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# Single Point Ocean Current Measurements during two different seasons near Kalingapatnam region – Case Study

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**Abstract**

Oceanographic measurements play a key role on ocean engineering design, construction, operations, planning, and other marine related activities. Wind, wave, tide and ocean current are important and critical for the design and construction of near-shore structures like breakwater, wharf, jetty etc., and offshore structures like oil platforms & oil pipelines. As oceans are very active, powerful, and unpredictable, deploying meteorological equipment to collect accurate and reliable data is a challenging job. Also, the field studies in oceans are much more complex and costlier than laboratory/land studies. The oceanographic measurements generally consists of waves, ocean current, wind, , atmospheric pressure, turbidity, water vapor, temperature, water depth, radiation, conductivity, chlorophyll, dissolved oxygen, etc. Among these parameters, this study focuses to collect and analysis of ocean currents for duration of 16 days at one location for two different seasons in order to understand the movement of water speed and direction to determine the ocean energy environment.

***Keywords:*** *Current speed, Current direction, Ocean energy environment, single point current meters and Currents.*

## 1. Introduction

The oceanographic measurements generally consists of waves, ocean current, wind, , atmospheric pressure, turbidity, water vapor, temperature, water depth, radiation, conductivity, chlorophyll, dissolved oxygen, etc. The ocean water movements permit to predict the sediment transport, understand the mixing and transport process. Currents are the coherent horizontal movement of water. Long-shore currents run in one direction along the coast between the shore and breakers. These currents normally form circulatory patterns and makes the rip currents and returning to shore as it disperse its flow due to breaking waves. The long-shore currents are powerful when the waves are approaching at a greater angle from the perpendicular to shore with high energy. The high speed currents occur typically near water surface and nearer the breakers than the shore. Rip currents are usually narrow and can be experienced where a long-shore current encounters a physical barrier such as a breakwater, peninsula, long groin, near-shore reefs, or shoal, and is deflected lake ward. These currents also take place along an open-beach area where there is a smaller amount opposition to lake-ward flow, such as places where the breaking waves are lesser, or where there is a gap or trough in the near-shore sand bars.

The ocean current indicates a intricate mixture of aperiodic and aperiodic movement of water ranging from a broad scale of time, size and velocity. The current measurement techniques were described nearly fifteen years ago (Dobson et al., 1980).The current meters act as a vital role in measurement of ocean currents. The current measurement techniques have processed from mechanical sensors to electromagnetic, acoustic and optical sensors and systems. The development of recent bio-optical, acoustical and chemical sensors and systems bonded with the current measurement devices (Dickey, 1988, 1990, 1991, 1993a,b; Dickey et al., 1991, 1993a,b,c, ,1994,1997; Dickey and Siegel, 1993).A broad category of distinction can be made between single point and profiling sensors for ocean current measurement. The water transportation in the ocean may also be determined with the aid of drifters, tracked acoustically or positioned by satellite transmission. Monitoring the

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surface ocean current is greatest important for the transporters of salt and heat in ocean.Also the change on shore is associated with waves, tides ,winds, periodeic storms, sea-level change, geomorphological process(Van et al, 2009, Deepika et al, 2014).The morphological and structural studies of Indian coast indicate that the beach erosion and coastal properties damage are governed by seasonal waves (Jayappa et al, 2003,Avinash et al, 2013). The hydrodynamics of ocean was always influenced by the physical process. The transport of pollutants and mixing of sediments are extremely involved in tides and ocean current studies(Shynu et al,2015, Van der Molen,2009). The ocean current pattern along the east coast and existing current pattern along the west coast of India is known as East India Coastal Current(EICC) and West India Coastal Current(Shankar et al,2002). The oceanographic conditions in the southern tip of India are very dynamic due to interaction of currents ( Gurumoorthi and Venkatachalapathy,2017).This present study focuses on ocean current measurements to determine the ocean energy environment near Kalingapatnam coast, Andhra Pradesh.

climate studies which are the major

## 2. Study Area

Kalingapatnam is a village in Srikakulam district of Andhra Pradesh in Indian State. It is located in Garamandal of Srikakulam revenue division and falls in geographical coordinates 18.3387° N and 84.1211° E. It has one of the major beach sand deposits in the state. This is the place where river Vamsadhara enters into Bay of Bengal. The coastal stretch beyond Vishakhapatnam does show any major coastal developments till border of Odisha state. The coastline till the limit of Gopalpur port has no fishing harbours. As the trawler type of fishing boats can only be berthed in jetty or wharf sheltered by breakwaters, the fishermen in this region are using small fishing boats which can be berthed on shore or rivers due to unavailability of fishing harbour in this stretch of 240 km. Similarly, the commercial activities are also minor in these regions. Hence, this study has been focused to identify a suitable zone for coastal development between Vishakhapatnam and Gopalpur. Accordingly, the coast off Kalingapatnam has been taken for the investigations. The current meter has been deployed at a depth of 5 meter and at the distance of 3 km from the mouth of the river. The location of study area satellite image is shown in Fig. 1

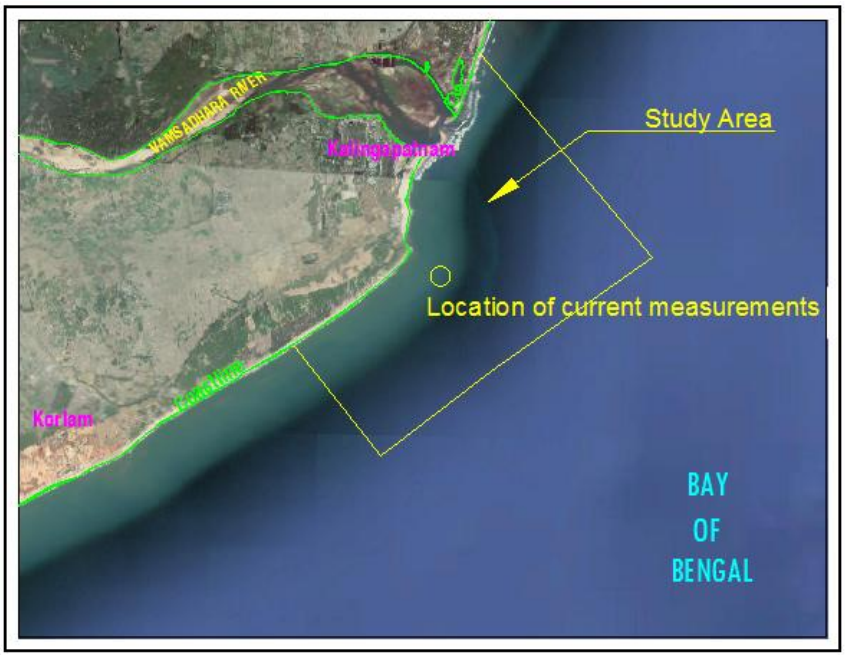


Fig. 1. Study area and location of Current measurements during pre and post monsoon season

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## 3. Data and Methodology

The current measurement was carried out at one location for two seasons using a single point, rotor type current meter. A rotor current meter (RCM) is a mechanical current meter which uses a propeller to measure the current speed and magnetic compass to measure the current directions. The gimbal rings of the RCM-instruments allow compensating a tilt of up to 40° of the mooring line. The current meter is ideal for use in rivers and coastal applications, or from small boats, this can be operated with either the Windows based PC software supplied, or an optional dedicated display unit. The temperature and pressure also sampled at every second over the averaging period in some models. In this study, the current measurement was carried out using the Vale-Port Directional Current Meter Model 106 which is a light weight impeller type current meter, designed for real time current measurement or short to medium term autonomous deployments. It also includes the high impact styrene impeller type with the pitch range of 0.03 to 5 m/s at the rate of accuracy as ±1.5% of reading above 0.15m/s for the current speed observation. For the current direction measurement flux gate compass with a range varies from 0° to 360° at the rate of ± 2.5° accuracy with a resolution of 0.5° is used. During deployment, the instrument was checked for all preliminary recording parameters such as battery voltage, data storage, recording interval and other software configurations. The deployment date, time and data logging interval were noted on log sheet. Trimble DGPS system was used to navigate the boat to planned location of measurements. The unit was pinged and data logging were confirmed though appropriate software installed on laptop. Appropriated mooring was performed and instrument hanged at a water depth of 3 m from the watch-keeping boat. The data was retrieved after 16 days and processed using Vale-port software. Devar et al., has used the Doppler current profiler (ADCP) for the water column velocity measurements by mounted on a surface buoy with a downward-looking of 300-kHz. The velocity records also get the preference of the surface wave induced vertical records (Pollard 1973). This type of instrument has the titanium construction which ensures the durability and the optional temperature and pressure sensors to increase the versatility of the devices.

## 4. Results and Discussions

In the present study, the current measurements were observed for pre-monsoon study between 16th March 2018 and 4th April 2018. The pre-monsoon current data shows that the speed of current is 0.01m/s in the beginning and it increases gradually till 0.27 m/s in the early morning hours of second day observation. The speed of current started decreasing gradually till 0.05 m/s in the noon hours of the same day (Fig. 2). The rise and falls stared continuing till end of the observed period with a random time interval. The fluctuation of rise and fall could be the reason of tidal influence. The maximum rise in current speed is observed during 18th March, 00:00 hours. The directions of currents are mainly remained between 0° and 90°. According to polar plot (Fig. 3), the currents are running in the North-East and South-

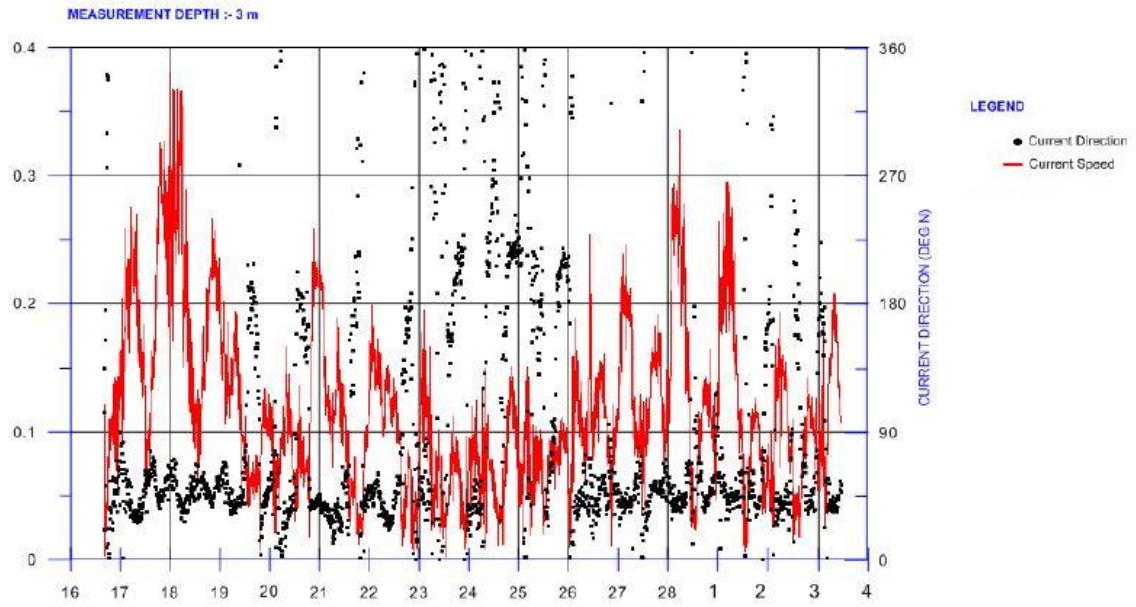


Fig. 2. Current speed and Direction during Pre-monsoon season

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West direction. The overall study during pre-monsoon demonstrates that the current speed seems to be varied up to the maximum of 0.37 m/s and the minimum lies at 0.05 m/s. The average current speed noticed during post monsoon is 0.12 m/s and the average direction calculated for these periods is about 120°.The polar chart explains that the current direction varies between 30° to 75° for the current speed of almost 0.3 m/s. As the current direction determines the direction of sediment transportation, the sediment movement could be the direction between 30° to 75° during pre-monsoon.

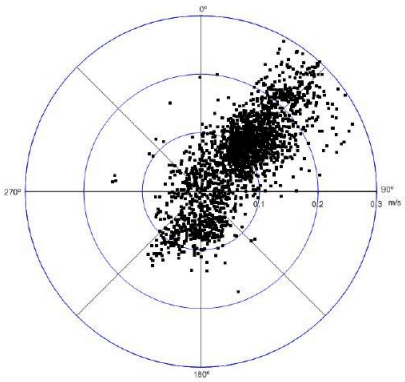

Fig. 3. Distribution of Current speed and Direction during pre-monsoon season

The post-monsoon current measurements were carried out between 16th December 2017 and 04th January 2018 in the same geographical locations where pre-monsoon currents measured. The current data during this season shows that the current reaches the maximum speed of 0.28 m/s and the minimum lies near 0 m/s after monsoon (Fig. 4). Like pre-monsoon, the current speed appears to be rise and fall with random time intervals. The current direction mainly varies between 120° to 360° for the current speed 0.1 m/s to 0.2 m/s. The average current speed noticed during post monsoon is 0.12 m/s and the average direction calculated for these periods is about 120°. From the polar chart (Fig. 5), it is understood that the current direction is almost scattered many directions with lesser energy. When compare to pre and post monsoon currents, the current speed almost shows the same range. But the direction appears to be in a narrow range during pre-monsoon; whereas, the direction during post-monsoon seems to be in the range of various angles.

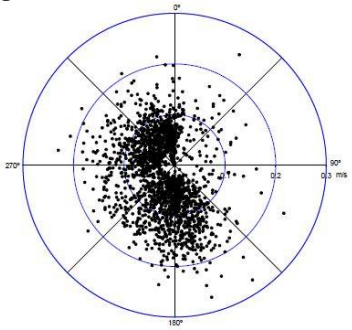

Fig. 5. Distribution of Current speed and Direction during Post monsoon season

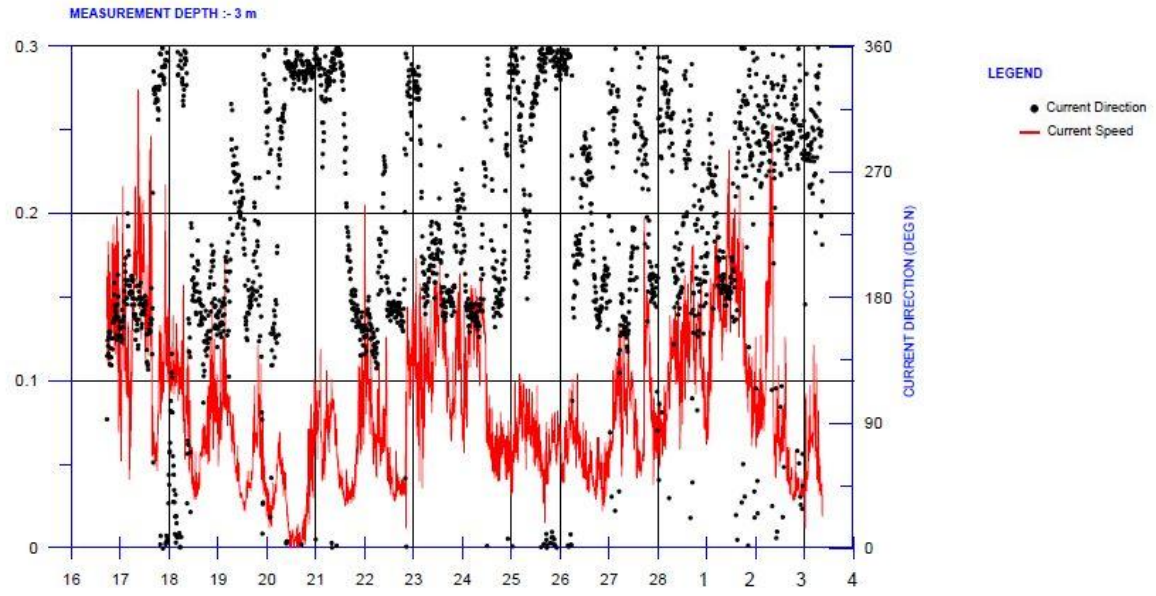


Fig. 4. Current speed and Direction during Post monsoon season

## 5. Conclusion

The study concludes that the near the shore water moves horizontally which is mainly caused due to the vertical motion of tide in the near-shore as per per-monsoon study. The near-shore current is noticed as rectilinear current as the flood currents occur due to the tidal current, moves landward or in to the river and the ebb-currents occur when the water moves seaward. Since the sediment movement and deposition depend on current speed and direction, it can be clearly understood that the area is not considerably active on sediment movement. Also, further study on numerical modeling is essential to have the exact prediction on sediment movement which determines the near shore geomorphological conditions to make decisions on coastal engineering.

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## References

[1] Avinash, K., Deepika, B. and Jayappa, K. S., 2013, Evolution of spit morphology; a case study using remote sensing and statistical based approach. J. Coast. Conserv. 17, 327–337.

[2] Deepika, B., Avinash, K. and Jayappa, K. S., Shoreline change rate estimation and its forecast; remote sensing, geographical information system and statistics based approach. Int. J. Environ. Sci. Technol., 2014, 11(2), 395–416.

[3] Dever, E. P., C. E. Dorman, and J. L. Largier, 2006: Surface boundary-layer variability off northern California, USA, during upwelling. Deep-Sea Res. II, 53, 2887–2905, doi:10.1016/j.dsr2.2006.09.001.

[4] Dickey, T.D., 1988. Recent advances and future directions in multi-disciplinary in situ oceanographic measurement systems. In towards theory on a biological and physical interactions in the world ocean, B. Rothchild, ed. Kluwer, Dordercht, The Netherlands, pp.555-598.

[5] Dickey, T.D., 1990. Physical-optical-biological scales relevant to recruitment in large marine ecosystems. In Large Marine ecosystem: Patterns, Processes, and Yields, K. Sharman, L. M. Alexandar and B.D. Gold, eds. American Association for the Advancement of Sciences, Washington, D.C.,pp.82-98.

[6] Dickey, T.D., 1991. The emergence of concurrent high-resolution physical and bio-optical measurements in the upper ocean and their applications.Rev.Geophys.,29,383-413.

[7] Dickey, T.D., 1993a. Technology and related developments for interdisciplinary global studies. Sea Tech-nol.,34(8),47-53.

[8] Dickey, T.D., 1993b. Sampling and Observational Systems, Globec Report 3, Globec-International, Chesapeake Biological Laboratory, Solomons, Md., 99p.

[9] Dickey, T.D and D.A. Sigel, ed., 1993. Bio-optics in U.S.JGOFS Planning Report 18, U.S.JGFOS Planning Office, Woods Hole, Mass.,180pp.

[10] Dickey, T., Marra, T. Granata, C. Langdon, M. Hamilton, J. Wiggert, D. siegel and A. Bratkovich, 1991. Concurrent high resolution bio-optical and physical time series observations in the Sargasso Sea during the spring of 1987. J. Geophys. Res., 96,8643-8663.

[11] Dickey, T.T.C. Granata and I. Taupier-Letage, 1993a. Automated in situ observations of Upper ocean biogeochemistry, bio-optics, and physics and their potential use for global Studies. In Proc. Ocean climate Data Workshop, Goddard Space Flight Center, Greenbelt,Md.,pp.317-353.

[12] Dickey, T.D., T. Granata, J. Marra, C. Langdon, J. Wiggert, Z. Chai-Jochner, M. Hamilton, J. Vazques, M. Stramska, R. Bidigare and D. Siegel, 1993b. Seasonal Variability of bio-optical and physical properties in the Sargasso Sea. J. Geophys. Res., 98,865-898.

[13] Dickey, T.D., R.H. Douglass, D. Manov, D. Bogucki, P.C. Walker and P. Petrelis,

1993c. An experiment in two-way communication with a multi-variable moored system in coastal waters. J. Atmos. Ocean Technol., 10,637-644.

[14] Dickey, T., J. Marra, M. Stramska, C. Langdon, T. Granata, A. Plueddemann, R. Weller and J. Yoder, 1994. Bio-optical and physical variability in the subarctic North Atlantic Ocean during spring of 1989.J.Gophy.Res.,99,22541-22556.

[15] Dickey, T., D. Frye, H., Jannasch, E., Boyle, D. Manov, D. Sigurdson, J. McNeil, M. Stramska, A. Michaels, N. Nelson, D. Siegel, G. Chang, J. Wu and A. Knap,1997. Preliminary results from the Bermuda Testbed Mooring Program, Deep-Sea Res.,

[16] Gurumoorthi. K and Venkatachalapathy,R, Hydrodynamic modeling along the southern tip of India: A special emphasis on Kanyakumari coast, Journal of Ocean Engineering and Science,2017, Vol.2, pp. 229-244.

[17] Jayappa, K. S., Vijayakumar, G. T. and Subrahmanya, K. R.,Influence of coastal structures on the beaches of Southern Karnataka, India. J. Coast. Res., 2003, 19(2), 389–408.

[18] Pollard, R., 1973: Interpretation of near-surface current meter observations. Deep-Sea Res. Oceanogr. Abstr., 20, 261–268, doi:10.1016/0011-7471(73)90015-6.

[19] Shankar, D, Vinayachandran, P. N, Unnikrishnan, A.S, The monsoon currents in the north Indian Ocean Prog. Oceanogr., 52 (2002), pp. 63-120

[20] Shynu, R.,Purnachandra Rao, V.,Sarma, V.V.S.S.,Kessarkar, P.M., Mani Murali, R Sources and fate of organic matter in suspended and bottom sediments of the Mandovi and Zuari estuaries, western India(Article)

[21] Siegel, D.A. and A.J. Plueddemann, 1991. The motion of a solid sphere in an oscillating flow: an evaluation of remotely sensed Doppler velocity estimates in the sea. J. Atmos. Ocean. Tech., 8,296-304.

[22] Van, T. T. and Binh, T. T., Application of remote sensing for shore line change detection in Cuu Long estuary. VNU J. Sci., Earth Sciences, 2009, 25, 217–222.

[23] Van der Molen. J, The influence of tides, wind and waves on the net sand transport in the North Sea, Cont. Shelf. Res., 22 (2002), pp. 2739-2762.