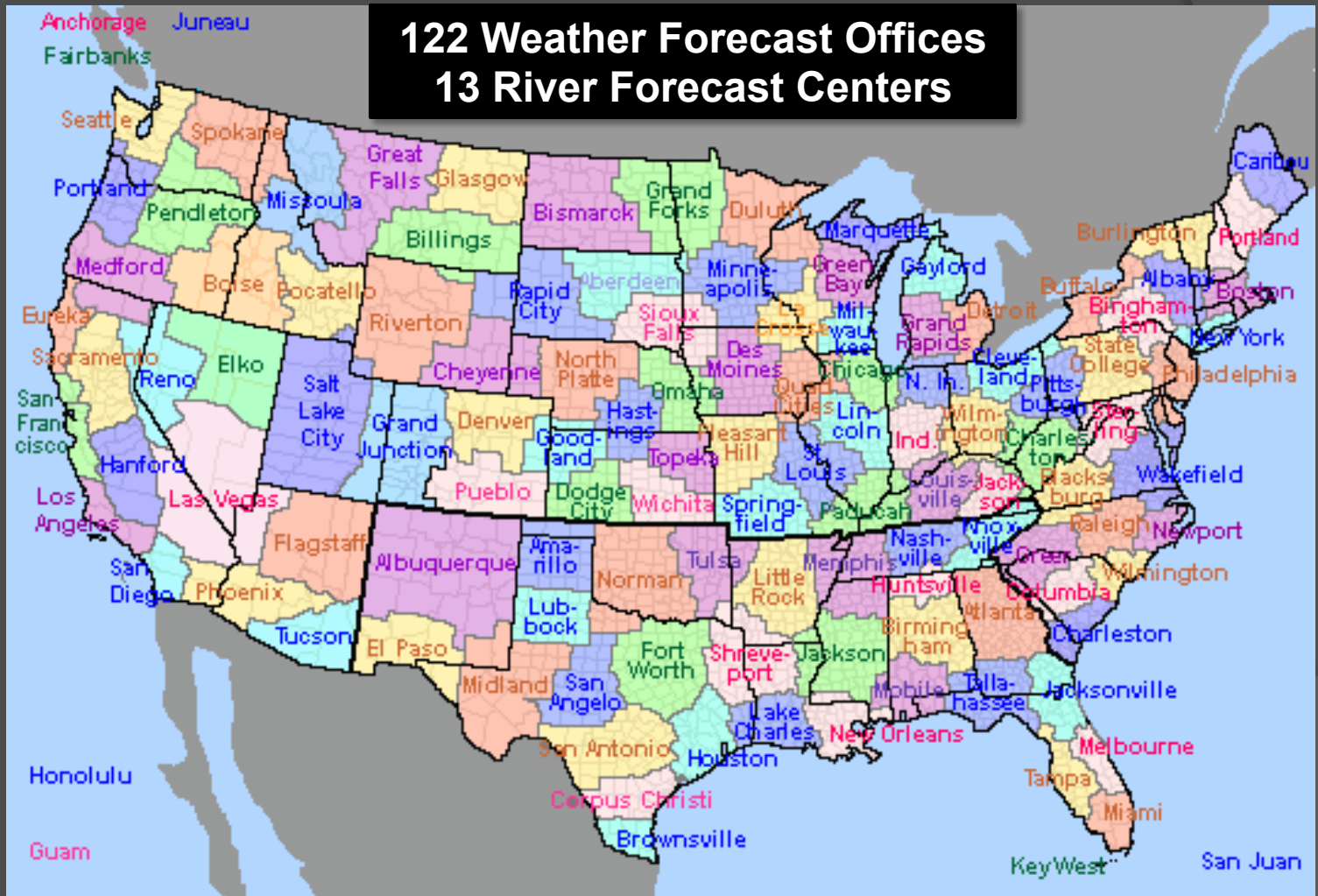


NWS



National Weather Service

**122 Weather Forecast Offices
13 River Forecast Centers**



National Weather Service Mission:

“To provide warnings, forecasts and advisories primarily for the protection of life and property.”

“There is no greater calling than the protection of life...”



Vulnerability

- ❖ Coastal areas are at increasing risk from sea-level rise.
- ❖ Rising sea-levels provide a higher “base” for future inundation events, thus producing an increasing threat to:
 - ❖ Coastal communities
 - ❖ Ecosystems (wetlands, habitat loss, critical species)
 - ❖ Transportation systems (highways, ports, rail)
 - ❖ Economic viability (tourism, natural resources)
 - ❖ Energy
- ❖ *Locally: Impacts are noticed when water reaches ~2.0 MSL*



How do we forecast/monitor coastal flooding?



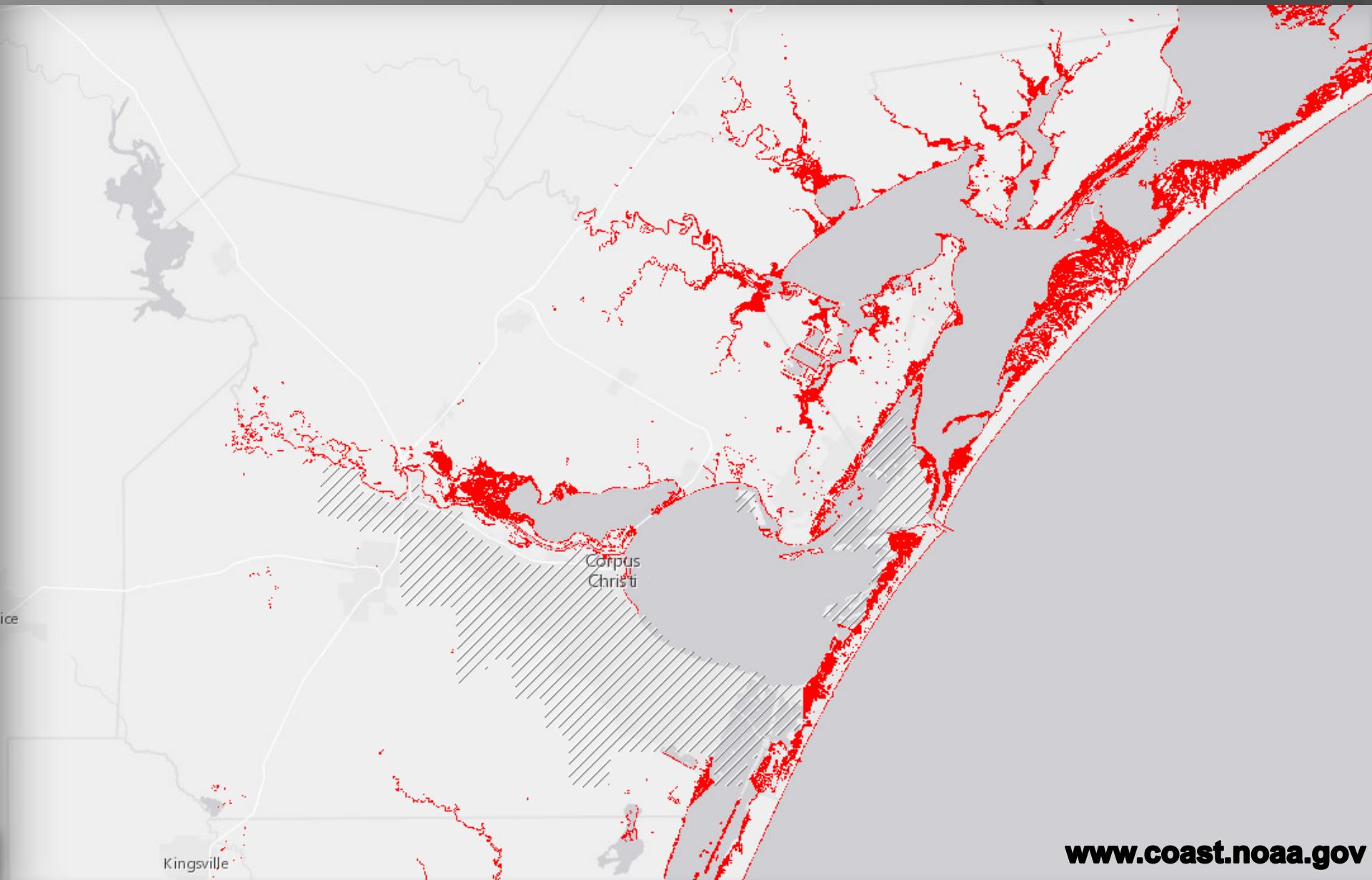
Forecaster Viewpoint

- 1: Know areas most susceptible to flooding
- 2: Processes of flooding
- 3: Statistical occurrence
- 4: Data analysis & forecasting
- 5: Coastal Flood Watch/Warning Issuance

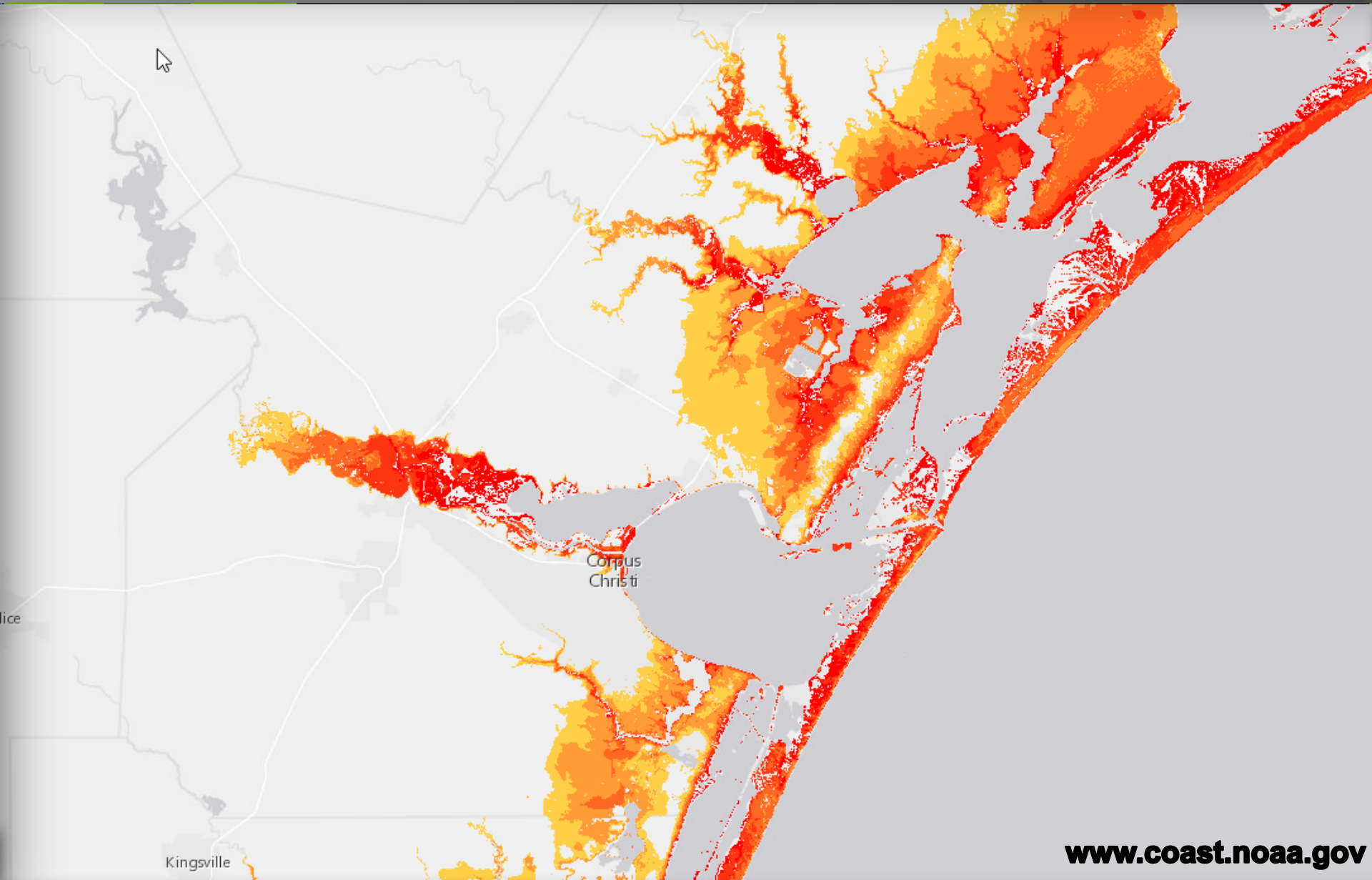


Which areas are most likely to flood?

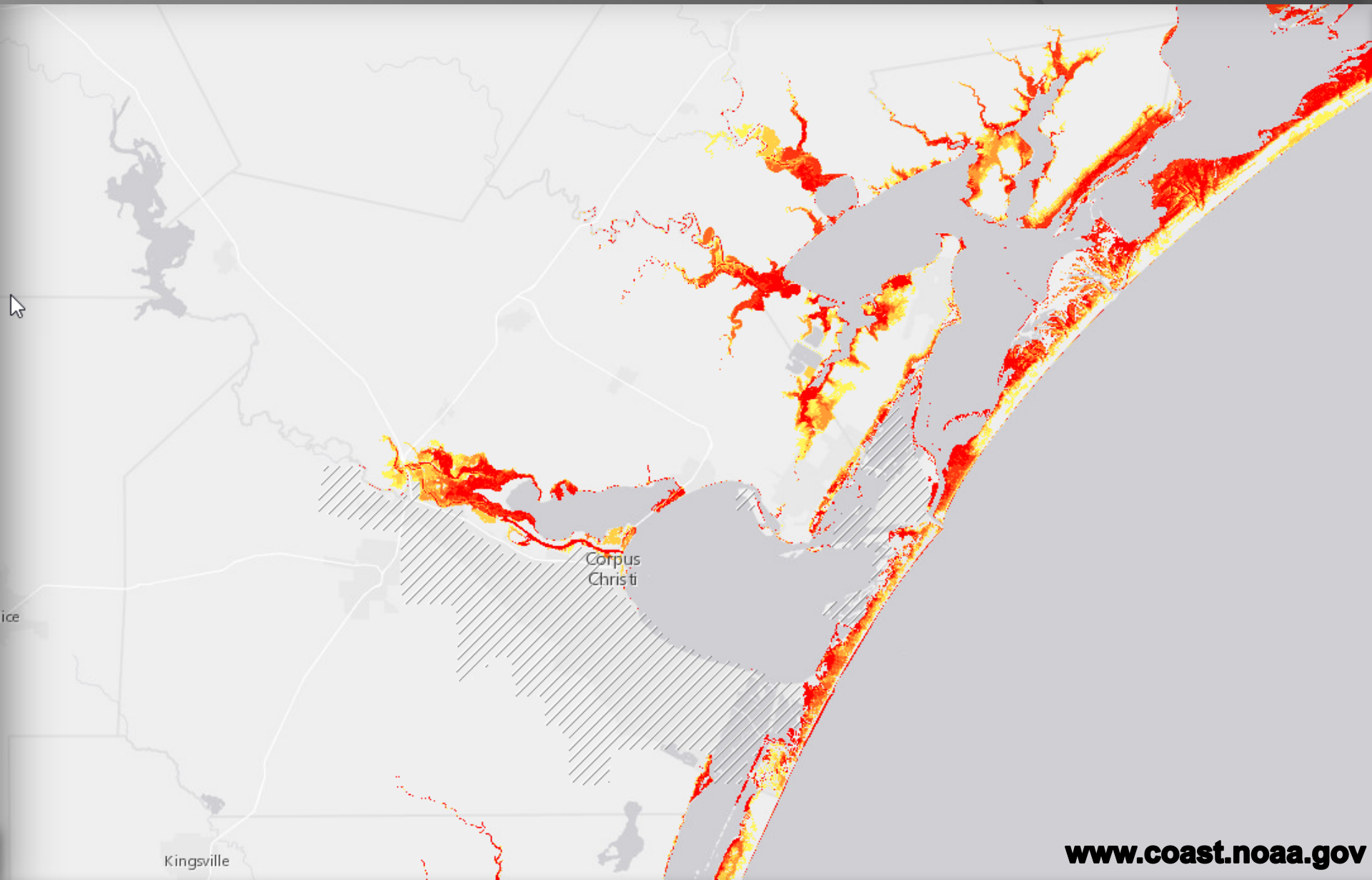
Shallow Coastal Flooding



Storm Surge Flooding



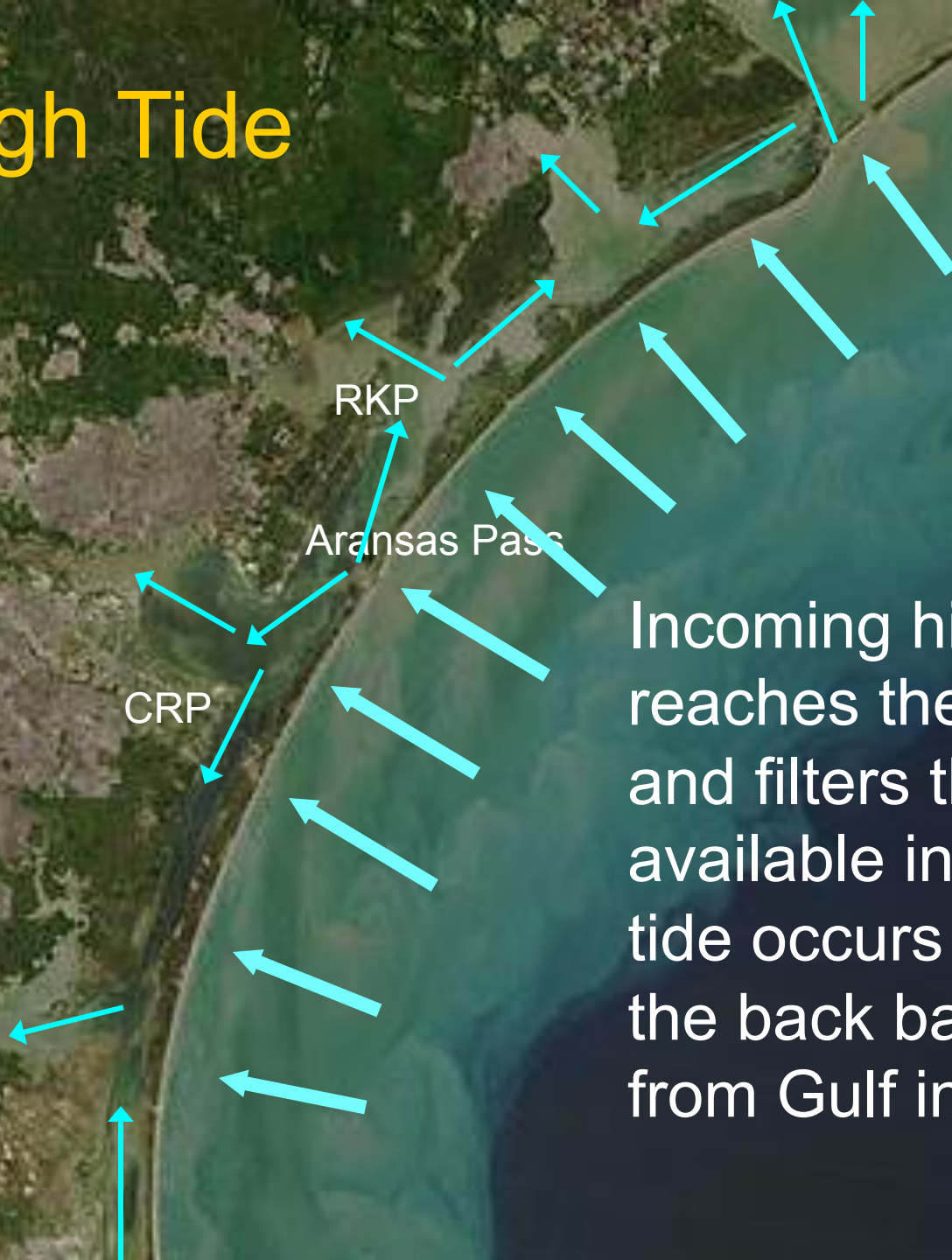
Sea Level Rise





Coastal Flooding Process

High Tide



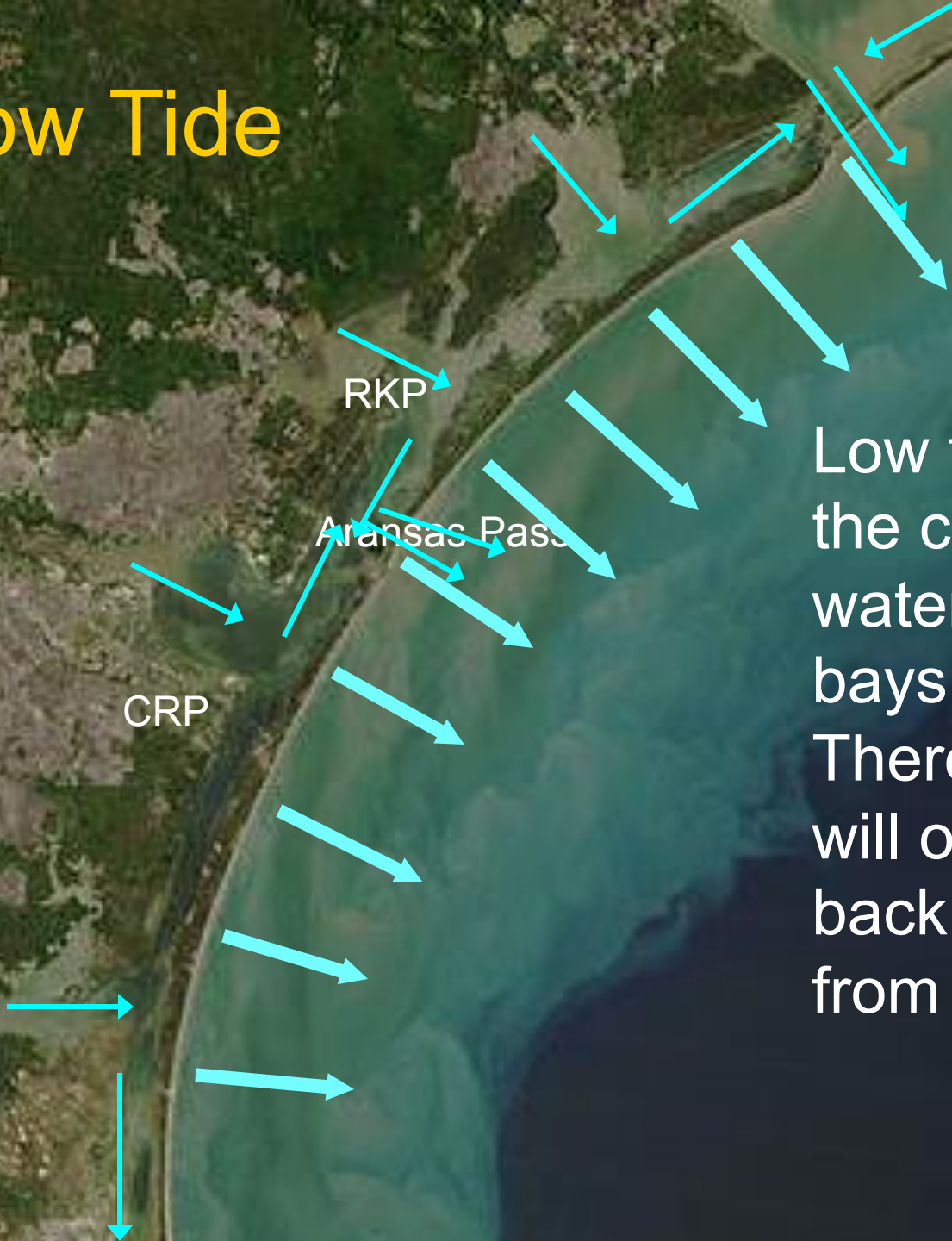
CRP

RKP

Aransas Pass

Incoming high tide reaches the shoreline and filters through available inlets. High tide occurs last in the back bays furthest from Gulf inlets.

Low Tide



CRP

RKP

Aransas Pass

Low tide occurs at the coast first and water flows out of the bays to fill the void. Therefore, low tide will occur last in the back bays furthest from the inlets.

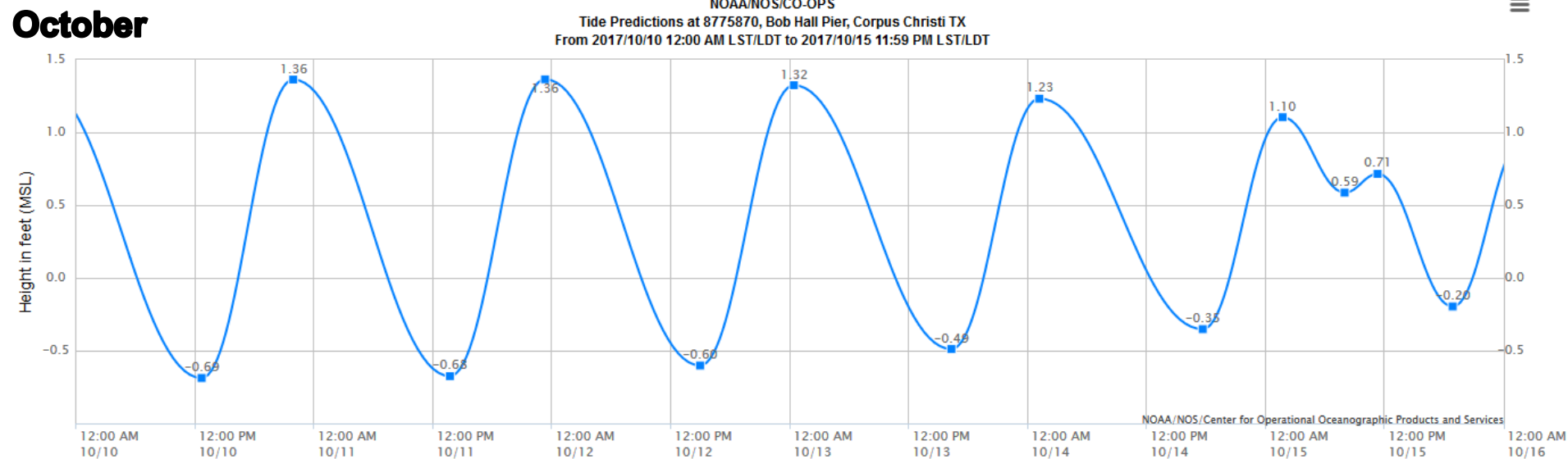


Statistical Occurrence



What time of year is coastal flooding most likely?

- ❖ Late summer and fall
 - ❖ Astronomical high tides are “high”
 - ❖ Little additional water may lead to flooding

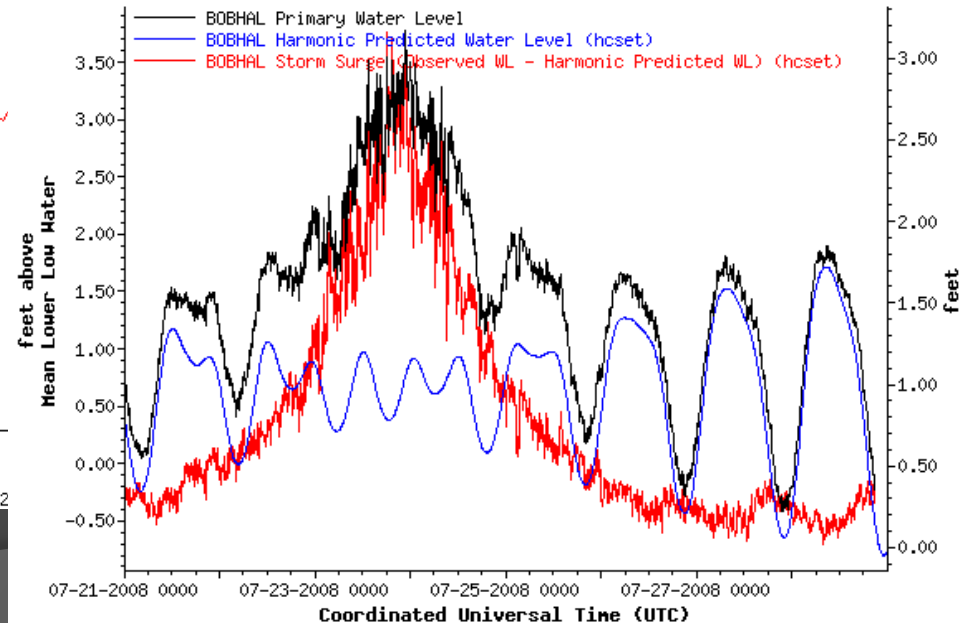
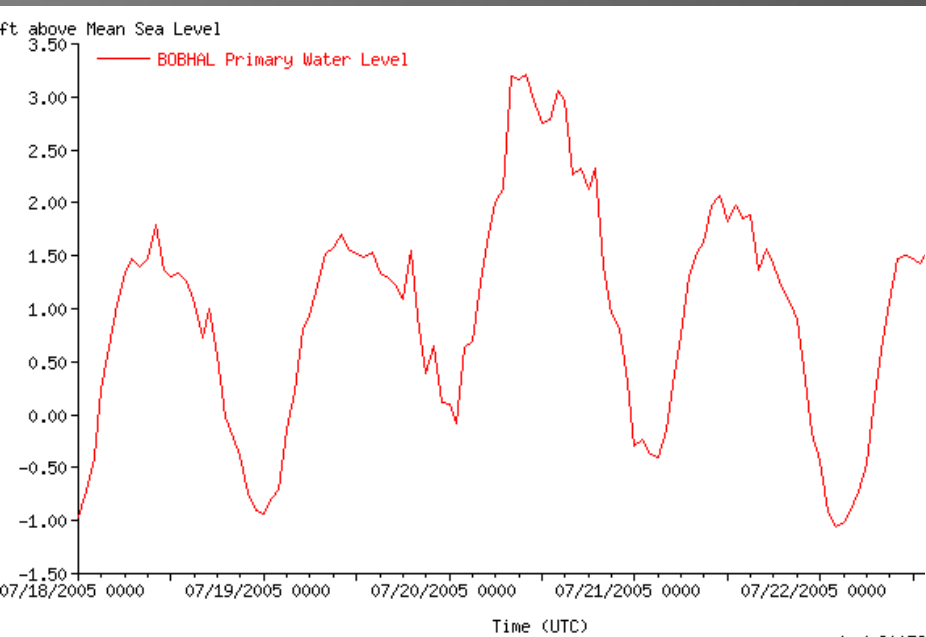




What time of year is coastal flooding most likely?

❖ Summer

❖ Tropical cyclones



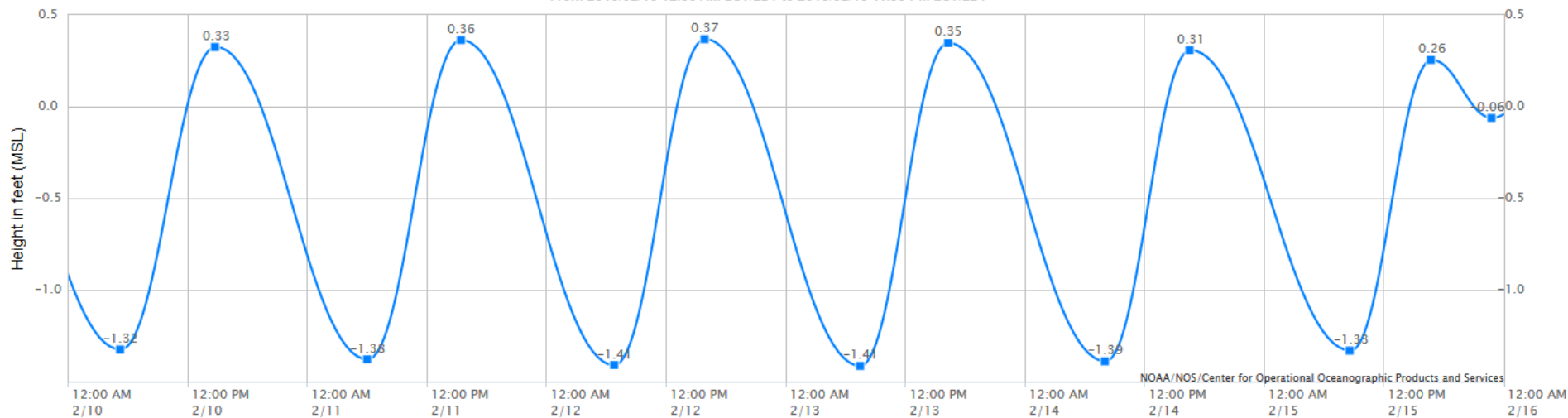


What time of year is coastal flooding most likely?

- ❖ Opposite for mid/late winter
 - ❖ Astronomical high tides are “low”

February

NOAA/NOS/CO-OPS
Tide Predictions at 8775870, Bob Hall Pier, Corpus Christi TX
From 2018/02/10 12:00 AM LST/LDT to 2018/02/15 11:59 PM LST/LDT



NOAA/NOS/Center for Operational Oceanographic Products and Services

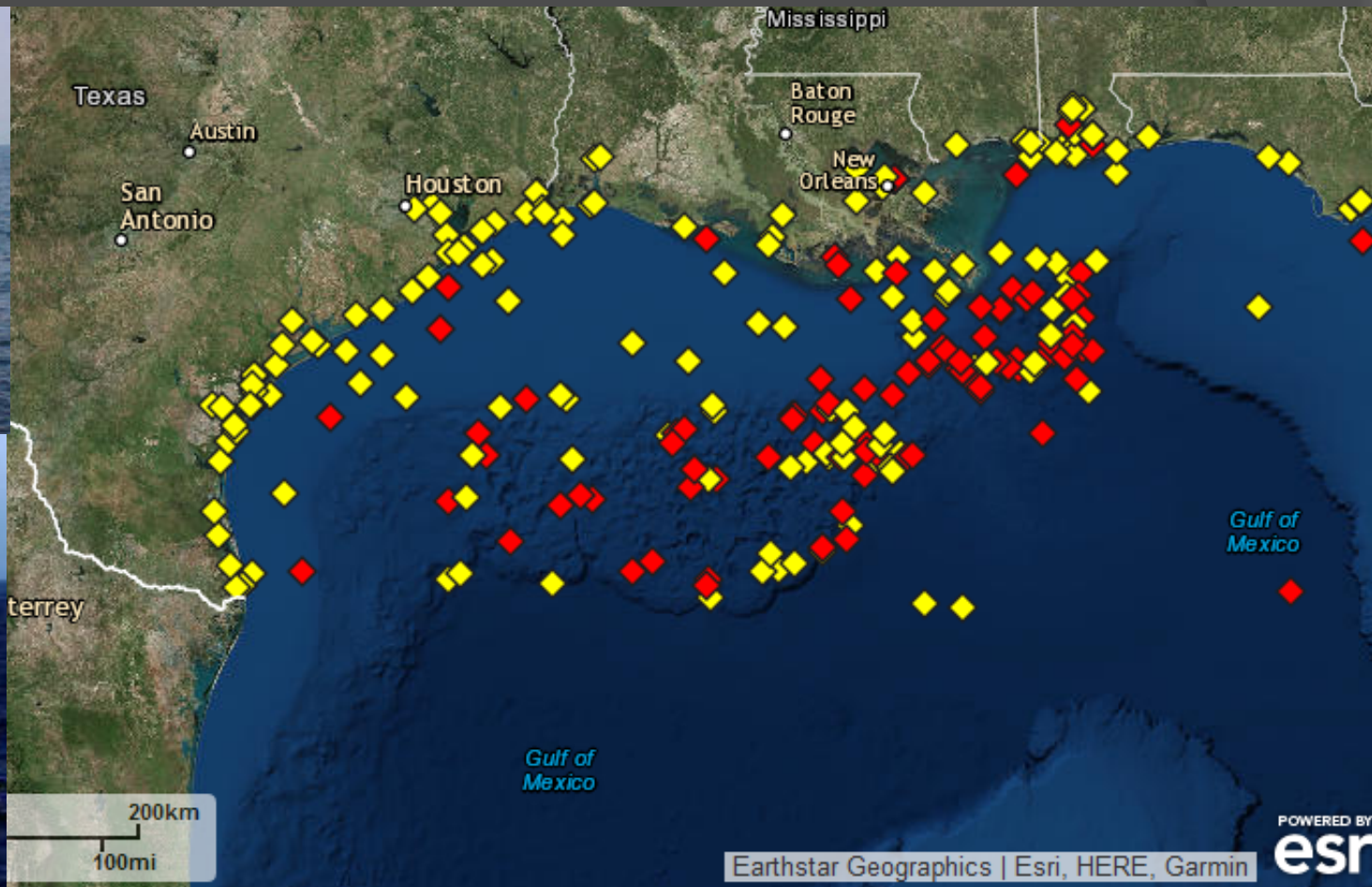


Data Analysis & Forecasting



Current Conditions

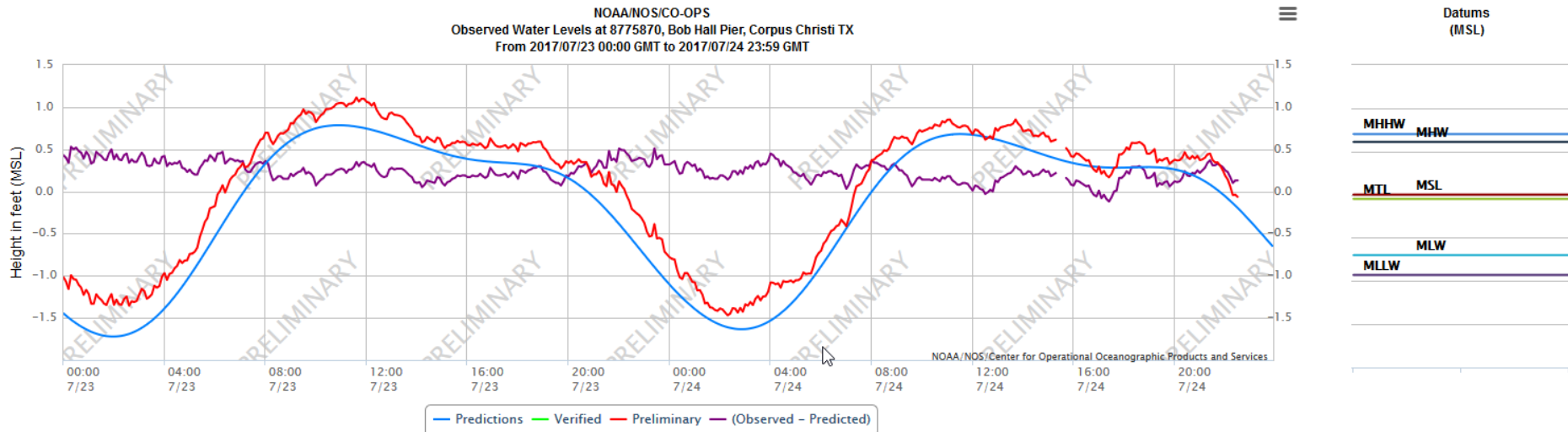
⦿ Buoys & Tide Gauges





NWS Tide Data

❖ Real-time data along Texas Coast



Options for

8775870 Bob Hall Pier, Corpu...

From: Jul 23 2017

To: Jul 24 2017

Units

Feet

Timezone

GMT

Datum

MSL

Shift dates

Back 1 Day Forward 1 Day

Interval

6 min 1 hr H/L Day Month

Update

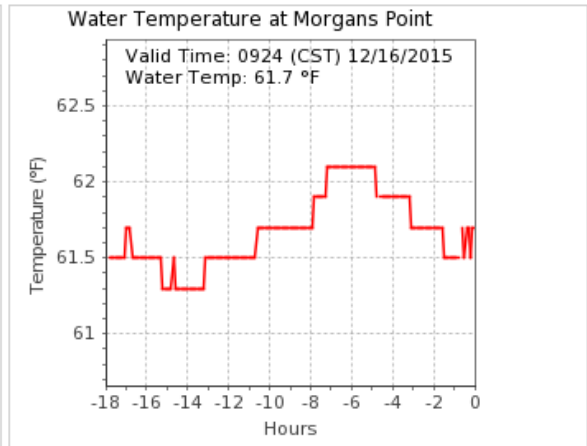
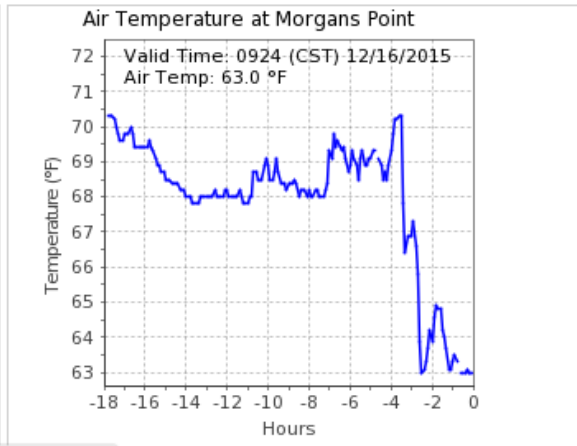
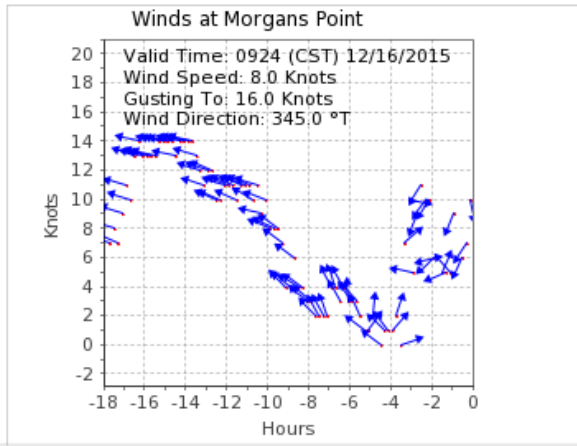
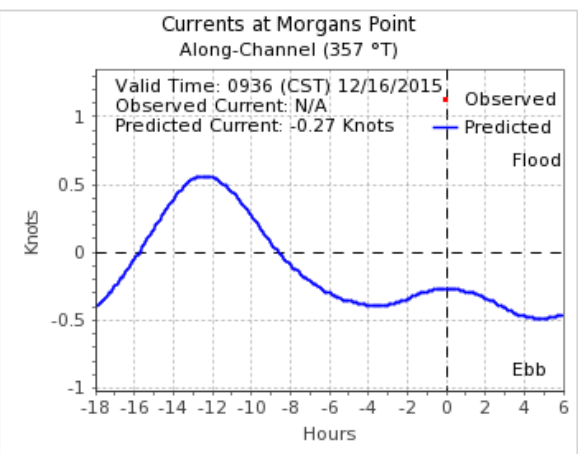
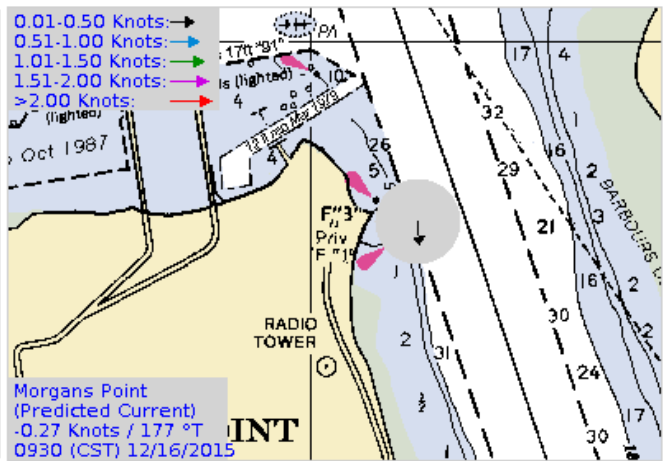
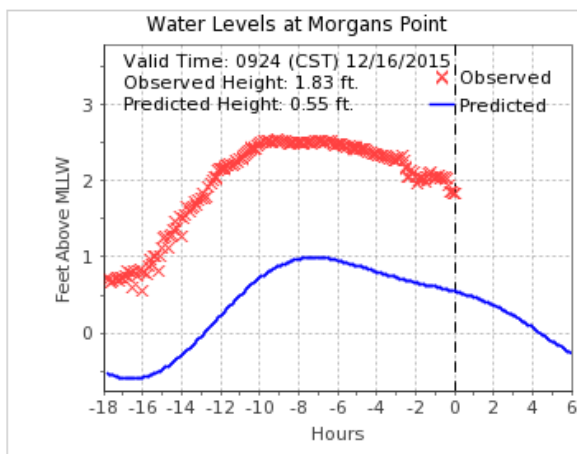
Plot Data Only

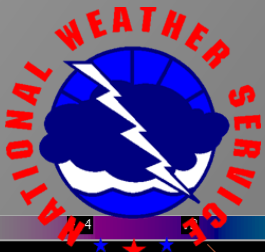


NOAA PORTS - Data Display

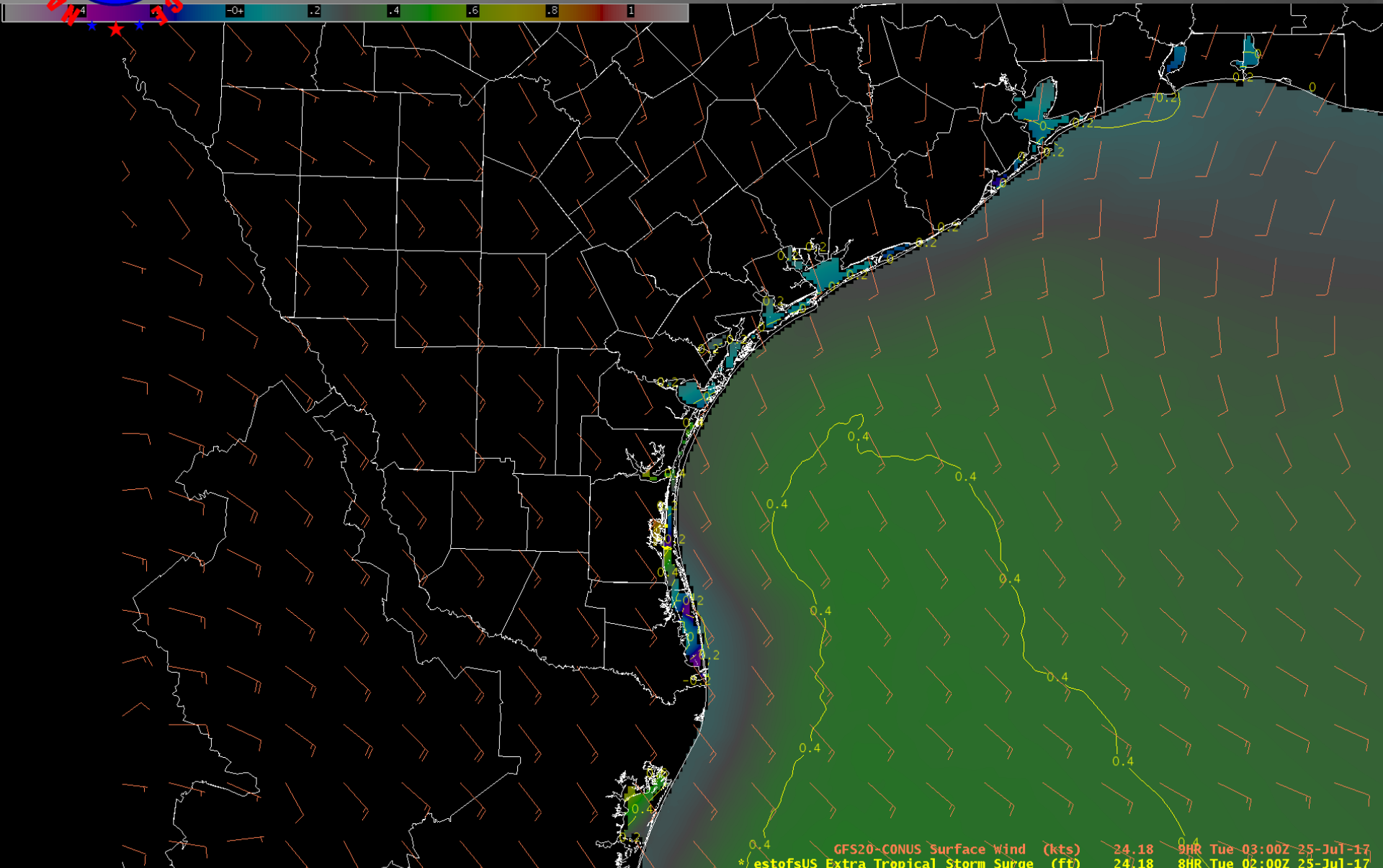
PORTS®: g02010

- Summary
- Composite
- All Water Levels
- 3 Days WL/Met
- All Currents
- 3 Days Currents
- All Met
- All CT
- 3 Days CT





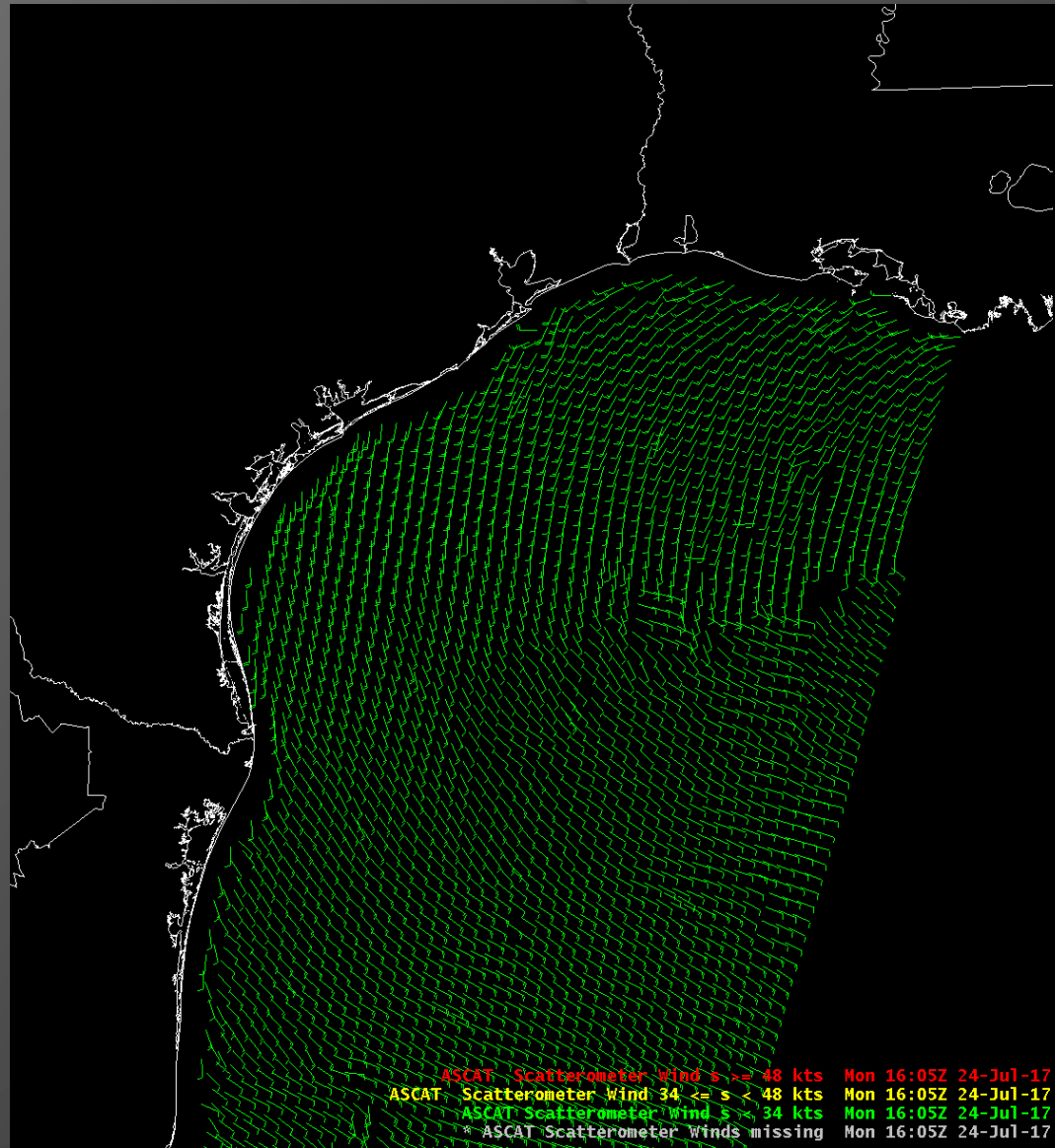
NWS Model Data





NWS Derived Satellite Data

- ❖ Certain satellites make passes over the Gulf a few times a day
- ❖ Satellites can estimate wind speeds
- ❖ Allows forecasters to obtain estimated wind speeds in an otherwise data void area

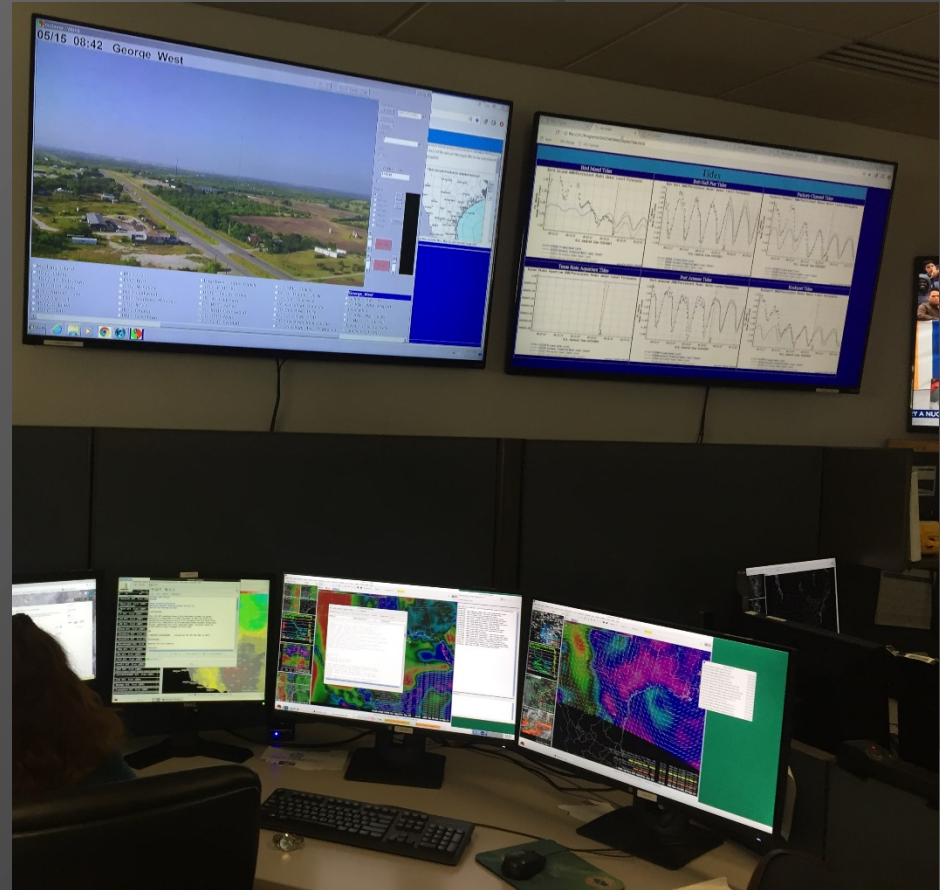


ASCAT Scatterometer Wind $s \geq 48$ kts Mon 16:05Z 24-Jul-17
ASCAT Scatterometer Wind $34 \leq s < 48$ kts Mon 16:05Z 24-Jul-17
ASCAT Scatterometer Wind $s < 34$ kts Mon 16:05Z 24-Jul-17
* ASCAT Scatterometer Winds missing Mon 16:05Z 24-Jul-17



NWS Display of Coastal Data

- ❖ Water Level Predictions continuously displayed on Situation Awareness Monitor in Operations.
- ❖ Allows forecasters to observe current:
 - ✓ Current tide levels
 - ✓ Trends
 - ✓ Harmonic predictions
 - ✓ Neural net predictions





Most critical part of forecasting?

EXPERIENCE!!!



Product Issuance



Coastal Flood Products

❖ NWS Corpus Christi will issue one of the following when there is a threat of coastal flooding.

Coastal Flood Watch	A Coastal Flood Watch is issued to inform the public and cooperating agencies that coastal flooding is possible approximately 12 to 36 hours after issuance time.
Coastal Flood Warning	A Coastal Flood Warning is issued to inform the public and cooperating agencies that coastal flooding, posing a serious threat to life and property is occurring, is imminent, or is expected within the next 24 hours.
Coastal Flood Advisory	A Coastal Flood Advisory is issued to inform the public that minor or nuisance flooding is possible.



Coastal Flood Products

- ❖ **Minor tidal overall (2.0ft to 2.9ft above MSL):** Water to dunes along barrier islands and minor beach erosion.
- ❖ **Moderate coastal flooding (3.0 to 3.9ft above MSL):** water well into dunes, significant beach erosion, homes immediately along bays become flooded.
- ❖ **Major coastal flooding (4.0ft or greater above MSL):** Major beach erosion, widespread flooding of low lying roads, several homes flooded.

Coastal Flood Impacts

Level above MSL

1 3/4'	2/3rds beach under water.	
2'	Minor flooding along barrier island beaches facing the Gulf of Mexico. Vehicles must be evacuated off 68 mile stretch of Padre Island National Seashore if water is forecast to reach this level. Vehicle traffic is halted at the National Seashore. Steady periods of water at dunes. North Beach in eastern Corpus Christi Bay begins to flood with water well into some picnic areas on the beach. Water crosses over Laguna Shores Drive in Flour Bluff with the lowest sections becoming impassible. A low spot in a road located in an Ingleside neighborhood along Corpus Christi Bay floods.	
2.5'	Beach is completely inundated with water. Baseball fields near North beach, eventually bait/convenience store in Indianola. Some	6'
3'	Major dune erosion occurs. Cross channel areas on St. Joseph Island occurs. Mino Bay and water cutting off Hwy 35 north Laguna Madre along Laguna Shores Dr Matagorda Bay from Magnolia Beach to bait/convenience store at Indianola.	7'
4'	Waterfront facilities flooded in Fulton, F Fulton and north of Fulton. Water about becoming flooded. Harbor facilities at F flooded. Water over most of North Beach Christi T-heads start to see impacts. Water of Turning Basin (see protection dike south of Ward Island) flooded. Some facilities installations flooded below bluff at Port	8'
5'	Water into Lamar with front streets flooded Aransas Pass and Rockport under 1 foot facilities flooded at Port Aransas and water becoming flooded. All waterfront facilities and docks, under water. All of T-heads, Lawrence St. T-Heads. Cooper's Alley I flooded. Some shallow flooding in Port	9'
		10'
		11'
		12'
		14'
		15'

Water well into Lamar with escape route to north becoming cut-off. All routes out of Fulton cut-off. All escape routes out of Rockport cut-off and water 2 to 3 feet deep along Rockport waterfront. Water moving into the draw through center of Bayside. Considerable part of Port Aransas flooded and some sections under 2 feet of water. Water moving around north and south ends of Aransas Pass seawall and town being flooded with water 2' deep on Main St. Water into extreme southwestern edge of Flour Bluff. North Beach completely flooded, shallow to 4' deep. Water 1/2 foot above breakwater and 2' above some T-heads. Coopers Alley L-Head is now under water. Water up to 4' deep on low spots of Laguna Shore Dr south of Padre Island Causeway.

Approximately 1/2 of Fulton and Rockport underwater. Most sections of Port Aransas underwater. Water into Aransas Pass just west of Main St., lower spots in east sections under 3' of water. Escape routes out of Aransas Pass cut off. About 1' of water in part of the Carbon Black area. Port O'Connor isolated and water up to 3' deep in places. Hwy 2143 flooded at Keller's Creek between Olivia and Point Comfort. Hwy 1289 flooded at Coloma Creek, 8 miles west-northwest of Port O'Connor. All Corpus Christi Marina T-Heads are completely under water.

Approximately 1/2 of Lamar underwater. Port Aransas underwater to 4' deep in places. Water 1 to 2 blocks west of Main St. in parts of Aransas Pass. Water into low spots in port area of Corpus Christi. Hwy 316 flooded between Indianola and Magnolia Beach. Hwy 35 flooded at north end of Carancahua Bay 12 miles east-northeast of Port O'Connor. Matagorda Island flooded up to 5' deep in places.

Hwy 238 flooded at two points south of Port Lavaca near Chocolate Bay.

Most of Lamar underwater. All except extreme northwestern Rockport underwater (some sections 5 to 6' deep). Water 1 to 3 blocks west of Main St in Aransas Pass. Water to northern outskirts of Ingleside. Water over 1/3 of Ward Island. Port Aransas 4 to 6' underwater. Southernmost section of Hwy 172 in Olivia flooded 1 to 2' deep (3 to 5' deep in isolated spots). Some flooding of installations in low coastal sections on north shore of Point Comfort. Some flooding in north section of Port Lavaca near Ice Plant.

Hwy 185 flooded in Seadrift, parts of town flooded 1' deep (4 to 5' deep in small area near creeks). Hwy 316 flooded south of Magnolia Beach isolating the area. Most of Magnolia Beach approximately 1' underwater. Shallow flooding beginning in parts of Alamo Beach area. Port Alto flooded, most of town flooded 1' deep (2 to 3' in isolated spots). Parts of Carancahua (Jackson Co) flooded 1' deep.

Rockport and Fulton underwater. Aransas Pass flooded 3 to 6 blocks west of Main St. Water moving into Ingleside. All of North Beach underwater and northern parts of Corpus Christi near tank farm, railroad tracks, and docks becoming flooded if protection dikes have not been installed. Ward Island almost entirely underwater. Flooding 2' deep in places at Riviera Beach and Loyola Beach. Flour Bluff flooded.

Water even with the Corpus Christi seawall and Corpus Christi protection dike for northern part of the city. Waves over the seawall long before this. Water flooding over all of the Oso Bay shorelines.

Water 1' above Corpus Christi seawall and over protection dike. All areas east of Broadway underwater. Tank farm and railroad areas south of Turning Basin Flooded. Low lying areas west of Washington School(?) southward to just north of Southgate School(?) becoming flooded. Ward Island underwater (shallow to 5' deep). North Beach flooded 10 to 13' deep. Water more than 5' deep in lower sections of Flour Bluff near causeway. Water more than 10' deep in places at Harbor Island, Mustang Island, Padre Island, and St. Joseph Island. Parts of Ingleside flooded 3' deep, 5 to 10' deep at Ingleside. Port Aransas 9 to 11'

Coastal Flood Product Issuance

COASTAL HAZARD MESSAGE
NATIONAL WEATHER SERVICE CORPUS CHRISTI TX
358 AM CDT SAT OCT 29 2016

...MINOR COASTAL FLOODING AND A HIGH RISK OF RIP CURRENTS WILL OCCUR THIS WEEKEND...

.MODERATE EAST TO NORTHEAST WINDS ACROSS MOST OF THE GULF WILL CONTINUE TO PRODUCE LONG PERIOD LARGE SWELLS THROUGH THE WEEKEND. THE RESULT WILL BE MINOR COASTAL FLOODING AT THE TIME OF HIGH TIDE AND A HIGH RISK OF RIP CURRENTS ALONG GULF-FACING BEACHES.

TXZ242-243-245-247-291700-
/O.NEW.KCRP.CF.Y.0018.161029T0858Z-161031T0000Z/
/O.EXT.KCRP.RP.S.0016.000000T0000Z-161031T0000Z/
KLEBERG-NUECES-ARANSAS-CALHOUN-
358 AM CDT SAT OCT 29 2016

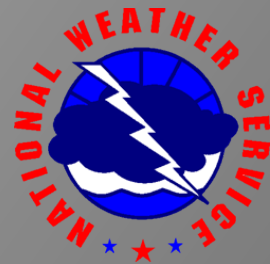
...COASTAL FLOOD ADVISORY IN EFFECT UNTIL 7 PM CDT SUNDAY...
...HIGH RIP CURRENT RISK NOW IN EFFECT THROUGH SUNDAY EVENING...

THE NATIONAL WEATHER SERVICE IN CORPUS CHRISTI HAS ISSUED A COASTAL FLOOD ADVISORY...WHICH IS IN EFFECT UNTIL 7 PM CDT SUNDAY.

* COASTAL FLOODING...TIDAL LEVELS WILL AVERAGE 1 TO 1.2 FEET ABOVE NORMAL THIS WEEKEND. THIS WILL RESULT IN ACTUAL TIDES BETWEEN 2 AND 2.2 FEET MSL AT THE TIME OF HIGH TIDE.

* TIMING...NOW THROUGH SUNDAY EVENING.

* IMPACTS...WATER WILL LIKELY REACH THE DUNES AT THE TIME OF HIGH TIDE AND POSSIBLY CAUSE MINOR BEACH EROSION. VEHICLES DRIVING ON THE BEACH MAY BE SIGNIFICANTLY IMPACTED AND POSSIBLY HALTED AT TIMES. FREQUENT LIFE THREATENING RIP CURRENTS ARE EXPECTED. THE SURF IS EXPECTED TO BE DANGEROUS FOR ALL LEVELS OF SWIMMERS.



Coastal Flood Product Issuance

- ❖ Our office notifies:
 - ❖ Emergency managers
 - ❖ Beach patrol
 - ❖ National Seashore
 - ❖ TXDOT
 - ❖ Decision makers



Coastal Flood Product Issuance



National Weather Service
Corpus Christi, Texas



...Coastal Flood Advisory in Effect From 8 PM Saturday Until 4 AM Sunday...

Briefing:

Easterly flow overnight, albeit weak, will aid in bringing high tide levels to Padre and Mustang Islands. This may lead to minor coastal flooding during tonight's high tide cycle.

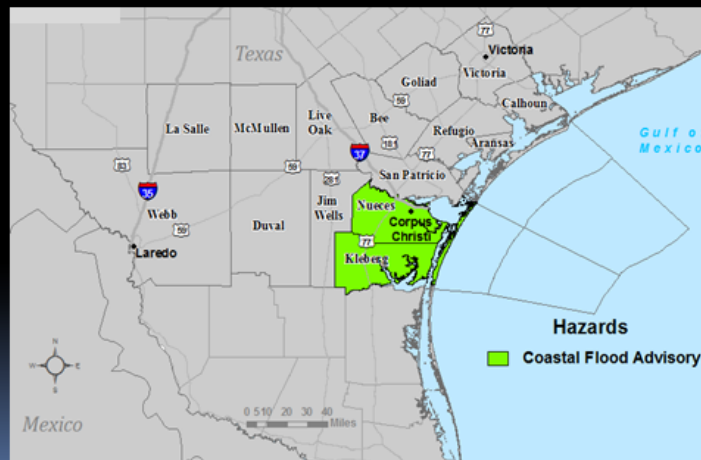
Impacts:

- Water may reach the dune line along Padre and Mustang Islands.
- Driving along area beaches may become difficult to impossible.
- Beach access roads may become flooded.



Coastal Flood Advisory

In Effect from 8pm-4am Tonight



Impacts:

- Peak water levels ~2 ft above Mean Sea Level during tonight's high tide cycle
- Minor impacts to beaches along Padre & Mustang Islands
- Water to dune lines
- Driving along beaches to become nearly impossible

Issued at 2:39 PM - October 22, 2016

Additional Information Resources:

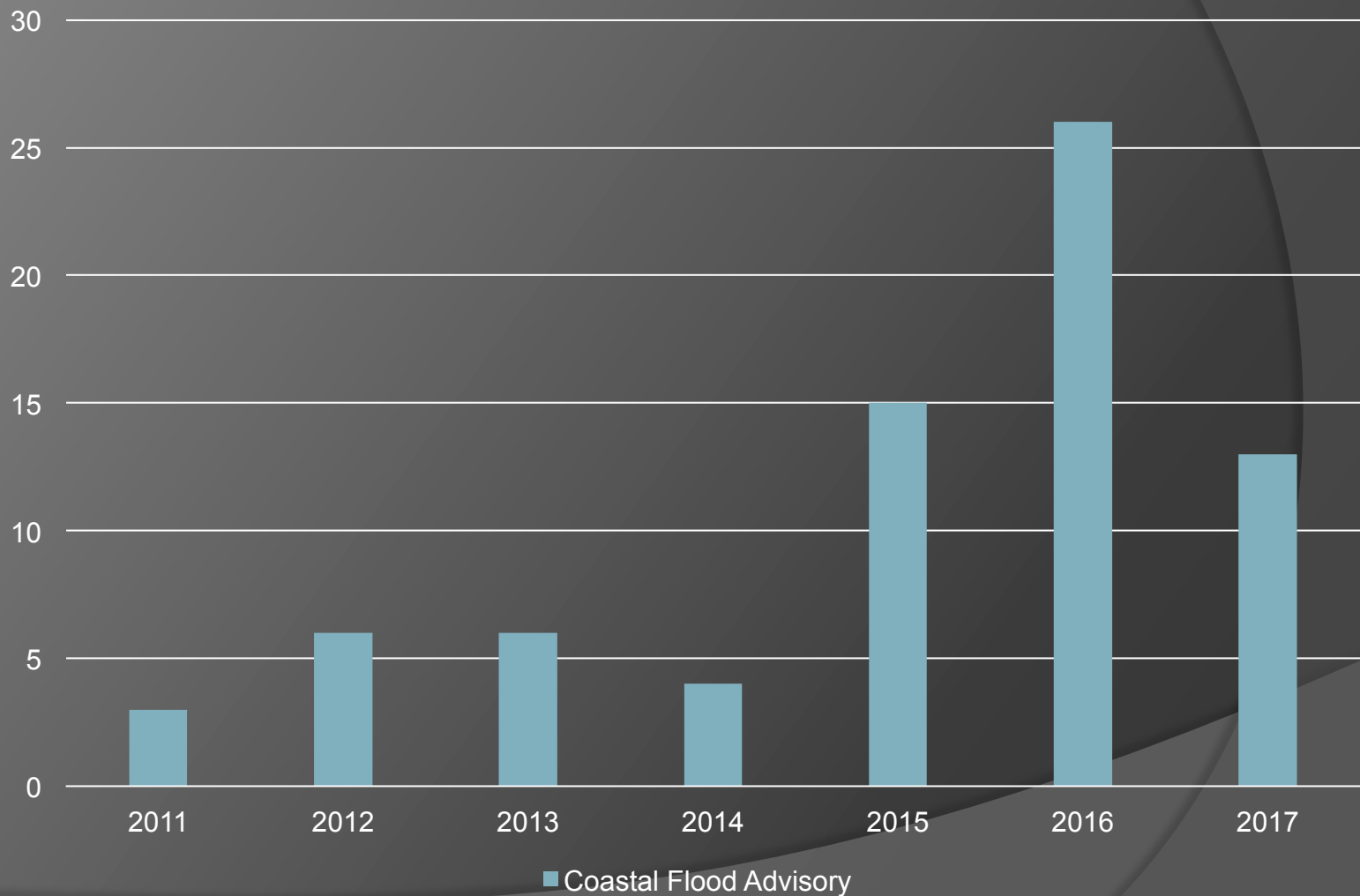
NWS Corpus Christi Contact Numbers: [888-579-9731](tel:888-579-9731) or [361-289-0725](tel:361-289-0725)

NWS Corpus Christi Tide Webpage: <http://www.weather.gov/crp/tides>



Coastal Flood Products

Coastal Flood Advisories Issued





What's Occurred Recently?

- ❖ Frequency of flooding from non-tropical systems has increased
- ❖ Beaches along Port Aransas are flooding more frequently
- ❖ North Beach has experienced an increase in frequency of impacts
- ❖ Public taking greater notice of coastal flooding





Challenges we face

- ❖ Many events are marginal
 - ❖ May only briefly experience nuisance flooding
 - ❖ Do we issue advisories?

- ❖ Lack of reports/
 - ❖ Conditions are prime for flooding, but is it really occurring?

- ❖ Related to sea-level rise?

Questions?

Robert.hart@noaa.gov

Office: 361-289-0959

