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**Metocean Data in the South China Sea: Hindcast (SEAFINE) vs. Measured Data**

Offshore engineering has always been significantly more complex in design compared to land-based civil engineering works due to the fact that it is located in a fluid body which has an unpredictable nature or in statistical terms, stochastic in nature. The stochastic nature of sea conditions are coupled with the effect of ocean currents on top of the more extreme wind conditions prevalent in open seas. As such, a strong understanding or fundamental of these environmental/metocean loads at sea form a critical component in almost every stage of an offshore facility’s life cycle. These stages include the design of facilities and forecasting of operations for offshore vessels. The understanding of these metocean loads will be critical from two ends of the engineering consideration, which is to prevent loss of life as a result of structural failure or capsizing (underdesign) and to prevent the overdesign of offshore structures (which results in excessive usage of steel in fabrication).

Understanding the importance of metocean loads and carrying out associated optimizations associated with it forms only one part of the equation in which the other half requires the design engineer to have comprehensive knowledge of the metocean data he is handling with (be it wave, wind or current). Historically, data has always been obtained through a multitude of resources which dates back from 150 years ago through the Voluntary Observers Fleets (VOF) up to the modern day practice of using recording buoys, remote satellite sensing and numerical modeling. In industrial practice there are mainly two most common types of data used in metcoean assessment, **platform measured values as well as hindcast values**. Measured values are usually recorded off sensors placed in-situ at the platform itself and consists of interconnected anemometers, weather vanes and wave/current buoys that records data for that particular locality. Examples of this system include Shell’s METNET which provides data real-time for operations vessel and helicopter operations. Continuous recording of such data can go up to 10 to 15 years’ worth of data population which will by then, allow better estimations of metocean parameters in future designs in the area or even when considering post-life span analysis. The practice of collecting real-time data while very accurate in nature is not a practice that is homogenous across different oil operators and contractors in the South China Sea. Only very recently that efforts are invested in putting up monitoring sensors at new platforms as a result of realizing the significant impact of understanding metocean loads on design. It would require a fair bit of time to populate regional metocean data before it can be utilized for reliable metocean assessments such as extreme value analysis and ARIMA modeling. As a result of a lack of consolidated measured data throughout the South China Sea, the inability to conclude metocean assessments without a fair bit of assumptions becomes apparent, which comes to the next point of discussion, the usage of hindcast data in metocean assessment.

Hindcast is based upon the numerical modeling and extremal extrapolation of historical meterological and oceanographic to describe the metocean parameters in the past. Recently, hindcast technique has also in recent times utilized QuickSAT (remote sensing satellite) to provide localized storm data to increase its accuracy. Previously, joint industry projects (JIP) were initiated via companies such as Oceanweather to conduct a full-scale hindcast study of a particular sea and SEAMOS–South Fine Grid Hindcast (SEAFINE) was one of the results of this global study. As a result, a more complete characterization of the South China Sea was depicted compared to having scattered measurements of metocean data and was claimed that it can be used reliably in the design and operations of offshore structures. Along with this exceptional consistency and coverage of hindcast data, it too came with limitations that manifested themselves in values containing a certain degree of error from measured values. Mean absolute error values of up to 1.0m between SEAFINE and measured data are a considerably large value when wave heights in South China Sea barely rise above 3.0m (this can be a concern for sensitive operations such as floatover installations). Futhermore, SEAFINE data is projected at one-hour intervals causing significant loss of sea characteristic conditions as show below. In essence, as there is a lack of research on how accurate is the metocean data which is derived from the hindcast. It must be noted that the hindcast data is strictly regional based, and as such, the reliability of the hindcast data must be ascertained

However, in recent years, studies have been conducted to marry together the consistency of hindcast data together with the accuracy of measured values (Table 1). This pilot study was conducted in Malaysian waters and has thus far successfully recreated measured value conditions based upon hindcast data through a set of statistically formulated coefficients. These coefficients vary by monsoonality and operating waters and have proven thus far to statistically relate the hindcast values with the measured values of the Malaysian waters. This method is significant in industrial practice as procurement of measured values can be fast-tracked via correction of hindcast data. In this situation, in-situ measure values are then used to validate these coefficients as time progresses. This represents the way forward for oil operators and contractors in the region as this will provide them with powerful tools to accurately carry out metocean assessments such as design optimization (extreme value analysis) and even forecasting of wave sensitive operations such as floatover installations via more accurate forecasting methods (ARIMA modeling). The marriage of the strong qualities of both measured and hindcast values will ultimately lead to the financial edge of parties at concern and push further the boundaries of offshore engineering

Table 1: Comparative table between hindcast and measured values. Corrected hindcast values are shown to be the way forward by merging the advantages of the former techniques.

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|  | Advantages | Disadvantages |
| Hindcast (SEAFINE) | Consistent long term data coverage | Issues with accuracy of data (mean absolute error) |
| Measured values | Accurate representation of metocean criteria in area of concern | Short term data, scattered in data population, not a standard practice across oil operators |
| Corrected hindcast (SEAFINE) | Consistency of data over long periods, accuracy of measured value data |