AN EVALUATION OF TIDES IN THE CARIBBEAN

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OVERVIEW

- Introduction
- Tides
- Tidal Constituents
- Tides In The Caribbean
- Conclusion

INTRODUCTION

The Caribbean Region

INTRODUCTION

- It is necessary to understand the nature and pattern of the tides in the Caribbean Sea, as this will allow for more efficient protection and sustainable management strategies.

INTRODUCTION

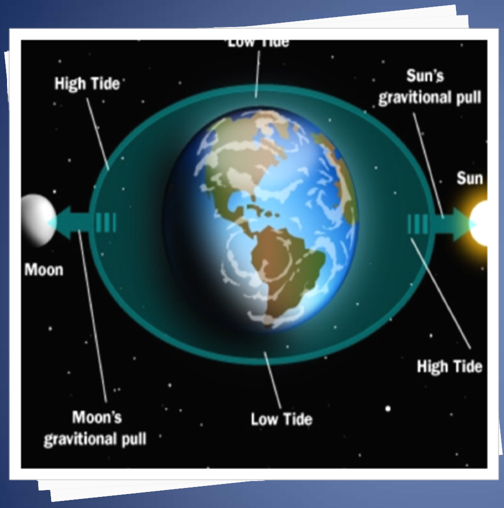
Purpose of Evaluation:

- Development of a methodology for vertical separation models in the Caribbean
- Benefits:
  - ✓ seamless data integration across the land sea interface
  - ✓ tide gauge-free geophysical surveys
  - ✓ establishing a link between vertical datums in the Caribbean
  - ✓ asset for sustainable coastal zone management

INTRODUCTION

- The Caribbean sea as has a microtidal range
- Shallow water current meter records indicate the importance and sometimes dominance of tidal motions in the Caribbean
- Evaluating the tides in the Caribbean Sea is an important step in developing a methodology for vertical separation models in the Caribbean region

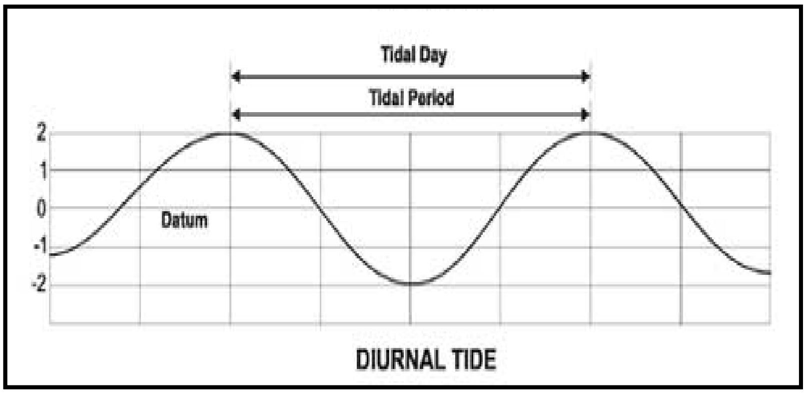
TIDES



Shallow water waves which results in the vertical displacement of the sea level as a function of astronomical argument

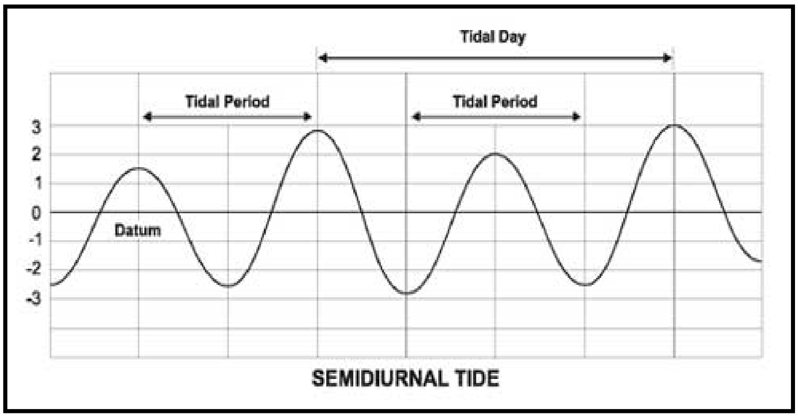
TIDES

Diurnal Tide



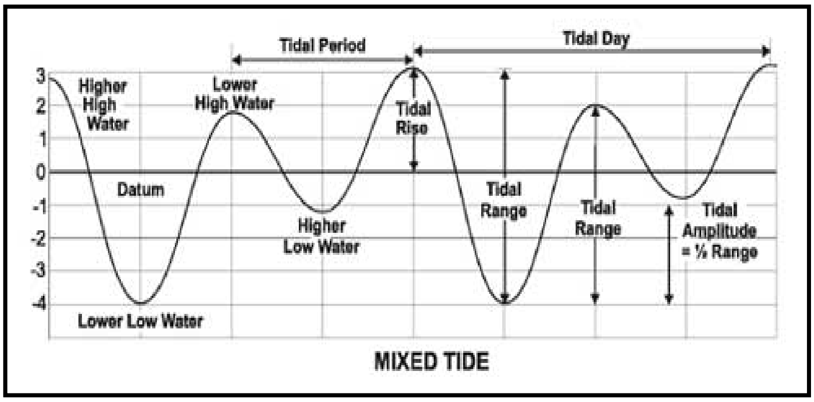
TIDES

Semidiurnal Tide



TIDES

Mixed Tides



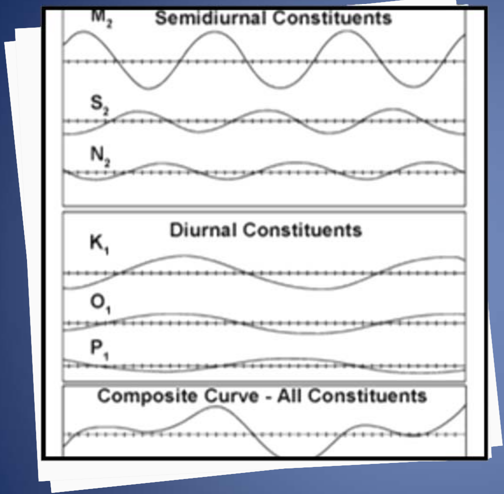
TIDAL CONSTITUENTS

- Tidal changes are the net result of multiple influences that act over varying periods.
- Each tidal constituent is defined by its period in mean solar hours or alternatively by speed in degrees per mean solar hour.

TIDAL CONSTITUENTS

TIDAL CONSTITUENT (DARWINIAN)	PERIOD (SOLAR HOURS)	SPEED (DEGREES/HOUR)	NATURE
M_2 (principal lunar)	12.42	28.984	Semi-diurnal
S_2 (principal solar)	12.00	30	Semi-diurnal
N_2 (larger lunar elliptic)	12.66	28.439	Semi-diurnal
K_1 (luni-solar declinational)	23.93	15.041	Diurnal
O_1 Principal lunar declinational	25.82	13.943	Diurnal
P_1 principal solar declinational	24.07	14.958	Diurnal

TIDAL CONSTITUENTS



The extended tidal measurements at a given point result in a dataset that is a combination of these constituents for the given time period.

TIDAL CONSTITUENTS

Form Number

- The form number (F) or the amplitude ratio, is used to determine the best description of the tide in an area. (Defant 1961).

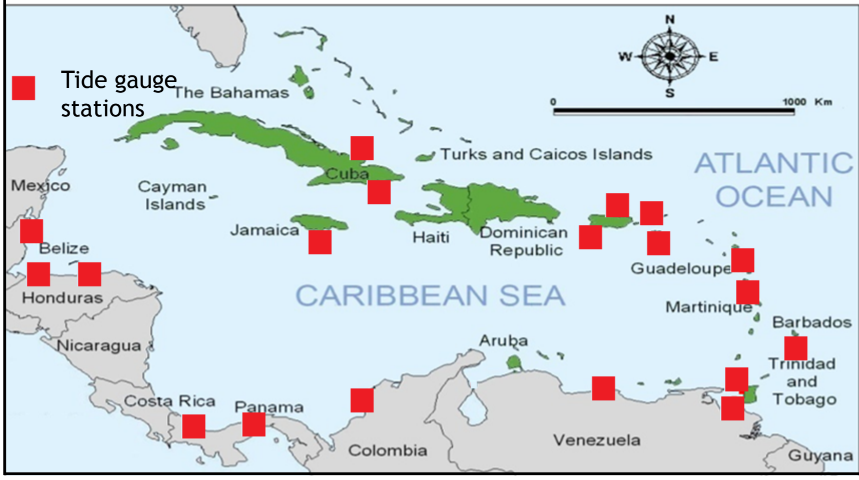
$$F = (K1 + O1)/(M2 + S2)$$

$F < 0.25$	Semi-diurnal
$0.25 \le F < 1.5$	Mixed primarily semi-diurnal
$1.5 \le F < 3$	Mixed primarily diurnal
$F \ge 3$	Diurnal

TIDES IN THE CARIBBEAN

Description Of Tidal Data Sets

- Constituents were obtained from 19 tide gauges located in 15 countries in and around the Caribbean Sea.



TIDES IN THE CARIBBEAN

Description Of Tidal Data Sets

Country	Data Period (years)	Length Of Datasets (years)
Panama	1907-1978	71
Colombia	1951-1993	42
St Thomas	1978-2001	23
Honduras	1948-1968	20
St Croix	1982-2001	19
Puerto Rico	1985-2001	16
Cuba	1937-1948	11
Venezuela	1985-1994	9
Guadeloupe	1991-1998	7
Trinidad	1984-1992	8
Costa Rica	1976-1981	5
Martinique	1976-1979	3
Barbados	1993-1996	3
Jamaica	1965-1968	3
Belize	1964-1967	3

TIDES IN THE CARIBBEAN

SEMI-DIURNAL CONSTITUENTS

CONSTITUENT	AMPLITUDE RANGE	EXCEPTIONS	AGREEMENT WITH Kjerfve (1981)
M_2 Principal lunar	Generally $M_2 \leq 100$mm	Cuba, Puerto Rico $M_2 \approx 200$mm. At Trinidad $M_2 >$ 400mm	Agrees
S_2 Principal solar	Generally $S_2 < 50$mm for most of the sea	Barbados and Trinidad, $70\text{mm} < S_2 < 140\text{mm}$	Same exception at Trinidad noted. $20\text{mm} < S_2 < 50\text{mm}$ uniform throughout
N_2 Larger lunar elliptic	$20\text{mm} < N_2 < 40\text{mm}$ for most of the stations.	Trinidad $N_2 \approx 90$mm, St. Thomas and Puerto Rico 8.8mm and 2.7mm.	Agrees

TIDES IN THE CARIBBEAN

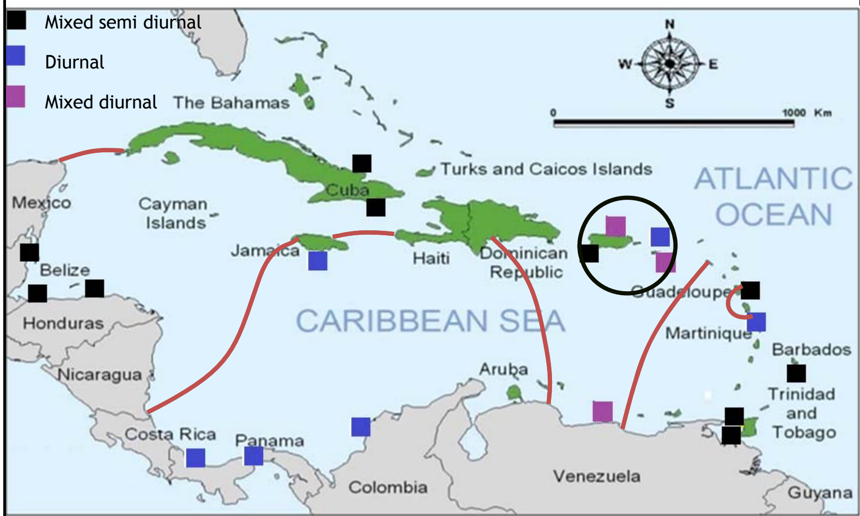
DIURNAL CONSTITUENTS

CONSTITUENT	AMPLITUDE RANGE	EXCEPTIONS	AGREEMENT WITH Kjerfve (1981)
K_1 Luni solar declinational	For Honduras, Belize, Jamaica and Cuba $20\text{mm} < K_1 < 70\text{mm}$. Towards the eastern region $80\text{mm} < K_1 < 100\text{mm}$	Higher values were recorded in the south eastern region.	Agrees
O_1 Principal lunar declinational	$50\text{mm} < O_1 < 80\text{mm}$ for most of the Sea	Lower amplitudes were recorded in the western Caribbean Sea.	O_1 amplitudes agreed closely with the K1 values and were generally uniform for the region.
P_1 Principal solar declinational	$7\text{mm} < P_1 < 32\text{mm}$, with values gradually increasing towards the south.		Agrees

LOCATION	FORM NUMBER = (K1+O1)/(M2+S2)	TYPE OF TIDE
Jamaica	1.72	Mixed primarily diurnal
Puerto Rico (Magueyes)	7.67	Diurnal
Puerto Rico (San Juan)	0.92	Mixed primarily semi diurnal
St. Thomas	2.82	Mixed primarily diurnal
St. Croix	7.56	Diurnal
Cuba (Gibara)	0.45	Mixed primarily semi diurnal
Cuba (Guantanamo)	0.56	Mixed primarily semi diurnal
Honduras (Puerto Castillas)	0.45	Mixed primarily semi diurnal
Honduras (Puerto Cortes)	0.51	Mixed primarily semi diurnal
Belize	0.44	Mixed primarily semi diurnal
Costa Rica	1.63	Mixed primarily diurnal
Panama	1.73	Mixed primarily diurnal
Colombia	1.72	Mixed primarily diurnal
Venezuela	3.24	Diurnal
Trinidad (Port of Spain)	0.42	Mixed primarily semi diurnal
Trinidad (Point Fortin)	0.34	Mixed primarily semi diurnal
Barbados	0.53	Mixed primarily semi diurnal
Martinique	1.97	Mixed primarily diurnal
Guadeloupe	1.11	Mixed primarily semi diurnal

TIDES IN THE CARIBBEAN

Types of Tides in the Caribbean



CONCLUSION

- The evaluation of tides in the Caribbean was carried out assessing astronomical constituents and form numbers.
- The tides of the Caribbean Sea can be described as mostly mixed; with some areas experiencing mixed primarily semi diurnal tides and others experiencing mixed primarily diurnal tides. A small region also experiences diurnal tides.

CONCLUSION

- Higher constituent amplitudes were generally noted in this study compared to previous study.
- These findings can now be integrated into the methodology for the development of vertical separation models for the Caribbean.

ACKNOWLEDGEMENTS

- Dr Keith Miller

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THANK YOU