

Time Series Analysis of Cedar Bayou



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Introduction

Cedar Bayou is a natural pass that provides a connection between the Gulf of Mexico and Mesquite Bay which in turn connects to San Antonio Bay and Aransas Bay, and separates Matagorda Island and a huge washover fan and tidal delta complex of San Jose Island.

Cedar Bayou serves as a migratory route between the bay and the Gulf for different organisms and water quality. The pass helps fish habitat within Mesquite Bay that could adversely affected by long term increase in salinity. The connection of Cedar Bayou to Vinson Slough increases wetland area with the connection to huge washover fan and tidal delta complex of San Jose Island.

The back-island configuration of Cedar Bayou has remained relatively stable while the beach zone is remarkably changed. Due to natural processes and human activities, the flow through CB has decreased and has been considered open and closed regularly, before it has completely closed in 2008.

Objective of the Study

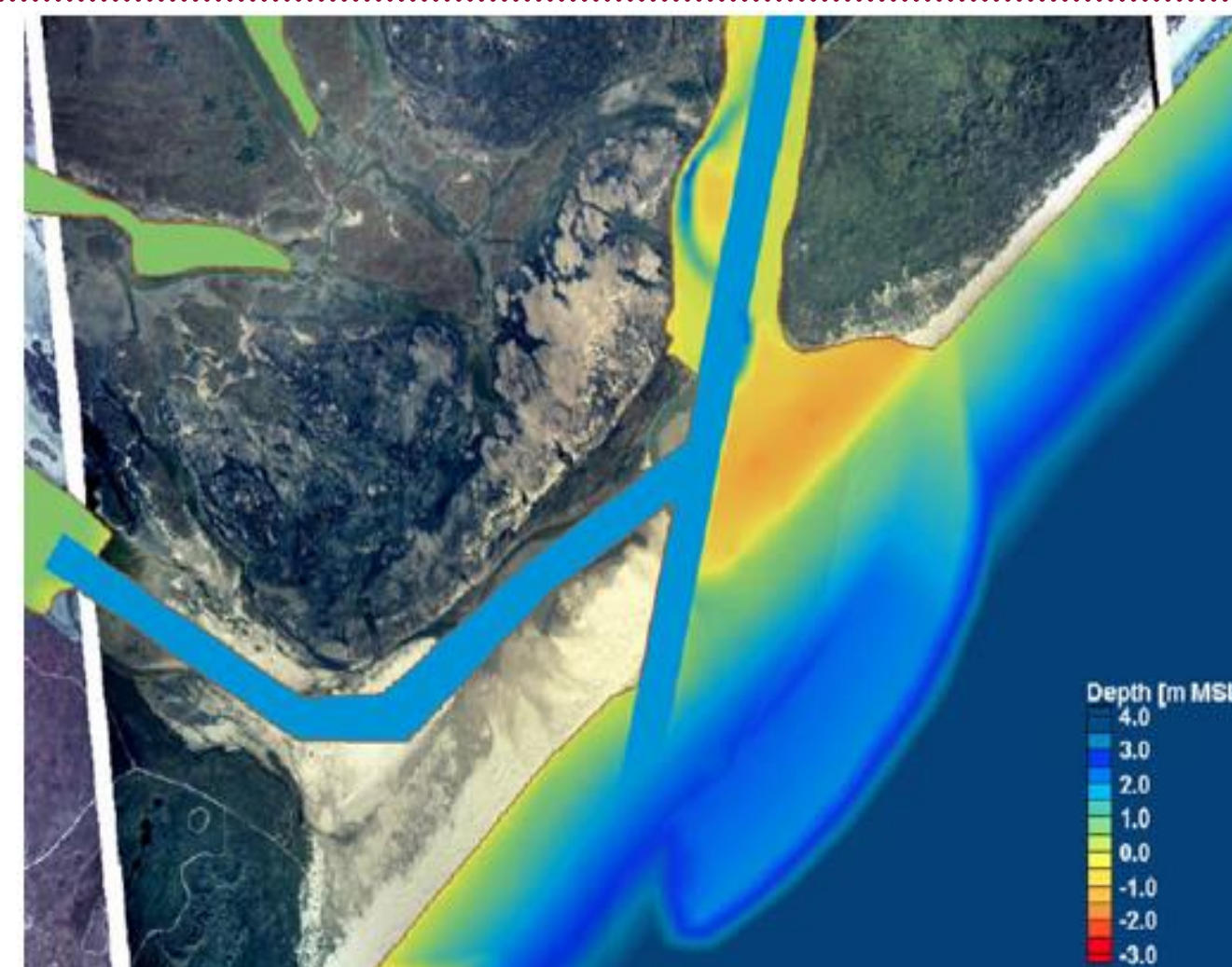


Figure: Layout of the mouth of Cedar Bayou: Dredge Cedar Bayou to Gulf, dredge Vinson Slough to Cedar Bayou with deeper cut

(Source: Shepsis and Carter(2007))

The main objective of this study is to understand if Cedar Bayou stays open:

- Based on morphologic responses of the pass to past processes
- What happened in the past?

Coast and Harbor Engineering (2005) approach to restore Cedar Bayou to it's original state:

- Dredge a straight Cedar Bayou connection to the Gulf, connection to Vinson Slough, and reconstruction of the submerged ebb shoal with dredged material
- Hypothesis 1: Reconnecting Cedar Bayou and Vinson Slough, and constructing an ebb shoal offshore of the inlet mouth with dredged material would help sediment bypassing and reduce sedimentation in the Cedar Bayou inlet mouth.
- Hypothesis 2: Connecting Vinson Slough to Cedar Bayou increases flow into both channels and increases the velocity that helps to make the channel stable by flushing the mouth of sediment.

Study Area: Location



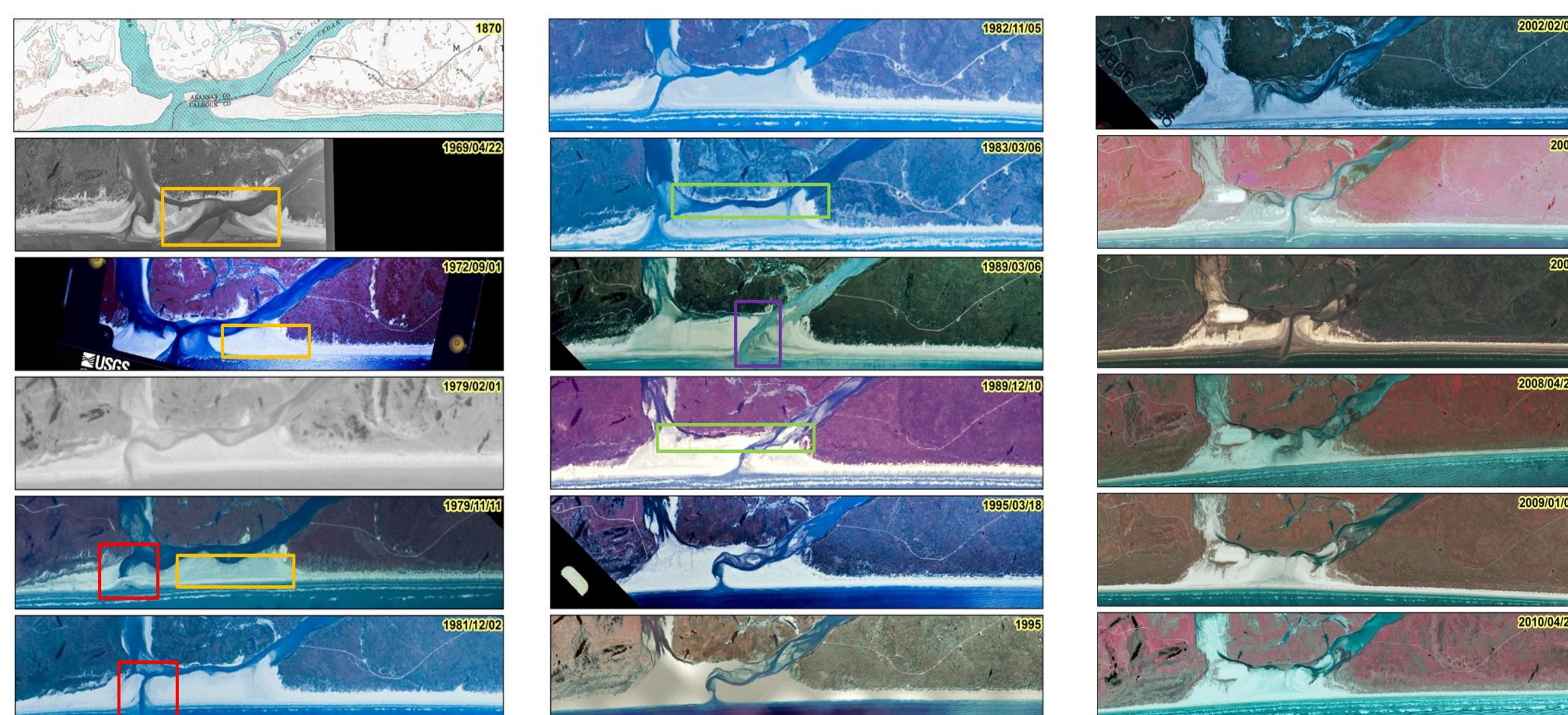
Figure - The study area is Cedar Bayou that is located in Aransas County near Rockport, Texas, which separates St. Josephs Island from Matagorda Island.

Data Used

- Aerial Imagery (1860-2010) – Total 18 aerial photographs from 1860 to 2010
- River discharge data (1939-2013) – Daily for Mission River and Copano Creek in cubic feet per second
- Tropical Storm and Hurricane data (1851-2013) – IBTrACS data in Knot
- Tide data (1963-2013) – Hourly tide height in meter
- Wave Hindcast data (1956-1999) – 3-hourly Significant Wave Height in meter
- LiDAR and Historical Shoreline (1860-2012) – Shoreline extraction for 9 years from 1860 to 2012

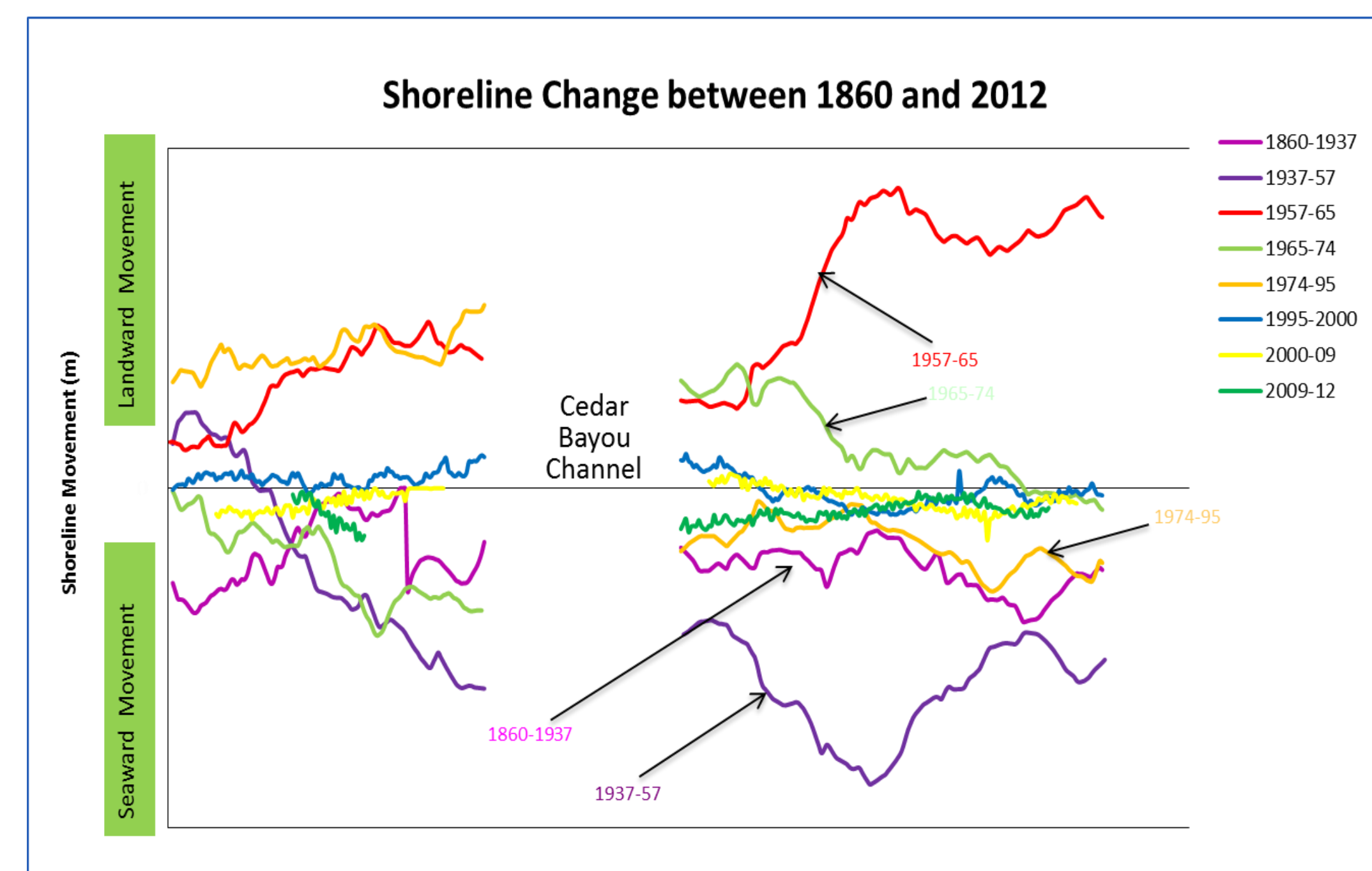
Results

Aerial Photographs: Throat Width Calculation



Date	Throat Width (meter)	Observation
1870	480	Significant connection between CB and VS, single channel to the Gulf
4/22/1969	415	Separate channels from both CB and VS; CB and VS connected
9/1/1972	425	Channel move westward from CB and VS merged as a single channel to the Gulf
2/1/1979	70	Small channel between CB and VS, channel has further shifted towards VS
11/11/1979	CLOSED	Closed by sand berm to prevent pollution from Ixtoc I oil spill (June 1979)
2/12/1981	58	No more sand berm, very small opening to the Gulf; small connection between CB and VS
11/5/1982	45	CB and VS still connected but even smaller channel from VS than 1981, the island on the mouth of VS has increased and the pass has moved slightly westward than 1981
3/6/1983	65	Increasing seashore mouth width, slightly wider channel to the Gulf than 1982
3/6/1989	60	Dredged in June 1988 that shifted the pass toward CB and completely closed along VS, very small connection between CB and VS
12/10/1989	32	Throat width reduces even more with barely connection between CB and VS
3/18/1995	40	Almost no connection between CB and VS
2/7/2002	CLOSED	Closed, although 300,000 cu yards dredged in 1995 and hurricane in 1999
2004	40	Narrow channel and low water level, hurricane Claudette in 2003 could have opened the channel
2005	90	Could be the result of hurricane Emily in 2005 as it looks like high tide event
4/28/2008	CLOSED	Drainage channel can be seen
1/8/2009	CLOSED	No channel at all
4/28/2010	CLOSED	No channel

Shoreline Change



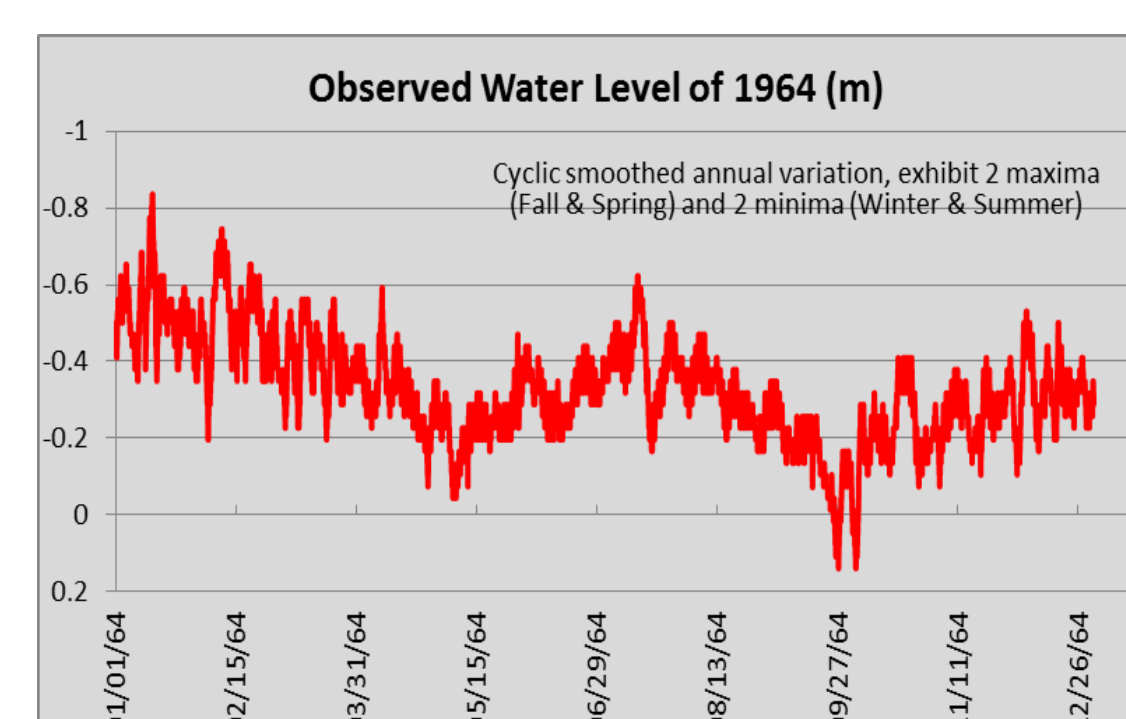
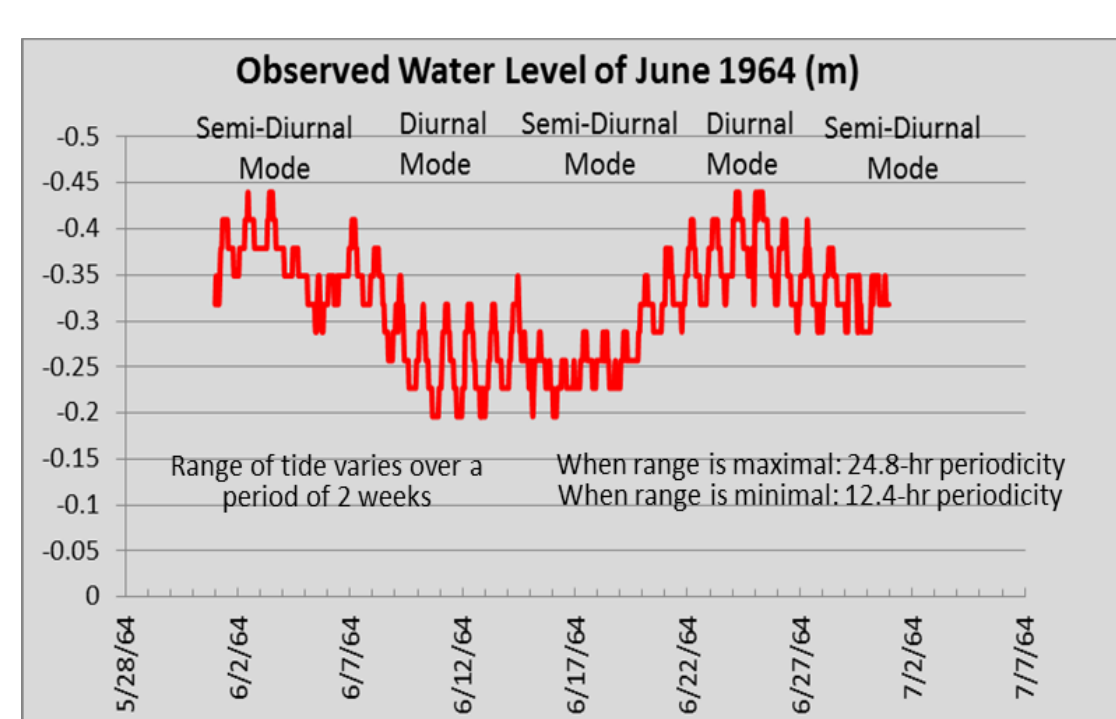
Tide Effect

Gulf of Mexico seafront tide is described by 12.4-hr semidiurnal and 28.4-hr diurnal tide, and 13.6 day fortnightly cycle and semi-annual mode of tide.

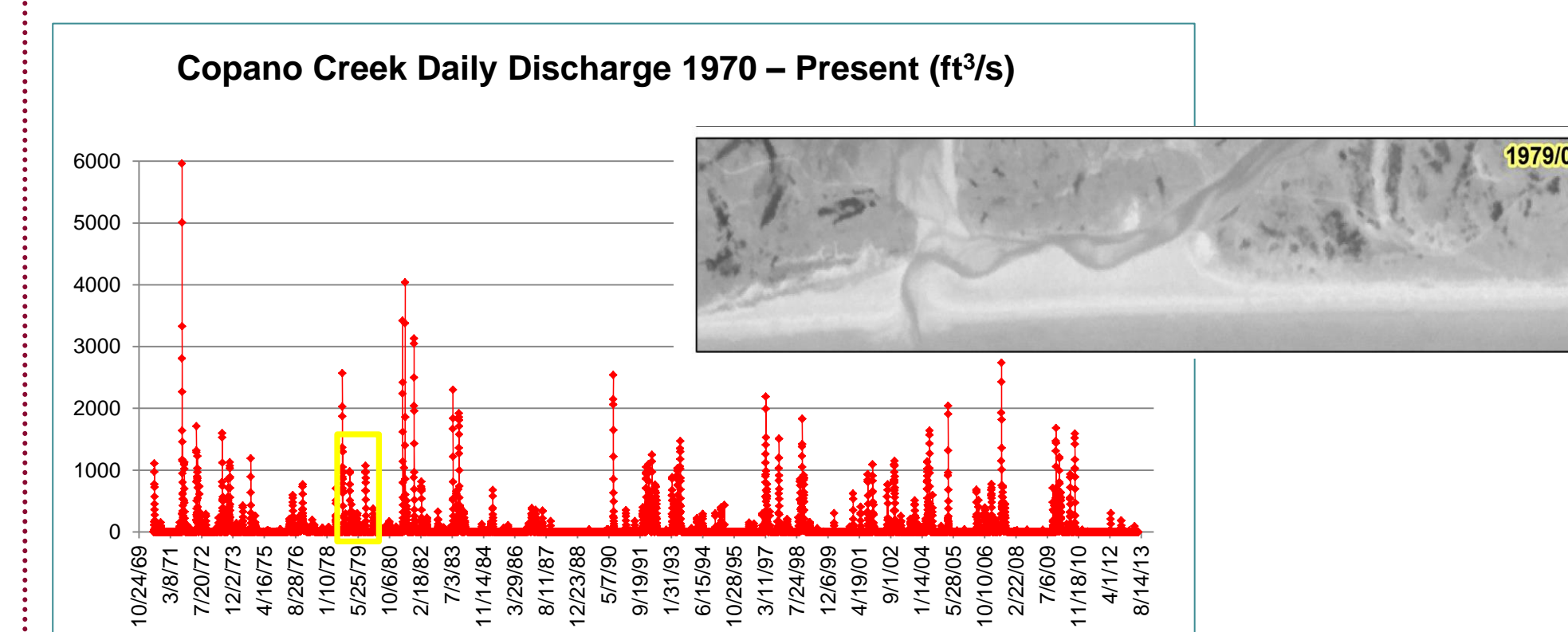
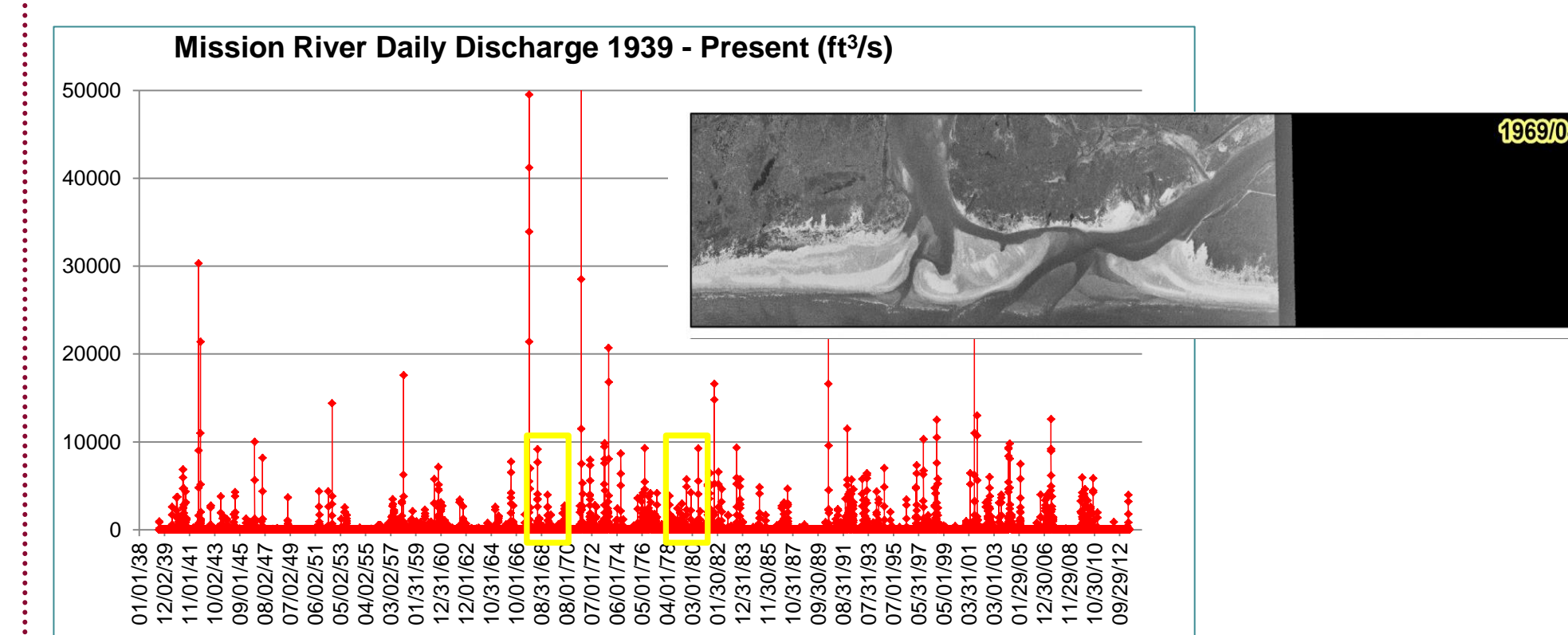
The slower, longer-period variations (fortnightly and semi-annual tides) are likely to pass through the inlets but the shorter-period variations are significantly filtered.

Stilling well effect: Inlet acts as a small port that connects a large oscillating chamber of water to smaller chamber in co-oscillation.

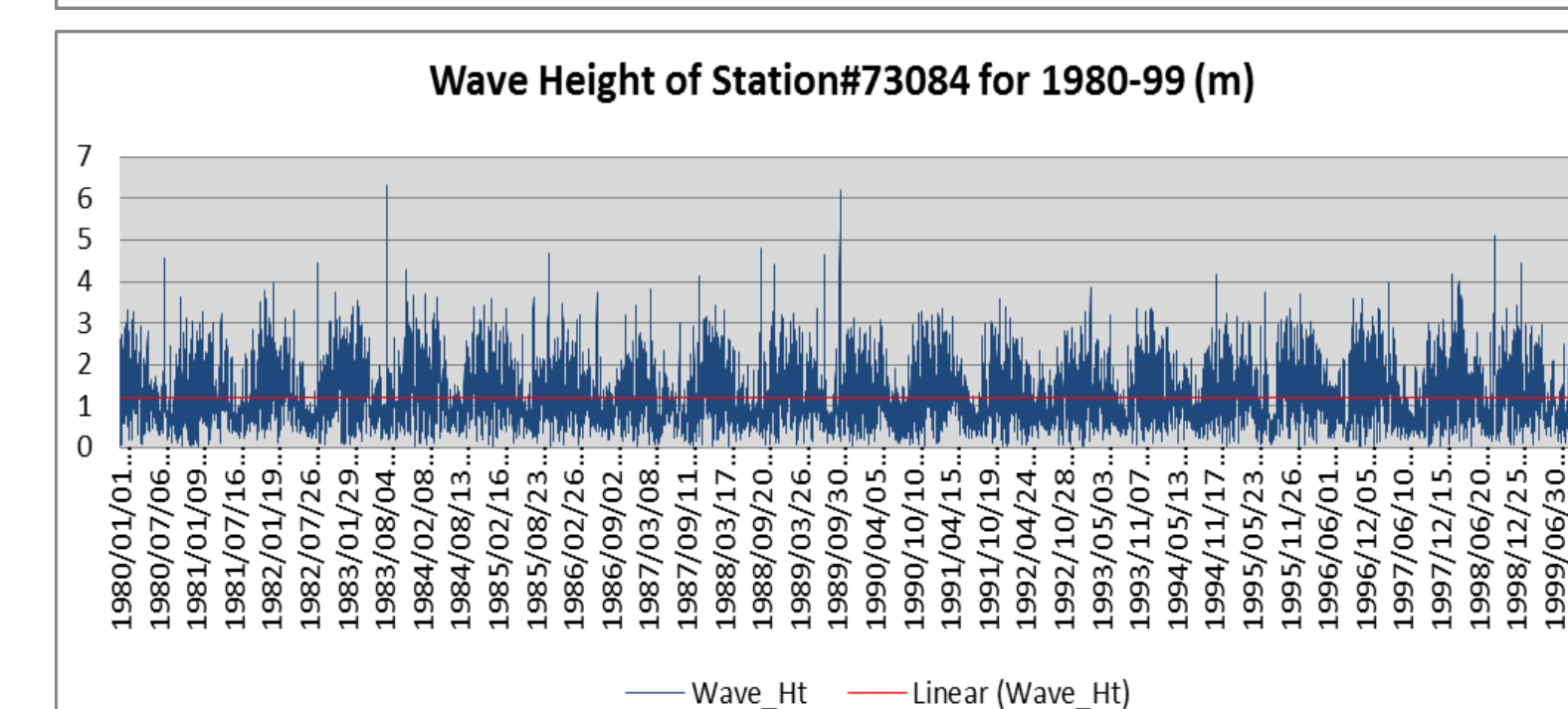
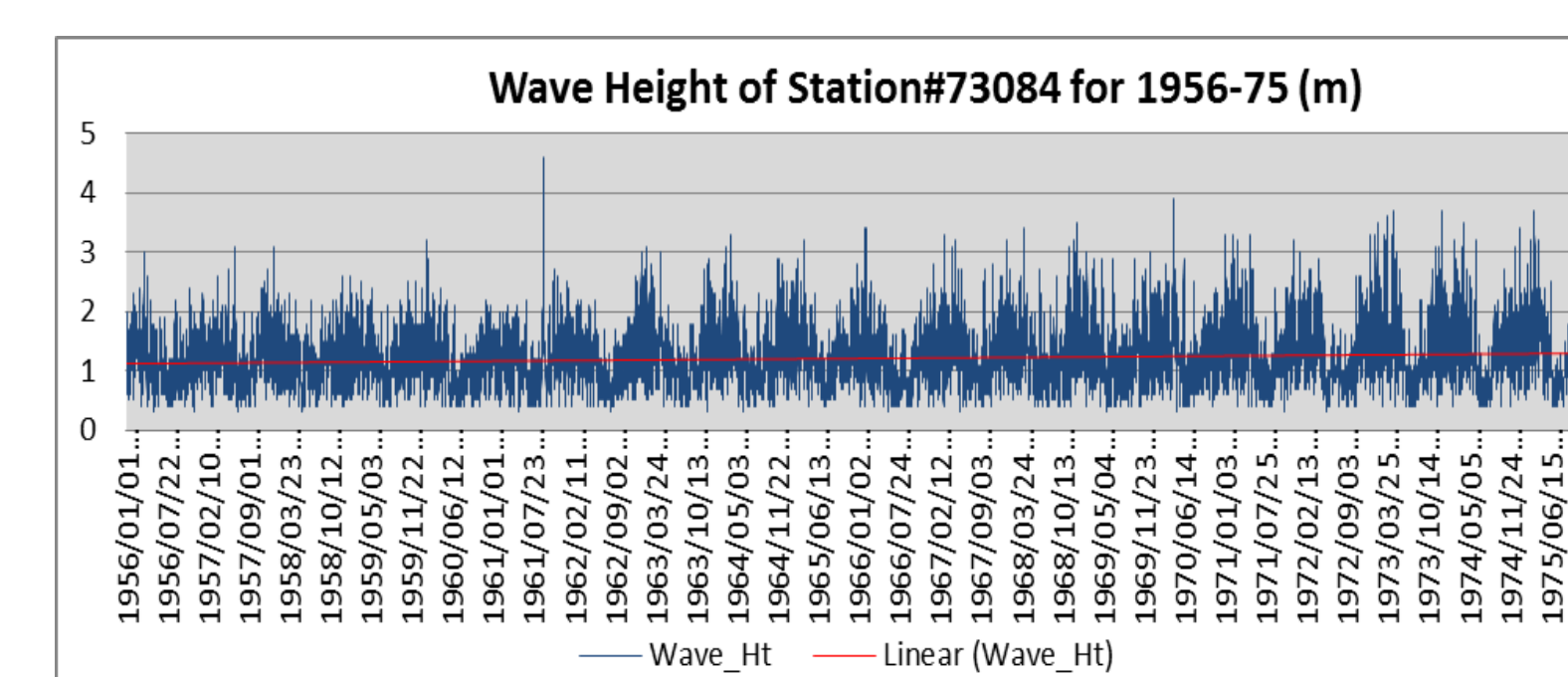
The tide in the Gulf loses most of its energy as it passes through the inlets.



Surface Water Discharge



Wave Hindcast



No significant difference in wave height over time.

Conclusions

For Cedar Bayou to remain open:

- Need of sufficient channel flow to remove sediments deposited in the channel by longshore drift

From our observations,

- The "stilling well" effect reduces tidal energy when passing through the channel.
- The fresh water discharge into the bay is not able to maintain the opening.
- The occurrence of large hurricanes and dredging activities have historically played a major role in the opening/closing of Cedar Bayou.
- However, variations in non-storm tide and wave energy are not strongly related to the opening/closing of Cedar Bayou.

Concerns regarding the project plan:

- Vinson Slough is only dredged to connect Cedar Bayou channel which would only connect Aransas Bay during high tide.
- The claim that the ebb delta was present cannot be verified.
- Need of jetties and continuous maintenance dredging
- Environmental impacts

References

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Tropical Storms and Hurricanes

