Tidal variation in the west coastal area of Sri Lanka

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Abstract

The present study was carried out in an attempt to observe and analyze the tidal height changes due to the motion of the sun, moon and earth, in the west coastal area of Sri Lanka. Tidal height deviations from the Mean Sea Level (MSL) were measured every 15 minutes throughout the year 2015 using the tide pole installed in the sea, 100m away from Colombo Fort, which was built by the Hydrography Survey Unit of the Sri Lanka Navy. Using the obtained data, the behaviour of tidal waves was identified. The main tidal constituents were obtained using the Fast Fourier Transformation (FFT) and the Interpolation method. The mean value of the High Water Level (MHWL) and the mean value of the Low Water Level (MLWL) of the tides were then calculated for each month of the year. These mean values were used to update the Mean Sea Level (MSL). The main tidal constituents for each month were then used to identify the behaviour of tidal waves.

Keywords: **Semidiurnal tide system, Fast Fourier Transformation, Tidal constituents, Gaussian filtering, Spring tide**

I. INTRODUCTION

A tide is fundamentally caused by the gravitational interactions between the sun, moon and earth. These gravitational forces are the same as those which cause the moon and the earth to remain in their respective positions. The study of tide generating forces and the observed tides in space and time is a vast area. These tide generating forces are regulated by various terrestrial and extra-terrestrial factors. In general, research in this area considers the gravitational forces between the sun, moon and earth.

Sri Lanka is an equatorial country that experiences a semidiurnal tide system (two high tides and two low tides during the day and night). Tidal heights that are above the Mean Sea Level (MSL) were measured at 15 minute intervals during 2015 using the tide gauge built by the Hydrography Survey Unit of the Sri Lanka Navy and installed in the sea near the Colombo harbour. The analysis of the observed data was focused on updating the mean sea level and also on finding the main tidal constituents for future tidal level predictions, by collecting sea-level data on a regular basis.

II. METHODOLOGY

Data obtained during the period of the twelve months of 2015 in the coastal area of Colombo in Sri Lanka were used to identify the behaviour of tidal waves. The Mean High Water (MHW) and Mean Low Water (MLW) levels were obtained relative to the Mean Sea Level (MSL) for each day, and the average value of the difference of the MHW and the MLW was calculated for each month. These data were used to update the MSL.

The values of tidal constituents were obtained according to the Fourier Transformation and Interpolation method. The Gaussian filtering method was used for data filtering. The Fourier Transformation was used to transform the periodic signal into a set of simpler signals. Interpolation was used to find the values in between consecutive sample frequencies. A Tidal Analyzing Tool (TAT) was created by the authors in order to find the tidal constituents and this can be used in future analyzing processes (Munasinghe and Gunasekera 2016).

III. RESULTS

The spring tide water level range was about 0 - 0.7 meters and the neap tide water level range was about -0.4 to 0.2 meters from the MSL (1.562 m) during the year 2015. The MSL of 1.737 meters, calculated from 1st January, 2015 to 31st December, 2015 differed by 0.175 meters from the current MSL value of 1.562 meters. The main tidal constituents were calculated using a data set of twelve months obtained from 1st January, 2015 to 31st December, 2015. The TAT program was used for this purpose.

TABLE I

Calculated values of MHW, MLW with Average from the MSL (1.562 m) for the year 2015 in the Colombo coastal area.

Month	MHW	MLW	Avarage
Jan	0.4598	0.0168	0.2383
Feb	0.4678	-0.0120	0.2279
Mar	0.4514	-0.0059	0.2228
Apr	0.4273	-0.0333	0.1970
May	0.3699	-0.0943	0.1378
Jun	0.3793	-0.0585	0.1604
Jul	0.3067	-0.1641	0.0713
Aug	0.3257	-0.1504	0.0877
Sep	0.3685	-0.1242	0.1222
Oct	0.4446	-0.0754	0.1846
Nov	0.4565	-0.0503	0.2031
Dec	0.4290	-0.0536	0.1877